SECTION 5 MECHATRONICS SYSTEM

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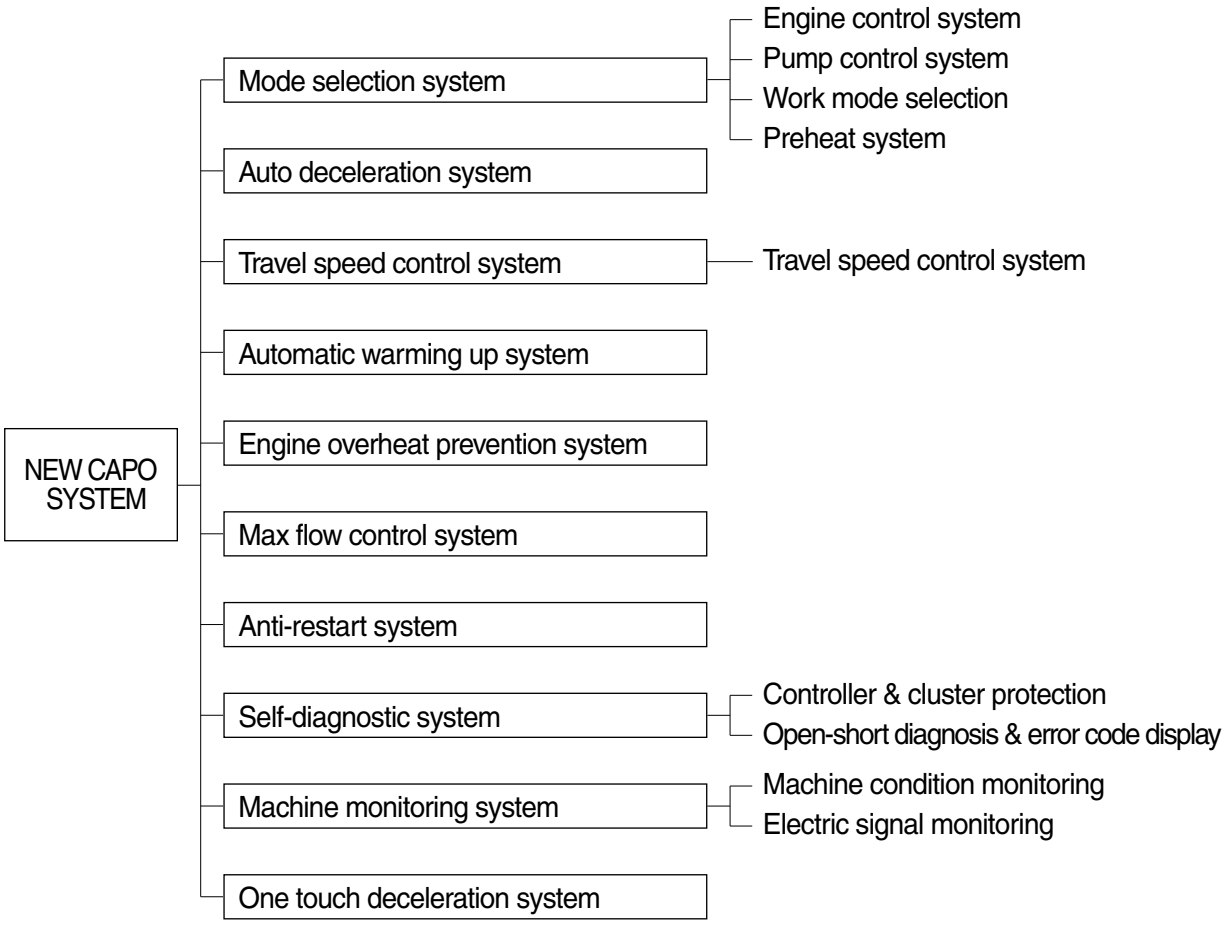
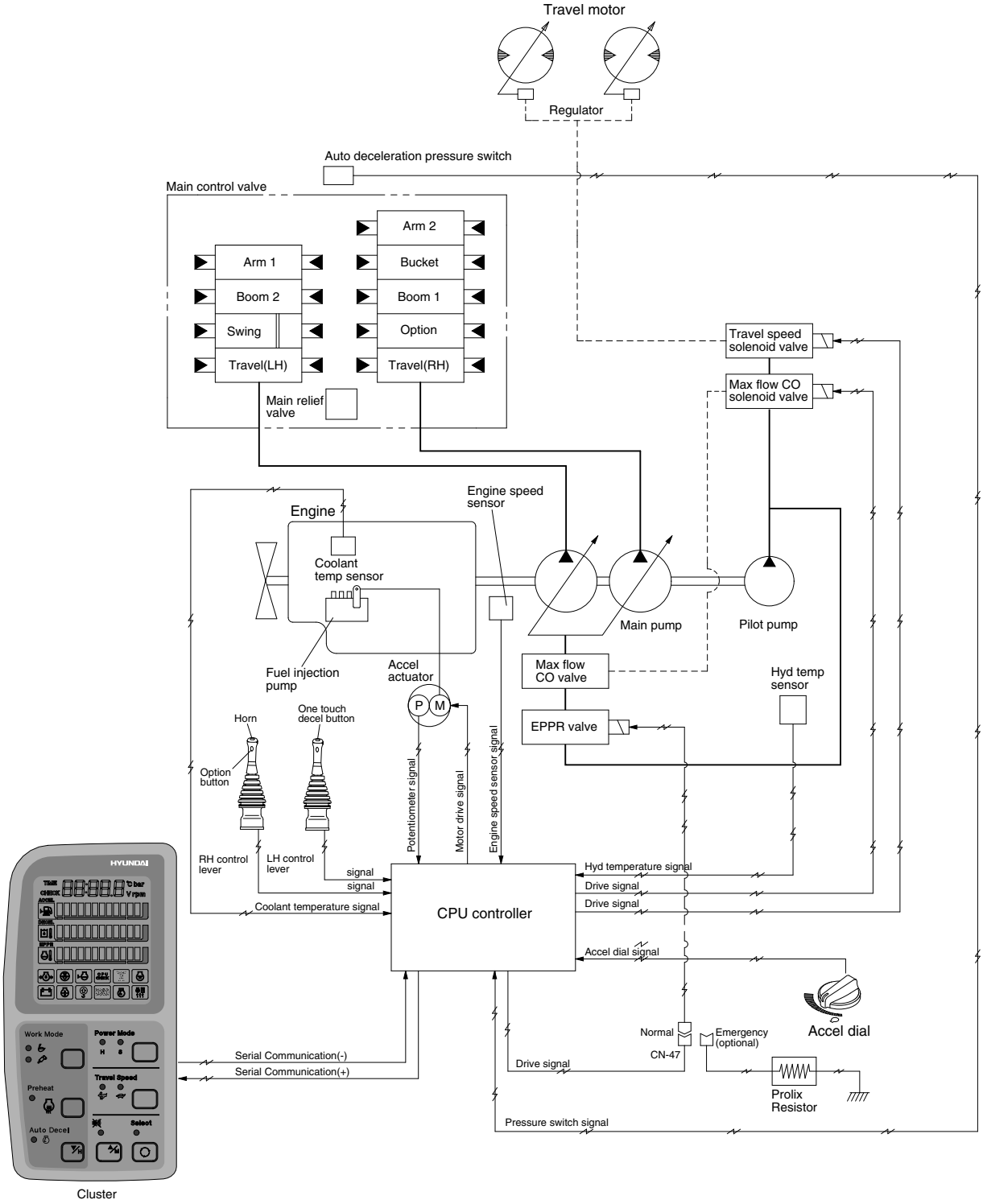
GROUP 1 OUTLINE

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 CPU controller, a cluster, an accel actuator, an EPPR valve, and other components. The CPU controller 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.



