SECTION 5 MECHATRONICS SYSTEM
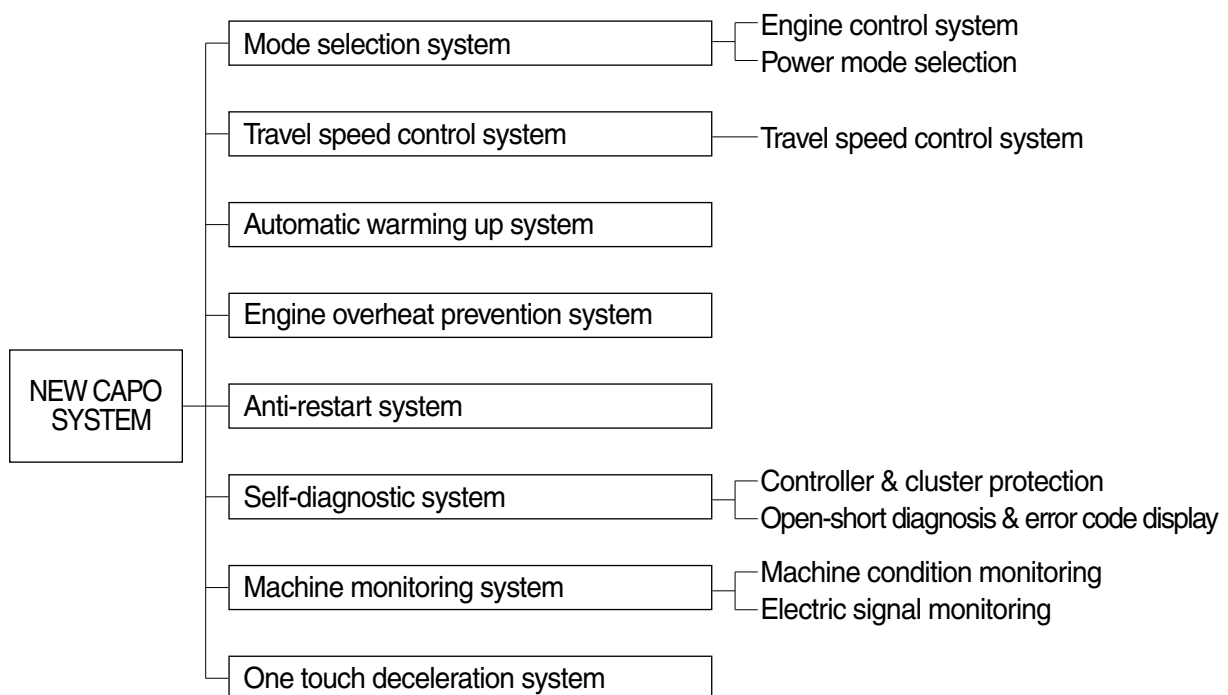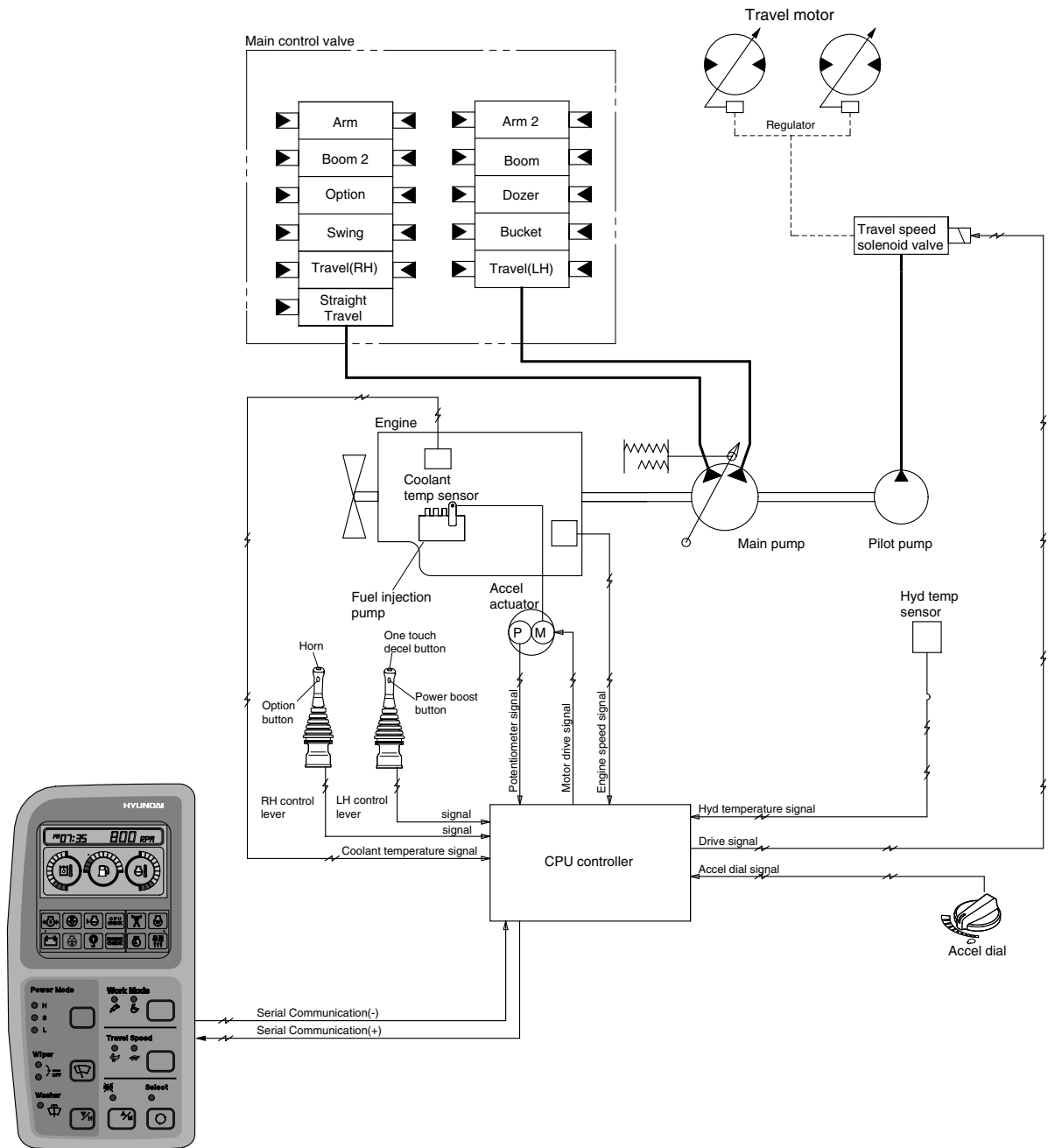
GROUP 1 OUTLINE

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, one touch deceleration etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.

It consists of a CPU controller, a cluster, an accel actuator, 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.
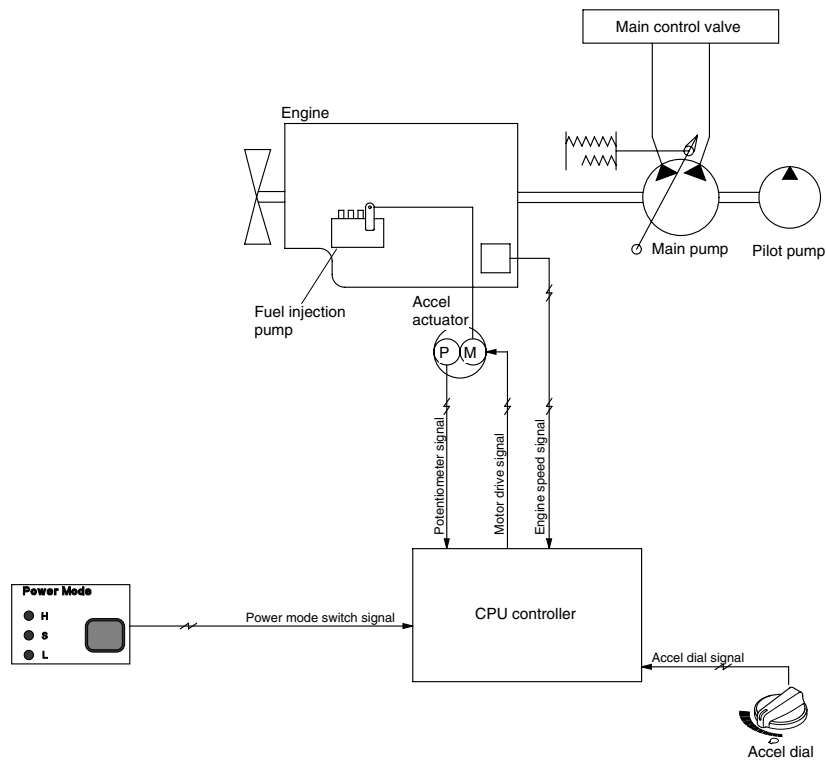
```
                  ┌── Mode selection system ──────────── ┌ Engine control system
                  │                                       └ Power mode selection
                  │
                  ├── Travel speed control system ─────── Travel speed control system
                  │
                  ├── Automatic warming up system
                  │
                  ├── Engine overheat prevention system
 NEW CAPO ────────┤
 SYSTEM           ├── Anti-restart system
                  │
                  ├── Self-diagnostic system ──────────── ┌ Controller & cluster protection
                  │                                       └ Open-short diagnosis & error code display
                  │
                  ├── Machine monitoring system ───────── ┌ Machine condition monitoring
                  │                                       └ Electric signal monitoring
                  │
                  └── One touch deceleration system
```

