Hyundai Industrial R-engine 2.2L DTC Diagnosis Guide

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HYUNDAI
MOTOR GROUP

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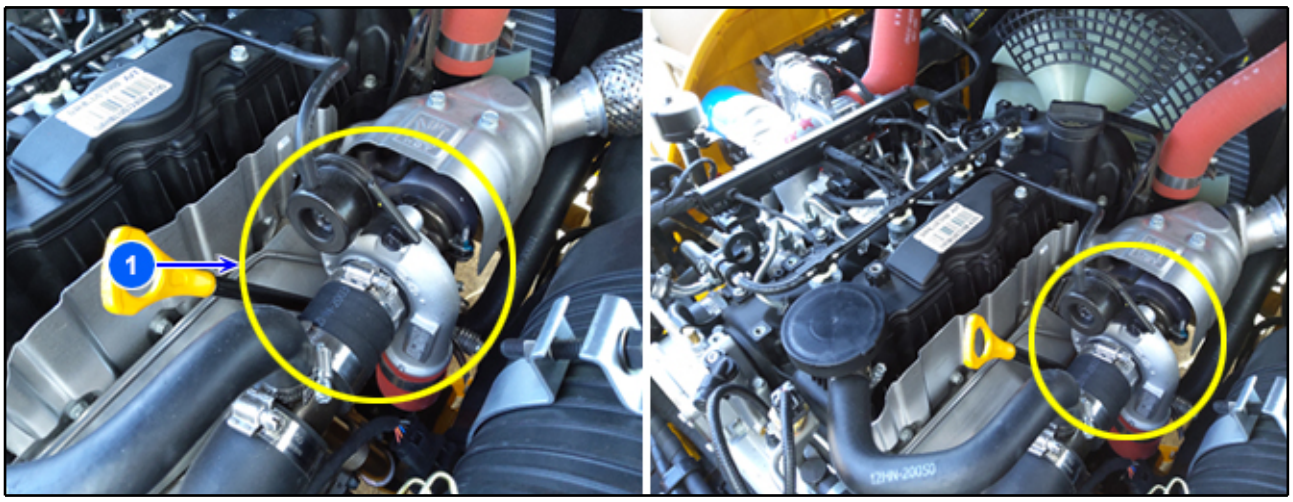
P004700 Turbo/Super Charger Boost Control Solenoid Circuit Low

Component Location



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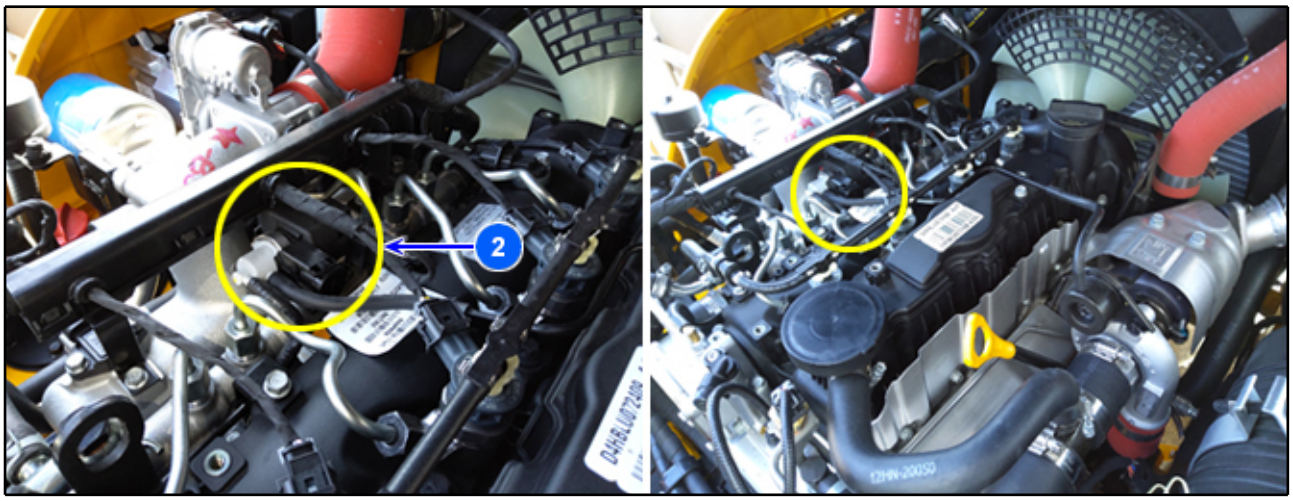

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1. VGT Actuator

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 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

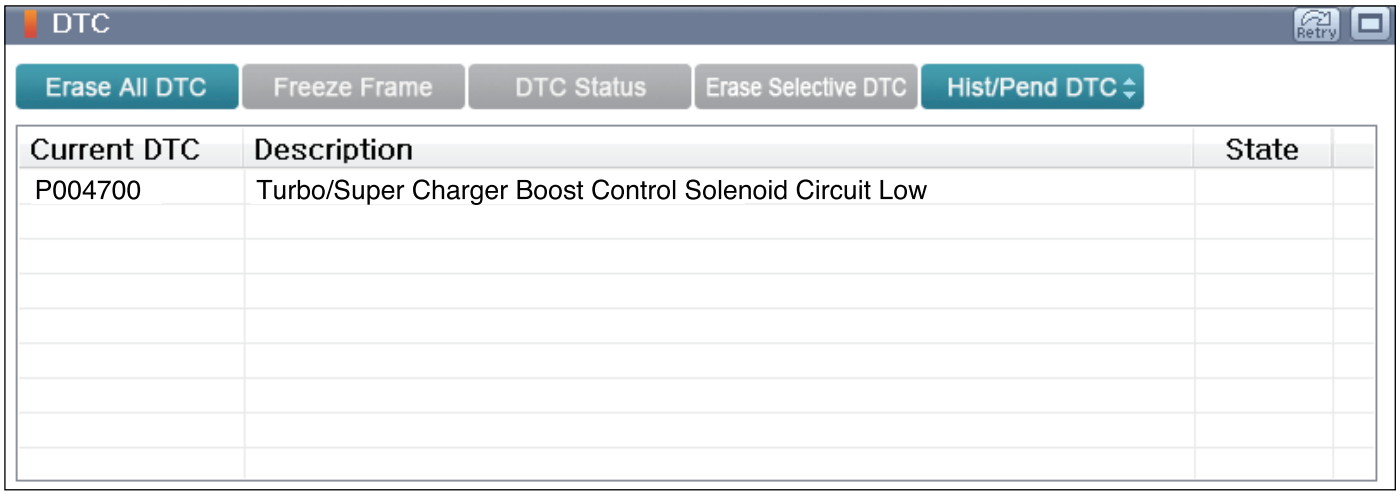
Item	Detecting Condition		Possible Cause
DTC Strategy	• Electric VGT control actuator circuit monitoring		1. Open or short to ground in VGT control actuator circuit 2. Defected VGT control actuator
Enable Conditions	• Engine running		
Threshold Value	• Open or short to ground in VGT control actuator circuit		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

VGT Control Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	VGT Actuator Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	-
	2	VGT Actuator Control		Approx. 3.4V	-

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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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.

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.
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"
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.

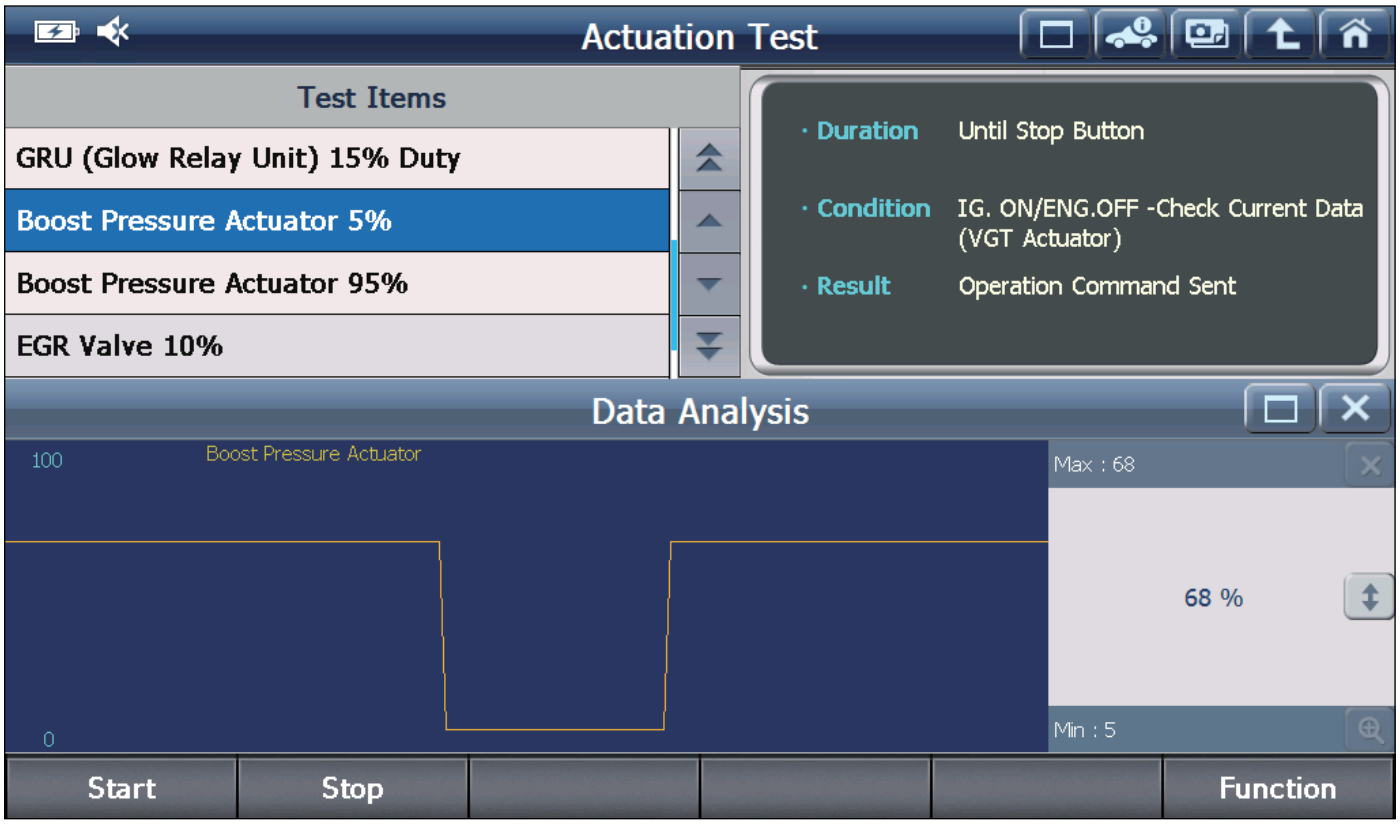
NO ▸ Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

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

Specification : Refer to figure below



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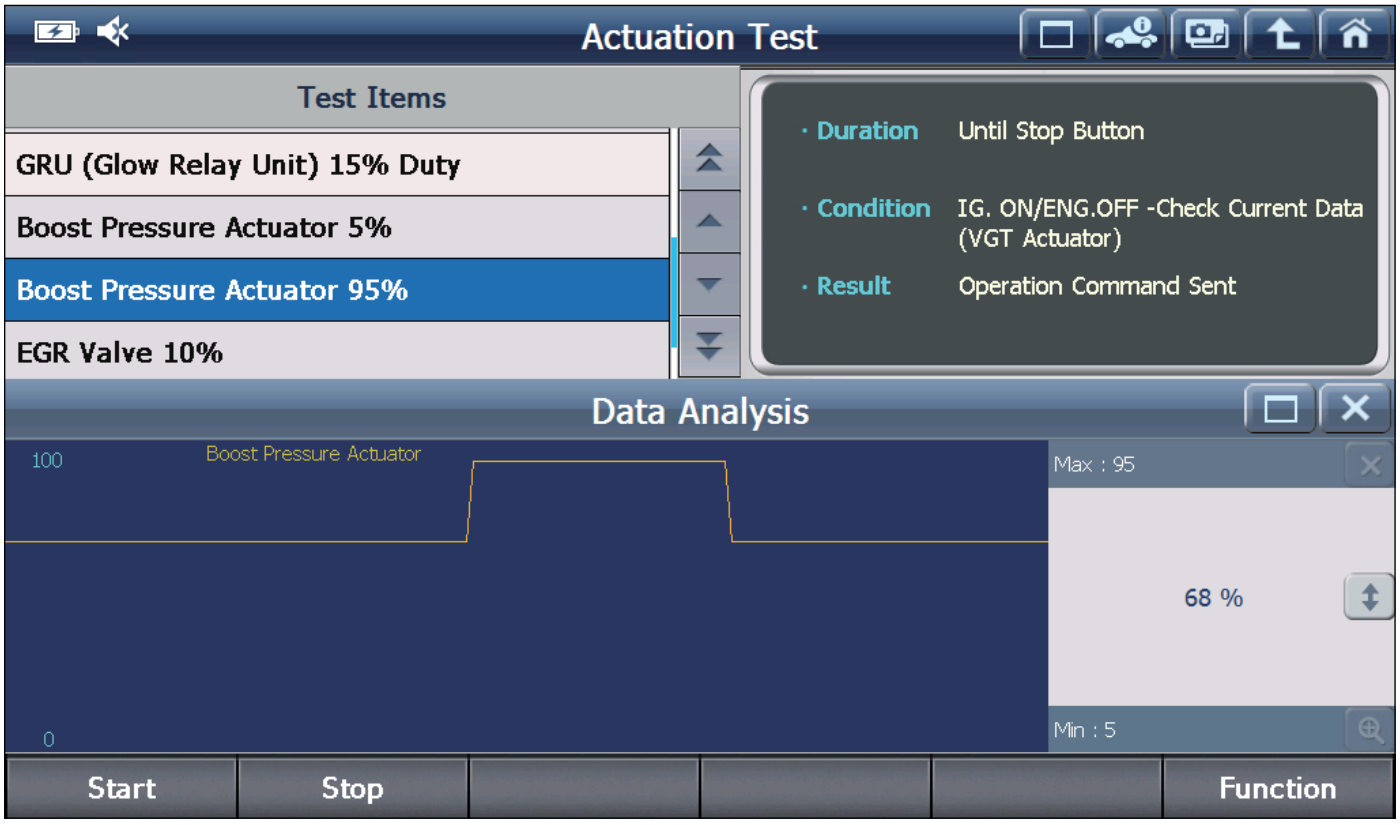

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Fig.1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

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.

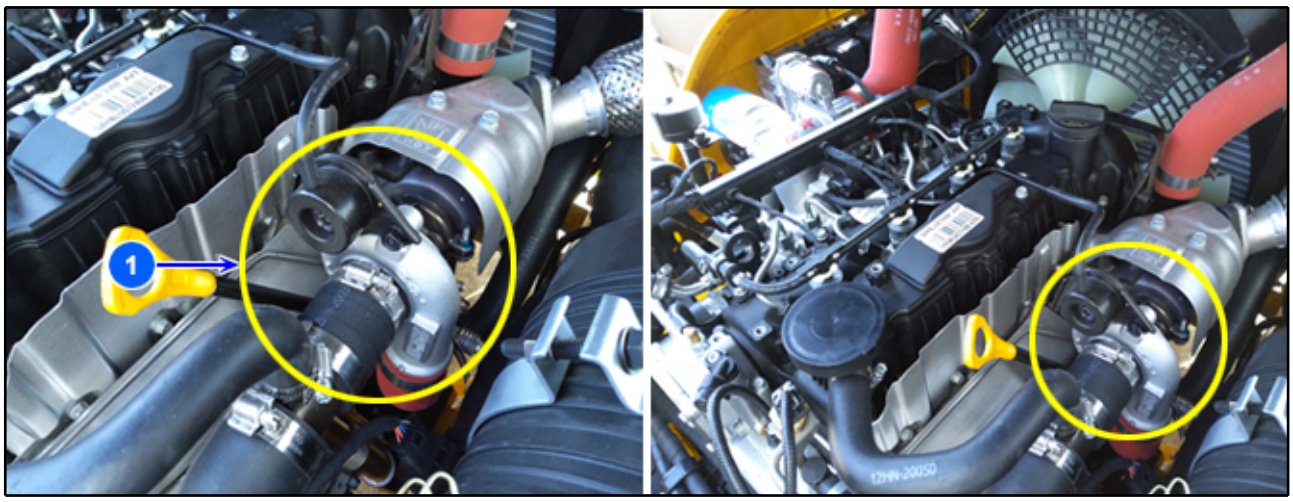
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P004800 Turbo/Super Charger Boost Control Solenoid Circuit High

Component Location



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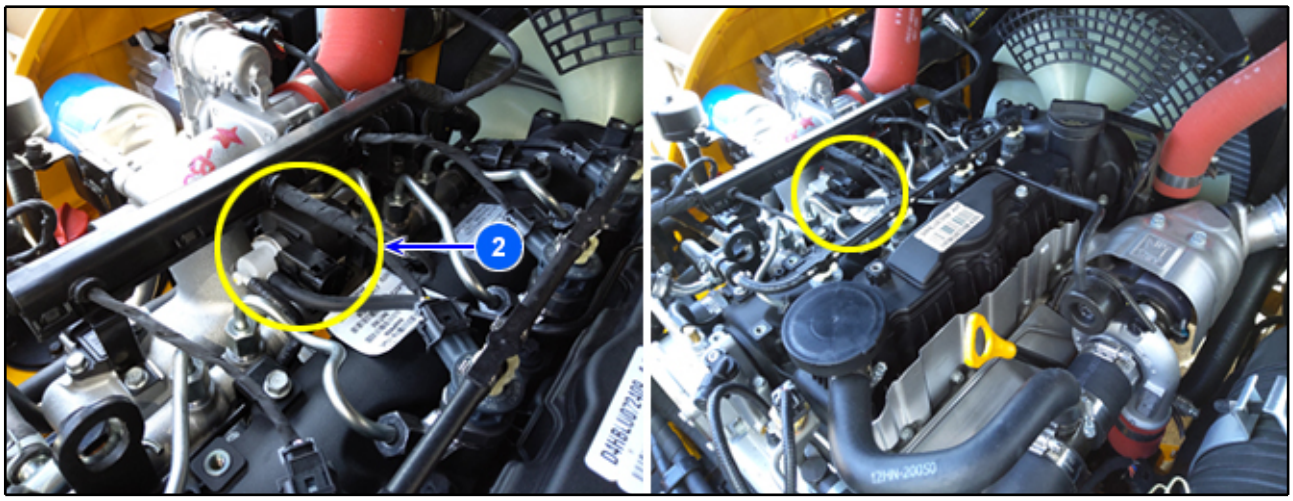


CRC12EN5010P004712

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 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

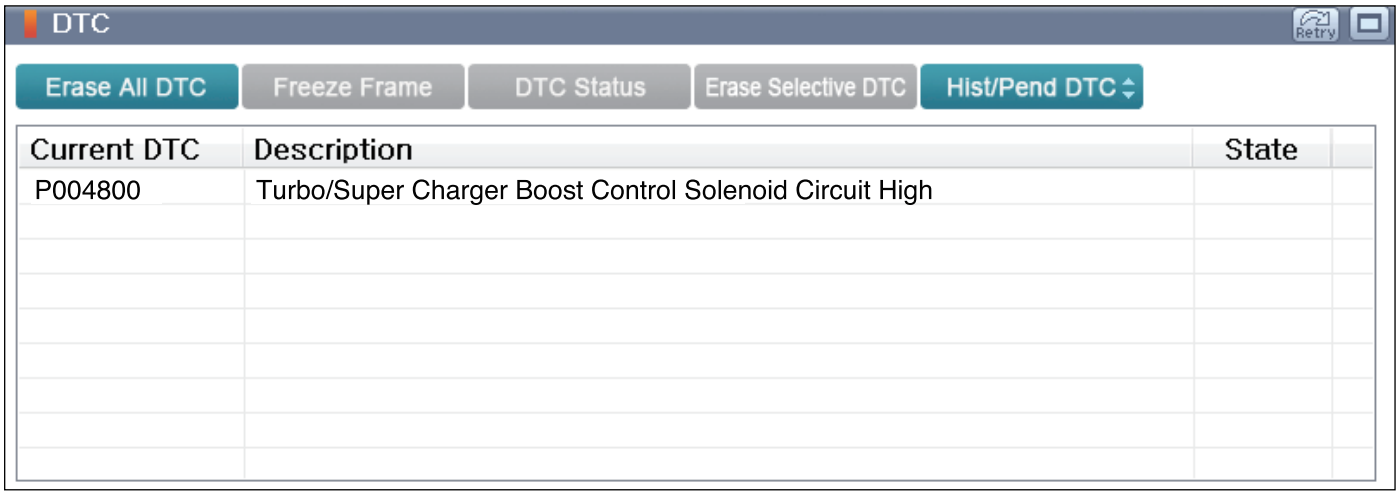
Item	Detecting Condition		Possible Cause
DTC Strategy	• Electric VGT control actuator circuit monitoring		1. Short to ground in VGT control actuator circuit 2. Defected VGT control actuator
Enable Conditions	• Engine running		
Threshold Value	• Short to power in VGT control actuator circuit		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

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

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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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.

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.
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"
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.

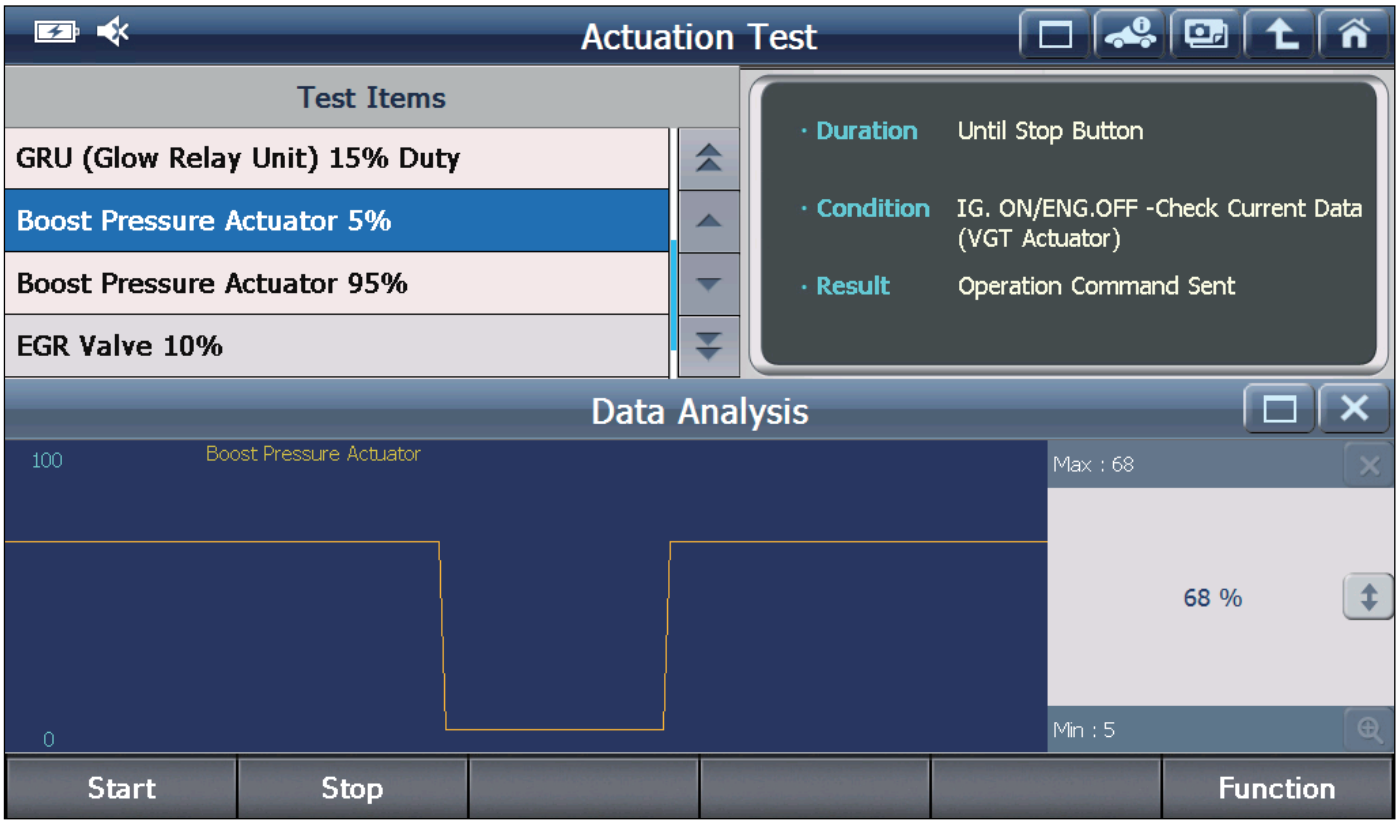
NO ▸ Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

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

Specification : Refer to figure below



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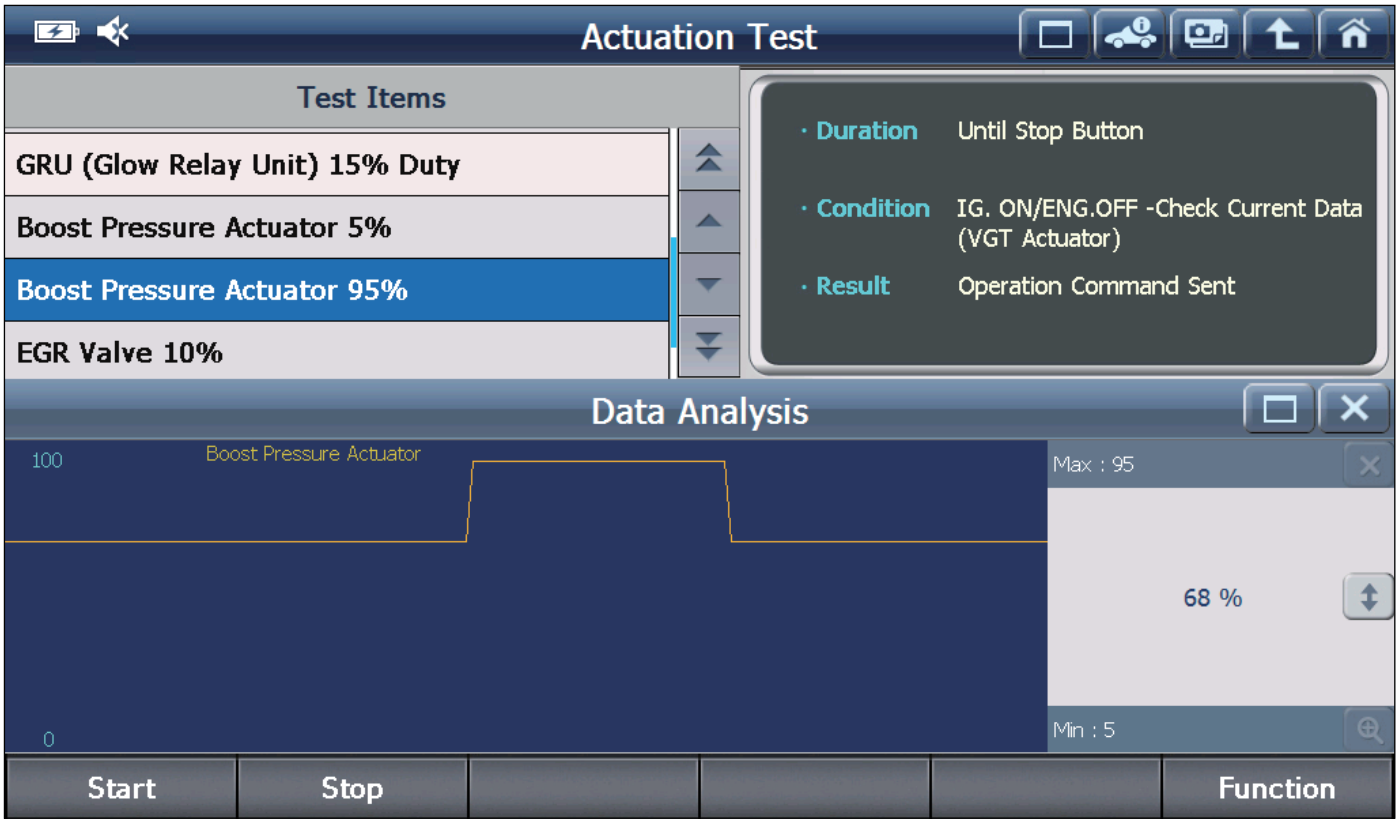

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Fig. 1) Boost pressure actuator current data when performing "Boost Pressure Actuator 5%" in "Actuation Test" with GDS.

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.

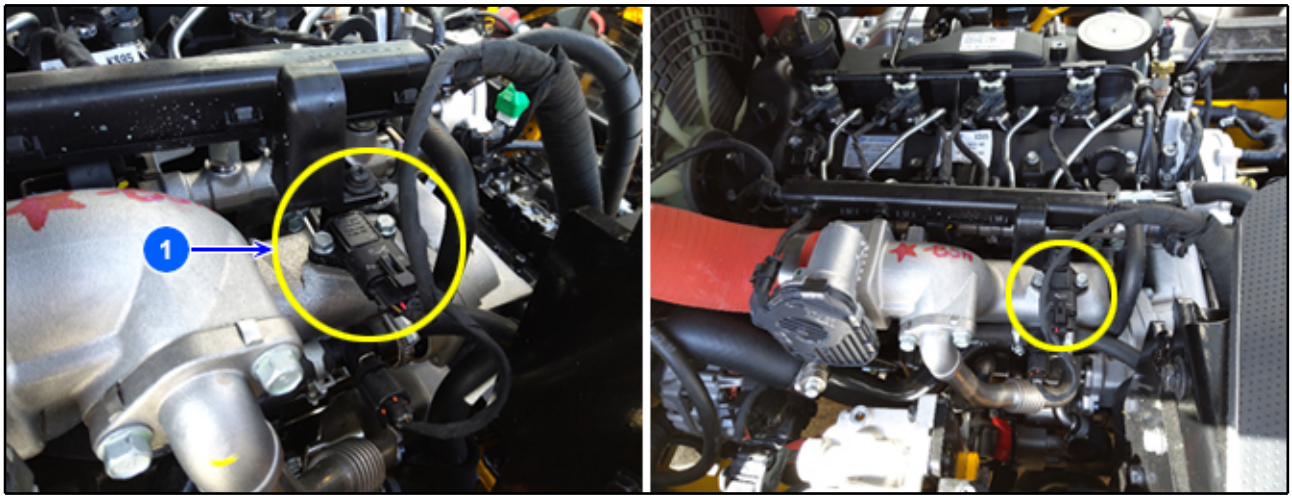
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P006900 Manifold Absolute Pressure - Barometric Pressure Correlation

Component Location



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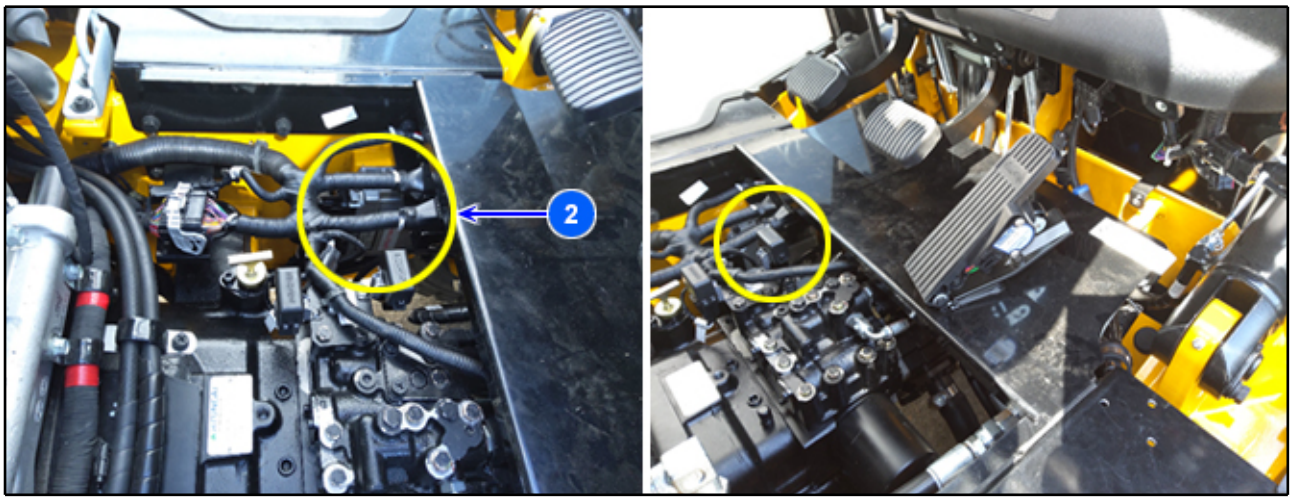


CRC12EN5010P00690012

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.

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	Detecting Condition		Possible Cause
DTC Strategy	• Correlation beween boost pressure sensor and atmospheric pressure sensor		1. Faulty boost pressure sensor circuit 2. Defected atmospheric pressure sensor 3. Defected boost pressure sensor 4. Defected ECM
Enable Conditions	• Ignition Switch "ON"		
Threshold Value	• Signal difference between boost pressure sensor and atmospheric pressure sensor is over 300 hPa		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• On	

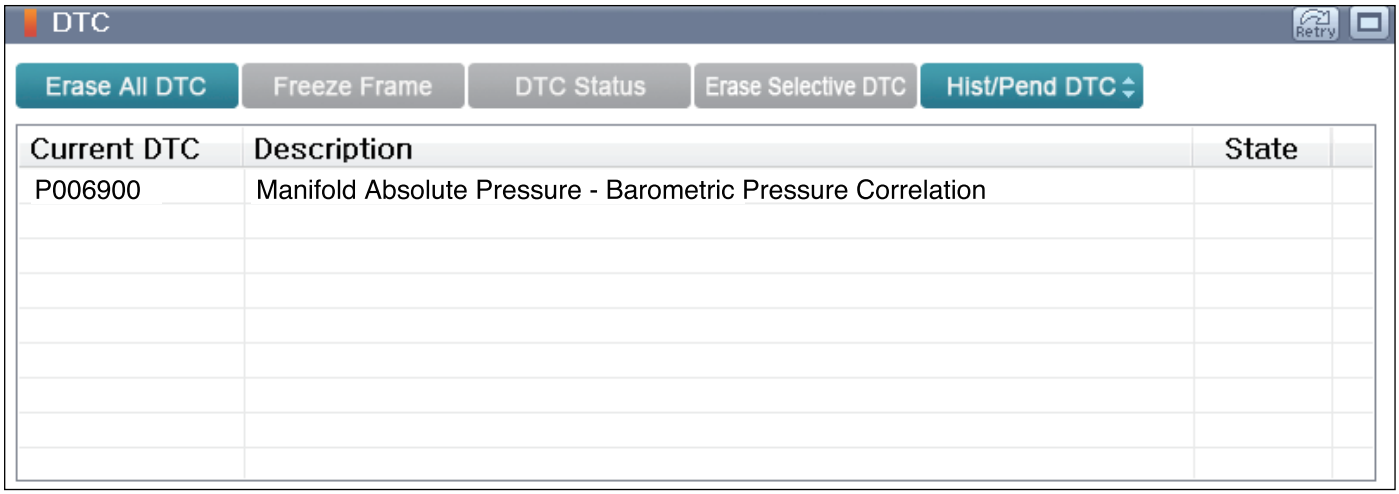
Vehicle Data

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.5V	-
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor Ground		0 V	-

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 1.0V	Atmospheric Pressure
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor 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.



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

Specification : Refer to figure below

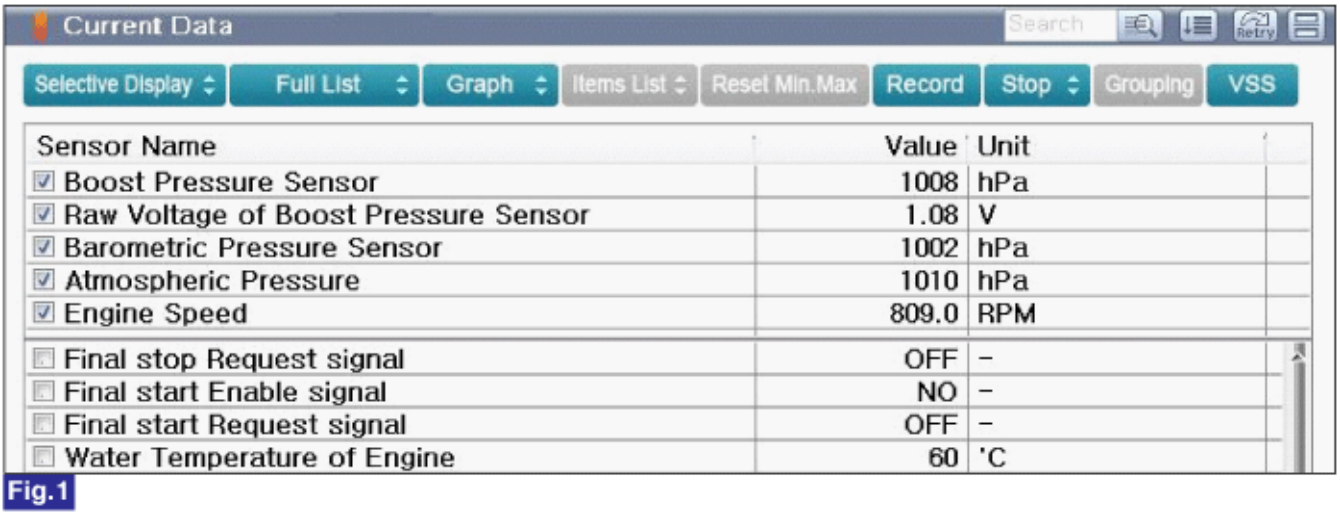


Fig.1

CRC12EN5010P00690022S

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

※Atmospheric 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 ▸ 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 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.
4. Measure the resistance between ground terminal of BPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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"
2. Refer to "Shop Manual" and disconnect boost pressure sensor connector.
3. Ignition switch "ON"
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 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**

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

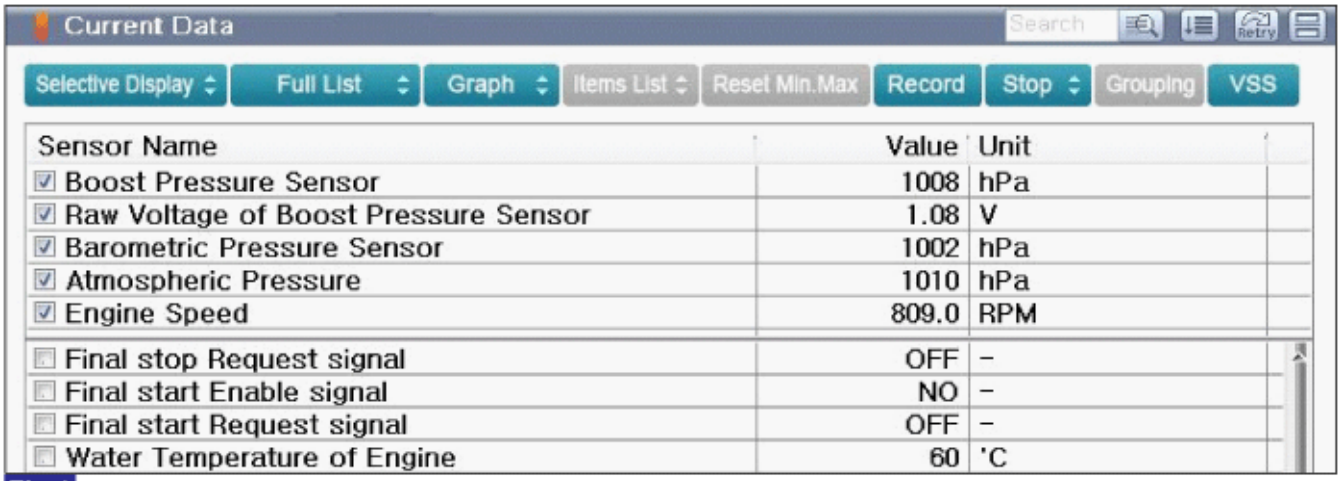


Fig.1

CRC12EN5010P00690022S

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

※Atmospheric 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.

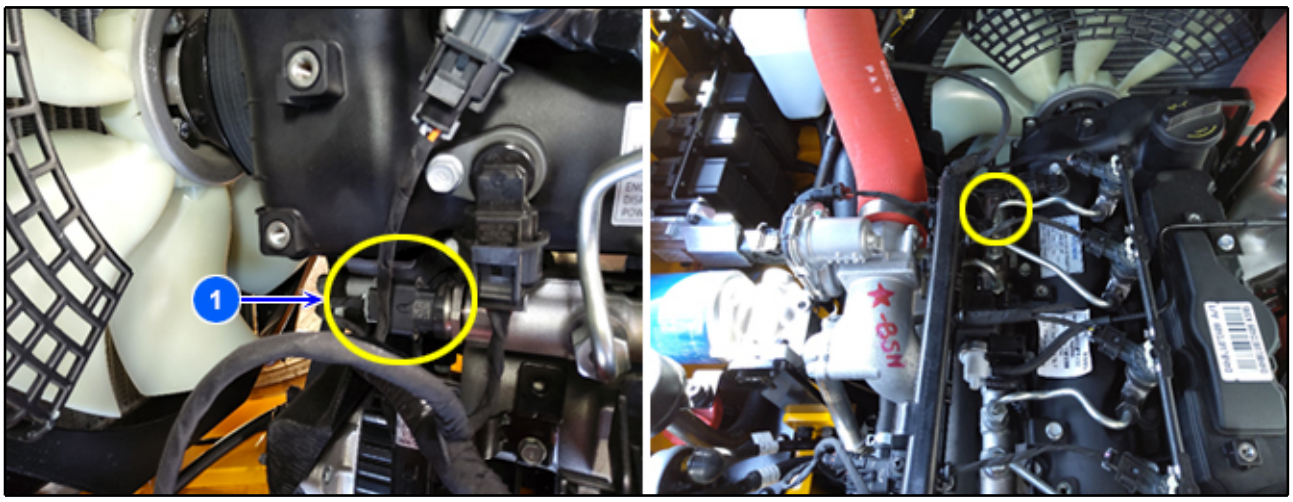
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P008700 Fuel Rail/System Pressure - Too Low

Component Location



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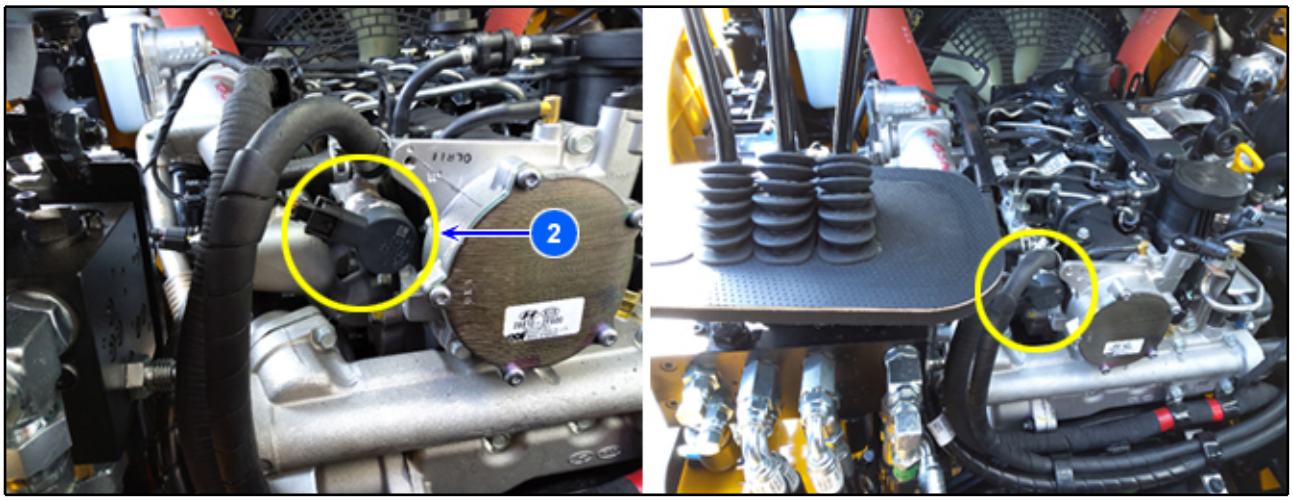

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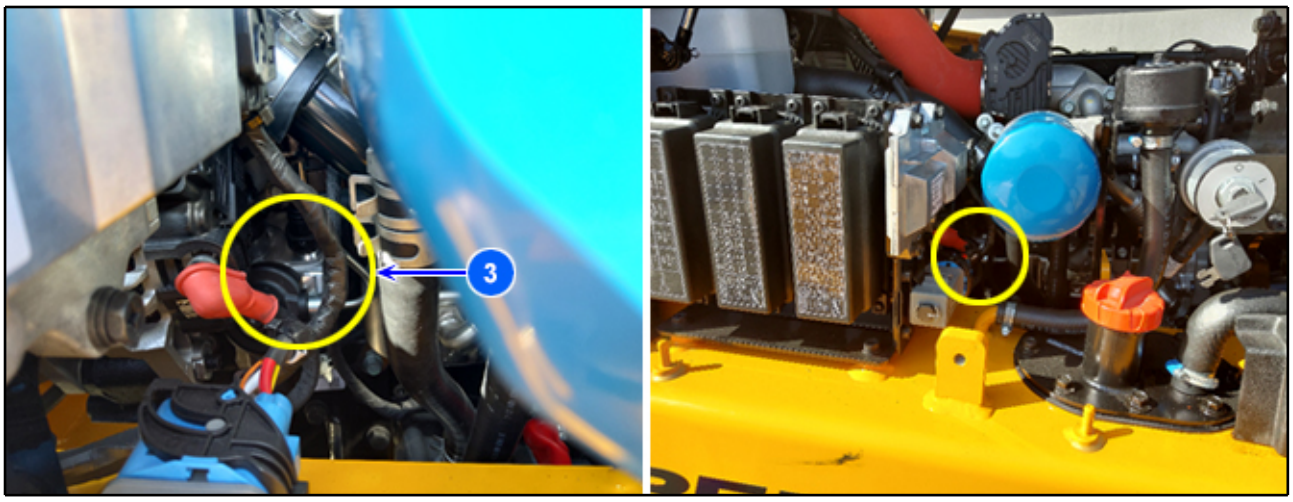


CRC12EN5010P008713

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

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Rail pressure regulator valve signal monitoring		1. Faulty fuel pressure regulator valve circuit 2. Defected FPRV 3. Faulty rail pressure regulator valve circuit 4. Defected RPRV 5. Fuel line leakage 6. Defected ECM
Enable Condition	• Engine running		
Threshold Value	Case 1	• Rail pressure is above limitation	
	Case 2	• Actual pressure is higher than target pressure and target pressure is above certain value	
	Case 3	• Rail pressure is below limitation	
Detecting Time	Case 1	• 1 sec	
	Case 2	• 750 msec	
	Case 3	• 300 msec	
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

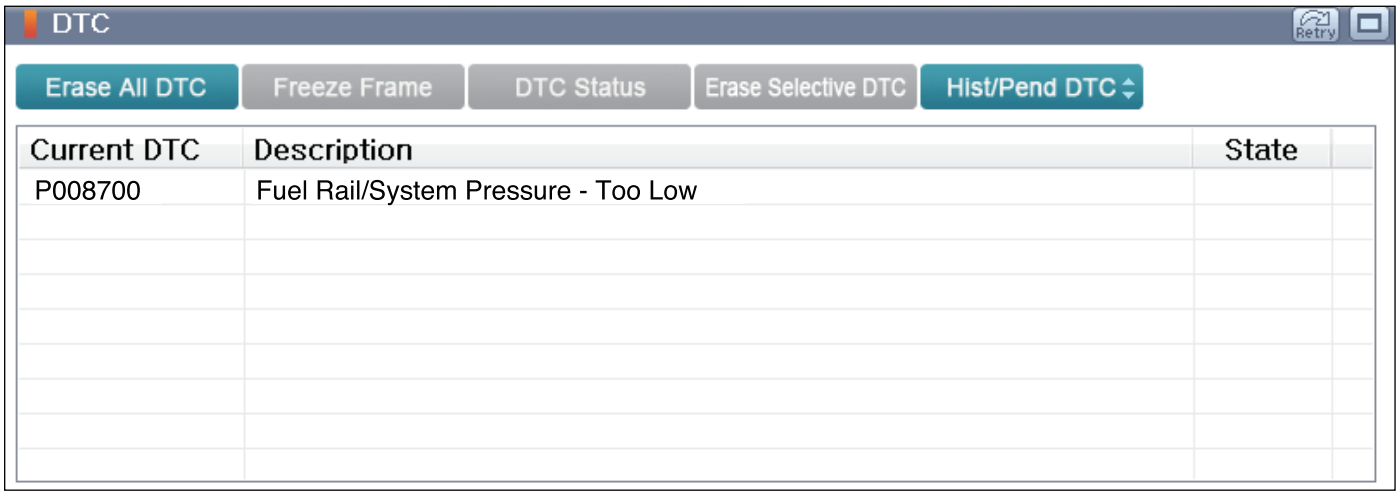
Vehicle Data

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

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

Monitor DTC Status

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



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

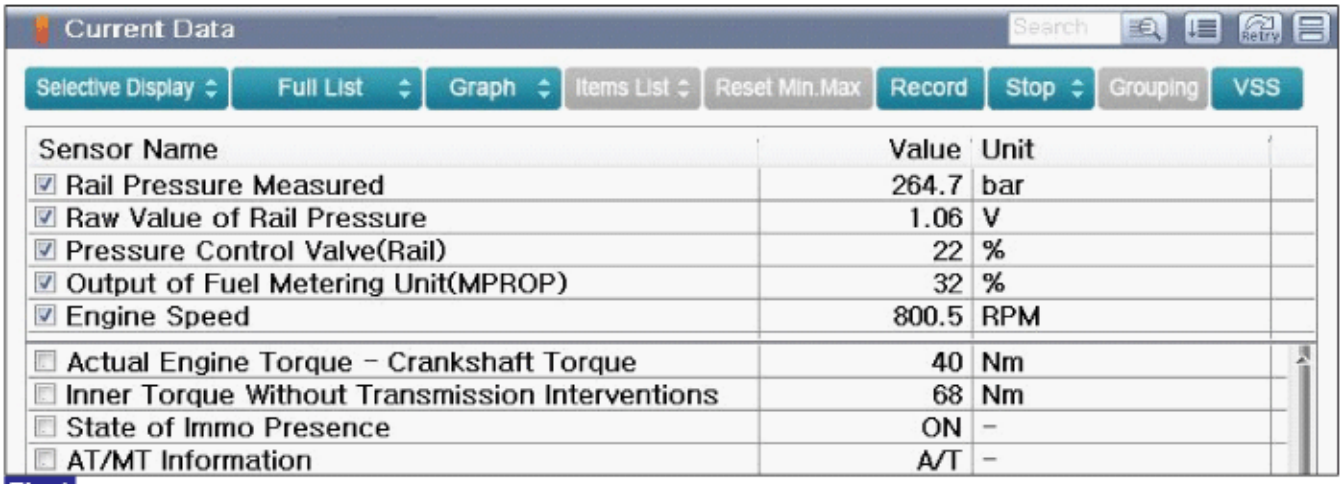


Fig.1

CRC12EN5010P00870022S

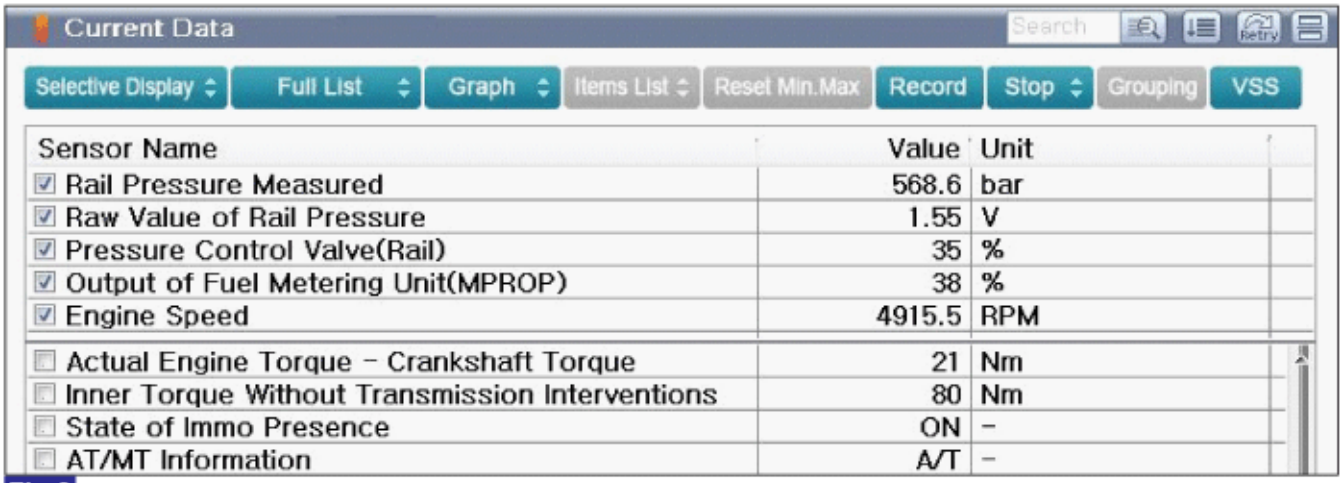


Fig.2

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?

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?

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

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 .

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.
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.

NO ▸ ▸ Inspect and repair open or short in circuit , 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 .

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

■ Fuel Pressure Regulator Valve Inspection

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

Specification : 2.60 ~ 3.15Ω (20℃/20℉)

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.

■ **Rail Pressure Regulator Valve Inspection**

1. Ignition switch "OFF"
2. Disconnect batter (-) cable.
3. 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℃/20℉)

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.

⚠ 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.

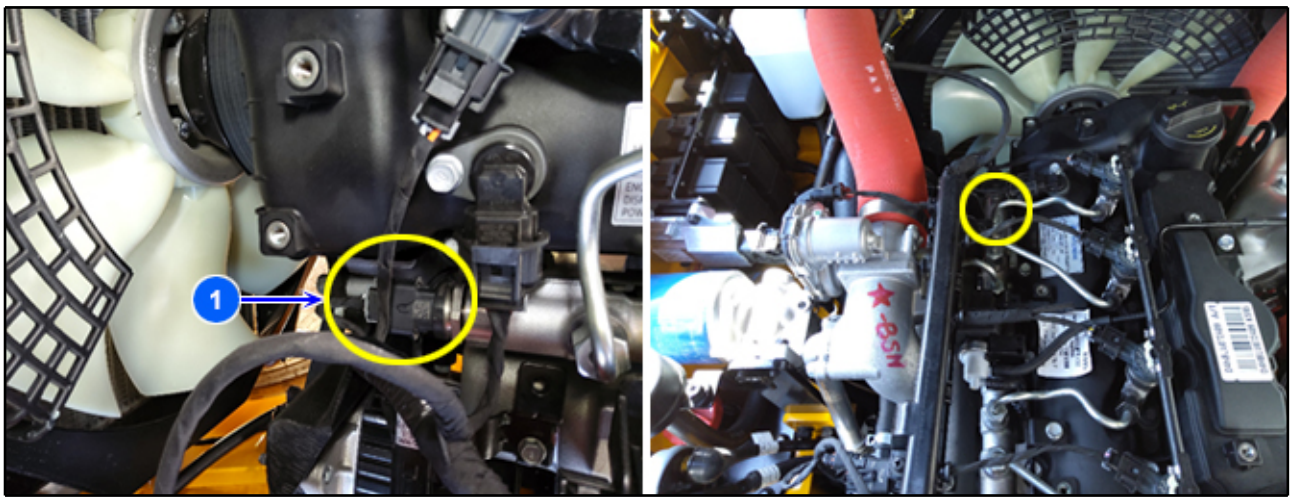
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P008800 Fuel Rail/System Pressure - Too High

Component Location



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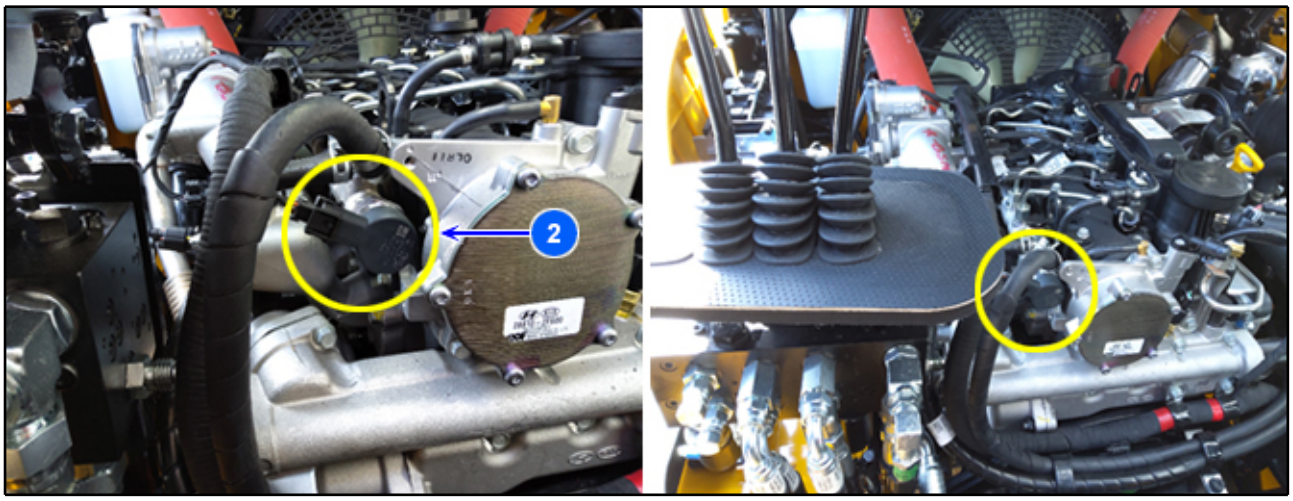

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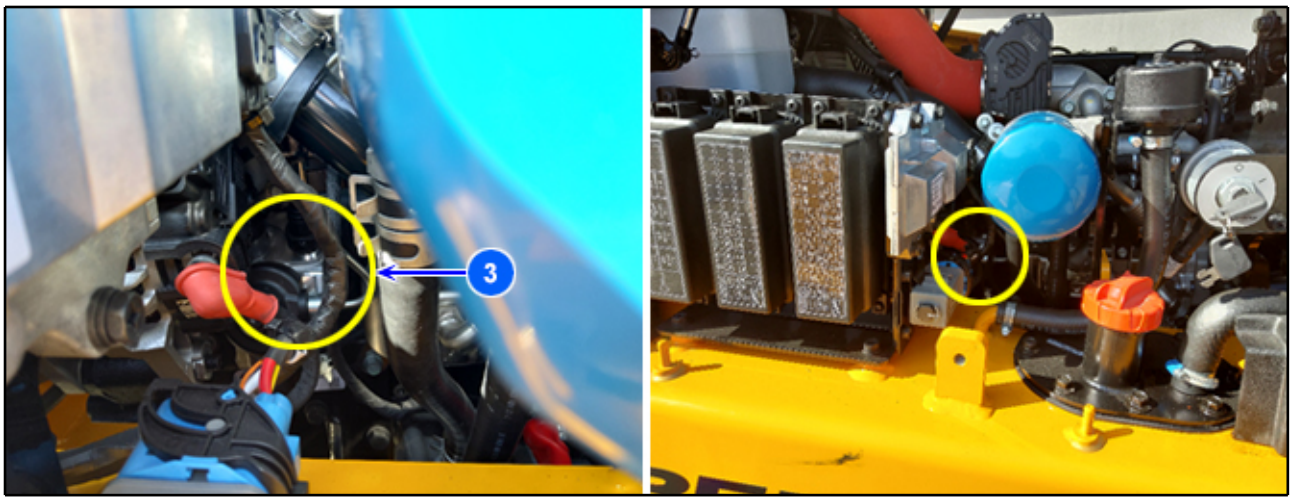


CRC12EN5010P008713

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 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		1. Faulty fuel pressure regulator valve circuit 2. Defected FPRV 3. Faulty rail pressure regulator valve circuit 4. Defected RPRV 5. Blocked fuel return line 6. Defected ECM
Enable Condition	• Engine running		
Threshold Value	Case 1	• Pressure difference in actual pressure and target pressure is lower than specification and target pressure is below specified value	
	Case 2	• Rail pressure is over limitation	
Detecting Time	Case 1	• 2 sec	
	Case 2	• 300 msec	
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

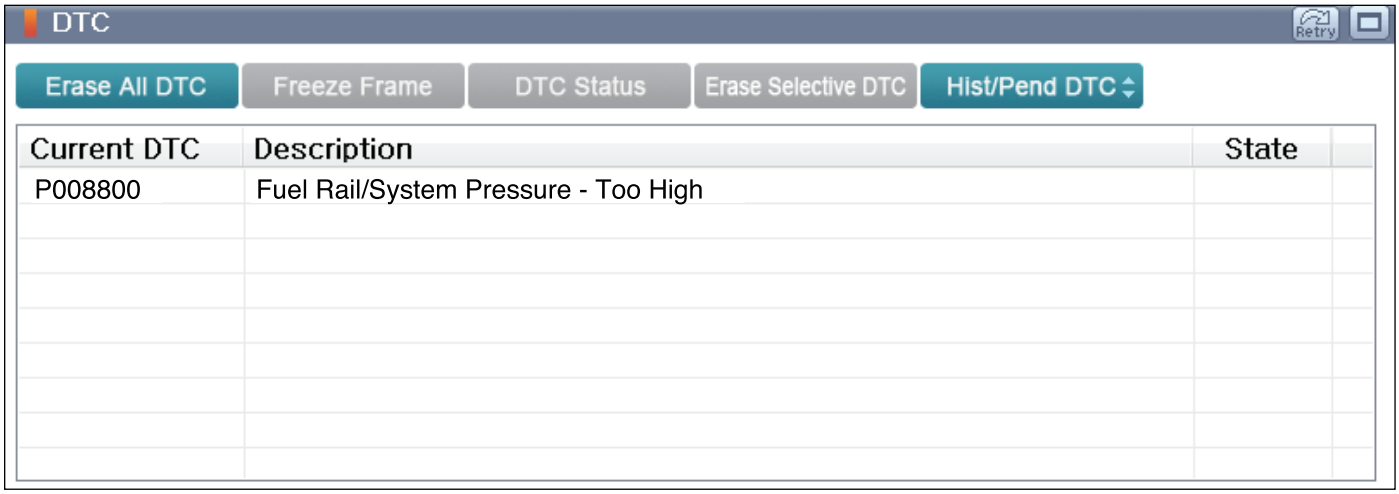
Vehicle Data

Rail Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Rail Pressure Regulator Valvue Control	• Ignition Switch "ON", Engine " OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	Rail Pressure Regulator Valvue Power		B+	-

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

Monitor DTC Status

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



CRC12EN5010P00880021S

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

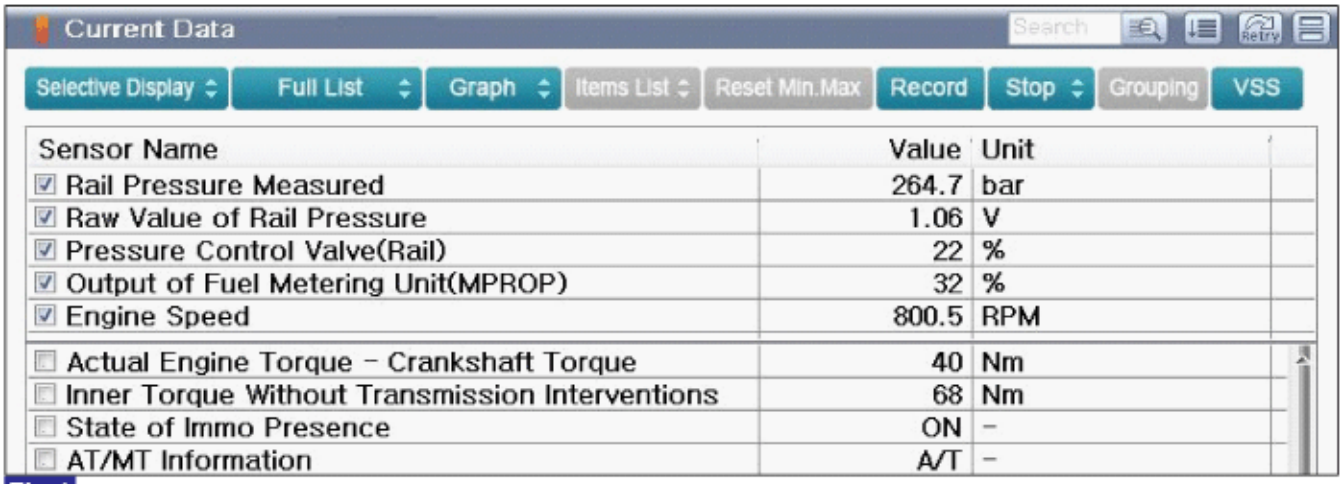


Fig.1

CRC12EN5010P00870022S

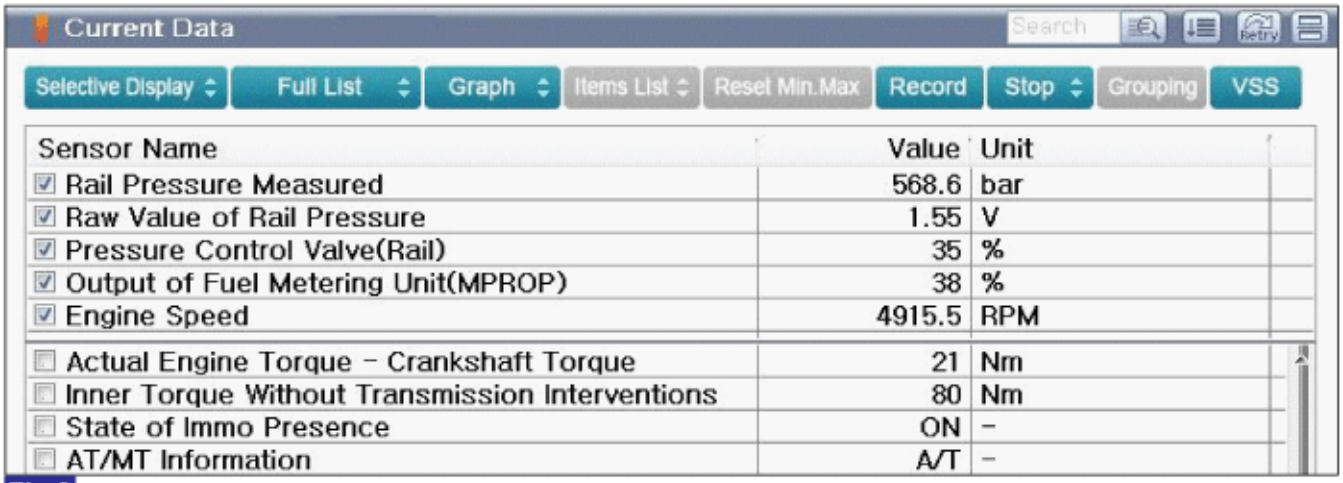


Fig.2

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?

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?

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

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 .

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.
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.

NO ▸ ▸ Inspect and repair open or short in circuit , 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 .

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

■ **Fuel Pressure Regulator Valve Inspection**

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

Specification : 2.60 ~ 3.15Ω (20℃/20℉)

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.

■ **Rail Pressure Regulator Valve Inspection**

1. Ignition switch "OFF"
2. Disconnect batter (-) cable.
3. 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℃/20℉)

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.

⚠ 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.

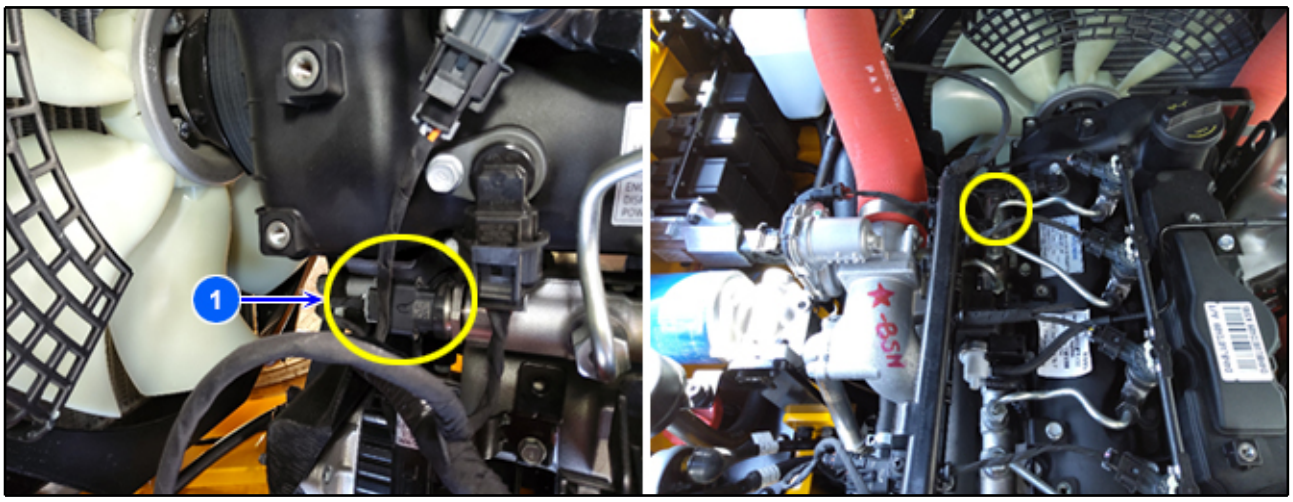
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P008900 Fuel Pressure Regulator 1 Performance

Component Location



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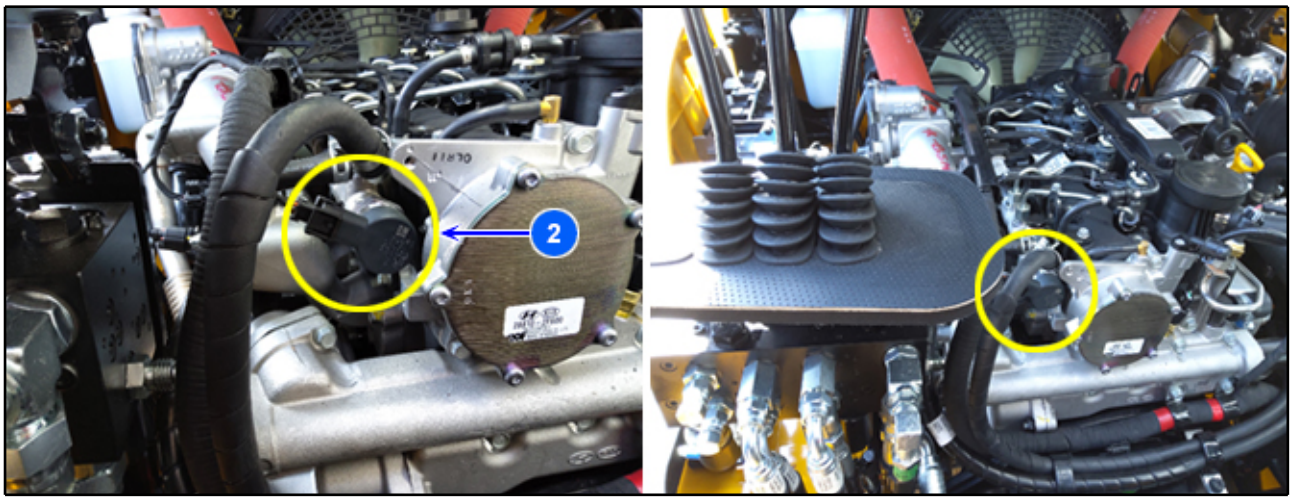

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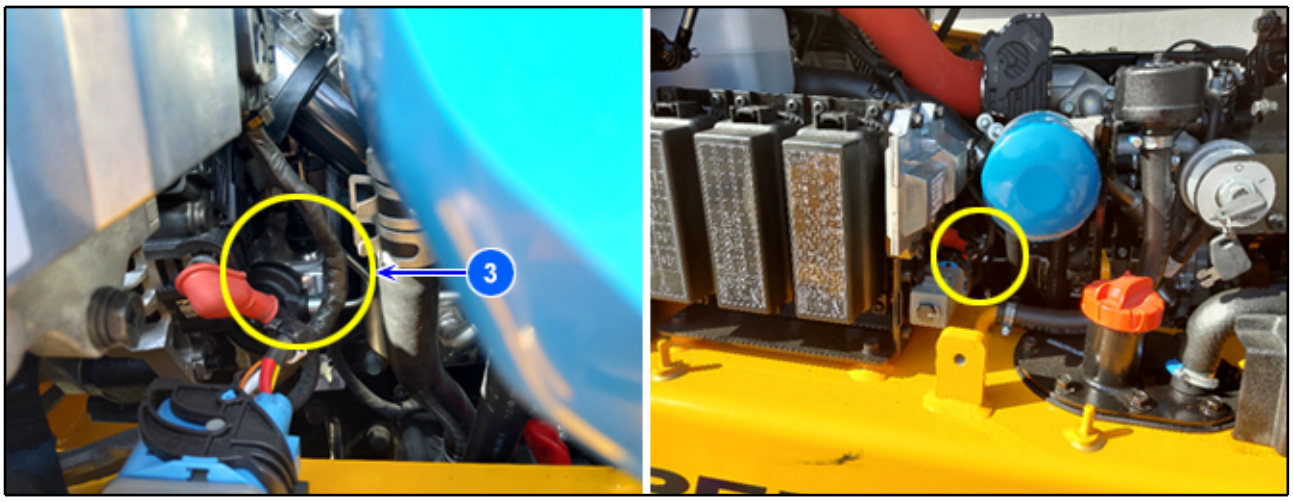


CRC12EN5010P008713

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 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

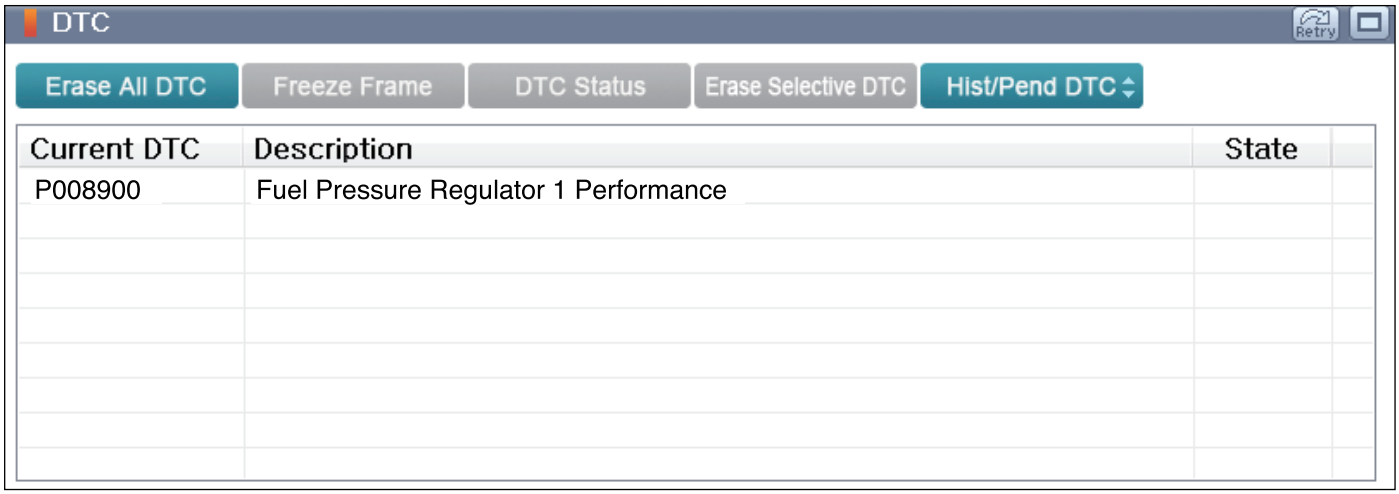
Item	Detecting Condition		Possible Cause
DTC Strategy	• Rail pressure regulator valve signal monitoring		1. Short to power in rail pressure regulator valve circuit 2. Defected rail pressure regulator valve 3. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Short to power in rail pressure regulator valve circuit		
Detecting Time	• 280 msec		
Fail Safe	Engine OFF	• Yes	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

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

Monitor DTC Status

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



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

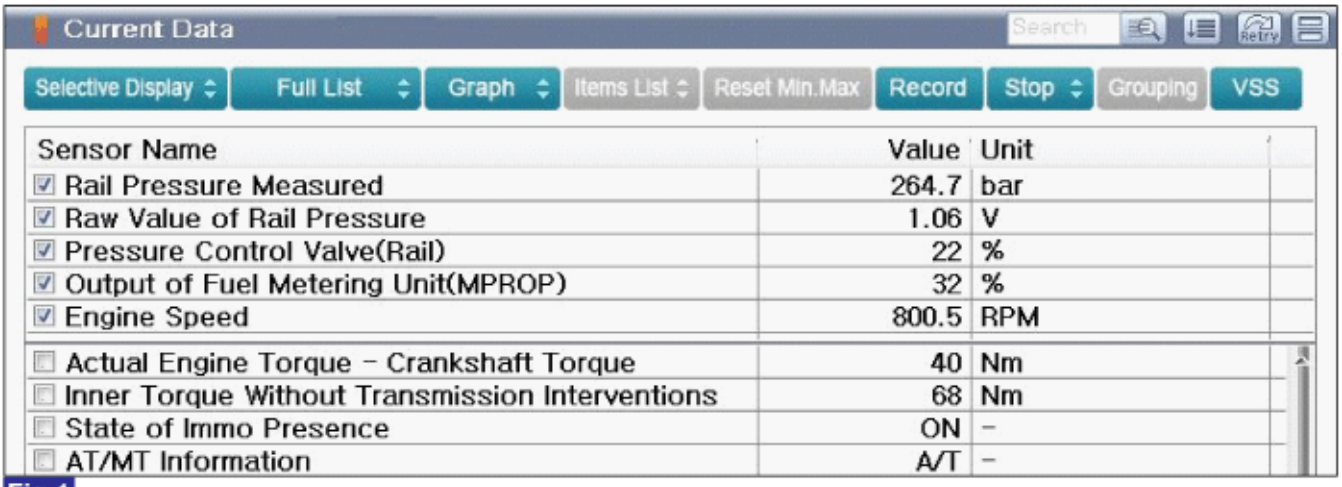


Fig.1

CRC12EN5010P00870022S

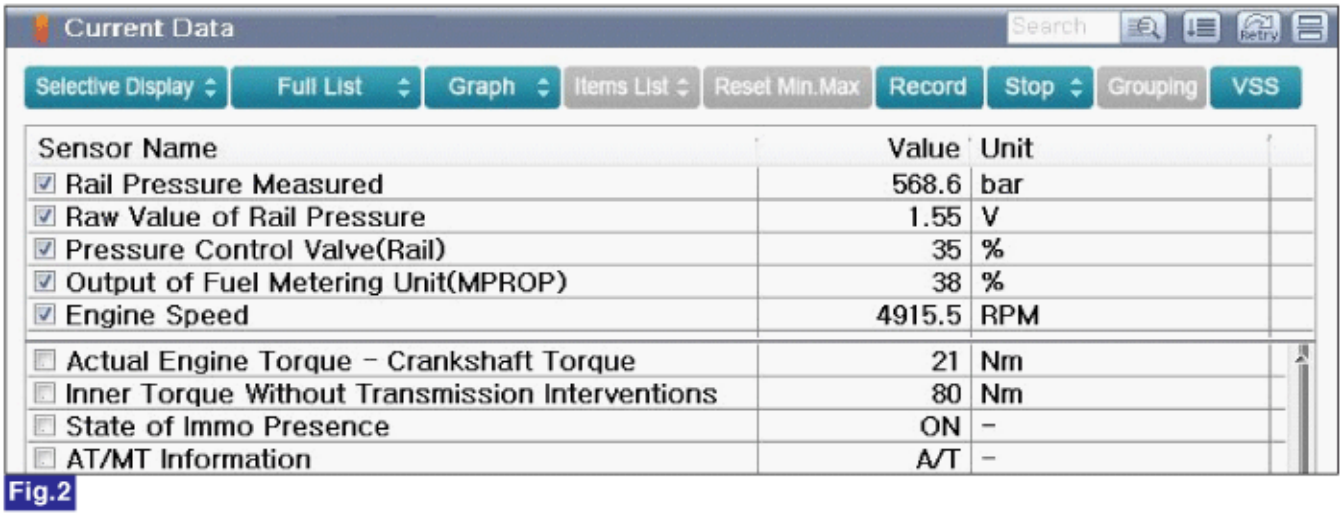


Fig.2

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?

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 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.

3. 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℃/20℉)

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.

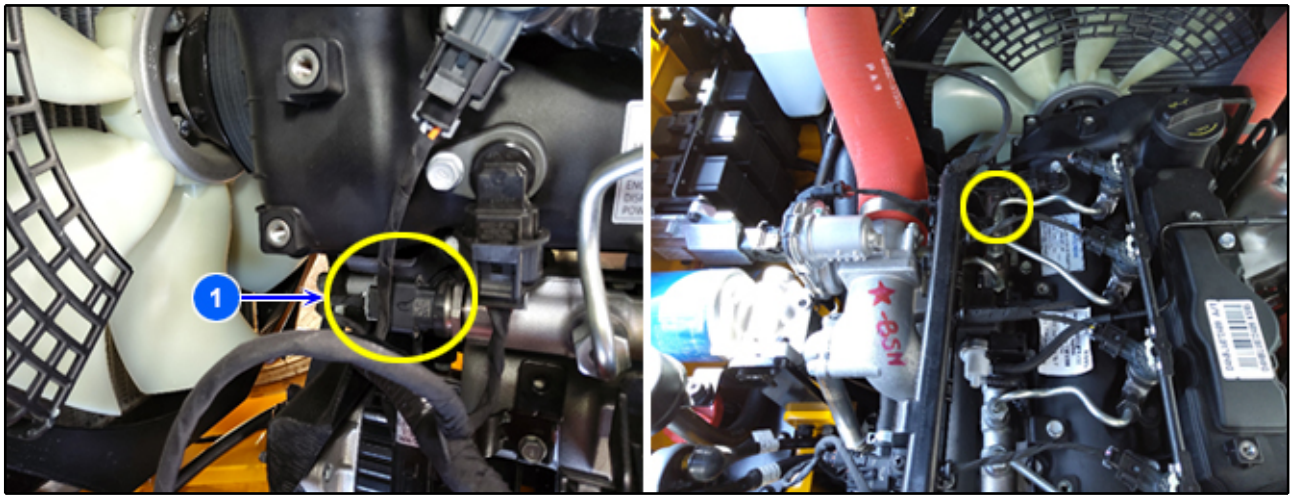
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

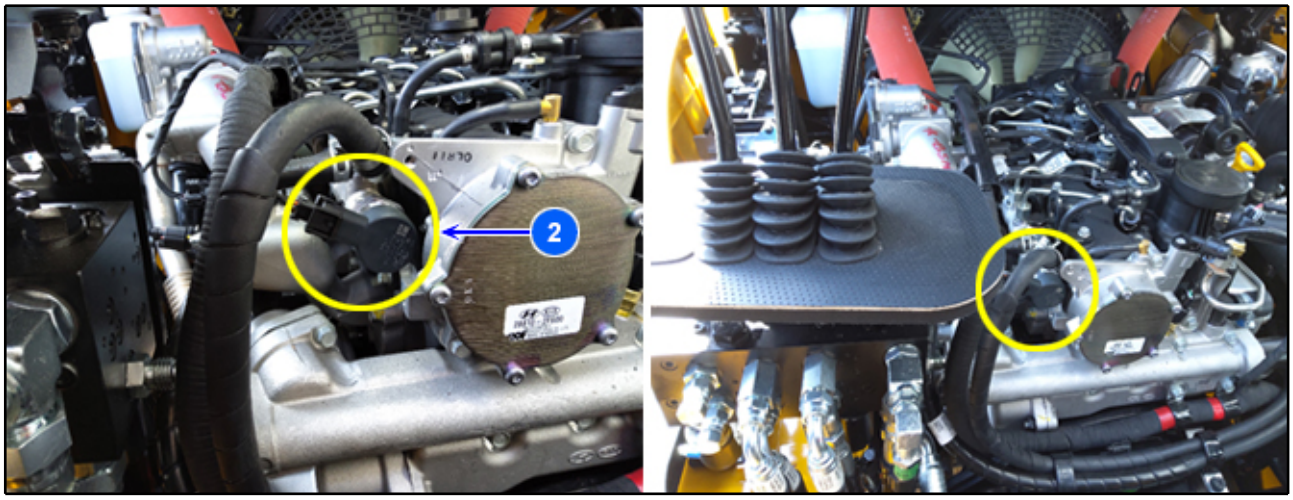
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P009100 Fuel Pressure Regulator 1 Control Circuit Low

Component Location



CRC12EN5010P008711



CRC12EN5010P008712

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

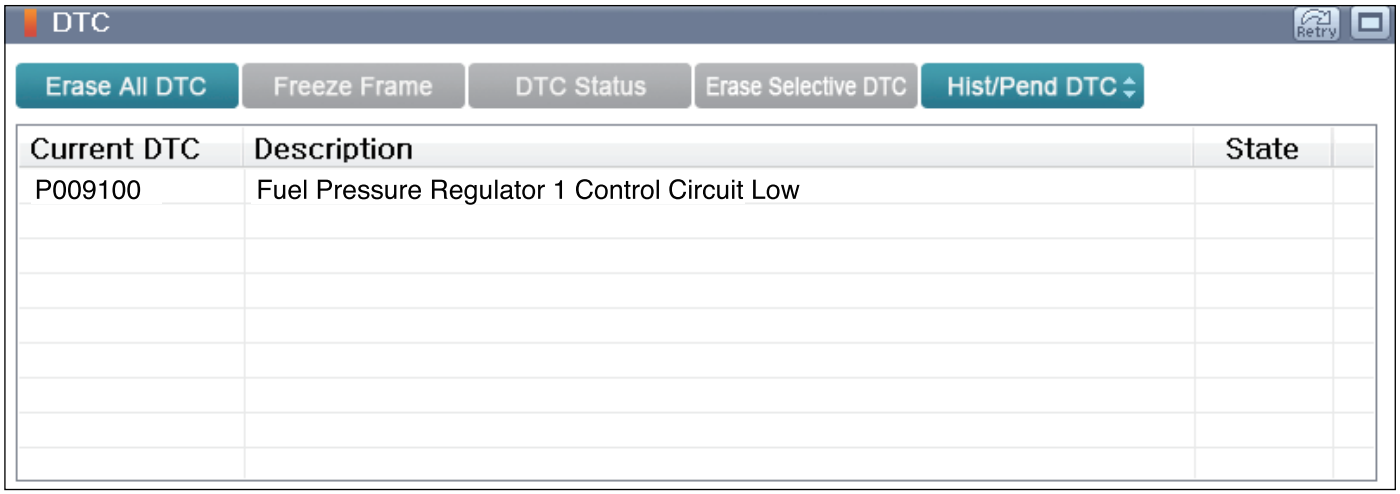
Item	Detecting Condition		Possible Cause
DTC Strategy	• Rail Pressure Regulator Valve Voltage Monitoring		1. Short to ground in rail pressure regulator valve circuit 2. Defected rail pressure regulator valve 3. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Short to ground in rail pressure regulator valve		
Detecting Time	• 280 msec		
Fail Safe	Engine OFF	• Yes	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• No	

Vehicle Data

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

Monitor DTC Status

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



CRC12EN5010P00910021S

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

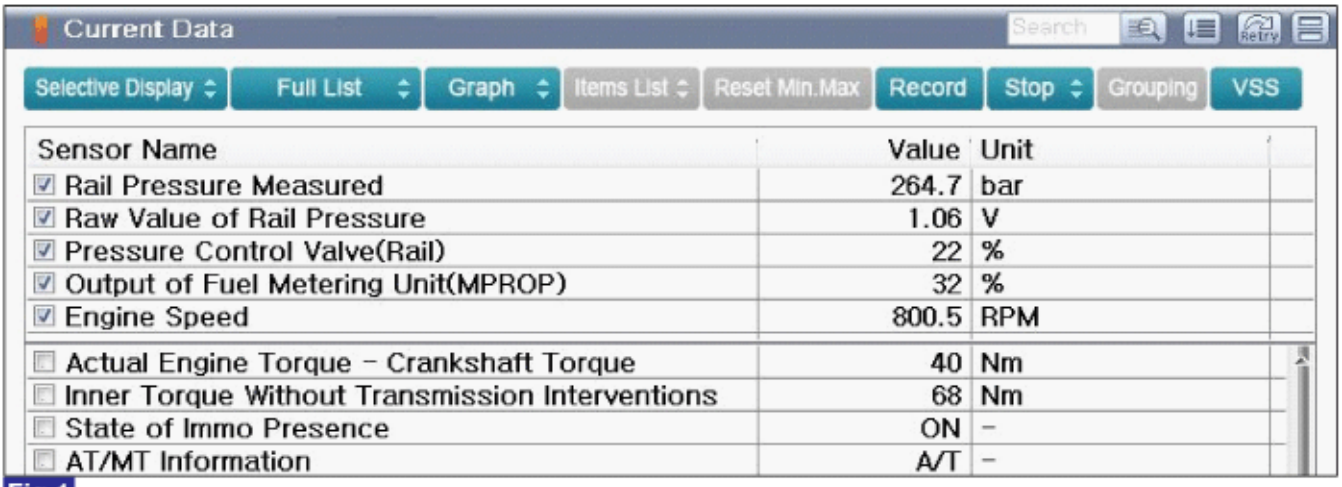


Fig.1

CRC12EN5010P00870022S

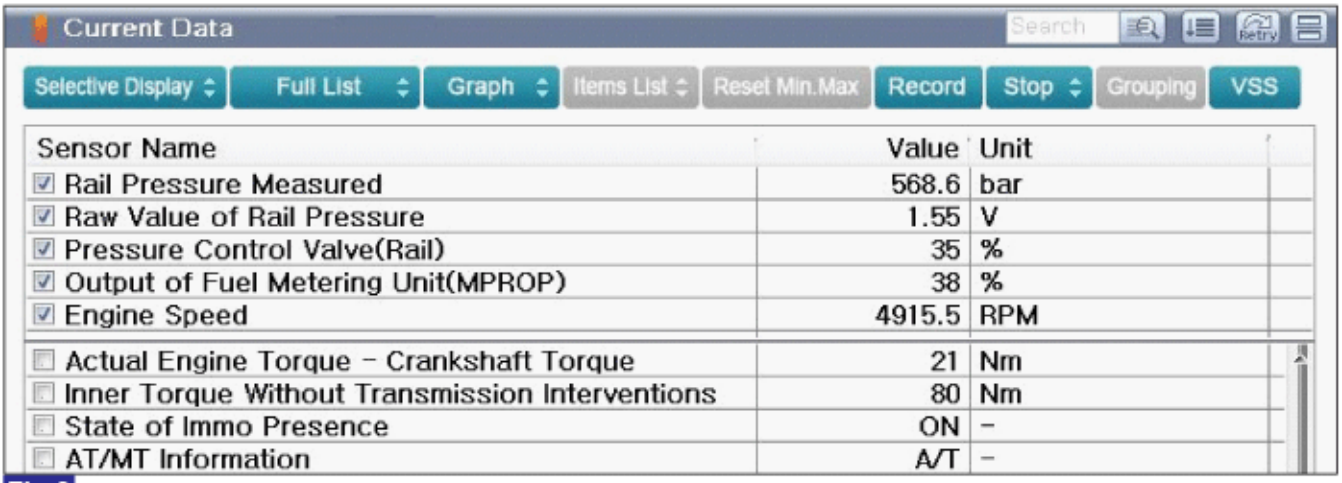


Fig.2

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?

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 "OFF".
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.

3. 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℃/20℉)

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.

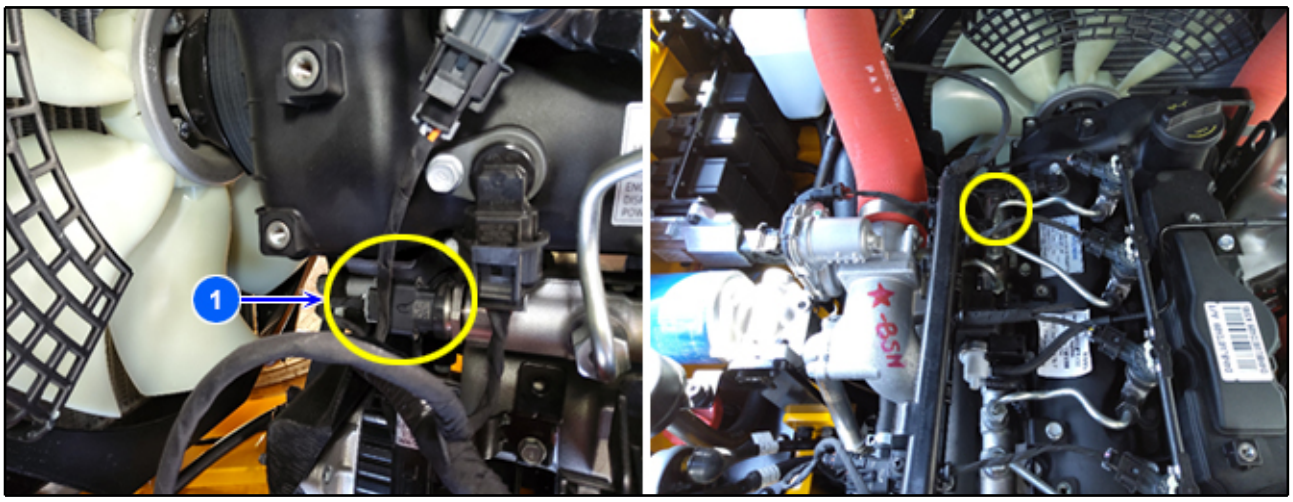
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

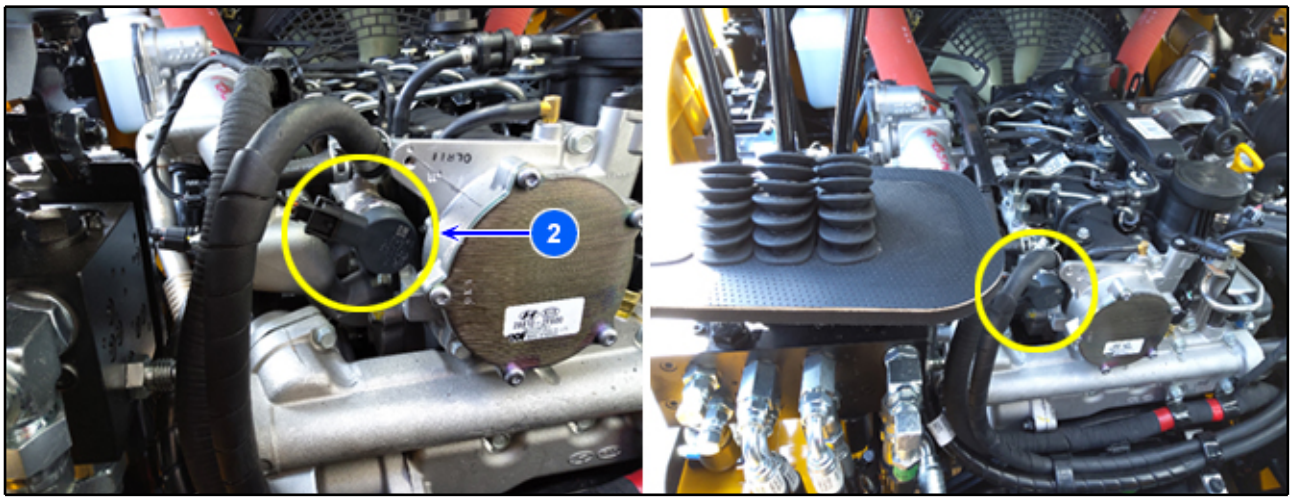
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P009200 Fuel Pressure Regulator 1 Control Circuit High

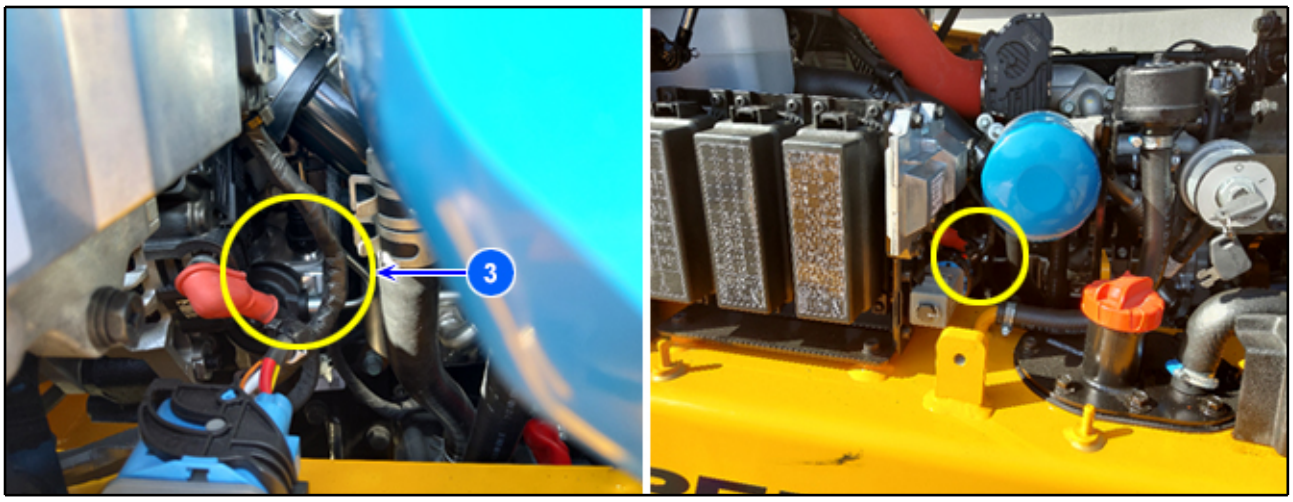
Component Location



CRC12EN5010P008711



CRC12EN5010P008712



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 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

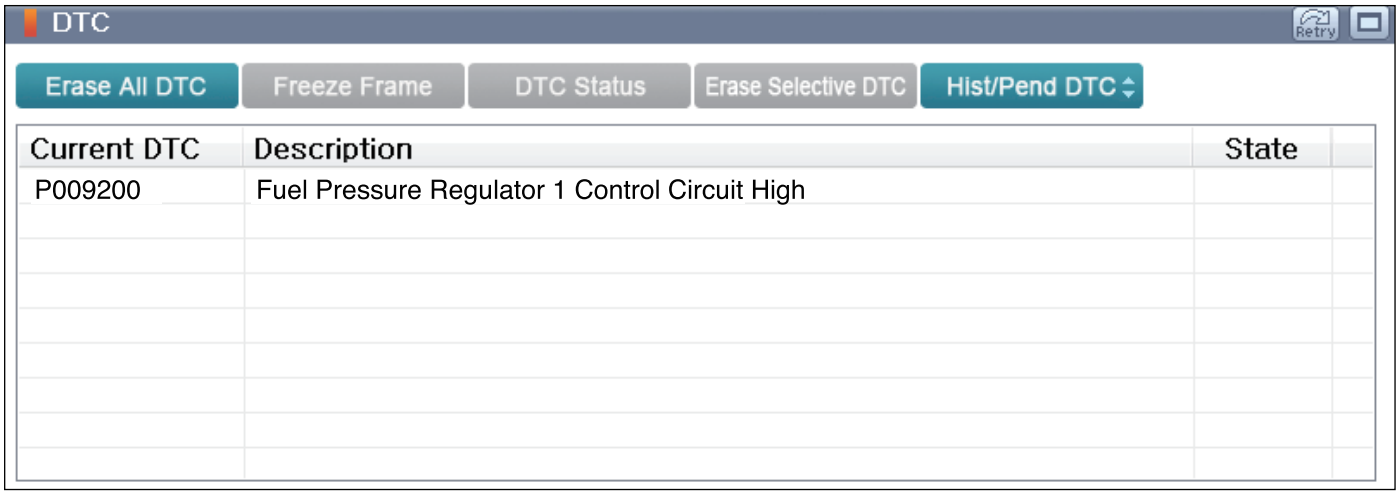
Item	Detecting Condition		Possible Cause
DTC Strategy	• Rail Pressure Regulator Valve Voltage Monitoring		1. Short to ground in rail pressure regulator valve circuit 2. Defected rail pressure regulator valve 3. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Short to ground in rail pressure regulator valve • Excessive temperature on rail pressure regulator valve		
Detecting Time	• 280 msec		
Fail Safe	Engine OFF	• Yes	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

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

Monitor DTC Status

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



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

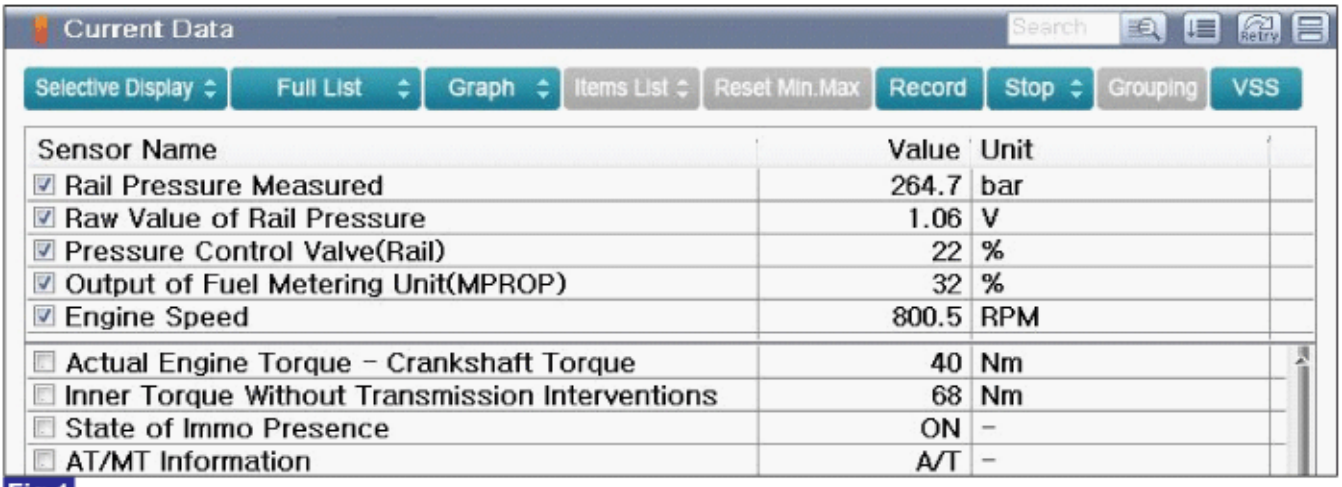


Fig.1

CRC12EN5010P00870022S

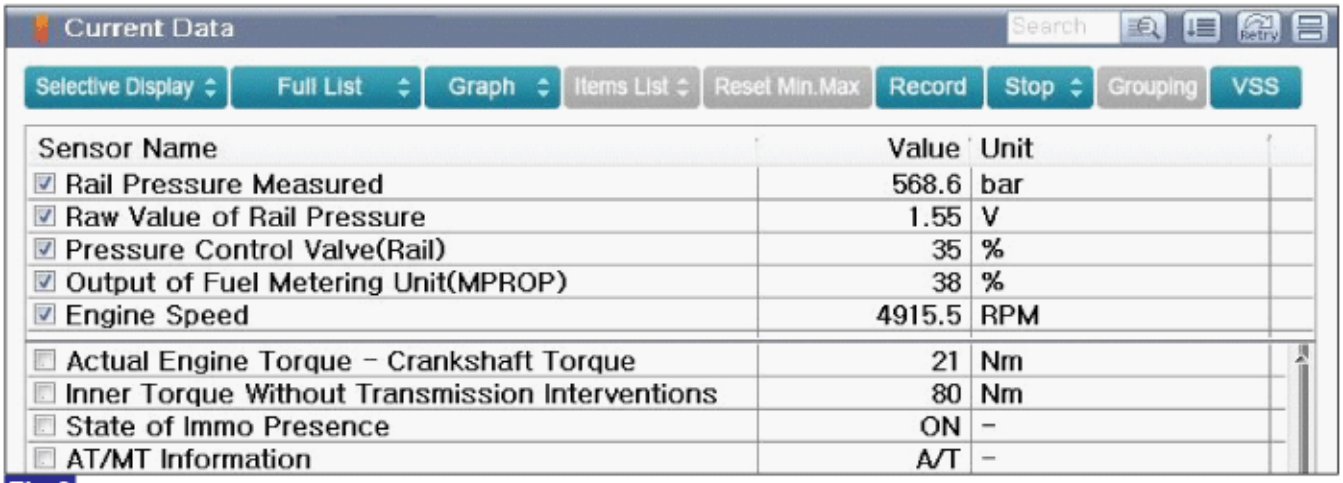


Fig.2

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?

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 "OFF".
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.

3. 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℃/20℉)

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?

YES ▸ Go to the applicable troubleshooting procedure.

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

CRC12EN5010P00970011

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.

DTC Detecting Condition

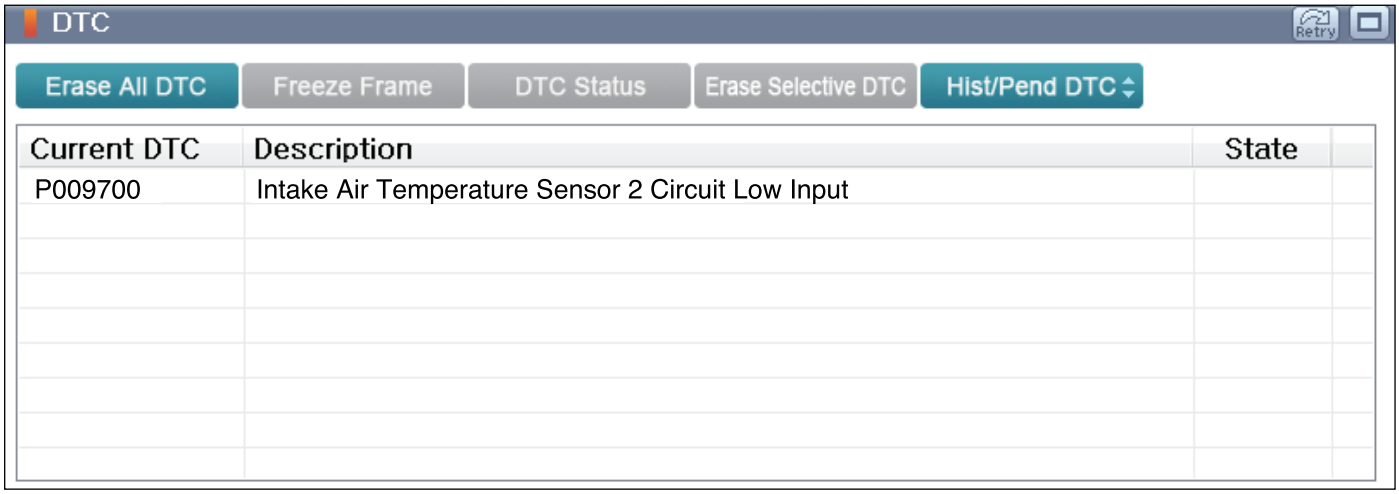
Item	Detecting Condition		Possible Cause
DTC Strategy	• Intake air temperature sensor signal monitoring		1. Short to ground in intake air temperature sensor #2 circuit 2. Defected intake air temperature sensor #2
Enable Condition	• Engine running		
Threshold Value	• Intake air temperature sensor signal value is below specification		
Detecting Time	• 3 msec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Intake Air Temperature Sensor #2		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	IATS Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	IATS 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.



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

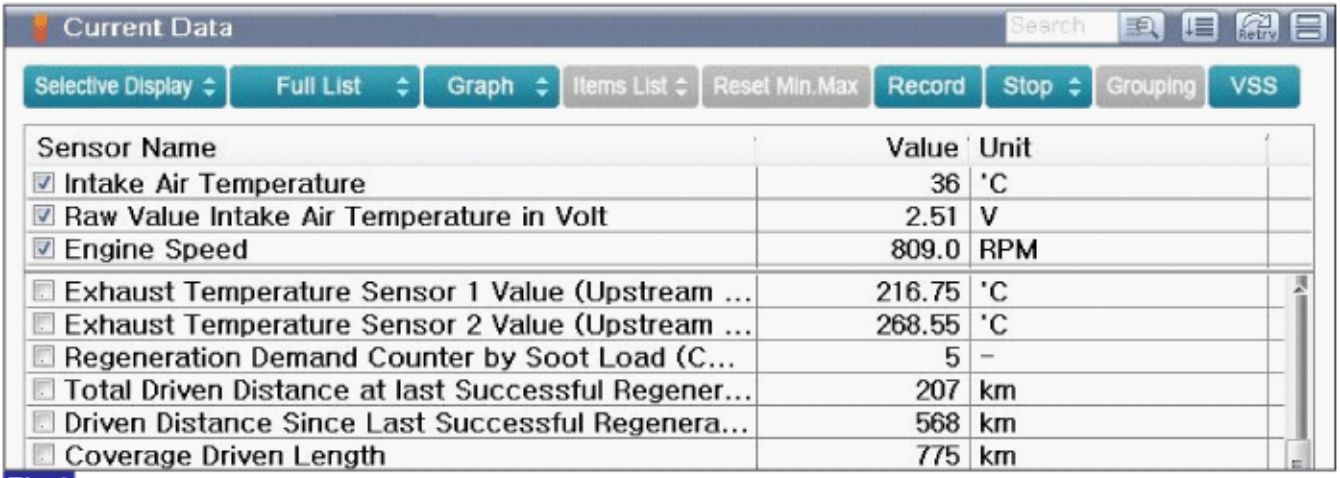


Fig.1

CRC12EN5010P00970022S

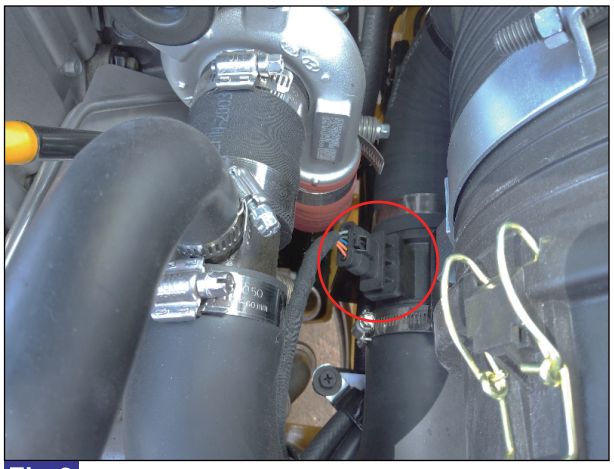


Fig.2

Fig.3

CRC12EN5010P01120023S

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.

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 "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 Ω

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.
4. Measure the resistance between ground terminal and gignal terminal of intake air temperature sensor #2 harness connector.

Specification : Refer to table below

Temperature (℃/℉)	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)".
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.

P009800 Intake Air Temperature Sensor 2 Circuit High Input

Component Location

CRC12EN5010P00970011

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.

DTC Detecting Condition

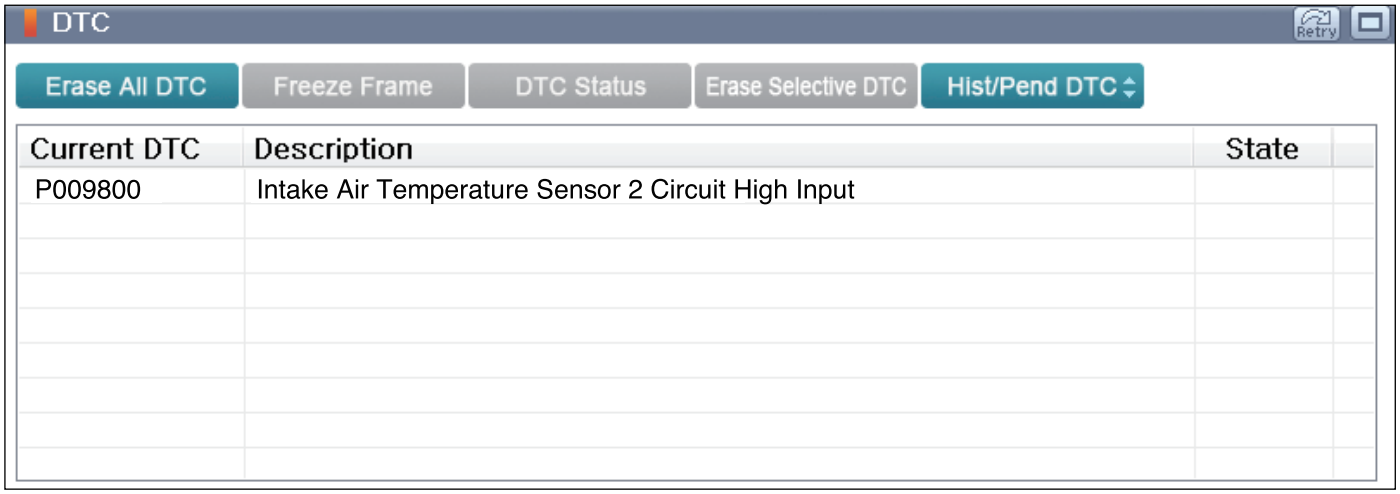
Item	Detecting Condition		Possible Cause
DTC Strategy	• Intake air temperature sensor signal monitoring		1. Short to ground in intake air temperature sensor #2 circuit 2. Open in intake air temperature sensor #2 ground circuit 3. Defected intake air temperature sensor #2
Enable Condition	• Engine running		
Threshold Value	• Intake air temperature sensor signal value is below specification		
Detecting Time	• 3 msec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Intake Air Temperature Sensor #2		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	IATS Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	IATS 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.



CRC12EN5010P00980021S

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

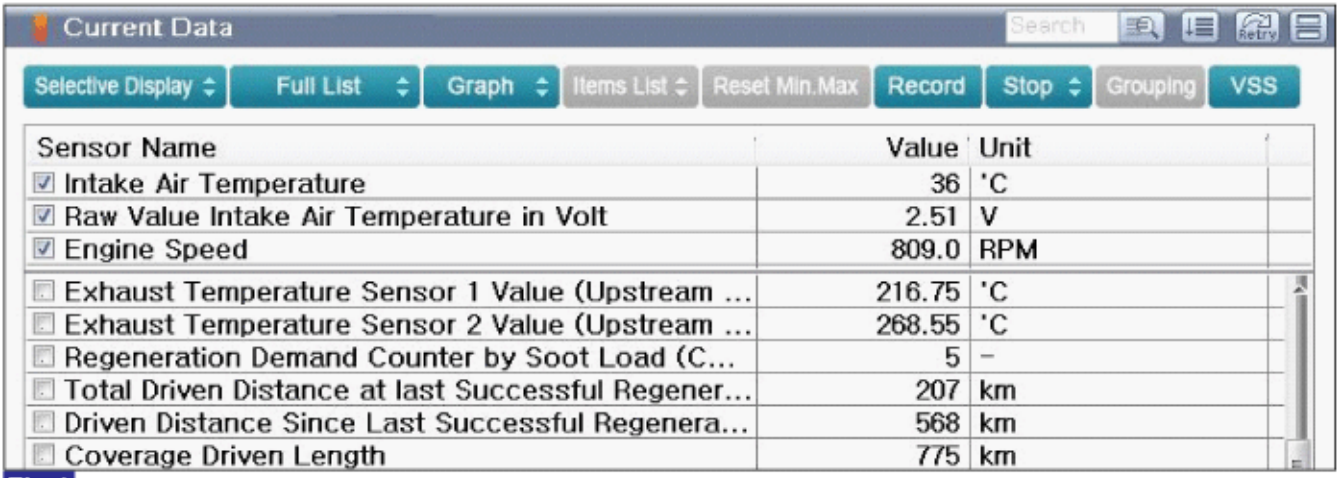


Fig.1

CRC12EN5010P00970022S

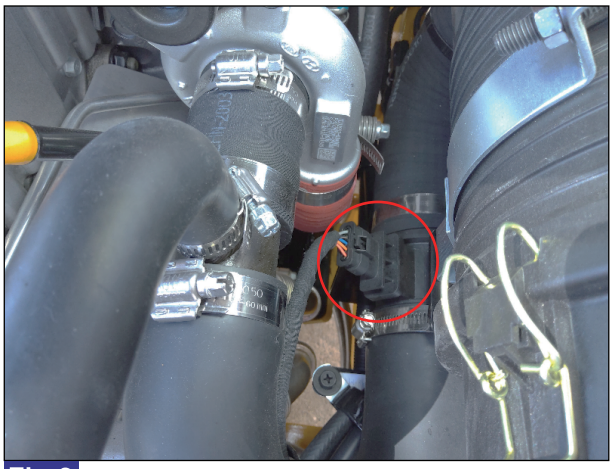


Fig.2

Fig.3

CRC12EN5010P01120023S

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.

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 "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 Ω

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.
4. Measure the resistance between ground terminal and gignal terminal of intake air temperature sensor #2 harness connector.

Specification : Refer to table below

Temperature (℃/℉)	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)".
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

CRC12EN5010P00970011

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℃(86℉), ECM sets DTC P009A00.

DTC Detecting Condition

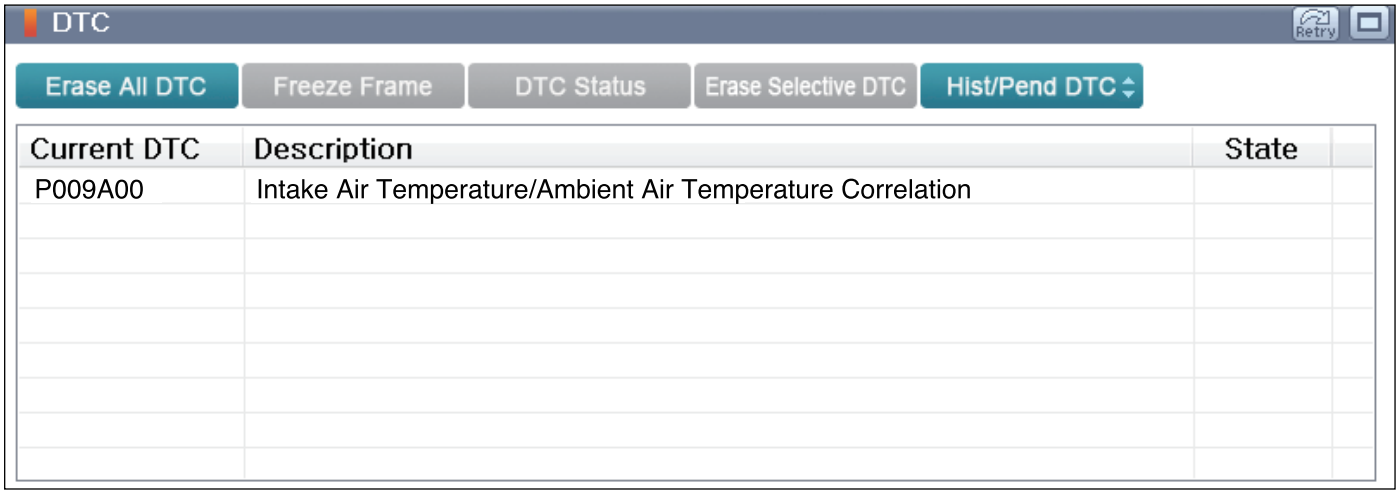
Item	Detecting Condition		Possible Cause
DTC Strategy	• Intake air temperature sensor signal monitoring		1. Faulty intake air temperature sensor #2 circuit 2. Defected intake air temperature sensor #2
Enable Condition	• Normal intake air temperature sensor #1(MAFS) • Monitoring enabled when intake air temperature sensor #1(MAFS) temperature is over -7℃(19.4℉) since 6 hours after engine "OFF" • 10 sec. after engine "ON"		
Threshold Value	• Signal difference between intake air temperature sensor #2 and intake air temperature sensor #1 (MAFS) is over 30℃(86℉)		
Detecting Time	• -		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Intake Air Temperature Sensor #2		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	IATS Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	IATS 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.



CRC12EN5010P009A0021S

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

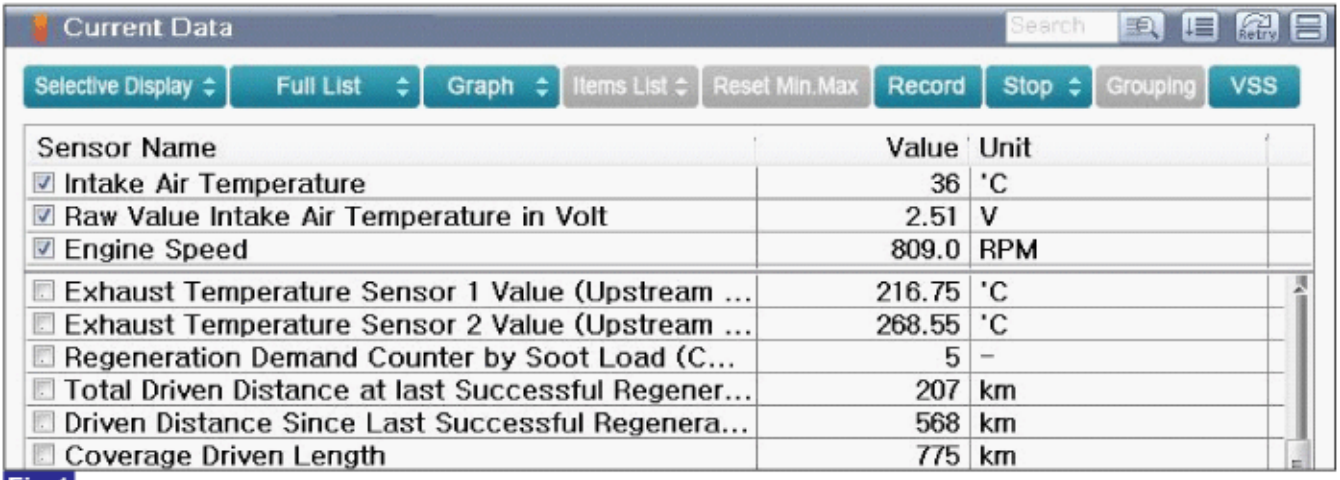


Fig.1

CRC12EN5010P00970022S

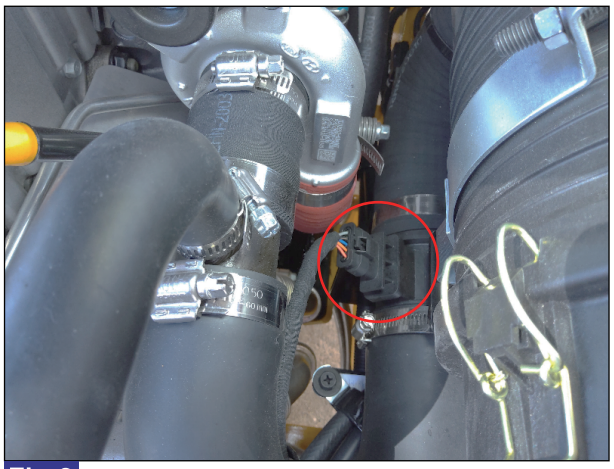


Fig.2


Fig.3

CRC12EN5010P01120023S

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.

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 "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 Ω

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.
4. Measure the resistance between ground terminal and gignal terminal of intake air temperature sensor #2 harness connector.

Specification : Refer to table below

Temperature (℃/℉)	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. T-horoughly check connectors for looseness, po-or connection, bending, corrosion, contaminati-on, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

NO ▸ Carefully re-do this troubleshooting guide st-eps.
▸ If no problems were found with the circuits or connectors, replace the Intake Air Temperat-ure 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.

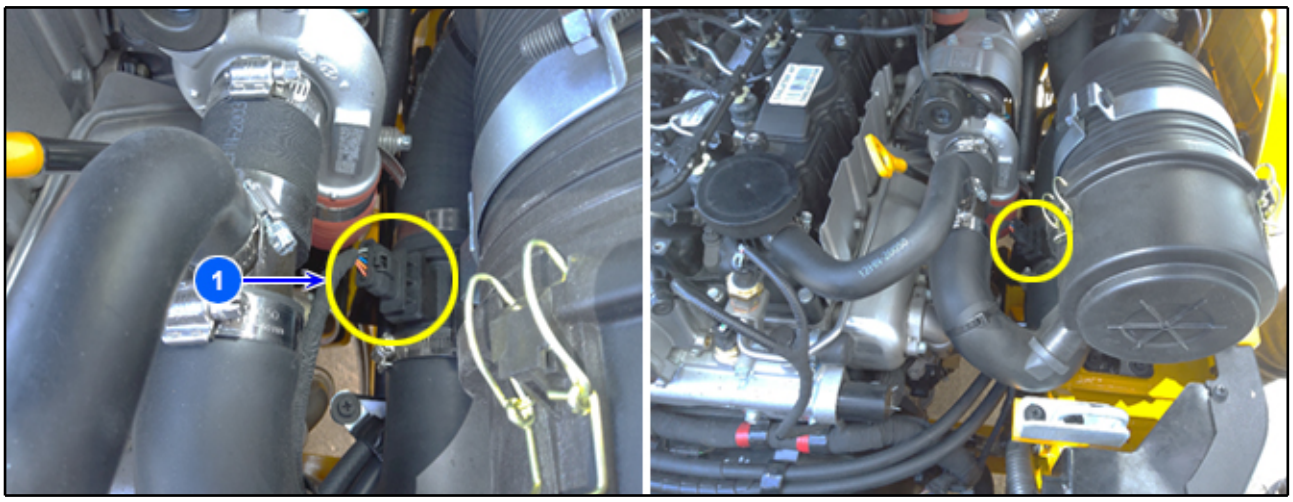
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting proced-ure.

NO ▸ Problem is corrected and the system operat-ion 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

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Faulty MAFS circuit 2. Defected MAFS
Enable Condition	• Engine running		
Threshold Value	Case 1	• Filtered intake air volume is less than specification	
	Case 2	• Open or short in MAFS signal circuit	
	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	
Detecting Time	Case 1	• 4 sec	
	Case 2	• 1sec	
	Case 3	• 1sec	
	Case 4	• 1sec	
	Case 5	• 4 sec	
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	• Ignition switch "ON" & Engine "OFF"Voltage is measured on wiring side(Disconnected) • Voltage is measured on wiring side(Disconnected)	Approx. 4.8V	-
	2	Reference Frequency		Approx. 4.8V	-
	3	Intake Air Temperature Sensor #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" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 2.5V	Signal Waveform(Fig. 2)
	2	Reference Frequency		Approx. 3.5V	Signal Waveform(Fig. 1
	3	Intake Air Temperature Sensor #1 Signal		Approx. 2.35V	Approx. 28℃(82.4℉)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

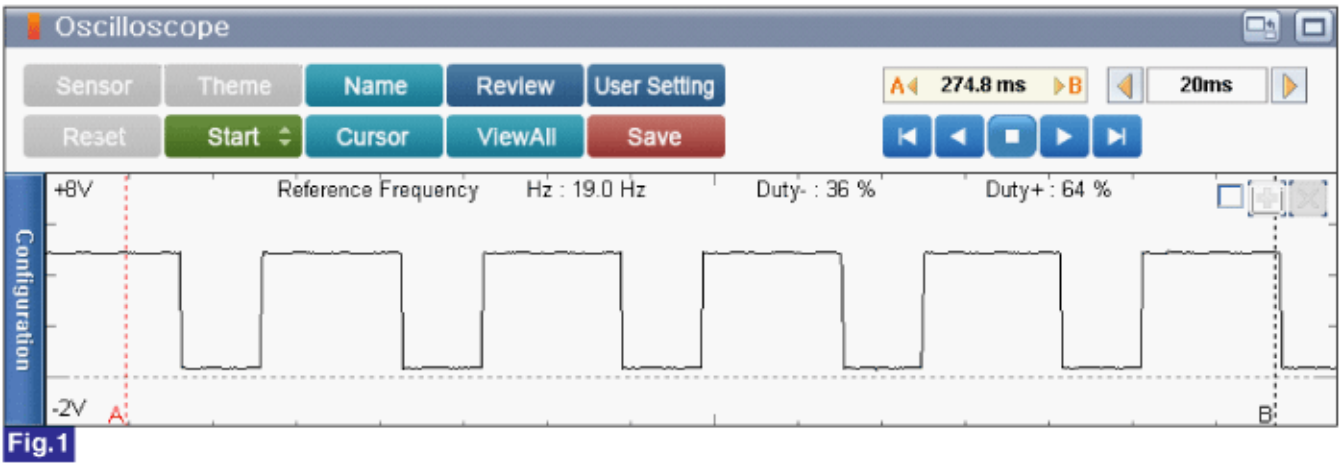


Fig.1

CRC12EN5010P01010011S

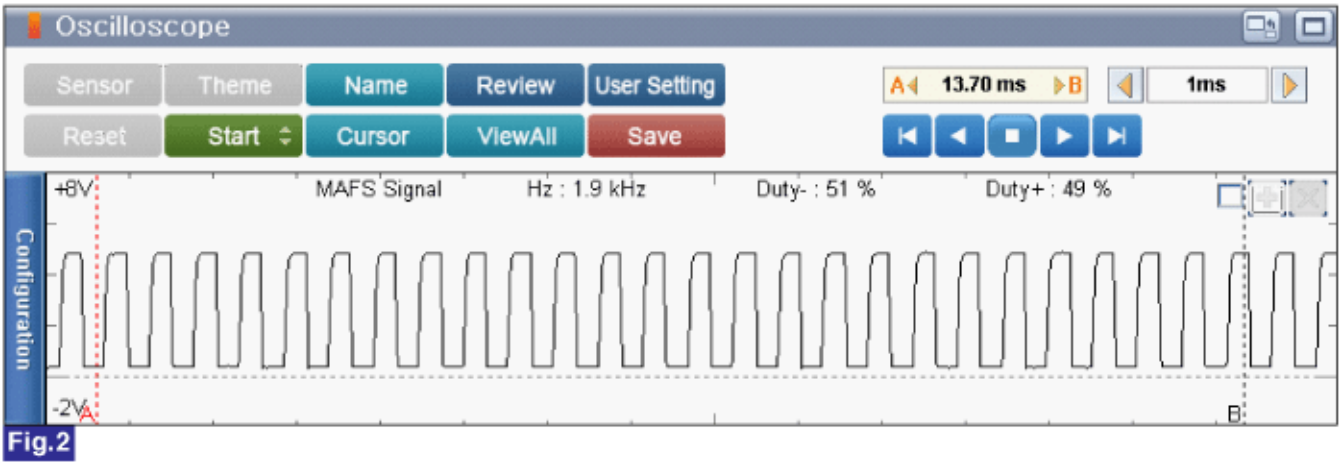
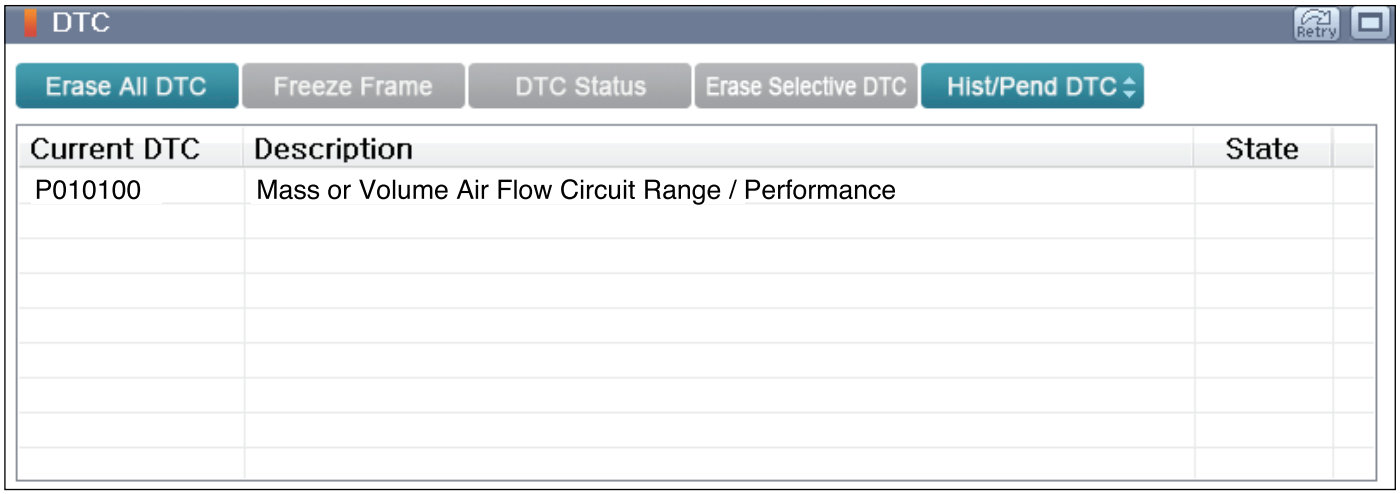


Fig.2

CRC12EN5010P01010012S

Monitor DTC Status

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



CRC12EN5010P01010021S

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

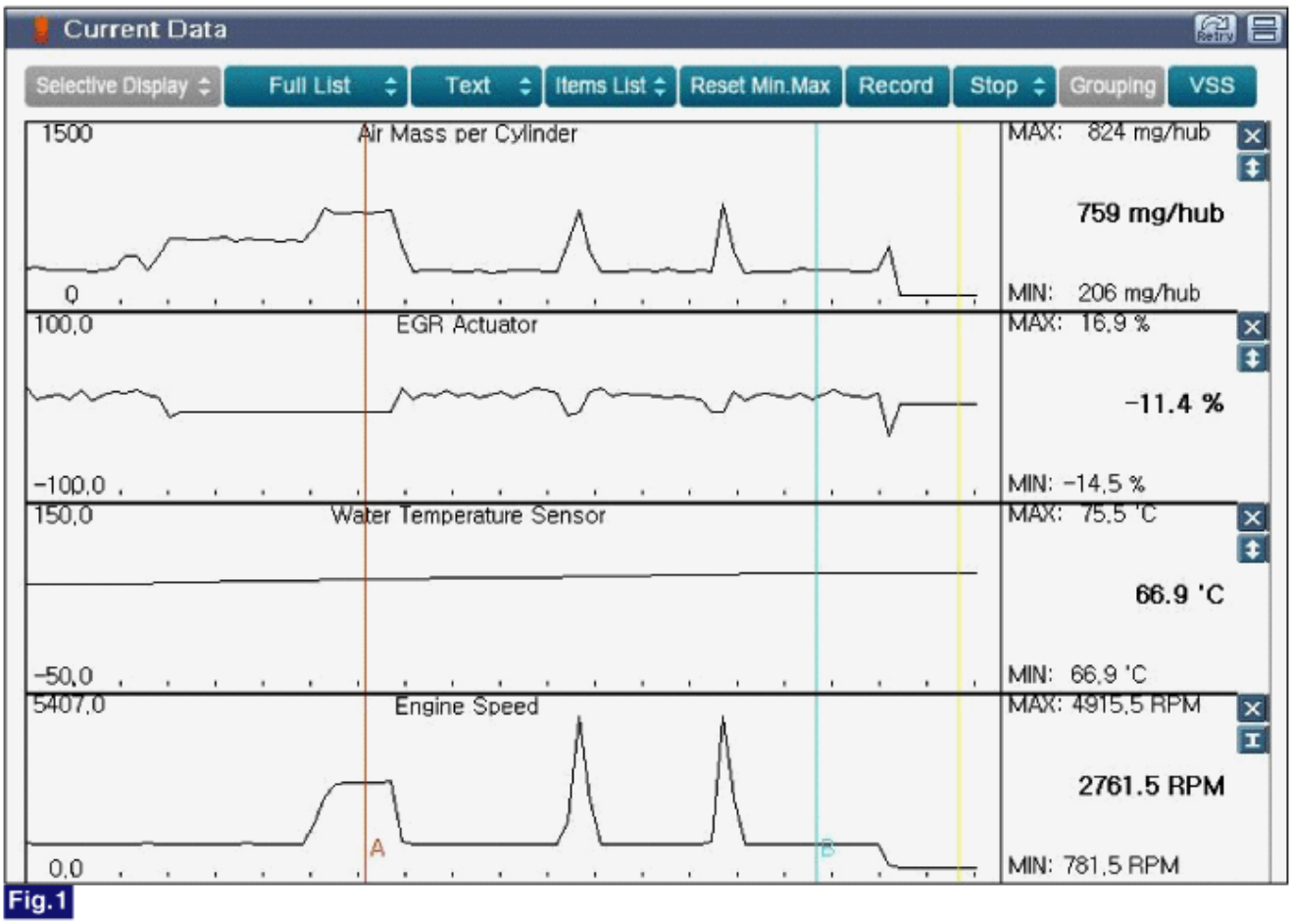


Fig.1

CRC12EN5010P01010022S

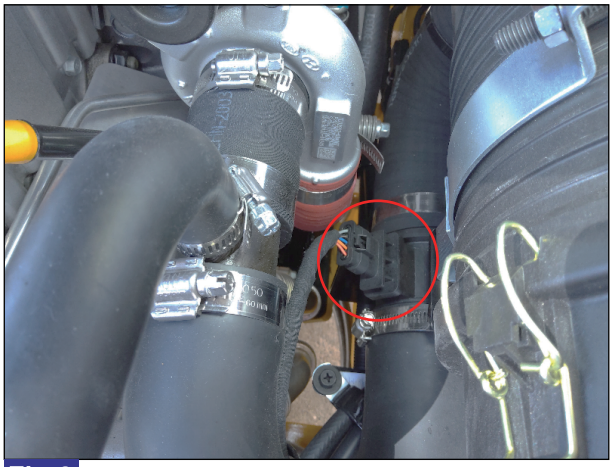


Fig.2

Fig.3

CRC12EN5010P01120023S

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.

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 go to "Verification of Vehicle Repair" procedure.

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

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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.

■ Electric Exhaust Gas Re-Circulation(EEGR) Actuator Inspection

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

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

NO ▸ Go to "Wiring Inspection" procedure.

⚠ 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.
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 Ω

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)

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

5. Is the measured value within specification?

YES ▸ Go to "MAFS Reference Frequency Circuit Inspection" 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

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

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

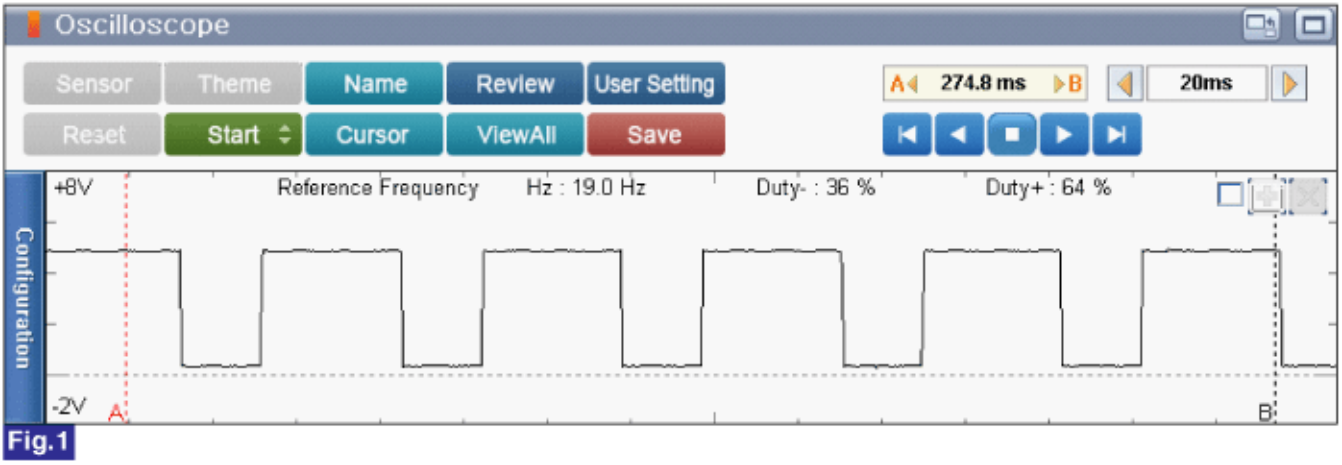


Fig.1

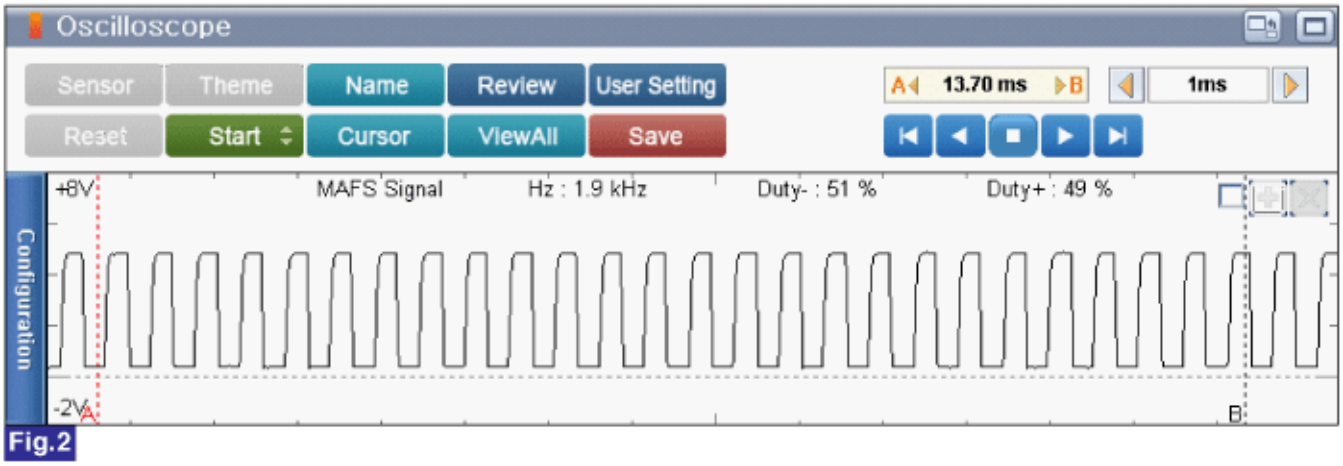


Fig.2

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?

YES ▸ 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℃/82.4℉)

※Voltage 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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Air Flow Sensor Change"

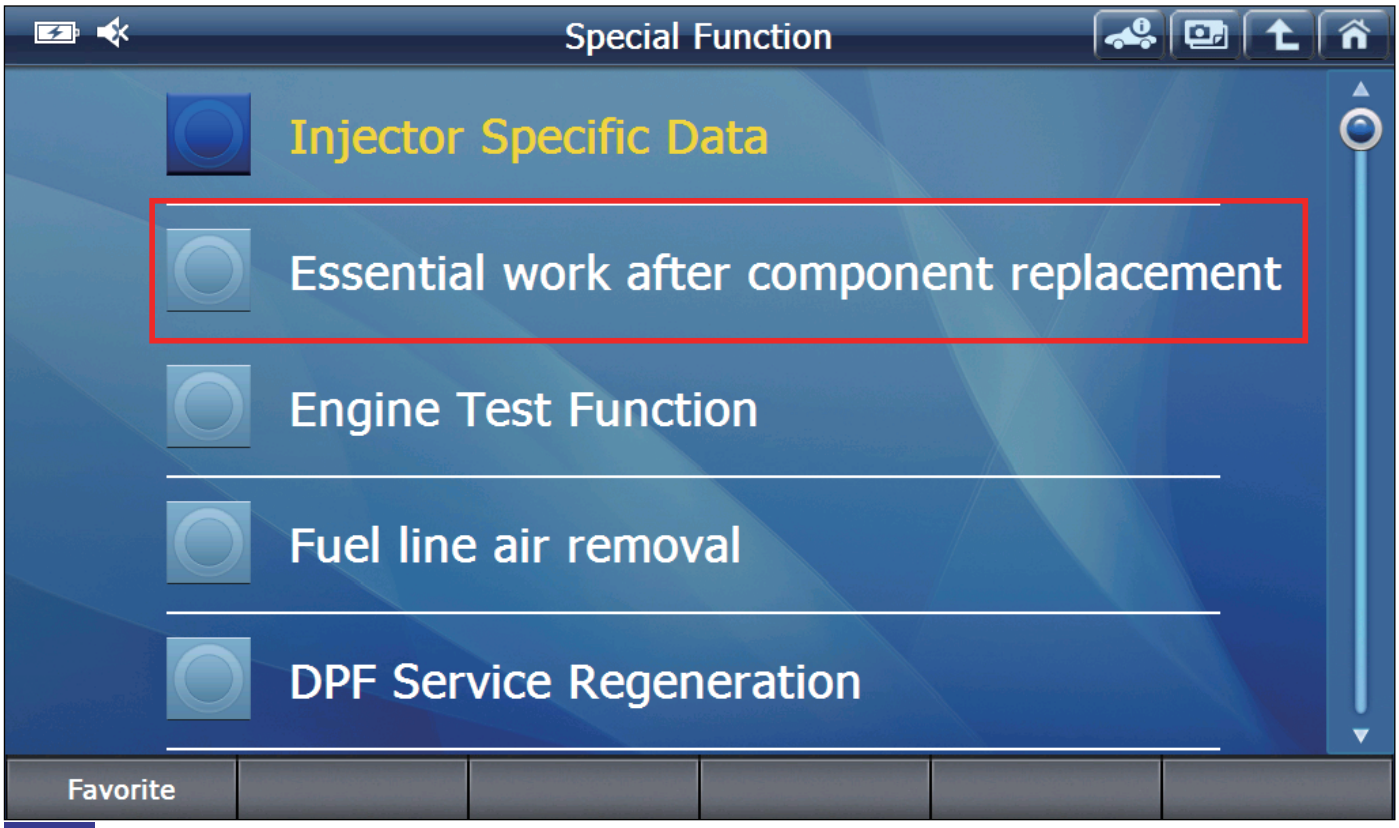


Fig.1

CRC12EN5010P01010041S

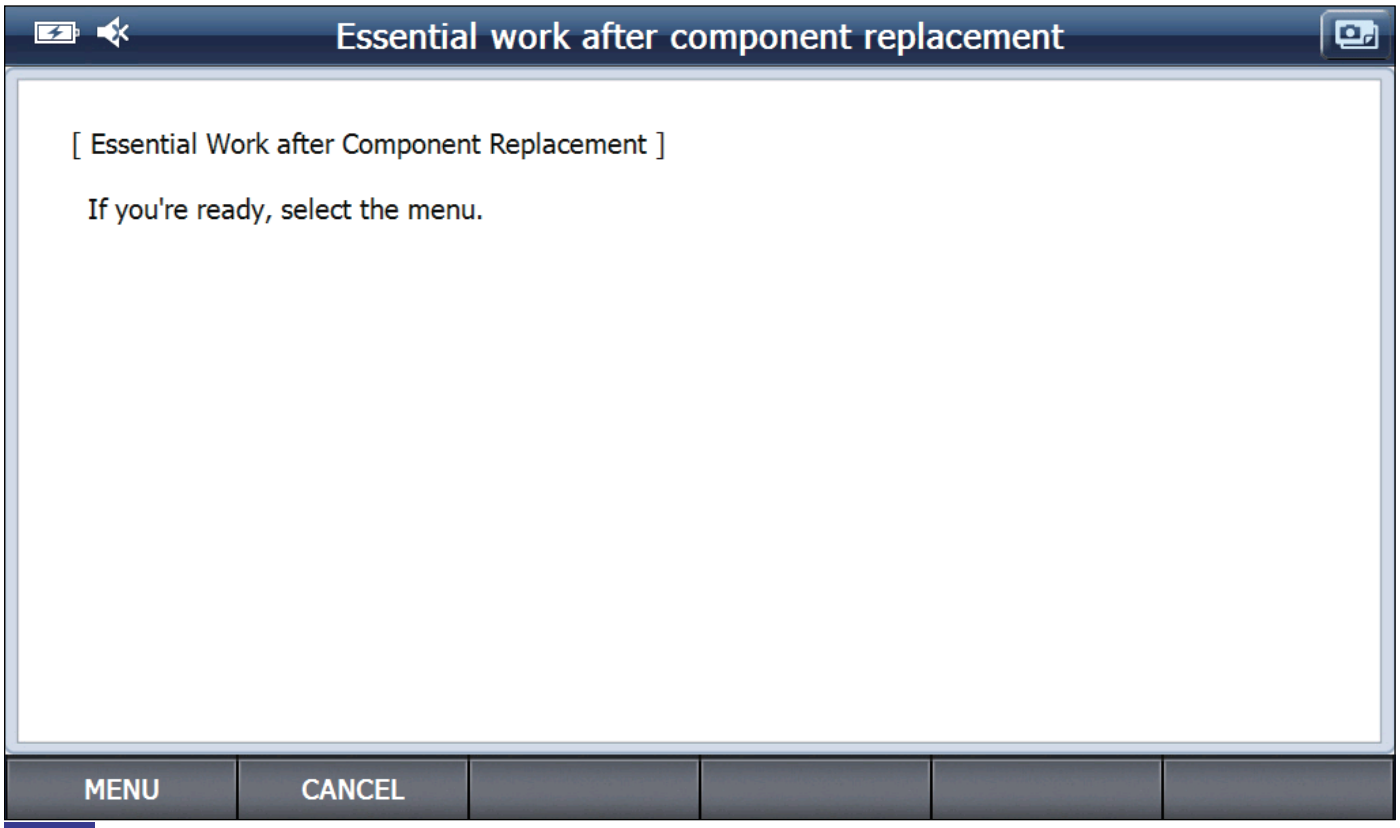


Fig.2

CRC12EN5010P01010042S

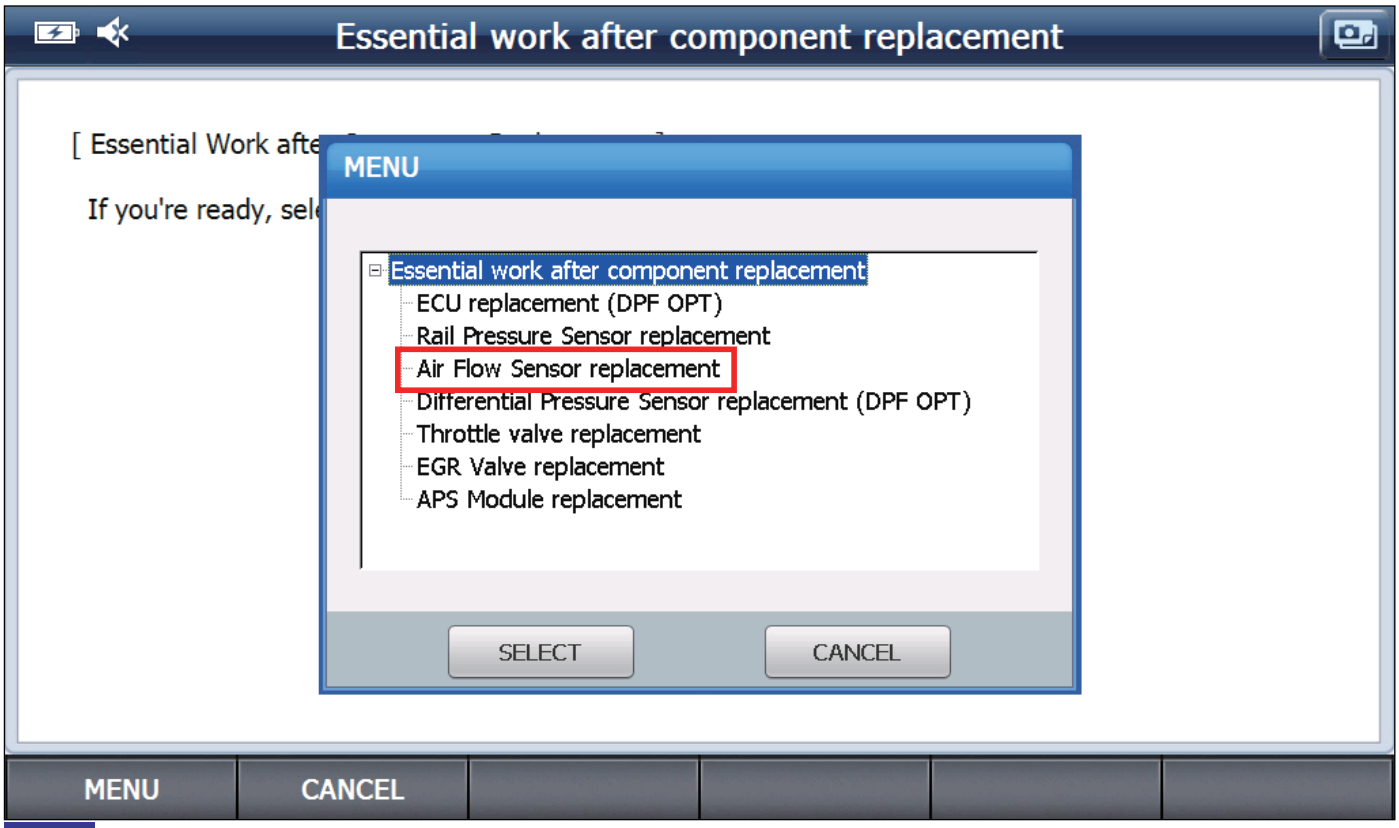


Fig.3

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.

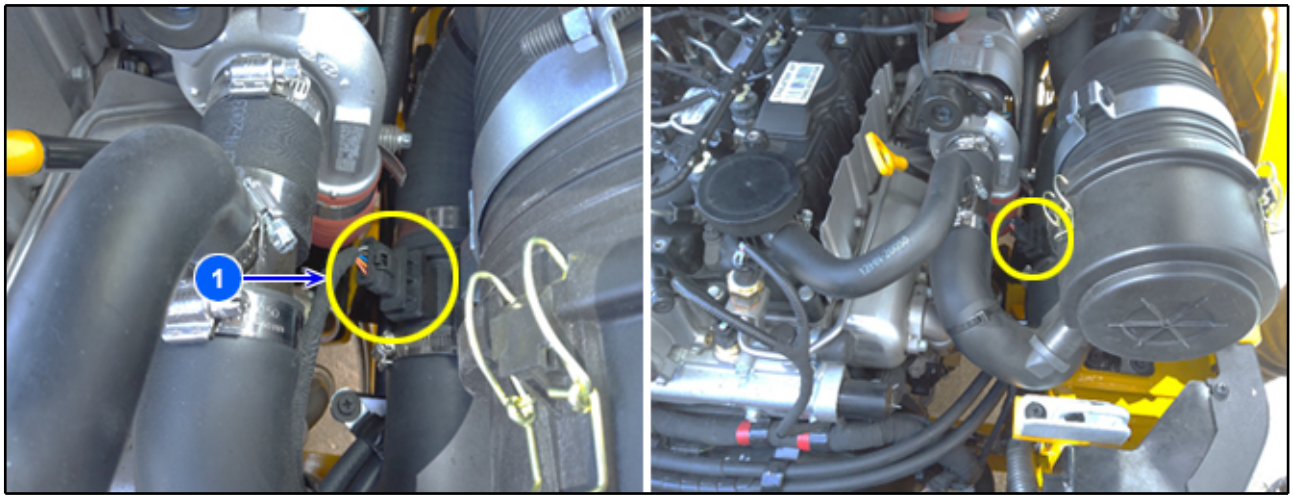
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	• Ignition switch "ON" & Engine "OFF"Voltage is measured on wiring side(Disconnected) • Voltage is measured on wiring side(Disconnected)	Approx. 4.8V	-
	2	Reference Frequency		Approx. 4.8V	-
	3	Intake Air Temperature Sensor #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" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 2.5V	Signal Waveform(Fig. 2)
	2	Reference Frequency		Approx. 3.5V	Signal Waveform(Fig. 1
	3	Intake Air Temperature Sensor #1 Signal		Approx. 2.35V	Approx. 28℃(82.4℉)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

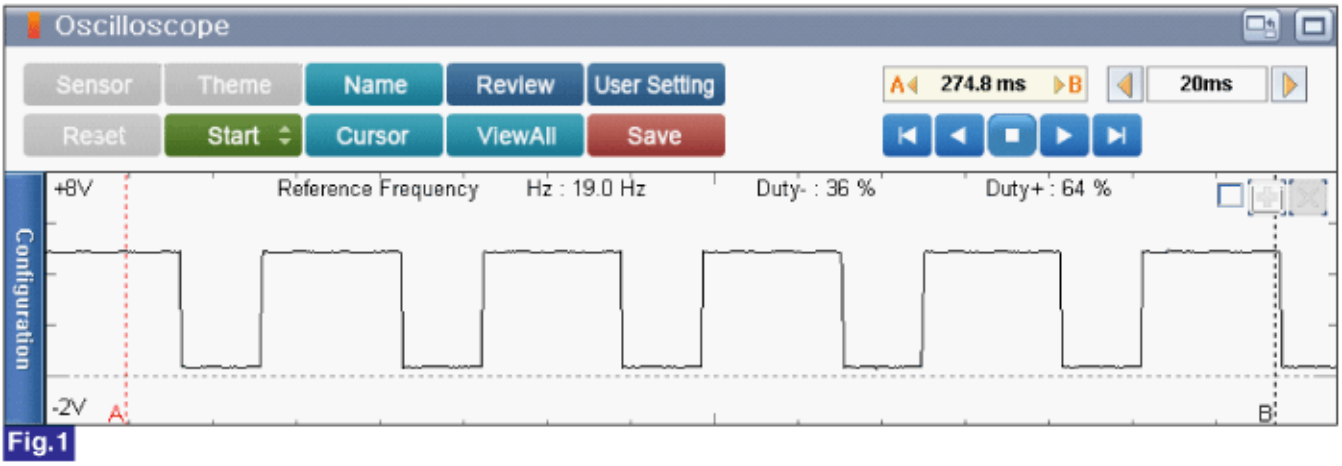


Fig.1

CRC12EN5010P01010011S

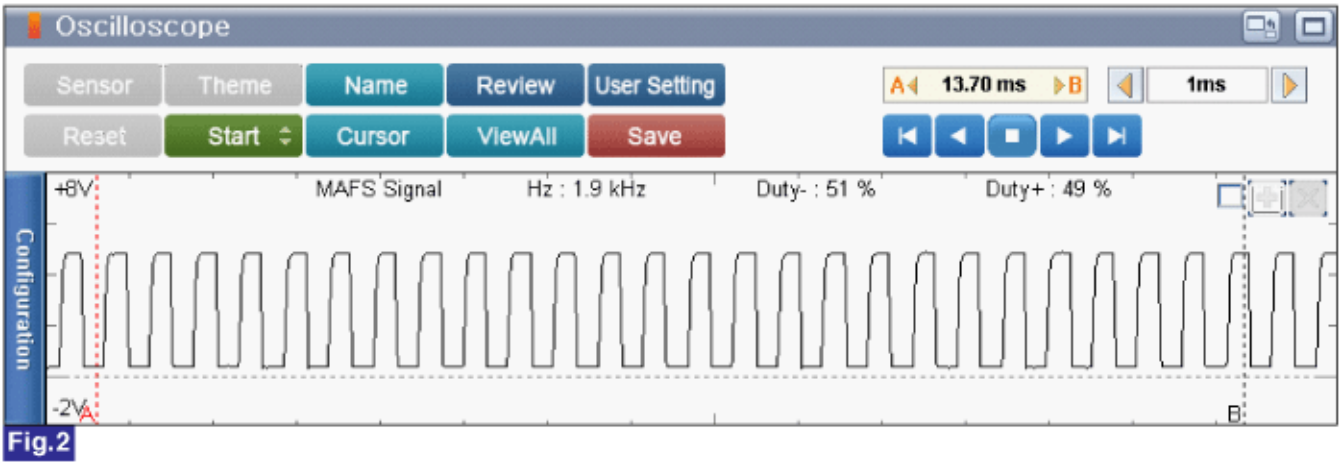
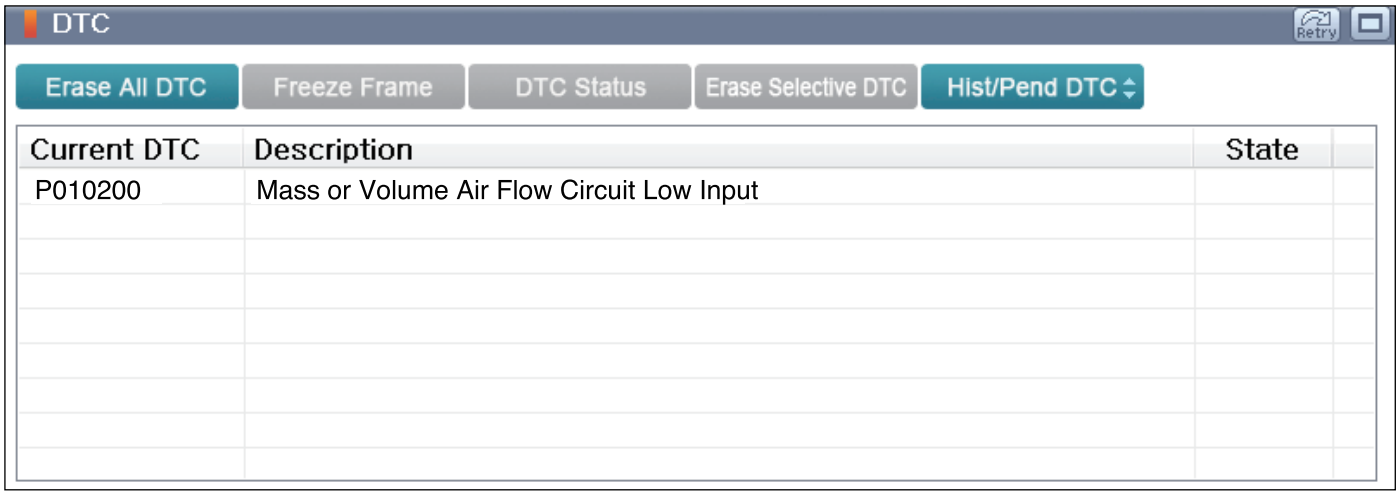


Fig.2

CRC12EN5010P01010012S

Monitor DTC Status

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



CRC12EN5010P01020021S

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

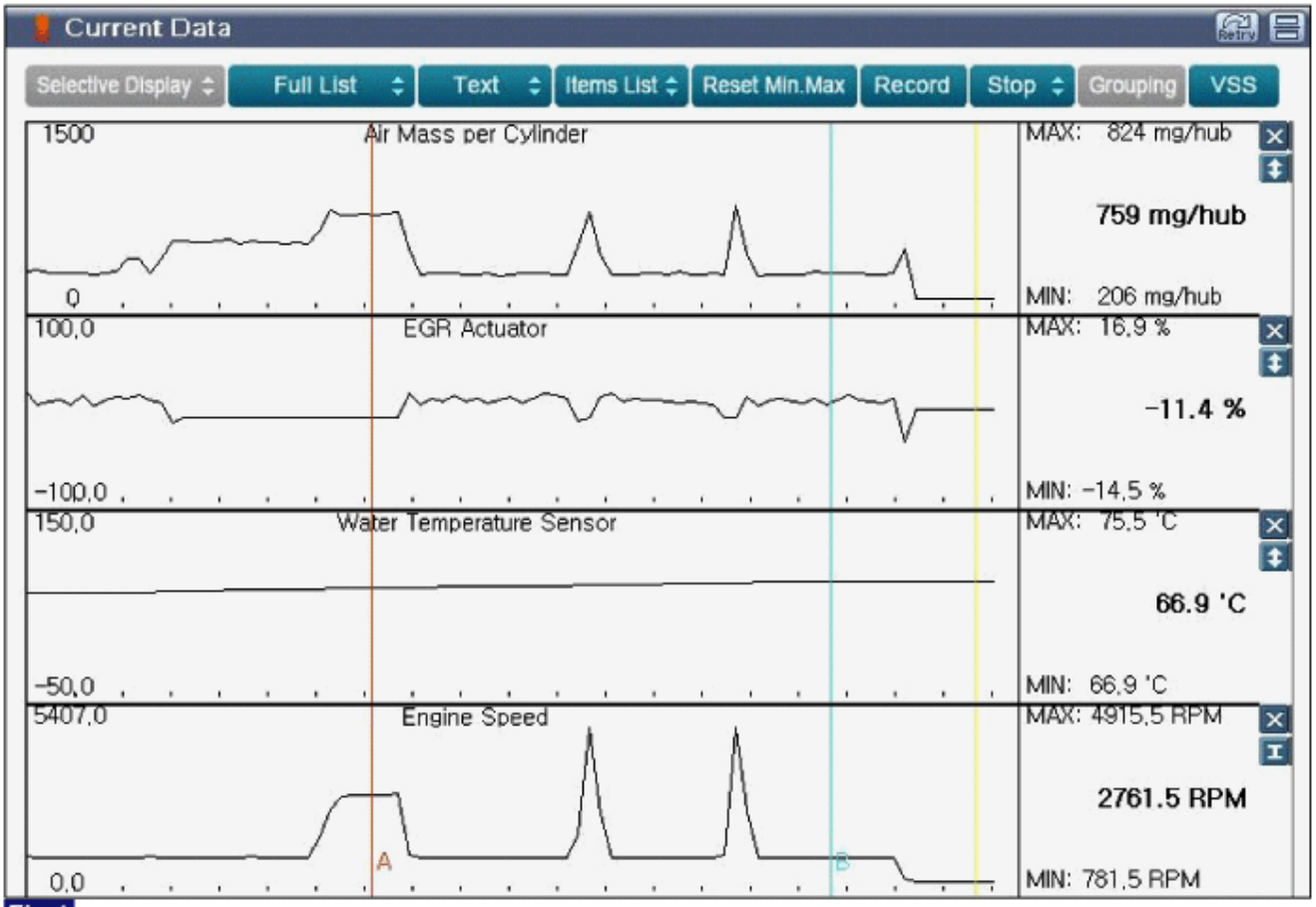


Fig.1

CRC12EN5010P01010022S

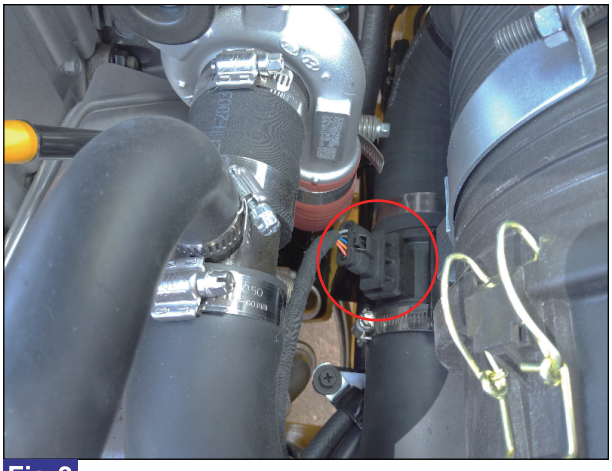


Fig.2

Fig.3

CRC12EN5010P01120023S

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.

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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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

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 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 Ω

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)

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

5. Is the measured value within specification?

YES ▸ Go to "MAFS Reference Frequency Circuit Inspection" 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

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

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

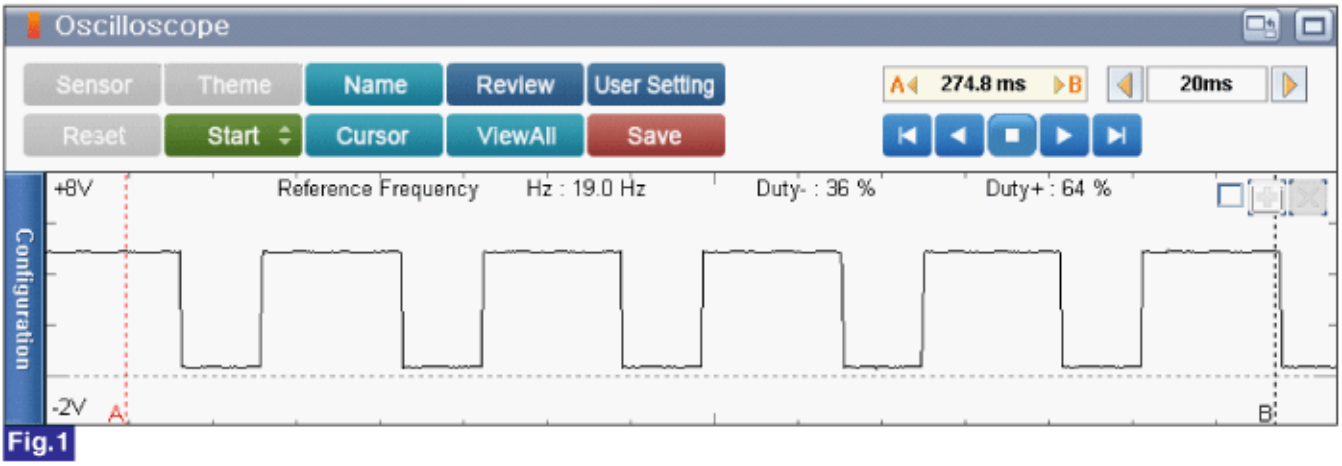


Fig.1

CRC12EN5010P01010011S

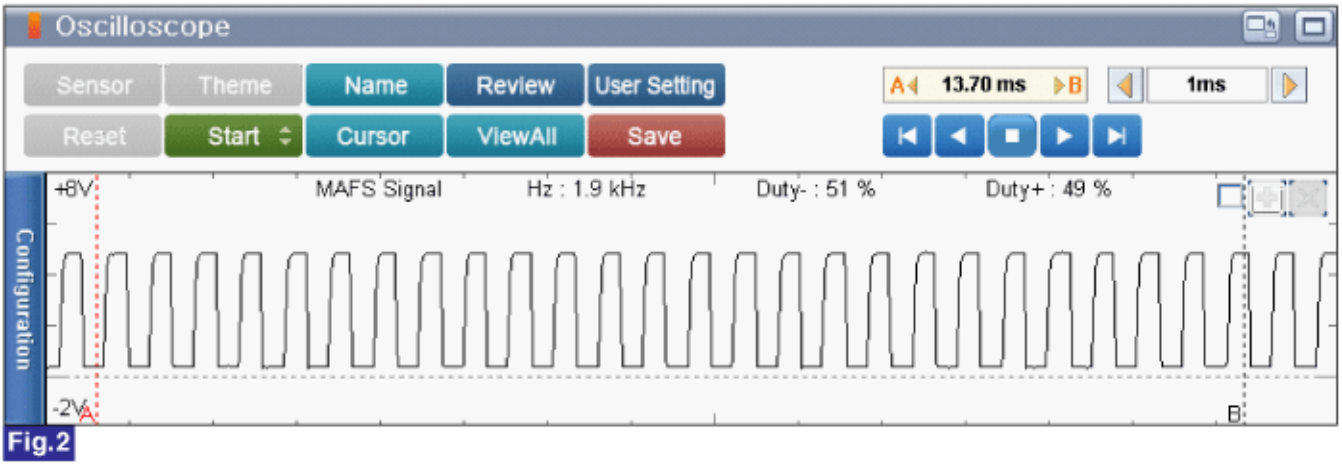


Fig.2

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?

YES ▸ 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℃/82.4℉)

※Voltage 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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Air Flow Sensor Change"

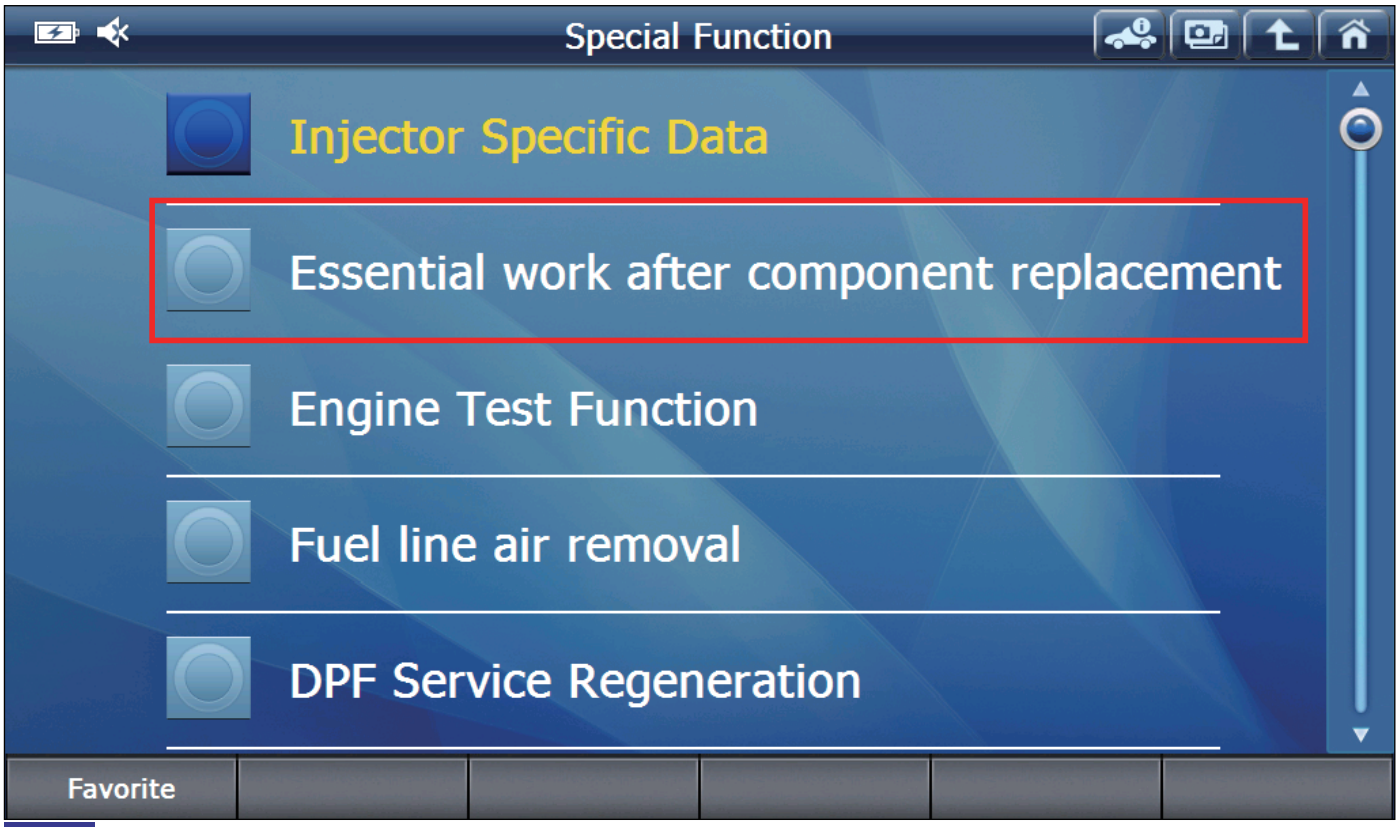


Fig.1

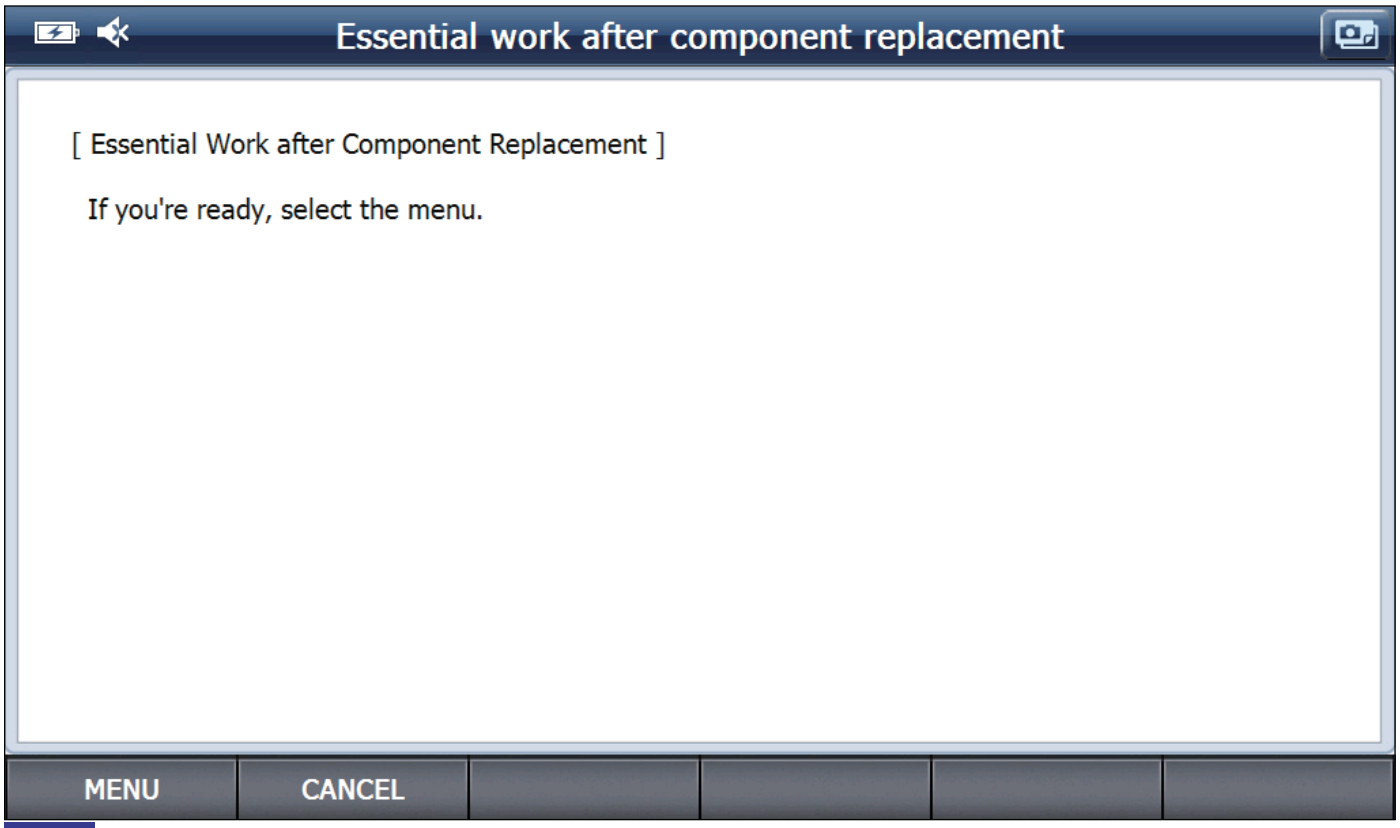


Fig.2

CRC12EN5010P01010042S

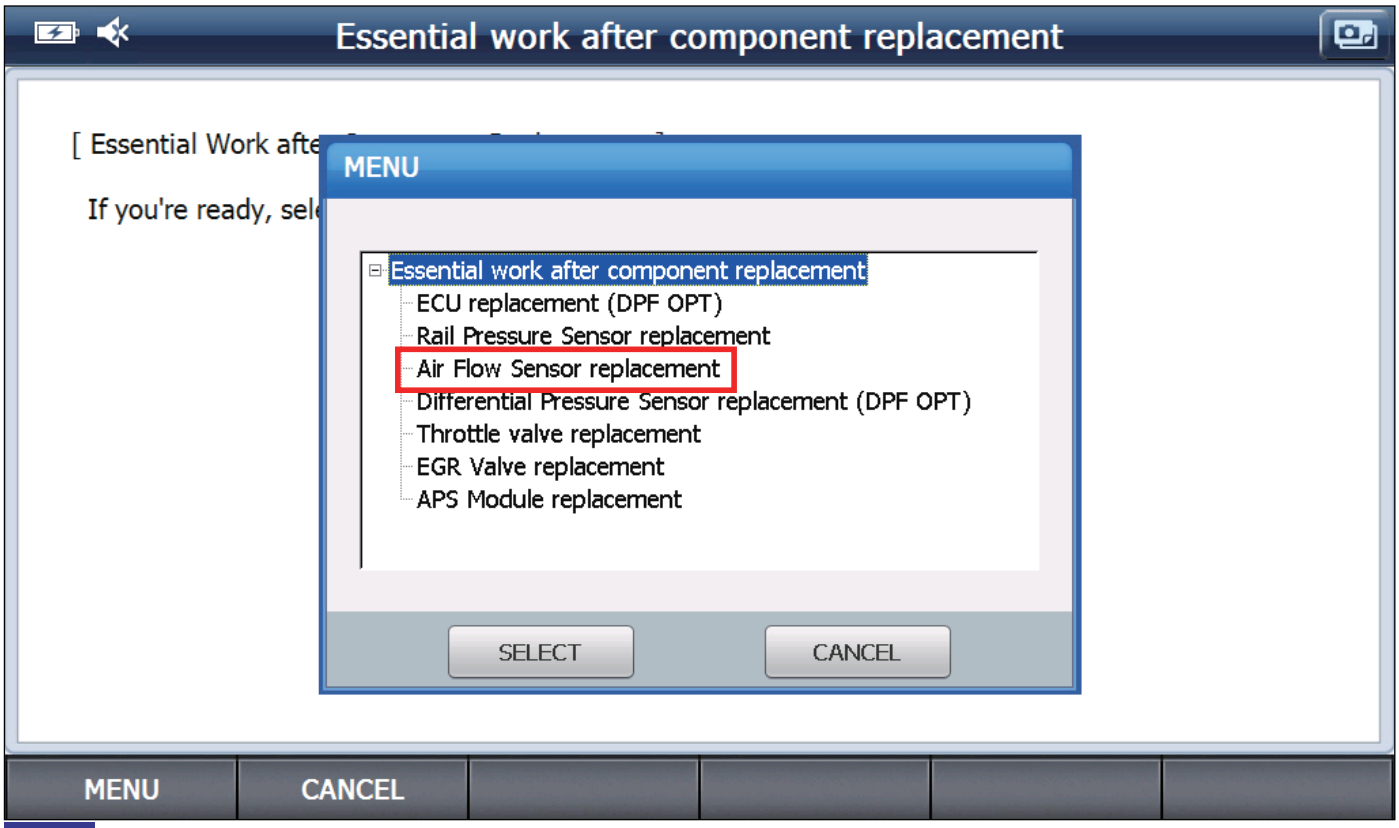


Fig.3

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.

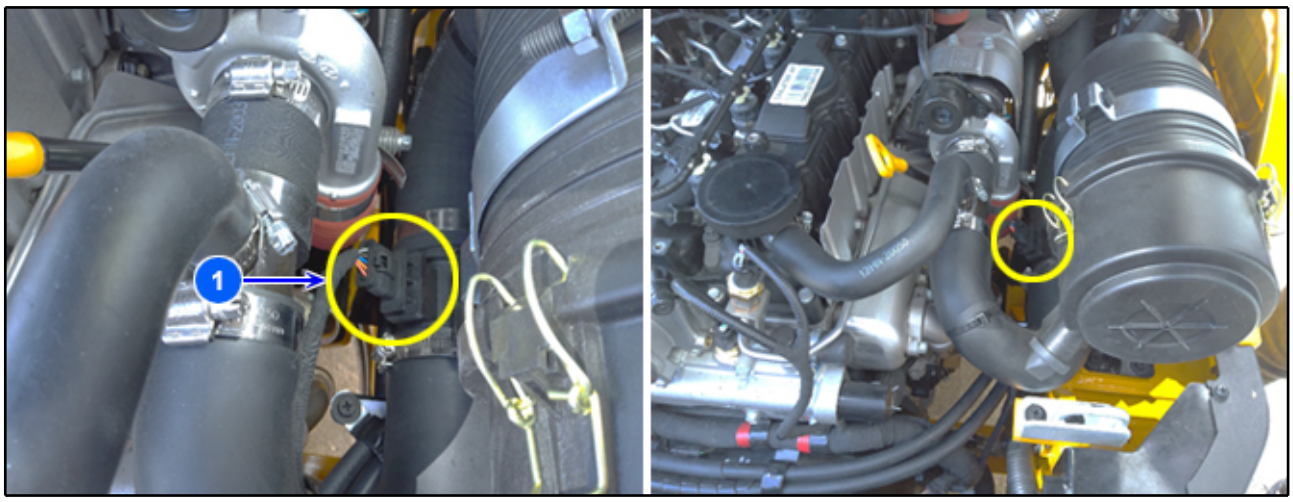
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open in power circuit of MAFS 2. Open or short to ground in signal circuit of MAFS 3. Defected MAFS
Enable Condition	• Engine running		
Threshold Value	• Output signal is under minimum value(Below 1200Hz)		
Detecting Time	• 1sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	• Ignition switch "ON" & Engine "OFF"Voltage is measured on wiring side(Disconnected) • Voltage is measured on wiring side(Disconnected)	Approx. 4.8V	-
	2	Reference Frequency		Approx. 4.8V	-
	3	Intake Air Temperature Sensor #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" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 2.5V	Signal Waveform(Fig. 2)
	2	Reference Frequency		Approx. 3.5V	Signal Waveform(Fig. 1
	3	Intake Air Temperature Sensor #1 Signal		Approx. 2.35V	Approx. 28℃(82.4℉)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

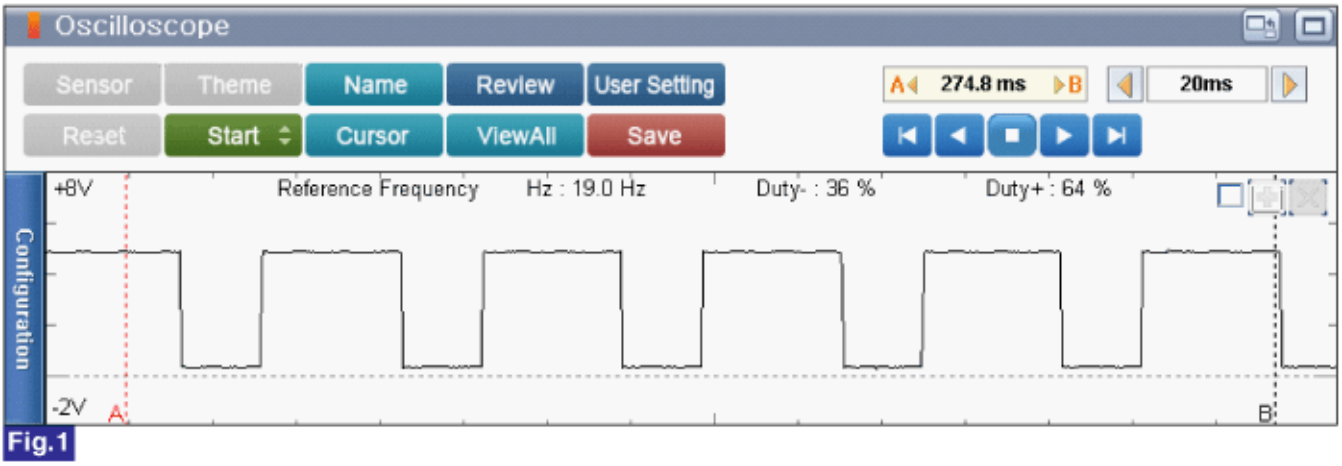


Fig.1

CRC12EN5010P01010011S

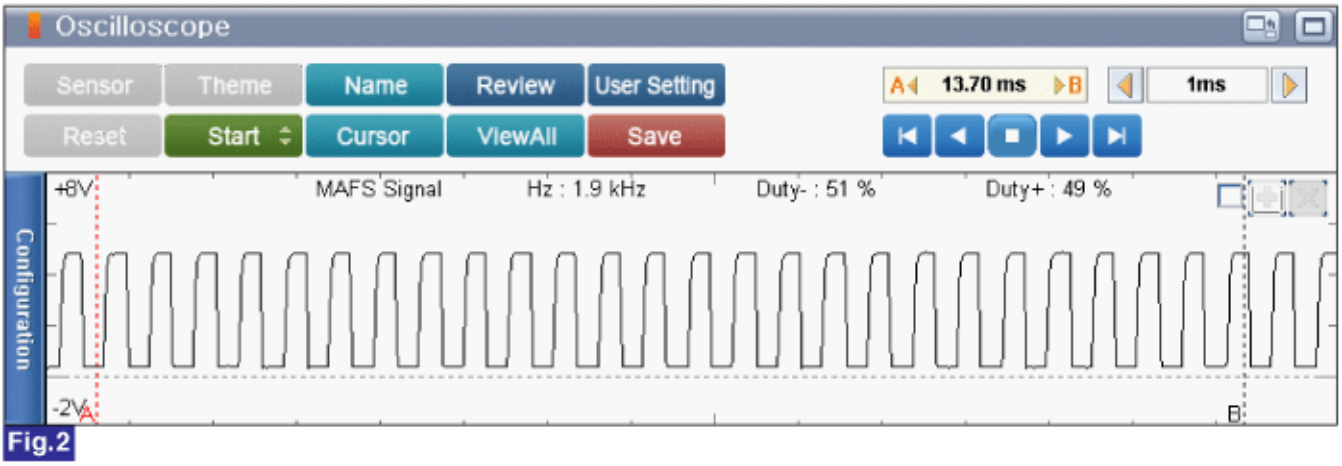
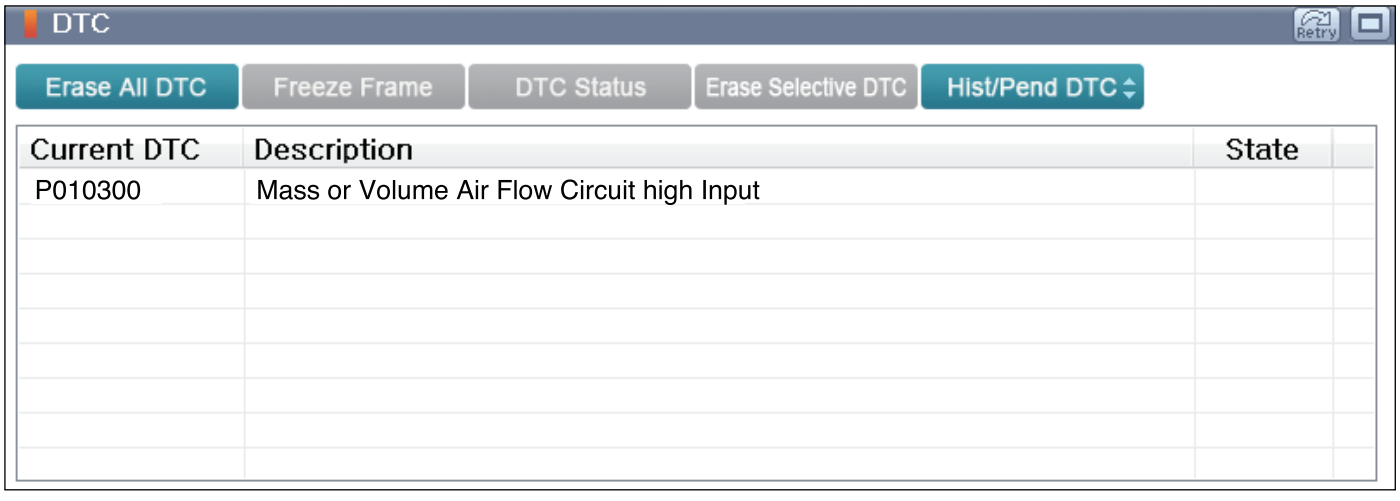


Fig.2

CRC12EN5010P01010012S

Monitor DTC Status

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



CRC12EN5010P01030021S

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

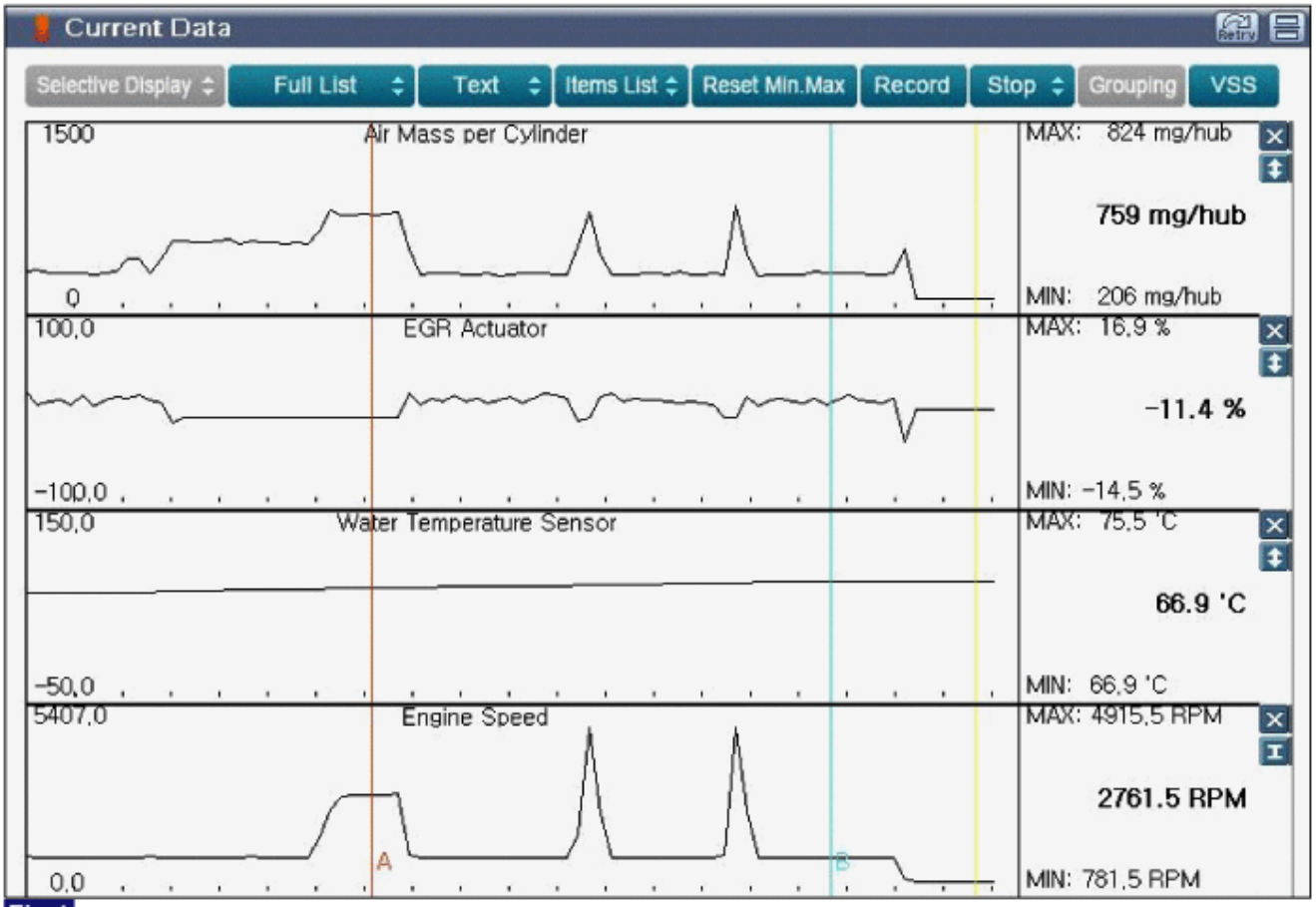


Fig.1

CRC12EN5010P01010022S

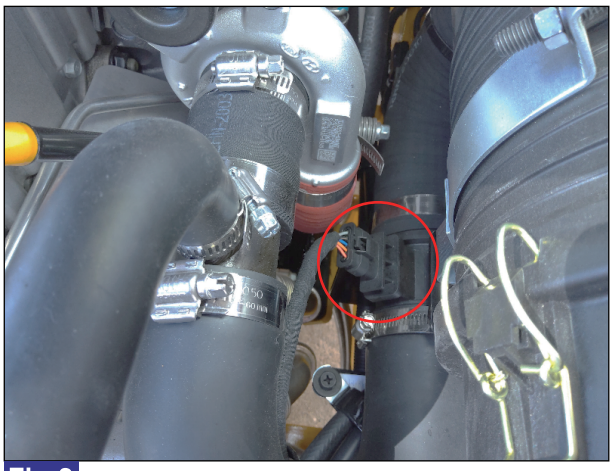


Fig.2

Fig.3

CRC12EN5010P01120023S

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.

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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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

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 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 Ω

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)

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

5. Is the measured value within specification?

YES ▸ Go to "MAFS Reference Frequency Circuit Inspection" 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

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

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

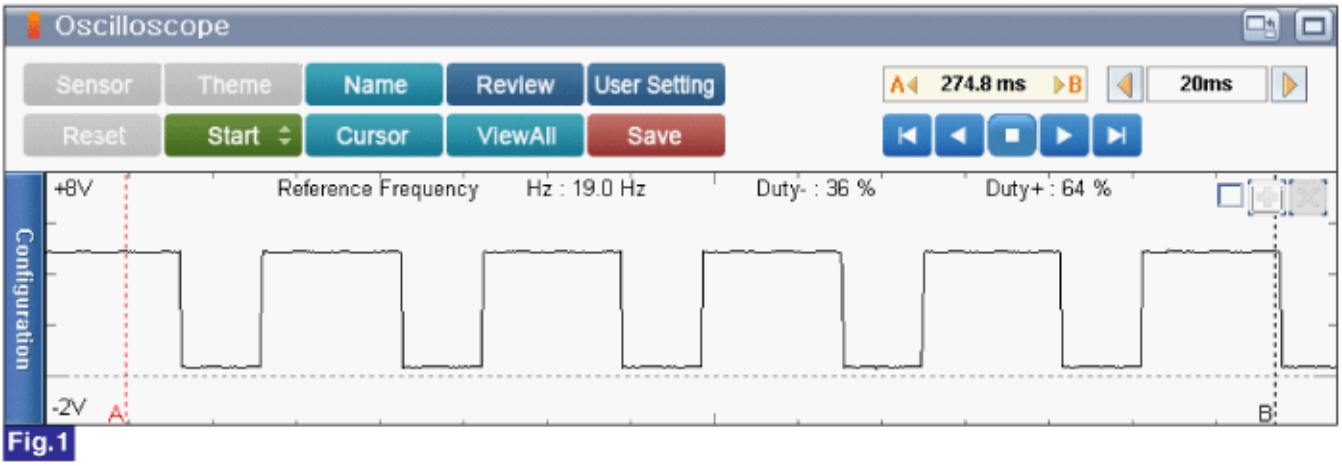


Fig.1

CRC12EN5010P01010011S

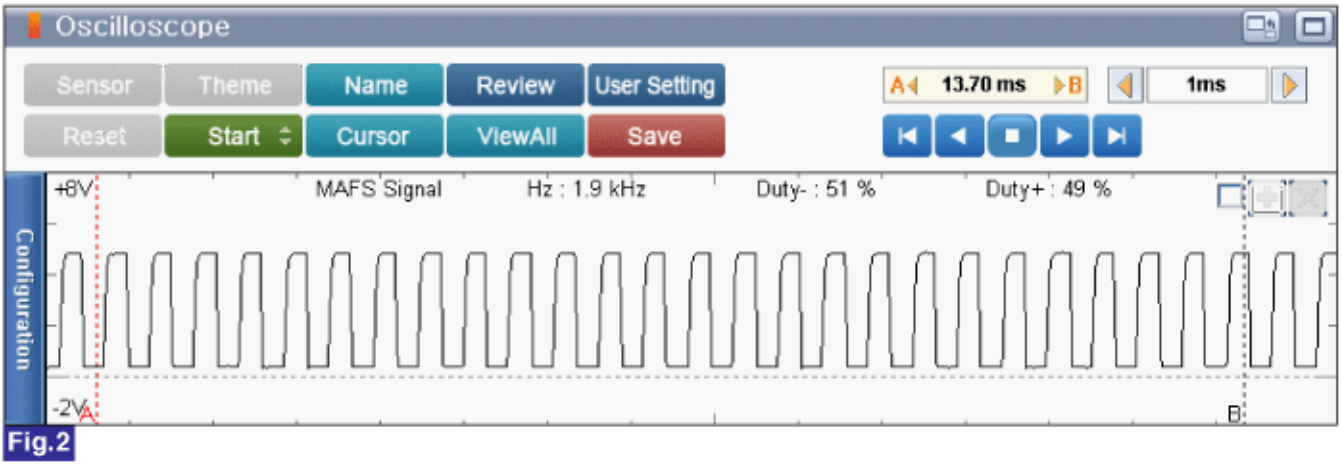


Fig.2

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?

YES ▸ 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℃/82.4℉)

※Voltage 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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Air Flow Sensor Change"

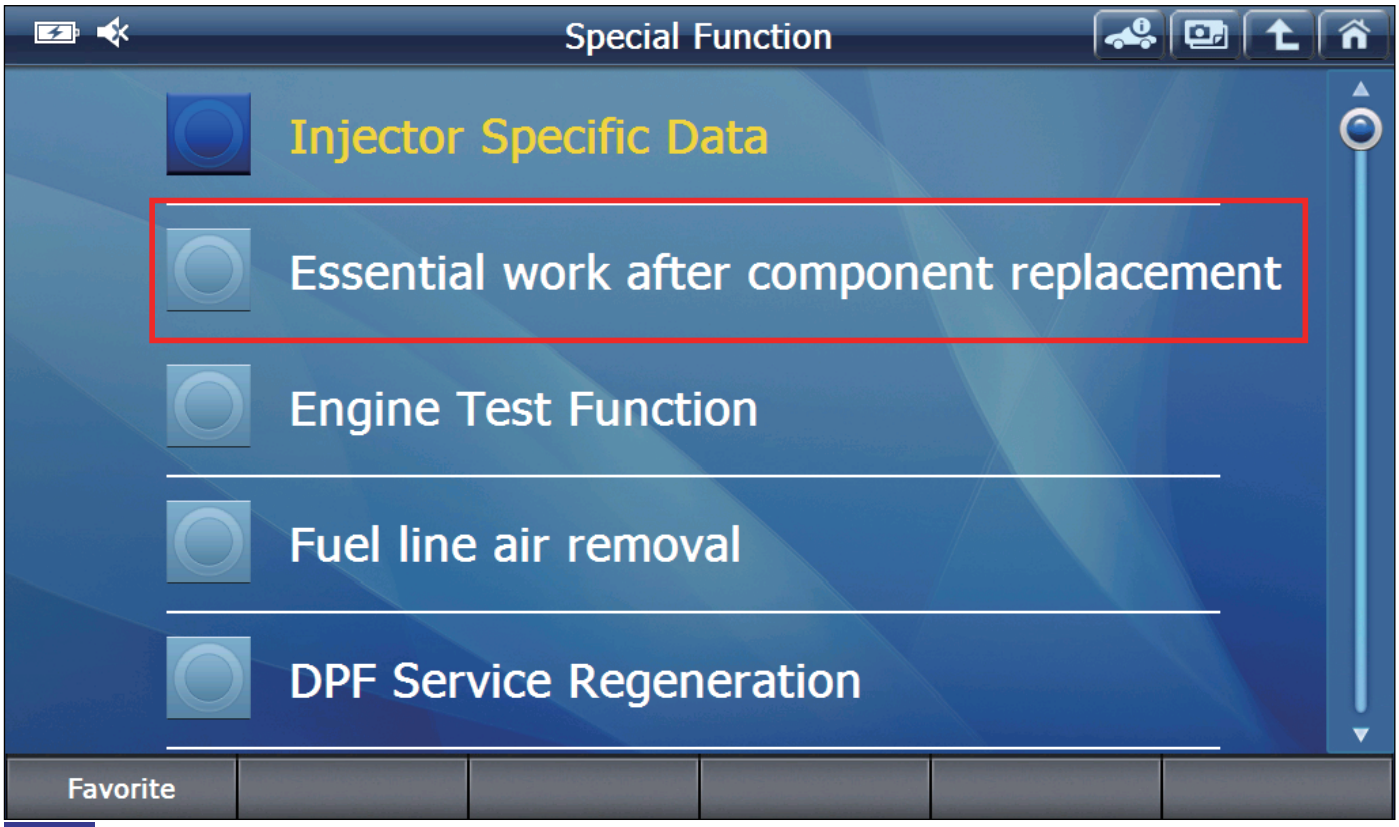


Fig.1

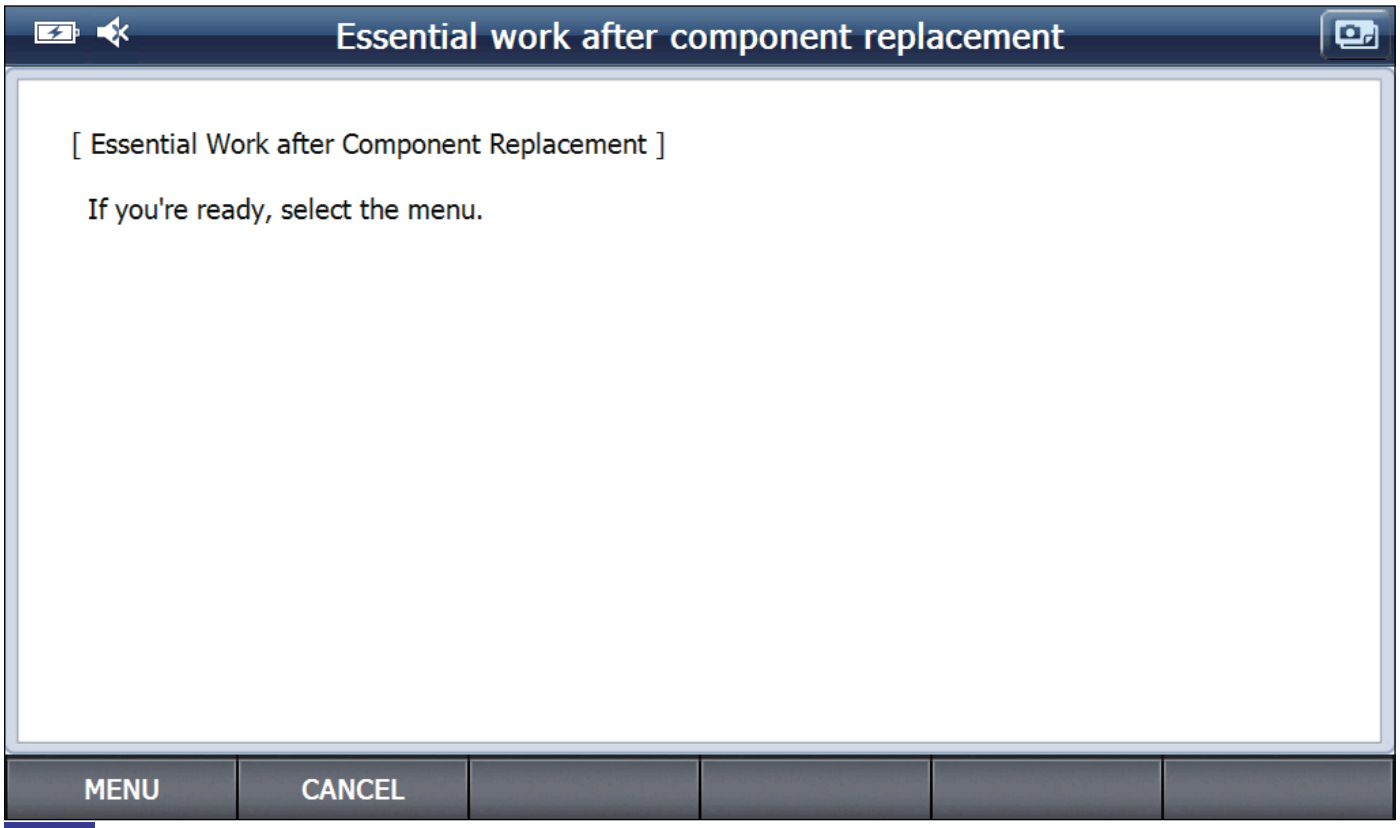


Fig.2

CRC12EN5010P01010042S

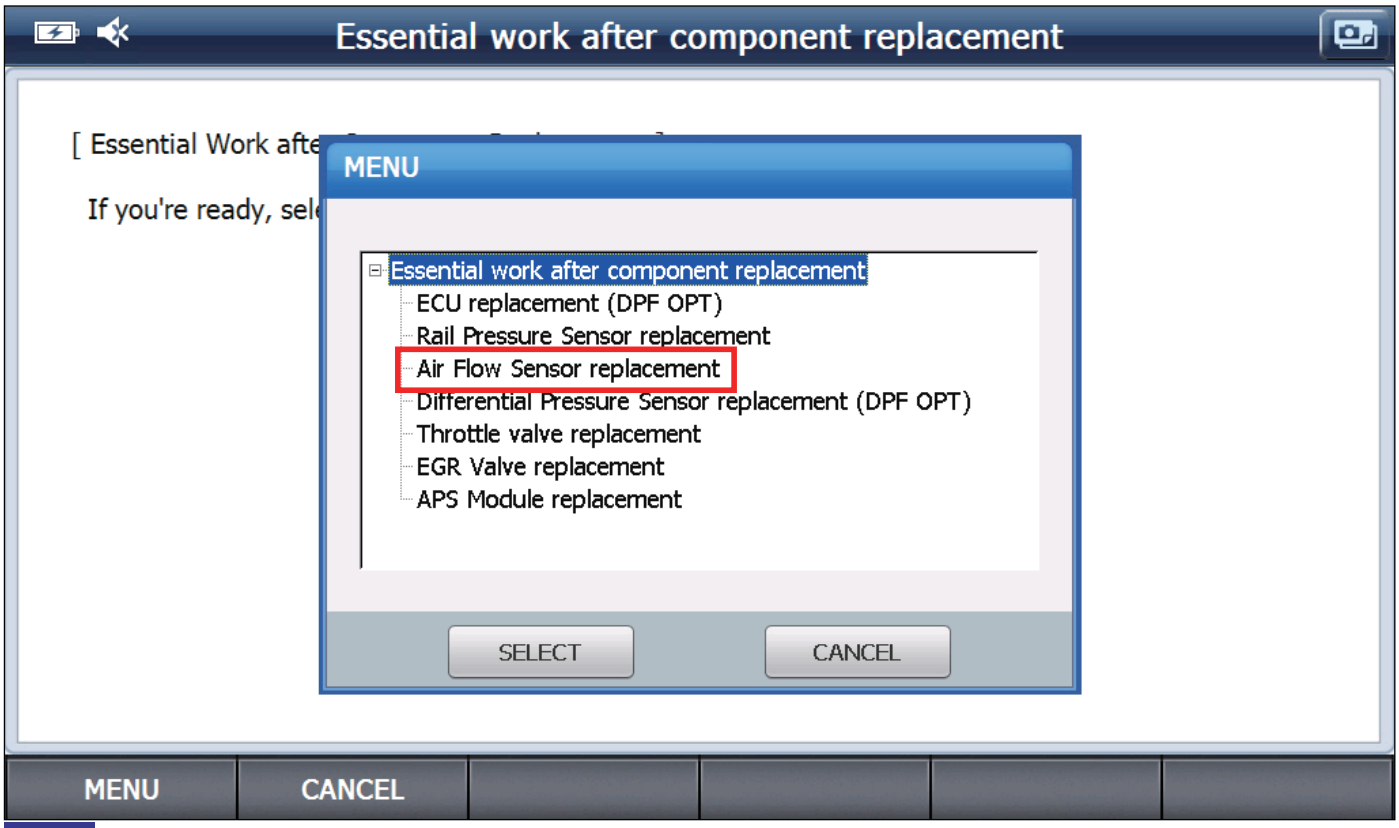


Fig.3

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.

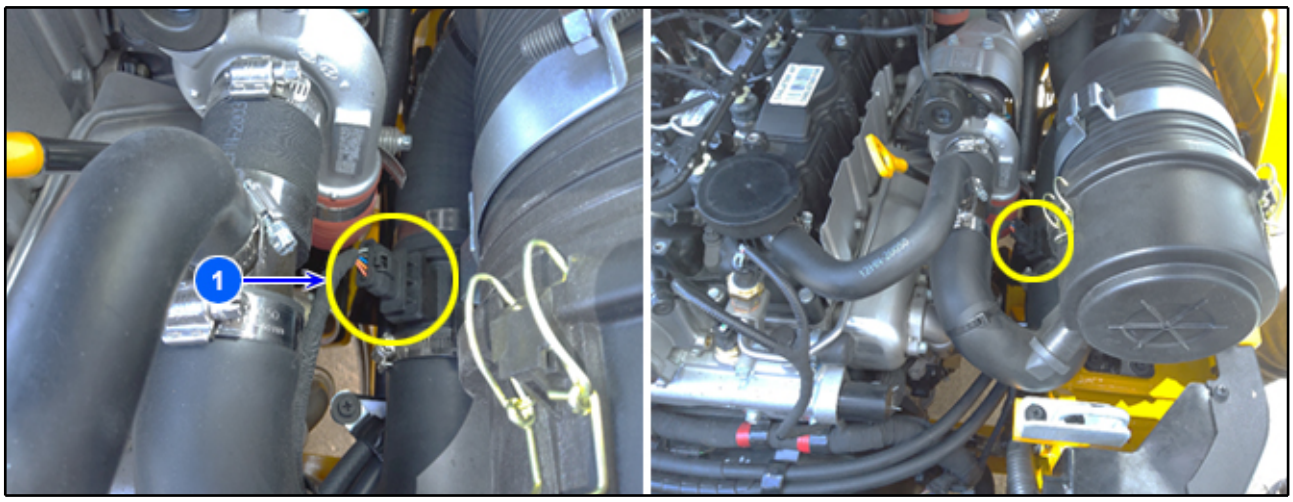
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P011200 Intake Air Temperature Sensor 1 Circuit Low 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 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.