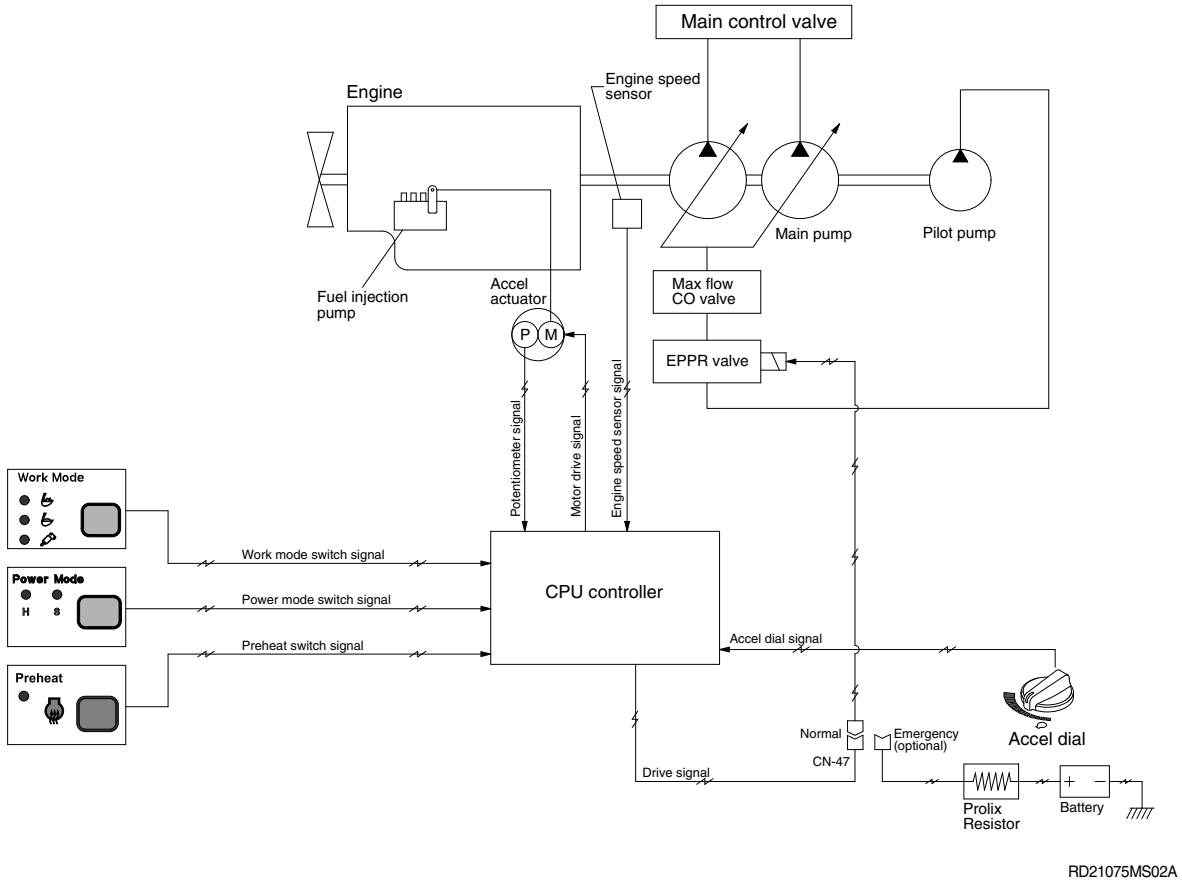
SYSTEM DIAGRAM



RD21075MS01A

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



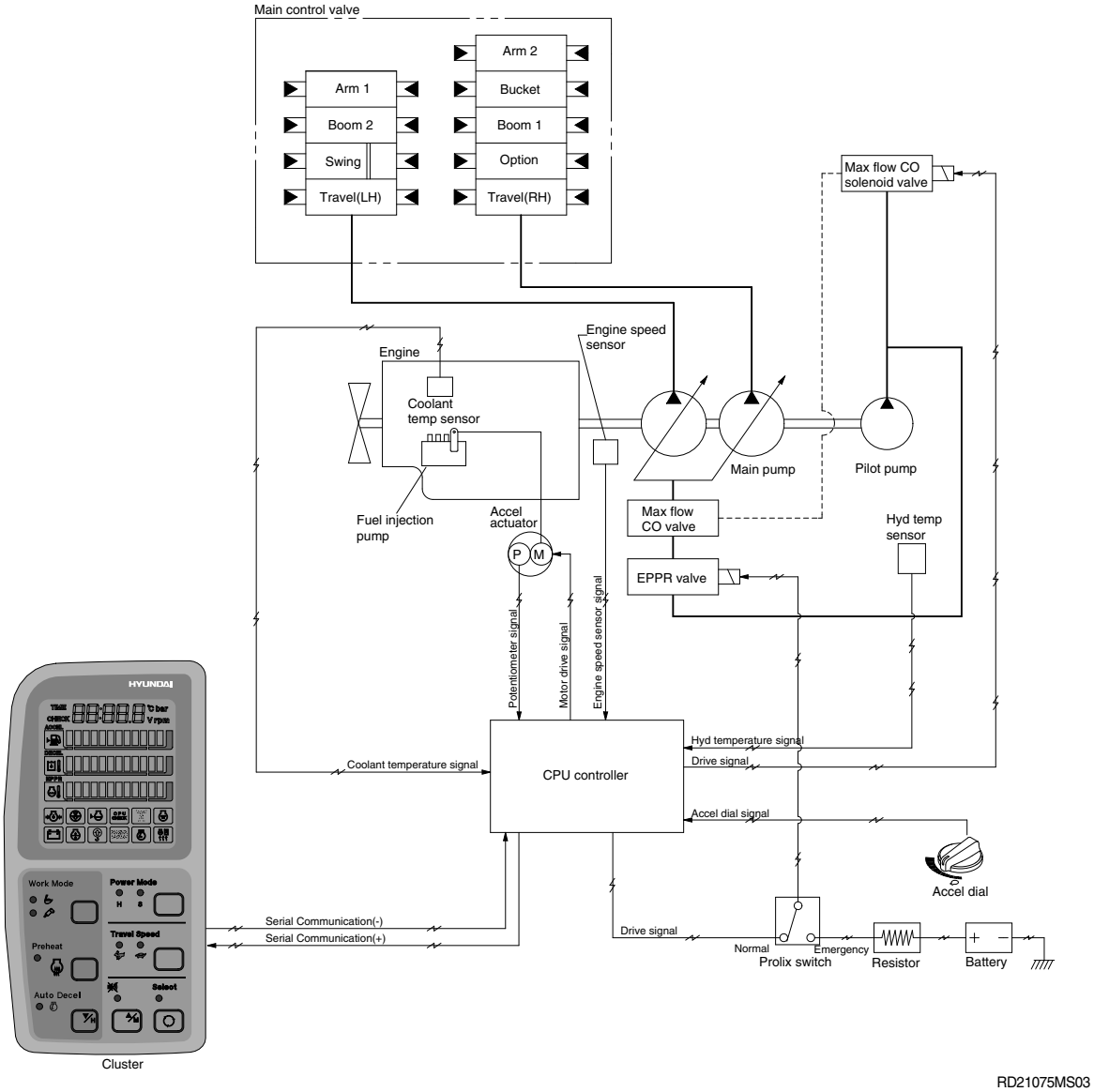
Mode selection system(Micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 2 power modes(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	Power set (%)	Engine rpm		Power shift by EPPR valve			
					Default		Other case	
			Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
H	High power	100	2050±50	-	250±30	5	190	2.5
S	Standard power	85	1750±50	-	330±30	10	300	8
AUTO DECEL	Engine deceleration	-	1200±100	-	670±30	31	670±30	31
One touch decel	Engine quick deceleration	-	1000±100	-	700±30	35	700±30	35
KEY START	Key switch start position	-	1000±100	-	700±30	35	700±30	35

2. WORK MODE SELECTION SYSTEM

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



RD21075MS03

1) GENERAL WORK MODE

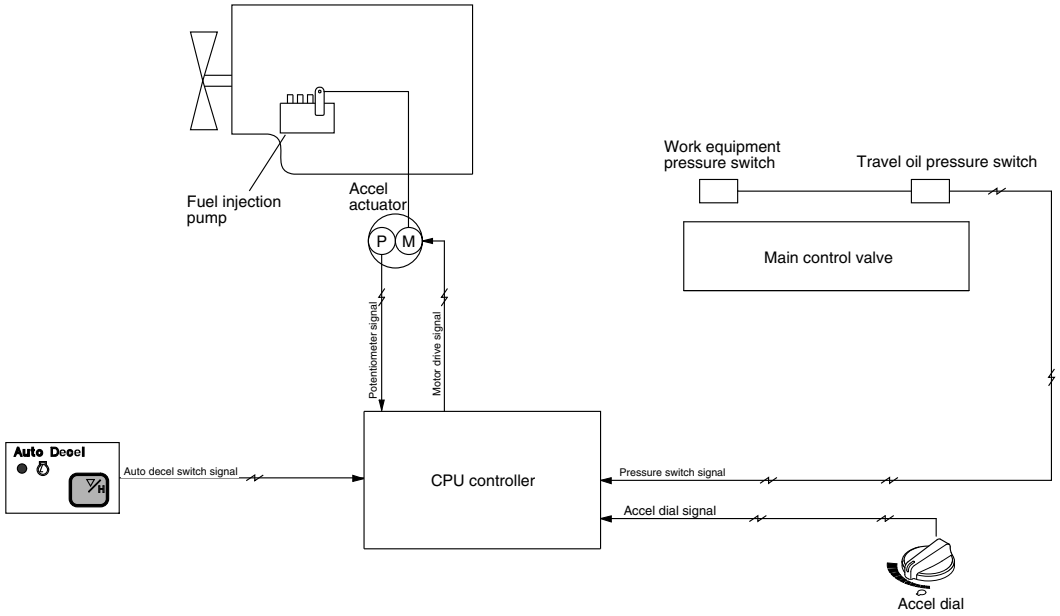
When key switch is turned ON, this mode is selected and swing operation speed is faster than heavy duty work mode.

2) BREAKER OPERATION MODE

It sets the pump flow to the optimal operation of breaker by activating the max flow cut-off solenoid.

Work mode	Max flow cut-off solenoid
General	OFF
Breaker	ON

GROUP 3 AUTOMATIC DECELERATION SYSTEM

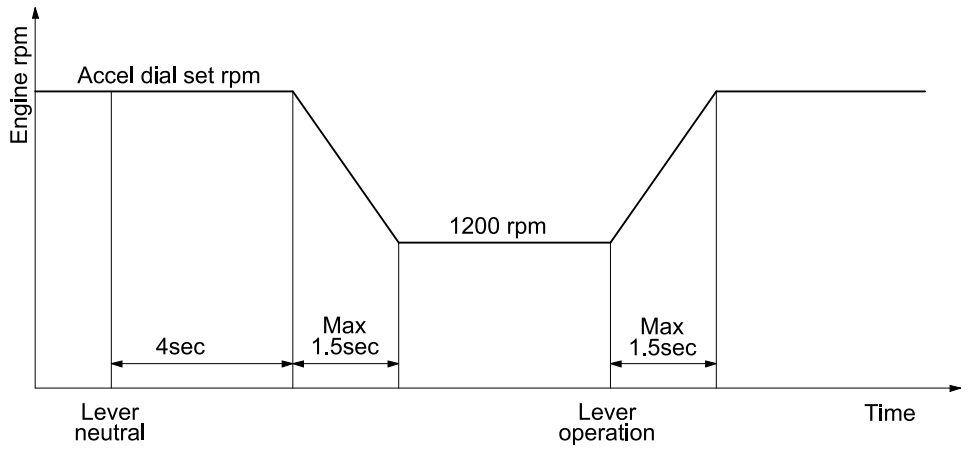


21075MS04

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, CPU controller drives the governor motor to reduce the engine speed to 1200rpm. 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.



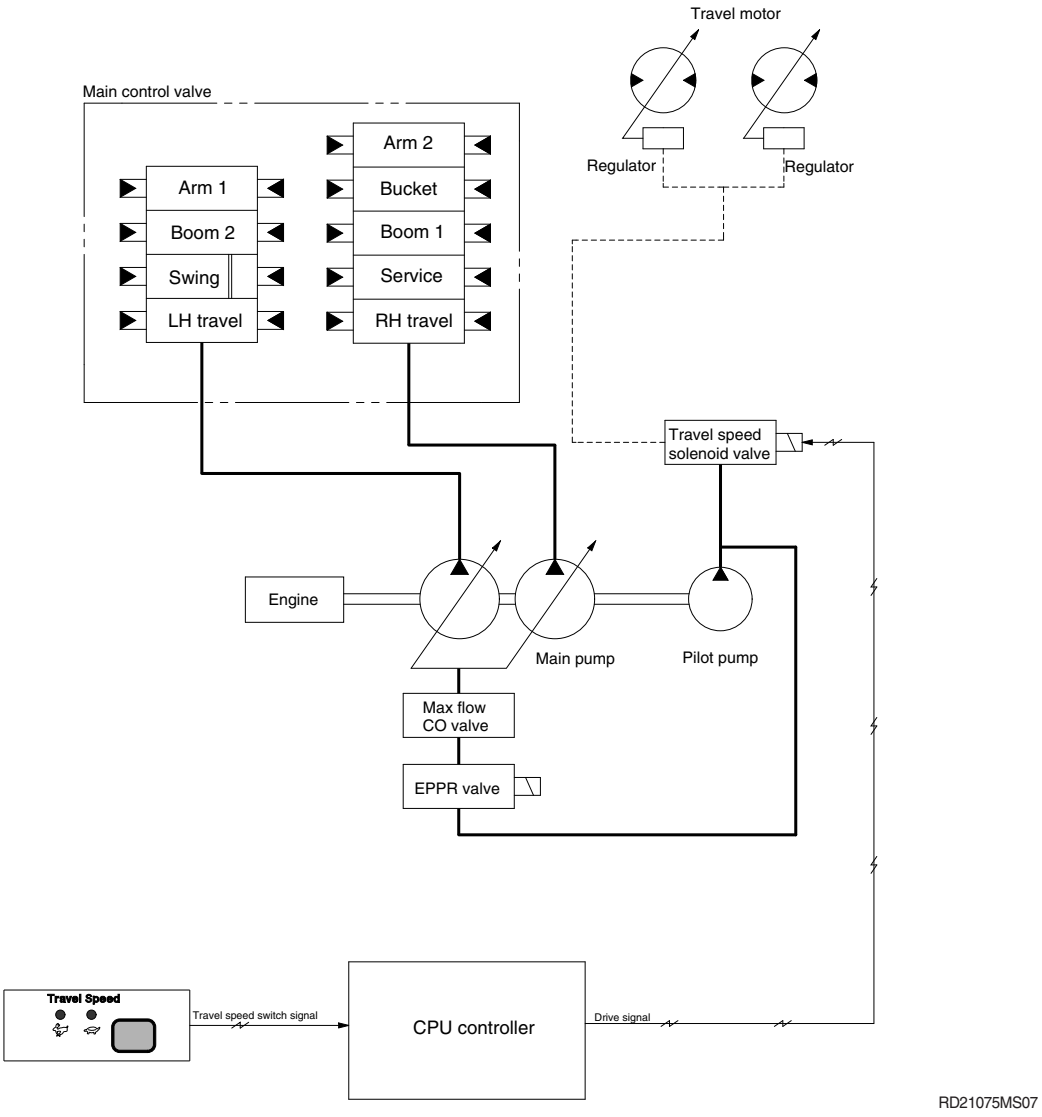
21075MS05

2. WHEN AUTO DECEL LAMP OFF

The engine speed can be set as desired using the engine speed 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

