# Hyundai Industrial R-engine 2.2L DTC Diagnosis Guide

2020.05.



# <u>GI-2</u>

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# **General Information**

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## P004700 Turbo/Super Charger Boost Control Solenoid Circuit Low

### **Component Location**



CRC12EN5010P004711



#### 1. VGT Actuator

2. VGT Control Valve

#### **General Description**

VGT(Variable Geometric Turbocharger) is the device which increases the efficiency of turbocharger at low rpm and lasts optimum turbo efficiency at high rpm as varying the cross sectional area through which exhaust gas passes turbocharger impeller. It relieves turbo lag at low speed and increase engine power generation.

The VGT adapted on Engine is activated by VGT actuator control unit and electronic actuator integrated with DC motor. Engine speed, APS signal, MAFS and Boost pressure sensor data are inputted to ECM. ECM controls VGT actuator control unit to control exhaust gas line as controlling VGT actuator duty to maintain optimum

CRC12EN5010P004712

state of air compression.

#### **DTC Description**

If open/short to ground in VGT control acutator circuit or defected VGT control actuator is detected, ECM sets DTC P004700.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Electric VGT contro	l actuator circuit monitoring	
Enable Conditions	Engine running		
Threshold Value	Open or short to gro	ound in VGT control actuator circuit	1 Open or short to ground in VG-
	Engine OFF	• No	T control actuator circuit
	EGR Off	• Yes	2. Defected VGT control actuator
Fall Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

VGT Control Actuator		Terminal	Inspection Conditi	on Measured Valu e	Remarks
	1	VGT Actuator Power	Ignition switch "ON"	& E- B+	-
Pin No.	2	VGT Actuator Control	ngine "OFF" Voltage is measured on wiring side(Disconnected )	d on ected Approx. 3.4V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P004700	Turbo/Super Charger Boost Control Solenoid Circuit Low	

- 4. Is DTC status displayed as Present?

  - **YES** Go to "Wiring Inspection" procedure.



**Terminal and Connector Inspection** 

- CRC12EN5010P00470021S
- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.

#### 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between power terminal of VGT control actuator harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



- YES 
  Go to "Control Circuit Inspection" procedure
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between control terminal of VGT control actuator harness connector and chassis ground.
- Specification : Approx. 3.4V
- 5. Is the measured value within specification?



YES • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### Actuation Test

- 1. ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Boost Pressure Actuator 5%" and "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

Monitor "Boost Pressure Actuator" parameter in 5. "Current Data" with GDS.

**General Information** 

Specification : Refer to figure below

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**Test Items** 

GRU (Glow Relay Unit) 15% Duty

**Boost Pressure Actuator 5%** 

Boost Pressure Actuator 95%			-	• Result	Operation Commar	nd Sent
EGR Valve 10%						
		Data	Analy	/sis		
100	Boost Pressure Actuator				Max : 68	×
						68 %
0					Min : 5	æ
St	tart Stop					Function

CRC12EN5010P00470041S

🖅 🐟	Actuation Test	
Test Items	Duration	Lintil Stan Ruttan
GRU (Glow Relay Unit) 15% Duty		
Boost Pressure Actuator 5%	· Condition	IG. ON/ENG.OFF -Check Current Data (VGT Actuator)
Boost Pressure Actuator 95%	🔽 · Result	Operation Command Sent
EGR Valve 10%	Ŧ	
	Data Analysis	
100 Boost Pressure Actuator		Max : 95
		68 %
0		Min : 5
Start Stop		Function

CRC12EN5010P00470042S

Fig.1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

Fig.2) Boost pressure actuator current data when performing "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the VGT control actuator and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## P004800 Turbo/Super Charger Boost Control Solenoid Circuit High

### **Component Location**



CRC12EN5010P004711



#### 1. VGT Actuator

2. VGT Control Valve

#### **General Description**

VGT(Variable Geometric Turbocharger) is the device which increases the efficiency of turbocharger at low rpm and lasts optimum turbo efficiency at high rpm as varying the cross sectional area through which exhaust gas passes turbocharger impeller. It relieves turbo lag at low speed and increase engine power generation.

The VGT adapted on Engine is activated by VGT actuator control unit and electronic actuator integrated with DC motor. Engine speed, APS signal, MAFS and Boost pressure sensor data are inputted to ECM. ECM controls VGT actuator control unit to control exhaust gas line as controlling VGT actuator duty to maintain optimum

CRC12EN5010P004712

state of air compression.

#### **DTC Description**

If short to power in VGT control actuator circuit is detected for 2 sec., ECM sets DTC P004800.

### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Electric VGT contro	l actuator circuit monitoring	
Enable Conditions	Engine running		
Threshold Value	Short to power in V	GT control actuator circuit	1. Short to around in VGT control
	Engine OFF	• No	actuator circuit
	EGR Off	• Yes	2. Defected VGT control actuator
Fall Safe	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

VGT Control Actuator		Terminal	Inspection Condition Reasured Value	Remarks
	1	VGT Actuator Power	Ignition switch "ON" & E- B+	-
Pin No.	2	VGT Actuator Control	ngine "OFF" • Voltage is measured on wiring side(Disconnected )	-

#### Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P004800	Turbo/Super Charger Boost Control Solenoid Circuit High	

- 4. Is DTC status displayed as Present?

  - **YES** Go to "Wiring Inspection" procedure.



**Terminal and Connector Inspection** 

- CRC12EN5010P00480021S
- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.

Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition Switch "OFF" 1.
- Refer to "Shop Manual" and disconnect VGT control 2. actuator connector.
- 3. Ignition Switch "ON"
- Measure the voltage between power terminal of VGT 4. control actuator harness connector and chassis ground.

#### Specification : B+

Is the measured value within specification? 5.



- YES 
  Go to "Control Circuit Inspection" procedure
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of VGT 4. control actuator harness connector and chassis ground.
- Specification : Approx. 3.4V
- 5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### Actuation Test

- 1. ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Boost Pressure Actuator 5%" and "Boost 4. Pressure Actuator 95%" in "Actuation Test" with GDS.

5. Monitor "Boost Pressure Actuator" parameter in "Current Data" with GDS.

Specification : Refer to figure below

## **General Information**



CRC12EN5010P00470041S

🖅 🐟	Actuation Te	st		🖭 🕇 🏠
Test Items		Duration	Until Stop Buttop	
GRU (Glow Relay Unit) 15% Duty	*			
Boost Pressure Actuator 5%	<u>^</u>	• Condition	IG. ON/ENG.OFF - (VGT Actuator)	Check Current Data
Boost Pressure Actuator 95%	-	• Result	Operation Comman	id Sent
EGR Valve 10%	¥			
	Data Analysi	is		
100 Boost Pressure Actuator			Max : 95	×
}				
				68 %
0			Min : 5	Ð
Start Stop				Function

CRC12EN5010P00470042S

Fig. 1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

Fig. 2) Boost pressure actuator current data when performing "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

- 6. Is the parameter displayed within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

- NO 

   Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the VGT control actuator and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## **General Information**

### P006900 Manifold Absolute Pressure - Barometric Pressure Correlation

### **Component Location**



CRC12EN5010P006911



#### 1. Boost Pressure Sensor (BPS)

#### 2. ECM (Atmospheric pressure sensor integrated)

#### **General Description**

Boost Pressure Sensor(BPS) is installed in intake manifold and senses the pressure of air inside of intake manifold which is compressed by turbo charager. Measuring mass air flow accurately with the information of intake mainfold pressure, mass air flow and intake air temperature, ECM performs actuating correction of EGR and VGT.

When excessive intake manifold pressure is detected, engine power generation is limited to protect engine because too highly compressed pressure due to turbo charger may harm engine.

#### CRC12EN5010P00690012

#### **DTC Description**

If the signal difference between boost pressure sensor and atmospheric pressure sensor is over 300 hPa under engine speed below 100 RPM (Ignition switch "ON"), ECM sets DTC P006900. This fault is due to abnormal output characteristics of boost pressure sensor.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	<ul> <li>Correlation beween boost pressure sensor and atmospheric pressure sensor</li> </ul>		
Enable Conditions	Ignition Switch "ON"		1. Faulty boost pressure sensor
Threshold Value	<ul> <li>Signal difference between boost pressure sensor and atmospheric pressure sensor is over 300 hPa</li> </ul>		<ol> <li>circuit</li> <li>Defected atmospheric pressure sensor</li> </ol>
	Engine OFF		3. Defected boost pressure sens-
	EGR Off	• No	0r 4 Defected FCM
Fail Sale	Torque Limit	• No	
	MIL	• On	

### Vehicle Data

Lambda Sen	sor Unit	Terminal	Inspection Condition	Measured Value	Remarks
	1	Boost Pressure Sensor Signal	<ul> <li>Ignition Switch "ONI" En</li> </ul>	Approx. 5.5V	-
Pin No.	Boost Pressure     Sensor Power     Voltage is measured o	<ul> <li>ignition Switch ON , En- gine "OFF"</li> <li>Voltage is measured on</li> </ul>	Approx. 5.0V	-	
	3	-	wiring side(Disconnected		-
	4	Boost Pressure Sensor Gro- und	)	0 V	-
Lambda Sen	sor Unit	Terminal	Inspection Condition	Measured Value	Remarks
	1	Boost Pressure Sensor Signal	<ul> <li>Ignition Switch "ONI" En</li> </ul>	Approx. 1.0V	Atmosphe- ric Pressu- re
Pin No. 2	Boost Pressure Sensor Power	<ul> <li>ignition switch on , en- gine "OFF"</li> <li>Voltage is measured on</li> </ul>	Approx. 5.0V	-	
	3	-	wiring side(Connected)	-	-
	4	Boost Pressure Sensor Gro- und		0 V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

I

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

## **General Information**

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P006900	Manifold Absolute Pressure - Barometric Pressure Correlation	

CRC12EN5010P00690021S

#### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition Switch "ON" & Engine "Off"
- 4. Check "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search		
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Res	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit	Sala Sala Jakaba	and parent
Boost Pressure Sensor	1008	hPa		
Raw Voltage of Boost Pressure Sensor	1.08	v		
Barometric Pressure Sensor	1002	hPa		
Atmospheric Pressure	1010	hPa		
Engine Speed	809.0	RPM		
Final stop Request signal	OFF	-		- A
Final start Enable signal	NO	-		
Final start Request signal	OFF			
Water Temperature of Engine	60	'C		

Fig.1

Fig. 1) Boost pressure and atmospheric pressure current data under engine idle condition.

XAtmospheric pressure sensor outputs 1 atm at sea level. Check for abnormal atmospheric pressure sensor signal value.

#### CRC12EN5010P00690022S

5. Is the parameter displayed within specification?

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor 2. connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect the boost 2 pressure sensor connector.
- 3. Ignition Switch "ON"
- Measure voltage of power terminal of the boost 4. pressure sensor connector and chassis ground.

Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual"and disconnect the boost 3. pressure sensor connector.
- 4. Measure the resistance between ground terminal of

BPS harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect the boost pressure sensor connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of BPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of BPS harness connector.(B)

Specification :(A) - (B) = below 200 mV

- 10. Is the measured value within specification?
  - **YES** Go to "Signal Circuit Inspection" procedure.
  - NO 

     Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect boost 2. pressure sensor connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of BPS 4. harness connector and chassis ground.

#### Specification : Approx. 5.5V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Visual Inspection of BPS

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove the boost pressure sensor.
- Inspect for corrosion and contamination on connector 3. terminal of boost pressure sensor.
- 4. Check for proper installation of boost pressure sensor and inspect for leakage of O-ring, excessive carbon on sensing area.
- Have any problems been found?

## **General Information**

YES 
Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Boost Pressure Sensor Output Signal Inspection" procedure.

### Boost Pressure Sensor Output Signal Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Signal terminal (BPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

#### Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES Go to "Atmospheric Pressure Sensor Inspection" procedure.
  - NO 

     Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.

#### Atmospheric Pressure Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- 4. Monitor "Atmospherica Pressure" parameter in "Current Data" with GDS.

Specification : Approx. 1000 hPa

## GI-21

🝟 Current Data		Search 🔍 🖡	
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop  Crouping	VSS
Sensor Name	Value L	Jnit	ener terrer
Boost Pressure Sensor	1008 1	nPa	
Raw Voltage of Boost Pressure Sensor	1.08 \	/	
Barometric Pressure Sensor	1002	ıPa	
Atmospheric Pressure	1010 1	nPa	
Engine Speed	809.0 F	3PM	
🗉 Final stop Request signal	OFF -		1
Final start Enable signal	NO -	-	
Final start Request signal	OFF -	-	
Water Temperature of Engine	60 '	С	

Fig.1

Fig. 1) Boost pressure and atmospheric pressure current data under engine idle condition.

XAtmospheric pressure sensor outputs 1 atm at sea level. Check for abnormal atmospheric pressure sensor signal value.

5. Is the parameter displayed within specification?

YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Carefully re-do this troubleshooting guide steps.

> ► If no problems were found with the circuits or connectors, replace the ECM/PCM and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES ► Go to the applicable troubleshooting procedure.

#### CRC12EN5010P00690022S

NO ► F

 Problem is corrected and the system operation performs to specification at this time.

## P008700 Fuel Rail/System Pressure - Too Low

## Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If the rail pressure is out of specification for certain amount of time compare to target value, ECM sets DTC P008700.

#### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Rail pressure regulator valve signal monitoring		
Enable Condition	Engine running		
	Case 1	<ul> <li>Rail pressure is above limitatio- n</li> </ul>	
Threshold Value	Case 2	<ul> <li>Actual pressure is higher than target pressure and target pre- ssure is above certain value</li> </ul>	<ol> <li>Faulty fuel pressure regulator valve circuit</li> </ol>
	Case 3	<ul> <li>Rail pressure is below limitatio- n</li> </ul>	<ol> <li>Defected FPRV</li> <li>Faulty rail pressure regulator v- alve circuit</li> </ol>
	Case 1	• 1 sec	4. Defected RPRV
Detecting Time	Case 2	• 750 msec	5. Fuel line leakage
	Case 3	• 300 msec	6. Defected EGM
	Engine OFF	• No	
	EGR OFF	• No	
Fail Safe	Torque Limit	• No	]
	MIL	• On	

### Vehicle Data

Rail Pressure F Valve	Rail Pressure Regulator Valve Terminal Inspection Condition		Measured Value	Remarks		
	1	Rail Pressure Regulator Val- vue Control	•	Ignition Switch "ON", Engine " OFF"	Approx. 3. 4V	-
Pin No.	2	Rail Pressure Regulator Val- vue Power	•	Voltage is measured on wiring side(Disconnected)	B+	-
Fuel Pressure I Vavle	Regulator	Terminal		Inspection Condition	Measured Value	Remarks
Fuel Pressure I Vavle	Regulator	Terminal Fuel Pressure Regulator Va- Ivue Control	•	Inspection Condition Ignition Switch "ON", Engine " OFF"	Measured Value Approx. 3. 4V	Remarks

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P008700	Fuel Rail/System Pressure - Too Low	

CRC12EN5010P00870021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# GI-2

🚪 Current Data		Search 😰	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Res	et Min.Max Record	Stop ‡ Groupin	g VSS
Sensor Name	Value	Unit	ana ing
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	-
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.1			

#### CRC12EN5010P00870022S

Current Data		Search 🙉 💷 🖉	2) =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗧 Res	et Min.Max Record	Stop 🗧 Grouping V	SS
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.2			

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?
  - **YES** Repair as necessary and go to "Verification of Vehicle Repair" procedure.
  - NO Go to "Rail Pressure Regulator Valve Inspection" procedure.

#### **Rail Pressure Regulator Valve Inspection**

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV

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## **General Information**

#### connector.

- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.
- Specification : Approx. 3.4V
- 5. Is the measured value within specification?



**YES** • Go to "Fuel Pressure Regulator Valve Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Fuel Pressure Regulator Valve Inspection**

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



#### Control Circuit Inspection

1. Ignition switch "OFF"

- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of FPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit NO , and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### Visual Inspection on Fuel Line

- Refer to "Shop Manual" and inspect for blockage, 1. leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- 2. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between high pressure fuel pump and common rail.
- 3. Have any problems been found?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Fuel Pressure Regulator Valve Inspection

- Ignition switch "OFF" 1.
- Disconnect batter (-) cable. 2.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of FPRV.

#### Specification : 2.60 ~ 3.15Ω (20°C/20°F)

- 5. Is the measured value within specification?
  - YES 
    Go to "Rail Pressure Regulator Valve Inspection" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.
    - If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

### Rail Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- 3. Refer to "Shop Manual" and disconnect RPRV connector.
- Measure the resistance between power terminal and 4. control terminal of RPRV.

Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- YES 

   Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within ٠ specification.
- If component is dropped, check for proper • operation. The internal damage may be present.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 

 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## P008800 Fuel Rail/System Pressure - Too High

## Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If rail pressure is below specification or out of specified value for certain amount of time, ECM sets DTC P008800.

#### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Rail pressure regulator valve signal monitoring		
Enable Condition	Engine running		
Threshold Value	Case 1	• Pressure difference in actual p- ressure and target pressure is lower than specification and ta- rget pressure is below specifie- d value	<ol> <li>Faulty fuel pressure regulator valve circuit</li> <li>Defected FPRV</li> </ol>
	Case 2	Rail pressure is over limitation	3. Faulty rail pressure regulator v-
Detecting Time	Case 1	• 2 sec	4. Defected RPRV
Delecting time	Case 2	• 300 msec	5. Blocked fuel return line
	Engine OFF	• No	6. Defected ECIM
	EGR OFF	• No	
raii Safe	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Rail Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.     1     Rail Pressure Regulator Val- vue Control     Ignition Switch "ON", OFF"       2     Rail Pressure Regulator Val- vue Power     Voltage is measured side(Disconnected)	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-		
	2	Rail Pressure Regulator Val- vue Power	Voltage is measured on wiring side(Disconnected)	B+	-

## **General Information**

Fuel Pressure Regulator Vavle		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Fuel Pressure Regulator Va- Ivue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
	2	Fuel Pressure Regulator Va- Ivue Power	Voltage is measured on wiring side(Disconnected)	B+	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P008800	Fuel Rail/System Pressure - Too High	

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#### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

Current Data		Search	
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop 🗘 Gro	uping VSS
Sensor Name	Value	Unit	
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	4
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON	-	
AT/MT Information	A/T	-	
Fig.1			

#### CRC12EN5010P00870022S

Current Data		Search 🙉 🔳	2) e
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 🗍 items List 🗧 Res	et Min.Max Record	Stop   Grouping V	SS
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.2			

Fig. 1) Rail pressure current data under engine idle condition.

Fig. 2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- Has a problem been found?
  - **YES** Repair as necessary and go to "Verification of Vehicle Repair" procedure.
  - NO 

    Go to "Rail Pressure Regulator Valve Inspection" procedure.

#### **Rail Pressure Regulator Valve Inspection**

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV

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## **General Information**

#### connector.

- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.
- Specification : Approx. 3.4V
- 5. Is the measured value within specification?



**YES** • Go to "Fuel Pressure Regulator Valve Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Fuel Pressure Regulator Valve Inspection**

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



#### Control Circuit Inspection

1. Ignition switch "OFF"

- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of FPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit NO , and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### Visual Inspection on Fuel Line

- Refer to "Shop Manual" and inspect for blockage, 1. leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- 2. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between high pressure fuel pump and common rail.
- 3. Have any problems been found?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Fuel Pressure Regulator Valve Inspection

- Ignition switch "OFF" 1.
- 2. Disconnect batter (-) cable.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of FPRV.

#### Specification : 2.60 ~ 3.15Ω (20°C/20°F)

- 5. Is the measured value within specification?
  - YES 
    Go to "Rail Pressure Regulator Valve Inspection" procedure.

 Carefully re-do this troubleshooting guide st-NO eps.

> If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

### Rail Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- 3. Refer to "Shop Manual" and disconnect RPRV connector.
- Measure the resistance between power terminal and 4. control terminal of RPRV.

Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- YES 

   Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within ٠ specification.
- If component is dropped, check for proper • operation. The internal damage may be present.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 

 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## P008900 Fuel Pressure Regulator 1 Performance

## Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If over-current in rail pressure regulator valve circuit is detected for 0.28 sec., ECM sets DTC P008900. The fault is caused by short to power or internal short circuit in rail pressure regulator valve.

#### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Rail pressure regulator valve signal monitoring		
Enable Condition	Engine running		
Threshold Value	Short to power in ra	il pressure regulator valve circuit	1. Short to power in rail pressure
Detecting Time	• 280 msec		regulator valve circuit
Fail Safe	Engine OFF	• Yes	or valve
	EGR OFF	• No	3. Defected ECM
	Torque Limit	• No	
	MIL	Off	

### Vehicle Data

Rail Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Rail Pressure Regulator Val- vue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	Approx. 3. 4V	-
	2	Rail Pressure Regulator Val- vue Power		B+	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

## **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P008900	Fuel Pressure Regulator 1 Performance	

CRC12EN5010P00890021S

#### 4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

Current Data		Search 🙉 🗐 🔬	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🛛 Items List 🗘 Res	et Min.Max Record	Stop   Grouping VSS	
Sensor Name	Value	Unit	
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	v	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	~
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	

Fig.1

CRC12EN5010P00870022S
🚪 Current Data		Search 🙉 💷 🔬 🗄
Selective Display \$ Full List \$ Graph \$ Items List \$ Re	set Min.Max Record	Stop ‡ Grouping VSS
Sensor Name	Value	Unit
Rail Pressure Measured	568.6	bar
Raw Value of Rail Pressure	1.55	v
Pressure Control Valve(Rail)	35	%
Output of Fuel Metering Unit(MPROP)	38	%
Engine Speed	4915.5	RPM
Actual Engine Torque - Crankshaft Torque	21	Nm
Inner Torque Without Transmission Interventions	80	Nm
State of Immo Presence	ON	-
AT/MT Information	A/T	-

Fig.2

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?





• Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

1. Ignition switch "OFF"

#### CRC12EN5010P00870023S

- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
  - **YES** Go to "Component Inspection" procedure.
  - NO ► Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.

- Refer to "Shop Manual" and disconnect RPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of RPRV.

#### Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- **YES** > Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO 

   Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





NO Problem is corrected and the system operation performs to specification at this time.

### P009100 Fuel Pressure Regulator 1 Control Circuit Low

### Component Location



CRC12EN5010P008711



CRC12EN5010P008712



**GI-40** 

### **General Information**

CRC12EN5010P008713

- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

P009100 is set when "0"A in control circuit of RPRV is detected for more than specified duration. This code is due to open or short to ground in control circuit or RPRV internal open.

#### **DTC Detecting Condition**

ltem	Detecting Condition	Possible Cause
DTC Strategy	Rail Pressure Regulator Valve Voltage Monitoring	
Enable Condition	Engine running	
Threshold Value	Short to ground in rail pressure regulator valve	1. Short to ground in rail pressure
Detecting Time	• 280 msec	regulator valve circuit
	Engine OFF • Yes	or valve
	EGR OFF • No	3. Defected ECM
raii Safe	Torque Limit • No	
	MIL • No	

#### Vehicle Data

Rail Pressure Regulator ValveTerminalInspection Condition		Measured Value	Remarks		
	1	Rail Pressure Regulator Val- vue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
Pin No.	2	Rail Pressure Regulator Val- vue Power	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	-

#### **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

2. Ignition "ON".

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-41

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P009100	Fuel Pressure Reg	ulator 1 Control (	Circuit Low		

CRC12EN5010P00910021S

#### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

Current Data		Search 🗐 🗐	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	A.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.1			

CRC12EN5010P00870022S

### **General Information**

🚪 Current Data		Search 🙉 💷 🕋
Selective Display 🗘 🛛 Full List 💠 🗌 Graph 🗘 Items List 🗘 Res	et Min.Max Record	Stop   Grouping VSS
Sensor Name	Value	Unit
Rail Pressure Measured	568.6	bar
Raw Value of Rail Pressure	1.55	V
Pressure Control Valve(Rail)	35	%
Output of Fuel Metering Unit(MPROP)	38	%
Engine Speed	4915.5	RPM
Actual Engine Torque - Crankshaft Torque	21	Nm
Inner Torque Without Transmission Interventions	80	Nm
State of Immo Presence	ON	-
AT/MT Information	A/T	-

Fig.2

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?





NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

1. Ignition "OFF".

#### CRC12EN5010P00870023S

- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.

- Refer to "Shop Manual" and disconnect RPRV connector.
- 4. Measure the resistance between power terminal and control terminal of RPRV.

#### Specification : 3.42 ~ 3.78 $\Omega$ (20°C/20°F )

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO ► Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





 Problem is corrected and the system operation performs to specification at this time.

### **General Information**

### P009200 Fuel Pressure Regulator 1 Control Circuit High

### Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If over-current in RPRV circuit is detected for over 0.28 sec., ECM sets DTC P009200. This fault might be caused by short to power or internal short in RPRV.

#### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Rail Pressure Regulator Valve Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>Short to ground in rail pressure regulator valve</li> <li>Excessive temperature on rail pressure regulator valve</li> </ul>		1. Short to ground in rail pressure
Detecting Time	• 280 msec		2. Defected rail pressure regulat-
	Engine OFF	• Yes	or valve
Foil Sofo	EGR OFF	• No	3. Defected ECM
Fall Sale	Torque Limit	• No	
MIL • On			

#### Vehicle Data

Rail Pressure I Valve	ail Pressure Regulator Valve Terminal Inspection Condition		Measured Value	Remarks	
Die No	1	Rail Pressure Regulator Val- vue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
Pin No.	2	Rail Pressure Regulator Val- vue Power	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

### **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P009200	Fuel Pressure Regulator 1 Control Circuit High	

CRC12EN5010P00920021S

#### 4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

Current Data		Search 😰 🚛	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	t Min.Max Record	Stop 🗧 Grouping	VSS
Sensor Name	Value	Unit	i and
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	4
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.1			

CRC12EN5010P00870022S

Current Data	Search 🛋 🛤	
Selective Display \$ Full List \$ Graph \$ Items Li	ist ‡ ] Reset Min.Max   Record   Stop ‡ ] Grouping   VSS	
Sensor Name	Value Unit	
🗵 Rail Pressure Measured	568.6 bar	
Raw Value of Rail Pressure	1.55 V	
Pressure Control Valve(Rail)	35 %	
Output of Fuel Metering Unit(MPROP)	38 %	
Engine Speed	4915.5 RPM	
Actual Engine Torque - Crankshaft Torque	21 Nm	
Inner Torque Without Transmission Intervent	tions 80 Nm	
State of Immo Presence	ON -	
AT/MT Information	Δ/Τ -	

#### Fig.2

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?





• Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

1. Ignition "OFF".

#### CRC12EN5010P00870023S

- Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - **YES** Go to "Control Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
  - **YES** Go to "Component Inspection" procedure.
  - NO ► Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.

- Refer to "Shop Manual" and disconnect RPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of RPRV.

#### Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- **YES** > Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO 

   Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





NO Problem is corrected and the system operation performs to specification at this time.

### P009700 Intake Air Temperature Sensor 2 Circuit Low Input

#### **Component Location**



#### 1. Intake Air Temperature #2

#### **General Description**

Intake Air Temperature Sensor (IATS) uses a Negative Temperature Characteristics (NTC) thermistor and senses intake air temperature. Two intake air temperature sensors are installed in this engine.

IATS #1 in Mass Air Flow Sensor (MAFS) and IATS #2 installed at intercooler pipe are located in front of and behind turbo-charger respectively. IATS #1 senses air temperature entering turbo-charger and the other (IATS #2) does air temperature coming out from the turbo-charger.

Comparing these air temperature values from both sensors, more accurate sensing of intake air temperature is possible. ECM uses these air temperature signals to perform EGR control correction and fuel injection quantity correction.

#### **DTC Description**

If short to ground in intake air temperature sensor circuit is detected, ECM sets DTC P009700.

CRC12EN5010P00970011

#### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Intake air temperature sensor signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>Intake air temperature sensor signal value is below sp- ecification</li> </ul>		1. Short to ground in intake air te-
Detecting Time	• 3 msec		mperature sensor #2 circuit
	Engine OFF		<ul> <li>Delected intake air temperatur- e sensor #2</li> </ul>
	EGR OFF • Yes		
Fail Sale	Torque Limit		
	MIL	• On	]

#### Vehicle Data

Intake Air Temper- ature Sensor #2		Terminal	Inspection Condition	Measured Value	Rema- rks
Pin No.	1	IATS Signal	Ignition switch "ON" & Engine "OFF"	Approx. 5. 0V	-
	2	IATS Ground	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	0 V	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC \$
State

CRC12EN5010P00970021S

- 4. Is DTC status displayed as Present?

  - YES Go to "Monitor GDS Data" procedure.
  - NO Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🔍 🖡	] (2) (3)
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	t Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	in the second
Intake Air Temperature	36	'C	
Raw Value Intake Air Temperature in Volt	2.51	V	
Engine Speed	809.0	RPM	
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C	4
Exhaust Temperature Sensor 2 Value (Upstream	268.55	'C	
Regeneration Demand Counter by Soot Load (C	5		
Total Driven Distance at last Successful Regener	207	km	
Driven Distance Since Last Successful Regenera	568	km	
Coverage Driven Length	775	km	-





Fig.1 ) Intake air temperature sensor current data during engine idle

- Fig. 2) Intake Air Temperature Senson #1 (MAFS)
- Fig. 3) Intake Air Temperature Sensor #2
- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Go to "Wiring Inspection" procedure.



Fig.3

CRC12EN5010P01120023S

CRC12EN5010P00970022S

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



NO

**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "Ground Circuit Inspection" procedure

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- 4. Measure the resistance between ground terminal of intake air temperature sensor #2 harness connector and chassis ground.

#### **Specification** : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between signal terminal of intake air temperature sensor #2 harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of intake air temperature sensor #2 harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

- 10. Is the measured value within specification?

**YES** • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the intake air temperature sensor #2 connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of intake air temperature sensor #2 harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



- YES Go to "Component Inspection" procedure.
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- Measure the resistance between ground terminal and 4. gignal terminal of intake air temperature sensor #2 harness connector.

Specification : Refer to table below

Temperature (°C/°F)	Resistance (kΩ)
-40 / -40	40.93 ~ 48.35
-20 / -4	13.89 ~ 16.03
0 / 32	5.38 ~ 6.09
20 / 68	2.31 ~ 2.57
30 / 86	1.56 ~ 1.76
40 / 104	1.08 ~ 1.21
60 / 140	0.54 ~ 0.62
80 / 176	0.29 ~ 0.34

5. Is the measured voltage within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the Intake Air Temperature Sensor #2 and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

### P009800 Intake Air Temperature Sensor 2 Circuit High Input

#### **Component Location**



1. Intake Air Temperature #2

#### **General Description**

Intake Air Temperature Sensor (IATS) uses a Negative Temperature Characteristics (NTC) thermistor and senses intake air temperature. Two intake air temperature sensors are installed in this engine.

IATS #1 in Mass Air Flow Sensor (MAFS) and IATS #2 installed at intercooler pipe are located in front of and behind turbo-charger respectively. IATS #1 senses air temperature entering turbo-charger and the other (IATS #2) does air temperature coming out from the turbo-charger.

Comparing these air temperature values from both sensors, more accurate sensing of intake air temperature is possible. ECM uses these air temperature signals to perform EGR control correction and fuel injection quantity correction.

#### **DTC Description**

If short to power in intake air temperature sensor #2 is detected, ECM sets DTC P009800.

CRC12EN5010P00970011

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Intake air temperatu	ure sensor signal monitoring	
Enable Condition	Engine running		
Threshold Value	<ul> <li>Intake air temperature sensor signal value is below sp- ecification</li> </ul>		<ol> <li>Short to ground in intake air te- mperature sensor #2 circuit</li> </ol>
Detecting Time	• 3 msec		2. Open in intake air temperature
	Engine OFF	• No	<ol> <li>3. Defected intake air temperatur-</li> </ol>
	EGR OFF	• Yes	e sensor #2
Fall Sale	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Intake Air Temper- ature Sensor #2		Terminal	Inspection Condition	Measured Value	Rema- rks
Pin No.	1	IATS Signal	Ignition switch "ON" & Engine "OFF"	Approx. 5. 0V	-
	2	IATS Ground	<ul> <li>voltage is measured on wiring side(Disconnected)</li> </ul>	0 V	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P009800	Intake Air Temperature Sensor 2 Circuit High Input	
		I I

#### 4. Is DTC status displayed as Present?



dure.

**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" proce-

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- 4. Monitor follow parameters in "Current Data" with GDS.

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Specification : Refer to figure below

Current Data		Search 🙉 🗐	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	t Min.Max Record	Stop 🗧 Grouping	VSS
Sensor Name	Value	Unit	1
Intake Air Temperature	36	'C	
Raw Value Intake Air Temperature in Volt	2.51	V	
Engine Speed	809.0	RPM	
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C	4
Exhaust Temperature Sensor 2 Value (Upstream	268.55	'C	
Regeneration Demand Counter by Soot Load (C	5	<u> </u>	
Total Driven Distance at last Successful Regener	207	km	
Driven Distance Since Last Successful Regenera	568	km	
Coverage Driven Length	775	km	
Fig.1			



Fig.1 ) Intake air temperature sensor current data during engine idle

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

Fig. 3) Intake Air Temperature Sensor #2

- 5. Is the parameter displayed within specification?
- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - **NO** Go to "Wiring Inspection" procedure.

Fig.3

CRC12EN5010P01120023S

#### Terminal and Connector Inspection

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "Ground Circuit Inspection" procedure NO

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#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- Measure the resistance between ground terminal of 4. intake air temperature sensor #2 harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between signal terminal of intake air temperature sensor #2 harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of intake air temperature sensor #2 harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?

**YES** • Go to "Signal Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the intake air temperature sensor #2 connector.
- 3. Ignition switch "ON"
- Measure the voltage between signal terminal of 4. intake air temperature sensor #2 harness connector and chassis ground.

Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- 4. Measure the resistance between ground terminal and gignal terminal of intake air temperature sensor #2 harness connector.

#### Specification : Refer to table below

Temperature (°C/°F)	Resistance (kΩ)
-40 / -40	40.93 ~ 48.35
-20 / -4	13.89 ~ 16.03
0 / 32	5.38 ~ 6.09
20 / 68	2.31 ~ 2.57
30 / 86	1.56 ~ 1.76
40 / 104	1.08 ~ 1.21
60 / 140	0.54 ~ 0.62
80 / 176	0.29 ~ 0.34

- 5. Is the measured voltage within specification?
  - **YES** > Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

  - NO 
    Carefully re-do this troubleshooting guide steps.
    - If no problems were found with the circuits or connectors, replace the Intake Air Temperature Sensor #2 and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.

5. Are any DTCs stored in the system?



- YES 
   Go to the applicable troubleshooting procedure.
- NO

 Problem is corrected and the system operation performs to specification at this time.

### P009A00 Intake Air Temperature/Ambient Air Temperature Correlation

#### **Component Location**



#### 1. Intake Air Temperature #2

#### **General Description**

Intake Air Temperature Sensor (IATS) uses a Negative Temperature Characteristics (NTC) thermistor and senses intake air temperature. Two intake air temperature sensors are installed in this engine.

IATS #1 in Mass Air Flow Sensor (MAFS) and IATS #2 installed at intercooler pipe are located in front of and behind turbo-charger respectively. IATS #1 senses air temperature entering turbo-charger and the other (IATS #2) does air temperature coming out from the turbo-charger.

Comparing these air temperature values from both sensors, more accurate sensing of intake air temperature is possible. ECM uses these air temperature signals to perform EGR control correction and fuel injection quantity correction.

#### **DTC Description**

If signal difference between intake air temperature sensor #2 and intake air temperature sensor #1 (MAFS) is over 30°C(86°F), ECM sets DTC P009A00.

CRC12EN5010P00970011

### DTC Detecting Condition

ltem	Detecting Condition		Possible Cause
DTC Strategy	Intake air temperatu	ure sensor signal monitoring	
Enable Condition	<ul> <li>Normal intake air temperature sensor #1(MAFS)</li> <li>Monitoring enabled when intake air temperature ser #1(MAFS) temperature is over -7°C(19.4°F) since 6 urs after engine "OFF"</li> <li>10 sec. after engine "ON"</li> </ul>		
Threshold Value	<ul> <li>Signal difference between intake air temperature sensor #2 and intake air temperature sensor #1 (MAFS) is over 30°C(86°F)</li> </ul>		<ol> <li>Faulty intake air temperature s- ensor #2 circuit</li> <li>Defected intake air temperatur- o concer #2</li> </ol>
Detecting Time	• _		
	Engine OFF	• No	
Foil Sofo	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

#### Vehicle Data

Intake Air Temper- ature Sensor #2		Terminal	Inspection Condition	Measured Value	Rema- rks
Pin No.	1	IATS Signal	Ignition switch "ON" & Engine "OFF"	Approx. 5. 0V	-
	2	IATS Ground	• voltage is measured on wiring side(Disconnected)	0 V	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P009A00	Intake Air Temperature/Ambient Air Temperature Correlation	

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General

- Is DTC status displayed as Present? 4.
  - ► Go to "Monitor GDS Data" procedure.
  - ► Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- Ignition switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- Monitor follow parameters in "Current Data" with 4. GDS.

#### Specification : Refer to figure below

Current Data		Search 🖭 🗐 🔐 吕
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Rese	et Min.Max Record	Stop   Grouping VSS
Sensor Name	Value	Unit
Intake Air Temperature	36	'C
Raw Value Intake Air Temperature in Volt	2.51	v
Engine Speed	809.0	RPM
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C
Exhaust Temperature Sensor 2 Value (Upstream	268.55	.С
Regeneration Demand Counter by Soot Load (C	5	-
Total Driven Distance at last Successful Regener	207	km
Driven Distance Since Last Successful Regenera	568	km
Coverage Driven Length	775	km 📃

#### Fig.1

CRC12EN5010P00970022S



Fig.2





CRC12EN5010P01120023S

Fig. 3) Intake Air Temperature Sensor #2

Fig.1 ) Intake air temperature sensor current data during engine idle

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

### **General Information**

- 5. Is the parameter displayed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, corrosion, contamination, bending, deterioration, or damage.
- 3. Has a problem been found?



NO 
 Go to "Ground Circuit Inspection" procedure

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- Measure the resistance between ground terminal of 4. intake air temperature sensor #2 harness connector and chassis ground.

#### Specification : Approx. below 1 Ω

- Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect intake air temperature sensor #2 connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between signal terminal of intake air temperature sensor #2 harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of intake air temperature sensor #2 harness connector.(B)

Specification : Difference in (A) and (B) is less than 200

#### mV

10. Is the measured value within specification?

- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect the intake air temperature sensor #2 connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between signal terminal of intake air temperature sensor #2 harness connector and chassis ground.

#### Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect intake air 3. temperature sensor #2 connector.
- Measure the resistance between ground terminal and 4. gignal terminal of intake air temperature sensor #2 harness connector.

Specification : Refer to table below

Temperature (°C/°F)	Resistance (kΩ)
-40 / -40	40.93 ~ 48.35
-20 / -4	13.89 ~ 16.03
0 / 32	5.38 ~ 6.09
20 / 68	2.31 ~ 2.57
30 / 86	1.56 ~ 1.76
40 / 104	1.08 ~ 1.21
60 / 140	0.54 ~ 0.62
80 / 176	0.29 ~ 0.34

5. Is the measured voltage within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the Intake Air Temperature Sensor #2 and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- Are any DTCs stored in the system? 5.



YES 
Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

### P010100 Mass or Volume Air Flow Circuit Range / Performance

#### **Component Location**



CRC12EN5010P01010011

### 1. Mass Air Flow Sensor (Intake Air Temperature Sensor #1 integrated)

#### **General Description**

Mass Air Flow Sensor (MAFS) is digital sensor. Measuring mass of air flow, signal is outputted as frequency (Hz). ECM performs EGR system feed back control with the information of measured mass air flow. (The role of MAFS in diesel engine is different from gasoline engine. Fuel injection quantity is decided by MAFS signal in gasoline engine.) When the amount of EGR gas (contains no oxygen) flowing into combustion chamber increases, the air passing through MAFS (contains oxygen) decreases. Thus, with the output signal change of MAFS accompanied by EGR actuator actuation, ECM determines the amount of recirculated EGR gas quantity.

#### **DTC Description**

If short to battery/ground in intake air temperature sensor #1 (MAFS) is detected, ECM sets DTC P010100.

### **DTC Detecting Condition**

ltem	Detecting Condition       Possible Cause         • Voltage monitoring       •         • Engine running       •         Case 1       •         •       Filtered intake air volume is less than specification         Case 2       •         Case 3       •         Measured intake air temperature period is higher than specification         Case 4       •         Measured intake air temperature period is lower than specification         Case 5       •         •       Exceeded maximum output signal value         Lee       •         Case 1       •         Case 2       •         Case 3       •         Exceeded maximum output signal value       1.         Faulty MAFS circuit       2.         Defected MAFS       2.         Case 1       •         Case 3       •         Case 3       •         Case 4       •         0       •         Case 1       •         0       •         0       •         0       •         0       •         0       •         0       • <tr< th=""></tr<>		
DTC Strategy	Voltage monit	oring	
Enable Condition	Engine runnir	ng	
	Case 1	<ul> <li>Filtered intake air volume is less than specification</li> </ul>	
	Case 2	Open or short in MAFS signal circuit	
Threshold Value	Case 3	<ul> <li>Measured intake air temperature per- iod is higher than specification</li> </ul>	
	Case 4	<ul> <li>Measured intake air temperature per- iod is lower than specification</li> </ul>	
	Case 5	<ul> <li>Exceeded maximum output signal va- lue</li> </ul>	1. Faulty MAFS circuit
	Case 1	• 4 sec	2. Delected MAPS
	Case 2	• 1sec	
Detecting Time	Case 3	• 1sec	
	Case 4	• 1sec	
	Case 5	• 4 sec	
	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Mass Air Flov	v Sensor	Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal	<ul> <li>Ignition switch "ON" &amp; E-</li> </ul>	Approx. 4.8V	-
	2	Reference Frequency	ngine "OFF"Voltage is m-	Approx. 4.8V	-
Pin No.	3	Intake Air Temperature Sen- sor #1 Signal	easured on wiring side( Disconnected) • Voltage is measured on	Approx. 5.0V	-
	4	MAFS Ground	wiring side(Disconnected	0V	-
	5	MAFS Power	)	B+	-

# **General Information**

Mass Air Flov	v Sensor	Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal		Approx. 2.5V	Signal W- aveform( Fig. 2)
Pin No.	2	Reference Frequency	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	Approx. 3.5V	Signal W- aveform( Fig. 1
1	3	Intake Air Temperature Sen- sor #1 Signal	<ul> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Approx. 2.35V	Approx. 2 8°C(82.4 °F)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-



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	Oscillosc	ope				
	Sensor	Theme	Name	Review	User Setting	A
	Reset	Start ‡	Cursor	ViewAll	Save	
Configura	-•∨ - 	ΠΠ	MAFS <sup>'</sup> Signal	Hż : 1	.9 kHz	Duty-: 51 % Duty+: 49 %
ation	-2VA					

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P010100	Mass or Volume Air Flow Circuit Range / Performance	

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4. Is DTC status displayed as Present?



- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below



# **General Information**



Fig. 1) Intake air volume and EGR actuator current data under engine speed approx. 3500RPM (A) and engine idle (B).

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

Fig. 3) Intake Air Temperature Sensor #2

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



Go to "System Inspection" procedure.

#### Intake System Inspection

#### Visual Inspection On Mass Air Flow Sensor(MAFS)

- Inspect the Mass Air Flow Sensor (MAFS) for 1. following conditions:
  - Proper installation of sensor.
  - Corrosion, contamination, or damaged connector.
  - Excessive dirt or wet air cleaner.
  - Distortion or clogged MAFS.
- 2. Check for leakage on intake and intercooler system.
- 3. Have any problems been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO 
Go to "Electric Exhaust Gas Re-Circulation" Control Actuator Inspection" procedure.



Fig.3

CRC12EN5010P01120023S

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

Careful not to damage the sensing element.

#### 

When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Electric Exhaust Gas Re-Circulation(EEGR) **Actuator Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect EEGR 3. actuator connector.
- 4. Refer to "Shop Manual" and inspect for foreign substance on EEGR actuator.
- Refer to "Shop Manual" and check for stuck or 5. damaged EEGR actuator.
- Have any problems been found? 6.
  - YES 

     Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **A**CAUTION

When installing component, tighten it within specification.

If component is dropped, check for proper operation. The internal damage may be present.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor 2. connection. bending, corrosion, contamination. deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- Ignition Switch "OFF" 1.
- Refer to "Shop Manual" and disconnect MAFS 2 connector.
- Ignition Switch "ON" 3.
- Measure the voltage between power terminal of 4. MAFS harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- Disconnect battery (-) cable. 2.
- 3. Refer to "Shop Manual" and disconnect MAFS connector.
- Measure the resistance between ground terminal of 4 MAFS harness connector and chassis ground.

#### **Specification** : Approx. below 1 $\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect MAFS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. MAFS harness connector and chassis ground.(A)

Measure the voltage between power terminal and 9. ground terminal of MAFS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

- 10. Is the measured value within specification?
  - YES
- Go to "Signal Circuit Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- MAFS Signal Circuit Inspection
- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of MAFS harness connector and chassis ground.

Specification : Approx. 4.8V

- Is the measured value within specification? 5.
- YES 
  Go to "MAFS Reference Frequency Circuit I nspection" procedure.
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### MAFS Reference Frequency Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual"and disconnect the intake air temperature sensor connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between Reference frequency terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 4.8V

- Is the measured value within specification? 5.
  - YES 
    Go to "Intake Air Temperature Sensor #1 Signal Circuit Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Signal Circuit Inspection

1. Ignition switch "OFF"

- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition switch "ON"

4. Measure the voltage between intake Air Temperature #1 terminal of MAFS harness connector and chassis ground.

Specification : Approx. 5.0V

- 5. Is the measured value within specification?

YES • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### MAFS Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : MAFS signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

Channel B (+) : Reference frequency terminal (MAFS Harness Connector)

- Channel B (-) : Ground
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Reference frequency : Approx. 19.0 Hz / MAFS signal : Approx. 1.9 kHz



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Fig. 1) MAFS reference frequency signal under Ignition switch "ON"

Fig. 2) MAFS signal under Ignition switch "ON"

- 5. Is the measured value within specification?
  - ► Go to "Intake Air Temperature Sensor #1 In-YES spection" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Inspection

- Ignition Switch "OFF" 1.
- 2. Connect VMI to GDS and perform oscilloscope.(2 Chennel):

Channel A (+) : Intake air temperature #1 signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

- Ignition Switch "ON" & Engine "OFF" 3.
- Inspection Condition : Ignition Switch "ON" 4.

Specification : Approx. 2.35V (28°C/82.4°F)

XVoltage value decreases as temperature increases.

5. Is the measured value within specification?



**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01010012S

NO ► Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### **A**CAUTION

Careful not to damage the sensing element.

#### 

When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- Select "Air Flow Sensor Change" 5.

### **General Information**



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<b>E *</b>	Essential work after component replacement	
Essential W	rk after Component Replacement j	
If you're rea	ly, select the menu.	
MENU	CANCEL	
Fig.2		

CRC12EN5010P01010042S

## **General Information**

<b>E</b> •	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

CRC12EN5010P01010043S

Replacement"

Fig.3) Air Flow Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### P010200 Mass or Volume Air Flow Circuit Low Input

#### **Component Location**



CRC12EN5010P01010011

### 1. Mass Air Flow Sensor (Intake Air Temperature Sensor #1 integrated)

#### **General Description**

Mass Air Flow Sensor (MAFS) is digital sensor. Measuring mass of air flow, signal is outputted as frequency (Hz). ECM performs EGR system feed back control with the information of measured mass air flow. (The role of MAFS in diesel engine is different from gasoline engine. Fuel injection quantity is decided by MAFS signal in gasoline engine.) When the amount of EGR gas (contains no oxygen) flowing into combustion chamber increases, the air passing through MAFS (contains oxygen) decreases. Thus, with the output signal change of MAFS accompanied by EGR actuator actuation, ECM determines the amount of recirculated EGR gas quantity.

#### **DTC Description**

If output signal of MAFS is over 14100Hz for more than 1 sec., ECM sets DTC P010200. This fault might be caused by defected MAFS or poor connection on MAFS connector.

### DTC Detecting Condition

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal excee	eds maximum value(over 14100Hz)	
Detecting Time	• 1sec		1. Faulty MAFS circuit
	Engine Off	• No	2. Defected MAFS
Fail Safe	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• Yes	

### Vehicle Data

Mass Air Flow Sensor		Terminal		Inspection Condition	Measured Value	Remarks
	1	MAFS Signal		Ignition switch "ON" & E-	Approx. 4.8V	-
Pin No.	2	Reference Frequency	ency ure Sen- d	ngine "OFF"Voltage is m-	Approx. 4.8V	-
	3	Intake Air Temperature Sen- sor #1 Signal		easured on wiring side( Disconnected) • Voltage is measured on	Approx. 5.0V	-
	4	MAFS Ground		wiring side(Disconnected	0V	-
	5 MAFS Power		)	B+	-	

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal		Approx. 2.5V	Signal W- aveform( Fig. 2)
Pin No.	2	Reference Frequency	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	Approx. 3.5V	Signal W- aveform( Fig. 1
	3	Intake Air Temperature Sen- sor #1 Signal	<ul> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Approx. 2.35V	Approx. 2 8°C(82.4 °F)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

# <u>GI-77</u>

# General

	Oscillos	соре						
	Sensor	Theme	Name	Review	User Setting	A4	274.8 ms 🕨 🛛 📢	20ms 🕨
	Reset	Start ‡	Cursor	ViewAll	Save	M		
	+8V	Ref	erence Freque	nicy Hz:1	9.0 Hz	Duty-: 36 %	Duty+: 64 %	
Confi		r		[				
gurat	-							-
ion								
Fie	-2∨ <u>A</u>							B

#### CRC12EN5010P01010011S



#### CRC12EN5010P01010012S

#### Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P010200	Mass or Volume Air Flow Circuit Low Input	

CRC12EN5010P01020021S

NO

### **General Information**

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.
    - Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below



CRC12EN5010P01010022S



Fig. 1) Intake air volume and EGR actuator current data under engine speed approx. 3500RPM (A) and engine idle (B).



Fig.3

CRC12EN5010P01120023S

Fig. 2) Intake Air Temperature Senson #1 (MAFS)Fig. 3) Intake Air Temperature Sensor #25. Is the parameter displayed within specification?

# <u>GI-79</u>

# General

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Go to "System Inspection" procedure.

#### Intake System Inspection

#### Visual Inspection On Mass Air Flow Sensor(MAFS)

- 1. Inspect the Mass Air Flow Sensor (MAFS) for following conditions:
  - Proper installation of sensor.
  - Corrosion, contamination, or damaged connector.
  - Excessive dirt or wet air cleaner.
  - Distortion or clogged MAFS.
- 2. Check for leakage on intake and intercooler system.
- 3. Have any problems been found?

YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **A**CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

• Careful not to damage the sensing element.

#### **A**CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination,

deterioration, or damage.

- 3. Has a problem been found?
  - YES Repair as necessary and go to "Verification of Vehicle Repair" procedure.
  - **NO** Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of MAFS harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO ► Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect MAFS connector.
- 4. Measure the resistance between ground terminal of MAFS harness connector and chassis ground.

#### **Specification** : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect MAFS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of MAFS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of MAFS harness connector.(B)

 $\ensuremath{\textbf{Specification}}$  : Difference in (A) and (B) is less than 200 mV

### **General Information**

#### 10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

#### MAFS Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- Ignition switch "ON"
- 4. Measure the voltage between signal terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 4.8V

5. Is the measured value within specification?

YES 
Go to "MAFS Reference Frequency Circuit I nspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### MAFS Reference Frequency Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual"and disconnect the intake air 2. temperature sensor connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between Reference frequency terminal of MAFS harness connector and chassis ground.

Specification : Approx. 4.8V

5. Is the measured value within specification?



NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Signal Circuit Inspection

- Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition switch "ON"
- Measure the voltage between intake Air Temperature 4.

#1 terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- NO

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### MAFS Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : MAFS signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

Channel B (+) : Reference frequency terminal (MAFS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- Inspection condition : Ignition switch "ON" 4.

Specification : Reference frequency : Approx. 19.0 Hz / MAFS signal : Approx. 1.9 kHz

# General



#### CRC12EN5010P01010011S

CRC12EN5010P01010012S



3.

Fig. 1) MAFS reference frequency signal under Ignition switch "ON"

Fig. 2) MAFS signal under Ignition switch "ON"

5. Is the measured value within specification?



 Go to "Intake Air Temperature Sensor #1 Inspection" procedure.

NO ► Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Inspection

- 1. Ignition Switch "OFF"
- Connect VMI to GDS and perform oscilloscope.(2 Chennel):

Channel A (+) : Intake air temperature #1 signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

- Ignition Switch "ON" & Engine "OFF"
- 4. Inspection Condition : Ignition Switch "ON"

Specification : Approx. 2.35V (28°C/82.4°F)

XVoltage value decreases as temperature increases.

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

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#### A CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### A CAUTION

• Careful not to damage the sensing element.

#### A CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Air Flow Sensor Change"

<b>F</b>		Special Function 😽 💷 1	
		Injector Specific Data	Ŷ
	0	Essential work after component replacement	
	0	Engine Test Function	
	0	Fuel line air removal	
	0	DPF Service Regeneration	
Favorit	e		
Fig.1			

CRC12EN5010P01010041S

🖅 🔹	Essential work after component replacement								
Essential W	[ Essential Work after Component Replacement ]								
If you're rea	dy, select the menu.								
MENU	CANCEL								
Fig.2									

CRC12EN5010P01010042S

## **General Information**

<b>F</b>	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU C/	ANCEL

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3 ) Air Flow Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P010300 Mass or Volume Air Flow Circuit high Input

#### **Component Location**



CRC12EN5010P01010011

### 1. Mass Air Flow Sensor (Intake Air Temperature Sensor #1 integrated)

#### **General Description**

Mass Air Flow Sensor (MAFS) is digital sensor. Measuring mass of air flow, signal is outputted as frequency (Hz). ECM performs EGR system feed back control with the information of measured mass air flow. (The role of MAFS in diesel engine is different from gasoline engine. Fuel injection quantity is decided by MAFS signal in gasoline engine.) When the amount of EGR gas (contains no oxygen) flowing into combustion chamber increases, the air passing through MAFS (contains oxygen) decreases. Thus, with the output signal change of MAFS accompanied by EGR actuator actuation, ECM determines the amount of recirculated EGR gas quantity.

