

SECTION 5 MECHATRONICS SYSTEM

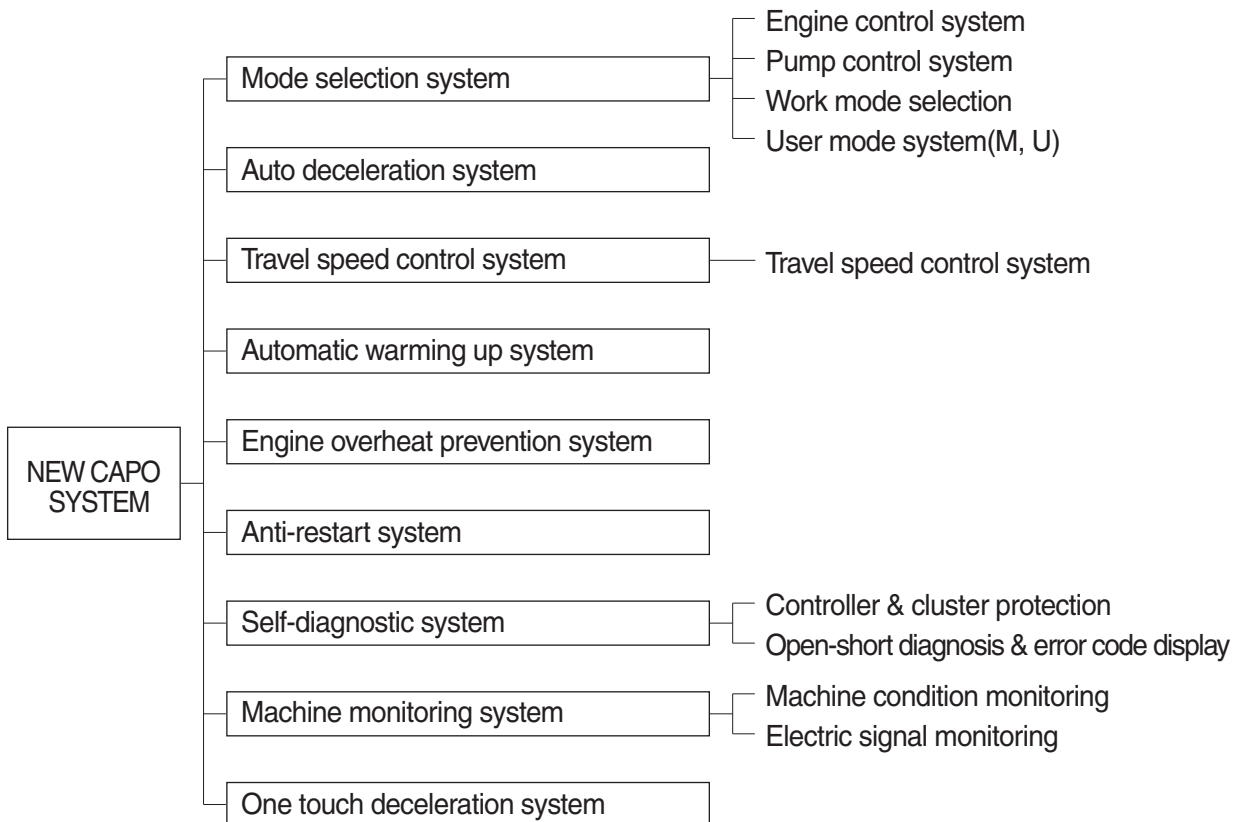
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SECTION 5 MECHATRONICS SYSTEM

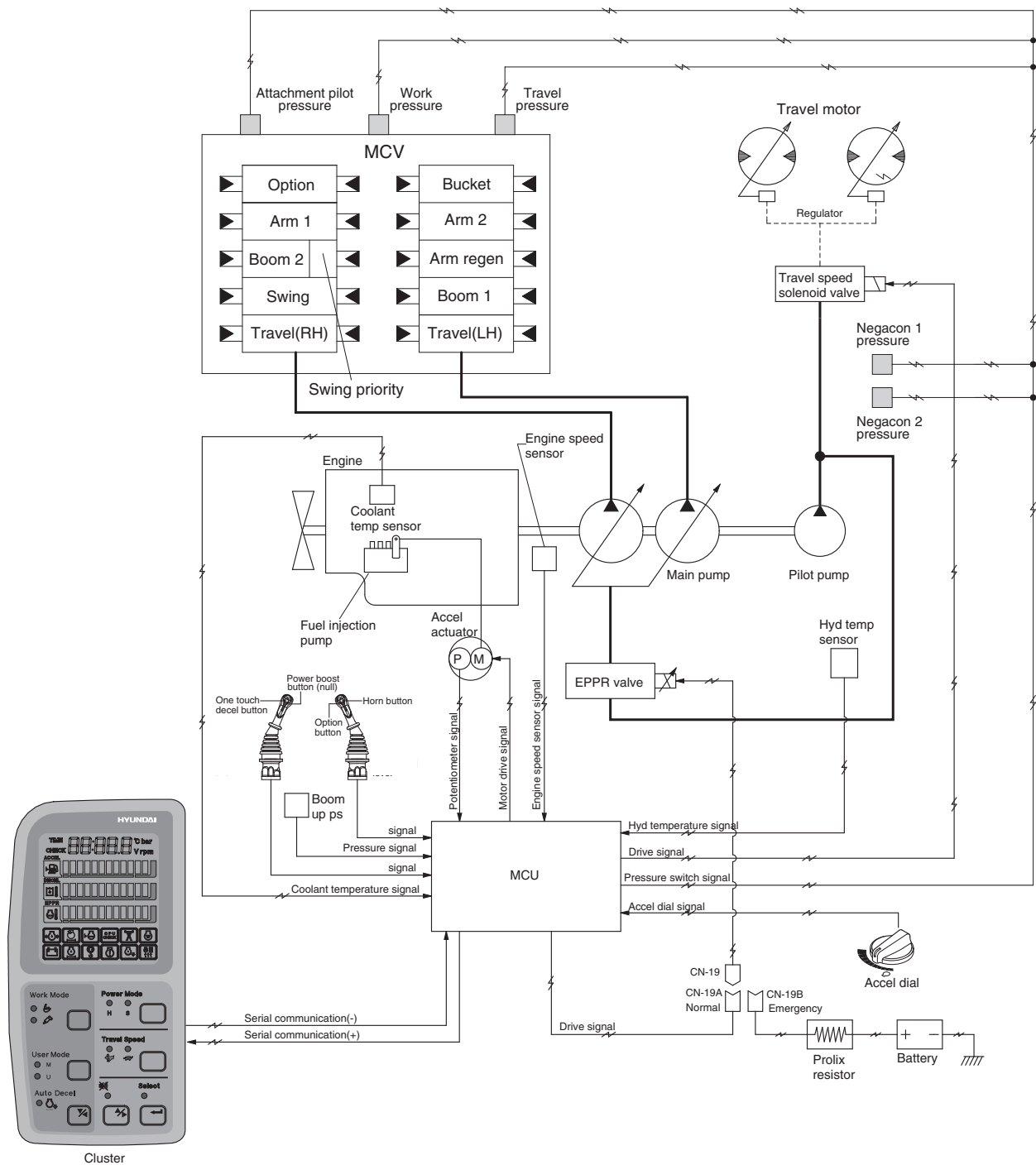
GROUP 1 OUTLINE

The NEW CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.

It consists for a MCU, a cluster, an accel actuator, an EPPR valve, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.