SYSTEM DIAGRAM

RD8075MS01

GROUP 2 MODE SELECTION SYSTEM

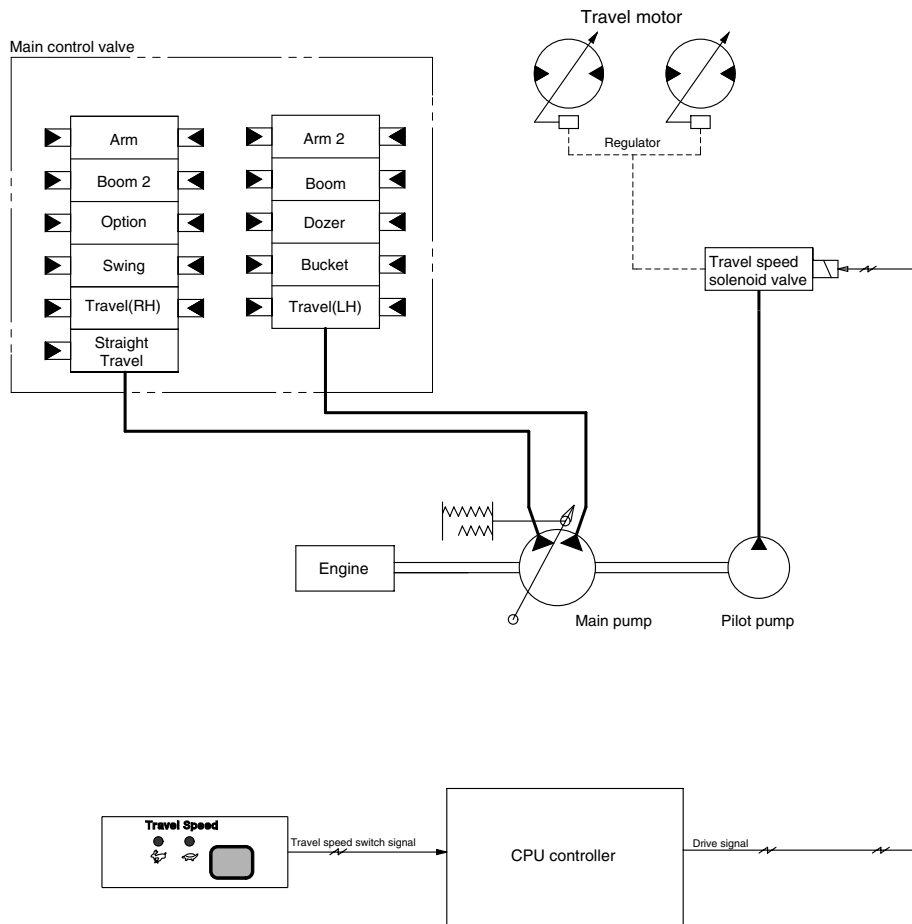## 1. POWER MODE SELECTION SYSTEM

7075MS02

Mode selection system(Micro computer based engine mutual control system) optimizes the engine performance.

The combination of 3 power modes(H, S, L) and accel dial position(10 set) makes it possible to use the engine 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
H	High power	100	2050±50
S	Standard power	85	1850±50
L	Light power	70	1750±50
One touch decel	Engine quick deceleration	-	1000±100
KEY START	Key switch start position	-	1000±100

Main control valve

Arm	Arm 2
Boom 2	Boom
Option	Dozer
Swing	Bucket
Travel(RH)	Travel(LH)
Straight Travel	

Travel motor

Regulator

Travel speed solenoid valve

Engine

Main pump   Pilot pump

Travel Speed

Travel speed switch signal

CPU controller

Drive signal

7075MS04

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 4 AUTOMATIC WARMING UP FUNCTION
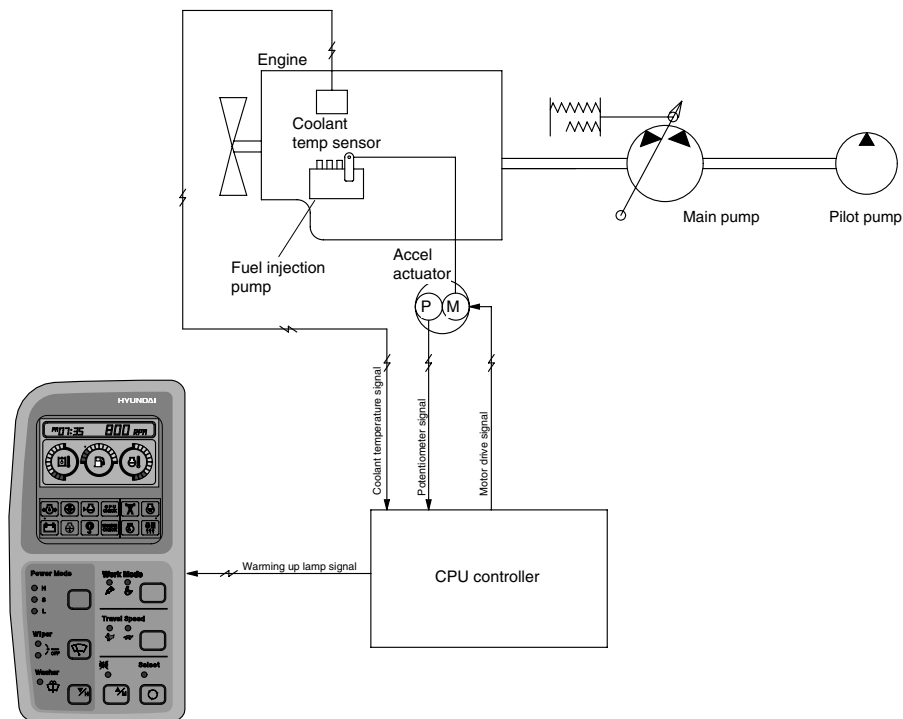
RD8075MS05

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.

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 5 ENGINE OVERHEAT PREVENTION FUNCTION
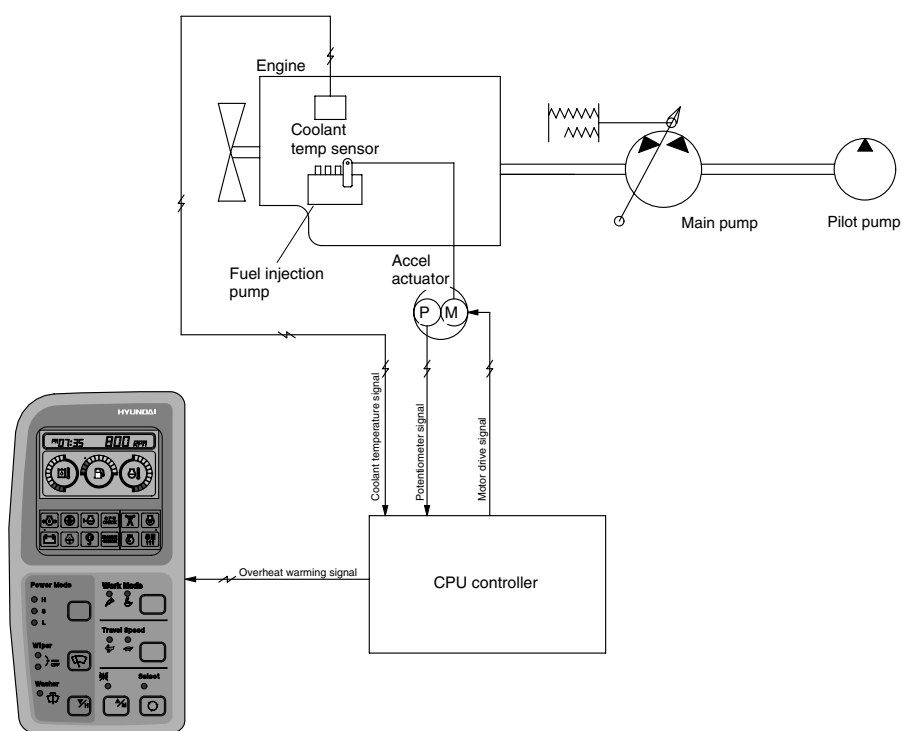

RD8075MS06

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

5-7

Engine

Starter

Start safety relay

CPU controller

Drive signal

CN-92a

CN-92b
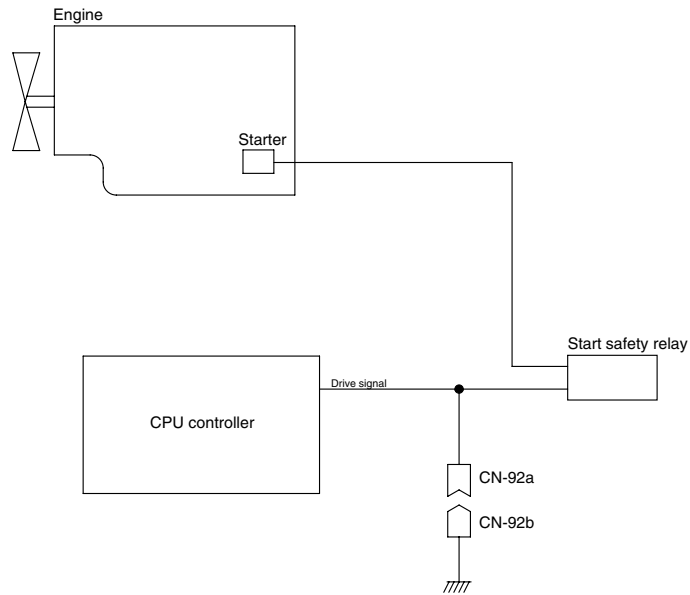
21075MS10

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 7 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 : Err** 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 : Err & Buzzer sound

2) No problem

   CHECK Er : [0][0]

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

   CHECK Er : [0][3]

[0][3] — Press ▼ / Press ▲ — [0][6] — Press ▼ / Press ▲ — [1][0] — Press ▼ / Press ▲ — [4][3] — Press ▲ — No change
Start
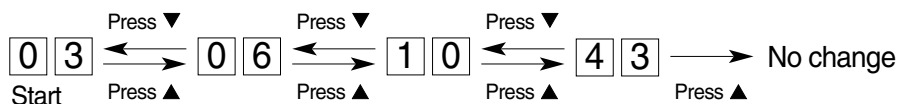
3. RECORDED ERROR DISPLAY

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]

[0][3] — Press ▼ / Press ▲ — [0][6] — Press ▼ / Press ▲ — [1][0] — Press ▼ / Press ▲ — [2][0] — Press ▼ / Press ▲ — [3][2] — Press ▲ — No change
Start
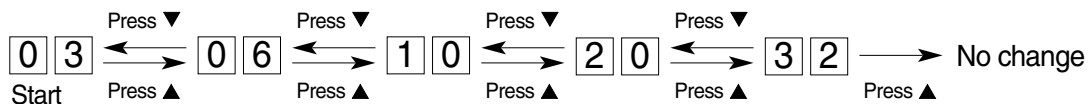
### 4. DELETE ALL RECORDED ERROR CODES