#### **DTC Description**

If output signal voltage of MAFS is less than 0.2V (below 1200Hz) for more than 1 sec., ECM sets DTC P010300. This fault might be caused by open in power circuit or open/short to ground in signal circuit of MAFS.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal is und	ler minimum value(Below 1200Hz)	1 Open in neuror sizewit of MAES
Detecting Time	• 1sec		2. Open or short to ground in sig-
	Engine Off	• No	nal circuit of MAFS
Fail Safe	EGR Off	• Yes	3. Defected MAFS
	Torque Limit	• Yes	]
	MIL	• On	

### Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal	<ul> <li>Ignition switch "ON" &amp; E-</li> </ul>	Approx. 4.8V	-
Pin No.	2	Reference Frequency	ngine "OFF"Voltage is m-	Approx. 4.8V	-
	3	Intake Air Temperature Sen- sor #1 Signal	easured on wiring side( Disconnected) • Voltage is measured on	Approx. 5.0V	-
	4	MAFS Ground	wiring side(Disconnected	0V	-
	5	5 MAFS Power	)	B+	-

Mass Air Flow Sensor		Terminal		Inspection Condition	Measured Value	Remarks
	1	MAFS Signal			Approx. 2.5V	Signal W- aveform( Fig. 2)
Pin No	2	Reference Frequency	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Ignition switch "ON" & E- ngine "OFF"	Approx. 3.5V	Signal W- aveform( Fig. 1
	3	Intake Air Temperature Sen- sor #1 Signal		<ul> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Approx. 2.35V	Approx. 2 8°C(82.4 °F )
	4	MAFS Ground		0V	-	
	5	MAFS Power			B+	-

# <u>GI-87</u>

## General

	Oscillos	соре						
	Sensor	Theme	Name	Review	User Setting	A4	274.8 ms 🕨 🛛	20ms 🗼
	Reset	Start ≎	Cursor	ViewAll	Save	I.		
	+8V	Ref	erence Freque	ncy Hz:1	9.0 Hz	Duty-: 36 %	Duty+: 64 %	
Configuration								
	-2V 🔥							В
Fig	<b>J.1</b>							

#### CRC12EN5010P01010011S



#### CRC12EN5010P01010012S

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

Erase Selective DTC His	/Pend DTC \$
	State
Input	
	Input

CRC12EN5010P01030021S

NO

### **General Information**

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.
    - Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below



CRC12EN5010P01010022S



Fig. 1) Intake air volume and EGR actuator current data under engine speed approx. 3500RPM (A) and engine idle (B).



Fig.3

CRC12EN5010P01120023S

Fig. 2) Intake Air Temperature Senson #1 (MAFS)Fig. 3) Intake Air Temperature Sensor #25. Is the parameter displayed within specification?

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO

Go to "System Inspection" procedure.

#### **Intake System Inspection**

#### Visual Inspection On Mass Air Flow Sensor(MAFS)

- 1. Inspect the Mass Air Flow Sensor (MAFS) for following conditions:
  - Proper installation of sensor.
  - Corrosion, contamination, or damaged connector.
  - Excessive dirt or wet air cleaner.
  - Distortion or clogged MAFS.
- 2. Check for leakage on intake and intercooler system.
- 3. Have any problems been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

Careful not to damage the sensing element.

#### 

When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection. bending, corrosion, contamination.

deterioration, or damage.

- 3. Has a problem been found?
  - **YES** Repair as necessary and go to "Verification of Vehicle Repair" procedure.
  - Go to "Power Circuit Inspection" procedure. NO

#### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between power terminal of MAFS harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit. a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect MAFS 3. connector.
- Measure the resistance between ground terminal of 4. MAFS harness connector and chassis ground.

#### Specification : Approx. below 1 Ω

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect MAFS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. MAFS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of MAFS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

**YES** • Go to "Signal Circuit Inspection" procedure.

#### NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

#### MAFS Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 4.8V

- 5. Is the measured value within specification?

YES 
Go to "MAFS Reference Frequency Circuit I nspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### MAFS Reference Frequency Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual"and disconnect the intake air temperature sensor connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between Reference frequency terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 4.8V

5. Is the measured value within specification?



YES 
Go to "Intake Air Temperature Sensor #1 Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect MAFS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between intake Air Temperature #1 terminal of MAFS harness connector and chassis ground.

Specification : Approx. 5.0V

- Is the measured value within specification? 5.
- - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### MAFS Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : MAFS signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

Channel B (+) : Reference frequency terminal (MAFS Harness Connector)

- Channel B (-) : Ground
- 3. Ignition switch "ON" & Engine "OFF"
- Inspection condition : Ignition switch "ON" 4.

Specification : Reference frequency : Approx. 19.0 Hz / MAFS signal : Approx. 1.9 kHz



# General



CRC12EN5010P01010011S

CRC12EN5010P01010012S



Fig. 1) MAFS reference frequency signal under Ignition switch "ON"

Fig. 2) MAFS signal under Ignition switch "ON"

5. Is the measured value within specification?



 Go to "Intake Air Temperature Sensor #1 Inspection" procedure.

NO ► Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

#### Intake Air Temperature Sensor #1 Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and perform oscilloscope.(2 Chennel):

Channel A (+) : Intake air temperature #1 signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Inspection Condition : Ignition Switch "ON"

Specification : Approx. 2.35V (28°C/82.4°F)

XVoltage value decreases as temperature increases.

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

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#### A CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### A CAUTION

• Careful not to damage the sensing element.

#### **A**CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Air Flow Sensor Change"

<b>F</b>		Special Function 🛛 🙈 🖭 🏾	t î
		Injector Specific Data	Ô
	0	Essential work after component replacement	:
	0	Engine Test Function	
	0	Fuel line air removal	
	0	DPF Service Regeneration	ļ
Favori	te		
Fig.1			

CRC12EN5010P01010041S

<b>B *</b>	Essential work after component replacement							
If you're rea	dy, select the menu.							
MENUL								
MENU	CANCEL							
Fig.2								

CRC12EN5010P01010042S

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## **General Information**

<b>F</b>	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU         Essential work after component replacement         ECU replacement (DPF OPT)         Rail Pressure Sensor replacement         Air Flow Sensor replacement         Differential Pressure Sensor replacement         Differential Pressure Sensor replacement         EGR Valve replacement         APS Module replacement         APS Module replacement         SELECT
MENU C/	ANCEL

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3 ) Air Flow Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P011200 Intake Air Temperature Sensor 1 Circuit Low Input

#### **Component Location**



1. Mass Air Flow Sensor (Intake Air Temperature Sensor #1 integrated)

#### **General Description**

Intake Air Temperature Sensor (IATS) is NTC thermister which voltage gets low if the temperature comes to be high. One is installed inside of MAFS and the other is installed between BPS and intercooler. It senses intake air temperature. In case of EURO-5 diesel engine, IATS is installed in front of turbocharger (inside of MAFS) and behind it (between BPS and intercooler). Comparing air temperature from both sensors (one is intake air temperature, the other is air temperature passing through turbo charger), more accurate sensing of intake air temperature is possible. With intake air temperature signal, ECM performs EGR control correction and fuel injection quantity correction. (MAFS is needed for EGR FEED BACK control in electronically controlled diesel engine. The calculation of air density at certain temperature is required to perform EGR FEED BACK control correctly.)

#### **DTC Description**

If intake air temperature sensor #1 signal output is less than 73mV for more than 3 sec., ECM sets DTC P011200. This fault might be caused by short to ground in intake air temperature #1 circuit. CRC12EN5010P01010011

### DTC Detecting Condition

Item	Dete	Possible Cause	
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal is less	s than specification (Below 73mV)	1. Short to ground in signal circuit
Detecting Time	• 3 sec.		of intake air temperature sens-
	Engine Off	• No	2. Defected intake air temperatur-
	EGR Off	• Yes	e sensor #1
Fall Safe	Torque Limit	• No	
	MIL	• On	

### Vehicle Data

Mass Air Flow Sensor		Terminal Inspection Condition		Measured Value	Remarks
	1	MAFS Signal	<ul> <li>Ignition switch "ON" &amp; E-</li> </ul>	Approx. 4.8V	-
	2	Reference Frequency	ngine "OFF"Voltage is m-	Approx. 4.8V	-
Pin No.	3	Intake Air Temperature Sen- sor #1 Signal	<ul> <li>easured on wiring side( Disconnected)</li> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	Approx. 5.0V	-
	4	MAFS Ground		0V	-
	5	MAFS Power	)	B+	-

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal		Approx. 2.5V	Signal W- aveform( Fig. 2)
Pin No	2	Reference Frequency	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	Approx. 3.5V	Signal W- aveform( Fig. 1
	3	Intake Air Temperature Sen- sor #1 Signal	<ul> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Approx. 2.35V	Approx. 2 8°C(82.4 °F)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

# <u>GI-97</u>

## General

	Oscillos	соре						
	Sensor	Theme	Name	Review	User Setting	A4	274.8 ms 🕨 🔌	20ms 🗼
	Reset	Start ≎	Cursor	ViewAll	Save	I.		
	+8V	Ref	erence Freque	nicy Hz:1	9.0 Hz	Duty-: 36 %	Duty+: 64 %	
Configuration	-							
	-2V A							B
Fig	<b>j.1</b>							

#### CRC12EN5010P01010011S



#### CRC12EN5010P01010012S

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P011200	Intake Air Temperature Sensor 1 Circuit Low Input	

CRC12EN5010P01120021S

**GI-98** 

- 4. Is DTC status displayed as Present?
  - Go to "Monitor GDS Data" procedure.
  - ► Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🖭 🖽 🖴
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	t Min.Max Record	Stop  Grouping VSS
Sensor Name	Value	Unit
Intake Air Temperature	36	'C
Raw Value Intake Air Temperature in Volt	2.51	v
Engine Speed	809.0	RPM
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C
Exhaust Temperature Sensor 2 Value (Upstream	268.55	.C
Regeneration Demand Counter by Soot Load (C	5	-
Total Driven Distance at last Successful Regener	207	km
Driven Distance Since Last Successful Regenera	568	km
Coverage Driven Length	775	km 📄

#### Fig.1

CRC12EN5010P00970022S



Fig.2





CRC12EN5010P01120023S

Fig. 3) Intake Air Temperature Sensor #2

Fig.1 ) Intake air temperature sensor current data during engine idle

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

- 5. Is the parameter displayed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO

► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the MAFS connector.
- 4. Measure the resistance between ground terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect MAFS connector.
- 7. Ignition switch "ON"
- Measure the voltage between temperature signal terminal of MAFS harness connector and chassis ground.(A)
- Measure the voltage between temperature signal terminal and ground terminal of MAFS harness connector.(B)

 $\ensuremath{\textbf{Specification}}$  : Difference in (A) and (B) is less than 200 mV

- 10. Is the measured value within specification?
  - **YES** Go to "Signal Circuit Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the MAFS connector.
- 3. Ignition Switch "ON"
- Measure the voltage between intake Air Temperature #1 terminal of MAFS harness connector and chassis ground.

#### Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - **YES** Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Intake air temperature #1 signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 2.35V (28°C/82.4°F)

XVoltage value decreases as temperature increases.

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO ► Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### **A**CAUTION

• Careful not to damage the sensing element.

#### 

• When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Air Flow Sensor Change"

## GI-101



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essential work after compor	ent replacement
Essential W	ork after Component Replacement J	
If you're rea	dy, select the menu.	
MENU	CANCEL	
Fig.2		

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3 ) Air Flow Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### **GI-103**

### P011300 Intake Air Temperature Sensor 1 Circuit High Input

#### **Component Location**



CRC12EN5010P01010011

## 1. Mass Air Flow Sensor (Intake Air Temperature Sensor #1 integrated)

#### **General Description**

Intake Air Temperature Sensor (IATS) is NTC thermister which voltage gets low if the temperature comes to be high. One is installed inside of MAFS and the other is installed between BPS and intercooler. It senses intake air temperature. In case of EURO-5 diesel engine, IATS is installed in front of turbocharger (inside of MAFS) and behind it (between BPS and intercooler). Comparing air temperature from both sensors (one is intake air temperature, the other is air temperature passing through turbo charger), more accurate sensing of intake air temperature is possible. With intake air temperature signal, ECM performs EGR control correction and fuel injection quantity correction. (MAFS is needed for EGR FEED BACK control in electronically controlled diesel engine. The calculation of air density at certain temperature is required to perform EGR FEED BACK control correctly.)

#### **DTC Description**

If intake air temperature sensor #1 signal output is higher than 3200mV for more than 3 sec.

ECM sets DTC P011300. This fault might be caused by open or short to power in intake air temperature #1 circuit.

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>Output signal is hig 0mV)</li> </ul>	her than specification (Above 320	<ol> <li>Open or short to power in signal circuit of MAFS</li> <li>Open in ground circuit of MAF-</li> </ol>
Detecting Time	• 3 sec		
	Engine Off	• No	S Defected MAEO
Fail Safe	EGR Off	• Yes	3. Defected MAPS
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	MAFS Signal	Ignition switch "ON" & E-	Approx. 4.8V	-
Pin No.	2	Reference Frequency	ngine "OFF"Voltage is m- easured on wiring side( Disconnected) Voltage is measured on- wiring side(Disconnected	Approx. 4.8V	-
	3	Intake Air Temperature Sen- sor #1 Signal		Approx. 5.0V	-
	4	MAFS Ground		0V	-
	5	MAFS Power	)	B+	_

Mass Air Flow Sensor		Terminal		Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	•	Ignition switch "ON" & E- ngine "OFF"	Approx. 2.5V	Signal W- aveform( Fig. 2)
	2	Reference Frequency			Approx. 3.5V	Signal W- aveform( Fig. 1
	3	Intake Air Temperature Sen- sor #1 Signal		Voltage is measured on wiring side(Connected)	Approx. 2.35V	Approx. 2 8°C(82.4 °F)
	4	MAFS Ground			0V	-
	5	MAFS Power			B+	-

# **General Information**

📕 Oscillo	oscope						
Sensor	Theme	Name	Review	User Setting	A4	274.8 ms 🕨 📕	20ms 🗼
Reset	Start ‡	Cursor	ViewAll	Save	M		
+8∨	Ref	erence Freque	ncy Hz:1	9.0 Hz	Duty- : 36 %	Duty+: 64 %	
Conf			[			r	
igurat							
<u> </u>							
-2∨ A							В

CRC12EN5010P01010011S

CRC12EN5010P01010012S



#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P011300	Intake Air Temperature Sensor 1 Circuit High Input	

CRC12EN5010P01130021S

General

- Is DTC status displayed as Present? 4.
  - ► Go to "Monitor GDS Data" procedure.
  - ► Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- Ignition switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- Monitor follow parameters in "Current Data" with 4. GDS.

#### Specification : Refer to figure below

Current Data		Search 🔍 🗐 🔐 😑
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Rese	t Min.Max Record	Stop   Grouping VSS
Sensor Name	Value	Unit
Intake Air Temperature	36	·С
Raw Value Intake Air Temperature in Volt	2.51	v
Engine Speed	809.0	RPM
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C
Exhaust Temperature Sensor 2 Value (Upstream	268.55	'C
Regeneration Demand Counter by Soot Load (C	5	-
Total Driven Distance at last Successful Regener	207	km
Driven Distance Since Last Successful Regenera	568	km
Coverage Driven Length	775	km =

#### Fig.1

CRC12EN5010P00970022S



Fig.2





CRC12EN5010P01120023S

Fig. 3) Intake Air Temperature Sensor #2

Fig.1 ) Intake air temperature sensor current data during engine idle

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the MAFS connector.
- Measure the resistance between ground terminal of 4. MAFS harness connector and chassis ground.

#### Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect MAFS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between temperature signal terminal of MAFS harness connector and chassis ground.(A)
- 9. Measure the voltage between temperature signal terminal and ground terminal of MAFS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 m٧

- 10. Is the measured value within specification?
  - YES Go to "Signal Circuit Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Signal Circuit Inspection**

- Ignition Switch "OFF" 1.
- Refer to "Shop Manual" and disconnect the MAFS 2. connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between intake Air Temperature #1 terminal of MAFS harness connector and chassis ground.

Specification : Approx. 5.0V

5. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Intake air temperature #1 signal terminal (MAFS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 2.35V (28°C/82.4°F)

XVoltage value decreases as temperature increases.

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.


- NO 
  Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the MAFS and go to "Verification of Vehicle Repair" procedure.

### A CAUTION

- When installing component, tighten it within • specification.
- If component is dropped, check for proper • operation. The internal damage may be present.

#### **A**CAUTION

• Careful not to damage the sensing element.

### **A**CAUTION

When EEGR is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Air Flow Sensor Change"

# **General Information**



CRC12EN5010P01010041S

🖅 🔹	Essential	work after co	omponent repl	acement	
[ Essential W	a da a fita a Camara a da	Deule concert 1			
	ork after Component	Replacement J			
If you're rea	dy, select the menu				
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

# **General Information**

📼 < Essential work after con	nponent replacement
[ Essential Work afte If you're ready, sele ECU replacement (DPF OPT) Rail Pressure Sensor replacement Differential Pressure Sensor replacement EGR Valve replacement APS Module replacement	replacement nent eplacement (DPF OPT)
SELECT	CANCEL
MENU CANCEL	
Fig.3	

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3 ) Air Flow Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO • Problem is corrected and the system operation performs to specification at this time.

## P011600 Engine Coolant Temperature Circuit Range / Performance

### **Component Location**



CRC12EN5010P01160011

### 1. Engine Coolant Temperature Sensor (ECTS)

#### **General Description**

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature.

The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference +5V is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation, the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

#### **DTC Description**

If the engine temperature increment is below threshold rate after engine "ON", ECM sets DTC P011600.

### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>Engine temperature after engine "ON"</li> </ul>	e increment is below threshold value	<ul> <li>Faulty engine coolant tempera</li> </ul>
Detecting Time	Immediately		ture sensor circuit
	Engine Off	• No	erature sensor
EGR Off		• No	
Torque Limit		• No	
	MIL	• On	]

### Vehicle Data

Engine Coolant Temperat- ure Sensor		Terminal	erminal Inspection Condition		Remarks
1 ECTS Signal • Ignition Switch		<ul> <li>Ignition Switch "ON", Engine "OFF"</li> </ul>	Approx. 5. 0V	-	
Pin No.	2	-	<ul> <li>Voltage is measured on wiring side( Disconnected)</li> </ul>	-	-
	3	ECTS Ground		0V	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

	Retry 🗖
Freeze Frame DTC Status Frase Selective DTC Hist/Pend DTC \$	
Description	State
Engine Coolant Temperature Circuit Range / Performance	
	Freeze Frame       DTC Status       Erase Selective DTC       Hist/Pend DTC \$         Description       Engine Coolant Temperature Circuit Range / Performance

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

CRC12EN5010P01160021S

NO • Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition "OFF".
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "ON" 3.
- Monitor follow parameters in "Current Data" with 4 GDS.

Current Data		Search	<b>R H</b>	a 8
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		t de
Vater Temperature Sensor	70.0	'C		
Vater Temperature of Engine	70	'C		
Engine Speed	798.0	RPM		
Invalid Condition of Battery Sensor(AMS)	YES	-		~
Response Error Flag from Battery Sensor(AMS)	NO	-		
AMS Stop Reason - Head Lamp(AMS)	NO	-		
AMS Stop Reason - Wiper(AMS)	NO	-		
Engine ON Time	172927	Sec		
Kilometer Count with MIL ON	0	-		
Fig.1				

Fig. 1) Engine coolant temperature sensor current data.

Is the parameter displayed within specification? 5.





Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

CRC12EN5010P01160022S

Go to "Ground Circuit Inspection" procedure NO

### **Ground Circuit Inspection**

Specification : Refer to Figure below

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECTS connector.
- 4. Measure the resistance between ground terminal of ECTS harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect ECTS connector.
- Ignition switch "ON" 7.
- Measure the voltage between signal terminal of 8 ECTS harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9. ground terminal of ECTS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

Go to "Signal Circuit Inspection" procedure.



#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECTS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of ECTS harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECTS connector.
- 4. Refer to "Shop Manual" and remove ECTS.
- 5. Put the ECTS into the engine coolant.
- 6. Measure the resistance between signal terminal and ground terminal of ECTS.

#### Specification : Refer to table below

Ж	Resistance	value	decreases	as	temperature
inc	reases.				

Temp.( ℃/℉)	-40 / -40	-20 / -4	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	100 / 212	110 / 230	120 / 248
Resista- nce (kΩ)	48.14	14.13 ~ 1 6.83	5.79	2.31 ~ 2. 59	1.15	0.59	0.32	0.19	0.15	0.12

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CRC12EN5010P01160041S

Fig.1) Measuring ECTS resistance

7. Is the measured value within specification?

Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. T-

- horoughly check connectors for looseness, po-YES or connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the ECTS and go to "Verification of Vehicle Repair" procedure.

#### 

NO

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### A CAUTION

Top up the engine coolant after re-installing • engine coolant temperature sensor.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



- YES 
  Go to the applicable troubleshooting procedure.
- NO
- Problem is corrected and the system operation performs to specification at this time.

## P011700 Engine Coolant Temperature Circuit Low Input

### **Component Location**



CRC12EN5010P01160011

#### 1. Engine Coolant Temperature Sensor (ECTS)

#### **General Description**

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature.

The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference +5V is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation, the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

#### **DTC Description**

If ECTS output voltage is less than minimum threshold value (225mV) for more than 2 sec., ECM sets DTC P011700. This fault might be casued by short to ground in signal circuit of ECTS.

### **DTC Detecting Condition**

Item		Possible Cause		
DTC Strategy	Voltage Monitoring	Voltage Monitoring		
Enable Condition	Engine running	Engine running		
Threshold Value	Output voltage is le	1 Chart to ground in		
Detecting Time	• 2 sec	signal circuit of E		
	Engine Off	• No	CTS	
	EGR Off	• No	2. Defected ECTS	
Fall Safe	Torque Limit	• No		
	MIL	• On		

### Vehicle Data

Engine Coolant Temperat- ure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	ECTS Signal	<ul> <li>Ignition Switch "ON", Engine "OFF"</li> </ul>	Approx. 5. 0V	-
Pin No.	2	-	<ul> <li>Voltage is measured on wiring side( Disconnected)</li> </ul>	-	-
	3	ECTS Ground	Dioconnoology	0V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P011700	Engine Coolant Temperature Circuit Low Input	

CRC12EN5010P01170021S

4. Is DTC status displayed as Present?

dure.

YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" proce-

### Monitor GDS Data

- 1. Ignition "OFF".
- 2. Connect GDS to Data Link Connector(DLC).
  - 3. Ignition switch "ON" & Engine "ON"
  - 4. Monitor follow parameters in "Current Data" with

# **General Information**

#### GDS.

Specification : Refer to Figure below

Current Data		Search 🔍 🗐 🖓 😑
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Rese	et Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Vater Temperature Sensor	70.0	'C
Vater Temperature of Engine	70	'C
Engine Speed	798.0	RPM
Invalid Condition of Battery Sensor(AMS)	YES	- ^
Response Error Flag from Battery Sensor(AMS)	NO	-
AMS Stop Reason – Head Lamp(AMS)	NO	-
AMS Stop Reason - Wiper(AMS)	NO	-
Engine ON Time	172927	Sec
Kilometer Count with MIL ON	0	

#### Fig.1

Fig. 1) Engine coolant temperature sensor current data.

- 5. Is the parameter displayed within specification?
  - YES 
    Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

Many malfunctions in the electrical system are 1. caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



NO 
 Go to "Ground Circuit Inspection" procedure

#### CRC12EN5010P01160022S

### **Ground Circuit Inspection**

- 1. Ianition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECTS connector.
- 4. Measure the resistance between ground terminal of ECTS harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect ECTS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between signal terminal of 8. ECTS harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9. ground terminal of ECTS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

- 10. Is the measured value within specification?
  - **YES** Go to "Signal Circuit Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECTS

connector.

- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of ECTS harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Ignition Switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECTS 3. connector.
- 4. Refer to "Shop Manual" and remove ECTS.
- Put the ECTS into the engine coolant. 5.
- 6. Measure the resistance between signal terminal and ground terminal of ECTS.

#### Specification : Refer to table below

※ Resistance value decreases as temperature increases.

Temp.( ℃/℉)	-40 / -40	-20 / -4	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	100 / 212	110 / 230	120 / 248
Resista- nce (kΩ)	48.14	14.13 ~ 1 6.83	5.79	2.31 ~ 2. 59	1.15	0.59	0.32	0.19	0.15	0.12



CRC12EN5010P01160041S

Fig.1) Measuring ECTS resistance

7. Is the measured value within specification?



in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

Fault is intermittent caused by poor contact

Carefully re-do this troubleshooting guide st-

NO

If no problems were found with the circuits or connectors, replace the ECTS and go to "Verification of Vehicle Repair" procedure.

#### **A**CAUTION

eps.

- When installing component, tighten it within specification.
- If component is dropped, check for proper

operation. The internal damage may be present.

#### **A**CAUTION

• Top up the engine coolant after re-installing engine coolant temperature sensor.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.

NO 
• Problem is corrected and the system operation performs to specification at this time.

## P011800 Engine Coolant Temperature Circuit High Input

### **Component Location**



CRC12EN5010P01160011

### 1. Engine Coolant Temperature Sensor (ECTS)

#### General Description

Engine Coolant Temperature Sensor (ECTS) is located in the engine coolant passage of the cylinder head for detecting the engine coolant temperature. The ECTS uses a thermistor whose resistance changes with the temperature.

The electrical resistance of the ECTS decreases as the temperature increases, and increases as the temperature decreases. The reference +5V is supplied to the ECTS via a resistor in the ECM. That is, the resistor in the ECM and the thermistor in the ECTS are connected in series. When the resistance value of the thermistor in the ECTS changes according to the engine coolant temperature, the output voltage also changes.

During cold engine operation, the ECM increases the fuel injection duration and controls the ignition timing using the information of engine coolant temperature to avoid engine stalling and improve drivability.

#### **DTC Description**

If output voltage is higher than threshold value (3225mV) for more than 2 sec., ECM sets DTC P011800. This fault might be caused by open or short to power in signal circuit or open in ground circuit of ECTS.

### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		]
Threshold Value	<ul> <li>Output voltage is h (3225mV)</li> </ul>	igher than maximum threshold value	1. Open or short to power in sign-
Detecting Time	• 2 sec		al circuit of ECTS
	Engine Off	• No	3. Defected ECTS
	EGR Off	• No	]
Fail Sale	Torque Limit	• No	
	MIL	• On	]

### Vehicle Data

Engine Coolant Temperat- ure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	ECTS Signal	<ul> <li>Ignition Switch "ON", Engine "OFF"</li> </ul>	Approx. 5. 0V	-
	2	-	<ul> <li>Voltage is measured on wiring side( Disconnected)</li> </ul>	-	-
	3	ECTS Ground		0V	-

### **Monitor GDS Data**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

te

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

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NO • Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition "OFF".
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "ON" 3.
- Monitor follow parameters in "Current Data" with 4 GDS.

Current Data		Search	<b>R H</b>	a 8
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		t de
Vater Temperature Sensor	70.0	'C		
Vater Temperature of Engine	70	'C		
Engine Speed	798.0	RPM		
Invalid Condition of Battery Sensor(AMS)	YES	-		~
Response Error Flag from Battery Sensor(AMS)	NO	-		
AMS Stop Reason - Head Lamp(AMS)	NO	-		
AMS Stop Reason - Wiper(AMS)	NO	-		
Engine ON Time	172927	Sec		
Kilometer Count with MIL ON	0	-		
Fig.1				

Fig. 1) Engine coolant temperature sensor current data.

Is the parameter displayed within specification? 5.





Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

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Go to "Ground Circuit Inspection" procedure NO

### **Ground Circuit Inspection**

Specification : Refer to Figure below

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECTS connector.
- 4. Measure the resistance between ground terminal of ECTS harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect ECTS connector.
- Ignition switch "ON" 7.
- Measure the voltage between signal terminal of 8 ECTS harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9. ground terminal of ECTS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

Go to "Signal Circuit Inspection" procedure.



#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECTS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of ECTS harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECTS connector.
- 4. Refer to "Shop Manual" and remove ECTS.
- 5. Put the ECTS into the engine coolant.
- 6. Measure the resistance between signal terminal and ground terminal of ECTS.

#### Specification : Refer to table below

Ж	Resistance	value	decreases	as	temperature
inc	reases.				

Temp.( ℃/℉)	-40 / -40	-20 / -4	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	100 / 212	110 / 230	120 / 248
Resista- nce (kΩ)	48.14	14.13 ~ 1 6.83	5.79	2.31 ~ 2. 59	1.15	0.59	0.32	0.19	0.15	0.12

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Fig.1) Measuring ECTS resistance

7. Is the measured value within specification?

Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. T-

- horoughly check connectors for looseness, po-YES or connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the ECTS and go to "Verification of Vehicle Repair" procedure.

#### 

NO

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### A CAUTION

Top up the engine coolant after re-installing • engine coolant temperature sensor.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



- YES Go to the applicable troubleshooting procedure.
- NO
- Problem is corrected and the system operation performs to specification at this time.

## **General Information**

### P012200 Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input

### **Component Location**



#### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If ACV position sensor output voltage is less than threshold value (200mV) for more than 2.5 sec., ECM sets DTC P012200.

### **DTC Detecting Condition**

Item	Det	Possible Cause	
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	ACV position output	t voltage is less than 200 mV	
Detecting Time	• 2 sec		1. Short to ground feedback circ-
	Engine Off	• No	2. Defected ACV
	EGR Off	• No	
Fall Sale	Torque Limit	• Yes	]
	MIL	• On	

### Vehicle Data

Air Control Valve		Terminal		Inspection Condition	Measured Value	Remarks
Pin No.	1	motor(+) motor(-) ACV Feedback Signal			B+	Signal W- aveform( Fig. 1)
	2			Ignition Switch "ON", En- gine "OFF" Voltage is measured on wiring side(Disconnected	B+	Signal W- aveform( Fig. 2)
	3			)	Approx. 5V	-
	4	ACV Position Sensor Power			Approx. 5V	-
	5	ACV Position Sensor Ground			0V	-
Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1	motor(+)			B+	-
	2	motor(-)	•	Ignition Switch "ON", En-	B+	-
Pin No.	3	ACV Feedback Signal	].	gine "OFF" Voltage is measured on	Approx. 0.7V	-
	4	ACV Position Sensor Power		wiring side(Connected)	Approx. 5V	-
	5 ACV Position Sensor Ground				0V	-

# **General Information**

📕 Oscil	loscope						<b>-</b>
Senso	r Theme	Name	Review	User Setting	A	14.44 s 🕨 🛛 📢	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save			
+20		Motor +	' Hz : 0	.3 Hz	Duty-: 70 %	Duty+: 30 %	
-5×							В

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P012200	Throttle/Pedal Position Sensor/Switch "A" Circuit Low Input	

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#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- Monitor follow parameters in "Current Data" with GDS.

#### Specification: Refer to figure below

Current Data		Search 🗐 🗐	a) =
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Rese	et Min.Max Record	Stop Crouping	/SS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	2
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO	·	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO		
Fig.1			

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?

### YES

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S

# **General Information**

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between ACV position sensor power terminal of ACV harness connector and chassis ground.

#### Specification : Approx. 5V

- 5. Is the measured value within specification?
- YES 
  Go to "Ground Circuit Inspection" procedure

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the ACV connector.
- Measure the resistance between ACV position sensor 4 ground terminal of ACV harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect the ACV connector.

- Ignition switch "ON" 7.
- 8. Measure the voltage between ACV position sensor power terminal of ACV harness connector and chassis ground.(A)
- 9. Measure the voltage between ACV position sensor power terminal and ACV position sensor ground terminal of ACV harness connector.(B)

Specification : Difference (A) and (B) is less then 200 mV

10. Is the measured value within specification?

**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between ACV feedback signal terminal of ACV harness connector and chassis ground.

#### Specification : Approx. 5V

- Is the measured value within specification? 5.

  - **YES** Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### ACV Position Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : ACV feedback signal terminal (ACV Harness Connector)

Channel A (-) : Ground

- 3. Connect GDS to Data Link Connector (DLC).
- 4. Ignition switch "ON" & Engine "OFF"
- Perform "Throttle Valve Actuator 10%" and "Throttle 5. Valve Actuator 90%" in "Actuation Test" with GDS.

Specification : Refer to table below

Item	Specification
Voltage value at W.O.T (V)	Approx. 0.5V
Voltage value at closed (V)	Approx. 4.5V

#### 6. Is the measured value within specification?



YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within • specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### A CAUTION

When ACV is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- "Essential 4. Perform Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

# **General Information**



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🖅 📢	Essentia	l work after co	omponent repla	acement	•
Essential W	ork after Componen	t Replacement ]			
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

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# **General Information**

<b>E *</b>	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU         Essential work after component replacement         ECU replacement (DPF OPT)         Rail Pressure Sensor replacement         Air Flow Sensor replacement         Differential Pressure Sensor replacement         Differential Pressure Sensor replacement         EGR Valve replacement         APS Module replacement         SELECT
MENU C	ANCEL

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Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P012300 Throttle/Pedal Position Sensor/Switch "A" Circuit High Input

### **Component Location**



#### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If ACV position sensor output voltage is higher than threshold value (4800mV) for more than 2.5 sec., ECM sets DTC P012300. This fault might be caused by open or short to battery in circuit of ACV.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal Monitoring		
Enable Condition	Engine running		
Threshold Value	ACV position output	t voltage is higher than 4800 mV	
Detecting Time	• 2 sec		1. Short to ground feedback circ-
	Engine Off	• No	2. Defected ACV
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1	motor(+)			B+	Signal W- aveform( Fig. 1)
Pin No.     2     motor(-)       3     ACV Feedback Signal       4     ACV Position Sensor Power	•	Ignition Switch "ON", En- gine "OFF" Voltage is measured on wiring side(Disconnected	B+	Signal W- aveform( Fig. 2)		
		)	Approx. 5V	-		
			Approx. 5V	-		
5 ACV Position Sensor Ground				0V	-	
Air Control Valve Terminal			Inspection Condition	Measured Value	Remarks	
	1	motor(+)			B+	-
	2	motor(-)	-	Ignition Switch "ON", En- gine "OFF" Voltage is measured on	B+	-
Pin No.	3	ACV Feedback Signal	].		Approx. 0.7V	-
	4	ACV Position Sensor Power		wiring side(Connected) Appro		-
	5	ACV Position Sensor Ground			0V	-

# General

l Oscillos	соре						
Sensor	Theme	Name	Review	User Setting	A	14.44 s 🕨 📢	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save			
+20∨		Motor +	' Hz : C	).3 Hz	Duty-: 70 %	Duty+: 30 %	
onfiguration				]			
-5×							, В

#### CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P012300	Throttle/Pedal Position Sensor/Switch "A" Circuit High Input	

CRC12EN5010P01230021S

#### 4. Is DTC status displayed as Present?



YES 
Go to "Monitor GDS Data" procedure.

NO 
 Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

Current Data		Search 🗐 🚛	<b>2) (=)</b>
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Rese	t Min.Max Record	Stop Crouping	/SS
Sensor Name	Value	Unit	
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	Part of
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	<u> </u>	
Flag Status of Quiescent Current(AMS)	NO		
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO		
Fig.1			

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?



Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

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## General

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection. bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

Go to "Power Circuit Inspection" procedure. NO >

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between ACV position sensor power terminal of ACV harness connector and chassis ground.

#### Specification : Approx. 5V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect the ACV 3. connector.
- Measure the resistance between ACV position sensor 4. ground terminal of ACV harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect the ACV 6. connector.

- 7. Ignition switch "ON"
- 8. Measure the voltage between ACV position sensor power terminal of ACV harness connector and chassis ground.(A)
- 9. Measure the voltage between ACV position sensor power terminal and ACV position sensor ground terminal of ACV harness connector.(B)

Specification : Difference (A) and (B) is less then 200 mV

10. Is the measured value within specification?

- Go to "Signal Circuit Inspection" procedure. YES
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between ACV feedback signal terminal of ACV harness connector and chassis ground.

#### Specification : Approx. 5V

- Is the measured value within specification? 5.

  - **YES** Go to "Component Inspection" procedure.
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

#### ACV Position Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : ACV feedback signal terminal (ACV Harness Connector)

Channel A (-) : Ground

- 3. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "OFF" 4.
- Perform "Throttle Valve Actuator 10%" and "Throttle 5. Valve Actuator 90%" in "Actuation Test" with GDS.

Specification : Refer to table below

## **General Information**

Item	Specification
Voltage value at W.O.T (V)	Approx. 0.5V
Voltage value at closed (V)	Approx. 4.5V

#### 6. Is the measured value within specification?

- YES 

   Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO 
  Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

#### **A**CAUTION

- When installing component, tighten it within ٠ specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### **A**CAUTION

When ACV is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- Connect GDS to Data Link Connector(DLC). 2.
- 3. Ignition switch "ON" & Engine "OFF"
- "Essential Work 4. Perform After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

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CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement	
[ Eccential W	ork ofter Componen	t Poplacement 1			
	ork after componen	г керіасеттені ј			
If you're rea	dy, select the menu				
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S
# 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

# **GI-145**

# P018200 Fuel Temp Sensor A Circuit Low Input

# **Component Location**



CRC12EN5010P018211

### 1. Fuel Temperature Sensor (FTS)

## **General Description**

Fuel Temperature Sensor is NTC thermister which voltage gets low if the temperature comes to be high. It is installed in fuel supplying line. It senses the temperature of fuel supplied to high pressure pump. Fuel temperature is limited (engine power is limited) to keep fuel temperature from reaching at 80°C(176°F). This limit is to protect fuel line such as high pressure pump and injectors from damages due to rapid deterioration by vapor-lock phenomenon which can occur at high temperature or destruction of oil membrane.

### **DTC Description**

If ouput voltage of Fuel Temperature Sensor (FTS) is below threshold value (172mV) for more than 1 sec., ECM sets DTC P018200.

# **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		]
Threshold Value	<ul><li>Output signal is bel</li><li>Short to ground in s</li></ul>	ow threshold value (Below 172mV) signal circuit	
Detecting Time	• 1 sec		of FTS
	Engine OFF	• No	2. Defected FTS
	EGR OFF	• No	]
Fail Sale	Torque Limit	• No	]
	MIL	• Off	]

## Vehicle Data

Fuel Temperature Sensor Terminal		Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	FTS Signal	Ignition switch "ON" & Engine "OFF"	Approx. 5.0V	-
Pin No.	2	FTS Ground	<ul> <li>Voltage is measured on wiring side(Discon- nected)</li> </ul>	0V	-

# Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P018200	Fuel Temp Sensor A Circuit Low Input	

### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

## **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with

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NO • Go to "Verification of Vehicle Repair" procedure.

GDS.

Specification : Refer to figure below

Current Data		Search 🙉 🚛	a e
Selective Display 🛊 📔 Fuli List 💠 🗍 Graph 💠 Items List 🗧 Res	et Min.Max Record	Stop 😂 Grouping	VSS
Sensor Name	Value	Unit	1
Fuel Temperature Sensor	38	'C	
Engine Cooling Fan-High	OFF	-	~
Elec. Fuel Pump Relay	ON	-	
Boost Pressure Actuator	78	%	
Syncronizing Status			
Engine Status	Running	-	=
PTC Heater Realy	OFF		
Immobilizer Status Lamp	OFF	-	
Fuel Pressure Set Point Value	300000	hPa	

#### Fig.1

Fig. 1) Fuel temperature sensor current data under engine idle.

× In case of fuel temperature sensor failure, the temperature value is fixed at 80°C(176°F)

- 5. Is the parameter displayed within specification?
  - **YES** > Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



NO • Go to "Wiring Inspection" procedure.

## Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection. bending, corrosion, contamination. deterioration, or damage.
- 3. Has a problem been found?



NO 
Go to "Ground Circuit Inspection" procedure

CRC12EN5010P01820022S

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the FTS connector.
- Measure the resistance between ground terminal of 4. FTS harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect the FTS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between signal terminal of FTS 8. harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of FTS harness connector.(B)

Specification : Difference (A) and (B) is less then 200 mV

10. Is the measured value within specification?

**YES** • Go to "Signal Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the FTS

connector.

- 3. Ignition Switch "ON"
- Measure the voltage between signal terminal of FTS 4 harness connector and chassis ground.

### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect FTS 3. connector.
- Refer to "Shop Manual" and remove the FTS. 4.
- Measure the resistance between signal terminal and 5. ground terminal of FTS.

### Specification : Refer to table below

※ Resistance value decreases as temperature increases.

Temp.(°C)	-20 / -4	-10 / 14	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	120 / 24 8
Resistance (k $\Omega$ )	15.67	9.45	5.89	2.27 ~ 2.73	1.17	0.597	0.30 ~ 0.32	0.11

### 6. Is the measured value within specification?

NO Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the FTS and go to "Verification of Vehicle Repair" procedure.

### A CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

# Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting

**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

# **General Information**

condition in DTC Detecting Condition chart.

- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO 

Problem is corrected and the system operation performs to specification at this time.

# P018300 Fuel Temp Sensor A Circuit High Input

## **Component Location**



## 1. Fuel Temperature Sensor (FTS)

## **General Description**

Fuel Temperature Sensor is NTC thermister which voltage gets low if the temperature comes to be high. It is installed in fuel supplying line. It senses the temperature of fuel supplied to high pressure pump. Fuel temperature is limited (engine power is limited) to keep fuel temperature from reaching at  $80^{\circ}C(176^{\circ}F)$ . This limit is to protect fuel line such as high pressure pump and injectors from damages due to rapid deterioration by vapor-lock phenomenon which can occur at high temperature or destruction of oil membrane.

## **DTC Description**

If output signal voltage of FTS is higher than maximum threshold value (3204mV) for more than 1 sec., ECM sets DTC P018300. This fault might be caused by open/short to power in signal circuit or open in ground circuit of FTS.

CRC12EN5010P018211

# **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	<ul><li>Ouput signal is high</li><li>Open in signal circu</li></ul>	ner than threshold value (3204mV) uit	1. Open or short to power in sign-
Detecting Time	• 1 sec		al circuit FTS
	Engine OFF	• No	3. Defected FTS
	EGR OFF	• No	
Fall Sale	Torque Limit	• No	
	MIL	• On	

## Vehicle Data

Fuel Temperature Sensor Terminal		Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	FTS Signal	Ignition switch "ON" & Engine "OFF"	Approx. 5.0V	-
Pin No.	2	FTS Ground	<ul> <li>Voltage is measured on wiring side(Discon- nected)</li> </ul>	0V	-

# Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P018300	Fuel Temp Sensor A Circuit High Input	

### 4. Is DTC status displayed as Present?



dure.

**YES** • Go to "Monitor GDS Data" procedure.

# **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC). NO • Go to "Verification of Vehicle Repair" proce-
  - 3. Ignition switch "ON" & Engine "ON"
  - 4. Monitor follow parameters in "Current Data" with

CRC12EN5010P01830021S

General

### GDS.

Specification : Refer to figure below

Current Data		Search 🙉 🚛	<b>a</b> =
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop ‡ Grouping	VSS
Sensor Name	Value	Unit	1
Fuel Temperature Sensor	38	'C	
Engine Cooling Fan-High	OFF	-	V
Elec. Fuel Pump Relay	ON		
Boost Pressure Actuator	78	%	
Syncronizing Status	5. 		
Engine Status	Running	-	-
PTC Heater Realy	OFF		
🗉 Immobilizer Status Lamp	OFF	-	
Fuel Pressure Set Point Value	300000	hPa	

#### Fig.1

Fig. 1) Fuel temperature sensor current data under engine idle.

X In case of fuel temperature sensor failure, the temperature value is fixed at 80°C(176°F)

- 5. Is the parameter displayed within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



► Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor 2. connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



NO 
Go to "Ground Circuit Inspection" procedure

#### CRC12EN5010P01820022S

### Ground Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the FTS connector.
- 4. Measure the resistance between ground terminal of FTS harness connector and chassis ground.

Specification : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect the FTS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between signal terminal of FTS 8 harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9 ground terminal of FTS harness connector.(B)

Specification : Difference (A) and (B) is less then 200 mV

10. Is the measured value within specification?

- YES Go to "Signal Circuit Inspection" procedure.
- NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the FTS

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connector.

- 3. Ignition Switch "ON"
- Measure the voltage between signal terminal of FTS harness connector and chassis ground.

### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect FTS connector.
- 4. Refer to "Shop Manual" and remove the FTS.
- 5. Measure the resistance between signal terminal and ground terminal of FTS.

### Specification : Refer to table below

※ Resistance value decreases as temperature increases.

Temp.(°C)	-20 / -4	-10 / 14	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	120 / 24 8
Resistance (kΩ)	15.67	9.45	5.89	2.27 ~ 2.73	1.17	0.597	0.30 ~ 0.32	0.11

#### 6. Is the measured value within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the FTS and go to "Verification of Vehicle Repair" procedure.

### A CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting

condition in DTC Detecting Condition chart.

- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# P019100 Fuel Rail Pressure Sensor Circuit Range/Performance

# **Component Location**



CRC12EN5010P008711

## 1. Rail Pressure Sensor (RPS)

## **General Description**

The Rail Pressure Sensor (RPS) is installed at the end of the common rail and measures the instantaneous fuel pressure in the common rail. The sensing element (semiconductor device) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and timing. And it adjusts the rail pressure with the rail pressure regulator valve if the target pressure and the actual pressure calculated by the RPS output signal are different.

## **DTC Description**

If rail pressure sensor offset exceeds specification, ECM sets DTC P019100.

## DTC Detecting Condition

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	Rail pressure sense	or offset exceeds specification	1. Faulty RPS circuit
Detecting Time	• -		2. Short to power in signal circuit
	Engine OFF	• No	3. Open in ground circuit of RPS
	EGR OFF	• No	4. Defected RPS
Fall Sale	Torque Limit	• No	
	MIL	• Off	

# Vehicle Data

Fuel Rail Pressure Sensor Terminal		Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	RPS Power	Ignition switch "ON" & Engine "OFF"	Approx. 5.0V	-
Pin No. 2 R 3 RF	RPS Signal	<ul> <li>Voltage is measured on wiring side(Discon-</li> </ul>	Approx. 5.0V	-	
	3	RPS Ground	nected)	0V	

# **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P019100	Fuel Rail Pressure Sensor Circuit Range/Performance	

#### CRC12EN5010P01910021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.
  - NO Go to "Verification of Vehicle Repair" procedure.

## Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# **General Information**

Current Data		Search 🙉 🚛	) a e
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop 🗘 Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	4
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

Fig.1

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🧧 Current Data		Search 🙉 💷 🕼	
Selective Display 🗧 🛛 Full List 💠 🗌 Graph 💠 🛛 items List 🗘 Res	et Min.Max Record	Stop ‡ Grouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.2		-	

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



Go to "Wiring Inspection" procedure.

# **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found? 3.



NO

Go to "Power Circuit Inspection" procedure.

# **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS connector.

# GI-159

- Ignition switch "ON" 3.
- 4. Measure the voltage between power terminal of RPS harness connector and chassis ground.

## Specification : Approx. 5 V

5. Is the measured value within specification?



YES 
Go to "Ground Inspection" procedure.



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Ground Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect RPS 3. connector.
- Measure the resistance between ground terminal of 4 RPS harness connector and chassis ground.

### Specification : Approx. below 1 $\Omega$

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect RPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of RPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of RPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.



# Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of RPS 4. harness connector and chassis ground.

Specification : Approx. 5 V

5. Is the measured value within specification?



- YES Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

## Fuel Rail Pressure Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up an oscilloscope as follow (2-channel);

Channel A (+) : Signal terminal (RPS Harness Connector)

Channel A (-) : Ground

- Connect GDS to Data Link Connector (DLC). 3.
- Ignition switch "ON" & Engine "ON" 4.
- Inspection condition : Engine idle & W.O.T 5.

## Specification :

Output signal voltage under engine idle: Approx. below 1.1V (Rail pressure : Approx. 120 ~ 300 bar)

Output signal voltage under W.O.T : Approx. 4.5V (Rail Pressure : Approx. 1,600 ~ 2,000 bar)

- Is the measured value within specification? 6.
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the RPS and go to "Verification of Vehicle Repair" procedure.

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

# Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".

- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to the applicable troubleshooting procedure.



NO 
• Problem is corrected and the system operation performs to specification at this time.

# P019200 Fuel Rail Pressure Sensor Circuit Low Input

# **Component Location**



CRC12EN5010P008711

## 1. Rail Pressure Sensor (RPS)

### **General Description**

The Rail Pressure Sensor (RPS) is installed at the end of the common rail and measures the instantaneous fuel pressure in the common rail. The sensing element (semiconductor device) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and timing. And it adjusts the rail pressure with the rail pressure regulator valve if the target pressure and the actual pressure calculated by the RPS output signal are different.

## **DTC Description**

If rail pressure sensor output voltage is below threshold value (Below 25mV) for more than 0.14 sec., ECM sets DTC P019200. This fault might be caused by open in power circuit or short to ground in signal circuit of RPS.

### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal is bel	ow threshold value (Below 254mV)	1 Open in newer aircuit of PDS
Detecting Time	• 140 msec		2. Short to ground in signal circuit
	Engine OFF	• No	of RPS
	EGR OFF	• No	3. Defected RPS
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

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# Vehicle Data

Fuel Rail Ser	Pressure Isor	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	RPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5.0V	-
Pin No.	2	RPS Signal	<ul> <li>Voltage is measured on wiring side(Discon-</li> </ul>	Approx. 5.0V	-
	3	RPS Ground	nected)	0V	

## **Monitor GDS Data**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P019200	Fuel Rail Pressure Sensor Circuit Low Input	

## 4. Is DTC status displayed as Present?



- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

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Current Data		Search 🙉 🚛	<b>a</b> =
Selective Display 🗘 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	A.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.1			

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Current Data		Search 🙉 💷 🚑	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗧 Res	et Min.Max Record	Stop Crouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.2			

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS connector.

- Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPS harness connector and chassis ground.

## Specification : Approx. 5 V

5. Is the measured value within specification?



YES 
Go to "Ground Inspection" procedure.



# **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect RPS connector.
- 4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

### Specification : Approx. below 1 $\Omega$

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect RPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of RPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of RPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.



# Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS connector.
- Ignition switch "ON"
- 4. Measure the voltage between signal terminal of RPS harness connector and chassis ground.

Specification : Approx. 5 V

5. Is the measured value within specification?

# **General Information**

- YES Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

## Fuel Rail Pressure Sensor Inspection

- 1. Ianition switch "OFF"
- 2. Connect VMI to GDS and set up an oscilloscope as follow (2-channel);

Channel A (+) : Signal terminal (RPS Harness Connector)

Channel A (-) : Ground

- Connect GDS to Data Link Connector (DLC). 3.
- 4. Ignition switch "ON" & Engine "ON"
- 5. Inspection condition : Engine idle & W.O.T

## Specification :

Output signal voltage under engine idle: Approx. below 1.1V (Rail pressure : Approx. 120 ~ 300 bar)

Output signal voltage under W.O.T : Approx. 4.5V (Rail Pressure : Approx. 1,600 ~ 2,000 bar)

- Is the measured value within specification? 6.
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the RPS and go to "Verification of Vehicle Repair" procedure.

# **A**CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

# Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".

- Clear all DTCs in the system with GDS. 2.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

# P019300 Fuel Rail Pressure Sensor Circuit High Input

# **Component Location**



1. Rail Pressure Sensor (RPS)

## **General Description**

The Rail Pressure Sensor (RPS) is installed at the end of the common rail and measures the instantaneous fuel pressure in the common rail. The sensing element (semiconductor device) built in the sensor converts the pressure to voltage signal. By using this signal, the ECM can control correct injection amount and timing. And it adjusts the rail pressure with the rail pressure regulator valve if the target pressure and the actual pressure calculated by the RPS output signal are different.

## **DTC Description**

If rail pressure sensor output voltage is higher than threshold value (Higher than 4750mV) for more than 0.14 sec., ECM sets DTC P019300. This fault might be caused by open or short to power in signal circuit or open in ground circuit of RPS. CRC12EN5010P008711

# **DTC Detecting Condition**

Item	Det	Possible Cause	
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>Output signal is hig an 4750mV)</li> </ul>	her than threshold value (Higher th-	1. Open or short to power in sign-
Detecting Time	• 140 msec		al circuit of RPS
	Engine OFF	• No	3. Defected RPS
	EGR OFF	• No	
Fall Sale	Torque Limit	• Yes	
	MIL	• On	

## Vehicle Data

Fuel Rail Ser	Pressure Isor	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	RPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5.0V	-
Pin No.	2	RPS Signal	<ul> <li>Voltage is measured on wiring side(Discon-</li> </ul>	Approx. 5.0V	-
	3	RPS Ground	nected)	0V	

## Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P019300	Fuel Rail Pressure Sensor Circuit High Input	

## 4. Is DTC status displayed as Present?

**YES** • Go to "Monitor GDS Data" procedure.

# Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with

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NO • Go to "Verification of Vehicle Repair" procedure.

# **General Information**

GDS.

Specification : Refer to Figure below

🚪 Current Data		Search	1 🗉 🔊 🗄
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	et Min.Max Record	Stop 🗘 Gro	uping VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	1
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

-ig.1

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🚪 Current Data		Search 😰 💷 🔐 🖶
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	et Min.Max Record	Stop   Grouping VSS
Sensor Name	Value	Unit
Rail Pressure Measured	568.6	bar
Raw Value of Rail Pressure	1.55	v
Pressure Control Valve(Rail)	35	%
Output of Fuel Metering Unit(MPROP)	38	%
Engine Speed	4915.5	RPM
Actual Engine Torque - Crankshaft Torque	21	Nm
Inner Torque Without Transmission Interventions	80	Nm
State of Immo Presence	ON	-
AT/MT Information	A/T	-

Fig.2

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### CRC12EN5010P00870023S

### **Terminal and Connector Inspection**

Many malfunctions in the electrical system are 1. caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

# **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect RPS 2 connector.
- Ignition switch "ON" 3.
- Measure the voltage between power terminal of RPS 4. harness connector and chassis ground.