DTC Detecting Condition

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

Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	• Ignition switch "ON" & Engine "OFF"Voltage is measured on wiring side(Disconnected) • Voltage is measured on wiring side(Disconnected)	Approx. 4.8V	-
	2	Reference Frequency		Approx. 4.8V	-
	3	Intake Air Temperature Sensor #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" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 2.5V	Signal Waveform(Fig. 2)
	2	Reference Frequency		Approx. 3.5V	Signal Waveform(Fig. 1
	3	Intake Air Temperature Sensor #1 Signal		Approx. 2 8℃(82.4 ℉)	
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

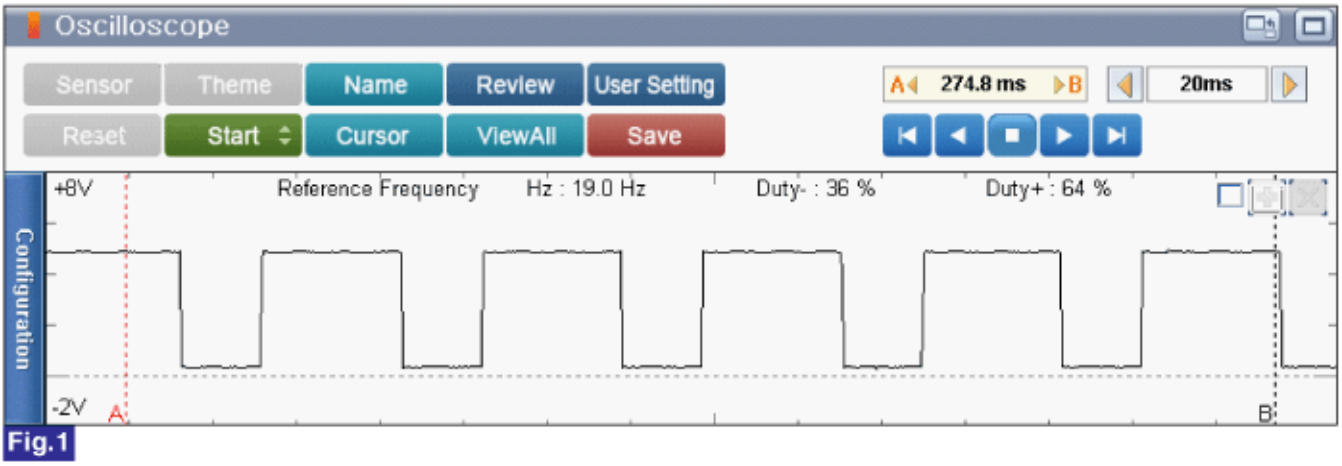


Fig.1

CRC12EN5010P01010011S

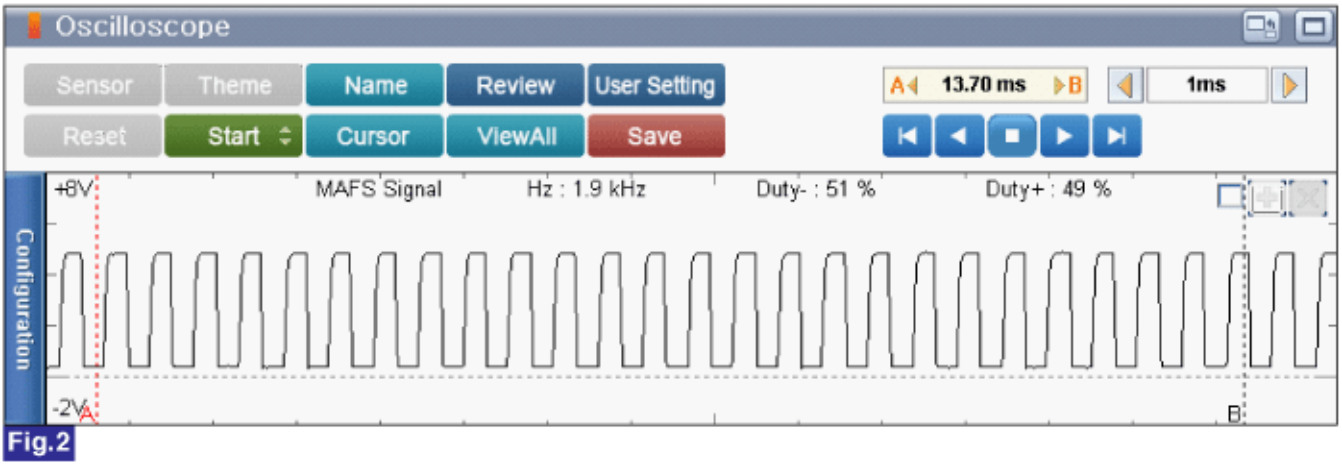
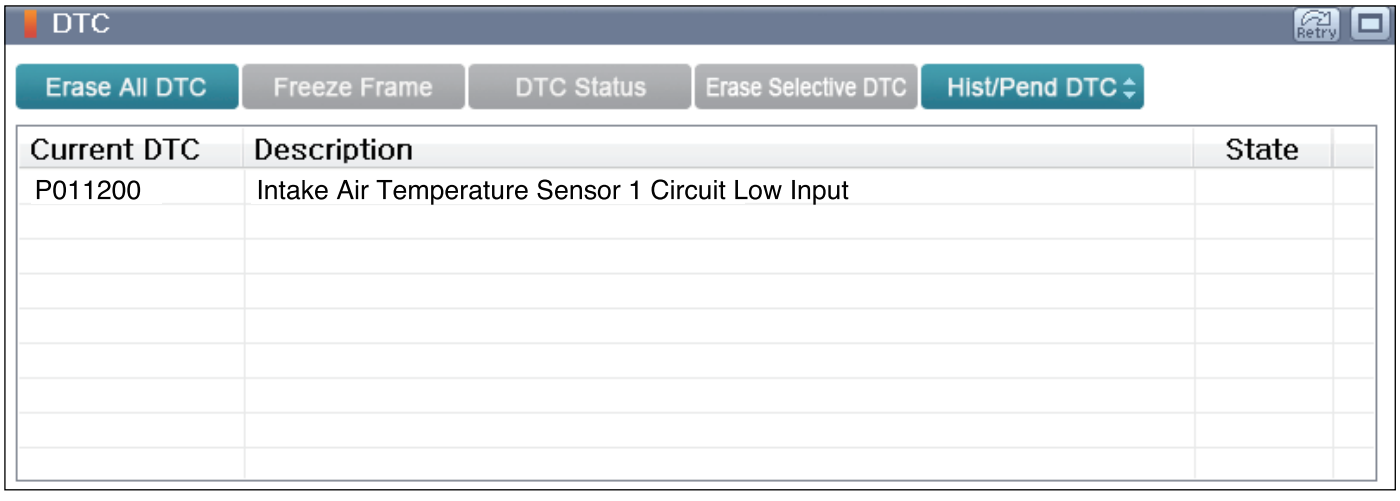


Fig.2

CRC12EN5010P01010012S

Monitor DTC Status

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



CRC12EN5010P01120021S

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

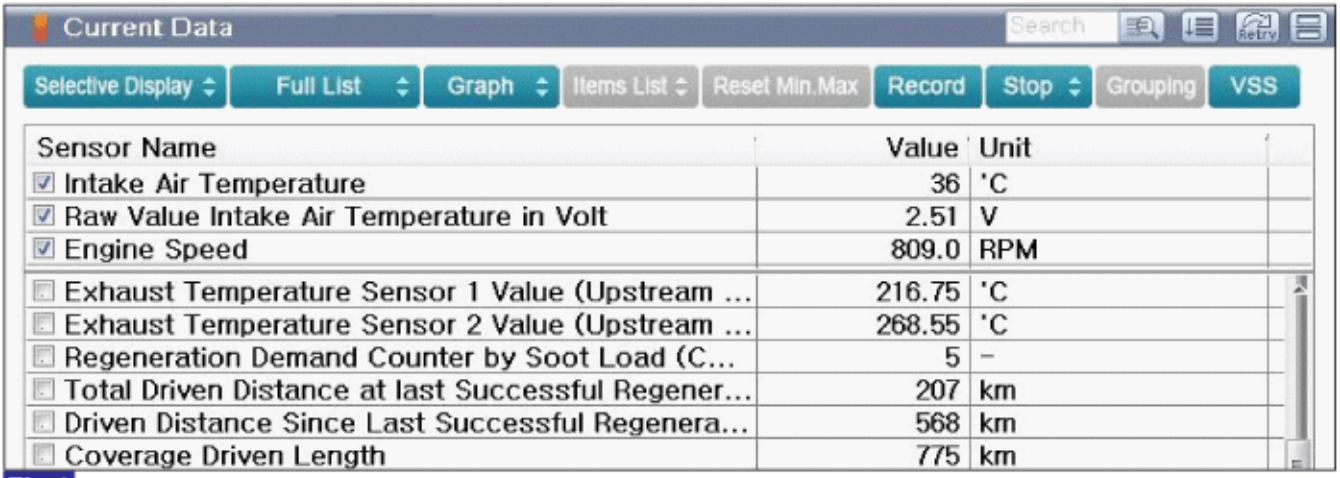


Fig.1

CRC12EN5010P00970022S

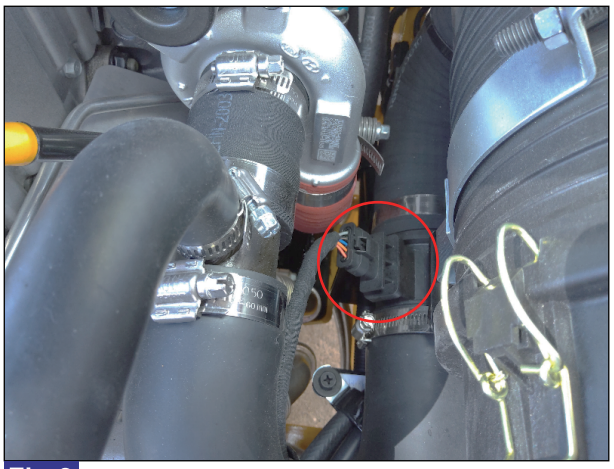


Fig.2


Fig.3

CRC12EN5010P01120023S

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.

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.

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 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 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"
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

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℃/82.4℉)

※Voltage 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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Air Flow Sensor Change"

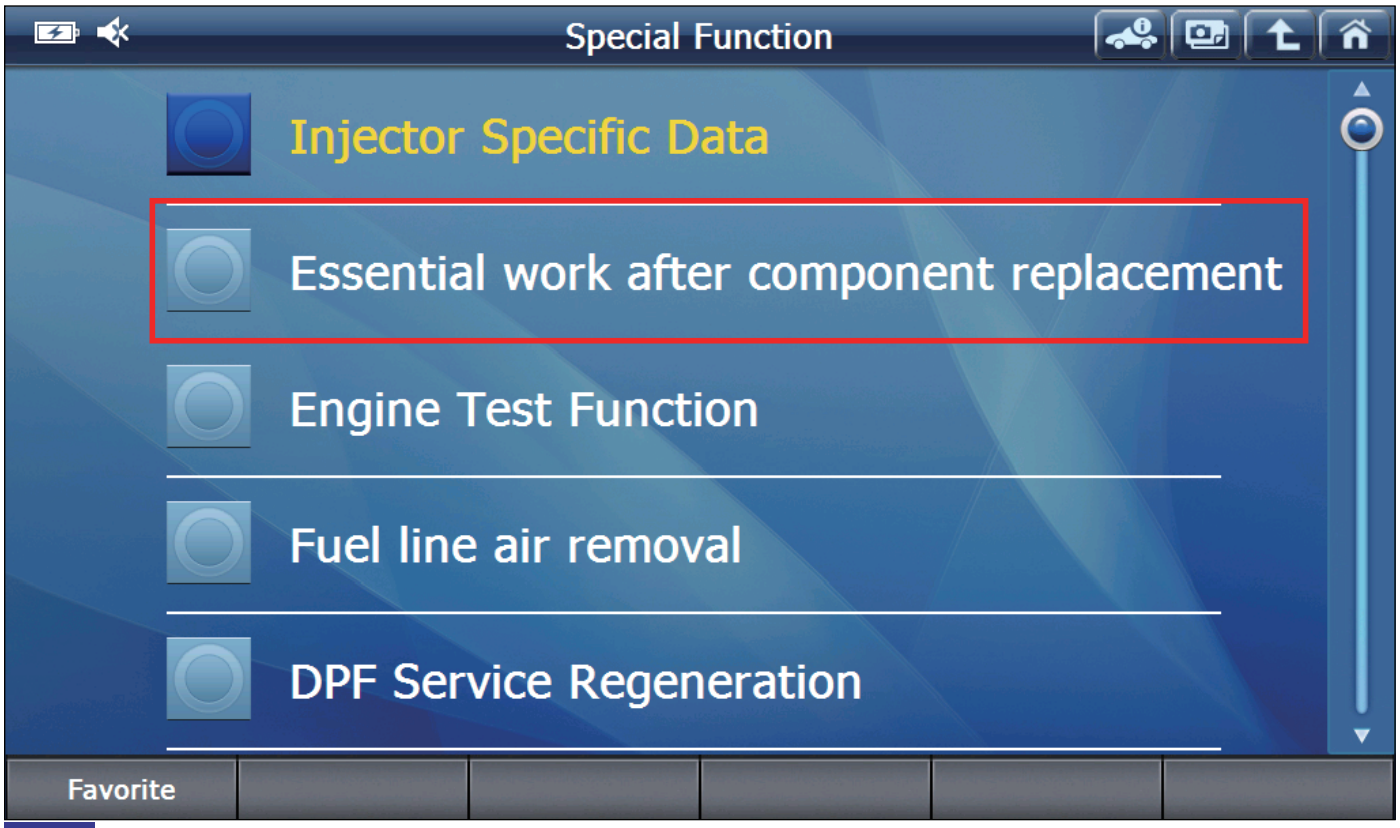


Fig.1

CRC12EN5010P01010041S

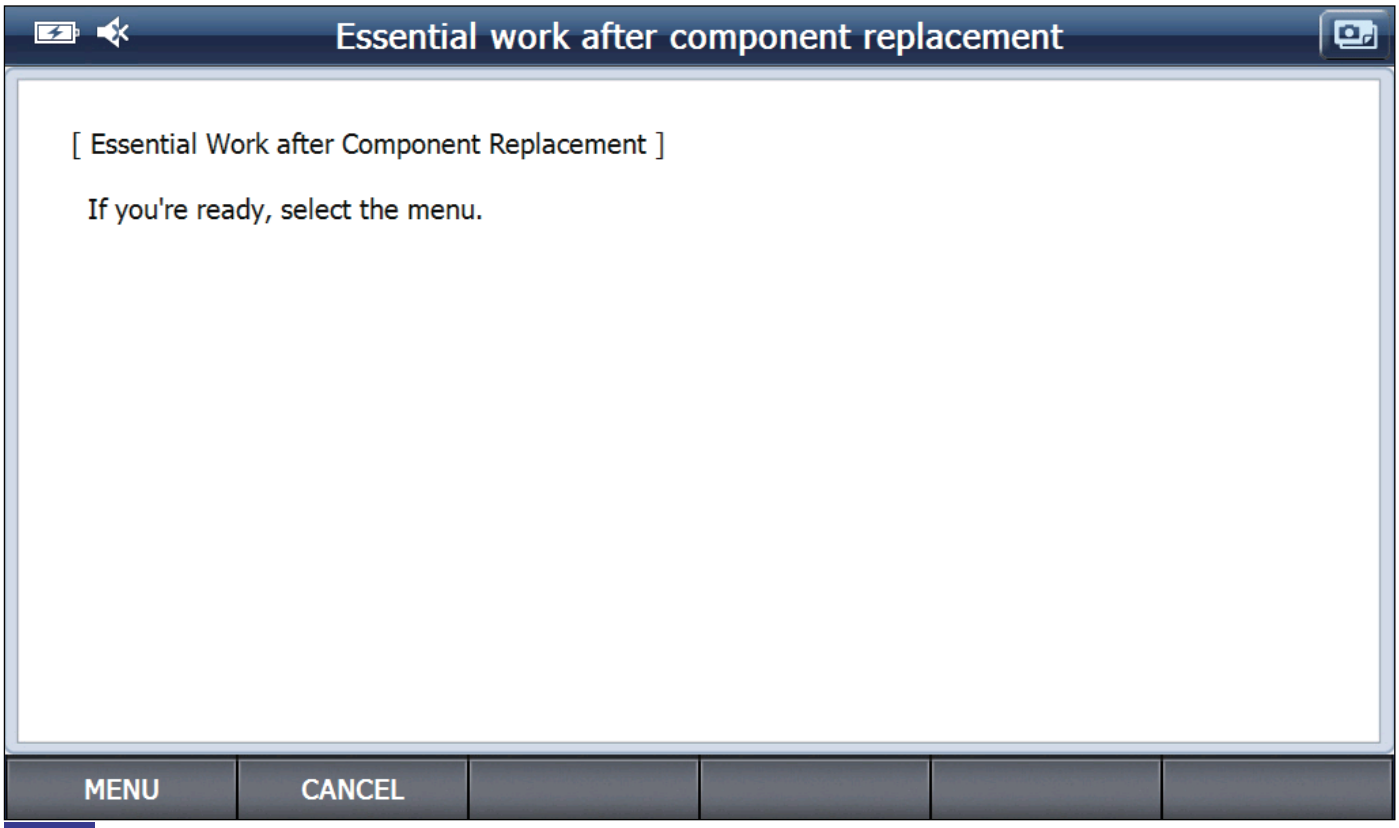


Fig.2

CRC12EN5010P01010042S

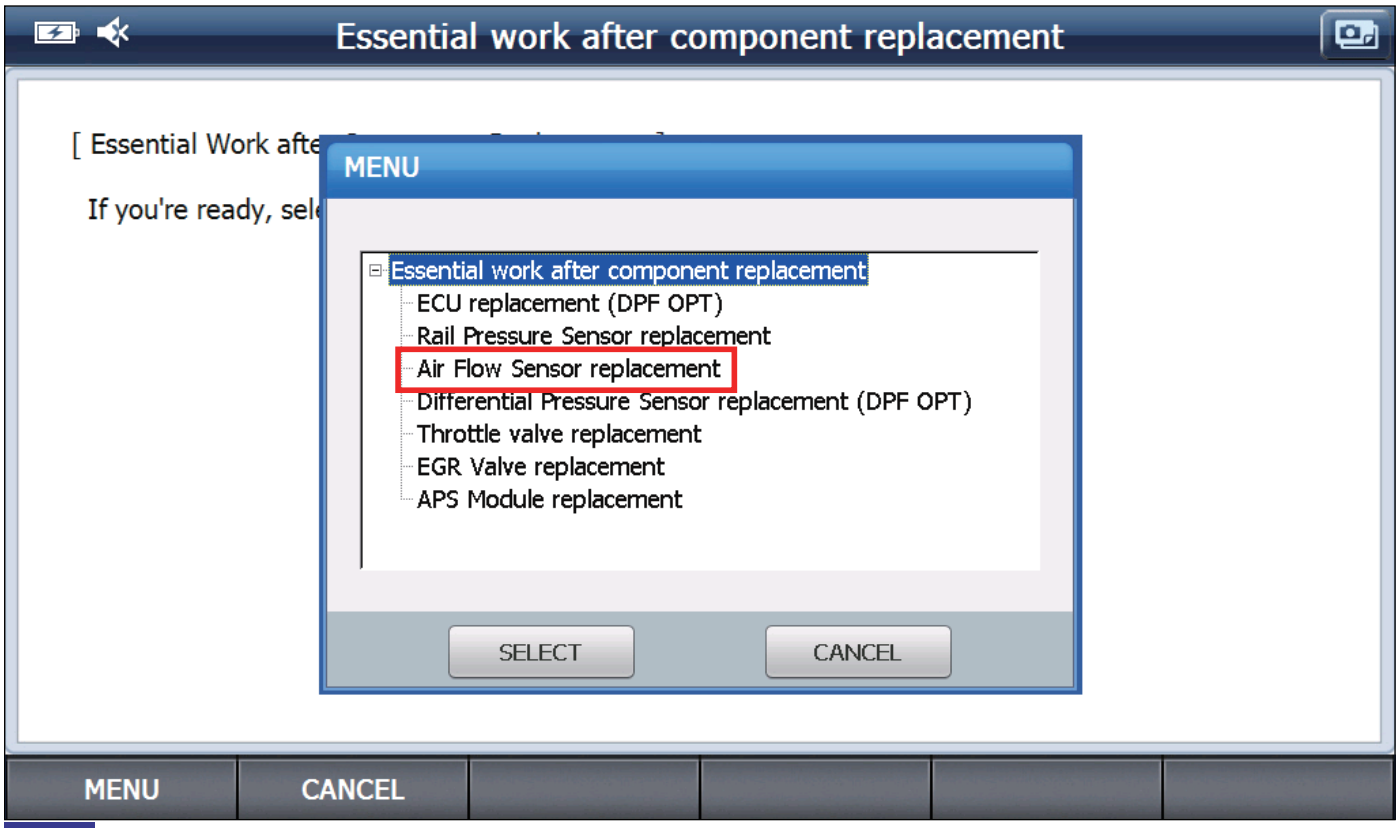


Fig.3

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.

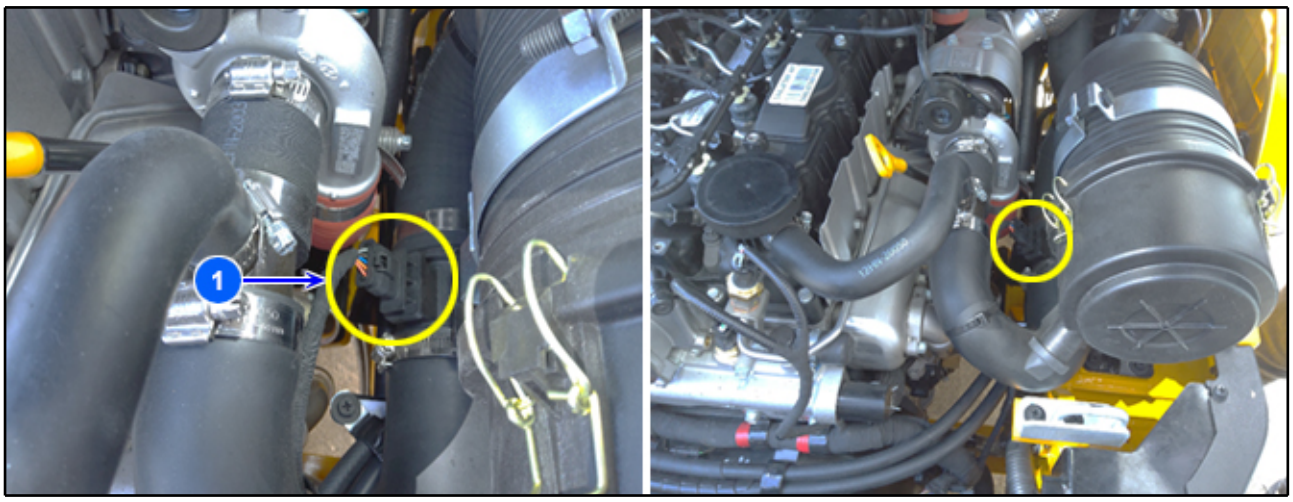
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open or short to power in signal circuit of MAFS 2. Open in ground circuit of MAFS 3. Defected MAFS
Enable Condition	• Engine running		
Threshold Value	• Output signal is higher than specification (Above 3200mV)		
Detecting Time	• 3 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Mass Air Flow Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	MAFS Signal	• Ignition switch "ON" & Engine "OFF"Voltage is measured on wiring side(Disconnected) • Voltage is measured on wiring side(Disconnected)	Approx. 4.8V	-
	2	Reference Frequency		Approx. 4.8V	-
	3	Intake Air Temperature Sensor #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" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 2.5V	Signal Waveform(Fig. 2)
	2	Reference Frequency		Approx. 3.5V	Signal Waveform(Fig. 1
	3	Intake Air Temperature Sensor #1 Signal		Approx. 2.35V	Approx. 28℃(82.4℉)
	4	MAFS Ground		0V	-
	5	MAFS Power		B+	-

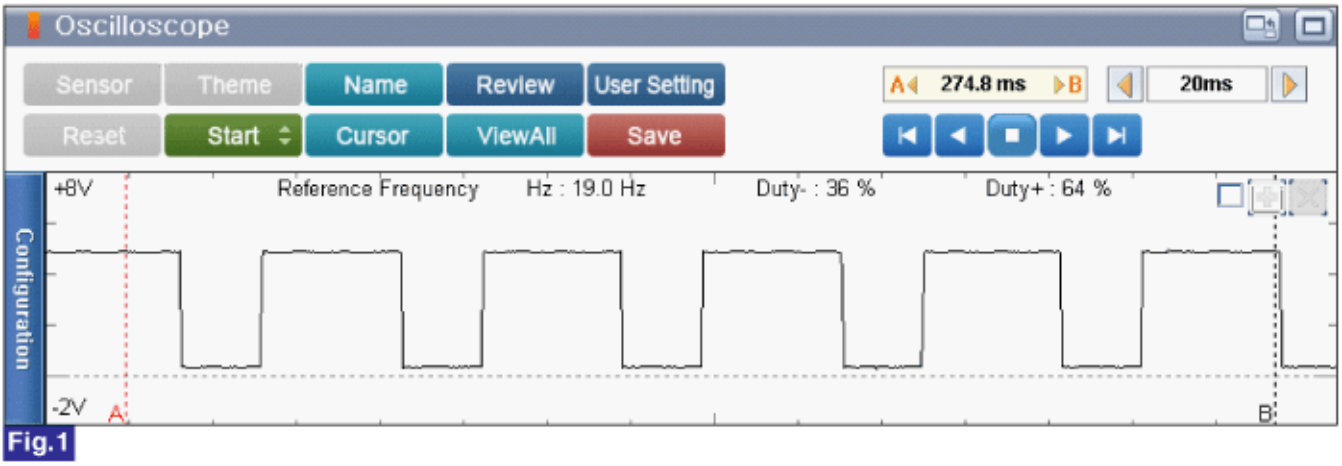


Fig.1

CRC12EN5010P01010011S

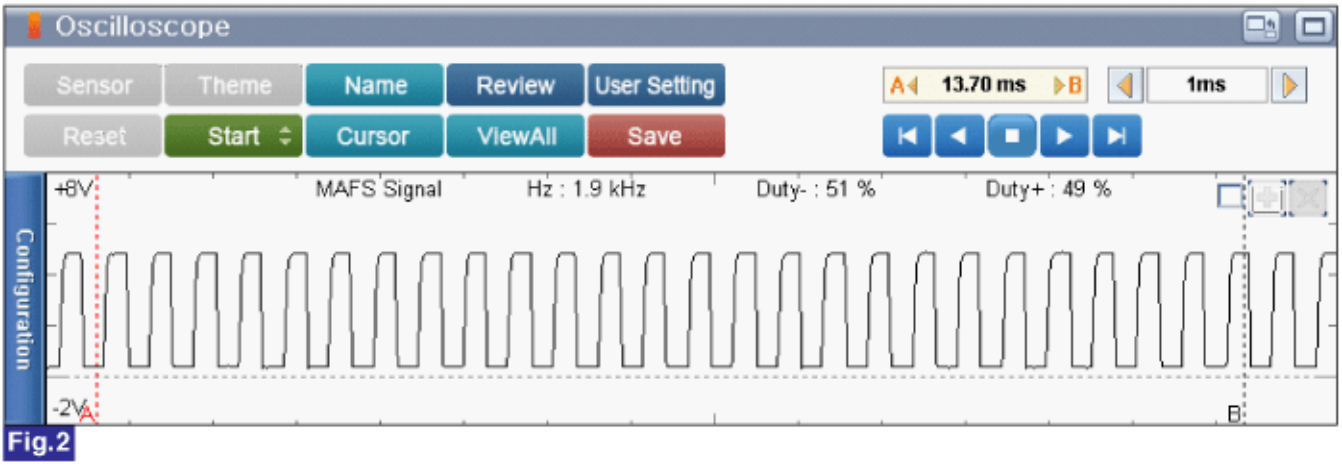
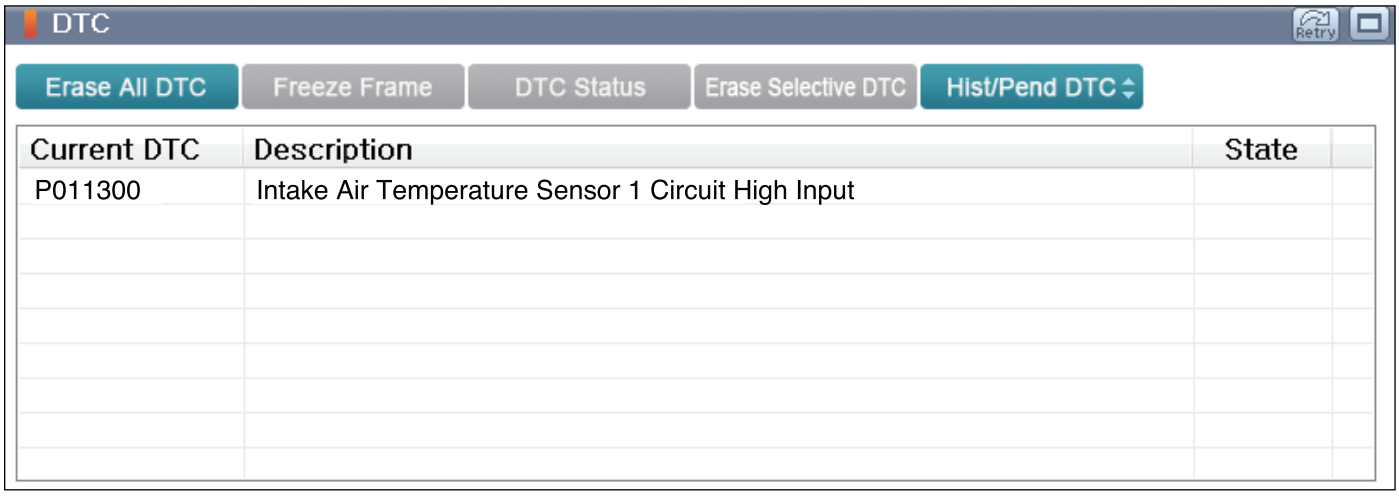


Fig.2

CRC12EN5010P01010012S

Monitor DTC Status

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



CRC12EN5010P01130021S

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

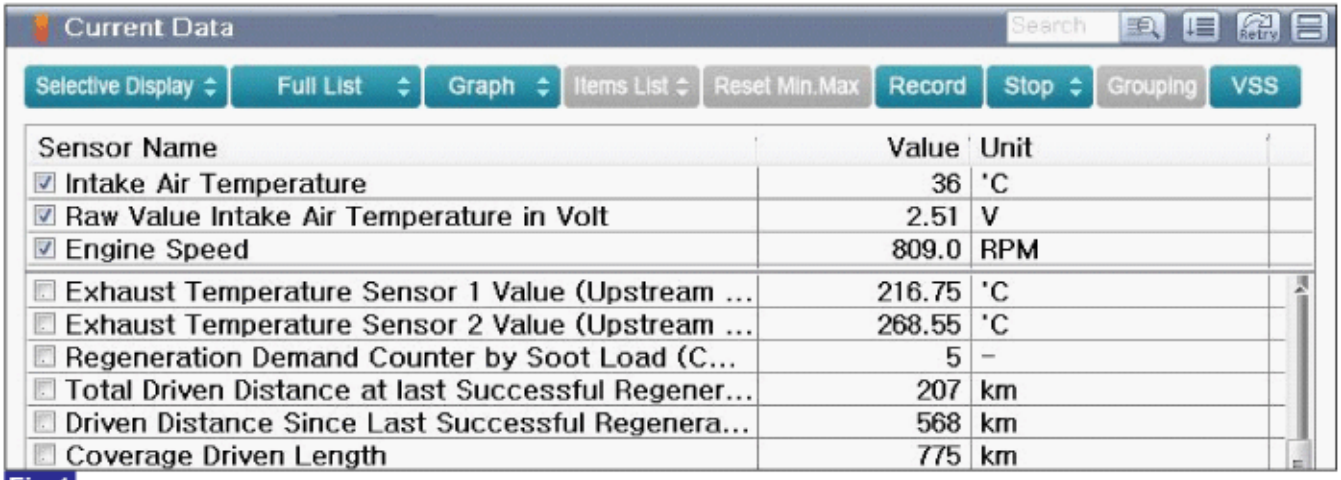


Fig.1

CRC12EN5010P00970022S

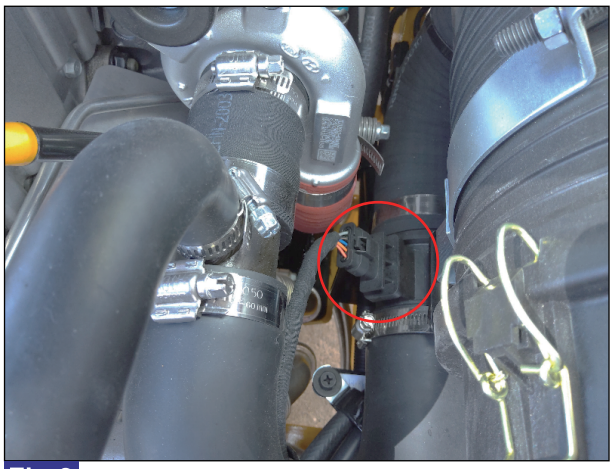


Fig.2


Fig.3

CRC12EN5010P01120023S

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.

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.

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 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 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"
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

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℃/82.4℉)

※Voltage 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.

⚠ CAUTION

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

⚠ CAUTION

- Careful not to damage the sensing element.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Air Flow Sensor Change"

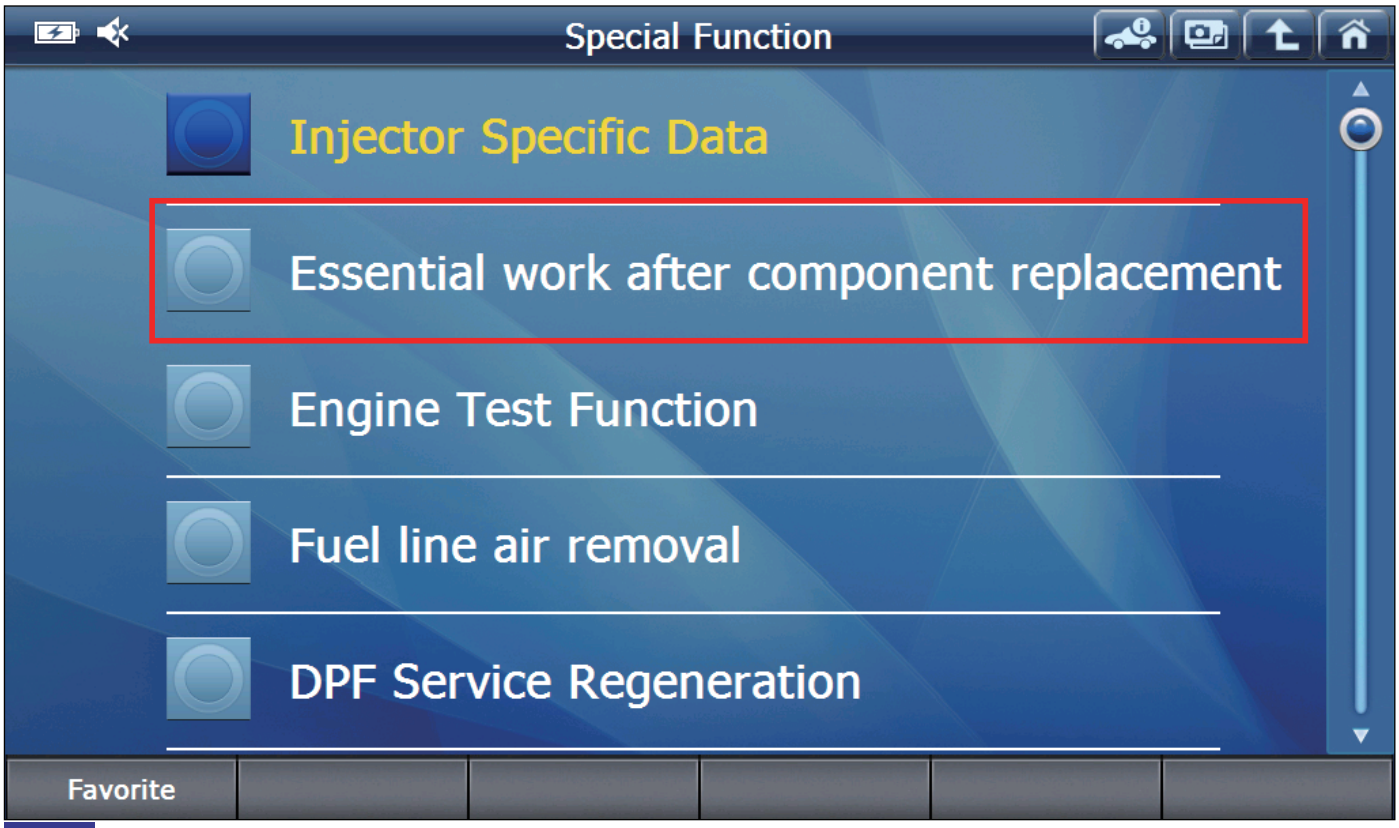


Fig.1

CRC12EN5010P01010041S

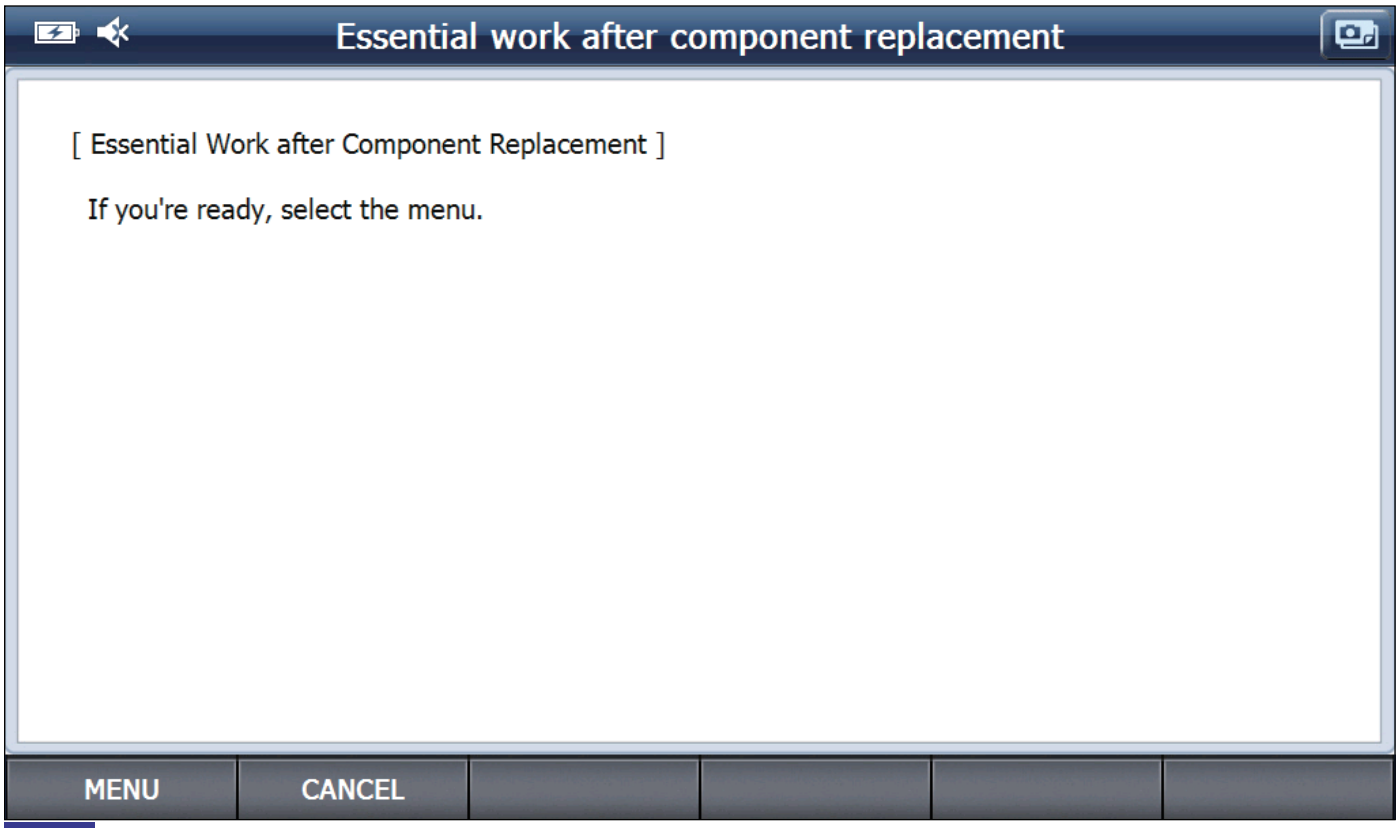


Fig.2

CRC12EN5010P01010042S

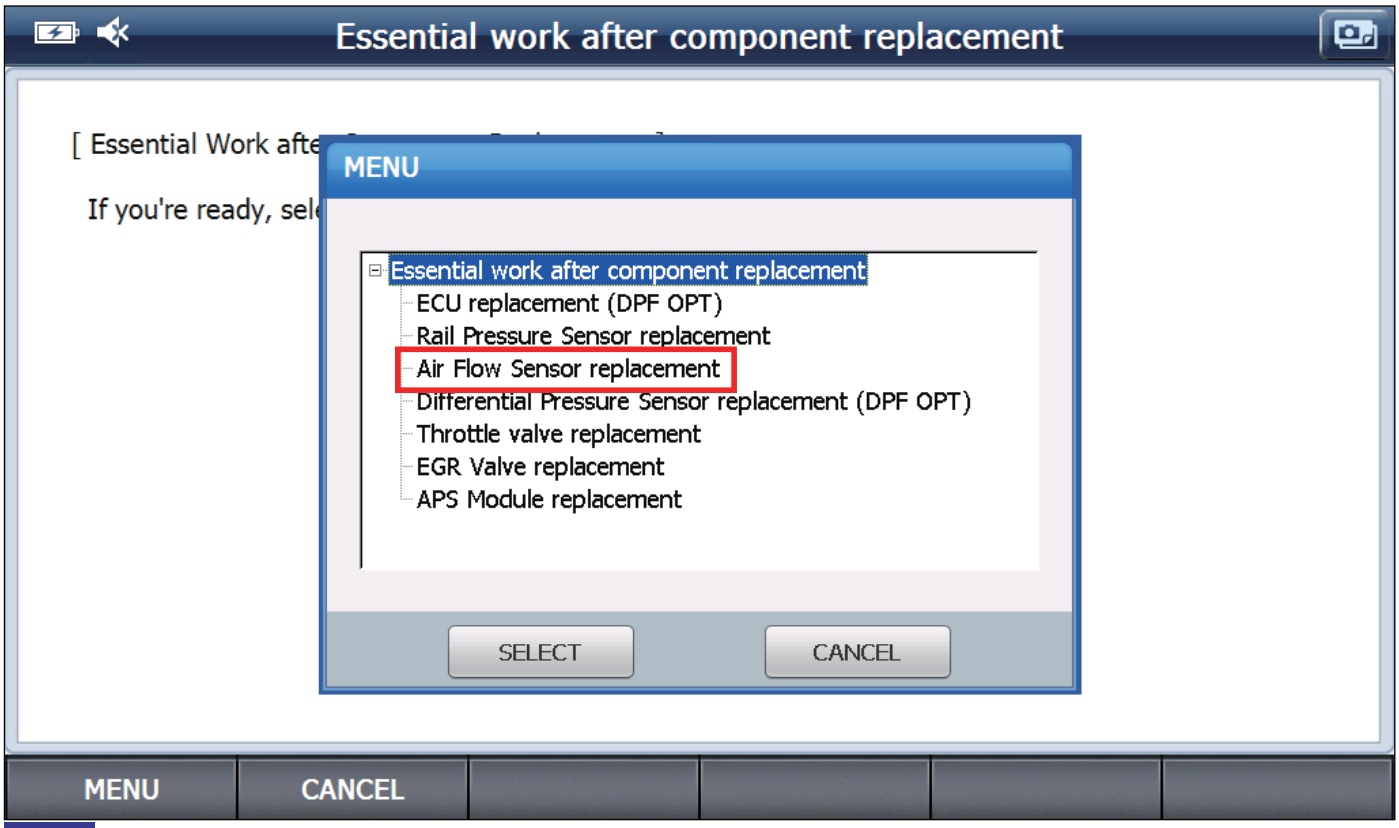


Fig.3

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.

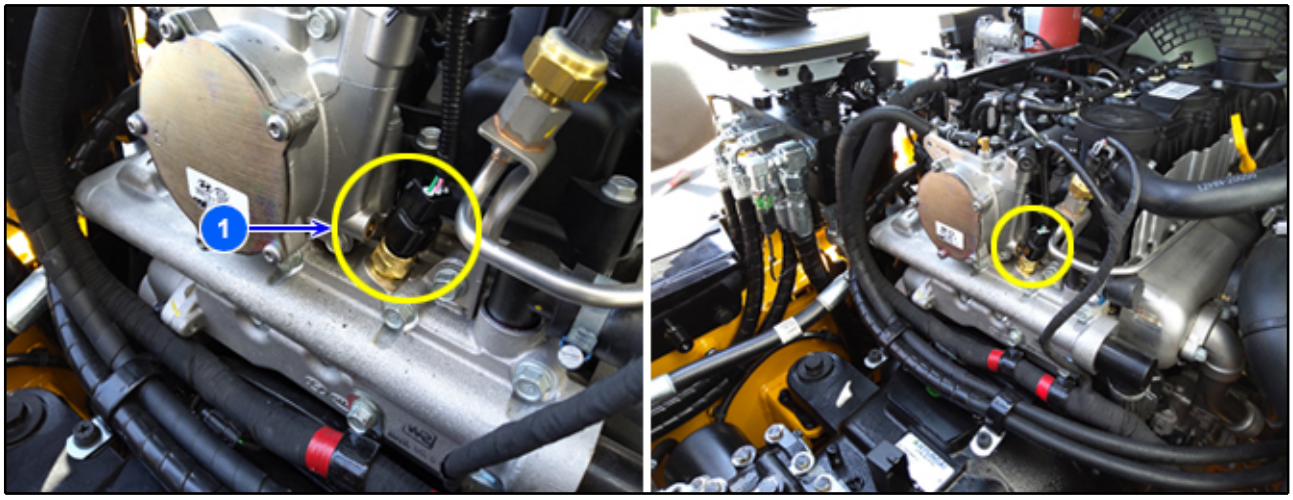
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

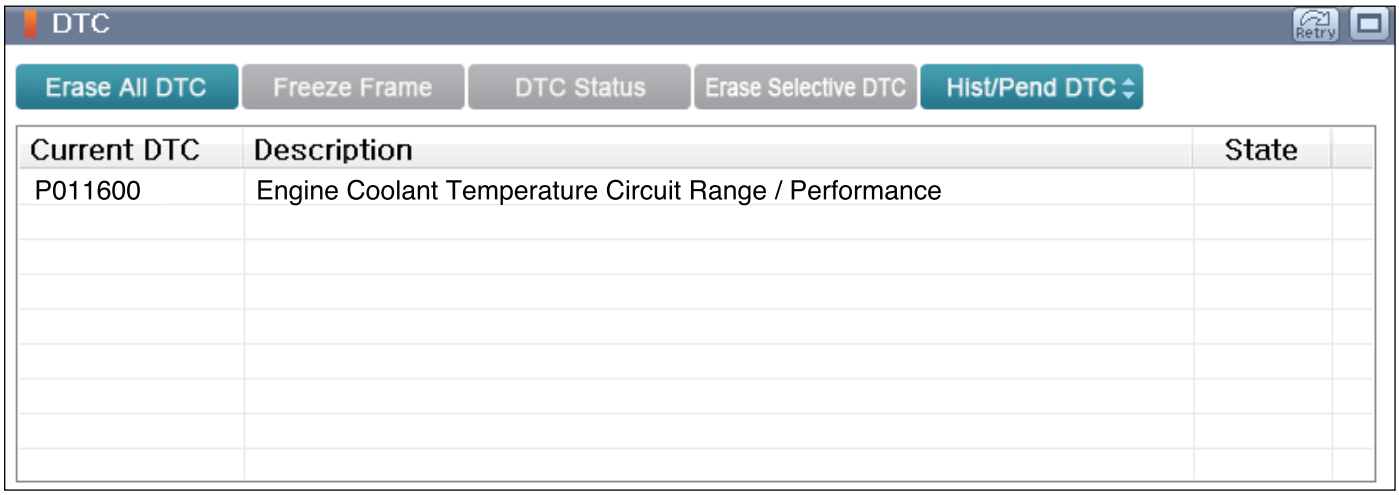
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Faulty engine coolant temperature sensor circuit 2. Defected engine coolant temperature sensor
Enable Condition	• Engine running		
Threshold Value	• Engine temperature increment is below threshold value after engine "ON"		
Detecting Time	• Immediately		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Engine Coolant Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	ECTS Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5. 0V	-
	2	-		-	-
	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.



CRC12EN5010P01160021S

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 "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

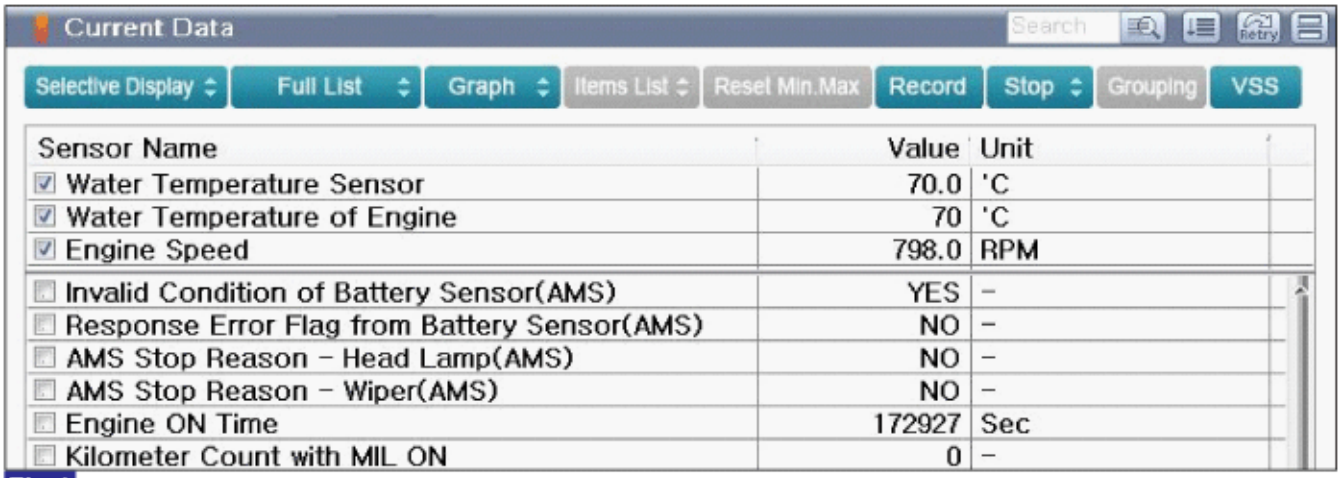


Fig.1

CRC12EN5010P01160022S

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

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 "Ground Circuit Inspection" procedure .

Ground Circuit Inspection

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 Ω

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

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 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

※ 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
Resistance (kΩ)	48.14	14.13 ~ 16.83	5.79	2.31 ~ 2.59	1.15	0.59	0.32	0.19	0.15	0.12

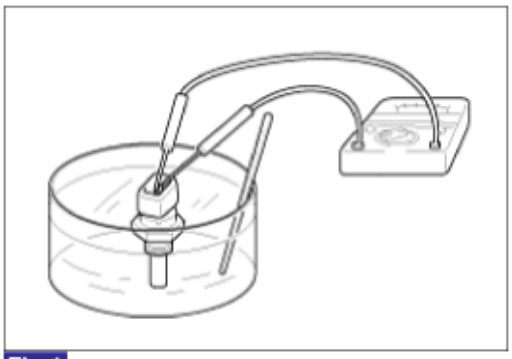


Fig.1

CRC12EN5010P01160041S

Fig.1) Measuring ECTS resistance

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.

NO
- ▸ 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.

⚠ CAUTION

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

⚠ 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.

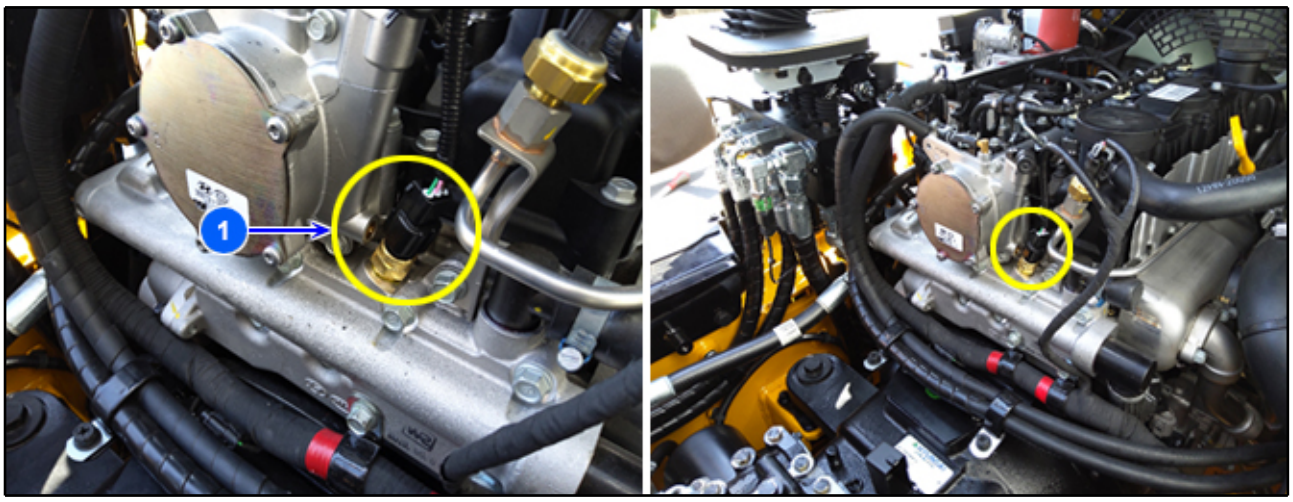
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

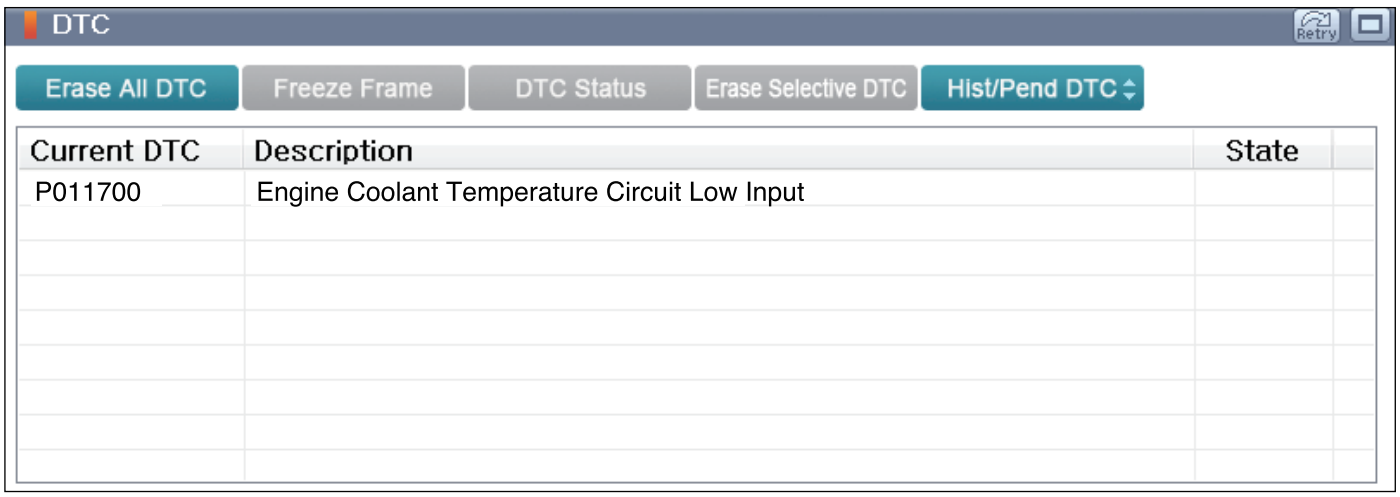
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Short to ground in signal circuit of E-CTS 2. Defected ECTS
Enable Condition	• Engine running		
Threshold Value	• Output voltage is less than minimum threshold value (225mV)		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Engine Coolant Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	ECTS Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5. 0V	-
	2	-		-	-
	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.



CRC12EN5010P01170021S

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 "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

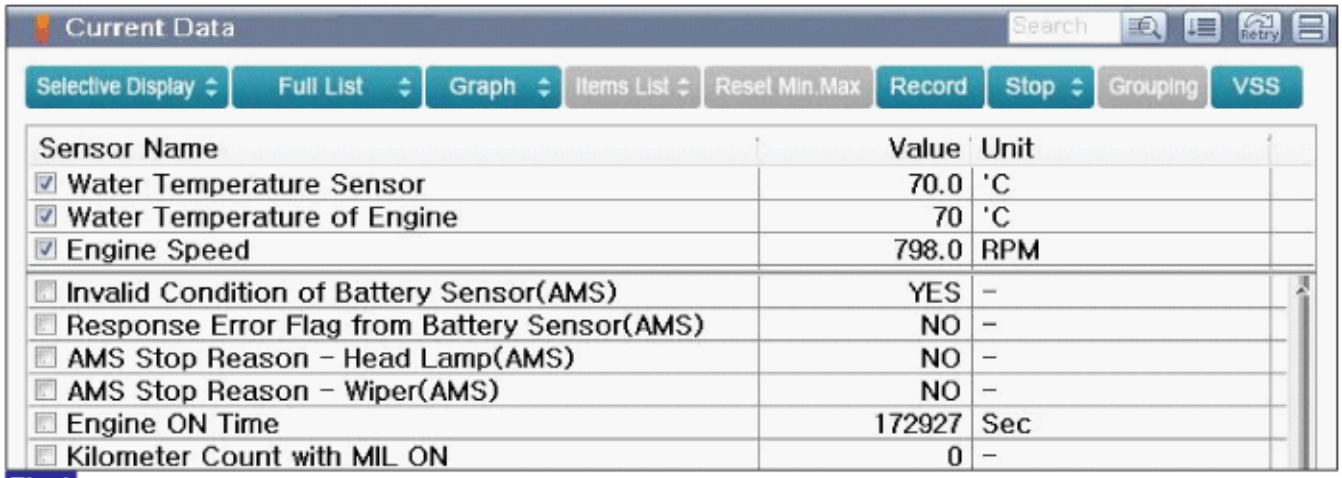


Fig.1

CRC12EN5010P01160022S

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

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 "Ground Circuit Inspection" procedure.

Ground Circuit Inspection

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 Ω

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

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 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

※ 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
Resistance (kΩ)	48.14	14.13 ~ 16.83	5.79	2.31 ~ 2.59	1.15	0.59	0.32	0.19	0.15	0.12

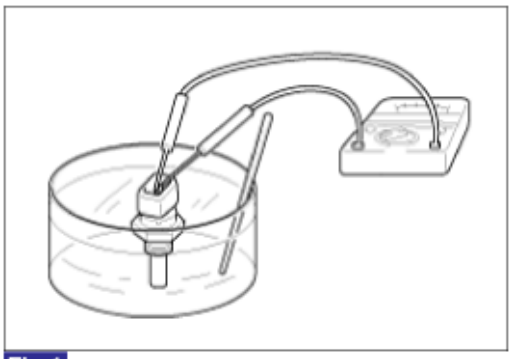


Fig.1

CRC12EN5010P01160041S

Fig.1) Measuring ECTS resistance

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.

NO ▸ 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.

⚠ CAUTION

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

operation. The internal damage may be present.

⚠ 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.

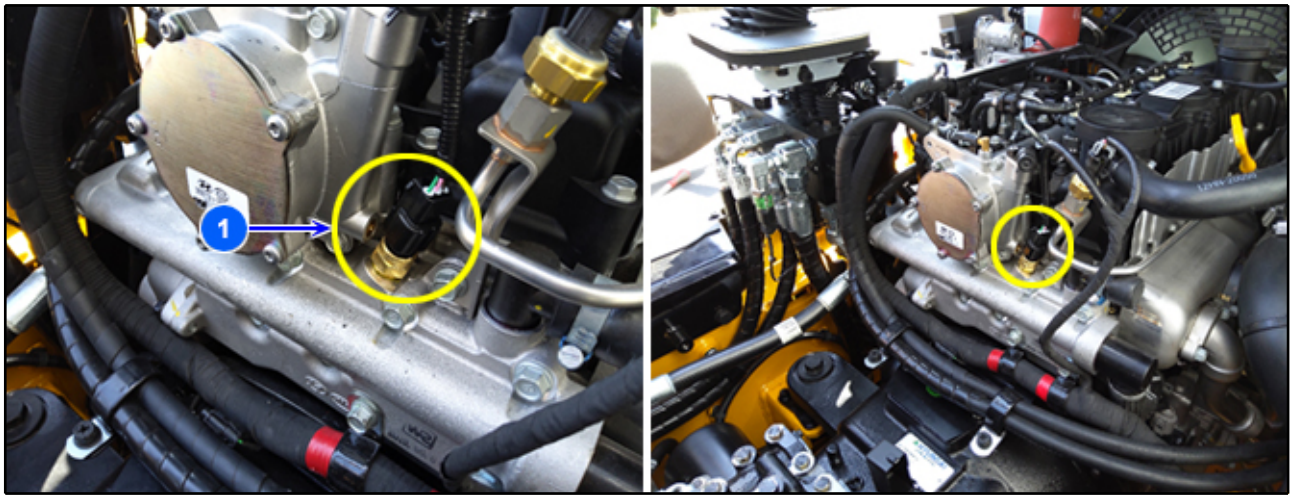
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

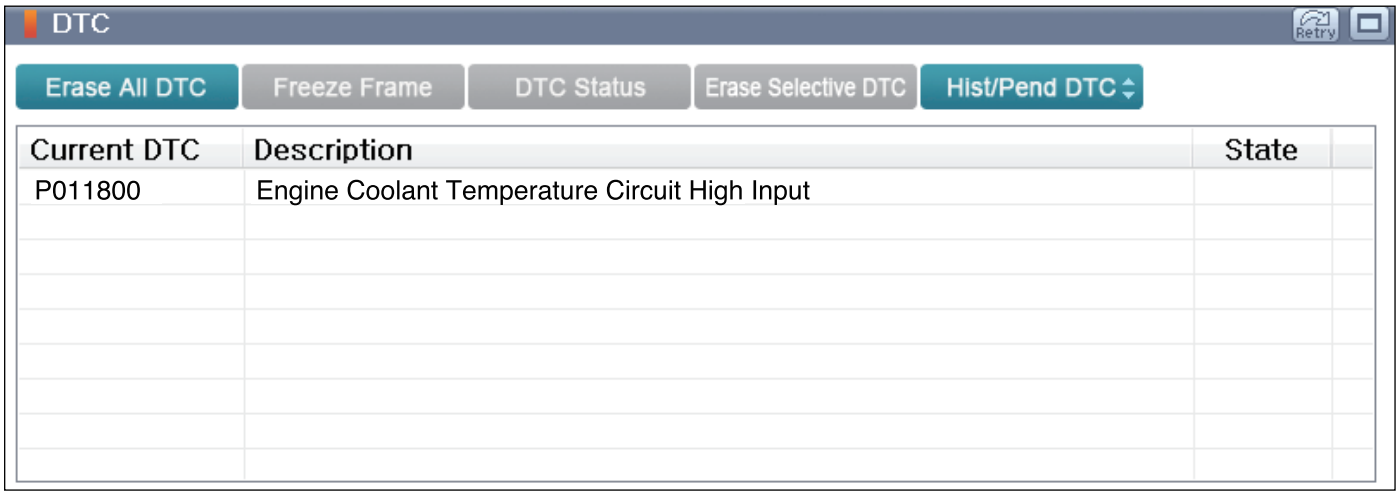
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open or short to power in signal circuit of ECTS 2. Open in ground circuit of ECTS 3. Defected ECTS
Enable Condition	• Engine running		
Threshold Value	• Output voltage is higher than maximum threshold value (3225mV)		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Engine Coolant Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	ECTS Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5. 0V	-
	2	-		-	-
	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.



CRC12EN5010P01180021S

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 "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

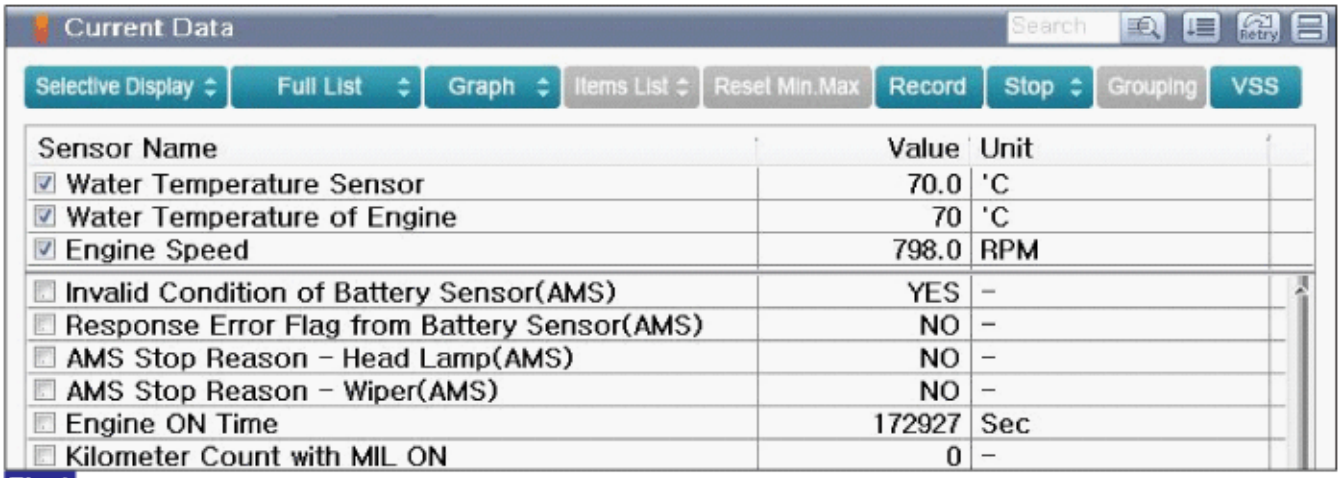


Fig.1

CRC12EN5010P01160022S

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

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 "Ground Circuit Inspection" procedure .

Ground Circuit Inspection

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 Ω

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

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 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

※ 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
Resistance (kΩ)	48.14	14.13 ~ 16.83	5.79	2.31 ~ 2.59	1.15	0.59	0.32	0.19	0.15	0.12

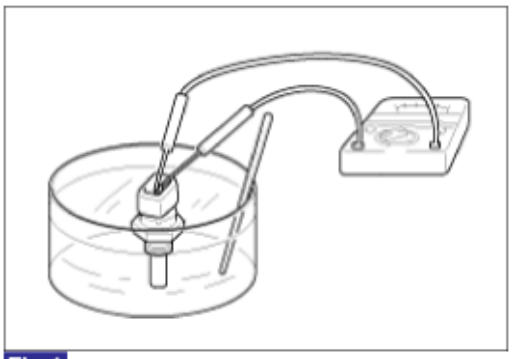


Fig.1

CRC12EN5010P01160041S

Fig.1) Measuring ECTS resistance

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.

NO
- ▸ 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.

⚠ CAUTION

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

⚠ 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.

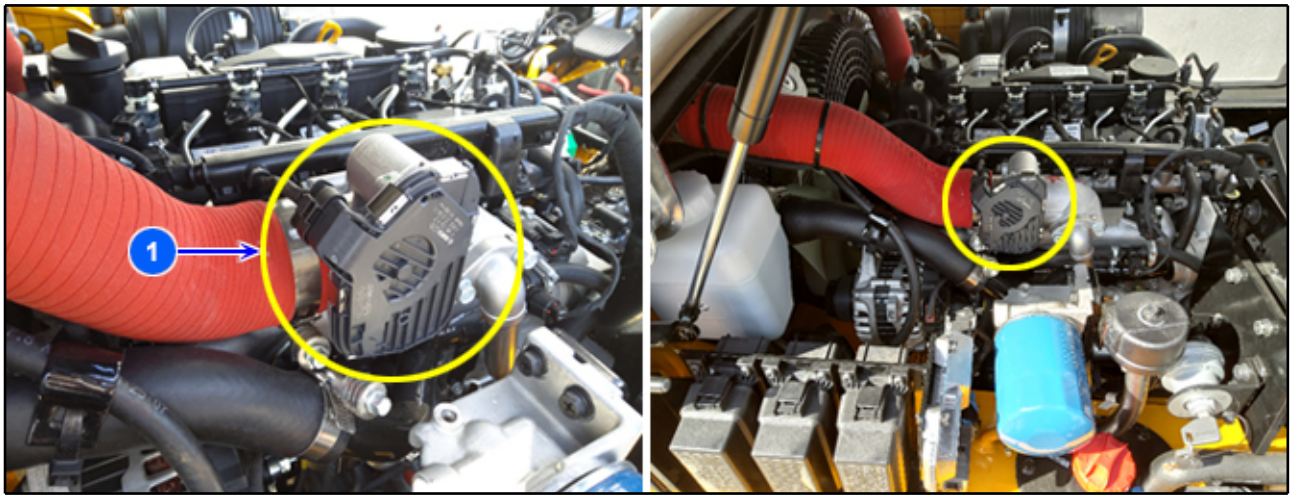
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

Component Location



CRC12EN5010P01220011

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.

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.

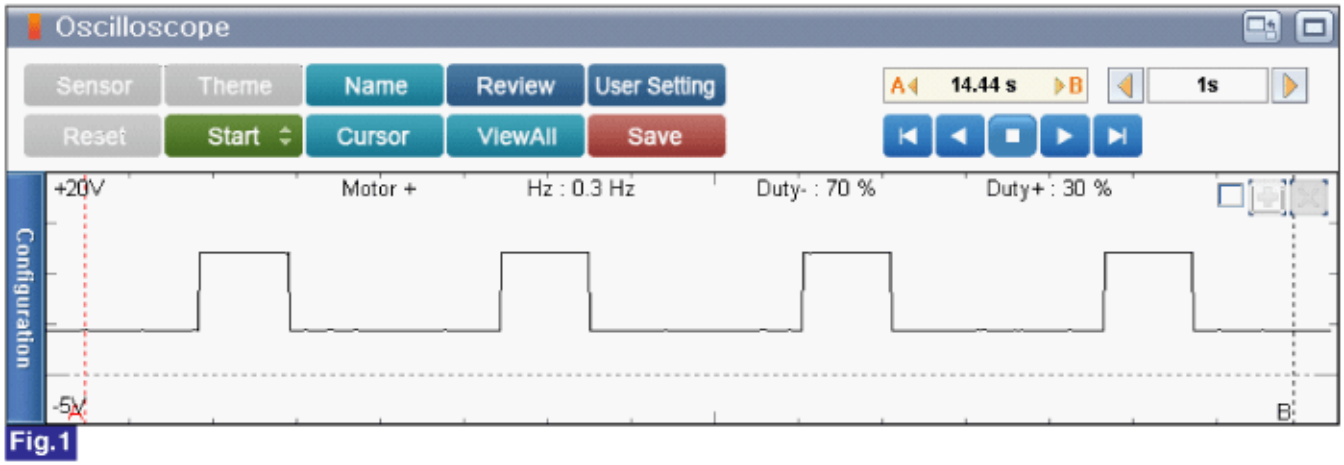
DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Short to ground feedback circuit of ACV 2. Defected ACV
Enable Condition	• Engine running		
Threshold Value	• ACV position output voltage is less than 200 mV		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

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

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



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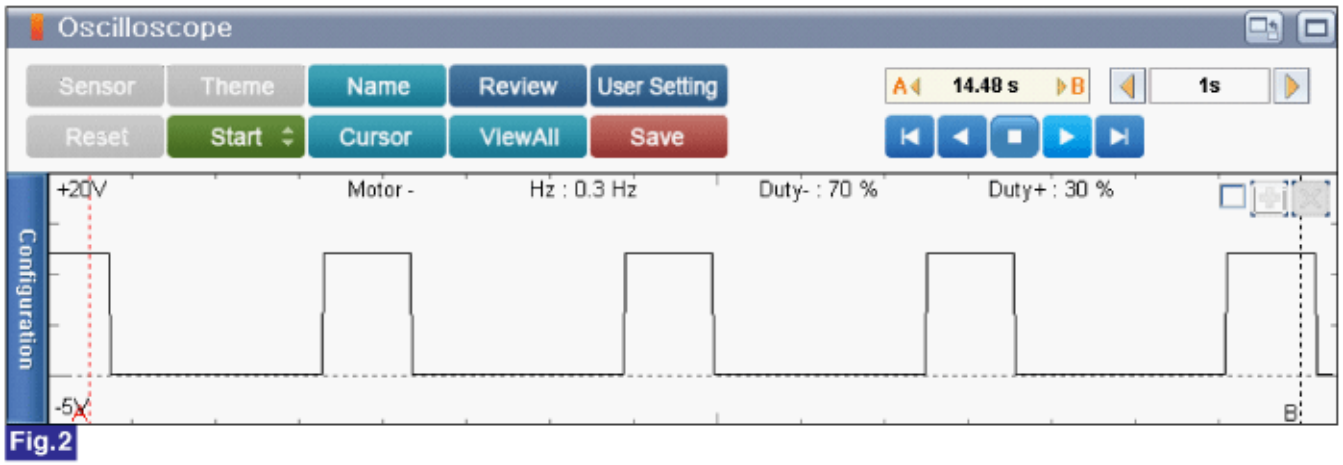


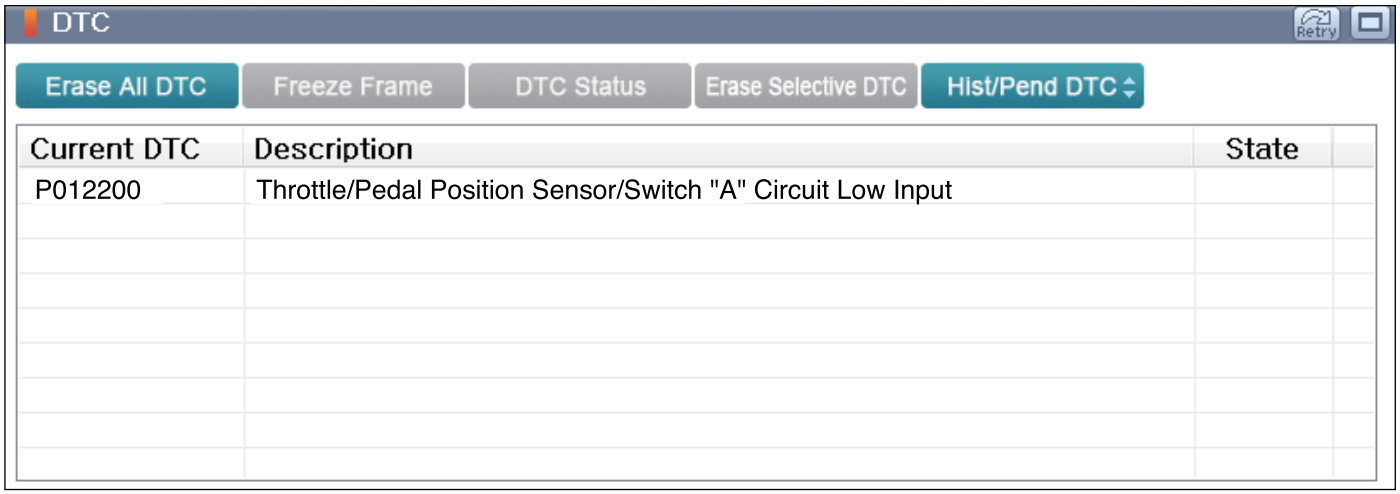
CRC12EN5010P01220012S

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.



CRC12EN5010P01220021S

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

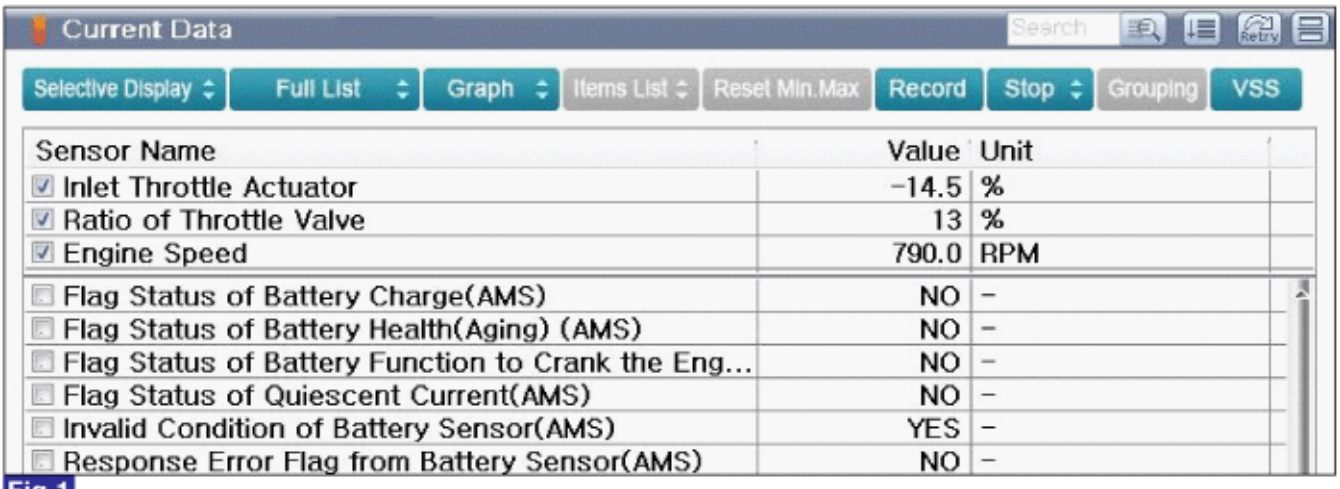


Fig.1

CRC12EN5010P01220022S

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.

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.
4. Measure the resistance between ACV position sensor ground terminal of ACV harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect the ACV 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?

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 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

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

■ 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"
5. Perform "Throttle Valve Actuator 10%" and "Throttle 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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

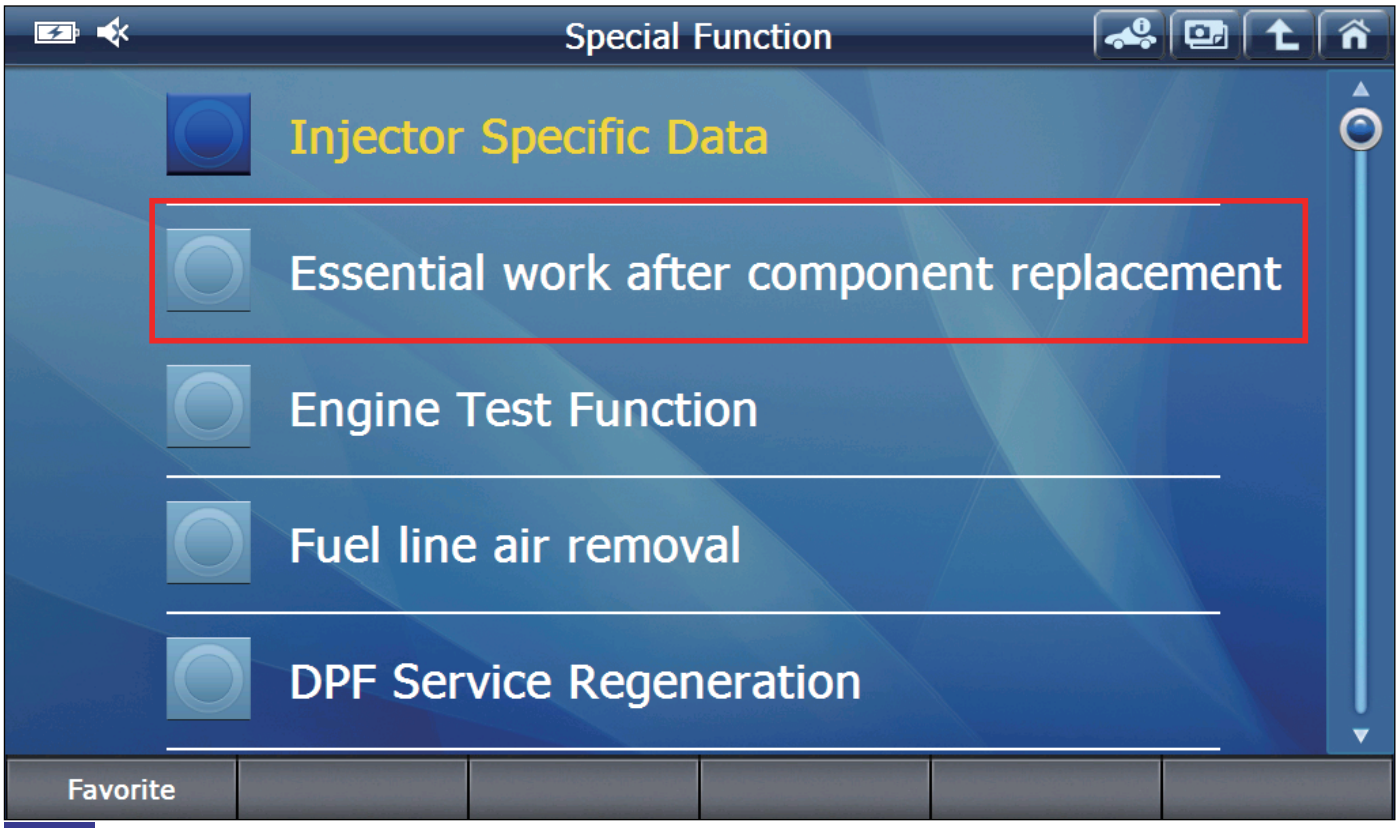


Fig.1

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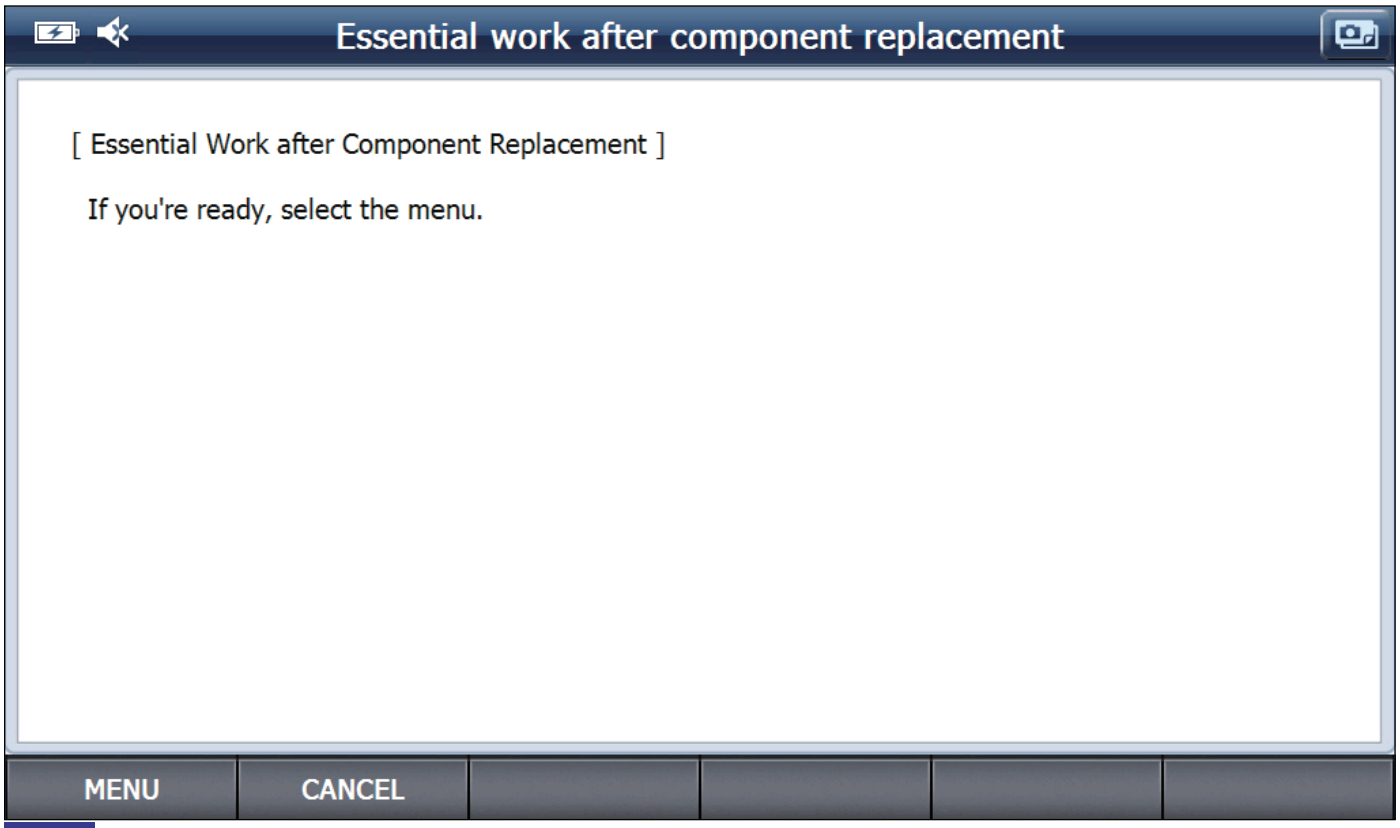


Fig.2

CRC12EN5010P01010042S

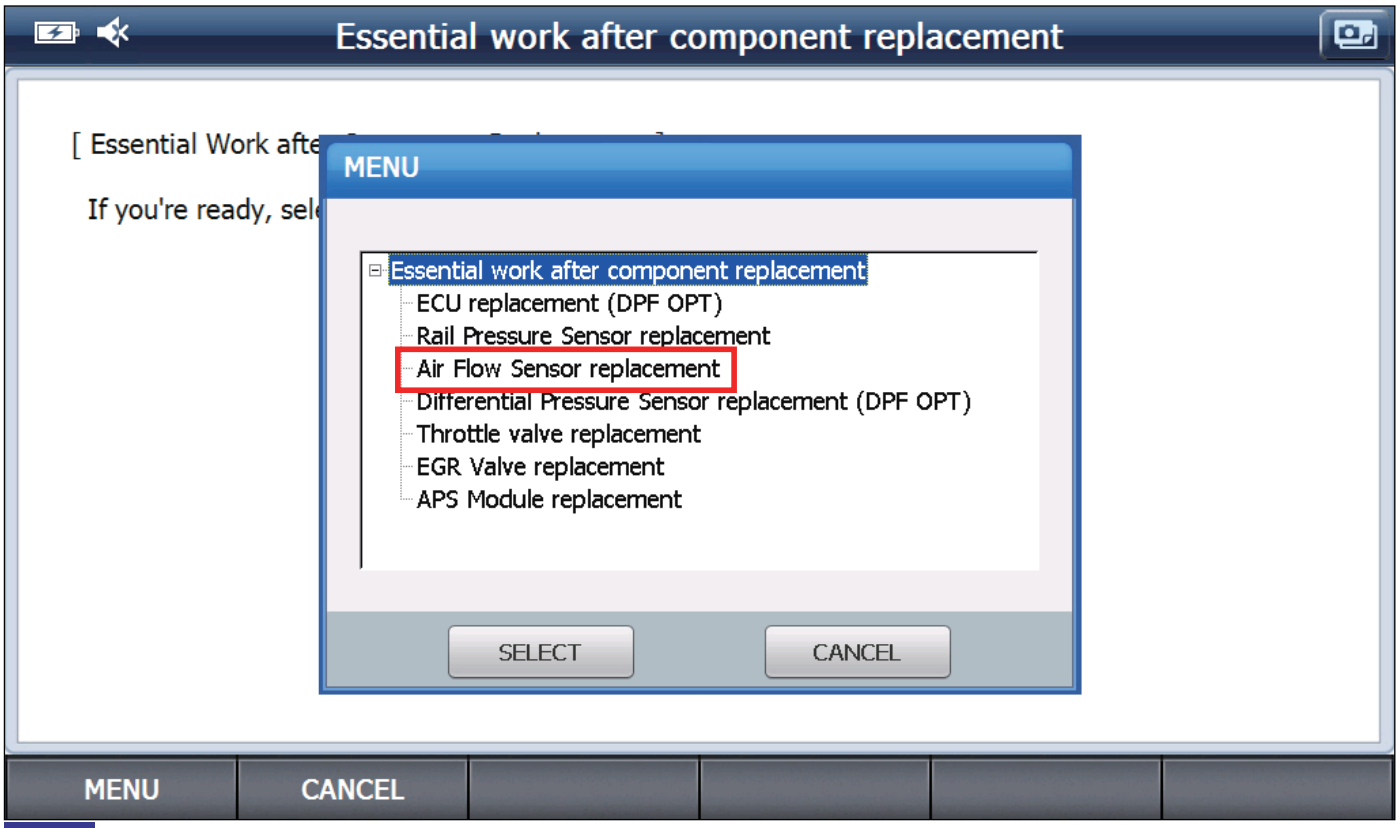


Fig.3

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.

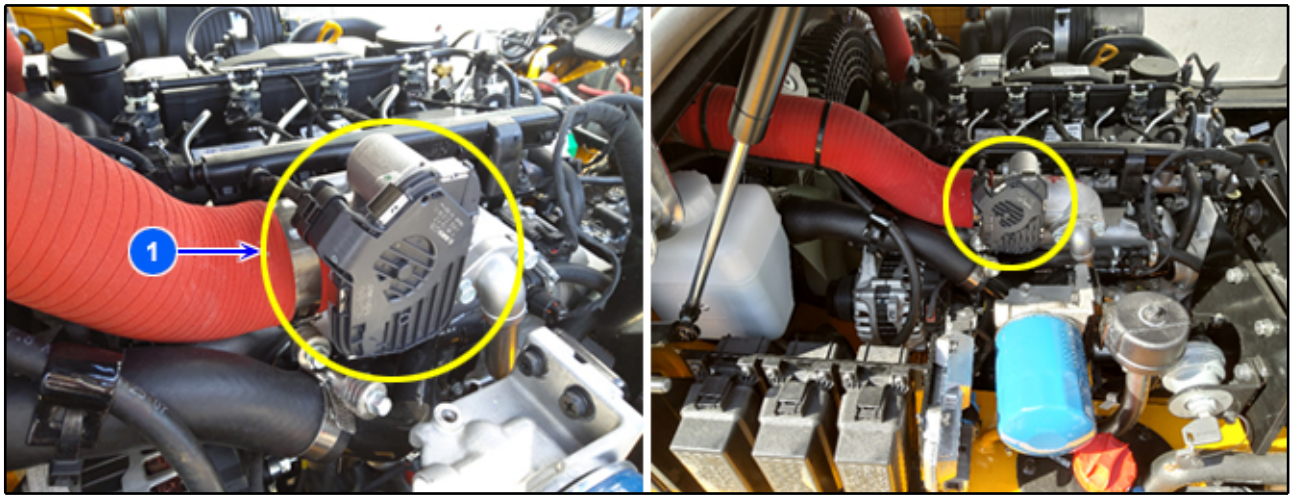
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P012300 Throttle/Pedal Position Sensor/Switch "A" Circuit High Input

Component Location



CRC12EN5010P01220011

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.

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	Detecting Condition		Possible Cause
DTC Strategy	• Signal Monitoring		1. Short to ground feedback circuit of ACV 2. Defected ACV
Enable Condition	• Engine running		
Threshold Value	• ACV position output voltage is higher than 4800 mV		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

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

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

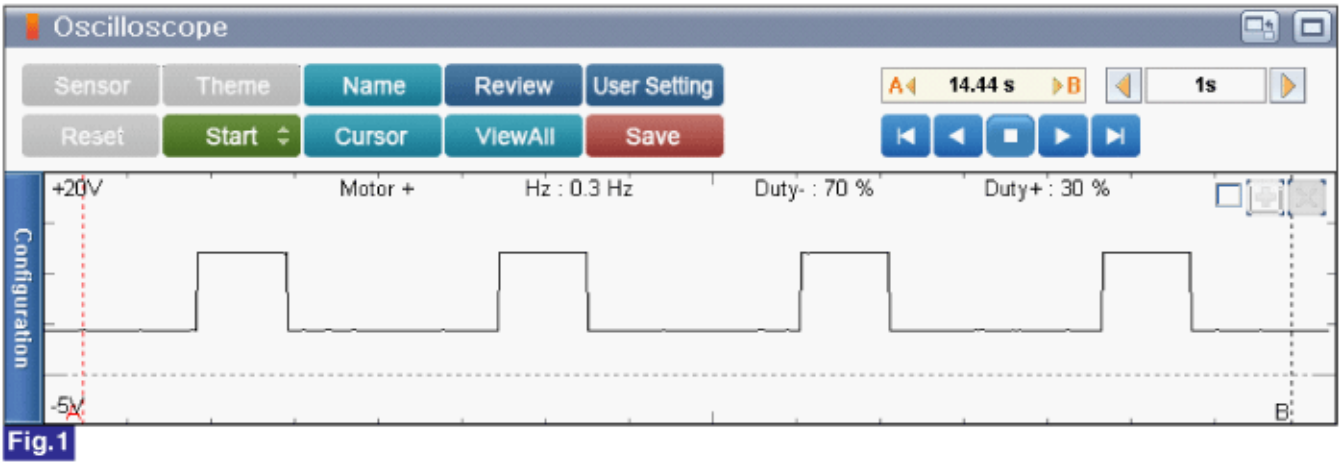


Fig.1

CRC12EN5010P01220011S

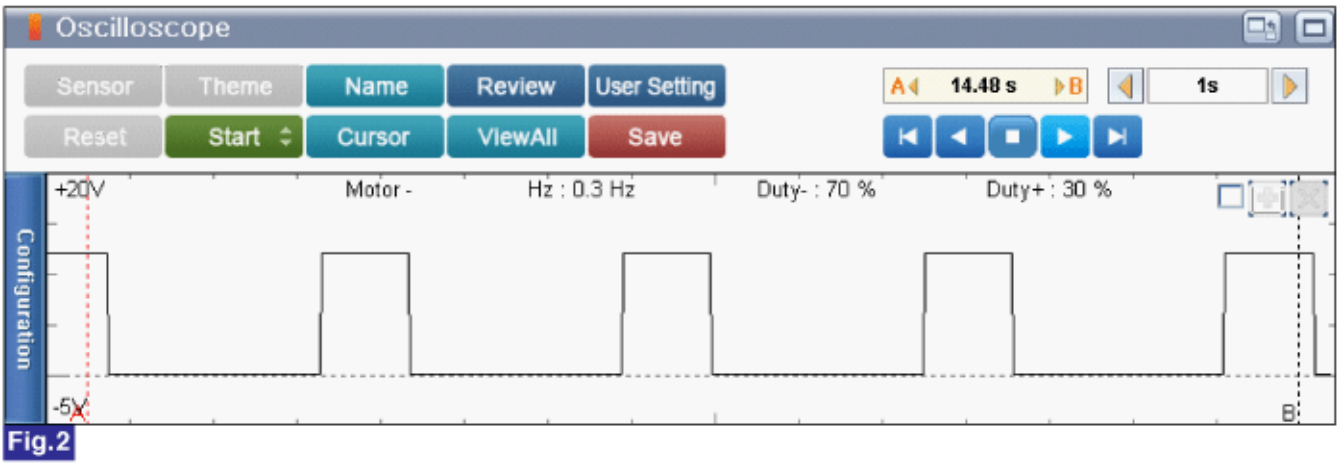


Fig.2

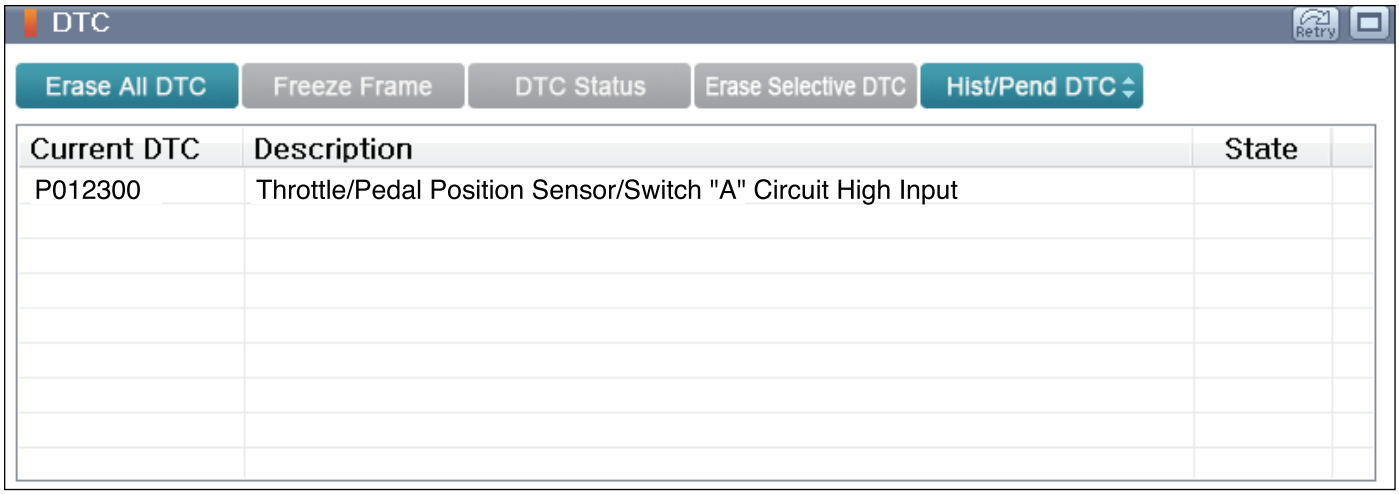
CRC12EN5010P01220012S

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.



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).
3. Ignition switch "ON" & Engine "ON"
4. Monitor follow parameters in "Current Data" with GDS.

Specification: Refer to figure below

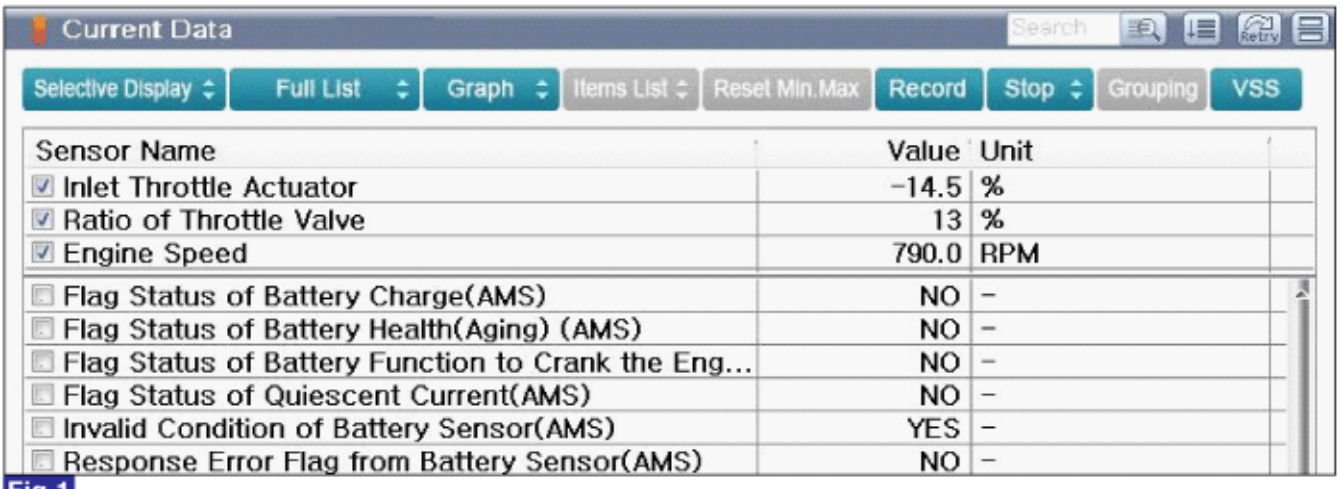


Fig.1

CRC12EN5010P01220022S

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.

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.
4. Measure the resistance between ACV position sensor ground terminal of ACV harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect the ACV 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?

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 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

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

■ 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"
5. Perform "Throttle Valve Actuator 10%" and "Throttle 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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

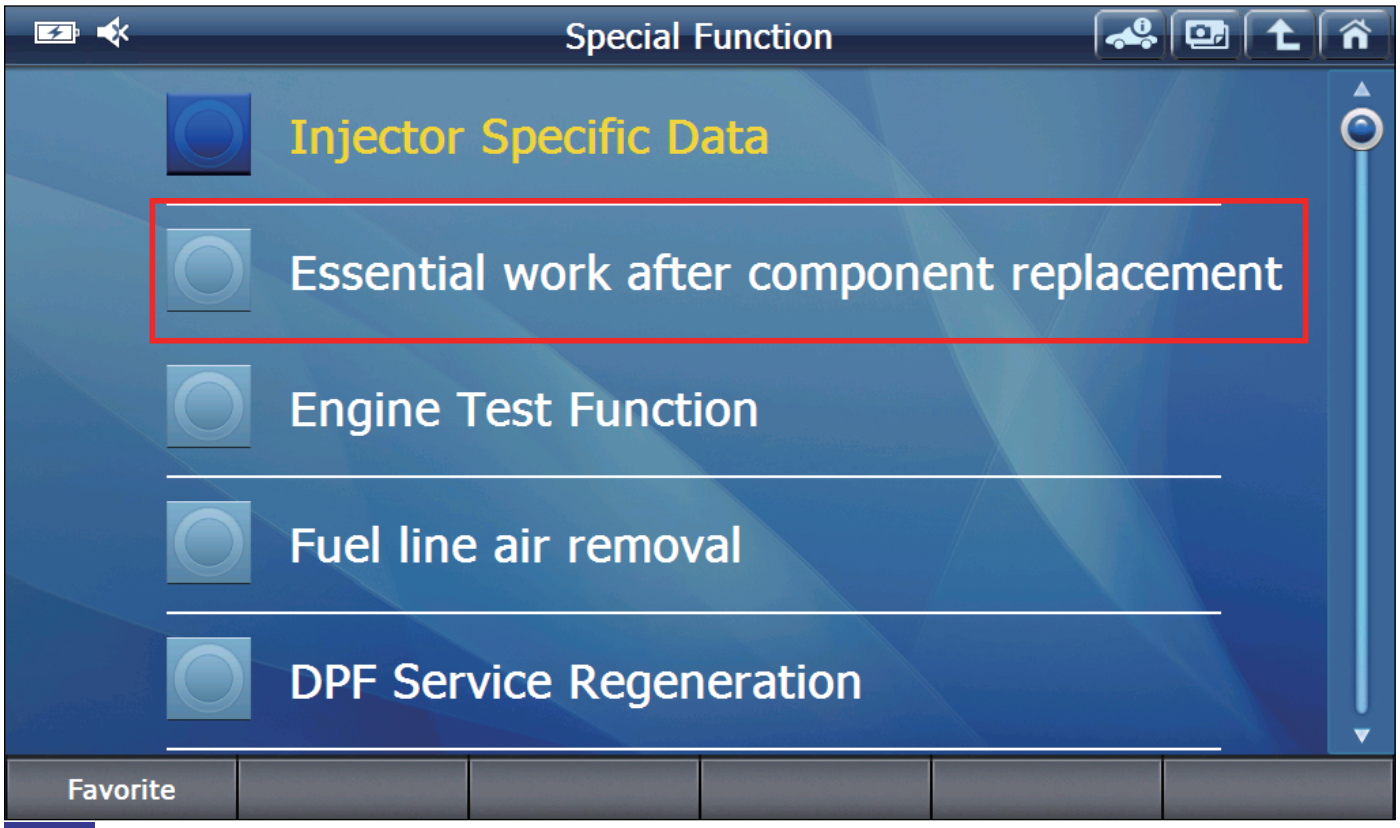


Fig.1

CRC12EN5010P01010041S

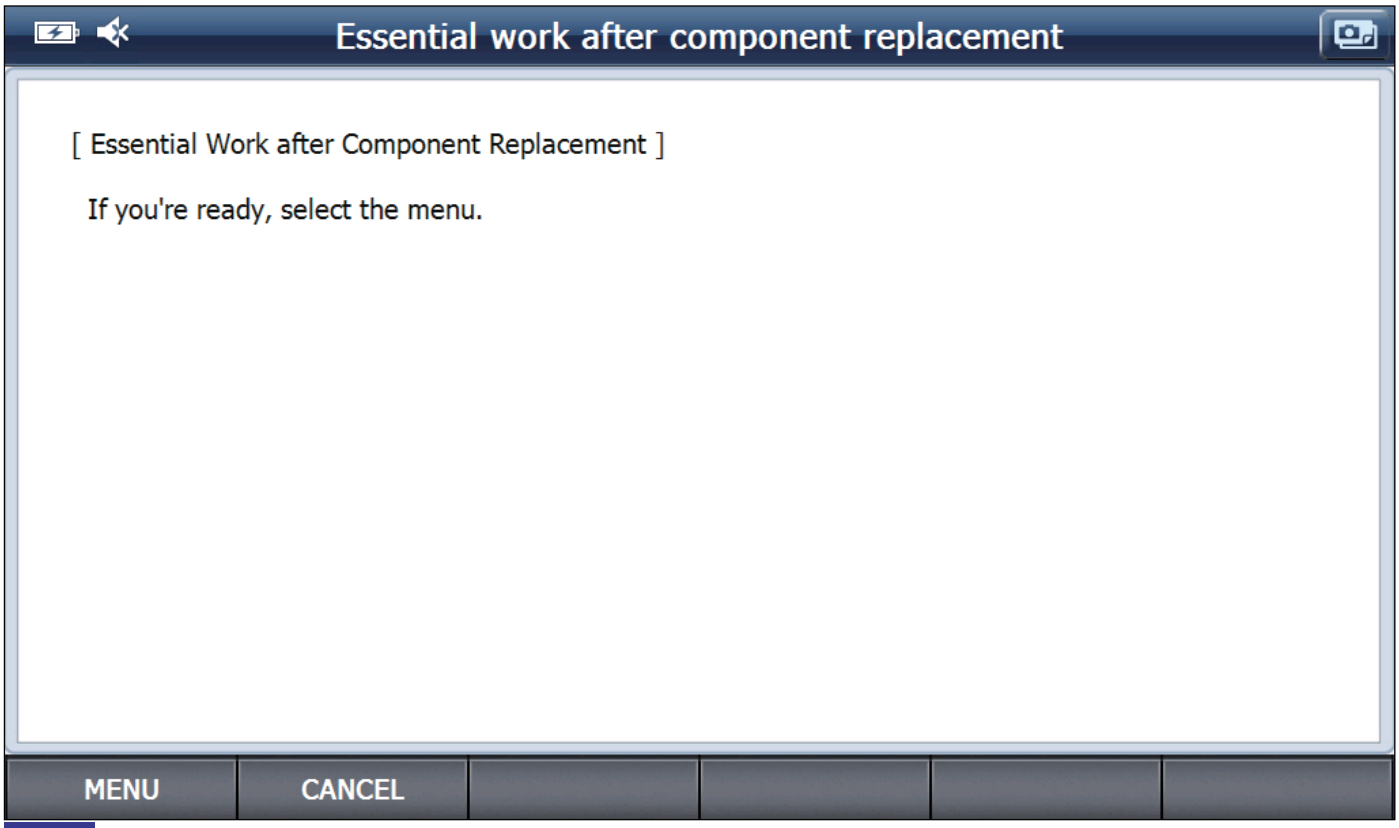


Fig.2

CRC12EN5010P01010042S

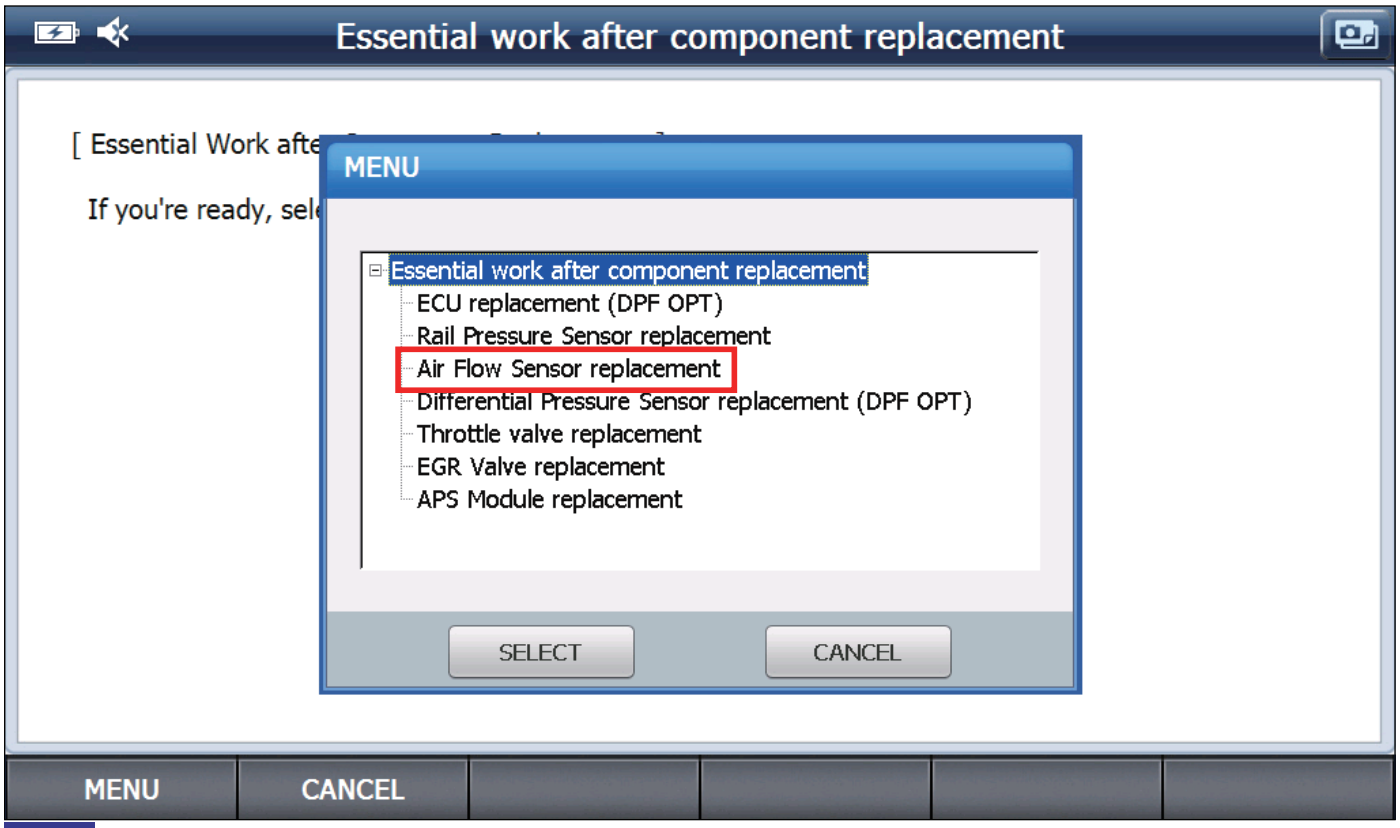


Fig.3

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.

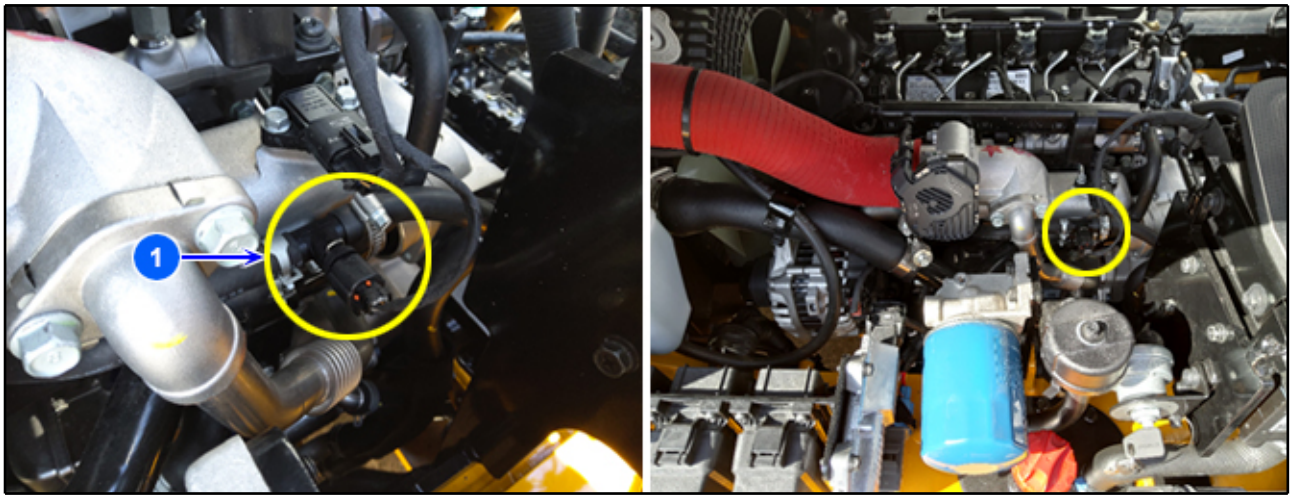
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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℃(176℉). 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

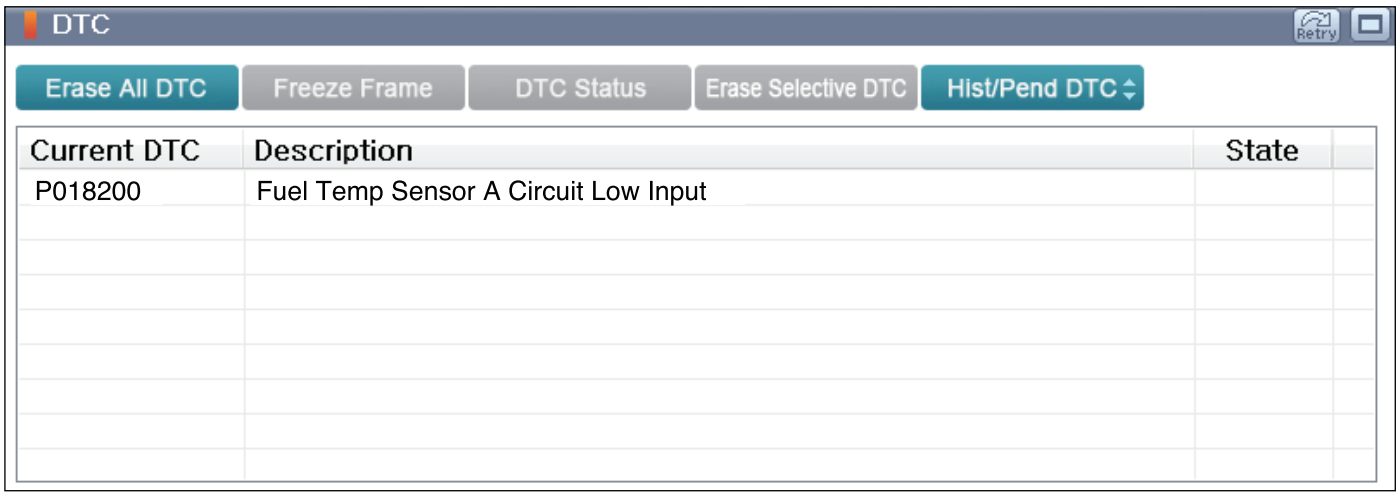
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Short to ground in signal circuit of FTS 2. Defected FTS
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value (Below 172mV) • Short to ground in signal circuit		
Detecting Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Fuel Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	FTS Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	FTS Ground		0V	-

Monitor GDS Data

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



CRC12EN5010P01820021S

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

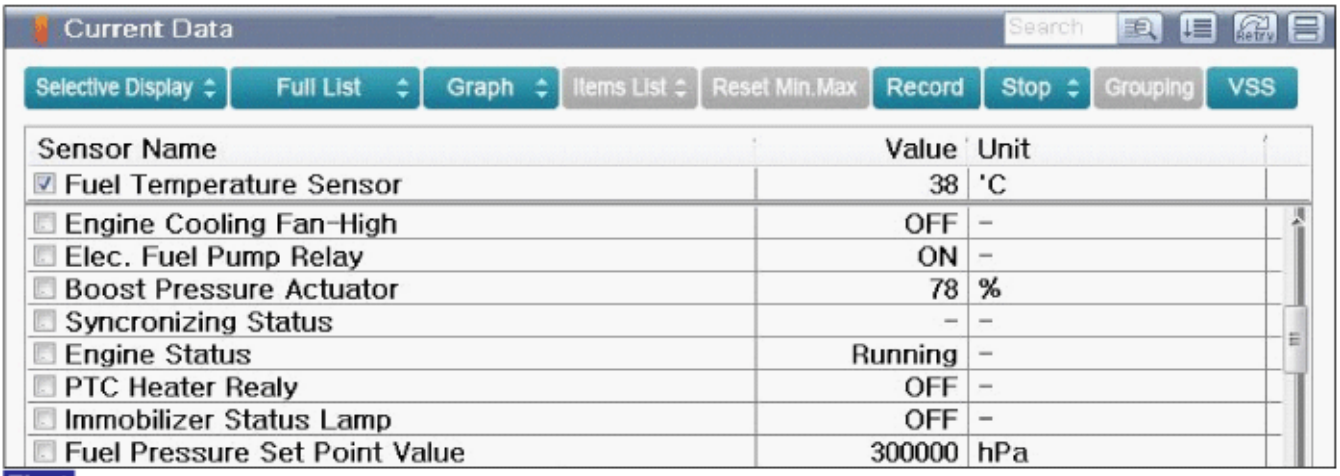


Fig.1

CRC12EN5010P01820022S

Fig. 1) Fuel temperature sensor current data under engine idle.

※ In case of fuel temperature sensor failure, the temperature value is fixed at 80℃(176℉)

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?

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

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 the FTS connector.
4. Measure the resistance between ground terminal of FTS harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect the FTS connector.
7. Ignition switch "ON"
8. Measure the voltage between signal terminal of FTS 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"
4. 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.(℃)	-20 / -4	-10 / 14	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	120 / 248
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.

⚠ 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.

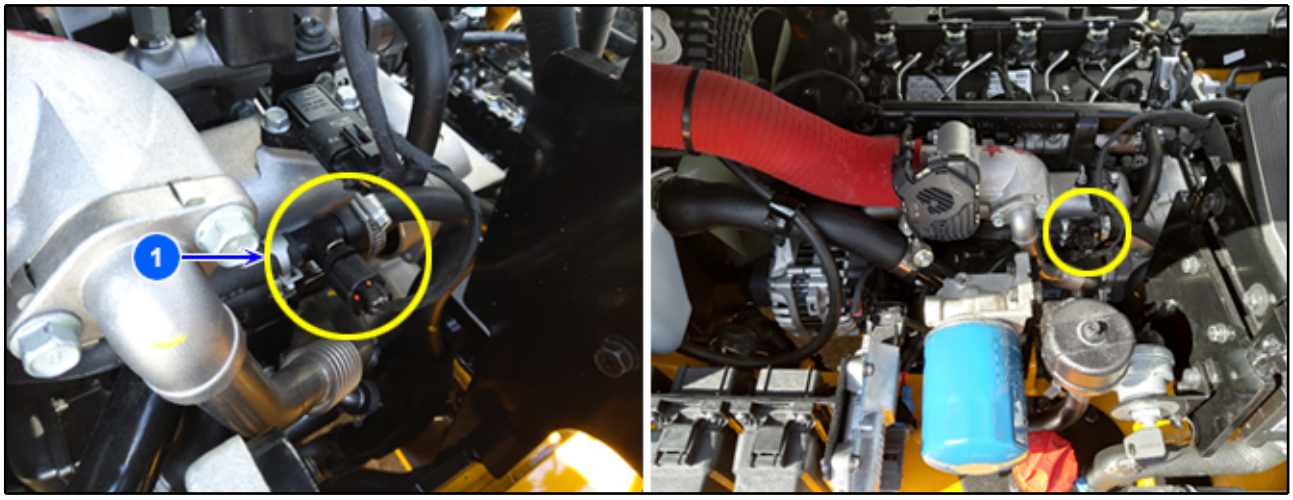
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
5. Are any DTCs stored in the system?

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



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℃(176℉). 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.

DTC Detecting Condition

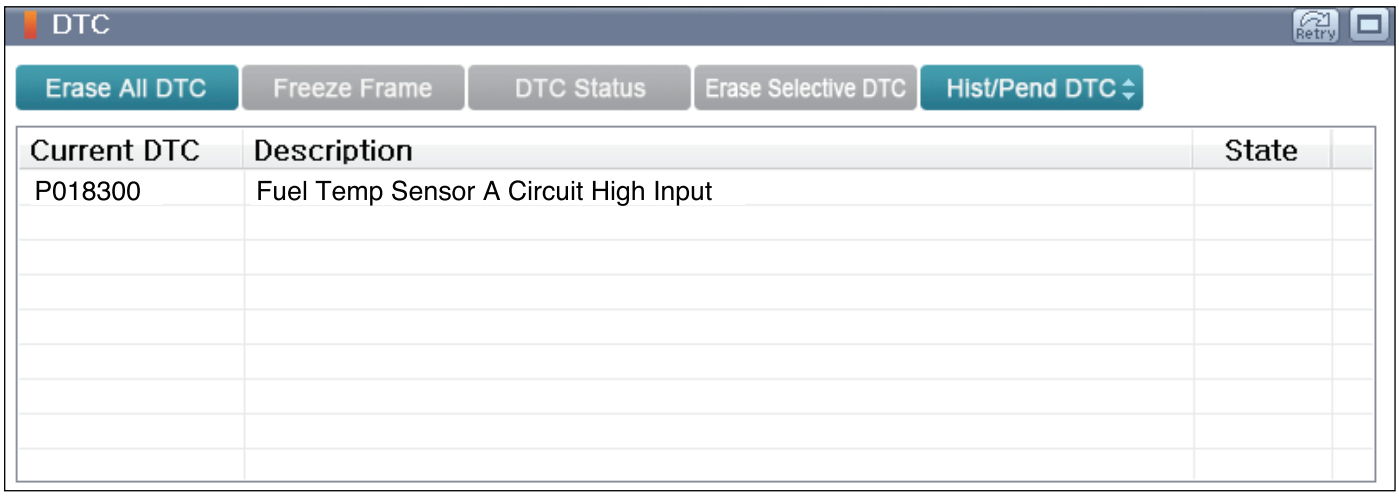
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open or short to power in signal circuit FTS 2. Open in ground circuit of FTS 3. Defected FTS
Enable Condition	• Engine running		
Threshold Value	• Ouput signal is higher than threshold value (3204mV) • Open in signal circuit		
Detecting Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Fuel Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	FTS Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	FTS Ground		0V	-

Monitor GDS Data

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



CRC12EN5010P01830021S

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

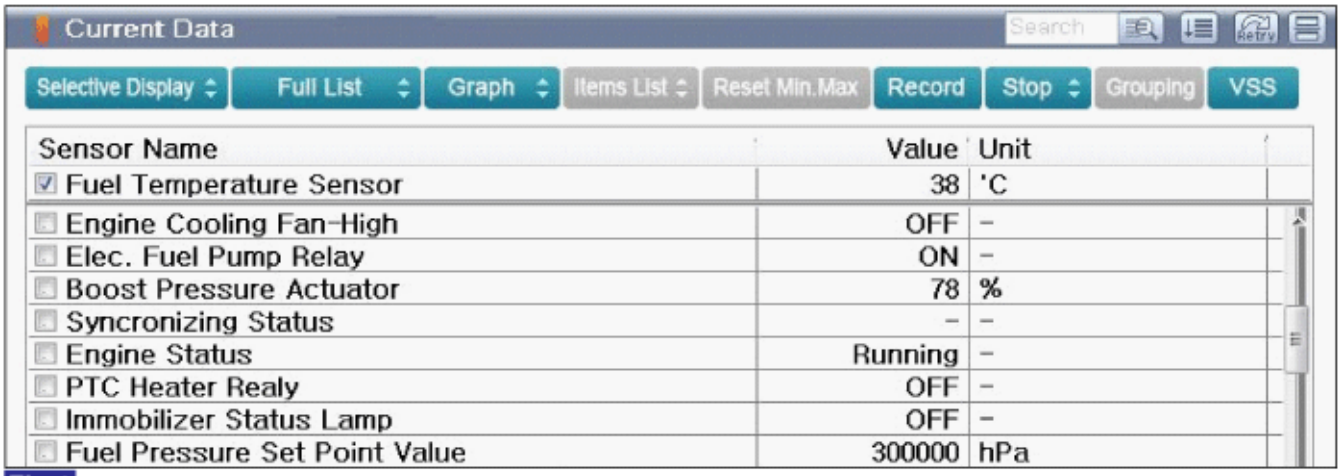


Fig.1

CRC12EN5010P01820022S

Fig. 1) Fuel temperature sensor current data under engine idle.

※ In case of fuel temperature sensor failure, the temperature value is fixed at 80℃(176℉)

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?

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

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 the FTS connector.
4. Measure the resistance between ground terminal of FTS harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect the FTS connector.
7. Ignition switch "ON"
8. Measure the voltage between signal terminal of FTS 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"
4. 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.(℃)	-20 / -4	-10 / 14	0 / 32	20 / 68	40 / 104	60 / 140	80 / 176	120 / 248
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.

⚠ 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.

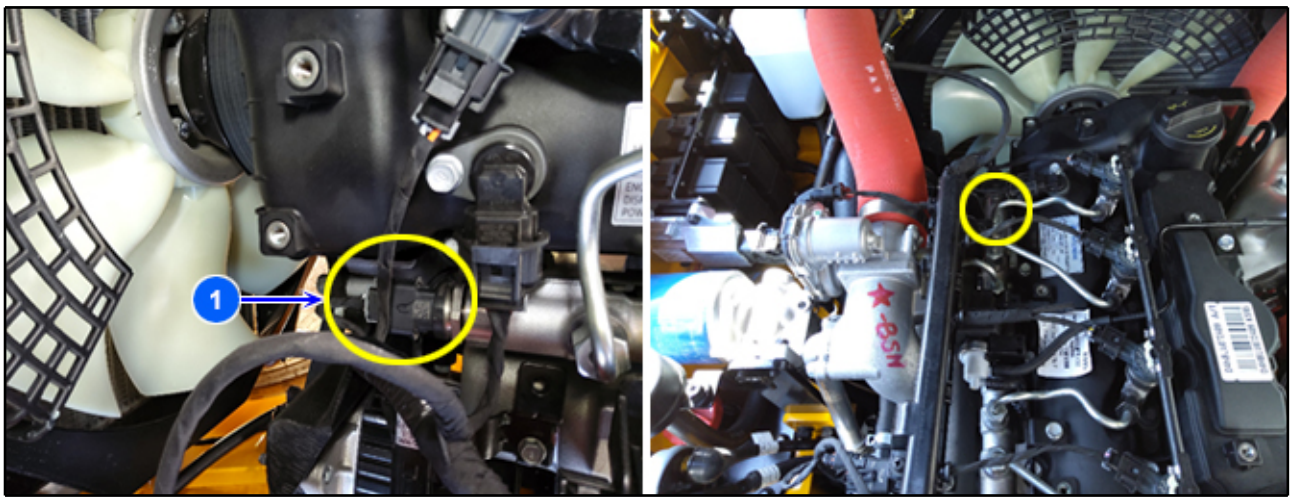
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
5. Are any DTCs stored in the system?

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

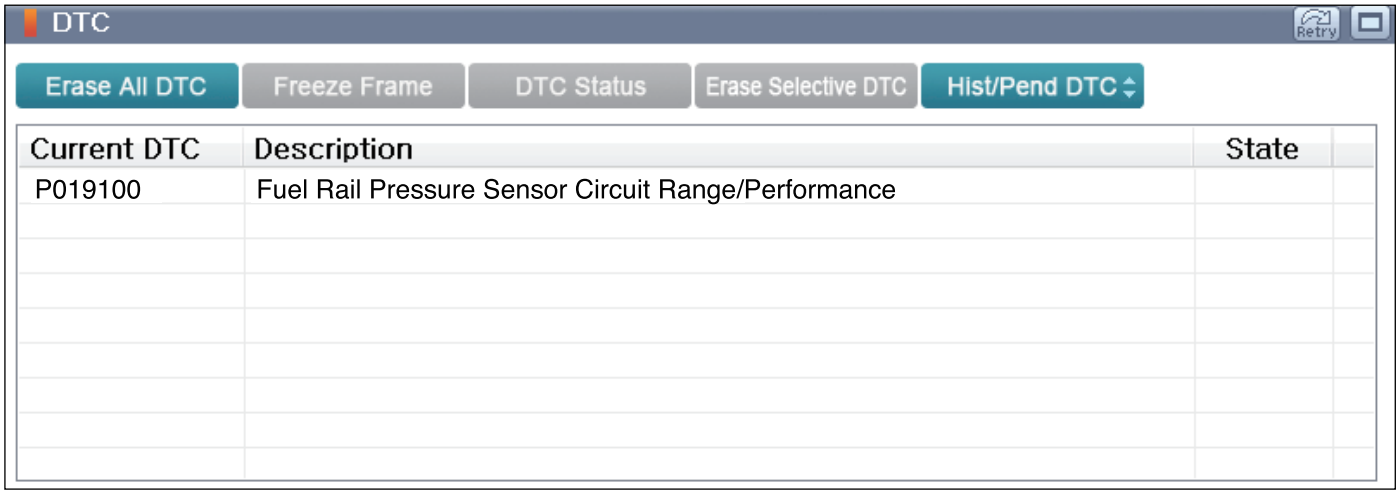
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Faulty RPS circuit 2. Short to power in signal circuit of RPS 3. Open in ground circuit of RPS 4. Defected RPS
Enable Condition	• Engine running		
Threshold Value	• Rail pressure sensor offset exceeds specification		
Detecting Time	• -		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	RPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	RPS Signal		Approx. 5.0V	-
	3	RPS Ground		0V	

Monitor DTC Status

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



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

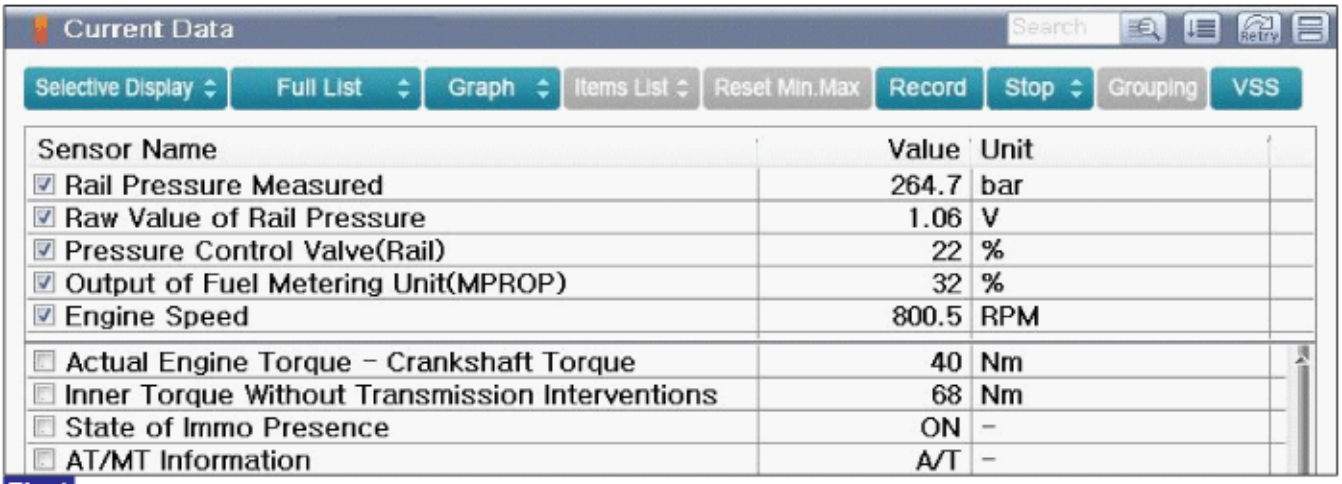


Fig.1

CRC12EN5010P00870022S

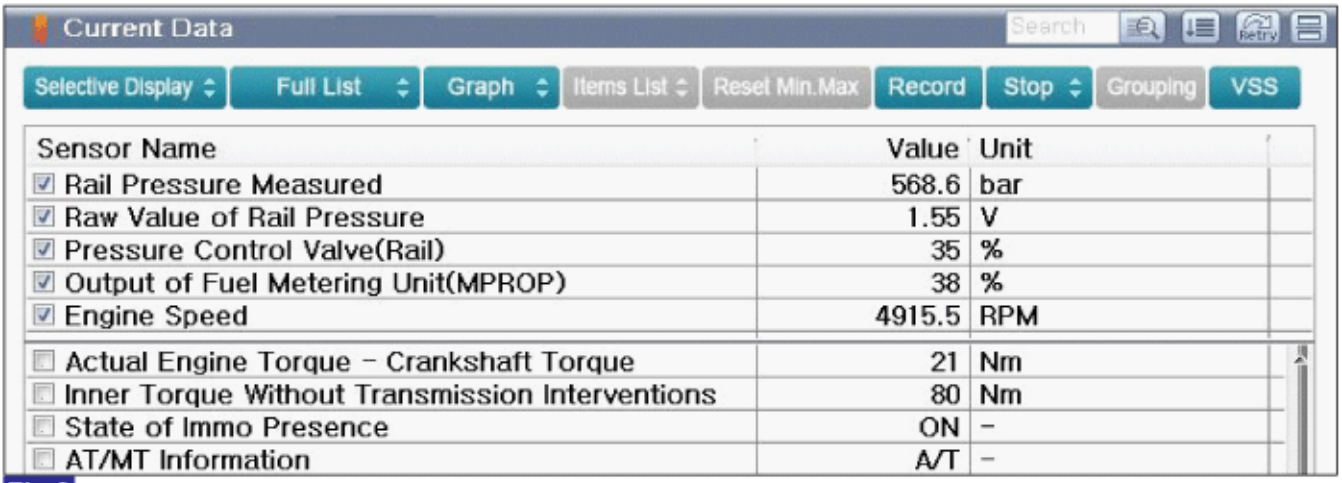


Fig.2

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?

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 RPS connector.

3. 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.

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 RPS connector.
4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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)
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.

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 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?

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).
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)

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 RPS and go to "Verification of Vehicle Repair" procedure.

⚠ 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)".

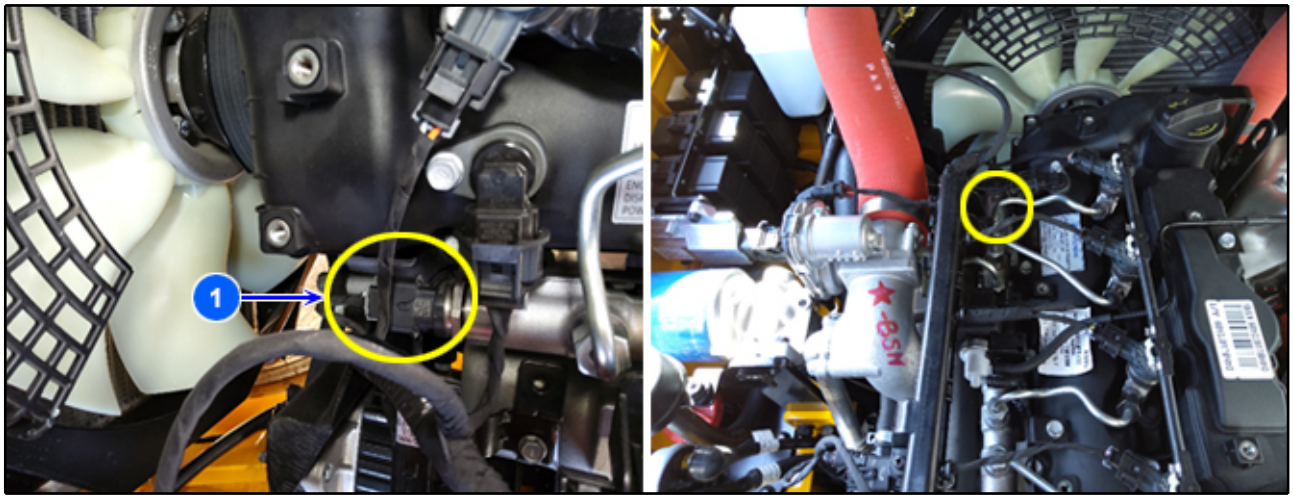
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
5. Are any DTCs stored in the system?

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

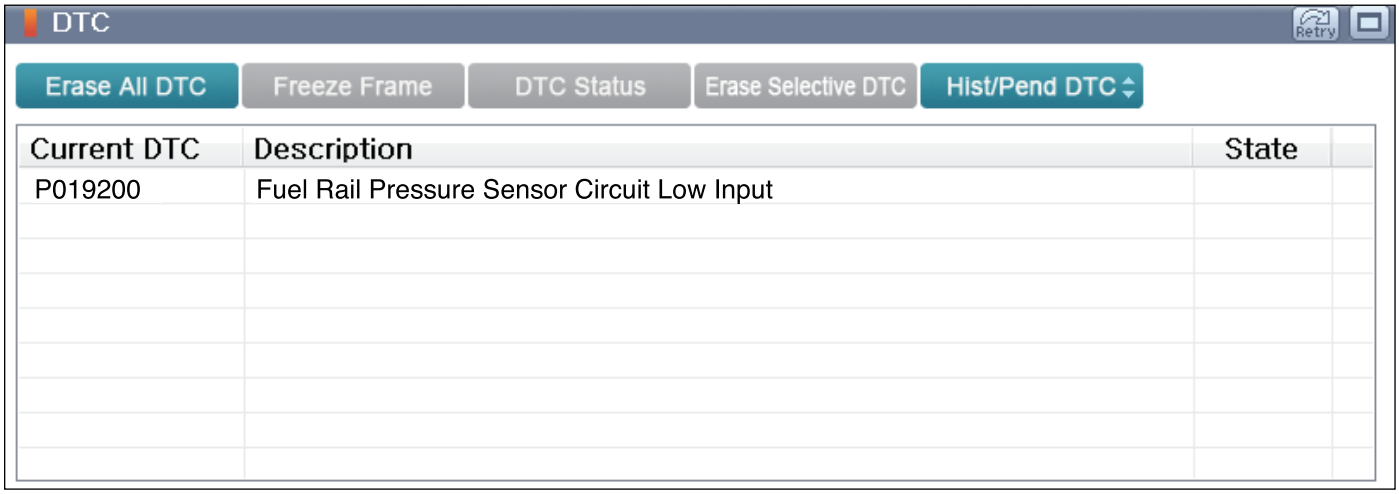
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open in power circuit of RPS 2. Short to ground in signal circuit of RPS 3. Defected RPS
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value (Below 254mV)		
Detecting Time	• 140 msec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Valu-e	Remarks
Pin No.	1	RPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Discon-nected)	Approx. 5.0V	-
	2	RPS Signal		Approx. 5.0V	-
	3	RPS Ground		0V	

Monitor GDS Data

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



CRC12EN5010P01920021S

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

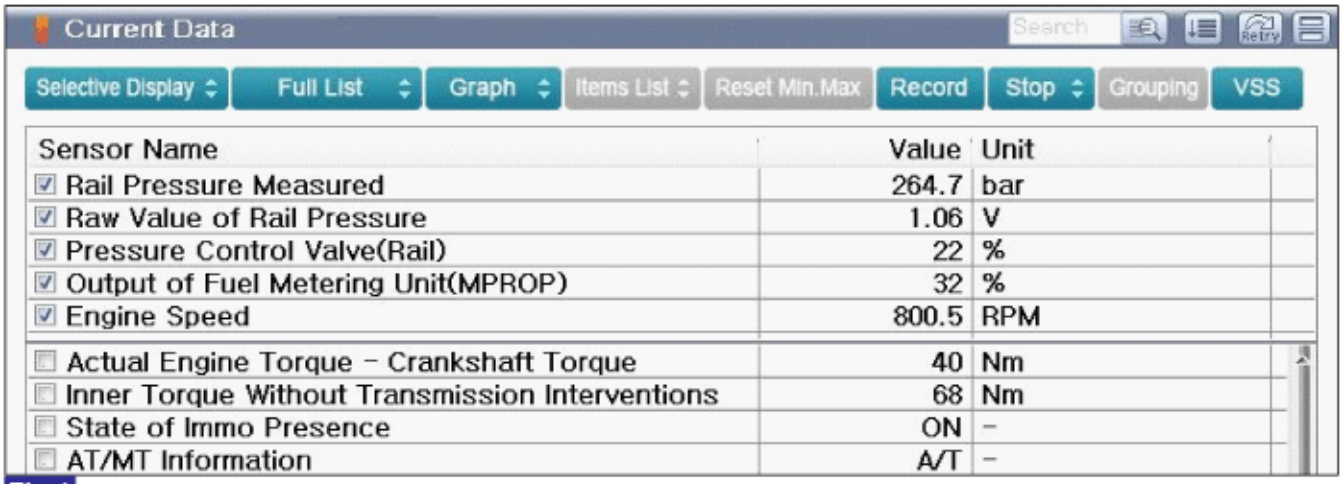


Fig.1

CRC12EN5010P00870022S

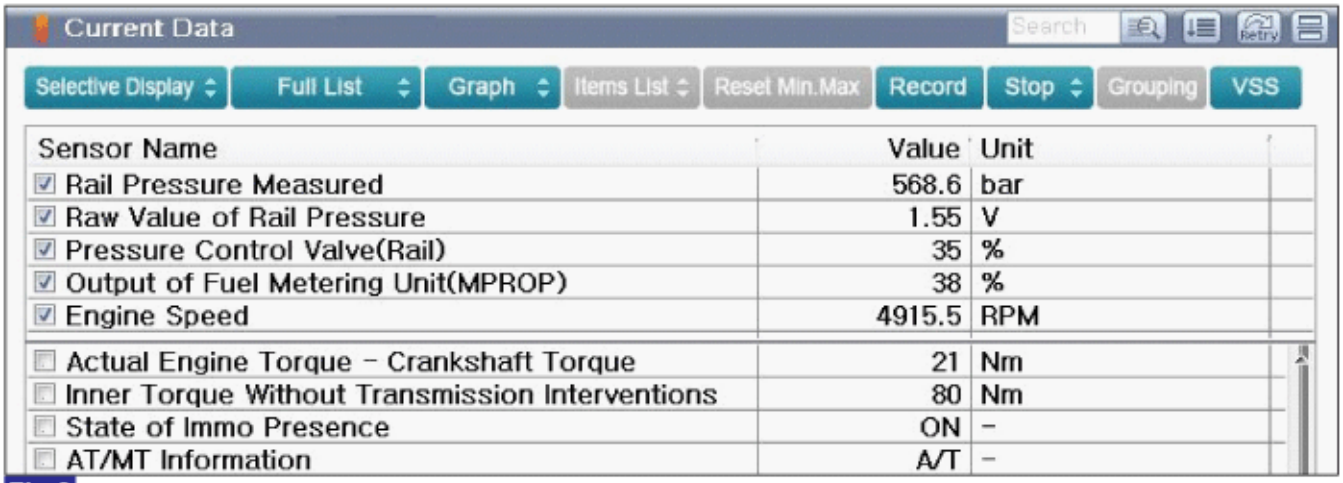


Fig.2

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?

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 RPS connector.

3. 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.

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 RPS connector.
4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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)
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.

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 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?

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).
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)

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 RPS and go to "Verification of Vehicle Repair" procedure.

⚠ 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)".

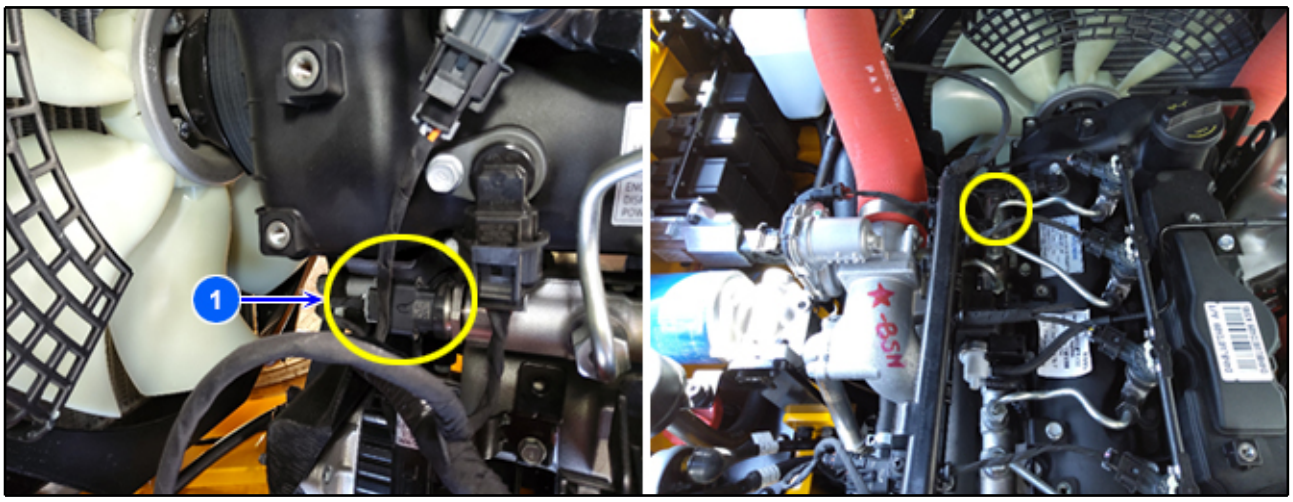
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is stored.
5. Are any DTCs stored in the system?

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



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 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.

DTC Detecting Condition

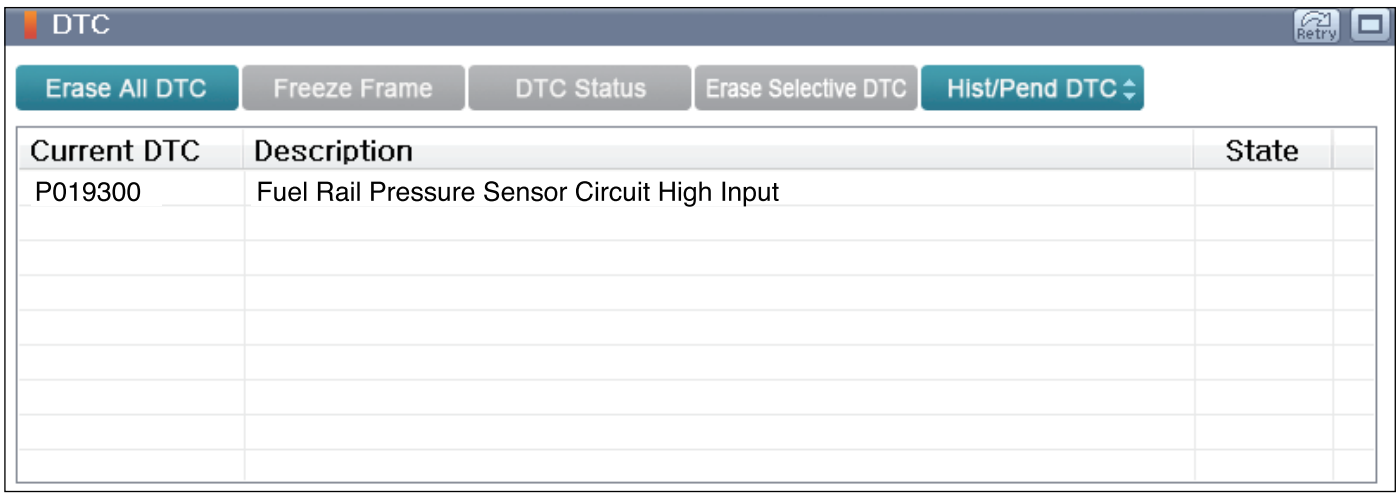
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Open or short to power in signal circuit of RPS 2. Open in ground circuit of RPS 3. Defected RPS
Enable Condition	• Engine running		
Threshold Value	• Output signal is higher than threshold value (Higher than 4750mV)		
Detecting Time	• 140 msec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	RPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	RPS Signal		Approx. 5.0V	-
	3	RPS Ground		0V	

Monitor GDS Data

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



CRC12EN5010P01930021S

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

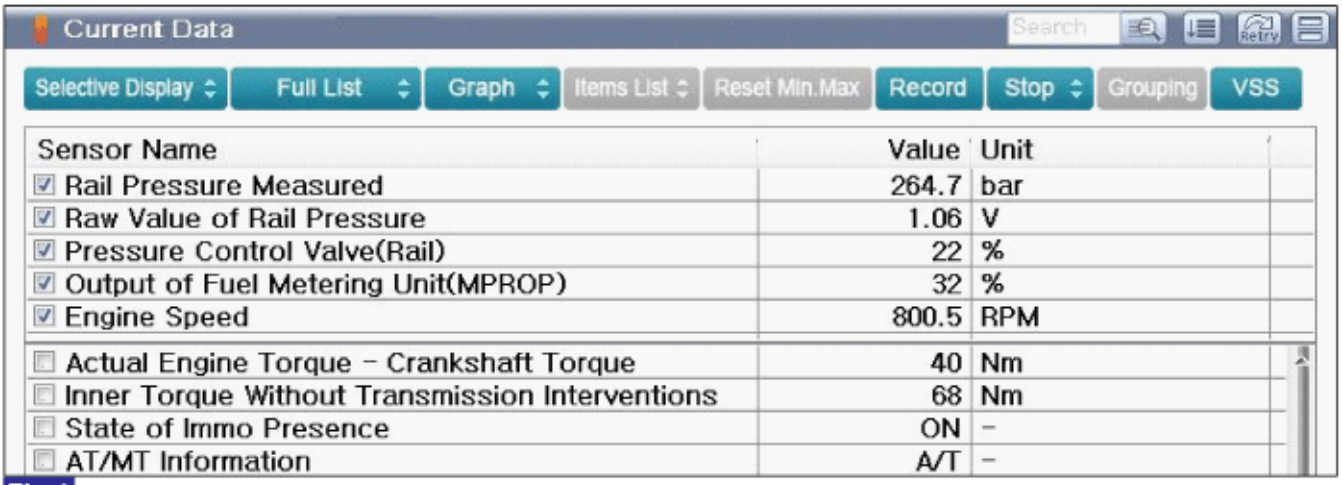


Fig.1

CRC12EN5010P00870022S

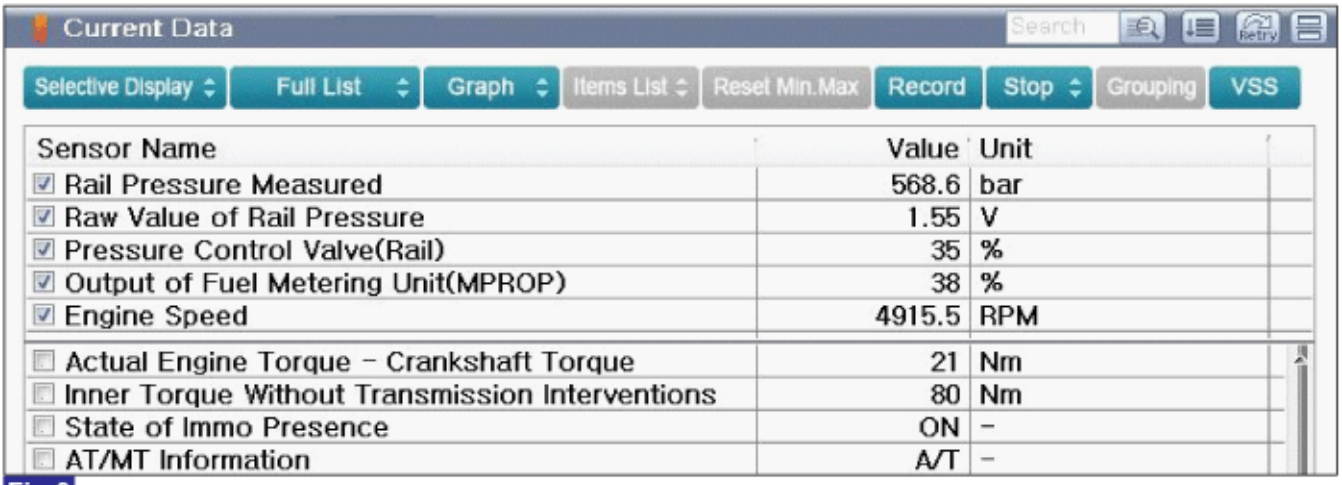


Fig.2

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?

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 RPS connector.
3. 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.

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 RPS connector.
4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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)
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.

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 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?

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).
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)

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 RPS and go to "Verification of Vehicle Repair" procedure.

⚠ 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.

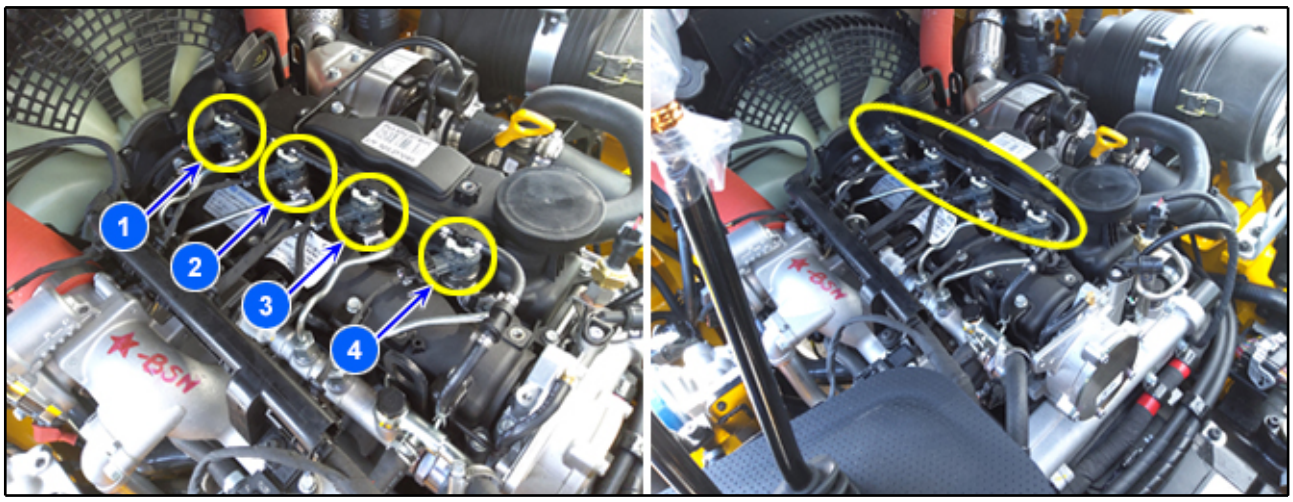
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P020100 Injector Circuit/Open-Cylinder 1

Component Location



CRC12EN5010P02010011

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 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		1. Poor connector connection 2. Open in circuit of injector #1 3. Short circuit in wiring of injector #1 4. Defected injector #1
Enable Condition	• Engine running		
Threshold Value	Case 1	• Open in injector circuit	
	Case 2	• Short circuit in wiring	
Detecting Time	• -		
Fail Safe	Engine OFF	• Yes (Case 1) • No (Case 2)	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5.0V	-
	2	Injector Control(Low)		Approx. 5.0V	-

Signal Waveform & Data

Fig.1

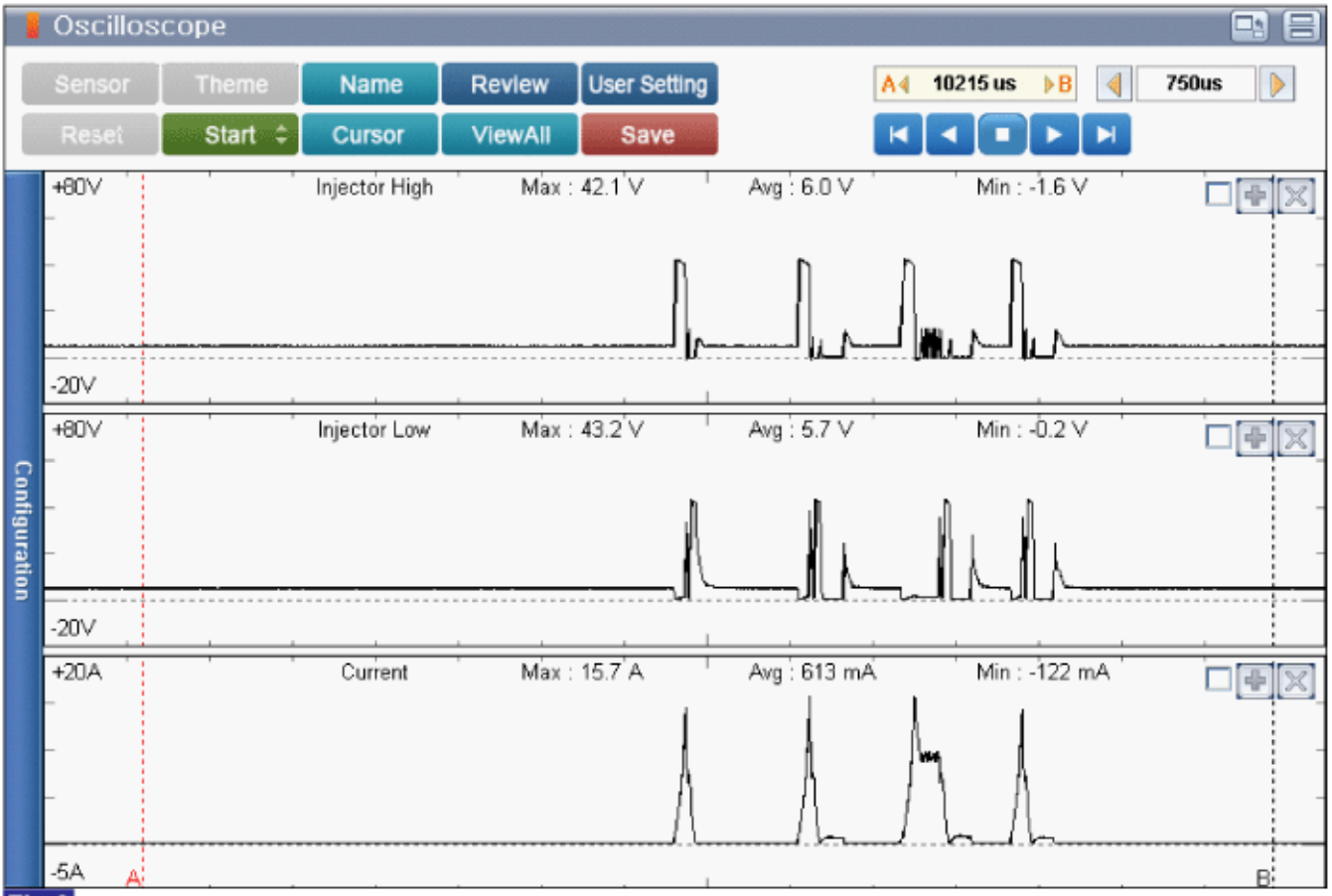


Fig.2

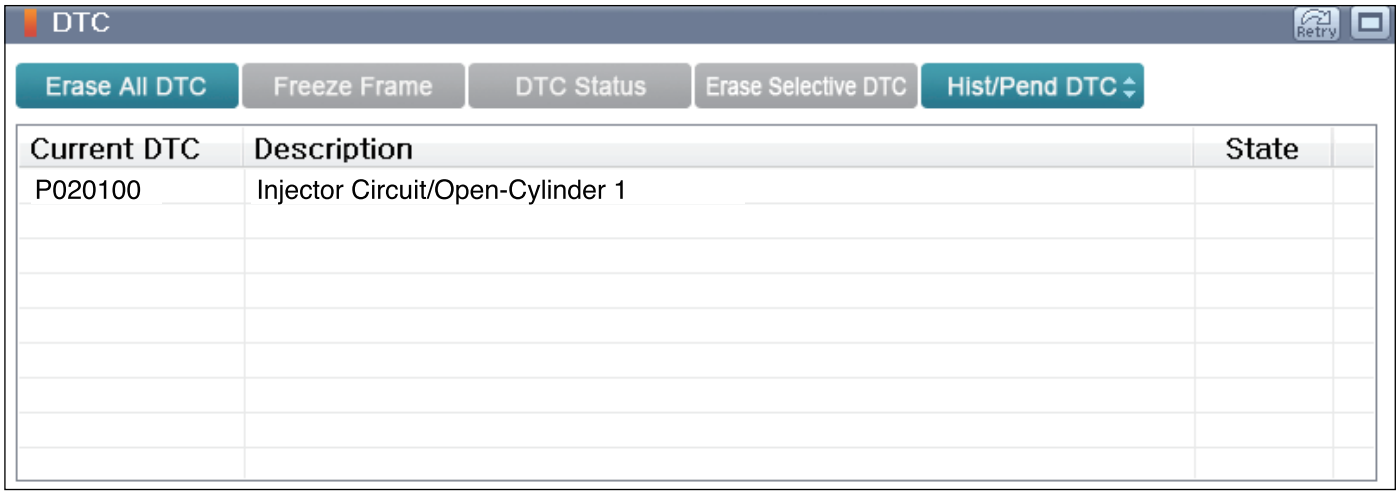
CRC12EN5010P02010012S

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.



CRC12EN5010P02010021S

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

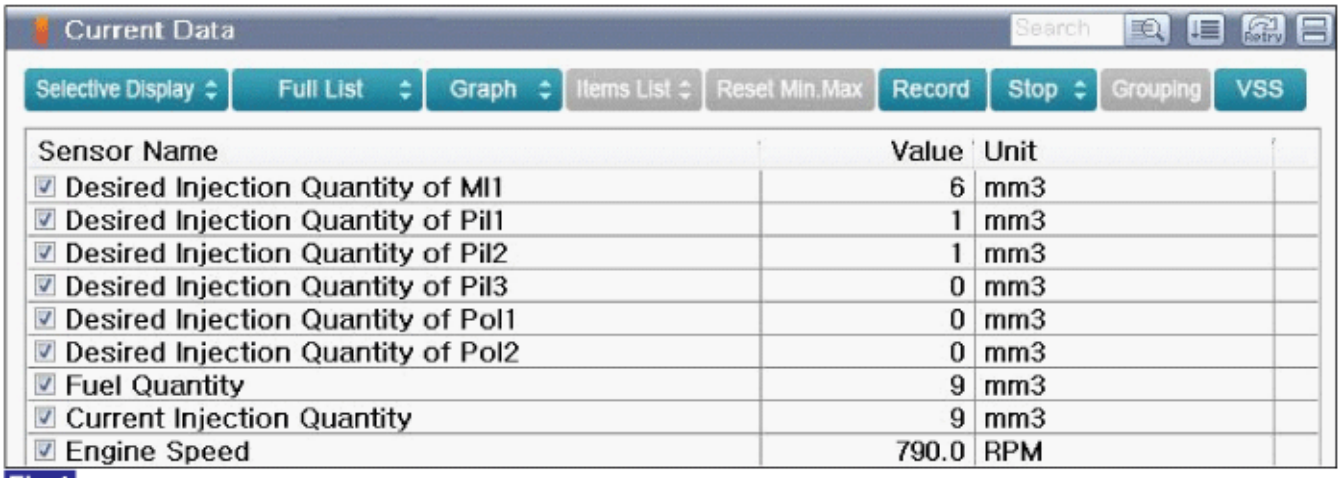


Fig.1

CRC12EN5010P02010022S

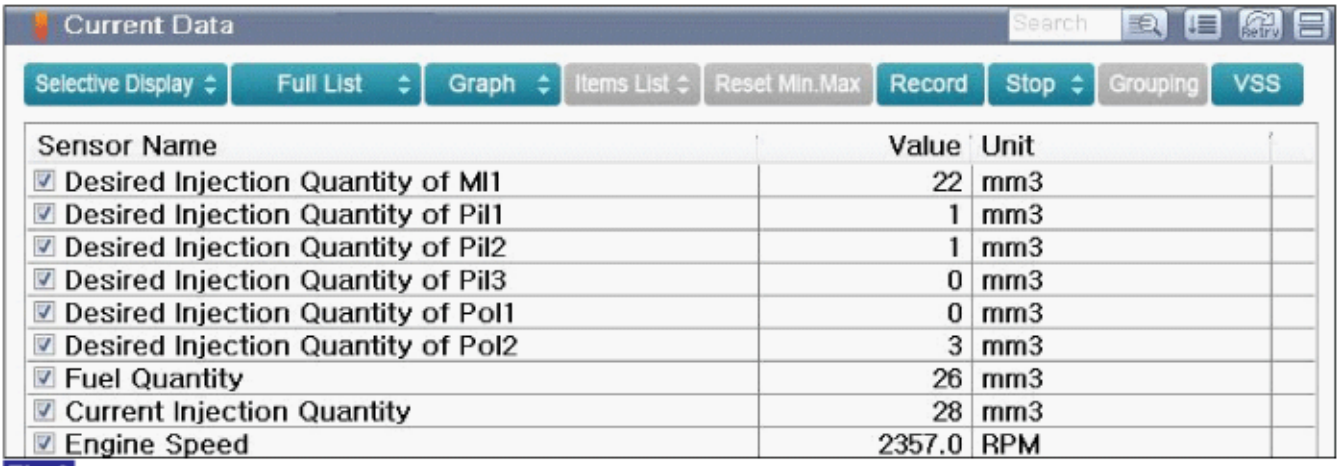


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #1 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

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"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"
4. 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"
9. 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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

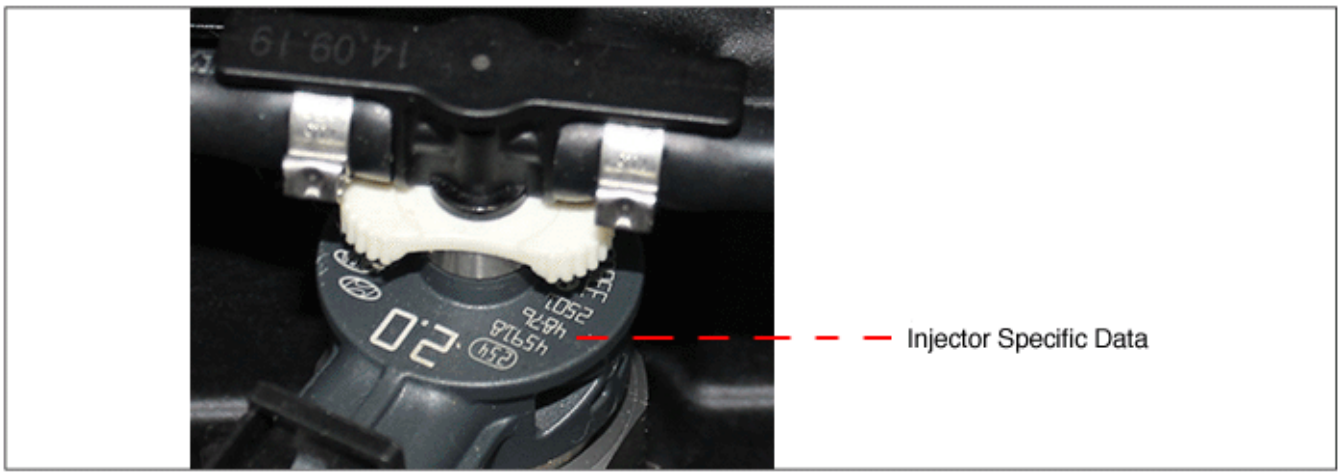
  Do not re-use high pressure fuel pipe.

  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

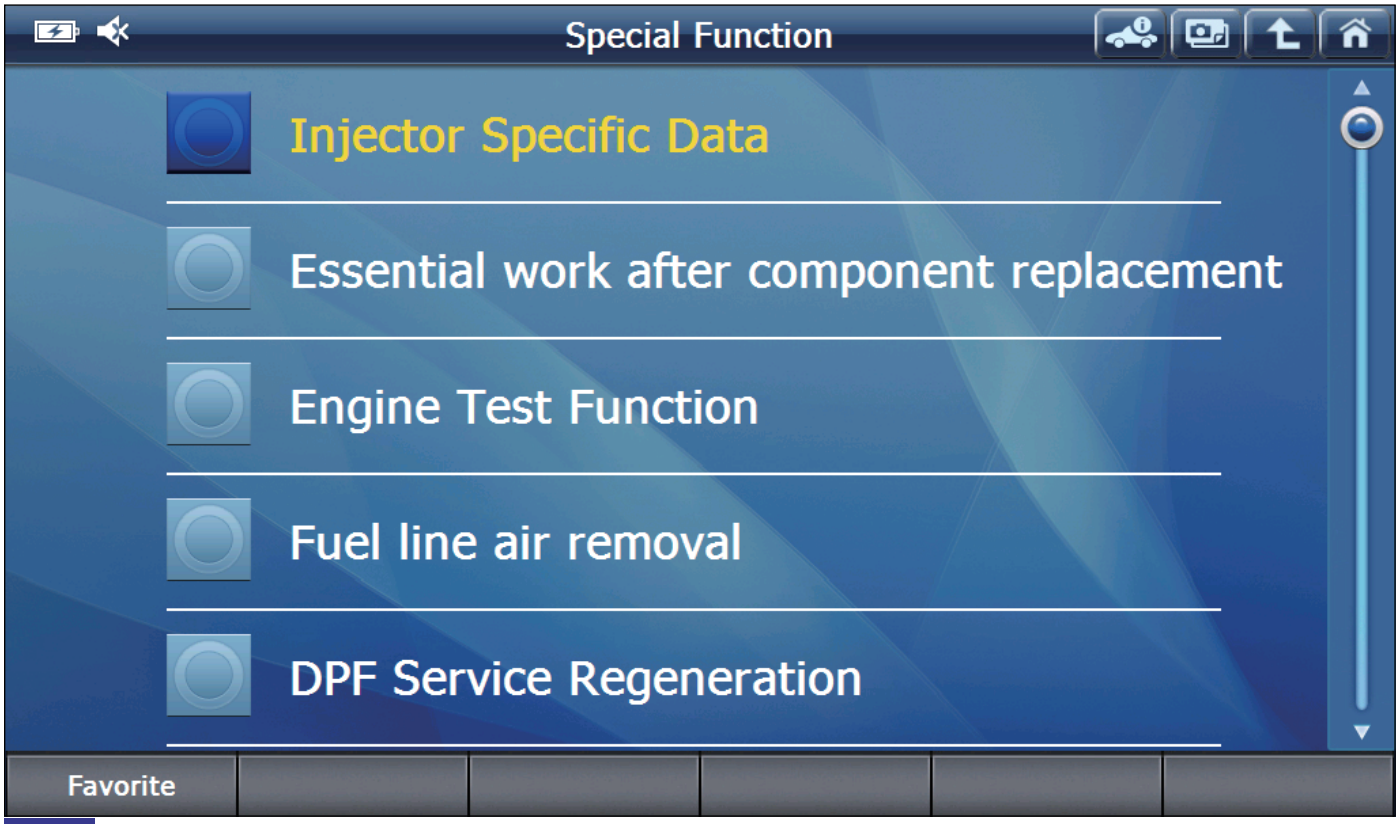


Fig.1

CRC12EN5010P02010041S

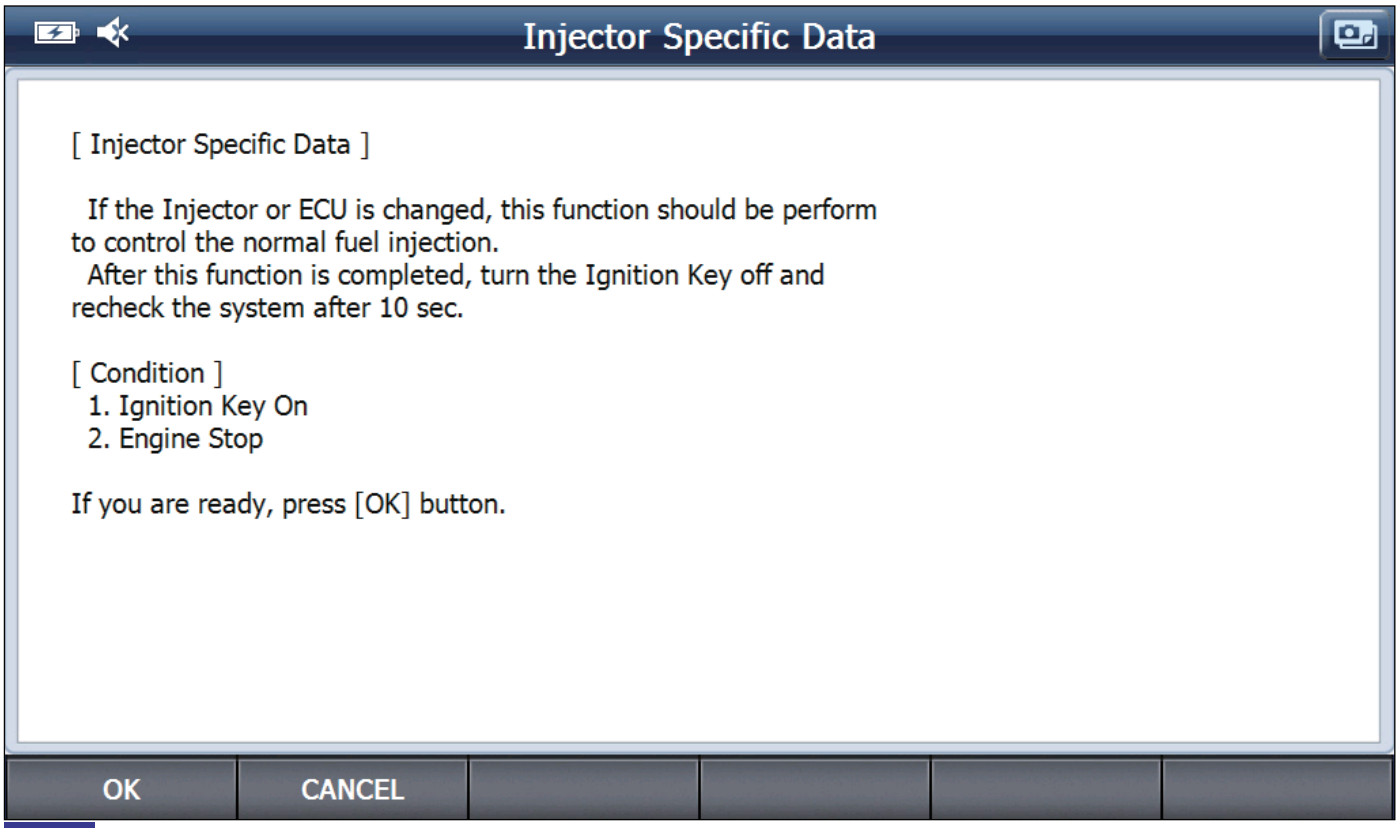


Fig.2

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.

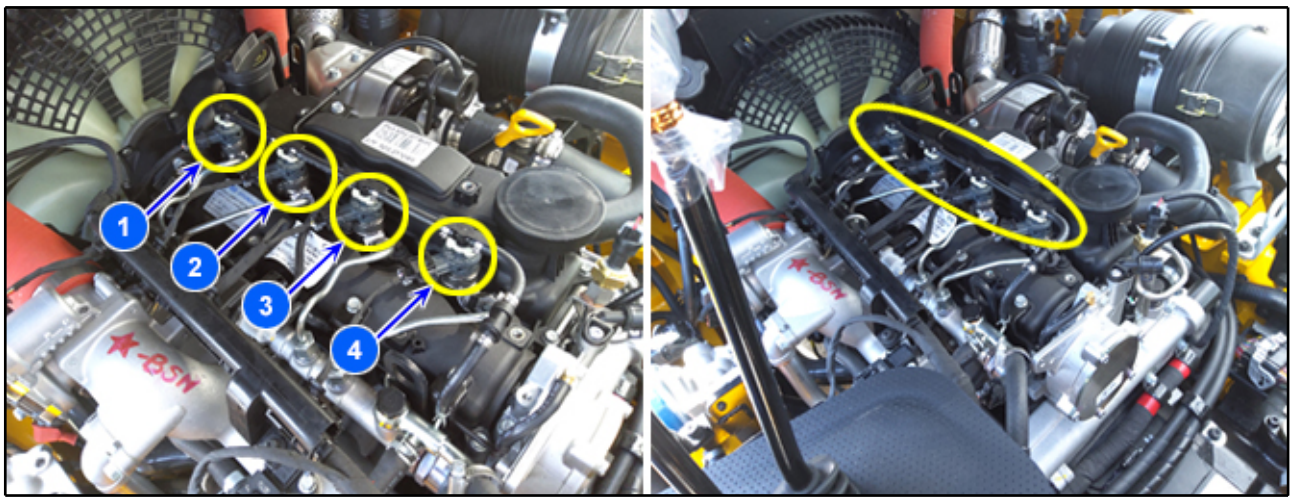
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P020200 Injector Circuit/Open-Cylinder 2

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Poor connector connection 2. Open in circuit of injector #2 3. Short circuit in wiring of injector #2 4. Defected injector #2
Enable Condition	• Engine running		
Threshold Value	Case 1	• Open in injector circuit	
	Case 2	• Short circuit in wiring	
Detecting Time	• -		
Fail Safe	Engine OFF	• Yes (Case 1) • No (Case 2)	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5.0V	-
	2	Injector Control(Low)		Approx. 5.0V	-

Signal Waveform & Data

Fig.1

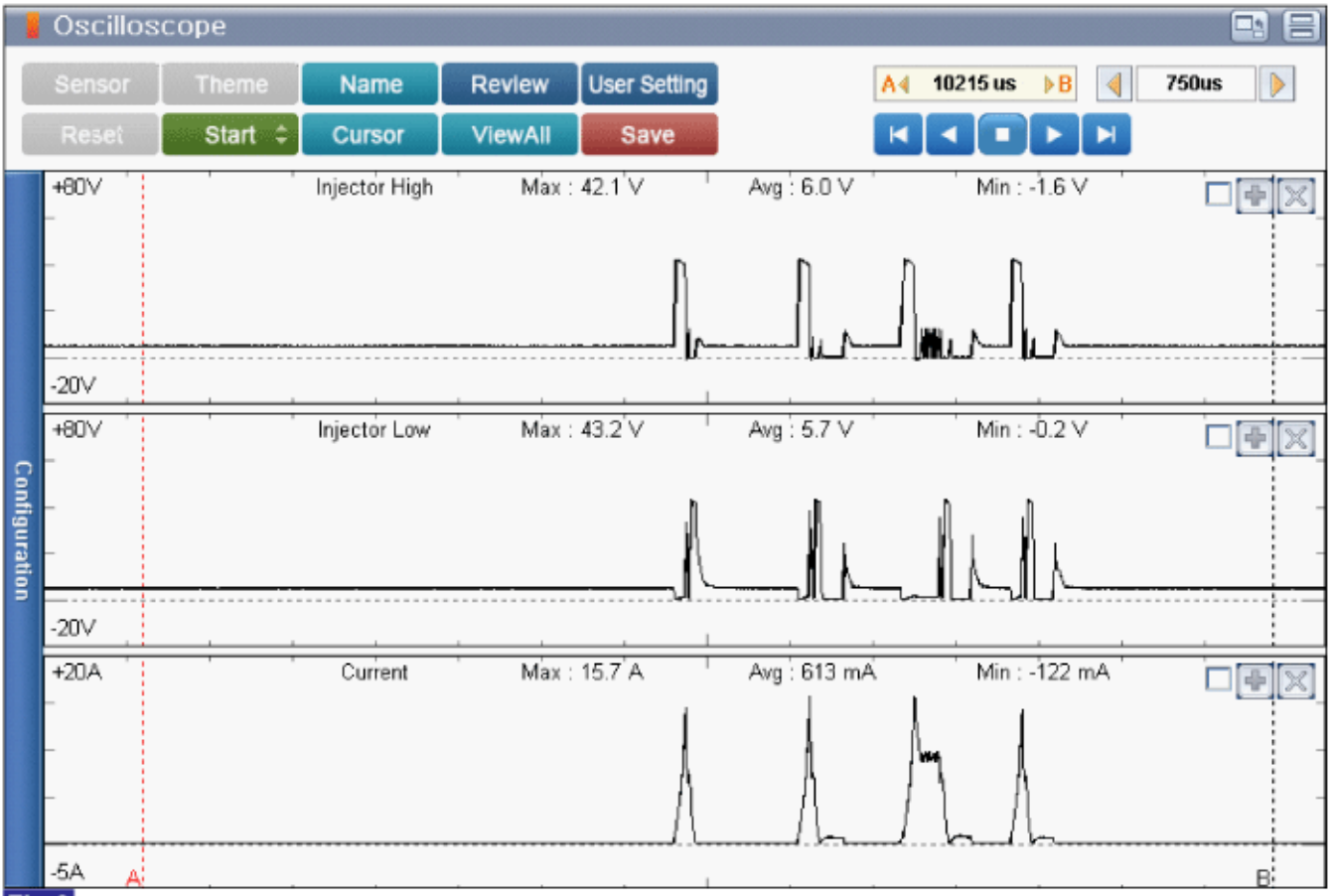


Fig.2

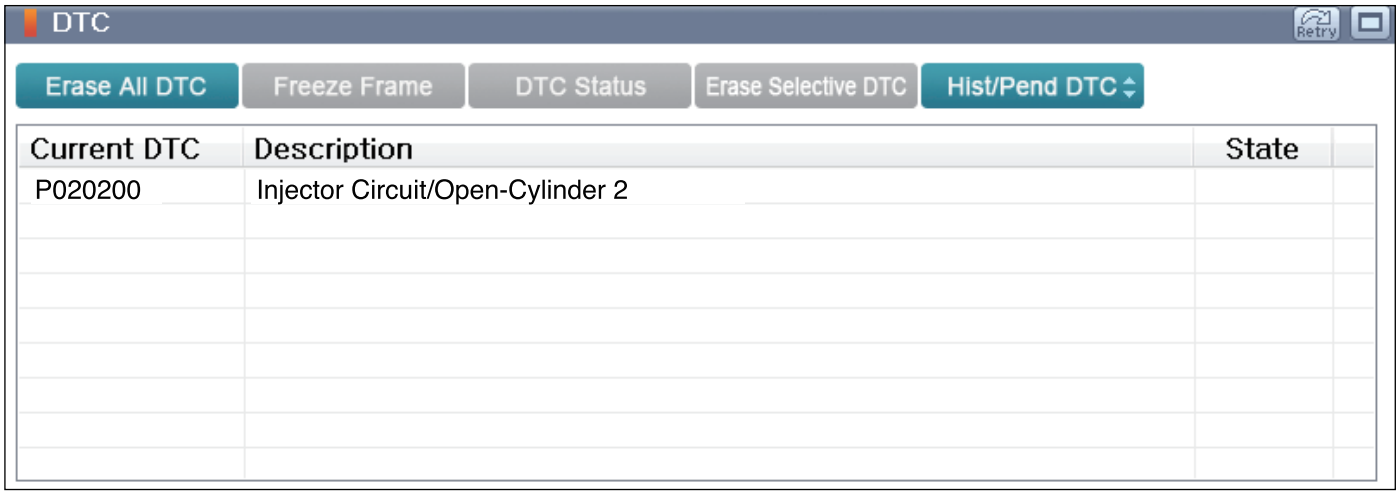
CRC12EN5010P02010012S

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.



CRC12EN5010P02020021S

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

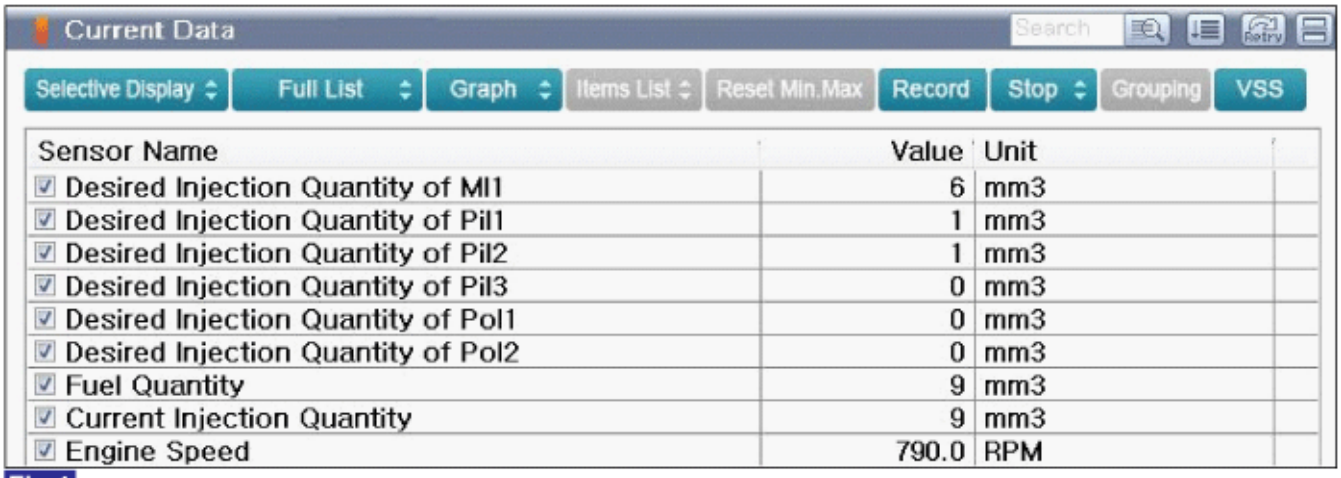


Fig.1

CRC12EN5010P02010022S

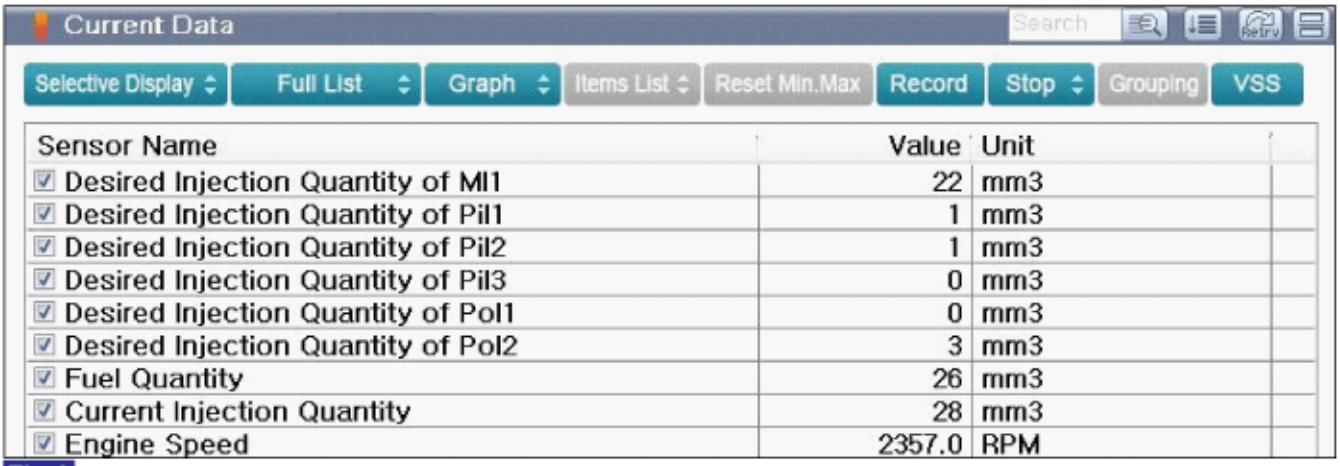


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #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

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"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"
4. 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"
9. 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"
4. Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

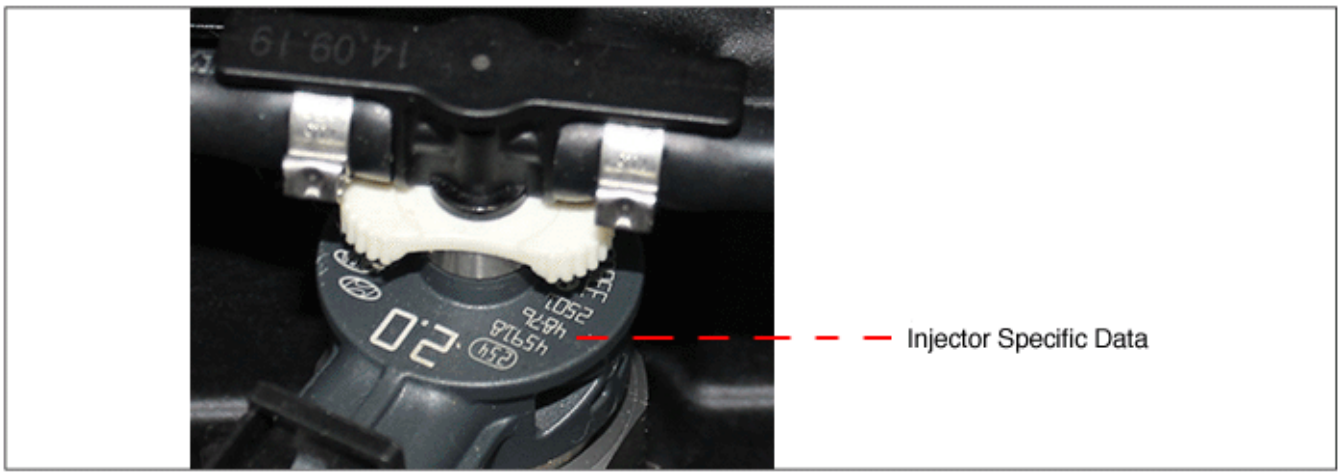
  Do not re-use high pressure fuel pipe.

  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

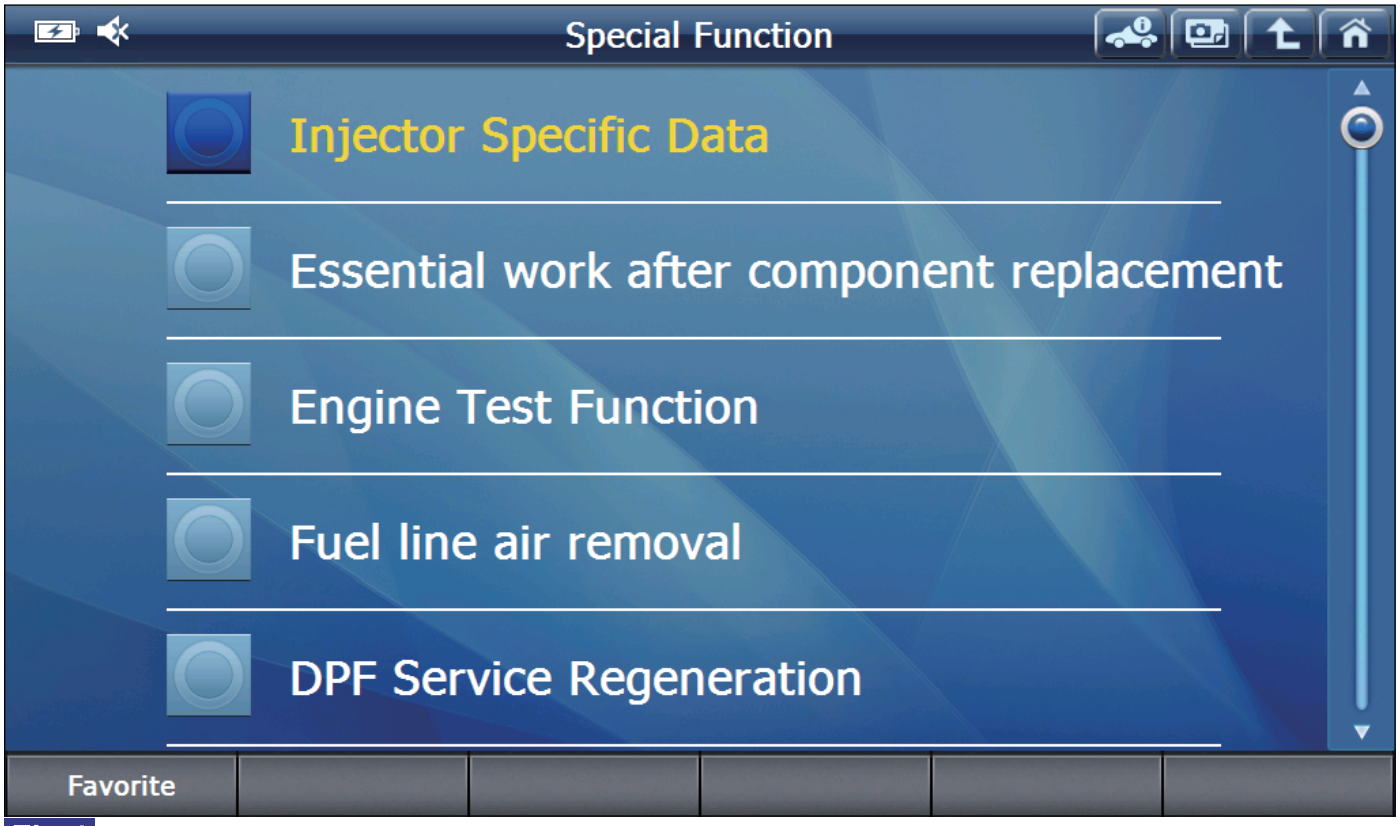


Fig.1

CRC12EN5010P02010041S

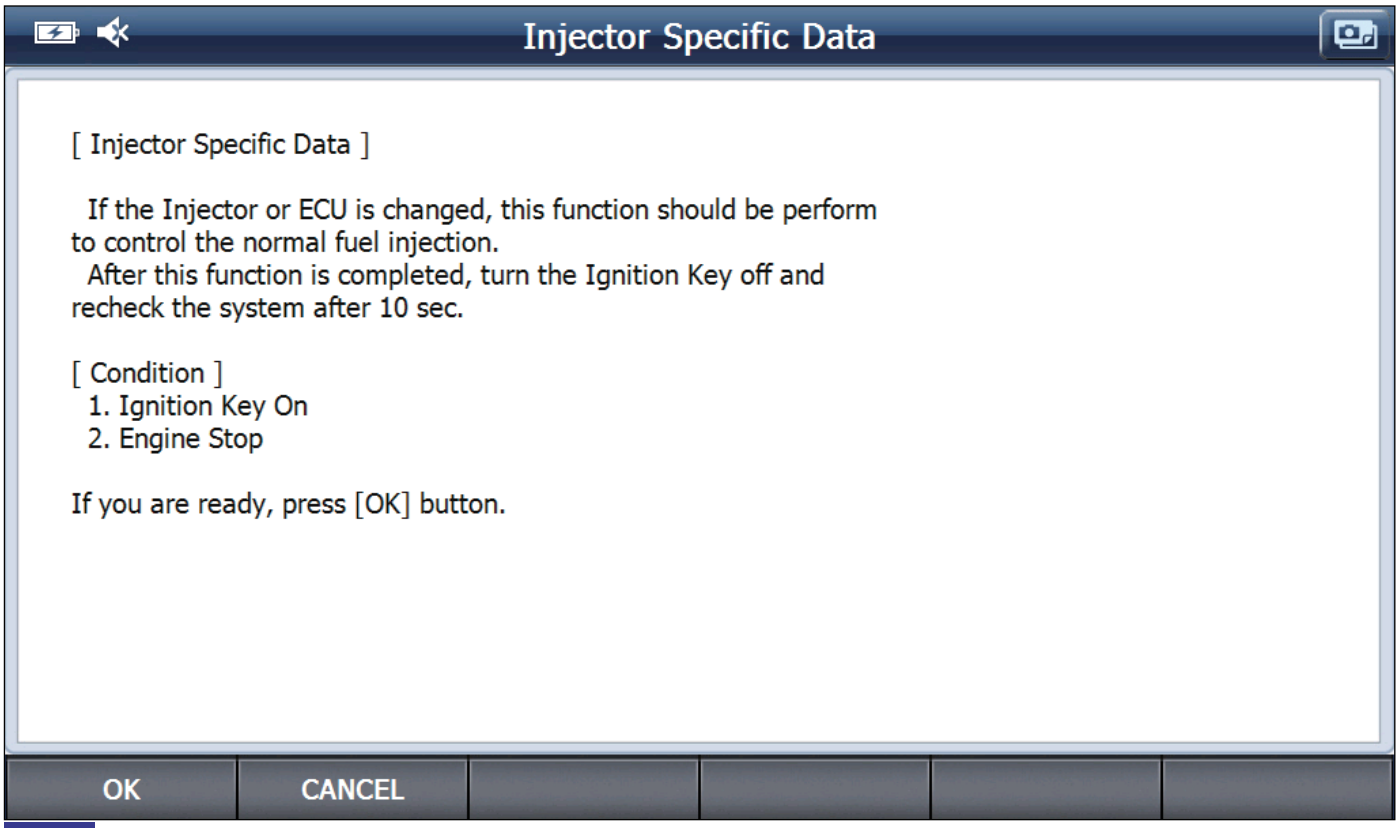


Fig.2

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.

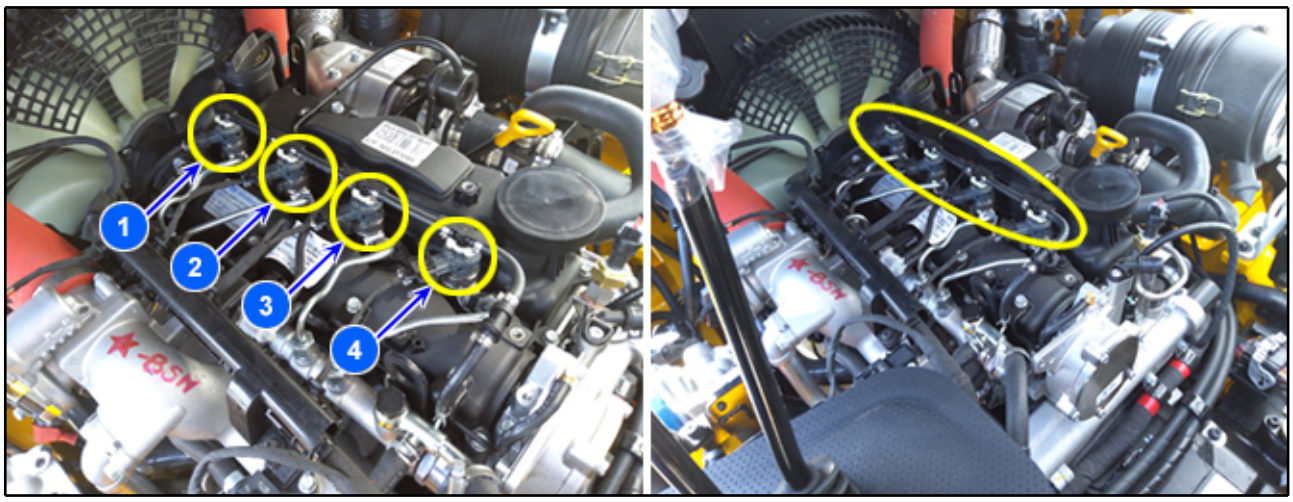
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P020300 Injector Circuit/Open-Cylinder 3

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Poor connector connection 2. Open in circuit of injector #3 3. Short circuit in wiring of injector #3 4. Defected injector #3
Enable Condition	• Engine running		
Threshold Value	Case 1	• Open in injector circuit	
	Case 2	• Short circuit in wiring	
Detecting Time	• -		
Fail Safe	Engine OFF	• Yes (Case 1) • No (Case 2)	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5.0V	-
	2	Injector Control(Low)		Approx. 5.0V	-

Signal Waveform & Data

Fig.1

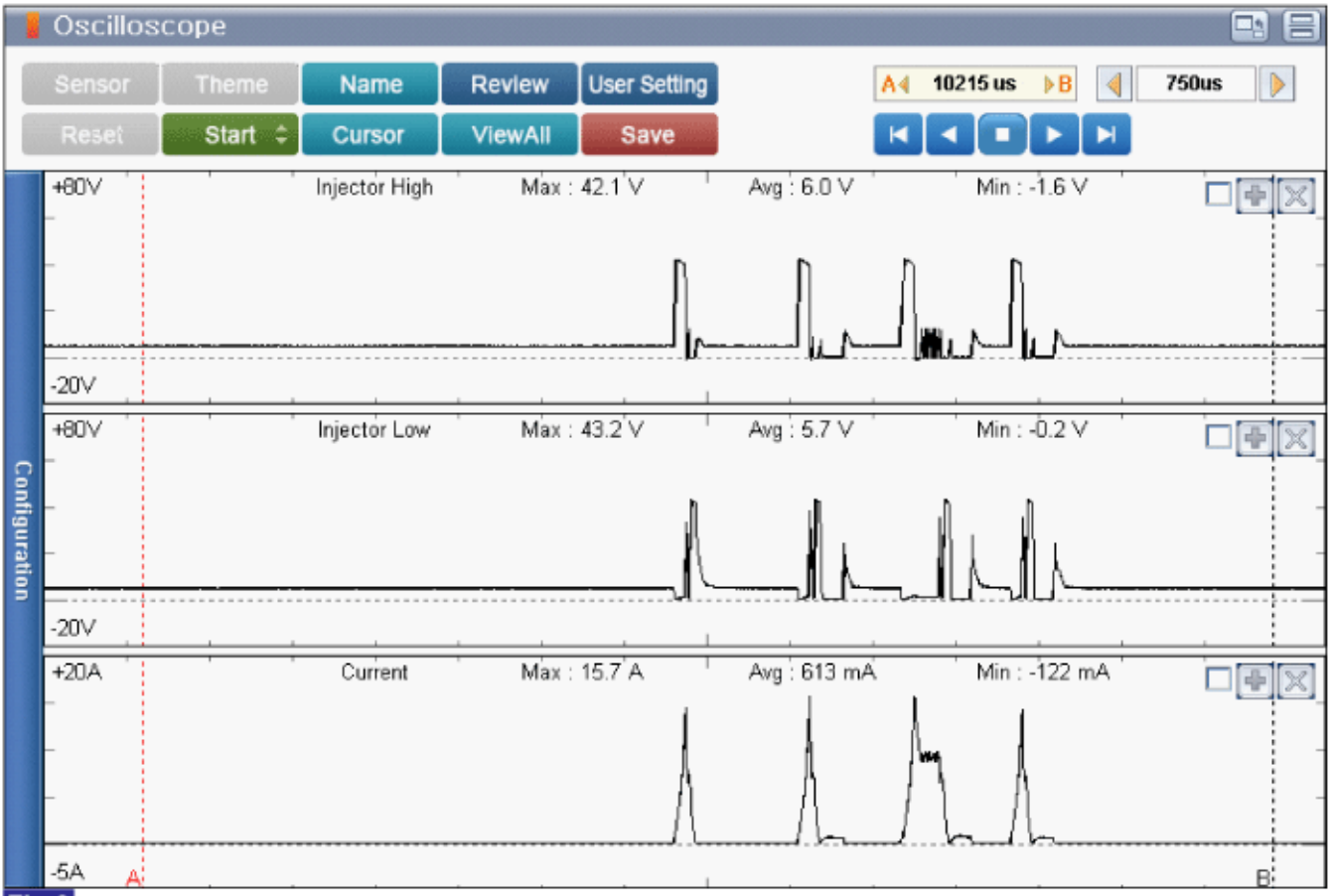


Fig.2

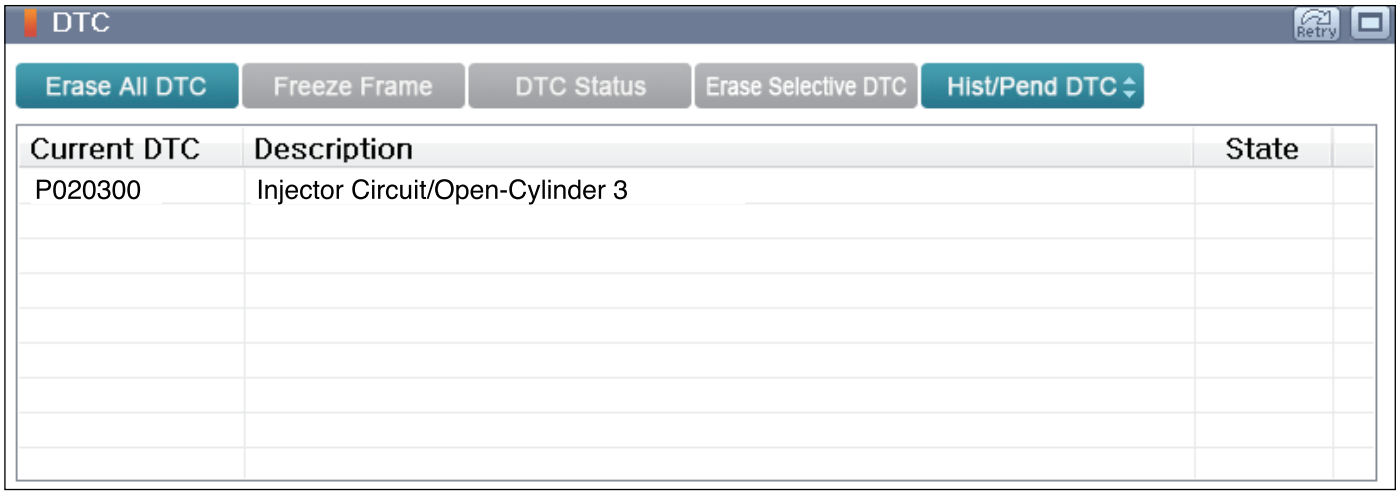
CRC12EN5010P02010012S

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.



CRC12EN5010P02030021S

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

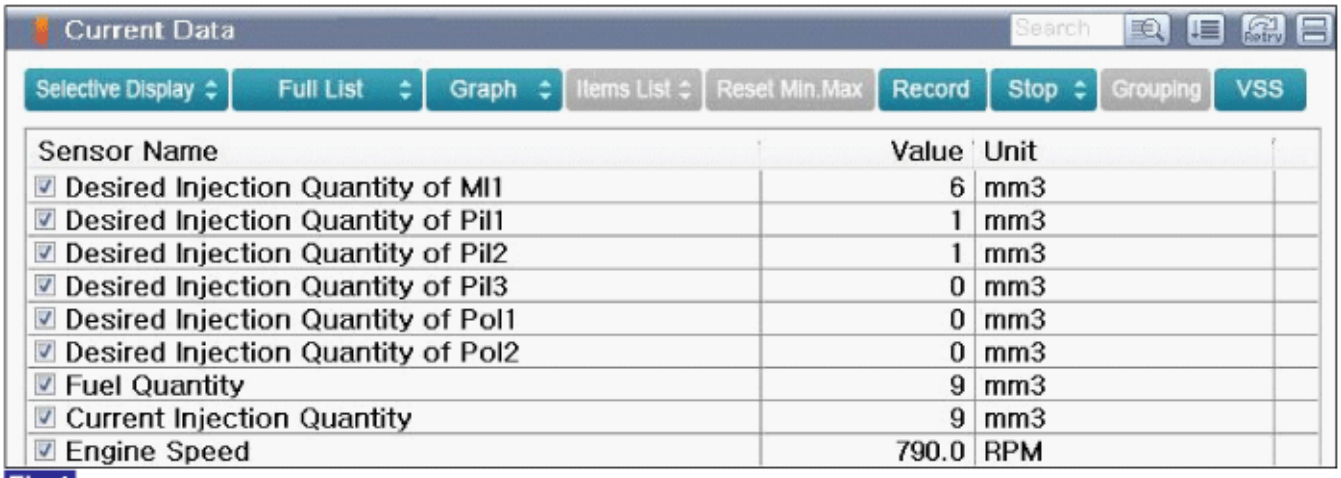
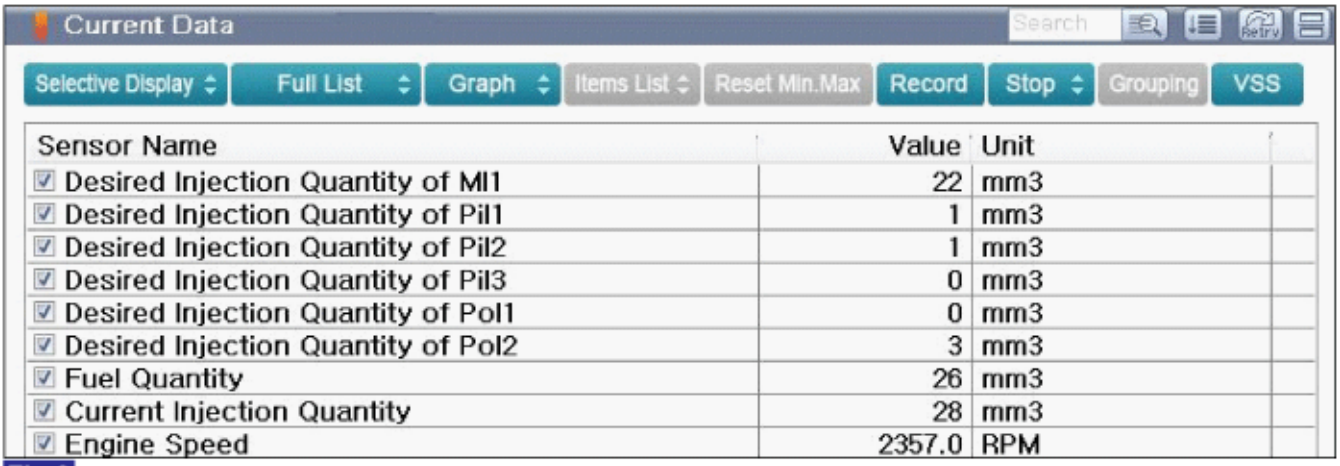


Fig.1

CRC12EN5010P02010022S



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
Engine Speed	2357.0	RPM

Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #3 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

5. Ignition Switch "OFF"
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
8. Ignition switch "ON"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"
4. 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"
9. 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"
4. Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

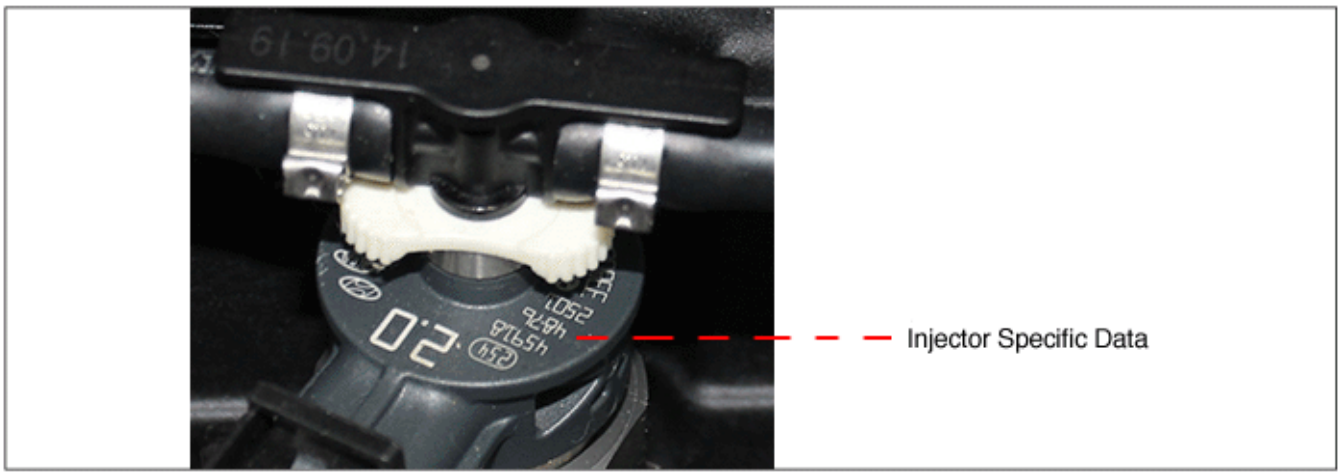
  Do not re-use high pressure fuel pipe.