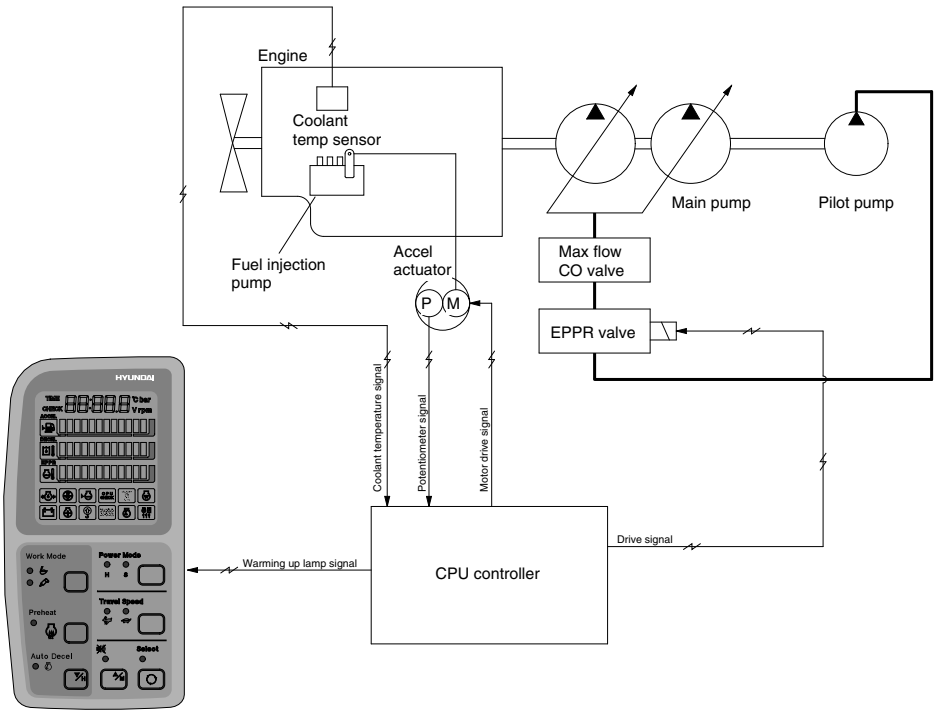


Travel speed can be switched manually by pressing the travel speed switch on the cluster.

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



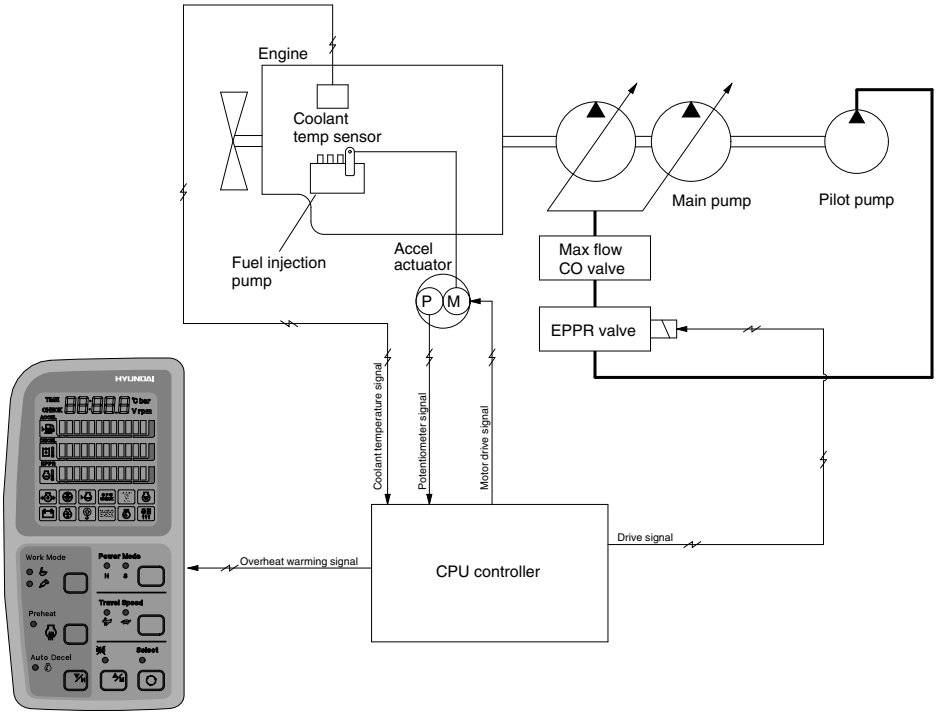
RD21075MS08

1. CPU controller reads engine coolant temperature through the temperature sensor, and if the coolant temperature is less than 30℃, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change.
2. In case of the coolant temperature increases up to 30℃, the engine speed is decreased to key start speed. And if an operator changes mode set during the warming up function, the CPU controller cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Less than 30℃(After engine run) - Accel dial position is under **3**	- Mode : Default(**S** mode) - Warming up time : 10 minutes(Max) - Warming up lamp : ON
Canceled	- Coolant temperature : Above 30℃ - 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	- Default mode - Default mode - Changed mode
Warming up lamp	- Coolant temperature : Above 30℃	- Warming up lamp : OFF

GROUP 6 ENGINE OVERHEAT PREVENTION FUNCTION



RD21075MS09

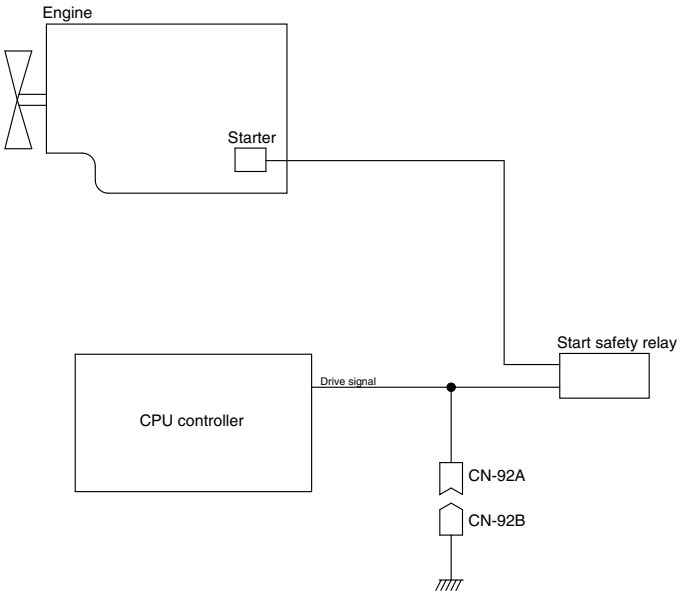
1. CPU controller reads engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110℃, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial **7** position.

2. If the coolant temperature drops less than 100℃, the CPU controller returns the mode to the mode set before. And if mode set is changed during the function, the CPU controller 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℃.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Above 110℃ - Accel dial set : Above **8**	- Engine rpm drop to accel dial 7 position - Overheat warning lamp & buzzer : ON
Canceled	- Coolant temperature : Less than 100℃ - 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℃	- Overheat warning lamp : OFF

GROUP 7 ANTI-RESTART SYSTEM



21075MS10

1. ANTI-RESTART FUNCTION

After 10 seconds from the engine starts to run, CPU controller turns off the start safety relay to protect the starter from inadvertent restarting.

2. When a replacement or taking-off of the CPU controller is needed, connect CN-92a and CN-92b to ensure the engine start without the CPU controller.

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 CPU controller 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 CPU controller occurs.

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

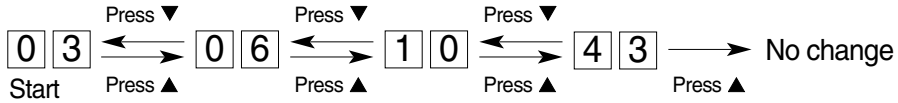
If there are more than 2 error codes, each one can be displayed by pressing ▲ and ▼ switch respectively.

Examples :

1) Communication Error
   Co : Er & Buzzer sound

2) No problem
   CHECK Er : 0 0

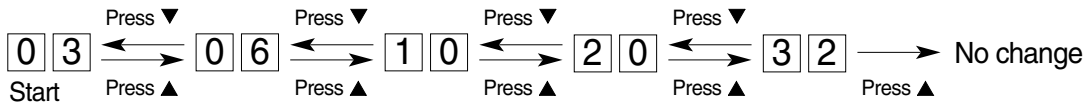
3) 4 Error codes(03, 06, 10, 43) display
   CHECK Er : 0 3



3. RECORDED ERROR DISPLAY

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

Examples : 5 Recorded error codes(03, 06, 10, 20, 32) display
TIME Er : 0 3



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 CPU controller deleted all the recorded error codes in the memory.