## Specification : Approx. 5 V

5. Is the measured value within specification?



YES 
Go to "Ground Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect RPS 3 connector.
- Measure the resistance between ground terminal of 4. RPS harness connector and chassis ground.

## Specification : Approx. below 1 $\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect RPS 6. connector.
- Ignition switch "ON" 7.
- Measure the voltage between power terminal of RPS 8. harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of RPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.



# Signal Circuit Inspection

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect RPS 2. connector.
- Ignition switch "ON" 3.

Measure the voltage between signal terminal of RPS 4. harness connector and chassis ground.

Specification : Approx. 5 V

- 5. Is the measured value within specification?
  - **YES** Go to "Component Inspection" procedure.
  - NO

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

## Fuel Rail Pressure Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up an oscilloscope as follow (2-channel);

Channel A (+) : Signal terminal (RPS Harness Connector)

Channel A (-) : Ground

- 3. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 4.
- 5. Inspection condition : Engine idle & W.O.T

## Specification :

Output signal voltage under engine idle: Approx. below 1.1V (Rail pressure : Approx. 120 ~ 300 bar)

Output signal voltage under W.O.T : Approx. 4.5V (Rail Pressure : Approx. 1,600 ~ 2,000 bar)

6. Is the measured value within specification?

- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the RPS and go to "Verification of Vehicle Repair" procedure.

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

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# **General Information**

# Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO • Problem is corrected and the system operation performs to specification at this time.

# P020100 Injector Circuit/Open-Cylinder 1

## **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

## **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

## **DTC Description**

If open or short in circuit of injector #1 in detected under injector operationg condition, ECM sets DTC P020100. This fault might be caused by open or short circuit in wiring of injector #1.

# DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Three hold \ (alue	Case 1	Open in injector circuit	
Infeshold value	Case 2	Short circuit in wiring	1. Poor connector connection
Detecting Time	• -		<ol> <li>Open in circuit of injector #1</li> <li>Short circuit in wiring of injecto-</li> </ol>
Fail Safe	Engine OFF	<ul> <li>Yes (Case 1)</li> <li>No (Case 2)</li> </ul>	<ul><li>r #1</li><li>4. Defected injector #1</li></ul>
	EGR Off	• NO	
	Torque Limit	• YES	]
	MIL	• On	

# Vehicle Data

Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	•	Ignition switch "ON" & Engine "OFF" Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)			0V	-
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks

# Signal Waveform & Data



CRC12EN5010P02010011S

# **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

## Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P020100	Injector Circuit/Open-Cylinder 1	

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### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

## Specification : Refer to figure below

🧯 Current Data		Search	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Res	et Min.Max Record	Stop ‡	Grouping
Sensor Name	Value	Unit	
Desired Injection Quantity of MI1	6	mm3	
Desired Injection Quantity of Pil1	1	mm3	
Desired Injection Quantity of Pil2	1	mm3	
Desired Injection Quantity of Pil3	0	mm3	
Desired Injection Quantity of Pol1	0	mm3	
Desired Injection Quantity of Pol2	0	mm3	
Fuel Quantity	9	mm3	
Current Injection Quantity	9	mm3	
Engine Speed	790.0	RPM	

Fig.1

CRC12EN5010P02010022S

# **General Information**

	Search	<b>1</b>	a) e
et Min.Max Record	Stop ‡	Grouping	VSS
Value	Unit		in the second
22	mm3		
1	mm3		
1	mm3		
0	mm3		
0	mm3		
3	mm3		
26	mm3		
28	mm3		
2357.0	RPM		
	et Min.Max Record Value 22 1 1 1 0 0 0 3 26 28 2357.0	Search           et Min.Max         Record         Stop            Value         Unit         22         mm3           1         mm3         1         mm3           0         mm3         0         mm3           26         mm3         28         mm3           2357.0         RPM         2357.0         RPM	et Min.Max Record Stop \$ Grouping Value Unit 22 mm3 1 mm3 0 mm3 0 mm3 26 mm3 28 mm3 2357.0 RPM

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 🕨

Go to "Wiring Inspection" procedure.

## **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

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## **Control Circuit Inspection**

## Injector Control High Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #1 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between Injector control high terminal of injector #1 harness connector and chassis ground.

Specification : Approx. 5V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #1 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition " Ignition switch "ON" & Engine 9. "OFF"

## Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #1

connector.

- 3. Ignition Switch "ON"
- Measure the voltage between injector control low terminal of injector #1 harness connector and chassis ground.

### Specification : 0V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #1 connector.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine "OFF"

### Specification : Approx. 5V

10. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO • Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- Injector Signal Waveform & Operating Current Inspection
- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Injector control low connector (On Injector Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- 3. Ignition switch "ON" & Engine "ON"
- 4. Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



CRC12EN5010P02010011S



Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

## Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43 Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

# NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #1 and go to "Verification of Vehicle Repair" procedure.

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

## 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe;
   Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.
#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



CRC12EN5010P02010043S



CRC12EN5010P02010041S

## **General Information**

😎 🐳	Injector Specific Data	
[ Injector Specific I If the Injector or to control the norm After this function recheck the system [ Condition ] 1. Ignition Key Or 2. Engine Stop If you are ready, p	rata ] CU is changed, this function should be perform al fuel injection. is completed, turn the Ignition Key off and after 10 sec. ess [OK] button.	
ОК	CANCEL	
Fig.2		

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P020200 Injector Circuit/Open-Cylinder 2

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If open or short in circuit of injector #2 in detected under injector operationg condition, ECM sets DTC P020200. This fault might be caused by open or short circuit in wiring of injector #2.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Three hold \ (alue	Case 1	Open in injector circuit	
Infeshold value	Case 2	Short circuit in wiring	1. Poor connector connection
Detecting Time	• -		<ol> <li>Open in circuit of injector #2</li> <li>Short circuit in wiring of injecto-</li> </ol>
	Engine OFF	<ul> <li>Yes (Case 1)</li> <li>No (Case 2)</li> </ul>	<ul><li>4. Defected injector #2</li></ul>
Fail Safe	EGR Off	• NO	
	Torque Limit	• YES	]
	MIL	• On	

#### Vehicle Data

Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	•	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side (Disconnected)</li> </ul>	Approx. 5 V	-
Pin No.	2	Injector Control(Low)			0V	-
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks -

#### Signal Waveform & Data



CRC12EN5010P02010011S

## **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-187

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P020200	Injector Circuit/Open-Cylinder 2	

CRC12EN5010P02020021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO 
  Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search		<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		-
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

# **General Information**

Current Data		Search	
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 🗍 Items List 🗘 Res	set Min.Max Record	Stop ‡ Gro	uping VSS
Sensor Name	Value	Unit	
Desired Injection Quantity of MI1	22	mm3	
Desired Injection Quantity of Pil1	1	mm3	
Desired Injection Quantity of Pil2	1	mm3	
Desired Injection Quantity of Pil3	0	mm3	
Desired Injection Quantity of Pol1	0	mm3	
Desired Injection Quantity of Pol2	3	mm3	
Fuel Quantity	26	mm3	
Current Injection Quantity	28	mm3	
Z Engine Speed	2357.0	RPM	

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

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#### **Control Circuit Inspection**

#### Injector Control High Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #2 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between Injector control high terminal of injector #2 harness connector and chassis ground.

Specification : Approx. 5V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #2 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition " Ignition switch "ON" & Engine 9. "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #2

connector.

- 3. Ignition Switch "ON"
- Measure the voltage between injector control low terminal of injector #2 harness connector and chassis ground.

#### Specification : 0V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #2 connector.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO • Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Injector Signal Waveform & Operating Current Inspection
- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- 3. Ignition switch "ON" & Engine "ON"
- Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



CRC12EN5010P02010011S



Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

#### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43  $\Omega$  (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

#### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #2 and go to "Verification of Vehicle Repair" procedure.

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe;
   Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



CRC12EN5010P02010043S



## **General Information**

🖙 🔦 Injector Specific Data
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection. After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ] <ol> <li>Ignition Key On</li> <li>Engine Stop</li> </ol> </li> <li>If you are ready, press [OK] button.</li> </ul>
OK CANCEL
Fig.2

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P020300 Injector Circuit/Open-Cylinder 3

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If open or short in circuit of injector #3 in detected under injector operationg condition, ECM sets DTC P020300. This fault might be caused by open or short circuit in wiring of injector #3.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threads ald \/alva	Case 1	Open in injector circuit	
Inresnoid value	Case 2	Short circuit in wiring	1. Poor connector connection
Detecting Time	• -		<ol> <li>Open in circuit of injector #3</li> <li>Short circuit in wiring of injecto-</li> </ol>
	Engine OFF	<ul> <li>Yes (Case 1)</li> <li>No (Case 2)</li> </ul>	<ul><li>4. Defected injector #3</li></ul>
Fail Safe	EGR Off	• NO	
	Torque Limit	• YES	
	MIL	• On	

#### Vehicle Data

Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	•	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side (Disconnected)</li> </ul>	Approx. 5 V	-
Pin No.	2	Injector Control(Low)			0V	-
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks -

#### Signal Waveform & Data



CRC12EN5010P02010011S

## **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-199

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P020300	Injector Circuit/Open-Cylinder 3	

CRC12EN5010P02030021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search		<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		-
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

# **General Information**

🕴 Current Data		Search	1) 1	e e
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Re	eset Min.Max Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		in the second
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
V Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Engine Speed	2357.0	RPM		

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

CRC12EN5010P02010023S

#### **Control Circuit Inspection**

#### Injector Control High Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #3 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between Injector control high terminal of injector #3 harness connector and chassis ground.

Specification : Approx. 5V

- 5. Ignition Switch "OFF"
- Re-connect injector #3 connector. 6.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #3 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition " Ignition switch "ON" & Engine 9. "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #3

connector.

- 3. Ignition Switch "ON"
- Measure the voltage between injector control low terminal of injector #3 harness connector and chassis ground.

#### Specification : 0V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #3 connector.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #3 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO • Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Injector Signal Waveform & Operating Current Inspection
- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- 3. Ignition switch "ON" & Engine "ON"
- Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



CRC12EN5010P02010011S



Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

#### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43  $\Omega$  (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

#### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #2 and go to "Verification of Vehicle Repair" procedure.

# GI-203

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe; Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



CRC12EN5010P02010043S



CRC12EN5010P02010041S

## **General Information**

🖙 < Injector Specific Data
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection. After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ]</li> <li>1. Ignition Key On</li> <li>2. Engine Stop</li> </ul>
If you are ready, press [OK] button.
OK CANCEL
Fig.2

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P020400 Injector Circuit/Open-Cylinder 4

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If open or short in circuit of injector #4 in detected under injector operationg condition, ECM sets DTC P020400. This fault might be caused by open or short circuit in wiring of injector #4.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage Monitoring		
Enable Condition	Engine running		
Threehold \/olug	Case 1	Open in injector circuit	
I hreshold Value	Case 2	Short circuit in wiring	1. Poor connector connection
Detecting Time	• -		<ol> <li>Open in circuit of injector #4</li> <li>Short circuit in wiring of injecto-</li> </ol>
Fail Safe	Engine OFF	<ul> <li>Yes (Case 1)</li> <li>No (Case 2)</li> </ul>	<ul> <li>4. Defected injector #4</li> </ul>
	EGR Off	• NO	
	Torque Limit	• YES	]
	MIL	• On	

#### Vehicle Data

Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	•	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
	2	Injector Control(Low)	<ul> <li>Voltage is measured on wiring side (Disconnected)</li> </ul>	0V	-	
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks

#### Signal Waveform & Data



CRC12EN5010P02010011S

# **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-211

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC	Hist/Pend DTC \$
Current DTC	Description	State
P020400	Injector Circuit/Open-Cylinder 4	

CRC12EN5010P02040021S

#### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search	<b>1</b>	<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit	0.000.000000	
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

# **General Information**

🧯 Current Data		Search		
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘	Reset Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
V Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Engine Speed	2357.0	BPM		

·ıg.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

CRC12EN5010P02010023S

#### **Control Circuit Inspection**

#### Injector Control High Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #4 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between Injector control high terminal of injector #4 harness connector and chassis ground.

Specification : Approx. 5V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #4 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

- Ignition switch "ON" 8.
- Inspection condition " Ignition switch "ON" & Engine 9. "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect injector #4

connector.

- 3. Ignition Switch "ON"
- Measure the voltage between injector control low terminal of injector #4 harness connector and chassis ground.

#### Specification : 0V

- 5. Ignition Switch "OFF"
- 6. Re-connect injector #4 connector.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO • Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Injector Signal Waveform & Operating Current Inspection
- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- 3. Ignition switch "ON" & Engine "ON"
- 4. Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



CRC12EN5010P02010011S



Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

#### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43  $\Omega$  (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

#### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #4 and go to "Verification of Vehicle Repair" procedure.

# <u>GI-215</u>

# <u>GI-216</u>

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe;
   Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.
#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



CRC12EN5010P02010043S



CRC12EN5010P02010041S

## **General Information**

🖙 < Injector Specific Data
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection.</li> <li>After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ] <ol> <li>Ignition Key On</li> <li>Engine Stop</li> </ol> </li> <li>If you are ready, press [OK] button.</li> </ul>
OK CANCEL
Fig.2

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



## GI-219

### P021900 Engine Overspeed Condition

### **Component Location**



## 1. Engine Control Module (Atmoshpere Pressure Sensor Integrated)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

#### **DTC Description**

If the engine speed is exceeded 5500RPM, ECM sets DTC P021900.

#### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Engine speed monitoring		
Enable Condition	Engine running		
Threshold Value	Engine speed exce	eds 5500RPM	
Detecting Time	• 1 sec		1. Poor connector connection
	Engine Off	• Yes	2. Defected ECM
	EGR Off	• No	
Fail Sale	Torque Limit	• No	]
	MIL	• Off	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

CRC12EN5010P02190011

# **General Information**

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P021900	Engine Overspeed Condition	

CRC12EN5010P02190021S

#### 4. Is DTC status displayed as Present?



YES 
Go to "Monitor GDS Data" procedure.

NO 
 Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Selective Display \$ Full List \$ Graph \$ Items List \$ Rese	t Min.Max Record	Stop ‡ Grouping VSS
Sensor Name	Value	Unit
Engine Speed	4931.0	RPM
C Accelerator Pedal Position Sensor	100	%
Pressure Control Valve(Rail)	35	%
C Air Mass per Cylinder	800	mg/hub
Barometric Pressure Sensor	1002	hPa
Clutch Switch (M/T only)	ON	-
A/C ON Signal Switch	ON	-
Gearbox Neutral Position Status Signal	ON	-
Brake Switch 2	OFF	-

Fig.1

Fig.1) Engine speed at W.O.T

5. Is the parameter displayed within specification?



Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P02190022S

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

Many malfunctions in the electrical system are 1. caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found? 3.



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect ECM 2 connector.
- Ignition switch "ON" 3.
- Measure the voltage between Engine control relay 4. "ON" Power terminal of ECM harness connector and chassis ground.

#### Specification : B+

- Is the measured value within specificaiton? 5.

YES 
Go to "Ground Circuit Inspection" procedure

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shp Manual" and disconnect ECM 3. connector.
- Measure the resistance between Ground terminal of 4. ECM harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

5. Is the measured value within specificaiton?



Go to "Component Inspection" procedure.



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 4.
- Clear any DTCs stored in the system with GDS. 5.
- Re-check DTC in the system with GDS. 6.
- 7. Did the same DTC is stored in the system?
  - Inspect for fault in injection system. If the in-YES jection system fault is detected, perform applicable troubleshooting steps and then go to "Verification of Vehicle Repair" procedure.

If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

Fault is intermittent caused by poor contact NO in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### 

- After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS
- In the case the vehicle is equipped with immobilizer smart key, perform "KEY or procedure together TEACHING" (Refer to "Immobilizer" or "Smart key system" in BE group)

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

## **General Information**



CRC12EN5010P01010041S

🖅 📢	Essentia	l work after co	mponent repla	acement	
<b>F - - - - - - - - - -</b>					
Essential W	ork after Componen	t Replacement ]			
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## **General Information**

🖙 < Essential work after component replacement
[ Essential Work after       MENU         If you're ready, self       Essential work after component replacement         ECU replacement (DPF OPT)       Rail Pressure Sensor replacement         Air Flow Sensor replacement       Differential Pressure Sensor replacement         Differential Pressure Sensor replacement       EGR Valve replacement         EGR Valve replacement       APS Module replacement
SELECT CANCEL
MENU CANCEL

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

GI-225

### P023000 Fuel Pump Primary Circuit

#### **Component Location**



1. Fuel Pump Relay

#### **General Description**

Vain pump type fuel pump which is driven by electric motor is applied to this vehicle. Fuel pump which is installed inside of fuel tank supplies fuel to high pressure pump. ECM controls Fuel pump relay to supply power to low pressure fuel pump. The relay operates for approx. 2 sec. for the diagnosis fuel pump relay at IG key ON, then if engine speed above 45rpm is detected by CKPS, relay turns ON and fuel is supplied to high pressure pump.

#### **DTC Description**

If the open, short or over-temperature on fuel pump circuit is detected, ECM sets DTC P023000.

CRC12EN5010P02300011

### **DTC Detecting Condition**

ltem	Detecting Condition		Possible Cause
DTC Strategy	Plausibility monitoring		
Enable Condition	Engine running		
	Case 1	No load error is detected	
	Case 2	Over-temperature is detected	
Threshold Value	Case 3	<ul> <li>Short to power in fuel pump cir- cuit</li> </ul>	
	Case 4	<ul> <li>Short to ground in fuel pump circuit</li> </ul>	1. Poor connector connection
	Case 1	• 270 msec	pump circuit
Detecting Time	Case 2	• 1 sec	3. Open in fuel pump circuit
Detecting time	Case 3	• 270 msec	4. Defected ECM
	Case 4	• 2 sec	
	Engine OFF	• Yes	
	EGR OFF	• No	
Fail Safe	Torque Limit	<ul> <li>Yes (Case 1, Case 3)</li> <li>No (Case 2, Case 4)</li> </ul>	
	MIL	• Off	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P023000	Fuel Pump Primary Circuit	

CRC12EN5010P02300021S

4. Is DTC status displayed as Present?



**YES** • Go to "Wiring Inspection" procedure.



### Terminal and Connector Inspection

Many malfunctions in the electrical system are 1. caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and remove fuel pump relay.
- Ignition switch "ON" 3.
- 4. Measure the voltage between power terminal of fuel pump relay harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and remove fuel pump relay. 2.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of fuel 4. pump relay harness connector and chassis ground.

#### Specification : Approx. 3.4 V

Is the measured value within specification? 5.



If no problems were found with the circuits or connectors, replace the Fuel pump relay and go to "Verification of Vehicle Repair" procedure



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO Problem is corrected and the system operation performs to specification at this time.



## **General Information**

## P023400 Turbocharger/Supercharger System Overboost Condition

### **Component Location**



CRC12EN5010P004711



CRC12EN5010P004711

#### 1. VGT Actuator

2. VGT Control Valve

#### **General Description**

The VGT Control Actuator is installed on the turbocharger. It operates the vain in the Variable Geometry Turbocharger (VGT) and regulates the compressed air amount by the ECM's signal. This valve consists of a DC motor which actuates the vane, a 2-step gear which increases torque of the DC motor, a position sensor which detects status of the vane, an electric control unit which drives the DC motor, and a reset spring which resets the de-energized vane to its open position.

### **DTC Description**

If boost pressure sensor output value is higher than target value for more than 6 sec. under engine speed over 1500 RPM and amount of fuel injection 20mg/hub condition ECM sets DTC P023400. This fault might be caused by defected VGT actuator, vacuum leakage or increased back pressure due to clogged exhaust system.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Measured BPS outp	out value is higher than target value	
Detecting Time	• 6 sec		1. Poor connector connection
	Engine Off	• No	3. Clogged exhaust system
Fail Safe	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

VGT Control	Actuator	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	VGT Actuator Power	Ignition switch "ON" & E-	B+	-
Pin No.	2	VGT Actuator Control	ngine "OFF" • Voltage is measured on wiring side(Disconnected )	Approx. 3.4V	-

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P023400	Turbocharger/Supercharger System Overboost Condition	

CRC12EN5010P02340021S



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

'			
Current Data		Search 😰 💷	Retry
Selective Display \$ Full List \$ Graph \$ Items List \$	Resel Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Boost Pressure Actuator	78	%	
Boost Pressure Sensor	1.0	bar	
Raw Voltage of Boost Pressure Sensor	1.08	V	
Engine Speed	815.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO	-	A.
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
Hood Switch	CLOSED	-	
Battery Current(AMS)	15.1	Α	

Fig.1

CRC12EN5010P00470022S

Specification : Refer to figure below

Current Data		Search 🙉 💷 🕷	) E
Selective Display \$ Full List \$ Graph \$ Items List \$ Re	set Min.Max Record	Stop Crouping VS	s
Sensor Name	Value	Unit	1
Boost Pressure Actuator	47	%	
Boost Pressure Sensor	1.8	bar	
Raw Voltage of Boost Pressure Sensor	2.00	v	
Engine Speed	4915.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO		-
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
Hood Switch	CLOSED		
Battery Current(AMS)	25.5	Α	

Fig.2

Fig. 1) Boost pressure actuator control duty current data on engine idle.

Fig. 2) Boost pressure actuator control duty current data on engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.



Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- Ignition Switch "OFF" 1.
- Refer to "Shop Manual" and disconnect VGT control 2.

CRC12EN5010P00470023S

- actuator connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between power terminal of VGT control actuator harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of VGT 4. control actuator harness connector and chassis ground.

#### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **General Information**

#### **Component Inspection**

#### Actuation Test

- 1. ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Boost Pressure Actuator 5%" and "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.
- 5. Monitor "Boost Pressure Actuator" parameter in "Current Data" with GDS.

#### 🗆 🛹 📴 主 ñ 🖅 🔹 Actuation Test **Test Items** Duration Until Stop Button GRU (Glow Relay Unit) 15% Duty · Condition IG. ON/ENG.OFF - Check Current Data **Boost Pressure Actuator 5%** (VGT Actuator) **Boost Pressure Actuator 95%** -· Result Operation Command Sent T EGR Valve 10% **Data Analysis** Boost Pressure Actuator \$ 68 % Start Stop Function

CRC12EN5010P00470041S

Specification : Refer to figure below

📼 📢 🛛 Actu	lation	Test		
Test Items		Duration	Until Ston Button	
GRU (Glow Relay Unit) 15% Duty		Duration		
Boost Pressure Actuator 5%		· Condition	IG. ON/ENG.OFF - (VGT Actuator)	Check Current Data
Boost Pressure Actuator 95%	~	· Result	Operation Commar	nd Sent
EGR Valve 10%	₹			
Dat	a Anal	lysis		
100 Boost Pressure Actuator			Max : 95	×
				68 %
0			Min : 5	Đ
Start Stop				Function

Fig. 1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

Fig. 2) Boost pressure actuator current data when performing "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

6. Is the parameter displayed within specification?

YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Carefully re-do this troubleshooting guide steps.

> ► If no problems were found with the circuits or connectors, replace the VGT control actuator and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- CRC12EN5010P00470042S
- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.

NO • Problem is corrected and the system operation performs to specification at this time.

## **General Information**

## P023700 Turbocharger/Supercharger System Boost Sensor "A" Circuit Low

### **Component Location**



CRC12EN5010P00690011

#### 1. Boost Pressure Sensor (BPS)

#### **General Description**

Boost Pressure Sensor(BPS) is installed in intake manifold and senses the pressure of air inside of intake manifold which is compressed by turbo charager. Measuring mass air flow accurately with the information of intake mainfold pressure, mass air flow and intake air temperature, ECM performs actuating correction of EGR and VGT.

When excessive intake manifold pressure is detected, engine power generation is limited to protect engine because too highly compressed pressure due to turbo charger may harm engine.

#### **DTC Description**

If output value of boost pressure sensor is below threshold value for more than 2 sec. ECM sets DTC P023700. This fault might be caused by short to ground in signal circuit of BPS.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Output value is belo	ow threshold value	1 Deer connector connection
Detecting Time	• 2 sec		<ol> <li>Poor connector connection</li> <li>Short to ground in signal circuit</li> </ol>
	Engine Off	• No	of BPS
	EGR Off	• Yes	3. Defected BPS
Fail Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Lambda Sen	sor Unit	Terminal	Inspection Condition	Measured Value	Remarks
	1	Boost Pressure Sensor Signal	<ul> <li>Ignition quitch "ON" % E</li> </ul>	Approx. 5.5V	-
Pin No. 2 Boost Pressure Sensor Power	Boost Pressure Sensor Power	<ul> <li>Ignition switch ON &amp; E- ngine "OFF"</li> <li>Voltage is measured on</li> </ul>	Approx. 5.0V	-	
	3	-	wiring side(Disconnected	-	-
	4	Boost Pressure Sensor Gro- und	)	0 V	-
Lambda Sensor Unit Tei					
Lambda Sen	sor Unit	Terminal	Inspection Condition	Measured Value	Remarks
Lambda Sen:	sor Unit	<b>Terminal</b> Boost Pressure Sensor Signal	Inspection Condition	Measured Value Approx. 1.0V	Remarks Atmosphe- ric Pressu- re
Lambda Sen: Pin No.	sor Unit 1 2	Terminal Boost Pressure Sensor Signal Boost Pressure Sensor Power	<ul> <li>Inspection Condition</li> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> <li>Voltage is measured on</li> </ul>	Measured Value Approx. 1.0V Approx. 5.0V	Remarks Atmosphe- ric Pressu- re -
Lambda Sen: Pin No.	sor Unit 1 2 3	Terminal Boost Pressure Sensor Signal Boost Pressure Sensor Power	<ul> <li>Inspection Condition</li> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Measured Value Approx. 1.0V Approx. 5.0V	Remarks Atmosphe- ric Pressu- re -

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

	Retry
Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Description	State
Turbocharger/Supercharger System Boost Sensor "A" Circuit Low	
	Freeze Frame       DTC Status       Erase Selective DTC       Hist/Pend DTC \$         Description       Turbocharger/Supercharger System Boost Sensor "A" Circuit Low

CRC12EN5010P02370021S

#### 4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification :Refer to figure below

Current Data		Search 😰 🗉 🏭 🚍
Selective Display 🛊 📔 Fuli List 💠 🗍 Graph 💠 🗍 Items List 😂 🔤 Res	el Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Boost Pressure Actuator	78	%
Boost Pressure Sensor	1.0	bar
Raw Voltage of Boost Pressure Sensor	1.08	V
Engine Speed	815.5	RPM
Idle Stop request by Drivers demand(ISG)	NO	- 4
Driver`s Seat Belt	Unbelted	-
Driver`s Door	CLOSED	-
E Hood Switch	CLOSED	-
Battery Current(AMS)	15.1	Α

Fig.1

CRC12EN5010P00470022S

Current Data		Search 🗩 🖛 🙉 🖛
		Eatry E
Selective Display  Full List  Graph  Items List  Re	set Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Boost Pressure Actuator	47	%
Boost Pressure Sensor	1.8	bar
Raw Voltage of Boost Pressure Sensor	2.00	V
Engine Speed	4915.5	RPM
Idle Stop request by Drivers demand(ISG)	NO	-
Driver`s Seat Belt	Unbelted	
Driver`s Door	CLOSED	-
Hood Switch	CLOSED	
Battery Current(AMS)	25.5	A

Battery Current(AMS) Fig.2

Fig. 1) Boost pressure actuator control duty current data on engine idle.

Fig. 2) Boost pressure actuator control duty current data on engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor 2. connection. bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

1. Ignition switch "OFF"

#### CRC12EN5010P00470023S

- 2. Refer to "Shop Manual" and disconnect the boost pressure sensor connector.
- 3. Ignition Switch "ON"
- 4 Measure voltage of power terminal of the boost pressure sensor connector and chassis ground.

Specification : Approx. 5V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual"and disconnect the boost pressure sensor connector.
- Measure the resistance between ground terminal of 4. BPS harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect the boost pressure sensor connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of BPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of BPS harness connector.(B)

Specification :(A) - (B) = below 200 mV



# **General Information**

#### 10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.



NO 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual"and disconnect the boost pressure sensor connector.
- 3. Ignition switch "ON"
- 4. Measure voltage between signal of the boost pressure sensor and chassis ground.

Specification : Difference in (A) and (B) is less than 200 mV

5. Is the measured value within specification?



► Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect boost pressure sensor connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between signal terminal of BPS harness connector and chassis ground.
- Specification : Approx. 5.5V
- 5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Visual Inspection of BPS

- 1. ignition Switch "OFF"
- 2. Refer to "Shop Manual" and remove boost pressure sensor.
- Inspect for corrosion and contamination on connector 3. terminal of boost pressure sensor.
- 4. Check for proper installation of boost pressure sensor and inspect for leakage of O-ring, excessive carbon

on sensing area.

5. Have any problems been found?



If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.

NO

Go to "Boost Pressure Sensor Output Signal Inspection" procedure.

### Boost Pressure Sensor Output Signal Inspection

- Ignition Switch "OFF" 1.
- Connect VMI to GDS and set up the Oscilloscope.(2 2. Channel):

Channel A (+) : Signal terminal (BPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within spcification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

 Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to the applicable troubleshooting procedure.



NO 

Problem is corrected and the system operation performs to specification at this time.

## **General Information**

## P023800 Turbocharger/Supercharger System Boost Sensor "A" Circuit High

### **Component Location**



CRC12EN5010P00690011

#### 1. Boost Pressure Sensor (BPS)

#### **General Description**

Boost Pressure Sensor(BPS) is installed in intake manifold and senses the pressure of air inside of intake manifold which is compressed by turbo charager. Measuring mass air flow accurately with the information of intake mainfold pressure, mass air flow and intake air temperature, ECM performs actuating correction of EGR and VGT.

When excessive intake manifold pressure is detected, engine power generation is limited to protect engine because too highly compressed pressure due to turbo charger may harm engine.

#### **DTC Description**

If output value of boost pressure sensor is higher than threshold value for more than 2 sec. ECM sets DTC P023800. This fault might be caused by open in ground/power circuit or short to power in signal circuit of BPS.

### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Output value is belo	ow threshold value	1. Poor connector connection
Detecting Time	• 2 sec		of BPS
	Engine Off	• No	3. Open in ground circuit of BPS
	EGR Off	• Yes	5. Defected BPS
Fall Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Lambda Sensor Unit Terminal		Inspection Condition	Measured Value	Remarks		
	1	Boost Pressure Sensor Signal	e Ignition Switch "ONI" En	Ignition Switch "ONI" En	Approx. 5.5V	-
Pin No. Boost	Boost Pressure Sensor Power	gine "OFF" Appl • Voltage is measured on	Approx. 5.0V	-		
	3	-	wiring side(Disconnected )	-	-	
	4	Boost Pressure Sensor Gro- und		0 V	-	
Lambda Sensor Unit Ter						
Lambda Sens	sor Unit	Terminal	Inspection Condition	Measured Value	Remarks	
Lambda Sen:	sor Unit	<b>Terminal</b> Boost Pressure Sensor Signal	Inspection Condition	Measured Value Approx. 1.0V	Remarks Atmosphe- ric Pressu- re	
Lambda Sen: Pin No.	sor Unit 1 2	Terminal Boost Pressure Sensor Signal Boost Pressure Sensor Power	<ul> <li>Inspection Condition</li> <li>Ignition Switch "ON", Engine "OFF"</li> <li>Voltage is measured on</li> </ul>	Measured Value Approx. 1.0V Approx. 5.0V	Remarks Atmosphe- ric Pressu- re -	
Lambda Sen: Pin No.	sor Unit 1 2 3	Terminal Boost Pressure Sensor Signal Boost Pressure Sensor Power	<ul> <li>Inspection Condition</li> <li>Ignition Switch "ON", Engine "OFF"</li> <li>Voltage is measured on wiring side(Connected)</li> </ul>	Measured Value Approx. 1.0V Approx. 5.0V	Remarks Atmosphe- ric Pressu- re -	

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P023800	Turbocharger/Supercharger System Boost Sensor "A" Circuit High	

CRC12EN5010P02380021S

#### 4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification :Refer to figure below

Current Data		Search 🔍 💷	<b>a</b> 8
Selective Display 🛊 📔 Fuli List 💠 🗍 Graph 💠 Items List 🗘 Rese	t Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Boost Pressure Actuator	78	%	
Boost Pressure Sensor	1.0	bar	
Raw Voltage of Boost Pressure Sensor	1.08	V	
Engine Speed	815.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO	-	
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
E Hood Switch	CLOSED	-	
Battery Current(AMS)	15.1	Α	
Fig.1			

CRC12EN5010P00470022S

# GI-24

🚪 Current Data		Search 🖭 🗐	ar) (=
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop   Grouping \	/SS
Sensor Name	Value	Unit	toologi
Boost Pressure Actuator	47	%	
Boost Pressure Sensor	1.8	bar	
Raw Voltage of Boost Pressure Sensor	2.00	V	
Engine Speed	4915.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO	· — · ·	1
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
Hood Switch	CLOSED	-	
Battery Current(AMS)	25.5	Α	

Fig.2

Fig. 1) Boost pressure actuator control duty current data on engine idle.

Fig. 2) Boost pressure actuator control duty current data on engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check connectors for looseness, poor 2. connection. bending, corrosion. contamination, deterioration, or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.



Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

1. Ignition switch "OFF"

#### CRC12EN5010P00470023S

- 2. Refer to "Shop Manual" and disconnect the boost pressure sensor connector.
- 3. Ignition Switch "ON"
- 4 Measure voltage of power terminal of the boost pressure sensor connector and chassis ground.

Specification : Approx. 5V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual"and disconnect the boost pressure sensor connector.
- Measure the resistance between ground terminal of 4. BPS harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect the boost pressure sensor connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of BPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of BPS harness connector.(B)

Specification :(A) - (B) = below 200 mV

# **General Information**

#### 10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.



**NO** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual"and disconnect the boost pressure sensor connector.
- Ignition switch "ON" 3.
- 4. Measure voltage between signal of the boost pressure sensor and chassis ground.

Specification : Difference in (A) and (B) is less than 200 mV

5. Is the measured value within specification?



► Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect boost pressure sensor connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between signal terminal of BPS harness connector and chassis ground.

#### Specification : Approx. 5.5V

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Component Inspection

### Visual Inspection of BPS

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove the boost pressure sensor.
- 3. Inspect for corrosion and contamination on connector terminal of boost pressure sensor.
- 4. Check for proper installation of boost pressure sensor and inspect for leakage of O-ring, excessive carbon

on sensing area.

- 5. Have any problems been found?
  - YES 
    Carefully re-do this troubleshooting guide steps. If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.
  - NO Go to "Boost Pressure Sensor Output Signal Inspection" procedure.

### Boost Pressure Sensor Output Signal Inspection

- Ignition Switch "OFF" 1.
- Connect VMI to GDS and select oscilloscope.(2 2. Channel)

Channel A (+) : Signal terminal (BPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES 
    Go to "Atmospheric Pressure Sensor Inspection" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the BPS and go to "Verification of Vehicle Repair" procedure.

### Atmospheric Pressure Sensor Inspection

- Ignition switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & engine "OFF"
- 4. Monitor "Atmospherica Pressure" parameter in "Current Data" with GDS.

### Specification : Approx. 1000 hPa

## GI-245

🝟 Current Data		Search 🙉 💷 🔬	
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Res	et Min.Max Record	Stop  Crouping VSS	
Sensor Name	Value	Unit	
Boost Pressure Sensor	1008	hPa	
Raw Voltage of Boost Pressure Sensor	1.08	V	
Barometric Pressure Sensor	1002	hPa	1
Atmospheric Pressure	1010	hPa	
Engine Speed	809.0	RPM	
E Final stop Request signal	OFF	-	
Final start Enable signal	NO	-	
Final start Request signal	OFF		
Water Temperature of Engine	60	'C	

Fig.1

Fig. 1) Boost pressure and atmospheric pressure current data under engine idle condition.

XAtmospheric pressure sensor outputs 1 atm at sea level. Check for abnormal atmospheric pressure sensor signal value.

- 5. Is the parameter displayed within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the ECM/PCM and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?
  - YES 
    Go to the applicable troubleshooting procedure.

#### CRC12EN5010P00690022S

NO ► I

Problem is corrected and the system operation performs to specification at this time.

## **General Information**

## P025200 Injection Pump Fuel Metering Control "A" Range/Performance (Cam/ Rotor/Injector)

### **Component Location**



CRC12EN5010P008711

#### 1. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If over-temperature on Fuel Pressure Regulator Valve (FPRV) is detected for more than 0.22 sec., ECM sets dTC P025200.

#### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Over-temperature on FPRV is detected		
Detecting Time	• 220 msec		1. Poor connector connection
	Engine Off	• No	3. Defected FPRV
	EGR Off	• No	
Fail Sale	Torque Limit	• No	
	MIL	• On	

### Vehicle Data

Fuel Press ator	sure Regul- Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	FPRV Control	Ignition switch "ON" & Engine "OFF"	Approx. 3.4V	-
Pin No.	2	FPRV Power	<ul> <li>Voltage is measured on wiring side(Discon- nected)</li> </ul>	B+	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P025200	Injection Pump Fuel Metering Control "A" Range/Performance (Cam/Rotor/Injector)	

CRC12EN5010P02520021S

4. Is DTC status displayed as Present?



NO • Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).

**YES** • Go to "Monitor GDS Data" procedure.

- 3. Ignition switch "ON" & Engine "ON"
- Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# **General Information**

Current Data		Search 🙉 🚛	Retry (
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	et Min.Max Record	Stop 🗧 Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

Fig.1

#### CRC12EN5010P00870022S

Current Data		Search 🙉 💷 🕼	98
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🛛 Items List 🗘 Res	et Min.Max Record	Stop  Crouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON	-	
AT/MT Information	A/T	-	
Fig.2	-	-	

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

CRC12EN5010P00870023S

caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found? 3.

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.

- Ignition Switch "ON" 3.
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- Ignition Switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- Ignition Switch "ON" 3.
- Measure the voltage between control terminal of 4. FPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition Switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect FPRV connector.
- 4. Measure the resistance between power terminal and control terminal of FPRV.

Specification : Approx. 2.6 ~ 3.15  $\Omega$  (Approx. 20°C/68°F)

- Is the measured value within specification? 5.
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

- NO
  - Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, Replace the FPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.

Problem is corrected and the system operat-NO ion performs to specification at this time.

## **General Information**

CRC12EN5010P008711

## P025300 Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)

### **Component Location**



### 1. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If current value in control circuit of FPRV is 0 A for certain amount of time, ECM sets DTC P025300. This fault might caused by open or short to ground in control circuit of FPRV.

### **DTC Detecting Condition**

ltem		Detecting Condition	Possible Cause
DTC Strategy	Voltage monit	toring	
Enable Condition	Engine runnir	ng	
Threehold \ /olug	Case 1	Open in FPRV circuit	
Infeshold value	Case 2	Short to ground in FPRV circuit	
Detecting Time	Case 1	• 220 msec	1. Poor connector connection
	Case 2	• 280 msec	of FPRV
	Engine OFF	• No	3. Defected FPRV
	EGR OFF	• No	
Fail Safe	Torque Limit	<ul><li>Yes (Case 1)</li><li>No (Case 2)</li></ul>	
	MIL	• On	

### Vehicle Data

Fuel Press ator	sure Regul- Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	FPRV Control	Ignition switch "ON" & Engine "OFF"	Approx. 3.4V	-
Pin No.	2	FPRV Power	<ul> <li>Voltage is measured on wiring side(Discon- nected)</li> </ul>	B+	-

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P025300	Injection Pump Fuel Metering Control "A" Low (Cam/Rotor/Injector)	

CRC12EN5010P02530021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

# **General Information**

Specification : Refer to Figure below

NO ► Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Current Data		Search 🙉 🚛	) @ E
Selective Display ≎	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
🛛 Actual Engine Torque - Crankshaft Torque	40	Nm	4
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

#### Fig.1

#### CRC12EN5010P00870022S

🚪 Current Data		Search 💽 🚛	
Selective Display ≎	et Min.Max Record	Stop ‡ Grouping	VSS
Sensor Name	Value	Unit	and have
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON	-	
AT/MT Information	A/T		
Fig.2			

CRC12EN5010P00870023S

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?
## General

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect FPRV 2 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition Switch "OFF"
- Refer to "Shop Manual" and disconnect FPRV 2 connector.
- 3. Ignition Switch "ON"
- Measure the voltage between control terminal of 4.

FPRV harness connector and chassis ground.

Specification : Approx. 3.4V

- 5. Is the measured value within specification?

  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect FPRV 3 connector
- Measure the resistance between power terminal and 4. control terminal of FPRV.

Specification : Approx. 2.6 ~ 3.15  $\Omega$ (Approx. 20°C/68°F)

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, Replace the FPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3 condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

 Go to the applicable troubleshooting proced-YES ure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P025400 Injection Pump Fuel Metering Control "A" High (Cam/Rotor/Injector)

### **Component Location**



#### 1. Fuel Pressure Regulator Valve (FPRV)

#### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If over-current in FPRV circuit is detected for more than 0.22 sec., ECM sets DTC P025400. This fault might be caused by short to power in control circuit of FPRV.

#### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Short to battery in a	control circuit	1 Deer connector connection
Detecting Time	• 220 msec		2. Short to power in control circuit
	Engine Off	• No	of FPRV
Fail Safe	EGR Off	• No	3. Defected FPRV
	Torque Limit	• Yes	
	MIL	• On	

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### Vehicle Data

Fuel Press ator	sure Regul- Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	FPRV Control	Ignition switch "ON" & Engine "OFF"	Approx. 3.4V	-
Pin No.	2	FPRV Power	<ul> <li>Voltage is measured on wiring side(Discon- nected)</li> </ul>	B+	-

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P025400	Injection Pump Fuel Metering Control "A" High (Cam/Rotor/Injector)	

CRC12EN5010P02540021S

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# GI-257

Current Data		Search 🙉 💷	
Selective Display 🗘 📔 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	A.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.1			

#### CRC12EN5010P00870022S

Current Data		Search 🙉 💷 🕼	
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop  Grouping V	SS
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON	-	
AT/MT Information	A/T		
Fig.2			

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



• Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.

### **General Information**

- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



Go to "Control Circuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between control terminal of FPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?



Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect FPRV connector.
- 4. Measure the resistance between power terminal and control terminal of FPRV.

Specification : Approx. 2.6 ~ 3.15  $\Omega$  (Approx. 20°C/68°F)

5. Is the measured value within specification?

**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

 Carefully re-do this troubleshooting guide st-NO eps.

> If no problems were found with the circuits or connectors, Replace the FPRV and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1 monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.

Problem is corrected and the system operat-NO ion performs to specification at this time.

### P026200 Cylinder 1 Injector Circuit High

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If short in injector #1 circuit is detected during injector operating condition, ECM sets DTC P026200. ECM detects fault via monitoring the injector operating voltage.

### DTC Detecting Condition

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Short in injector circ	cuit	
Detecting Time	• -		1. Poor connector connection
	Engine Off	• Yes	<ol> <li>Short in Injector #1 circuit</li> <li>Defected injector #1</li> </ol>
Fail Safe	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Inje	ector	Terminal	Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
PIN NO.	2	Injector Control(Low)	(Disconnected)	0V	-
Inje	ector	Terminal	Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	Inspection Condition Ignition switch "ON" & Engine "OFF"	Measured Value Approx. 5. 0V	Remarks

### Signal Waveform & Data



CRC12EN5010P02010011S

### **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Refry
Erase All DTC	Freeze Frame DTC Status Erase Selectiv	/e DTC Hist/Pend DTC ≎
Current DTC	Description	State
P026200	Cylinder 1 Injector Circuit High	

CRC12EN5010P02620021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search		<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		-
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

### **General Information**

🛔 Current Data		Search	<b>1</b>	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 🤇 Re	set Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		state (
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Engine Speed	2357.0	RPM		

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO

Go to "Control Circuit Inspection" procedure

#### **Control Circuit Inspection**

Injector Control High Inspection

CRC12EN5010P02010023S

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect injector #1 2 connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between Injector control high terminal of injector #1 harness connector and chassis ground.

#### Specification : Approx. 5V

- Ignition Switch "OFF" 5.
- 6. Re-connect injector #1 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

- Ignition switch "ON" 8.
- 9. Inspection condition " Ignition switch "ON" & Engine "OFF"

Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the Inj. #1 connector.
- 3. Ignition Switch "ON"

Measure the voltage between injector control low terminal of injector #1 harness connector and chassis ground.

#### Specification: 0V

- 5. Ignition Switch "OFF"
- Re-connect injector #1 connector. 6.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine 9 "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES Go to "Short in Injector Control Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Short in Injector Control Circuit Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect Injector and 3. ECM connector.
- Measure the resistance between low terminal and 4. high terminal of injector #1 harness connector.

#### **Specification** : Infinite ( $\infty \Omega$ )

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

Injector Signal Waveform & Operating Current Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Injector control low connector (On Injector Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- Ignition switch "ON" & Engine "ON" 3.
- Inspection condition : Engine "ON" & Engine speed 4. Approx. 3,000RPM

Specification : Refer to figure below

## **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

#### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43 Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

#### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #1 and go to "Verification of Vehicle Repair" procedure.

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- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe;
   Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



CRC12EN5010P02010043S



### **General Information**

🖙 < Injector Specific Data
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection.</li> <li>After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ] <ol> <li>Ignition Key On</li> <li>Engine Stop</li> </ol> </li> <li>If you are ready, press [OK] button.</li> </ul>
OK CANCEL
Fig.2

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P026500 Cylinder 2 Injector Circuit High

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If short in injector #2 circuit is detected during injector operating condition, ECM sets DTC P026500. ECM detects fault via monitoring the injector operating voltage.

### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Short in injector circ	cuit	
Detecting Time	• -		1. Poor connector connection
	Engine Off	• Yes	<ol> <li>Short in Injector #2 circuit</li> <li>Defected injector #2</li> </ol>
Fail Safe	EGR Off	• No	
	Torque Limit	• Yes	]
	MIL	• On	]

#### Vehicle Data

Injector		Terminal		Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	•	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
	2	Injector Control(Low)		Voltage is measured on wiring side (Disconnected)	0V	-
Injector						
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks

### Signal Waveform & Data



CRC12EN5010P02010011S

### **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P026500	Cylinder 2 Injector Circuit High	

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#### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Res	et Min.Max Record	Stop ‡	Grouping
Sensor Name	Value	Unit	
Desired Injection Quantity of MI1	6	mm3	
Desired Injection Quantity of Pil1	1	mm3	
Desired Injection Quantity of Pil2	1	mm3	
Desired Injection Quantity of Pil3	0	mm3	
Desired Injection Quantity of Pol1	0	mm3	
Desired Injection Quantity of Pol2	0	mm3	
Fuel Quantity	9	mm3	
Current Injection Quantity	9	mm3	
Engine Speed	790.0	RPM	

Fig.1

CRC12EN5010P02010022S

### **General Information**

🛔 Current Data		Search	<b>1</b>	
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 🗍 Items List 🗘 🗍	Reset Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		in the second
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Engine Speed	2357.0	RPM		

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO

Go to "Control Circuit Inspection" procedure

#### **Control Circuit Inspection**

Injector Control High Inspection

CRC12EN5010P02010023S

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect injector #2 2 connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between Injector control high terminal of injector #2 harness connector and chassis ground.

#### Specification : Approx. 5V

- Ignition Switch "OFF" 5.
- 6. Re-connect injector #2 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

- Ignition switch "ON" 8.
- 9. Inspection condition " Ignition switch "ON" & Engine "OFF"

Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- 1. Ignition Switch "OFF"
- Refer to "Shop Manual" and disconnect injector #2 2. connector.
- 3. Ignition Switch "ON"

Measure the voltage between injector control low terminal of injector #2 harness connector and chassis ground.

#### Specification: 0V

- 5. Ignition Switch "OFF"
- Re-connect injector #2 connector. 6.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #2 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine 9 "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES Go to "Short in Injector Control Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Short in Injector Control Circuit Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect Injector and 3. ECM connector.
- Measure the resistance between low terminal and 4. high terminal of injector #2 harness connector.

#### **Specification** : Infinite ( $\infty \Omega$ )

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

Injector Signal Waveform & Operating Current Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Injector control low connector (On Injector Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- Ignition switch "ON" & Engine "ON" 3.
- Inspection condition : Engine "ON" & Engine speed 4. Approx. 3,000RPM

Specification : Refer to figure below

## **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

#### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43 Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

#### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #1 and go to "Verification of Vehicle Repair" procedure.

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- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe;
   Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

#### NOTICE



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### **General Information**

🖙 🔦 Injector Specific Data	
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection.</li> <li>After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ] <ol> <li>Ignition Key On</li> <li>Engine Stop</li> </ol> </li> <li>If you are ready, press [OK] button.</li> </ul>	
OK CANCEL	
Fig.2	

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Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P026800 Cylinder 3 Injector Circuit High

#### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

#### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

#### CRC12EN5010P02010011

recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

#### **DTC Description**

If short in injector #3 circuit is detected during injector operating condition, ECM sets DTC P026800. ECM detects fault via monitoring the injector operating voltage.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Short in injector circuit		
Detecting Time	• -		1. Poor connector connection
Fail Safe	Engine Off	• Yes	<ol> <li>Short in Injector #3 circuit</li> <li>Defected injector #3</li> </ol>
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Injector Terminal Inspection Condition		Inspection Condition	Measured Value	Remarks	
Pin No.	1	Injector Control(High)	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
	2	Injector Control(Low)	(Disconnected)	0V	-
Injector					
Inje	ector	Terminal	Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	Inspection Condition Ignition switch "ON" & Engine "OFF"	Measured Value Approx. 5. 0V	Remarks

### Signal Waveform & Data



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### **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

#### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P026800	Cylinder 3 Injector	Circuit High			

CRC12EN5010P02680021S

#### 4. Is DTC status displayed as Present?

- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search		<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		-
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

### **General Information**

🧧 Current Data		Search	2) (II)	
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 Items List 🗘 Res	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		i and
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Z Engine Speed	2357.0	RPM		

FIG.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 🕨

Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO

Go to "Control Circuit Inspection" procedure

#### **Control Circuit Inspection**

Injector Control High Inspection

CRC12EN5010P02010023S

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect injector #3 2 connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between Injector control high terminal of injector #3 harness connector and chassis ground.

#### Specification : Approx. 5V

- Ignition Switch "OFF" 5.
- 6. Re-connect injector #3 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #3 Harness Connector)

Channel A (-) : Ground

- Ignition switch "ON" 8.
- 9. Inspection condition " Ignition switch "ON" & Engine "OFF"

Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- Ignition Switch "OFF" 1.
- Refer to "Shop Manual" and disconnect injector #3 2. connector.
- 3. Ignition Switch "ON"
Measure the voltage between injector control low terminal of injector #3 harness connector and chassis ground.

#### Specification: 0V

- 5. Ignition Switch "OFF"
- Re-connect injector #3 connector. 6.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #3 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine 9 "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES Go to "Short in Injector Control Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Short in Injector Control Circuit Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect Injector and 3. ECM connector.
- Measure the resistance between low terminal and 4. high terminal of injector #3 harness connector.

#### **Specification** : Infinite ( $\infty \Omega$ )

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

Injector Signal Waveform & Operating Current Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Injector control low connector (On Injector Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- Ignition switch "ON" & Engine "ON" 3.
- Inspection condition : Engine "ON" & Engine speed 4. Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43  $\Omega$  (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #1 and go to "Verification of Vehicle Repair" procedure.

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### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe; Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

### NOTICE



CRC12EN5010P02010043S



CRC12EN5010P02010041S

## **General Information**

🖙 < Injector Specific Data
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection. After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ]</li> <li>1. Ignition Key On</li> <li>2. Engine Stop</li> </ul>
If you are ready, press [OK] button.
OK CANCEL
Fig.2

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Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P026A00 Charge Air Cooler Efficiency Below Threshold

### **Component Location**



CRC12EN5010P004711



#### 1. VGT Actuator

2. VGT Control Valve

### **General Description**

VGT(Variable Geometric Turbocharger) is the device which increases the efficiency of turbocharger at low rpm and lasts optimum turbo efficiency at high rpm as varying the cross sectional area through which exhaust gas passes turbocharger impeller. It relieves turbo lag at low speed and increase engine power generation.

The VGT adapted on Engine is activated by VGT actuator control unit and electronic actuator integrated with DC motor. Engine speed, APS signal, MAFS and Boost pressure sensor data are inputted to ECM. ECM controls VGT actuator control unit to control exhaust gas line as controlling VGT actuator duty to maintain optimum

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state of air compression.

#### **DTC Description**

If the efficient of inter-cooler is below threshold value, ECM sets DTC P026A00.

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Efficient of inter-coo	oler is below threshold value	1 Deer connector connection
Detecting Time	• 220 sec		2. Defected intake air temperatur-
	Engine Off	• No	e sensor #2
	EGR Off	• No	3. Defected inter-cooler
raii Safe	Torque Limit	• No	]
	MIL	• Off	

#### Vehicle Data

VGT Control	Actuator	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	VGT Actuator Power	<ul> <li>Ignition switch "ON" &amp; E-</li> </ul>	B+	-
Pin No.	2	VGT Actuator Control	ngine "OFF" • Voltage is measured on wiring side(Disconnected )	Approx. 3.4V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

	Retry 🗖
Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Description	State
Charge Air Cooler Efficiency Below Threshold	
	Freeze Frame       DTC Status       Erase Selective DTC       Hist/Pend DTC \$         Description       Charge Air Cooler Efficiency Below Threshold

#### 4. Is DTC status displayed as Present?



dure.

**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" proce-

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
  - 3. Ignition switch "ON" & engine "OFF"
  - 4. Monitor follow parameters in "Current Data" with

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#### GDS.