  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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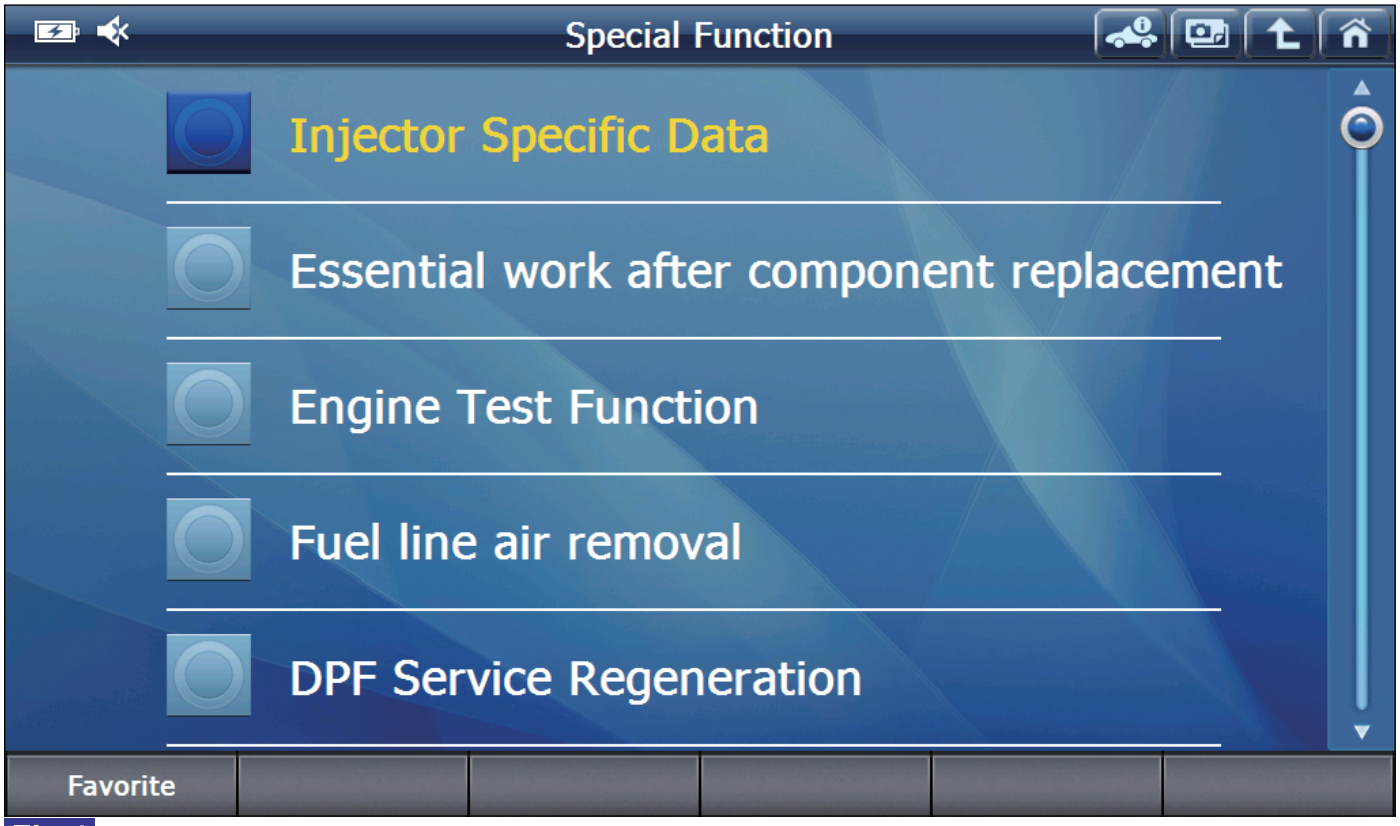


Fig.1

CRC12EN5010P02010041S

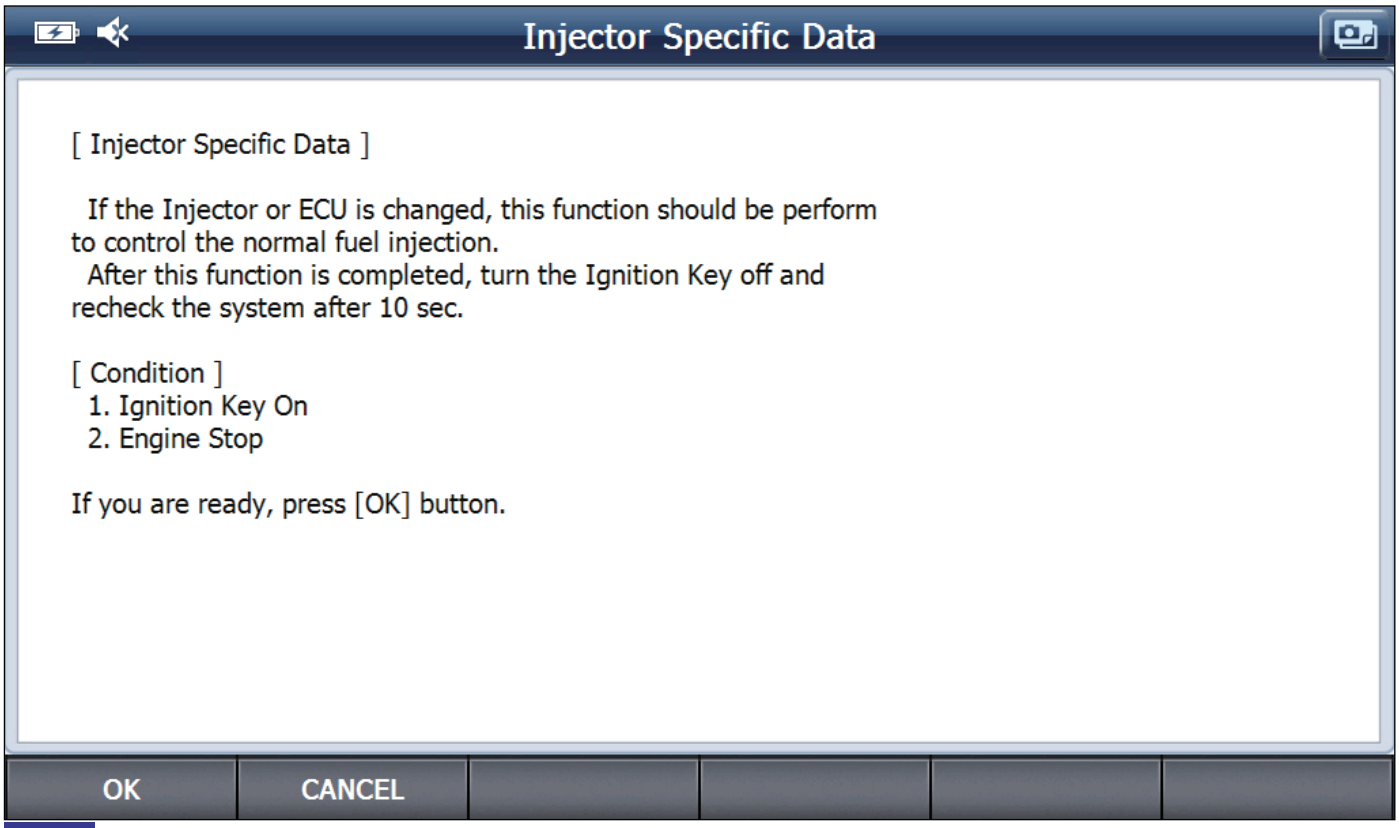


Fig.2

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.

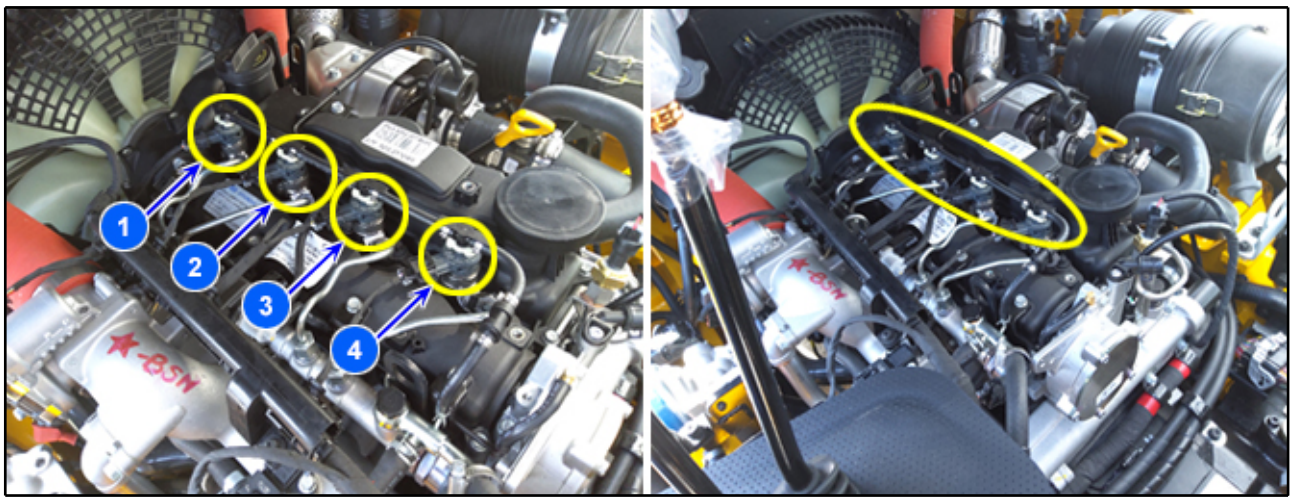
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P020400 Injector Circuit/Open-Cylinder 4

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage Monitoring		1. Poor connector connection 2. Open in circuit of injector #4 3. Short circuit in wiring of injector #4 4. Defected injector #4
Enable Condition	• Engine running		
Threshold Value	Case 1	• Open in injector circuit	
	Case 2	• Short circuit in wiring	
Detecting Time	• -		
Fail Safe	Engine OFF	• Yes (Case 1) • No (Case 2)	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5.0V	-
	2	Injector Control(Low)		Approx. 5.0V	-

Signal Waveform & Data

Fig.1

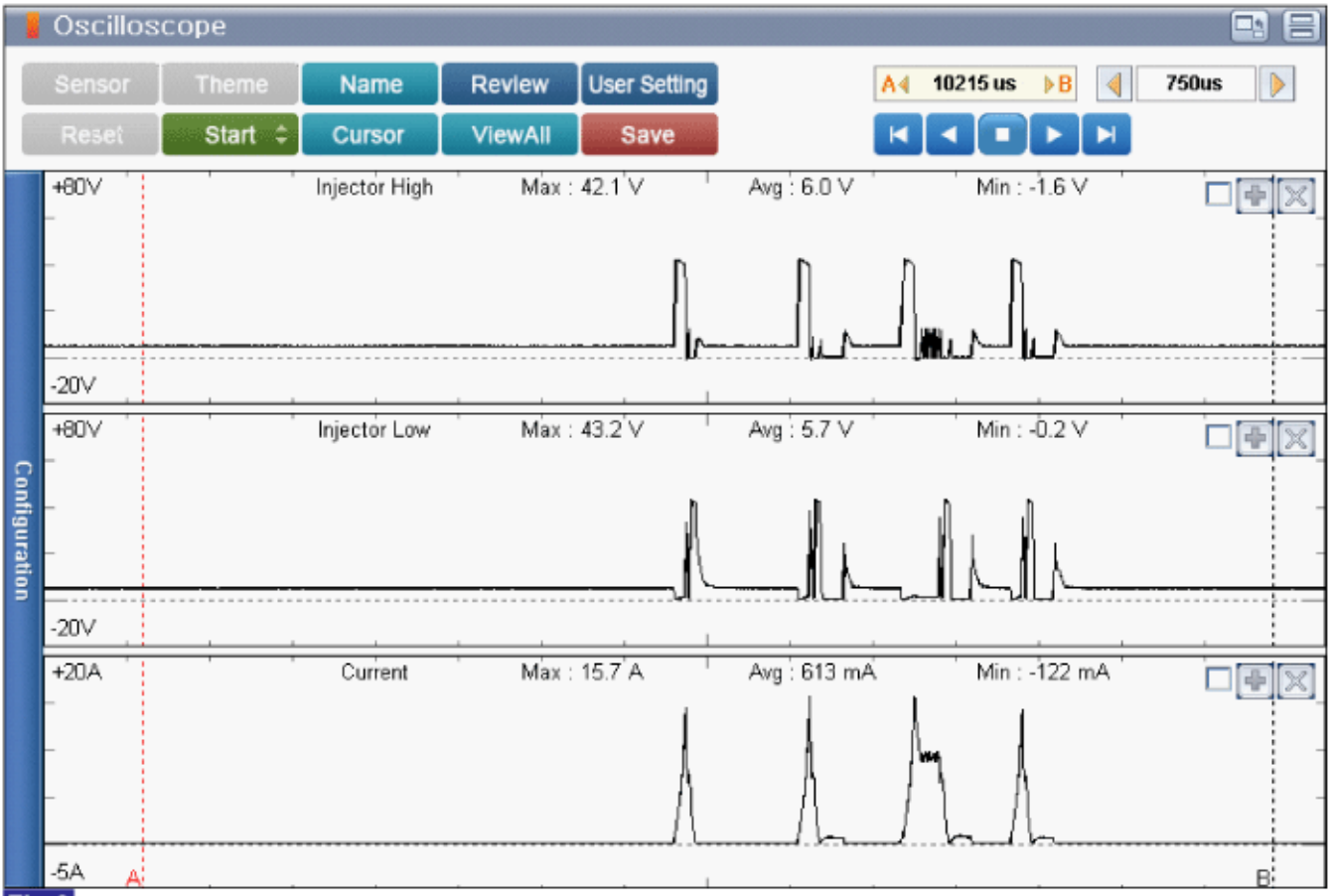


Fig.2

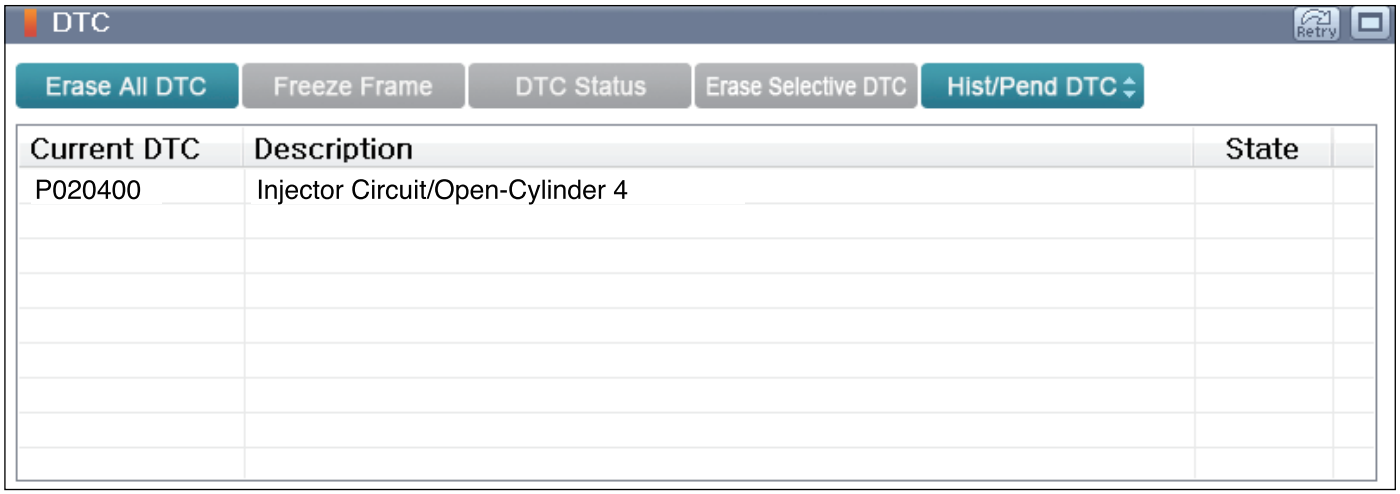
CRC12EN5010P02010012S

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.



CRC12EN5010P02040021S

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

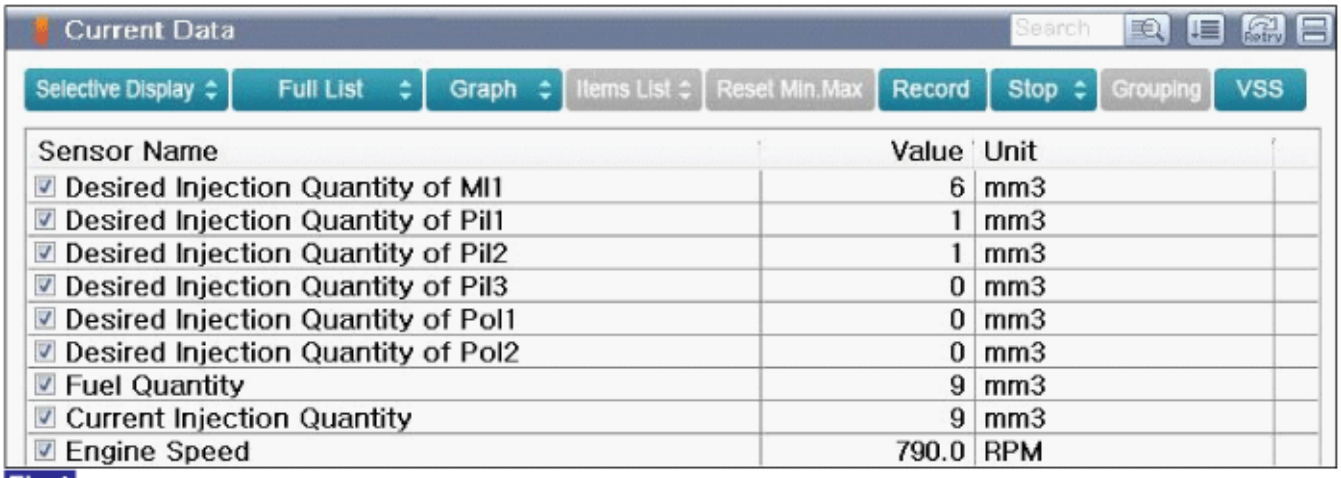


Fig.1

CRC12EN5010P02010022S

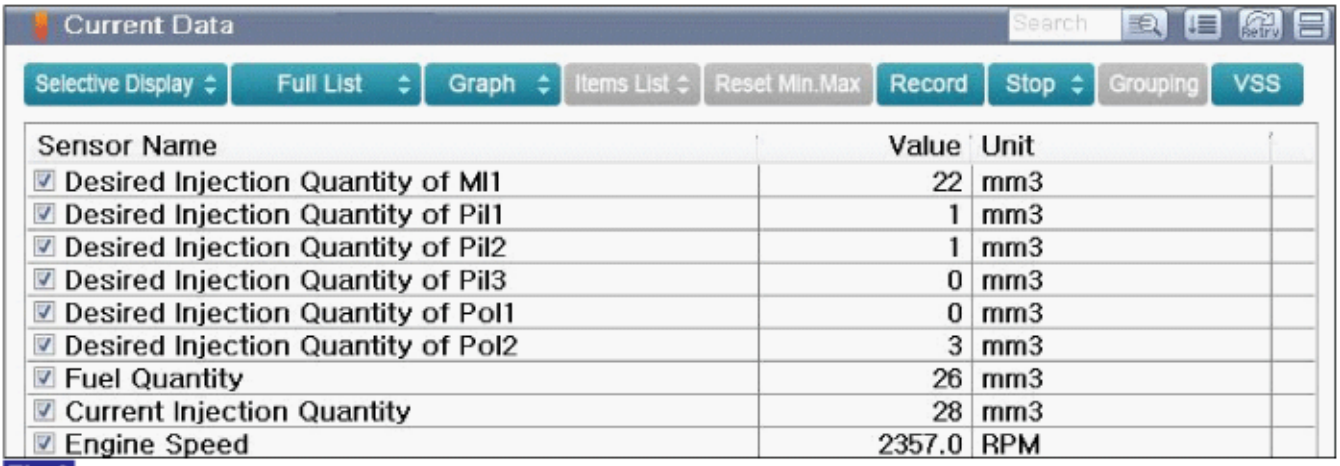


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #4 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

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
8. Ignition switch "ON"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"
4. 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"
9. 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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

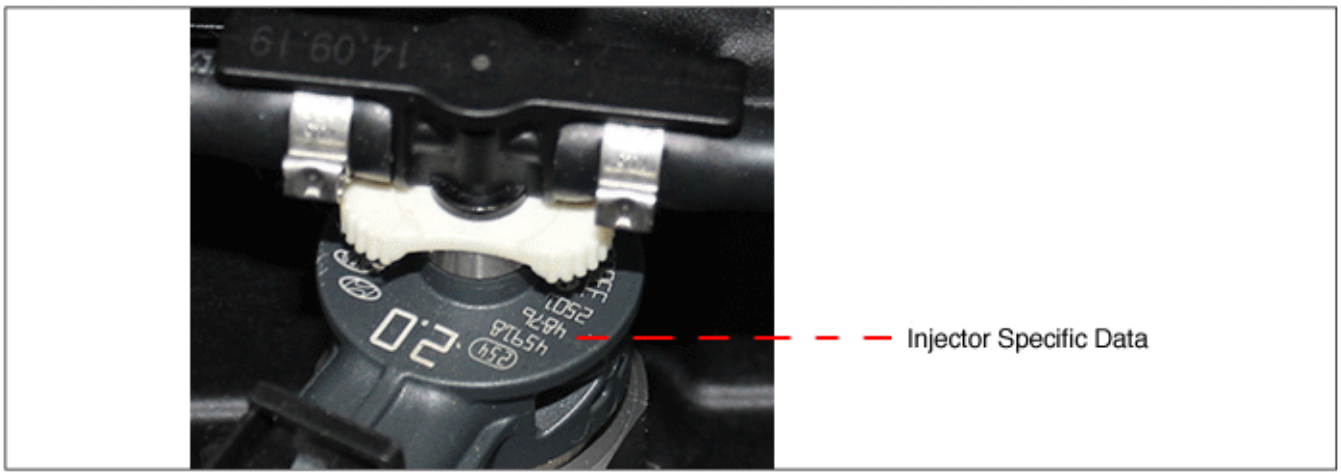
  Do not re-use high pressure fuel pipe.

  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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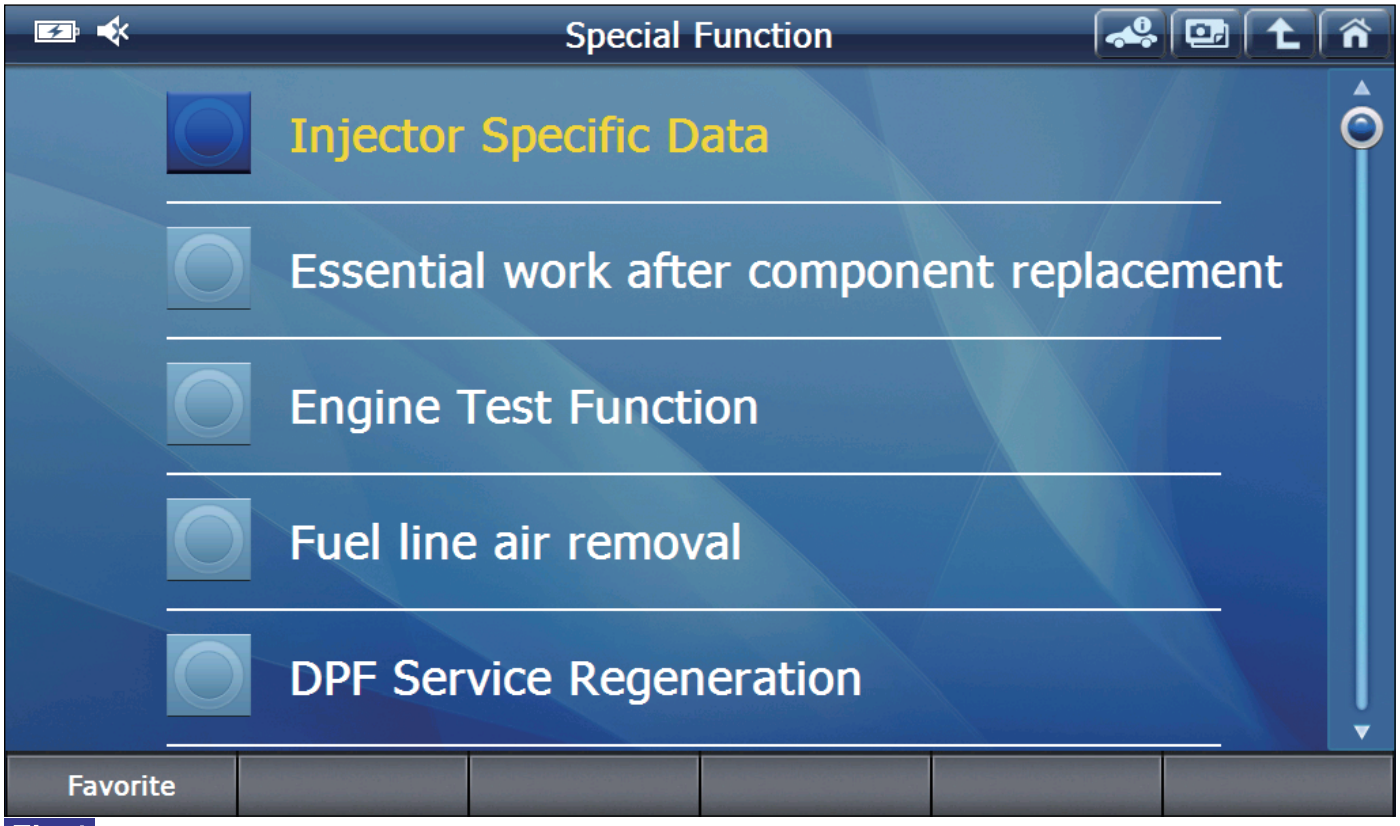


Fig.1

CRC12EN5010P02010041S

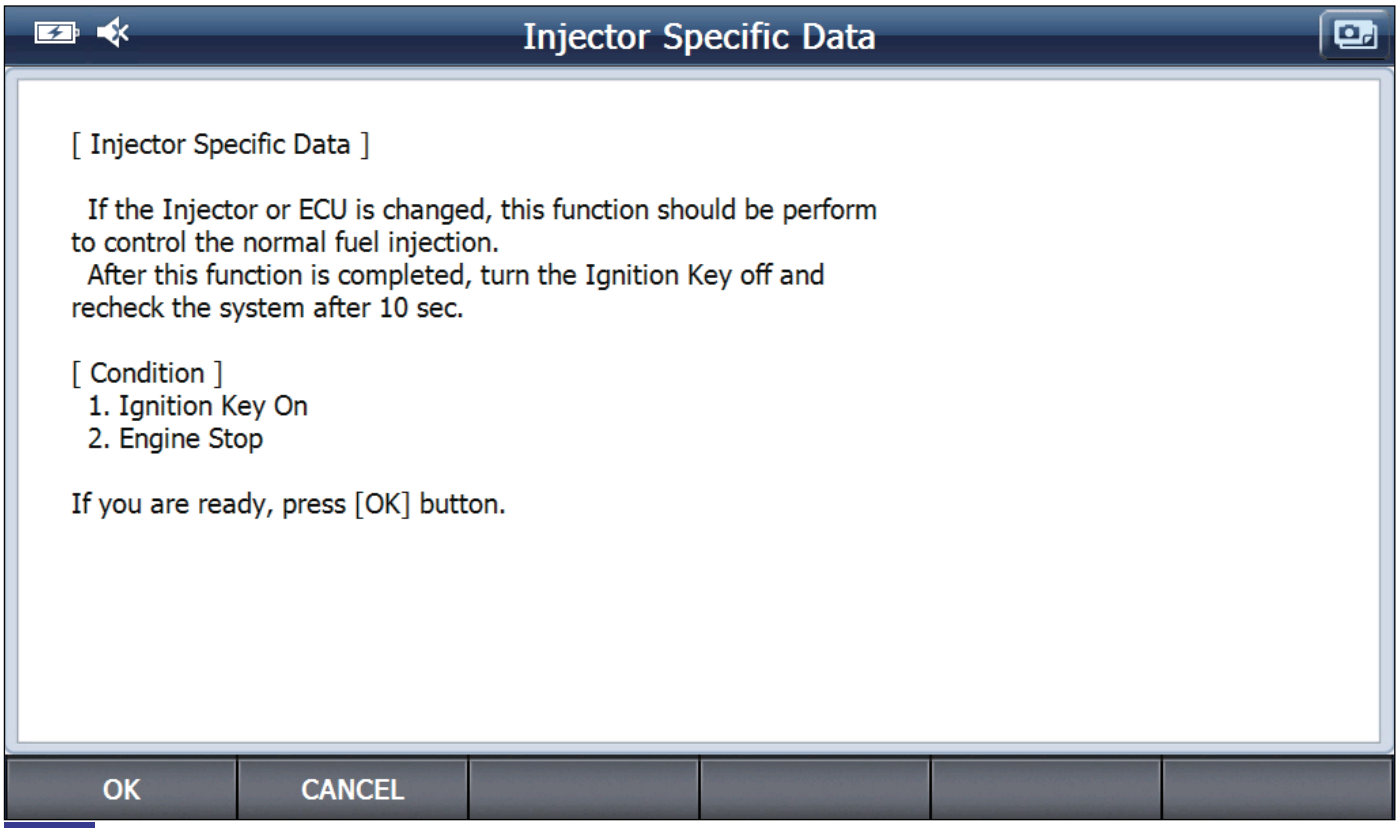


Fig.2

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.

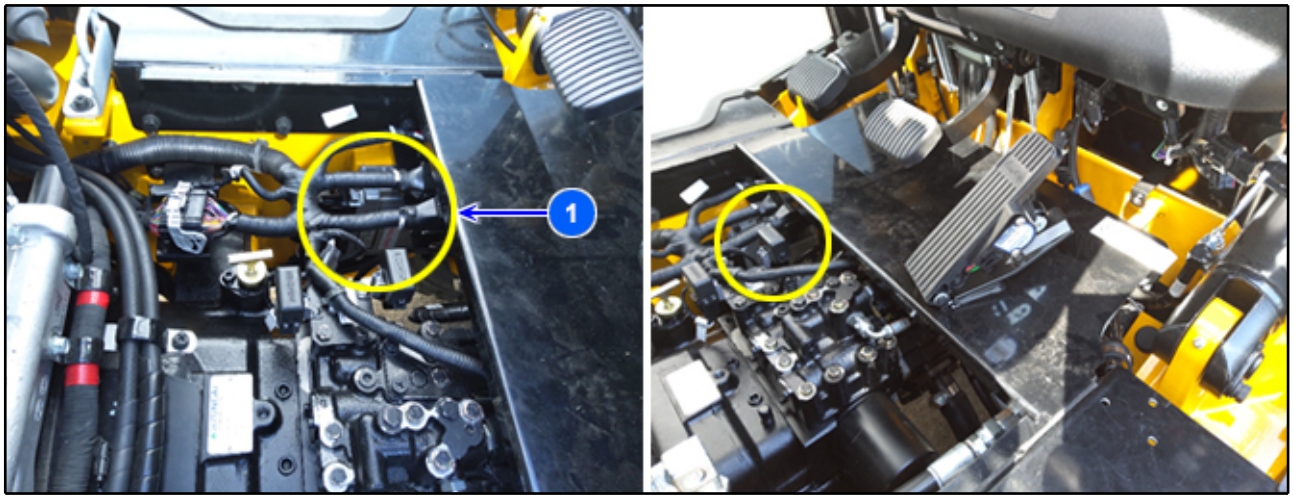
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P021900 Engine Overspeed Condition

Component Location



CRC12EN5010P02190011

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

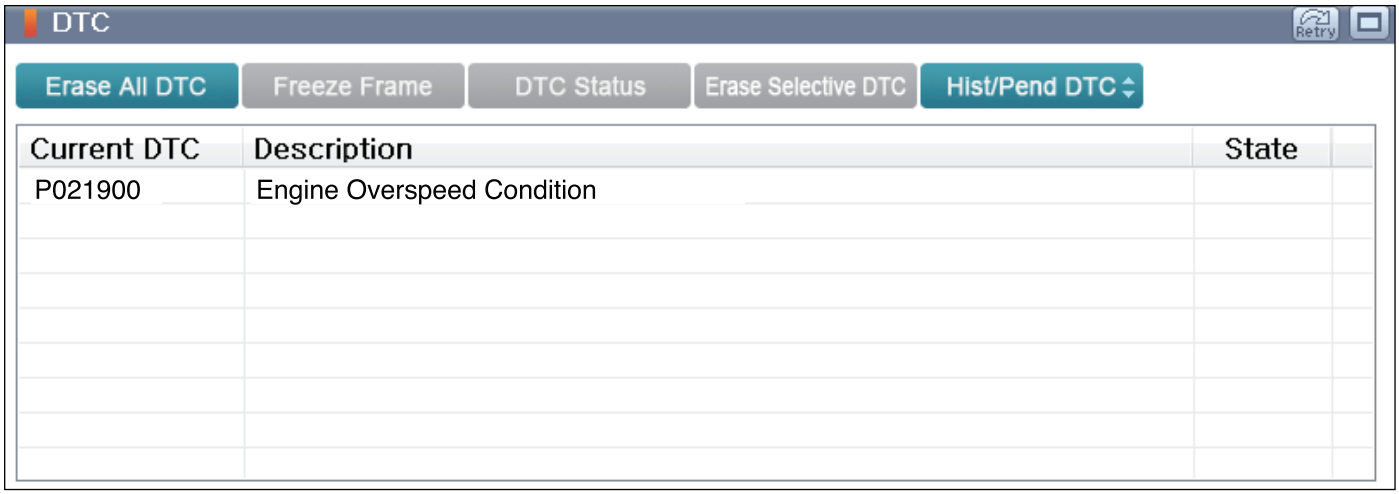
If the engine speed is exceeded 5500RPM, ECM sets DTC P021900.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Engine speed monitoring		1. Poor connector connection 2. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Engine speed exceeds 5500RPM		
Detecting Time	• 1 sec		
Fail Safe	Engine Off	• Yes	
	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.



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).
3. Ignition switch "ON" & Engine "ON"
4. Monitor follow parameters in "Current Data" with GDS.

Specification :Refer to figure below

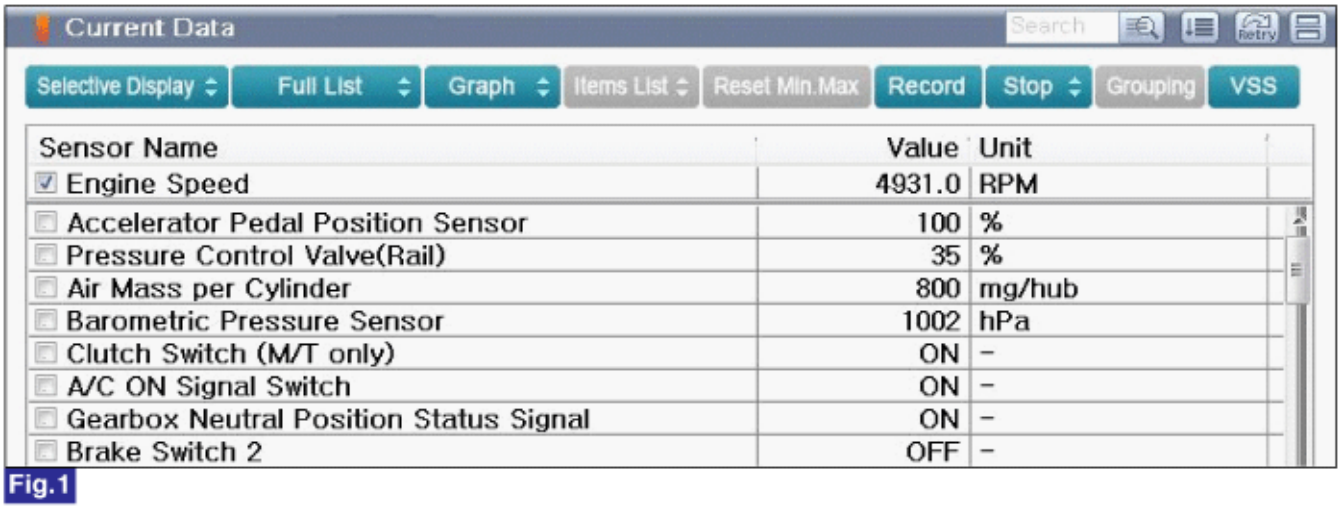


Fig.1

CRC12EN5010P02190022S

Fig.1) Engine speed at W.O.T

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 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.
3. Ignition switch "ON"
4. Measure the voltage between Engine control relay "ON" Power terminal of ECM harness connector and chassis ground.

Specification : B+

5. 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"
2. Disconnect battery (-) cable.
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 Ω

5. Is the measured value within specificaiton?

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?

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.

⚠ CAUTION

- 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "ECU Change"

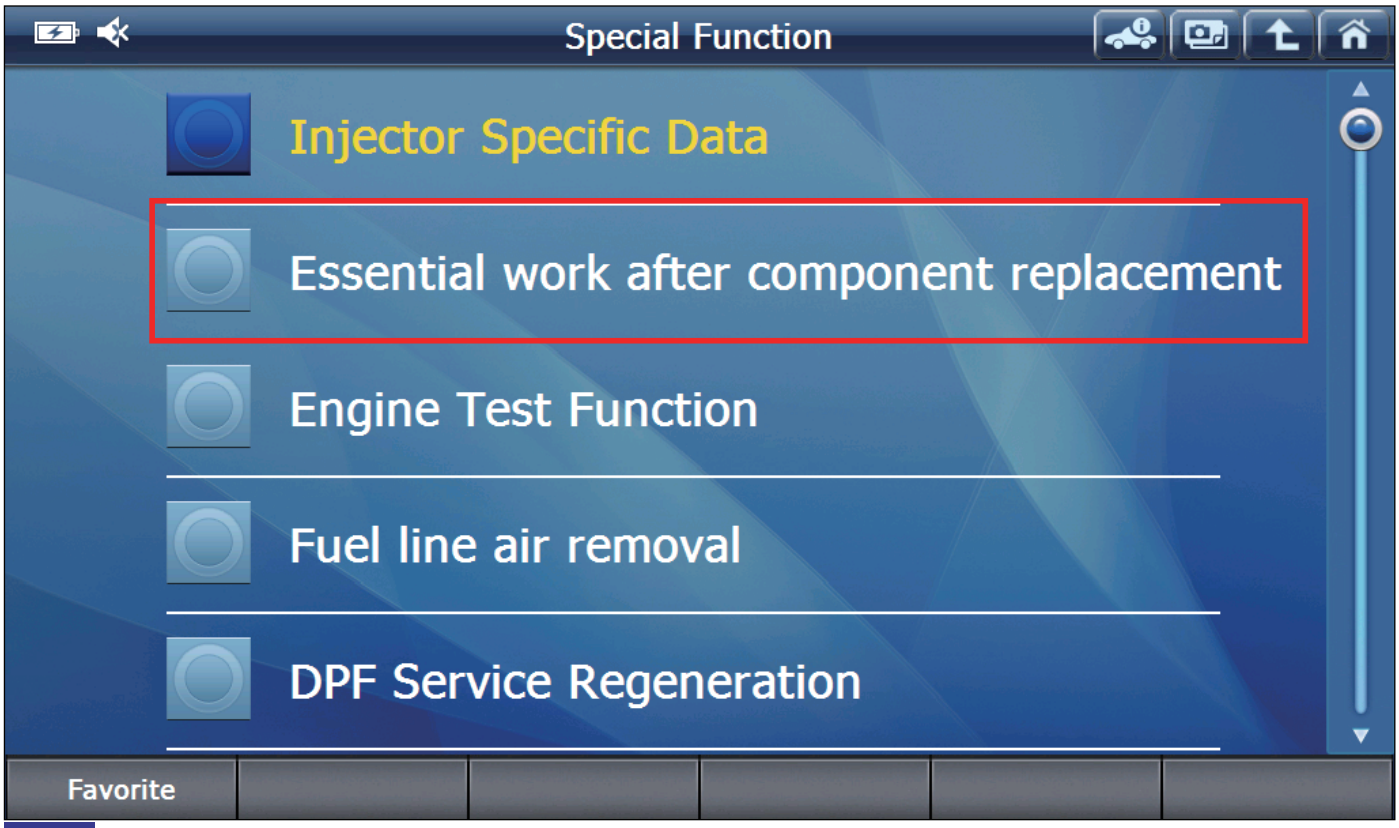


Fig.1

CRC12EN5010P01010041S

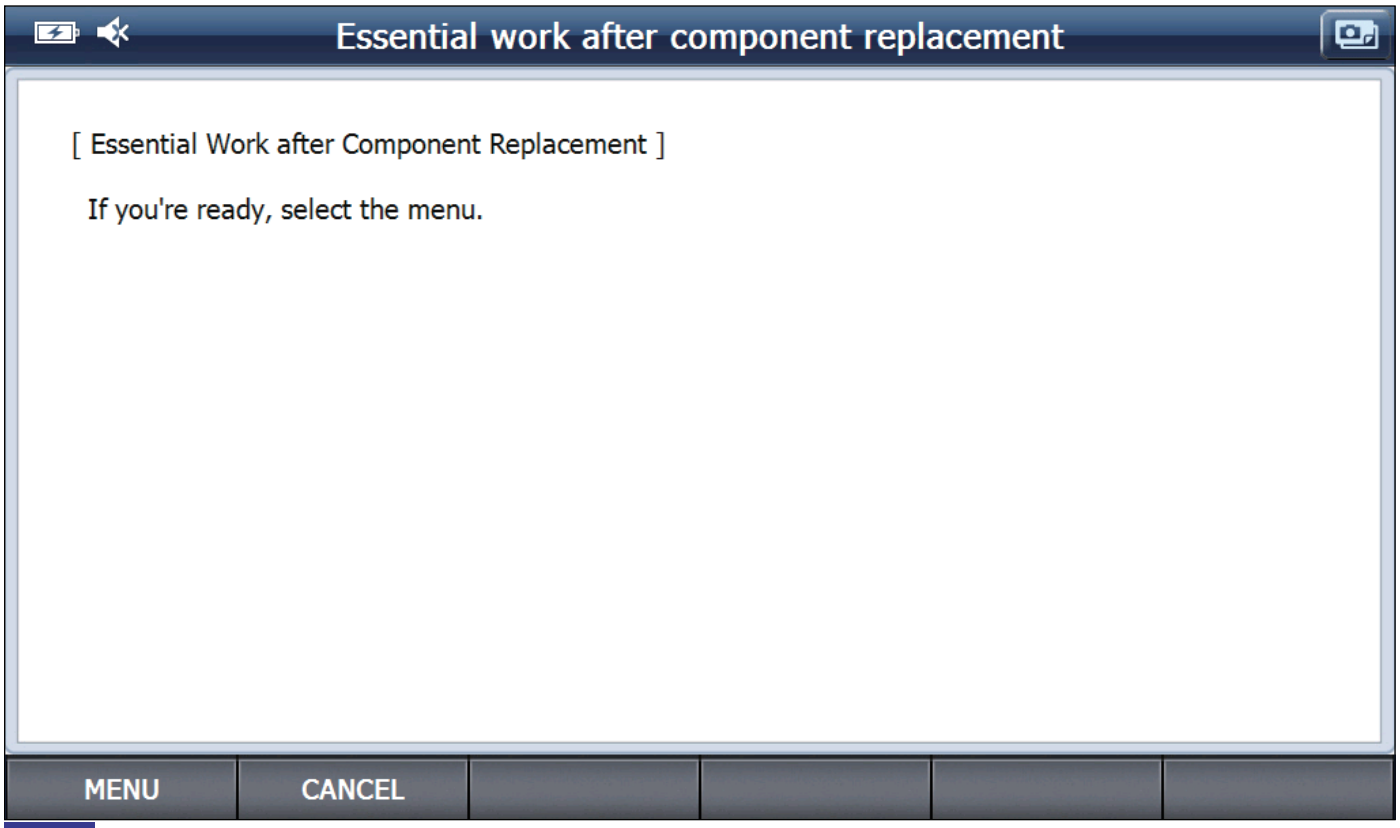


Fig.2

CRC12EN5010P01010042S

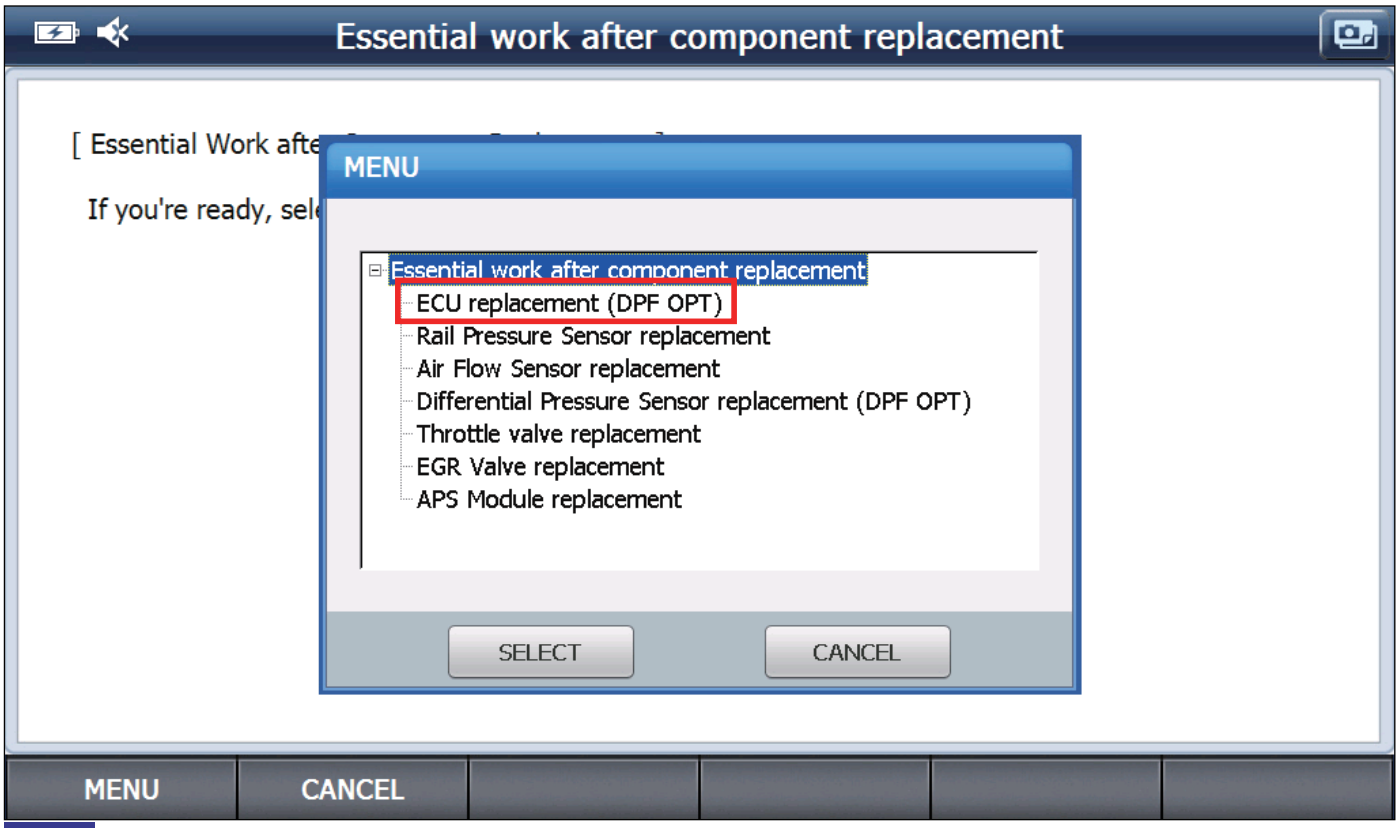


Fig.3

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.

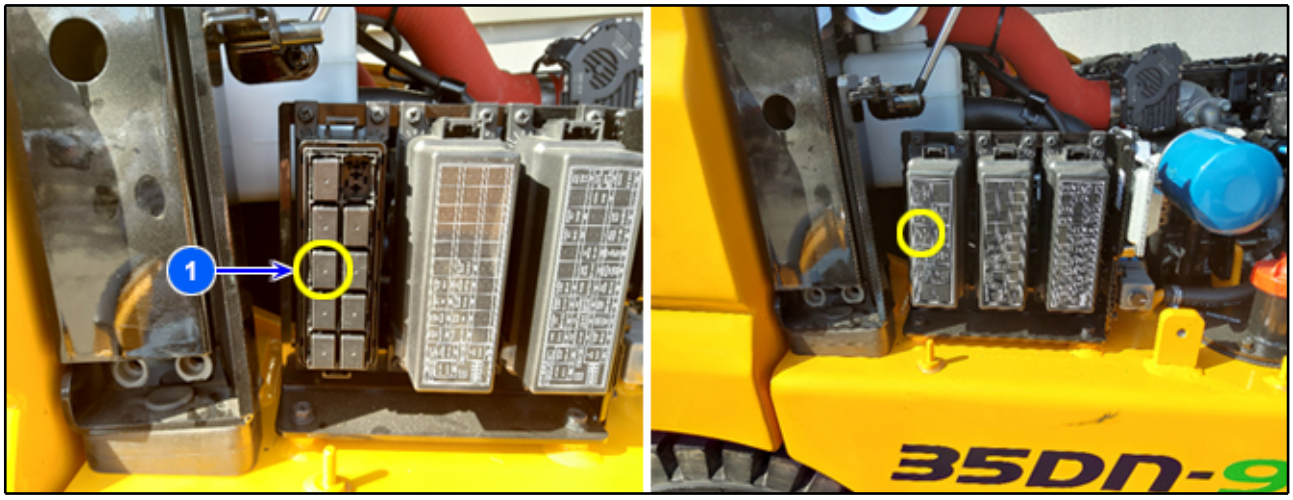
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P023000 Fuel Pump Primary Circuit

Component Location



CRC12EN5010P02300011

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

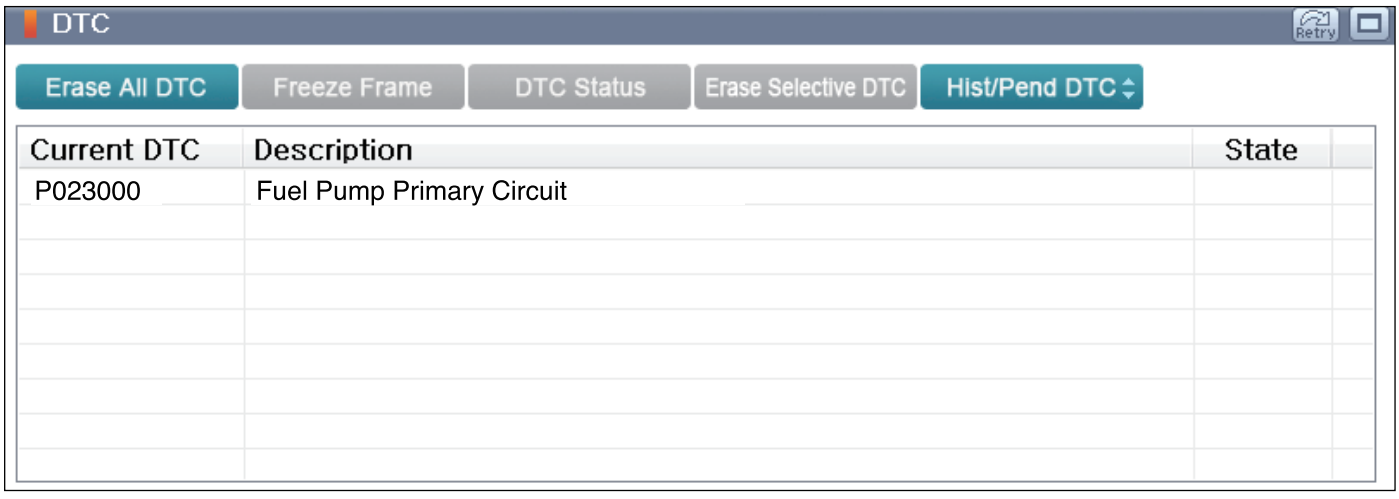
If the open, short or over-temperature on fuel pump circuit is detected, ECM sets DTC P023000.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Plausibility monitoring		1. Poor connector connection 2. Short to power/ground in fuel pump circuit 3. Open in fuel pump circuit 4. Defected ECM
Enable Condition	• Engine running		
Threshold Value	Case 1	• No load error is detected	
	Case 2	• Over-temperature is detected	
	Case 3	• Short to power in fuel pump circuit	
	Case 4	• Short to ground in fuel pump circuit	
Detecting Time	Case 1	• 270 msec	
	Case 2	• 1 sec	
	Case 3	• 270 msec	
	Case 4	• 2 sec	
Fail Safe	Engine OFF	• Yes	
	EGR OFF	• No	
	Torque Limit	• Yes (Case 1, Case 3) • No (Case 2, Case 4)	
	MIL	• Off	

Monitor DTC Status

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



CRC12EN5010P02300021S

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 remove fuel pump relay.
3. Ignition switch "ON"
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 .

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 remove fuel pump relay.
3. Ignition switch "ON"
4. Measure the voltage between control terminal of fuel pump relay harness connector and chassis ground.

Specification : Approx. 3.4 V

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 Fuel pump relay 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.

Verification of Vehicle Repair

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

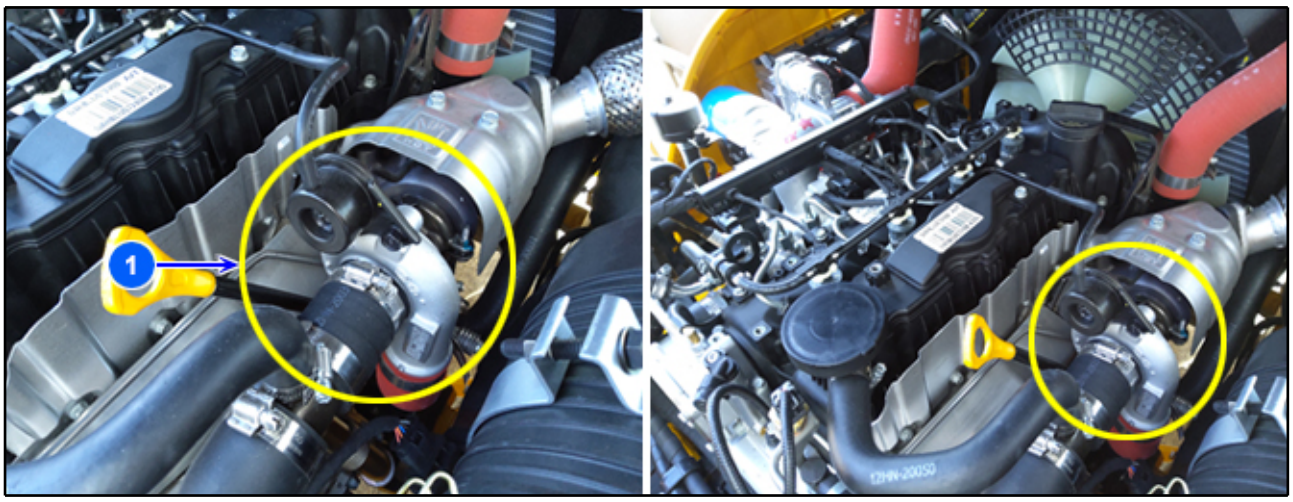
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

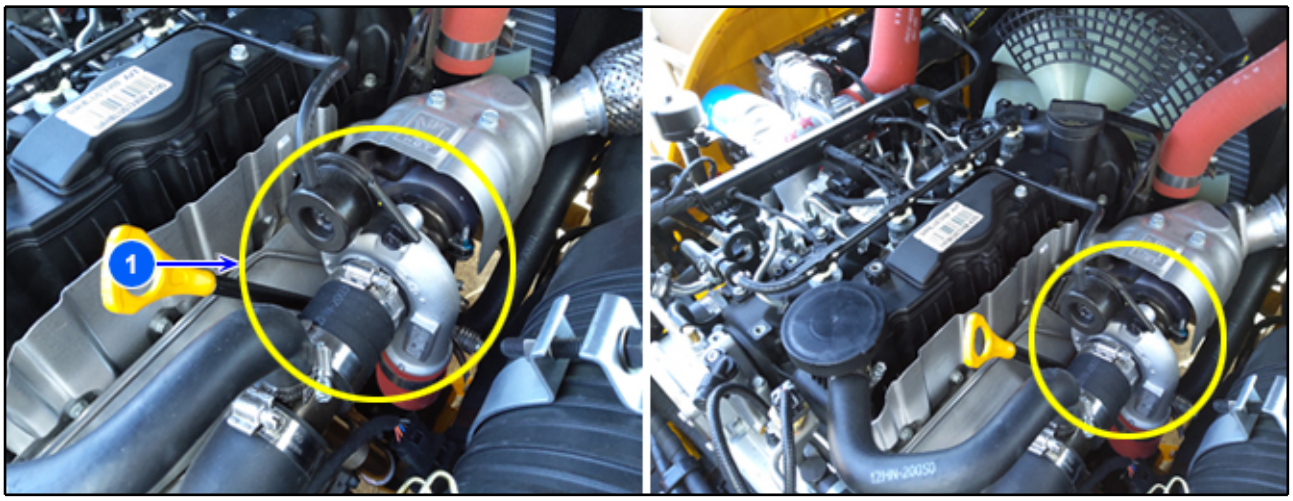
NO ▸ Problem is corrected and the system operation performs to specification at this time.

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

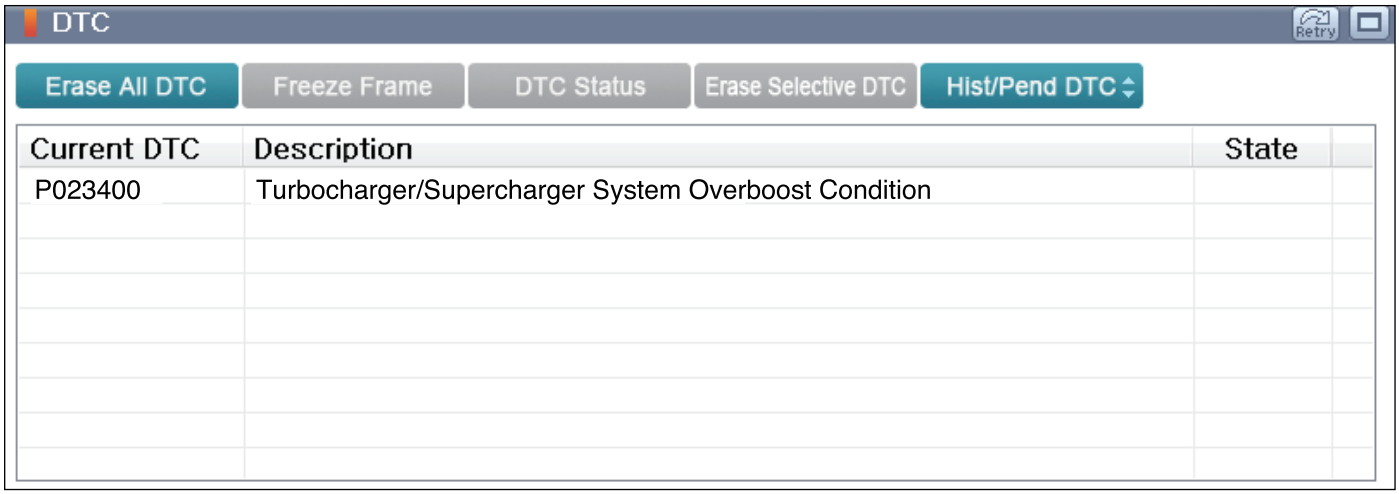
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Defected VGT control actuator 3. Clogged exhaust system
Enable Condition	• Engine running		
Threshold Value	• Measured BPS output value is higher than target value		
Detecting Time	• 6 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

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



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.

Specification :Refer to figure below

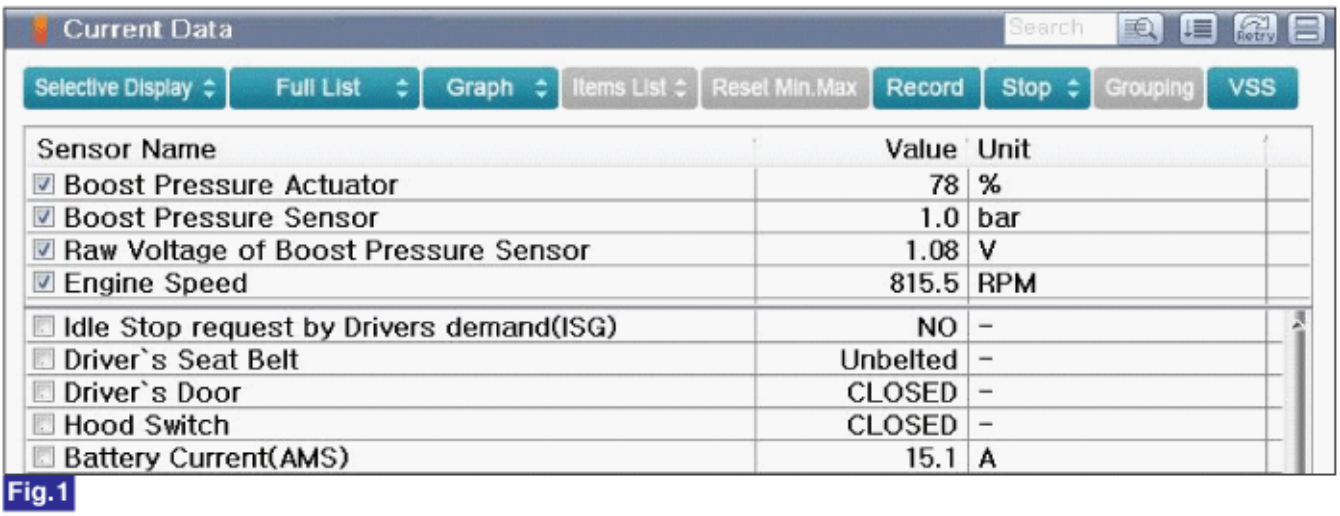


Fig.1

CRC12EN5010P00470022S

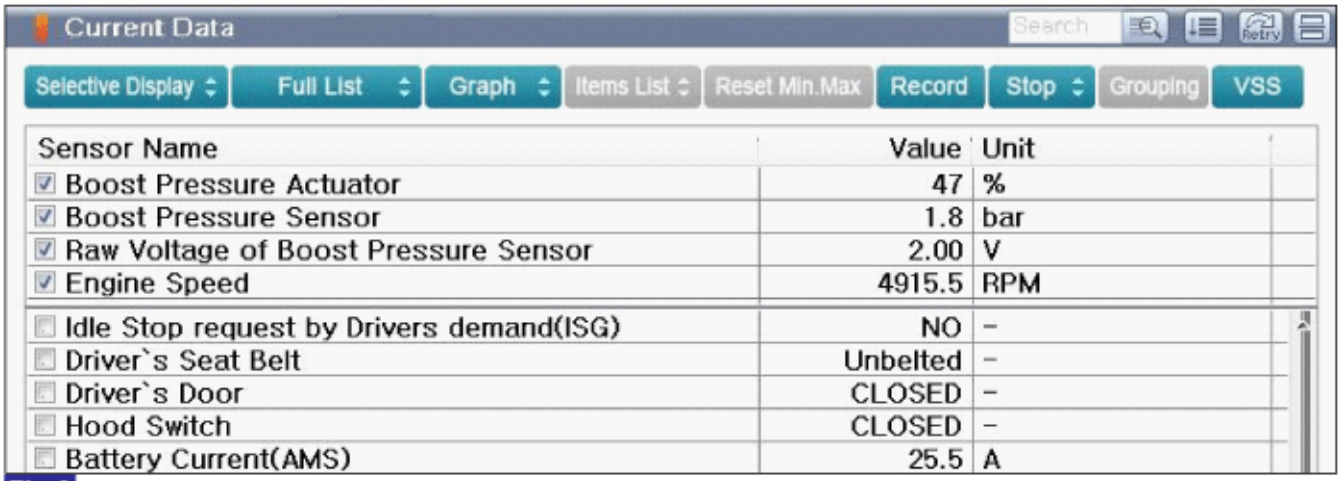


Fig.2

CRC12EN5010P00470023S

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

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.
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"
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.

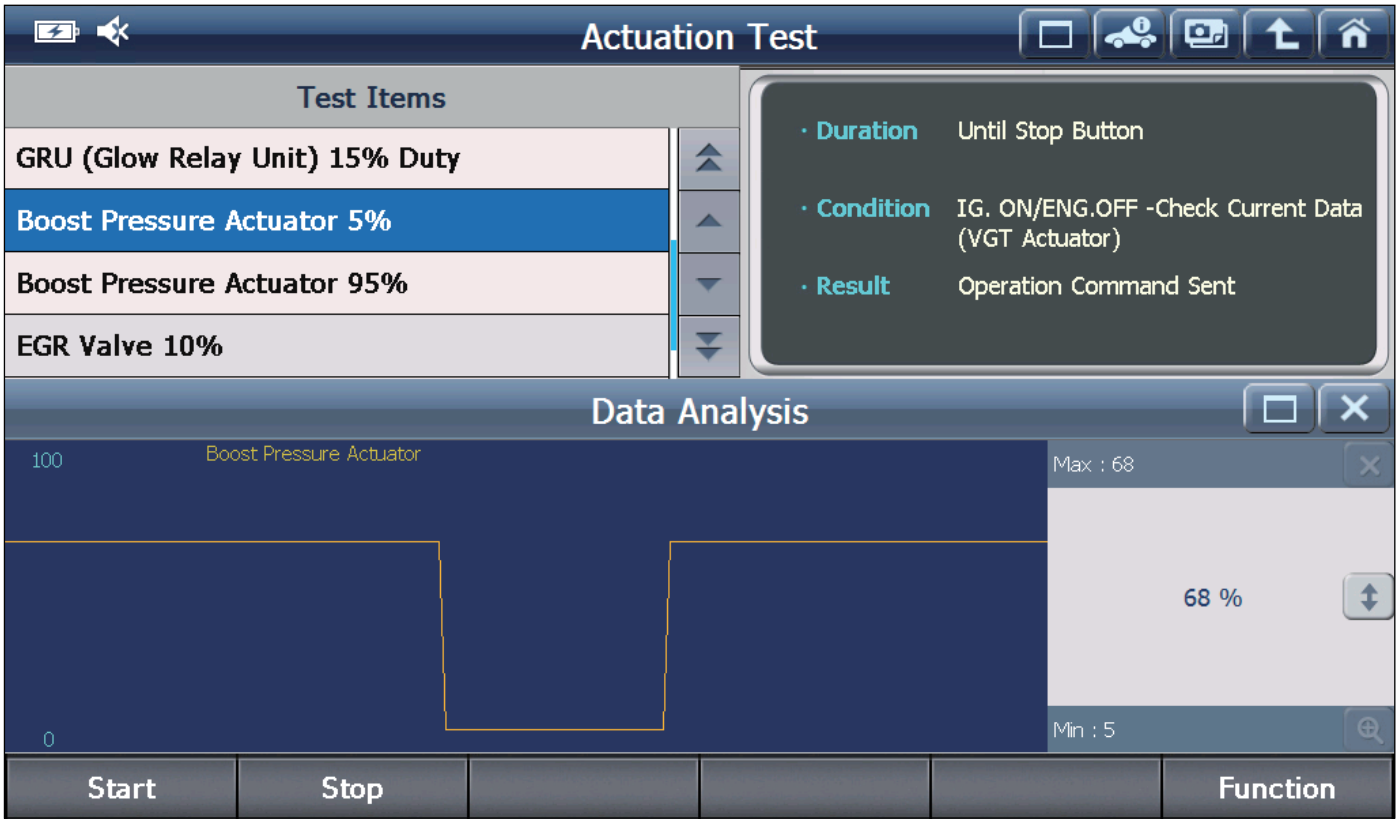
NO ▸ Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

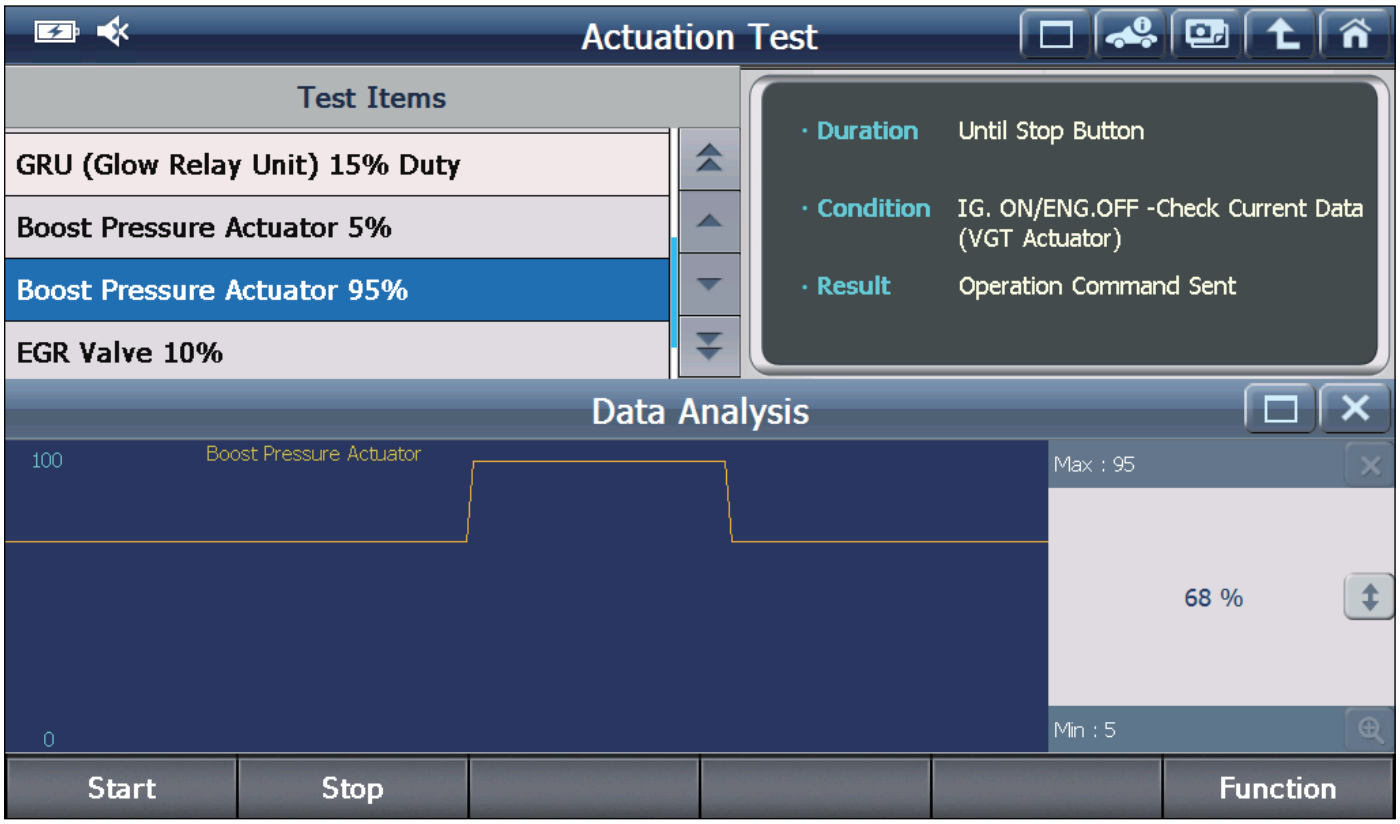
■ **Actuation Test**

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

Specification :Refer to figure below



CRC12EN5010P00470041S



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.

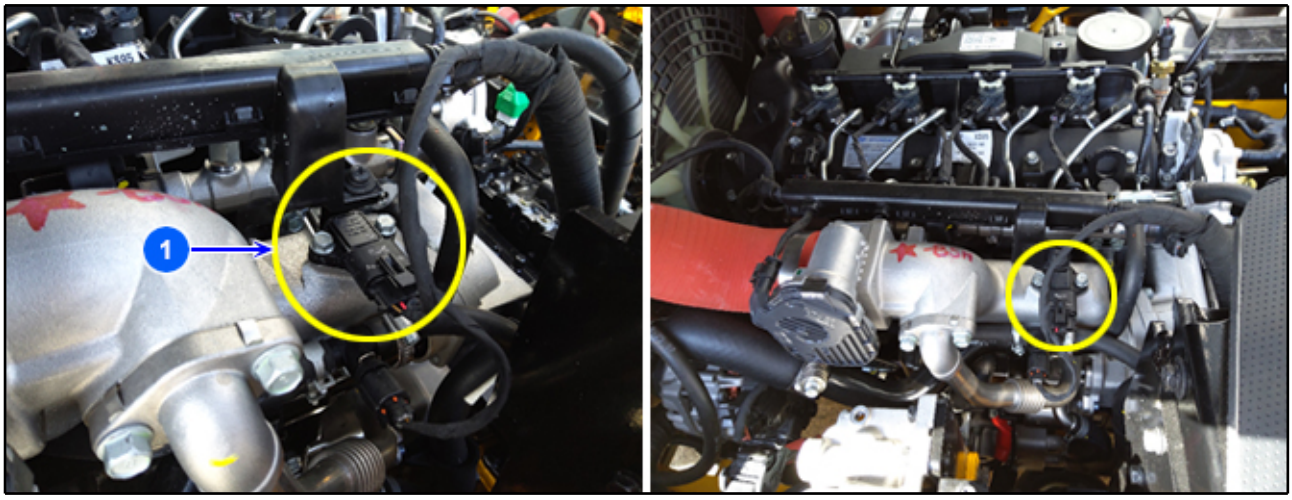
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short to ground in signal circuit of BPS 3. Defected BPS
Enable Condition	• Engine running		
Threshold Value	• Output value is below threshold value		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

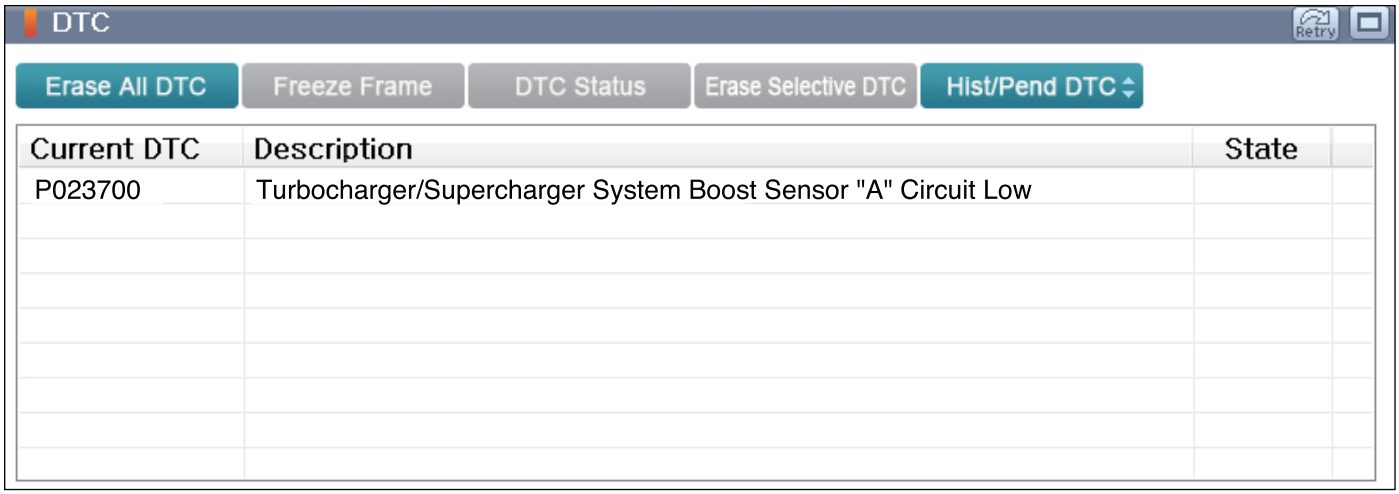
Vehicle Data

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.5V	-
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor Ground		0 V	-

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 1.0V	Atmospheric Pressure
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor Ground		0 V	-

Monitor GDS Data

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



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

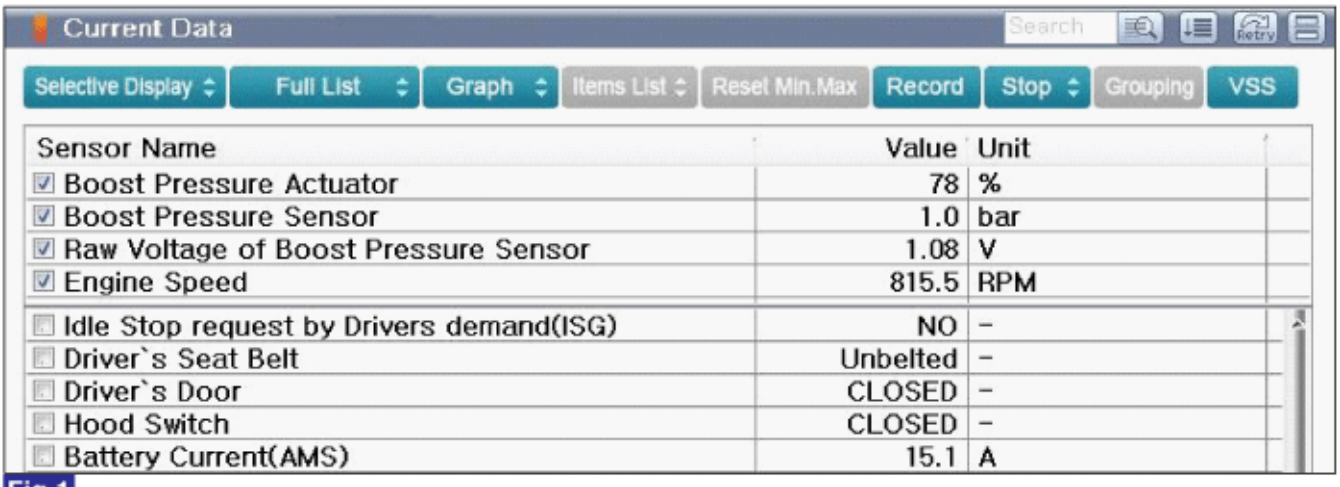


Fig.1

CRC12EN5010P00470022S

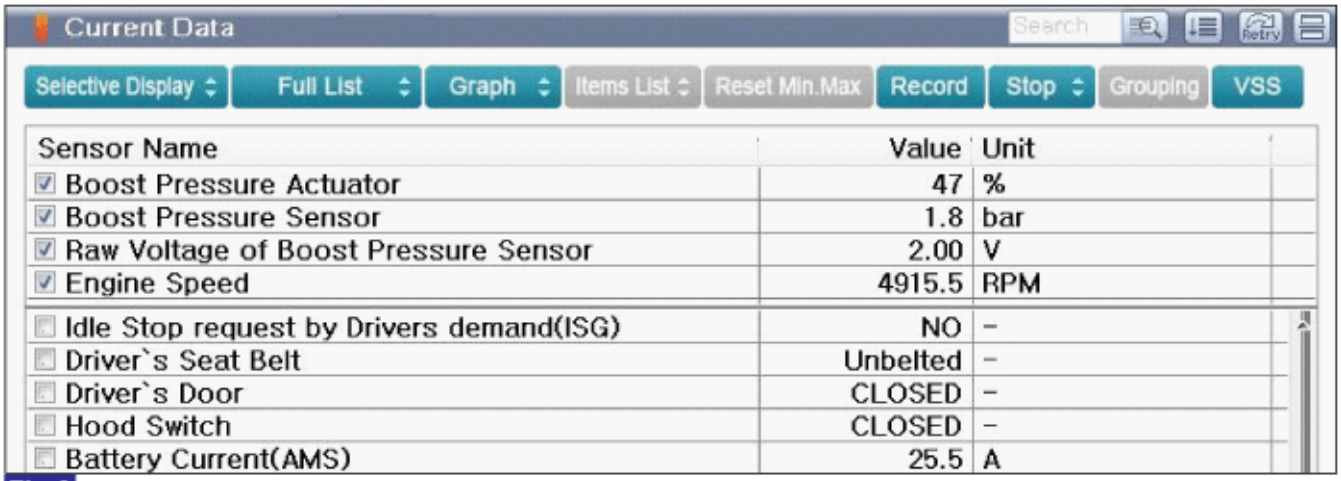


Fig.2

CRC12EN5010P00470023S

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

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 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.
4. Measure the resistance between ground terminal of BPS harness connector and chassis ground.

Specification :Approx. below 1 Ω

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"
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?

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 boost pressure sensor connector.
3. Ignition switch "ON"
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.
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.

Specification : Refer to Fig

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

1. Ignition Switch "OFF"
2. Connect VMI to GDS and set up the 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 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.

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.

Verification of Vehicle Repair

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

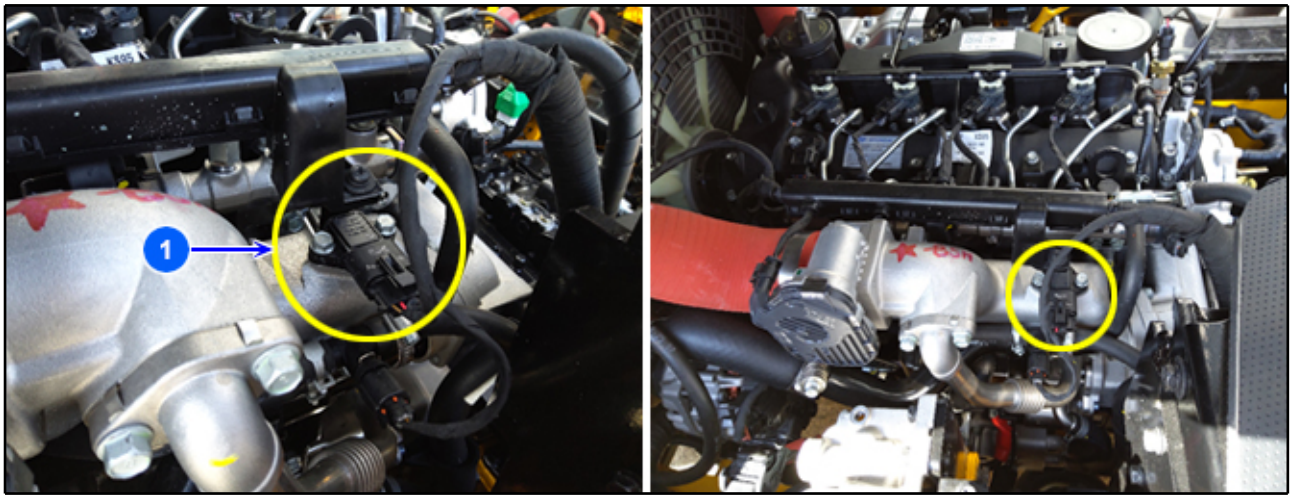
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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		1. Poor connector connection 2. Short to power in signal circuit of BPS 3. Open in ground circuit of BPS 4. Open in power circuit of BPS 5. Defected BPS
Enable Condition	• Engine running		
Threshold Value	• Output value is below threshold value		
Detecting Time	• 2 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

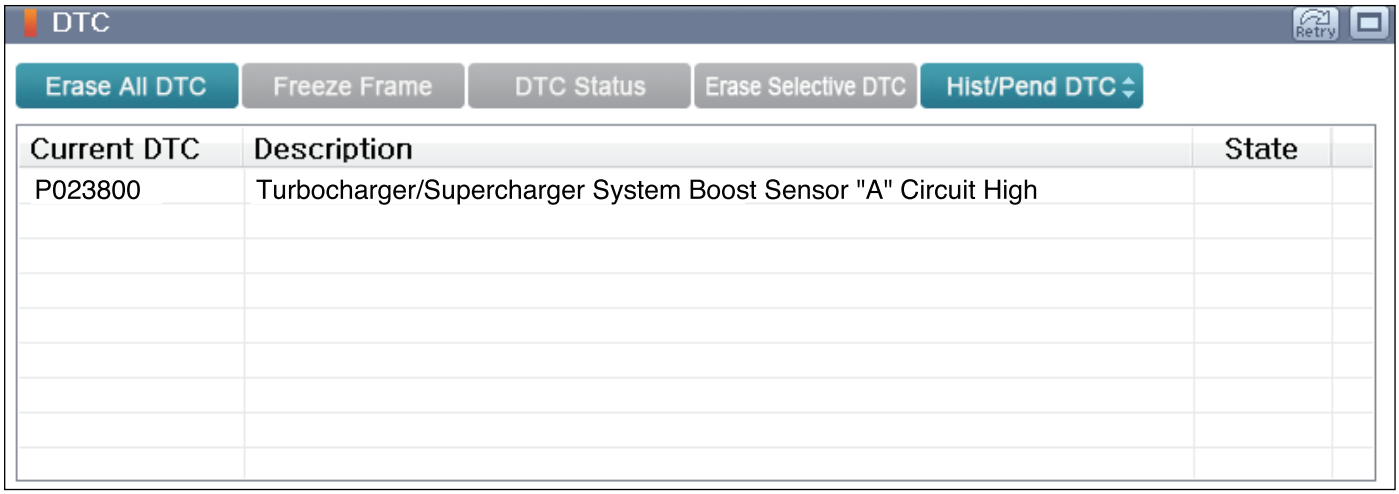
Vehicle Data

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.5V	-
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor Ground		0 V	-

Lambda Sensor Unit		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Boost Pressure Sensor Signal	• Ignition Switch "ON", Engine "OFF" • Voltage is measured on wiring side(Connected)	Approx. 1.0V	Atmospheric Pressure
	2	Boost Pressure Sensor Power		Approx. 5.0V	-
	3	-		-	-
	4	Boost Pressure Sensor Ground		0 V	-

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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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

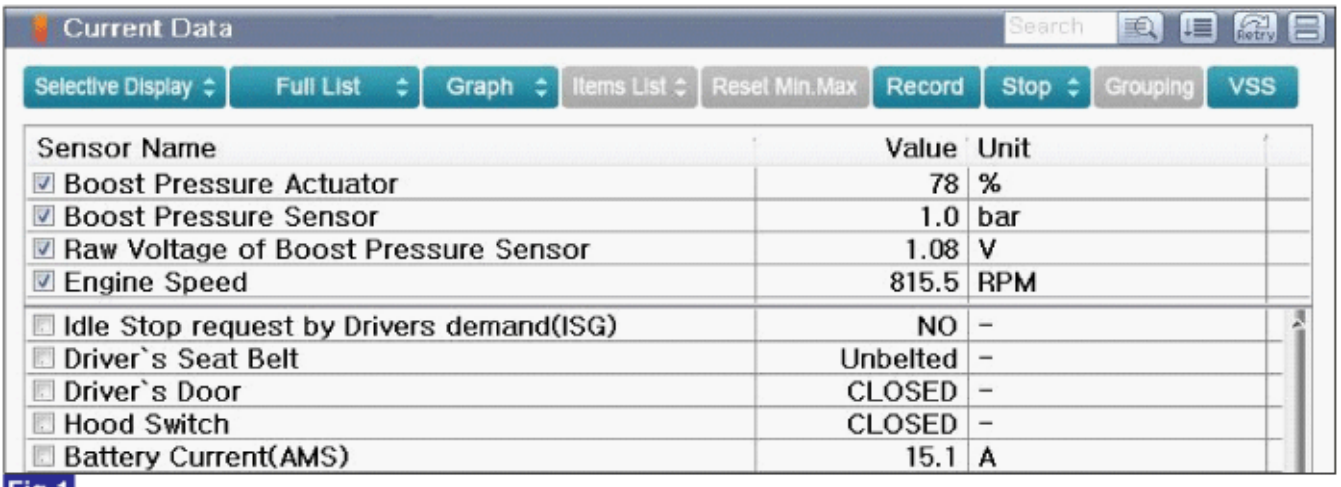


Fig.1

CRC12EN5010P00470022S

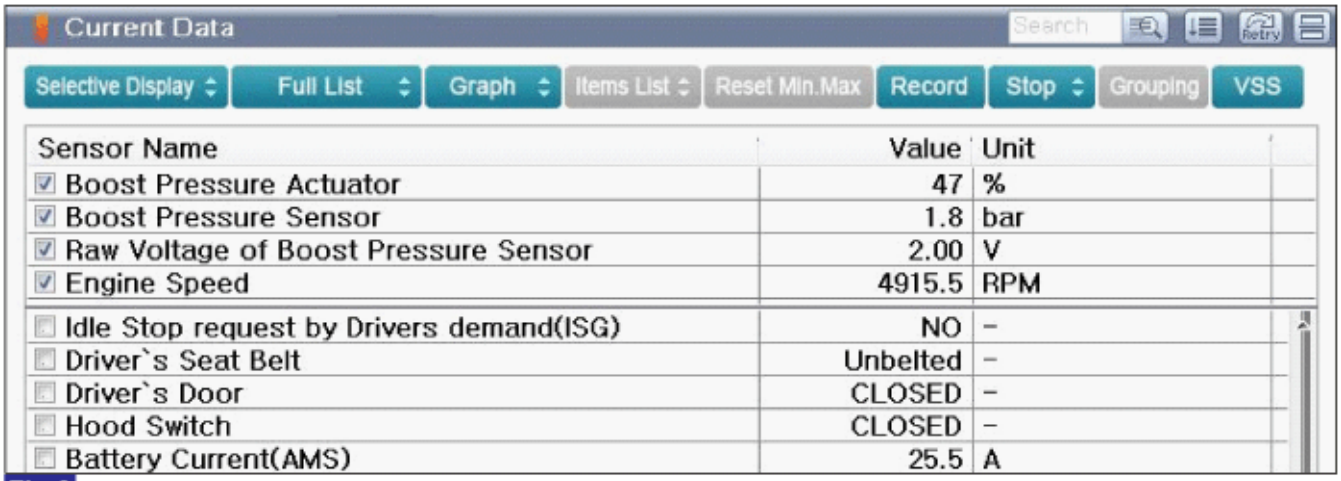


Fig.2

CRC12EN5010P00470023S

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

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 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.
4. Measure the resistance between ground terminal of BPS harness connector and chassis ground.

Specification :Approx. below 1 Ω

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"
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?

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 boost pressure sensor connector.
3. Ignition switch "ON"
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 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

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

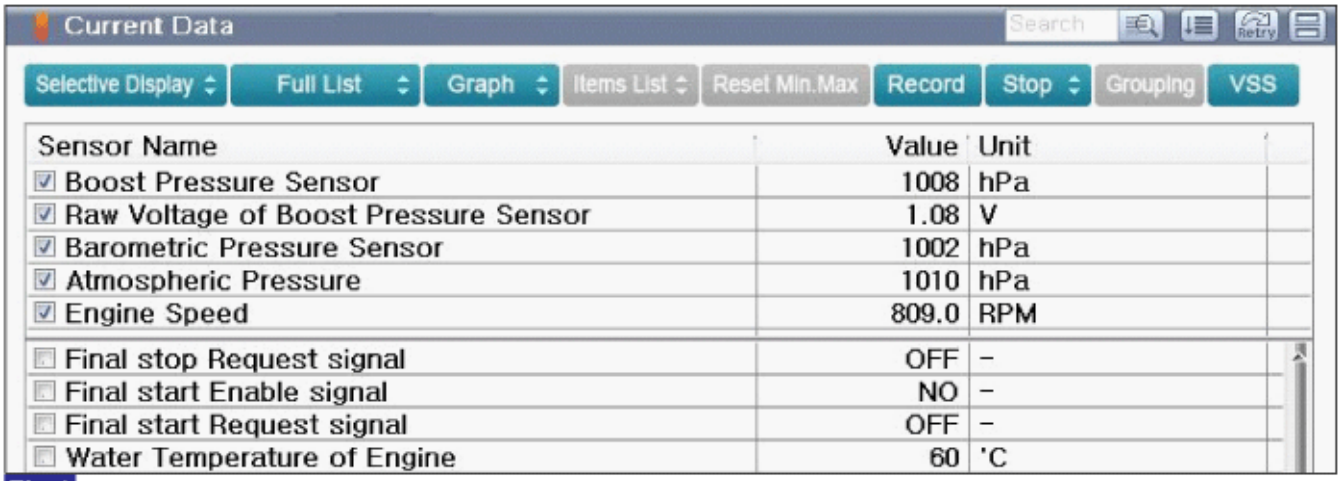


Fig.1

CRC12EN5010P00690022S

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

※Atmospheric 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.

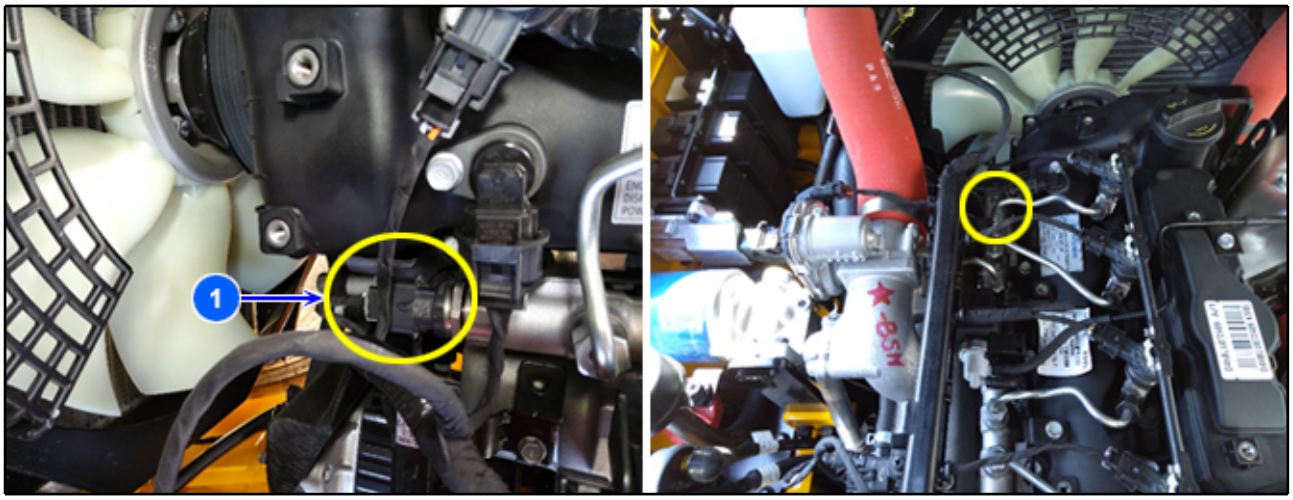
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

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

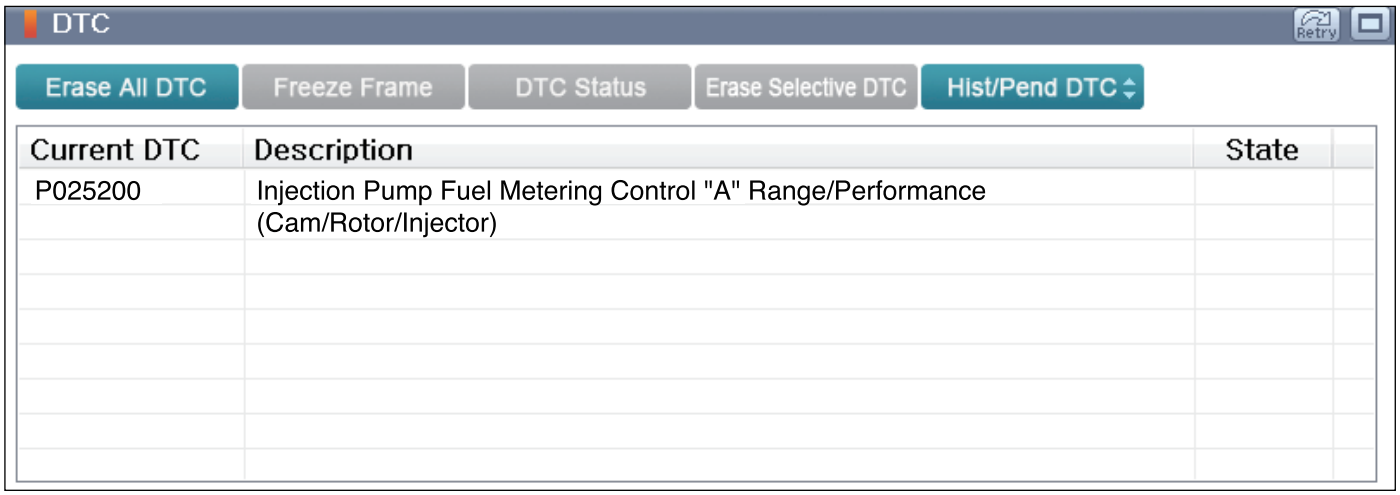
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty FPRV circuit 3. Defected FPRV
Enable Condition	• Engine running		
Threshold Value	• Over-temperature on FPRV is detected		
Detecting Time	• 220 msec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Fuel Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	FPRV Control	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	FPRV Power		B+	-

Monitor DTC Status

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



CRC12EN5010P02520021S

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

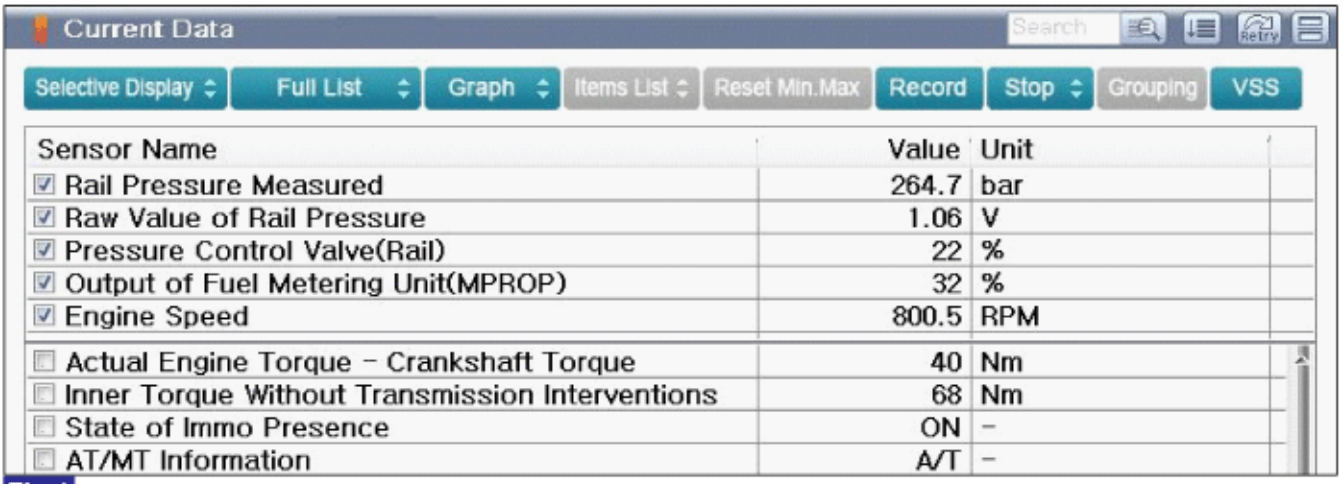


Fig.1

CRC12EN5010P00870022S

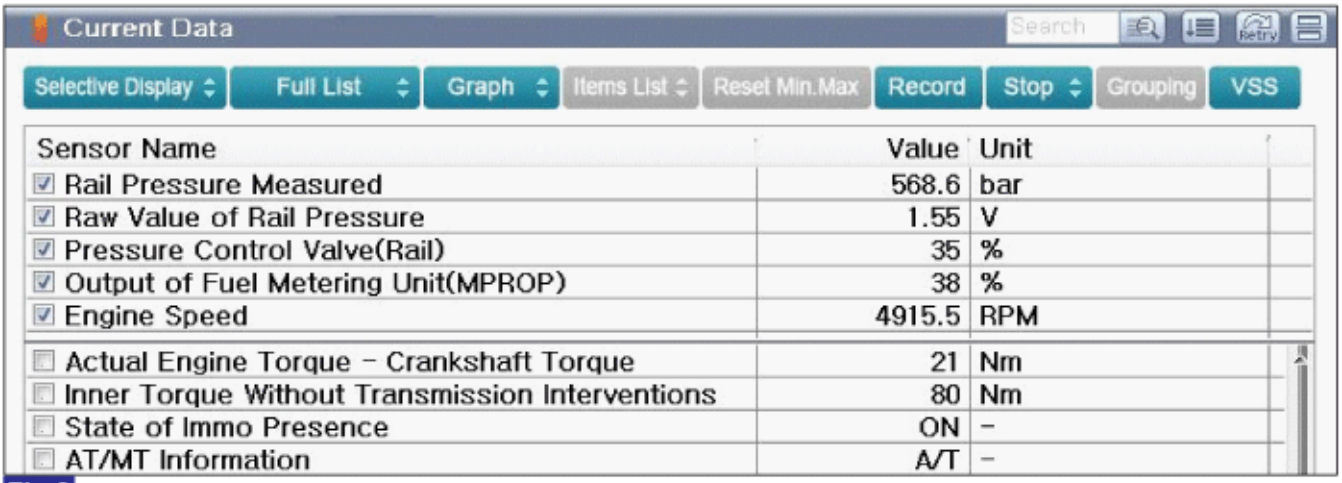


Fig.2

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?

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 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 .

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.
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.

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 Ω (Approx. 20℃/68℉)

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.

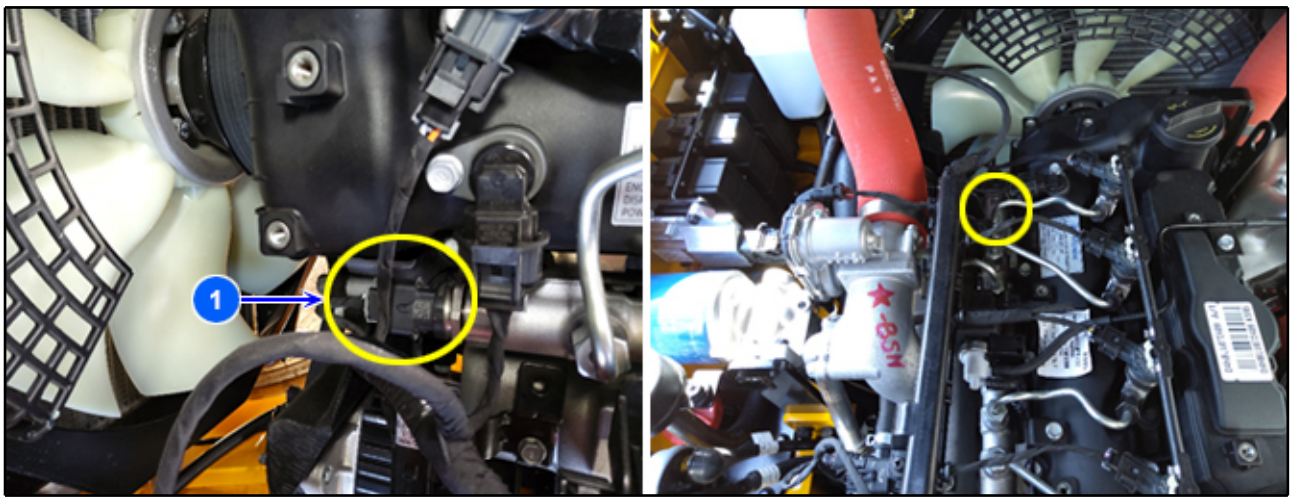
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P025300 Injection Pump Fuel Metering Control "A" Low (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 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

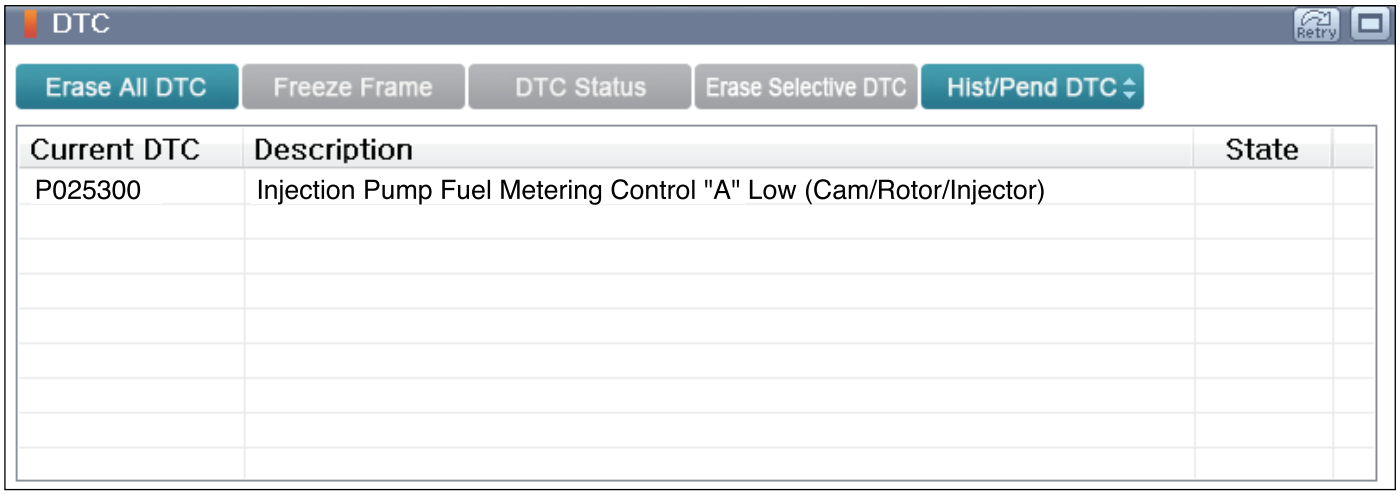
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Open or short in control circuit of FPRV 3. Defected FPRV
Enable Condition	• Engine running		
Threshold Value	Case 1	• Open in FPRV circuit	
	Case 2	• Short to ground in FPRV circuit	
Detecting Time	Case 1	• 220 msec	
	Case 2	• 280 msec	
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes (Case 1) • No (Case 2)	
	MIL	• On	

Vehicle Data

Fuel Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	FPRV Control	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	FPRV Power		B+	-

Monitor GDS Data

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



CRC12EN5010P02530021S

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

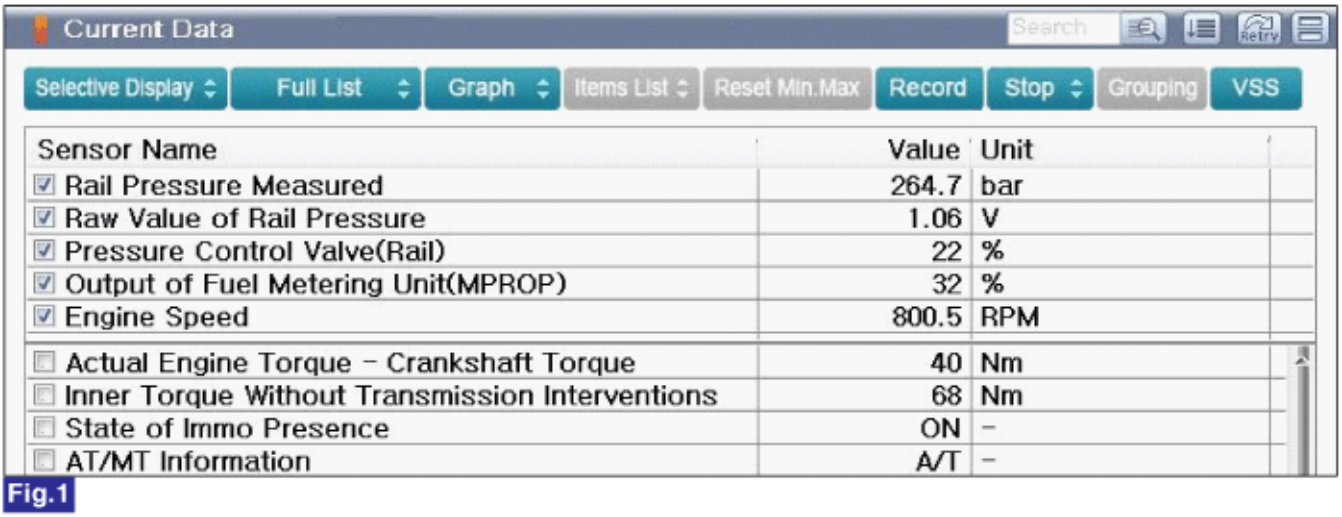


Fig.1

CRC12EN5010P00870022S

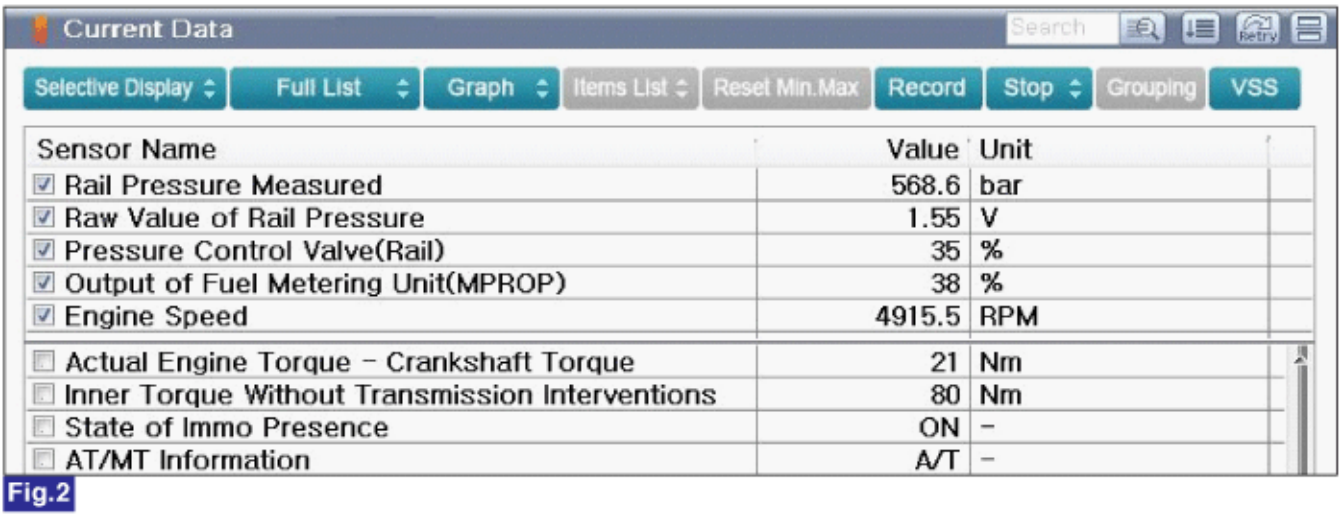


Fig.2

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?

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 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.

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.
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.

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 Ω (Approx. 20℃/68℉)

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.

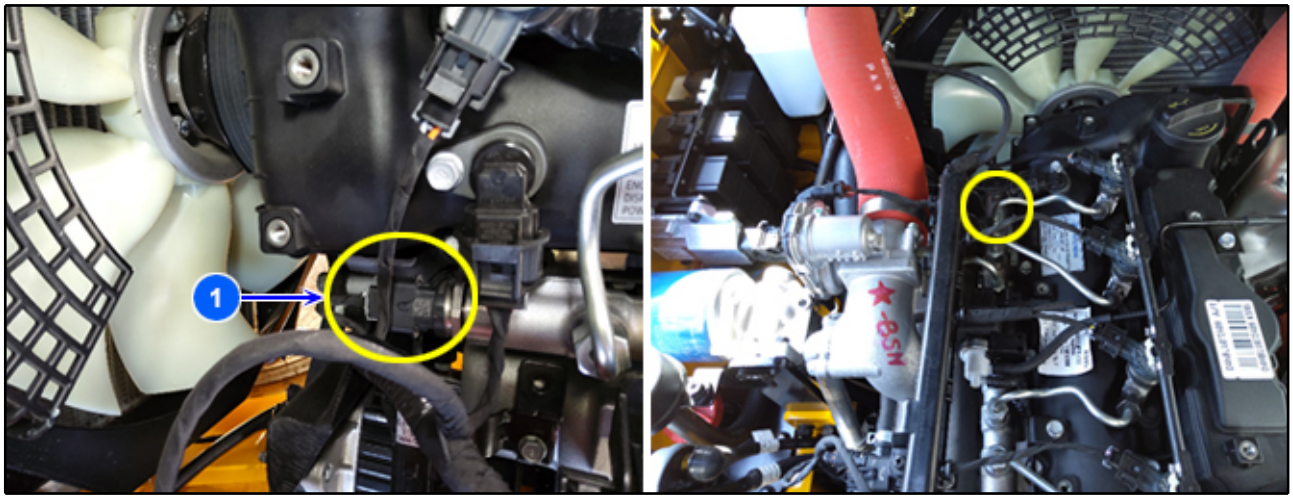
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P025400 Injection Pump Fuel Metering Control "A" High (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-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

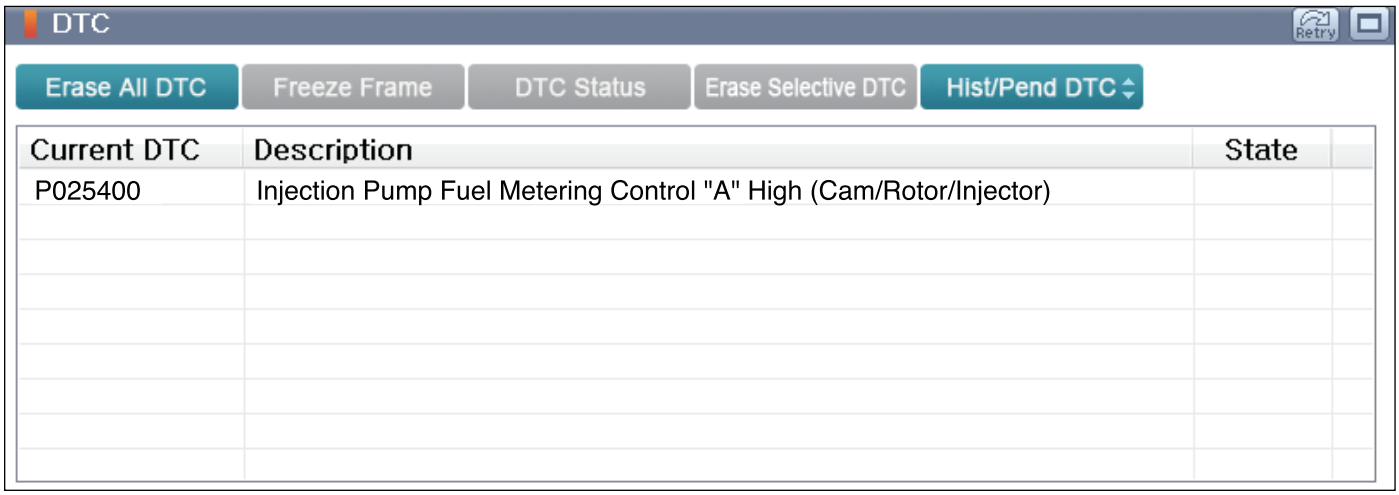
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short to power in control circuit of FPRV 3. Defected FPRV
Enable Condition	• Engine running		
Threshold Value	• Short to battery in control circuit		
Detecting Time	• 220 msec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Fuel Pressure Regulator Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	FPRV Control	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	FPRV Power		B+	-

Monitor GDS Data

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



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

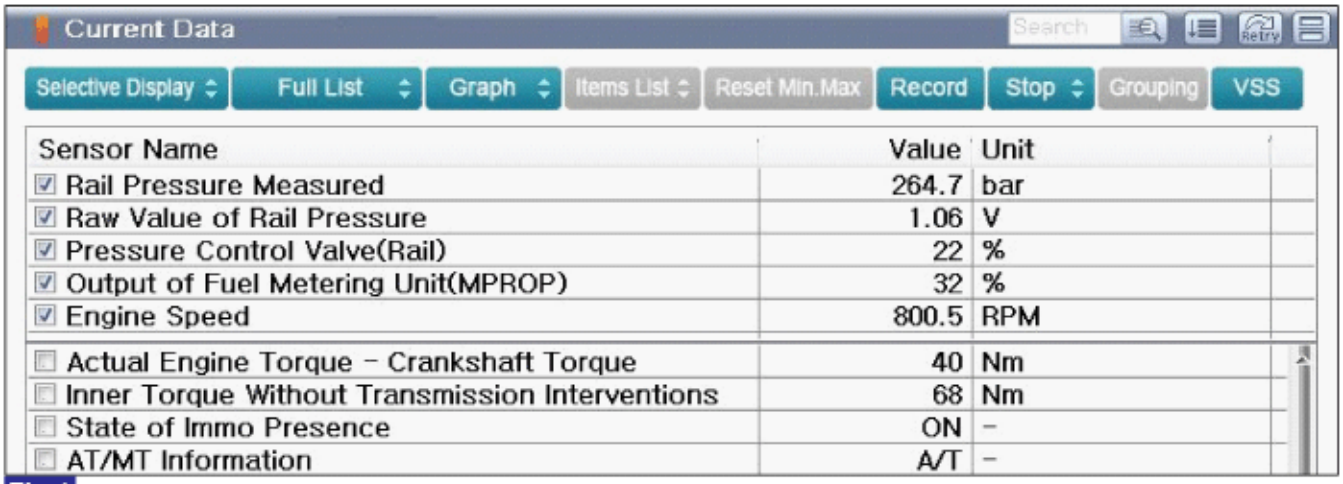


Fig.1

CRC12EN5010P00870022S

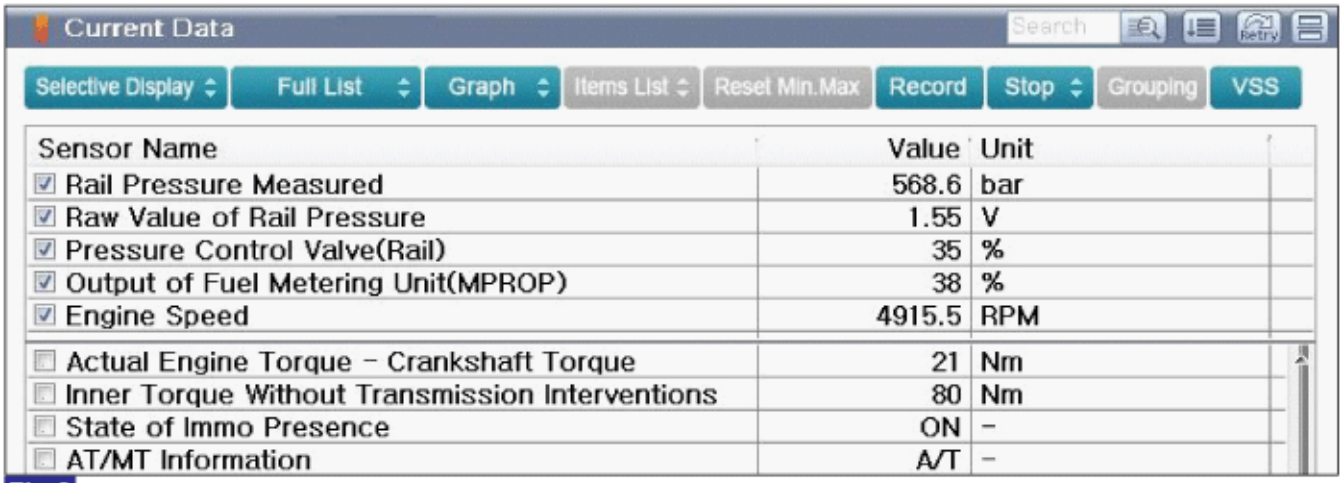


Fig.2

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?

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 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 .

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.
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.

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 Ω (Approx. 20℃/68℉)

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.

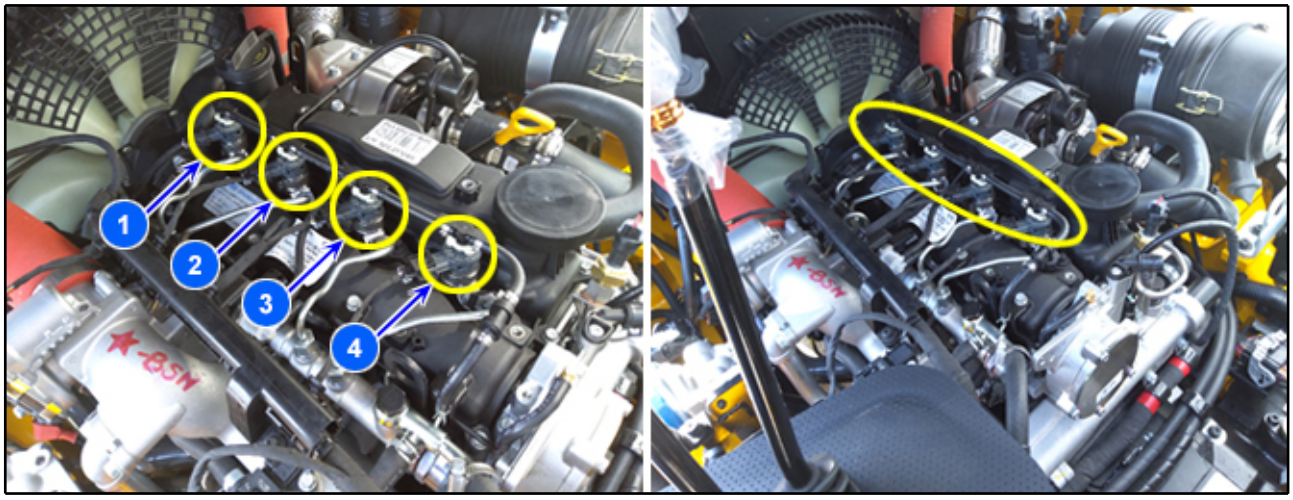
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P026200 Cylinder 1 Injector Circuit High

Component Location



CRC12EN5010P02010011

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 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

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short in injector #1 circuit 3. Defected injector #1
Enable Condition	• Engine running		
Threshold Value	• Short in injector circuit		
Detecting Time	• -		
Fail Safe	Engine Off	• Yes	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5. 0V	-
	2	Injector Control(Low)		Approx. 5. 0V	-

Signal Waveform & Data

Fig.1

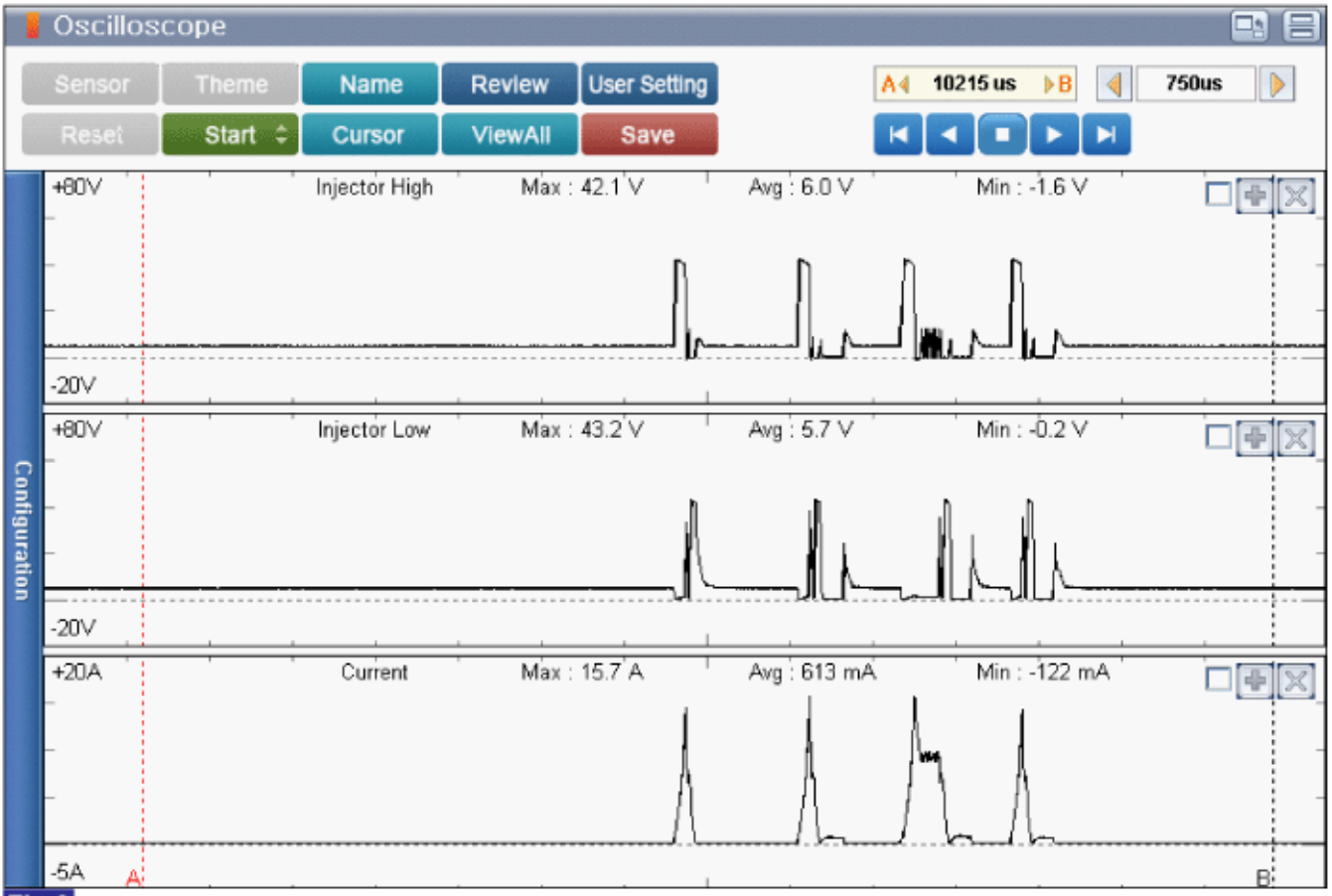


Fig.2

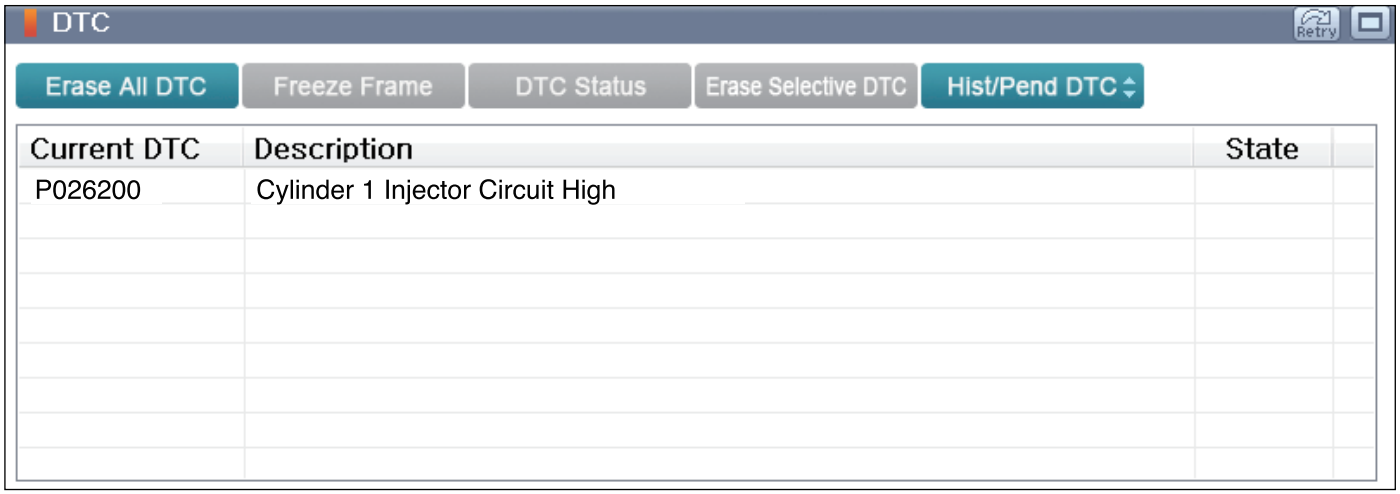
CRC12EN5010P02010012S

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.**



CRC12EN5010P02620021S

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

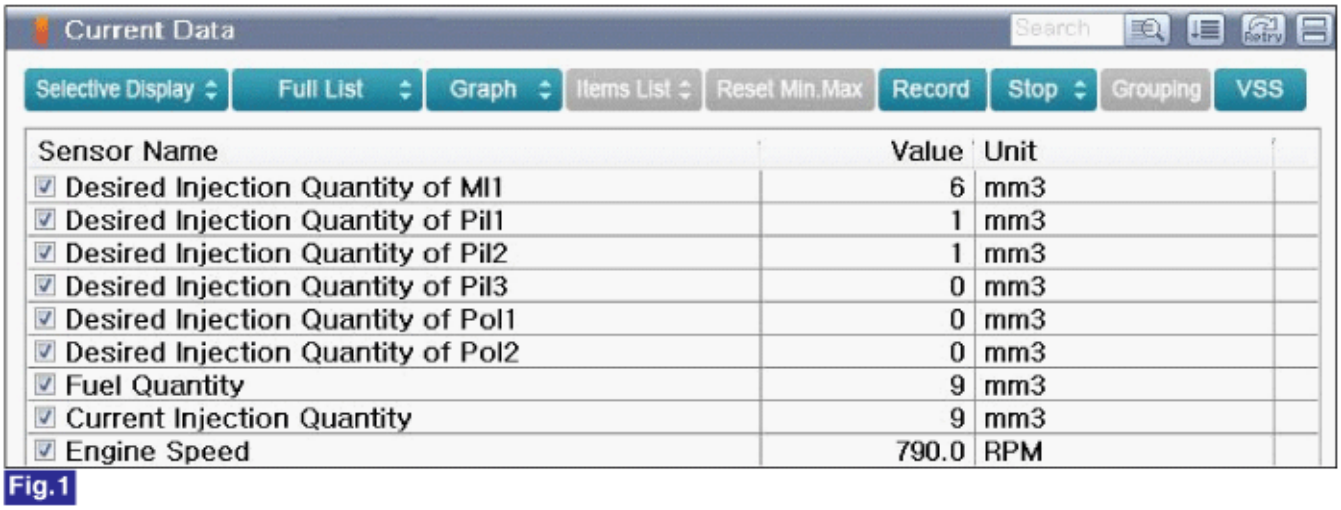
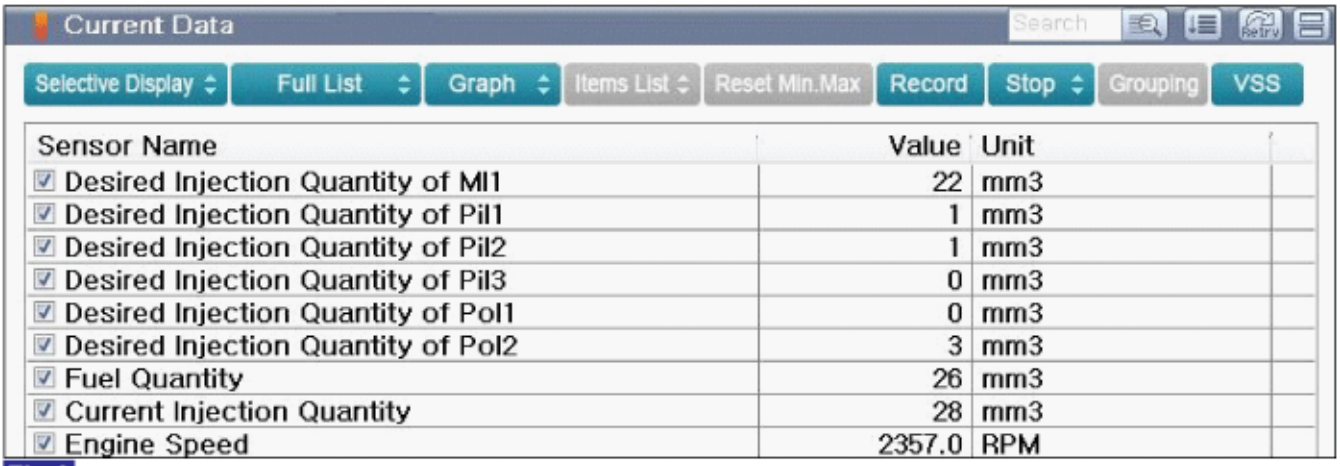


Fig.1

CRC12EN5010P02010022S



Sensor Name	Value	Unit
Desired Injection Quantity of MI1	22	mm3
Desired Injection Quantity of PiI1	1	mm3
Desired Injection Quantity of PiI2	1	mm3
Desired Injection Quantity of PiI3	0	mm3
Desired Injection Quantity of PoI1	0	mm3
Desired Injection Quantity of PoI2	3	mm3
Fuel Quantity	26	mm3
Current Injection Quantity	28	mm3
Engine Speed	2357.0	RPM

Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #1 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

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"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"

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

Specification : Approx. 5V

10. Is the measured value within specification?

YES ▸ Go to "Short in Injector Control Circuit Inspection" procedure.

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

■ **Short in Injector Control Circuit Inspection**

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect Injector and ECM connector.
4. Measure the resistance between low terminal and high terminal of injector #1 harness connector.

Specification : Infinite (∞ Ω)

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

■ **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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

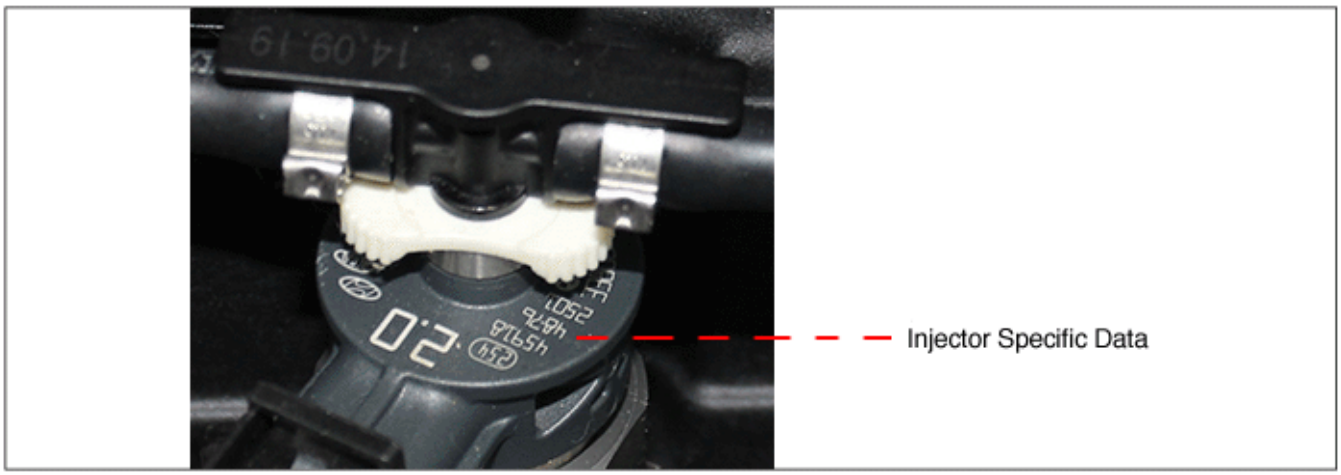
  Do not re-use high pressure fuel pipe.

  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

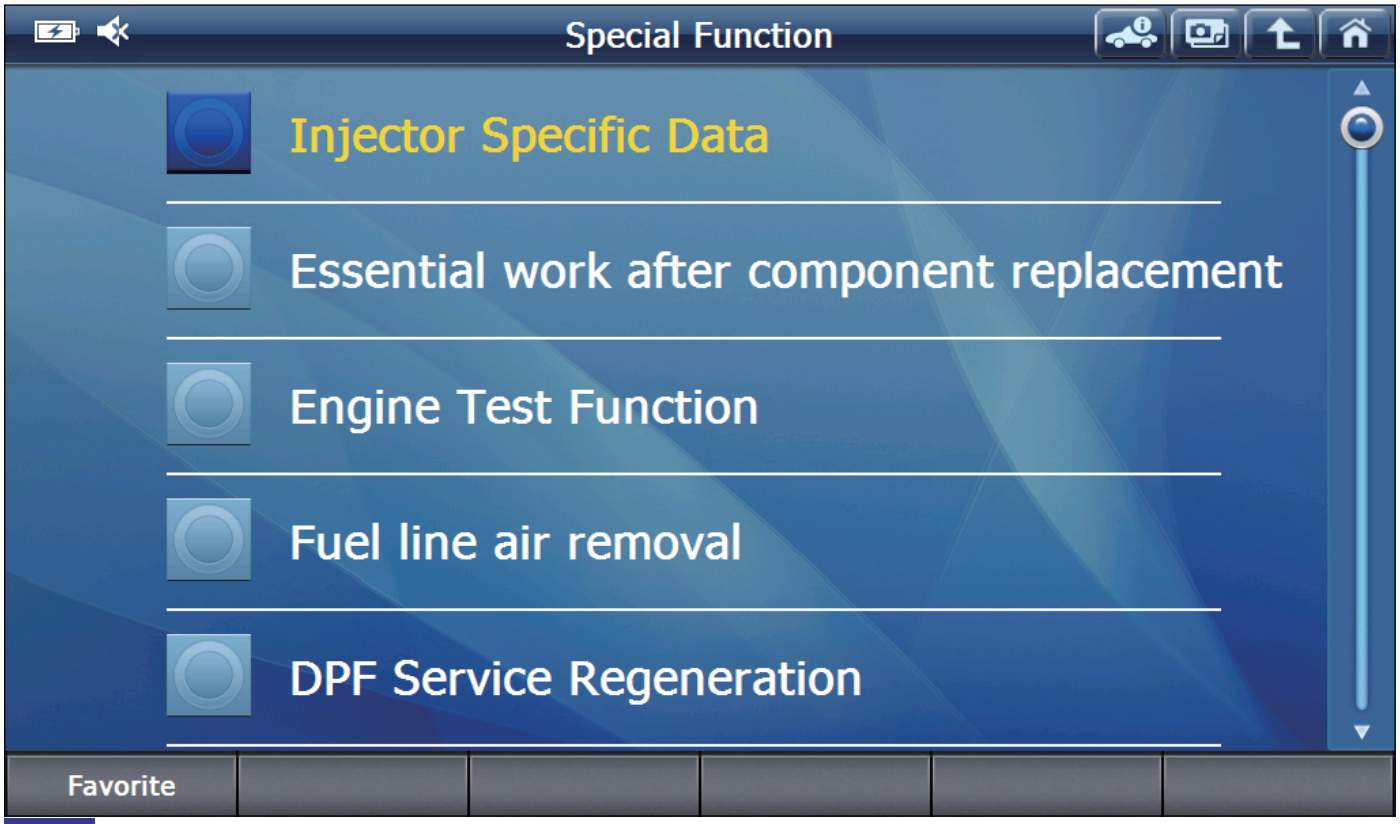


Fig.1

CRC12EN5010P02010041S

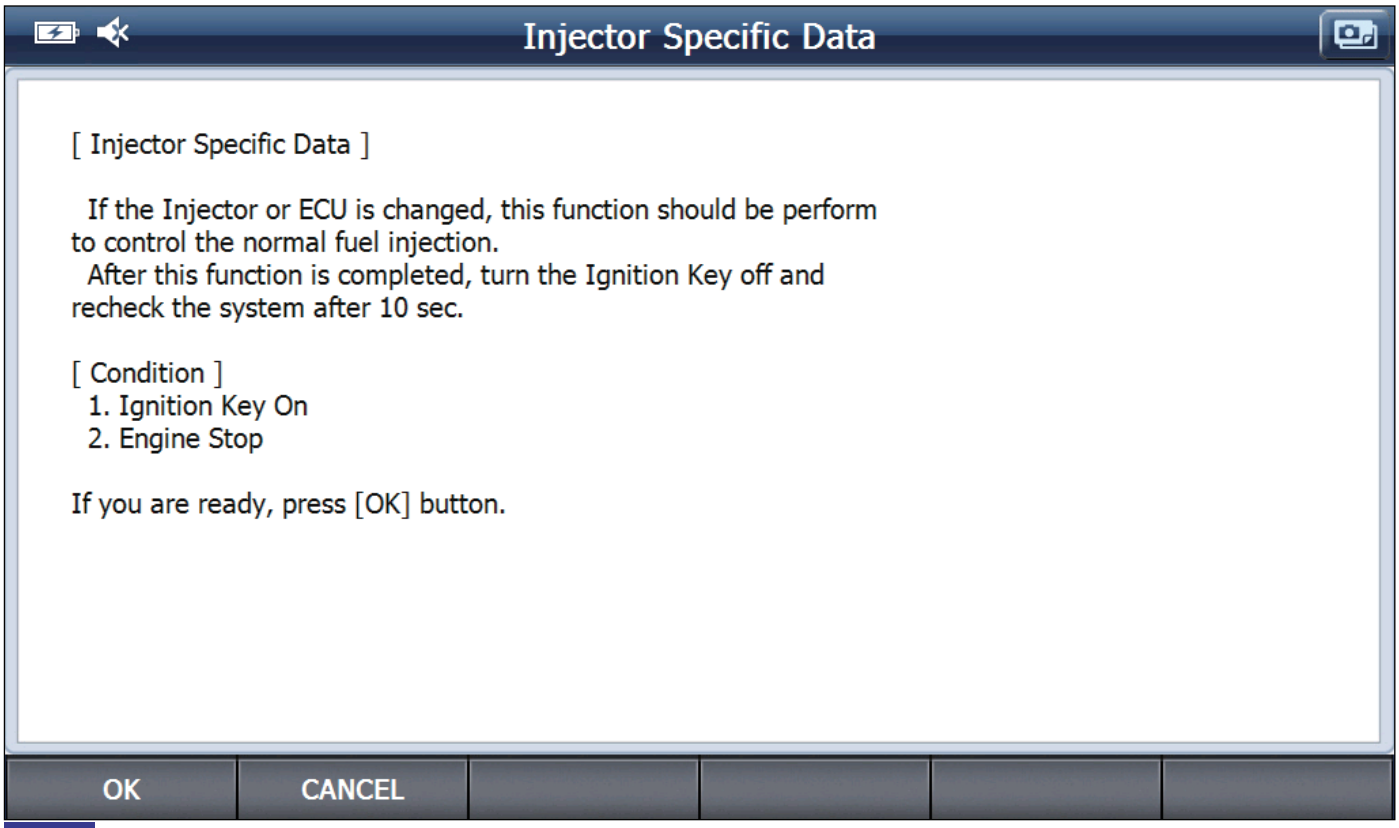


Fig.2

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.

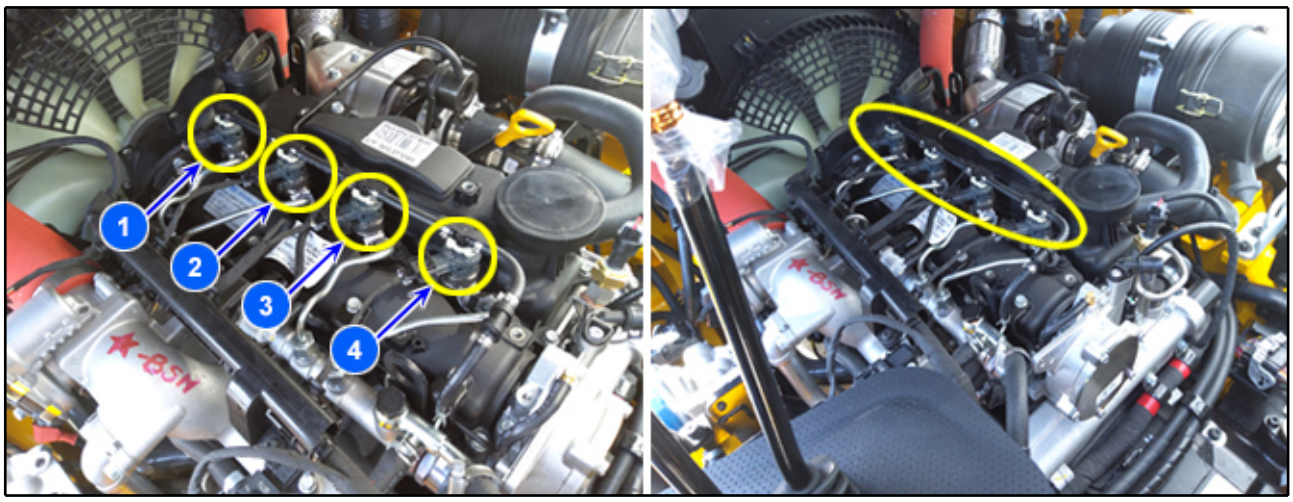
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P026500 Cylinder 2 Injector Circuit High

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short in injector #2 circuit 3. Defected injector #2
Enable Condition	• Engine running		
Threshold Value	• Short in injector circuit		
Detecting Time	• -		
Fail Safe	Engine Off	• Yes	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5. 0V	-
	2	Injector Control(Low)		Approx. 5. 0V	-

Signal Waveform & Data

Fig.1

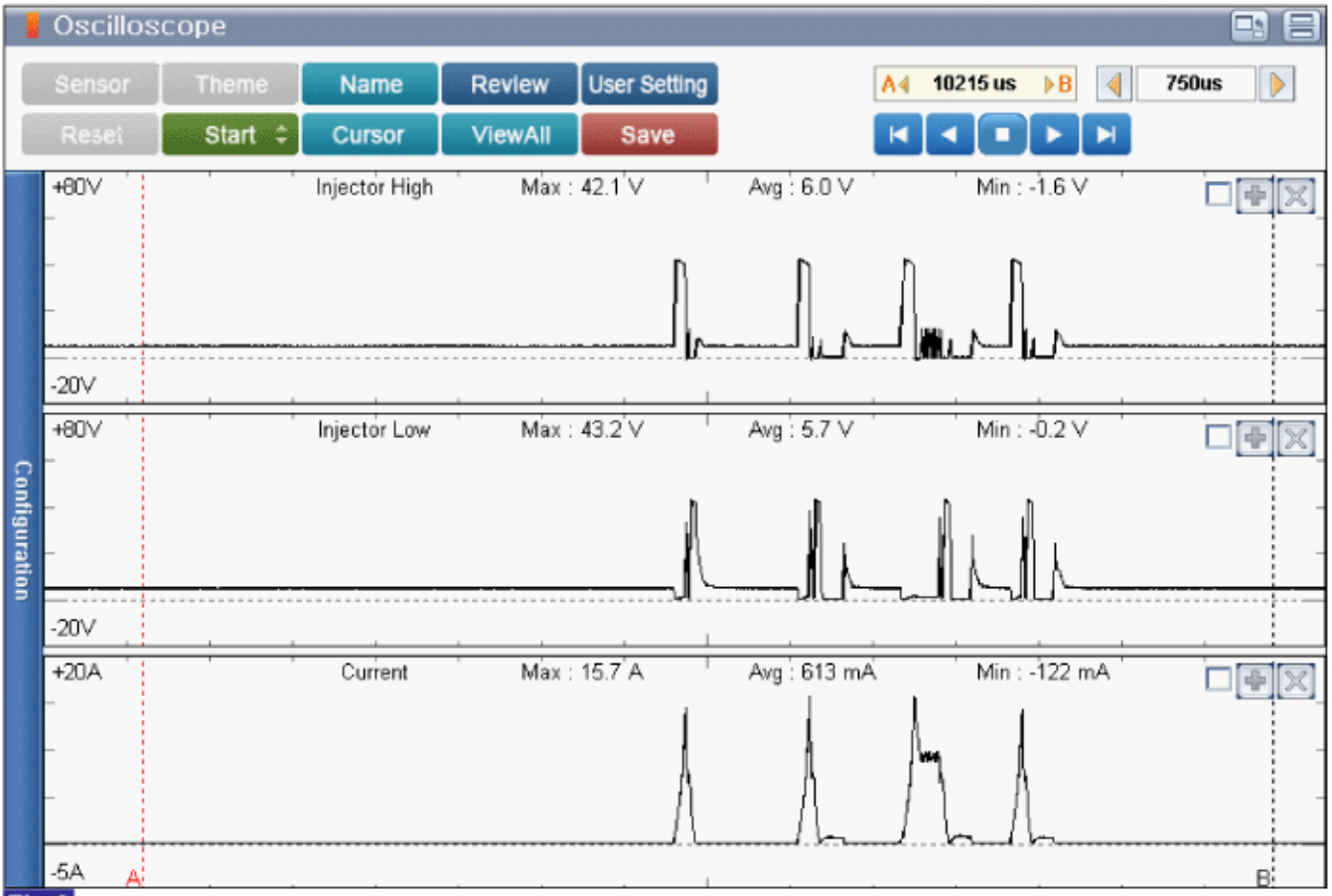


Fig.2

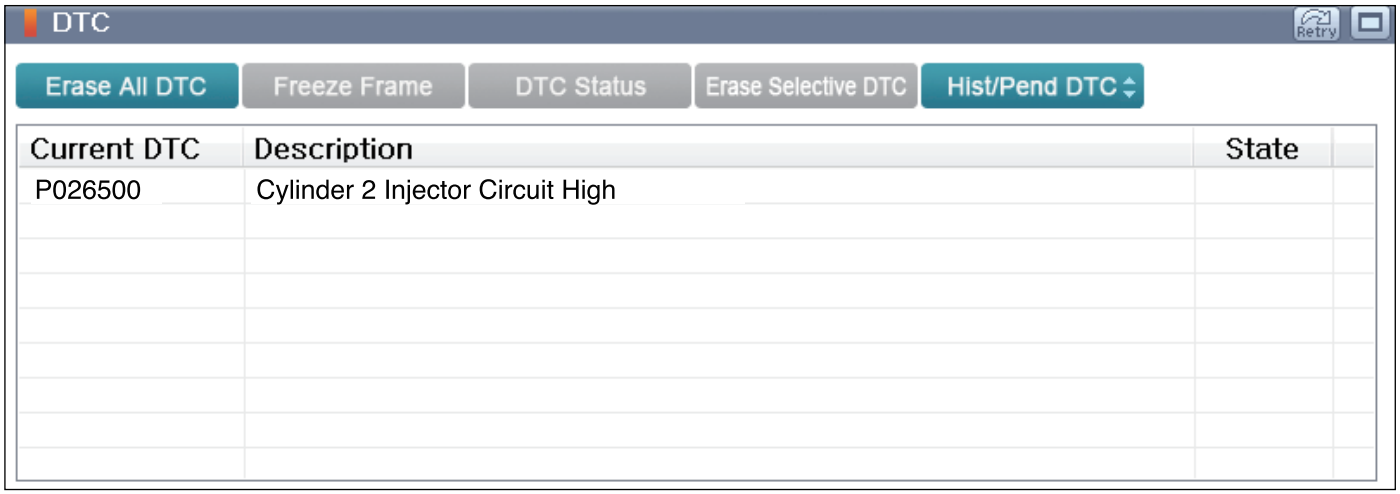
CRC12EN5010P02010012S

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.**



CRC12EN5010P02650021S

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

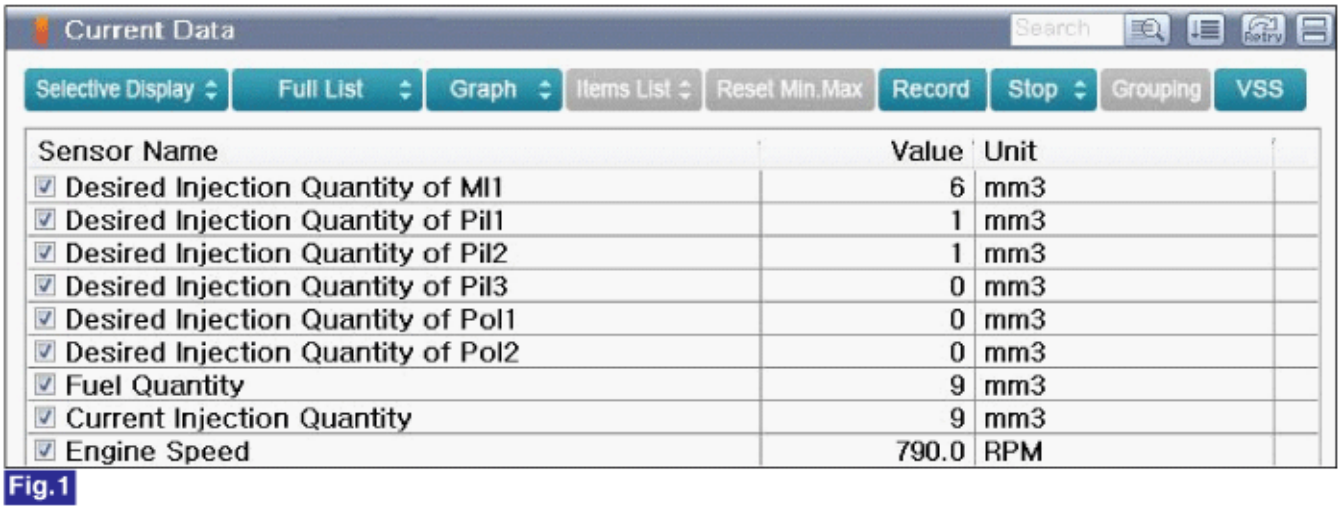


Fig.1

CRC12EN5010P02010022S

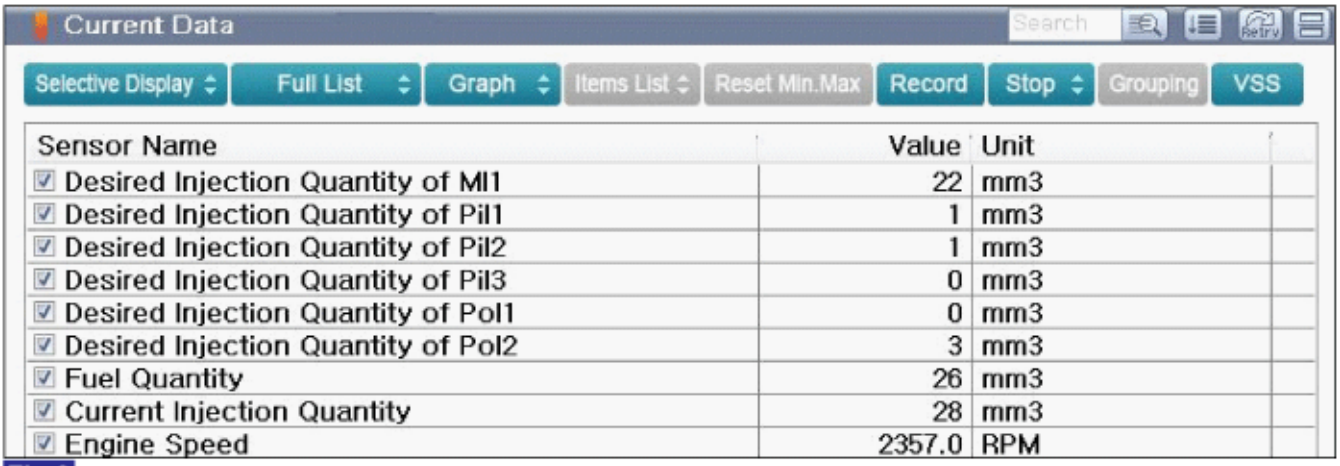


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #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

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"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"

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

Specification : Approx. 5V

10. Is the measured value within specification?

YES ▸ Go to "Short in Injector Control Circuit Inspection" procedure.

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

■ **Short in Injector Control Circuit Inspection**

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect Injector and ECM connector.
4. Measure the resistance between low terminal and high terminal of injector #2 harness connector.

Specification : Infinite (∞ Ω)

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

■ **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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

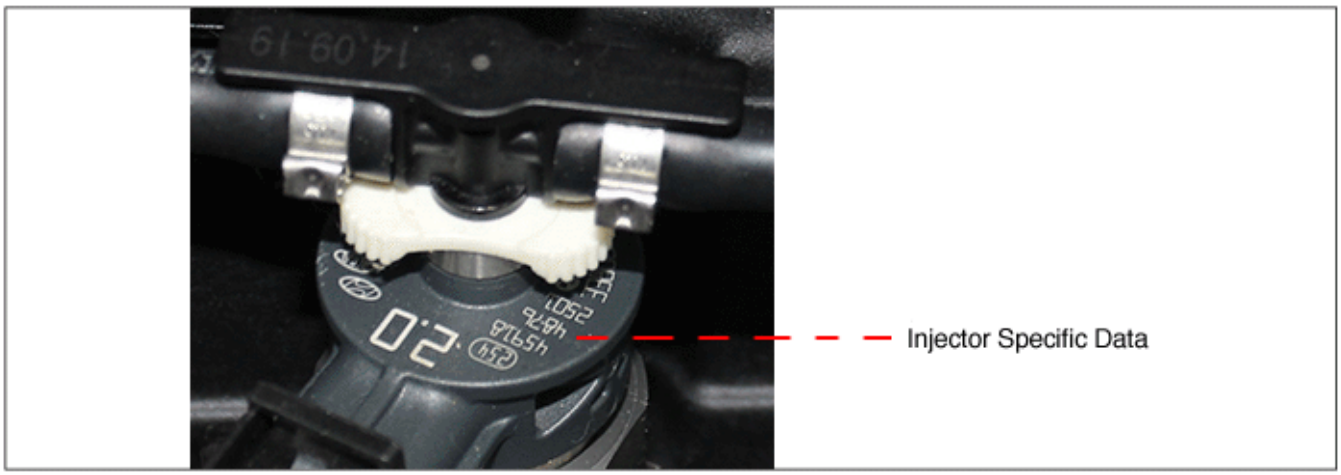
  Do not re-use high pressure fuel pipe.

  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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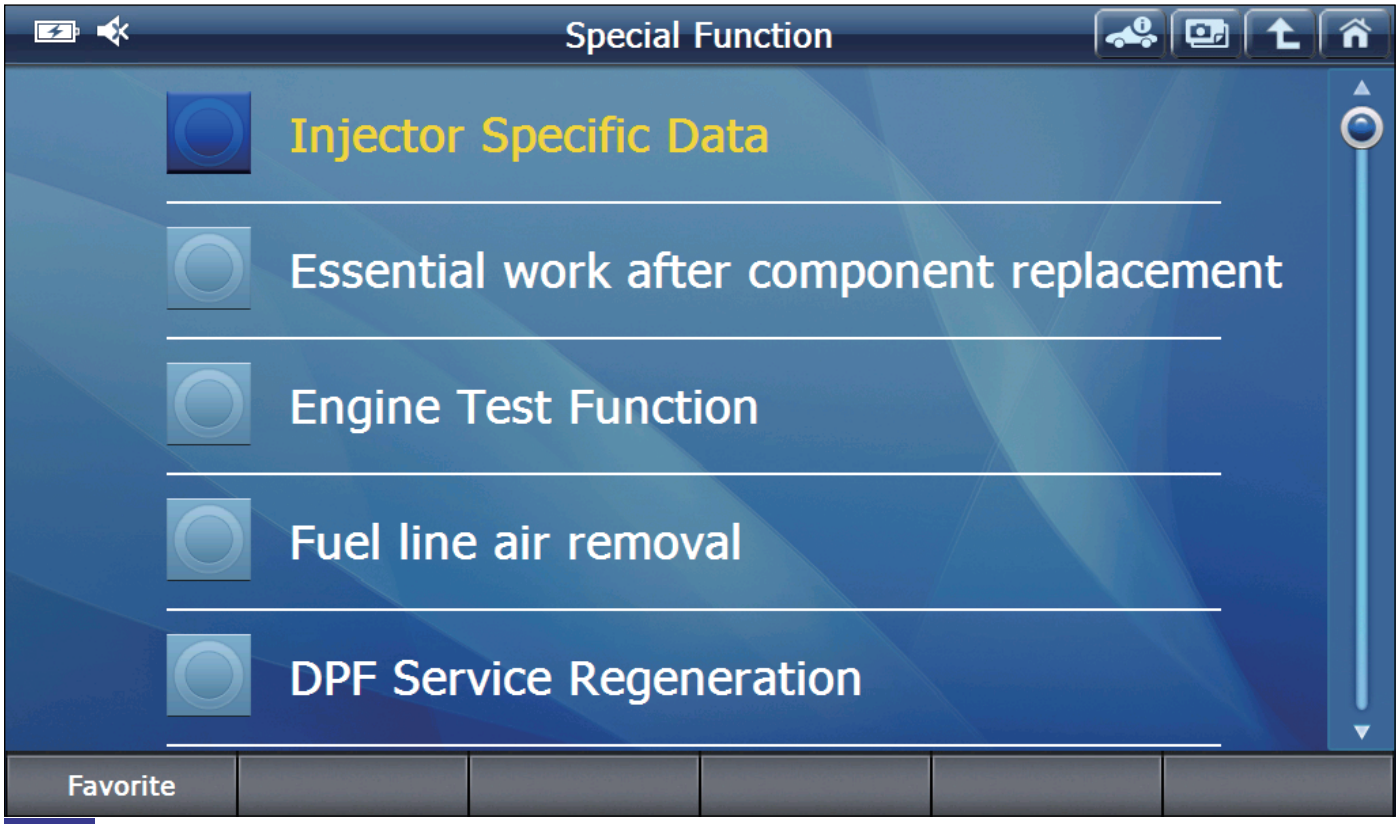


Fig.1

CRC12EN5010P02010041S

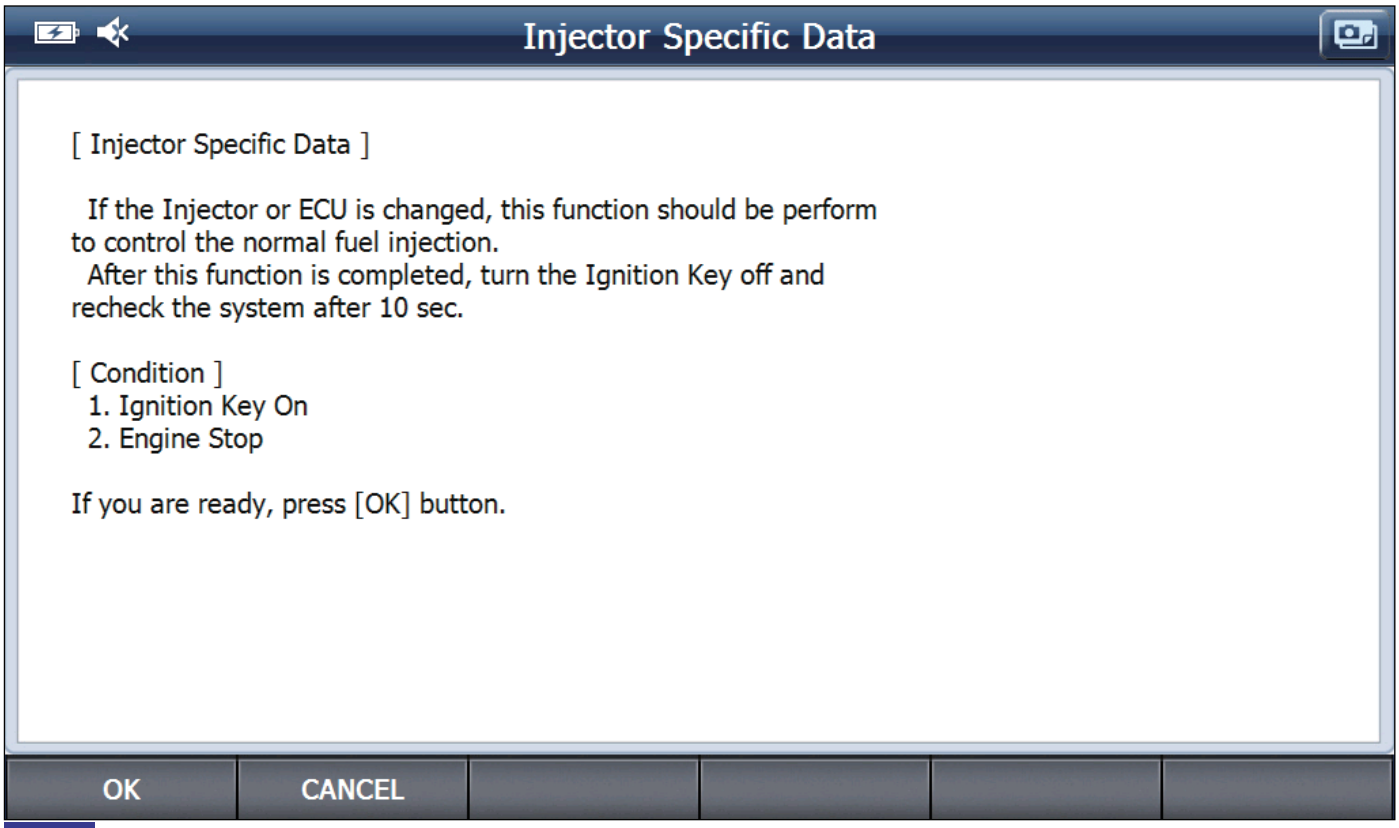


Fig.2

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.

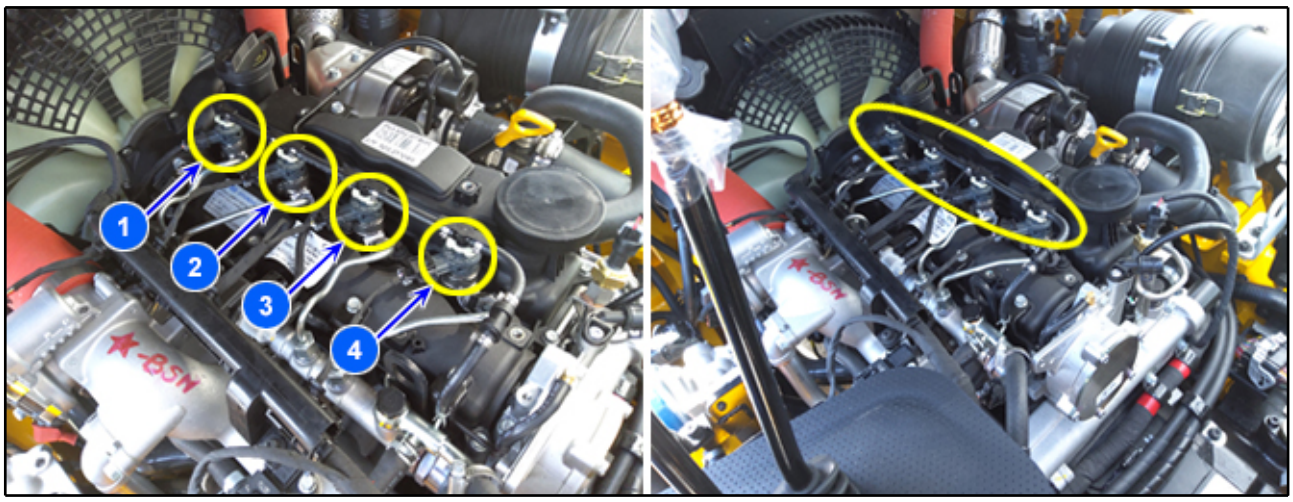
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P026800 Cylinder 3 Injector Circuit High

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short in injector #3 circuit 3. Defected injector #3
Enable Condition	• Engine running		
Threshold Value	• Short in injector circuit		
Detecting Time	• -		
Fail Safe	Engine Off	• Yes	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5. 0V	-
	2	Injector Control(Low)		Approx. 5. 0V	-

Signal Waveform & Data

Fig.1

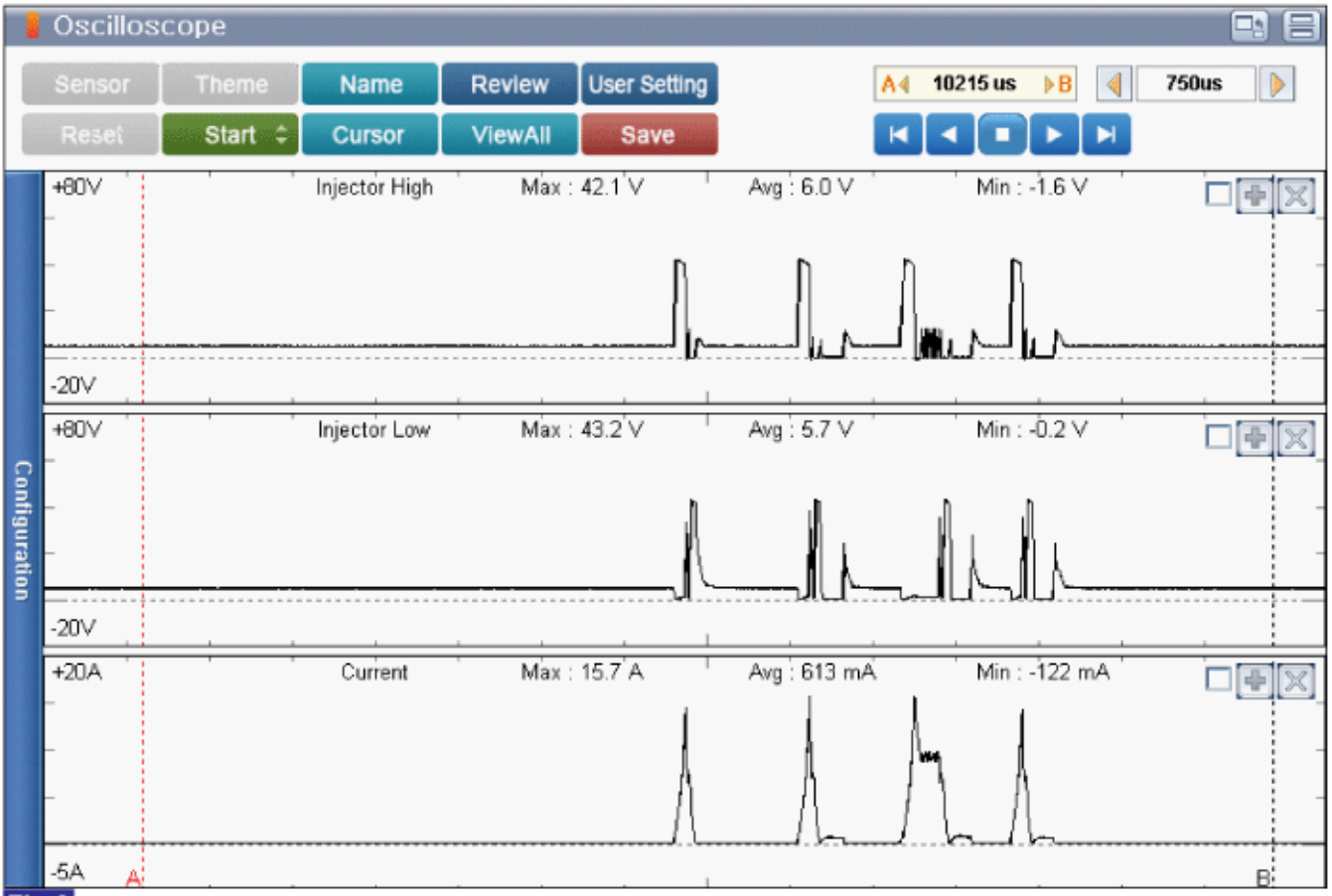


Fig.2

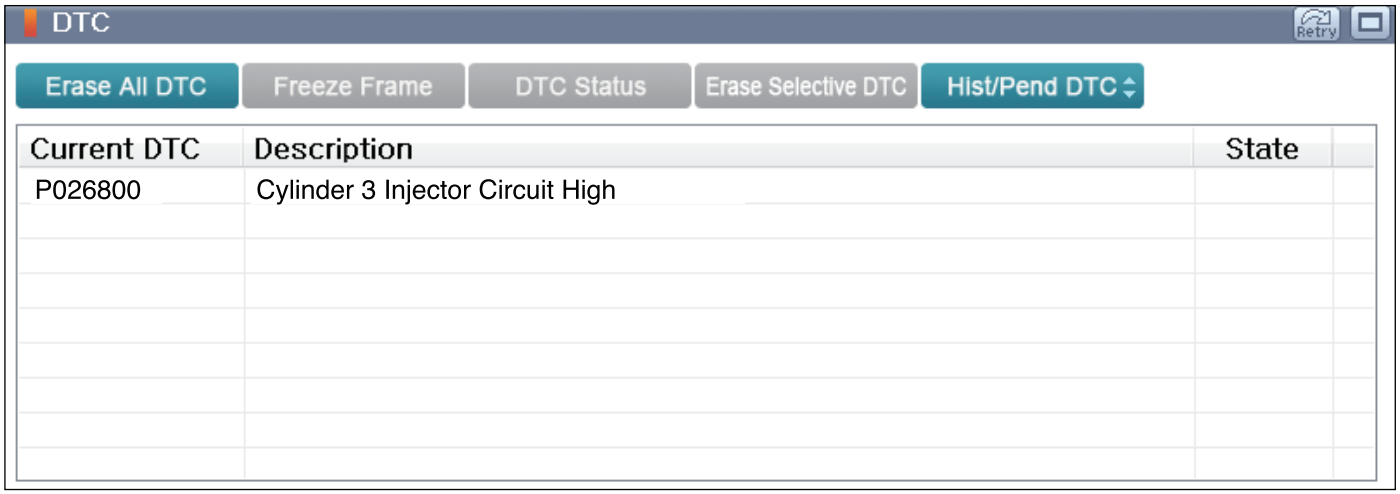
CRC12EN5010P02010012S

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.**



CRC12EN5010P02680021S

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

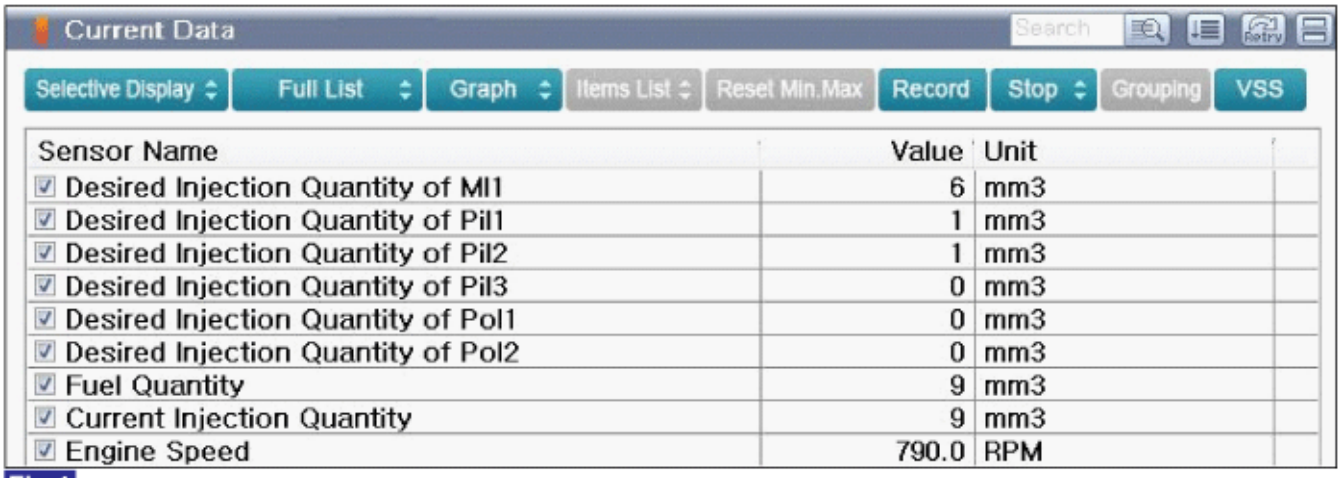


Fig.1

CRC12EN5010P02010022S

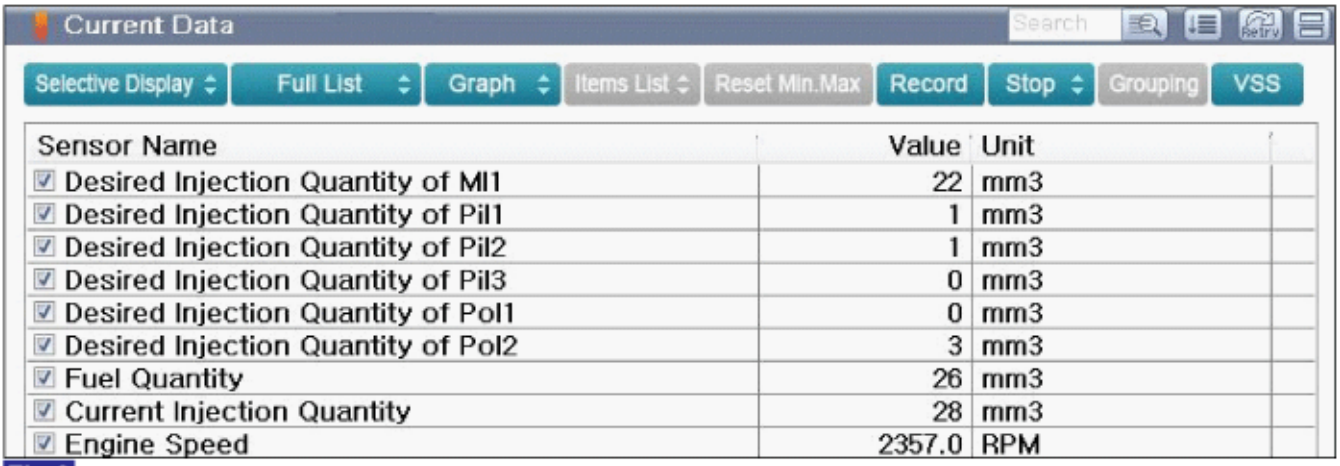


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #3 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

5. Ignition Switch "OFF"
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
8. Ignition switch "ON"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"

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

Specification : Approx. 5V

10. Is the measured value within specification?

YES ▸ Go to "Short in Injector Control Circuit Inspection" procedure.

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

■ **Short in Injector Control Circuit Inspection**

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect Injector and ECM connector.
4. Measure the resistance between low terminal and high terminal of injector #3 harness connector.

Specification : Infinite (∞ Ω)

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

■ **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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

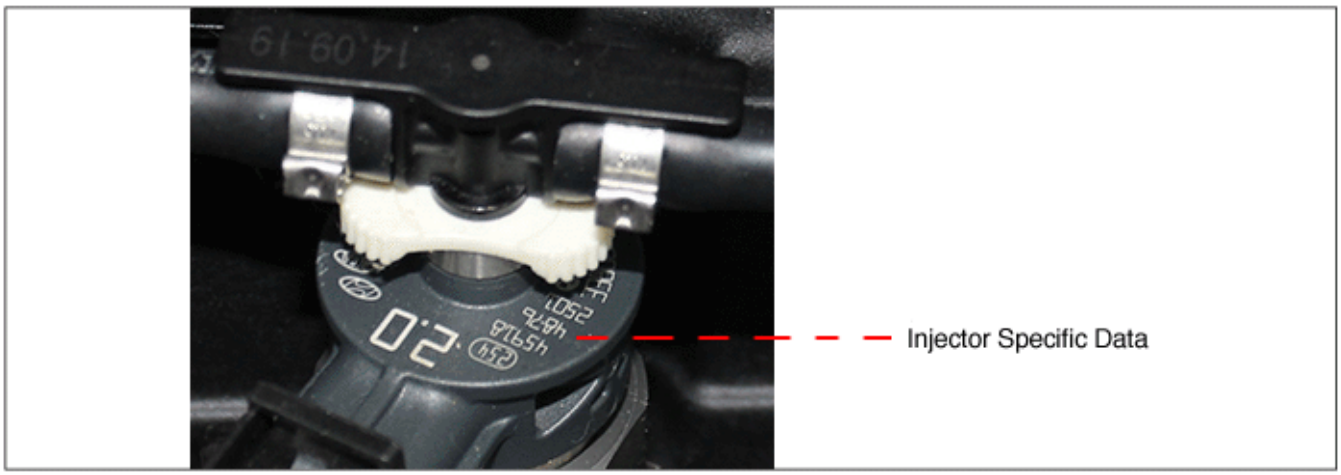
  Do not re-use high pressure fuel pipe.

  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

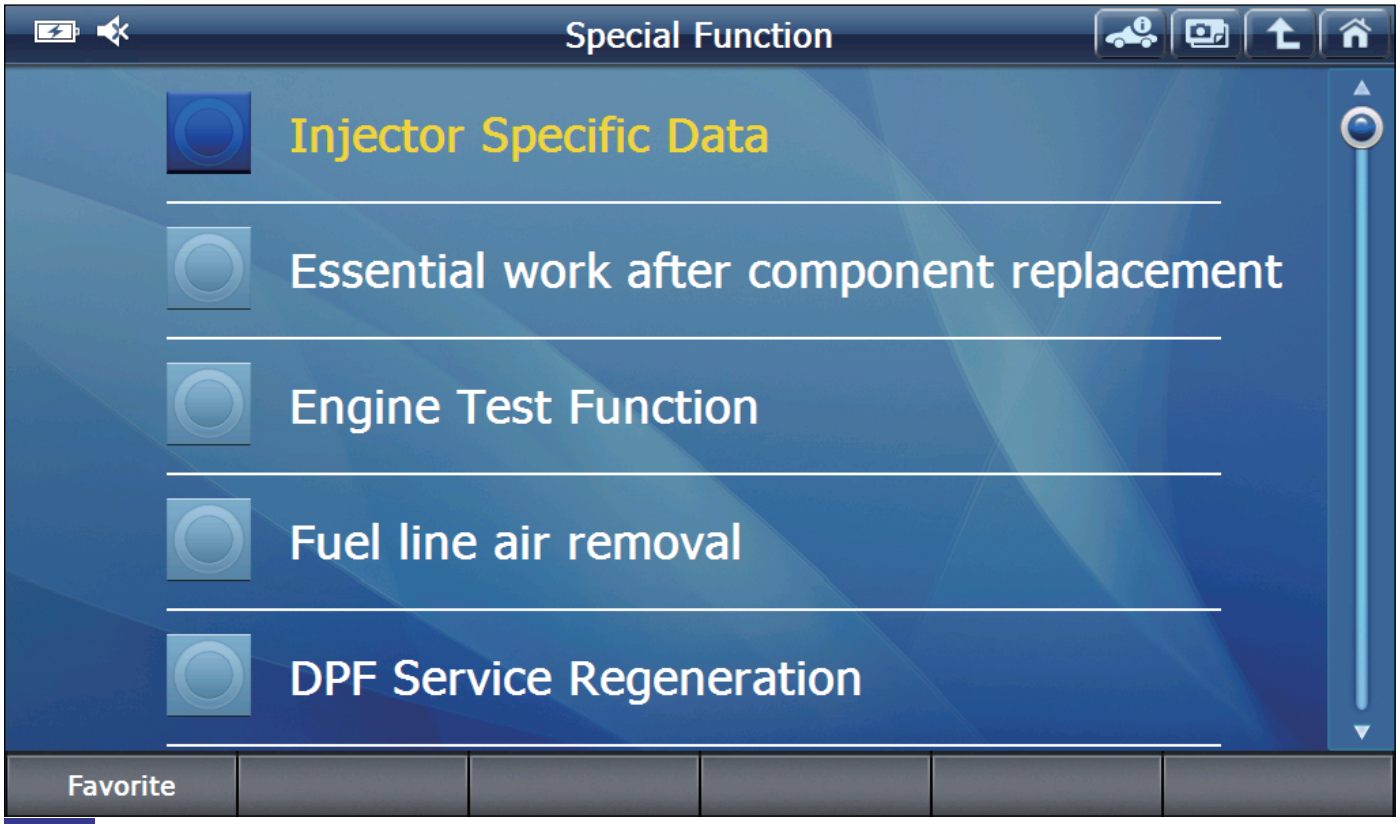


Fig.1

CRC12EN5010P02010041S

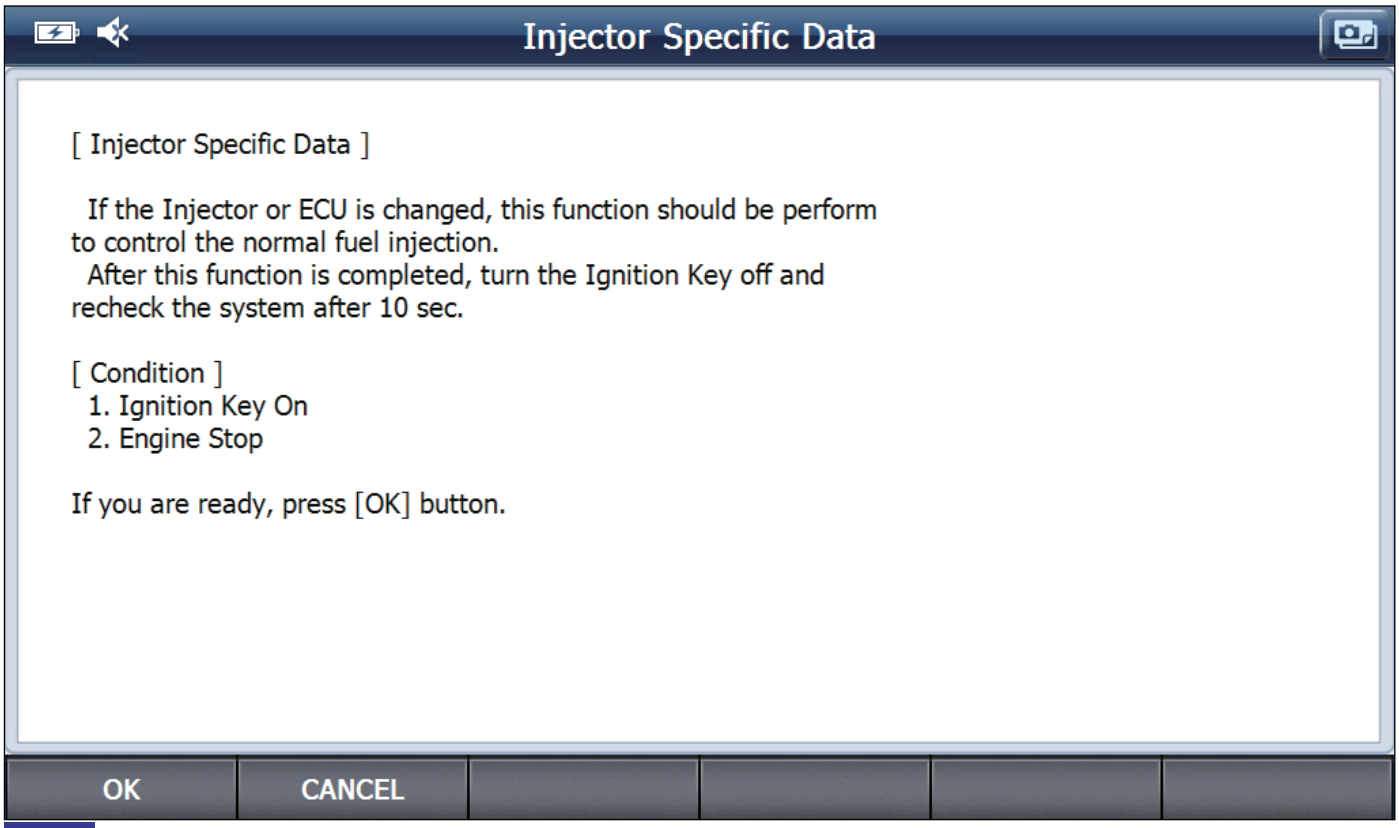


Fig.2

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.

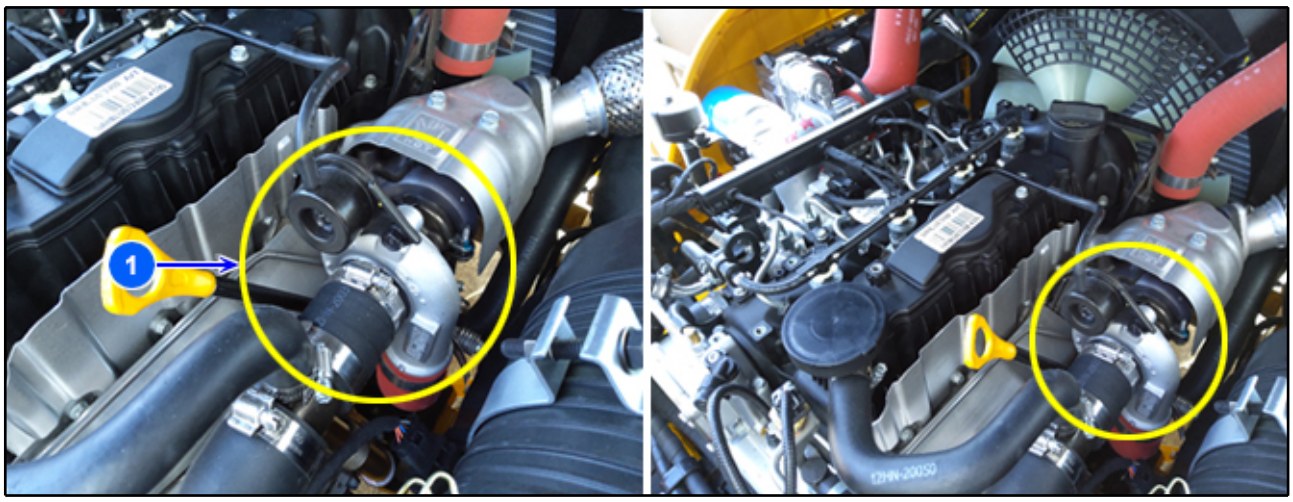
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

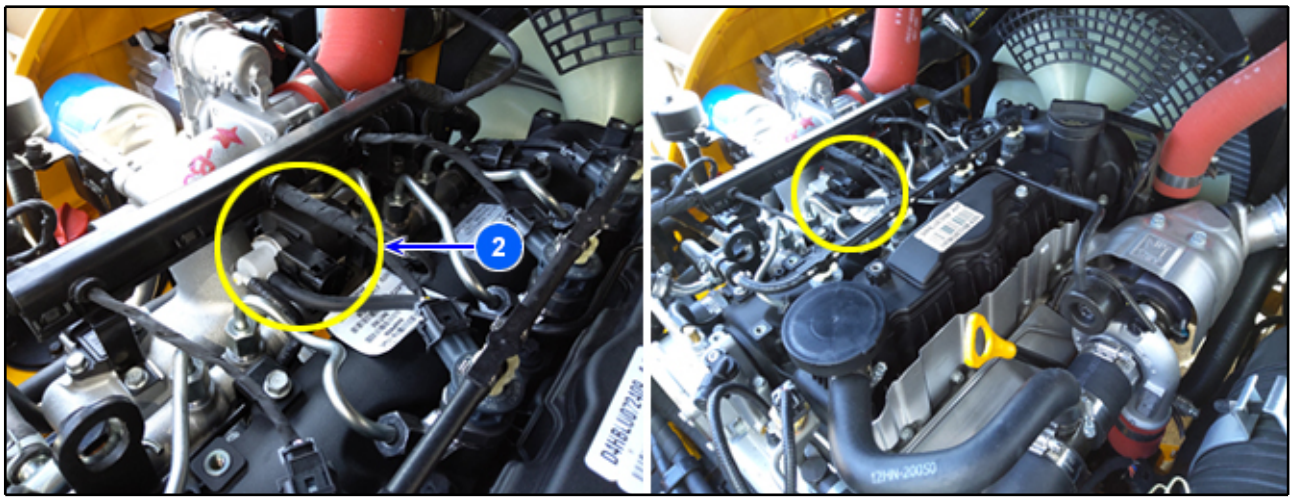
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P026A00 Charge Air Cooler Efficiency Below Threshold

Component Location



CRC12EN5010P004711



CRC12EN5010P004712

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 state of air compression.

DTC Description

If the efficient of inter-cooler is below threshold value, ECM sets DTC P026A00.

DTC Detecting Condition

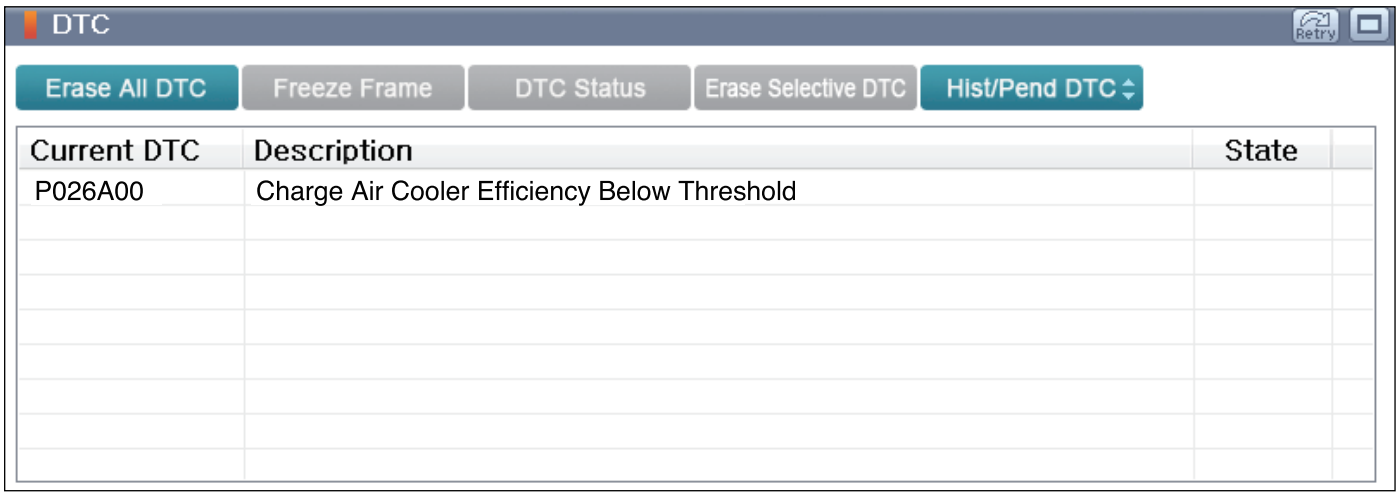
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Defected intake air temperature sensor #2 3. Defected inter-cooler
Enable Condition	• Engine running		
Threshold Value	• Efficient of inter-cooler is below threshold value		
Detecting Time	• 220 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

VGT Control Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	VGT Actuator Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	-
	2	VGT Actuator Control		Approx. 3.4V	-

Monitor DTC Status

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



CRC12EN5010P026A0021S

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

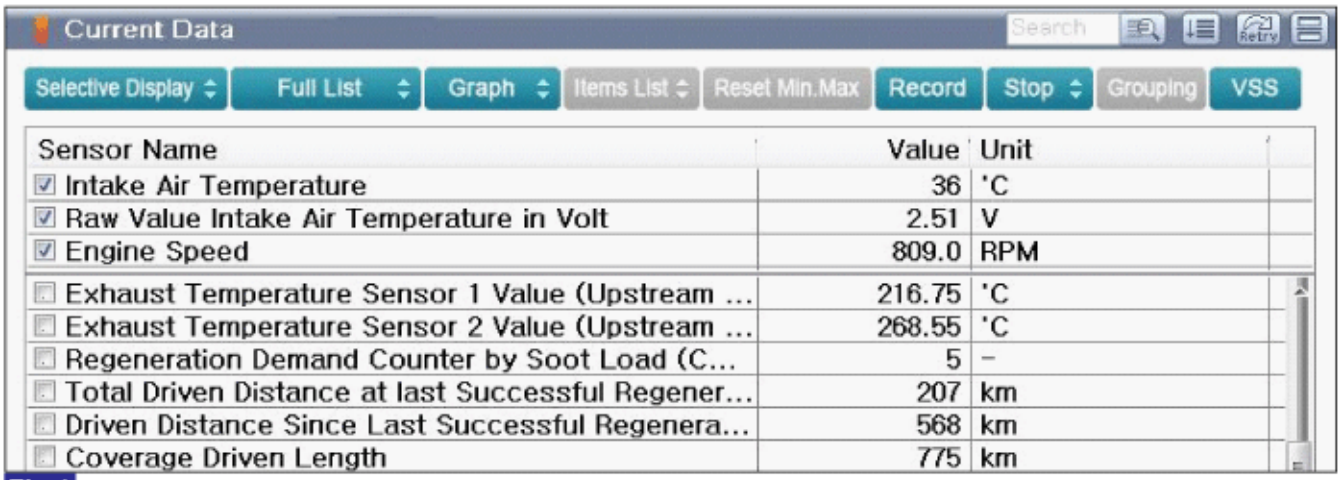


Fig.1

CRC12EN5010P00970022S

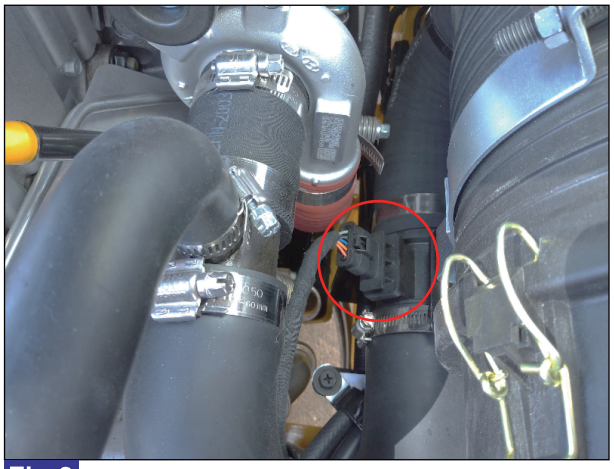


Fig.2


Fig.3

CRC12EN5010P01120023S

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.

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 "Ground Circuit Inspection" procedure .

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"
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 "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 for following conditions;

   - Proper installation of hose/pipe.
   - Condition of hose/pipe (Distortion, damage, tear or proper installation).
   - Any other abnormal condition of hose/pipe.
   - Proper installation of clamps.

3. Inspect inter-cooler for following conditions;

   - leakage on inter-cooler and tube(Leakage, crack or any other damage).

4. Inspect for leakage or crack between center housing of turbo-charger and compressor housing.
5. Have any problems been found?

YES ▸ Go to "Component Inspection" procedure.

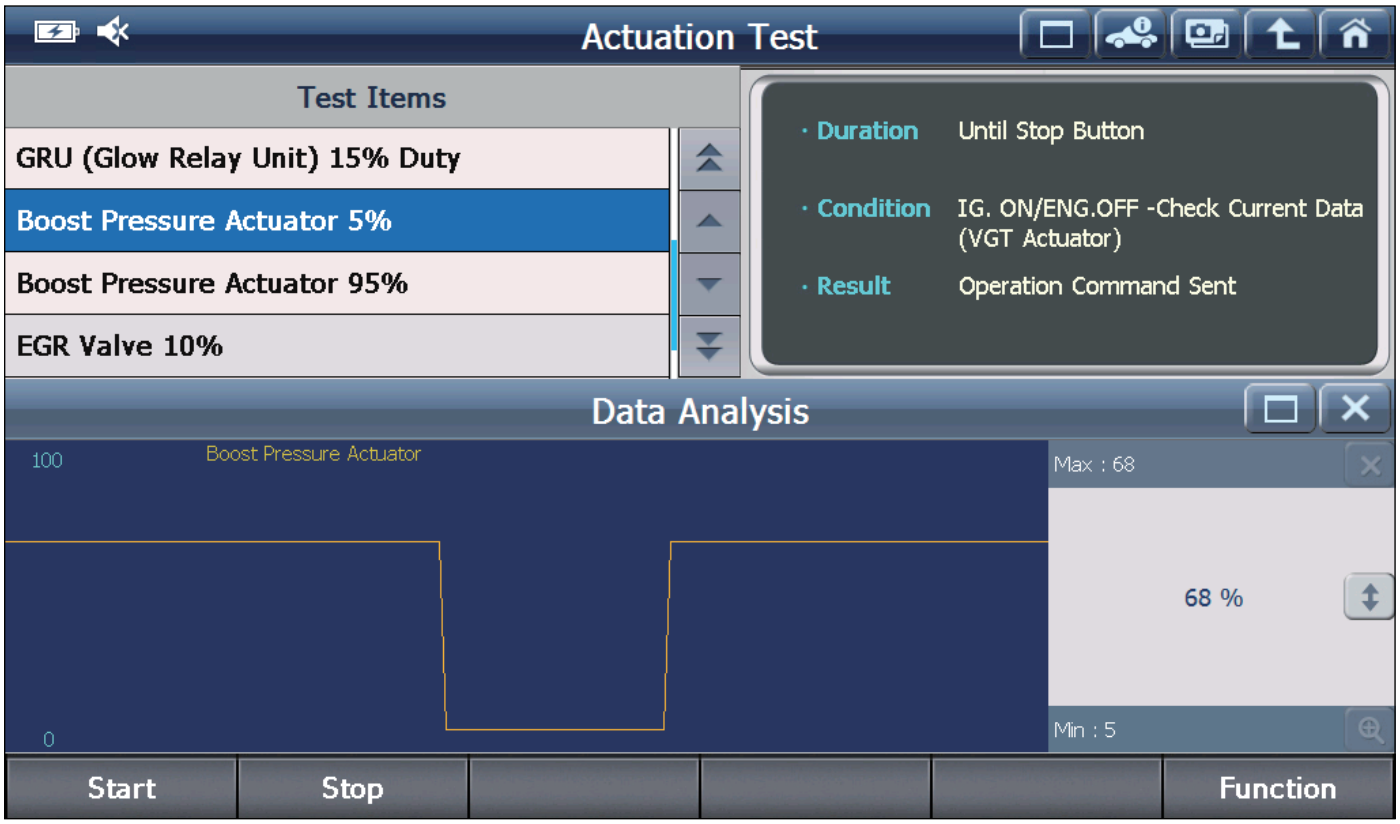
NO ▸ Repair as necessary and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

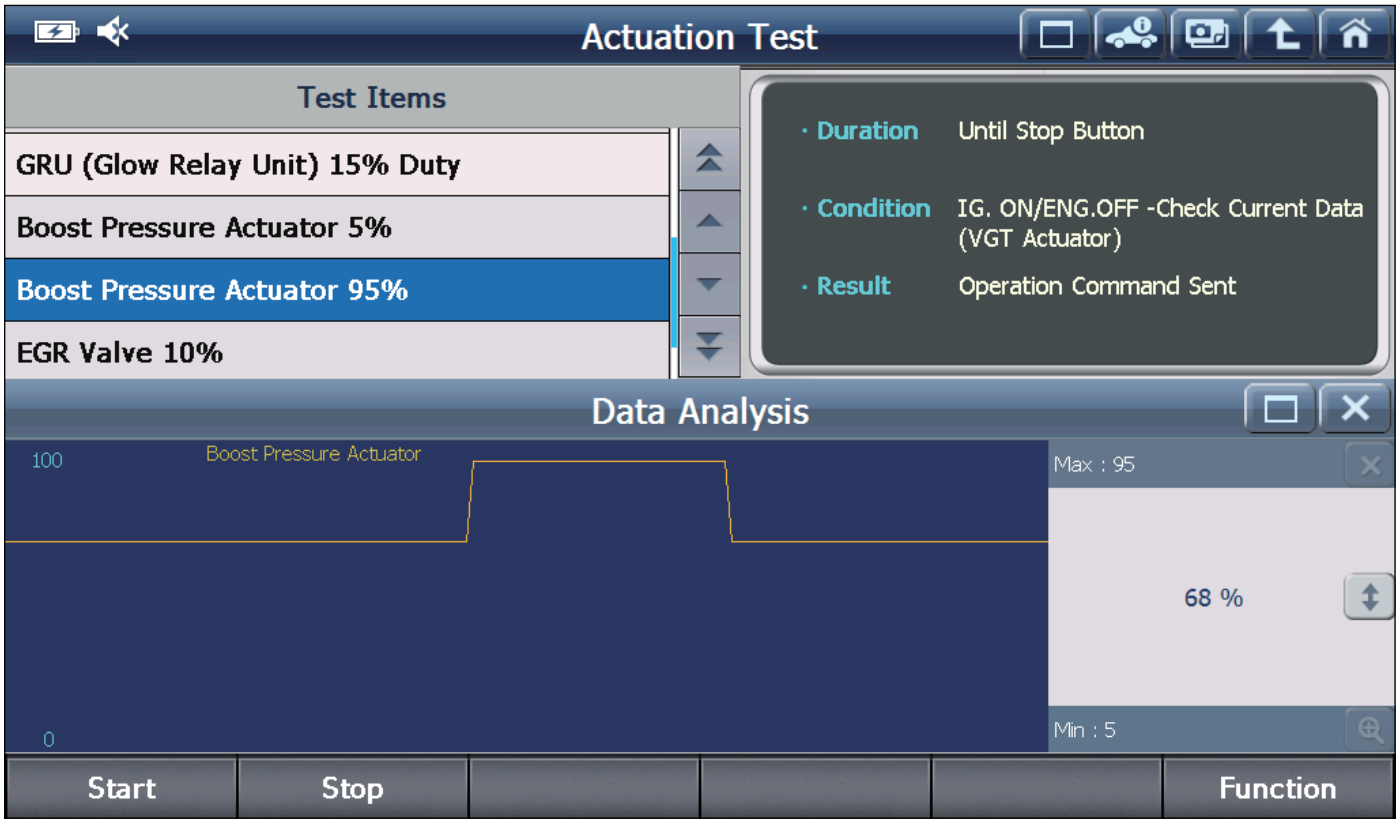
■ **Actuation Test**

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



CRC12EN5010P00470041S



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.

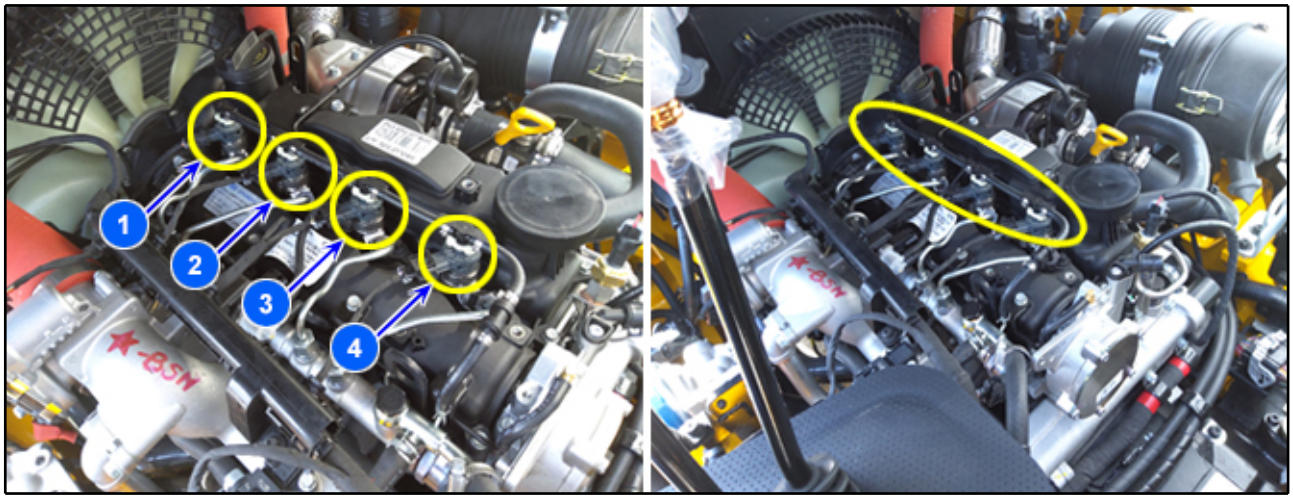
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P027100 Cylinder 4 Injector Circuit High

Component Location



CRC12EN5010P02010011

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 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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short in injector #4 circuit 3. Defected injector #4
Enable Condition	• Engine running		
Threshold Value	• Short in injector circuit		
Detecting Time	• -		
Fail Safe	Engine Off	• Yes	
	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" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5. 0V	-
	2	Injector Control(Low)		Approx. 5. 0V	-

Signal Waveform & Data

Fig.1

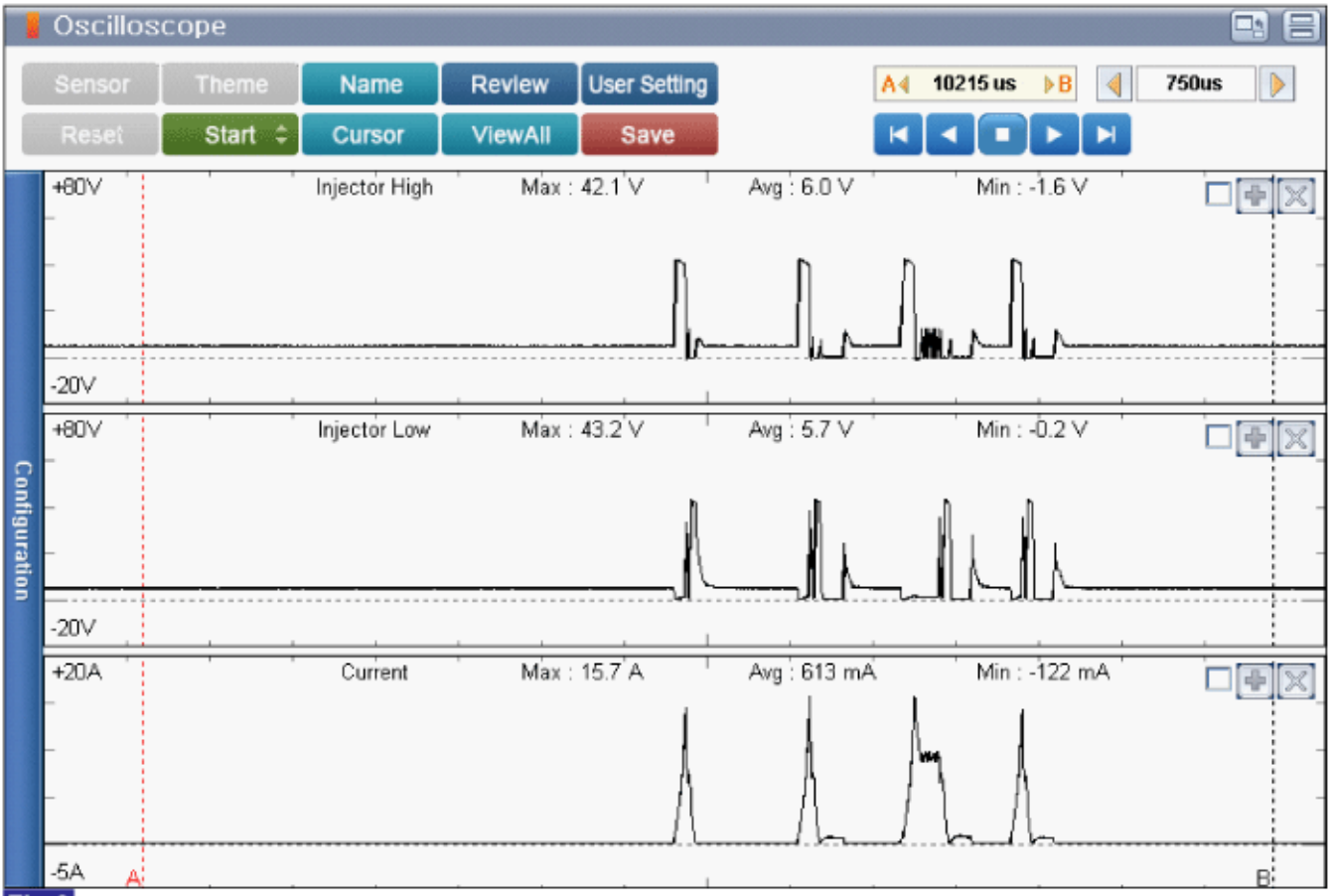


Fig.2

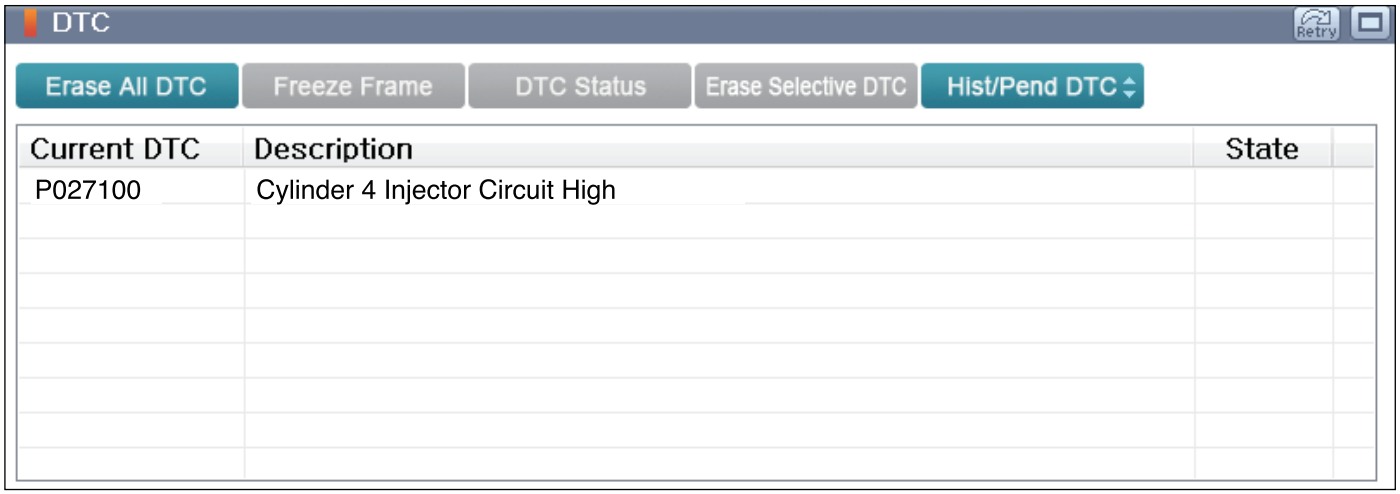
CRC12EN5010P02010012S

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.**



CRC12EN5010P02710021S

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

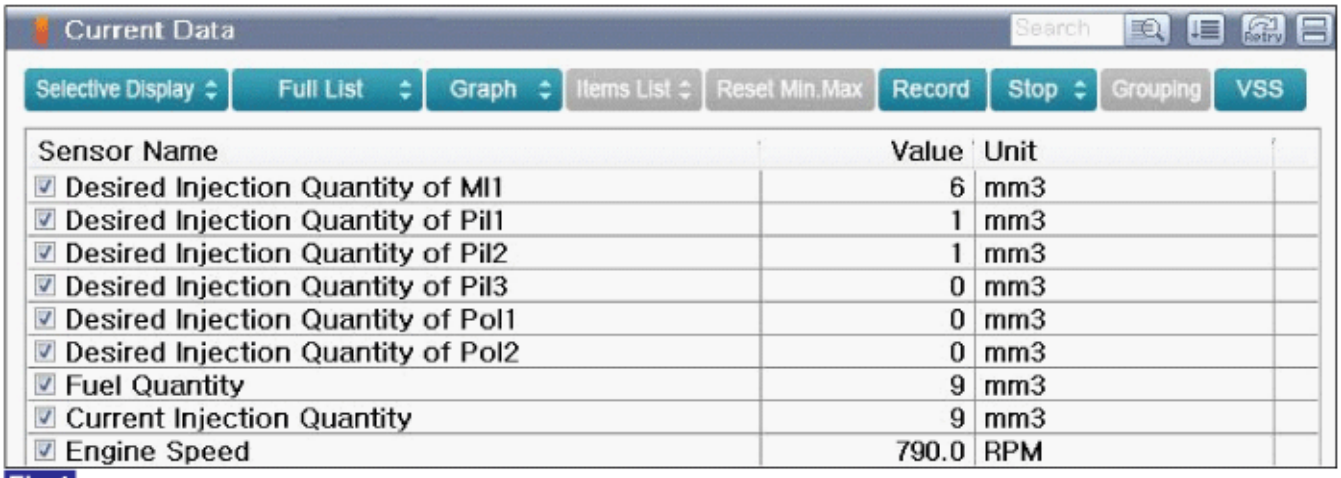


Fig.1

CRC12EN5010P02010022S

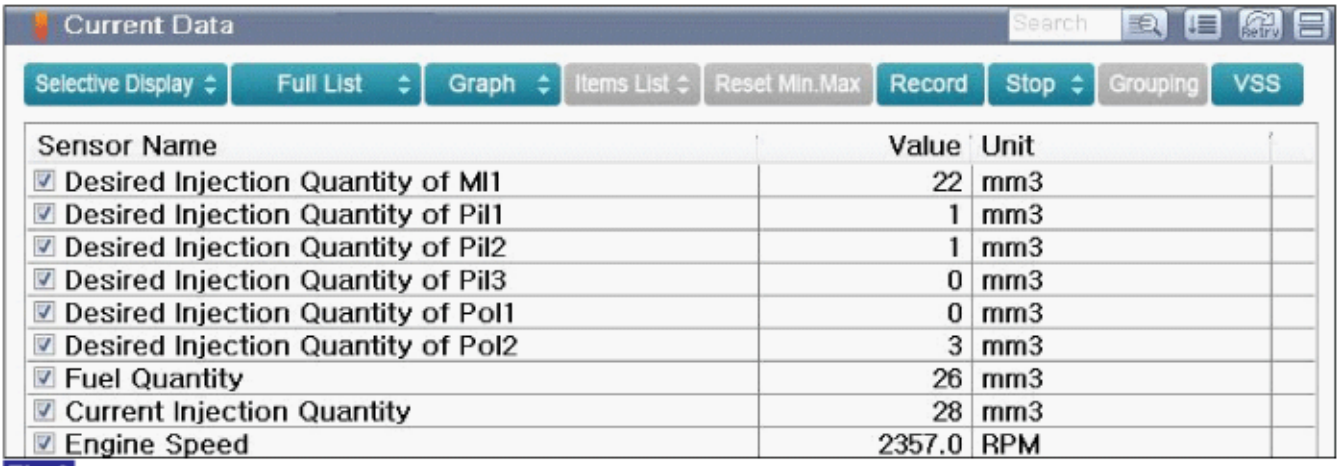


Fig.2

CRC12EN5010P02010023S

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

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and disconnect injector #4 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

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
8. Ignition switch "ON"
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.