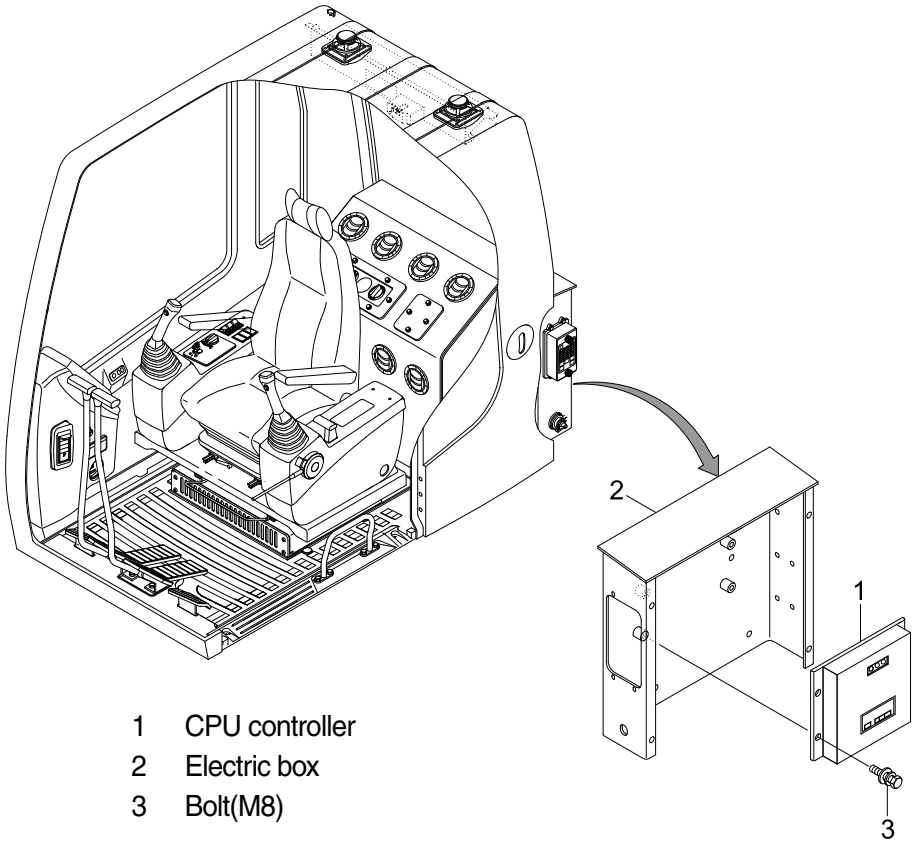
5. ERROR CODES TABLE

Fault code No.	Description
1	Short circuit in governor motor system
2	Potentiometer circuit is shorted to Vcc(5V) or battery +
3	Short circuit in pump EPPR valve system
4	Short circuit in boom down EPPR valve system
5	Short circuit in travel speed solenoid system
7	Short circuit in max flow solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
12	P1 pressure sensor circuit is shorted to power supply(24V) line
13	P2 pressure sensor circuit is shorted to power supply(24V) line
14	P3 pressure sensor circuit is shorted to power supply(24) line
15	Boom down pressure circuit is shorted to power supply(24V) line
16	Governor motor circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR valve circuit is open or shorted to ground
19	Boom down EPPR valve circuit is open or shorted to ground
20	Travel speed solenoid circuit is open or shorted to ground
22	Max flow solenoid circuit is open or shorted to ground
25	Hour-meter circuit is open or shorted to ground
26	Accel dial 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
29	P3 pressure sensor circuit is open or shorted to ground
30	Boom down pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Controller input voltage is below 18V
35	Controller input voltage is over 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
38	Anti-restart relay circuit is open or shorted to ground
39	Accel actuator does not stop at a target position
40	There is more than 500rpm difference between target speed and actual speed
41	Hydraulic oil temperature sensor circuit is shorted to ground
42	Fuel level sensor circuit is shorted to ground
43	Coolant temperature sensor circuit is shorted to ground

Fault code No.	Description
44	Boom up pressure sensor circuit is shorted to power supply(24V) line
45	Hydraulic oil temperature sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temperature 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 +

GROUP 9 ENGINE CONTROL SYSTEM

1. CPU CONTROLLER MOUNTING



1 CPU controller
2 Electric box
3 Bolt(M8)

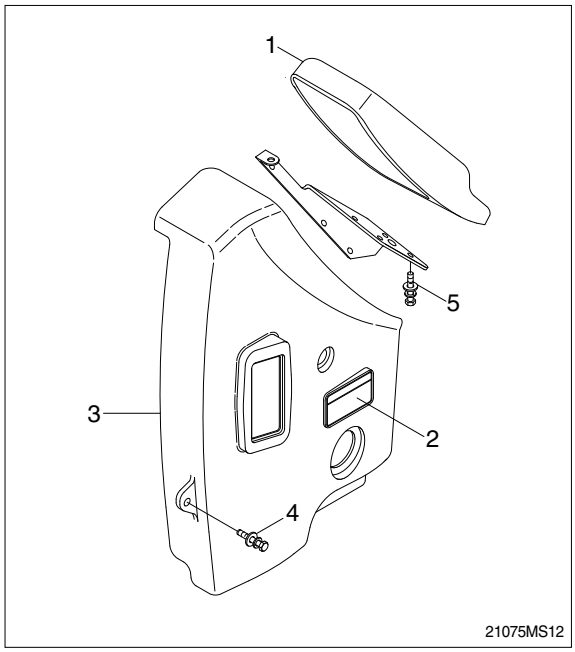
RD21075MS11A

2. CPU CONTROLLER ASSEMBLY

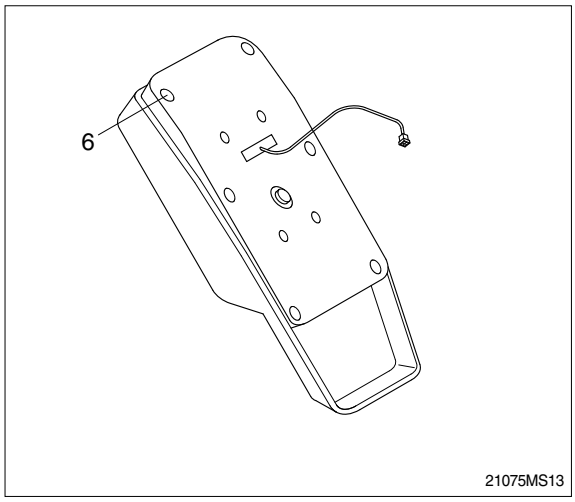
1) Remove four pieces of bolt(3) of electric box(2).
2) Disconnect 2 connectors from CPU controller.
3) Remove 6 pieces of screw and open the cover of CPU controller.
4) Inspection : Check PCB(Printed Circuit Board)
   (1) If any damage is found, replace CPU controller assembly.
   (2) If not, but CAPO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

3. EXCHANGE METHOD OF THE ROM

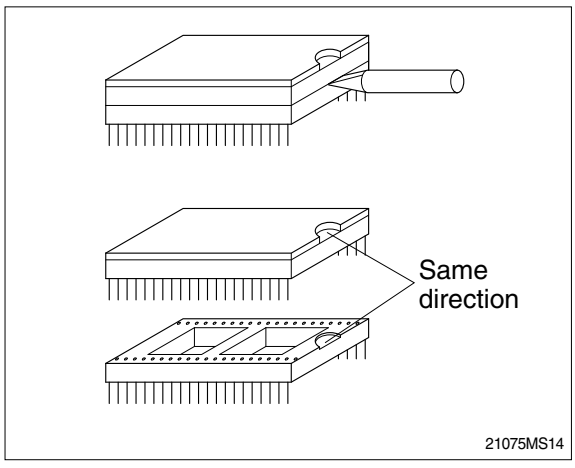
1) Disassemble the ash tray(2).
2) Disassemble the wiper motor cover(3).
3) Disassemble the cluster(1).



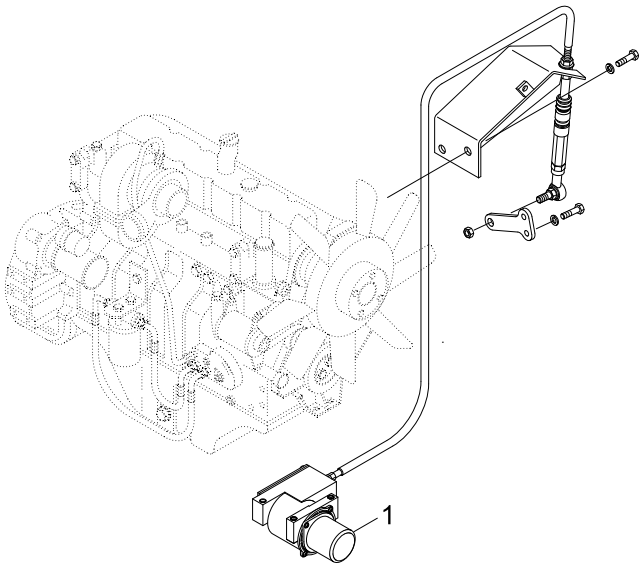
4) Loosen the screws(6EA) located back of the cluster.
5) Then you can open the upper case of the cluster easily.



6) Install the new ROM.(Be careful of direction and assemble the cluster in the reverse order to removal).



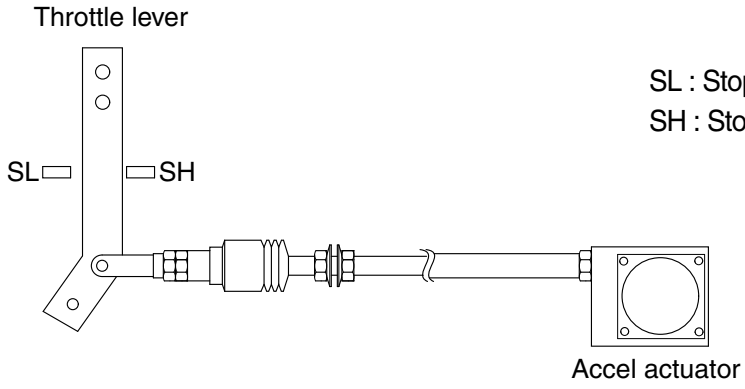
4. ENGINE ACCEL ACTUATOR



1 Accel actuator

RD21075MS60

1) ENGINE THROTTLE LEVER



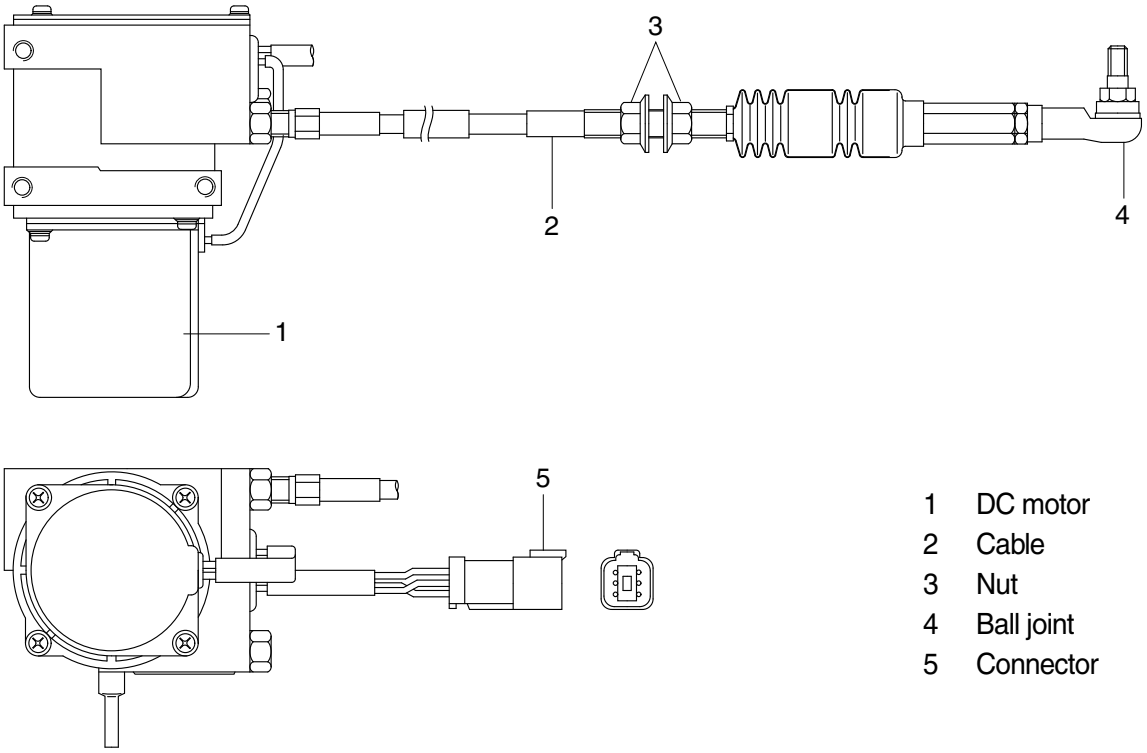
SL : Stopper, low idle
SH : Stopper, high idle

(210-7) 5-18(2)

2) EMERGENCY CABLE (Push-pull cable)

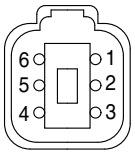
It controls engine speed by connecting onto the lever of the injection pump when the malfunction of the CPU controller or the accel actuator happen.