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
00	No error
01	Short circuit in accel actuator motor system
02	Potentiometer circuit is shorted to Vcc(5V) or battery +
05	Short circuit in travel speed solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
16	Accel actuator motor circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
20	Travel speed 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
31	Engine preheater circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Actuator input voltage is below 18V
35	Actuator input voltage is over 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
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
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 +
49	Engine preheater circuit is shorted to battery +

GROUP 8 ENGINE CONTROL SYSTEM

1. CPU CONTROLLER MOUNTING

1   CPU controller
2   Bolt(M8)
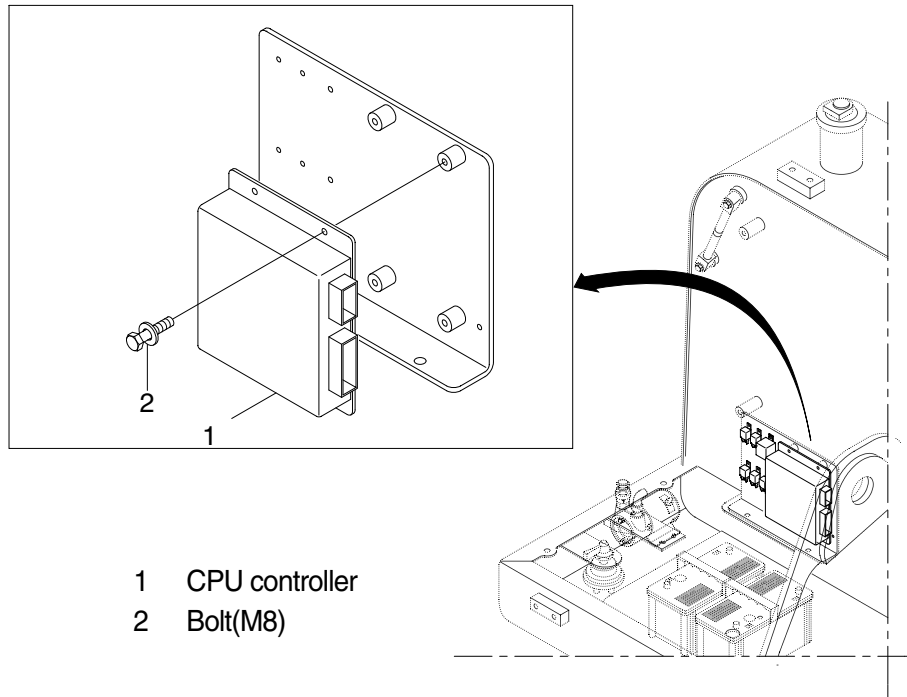
7075MS12

2. CPU CONTROLLER ASSEMBLY

1) Disconnect 2 connectors from CPU controller.

2) Remove four pieces of bolt(2).

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).

21075MS12
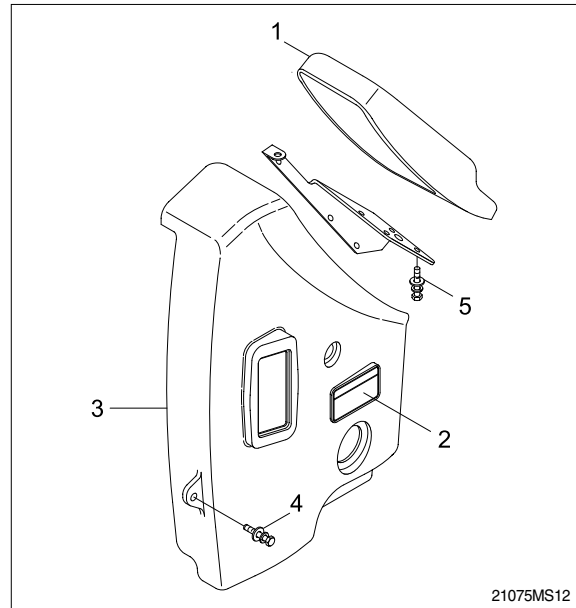
4) Loosen the screws(6EA) located back of the cluster.

5) Then you can open the upper case of the cluster easily.

21075MS13
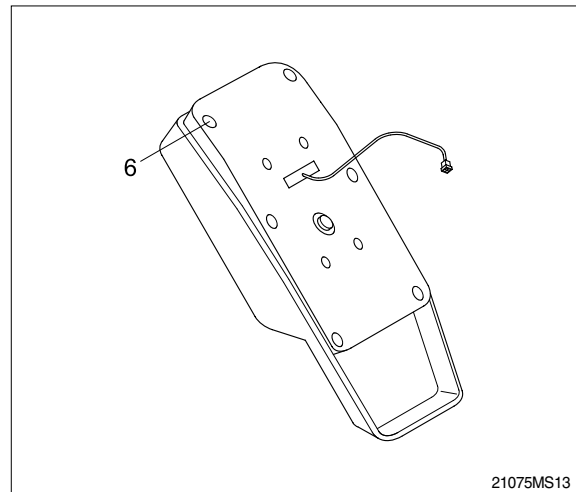
6) Install the new ROM.(Be careful of direction and assmelbe the cluster in the reverse order to removal).

Same direction

21075MS14
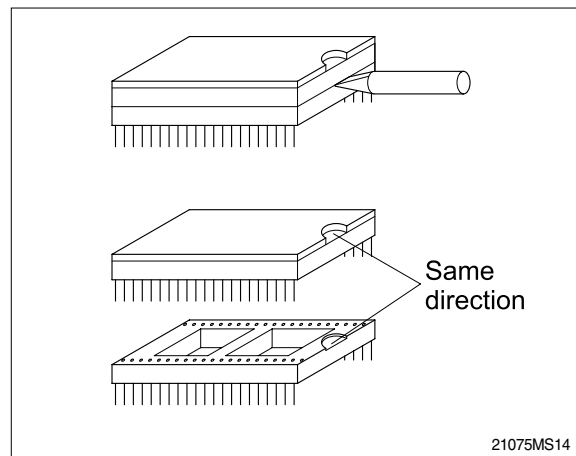
4. ENGINE ACCEL ACTUATOR
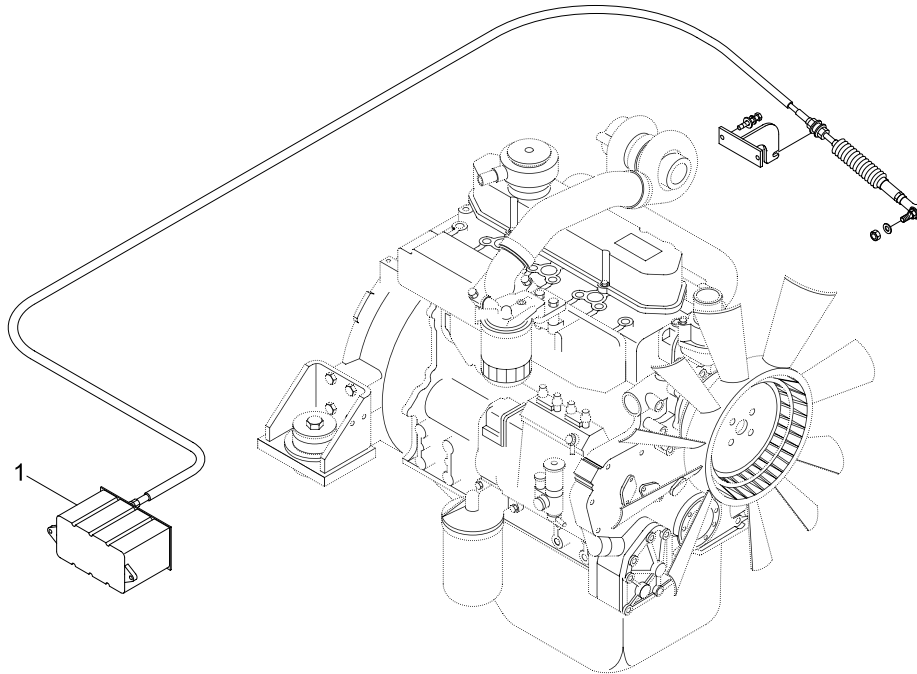
1   Accel actuator

RD8075MS07

1) ENGINE THROTTLE LEVER

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

Throttle lever

SL   SH
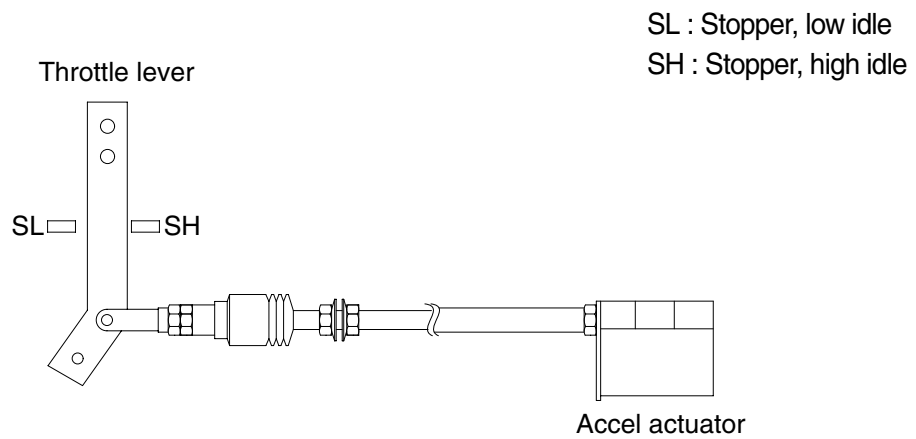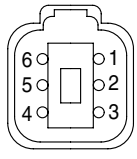
Accel actuator

