

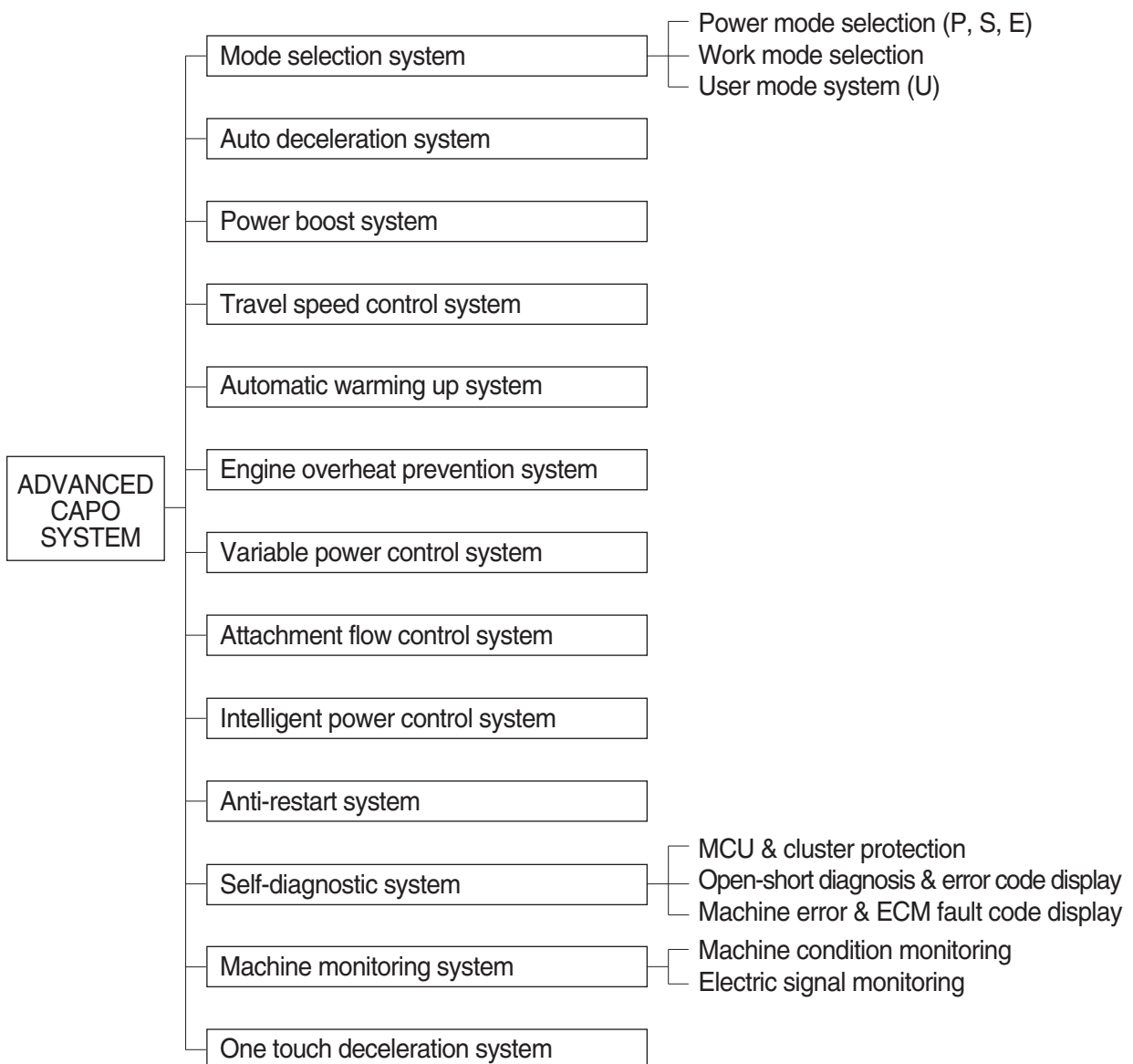
## SECTION 5 MECHATRONICS SYSTEM

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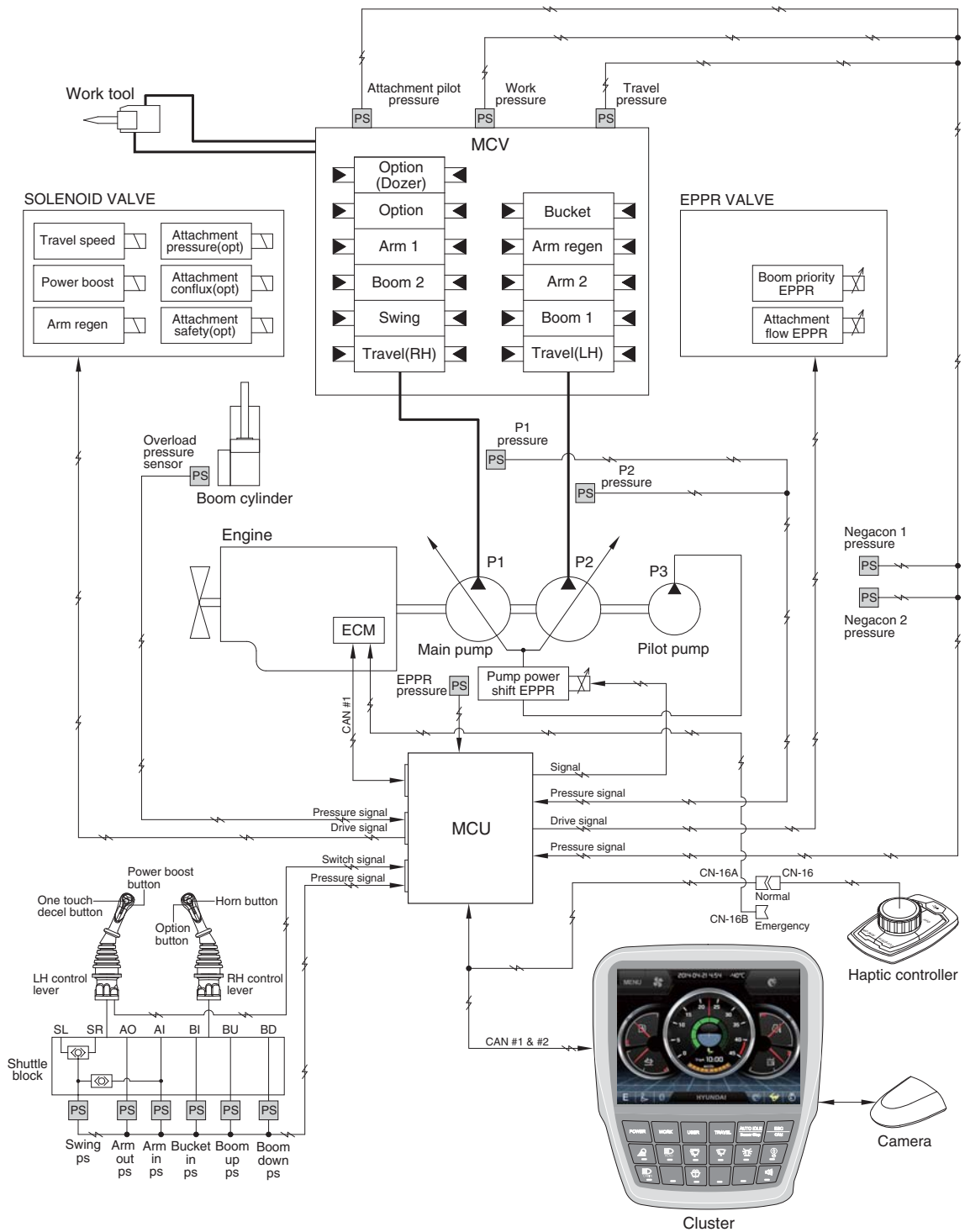
# SECTION 5 MECHATRONICS SYSTEM

## GROUP 1 OUTLINE

The ADVANCED 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 of a MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.



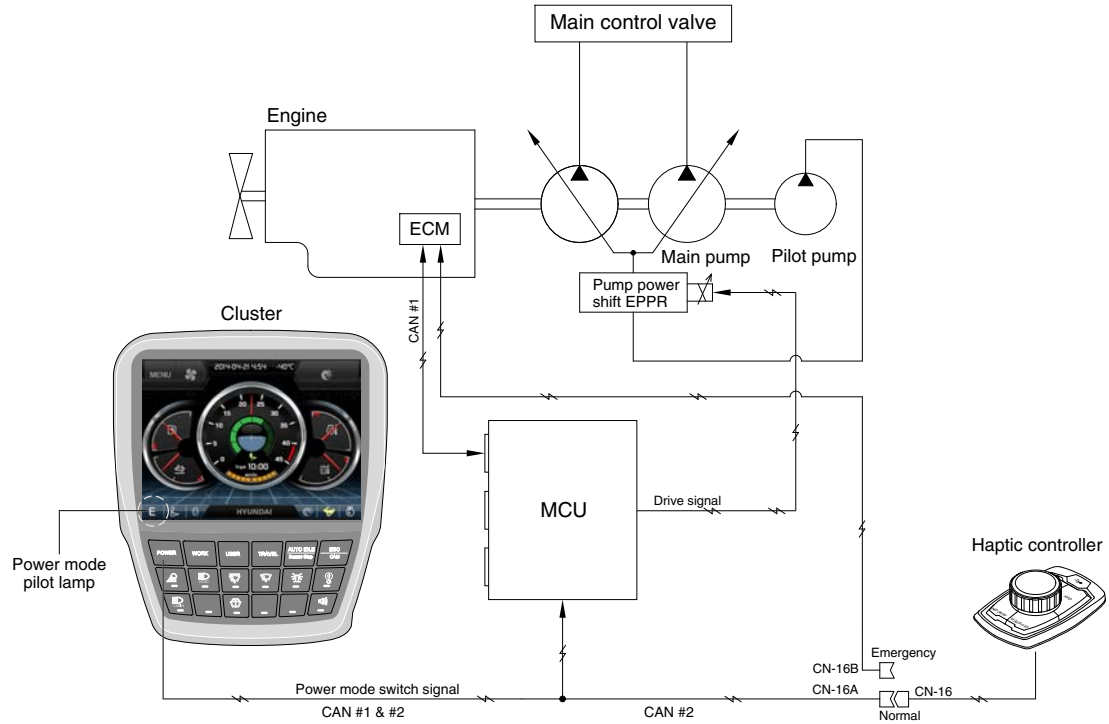
# SYSTEM DIAGRAM



140LC5MS04

# GROUP 2 MODE SELECTION SYSTEM

## 1. POWER MODE SELECTION SYSTEM



140L5MS02

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

The combination of 3 power modes (P, S, E) and acceleration mode (10 set) of haptic controller 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.

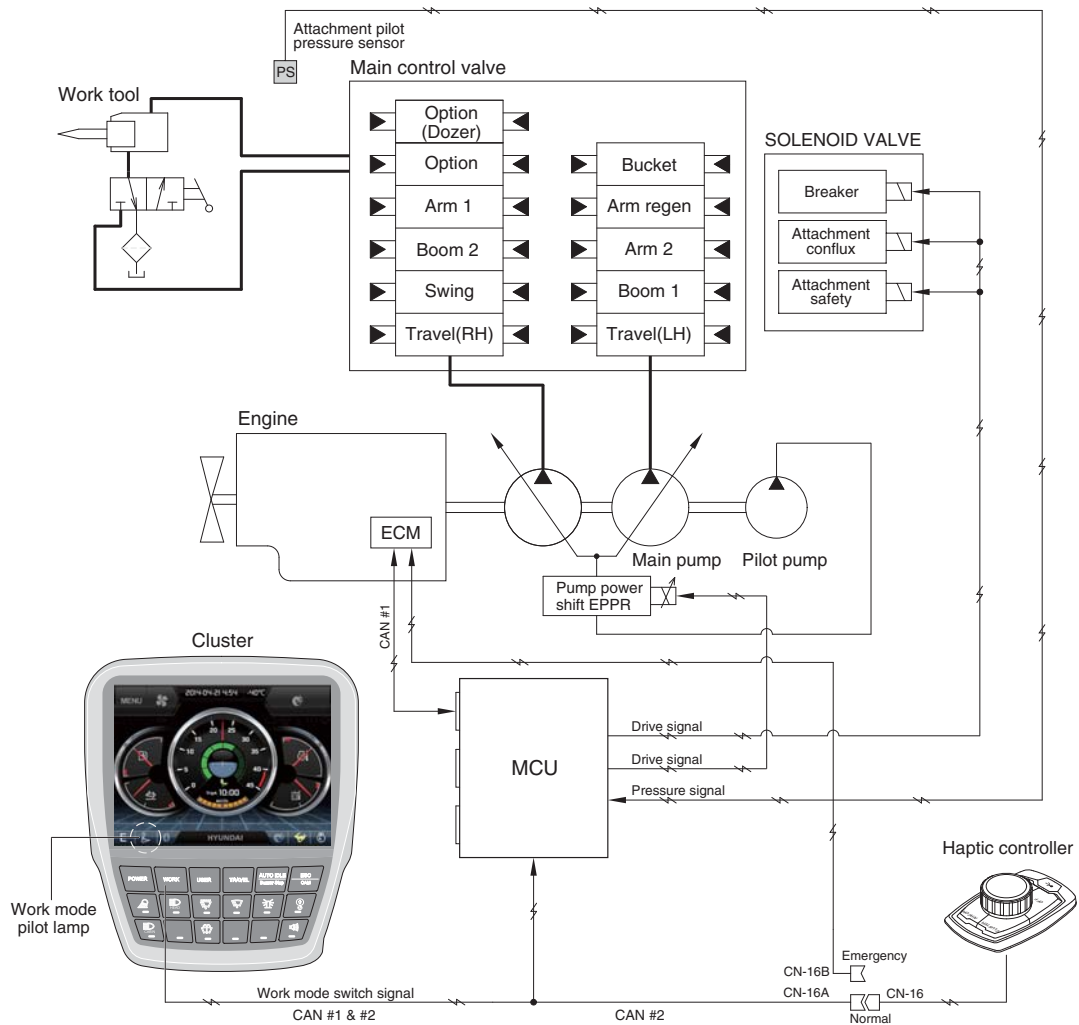
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm <sup>2</sup> )	Current (mA)	Pressure (kgf/cm <sup>2</sup> )
P	Heavy duty power	1850 ± 50	1950 ± 50	1850 ± 50	2000 ± 50	400 ± 30	15 (10)	330 ± 30	10 (5)
S	Standard power	1750 ± 50	1850 ± 50	1750 ± 50	1900 ± 50	460 ± 30	18 (13) ± 3	365 ± 30	13 (8) ± 3
E	Economy operation	1650 ± 50	1750 ± 50	1650 ± 50	1800 ± 50	500 ± 30	20 (15) ± 3	400 ± 30	15 (10) ± 3
AUTO DECEL	Engine deceleration	1100 ± 100	-	1100 ± 100	-	700 ± 30	38 ± 3	700 ± 30	38 ± 3
One touch decel	Engine quick deceleration	1000 ± 100	-	1000 ± 100	-	700 ± 30	38 ± 3	700 ± 30	38 ± 3
KEY START	Key switch start position	1000 ± 100	-	1000 ± 100	-	700 ± 30	38 ± 3	700 ± 30	38 ± 3

※ Power shift (Standard/Option) can be changed by "Service menu" in "Management" on the cluster.

※ (~\*) : Load

## 2. WORK MODE SELECTION SYSTEM

Work mode consists of the general operation (bucket) and the optional attachment (breaker, crusher).



140LC5MS05

### 1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

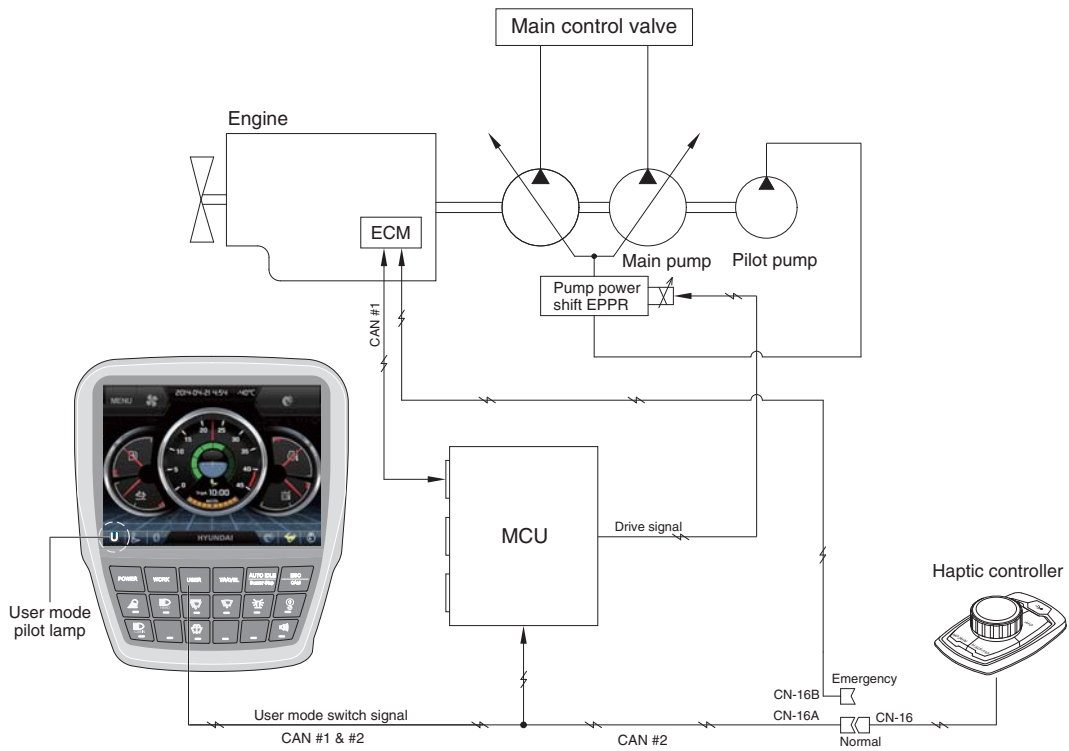
### 2) ATT WORK MODE (breaker, crusher)

It controls the pump flow and system pressure according to the operation of breaker or crusher.

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	-	ON
Attachment conflux solenoid	OFF	ON/OFF	ON/OFF
Attachment flow EPPR current	100 mA	100~700 mA	100~700 mA
Breaker solenoid*	OFF	ON	-

★ When breaker operating button is pushed.