3) ACCEL ACTUATOR



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

(210-7) 5-19(1)

Connector		
Type		6P, female
Line color & description	1	White(Potentiometer 5V)
	2	Blue(Potentiometer SIG)
	3	Black(Potentiometer GND)
	4	-
	5	Green(Motor+)
	6	Yellow(Motor -)
Inspection		Check resistance Spec : 1~2 Ω (Between No.5-6) 0.8~1.2kΩ (Between No.1-3)

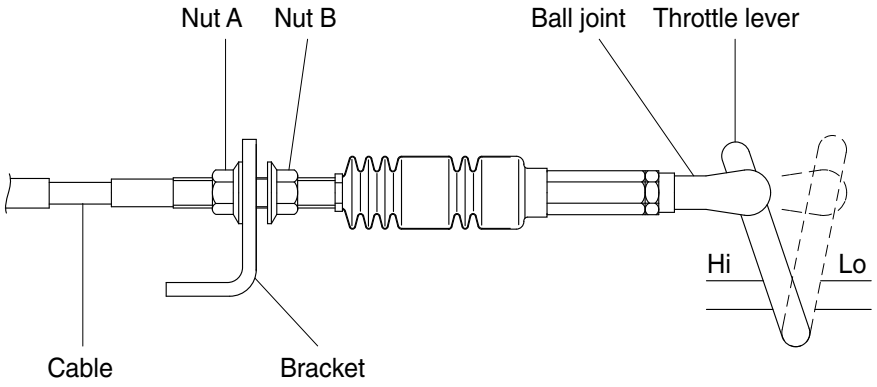
4) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(1) Key OFF

① Connect the ball joint of cable to engine throttle lever.
② Pull the cable to high stopper and put nut **A** edge to yoke of the bracket.
※ Make throttle 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.

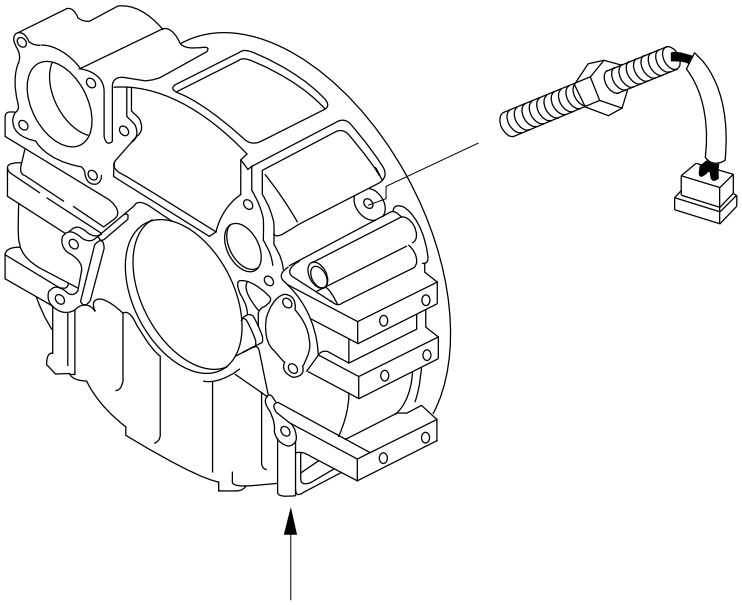


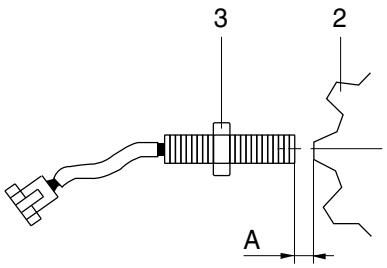
130W5MS05

Mode	RPM
H	2050±50
S	1750±50
Auto decel	1200±100
Key start	1000±100

5. ENGINE SPEED SENSOR

1) DETECT ACTUAL ENGINE RPM AND SEND SIGNAL TO TACHOMETER





2 Gear teeth, flywheel
3 Lock nut, speed sensor
A Clearance

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.

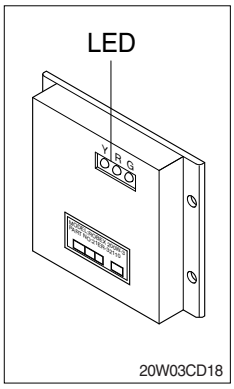
(5) Tight lock nut and connect wiring.

3) INSPECTION

(1) Check resistance
- SPEC : 300±30KΩ

(2) Check voltage while engine run.
- SPEC : 2~28Vac, dependent on the engine speed(rpm)

6. CPU CONTROLLER



(1) To match the engine torque with the pump absorption torque, CPU controller 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 CPU controller display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on CPU or ROM	· Change the controller
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on CPU controller power	· Check if the input power wire (24V, GND) of controller 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 CPU controller 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)	H	5 ± 3	71 ± 40	250 ± 30	2050 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1750 ± 50
Option (Ver : 2.x)	H	3 ± 3	40 ± 40	190 ± 30	2150 ± 50
	S	8 ± 3	114 ± 40	300 ± 30	1950 ± 50

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**.

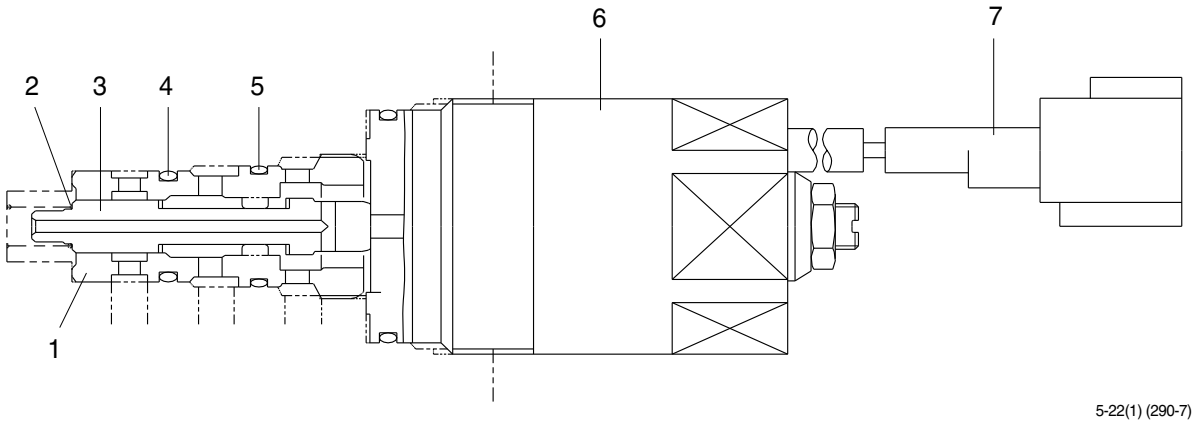
Step 2. Press the **SELECT** switch 3 times.

Step 3. While 7 segment on the cluster shows the version of the CPU controller program, for example **21C1.4** press the buzzer stop switch( ) + travel speed control switch( ) at the same time for 2 seconds.
The display changes to **21C2.4**, and it indicates that version 2.4(Option) is selected.

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

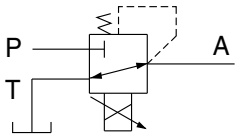
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1) (290-7)

1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

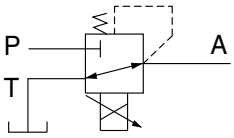


5-22A (290-7)

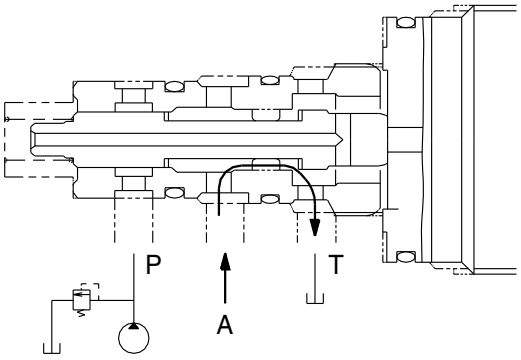
P	Pilot oil supply line(Pilot pressure)
T	Return to tank
A	Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

Pressure line is blocked and A oil returns to tank.

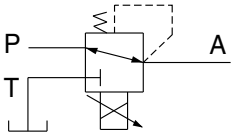


5-22B (290-7)

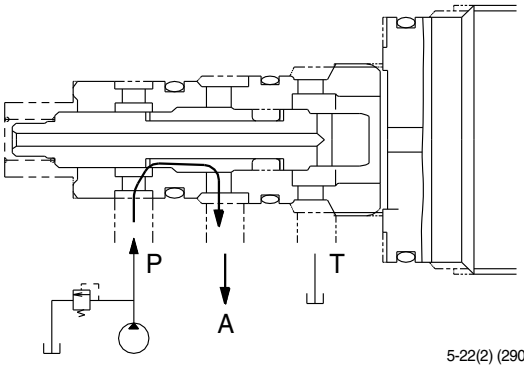


3) AT S MODE

Secondary pressure enters into A.



5-22C (290-7)



5-22(2) (290-7)

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

(2) Set S-mode and cancel auto decel mode.

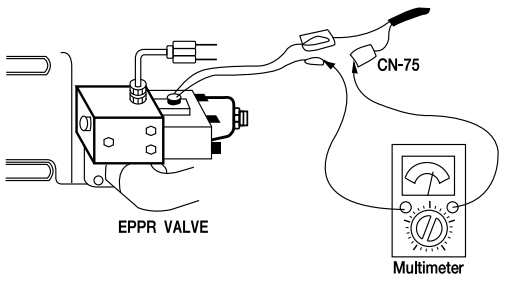
(3) Position the accel dial at 10.

(4) If tachometer show approx 1750±50rpm, disconnect one wire harness from EPPR valve.

(5) Install multimeter as figure.

(6) Check electric current at bucket circuit relief position.

Spec : 200~450mA



5-23(1) (290-7)

2) CHECK PRESSURE AT EPPR VALVE

(1) Remove plug and connect pressure gauge as figure.
- Gauge capacity : 0 to 40-50kgf/cm^2 (0 to 580-725psi)

(2) Start engine.

(3) Set S-mode and cancel auto decel mode.

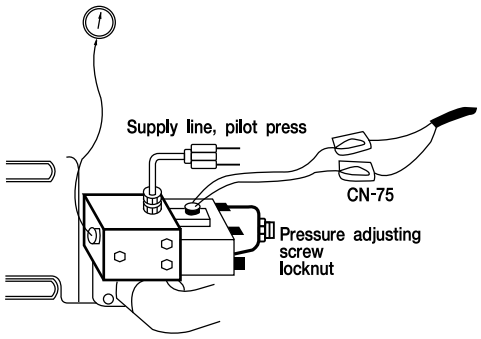
(4) Position the accel dial at 10.

(5) If tachometer show approx 1750±50rpm, 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.