NO ▸ Inspect and repair open or short in circuit, and 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"

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

Specification : Approx. 5V

10. Is the measured value within specification?

YES ▸ Go to "Short in Injector Control Circuit Inspection" procedure.

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

■ **Short in Injector Control Circuit Inspection**

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect Injector and ECM connector.
4. Measure the resistance between low terminal and high terminal of injector #4 harness connector.

Specification : Infinite (∞ Ω)

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

■ **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

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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 "Component Resistance Measurement" procedure.

■ Component Resistance Measurement

1. Ignition Switch "OFF"
2. Disconnect battery (-) cable.
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℃/68℉)

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.

⚠ CAUTION

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

⚠ CAUTION

- 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;

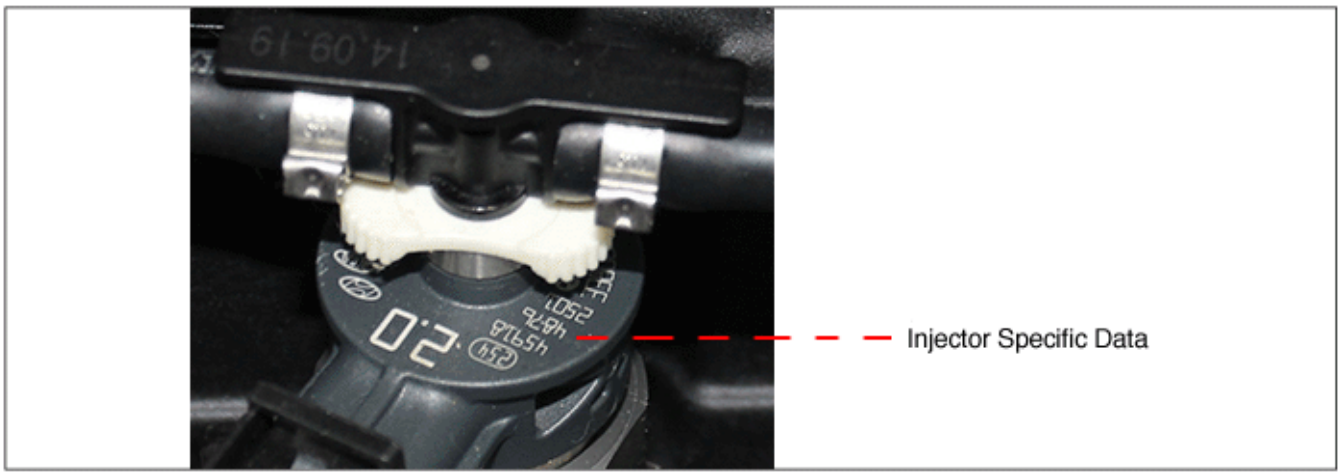
  Do not re-use high pressure fuel pipe.

  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

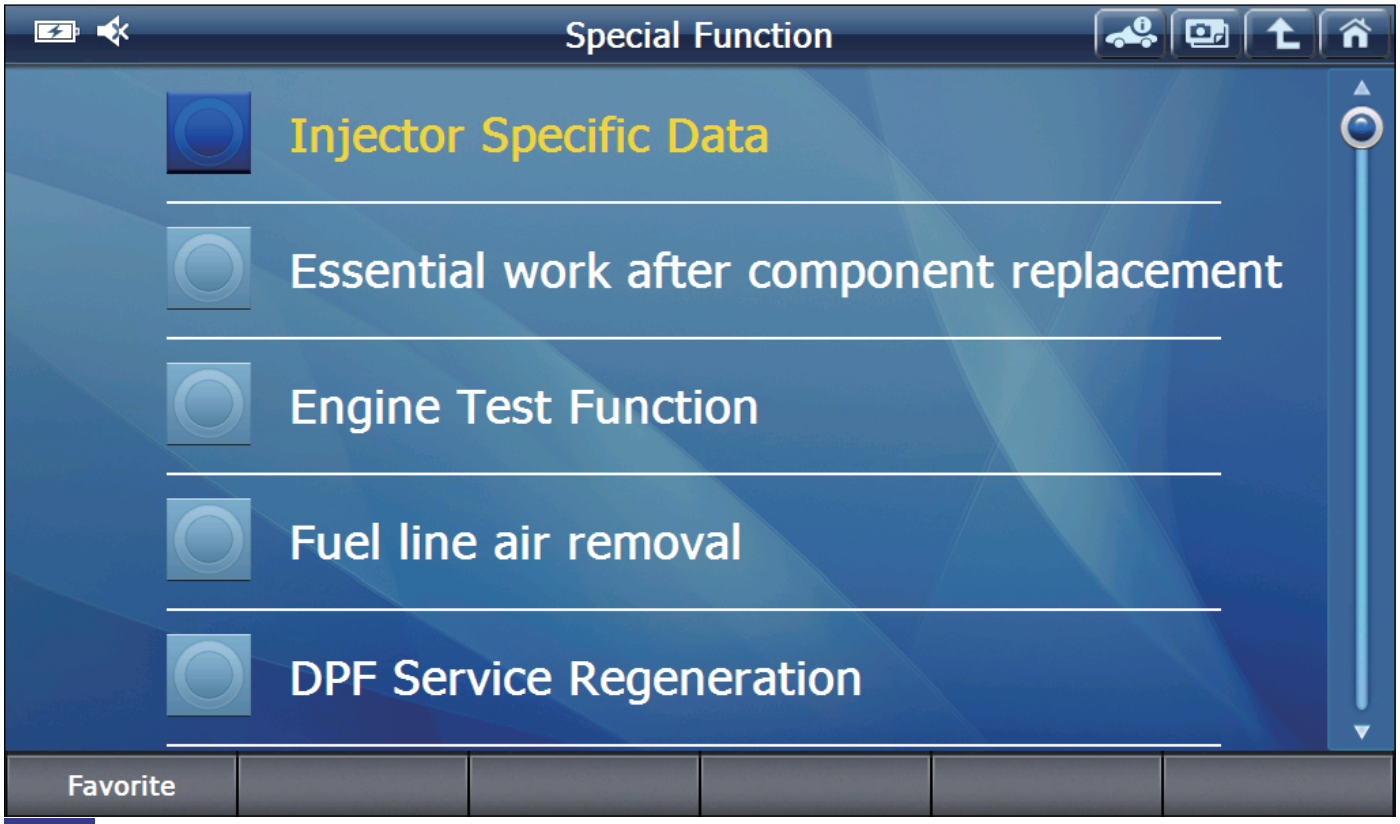


Fig.1

CRC12EN5010P02010041S

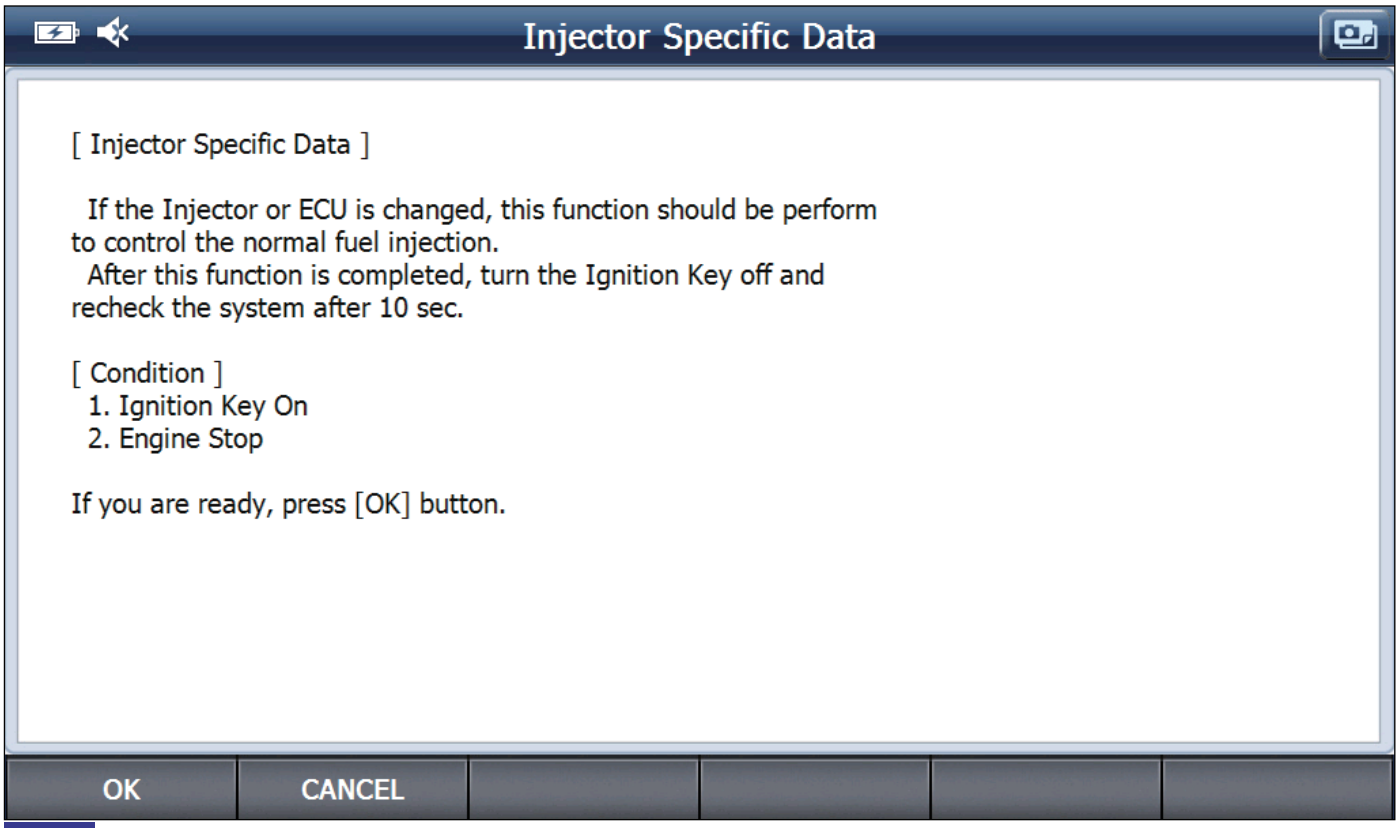


Fig.2

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.

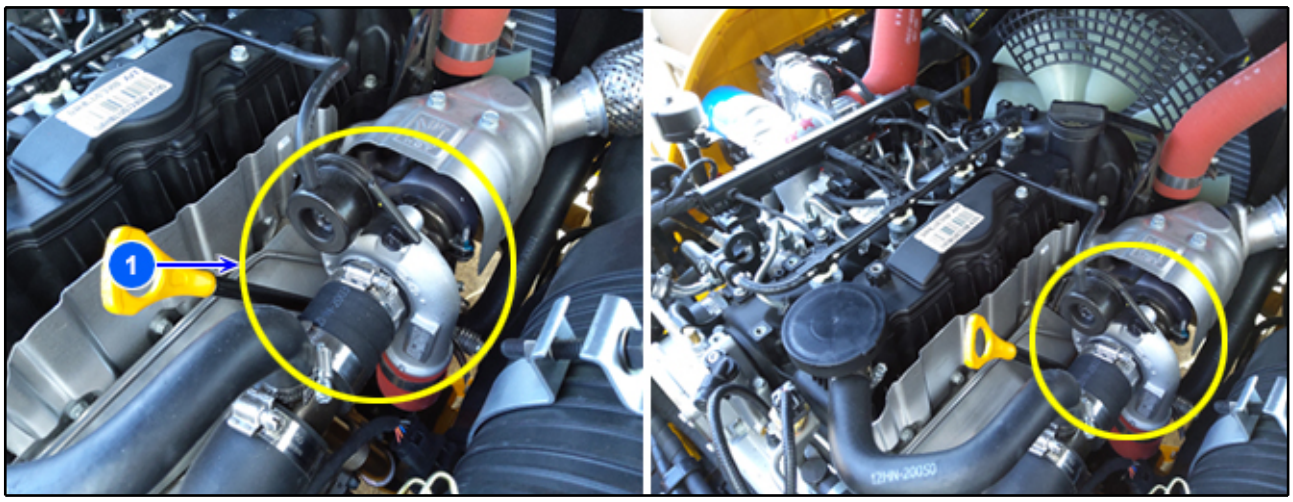
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

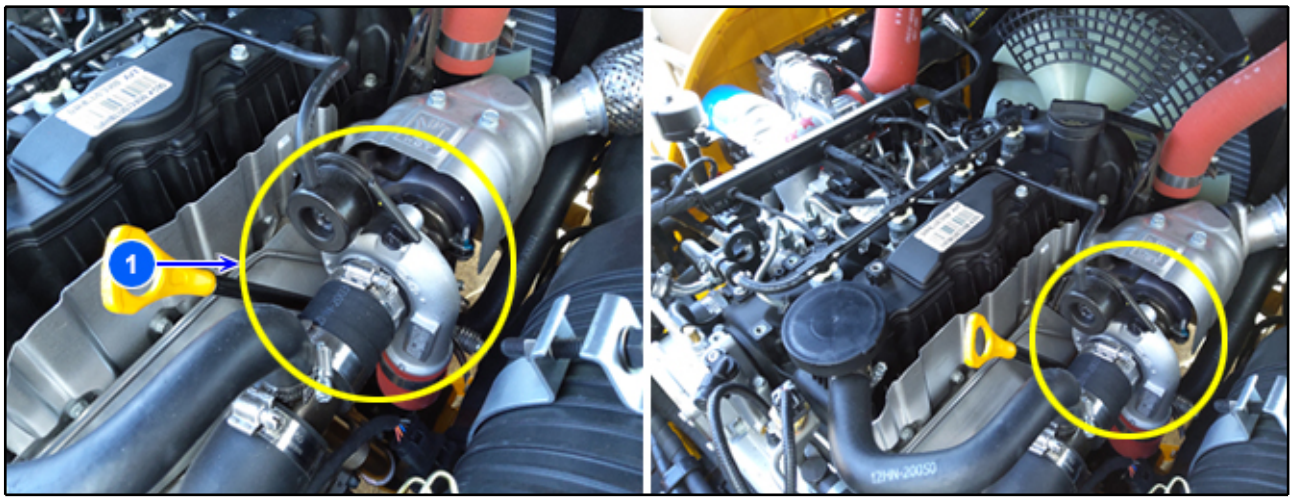
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P029900 Turbocharger/Supercharger System Underboost

Component Location



CRC12EN5010P004711



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 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

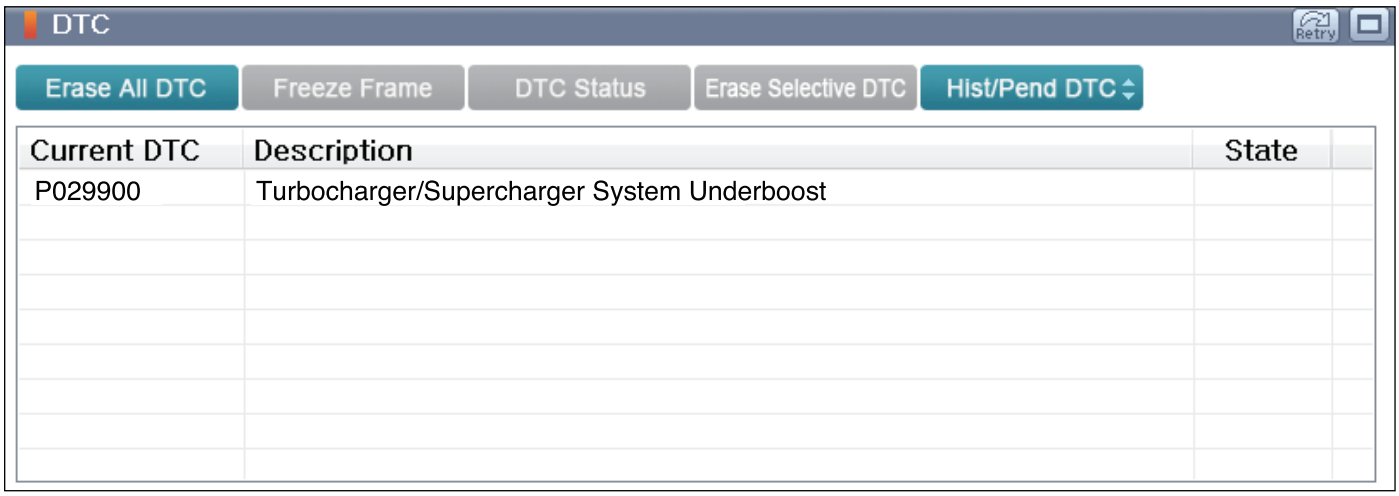
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Air leakage on intake system(Air intake hose, air cleaner, inter-cooler, compressor housing of turbo-charger) 3. Disconnected air intake hose 4. Damaged inter-cooler
Enable Condition	• Engine running		
Threshold Value	• Measured BPS output value is lower than target value		
Detecting Time	• 6 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• Blink	

Vehicle Data

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



CRC12EN5010P02990021S

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

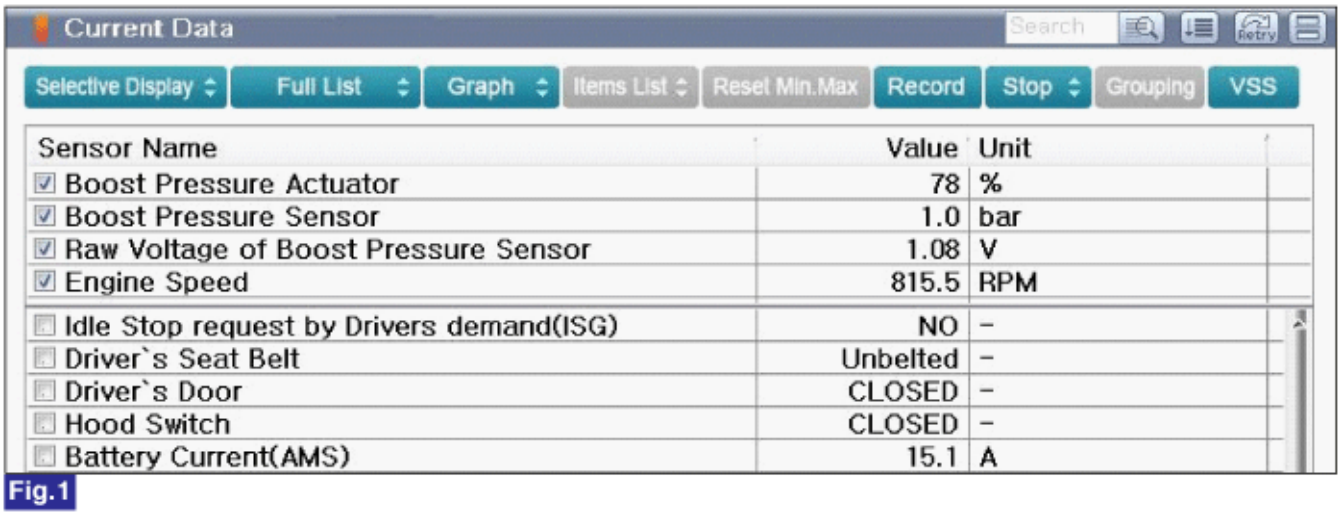


Fig.1

CRC12EN5010P00470022S

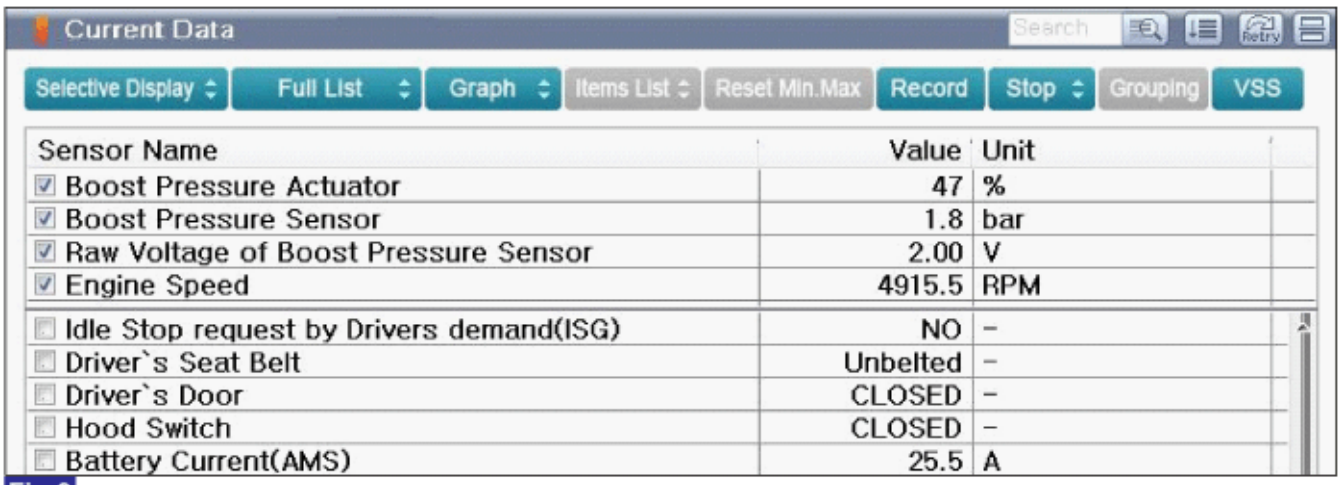


Fig.2

CRC12EN5010P00470023S

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

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.
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"
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 "System Inspection" procedure.

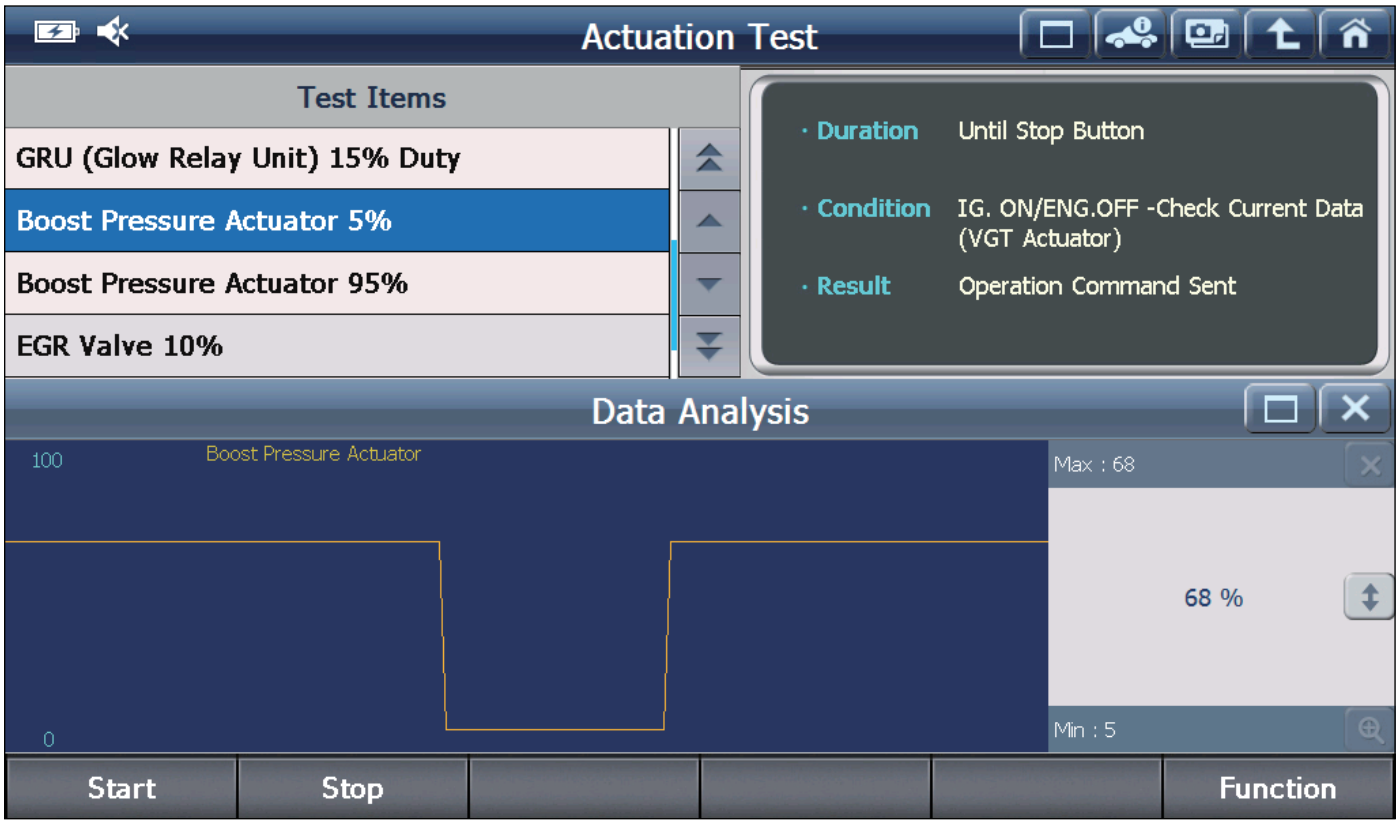
NO ▸ Inspect and repair open or short in circuit, and then go to "Verification of Vehicle Repair" procedure.

Component Inspection

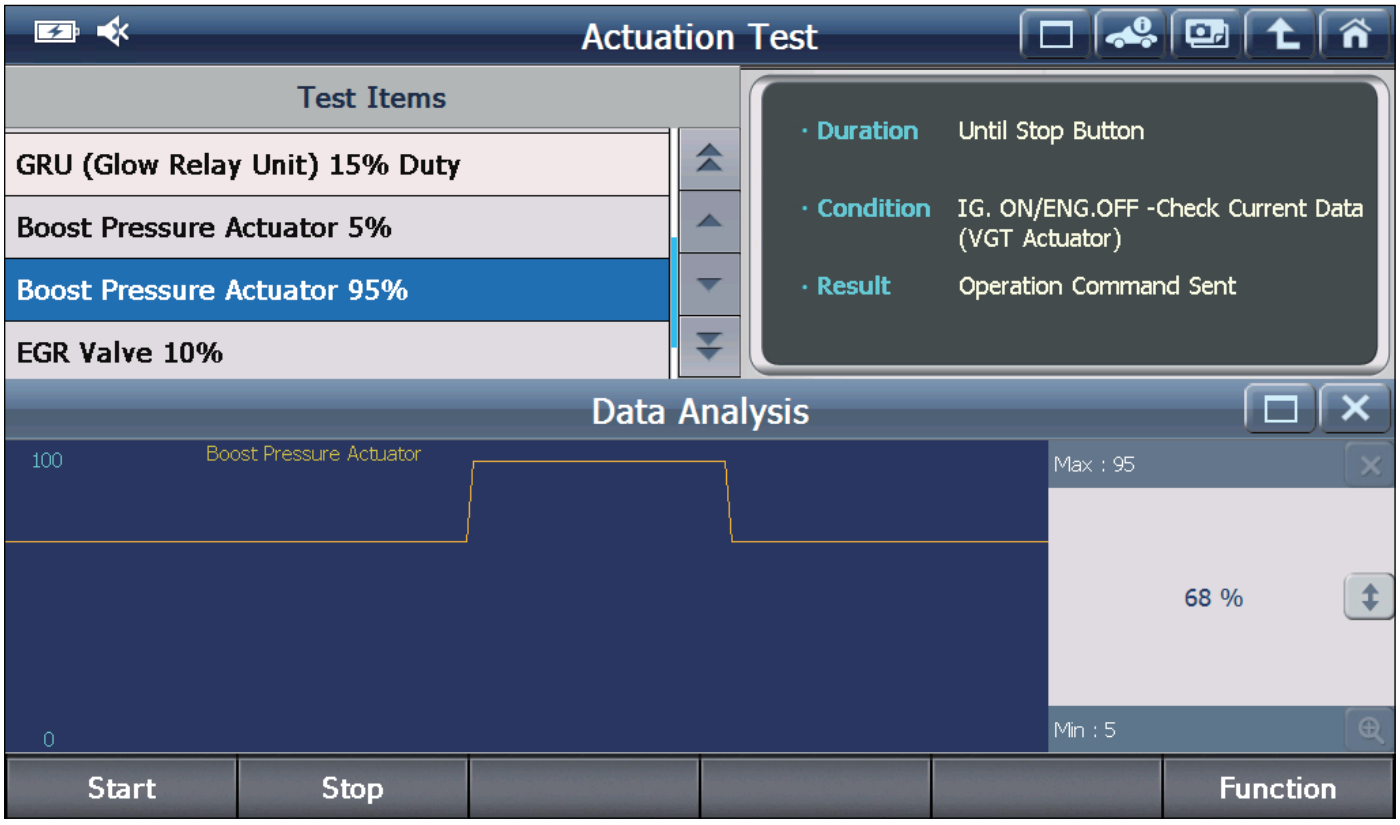
■ **Actuation Test**

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



CRC12EN5010P00470041S



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)".
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.

P033500 Crankshaft Position Sensor "A" Circuit

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 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.

DTC Detecting Condition

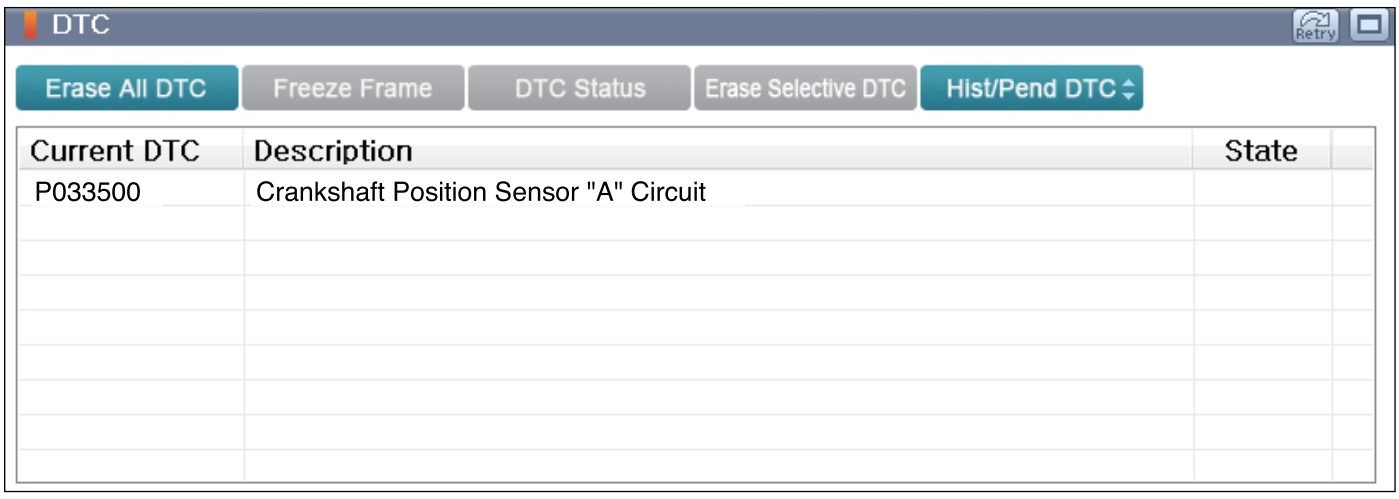
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty CKPS circuit 3. Defected CKPS
Enable Condition	• Engine running		
Threshold Value	• CKPS signal is not generated when CMPS signal is generated		
Detecting Time	• 6 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Crankshaft Position Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Sensor Shield	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	0V	-
	2	CKPS Signal		Approx. 4.8V	-
	3	CKPS Power		B+	-

Monitor GDS Data

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



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

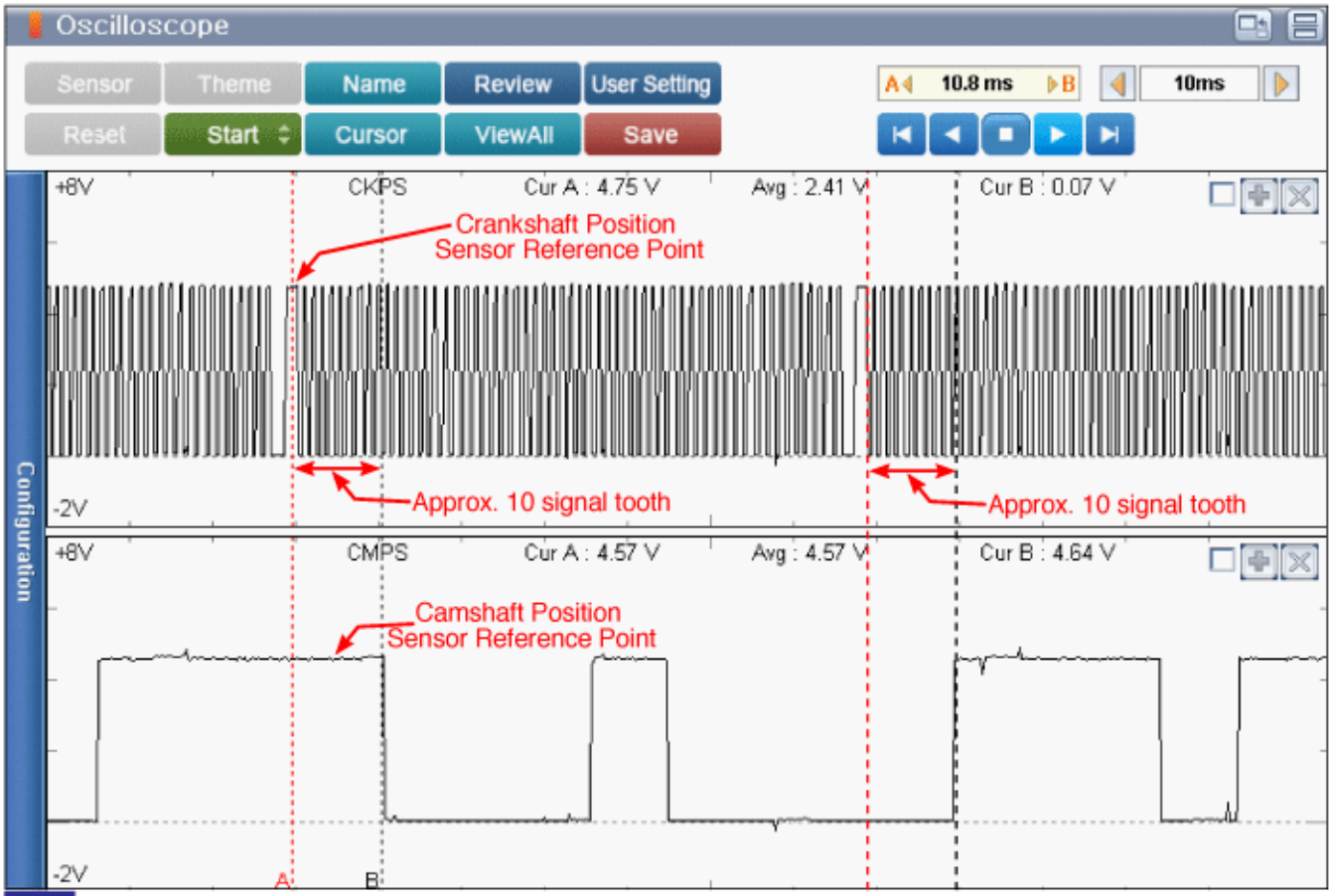


Fig.1

CRC12EN5010P03350022S

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 ▸ 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 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 1Ω

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.

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 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.

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

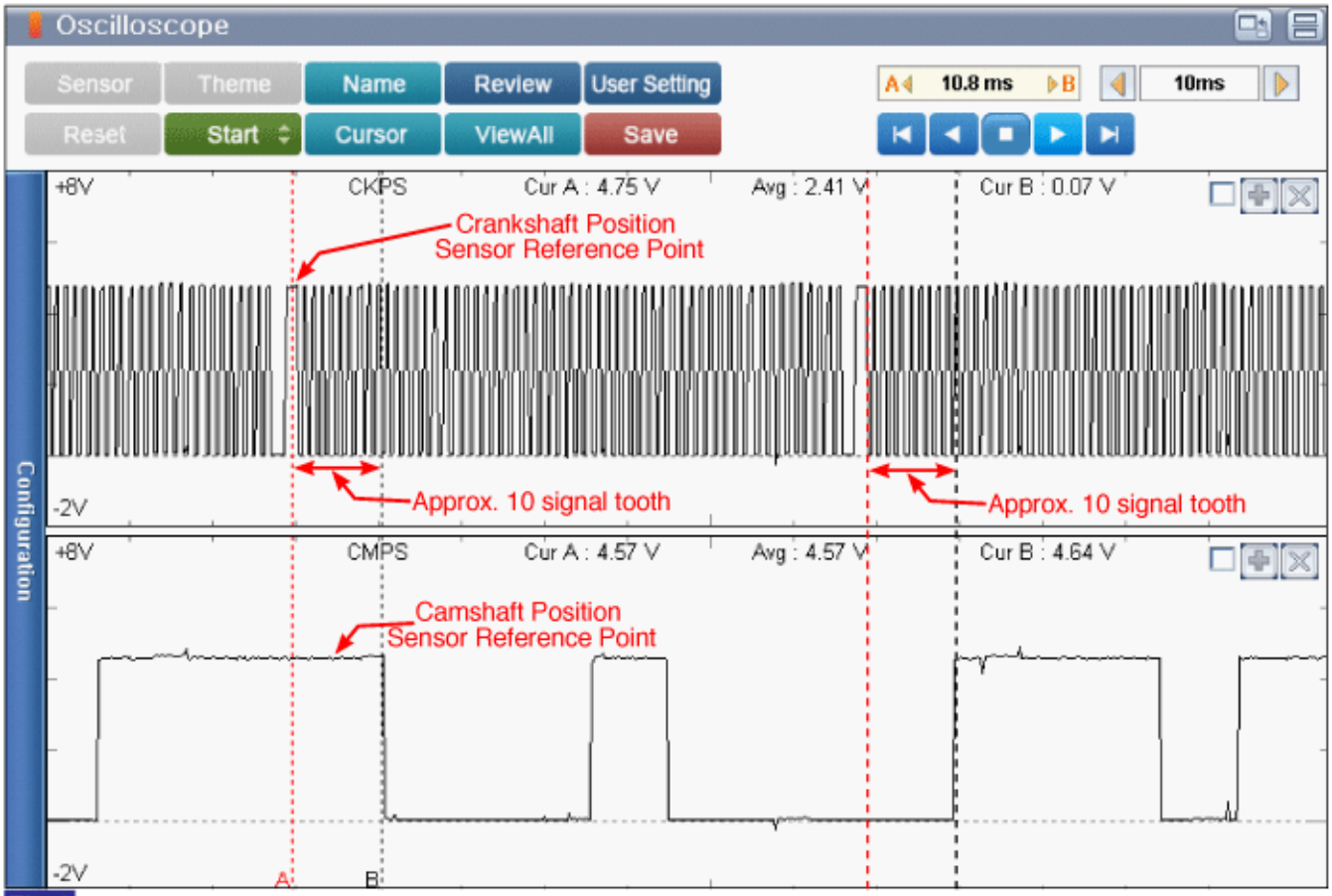


Fig.1

CRC12EN5010P03350022S

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.

⚠ 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.
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.

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

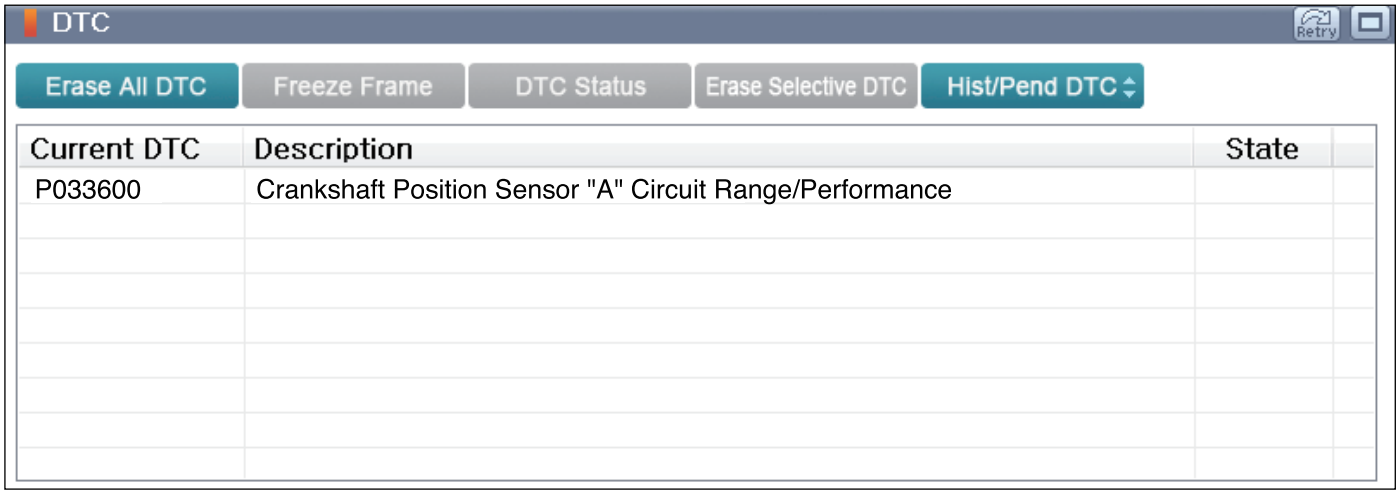
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty CKPS circuit 3. Defected flywheel tone-wheel 4. Defected CKPS
Enable Condition	• Engine running		
Threshold Value	• Abnormal CKPS signal is detected		
Detecting Time	• -		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Crankshaft Position Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Sensor Shield	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	0V	-
	2	CKPS Signal		Approx. 4.8V	-
	3	CKPS Power		B+	-

Monitor GDS Data

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



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

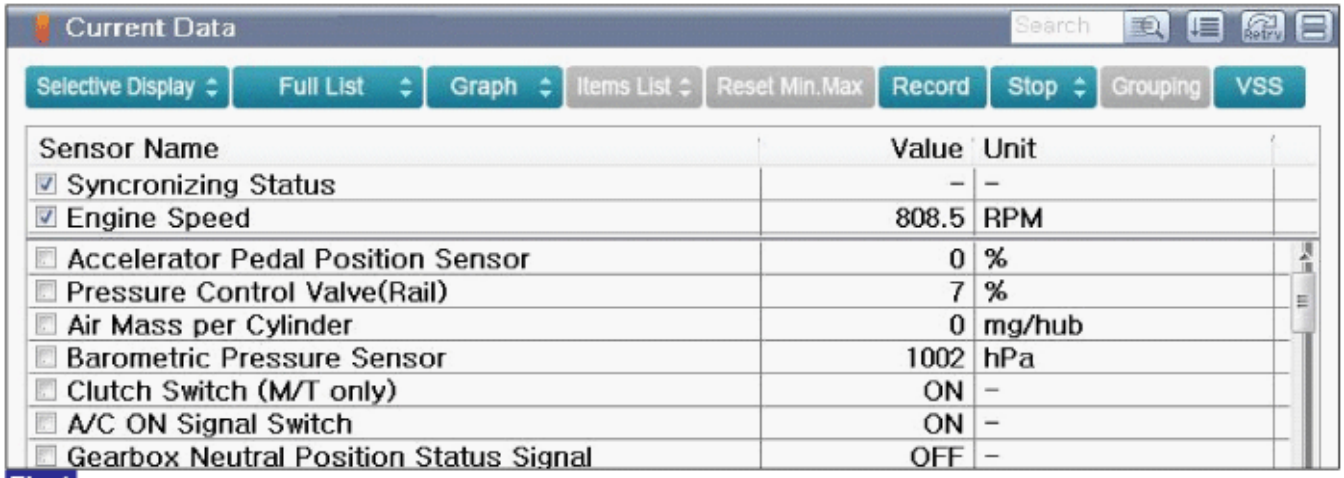


Fig.1

CRC12EN5010P03360022S

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?

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 1Ω

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.

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 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.

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

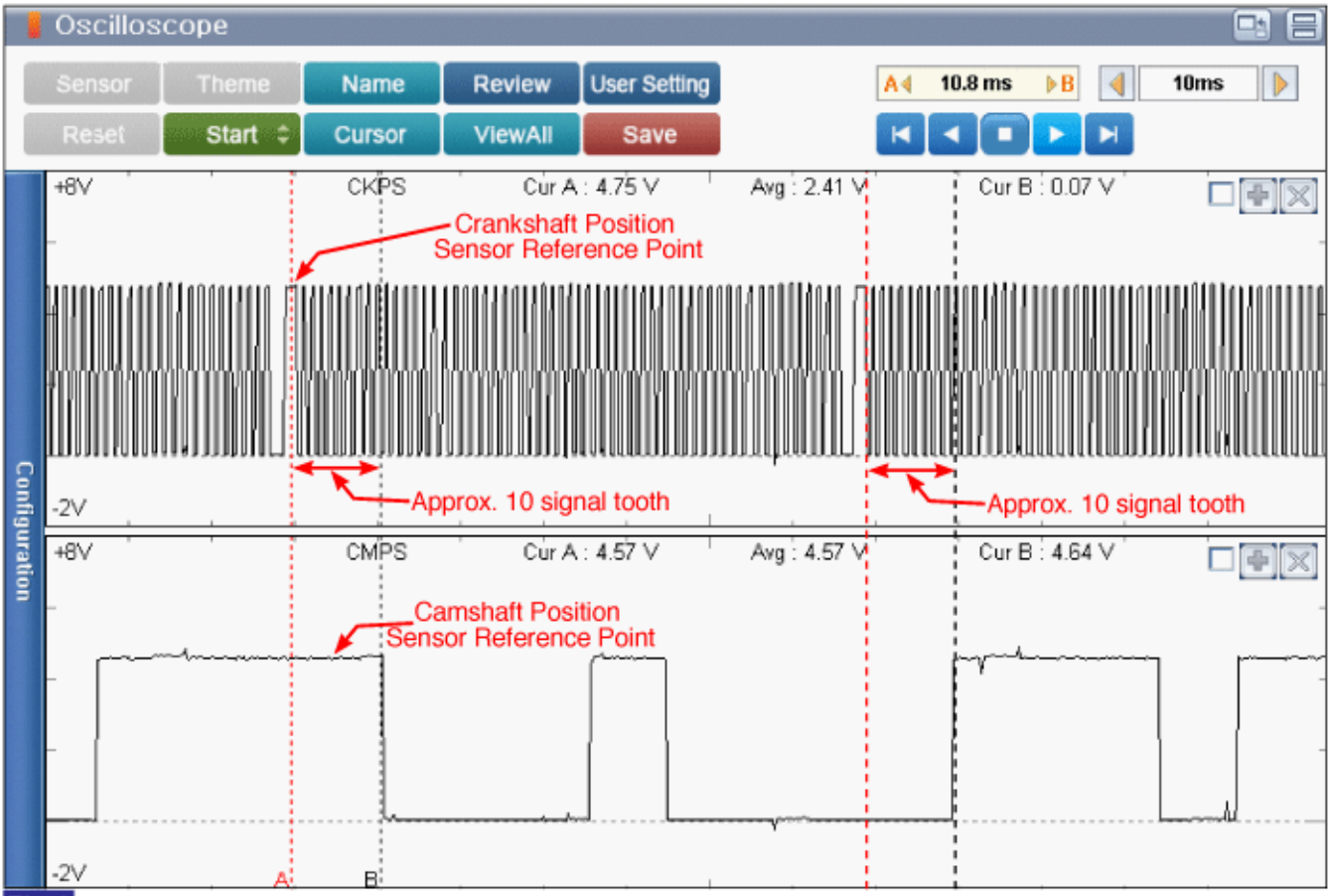


Fig.1

CRC12EN5010P03350022S

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.

⚠ 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.

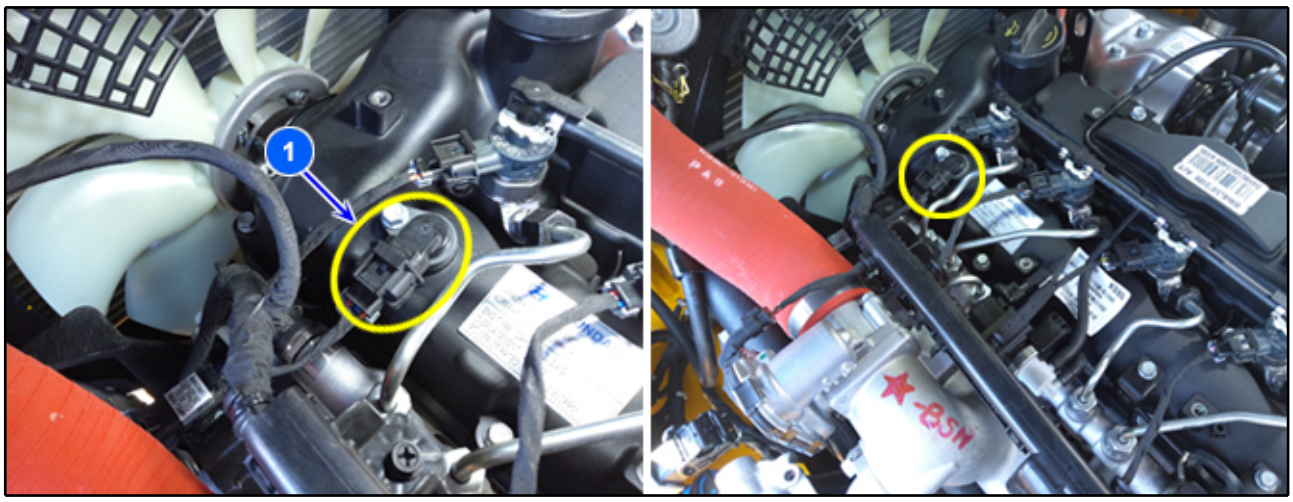
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P034000 Camshaft Position Sensor A Circuit Malfunction (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 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.

DTC Detecting Condition

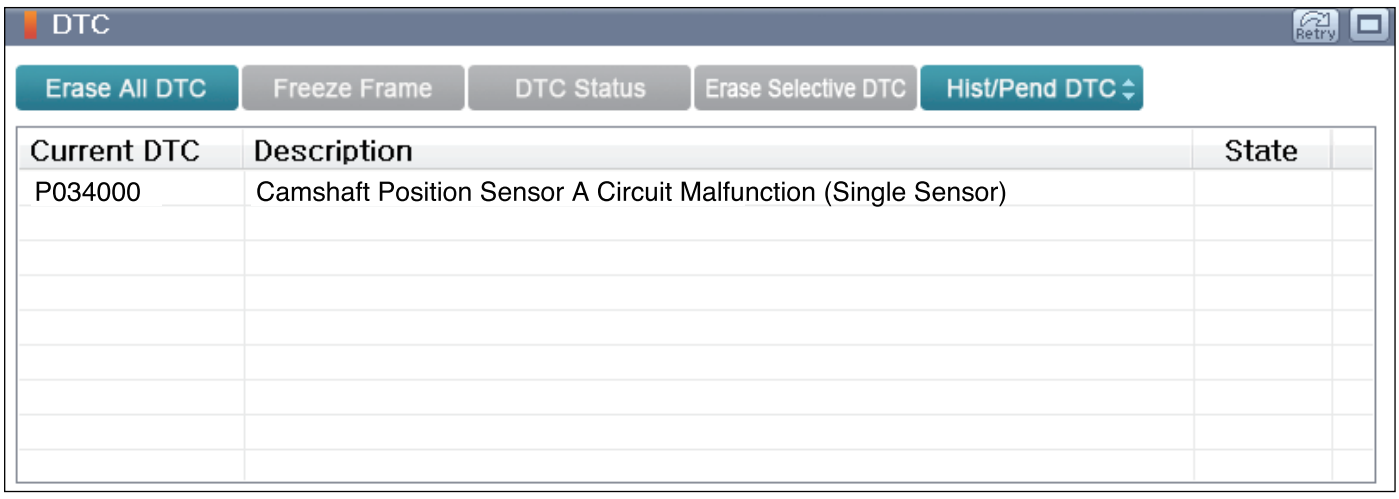
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty CMPS circuit 3. Defected CMPS
Enable Condition	• Engine running		
Threshold Value	• CMPS signal is not generated when CKPS signal is generated		
Detecting Time	• -		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	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" • Voltage is measured on wiring side(Disconnected)	B+	-
	2	CMPS Signal		Approx. 4.7V	-
	3	CMPS Ground		0V	-

Monitor GDS Data

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



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

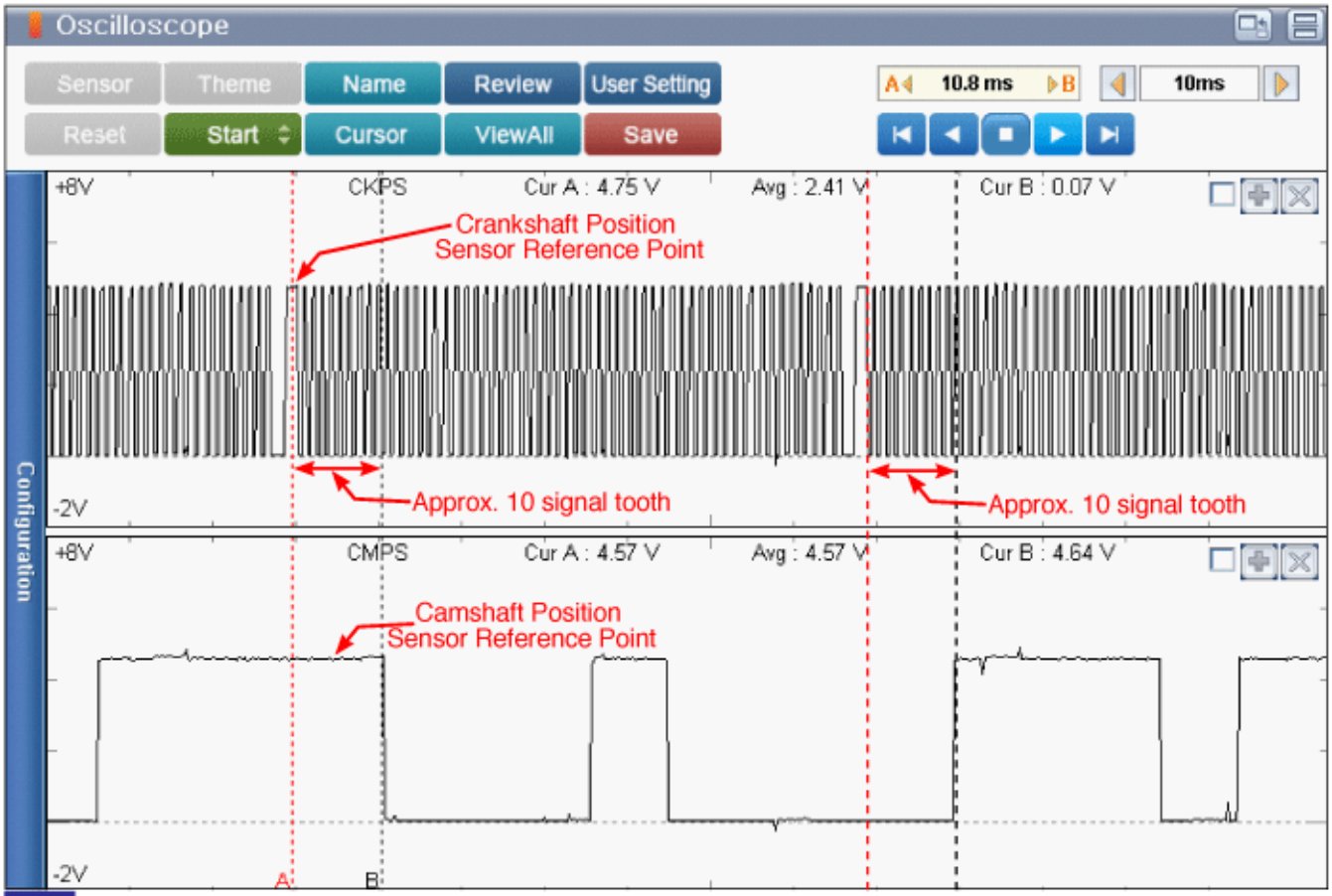


Fig.1

CRC12EN5010P03350022S

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. T-horoughly check connectors for looseness, po-or connection, bending, corrosion, contaminati-on, 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. 1Ω

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.

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

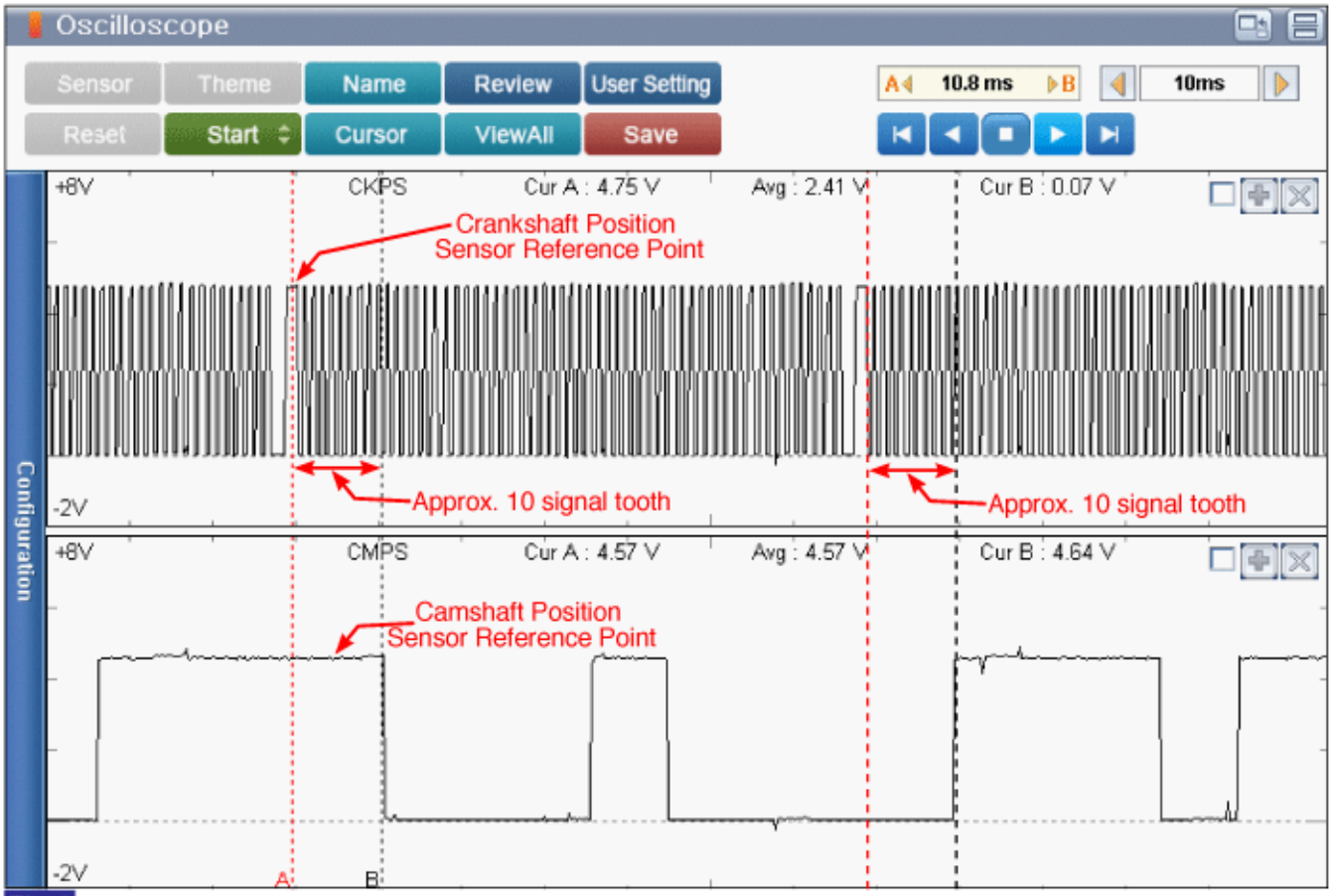


Fig.1

CRC12EN5010P03350022S

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.

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.

⚠ CAUTION

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

⚠ CAUTION

- Apply the engine oil to the O-ring.
- Be careful not to damage the O-ring.

⚠ 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.

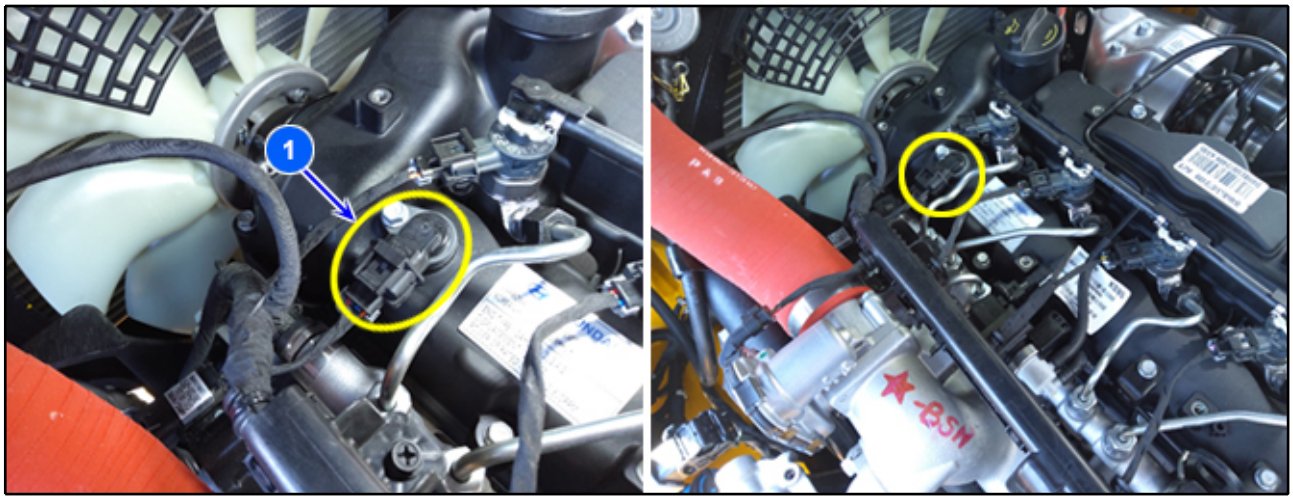
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

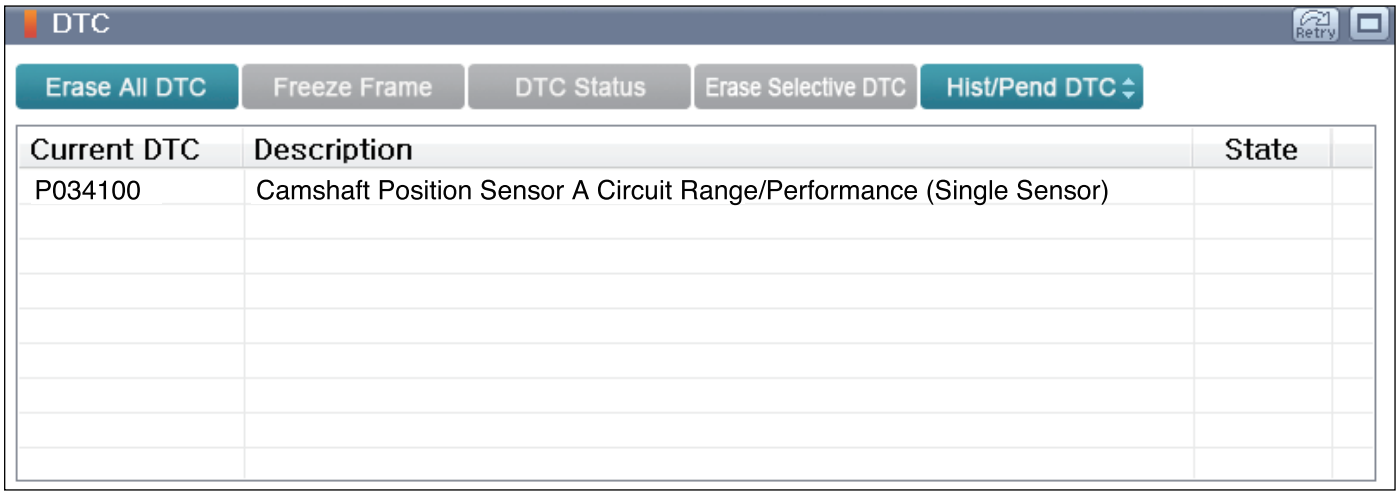
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty CMPS circuit 3. Defected tone-wheel 4. Defected CMPS
Enable Condition	• Engine running		
Threshold Value	• Abnormal CMPS signal is detected		
Detecting Time	• -		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	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" • Voltage is measured on wiring side(Disconnected)	B+	-
	2	CMPS Signal		Approx. 4.7V	-
	3	CMPS Ground		0V	-

Monitor GDS Data

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



CRC12EN5010P03410021S

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

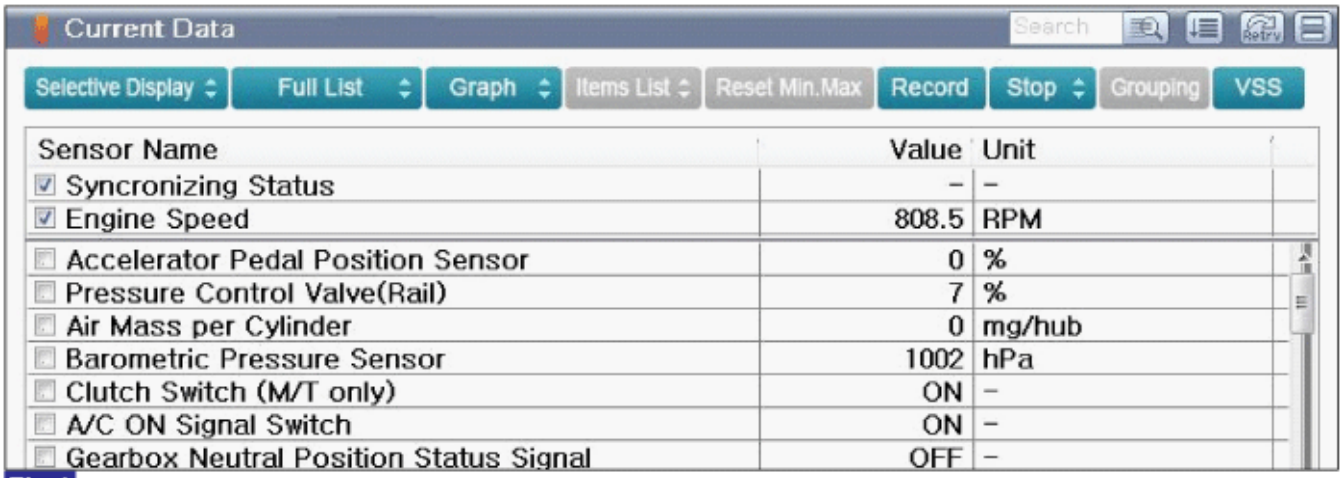


Fig.1

CRC12EN5010P03360022S

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?

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 termonal 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. 1Ω

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.

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

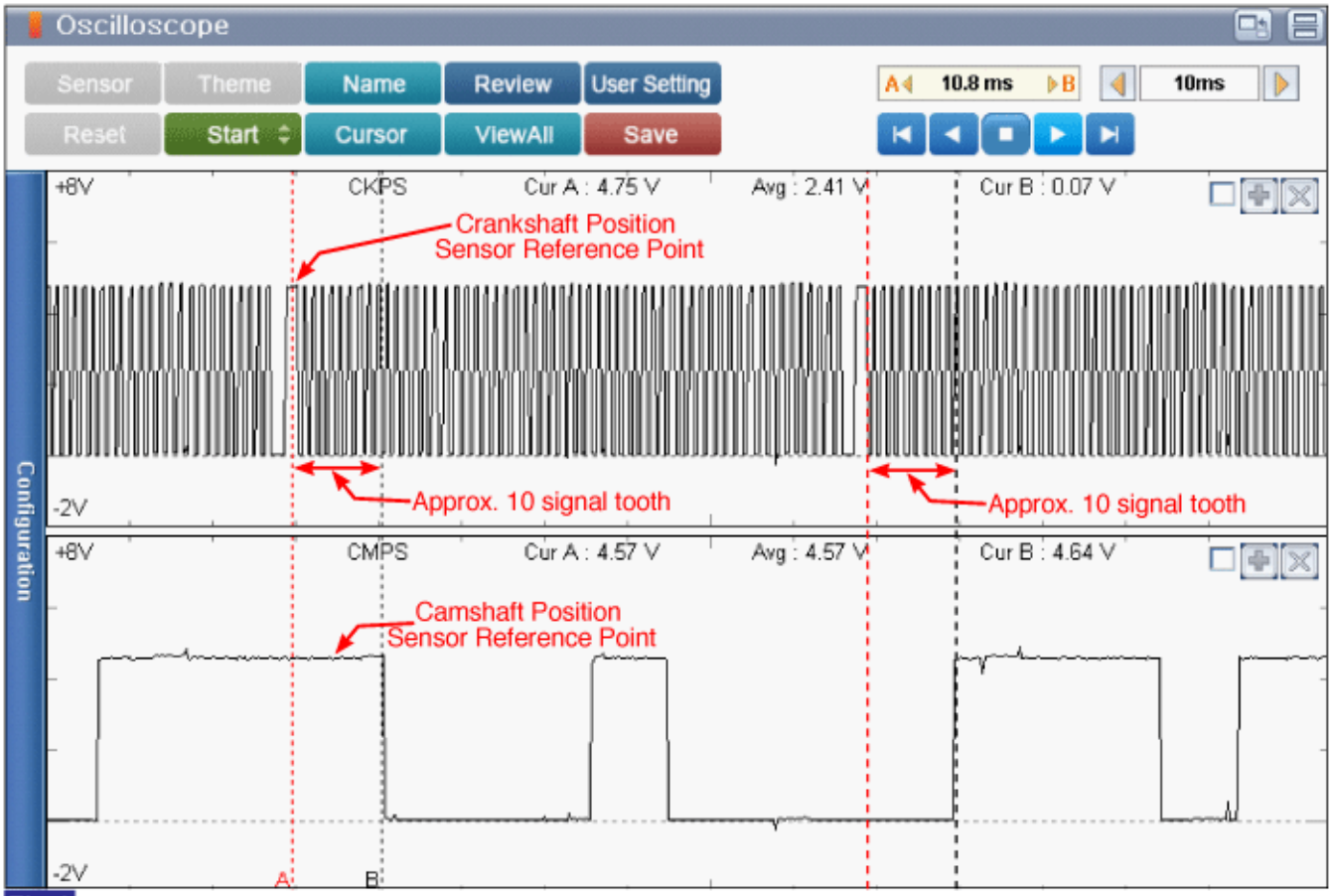


Fig.1

CRC12EN5010P03350022S

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.

NO ▸ Go to "Camshaft Tone-Wheel Inspection" procedure.

■ Camshaft Tone-Wheel Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and remove CMPS.
4. Inspect camshaft tone-wheel through CMPS installation hole.
5. Have any problem been found?

⚠ WARNING

- DO NOT remove camshaft position sensor right after engine is stopped or running. Enigine oil may leak and cuases the scald.

YES ▸ Refer to "Shop Manual" and inspect the flywheel.
▸ If no problem is found on flywheel, replace the Camshaft assembly and then 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 CMPS and then go to "Verification of Vehicle Repair" procedure.

⚠ CAUTION

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

⚠ CAUTION

- Apply the engine oil to the O-ring.
- Be careful not to damage the O-ring.

⚠ 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.

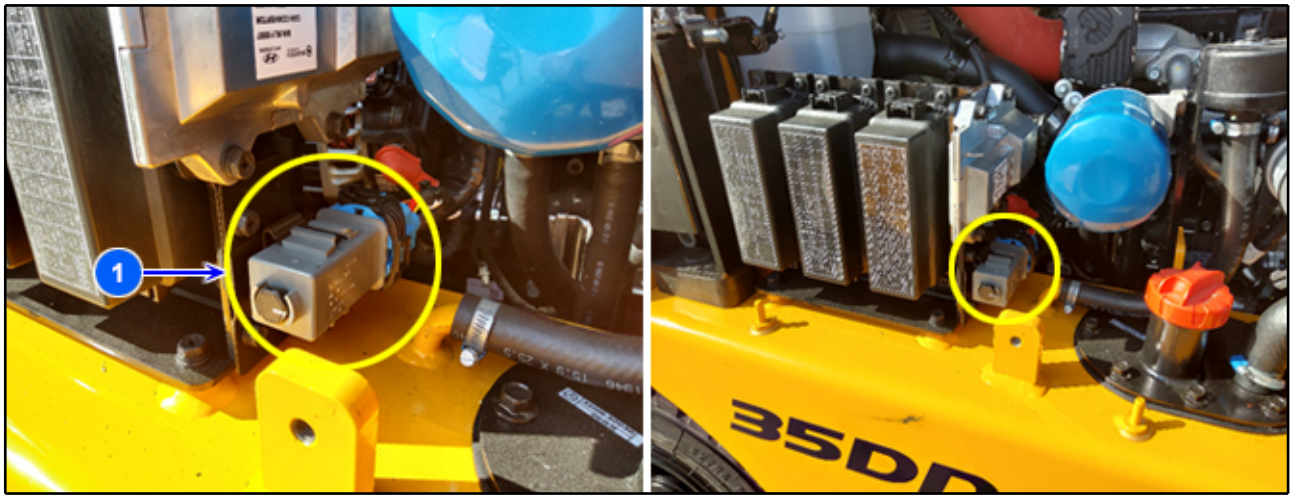
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



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

Short to ground in glow relay circuit is detected, ECM sets DTC P038300.

DTC Detecting Condition

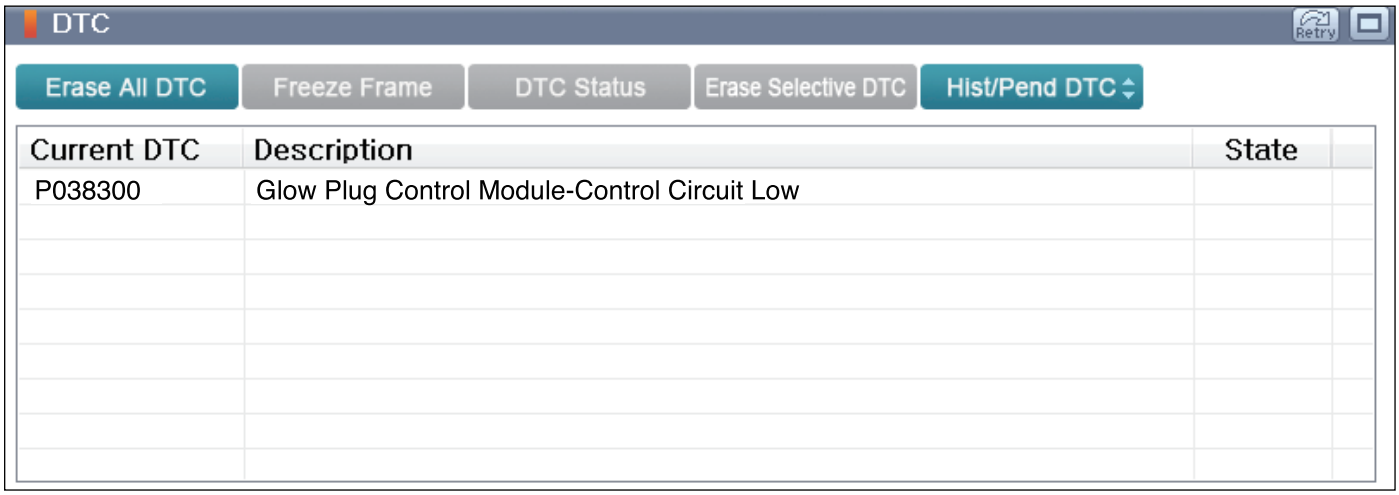
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to ground in GRU circuit 3. Defected GRU
Enable Conditions	• Engine running		
Threshold Value	• Short to ground in glow relay circuit		
Diagnostic Time	• 3 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Glow Relay Unit		Terminal	Ispection Condition	Measured Valu-e	Remarks
Pin No.	1	Glow Time Feedback Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 10.5V	-
	2	Power		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"
3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.



CRC12EN5010P03830021S

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

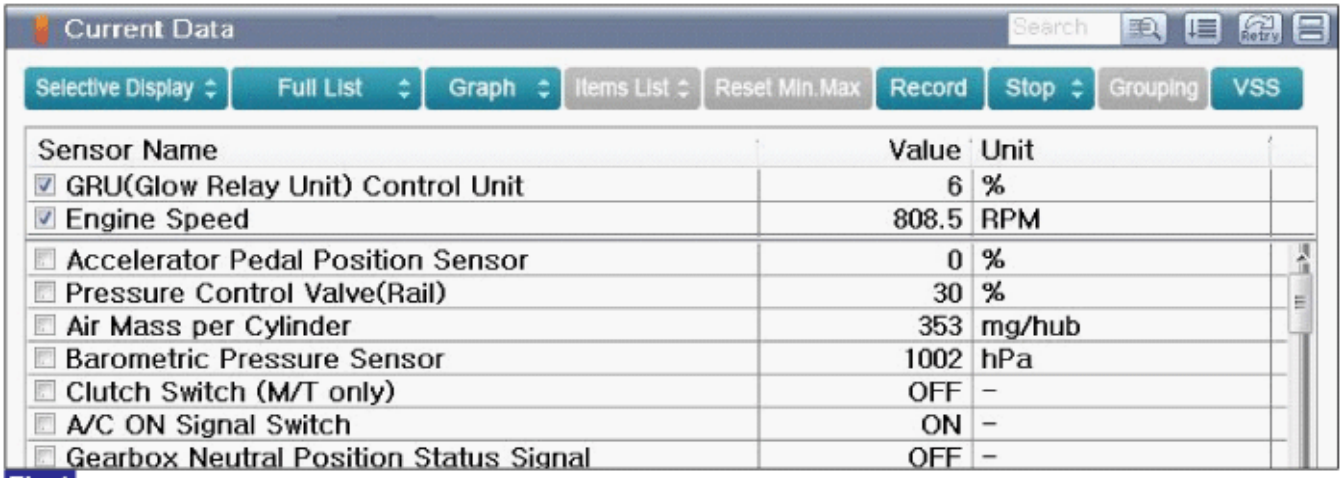


Fig.1

CRC12EN5010P03830022S

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?

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
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 1Ω

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

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect GRU connector.
4. Measure the resistance between glow plug terminal 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).
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

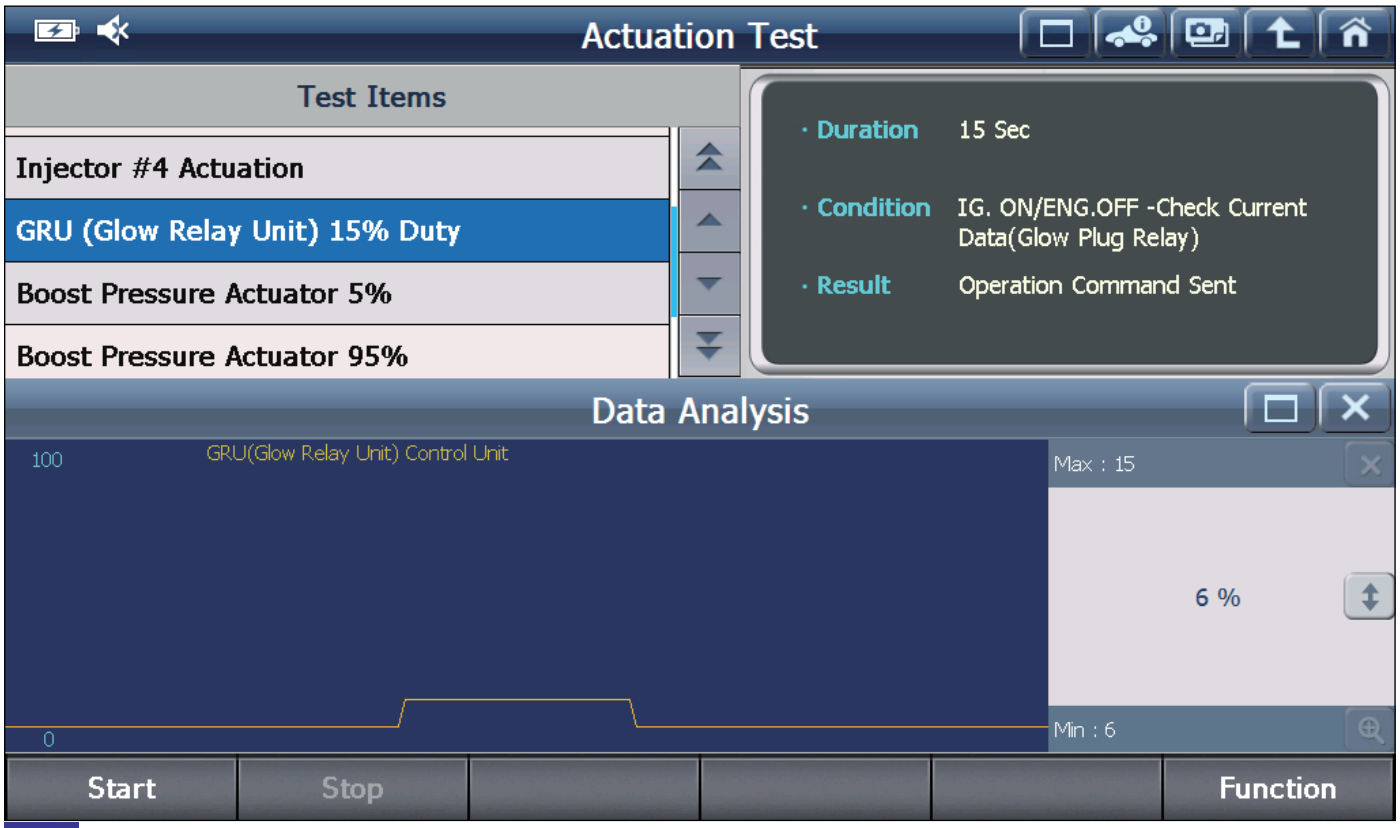


Fig.1

CRC12EN5010P03830041S

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.

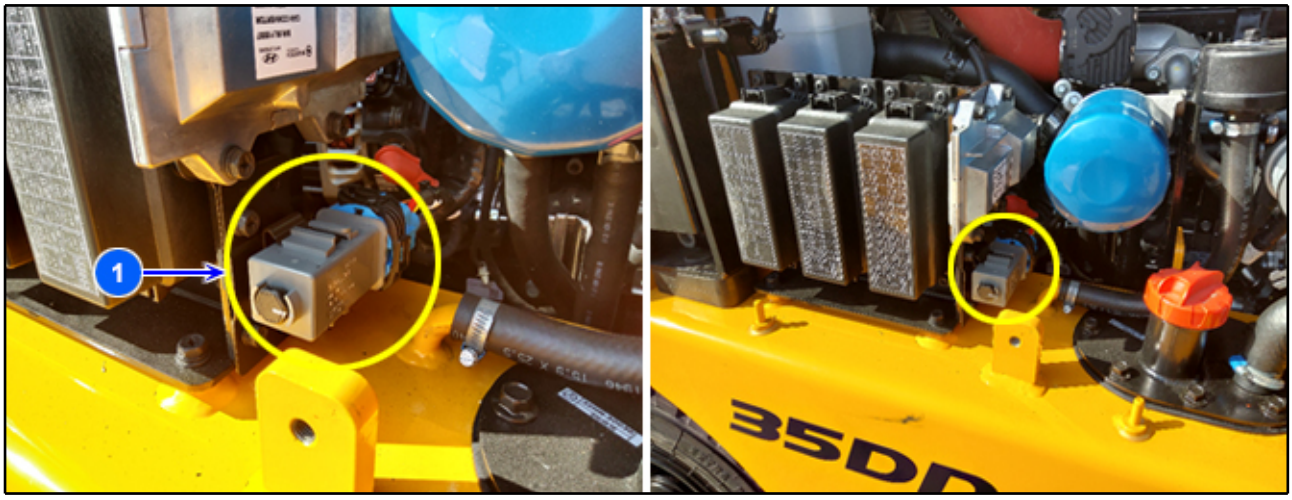
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P038400 Glow Plug Control Module-Control Circuit High

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 short to power in glow relay unit circuit is detected, ECM sets DTC P038400.

DTC Detecting Condition

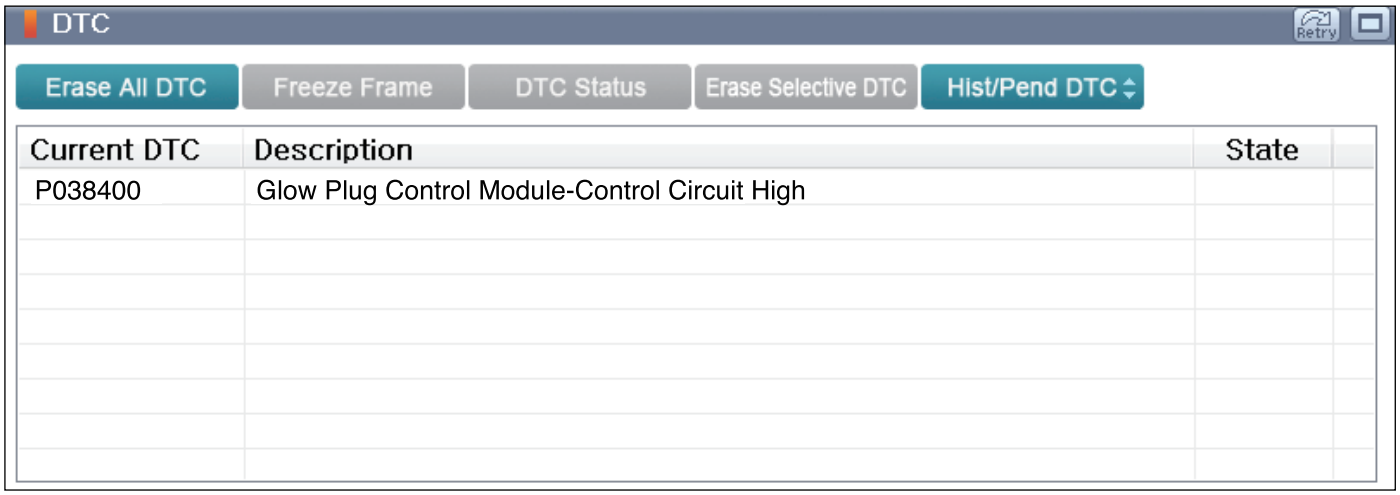
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to power in glow relay unit circuit 3. Defected CMPS
Enable Condition	• Engine running		
Threshold Value	• Short to power in glow relay unit circuit		
Detecting Time	• 1 sec		
Fail Safe	Engine Off	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Glow Relay Unit		Terminal	Ispection Condition	Measured Valu-e	Remarks
Pin No.	1	Glow Time Feedback Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 10.5V	-
	2	Power		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"
3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.



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

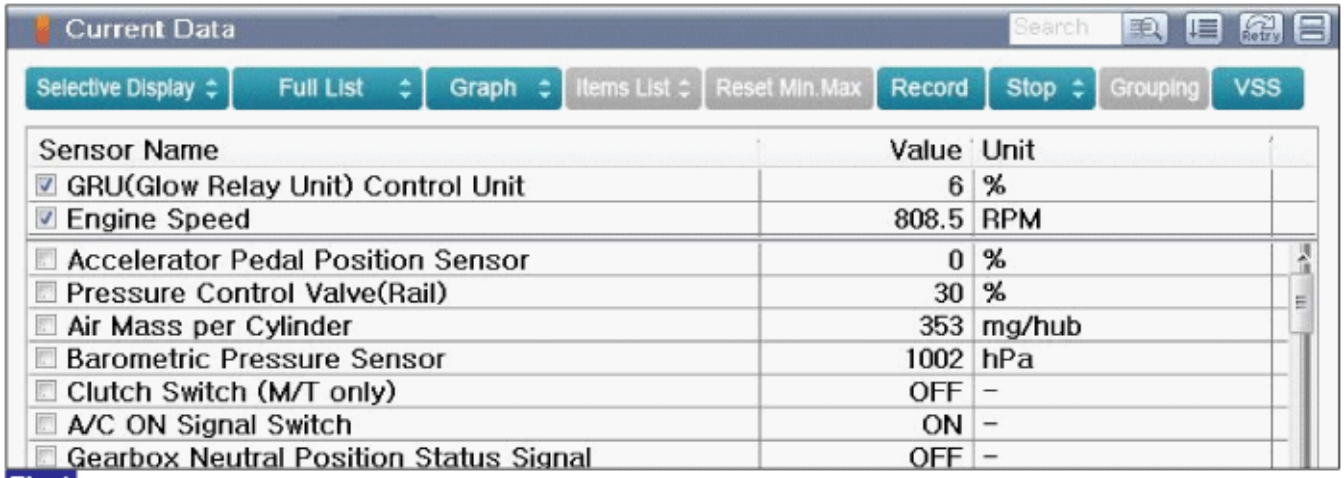


Fig.1

CRC12EN5010P03830022S

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?

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
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 1Ω

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

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect GRU connector.
4. Measure the resistance between glow plug terminal 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).
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

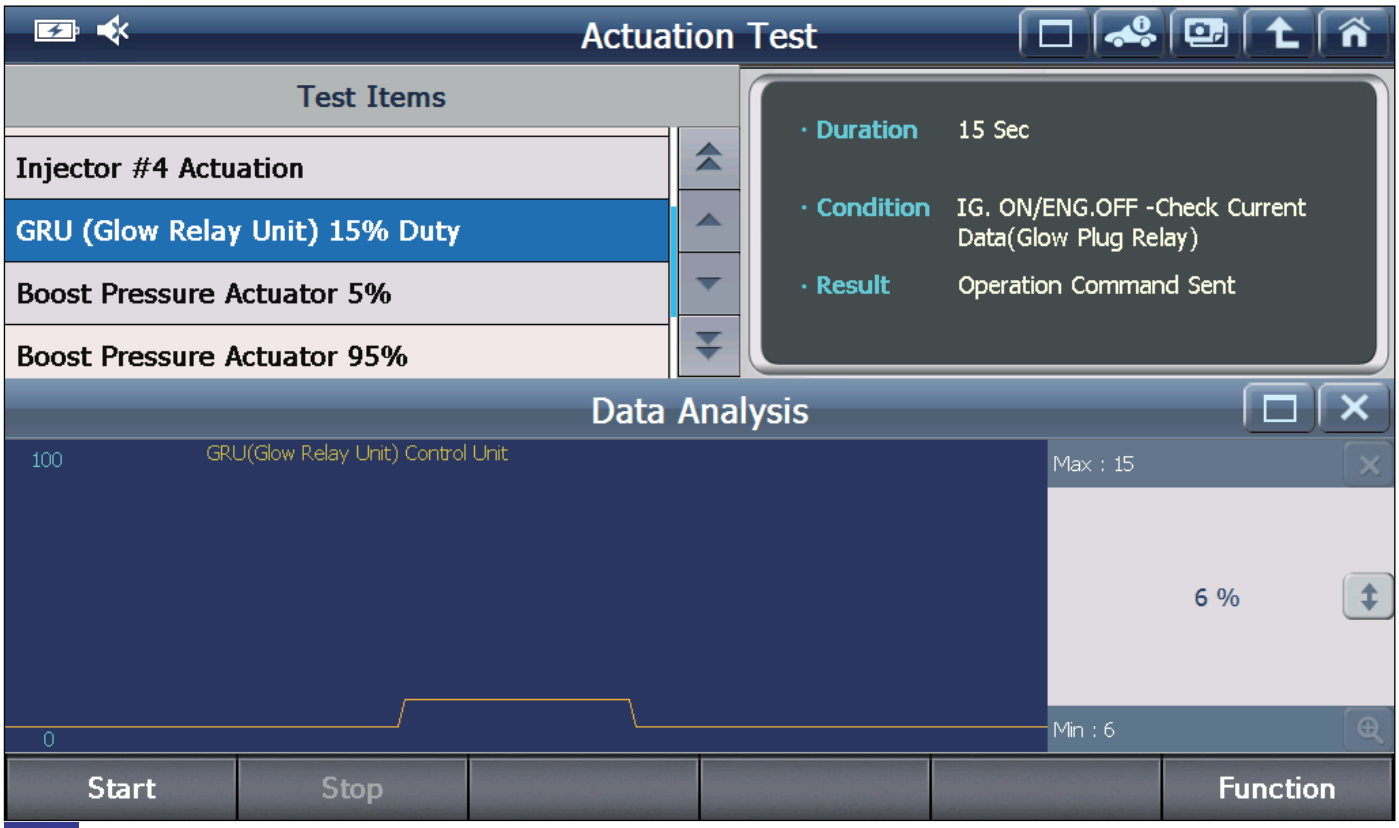


Fig.1

CRC12EN5010P03830041S

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.

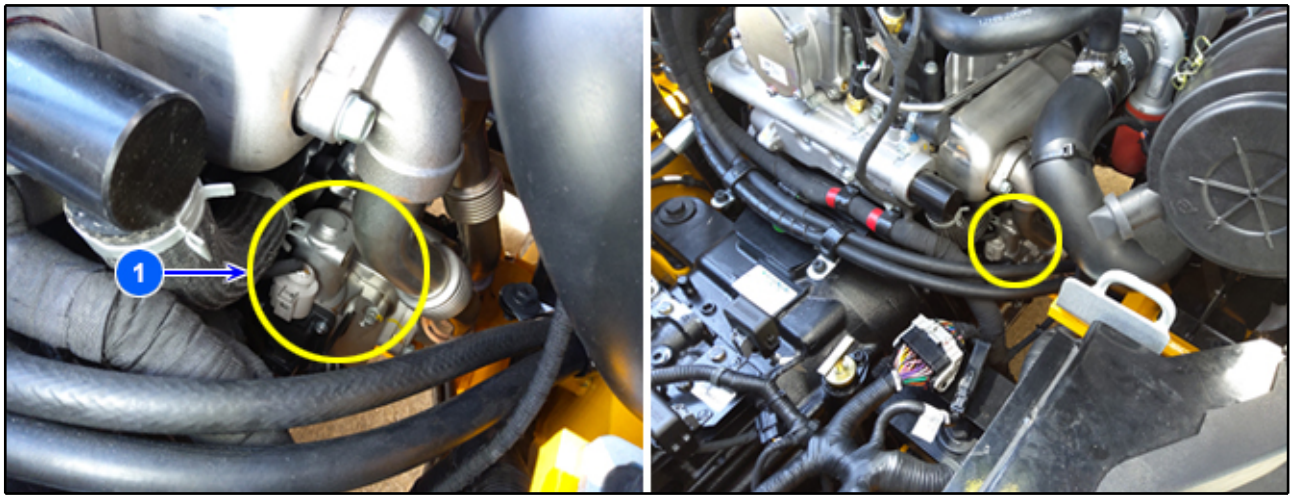
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P040111

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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Clogged EGR cooler 3. Clogged or leaked exhaust gas re-circulation path 4. Leakage on intake manifold 5. Leakage on exhaust manifold
Enable Conditions	• Engine running		
Threshold Value	• Exhaust gas re-circulation rate is below set-point		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

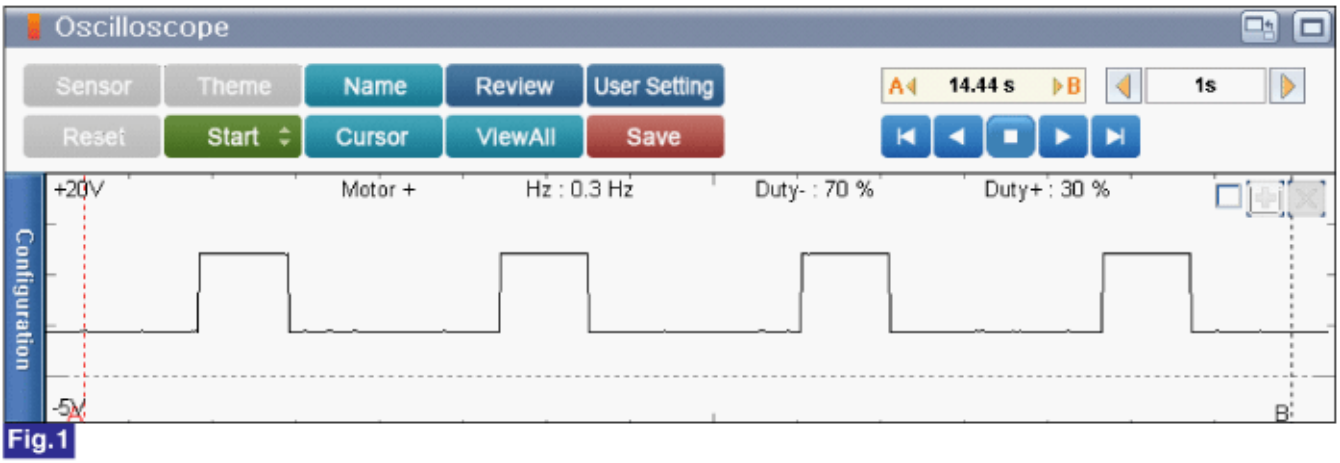
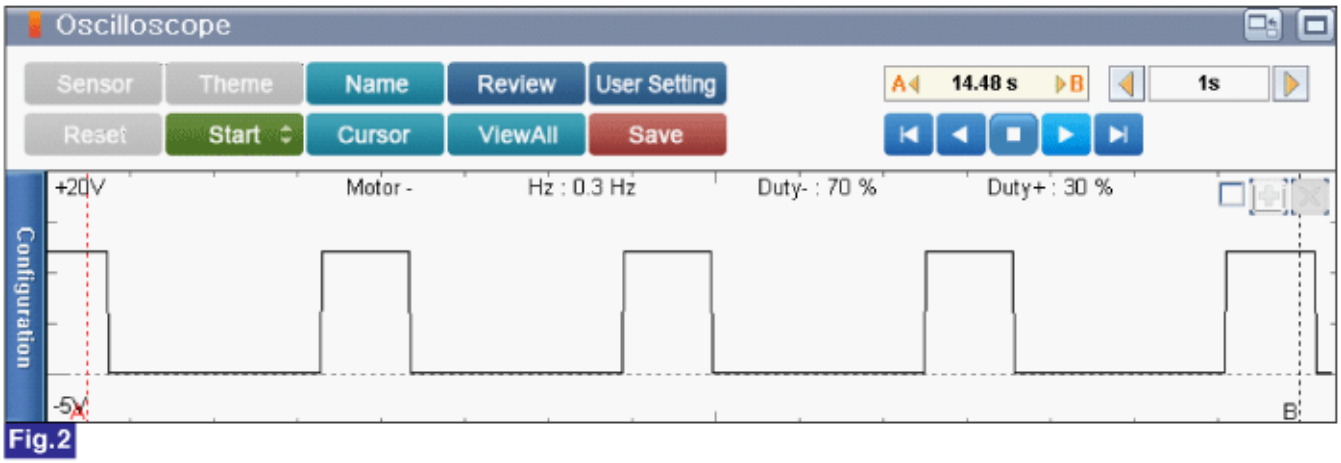


Fig.1



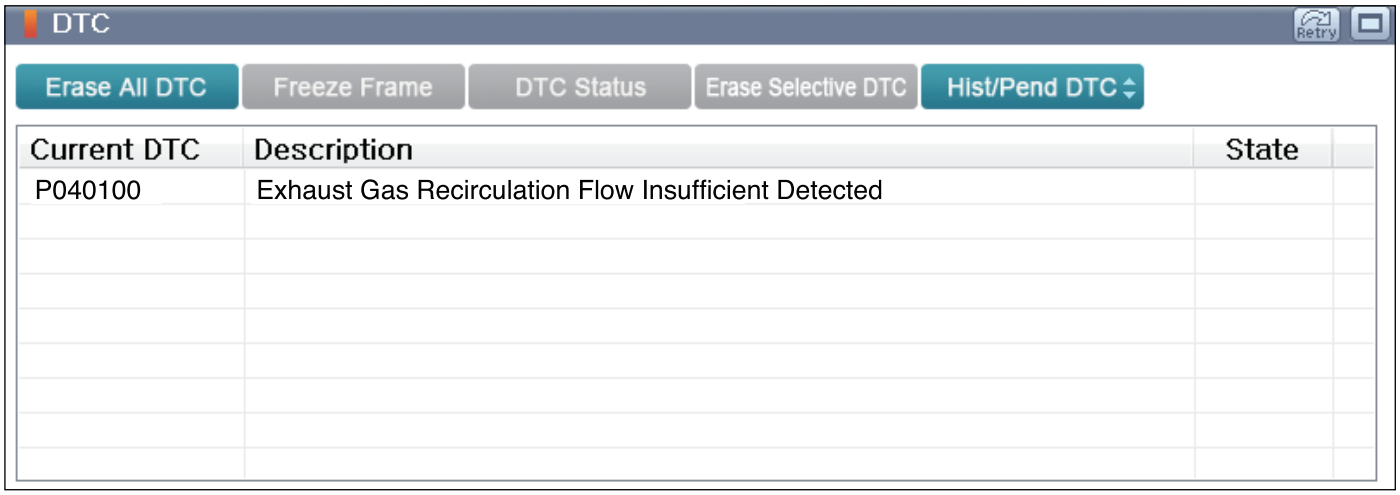
CRC12EN5010P04010012S

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.



CRC12EN5010P04010021S

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

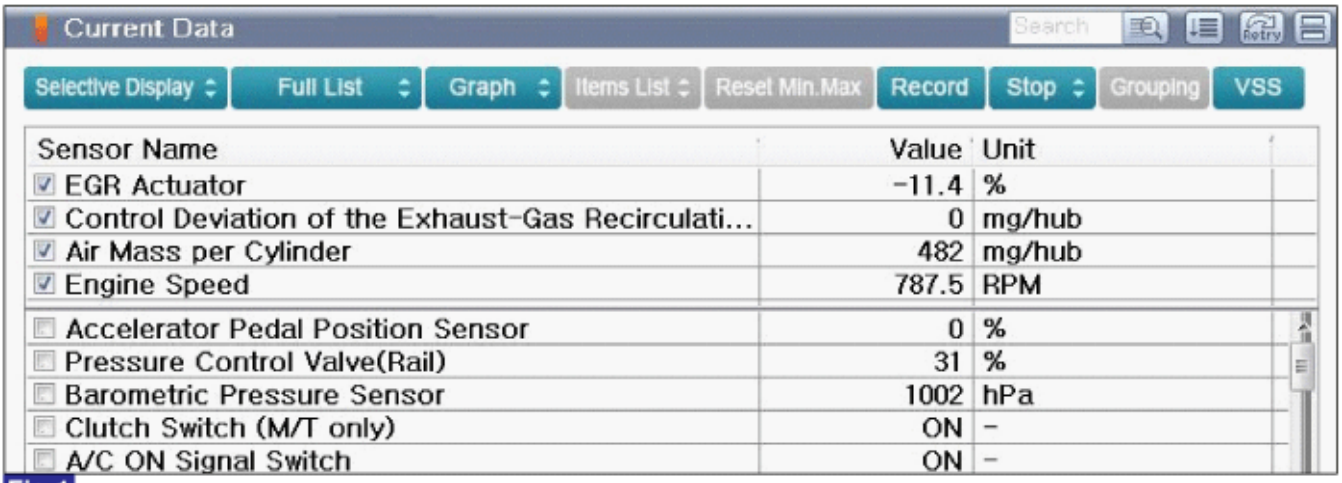


Fig.1

CRC12EN5010P04010022S

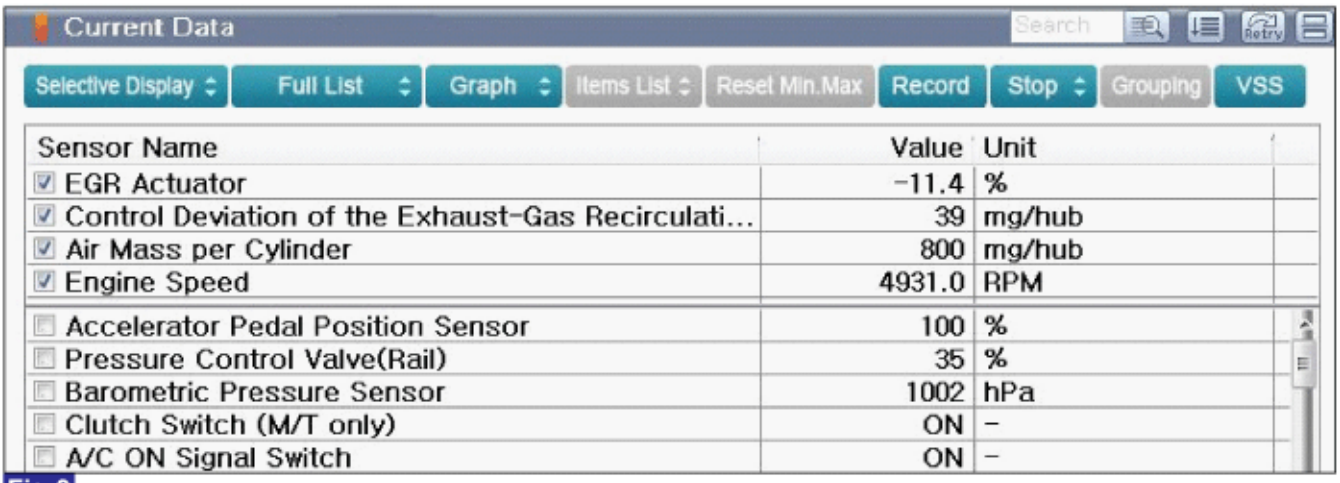


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

NO ▸ Inspect and repair open or short in circuit, and 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.

NO ▸ Go to "EGR Actuator Inspection" procedure.

■ **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.

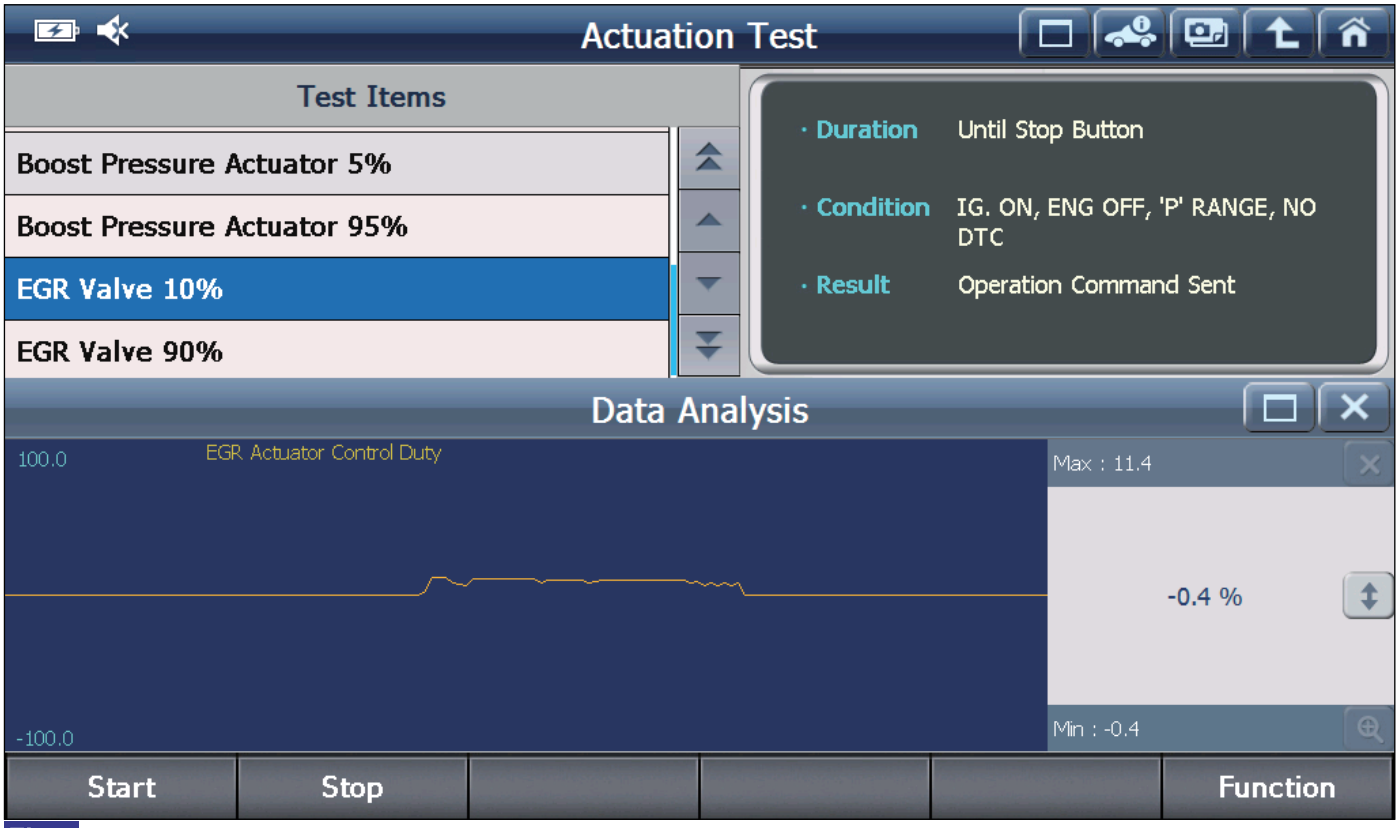


Fig.1

CRC12EN5010P04010041S

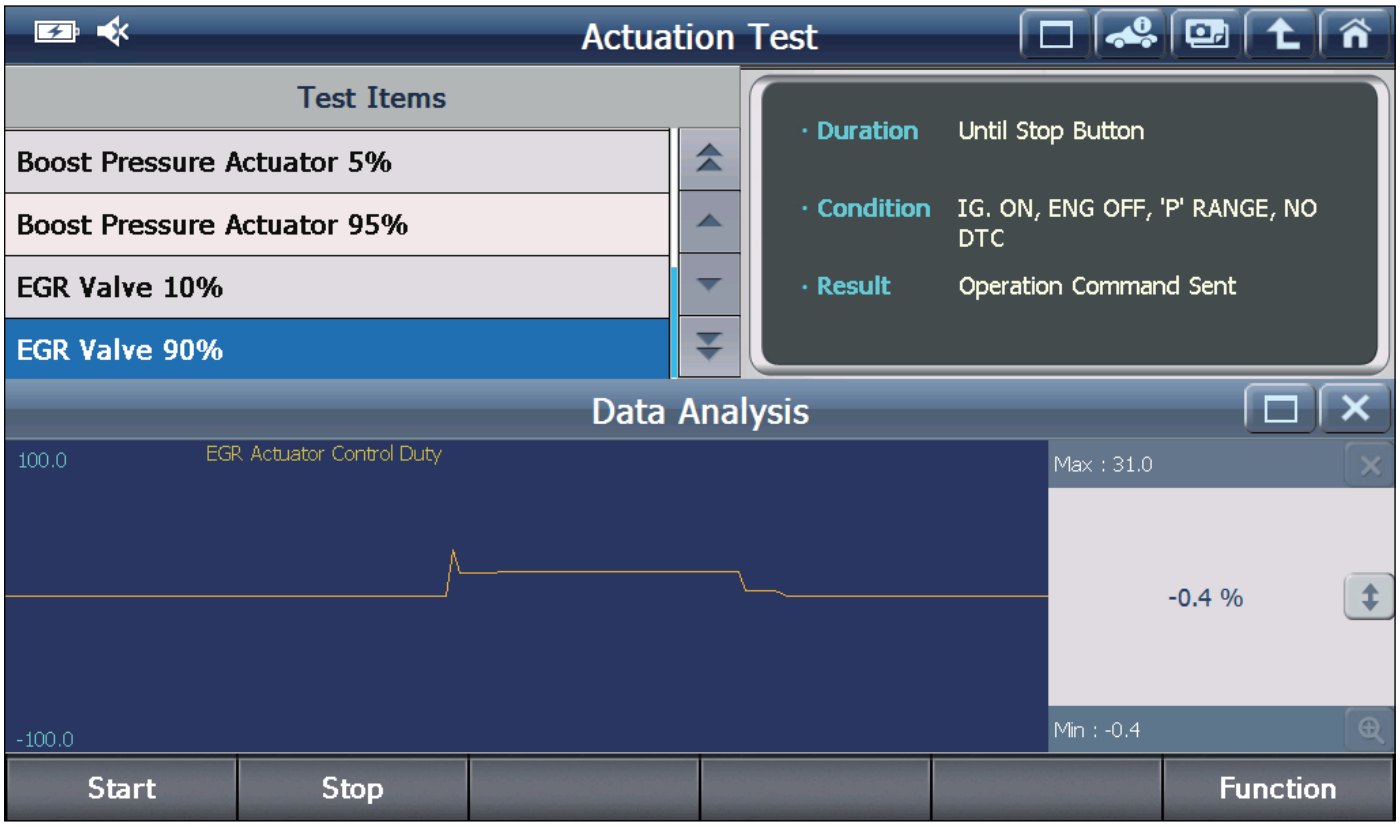


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

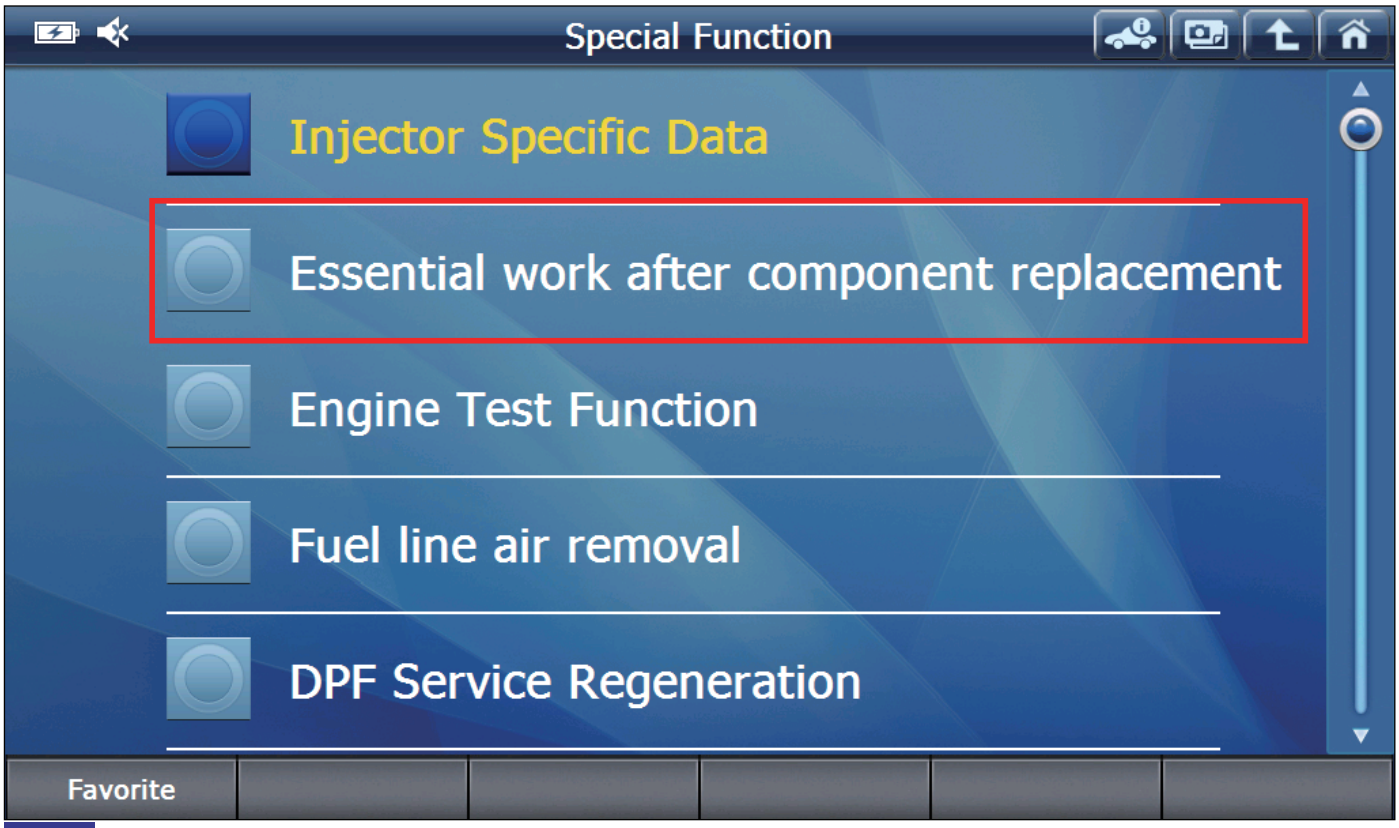


Fig.1

CRC12EN5010P01010041S

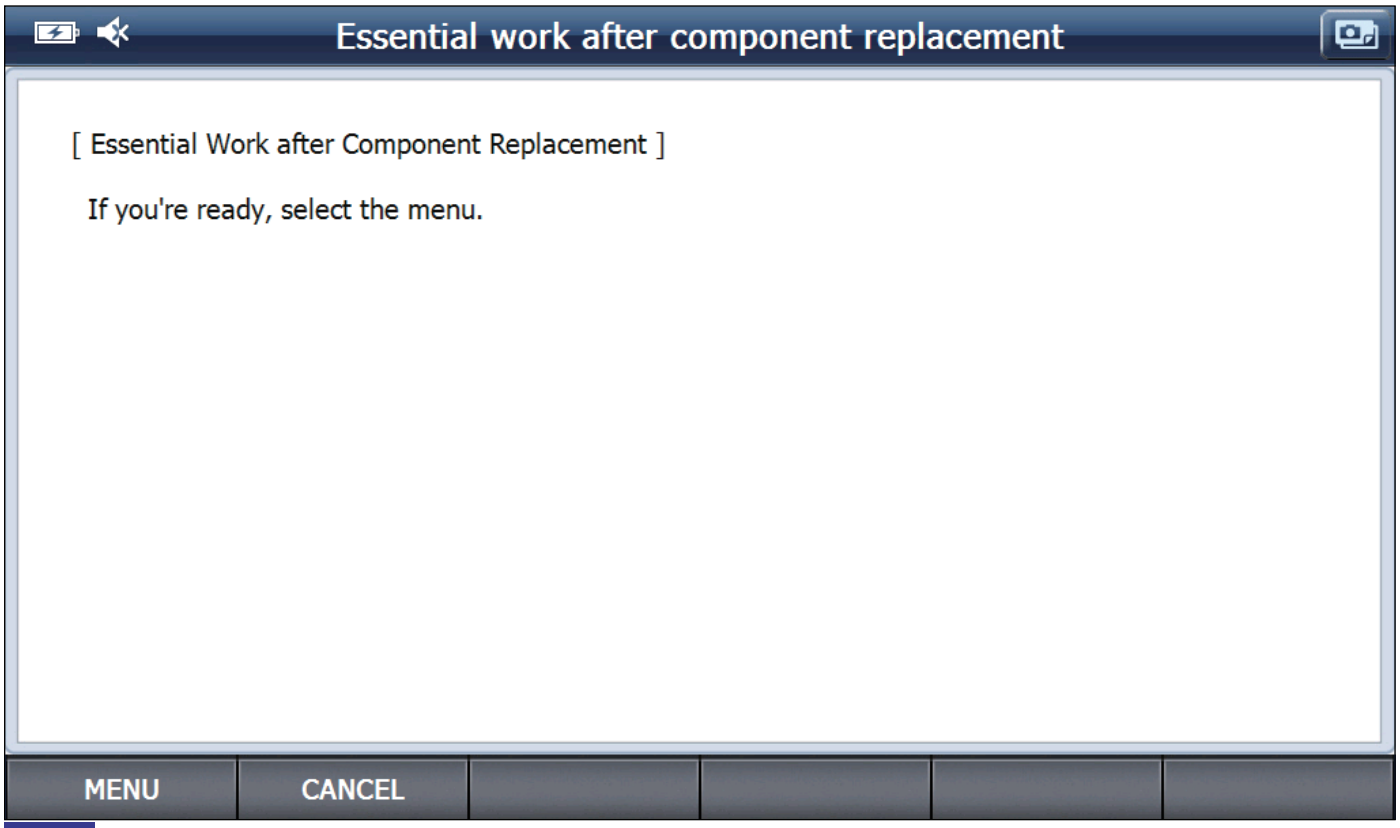


Fig.2

CRC12EN5010P01010042S

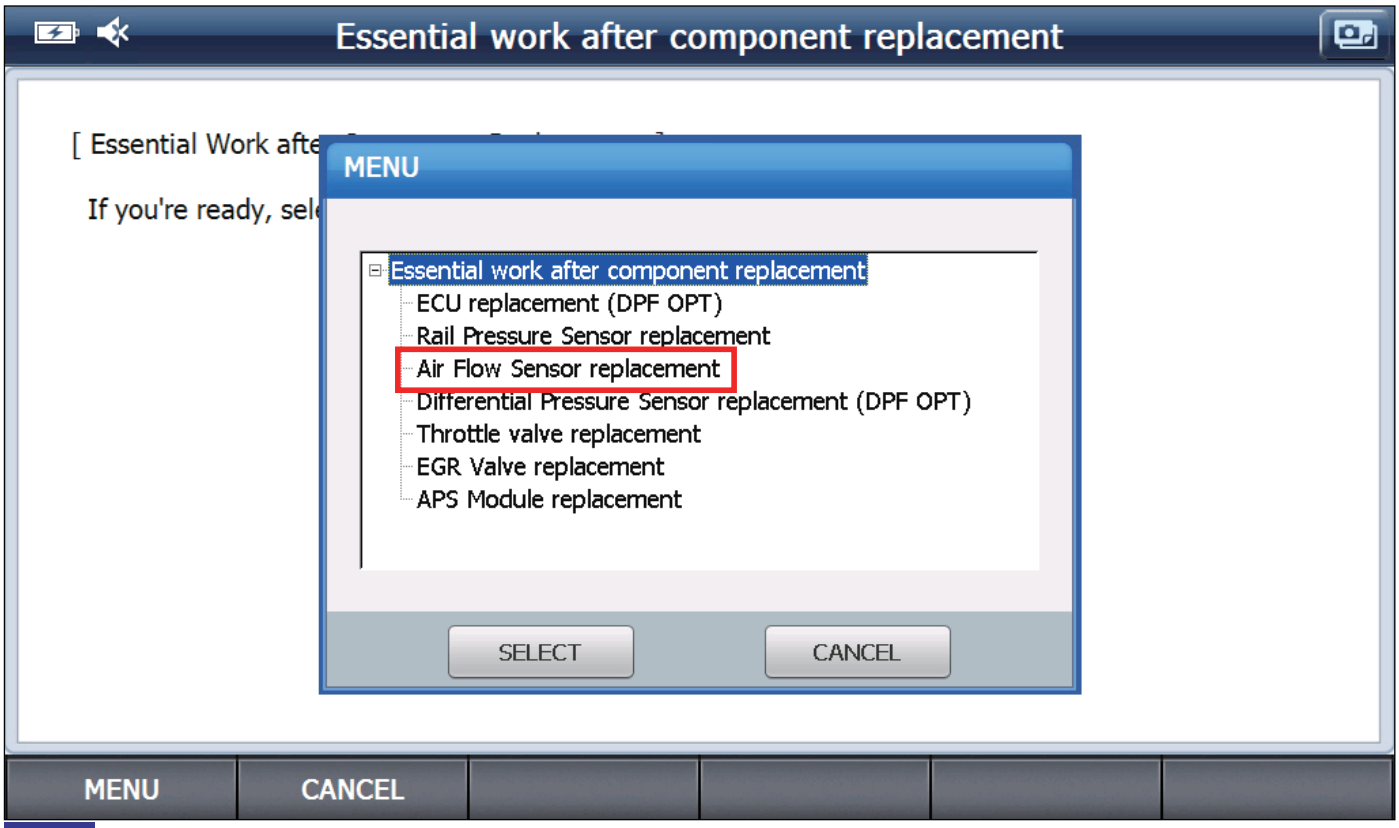


Fig.3

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.

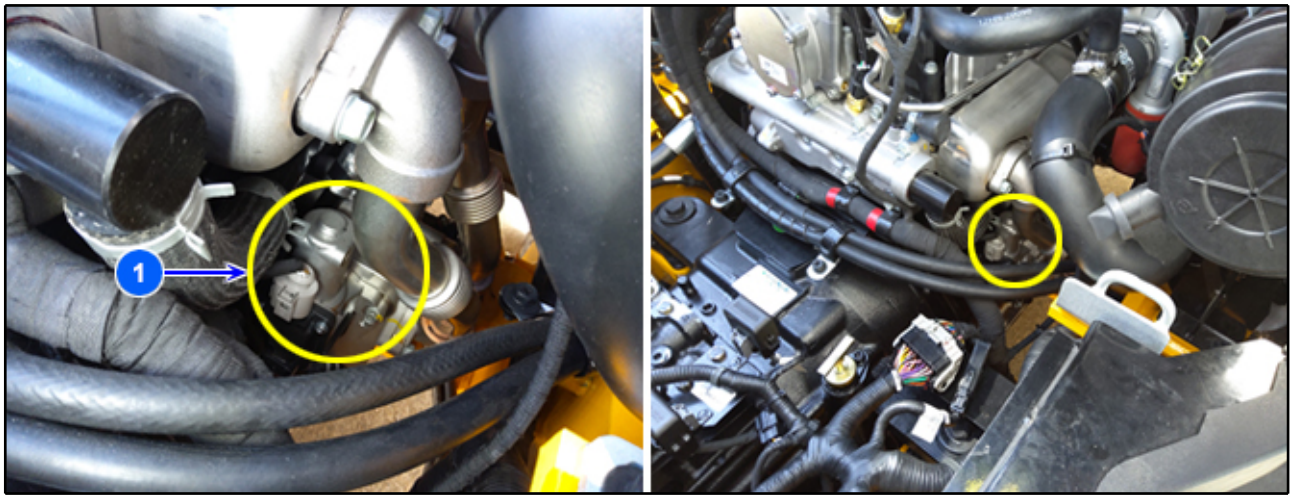
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P040200 Exhaust Gas Recirculation Flow Excessive Detected

Component Location



CRC12EN5010P040111

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

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Defected EGR valve disc 3. High pressure on exhaust system
Enable Conditions	• Engine running		
Threshold Value	• Exhaust gas re-circulation rate is below set-point		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

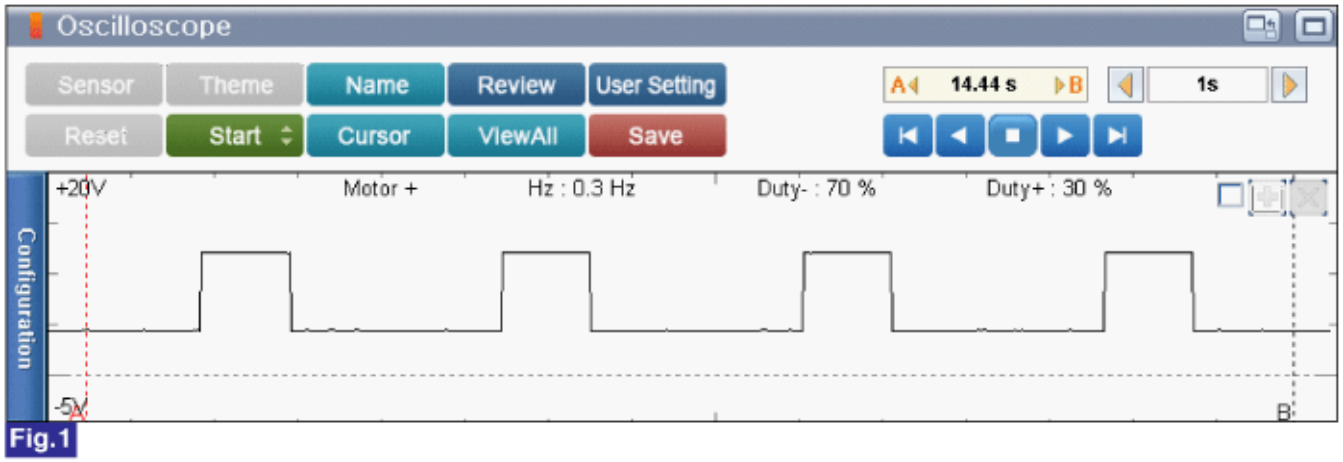


Fig.1

CRC12EN5010P04010011S

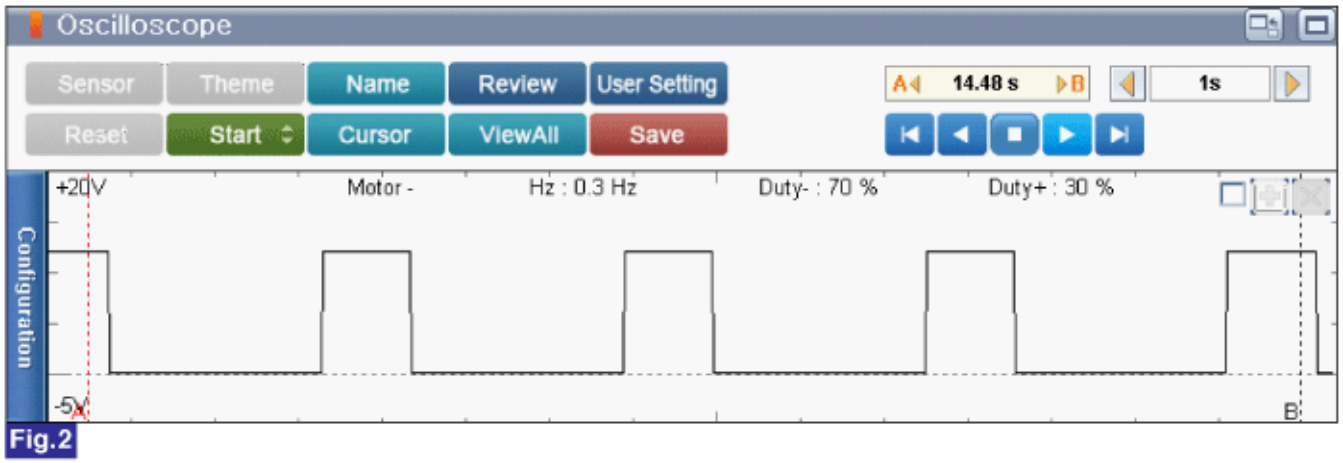


Fig.2

CRC12EN5010P04010012S

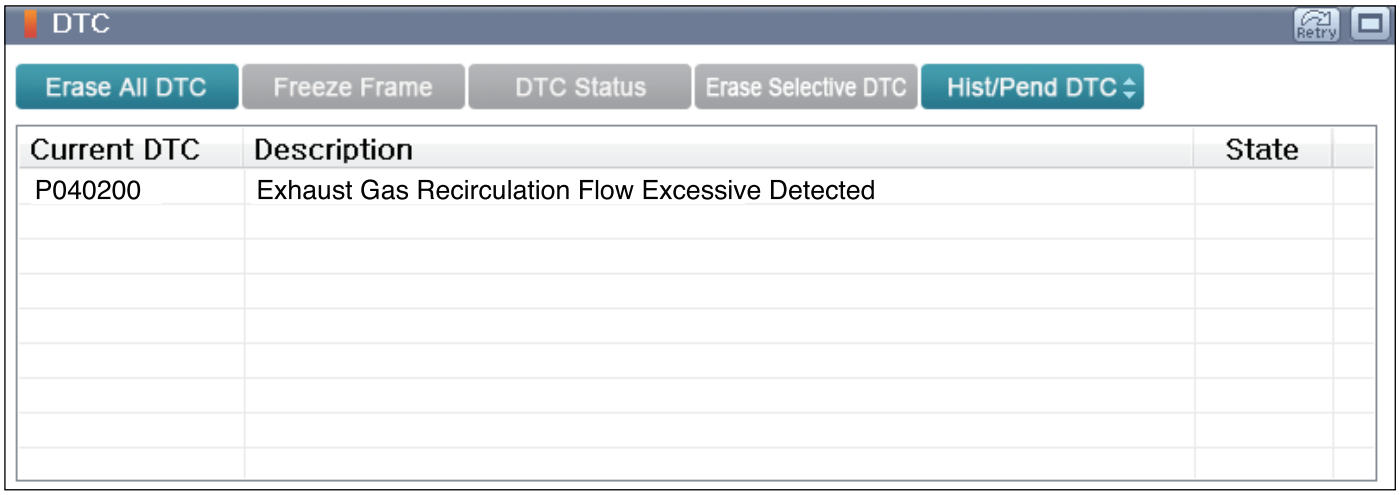
Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

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.



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

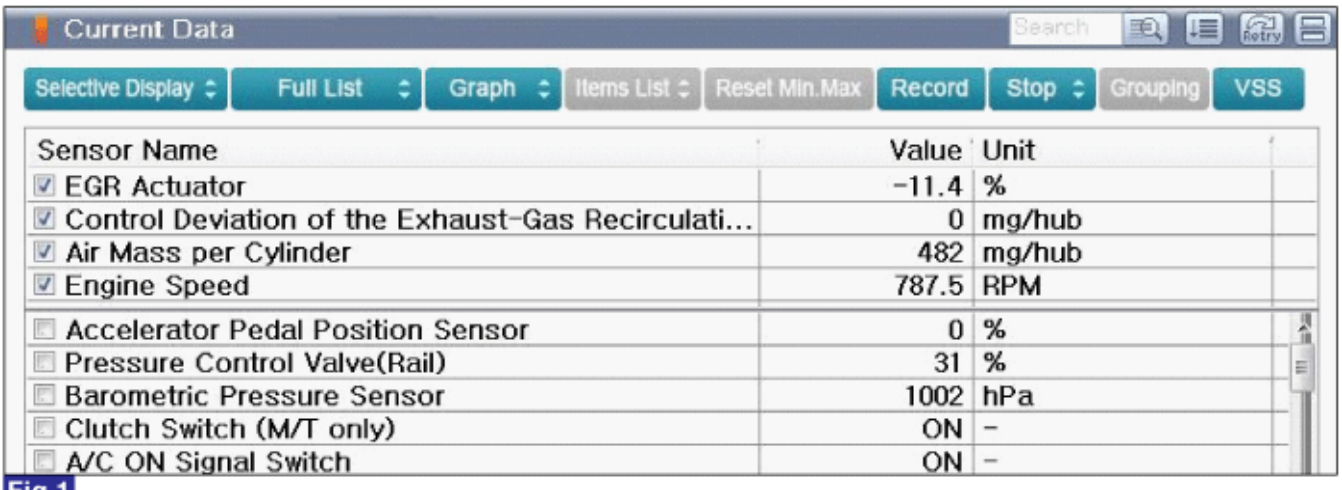


Fig.1

CRC12EN5010P04010022S

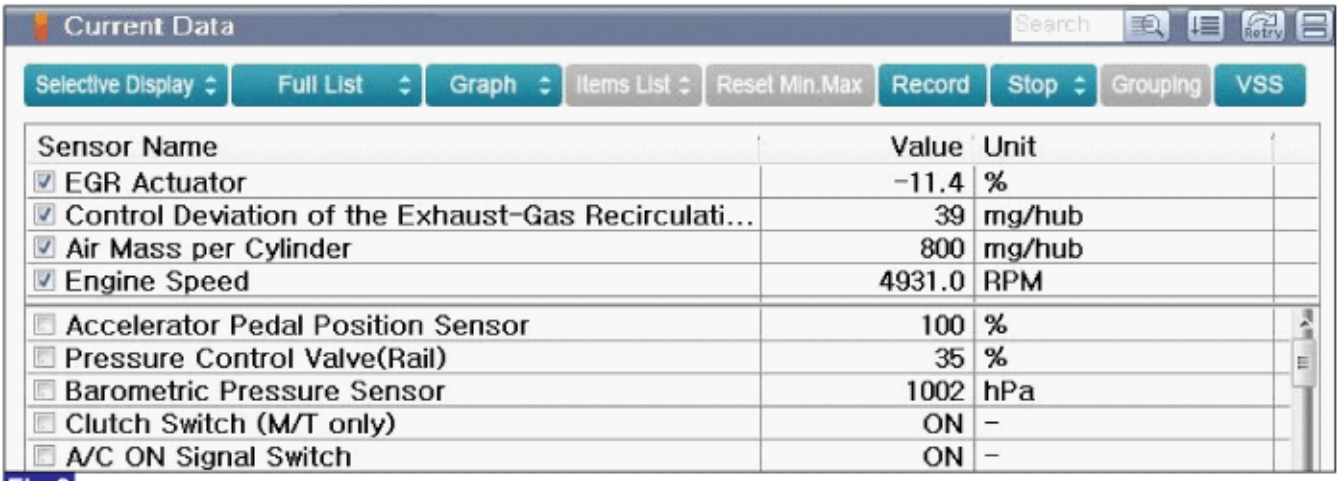


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

NO ▸ Inspect and repair open or short in circuit, and 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.

NO ▸ Go to "EGR Actuator Inspection" procedure.

■ 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.

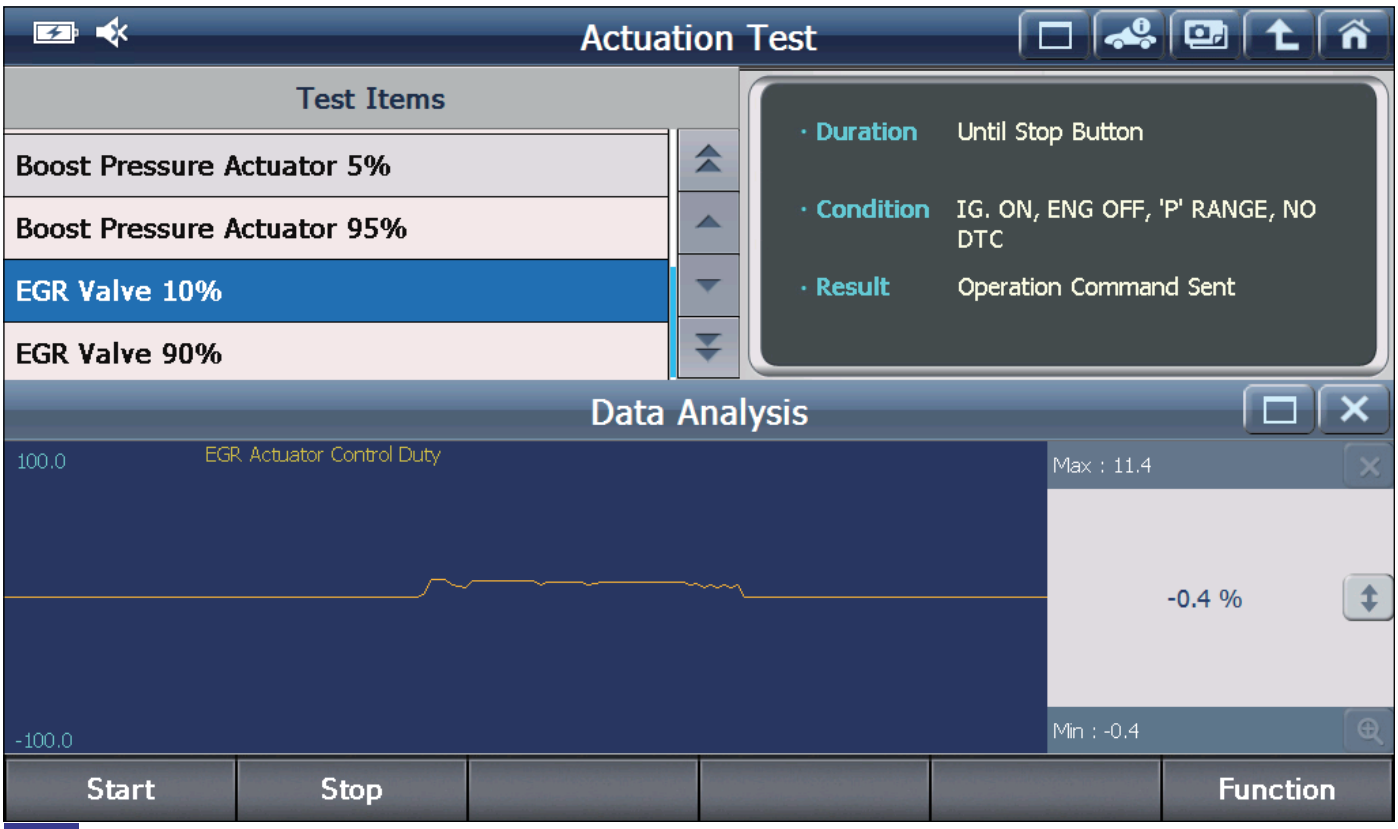


Fig.1

CRC12EN5010P04010041S

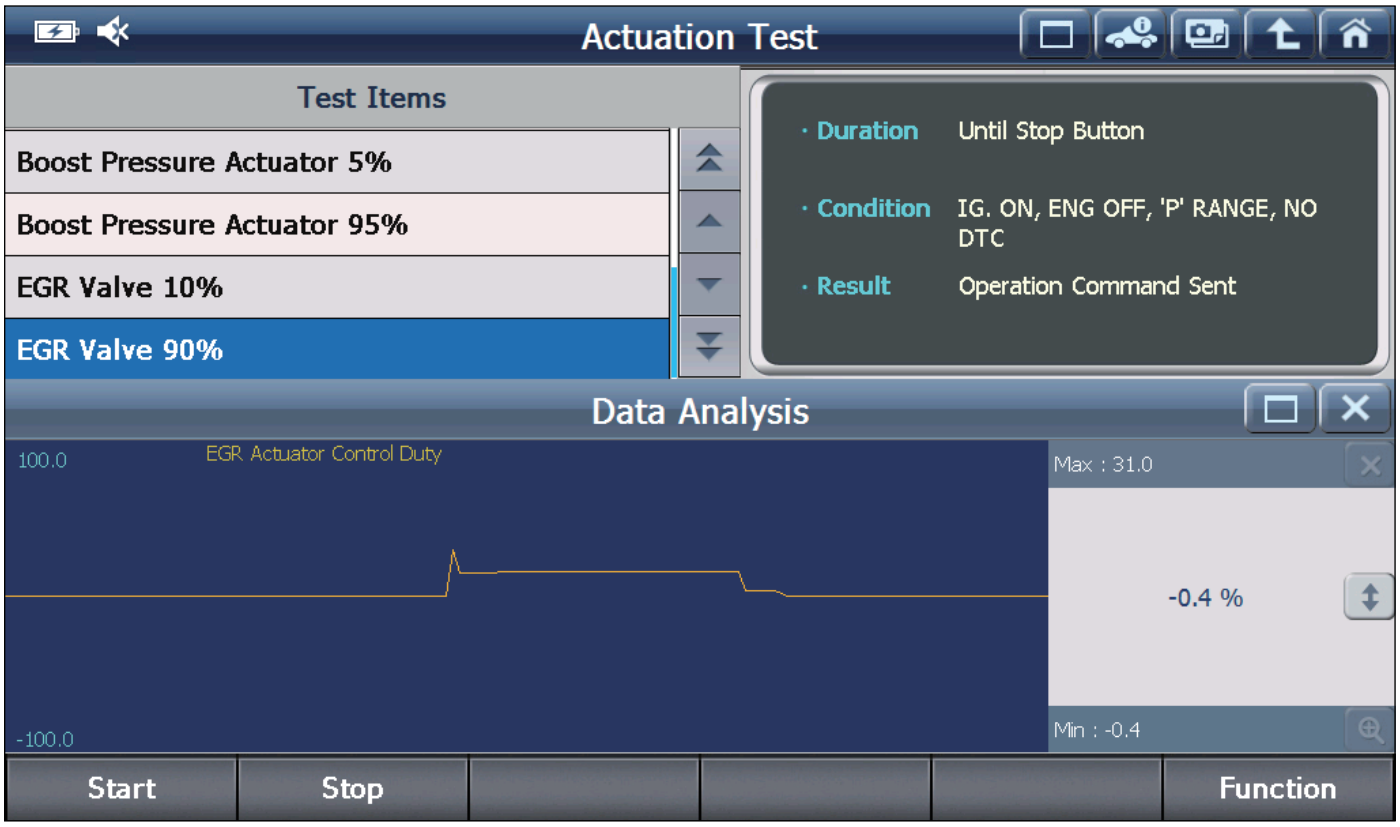


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

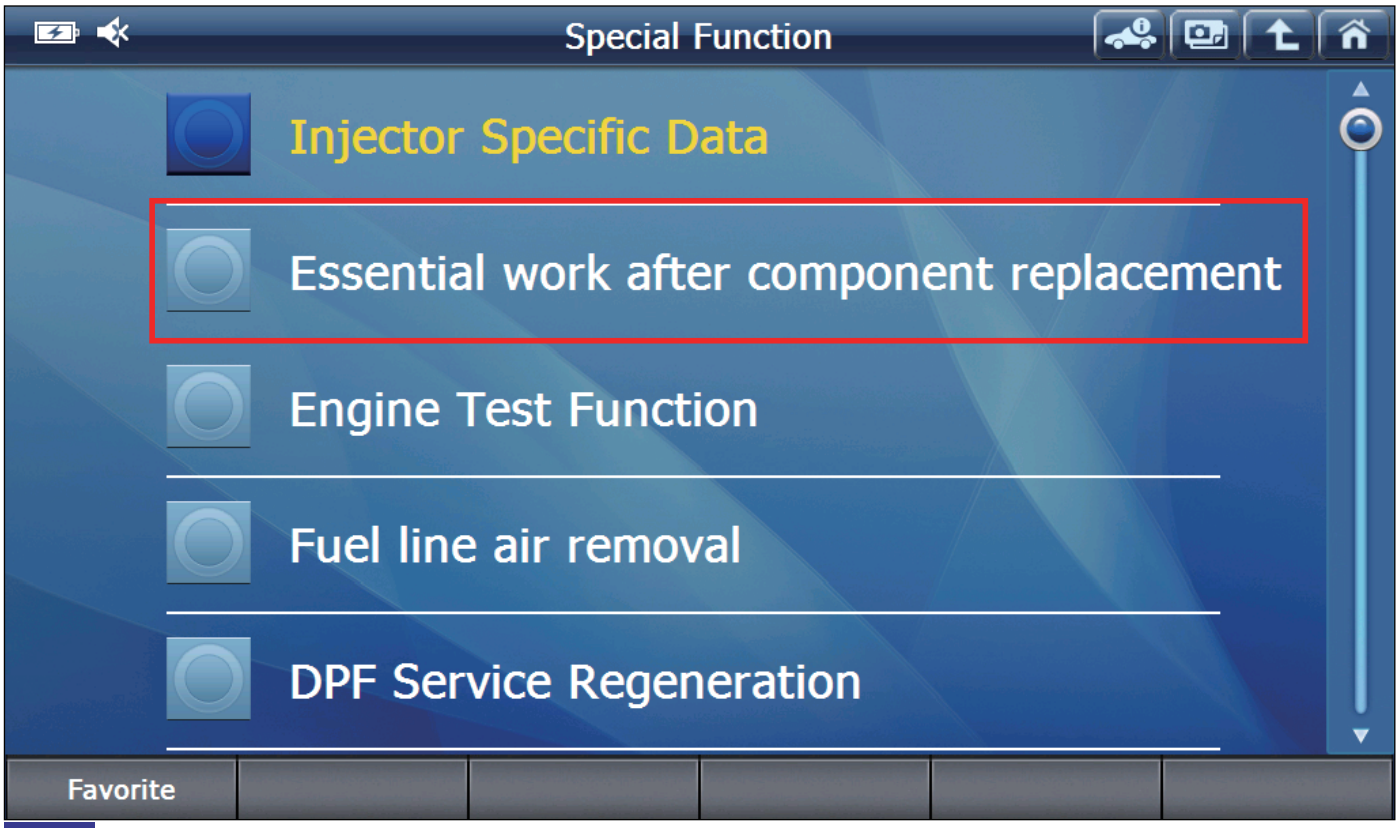


Fig.1

CRC12EN5010P01010041S

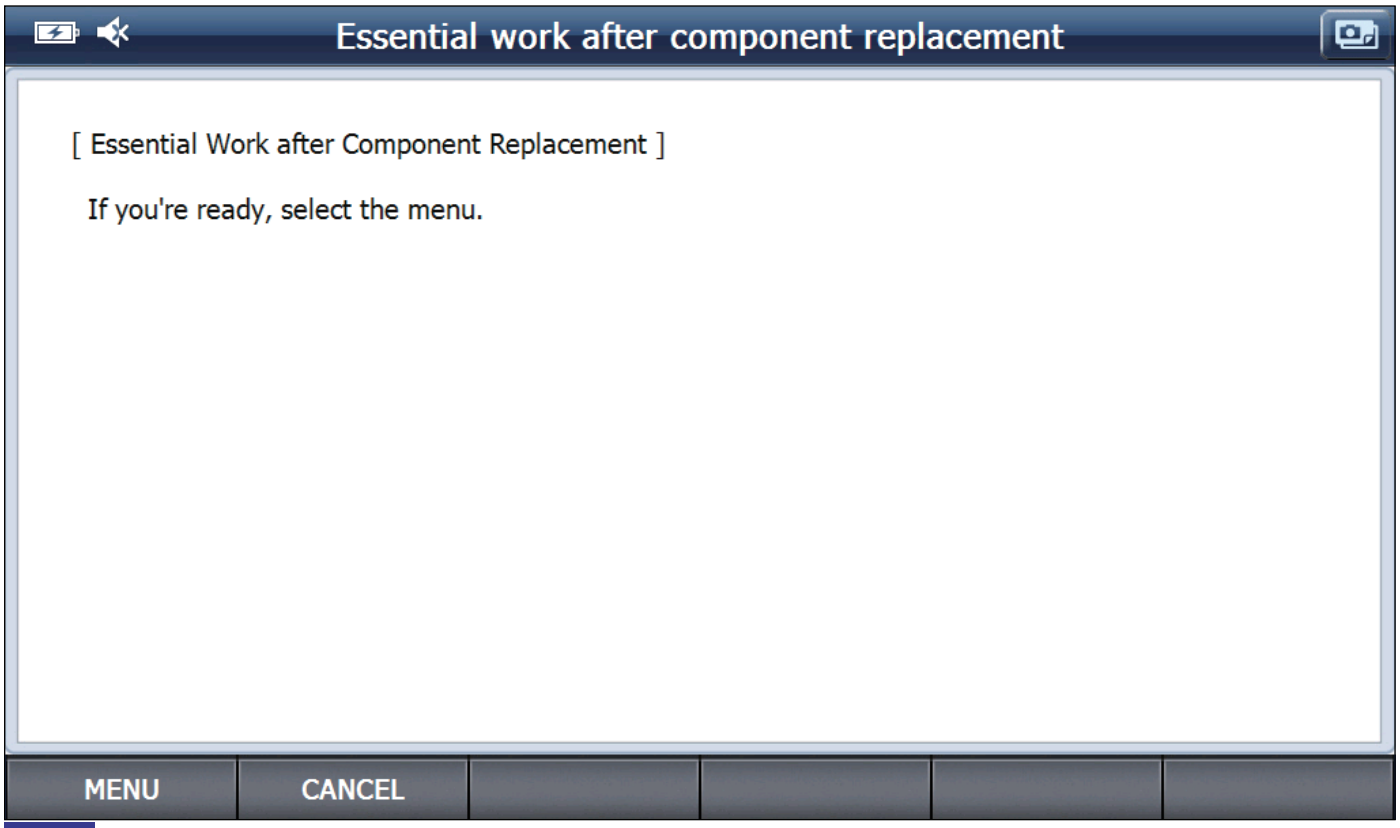


Fig.2

CRC12EN5010P01010042S

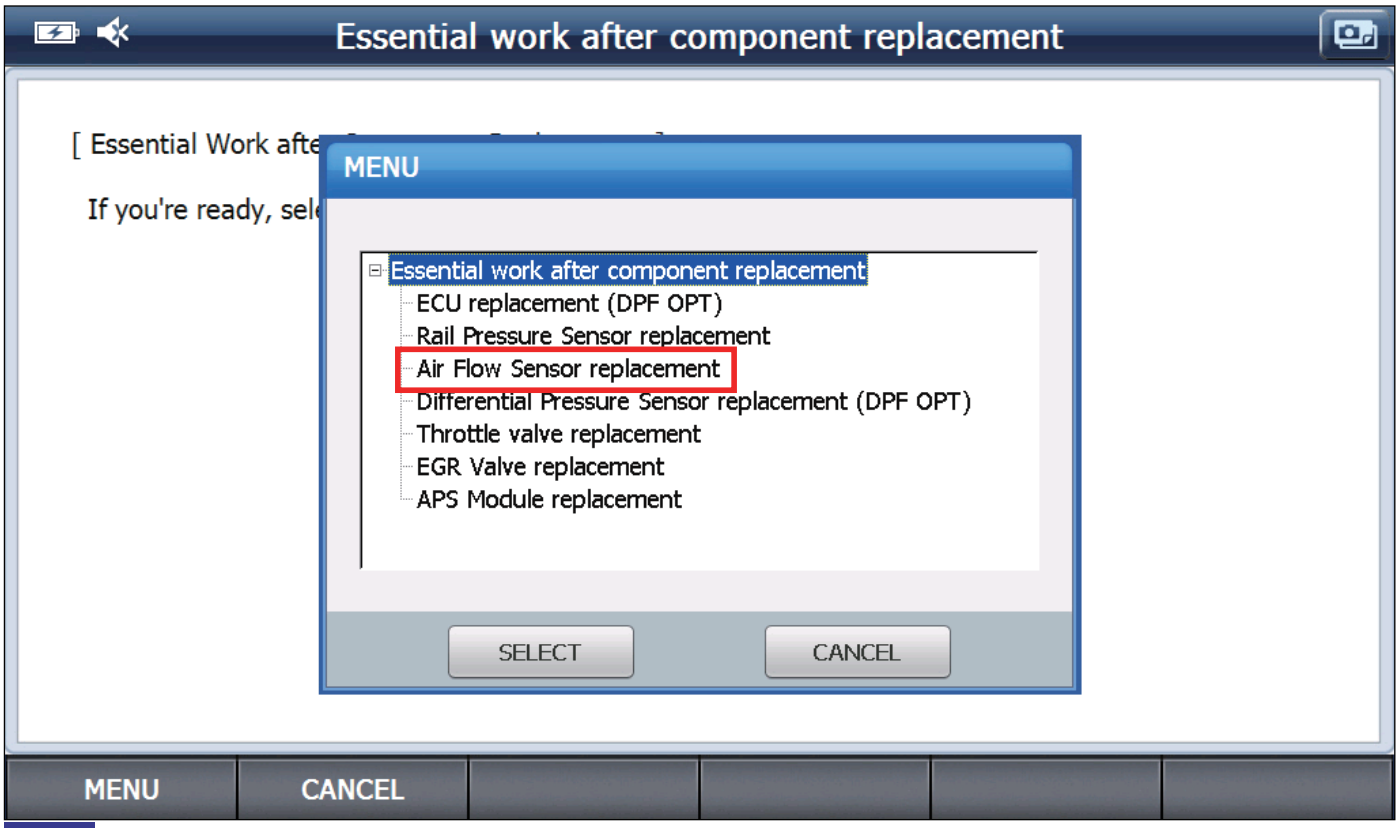


Fig.3

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.

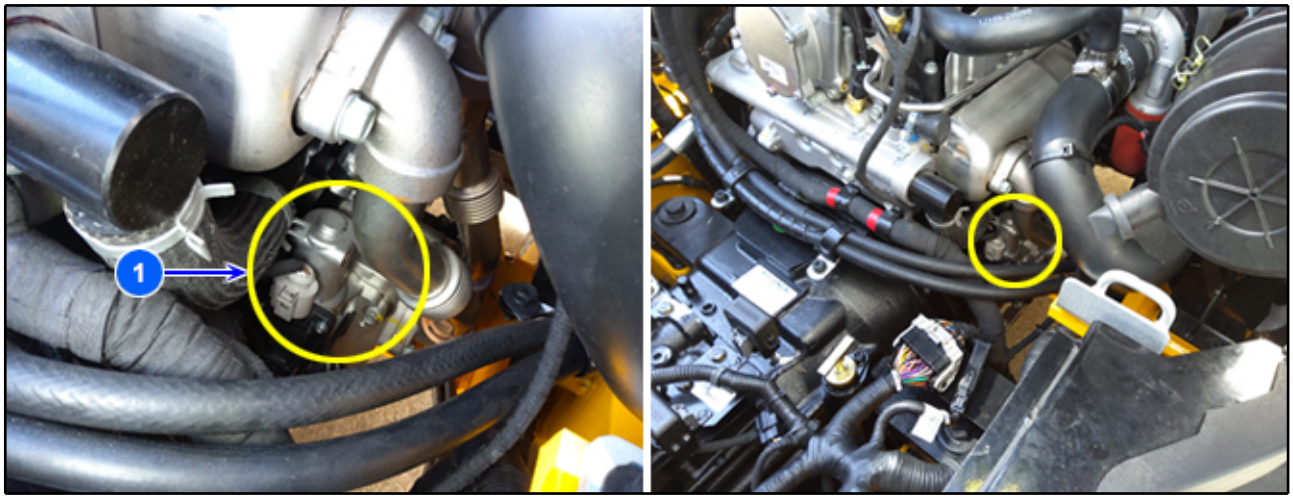
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P040300 Exhaust Gas Recirculation Control Circuit

Component Location



CRC12EN5010P040111

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	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Open in motor circuit of E-EGR actuator 3. Defected E-EGR actuator
Enable Conditions	• Engine running		
Threshold Value	• Exhaust gas re-circulation rate is below set-point		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

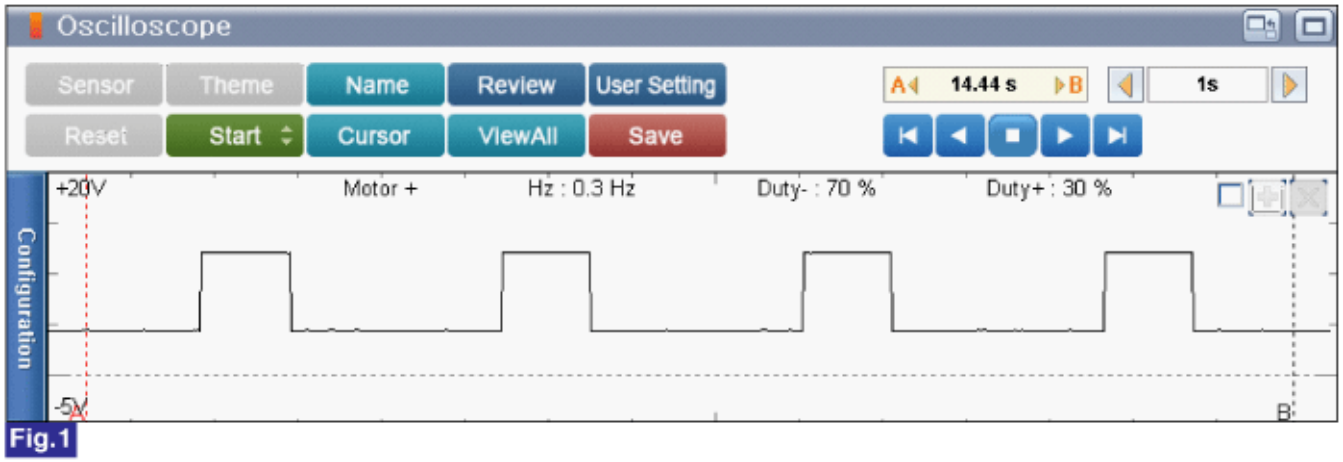


Fig.1

CRC12EN5010P04010011S

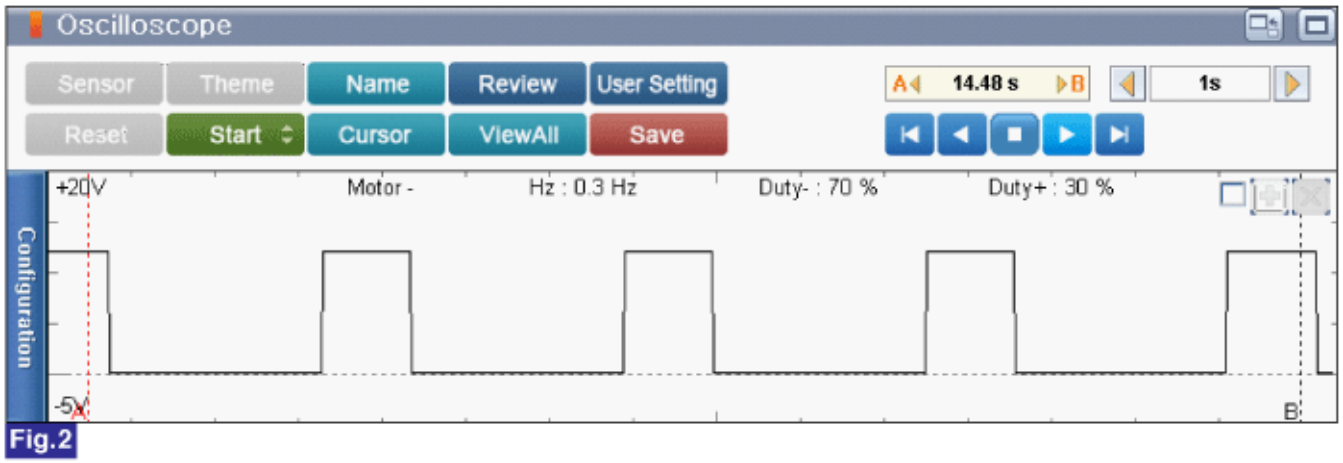


Fig.2

CRC12EN5010P04010012S

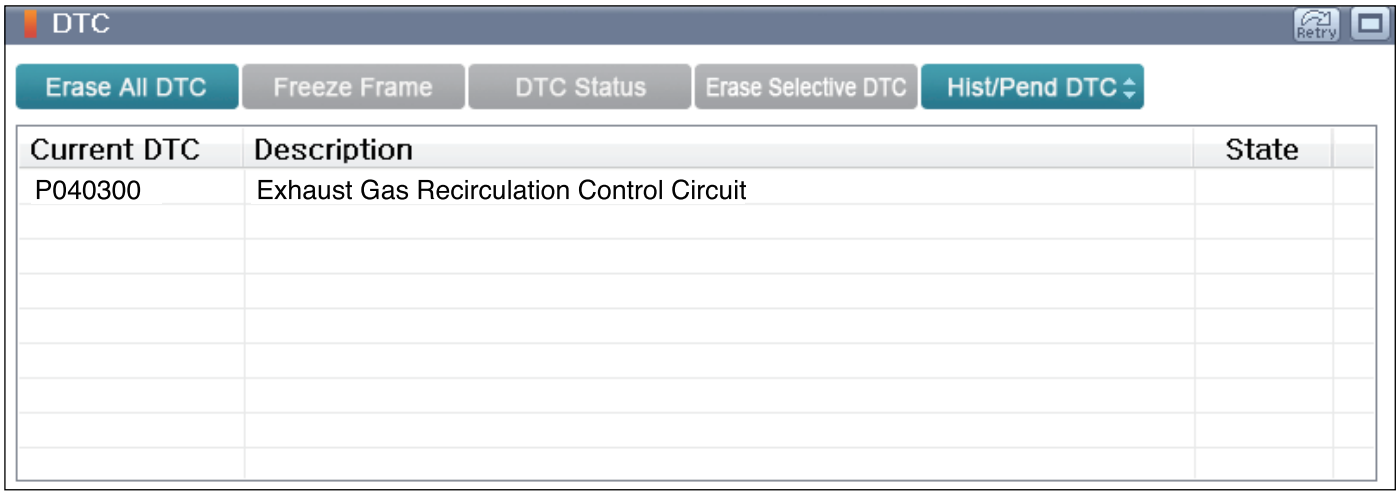
Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

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.



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

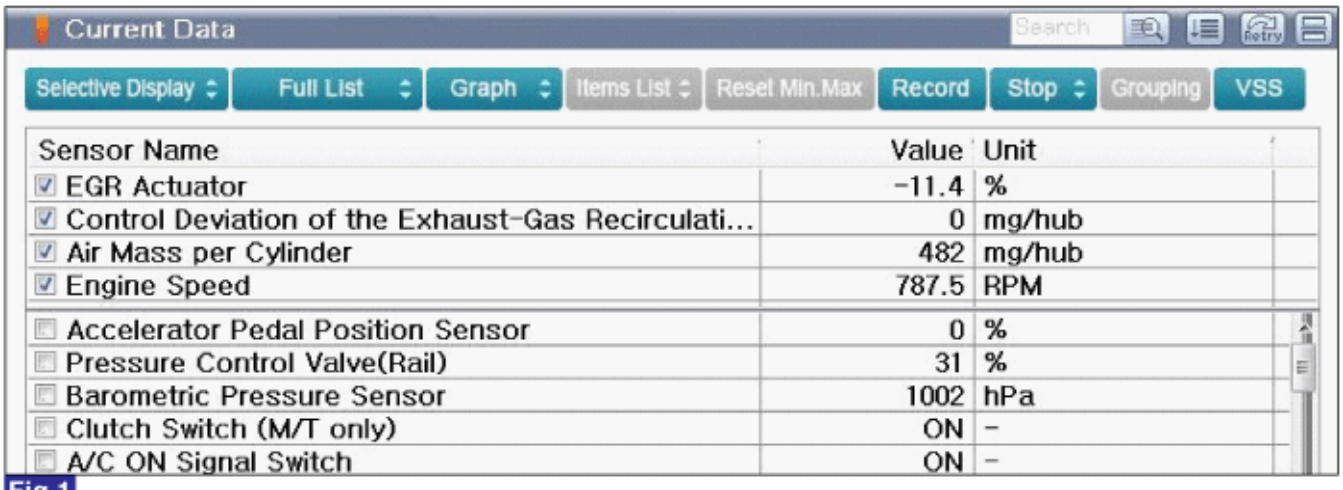


Fig.1

CRC12EN5010P04010022S

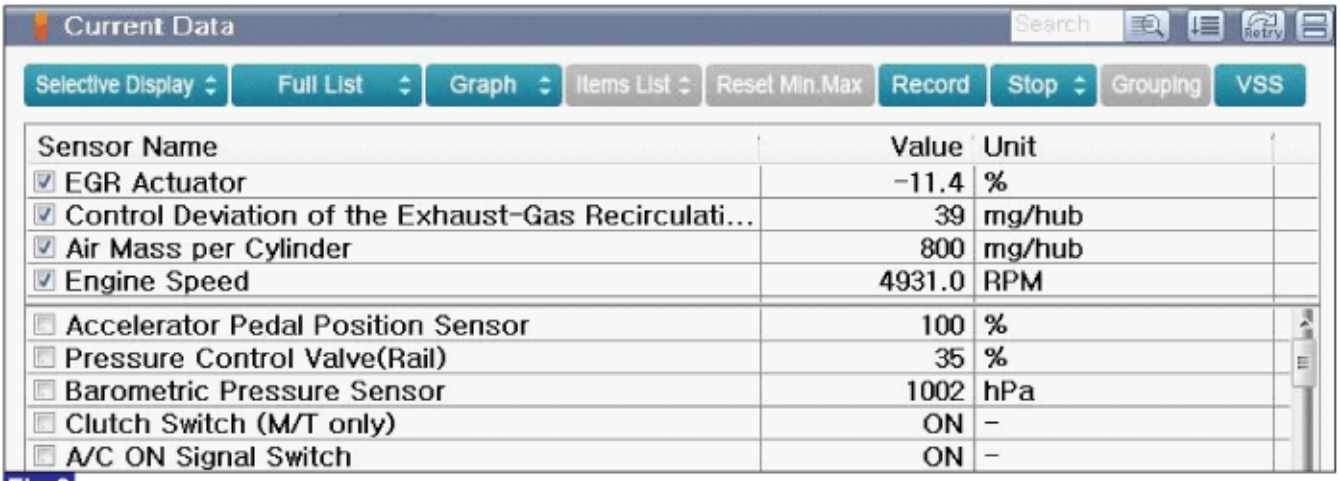


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

NO ▸ Inspect and repair open or short in circuit, and 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.

NO ▸ Go to "EGR Actuator Inspection" procedure.

■ 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.

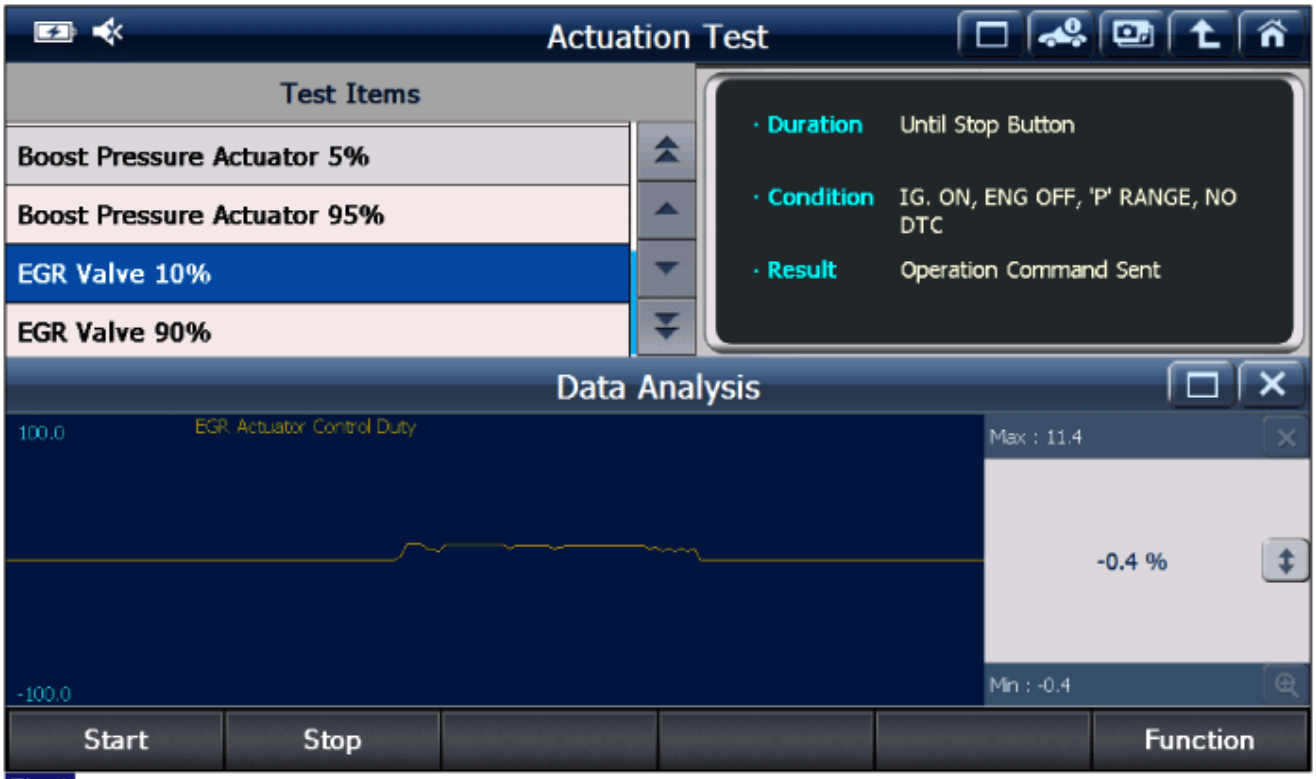


Fig.1

CRC12EN5010P04010041S

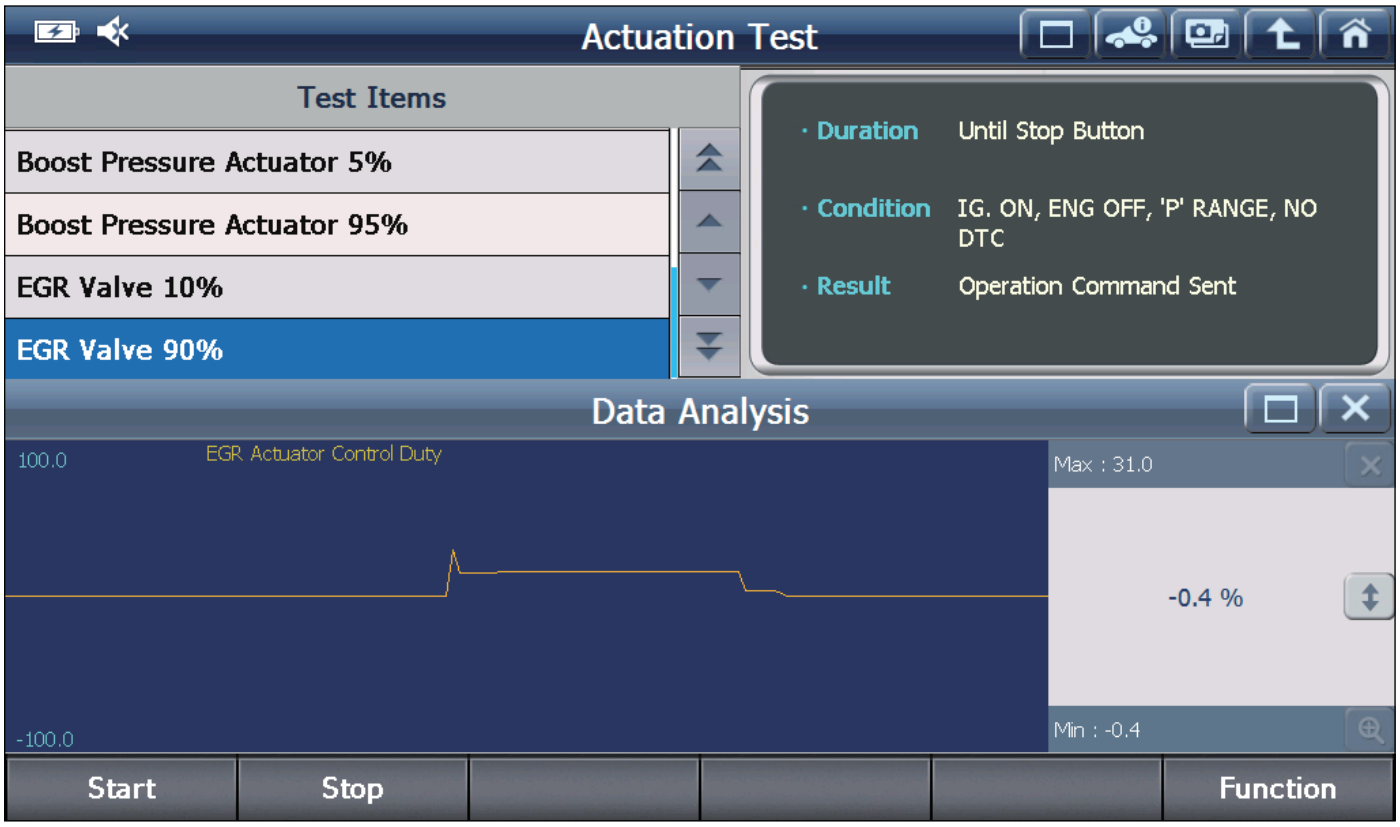


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

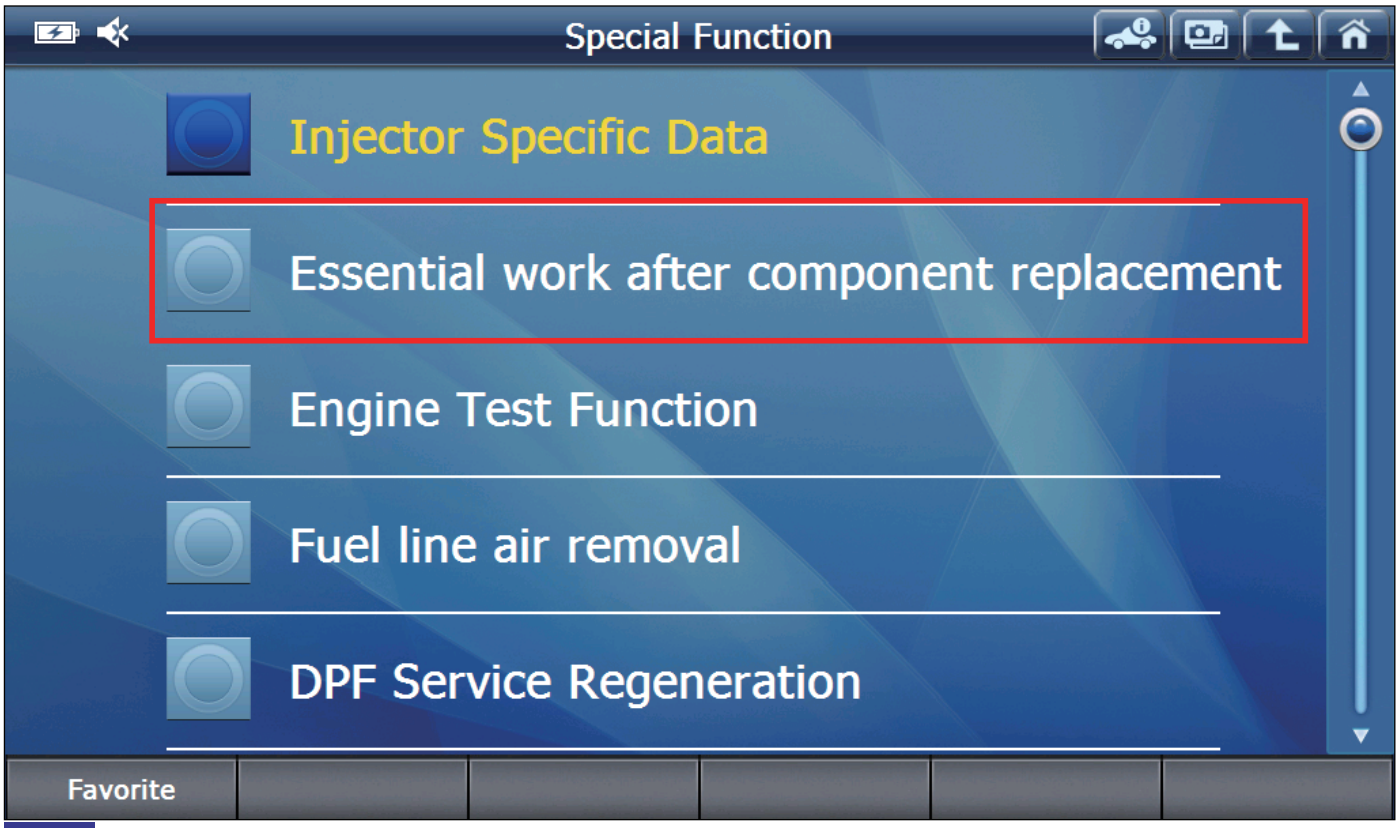


Fig.1

CRC12EN5010P01010041S

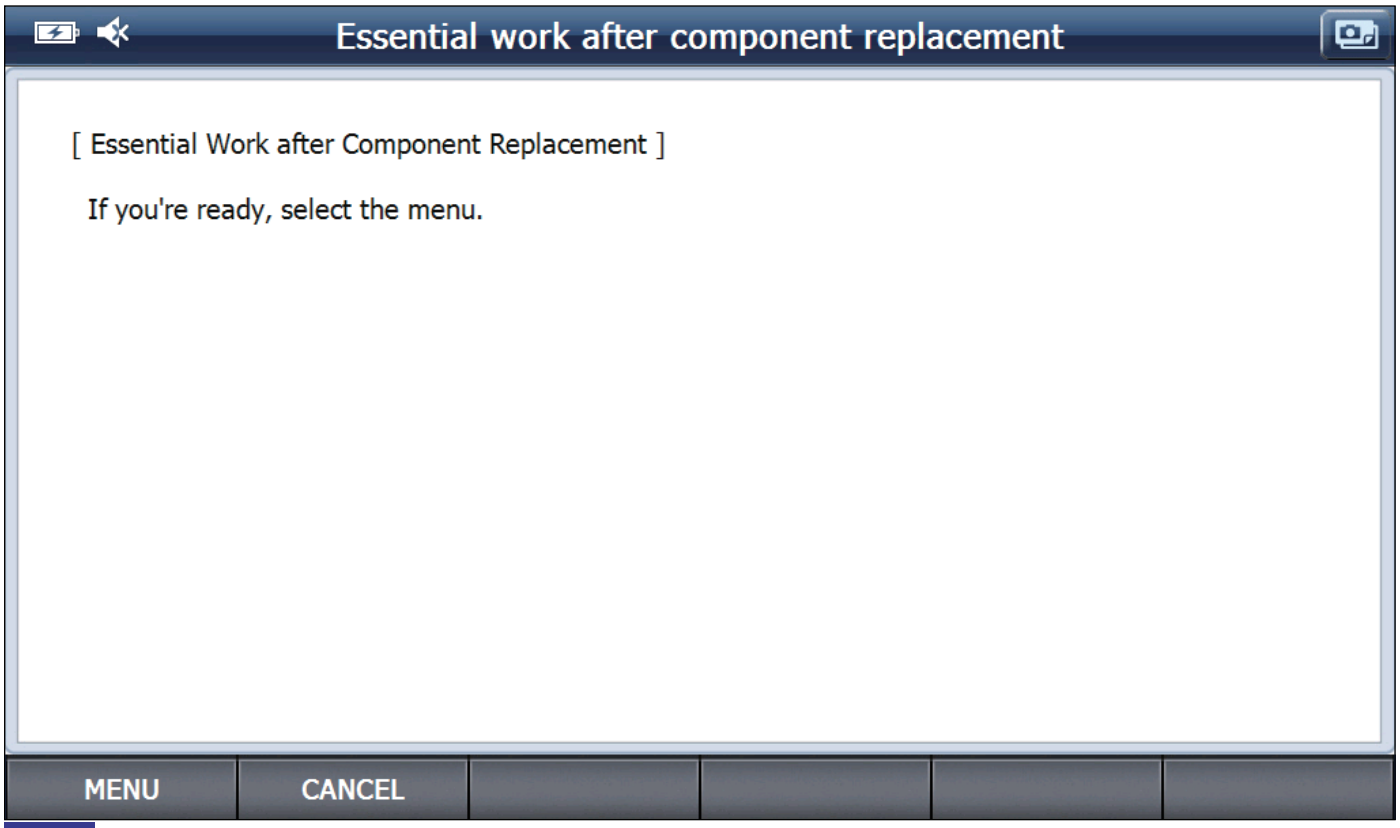


Fig.2

CRC12EN5010P01010042S

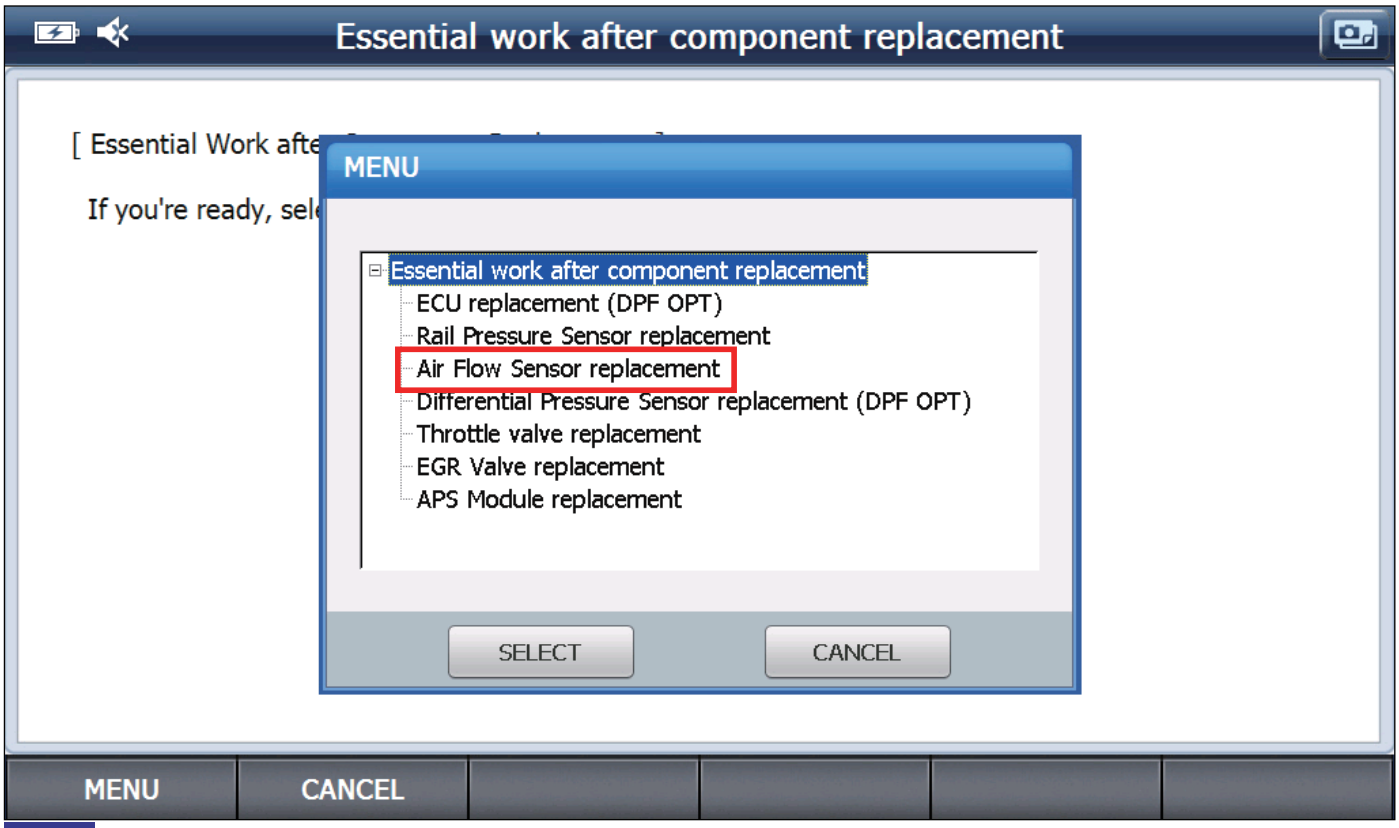


Fig.3

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.

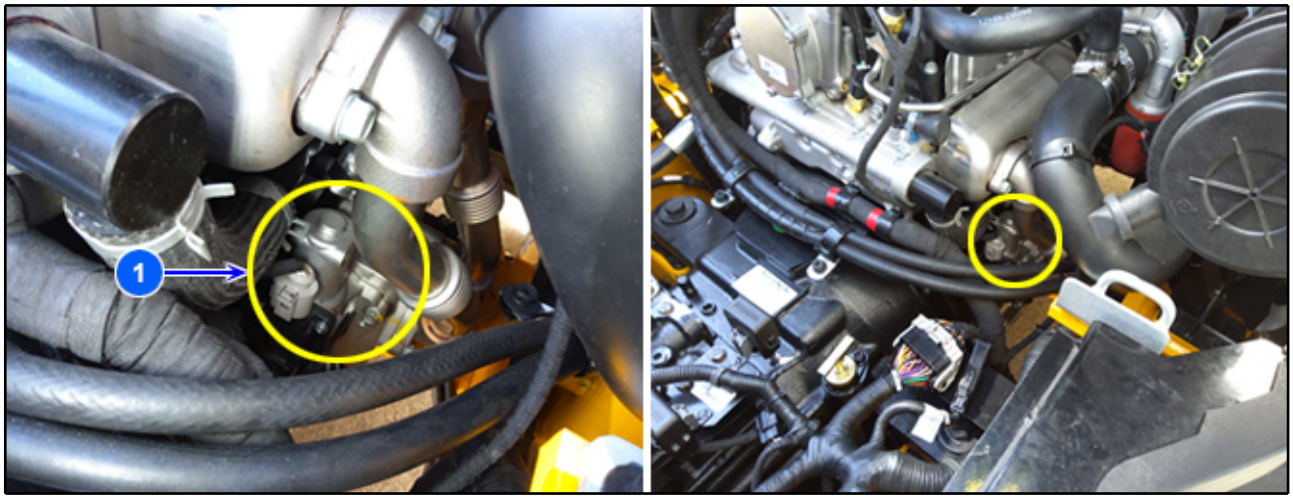
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P040400 Exhaust Gas Recirculation Control Circuit Range/Performance

Component Location



CRC12EN5010P040111

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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty E-EGR actuator circuit 3. Stuck on E-EGR actuator 4. Defected E-EGR actuator
Enable Condition	• Engine running		
Threshold Value	Case 1	• Excessive temperature on E-EGR Actuator	
	Case 2	• Stuck closed on E-EGR Actuator • Stuck open on E-EGR Actuator	
Detecting Time	Case 1	• 1 sec	
	Case 2	• 4.4 sec	
Fail Safe	Engine OFF	• No	
	EGR OFF	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

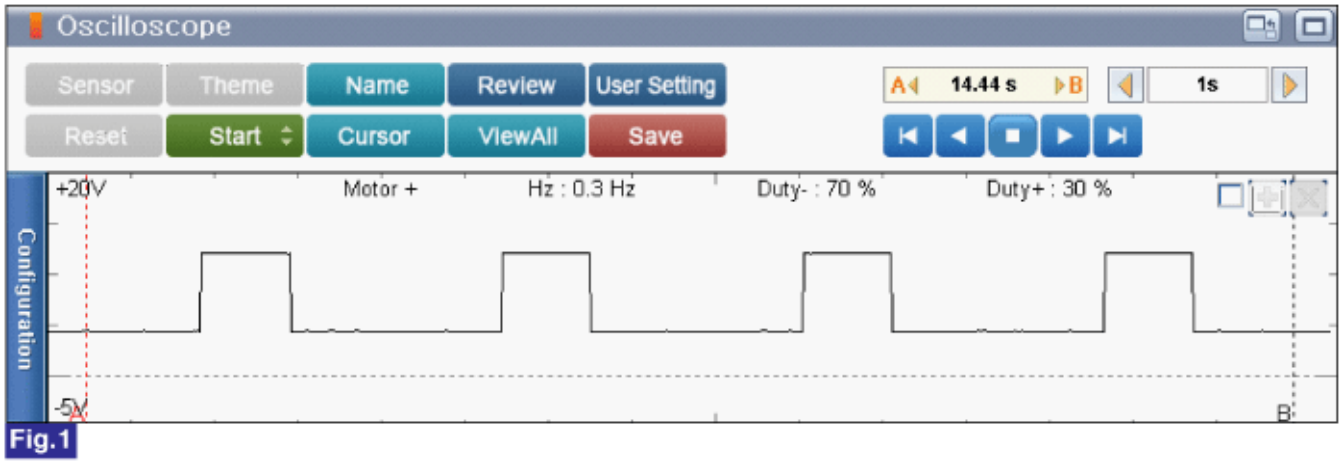


Fig.1

CRC12EN5010P04010011S

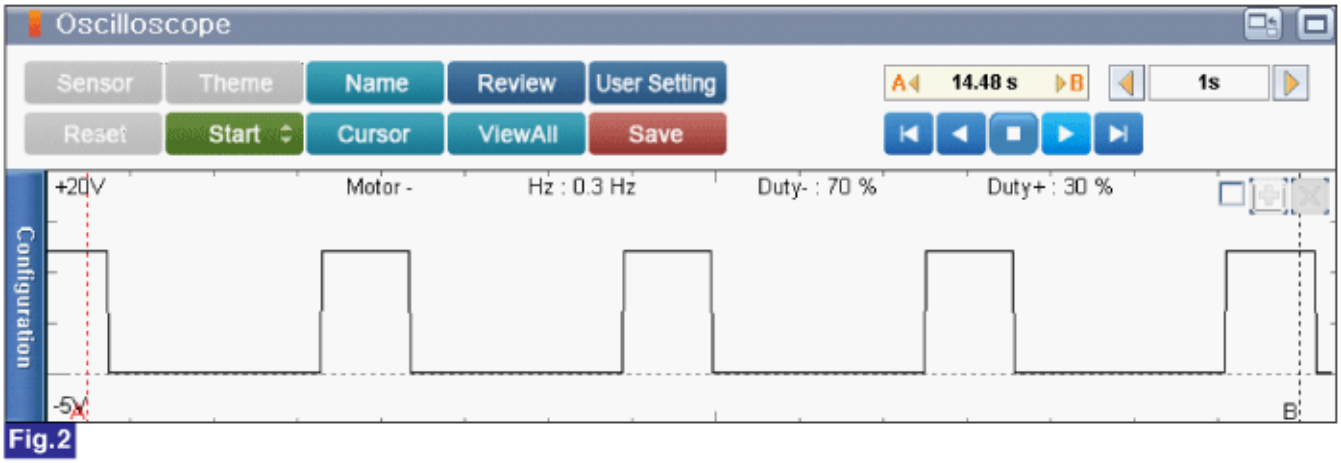


Fig.2

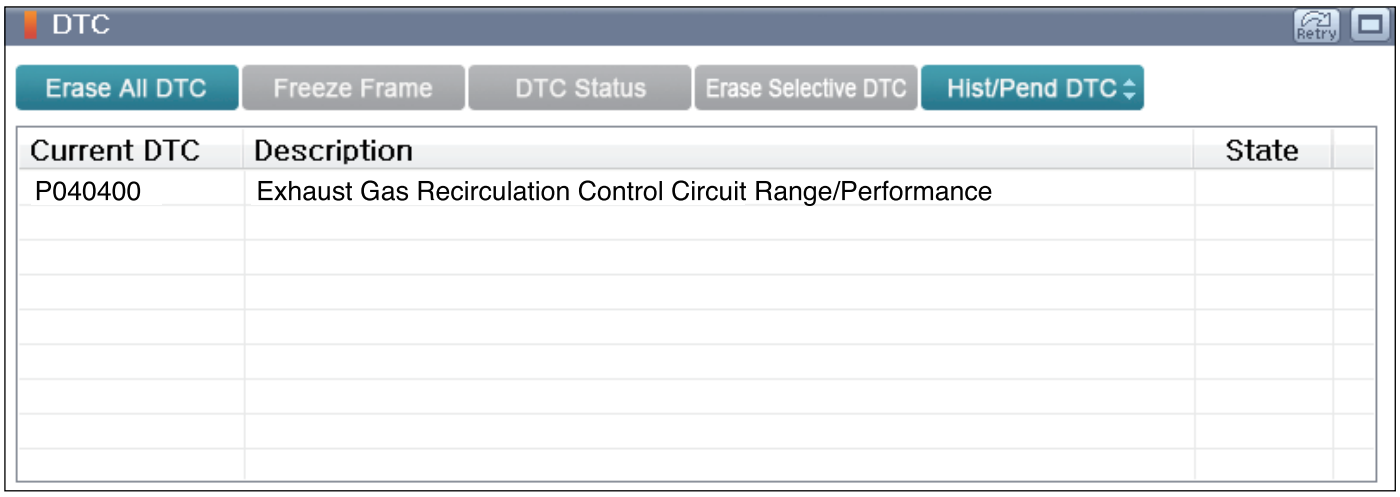
CRC12EN5010P04010012S

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.



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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 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

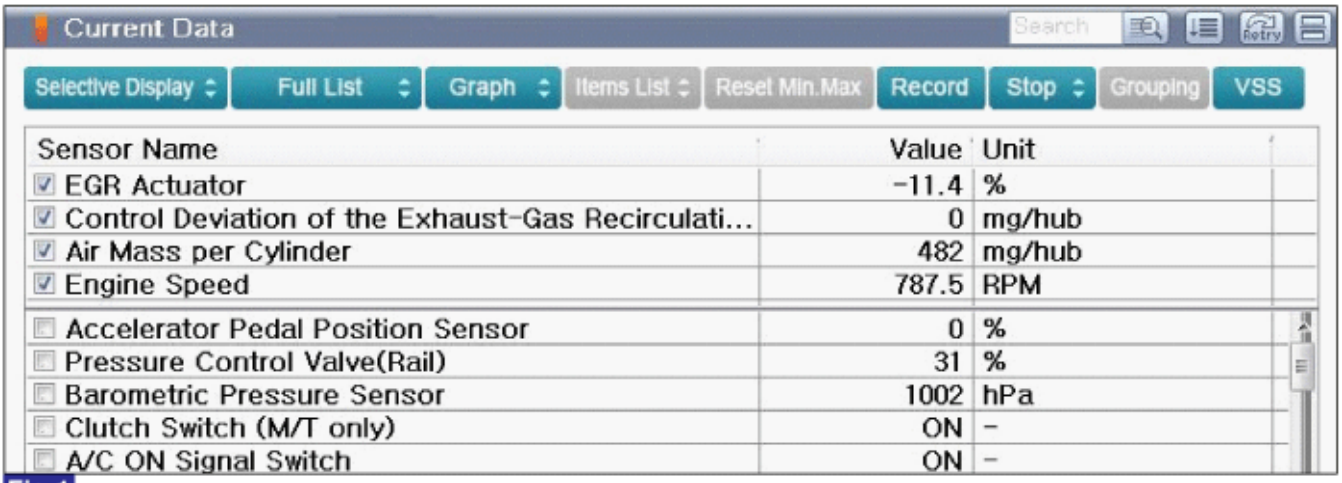

Fig.1

CRC12EN5010P04010022S

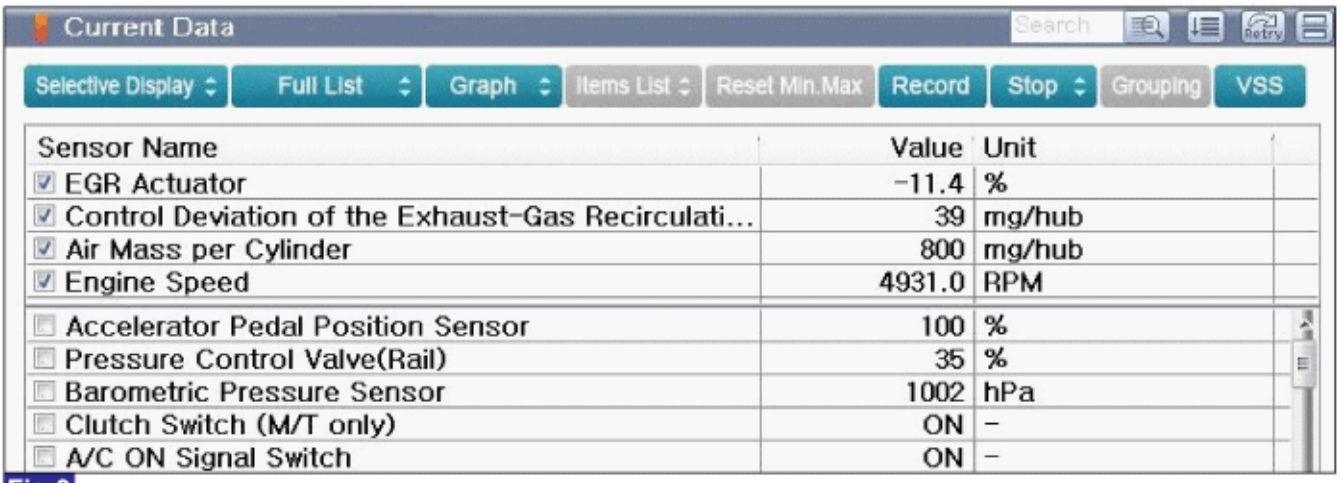

Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

NO ▸ Inspect and repair open or short in circuit, and 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.

NO ▸ Go to "EGR Actuator Inspection" procedure.

■ **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.

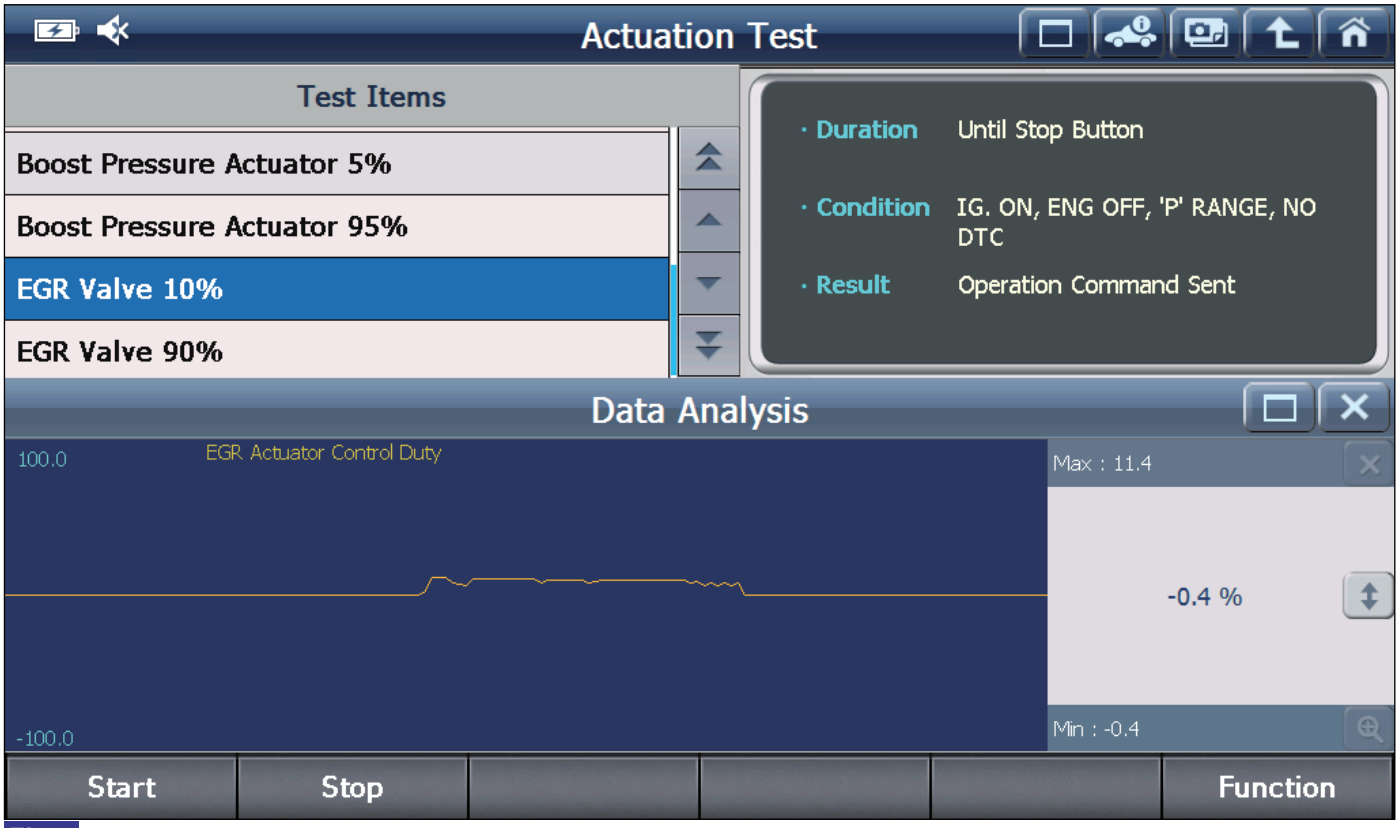

Fig.1

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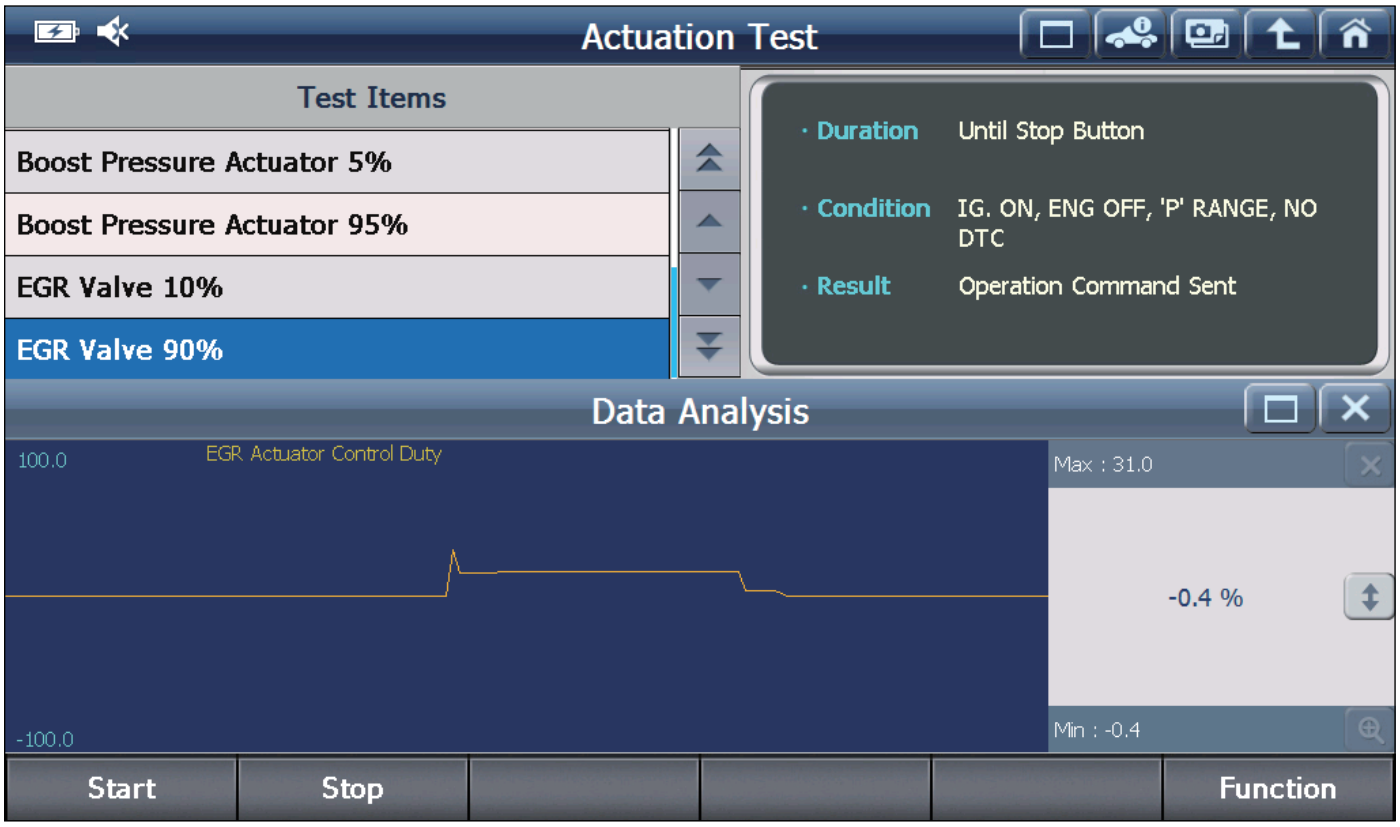


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

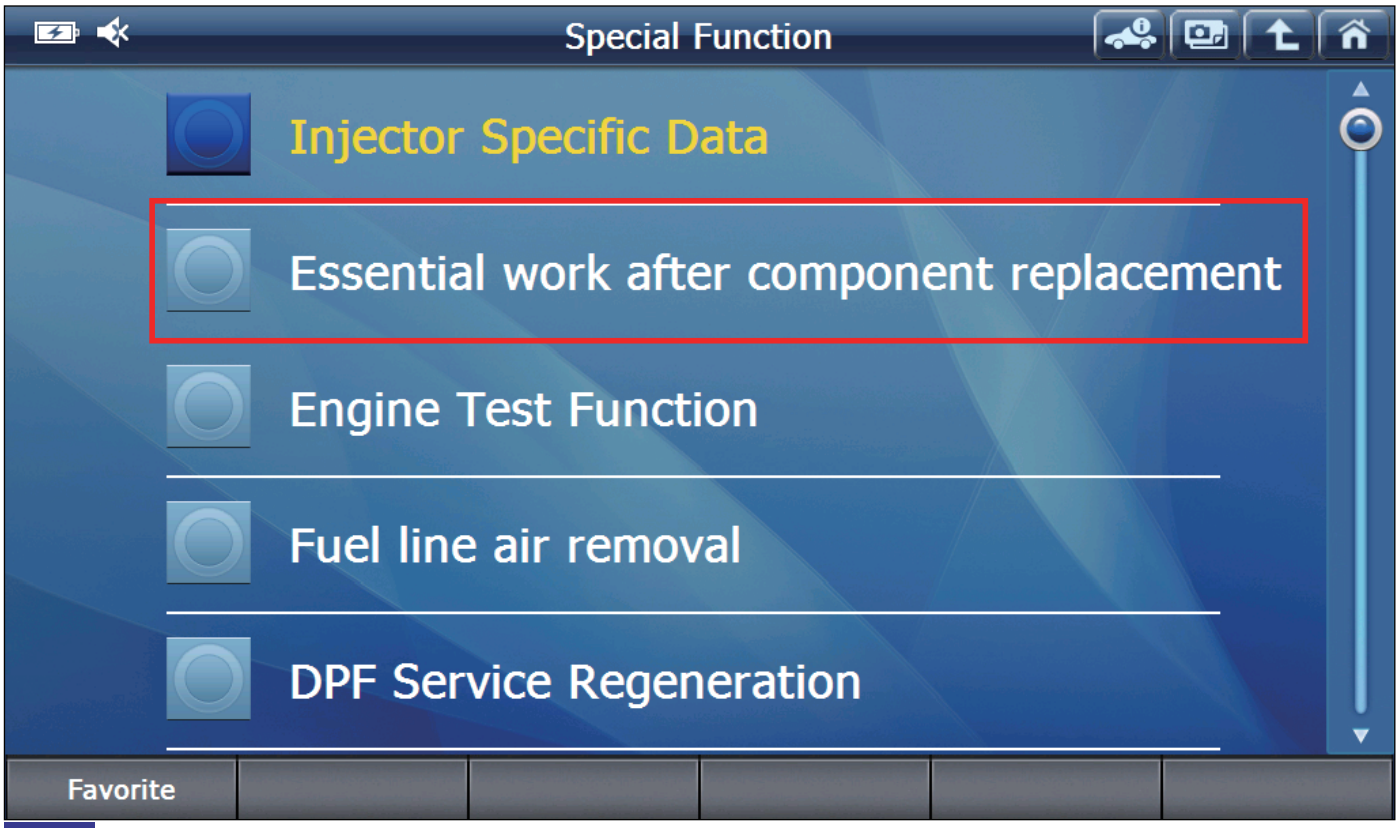


Fig.1

CRC12EN5010P01010041S

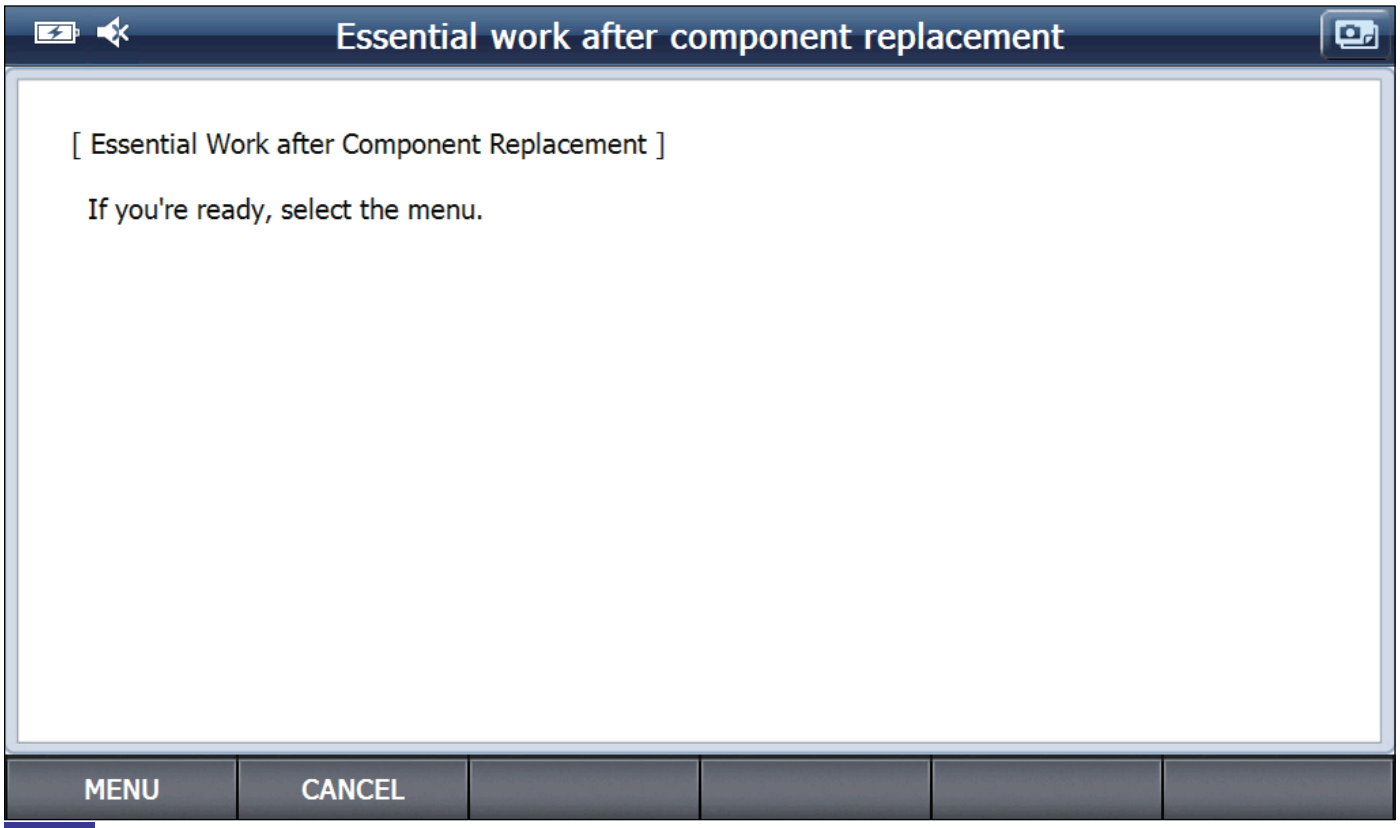


Fig.2

CRC12EN5010P01010042S

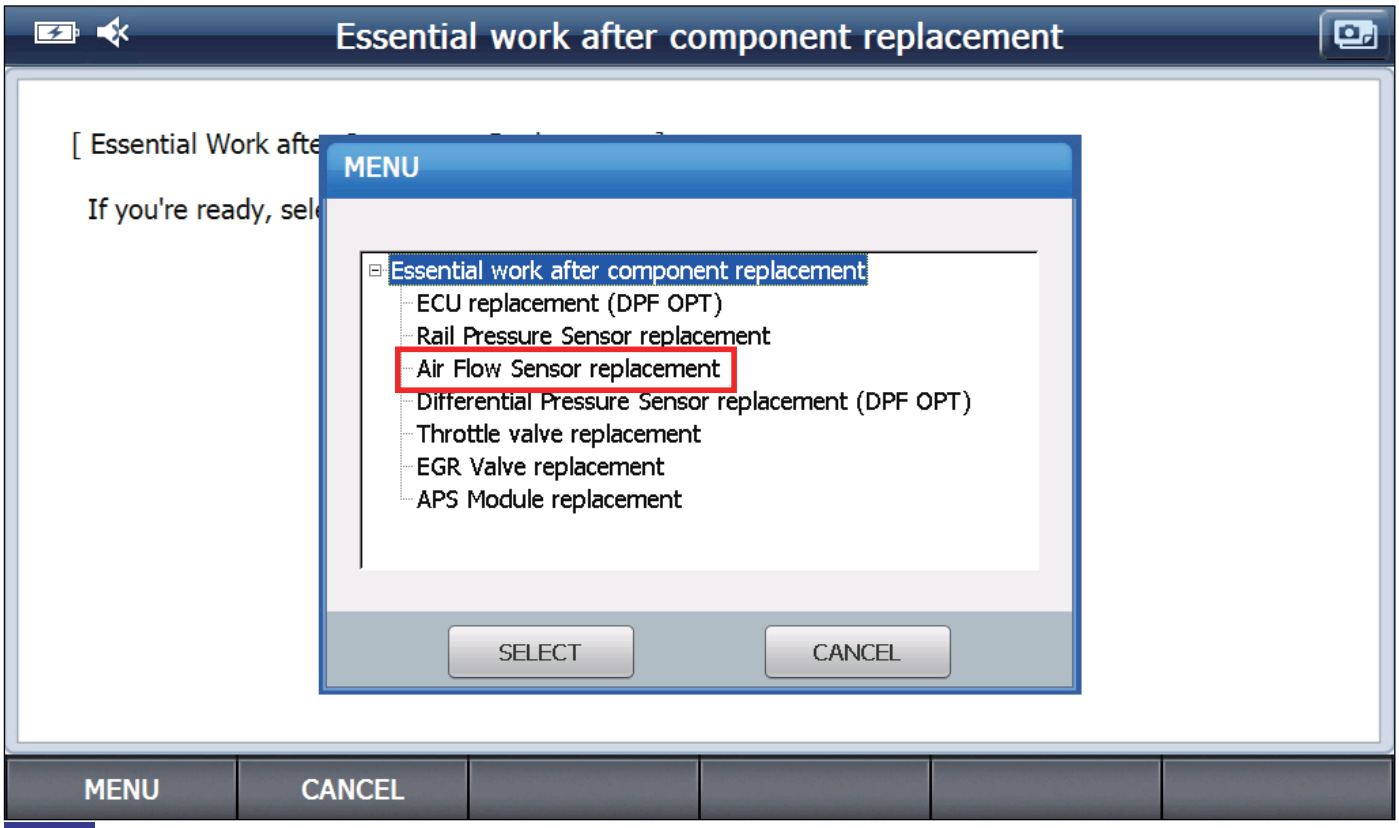


Fig.3

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.