### 3. USER MODE SELECTION SYSTEM



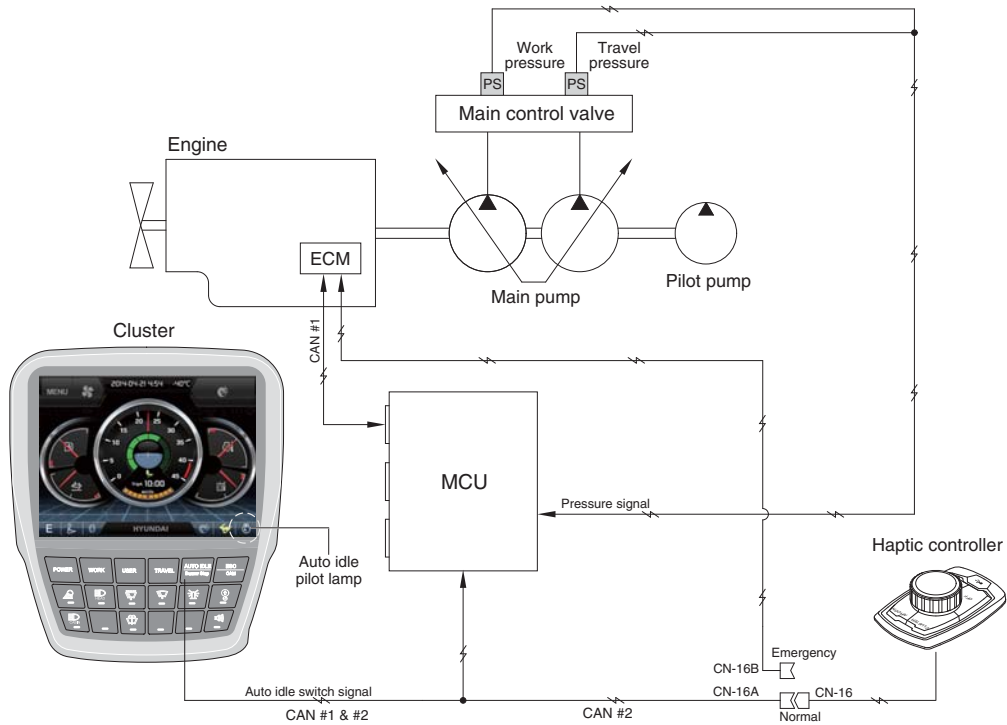
140L5MS104

1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

#### 2) LCD segment vs parameter setting

Step ( )	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000	16
7	1850	1050	20
8	1900	1100 (auto decel)	26
9	1950	1150	32
10	2000	1200	38

## GROUP 3 AUTOMATIC DECELERATION SYSTEM

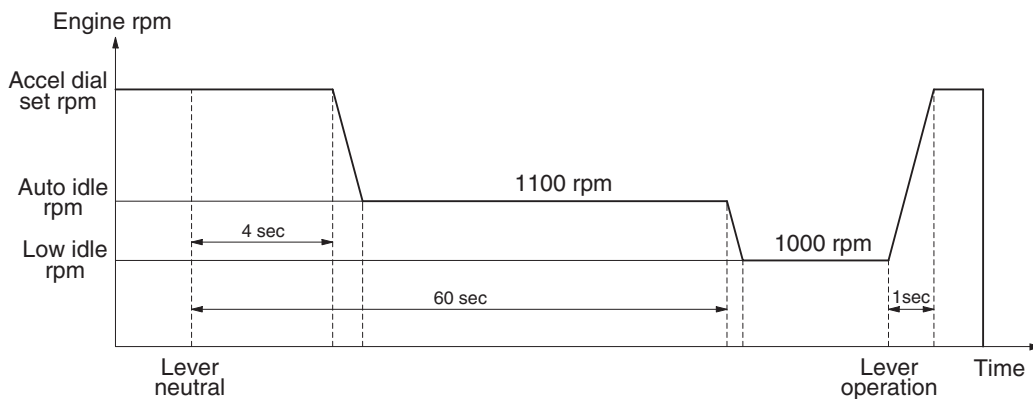


140L5MS5

### 1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1100 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1000 rpm. 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 idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.



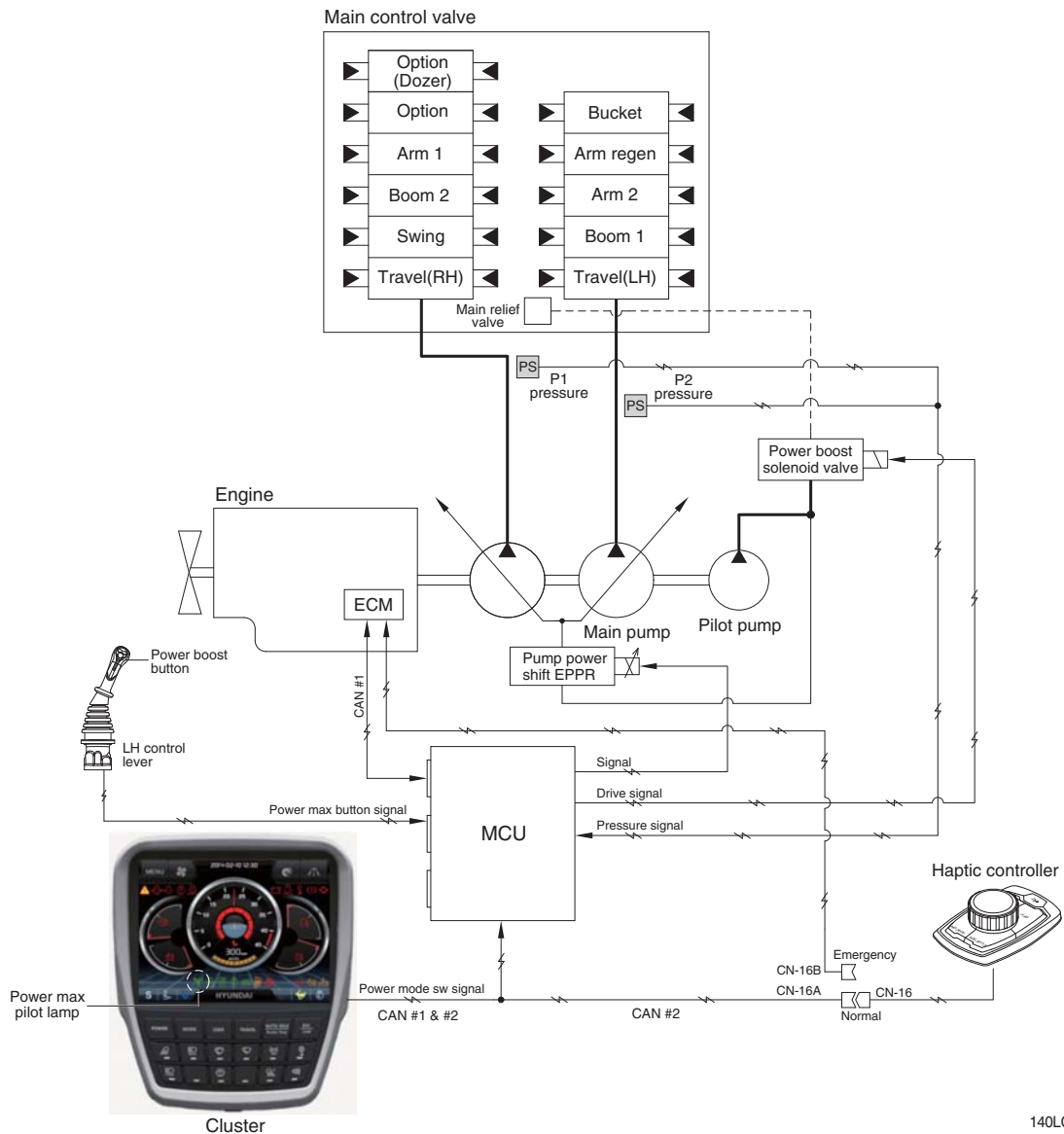
140L5MS01

### 2. WHEN AUTO IDLE PILOT LAMP OFF

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

※ Auto idle function can be activated when multimodal dial position is over 4.

## GROUP 4 POWER BOOST SYSTEM



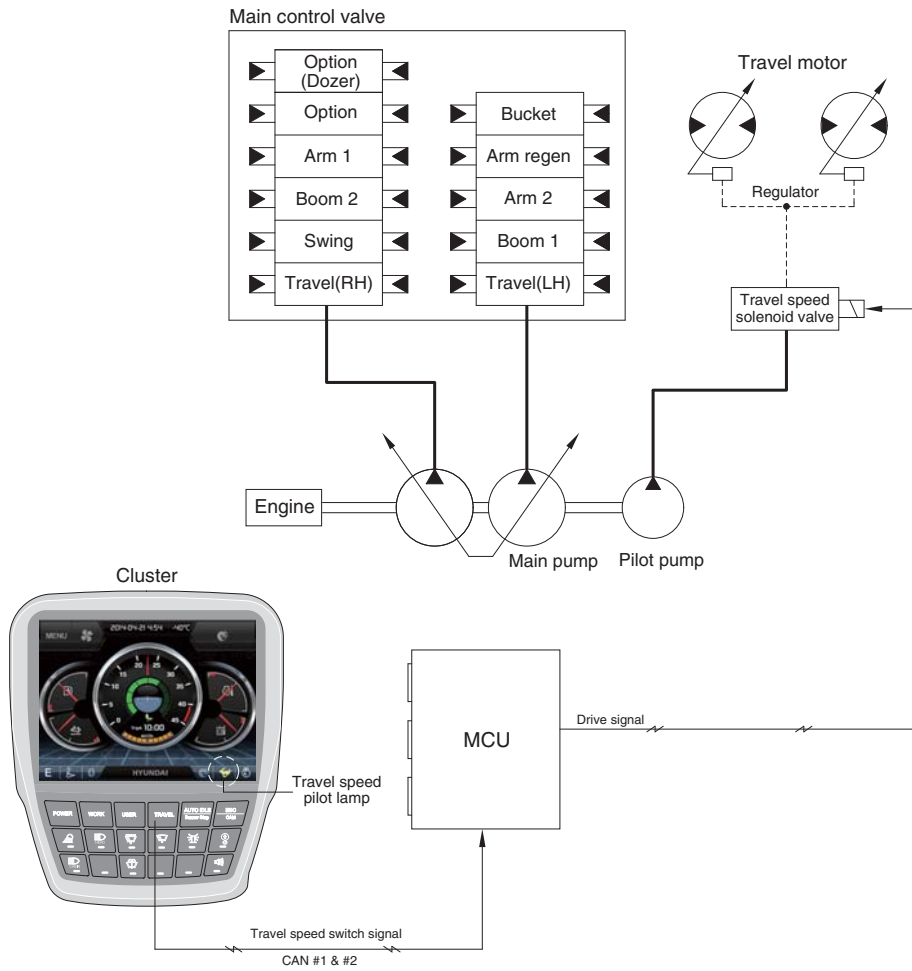
- When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.
- When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase the digging power.

Description	Condition	Function
Activated	Power boost switch : ON Accel dial : over 8	- Power mode : P - Accel dial power : 9 - Power boost solenoid : ON - Power boost pilot lmap : ON - Operating time : max 8 seconds
Canceled	Power boost switch : OFF	- Pre-set power mode - Power boost solenoid : OFF - Power boost pilot lamp : OFF

※ When the auto power boost is set to Enable and power mode is set to P mode on the cluster, the digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.



# GROUP 5 TRAVEL SPEED CONTROL SYSTEM



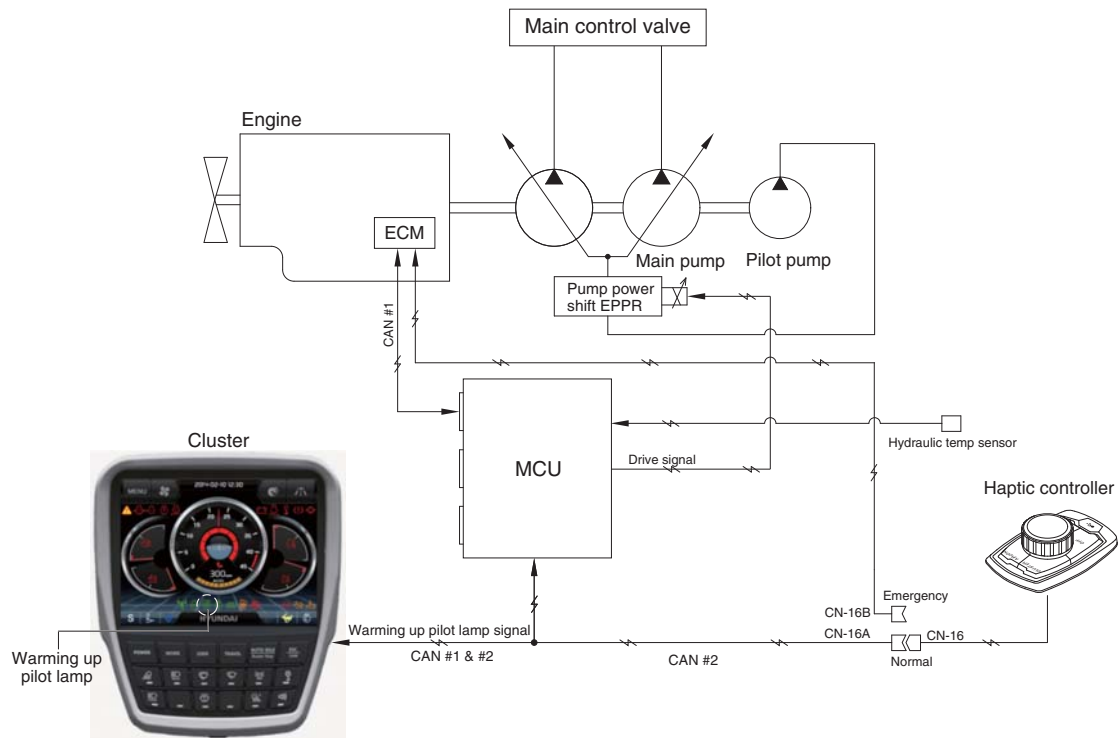
140LC5MS07

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

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

※ Default : Turtle (Low)

## GROUP 6 AUTOMATIC WARMING UP SYSTEM



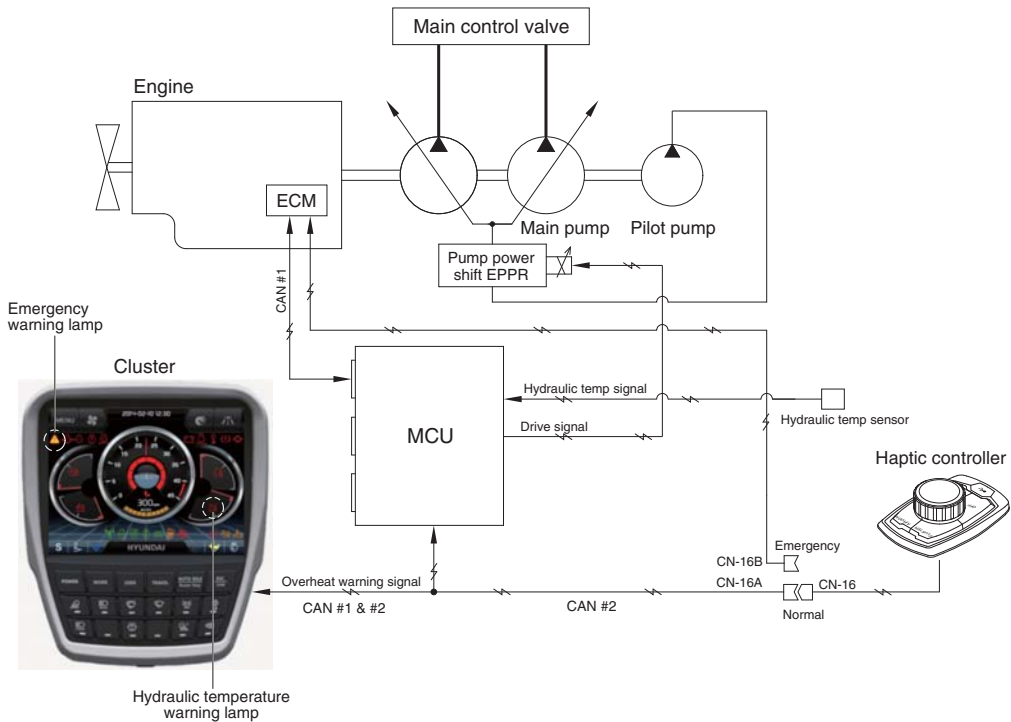
140L5MS08

1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30°C, it increases the engine speed from key start rpm to 1100 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.
2. In case of the coolant temperature increases up to 30°C, the engine speed is decreased to key start speed. And if an operator changes power mode set during the warming up function, the MCU cancels the automatic warming up function.

### 3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : below 30°C (after engine run)	- Power mode : Default (E mode) - Warming up time : 10 minutes (max) - Warming up pilot lamp : ON
Canceled	- Coolant temperature : Above 30°C - Warming up time : Above 10 minutes - Changed power mode set by operator - RCV lever or pedal operating - Auto idle cancel ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Power mode : set mode - Warming up pilot lamp : OFF

## GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

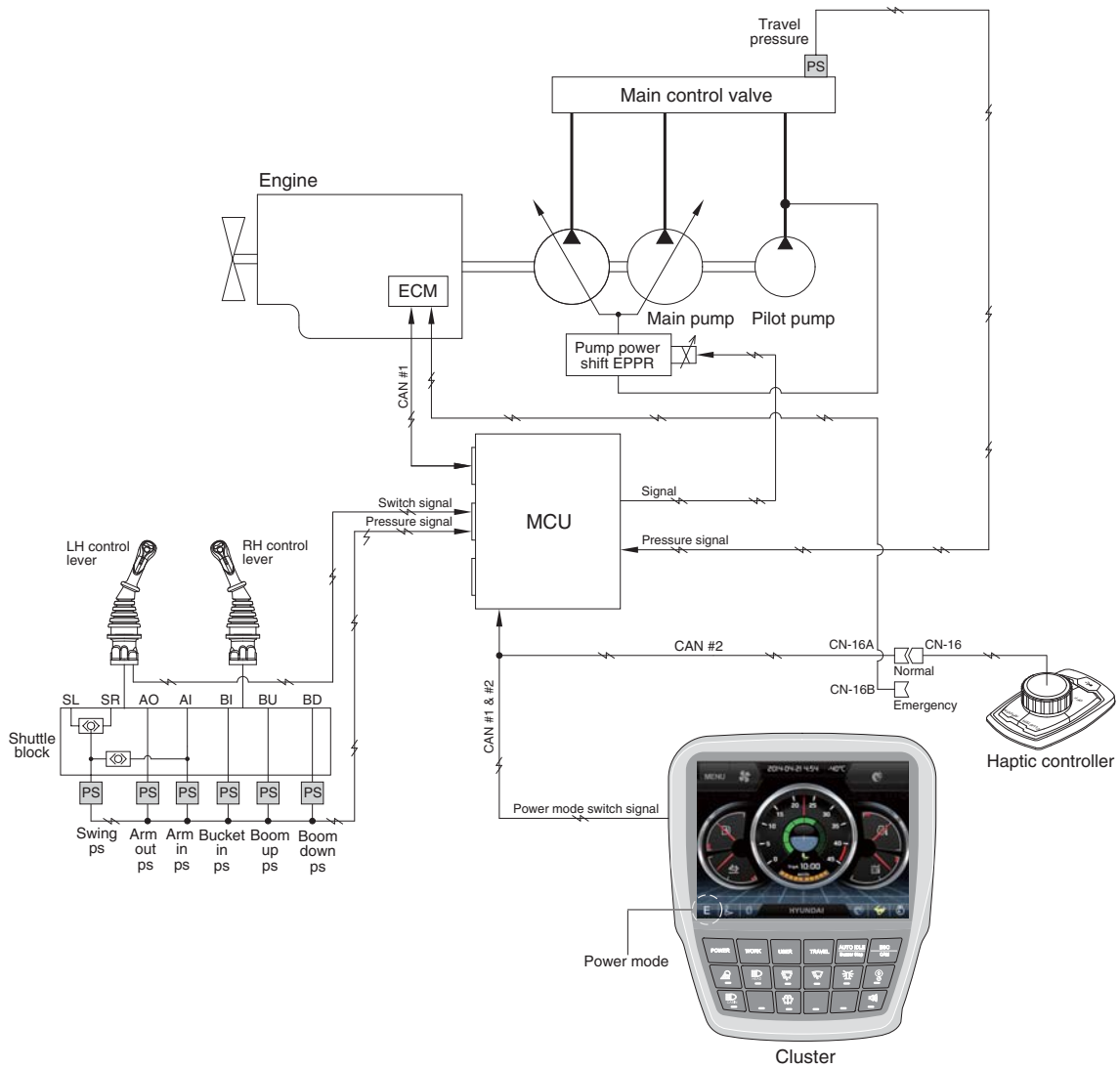


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100°C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

### 2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 103°C - Hydraulic oil temperature : Above 100°C	- Warning lamp : ON , buzzer : OFF - Pump input torque is reduced.
	Canceled	- Coolant temperature : Less than 100°C - Hydraulic oil temperature : Less than 95°C	- Warning lamp & buzzer : ON - Pump input torque is reduced.
Second step warning	Activated	- Coolant temperature : Above 107°C - Hydraulic oil temperature : Above 105°C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 103°C - Hydraulic oil temperature : Less than 100°C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

## GROUP 8 VARIABLE POWER CONTROL SYSTEM



140LC5MS10

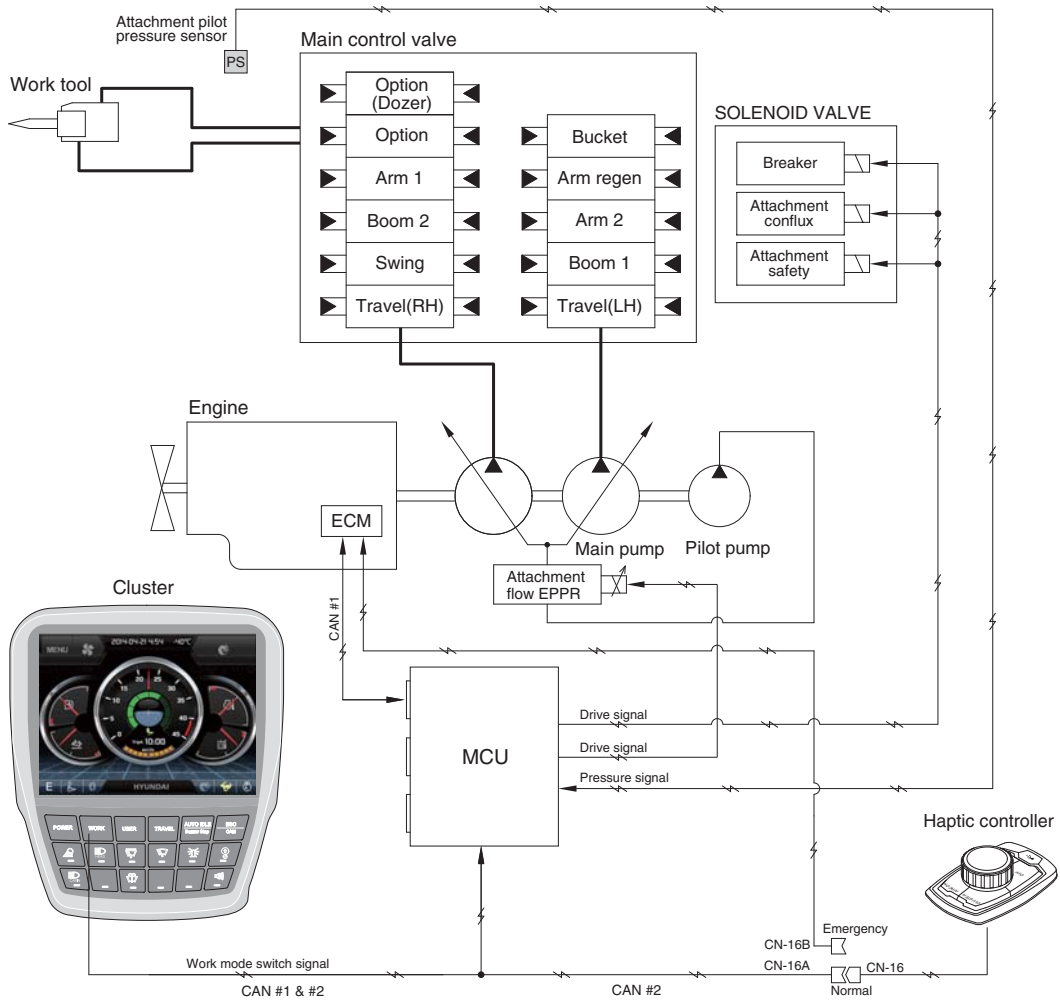
- The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.