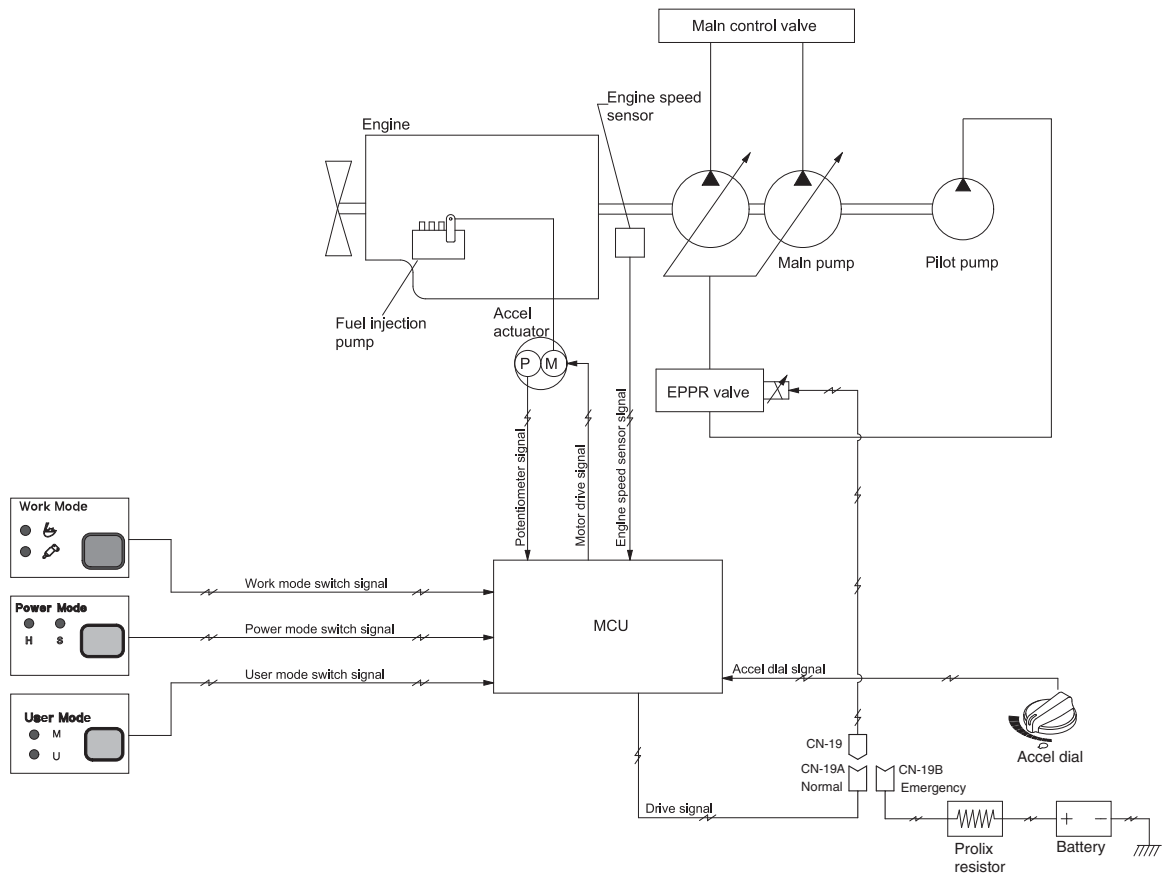
SYSTEM DIAGRAM



210S5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



210S5MS02

Mode selection system (Micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

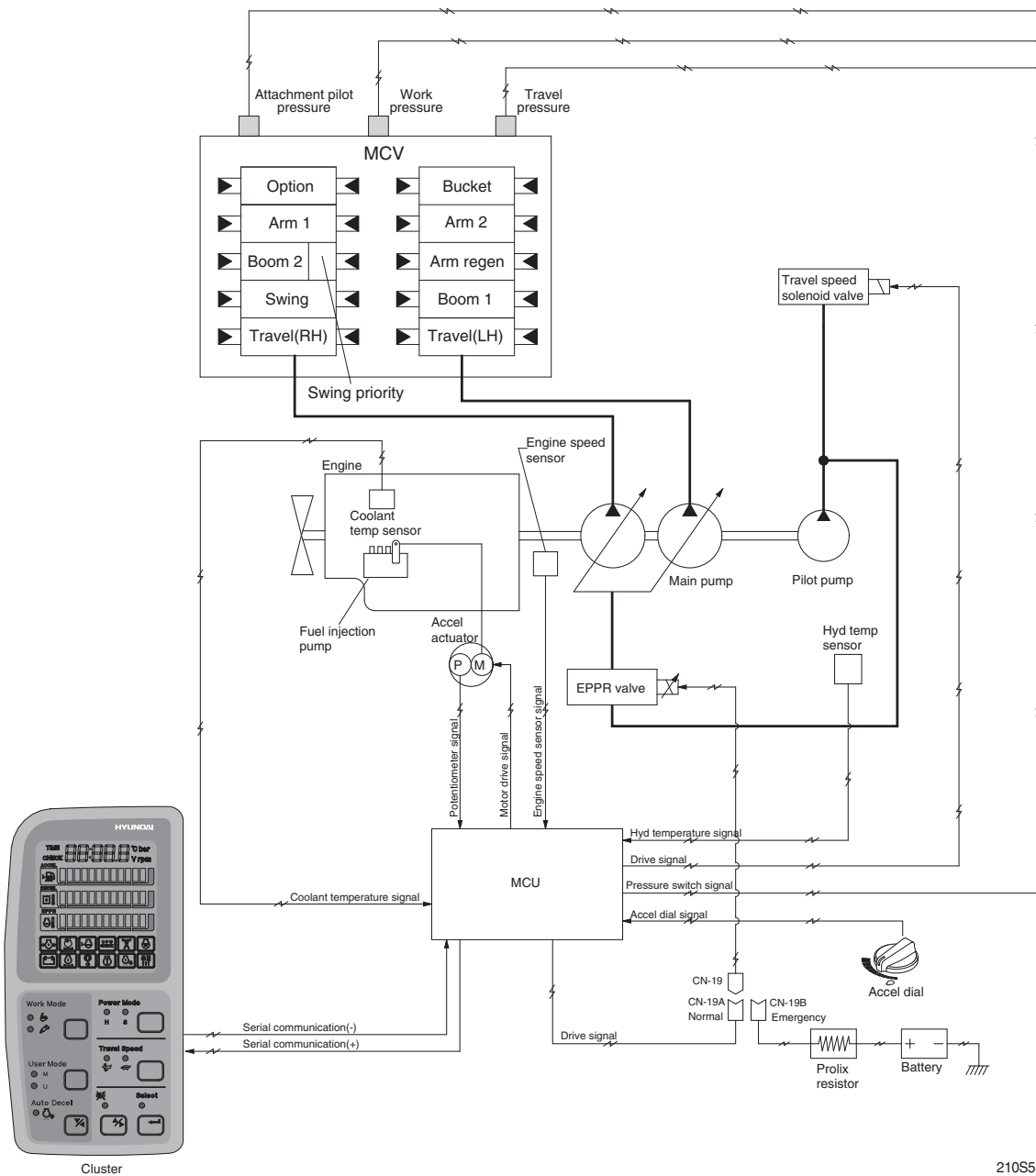
The combination of 3 power modes (M, H, S) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm ²)	Current (mA)	Pressure (kgf/cm ²)
M mode	Maximum power	2100±100	2000±100	2200±100	2100±100	-	12(~7)	-	12(~6)
H mode	High power	2000±100	1900±100	2050±100	1950±100	-	15(~10)	-	13(~7)
S mode	Standard power	1900±100	1800±100	1950±100	1850±100	-	15(~10)	-	13(~7)
Auto decel	Engine deceleration	1150±100	-	1150±100	-	700±30	38	700±30	38
One touch decel	Engine quick deceleration	1050±100	-	1050±100	-	700±30	38	700±30	38
Key start	Key switch start position	850±100	-	850±100	-	700±30	38	700±30	38

※(~※): Load

2. WORK MODE SELECTION SYSTEM

3 work modes can be selected for the optional work speed of the machine operation.



210S5MS03

1) HEAVY DUTY WORK MODE

2) BREAKER OPERATION MODE

It sets the pump flow to the optimal operation of breaker by MCU.

3. USER MODE SELECTION SYSTEM

Through 1 memory sets of M and U, an operator can change the engine and pump power and memorize it for his preference.

Mode	Operation
M	Maximum power
U	High idle rpm, auto decel rpm EPPR pressure can be modulated and memorized separately

HOW TO MODULATE THE MEMORY SET

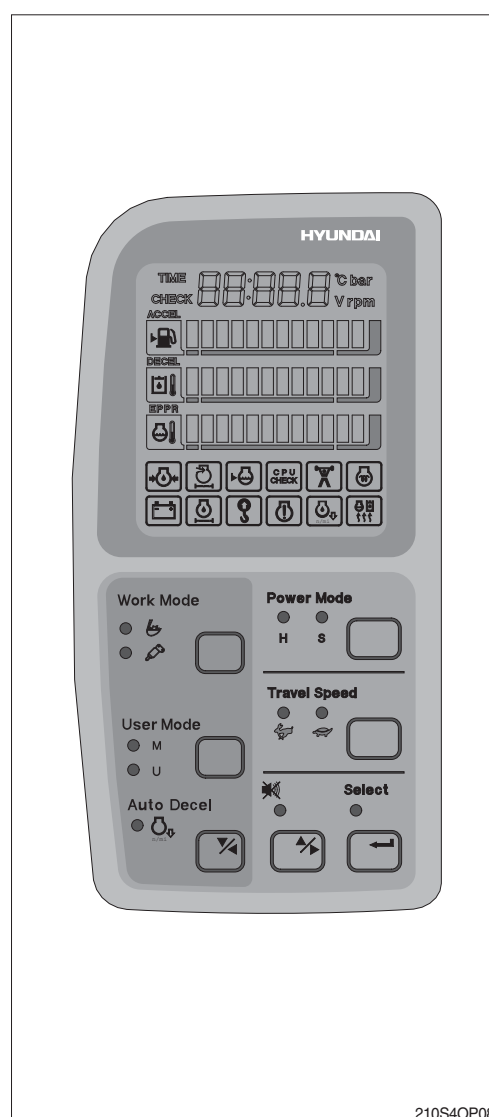
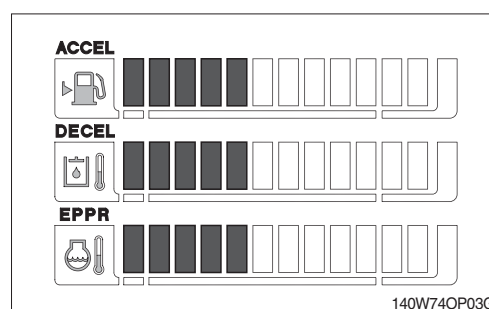
- Each memory mode has a initial set which are mid-range of max engine speed, auto decel rpm, and EPPR valve input current. When you select "U", cluster LCD displays.
- To change the engine high idle speed, press the USER mode switch and SELECT switch at the same time and then ACCEL blinks at 0.5 seconds interval.
 - By pressing ▲ or ▼ switch, █ will increase or decrease.
- To change DECEL rpm, press the USER mode switch and SELECT switch once more and then DECEL blinks at 0.5 seconds interval.
 - By pressing ▲ or ▼ switch, █ will increase or decrease.
- To change EPPR current, press the USER mode switch and SELECT switch one more and then EPPR blinks at 0.5 seconds interval.
 - By pressing ▲ or ▼ switch, █ will increase or decrease.

· LCD segment vs parameter setting

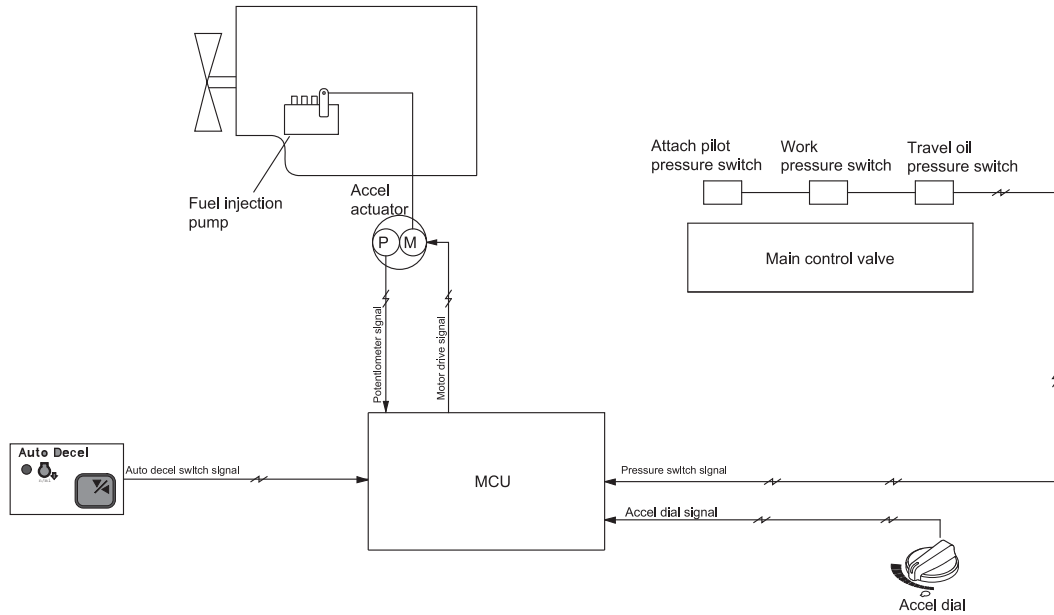
Segment (█)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1300	1000 (low idle)	0
2	1400	1050	3
3	1500	1080	6
4	1600	1100	9
5	1650	1150	12
6	1700	1200	16
7	1750	1250 (auto decel)	20
8	1800	1300	26
9	1850	1350	32
10	1900	1400	38

※ : One touch decel : 1050 rpm

- To memorize the final setting, press the USER mode switch and SELECT switch one more time.



GROUP 3 AUTOMATIC DECELERATION SYSTEM

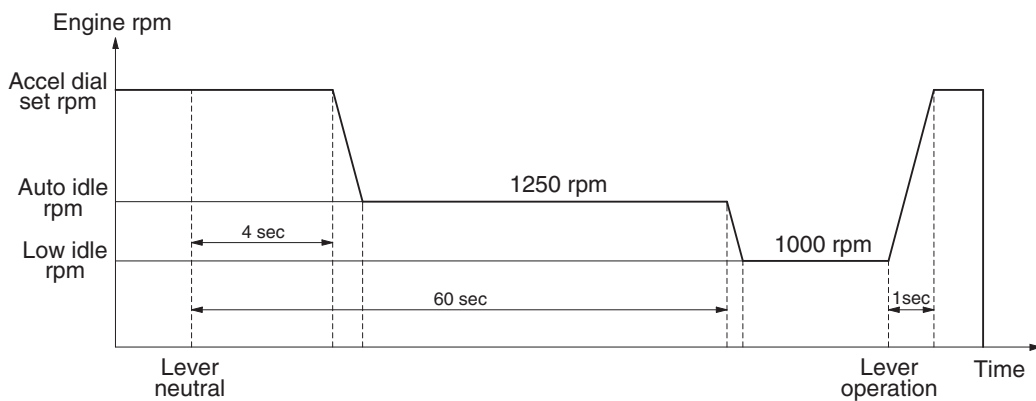


210S5MS04

1. WHEN AUTO DECEL LAMP ON

If all the work equipment control levers including swing and travel levers are at neutral for at least 4 seconds, the MCU drives the accel actuator to reduce the engine speed to 1250rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto decel lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed set before deceleration in a second.