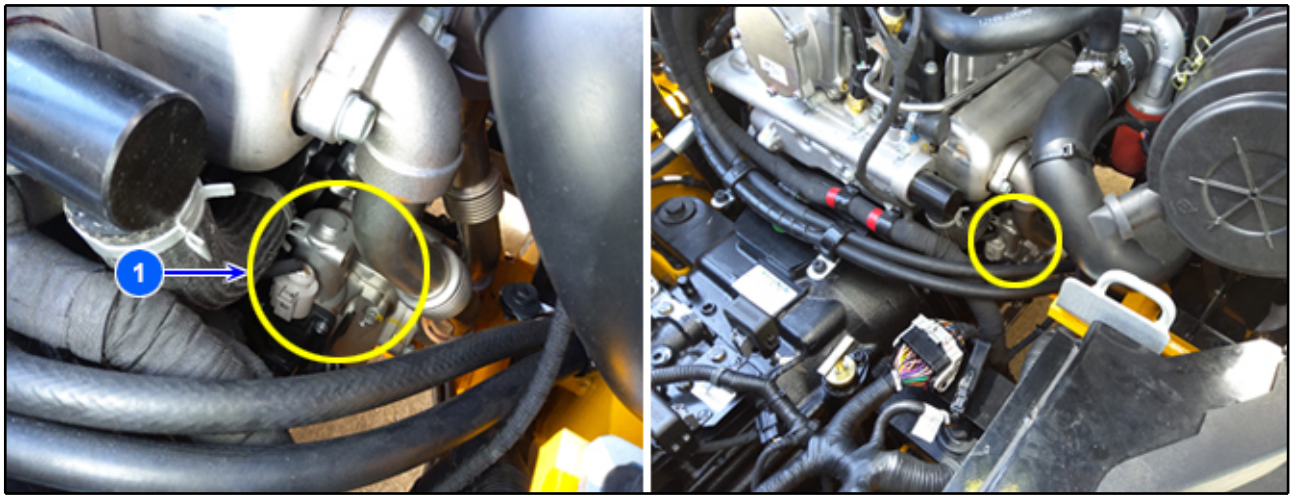
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P040111

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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Open in power circuit of E-EGR actuator 3. Short to ground in signal circuit of E-EGR actuator 4. Defected E-EGR actuator position sensor
Enable Conditions	• Engine running		
Threshold Value	• Output voltage of E-EGR actuator position sensor is below threshold value		
Diagnostic Time	• 2.5sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

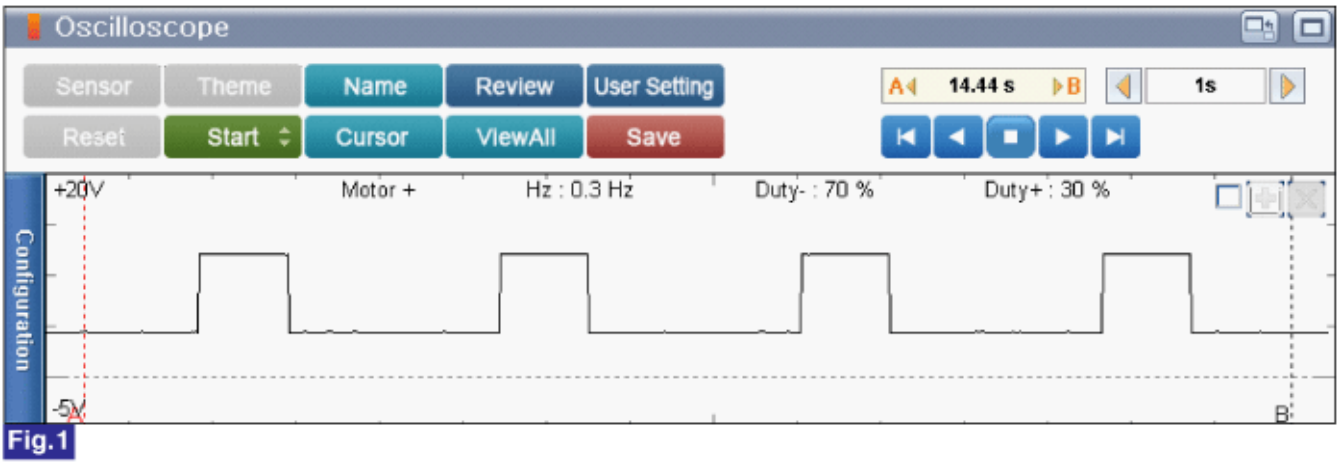
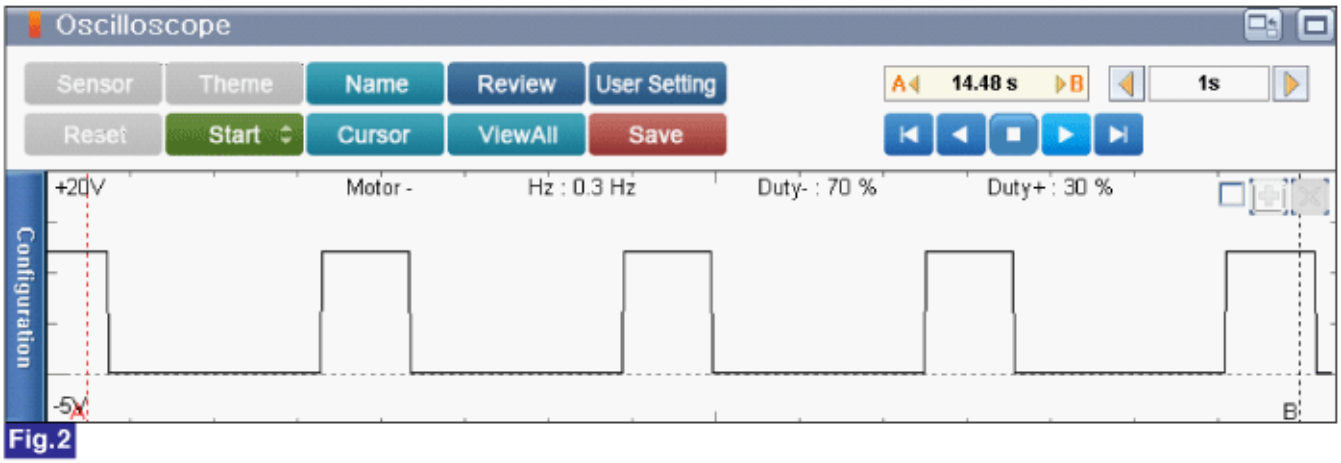


Fig.1



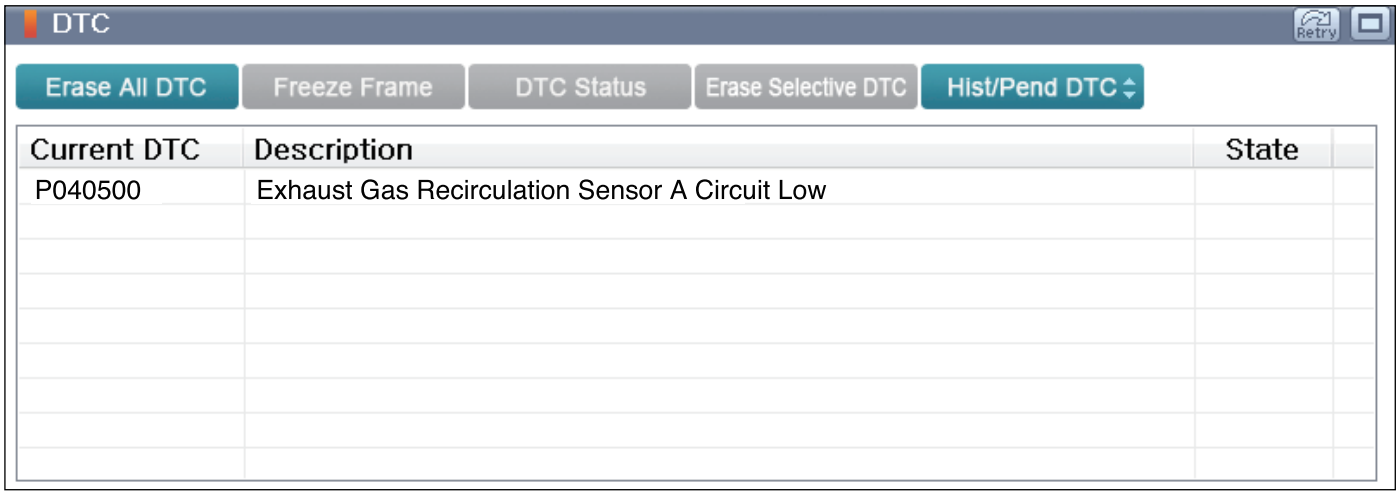
CRC12EN5010P04010012S

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.



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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 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

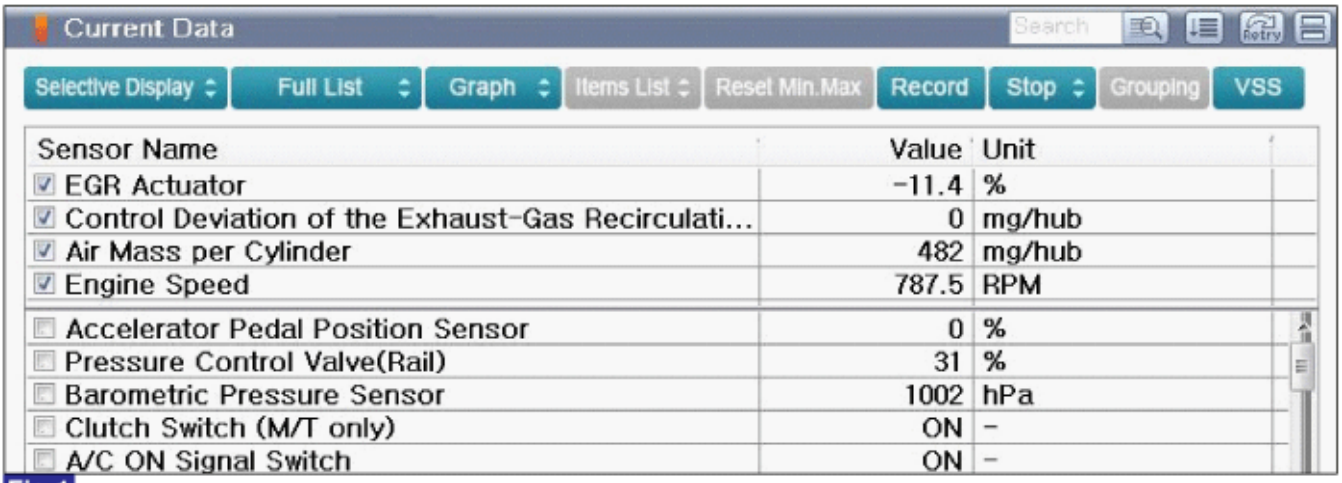


Fig.1

CRC12EN5010P04010022S

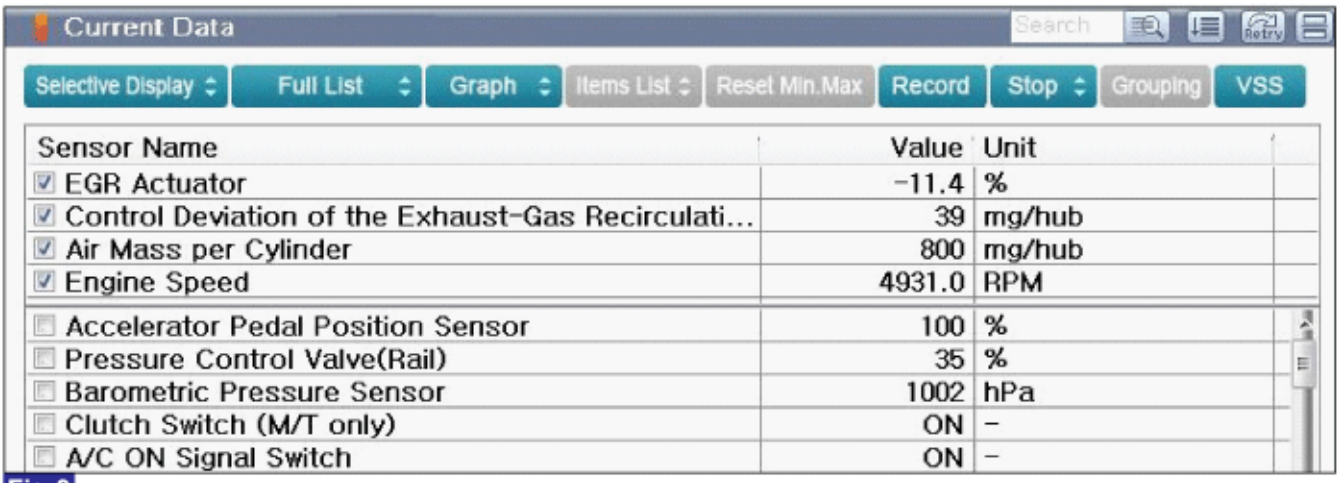


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition Switch "ON"
4. Measure the voltage between signal terminal of 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.

NO ▸ Inspect and repair open or short in circuit, and 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.
6. Inspection condition : Ignition switch "ON" & Engine "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.

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

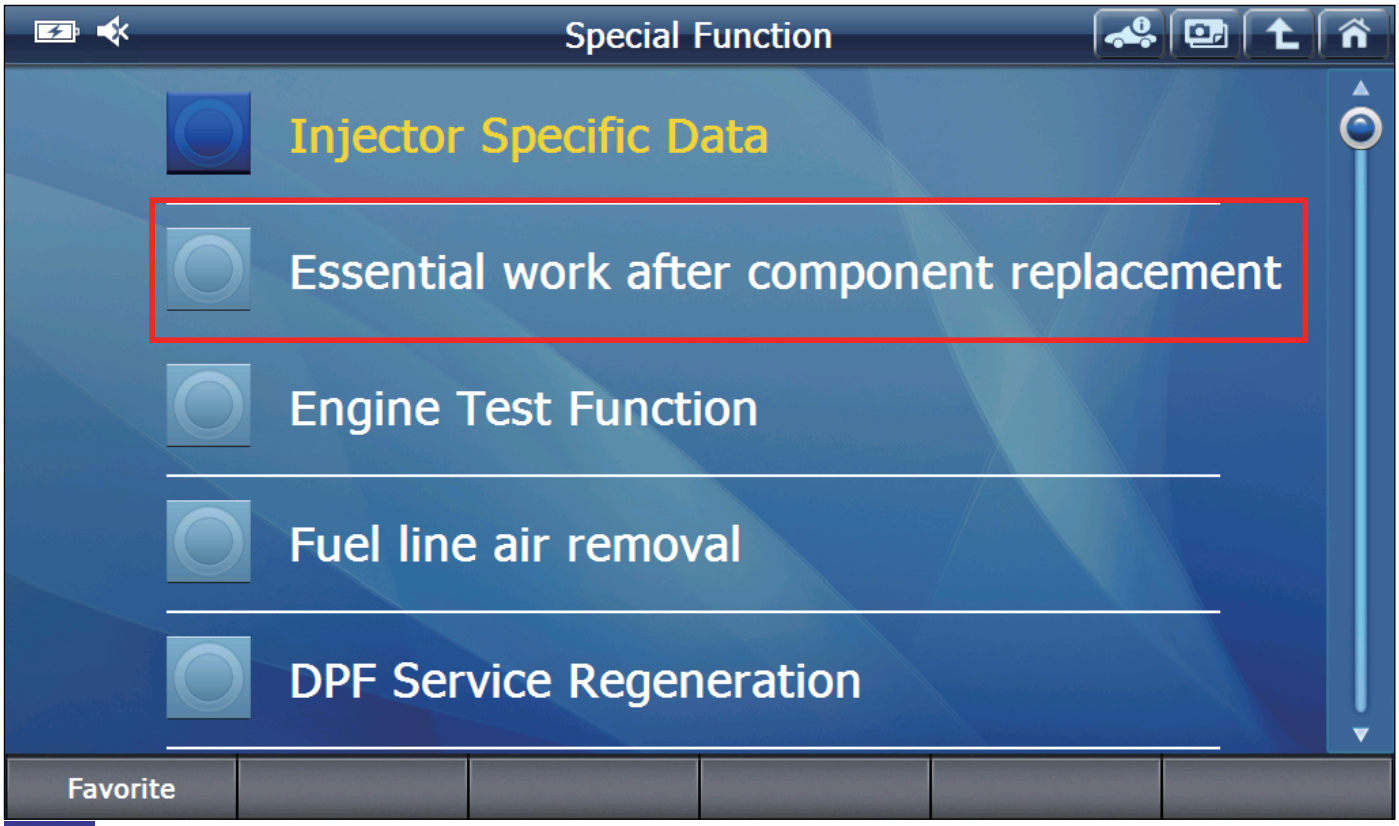


Fig.1

CRC12EN5010P01010041S

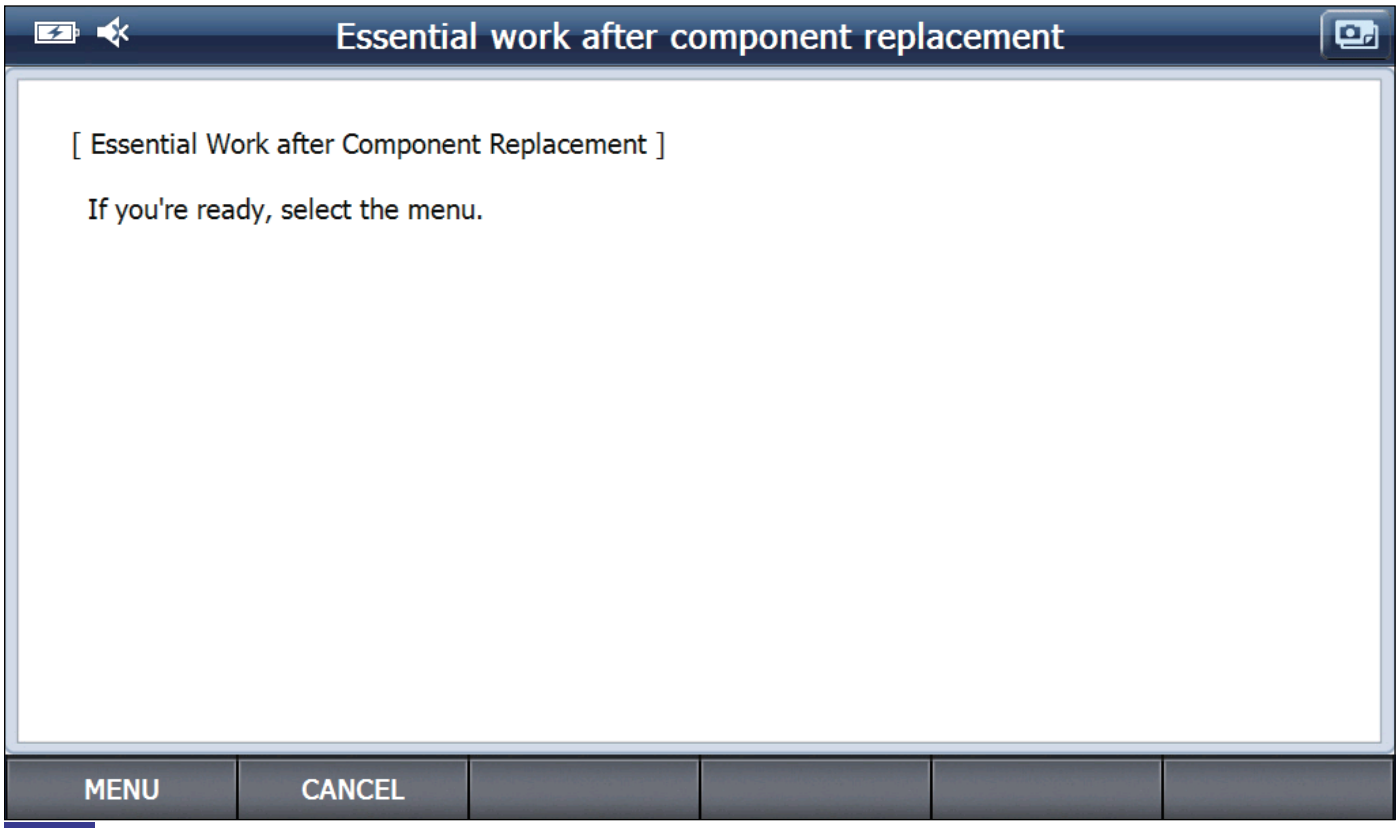


Fig.2

CRC12EN5010P01010042S

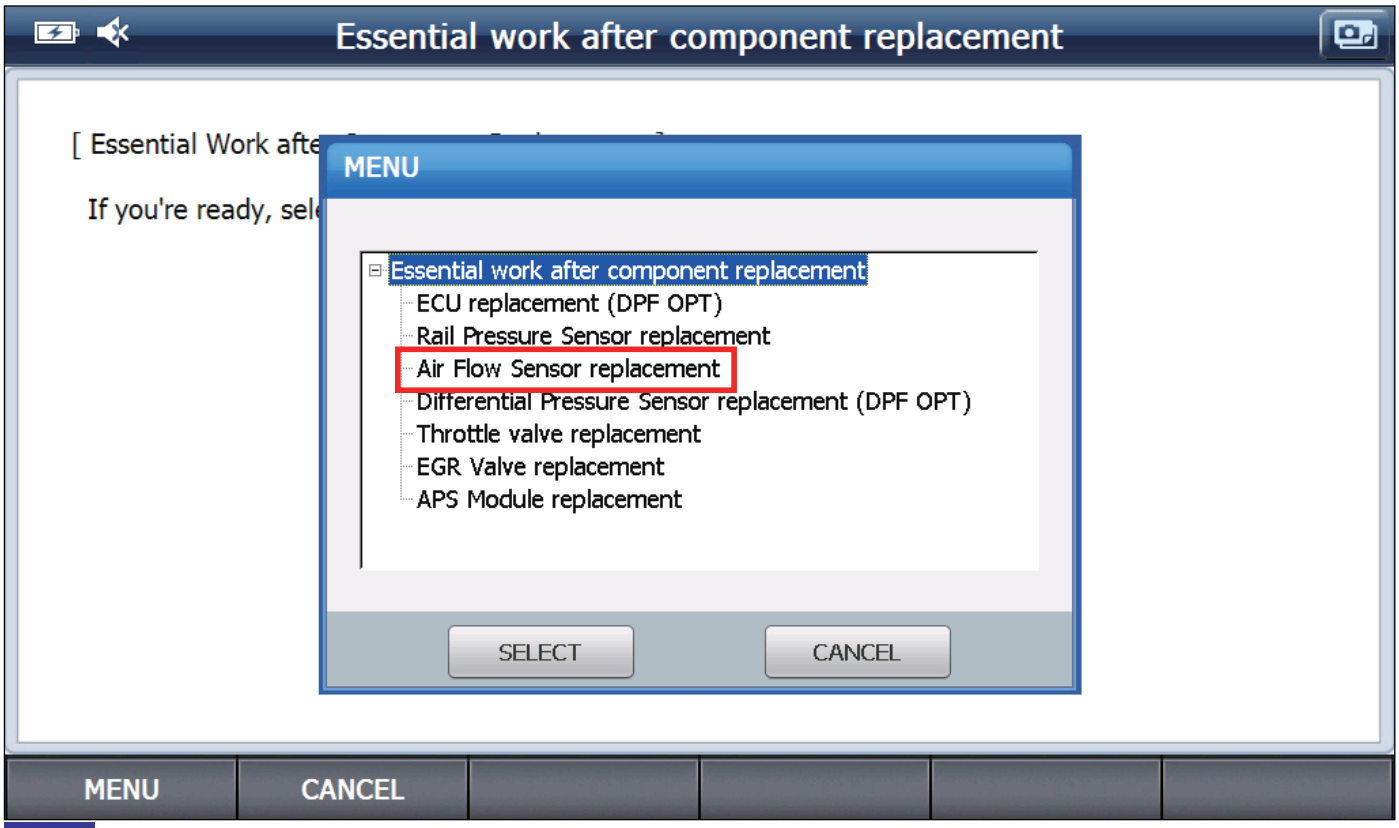


Fig.3

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.

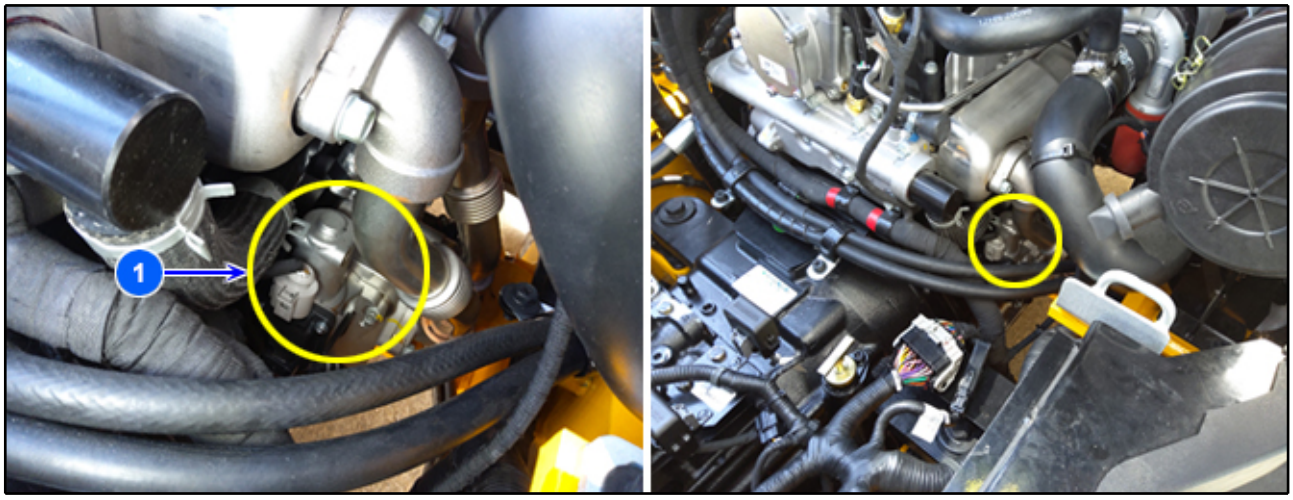
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P040600 Exhaust Gas Recirculation Sensor A Circuit High

Component Location



CRC12EN5010P040111

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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to power in signal circuit of E-EGR actuator 3. Defected E-EGR actuator position sensor
Enable Conditions	• Engine running		
Threshold Value	• Output voltage of E-EGR actuator position sensor is higher than threshold value		
Diagnostic Time	• 2.5sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

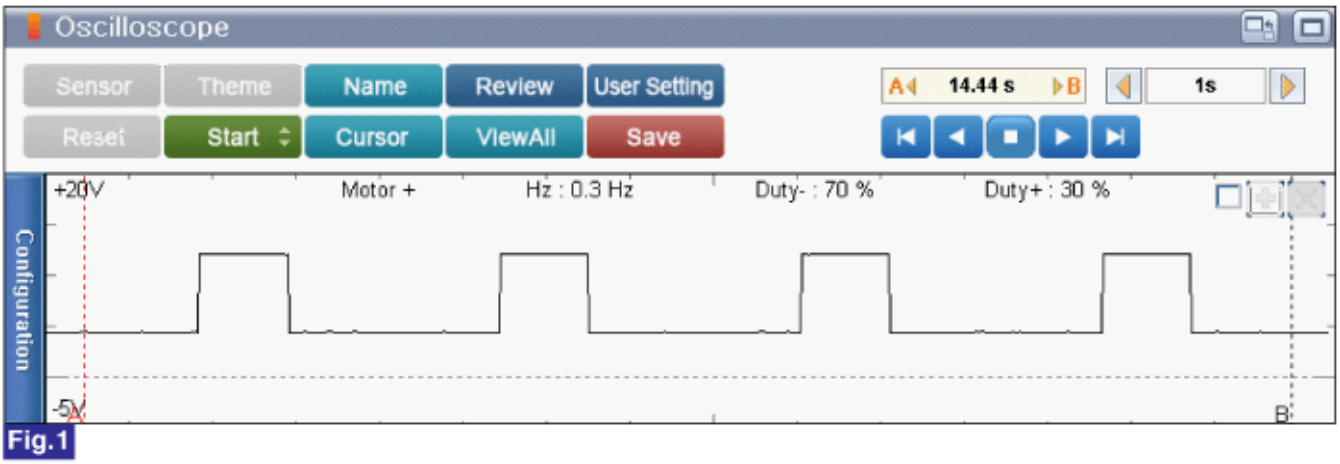
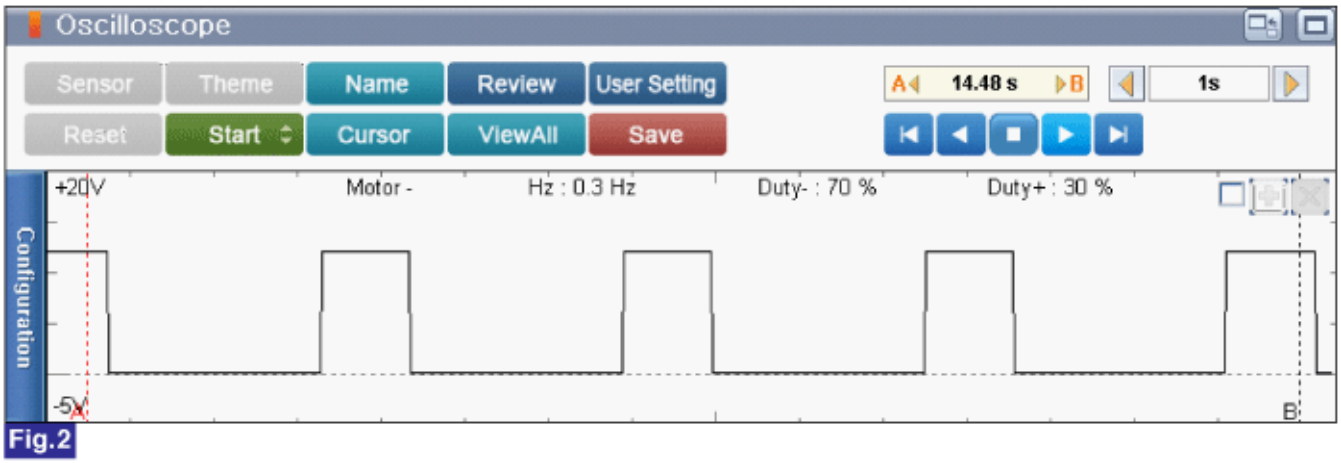


Fig.1



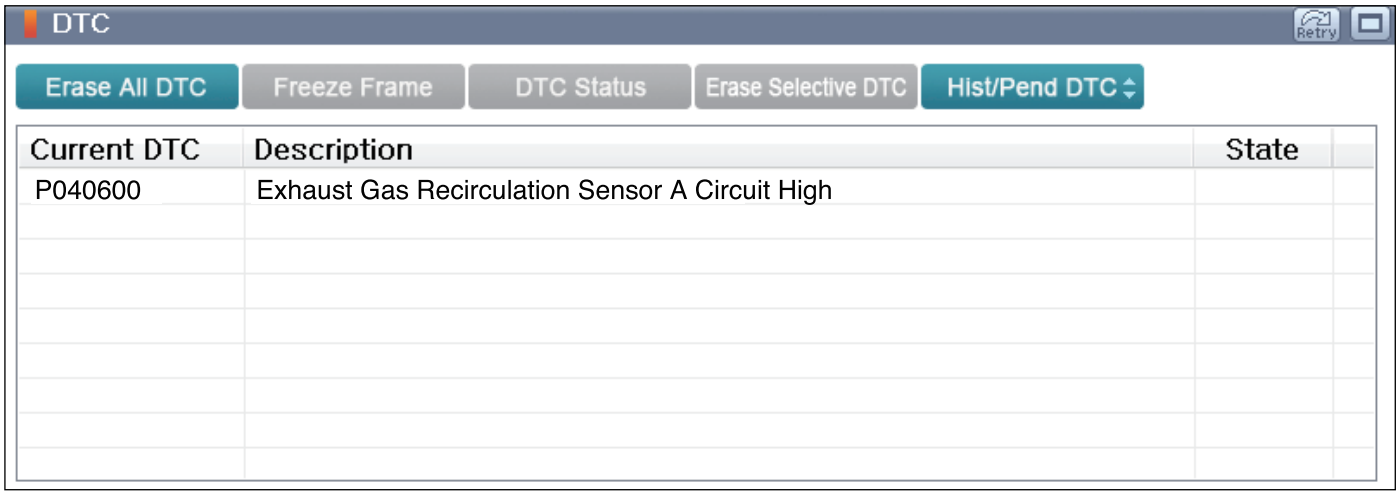
CRC12EN5010P04010012S

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.



CRC12EN5010P04060021S

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

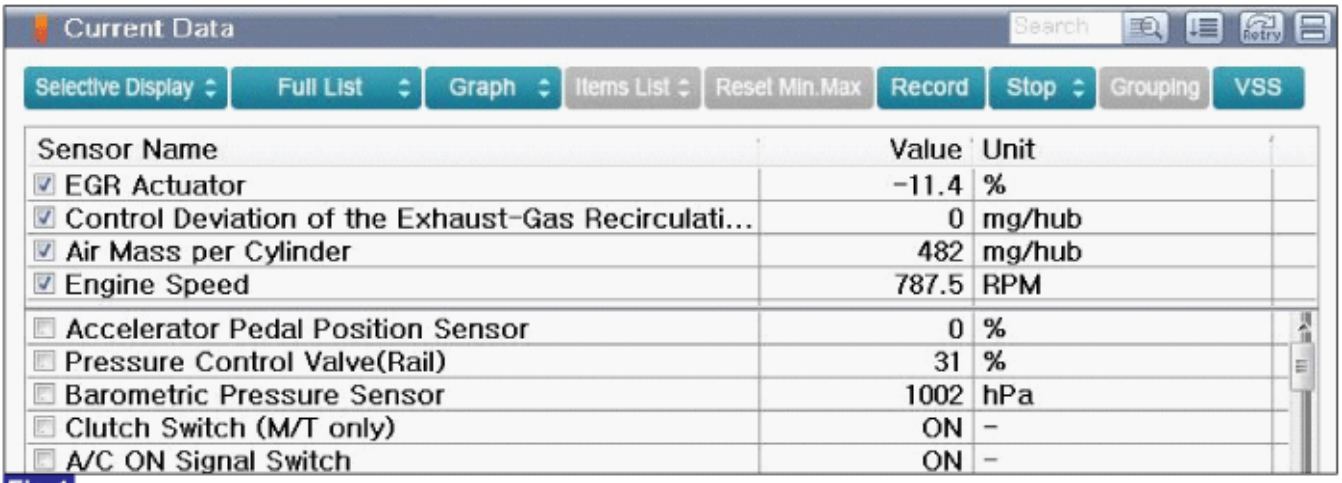


Fig.1

CRC12EN5010P04010022S

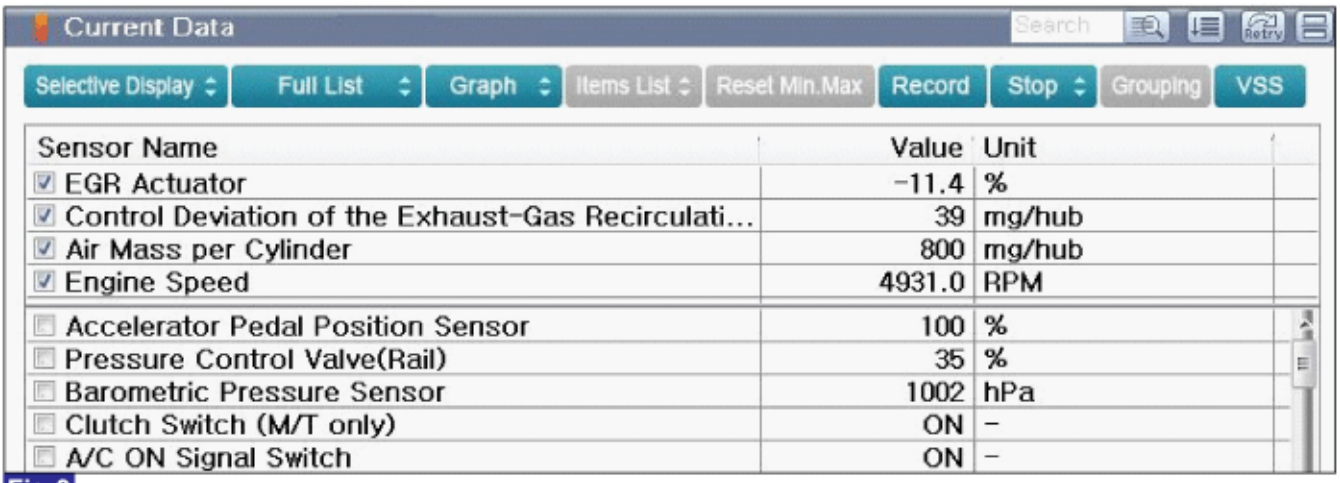


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition Switch "ON"
4. Measure the voltage between signal terminal of 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.

NO ▸ Inspect and repair open or short in circuit, and 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.
6. Inspection condition : Ignition switch "ON" & Engine "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.

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

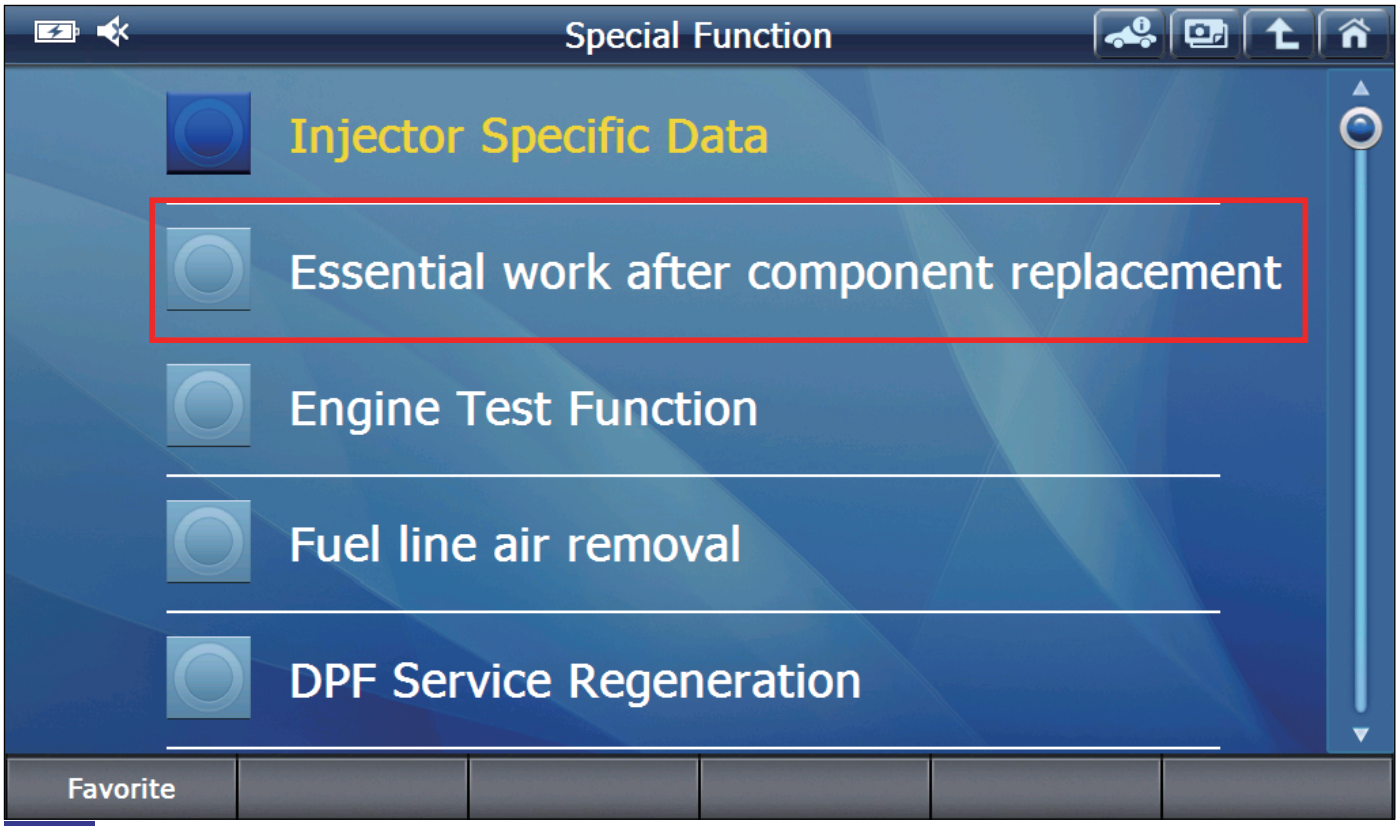


Fig.1

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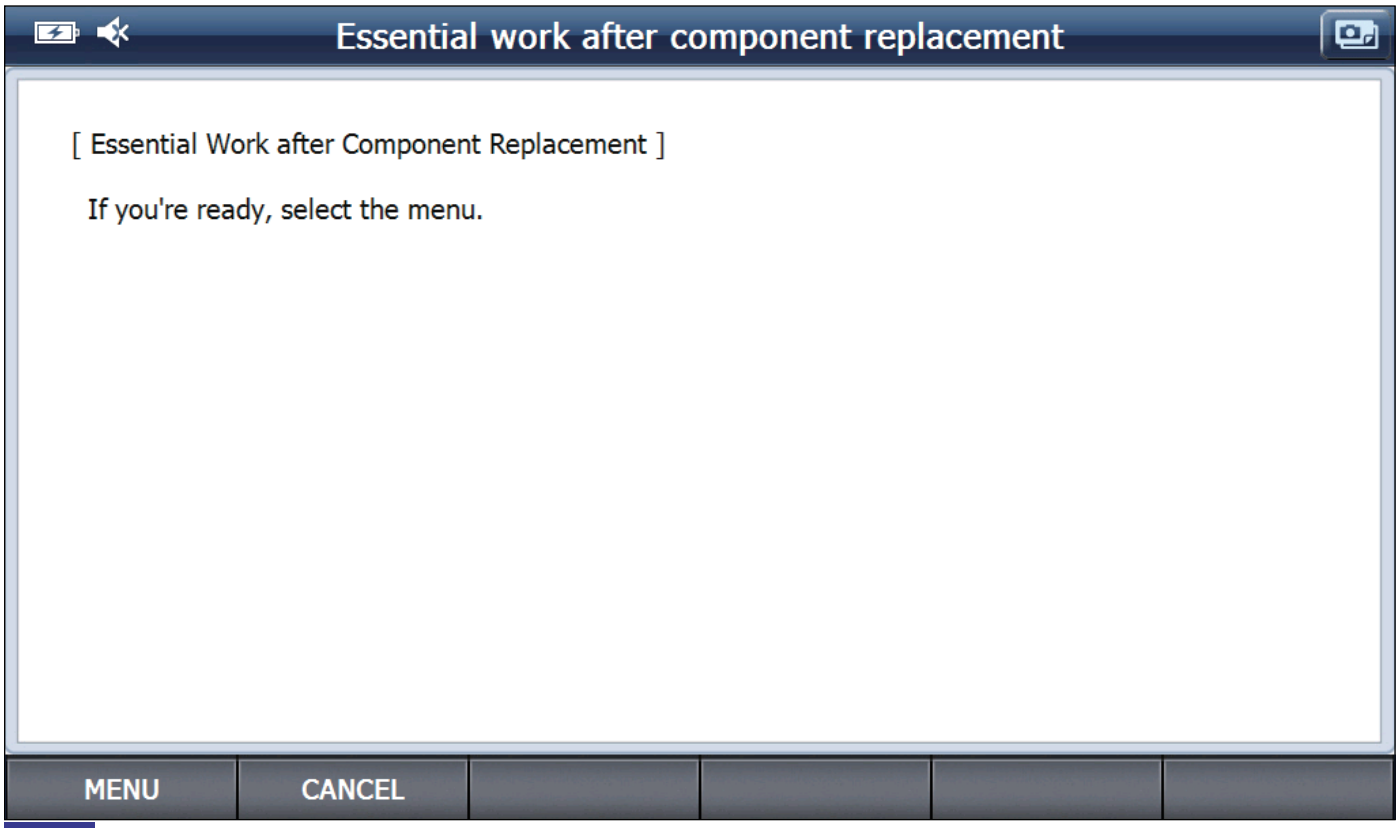


Fig.2

CRC12EN5010P01010042S

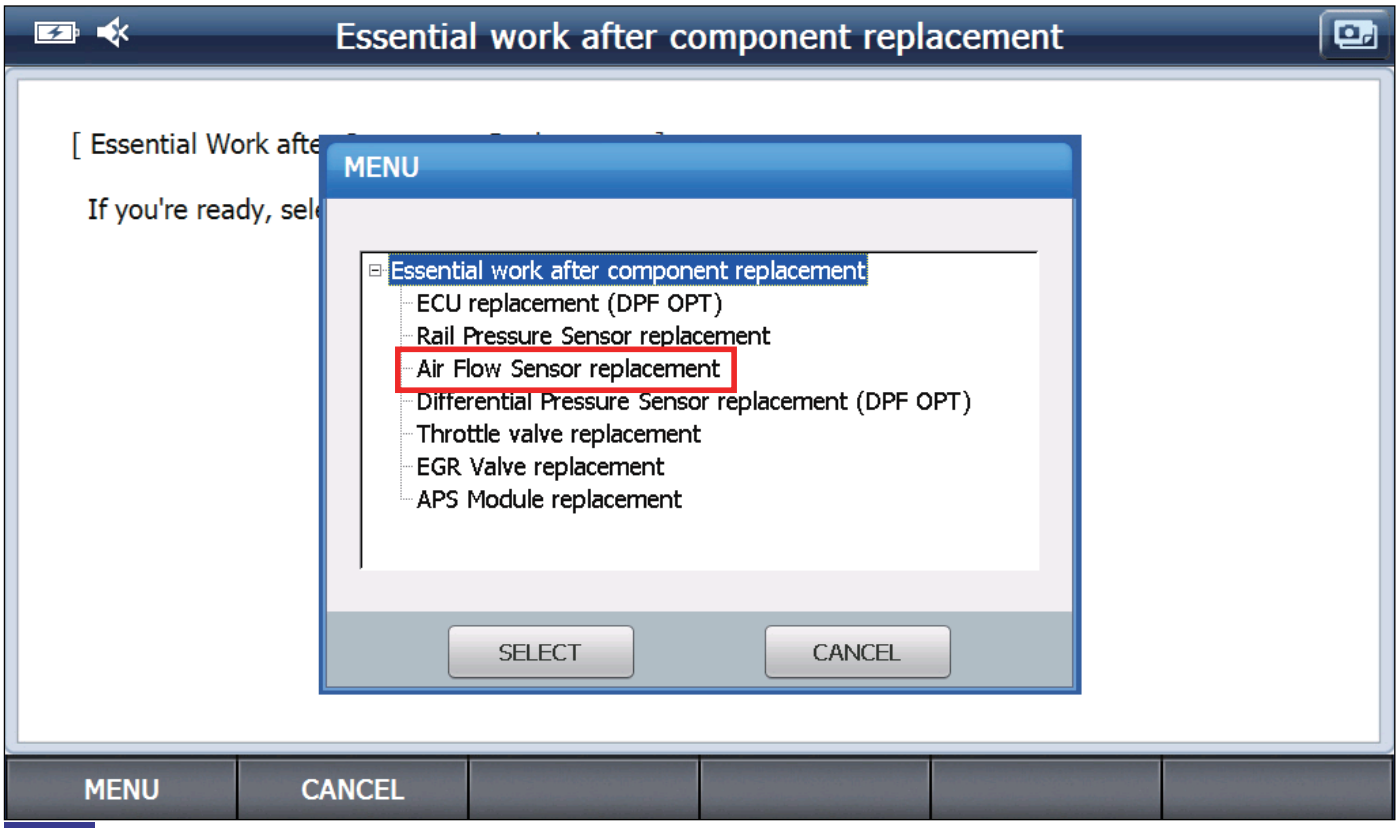


Fig.3

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.

P047100 Exhaust Pressure Sensor "A" Circuit Range/Performance

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Clogged DPS hose 3. Defected DPS
Enable Conditions	• Engine running		
Threshold Value	• Clogged DPS hose by soot • Differential pressure value is over 50 hPa		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

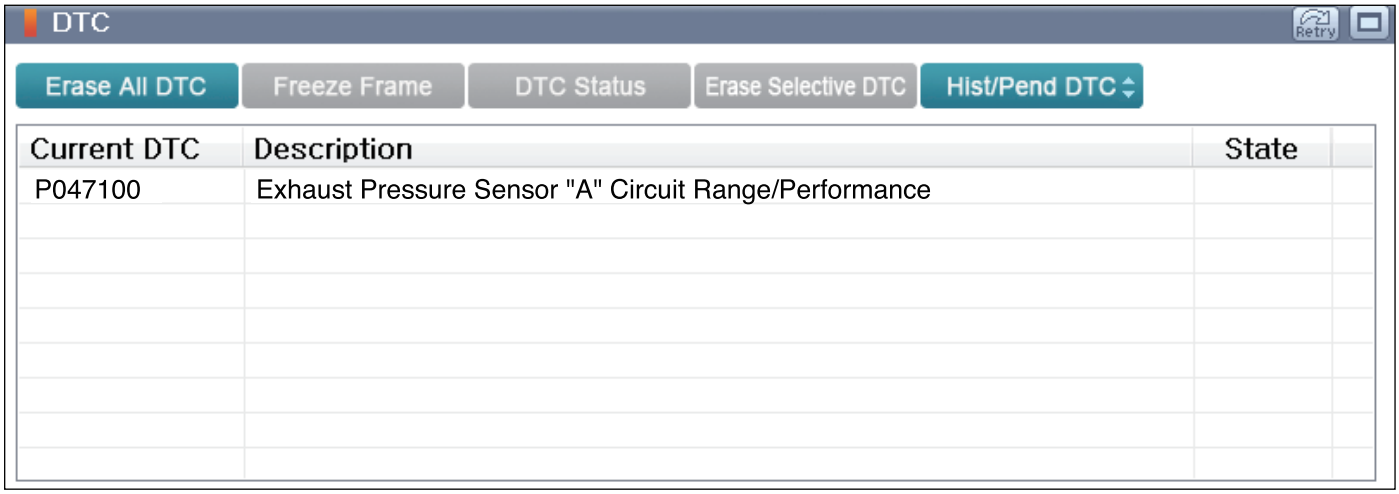
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



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"
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

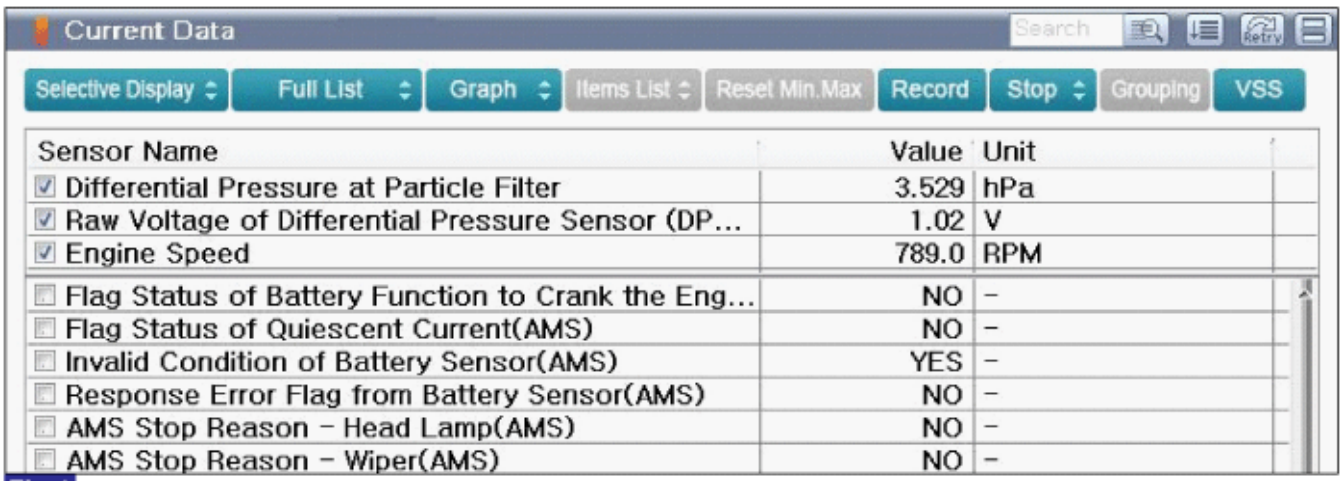


Fig.1

CRC12EN5010P04710022S

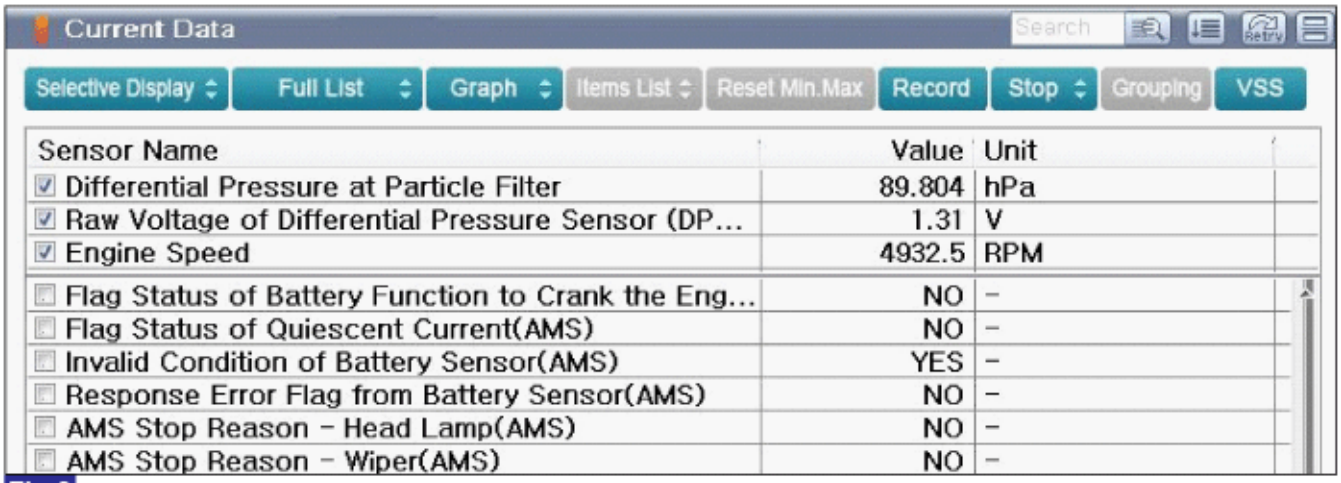


Fig.2

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.

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.

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 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 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)
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.
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.

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 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 "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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

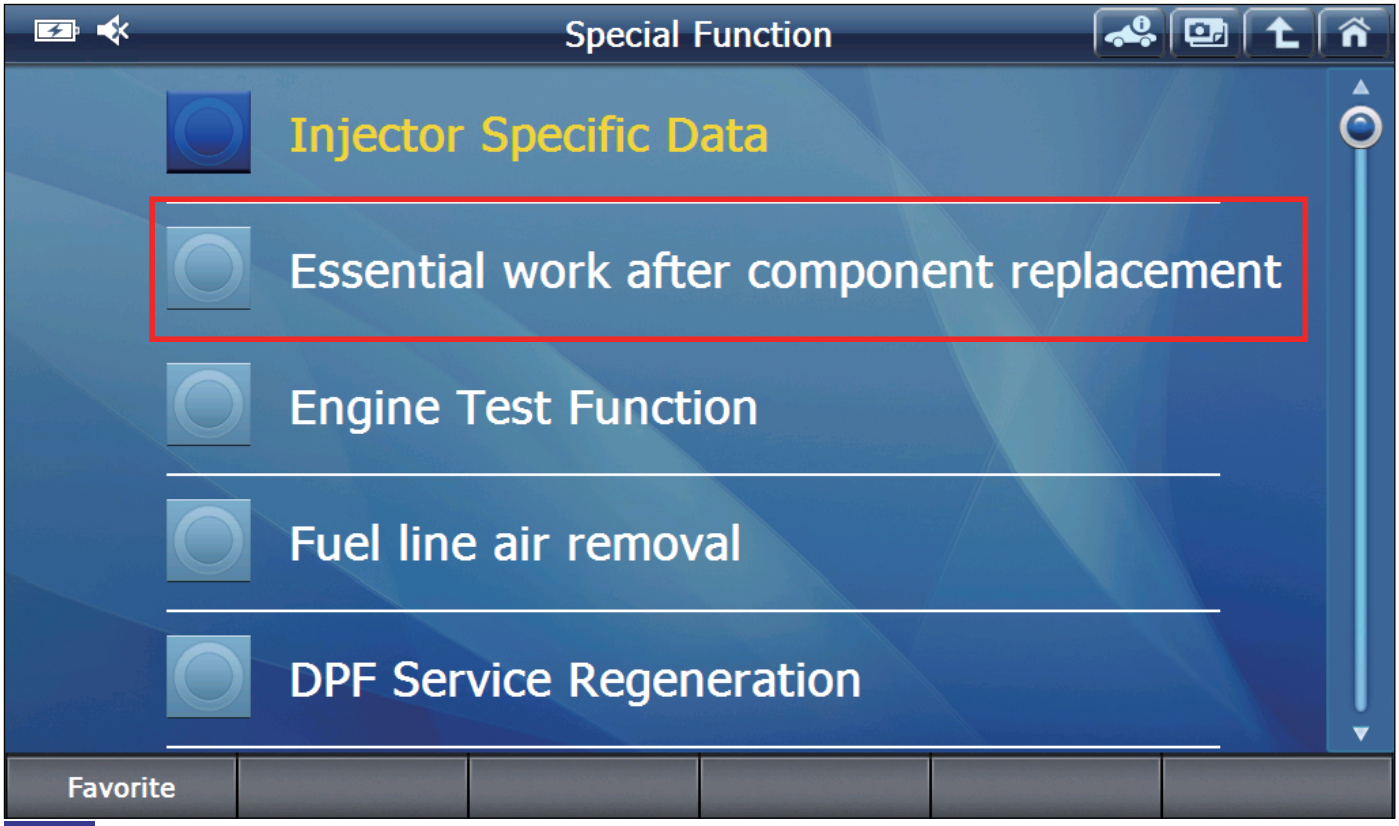


Fig.1

CRC12EN5010P01010041S

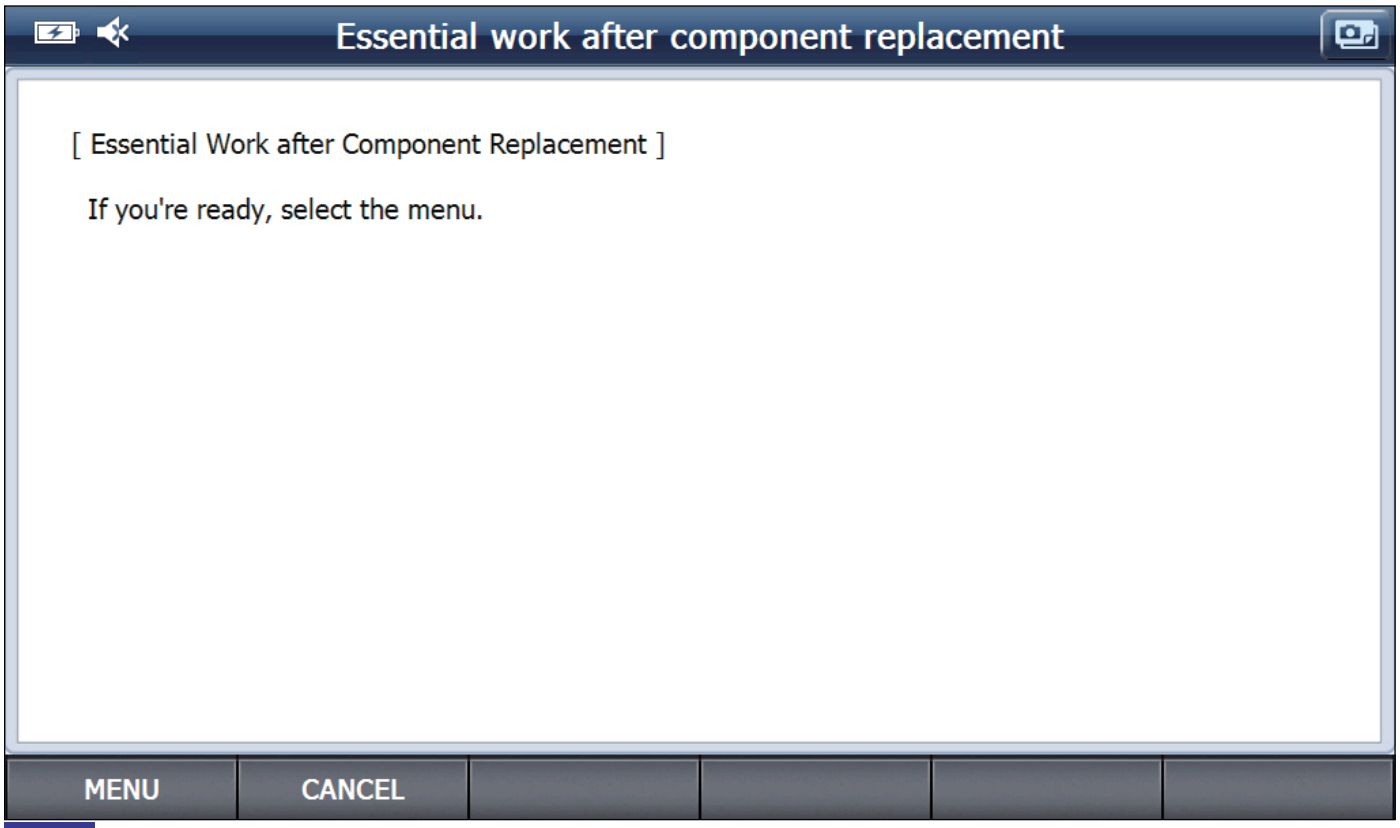


Fig.2

CRC12EN5010P01010042S

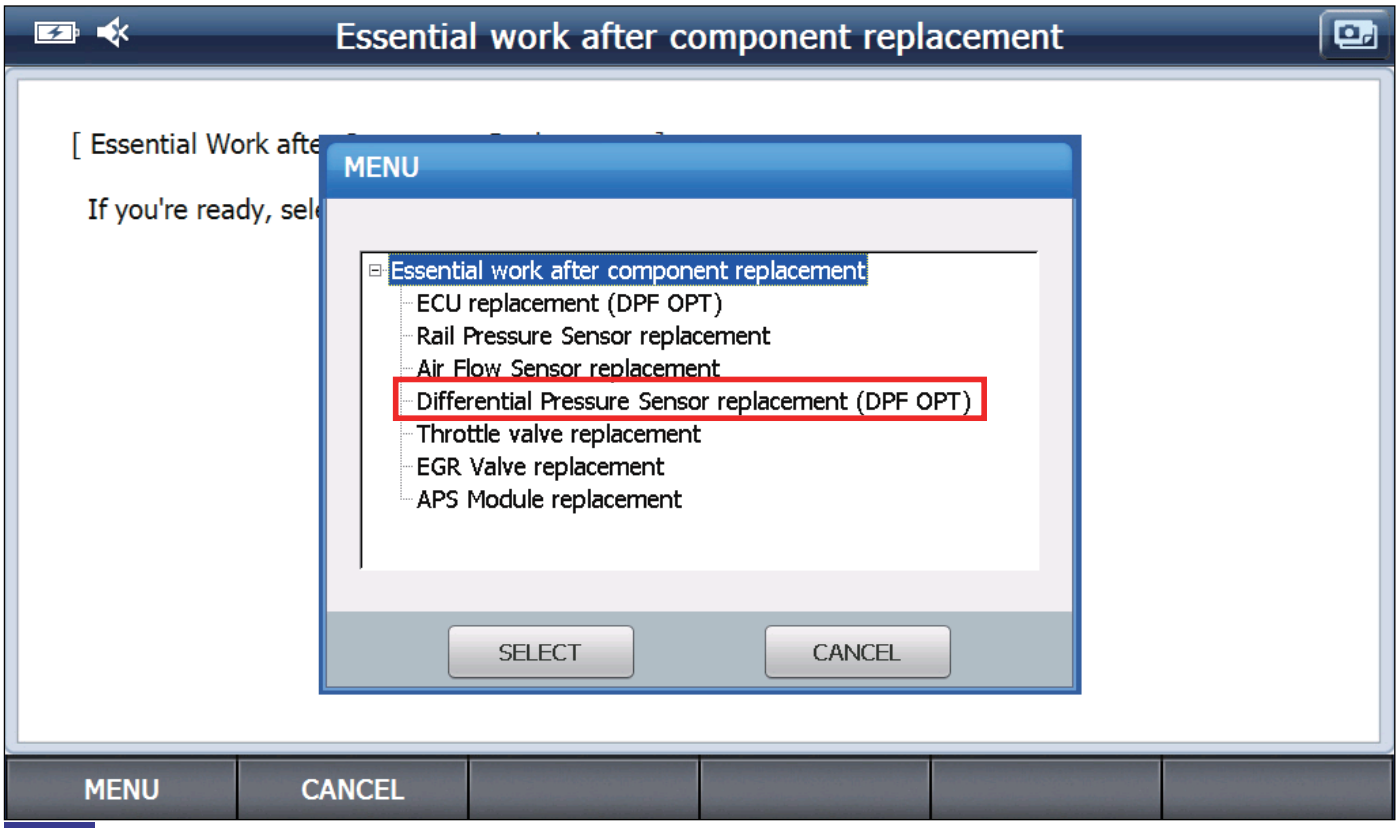


Fig.3

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 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

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to ground in signal circuit of DPS 3. Open in power circuit of DPS 4. Defected DPS
Enable Conditions	• Engine running		
Threshold Value	• DPS output signal is below minimum threshold value		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

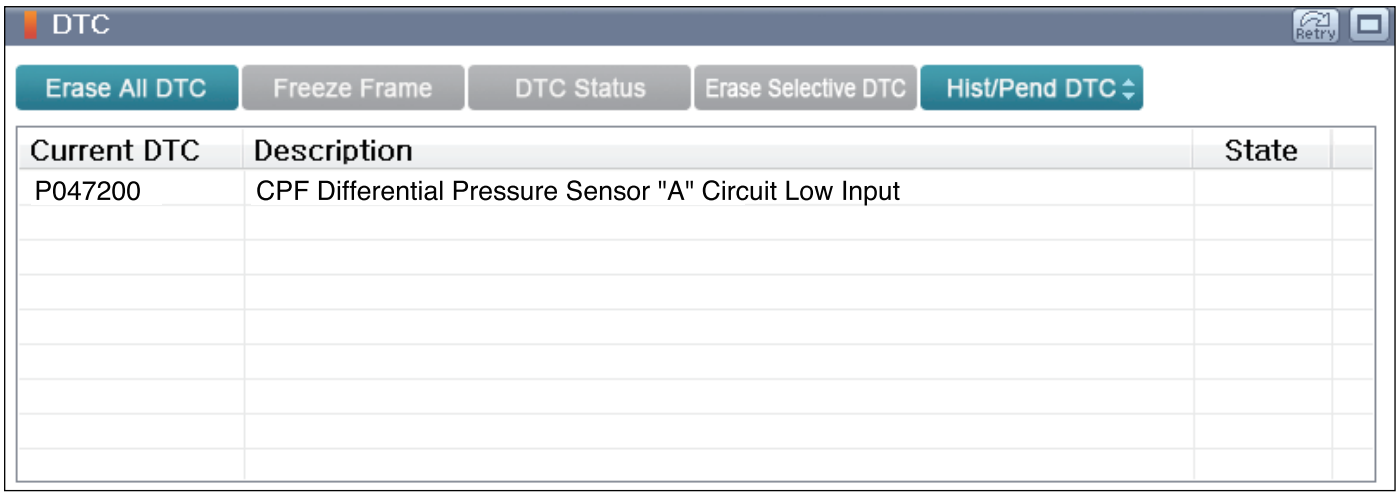
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



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.

Specification : Refer to figure below

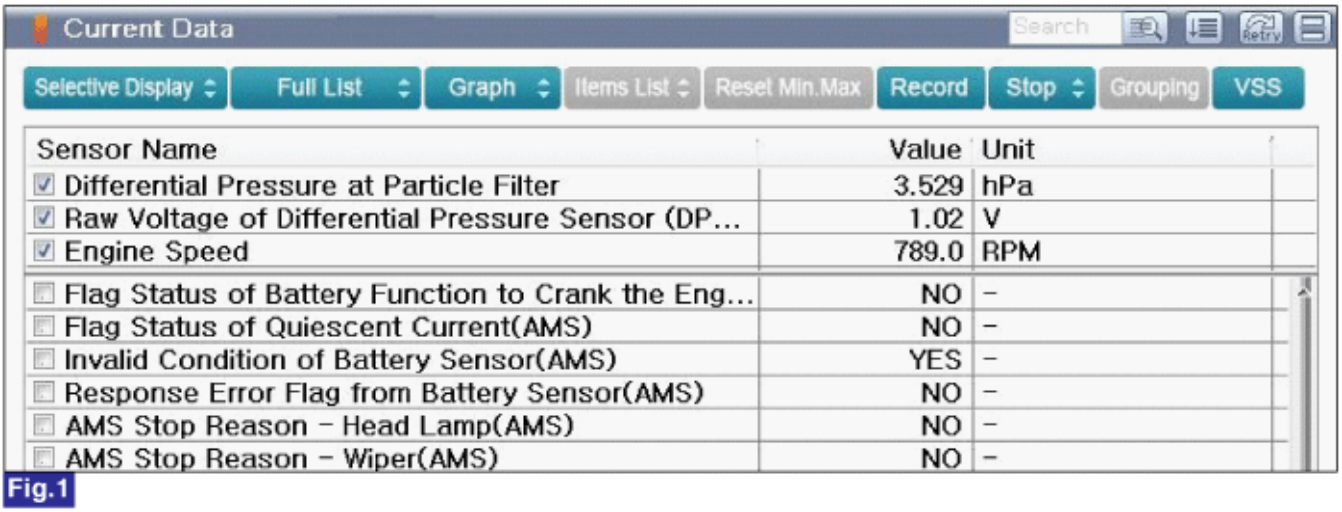


Fig.1

CRC12EN5010P04710022S

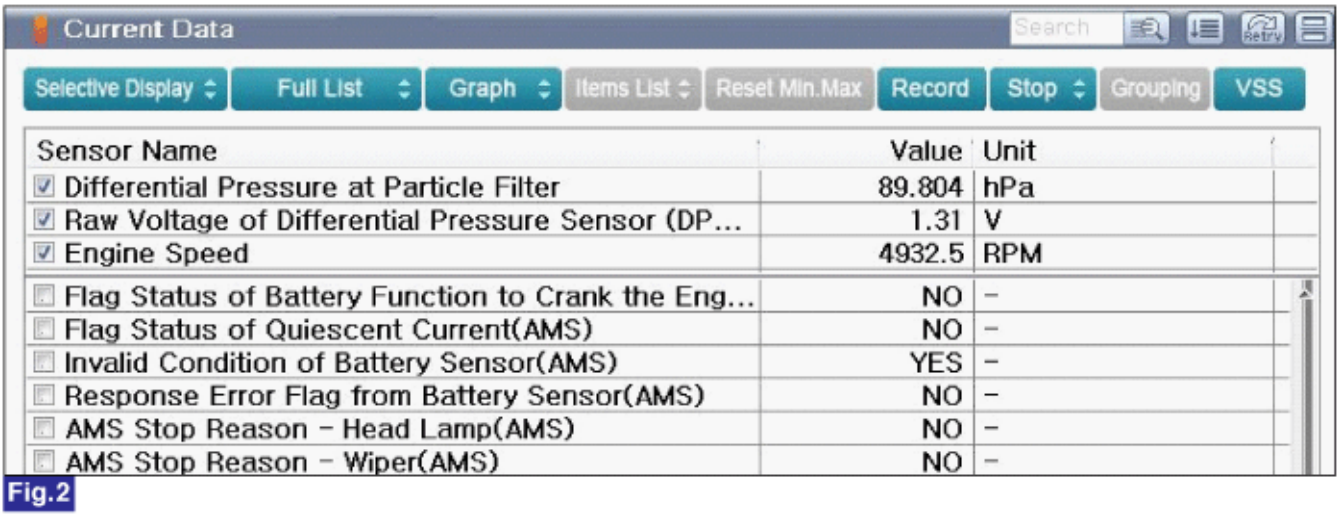


Fig.2

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. 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.

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 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 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)
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.
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.

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 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.

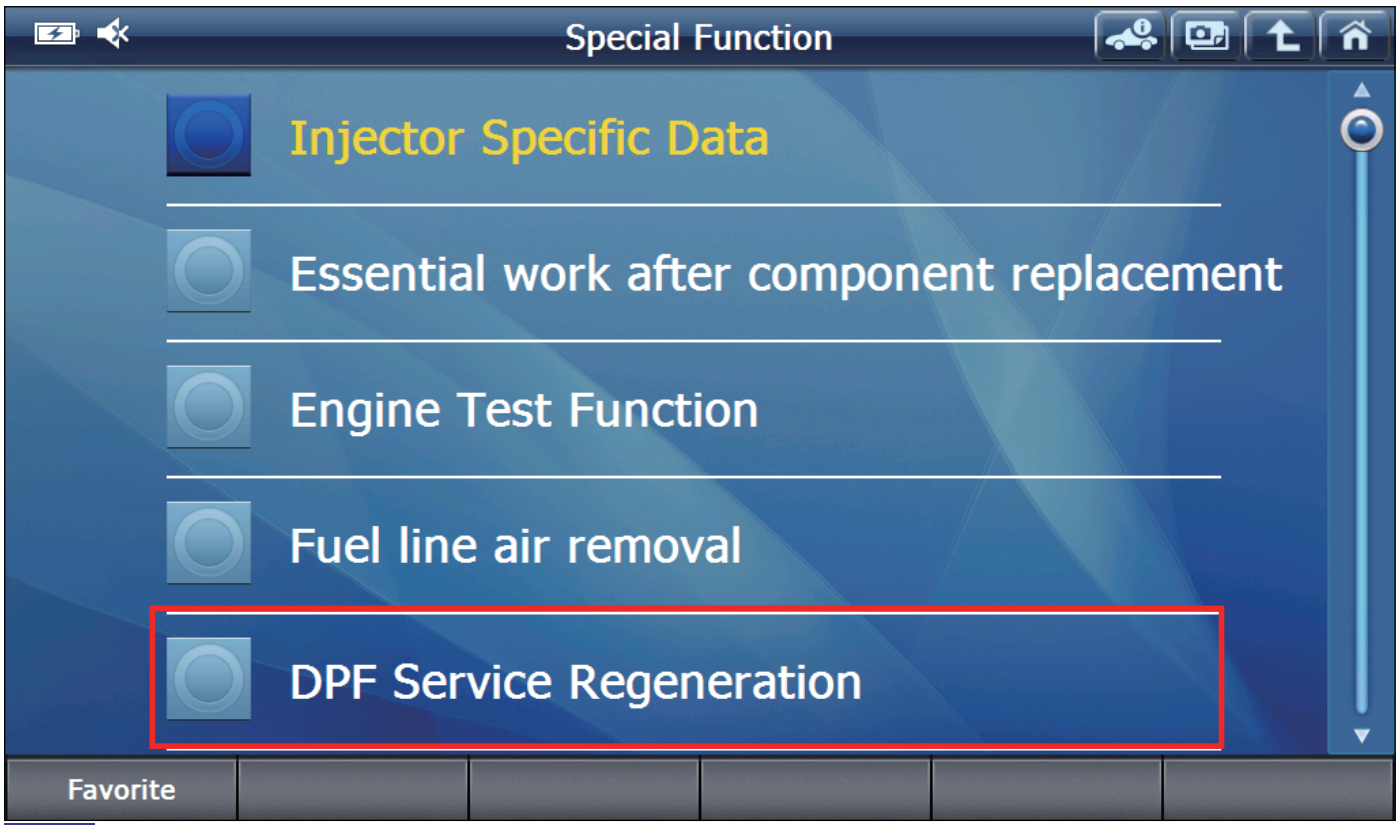


Fig.1

CRC12EN5010P04720041S

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

⚠ CAUTION

- 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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

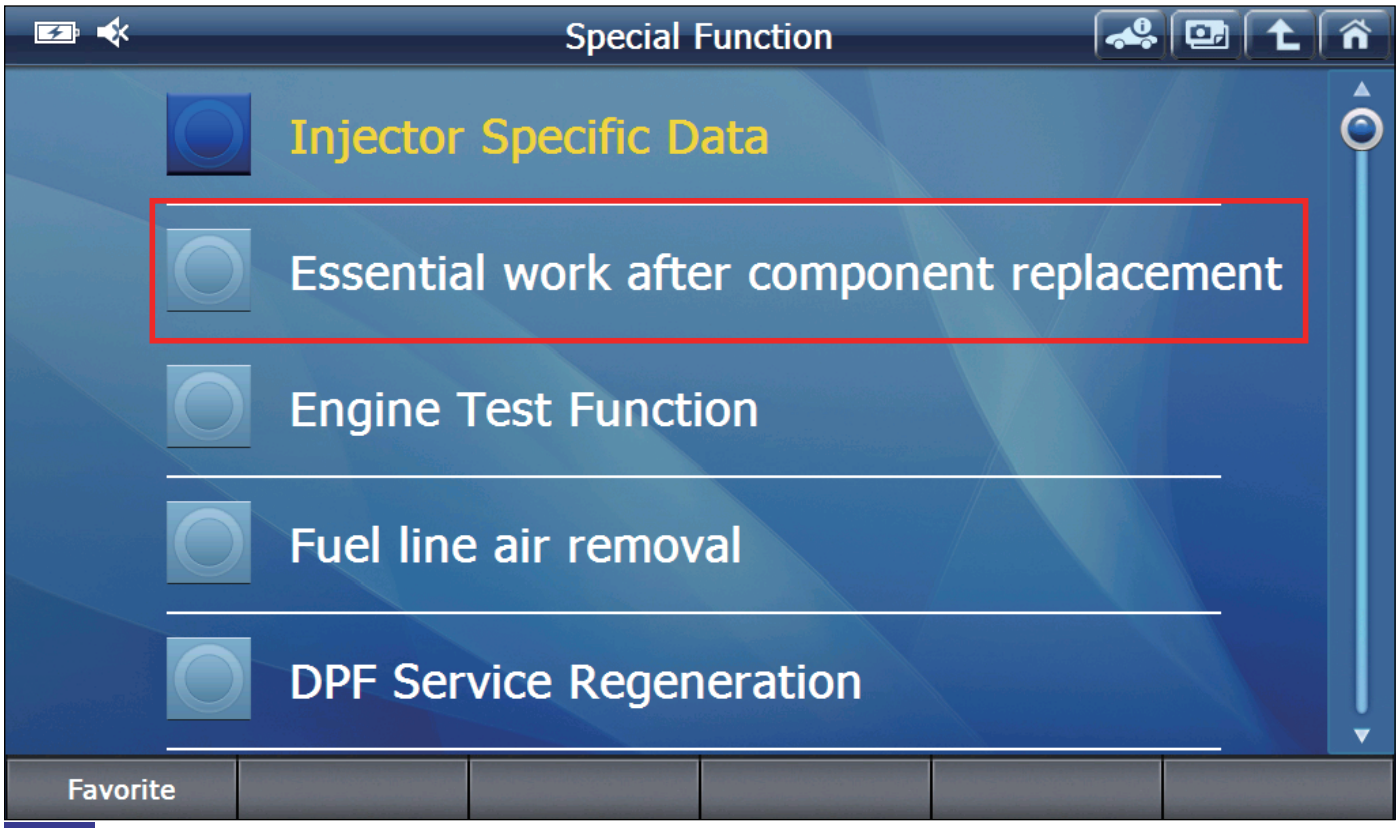


Fig.1

CRC12EN5010P01010041S

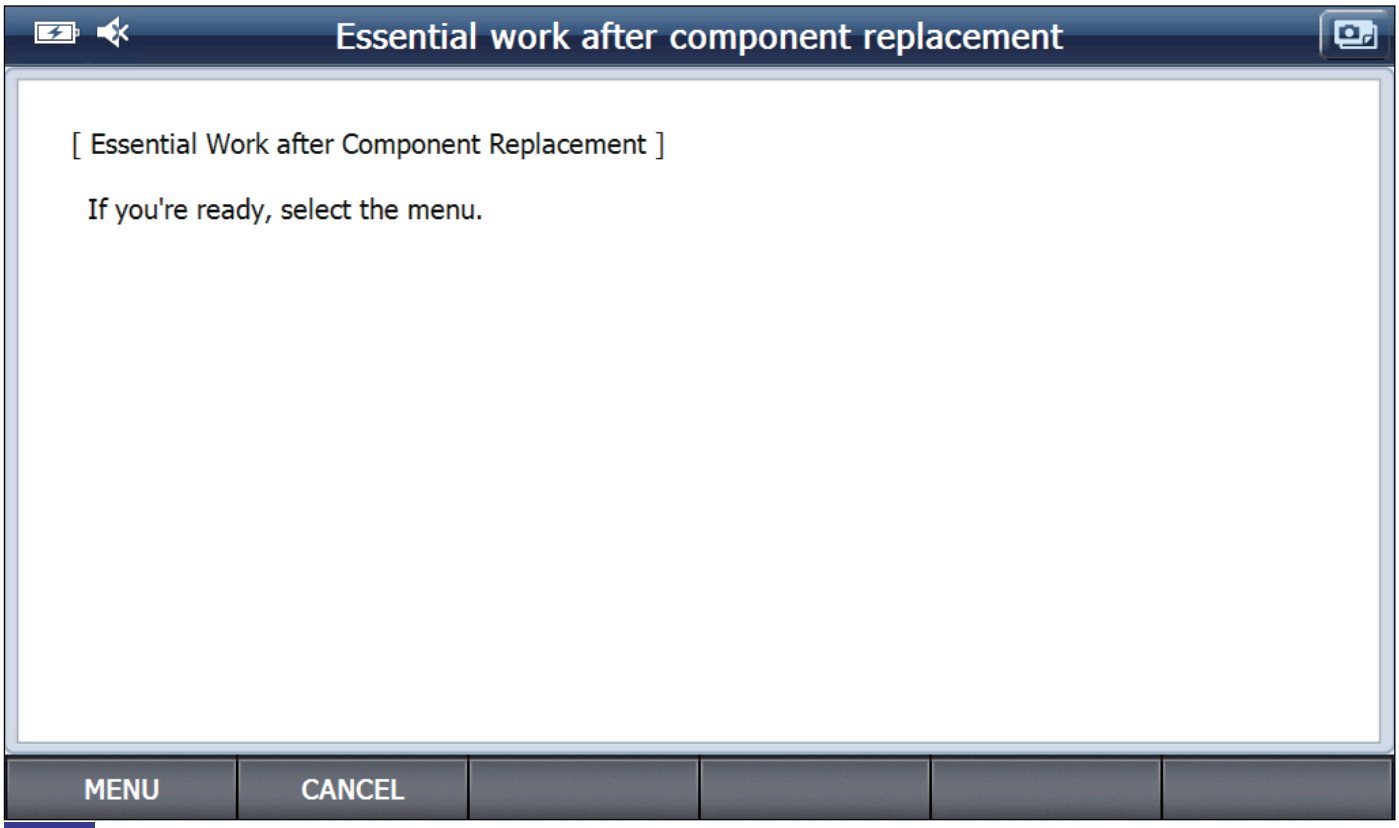


Fig.2

CRC12EN5010P01010042S

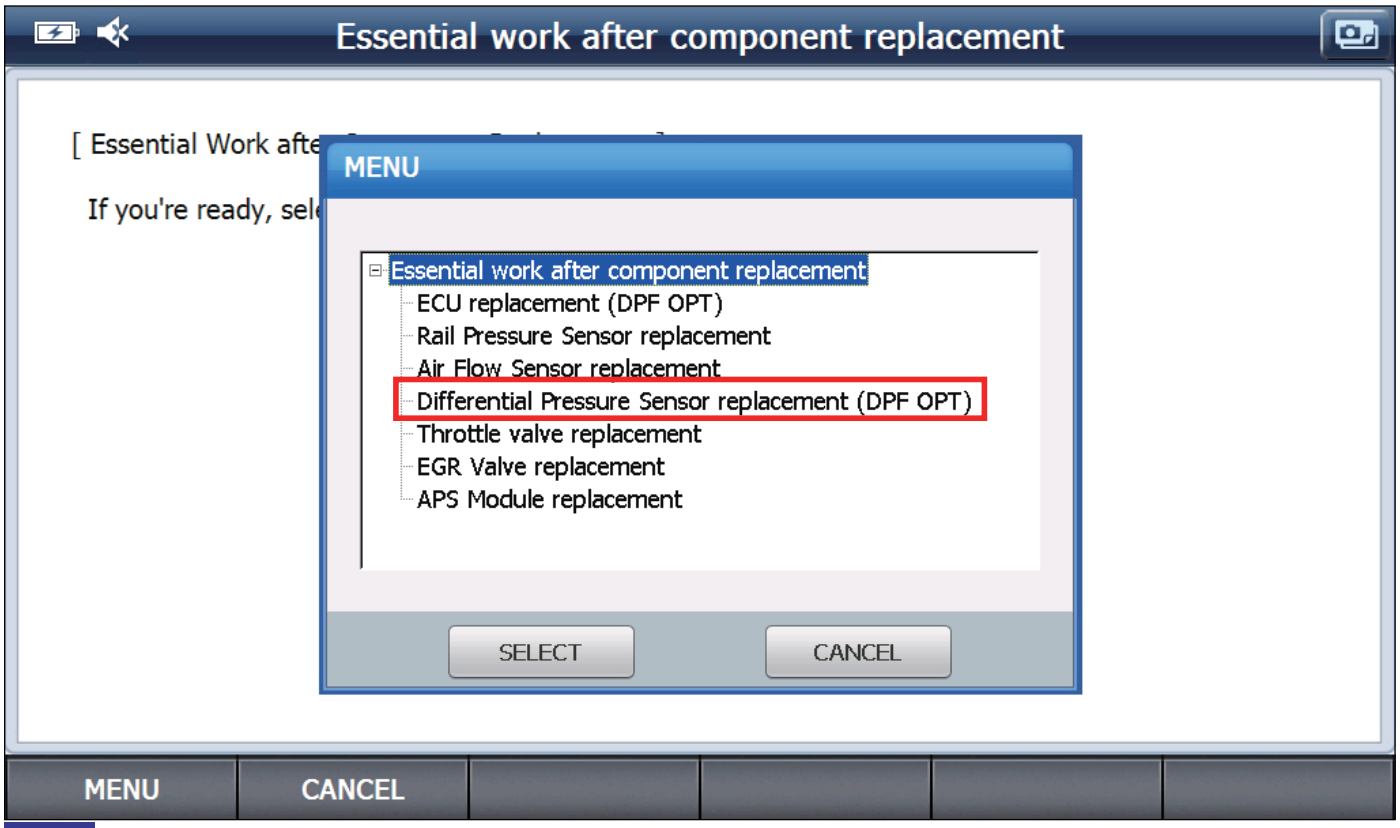


Fig.3

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 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.

P047300 CPF/DPF Differential Pressure Sensor "A" Circuit High Input

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to power in signal circuit of DPS 3. Open in ground circuit of DPS 4. Defected DPS
Enable Conditions	• Engine running		
Threshold Value	• DPS output signal is higher than maximum threshold value(500 hPa)		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Blink	

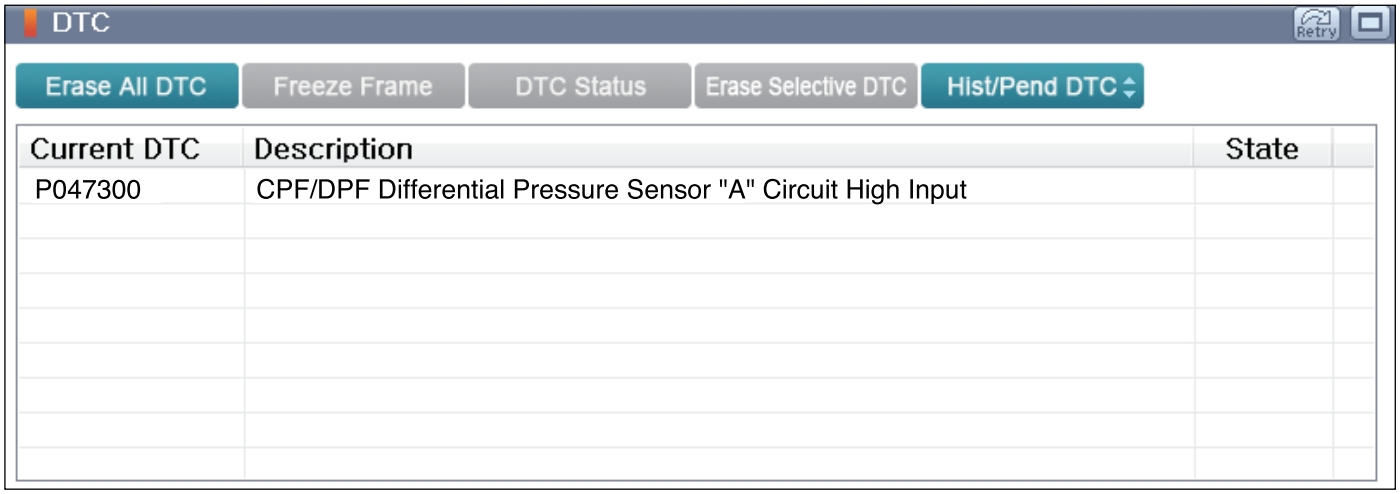
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



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

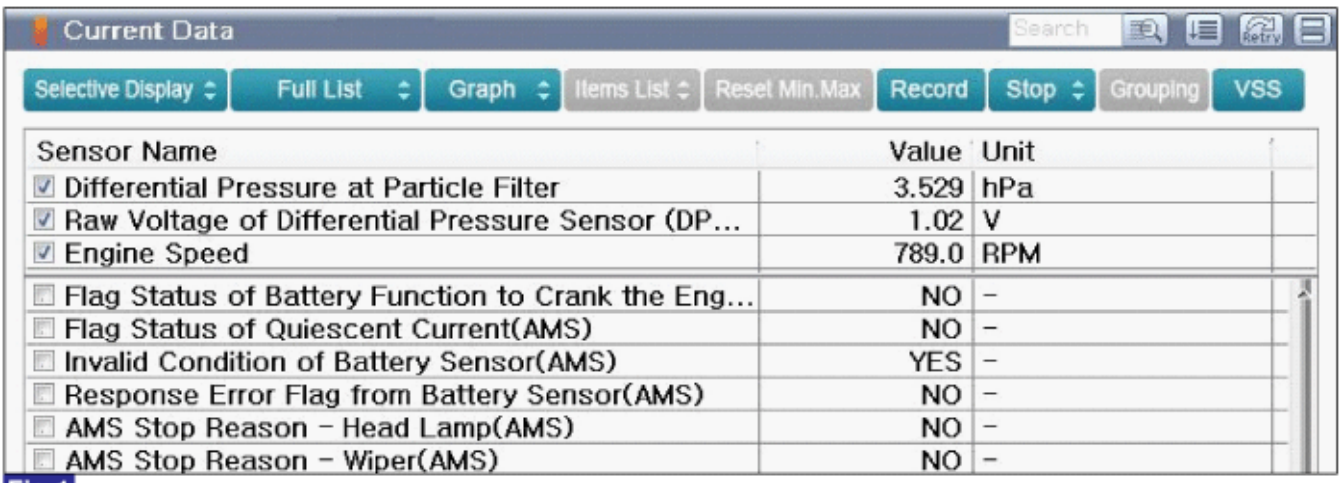


Fig.1

CRC12EN5010P04710022S

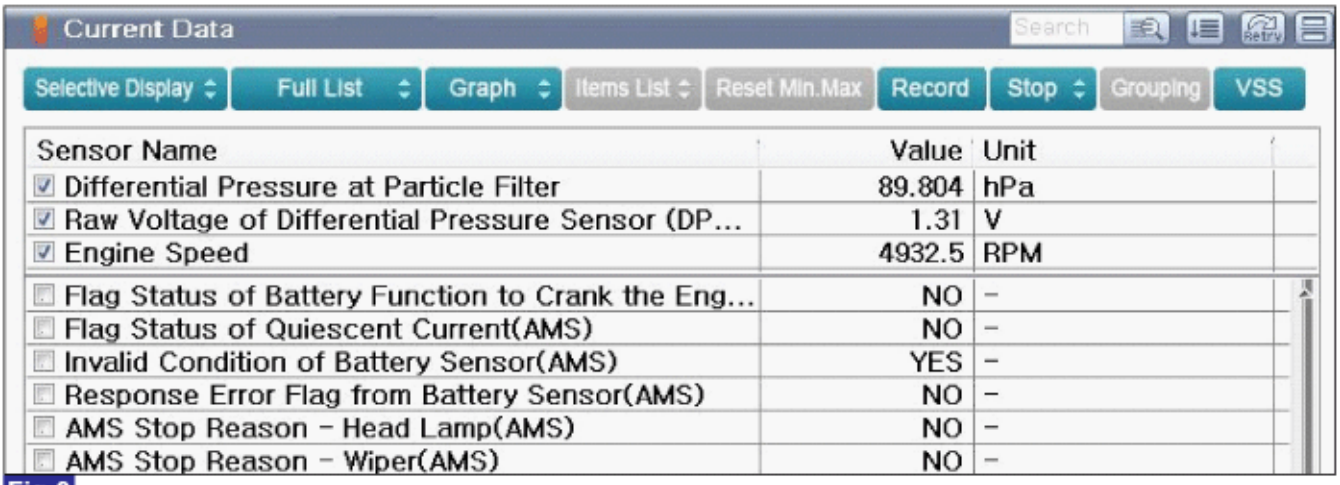


Fig.2

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. 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.

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 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 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)
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.
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.

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

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.

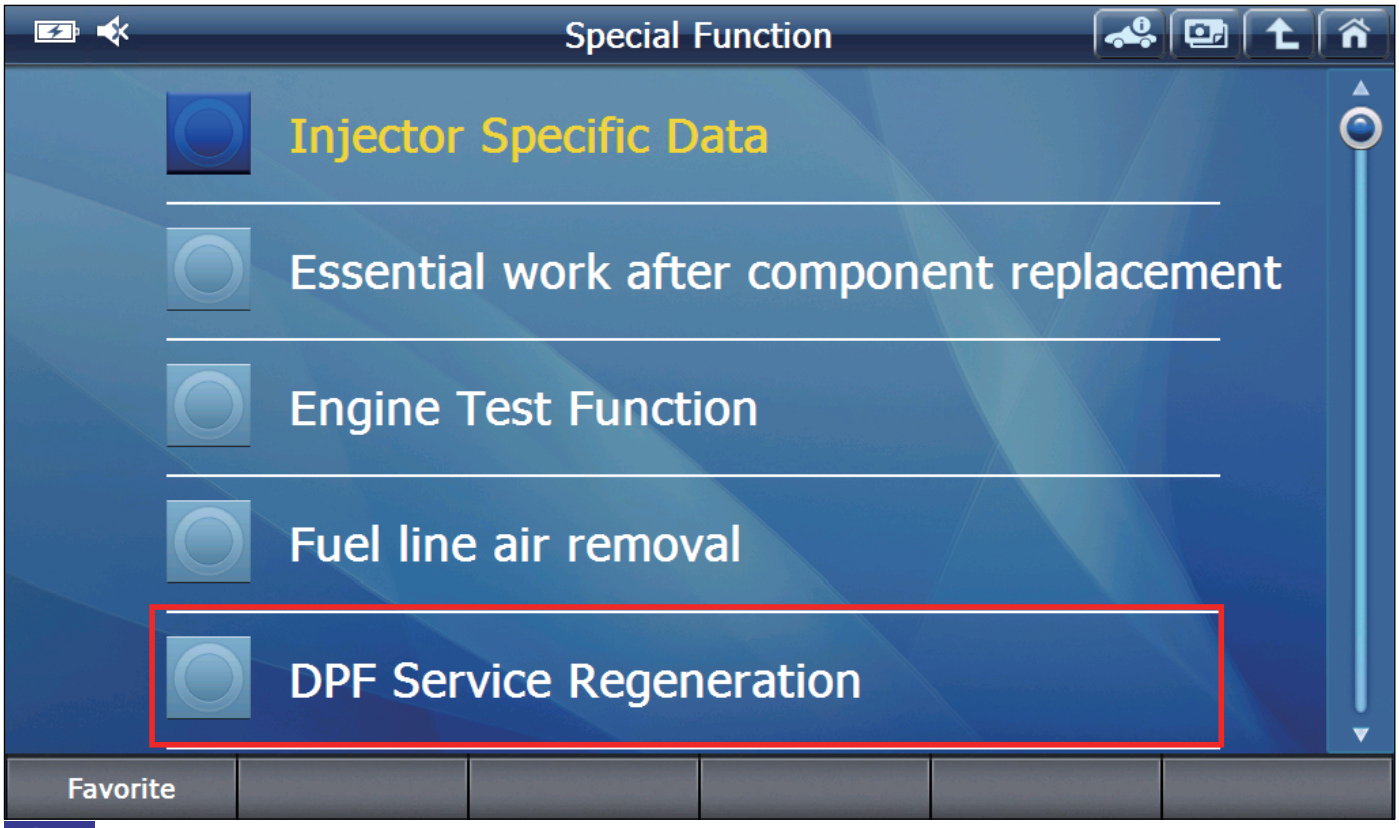


Fig.1

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

⚠ CAUTION

- 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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

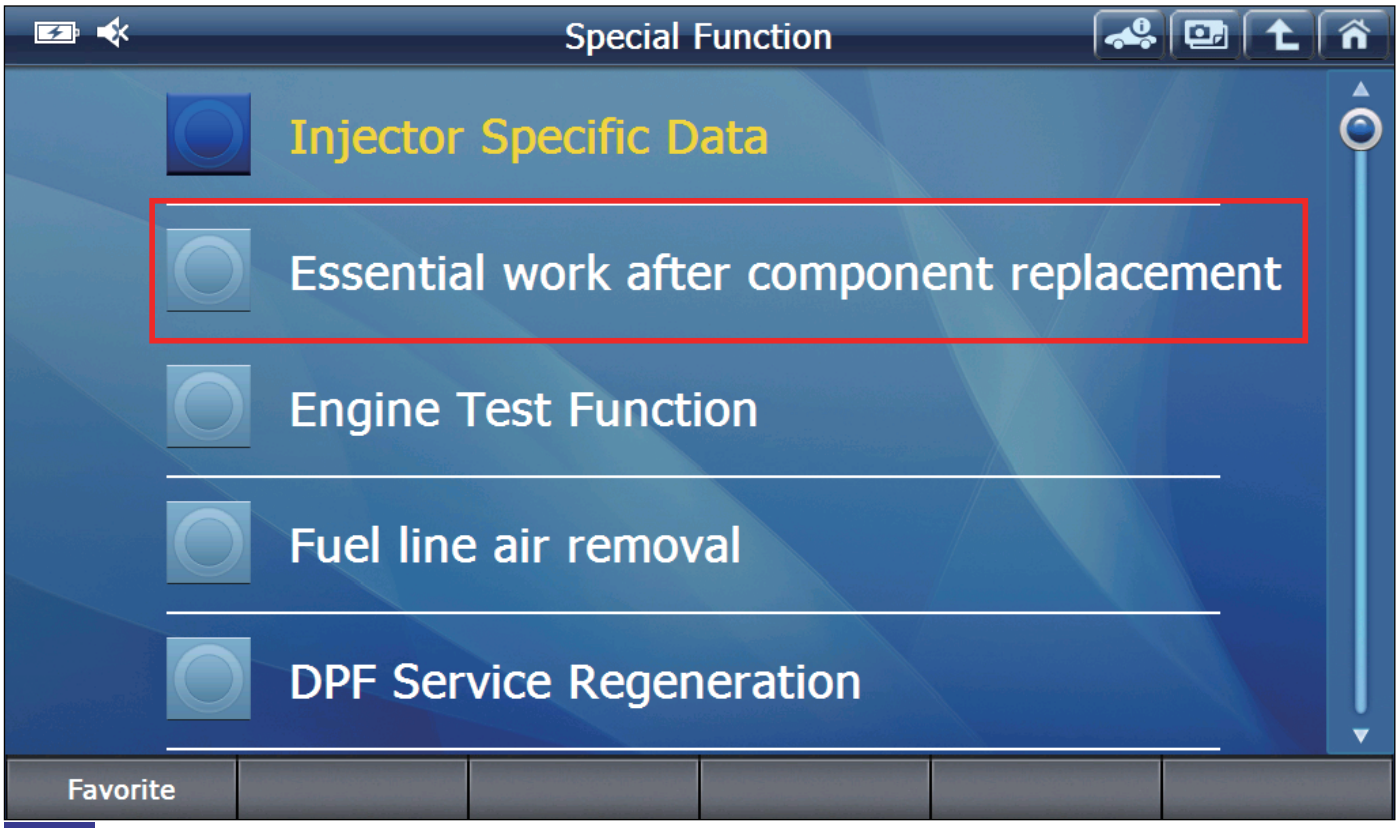


Fig.1

CRC12EN5010P01010041S

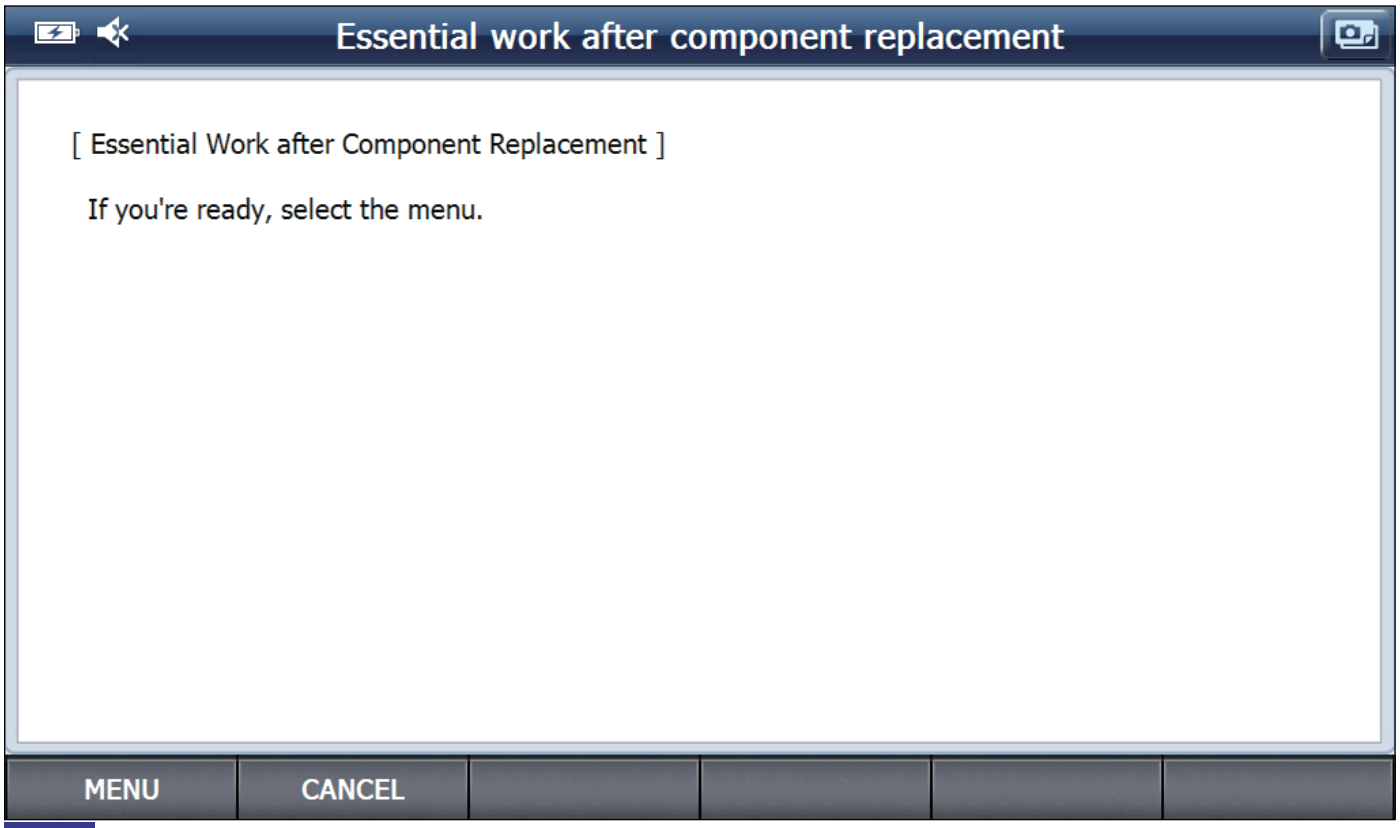


Fig.2

CRC12EN5010P01010042S

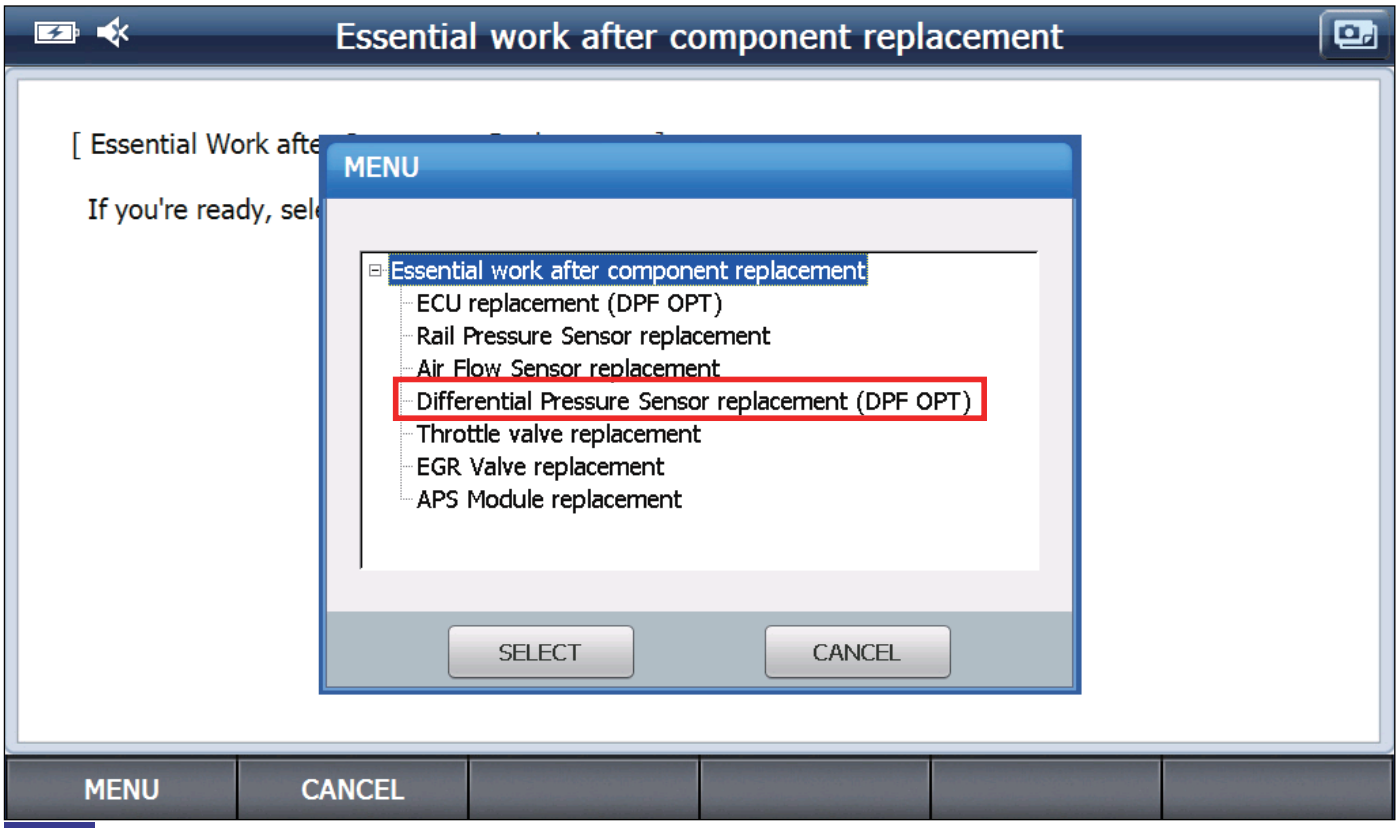


Fig.3

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 has been corrected.

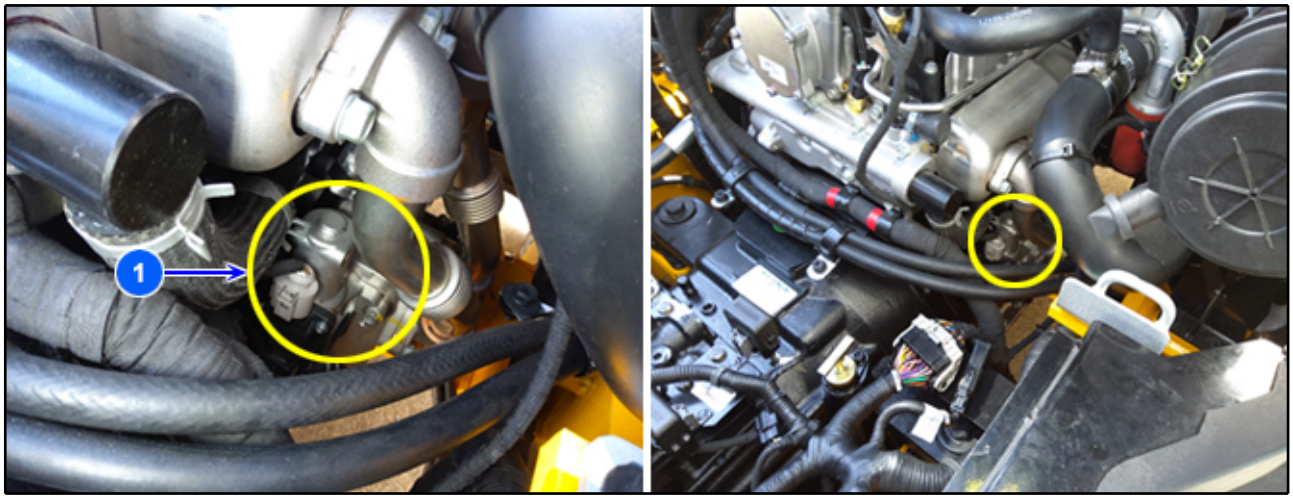
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P040111

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	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to ground in motor circuit of E-EGR actuator 3. Defected E-EGR actuator
Enable Conditions	• Engine running		
Threshold Value	• Short to ground in motor circuit of E-EGR actuator		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

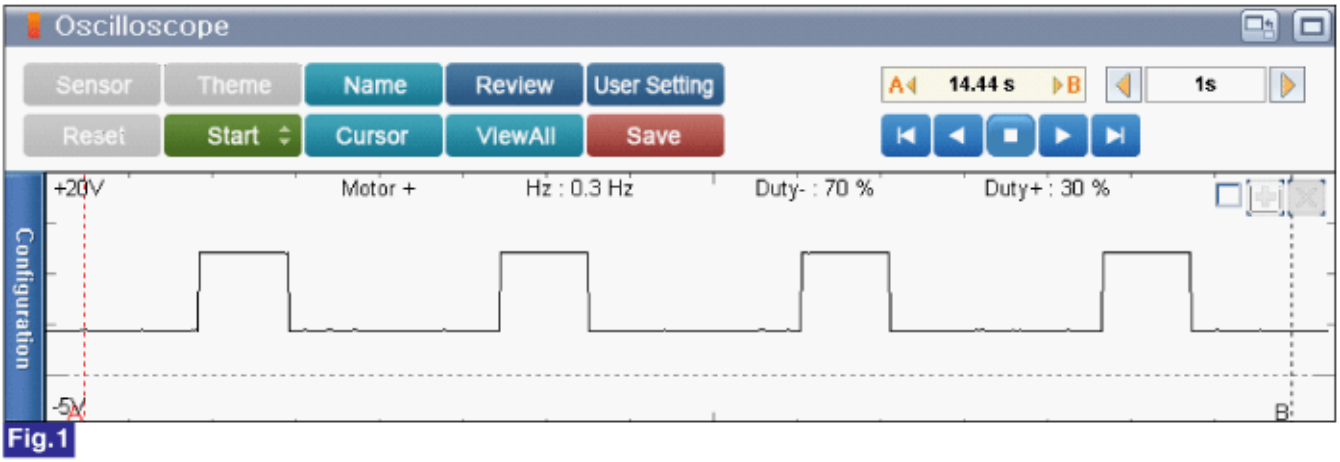


Fig.1

CRC12EN5010P04010011S

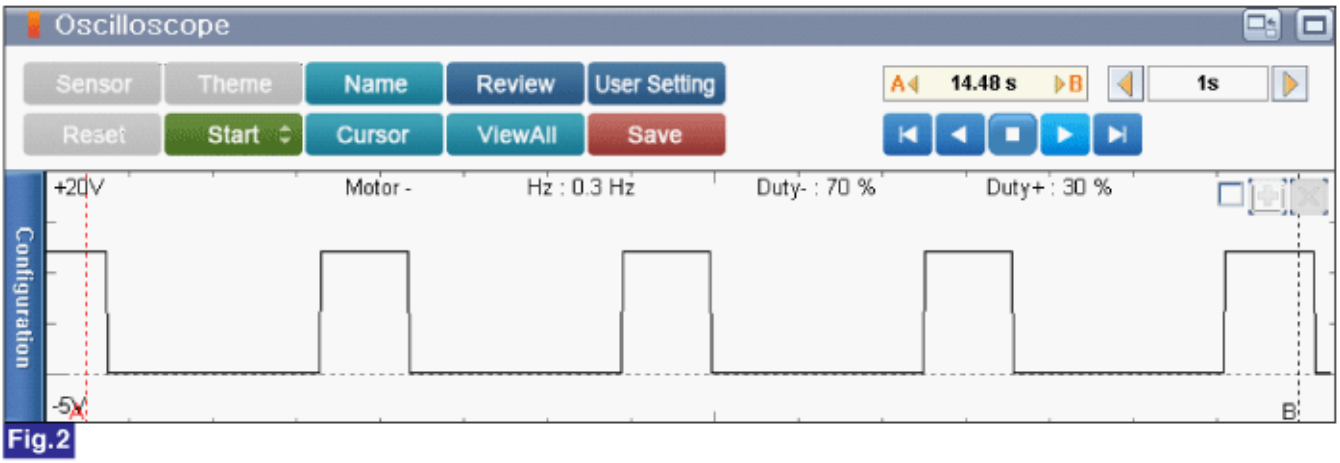


Fig.2

CRC12EN5010P04010012S

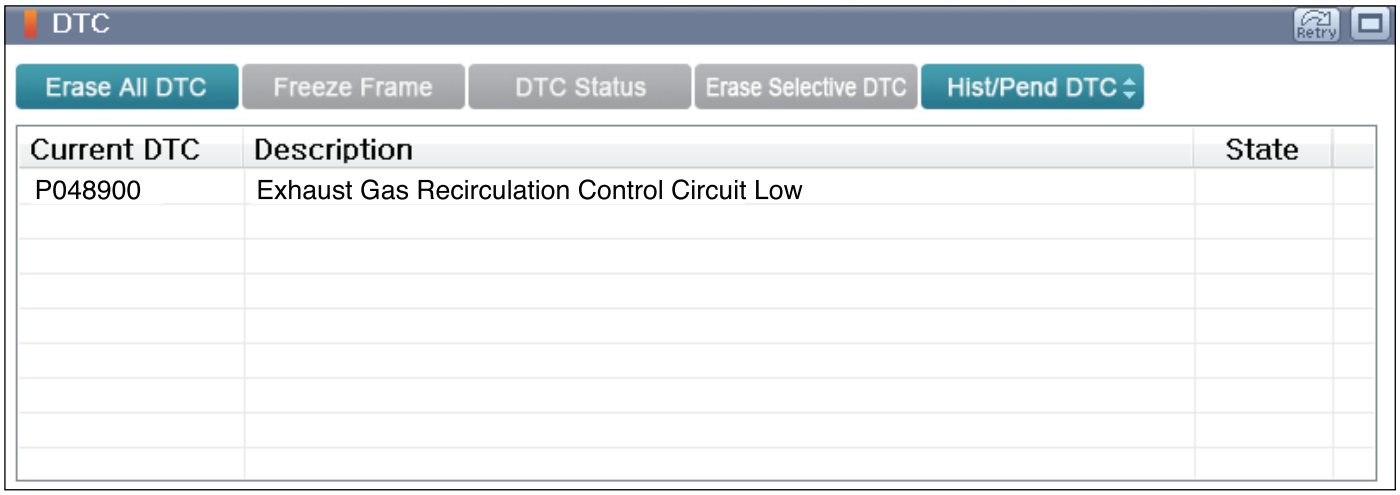
Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

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.



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

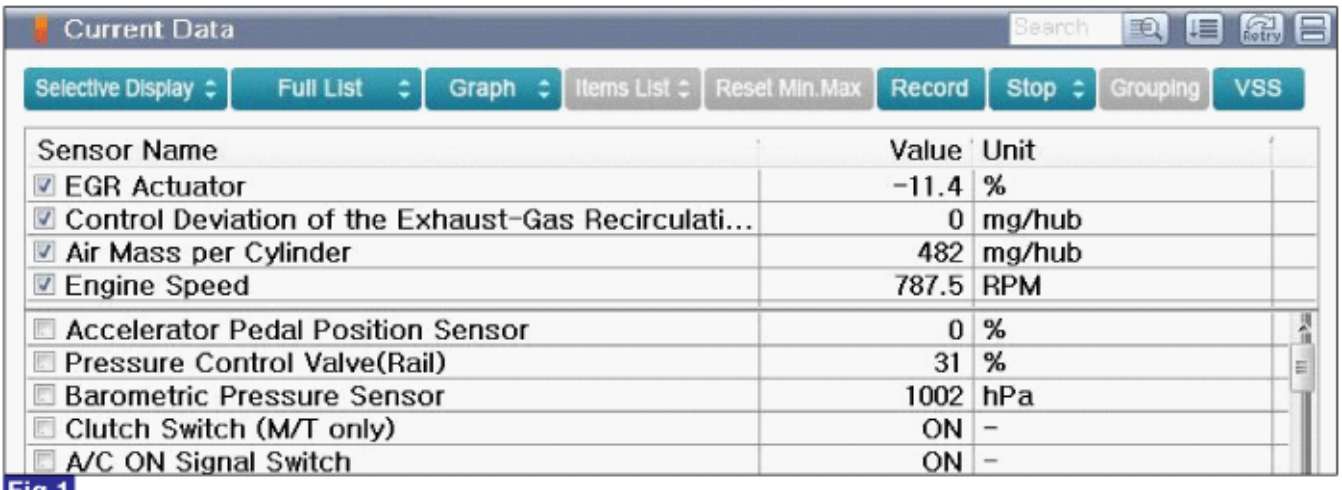


Fig.1

CRC12EN5010P04010022S

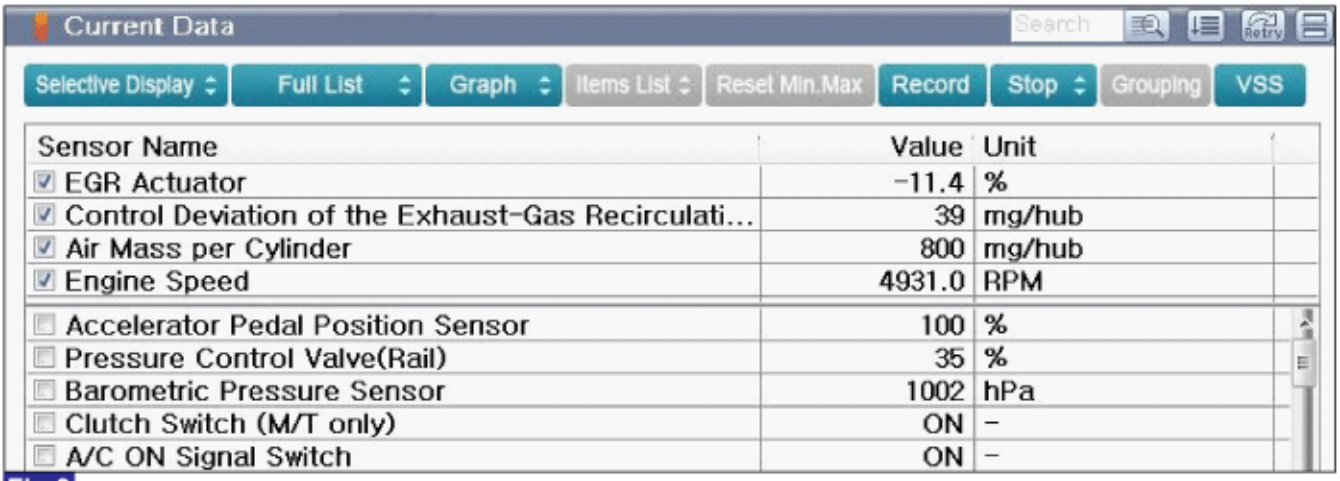


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

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

Component Inspection

■ E-EGR Actuator Coil Resistance Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of E-EGR Actuator.

Specification : Approx. 2.16 ~ 2.64Ω (20℃/68℉)

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.

⚠ CAUTION

- 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.

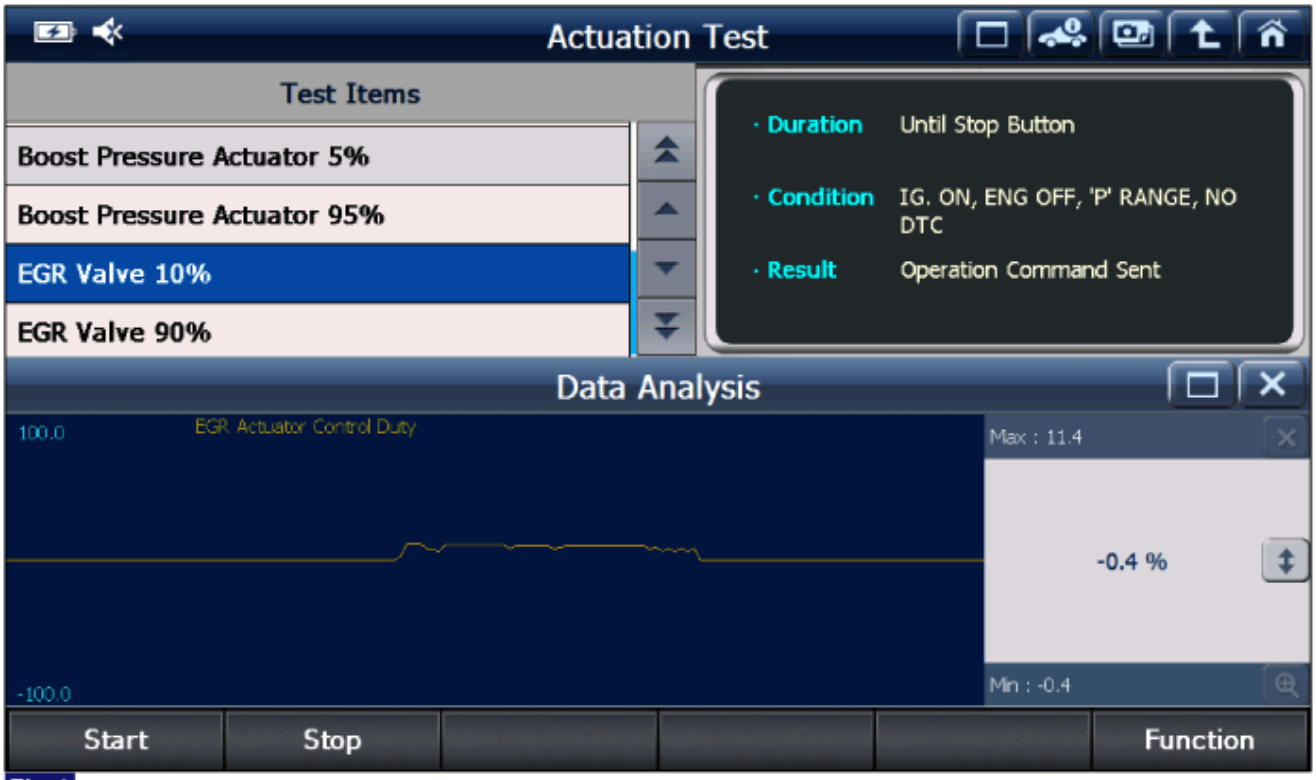


Fig.1

CRC12EN5010P04010041S

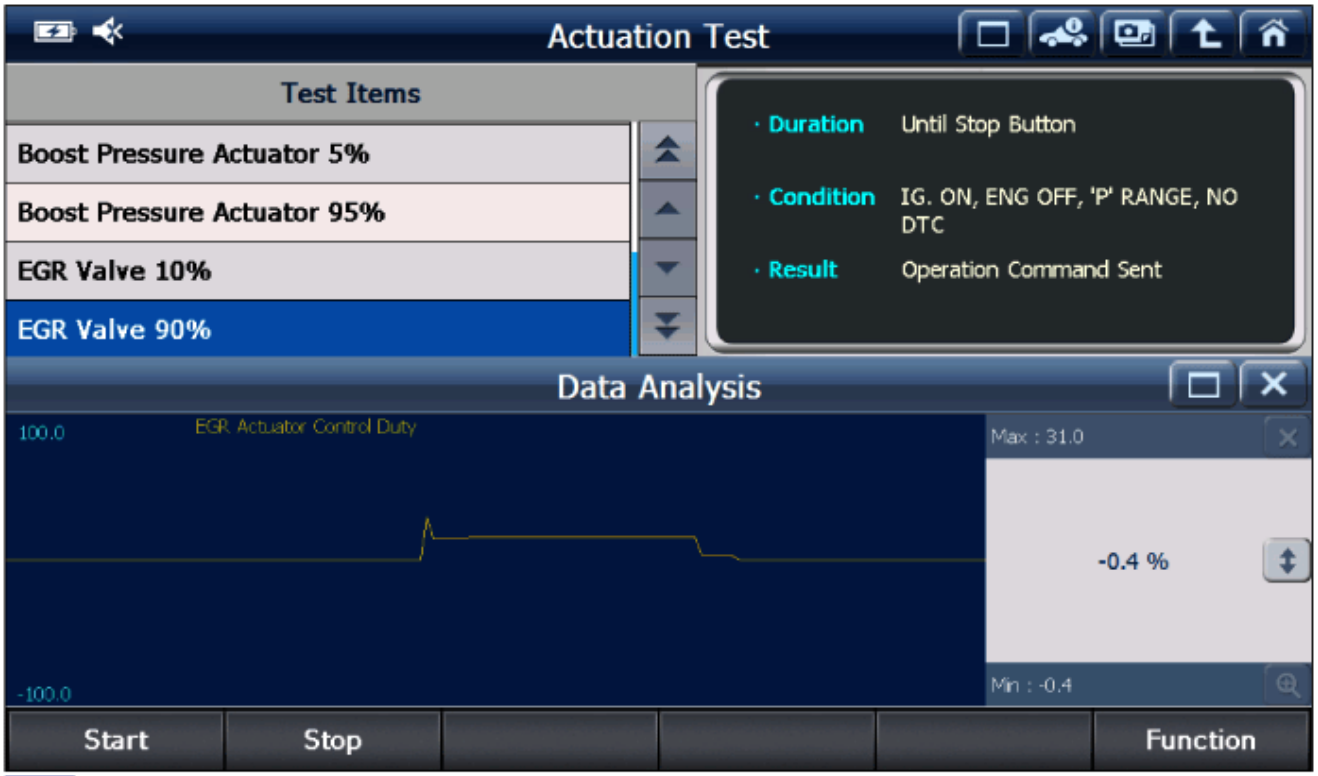


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

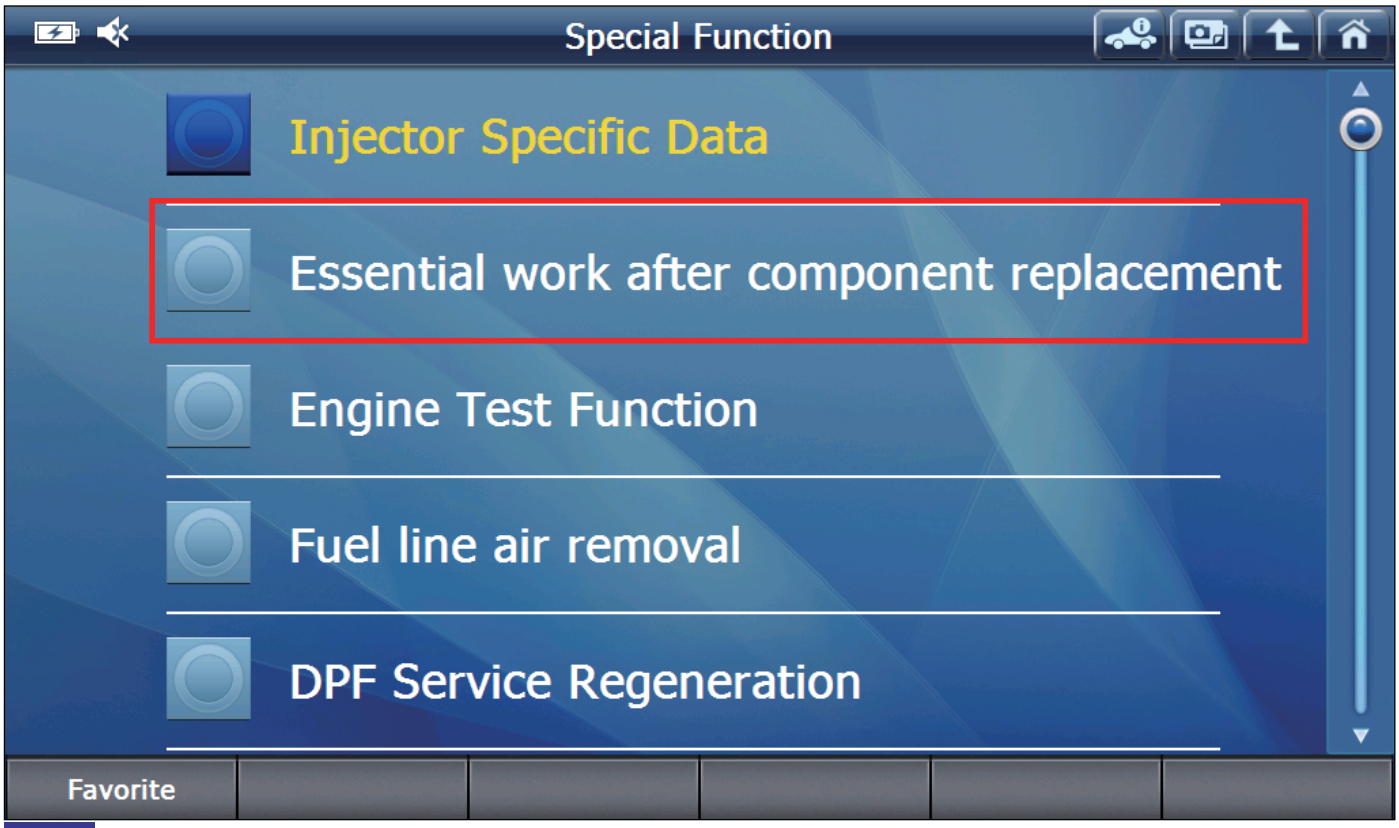


Fig.1

CRC12EN5010P01010041S

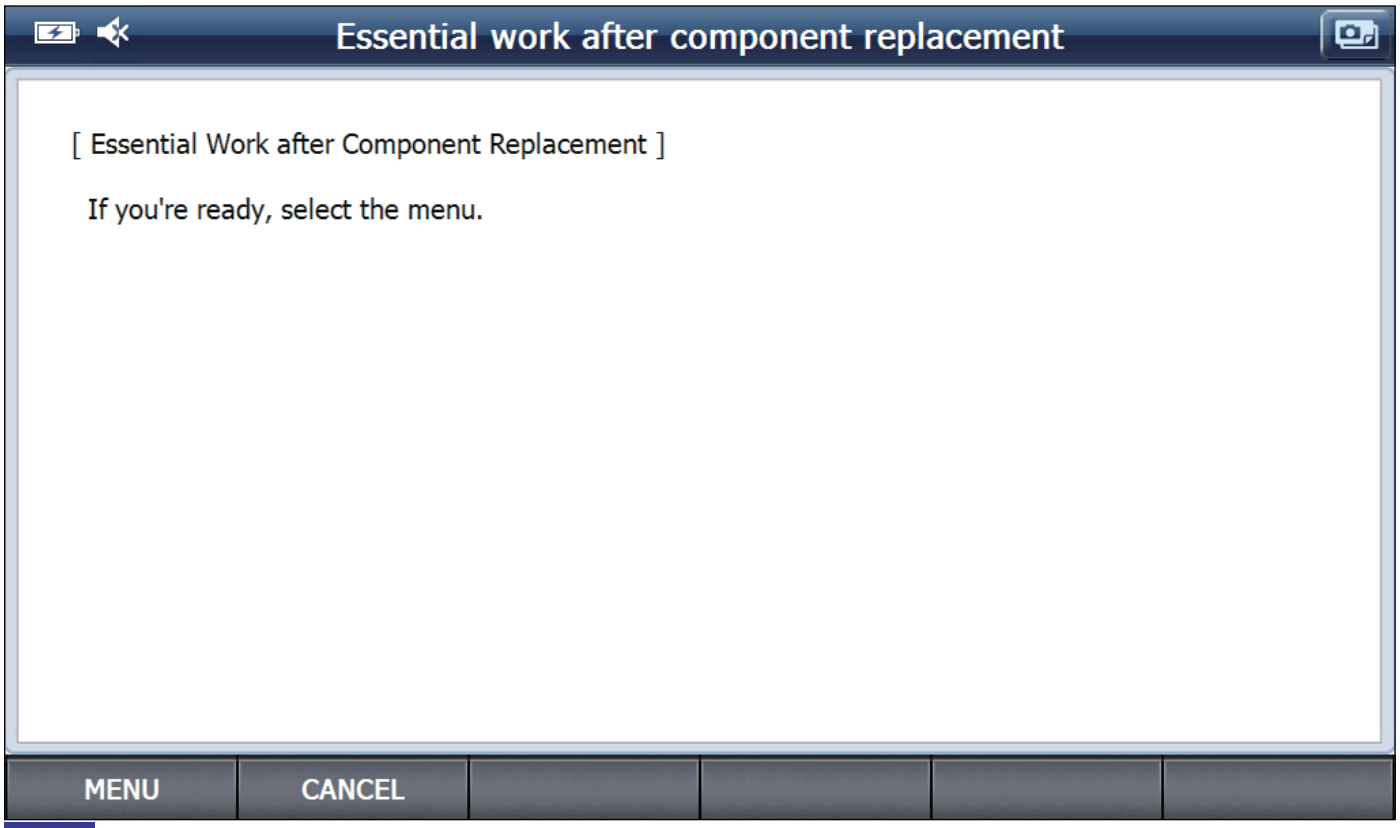


Fig.2

CRC12EN5010P01010042S

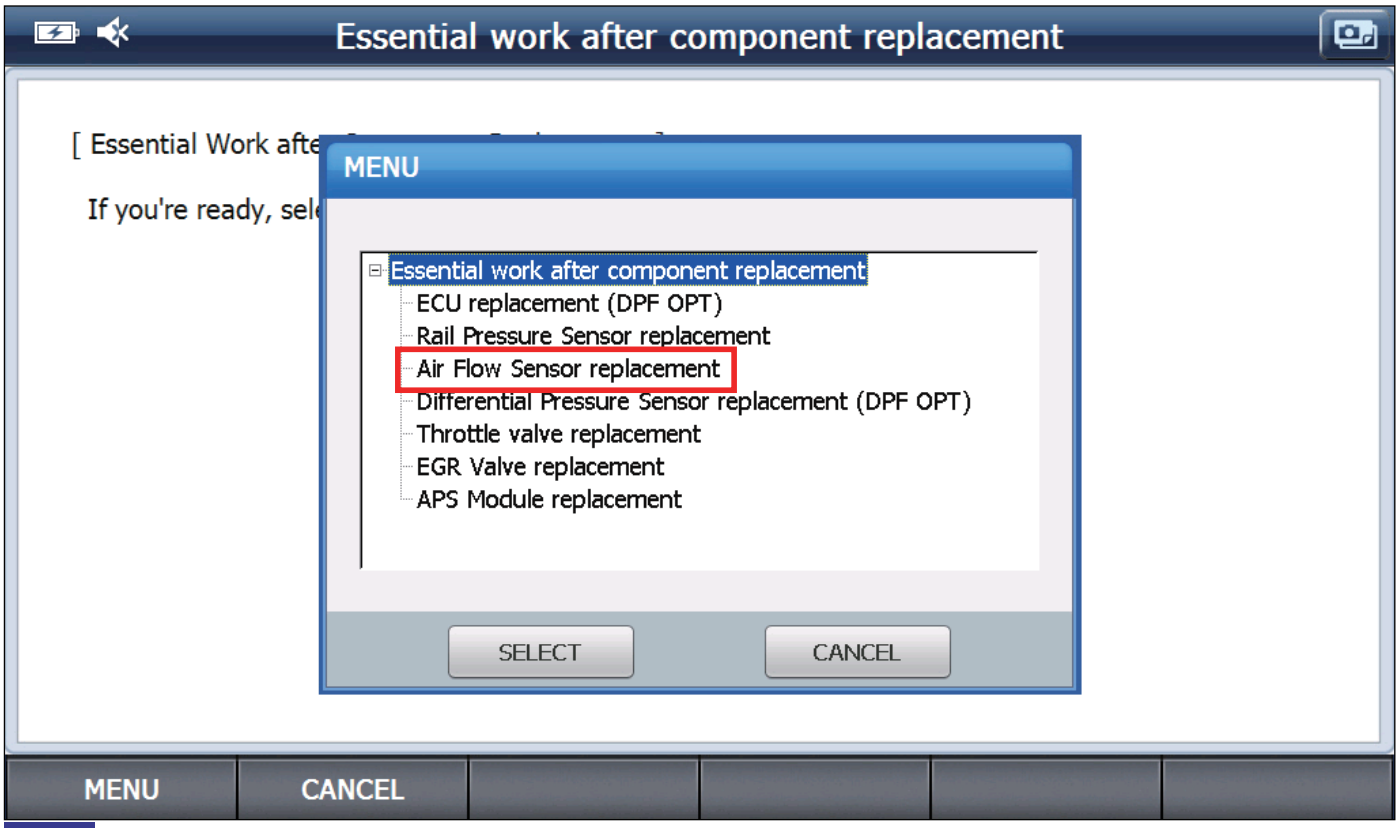


Fig.3

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.

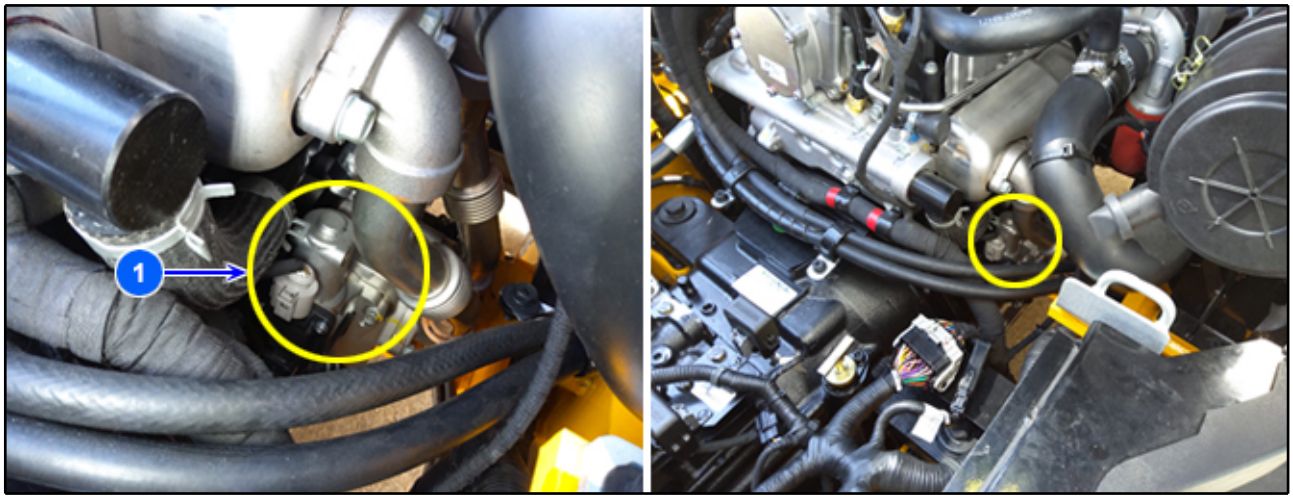
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P049000 Exhaust Gas Recirculation Control Circuit High

Component Location



CRC12EN5010P040111

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	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Shorted wiring or short to power in motor circuit of E-EGR actuator 3. Defected E-EGR actuator
Enable Conditions	• Engine running		
Threshold Value	• Short to ground in motor circuit of E-EGR actuator		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• Yes	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Electronic EGR Actuator		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	EGR Actuator motor(+)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	Signal Waveform (Fig. 1)
	2	-		-	-
	3	EGR Actuator motor(-)		B+	Signal Waveform (Fig. 2)
	4	EGR Actuator Feedback Signal		Approx. 4.8V	-
	5	EGR Actuator Ground		0V	-
	6	EGR Actuator Power		Approx. 5 V	-

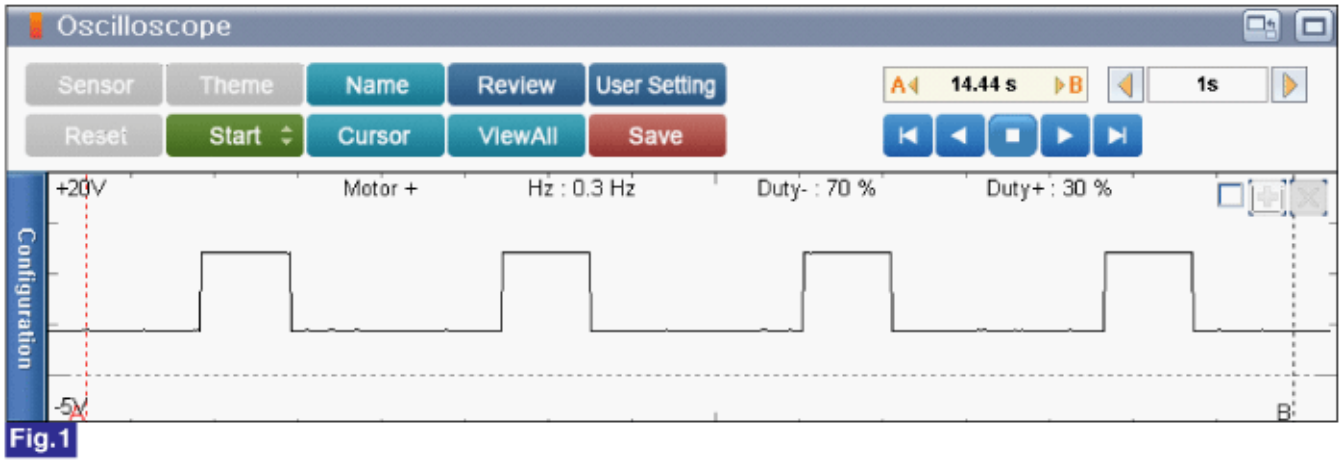


Fig.1

CRC12EN5010P04010011S

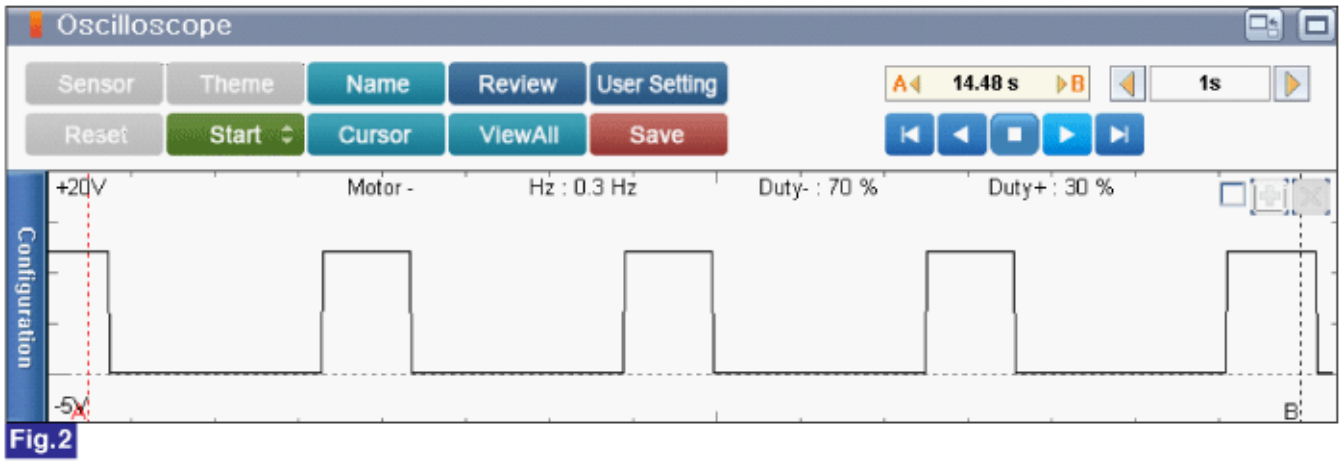


Fig.2

CRC12EN5010P04010012S

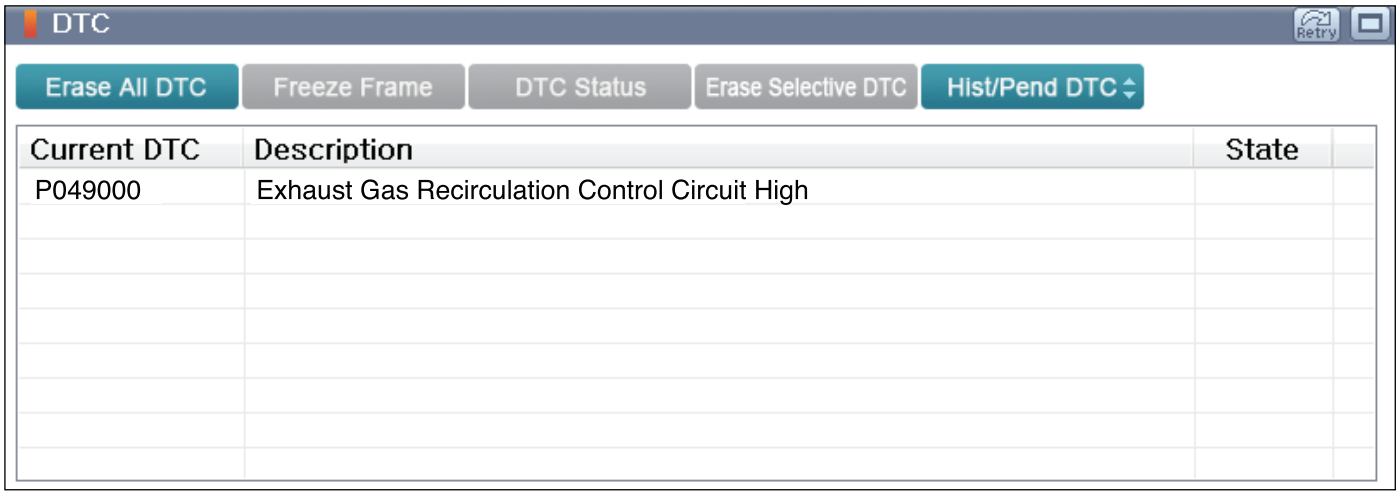
Fig.1) Pull-up voltage value of motor(+) (Duty value = Approx. 70%)

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.



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

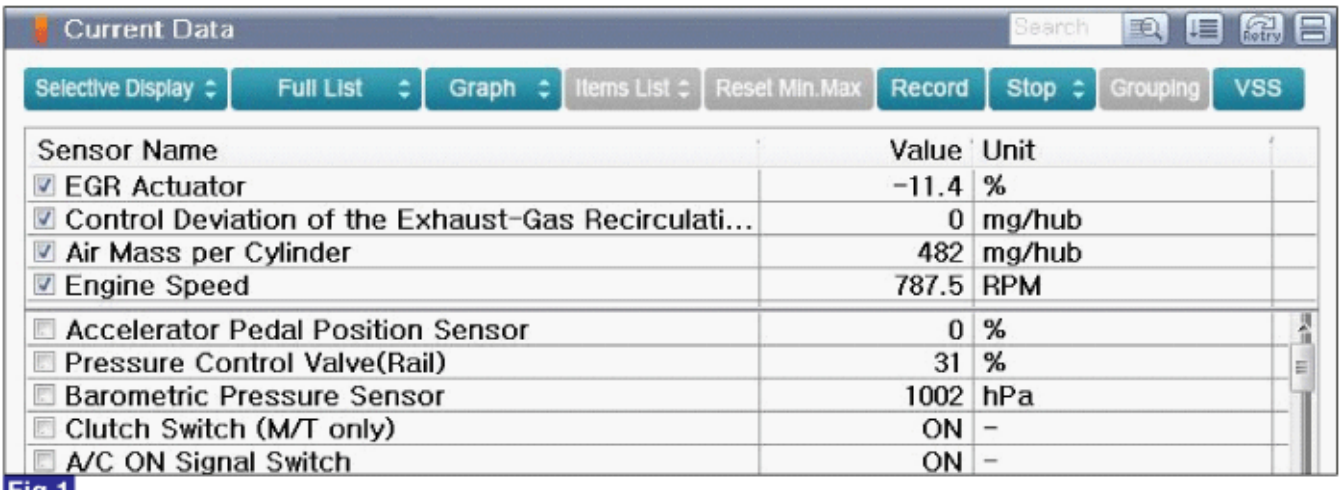


Fig.1

CRC12EN5010P04010022S

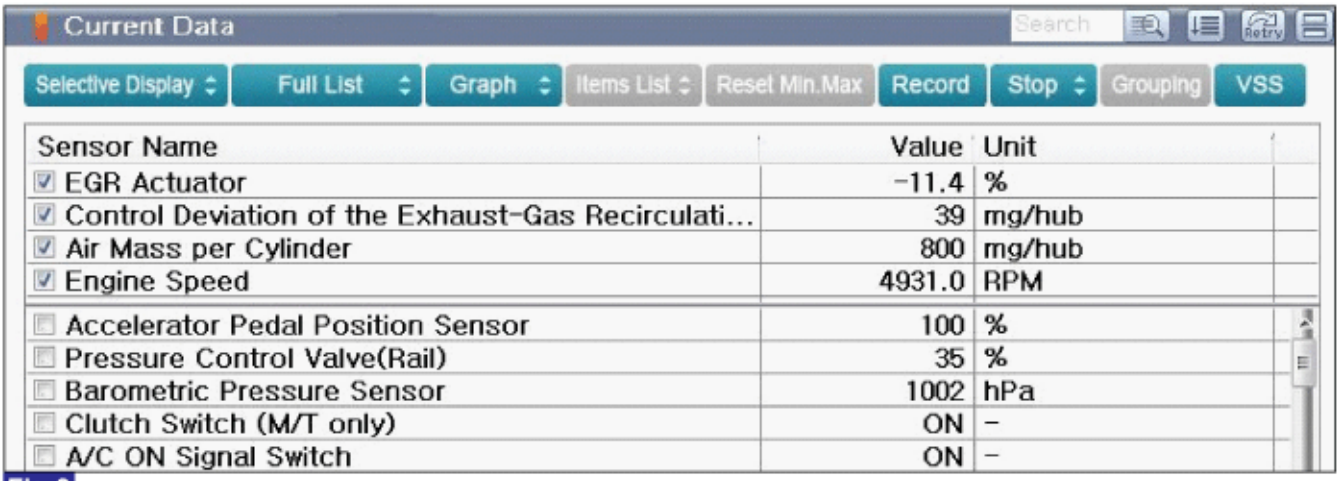


Fig.2

CRC12EN5010P04010023S

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?

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 E-EGR 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 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 E-EGR Actuator connector.
4. Measure the resistance between ground terminal of E-EGR Actuator harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
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 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 E-EGR Actuator connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of 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.
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.

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

Component Inspection

■ E-EGR Actuator Coil Resistance Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect E-EGR Actuator connector.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of E-EGR Actuator.

Specification : Approx. 2.16 ~ 2.64Ω (20℃/68℉)

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.

⚠ CAUTION

- 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.

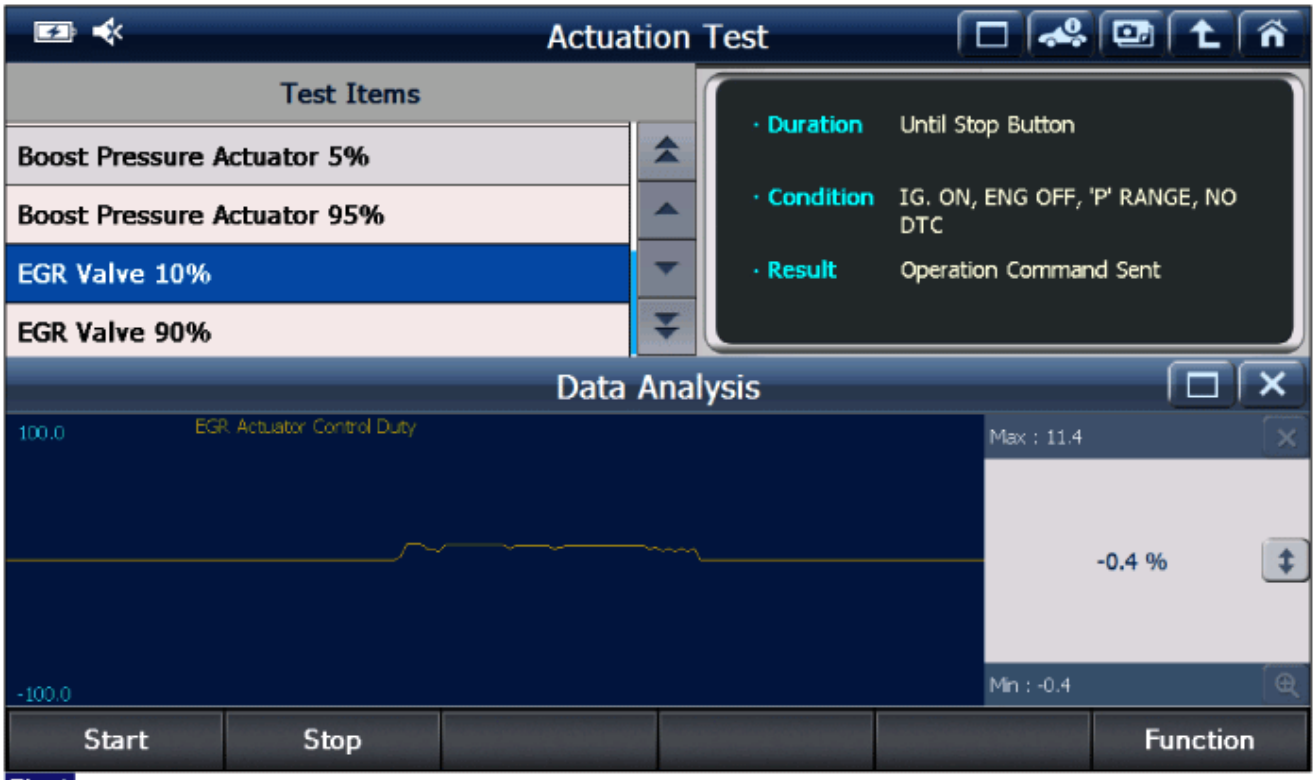


Fig.1

CRC12EN5010P04010041S

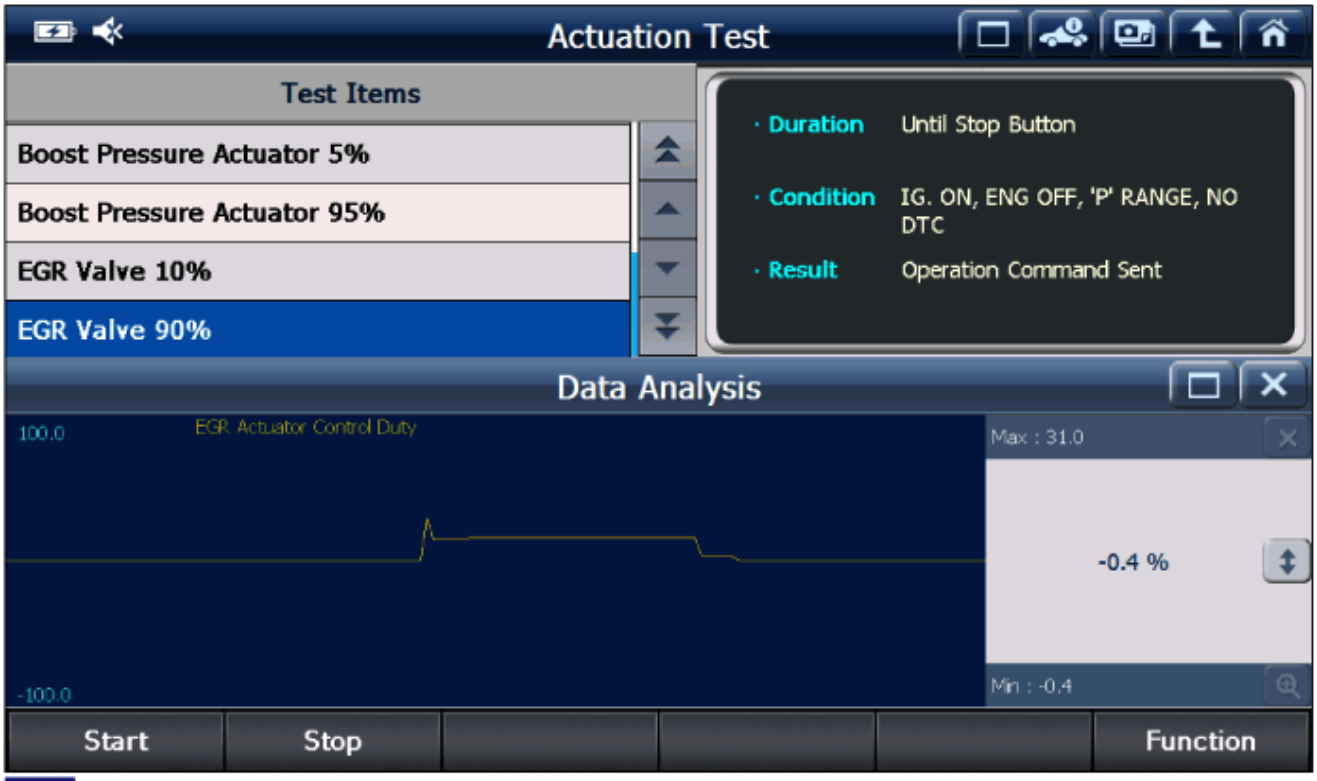


Fig.2

CRC12EN5010P04010042S

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 .

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "EGR Valve Change"

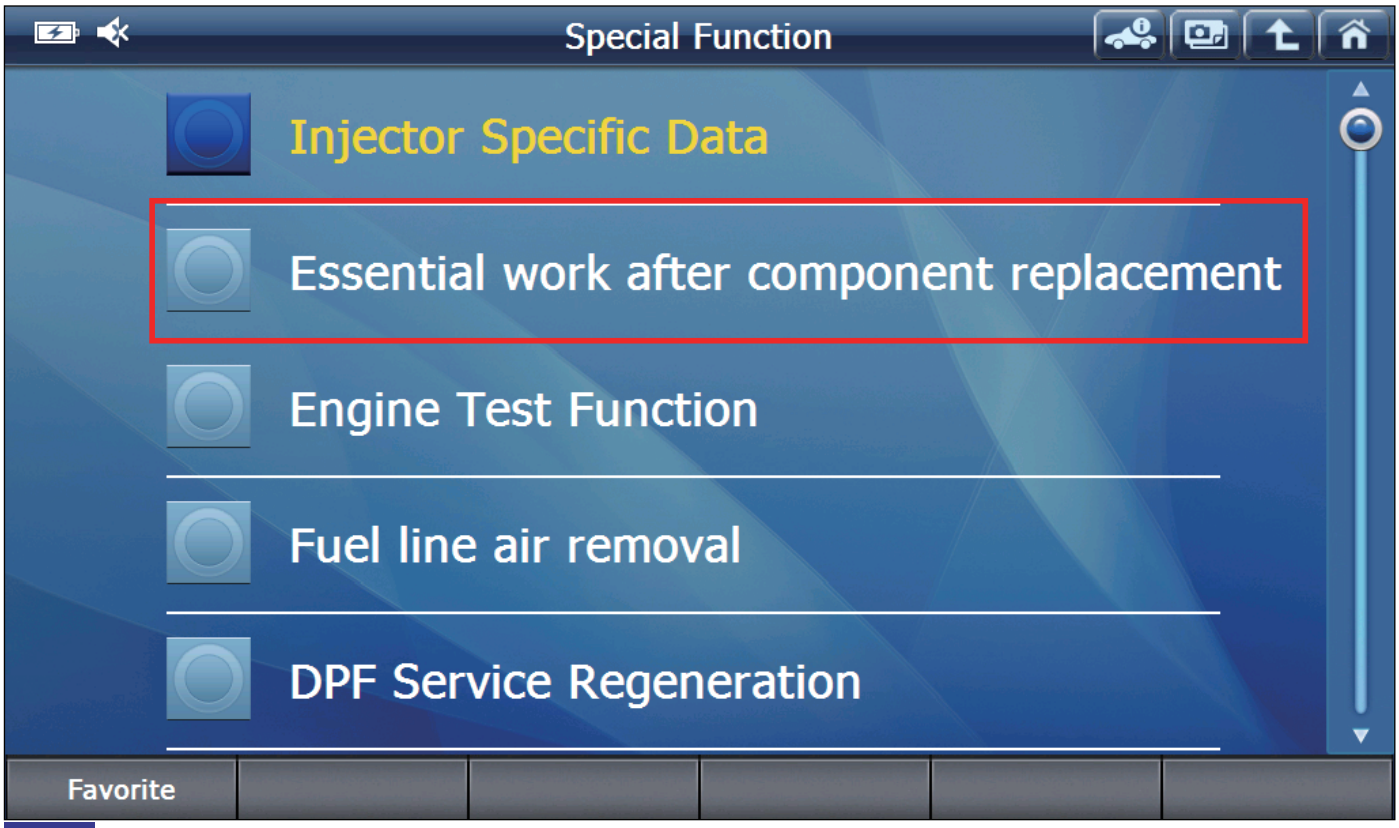


Fig.1

CRC12EN5010P01010041S

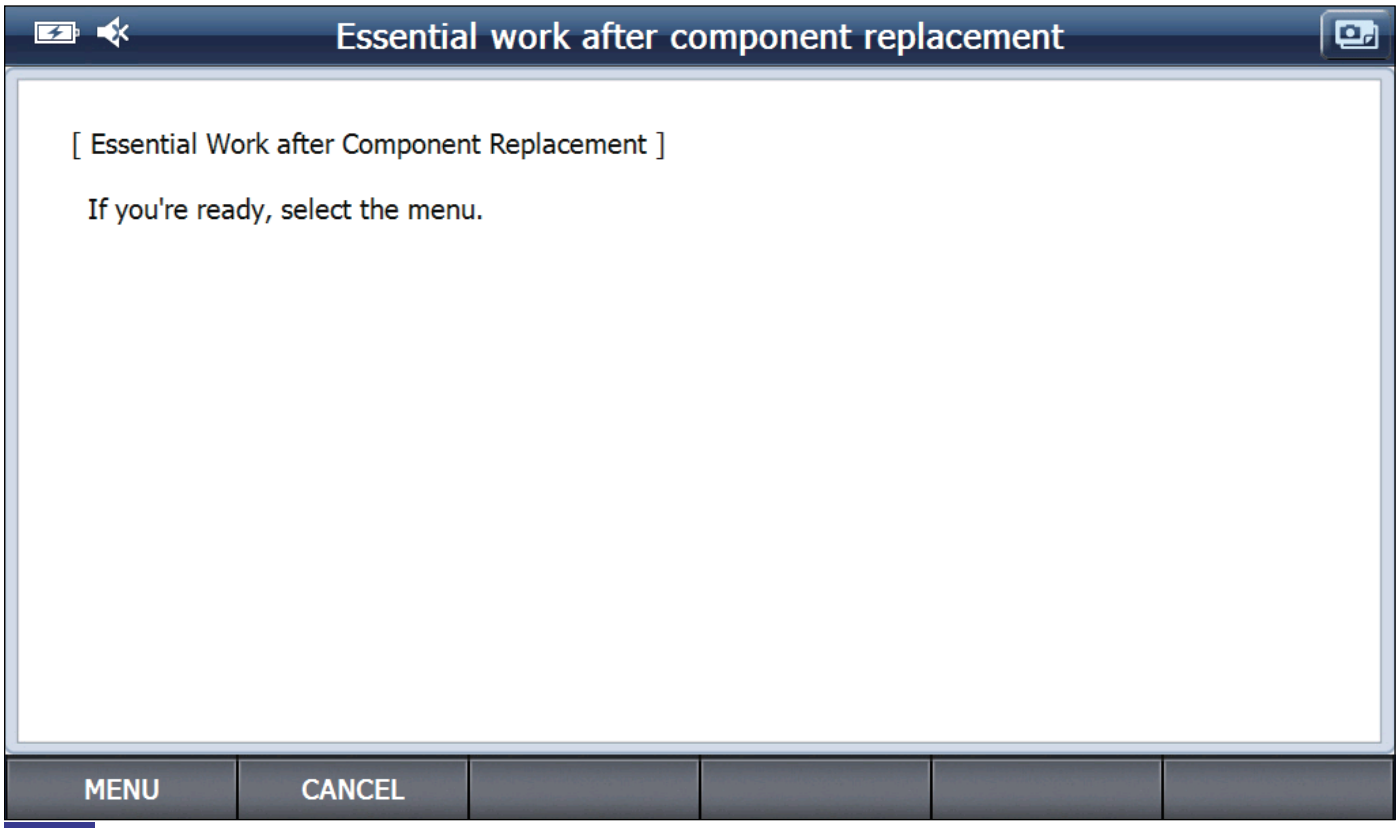


Fig.2

CRC12EN5010P01010042S

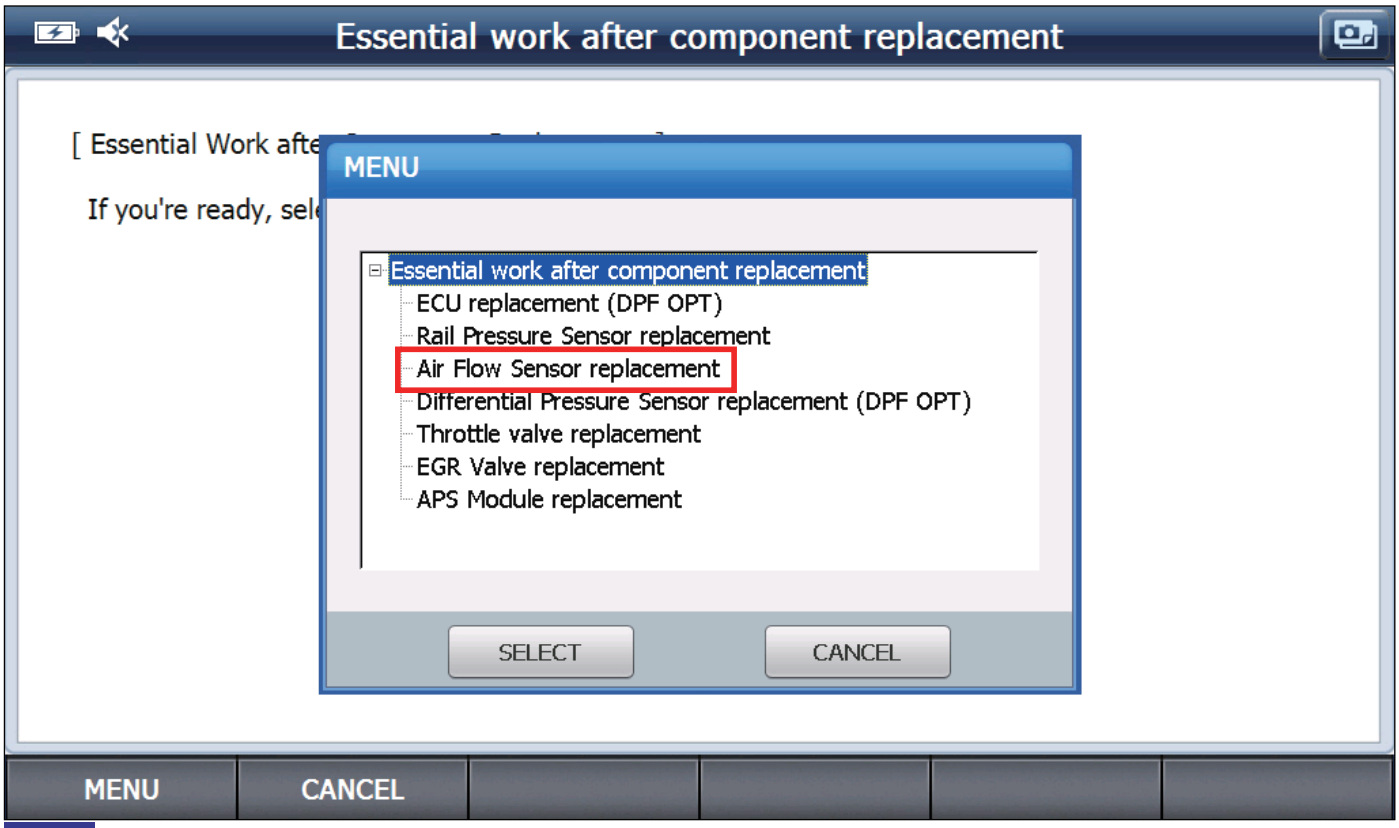


Fig.3

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.

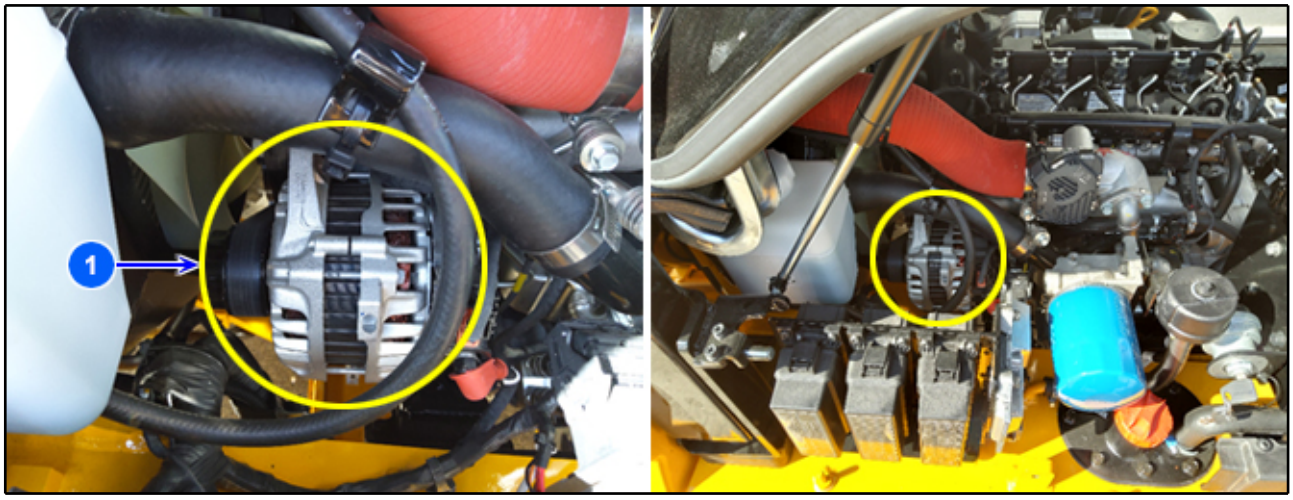
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

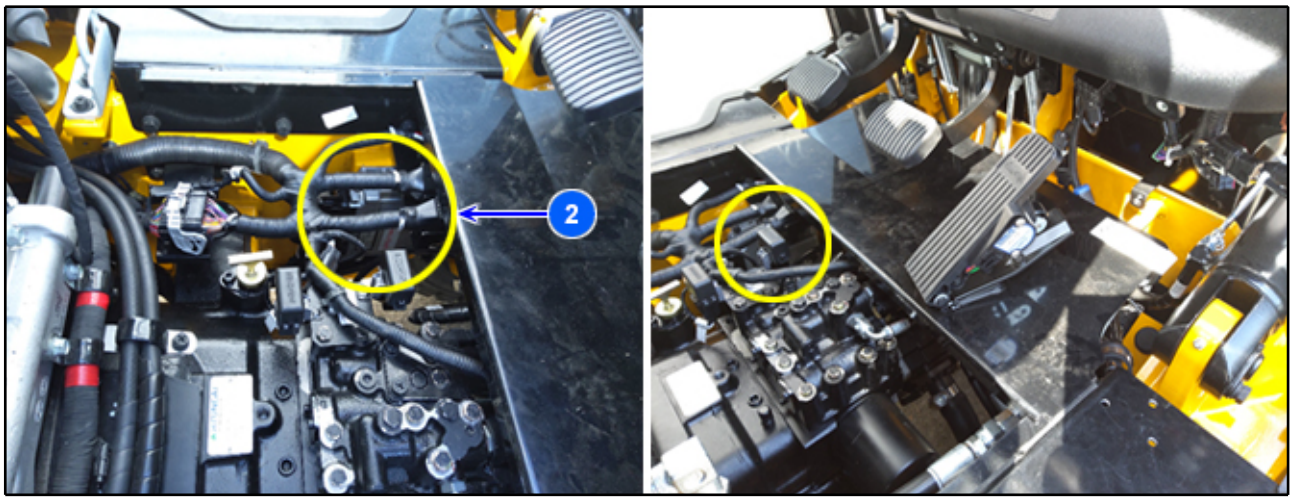
NO ▸ Problem is corrected and the system operation performs to specification at this time.

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

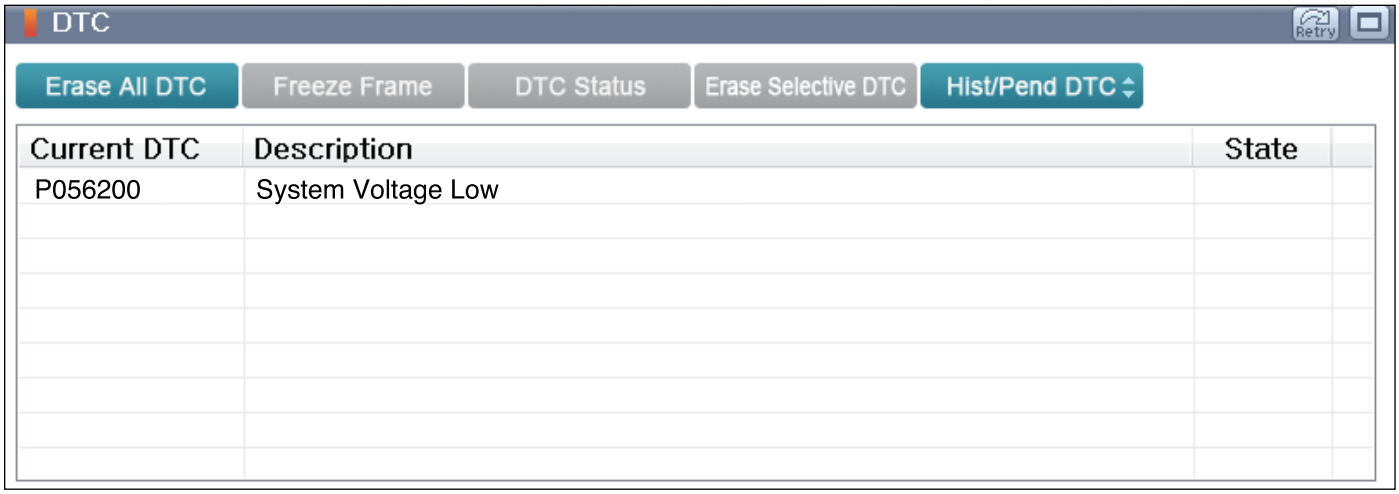
If low battery voltage is detected for more than 2 sec., ECM sets DTC P056200. This fault might be caused by defected battery or faulty power circuit.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Defected charging system 3. Defected alternator 4. Defected battery 5. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Low battery voltage is detected		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P05620021S

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

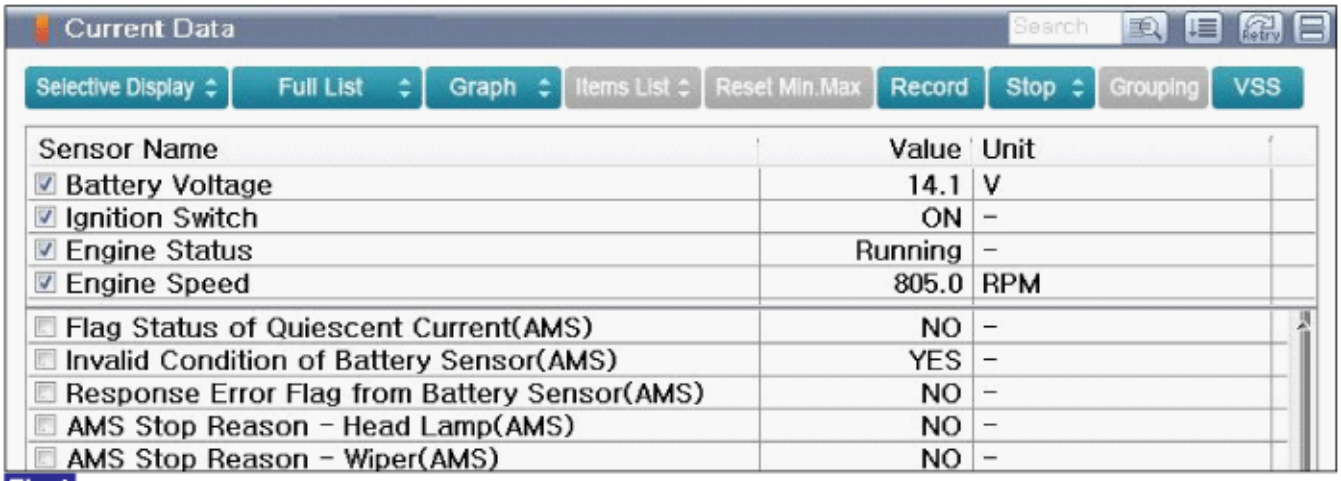


Fig.1

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

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.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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

■ 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.

3. Measure the voltage between (+) terminal and (-) terminal of battery.

Specification : Approx. 12.5 ~ 12.9V(20℃/68℉)

4. Is the measured value within specification?

YES ▸ Go to "General Inspection" procedure.

NO ▸ Refer to "Shop Manual" and re-charge the 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?

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

NO ▸ Go to "Charging Voltage Inspection" procedure.

■ 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.

⚠ CAUTION

- 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "ECU Change"

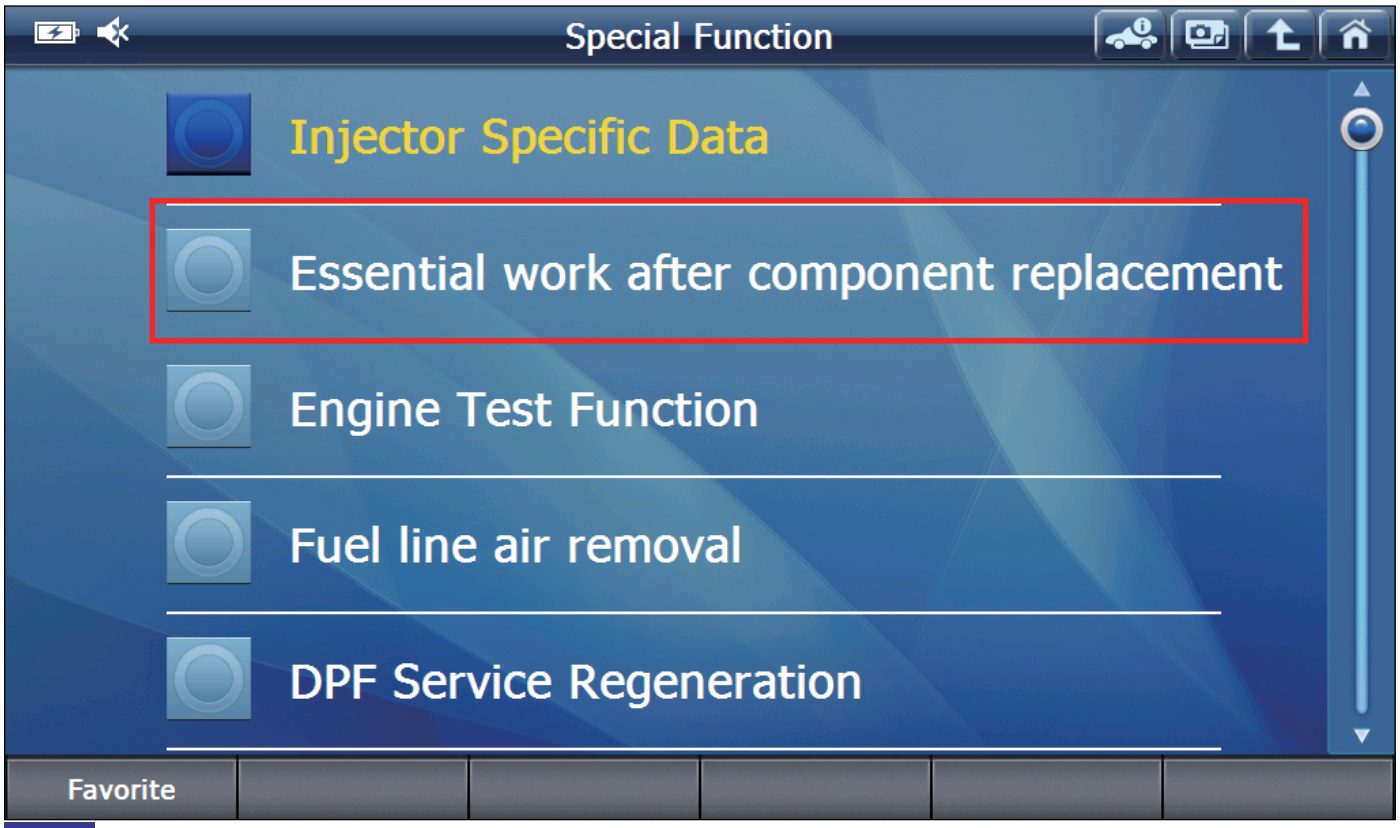


Fig.1

CRC12EN5010P01010041S

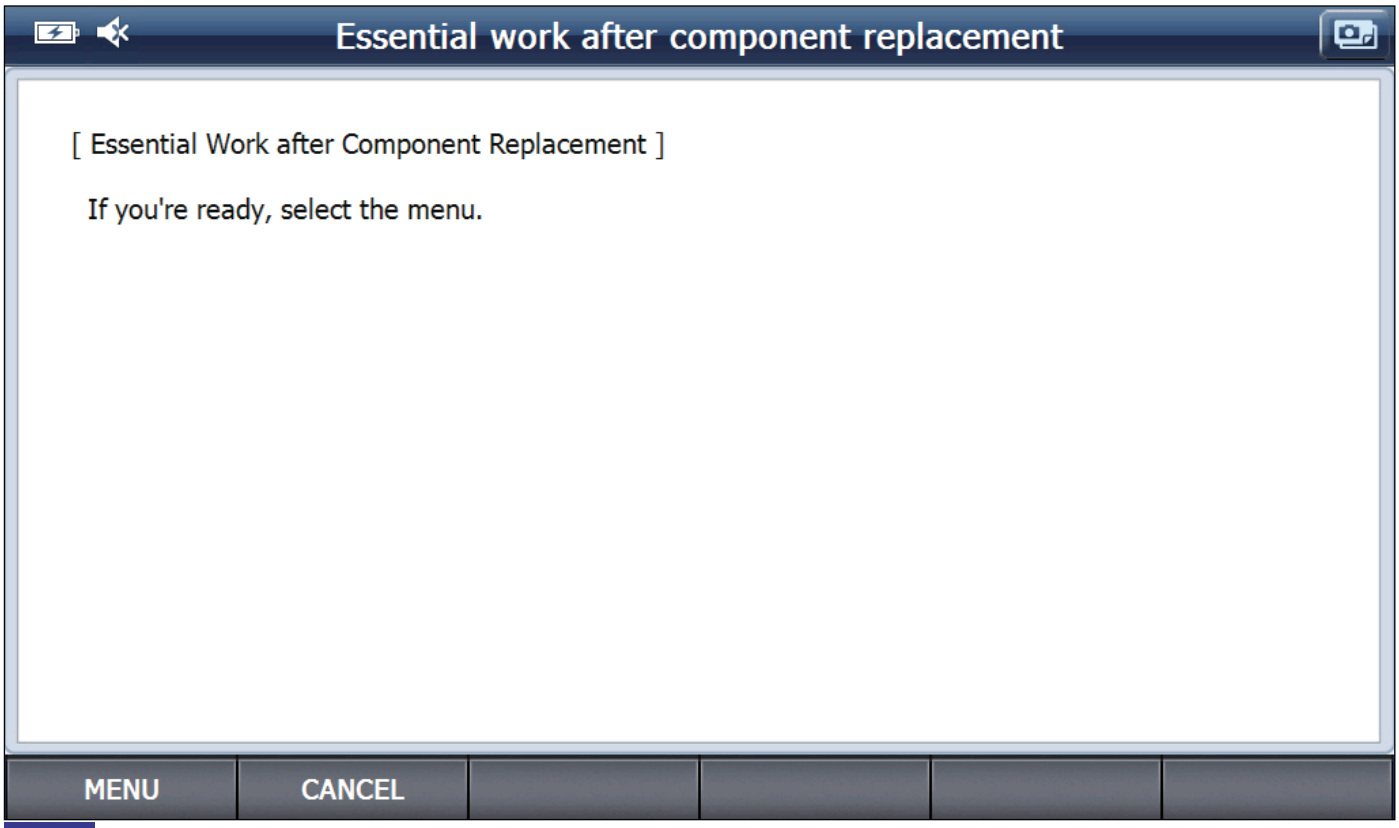


Fig.2

CRC12EN5010P01010042S

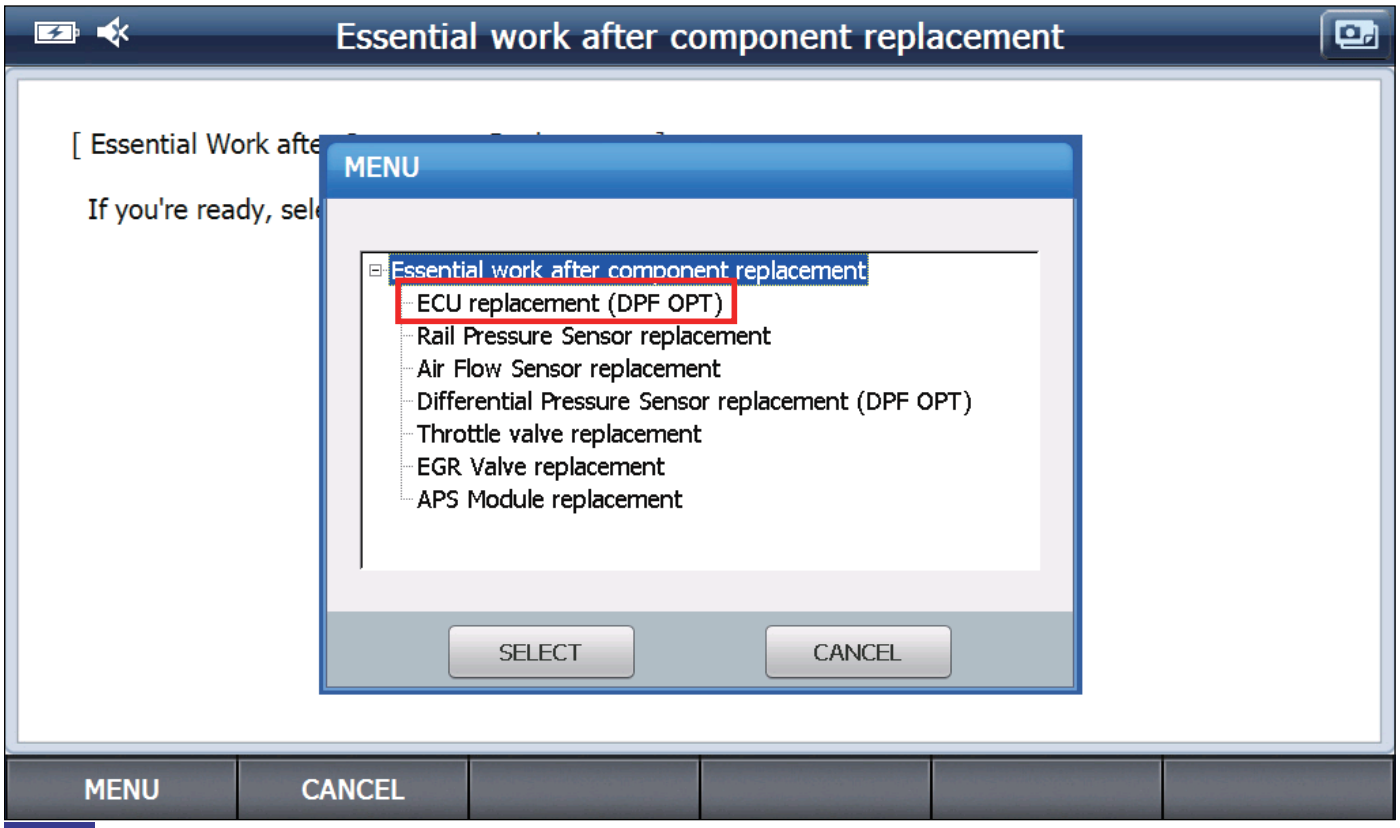


Fig.3

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.

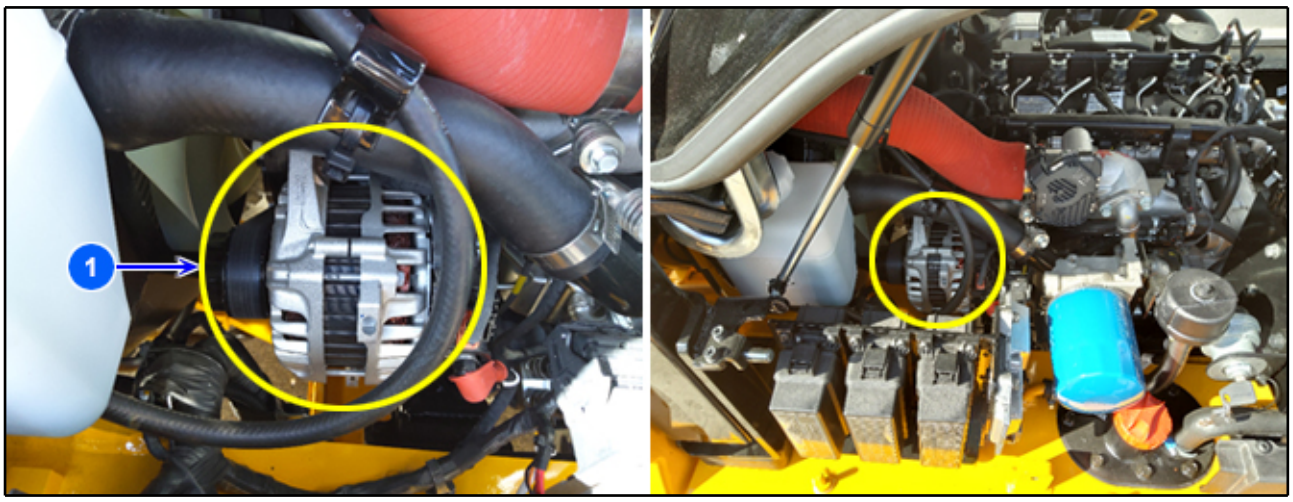
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

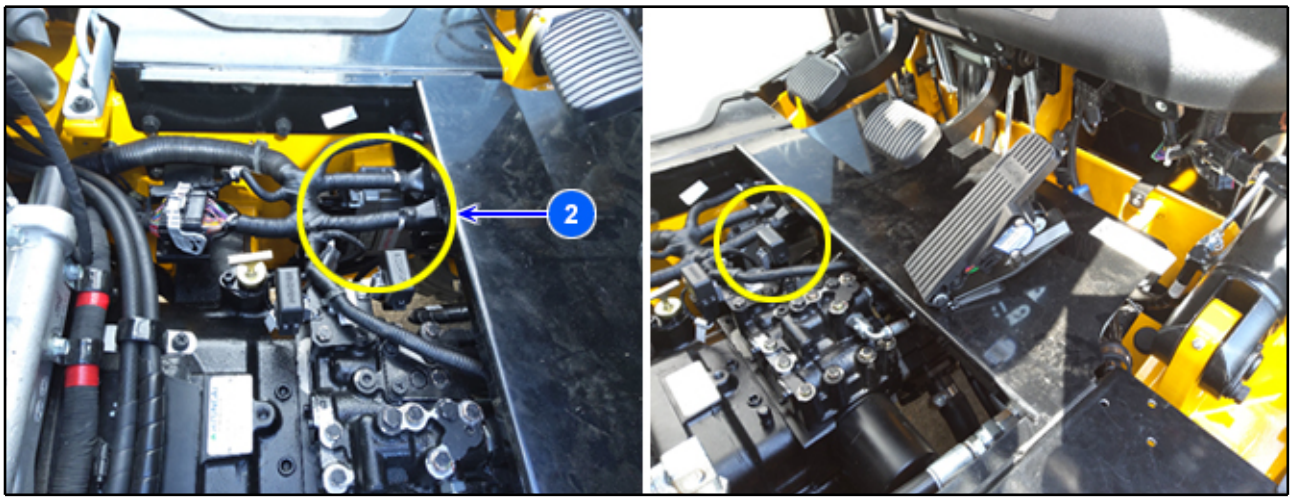
NO ▸ Problem is corrected and the system operation performs to specification at this time.

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

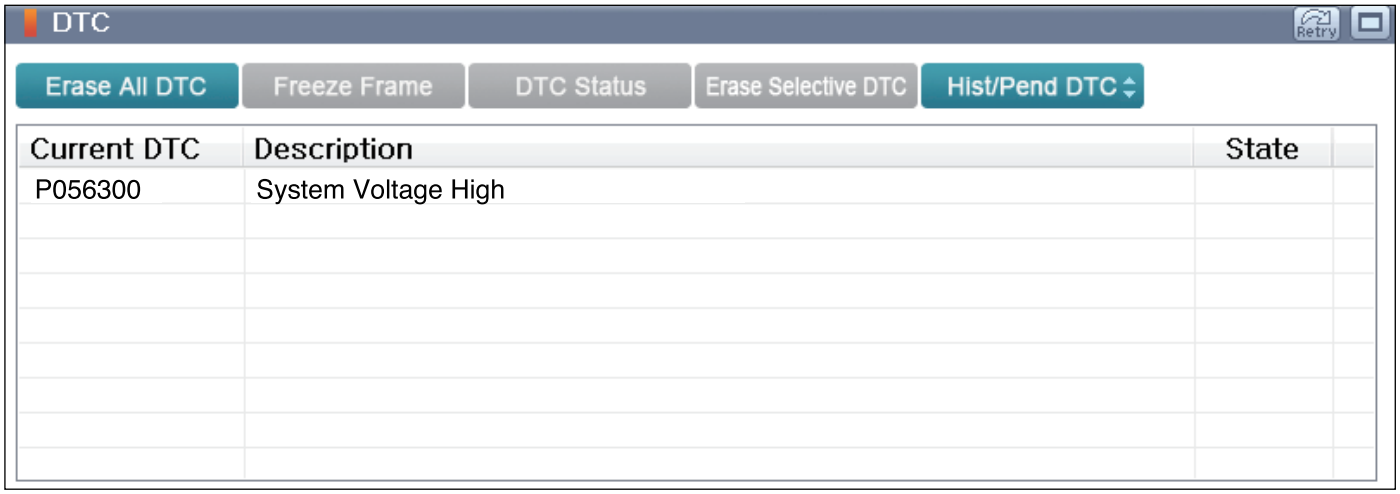
If high battery voltage is detected for more than 2 sec., ECM sets DTC P056300. This fault might be caused by faulty charging system.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty charging system 3. Defected alternator 4. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• High battery voltage is detected		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



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

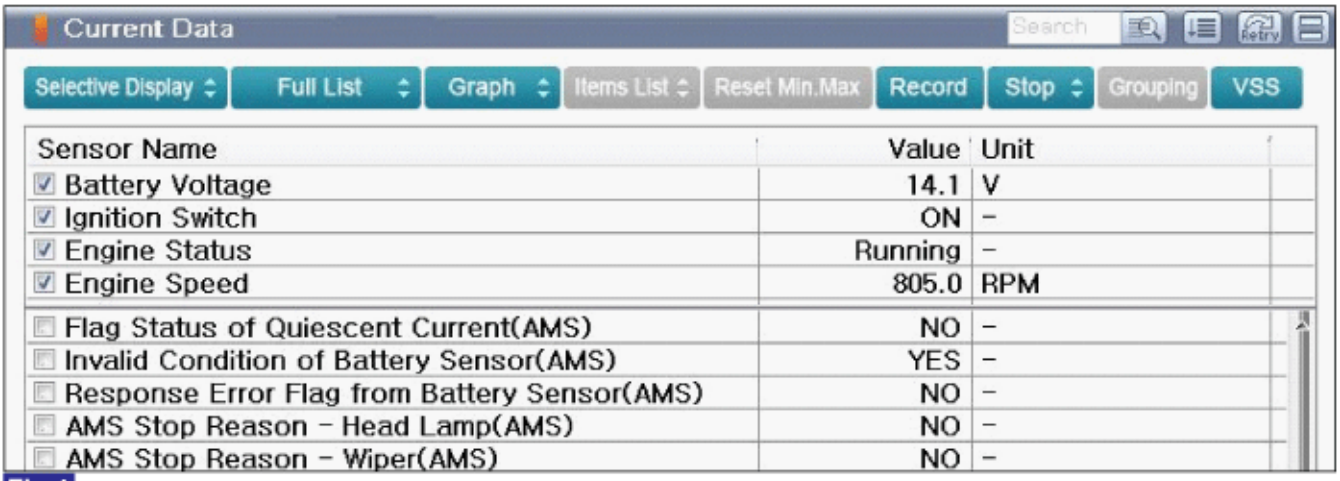


Fig.1

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

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.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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

■ 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.

⚠ CAUTION

- 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "ECU Change"

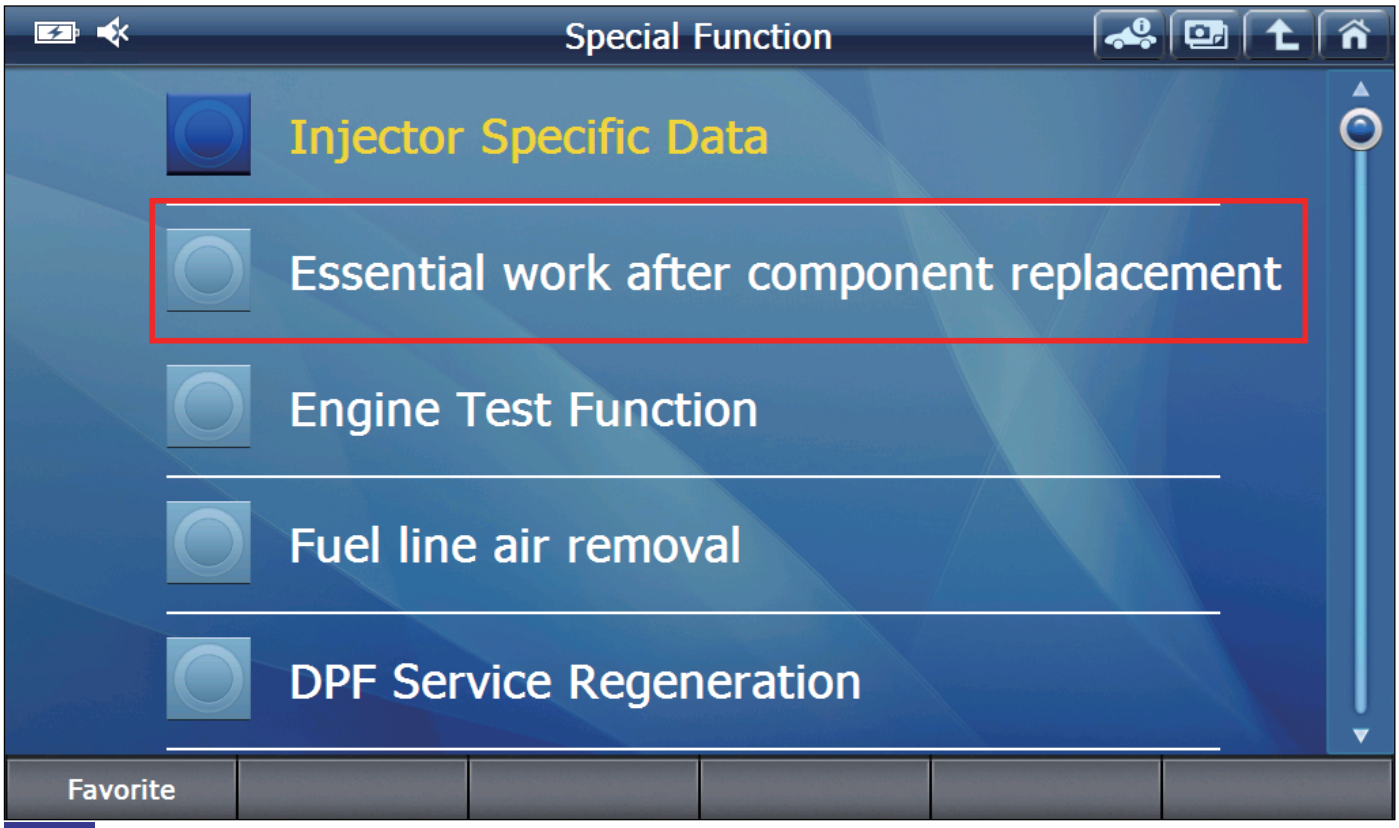


Fig.1

CRC12EN5010P01010041S

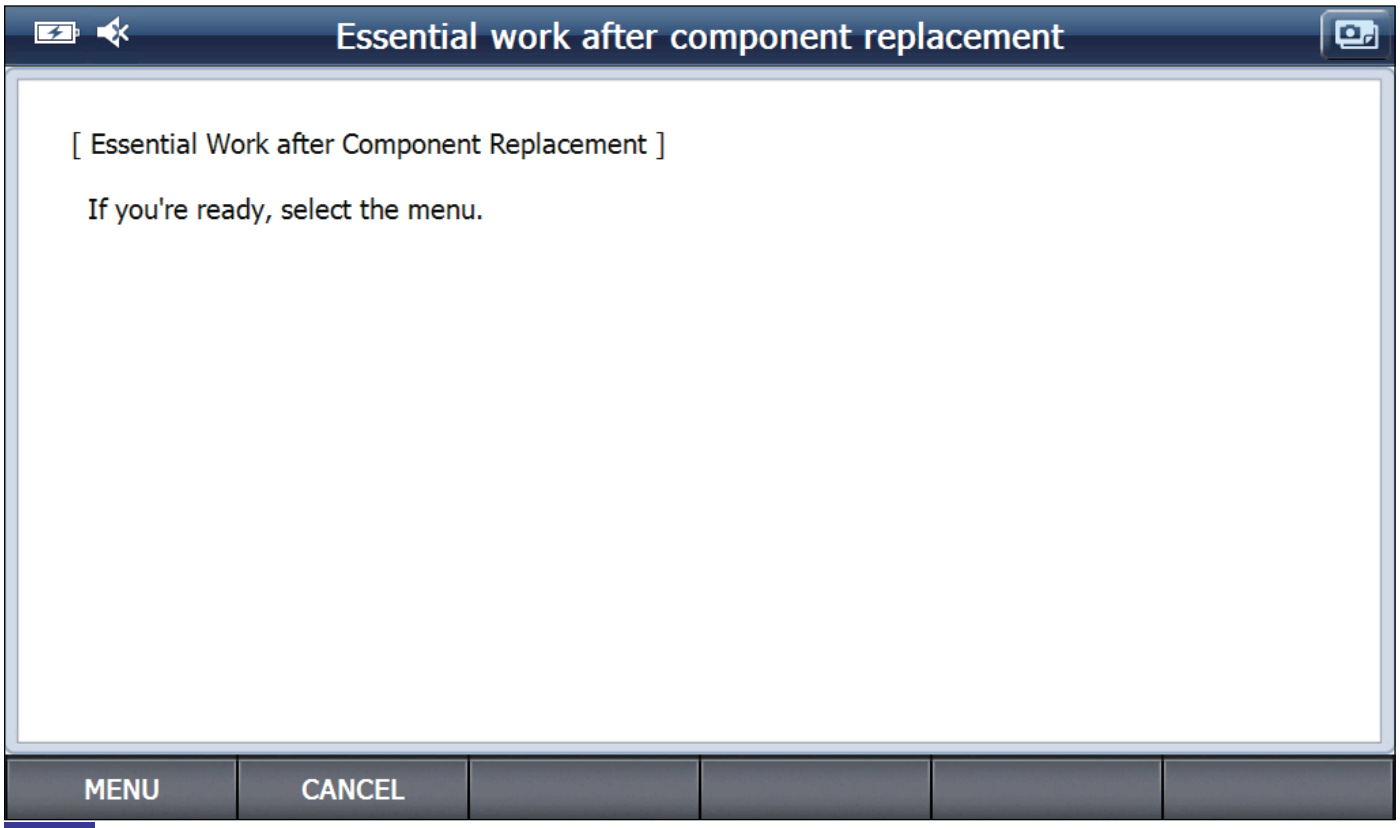


Fig.2

CRC12EN5010P01010042S

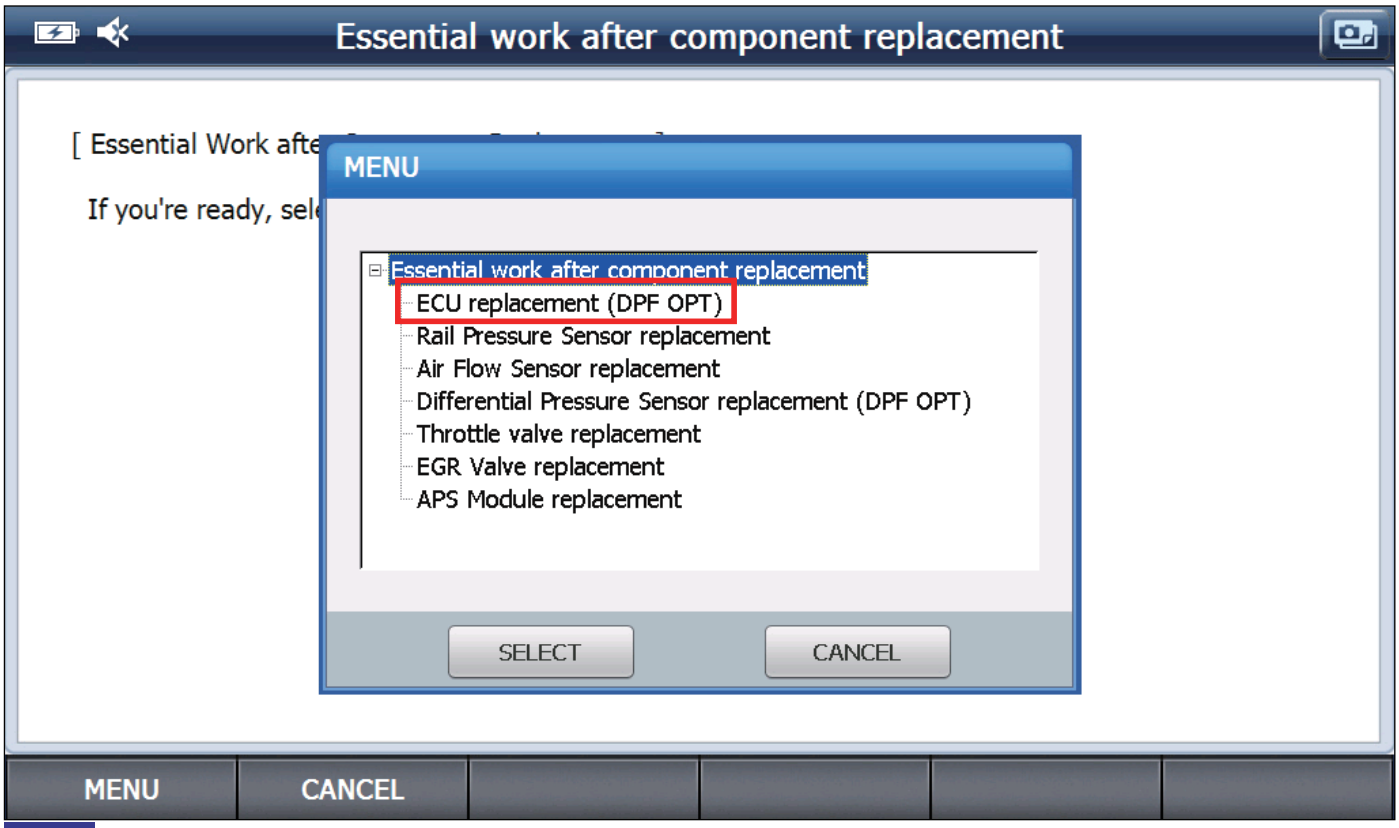


Fig.3

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.