It makes fuel saving and smooth control at precise work.

Description	Working condition
Power mode	P, S, E
Work mode	General (bucket)
Pressure sensor	Normal

※ The variable power control function can be activated when the power mode is set to all power mode.

## GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



140LC5MS11

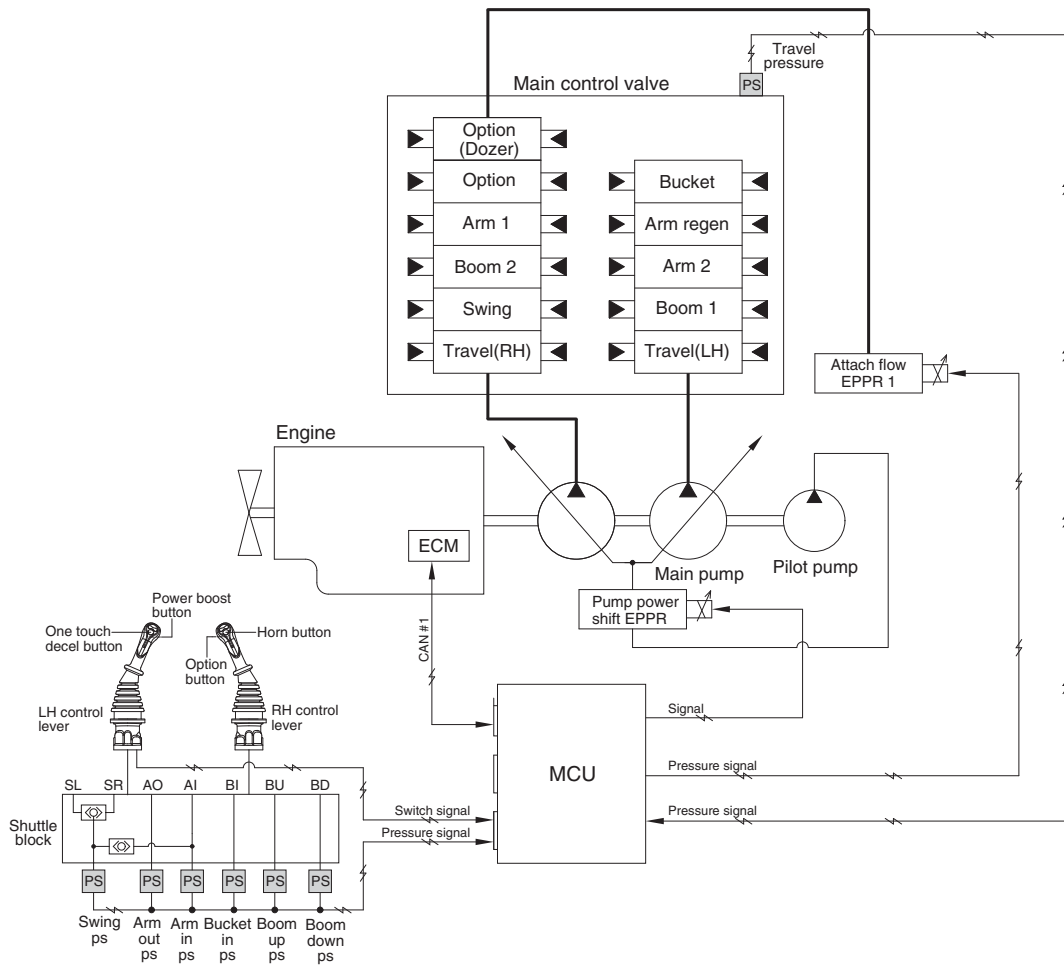
- The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	100 ~ 180 lpm	100 ~ 440 lpm
Attach safety solenoid	-	ON
Attach conflux solenoid	ON/OFF	ON/OFF
Breaker solenoid★	ON	-

※ Refer to the page 5-79 for the attachment kinds and max flow.

★ When breaker operating button is pushed.

# GROUP 10 INTELLIGENT POWER CONTROL SYSTEM



140LC5MS18

1. When the requirement of pump flow rate is low, IPC mode controls pump flow rate to improve fuel efficiency.

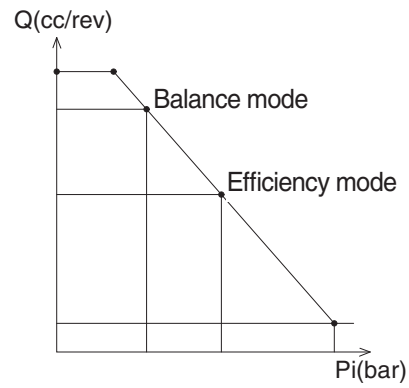
Condition*1	Function
IPC mode : ON*2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

\*1 AND condition

\*2 IPC mode ON/OFF is selected at "Mode setup > IPC mode". See next page.

## 2. IPC MODE SELECTION

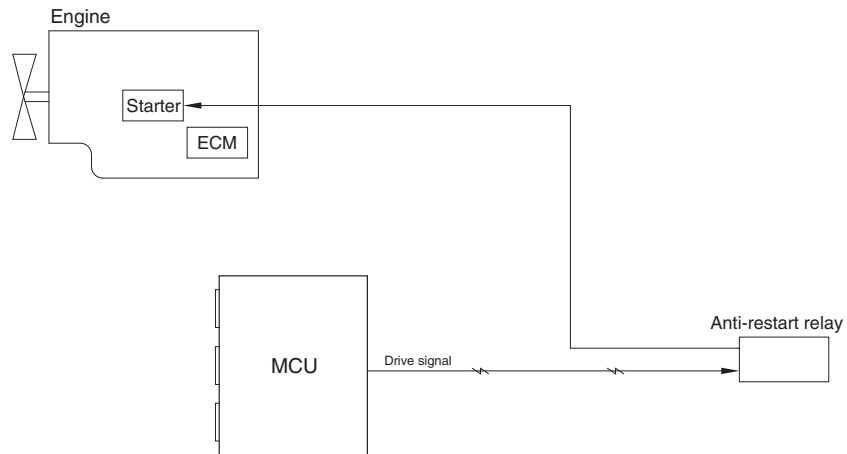
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



290F3CD311

IPC mode	Description
Balance mode (default)	IPC mode ON, limit level 1
Efficiency mode	IPC mode ON, limit level 2
Speed mode	IPC mode OFF

## GROUP 11 ANTI-RESTART SYSTEM



140L5MS12

### 1. ANTI-RESTART FUNCTION

After a few seconds from the engine starts to run, MCU turns off the start safety relay to protect the starter from inadvertent restarting.



## GROUP 12 SELF-DIAGNOSTIC SYSTEM

### 1. OUTLINE

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

### 2. MONITORING

#### 1) ACTIVE FAULT



- The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

#### 2) LOGGED FAULT



- The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

#### 3) DELETE LOGGED FAULT



- The logged faults of the MCU, engine ECM or air conditioner can be deleted by this menu.

## MACHINE ERROR CODES TABLE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Hydraulic oil temperature display failure 2. Control Function – Fan revolutions control failure (Checking list) 1. CD-1 (#2)- CN-51 (#16) Checking Open/Short 2. CD-1 (#1)- CN-51 (#24, #25) Checking Open/Short				
105	0	10 seconds continuous, Working Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Working Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Working Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Working Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure (Checking list) 1. CD-7 (#B) – CN-52 (#19) Checking Open/Short 2. CD-7 (#A) – CN-51 (#32) Checking Open/Short 3. CD-7 (#C) – CN-51 (#31) Checking Open/Short				
108	0	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V		●	
	1	10 seconds continuous, $0.3V \leq$ Travel Oil Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Travel Oil Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure, IPC operation failure, Driving alarm operation failure (Checking list) 1. CD-6 (#B) – CN-52 (#27) Checking Open/Short 2. CD-6 (#A) – CN-51 (#32) Checking Open/Short 3. CD-6 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
120	0	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump 1 (P1) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure  (Checking list) 1. CD-42 (#B) – CN-52 (#22) Checking Open/Short 2. CD-42 (#A) – CN-51 (#32) Checking Open/Short 3. CD-42 (#C) – CN-51 (#31) Checking Open/Short				
121	0	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Main Pump 2 (P2) Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure  (Checking list) 1. CD-43 (#B) – CN-51 (#14) Checking Open/Short 2. CD-43 (#A) – CN-51 (#32) Checking Open/Short 3. CD-43 (#C) – CN-51 (#31) Checking Open/Short				
122	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, $0.3V \leq$ Overload Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Overload Press. display failure 2. Control Function – Overload warning alarm failure  (Checking list) 1. CD-31 (#B) – CN-52 (#28) Checking Open/Short 2. CD-31 (#A) – CN-51 (#32) Checking Open/Short 3. CD-31 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
123	0	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Negative 1 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Negative 1 Press. display failure 2. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CD-70 (#B) – CN-51 (#22) Checking Open/Short 2. CD-70 (#A) – CN-51 (#32) Checking Open/Short 3. CD-70 (#C) – CN-51 (#31) Checking Open/Short				
124	0	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Negative 2 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Negative 2 Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-71 (#B) – CN-51 (#28) Checking Open/Short 2. CD-71 (#A) – CN-51 (#32) Checking Open/Short 3. CD-71 (#C) – CN-51 (#31) Checking Open/Short				
127	0	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Up Pilot Press. display failure 2. Control Function – Engine/Pump variable horse power control operation failure, IPC operation failure, Boom first operation failure (Checking list) 1. CD-32 (#B) – CN-52 (#23) Checking Open/Short 2. CD-32 (#A) – CN-51 (#32) Checking Open/Short 3. CD-32 (#C) – CN-5 1(#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
128	0	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, $0.3V \leq$ Boom Down Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Down Pilot Press. display failure 2. Control Function – Boom floating operation failure (Checking list) 1. CD-85 (#B) – CN-52 (#31) Checking Open/Short 2. CD-85 (#A) – CN-51 (#32) Checking Open/Short 3. CD-85 (#C) – CN-51 (#31) Checking Open/Short				
129	0	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage > 4.8V	●		
	1	10 seconds continuous, $0.3V \leq$ Arm In Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm In Pilot Press. display failure 2. Control Function – IPC operation failure (Checking list) 1. CD-90 (#B) – CN-51 (#21) Checking Open/Short 2. CD-90 (#A) – CN-51 (#32) Checking Open/Short 3. CD-90 (#C) – CN-51 (#31) Checking Open/Short				
133	0	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, $0.3V \leq$ Arm Out Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm Out Pilot Press. display failure 2. Control Function – Engine variable horse power control operation failure (Checking list) 1. CD-35 (#B) – CN-52 (#27) Checking Open/Short 2. CD-35 (#A) – CN-51 (#32) Checking Open/Short 3. CD-35 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
135	0	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Swing Pilot Press. display failure 2. Control Function – IPC operation, Boom first operation failure (Checking list) 1. CD-24 (#B) – CN-52 (#18) Checking Open/Short 2. CD-24 (#A) – CN-51 (#32) Checking Open/Short 3. CD-24 (#C) – CN-51 (#31) Checking Open/Short				
138	0	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, 0.3V ≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Attachment Pilot Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-69 (#B) – CN-52 (#32) Checking Open/Short 2. CD-69 (#A) – CN-51 (#32) Checking Open/Short 3. CD-69 (#C) – CN-51 (#31) Checking Open/Short				
139	1	10 seconds continuous, 0.3V ≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Option Pilot Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Option Pilot Press. display failure 2. Control Function – Auto Idle operation failure (Checking list) 1. CD-100 (#B) – CN-52 (#21) Checking Open/Short 2. CD-100 (#A) – CN-51 (#3) Checking Open/Short 3. CD-100 (#C) – CN-1 (#6) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
140	5	(Detection) (When Main Pump EPPR Current is more than 10 mA) 10 seconds continuous, Main Pump EPPR drive current < 0 mA (Cancellation) (When Main Pump EPPR Current is more than 10 mA) 3 seconds continuous, Main Pump EPPR drive current ≥10 mA	●		
	6	(Detection) 10 seconds continuous, Main Pump EPPR drive current > 1.0A (Cancellation) 3 seconds continuous, Main Pump EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Main Pump horse power setting specification difference (Fuel efficiency/speed specification failure) (Checking list) 1. CN-75 (#2) – CN-54 (#28) Checking Open/Short 2. CN-75 (#1) – CN-54 (#1) Checking Open/Short				
141	5	(Model Parameter) mounting Boom Priority EPPR (Detection) (When Boom Priority EPPR Current is more than 10 mA) 10 seconds continuous, Boom Priority EPPR drive current < 0 mA (Cancellation) (When Boom Priority EPPR Current is more than 10 mA) 3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, Boom Priority EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Boom first control operation failure (Checking list) 1. CN-133 (#2) – CN-54 (#34) Checking Open/Short 2. CN-133 (#1) – CN-54 (#4) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
143	5	(Detection) (When Travel EPPR Current is more than 10 mA) 10 seconds continuous, Travel EPPR drive current = 0 mA (Cancellation) (When Travel EPPR Current is more than 100 mA) 3 seconds continuous, Travel EPPR drive current $\geq$ 10 mA			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current $\leq$ 1.0 A			●
(Results / Symptoms) 1. Control Function – cruise control operation failure (Checking list) 1. CN-246 (#2) – CN-54 (#39) Checking Open/Short 2. CN-246 (#1) – CN-51 (#40) Checking Open/Short					
145	5	(Model Parameter) mounting Remote Cooling Fan EPPR (Detection) (When Remote Cooling Fan EPPR Current is more than 10 mA) 10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA (Cancellation) (When Remote Cooling Fan EPPR Current is more than 10 mA) 3 seconds continuous, Remote Cooling Fan EPPR drive current $\geq$ 10 mA	●		
	6	(Detection) 10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Remote Cooling Fan EPPR drive current $\leq$ 1.0 A	●		
(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CN-385 (#3) – CN-53 (#7) Checking Open/Short 2. CN-385 (#1) – CN-51 (#3) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General                      C : Crawler Type                      W : Wheel Type



DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
164	4	(Detection) (When Working Cutoff Relay is Off) 10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Working Cutoff Relay is Off) 3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage $> 3.0V$			●
	6	(Detection) (When Working Cutoff Relay is On) 10 seconds continuous, Working Cutoff Relay drive current $> 6.5 A$ (Cancellation) (When Working Cutoff Relay is On) 3 seconds continuous, Working Cutoff Relay drive current $\leq 6.5 A$			●
(Results / Symptoms) 1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure  (Checking list) 1. CR-47 (#85) – CN-54 (#9) Checking Open/Short 2. CR-47 (#30, #86) – Fuse box (#28) Checking Open/Short					
166	4	(Detection) (When Power Max Solenoid is Off) 10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Power Max Solenoid is Off) 3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage $> 3.0V$	●		
	6	(Detection) (When Power Max Solenoid is On) 5 seconds continuous, Power Max Solenoid drive current $> 4.5 A$ (Cancellation) (When Power Max Solenoid is On) 3 seconds continuous, Power Max Solenoid drive current $\leq 4.5 A$	●		
(Results / Symptoms) 1. Control Function – Voltage increase operation failure  (Checking list) 1. CN-88 (#1) – CN-53 (#10) Checking Open/Short 2. CN-88 (#2) – Fuse box (#31) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $> 3.0V$		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage $> 3.0V$			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current $> 4.5 A$ (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current $\leq 4.5 A$	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#1) – CN-52 (#5) Checking Open/Short 2. CN-70 (#2) – Fuse box (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
169	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Attachment Conflux Solenoid is Off) 10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Attachment Conflux Solenoid is Off) 3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage $> 3.0V$	●		
	6	(Detection) (When Attachment Conflux Solenoid is On) 10 seconds continuous, Attachment Conflux Solenoid drive Current $> 6.5 A$ (Cancellation) (When Attachment Conflux Solenoid is On) 3 seconds continuous, Attachment Conflux Solenoid drive Current $\leq 6.5 A$	●		
	(Results / symptoms) 1. Control Function – Option attachment flow control – Joining operation failure (Eco breaker mode, crusher mode) (Checking list) 1. CN-237 (#1) – CN-52 (#16) Checking Open/Short 2. CN-237 (#2) – Fuse box (#28) Checking Open/Short				
170	4	(Model Parameter) mounting Arm Regenerating Solenoid (Detection) (When Arm Regeneration Solenoid is Off) 10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Arm Regeneration Solenoid is Off) 3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage $> 3.0V$	●		
	6	(Detection) (When Arm Regeneration Solenoid is On) 10 seconds continuous, Arm Regeneration Solenoid drive current $> 4.5 A$ (Cancellation) (When Arm Regeneration Solenoid is On) 3 seconds continuous, Arm Regeneration Solenoid drive current $\leq 4.5 A$	●		
	(Results / symptoms) 1. Control Function – Arm regeneration operation failure (Checking list) 1. CN-135 (#1) – CN-52 (#7) Checking Open/Short 2. CN-135 (#2) – Fuse box (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
171	4	Monitor – Selecting attachment(crusher) (Detection) (When Attachment Safety Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Attachment Safety Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage $>$ 3.0V	●		
	6	(Detection) (When Attachment Safety Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current $>$ 6.5 A (Cancellation) (When Attachment Safety Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current $\leq$ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode) (Checking list) 1. CN-149 (#1) – CN-53 (#9) Checking Open/Short 2. CN-149 (#2) – Fuse box (#28) Checking Open/Short				
179	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Breaker Operating Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Breaker Operating Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage $>$ 3.0V	●		
	6	(Detection) (When Breaker Operating Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current $>$ 6.5 A (Cancellation) (When Breaker Operating Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current $\leq$ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode) (Checking list) 1. CN-66 (#1) – CN-52 (#8) Checking Open/Short 2. CN-66 (#2) – Fuse box (#34) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
181	4	(Model Parameter) mounting Reverse Cooling Fan Solenoid (Detection) (When Reverse Cooling Fan Solenoid is Off) 10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Reverse Cooling Fan Solenoid is Off) 3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage $>$ 3.0V	●		
	6	(Detection) (When Reverse Cooling Fan Solenoid is On) 10 seconds continuous, Reverse Cooling Fan Solenoid drive current $>$ 4.5 A (Cancellation) (When Reverse Cooling Fan Solenoid is On) 3 seconds continuous, Reverse Cooling Fan Solenoid drive current $\leq$ 4.5 A	●		
(Results / Symptoms) 1. Control Function – Cooling Fan reverse control operation failure (not applicable)					
188	5	(Detection) (When Attach Flow EPPR A1 current is equal or more than 300 mA) 10 seconds continuous, Attach Flow EPPR A1 drive current $<$ 100 mA (Cancellation) (When Attach Flow EPPR A1 current is equal or more than 300 mA) 3 seconds continuous, Attach Flow EPPR A1 drive current $\geq$ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attach Flow EPPR A1 drive current $>$ 1.0 A (Cancellation) 3 seconds continuous, Attach Flow EPPR A1 drive current $\leq$ 1.0 A	●		
(Results / Symptoms) 1. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CN-242 (#2) – CN-54 (#27) Checking Open/Short 2. CN-242 (#1) – CN-54 (#2) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When Attach Flow EPPR A2 current is equal or more than 300 mA) 10 seconds continuous, Attach Flow EPPR A2 drive current < 100 mA (Cancellation) (When Attach Flow EPPR A2 current is equal or more than 300 mA) 3 seconds continuous, Attach Flow EPPR A2 drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attach Flow EPPR A2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attach Flow EPPR A2 drive current ≤ 1.0 A	●		
(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-378 (#2) – CN-54 (#26) Checking Open/Short 2. CN-378 (#1) – CN-54 (#3) Checking Open/Short					
196	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V ≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-93 (#B) – CN-52 (#34) Checking Open/Short 2. CD-93 (#A) – CN-51 (#32) Checking Open/Short 3. CD-93 (#C) – CN-51 (#31) Checking Open/Short					
200	0	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V	●		
(Results / Symptoms) 1. Monitor – Pump EPPR Press. display failure 2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure (Fuel efficiency/speed performance failure) (Checking list) 1. CD-44 (#B) – CN-51 (#13) Checking Open/Short 2. CD-44 (#A) – CN-51 (#32) Checking Open/Short 3. CD-44 (#C) – CN-51 (#31) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General                      C : Crawler Type                      W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
205	0	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V	●		
	1	(Mounting pressure sensor) 10 seconds continuous, 0.3V ≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V	●		
	4	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Cylinder Rod Press. display failure 2. Control Function – Boom floating control operation failure (Checking list) 1. CD-124 (#B) – CN-52 (#25) Checking Open/Short 2. CD-124 (#A) – CN-51 (#32) Checking Open/Short 3. CD-124 (#C) – CN-51 (#31) Checking Open/Short				
218	4	Mounting pressure sensor (HCESPN128 or HCESPN 205) (Detection) (When Boom Up Floating Solenoid is Off) 10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Up Floating Solenoid is Off) 3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Up Floating Solenoid is On) 10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A (Cancellation) (When Boom Up Floating Solenoid is On) 3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CN-368 (#1) – CN-53 (#5) Checking Open/Short 2. CN-368 (#2) – Fuse box (#15) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
220	4	Mounting pressure sensor (HCESPN 128 or 205) (Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage $>$ 3.0V	●		
	6	(Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current $>$ 6.5 A (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current $\leq$ 6.5 A	●		
(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CN-369 (#1) – CN-53 (#8) Checking Open/Short 2. CN-369 (#2) – Fuse box (#15) Checking Open/Short					
221	5	Monitor – Selecting attachment(breaker / crusher) (Detection) (When ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current = 0 mA (Cancellation) ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current $\geq$ 10 mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current $>$ 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current $\leq$ 1.0 A	●		
(Results / Symptoms) 1. Control Function – Option attachment flow control – P1 relief pressure setting failure (Checking list) 1. CN-365 (#2) – CN-54 (#17) Checking Open/Short 2. CN-365 (#1) – CN-54 (#9) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type



DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
222	5	Monitor – Selecting attachment(crusher) (Detection) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA (Cancellation) (When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A	●		
(Results / Symptoms) 1. Control Function – Option attachment flow control – P2 relief pressure setting failure (Checking list) 1. CN-366 (#2) – CN-54 (#17) Checking Open/Short 2. CN-366 (#1) – CN-54 (#10) Checking Open/Short					
301	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel remaining display failure (Checking list) 1. CD-2 (#2) – CN-51 (#19) Checking Open/Short 2. CD-2 (#1) – CN-51 (#24, 25) Checking Open/Short				
325	4	(Model Parameter) mounting Fuel Warmer Relay (Detection) (When Fuel Warmer Relay is Off) 10 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Warmer Relay is Off) 3 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Fuel Warmer Relay is On) 10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A (Cancellation) (When Fuel Warmer Relay is On) 3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A	●		
(Results / Symptoms) 1. Control Function – Fuel warmer operation failure (Checking list) 1. CR-46 (#85) – CN-52 (#13) Checking Open/Short 2. CR-46 (#86) – Fuse box (#22) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
501	0	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V ≤ Transmission Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Transmission Oil Press. display failure, Transmission Oil low pressure warning failure (Checking list) 1. CD-5 (#B) – CN-52 (#26) Checking Open/Short 2. CD-5 (#A) – CN-51 (#32) Checking Open/Short 3. CD-5 (#C) – CN-51 (#31) Checking Open/Short				
503	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V ≤ Brake Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (Checking list) 1. CD-3 (#B) – CN-52 (#29) Checking Open/Short 2. CD-3 (#A) – CN-51 (#32) Checking Open/Short 3. CD-3 (#C) – CN-51 (#31) Checking Open/Short				
505	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V ≤ Working Brake Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure warning failure (Checking list) 1. CD-38 (#B) – CN-51 (#30) Checking Open/Short 2. CD-38 (#A) – CN-51 (#32) Checking Open/Short 3. CD-38 (#C) – CN-51 (#31) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
514	4	(Detection) (When Parking Relay is Off) 10 seconds continuous, Parking Relay drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Parking Relay is Off) 3 seconds continuous, Parking Relay drive unit Measurement Voltage $>$ 3.0V			●
	6	(Detection) (When Parking Relay is On) 10 seconds continuous, Parking Relay drive current $>$ 6.5 A (Cancellation) (When Parking Relay is On) 3 seconds continuous, Parking Relay drive current $\leq$ 6.5 A			●
(Results / Symptoms) 1. Control Function – Parking Relay operation failure (Checking list) 1. CR-66 (#1) – CN-53 (#11) Checking Open/Short 2. CR-66 (#2) – Fuse box (#30) Checking Open/Short					
517	4	(Detection) (When Traveling Cutoff Relay is Off) 10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage $\leq$ 3.0V (Cancellation) (When Traveling Cutoff Relay is Off) 3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage $>$ 3.0V			●
	6	(Detection) (When Traveling Cutoff Relay is On) 10 seconds continuous, Traveling Cutoff Relay drive current $>$ 6.5 A (Cancellation) (When Traveling Cutoff Relay is On) 3 seconds continuous, Traveling Cutoff Relay drive current $\leq$ 6.5 A			●
(Results / Symptoms) 1. Control Function – Traveling Cutoff Relay operation failure (Checking list) 1. CR-47 (#85) – CN-53 (#04) Checking Open/Short 2. CR-47 (#86) – Fuse box (#28) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
525	4	(Detection) (When Ram Lock Solenoid is Off) 10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Ram Lock Solenoid is Off) 3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage $> 3.0V$			●
	6	(Detection) (When Ram Lock Solenoid is On) 10 seconds continuous, Ram Lock Solenoid drive current $> 6.5 A$ (Cancellation) (When Ram Lock Solenoid is On) 3 seconds continuous, Ram Lock Solenoid drive current $\leq 6.5 A$			●
(Results / Symptoms) 1. Control Function – Ram lock control operation failure (Checking list) 1. CN-69 (#1) – CN-53 (#12) Checking Open/Short 2. CN-69 (#2) – Fuse box (#33) Checking Open/Short					
527	4	(Detection) (When Creep Solenoid is Off) 10 seconds continuous, Creep Solenoid drive unit Measurement Voltage $\leq 3.0V$ (Cancellation) (When Creep Solenoid is Off) 3 seconds continuous, Creep Solenoid drive unit Measurement Voltage $> 3.0V$			●
	6	(Detection) (When Creep Solenoid is On) 10 seconds continuous, Creep Solenoid drive current $> 6.5 A$ (Cancellation) (When Creep Solenoid is On) 3 seconds continuous, Creep Solenoid drive current $\leq 6.5 A$			●
(Results / Symptoms) 1. Control Function – Creep mode operation failure (Checking list) 1. CN-206 (#1) – CN-52 (#17) Checking Open/Short 2. CN-206 (#2) – Fuse box (#30) Checking Open/Short					

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
530	0	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V ≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Travel Forward Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-73 (#B) – CN-51 (#20) Checking Open/Short 2. CD-73 (#A) – CN-51 (#32) Checking Open/Short 3. CD-73 (#C) – CN-51 (#31) Checking Open/Short				
531	1	10 seconds continuous, 0.3V ≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Travel Reverse Press. display failure 2. Control Function – Driving interoperability power control operation failure (Checking list) 1. CD-74 (#B) – CN-52 (#20) Checking Open/Short 2. CD-74 (#A) – CN-51 (#32) Checking Open/Short 3. CD-74 (#C) – CN-51 (#31) Checking Open/Short				
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74A (#1) – CN-51 (#1) Checking Open/Short				
707	1	(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node L Measurement Voltage < 18V (In case 12v goods, Alternator Node L Measurement Voltage < 9V)	●		
	(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CS-74A (#1) – CN-51 (#26) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
714	3	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V	●		
	4	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Acc. Dial Voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-7 (#15) – CN-52 (#33) Checking Open/Short				
722	4	(Detection) (When Travel Alarm (Buzzer) Sound is Off) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Alarm (Buzzer) Sound Relay is Off) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Travel Alarm (Buzzer) Sound is On) 10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current > 4.5 A (Cancellation) (When Travel Alarm (Buzzer) Sound is On) 3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Driving alarm operation failure (Checking list) 1. CN-81 (#1) – CN-52 (#9) Checking Open/Short 2. CN-81 (#2) – Fuse box (#31) Checking Open/Short				
831	2	(When mounting the A/C Controller) 60 seconds continuous, A/C Controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – A/C Controller operation failure (Checking list) 1. CN-11 (#8) – CN-51 (#9) Checking Open/Short 2. CN-11 (#7) – CN-51 (#8) Checking Open/Short				
840	2	60 seconds continuous, Cluster Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Cluster operation failure (Checking list) 1. CN-56A (#5) – CN-52 (#1) Checking Open/Short 2. CN-56A (#4) – CN-52 (#2) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
841	2	10 seconds continuous, ECM Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#22) – CN-52 (#2) Checking Open/Short 2. CN-93 (#46) – CN-52 (#1) Checking Open/Short				
848	2	(When mounting the Haptic Controller) 60 seconds continuous, Haptic Controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Haptic Controller operation failure (Checking list) 1. CN-8 (#2) – CN-51 (#9) Checking Open/Short 2. CN-8 (#3) – CN-51 (#8) Checking Open/Short				
850	2	(When mounting the RMCU) 60 seconds continuous, RMCU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – RMCU operation failure (Checking list) 1. CN-125A (#3) – CN-51 (#9) Checking Open/Short 2. CN-125A (#11) – CN-51 (#8) Checking Open/Short				
866	2	(When mounting the AAVM) 60 seconds continuous, AAVM communication Data Error	●		
	(Results / Symptoms) 1. Control Function – AAVM operation failure (Checking list) 1. CN-9 (#5) – CN-51 (#9) Checking Open/Short 2. CN-9 (#6) – CN-51 (#8) Checking Open/Short				
867	2	60 seconds continuous, Membrane controller communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Membrane controller operation failure (Checking list) 1. CN-376 (#10) – CN-51 (#9) Checking Open/Short 2. CN-376 (#18) – CN-51 (#8) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
868	2	60 seconds continuous, Switch Controller communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Switch Controller operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#8) Checking Open/Short 2. CN-56A (#6) – CN-51 (#9) Checking Open/Short				
869	2	(When mounting the BKCU) 60 seconds continuous, BKCU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – BKCU operation failure (Checking list) 1. CS-2B (#B) – CN-51 (#8) Checking Open/Short 2. CS-2B (#A) – CN-51 (#9) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General

C : Crawler Type

W : Wheel Type



#### 4. ENGINE FAULT CODE

J1939 SPN J1939 FMI	Name	Description
27 4	EGR valve position circuit	Voltage below normal, or shorted to low source
51 3	Engine intake throttle actuator position sensor circuit	Voltage above normal, or shorted to high source
51 4	Engine intake throttle actuator position sensor circuit	Voltage above normal, or shorted to low source
84 2	Wheel-based vehicle speed	Data erratic, intermittent or incorrect
84 10	Wheel-based vehicle speed sensor circuit tampering has been detected	Abnormal rate of change
84 19	Wheel-based vehicle speed	Received network data in error
91 3	Accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
91 4	Accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
91 1	Accelerator pedal or lever position 1 sensor circuit frequency	Data valid but below normal operating range
91 0	Accelerator pedal or lever position sensor 1	Data valid but above normal operational range - most severe level
91 2	Accelerator pedal or lever position sensor 1	Data erratic, intermittent or incorrect
91 3	Accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
91 4	Accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
91 19	SAE J1939 multiplexed accelerator pedal or lever sensor system	Received network data in error
91 9	SAE J1939 multiplexed accelerator pedal or lever sensor system	Abnormal update rate
94 3	Fuel delivery pressure sensor circuit	Voltage above normal, or shorted to high source
94 4	Fuel delivery pressure sensor circuit	Voltage below normal, or shorted to low source
95 16	Fuel filter differential pressure	Data valid but above normal operating range - moderately severe level
97 15	Water in fuel indicator	Data valid but above normal operating range - least severe level
97 3	Water in fuel indicator sensor circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
97 4	Water in fuel indicator sensor circuit	Voltage below normal, or shorted to low source
97 16	Water in fuel indicator	Data valid but above normal operating range - moderately severe level
100 3	Engine oil rifle pressure 1 sensor circuit	Voltage above normal, or shorted to high source
100 4	Engine oil rifle pressure 1 sensor circuit	Voltage below normal, or shorted to low source
100 18	Engine oil rifle pressure	Data valid but below normal operating range - moderately severe level
100 1	Engine oil rifle pressure	Data valid but below normal operational range - most severe level
100 2	Engine oil rifle pressure	Data erratic, intermittent or incorrect
102 3	Intake manifold 1 pressure sensor circuit	Voltage above normal, or shorted to high source
102 4	Intake manifold 1 pressure sensor circuit	Voltage below normal, or shorted to low source
102 16	Intake manifold 1 pressure	Data valid but above normal operating range - moderately severe level
102 2	Intake manifold 1 pressure	Data erratic, intermittent or incorrect
105 3	Intake manifold 1 temperature sensor circuit	Voltage above normal, or shorted to high source
105 4	Intake manifold 1 temperature sensor circuit	Voltage below normal, or shorted to low source
105 0	Intake manifold 1 temperature	Data valid but above normal operational range - most severe level
105 16	Intake manifold 1 temperature	Data valid but above normal operating range - moderately severe level
105 15	Intake manifold 1 temperature	Data valid but above normal operating range - least severe level
107 16	Engine air filter differential pressure	Data valid but above normal operating range - moderately severe level
107 15	Engine air filter differential pressure	Data valid but above normal operating range - least severe level
108 3	Barometric pressure sensor circuit	Voltage above normal, or shorted to high source
108 4	Barometric pressure sensor circuit	Voltage above normal, or shorted to low source
110 3	Engine coolant temperature 1 sensor circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
110 4	Engine coolant temperature 1 sensor circuit	Voltage below normal, or shorted to low source
110 16	Engine coolant temperature	Data valid but above normal operating range - moderately severe level
110 0	Engine coolant temperature	Data valid but above normal operational range - most severe level
110 31	Engine coolant temperature	Condition exists
111 3	Coolant level sensor 1 circuit	Voltage above normal, or shorted to high source
111 4	Coolant level sensor 1 circuit	Voltage below normal, or shorted to low source
111 18	Coolant level	Data valid but below normal operating range - moderately severe level
111 1	Coolant level	Data valid but below normal operational range - most severe level
111 17	Coolant level	Data valid but below normal operating range - least severe level
111 9	Coolant level sensor	Abnormal update rate
111 3	Coolant level sensor 1 circuit	Voltage above normal, or shorted to high source
111 4	Coolant level sensor 1 circuit	Voltage below normal, or shorted to low source
157 0	Injector metering rail 1 pressure	Data valid but above normal operational range - most severe level
157 3	Injector metering rail 1 pressure sensor circuit	Voltage above normal, or shorted to high source
157 4	Injector metering rail 1 pressure sensor circuit	Voltage below normal, or shorted to low source
157 16	Injector metering rail 1 pressure	Data valid but above normal operating range - moderately severe level
157 18	Injector metering rail 1 pressure	Data valid but below normal operating range - moderately severe level
168 18	Battery 1 voltage	Data valid but below normal operating range - moderately severe level
168 16	Battery 1 voltage	Data valid but above normal operating range - moderately severe level
168 17	Battery 1 voltage	Data valid but below normal operating range - least severe level
168 15	Battery 1 voltage	Data valid but above normal operating range - least severe level

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
168 17	Battery 1 voltage	Data valid but below normal operating range - moderately severe level
171 3	Ambient air temperature sensor 1 circuit	Voltage above normal, or shorted to high source
171 4	Ambient air temperature sensor 1 circuit	Voltage below normal, or shorted to low source
171 9	Ambient air temperature	Abnormal update rate
175 3	Engine oil temperature sensor 1 circuit	Voltage above normal, or shorted to high source
175 4	Engine oil temperature sensor 1 circuit	Voltage below normal, or shorted to low source
190 0	Engine crankshaft speed/position	Data valid but above normal operational range - most severe level
190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect
190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect
191 16	Transmission output shaft speed	Data valid but above normal operating range - moderately severe level
191 18	Transmission output shaft speed	Data valid but below normal operating range - moderately severe level
191 9	Transmission output shaft speed	Abnormal update rate
191 19	Transmission output shaft speed	Received network data in error
237 13	Vehicle identification number	Out of calibration
411 2	Exhaust gas recirculation differential pressure	Data erratic, intermittent or incorrect
411 3	Exhaust gas recirculation differential pressure sensor circuit	Voltage above normal, or shorted to high source
411 4	Exhaust gas recirculation differential pressure sensor circuit	Voltage below normal, or shorted to low source
412 3	Exhaust gas recirculation temperature sensor circuit	Voltage above normal, or shorted to high source
412 4	Exhaust gas recirculation temperature sensor circuit	Voltage below normal, or shorted to low source
412 15	Exhaust gas recirculation temperature	Data valid but above normal operating range - least severe level
412 16	Exhaust gas recirculation temperature	Data valid but above normal operating range - moderately severe level

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
441 14	Auxiliary temperature sensor input 1	Special instructions
441 3	Auxiliary temperature sensor input 1 circuit	Voltage above normal, or shorted to high source
441 4	Auxiliary temperature sensor input 1 circuit	Voltage below normal, or shorted to low source
441 14	Auxiliary temperature sensor input 1	Special instructions
442 3	Auxiliary temperature sensor input 2 circuit	Voltage above normal, or shorted to high source
442 4	Auxiliary temperature sensor input 2 circuit	Voltage below normal, or shorted to low source
558 2	Accelerator pedal or lever idle validation switch	Data erratic, intermittent or incorrect
558 13	Accelerator pedal or lever idle validation switch circuit	Out of calibration
558 19	Accelerator pedal or lever idle validation switch	Received network data in error
563 9	Anti-lock braking (ABS) controller	Abnormal update rate
563 31	Anti-lock braking (ABS) active	Condition exists
611 2	Auxiliary intermediate (PTO) speed switch validation	Data erratic, intermittent or incorrect
612 2	Engine magnetic speed/position lost both of two signals	Data erratic, intermittent or incorrect
625 9	Proprietary datalink error (OEM/vehicle datalink)	Abnormal update rate
629 12	Engine control module critical internal failure	Bad intelligent device or component
629 12	Engine control module warning internal hardware failure	Bad intelligent device or component
630 12	Engine control module calibration memory	Bad intelligent device or component
633 31	Electronic fuel injection control valve circuit	Condition exists
639 9	SAE J1939 multiplexing PGN timeout error	Abnormal update rate
639 13	SAE J1939 multiplexing configuration error	Out of calibration
640 14	Auxiliary commanded dual output shutdown	Special instructions