Spec : 2~25kgf/cm^2(30~350psi)



5-23(2) (290-7)

GROUP 11 MONITORING SYSTEM

1. OUTLINE

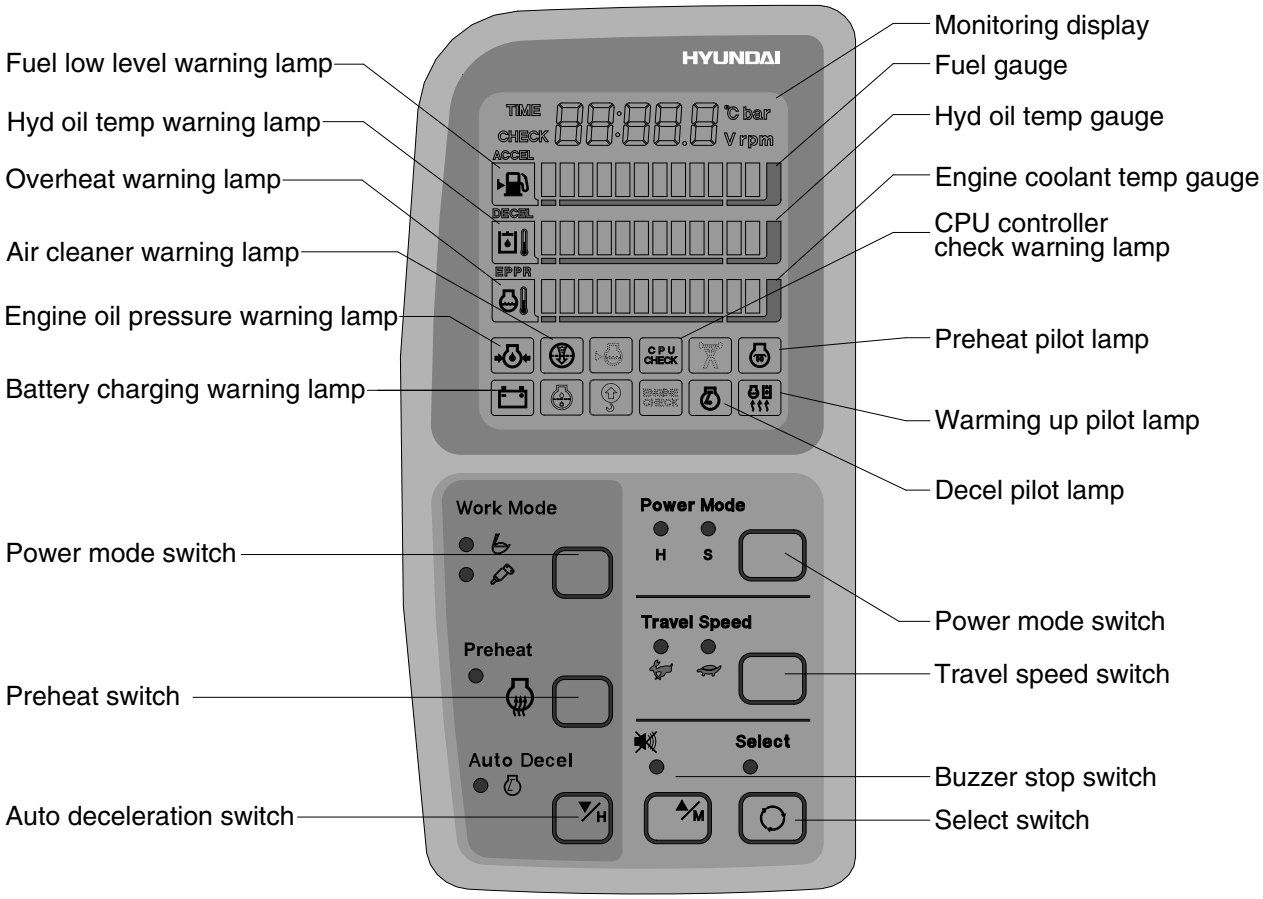
Monitoring system consists of the monitor part and switch part.

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



RD21075MS65A

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

a. All lamps light up.
b. Buzzer sound.

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

a. Cluster program version : CL : 2.0 ← Indicates program version 2.0 for 2 seconds.
b. Tachometer : 0rpm
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 key **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 : General work
b. Power mode selection : S mode
c. User mode selection : No LED ON
d. Auto decel LED : ON
e. Travel speed pilot lamp : Low(Turttle)

(2) Start of engine

① Check machine condition

a. Tachometer indicates at present rpm
b. Gauge and warning lamp : Indicate at present condition.

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work
d. Power mode selection : S mode
e. User mode selection : No LED ON
f. Auto decel LED : ON
g. Travel speed pilot lamp : Low(Turttle)

② When warming up operation

a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to1200 rpm(Auto decel LED : ON)

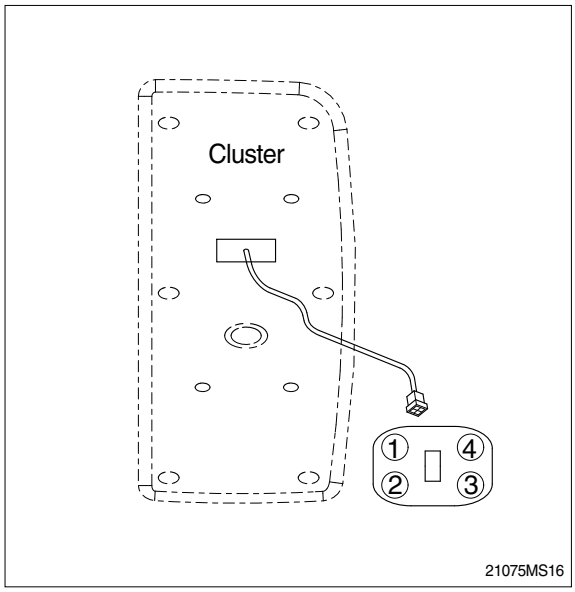
※ Others same as above ①.

③ When abnormal condition

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

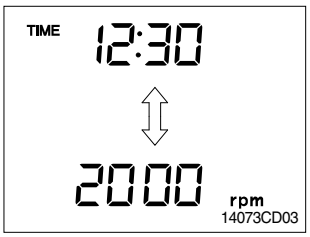
3. CLUSTER CONNECTOR

No.	Signal	Input / Output
1	Power IG(24V)	Input(20~32V)
2	GND	Input(0V)
3	Serial-(RX)	Input(Vpp=12V)
4	Serial+(TX)	Output(Vpp=4V)



4. CLUSTER FUNCTION

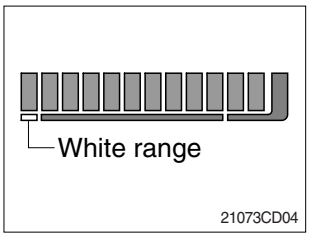
1) MONITORING DISPLAY



(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 page 5-34 for details.

2) FUEL GAUGE

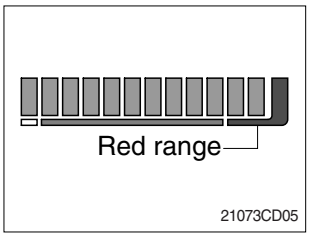


(1) This gauge indicates the amount of fuel in the fuel tank.

(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.**

3) HYDRAULIC OIL TEMPERATURE GAUGE



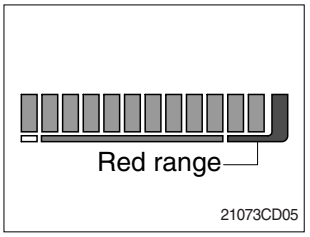
(1) This indicates the temperature of coolant.
- White range : Below 30°C(86°F)
- Green range : 30-105 °C(86-221°F)
- Red range : Above 105°C(221°F)

(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



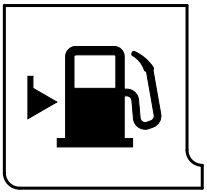
(1) This indicates the temperature of coolant.
- White range : Below 30°C(86°F)
- Green range : 30-105 °C(86-221°F)
- Red range : Above 105°C(221°F)

(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, turn OFF the engine, check the radiator and engine.

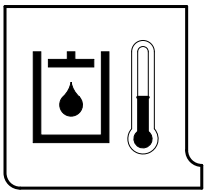
5) FUEL LOW LEVEL WARNING LAMP


21073CD04A

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

(2) Fill the fuel immediately when the lamp blinks.

6) HYDRAULIC OIL TEMPERATURE WARNING LAMP

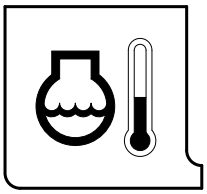

21073CD05A

(1) This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105℃(221℉).

(2) Check the hydraulic oil level when the lamp blinks.

(3) Check for debris between oil cooler and radiator.

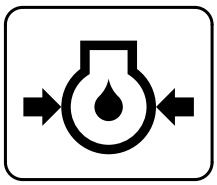
7) OVERHEAT WARNING LAMP


21073CD06A

(1) This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 110℃(230℉) .

(2) Check the cooling system when the lamp blinks.

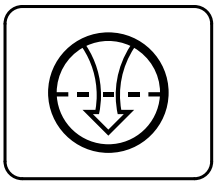
8) ENGINE OIL PRESSURE WARNING LAMP


21073CD07

(1) This lamp blinks and the buzzer sounds after starting the engine because of pressure.

(2) If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

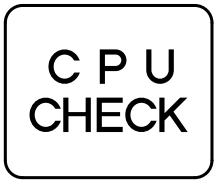
9) AIR CLEANER WARNING LAMP


21073CD08

(1) This lamp is operated by the vacuum caused inside when the filter of air cleaner is clogged which supply air to the engine.

(2) Check the filter and clean or replace it when the lamp blinks.

10) CPU CONTROLLER CHECK WARMING LAMP



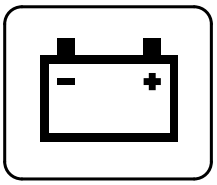
21073CD10

(1) Communication problem with CPU controller makes the lamp blinks and the buzzer sounds.

(2) Check if any fuse for CPU burnt off.

(3) If not check the communication line between them.

11) BATTERY CHARGING WARNING LAMP

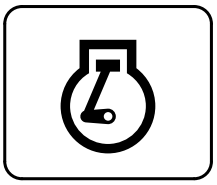


21073CD13

(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) DECEL PILOT LAMP

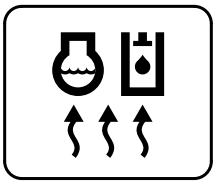


21073CD17

(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.

13) WARMING UP PILOT LAMP

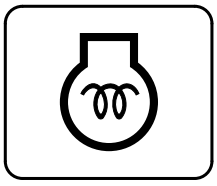


21073CD18

(1) This lamp is turned ON when the coolant temperature is below 30℃(86 ℉).

(2) The automatic warming up is cancelled when the engine coolant temperature is above 30 ℃, or when 10 minutes have passed since starting.

14) PREHEAT PILOT LAMP

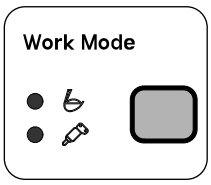


21073CD12

(1) Turning the start key switch ON position starts preheating in cold weather.

(2) Start the engine as this lamp is OFF.