Specification : Refer to figure below

Current Data		Search 🗐 🚛	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	et Min.Max Record	Stop 🗘 Grouping	VSS
Sensor Name	Value	Unit	n terre
Intake Air Temperature	36	'C	
Raw Value Intake Air Temperature in Volt	2.51	V	
Engine Speed	809.0	RPM	
Exhaust Temperature Sensor 1 Value (Upstream	216.75	'C	4
Exhaust Temperature Sensor 2 Value (Upstream	268.55	'C	
Regeneration Demand Counter by Soot Load (C	5		
Total Driven Distance at last Successful Regener	207	km	
Driven Distance Since Last Successful Regenera	568	km	
Coverage Driven Length	775	km	

#### Fig.1



Fig.1 ) Intake air temperature sensor current data during engine idle

Fig. 2) Intake Air Temperature Senson #1 (MAFS)

Fig. 3) Intake Air Temperature Sensor #2

- 5. Is the parameter displayed within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

► Go to "Wiring Inspection" procedure.

Fig.3

CRC12EN5010P01120023S

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### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor bending, connection. corrosion, contamination. deterioration, or damage.
- 3. Has a problem been found?



- **YES** Repair as necessary and go to "Verification of Vehicle Repair" procedure.
- Go to "Ground Circuit Inspection" procedure NO

NO

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- 3. Ignition Switch "ON"
- Measure the voltage between power terminal of VGT 4. control actuator harness connector and chassis ground.

### Specification : B+

- 5. Is the measured value within specification?

YES 
Go to "Control Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of VGT control actuator harness connector and chassis ground.

### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
- - YES Go to "System Inspection" procedure.
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### System Inspection

- 1. Refer to "Shop Manual" and inspect for following conditions;
  - Air intake hose before the turbo-charger for any damages or leakage.
  - Condition of air intake hose (Distortion, damage, tear or proper installation).
  - Any dirt or foreign substance on air cleaner.
  - Water influx in air cleaner.
  - Correct air cleaner.
- 2. Inspect inter-cooler hose/pipe following for conditions;
  - Proper installation of hose/pipe.

- Condition of hose/pipe (Distortion, damage, tear or proper installation).

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- Any other abnormal condition of hose/pipe.
- Proper installation of clamps.
- Inspect inter-cooler for following conditions; 3. - leakage on inter-cooler and tube(Leakage, crack or any other damage).
- Inspect for leakage or crack between center housing 4. of turbo-charger and compressor housing.
- Have any problems been found? 5.

- YES Go to "Component Inspection" procedure.
- Repair as necessary and then go to "Verific-NO ation of Vehicle Repair" procedure.

### **Component Inspection**

### Actuation Test

- 1. ignition Switch "OFF"
- Connect GDS to Data Link Connector (DLC). 2.
- Ignition switch "ON" & Engine "OFF" 3.
- 4. Perform "Boost Pressure Actuator 5%" and "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.
- 5. Monitor "Boost Pressure Actuator" parameter in "Current Data" with GDS.

Specification : Refer to figure below

- <b>E</b>	Actuation Test	
Test Items		Until Chan Putter
GRU (Glow Relay Unit) 15% Duty		Until Stop Button
Boost Pressure Actuator 5%	· Condition	IG. ON/ENG.OFF -Check Current Data (VGT Actuator)
Boost Pressure Actuator 95%	· Result	Operation Command Sent
EGR Valve 10%	<b>Ŧ</b>	
	Data Analysis	
100 Boost Pressure Actuator		Max : 68
		68 %
0		Min : 5
Start Stop		Function

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<b>F</b>	Actuation	Test		📴 🕇 🐔
Test Items		Duration	Until Stop Buttop	
GRU (Glow Relay Unit) 15% Duty				
Boost Pressure Actuator 5%	<u>^</u>	· Condition	IG. ON/ENG.OFF -C (VGT Actuator)	Check Current Data
Boost Pressure Actuator 95%	-	• Result	Operation Comman	nd Sent
EGR Valve 10%	¥			)
	Data Anal	ysis		
100 Boost Pressure Actuator			Max : 95	×
				68 %
				<u> </u>
Start Stop				Function

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Fig.1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

Fig.2) Boost pressure actuator current data when performing "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the VGT control actuator and go to "Verification of Vehicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

### P027100 Cylinder 4 Injector Circuit High

### **Component Location**



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4

### **General Description**

ECM controls injection amount and injection timing through Electrical control injector in order to control system pressure which is required for measuring and injection of diesel fuel. Injectors on CRDi injects atomized fuel with highly pressurized directly into the combustion chamber corresponding to fuel amount ECM decided. Fuel injected into combustion chamber generates power through the explosion.

There are 3 different fuel injection. Pilot & post injection is used for reducing explosion noise during fuel control and main injection is used for generating power. In addition, those are controlled independently by ECM and injection time (injection amount) as well. Injector is newly adopted new technology. that are hydraulic coupler which transfer operating force of actuator as quickly as possible and PIEZO actuator what is operating response better than solenoid actuator. Both PIEZO actuator and hydraulic coupler realized to increase the fuel pressure to 250 ~ 1600bar. That makes high combustion efficiency resulting to reduced smog and improved engine power and fuel efficiency.

Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic as

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recognizing specific fuel injection map which is different for each serial number. [IQA, Injector Quantity Adjustment] IQA means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.

### **DTC Description**

If short in injector #4 circuit is detected during injector operating condition, ECM sets DTC P027100. ECM detects fault via monitoring the injector operating voltage.

### **DTC Detecting Condition**

Item	Dete	Possible Cause	
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Short in injector circ	cuit	
Detecting Time	• -		1. Poor connector connection
	Engine Off	• Yes	<ol> <li>Short in Injector #4 circuit</li> <li>Defected injector #4</li> </ol>
	EGR Off	• No	
raii Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Din No.	1	Injector Control(High)	•	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
PIN NO.	2	Injector Control(Low)		(Disconnected)	0V	-
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks

### Signal Waveform & Data



CRC12EN5010P02010011S

# **General Information**



CRC12EN5010P02010012S

Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P027100	Cylinder 4 Injector Circuit High	

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#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

🧯 Current Data		Search		<b>a</b> =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Reset Min. Max	Record	Stop 💲	Grouping	VSS
Sensor Name	Value	Unit		-
Desired Injection Quantity of MI1	6	mm3		
Desired Injection Quantity of Pill	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	0	mm3		
V Fuel Quantity	9	mm3		
Current Injection Quantity	9	mm3		
Engine Speed	790.0	RPM		

Fig.1

CRC12EN5010P02010022S

# **General Information**

🕴 Current Data		Search		
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 Items List 🗘 Res	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		in the second
Desired Injection Quantity of MI1	22	mm3		
Desired Injection Quantity of Pil1	1	mm3		
Desired Injection Quantity of Pil2	1	mm3		
Desired Injection Quantity of Pil3	0	mm3		
Desired Injection Quantity of Pol1	0	mm3		
Desired Injection Quantity of Pol2	3	mm3		
V Fuel Quantity	26	mm3		
Current Injection Quantity	28	mm3		
Engine Speed	2357.0	RPM		

Fig.2

Fig.1) Amount of injection current data under engine idle.

Fig.2) Amount of injection current data under acceleration.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 🕨

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage. .
- 3. Has a problem been found?

YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO

Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

Injector Control High Inspection

CRC12EN5010P02010023S

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect injector #4 2 connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between Injector control high terminal of injector #4 harness connector and chassis ground.

#### Specification : Approx. 5V

- Ignition Switch "OFF" 5.
- 6. Re-connect injector #4 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

- Ignition switch "ON" 8.
- 9. Inspection condition " Ignition switch "ON" & Engine "OFF"

Specification : Approx. 5V

10. Is the measured value within specification?

- YES 
  Go to "Injector Control Low Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Injector Control Low Inspection

- Ignition Switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect injector #4 connector.
- 3. Ignition Switch "ON"

Measure the voltage between injector control low terminal of injector #4 harness connector and chassis ground.

#### Specification: 0V

- 5. Ignition Switch "OFF"
- Re-connect injector #4 connector. 6.
- 7. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : injector control low terminal (Injector #4 Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine 9 "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?

- YES Go to "Short in Injector Control Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Short in Injector Control Circuit Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect Injector and 3. ECM connector.
- Measure the resistance between low terminal and 4. high terminal of injector #4 harness connector.

#### **Specification** : Infinite ( $\infty \Omega$ )

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

Injector Signal Waveform & Operating Current Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : Injector control low connector (On Injector Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector #1 Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- Ignition switch "ON" & Engine "ON" 3.
- Inspection condition : Engine "ON" & Engine speed 4. Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



CRC12EN5010P02010011S



Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?



NO • Go to "Component Resistance Measurement" procedure.

### Component Resistance Measurement

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.

#### CRC12EN5010P02010012S

- 3. Refer to "Shop Manual" and disconnect injector connector.
- 4. Measure the resistance between Injector control high terminal and injector control low terminal of injector harness connector.

Specification :0.35 ~ 0.43 Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### NO

• Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Injector #1 and go to "Verification of Vehicle Repair" procedure.

# <u>GI-309</u>

### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### 

- Common Rail Fuel Injection System operates with extremely high pressure (approximately 1,600bar), so never perform any work on injection system with engine running or within 30 seconds after the engine stops.
- Keep the parts and the working area clean.
- Inspect for any foreign substance while installing fuel delivery system.
- Remove the protect-cap attached just before installing injector, tube or hose.
- When installing Injector;

- Clean the contact area of the injector and replace the gasket with a new one.

- Apply diesel on injector O-ring.

- When installing the injector, to protect damage caused by shock and other condition, vertically insert the injector into the cylinder head.

- When installing High Pressure Fuel Pipe; Do not re-use high pressure fuel pipe.
   Properly install the flange nut.
- After replacing the injector, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

### NOTICE



CRC12EN5010P02010043S



# **General Information**

🖙 < Injector Specific Data	•
<ul> <li>[ Injector Specific Data ]</li> <li>If the Injector or ECU is changed, this function should be perform to control the normal fuel injection. After this function is completed, turn the Ignition Key off and recheck the system after 10 sec.</li> <li>[ Condition ] <ol> <li>Ignition Key On</li> <li>Engine Stop</li> </ol> </li> <li>If you are ready, press [OK] button.</li> </ul>	
OK CANCEL	
Fig.2	

CRC12EN5010P02010042S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) Condition of Injector Specific Data

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



### P029900 Turbocharger/Supercharger System Underboost

### **Component Location**



CRC12EN5010P004711



#### 1. VGT Actuator

2. VGT Control Valve

### **General Description**

VGT(Variable Geometric Turbocharger) is the device which increases the efficiency of turbocharger at low rpm and lasts optimum turbo efficiency at high rpm as varying the cross sectional area through which exhaust gas passes turbocharger impeller. It relieves turbo lag at low speed and increase engine power generation.

The VGT adapted on Engine is activated by VGT actuator control unit and electronic actuator integrated with DC motor. Engine speed, APS signal, MAFS and Boost pressure sensor data are inputted to ECM. ECM controls VGT actuator control unit to control exhaust gas line as controlling VGT actuator duty to maintain optimum

CRC12EN5010P004711

state of air compression.

### **DTC Description**

If boost pressure sensor output value is lower than target value for more than 6 sec. under engine speed over 1500 RPM and amount of fuel injection 20mg/hub condition ECM sets DTC P029900. This fault might be caused by air leakage on intake system.

### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		1 Poor connector connection
Threshold Value	Measured BPS out	out value is lower than target value	2. Air leakage on intake system(
Detecting Time	• 6 sec		Air intake hose, air cleaner, int-
	Engine Off	• No	of turbo-charger)
	EGR Off	• Yes	3. Disconnected air intake hose
Fall Safe	Torque Limit	• Yes	4. Damaged inter-cooler
	MIL	• Blink	]

#### Vehicle Data

VGT Control	Control Actuator Terminal		Inspection Condition	Measured Valu- e	Remarks
	1	VGT Actuator Power	<ul> <li>Ignition switch "ON" &amp; E-</li> </ul>	B+	-
Pin No.	2	VGT Actuator Control	ngine "OFF" • Voltage is measured on wiring side(Disconnected )	Approx. 3.4V	-

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P029900	Turbocharger/Supercharger System Underboost	

#### 4. Is DTC status displayed as Present?



dure.

**YES** • Go to "Monitor GDS Data" procedure.

### **Monitor GDS Data**

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC). NO • Go to "Verification of Vehicle Repair" proce-
  - 3. Ignition switch "ON" & Engine "ON"
  - 4. Monitor follow parameters in "Current Data" with

CRC12EN5010P02990021S

GDS.

Specification : Refer to figure below

Current Data		Search 🔍 💷	ary E
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 🤇 Res	el Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Boost Pressure Actuator	78	%	
Boost Pressure Sensor	1.0	bar	
Raw Voltage of Boost Pressure Sensor	1.08	V	
Engine Speed	815.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO	-	~
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
E Hood Switch	CLOSED	-	
Battery Current(AMS)	15.1	Α	

Fig.1

CRC12EN5010P00470022S

🚪 Current Data		Search 🙉 🗐	
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	and final d
Boost Pressure Actuator	47	%	
Boost Pressure Sensor	1.8	bar	
Raw Voltage of Boost Pressure Sensor	2.00	V	
Engine Speed	4915.5	RPM	
Idle Stop request by Drivers demand(ISG)	NO		
Driver`s Seat Belt	Unbelted	-	
Driver`s Door	CLOSED	-	
E Hood Switch	CLOSED		
Battery Current(AMS)	25.5	Α	
Fig.2	-	-	

Fig. 1) Boost pressure actuator control duty current data on engine idle.

Fig. 2) Boost pressure actuator control duty current data on engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### CRC12EN5010P00470023S

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



 Repair as necessary and go to "Verification of Vehicle Repair" procedure.



NO • Go to "Power Circuit Inspection" procedure.

# **General Information**

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of VGT control actuator harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
- YES 
  Go to "Control Circuit Inspection" procedure
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect VGT control actuator connector.
- 3. Ignition switch "ON"
- Measure the voltage between control terminal of VGT control actuator harness connector and chassis ground.

#### Specification : Approx. 3.4V

- 5. Is the measured value within specification?
  - YES Go to "System Inspection" procedure.
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Actuation Test

- 1. ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Boost Pressure Actuator 5%" and "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.
- 5. Monitor "Boost Pressure Actuator" parameter in "Current Data" with GDS.

### Specification : Refer to figure below

🖙 🔹 🗛 Actua	ation	Test		📴 主 🐔
Test Items		Duration		
GRU (Glow Relay Unit) 15% Duty			Until Stop Button	
Boost Pressure Actuator 5%		· Condition	IG. ON/ENG.OFF -C (VGT Actuator)	Check Current Data
Boost Pressure Actuator 95%	-	• Result	Operation Comman	nd Sent
EGR Valve 10%	₹			
Data	Anal	ysis		
100 Boost Pressure Actuator			Max : 68	×
				68 %
0			Min : 5	æ
Start Stop				Function

CRC12EN5010P00470041S

<b>1</b>		Actuation	n Test		📴 🕇 🐔
	Test Items		Duration	Until Stop Buttop	
GRU (Glow Relay	/ Unit) 15% Duty	\$	·Duration		
Boost Pressure A	ctuator 5%	<u>^</u>	· Condition	IG. ON/ENG.OFF -( (VGT Actuator)	Check Current Data
Boost Pressure A	Actuator 95%	-	· Result	Operation Comman	nd Sent
EGR Valve 10%		¥			)
		Data Ana	alysis		
100 Boo	ost Pressure Actuator	,		Max : 95	×
					68.0%
					00 %
0				Min : 5	æ
Start	Stop				Function

CRC12EN5010P00470042S

Fig.1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

Fig.2) Boost pressure actuator current data when performing "Boost Pressure Actuator 95%" in "Actuation Test" with GDS.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the VGT control actuator and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

### P033500 Crankshaft Position Sensor "A" Circuit

### **Component Location**



1. Crankshaft Position Sensor (CKPS)

#### **General Description**

Crank Shaft Position Sensor (CKPS) is magnetic inductive type. Mounted on cylinder block, it senses magnetic encoder position of crank shaft. As magnetic encoder is divided with 58 teeth and 2 missing teeth (reference point), 1 tooth corresponds to 6 degree. CKPS which calculates RPM and crank angle is important to determine fuel injection quantity and injection timing with APS. Crank shaft position is closely related to engine starting.

### **DTC Description**

If crankshaft position sensor signal is not generated when camshaft position sensor signal is generated, ECM sets DTC P033500. This fault might be caused by defected CKPS or faulty circuit. If fault is detected during vehicle operating condition, ECM calculates CKPS signal with CMPS signal. CRC12EN5010P03350011

### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>CKPS signal is not nerated</li> </ul>	generated when CMPS signal is ge-	1 Deer connector connection
Detecting Time	• 6 sec		2. Faulty CKPS circuit
	Engine Off	• No	3. Defected CKPS
	EGR Off • No		
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Crankshat Ser	t Position Isor	Terminal	Inspection Condition	Measured Value	Remarks
	1	Sensor Shield	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side(</li> </ul>	0V	-
Pin No.	2	CKPS Signal		Approx. 4.8V	-
	3	CKPS Power	Disconnected)	B+	-

### **Monitor GDS Data**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P033500	Crankshaft Position Sensor "A" Circuit	

CRC12EN5010P03350021S

- 4. Is DTC status displayed as Present?
- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

### CKPS & CMPS Signal Waveform Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- 4. Inspection condition : Engine Idle

#### Specification : Refer to figure below



Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.

5. Is the measured value within specification?

#### CRC12EN5010P03350022S

YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

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#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect CKPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of CKPS harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect CKPS connector.
- 4. Measure the resistance between ground terminal of CKPS harness connector and chassis ground.

#### **Specification** : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect CKPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of CKPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of CKPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200

#### mV

10. Is the measured value within specification?

- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect CKPS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of CKPS harness connector and chassis ground.

#### Specification : Approx. 4.8V

5. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### CKPS & CMPS Signal Waveform Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- 4. Inspection condition : Engine Idle

Specification : Refer to figure below



# <u>GI-323</u>



Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 
    Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the CKPS and go to "Verification of Vehicle Repair" procedure.

### A CAUTION

• When installing component, tighten it within specification.

#### CRC12EN5010P03350022S

• If component is dropped, check for proper operation. The internal damage may be present.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





 Problem is corrected and the system operation performs to specification at this time.

### **General Information**

### P033600 Crankshaft Position Sensor "A" Circuit Range/Performance

### **Component Location**



CRC12EN5010P03350011

### 1. Crankshaft Position Sensor (CKPS)

### **General Description**

Crank Shaft Position Sensor (CKPS) is magnetic inductive type. Mounted on cylinder block, it senses magnetic encoder position of crank shaft. As magnetic encoder is divided with 58 teeth and 2 missing teeth (reference point), 1 tooth corresponds to 6 degree. CKPS which calculates RPM and crank angle is important to determine fuel injection quantity and injection timing with APS. Crank shaft position is closely related to engine starting.

### **DTC Description**

If abnormal signal of CKPS is detected, ECM sets DTC P033600. This fault might be caused by poor connector connection, defected sensor or tone-wheel.

### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Abnormal CKPS si	gnal is detected	1 Deer connector connection
Detecting Time	• -		2. Faulty CKPS circuit
	Engine Off	• No	3. Defected flywheel tone-wheel
	EGR Off	• No	4. Defected CKPS
Fail Sale	Torque Limit	• Yes	
	MIL	• On	
### Vehicle Data

Crankshat Ser	ft Position nsor	Terminal	Inspection Condition	Measured Value	Remarks
	1 Sensor Shield	Ignition switch "ON" & Engine "OFF"	0V	-	
Pin No.	2	CKPS Signal	• Voltage is measured on wiring side(	Approx. 4.8V	-
	3	CKPS Power	Disconnected)	B+	-

### Monitor GDS Data

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P033600	Crankshaft Position Sensor "A" Circuit Range/Performance	

### CRC12EN5010P03360021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.
  - NO Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

Current Data		Search 🔍 🚛	) æie
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	í.
Syncronizing Status	-	-	
Engine Speed	808.5	RPM	
Accelerator Pedal Position Sensor	0	%	P.
Pressure Control Valve(Rail)	7	%	=
Air Mass per Cylinder	0	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		
Cearbox Neutral Position Status Signal	OFF		

Fig.1

Fig.1) Engine speed synchronization current data under engine idle.

- 5. Is the measured value within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition Switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect CKPS connector.
- Ignition Switch "ON" 3.

### CRC12EN5010P03360022S

Measure the voltage between power terminal of 4 CKPS harness connector and chassis ground.

### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect CKPS connector.
- 4. Measure the resistance between ground terminal of CKPS harness connector and chassis ground.

Specification : Approx. below  $1\Omega$ 

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect CKPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of CKPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of CKPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



YES 
Go to "Signal Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect CKPS 2. connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of CKPS harness connector and chassis ground.

Specification : Approx. 4.8V

5. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### CKPS & CMPS Signal Waveform Inspection

- Ignition Switch "OFF" 1.
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- Inspection condition : Engine Idle 4.

Specification : Refer to figure below

# **General Information**



Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.

5. Is the measured value within specification?

YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Refer to "Shop Manual" and inspect the flywheel.

> If no problem is found on flywheel, replace the CKPS and then go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

• When installing component, tighten it within specification.

### CRC12EN5010P03350022S

 If component is dropped, check for proper operation. The internal damage may be present.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



 Go to the applicable troubleshooting procedure.

NO

 Problem is corrected and the system operation performs to specification at this time.

### P034000 Camshaft Position Sensor A Circuit Malfunction (Single Sensor)

### **Component Location**



### 1. Camshaft Position Sensor (CMPS)

### **General Description**

The Camshaft Position Sensor (CMPS) is installed on the cylinder head cover and detects the camshaft position. This is a hall sensor and has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of the each cylinder which the CKPS can't detect. By using this signal, the ECM perceives the position of each cylinder and controls sequential injection.

### **DTC Description**

If camshaft position sensor signal is not generated when crankshaft position sensor signal is generated, ECM sets DTC P034000. This fault might be caused by defected CMPS or faulty circuit. CRC12EN5010P034011

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>CMPS signal is not generated when CKPS signal is ge- nerated</li> </ul>		1 Deer connector connection
Detecting Time	• _		2. Faulty CMPS circuit
	Engine Off	• No	3. Defected CMPS
	EGR Off	• No	
Fail Sale	Torque Limit	• No	
	MIL	• On	]

### Vehicle Data

Camshaft Position Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	CMPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF" B+</li> <li>Voltage is measured on wiring side( Approx. 4.7V</li> </ul>	B+	-
	2	CMPS Signal		-	
	3	CMPS Ground	Disconnected)	0V	-

### **Monitor GDS Data**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P034000	Camshaft Position Sensor A Circuit Malfunction (Single Sensor)	

CRC12EN5010P03400021S

- 4. Is DTC status displayed as Present?
- **YES** Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

### CKPS & CMPS Signal Waveform Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- 4. Inspection condition : Engine Idle

### Specification : Refer to figure below



Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.When CMPS high signal voltage is decreased to 2.0V, ECM recognizes as low signal. Also, low signal voltage is increased to 3.8V, ECM recognizes as high signal. Low signal of CMPS does not reach 0.0V because of interner resistance of hall sensor. When low signal of CMPS is over 0.6V, it might be indication of high resistance on CMPS or ground circuit.

5. Is the measured value within specification?

### CRC12EN5010P03350022S

YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the CMPS connector.
- 3. Ignition Switch "ON"
- 4. Measure voltage between power of the CMPS connector and chassis ground.

### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect the CMPS connector.
- 4. Measure resistance between ground termianl of the CMPS and chassis ground.

### Specification : Below Approx. $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect the CMPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of CMPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of CMPS harness connector.(B)

Specification : Difference (A) and (B) is less then 200

### mV

10. Is the measured value within specification?

- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the CMPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between signal terminal of CMPS harness connector and chassis ground.

### Specification : Approx. 4.7V

5. Is the measured value within specification?

YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### CKPS & CMPS Signal Waveform Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- 4. Inspection condition : Engine Idle

Specification : Refer to figure below



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Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.When CMPS high signal voltage is decreased to 2.0V, ECM recognizes as low signal. Also, low signal voltage is increased to 3.8V, ECM recognizes as high signal. Low signal of CMPS does not reach 0.0V because of interner resistance of hall sensor. When low signal of CMPS is over 0.6V, it might be indication of high resistance on CMPS or ground circuit.

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### CRC12EN5010P03350022S

- NO Refer to "Shop Manual" and inspect the flywheel.
  - If no problem is found on flywheel, replace the CMPS and then go to "Verification of Vehicle Repair" procedure.

### A CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### **A**CAUTION

- Apply the engine oil to the O-ring.
- Be careful not to damage the O-ring.

### 

- Insert the sensor in the installation hole and be careful not to damage when installation.
- Be careful not to damage the sensor housing and the connector.

# **General Information**

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO • Problem is corrected and the system operation performs to specification at this time.

# P034100 Camshaft Position Sensor A Circuit Range/Performance (Single Sensor)

### **Component Location**



CRC12EN5010P034011

### 1. Camshaft Position Sensor (CMPS)

### **General Description**

The Camshaft Position Sensor (CMPS) is installed on the cylinder head cover and detects the camshaft position. This is a hall sensor and has a hall-effect IC which output voltage changes when magnetic field is made on the IC with current flow.

It is related with Crankshaft Position Sensor (CKPS) and detects the piston position of the each cylinder which the CKPS can't detect. By using this signal, the ECM perceives the position of each cylinder and controls sequential injection.

### **DTC Description**

If abnormal signal of CMPS is detected, ECM sets DTC P034100. This fault might be caused by poor connector connection, defected sensor or tone-wheel.

### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Abnormal CMPS si	gnal is detected	1 Door connector connection
Detecting Time	• -		2. Faulty CMPS circuit
	Engine Off	• No	3. Defected tone-wheel
Fail Safe	EGR Off	• No	4. Defected CMPS
	Torque Limit	• No	
	MIL	• On	

### Vehicle Data

Camshaft Position Sensor		Terminal		Inspection Condition	Measured Value	Remarks
Pin No.	1	CMPS Power		Ignition switch "ON" & Engine "OFF"	B+	-
	2	CMPS Signal	•	Voltage is measured on wiring side(	Approx. 4.7V	-
	3	CMPS Ground		Disconnected)	0V	-

### **Monitor GDS Data**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P034100	Camshaft Position Sensor A Circuit Range/Performance (Single Sensor)	

4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

CRC12EN5010P03410021S

### Specification : Refer to figure below

Current Data		Seàrch 🔍 🎞	<b>R</b> =
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	and from the
Syncronizing Status	-	-	
Engine Speed	808.5	RPM	
Accelerator Pedal Position Sensor	0	%	-
Pressure Control Valve(Rail)	7	%	=
Air Mass per Cylinder	0	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	-	
Gearbox Neutral Position Status Signal	OFF	-	
Fig.1			

Fig.1) Engine speed synchronization current data under engine idle.

- 5. Is the measured value within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

► Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO

Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- Refer to "Shop Manual" and disconnect the CMPS 2.

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Ignition Switch "ON" 3.

connector.

4. Measure voltage between power termonal of the CMPS connector and chassis ground.

### Specification : B+

Is the measured value within specification?

YES

- Go to "Ground Circuit Inspection" procedure
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3 Refer to "Shop Manual" and disconnect the CMPS connector.
- 4. Measure resistance between ground termianl of the CMPS and chassis ground.

### Specification : Below Approx. 1Ω

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect the CMPS 6. connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8 CMPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of CMPS harness connector.(B)

Specification : Difference (A) and (B) is less then 200

**GI-338** 

### mV

10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect the CMPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between signal terminal of CMPS harness connector and chassis ground.

### Specification : Approx. 4.7V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### CKPS & CMPS Signal Waveform Inspection

- 1. Ignition Switch "OFF"
- 2. Connect VMI to GDS and select oscilloscope.(2 Channel)

Channel A (+) : CKPS signal terminal (CKPS Harness Connector)

Channel A (-) : Ground

Channel B (+) : CMPS signal terminal (CMPS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Enigne "ON"
- 4. Inspection condition : Engine Idle

Specification : Refer to figure below

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Fig.1) CKPS & CMPS signal waveform under engine idle. ECM determines injection sequence and cylinder based on CKPS and CMPS signals.When CMPS high signal voltage is decreased to 2.0V, ECM recognizes as low signal. Also, low signal voltage is increased to 3.8V, ECM recognizes as high signal. Low signal of CMPS does not reach 0.0V because of interner resistance of hall sensor. When low signal of CMPS is over 0.6V, it might be indication of high resistance on CMPS or ground circuit.

- 5. Is the measured value within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
    - Go to "Camshaft Tone-Wheel Inspection" procedure.

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### Camshaft Tone-Wheel Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove CMPS. 3.
- 4. Inspect camshaft tone-wheel through CMPS installation hole.
- Have any problem been found? 5.

### **WARNING**

- DO NOT remove camshaft position sensor right after engine is stopped or running. Enigine oil may leak and cuases the scald.
- Refer to "Shop Manual" and inspect the fly-YES wheel.

If no problem is found on flywheel, replace the Camshaft assembly and then go to "Verification of Vehicle Repair" procedure.

NO

NO 

 Refer to "Shop Manual" and inspect the flywheel.

> If no problem is found on flywheel, replace the CMPS and then go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### **A**CAUTION

- Apply the engine oil to the O-ring.
- Be careful not to damage the O-ring.

### **A**CAUTION

- Insert the sensor in the installation hole and be careful not to damage when installation.
- Be careful not to damage the sensor housing and the connector.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## P038300 Glow Plug Control Module-Control Circuit Low

### **Component Location**



1. Glow Relay Unit (GRU)

### **General Description**

Glow plug heats the combustion chamber via electric heating wire. This allows fuel to atomize and increase ignitionability therefore, cold starting ability is increased and emission is reduced. ECM controls glow relay with engine coolant sensor, battery voltage and ignition switch state.

### **DTC Description**

Short to ground in glow relay circuit is detected, ECM sets DTC P038300.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause		
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>				
Enable Conditions	Engine running				
Threshold Value	Short to ground in g	low relay circuit			
Diagnostic Time	• 3 sec		1. Poor connector connection		
	Engine OFF	• No	3. Defected GRU		
Fail Safe	EGR Off	• No			
	Torque Limit	• No			
	MIL	• Off			

CRC12EN5010P038311

### Vehicle Data

Glow Re	elay Unit	Terminal	Ispection Condition	Measured Valu- e	Remarks
	1	Glow Time Feedback Signal		Approx. 10.5V	-
Pin No.	2	Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side( Disconnected)</li> </ul>	B+	-
	3	Glow Plug Output Sig- nal		Approx. 3.2V	-
	4	ON/START Power		B+	-
	5	Ground		0V	-
	6	Glow Plug		0V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P038300	Glow Plug Control Module-Control Circuit Low	

### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

- NO Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification :Refer to figure below

CRC12EN5010P03830021S

🕴 Current Data			Search	1111 1111	Retry (
Selective Display \$ Full List \$ Graph \$ Items List	st ‡ ] Reset Min.Ma	x Record	Stop ‡	Grouping	VSS
Sensor Name		Value	Unit		
GRU(Glow Relay Unit) Control Unit		6	%		
Engine Speed		808.5	RPM		
Accelerator Pedal Position Sensor		0	%		
Pressure Control Valve(Rail)		30	%		
Air Mass per Cylinder		353	mg/hub		
Barometric Pressure Sensor		1002	02 hPa		
Clutch Switch (M/T only)		OFF	-		
A/C ON Signal Switch		ON			
Gearbox Neutral Position Status Signal		OFF	-		

### Fig.1

Fig.1) ECM controls glow plug for certain amount of time under engine idle.

- 5. Is the parameter dispalyed within specification?

**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect GRU connector.
- Ignition switch "ON" 3.

### CRC12EN5010P03830022S

- 4. Measure the voltage between power terminal of GRU harness connector and chassis ground.
- 5. Measure the voltage between ON/START power terminal of GRU harness connector and chassis ground.

### Specification : B+

- 6. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect GRU 3 connector.
- 4. Measure the resistance between ground terminal of GRU harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect GRU connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of GRU 8 harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of GRU harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

# GI-3

# **General Information**

### 10. Is the measured value within specification?



YES • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect GRU 2. connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between feedback signal terminal of GRU harness connector and chassis ground.
- 5. Measure the voltage between output signal terminal of GRU harness connector and chassis ground.

### Specification :

feedback signal terminal : Approx. 10.5V Ouput signal terminal : Approx. 3.2V

6. Is the measured value within specification?



YES • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Glow Plug Resistance Inspection

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect GRU connector.
- Measure the resistance between glow plug terminal 4. of GRU harness connector and chassis ground.

Specification : Approx. 0.5 Ω (20 ~ 30 °C/68 ~ 86 °F)

5. Is the measured value within specification?

YES 
Go to "Glow Relay Actuation Test" procedure.

 Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

- Glow Plug Relay Actuation Test
- Ignition switch "OFF" 1.
- Connect GDS to Data Link Connector (DLC). 2.
- 3. Ignition switch "ON" & Engine "OFF"
- 4. Perform "Glow Relay" in "Actuation Test" with GDS.
- 5. Monitor "Glow Relay Unit Control Duty" parameter in "Current Data" with GDS.

Specification : Refer to figure below

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<b>E</b>	Actuation	Test			<b>î</b>
Test Items		Duration	15 Sec		
Injector #4 Actuation			15 500		
GRU (Glow Relay Unit) 15% Duty		• Condition	IG. ON/ENG.OFF -C Data(Glow Plug Rel	heck Current ay)	
Boost Pressure Actuator 5%	~	• Result	Operation Comman	d Sent	
Boost Pressure Actuator 95%	₹				
	Data Ana	lysis			×
100 GRU(Glow Relay Unit) Control Unit			Max : 15	-	×
				6 %	\$
0			Min : 6		Ð
Start Stop				Function	
Fig.1					

Fig.1) Glow relay current data when actuation test is performed.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 

     Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

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- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO

YES 
 Go to the applicable troubleshooting procedure.

> Problem is corrected and the system operation performs to specification at this time.

### P038400 Glow Plug Control Module-Control Circuit High

### **Component Location**



1. Glow Relay Unit (GRU)

### **General Description**

Glow plug heats the combustion chamber via electric heating wire. This allows fuel to atomize and increase ignitionability therefore, cold starting ability is increased and emission is reduced. ECM controls glow relay with engine coolant sensor, battery voltage and ignition switch state.

### **DTC Description**

If short to power in glow relay unit circuit is detected, ECM sets DTC P038400.

### **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Short to power in g	low relay unit circuit	1 Door connector connection
Detecting Time	• 1 sec		<ol> <li>Poor connector connection</li> <li>Short to power in glow relay u-</li> </ol>
	Engine Off	• No	nit circuit
Fail Safe	EGR Off	• No	3. Defected CMPS
	Torque Limit	• No	
	MIL	• Off	

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### Vehicle Data

Glow Relay Unit		Terminal Ispection Condition		Measured Valu- e	Remarks
	1	Glow Time Feedback Signal		Approx. 10.5V	-
	2	Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side( Disconnected)</li> </ul>	B+	-
Pin No.	3	Glow Plug Output Sig- nal		Approx. 3.2V	-
	4	ON/START Power		B+	-
	5	Ground		0V	-
	6	Glow Plug		0V	_

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P038400	Glow Plug Control Module-Control Circuit High	

CRC12EN5010P03840021S

4. Is DTC status displayed as Present?



YES 
Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

🚪 Current Data		Search 🙉 🖡	I # E
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 😂 🗍 F	Reset Min.Max Record	Stop  Crouping	VSS
Sensor Name	Value	Unit	1
GRU(Glow Relay Unit) Control Unit	6	%	
Engine Speed	808.5	RPM	
Accelerator Pedal Position Sensor	0	%	~
Pressure Control Valve(Rail)	30	%	=
Air Mass per Cylinder	353	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	OFF	-	
A/C ON Signal Switch	ON	<u></u> :	
Gearbox Neutral Position Status Signal	OFF	-	
Fig.1			

Fig.1) ECM controls glow plug for certain amount of time under engine idle.

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect GRU connector.
- Ignition switch "ON" 3.

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- 4. Measure the voltage between power terminal of GRU harness connector and chassis ground.
- 5. Measure the voltage between ON/START power terminal of GRU harness connector and chassis ground.

### Specification : B+

- 6. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect GRU connector.
- 4. Measure the resistance between ground terminal of GRU harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect GRU connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of GRU 8. harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of GRU harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect GRU 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between feedback signal 4 terminal of GRU harness connector and chassis ground.
- Measure the voltage between output signal terminal 5. of GRU harness connector and chassis ground.

Specification : feedback signal terminal : Approx. 10.5V / Ouput signal terminal : Approx. 3.2V

- 6. Is the measured value within specification?

**YES** • Go to "Component Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Glow Plug Resistance Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect GRU 3. connector.
- Measure the resistance between glow plug terminal 4. of GRU harness connector and chassis ground.

Specification : Approx. 0.5 Ω (20 ~ 30 °C/68 ~ 86 °F)

5. Is the measured value within specification?



YES 
Go to "Glow Relay Actuation Test" procedure.

- NO Carefully re-do this troubleshooting guide steps.
  - If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

### Glow Plug Relay Actuation Test

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Glow Relay" in "Actuation Test" with GDS. 4.
- 5. Monitor "Glow Relay Unit Control Duty" parameter in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

<b>E</b>	Actuation	Test		🖭 主 🐔
Test Items		Duration	15 Sec	
Injector #4 Actuation	\$	· Duration	15 560	
GRU (Glow Relay Unit) 15% Duty	<b>^</b>	• Condition	IG. ON/ENG.OFF -C Data(Glow Plug Rel	Check Current ay)
Boost Pressure Actuator 5%	-	• Result	Operation Comman	d Sent
Boost Pressure Actuator 95%	₹			)
	Data Ana	lysis		
100 GRU(Glow Relay Unit) Control Unit			Max : 15	×
				6 %
				0 //0
0			Min : 6	( <del>Q</del>
Start Stop				Function
Fig.1				

Fig.1) Glow relay current data when actuation test is performed.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 
    Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

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- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.

- NO
  - Problem is corrected and the system operation performs to specification at this time.

### P040100 Exhaust Gas Recirculation Flow Insufficient Detected

### **Component Location**



# 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

### **DTC Description**

If exhaust gas re-circulation rate is below set-point, ECM sets DTC P040100. This fault might be caused by clogged EGR cooler and leakage on intake/exhaust manifold.

CRC12EN5010P040111

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Exhaust gas re-circ	ulation rate is below set-point	1. Poor connector connection
Diagnostic Time	• -		3. Clogged or leaked exhaust gas
	Engine OFF	• No	re-circulation path
Fail Safe	EGR Off	• No	5. Leakage on intake manifold
	Torque Limit	• No	
	MIL	• Off	

### Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
	1	EGR Actuator motor(+)		B+	Signal Wavefor- m (Fig. 1)
	2	-		-	-
Dia Na	3	EGR Actuator motor(-)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	B+	Signal Wavefor- m (Fig. 2)
Pin No.	4	EGR Actuator Feedback Sig- nal	<ul> <li>Voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

📕 Oscillo	oscope						
Sensor	Theme	Name	Review	User Setting	A	14.44 s 🕨 📕	1s 👂
Reset	Start ‡	Cursor	ViewAll	Save	M		
+20∨		Motor +	Hz : (	0.3 Hz	Duty- : 70 %	Duty+: 30 %	
Configurati				]			
9 -5X							. В

CRC12EN5010P04010011S

	Oscillo	scope						
	Sensor	Theme	Name	Review	User Setting	A	14.48 s 🕨 😽	1s 🕨
	Reset	Start 🗘	Cursor	ViewAll	Save	<b>H</b>		
Configuration	+20V		Motor -	' Hz : 0	).3 Hz	Duty- : 70 %	Duty+: 30 %	
Fiç	-5x( g.2							B

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

### DTC 2 Erase All DTC Erase Selective DTC Hist/Pend DTC \$ Current DTC Description State P040100 Exhaust Gas Recirculation Flow Insufficient Detected

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

► Go to "Verification of Vehicle Repair" proce-NO dure.

### Monitor GDS Data

- Ignition Switch "OFF" 1.
- 2. Connect Data Link Connector(DLC) to GDS.

- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

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Specification : Refer to figure below

# GI-3

# **General Information**

Current Data		Search 🖭 🚛	
Selective Display C Full List C Graph Illems List C Rese	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	1
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		

Fig.1

### CRC12EN5010P04010022S

Current Data	Search 🖭 🗐 🏭 😑
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 😂 İtems List 🗧 Reset Min.Max 🛛 Res	cord Stop ‡ Grouping VSS
Sensor Name Va	lue Unit
EGR Actuator -1	1.4 %
Control Deviation of the Exhaust-Gas Recirculati	39 mg/hub
🗹 Air Mass per Cylinder 💦 🗧	300 mg/hub
Engine Speed 493	1.0 RPM
Accelerator Pedal Position Sensor	100 %
Pressure Control Valve(Rail)	35 %
Barometric Pressure Sensor 10	002 hPa
Clutch Switch (M/T only)	ON -
A/C ON Signal Switch	ON -
Fig.2	

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

5. Is the parameter dispalyed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"



### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Ground Clrcuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4 E-EGR Actuator harness connector and chassis ground.

### **Specification** : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect E-EGR 6. Actuator connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis

ground.

Specification : Approx. 4.8V

5. Is the measured value within specification?

- YES 
  Go to "E-EGR Actuator Motor Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **E-EGR Actuator Motor Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- 5. Measure the voltage between motor(-) terminal of E-EGR Actuator harness connector and chassis ground.

### Specification : B+

- 6. Is the measured value within specification?

  - **YES** Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Clogged Re-circulation Path of Exhaust Gas and leakage on Intake System Inspection

1. Refer to "Shop Manual" and inspect for following conditions;

- Tear, crack or damage on intake hose/pipp after the ACV.

- Damage or air leakageon intake system include inter-cooler and pipe/hose.

- Crack or damage on Re-circulation path of exhaust gas.

2. Have problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "EGR Actuator Inspection" procedure. NO

### EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

🖅 < A	ctuation Test		
Test Items	Duration	Until Stop Ruttop	
Boost Pressure Actuator 5%			
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC	
EGR Valve 10%	· Result	Operation Command Sent	
EGR Valve 90%	₹		
Data Analysis			
100.0 EGR Actuator Control Duty		Max : 11.4	
		-0.4 %	
-100.0		Min : -0.4	
Start Stop		Function	

Fig.1

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- <b>E</b>	Actuation Test	🗆 🥵 🖭 🕇 🐔
Test Items		Lintil Stan Buttan
Boost Pressure Actuator 5%		
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	¥	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 31.0
		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.2		

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

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### 

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

# **General Information**



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# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

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# **General Information**

🖾 🔸	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU	ANCEL
Fig 3	

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Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.
# P040200 Exhaust Gas Recirculation Flow Excessive Detected

# **Component Location**



# 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

### **DTC Description**

If exhaust gas re-circulation rate is higher than set-point, ECT sets DTC P040200. This fault might be caused by stuck open or damaged on EGR valve.

### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Exhaust gas re-circ	ulation rate is below set-point	1 Door connector connection
Diagnostic Time	• -		2. Defected EGR valve disc
Fail Safe	Engine OFF	• No	3. High pressure on exhaust syst-
	EGR Off	• No	em
	Torque Limit	• No	
	MIL	• Off	

CRC12EN5010P040111

# **General Information**

# Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
	1	EGR Actuator motor(+)		B+	Signal Wavefor- m (Fig. 1)
	2	-	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	-	-
Dia Ma	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
Pin No.	4	EGR Actuator Feedback Sig- nal	<ul> <li>Voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-



### CRC12EN5010P04010011S

	Oscillos	scope						
	Sensor	Theme	Name	Review	User Setting	A		4 1s
	Reset	Start 🗘	Cursor	ViewAll	Save			M
	+20∨		Motor -	Hz : 0	).3 Hz	Duty- : 70 %	Duty+: 30	× □[]][]
Con	-							
figura								
ation	-							
	-5							. В
Fig	<b>j.2</b>							

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Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

# Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

	Retry _
Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Description	State
Exhaust Gas Recirculation Flow Excessive Detected	
	Freeze Frame       DTC Status       Erase Selective DTC       Hist/Pend DTC \$         Description         Exhaust Gas Recirculation Flow Excessive Detected

### CRC12EN5010P04020021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.

  - NO Go to "Verification of Vehicle Repair" procedure.

# Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

# Specification : Refer to figure below

Current Data		Search 🔍 💵	
Selective Display C Full List C Graph Illems List Reset	Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	ĺ.
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
C Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	-
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		
Fig.1			

CRC12EN5010P04010022S

# **General Information**

Current Data		Seàrch	R.	<b>a</b> =
Selective Display \$ Full List \$ Graph \$ Items List \$ Rese	Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
EGR Actuator	-11.4	%		
Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub		
Air Mass per Cylinder	800	mg/hub		
Engine Speed	4931.0	RPM		
Accelerator Pedal Position Sensor	100	%		
Pressure Control Valve(Rail)	35	%		
Barometric Pressure Sensor	1002	hPa		
Clutch Switch (M/T only)	ON			
A/C ON Signal Switch	ON	-		

Fig.2

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

- 5. Is the parameter dispalyed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR

Actuator connector.

- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.

CRC12EN5010P04010023S

Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4. E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness

connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO

Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR 2. Actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis ground.

### Specification : Approx. 4.8V

5. Is the measured value within specification?

YES 
Go to "E-EGR Actuator Motor Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# E-EGR Actuator Motor Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. E-EGR Actuator harness connector and chassis ground.

### Specification : B+

6. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Component Inspection

Clogged Re-circulation Path of Exhaust Gas and leakage on Intake System Inspection

- 1. Refer to "Shop Manual" and inspect for following conditions;
  - Tear, crack or damage on intake hose/pipp after the ACV.

- Damage or air leakageon intake system include inter-cooler and pipe/hose.

- Crack or damage on Re-circulation path of exhaust gas.

- 2. Have problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - Go to "EGR Actuator Inspection" procedure. NO

### EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" 3.
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

# **General Information**

📼 🐟 🗛	ctuation Test	
Test Items		Lintil Stop Buttop
Boost Pressure Actuator 5%		
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	Ŧ	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 11.4
		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.1		· · · · · ·

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► ★	Actuation Test	🗆 🛹 🖭 🕇 🏠
Test Items	Durati	Linkil Chan Buttan
Boost Pressure Actuator 5%		
Boost Pressure Actuator 95%	· Condit	ion IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	₹	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 31.0
		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.2		

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

**A**CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

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### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

# **General Information**



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# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

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# **General Information**

<b>E</b> •	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU         Essential work after component replacement         ECU replacement (DPF OPT)         Rail Pressure Sensor replacement         Air Flow Sensor replacement         Differential Pressure Sensor replacement (DPF OPT)         Throttle valve replacement         EGR Valve replacement         APS Module replacement         SELECT         CANCEL
MENU C	ANCEL

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# P040300 Exhaust Gas Recirculation Control Circuit

# **Component Location**



# 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

### **DTC Description**

If open in motor circuit of E-EGR actuator is detected, ECM sets DTC P040300.

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Exhaust gas re-circ	ulation rate is below set-point	1 Deer connector connection
Diagnostic Time	• 1 sec		2. Open in motor circuit of E-EGR
	Engine OFF	• No	actuator
	EGR Off	• Yes	3. Defected E-EGR actuator
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

CRC12EN5010P040111

# **General Information**

# Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
	1	EGR Actuator motor(+)		B+	Signal Wavefor- m (Fig. 1)
	2	-	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	-	-
Dia Ma	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
Pin No.	4	EGR Actuator Feedback Sig- nal	<ul> <li>voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-



### CRC12EN5010P04010011S

	Oscillos	scope						
	Sensor	Theme	Name	Review	User Setting	A	( 14.48 s ▶B	1s 🕨
	Reset	Start 🗘	Cursor	ViewAll	Save	F		
	+20∨		Motor -	Hz : 0	).3 Hz	Duty- : 70 %	Duty+: 30 %	
Con	-							
figura			ļĮ				ļļ	
ation								
	-5X						1 1 1	. В
Fig	3.2							

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

# Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P040300	Exhaust Gas Recirculation Control Circuit	
L		

### CRC12EN5010P04030021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.

  - NO Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

# Specification : Refer to figure below

Current Data		Search 🔍 💵	
Selective Display C Full List C Graph Illems List Reset	Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	ĺ.
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
C Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	-
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		
Fig.1			

CRC12EN5010P04010022S

# **General Information**

Current Data		Search	<b>1</b>	<b>2</b>
Selective Display \$ Full List \$ Graph \$ Items List \$ Rese	I Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
EGR Actuator	-11.4	%		
Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub		
Air Mass per Cylinder	800	mg/hub		
Engine Speed	4931.0	RPM		
Accelerator Pedal Position Sensor	100	%		a Van
Pressure Control Valve(Rail)	35	%		E
Barometric Pressure Sensor	1002	hPa		1
Clutch Switch (M/T only)	ON			
A/C ON Signal Switch	ON	-		

Fig.2

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

- 5. Is the parameter dispalyed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR

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- Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4. E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness

connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO

Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Signal Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR 2. Actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis ground.

### Specification : Approx. 4.8V

5. Is the measured value within specification?

YES 
Go to "E-EGR Actuator Motor Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# E-EGR Actuator Motor Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. E-EGR Actuator harness connector and chassis ground.

### Specification : B+

6. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Component Inspection

Clogged Re-circulation Path of Exhaust Gas and leakage on Intake System Inspection

- 1. Refer to "Shop Manual" and inspect for following conditions;
  - Tear, crack or damage on intake hose/pipp after the ACV.
  - Damage or air leakageon intake system include inter-cooler and pipe/hose.

- Crack or damage on Re-circulation path of exhaust gas.