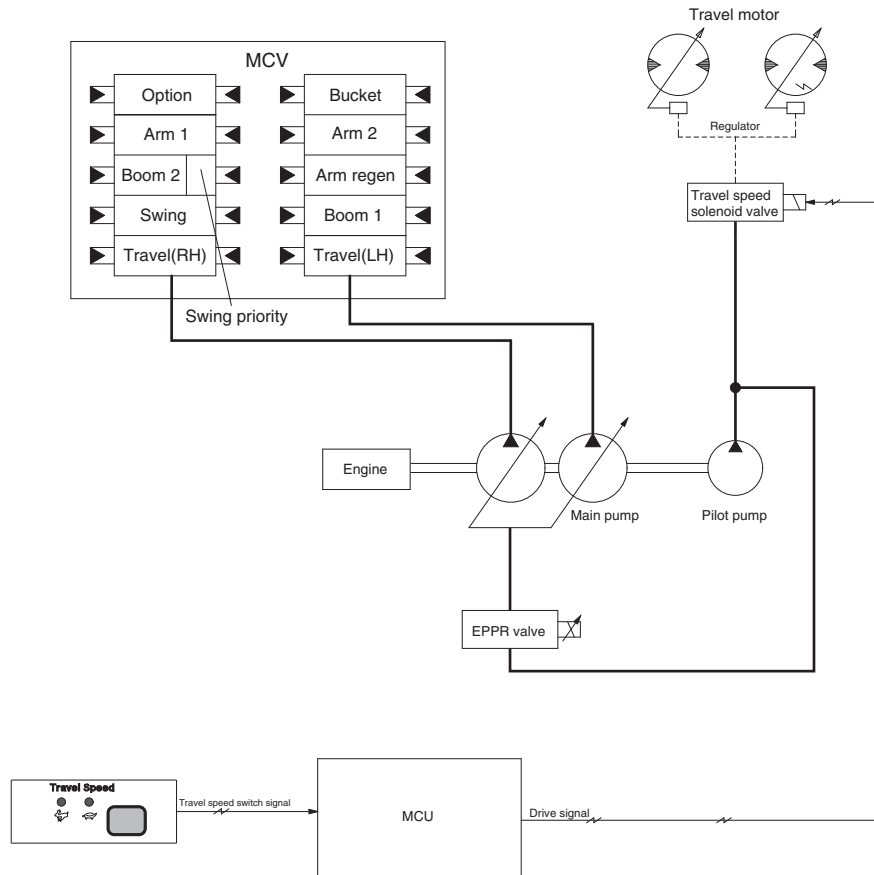
210S5MS05

2. WHEN AUTO DECEL LAMP OFF

The engine speed can be set as desired using the accel dial switch, and even if the control levers are neutral, the engine speed is not reduced.

Note : Auto decel function can be activated when accel dial position is over 4.

GROUP 4 TRAVEL SPEED CONTROL SYSTEM



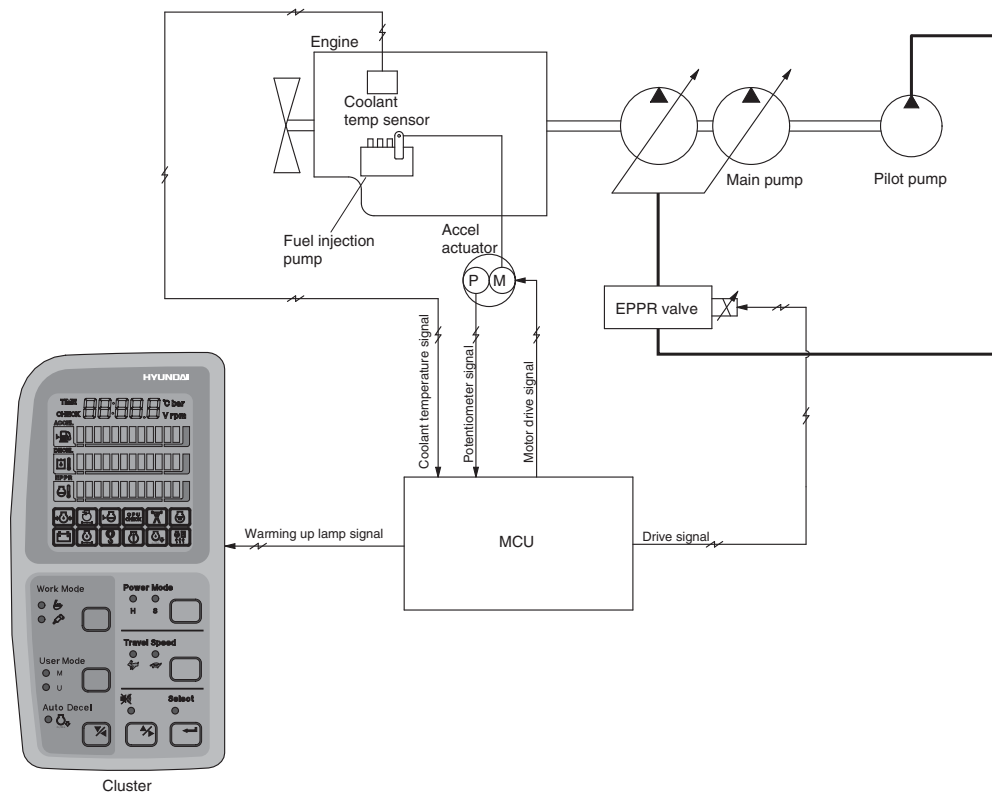
210S5MS07

Travel speed can be switched manually by pressing the travel speed switch on the cluster.

Speed	Travel speed solenoid valve	Lamp on cluster	Operation
Lo	OFF	Turtle	Low speed, high driving torque in the travel motor
Hi	ON	Rabbit	High speed, low driving torque in the travel motor

※ Default : Turtle(Lo)

GROUP 5 AUTOMATIC WARMING UP FUNCTION



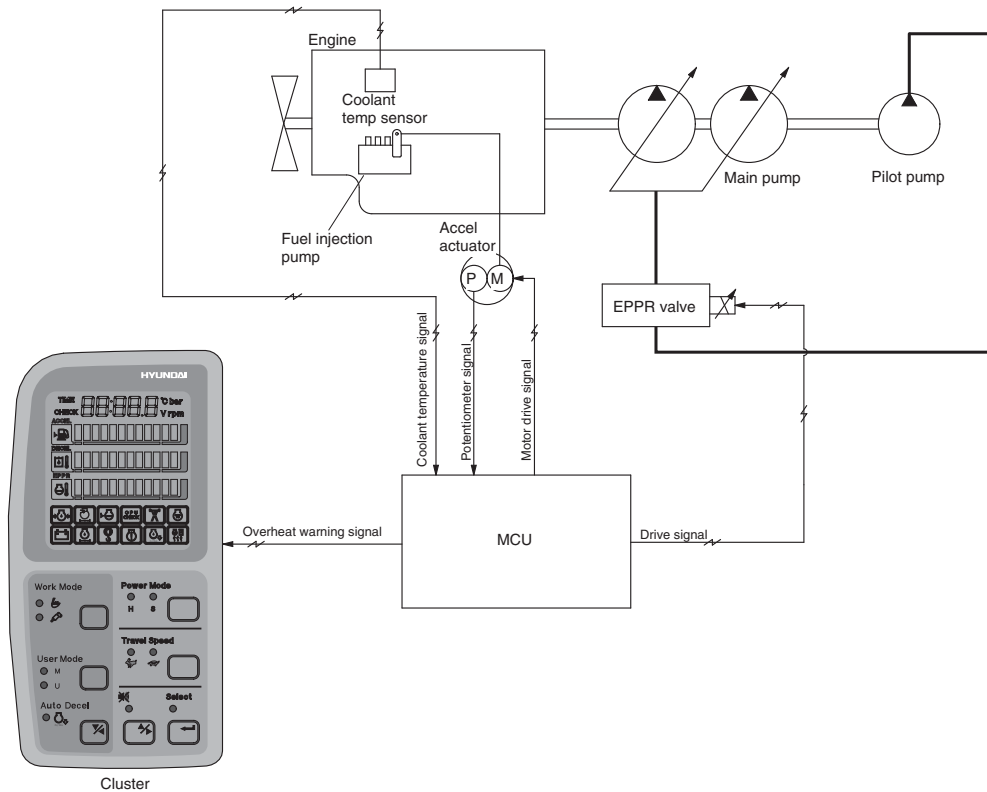
210S5MS08

1. The MCU reads engine coolant temperature through the temperature sensor, and if the coolant temperature is less than 30 °C, it increases the engine speed from key start rpm to 1250rpm. At this time the mode does not change.
2. In case of the coolant temperature increases up to 30 °C, the engine speed is decreased to key start speed. And if an operator changes mode set during the warming up function, the MCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	<ul style="list-style-type: none"> - Coolant temperature : Less than 30 °C (After engine run) - Accel dial position is under 3 	<ul style="list-style-type: none"> - Mode : Default (S mode) - Warming up time : 10 minutes (Max) - Warming up pilot lamp : ON
Canceled	<ul style="list-style-type: none"> - Coolant temperature : Above 30 °C - Warming up time : Above 10 minutes - Changed mode set by operator - Increase engine speed by rotating accel dial clockwise ※ If any of the above conditions is applicable, the automatic warming up function is canceled 	<ul style="list-style-type: none"> - Default mode - Changed mode - Warming up pilot lamp : OFF

GROUP 6 ENGINE OVERHEAT PREVENTION FUNCTION



210S5MS09

1. The MCU reads engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110 °C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial 7 position.

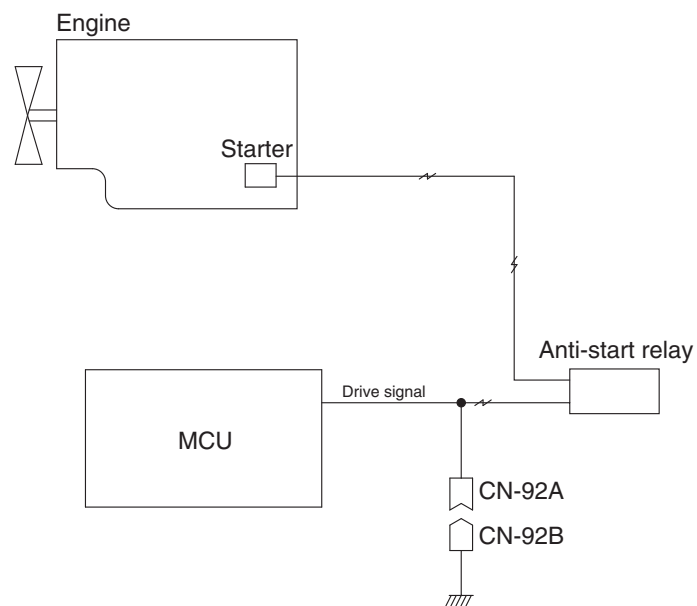
2. If the coolant temperature drops less than 100 °C, the The MCU returns the mode to the mode set before. And if mode set is changed during the function, the The MCU cancels the function.