11075MS08

2) ACCEL ACTUATOR

1 DC motor
2 Cable
3 Nut
4 Ball joint
5 Connector
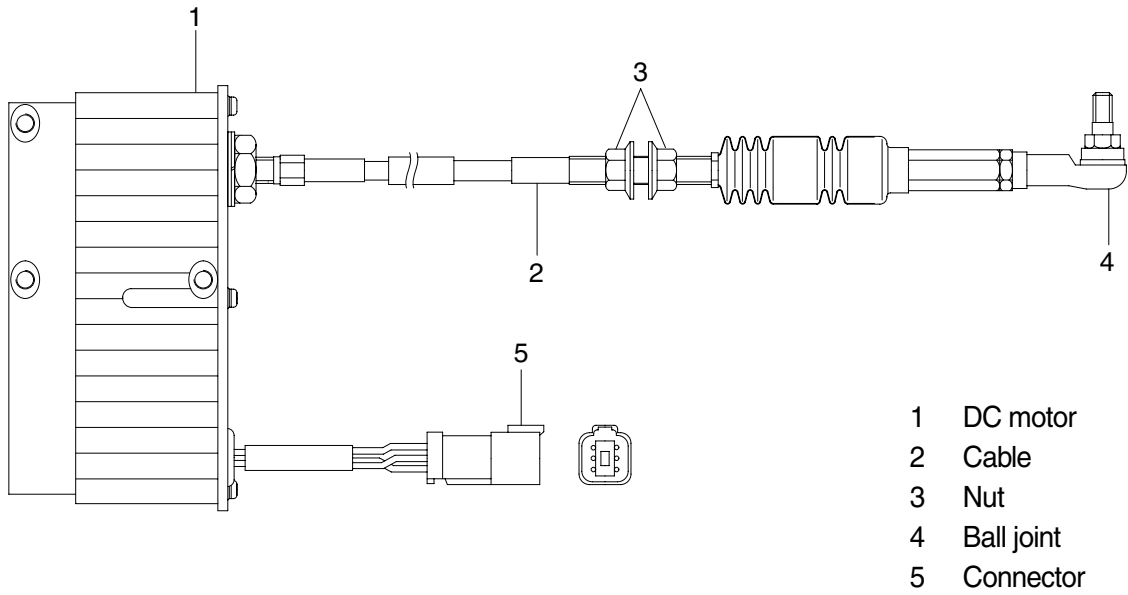
RD8075MS09

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)		

3) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(1) Key ON
① Set the engine control dial max position and the one touch decel switch OFF.

② Connect the ball joint of cable to engine throttle lever.

③ 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.

(2) Key START
④ Confirm if the engine speed on cluster is same as each mode specification.

⑤ If the engine speed displayed on cluster is highter than each mode specification, then turn the nut

⑥ **A** to counter clockwise and make the engine speed same to each mode specification.

If the engine speed displayed on cluster is lower than each mode specification, then turn the nut

⑦ **A** to clockwise and make the engine speed same to each mode specification.

Turn nut **B** to clockwise and fix the cable to bracket.
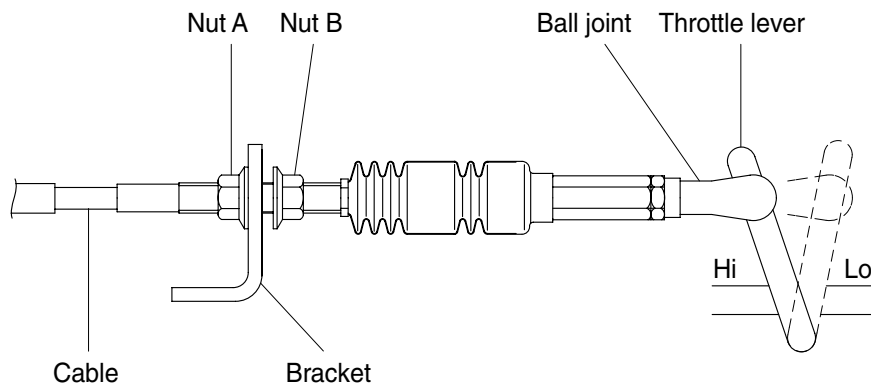
130W5MS05

Mode	RPM
H	2050 ± 50
S	1850 ± 50
L	1750 ± 50
Key start(one touch decel)	1000 ± 100

5. CPU CONTROLLER

LED

29073CD72
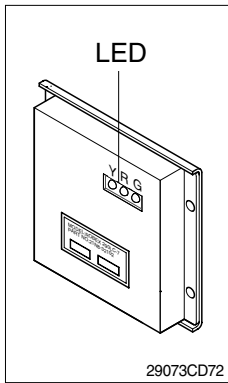
(1) To match the engine torque with the pump absorption torque, CPU controller varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.

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

LED lamp	Trouble	Service
G is turned ON	Normal	-
R is turned ON	Trouble on CPU	· 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 9 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

Fuel low level warning lamp
Hyd oil temp warning lamp
Overheat warning lamp
Air cleaner warning lamp
Engine oil pressure warning lamp
Battery charging warning lamp
Overload warning lamp

Power mode switch

Wiper switch

Washer switch

Monitoring display
Fuel gauge
Hyd oil temp gauge
Engine coolant temp gauge
CPU controller check warning lamp
Preheat pilot lamp
Warming up pilot lamp
Decel pilot lamp
Coolant level warning lamp
Preheat switch
Travel speed switch
Buzzer stop switch
Select switch
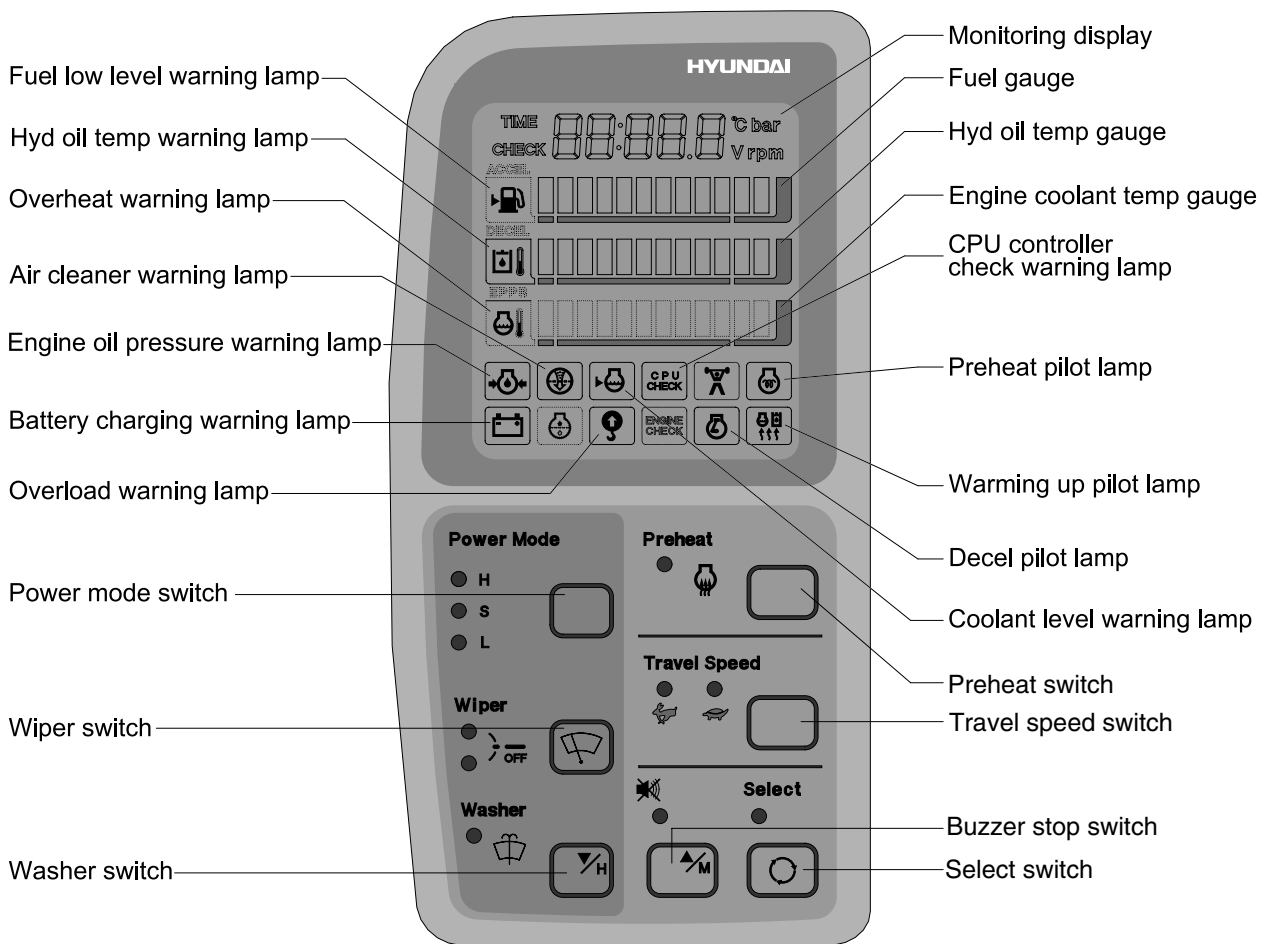
7075MS11

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 5 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℃, the warming up lamp lights up.