15) WORK MODE SWITCH

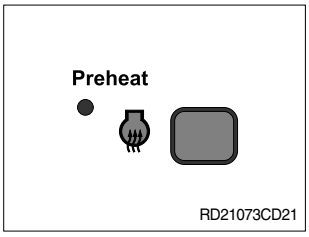


RD21073CD20

(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 raw by pressing the switch.
- : General work mode
- : Breaker operation mode

※ **Refer to the page 5-4 for details.**

16) PREHEAT SWITCH



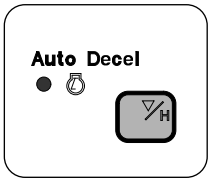
RD21073CD21

(1) This switch is used for starting the engine in cold weather.
If pressed, grid heater is activated to get easier engine starting.

※ **Never hold the push button switch in for more than 30 seconds, as this can damage the grid heater.**

(2) The indicator lamp is turned ON when operating this switch.

17) AUTO DECELERATION SWITCH

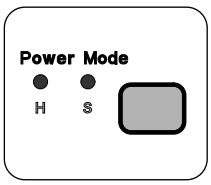


21073CD22

(1) This switch is used to actuate or cancel the auto deceleration function.
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.

(2) Operating the auto deceleration function makes the decel indicating lamp on the LCD panel ON.

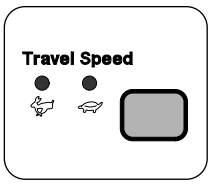
18) POWER MODE SWITCH



21073CD23

(1) The lamp of selected mode is turned ON by pressing the switch( ).
- H : High power work.
- S : Standard power work.

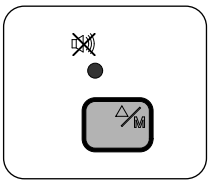
19) TRAVEL SPEED CONTROL SWITCH



21073CD24

(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 it again.

20) BUZZER STOP SWITCH

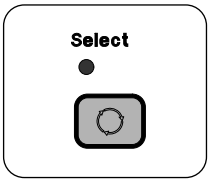


21073CD25

(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.

21) SELECT SWITCH



21073CD25A

(1) This switch is used to select the monitor display function.

※ **Refer to the page 5-31 for details.**

(2) If the switch is pressed for 3 seconds in time display mode, it is selected time adjusting function, 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.

5. MONITORING DISPLAY

1) OUTLINE

Information of machine performance as monitored by the CPU controller 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	1000 rpm
		Touch **SELECT** 1 time	Time	TIME 12:30
		Touch **SELECT** 2 times	Power shift pressure (EPPR valve)	EP: 10 bar
		Touch **SELECT** 3 times	CPU model & version	21C5.1
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:24.8v
		Touch **SELECT** 1 time	Potentiometer voltage(V)	Po: 2.5v
		Touch **SELECT** 2 times	Accel dial voltage(V)	dL: 3.8v
		Touch **SELECT** 3 times	Hydraulic oil temperature(℃)	Hd: 50℃
		Touch **SELECT** 4 times	Coolant temperature(℃)	Ct: 85℃
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 (Only key switch ON)	TIME Er: 03
		Press down(▼) & **SELECT** at the same time	Recorded error deletion (Only key switch ON)	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	Auto decel pressure switch	dP:on or oFF
		Touch **SELECT** 1 times	Travel oil pressure switch	oP:on or oFF
		Touch **SELECT** 2 times	One touch decel switch	od:on or oFF
		Touch **SELECT** 3 times	Preheat switch	PH:on or oFF
Group 4 (Output)	Touch **SELECT** switch **4 times** while pressing **BUZZER STOP.** In this group **SELECT** LED blinks at 1sec interval	Default	Hourmeter	Ho:on or oFF
		Touch **SELECT** 1 time	Neutral relay (Anti-restart relay)	nr:on or oFF
		Touch **SELECT** 2 times	Travel speed solenoid	tS:on or oFF
		Touch **SELECT** 3 times	Max flow cut off solenoid	FS:on or oFF
		Touch **SELECT** 4 times	Preheat relay	PR: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	1000 rpm	Engine speed	It displays current engine speed detected by engine speed sensor from 500 to 3000rpm. Range : 500~3000rpm by 10rpm
	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 CPU controller is 10bar. Range : 00~50bar by 1bar
	21 : C1.4	Model and CPU program version	It shows that machine model(R210LC-7) and the program version of the CPU controller is 1.4. Version display range : 0.0~9.9 by 0.1
Group 1	b : 24.8V	Battery voltage	It shows that battery power of 24.8V is supplied into CPU controller. 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 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 CPU controller. 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 CPU controller memory.

Group	Display	Name	Description
Group 3	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).
	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.
	PH : on or oFF	Preheat switch	PH : on Shows that preheat switch is pressed. PH : oFF Shows that preheat switch is released.
Group 4	Ho : on or oFF	Hourmeter	Ho : on Shows that hourmeter is activated by CPU controller. 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).

GROUP 11 MONITORING SYSTEM

1. CLUSTER(CMCU)

1) MONITOR PANEL

The monitor panel consists of LCD and lamps as shown below, to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.

LCD : Indicate operating status of the machine.

Warning lamp : Indicate abnormality of the machine

Pilot lamp : Indicate operating status of the machine

※ The monitor installed on this machine does not entirely guarantee the condition of the machine. Daily inspection should be performed according to chapter 6, Maintenance.

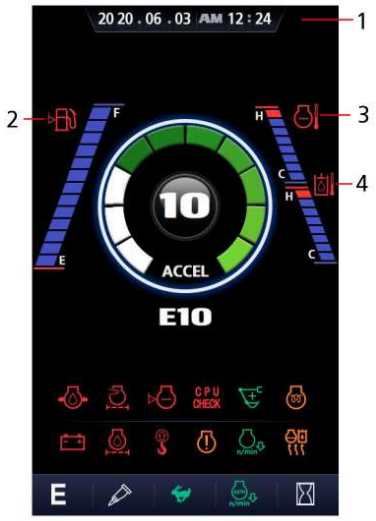
※ When the monitor provides a warning immediately check the problem, and perform the required action.

※ The warming lamp lights ON and the buzzer sounds when the machine has a problem.

In this case, press the buzzer stop switch and buzzer stop, but the warming lamp lights until the problem is cleared.

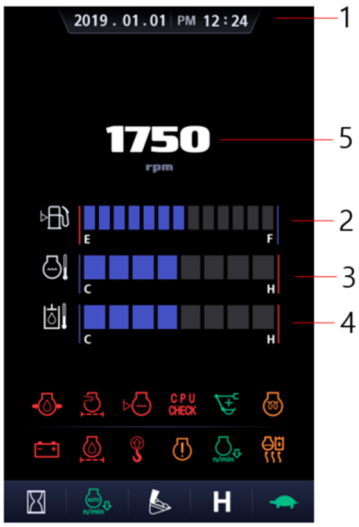
2) LCD main operation display

Dial screen(Default)



Analog screen(Option 1)

Digital screen(Option 2)

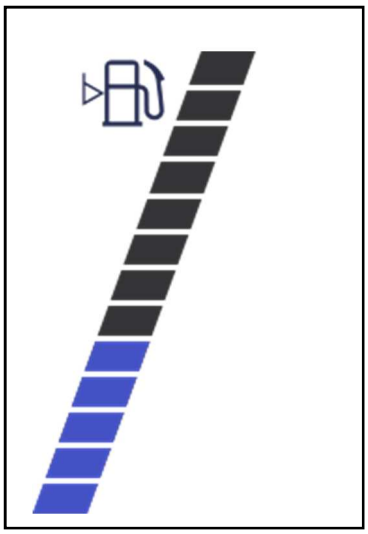


1. Time
2. Fuel level
3. Engine coolant temperature
4. Hydraulic oil temperature
5. RPM

(1) Time display

① This displays the current time.

(2) Fuel level gauge

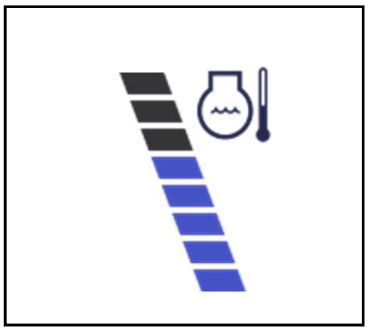


① This gauge indicates the amountof fuel in the fuel tank.

② Fill the fuel when the 1st step or fuel icon blinks in red.

※ If the gauge illuminates the 1st step or fuel icon blinks in red 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.

(3) Engine coolant temperature gauge



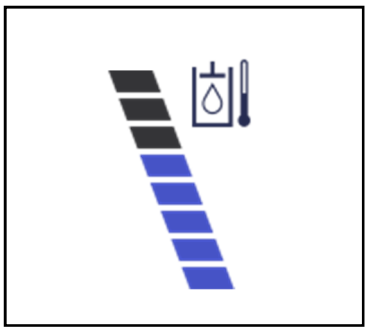
① This gauge indicates the temperature of coolant in 9 step gauge.

- 0(zero) : Below 30℃ (86℉)
- 1st ~ 7th : 30℃ ~ 104℃ (86 ~ 219℉)
- 8th : Above 104℃ (219℉)

② If the warning lamp flashes red, do not stop the engine suddenly, run it at medium speed, cool it step by step and stop it.

※ If the engine is not cooled enough and the engine is switched off, the temperature of the engine may rise sharply, causing problems with parts within the engine.

(4) Hydraulic oil temperature gauge



① This gauge indicates the temperature of hydraulic oil in 9 step gauge.

•0(zero) : Below 30℃ (86℉)

•1st ~ 7th : 30℃ ~ 104℃ (86 ~ 219℉)

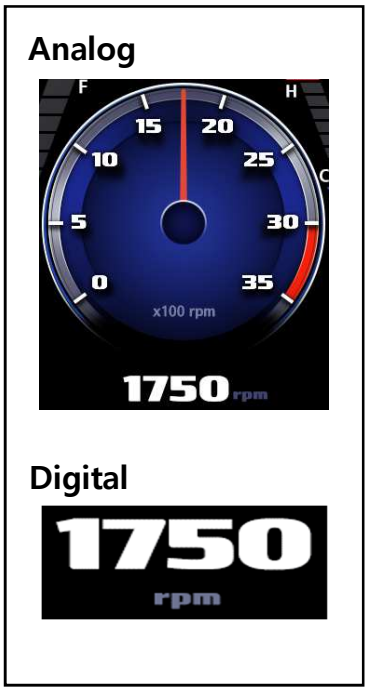
•8th : Above 104℃ (219℉)

② The gauge between 1st and 7th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 1st and 7th steps illuminates, before operation of machine.

④ When the gauge of 8th steps illuminates, reduce the load on the system. If the gauge stays in the 8th steps, stop the machine and check the cause of the problem.

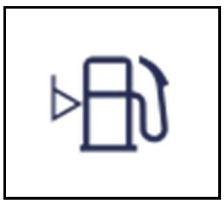
(5) RPM display



① This displays the engine rpm.

3) Warning lamp

(1) Fuel level



① This lamp blinks and the buzzer sounds when the level of fuel is below 36 ℓ (9.5 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(2) Hydraulic oil temperature

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.

(3) Engine coolant temperature

① This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 105°C (221°F).

② Check the cooling system when the lamp blinks.