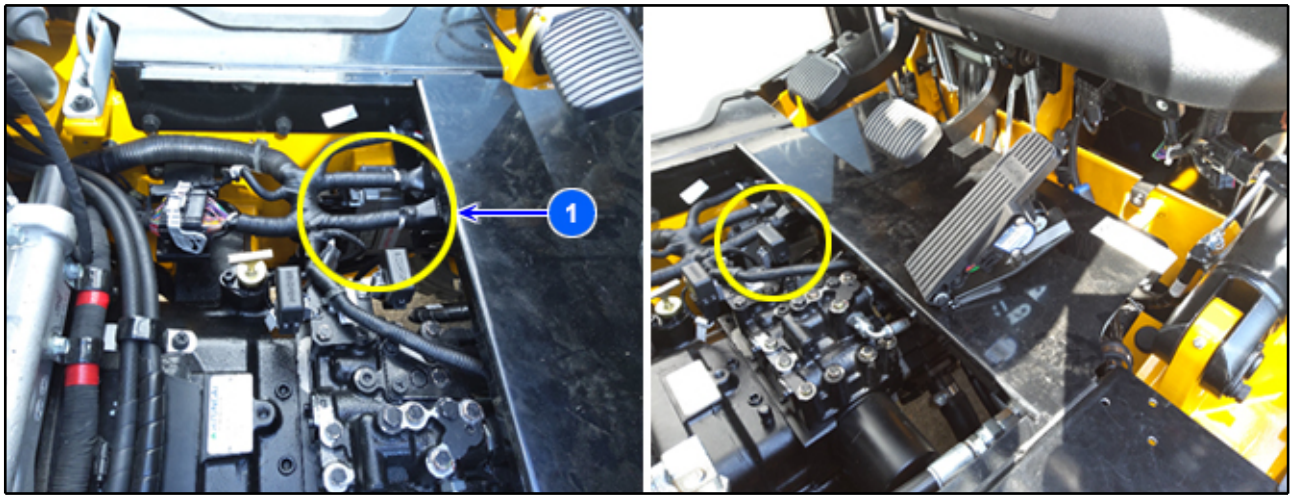
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



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

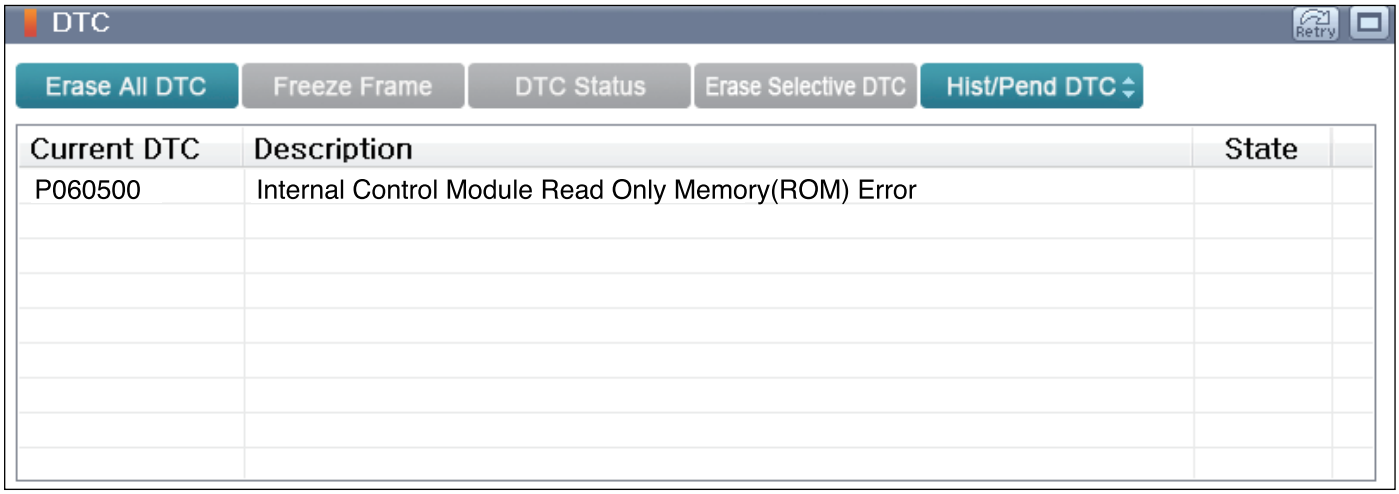
P060500 is set when communication error between micro controller inside of ECM and EEPROM is detected or a different vision of ECM is installed.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Internal monitoring		1. Poor connector connection 2. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• ECU Reset • Faulty internal circuit of ECU • EEPROM error • Communication failure between micro controller inside of ECM and EEPROM		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	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.



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

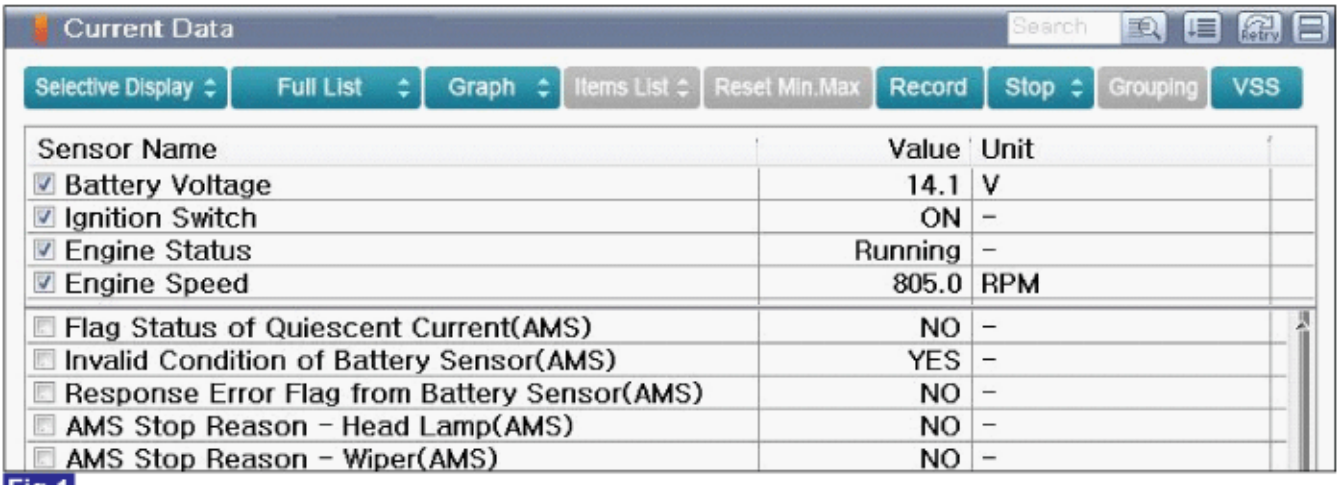


Fig.1

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

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.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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?

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.

⚠ CAUTION

- 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"

4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "ECU Change"

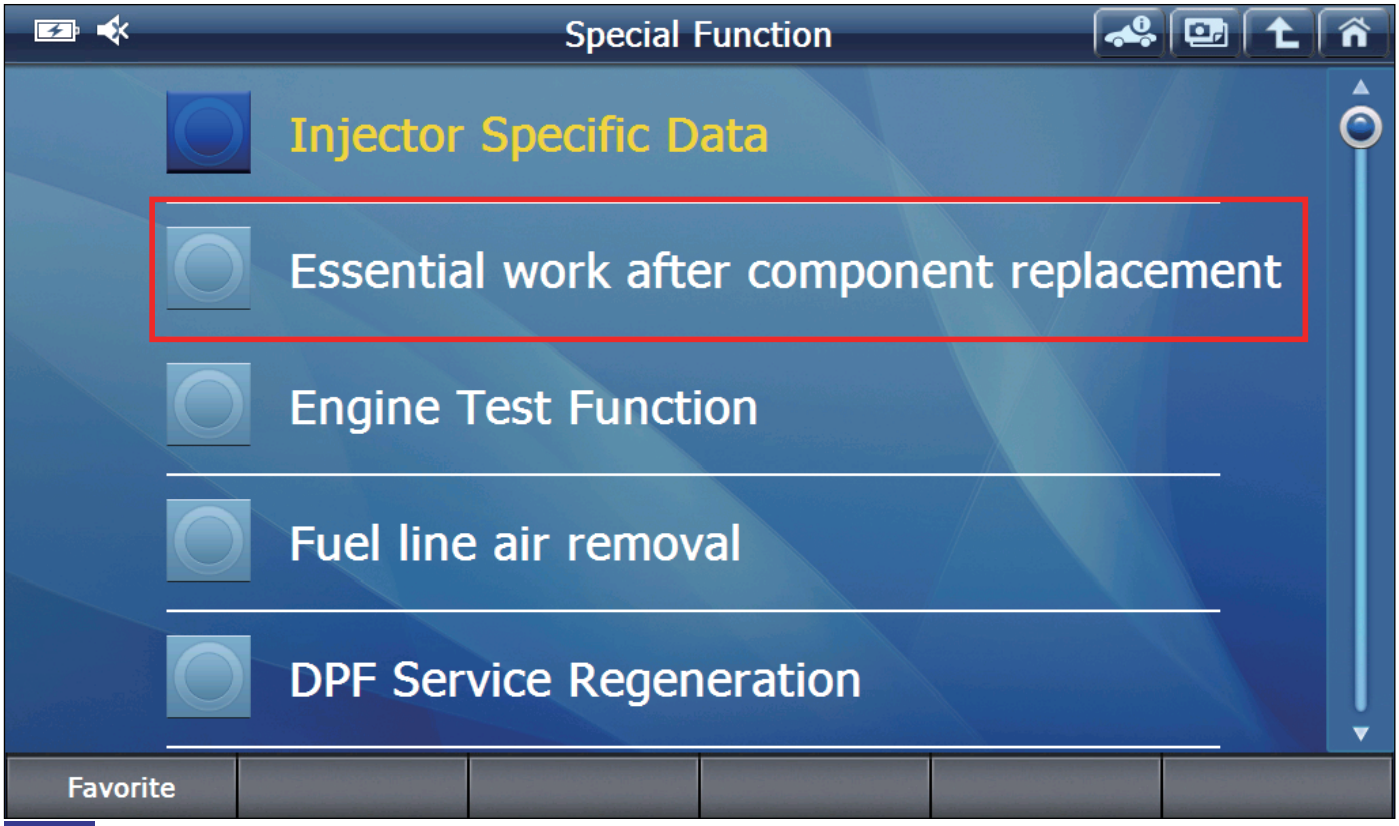


Fig.1

CRC12EN5010P01010041S

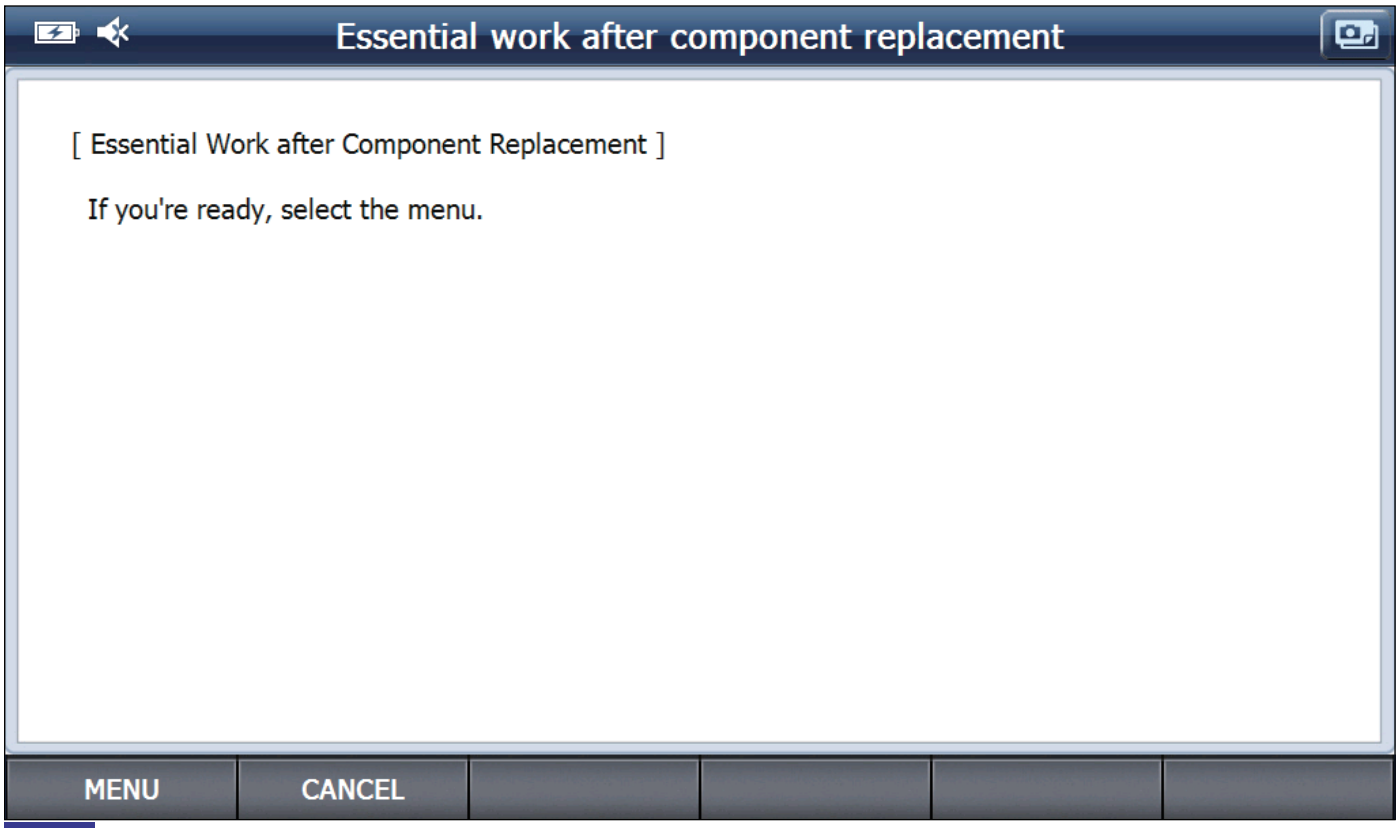


Fig.2

CRC12EN5010P01010042S

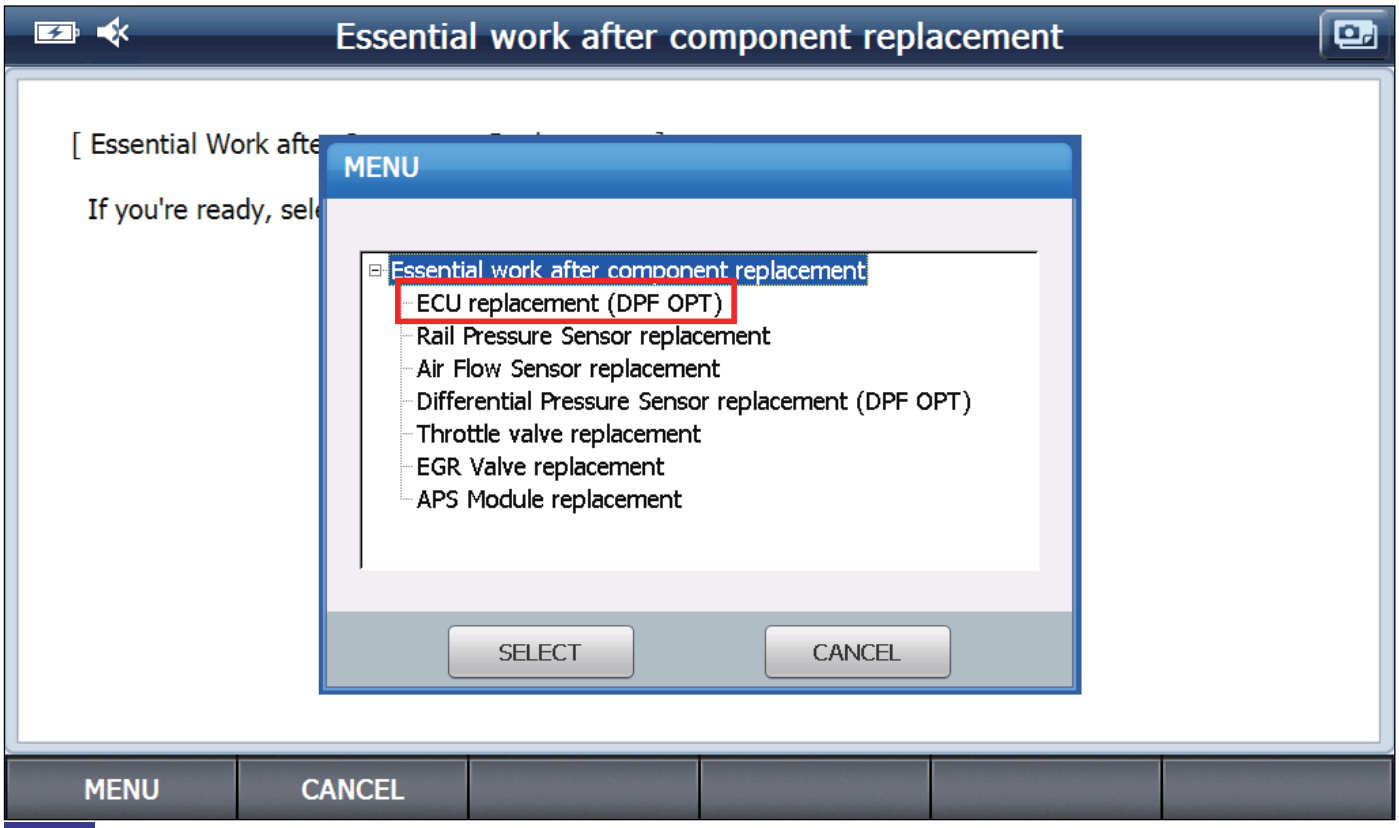


Fig.3

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.

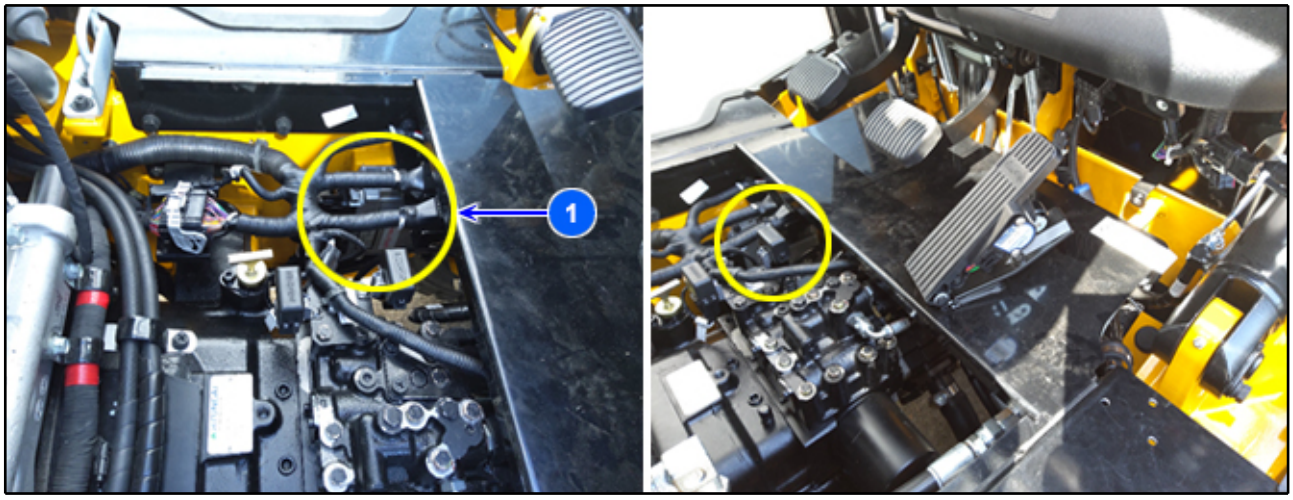
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

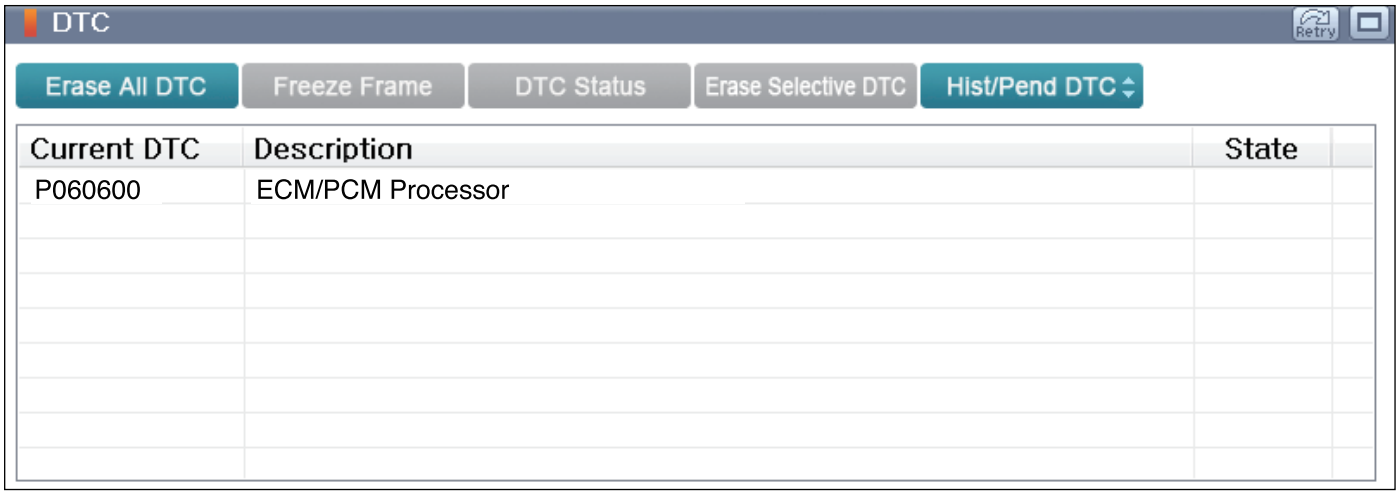
If defected ECU itself is detected, ECM sets DTC P060600.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Internal monitoring		1. Poor connector connection 2. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• ECU Internal analog digital converter of ECU error • Hardware error		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	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.



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).
3. Ignition switch "ON" & Engine "ON"
4. Monitor follow parameters in "Current Data" with GDS.

Specification :Refer to figure below

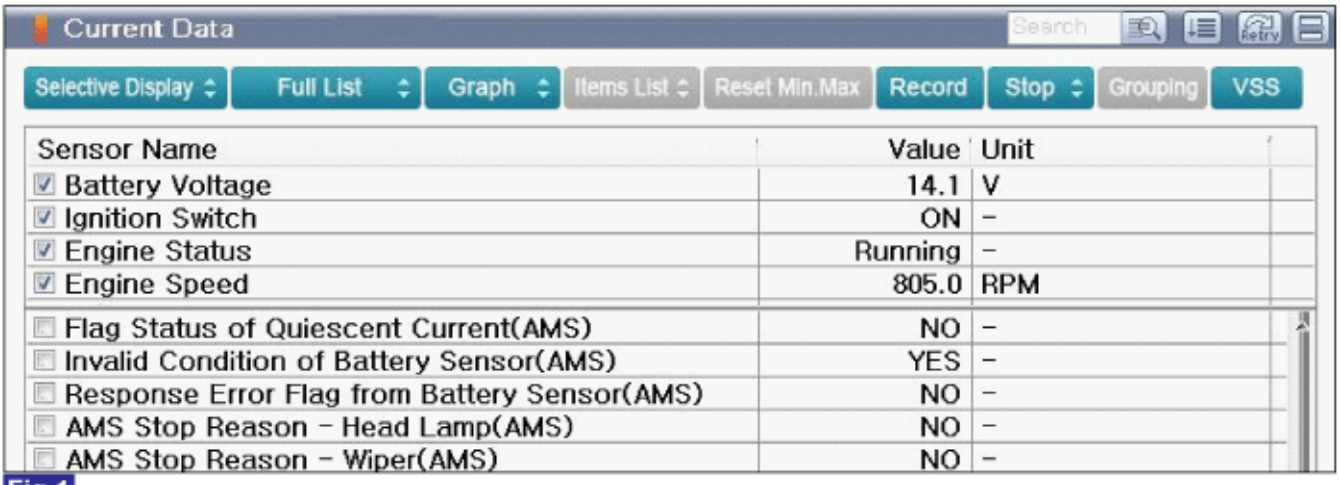


Fig.1

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

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.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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?

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.

⚠ CAUTION

- 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "ECU Change"

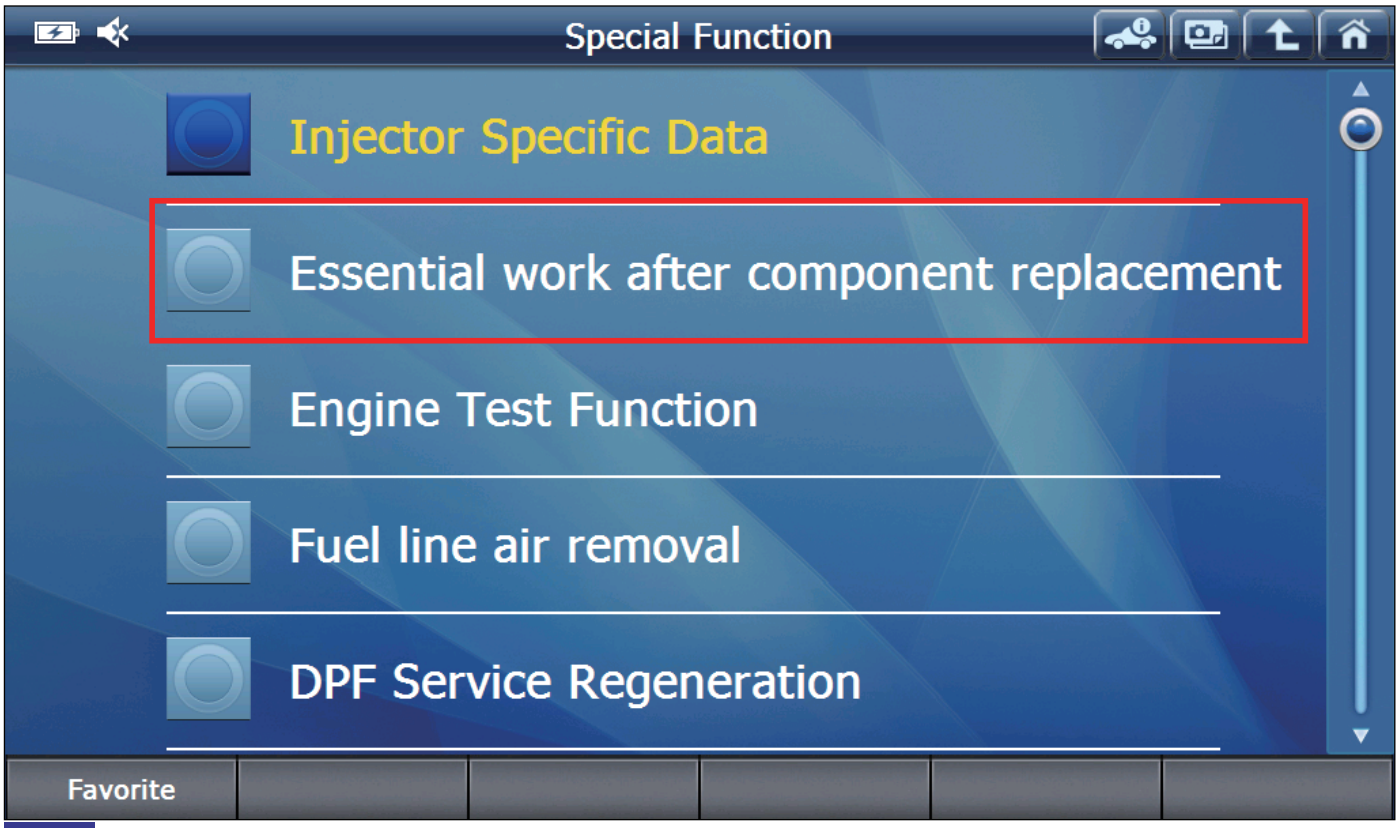


Fig.1

CRC12EN5010P01010041S

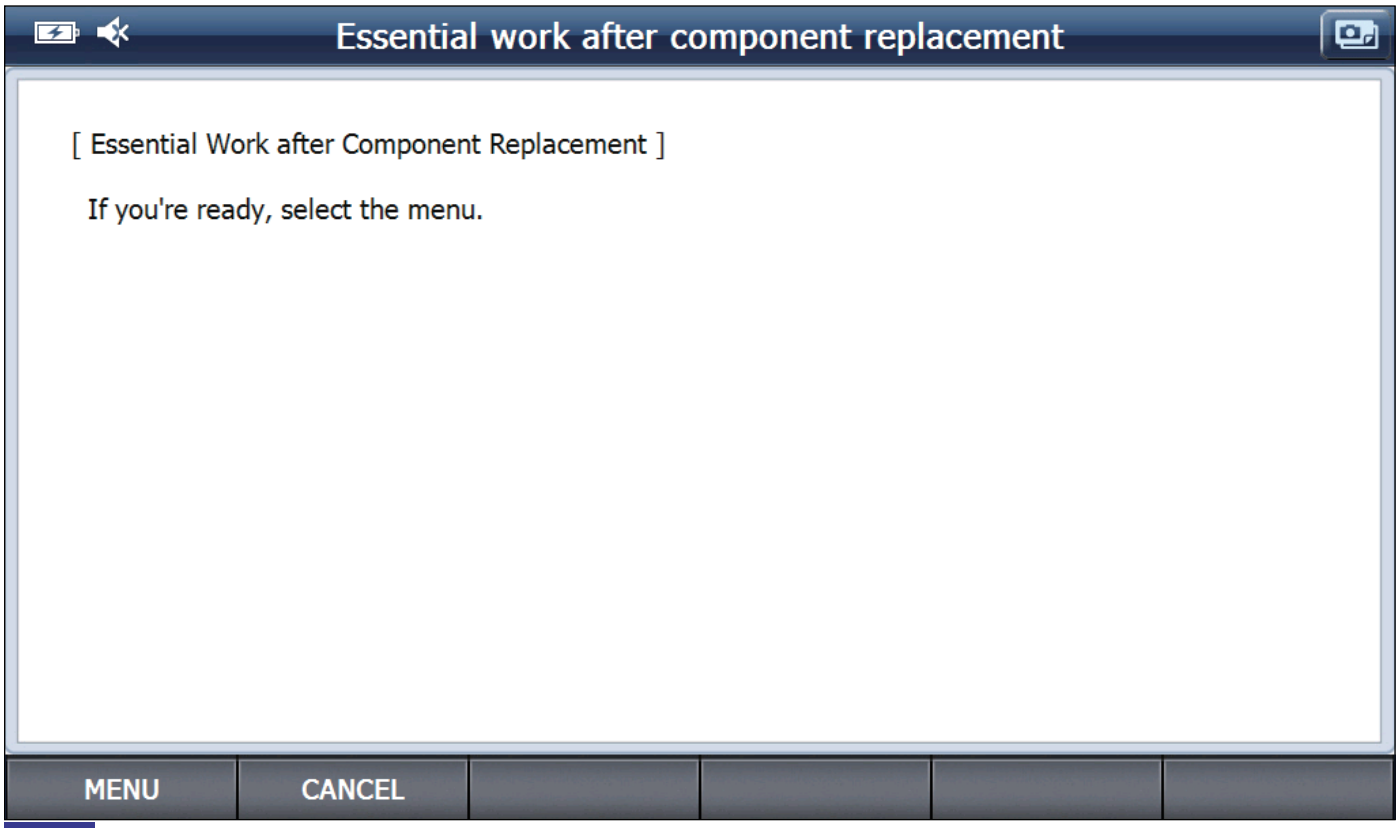


Fig.2

CRC12EN5010P01010042S

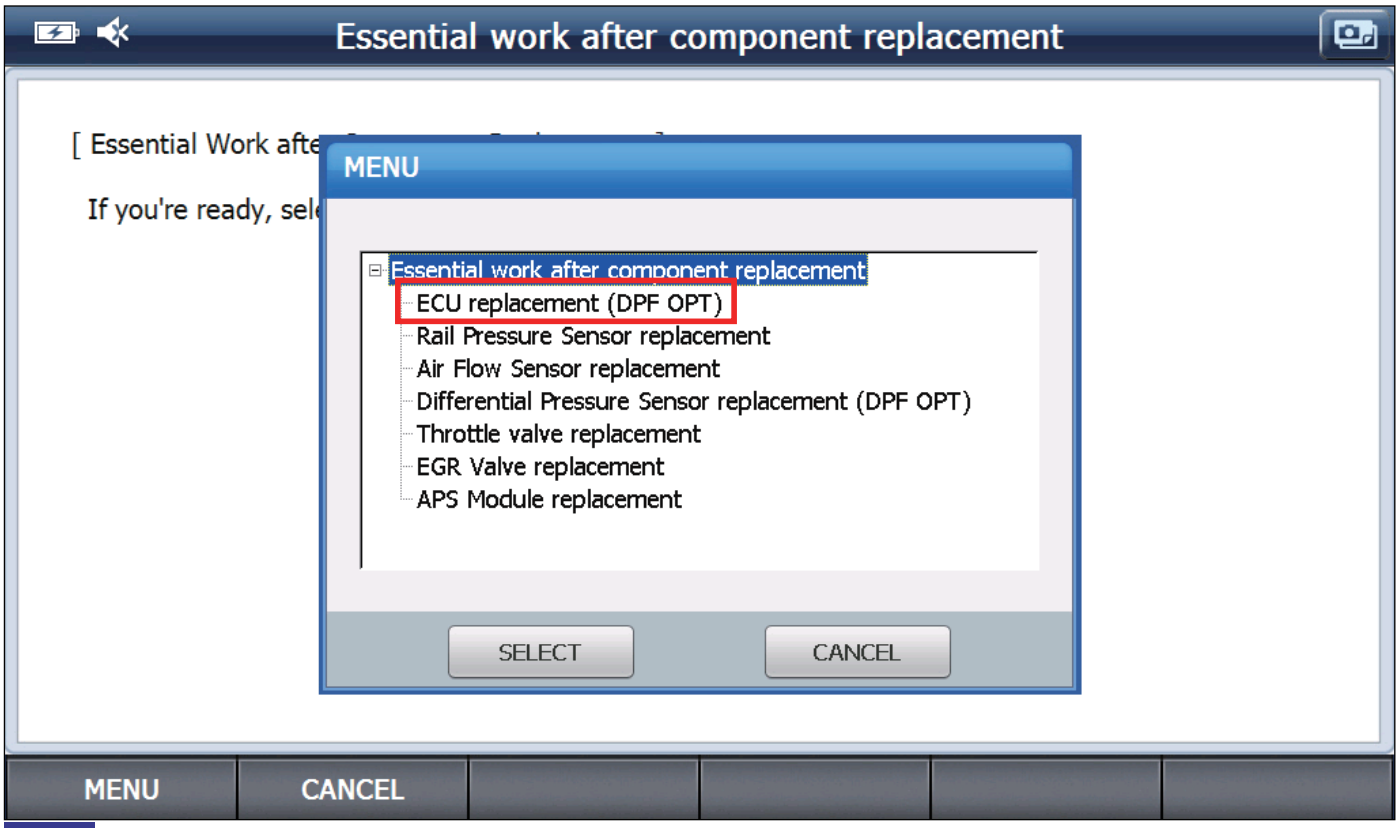


Fig.3

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.

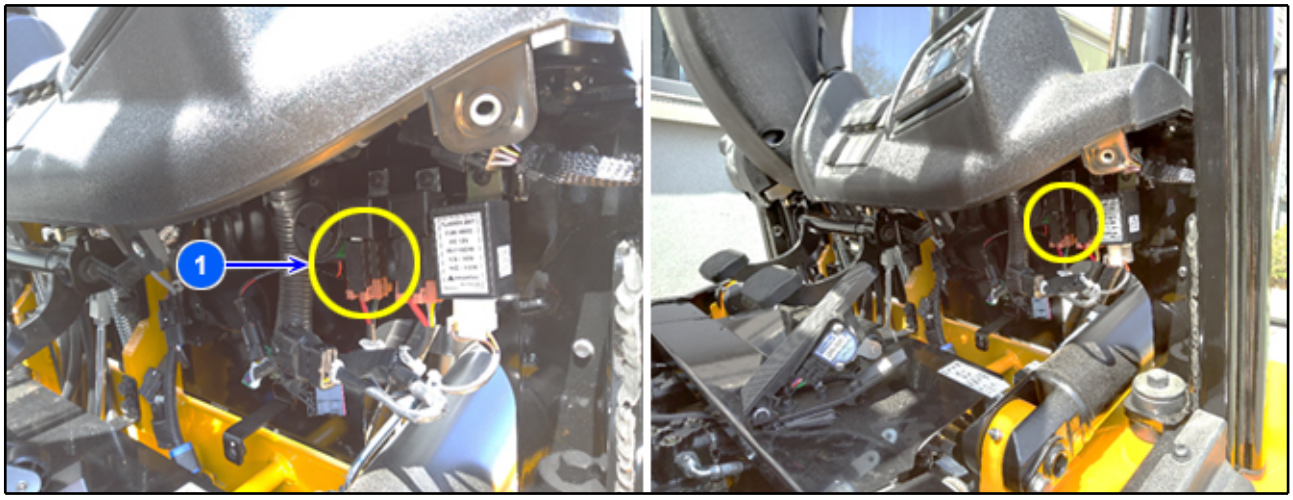
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P06160011

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

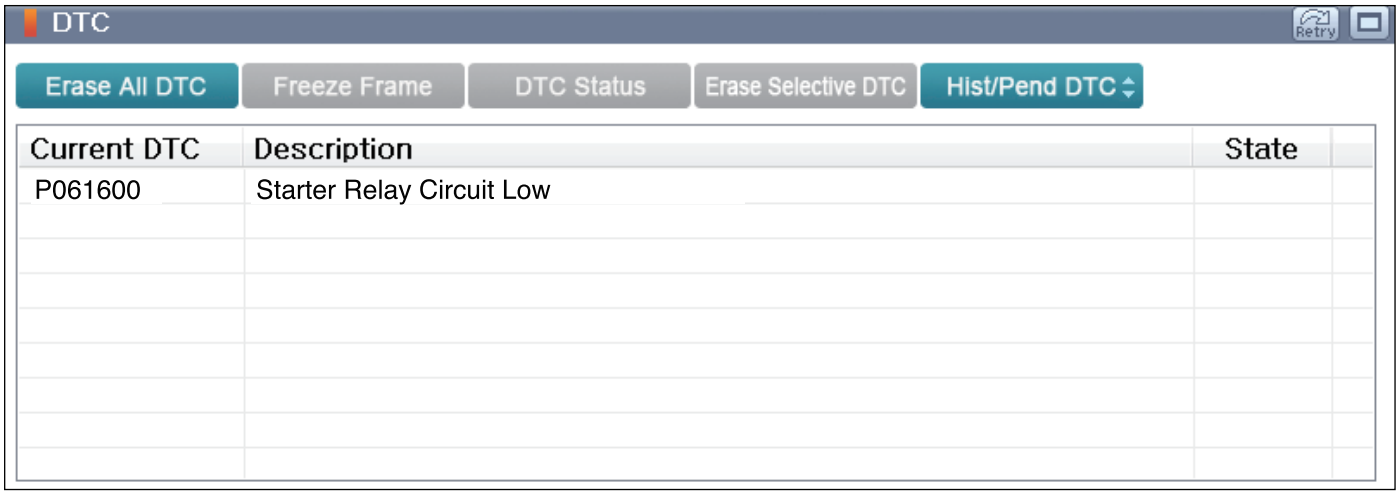
If low signal is detected on starter relay control circuit during engine cranking, ECM sets DTC P061600.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Short to ground in control circuit 2. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Short to ground in control circuit		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06160021S

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.
3. 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.

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 remove starter relay.
3. Ignition switch "ON"
4. Measure the voltage between starter relay control high terminal of starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

5. Measure the voltage between starter relay control low terminal of starter relay harness connector and chassis ground.

Specification : Approx. 2.5V

6. Refer to "Shop Manual" and disconnect ECM 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 Ω

9. 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 remove the starter relay.
4. Measure resistance between relay control low and 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.

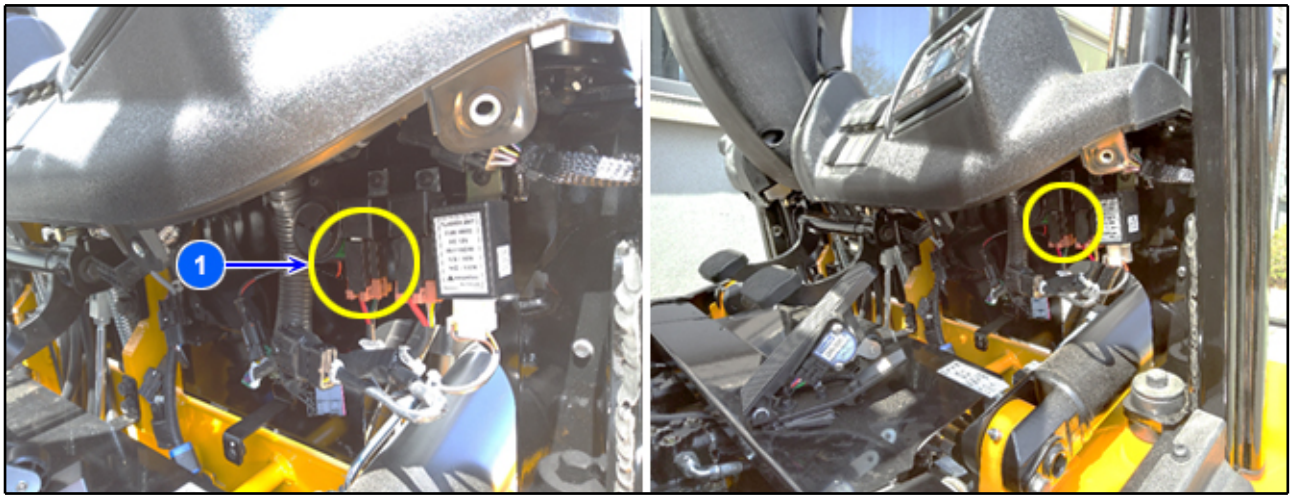
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P061700 Starter Cut Relay Circuit High

Component Location



CRC12EN5010P06160011

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

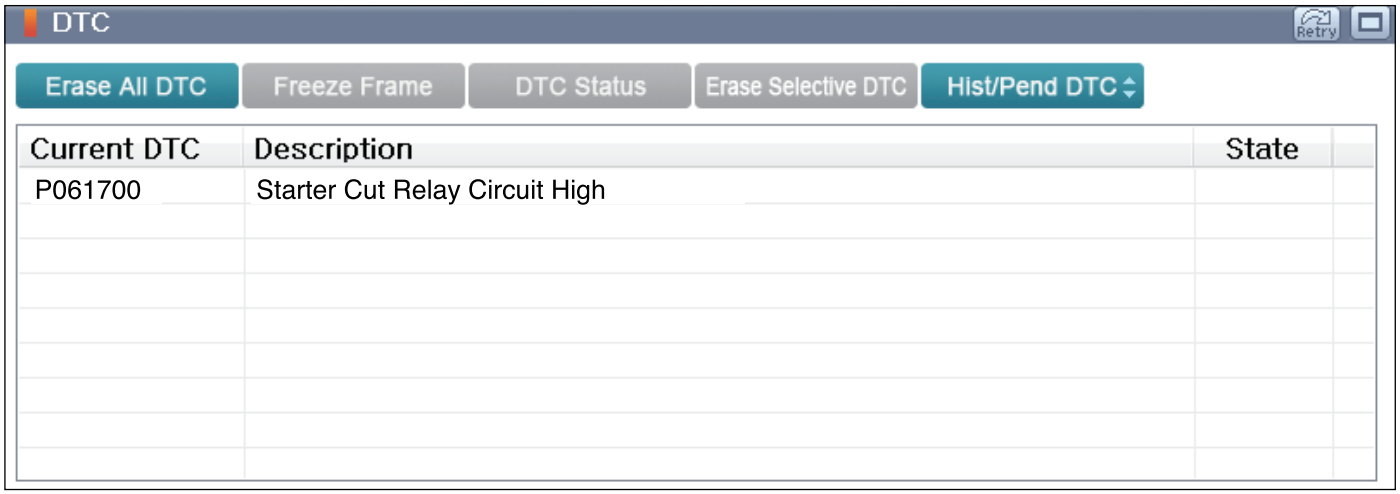
If high signal is detected on starter relay control circuit, ECM sets DTC P061700.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Open or short in control circuit 2. Defected starter relay
Enable Conditions	• Engine running		
Threshold Value	• Open or short in control circuit of starter relay		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06170021S

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 "Control Circuit Inspection" procedure .

Control Circuit Inspection

1. Ignition switch "OFF"
2. Refer to "Shop Manual" and remove starter relay.
3. Ignition switch "ON"
4. Measure the voltage between starter relay control high terminal of starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

5. Measure the voltage between starter relay control low terminal of starter relay harness connector and chassis ground.

Specification : Approx. 2.5V

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

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 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.

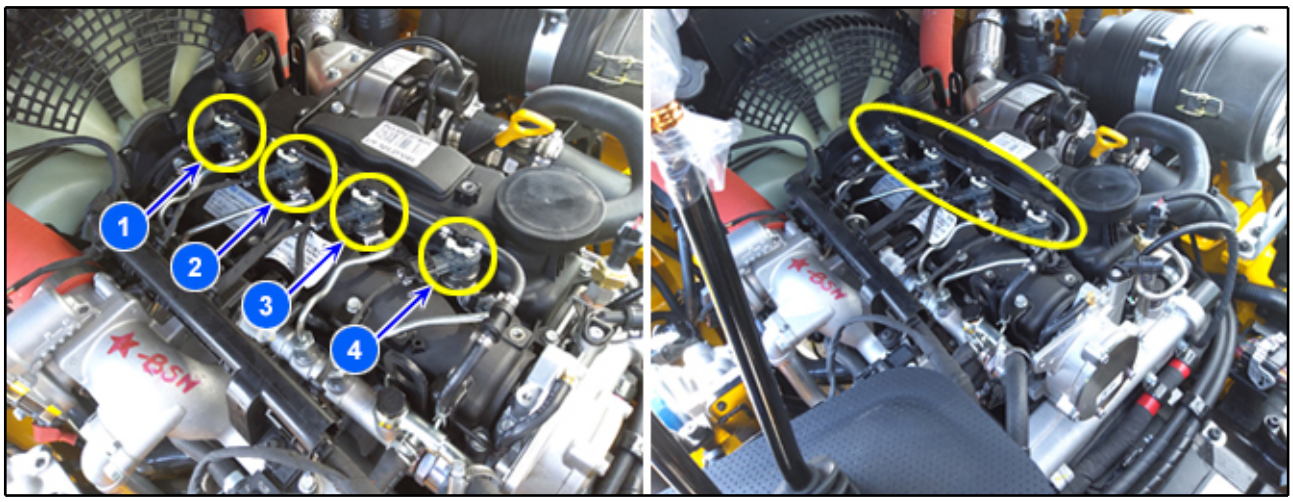
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

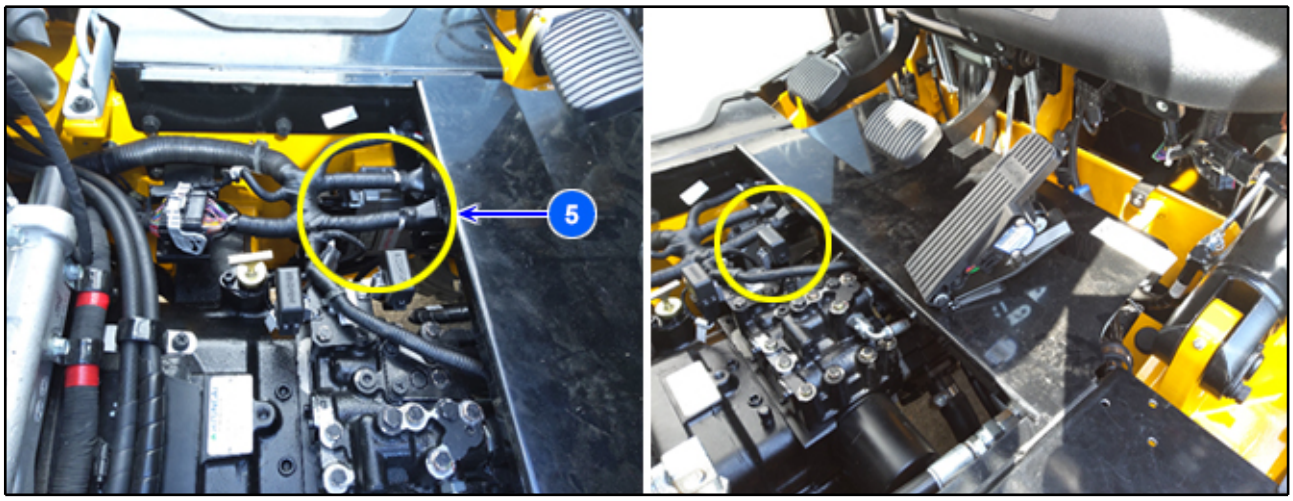
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P062D00 Fuel Injector Driver Circuit Performance (Bank 1)

Component Location



CRC12EN5010P020111



CRC12EN5010P062D12

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 the cylinders, ECM sets DTC P062D00.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Short in injector circuit 3. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Short in injector circuit		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• Yes	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

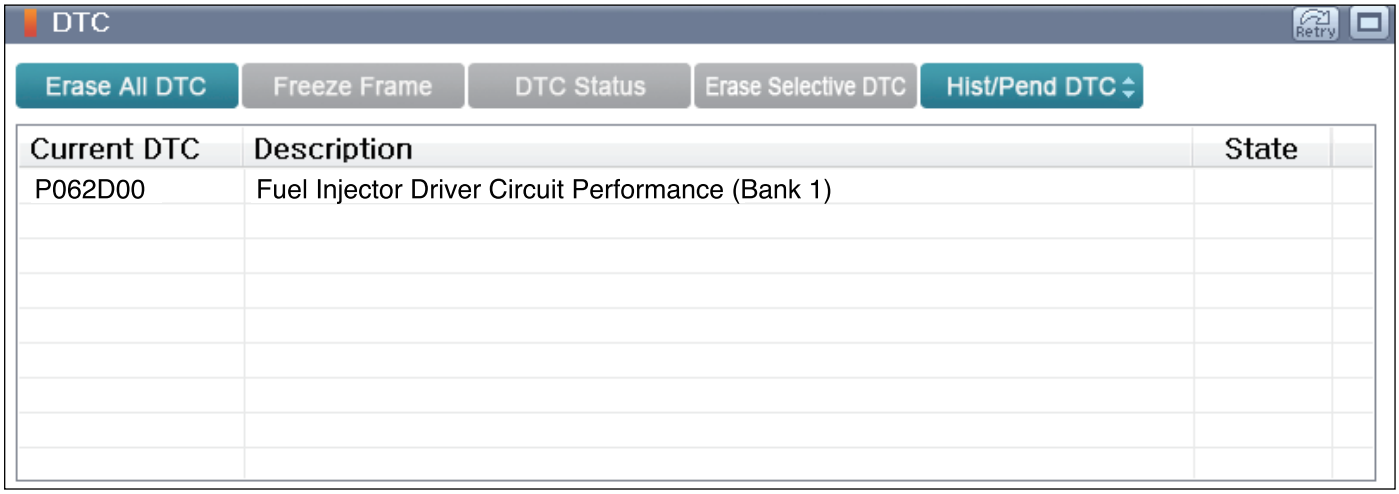
Vehicle Data

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Disconnected)	Approx. 5 V	-
	2	Injector Control(Low)		0V	-

Injector		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Injector Control(High)	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side (Connected)	Approx. 5.0V	-
	2	Injector Control(Low)		Approx. 5.0V	-

Monitor DTC Status

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



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"
4. Inspection condition : Engine "ON" & Engine speed Approx. 3,000RPM

Specification : Refer to figure below

Fig.1

CRC12EN5010P02010011S

Fig.2

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)

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?

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"
2. Refer to "Shop Manual" and disconnect injector #1, #4 connector.
3. Ignition switch "ON"
4. Measure the voltage between Injector control high terminal of injector #1, #4 harness connector and chassis ground.

Specification : Approx. 5V

5. Ignition switch "OFF"
6. 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"
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.

NO ▸ Inspect and repair open or short in circuit, and 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, #4 connector.
3. Ignition Switch "ON"
4. Measure the voltage between injector control low terminal of injector #1, #4 harness connector and chassis ground.

Specification :0V

5. Ignition switch "OFF"
6. Re-connect injector #1, #4 connector.
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"
9. Inspection condition : Ignition switch "ON" & Engine "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.

⚠ 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"

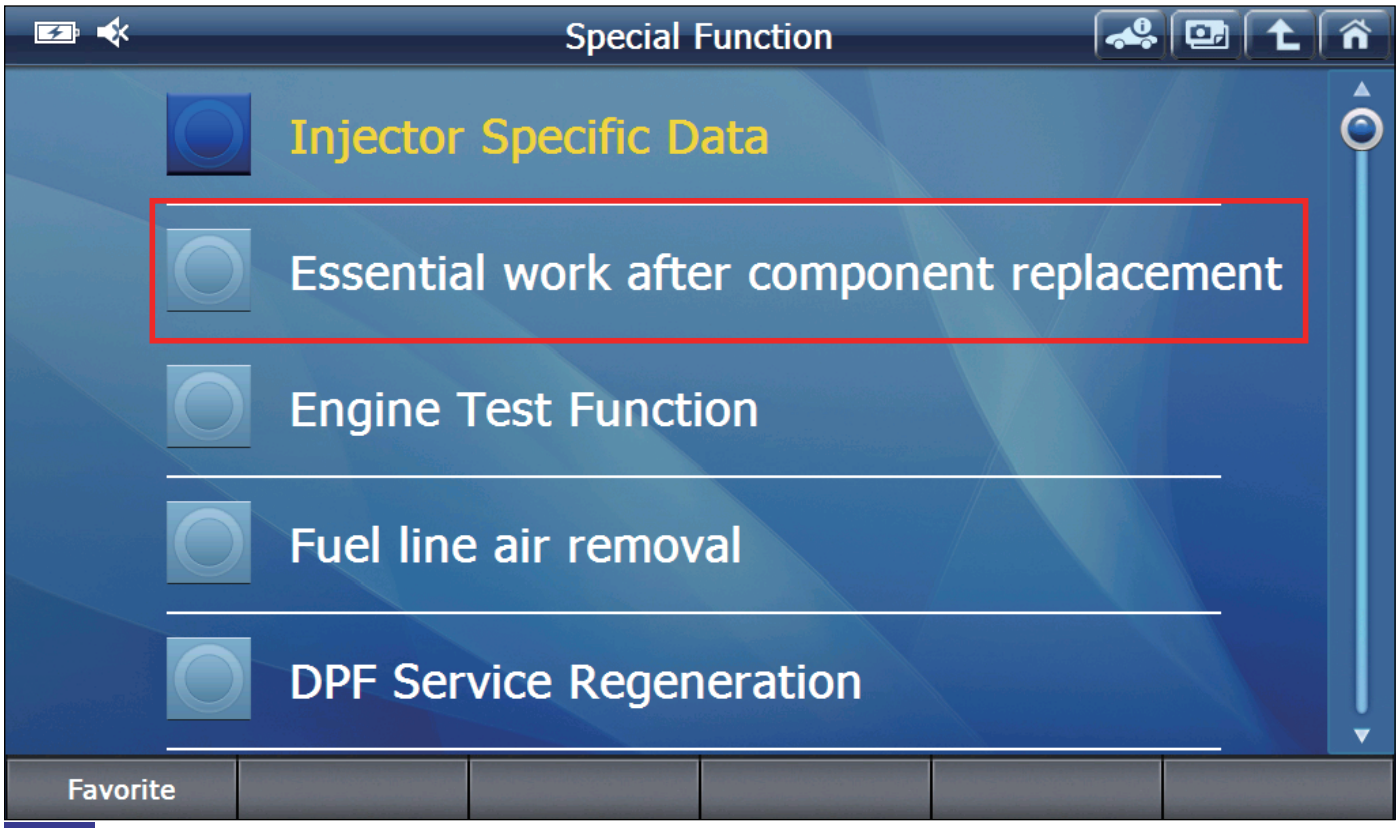


Fig.1

CRC12EN5010P01010041S

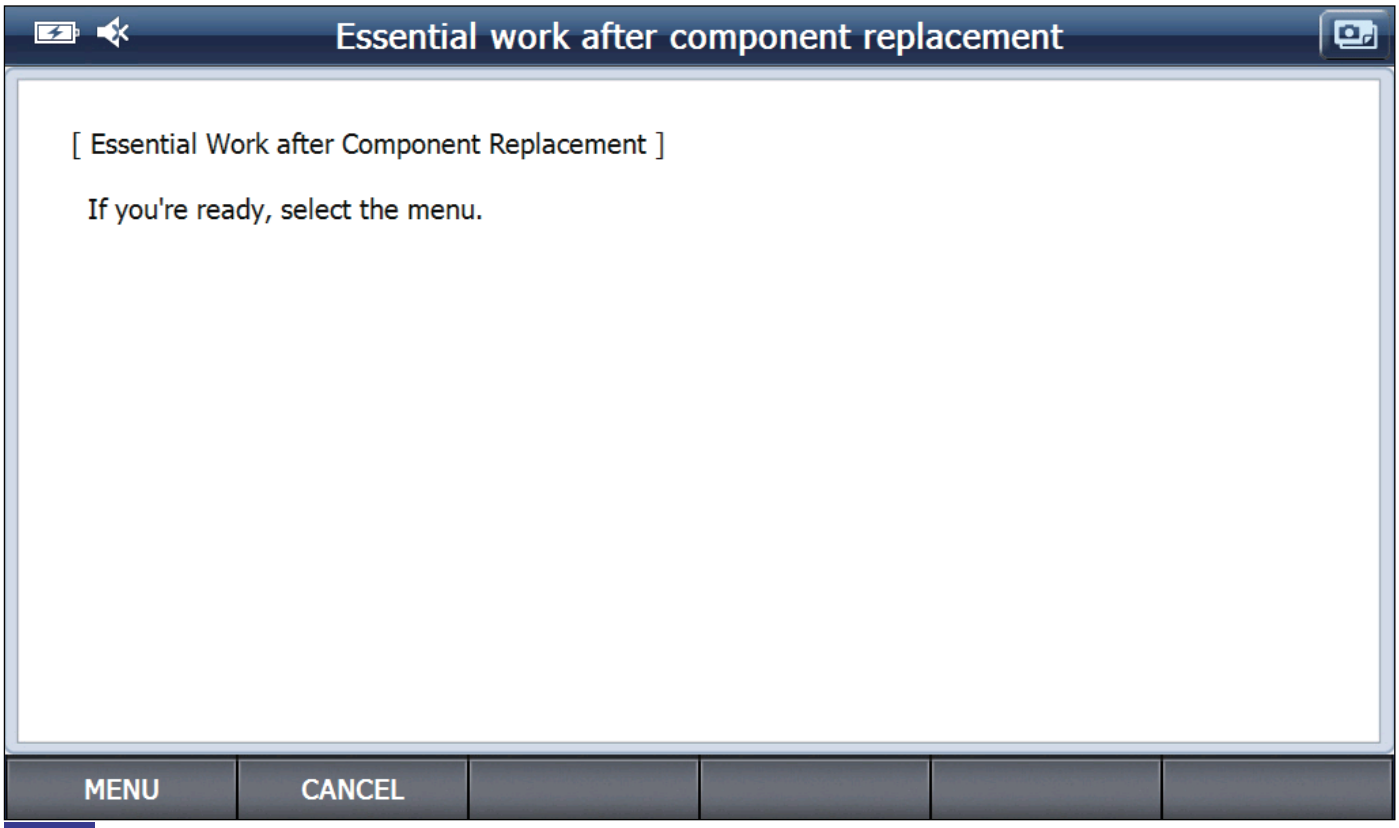


Fig.2

CRC12EN5010P01010042S

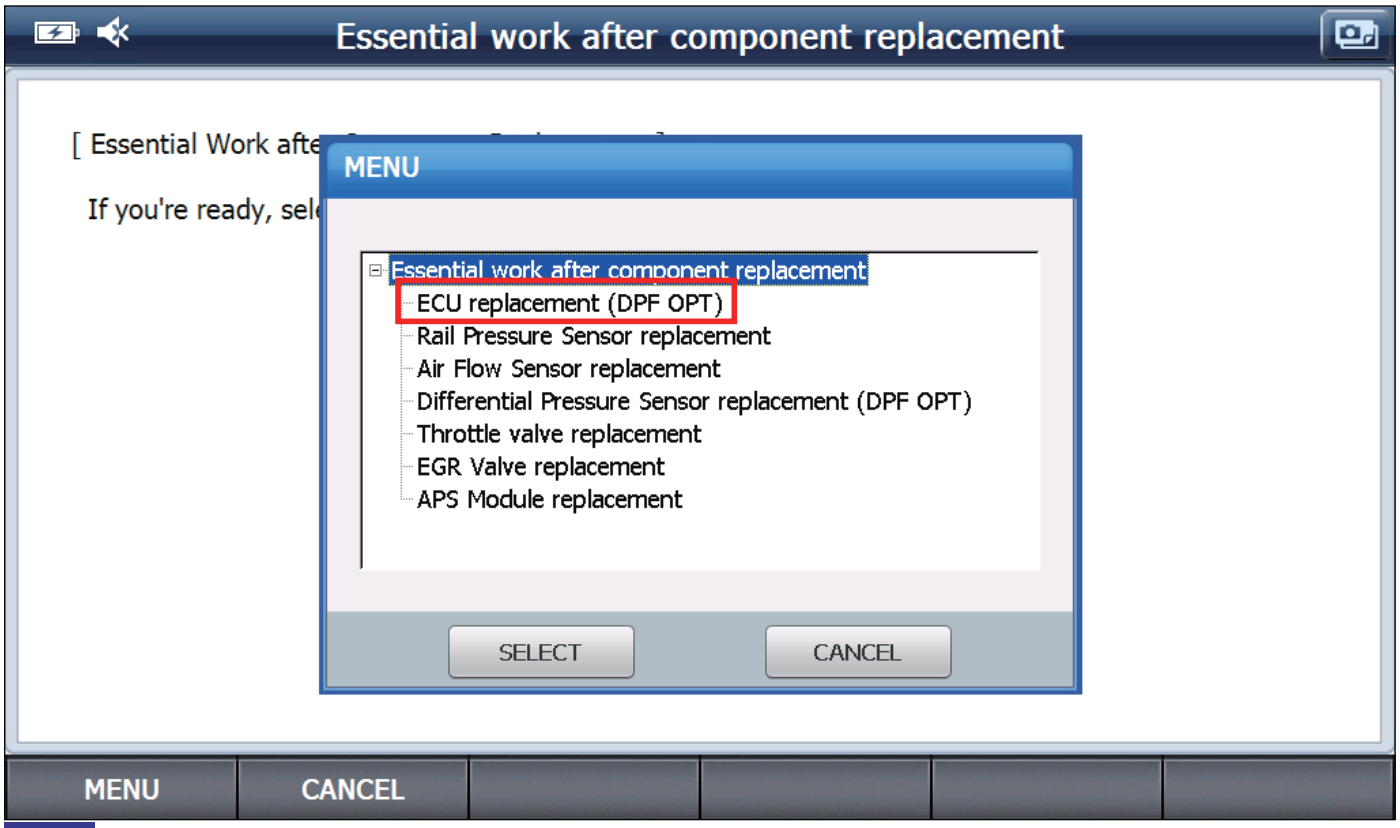


Fig.3

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.

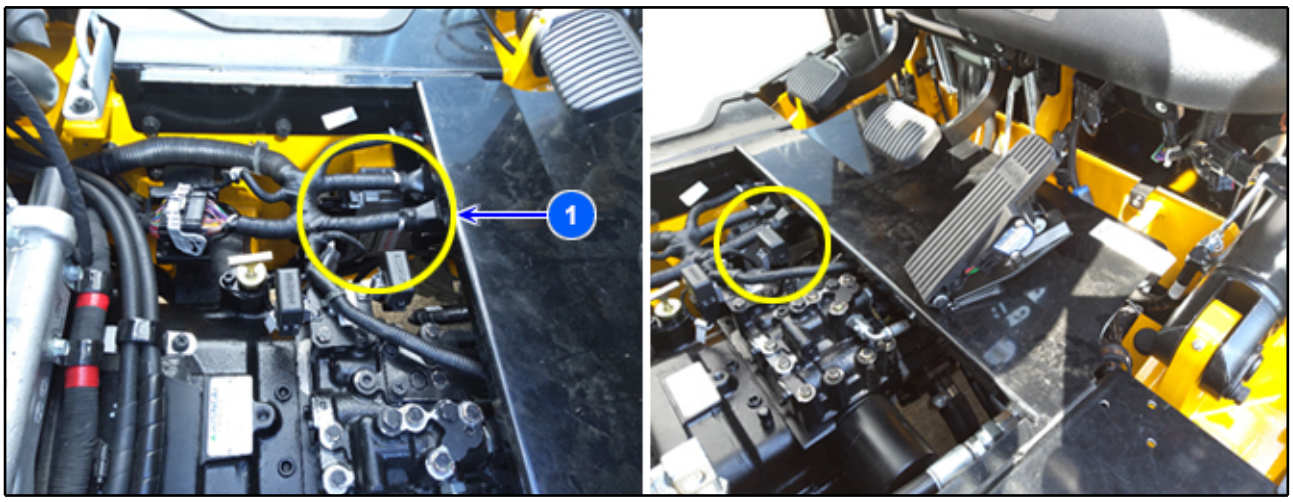
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P064300 Sensor Reference Voltage "A" Circuit High

Component Location



CRC12EN5010P02190011

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

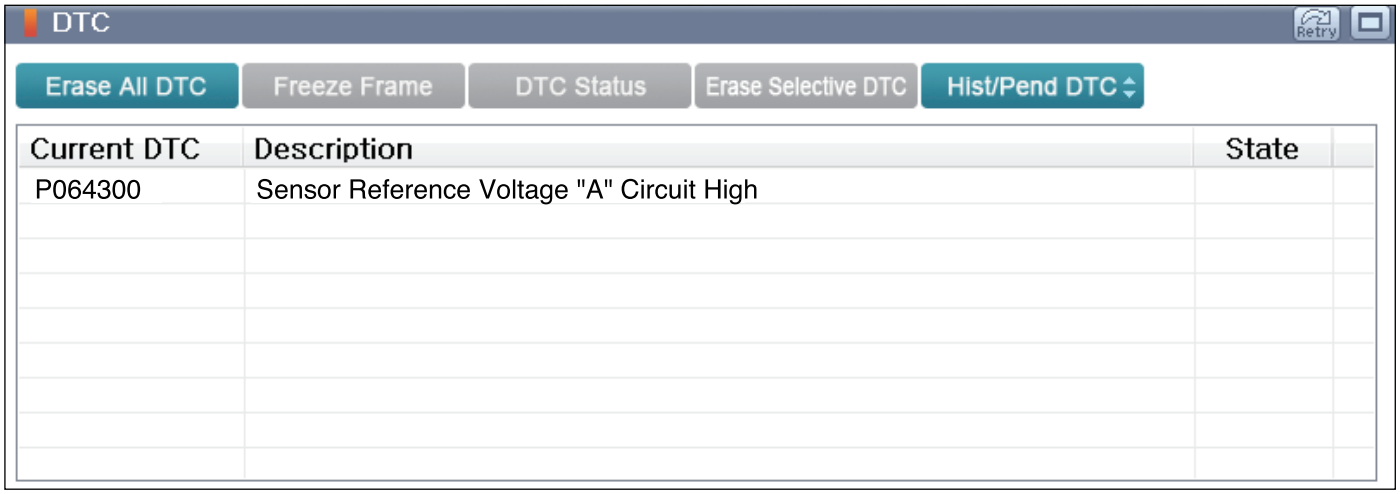
If faulty sensor "A" supply voltage is detected for more than 0.1 sec., ECM sets DTC P064300. This fault might be caused by short to power/ground in sensor supply "A" circuit or internal error of ECM.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty sensor "A" supply circuit 3. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Faulty sensor "A" supply voltage		
Diagnostic Time	• 100 msec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06430021S

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 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

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

Specification : Approx. below 1 Ω

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?

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.

⚠ 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"

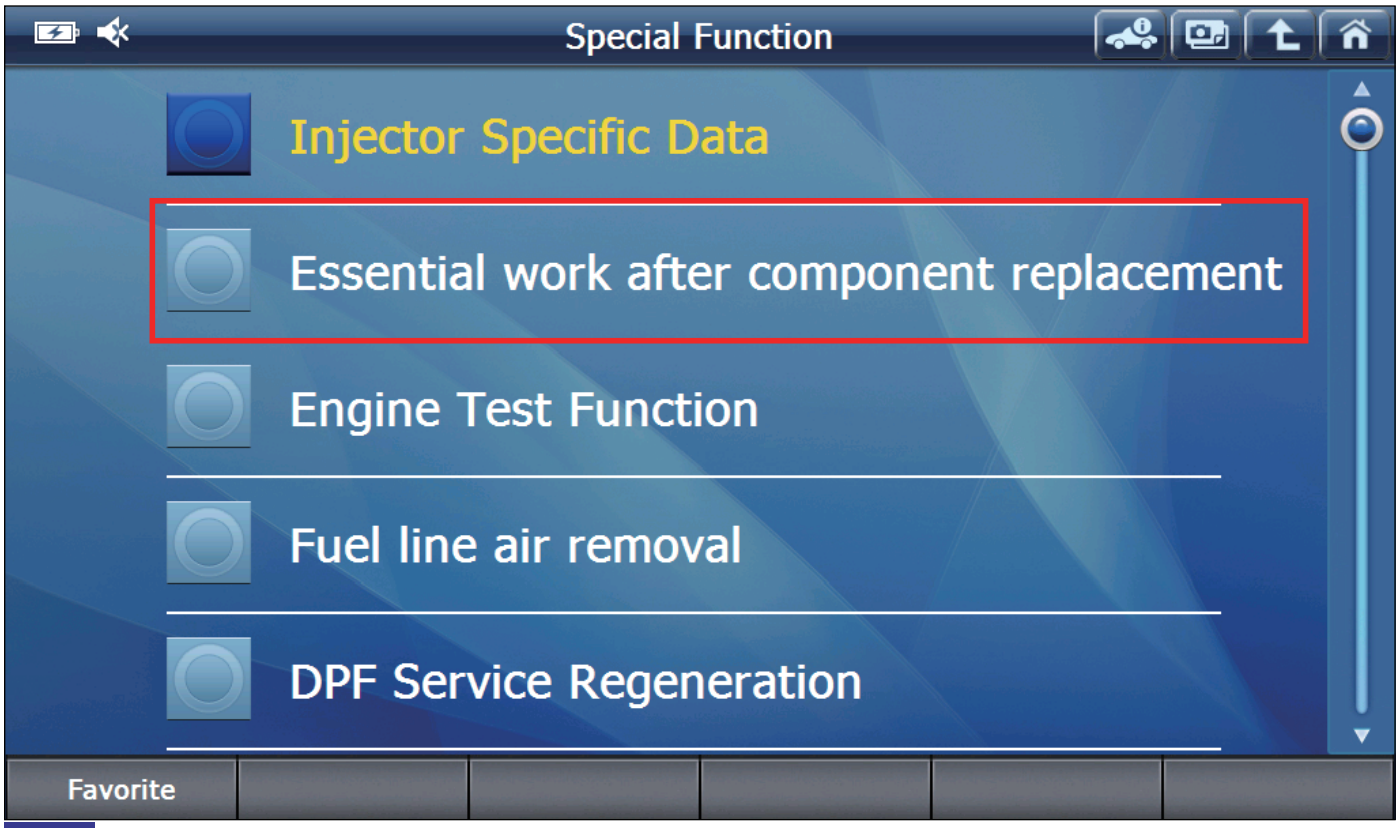


Fig.1

CRC12EN5010P01010041S

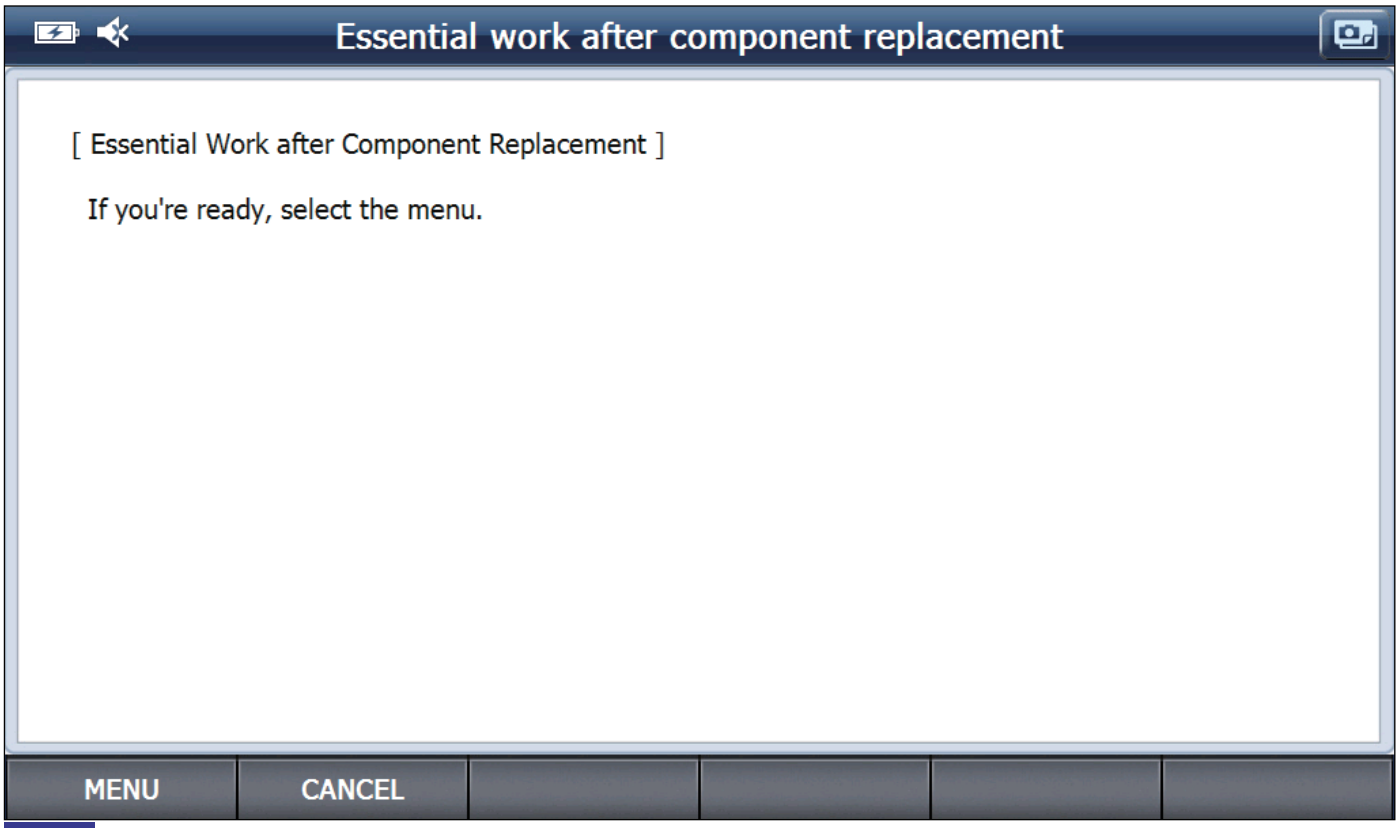


Fig.2

CRC12EN5010P01010042S

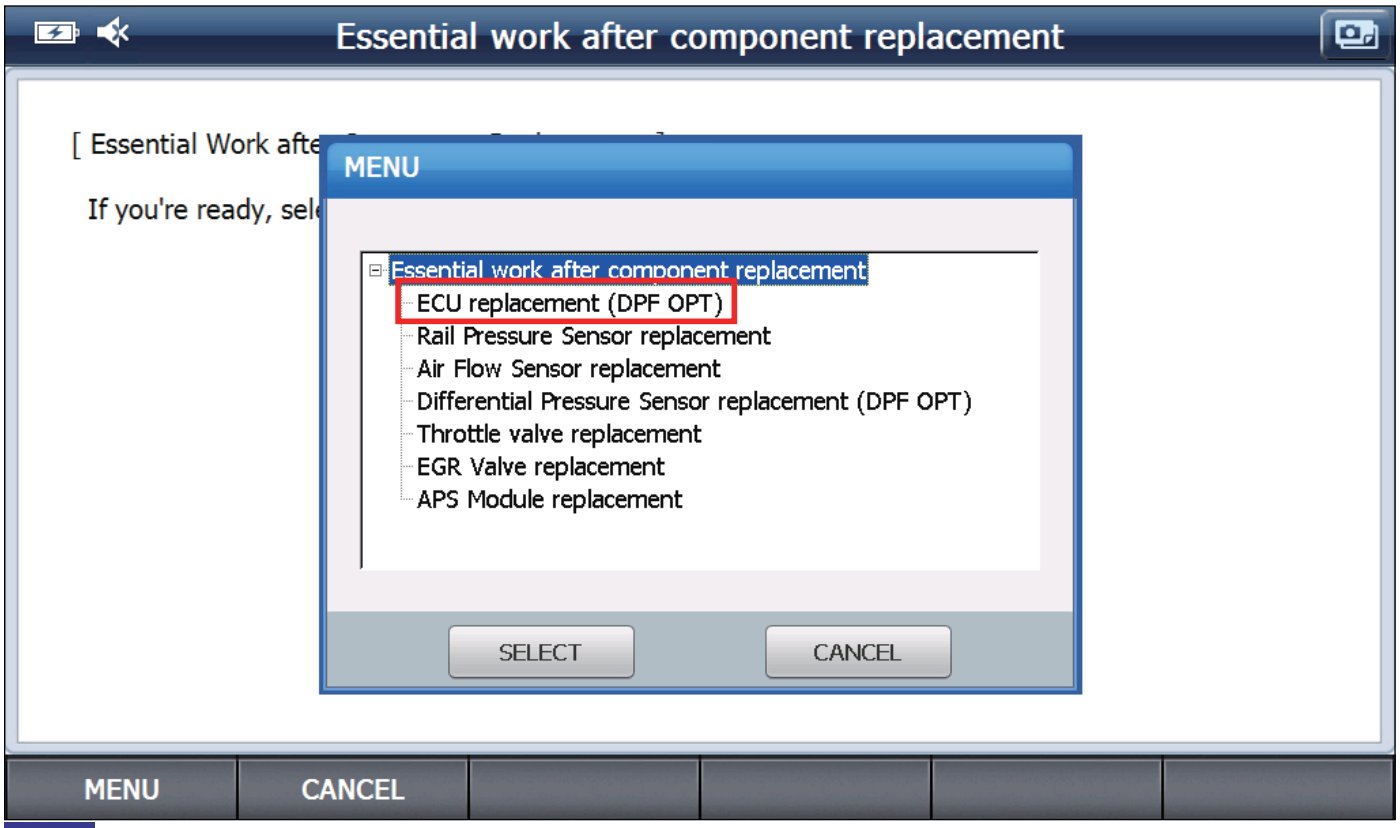


Fig.3

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.

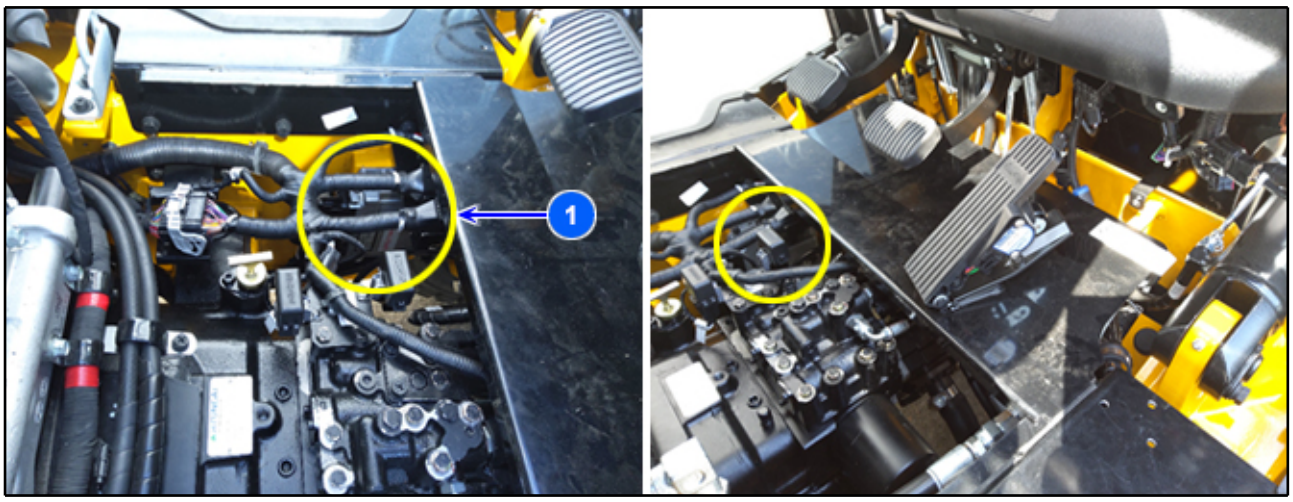
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P065300 Sensor Reference Voltage "B" Circuit High

Component Location



CRC12EN5010P02190011

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

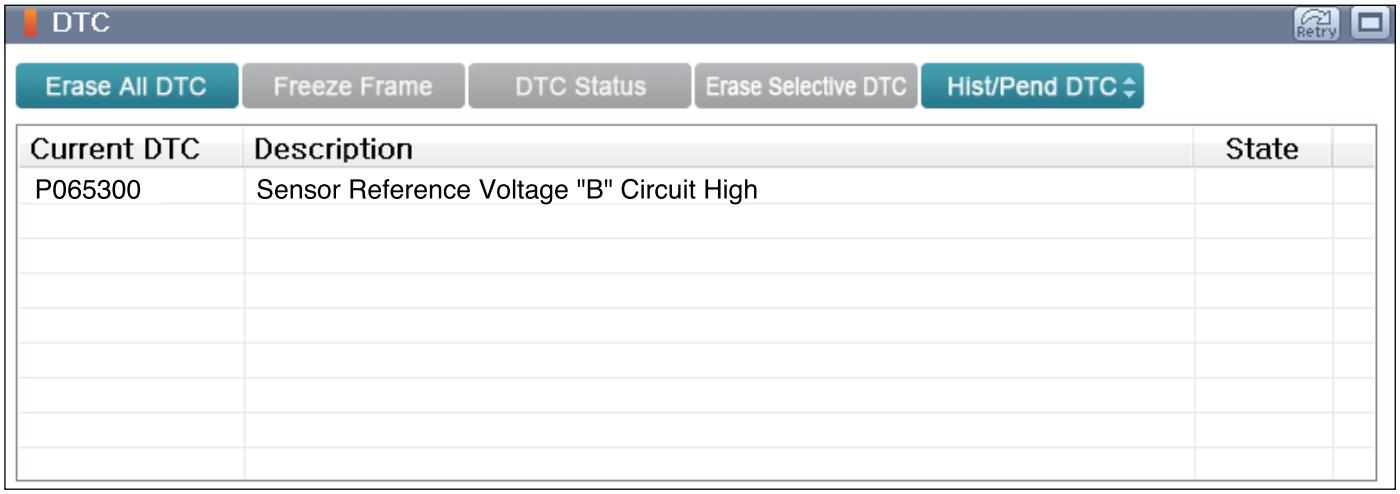
If faulty sensor "B" supply voltage is detected for more than 0.1 sec., ECM sets DTC P065300. This fault might be caused by short to power/ground in sensor supply "B" circuit or internal error of ECM.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty sensor "B" supply circuit 3. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Faulty sensor "B" supply voltage		
Diagnostic Time	• 100 msec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06530021S

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 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

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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?

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.

⚠ 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"

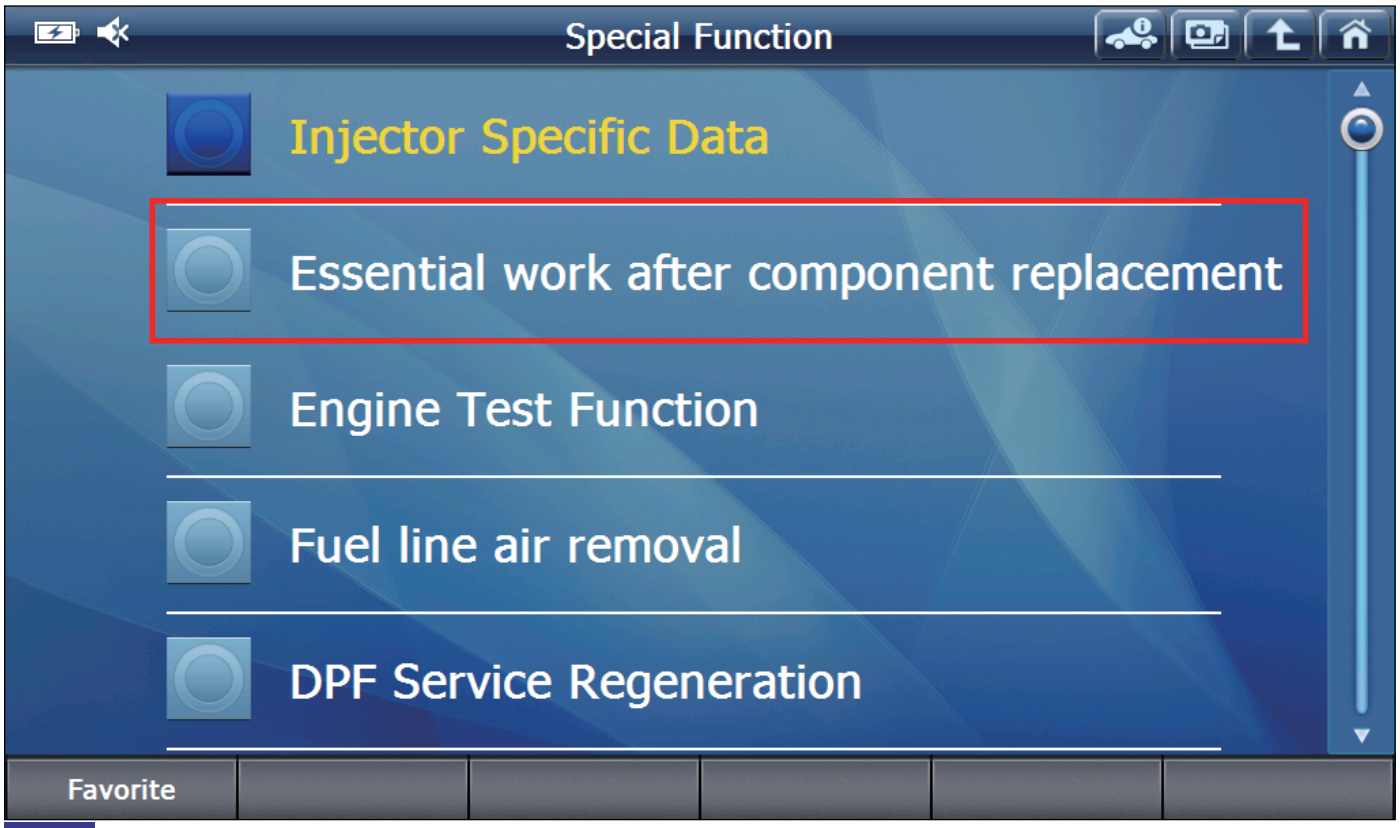


Fig.1

CRC12EN5010P01010041S

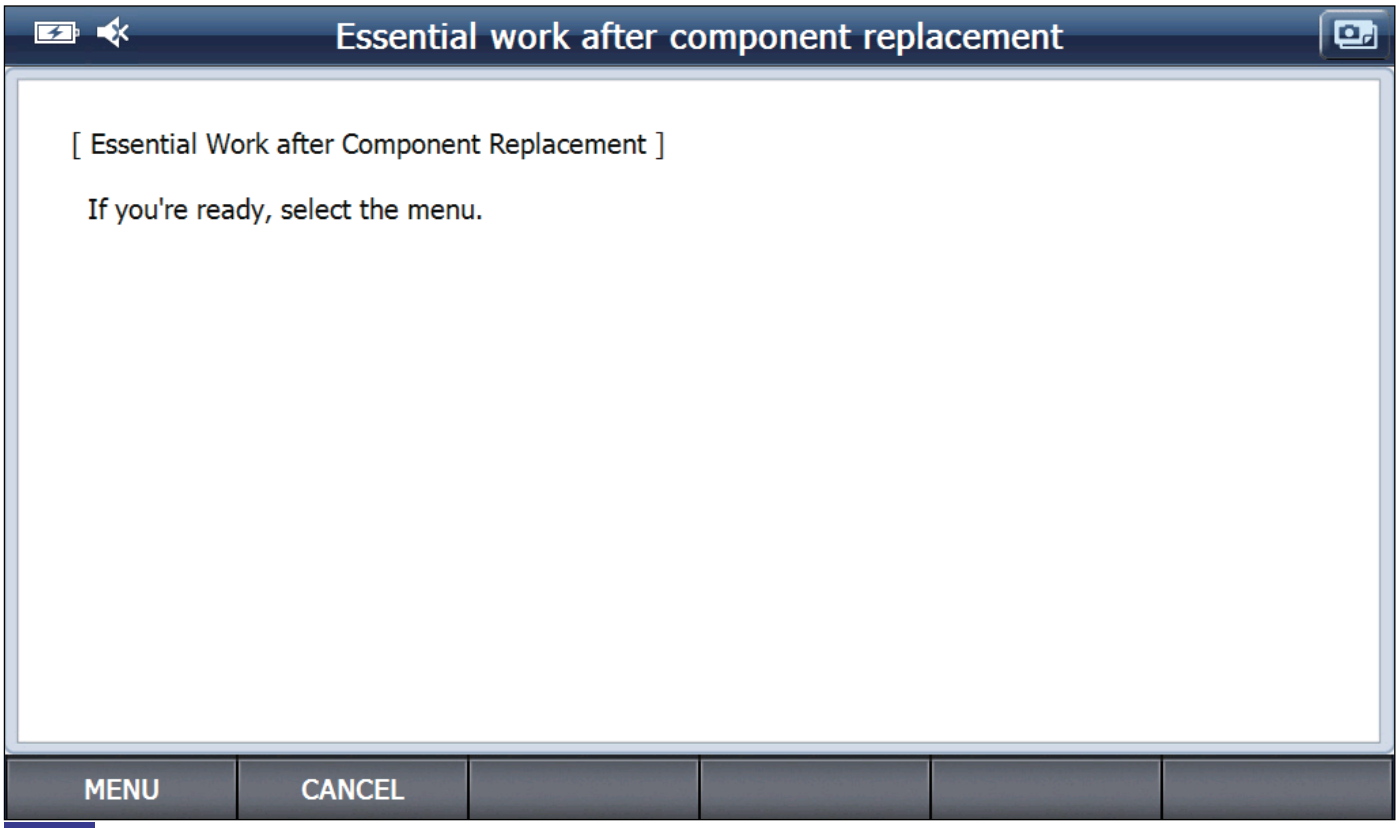


Fig.2

CRC12EN5010P01010042S

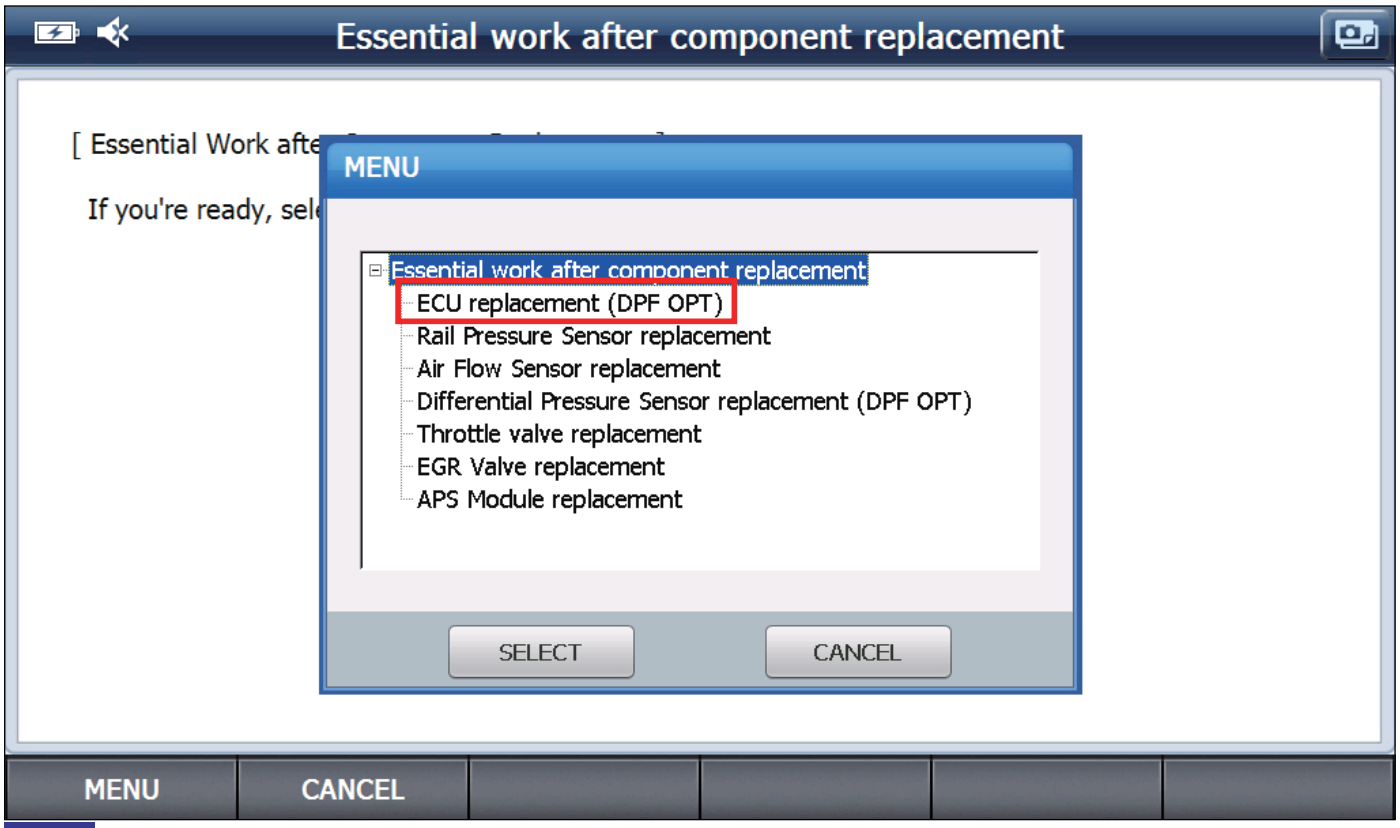


Fig.3

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.

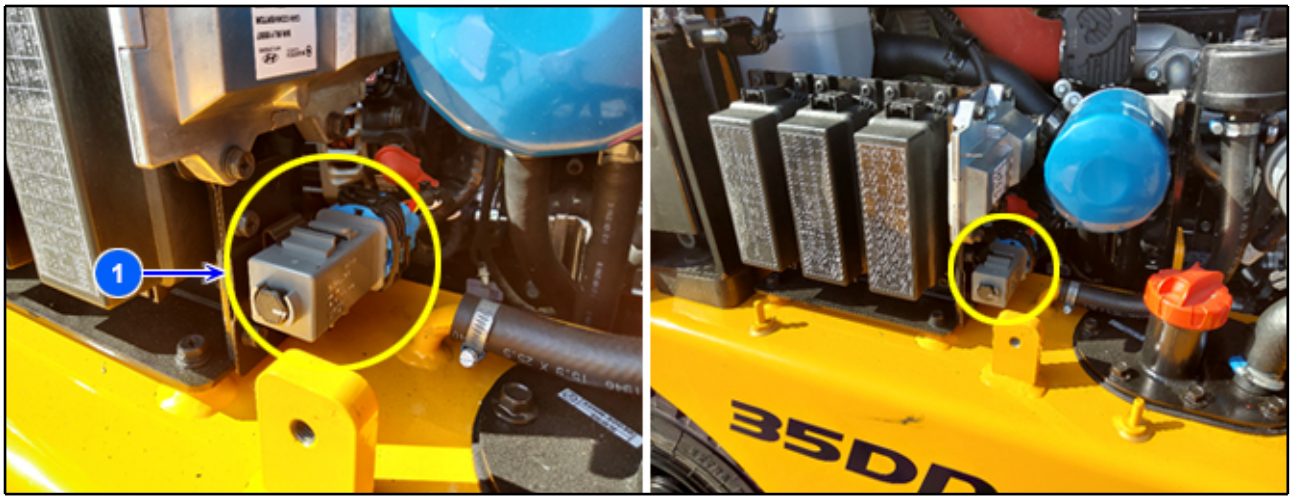
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

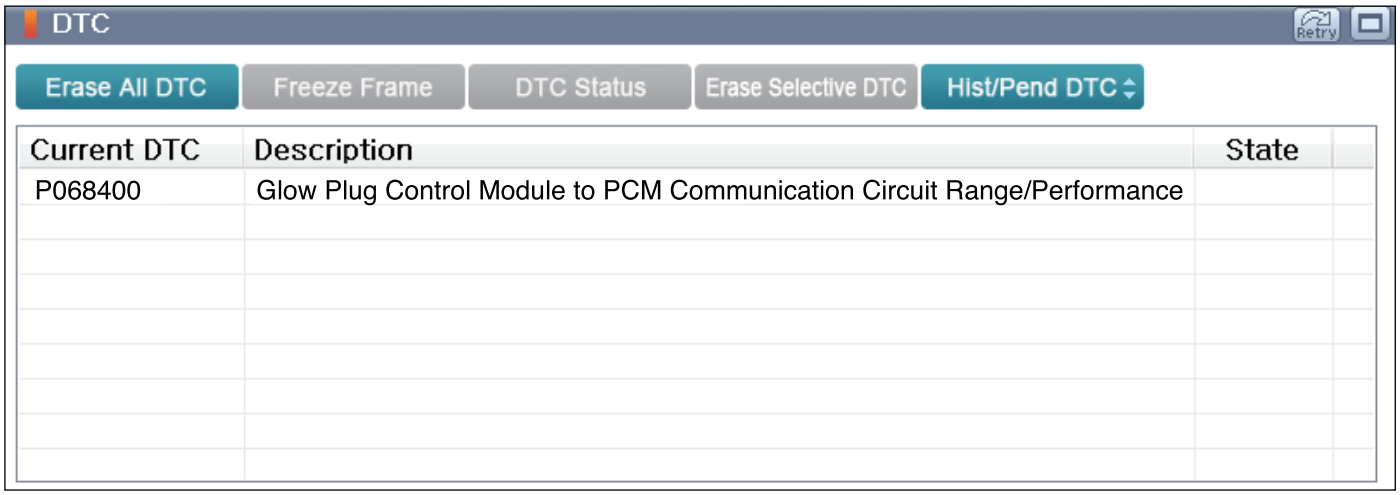
Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty glow relay circuit 3. Defected GRU
Enable Conditions	• Engine running		
Threshold Value	• Error feedback signal from the GRU is detected		
Diagnostic Time	• 8 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

Glow Relay Unit		Terminal	Ispection Condition	Measured Valu-e	Remarks
Pin No.	1	Glow Time Feedback Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 10.5V	-
	2	Power		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"
3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.



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

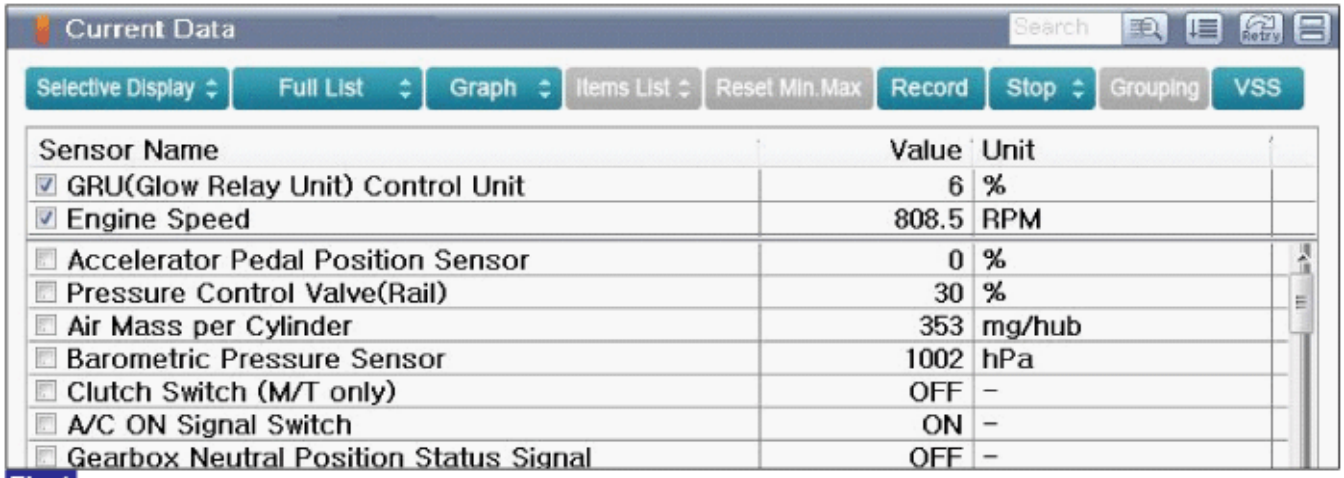


Fig.1

CRC12EN5010P03830022S

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?

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
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 1Ω

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

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 GRU connector.
3. Ignition switch "ON"
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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect GRU connector.
4. Measure the resistance between glow plug terminal 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).
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

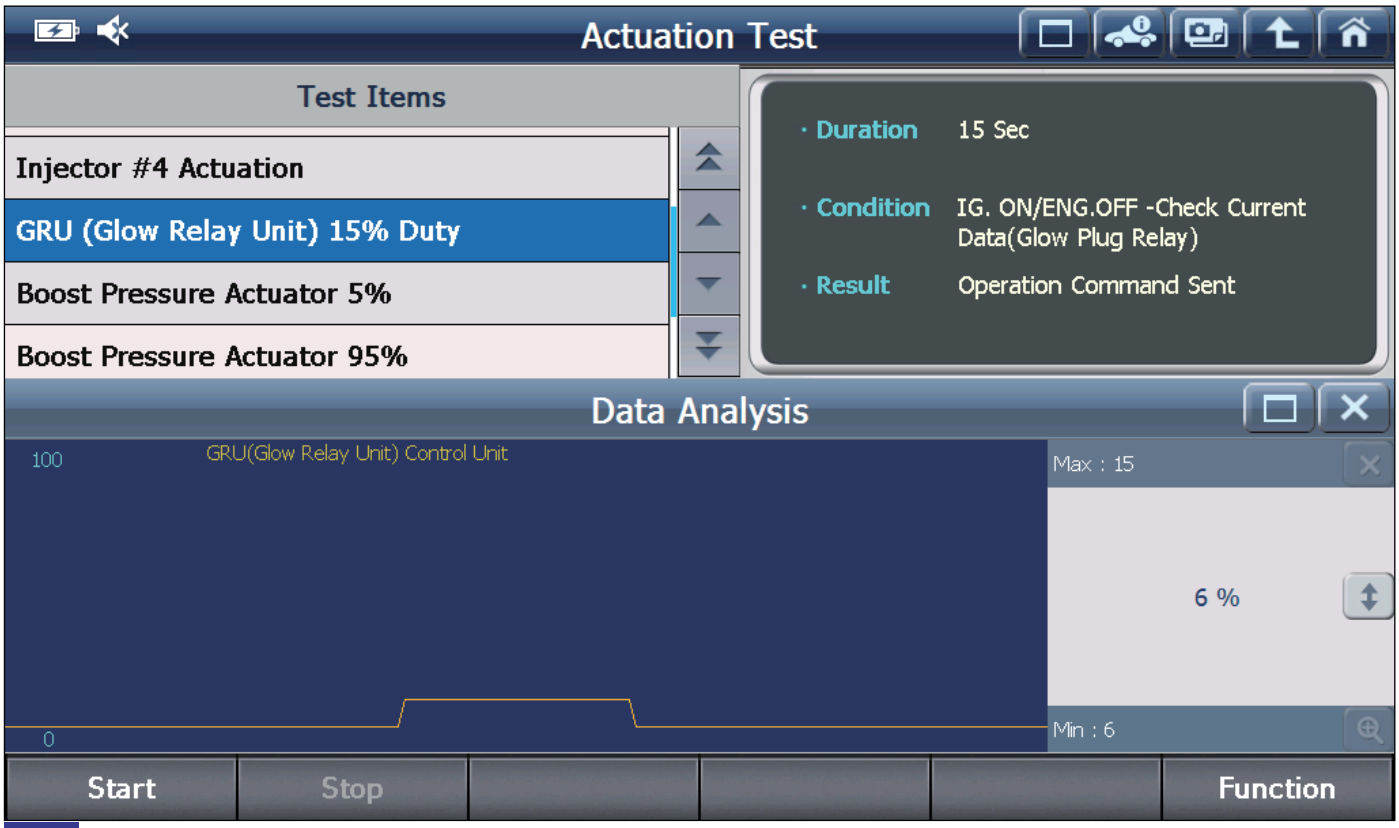


Fig.1

CRC12EN5010P03830041S

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.

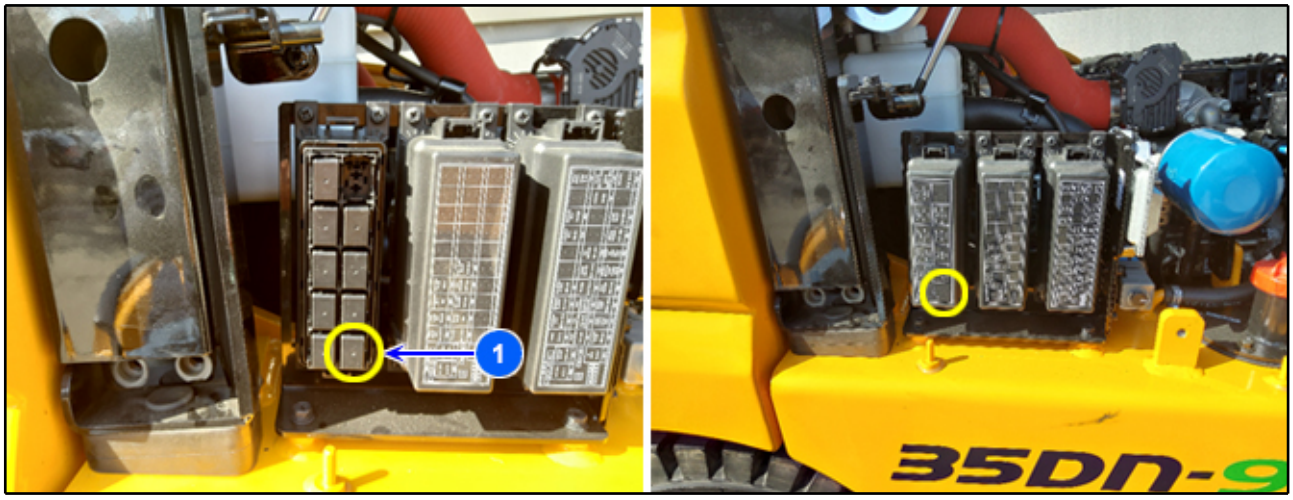
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P06850011

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

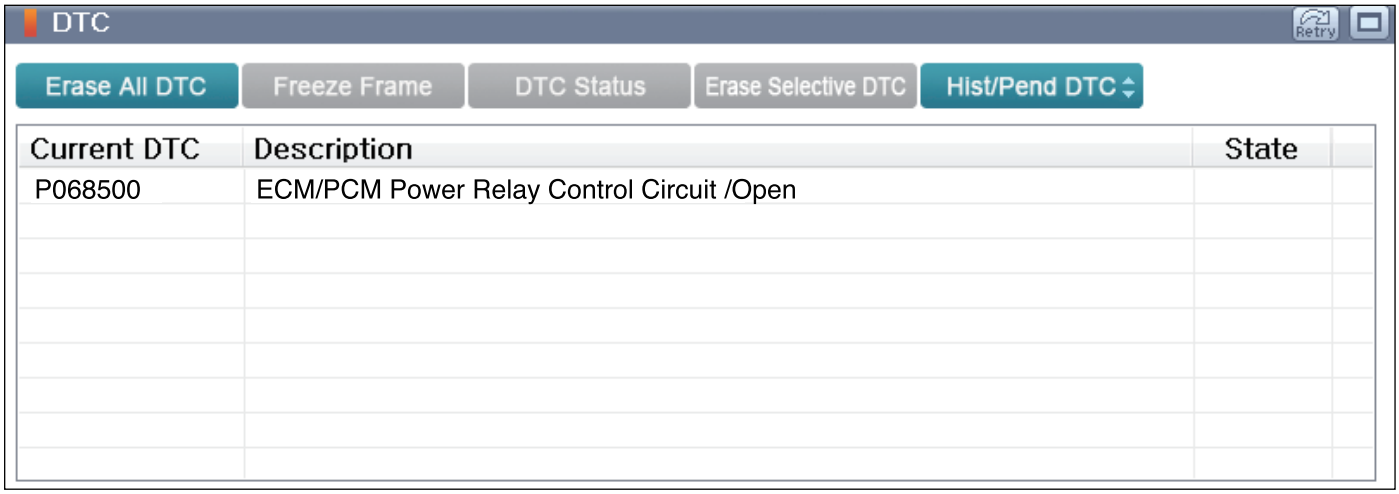
ECM performs After-run process (Turning off the internal system process of ECM) in order to shut down the system. If main relay power supply is cut before the After-run for 3 times or 2 sec. afte the After-run, ECM sets DTC P068500. This fault might be caused by open or short to ground in control circuit of main relay

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Open or short to ground in control circuit of main relay 3. Defected main relay
Enable Conditions	• Engine running		
Threshold Value	• Faulty control circuit of main relay		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06850021S

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 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+

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. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect ECM and engine room junction box connector.
4. Measure the resistance between engine control(main) relay terminal of engine room junction box harness connector and engine control(main) relay terminal of ECM harness connector.

Specification : Approx. below 1Ω

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.

NO ▸ 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.

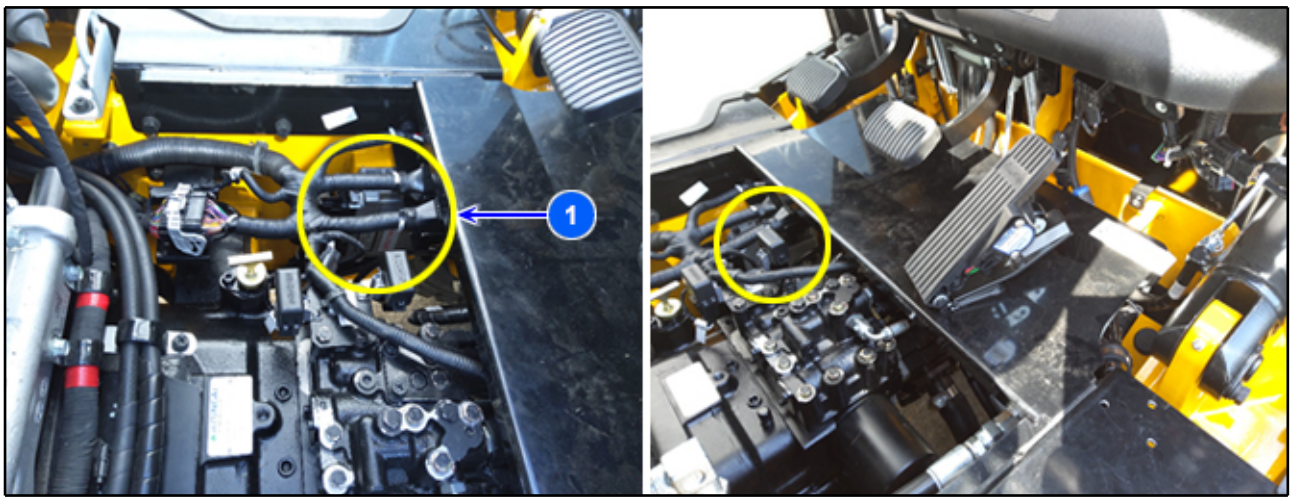
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

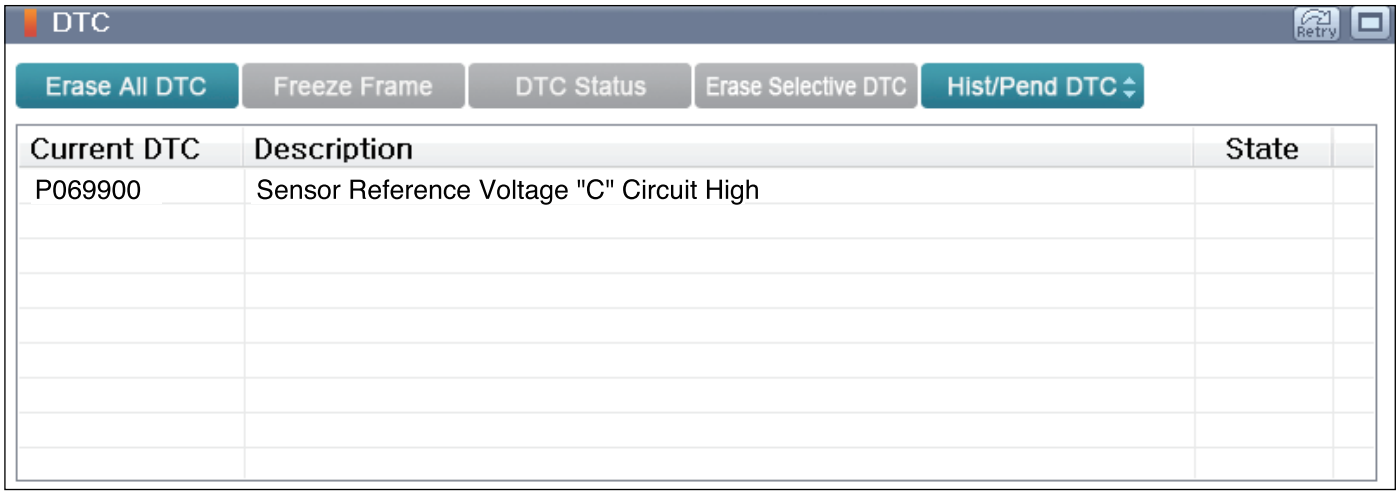
If faulty sensor "C" supply voltage is detected for more than 0.1 sec., ECM sets DTC P069900. This fault might be caused by short to power/ground in sensor supply "C" circuit or internal error of ECM.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Faulty sensor "C" supply circuit 3. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• Faulty sensor "C" supply voltage		
Diagnostic Time	• 100 msec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P06990021S

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 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?

YES ▸ Go to "Ground Circuit Inspection" procedure.

NO ▸ Repair as necessary and 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 ECM connector.
4. Measure the resistance ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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?

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.

⚠ 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"

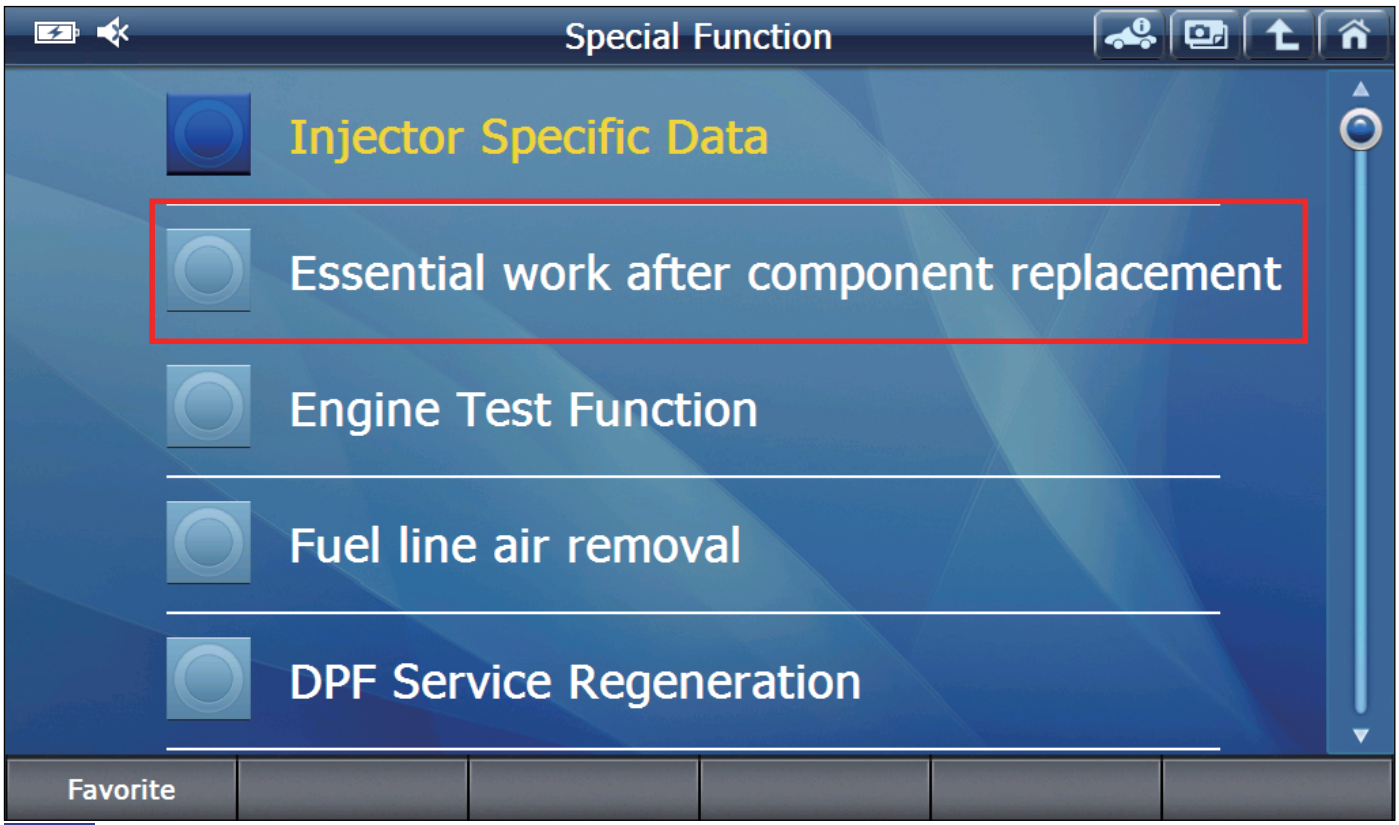


Fig.1

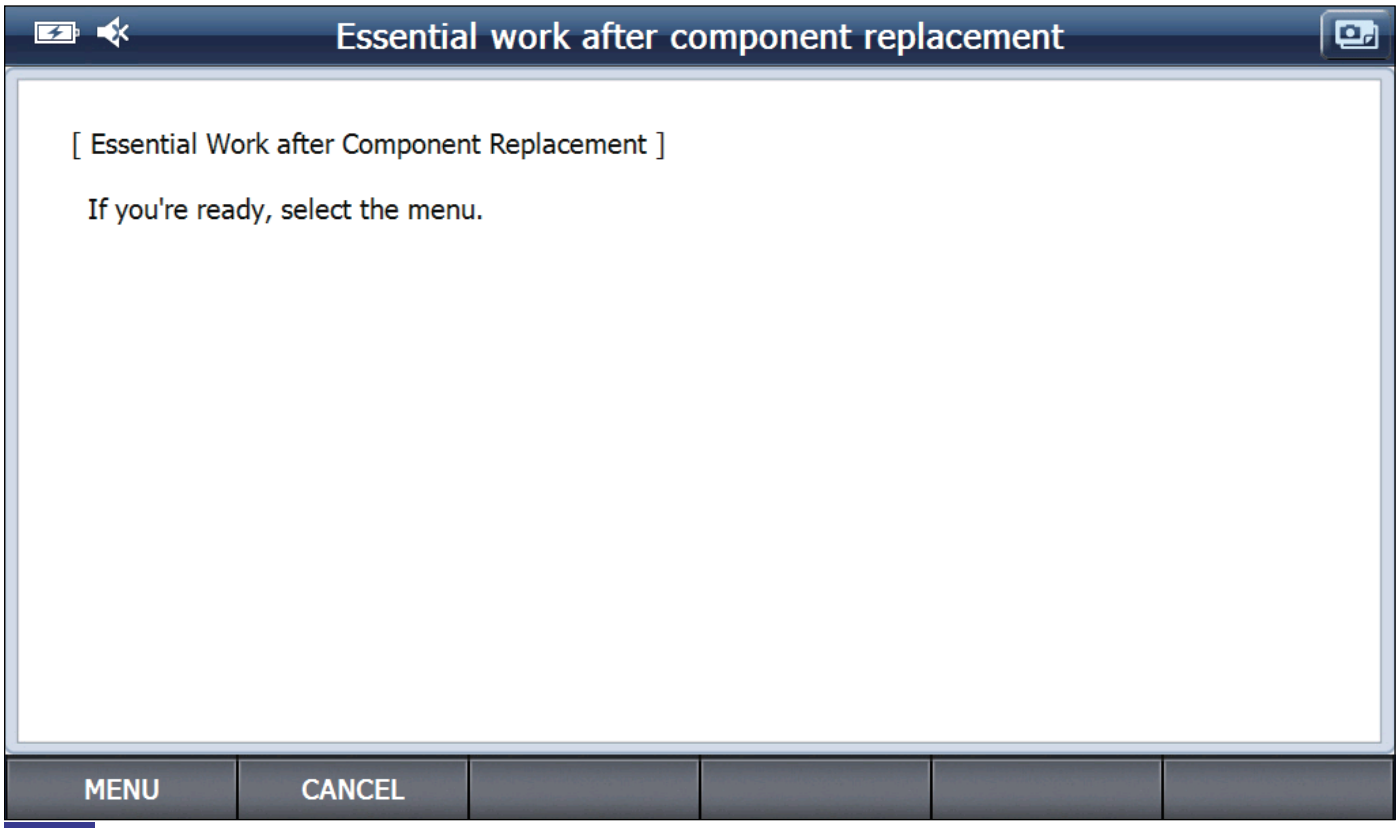


Fig.2

CRC12EN5010P01010042S

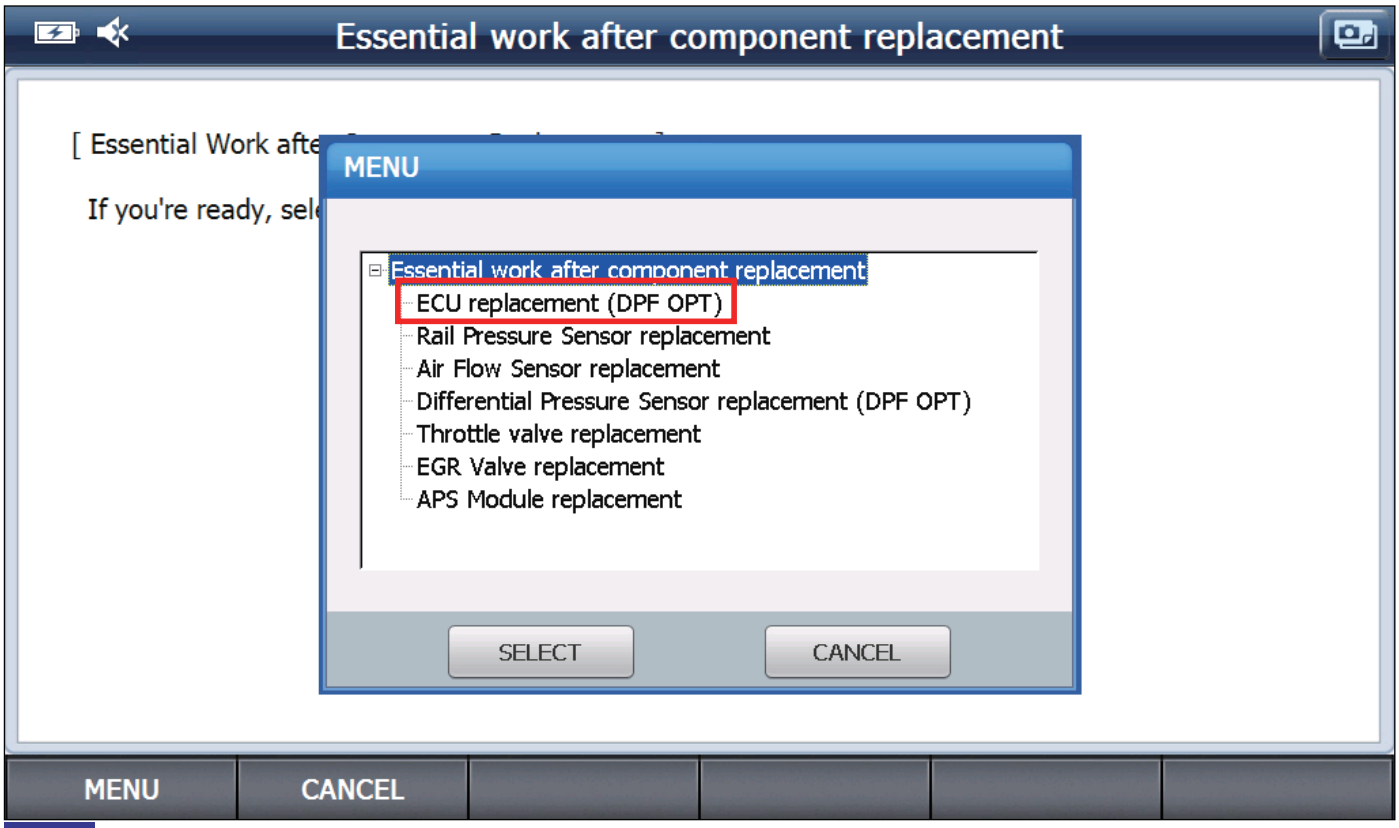


Fig.3

CRC12EN5010P05620043S

Replacement"

Fig.3) ECU Change

Verification of Vehicle Repair

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

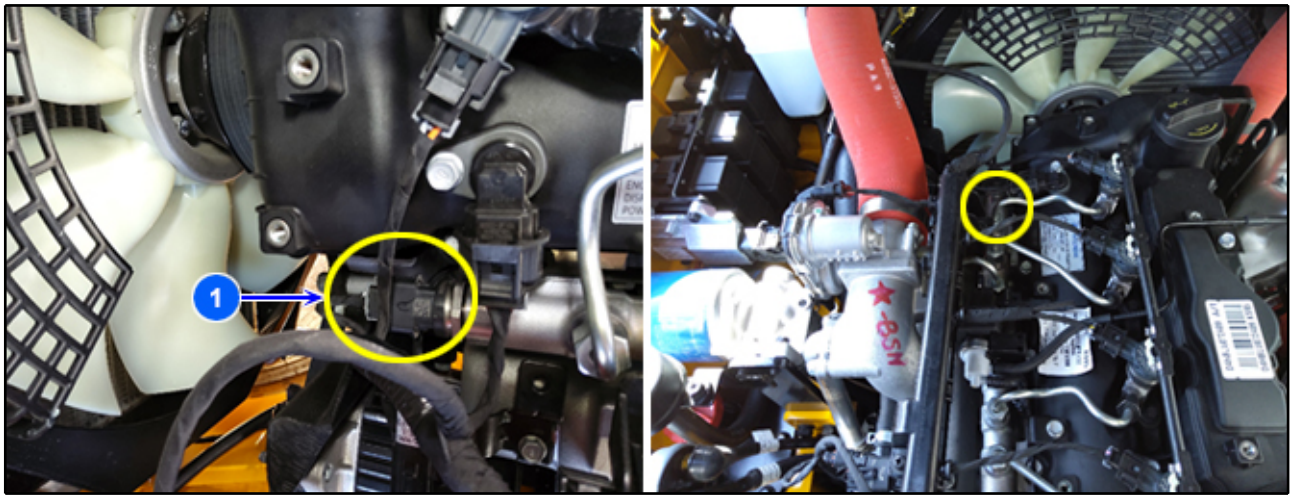
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

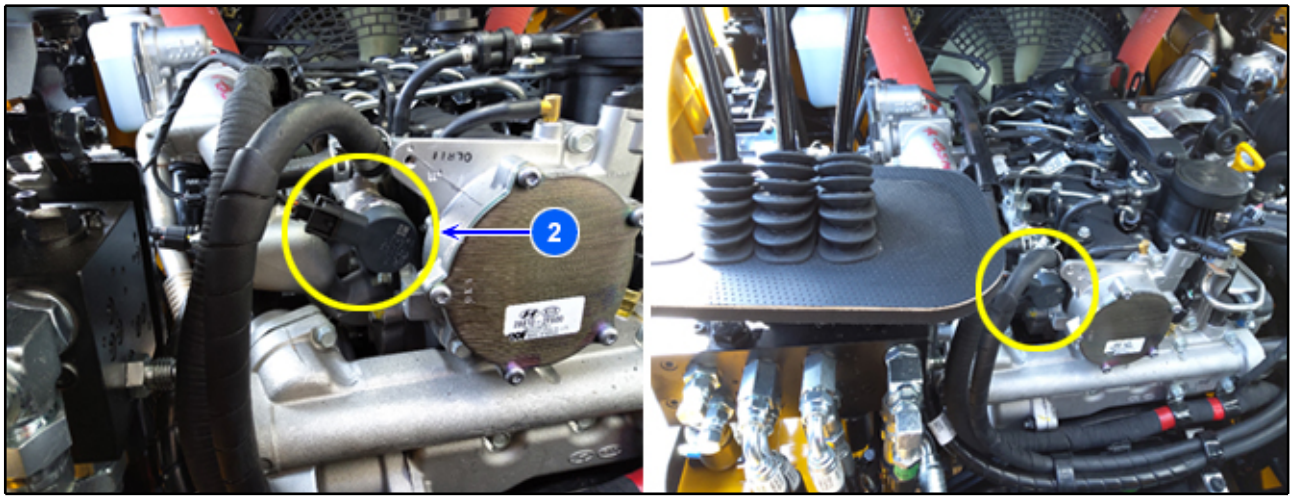
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P117100 CPC Mode Monitoring - Low Input

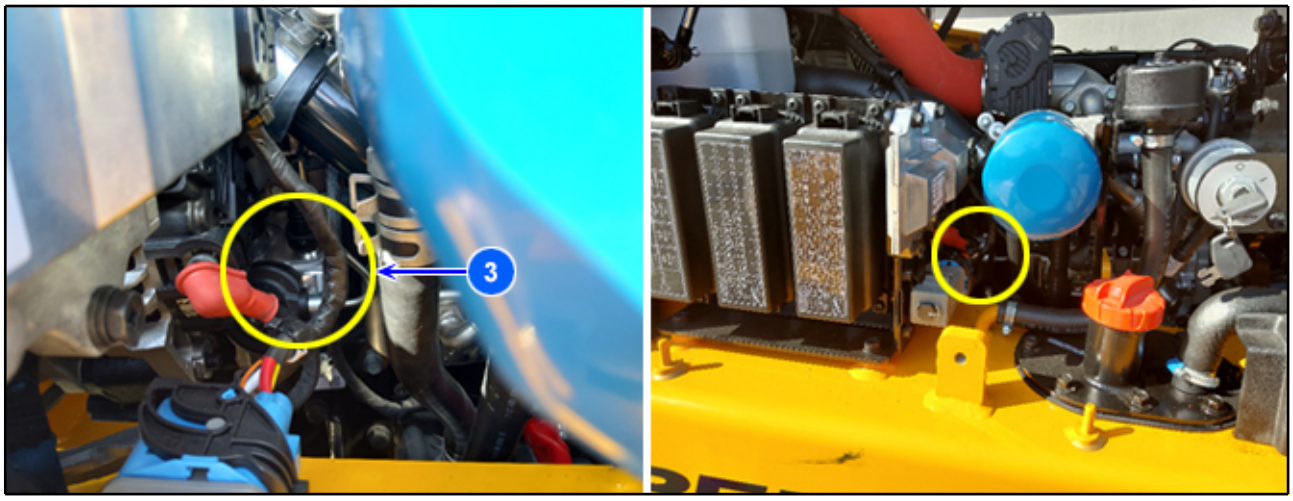
Component Location



CRC12EN5010P008711



CRC12EN5010P008712



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		1. Poor connector connection 2. Defected RPRV 3. Defected FPRV 4. Defected RPS
Enable Conditions	• Engine running		
Threshold Value	• If the fuel rail pressure is below minimum pressure under each certain engine condition		
Diagnostic Time	• 300 msec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

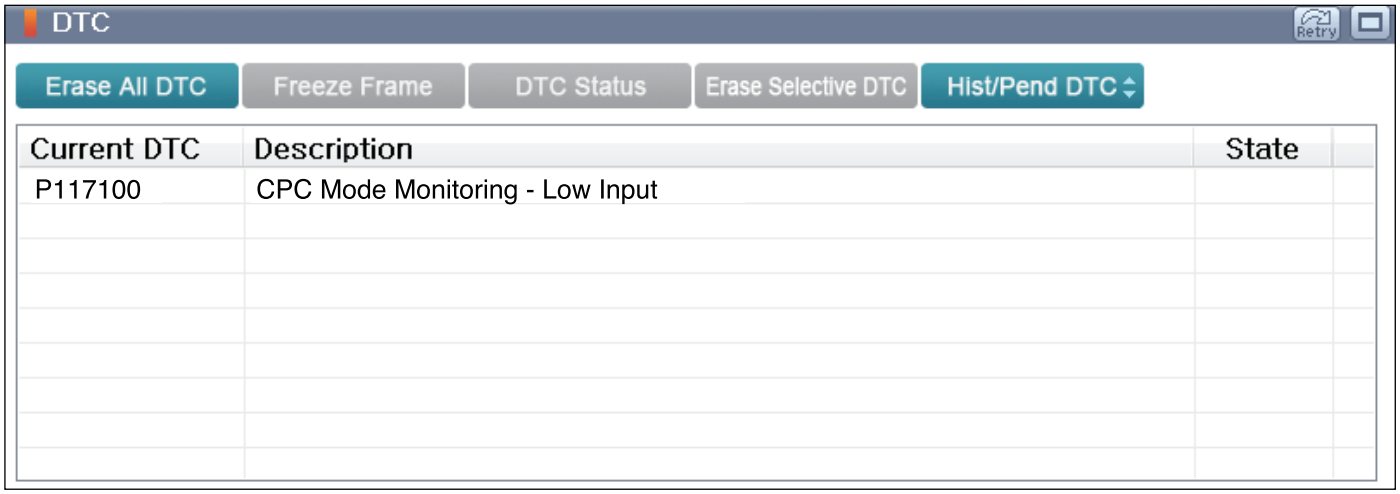
Vehicle Data

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

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

Monitor DTC Status

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



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

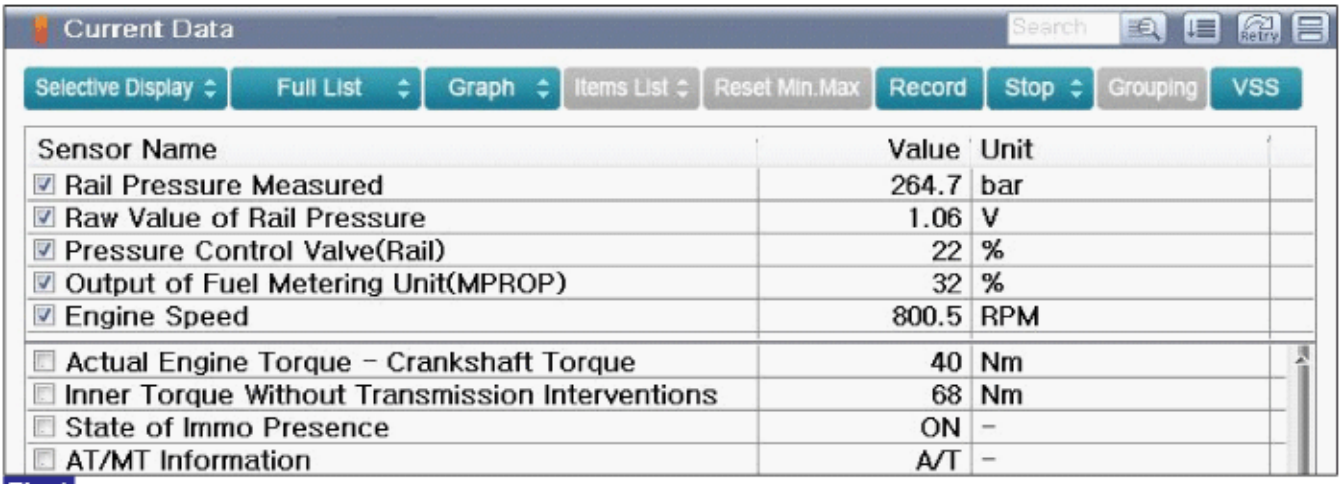


Fig.1

CRC12EN5010P00870022S

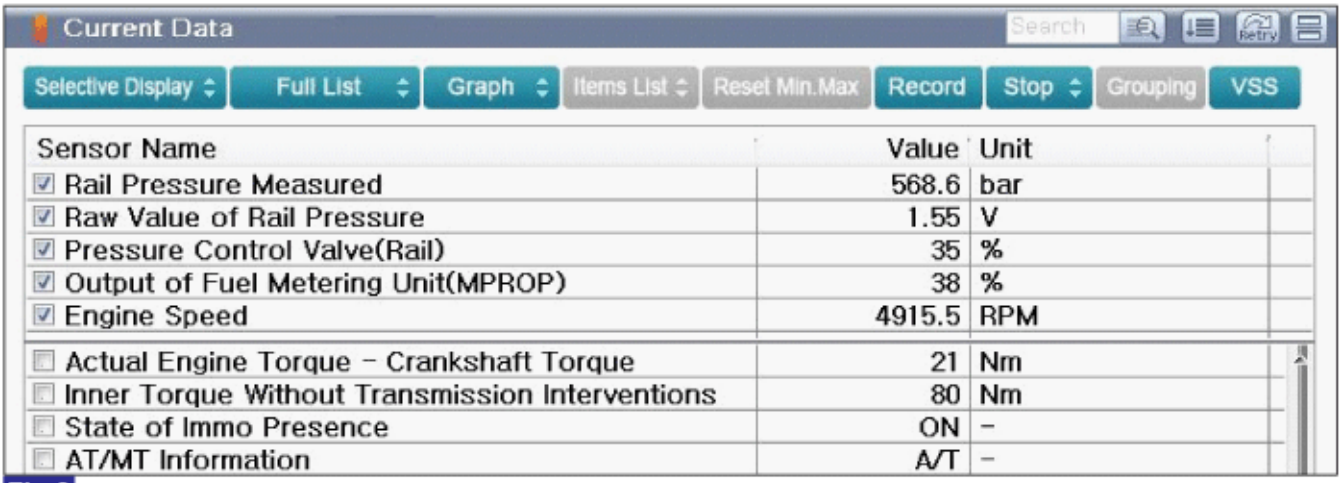


Fig.2

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?

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?

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

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 .

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.
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.

NO ▸ ▸ Inspect and repair open or short in circuit , 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 .

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

■ **Fuel Pressure Regulator Valve Inspection**

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

Specification : 2.60 ~ 3.15Ω (20℃/20℉)

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.

■ **Rail Pressure Regulator Valve Inspection**

1. Ignition switch "OFF"
2. Disconnect batter (-) cable.
3. 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℃/20℉)

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.

⚠ 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.

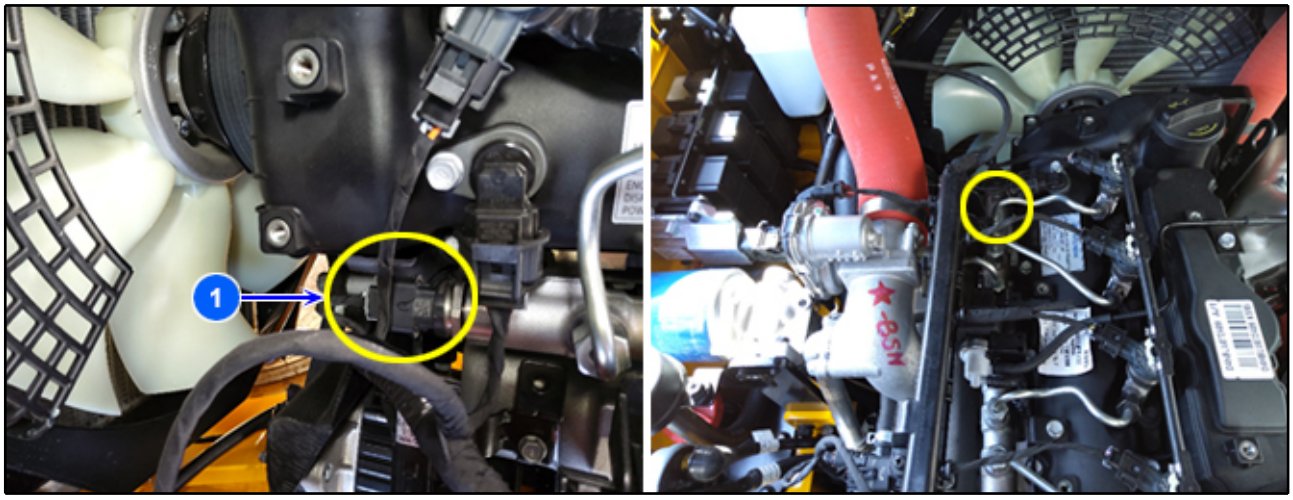
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

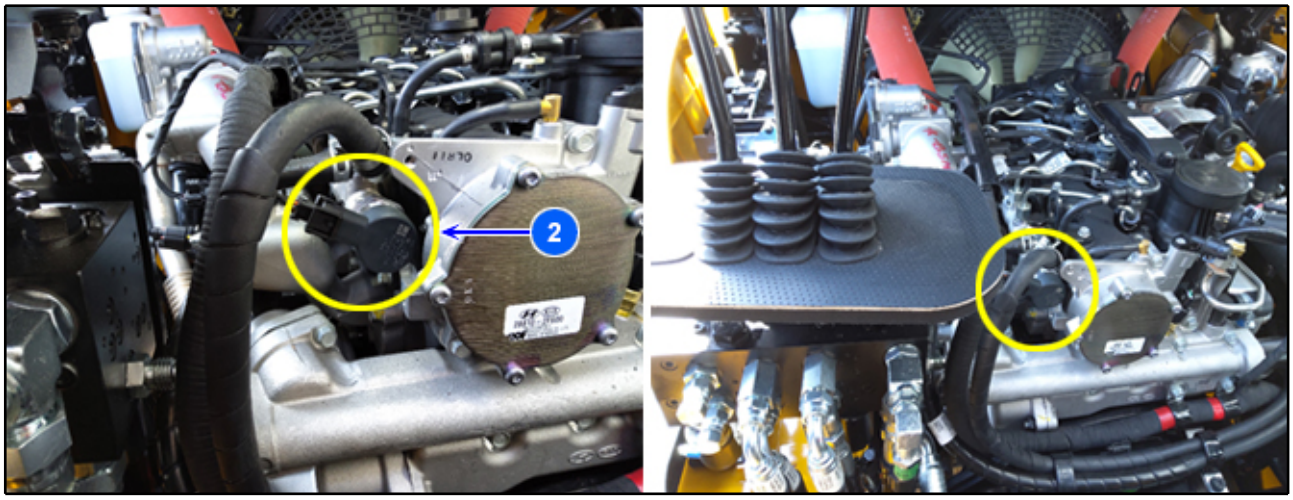
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P117200 CPC Mode Monitoring - High Input

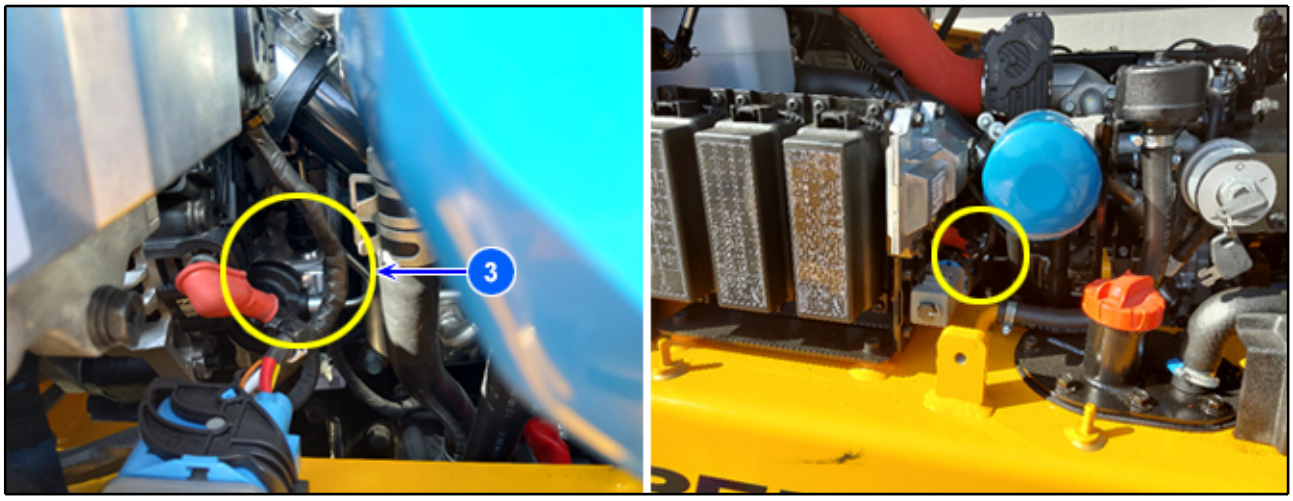
Component Location



CRC12EN5010P008711



CRC12EN5010P008712



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	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Defected RPRV 3. Defected FPRV 4. Defected RPS
Enable Conditions	• Engine running		
Threshold Value	• If the fuel rail pressure is higher than minimum pressure under each certain engine condition		
Diagnostic Time	• 300 msec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• No	
	MIL	• Off	

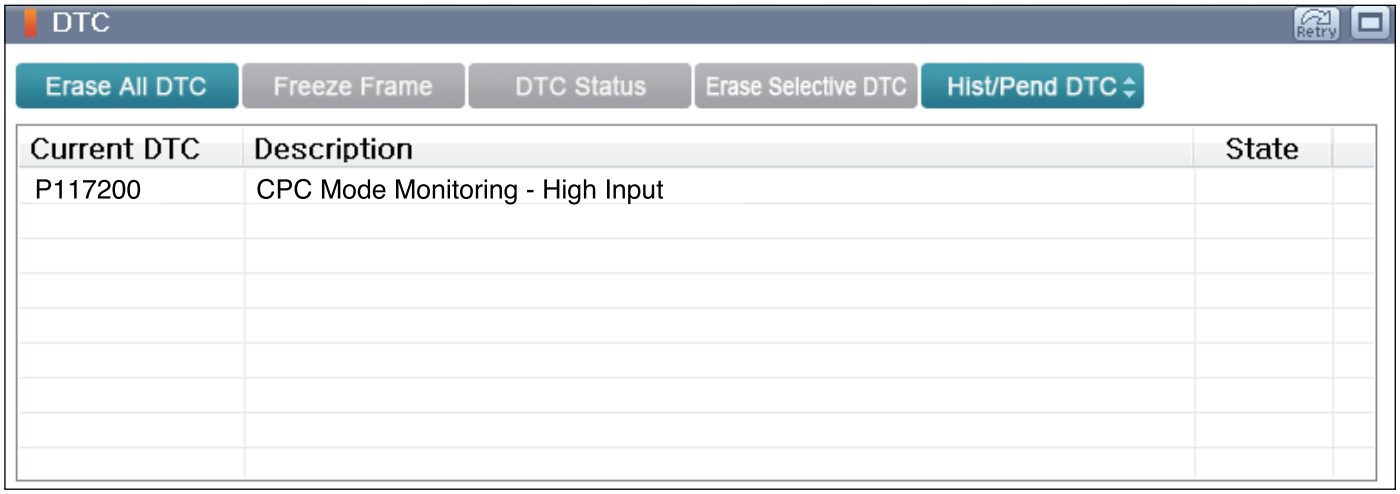
Vehicle Data

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

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

Monitor DTC Status

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



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

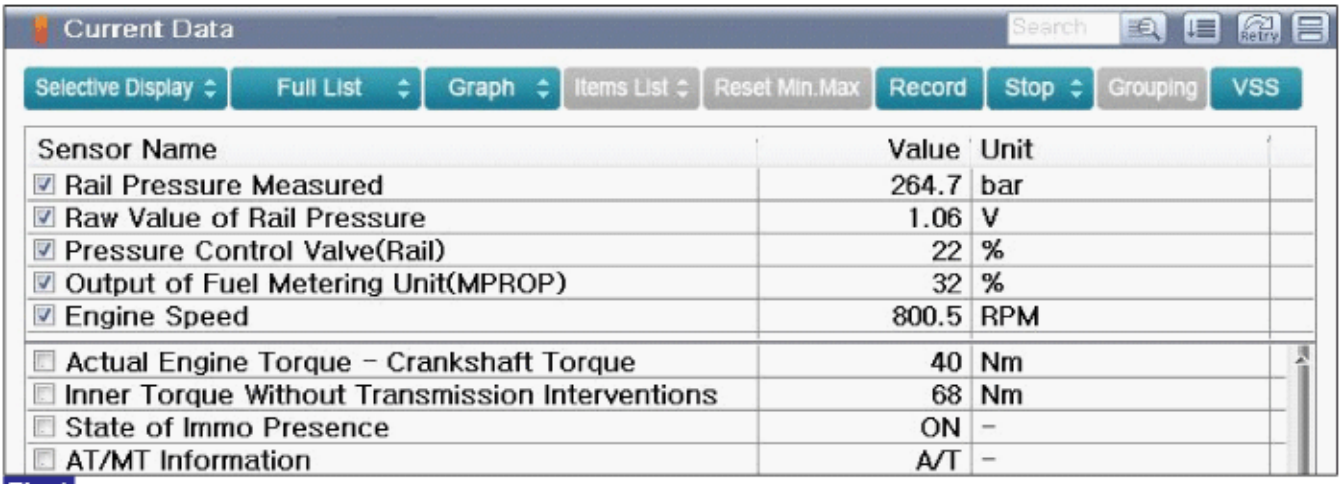


Fig.1

CRC12EN5010P00870022S

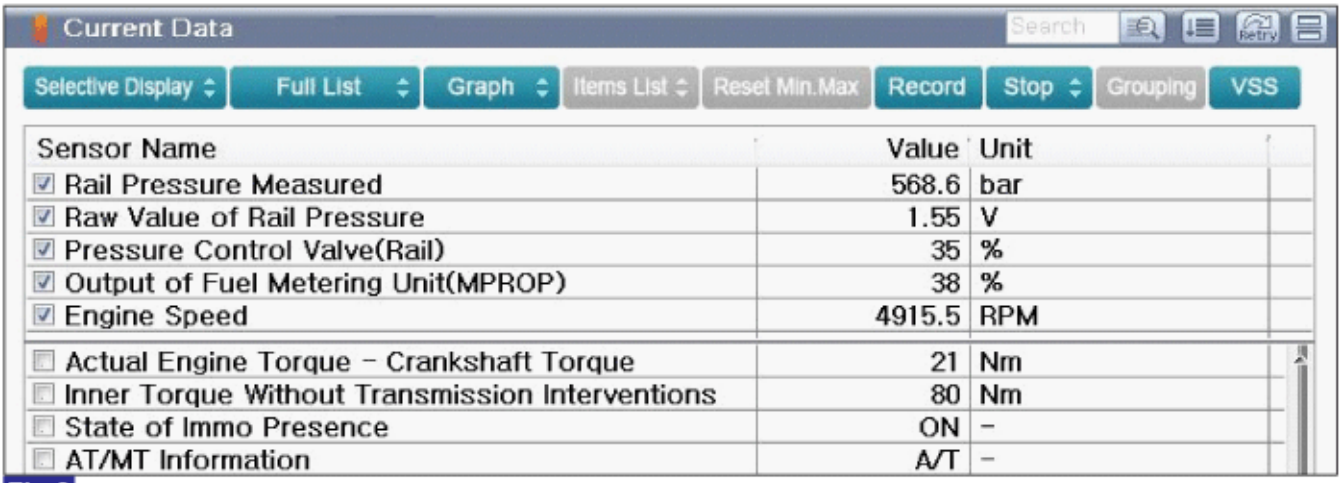


Fig.2

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?

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?

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

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 .

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.
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.

NO ▸ ▸ Inspect and repair open or short in circuit , 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 .

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

■ **Fuel Pressure Regulator Valve Inspection**

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

Specification : 2.60 ~ 3.15Ω (20℃/20℉)

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.

■ **Rail Pressure Regulator Valve Inspection**

1. Ignition switch "OFF"
2. Disconnect batter (-) cable.
3. 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℃/20℉)

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.

⚠ 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.

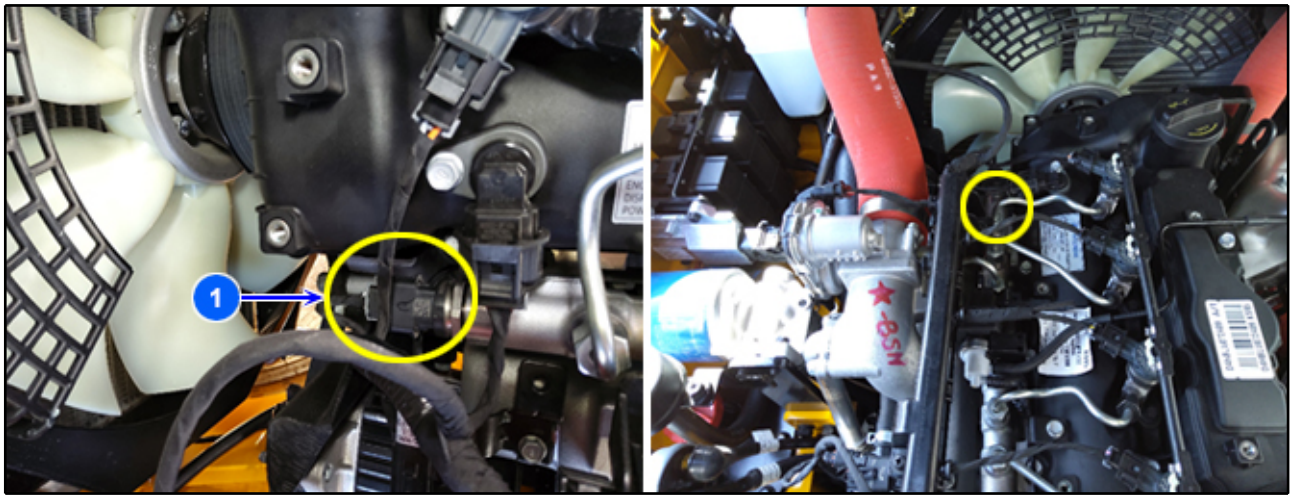
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

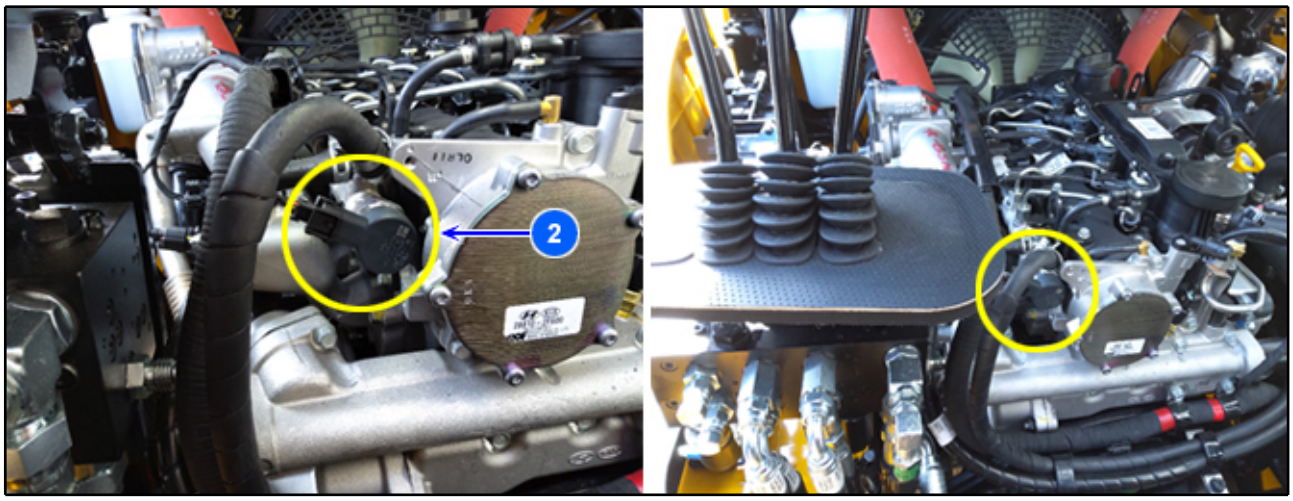
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P117300 CPC Mode Monitoring - maximum PCV pressure exceeded

Component Location



CRC12EN5010P008711



CRC12EN5010P008712

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

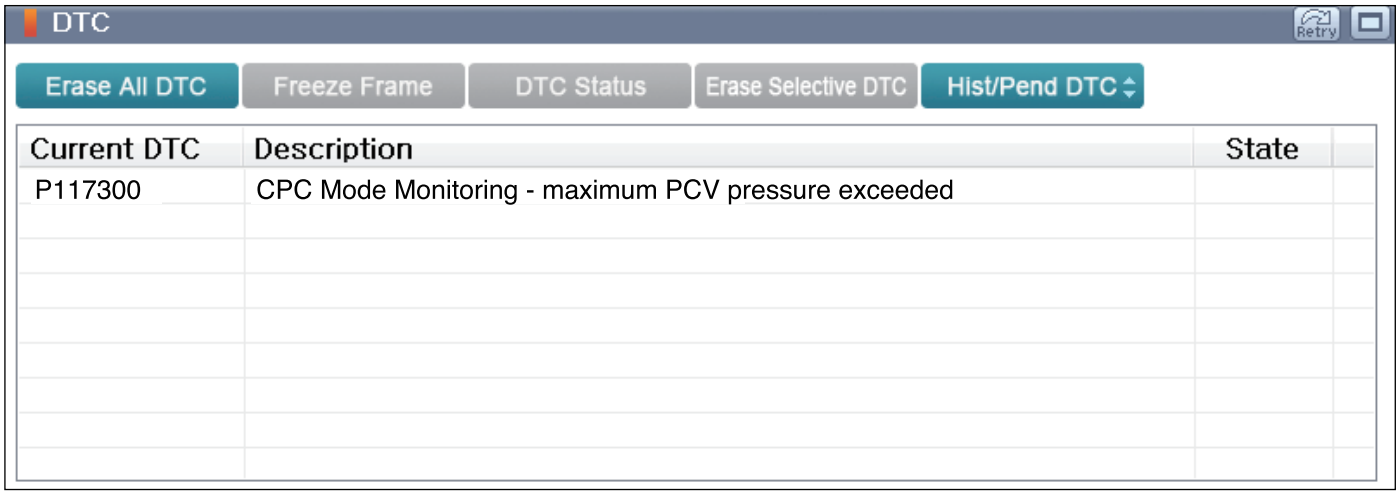
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Stuck closed RPRV 3. Stuck open RPRV 4. Leakage on high fuel pressure system
Enable Condition	• Engine running		
Threshold Value	• Current of RPRV is exceeded threshold value		
Detecting Time	• 700 msec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

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

Monitor DTC Status

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



CRC12EN5010P11730021S

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

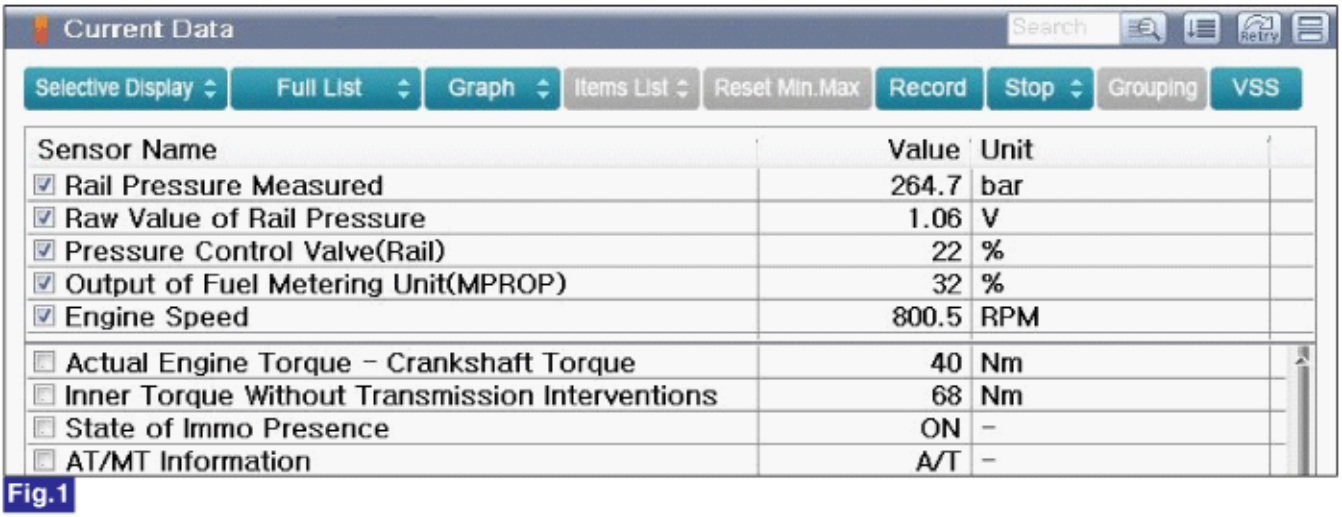


Fig.1

CRC12EN5010P00870022S

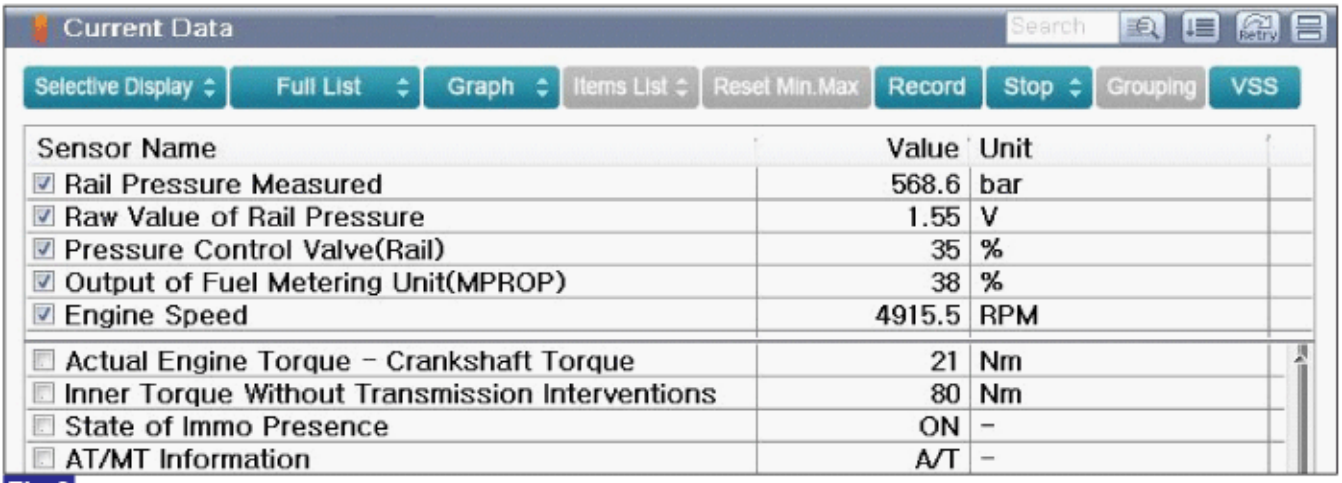


Fig.2

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?

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 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.

3. 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℃/20℉)

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.

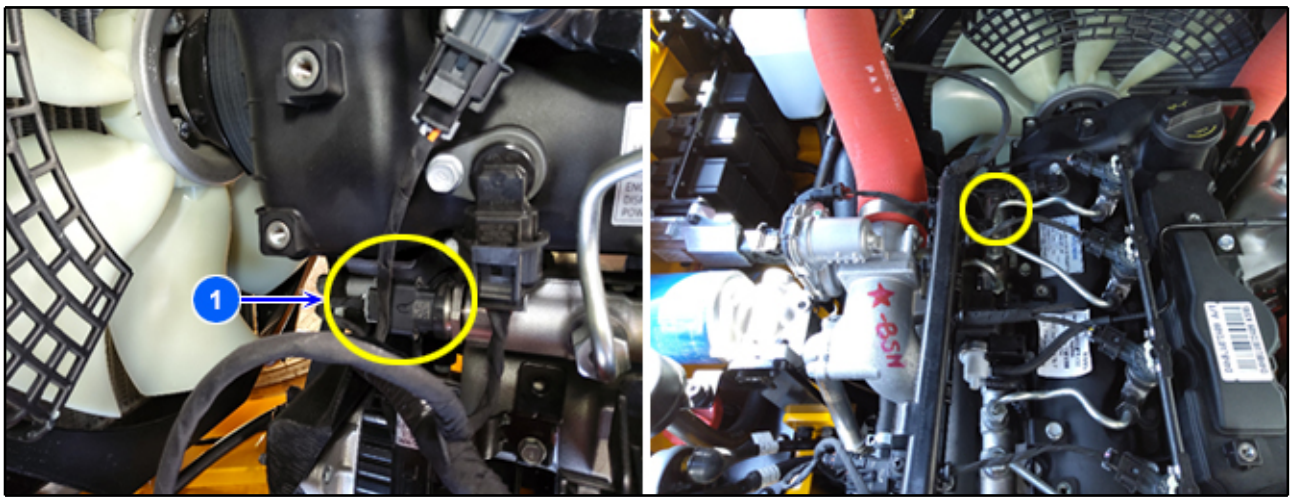
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

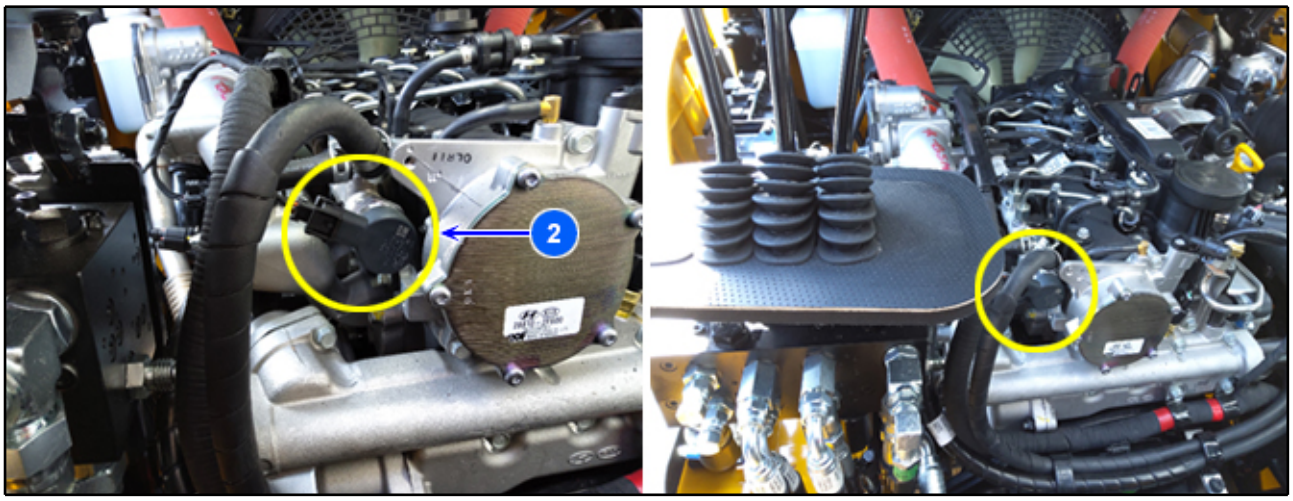
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P118500 Maximum Pressure Exceeded

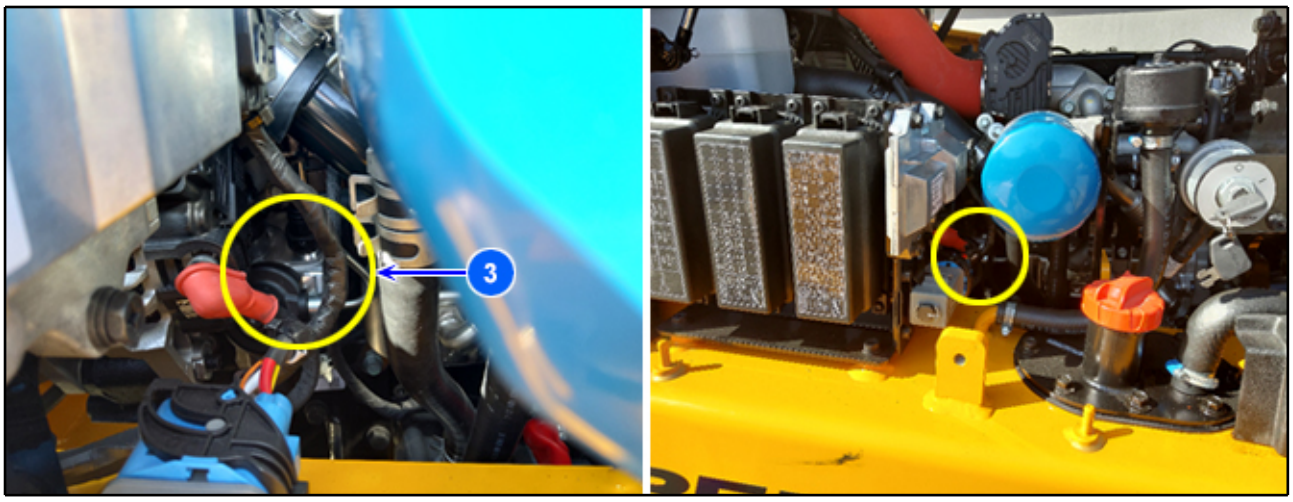
Component Location



CRC12EN5010P008711



CRC12EN5010P008712



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 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 Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Stuck closed FPRV 3. Stuck opened FPRV 4. Defected RPS
Enable Condition	• Engine running		
Threshold Value	Case 1	• Rail pressure exceeds threshold value by 200bar	
	Case 2	• Rail pressure is higher than maximum pressure (1999bar)	
Detecting Time	Case 1	• 2 sec	
	Case 2	• 300 msec	
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

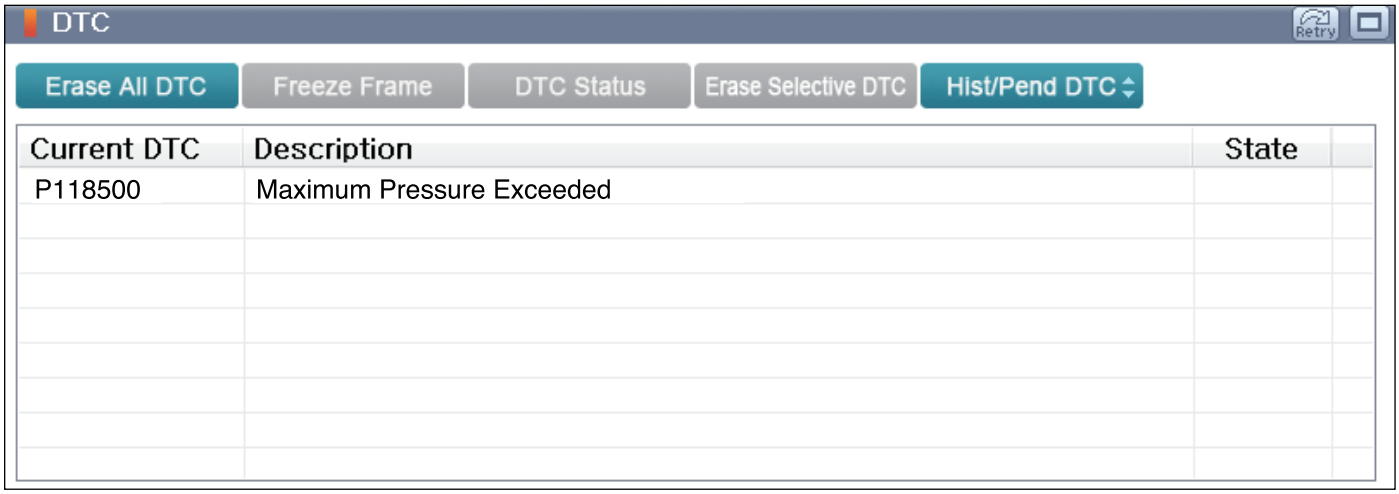
Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	RPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	RPS Signal		Approx. 5.0V	-
	3	RPS Ground		0V	

Fuel Pressure Regulator Vavle		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Fuel Pressure Regulator Valve Control	• Ignition Switch "ON", Engine " OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	Fuel Pressure Regulator Valve Power		B+	-

Monitor DTC Status

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



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

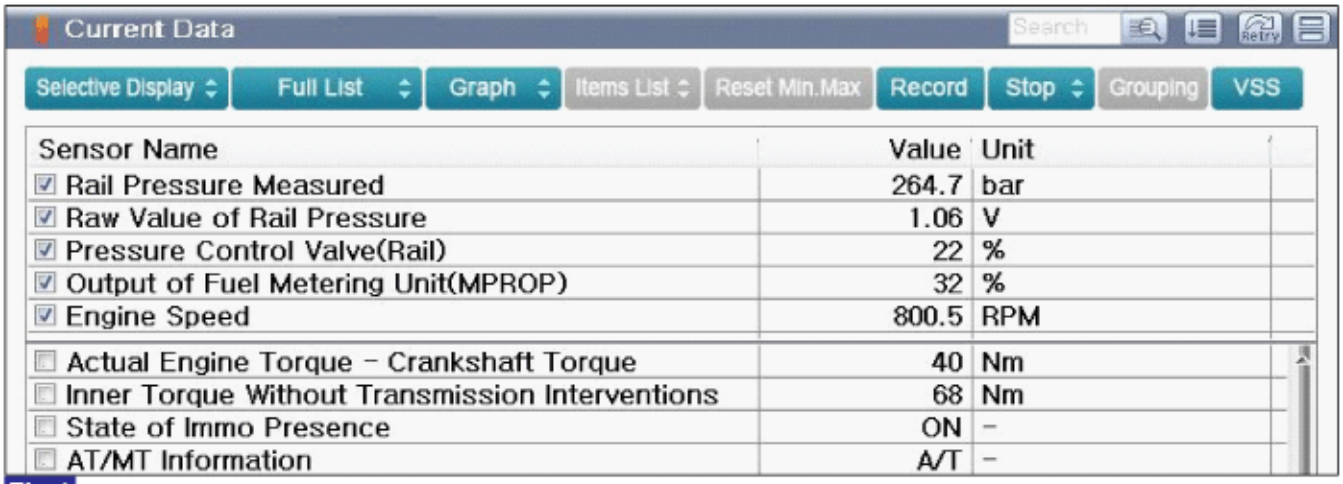


Fig.1

CRC12EN5010P00870022S

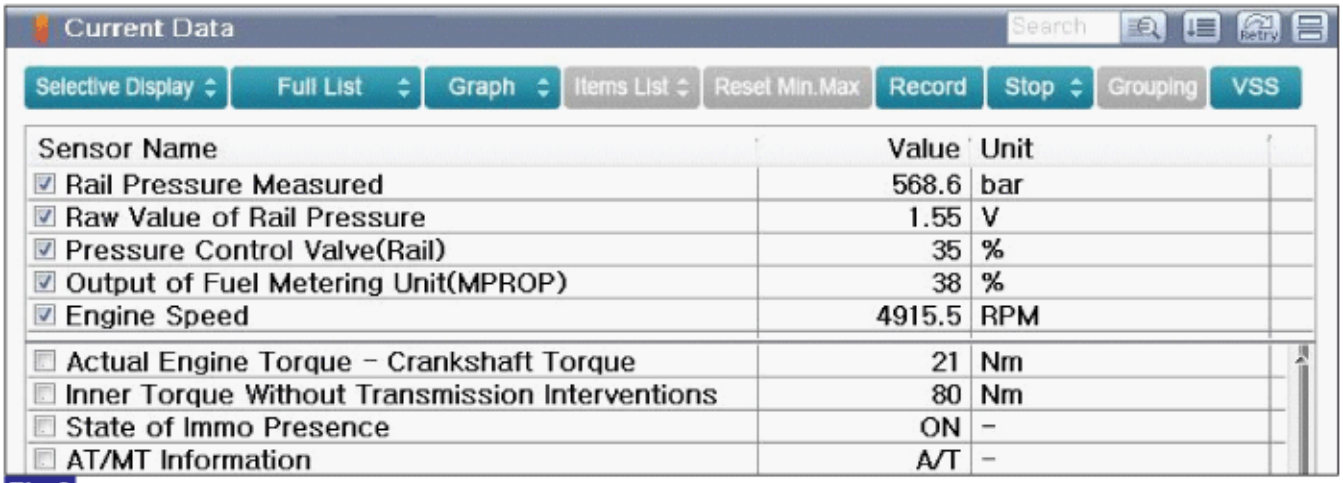


Fig.2

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?

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 "Rail Pressure Sensor Inspection" procedure.

Rail Pressure Sensor Inspection

■ Power Circuit Inspection

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

connector.

3. 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 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 RPS connector.
4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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)
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.

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 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?

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 .

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.
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.

NO ▸ Inspect and repair open or short in circuit, 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 ▸ 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**

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 : 2.60 ~ 3.15Ω (20℃/20℉)

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.

⚠ 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.

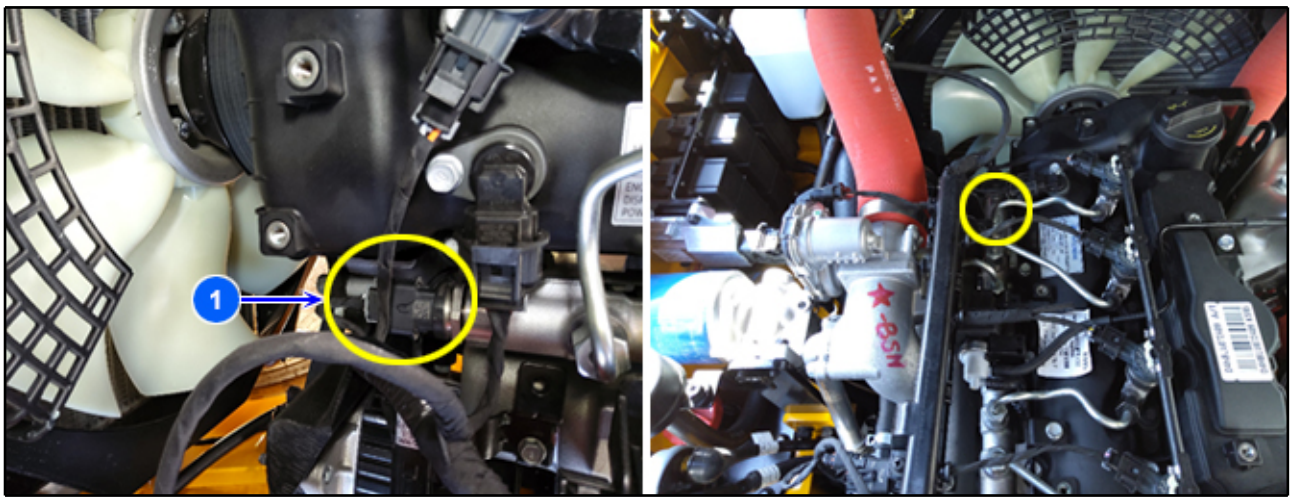
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

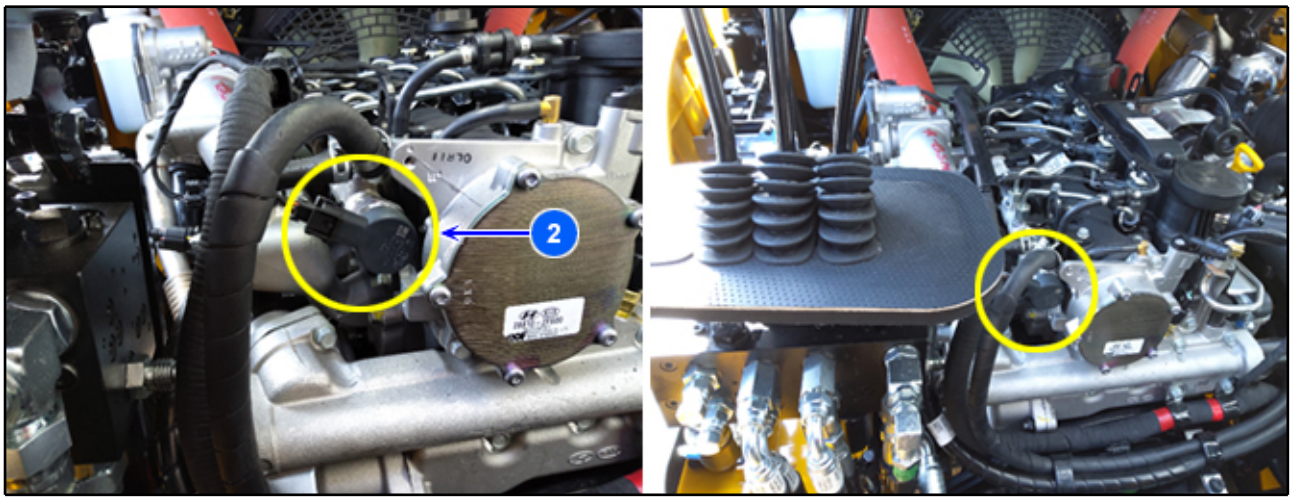
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P118600 Minimum Pressure at Engine Speed Too Low

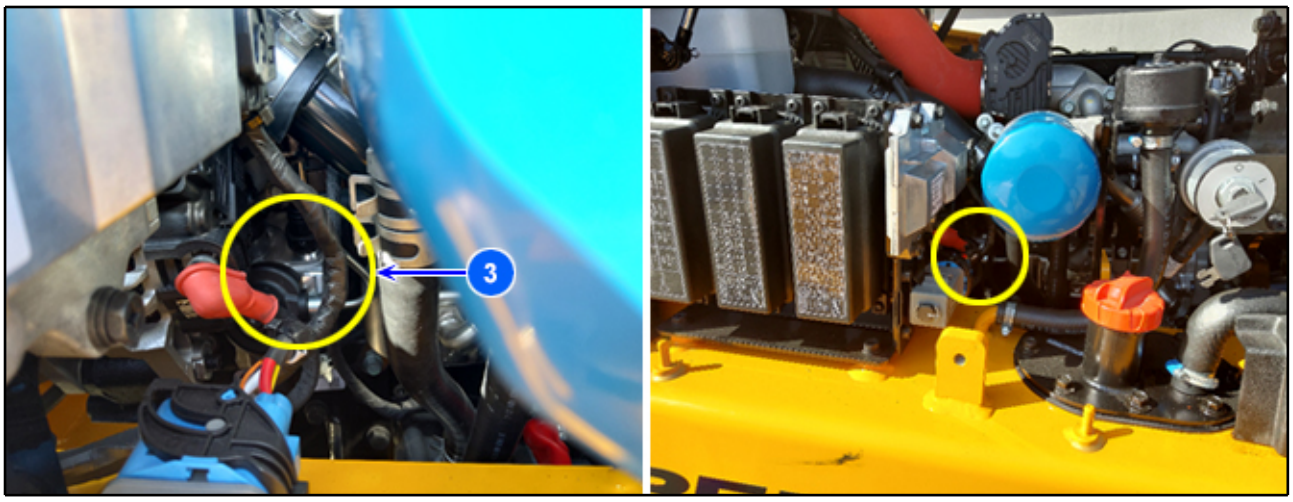
Component Location



CRC12EN5010P008711



CRC12EN5010P008712



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 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	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Stuck closed FPRV 3. Stuck opened FPRV 4. Defected RPS
Enable Condition	• Engine running		
Threshold Value	Case 1	• Rail pressure is below threshold value by 200bar	
	Case 2	• Rail pressure is lower than minimum pressure	
Detecting Time	Case 1	• 1 sec	
	Case 2	• 300 msec	
Fail Safe	Engine OFF	• Yes (Case 1) • No (Case 2)	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

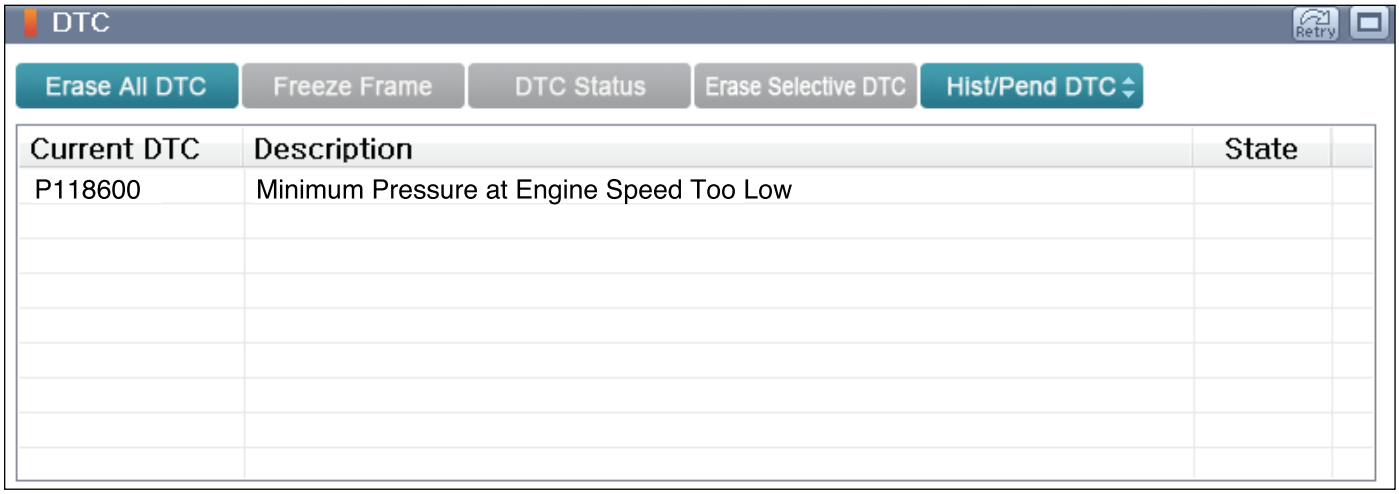
Vehicle Data

Fuel Rail Pressure Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	RPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5.0V	-
	2	RPS Signal		Approx. 5.0V	-
	3	RPS Ground		0V	

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

Monitor DTC Status

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



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

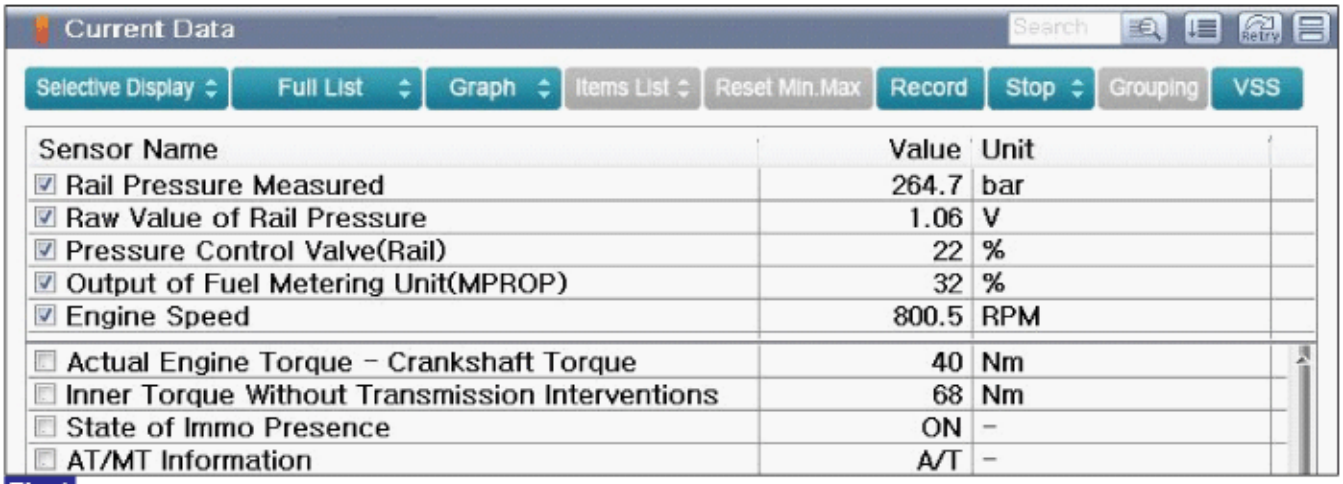


Fig.1

CRC12EN5010P00870022S

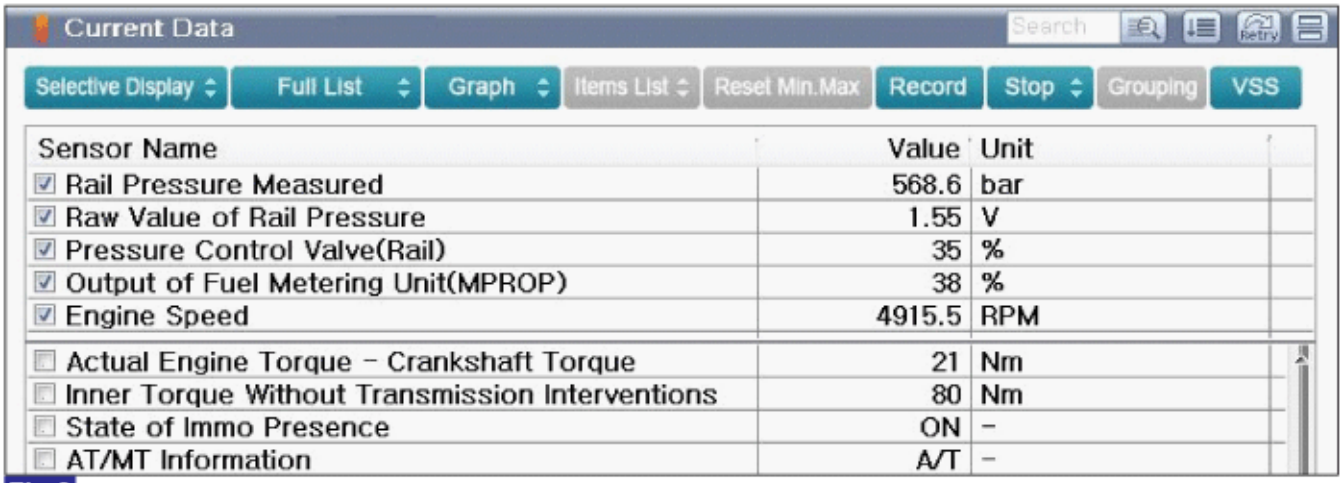


Fig.2

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?

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 "Rail Pressure Sensor Inspection" procedure.

Rail Pressure Sensor Inspection

■ Power Circuit Inspection

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

connector.

3. 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 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 RPS connector.
4. Measure the resistance between ground terminal of RPS harness connector and chassis ground.

Specification : Approx. below 1 Ω

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)
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.

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 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?

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 .

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.
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.

NO ▸ Inspect and repair open or short in circuit, 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 ▸ 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**

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 : 2.60 ~ 3.15Ω (20℃/20℉)

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.

⚠ 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.

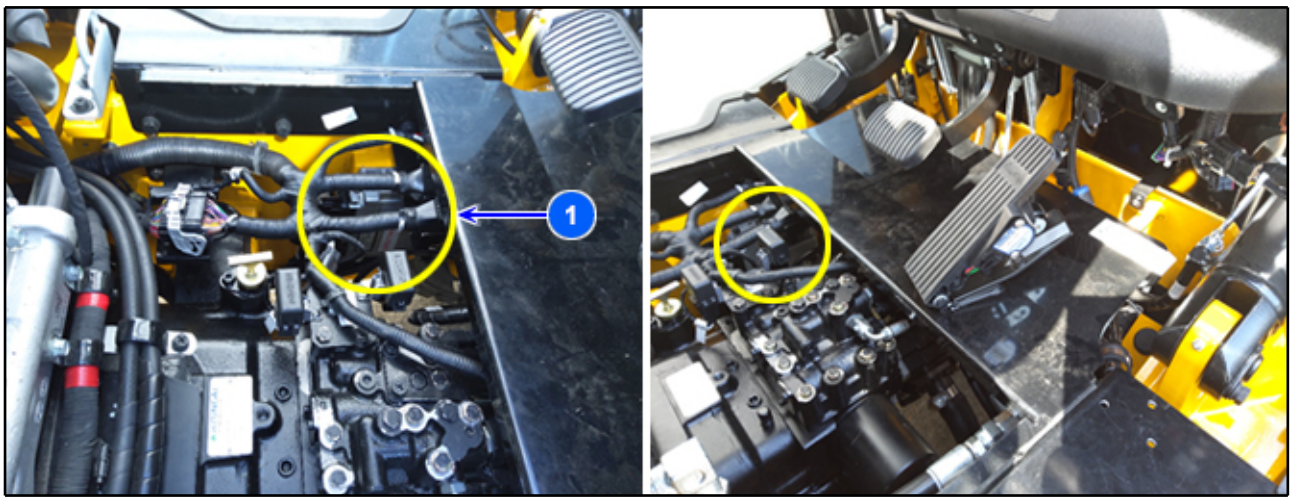
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

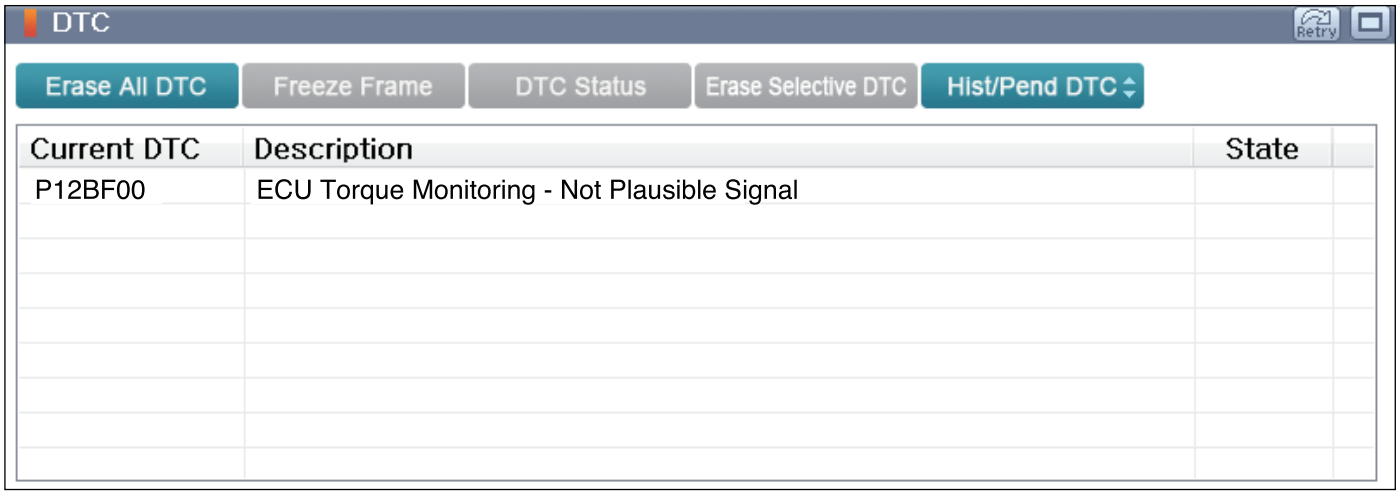
If actual torque and the calculated torque is different, ECM sets DTC 12BF00.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Internal Monitoring		1. Poor connector connection 2. Defected ECM
Enable Conditions	• Engine running		
Threshold Value	• ECU torque monitoring signal error		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• Yes	
	EGR Off	• No	
	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.



CRC12EN5010P12BF0021S

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 disconnect ECM connector.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1 Ω

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?

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.

⚠ 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"

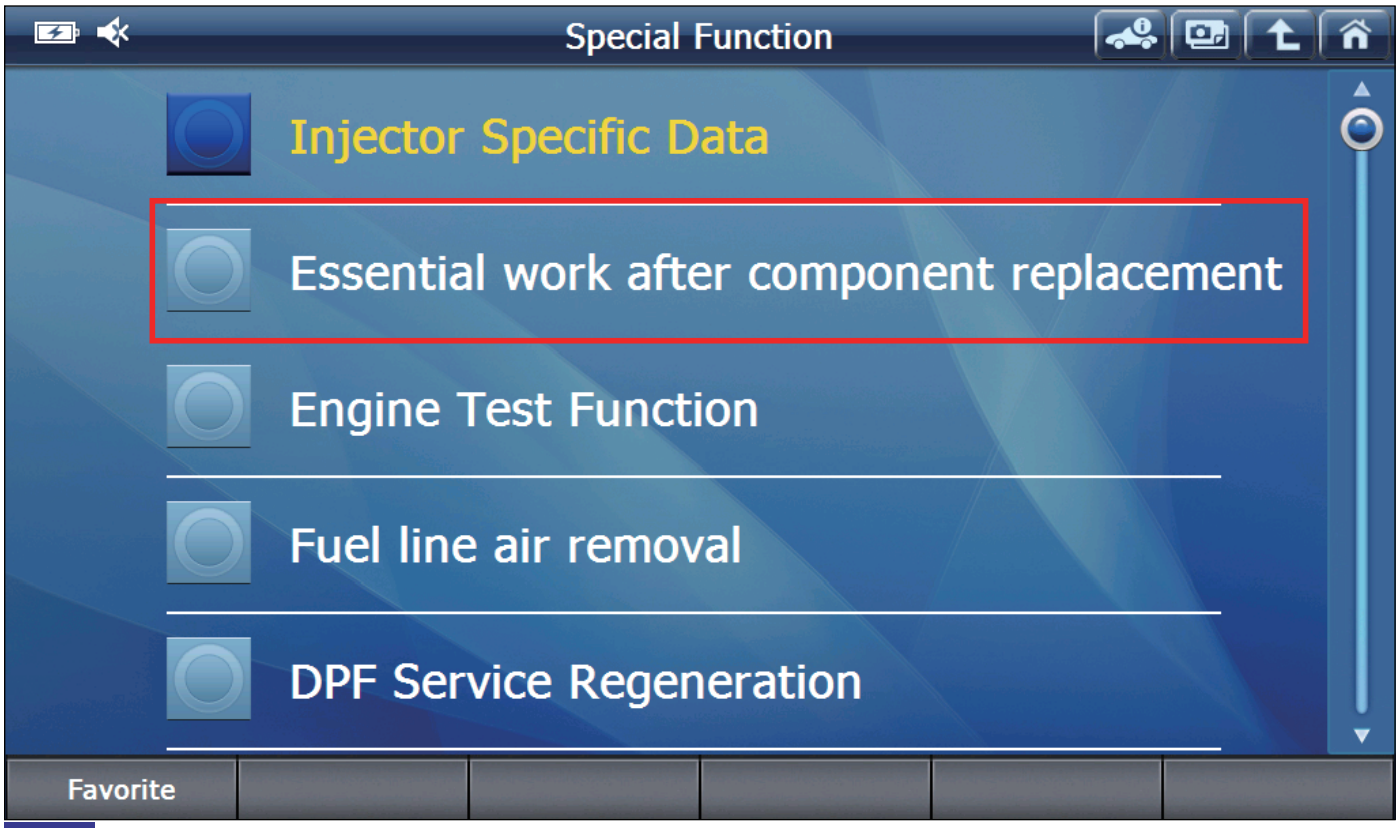


Fig.1

CRC12EN5010P01010041S

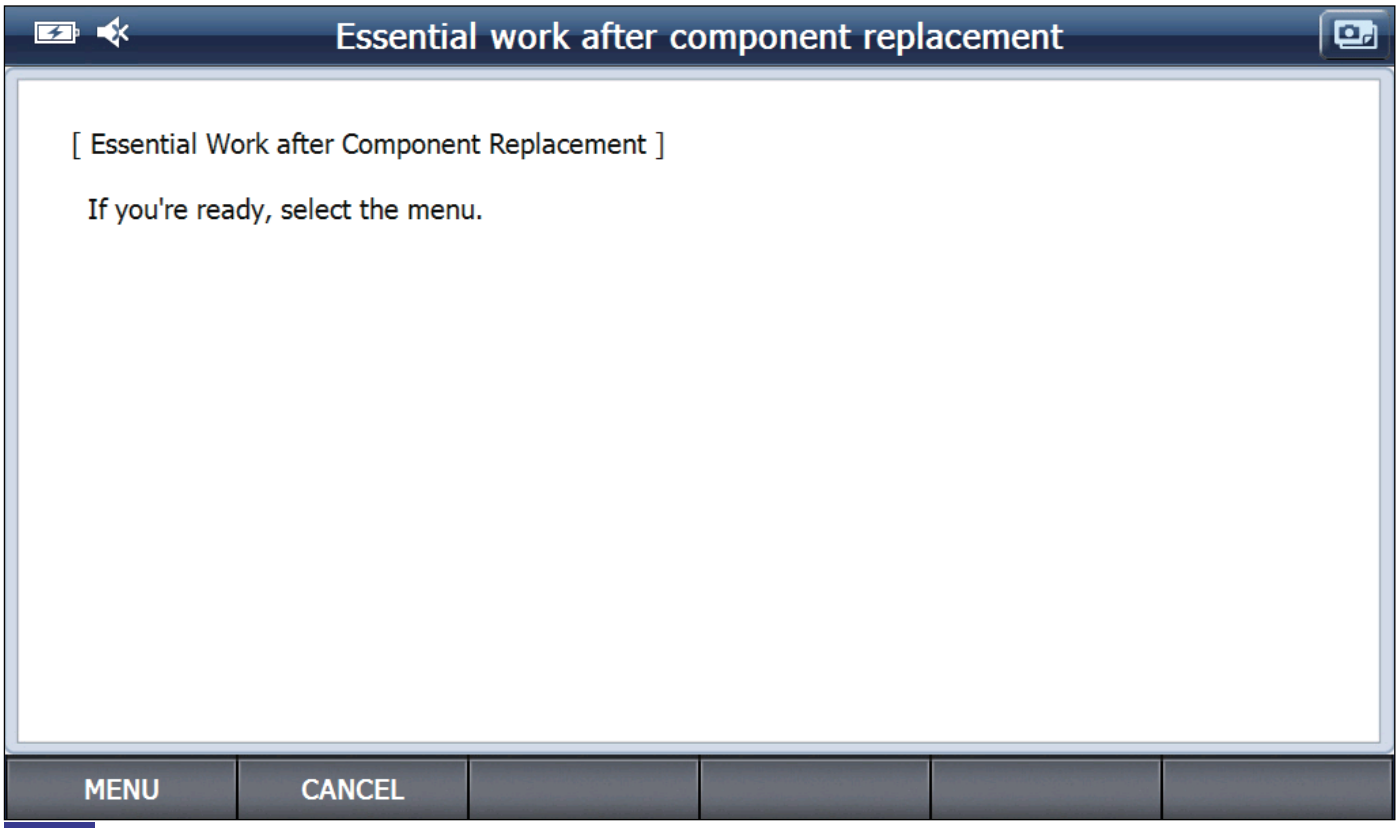


Fig.2

CRC12EN5010P01010042S

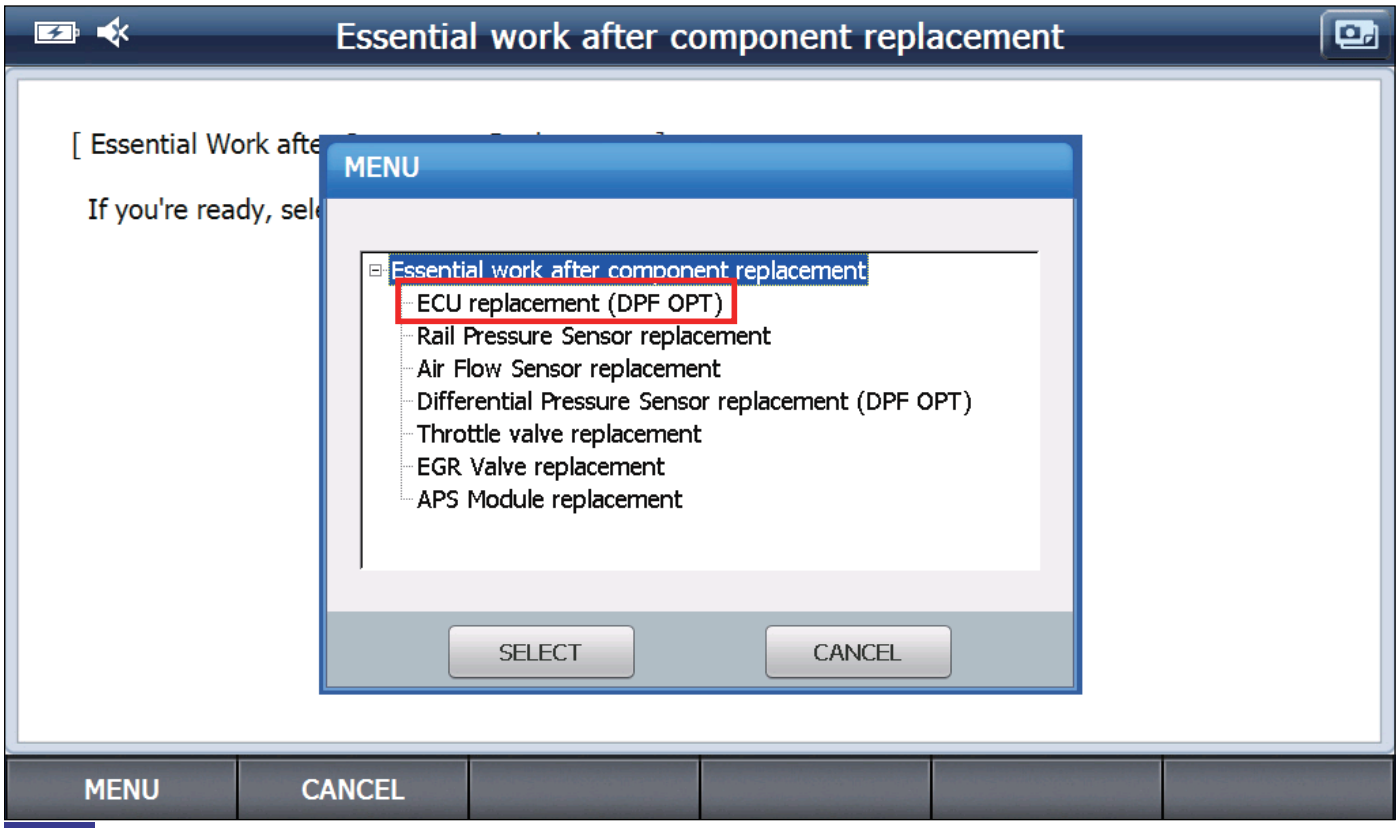


Fig.3

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.

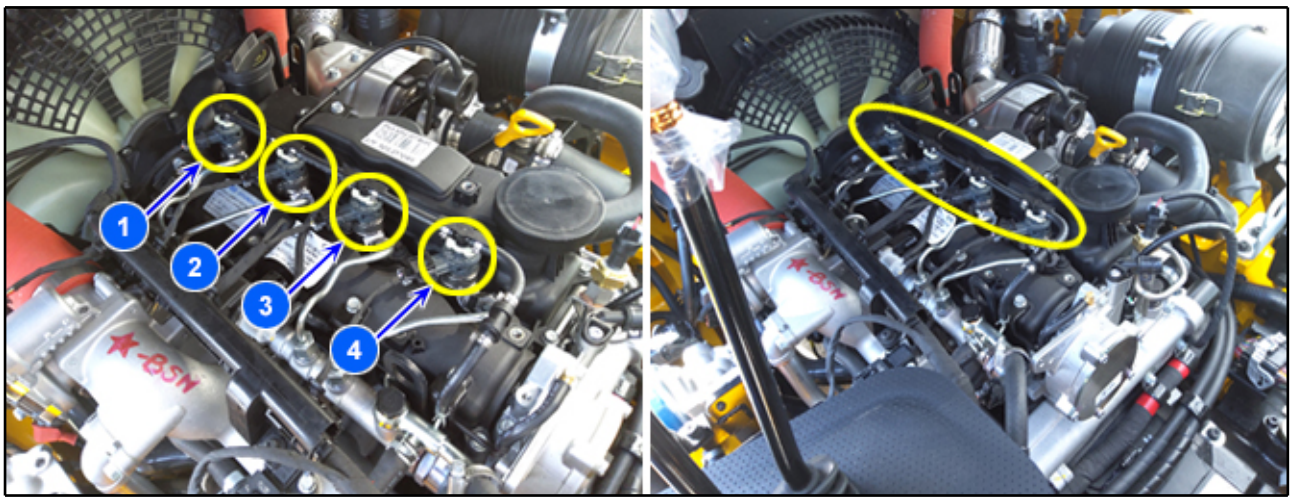
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

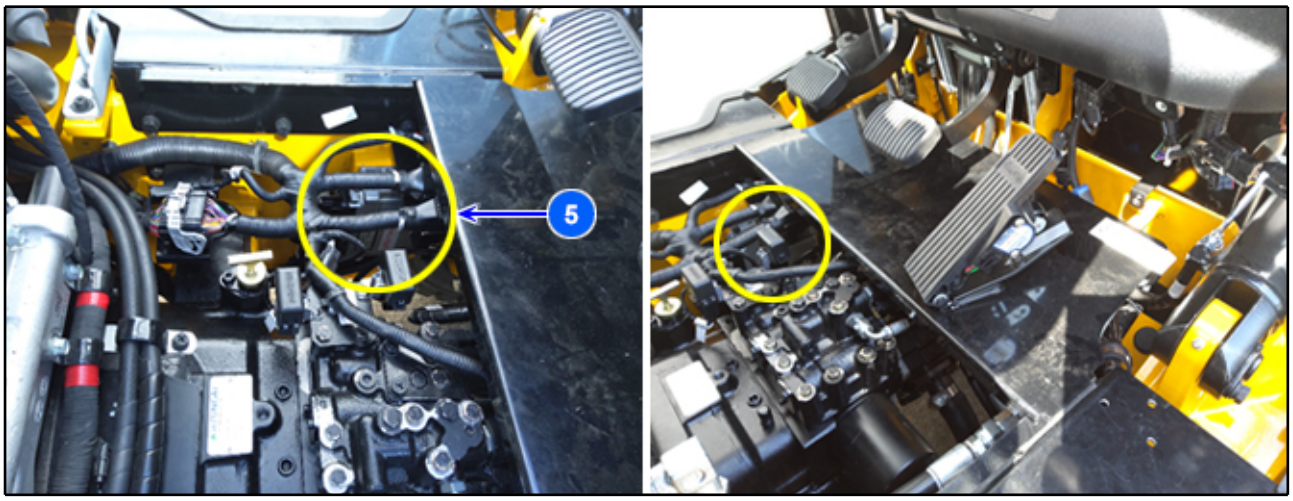
NO ▸ Problem is corrected and the system operation performs to specification at this time.

P167000 Invalid Injector IQA/C2I

Component Location



CRC12EN5010P020111



CRC12EN5010P062D12

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 as recognizing specific fuel injection map which is different for each serial number.

DTC Description

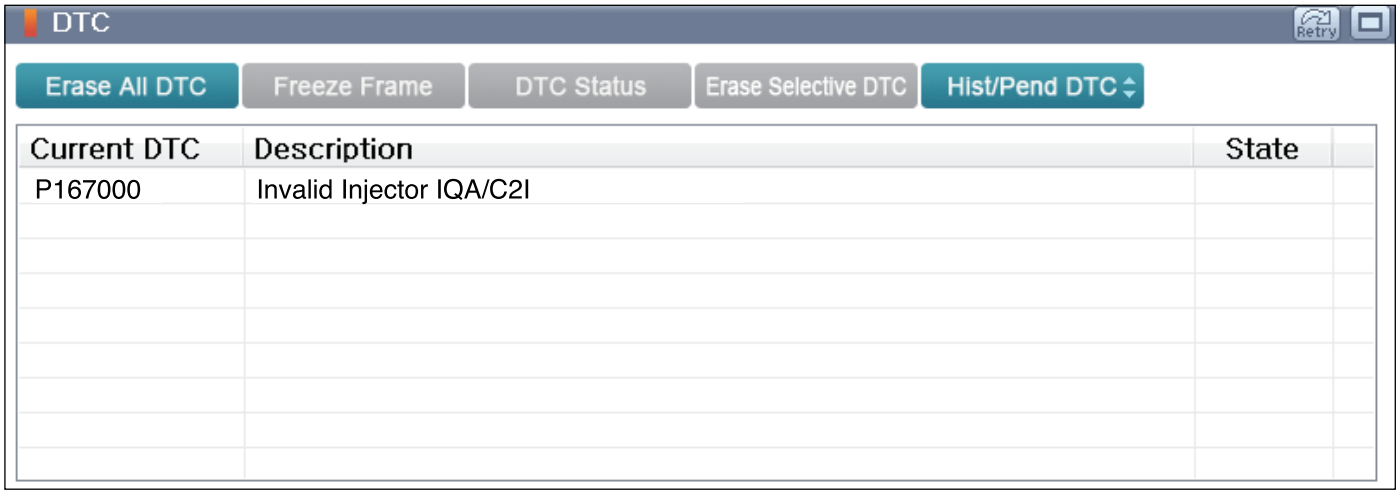
If the injector IQA data error or saved data is corrupted in EEPROM, ECM sets DTC P167000.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Internal monitoring		1. Poor connector connection 2. Defected ECM
Enable Conditions	• Ignition switch "ON"		
Threshold Value	• IQA data error is detected		
Diagnostic Time	• Immediately		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



CRC12EN5010P16700021S

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 disconnect ECM connector.
3. 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 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"
2. Disconnect battery (-) cable.
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 Ω

5. Is the measured value within specificaiton?

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" & Engine "OFF"
4. Perform "Injector Specific Data" in "Vehicle Software Management" with GDS.