- 2. Have problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - Go to "EGR Actuator Inspection" procedure. NO

### EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" 3.
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

<b>•</b>	Actuation Test	
Test Items	Duration	Linkil Chan Duittan
Boost Pressure Actuator 5%		
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	¥	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 11.4 🛛 🗙
~~~~~		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.1		

CRC12EN5010P04010041S

<b>E</b>	Actuation Test	
Test Items	Duration	Linkil Chan Ruttan
Boost Pressure Actuator 5%		Until Stop Button
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	Ŧ	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 31.0
		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.2		

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

**A**CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

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### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

# **General Information**



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<b>F </b>	Essentia	work after co	mponent repla	acement					
[ Econtic   W		t Daula como at 1							
Essential work after component Replacement j									
If you're rea	If you're ready, select the menu.								
MENU	CANCEL								
Fig.2									

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# **General Information**

😎 🔸	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU CA	ANCEL

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# P040400 Exhaust Gas Recirculation Control Circuit Range/Performance

# **Component Location**



# 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

### **DTC Description**

If stuck open/closed on E-EGR actuator is continued under driving condition, ECM sets DTC P040400.

CRC12EN5010P040111

# **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>		
Enable Condition	Engine running		
	Case 1	<ul> <li>Excessive temperature on E- EGR Actuator</li> </ul>	
Threshold Value	Case 2	<ul> <li>Stuck closed on E-EGR Actuat- or</li> <li>Stuck open on E-EGR Actuator</li> </ul>	<ol> <li>Poor connector connection</li> <li>Faulty E-EGR actuator circuit</li> </ol>
	Case 1	• 1 sec	3. Stuck on E-EGR actuator
Detecting Time	Case 2	• 4.4 sec	4. Delected E-EGR actuator
	Engine OFF	• No	
	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

# Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
	1	EGR Actuator motor(+)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	B+	Signal Wavefor- m (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
Pin No.	4	EGR Actuator Feedback Sig- nal	<ul> <li>voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-



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	Oscillos	scope						
	Sensor	Theme	Name	Review	User Setting	A	14.48 s 🕨 😽 📢	1s 🕨
	Reset	Start 🗘	Cursor	ViewAll	Save	H		
	+20V		Motor -	. Hz : 0	1.3 Hz	Duty- : 70 %	Duty+: 30 %	
Configuration	-							-
Fiç	-5x g.2							В

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

# **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P040400	Exhaust Gas Recirculation Control Circuit Range/Performance	

CRC12EN5010P04040021S

4. Is DTC status displayed as Present?



- YES 
  Go to "Monitor GDS Data" procedure.
- dure.
- NO Go to "Verification of Vehicle Repair" proce-

# Monitor GDS Data

1. Ignition Switch "OFF"

- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

Current Data		Search 🖭 🚛	
Selective Display C Full List C Graph Illems List C Rese	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	1
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		

Fig.1

### CRC12EN5010P04010022S

	Current Data		Search 🖭 🗐	
1	Selective Display 🗧 🛛 Full List 💠 🗍 Graph 😂 Items List 🗧 Reset I	Min.Max Record	Stop ‡ Grouping	VSS
	Sensor Name	Value	Unit	
	EGR Actuator	-11.4	%	
	Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub	
	Air Mass per Cylinder	800	mg/hub	
	Engine Speed	4931.0	RPM	
	Accelerator Pedal Position Sensor	100	%	<b>J</b>
	Pressure Control Valve(Rail)	35	%	=
	Barometric Pressure Sensor	1002	hPa	
	Clutch Switch (M/T only)	ON		
	A/C ON Signal Switch	ON	-	
Fi	g.2			

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

5. Is the parameter dispalyed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

CRC12EN5010P04010023S

caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

# **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"



### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4 E-EGR Actuator harness connector and chassis ground.

### **Specification** : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect E-EGR 6. Actuator connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis

ground.

Specification : Approx. 4.8V

5. Is the measured value within specification?

- YES 
  Go to "E-EGR Actuator Motor Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **E-EGR Actuator Motor Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- 5. Measure the voltage between motor(-) terminal of E-EGR Actuator harness connector and chassis ground.

### Specification : B+

- 6. Is the measured value within specification?

  - **YES** Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Clogged Re-circulation Path of Exhaust Gas and leakage on Intake System Inspection

1. Refer to "Shop Manual" and inspect for following conditions;

- Tear, crack or damage on intake hose/pipp after the ACV.

- Damage or air leakageon intake system include inter-cooler and pipe/hose.

- Crack or damage on Re-circulation path of exhaust gas.

2. Have problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "EGR Actuator Inspection" procedure. NO

# EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

🖅 🐳 🛛 Actu	ation Test		📴 🕇 🐔
Test Items		ration Until Stop Puttop	
Boost Pressure Actuator 5%			
Boost Pressure Actuator 95%	• · Co	DIG. ON, ENG OFF, ' DTC	P' RANGE, NO
EGR Valve 10%	- · Re	esult Operation Comman	d Sent
EGR Valve 90%	₹ L		
Dat	a Analysis		
100.0 EGR Actuator Control Duty		Max : 11.4	×
			-0.4 %
-100.0		Min : -0.4	æ
Start Stop			Function

Fig.1

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Test Items   Boost Pressure Actuator 5%   Boost Pressure Actuator 95%   EGR Valve 10%   EGR Valve 90%   Data Analysis   100.0   EGR Actuator Control Duty   Max : 31.0   -0.4 %   1000   Start   Stop	<b>F</b>	Actuation Test	
Boost Pressure Actuator 5%   Boost Pressure Actuator 95%   EGR Valve 10%   EGR Valve 90%     Data Analysis     100.0   EGR Actuator Control Duty     Max : 31.0        -0.4 %   100.0     Start     Stop     Data Analysis	Test Items	Duration	Linkil Chan Dutter
Boost Pressure Actuator 95%   EGR Valve 10%   EGR Valve 90%	Boost Pressure Actuator 5%		
EGR Valve 10%   EGR Valve 90%     Data Analysis     100.0   EGR Actuator Control Duty     Max : 31.0        -0.4 %   +100.0   Min : -0.4   Start   Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start     Start	Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 90%         Image: Control Duty         Data Analysis           100.0         EGR Actuator Control Duty         Max : 31.0         Image: Control Duty         -0.4 %         Image: Control Duty         Image: Control Duty         Image: Control Duty         -0.4 %         Image: Control Duty         -0.4 %         Image: Control Duty         Image: Control Duty         Image: Control Duty         -0.4 %         Image: Control Duty         Image: Control	EGR Valve 10%	· Result	Operation Command Sent
Data Analysis         100.0       EGR Actuator Control Duty       Max : 31.0         -0.4 %       -0.4 %         -100.0       Min : -0.4         Start       Stop       Image: Control Duty	EGR Valve 90%	Ŧ	
100.0       EGR Actuator Control Duty       Max : 31.0         -0.4 %       -0.4 %         -100.0       Min : -0.4         Start       Stop		Data Analysis	
-100.0 -0.4 % -100.0 Min : -0.4 % Min : -0.4 % Function	100.0 EGR Actuator Control Duty		Max : 31.0
-100.0 Min : -0.4 Stop Min : -0.4 Function	/		-0.4 %
Start Stop Function	-100.0		Min : -0.4
	Start Stop		Function

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

# 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

**A**CAUTION

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

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### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

# **General Information**



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# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

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# **General Information**

🖾 🛠	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU CA	ANCEL
Fig 3	

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# P040500 Exhaust Gas Recirculation Sensor A Circuit Low

# **Component Location**



# 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

### **DTC Description**

If output voltage of E-EGR actuator position sensor is below threshold value for more than 2.5 sec., ECM sets DTC P040500.

CRC12EN5010P040111

# DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>Output voltage of E low threshold value</li> </ul>	-EGR actuator position sensor is be-	<ol> <li>Poor connector connection</li> <li>Open in power circuit of E-EG- D actuator</li> </ol>
Diagnostic Time	2.5sec 3		3. Short to ground in signal circuit
	Engine OFF	• No	of E-EGR actuator
	EGR Off	• Yes	tion sensor
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

# Vehicle Data

Electronic EGF	R Actuator	Terminal	Inspection Condition	Measured Value	Remarks		
	1	EGR Actuator motor(+)	(+)			B+	Signal Wavefor- m (Fig. 1)
	2 -	-		-	-		
Dia No	3	EGR Actuator motor(-)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> <li>Voltage is measured on- wiring side(Disconnected )</li> </ul>	B+	Signal Wavefor- m (Fig. 2)		
Pin No.	4	EGR Actuator Feedback Sig- nal		Approx. 4. 8V	-		
	5	EGR Actuator Ground		0V	-		
	6	EGR Actuator Power		Approx. 5 V	-		

	Oscillos	соре						-
	Sensor	Theme	Name	Review	User Setting	<b>₽</b> A	14.44 s 🕨 😽	1s 🕨
	Reset	Start ‡	Cursor	ViewAll	Save	M		
	+20∨ -		Motor +	Hz : 0	1.3 Hz	Duty- : 70 %	Duty+: 30 %	
Configura	-				]			-
ation	-51/	L.			· · · · · · · · · · · · · · · · · · ·	L		
Fiç	g.1							. B'

CRC12EN5010P04010011S

	Oscillo	scope						
	Sensor	Theme	Name	Review	User Setting	A	14.48 s 🕨 B	1s 🕨
	Reset	Start 🗘	Cursor	ViewAll	Save	I		
	+20∨ -		Motor -	Hz : 0	.3 Hz	Duty-:70 %	Duty+: 30 %	
Config	-					[		
uratio	- 1							
-	-51				JL-	l		JL
Fig	g.2							

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# DTC 2 Erase All DTC Erase Selective DTC Hist/Pend DTC \$ Current DTC Description State P040500 Exhaust Gas Recirculation Sensor A Circuit Low

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

► Go to "Verification of Vehicle Repair" proce-NO dure.

### Monitor GDS Data

- Ignition Switch "OFF" 1.
- 2. Connect Data Link Connector(DLC) to GDS.

- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

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Specification : Refer to figure below

# **GI-3**

# **General Information**

Current Data		Search 🖭 🚛	
Selective Display C Full List C Graph Illems List C Rese	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	1
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		

Fig.1

### CRC12EN5010P04010022S

	Current Data		Search 🔍 🚛	
8	Selective Display \$   Full List \$   Graph \$   Items List \$   Rese	t Min.Max Record	Stop   Grouping	VSS
	Sensor Name	Value	Unit	1
8	EGR Actuator	-11.4	%	
8	Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub	
8	Air Mass per Cylinder	800	mg/hub	
	Engine Speed	4931.0	RPM	
E	Accelerator Pedal Position Sensor	100	%	Va
E	Pressure Control Valve(Rail)	35	%	=
E	Barometric Pressure Sensor	1002	hPa	
1	Clutch Switch (M/T only)	ON	. <del></del>	
E	A/C ON Signal Switch	ON	-	
Fig	.2			

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

5. Is the parameter dispalyed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"

- Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis around.
- Specification : Approx. 5.0V
- 5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4 E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect E-EGR 6. Actuator connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition Switch "ON"
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis

ground.

Specification : Approx. 4.8V

- 5. Is the measured value within specification?
- YES Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

# E-EGR Actuator Position Sensor Resistance Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Feedback signal terminal (E-EGR Actuator Harness Connector)

Channel A (-) : Ground

- 4. Ignition switch "ON" & Engine "OFF"
- 5. Perform "EGR Actuator" in "Actuation Test" with GDS
- Inspection condition : Ignition switch "ON" & Engine 6. "OFF"

Specification : Voltage at closed : Approx. 3.6 ~ 4.3V / Voltage at open (6mm) : Approx. 0.6 ~ 1.3V

- 7. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

**GI-396** 

# **A**CAUTION

• When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

🖅 🛠	Special Function	a 💽	<b>t</b> î
	Injector Specific Data		Ô
0	Essential work after component repl	acemen	t
0	Engine Test Function		
0	Fuel line air removal		
0	DPF Service Regeneration		
Favorite			
Fig.1			

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<b>F </b>	Essentia	l work after co	omponent repla	acement	•
[ Free stiel W		t Deule content 1			
	ork after Componen	it Replacement J			
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

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## GI-397

## **General Information**

🖾 🔸	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

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Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

## P040600 Exhaust Gas Recirculation Sensor A Circuit High

#### **Component Location**



## 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

#### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

#### **DTC Description**

If output voltage of E-EGR actuator position sensor is higher than threshold value for more than 2.5 sec., ECM sets DTC P040600.

CRC12EN5010P040111

## DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>Output voltage of E gher than threshold</li> </ul>	-EGR actuator position sensor is hi- value	1. Poor connector connection
Diagnostic Time	• 2.5sec		of E-EGR actuator
	Engine OFF	• No	3. Defected E-EGR actuator posi-
Fail Safe	EGR Off	• Yes	tion sensor
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
	1	EGR Actuator motor(+)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	B+	Signal Wavefor- m (Fig. 1)
	2	-		-	-
Dia Na	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
Pin No.	4	EGR Actuator Feedback Sig- nal	<ul> <li>voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5 EGR Actuator Grou	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

📒 Oscillos	соре						
Sensor	Theme	Name	Review	User Setting	A	14.44 s 🕨 🛛 📢	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save	M		
+20∨		Motor +	Hz : 0	).3 Hz	Duty-: 70 %	Duty+: 30 %	
onfinura -				]			1
-54							. в

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	Oscillos	scope						
1	Sensor	Theme	Name	Review	User Setting	A4	14.48 s 🕨 🛛 🚽	1s 🕨
	Reset	Start ¢	Cursor	ViewAll	Save	H		
_	+20∨ -		Motor -	Hz : 0	1.3 Hz	Duty- : 70 %	Duty+: 30 %	
Configu	- ]							
iration			ĺĹ					
	-5							В
Fig	1.2							

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

## DTC 2 Erase Selective DTC Erase All DTC Hist/Pend DTC \$ Current DTC Description State P040600 Exhaust Gas Recirculation Sensor A Circuit High

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

► Go to "Verification of Vehicle Repair" proce-NO dure.

#### Monitor GDS Data

- Ignition Switch "OFF" 1.
- 2. Connect Data Link Connector(DLC) to GDS.

- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

CRC12EN5010P04060021S

Specification : Refer to figure below



# **General Information**

Current Data	Search 🖭 💷 🟭
Selective Display C Full List C Graph Items List C Resel	Min.Max Record Stop Crouping VSS
Sensor Name	Value Unit
EGR Actuator	-11.4 %
Control Deviation of the Exhaust-Gas Recirculati	0 mg/hub
Air Mass per Cylinder	482 mg/hub
Engine Speed	787.5 RPM
Accelerator Pedal Position Sensor	0 %
Pressure Control Valve(Rail)	31 %
Barometric Pressure Sensor	1002 hPa
Clutch Switch (M/T only)	ON -
A/C ON Signal Switch	ON -

ig.1

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	Current Data		Search 🖭 🗐	
1	Selective Display 🗧 🛛 Full List 💠 🗍 Graph 😂 Items List 😂 Reset	Min.Max Record	Stop  Crouping	VSS
	Sensor Name	Value	Unit	
	EGR Actuator	-11.4	%	
	Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub	
	Air Mass per Cylinder	800	mg/hub	
	Engine Speed	4931.0	RPM	
	Accelerator Pedal Position Sensor	100	%	<b>J</b> .
	Pressure Control Valve(Rail)	35	%	=
	Barometric Pressure Sensor	1002	hPa	
	Clutch Switch (M/T only)	ON		
	A/C ON Signal Switch	ON	-	
Fi	g.2			

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

5. Is the parameter dispalyed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

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caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

#### **Power Circuit Inspection**

- Ignition Switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"



5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4 E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect E-EGR 6. Actuator connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of 8. E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition Switch "ON"
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis

ground.

Specification : Approx. 4.8V

- 5. Is the measured value within specification?
- YES Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### E-EGR Actuator Position Sensor Resistance Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Feedback signal terminal (E-EGR Actuator Harness Connector)

Channel A (-) : Ground

- 4. Ignition switch "ON" & Engine "OFF"
- 5. Perform "EGR Actuator" in "Actuation Test" with GDS
- Inspection condition : Ignition switch "ON" & Engine 6. "OFF"

Specification : Voltage at closed : Approx. 3.6 ~ 4.3V / Voltage at open (6mm) : Approx. 0.6 ~ 1.3V

- 7. Is the measured value within specification?
  - YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

#### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

### 

• When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

🖅 🛠	Special Function	ra 🖸 🕻	L î
	Injector Specific Data		Ô
0	Essential work after component repl	acement	:
0	Engine Test Function		
0	Fuel line air removal		
0	DPF Service Regeneration		Ţ
Favorite			
Fig.1			

CRC12EN5010P01010041S

# **General Information**

# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

## GI-405

## **General Information**

<b>F</b>	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU
MENU CA	ANCEL

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

## P047100 Exhaust Pressure Sensor "A" Circuit Range/Performance

#### **Component Location**



#### 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

#### **DTC Description**

If the DPS hose is clogged by soot, ECM sets DTC P047100.

CRC12EN5010P04710011

## DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause		
DTC Strategy	Signal monitoring				
Enable Conditions	Engine running				
Threshold Value	Clogged DPS hose by soot Differential pressure value is over 50 hPa		1 Deer connector connection		
Diagnostic Time	• -		2. Clogged DPS hose		
	Engine OFF	• No	3. Defected DPS		
Fail Safe	EGR Off	• No			
	Torque Limit	• No			
	MIL	• Off			

#### Vehicle Data

DPF DPS		Terminal	Inspection Condition	Measured Value	Remarks
	1	DPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side(</li> </ul>	Approx. 5V	-
Pin No.	2	DPS Signal		Approx. 5.6V	-
	3 DPS Ground	Disconnected)	0 V	-	
		Torminal	Inspection Condition	Measured	Pomorko

DPF DPS		Terminal	Inspection Condition	Value	Remarks
Pin No.	1	DPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side( Connected)</li> </ul>	Approx. 5V	_
	2	DPS Signal		Approx. 1.0V	-
	3	DPS Ground		0 V	-

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

Retry
State

CRC12EN5010P04710021S

4. Is DTC status displayed as Present?



YES > Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- Connect GDS to Data Link Connector (DLC). 2.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	et Min.Max Record	Stop ‡ G	rouping VSS
Sensor Name	Value	Unit	1
Differential Pressure at Particle Filter	3.529	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.02	V	
Engine Speed	789.0	BPM	
E Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	<u> </u>	
AMS Stop Reason - Wiper(AMS)	NO	-	

FIG.1

CRC12EN5010P04710022S

Current Data		Search 😥	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 🗍 items List 🗘 Rese	t Min.Max Record	Stop ‡ Groupin	g VSS
Sensor Name	Value	Unit	and the second
Differential Pressure at Particle Filter	89.804	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.31	V	
Engine Speed	4932.5	RPM	
E Flag Status of Battery Function to Crank the Eng	NO	- <u>-</u>	4
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO		
AMS Stop Reason - Wiper(AMS)	NO	-	

Fig.2

#### CRC12EN5010P04710023S

Fig.1) DPS current data under engine idle

※ Displayed value may different in according to

actual vehicle condition

Fig.2) DPS current data under engine speed approx.

# **General Information**

#### 5.000RPM

X Displayed value may different in according to actual vehicle condition

5. Is the parameter dispalyed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



NO • Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Ground Clrcuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.

- Refer to "Shop Manual" and disconnect DPS 3. connector.
- 4. Measure the resistance between ground terminal of DPS harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect DPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of DPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

- 10. Is the measured value within specification?
  - **YES** Go to "Signal Circuit Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2. connector.
- 3. Ignition switch "ON"
- Measure the voltage between signal terminal of DPS 4. harness connector and chassis ground.

Specification : Approx. 5.6V

5. Is the measured value within specification?

- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Visual Inspection on DPF Differential Pressure Sensor

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Inspect for corrosion or contamination on DPS 3. terminal.

- Inspect for proper installation of DPS, DPS hose and leakage on exhaust system.
- 5. Inspect for foreign substance on DPS and DPF assembly.
- 6. Inspect for Leakage on exhaust system.
- 7. Have any problems been found?
  - **YES** Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - NO Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- 1. Ignition switch "OFF"
- Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

#### Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO
- Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### 

• When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

## **General Information**

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

<b>₽ ↓</b>	Special Function	& 🖭 主	Â
	Injector Specific Data		Ô
0	Essential work after component repla	cement	
0	Engine Test Function		
0	Fuel line air removal		
0	DPF Service Regeneration		
Favorite			
Fig.1			

CRC12EN5010P01010041S

<b>F </b>	Essentia	l work after co	omponent repla	acement	•				
Essential W	[ Essential Work after Component Replacement ]								
If you're rea	ady, select the menu	ı.							
MENU	CANCEL								
Fig.2									

CRC12EN5010P01010042S

## GI-413

## **General Information**

<b>E</b> •	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU         Essential work after component replacement         ECU replacement (DPF OPT)         Rail Pressure Sensor replacement         Air Flow Sensor replacement         Differential Pressure Sensor replacement (DPF OPT)         Throttle valve replacement         EGR Valve replacement         APS Module replacement         SELECT       CANCEL
MENU C	ANCEL

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) Differential Pressure Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO • Problem is corrected and the system operation performs to specification at this time.

## P047200 CPF Differential Pressure Sensor "A" Circuit Low Input

#### **Component Location**



#### 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

#### **DTC Description**

If the DPS output signal is lower than minimum threshold value, ECM sets DTC P047200.

CRC12EN5010P04710011

#### **DTC Detecting Condition**

Item	Detect	Possible Cause	
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	DPS output signal is below minimum threshold value		1. Poor connector connection
Diagnostic Time	• -	<ol> <li>Short to ground in signal circuit</li> </ol>	
	Engine OFF •	No	3. Open in power circuit of DPS
	EGR Off •	No	4. Defected DPS
raii Safe	Torque Limit •	No	
	MIL •	Off	

#### Vehicle Data

DPF DPS		Terminal		Inspection Condition	Measured Value	Remarks
Pin No.	1	DPS Power	•	Ignition switch "ON" & Engine "OFF" Voltage is measured on wiring side( Disconnected)	Approx. 5V	-
	2	DPS Signal			Approx. 5.6V	-
	3	DPS Ground			0 V	-
DPF	DPS	Terminal		Inspection Condition	Measured Value	Remarks
DPF	DPS	Terminal DPS Power	•	Inspection Condition	Measured Value Approx. 5V	Remarks
DPF Pin No.	DPS 1 2	Terminal DPS Power DPS Signal	•	Inspection Condition Ignition switch "ON" & Engine "OFF" Voltage is measured on wiring side(	Measured Value Approx. 5V Approx. 1.0V	Remarks -

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P047200	CPF Differential Pressure Sensor "A" Circuit Low Input	

CRC12EN5010P04720021S

- 4. Is DTC status displayed as Present?
  - Go to "Monitor GDS Data" procedure.
  - ► Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

	Search	1 II & E
et Min.Max Record	Stop ‡ Gro	uping VSS
Value	Unit	ana ana ana amin'ny saratra amin'ny saratra amin'ny saratra amin'ny saratra amin'ny saratra amin'ny saratra ami
3.529	hPa	
1.02	V	
789.0	RPM	
NO	-	
NO	-	
YES	<u> </u>	
NO		
NO	<u> </u>	
NO		
	et Min.Max Record Value 3.529 1.02 789.0 NO NO YES NO NO NO	Search         Image: Search         Image: Search         Image: Search         Image: Search         Growth           et Min.Max         Record         Stop \$         Growth         Gro

Fig.1

#### CRC12EN5010P04710022S

Current Data		Search 🚉	
Selective Display \$ Full List \$ Graph \$ Items List \$ Rese	t Min.Max Record	Stop 🗘 Group	ing VSS
Sensor Name	Value	Unit	ana
Differential Pressure at Particle Filter	89.804	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.31	V	
Engine Speed	4932.5	RPM	
E Flag Status of Battery Function to Crank the Eng	NO		4
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS)	NO	-	
Fig. 2			

#### Fig.2

Fig.1) DPS current data under engine idle

 $\times$  Displayed value may different in according to actual vehicle condition

#### CRC12EN5010P04710023S

Fig.2) DPS current data under engine speed approx. 5,000RPM

 $\times$  Displayed value may different in according to actual vehicle condition

#### Specification : Refer to figure below

## **General Information**

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2 connector.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

Specification : Approx. 5.0V

5. Is the measured value within specification?



YES 
Go to "Ground Clrcuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect DPS connector.
- Measure the resistance between ground terminal of 4.

DPS harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect DPS connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of DPS 8. harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?

- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of DPS 4. harness connector and chassis ground.

#### Specification : Approx. 5.6V

- 5. Is the measured value within specification?
  - YES 
    Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Visual Inspection on DPF Differential Pressure Sensor

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Inspect for corrosion or contamination on DPS 3. terminal.
- Inspect for proper installation of DPS, DPS hose and 4. leakage on exhaust system.
- Inspect for foreign substance on DPS and DPF 5.

assembly.

- 6. Inspect for Leakage on exhaust system.
- 7. Have any problems been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "CPF Service Regeneration" procedure.

#### CPF Service Regeneration

- Ignition switch "OFF" 1.
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 3.
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

<b>E *</b>			Special I	Function		ra 🖸 🖓	L î
		Injector	Specific D	ata			Ô
		Essentia	l work afte	er compon	ent repl	acement	:
	0	Engine <sup>-</sup>	Test Functi	ion			
	0	Fuel line	e air remov	al			
	0	DPF Ser	vice Regen	eration			
Favorit	e						
Fig.1							

Fig.1) Vehicle S/W Management list of Engine

#### **A**CAUTION

DPF service regeneration MUST be performed ٠ outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor,

#### CRC12EN5010P04720041S

fire or burn injury may occur from the high exhaust gas temperature.

- Does the result of the function normal?
  - YES 

     This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- 1. Ignition switch "OFF"
- Connect VMI to GDS and set up the Oscilloscope.(2) Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO
- Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### 

When DPS is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

GI-421



CRC12EN5010P01010041S

# **General Information**

<b>E</b> 4	Essentia	l work after co	omponent repla	acement	•
[ Essential Work after Component Replacement ]					
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) Differential Pressure Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## GI-423

## **General Information**

## P047300 CPF/DPF Differential Pressure Sensor "A" Circuit High Input

#### **Component Location**



#### 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

#### **DTC Description**

If the DPS output signal is higher than minimum threshold value, ECM sets DTC P047300.

CRC12EN5010P04710011

Approx. 1.0V

0 V

-

\_

#### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>DPS output signal is alue(500 hPa)</li> </ul>	s higher than maximum threshold v-	1. Poor connector connection
Diagnostic Time	• -		of DPS
	Engine OFF	• No	3. Open in ground circuit of DPS
	EGR Off	• No	4. Defected DPS
Fall Sale	Torque Limit	• No	
	MIL	• Blink	

#### Vehicle Data

DPS	Terminal	Inspection Condition		Measured Value	Remarks
1	DPS Power		lanition switch "ON" & Engine "OFF"	Approx. 5V	-
2	DPS Signal	al • Voltage is measured on wiring side(		Approx. 5.6V	-
3	DPS Ground		Disconnected)	0 V	-
DPS	Terminal		Inspection Condition	Measured Value	Remarks
1	DPS Power		Ignition switch "ON" & Engine "OFF"	Approx. 5V	-
	DPS 1 2 3 DPS 1 1	DPSTerminal1DPS Power2DPS Signal3DPS GroundDPSTerminal1DPS Power	DPSTerminal1DPS Power2DPS Signal3DPS GroundDPSTerminal1DPS Power	DPSTerminalInspection Condition1DPS PowerIgnition switch "ON" & Engine "OFF"2DPS SignalVoltage is measured on wiring side( Disconnected)3DPS GroundInspection ConditionDPSTerminalInspection Condition1DPS PowerIgnition switch "ON" & Engine "OFF"	DPSTerminalInspection ConditionMeasured Value1DPS PowerIgnition switch "ON" & Engine "OFF"Approx. 5V2DPS SignalVoltage is measured on wiring side( Disconnected)Approx. 5.6V3DPS GroundInspection Condition0 VDPSTerminalInspection ConditionMeasured Value1DPS PowerIgnition switch "ON" & Engine "OFF"Approx. 5V

Connected)

Voltage is measured on wiring side(

## Monitor DTC Status

2

3

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

Pin No.

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DPS Signal

DPS Ground

•

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P047300	CPF/DPF Differential Pressure Sensor "A" Circuit High Input	

**GI-426** 

## **General Information**

CRC12EN5010P04730021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🕰 月	) <i>a</i> e
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	t Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	and the second second
Differential Pressure at Particle Filter	3.529	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.02	V	
Engine Speed	789.0	RPM	
E Flag Status of Battery Function to Crank the Eng	NO	-	>
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES		
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-2	
AMS Stop Reason - Wiper(AMS)	NO		

Fig.1

CRC12EN5010P04710022S

Current Data		Search 🕄 🚛	
Selective Display ≎	t Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	t in
Differential Pressure at Particle Filter	89.804	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.31	V	
Engine Speed	4932.5	RPM	
Flag Status of Battery Function to Crank the Eng	NO		4
Flag Status of Quiescent Current(AMS)	NO		
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS)	NO		
Fig. 0			

Fig.2

CRC12EN5010P04710023S

Fig.1) DPS current data under engine idle ※ Displayed value may different in according to actual vehicle condition

# GI-427

Fig.2) DPS current data under engine speed approx. 5.000RPM

X Displayed value may different in according to actual vehicle condition

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - NO Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

#### Specification : Approx. 5.0V

- 5. Is the measured value within specification?

YES 
Go to "Ground Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

1. Ignition switch "OFF"

- Disconnect battery (-) cable. 2.
- 3. Refer to "Shop Manual" and disconnect DPS connector.
- Measure the resistance between ground terminal of 4 DPS harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect DPS 6. connector.
- Ignition switch "ON" 7.
- Measure the voltage between power terminal of DPS 8 harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between signal terminal of DPS harness connector and chassis ground.

Specification : Approx. 5.6V

5. Is the measured value within specification?



- Go to "Component Inspection" procedure.
- NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Visual Inspection on DPF Differential Pressure Sensor

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Inspect for corrosion or contamination on DPS

# **General Information**

terminal.

- 4. Inspect for proper installation of DPS, DPS hose and leakage on exhaust system.
- 5. Inspect for foreign substance on DPS and DPF assembly.
- 6. Inspect for Leakage on exhaust system.
- 7. Have any problems been found?
  - YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - NO Go to "CPF Service Regeneration" procedure.
- CPF Service Regeneration
- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

<b>F</b>	Special Function	🤹 🖭 主 🕥
	Injector Specific Data	Ô
C	Essential work after component repla	acement
O	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	
Favorite		
Fig.1		

CRC12EN5010P04720041S

General

Fig.1) Vehicle S/W Management list of Engine

#### 

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?

YES 

 This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- Ignition switch "OFF" 1.
- Connect VMI to GDS and set up the Oscilloscope.(2 2. Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- Inspection condition : Ignition switch "ON" 4.

Specification : Approx. 1.0V

5. Is the measured value within specification?

NO Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### 

When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- Connect GDS to Data Link Connector(DLC). 2.
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

# **General Information**



CRC12EN5010P01010041S

<b>B 4</b>	Essentia	l work after co	omponent repla	acement	•
[ ====					
Essential work after component Replacement j					
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## **General Information**

🖅 🐟	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU CA	NCEL

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) Differential Pressure Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

- **YES** Go to the applicable troubleshooting procedure.
- NO 

   Problem is corrected and the system operation performs to specification at this time.
## P048900 Exhaust Gas Recirculation Control Circuit Low

#### **Component Location**



## 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

#### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

#### **DTC Description**

If short to ground in motor circuit is detected for more than 1 sec., ECM sets DTC P048900.

#### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Short to ground in r	notor circuit of E-EGR actuator	1 Dear connector connection
Diagnostic Time	• 1 sec		2. Short to ground in motor circuit
	Engine OFF	• No	of E-EGR actuator
	EGR Off	• Yes	3. Defected E-EGR actuator
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

CRC12EN5010P040111

## **General Information**

#### Vehicle Data

Electronic EGR Actuator		Terminal Inspection Condition		Measured Value	Remarks
	1	EGR Actuator motor(+)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	B+	Signal Wavefor- m (Fig. 1)
Pin No.	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
	4	EGR Actuator Feedback Sig- nal	<ul> <li>Voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-



#### CRC12EN5010P04010011S

	Oscillos	scope						
	Sensor	Theme	Name	Review	User Setting	A		4 1s
	Reset	Start 🗘	Cursor	ViewAll	Save			M
	+20∨		Motor -	Hz : 0	).3 Hz	Duty- : 70 %	Duty+: 30	× □[]][]
Con	-							
figura								
ation	-							
	-5							. В
Fig	<b>j.2</b>							

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

#### Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P048900	Exhaust Gas Recirculation Control Circuit Low	

#### CRC12EN5010P04890021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.

  - NO Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🔍 💵	
Selective Display C Full List C Graph Illems List Reset	Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	ĺ.
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
C Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	-
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		
Fig.1			

CRC12EN5010P04010022S

## **General Information**

Current Data		Search	<b>1</b>	<b>2</b>
Selective Display \$ Full List \$ Graph \$ Items List \$ Rese	I Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
EGR Actuator	-11.4	%		
Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub		
Air Mass per Cylinder	800	mg/hub		
Engine Speed	4931.0	RPM		
Accelerator Pedal Position Sensor	100	%		a Van
Pressure Control Valve(Rail)	35	%		E
Barometric Pressure Sensor	1002	hPa		1
Clutch Switch (M/T only)	ON			
A/C ON Signal Switch	ON	-		

Fig.2

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

- 5. Is the parameter dispalyed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR

CRC12EN5010P04010023S

- Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4. E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness

connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO

Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR 2. Actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis ground.

#### Specification : Approx. 4.8V

5. Is the measured value within specification?

YES 
Go to "E-EGR Actuator Motor Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### E-EGR Actuator Motor Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. E-EGR Actuator harness connector and chassis ground.

#### Specification : B+

6. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### E-EGR Actuator Coil Resistance Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3 Actuator connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of E-EGR Actuator.

Specification : Approx. 2.16 ~ 2.64Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Go to "EGR Actuator Inspection" procedure.
    - NO
      - Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

📼 < 🗛	ation	Test		🖸 🕇 🐔
Test Items		Duration	Lintil Chan Putton	
Boost Pressure Actuator 5%	\$	· Duration	Until Stop Button	
Boost Pressure Actuator 95%		Condition	IG. ON, ENG OFF, 'I DTC	P' RANGE, NO
EGR Valve 10%		· Result	Operation Comman	d Sent
EGR Valve 90%	¥			
Data	a Analy	ysis		
100.0 EGR. Actuator Control Duty			Max : 11.4	x
~~~~~~~				-0.4 %
				_
-100.0			Min : -0.4	æ
Start Stop				Function
Fig.1				

CRC12EN5010P04010041S

E *	Actuation Test	🗆 🥵 🕑 主 🏠
Test Items	Duration	Lintil Stan Buttan
Boost Pressure Actuator 5%		
Boost Pressure Actuator 95%	· Condition	IG. ON, ENG OFF, 'P' RANGE, NO DTC
EGR Valve 10%	· Result	Operation Command Sent
EGR Valve 90%	₹	
	Data Analysis	
100.0 EGR Actuator Control Duty		Max : 31.0
/		-0.4 %
-100.0		Min : -0.4
Start Stop		Function
Fig.2		

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

#### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

CRC12EN5010P04010042S

#### 

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

## **General Information**



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<b>F *</b>	Essentia	work after co	omponent repla	acement	
[ Frankis   W		t Daula como at 1			
Essential W	ork after Componen	t Replacement J			
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## GI-441

## **General Information**

🖅 🐳	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU CA	NCEL

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

## P049000 Exhaust Gas Recirculation Control Circuit High

#### **Component Location**



## 1. Electronic Exhaust Gas Recirculation (E-EGR) Actuator

#### **General Description**

The Electric EGR Control Valve is installed in between the EGR cooler and the exhaust line and is a solenoid valve. This valve controls EGR (Exhaust Gas Recirculation) amount by the ECM's duty control signal depending on engine load and the need of intake air.

The Exhaust Gas Recirculation (EGR) system is used to add the exhaust gas to intake air in order to reduce an excess of air and the temperature in the combustion chamber.

#### **DTC Description**

If shorted wiring or short to power in motor circuit of E-EGR actuator is detected, ECM sets DTC P049000.

#### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Short to ground in r	notor circuit of E-EGR actuator	1. Poor connector connection
Diagnostic Time	• 1 sec		2. Shorted wiring or short to pow-
	Engine OFF	• No	ctuator
	EGR Off	• Yes	3. Defected E-EGR actuator
Fail Sale	Torque Limit	• Yes	
	MIL	• On	

CRC12EN5010P040111

## **General Information**

#### Vehicle Data

Electronic EGR Actuator		Terminal Inspection Condition		Measured Value	Remarks
	1	EGR Actuator motor(+)	<ul> <li>Ignition switch "ON" &amp; E- ngine "OFF"</li> </ul>	B+	Signal Wavefor- m (Fig. 1)
Pin No.	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Wavefor- m (Fig. 2)
	4	EGR Actuator Feedback Sig- nal	<ul> <li>Voltage is measured on wiring side(Disconnected )</li> </ul>	Approx. 4. 8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-



#### CRC12EN5010P04010011S

	Oscillos	соре						
	Sensor	Theme	Name	Review	User Setting	A	14.48 s      ▶B	1s 🕨
	Reset	Start 🗘	Cursor	ViewAll	Save	ŀ		
	+20∨ -	1 1	Motor -	Hz : 0	).3 Hz	Duty- : 70 %	Duty+: 30 %	
Configurat								
tion	-51							
Fig	1.2							

CRC12EN5010P04010012S

Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

Fig.2) Pull-up voltage value of motor(-) (Duty value = Approx. 70%)

#### Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P049000	Exhaust Gas Recirculation Control Circuit High	

#### CRC12EN5010P04900021S

- 4. Is DTC status displayed as Present?
  - YES Go to "Monitor GDS Data" procedure.

  - NO Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect Data Link Connector(DLC) to GDS.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🔍 💵	
Selective Display C Full List C Graph Illems List Reset	Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	ĺ.
EGR Actuator	-11.4	%	
Control Deviation of the Exhaust-Gas Recirculati	0	mg/hub	
Air Mass per Cylinder	482	mg/hub	
Engine Speed	787.5	RPM	
C Accelerator Pedal Position Sensor	0	%	
Pressure Control Valve(Rail)	31	%	-
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON		
Fig.1			

CRC12EN5010P04010022S

## **General Information**

Current Data		Search		<b>a</b> =
Selective Display  Full List  Graph  Ilems List  Resel	Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		in the second
EGR Actuator	-11.4	%		
Control Deviation of the Exhaust-Gas Recirculati	39	mg/hub		
Air Mass per Cylinder	800	mg/hub		
Engine Speed	4931.0	RPM		
Accelerator Pedal Position Sensor	100	%		a Na
Pressure Control Valve(Rail)	35	%		E
Barometric Pressure Sensor	1002	hPa		1
Clutch Switch (M/T only)	ON			
A/C ON Signal Switch	ON	-		

Fig.2

Fig.1) EGR Actuator & Air flow rate current data under engine idle.

Fig.2) EGR Actuator & Air flow rate current data under engine speed approx. 5,000RPM.

- 5. Is the parameter dispalyed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR

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- Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. 5.0V

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Clrcuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3. Actuator connector.
- Measure the resistance between ground terminal of 4. E-EGR Actuator harness connector and chassis ground.

**Specification** : Approx. below  $1\Omega$ 

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of E-EGR Actuator harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of E-EGR Actuator harness

connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO

Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect E-EGR 2. Actuator connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of 4. E-EGR Actuator harness connector and chassis ground.

#### Specification : Approx. 4.8V

5. Is the measured value within specification?

YES 
Go to "E-EGR Actuator Motor Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### E-EGR Actuator Motor Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of E-EGR Actuator harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. E-EGR Actuator harness connector and chassis ground.

#### Specification : B+

6. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### E-EGR Actuator Coil Resistance Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect E-EGR 3 Actuator connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of E-EGR Actuator.

Specification : Approx. 2.16 ~ 2.64Ω (20°C/68°F)

- 5. Is the measured value within specification?
  - YES Go to "EGR Actuator Inspection" procedure.
    - NO
      - Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

#### 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### EGR Actuator Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Perform "EGR Valve Position" in "Actuation Test" with GDS.

📼 < Actu	ation	Test		
Test Items		Duration	Until Stop Buttop	
Boost Pressure Actuator 5%	\$	· Duration		
Boost Pressure Actuator 95%		Condition	IG. ON, ENG OFF, 'P' R. DTC	ANGE, NO
EGR Valve 10%	-	· Result	Operation Command Se	nt
EGR Valve 90%	Ŧ			
Data	a Anal	ysis		
100.0 EGR. Actuator Control Duty			Max : 11.4	×
			-0.4	%
100.0			Min : -0.4	æ
Start Stop				Function
Fig.1				

CRC12EN5010P04010041S

<b>F</b>	Actuation	Test		🖸 🕇 🐔
Test Ite	ms	Duration	Lintil Stop Putton	
Boost Pressure Actuator 5%	\$	·Duration	unui stop button	
Boost Pressure Actuator 95%	<b>^</b>	Condition	IG. ON, ENG OFF, DTC	'P' RANGE, NO
EGR Valve 10%		· Result	Operation Comman	nd Sent
EGR Valve 90%	¥			
	Data Ana	lysis		
100.0 EGR Actuator Control D	uty		Max : 31.0	×
				-0.4 %
-100.0			Min : -0.4	æ
Start Stop				Function
Fig.2				

Fig.1) EGR Valve Actuation Test (10%)

Fig.2) EGR Valve Actuation Test (90%)

- 5. Is the parameter dispalyed within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

 If no problems were found with the circuits or connectors, replace the E-EGR Actuator and go to "Verification of Vehicle Repair" procedure

#### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

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#### 

 When EEGR is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "EGR Valve Change"

## **General Information**



CRC12EN5010P01010041S

🖅 📢	Essentia	work after co	omponent repla	acement			
[ Essential Work after Component Replacement ]							
If you're rea	dy, select the menu	l.					
MENU	CANCEL						
Fig.2							

CRC12EN5010P01010042S

## **General Information**

🖾 🔸	Essential work after component replacement
[ Essential Work afte	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig 3	

CRC12EN5010P01010043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) EGR Valve Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P056200 System Voltage Low

#### **Component Location**



CRC12EN5010P05620011



CRC12EN5010P006912

#### 1. Alternator

#### 2. Engine Control Module (ECM)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

#### **DTC Description**

If low battery voltage is detected for more than 2 sec., ECM sets DTC P056200. This fault might be caused by defected battery or faulty power circuit.

#### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Low battery voltage	is detected	1. Poor connector connection
Diagnostic Time	• 2 sec		2. Defected charging system
	Engine OFF	• No	4. Defected battery
	EGR Off	• No	5. Defected ECM
Fall Sale	Torque Limit	• No	
	MIL	• Off	

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P056200	System Voltage Low	

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4. Is DTC status displayed as Present?



- YES 
  Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

# **GI-45**

Current Data		Search 😰 🗐	a) e
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop   Grouping V	'SS
Sensor Name	Value	Unit	1
Battery Voltage	14.1	V	
Ignition Switch	ON		
Engine Status	Running	<u> </u>	
Z Engine Speed	805.0	RPM	
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS)	NO	-	

Fig.1

Fig.1) battery voltage current data under engine idle.

- 5. Is the parameter dispalyed within specification?
- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect ECM connector.
- Ignition switch "ON" 3.
- Measure the voltage between power terminal of ECM 4.

CRC12EN5010P05620022S

harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
- YES 
  Go to "Ground Clrcuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Ground Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3 connector.
- Measure the resistance between ground terminal of 4. ECM harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

5. Is the measured value within specification?



- YES 
  Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Battery Voltage Inspection

- 1. If time after engine "OFF" is not past 20 minutes, to remove remained current, turn the ignition switch to "ON" and turn on the electronic devices (Head lamp, blower motor, rear defogger, etc.).
- 2. Turn off the electronic devices and ignition switch.

# **General Information**

3. Measure the voltage between (+) terminal and (-) terminal of battery.

Specification : Approx. 12.5 ~ 12.9V(20°C/68°F)

4. Is the measured value within specification?



YES 
Go to "General Inspection" procedure.

Refer to "Shop Manual" and re-charge the NO battery and then go to "Verification of Vehicle Repair" procedure.

#### General Inspection

- 1. Battery termina and fuse
  - Loose or corrosion on battery terminal cable
  - Testing continuity of fuse.
- 2. Drive belt Inspection
  - Inspect for tear and abrasion
- 3. Adjust tension of the belt. (Refer to "Shop Manual")
- 4. Alternator noise and wiring harness inspection
  - Inspect for condition of wiring harness of alternator
  - Check for abnormal noise on alternator under engine operation
- 5. Have any problems been found?



NO • Go to "Charging Voltage Inspection" procedure.

#### Charging Voltage Inspection

- Ignition switch "ON" & Engine "ON" 1.
- Turn on the all the electronic devices "ON". 2.
- 3. Maintain engine speed at approx. 2,500RPM.
- 4. Measure the voltage between (+) terminal and (-) terminal of battery.

#### Specification : Approx. 13.5 ~ 14.5V

- 5. Is the measured value within specification?
  - Carefully re-do this troubleshooting guide st-YES eps.

If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Alternator and go to "Verification of Vehicle Repair" procedure.

#### 

- After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS
- In the case the vehicle is equipped with perform "KEY immobilizer or smart key, TEACHING" procedure together (Refer to "Immobilizer" or "Smart key system" in BE group)

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- "Essential 4. Perform Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

GI-457



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement	
[ Eccential W	ork ofter Compense	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## Essential work after component replacement 🗲 🔹 [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) ECU Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## **GI-459**

## P056300 System Voltage High

#### **Component Location**



CRC12EN5010P05620011



CRC12EN5010P006912

#### 1. Alternator

#### 2. Engine Control Module (ECM)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

#### **DTC Description**

If high battery voltage is detected for more than 2 sec., ECM sets DTC P056300. This fault might be caused by faulty charging system.

#### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Voltage monitoring		<ol> <li>Poor connector connection</li> <li>Faulty charging system</li> </ol>
Enable Conditions	Engine running		
Threshold Value	High battery voltage is detected		
Diagnostic Time	• 2 sec		
	Engine OFF	• No	3. Defected alternator
Fail Safe	EGR Off	• No	4. Defected ECM
	Torque Limit	• No	
	MIL	• Off	

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P056300	System Voltage Hi	gh			

CRC12EN5010P05630021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

## **General Information**

Current Data		Search 🖭 💷 🕋	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Res	et Min.Max Record	Stop 2 Grouping VSS	
Sensor Name	Value	Unit	
Battery Voltage	14.1	V	
Ignition Switch	ON		
Engine Status	Running	-	
Engine Speed	805.0	RPM	
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES		Ш
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO		
AMS Stop Reason - Wiper(AMS)	NO	-	

Fig.1

Fig.1) battery voltage current data under engine idle.

- 5. Is the parameter dispalyed within specification?
- YES 

   Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



NO • Go to "Power Circuit Inspection" procedure.

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECM connector.
- Ignition switch "ON" 3.
- 4. Measure the voltage between power terminal of ECM

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harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- Measure the resistance between ground terminal of 4. ECM harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

- 5. Is the measured value within specification?

  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

#### Charging Voltage Inspection

- 1. Ignition switch "ON" & Engine "ON"
- 2. Turn on the all the electronic devices "ON".
- 3. Maintain engine speed at approx. 2,500RPM.
- 4. Measure the voltage between (+) terminal and (-) terminal of battery.

#### Specification : Approx. 13.5 ~ 14.5V

5. Is the measured value within specification?



YES 
Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the Alternator and go to "Verification of Vehicle Repair" procedure.

#### 

- After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS
- In the case the vehicle is equipped with • immobilizer or smart key, perform "KEY TEACHING" procedure together (Refer to "Immobilizer" or "Smart key system" in BE group)

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- "Essential 4. Perform Work After Component Replacement" in "Vehicle Software Management" with GDS.
- Select "ECU Change" 5.

## **General Information**



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# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

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## GI-465

## **General Information**

🖾 🔸	Essential work after component replacement
[ Essential Work afte	MENU
MENU C	ANCEL
Fig 3	

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

## P060500 Internal Control Module Read Only Memory(ROM) Error

#### **Component Location**



1. Engine Control Module (ECM)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

#### **DTC Description**

P060500 is set when communication error between micro controller inside of ECM and EEPROM is detected or a different vision of ECM is installed.

#### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Internal monitoring		<ol> <li>Poor connector connection</li> <li>Defected ECM</li> </ol>
Enable Conditions	Engine running		
Threshold Value	<ul> <li>ECU Reset</li> <li>Faulty internal circuit of ECU</li> <li>EEPROM error</li> <li>Communication failure between micro controller inside of ECM and EEPROM</li> </ul>		
Diagnostic Time	• -		
	Engine OFF	• No	
Fail Safe	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

CRC12EN5010P02190011

#### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P060500	Internal Control Module Read Only Memory(ROM) Error	

CRC12EN5010P06050021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

#### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 😰 🗐 🕋 🗄
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Battery Voltage	14.1	V
Ignition Switch	ON	
Engine Status	Running	-
I Engine Speed	805.0	RPM
Flag Status of Quiescent Current(AMS)	NO	-
Invalid Condition of Battery Sensor(AMS)	YES	-
Response Error Flag from Battery Sensor(AMS)	NO	-
AMS Stop Reason - Head Lamp(AMS)	NO	-
AMS Stop Reason - Wiper(AMS)	NO	-
Fig.1		
GI-469

CRC12EN5010P05620022S

Fig.1) battery voltage current data under engine idle.

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

► Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2 Refer to "Shop Manual" and disconnect ECM connector.
- Ignition switch "ON" 3.
- Measure the voltage between power terminal of ECM 4. harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3.

connector.

4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

5. Is the measured value within specification?



YES • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" 3.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 4.
- Clear any DTCs stored in the system with GDS. 5.
- Re-check DTC in the system with GDS. 6.
- 7. Did the same DTC is stored in the system?
  - YES Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

Fault is intermittent caused by poor contact NO in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### 

- After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS
- In the case the vehicle is equipped with immobilizer or smart key, perform "KEY TEACHING" procedure together (Refer to "Immobilizer" or "Smart key system" in BE group)

#### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"

- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

<b>F</b>	Special Function	📣 🖭 🕇	
	Injector Specific Data		Ô
O	Essential work after component rep	lacement	
O	Engine Test Function		
	Fuel line air removal		
	DPF Service Regeneration		v
Favorite			

Fig.1

CRC12EN5010P01010041S

🖅 📢	Essentia	work after co	omponent repla	acement	
Essential W	ork after Componen	t Replacement J			
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### **General Information**

<b>E *</b>	Essential work after component replacement
[ Essential Work afte	MENU  Fesential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCE
MENU C	ANCEL
Fig.3	

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

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### P060600 ECM/PCM Processor

### **Component Location**



CRC12EN5010P02190011

### 1. Engine Control Module (ECM)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

#### **DTC Description**

If defected ECU itself is detected, ECM sets DTC P060600.

#### **DTC Detecting Condition**

Item	Dete	Possible Cause	
DTC Strategy	Internal monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul><li>ECU Internal analog</li><li>Hardware error</li></ul>	g digital converter of ECU error	
Diagnostic Time	• -		1. Poor connector connection
	Engine OFF	• No	Z. Delected EGM
Fail Safe	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

### **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P060600	ECM/PCM Processor	

CRC12EN5010P06060021S

#### 4. Is DTC status displayed as Present?



YES 
Go to "Monitor GDS Data" procedure.

NO 
 Go to "Verification of Vehicle Repair" procedure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search 🗨	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 🤇 Res	et Min.Max Record	Stop 😂 Grou	ping VSS
Sensor Name	Value	Unit	1
Battery Voltage	14.1	V	
Ignition Switch	ON	1.7 m	
🗹 Engine Status	Running	<u>-</u>	
Engine Speed	805.0	RPM	
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO		
AMS Stop Reason - Wiper(AMS)	NO	-	

Fig.1

Fig.1) battery voltage current data under engine idle.

5. Is the parameter dispalyed within specification?



Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P05620022S



**NO** • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 
• Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect ECM 2 connector.
- 3. Ignition switch "ON"
- Measure the voltage between power terminal of ECM 4. harness connector and chassis ground.

### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Ground Clrcuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- 3. Refer to "Shop Manual" and disconnect ECM connector.
- Measure the resistance between ground terminal of 4. ECM harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

5. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- 5. Clear any DTCs stored in the system with GDS.
- 6. Re-check DTC in the system with GDS.
- 7. Did the same DTC is stored in the system?
- Carefully re-do this troubleshooting guide st-YES eps.

If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

Fault is intermittent caused by poor contact NO in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### 

- After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS
- In the case the vehicle is equipped with perform "KEY immobilizer or smart key, TEACHING" procedure together (Refer to "Immobilizer" or "Smart key system" in BE group)

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

### **General Information**



CRC12EN5010P01010041S

🖅 🔹	Essentia	work after co	mponent repla	acement	
Essential W	ork after Componen	t Replacement J			
If you're rea	dy, select the menu	I.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### **General Information**

<b>E *</b>	Essential work after component replacement
[ Essential Work afte	MENU  Fesential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCE
MENU C	ANCEL
Fig.3	

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

### P061600 Starter Relay Circuit Low

### **Component Location**



1. Starter Relay

#### **General Description**

In normal vehicle condition, voltage and current is not supplied to starter motor after engine "ON". If voltage and current is supplied to starter motor after engine is operating, it can cause damage on starter motor and flywheel. To prevent these damages, ECM monitors current that supplied to starter motor and protect the system.

### **DTC Description**

If low signal is detected on starter relay control circuit during engine cranking, ECM sets DTC P061600.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	Short to ground in control circuit		
Diagnostic Time	• 2 sec		1. Short to ground in control circ-
	Engine OFF	• No	2. Defected ECM
	EGR Off	• No	
Fail Sale	Torque Limit	• No	
	MIL	• Off	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

CRC12EN5010P06160011

# **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P061600	Starter Relay Circuit Low	

#### 4. Is DTC status displayed as Present?



YES 
Go to "Monitor GDS Data" procedure.

NO 
 Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove starter relay.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of starter relay harness connector and chassis ground.

Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove starter relay.
- 3. Ignition switch "ON"
- Measure the voltage between starter relay control 4. high terminal of starter relay harness connector and chassis ground.

#### Specification : Approx. 3.4V

Measure the voltage between starter relay control low 5. terminal of starter relay harness connector and chassis ground.

#### Specification : Approx. 2.5V

- Refer to "Shop Manual" and disconnect ECM 6. connector.
- 7. Measure the resistance between starter relay control high terminal of starter relay harness connector and starter relay control high terminal of ECM harness connector.
- 8. Measure the resistance between starter relay control low terminal of starter relay harness connector and starter relay control low terminal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

9. Is the measured value within specification?

```
YES • Go to "Component Inspection" procedure.
```

CRC12EN5010P06160021S

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition Switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove the starter relay. 3.
- Measure resistance between relay control low and 4. relay control high terminal of the starter relay.

#### Specification : Approx. 90 Ω

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the Starter Relay and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.

Problem is corrected and the system operat-NO ion performs to specification at this time.

### P061700 Starter Cut Relay Circuit High

### **Component Location**



#### 1. Starter Relay

#### **General Description**

In normal vehicle condition, voltage and current is not supplied to starter motor after engine "ON". If voltage and current is supplied to starter motor after engine is operating, it can cause damage on starter motor and flywheel. To prevent these damages, ECM monitors current that supplied to starter motor and protect the system.

### **DTC Description**

If high signal is detected on starter relay control circuit, ECM sets DTC P061700.

### **DTC Detecting Condition**

Item	Det	Possible Cause			
DTC Strategy	Signal monitoring		Signal monitoring		
Enable Conditions	Engine running				
Threshold Value	Open or short in control circuit of starter relay				
Diagnostic Time	• 2 sec		1. Open or short in control circuit		
	Engine OFF	• No	2. Defected starter relay		
Fail Safe	EGR Off	• No			
	Torque Limit	• No	]		
	MIL	• Off			

### **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

CRC12EN5010P06160011

DIC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P061700	Starter Cut Relay (	Circuit High			

#### 4. Is DTC status displayed as Present?

- YES 
  Go to "Monitor GDS Data" procedure.
  - ► Go to "Verification of Vehicle Repair" proce-NO dure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1 caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found? 3.



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove starter relay.
- Ignition switch "ON" 3.
- 4. Measure the voltage between starter relay control high terminal of starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

Measure the voltage between starter relay control low 5. terminal of starter relay harness connector and chassis ground.

#### Specification : Approx. 2.5V

- Is the measured value within specification? 6.
  - YES
- Go to "Component Inspection" procedure.

CRC12EN5010P06170021S

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove the starter relay. 3.
- Measure resistance between relay control low and 4 relay control high terminal of the starter relay.

#### Specification : Approx. 90 $\Omega$

- 5. Is the measured value within specification?
  - Fault is intermittent caused by poor contact YES in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Starter Relay and go to "Verification of Vehicle Repair" procedure.

NO

# **General Information**

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO • Problem is corrected and the system operation performs to specification at this time.

### GI-485

### P062D00 Fuel Injector Driver Circuit Performance (Bank 1)

### **Component Location**



CRC12EN5010P020111



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4
- 5. Engine Control Module (ECM)

### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

### **DTC Description**

If one of injector circuit has error or unable to recognize

CRC12EN5010P062D12

the cylinders, ECM sets DTC P062D00.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Short in injector circ	cuit	
Diagnostic Time	• -		1. Poor connector connection
Fail Safe	Engine OFF	• Yes	3. Defected ECM
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Inje	ector	Terminal	Inspection Condition		Measured Value	Remarks
Din No.	1	Injector Control(High)	•	Ignition switch "ON" & Engine "OFF"	Approx. 5 V	-
	2	2 Injector Control(Low)	(Disconnected)	0V	-	
Inje	ector	Terminal		Inspection Condition	Measured Value	Remarks
Inje	ector 1	Terminal Injector Control(High)	•	Inspection Condition	Measured Value Approx. 5. 0V	Remarks

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P062D00	Fuel Injector Driver Circuit Performance (Bank 1)	

CRC12EN5010P062D0021S

- 4. Is DTC status displayed as Present?