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
641 15	VGT actuator driver over temperature (calculated)	Data valid but above normal operating range - least severe level
647 4	Fan control circuit	Voltage below normal, or shorted to low source
647 3	Fan control circuit	Voltage above normal, or shorted to high source
647 3	Fan control circuit	Voltage above normal, or shorted to high source
647 4	Fan control circuit	Voltage below normal, or shorted to low source
649 3	Engine exhaust back pressure regulator control circuit	Voltage above normal, or shorted to high source
649 4	Engine exhaust back pressure regulator control circuit	Voltage below normal, or shorted to low source
649 5	Engine exhaust back pressure regulator control circuit	Current below normal or open circuit
651 5	Injector solenoid driver cylinder 1 circuit	Current below normal or open circuit
652 5	Injector solenoid driver cylinder 2 circuit	Current below normal or open circuit
652 7	Injector solenoid driver cylinder 2	Mechanical system not responding or out of adjustment
653 5	Injector solenoid driver cylinder 3 circuit	Current below normal or open circuit
653 7	Injector solenoid driver cylinder 3	Mechanical system not responding or out of adjustment
654 5	Injector solenoid driver cylinder 4 circuit	Current below normal or open circuit
654 7	Injector solenoid driver cylinder 4	Mechanical system not responding or out of adjustment
677 3	Starter relay driver circuit	Voltage above normal, or shorted to high source
677 4	Starter relay driver circuit	Voltage below normal, or shorted to low source
697 3	Auxiliary PWM driver 1 circuit	Voltage above normal, or shorted to high source
697 4	Auxiliary PWM driver 1 circuit	Voltage below normal, or shorted to low source
701 14	Auxiliary input/output 1	Special instructions
702 3	Auxiliary input/output 2 circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
703 3	Auxiliary input/output 3 circuit	Voltage above normal, or shorted to high source
723 7	Engine speed / position camshaft and crankshaft misalignment	Mechanical system not responding or out of adjustment
723 2	Engine camshaft speed / position sensor	Data erratic, intermittent or incorrect
729 3	Engine intake air heater 1 circuit	Voltage above normal, or shorted to high source
729 4	Engine intake air heater 1 circuit	Voltage below normal, or shorted to low source
748 9	Transmission output retarder	Abnormal update rate
862 3	Crankcase breather filter heater circuit	Voltage above normal, or shorted to high source
862 4	Crankcase breather filter heater circuit	Voltage below normal, or shorted to low source
974 3	Remote accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
974 4	Remote accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
974 19	SAE J1939 multiplexing remote accelerator pedal or lever position sensor system	Received network data in error
976 2	Auxiliary intermediate (PTO) speed switch validation	Data erratic, intermittent or incorrect
1072 3	Engine brake actuator driver 1 circuit	Voltage above normal, or shorted to high source
1072 4	Engine brake actuator driver 1 circuit	Voltage below normal, or shorted to low source
1073 4	Engine brake actuator driver output 2 circuit	Voltage below normal, or shorted to low source
1073 3	Engine brake actuator driver output 2 circuit	Voltage above normal, or shorted to high source
1075 3	Electric lift pump for engine fuel supply circuit	Voltage above normal, or shorted to high source
1075 4	Electric lift pump for engine fuel supply circuit	Voltage below normal, or shorted to low source
1081 9	Engine wait to start lamp	Abnormal update rate
1172 3	Turbocharger 1 compressor intake temperature circuit	Voltage above normal, or shorted to high source
1172 4	Turbocharger 1 compressor intake temperature circuit	Voltage below normal, or shorted to low source

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
1176 3	Turbocharger 1 compressor intake pressure circuit	Voltage above normal, or shorted to high source
1176 4	Turbocharger 1 compressor intake pressure circuit	Voltage below normal, or shorted to low source
1176 2	Turbocharger 1 compressor intake pressure	Data erratic, intermittent or incorrect
1194 13	Anti-theft encryption seed	Out of calibration
1209 3	Exhaust gas pressure sensor 1 circuit	Voltage above normal, or shorted to high source
1209 4	Exhaust gas pressure sensor 1 circuit	Voltage below normal, or shorted to low source
1209 2	Exhaust gas pressure 1	Data erratic, intermittent or incorrect
1231 2	J1939 network #2	Data erratic, intermittent or incorrect
1235 2	J1939 network #3	Data erratic, intermittent or incorrect
1267 3	Idle shutdown vehicle accessories relay driver circuit	Voltage above normal, or shorted to high source
1267 4	Idle shutdown vehicle accessories relay driver circuit	Voltage below normal, or shorted to low source
1323 31	Engine misfire cylinder 1	Condition exists
1324 31	Engine misfire cylinder 2	Condition exists
1325 31	Engine misfire cylinder 3	Condition exists
1326 31	Engine misfire cylinder 4	Condition exists
1347 4	Engine fuel pump pressurizing assembly 1 circuit	Voltage below normal, or shorted to low source
1347 3	Engine fuel pump pressurizing assembly 1 circuit	Voltage above normal, or shorted to high source
1347 7	Engine fuel pump pressurizing assembly 1	Mechanical system not responding or out of adjustment
1349 3	Injector metering rail 2 pressure sensor circuit	Voltage above normal, or shorted to high source
1377 2	Multiple unit synchronization switch	Data erratic, intermittent or incorrect
1378 31	Engine oil change interval	Condition exists

※ Some fault codes are not applied to this machine.



J1939 SPN J1939 FMI	Name	Description
1387 3	Auxiliary pressure sensor input 1 circuit	Voltage above normal, or shorted to high source
1387 4	Auxiliary pressure sensor input 1 circuit	Voltage below normal, or shorted to low source
1388 14	Auxiliary pressure sensor input 2	Special instructions
1388 3	Auxiliary pressure sensor input 2 circuit	Voltage above normal, or shorted to high source
1388 4	Auxiliary pressure sensor input 2 circuit	Voltage below normal, or shorted to low source
1569 31	Engine protection torque derate	Condition exists
1623 9	Tachograph output shaft speed	Abnormal update rate
1623 19	Tachograph output shaft speed	Received network data in error
1623 13	Tachograph output shaft speed	Out of calibration
1632 14	Engine torque limit feature	Special instructions
1639 0	Fan speed	Data valid but above normal operational range - most severe level
1639 1	Fan speed	Data valid but below normal operational range - most severe level
1639 15	Fan speed	Data valid but above normal operational range - least severe level
1639 17	Fan speed	Data valid but below normal operational range - most severe level
1639 2	Fan speed	Data erratic, intermittent, or incorrect
1668 2	SAE J1939 network #4	Data erratic, intermittent or incorrect
1675 31	Engine starter mode overcrank protection	Condition exists
1761 4	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage below normal, or shorted to low source
1761 3	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage above normal, or shorted to high source
1761 1	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operational range - most severe level
1761 17	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - least severe level

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
1761 18	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - moderately severe level
1761 9	SAE J1939 multiplexing PGN timeout error	Abnormal update rate
1761 13	Aftertreatment 1 diesel exhaust fluid tank level sensor	Out of calibration
1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor	Root cause not known
1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor	Abnormal rate of change
2623 3	Accelerator pedal or lever position sensor 2 circuit	Voltage above normal, or shorted to high source
2623 4	Accelerator pedal or lever position sensor 2 circuit	Voltage below normal, or shorted to low source
2630 3	Engine charge air cooler outlet temperature	Voltage above normal, or shorted to high source
2630 4	Engine charge air cooler outlet temperature	Voltage below normal, or shorted to low source
2789 15	Turbocharger turbine intake temperature	Data valid but above normal operating range - least severe
2791 13	EGR valve controller	Out of calibration
2791 15	EGR valve control circuit over temperature	Data valid but above normal operating range - least severe level
2791 5	EGR valve control circuit	Current below normal or open circuit
2791 6	EGR valve control circuit	Current above normal or grounded circuit
2791 7	EGR valve control circuit	Mechanical system not responding or out of adjustment
2797 13	Engine injector bank 1 barcodes	Out of calibration
3031 4	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage below normal, or shorted to low source
3031 3	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage above normal, or shorted to high source
3031 2	Aftertreatment 1 diesel exhaust fluid tank temperature	Data erratic, intermittent or incorrect
3031 9	Aftertreatment 1 diesel exhaust fluid tank temperature	Abnormal update rate
3031 13	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Out of calibration

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
3031 11	Aftertreatment 1 diesel exhaust fluid tank temperature	Root cause not known
3216 4	Aftertreatment 1 intake NOx sensor circuit	Voltage below normal, or shorted to low source
3216 2	Aftertreatment 1 intake NOx sensor	Data erratic, intermittent or incorrect
3216 9	Aftertreatment 1 intake NOx sensor	Abnormal update rate
3216 13	Aftertreatment 1 intake NOx	Out of calibration
3216 10	Aftertreatment 1 intake NOx sensor	Abnormal rate of change
3216 20	Aftertreatment 1 intake NOx sensor	Data not rational - drifted high
3216 21	Aftertreatment 1 intake NOx sensor	Data not rational - drifted low
3218 2	Aftertreatment 1 intake NOx sensor power supply	Data erratic, intermittent or incorrect
3226 2	Aftertreatment 1 outlet NOx sensor	Data erratic, intermittent or incorrect
3226 4	Aftertreatment 1 outlet NOx sensor circuit	Voltage below normal, or shorted to low source
3226 9	Aftertreatment 1 outlet NOx sensor	Abnormal update rate
3226 10	Aftertreatment 1 outlet NOx sensor	Abnormal rate of change
3226 13	Aftertreatment 1 outlet NOx sensor	Out of calibration
3226 20	Aftertreatment 1 outlet NOx sensor	Data not rational - drifted high
3226 21	Aftertreatment 1 outlet NOx sensor	Data not rational - drifted high
3228 2	Aftertreatment 1 outlet NOx sensor power supply	Data erratic, intermittent or incorrect
3249 17	Aftertreatment exhaust gas temperature 2	Data valid but below normal operating range - least severe level
3249 18	Aftertreatment exhaust gas temperature 2	Data valid but below normal operating range - moderately severe level
3361 2	Aftertreatment 1 diesel exhaust fluid dosing unit temperature	Data erratic, intermittent or incorrect
3361 3	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
3361 4	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage below normal, or shorted to low source
3362 31	Aftertreatment 1 diesel exhaust fluid dosing unit input lines	Condition exists
3363 3	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage above normal, or shorted to high source
3363 4	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage below normal, or shorted to low source
3363 18	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but below normal operating range - moderately severe level
3363 16	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but above normal operating range - moderately severe level
3363 7	Aftertreatment 1 diesel exhaust fluid tank heater	Mechanical system not responding or out of adjustment
3363 18	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but below normal operating range - moderately severe level
3363 3	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage above normal, or shorted to high source
3363 4	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage below normal, or shorted to low source
3364 4	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage below normal, or shorted to low source
3364 3	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage above normal, or shorted to high source
3364 13	Aftertreatment diesel exhaust fluid quality	Out of calibration
3364 11	Aftertreatment diesel exhaust fluid quality	Root cause not known
3364 1	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operational range - most severe level
3364 18	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operating range - moderate severe level
3364 9	Aftertreatment diesel exhaust fluid quality	Abnormal update rate
3364 7	Aftertreatment diesel exhaust fluid quality sensor	Mechanical system not responding or out of adjustment
3364 12	Aftertreatment diesel exhaust fluid quality sensor	Bad intelligent device or component
3364 2	Aftertreatment diesel exhaust fluid quality	Data erratic, intermittent or incorrect
3364 10	Aftertreatment diesel exhaust fluid quality	Abnormal rate of change

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
3364 18	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operating range - moderately severe level
3464 3	Electronic throttle control actuator driver circuit	Voltage above normal, or shorted to high source
3464 4	Electronic throttle control actuator driver circuit	Voltage above normal, or shorted to low source
3464 5	Electronic throttle control actuator driver circuit	Current below normal or open circuit
3509 4	Sensor supply 1 circuit	Voltage below normal, or shorted to low source
3509 3	Sensor supply 1 circuit	Voltage above normal, or shorted to high source
3510 4	Sensor supply 2 circuit	Voltage below normal, or shorted to low source
3510 3	Sensor supply 2 circuit	Voltage above normal, or shorted to high source
3511 4	Sensor supply 3 circuit	Voltage below normal, or shorted to low source
3511 3	Sensor supply 3 circuit	Voltage above normal, or shorted to high source
3512 3	Sensor supply 4 circuit	Voltage above normal, or shorted to high source
3512 4	Sensor supply 4 circuit	Voltage below normal, or shorted to low source
3513 3	Sensor supply 5	Voltage above normal, or shorted to high source
3513 4	Sensor supply 5	Voltage below normal, or shorted to low source
3514 3	Sensor supply 6 circuit	Voltage above normal, or shorted to high source
3514 4	Sensor supply 6 circuit	Voltage below normal, or shorted to low source
3515 10	Aftertreatment 1 diesel exhaust fluid temperature 2	Abnormal rate of change
3515 5	Aftertreatment 1 diesel exhaust fluid temperature 2 sensor circuit	Current below normal or open circuit
3515 6	Aftertreatment 1 diesel exhaust fluid temperature 2 sensor circuit	Current above normal or grounded
3515 11	Aftertreatment 1 diesel exhaust fluid temperature 2	Root cause not known
3515 10	Aftertreatment 1 diesel exhaust fluid temperature 2	Abnormal rate of change

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
3521 11	Aftertreatment 1 diesel exhaust fluid property	Root cause not known
3597 12	Injector power supply	Bad intelligent device or component
3597 2	Power supply lost with ignition on	Data erratic, intermittent or incorrect
3597 17	ECU power output supply voltage 1	Data valid but below normal operating range - moderately severe level
3667 3	Engine air shutoff circuit	Voltage above normal, or shorted to high source
3667 4	Engine air shutoff circuit	Voltage below normal, or shorted to low source
3695 2	Aftertreatment regeneration inhibit switch	Data erratic, intermittent or incorrect
3695 2	Aftertreatment regeneration inhibit switch	Data erratic, intermittent or incorrect
3750 14	Diesel particulate filter 1 conditions not met for active regeneration	Condition exists
4094 31	NOx limits exceeded due to insufficient reagent quality	Condition exists
4096 31	Aftertreatment diesel exhaust fluid tank empty	Condition exists
4185 31	Overspeed shutdown relay driver diagnostic has detected an error	Condition exists
4186 31	Low oil pressure (LOP) shutdown relay driver diagnostic has detected an error	Condition exists
4187 31	High engine temperature (HET) shutdown relay driver diagnostic has detected an error	Condition exists
4188 31	Pre-low oil pressure warning relay driver diagnostic has detected an error	Condition exists
4223 31	Pre-high engine temperature warning relay driver diagnostic has detected an error	Condition exists
4334 3	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage above normal, or shorted to high source
4334 4	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage below normal, or shorted to low source
4334 18	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but below normal operating range
4334 16	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but above normal operating range

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
4334 2	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data erratic, intermittent or incorrect
4337 10	Aftertreatment 1 diesel exhaust fluid dosing temperature	Abnormal rate of change
4340 3	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage above normal, or shorted to high source
4340 4	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage below normal, or shorted to low source
4340 5	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Current below normal or open circuit
4342 3	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage above normal, or shorted to high source
4342 4	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage below normal, or shorted to low source
4342 5	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Current below normal or open circuit
4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage above normal, or shorted to high source
4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage below normal, or shorted to low source
4344 5	Aftertreatment diesel exhaust fluid line heater 3 circuit	Current below normal or open circuit
4360 3	Aftertreatment 1 SCR intake temperature sensor circuit	Voltage above normal, or shorted to high source
4360 4	Aftertreatment 1 SCR intake temperature sensor circuit	Voltage below normal, or shorted to low source
4360 2	Aftertreatment 1 SCR intake temperature sensor	Data erratic, intermittent or incorrect
4360 15	Aftertreatment 1 SCR intake temperature	Data valid but above normal operating range - least severe
4360 0	Aftertreatment 1 SCR intake temperature	Data valid but above normal operational range - most severe level
4360 16	Aftertreatment 1 SCR intake temperature	Data valid but above normal operating range - moderately severe level
4363 3	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage above normal, or shorted to high source
4363 4	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage below normal, or shorted to low source
4363 2	Aftertreatment 1 SCR outlet temperature sensor	Data erratic, intermittent or incorrect
4363 0	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operational range - most severe

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
4363 16	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operating range - moderately severe level
4364 18	Aftertreatment SCR catalyst conversion efficiency	Data valid but below normal operating range - moderately severe level
4364 17	Aftertreatment SCR catalyst conversion efficiency	Data valid but below normal operating range - moderately severe level
4376 3	Aftertreatment diesel exhaust fluid return valve	Voltage above normal, or shorted to high source
4376 4	Aftertreatment diesel exhaust fluid return valve	Voltage below normal, or shorted to low source
4376 7	Aftertreatment diesel exhaust fluid return valve	Mechanical system not responding or out of adjust
4765 16	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data valid but above normal operating range
4765 4	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage below normal, or shorted to low source
4765 3	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage above normal, or shorted to high source
4765 2	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data erratic, intermittent or incorrect
4792 7	Aftertreatment SCR catalyst system	Mechanical system not responding or out of adjustment
4792 14	Aftertreatment 1 SCR catalyst system	Special instructions
4794 31	Aftertreatment 1 SCR catalyst system missing	Condition exists
4796 31	Aftertreatment 1 diesel oxidation catalyst missing	Condition exists
5018 11	Aftertreatment 1 diesel oxidation catalyst face plugged	Root cause not known
5024 10	Aftertreatment 1 intake NOx sensor heater	Abnormal rate of change
5031 10	Aftertreatment 1 outlet NOx sensor heater	Abnormal rate of change
5125 3	Sensor supply 7 circuit	Voltage above normal, or shorted to high source
5125 4	Sensor supply 7 circuit	Voltage below normal, or shorted to low source
5245 31	Aftertreatment diesel exhaust fluid tank low level indicator	-
5246 0	Aftertreatment SCR operator inducement	Data valid but above normal operational range - most severe level

※ Some fault codes are not applied to this machine.