Even if the overheat prevention function is canceled by mode change, the overheat warning lamp turns OFF only when the coolant temperature is less than 100 °C.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Above 110 °C - Accel dial set : Above 8	- Engine rpm drop to accel dial 7 position - Overheat warning lamp & buzzer : ON
Canceled	- Coolant temperature : Less than 100 °C - Changed mode set by operator ※ If any of the above conditions is applicable, engine overheat prevention function is canceled	- Return to the mode and accel dial set before - Hold on the changed set
Overheat warning lamp	- Coolant temperature : Less than 100 °C	- Overheat warning lamp : OFF

GROUP 7 ANTI-RESTART SYSTEM



210S5MS10

1. ANTI-RESTART FUNCTION

After 10 seconds from the engine starts to run, the MCU turns off the anti-restart relay to protect the starter from inadvertent restarting.

2. When a replacement or taking-off of the MCU is needed, connect CN-92A and CN-92B to ensure the engine start without the MCU.

GROUP 8 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

When any abnormality occurs in the NEW CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

The current or recorded error codes are displayed at the error display mode selected by touching **SELECT** switch 2 times while pressing **BUZZER STOP** switch.

2. CURRENT ERROR DISPLAY

Cluster displays **Co : Er** and makes buzzer sound itself to warn the communication error when communication problem caused by wire-cut or malfunction of the MCU occurs.

Cluster displays real time error codes received from MCU through communication. In case of no problem it displays **CHECK Er : 00**.

If there are more than 2 error codes, each one can be displayed by pressing ▲ and ▼ switch respectively.

Examples :

1) Communication Error

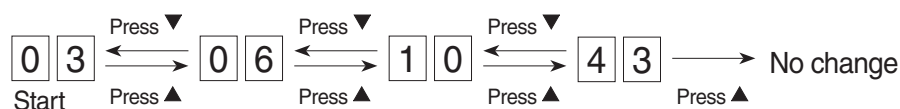
Co : Er & Buzzer sound

2) No problem

CHECK Er : 00

3) 4 Error codes(03, 06, 10, 43) display

CHECK Er : 03

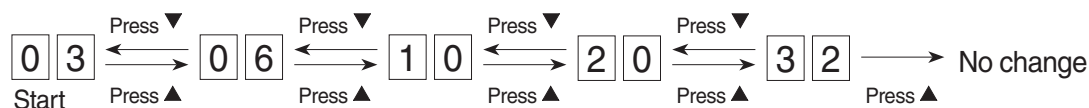


3. RECORDED ERROR DISPLAY



The recorded error can be displayed only when the start switch is at ON position.

Examples : 5 Recorded error codes(03, 06, 10, 20, 32) display

TIME Er : 03



4. DELETE ALL RECORDED ERROR CODES

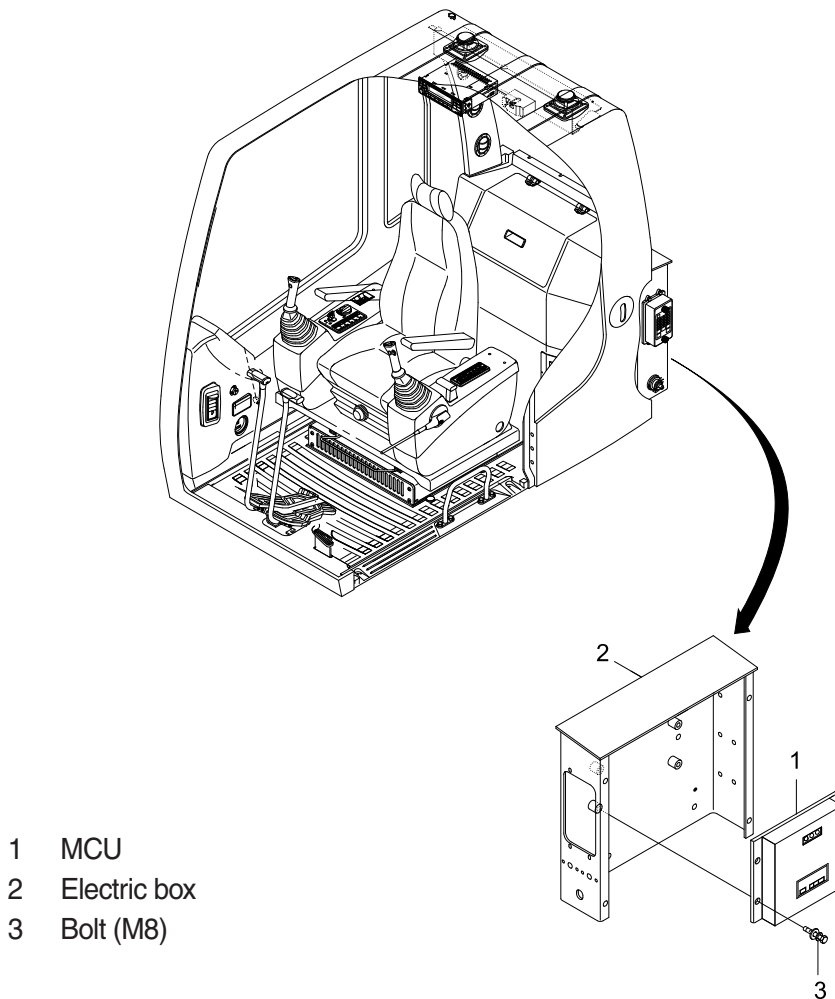
Select recorded error(**TIME Er**) display and press engine  and select switch  at the same time for 2 seconds or more. Cluster display changes to **TIME Er : 00**, which shows that MCU deleted all the recorded error codes in the memory.

5. ERROR CODES TABLE

Fault code No.	Description
2	POTENTIOMETER is shorted to Vcc (5V) or battery +
3	Pump EPPR valve circuit is shorted
5	Travel solenoid valve circuit is shorted
10	Hour meter circuit is shorted
11	Accel dial circuit is shorted to Vcc (5V) or battery +
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR circuit is open or shorted to ground
20	Travel solenoid valve circuit is open or shorted to ground
22	Max flow co solenoid valve circuit is open or shorted to ground
25	Hour meter circuit is open or shorted to ground
26	Accel dial signal circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
33	Alternator signal circuit is open or shorted to ground
34	Voltage under 18V
35	Voltage over 35V
36	Communication error
37	Engine speed sensor circuit is open or shorted to ground
40	Engine rpm discrepancy value is over ± 500
41	Hydraulic oil temp sensor circuit is open or shorted to ground
42	Fuel level sensor circuit is open or shorted to ground
43	Coolant temp sensor circuit is open or shorted to ground
45	Hydraulic oil temp sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temp sensor circuit is open or shorted to battery +
48	Boom up pressure sensor circuit is open or shorted to ground
49	Engine preheater circuit is shorted to battery +
61	Power shift pressure sensor circuit is open or shorted to battery +
99	MCU-RMCU communication error

GROUP 9 ENGINE CONTROL SYSTEM

1. MCU MOUNTING

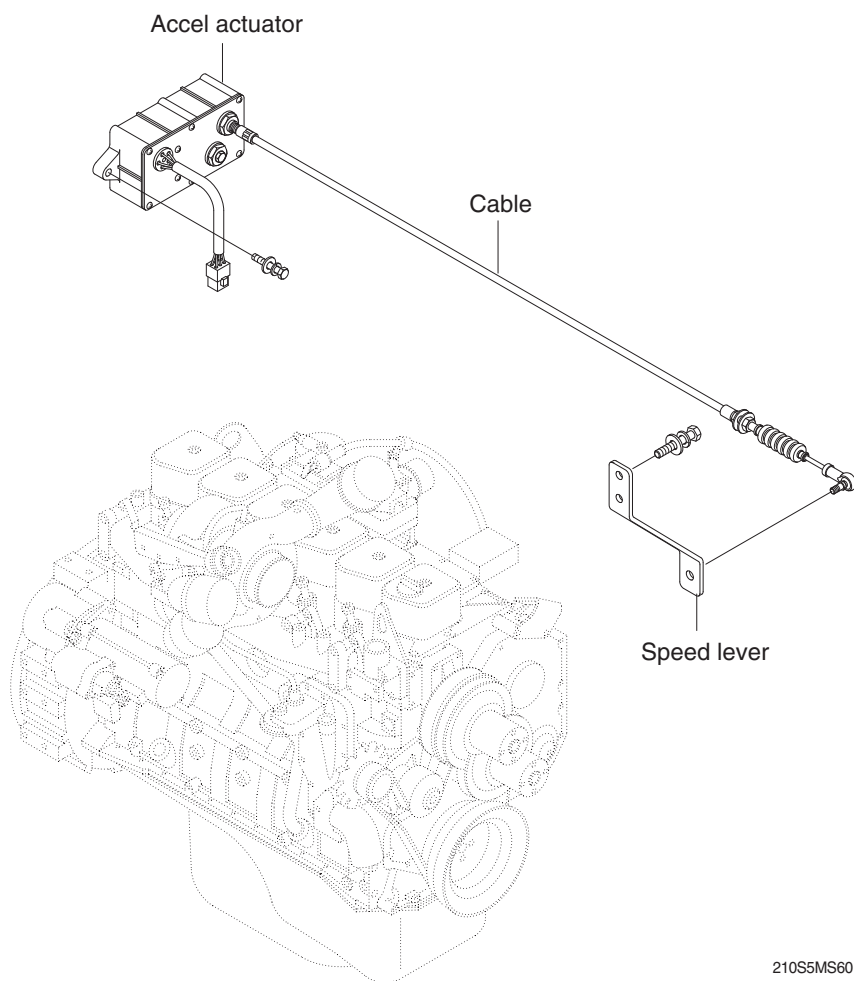


210S5MS11

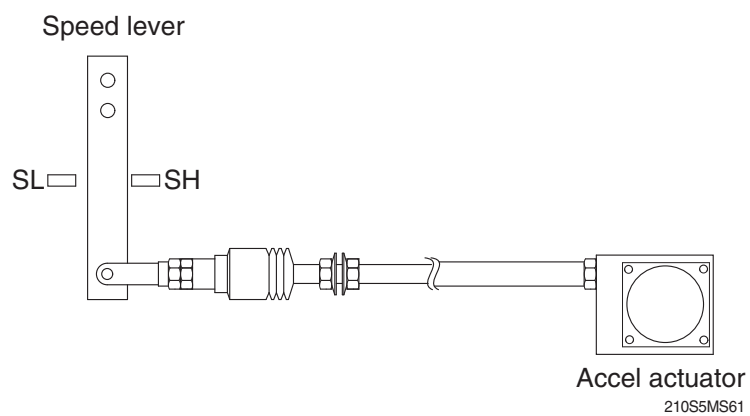
2. MCU ASSEMBLY

- 1) Remove four pieces of bolt (3) of electric box (2).
- 2) Disconnect 2 connectors from MCU.
- 3) Remove 6 pieces of screw and open the cover of MCU.
- 4) Inspection : Check PCB (Printed Circuit Board)
 - (1) If any damage is found, replace MCU assembly.
 - (2) If not, but CAPO system does not work please report it to HD Hyundai Construction Equipment dealer or A/S department.