YES 
Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

### Injector Signal Waveform & Operating Current Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : injector control low terminal (Injector Harness Connector)

Channel A (-) : Ground

Channel A (+) : Injector control high terminal (Injector Harness Connector)

Channel A (-) : Ground

Aux : Measure the current on "Injector Control Low" wire with low current sensor

- 3. Ignition switch "ON" & Engine "ON"
- Inspection condition : Engine "ON" & Engine speed 4. Approx. 3,000RPM

Specification : Refer to figure below

# **General Information**



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Fig.1) Injector control low/high signal waveform and current under engine idle. (2 Pilot injection, 1 main injection)

Fig.2) Injector control low/high signal waveform and current under engine speed approx. 3,000RPM. (2 Pilot injection, 1 main injection and 1 post injection)

5. Is the measured value within specification?





► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can

#### CRC12EN5010P02010012S

also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?
  - **YES** Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
  - NO Go to "Control Circuit Inspection" procedure

#### **Control Circuit Inspection**

#### Injector Control High Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect injector #1, #4 connector.
- 3. Ignition switch "ON"
- Measure the voltage between Injector control high terminal of injector #1, #4 harness connector and chassis ground.

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# **General Information**

#### Specification : Approx. 5V

- 5. Ignition switch "OFF"
- Re-connect injector #1, #4 connector.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Injector control high terminal (Injector Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition " Ignition switch "ON" & Engine 9. "OFF"

#### Specification : Approx. 5V

10. Is the measured value within specification?



YES 
Go to "Injector Control Low Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

#### Injector Control Low Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect injector #1, #4 connector.
- Ignition Switch "ON" 3.
- 4. Measure the voltage between injector control low terminal of injector #1, #4 harness connector and chassis ground.

#### Specification :0V

- 5. Ignition switch "OFF"
- Re-connect injector #1, #4 connector. 6.
- 7. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : injector control low terminal (Injector Harness Connector)

Channel A (-) : Ground

- 8. Ignition switch "ON"
- Inspection condition : Ignition switch "ON" & Engine 9. "OFF"

Specification : Appox. 5V

10. Is the measured value within specification?

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits ► or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

### A CAUTION

After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

GI-491



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essentia	l work after co	omponent repl	acement	
[ Eccential W/		t Danlagement 1			
	ork after Componen	t Replacement j			
If you're rea	dy, select the menu	I.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### Essential work after component replacement 🗲 🔹 [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) ECU Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### GI-493

### **General Information**

### P064300 Sensor Reference Voltage "A" Circuit High

### **Component Location**



1. Engine Control Module (ECM)

#### **General Description**

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted signals with control LOGIC saved at micro controller and EEPROM, ECM controls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurs, ECM sets DTCs. At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

### **DTC Description**

If faulty sensor "A" supply voltage is detected for more than 0.1 sec., ECM sets DTC P064300. This fault might be caused by short to power/ground in sensor supply "A" circuit or internal error of ECM. CRC12EN5010P02190011

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Faulty sensor "A" supply voltage		
Diagnostic Time	• 100 msec		1. Poor connector connection
Fail Safe	Engine OFF	• No	3. Defected ECM
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P064300	Sensor Reference Voltage "A" Circuit High	

4. Is DTC status displayed as Present?



- **YES** Go to "Monitor GDS Data" procedure.
- NO
  - ► Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

CRC12EN5010P06430021S

Repair as necessary and then go to "Verific-YES ation of Vehicle Repair" procedure.

► Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect and APS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of APS 1 harness connector and chassis ground.

#### Specification : Approx. 5V

5. Is the measured value within specification?



- YES 
  Go to "Ground CIrcuit Inspection" procedure
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### **Specification :** Approx. below 1 $\Omega$

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 4.
- 5. Clear any DTCs stored in the system with GDS.
- Re-check DTC in the system with GDS. 6.
- Did the same DTC is stored in the system? 7.
  - YES 

     Carefully re-do this troubleshooting guide steps.
    - If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.
  - **NO** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### 

After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS

### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- Connect GDS to Data Link Connector(DLC). 2.
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- Select "ECU Change" 5.

GI-497



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essential work afte	r component replacement	
	rk after Component Peolacomen	• ]	
Essential Wo	rk alter Component Replacemen	- ]	
If you're read	ly, select the menu.		
MENU	CANCEL		
Fig.2			

CRC12EN5010P01010042S

### Essential work after component replacement 🗲 🔹 [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) ECU Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### **GI-499**

### **General Information**

### P065300 Sensor Reference Voltage "B" Circuit High

### **Component Location**



1. Engine Control Module (ECM)

### **General Description**

ECM is activated by power supply. Signals from several sensors, such as CKPS and APS, is inputted to ECM. Comparing inputted signals with control LOGIC saved at micro controller and EEPROM, ECM controls engine as actuating injectors, solenoids and relays. To guarantee accurate control, ECM performs SELF TEST, DIAGNOSIS of several sensors and actuators. And if serious trouble which affects vehicle performance occurs, ECM sets DTCs. At certain cases, ECM shuts down whole systems in order to prevent dangerous situation due to incorrect control.

### **DTC Description**

If faulty sensor "B" supply voltage is detected for more than 0.1 sec., ECM sets DTC P065300. This fault might be caused by short to power/ground in sensor supply "B" circuit or internal error of ECM.

CRC12EN5010P02190011

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Faulty sensor "B" supply voltage		
Diagnostic Time	• 100 msec		1. Poor connector connection
Fail Safe	Engine OFF	• No	3. Defected ECM
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P065300	Sensor Reference Voltage "B" Circuit High	

4. Is DTC status displayed as Present?



- **YES** Go to "Monitor GDS Data" procedure.
- NO 
   Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

CRC12EN5010P06530021S

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

► Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect E-EGR control actuator connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of E-EGR actuator harness connector and chassis ground.

### Specification : Approx. 5V

### **General Information**

- Is the measured value within specification?
  - YES 🕨
- Go to "Ground Clrcuit Inspection" procedure
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

5. Is the measured value within specification?



Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" 3.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- 5. Clear any DTCs stored in the system with GDS.
- Re-check DTC in the system with GDS. 6.
- 7. Did the same DTC is stored in the system?



 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.



**NO** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

### **A**CAUTION

After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS

### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- Select "ECU Change" 5.

GI-503



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essentia	work after co	omponent repla	acement	•
[ Frankish W	a da a fita a Camara a a	Daula anns at 1			
Essential W	ork after Componen	t Replacement J			
If you're rea	dy, select the menu				
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S
# GI-505

📼 < Essential w	work after component replacement
[ Essential Work afte If you're ready, sele Essential w ECU repl Rail Press Air Flow Different Throttle EGR Valv APS Mod	vork after component replacement placement (DPF OPT) ssure Sensor replacement r Sensor replacement itial Pressure Sensor replacement (DPF OPT) e valve replacement live replacement dule replacement
s	SELECT CANCEL
MENU CANCEL	

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

# **General Information**

# P068400 Glow Plug Control Module to PCM Communication Circuit Range/ Performance

# **Component Location**



CRC12EN5010P038311

1. Glow Relay Unit (GRU)

## **General Description**

Glow plug heats the combustion chamber via electric heating wire. This allows fuel to atomize and increase ignitionability therefore, cold starting ability is increased and emission is reduced. ECM controls glow relay with engine coolant sensor, battery voltage and ignition switch state.

### **DTC Description**

If error feedback signal from the glow relay unit is detected, ECM sets DTC P068400.

## **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Error feedback sign	al from the GRU is detected	
Diagnostic Time	• 8 sec		1. Poor connector connection
	Engine OFF	• No	<ol> <li>Faulty glow relay circuit</li> <li>Defected GRU</li> </ol>
Fail Safe	EGR Off	• No	
	Torque Limit	• No	]
	MIL	• Off	

# Vehicle Data

Glow R	Glow Relay Unit Terminal		Ispection Condition	Measured Valu- e	Remarks
	1	Glow Time Feedback Signal		Approx. 10.5V	-
	2	Power		B+	-
Pin No.	3	Glow Plug Output Sig- nal	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> <li>Voltage is measured on wiring side(</li> </ul>	Approx. 3.2V	-
	4	ON/START Power	Disconnected)	B+	-
	5	Ground		0V	-
	6	Glow Plug		0V	-

# **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P068400	Glow Plug Control Module to PCM Communication Circuit Range/Performance	

CRC12EN5010P06840021S

4. Is DTC status displayed as Present?



- YES 
  Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

# **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

e Current Data		Search 🖭 🗐 🏭	) e
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Re	set Min.Max Record	Stop ‡ Grouping VS	S
Sensor Name	Value	Unit	1
GRU(Glow Relay Unit) Control Unit	6	%	
Engine Speed	808.5	RPM	
Accelerator Pedal Position Sensor	0	%	4
Pressure Control Valve(Rail)	30	%	=
Air Mass per Cylinder	353	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	OFF	-	
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	OFF	-	

Fig.1

Fig.1) ECM controls glow plug for certain amount of time under engine idle.

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO Go to "Wiring Inspection" procedure.

# Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect GRU connector.
- Ignition switch "ON" 3.

#### CRC12EN5010P03830022S

- 4. Measure the voltage between power terminal of GRU harness connector and chassis ground.
- 5. Measure the voltage between ON/START power terminal of GRU harness connector and chassis ground.

#### Specification : B+

- 6. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# **Ground Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect GRU 3. connector.
- 4. Measure the resistance between ground terminal of GRU harness connector and chassis ground.

### Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect GRU connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of GRU 8. harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of GRU harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Signal Circuit Inspection

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect GRU 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between feedback signal 4 terminal of GRU harness connector and chassis ground.
- Measure the voltage between output signal terminal 5. of GRU harness connector and chassis ground.

Specification : feedback signal terminal : Approx. 10.5V / Ouput signal terminal : Approx. 3.2V

- Is the measured value within specification? 6.

**YES** • Go to "Component Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

## Glow Plug Resistance Inspection

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect GRU 3. connector.
- Measure the resistance between glow plug terminal 4. of GRU harness connector and chassis ground.

Specification : Approx. 0.5 Ω (20 ~ 30 °C/68 ~ 86 °F)

5. Is the measured value within specification?



YES 
Go to "Glow Relay Actuation Test" procedure.

- NO Carefully re-do this troubleshooting guide steps.
  - If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

## Glow Plug Relay Actuation Test

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Glow Relay" in "Actuation Test" with GDS. 4.
- 5. Monitor "Glow Relay Unit Control Duty" parameter in "Current Data" with GDS.

Specification : Refer to figure below

# **General Information**

<b>F</b>	Actuation	Test		🖭 主 🐔
Test Items		Duration	15 Sec	Ì
Injector #4 Actuation	\$	Duration	15 560	
GRU (Glow Relay Unit) 15% Duty		Condition	IG. ON/ENG.OFF -C Data(Glow Plug Rel	Check Current ay)
Boost Pressure Actuator 5%	~	• Result	Operation Comman	d Sent
Boost Pressure Actuator 95%	₹			
	Data Ana	lysis		
100 GRU(Glow Relay Unit) Control Unit			Max : 15	×
				6 %
0			Min : 6	Ð
Start Stop				Function
Fig.1				

Fig.1) Glow relay current data when actuation test is performed.

- 6. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 
    Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Glow Plug and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

CRC12EN5010P03830041S

- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.

- NO
  - Problem is corrected and the system operation performs to specification at this time.

# P068500 ECM/PCM Power Relay Control Circuit /Open

# **Component Location**



### 1. Main Relay

### **General Description**

Main relay operates when Ignition ON signal is inputted to ECM and it supplies power to ECM, fuel pump relay, CMPS, EGR actuator, throttle flap actuator, PTC heater relay and brake switch, etc. Especially, the power supplied to ECM is used as a main power of injectors, rail pressure control valve and ECM operation. When IG key ON signal is shut off during turning engine OFF, ECM stops injector operation then engine turns OFF after approx. 16 ~ 20 sec. ECM shuts OFF main relay and system turns OFF. Main relay is very important for engine operation, so careful inspection is strongly required.

## **DTC Description**

ECM performs After-run process (Turning off the internal system process of ECM) in order to shut down the system. If main relay power supply is cut before the After-run for 3 times or 2 sec. afte the After-run, ECM sets DTC P068500. This fault might be caused by open or short to ground in control circuit of main relay

CRC12EN5010P06850011

# **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Faulty control circuit of main relay		1 Deer connector connection
Diagnostic Time	• -		<ol> <li>Poor connector connection</li> <li>Open or short to ground in (</li> </ol>
	Engine OFF	• No	ntrol circuit of main relay
Fail Safe	EGR Off	• No	3. Defected main relay
	Torque Limit	• No	
	MIL	• Off	

# Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P068500	ECM/PCM Power Relay Control Circuit /Open	

4. Is DTC status displayed as Present?



- **YES** Go to "Wiring Inspection" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

# **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

CRC12EN5010P06850021S

- YES 

   Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
- Go to "Power Circuit Inspection" procedure. NO ►

# **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove engine control(main) relay.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of engine control(main) relay harness connector and chassis ground.

### Specification : B+

Is the measured value within specification? 5.



- YES 
  Go to "Control Circuit Inspection" procedure
- NO 

   Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Control Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ECM and engine room junction box connector.
- Measure the resistance between engine 4 control(main) relay terminal of engine room junction box harness connector and engine control(main) relay terminal of ECM harness connector.

Specification : Approx. below  $1\Omega$ 

- 5. Is the measured value within specification?
  - YES 
    Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the engine control(main) relay and go to "Verification of Vehicle Repair" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- Are any DTCs stored in the system? 5.



YES 
Go to the applicable troubleshooting proced-



 Problem is corrected and the system operation performs to specification at this time.

# **General Information**

# P069900 Sensor Reference Voltage "C" Circuit High

# **Component Location**



CRC12EN5010P02190011

# 1. Engine Control Module (ECM)

### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

## **DTC Description**

If faulty sensor "C" supply voltage is detected for more than 0.1 sec., ECM sets DTC P069900. This fault might be caused by short to power/ground in sensor supply "C" circuit or internal error of ECM.

## **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>Faulty sensor "C" supply voltage</li> </ul>		
Diagnostic Time	• 100 msec		1. Poor connector connection
	Engine OFF	• No	3. Defected ECM
Fail Safe	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

## **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-515

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P069900	Sensor Reference Voltage "C" Circuit High	

4. Is DTC status displayed as Present?

- **YES** > Go to "Wiring Inspection" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

# **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1 caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FRPS and BPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of FRPS harness connector and chassis ground.
- 5. Measure the voltage between power terminal of BPS harness connector and chassis ground.

Specification : Approx. 5V

6. Is the measured value within specification?



Go to "Ground Circuit Inspection" procedure

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 Repair as necessary and go to "Verification NO of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2
- 3. Refer to "Shop Manual" and disconnect ECM connector.
- 4. Measure the resistance ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1  $\Omega$ 

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- 5. Clear any DTCs stored in the system with GDS.
- 6. Re-check DTC in the system with GDS.
- 7. Did the same DTC is stored in the system?

# <u>GI-516</u>

YES 
Carefully re-do this troubleshooting guide st-

Vehicle S/W Management

1. Ignition Switch "OFF" eps. If no problems were found with the circuits Connect GDS to Data Link Connector(DLC). 2. or connectors, replace the ECM and go to "Ver-Ignition Switch "ON" & Engine "OFF" 3. ification of Vehicle Repair" procedure. 4. Perform "Essential Work After Component **NO** • Fault is intermittent caused by poor contact Replacement" in "Vehicle Software Management" in the sensor's and/or ECM's connector or was with GDS. repaired and ECM memory was not cleared. T-5. Select "ECU Change" horoughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure. After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS 🗩 🐳 **Special Function** - <u>-</u> **Injector Specific Data** Essential work after component replacement **Engine Test Function** Fuel line air removal **DPF Service Regeneration** Favorite Fig.1

CRC12EN5010P01010041S

<b>F</b>	Essentia	l work after co	omponent repl	acement	
[ Freential W		t Daula contont 1			
	ork after Componen	t Replacement J			
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

# GI-517

# **General Information**

🖾 🔸	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU          Essential work after component replacement         - ECU replacement (DPF OPT)         - Rail Pressure Sensor replacement         - Air Flow Sensor replacement         - Differential Pressure Sensor replacement (DPF OPT)         - Throttle valve replacement         - EGR Valve replacement         - APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

CRC12EN5010P05620043S

Replacement"

Fig.3) ECU Change

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

# GI-519

# P117100 CPC Mode Monitoring - Low Input

# Component Location



CRC12EN5010P008711



CRC12EN5010P008712



**GI-520** 

# **General Information**

CRC12EN5010P008713

- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

### **DTC Description**

Rail pressure is controlled by only RPRV or both RPRV and FPRV or only FPRV depending on engine condition. These three modes are called 'CPC mode'. During transition from one mode to another mode, if rail pressure is below the minimum rail pressure for each certain engine condition for more than 300ms. P11710000 is set. When DTC is set rail pressure is controlled by RPRV alone.

### **DTC Detecting Condition**

Item	Detecting Condition			Possible Cause
DTC Strategy	Signal monitoring			
Enable Conditions	Engine running			
Threshold Value	<ul> <li>If the fuel rail pressure is below minimum pressure und- er each certain engine condition</li> </ul>		1.	Poor connector connection
Diagnostic Time	• 300 msec		2.	Defected RPRV
	Engine OFF	Engine OFF • No		Defected RPS
EGR Off •		• No		
Fall Sale	Torque Limit	• No		
	MIL	• Off	]	

### Vehicle Data

Rail Pressure Regulator Valve		Terminal		Inspection Condition	Measured Value	Remarks
	1	Rail Pressure Regulator Val- vue Control	•	Ignition Switch "ON", Engine " OFF"	Approx. 3. 4V	-
Pin No.	2	Rail Pressure Regulator Val- vue Power	•	Voltage is measured on wiring side(Disconnected)	B+	-

Fuel Pressure Regulator Vavle		Terminal	Inspection Condition	Measured Value	Remarks
1 Fuel Pressure Re Ivue Con	Fuel Pressure Regulator Va- Ivue Control	Ignition Switch "ON", Engine " OFF"	Approx. 3. 4V	-	
Pin No.	2	Fuel Pressure Regulator Va- Ivue Power	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

	Retry
Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Description	State
CPC Mode Monitoring - Low Input	
	Freeze Frame       DTC Status       Erase Selective DTC       Hist/Pend DTC \$         Description       CPC Mode Monitoring - Low Input       Input

#### CRC12EN5010P11710021S

4. Is DTC status displayed as Present?



- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# **General Information**

Current Data		Search 🙉 🚛	Retry (
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	et Min.Max Record	Stop 🗧 Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

Fig.1

CRC12EN5010P00870022S

🧧 Current Data		Search 🙉 💷 🕼	
Selective Display 🗧 🛛 Full List 💠 🗌 Graph 💠 🛛 items List 🗘 Res	et Min.Max Record	Stop ‡ Grouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.2		-	

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

# **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

#### CRC12EN5010P00870023S

caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "Rail Pressure Regulator Valve Inspe-NO ction" procedure.

# **Rail Pressure Regulator Valve Inspection**

## Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV

connector.

- 3. Ignition switch "ON"
- Measure the voltage between power terminal of 4 RPRV harness connector and chassis ground.

## Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Control Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of 4 RPRV harness connector and chassis ground.

## Specification : Approx. 3.4V

Is the measured value within specification? 5.



Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **Fuel Pressure Regulator Valve Inspection**

## Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- Measure the voltage between power terminal of 4. FPRV harness connector and chassis ground.

## Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# Control Circuit Inspection

1. Ignition switch "OFF"

- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of FPRV harness connector and chassis ground.

Specification : Approx. 3.4V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit NO , and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

# Visual Inspection on Fuel Line

- 1. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- 2. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between high pressure fuel pump and common rail.
- 3. Have any problems been found?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Fuel Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- 4. Measure the resistance between power terminal and control terminal of FPRV.

Specification : 2.60 ~ 3.15Ω (20°C/20°F)

- 5. Is the measured value within specification?
- Go to "Rail Pressure Regulator Valve Inspe-YES ction" procedure.
- Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

### Rail Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- Refer to "Shop Manual" and disconnect RPRV connector.
- 4. Measure the resistance between power terminal and control terminal of RPRV.

Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

## **A**CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to the applicable troubleshooting procedure.



 Problem is corrected and the system operation performs to specification at this time.

# GI-525

# P117200 CPC Mode Monitoring - High Input

# Component Location



CRC12EN5010P008711



CRC12EN5010P008712



**GI-526** 

# **General Information**

CRC12EN5010P008713

- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

### **DTC Description**

Rail pressure is controlled by only RPRV or both RPRV and FPRV or only FPRV depending on engine condition. These three modes are called 'CPC mode'. During transition from one mode to another mode, if rail pressure is higher than the minimum rail pressure for each certain engine condition for more than 300ms. P11720000 is set. When DTC is set rail pressure is controlled by RPRV alone.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>If the fuel rail pressure is higher than minimum pressure under each certain engine condition</li> </ul>		e 1. Poor connector connection
Diagnostic Time	• 300 msec		2. Defected RPRV
	Engine OFF	• No	4. Defected RPS
EGR Off •		• No	
Fail Safe Torque Limit		• No	
	MIL	• Off	

### Vehicle Data

Rail Pressure Regulator Valve		Terminal		Inspection Condition	Measured Value	Remarks
	1	Rail Pressure Regulator Val- vue Control	•	Ignition Switch "ON", Engine " OFF"	Approx. 3. 4V	-
Pin No.	2	Rail Pressure Regulator Val- vue Power	•	Voltage is measured on wiring side(Disconnected)	B+	-

Fuel Pressure Regulator Vavle		Terminal		Inspection Condition	Measured Value	Remarks
1 Fuel Pressure Regulator Va- Ivue Control OFF"	Ignition Switch "ON", Engine " OFF"	Approx. 3. 4V	-			
Pin No.	2	Fuel Pressure Regulator Va- Ivue Power	•	Voltage is measured on wiring side(Disconnected)	B+	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P117200	CPC Mode Monitoring - High Input	

#### CRC12EN5010P11720021S

4. Is DTC status displayed as Present?



- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# **General Information**

Current Data		Search 🙉 🗐 🕷	) e
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop Crouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	N.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		

Fig.1

CRC12EN5010P00870022S

🧧 Current Data		Search 🙉 💷 🕼	
Selective Display 🗧 🛛 Full List 💠 🗌 Graph 💠 🛛 items List 🗘 Res	et Min.Max Record	Stop ‡ Grouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.2		-	

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** • Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

# **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

CRC12EN5010P00870023S

caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?
  - YES 

     Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "Rail Pressure Regulator Valve Inspe-NO ction" procedure.

# **Rail Pressure Regulator Valve Inspection**

## Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPRV

connector.

- 3. Ignition switch "ON"
- Measure the voltage between power terminal of 4 RPRV harness connector and chassis ground.

## Specification : B+

5. Is the measured value within specification?



YES 
Go to "Control Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# Control Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- Ignition switch "ON" 3.
- Measure the voltage between control terminal of 4 RPRV harness connector and chassis ground.

## Specification : Approx. 3.4V

Is the measured value within specification? 5.



Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **Fuel Pressure Regulator Valve Inspection**

## Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- Measure the voltage between power terminal of 4. FPRV harness connector and chassis ground.

## Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

# Control Circuit Inspection

1. Ignition switch "OFF"

- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of FPRV harness connector and chassis ground.

Specification : Approx. 3.4V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit NO , and then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

# Visual Inspection on Fuel Line

- 1. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- 2. Refer to "Shop Manual" and inspect for blockage, leakage, bent or damage on fuel line between high pressure fuel pump and common rail.
- 3. Have any problems been found?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# Fuel Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- 4. Measure the resistance between power terminal and control terminal of FPRV.

Specification : 2.60 ~ 3.15Ω (20°C/20°F)

- 5. Is the measured value within specification?
- Go to "Rail Pressure Regulator Valve Inspe-YES ction" procedure.
- Carefully re-do this troubleshooting guide st-NO eps.

If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

### Rail Pressure Regulator Valve Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.
- Refer to "Shop Manual" and disconnect RPRV connector.
- 4. Measure the resistance between power terminal and control terminal of RPRV.

Specification : 3.42 ~ 3.78Ω (20°C/20°F)

- 5. Is the measured value within specification?
- YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

## **A**CAUTION

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to the applicable troubleshooting procedure.



 Problem is corrected and the system operation performs to specification at this time.

# GI-531

# P117300 CPC Mode Monitoring - maximum PCV pressure exceeded

# Component Location



CRC12EN5010P008711



CRC12EN5010P008712



GI-532

# **General Information**

CRC12EN5010P008713

- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

### **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

### **DTC Description**

If RPRV control current value is exceeded maximum value for more than 0.7 sec. during rail pressure is controlled by RPCV, ECM sets DTC P117300. Once this DTC is set ECM controls rail pressure with FPRV. This fault might be caused by stucked RPCV or leakage on high fuel pressure system.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>		
Enable Condition	Engine running		
Threshold Value	Current of RPRV is	exceeded threshold value	1. Poor connector connection
Detecting Time	• 700 msec		2. Stuck closed RPRV
	Engine OFF	• No	3. Stuck open RPRV 4. Leakage on high fuel pressure
	EGR OFF	• No	system
Fall Sale	Torque Limit	• No	
	MIL	• Off	

### Vehicle Data

Rail Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
	1	Rail Pressure Regulator Val- vue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
PIN NO.	2	Rail Pressure Regulator Val- vue Power	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-533

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P117300	CPC Mode Monitoring - maximum PCV pressure exceeded	

CRC12EN5010P11730021S

### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

# Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

Current Data		Search 🗐 🗐	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop Crouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	A.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.1			

CRC12EN5010P00870022S

# **General Information**

🚪 Current Data		Search 😰 💷 🔐	
Selective Display \$ Full List \$ Graph \$ Items List \$ Res	et Min.Max Record	Stop   Grouping VSS	5
Sensor Name	Value	Unit	
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	v	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON	-	
AT/MT Information	A/T	-	
Fig.2	-		

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?





NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

1. Ignition switch "OFF"

#### CRC12EN5010P00870023S

- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of RPRV harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Control Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Control Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between control terminal of RPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?

```
YES • Go to "Component Inspection" procedure.
```

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect batter (-) cable.

- Refer to "Shop Manual" and disconnect RPRV connector.
- Measure the resistance between power terminal and control terminal of RPRV.

### Specification : 3.42 ~ 3.78 $\Omega$ (20°C/20°F )

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO ► Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the RPRV and go to "Verification of Vehicle Repair" procedure.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





 Problem is corrected and the system operation performs to specification at this time.

# P118500 Maximum Pressure Exceeded

# Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

## **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

## **DTC Description**

If rail pressure exceeds threshold value by 200 bar or is higher than maximum pressure(1999bar) while rail pressure is controlled by FPRV, ECM sets DTC P118500. This fault might be caused by too much fuel supply to common rail or faulty fuel return line of common rail or defected RPS.

DTC Detecting C	Condition
-----------------	-----------

ltem	Dete	Detecting Condition			Possible Cause
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>				
Enable Condition	Engine running				
Threshold Value	Case 1	•	Rail pressure exceeds thresho- Id value by 200bar		
I hreshold Value	Case 2	•	Rail pressure is higher than m- aximum pressure (1999bar)	1.	Poor connector connection
Detecting Time	Case 1	•	2 sec	2.	Stuck closed FPRV
Detecting Time	Case 2	•	300 msec	3. 4.	Defected RPS
	Engine OFF	•	No		
	EGR OFF	•	No		
	Torque Limit	•	Yes		
	MIL	•	On		

## Vehicle Data

Fuel Rail Ser	Pressure Isor	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	RPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5.0V	-
Pin No.	2	RPS Signal	<ul> <li>Voltage is measured on wiring side(Discon-</li> </ul>	Approx. 5.0V	-
	3	RPS Ground	nected)	0V	

# **General Information**

Fuel Pressure Regulator Vavle		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Fuel Pressure Regulator Va- Ivue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
	2	Fuel Pressure Regulator Va- Ivue Power	Voltage is measured on wiring side(Disconnected)	B+	-

# **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P118500	Maximum Pressure Exceeded	

#### CRC12EN5010P11850021S

### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# GI-539

Current Data		Search 🙉 💷	2) E
Selective Display 🗘 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop  Grouping V	ss
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	~
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T		
Fig.1			

#### CRC12EN5010P00870022S

Current Data		Search 😰 🗐 😭	) e
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 items List 🗘 Res	et Min.Max Record	Stop ‡ Grouping VS	S
Sensor Name	Value	Unit	
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.2			

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

- 5. Is the parameter displayed within specification?

**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



• Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

CRC12EN5010P00870023S

caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

 Go to "Rail Pressure Sensor Inspection" procedure.

### **Rail Pressure Sensor Inspection**

- Power Circuit Inspection
- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS

**GI-540** 

# **General Information**

connector.

- 3. Ignition switch "ON"
- Measure the voltage between power terminal of RPS harness connector and chassis ground.

### Specification : Approx. 5 V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Ground Circuit Inspection

- Ignition switch "OFF" 1.
- Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect RPS connector.
- 4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

## Specification : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect RPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of RPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of RPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of RPS harness connector and chassis ground.

Specification : Approx. 5 V

- 5. Is the measured value within specification?
  - Go to "Fuel Pressure Regulator Valve Insp-YES ection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **Fuel Pressure Regulator Valve Inspection**

## Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

### Specification : B+

5. Is the measured value within specification?

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Control Circuit Inspection

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- Measure the voltage between control terminal of 4. FPRV harness connector and chassis ground.

## Specification : Approx. 3.4V

5. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **Component Inspection**

## Visual Inspection on Fuel Line

- Refer to "Shop Manual" and inspect for blockage, 1. leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- Refer to "Shop Manual" and inspect for blockage, 2. leakage, bent or damage on fuel line between high pressure fuel pump and common rail.

YES 
Go to "Control Circuit Inspection" procedure
Have any problems been found? 3.



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Fuel Pressure Regulator Valve Inspection" procedure.

## Fuel Pressure Regulator Valve Inspection

- Ignition switch "OFF" 1.
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of FPRV.

Specification : 2.60 ~ 3.15Ω (20°C/20°F)

5. Is the measured value within specification?



YES 
Go to "Rail Pressure Regulator Valve Inspection" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

## 

- When installing component, tighten it within • specification
- If component is dropped, check for proper operation. The internal damage may be present

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## P118600 Minimum Pressure at Engine Speed Too Low

## Component Location



CRC12EN5010P008711



CRC12EN5010P008712



- 1. Rail Pressure Sensor (RPS)
- 2. Rail Pressure Regulator Valve (RPRV)
- 3. Fuel Pressure Regulator Valve (FPRV)

## **General Description**

The Fuel Pressure Regulator Valve and the Rail Pressure Regulator Valve are installed on high pressure pump and common rail respectively. These valves control fuel inlet (feed) from fuel tank via fuel filter and outlet (return) to fuel tank of high pressure fuel circuit.

This system is called "Dual Fuel Pressure Control System" and can precisely and quickly control the fuel pressure in accordance with various engine conditions by controlling the fuel inlet and outlet simultaneously.

#### **DTC Description**

If rail pressure is below threshold value by 200 bar or is lower than minimum pressure while rail pressure is controlled by FPRV, ECM sets DTC P118600. This fault might be caused by too much fuel return of common rail or defected RPS.

#### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>		
Enable Condition	Engine running		
Threshold Value	Case 1	<ul> <li>Rail pressure is below threshol- d value by 200bar</li> </ul>	
Inreshold Value	Case 2	<ul> <li>Rail pressure is lower than mi- nimum pressure</li> </ul>	1 Poor connector connection
Detecting Time	Case 1	• 1 sec	2. Stuck closed FPRV
Detecting time	Case 2	• 300 msec	3. Stuck opened FPRV
	Engine OFF	<ul><li>Yes (Case 1)</li><li>No (Case 2)</li></ul>	4. Defected RPS
Fail Safe	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	RPS Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5.0V	-
Pin No.	2	RPS Signal	Voltage is measured on wiring side(Discon-	Approx. 5.0V	-
	3	RPS Ground	nected)	0V	

## **General Information**

Fuel Pressure Regulator Vavle		Terminal	Inspection Condition	Measured Value	Remarks
	1	Fuel Pressure Regulator Va- Ivue Control	<ul> <li>Ignition Switch "ON", Engine " OFF"</li> </ul>	Approx. 3. 4V	-
Pin No.	2	Fuel Pressure Regulator Va- Ivue Power	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P118600	Minimum Pressure at Engine Speed Too Low	

CRC12EN5010P11860021S

#### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

## **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to Figure below

# **GI-545**

Current Data		Search 🙉 🚛	<b>a</b> =
Selective Display 🗘 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Rail Pressure Measured	264.7	bar	
Raw Value of Rail Pressure	1.06	V	
Pressure Control Valve(Rail)	22	%	
Output of Fuel Metering Unit(MPROP)	32	%	
Engine Speed	800.5	RPM	
Actual Engine Torque - Crankshaft Torque	40	Nm	A.
Inner Torque Without Transmission Interventions	68	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.1			

#### CRC12EN5010P00870022S

CRC12EN5010P00870023S

Current Data		Search 🙉 💷 🚑	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗧 Res	et Min.Max Record	Stop Crouping VS	S
Sensor Name	Value	Unit	1
Rail Pressure Measured	568.6	bar	
Raw Value of Rail Pressure	1.55	V	
Pressure Control Valve(Rail)	35	%	
Output of Fuel Metering Unit(MPROP)	38	%	
Engine Speed	4915.5	RPM	
Actual Engine Torque - Crankshaft Torque	21	Nm	
Inner Torque Without Transmission Interventions	80	Nm	
State of Immo Presence	ON		
AT/MT Information	A/T	-	
Fig.2			

Fig.1) Rail pressure current data under engine idle condition.

Fig.2) Rail pressure current data under engine speed approx. 5000 RPM.

5. Is the parameter displayed within specification?



**YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.



► Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are

caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

 Go to "Rail Pressure Sensor Inspection" procedure.

#### **Rail Pressure Sensor Inspection**

- Power Circuit Inspection
- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect RPS

**GI-546** 

## **General Information**

connector.

- 3. Ignition switch "ON"
- Measure the voltage between power terminal of RPS harness connector and chassis ground.

#### Specification : Approx. 5 V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure



NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Ground Circuit Inspection

- Ignition switch "OFF" 1.
- Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect RPS connector.
- 4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect RPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of RPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of RPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect RPS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of RPS harness connector and chassis ground.

Specification : Approx. 5 V

- 5. Is the measured value within specification?
  - Go to "Fuel Pressure Regulator Valve Insp-YES ection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Fuel Pressure Regulator Valve Inspection**

#### Power Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect FPRV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of FPRV harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Control Circuit Inspection

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect FPRV 2. connector.
- 3. Ignition switch "ON"
- Measure the voltage between control terminal of 4. FPRV harness connector and chassis ground.

#### Specification : Approx. 3.4V

5. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

## Visual Inspection on Fuel Line

- Refer to "Shop Manual" and inspect for blockage, 1. leakage, bent or damage on fuel line between low pressure fuel pump and high pressure fuel pump.
- Refer to "Shop Manual" and inspect for blockage, 2. leakage, bent or damage on fuel line between high pressure fuel pump and common rail.

YES 
Go to "Control Circuit Inspection" procedure

Have any problems been found? З.



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Fuel Pressure Regulator Valve Inspection" procedure.

## Fuel Pressure Regulator Valve Inspection

- Ignition switch "OFF" 1.
- Disconnect battery (-) cable. 2.
- Refer to "Shop Manual" and disconnect FPRV 3. connector.
- Measure the resistance between power terminal and 4. control terminal of FPRV.

Specification : 2.60 ~ 3.15Ω (20°C/20°F)

5. Is the measured value within specification?



YES 
Go to "Rail Pressure Regulator Valve Inspection" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the FPRV and go to "Verification of Vehicle Repair" procedure.

## 

- When installing component, tighten it within • specification
- If component is dropped, check for proper operation. The internal damage may be present

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

## **General Information**

## P12BF00 ECU Torque Monitoring - Not Plausible Signal

## **Component Location**



CRC12EN5010P02190011

## 1. Engine Control Module (ECM)

#### **General Description**

ECM power is supplied from battery and monitors crankshaft position sensor, accelerator pedal sensor and etc. In according to these signals ECM controls relays, solenoids, and injectors. Also, ECM performs self test to increase reliability and if problem is detected on vehicle, ECM warns drivers and technicians via DTC and the MIL.

## **DTC Description**

If actual torque and the calculated torque is different, ECM sets DTC 12BF00.

## **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Internal Monitoring		
Enable Conditions	Engine running		
Threshold Value	ECU torque monito	ring signal error	
Diagnostic Time	• 1 sec		1. Poor connector connection
	Engine OFF	• Yes	2. Defected ECM
	EGR Off	• No	
Fall Safe	Torque Limit	• No	
	MIL	• Blink	

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON".
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-549

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P12BF00	ECU Torque Monitoring - Not Plausible Signal	

CRC12EN5010P12BF0021S

- 4. Is DTC status displayed as Present?
  - YES 
    Go to "Monitor GDS Data" procedure.
    - Go to "Verification of Vehicle Repair" proce-NO dure.

## **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect ECM 2 connector.
- 3. Ignition switch "ON"
- Measure the voltage between power terminal of ECM 4 harness connector and chassis ground.

#### Specification : B+

5. Is the measured value within specification?



YES 
Go to "Ground Clrcuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

- Is the measured value within specification? 5.
- Go to "Component Inspection" procedure. YES
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON"
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- 5. Clear any DTCs stored in the system with GDS.
- 6. Re-check DTC in the system with GDS.
- 7. Did the same DTC is stored in the system?

## **General Information**

# <u>GI-550</u>

YES 
Inspect for fault in injection system. If the injection system fault is detected, perform applicable troubleshooting steps and then go to "Verification of Vehicle Repair" procedure.

► If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

NO ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

## **A**CAUTION

 After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS

## Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

GI-551



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement				
[ Eccential W	ork ofter Compense	t Poplacoment 1						
If you're rea	dy, select the menu	l.						
MENU	CANCEL							
Fig.2								

CRC12EN5010P01010042S

## 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) ECU Change

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## GI-553

## **General Information**

## P167000 Invalid Injector IQA/C2I

## **Component Location**



CRC12EN5010P020111



- 1. Injector #1
- 2. Injector #2
- 3. Injector #3
- 4. Injector #4
- 5. Engine Control Module (ECM)

#### **General Description**

IQA (Injector Quantity Adjustment) means adjusting fuel injection quantity difference between injectors which occurs inevitably at manufacturing process as allotting serial number consists of 7 letters to each injectors.Inputting IQA code of injectors installed in each cylinder to ECM, ECM recognizes the fuel injection quantity difference between each injectors. ECM adjusts every injector to have same fuel injecting characteristic

#### CRC12EN5010P062D12

as recognizing specific fuel injection map which is different for each serial number.

#### **DTC Description**

If the injector IQA data error or saved data is corrupted in EEPROM, ECM sets DTC P167000.

## **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Internal monitoring		
Enable Conditions	Ignition switch "ON"	1	
Threshold Value	IQA data error is de	etected	
Diagnostic Time	Immediately		1. Poor connector connection
	Engine OFF	• No	2. Defected ECM
	EGR Off	• No	
Fall Safe	Torque Limit	• No	
	MIL	• Blink	

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P167000	Invalid Injector IQA/C2I	
L		

4. Is DTC status displayed as Present?



- **YES** Go to "Monitor GDS Data" procedure.
- NO
  - Go to "Verification of Vehicle Repair" procedure.

## **Terminal and Connector Inspection**

Many malfunctions in the electrical system are 1. caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.

- CRC12EN5010P16700021S
- 3. Has a problem been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "Power Circuit Inspection" procedure. NO

## **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECM connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between power terminal of ECM harness connector and chassis ground.

## Specification : B+

## **General Information**

- Is the measured value within specificaiton?

  - YES 
    Go to "Ground Circuit Inspection" procedure
  - NO 

     Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- 3. Refer to "Shp Manual" and disconnect ECM connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### Specification : Approx. below 1 $\Omega$

5. Is the measured value within specificaiton?



- Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- 4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.



CRC12EN5010P02010041S

## GI-557

<b>5</b>	Injector Specific Data	
[ Injector Spe If the Injector to control the After this fur recheck the se [ Condition ] 1. Ignition K 2. Engine St If you are rea	ecific Data ] for or ECU is changed, this function should be perform a normal fuel injection. Inction is completed, turn the Ignition Key off and system after 10 sec. Key On top ady, press [OK] button.	
ОК Fig.2	CANCEL	

- 10. Re-check DTC in the system with GDS.
- 11. Did the same DTC is stored in the system?
- YES 
  Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

NO Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

## **A**CAUTION

 After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS

## Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 4. Perform "Essential Work After Component

CRC12EN5010P16700042S

Replacement" in "Vehicle Software Management" with GDS.

- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- 5. Select "ECU Change"

## <u>GI-558</u>

## **General Information**



CRC12EN5010P01010041S

# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

## GI-559

## **General Information**

<b>E *</b>	Essential work after component replacement
[ Essential Work afte	MENU          Essential work after component replacement         ECU replacement (DPF OPT)         Rail Pressure Sensor replacement         Air Flow Sensor replacement         Differential Pressure Sensor replacement (DPF OPT)         Throttle valve replacement         EGR Valve replacement         APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

CRC12EN5010P05620043S

Replacement"

Fig.3) ECU Change

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## GI-561

## P200200 DPF System Non Plausible

## **Component Location**



#### 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

#### **DTC Description**

If exhaust gas flow rate is normal but pressure difference calculated by DPS is below set-point(No pressure difference between front and rear CPF), ECM sets DTC P200200.

CRC12EN5010P04710011

## **DTC Detecting Condition**

Item	Detecting Condition				Possible Cause
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>				
Enable Condition	Engine running				
Threshold Valu	Case 1	•	If exhaust gas flow rate is incr- ease or decrease and pressure difference from DPS is below or above set-point	1.	Poor connector connection
	Case 2	•	DPS signal is at maximum set- point	2. 3. 4.	Faulty signal circuit of DPS Defected DPS Defected DPF
Detecting Time	• -			5.	Leakage on exhaust system
	Engine OFF	•	No		
Fail Safe	EGR OFF	•	No		
	Torque Limit	•	No		
	MIL	•	Blink		

## Vehicle Data

DPF	DPS	Terminal		Inspection Condition	Measured Value	Remarks
	1	DPS Power		Ignition switch "ON" & Engine "OFF"	Approx. 5V	-
Pin No.	2	DPS Signal	•	Voltage is measured on wiring side(	Approx. 5.6V	-
	3	DPS Ground		Disconnected)	0 V	-
DPF DPS						
DPF	DPS	Terminal		Inspection Condition	Measured Value	Remarks
DPF	DPS 1	Terminal DPS Power	•	Inspection Condition	Measured Value Approx. 5V	Remarks
DPF Pin No.	DPS 1 2	Terminal DPS Power DPS Signal	•	Inspection Condition Ignition switch "ON" & Engine "OFF" Voltage is measured on wiring side(	Measured Value Approx. 5V Approx. 1.0V	Remarks -

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-563

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P200200	DPF System Non	Plausible			

CRC12EN5010P20020021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

## Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification : Refer to figure below

🚪 Current Data		Search 🙉 🗐 🤬	
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗧 Rese	et Min.Max Record	Stop Crouping VSS	
Sensor Name	Value	Unit	
Differential Pressure at Particle Filter	3.529	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.02	V	
Engine Speed	789.0	BPM	
E Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO	-	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS)	NO	-	
Fig 1			

CRC12EN5010P04710022S

## **General Information**

Current Data		Search 🕄 🚛	i 📾 e
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Rese	at Min.Max Record	Stop ‡ Grouping	VSS
Sensor Name	Value	Unit	and the set
Differential Pressure at Particle Filter	89.804	hPa	
Raw Voltage of Differential Pressure Sensor (DP	1.31	V	
Engine Speed	4932.5	RPM	
E Flag Status of Battery Function to Crank the Eng	NO	- <u>-</u> -	4
Flag Status of Quiescent Current(AMS)	NO	(H)	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Head Lamp(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS)	NO		
Fig.2			

Fig.1) DPS current data under engine idle

X Displayed value may different in according to actual vehicle condition

Fig.2) DPS current data under engine speed approx. 5.000RPM

※ Displayed value may different in according to actual vehicle condition

- 5. Is the parameter dispalyed within specification?
  - YES 

    Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

CRC12EN5010P04710023S

#### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Ignition switch "ON"
- Measure the voltage between power terminal of DPS 4. harness connector and chassis ground.

#### Specification : Approx. 5.0V

- 5. Is the measured value within specification?

  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect DPS 3. connector.
- Measure the resistance between ground terminal of 4. DPS harness connector and chassis ground.

#### **Specification :** Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect DPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of DPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



**YES** • Go to "Signal Circuit Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2 connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of DPS 4. harness connector and chassis ground.

#### Specification : Approx. 5.6V

Is the measured value within specification? 5.



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

## Visual Inspection on DPF Differential Pressure Sensor

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2. connector.
- Inspect for corrosion or contamination on DPS 3. terminal.
- Inspect for proper installation of DPS, DPS hose and 4. leakage on exhaust system.
- Inspect for foreign substance on DPS and DPF 5. assembly.
- 6. Inspect for Leakage on exhaust system.
- Have any problems been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

► Go to "CPF Service Regeneration" procedu-NO re.

## CPF Service Regeneration

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

## **General Information**



Fig.1) Vehicle S/W Management list of Engine

## 

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?
  - YES ► This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO 🕨

Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P04720041S

NO 
Carefully re-do this troubleshooting guide steps.

> ► If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### **A**CAUTION

• When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle

General

performance and emission control may not work properly until auto learning is completed.

#### **Component Inspection**

- Visual Inspection on DPF Differential Pressure Sensor
- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Inspect for corrosion or contamination on DPS terminal.
- 4. Inspect for proper installation of DPS, DPS hose and leakage on exhaust system.
- 5. Inspect for foreign substance on DPS and DPF assembly.
- 6. Inspect for Leakage on exhaust system.
- 7. Have any problems been found?



YES ► Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

 Go to "CPF Service Regeneration" procedure.

#### CPF Service Regeneration

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

## **General Information**



Fig.1) Vehicle S/W Management list of Engine

## 

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?
  - YES ► This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

NO 🕨

Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P04720041S

NO 
Carefully re-do this troubleshooting guide steps.

> ► If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### **A**CAUTION

• When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle

performance and emission control may not work properly until auto learning is completed.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?
  - **YES** Go to the applicable troubleshooting procedure.



• Problem is corrected and the system operation performs to specification at this time.

## P210100 Throttle actuator Control Motor Circuit Range/Performance

## **Component Location**



## 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If difference in actual and target value or low voltage and high current is detected, ECM sets DTC P210100. This fault might be caused by short to ground in motor (+), short to power in motor (-), or open in control circuit.

## **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threehold \/olu	Case 1	• Difference in actual and target value is detected	
Threshold Valu	Case 2	<ul><li>Low voltage error on ACV</li><li>High current error on ACV</li></ul>	<ol> <li>Open in control circuit of ACV</li> <li>Short to ground in control (+) circuit of ACV</li> </ol>
Detecting Time	• 2 sec. (Case 2)		3. Short to power in control (-) cir-
	Engine OFF	• No	cuit of ACV
Fail Safe	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	<ul><li>Off (Case 1)</li><li>On (Case 2)</li></ul>	

## Vehicle Data

Air Control Valve		Terminal	Inspection Condition Val	ured ue Remarks
Pin No.	1	motor(+)	B	+ Signal W- aveform( Fig. 1)
	2	motor(-)	Ignition Switch "ON", En- gine "OFF" Voltage is measured on wiring side(Disconnected	+ Signal W- aveform( Fig. 2)
	3	ACV Feedback Signal	) Appro	x. 5V -
	4	ACV Position Sensor Power	Appro	x. 5V -
	5	ACV Position Sensor Ground	0\	J -
Air Control Valve		Terminal	Inspection Condition Val	ured ue Remarks
	1	motor(+)	B-	+ -
	2	motor(-)	Ignition Switch "ON", En-B-	+ -
Pin No.	3	ACV Feedback Signal	gine "OFF" Voltage is measured on Approx	0.7V -
	4	ACV Position Sensor Power	wiring side(Connected) Appro	x. 5V -
	5	ACV Position Sensor Ground	0\	v -

# <u>GI-572</u>

## **General Information**

📕 Oscilloso	соре						
Sensor	Theme	Name	Review	User Setting	A4	14.44 s 🕨 😽	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save			
+20∨		Motor +	Hz : 0	.3 Hz	Duty-:70 %	Duty+: 30 %	
Configuration							
-5×							B

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-573

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P210100	Throttle actuator Control Motor Circuit Range/Performance	

CRC12EN5010P21010021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

## Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- Monitor follow parameters in "Current Data" with GDS.

## Specification: Refer to figure below

Current Data		Search 🗐 🗐	a =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗧 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	P
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO		
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	

Fig.1

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?

## YES

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S

NO • Go to "Wiring Inspection" procedure.

## **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

## **Control Circuit Inspection**

#### Motor Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of ACV harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. ACV harness connector and chassis ground.

#### Specification : B+

- 6. Ignition switch "OFF"
- 7. Disconnect battery (-) cable.
- 8. Refer to "Shop Manual" and disconnect ACV connector.
- 9. Measure the resistance between motor(+) terminal of ACV harness connector and chassis ground.
- 10. Measure the resistance between motor(-) terminal of ACV harness connector and chassis ground.

#### **Specification** : Infinite ( $\infty \Omega$ )

11. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ACV connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of ACV.

Specification : Approx. 2.92 (Approx. 2.98Ω 20°C/Approx. 68°F)

- 5. Is the measured value within specification?
  - YES 
     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

## 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### A CAUTION

When ACV is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Essential 4. Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

GI-575



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essential work	after component repla	acement	
Essential W	ork after Component Replace	ment j		
If you're rea	dy, select the menu.			
MENU	CANCEL			
Fig.2				

CRC12EN5010P01010042S
### 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## **GI-577**

### P210200 Throttle Actuator Control Motor Circuit Low

### **Component Location**



### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If faulty control circuit of ACV is detected for more than 2 sec., ECM sets DTC P201200. This fault might be casued by open or short to ground in control circuit of ACV.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Open or short to gro	ound in control circuit of ACV	1. Open in control circuit of ACV
Diagnostic Time	• 2 sec		circuit of ACV
	Engine OFF	• No	3. Short to ground in control (-) ci-
	EGR Off	• No	4. Defected ACV
Fall Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Air Cont	rol Valve Terminal		Inspection Condition	Measured Value	Remarks
	1	motor(+)		B+	Signal W- aveform( Fig. 1)
Pin No.	2	motor(-)	<ul> <li>Ignition Switch "ON", Engine "OFF"</li> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	B+	Signal W- aveform( Fig. 2)
	3	ACV Feedback Signal	)	Approx. 5V	-
	4	ACV Position Sensor Power		Approx. 5V	-
	5	ACV Position Sensor Ground	Inspection Condition     Measured Value       •     Ignition Switch "ON", En- gine "OFF"     B+       •     Voltage is measured on wiring side(Disconnected )     B+       ower     Approx. 5V       round     0V       Inspection Condition     Measured Value       Inspection Condition     Measured Value       •     Ignition Switch "ON", En- gine "OFF"     B+       •     Ignition Switch "ON", En- gine "OFF"     B+       •     Voltage is measured on wiring side(Connected)     B+       •     Voltage is measured on wiring side(Connected)     OV	0V	-
Air Cont	rol Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	motor(+)		B+	-
	2	motor(-)	Ignition Switch "ON", En-	B+	-
Pin No.	3	ACV Feedback Signal	<ul> <li>gine "OFF"</li> <li>Voltage is measured on</li> </ul>	Approx. 0.7V	-
	4	ACV Position Sensor Power	wiring side(Connected)	Approx. 5V	-
	5	ACV Position Sensor Ground		0V	-

# **General Information**

📕 Oscil	loscope						<b>-</b>
Senso	r Theme	Name	Review	User Setting	A	14.44 s 🕨 🛛 📢	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save			
+20		Motor +	' Hz : 0	.3 Hz	Duty-: 70 %	Duty+: 30 %	
-5×							В

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-581

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P210200	Throttle Actuator (	Control Motor Circ	uit Low		

CRC12EN5010P21020021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

### Monitor GDS Data

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- Monitor follow parameters in "Current Data" with GDS.

### Specification: Refer to figure below

🧯 Current Data		Search 🗐 🗐 🕼	2) (=
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Rese	et Min.Max Record	Stop 🗘 Grouping VS	SS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Z Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	4
Flag Status of Battery Health(Aging) (AMS)	NO		
Flag Status of Battery Function to Crank the Eng	NO	<u> </u>	
Flag Status of Quiescent Current(AMS)	NO		
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO		
Fig.1			

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?

### YES

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S



NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

### Motor Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of ACV harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. ACV harness connector and chassis ground.

### Specification : B+

- 6. Ignition switch "OFF"
- 7. Disconnect battery (-) cable.
- 8. Refer to "Shop Manual" and disconnect ACV connector.
- 9. Measure the resistance between motor(+) terminal of ACV harness connector and chassis ground.
- 10. Measure the resistance between motor(-) terminal of ACV harness connector and chassis ground.

#### **Specification** : Infinite ( $\infty \Omega$ )

11. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ACV connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of ACV.