J1939 SPN J1939 FMI	Name	Description
5298 18	Aftertreatment 1 diesel oxidation catalyst conversion efficiency	Data valid but below normal operating range - moderately severe level
5298 17	Aftertreatment 1 diesel oxidation catalyst conversion efficiency	Data valid but below normal operating range - moderately severe level
5394 5	Aftertreatment diesel exhaust fluid dosing valve	Current below normal or open circuit
5394 7	Aftertreatment diesel exhaust fluid dosing valve	Mechanical system not responding or out of adjustment
5394 2	Aftertreatment diesel exhaust fluid dosing valve	Data erratic, intermittent or incorrect
5484 3	Engine fan clutch 2 control circuit	Voltage above normal, or shorted to high source
5484 4	Engine fan clutch 2 control circuit	Voltage below normal, or shorted to low source
5491 3	Aftertreatment diesel exhaust fluid line heater relay	Voltage above normal, or shorted to high source
5491 4	Aftertreatment diesel exhaust fluid line heater relay	Voltage below normal, or shorted to low source
5491 7	Aftertreatment 1 diesel exhaust fluid line heater relay	Mechanical system not responding or out of adjustment
5571 7	High pressure common rail fuel pressure relief valve	Mechanical system not responding or out of adjustment
5571 0	High pressure common rail fuel pressure relief valve	Data valid but above normal operational range
5571 15	High pressure common rail fuel pressure relief valve	Data valid but above normal operating range - least severe level
5603 9	Cruise control disable command	Abnormal update rate
5603 31	Cruise control disable command	Condition exists
5605 31	Cruise control pause command	Condition exists
5625 3	Engine exhaust back pressure regulator position sensor circuit	Voltage above normal, or shorted to high source
5625 4	Engine exhaust back pressure regulator position sensor circuit	Voltage below normal, or shorted to low source
5626 13	Engine exhaust back pressure regulator	Out of calibration
5742 12	Aftertreatment diesel particulate filter temperature sensor module	Bad intelligent device or component
5743 9	Aftertreatment selective catalytic reduction temperature sensor module	Abnormal update rate

※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
5743 12	Aftertreatment selective catalytic reduction temperature sensor module	Bad intelligent device or component
5743 3	Aftertreatment selective catalytic reduction temperature sensor module	Voltage above normal, or shorted to high source
5743 4	Aftertreatment selective catalytic reduction temperature sensor module	Voltage below normal, or shorted to low source
5743 16	Aftertreatment selective catalytic reduction temperature sensor module	Data valid but above normal
5743 11	Aftertreatment selective catalytic reduction temperature sensor module	Root cause not known
5745 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Voltage above normal, or shorted to high source
5745 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Voltage below normal, or shorted to low source
5745 18	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Data valid but below normal operating range
5745 17	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Data valid but below normal operating range
5746 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay	Voltage above normal, or shorted to high source
5746 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay	Voltage below normal, or shorted to low source
5798 10	Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature	Abnormal rate of change
6655 3	Maintain ECU power lamp	Voltage above normal, or shorted to high source
6655 4	Maintain ECU power lamp	Voltage below normal, or shorted to low source
6799 3	Fan blade pitch position sensor circuit	Voltage above normal, or shorted to high source
6799 4	Fan blade pitch position sensor circuit	Voltage below normal, or shorted to low source
6799 7	Fan blade pitch	Mechanical system not responding or out of adjustment
6799 2	Fan blade pitch	Data erratic, intermittent, or incorrect
6802 31	Aftertreatment 1 diesel exhaust fluid dosing system frozen	Condition exists
6881 9	Scr operator inducement override switch	Abnormal update rate
6881 13	Scr operator inducement override switch	Out of calibration

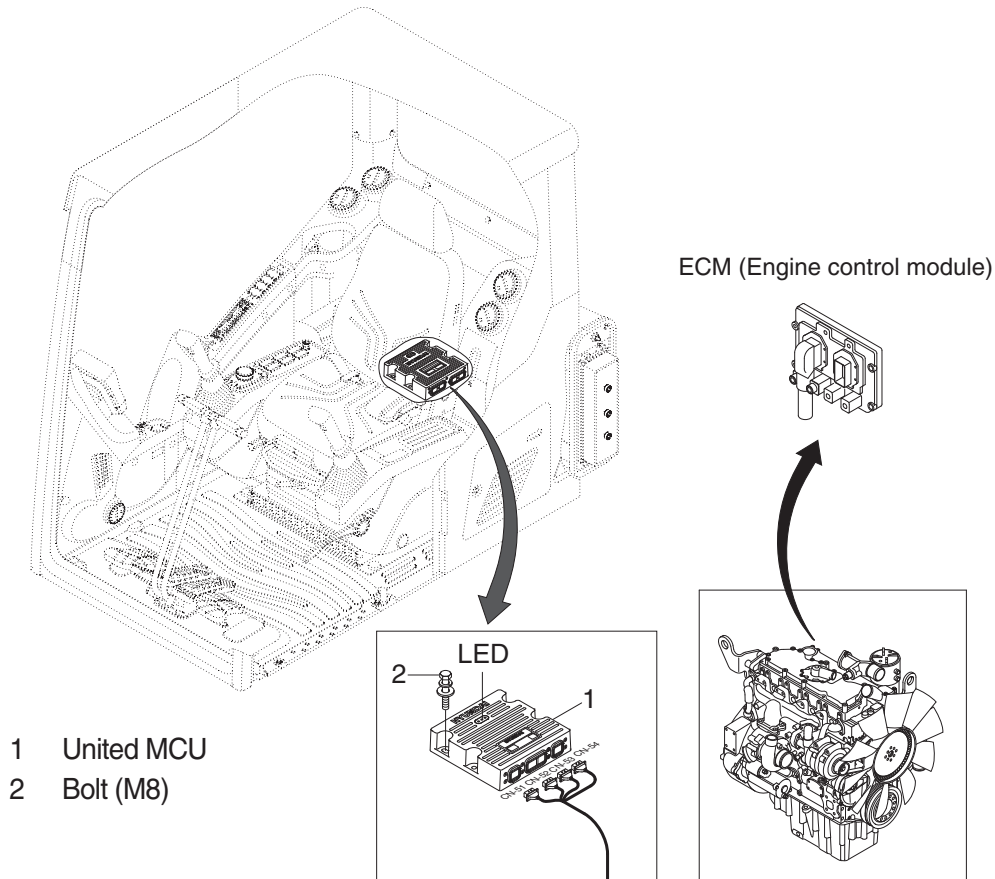
※ Some fault codes are not applied to this machine.

J1939 SPN J1939 FMI	Name	Description
6918 31	Scr system cleaning inhibited due to inhibit switch	Condition exists
6928 31	Scr system cleaning inhibited due to system timeout	Condition exists
7848 14	Aftertreatment 1 scr system conditions not met for active cleaning	Special instructions
520968 9	Machine constrained operation	Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the machine electronic control unit.
520968 19	Machine constrained operation	Received network data in error. The received J1939 datalink message was not valid.
524286 31	Aftertreatment 1 diesel oxidation catalyst system	Special instruction

※ Some fault codes are not applied to this machine.

## GROUP 13 ENGINE CONTROL SYSTEM

### 1. UNITED MCU and ENGINE ECM



140LC5MS52

### 2. UNITED MCU ASSEMBLY

- 1) To match the pump absorption torque with the engine torque, united MCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.
- 2) Three LED lamps on the united MCU display as below.

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

G : green, R : red, Y : yellow

## GROUP 14 EPPR VALVE

### 1. PUMP EPPR VALVE

#### 1) COMPOSITION

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

##### (1) Electro magnet valve

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

##### (2) Spool valve

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

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

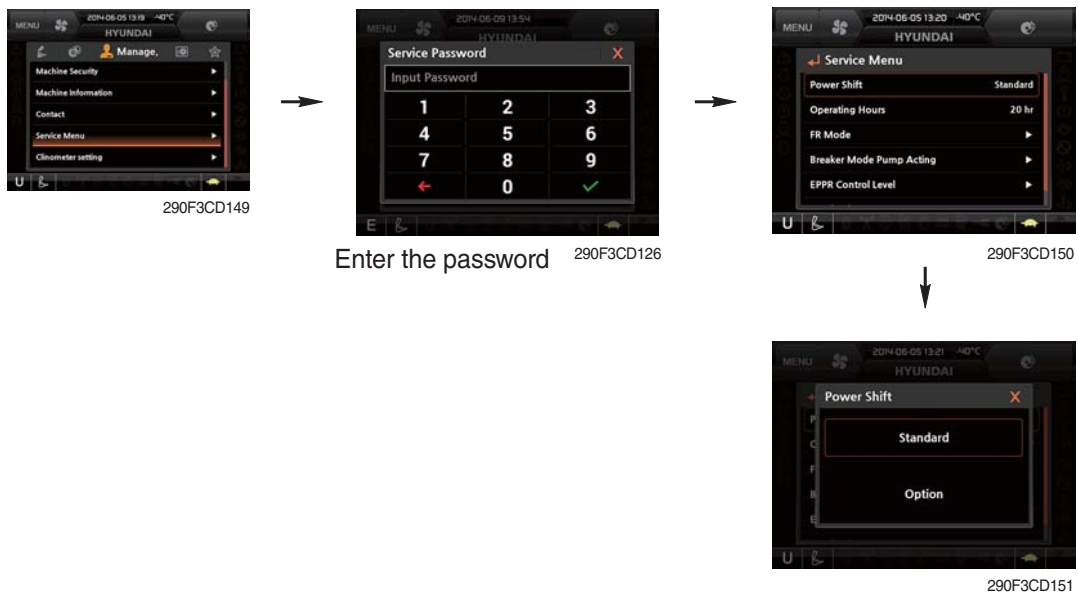
##### (3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm <sup>2</sup>	psi		
Standard	P	10	142	330 ± 30	1850 ± 50
	S	13 ± 3	189 ± 40	365 ± 30	1750 ± 50
	E	15 ± 3	218 ± 40	400 ± 30	1650 ± 50
Option	P	0	0	160 ± 30	2100 ± 50
	S	5 ± 3	73 ± 40	250 ± 30	2000 ± 50
	E	10 ± 3	142 ± 40	330 ± 30	1750 ± 50

### 2) HOW TO SWITCH THE POWER SHIFT (STANDARD ↔ OPTION) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the power shift (standard ↔ option).

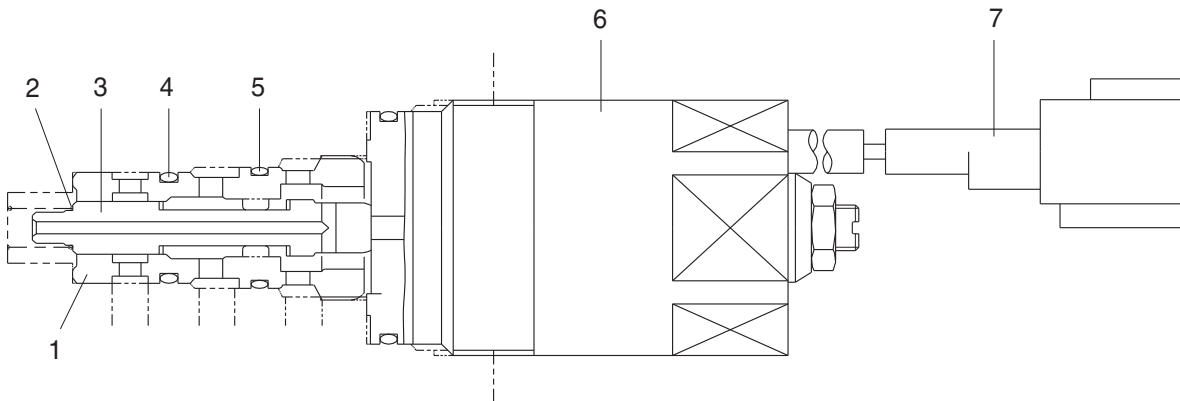
- Management
  - Service menu



- Power shift (standard/option) : Power shift pressure can be set by option menu.

### 3) OPERATING PRINCIPLE (PUMP EPPR VALVE)

#### (1) Structure

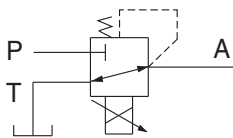


5-22(1)

- 1 Sleeve
- 2 Spring
- 3 Spool

- 4 O-ring
- 5 O-ring

- 6 Solenoid valve
- 7 Connector



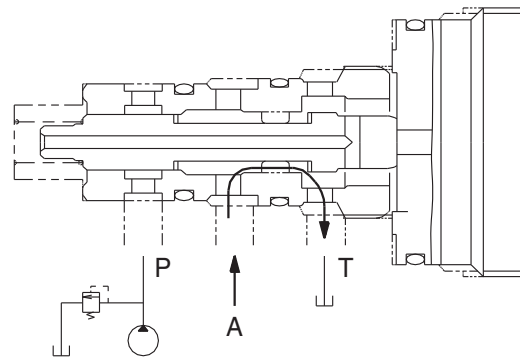
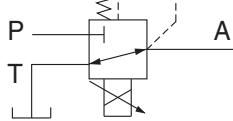
P Pilot oil supply line (pilot pressure)

T Return to tank

A Secondary pressure to flow regulator at main pump

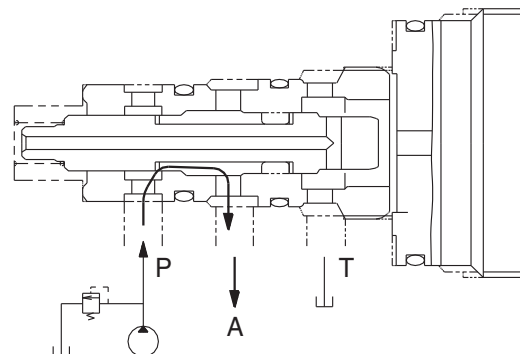
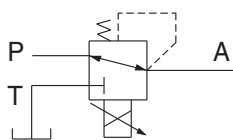
#### (2) Neutral

Pressure line is blocked and A oil returns to tank.



#### (3) Operating

Secondary pressure enters into A.

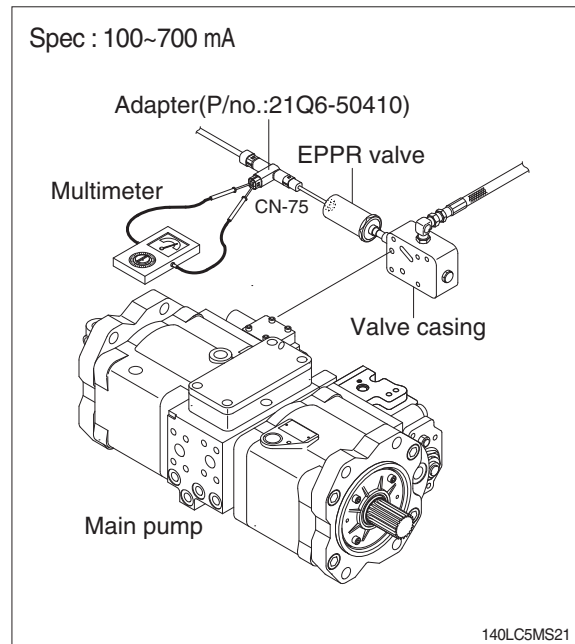


5-22(2)

#### 4) EPPR VALVE CHECK PROCEDURE

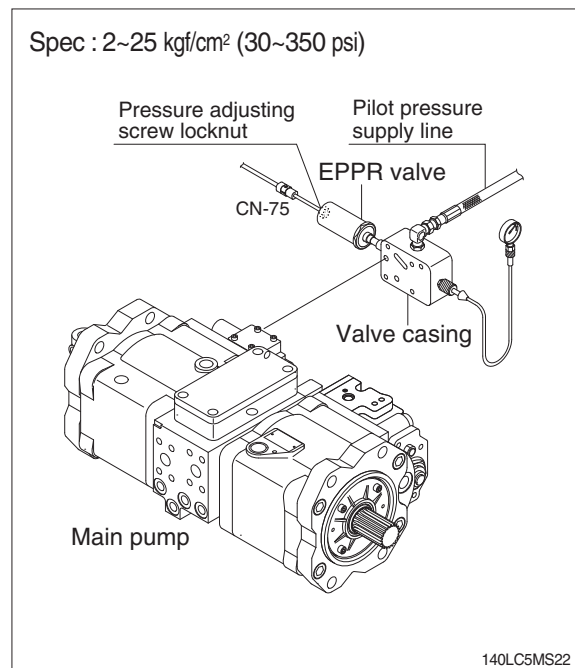
##### (1) Check electric current value at EPPR valve

- ① Disconnect connector CN-75 from EPPR valve.
- ② Insert the adapter to CN-75 and install multimeter as figure.
- ③ Start engine.
- ④ Set S-mode and cancel auto decel mode.  
Position the multimodal dial at 10.
- ⑤ If rpm display show approx  $1750 \pm 50$  rpm
- ⑥ check electric current at bucket circuit relief position.  
Check electric current at bucket circuit
- ⑦ relief position.



##### (2) Check pressure at EPPR valve

- ① Remove plug and connect pressure gauge as figure.  
· Gauge capacity : 0 to 50 kgf/cm<sup>2</sup>  
(0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- ④ Position the multimodal dial at 10.
- ⑤ If tachometer show approx  $1750 \pm 50$  rpm check pressure at relief position of bucket circuit by operating bucket control lever.
- ⑥ If pressure is not correct, adjust it.
- ⑦ After adjust, test the machine.



## 2. BOOM PRIORITY EPPR VALVE

### 1) COMPOSITION

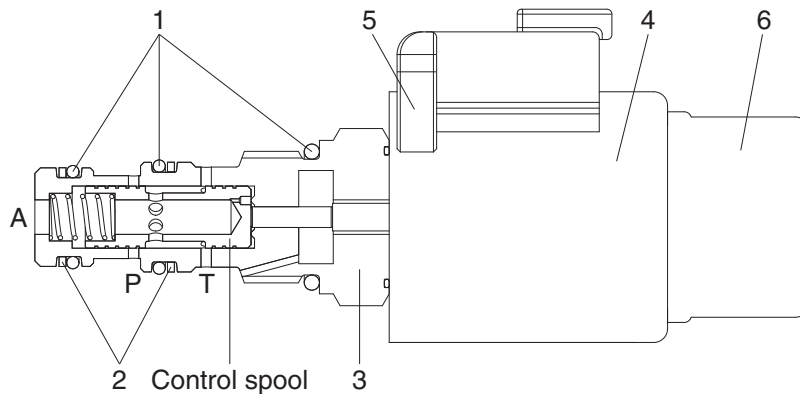
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

### 2) CONTROL

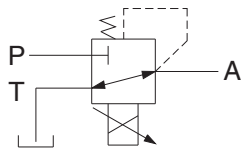
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

### 3) OPERATING PRINCIPLE

#### (1) Structure



21095MS14



P : Pilot supply line  
T : Return to tank  
A : Secondary pressure to flow MCV

- |   |              |   |            |   |           |
|---|--------------|---|------------|---|-----------|
| 1 | O-ring       | 3 | Valve body | 5 | Connector |
| 2 | Support ring | 4 | Coil       | 6 | Cover cap |

#### (2) Operation

In de-energized mode the inlet port (P) is closed and the outlet port (A) is connected to tank port (T).

In energized mode the solenoid armature presses onto the control spool with a force corresponding to the amount of current. This will set a reduced pressure at port A. The setting is proportional to the amount of current applied.

#### (3) Maximum pressure relief

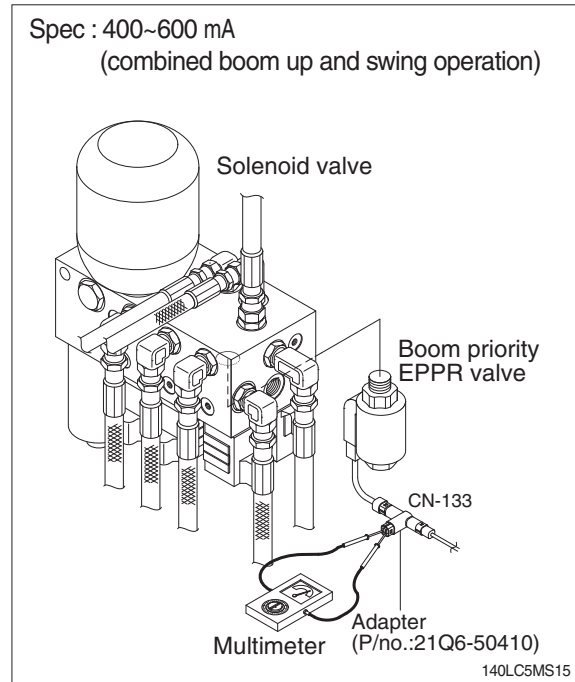
If a pressure from outside is applied on port A the valve may directly switch to tank port (T) and protect the system before overload.



## 2) EPPR VALVE CHECK PROCEDURE

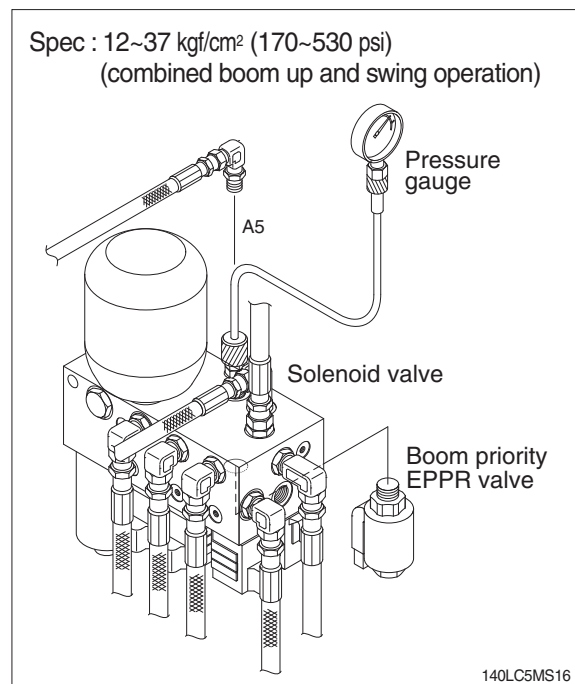
### (1) Check electric current value at EPPR valve

- ① Disconnect connector CN-133 from EPPR valve.
- ② Insert the adapter to CN-133 and install multimeter as figure.
- ③ Start engine.
- ④ Set S-mode and cancel auto decel mode.
- ⑤ If rpm display approx  $1750 \pm 50$  rpm disconnect one wire harness from EPPR valve.
- ⑥ Check electric current in case of combined boom up and swing operation.