③ Indicating lamp state

    a. Power mode selection : S mode
    b. Preheat : No LED ON
    c. Wiper : No LED ON
    d. Washer : No LED ON
    e. Travel speed pilot lamp : Low(Turtle)

(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. Preheat : No LED ON
    d. Power mode selection : S mode
    e. Wiper : No LED ON
    f. Washer : No 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 to1200 rpm
    ※ 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)

Cluster

21075MS16

4. CLUSTER FUNCTION

1) MONITORING DISPLAY

```
TIME  12:30
       ⇕
      2000  rpm
      14073CD03
```
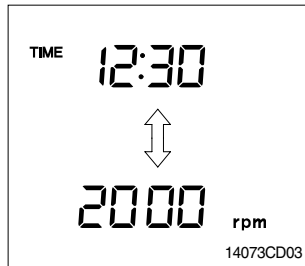
① This displays the current time and machine information such as engine rpm, coolant/hydraulic oil temperature, hydraulic oil pressure and also error codes.
※ **Refer to the page 5-24 for details.**

2) FUEL GAUGE

```
White range
      21073CD04
```
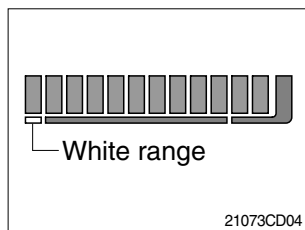
① This gauge indicates the amount of fuel in the fuel tank.
② Fill the fuel when the white range or warning lamp ⛽ blinks.
※ **If the gauge illuminates the white range or warning lamp ⛽ blinks even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

3) HYDRAULIC OIL TEMPERATURE GAUGE
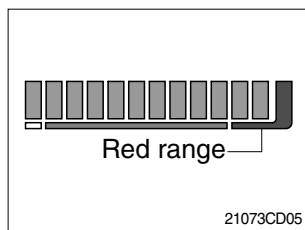
```
Red range
      21073CD05
```

① This indicates the temperature of coolant.
  · White range : 30℃(86°F) below
  · Green range : 30-105 ℃(86-221°F)
  · Red range   : 105℃(221℉) 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
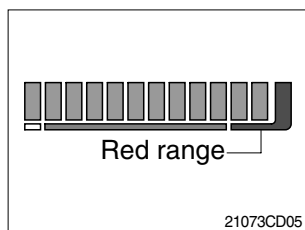
```
Red range
      21073CD05
```

① This indicates the temperature of coolant.
  · White range : 30℃(86°F) below
  · Green range : 30-105 ℃(86-221°F)
  · Red range   : 105℃(221℉) 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, turn OFF the engine, check the radiator and engine.

5) FUEL LOW LEVEL WARNING LAMP
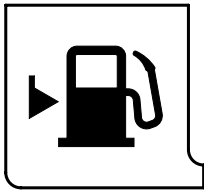
① This lamp blinks and the buzzer sounds when the level of fuel is below 21.5 l (5.7U.S. gal).
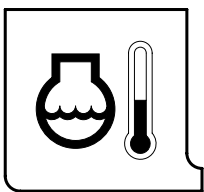
② Fill the fuel immediately when the lamp blinks.

21073CD04A

6) HYDRAULIC OIL TEMPERATURE WARNING LAMP
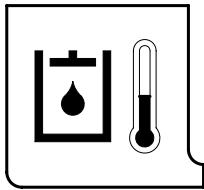
① This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105 ℃(221 ℉) .

② Check the hydraulic oil level when the lamp blinks.
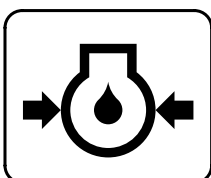
③ Check for debris between oil cooler and radiator.

21073CD05A

7) OVERHEAT WARNING LAMP

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.

21073CD06A

8) ENGINE OIL PRESSURE WARNING LAMP

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.

21073CD07

9) AIR CLEANER WARNING LAMP
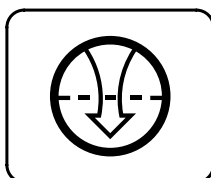
① This lamp is operated by the vacuum caused inside when the filter of air cleaner is clogged which supply air to the engine.

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

21073CD08

10) COOLANT LEVEL WARNING LAMP
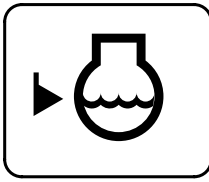
21073CD09

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) CPU CONTROLLER CHECK WARNING LAMP

C P U
CHECK
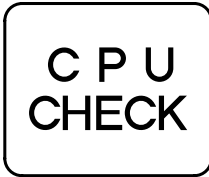
21073CD10

① Communication problem with CPU controller makes the lamp blinks and the buzzer sounds.
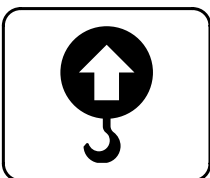② With lamp blinks all of the lamp on the cluster LCD will be OFF.

12) BATTERY CHARGING WARNING LAMP
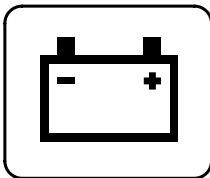
21073CD13

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.

13) OVERLOAD WARNING LAMP

21073CD15

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

14) ONE TOUCH DECEL PILOT LAMP
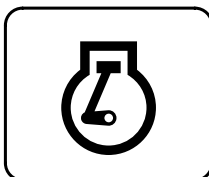
21073CD17

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.

15) WARMING UP PILOT LAMP
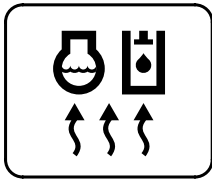
21073CD18

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.
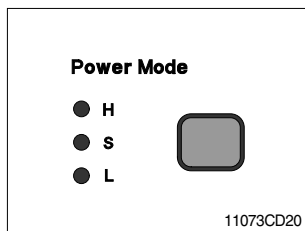
16) PREHEAT PILOT LAMP
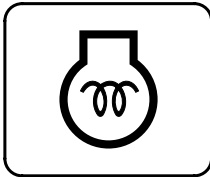
21073CD12

① This lamp is turned ON when the preheating function is actuated in cold weather.
② Start the engine as this lamp is OFF.

17) POWER MODE SWITCH

Power Mode
● H
● S
● L

11073CD20

① This switch is to select the machine power mode, which shifts from high power work to standard power work and light power work in a raw by pressing the switch.
· H : This is used for high power work
· S : This is used for standard power work
· L : This is used for light power work

18) WIPER SWITCH
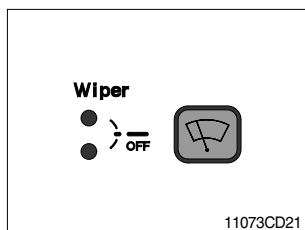
Wiper
OFF

11073CD21

① This switch is used to operate wiper.
· Press the switch once to operate wiper.
· Press the switch once more to intermittently operate wiper low speed.
· Press the switch more than one second to turn off wiper.
※ **Wiper motor doesn't operate with front sliding door open.**
※ **If wiper does not operate with the switch in the ON position, turn the switch off immediately. Check the cause.**
If the switch remains ON, it can result in motor failure.

19) WASHER SWITCH
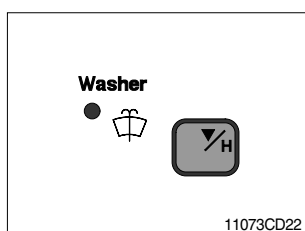
Washer

11073CD22

① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
② The indicator lamp is turned ON when operating this switch.

20) PREHEAT SWITCH

Preheat

11073CD23
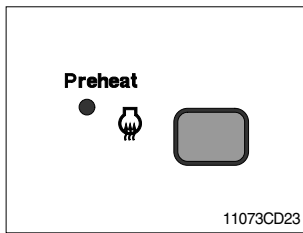
① This switch is used for starting the engine in cold weather.
   If pressed, grid heater is activated to get easier engine starting.
※ **Never hold the push button switch in for more than 30 seconds, as this can damage the grid heater.**
② The indicator lamp is turned ON when operating this switch.

21) TRAVEL SPEED CONTROL SWITCH
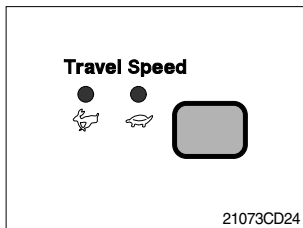
Travel Speed

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 again.

22) BUZZER STOP SWITCH

21073CD25
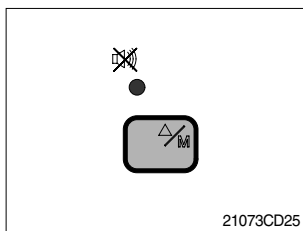
① When the starting switch is turned ON first, normally the alarm buzzer sounds for 5 seconds during lamp check operation.
② The red lamp lights ON and the buzzer sounds when the machine has a problem.
   In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

23) SELECT SWITCH

Select

21073CD25A
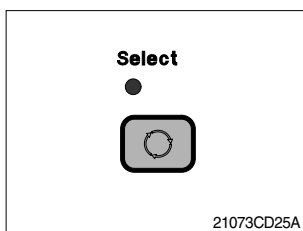
① This switch is used to select the monitor display function.
※ **Refer to the page 5-24 for details.**
② If the switch is pressed for 3 seconds in time display mode, it is selected time adjusting function, as below.
   · Hour by auto decel switch
   · Minute by buzzer stop switch.
③ After time set, the switch is pressed, it is returned clock.

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 **WASHER** switch while pressing **BUZZER STOP** at group 1~4.	Initial	Engine rpm	`1750` rpm
		Touch **SELECT** 1 time	Time	TIME `12:30`
		Touch **SELECT** 2 times	CPU model & version	`08:C 1.0`
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: 105℃`
		Touch **SELECT** 4 times	Coolant temperature(℃)	`Ct: 107℃`
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	One touch decel switch	`od:on` or `oFF`
		Touch **SELECT** 1 time	Preheat switch	`PH:on` or `oFF`
		Touch **SELECT** 2 times	Overload pressure switch	`ol: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	`SS:on` or `oFF`
		Touch **SELECT** 3 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	2200 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)
	08 : C1.0	Model and CPU program version	It shows that machine model(R80-7) and the program version of the CPU controller is 1.0. Version display range : 0.0~9.9 by 0.1
Group 1	b24 : 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℃	Hydraulic oil temperature	It shows that hydraulic oil temperature detected by temperature sensor is 50℃. Range : 0~150℃ by 1℃
	Ct : 85℃	Coolant temperature	It shows that coolant oil temperature detected by temperature sensor is 50℃. Range : 0~150℃ by 1℃
Group 2	CHECK Er : 01	Current error	It shows that current error of 01(Short circuit in accel actuator motor 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	**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.
	ol : on or **oFF**	Overload pressure switch	**ol : on** Shows that overload pressure switch is turned ON. **ol : oFF** Shows that overload pressure switch is turned OFF.
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).
	PR : on or **oFF**	Preheat relay	**PR : on** Shows that preheat relay is activated. **PR : oFF** Shows that preheat relay is released.