Specification : Approx. 2.92 (Approx. 2.98Ω 20°C/Approx. 68°F)

- 5. Is the measured value within specification?
  - YES 
     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

### A CAUTION

When ACV is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Essential 4. Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

GI-583



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	omponent repla	acement	
[ Eccential W	ork ofter Compense	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

# GI-585

<b>E</b> •	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement EGR Valve replacement APS Module replacement APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### P210300 Throttle Actuator Control Motor Circuit High

### **Component Location**



### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If faulty control circuit of ACV is detected for more than 2 sec., ECM sets DTC P201300. This fault might be casued by short in control circuit or short to power in control circuit of ACV.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Short or short to po	wer in control circuit of ACV	1. Short in control circuit of ACV
Diagnostic Time	• 2 sec		rcuit of ACV
	Engine OFF	• No	3. Short to power in control (-) cir-
Fail Safe	EGR Off	• No	4. Defected ACV
	Torque Limit	• Yes	]
	MIL	• On	

### Vehicle Data

Air Cont	rol Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	motor(+)		Value B+ B+ Approx. 5V Approx. 5V 0V	Signal W- aveform( Fig. 1)
Pin No.	2	motor(-)	<ul> <li>Ignition Switch "ON", Engine "OFF"</li> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	В+	Signal W- aveform( Fig. 2)
	3	ACV Feedback Signal	)	Approx. 5V	-
	4 ACV Position Sensor Power		Approx. 5V	-	
	5	ACV Position Sensor Ground		0V	-
Air Cont	rol Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	motor(+)		B+	-
	2	motor(-)	Ignition Switch "ON", En-	B+	-
Pin No.	3	ACV Feedback Signal	<ul><li>gine "OFF"</li><li>Voltage is measured on</li></ul>	Approx. 0.7V	-
	4	ACV Position Sensor Power	wiring side(Connected)	Approx. 5V	-
	5	ACV Position Sensor Ground		0V	-

# **General Information**

📕 Oscil	loscope						<b>-</b>
Senso	r Theme	Name	Review	User Setting	A	14.44 s 🕨 🛛 📢	1s 🕨
Reset	Start ‡	Cursor	ViewAll	Save			
+20		Motor +	' Hz : 0	.3 Hz	Duty-: 70 %	Duty+: 30 %	
-5×							В

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-589

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P210300	Throttle Actuator (	Control Motor Circ	uit High		

CRC12EN5010P21030021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

### Specification: Refer to figure below

Current Data		Search 🗐 🗐	a =
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗧 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	P
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO		
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO	-	

Fig.1

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?

### YES

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S



NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

### Motor Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of ACV harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. ACV harness connector and chassis ground.

### Specification : B+

- 6. Ignition switch "OFF"
- 7. Disconnect battery (-) cable.
- 8. Refer to "Shop Manual" and disconnect ACV connector.
- 9. Measure the resistance between motor(+) terminal of ACV harness connector and chassis ground.
- 10. Measure the resistance between motor(-) terminal of ACV harness connector and chassis ground.

#### **Specification** : Infinite ( $\infty \Omega$ )

11. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ACV connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of ACV.

**Specification** : Approx. 2.92 2.98Ω (Approx. 20°C/Approx. 68°F)

- 5. Is the measured value within specification?
  - YES 
     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

### A CAUTION

When ACV is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Essential 4. Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

GI-591



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement	
[ Eccential W	ork ofter Compense	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

## GI-593

### P211100 Throttle Actuator Control System - Stuck Open

### **Component Location**



### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If excessive current is detected for more than 1 sec., ECM sets DTC P211100. This fault might be casued by short to power in control circuit or internal circuir error on ACV.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>Short to power in co of ACV</li> </ul>	ontrol circuit or internal circuit error	<ol> <li>Short to power in control (+) ci- rcuit of ACV</li> </ol>
Diagnostic Time	• 1 sec		2. Short to power in control (-) cir
	Engine OFF	• No	3. Stuck opened ACV
	EGR Off	• No	4. Defected ACV
Fall Sale	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1 motor(+)				B+	Signal W- aveform( Fig. 1)
Pin No.	2	motor(-)	•	Ignition Switch "ON", En- gine "OFF" Voltage is measured on wiring side(Disconnected	B+	Signal W- aveform( Fig. 2)
	3	ACV Feedback Signal		)	Approx. 5V	-
	4	ACV Position Sensor Power			Approx. 5V	-
	5	ACV Position Sensor Ground			0V	-
Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1	motor(+)			B+	-
	2	motor(-)	]•	Ignition Switch "ON", En-	B+	-
Pin No.	3	ACV Feedback Signal	].	gine "OFF" Voltage is measured on	Approx. 0.7V	-
	4	ACV Position Sensor Power		wiring side(Connected)	Approx. 5V	-
	5	ACV Position Sensor Ground			0V	_

# **General Information**

📕 Oscil	loscope						
Senso	or Theme	Name	Review	User Setting	A	14.44 s 🕨 😽	1s 🕨
Rese	Start ‡	Cursor	ViewAll	Save	M		
+20∨		Motor +	Hz : 0	).3 Hz	Duty-:70 %	Duty+: 30 %	
Conf				1			¬ ]]
igural							
-5×		1					B

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-597

DTC					Retry 🗖
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P211100	Throttle Actuator C	ontrol System - S	tuck Open		

CRC12EN5010P21110021S

#### 4. Is DTC status displayed as Present?



Go to "Monitor GDS Data" procedure.

Go to "Verification of Vehicle Repair" proce-NO dure.

#### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification: Refer to figure below

Current Data		Search 🗐 🚛	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 🤇 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	<b>b</b>
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO	.—.:	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO		

Fig.1

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?



Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

#### Motor Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of ACV harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. ACV harness connector and chassis ground.

#### Specification : B+

- 6. Ignition switch "OFF"
- 7. Disconnect battery (-) cable.
- 8. Refer to "Shop Manual" and disconnect ACV connector.
- 9. Measure the resistance between motor(+) terminal of ACV harness connector and chassis ground.
- 10. Measure the resistance between motor(-) terminal of ACV harness connector and chassis ground.

#### **Specification** : Infinite ( $\infty \Omega$ )

11. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ACV connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of ACV.

**Specification** : Approx. 2.92 2.98Ω (Approx. 20°C/Approx. 68°F)

- 5. Is the measured value within specification?
  - YES 
     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### A CAUTION

When ACV is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Essential 4. Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

GI-599



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essentia	work after co	mponent repl	acement	•
[ Frankish W	a da a fita a Camara a a	Daula anns at 1			
Essential W	ork after Componen	t Replacement J			
If you're rea	dy, select the menu				
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

"Essential Work After Fig.2 ) Component Replacement"

Fig.3) Throttle vale Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### **GI-601**

### P211200 Throttle Actuator Control System - Stuck Closed

### **Component Location**



### 1. Air Control Valve (ACV)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P01220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

When current of control circuit of ACV is "0" for more than 1 sec., ECM sets DTC P211200. This fault might be caused by short to ground in control circuit or internal circuit error of ACV.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	<ul> <li>Short to ground in c of ACV</li> </ul>	control circuit or internal circuit error	1. Short to ground in control (+)
Diagnostic Time	• 1 sec		2. Short to ground in control (-) ci-
	Engine OFF	• No	rcuit of ACV
	EGR Off	• No	3. Defected ACV
Fall Safe	Torque Limit	• Yes	
	MIL	• On	

### Vehicle Data

Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1	1 motor(+)			B+	Signal W- aveform( Fig. 1)
Pin No.	2	motor(-)	•	Ignition Switch "ON", En- gine "OFF" Voltage is measured on wiring side(Disconnected	B+	Signal W- aveform( Fig. 2)
	3	ACV Feedback Signal		)	Approx. 5V	-
	4	ACV Position Sensor Power			Approx. 5V	-
	5	ACV Position Sensor Ground			0V	-
Air Cont	rol Valve	Terminal		Inspection Condition	Measured Value	Remarks
	1	motor(+)			B+	-
	2	motor(-)	•	Ignition Switch "ON", En-	B+	-
Pin No.	Pin No. 3 ACV Feedback Signal	].	gine "OFF" Voltage is measured on	Approx. 0.7V	-	
	4	ACV Position Sensor Power		wiring side(Connected)	Approx. 5V	-
	5	ACV Position Sensor Ground			0V	-

# **General Information**

📕 Osc	illoscope						
Sens	or Theme	Name	Review	User Setting	A	14.44 s 🕨 😽	1s 🕨
Res	et Start ‡	Cursor	ViewAll	Save	M		
+20∨		Motor +	Hz : 0	).3 Hz	Duty-: 70 %	Duty+: 30 %	
onfiguration				l			
-5×		, ,					, В

CRC12EN5010P01220011S



CRC12EN5010P01220012S

Fig.1) Pull-up voltage value of Motor + (Duty = Approx. 70%)

Fig.2) Pull-up voltage value of Motor - (Duty = Approx. 70%)

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-605

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P211200	Throttle Actuator (	Control System - S	Stuck Closed		

CRC12EN5010P21120021S

#### 4. Is DTC status displayed as Present?

- YES Go to "Monitor GDS Data" procedure.
- NO Go to "Verification of Vehicle Repair" proce
  - dure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- Monitor follow parameters in "Current Data" with GDS.

### Specification: Refer to figure below

Current Data		Search 🗐 🚛	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 🤇 Res	et Min.Max Record	Stop   Grouping	VSS
Sensor Name	Value	Unit	1
Inlet Throttle Actuator	-14.5	%	
Ratio of Throttle Valve	13	%	
Engine Speed	790.0	RPM	
Flag Status of Battery Charge(AMS)	NO	-	<b>b</b>
Flag Status of Battery Health(Aging) (AMS)	NO	-	
Flag Status of Battery Function to Crank the Eng	NO	-	
Flag Status of Quiescent Current(AMS)	NO	.—.:	
Invalid Condition of Battery Sensor(AMS)	YES	-	
Response Error Flag from Battery Sensor(AMS)	NO		

Fig.1

Fig.1) ACV current data under engine idle.

5. Is the parameter displayed within specification?

### YES

► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

CRC12EN5010P01220022S

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification" of Vehicle Repair" procedure.

NO 
Go to "Control Circuit Inspection" procedure

### **Control Circuit Inspection**

#### Motor Control Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ACV connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between motor(+) terminal of ACV harness connector and chassis ground.
- Measure the voltage between motor(-) terminal of 5. ACV harness connector and chassis ground.

#### Specification : B+

- 6. Ignition switch "OFF"
- 7. Disconnect battery (-) cable.
- 8. Refer to "Shop Manual" and disconnect ACV connector.
- 9. Measure the resistance between motor(+) terminal of ACV harness connector and chassis ground.
- 10. Measure the resistance between motor(-) terminal of ACV harness connector and chassis ground.

#### **Specification** : Infinite ( $\infty \Omega$ )

11. Is the measured value within specification?



**YES** • Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

#### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect ACV connector.
- Measure the resistance between motor(+) terminal 4. and motor(-) terminal of ACV.

**Specification** : Approx. 2.92 2.98Ω (Approx. 20°C/Approx. 68°F)

- 5. Is the measured value within specification?
  - YES 
     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the ACV and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### A CAUTION

When ACV is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

#### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition switch "ON" & Engine "OFF" 3.
- Perform "Essential 4. Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Throttle Valve"

GI-607



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repla	acement	
[ Eccential W/	ork ofter Componen	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

## GI-609

<b>E •</b>	Essential work after component replacement
[ Essential Work afte If you're ready, sel	MENU  Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement Differential Pressure Sensor replacement EGR Valve replacement APS Module replacement
	SELECT CANCEL
MENU C	ANCEL
Fig.3	

CRC12EN5010P01010043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) Throttle vale Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### P212200 Accelerator Position Sensor 1 Signal Circuit Low Input

### **Component Location**



1. Accelerator Pedal Sensor (APS)

#### **General Description**

Driver's intension to accelerate is transmitted to ECM through Accelerator Pedal Sensor(APS). And APS, whose mechanism is same as TPS, is required for ECM to determine optimum fuel injection quantity. As fidelity of APS is strongly required, APS is devided into two. One is APS1, which outputs main signals and the other is APS2, which monitors APS1 performance. APS1 and 2 do not share power supply and ground.

Normally, APS2 output voltage is the half of APS1 and if the ratio of two signal is out of specified value, error is recognized then, Limp Home mode is activated.When Limp Home mode is activated, engine speed is fixed at 1200RPM and driving performance is limited to prevent excessive power generation due to APS false signal.

### **DTC Description**

If output voltage of APS 1 is below threshold value for more than 0.18 sec., ECM sets DTC P212200. This fault might be caused by short to ground in power/signal circuit or open in power circuit of APS. CRC12EN5010P21220011

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Output voltage is below threshold value		1. Open or short to ground in po-
Diagnostic Time	• 0.18 sec		2. Open in power circuit of APS
Fail Safe	Engine OFF	• No	3. Short to ground in signal circuit
	EGR Off	• No	4. Defected APS
	Torque Limit	• No	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P212200	Accelerator Position Sensor 1 Signal Circuit Low Input	

CRC12EN5010P21220021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

# **General Information**

🛔 Current Data	Search 😰 🗐 🕼
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Res	et Min.Max Record Stop 🗘 Grouping VSS
Sensor Name	Value Unit
Accelerator Pedal Position Sensor	0 %
Accelerator Pedal Position Sensor-1 Voltage	0.75 V
Accelerator Pedal Position Sensor-2 Voltage	0.37 V
Pressure Control Valve(Rail)	31 %
Air Mass per Cylinder	259 mg/hub
Barometric Pressure Sensor	1002 hPa
Clutch Switch (M/T only)	ON -
A/C ON Signal Switch	ON -
Gearbox Neutral Position Status Signal	ON -

### Fig.1

#### CRC12EN5010P21220022S

🍦 Current Data		Search 🔍 🗐	2) E
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	set Min.Max Record	Stop 🗧 Grouping V	/SS
Sensor Name	Value	Unit	Í
Accelerator Pedal Position Sensor	14	%	
Accelerator Pedal Position Sensor-1 Voltage	1.29	V	
Accelerator Pedal Position Sensor-2 Voltage	0.65	V	
Pressure Control Valve(Rail)	34	%	4
Air Mass per Cylinder	606	mg/hub	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

Fig.2

CRC12EN5010P21220023S

🧯 Current Data		Search 😰 🗐 🕋 🚍
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗘 Res	et Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Accelerator Pedal Position Sensor	83	%
Accelerator Pedal Position Sensor-1 Voltage	3.43	v
Accelerator Pedal Position Sensor-2 Voltage	1.71	V
Pressure Control Valve(Rail)	34	%
Air Mass per Cylinder	471	mg/hub =
Barometric Pressure Sensor	1002	hPa –
Clutch Switch (M/T only)	ON	-
A/C ON Signal Switch	ON	-
Gearbox Neutral Position Status Signal	ON	-

#### Fig.3

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

#### CRC12EN5010P21220024S

 $\times$  Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1
# GI-613

- Is the parameter displayed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, contamination, bending, corrosion, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect APS 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS1 power terminal 4. of APS harness connector and chassis ground.

Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure



### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS 3. connector.

Measure the resistance between APS 1 ground 4. terminal of APS harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" 6. and disconnect APT connector.
- 7. Ignition switch "ON"
- Measure the voltage between APS 1 power terminal 8. of APS harness connector and chassis ground.(A)
- 9. Measure the voltage between APS 1 power terminal and APS 1 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect APS connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS 1 signal terminal 4. of APS harness connector and chassis ground.

### Specification : Approx. 0V

- 5. Ignition switch "OFF"
- 6. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS and 7. ECM connector.
- Measure the resistance between APS 1 signal 8 terminal of APS harness connector and APS 1 signal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

Is the measured value within specification? 9.



- Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

# **General Information**

### **Component Inspection**

### Accelerator Pedal Position Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : APS 1 signal terminal (APS Harness Connector)

Channel A (-) : Ground

Channel B (+) : APS2 signal terminal (APS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Operate the APS

#### Specification : Refer to table below

li e e e	Output Voltage (V) (Vref = 5.0V)		
item	APS1	APS2	
Not pressed (V)	Approx. 0.7 ~ 0.8	Approx 0.29 ~ 0.46	
Fully pressed (V)	Approx. 3.85 ~ 4.35	Approx. 1.93 ~ 2.18	

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the APS and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### 

When APS is replaced, perform "Essential work ٠ after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "APS Module Change"

<b>E *</b>	Special Function 😽 🖭	1 î
	Injector Specific Data	Ô
	Essential work after component replaceme	nt
	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	Ţ
Favorite		
Fig.1		

CRC12EN5010P01010041S

# **General Information**

<b>F *</b>	Essential work after component replacement	
[ Essential W	ork after Component Replacement ]	
If you're rea	dy, select the menu.	
MENU	CANCEL	
Fig.2		

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [ Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P21220043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) APS Module Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

### **GI-617**

### P212300 Accelerator Position Sensor 1 Signal Circuit High Input

### **Component Location**



### 1. Accelerator Pedal Sensor (APS)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P21220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **General Description**

If output voltage of APS 1 is above threshold value for more than 0.18 sec., ECM sets DTC P212300. This fault might be caused by short to power in power/signal circuit or open in ground circuit of APS.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Output voltage is al	pove threshold value	1. Short to power in power circuit
Diagnostic Time	• 0.18 sec		2. Open in ground circuit of APS
Fail Safe	Engine OFF	• No	3. Short to power in signal circuit
	EGR Off	• No	4. Defected APS
	Torque Limit	• No	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P212300	Accelerator Position Sensor 1 Signal Circuit High Input	

CRC12EN5010P21230021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

## **General Information**

🚪 Current Data		Search 🔍 🏭	<b>a</b> E
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Reset Min.N	lax Record	Stop ‡ Grouping	VSS
Sensor Name	Value	Unit	1
Accelerator Pedal Position Sensor	0	%	
Accelerator Pedal Position Sensor-1 Voltage	0.75	٧	
Accelerator Pedal Position Sensor-2 Voltage	0.37	V	
Pressure Control Valve(Rail)	31	%	-
Air Mass per Cylinder	259	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON		
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

### Fig.1

#### CRC12EN5010P21220022S

🛔 Current Data		Search 🔍 🗐	2) e
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Re	set Min.Max Record	Stop 🗧 Grouping V	SS
Sensor Name	Value	Unit	í
Accelerator Pedal Position Sensor	14	%	
Accelerator Pedal Position Sensor-1 Voltage	1.29	V	
Accelerator Pedal Position Sensor-2 Voltage	0.65	V	
Pressure Control Valve(Rail)	34	%	
Air Mass per Cylinder	606	mg/hub	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

Fig.2

CRC12EN5010P21220023S

Current Data		Search 😰 💷 🚑 🖃
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 Items List 🗧 Res	el Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Accelerator Pedal Position Sensor	83	%
Accelerator Pedal Position Sensor-1 Voltage	3.43	V
Accelerator Pedal Position Sensor-2 Voltage	1.71	V
Pressure Control Valve(Rail)	34	%
Air Mass per Cylinder	471	mg/hub 📲
Barometric Pressure Sensor	1002	hPa –
Clutch Switch (M/T only)	ON	-
A/C ON Signal Switch	ON	-
Gearbox Neutral Position Status Signal	ON	-

#### Fig.3

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

#### CRC12EN5010P21220024S

 $\times$  Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

# GI-621

- Is the parameter displayed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor connection, contamination, bending, corrosion, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect APS 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS1 power terminal 4. of APS harness connector and chassis ground.

Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure



### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS 3. connector.

Measure the resistance between APS 1 ground 4. terminal of APS harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" 6. and disconnect APT connector.
- 7. Ignition switch "ON"
- Measure the voltage between APS 1 power terminal 8. of APS harness connector and chassis ground.(A)
- 9. Measure the voltage between APS 1 power terminal and APS 1 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect APS connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS 1 signal terminal 4. of APS harness connector and chassis ground.

### Specification : Approx. 0V

- 5. Ignition switch "OFF"
- 6. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS and 7. ECM connector.
- Measure the resistance between APS 1 signal 8 terminal of APS harness connector and APS 1 signal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

Is the measured value within specification? 9.



- Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Accelerator Pedal Position Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : APS 1 signal terminal (APS Harness Connector)

Channel A (-) : Ground

Channel B (+) : APS2 signal terminal (APS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Operate the APS

#### Specification : Refer to table below

li e e e	Output Voltage (V) (Vref = 5.0V)		
item	APS1	APS2	
Not pressed (V)	Approx. 0.7 ~ 0.8	Approx 0.29 ~ 0.46	
Fully pressed (V)	Approx. 3.85 ~ 4.35	Approx. 1.93 ~ 2.18	

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the APS and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### 

When APS is replaced, perform "Essential work ٠ after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "APS Module Change"

<b>E *</b>	Special Function 😽 🖭	1 î
	Injector Specific Data	Ô
	Essential work after component replaceme	nt
	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	Ţ
Favorite		
Fig.1		

CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	l work after co	omponent repl	acement	
[ Eccential W		t Donlacement 1			
	ork after Componen	it Replacement j			
If you're rea	dy, select the menu	ı.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P21220043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) APS Module Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### GI-625

### P212700 Accelerator Position Sensor 2 Signal Circuit Low Input

### **Component Location**



### 1. Accelerator Pedal Sensor (APS)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

- an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P21220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If output voltage of APS 2 is below threshold value for more than 0.18 sec., ECM sets DTC P212700. This fault might be caused by short to ground in power/signal circuit or open in power circuit of APS.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Output voltage is be	elow threshold value	1. Open or short to ground in po-
Diagnostic Time	• 0.18 sec		2. Open in power circuit of APS
	Engine OFF	• No	3. Short to ground in signal circuit
Fail Safe	EGR Off	• No	4. Defected APS
	Torque Limit	• No	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P212700	Accelerator Position Sensor 2 Signal Circuit Low Input	

CRC12EN5010P21270021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

## **General Information**

🚪 Current Data		Search 🔍 🏭	<b>a</b> E
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 😂 Reset Min.N	lax Record	Stop ‡ Grouping	VSS
Sensor Name	Value	Unit	1
Accelerator Pedal Position Sensor	0	%	
Accelerator Pedal Position Sensor-1 Voltage	0.75	٧	
Accelerator Pedal Position Sensor-2 Voltage	0.37	V	
Pressure Control Valve(Rail)	31	%	-
Air Mass per Cylinder	259	mg/hub	
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON		
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

### Fig.1

#### CRC12EN5010P21220022S

🛔 Current Data		Search 🔍 🗐	2) e
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Re	set Min.Max Record	Stop 🗧 Grouping V	SS
Sensor Name	Value	Unit	í
Accelerator Pedal Position Sensor	14	%	
Accelerator Pedal Position Sensor-1 Voltage	1.29	V	
Accelerator Pedal Position Sensor-2 Voltage	0.65	V	
Pressure Control Valve(Rail)	34	%	
Air Mass per Cylinder	606	mg/hub	-
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

Fig.2

CRC12EN5010P21220023S

Current Data		Search 😰 💷 🚑 🖃
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 Items List 🗧 Res	el Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Accelerator Pedal Position Sensor	83	%
Accelerator Pedal Position Sensor-1 Voltage	3.43	V
Accelerator Pedal Position Sensor-2 Voltage	1.71	V
Pressure Control Valve(Rail)	34	%
Air Mass per Cylinder	471	mg/hub 📲
Barometric Pressure Sensor	1002	hPa –
Clutch Switch (M/T only)	ON	-
A/C ON Signal Switch	ON	-
Gearbox Neutral Position Status Signal	ON	-

#### Fig.3

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

#### CRC12EN5010P21220024S

 $\times$  Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

## GI-629

- Is the parameter displayed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor contamination, connection, bending, corrosion, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "Power Circuit Inspection" procedure. NO

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect APS 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS2 power terminal 4. of APS harness connector and chassis ground.

Specification : Approx. 5V

5. Is the measured value within specification?

YES 
Go to "Ground Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS 3. connector.

Measure the resistance between APS 2 ground 4. terminal of APS harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" 6. and disconnect APT connector.
- 7. Ignition switch "ON"
- Measure the voltage between APS 2 power terminal 8. of APS harness connector and chassis ground.(A)
- 9. Measure the voltage between APS 2 power terminal and APS 2 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect APS connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS 2 signal terminal 4. of APS harness connector and chassis ground.

### Specification :0V

- 5. Ignition switch "OFF"
- 6. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS and 7. ECM connector.
- Measure the resistance between APS 2 signal 8 terminal of APS harness connector and APS 2 signal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

Is the measured value within specification? 9.



- Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Accelerator Pedal Position Sensor Inspection

- Ignition switch "OFF" 1.
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : APS 1 signal terminal (APS Harness Connector)

Channel A (-) : Ground

Channel B (+) : APS2 signal terminal (APS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Operate the APS

#### Specification : Refer to table below

litere	Output Voltage (V) (Vref = 5.0V)		
item	APS1	APS2	
Not pressed (V)	Approx. 0.7 ~ 0.8	Approx 0.29 ~ 0.46	
Fully pressed (V)	Approx. 3.85 ~ 4.35	Approx. 1.93 ~ 2.18	

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the APS and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### 

When APS is replaced, perform "Essential work ٠ after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "APS Module Change"

<b>E *</b>	Special Function 😽 🖭	1 î
	Injector Specific Data	Ô
	Essential work after component replaceme	nt
	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	Ţ
Favorite		
Fig.1		

CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	omponent repla	acement	
[ Eccential W	ork ofter Compense	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P21220043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) APS Module Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### GI-633

### **General Information**

### P212800 Accelerator Position Sensor 2 Signal Circuit-High Input

### **Component Location**



#### 1. Accelerator Pedal Sensor (APS)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

 an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P21220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If output voltage of APS 2 is above threshold value for more than 0.18 sec., ECM sets DTC P212800. This fault might be caused by short to power in power/signal circuit or open in ground circuit of APS.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value	Output voltage is below threshold value		1. Short to power in power circuit
Diagnostic Time	• 0.18 sec		2. Open in ground circuit of APS:
	Engine OFF	• No	3. Short to power in signal circuit
Fail Safe	EGR Off	• No	4. Defected APS
	Torque Limit	• No	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P212800	Accelerator Position Sensor 2 Signal Circuit-High Input	
		1

CRC12EN5010P21280021S

4. Is DTC status displayed as Present?



YES • Go to "Monitor GDS Data" procedure.



NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

## **General Information**

🛔 Current Data	Search 😰 🗐 🕋
Selective Display 🗧 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗧 Res	et Min.Max Record Stop ‡ Grouping VSS
Sensor Name	Value Unit
Accelerator Pedal Position Sensor	0 %
Accelerator Pedal Position Sensor-1 Voltage	0.75 V
Accelerator Pedal Position Sensor-2 Voltage	0.37 V
Pressure Control Valve(Rail)	31 %
Air Mass per Cylinder	259 mg/hub =
Barometric Pressure Sensor	1002 hPa
Clutch Switch (M/T only)	ON -
A/C ON Signal Switch	ON -
Gearbox Neutral Position Status Signal	ON -

### Fig.1

#### CRC12EN5010P21220022S

🝦 Current Data		Search 🚉 🗐	2) (E
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	set Min.Max Record	Stop ‡ Grouping	/SS
Sensor Name	Value	Unit	í
Accelerator Pedal Position Sensor	14	%	
Accelerator Pedal Position Sensor-1 Voltage	1.29	V	
Accelerator Pedal Position Sensor-2 Voltage	0.65	V	
Pressure Control Valve(Rail)	34	%	-
Air Mass per Cylinder	606	mg/hub	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	_	
Gearbox Neutral Position Status Signal	ON		

Fig.2

CRC12EN5010P21220023S

Current Data		Search 😰 🗐 📾
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Re	set Min.Max Record	Stop Crouping VSS
Sensor Name	Value	Unit
Accelerator Pedal Position Sensor	83	%
Accelerator Pedal Position Sensor-1 Voltage	3.43	V
Accelerator Pedal Position Sensor-2 Voltage	1.71	V
Pressure Control Valve(Rail)	34	%
Air Mass per Cylinder	471	mg/hub 💡
Barometric Pressure Sensor	1002	hPa –
Clutch Switch (M/T only)	ON	-
A/C ON Signal Switch	ON	-
Gearbox Neutral Position Status Signal	ON	-

#### Fig.3

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

#### CRC12EN5010P21220024S

 $\times$  Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

## GI-637

- Is the parameter displayed within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor contamination, connection, bending, corrosion, deterioration, or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- Refer to "Shop Manual" and disconnect APS 2. connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS2 power terminal 4. of APS harness connector and chassis ground.

Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Ground Circuit Inspection" procedure



### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS 3. connector.

Measure the resistance between APS 2 ground 4. terminal of APS harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" 6. and disconnect APT connector.
- 7. Ignition switch "ON"
- Measure the voltage between APS 2 power terminal 8. of APS harness connector and chassis ground.(A)
- 9. Measure the voltage between APS 2 power terminal and APS 2 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?

YES

- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect APS connector.
- Ignition switch "ON" 3.
- Measure the voltage between APS 2 signal terminal 4. of APS harness connector and chassis ground.

### Specification :0V

- 5. Ignition switch "OFF"
- 6. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect APS and 7. ECM connector.
- Measure the resistance between APS 2 signal 8 terminal of APS harness connector and APS 2 signal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

Is the measured value within specification? 9.



- Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Accelerator Pedal Position Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : APS 1 signal terminal (APS Harness Connector)

Channel A (-) : Ground

Channel B (+) : APS2 signal terminal (APS Harness Connector)

Channel B (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Operate the APS

#### Specification : Refer to table below

ltere	Output Voltage (V) (Vref = 5.0V)		
item	APS1	APS2	
Not pressed (V)	Approx. 0.7 ~ 0.8	Approx 0.29 ~ 0.46	
Fully pressed (V)	Approx. 3.85 ~ 4.35	Approx. 1.93 ~ 2.18	

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 

 Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the APS and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within specification
- If component is dropped, check for proper operation. The internal damage may be present

#### 

When APS is replaced, perform "Essential work ٠ after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "APS Module Change"

<b>E *</b>	Special Function 😽 💷	1 î
	Injector Specific Data	Ô
	Essential work after component replacemen	t
	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	
Favorite		
Fig.1		

CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement	
[ Eccential W	ork ofter Componen	t Poplacement 1			
	ork after componen	г керіасеттені ј			
If you're rea	dy, select the menu				
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P21220043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) APS Module Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES • Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

### GI-641

### **General Information**

### P213800 Accelerator Position Sensor 1 & 2 Signal Voltage Correlation

### **Component Location**



### 1. Accelerator Pedal Sensor (APS)

#### **General Description**

The Throttle Control Actuator is mounted on throttle body of diesel engine and controls throttle valve according to PWM (Pulse With Modulation) signal from ECM.

It consists of;

- a DC motor which actuates the throttle valve.

 a 2-step gear which is located in between the DC motor and the throttle valve and increases torque of the DC motor.

- a position sensor which is a hall-effect sensor and detects status of the throttle valve.

 an electric control unit which is a micro-controller and drives the DC motor by the PWM (Pulse With Modulation) signal from the ECM.

- and a reset spring which resets the de-energized throttle valve to its open position.

Its function is described below:

1) Anti-judder function: When engine is shut off, the ECM can prevent intake air from entering to intake manifold by fully closing the throttle valve to reduce engine vibration.

2) Intake air control for EGR: When exhaust gas pressure is equal to or lower than intake air pressure (for example, when low engine speed), the exhaust gas would not enter to the intake manifold. At this time, the ECM partially closes the throttle valve to reduce the intake air quantity. The intake air pressure thus is lower than the exhaust gas pressure.

#### CRC12EN5010P21220011

3) Exhaust gas temperature control for DPF regeneration: When the Diesel Particulate Filter (DPF) is need to regenerate, the ECM partially closes the throttle valve to reduce the intake air quantity. At this time, the air-fuel ratio would become rich and the exhaust gas temperature would be high enough to burn the soot inside the DPF.

#### **DTC Description**

If output voltage difference between APS1 and APS2 is out of specification, ECM sets DTC P213800.

### **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Conditions	Engine running		
Threshold Value • Output voltage difference between APS1 and APS2 is out of specification			
Diagnostic Time	• -		1. Faulty APS1 and APS2 circuit
	Engine OFF	• No	2. Defected APS
<b>=</b> " <b>o</b> <i>i</i>	EGR Off	• No	
Fall Safe	Torque Limit	• No	
	MIL	• On	

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P213800	Accelerator Position Sensor 1 & 2 Signal Voltage Correlation	

CRC12EN5010P21380021S

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### **Monitor GDS Data**

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

## **General Information**

🚪 Current Data		Search 🔍 💷	<b>8</b> E
Selective Display 🗘 📔 Full List 💠 🗍 Graph 💠 🗍 Items List 🗧 Reset Min.M	lax Record	Stop 🗧 Grouping	VSS
Sensor Name	Value	Unit	i
Accelerator Pedal Position Sensor	0	%	
Accelerator Pedal Position Sensor-1 Voltage	0.75	V	
Accelerator Pedal Position Sensor-2 Voltage	0.37	V	
Pressure Control Valve(Rail)	31	%	
Air Mass per Cylinder	259	mg/hub	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON		
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

### Fig.1

#### CRC12EN5010P21220022S

🍦 Current Data		Search 🔍 🗐	2) E
Selective Display 🛊 📔 Full List 💠 🗍 Graph 💠 Items List 🗘 Res	set Min.Max Record	Stop 🗧 Grouping V	/SS
Sensor Name	Value	Unit	Í
Accelerator Pedal Position Sensor	14	%	
Accelerator Pedal Position Sensor-1 Voltage	1.29	V	
Accelerator Pedal Position Sensor-2 Voltage	0.65	V	
Pressure Control Valve(Rail)	34	%	4
Air Mass per Cylinder	606	mg/hub	=
Barometric Pressure Sensor	1002	hPa	
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	<u> </u>	
Gearbox Neutral Position Status Signal	ON		

Fig.2

CRC12EN5010P21220023S

🚪 Current Data		Search 😰 🗐 🕋	3
Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Re	set Min.Max Record	Stop ‡ Grouping VSS	
Sensor Name	Value	Unit	
Accelerator Pedal Position Sensor	83	%	
Accelerator Pedal Position Sensor-1 Voltage	3.43	v	
Accelerator Pedal Position Sensor-2 Voltage	1.71	V	
Pressure Control Valve(Rail)	34	%	
Air Mass per Cylinder	471	mg/hub	
Barometric Pressure Sensor	1002	hPa	8
Clutch Switch (M/T only)	ON	-	
A/C ON Signal Switch	ON	-	
Gearbox Neutral Position Status Signal	ON	-	

#### Fig.3

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

#### CRC12EN5010P21220024S

 $\times$  Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

### GI-645

- Is the parameter displayed within specification?
  - **YES** > Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness(es) and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check connectors for looseness, poor contamination, connection, bending, corrosion, deterioration, or damage.
- 3. Has a problem been found?



NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect APS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between APS1 power terminal of APS harness connector and chassis ground.

#### Specification : Approx. 5V

- Ignition switch "OFF" 5.
- Refer to "Shop Manual" and disconnect APS 6. connector.
- Ignition switch "ON" 7.
- Measure the voltage between APS2 power terminal 8. of APS harness connector and chassis ground.

Specification : Approx. 5V

Is the measured value within specification? 9



YES • Go to "Ground Circuit Inspection" procedure



Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect APS connector.
- 4. Measure the resistance between APS 1 ground terminal of APS harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- Disconnect battery (-) cable. 6
- 7. Refer to "Shop Manual" and disconnect APS connector.
- Measure the resistance between APS 2 ground 8. terminal of APS harness connector and chassis ground.

### Specification : Approx. below 1Ω

- 9. Ignition switch "OFF"
- 10. Refer to "Shop Manual" and disconnect APT connector.
- 11. Ignition switch "ON"
- 12. Measure the voltage between APS 1 power terminal of APS harness connector and chassis ground.(A)
- 13. Measure the voltage between APS 1 power terminal and APS 1 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

- 14. Ignition switch "OFF"
- 15. Refer to "Shop Manual" and disconnect APT connector.
- 16. Ignition switch "ON"
- 17. Measure the voltage between APS 2 power terminal of APS harness connector and chassis ground.(A)
- 18. Measure the voltage between APS 2 power terminal and APS 2 ground terminal of APS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

19. Is the measured value within specification?



YES 
Go to "Signal Circuit Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect APS connector.
- Measure the voltage between APS 1 signal terminal 4. of APS harness connector and chassis ground.

### Specification :0V

- Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect APS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between APS 2 signal terminal of APS harness connector and chassis ground.

### Specification: 0V

- 9. Ignition switch "OFF"
- 10. Disconnect battery (-) cable.
- 11. Refer to "Shop Manual" and disconnect APS and ECM connector.
- 12. Measure the resistance between APS 1 signal terminal of APS harness connector and APS 1 signal of ECM harness connector.

Specification : Approx. below 1  $\Omega$ 

- 13. Ignition switch "OFF"
- 14. Disconnect battery (-) cable.
- 15. Refer to "Shop Manual" and disconnect APS and ECM connector.
- 16. Measure the resistance between APS 2 signal terminal of APS harness connector and APS 2 signal of ECM harness connector.

#### Specification : Approx. below 1 $\Omega$

17. Is the measured value within specification?



- **YES** Go to "Component Inspection" procedure.
- NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

C	omponent Inspection	Specification : Refer to table below
•	Accelerator Pedal Position Sensor Inspection	
1.	Ignition switch "OFF"	
2.	Connect VMI to GDS and set up the Oscilloscope.(2 Channel):	
	Channel A (+) : APS 1 signal terminal (APS Harness Connector)	
	Channel A (-) : Ground	
	Channel B (+) : APS2 signal terminal (APS Harness Connector)	
	Channel B (-) : Ground	
3.	Ignition switch "ON" & Engine "OFF"	
4.	Operate the APS	

litere	Output Voltage (V) (Vref = 5.0V)		
nem	APS1	APS2	
Not pressed (V)	Approx. 0.7 ~ 0.8	Approx 0.29 ~ 0.46	
Fully pressed (V)	Approx. 3.85 ~ 4.35	Approx. 1.93 ~ 2.18	

- 5. Is the measured value within specification?

YES 

 Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO 
Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the APS and go to "Verification of Vehicle Repair" procedure.

### 

- When installing component, tighten it within • specification
- If component is dropped, check for proper • operation. The internal damage may be present

### 

When APS is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed

## **General Information**

### Vehicle S/W Management

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "APS Module Change"

🖅 🐳	Special Function	\$ 🖸 🖓	1 ñ
	Injector Specific Data		Ô
O	Essential work after component replace	cemen	t
0	Engine Test Function		
O	Fuel line air removal		
0	DPF Service Regeneration		
Favorite			
Fig.1			

CRC12EN5010P01010041S
# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

## GI-649

# **General Information**

🖙 < Essential work after component replacement
[ Essential Work after MENU If you're ready, selv Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement
SELECT CANCEL
MENU CANCEL
Fig 3

CRC12EN5010P21220043S

Fig.1 ) Vehicle S/W Management list of Engine

Fig.2 ) "Essential Work After Component Replacement"

Fig.3) APS Module Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# GI-651

CRC12EN5010P02190011

## P222800 Barometric Pressure Circuit Low Input

## **Component Location**



# 1. Engine Control Module (Atmoshpere Pressure Sensor Integrated)

#### **General Description**

The Barometric Pressure Sensor (BPS) is located inside the ECM. It detects the atmospheric pressure at the vehicle's current location. The barometric pressure sensor signal is used to calculates the density of the air. The Barometric Pressure Sensor plays an important role when driving in the mountains and in different altitudes.

#### **General Description**

If output voltage of barometric pressure sensor is below threshold value for more than 1 sec., ECM sets DTC P222800.

## **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Output voltage is be	elow threshold value	
Detecting Time	• 1 sec		1. Poor connector connection
	Engine OFF	• No	2. Defected ECM
Fail Safe	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

## **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P222800	Barometric Pressure Circuit Low Input	

4. Is DTC status displayed as Present?

- YES Go to "Wiring Inspection" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECM connector.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of ECM harness connector and chassis ground.

#### Specification :B+

5. Is the measured value within specification?



Go to "Ground Circuit Inspection" procedure

- CRC12EN5010P22280021S
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Is the measured value within specification? 5.
  - YES Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- Barometric Pressure Sensor Inspection
- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- Monitor "Barometric Pressure Sensor" parameter in 4. "Current Data" with GDS.

#### Specification : Approx. 1000 hPa

# GI-65

Current Data		Search 🙉 🚛	
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 🗘 Items List 🗘 Res	et Min.Max Record	Stop 🗘 Grouping	VSS
Sensor Name	Value	Unit	1
Boost Pressure Sensor	1777	hPa	
Atmospheric Pressure	1010	hPa	
Barometric Pressure Sensor	1002	hPa	
Ignition Switch	ON		
Accelerator Pedal Position Sensor	87	%	
Pressure Control Valve(Rail)	35	%	E
Air Mass per Cylinder	771	mg/hub	
Clutch Switch (M/T only)	ON		
A/C ON Signal Switch	ON	-	

#### Fig.1

Fig.1) Boost pressure and barometric pressure under Ignition switch "ON"

- 5. Is the parameter displayed within specification?
- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- Go to "Diagnostic Trouble Codes(DTC) Ins-NO pection" procedure.

#### Diagnostic Trouble Codes(DTC)

- Ignition switch "OFF" 1.
- Connect GDS to Data Link Connector (DLC). 2.
- Ignition switch "ON" 3.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- Clear any DTCs stored in the system with GDS. 5.
- Re-check DTC in the system with GDS. 6.
- Did the same DTC is stored in the system? 7.

YES 
Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

#### CRC12EN5010P22280041S

Fault is intermittent caused by poor contact NO in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

## 

After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- Connect GDS to Data Link Connector(DLC). 2.
- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

# **General Information**



CRC12EN5010P01010041S

# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

## GI-655

# **General Information**

🖅 🐳	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU  Fissential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU C	ANCEL

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# GI-657

CRC12EN5010P02190011

## P222900 Barometric Pressure Circuit High Input

## **Component Location**



1. Engine Control Module (Atmoshpere Pressure Sensor Integrated)

#### **General Description**

The Barometric Pressure Sensor (BPS) is located inside the ECM. It detects the atmospheric pressure at the vehicle's current location. The barometric pressure sensor signal is used to calculates the density of the air. The Barometric Pressure Sensor plays an important role when driving in the mountains and in different altitudes.

#### **General Description**

If output voltage of barometric pressure sensor is below threshold value for more than 1 sec., ECM sets DTC P222800.

## **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Voltage monitoring		
Enable Condition	Engine running		
Threshold Value	Output voltage is at	oove threshold value	
Detecting Time	• 1 sec		1. Poor connector connection
	Engine OFF	• No	2. Defected ECM
Fail Safe	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

## **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# **General Information**

DTC		æ 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC \$	
Current DTC	Description	State
P222900	Barometric Pressure Circuit High Input	

4. Is DTC status displayed as Present?

- YES Go to "Wiring Inspection" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

## **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect ECM connector.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of ECM harness connector and chassis ground.

## Specification :B+

5. Is the measured value within specification?



Go to "Ground Circuit Inspection" procedure

- CRC12EN5010P22290021S
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect ECM 3. connector.
- 4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Is the measured value within specification? 5.
  - YES Go to "Component Inspection" procedure.
  - NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

## Barometric Pressure Sensor Inspection

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "OFF"
- Monitor "Barometric Pressure Sensor" parameter in 4. "Current Data" with GDS.

#### Specification : Approx. 1000 hPa

# GI-659

Current Data		Search 🙉 🚛	
Selective Display 🗘 📔 Fuli List 💠 🗍 Graph 💠 🗍 items List 🗘 Res	et Min.Max Record	Stop 🗘 Grouping	VSS
Sensor Name	Value	Unit	
Boost Pressure Sensor	1777	hPa	
Atmospheric Pressure	1010	hPa	
Barometric Pressure Sensor	1002	hPa	
Ignition Switch	ON		
Accelerator Pedal Position Sensor	87	%	
Pressure Control Valve(Rail)	35	%	E
Air Mass per Cylinder	771	mg/hub	
Clutch Switch (M/T only)	ON		
A/C ON Signal Switch	ON		

#### Fig.1

Fig.1) Boost pressure and barometric pressure under Ignition switch "ON"

- 5. Is the parameter displayed within specification?
- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- Go to "Diagnostic Trouble Codes(DTC) Ins-NO pection" procedure.

#### Diagnostic Trouble Codes(DTC)

- Ignition switch "OFF" 1.
- Connect GDS to Data Link Connector (DLC). 2.
- Ignition switch "ON" 3.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.
- Clear any DTCs stored in the system with GDS. 5.
- Re-check DTC in the system with GDS. 6.
- Did the same DTC is stored in the system? 7.

YES 
Carefully re-do this troubleshooting guide steps.

> If no problems were found with the circuits or connectors, replace the ECM and go to "Verification of Vehicle Repair" procedure.

#### CRC12EN5010P22280041S

Fault is intermittent caused by poor contact NO in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

## 

After replacing the ECM, the injector specific data (7 digit) of each cylinder MUST be input into ECM with the GDS.

#### Vehicle S/W Management

- Ignition Switch "OFF" 1.
- Connect GDS to Data Link Connector(DLC). 2.
- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "ECU Change"

# **General Information**



CRC12EN5010P01010041S

# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

# GI-661

# **General Information**

🖅 🐳	Essential work after component replacement
[ Essential Work afte If you're ready, sele	MENU  Fissential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU C	ANCEL

CRC12EN5010P05620043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) ECU Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

YES 
Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

# GI-663

## P226400 Water in Fuel Sensor Circuit Low

#### **Component Location**



1. Water in fuel sensor

#### **General Description**

Diesel fuel filter can separate water from fuel. If water more than specified amount is detected by "water in fuel sensor" installed at the bottom of fuel filter, "Fuel warning lamp" on cluster turns ON. Especially for high pressure pump and injectors of common rail diesel engine water is fatal. because water causes poor lubrication and corrosion in such accurate devices, furthermore, it leads engine hesitation. In order to prevent this harsh condition to engine, "Water warning lamp" turns ON to let driver relief the gathered water from the filter and engine power generation is limited.

#### **DTC Description**

P226400 is set when water in fuel sensor operates for more than 4 sec. Water warning lamp turns on and engine power generation is limited in this condition. When this code is set, water in the filter should be removed to prevent engine from water contained fuel. If same code is set even after removing water, check short to battery in water in fuel sensor signal circuit or component failure. CRC12EN5010P22640011

## **DTC Detecting Condition**

ltem	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Short to power in si	ignal circuit	1. Poor connector connection
Detecting Time	• 4 sec		2. Water in fuel filter
	Engine OFF	• No	of water in fuel sensor
Fail Safe	EGR OFF	• No	4. Defected water in fuel sensor
	Torque Limit	• Yes	
	MIL	• On	

#### Vehicle Data

Water In F	uel Sensor	Terminal	Inspection Condition	Measured Valu- e	Remarks
	1	Power	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	B+	-
Pin No.	2	Signal	<ul> <li>Voltage is measured on wiring side(Discon-</li> </ul>	0V	-
	3	Ground	nected)	0V	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC					Retry
Erase All DTC	Freeze Frame	DTC Status	Erase Selective DTC	Hist/Pend DTC \$	
Current DTC	Description				State
P226400	Water in Fuel Sen	sor Circuit Low			

#### 4. Is DTC status displayed as Present?

- **YES** Go to "Wiring Inspection" procedure.
- NO Go to "Verification of Vehicle Repair" procedure.

#### CRC12EN5010P22640021S

#### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination,

deterioration, and/or damage.

3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect water in fuel 2. sensor connector.
- Ignition switch "ON" 3.
- Measure the voltage between power terminal of water 4. in fuel sensor harness connector and chassis ground.

#### Specification : B+

- 5. Is the measured value within specification?
  - YES 
    Go to "Ground Circuit Inspection" procedure
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.
- 3. Refer to "Shop Manual" and disconnect water in fuel sensor connector.
- Measure the resistance between ground terminal of 4. water in fuel sensor harness connector and chassis ground.

#### Specification : Approx. below $1\Omega$

- Ignition switch "OFF" 5.
- 6. Refer to "Shop Manual" and disconnect water in fuel sensor connector.
- Ignition switch "ON" 7.
- 8. Measure the voltage between power terminal of water in fuel sensor harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of water in fuel sensor harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?



YES 
Go to "Signal Circuit Inspection" procedure.

 Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect water in fuel sensor connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of water 4. in fuel sensor harness connector and chassis ground.

#### Specification :0V

- Ignition switch "OFF" 5.
- Disconnect battery (-) cable. 6.
- Refer to "Shop Manual" and disconnect water in fuel 7. and ECM connector.
- Measure the resistance between signal terminal of 8. water in fuel harness connector and signal of ECM harness connector.

#### **Specification** : Approx. below 1 $\Omega$

- 9. Is the measured value within specification?
  - YES
- Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove fuel filter assembly. The filter must be kept in vertical to avoid spills.
- Remove water in fuel sensor from the filter and pour 3 the fuel in the clean container.
- 4. Has any water presence in the fuel?
  - YES ► Check for odometer and filter usage duration.

If too much water is presence in the fuel, refer to "Shop Manual" and inspect the fuel tank. Clean or replace the fuel tank as necessary.

If no problems were found with the circuits or connectors, replace the fuel filter and go to " Verification of Vehicle Repair" procedure.



- NO 

   Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the water in fuel sensor and go to "Verification of Vehicle Repair" procedure.

## **A**CAUTION

O-ring must be change with new one, when ٠ replacing the fuel filter.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?





NO Problem is corrected and the system operation performs to specification at this time.

# GI-667

# P242C00 Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3 (Upstream LNT)

## **Component Location**



CRC12EN5010P242C0011

## 1. Exhaust Gas Temperature Sensor (EGTS) #1 (T4)

## 2. Exhaust Gas Temperature Sensor (EGTS) #2 (T5) General Description

Exhaust Gas Temperature Sensor (EGTS) #1 / #2 is each installed on upstream of LNT and upstream of DPF. EGTS monitors the temperature of exhaust gas that flows to E-VGT and DPF. ECM uses exhaust gas to burn off the soot accumulated in DPF when DPF regeneration condition is met. The exhaust gas temperature is one of the essential factor on engine operation.

Exhaust gas temperature sensor #1 (T4) : The post 1 injection increases exhaust gas temperature directly. EGTS #1 monitors successful post 1 injection with EGTS #1 and prevent excessive temperture increase.

Exhaust gas temperature #2 (T5) : The post 2 injection supplies HC(un-burned fuel) to oxidation catalyst converter. The HC(un-burned fuel) that supplied to oxidation catalyst converter is chemically reacted and increases the temperature of DPF and burn off the soot. EGTS #2 monitors temperature of DPF to prevent damage of DPF.

## **DTC Description**

If the output voltage of EGTS #1 is below threshold value for more than 3 sec., ECM sets DTC P242C00. This fault might be caused by short to ground in signal circuit of EGTS #1.

## DTC Detecting Condition

ltem	Det	tecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul><li>Output signal is below threshold value</li><li>Short to ground in signal circuit</li></ul>		1 Short to ground in signal sizewit
Detecting Time	• 3 sec		of EGTS #1
	Engine OFF	• No	2. Defected EGTS #1
	EGR OFF	• No	
Fail Sale	Torque Limit	• No	
	MIL	• On	

## Vehicle Data

Exhaust Gas Tem- perature Sensor Terminal Inspection Condition		Inspection Condition	Measured Value	Remarks	
		Signal	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5V	-
Pin No.	2	Ground	Voltage is measured on wiring side(Disconnected)	0V	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P242C00	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 3(Upstream LNT)	

CRC12EN5010P242C0021S

#### 4. Is DTC status displayed as Present?



**YES** • Go to "Wiring Inspection" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

## Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search	<b>1</b>	a =
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
Exhaust Temperature Sensor 1 Value (Upstream	287.39	'C		
Exhaust Temperature Sensor 2 Value (Upstream	282.68	'C		
Raw Voltage of Exhaust Temperature Sensor 1(U	4.84	V		
Raw Voltage of Temperature at Upstream of the	4.86	V		
Output of Fuel Metering Unit(MPROP)	41	%		~
Air Conditioner Pressure Sensor Voltage	2.00	٧		
Air Conditioner Pressure Sensor	170.68	psi		
Raw Voltage of Differential Pressure Sensor (DP	0.96	V		
Oxygen Sensor Subtraction Voltage	0.41	٧		I
Fig.1				

Fig.1) Exhaust gas temperature current data changes as actual exhaust gas temperature changes.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

## Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Ground Circuit Inspection" procedure

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.

#### CRC12EN5010P242C0022S

- Refer to "Shop Manual" and disconnect EGTS(T4) 3 connector.
- 4. Measure the resistance between ground terminal of EGTS(T4) harness connector and chassis ground.

Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect EGTS(T4) 6 connector.
- 7. Ignition switch "ON"
- Measure the voltage between signal terminal of 8 EGTS(T4) harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9. ground terminal of EGTS(T4) harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of EGTS(T4) harness connector and chassis ground.

# **General Information**

#### Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.



## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove EGTS.
- 4. Measure the resistance between signal terminal and ground terminal of EGTS.

#### Specification : Refer to table below

X The resistance value decreases as temperature increases.

Temp.(°C/°F)	100 / 212	300 / 572	600 / 1,112	900 / 1,652
Resistance(kΩ)	289.0 ~ 481.0	5.30 ~ 6.61	0.35 ~ 0.38	0.08 ~ 0.09

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 
    Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the EGTS(T4) and go to "Verification of Vehicle Repair" procedure.

## 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO Problem is corrected and the system operation performs to specification at this time.

# P242D00 Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3 (Upstream LNT)

## **Component Location**



CRC12EN5010P242C0011

## 1. Exhaust Gas Temperature Sensor (EGTS) #1 (T4)

## 2. Exhaust Gas Temperature Sensor (EGTS) #2 (T5) General Description

Exhaust Gas Temperature Sensor (EGTS) #1 / #2 is each installed on upstream of LNT and upstream of DPF. EGTS monitors the temperature of exhaust gas that flows to E-VGT and DPF. ECM uses exhaust gas to burn off the soot accumulated in DPF when DPF regeneration condition is met. The exhaust gas temperature is one of the essential factor on engine operation.

Exhaust gas temperature sensor #1 (T4) : The post 1 injection increases exhaust gas temperature directly. EGTS #1 monitors successful post 1 injection with EGTS #1 and prevent excessive temperture increase.