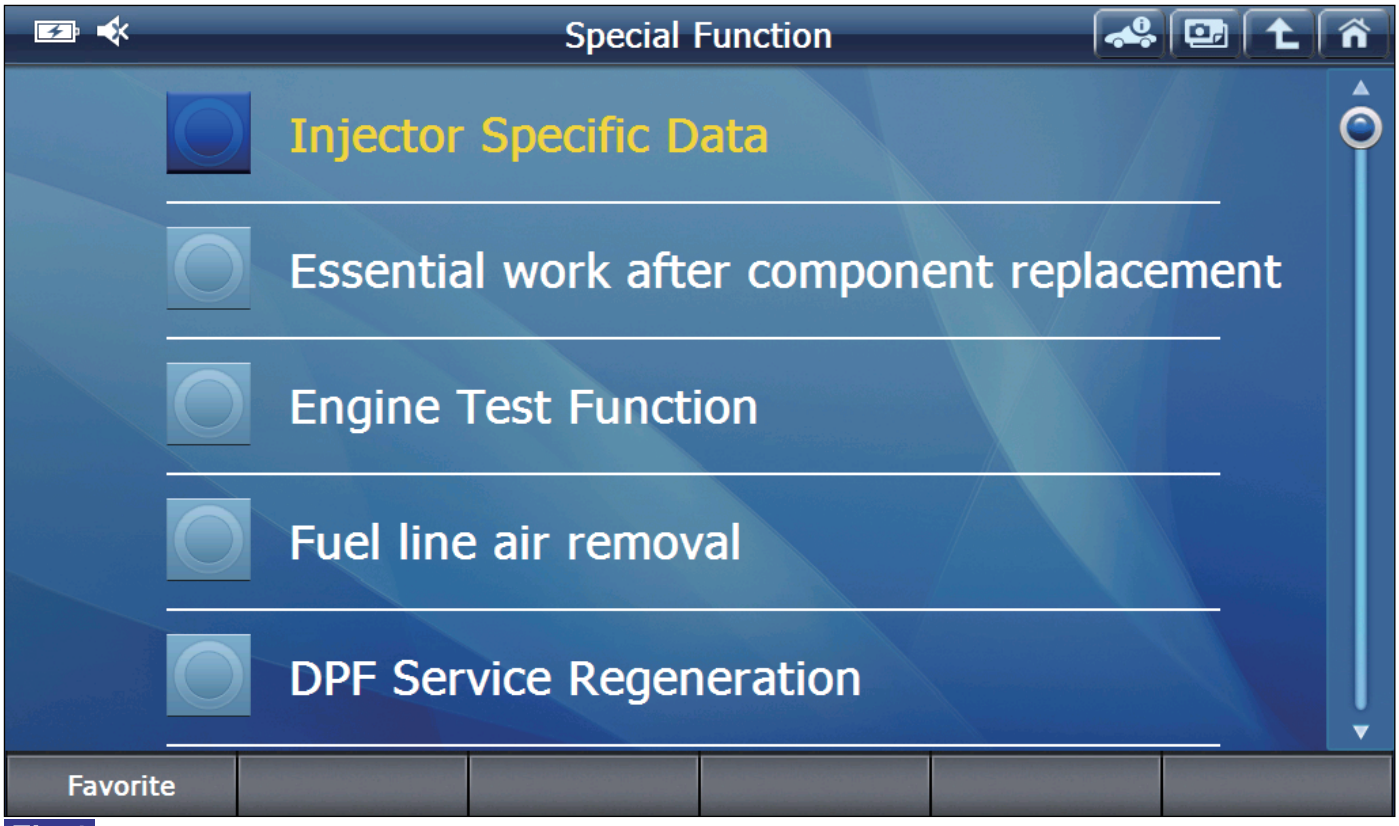


Fig.1

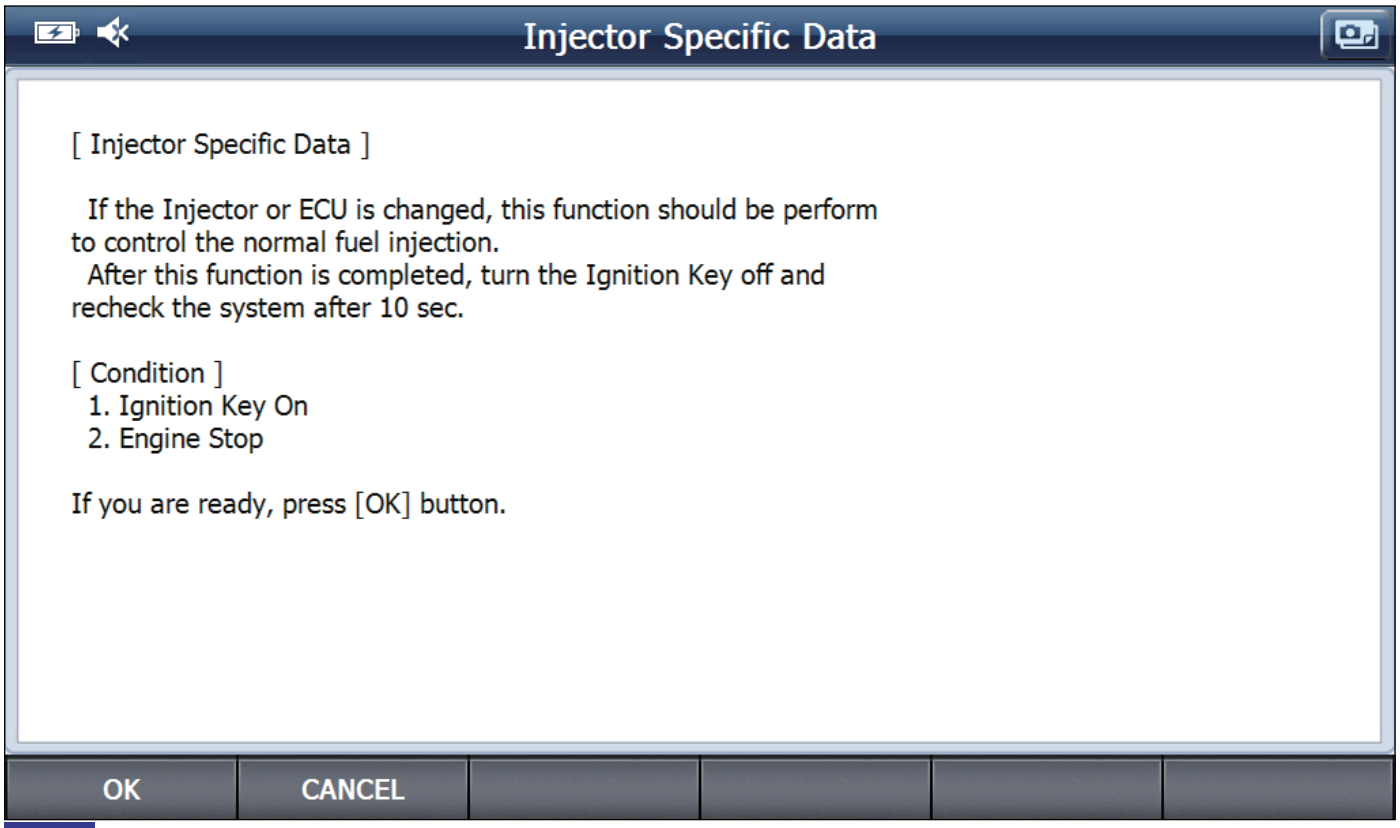


Fig.2

CRC12EN5010P16700042S

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.

⚠ 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 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"

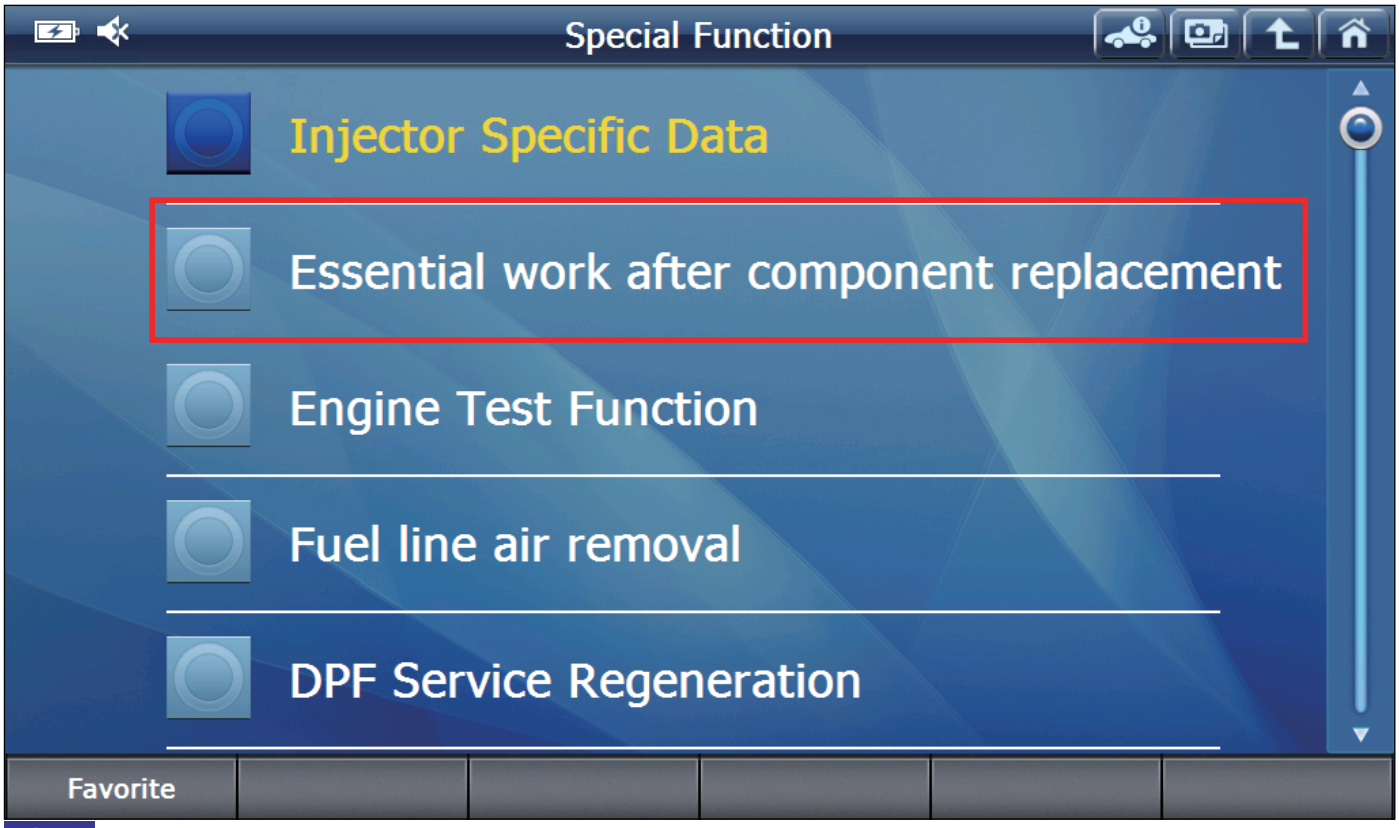


Fig.1

CRC12EN5010P01010041S

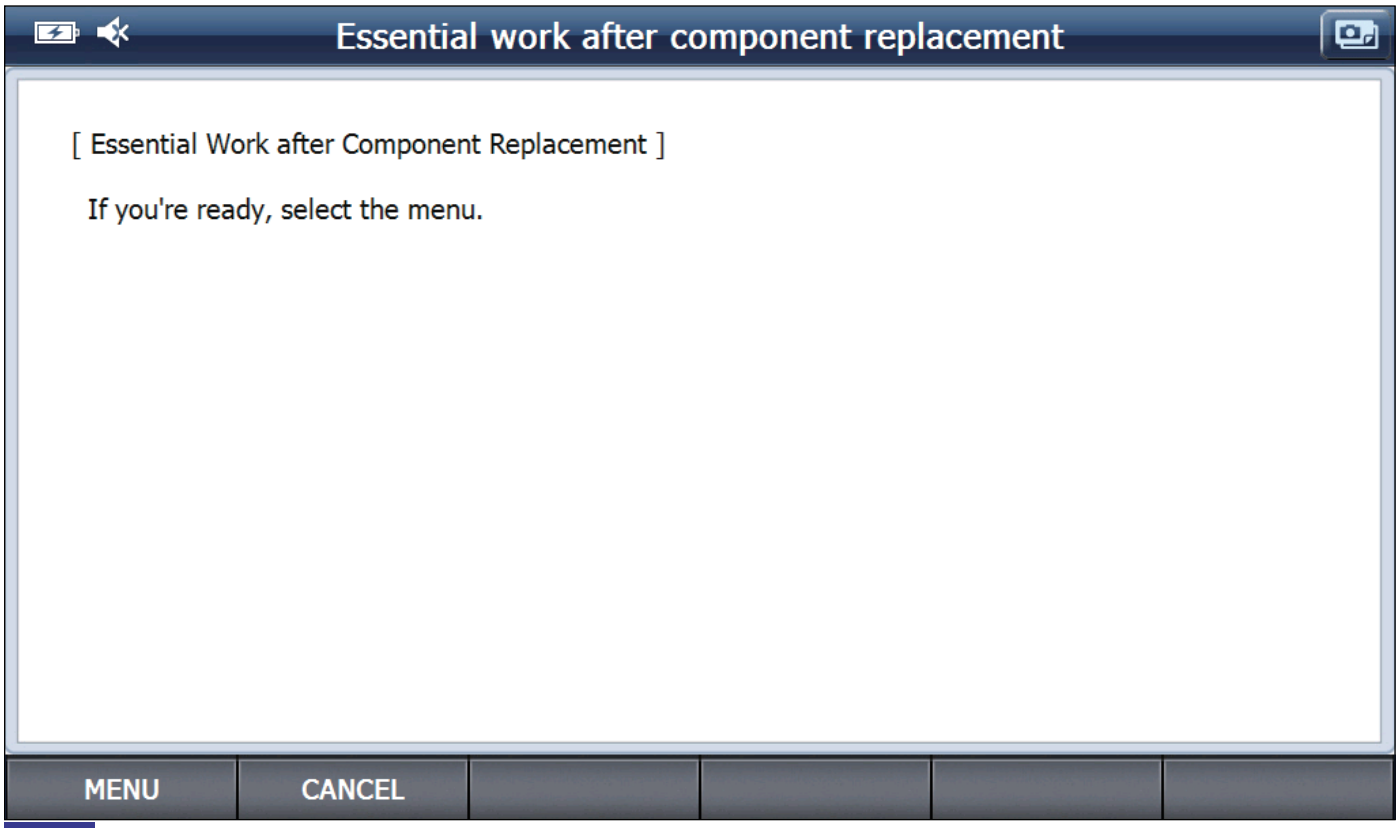


Fig.2

CRC12EN5010P01010042S

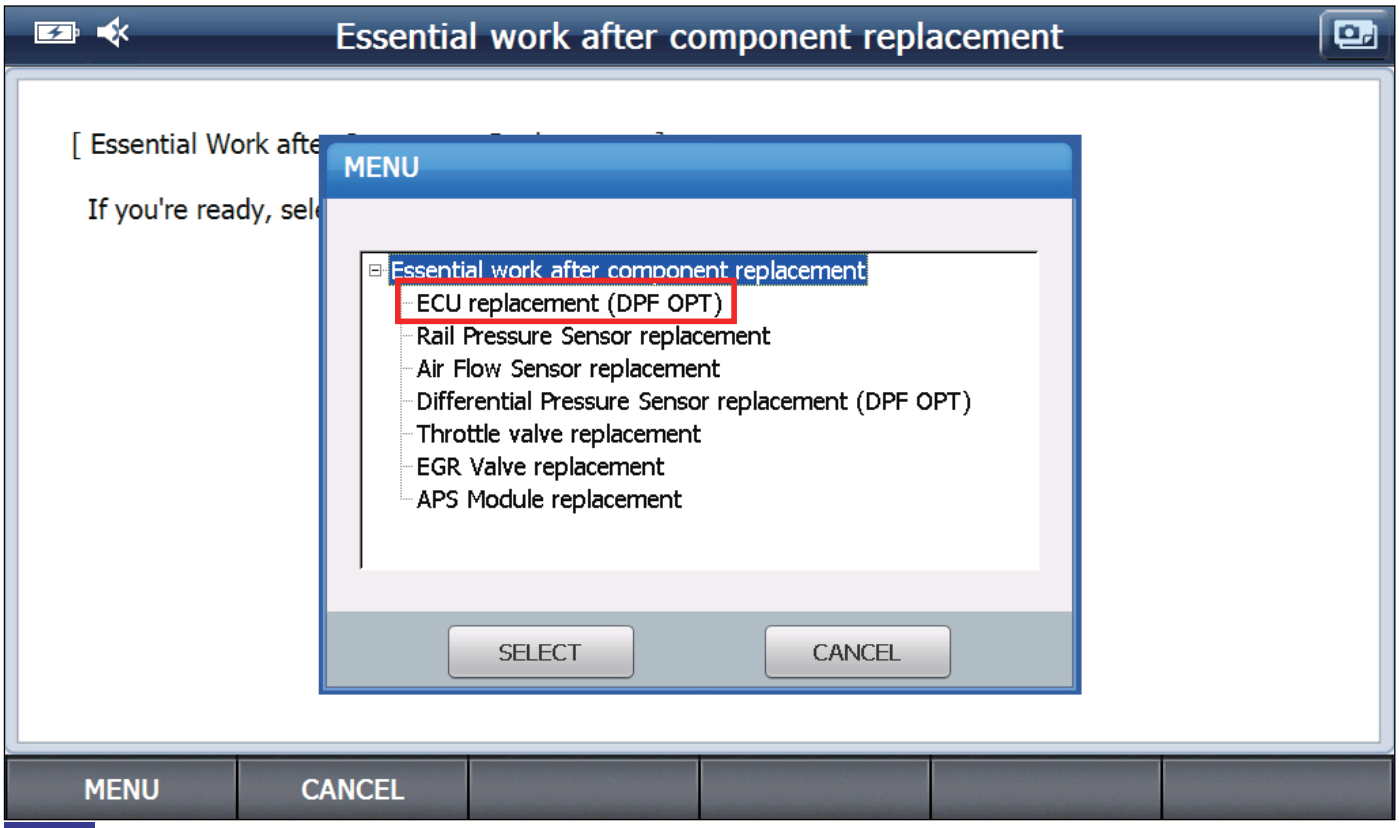


Fig.3

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.

P200200 DPF System Non Plausible

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty signal circuit of DPS 3. Defected DPS 4. Defected DPF 5. Leakage on exhaust system
Enable Condition	• Engine running		
Threshold Valu	Case 1	• If exhaust gas flow rate is increase or decrease and pressure difference from DPS is below or above set-point	
	Case 2	• DPS signal is at maximum set-point	
Detecting Time	• -		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Blink	

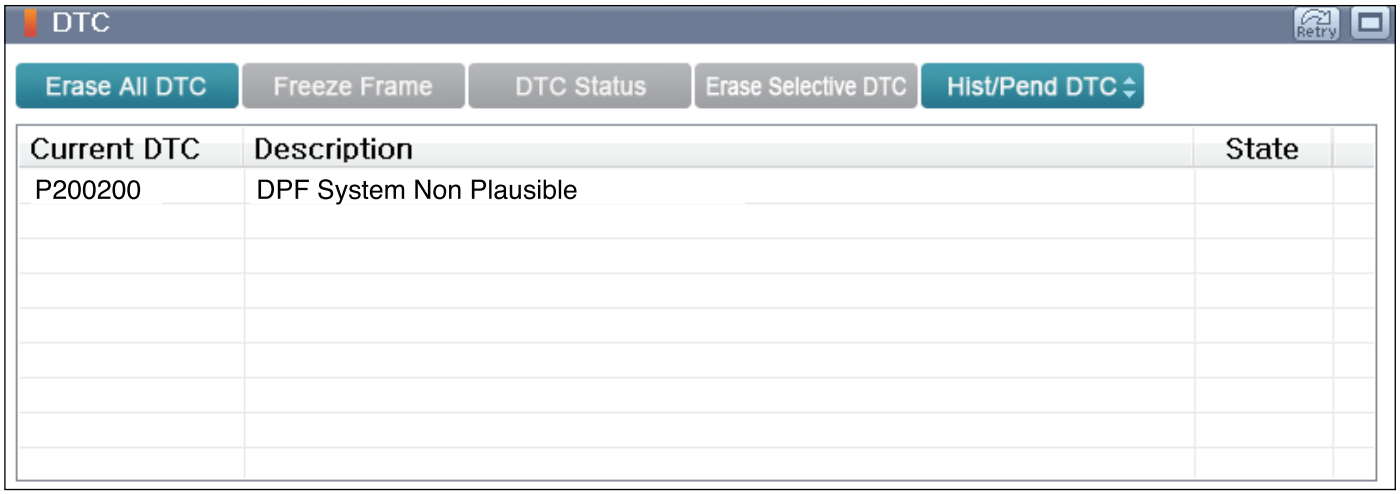
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



CRC12EN5010P20020021S

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

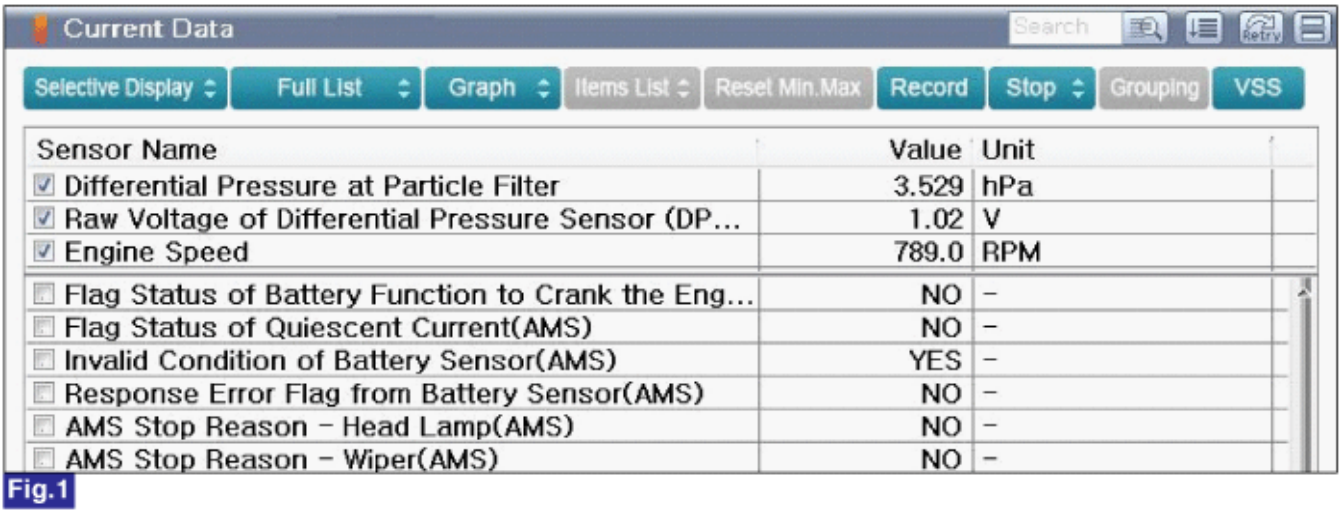


Fig.1

CRC12EN5010P04710022S

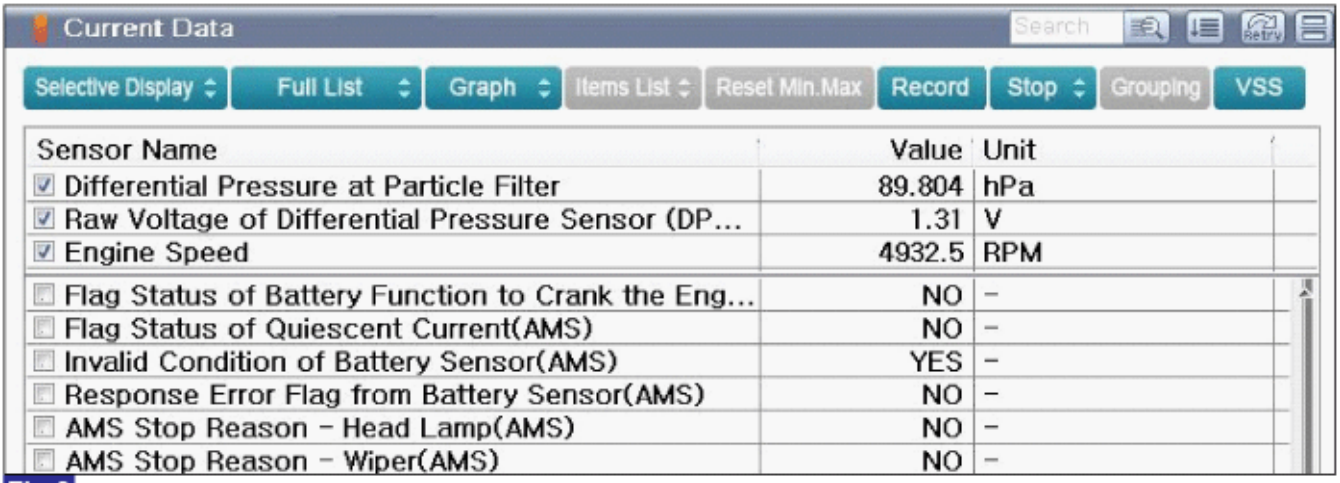


Fig.2

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. 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.

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 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 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)
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.
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.

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 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.

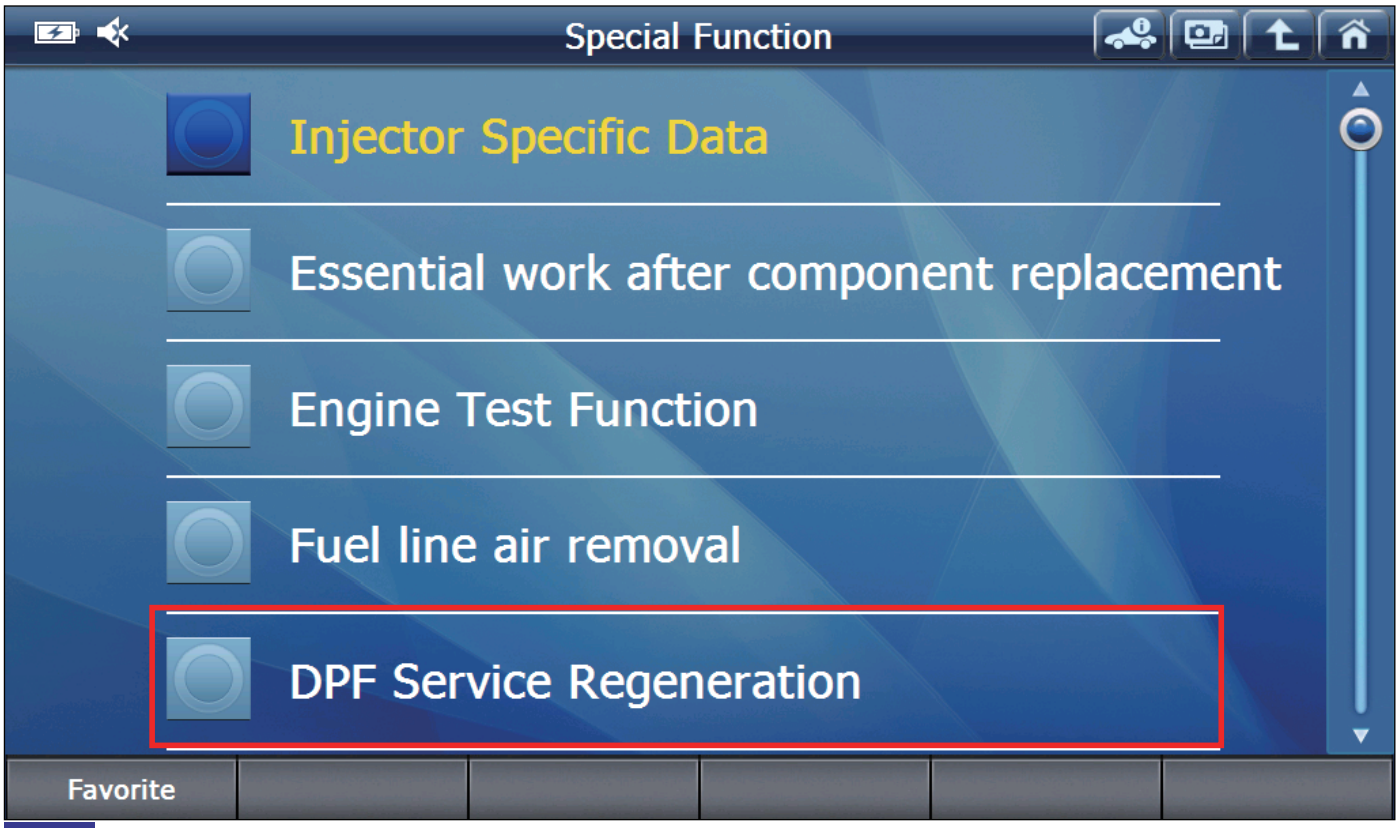


Fig.1

CRC12EN5010P04720041S

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

⚠ CAUTION

- 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.

⚠ 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.

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.

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.

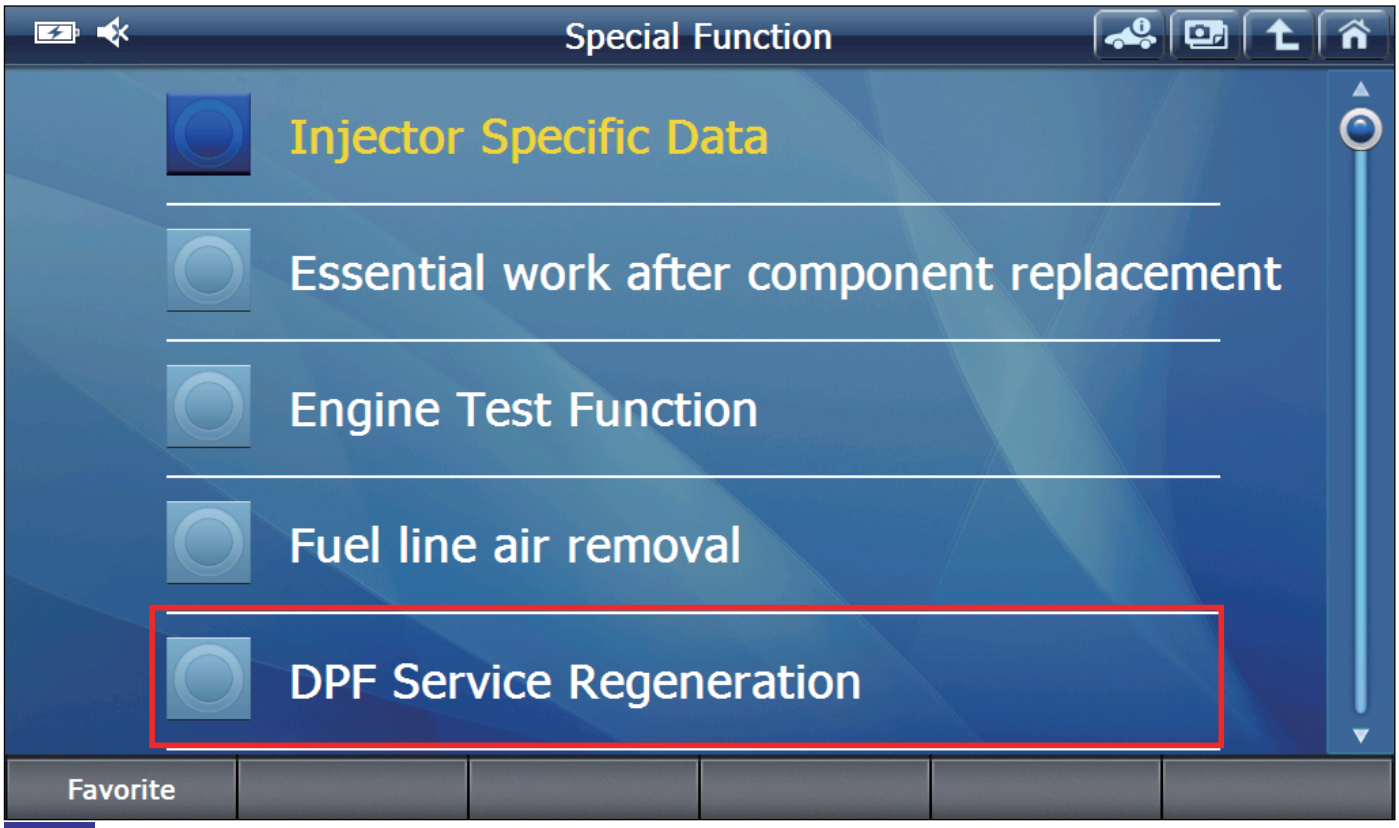


Fig.1

CRC12EN5010P04720041S

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

⚠ CAUTION

- 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.

⚠ 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.

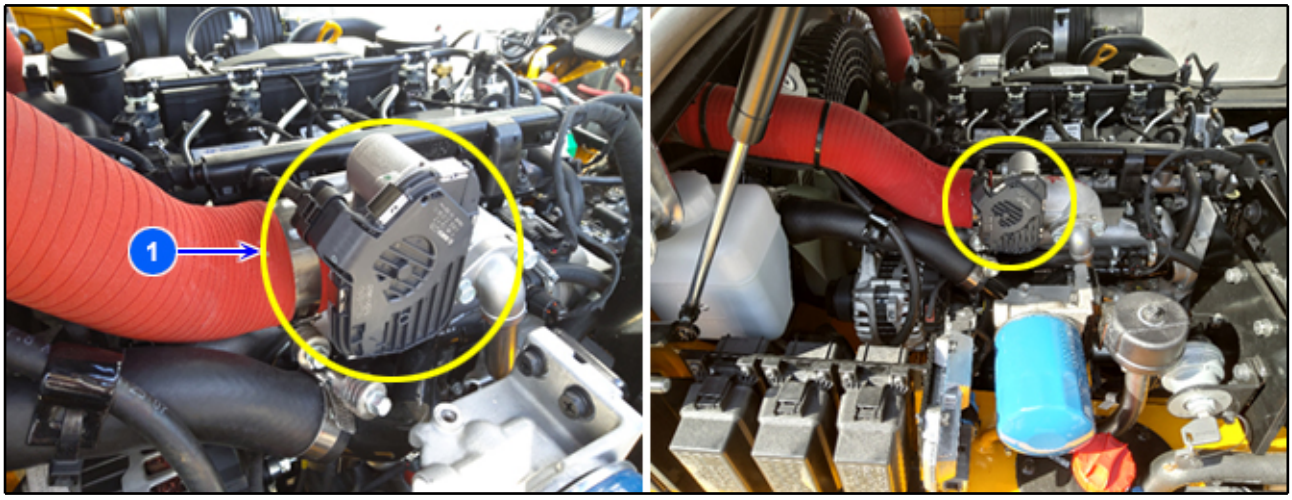
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting procedure.

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

P210100 Throttle actuator Control Motor Circuit Range/Performance

Component Location



CRC12EN5010P01220011

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.

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

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Open in control circuit of ACV 2. Short to ground in control (+) circuit of ACV 3. Short to power in control (-) circuit of ACV 4. Defected ACV
Enable Condition	• Engine running		
Threshold Valu	Case 1	• Difference in actual and target value is detected	
	Case 2	• Low voltage error on ACV • High current error on ACV	
Detecting Time	• 2 sec. (Case 2)		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• Off (Case 1) • On (Case 2)	

Vehicle Data

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

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

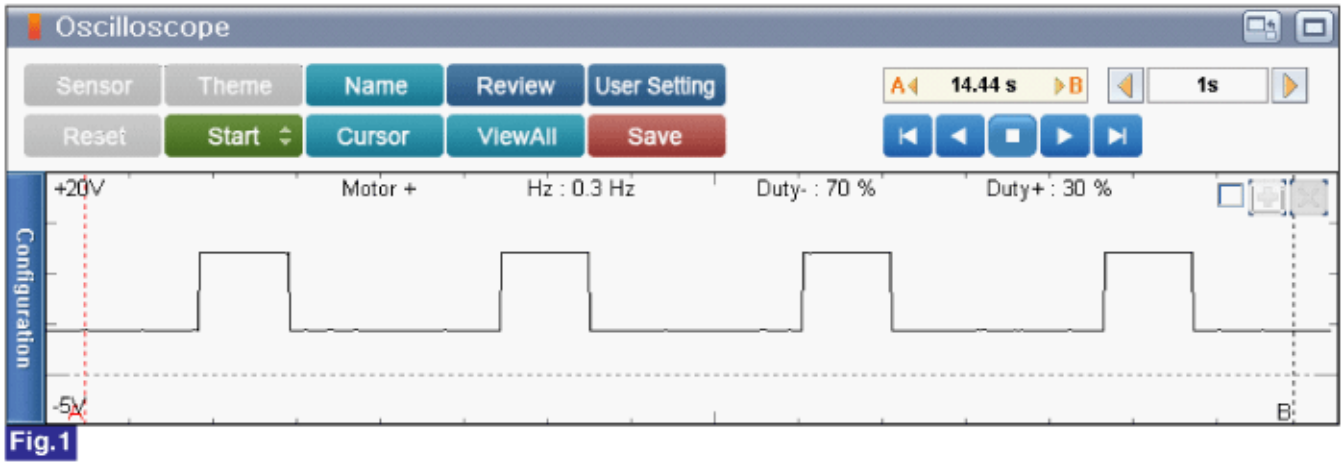


Fig.1

CRC12EN5010P01220011S

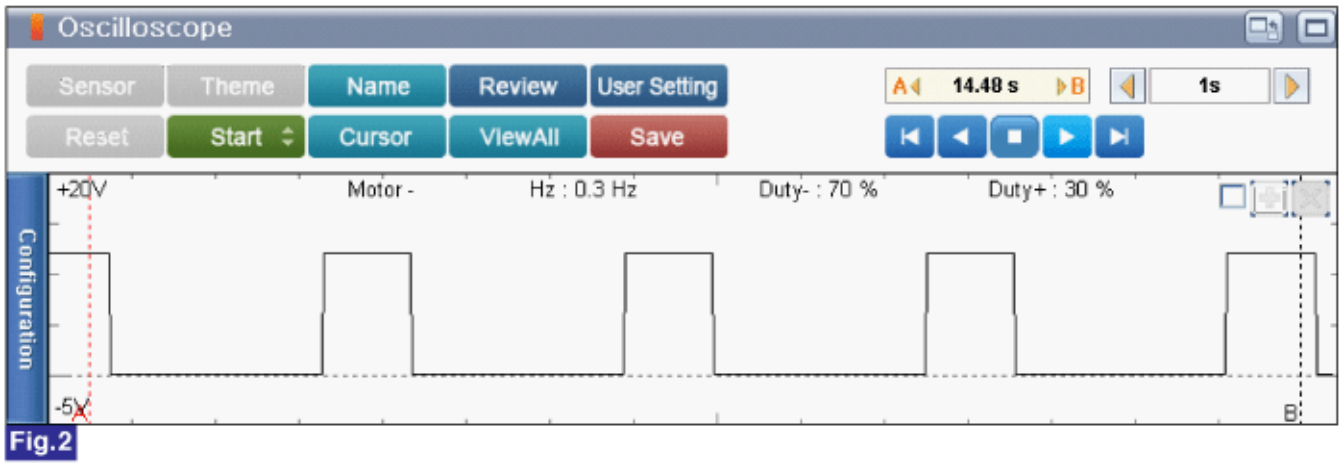


Fig.2

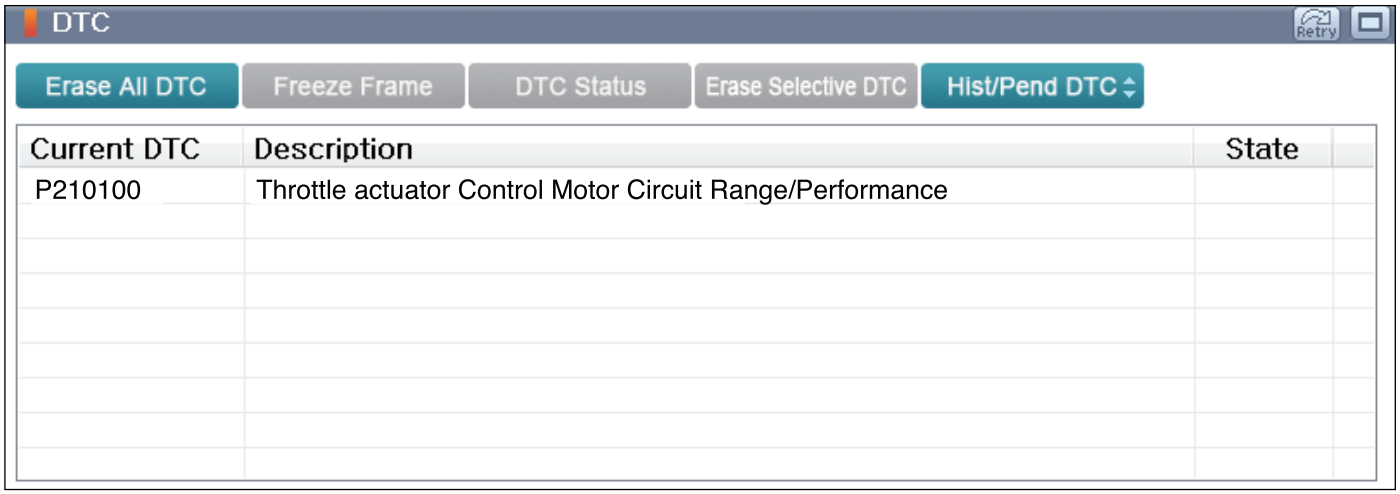
CRC12EN5010P01220012S

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.



CRC12EN5010P21010021S

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

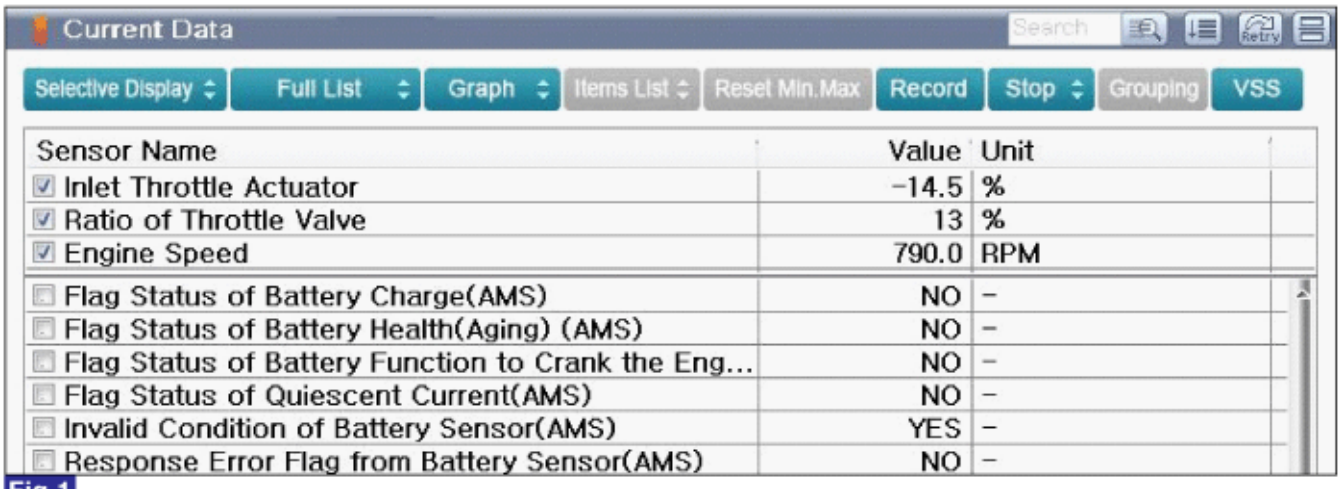


Fig.1

CRC12EN5010P01220022S

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.

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.
5. Measure the voltage between motor(-) terminal of 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 (∞ Ω)

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.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of ACV.

Specification :Approx. 2.92 ~ 2.98Ω (Approx. 20℃/Approx. 68℉)

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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

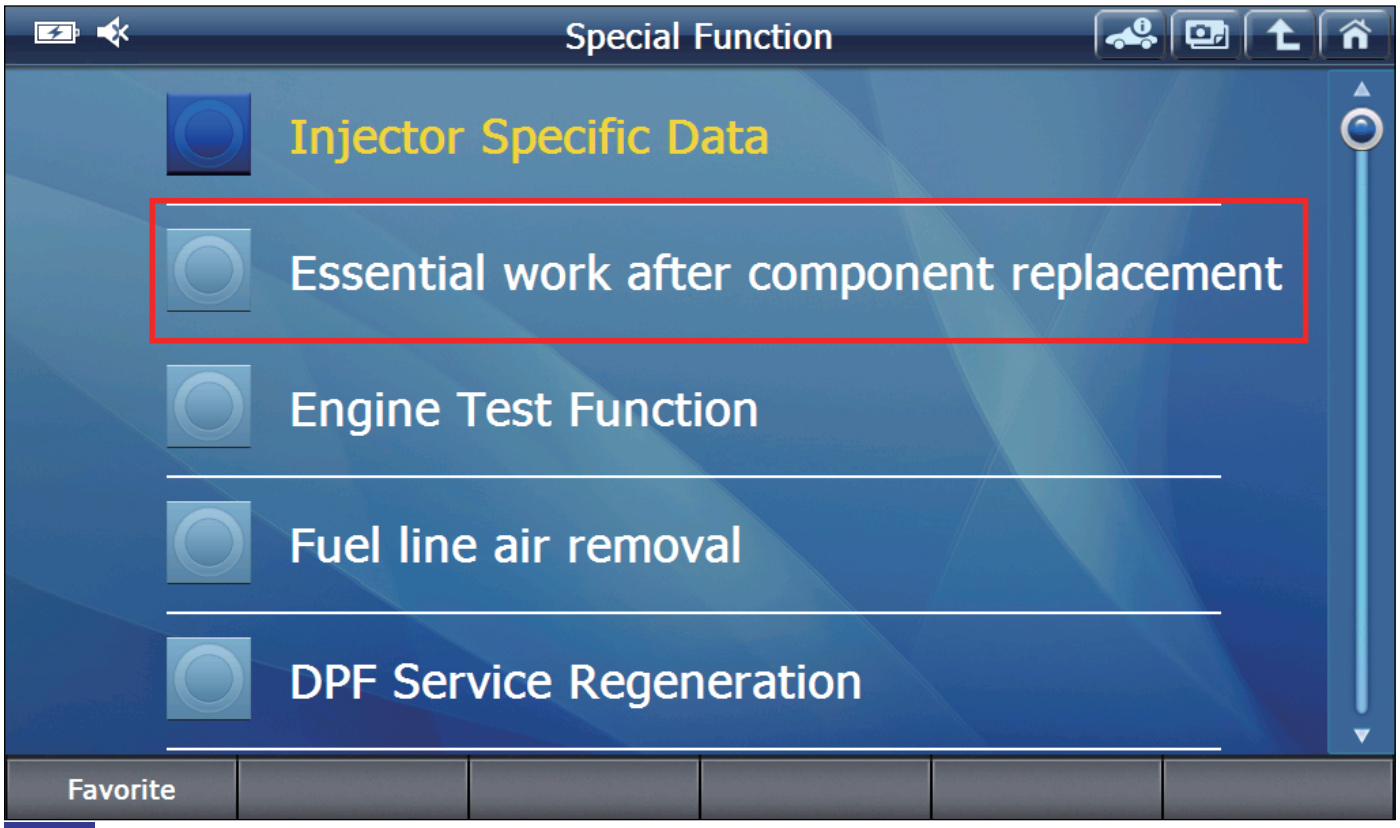


Fig.1

CRC12EN5010P01010041S

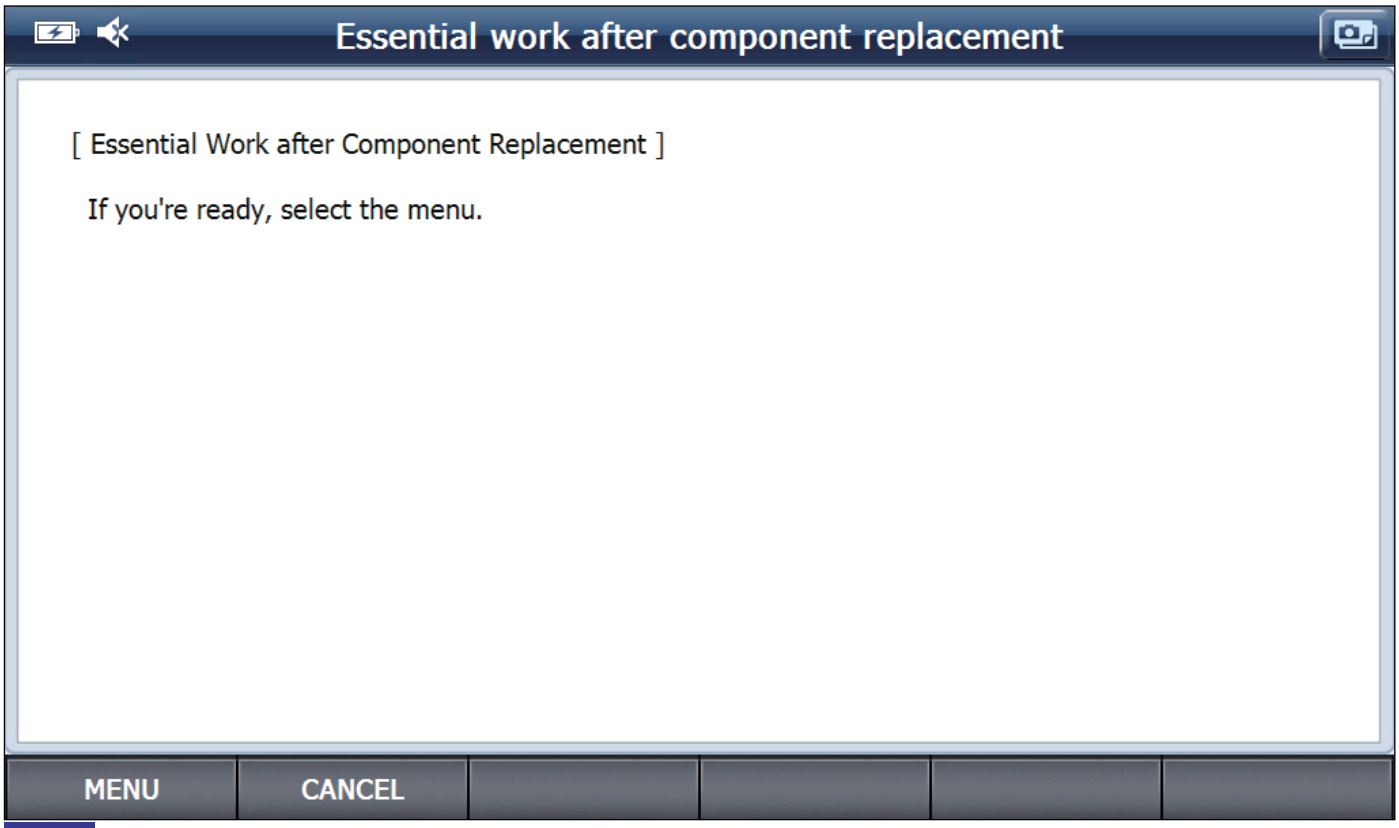


Fig.2

CRC12EN5010P01010042S

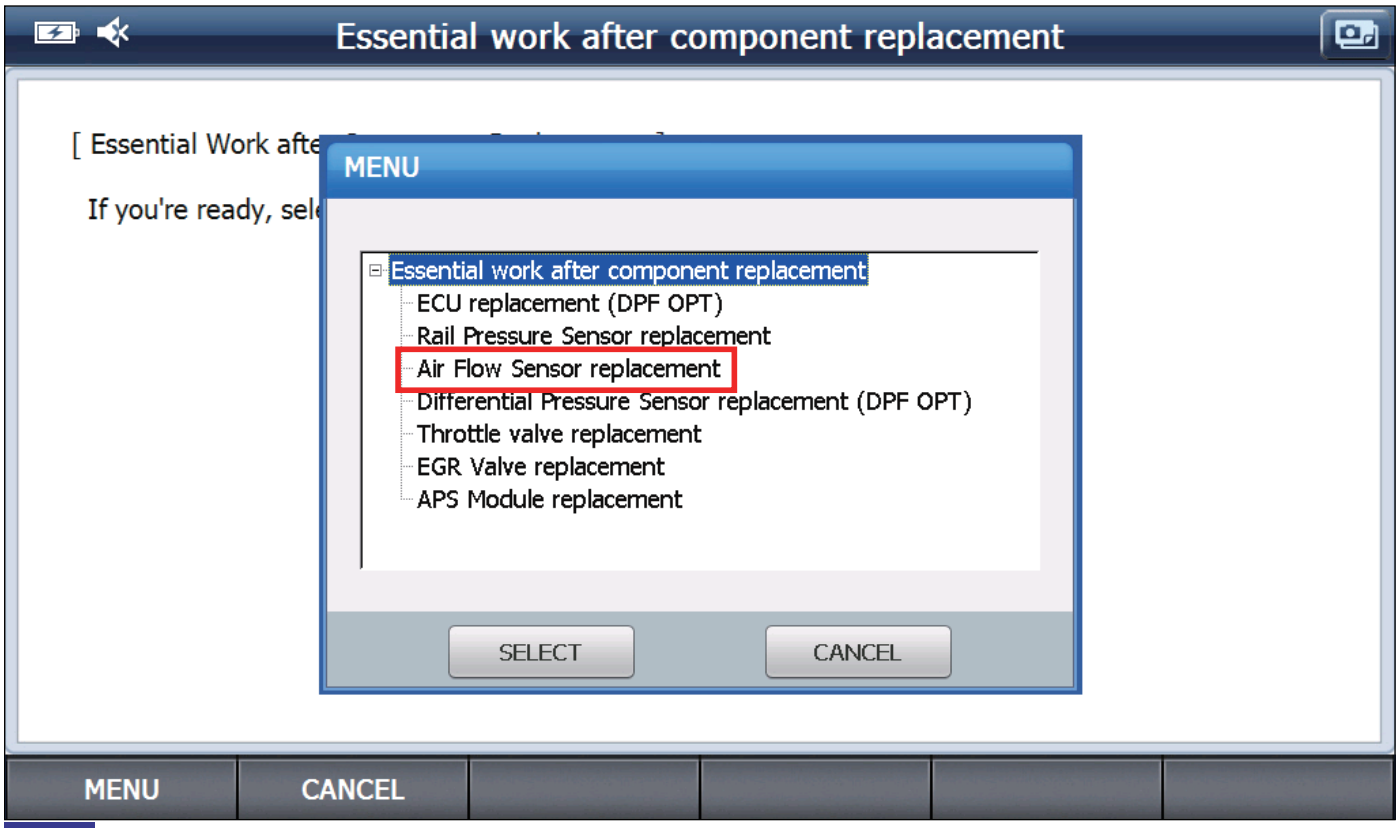


Fig.3

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.

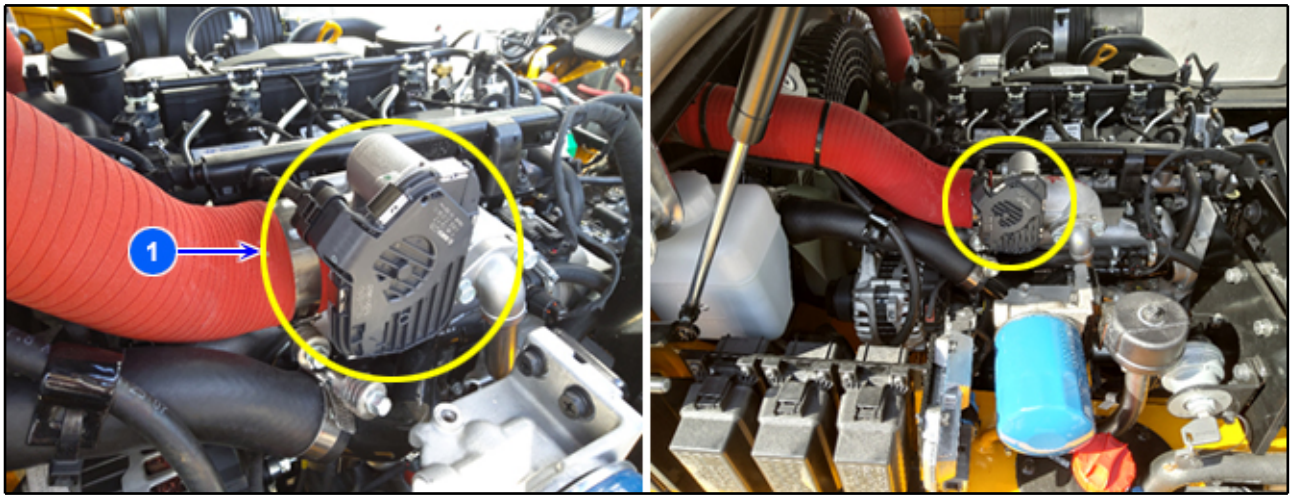
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P210200 Throttle Actuator Control Motor Circuit Low

Component Location



CRC12EN5010P01220011

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.

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.

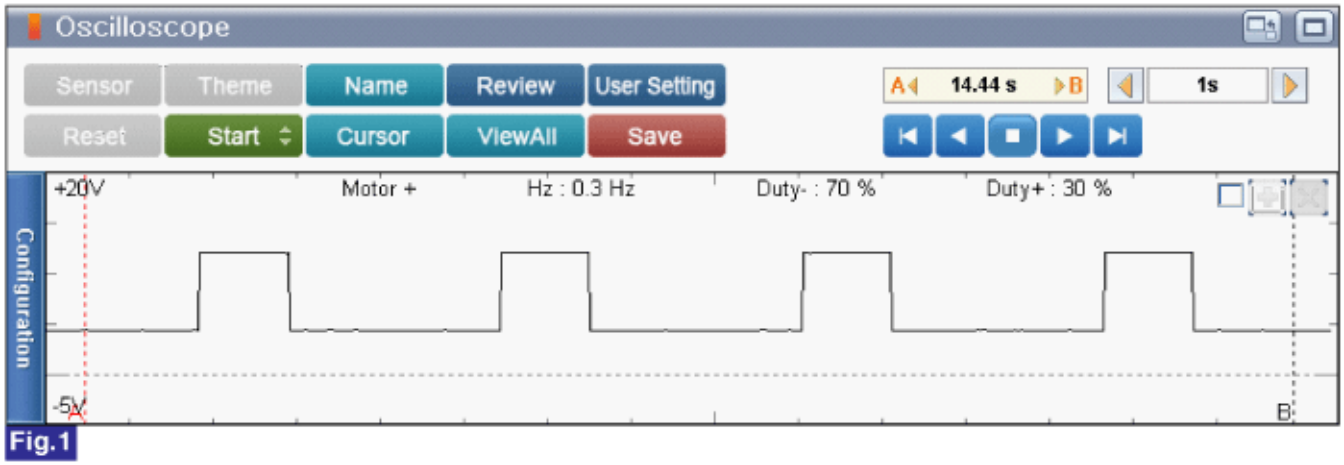
DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Open in control circuit of ACV 2. Short to ground in control (+) circuit of ACV 3. Short to ground in control (-) circuit of ACV 4. Defected ACV
Enable Conditions	• Engine running		
Threshold Value	• Open or short to ground in control circuit of ACV		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

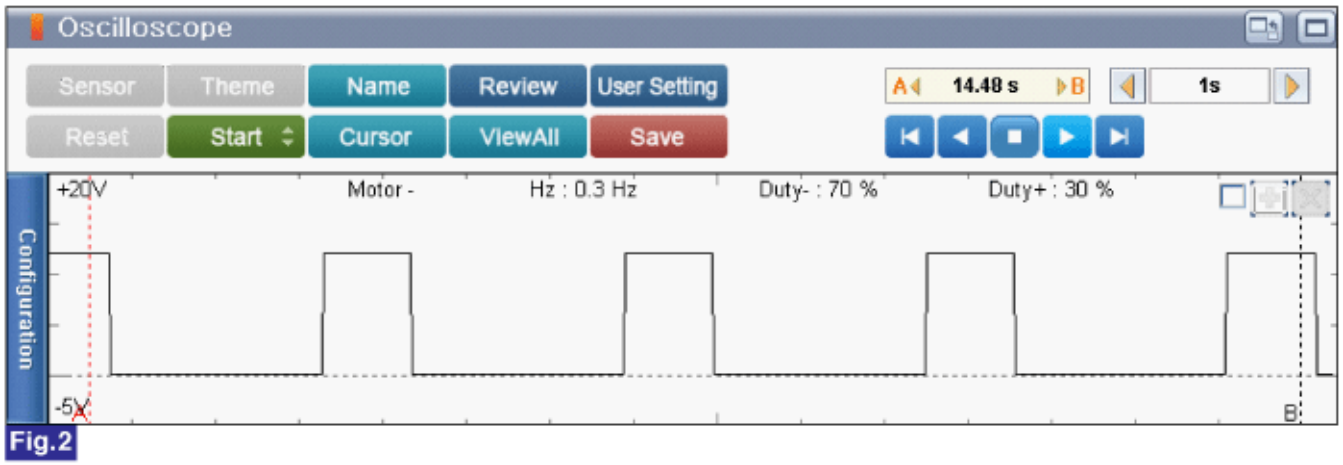
Vehicle Data

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

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



CRC12EN5010P01220011S



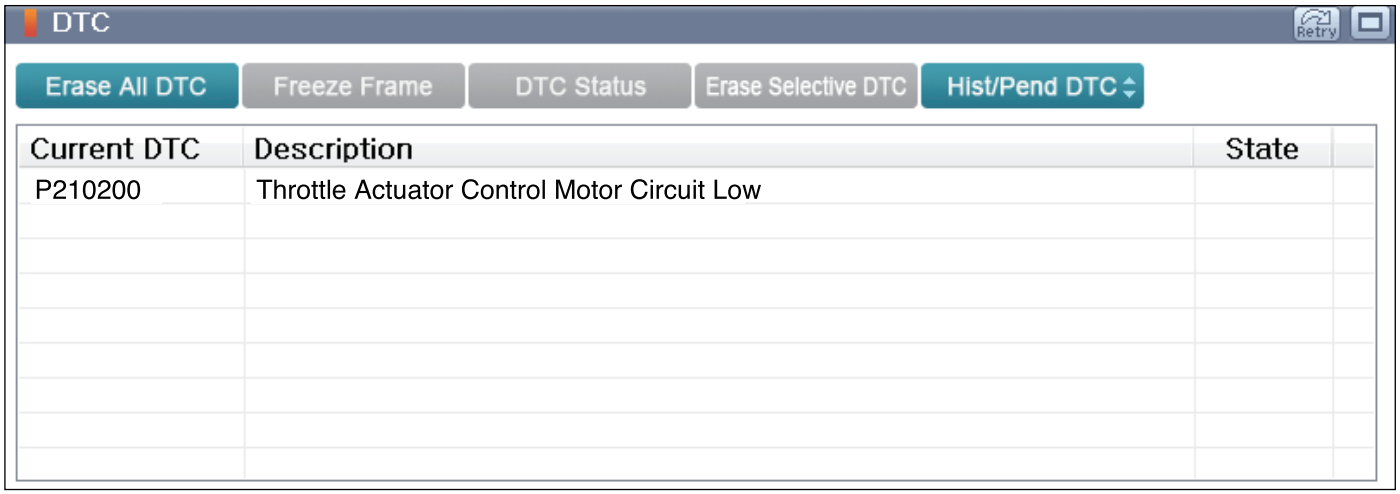
CRC12EN5010P01220012S

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.



CRC12EN5010P21020021S

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

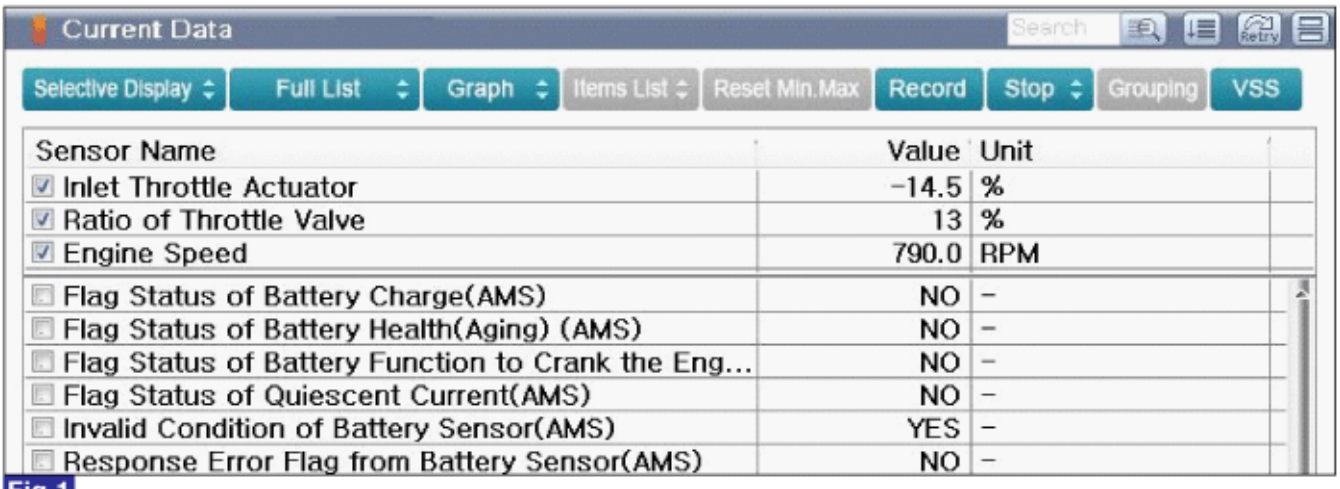


Fig.1

CRC12EN5010P01220022S

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.

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.
5. Measure the voltage between motor(-) terminal of 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 (∞ Ω)

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.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of ACV.

Specification :Approx. 2.92 ~ 2.98Ω (Approx. 20℃/Approx. 68℉)

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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

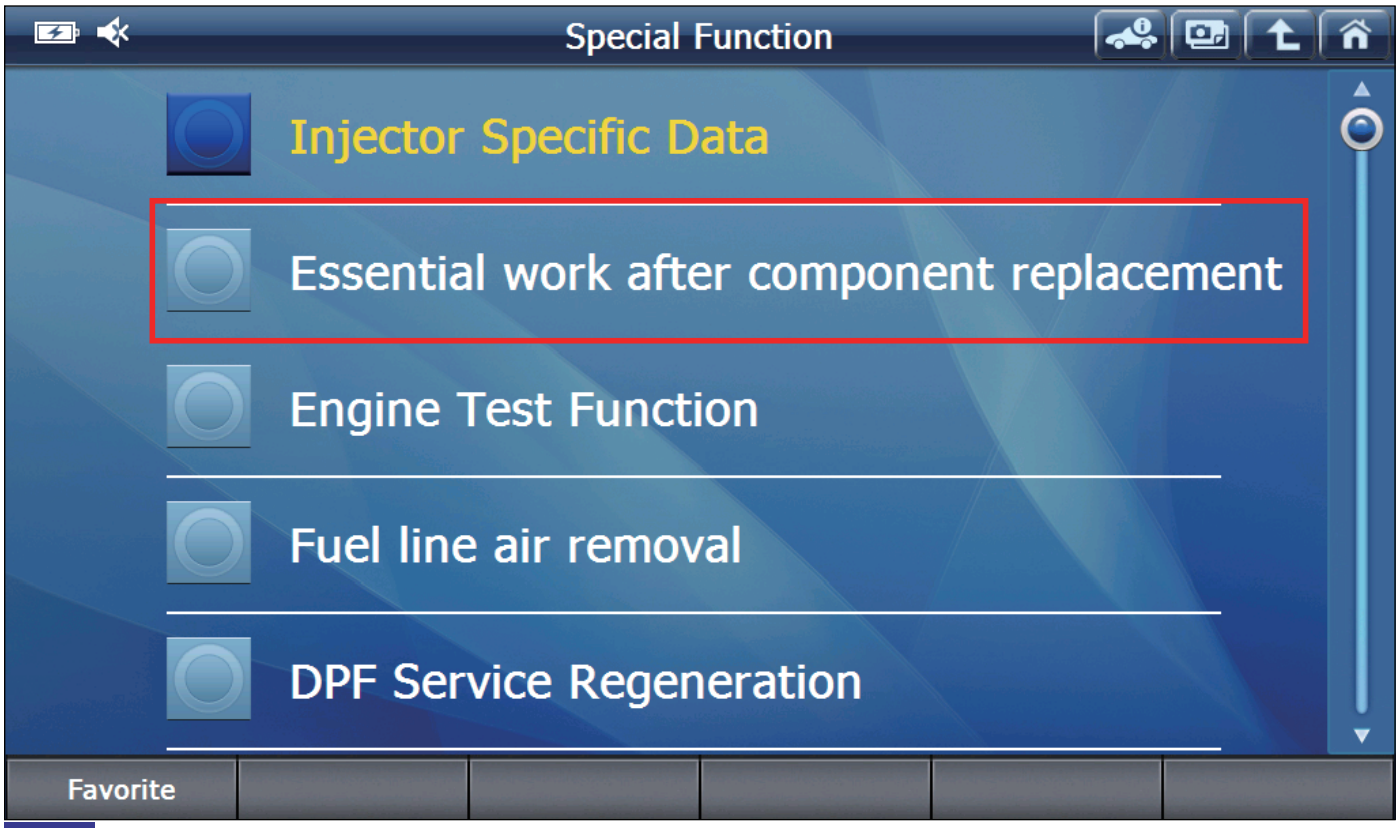


Fig.1

CRC12EN5010P01010041S

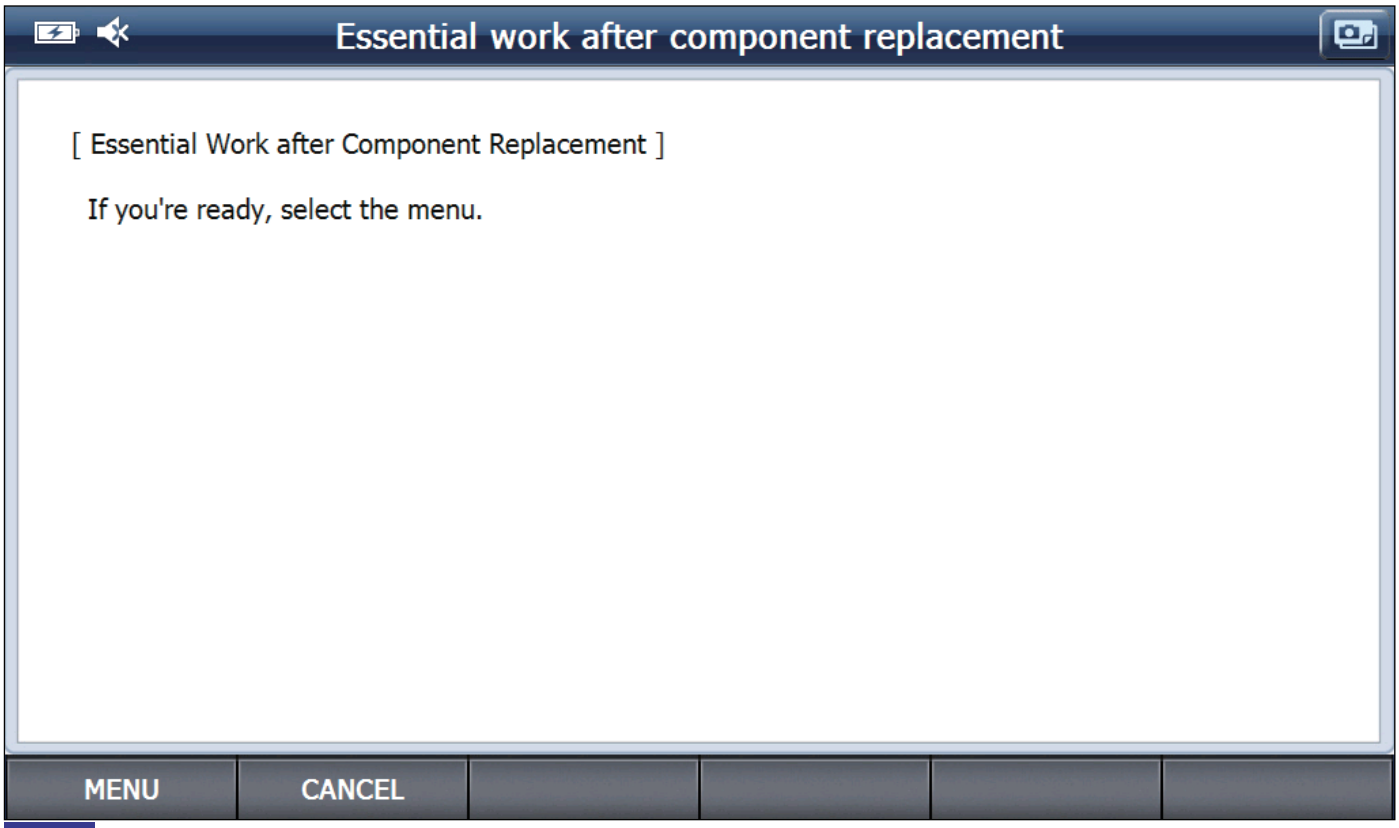


Fig.2

CRC12EN5010P01010042S

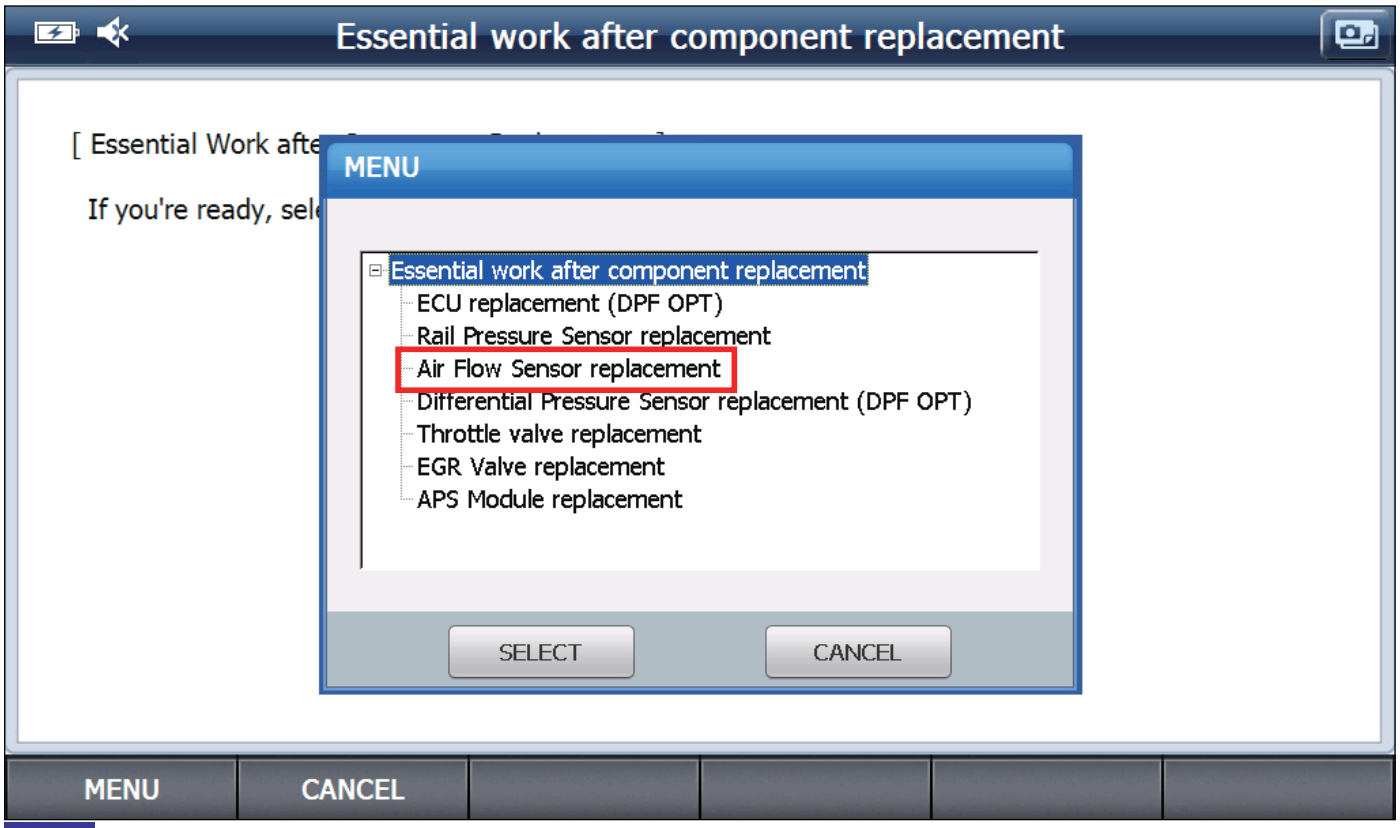


Fig.3

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.

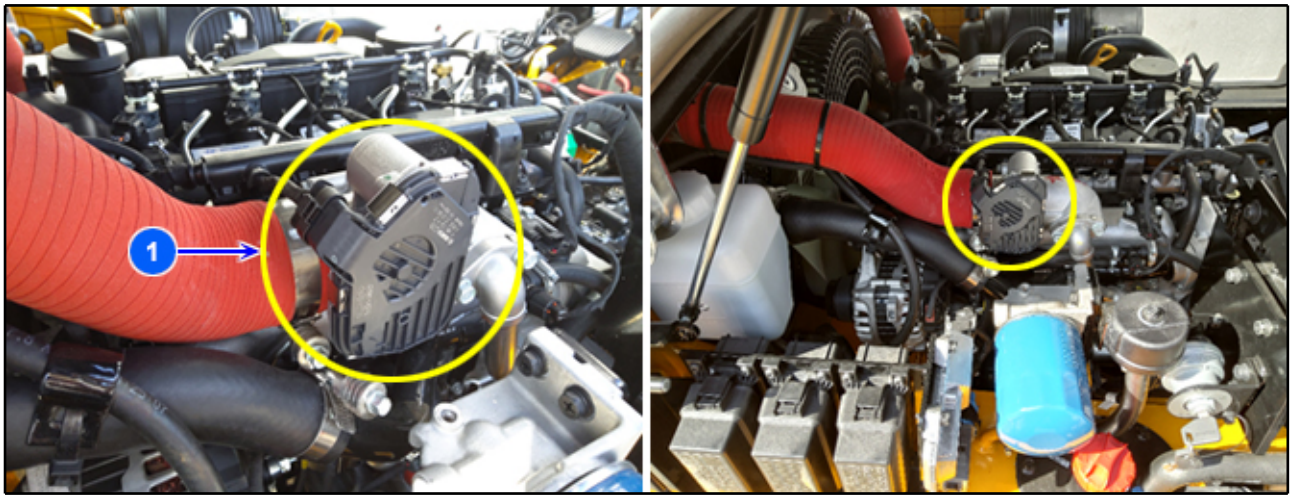
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P01220011

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.

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.

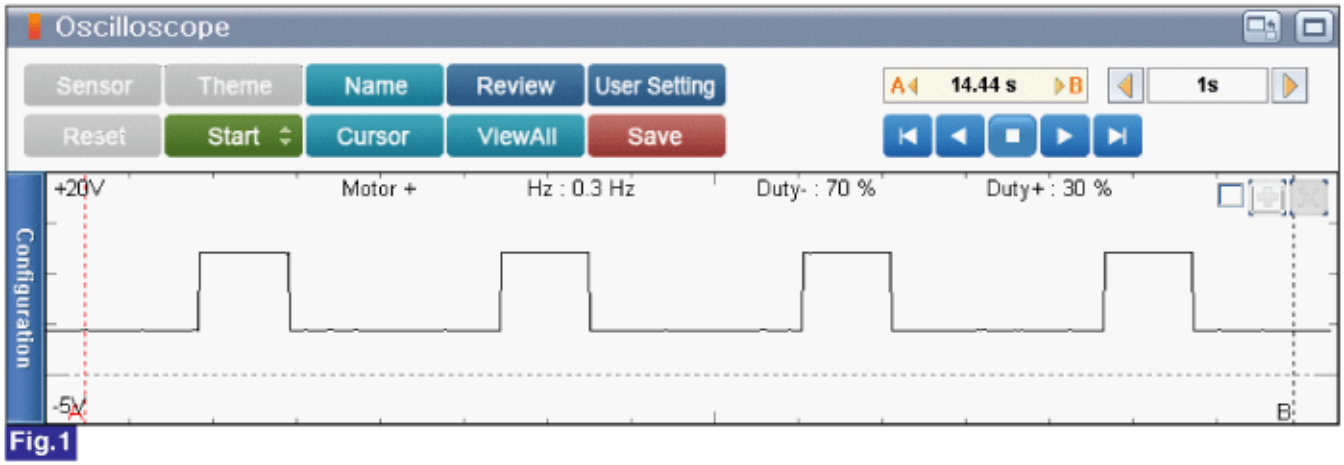
DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Short in control circuit of ACV 2. Short to power in control (+) circuit of ACV 3. Short to power in control (-) circuit of ACV 4. Defected ACV
Enable Conditions	• Engine running		
Threshold Value	• Short or short to power in control circuit of ACV		
Diagnostic Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

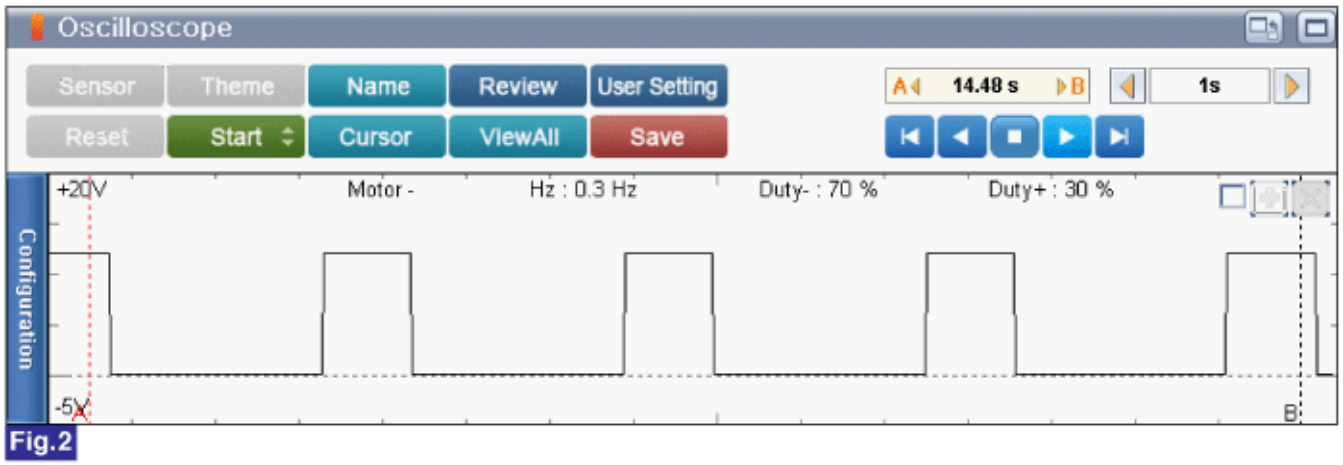
Vehicle Data

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

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



CRC12EN5010P01220011S



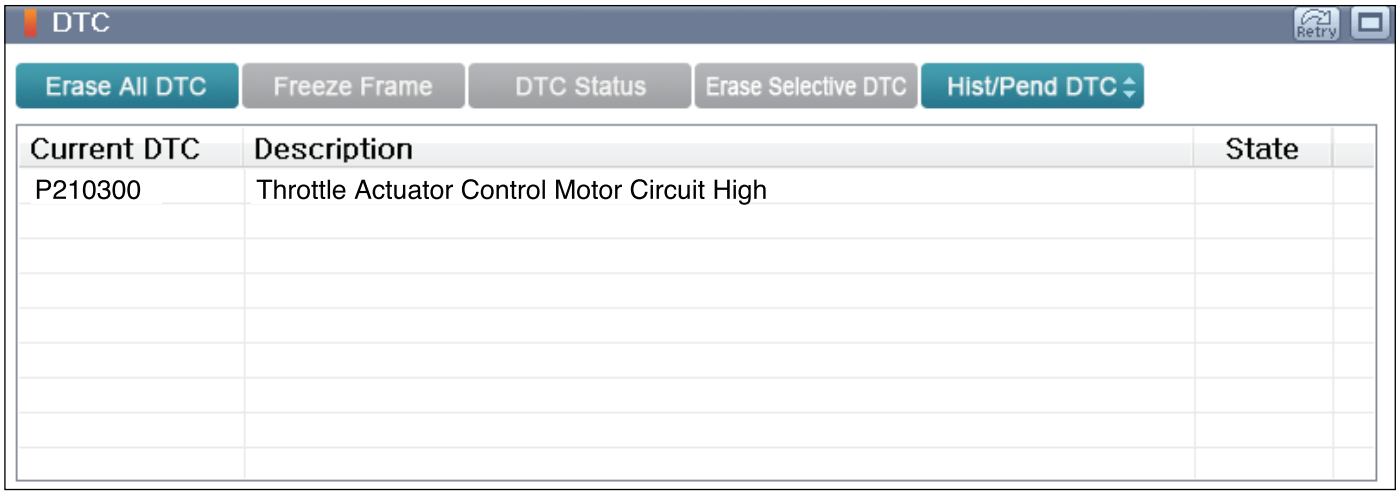
CRC12EN5010P01220012S

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.



CRC12EN5010P21030021S

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

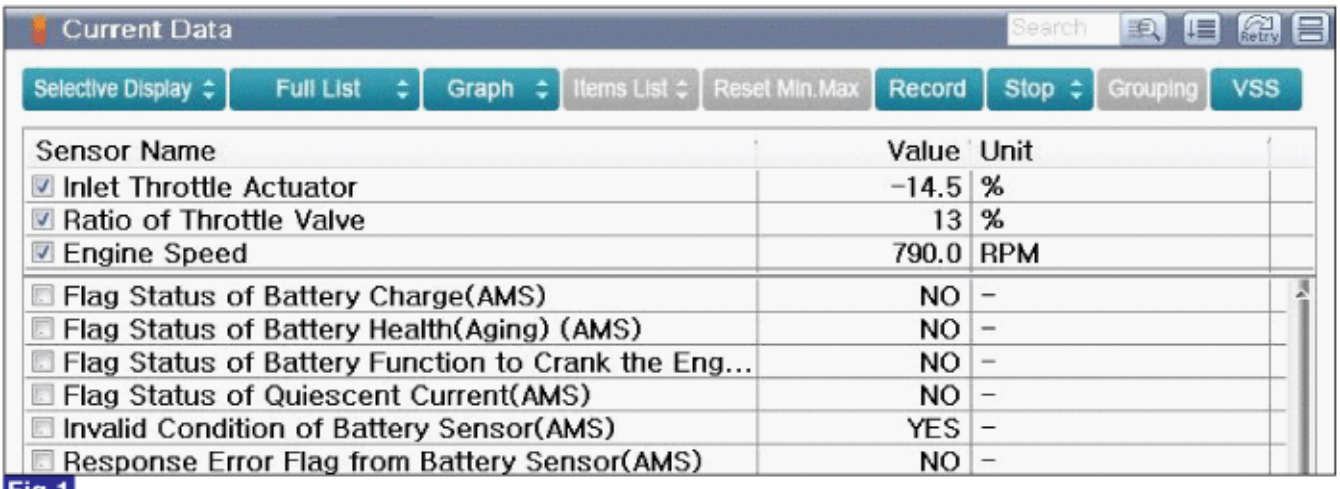


Fig.1

CRC12EN5010P01220022S

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.

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.
5. Measure the voltage between motor(-) terminal of 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 (∞ Ω)

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.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of ACV.

Specification :Approx. 2.92 ~ 2.98Ω (Approx. 20℃/Approx. 68℉)

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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

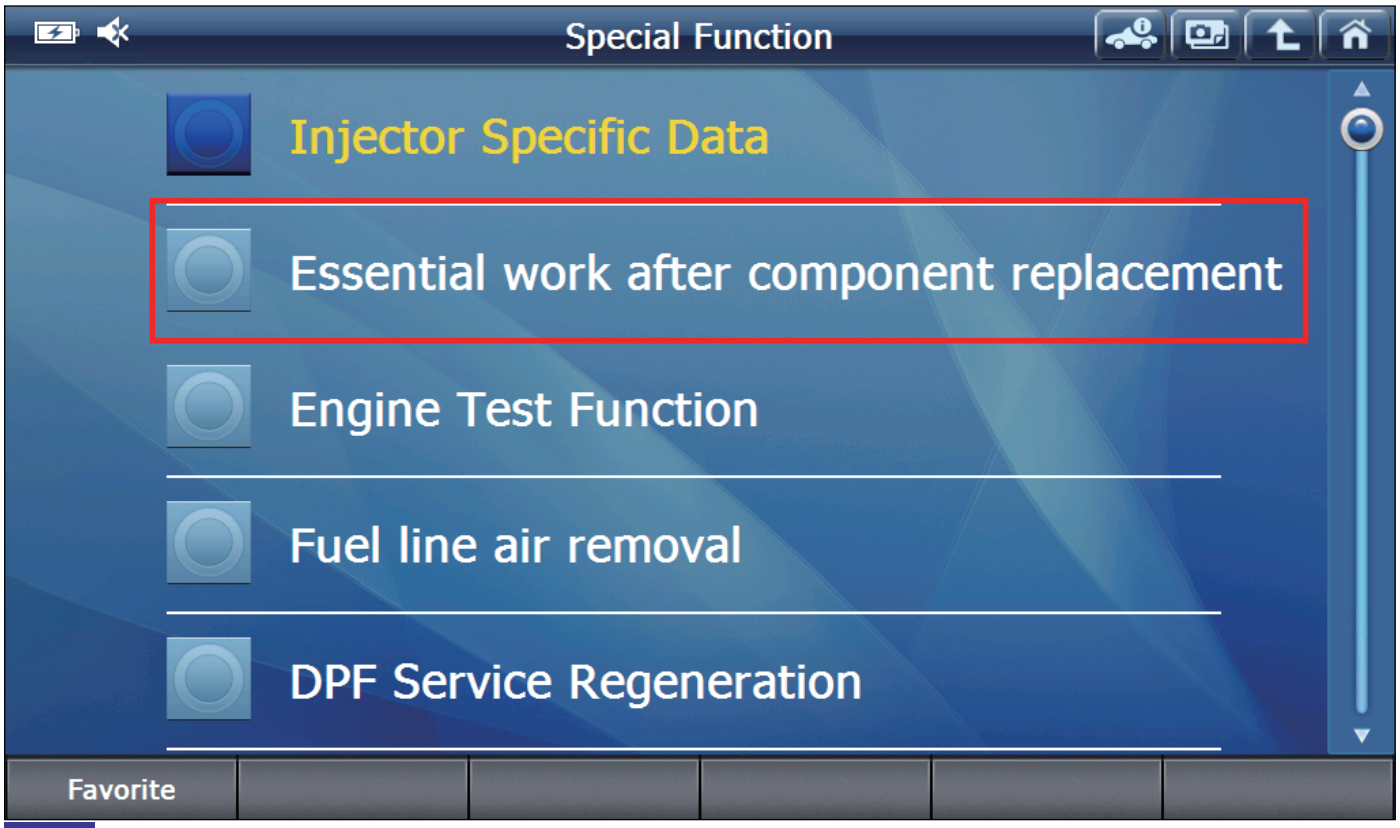


Fig.1

CRC12EN5010P01010041S

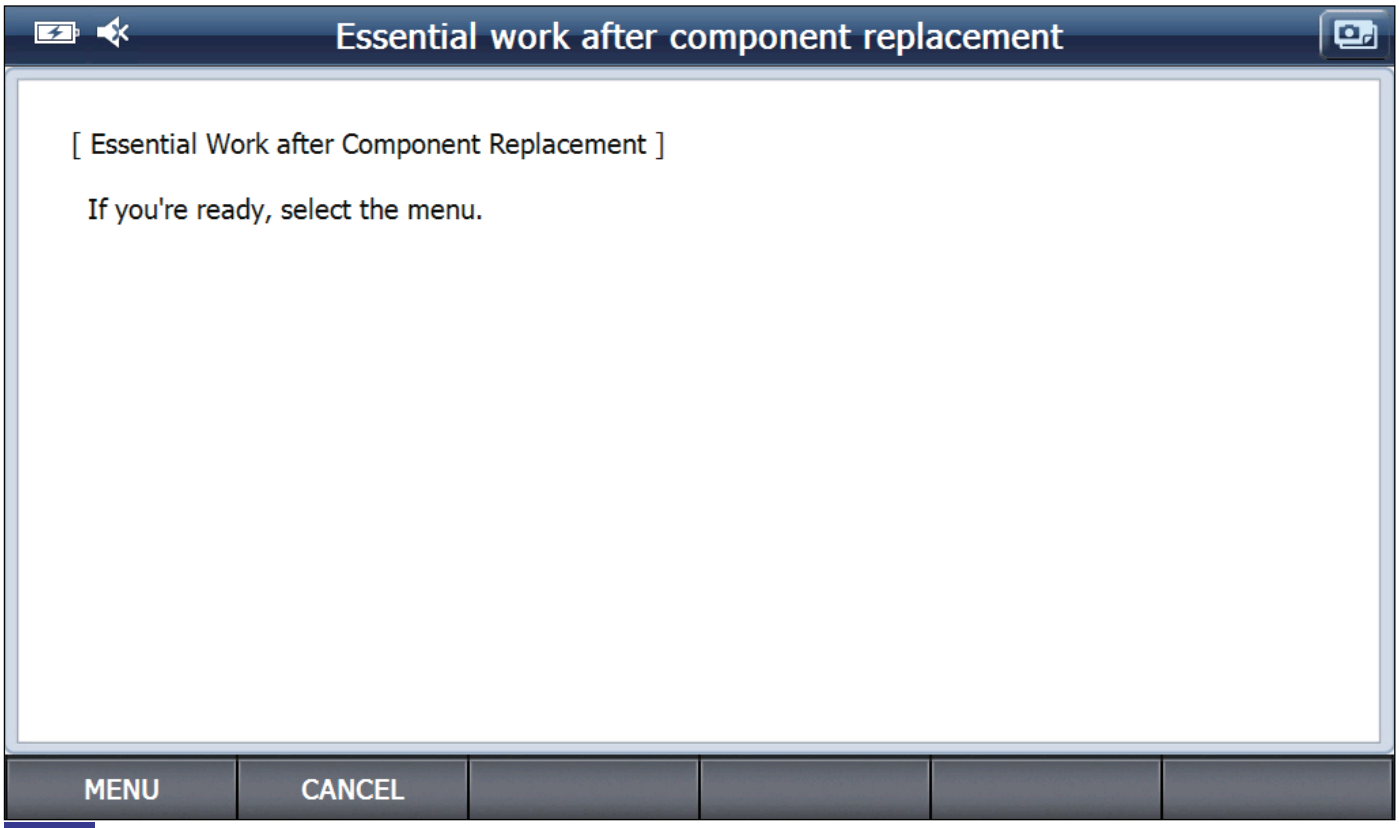


Fig.2

CRC12EN5010P01010042S

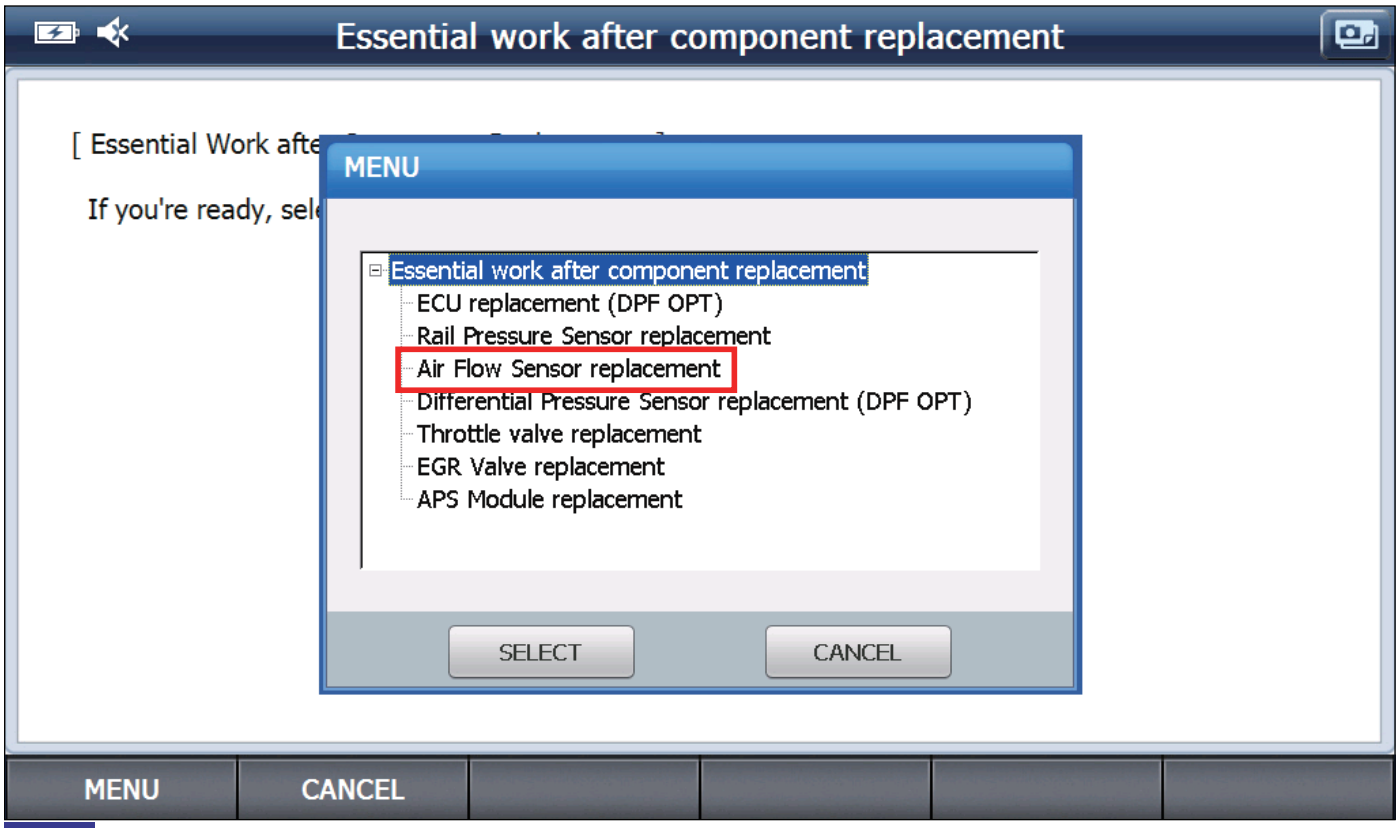


Fig.3

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.

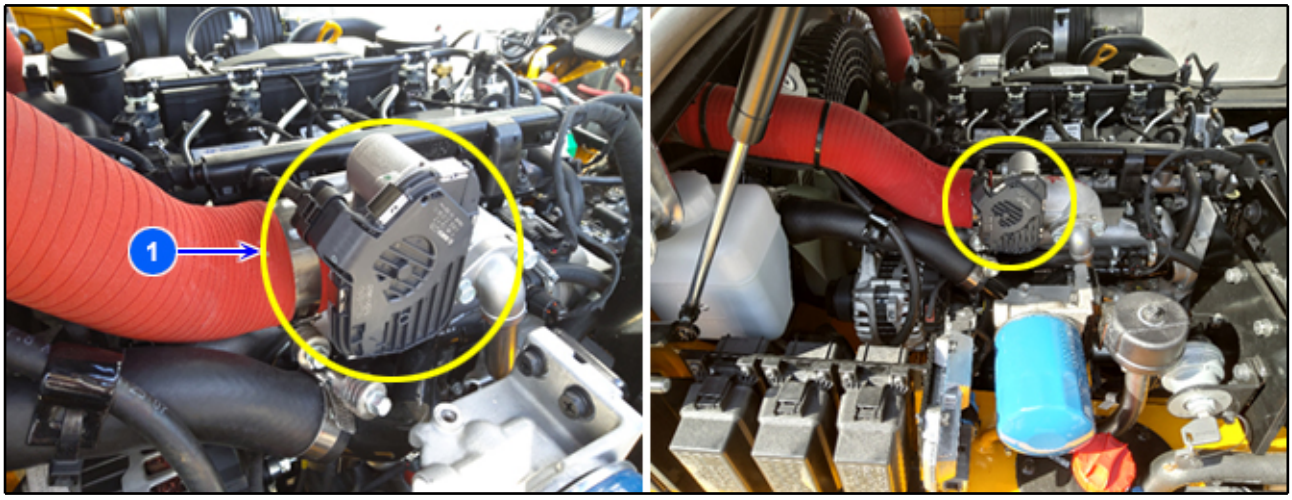
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P211100 Throttle Actuator Control System - Stuck Open

Component Location



CRC12EN5010P01220011

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.

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.

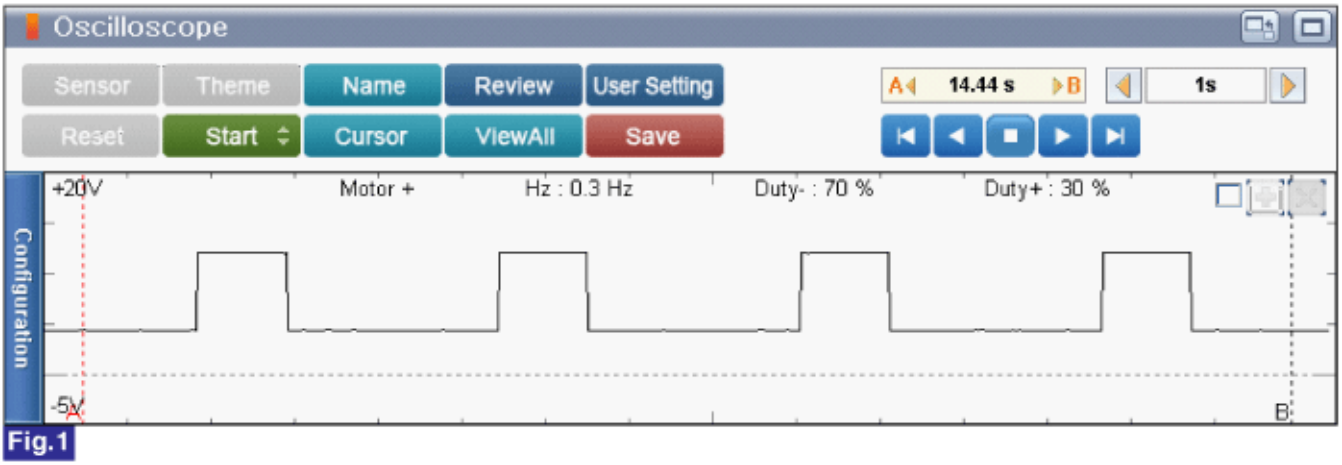
DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Short to power in control (+) circuit of ACV 2. Short to power in control (-) circuit of ACV 3. Stuck opened ACV 4. Defected ACV
Enable Conditions	• Engine running		
Threshold Value	• Short to power in control circuit or internal circuit error of ACV		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

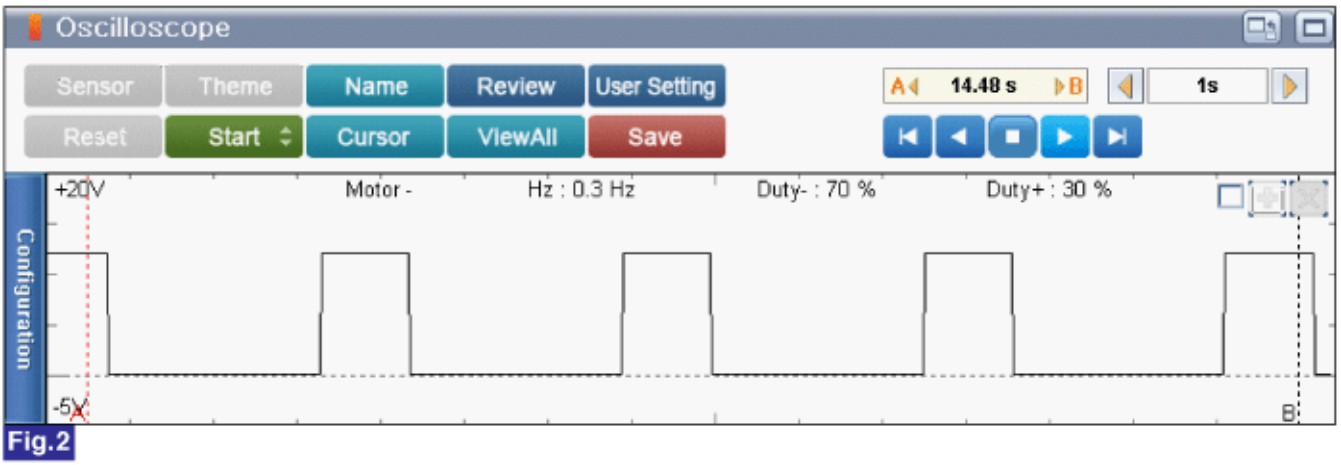
Vehicle Data

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

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



CRC12EN5010P01220011S



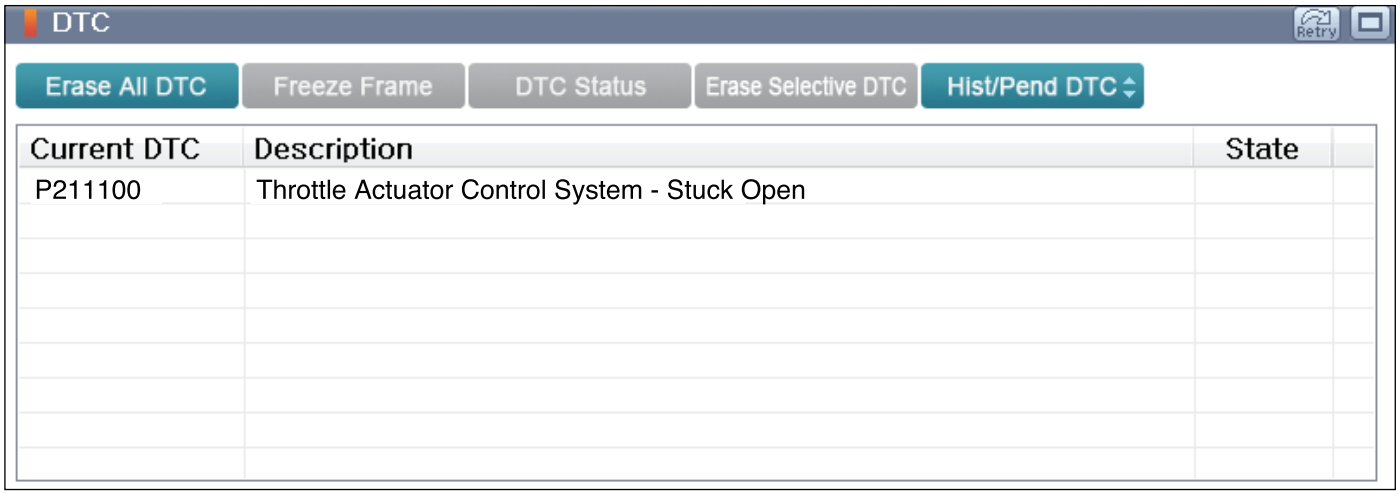
CRC12EN5010P01220012S

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.



CRC12EN5010P21110021S

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

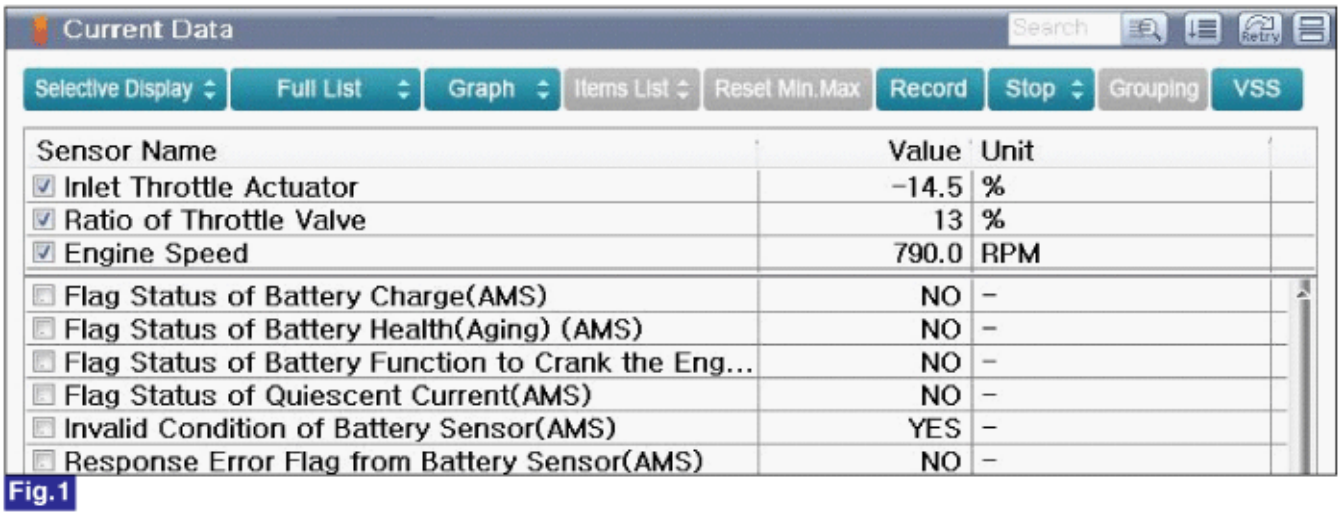


Fig.1

CRC12EN5010P01220022S

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.

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.
5. Measure the voltage between motor(-) terminal of 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 (∞ Ω)

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.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of ACV.

Specification :Approx. 2.92 ~ 2.98Ω (Approx. 20℃/Approx. 68℉)

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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

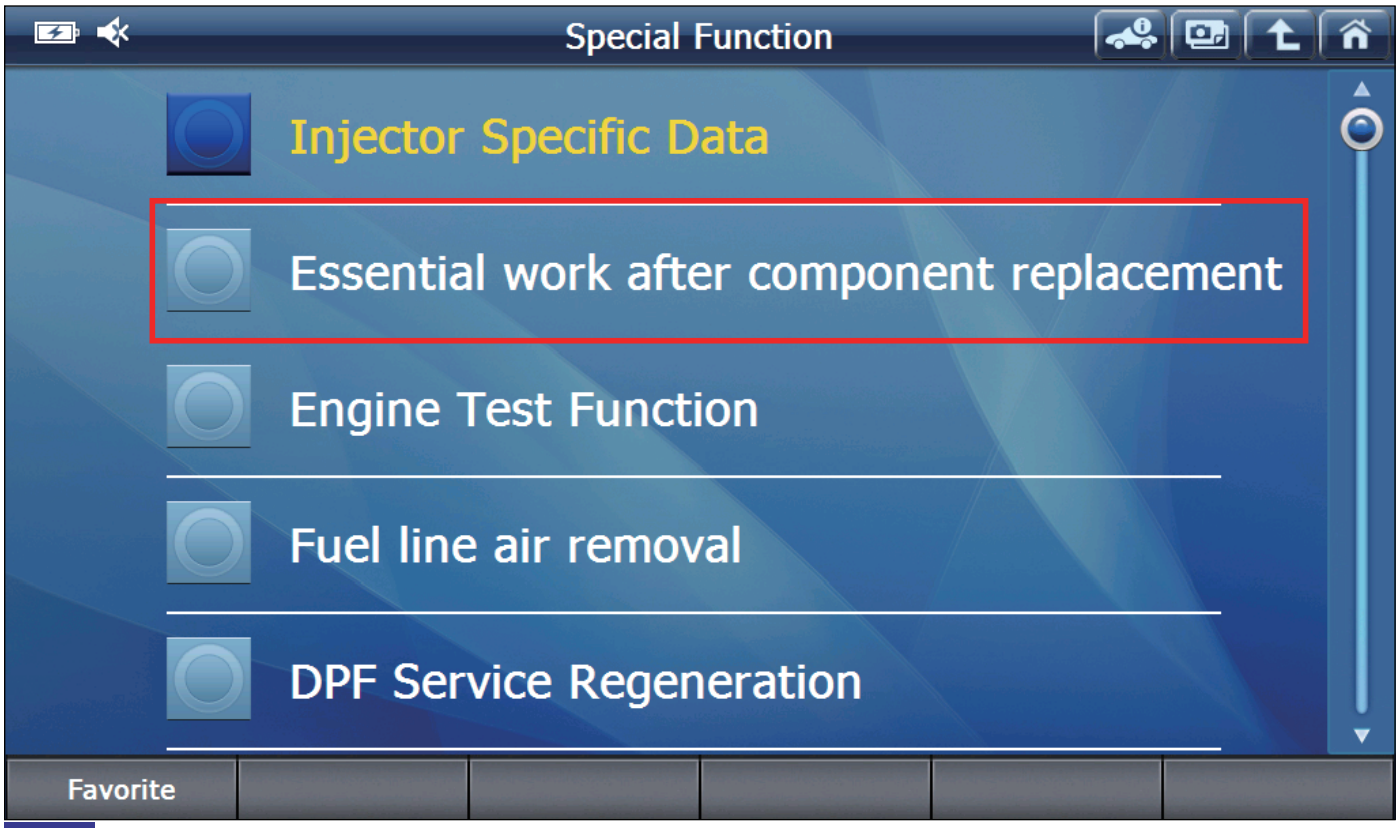


Fig.1

CRC12EN5010P01010041S

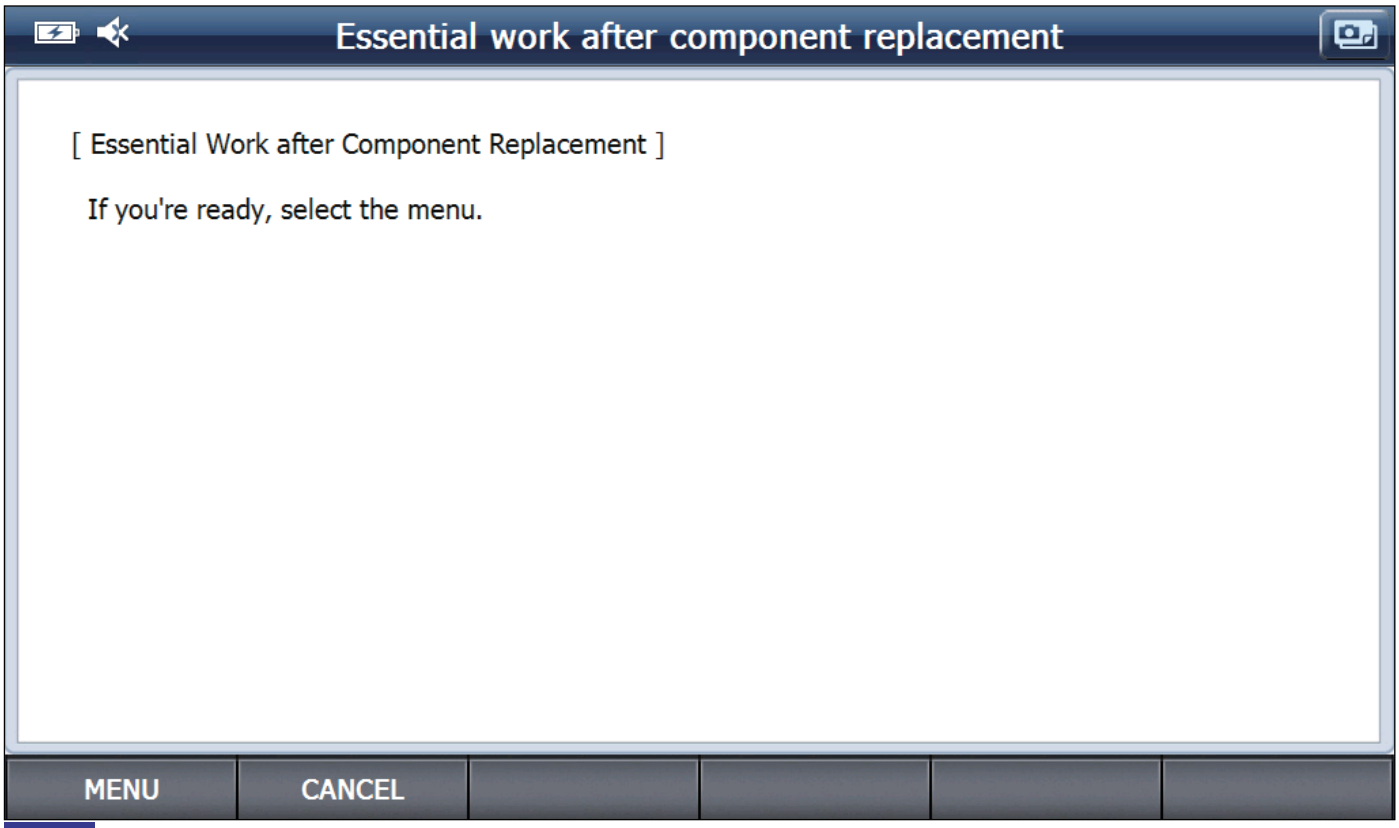


Fig.2

CRC12EN5010P01010042S

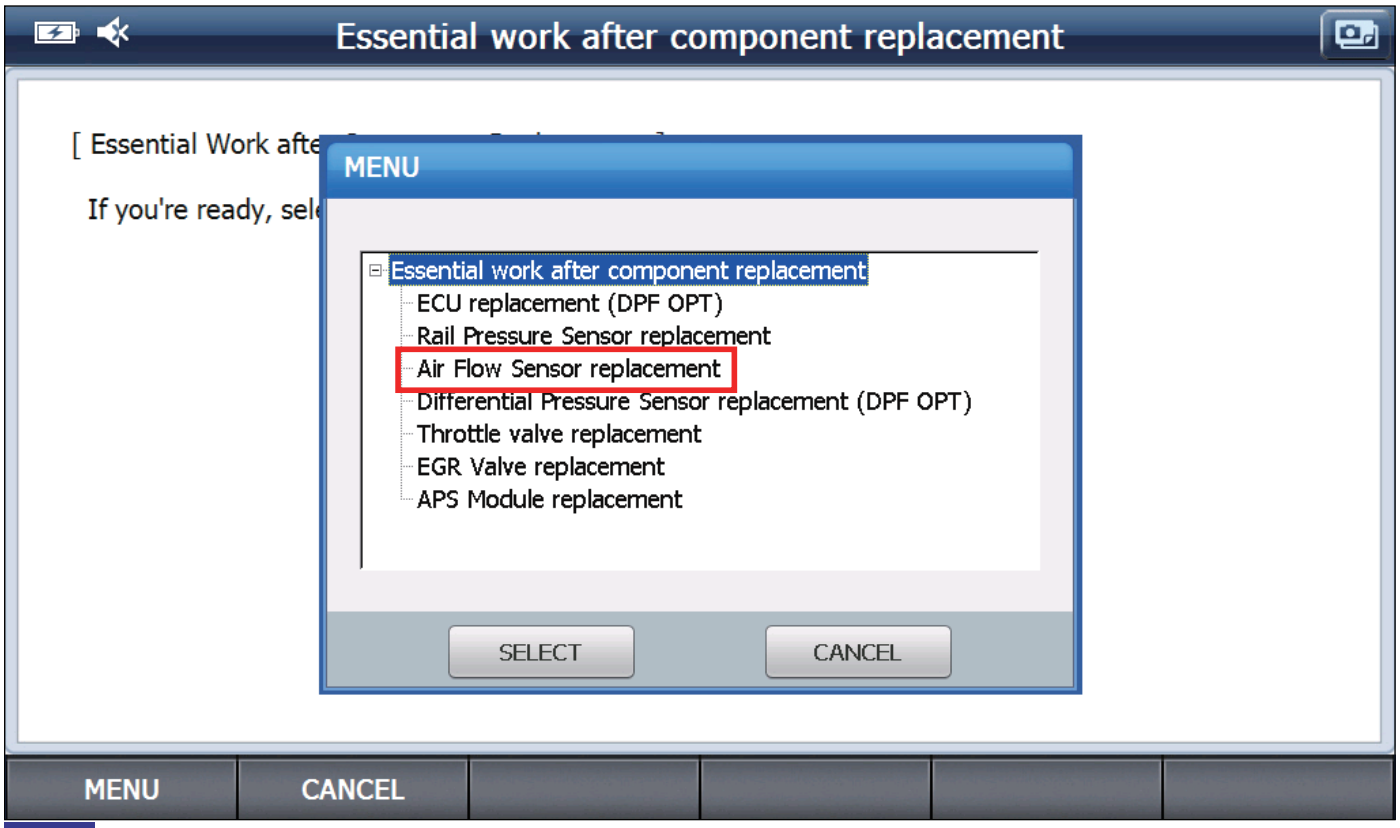


Fig.3

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.

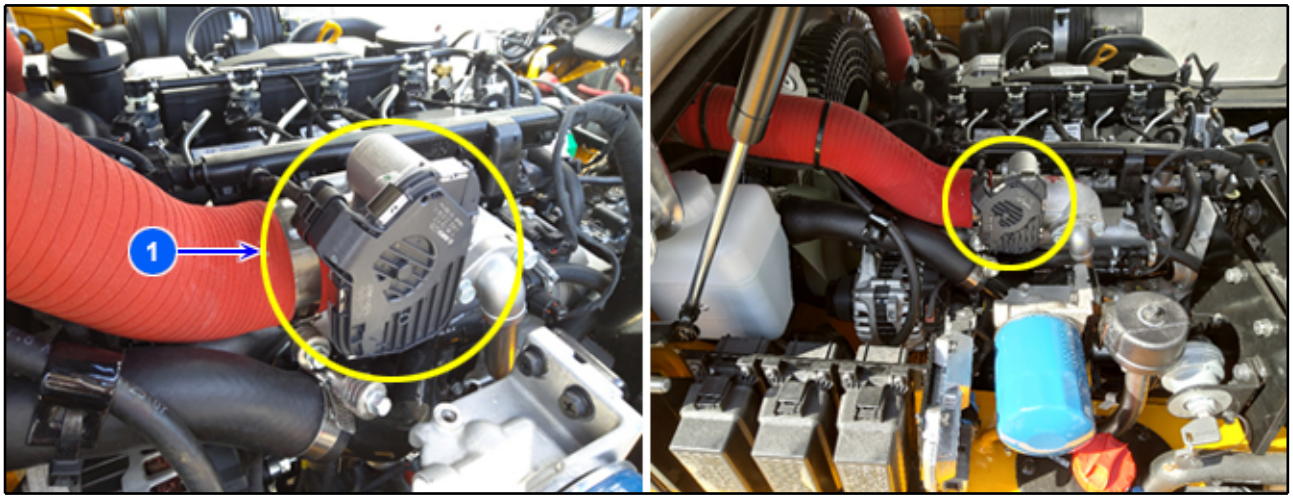
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P211200 Throttle Actuator Control System - Stuck Closed

Component Location



CRC12EN5010P01220011

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.

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	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Short to ground in control (+) circuit of ACV 2. Short to ground in control (-) circuit of ACV 3. Defected ACV
Enable Conditions	• Engine running		
Threshold Value	• Short to ground in control circuit or internal circuit error of ACV		
Diagnostic Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

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

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

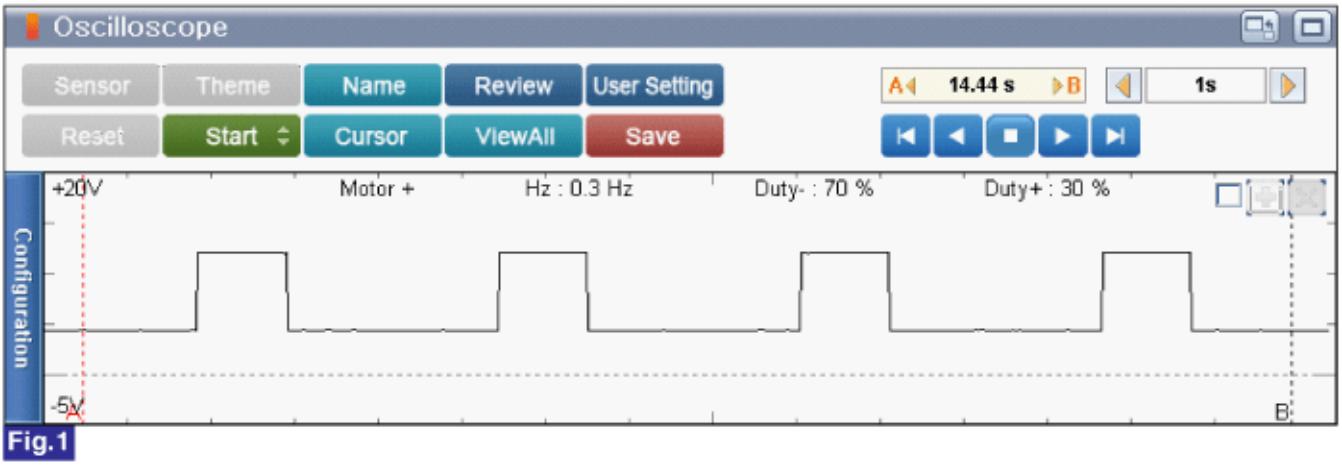


Fig.1

CRC12EN5010P01220011S

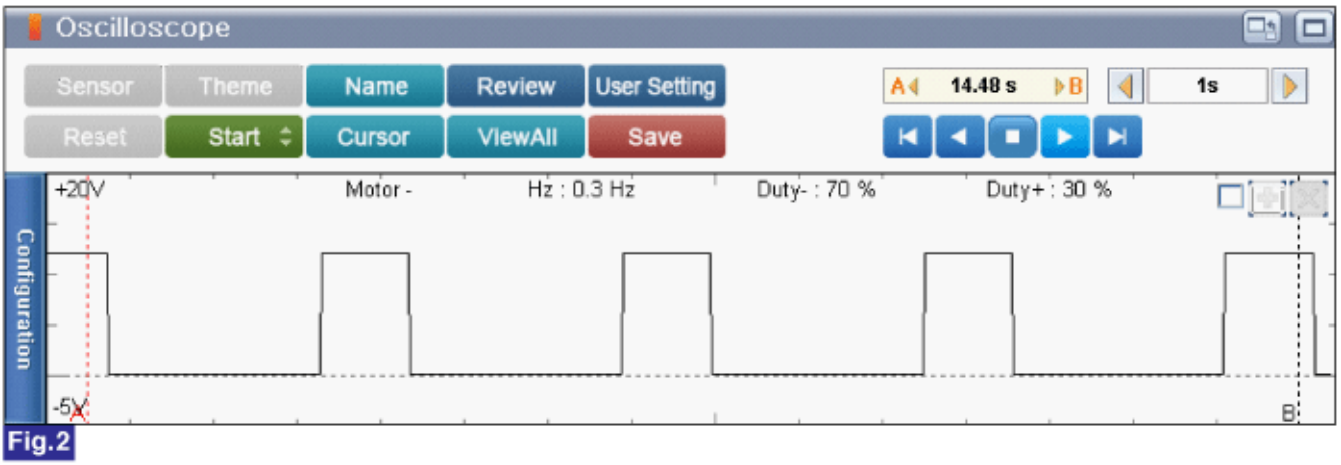


Fig.2

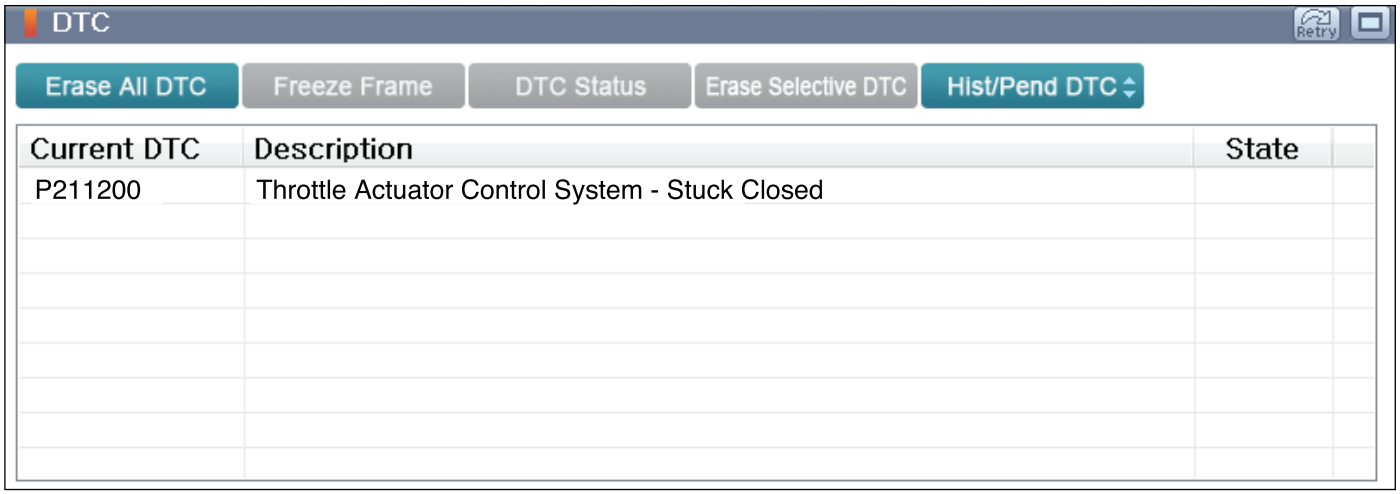
CRC12EN5010P01220012S

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.



CRC12EN5010P21120021S

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

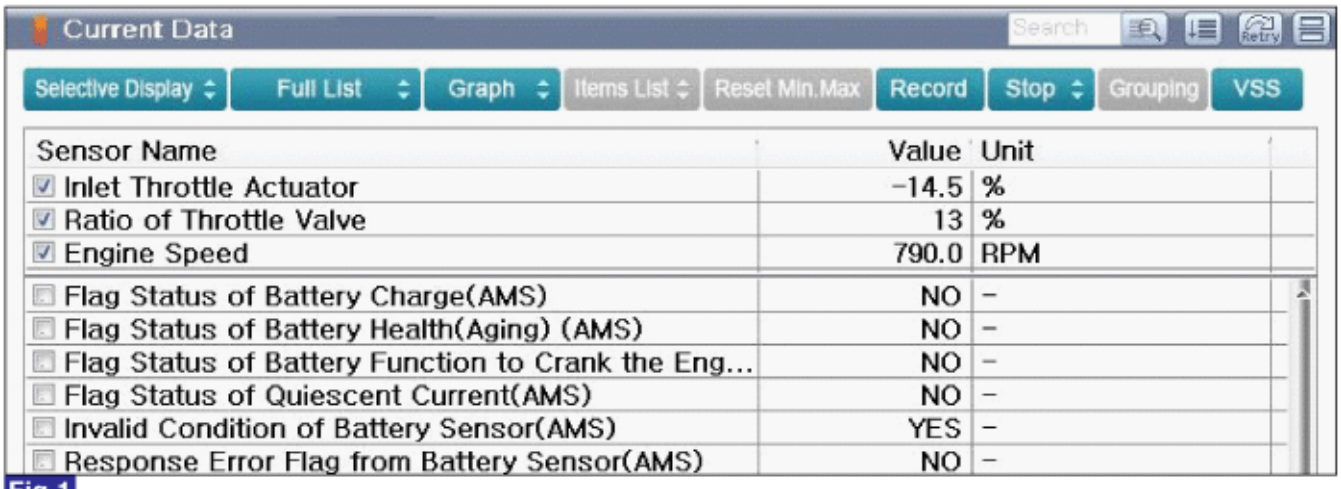


Fig.1

CRC12EN5010P01220022S

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.

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.
5. Measure the voltage between motor(-) terminal of 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 (∞ Ω)

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.
4. Measure the resistance between motor(+) terminal and motor(-) terminal of ACV.

Specification :Approx. 2.92 ~ 2.98Ω (Approx. 20℃/Approx. 68℉)

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.

⚠ CAUTION

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

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Throttle Valve"

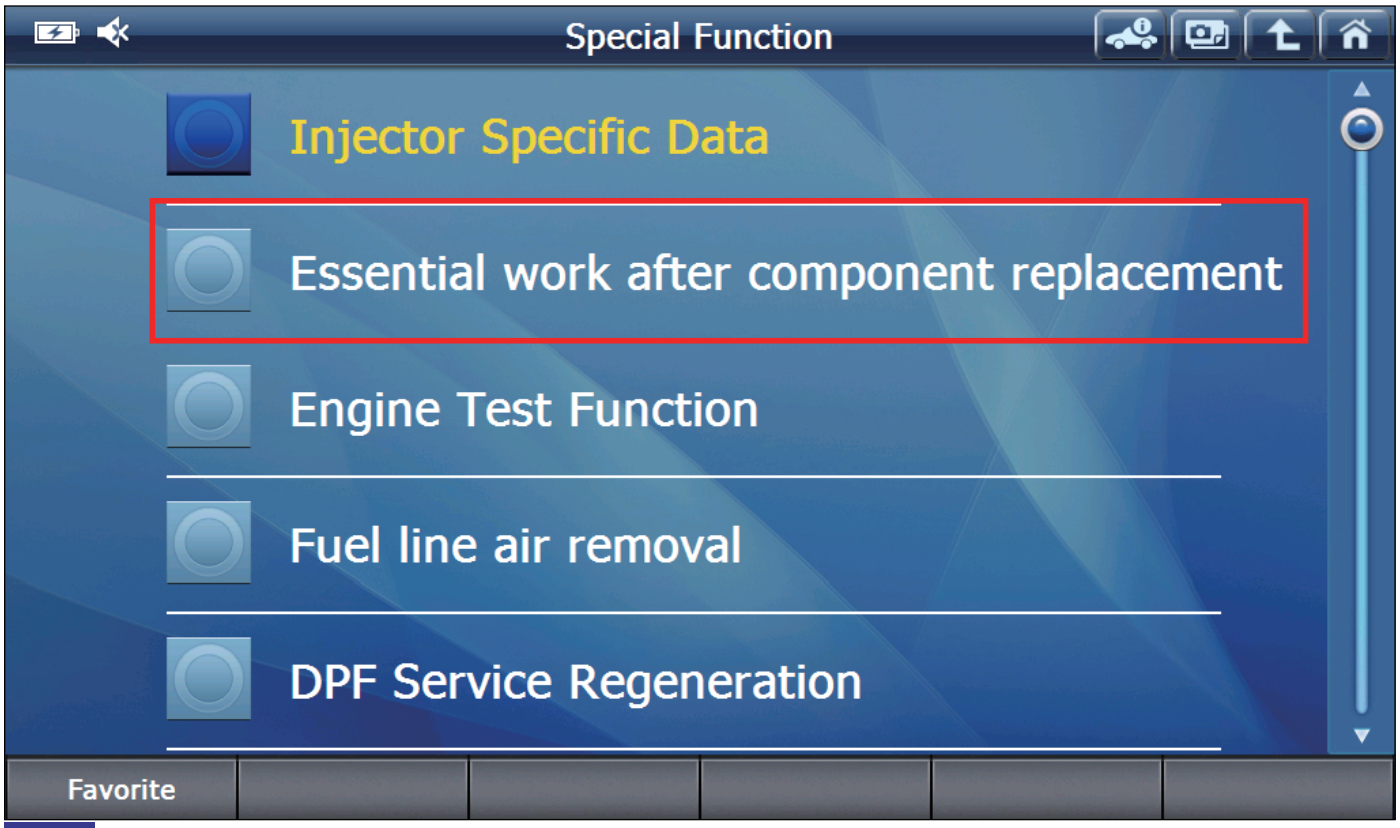


Fig.1

CRC12EN5010P01010041S

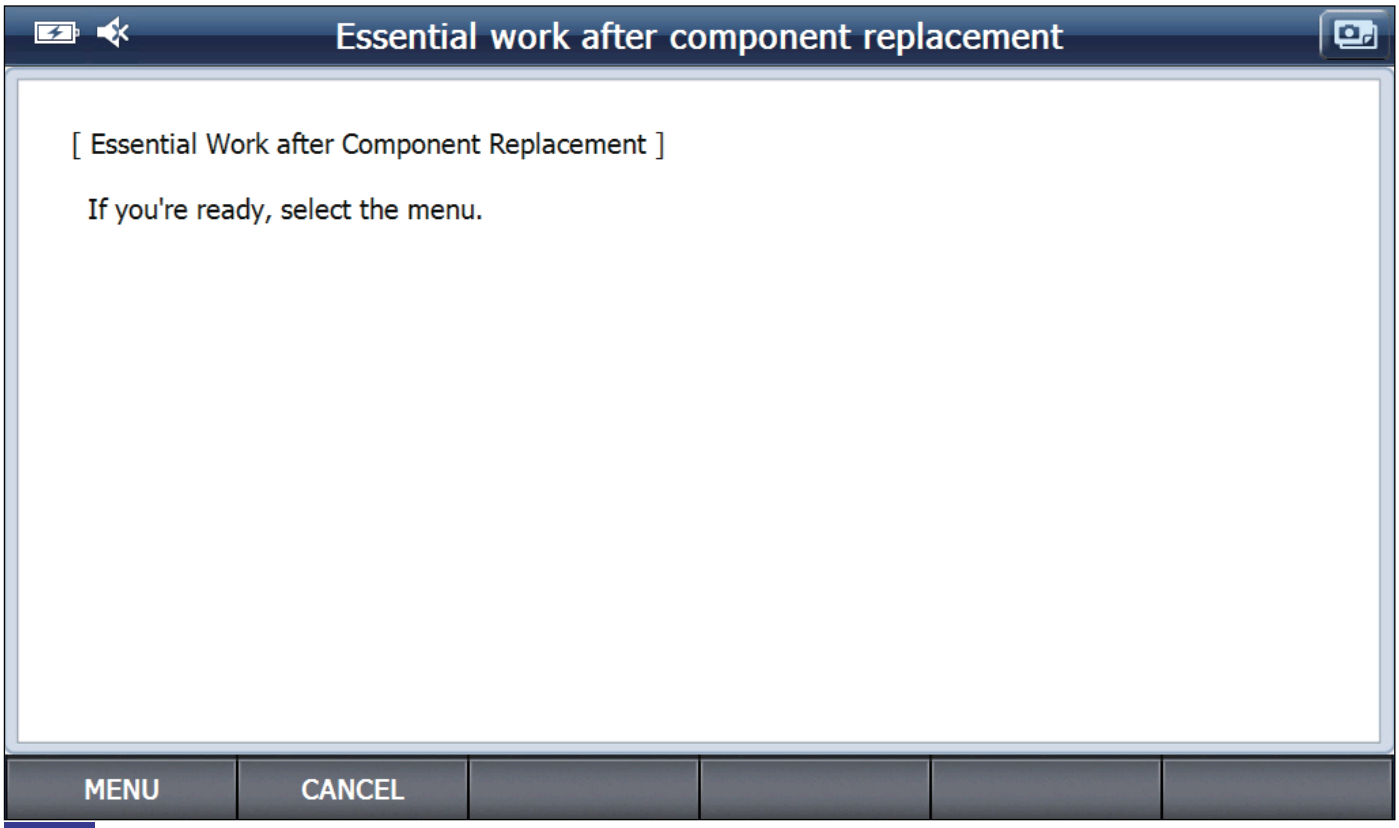


Fig.2

CRC12EN5010P01010042S

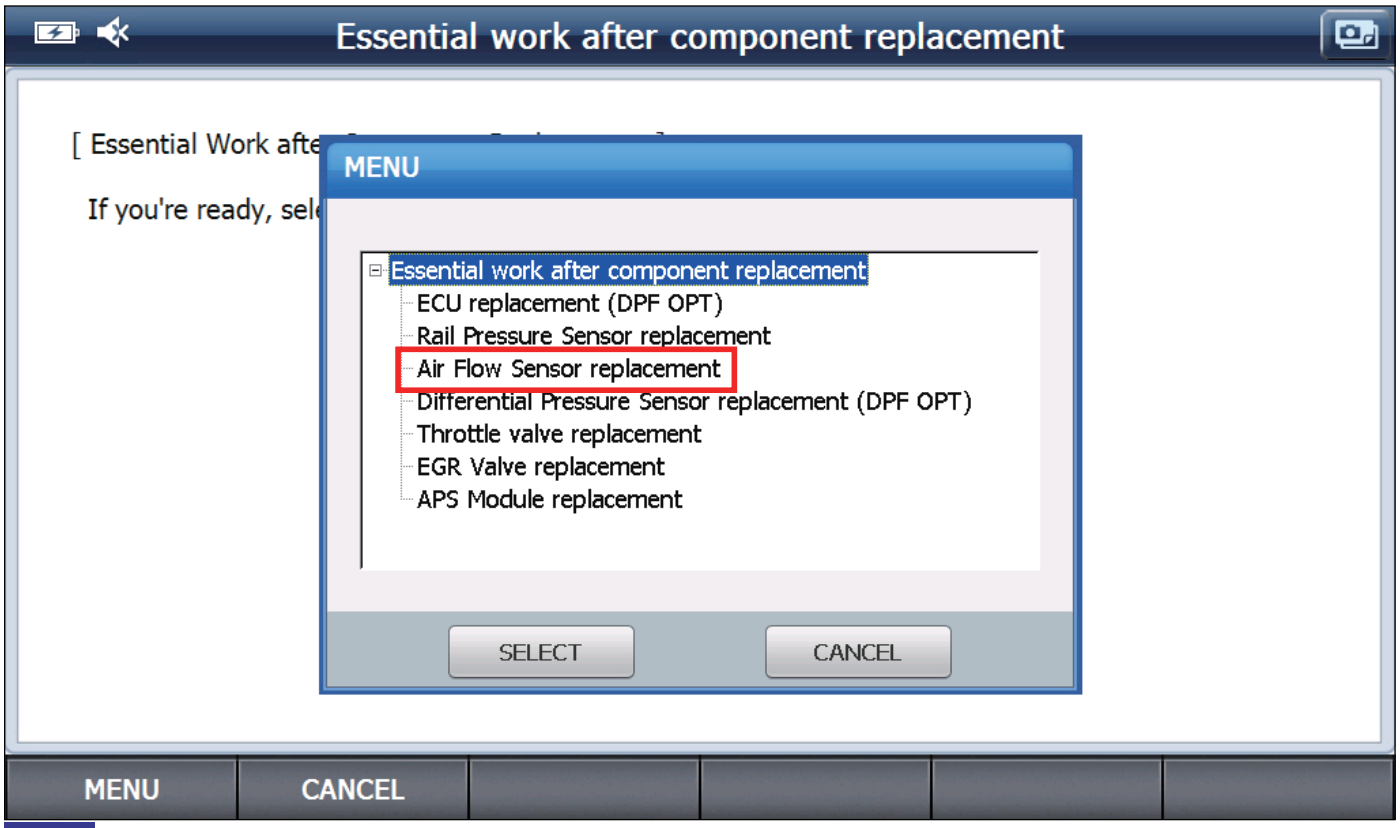


Fig.3

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.

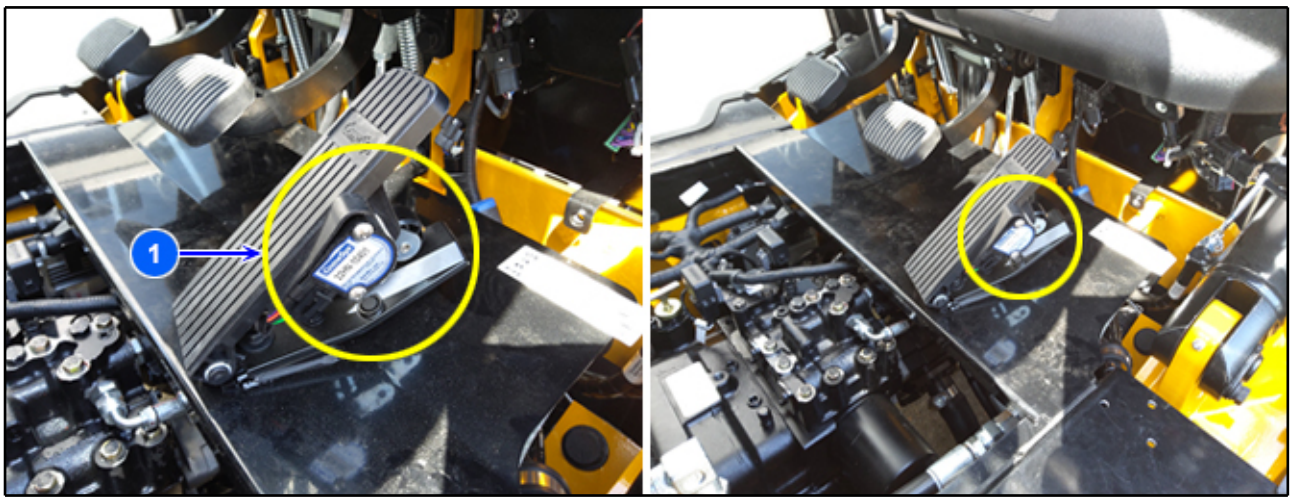
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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



CRC12EN5010P21220011

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

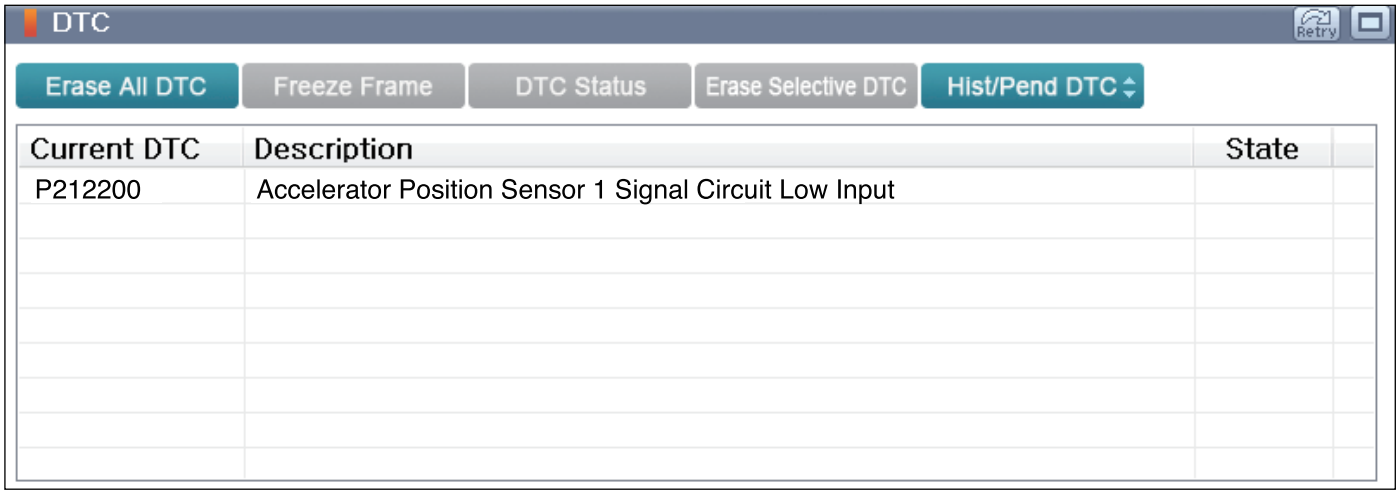
If output voltage of APS 1 is below threshold value for more than 0.18 sec., ECM sets DTC P212200. This fault might be caused by short to ground in power/signal circuit or open in power circuit of APS.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Open or short to ground in power circuit of APS1 2. Open in power circuit of APS1 3. Short to ground in signal circuit of APS 1 4. Defected APS
Enable Conditions	• Engine running		
Threshold Value	• Output voltage is below threshold value		
Diagnostic Time	• 0.18 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



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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

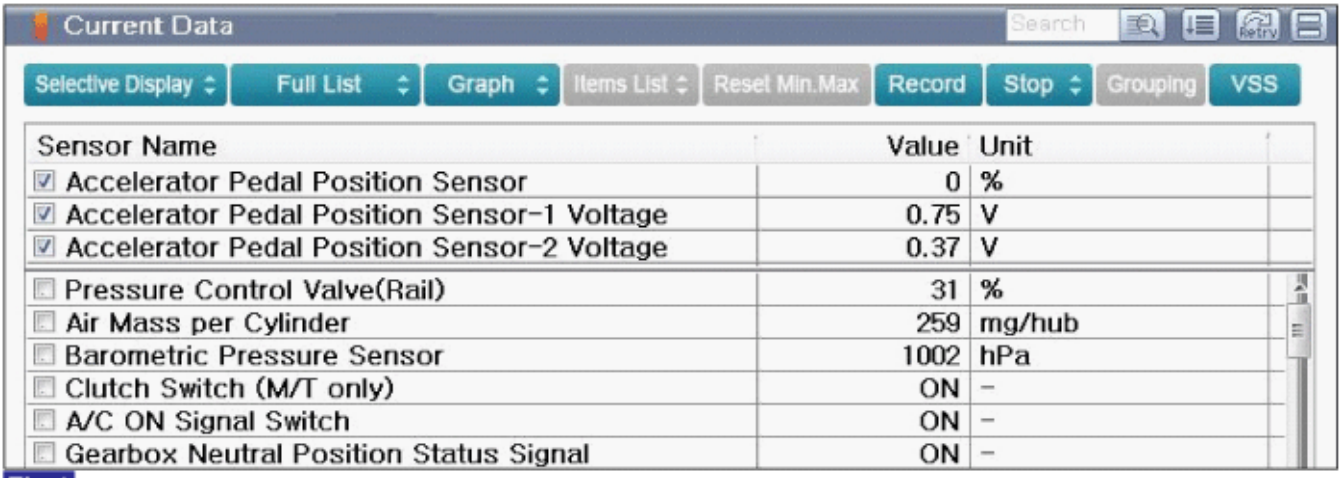


Fig.1

CRC12EN5010P21220022S

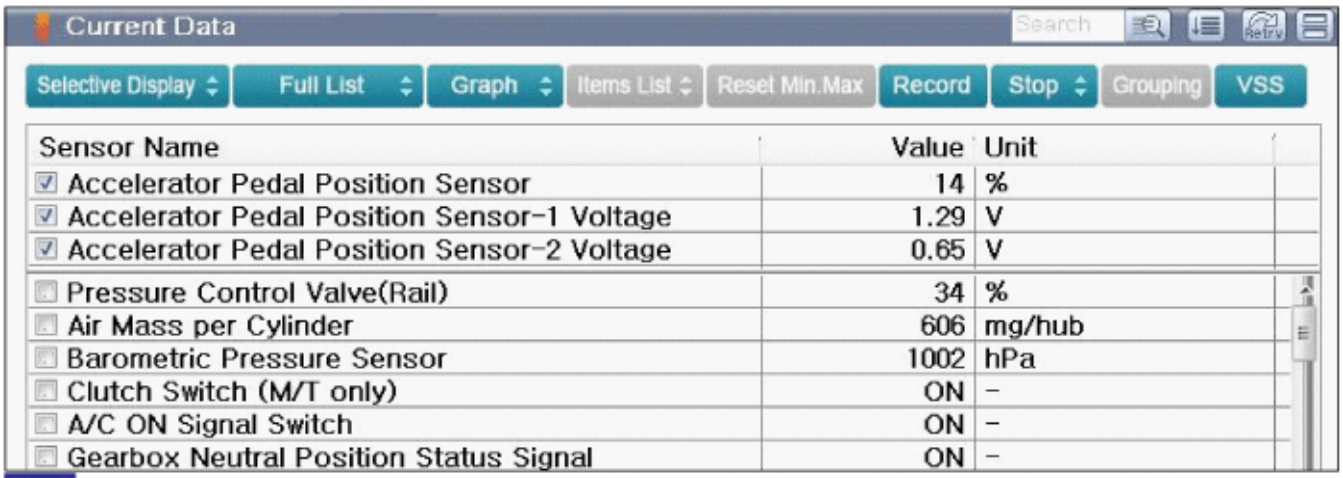


Fig.2

CRC12EN5010P21220023S

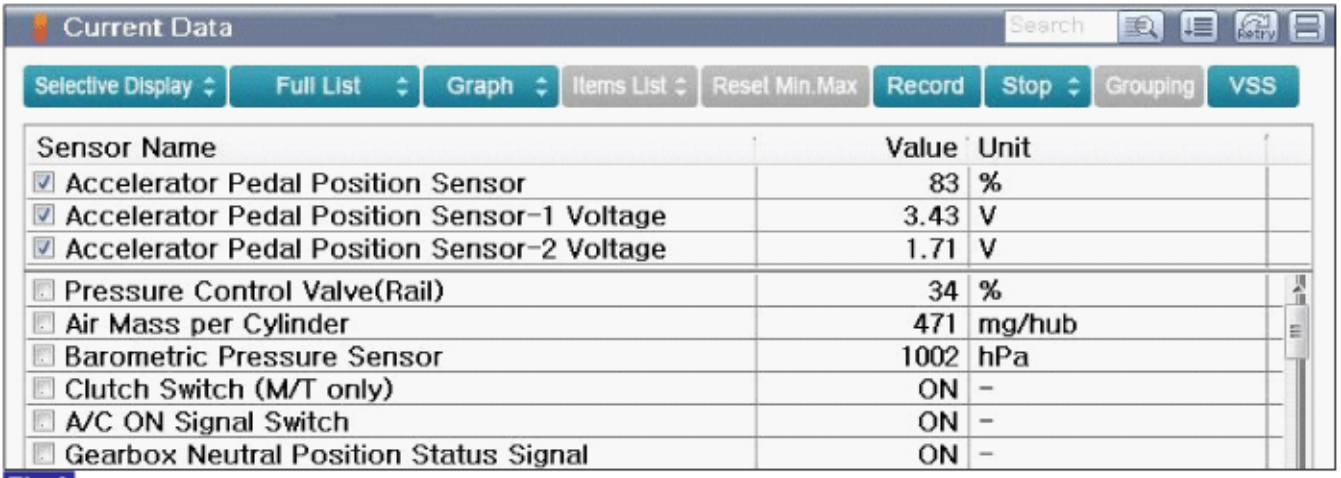


Fig.3

CRC12EN5010P21220024S

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

※ Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

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?

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS1 power terminal of APS 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 APS connector.
4. Measure the resistance between APS 1 ground terminal of APS harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect APT connector.
7. Ignition switch "ON"
8. Measure the voltage between APS 1 power terminal 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.

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS 1 signal terminal of APS harness connector and chassis ground.

Specification :Approx. 0V

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect APS and ECM connector.
8. Measure the resistance between APS 1 signal terminal of APS harness connector and APS 1 signal of ECM harness connector.

Specification :Approx. below 1 Ω

9. 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

■ 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

Item	Output Voltage (V) (Vref = 5.0V)	
	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.

⚠ CAUTION

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

⚠ CAUTION

- 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

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 "APS Module Change"

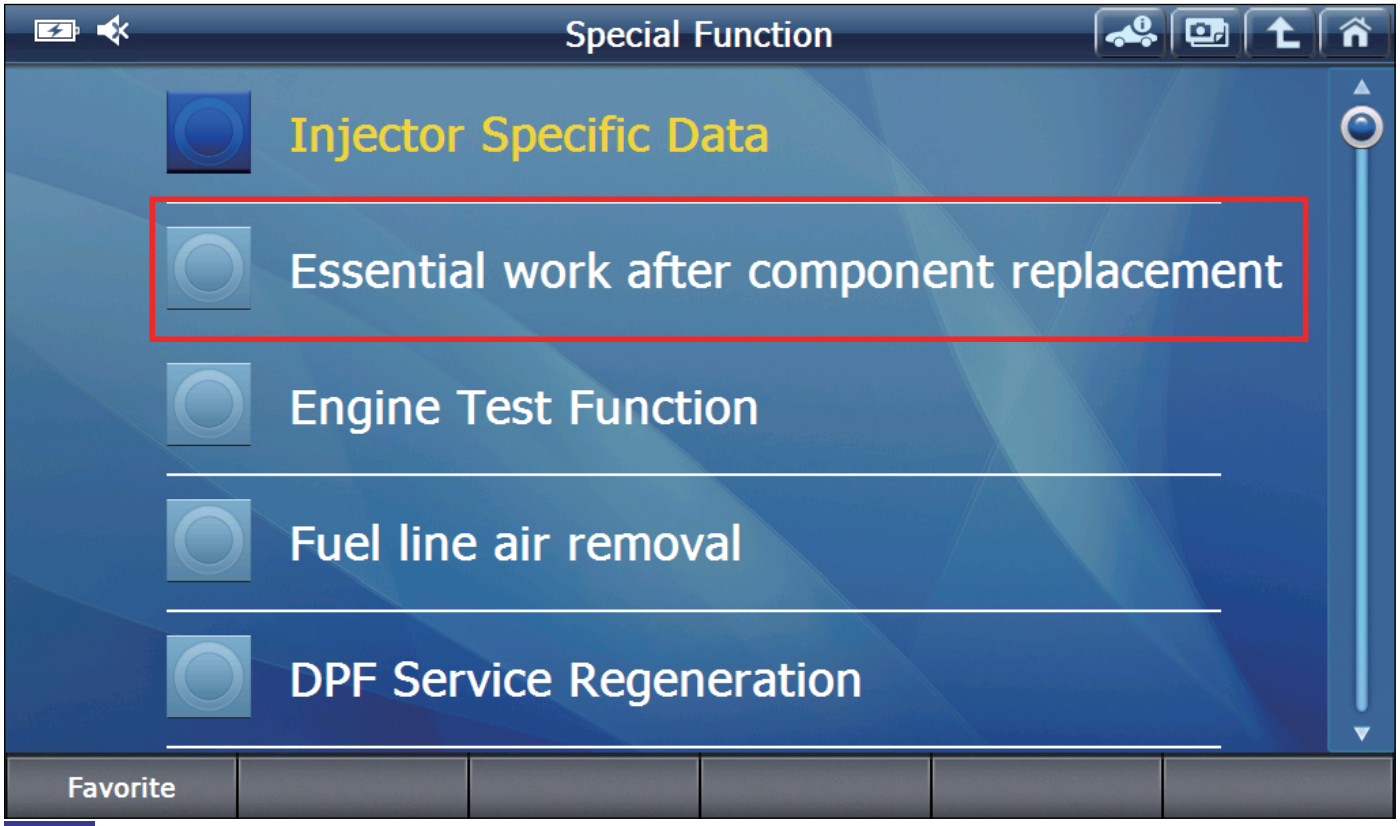


Fig.1

CRC12EN5010P01010041S

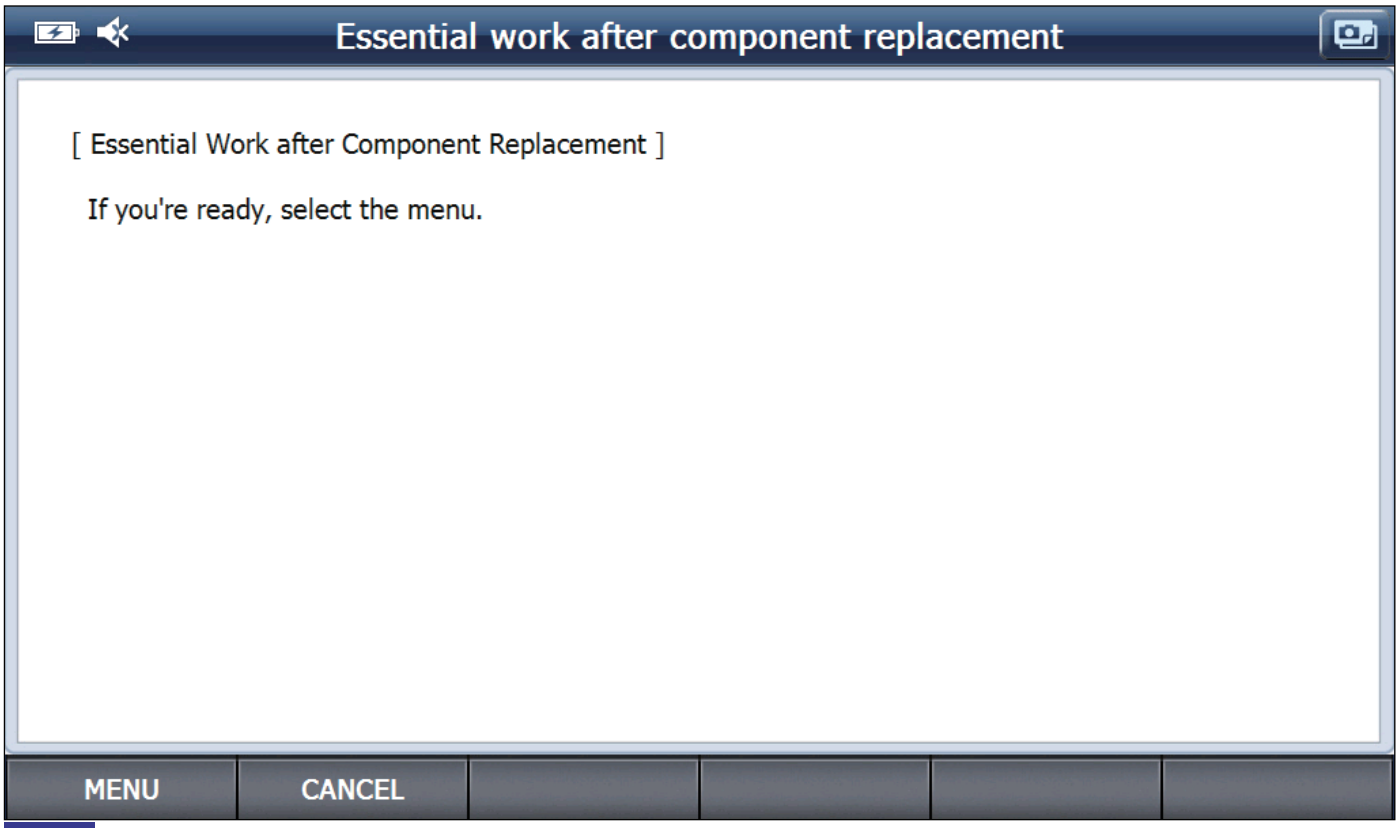


Fig.2

CRC12EN5010P01010042S

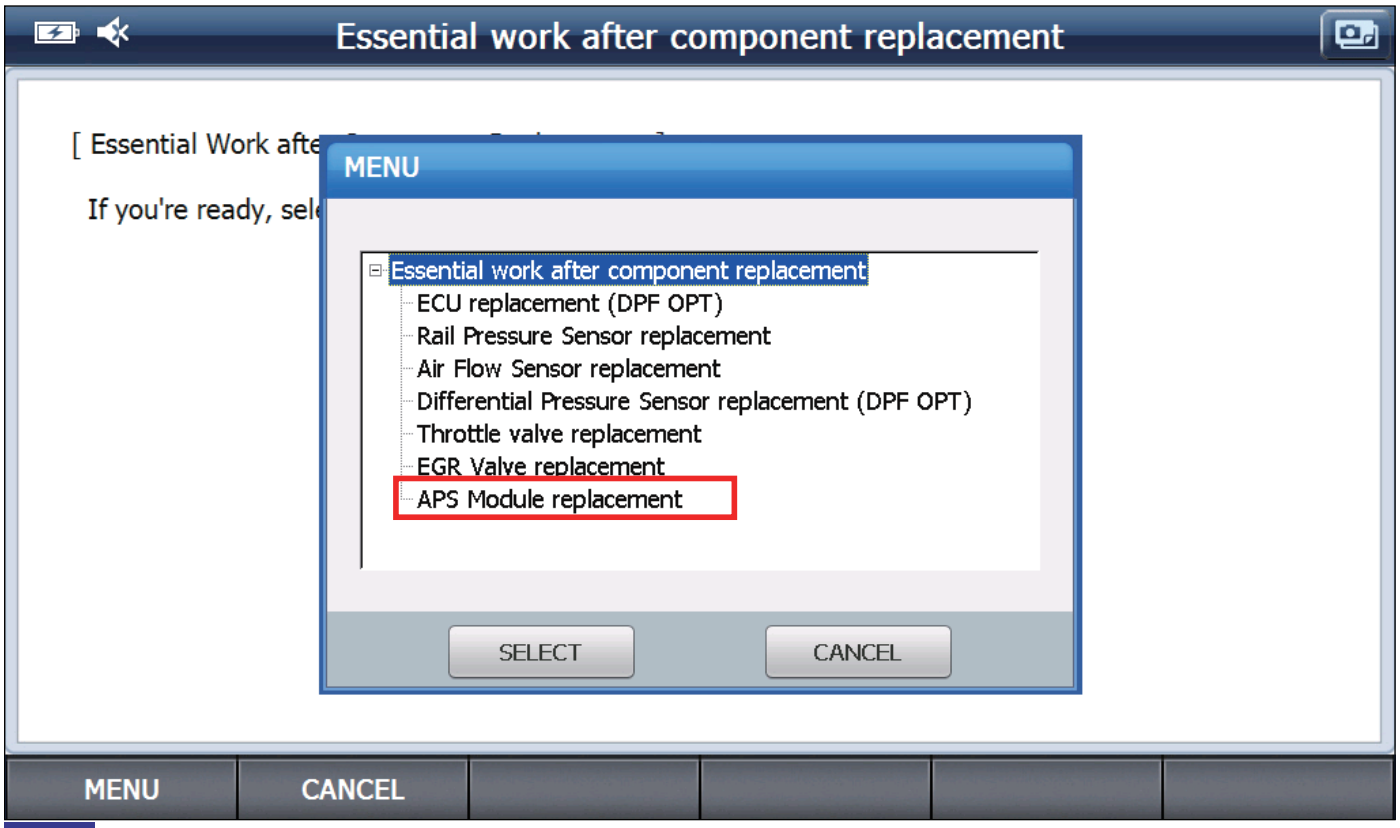


Fig.3

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.

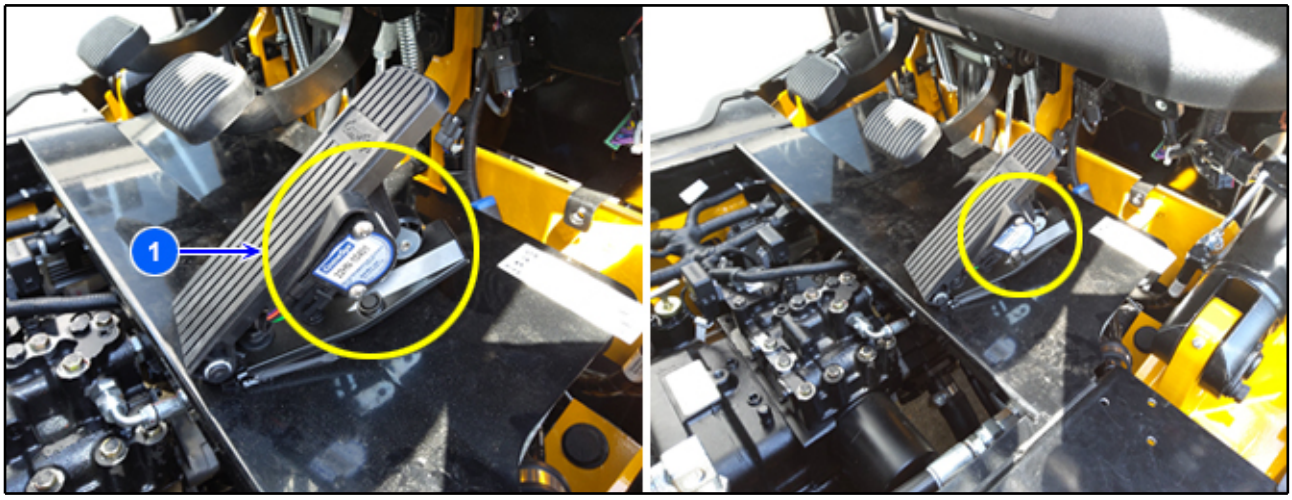
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P212300 Accelerator Position Sensor 1 Signal Circuit High Input

Component Location



CRC12EN5010P21220011

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.

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

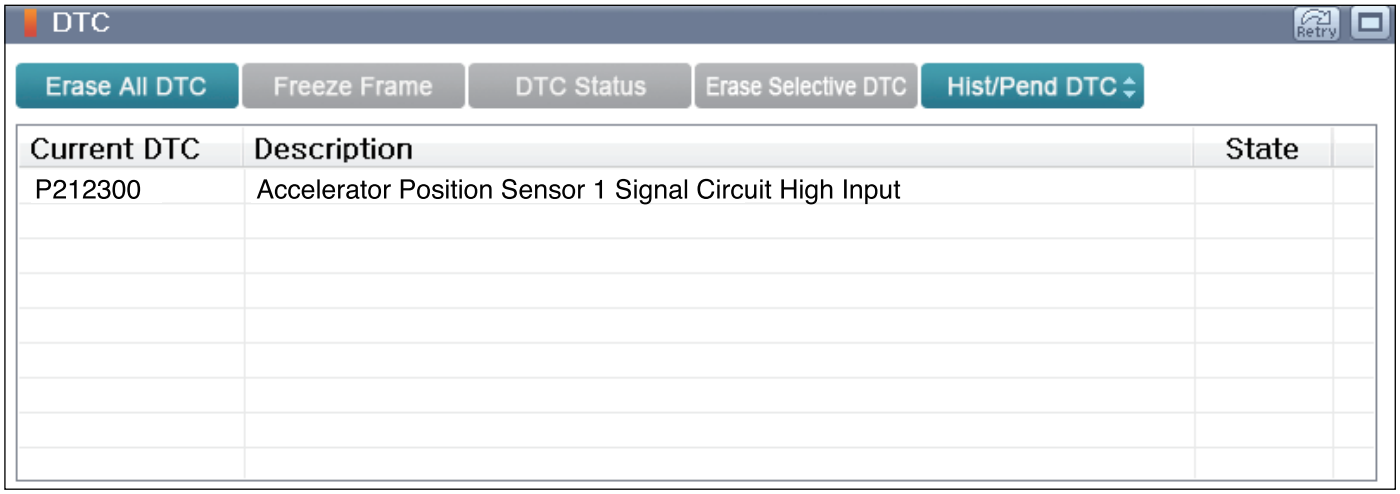
If output voltage of APS 1 is above threshold value for more than 0.18 sec., ECM sets DTC P212300. This fault might be caused by short to power in power/signal circuit or open in ground circuit of APS.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Short to power in power circuit of APS1 2. Open in ground circuit of APS1 3. Short to power in signal circuit of APS1 4. Defected APS
Enable Conditions	• Engine running		
Threshold Value	• Output voltage is above threshold value		
Diagnostic Time	• 0.18 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



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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

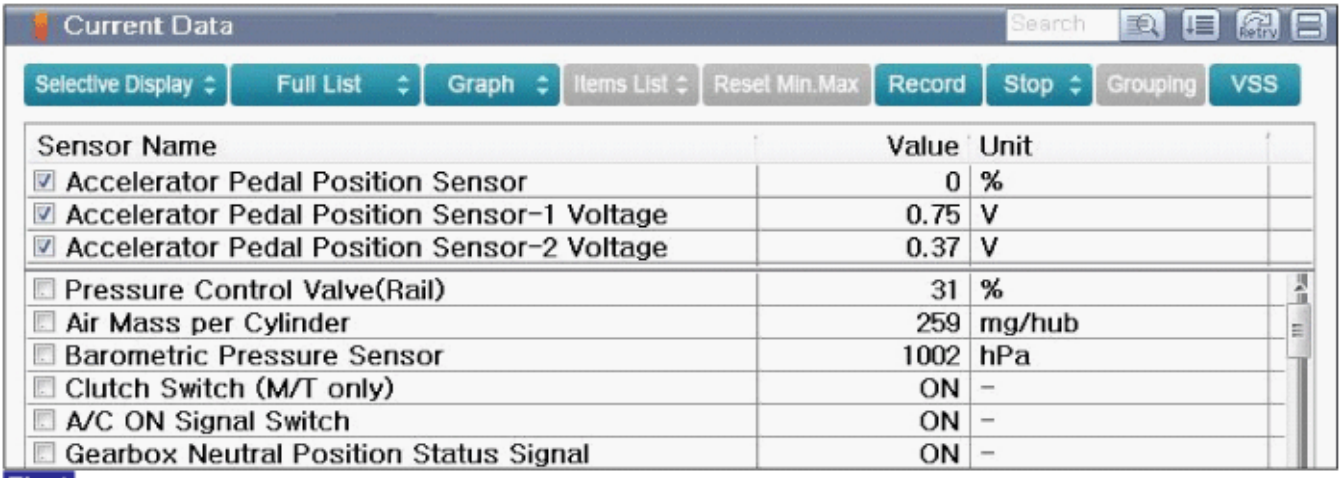


Fig.1

CRC12EN5010P21220022S

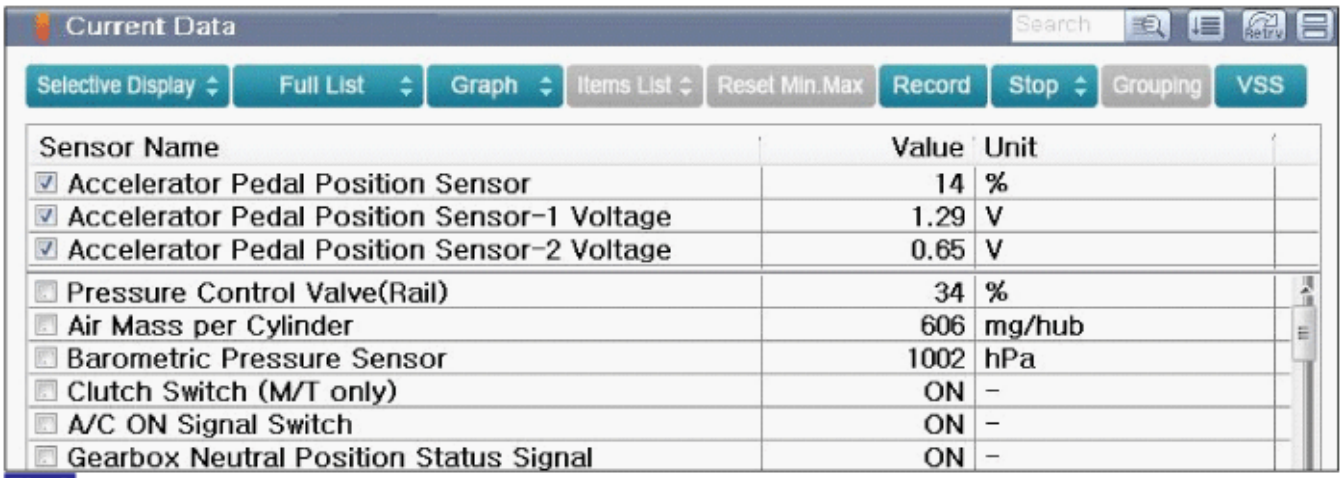


Fig.2

CRC12EN5010P21220023S

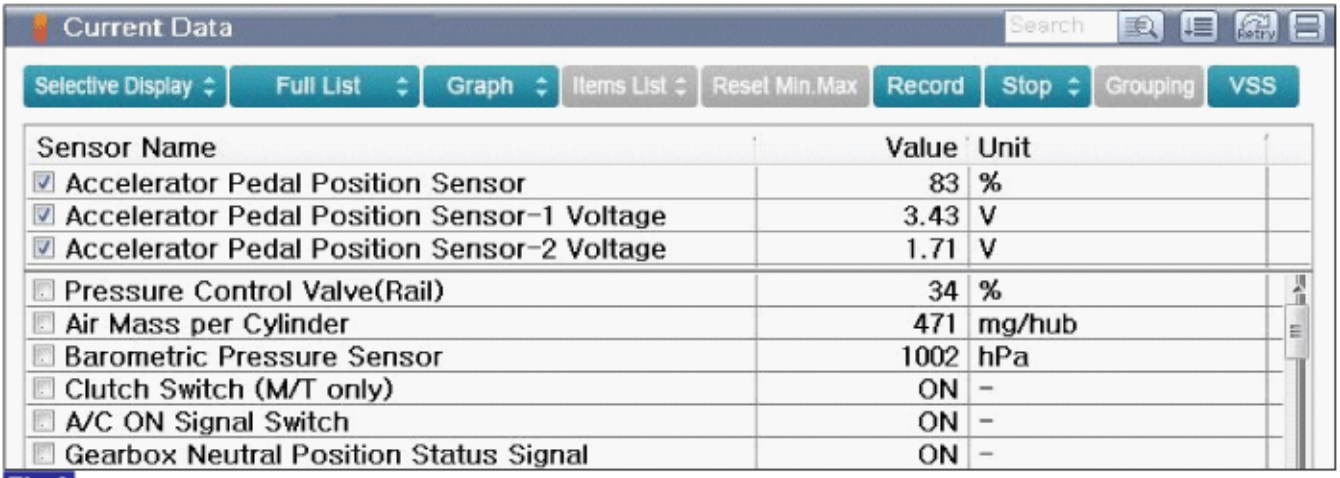


Fig.3

CRC12EN5010P21220024S

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

※ Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

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?

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS1 power terminal of APS 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 APS connector.
4. Measure the resistance between APS 1 ground terminal of APS harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect APT connector.
7. Ignition switch "ON"
8. Measure the voltage between APS 1 power terminal 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.

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS 1 signal terminal of APS harness connector and chassis ground.

Specification :Approx. 0V

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect APS and ECM connector.
8. Measure the resistance between APS 1 signal terminal of APS harness connector and APS 1 signal of ECM harness connector.

Specification :Approx. below 1 Ω

9. 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

■ 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

Item	Output Voltage (V) (Vref = 5.0V)	
	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.

⚠ CAUTION

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

⚠ CAUTION

- 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

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 "APS Module Change"

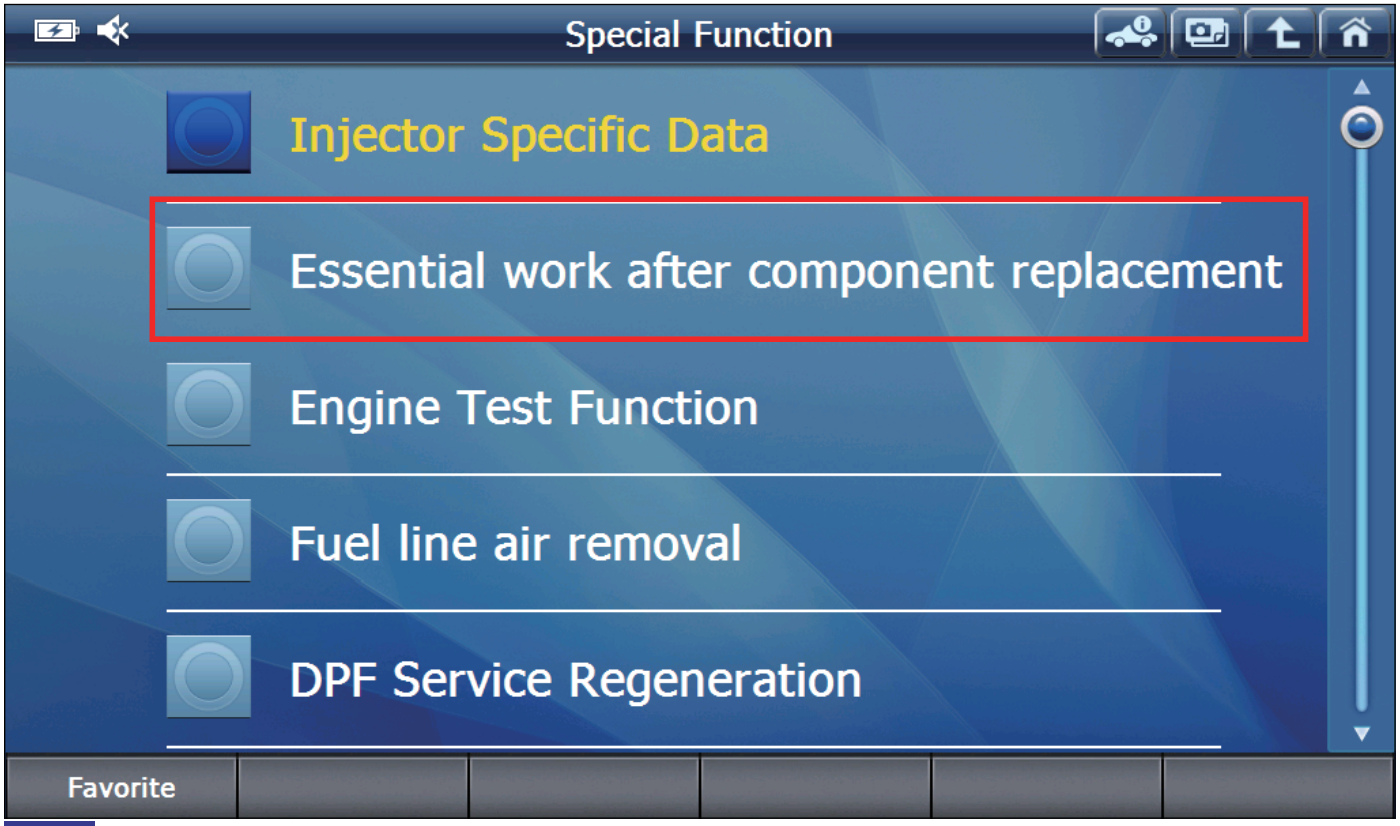


Fig.1

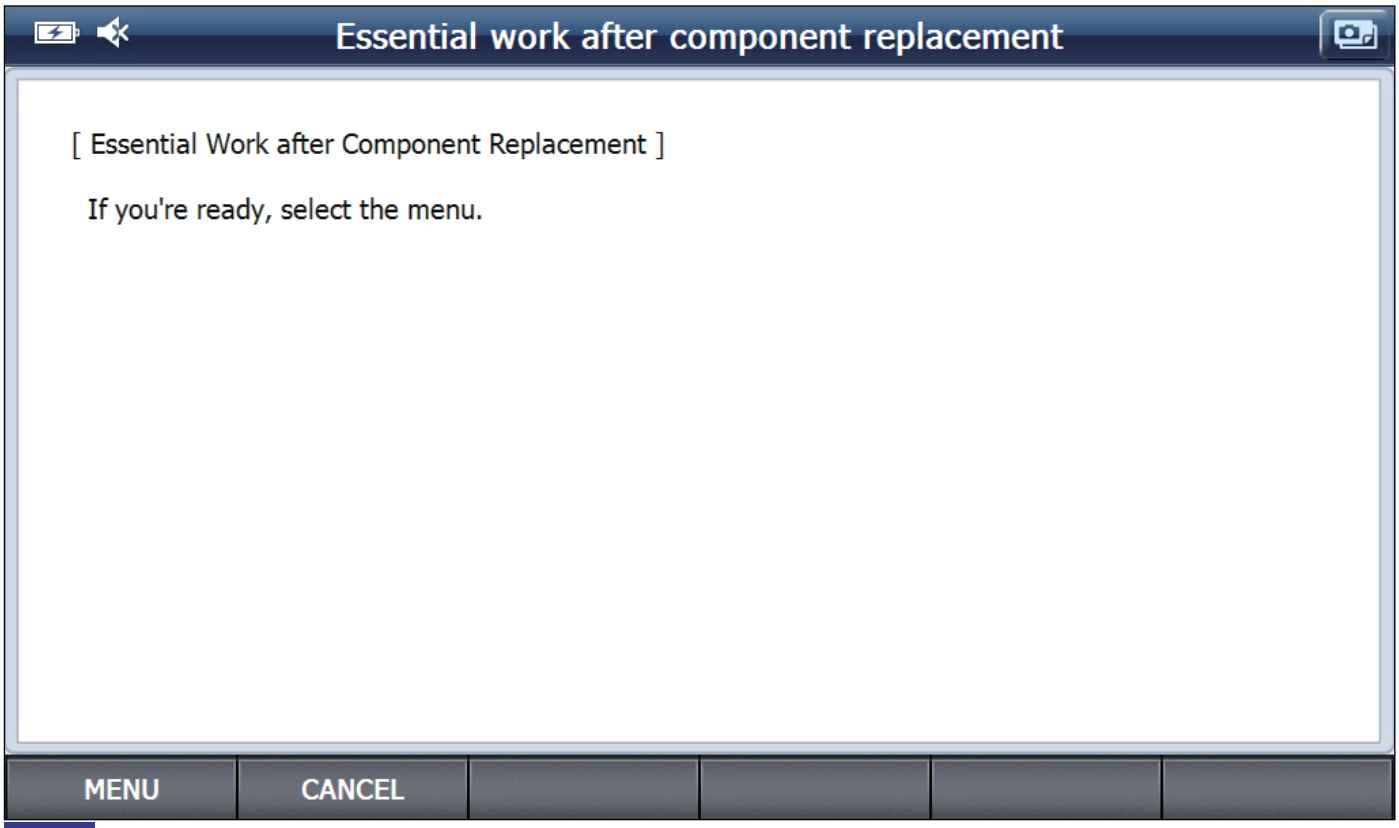


Fig.2

CRC12EN5010P01010042S

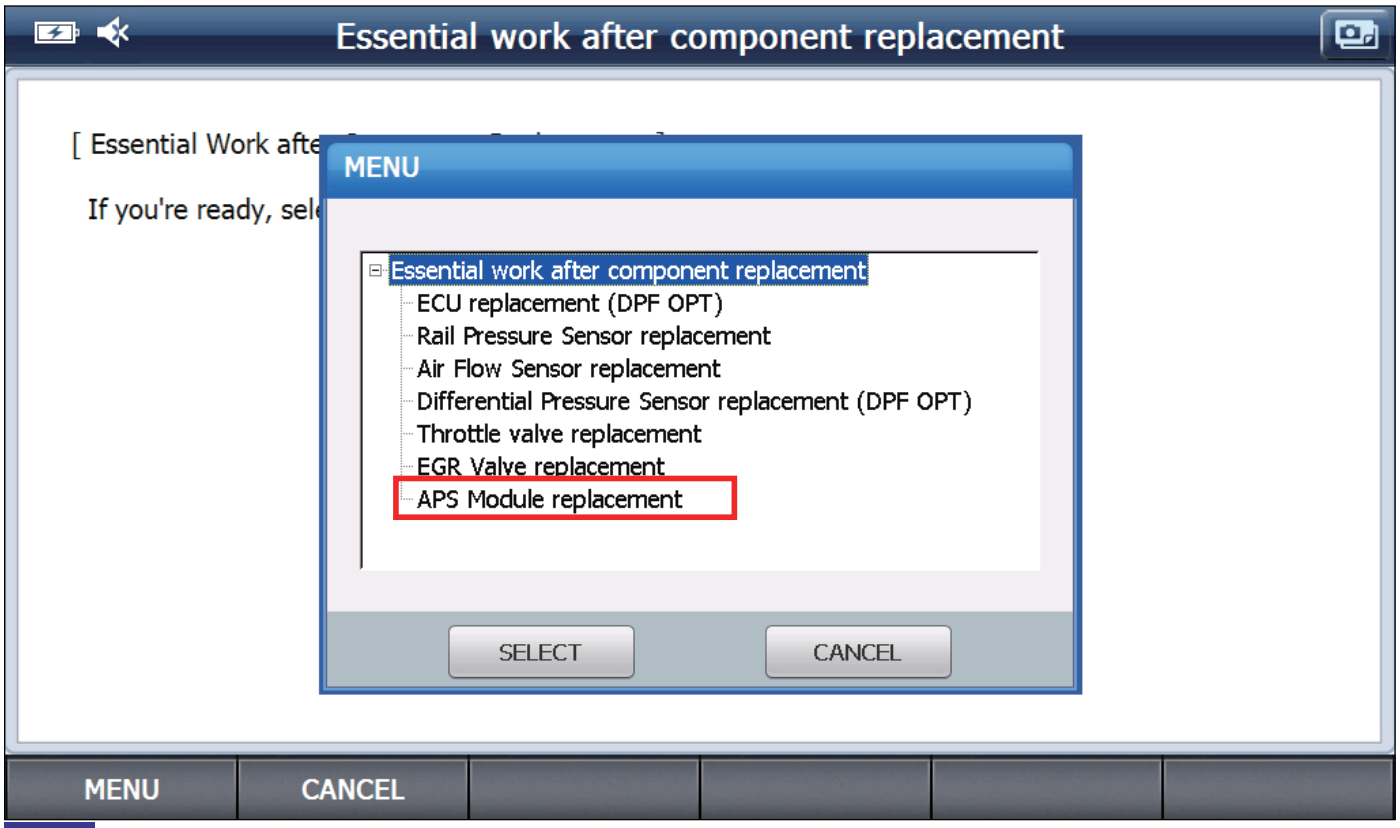


Fig.3

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.

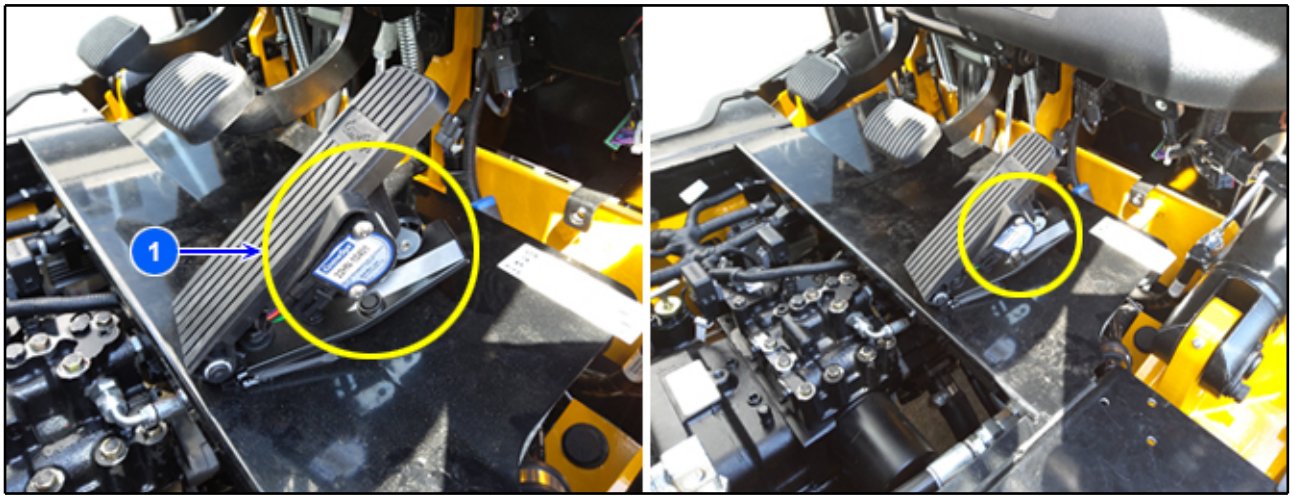
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P212700 Accelerator Position Sensor 2 Signal Circuit Low Input

Component Location



CRC12EN5010P21220011

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.

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

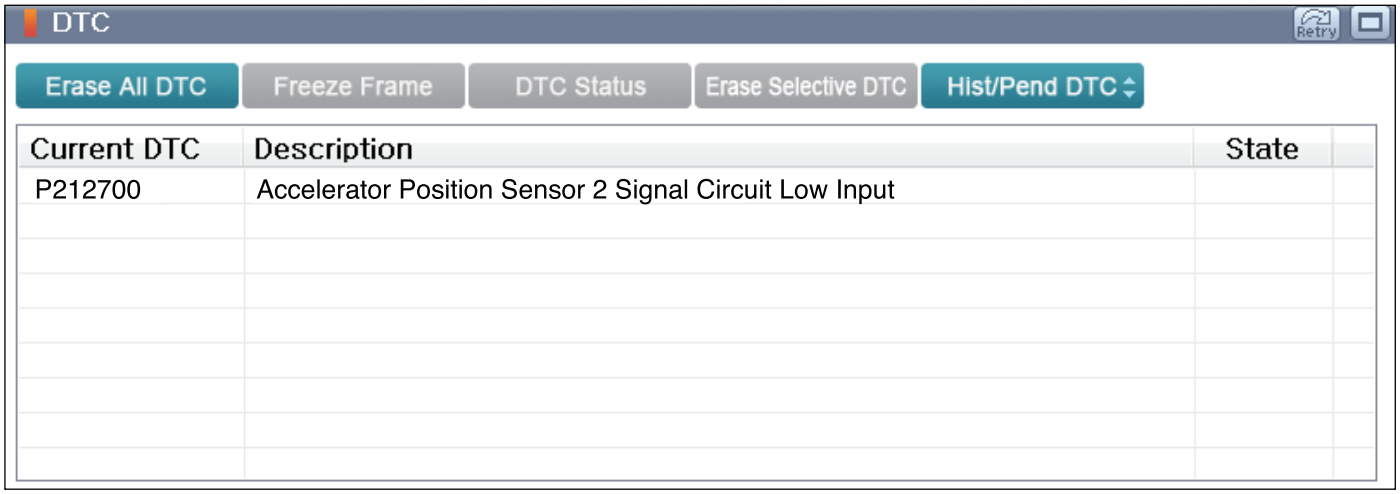
If output voltage of APS 2 is below threshold value for more than 0.18 sec., ECM sets DTC P212700. This fault might be caused by short to ground in power/signal circuit or open in power circuit of APS.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Open or short to ground in power circuit of APS2 2. Open in power circuit of APS2 3. Short to ground in signal circuit of APS 2 4. Defected APS
Enable Conditions	• Engine running		
Threshold Value	• Output voltage is below threshold value		
Diagnostic Time	• 0.18 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



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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

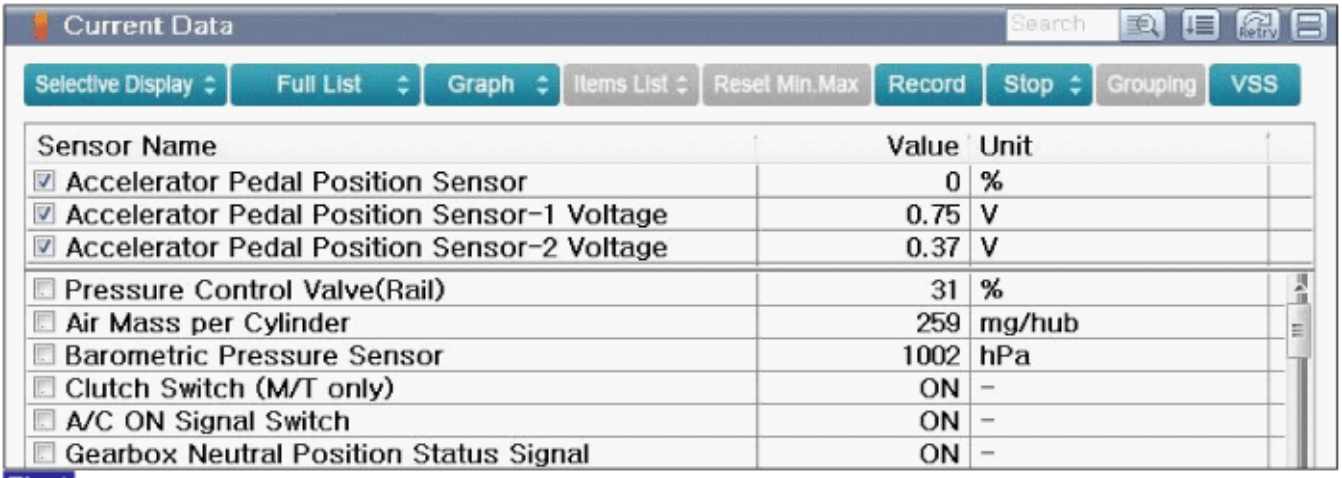


Fig.1

CRC12EN5010P21220022S

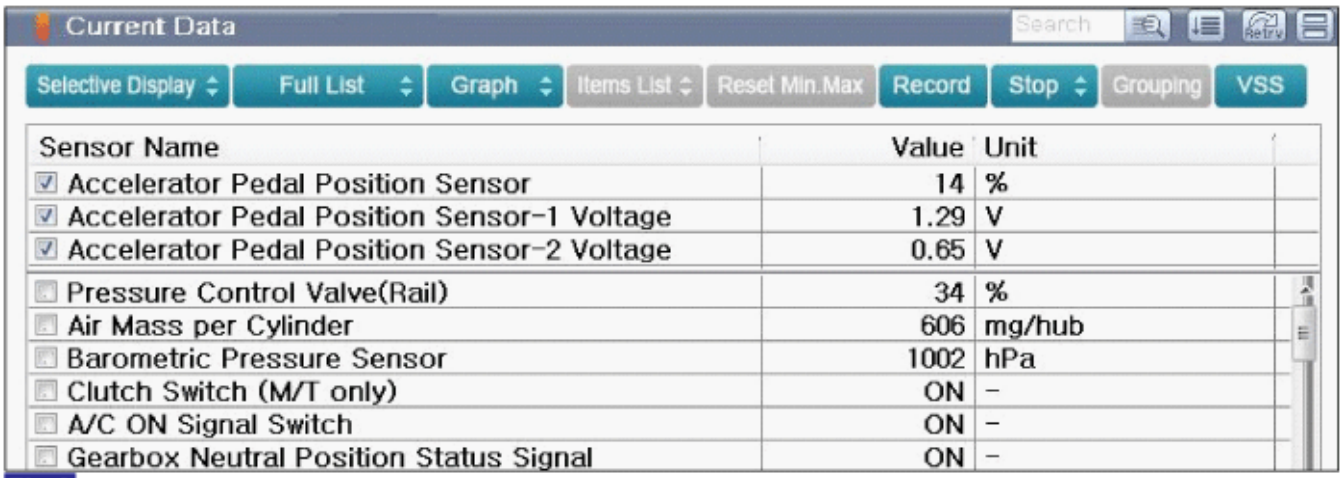


Fig.2

CRC12EN5010P21220023S

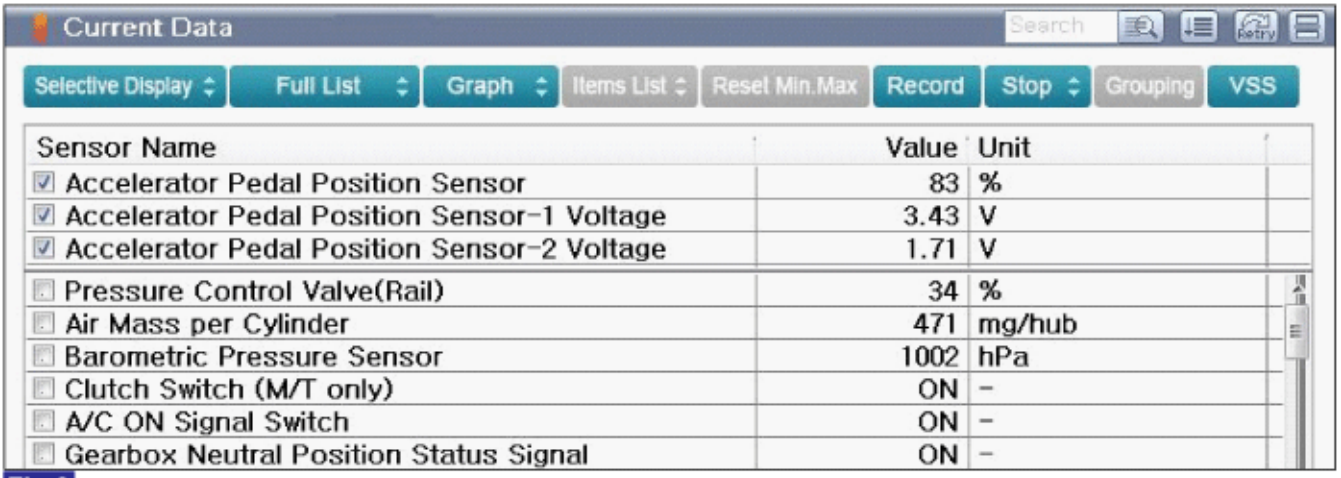


Fig.3

CRC12EN5010P21220024S

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

※ Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

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?

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS2 power terminal of APS 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 APS connector.
4. Measure the resistance between APS 2 ground terminal of APS harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect APT connector.
7. Ignition switch "ON"
8. Measure the voltage between APS 2 power terminal 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.

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS 2 signal terminal of APS harness connector and chassis ground.

Specification :0V

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect APS and ECM connector.
8. Measure the resistance between APS 2 signal terminal of APS harness connector and APS 2 signal of ECM harness connector.

Specification :Approx. below 1 Ω

9. 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

■ 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

Item	Output Voltage (V) (Vref = 5.0V)	
	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.

⚠ CAUTION

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

⚠ CAUTION

- 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

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 "APS Module Change"

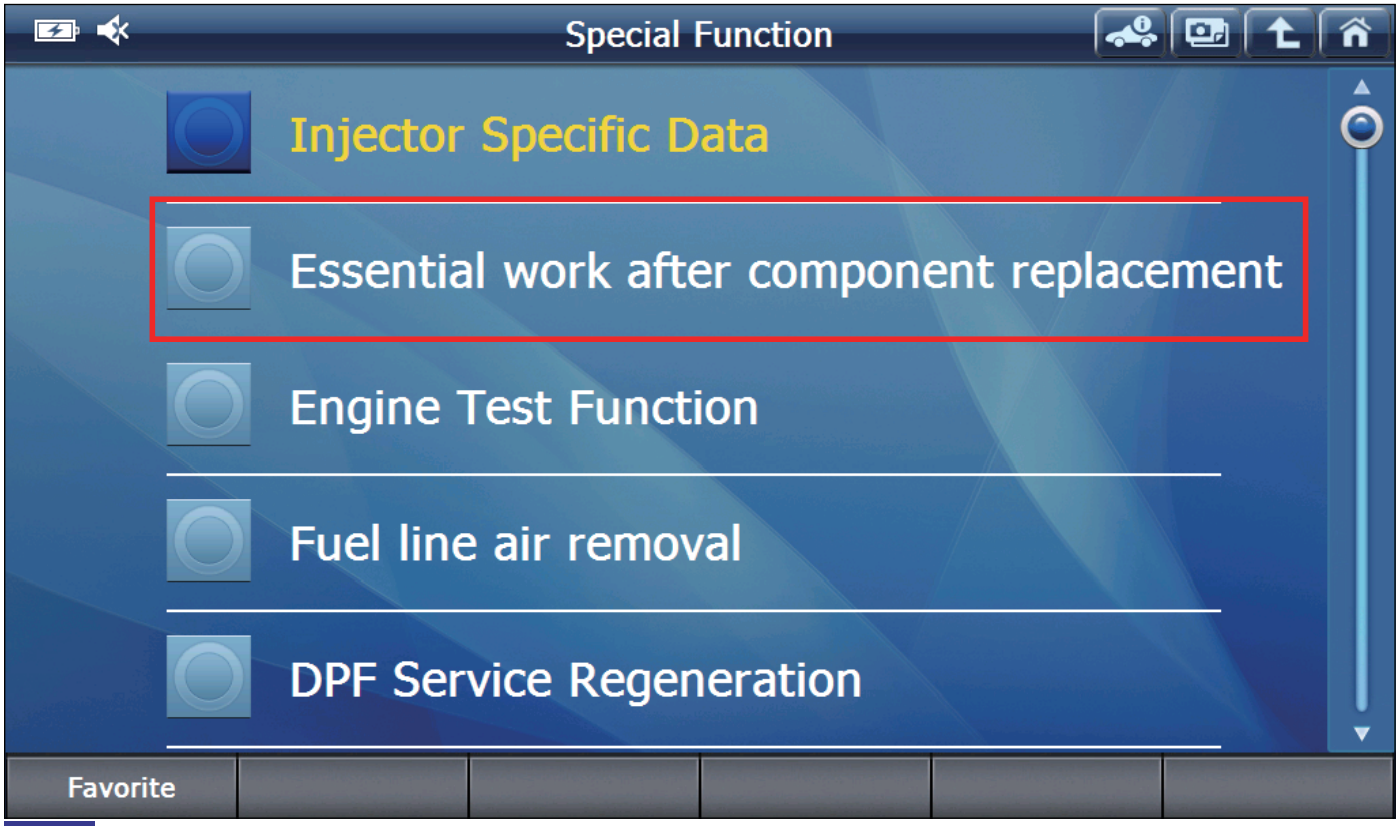


Fig.1

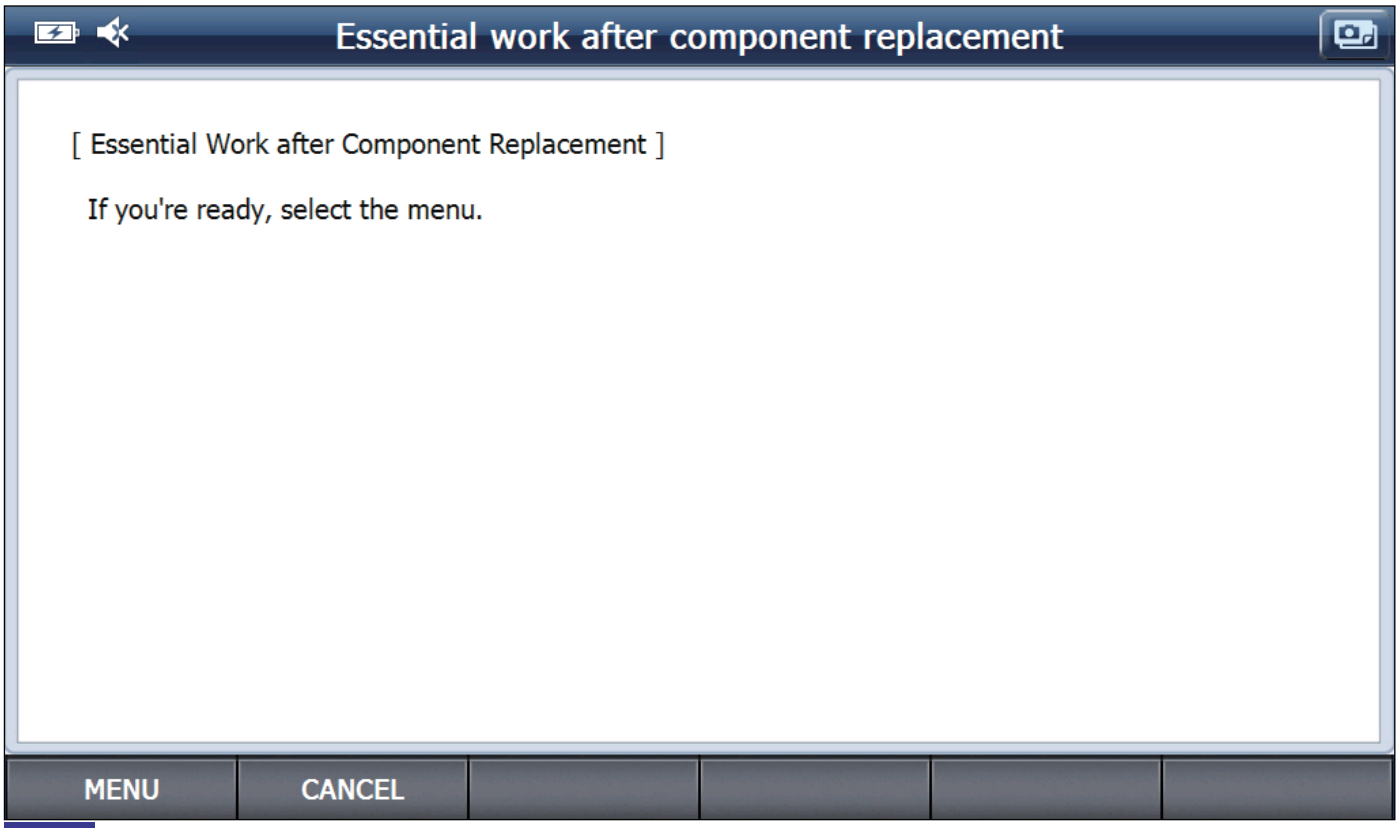


Fig.2

CRC12EN5010P01010042S

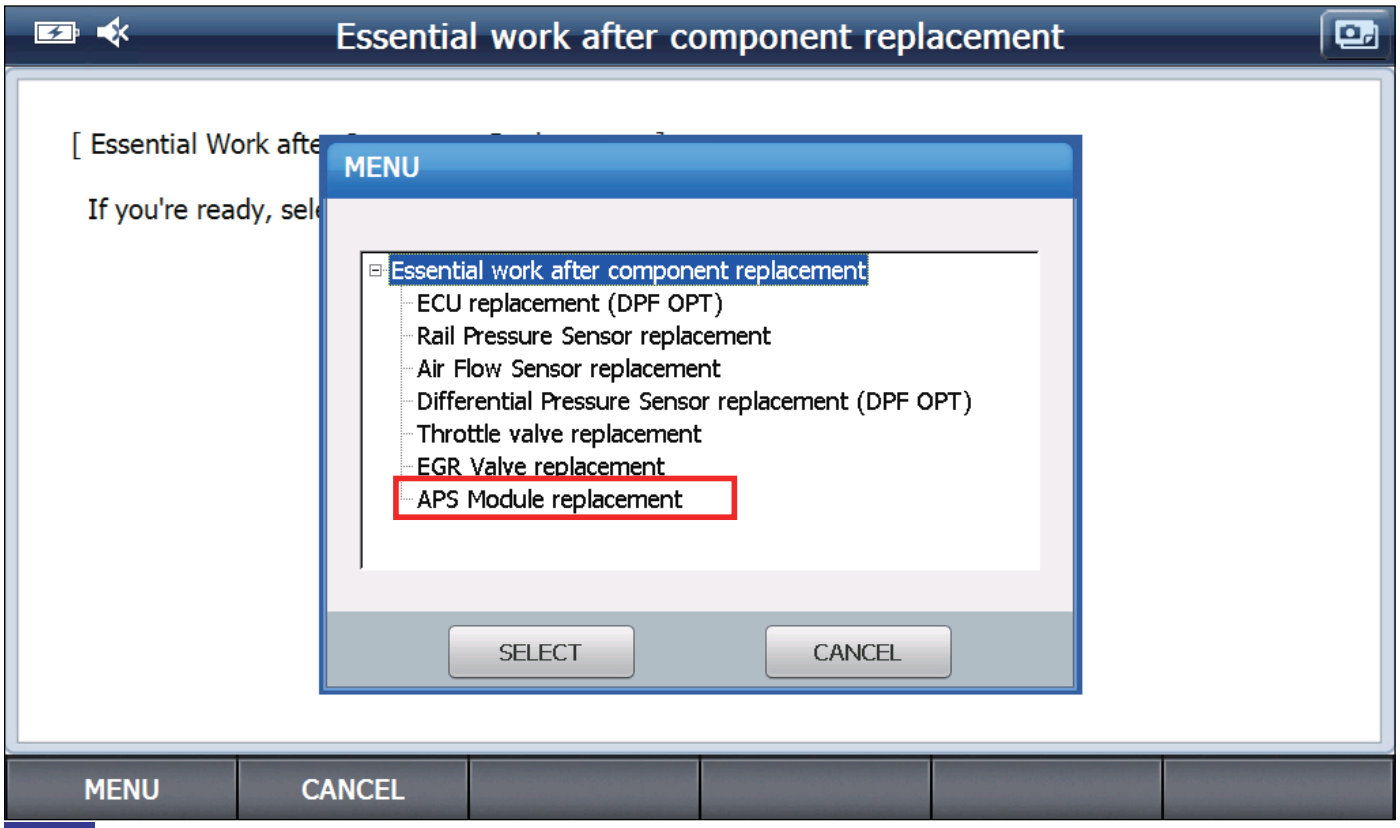


Fig.3

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.

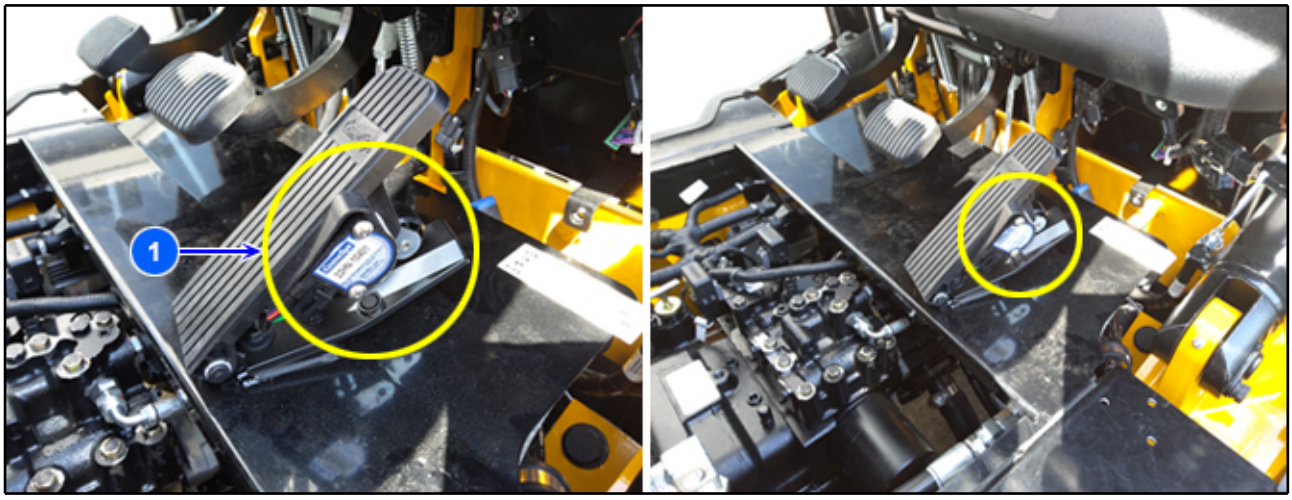
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P212800 Accelerator Position Sensor 2 Signal Circuit-High Input

Component Location



CRC12EN5010P21220011

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.