■ 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

Clock display

Hyd oil temp gauge

Air cleaner warning lamp

Engine oil pressure warning lamp

Battery charging warning lamp

Overload warning lamp

Power mode switch

Wiper switch

Washer switch

RPM display

Fuel gauge

Engine coolant temp gauge

CPU controller check warning lamp

Preheat pilot lamp

Warming up pilot lamp

Decel pilot lamp

Work mode switch

Travel speed switch

Buzzer stop switch

Select switch

RD8075MS08

5-27
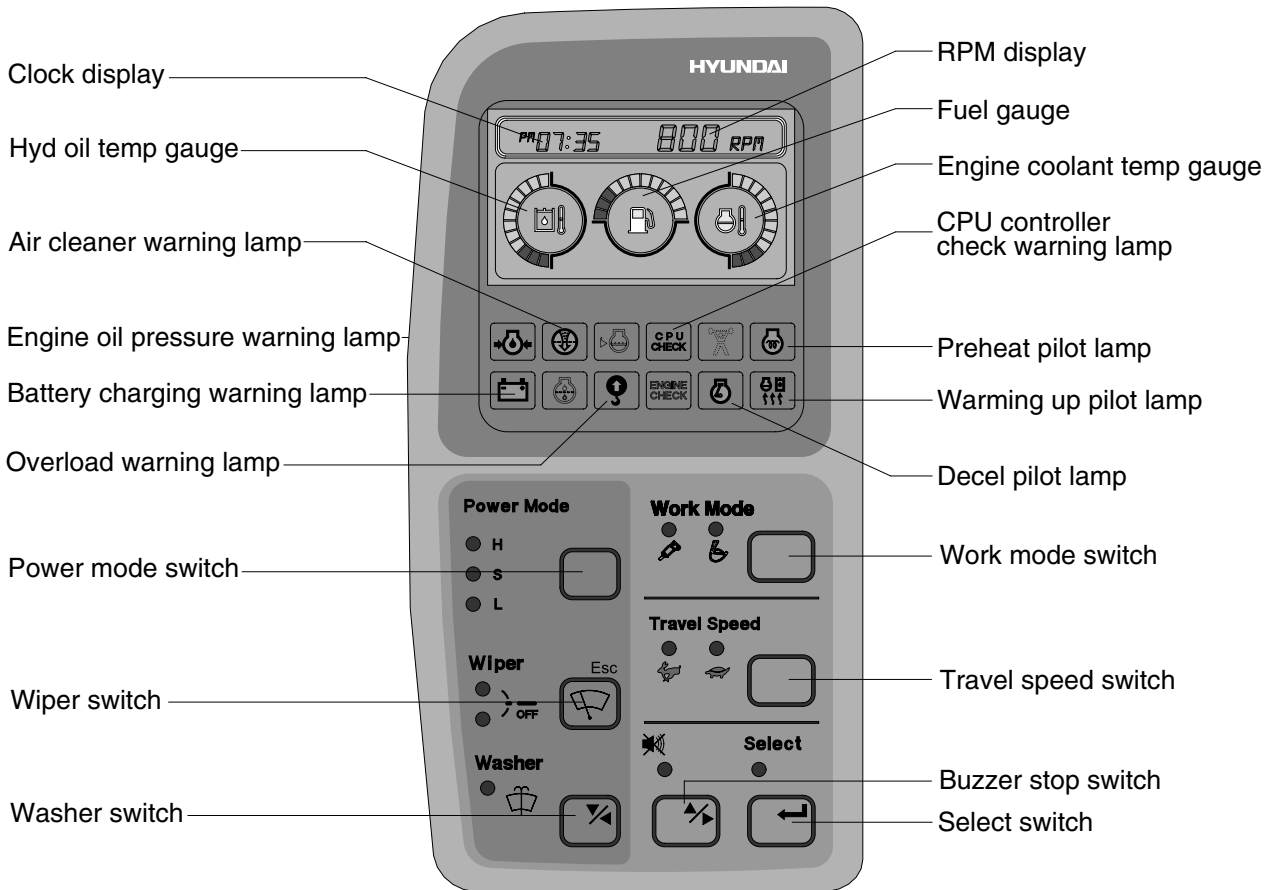
2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

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

② Check monitor after 5 seconds : Indicate cluster version and machine condition

    a. Cluster program version : 「1.00」 ◄── Indicates program version 「1.00」 for 5 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℃, the warming up lamp lights up.

③ Indicating lamp state

    a. Power mode selection : S mode
    b. Preheat : No LED ON
    c. Wiper : No LED ON
    d. Washer : No LED ON
    e. Travel speed pilot lamp : Low(Turtle)

(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. Preheat : No LED ON
    d. Power mode selection : S mode
    e. Wiper : No LED ON
    f. Washer : No 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 1200 rpm
    ※ 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)

Cluster

21075MS16

4. LCD main operation display

Default screen
1607A3CD02A

Option screen
1607A3CD02B
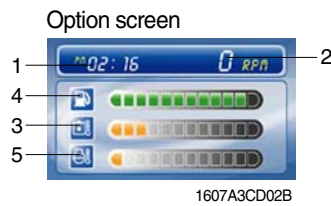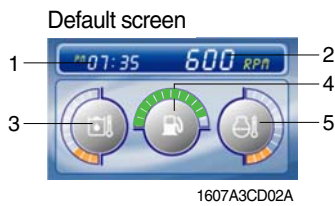
1 Time display
2 RPM display
3 Hydraulic oil temperature gauge
4 Fuel level gauge
5 Engine coolant temperature gauge

1) Time display

1607A3CD02C

① This displays the current time.
※ **Refer to the page 5-34 to set time for details.**

2) RPM display

1607A3CD02C

① This displays the engine rpm.

3) Hydraulic oil temperature gauge

12th step
1st step
1607A3CD02D
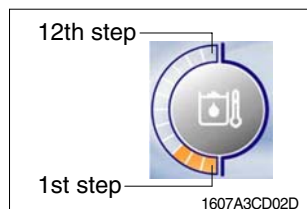
① This gauge indicates the temperature of hydraulic oil in 12 step gauge.
  · 1st step   : Below 30℃(86°F)
  · 2nd~10th step : 30-105 ℃(86-221°F)
  · 11th~12th step : Above 105℃(221°F)
② The gauge between 2nd and 10th steps illuminates when operating.
③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.
④ When the gauge of 11th and 12th steps illuminates, reduce the load on the system. If the gauge stays in the 11th~12th steps, stop the machine and check the cause of the problem.

4) Fuel level gauge

1st step
1607A3CD02E
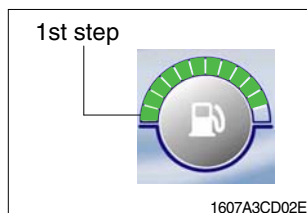
① This gauge indicates the amount of fuel in the fuel tank.
② Fill the fuel when the 1st step or fuel icon blinks in red.
※ **If the gauge illuminates the 1st step or fuel icon blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

5) Engine coolant temperature gauge

12th step
1st step
1607A3CD02F
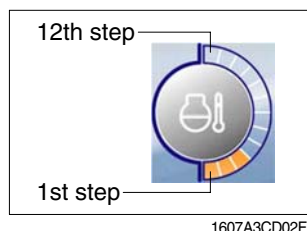
① This gauge indicates the temperature of coolant in 12 step gauge.
  · 1st step   : Below 30℃(86°F)
  · 2nd~10th step : 30-105 ℃(86-221°F)
  · 11th~12th step : Above 105℃(221°F)
② The gauge between 2nd and 10th steps illuminates when operating.
③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.
④ When the gauge of 11th and 12th steps illuminates, turn OFF the engine, check the radiator and engine.

5. Warning of main operation screen

1) Warning display

(1) Engine coolant temperature

- This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 105℃(221°F).
- Check the cooling system when the lamp blinks.

(2) Fuel level

- This lamp blinks and the buzzer sounds when the level of fuel is below 28 l (7.4U.S. gal).
- Fill the fuel immediately when the lamp blinks.

(3) Hydraulic oil temperature

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

(4) All gauge

- This lamp blinks and the buzzer sounds when the all gauge is abnormal.
- Check the each system when the lamp blinks.

(5) Communication error

- Communication problem between MCU controller and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for MCU burnt off. If not check the communication line between them.

2) Pop-up icon display

No	Switch	Selected mode	Display
1	Power mode switch	High power work mode	
		Standard power work mode	
		Light power work mode	

No	Switch	Selected mode	Display
2	Travel speed control switch	Low speed	
		High speed	

3) LCD

RD8075MS10
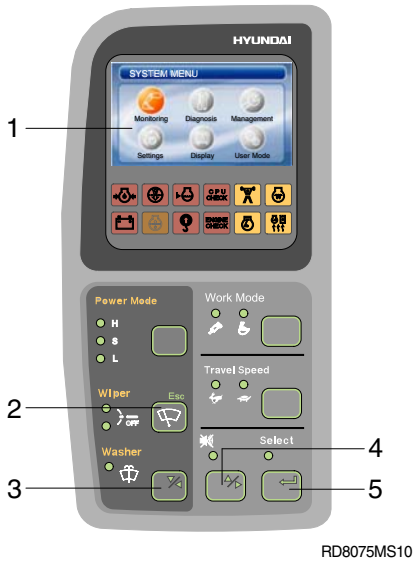
1		:	LCD
2		:	Escape, Return to the previous menu
3		:	Down/Left Direction
4		:	Up/Right Direction
5		:	Select(Enter) Activate the currently chosen item

(1) Main menu

2507A4OP94
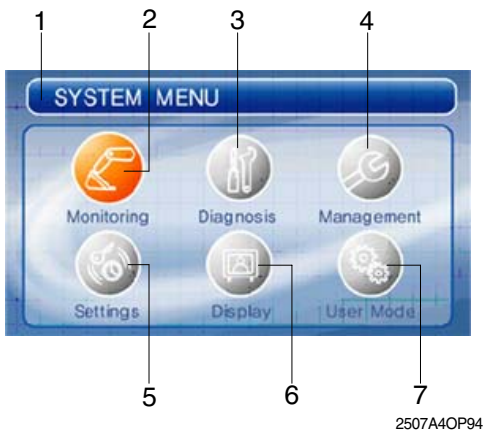
1	SYSTEM MENU	:	Menu information
2		:	Monitoring Equipment, Switch, Output
3		:	Diagnosis Current error, Recorded error
4		:	Maintenance
5		:	Settings Time set Dual mode System lock(Reserved)
6		:	Display Operation skin, Brightness, Language
7		:	User mode(null)