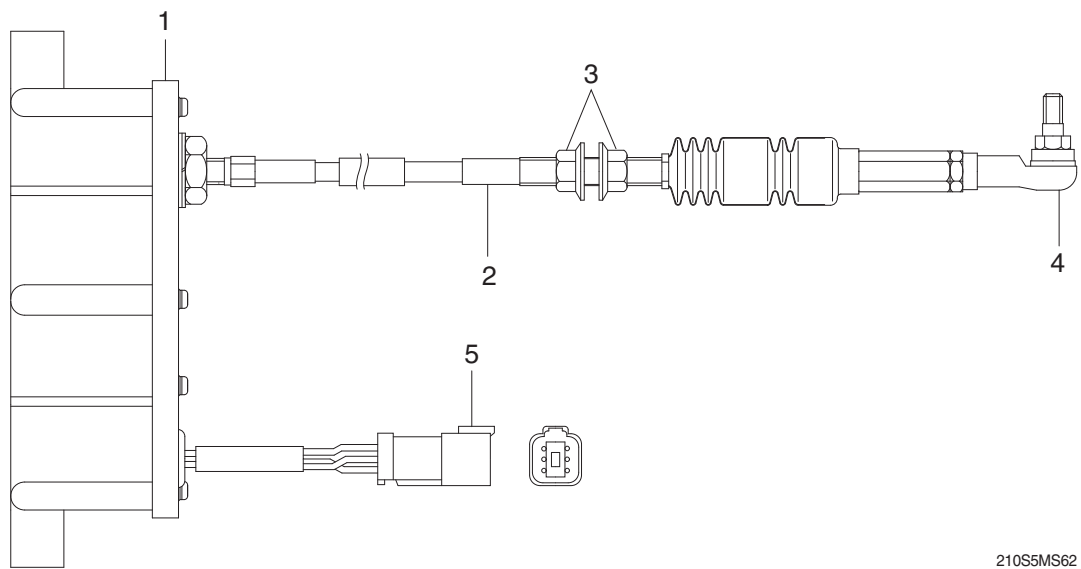
3. ENGINE ACCEL ACTUATOR



1) ENGINE SPEED LEVER

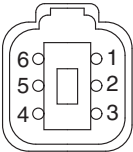


2) ACCEL ACTUATOR



210S5MS62

- 1 DC motor
- 2 Cable
- 3 Nut
- 4 Ball joint
- 5 Connector

Connector		
Type		6P, female
Line color & description	1	Red, sensor (VCC)
	2	Orange, sensor (OUT)
	3	Blue, sensor (GND)
	4	Null
	5	Green, motor (+)
	6	Yellow, motor (-)
Inspection		Check resistance Spec : 10Ω(Between No.5-6) 5kΩ(Between No.1-3)

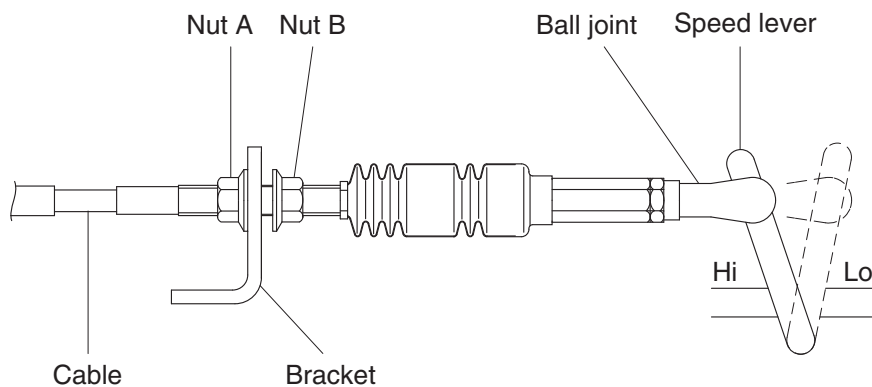
3) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(1) Key OFF

- ① Connect the ball joint of cable to engine speed lever.
- ② Pull the cable to high stopper and put nut **A** edge to yoke of the bracket.
- ※ Make speed lever not contact to the edge of high stopper.
- ③ Turn nut **A** to clockwise until touching to the edge of high stopper.
- ④ Make 1 turn more to clockwise in condition of the nut **A** contact to the edge of high stopper.

(2) Key START

- ⑤ Confirm if the engine speed on cluster is same as each mode specification.
- ⑥ If the engine speed displayed on cluster is higher than each mode specification, then turn the nut **A** to counter clockwise and make the engine speed same to each mode specification.
- ⑦ If the engine speed displayed on cluster is lower than each mode specification, then turn the nut **A** to clockwise and make the engine speed same to each mode specification.
- ⑧ Turn nut **B** to clockwise and fix the cable to bracket.

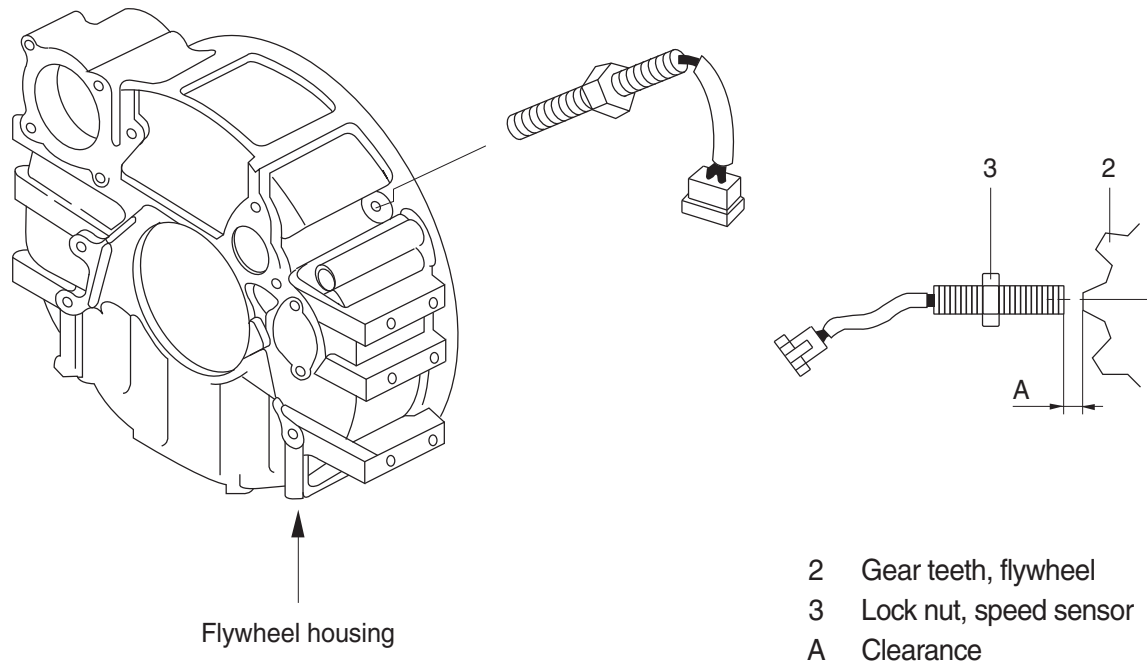


210S5MS63

Mode	RPM
M	2100 ± 100
H	2000 ± 100
S	1900 ± 100
Auto decel	1150 ± 100
Key start	850 ± 100

4. ENGINE SPEED SENSOR

1) STRUCTURE



5-20 (210-7)

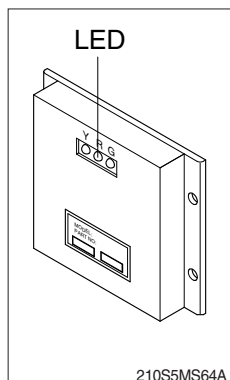
2) INSTALLATION

- (1) Clean contacting point of sensor.
- (2) Loosen lock nut.
- (3) Screw speed sensor into flywheel housing.
- (4) Turn it back 135° when it contacts with gear teeth.
- (5) Tight lock nut and connect wiring.

3) INSPECTION

- (1) Check resistance
 - SPEC : $300 \pm 30 \Omega$
- (2) Check voltage while engine run.
 - SPEC : 2~28Vac, dependent on the engine speed (rpm)

5. MCU



(1) To match the engine torque with the pump absorption torque, MCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.

(2) Three LED lamps on the MCU display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU or ROM	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between MCU and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24V, GND) of MCU is disconnected · Check the fuse

G : green, R : red, Y : yellow

GROUP 10 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

EPPR (Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main hydraulic pump.

1) ELECTRO MAGNET VALVE

Receive electric current from the MCU and move the spool proportionally according to the specific amount of electric current value.

2) SPOOL VALVE

Is the two way direction control valve for pilot pressure to reduce hydraulic pump flow.

When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump.

So, pump flow decreases to prevent engine stall.

3) PRESSURE AND ELECTRIC CURRENT VALUE FOR EACH MODE

Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm ²	psi		
Standard (Ver : 1.x)	M	12 ± 3	171 ± 43	-	2100 ± 100
	H	15 ± 3	213 ± 43	-	2000 ± 100
	S	15 ± 3	213 ± 43	-	1900 ± 100
Option (Ver : 2.x)	M	12 ± 3	171 ± 43	-	2200 ± 100
	H	13 ± 3	185 ± 43	-	2050 ± 100
	S	13 ± 3	185 ± 43	-	1950 ± 100

★ Manually operated condition when the prolix resistor is connected with CN-47.


2. HOW TO SWITCH THE VERSION (1.x↔ 2.x) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version (1.x↔ 2.x).

Step 1. Turn the key switch **ON**.

Step 2. Press the **SELECT** switch 3 times.

Step 3. While 7 segment on the cluster shows the version of the MCU program, for example

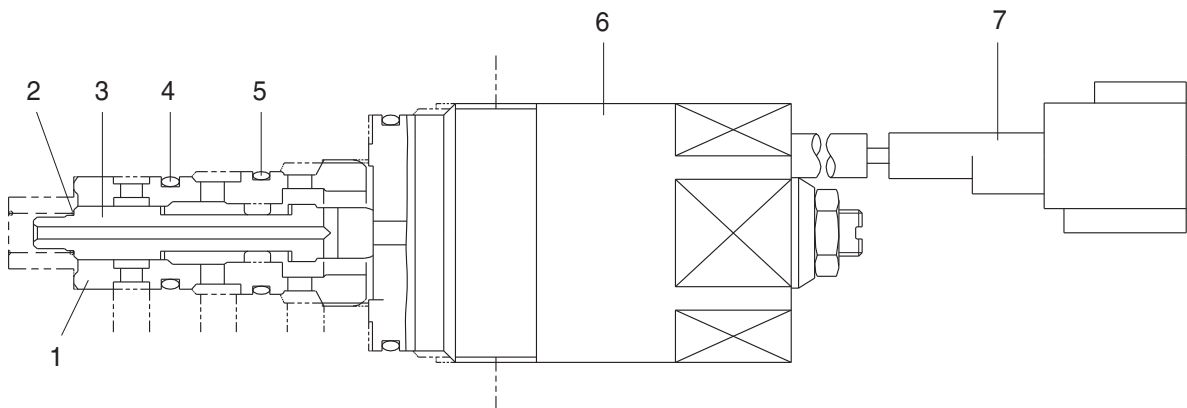
21SC1.0 press the buzzer stop switch () + travel speed control switch () at the same time for 2 seconds.