### (2) Check pressure at EPPR valve

- ① Remove hose from A5 port and connect pressure gauge as figure.
  - Gauge capacity : 0 to 50 kgf/cm<sup>2</sup>  
(0 to 725 psi)
- ② Start engine.
- ③ Set S-mode and cancel auto decel mode.
- ④ If rpm display approx  $1750 \pm 50$  rpm check pressure (In case of combined boom up and swing operation).
- ⑤ If pressure is not correct, adjust it.
- ⑥ After adjust, test the machine.



## GROUP 15 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



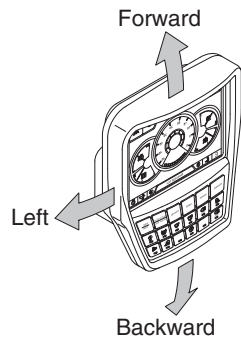
140LC3CD01

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.

The warning lamp blinks until the problem is cleared. Refer to page 5-71 for details.

※ This cluster is adjustable.

- Vertical (forward/backward) : each 15°
- Horizontal (left only) : 8°



290F3CD47

## 2) CLUSTER CHECK PROCEDURE

### (1) Start key : ON

#### ① Check monitor

- a. Buzzer sounding for 4 seconds with HYUNDAI logo on cluster.
- ※ If the ESL mode is set to the enable, enter the password to start engine.

#### ② After initialization of cluster, the operating screen is displayed on the LCD.

Also, self diagnostic function is carried out.

- a. Engine rpm display : 0 rpm
- b. Engine coolant temperature gauge : White range
- c. Hydraulic oil temperature gauge : White range
- d. Fuel level gauge : White range

#### ③ Indicating lamp state

- a. Power mode pilot lamp : E mode or U mode
- b. Work mode pilot lamp : General operation mode (bucket)
- c. Travel speed pilot lamp : Low (turtle)

### (2) Start of engine

#### ① Check machine condition

- a. RPM display indicates at present rpm
- b. Gauge and warning lamp : Indicate at present condition.
- ※ When normal condition : All warning lamp OFF
- c. Work mode selection : General work
- d. Power mode selection : E mode or U mode
- e. Travel speed pilot lamp : Low (turtle)

#### ② When warming up operation

- a. Warming up pilot lamp : ON
- b. After engine started, engine speed increases to 1100 rpm.
- ※ Others same as above.

#### ③ When abnormal condition

- a. The warning lamp lights up and the buzzer sounds.
- b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.
- ※ The pop-up warning lamp moves to the original position and blink when the buzzer stop switch is pushed. Also the buzzer stops.

### 3) CLUSTER CONNECTOR

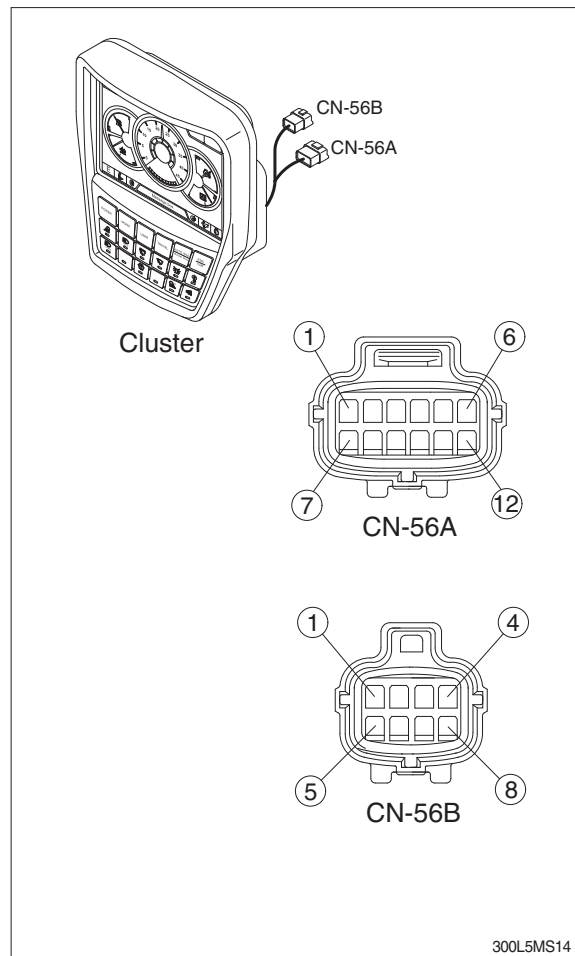
#### (1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32V
2	Power IG (24V)	20~32V
3	GND	-
4	CAN 1 (H)	0~5V
5	CAN 1 (L)	0~5V
6	CAN 2 (H)	0~5V
7	CAN 2 (L)	20~32V
8	NC	-
9	NC	-
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

#### (2) CN-56B

No.	Name	Signal
1	CAM 6.5V	6.3~6.7V
2	CAM GND	-
3	CAM DIFF (H)	0~5V
4	CAM DIFF (L)	0~5V
5	CAM 1	NTSC signal
6	CAM 2	NTSC signal
7	CAM 3	NTSC signal
8	CAM shield	0~5V

NTSC : National Television System Committee



300L5MS14

## 4) GAUGE

### (1) Operation screen

When you first turn starting switch ON, the operation screen will appear.



290F3CD51

- |                                    |                           |
|------------------------------------|---------------------------|
| 1 RPM / Speed gauge                | 5 DEF/AdBlue® level gauge |
| 2 Engine coolant temperature gauge | 6 Tripmeter display       |
| 3 Hydraulic oil temperature gauge  | 7 Eco guage               |
| 4 Fuel level gauge                 | 8 Accel dial gauge        |

※ Operation screen type can be set by the screen type menu of the display.  
Refer to page 5-94 for details.

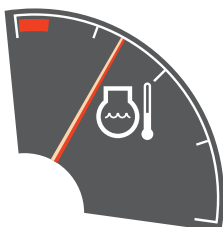
### (2) RPM / Speed gauge



290F3CD49

① This display the engine speed.


### (3) Engine coolant temperature gauge




290F3CD53

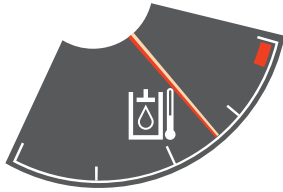
① This gauge indicates the temperature of coolant.

- White range : 40-107°C (104-225°F)
- Red range : Above 107°C (225°F)



② If the indicator is in the red range or  lamp pops up and the buzzer sounds turn OFF the engine and check the engine cooling system.

※ If the gauge indicates the red range or  lamp 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.

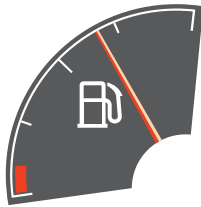
#### (4) Hydraulic oil temperature gauge





290F3CD54

- ① This gauge indicates the temperature of hydraulic oil.
    - White range : 40-105°C(104-221°F)
    - Red range : Above 105°C(221°F)
  - ② If the indicator is in the red range or  lamp pops up and the buzzer sounds reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.
- ※ If the gauge indicates the red range or  lamp 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.

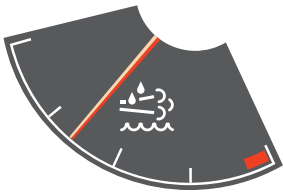
#### (5) Fuel level gauge





290F3CD55

- ① This gauge indicates the amount of fuel in the fuel tank.
  - ② Fill the fuel when the red range, or  lamp pops up and the buzzer sounds.
- ※ If the gauge indicates the red range or  lamp 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.

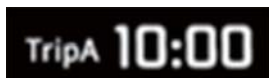
#### (6) DEF/AdBlue® Level gauge



290F3CD57

- ① This gauge indicates the amount of liquid in the DEF/AdBlue® tank.
  - ② Fill the DEF/AdBlue® when the red range, or  lamp pops up and the buzzer sounds.
  - ③ Do not pour DEF/AdBlue® any more when the DEF/AdBlue® fill up warning lamp lights ON.
- ※ Refer to page 5-76.
- ※ If the gauge indicates the red range or  lamp 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.

#### (7) Tripmeter display



290F3CD56

- ① This displays the engine the tripmeter.
- ※ Refer to page 5-96 for details.

### (8) Eco gauge



290F3CD58

- ① This gauge indicates the fuel consumption rate and machine load status. So that operators can be careful with fuel economy.
- ② The fuel consumption rate or machine load is higher, the number of segment is increased.
- ③ The color of Eco gauge indicates operation status.
  - White : Idle operation
  - Green : Economy operation
  - Yellow : Non-economy operation at a medium level.
  - Red : Non-economy operation at a high level.

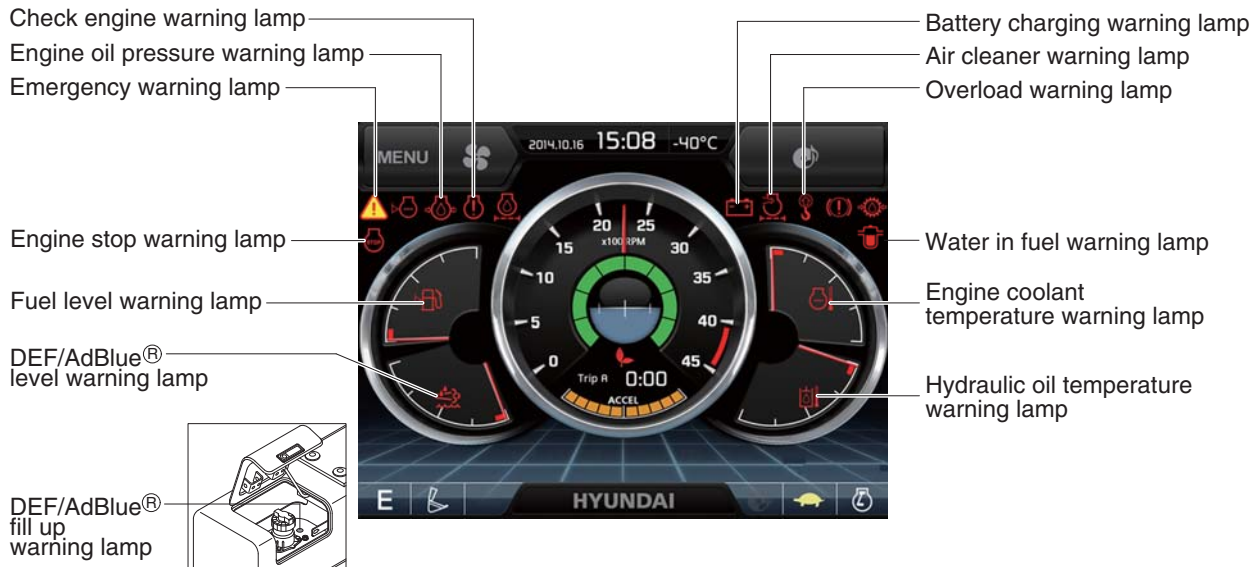
### (9) Accel dial gauge



290F3CD59





- ① This gauge indicates the level of accel dial.

## 5) WARNING LAMPS



140L3CD60

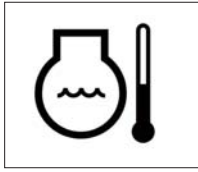
### ※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	<ul style="list-style-type: none"> <li>The pop-up warning lamp moves to the original position and blinks, and the buzzer stops when ;</li> <li>- the buzzer stop switch  is pushed</li> <li>- the knob of the haptic controller is pushed</li> <li>- the lamp of the LCD is touched</li> </ul>
	Warning lamp pops up on the center of the LCD and the buzzer sounds	<ul style="list-style-type: none"> <li>The pop-up warning lamp moves to the original position and light ON, and the buzzer stops when ;</li> <li>- the buzzer stop switch  is pushed</li> <li>- the knob of the haptic controller is pushed</li> <li>- the lamp of the LCD is touched</li> </ul> <p>※ Refer to operator's manual page 3-11 for details.</p>
	Warning lamp pops up on the center of the LCD and the buzzer sounds	<p>※ Refer to operator's manual page 3-7 for details.</p>








※ Refer to page 5-81 for the buzzer stop switch  and operator's manual page 3-57 for the haptic controller.



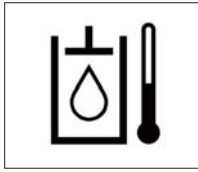
### (1) Engine coolant temperature warning lamp










290F3CD61

- ① Engine coolant temperature warning is indicated two steps.
  - 103°C over : The  lamp pops up and the buzzer sounds.
  - 107°C over : The  lamp pops up and the buzzer sounds.
- ② The pop-up ,  lamps move to the original position and blinks when the buzzer stop switch  is pushed. And the buzzer stops and ,  lamps keep blink.
- ③ Check the cooling system when the lamps keep blink.

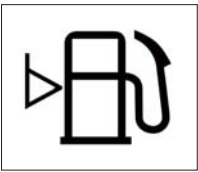
### (2) Hydraulic oil temperature warning lamp



290F3CD62

- ① Hydraulic oil temperature warning is indicated two steps.
  - 100°C over : The  lamp pops up and the buzzer sounds.
  - 105°C over : The  lamp pops up and the buzzer sounds.
- ② The pop-up ,  lamps move to the original position and blinks when the buzzer stop switch  is pushed. And the buzzer stops and ,  lamps keep blink.
- ③ Check the hydraulic oil level and hydraulic oil cooling system.

### (3) Fuel level warning lamp




290F3CD63

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

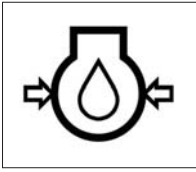
### (4) Emergency warning lamp



290F3CD64

- ① This warning lamp pops up and the buzzer sounds when each of the below warnings is happened.
  - Engine coolant overheating (over 107°C)
  - Hydraulic oil overheating (over 105°C)
  - MCU input voltage abnormal
  - Cluster communication data error
  - Engine ECM communication data error
- ※ The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch  is pushed. And the buzzer stops.
- ② When this warning lamp blinks, machine must be checked and serviced immediately.

#### (5) Engine oil pressure warning lamp



290F3CD65

- ① This warning lamp pops up and the buzzer sounds when the engine oil pressure is low.
- ② If the lamp blinks, shut OFF the engine immediately. Check oil level.

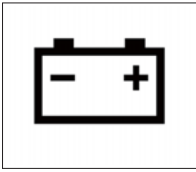
#### (6) Check engine warning lamp



290F3CD66

- ① This warning lamp pops up and the buzzer sounds when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received specific fault code from engine ECM.
- ② Check the communication line between them.  
If the communication line is OK, then check the fault codes on the cluster.

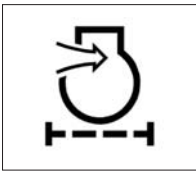
### (7) Battery charging warning lamp



290F3CD67

- ① This warning lamp pops up and the buzzer sounds when the battery charging voltage is low.
- ② Check the battery charging circuit when this lamp blinks.

### (8) Air cleaner warning lamp



290F3CD68

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

### (9) Overload warning lamp (opt)



290F3CD69

- ① When the machine is overload, the overload warning lamp pops up and the buzzer sounds during the overload switch is ON. (if equipped)
- ② Reduce the machine load.

#### (10) Engine stop warning lamp



290F3CD252

① This warning lamp pops up and the buzzer sounds when 30 minutes elapsed with empty condition of the DEF/AdBlue® tank, stop the engine immediately and check the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® immediately in the DEF/AdBlue® tank.

※ Refer to the 5-76 page.

#### (11) Water in fuel warning lamp



210WF3CD02

① This warning lamp pops up and the buzzer sounds when the water separator is full of water or malfunctioning.

※ When this lamp blinks, stop the machine and spill water out of the separator.

## (12) DEF/AdBlue® level warning lamp



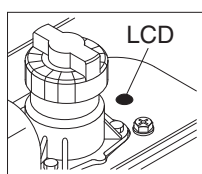
290F3CD257

① This warning lamp indicates when ON or blinking, that the DEF/AdBlue® level is low as table below.

※ It is recommended that the DEF/AdBlue® tank be filled completely full of the DEF/AdBlue® in order to correct any fault conditions.

Warning lamp			Description
DEF/AdBlue® level	Check engine	Stop engine	
On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (20%).
On	Off	Off	· The DEF/AdBlue® level has fallen below the critical warning level (14%).
On	On	Off	· The DEF/AdBlue® level has fallen below the initial derate warning level (8%). · 75% torque derate.
On	On	On	· The DEF/AdBlue® level has fallen below the initial warning level (3.5%). · 5 minute control engine speed and then hold idle only.

## (13) DEF/AdBlue® fill up warning lamp



290F3CD272

① This lamp lights ON when the DEF/AdBlue® tank is completely filled with DEF/AdBlue®.

※ Fill the tank with the DEF/AdBlue® after start switch ON and then turn OFF the start switch.













※ Do not pour DEF/AdBlue® any more when this lamp lights ON. Otherwise DEF/AdBlue® tank may freeze and burst in winter season.

## 6) PILOT LAMPS



290F3CD74

### (1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode		Heavy duty power work mode
			Standard power mode
			Economy power mode
2	User mode		User preferable power mode
3	Work tool mode		General operation - IPC speed mode
			General operation - IPC balance mode
			General operation - IPC efficiency mode
			Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
			High speed traveling
5	Auto idle mode		Auto idle

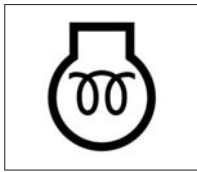
### (2) Power max pilot lamp



290F3CD78

- ① The lamp will be ON when pushing power max switch on the LH RCV lever.
  - ② The power max function is operated maximum 8 seconds.
- ※ Refer to the operator's manual page 3-38 for power max function.

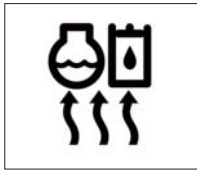
### (3) Preheat pilot lamp



290F3CD79

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

### (4) Warming up pilot lamp



290F3CD80

- 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 the engine.

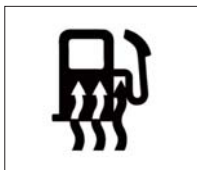
### (5) Decel pilot lamp



290F3CD81

- ① Operating one touch decel switch on the RCV lever makes the lamp ON.
  - ② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
- ※ **One touch decel is not available when the auto idle pilot lamp is turned ON.**
- ※ **Refer to the operator's manual page 3-38.**

### (6) Fuel warmer pilot lamp



290F3CD82

- ① This lamp is turned ON when the coolant temperature is below 10°C (50°F) or the hydraulic oil temperature 20°C (68°F).
- ② The automatic fuel warming is cancelled when the engine coolant temperature is above 60°C, and the hydraulic oil temperature is above 45°C since the start switch was ON position.

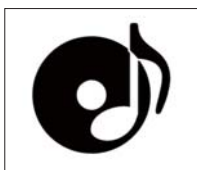
### (7) Maintenance pilot lamp



290F3CD83

- ① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
  - ② Check the message in maintenance information of main menu.
- Also, this lamp lights ON for 3 minutes when the start switch is ON position.
- ※ **Refer to the 5-90 page.**

**(8) Entertainment pilot lamp**

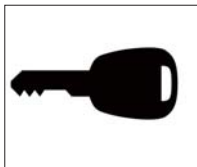


290F3CD84

① This lamp is on when audio or video files are playing.

※ **Refer to the 5-96 page.**

**(9) Smart key pilot lamp (opt)**



290F3CD214

① This lamp is ON when the engine is started by the start button.

② This lamp is red when the authentication fails, green when succeeds.

※ **Refer to the 5-91 page.**



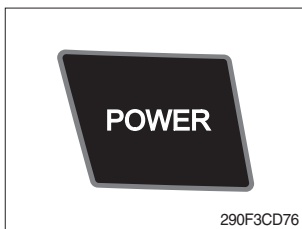
## 7) SWITCHES



290F3CD86

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-77 for details.




### (1) Power mode switch



- ① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.
  - P : Heavy duty power work.
  - S : Standard power work.
  - E : Economy power work.
- ② The pilot lamp changes E → S → P → E in order.