(2) Display map

① Monitoring
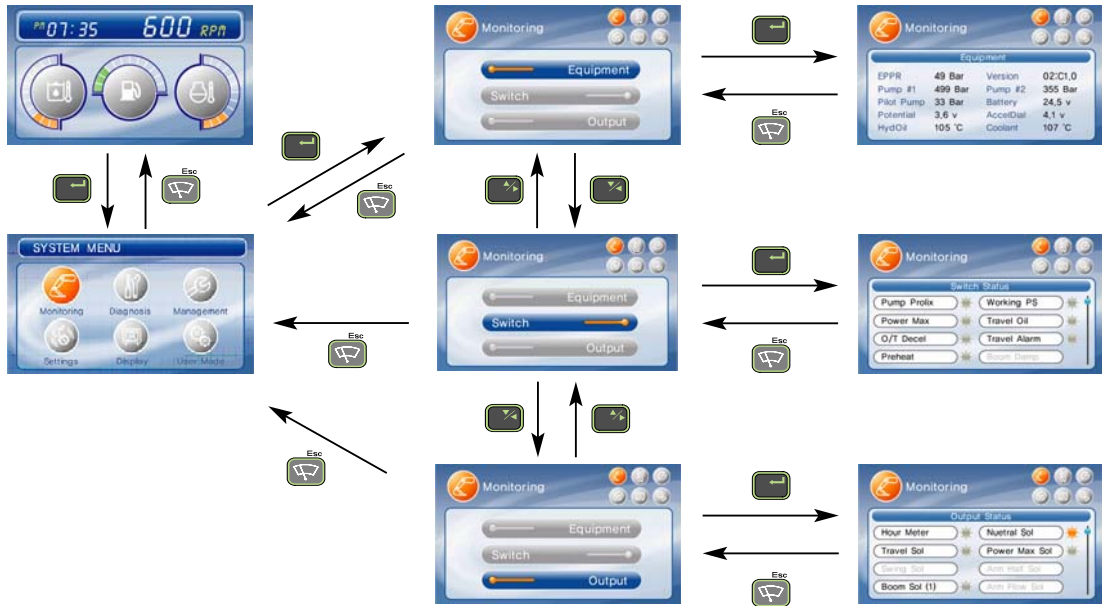
② Diagnosis

a. Protocol type 1

(Error display)

(Recorded error delete)
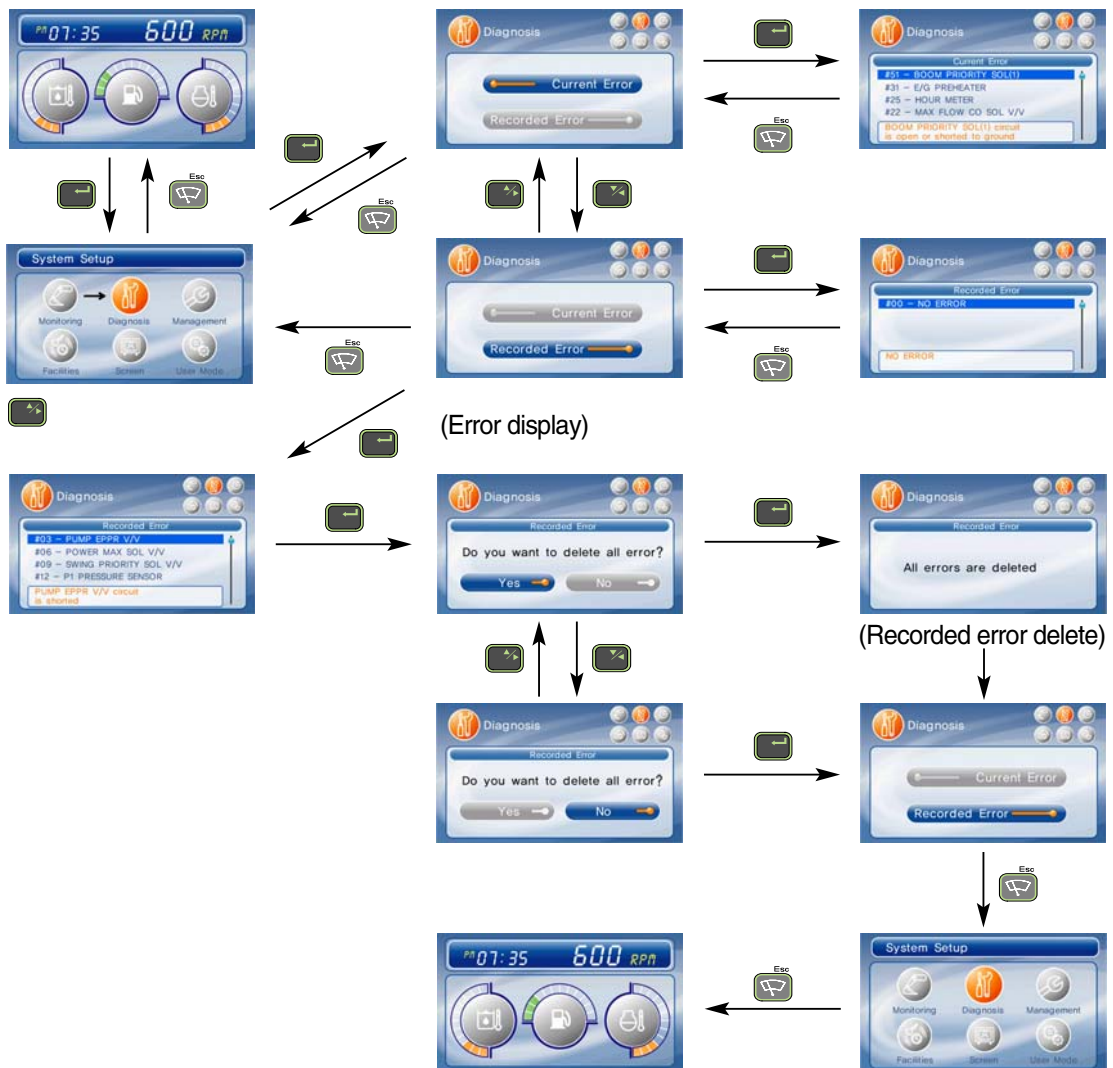
b. Protocol type 2
   - If there are more than 2 error codes, each one can be displayed by pressing ⊡ or ⊡
     switch respectively.
   - 3 error codes (①SPN200200, ②FMI06, ③SPN6789, ④FMI04, ⑤345) display.
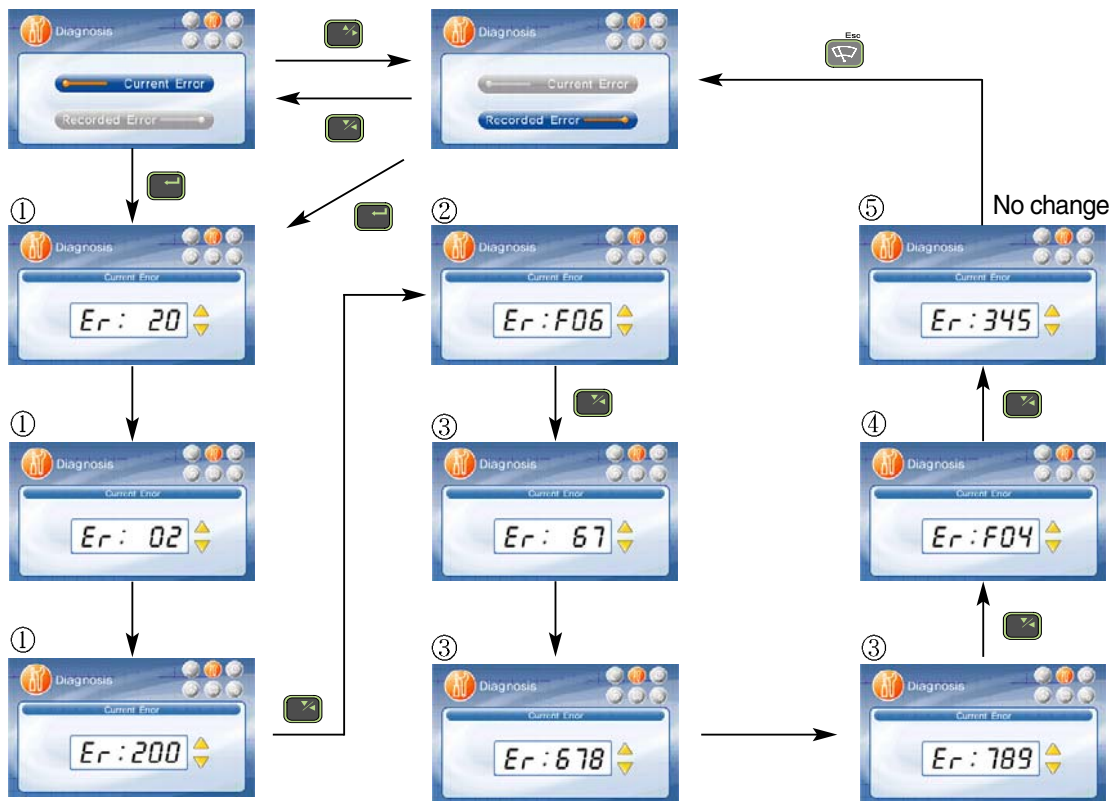
③ Maintenance
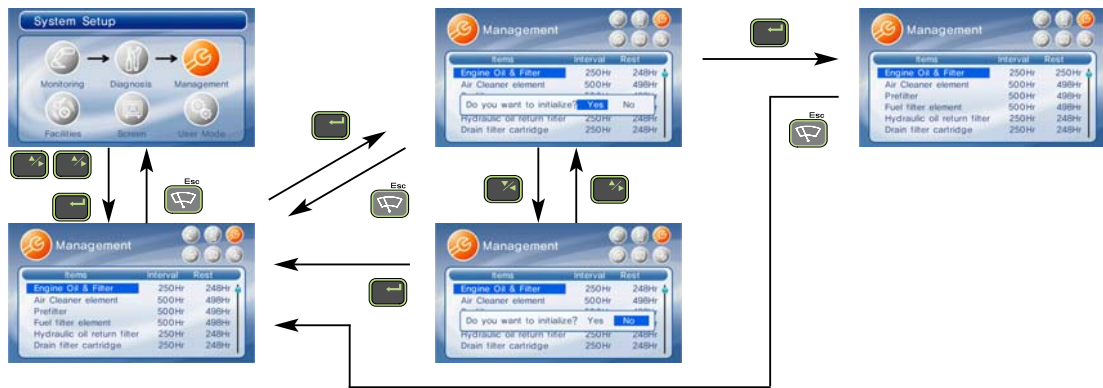
④ Setting
   a. Time set