The display changes to **21SC1.0**, and it indicates that version 2.0 (Option) is selected.

※ If you want to get back to ver: 1.x, go to step 1~3.

2. OPERATING PRINCIPLE

1) STRUCTURE

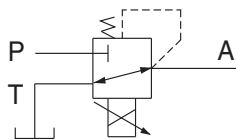


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- 1 Sleeve
- 2 Spring
- 3 Spool

- 4 O-ring
- 5 O-ring

- 6 Solenoid valve
- 7 Connector



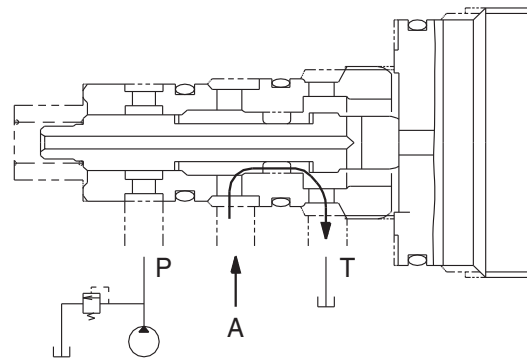
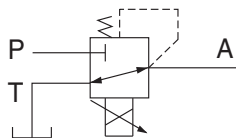
P Pilot oil supply line(Pilot pressure)

T Return to tank

A Secondary pressure to flow regulator at hydraulic pump

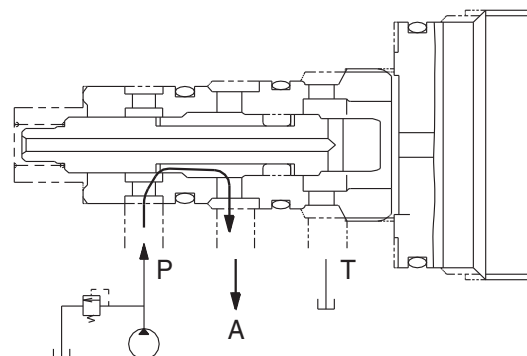
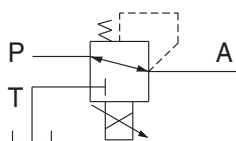
2) AT H MODE

Pressure line is blocked and A oil returns to tank.



3) AT S MODE

Secondary pressure enters into A.

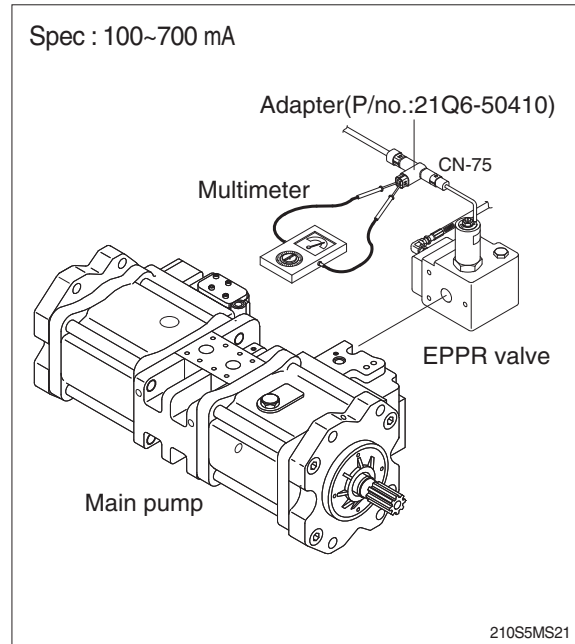


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3. EPPR VALVE CHECK PROCEDURE

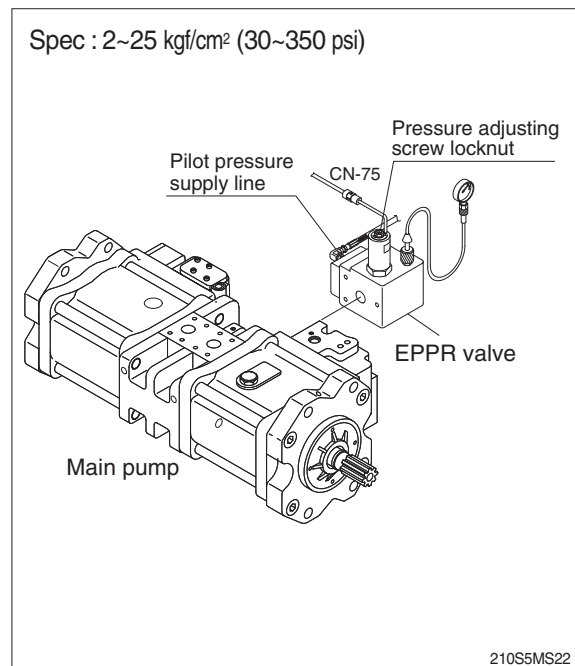
1) CHECK ELECTRIC CURRENT VALUE AT EPPR VALVE

- ① Disconnect connector CN-75 from EPPR valve.
- ② Insert the adapter to CN-75 and install multimeter as figure.
- ③ Start engine.
- ④ Set S-mode and cancel auto decel mode.
- ⑤ Position the multimodal dial at 10.
- ⑥ If engine rpm display show approx 1900 ± 100 rpm check electric current at bucket circuit relief position.
- ⑦ Check electric current at bucket circuit relief position.



2) CHECK PRESSURE AT EPPR VALVE

- ① Remove plug and connect pressure gauge as figure.
 - Gauge capacity : 0 to 50 kgf/cm²
(0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- ④ Position the multimodal dial at 10.
- ⑤ If engine rpm display show approx 1900 ± 100 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- ⑥ If pressure is not correct, adjust it.
- ⑦ After adjust, test the machine.



GROUP 11 MONITORING SYSTEM

1. OUTLINE

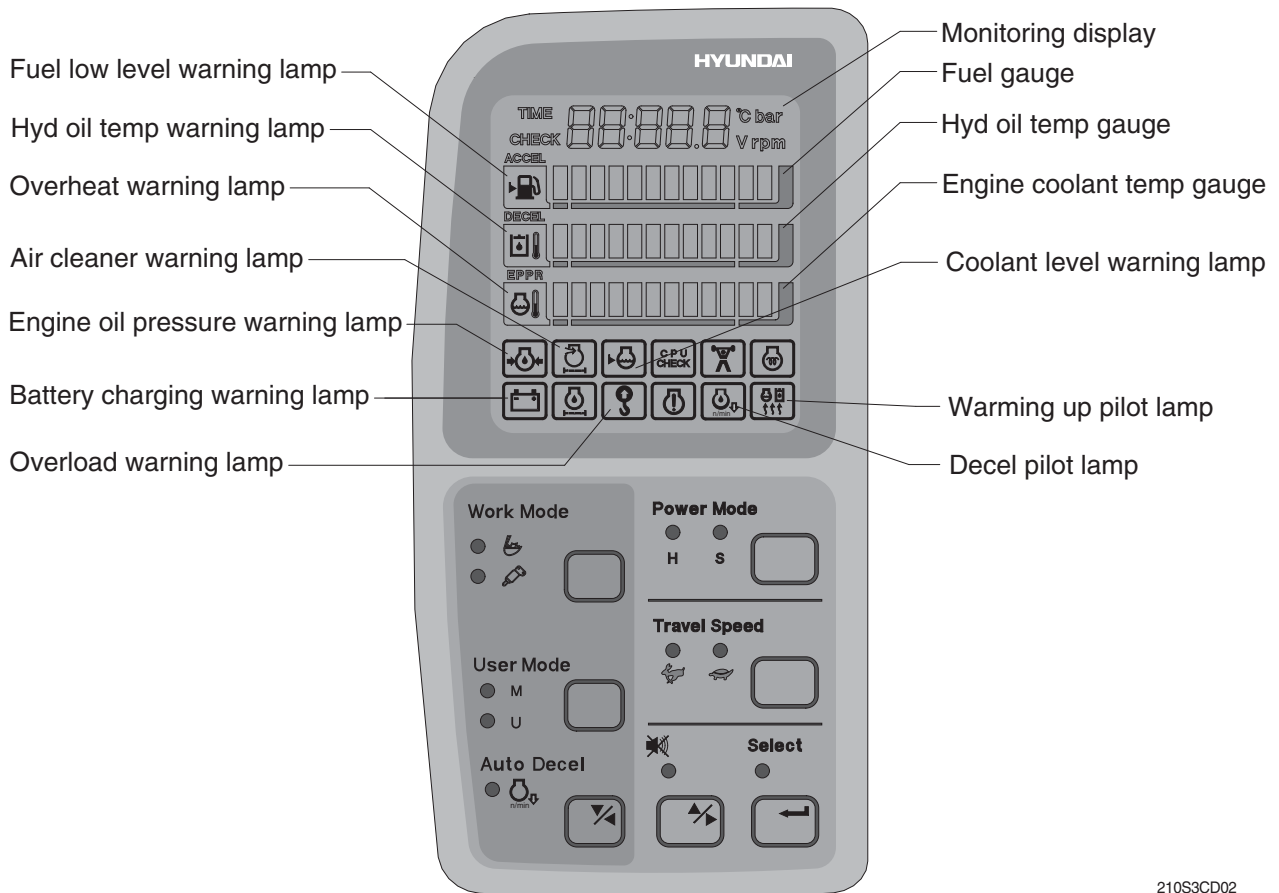
Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

1) MONITOR PANEL



210S3CD02

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

- a. Buzzer sounding for 4 seconds with HYUNDAI logo on cluster.

② Check monitor after 4 seconds : Indicate cluster version and machine condition

- a. Cluster program version : CL : 「1.0」 ← Indicates program version 「1.0」 for 2 seconds.
- b. Engine rpm display : 0 rpm
- c. Fuel gauge : All light up below appropriate level
- d. Hydraulic temperature : All light up below appropriate level
- e. Engine coolant temperature gauge : All light up below appropriate level
- f. Warning lamp
 - ※ During start switch ON the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.
 - ※ When engine coolant temperature below 30°C , the warming up lamp lights up.