Exhaust gas temperature #2 (T5) : The post 2 injection supplies HC(un-burned fuel) to oxidation catalyst converter. The HC(un-burned fuel) that supplied to oxidation catalyst converter is chemically reacted and increases the temperature of DPF and burn off the soot. EGTS #2 monitors temperature of DPF to prevent damage of DPF.

## **DTC Description**

If the output voltage of EGTS #1 is above threshold value for more than 3 sec., ECM sets DTC P242D00. This fault might be caused by open in signal circuit of EGTS #1.

## **DTC Detecting Condition**

ltem	Detecting Condition		Possible Cause		
DTC Strategy	Signal monitoring				
Enable Condition	Engine running				
Threshold Value	<ul><li>Output signal is below threshold value</li><li>Open in signal circuit</li></ul>		<ul><li>Output signal is below threshold value</li><li>Open in signal circuit</li></ul>		1 Open in signal signal is fECTS
Detecting Time	• 3 sec		#1		
	Engine OFF	• No	2. Defected EGTS #1		
	EGR OFF	• No			
	Torque Limit	• No			
	MIL	• On	]		

#### Vehicle Data

Exhaust Gas Tem- perature Sensor Terminal Inspection Condition		Inspection Condition	Measured Value	Remarks	
		Signal	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5V	-
Pin No.	2	Ground	Voltage is measured on wiring side(Disconnected)	0V	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P242D00	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 3(Upstream LNT)	

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#### 4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

dure.

NO • Go to "Verification of Vehicle Repair" proce-

## Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

#### Specification : Refer to figure below

Current Data		Search	<b>1</b>	a =
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 Items List 🗘 Rese	et Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
Exhaust Temperature Sensor 1 Value (Upstream	287.39	'C		
Exhaust Temperature Sensor 2 Value (Upstream	282.68	'C		
Raw Voltage of Exhaust Temperature Sensor 1(U	4.84	V		
Raw Voltage of Temperature at Upstream of the	4.86	V		
Output of Fuel Metering Unit(MPROP)	41	%		~
Air Conditioner Pressure Sensor Voltage	2.00	٧		
Air Conditioner Pressure Sensor	170.68	psi		
Raw Voltage of Differential Pressure Sensor (DP	0.96	V		
Oxygen Sensor Subtraction Voltage	0.41	٧		I
Fig.1				

Fig.1) Exhaust gas temperature current data changes as actual exhaust gas temperature changes.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

Go to "Wiring Inspection" procedure.

#### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO

Go to "Ground Circuit Inspection" procedure

## **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.

#### CRC12EN5010P242C0022S

- Refer to "Shop Manual" and disconnect EGTS(T4) 3 connector.
- 4. Measure the resistance between ground terminal of EGTS(T4) harness connector and chassis ground.

Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect EGTS(T4) 6 connector.
- 7. Ignition switch "ON"
- Measure the voltage between signal terminal of 8 EGTS(T4) harness connector and chassis ground.(A)
- Measure the voltage between signal terminal and 9. ground terminal of EGTS(T4) harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



- Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of EGTS(T4) harness connector and chassis ground.

# **General Information**

#### Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.



## **Component Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove EGTS.
- 4. Measure the resistance between signal terminal and ground terminal of EGTS.

#### Specification : Refer to table below

X The resistance value decreases as temperature increases.

Temp.(°C/°F)	100 / 212	300 / 572	600 / 1,112	900 / 1,652
Resistance(kΩ)	289.0 ~ 481.0	5.30 ~ 6.61	0.35 ~ 0.38	0.08 ~ 0.09

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO 
    Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the EGTS(T4) and go to "Verification of Vehicle Repair" procedure.

## 

- When installing component, tighten it within specification.
- If component is dropped, check for proper operation. The internal damage may be present.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



NO Problem is corrected and the system operation performs to specification at this time.

## P242F00 Diesel Particulate Filter Restriction - Ash Accumulation

## **Component Location**



## 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

## **DTC Description**

If accumulated soot is exceeded maximum threshold value, ECM sets DTC P242F00. This fault might be caused by defected DPF, leakage on exhaust system (damaged, clogged or leakage on exhuast pipe), or stucked signal of DPS.

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## DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>The accumulated so value</li> </ul>	pot is exceeded maximum threshold	1. Poor connector connection
Detecting Time	• 10 sec		2. Faulty signal circuit of DPS
	Engine OFF	• No	4. Defected DPS
	EGR OFF	• No	
Fail Sale	Torque Limit	• Yes	
	MIL	• Blink	

## Vehicle Data

DPF	DPS	Terminal	Inspection Condition	Measured Value	Remarks	
	1	DPS Power	Ignition switch "ON" & Engine "OFF"	Approx. 5V	-	
Pin No.	2	DPS Signal	<ul> <li>Voltage is measured on wiring side(</li> </ul>	• Voltage is measured on wiring side(	Approx. 5.6V	-
	3	DPS Ground	Disconnected)	0 V	-	
DPF	DPS	Terminal	Inspection Condition	Measured	Remarks	

DPF	DPS	rerminai	inspection Condition	Value	Remarks
	1	DPS Power	Ignition switch "ON" & Engine "OFF"	Approx. 5V	-
Pin No.	2	DPS Signal	<ul> <li>Voltage is measured on wiring side( Connected)</li> </ul>	Approx. 1.0V	-
	3	DPS Ground		0 V	-

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P242F00	Diesel Particulate Filter Restriction - Ash Accumulation	

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- 4. Is DTC status displayed as Present?

YES • Go to "Monitor GDS Data " procedure.

► Go to "Verification of Vehicle Repair" procedure.

## Monitor GDS Data

- Ignition switch "OFF" 1.
- Connect GDS to Data Link Connector (DLC). 2.
- Ignition switch "ON" & Engine "ON" 3.
- 4. Monitor follow parameters in "Current Data" with GDS.

## Specification : Refer to figure below

Current Data		Search	到目	a e
Selective Display 🗘 🛛 Full List 💠 🛛 Graph 💠 Items List 🗘 Rese	t Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		t i
Exhaust Temperature Sensor 1 Value (Upstream	287.39	'C		
Exhaust Temperature Sensor 2 Value (Upstream	282.68	'C		
Raw Voltage of Exhaust Temperature Sensor 1(U	4.84	V		
☑ Raw Voltage of Temperature at Upstream of the	4.86	V		
Output of Fuel Metering Unit(MPROP)	41	%		~
Air Conditioner Pressure Sensor Voltage	2.00	v		
Air Conditioner Pressure Sensor	170.68	psi		
Raw Voltage of Differential Pressure Sensor (DP	0.96	V		
Oxygen Sensor Subtraction Voltage	0.41	V		11

#### -ig.1

Fig.1) Exhaust gas temperature current data changes as actual exhaust gas temperature changes.

Is the parameter displayed within specification? 5.





Go to "Wiring Inspection" procedure.

## **Terminal and Connector Inspection**

Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical CRC12EN5010P242C0022S

systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



**NO** • Go to "Power Circuit Inspection" procedure.

## **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

NO

# **General Information**

#### Specification : Approx. 5.0V

5. Is the measured value within specification?



Go to "Ground Circuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Ground Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect DPS connector.
- 4. Measure the resistance between ground terminal of DPS harness connector and chassis ground.

#### Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 6 connector.
- 7. Ignition switch "ON"
- Measure the voltage between power terminal of DPS 8 harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



YES 
Go to "Signal Circuit Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON"
- 4. Measure the voltage between signal terminal of DPS harness connector and chassis ground.

Specification : Approx. 5.6V

5. Is the measured value within specification?



YES • Go to "Component Inspection" procedure.

NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

## **Component Inspection**

## Visual inspection on DPS

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove DPS.
- Inspect for corrosion or contamination on DPS 3. terminal.
- 4. Inspect for proper installation of DPS and hose.
- Inspect for foreing substance on DPF assembly or 5. DPS.
- 6. Inspect for leakage on exhaust system.
- 7. Have any problems been found?

YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO ► Go to "CPF Service Regeneration" procedure.

## CPF Service Regeneration

- Ignition switch "OFF" 1.
- Connect GDS to Data Link Connector (DLC). 2.
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- Operate the vehicle in according to regeneration 5. condition.

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Fig.1) Vehicle S/W Management list of Engine

## **WARNING**

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?
  - YES ► This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.
  - NO

Go to "DPS Signal Inspection" procedure.

#### DPS Signal Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - YES ► Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

#### 

• When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle

performance and emission control may not work properly until auto learning is completed.

## Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

<b>F *</b>		Special Function	🤹 🖭 主	Â
	0	Injector Specific Data		Ô
	0	Essential work after component re	eplacement	
	0	Engine Test Function		
	0	Fuel line air removal		
	0	DPF Service Regeneration		Ţ
Favori	te			
Fig.1				

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# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

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# **General Information**

If you're ready, set Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement - Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement SELECT CANCEL
MENU CANCEL

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) Differential Pressure Sensor Change

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?

**YES** • Go to the applicable troubleshooting procedure.



NO 

 Problem is corrected and the system operation performs to specification at this time.

## P245400 CPF Differential Pressure Sensor "A" Low Input

## **Component Location**



## 1. Differential Pressure Sensor (DPS)

#### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

## **DTC Description**

If output signal voltage of DPS is below threshold value (850mV) for more than 0.6 sec., ECM sets DTC P245400. This fault might be caused by short to ground in signal circuit of DPS.

CRC12EN5010P04710011

## **DTC Detecting Condition**

Item	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal is bel	ow threshold value (850mV)	1 Door connector connection
Detecting Time	• 0.6 sec		<ol> <li>Poor connector connection</li> <li>Short to ground in signal circ</li> </ol>
Fail Safe	Engine OFF	• No	of DPS
	EGR OFF	• No	3. Defected DPS
	Torque Limit	• Yes	
	MIL	• Blink	

## Vehicle Data

DPF	DPS	Terminal		Inspection Condition	Measured Value	Remarks
	1	DPS Power		lanition switch "ON" & Engine "OFF"	Approx. 5V	-
Pin No. 2 3	2	DPS Signal	•	Voltage is measured on wiring side( Disconnected)	Approx. 5.6V	-
	3	DPS Ground			0 V	-
DPF DPS						
DPF	DPS	Terminal		Inspection Condition	Measured Value	Remarks
DPF	DPS	Terminal DPS Power	•	Inspection Condition	Measured Value Approx. 5V	Remarks
DPF Pin No.	DPS 1 2	Terminal DPS Power DPS Signal	•	Inspection Condition Ignition switch "ON" & Engine "OFF" Voltage is measured on wiring side(	Measured Value Approx. 5V Approx. 1.0V	Remarks -

## **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P245400	CPF Differential Pressure Sensor "A" Low Input	

CRC12EN5010P24540021S
- 4. Is DTC status displayed as Present?
  - Go to "Monitor GDS Data " procedure.
  - ► Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

Current Data		Search		a) E
Selective Display 🗘 🛛 Full List 💠 🗍 Graph 💠 Items List 🗘 Reset N	Min.Max Record	Stop ‡	Grouping	VSS
Sensor Name	Value	Unit		1
Differential Pressure at Particle Filter	3.529	hPa		
Raw Voltage of Differential Pressure Sensor (DP	1.02	v		
Engine Speed	789.0	RPM		
E Flag Status of Battery Function to Crank the Eng	NO	_		1
Flag Status of Quiescent Current(AMS)	NO	-		
Invalid Condition of Battery Sensor(AMS)	YES	-		
Response Error Flag from Battery Sensor(AMS)	NO	-		
AMS Stop Reason - Head Lamp(AMS)	NO	- <u></u>		
AMS Stop Reason - Wiper(AMS)	NO	-		

Fig.1

### CRC12EN5010P04710022S

Selective Display ‡       Full List ‡       Graph ‡       Items List ‡       Reset Min.Max       Record       Stop ‡       Grouping       VSS         Sensor Name       Value       Unit       Image: Comparison of the sensor of the sensecon of the sensor of the sensor of the sensor	Current Data		Search 🛋	8 2 8
Sensor Name       Value       Unit         Ø Differential Pressure at Particle Filter       89.804       hPa         Ø Raw Voltage of Differential Pressure Sensor (DP       1.31       V         Ø Engine Speed       4932.5       RPM         Flag Status of Battery Function to Crank the Eng       NO       -         Flag Status of Quiescent Current(AMS)       NO       -         Invalid Condition of Battery Sensor(AMS)       YES       -         Response Error Flag from Battery Sensor(AMS)       NO       -         AMS Stop Reason - Head Lamp(AMS)       NO       -         AMS Stop Reason - Wiper(AMS)       NO       -	Selective Display ‡ Full List ‡ Graph ‡ Items List ‡ Rese	t Min.Max Record	Stop 🗘 Grouping	VSS
Image: Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Flag Status of Battery Sensor(AMS)       YES       -         Image: Flag Status of Flag From Battery Sensor(AMS)       NO       -         Image: Flag Status of Provide Flag From Battery Sensor(AMS)       NO       -         Image: Flag Status of Provide Flag From Battery Sensor(AMS)       NO       -         Image: Flag Status Stop Reason - Head Lamp(AMS)       NO       -         Image: Flag Status Stop Reason - Wiper(AMS)       NO       -	Sensor Name	Value	Unit	and a second second
Image: Raw Voltage of Differential Pressure Sensor (DP       1.31       V         Image: Engine Speed       4932.5       RPM         Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Flag Status of Reason of Battery Sensor(AMS)       YES       -         Image: Flag Status of Presson Pre	Differential Pressure at Particle Filter	89.804	hPa	
Image: Speed       4932.5       RPM         Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Flag Status of Reason of Battery Sensor(AMS)       YES       -         Image: Flag Status of Reason - Head Lamp(AMS)       NO       -         Image: Flag Status of Reason - Wiper(AMS)       NO       -	Raw Voltage of Differential Pressure Sensor (DP	1.31	V	
Image: Flag Status of Battery Function to Crank the Eng       NO       -         Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Invalid Condition of Battery Sensor(AMS)       YES       -         Image: Response Error Flag from Battery Sensor(AMS)       NO       -         Image: AMS Stop Reason - Head Lamp(AMS)       NO       -         Image: AMS Stop Reason - Wiper(AMS)       NO       -	Engine Speed	4932.5	RPM	
Image: Flag Status of Quiescent Current(AMS)       NO       -         Image: Invalid Condition of Battery Sensor(AMS)       YES       -         Response Error Flag from Battery Sensor(AMS)       NO       -         AMS Stop Reason - Head Lamp(AMS)       NO       -         AMS Stop Reason - Wiper(AMS)       NO       -	E Flag Status of Battery Function to Crank the Eng	NO		4
Invalid Condition of Battery Sensor(AMS)       YES       -         Response Error Flag from Battery Sensor(AMS)       NO       -         AMS Stop Reason - Head Lamp(AMS)       NO       -         AMS Stop Reason - Wiper(AMS)       NO       -	Flag Status of Quiescent Current(AMS)	NO	-	
Image: Response Error Flag from Battery Sensor(AMS)       NO       -         Image: AMS Stop Reason - Head Lamp(AMS)       NO       -         Image: AMS Stop Reason - Wiper(AMS)       NO       -	Invalid Condition of Battery Sensor(AMS)	YES	-	
Image: AMS Stop Reason - Head Lamp(AMS)         NO         -           Image: AMS Stop Reason - Wiper(AMS)         NO         -	Response Error Flag from Battery Sensor(AMS)	NO	-	
AMS Stop Reason - Wiper(AMS) NO -	AMS Stop Reason - Head Lamp(AMS)	NO	-	
	AMS Stop Reason - Wiper(AMS)	NO	-	

### Fig.2

Fig.1) DPS current data under engine idle

 $\times$  Displayed value may different in according to actual vehicle condition

### CRC12EN5010P04710023S

Fig.2) DPS current data under engine speed approx. 5,000RPM

 $\times$  Displayed value may different in according to actual vehicle condition

### Specification : Refer to figure below

# **General Information**

- 5. Is the parameter dispalyed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO • Go to "Wiring Inspection" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### Power Circuit Inspection

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2 connector.
- Ignition switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

Specification : Approx. 5.0V

5. Is the measured value within specification?



**YES** • Go to "Ground Clrcuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect DPS connector.
- Measure the resistance between ground terminal of 4.

DPS harness connector and chassis ground.

### Specification : Approx. below $1\Omega$

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect DPS connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of DPS harness connector and chassis ground.(A)
- 9. Measure the voltage between power terminal and ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?

- YES Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- Ignition switch "ON" 3.
- Measure the voltage between signal terminal of DPS 4. harness connector and chassis ground.

### Specification : Approx. 5.6V

- 5. Is the measured value within specification?

  - YES 
    Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Visual inspection on DPS
- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove DPS.
- 3. Inspect for corrosion or contamination on DPS terminal.
- 4. Inspect for proper installation of DPS and hose.
- Inspect for foreing substance on DPF assembly or 5. DPS.
- 6. Inspect for leakage on exhaust system.
- 7. Have any problems been found?



- YES 

   Repair as necessary and then go to "Verification of Vehicle Repair" procedure.
- NO ► Go to "CPF Service Regeneration" procedure.

### CPF Service Regeneration

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

<b>E *</b>	Special Function	🦀 📴 主 👘
	Injector Specific Data	Ŷ
C	Essential work after component repla	acement
C	Engine Test Function	
	Fuel line air removal	
	DPF Service Regeneration	
Favorite		
Fig.1		

Fig.1) Vehicle S/W Management list of Engine

### **WARNING**

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?



**YES** • This fault is caused by excessive PM(soot) on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

CRC12EN5010P04720041S

NO

Go to "DPS Signal Inspection" procedure.

- DPS Signal Inspection
- Ignition switch "OFF" 1.
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

### Specification : Approx. 1.0V

- 5. Is the measured value within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

  - NO 

     Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

### 

When DPS is replaced, perform "Essential work • after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- 4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

# GI-689



CRC12EN5010P01010041S

# **General Information**

🖾 🐟	Essentia	work after co	mponent repl	acement	
[ Eccential W	ork ofter Compense	t Poplacoment 1			
	ork after Componen				
If you're rea	dy, select the menu	l.			
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) Differential Pressure Sensor Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS 4. and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

# **GI-691**

### P245500 Differential Pressure Below Limit

### **Component Location**



### 1. Differential Pressure Sensor (DPS)

### **General Description**

Differential pressure sensor(DPS) is piezzo electric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.

Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

[CPF regeneration] When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas tempt. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration". Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects CPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

### **DTC Description**

If output signal voltage of DPS is above threshold value (4721mV) for more than 0.6 sec., ECM sets DTC P245500. This fault might be caused by short to power in signal circuit of DPS.

CRC12EN5010P04710011

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Output signal is abo	ove threshold value (4721mV)	1. Poor connector connection
Detecting Time	• 0.6 sec		2. Short to power in signal circuit
	Engine OFF	• No	3. Open in ground circuit of DPS
	EGR OFF	• No	4. Defected DPS
Fall Safe	Torque Limit	• Yes	]
	MIL	• Blink	

### Vehicle Data

DPF	DPS	Terminal	Inspection Condition	Measured Value	Remarks
	1	DPS Power	1. Ignition switch "ON" & Engine "OFF"	Approx. 5V	-
Pin No.	2	DPS Signal	2. Voltage is measured on wiring side(	Approx. 5.6V	-
	3	DPS Ground	Disconnected)	0 V	-
DPF	DPS	Terminal	Inspection Condition	Measured Value	Remarks
DPF	DPS	Terminal DPS Power	Inspection Condition 1. Ignition switch "ON" & Engine "OFF"	Measured Value Approx. 5V	Remarks
DPF Pin No.	DPS 1 2	Terminal DPS Power DPS Signal	Inspection Condition 1. Ignition switch "ON" & Engine "OFF" 2. Voltage is measured on wiring side(	Measured Value Approx. 5V Approx. 1.0V	Remarks -

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P245500	Differential Pressure Below Limit	

CRC12EN5010P24550021S

**GI-694** 

# **General Information**

- 4. Is DTC status displayed as Present?
  - Go to "Monitor GDS Data " procedure.

 Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

### Specification : Approx. 5.0V

5. Is the measured value within specification?



- YES 
  Go to "Ground Clrcuit Inspection" procedure
- NO Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect DPS connector.
- 4. Measure the resistance between ground terminal of DPS harness connector and chassis ground.

### Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect DPS connector.

- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of DPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mν

10. Is the measured value within specification?

- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Signal Circuit Inspection

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of DPS harness connector and chassis ground.

Specification : Approx. 5.6V

- 5. Is the measured value within specification?
  - YES Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Visual Inspection on DPF Differential Pressure Sensor

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2. connector.
- 3. Inspect for corrosion or contamination on DPS terminal.
- Inspect for proper installation of DPS, DPS hose and 4. leakage on exhaust system.
- Inspect for foreign substance on DPS and DPF 5. assembly.
- Inspect for Leakage on exhaust system. 6.
- 7. Have any problems been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "DPS Signal Inspection" procedure.

- DPS Signal Inspection
- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

### Specification : Approx. 1.0V

5. Is the measured value within specification?

- **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- Ignition Switch "ON" & Engine "OFF" 3.
- 4. Perform "Essential After Work Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

# **General Information**



CRC12EN5010P01010041S

# Essential work after component replacement [ Essential Work after Component Replacement ] If you're ready, select the menu.

CRC12EN5010P01010042S

# GI-697

# **General Information**

📼 < Essential worl	k after component replacement
[ Essential Work afte If you're ready, sele ECU replacerr Rail Pressure Air Flow Sens Differential Pr Throttle valve EGR Valve rej APS Module r	after component replacement nent (DPF OPT) Sensor replacement or replacement ressure Sensor replacement (DPF OPT) e replacement placement eplacement
SELEC	CT CANCEL
MENU CANCEL	
Fig.3	

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

Fig.2) "Essential Work After Component Replacement"

Fig.3) Differential Pressure Sensor Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault is corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



**YES** • Go to applicable troubleshooting procedure.



NO 

Problem is corrected and the system operation performs to specification at this time.

# GI-699

### P245700 EGR Cooler "A" Efficiency Below Threshold

### **Component Location**



1. EGR Cooler Bypass Solenoid Valve

### **General Description**

EGR cooler bypass vacuum valve is installed at low side of EGR cooler assembly. EGR cooler bypass solenoid valve controls the path to provide EGR gas to intake manifold directly in case of cold starting that engine coolant temperature is low. This system improves engine starting performance and exhaust gas reduction.

### **DTC Description**

If EGR cooling efficiency is below threshold, ECM sets DTC P245700. This fault might be caused by defected EGR cooler or system.

### **DTC Detecting Condition**

ltem	Dete	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul> <li>EGR cooling efficiency below threshold</li> </ul>		1 Door concreter connection
Detecting Time	• 220 sec.		2. Defected EGR cooler bypass
	Engine OFF	• No	solenoid valve
	EGR OFF	• No	3. Defected EGR cooler
Fall Safe	Torque Limit	• No	
	MIL	• Off	

CRC12EN5010P245711

### Vehicle Data

EGR Cool Soleno	<b>er Bypass</b> id Valve	Terminal	Inspection Condition	Measured Value	Remarks
	1	Control	1. Ignition switch "ON" & Engine "OFF"	Approx. 3.4V	-
Pin No.	2	Power	<ol> <li>Voltage is measured on wiring side( Disconnected)</li> </ol>	B+	-

### Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- Ignition "ON" 2.
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P245700	EGR Cooler "A" Efficiency Below Threshold	

### 4. Is DTC status displayed as Present?



- YES Go to "Wiring Inspection" procedure.
- NO 
  Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect EGR cooler bypass solenoid valve connector.

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- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of EGR cooler bypass solenoid valve harness connector and chassis ground.

### Specification : B+

5. Is the measured value within specification?

- YES 
  Go to "Control Circuit Inspection" procedure
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- Ignition Switch "OFF" 1.
- 2. Refer to "Shop Manual" and disconnect EGR cooler bypass solenoid valve connector.

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- Ignition switch "ON" 3.
- 4 Measure the voltage between control terminal of EGR cooler bypass solenoid valve harness connector and chassis ground.

### Specification : Approx. 3.4V

Is the measured value within specification? 5.



**YES** • Go to "Component Inspection" procedure.

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and disconnect EGR cooler 3. bypass solenoid valve connector.
- Measure the resistance between power terminal and 4. control terminal of EGR cooler bypass solenoid valve.

Specification : Approx. 28.3 ~ 31.1 Ω (20°C/68°F)

- Is the measured value within specification? 5.
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, EGR Cooler Bypass Solenoid Valve in fuel sensor and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- Are any DTCs stored in the system? 5.



- Go to the applicable troubleshooting procedure.
- NO
- Problem is corrected and the system operation performs to specification at this time.

# **General Information**

# P247000 Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 4 (Upstream DPF)

### **Component Location**



CRC12EN5010P242C0011

### 1. Exhaust Gas Temperature Sensor (EGTS) #1 (T4)

### 2. Exhaust Gas Temperature Sensor (EGTS) #2 (T5)

### **General Description**

Exhaust Gas Temperature Sensor (EGTS) #1 / #2 is each installed on upstream of LNT and upstream of DPF. EGTS monitors the temperature of exhaust gas that flows to E-VGT and DPF. ECM uses exhaust gas to burn off the soot accumulated in DPF when DPF regeneration condition is met. The exhaust gas temperature is one of the essential factor on engine operation.

Exhaust gas temperature sensor #1 (T4) : The post 1 injection increases exhaust gas temperature directly. EGTS #1 monitors successful post 1 injection with EGTS #1 and prevent excessive temperture increase.

Exhaust gas temperature #2 (T5) : The post 2 injection supplies HC(un-burned fuel) to oxidation catalyst converter. The HC(un-burned fuel) that supplied to oxidation catalyst converter is chemically reacted and increases the temperature of DPF and burn off the soot. EGTS #2 monitors temperature of DPF to prevent damage of DPF.

### **DTC Description**

If the output voltage of EGTS #2 is below threshold value for more than 3 sec., ECM sets DTC P247000. This fault might be caused by short to ground in signal circuit of EGTS #2.

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	<ul><li>Output signal is below threshold value</li><li>Short to ground in signal circuit</li></ul>		1. Chart to ground in signal signal
Detecting Time	• 3 sec.		of EGTS #2
	Engine OFF	• No	2. Defected EGTS #2
	EGR OFF	• No	
Fall Sale	Torque Limit	• No	
	MIL	• On	

### Vehicle Data

Exhaust Gas Tem- perature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
	1	Signal	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5V	-
PIN NO.	2	Ground	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	0V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P247000	Exhaust Gas Temperature Sensor Circuit Low Bank 1 Sensor 4 (Upstream DPF)	

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4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

### Specification : Refer to figure below

Current Data	Search 🔍 🗐	2 8
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 🛛 Items List 🗢 🗌 Reset Min.Max 🗌 Record 🗌	Stop 🗧 Grouping 🛛 V	SS
Sensor Name Value U	Jnit	1
Exhaust Temperature Sensor 1 Value (Upstream 287.39	С	
Exhaust Temperature Sensor 2 Value (Upstream 282.68	С	
Raw Voltage of Exhaust Temperature Sensor 1(U 4.84 V	V	
Raw Voltage of Temperature at Upstream of the 4.86 V	V	
Output of Fuel Metering Unit(MPROP)  41 9	%	
Air Conditioner Pressure Sensor Voltage 2.00 V	V	
Air Conditioner Pressure Sensor 170.68 p	osi	
Raw Voltage of Differential Pressure Sensor (DP 0.96 V	V	
Oxygen Sensor Subtraction Voltage     0.41 V	V	E
Fig.1		

Fig.1) Exhaust gas temperature current data changes as actual exhaust gas temperature changes.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

► Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO 
Go to "Ground Circuit Inspection" procedure

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.

### CRC12EN5010P242C0022S

- Refer to "Shop Manual" and disconnect EGTS(T5) 3. connector.
- 4. Measure the resistance between ground terminal of EGTS(T5) harness connector and chassis ground.

Specification : Approx. below  $1\Omega$ 

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between signal terminal of EGTS(T5) harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of EGTS(T5) harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of EGTS(T5) harness connector and chassis ground.

### Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and remove EGTS.
- Measure the resistance between signal terminal and 4 ground terminal of EGTS.

### Specification : Refer to table below

X The resistance value decreases as temperature increases.

Temp.(°C/°F)	100 / 212	300 / 572	600 / 1,112	900 / 1,652
Resistance(k $\Omega$ )	289.0 ~ 481.0	5.30 ~ 6.61	0.35 ~ 0.38	0.08 ~ 0.09

NO

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the EGTS(T4) and go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

- When installing component, tighten it within • specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



Problem is corrected and the system operation performs to specification at this time.

# **General Information**

# P247100 Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 4(Upstream DPF)

### **Component Location**



CRC12EN5010P242C0011

### 1. Exhaust Gas Temperature Sensor (EGTS) #1 (T4)

# 2. Exhaust Gas Temperature Sensor (EGTS) #2 (T5)

### **General Description**

Exhaust Gas Temperature Sensor (EGTS) #1 / #2 is each installed on upstream of LNT and upstream of DPF. EGTS monitors the temperature of exhaust gas that flows to E-VGT and DPF. ECM uses exhaust gas to burn off the soot accumulated in DPF when DPF regeneration condition is met. The exhaust gas temperature is one of the essential factor on engine operation.

Exhaust gas temperature sensor #1 (T4) : The post 1 injection increases exhaust gas temperature directly. EGTS #1 monitors successful post 1 injection with EGTS #1 and prevent excessive temperture increase.

Exhaust gas temperature #2 (T5) : The post 2 injection supplies HC(un-burned fuel) to oxidation catalyst converter. The HC(un-burned fuel) that supplied to oxidation catalyst converter is chemically reacted and increases the temperature of DPF and burn off the soot. EGTS #2 monitors temperature of DPF to prevent damage of DPF.

### **DTC Description**

If the output voltage of EGTS #2 is above threshold value for more than 3 sec., ECM sets DTC P247100. This fault might be caused by open in signal circuit of EGTS #2.

### **DTC Detecting Condition**

Item	Det	ecting Condition	Possible Cause			
DTC Strategy	Signal monitoring					
Enable Condition	Engine running					
Threshold Value	<ul><li>Output signal is be</li><li>Short to ground in s</li></ul>	low threshold value signal circuit				
Detecting Time	• 3 sec.		of EGTS #2			
	Engine OFF	• No	2. Defected EGTS #2			
	EGR OFF	• No				
Fail Sale	Torque Limit	• No				
	MIL	• On				

### Vehicle Data

Exhaust Gas Tem- perature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Signal	<ul> <li>Ignition switch "ON" &amp; Engine "OFF"</li> </ul>	Approx. 5V	-
	2	Ground	<ul> <li>Voltage is measured on wiring side(Disconnected)</li> </ul>	0V	-

### **Monitor DTC Status**

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- Monitor "Diagnostic Trouble Codes(DTC)" with GDS. 3.

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🖨	
Current DTC	Description	State
P247100	Exhaust Gas Temperature Sensor Circuit High Bank 1 Sensor 4 (Upstream DPF)	

CRC12EN5010P24710021S

4. Is DTC status displayed as Present?



**YES** • Go to "Monitor GDS Data" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### Monitor GDS Data

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Monitor follow parameters in "Current Data" with GDS.

### Specification : Refer to figure below

Current Data	Search 🔍 🗐 🕼	
Selective Display 🗧 🛛 Full List 💠 🛛 Graph 💠 🗍 Items List 😂 🛛 Reset Min.Max 🖉 Record 🗍	Stop   Grouping V	SS
Sensor Name Value U	Jnit	t.
Exhaust Temperature Sensor 1 Value (Upstream 287.39	С	
Exhaust Temperature Sensor 2 Value (Upstream 282.68	С	
Raw Voltage of Exhaust Temperature Sensor 1(U 4.84 V	/	
Raw Voltage of Temperature at Upstream of the 4.86 V	/	
Output of Fuel Metering Unit(MPROP)  41 9	6	~
Air Conditioner Pressure Sensor Voltage 2.00 V	/	
Air Conditioner Pressure Sensor 170.68 p	osi	
Raw Voltage of Differential Pressure Sensor (DP 0.96 V	/	1.00
Comparison Subtraction Voltage 0.41 V	/	III
Fig.1		

Fig.1) Exhaust gas temperature current data changes as actual exhaust gas temperature changes.

- 5. Is the parameter displayed within specification?
  - **YES** Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

► Go to "Wiring Inspection" procedure.

### Terminal and Connector Inspection

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- Thoroughly check all connectors (and connections) 2. for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



YES 

 Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO 
Go to "Ground Circuit Inspection" procedure

### **Ground Circuit Inspection**

- 1. Ignition switch "OFF"
- Disconnect battery (-) cable. 2.

### CRC12EN5010P242C0022S

- Refer to "Shop Manual" and disconnect EGTS(T5) 3. connector.
- 4. Measure the resistance between ground terminal of EGTS(T5) harness connector and chassis ground.

Specification : Approx. below  $1\Omega$ 

- 5. Ignition switch "OFF"
- 6. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
- 7. Ignition switch "ON"
- 8. Measure the voltage between signal terminal of EGTS(T5) harness connector and chassis ground.(A)
- 9. Measure the voltage between signal terminal and ground terminal of EGTS(T5) harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



- **YES** Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
- 3. Ignition switch "ON"
- 4. Measure the voltage between signal terminal of EGTS(T5) harness connector and chassis ground.

### Specification : Approx. 5V

5. Is the measured value within specification?



YES 
Go to "Component Inspection" procedure.

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- Ignition switch "OFF" 1.
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and remove EGTS.
- Measure the resistance between signal terminal and 4 ground terminal of EGTS.

### Specification : Refer to table below

X The resistance value decreases as temperature increases.

Temp.(°C/°F)	100 / 212	300 / 572	600 / 1,112	900 / 1,652
Resistance(k $\Omega$ )	289.0 ~ 481.0	5.30 ~ 6.61	0.35 ~ 0.38	0.08 ~ 0.09

NO

- 5. Is the measured value within specification?
  - YES 

     Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
  - NO

 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the EGTS(T4) and go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

- When installing component, tighten it within • specification.
- If component is dropped, check for proper operation. The internal damage may be present.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.

- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



Problem is corrected and the system operation performs to specification at this time.

# **General Information**

### P24A200 Particulate Filter Regeneration Incomplete Bank 1

### **Component Location**



### 1. Differential Pressure Sensor (DPS)

### **General Description**

Differential pressure sensor(DPS) is piezoelectric type sensor. Sensing the differential pressure between in front of CPF and in the back of CPF, DPS outputs linear signal from 0~5V.Using output signal, DPS detects the amount of soot, sulfide, SOF(soluble organic fraction) to determine if CPF regeneration is needed.

☆ CPF regeneration : When vehicle is in steady speed condition and above normal engine loading condition, if differential pressure between before and after CPF is above the specified pressure, ECM considers that stored soot inside of CPF is excessive. In this condition, exhaust gas temperature. is raised by post injection 1 and 2 to warm CPF up to 550°C~650°C. In this high tempt, soot inside of CPF burns up naturally and this mechanism is called as "CPF regeneration".

Most of soot is burned up during regeneration process but a little amount of soot is not burned up and stored inside of CPF continuously. The stored soot decreases the efficiency of CPF slowly. DPS corrects DPF regeneration period and duration as comparing and calculating the differential pressure due to stored soot with the total distance covered.

### **DTC Description**

If accumulated soot is exceeded maximum threshold value, ECM sets DTC P242F00. This fault might be caused by defected DPF, leakage on exhaust system (damaged, clogged or leakage on exhuast pipe), or stucked signal of DPS.

CRC12EN5010P04710011

0 V

### **DTC Detecting Condition**

Item	Detecting Condition				Possible Cause
DTC Strategy	<ul> <li>signal monit</li> </ul>	oring			
Enable Condition	Engine running				
Threshold Value	<ul> <li>The accumulated soot is exceeded maximum threshold value.</li> </ul>				Poor connector connection
Detecting Time	• 16msec.			2. 3.	. Defected DPS(Differential Pr
	Defected DPF	On			ssure Sensor)
	EGR OFF	Yes		4.	Detected DPF
Fail Sale	Torque Limit	No			
	MIL	On			

### Vehicle Data

DPF	DPS	Terminal	Inspection Condition	Measured Value	Remarks
	1	1 DPS Power 1. Janition switch "ON" & Engine "OFF"		Approx. 5V	-
Pin No.	2	DPS Signal	2. Voltage is measured on wiring side(	Approx. 5.6V	-
	3	DPS Ground	Disconnected)	0 V	-
DPF DPS		Terminal	Inspection Condition	Measured Value	Remarks
	1 DPS Power 1		1. Ignition switch "ON" & Engine "OFF"	Approx. 5V	-
Pin No.	2 DPS Signal	2. Voltage is measured on wiring side(	Approx. 1.0V	-	

Connected)

### **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

3

- 2. Ignition switch "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

DPS Ground

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
P24A200	Particulate Filter Regeneration Incomplete Bank 1	

**GI-712** 

# **General Information**

CRC12EN5010P24A20021S

4. Is DTC status displayed as Present?



- YES 
  Go to "DTC Information" and verify possible cause part in GDS.
- Go to "Verification of Vehicle Repair" proce-NO dure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition Switch "OFF"
- 2. Refer to "Shop Manual" and disconnect DPS connector.
- 3. Ignition Switch "ON"
- 4. Measure the voltage between power terminal of DPS harness connector and chassis ground.

### Specification : Approx. 5.0V

5. Is the measured value within specification?



YES • Go to "Ground Clrcuit Inspection" procedure

NO 

 Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

### **Ground Circuit Inspection**

- 1. Ignition Switch "OFF"
- Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and disconnect DPS connector.
- 4. Measure the resistance between ground terminal of DPS harness connector and chassis ground.

### Specification : Approx. below 1Ω

- 5. Ignition switch "OFF"
- Refer to "Shop Manual" and disconnect DPS

connector.

- 7. Ignition switch "ON"
- 8. Measure the voltage between power terminal of DPS harness connector and chassis ground.(A)
- Measure the voltage between power terminal and 9. ground terminal of DPS harness connector.(B)

Specification : Difference in (A) and (B) is less than 200 mV

10. Is the measured value within specification?



- YES Go to "Signal Circuit Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Signal Circuit Inspection**

- 1. Ignition Switch "OFF"
- Refer to "Shop Manual" and disconnect DPS 2. connector.
- 3. Ignition switch "ON"
- Measure the voltage between signal terminal of DPS 4. harness connector and chassis ground.

### Specification : Approx. 5.6V

- 5. Is the measured value within specification?
- **YES** Go to "Component Inspection" procedure.
- Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

### Visual inspection on DPS

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove DPS.
- Inspect for corrosion or contamination on DPS 3. terminal.
- 4. Inspect for proper installation of DPS and hose.
- 5. Inspect for foreing substance on DPF assembly or DPS.
- 6. Inspect for leakage on exhaust system.
- 7. Have any problems been found?
  - YES 

     Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

- NO Go to "CPF Service Regeneration" procedure.

### CPF Service Regeneration

- 1. Ignition switch "OFF"
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition switch "ON" & Engine "ON"
- 4. Perform "CPF Service Regeneration" in "Vehicle Software Management" with GDS.
- 5. Operate the vehicle in according to regeneration condition.

<b>F</b>	Special Function	🤹 💷 主	Â
	Injector Specific Data		Ô
	Essential work after component rep	lacement	
	Engine Test Function		
	Fuel line air removal		
	OPF Service Regeneration		
Favorite			
Fig.1			

Fig.1) Vehicle S/W Management list of Engine

### **WARNING**

- DPF service regeneration MUST be performed outdoor due to chance of fire and injury. If DPF service regeneration mode is performed indoor, fire or burn injury may occur from the high exhaust gas temperature.
- 6. Does the result of the function normal?

CRC12EN5010P04720041S

This fault is caused by excessive PM(soot) YES on CPF. Check for conditions that might affect CPF generation during vehicle operation. Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.



Go to "DPS Signal Inspection" procedure.

### DPS Signal Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and set up the Oscilloscope.(2 Channel):

Channel A (+) : Signal terminal (DPS Harness Connector)

Channel A (-) : Ground

- 3. Ignition switch "ON" & Engine "OFF"
- 4. Inspection condition : Ignition switch "ON"

Specification : Approx. 1.0V

- 5. Is the measured value within specification?
- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO ► Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the DPS and go to "Verification of Vehicle Repair" procedure.

### **A**CAUTION

• When DPS is replaced, perform "Essential work after component replacement. Otherwise, vehicle performance and emission control may not work properly until auto learning is completed.

### Vehicle S/W Management

- 1. Ignition Switch "OFF"
- 2. Connect GDS to Data Link Connector(DLC).
- 3. Ignition Switch "ON" & Engine "OFF"
- Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
- 5. Select "Differential Pressure Sensor Change"

# GI-715



CRC12EN5010P01010041S

# **General Information**

<b>E *</b>	Essential work after c	omponent replacement	•		
[ Eccential W	ork after Component Benjacement 1				
If you're ready, select the menu.					
MENU	CANCEL				
Fig.2					

CRC12EN5010P01010042S

### 🗲 🔹 Essential work after component replacement [Essential Work afte MENU If you're ready, sele Essential work after component replacement ECU replacement (DPF OPT) Rail Pressure Sensor replacement Air Flow Sensor replacement Differential Pressure Sensor replacement (DPF OPT) Throttle valve replacement EGR Valve replacement APS Module replacement CANCEL SELECT MENU CANCEL Fig.3

CRC12EN5010P04710043S

Fig.1) Vehicle S/W Management list of Engine

"Essential Work After Fig.2) Component Replacement"

Fig.3) Differential Pressure Sensor Change

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- Connect GDS to Data Link Connector(DLC), and 1. monitor DTC(Diagnostic Trouble Codes).
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?



YES 
 Go to the applicable troubleshooting procedure.



NO Problem is corrected and the system operation performs to specification at this time.

# **GI-717**

CRC12EN5010P06160011

# P26E500 Starter Relay "B" Circuit Low

### **Component Location**



1. Starter Relay

### **General Description**

In normal vehicle condition, voltage and current is not supplied to starter motor after engine "ON". If voltage and current is supplied to starter motor after engine is operating, it can cause damage on starter motor and flywheel. To prevent these damages, ECM monitors current that supplied to starter motor and protect the system.

### **DTC Description**

If low signal on high signal circuit of starter relay under cranking, ECM sets DTC P26E500. This fault might be caused by short to ground or open in high circuit of starter relay.

### **DTC Detecting Condition**

Item	Detecting Condition		Possible Cause
DTC Strategy	Signal monitoring		
Enable Condition	Engine running		
Threshold Value	Short to power or open in high signal circuit		
Detecting Time	• 2 sec		1. Short to ground in high signal
Fail Safe	Engine OFF	• No	2. Defected starter relay
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

### **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-719

CRC12EN5010P26E50021S

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P26E500	Starter Relay "B" Circuit Low	

4. Is DTC status displayed as Present?

- **YES** Go to "Wiring Inspection" procedure.
- NO

Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- Many malfunctions in the electrical system are 1. caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- Has a problem been found? 3.



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.



► Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- Ignition switch "OFF" 1.
- 2. Refer to "Shop Manual" and remove starter relay.
- Ignition switch "ON" 3.
- 4. Measure the voltage between coil power terminal of starter relay harness connector and chassis ground.

### Specification : B+

- 5. Is the measured value within specificaiton?
  - Go to "Control Circuit Inspection" procedure YES >

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove starter relay.
- Ignition switch "ON" 3.
- Measure the voltage between control high terminal of 4. starter relay harness connector and chassis ground.

### Specification : Approx. 3.4V

Measure the voltage between control low terminal of 5. starter relay harness connector and chassis ground.

### Specification : Approx. 2.5V

- Is the measured value within specificaiton? 6.
  - Go to "Component Inspection" procedure. YES
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### Component Inspection

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- Refer to "Shop Manual" and remove the starter relay. 3.
- 4. Measure resistance between relay control low and relay control high terminal of the starter relay.

### Specification : Approx. 90 $\Omega$

5. Is the measured value within specification?

# <u>GI-720</u>

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO Carefully re-do this troubleshooting guide steps.

► If no problems were found with the circuits or connectors, replace the Starter Relay and go to "Verification of Vehicle Repair" procedure.

### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?
  - **YES** Go to the applicable troubleshooting procedure.
  - NO Problem is corrected and the system operation performs to specification at this time.
# General

CRC12EN5010P06160011

# P26E600 Starter Relay "B" Circuit High

## **Component Location**



1. Starter Relay

#### **General Description**

In normal vehicle condition, voltage and current is not supplied to starter motor after engine "ON". If voltage and current is supplied to starter motor after engine is operating, it can cause damage on starter motor and flywheel. To prevent these damages, ECM monitors current that supplied to starter motor and protect the system.

#### **DTC Description**

If high signal on high signal circuit of starter relay under cranking, ECM sets DTC P26E600. This fault might be caused by short to power or open in high circuit of starter relay.

#### DTC Detecting Condition

Item	Dete	ecting Condition	Possible Cause		
DTC Strategy	<ul> <li>Signal monitoring</li> </ul>				
Enable Condition	Engine running				
Threshold Value	Short to power or o	pen in high signal circuit			
Detecting Time	• 2 sec		1. Open or short to power in high		
	Engine OFF	• No	2. Defected starter relay		
Fail Safe	EGR OFF	• No			
	Torque Limit	• No			
	MIL	• Off			

## **Monitor DTC Status**

1. Connect GDS to Data Link Connector(DLC).

2. Ignition "ON"

3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

# GI-722

# **General Information**

DTC		Retry 🗖
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗘	
Current DTC	Description	State
P26E600	Starter Relay "B" Circuit High	

#### 4. Is DTC status displayed as Present?



- YES Go to "Wiring Inspection" procedure.

NO • Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

- 1. Many malfunctions in the electrical system are caused by poor harness and terminals. Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.
- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

NO • Go to "Power Circuit Inspection" procedure.

### **Power Circuit Inspection**

- 1. Ignition switch "OFF"
- Refer to "Shop Manual" and remove starter relay. 2.
- Ignition switch "ON"
- 4. Measure the voltage between coil power terminal of starter relay harness connector and chassis ground.

Specification : B+

5. Is the measured value within specificaiton?



Go to "Control Circuit Inspection" procedure

Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

CRC12EN5010P26E60021S

### **Control Circuit Inspection**

- 1. Ignition switch "OFF"
- 2. Refer to "Shop Manual" and remove starter relay.
- 3. Ignition switch "ON"
- Measure the voltage between control high terminal of 4. starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

Measure the voltage between control low terminal of 5. starter relay harness connector and chassis ground.

#### Specification : Approx. 2.5V

- Is the measured value within specificaiton? 6.
  - **YES** Go to "Component Inspection" procedure.
  - Inspect and repair open or short in circuit, a-NO nd then go to "Verification of Vehicle Repair" procedure.

### **Component Inspection**

- 1. Ignition Switch "OFF"
- 2. Disconnect battery (-) cable.
- 3. Refer to "Shop Manual" and remove the starter relay.
- 4. Measure resistance between relay control low and relay control high terminal of the starter relay.

#### Specification : Approx. 90 $\Omega$

5. Is the measured value within specification?

# General

- YES Fault is intermittent caused by poor contact in the sensor's and/or ECM's connector or was repaired and ECM memory was not cleared. Thoroughly check connectors for looseness, poor connection, bending, corrosion, contamination, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.
- NO 🕨 Carefully re-do this troubleshooting guide steps.

If no problems were found with the circuits or connectors, replace the Starter Relay and go to "Verification of Vehicle Repair" procedure.

## Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- Clear all DTCs in the system with GDS. 2.
- Operate system or vehicle within DTC detecting 3. condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?
  - YES 
    Go to the applicable troubleshooting procedure.



Problem is corrected and the system operation performs to specification at this time.

# GI-724

# **U000100 High Speed CAN Communication Bus**

# **Component Location**



### 1. Engine Control Module (ECM)

#### **General Description**

The main features of CAN (Controller Area Network) bus system are:

- A data-Transfer rate up to 1 Mbit/s for the High-Speed CAN and up to 125 kbit/s for the Low-Speed CAN.

- Signals are broadcast in both directions
- The Multi-master principle.
- High availability by locating failed control units.
- Standardization in accordance with ISO 11898.

Vehicle electonic control need many informations of each module to reduce exhaust and increase convenience/safety by optimum control. The TCM can either receive data from the Engine Control Module or ABS control module, or it can send data to the ECM and ABSECM by using CAN communication. The CAN communicaton is one of the vehicle communications method, which is now widely used to transfer the vehicle data.

### **DTC Description**

If CAN Bus off is detected, ECM sets DTC U000100. This fault might be caused by short in CAN communication circuit.

### **DTC Detecting Condition**

CRC12EN5010P02190011

# General

ltem	Det	ecting Condition	Possible Cause		
DTC Strategy	CAN message mor	nitoring	1 Poor connector connection		
Enable Condition	Engine running				
Threshold Value	CAN Bus off is dete	ected	2. Short in CAN high line		
Detecting Time	• 2 sec		3. Short in CAN low line		
	Engine OFF	• No	4. Short circuit between CAN hig- h and low line		
	EGR OFF	• No	5. Defected modules that connec-		
Fall Safe	Torque Limit	• No	ted to CAN		
	MIL	Off			

# Signal Waveform



CRC12EN5010U00010011S

Fig.1) Normal CAN signal waveform.

## Monitor DTC Status

- 1. Connect GDS to Data Link Connector(DLC).
- 2. Ignition "ON"
- 3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.

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# **General Information**

DTC		Retry
Erase All DTC	Freeze Frame DTC Status Erase Selective DTC Hist/Pend DTC 🗢	
Current DTC	Description	State
U000100	High Speed CAN Communication Bus	

#### 4. Is DTC status displayed as Present?



**YES** • Go to "Wiring Inspection" procedure.

NO

► Go to "Verification of Vehicle Repair" procedure.

### **Terminal and Connector Inspection**

1. Many malfunctions in the electrical system are caused by poor harness and terminals.

Faults can also be caused by interference from other electrical systems, and mechanical or chemical damage.

- 2. Thoroughly check all connectors (and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- 3. Has a problem been found?



**YES** • Repair as necessary and go to "Verification of Vehicle Repair" procedure.

Go to "CAN Communication Line Inspection NO " procedure.

### CAN Communication Line Inspection

#### Inspection procedure for impedance measurement

When measureing impedance, it is generally necessary to disconnect the circuit being tested from the power supply before hand. The vehicle's battery should therefore be disconnected and wait about four minutes to allow all capacitors in the system to discharge.

Inspection procedure for resistance test:

- 1. The CAN bus must be disconnected from the power supply
- 2. The measurement is taken between the CAN High

and CAN Low leads

3. The measurement recorded may differ from the specified levels by a few ohms

CRC12EN5010U00010021S

#### Impedance measurement with matching resistor

- Ignition "OFF" and disconnect the battery and wait 1. about four minutes.
- 2. Make sure all modules are properly connected.
- 3. Measure resistance between CAN High and CAN Low terminal of Data LInk connector.

#### Specification : Approx. 60 $\Omega$

- 4. Is the measured value within specification?
- YES 

   Fault might be intermittent and caused either by poor contact in connectors or wiring harness, or it has been repaired and control module memory is not cleared yet. Thoroughly check terminal of battery, all connectors ( and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.
- If the value is out of specification then, go to NO "CAN Signal Inspection" procedure.  $\approx$  If the measured value is approx.  $0\Omega$ , then check for short CAN communication line. % If the measured value is approx.  $\infty \Omega$ , then check for open CAN communication line.

### CAN Signal Inspection

- 1. Ignition switch "OFF"
- 2. Connect VMI to GDS and launch the oscilloscope (2 Channel):

Channel A (+) : CAN High terminal (Data LInk connector)

Channel A (-) : Ground

Channel B (+) : CAN Low terminal (Data LInk connector)

Channel B (-) : Ground

3. Ignition switch "ON"

**Specification** :CAN High voltage - Approx. 2.8V / CAN Low voltage - Approx. 2.2V (Average)

	Osc	cillosco	pe							
		sor	Theme	Name	Review	User Setting		A 4 14.56 ms	<mark>▶</mark> B	1ms 🕨
	Rea	set in	Start \$	Cursor	ViewAll	Save				
	+8V	,		C-CAN High	Max :	3.51 <sup>°</sup> V	Avg : 2.75 V	Min : 2	.41 V	
	-	_111411	nww	WWWW_M	/W	W1\	M	/9\\\\/9\\\	_/\_/\//	WWW.~~~~
Config	-2V									
uration	+8V			C-CAN Low	Max :	2.51 <sup>'</sup> V	Awg : 2.15 ∨	Min : 1	.39 V	
Fig	-24	-Windo		,MANA/TY	\W	W				WMMWW в

Fig.1) Normal CAN signal waveform.

### 4. Is the measured value within specification?

YES Fault might be intermittent and caused either by poor contact in connectors or wiring harness, or it has been repaired and control module memory is not cleared yet. Thoroughly check terminal of battery, all connectors ( and connections) for looseness, bending, corrosion, contamination, deterioration, and/or damage.

• Repair or replace as necessary and then go to "Verification of Vehicle Repair" procedure.

CRC12EN5010U00010011S

- NO Repair open or short in CAN communication line and then, go to "Verification of Vehicle Repair" procedure.
  - ► If problem keep occurs, go to "Component Inspection" procedure

### **Component Inspection**

- Refer to "Shop Manual" and remove necessary parts to get access to control units that connected to CAN Communication circuit.
- 2. Connect GDS to Data Link Connector (DLC).
- 3. Ignition "ON"
- 4. Disconnect unit connector one after the other.
- 5. Check for control unit causing the fault by units using

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CAN communication with GDS.

- 6. Does the status of DTC U000100 changes to "History" when certain control module connector is disconnected?

**YES** • Carefully re-do this troubleshooting guide steps.

> If problem still occurs, replace control unit that casuing the fault and then go to "Verification of Vechicle Repair" procedure.

#### Verification of Vehicle Repair

After a repair, it is essential to verify that the fault has been corrected.

- 1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
- 2. Clear all DTCs in the system with GDS.
- 3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
- 4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
- 5. Are any DTCs stored in the system?
  - YES 
    Go to the applicable troubleshooting procedure.