   ⊡ ⊡ : Adjusting
   ⊡   : Setting

b. System lock - Reserved

c. Dual mode
  - Changing the MCU mode

⑤ Display
 a. Operation skin

 b. Brightness
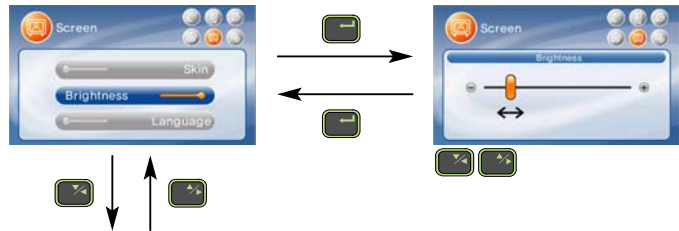
 c. Language
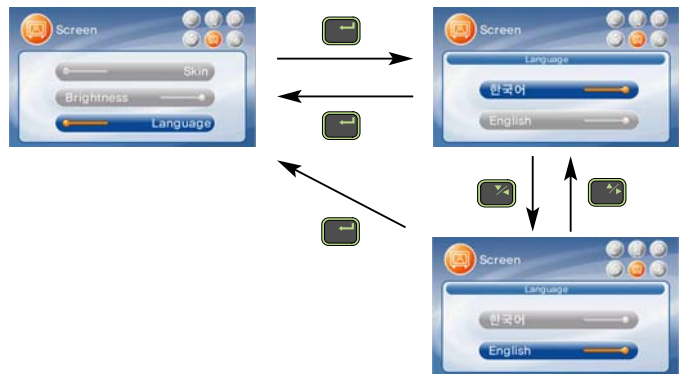
4) Warning and pilot lamp

(1) Engine oil pressure warning lamp
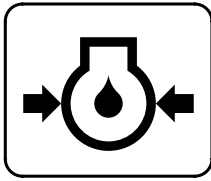
21073CD07

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.

(2) Air cleaner warning lamp
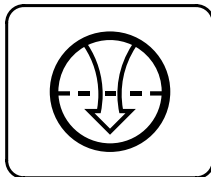
21073CD08

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.

(3) MCU controller check warning lamp

C P U
CHECK
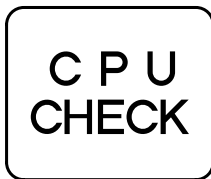
21073CD10

① If any fault code is received from MCU controller, this lamp blinks and the buzzer sounds.
② Check the communication line between MCU controller and cluster.

(4) Battery charging warning lamp
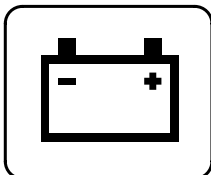
21073CD13

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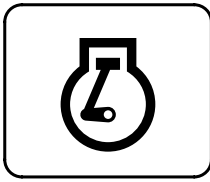② Check the battery charging circuit when this lamp blinks during engine operation.

(5) Overload warning lamp
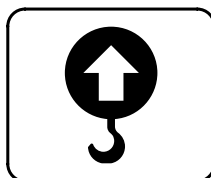
21073CD15

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

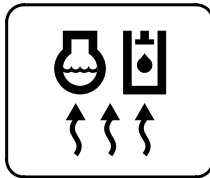## (6) Decel pilot lamp

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.

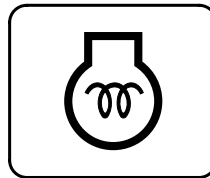## (7) Warming up pilot lamp

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.
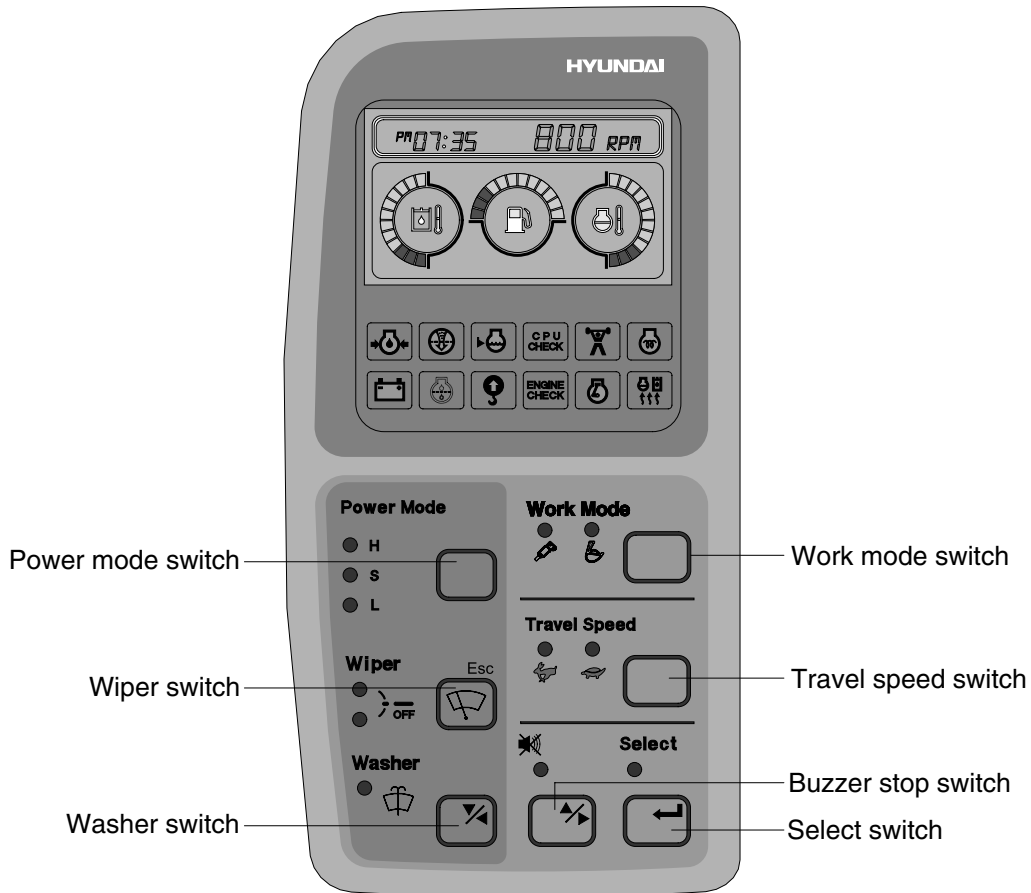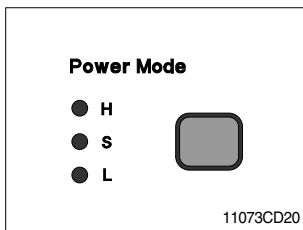
(8) Preheat pilot lamp

21073CD12

① Turning the start key switch ON position starts preheating in cold weather.
② Start the engine as this lamp is OFF.

5) SWITCH PANEL

RD8075MS11

(1) Power mode switch

11073CD20

① This switch is to select the machine power mode, which shifts from high power work to standard power work and light power work in a raw by pressing the switch.
- · H : High power work mode
- · S : Standard power work mode
- · L : Light power work mode

(2) Wiper mode switch

1107A3CD21

① This switch is used to operate wiper.
- · Press the switch once to operate wiper.
- · Press the switch once more to intermittently operate wiper low speed.
- · Press the switch once more to turn off wiper.

※ **Wiper motor doesn't operate with front sliding door open.**

※ **If wiper does not operate with the start switch in the ON position, turn the switch off immediately. Check the cause. If the switch remains ON, it can result in motor failure.**

(3) Washer switch
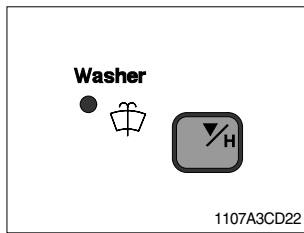
① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
② The indicator lamp is turned ON when operating this switch.

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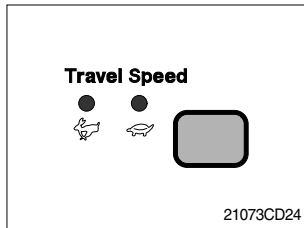
① This switch is to control the travel speed which is changed to high speed(Rabbit mark) by pressing the switch and low speed(Turtle mark) by pressing it again.

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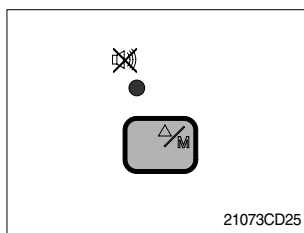
① When the starting switch is turned ON first, normally the alarm buzzer sounds for 2 seconds during lamp check operation.
② The red lamp lights ON and the buzzer sounds when the machine has a problem.
  In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

(6) Select switch

① This switch is used to enter main menu and sub menu for LCD.
※ **Refer to the page 5-32 for details.**

(7) Work mode switch
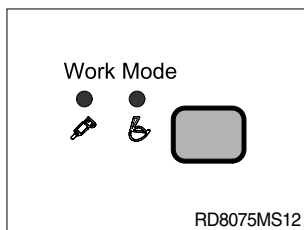
① This switch is to select the machine operation mode, which shifts from general operation mode to breaker mode by pressing the switch.
  · ᛣ : General work mode
  · ᛢ : Breaker operation mode