(4) Engine oil pressure warning lamp

① This lamp blinks and the buzzer sounds after starting the engine because of the low oil pressure. and goes off when the engine starts.

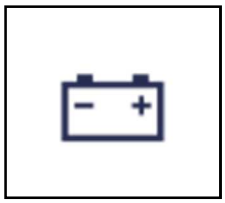
② If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

(5) Air cleaner warning lamp

① When the filter of the air purifier that purifies the air supplied to the engine is blocked and a vacuum occurs inside, the switch is activated and the lamp turned on.

② If the lamp blinks, Check the filter and clean or replace it.

(6) Battery charging warning lamp



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.

(7) Engine check warning lamp

① This lamp blinks and the buzzer sounds when the communication between MCU and ECM on the engine is abnormal, or if any fault code received from ECM.

② Check the communication line between them. If the communication line is OK, then check the fault code on the cluster.

4) Pilot lamp

(1) Preheat pilot lamp

① Turning the start key switch ON position starts preheating in cold weather.

② Start the engine as this lamp is OFF.

(2) One touch decel pilot lamp

① Operating one touch decel makes the lamp ON.

② The lamp will be ON when pushing one touch decel switch on the LH RCV lever.

(3) Warming up pilot lamp

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.

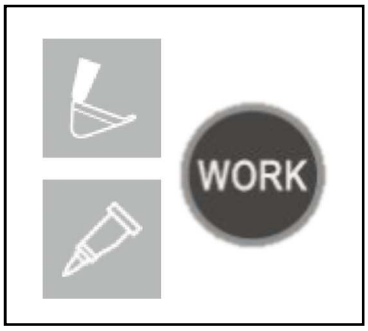
(4) Working pilot lamp

① This lamp is turned ON when engine is operating

5) Switch panel

※ When the switches (Work mode, Power mode, Auto decel, Travel speed control) are selected, the pop-up icon is displayed on the LCD.

(1) Work mode switch

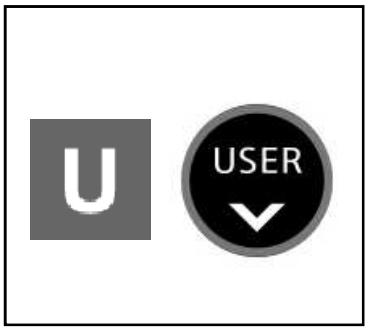


① This switch is to select the machine operation mode, which shifts from excavation operation mode to breaker operation mode in a raw by pressing the switch.

 : Excavation work mode

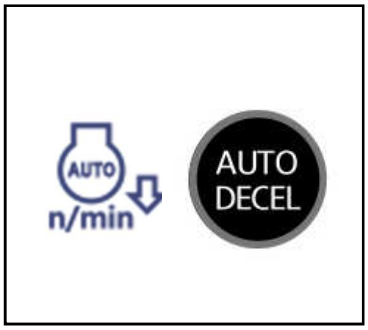
 : Breaker work mode

(2) User mode switch



① This switch is to select the user mode.

(3) Auto deceleration switch



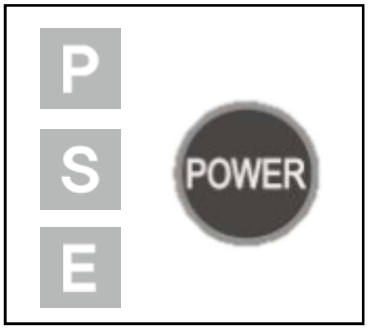
① This switch is used to actuate or cancel the auto deceleration function. When the switch actuated and all control levers and pedals are at neutral position, engine speed will be lowered automatically to save fuel consumption.

- Light ON : Auto deceleration function is selected.
- Light OFF :

  a. Auto deceleration function is cancelled so that the engine speed increased to previous setting value.

  b. One touch decel function is available.

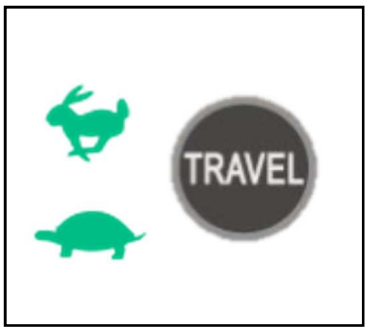
(4) Power mode switch



① The lamp of selected mode is turned ON by pressing the switch

- P : High power work.
- S : Standard power work.
- E : Economy power work.

(5) Travel speed control switch



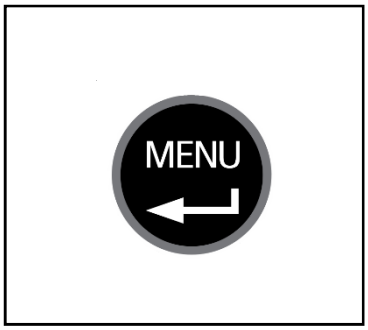
① This switch is to control the travel speed which is changed to high speed(Rabbit mark) by pressing the switch and low speed(Turtle mark) by pressing again.

(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 enter main menu and sub menu of LCD.

(8) ESC switch

① This switch returns to the previous menu or to the upper menu on the LCD.

6) LCD

(1) Main function

No.	Main menu	Sub menu	Description
1	Monitoring	Equipment Switch Output Operating Hours	Equipment information and status Switch status Output status Operating hour of each mode
2	Diagnosis	Current Error Recorded Error	Check and delete fault records of MCU and ECM
3	Management	Management	Check oil and filter exchange interval Reset remaining hours
4	Settings	Time Setting Machine Security Dual Mode Travel Buzzer Set Model Select	Time setting ESL mode setting Change password Mode, Model select
5	Display	Operation Skin Brightness Language	Three type Operation Skin LCD brightness setting English, Hindi, Tamil
6	User Mode	User Mode	ACCEL DECEL EPPR

(2) Menu tree

(2-1) Monitoring

① Equipment

- Information about the status of the equipment can be obtained.

② Switch

- Information about the status of the switch can be obtained.

③ Output

- Information about the status of the Output can be obtained.

④ Operating Hours

- Information about the operating hour of each operation mode can be obtained by entering Monitor password

(2-2) Diagnosis

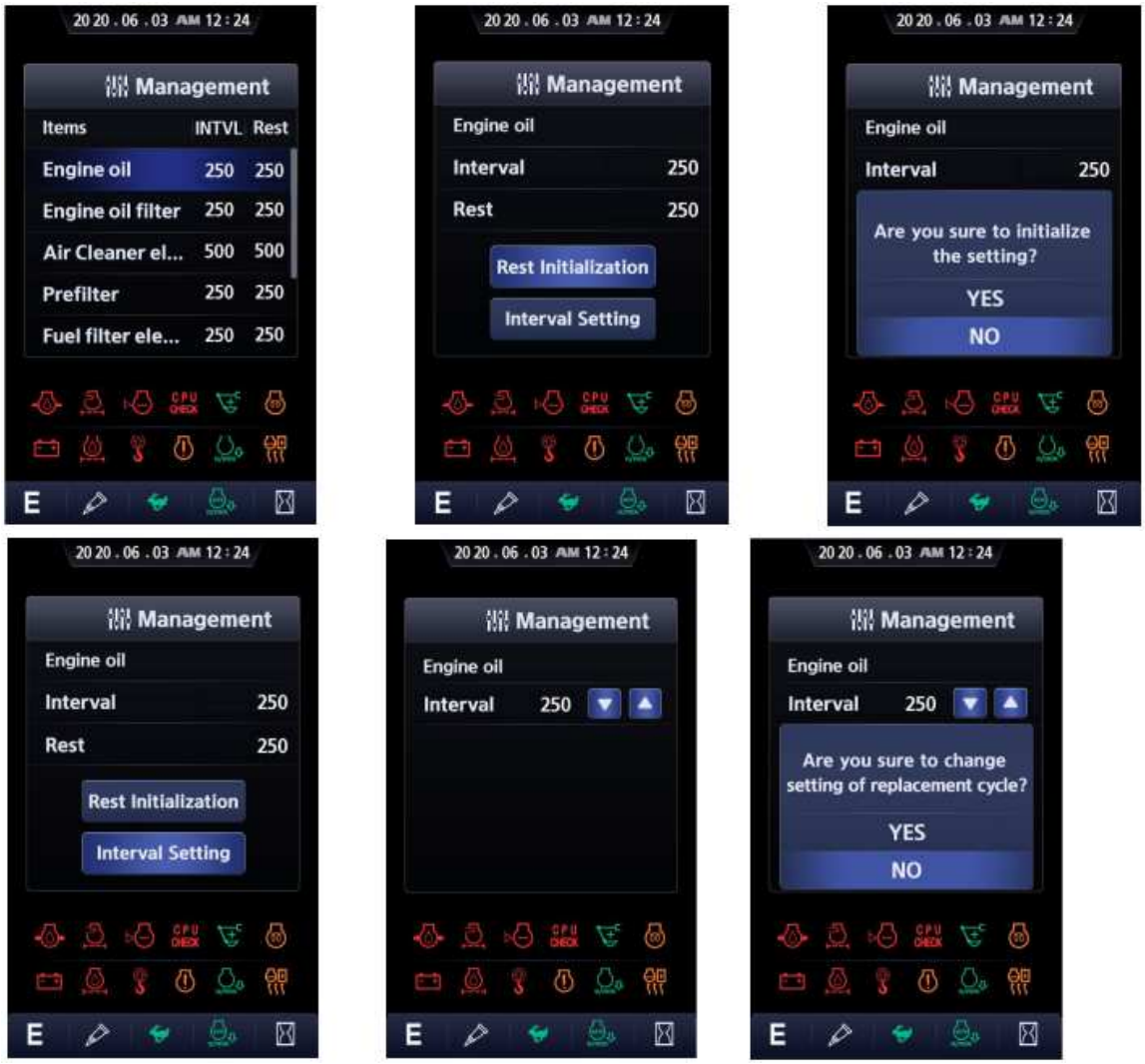
① Current Error

- You can check MCU or ECM for current error.

② Recorded Error

- You can check MCU or ECM for recorded error.

(2-3) Management



- You can check the exchange interval and the remaining hours of the parts.
- Rest Initialization : You can reset the remaining hours.
- Interval Setting : You can set the exchange interval.

(2-4) Settings

① Time Setting

- You can set the year, month, day, hour, and minute.

② Machine Security

a. ESL Mode Setting

- This function prevents theft and unauthorized operation of equipment.
- : If 'Inactive' selected, The Function is disabled.

- : If 'Active' selected, Require a password each time the engine is started.
- : If 'Delay Time' selected, Require a password first time the engine is started, and Do not require a password to restart within the setting time

b. Change Password

- The password is 5 to 8 digits. After entering your password, press ' ↵ ' to finish entering
- The initial User password is '00000'.

③ Dual Mode

- You can change the mode of the equipment.

④ Travel Buzzer Set

- You can turn on and off the buzzer when traveling.

⑤ Model Select

- You can change the model of the equipment by entering Service password

(2-5) Display

① Operation Skin

- You can set the operation skin type.

② Brightness

- You can set the screen brightness.

③ Language

- You can select the language you want to use, and all marks will be changed to the language you selected.

(2-6) User Mode

- Engine high speed idle rpm, auto decel rpm and EPPR valve input current can be set and stored in User Mode (U).
- You can enter the menu only if User Mode (U) is selected.