③ Indicating lamp state

- a. Work mode selection : Heavy duty work mode
- b. Power mode selection : S mode
- c. User mode selection : No LED ON
- d. Auto decel LED : ON
- e. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

- a. Engine rpm display indicates at present rpm
- b. Gauge and warning lamp : indicate at present condition.
 - ※ When normal condition : All warning lamp OFF
- c. Work mode selection : Heavy duty work mode
- d. Power mode selection : S mode
- e. User mode selection : No LED ON, M mode or U mode
- f. Auto decel LED : ON
- g. Travel speed pilot lamp : Low (turtle)

② When warming up operation

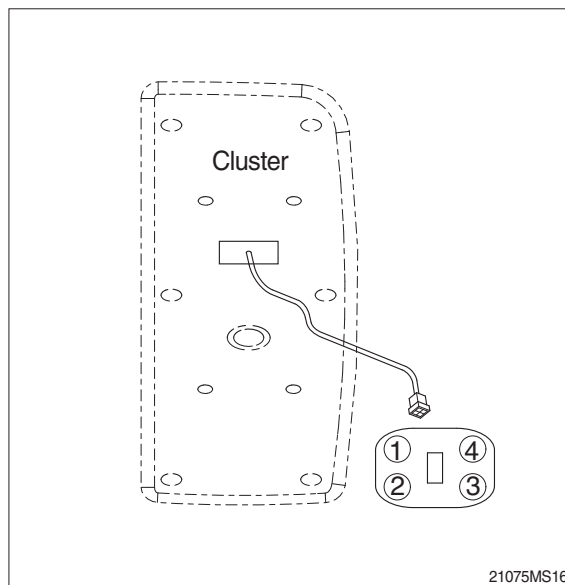
- a. Warming up lamp : ON
- b. 10 seconds after engine started, engine speed increases to 1250 rpm
 - ※ Others same as above ①.

③ When abnormal condition

- a. The warning lamp lights up and the buzzer sounds.
- b. If **BUZZER STOP** switch is pressed, buzzer sound is canceled but the warning lamp light up until normal condition.

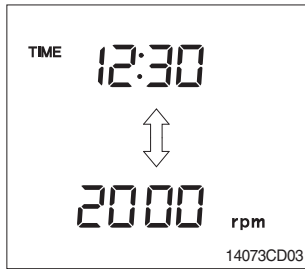
3) CLUSTER CONNECTOR

No.	Signal	Input / Output
1	Power IG (P)	Input (10~16V)
2	GND	Input (0V)
3	Serial- (RX)	Input (Vpp=12V)
4	Serial+ (TX)	Output (Vpp=12V)



4) CLUSTER FUNCTION

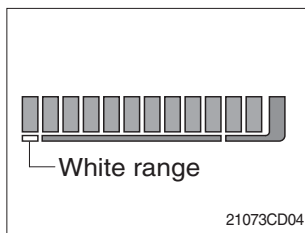
(1) Monitoring display



- ① This displays the current time and machine information such as engine rpm, coolant/hydraulic oil temperature, hydraulic oil pressure and also error codes.


※ Refer to the operator's manual page 4-12 for details.

(2) Fuel gauge

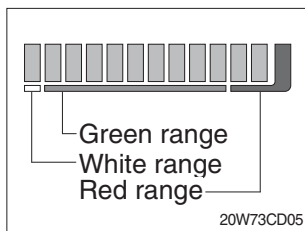


- ① This gauge indicates the amount of fuel in the fuel tank.

- ② Fill the fuel when the white range or warning lamp  blinks.

※ If the gauge illuminates the white range or warning lamp  blinks even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor. nection of electricity or sensor.

(3) Hydraulic oil temperature gauge



- ① This indicates the temperature of coolant.

- White range : Bolow 30 °C (86 °F) below
- Green range : 30-105 °C (86-221 °F)
- Red range : 105°C (221 °F) above

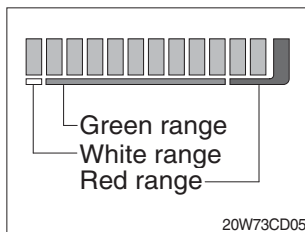
- ② The green range illuminates when operating.

- ③ Keep idling engine at low speed until the green range illuminates, before operation of machine.

- ④ When the red range illuminates, reduce the load on the system.

If the gauge stays in the red range, stop the machine and check the cause of the problem.

(4) Engine coolant temperature gauge



- ① This indicates the temperature of coolant.

- White range : Bolow 30 °C (86 °F) below
- Green range : 30-105 °C (86-221 °F)
- Red range : 105°C (221 °F) above

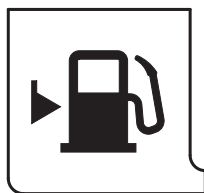
- ② The green range illuminates when operating.

- ③ Keep idling engine at low speed until the green range illuminates, before operation of machine.

- ④ When the red range illuminates, reduce the load on the system.

If the gauge stays in the red range, stop the machine and check the cause of the problem.

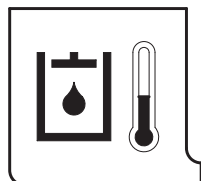
(5) Engine coolant temperature warning lamp



21073CD04A

- ① This lamp blinks and the buzzer sounds when the level of fuel is below 31 ℓ (8.2 U.S. gal).
- ② Fill the fuel immediately when the lamp blinks.

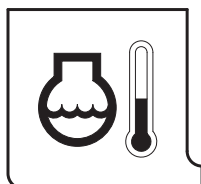
(6) Hydraulic oil temperature warning lamp



21073CD05A

- ① This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105 °C (221 °F).
- ② Check the hydraulic oil level when the lamp blinks.
- ③ Check for debris between oil cooler and radiator.

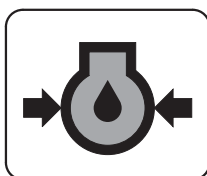
(7) Fuel level warning lamp



21073CD06A

- ① This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 110 °C (230 °F).
- ② Check the cooling system when the lamp blinks.

(8) Emergency warning lamp



210S3CD07

- ① This lamp blinks and the buzzer sounds after starting the engine because of the low oil pressure.
- ② If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

(9) Air cleaner warning lamp



210S3CD08

- ① This lamp blinks and the buzzer sounds when the filter of air cleaner is clogged.
- ② Check the filter and clean or replace it.

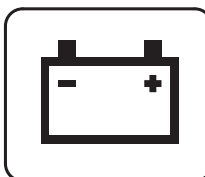
(10) COOLANT LEVEL WARNING LAMP



21073CD09

- ① This lamp blinks and the buzzer sounds when the coolant is below LOW in the reservoir tank of radiator.
- ② Check the reservoir tank when the lamp blinks.

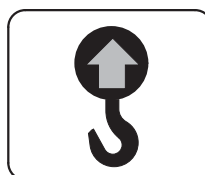
(11) BATTERY CHARGING WARNING LAMP



21073CD13

- ① This lamp blinks and the buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.
- ② Check the battery charging circuit when this lamp blinks, during engine operation.

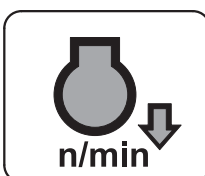
(12) OVERLOAD WARNING LAMP



210S3CD15

- ① When the machine is overload, the overload warning lamp blinks during the overload switch is ON.

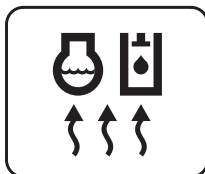
(13) DECEL PILOT LAMP



210S3CD17

- ① Operating auto decel or one touch decel makes the lamp ON.
- ② The lamp will be ON when pushing one touch decel switch on the LH RCV lever.

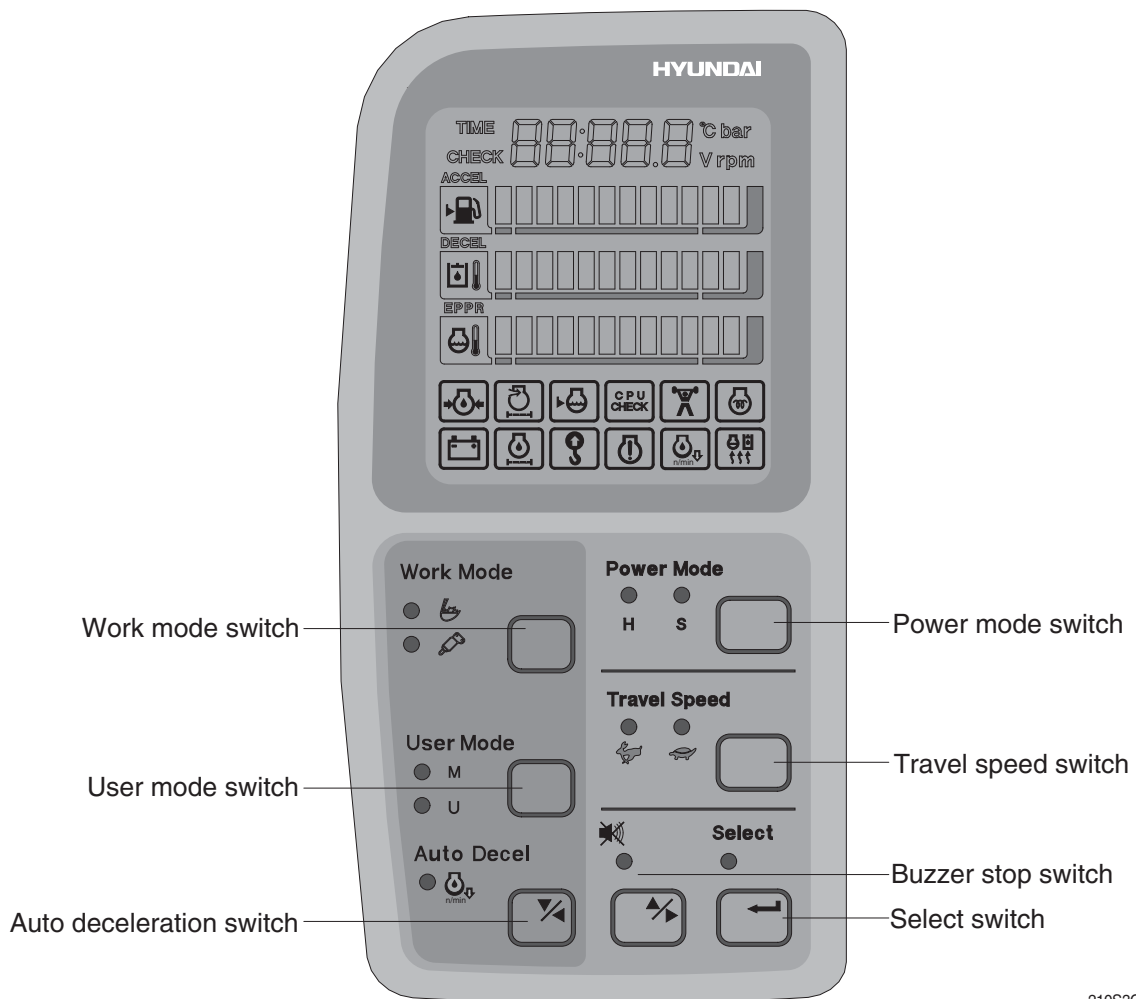
(14) WARMING UP PILOT LAMP



21073CD18

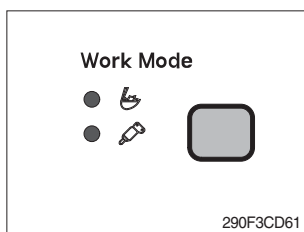
- ① This lamp is turned ON when the coolant temperature is below 30 °C (86 °F).
- ② The automatic warming up is cancelled when the engine coolant temperature is above 30 °C, or when 10 minutes have passed since starting.