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

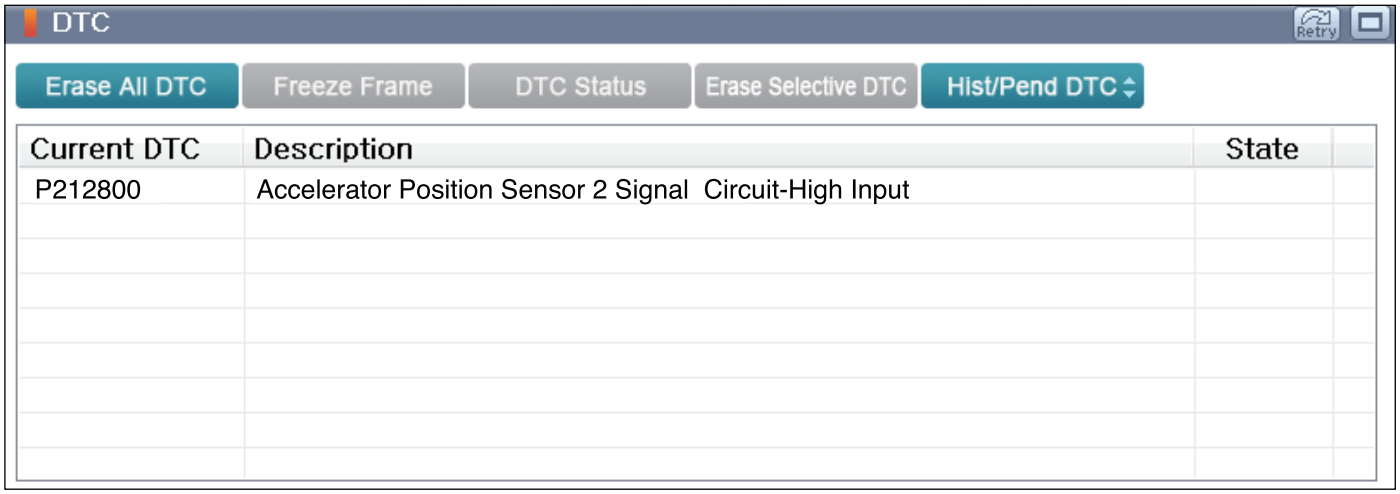
If output voltage of APS 2 is above threshold value for more than 0.18 sec., ECM sets DTC P212800. This fault might be caused by short to power in power/signal circuit or open in ground circuit of APS.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Short to power in power circuit of APS2 2. Open in ground circuit of APS2 3. Short to power in signal circuit of APS2 4. Defected APS
Enable Conditions	• Engine running		
Threshold Value	• Output voltage is below threshold value		
Diagnostic Time	• 0.18 sec		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



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

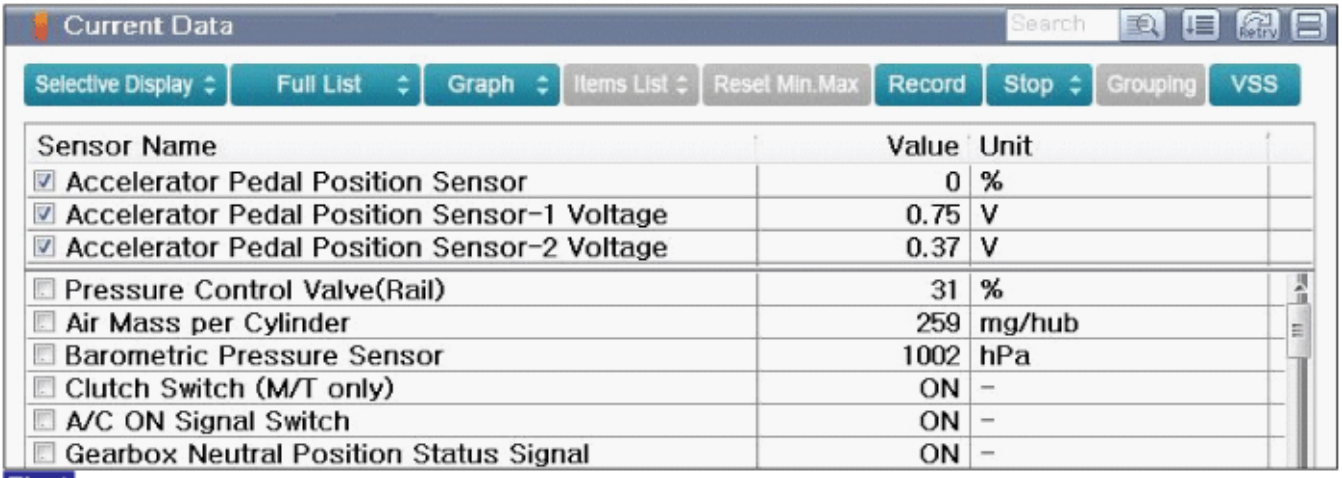


Fig.1

CRC12EN5010P21220022S

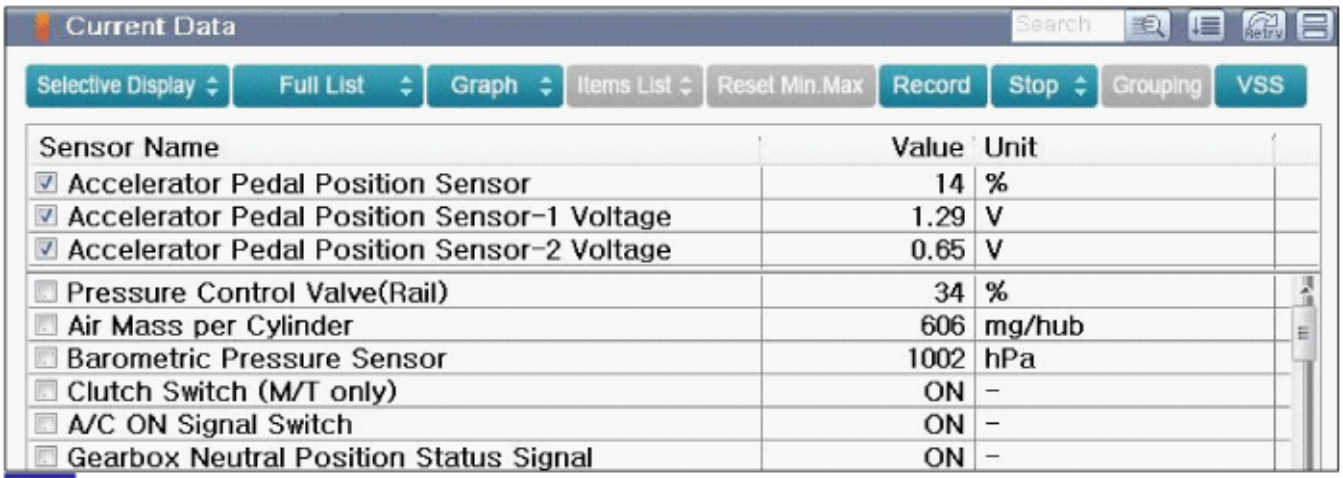


Fig.2

CRC12EN5010P21220023S

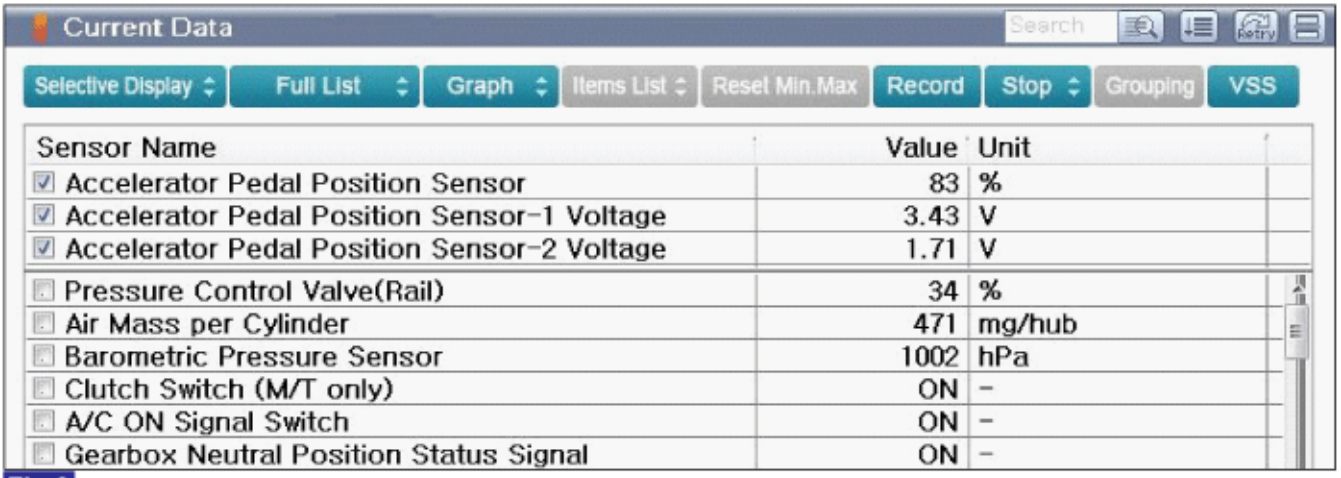


Fig.3

CRC12EN5010P21220024S

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

※ Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

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?

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS2 power terminal of APS 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 APS connector.
4. Measure the resistance between APS 2 ground terminal of APS harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect APT connector.
7. Ignition switch "ON"
8. Measure the voltage between APS 2 power terminal 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.

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS 2 signal terminal of APS harness connector and chassis ground.

Specification :0V

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect APS and ECM connector.
8. Measure the resistance between APS 2 signal terminal of APS harness connector and APS 2 signal of ECM harness connector.

Specification :Approx. below 1 Ω

9. 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

■ 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

Item	Output Voltage (V) (Vref = 5.0V)	
	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.

⚠ CAUTION

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

⚠ CAUTION

- 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

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 "APS Module Change"

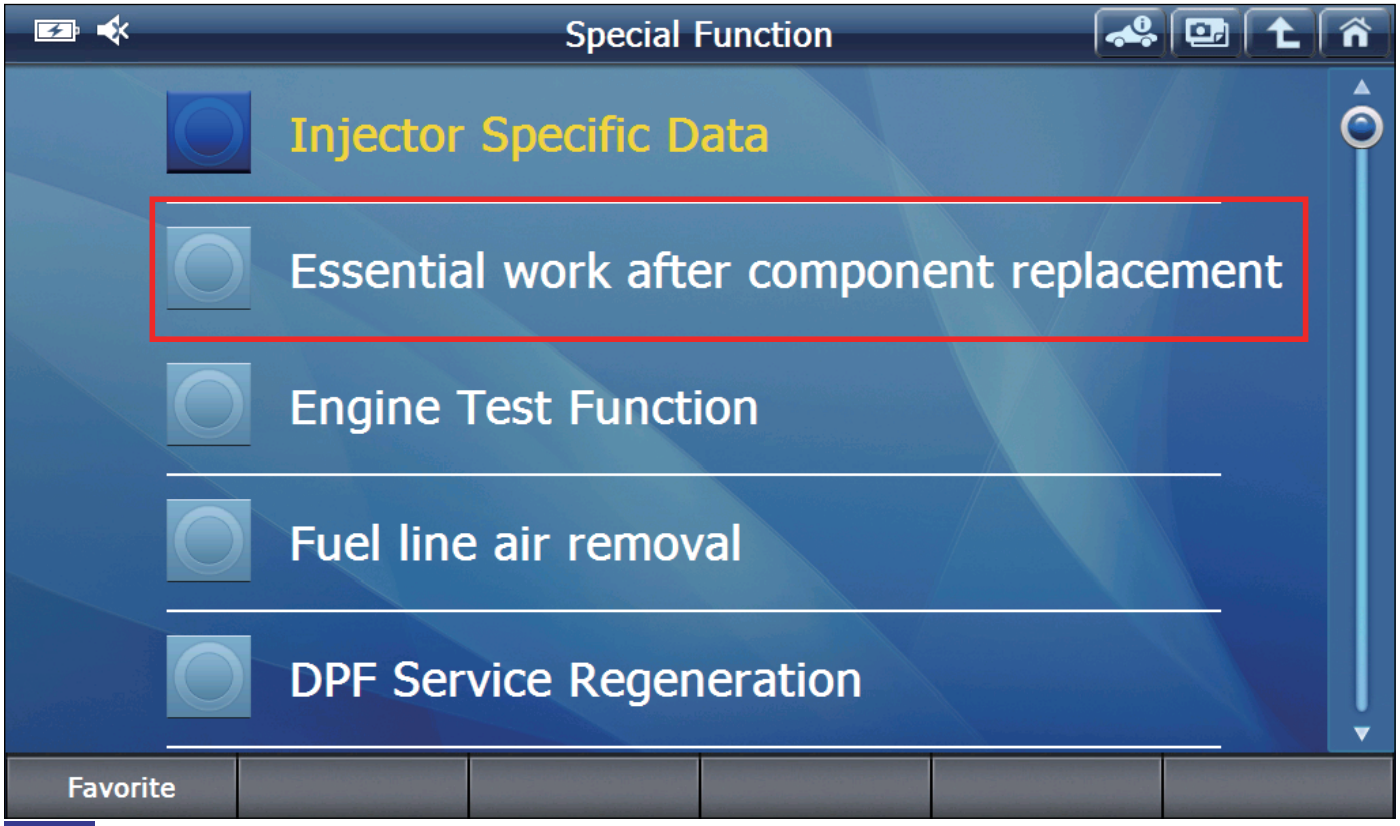


Fig.1

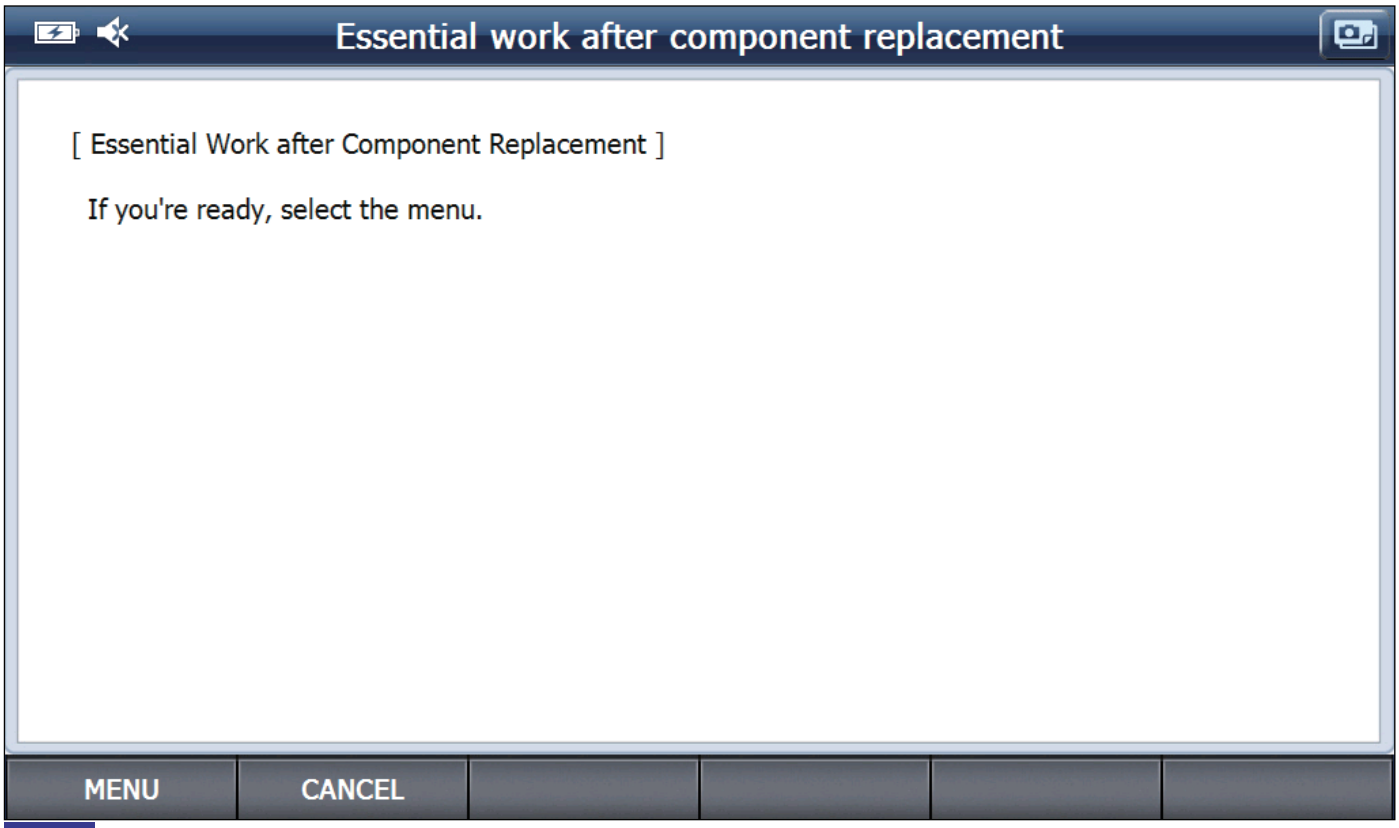


Fig.2

CRC12EN5010P01010042S

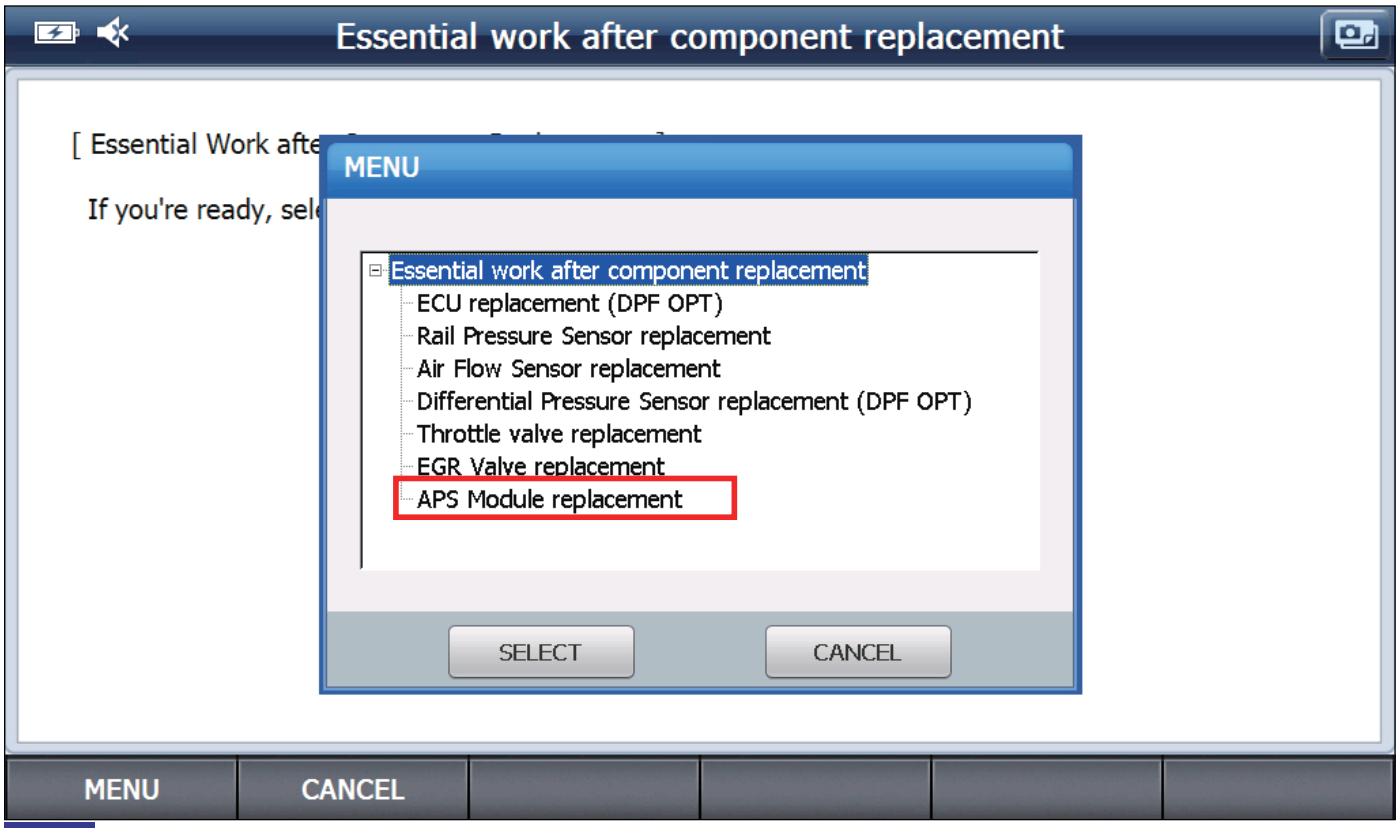


Fig.3

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.

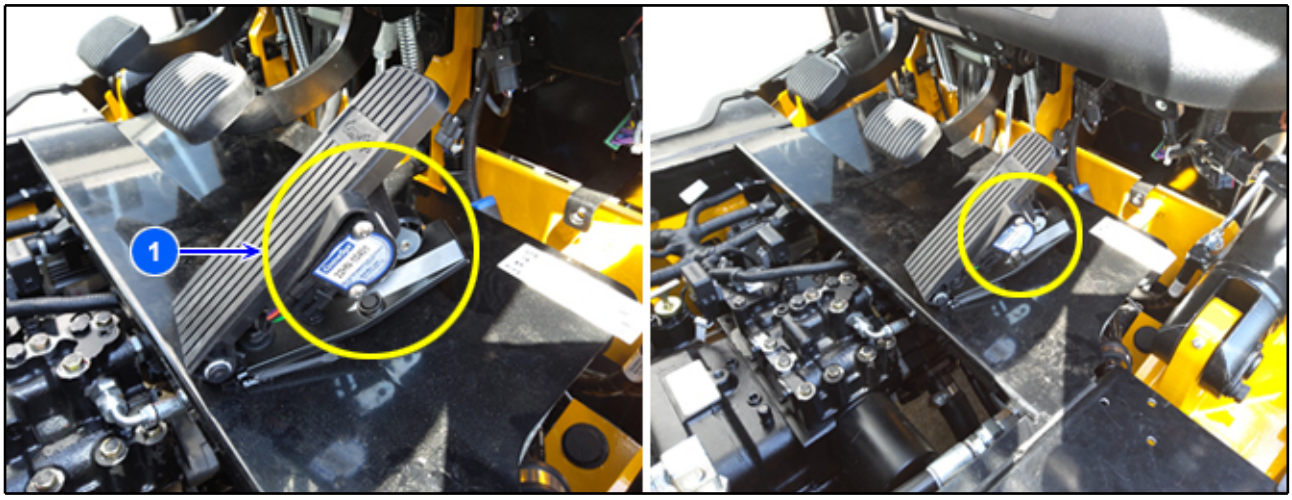
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P213800 Accelerator Position Sensor 1 & 2 Signal Voltage Correlation

Component Location



CRC12EN5010P21220011

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.

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

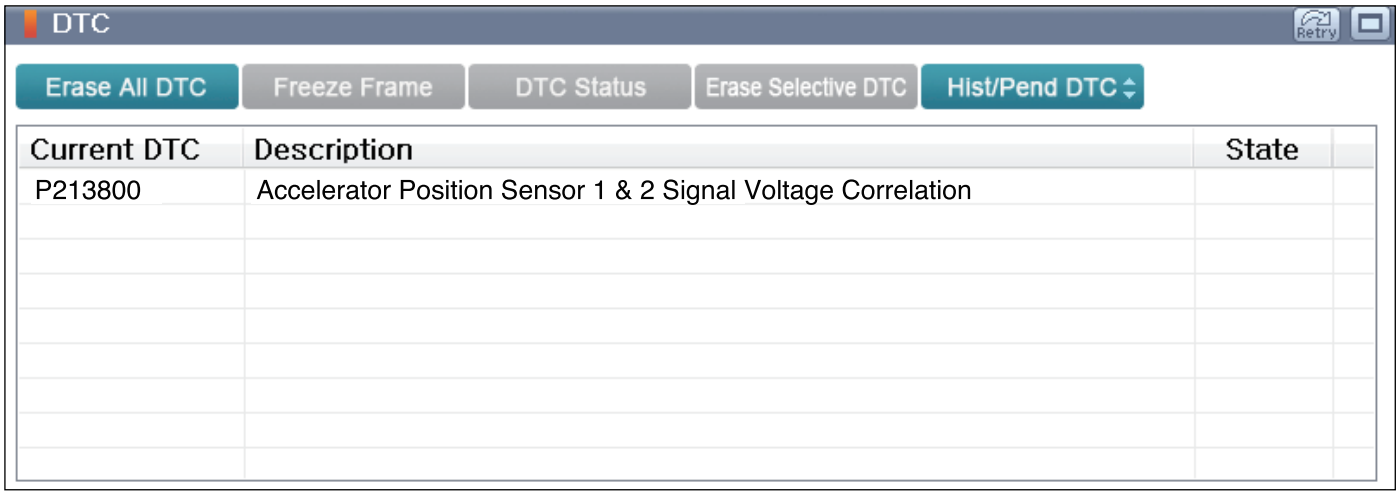
If output voltage difference between APS1 and APS2 is out of specification, ECM sets DTC P213800.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Faulty APS1 and APS2 circuit 2. Defected APS
Enable Conditions	• Engine running		
Threshold Value	• Output voltage difference between APS1 and APS2 is out of specification		
Diagnostic Time	• -		
Fail Safe	Engine OFF	• No	
	EGR Off	• No	
	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.



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

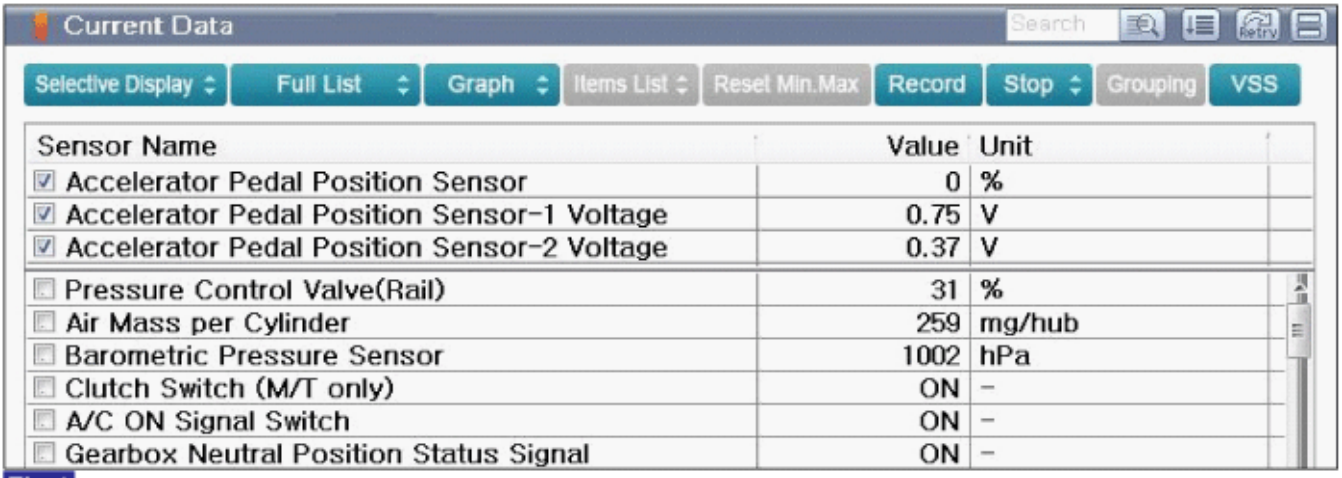


Fig.1

CRC12EN5010P21220022S

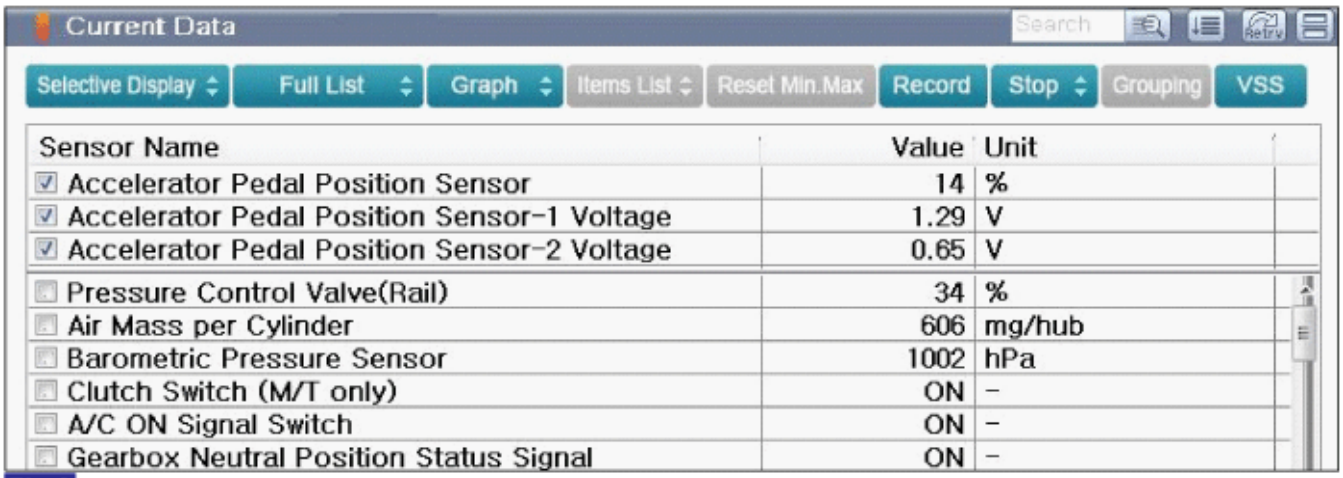


Fig.2

CRC12EN5010P21220023S

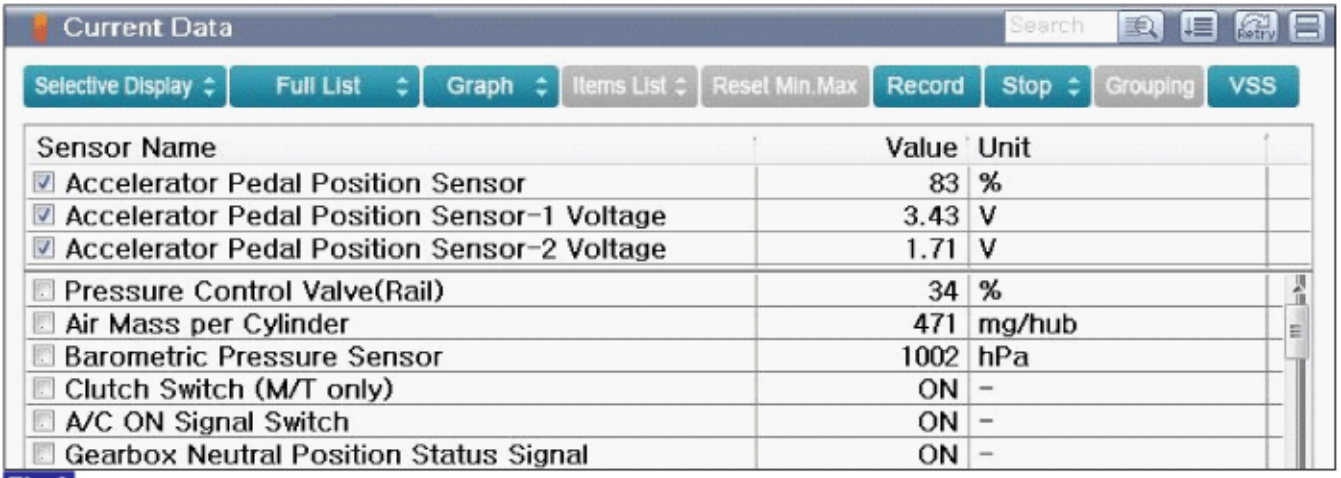


Fig.3

CRC12EN5010P21220024S

Fig.1, 2, 3) Sensor voltage current data in according to accelerator pedal position

※ Voltage of Accelerator Pedal Sensor 2 (APS2) is 1/2 of APS1

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?

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 APS connector.
3. Ignition switch "ON"
4. Measure the voltage between APS1 power terminal of APS harness connector and chassis ground.

Specification :Approx. 5V

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect APS connector.
7. Ignition switch "ON"
8. Measure the voltage between APS2 power terminal of APS harness connector and chassis ground.

Specification : Approx. 5V

9. 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 APS connector.
4. Measure the resistance between APS 1 ground terminal of APS harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect APS connector.
8. Measure the resistance between APS 2 ground 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.
4. Measure the voltage between APS 1 signal terminal of APS harness connector and chassis ground.

Specification : 0V

5. 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 Ω

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 Ω

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.

Component 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

Item	Output Voltage (V) (Vref = 5.0V)	
	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.

⚠ CAUTION

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

⚠ CAUTION

- 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

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 "APS Module Change"

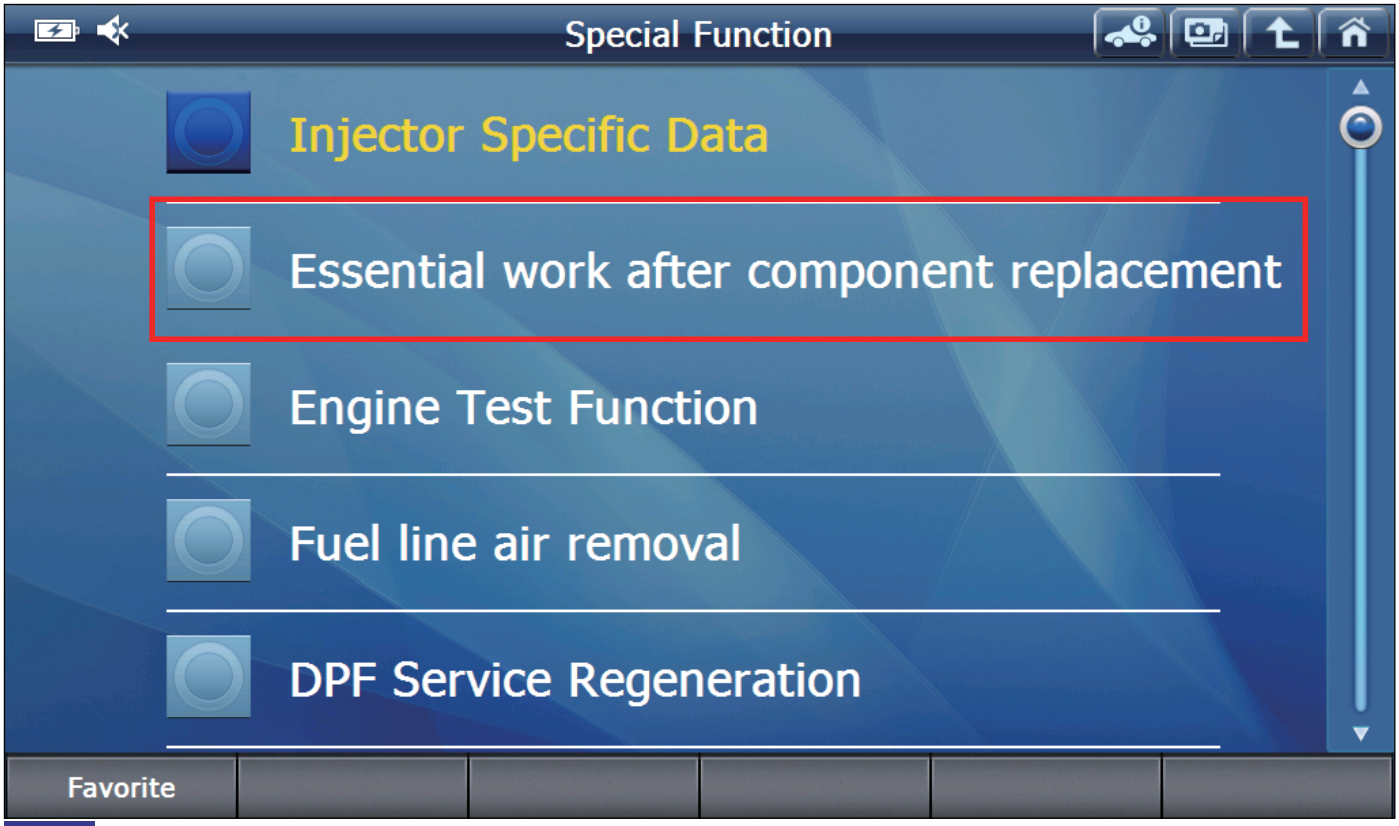


Fig.1

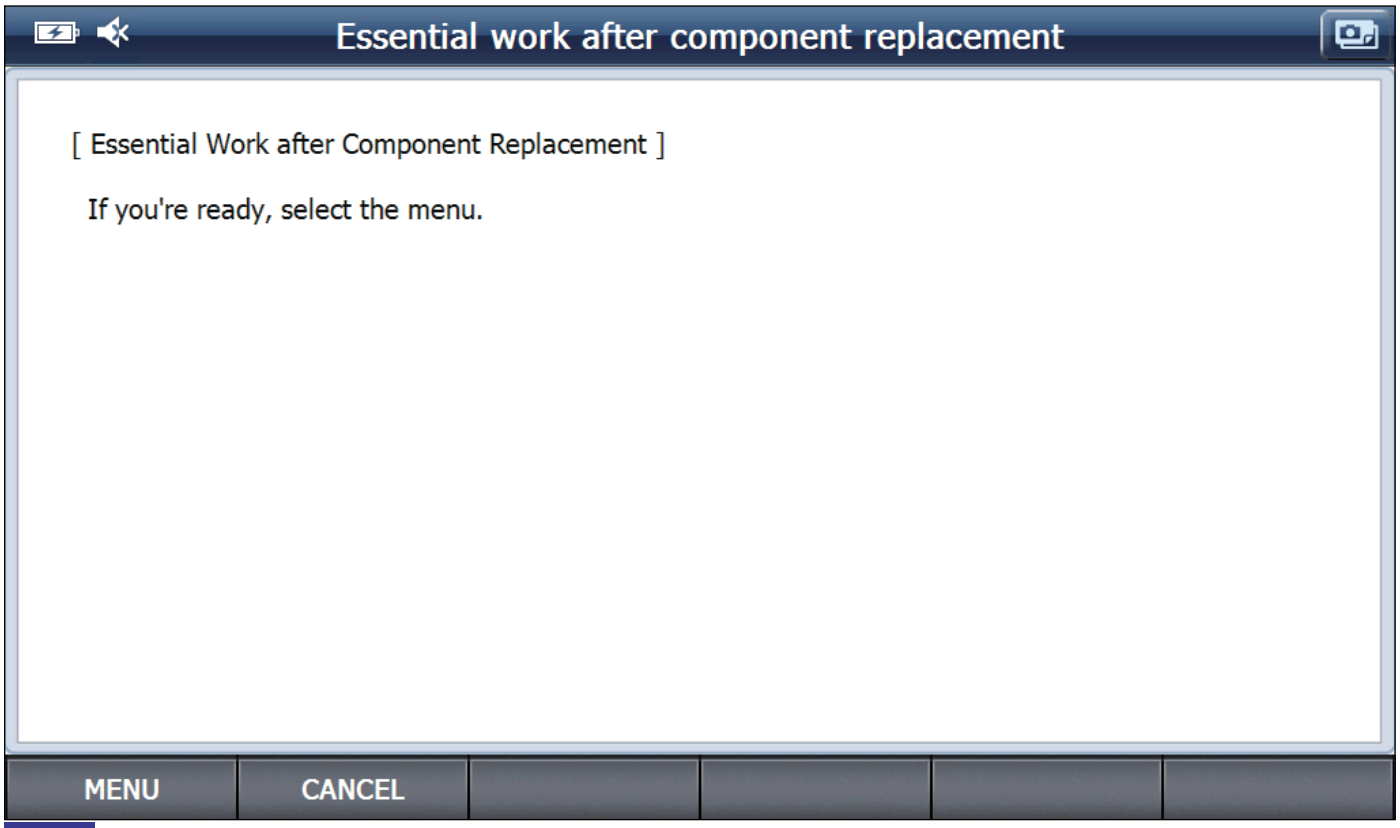


Fig.2

CRC12EN5010P01010042S

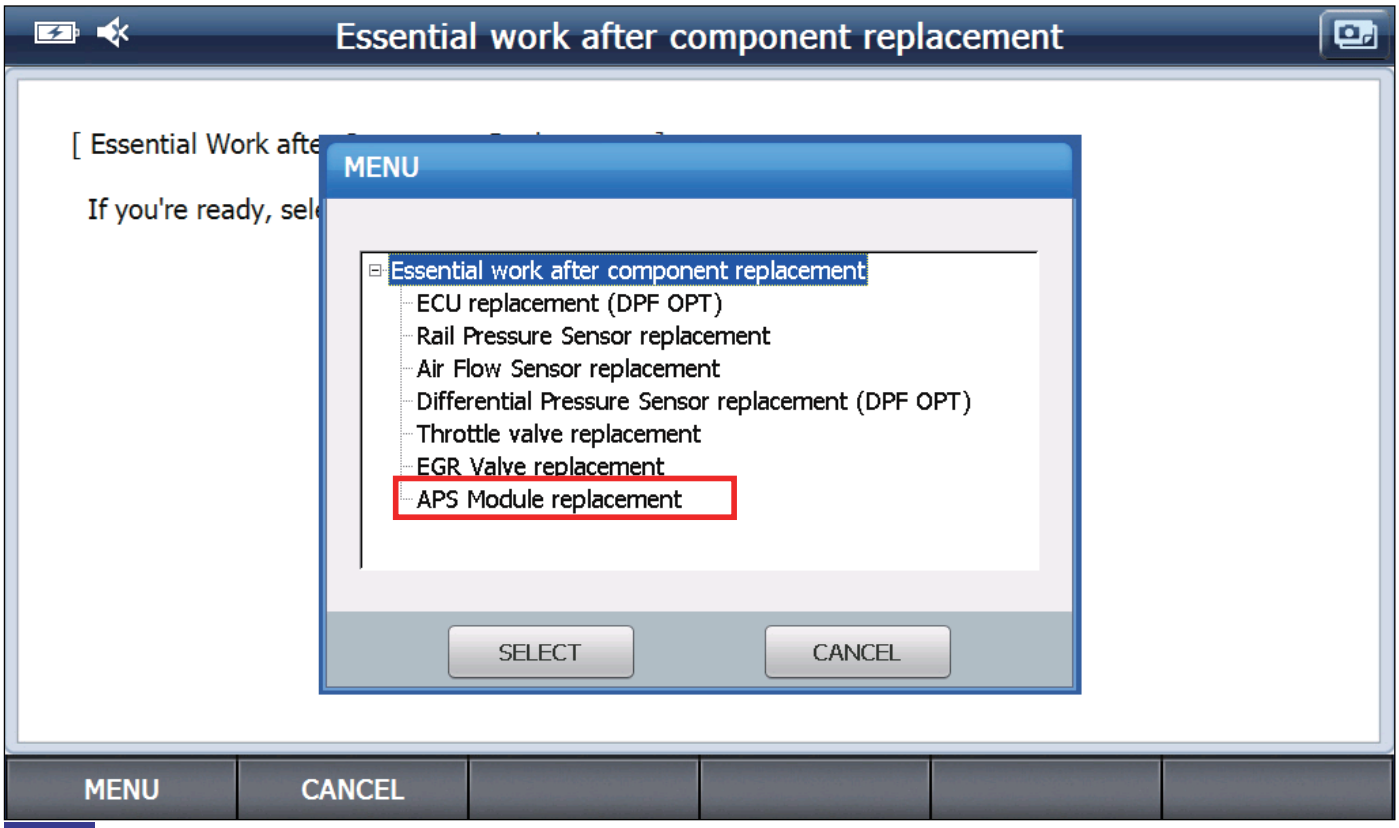


Fig.3

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.

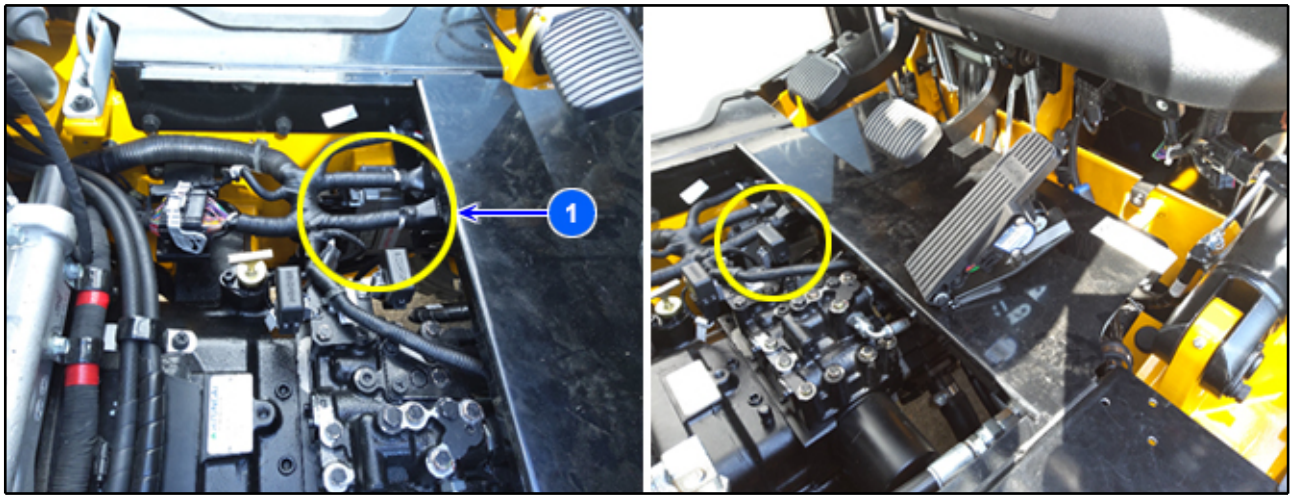
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P222800 Barometric Pressure Circuit Low Input

Component Location



CRC12EN5010P02190011

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 altitiudes.

General Description

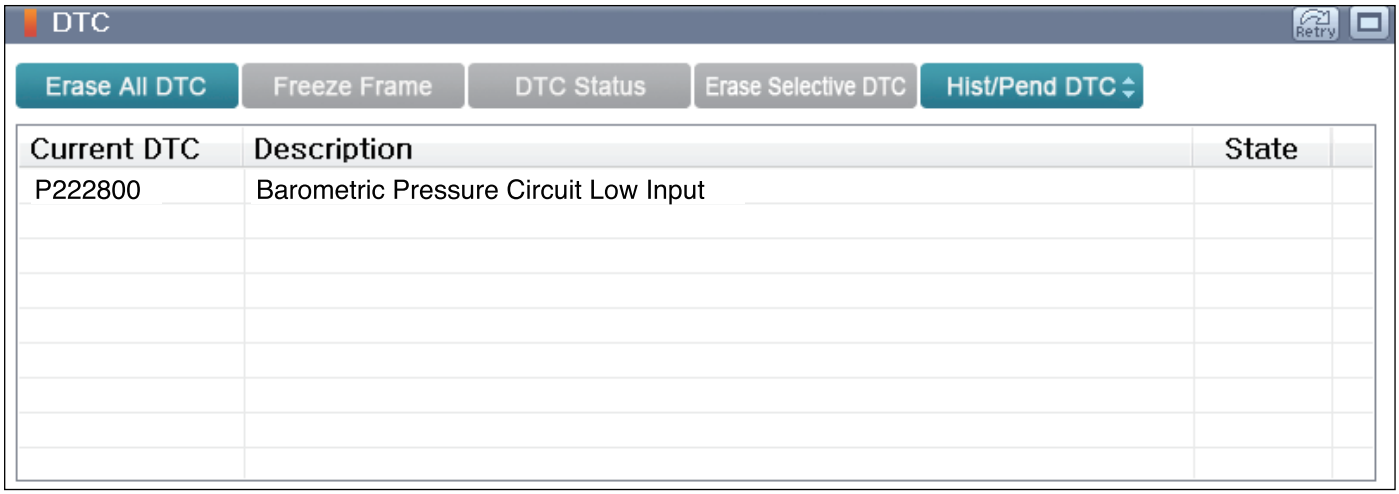
If output voltage of barometric pressure sensor is below threshold value for more than 1 sec., ECM sets DTC P222800.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Output voltage is below threshold value		
Detecting Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P22280021S

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 ECM connector.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1Ω

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

■ Barometric Pressure Sensor Inspection

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

Specification : Approx. 1000 hPa

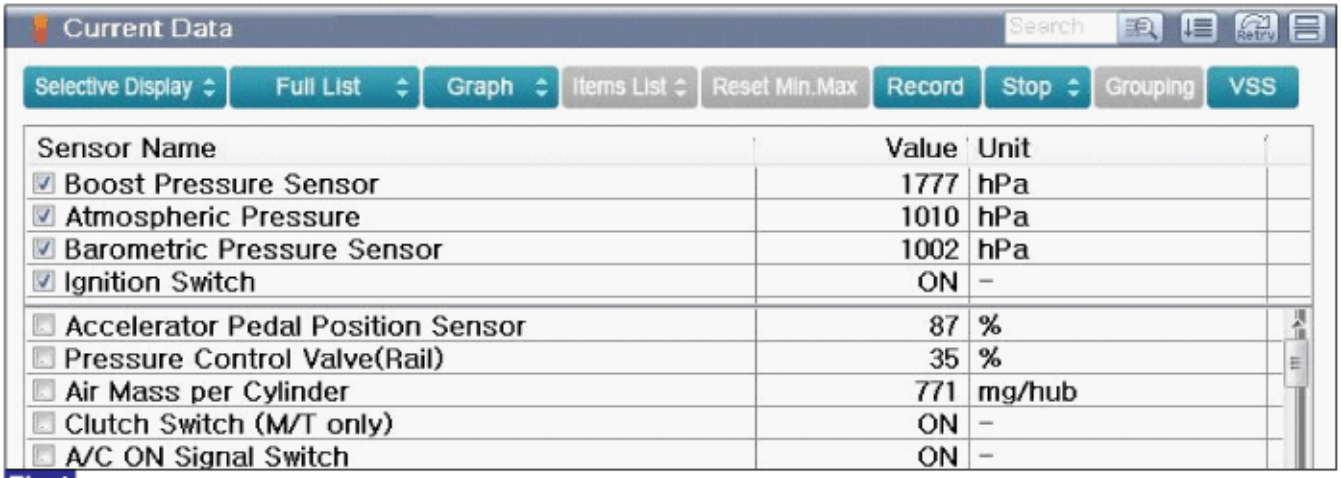


Fig.1

CRC12EN5010P22280041S

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.

NO ▸ Go to "Diagnostic Trouble Codes(DTC) Inspection" procedure.

■ Diagnostic Trouble Codes(DTC)

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?

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.

⚠ 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"

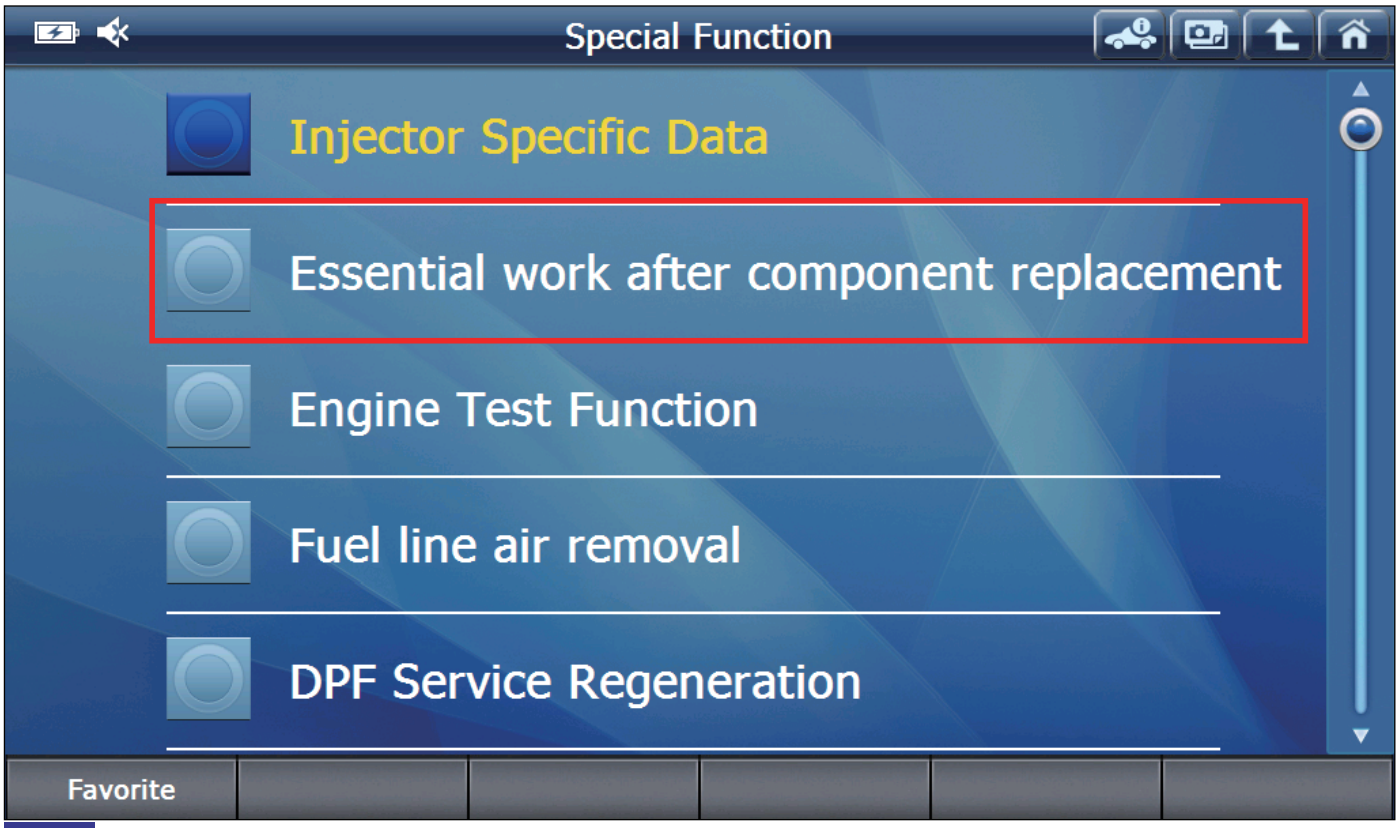


Fig.1

CRC12EN5010P01010041S

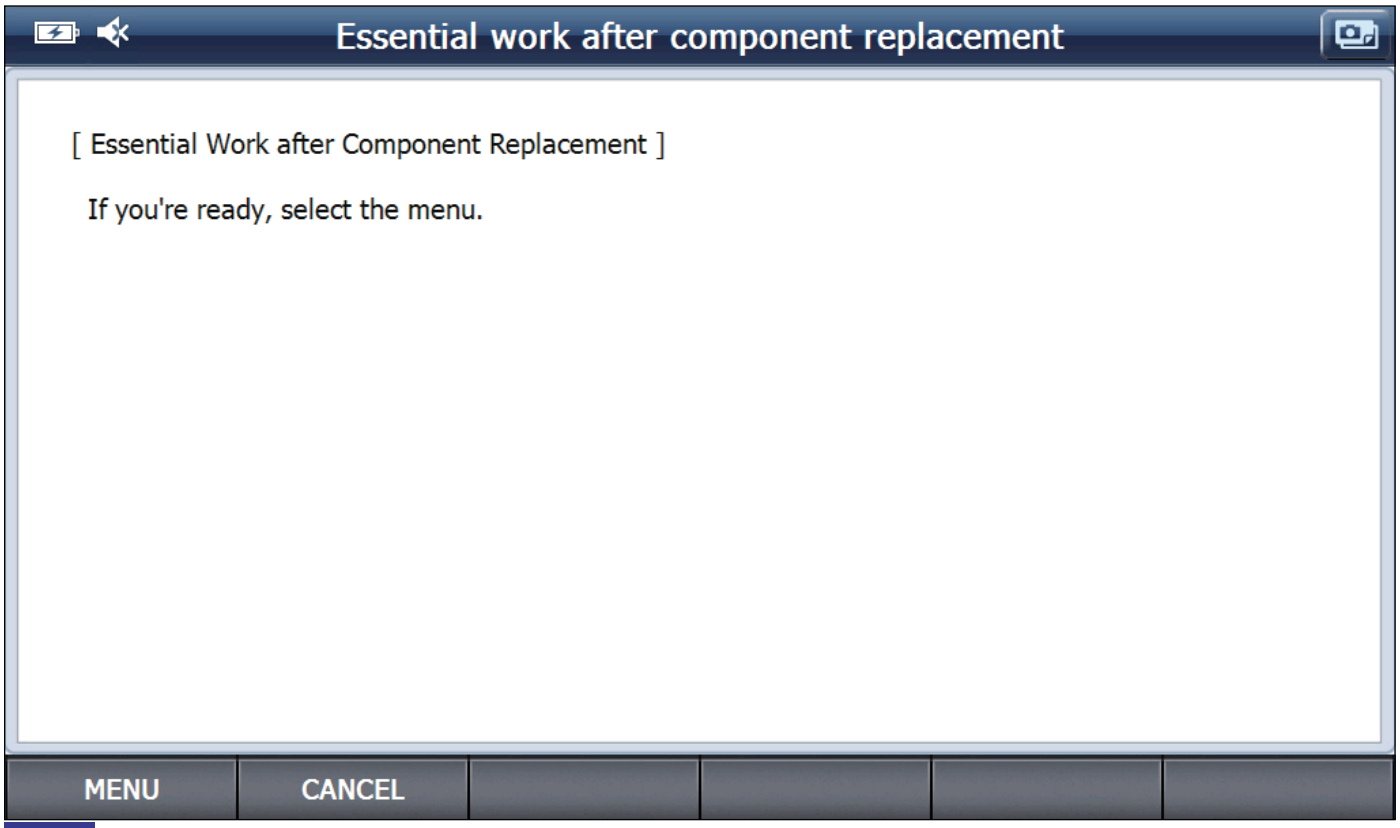


Fig.2

CRC12EN5010P01010042S

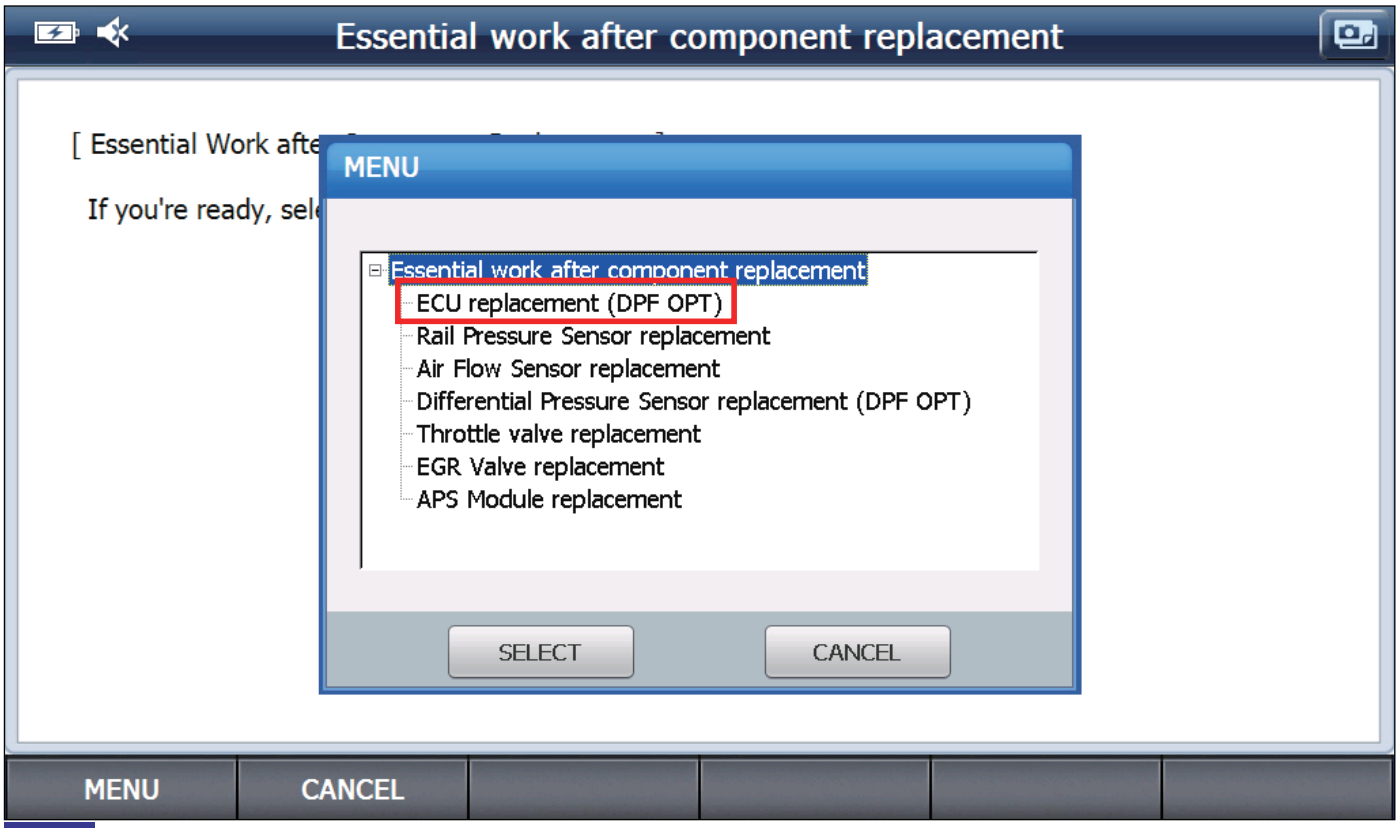


Fig.3

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.

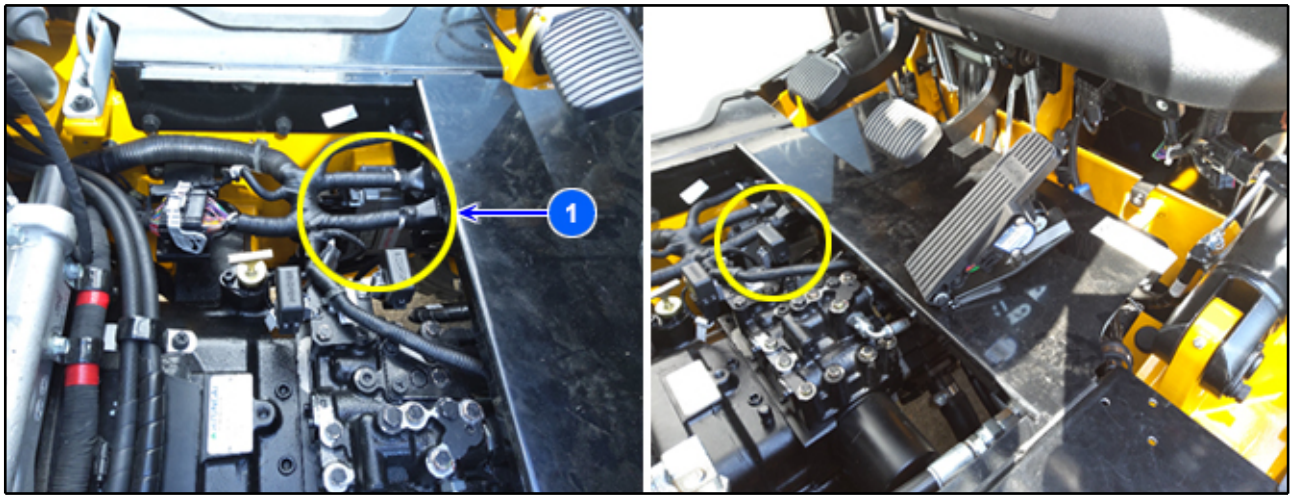
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P222900 Barometric Pressure Circuit High Input

Component Location



CRC12EN5010P02190011

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 altitiudes.

General Description

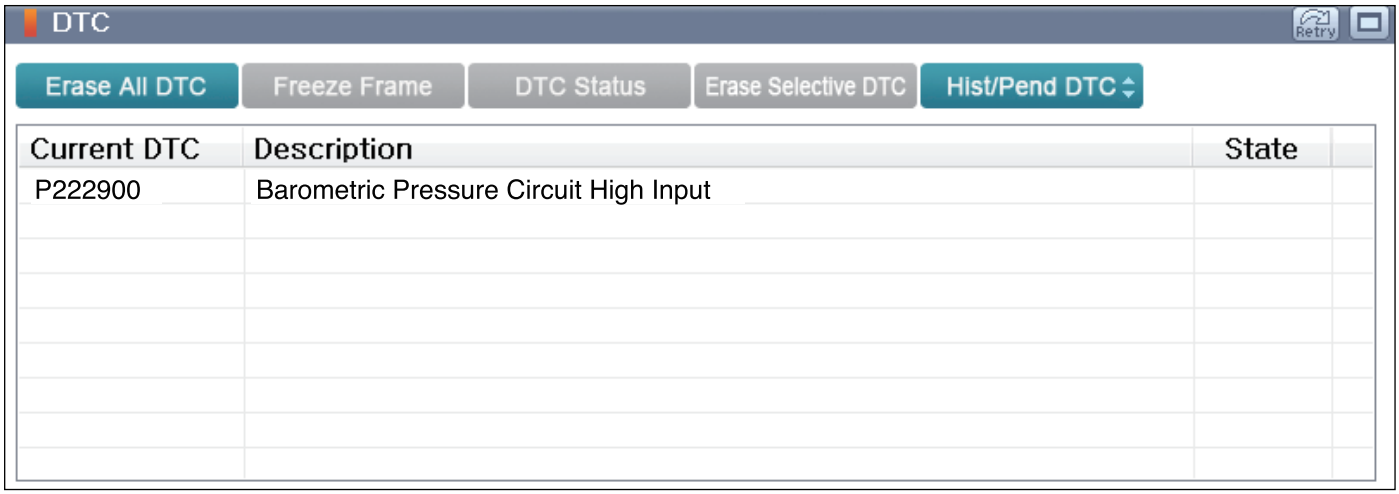
If output voltage of barometric pressure sensor is below threshold value for more than 1 sec., ECM sets DTC P222800.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Voltage monitoring		1. Poor connector connection 2. Defected ECM
Enable Condition	• Engine running		
Threshold Value	• Output voltage is above threshold value		
Detecting Time	• 1 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P22290021S

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 ECM connector.
3. 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?

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 ECM connector.
4. Measure the resistance between ground terminal of ECM harness connector and chassis ground.

Specification : Approx. below 1Ω

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

■ Barometric Pressure Sensor Inspection

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

Specification : Approx. 1000 hPa

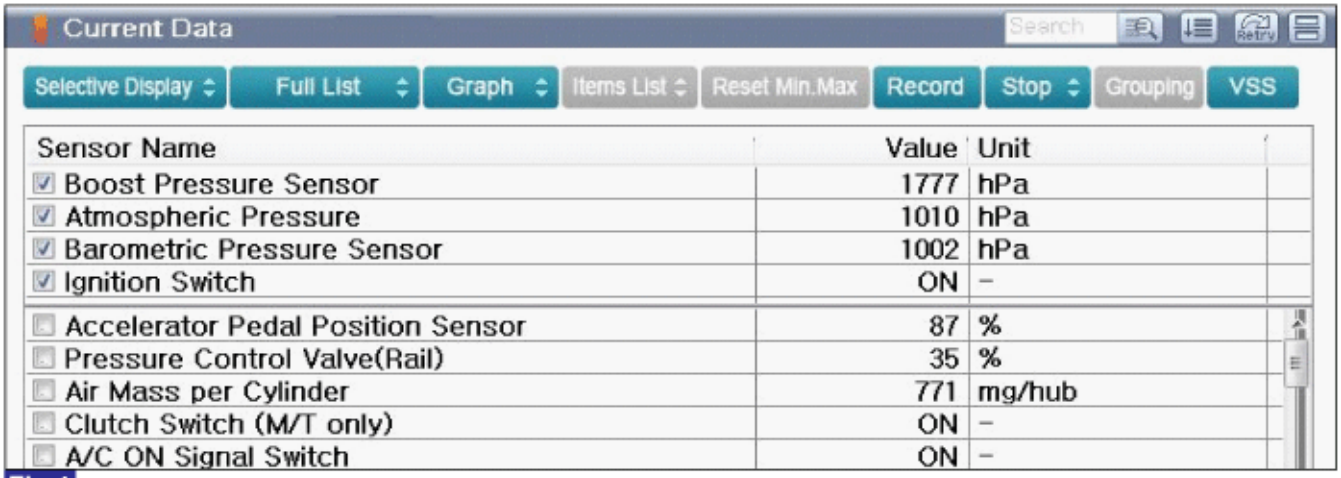


Fig.1

CRC12EN5010P22280041S

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.

NO ▸ Go to "Diagnostic Trouble Codes(DTC) Inspection" procedure.

■ Diagnostic Trouble Codes(DTC)

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?

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.

⚠ 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"

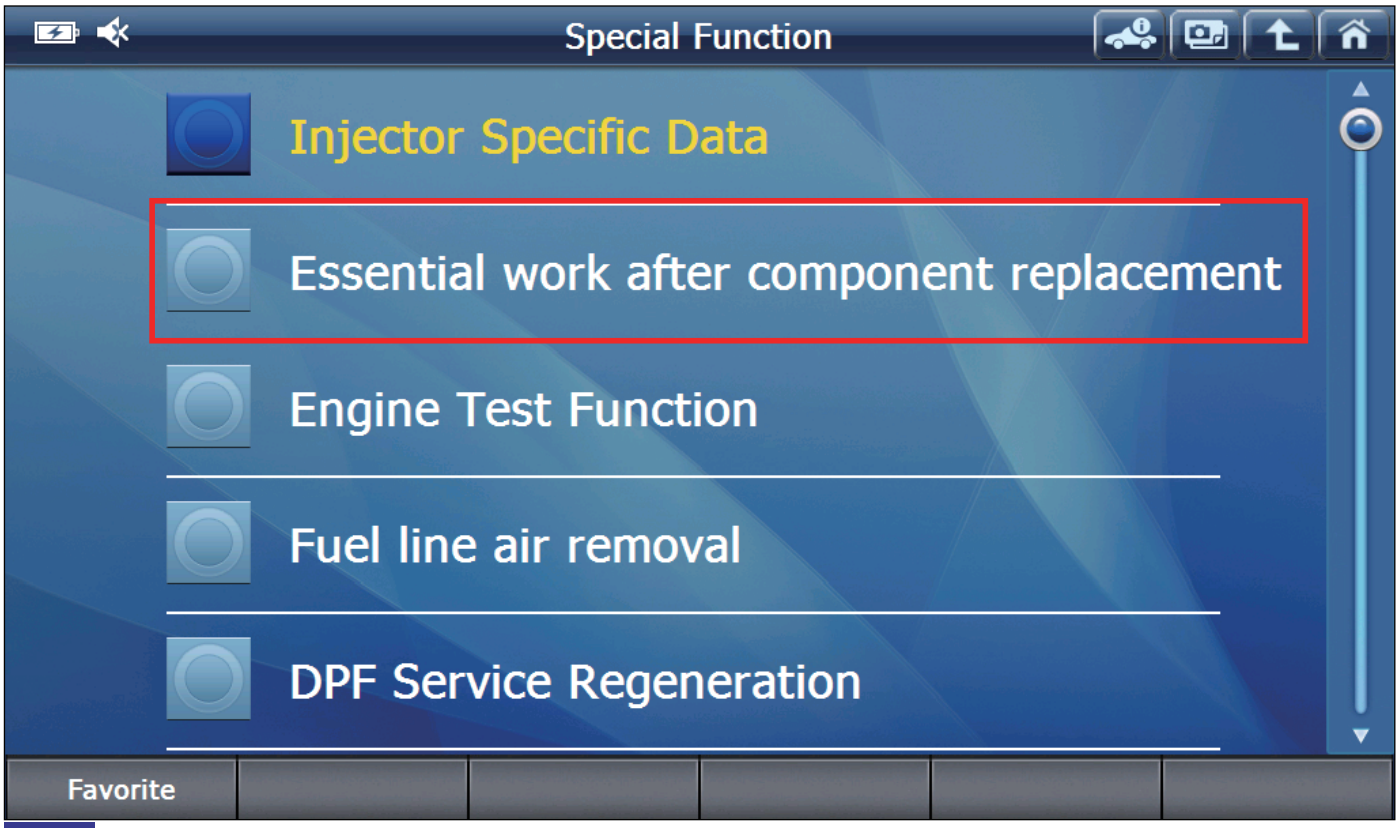


Fig.1

CRC12EN5010P01010041S

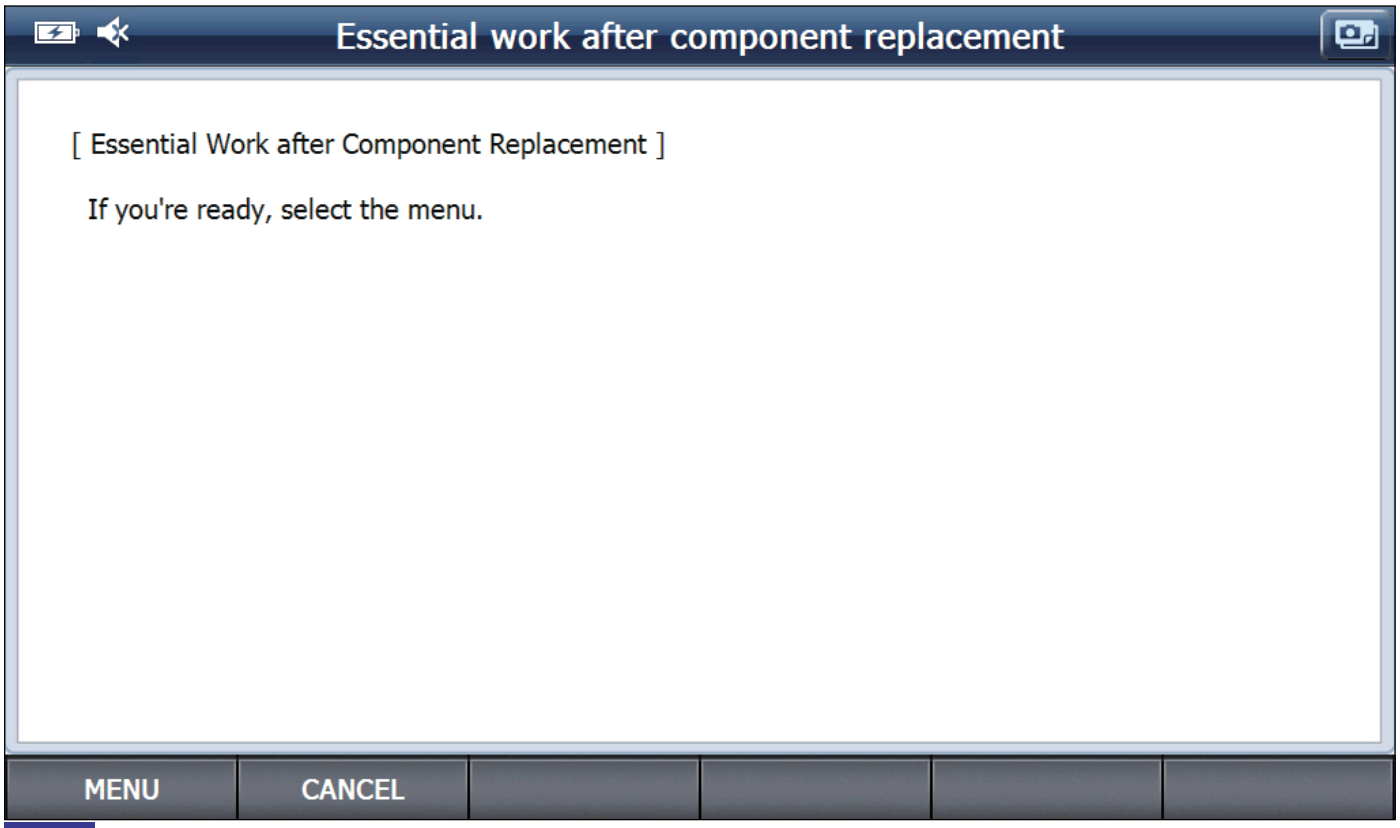


Fig.2

CRC12EN5010P01010042S

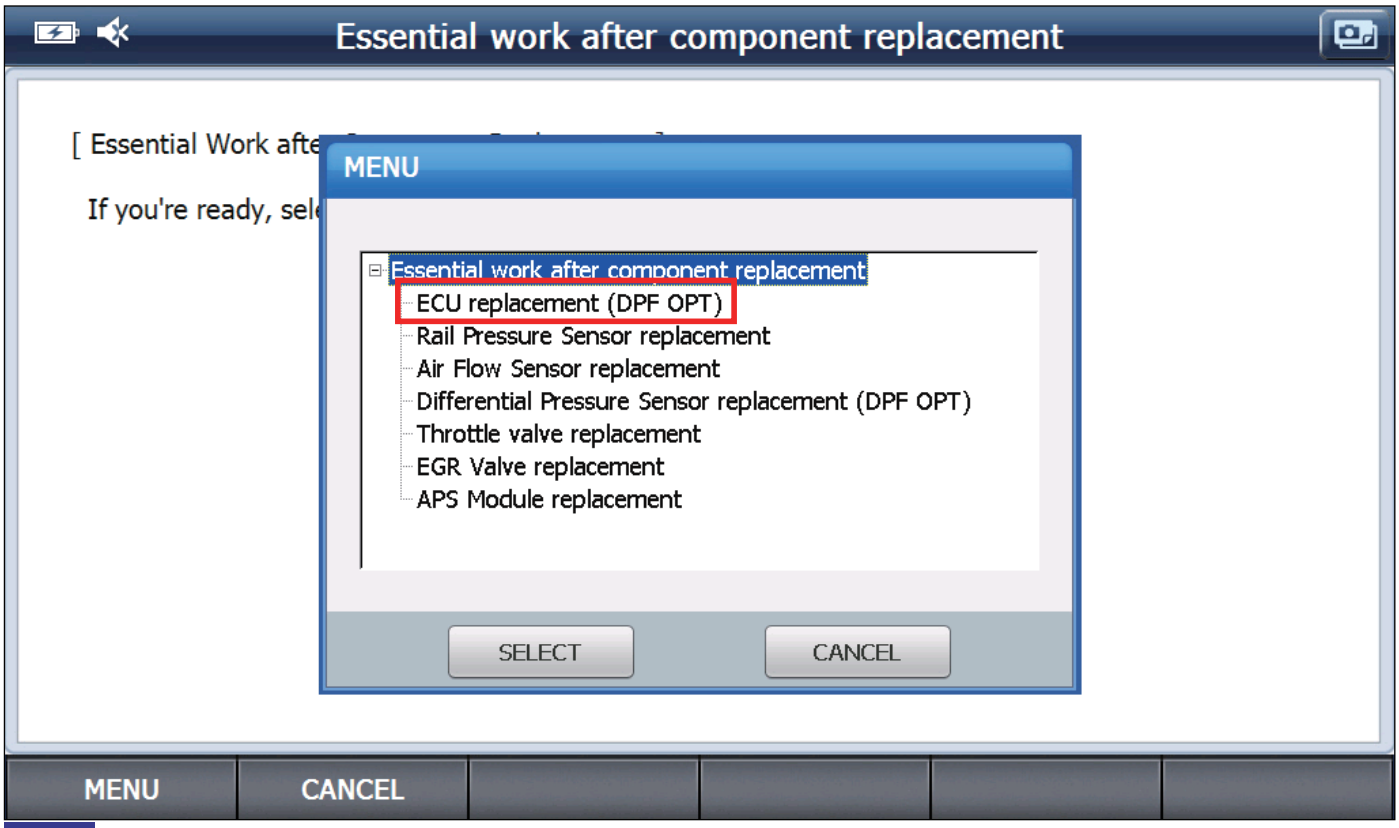


Fig.3

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.

P226400 Water in Fuel Sensor Circuit Low

Component Location

CRC12EN5010P22640011

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.

DTC Detecting Condition

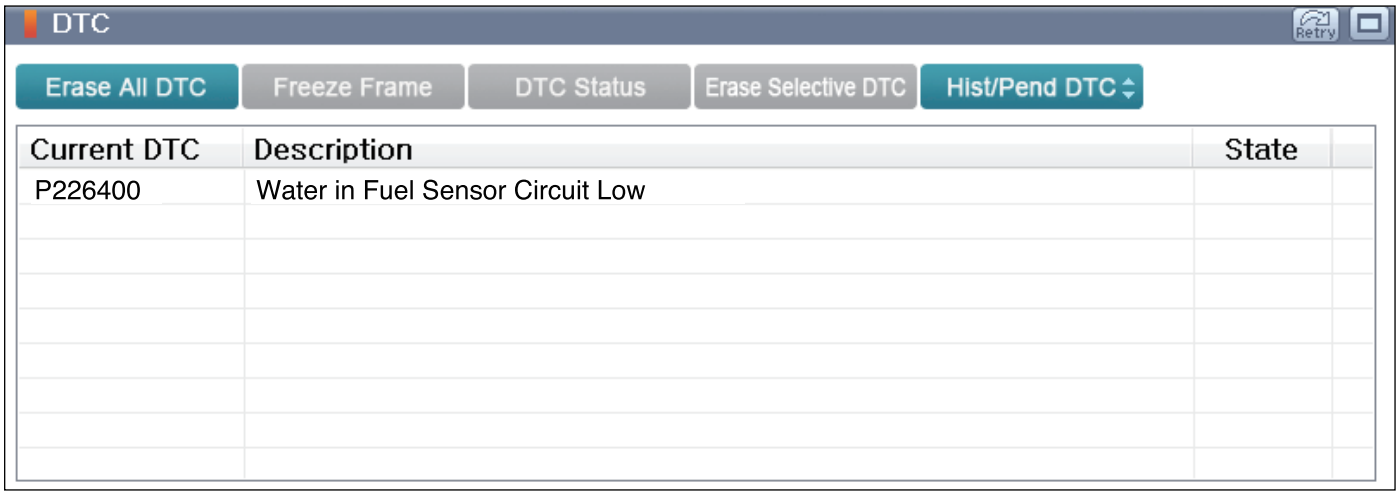
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Water in fuel filter 3. Short to power in signal circuit of water in fuel sensor 4. Defected water in fuel sensor
Enable Condition	• Engine running		
Threshold Value	• Short to power in signal circuit		
Detecting Time	• 4 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• On	

Vehicle Data

Water In Fuel Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	B+	-
	2	Signal		0V	-
	3	Ground		0V	-

Monitor DTC Status

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



CRC12EN5010P22640021S

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 water in fuel sensor connector.
3. Ignition switch "ON"
4. Measure the voltage between power terminal of water in fuel sensor 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 water in fuel sensor connector.
4. Measure the resistance between ground terminal of water in fuel sensor harness connector and chassis ground.

Specification :Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect water in fuel sensor connector.
7. Ignition switch "ON"
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 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 water in fuel sensor connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of water in fuel sensor harness connector and chassis ground.

Specification :0V

5. Ignition switch "OFF"
6. Disconnect battery (-) cable.
7. Refer to "Shop Manual" and disconnect water in fuel and ECM connector.
8. Measure the resistance between signal terminal of water in fuel harness connector and signal of ECM harness connector.

Specification : Approx. below 1 Ω

9. 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. Refer to "Shop Manual" and remove fuel filter assembly. The filter must be kept in vertical to avoid spills.
3. Remove water in fuel sensor from the filter and pour 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.

⚠ CAUTION

- O-ring must be change with new one, when replacing the fuel filter.

Verification of Vehicle Repair

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

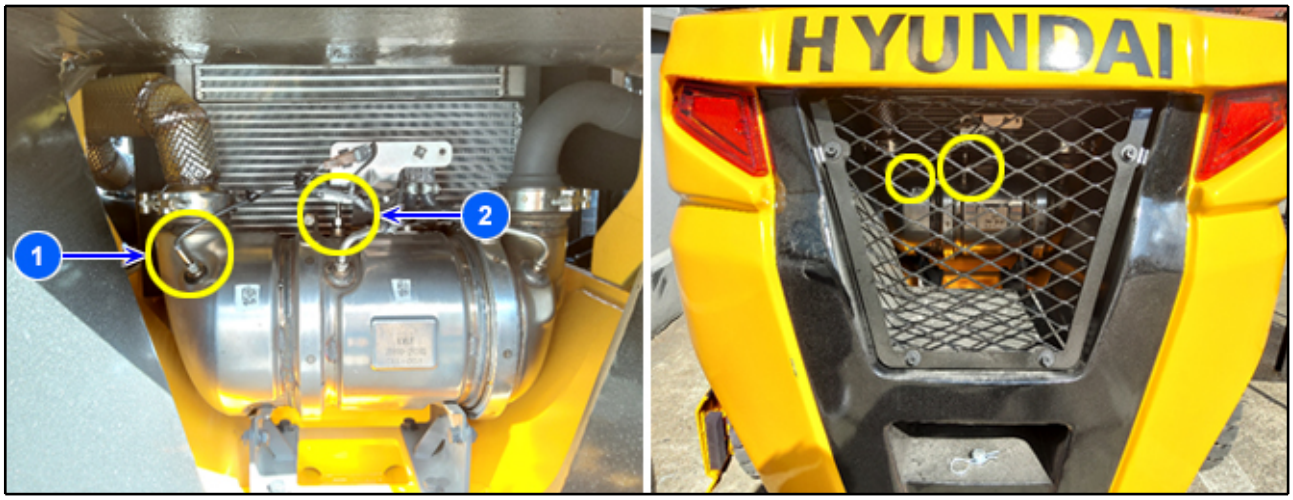
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

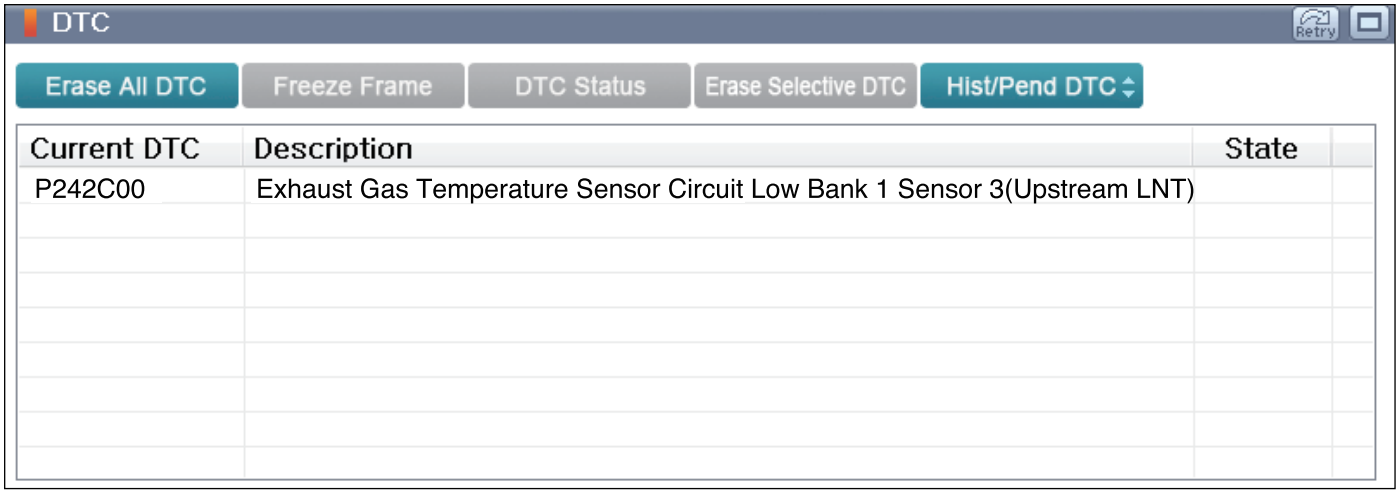
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Short to ground in signal circuit of EGTS #1 2. Defected EGTS #1
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value • Short to ground in signal circuit		
Detecting Time	• 3 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Exhaust Gas Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5V	-
	2	Ground		0V	-

Monitor DTC Status

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



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

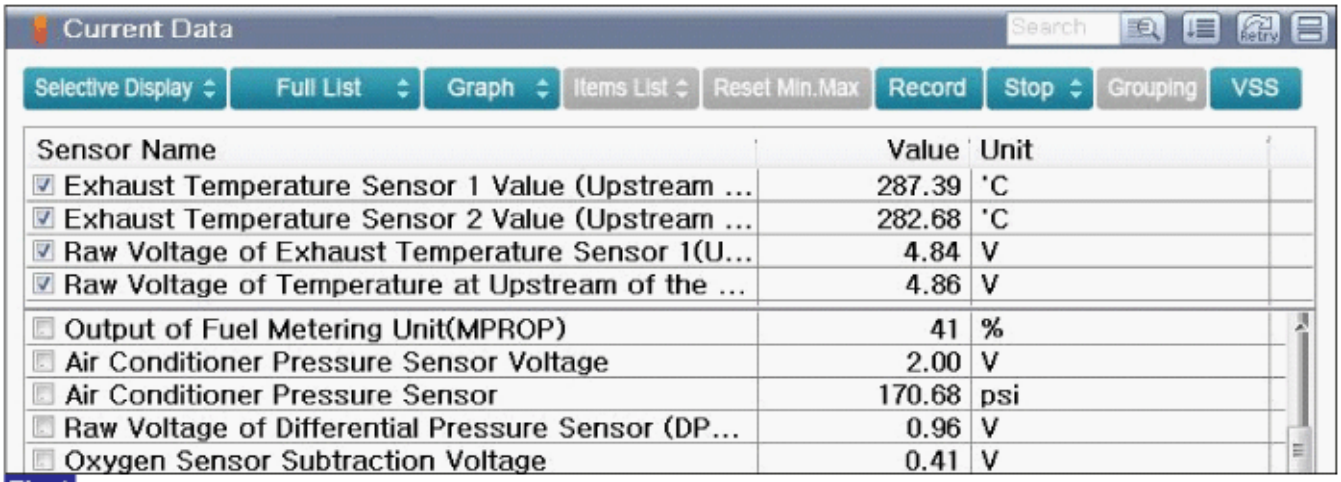


Fig.1

CRC12EN5010P242C0022S

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.
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 .

Ground Circuit Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
4. Measure the resistance between ground terminal of EGTS(T4) harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
7. Ignition switch "ON"
8. Measure the voltage between signal terminal of EGTS(T4) harness connector and chassis ground.(A)
9. Measure the voltage between signal terminal and 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?

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 EGTS(T4) connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of EGTS(T4) 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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and remove EGTS.
4. Measure the resistance between signal terminal and ground terminal of EGTS.

Specification : Refer to table below

※ The resistance value decreases as temperature increases.

Temp.(℃/℉)	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.

⚠ 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.

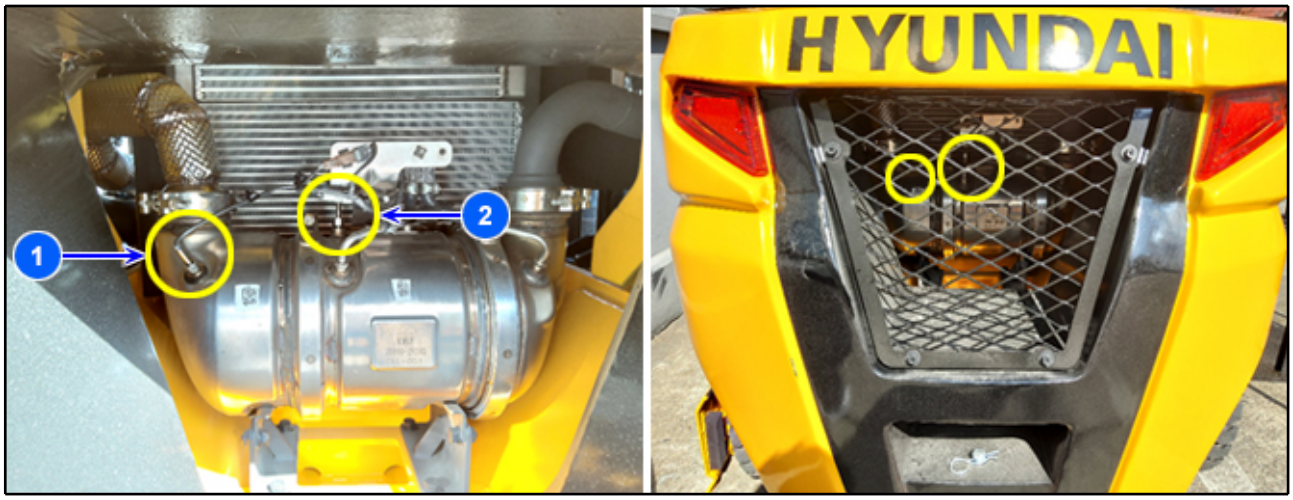
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

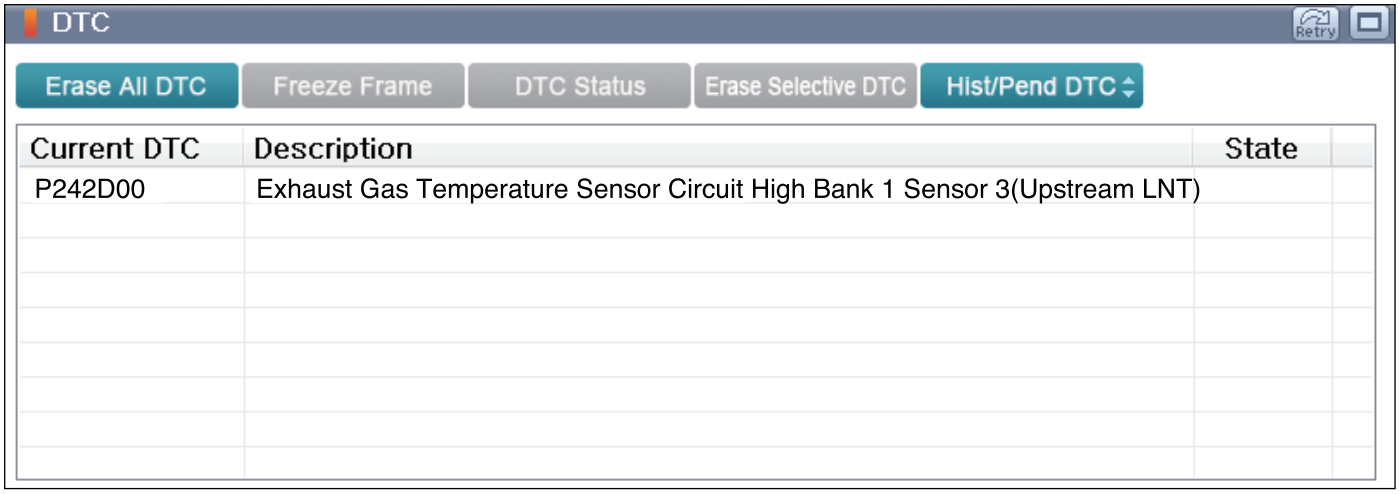
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Open in signal circuit of EGTS #1 2. Defected EGTS #1
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value • Open in signal circuit		
Detecting Time	• 3 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Exhaust Gas Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5V	-
	2	Ground		0V	-

Monitor DTC Status

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



CRC12EN5010P242D0021S

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

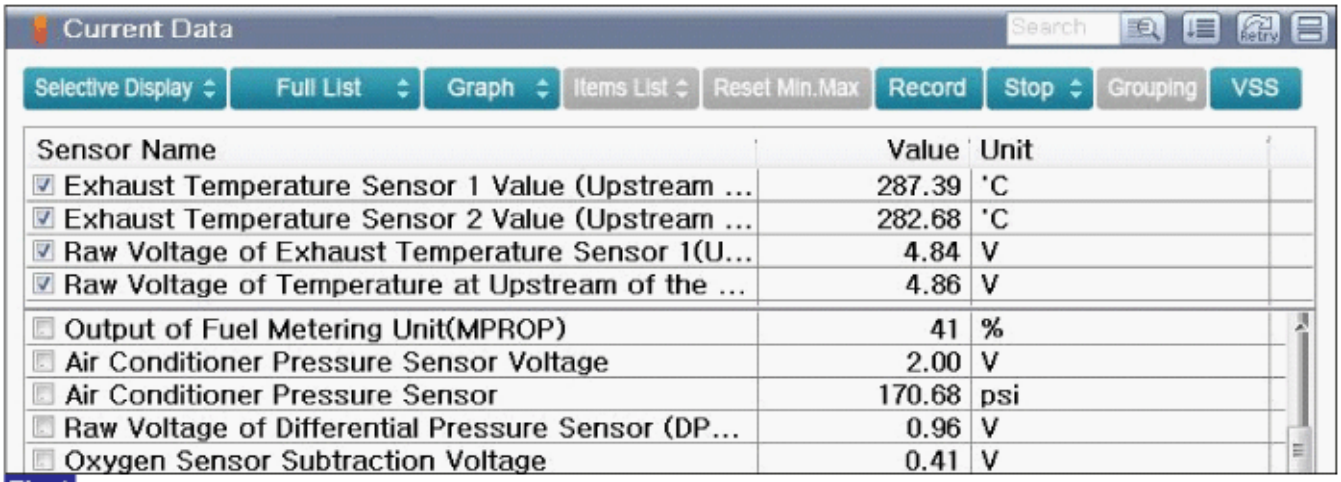


Fig.1

CRC12EN5010P242C0022S

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.
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.

Ground Circuit Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
4. Measure the resistance between ground terminal of EGTS(T4) harness connector and chassis ground.

Specification : Approx. below 1Ω

5. Ignition switch "OFF"
6. Refer to "Shop Manual" and disconnect EGTS(T4) connector.
7. Ignition switch "ON"
8. Measure the voltage between signal terminal of EGTS(T4) harness connector and chassis ground.(A)
9. Measure the voltage between signal terminal and 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?

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 EGTS(T4) connector.
3. Ignition switch "ON"
4. Measure the voltage between signal terminal of EGTS(T4) 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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and remove EGTS.
4. Measure the resistance between signal terminal and ground terminal of EGTS.

Specification : Refer to table below

※ The resistance value decreases as temperature increases.

Temp.(℃/℉)	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.

⚠ 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.
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.

P242F00 Diesel Particulate Filter Restriction - Ash Accumulation

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Faulty signal circuit of DPS 3. Defected DPS 4. Defected DPF
Enable Condition	• Engine running		
Threshold Value	• The accumulated soot is exceeded maximum threshold value		
Detecting Time	• 10 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• Blink	

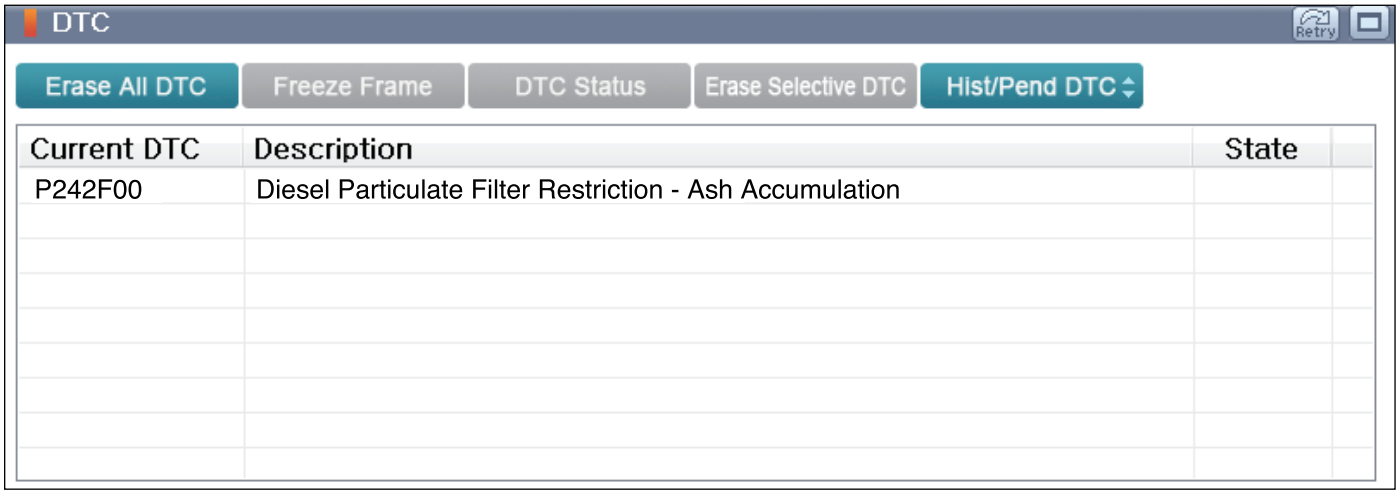
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



CRC12EN5010P242F0021S

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

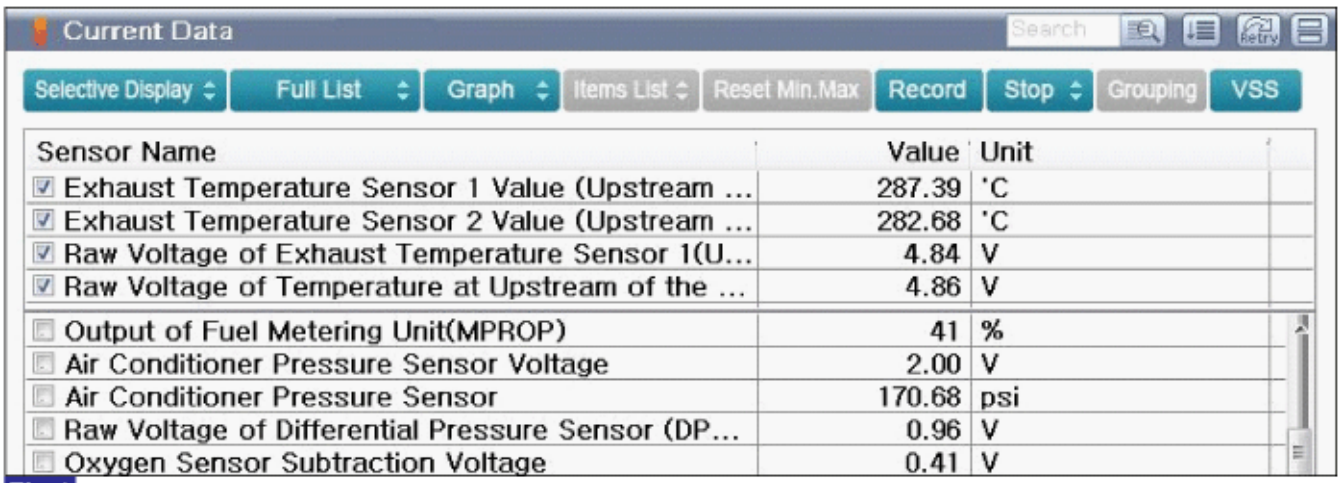


Fig.1

CRC12EN5010P242C0022S

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.
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 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 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)
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.
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.

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.
3. Inspect for corrosion or contamination on DPS 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.

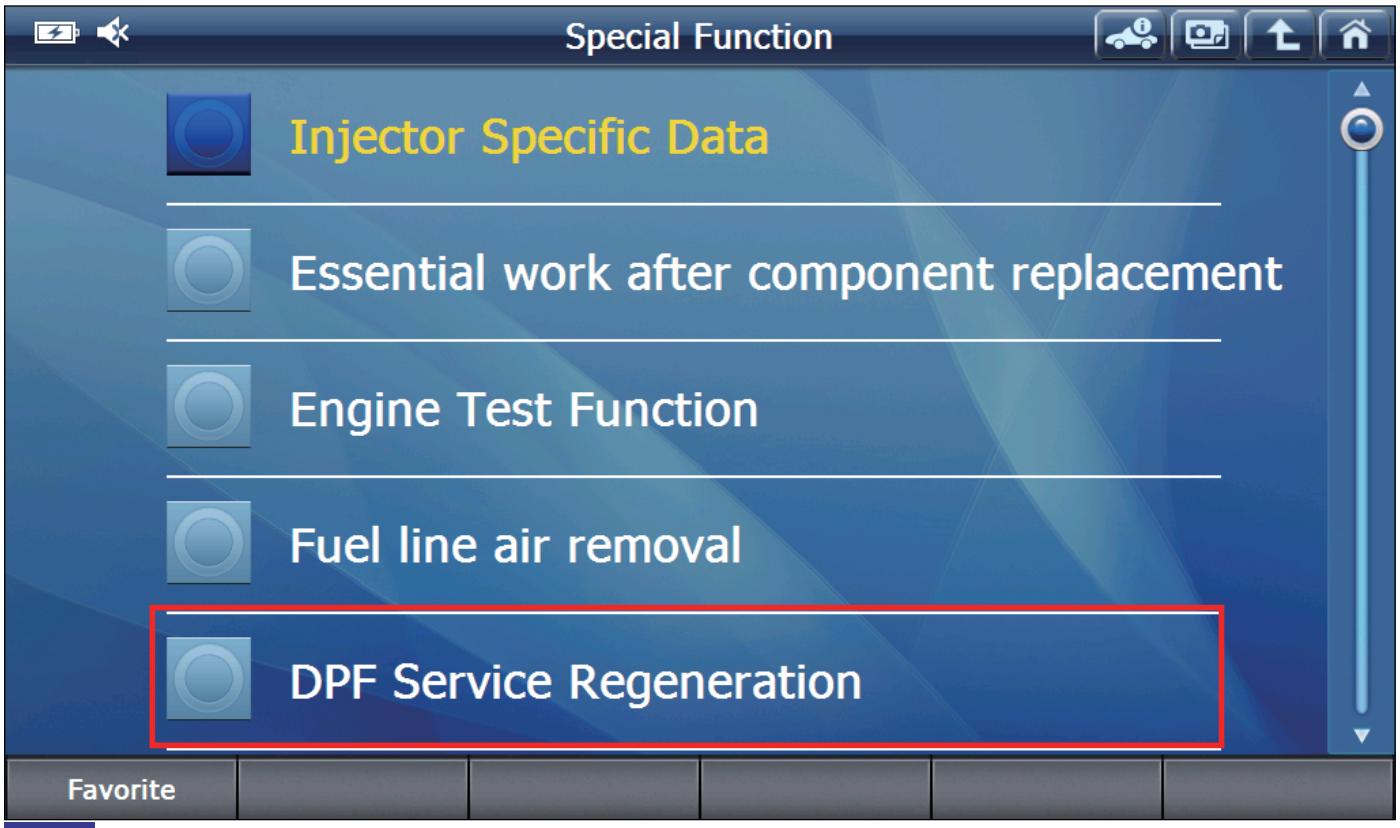


Fig.1

CRC12EN5010P04720041S

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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

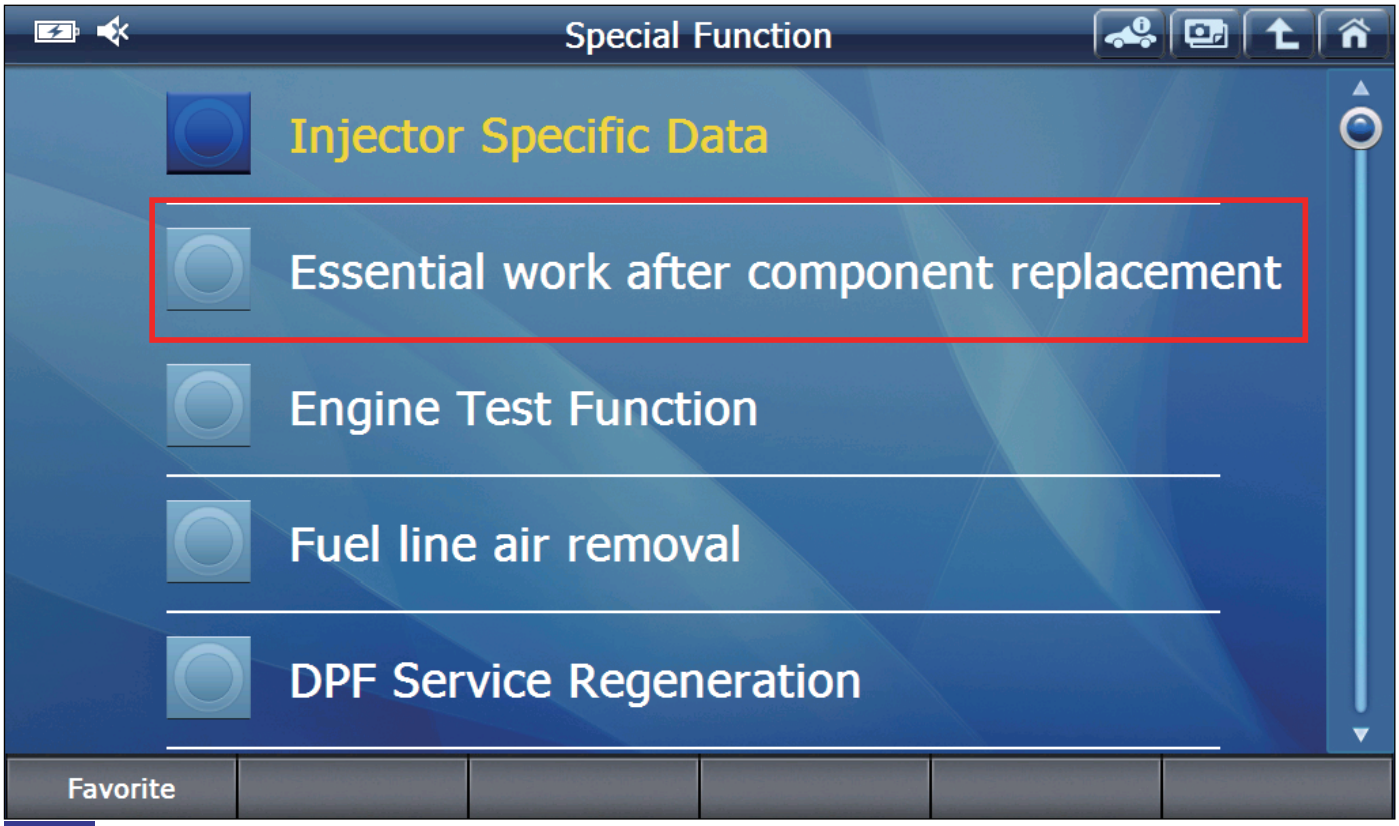


Fig.1

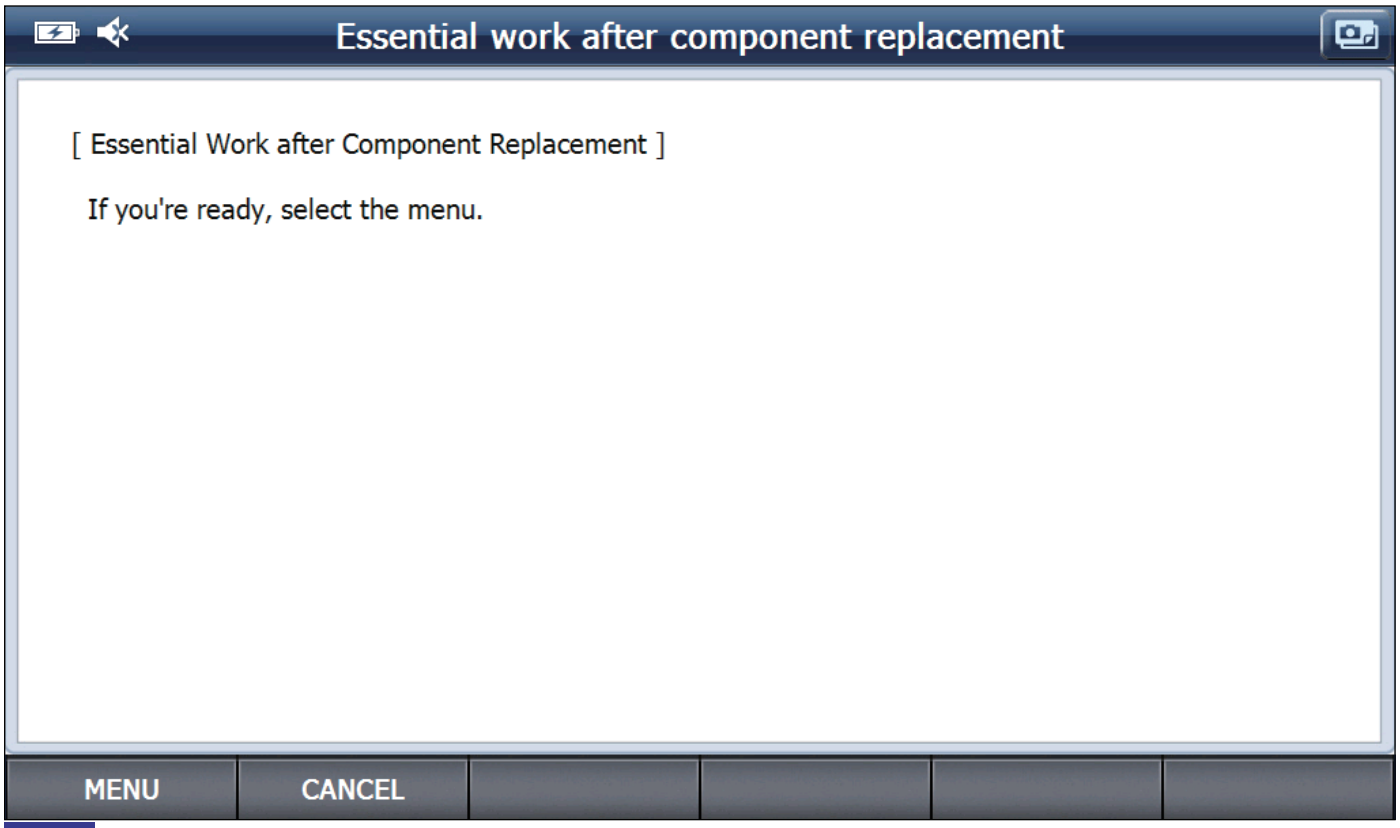


Fig.2

CRC12EN5010P01010042S

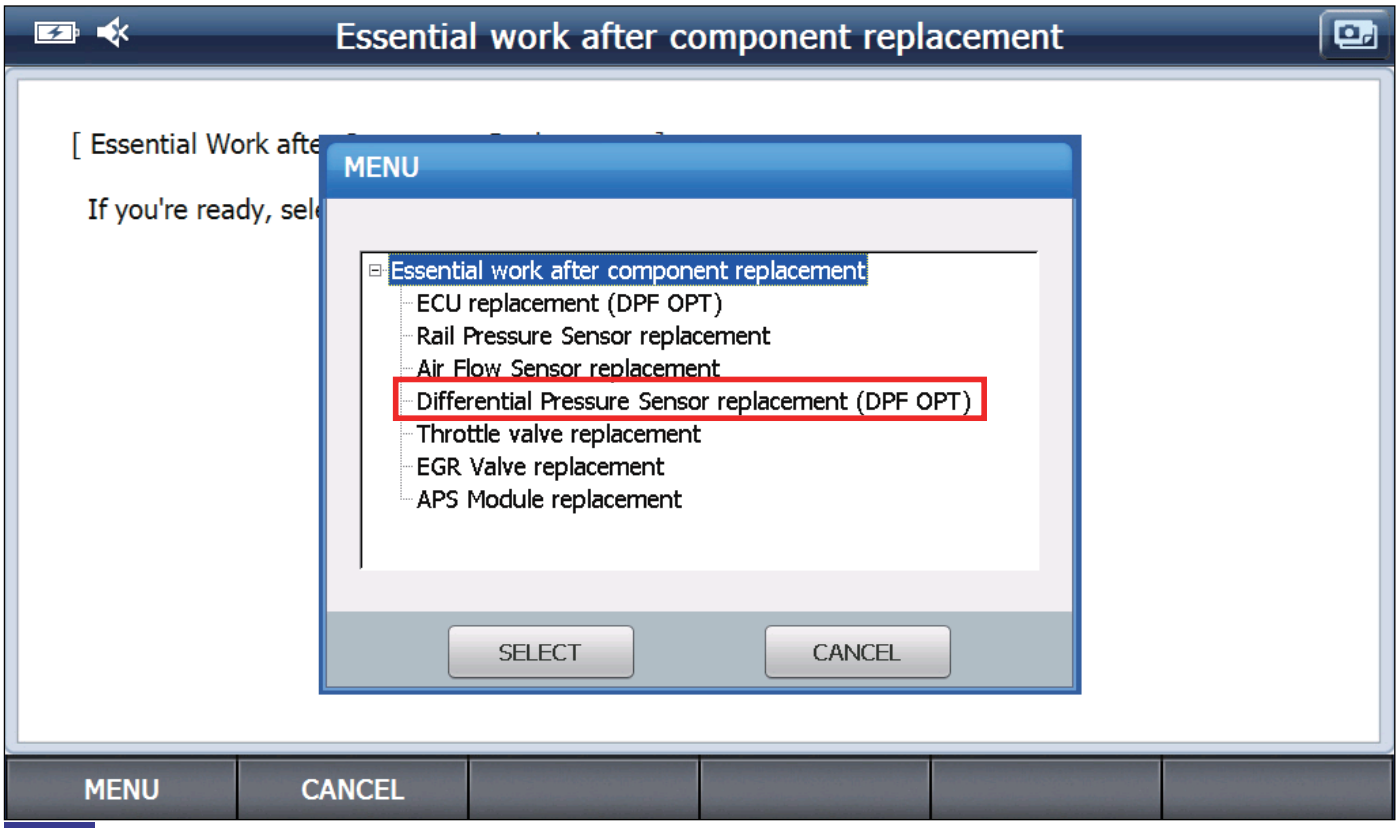


Fig.3

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 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

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to ground in signal circuit of DPS 3. Defected DPS
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value (850mV)		
Detecting Time	• 0.6 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• Blink	

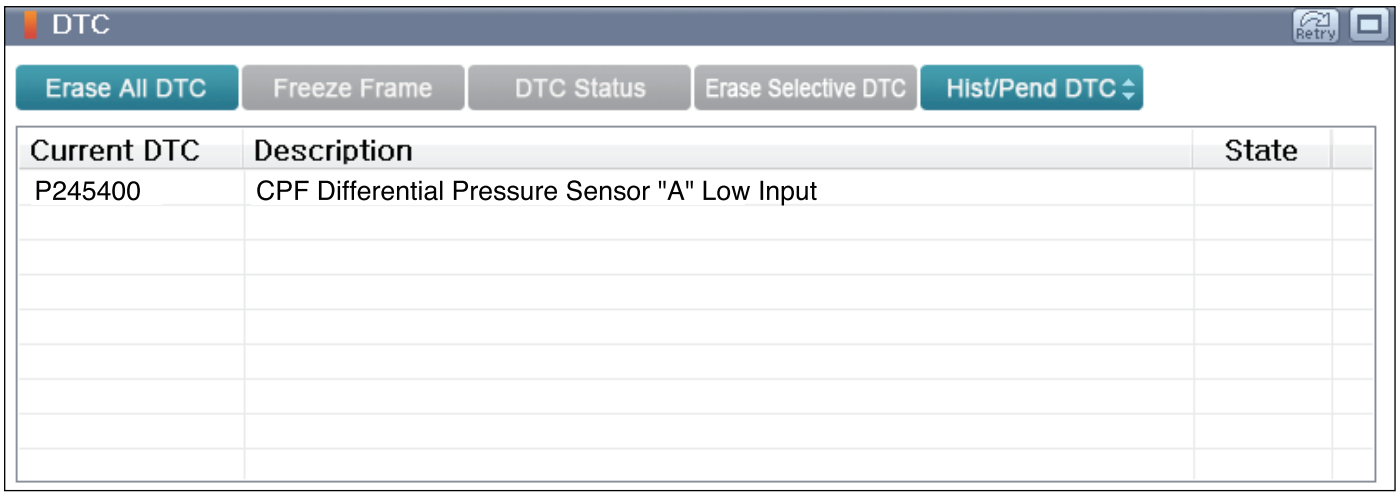
Vehicle Data

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
Pin No.	1	DPS Power	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Connected)	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.



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.

Specification : Refer to figure below

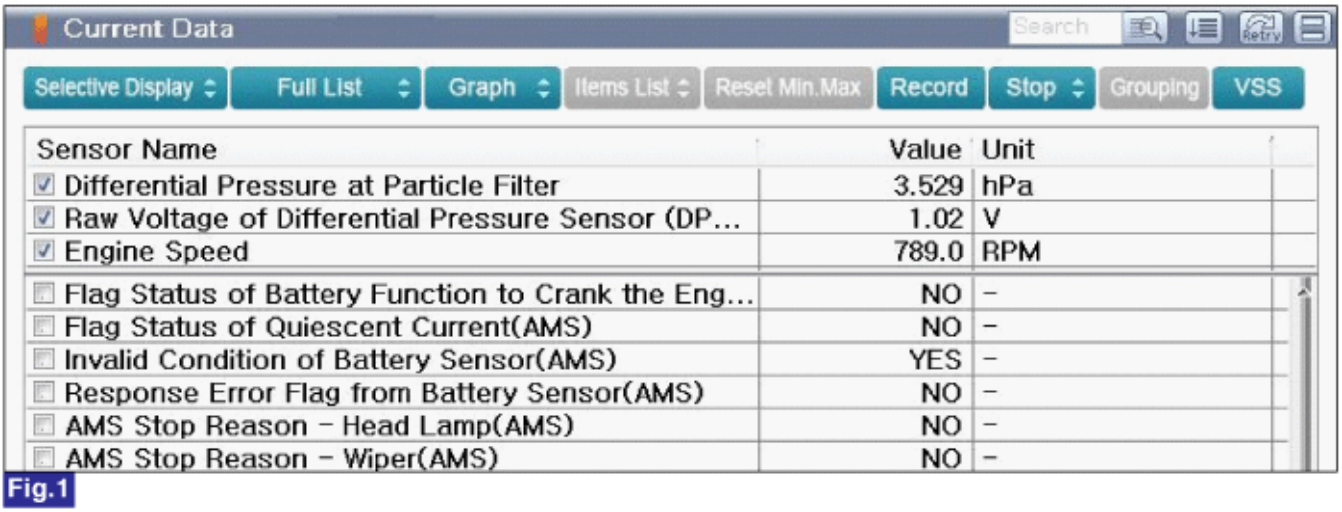


Fig.1

CRC12EN5010P04710022S

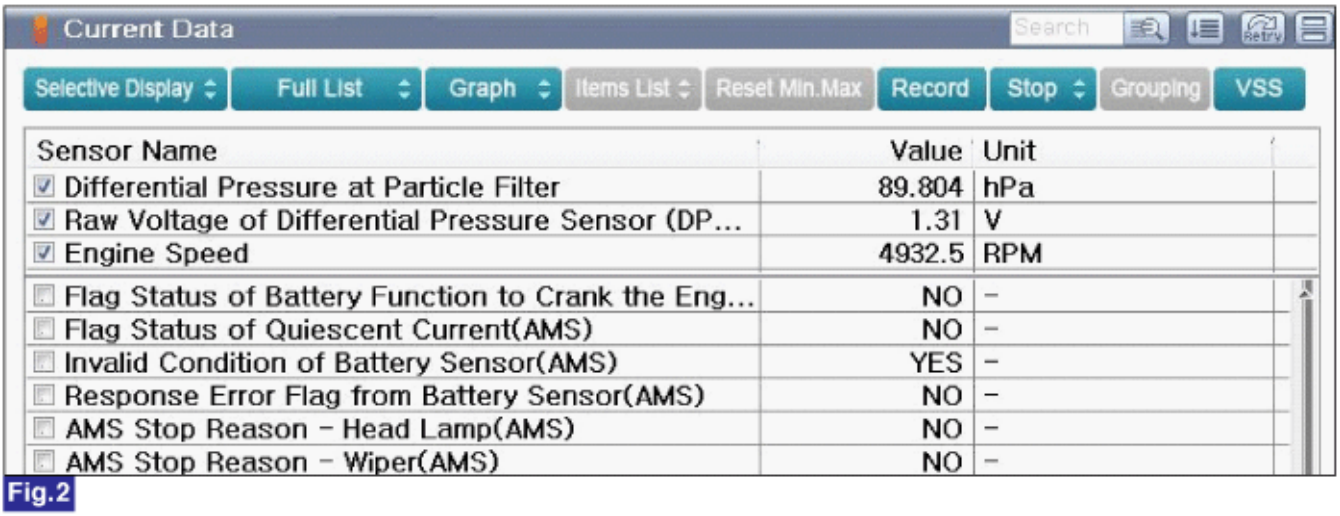


Fig.2

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. 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.

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 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 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)
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.
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.

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.
3. Inspect for corrosion or contamination on DPS 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.

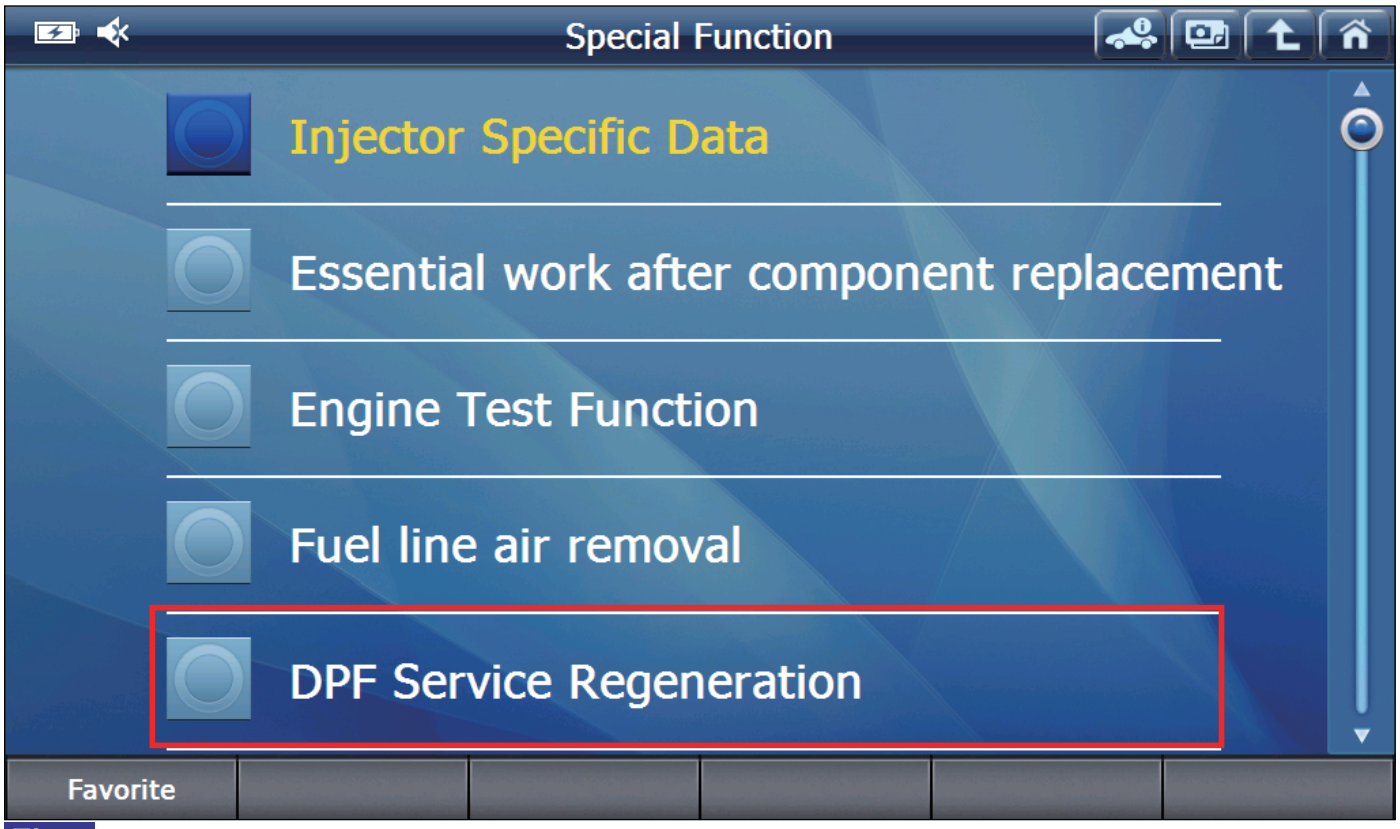


Fig.1

CRC12EN5010P04720041S

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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

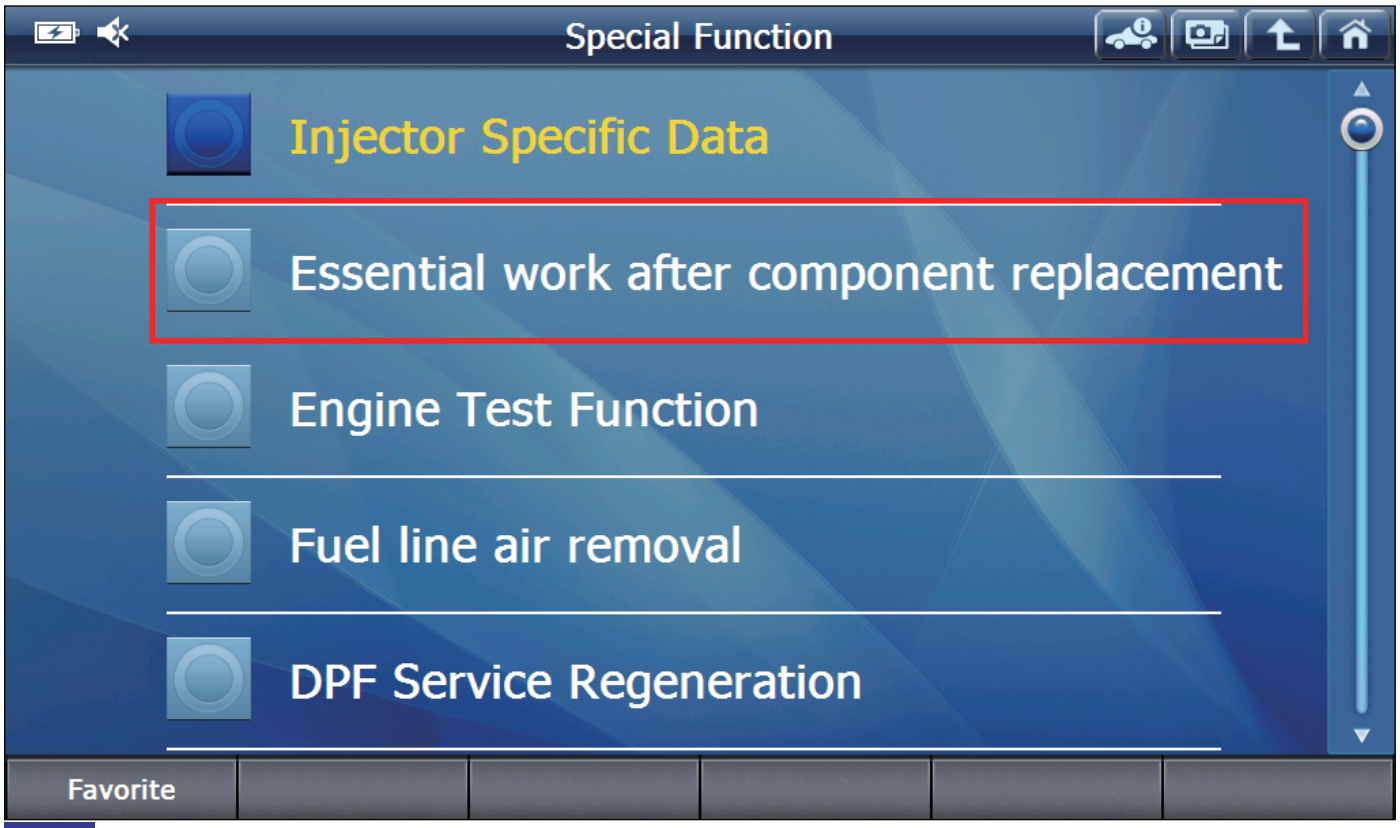


Fig.1

CRC12EN5010P01010041S

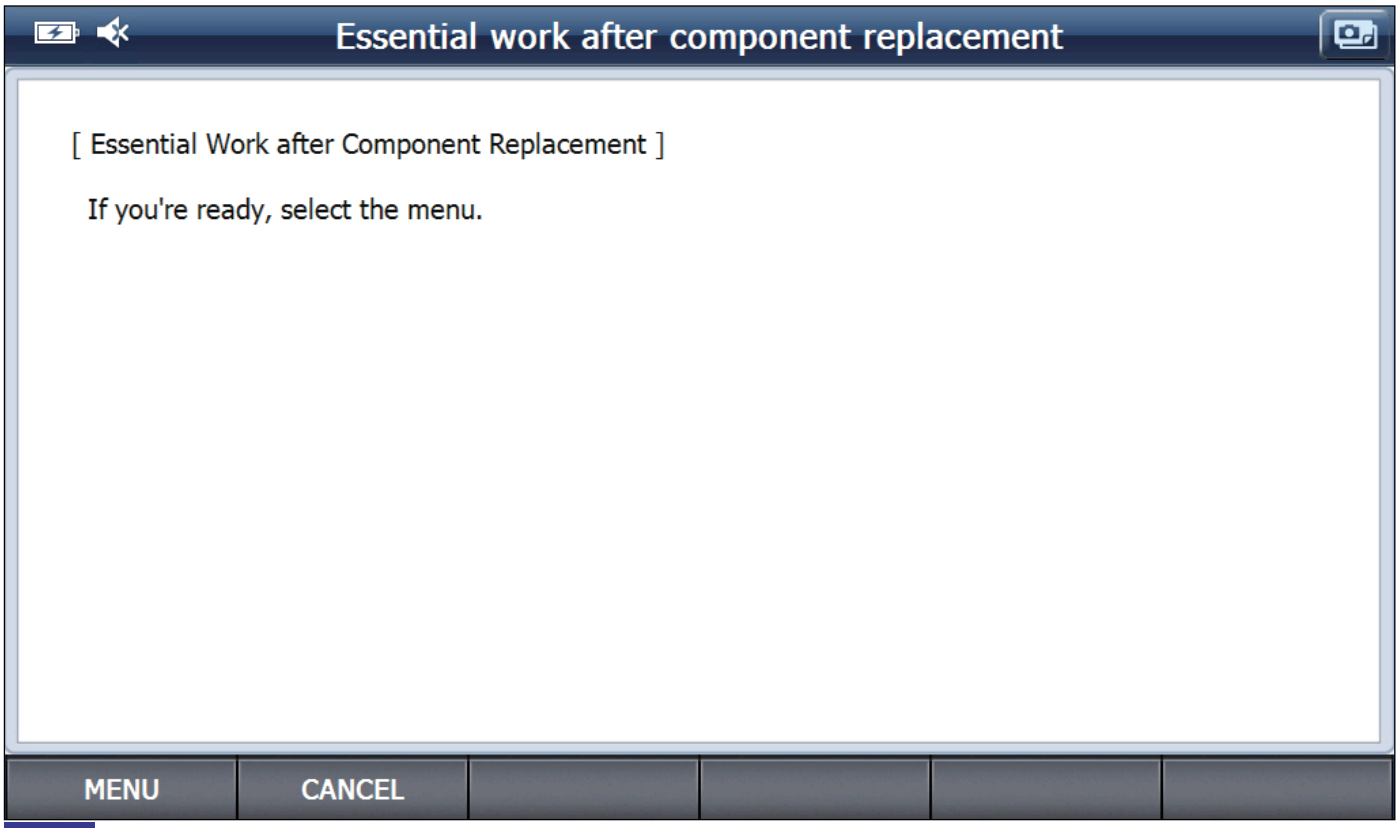


Fig.2

CRC12EN5010P01010042S

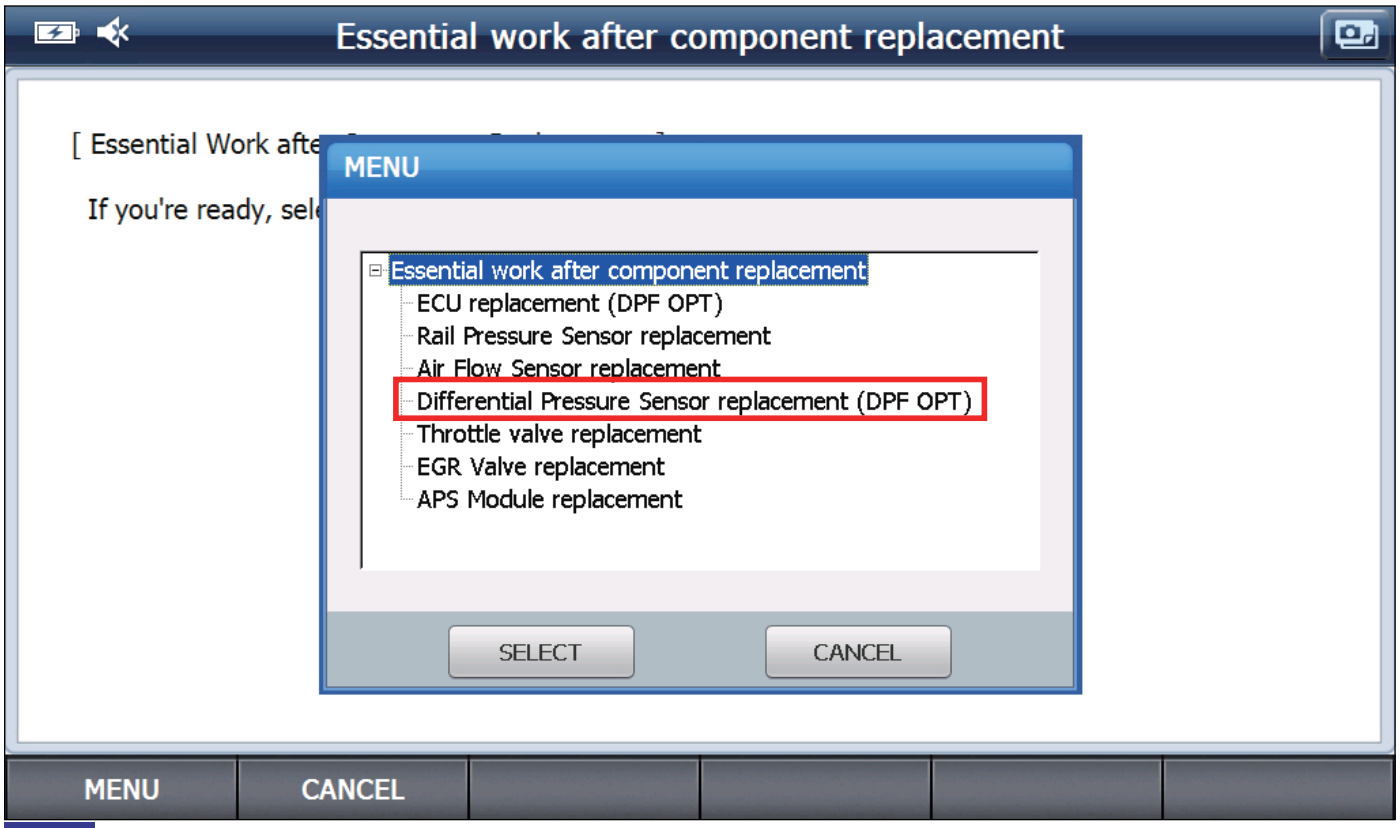


Fig.3

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 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.

P245500 Differential Pressure Below Limit

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor connector connection 2. Short to power in signal circuit of DPS 3. Open in ground circuit of DPS 4. Defected DPS
Enable Condition	• Engine running		
Threshold Value	• Output signal is above threshold value (4721mV)		
Detecting Time	• 0.6 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• Yes	
	MIL	• Blink	

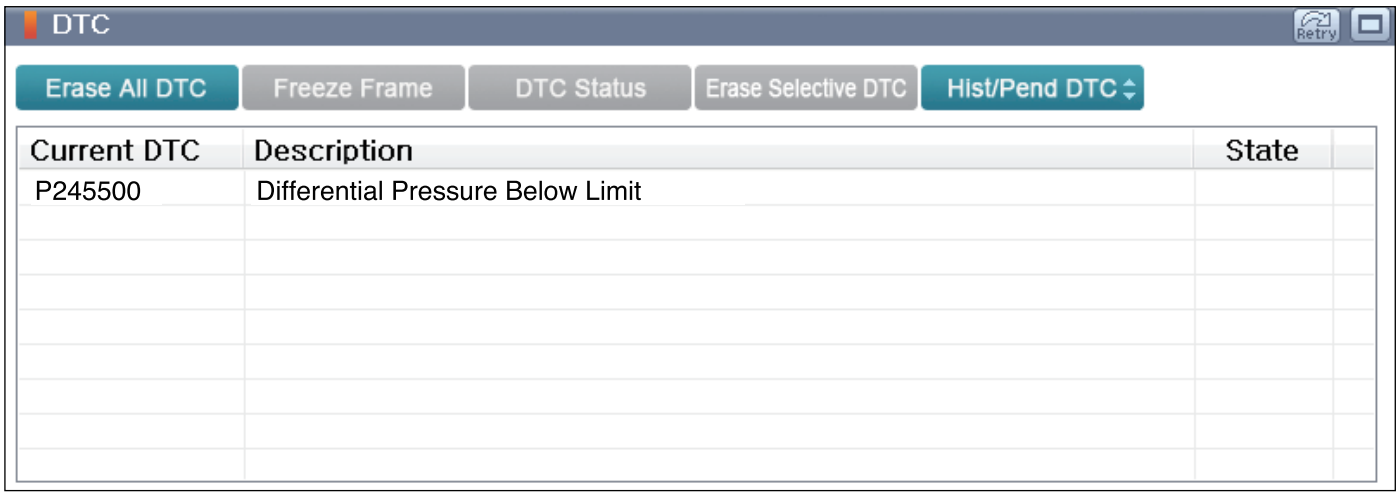
Vehicle Data

DPF DPS		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	DPS Power	1. Ignition switch "ON" & Engine "OFF" 2. 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
Pin No.	1	DPS Power	1. Ignition switch "ON" & Engine "OFF" 2. Voltage is measured on wiring side(Connected)	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.



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 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 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)
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.
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.

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 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 "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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

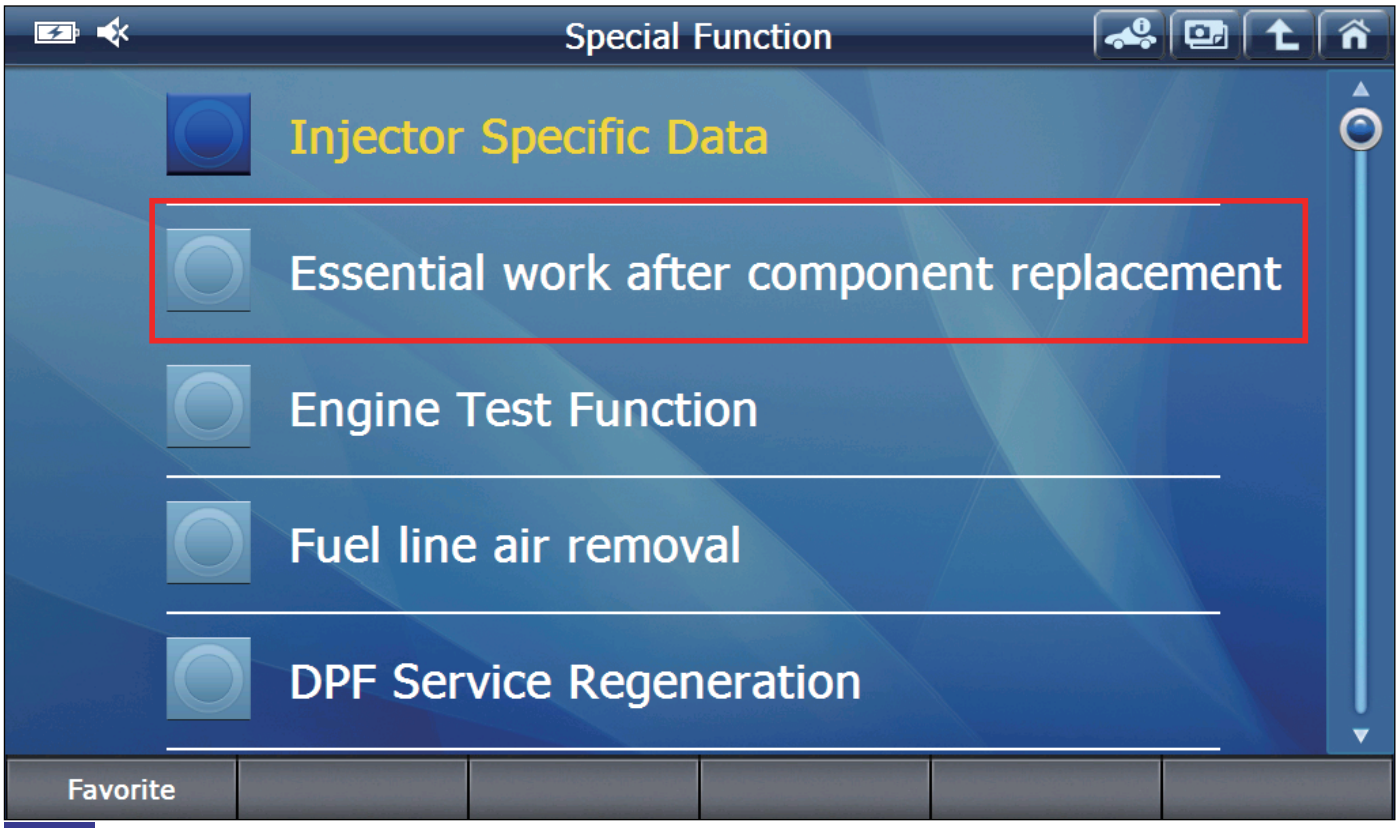


Fig.1

CRC12EN5010P01010041S

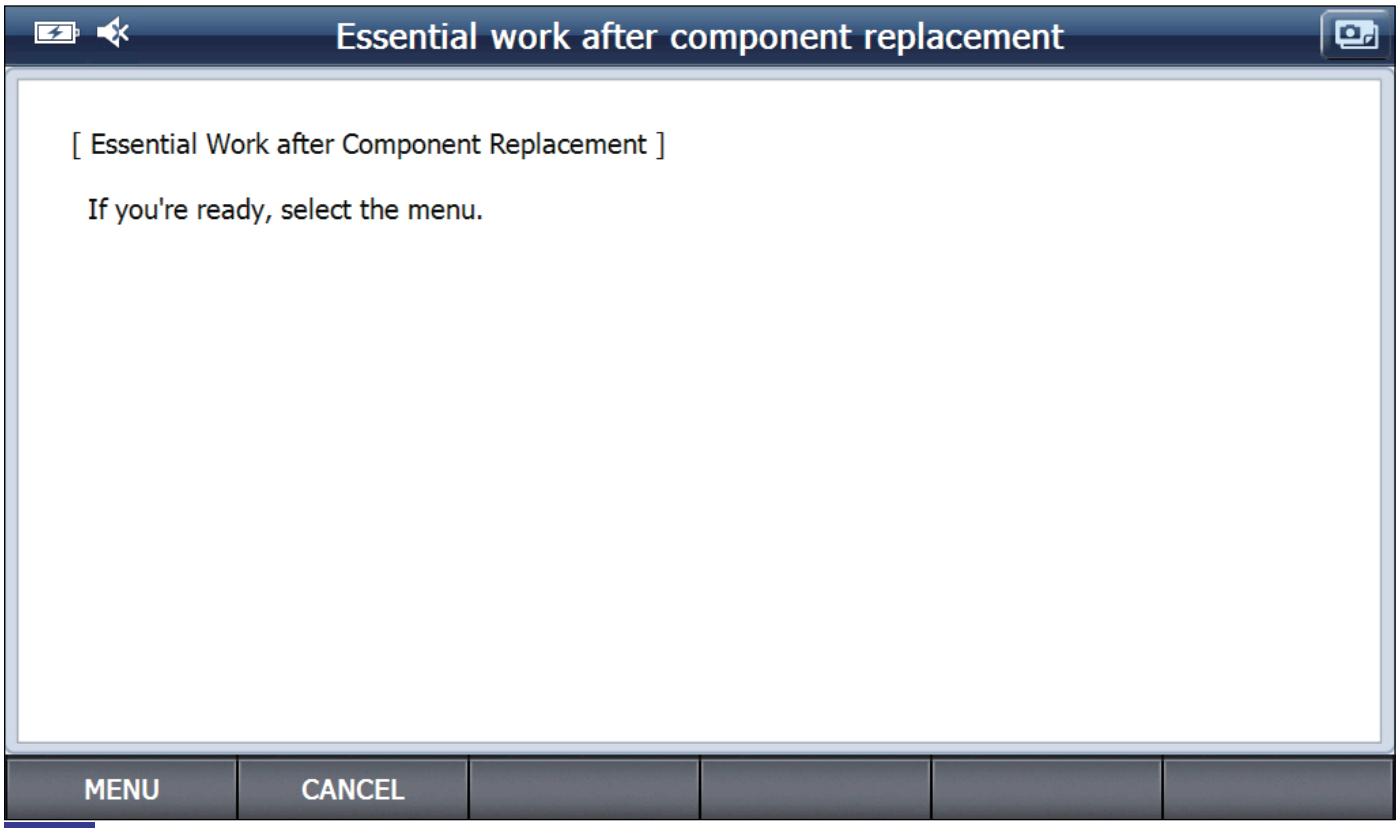


Fig.2

CRC12EN5010P01010042S

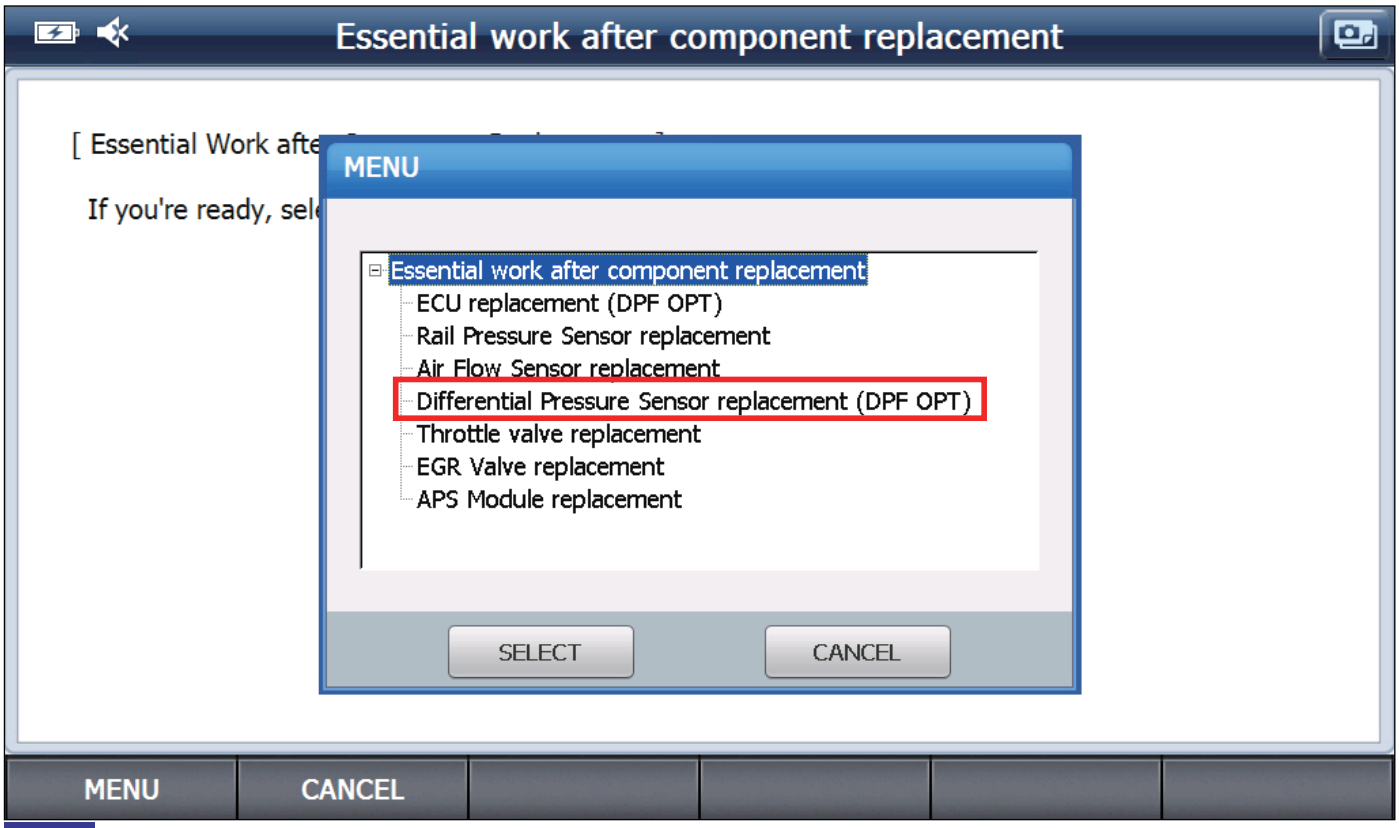


Fig.3

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.

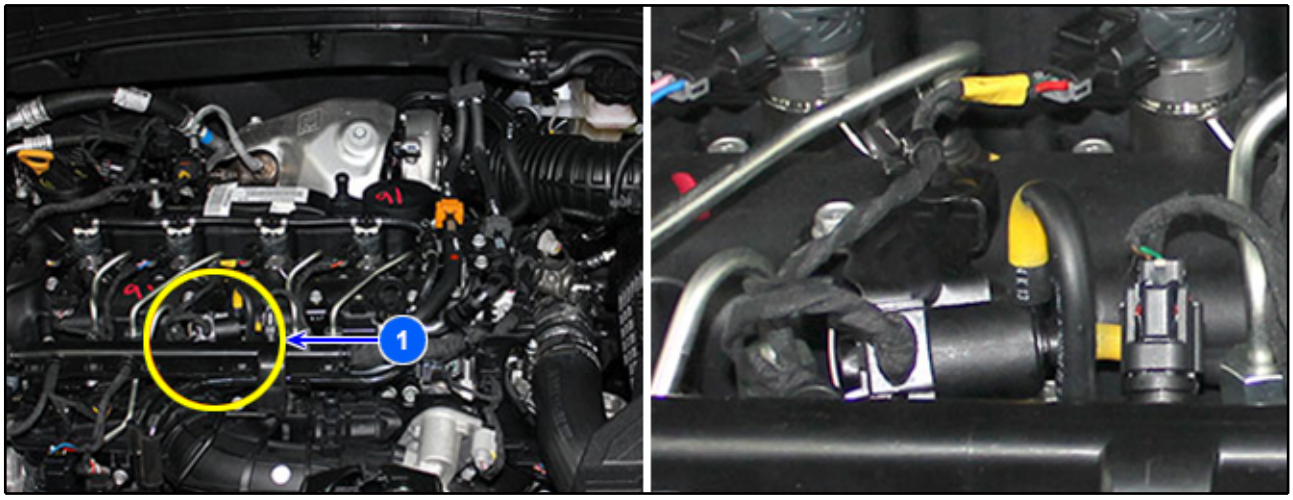
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P245700 EGR Cooler "A" Efficiency Below Threshold

Component Location



CRC12EN5010P245711

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

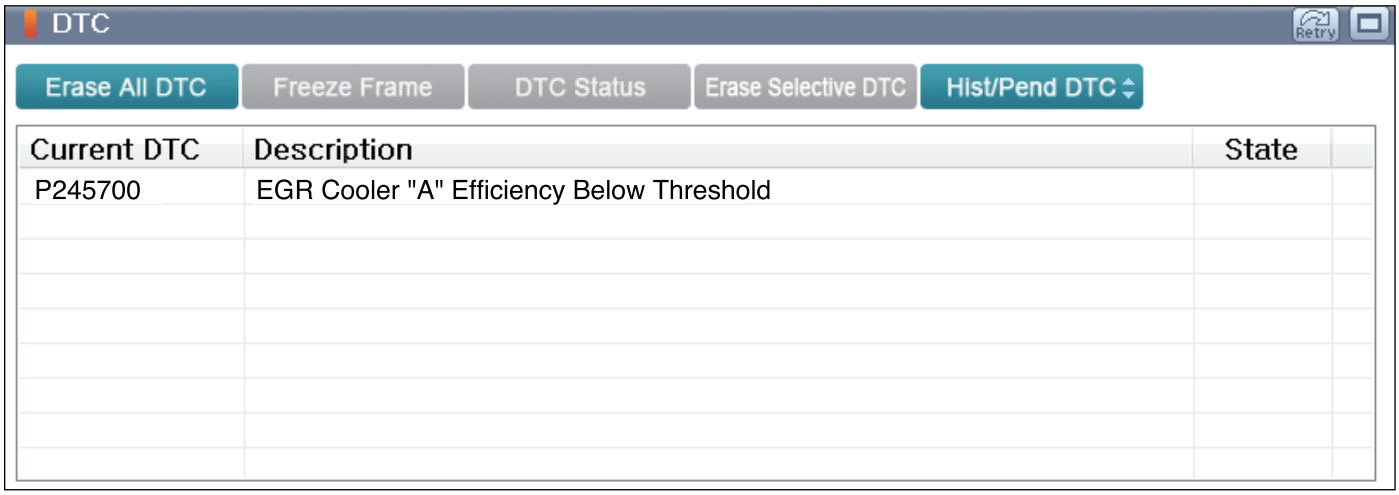
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Poor conenctor connection 2. Defected EGR cooler bypass solenoid valve 3. Defected EGR cooler
Enable Condition	• Engine running		
Threshold Value	• EGR cooling efficiency below threshold		
Detecting Time	• 220 sec.		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Vehicle Data

EGR Cooler Bypass Solenoid Valve		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Control	1. Ignition switch "ON" & Engine "OFF" 2. Voltage is measured on wiring side(Disconnected)	Approx. 3.4V	-
	2	Power		B+	-

Monitor DTC Status

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



CRC12EN5010P24570021S

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.
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 .

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 EGR cooler bypass solenoid valve connector.

3. Ignition switch "ON"
4. Measure the voltage between control terminal of EGR cooler bypass solenoid valve 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 battery (-) cable.
3. Refer to "Shop Manual" and disconnect EGR cooler bypass solenoid valve connector.
4. Measure the resistance between power terminal and control terminal of EGR cooler bypass solenoid valve.

Specification : Approx. 28.3 ~ 31.1 Ω (20℃/68℉)

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, 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.

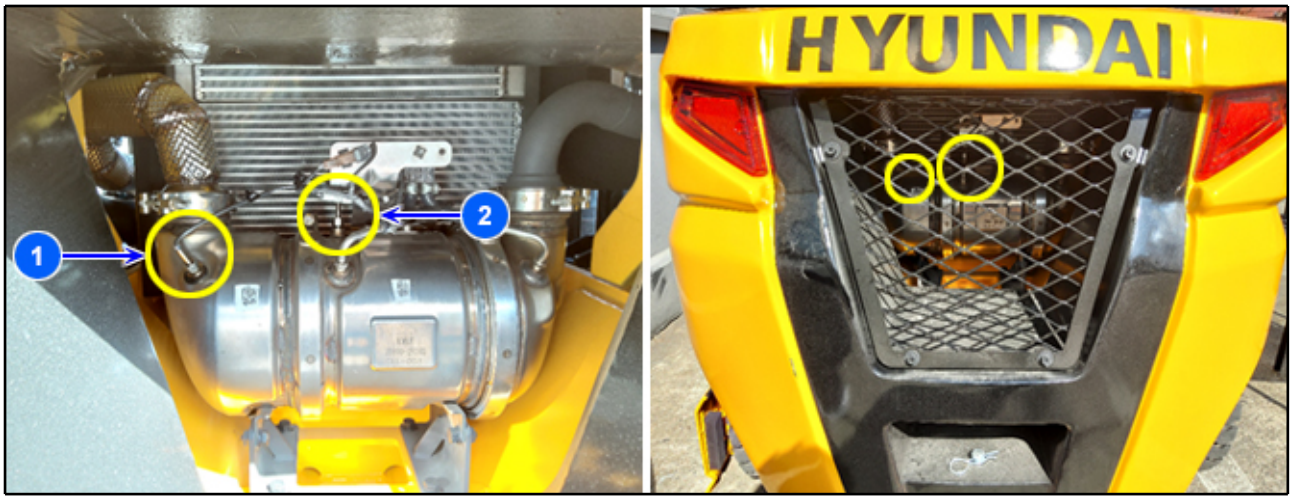
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

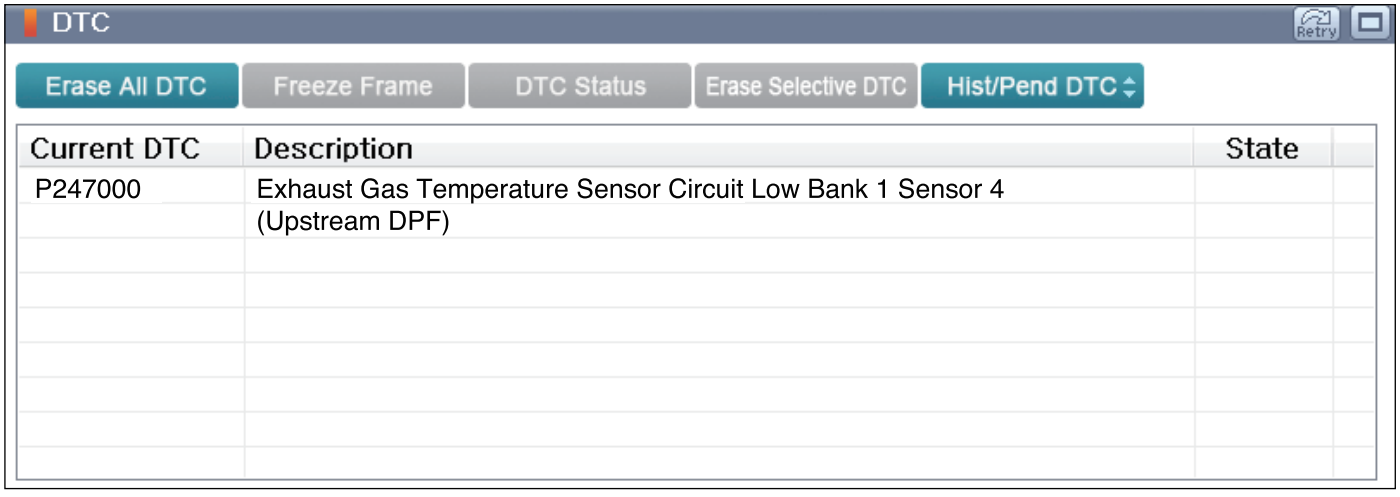
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Short to ground in signal circuit of EGTS #2 2. Defected EGTS #2
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value • Short to ground in signal circuit		
Detecting Time	• 3 sec.		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Exhaust Gas Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5V	-
	2	Ground		0V	-

Monitor DTC Status

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



CRC12EN5010P24700021S

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

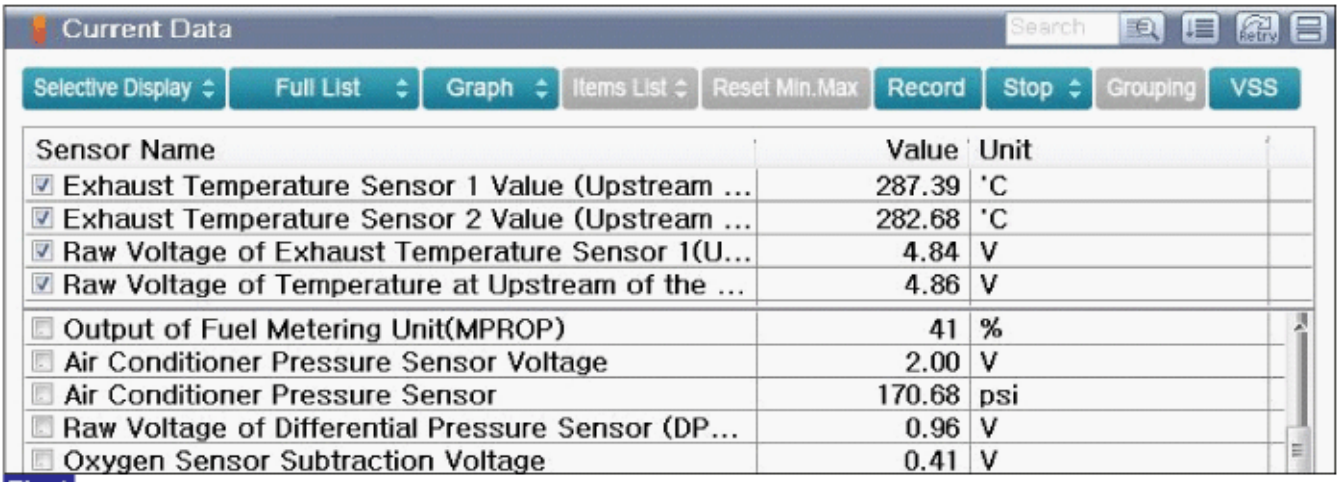


Fig.1

CRC12EN5010P242C0022S

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.
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 .

Ground Circuit Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
4. Measure the resistance between ground terminal of EGTS(T5) harness connector and chassis ground.

Specification : Approx. below 1Ω

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.

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 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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and remove EGTS.
4. Measure the resistance between signal terminal and ground terminal of EGTS.

Specification : Refer to table below

※ The resistance value decreases as temperature increases.

Temp.(℃/℉)	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.

⚠ 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.

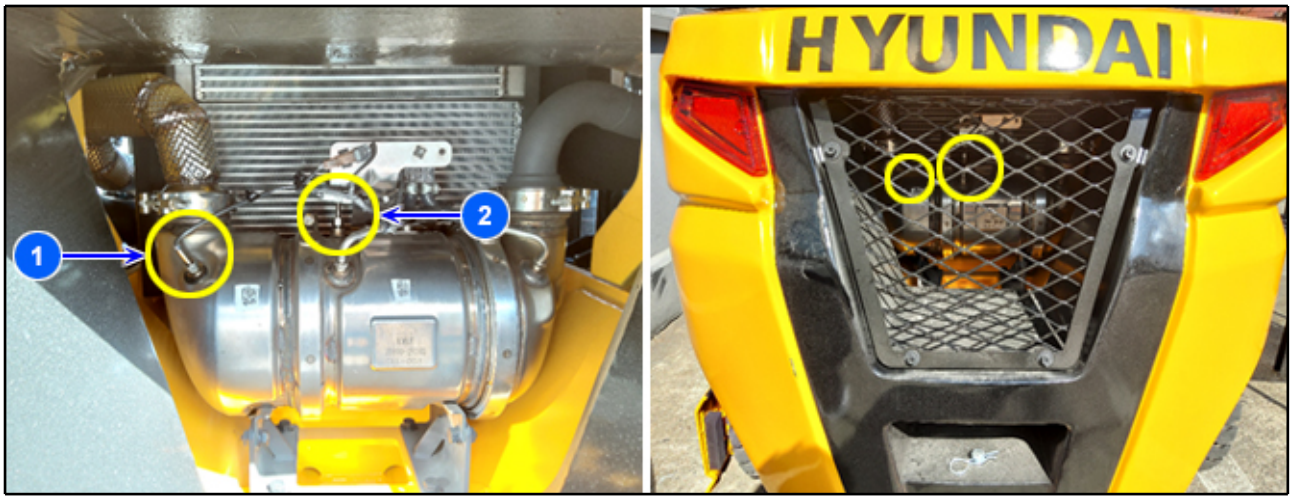
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

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

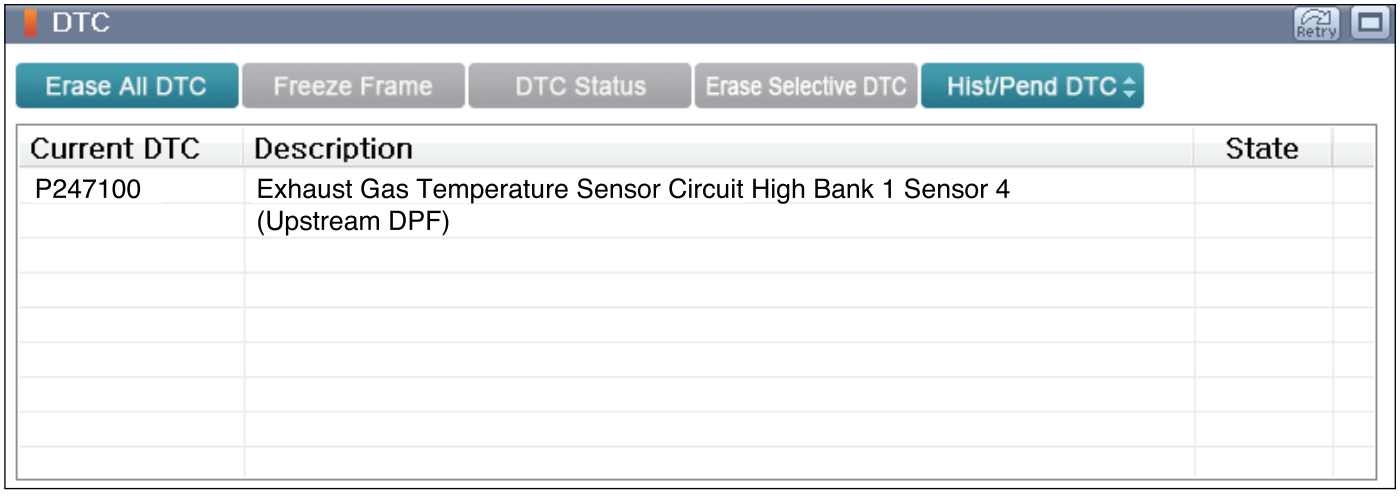
Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Short to ground in signal circuit of EGTS #2 2. Defected EGTS #2
Enable Condition	• Engine running		
Threshold Value	• Output signal is below threshold value • Short to ground in signal circuit		
Detecting Time	• 3 sec.		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• On	

Vehicle Data

Exhaust Gas Temperature Sensor		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	Signal	• Ignition switch "ON" & Engine "OFF" • Voltage is measured on wiring side(Disconnected)	Approx. 5V	-
	2	Ground		0V	-

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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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

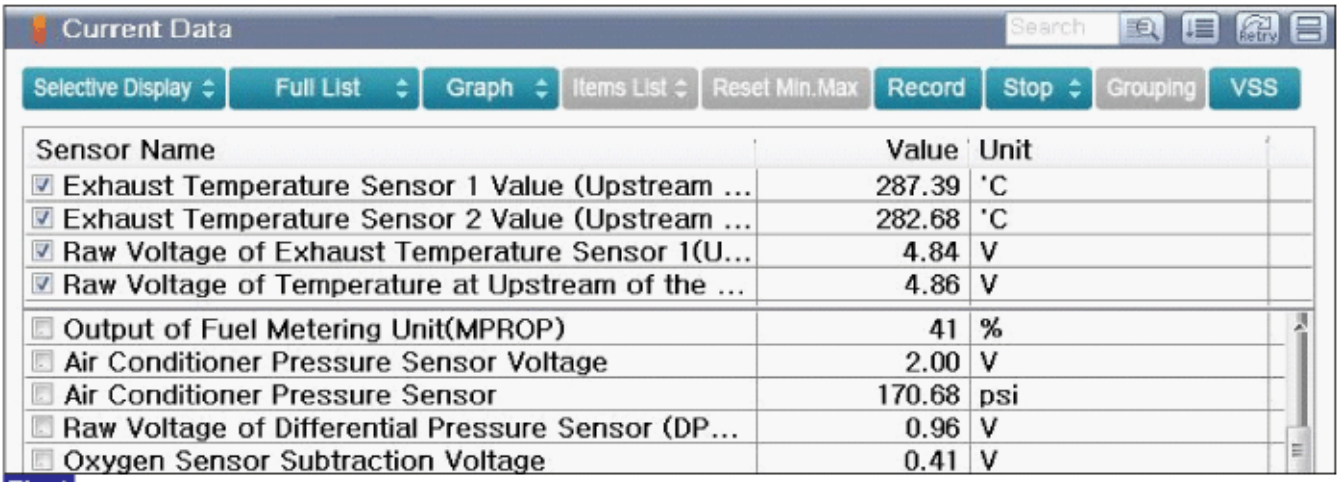


Fig.1

CRC12EN5010P242C0022S

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.
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 .

Ground Circuit Inspection

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and disconnect EGTS(T5) connector.
4. Measure the resistance between ground terminal of EGTS(T5) harness connector and chassis ground.

Specification : Approx. below 1Ω

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.

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 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

1. Ignition switch "OFF"
2. Disconnect battery (-) cable.
3. Refer to "Shop Manual" and remove EGTS.
4. Measure the resistance between signal terminal and ground terminal of EGTS.

Specification : Refer to table below

※ The resistance value decreases as temperature increases.

Temp.(℃/℉)	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.

⚠ 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.
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.

P24A200 Particulate Filter Regeneration Incomplete Bank 1

Component Location

CRC12EN5010P04710011

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℃~650℃. 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.

DTC Detecting Condition

Item	Detecting Condition			Possible Cause
DTC Strategy	• signal monitoring			1. Poor connector connection 2. Faulty signal circuit of DPS 3. Defected DPS(Differential Pressure Sensor) 4. Defected DPF
Enable Condition	• Engine running			
Threshold Value	• The accumulated soot is exceeded maximum threshold value.			
Detecting Time	• 16msec.			
Fail Safe	Defected DPF	On		
	EGR OFF	Yes		
	Torque Limit	No		
	MIL	On		

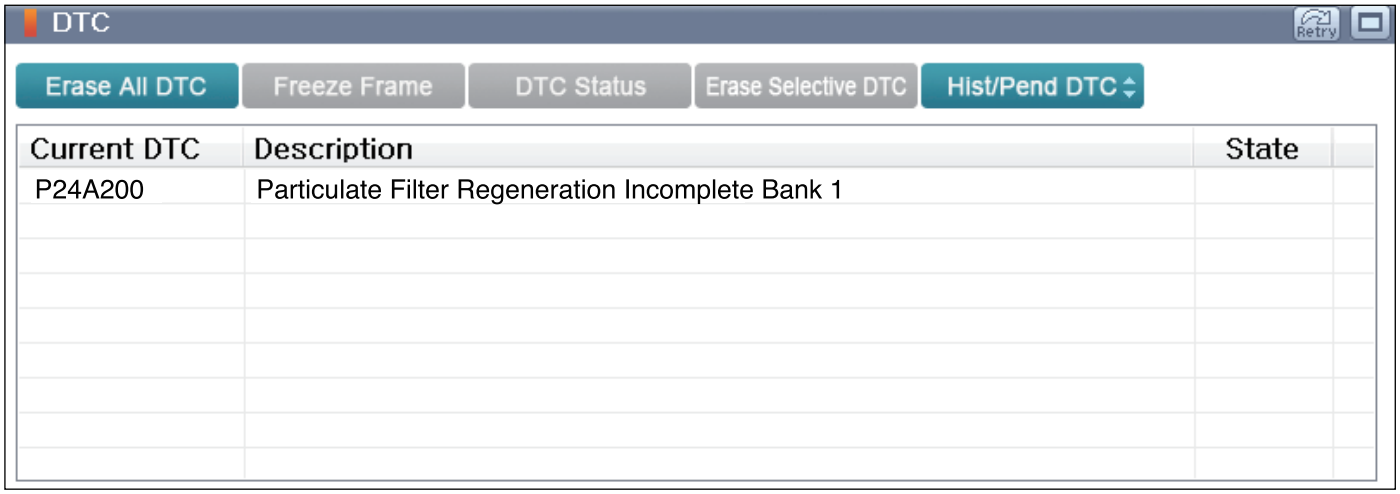
Vehicle Data

DPF DPS		Terminal	Inspection Condition	Measured Value	Remarks
Pin No.	1	DPS Power	1. Ignition switch "ON" & Engine "OFF" 2. 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
Pin No.	1	DPS Power	1. Ignition switch "ON" & Engine "OFF" 2. Voltage is measured on wiring side(Connected)	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 switch "ON"
3. Monitor "Diagnostic Trouble Codes(DTC)" with GDS.



CRC12EN5010P24A20021S

4. Is DTC status displayed as Present?

YES ▸ Go to "DTC Information" and verify possible cause part in GDS.

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 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 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 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)
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.
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.

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.
3. Inspect for corrosion or contamination on DPS 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.

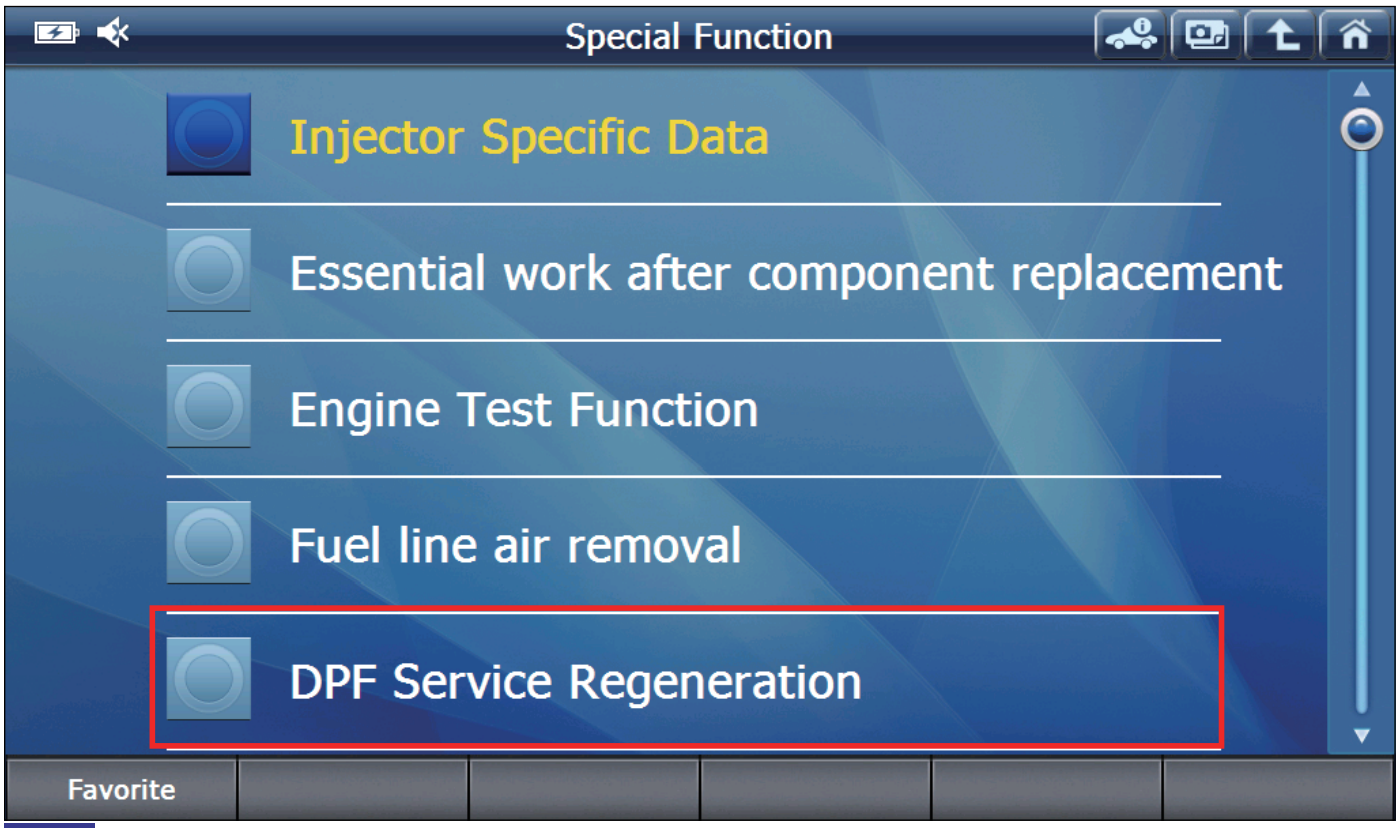


Fig.1

CRC12EN5010P04720041S

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.

⚠ 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"
4. Perform "Essential Work After Component Replacement" in "Vehicle Software Management" with GDS.
5. Select "Differential Pressure Sensor Change"

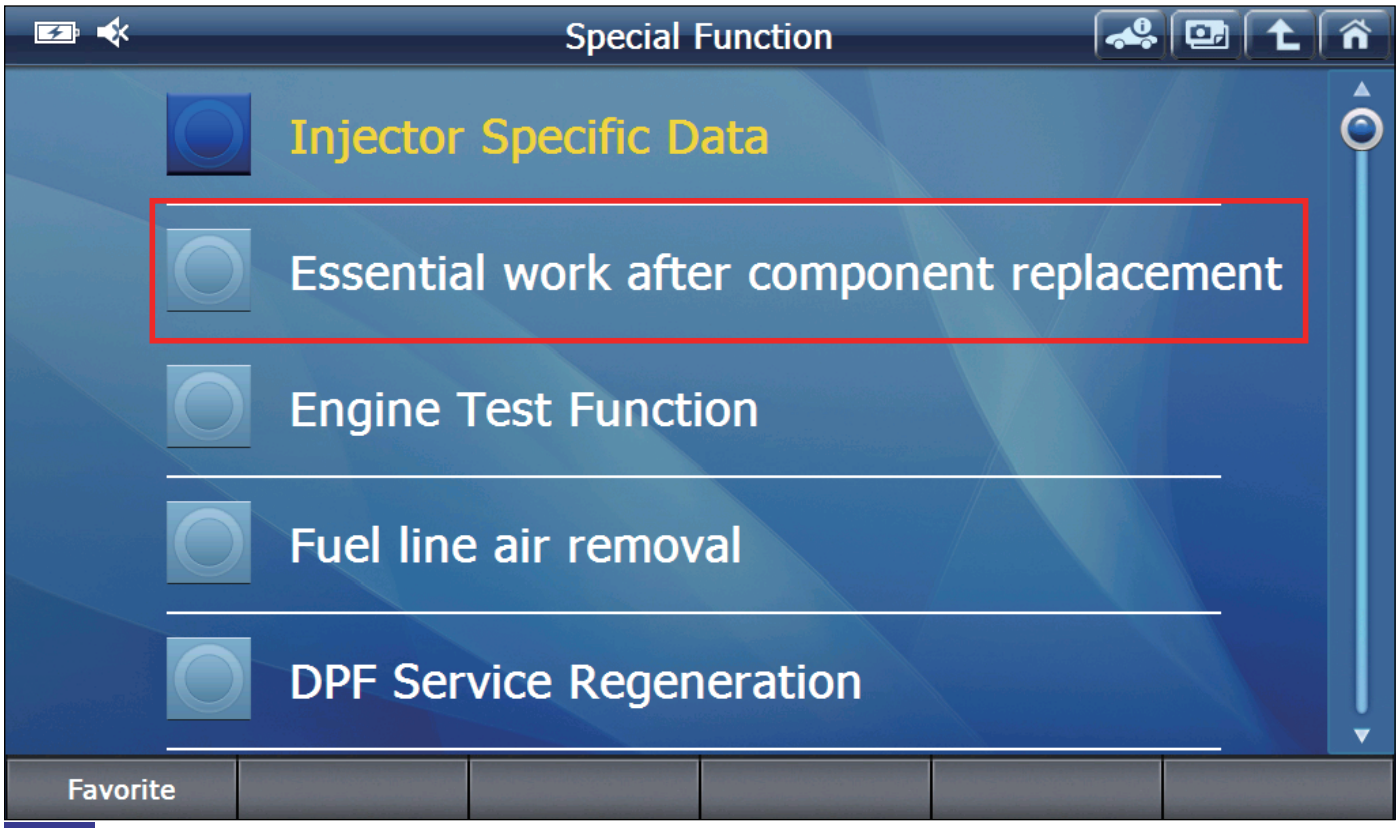


Fig.1

CRC12EN5010P01010041S

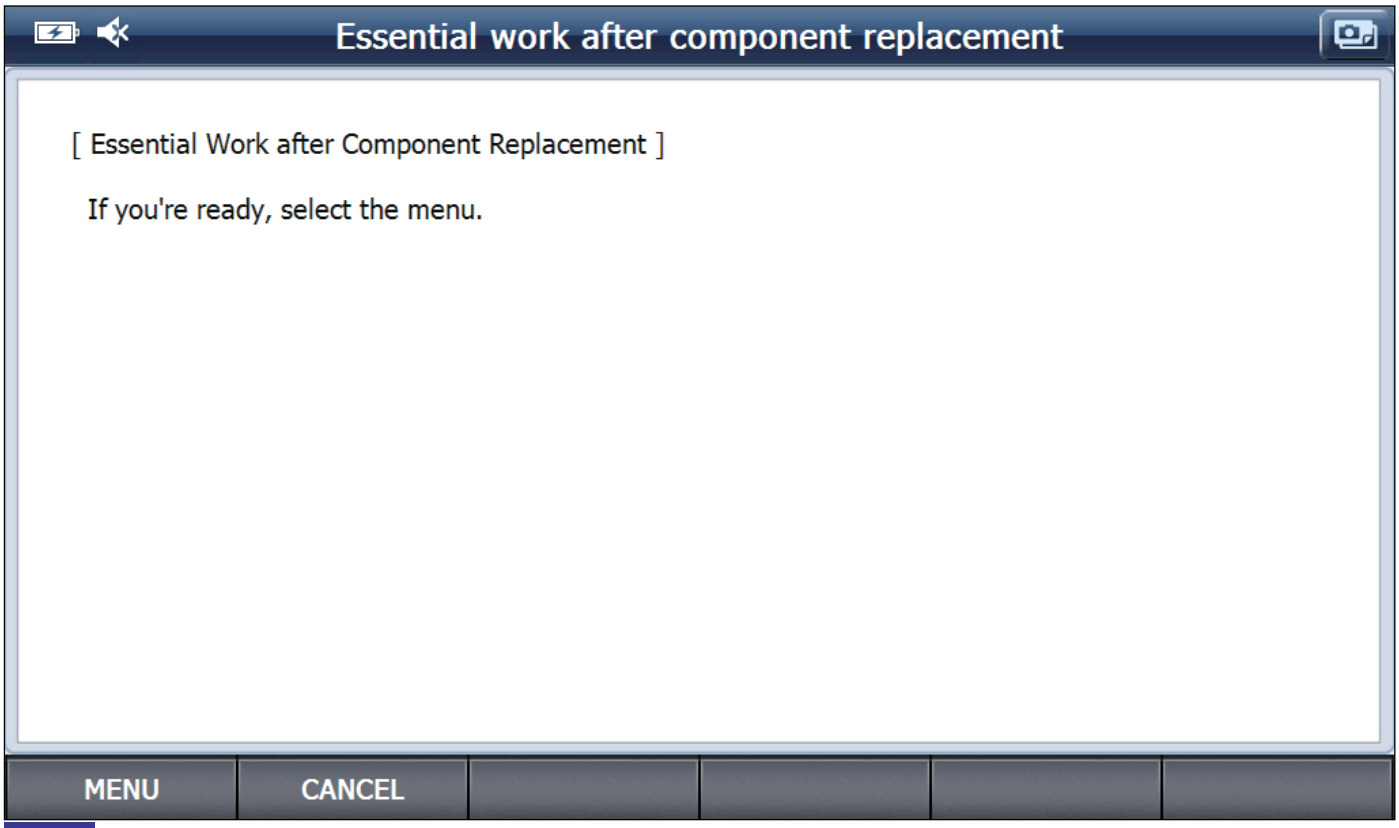


Fig.2

CRC12EN5010P01010042S

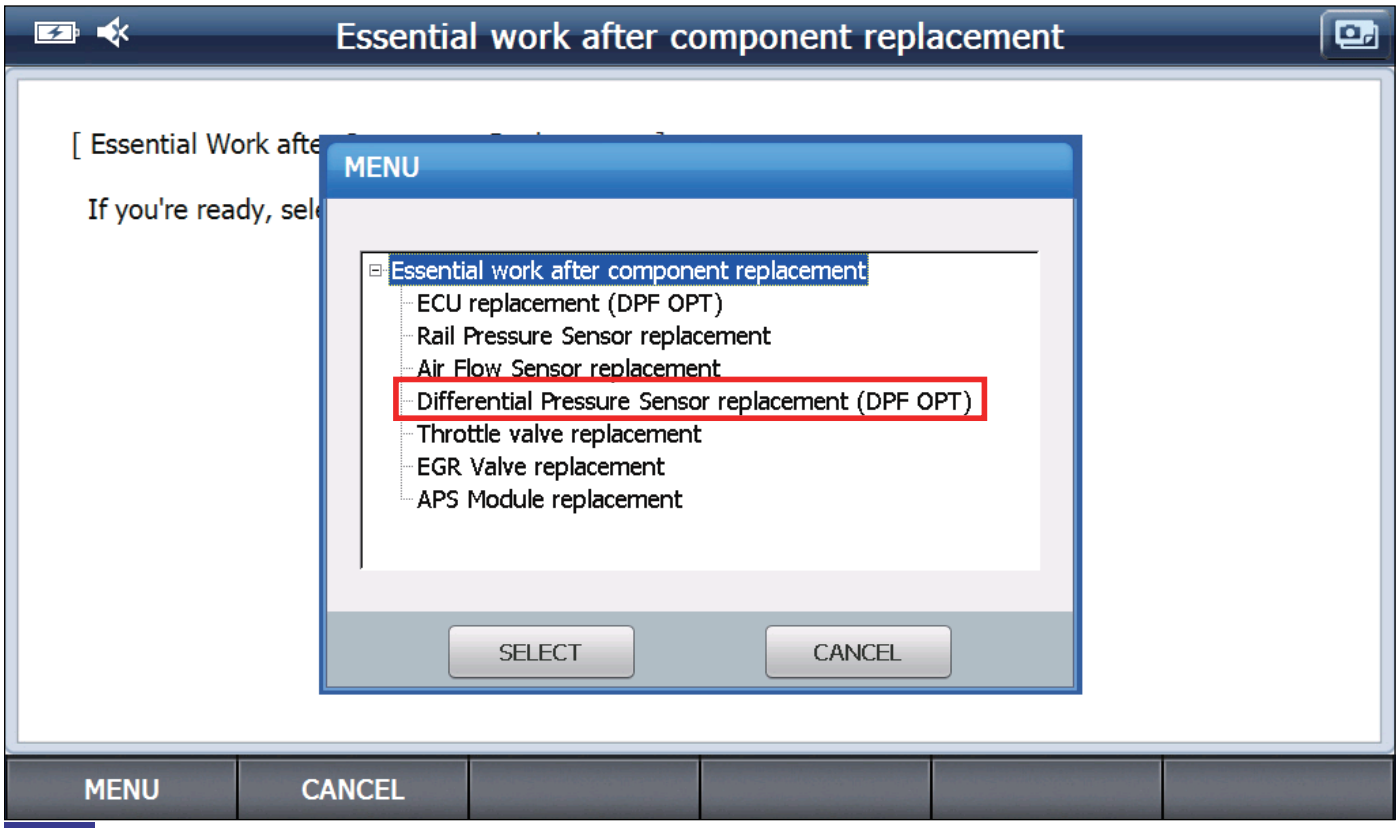


Fig.3

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 has been corrected.

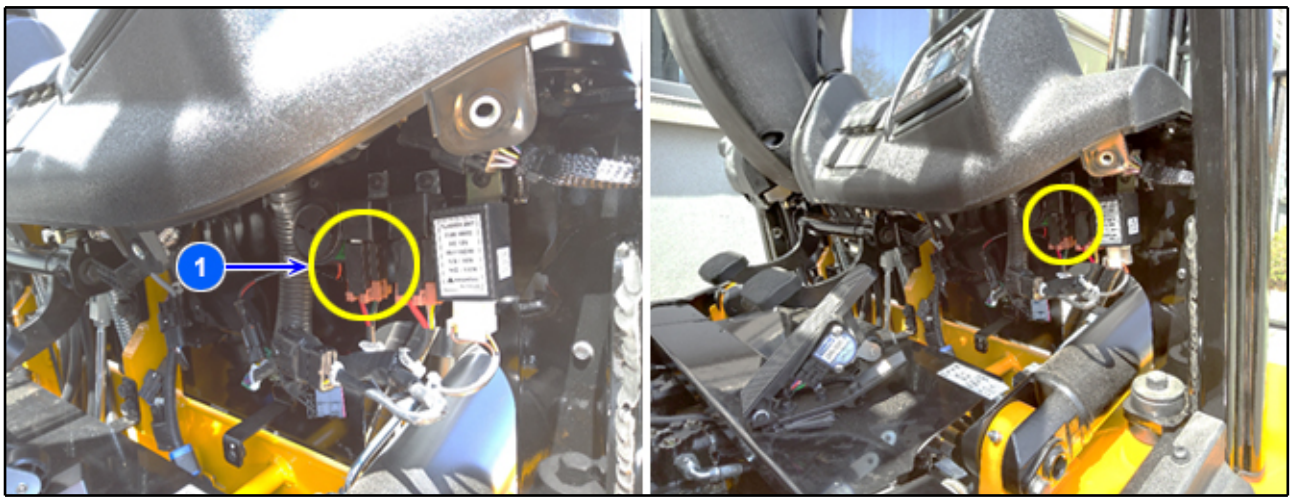
1. Connect GDS to Data Link Connector(DLC), and monitor DTC(Diagnostic Trouble Codes).
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC is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

P26E500 Starter Relay "B" Circuit Low

Component Location



CRC12EN5010P06160011

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

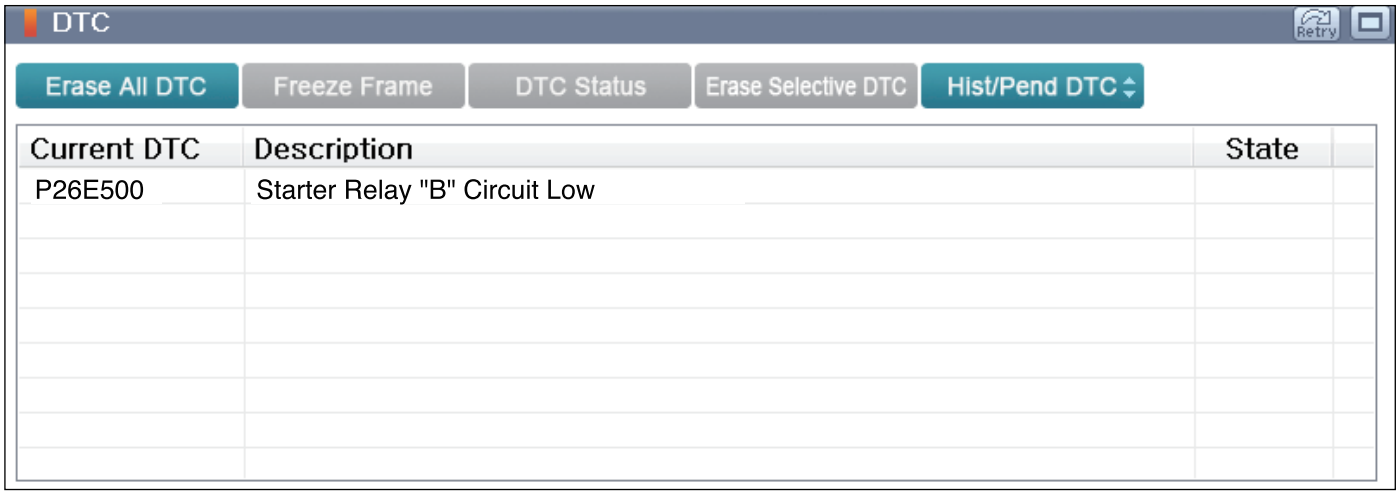
If low signal on high signal circuit of starter relay under cranking, ECM sets DTC P26E500. This fault might be caused by short to ground or open in high circuit of starter relay.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Short to ground in high signal circuit of starter relay 2. Defected starter relay
Enable Condition	• Engine running		
Threshold Value	• Short to power or open in high signal circuit		
Detecting Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P26E50021S

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 remove starter relay.
3. 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?

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 remove starter relay.
3. Ignition switch "ON"
4. Measure the voltage between control high terminal of starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

5. Measure the voltage between control low terminal of starter relay harness connector and chassis ground.

Specification :Approx. 2.5V

6. Is the measured value within specificaiton?

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 remove the starter relay.
4. Measure resistance between relay control low and 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.

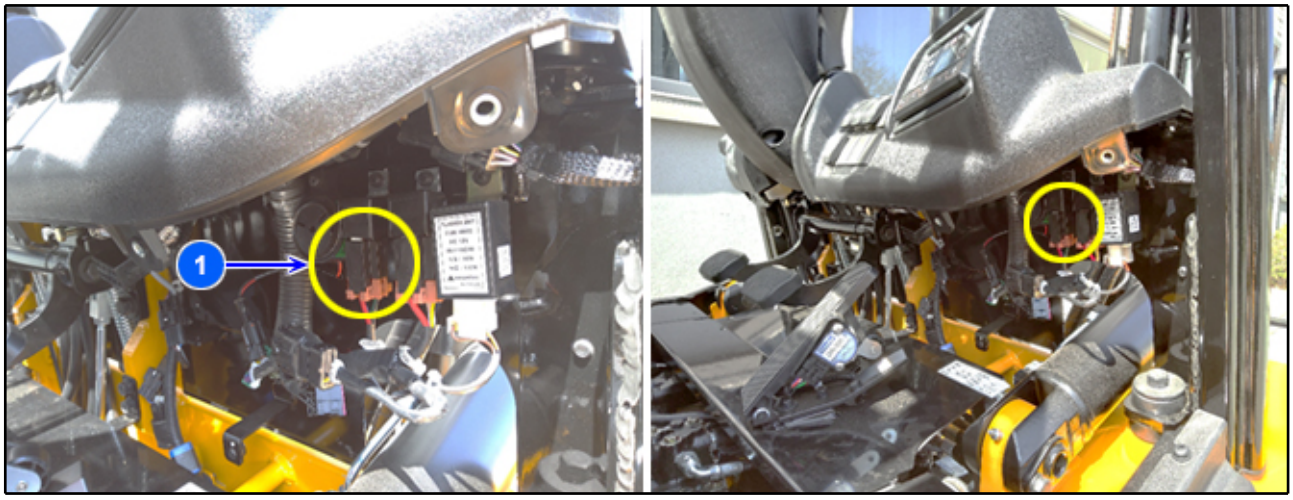
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

P26E600 Starter Relay "B" Circuit High

Component Location



CRC12EN5010P06160011

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

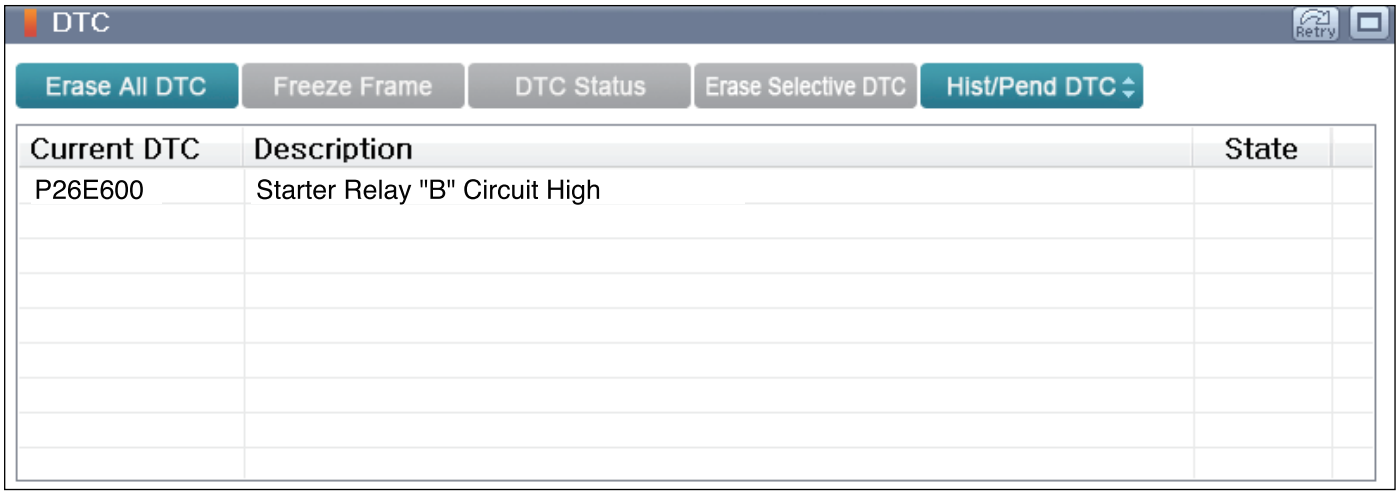
If high signal on high signal circuit of starter relay under cranking, ECM sets DTC P26E600. This fault might be caused by short to power or open in high circuit of starter relay.

DTC Detecting Condition

Item	Detecting Condition		Possible Cause
DTC Strategy	• Signal monitoring		1. Open or short to power in high signal circuit of starter relay 2. Defected starter relay
Enable Condition	• Engine running		
Threshold Value	• Short to power or open in high signal circuit		
Detecting Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	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.



CRC12EN5010P26E60021S

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 remove starter relay.
3. 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?

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 remove starter relay.
3. Ignition switch "ON"
4. Measure the voltage between control high terminal of starter relay harness connector and chassis ground.

Specification : Approx. 3.4V

5. Measure the voltage between control low terminal of starter relay harness connector and chassis ground.

Specification : Approx. 2.5V

6. Is the measured value within specificaiton?

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 remove the starter relay.
4. Measure resistance between relay control low and 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. T-horoughly check connectors for looseness, po-or connection, bending, corrosion, contaminati-on, deterioration, or damage. Repair or replace as necessary and go to "Verification of vehicle Repair" procedure.

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

▸ 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.

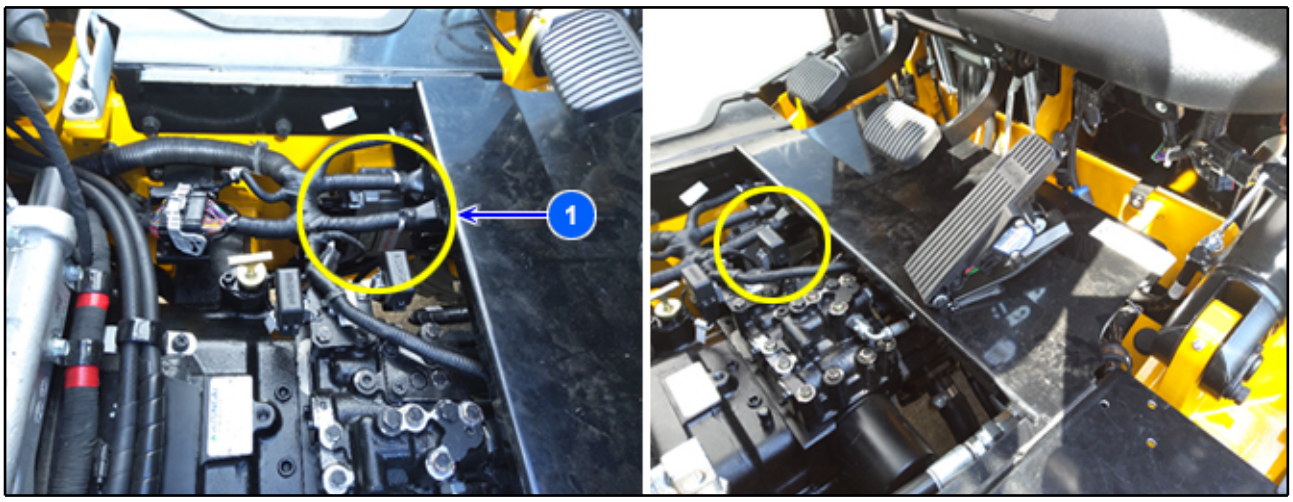
1. Connect GDS to Data Link Connector(DLC), and monitor "Diagnostic Trouble Codes(DTC)".
2. Clear all DTCs in the system with GDS.
3. Operate system or vehicle within DTC detecting condition in DTC Detecting Condition chart.
4. Monitor "Diagnostic Trouble Codes(DTC)" with GDS and verify that any DTC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

YES ▸ Go to the applicable troubleshooting proced-ure.

NO ▸ Problem is corrected and the system operat-ion performs to specification at this time.

U000100 High Speed CAN Communication Bus

Component Location



CRC12EN5010P02190011

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

Item	Detecting Condition		Possible Cause
DTC Strategy	• CAN message monitoring		1. Poor connector connection 2. Short in CAN high line 3. Short in CAN low line 4. Short circuit between CAN high and low line 5. Defected modules that connected to CAN
Enable Condition	• Engine running		
Threshold Value	• CAN Bus off is detected		
Detecting Time	• 2 sec		
Fail Safe	Engine OFF	• No	
	EGR OFF	• No	
	Torque Limit	• No	
	MIL	• Off	

Signal Waveform

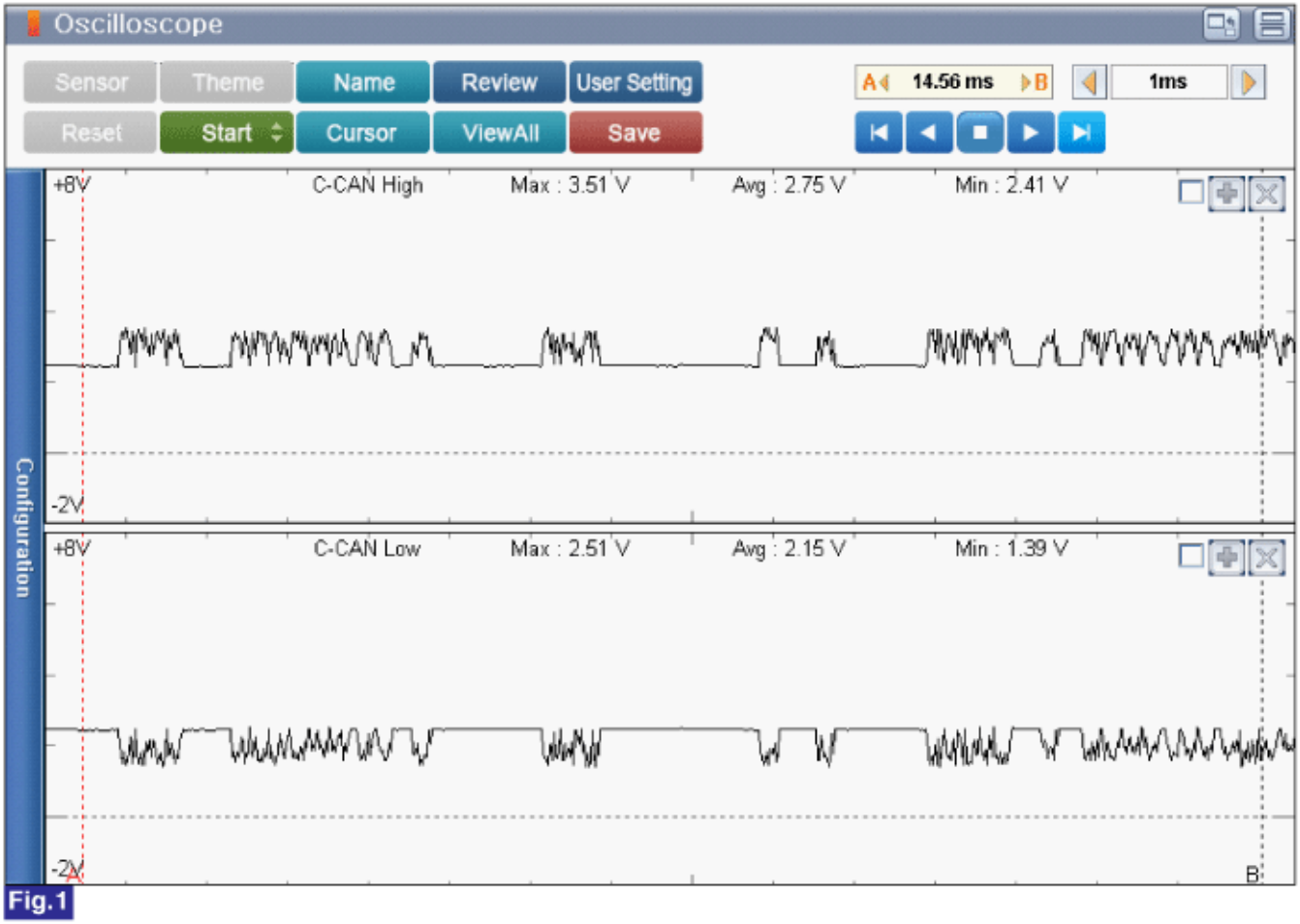


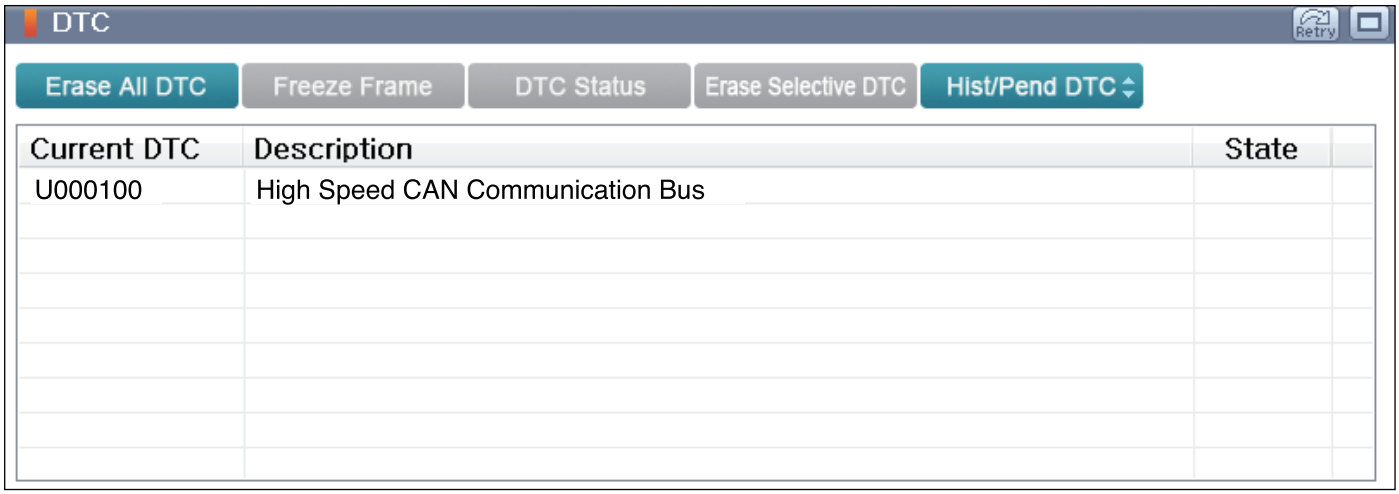
Fig.1

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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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.

NO ▸ Go to "CAN Communication Line Inspection " 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

■ Impedance measurement with matching resistor

1. Ignition "OFF" and disconnect the battery and wait 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 Ω

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.

NO ▸ If the value is out of specification then, go to "CAN Signal Inspection" procedure.
※If the measured value is approx. 0Ω, then check for short CAN communication line.
※If the measured value is approx. ∞Ω, 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)

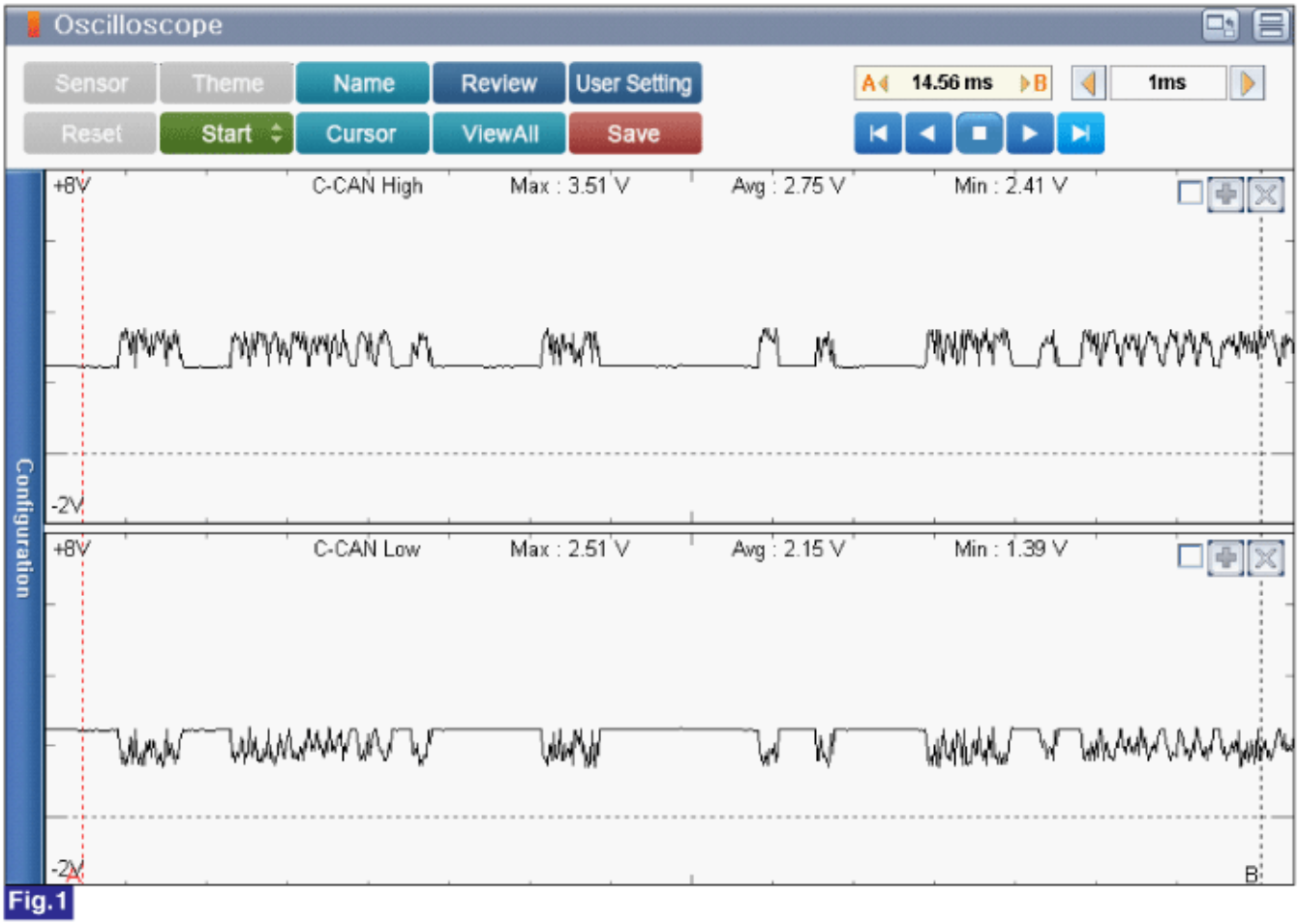

Fig.1

CRC12EN5010U00010011S

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.

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

1. 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

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.

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