5) SWITCH PANEL



210S3CD19

(1) Work mode switch

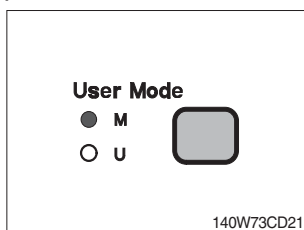


- ① This switch is to select the machine operation mode, which shifts from general operation mode to heavy operation mode and breaker mode in a row by pressing the switch.

- : Heavy duty work mode
- : Breaker operation mode

※ Refer to the operator's manual page 4-7 for details.

(2) User mode switch

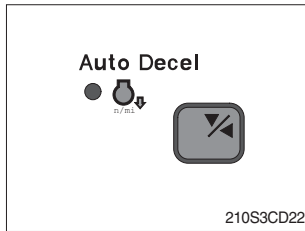


- ① This switch is to select the maximum power or user mode.

- M : Maximum power
- U : Memorizing operators preferable power setting

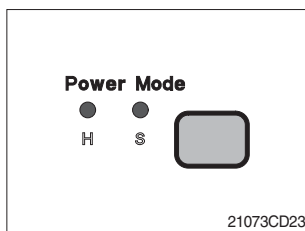
※ Refer to the operator's manual page 4-7 for details.

(3) Auto deceleration switch



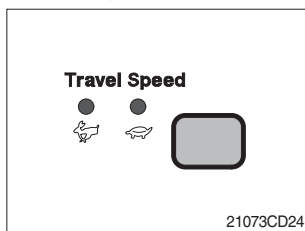
- ① This switch is used to actuate or cancel the auto deceleration function.
- ② When the switch actuated and all control levers and pedals are at neutral position, engine speed will be lowered automatically to save fuel consumption.
 - Light ON : Auto deceleration function is selected.
 - Light OFF : Auto deceleration function is cancelled so that the engine speed increased to previous setting value.
- ③ Operating the auto deceleration function makes the decel indicate lamp on the LCD panel ON.

(4) Power mode switch



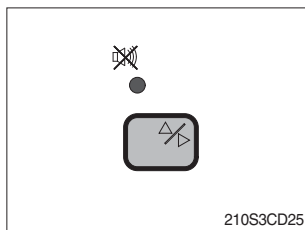
- ① The lamp of selected mode is turned ON by pressing the switch (), when selecting the power mode to use.
 - H : This is used for high power work.
 - S : This is used for standard power work.

(5) Travel speed switch



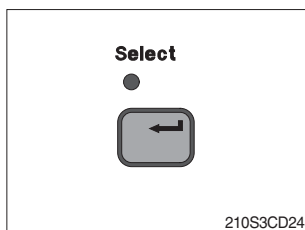
- ① This switch is to control the travel speed which is changed to high speed (Rabbit mark) by pressing the switch and low speed (Turtle mark) by pressing again.

(6) Buzzer stop switch



- ① When the starting switch is turned ON first, normally the alarm buzzer sounds for 2 seconds during lamp check operation.
- ② The red lamp lights ON and the buzzer sounds when the machine has a problem.
In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

(7) Select switch



- ① This switch is used to select the monitor display function.
※ **Refer to the operator's manual page 4-12 for details.**
- ② If the switch is pressed for 3 seconds in time display mode, it moves to time adjusting function, and you can adjust the time as below.
 - Hour by auto decel () switch
 - Minute by buzzer stop () switch.
- ③ After time set, the switch is pressed, it returns to clock display.

3. MONITORING DISPLAY

1) OUTLINE

Information of machine performance as monitored by the MCU can be displayed on the cluster when the operator selects a display mode by touching **SELECT** switch alone or with **BUZZER STOP** switch on the cluster as below.

Display group	How to select display mode		Name	Display on the cluster
	Group selection	Display mode selection		
Group 0 (Default)	Way 1 Key switch ON or START Way 2 Touch AUTO DECEL switch while pressing BUZZER STOP at group 1~4.	Initial	Engine rpm	950 rpm
		Touch SELECT 1 time	Time	TIME 12:30
		Touch SECTET 2 times	Power shift pressure (EPPR valve)	EP: 10 bar
		Touch SELECT 3 times	MCU model & version	2 1C 12
		Touch SELECT 4 times	Option (Only when a pressure sensor is installed)	P1: 100 bar
		Touch SELECT 5 times		P2: 200 bar
		Touch SELECT 6 times		P3: 30 bar
Group 1 (Volt, temp, EPPR press, version)	Touch SELECT switch once while pressing BUZZER STOP . In this group SELECT LED ON	Default	Battery voltage(V)	b: 24.8 v
		Touch SELECT 1 time	Potentiometer voltage(V)	Pa: 2.5 v
		Touch SELECT 2 times	Accel dial voltage(V)	dL: 3.8 v
		Touch SELECT 3 times	Hydraulic oil temperature(°C)	Hd: 50 °C
		Touch SELECT 4 times	Coolant temperature(°C)	Ct: 85 °C
Group 2 (Error code)	Touch SELECT switch twice while pressing BUZZER STOP . In this group BUZZER STOP LED blinks	Default	Current error	CHECK Er: 03
		Touch SELECT 1 time	Recorded error	TIME Er: 03
		Press down(▼) & SELECT at the same time	(Only key switch ON) Recorded error deletion	TIME Er: 00
Group 3 (Switch input)	Touch SELECT switch 3 times while pressing BUZZER STOP . In this group SELECT LED blinks at 0.5sec interval	Default	(Only key switch ON) Pump prolix switch	PP: on or off
		Touch SELECT 1 time	Auto decel pressure switch	dP: on or off
		Touch SELECT 2 times	Power boost switch	Pb: on or off
		Touch SELECT 3 times	Travel oil pressure switch	aP: on or off
		Touch SELECT 4 times	One touch decel switch	od: on or off
		Touch SELECT 5 times	Travel alarm switch	br: on or off

Display group	How to select display mode		Name	Display on the cluster
	Group selection	Display mode selection		
Group 4 (Output)	Touch SELECT switch 4 times while pressing BUZZER STOP . In this group SELECT LED blinks at 1sec interval	Default	Hourmeter	H o :on or oFF
		Touch SELECT 1 time	Neutral relay	n r :on or oFF
		Touch SELECT 2 times	(Anti-restart relay) Travel speed solenoid	tS:on or oFF
		Touch SELECT 3 times	Power boost solenoid	PS:on or oFF
		Touch SELECT 4 times	(2-stage relief solenoid) Boom priority solenoid	bS:on or oFF
		Touch SELECT 5 times	Travel alarm	AL:on or oFF
		Touch SELECT 6 times	Max flow cut off solenoid	FS:on or oFF

※ By touching **SELECT** switch once while pressing **BUZZER STOP**, display group shifts.

Example : Group 0 → 1 → 2 → 3 → 4 → 0

2) DESCRIPTION OF MONITORING DISPLAY

Group	Display	Name	Description
Group 0	2250 rpm	Engine speed	It displays current engine speed detected by engine speed sensor from 500 to 3000 rpm. Range : 500~3000 rpm by 10 rpm
	TIME 12 : 30	Time	It displays current time (12 is hour and 30 is minute) Range : Hour (1~12), minute (00~59)
	EP : 10bar	Power shift pressure of EPPR valve	It shows that pump power shift pressure of EPPR valve being controlled by the MCU is 10bar. Range : 00~50bar by 1bar
	21 : C1.4	Model and MCU program version	It shows that machine model(HX210S, HX220S) and the program version of the MCU is 1.4. Version display range : 0.0~9.9 by 0.1
	P1 : 100bar (Option)	Front pump pressure	It displays front pump pressure of 100bar which is detected by pressure sensor. Range : 000~500bar by 10bar
	P2 : 200bar (Option)	Rear pump pressure	It displays rear pump pressure of 200bar which is detected by pressure sensor. Range : 000~500bar by 10bar
	P3 : 30bar (Option)	Pilot pump pressure	It displays pilot pump pressure of 30bar which is detected by pressure sensor. Range : 00~50bar by 1bar
Group 1	b : 24.8V	Battery voltage	It shows that battery power of 24.8V is supplied into MCU. Range : 00.0~48.0V by 0.1V
	Po : 2.5V	Potentiometer voltage	It shows that potentiometer signal voltage is 2.5V. Range : 0.0~5.0V by 0.1V
	dL : 3.8V	Accel dial voltage	It shows that accel dial signal voltage is 3.8V. Range : 0.0~5.0V by 0.1V
	Hd : 50 °C	Hydraulic oil temperature	It shows that hydraulic oil temperature detected by temperature sensor is 50 °C. Range : 0~150 °C by 1 °C
	Ct : 85 °C	Coolant temperature	It shows that coolant oil temperature detected by temperature sensor is 50 °C. Range : 0~150 °C by 1 °C

Group	Display	Name	Description
Group 2	CHECK Er : 03	Current error	It shows that current error of 03(Short circuit in pump EPPR valve system) is diagnosed by self diagnosis system in the MCU. If more than 2 errors, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 03	Recorded error	It shows recorded error code of 03 which is diagnosed before. If more than 2 error codes, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 00	Recorded error deletion	It shows all recorded error codes are removed in the MCU memory.
Group 3	PP : on or oFF	Pump prolix switch	PP : on Shows that pump prolix switch is turned on (At emergency position). PP : oFF Shows that pump prolix switch is turned off(At normal position).
	dP : on or oFF	Auto decel pressure switch	dP : on Shows that auto decel pressure switch is pressed on (No operation of control lever). dP : oFF Shows that auto decel pressure switch is released off (Operation of control lever).
	Pb : on or oFF	Power boost switch	Pb : on Shows that power boost switch is pressed on (Activated). Pb : oFF Shows that power boost switch is released off (Canceled).
	oP : on or oFF	Travel oil pressure switch	oP : on Shows that travel oil pressure switch is pressed on (No operation of travel control lever). oP : oFF Shows that travel oil pressure switch is released off (Operation of travel control lever).
	od : on or oFF	One touch decel switch	od : on Shows that one touch decel switch is pressed. od : oFF Shows that one touch decel switch is released.
	br : on or oFF	Travel alarm switch	br : on Shows that travel alarm function is selected. br : oFF Shows that travel alarm function is canceled.

Group	Display	Name	Description
Group 4	Ho : on or oFF	Hourmeter	Ho : on Shows that hourmeter is activated by MCU. Ho : oFF Shows that hourmeter is turned off.
	nr : on or oFF	Neutral relay (Anti-restart relay)	nr : on Shows that neutral relay for anti-restarting function is activated(Engine start is possible). nr : oFF Shows that neutral relay is turned off to disable the engine restart.
	ts : on or oFF	Travel speed solenoid	ts : on Shows that travel speed solenoid is activated (High speed). ts : oFF Shows that travel speed solenoid is released (Low speed).
	PS : on or oFF	Power boost solenoid	PS : on Shows that power boost solenoid is activated to maximize the power(Power up). PS : oFF Shows that power boost solenoid is turned off(Cancel the power boost function).
	bs : on or oFF	Boom priority solenoid	bs : on Shows that boom priority solenoid is activated. bs : oFF Shows that boom priority solenoid is released.
	Ru : on or oFF	Travel alarm	Ru : on Shows that travel buzzer is activated. Ru : oFF Shows that travel buzzer is canceled.
	FS : on or oFF	Max flow cut off solenoid	FS : on Shows that max flow cut off solenoid is activated. FS : oFF Shows that max flow cut off solenoid is released.