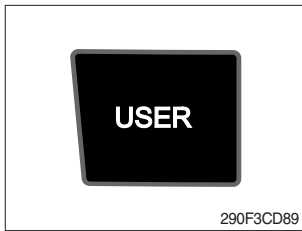
### (2) Work mode switch



- ① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.
  -  : General operation mode
  -  : Breaker operation mode (if equipped)
  -  : Crusher operation mode (if equipped)
  - Not installed : Breaker or crusher is not installed.

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



### (3) User mode switch



- ① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
  - Memory : Automatically saved after key OFF.
  - Action : Push this switch.
  - Cancel : Push this switch once more.
- ② Refer to the page 5-85 for another set of user mode.

### (4) Travel speed switch



- ① This switch is used to select the travel speed alternatively.
    -  : Low speed
    -  : High speed
- ※ Do not change the setting of the travel speed switch. Machine stability may be adversely affected.
- ▲ Personal injury can result from sudden changes in machine stability.

### (5) Auto idle/ buzzer stop switch



- ① This switch is used to activate or cancel the auto idle function.
  - Pilot lamp ON : Auto idle function is activated.
  - Pilot lamp OFF : Auto idle function is cancelled.
- ② The buzzer sounds when the machine has a problem. In this case, push this switch and buzzer stops, but the warning lamp blinks until the problem is cleared.

### (6) Escape/Camera switch



- ① This switch is used to return to the previous menu or parent menu.
- ② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped). Please refer to page 5-97 for the camera.
- ③ If the camera is not installed, this switch is used only ESC function.

### (7) Work light switch



- ① This switch is used to operate the work light.
- ② The pilot lamp is turned ON when operating the switch.

### (8) Head light switch



- ① This switch is used to operate the head light.
- ② The pilot lamp is turned ON when operating the switch.

### (9) Intermittent wiper switch



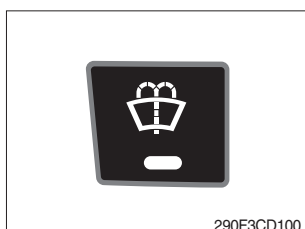
- ① This switch is used to wipe operates intermittently.
- ② The pilot lamp is turned ON when operating the switch.

### (10) Wiper switch



- ① This switch is used to operate the window wiper.
- ② Note that the wiper will self-park when switched off.
- ③ The pilot lamp is turned ON when operating the switch.
- ※ **If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause. If the switch remains ON, motor failure can result.**

### (11) Washer switch



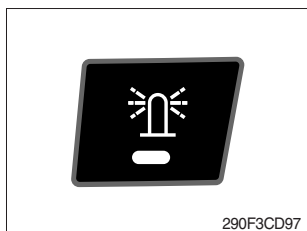
- ① The washer liquid is sprayed and the wiper is operated only while pressing this switch.
- ② The pilot lamp is turned ON when operating the switch.

### (12) Cab light switch



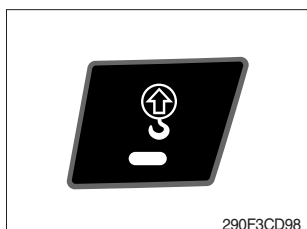
- ① This switch turns ON the cab light on the cab.
- ② The pilot lamp is turned ON when operating the switch.

### (13) Beacon switch



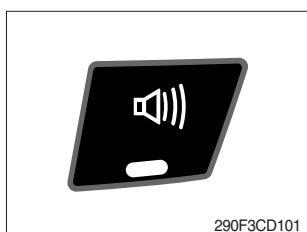
- ① This switch turns ON the rotary light on the cab.
- ② The pilot lamp is turned ON when operating the switch.

### (14) Overload switch



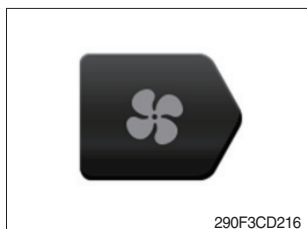
- ① When this switch turned ON, buzzer makes sound and overload warning lamp comes ON in case that the machine is overload.
  - ② When it turned OFF, buzzer stops and warning lamp goes out.
- ▲ Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.**

### (15) Travel alarm switch



- ① This switch is to activate travel alarm function surrounding when the machine travels.
  - ON : The travel alarm function is activated.
  - OFF : The travel alarm function is not activated.

### (16) Air conditioner quick touch switch



- ① This switch used to select air conditioner control mode.  
※ Refer to the page 5-100.

### (17) Main menu quick touch switch



- ① This switch is to activate the main menu in the cluster.  
※ Refer to the page 5-84.

### (18) Entertainment quick touch switch



- ① This switch is to activate the entertainment control menu in the cluster.  
※ Refer to the page 5-96.

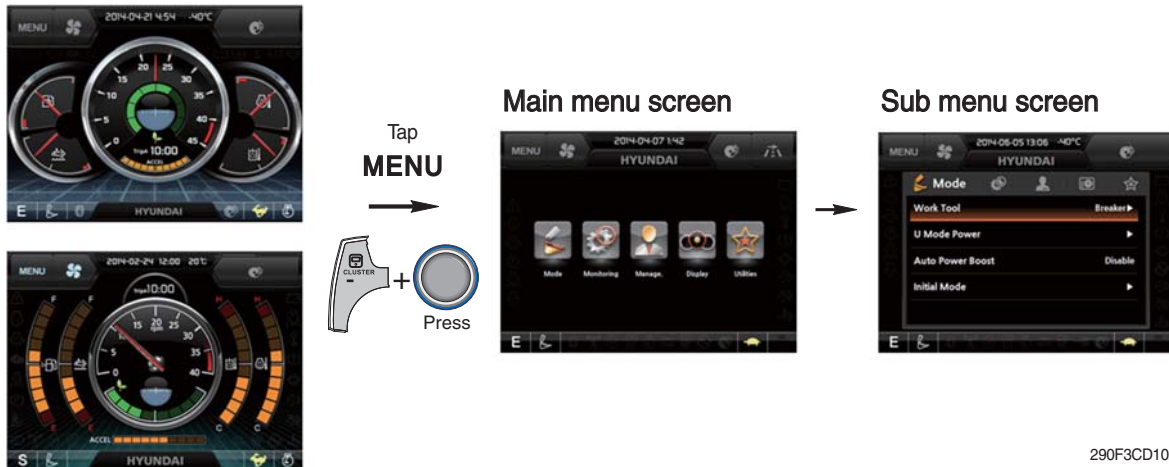
## 8) MAIN MENU

※ You can select or set the menu by the haptic controller or touch screen.

On the operation screen, tap MENU to access the main menu screen.

On the sub menu screen, you can tap the menu bar to access functions or applications.






· Operation screen



290F3CD102

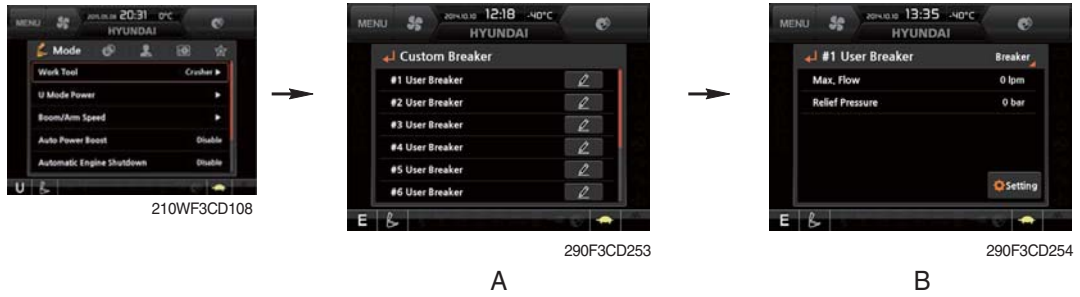
※ Please refer to the haptic controller, operator's manual page 3-58 for selection and change of menu and input value.

### (1) Structure

No	Main menu	Sub menu	Description
1	 Mode 290F3CD103	Work tool U mode power Boom/Arm speed Auto power boost IPC mode Auto engine shutdown (option) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode, Accel initial mode / step Switch function
2	 Monitoring 290F3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 290F3CD105	Fuel rate information Maintenance information Machine security Machine information  Contact Service menu  Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor, Haptic / switch controller, RMCU, Relay drive unit, FATC, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 290F3CD106	Display item Clock Brightness Unit setup Language selection Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 290F3CD107	Entertainment Tripmeter Camera	Play Video, Audio, Smart terminal. 3 kinds (A, B, C) Number of active, Display order, AAVM (opt)

## (2) Mode setup

### ① Work tool



- Select on installed optional attachment
  - A : It can set the user's attachment.  
It is available in setting #1~#10.
  - B : Max flow - Set the maximum flow for the attachment.  
Relief pressure - Set the relief pressure.

### ② U mode power



- Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.
- U-mode can be activated by user mode switch.

Step (■)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	750	0
2	1400	800	3
3	1500	850	6
4	1600	900	9
5	1700	950	12
6	1800	1000	16
7	1850	1050	20
8	1900	1100 (auto decel)	26
9	1950	1150	32
10	2000	1200	38

※ One touch decel & low idle : 1000 rpm

### ③ Boom/Arm speed



- **Boom speed**
  - Boom priority function can be activated or cancelled  
Enable - Boom up speed is automatically adjusted as working conditions by the MCU.  
Disable - Normal operation
- **Arm speed**
  - Arm regeneration function can be activated or cancelled.  
Enable - Arm in speed is up.  
Disable - Normal operation.

#### ④ Auto power boost



210WF3CD118



290F3CD117

- The power boost function can be activated or cancelled.
  - Enable - The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.
  - Disable - Not operated.

#### ⑤ IPC mode



290F3CD310



290F3CD311



290F3CD304



290F3CD312



290F3CD305



290F3CD313



290F3CD306

- The IPC mode can be selected by this menu.
  - Speed mode
  - Balance mode (default)
  - Efficiency mode
- This mode is applied only general operation mode of the work tool mode.
- ※ Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to the operator's manual page 3-25-1.

## ⑥ Automatic engine shutdown (option)



210WF3CD11



210WF3CD12



210WF3CD13

- The automatic engine shutdown function can be set by this menu.
  - One time
  - Always
  - Disable
  - Wait time setting : Max 40 minutes, min 2 minutes

## ⑦ Initial mode



290F3CD122



290F3CD119

- **Key on initial mode**
  - Selected the power mode is activated when the engine is started.
- **Accel initial mode**
  - Last setting value
  - User setting value
- **Accel initial step**
  - 0~9 step

## ⑧ Emergency mode



290F3CD248



290F3CD249

- This mode can be use when the switches are abnormal on the cluster.
- The cluster switches will be selected by touched each icon.



### (3) Monitoring

#### ① Active fault



- The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

#### ② Logged fault



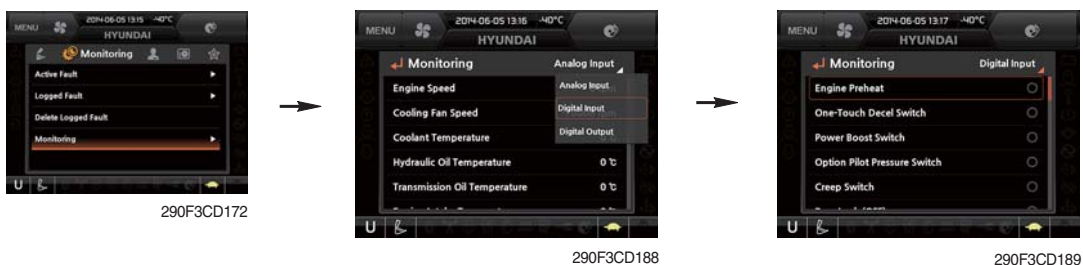
- The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

#### ③ Delete logged fault



- The logged faults of the MCU, engine ECM or air conditioner can be deleted by this menu.

#### ④ Monitoring



- The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).
- The switch status or output status can be confirmed by this menu (Digital input & Digital output).
- The activated switch or output pilot lamps ● are light ON.

#### (4) Management

##### ① Fuel rate information



210WF3CD14



210WF3CD15

A



B



C



D



210WF3CD16

- **General record (A)**
  - Average fuel rate (left) (from "Reset" to now)  
Fuel consumption divided by engine run time (service meter time).
  - A days fuel used (right)  
Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).
- **Hourly record (B)**
  - Hourly fuel rates for past 12 hours (service meter time).
  - No record during key-off time.
  - One step shift to the right for every one hour.
  - Automatic deletion for 12 hours earlier data.
  - All hourly records deletion by "Reset".
- **Daily record (C)**
  - Daily fuel consumption for past seven days (MCU real time).
  - No record during key-off time.
  - One step shift to the right at 24:00 for every day.
  - Automatic deletion for 7 days earlier data.
  - All daily records deletion by "Reset".
- **Mode record (D)**
  - Average fuel rate for each power mode/accel dial (at least 7) from "Reset" to now.
  - No record during idle.
  - All mode records deletion by "Reset".

## ② Maintenance information



210WF3CD131



290F3CD132

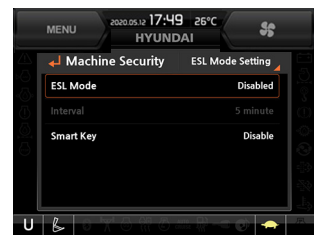


290F3CD133

- Alarm lamp ( ● ) is ON when oil or filter needs to be changed or replaced.
- Replacement : The elapsed time will be reset to zero (0).
- Change interval : The change or replace interval can be changed in the unit of 50 hours.
- **Change or replace interval**

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	1000
12	Air cleaner (inner & outer)	2000
13	Radiator coolant	2000
14	Swing gear pinion grease	1000
15	DEF/AdBlue® supply module filter	1500
16	Crankcase Breather Filter	1500

### ③ Machine security



#### · ESL mode setting

- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.

#### - Machine security

Disable : ESL function is disabled and password is not required to start engine.

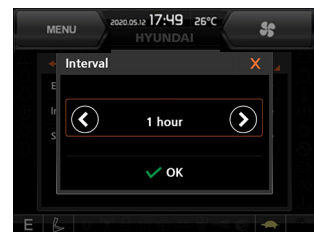
Enable (always) : The password is required whenever the operator starts engine.

- **Interval** : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password. The interval time can be set to a maximum 4 hours.

※ Default password : 00000 +

※ Password length : (5~10 digits) +

- Smart key (option) : Refer to next page.



#### · Password change

- The password is 5~10 digits.



Enter the current password



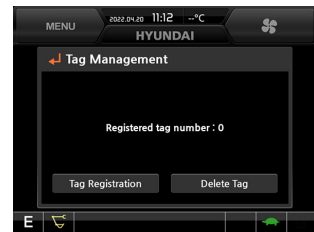
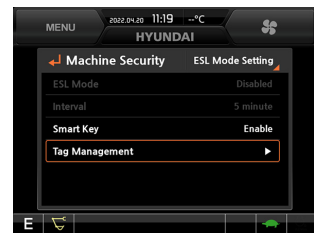
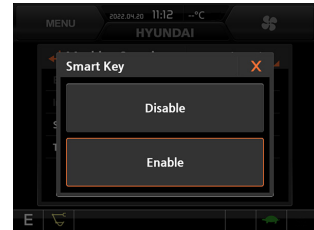
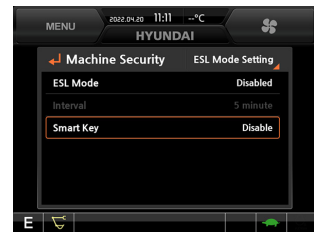
Enter the new password again



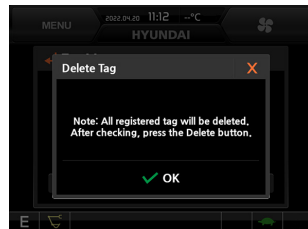
Enter the new password

※ Before first use, please set user password and owner password in advance for machine security.

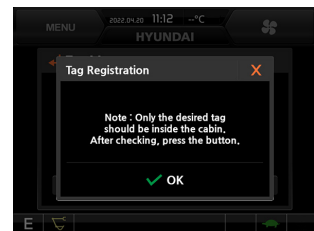
- Smart key



Deleting ←



Registering ↓

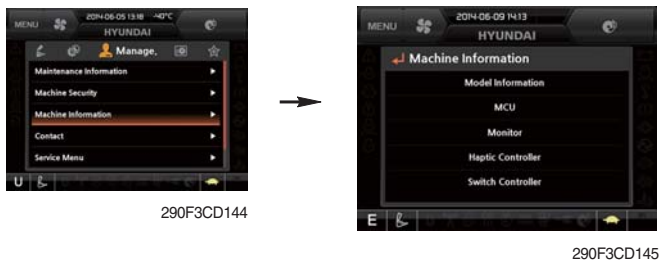


- Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.
- Tag management menu is activated when the Smart key menu is Enabled.  
You can register and delete the tags.

- Tag management

- When registering a tag : Only the tag you want to register must be in the cabin.
- When deleting a tag : All registered tags are deleted.

#### ④ Machine Information



- This can confirm the identification of the model information (ECU), MCU, monitor, haptic controller, switch controller, RMCU, relay driver unit, FATC (air conditioner controller), AAVM (opt).

#### ⑤ Contact (A/S phone number)



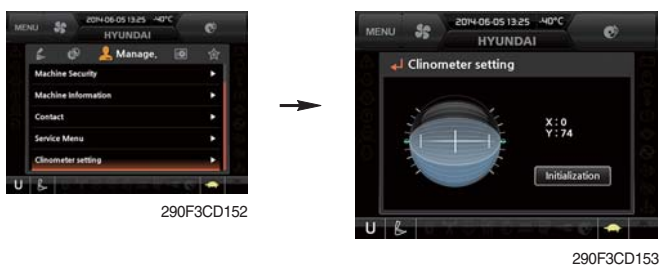
Enter the new A/S phone number

#### ⑥ Service menu



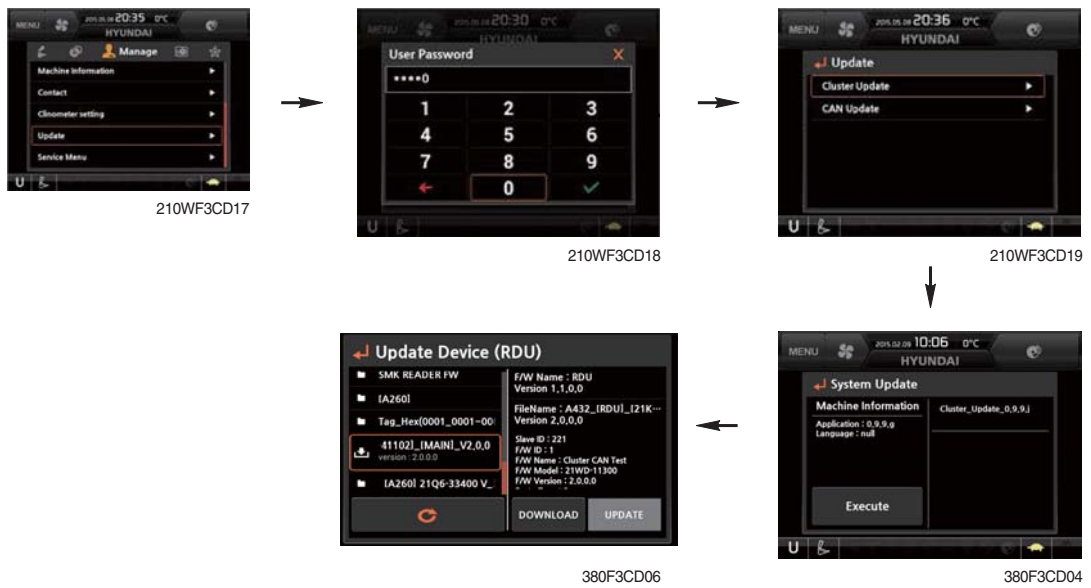
- Power shift (standard/option) : Power shift pressure can be set by option menu.
- Operating hours : Operating hours since the machine line out can be checked by this menu.
- Breaker mode pump acting (1 pump/2 pump)
- EPPR current level (attach flow EPPR 1 & 2, boom priority EPPR, attach relief pressure EPPR 1 & 2)
- Overload pressure : 100 ~ 350 bar

#### ⑦ Clinometer



- When the machine is on the flatland, if tap the "initialization", the values of X, Y reset "0".
- You can confirm tilt of machine in cluster's operating screen.

### ⑧ Update (cluster & ETC devices)



- ETC devices and cluster can be updated through CAN 2 network.
- Insert USB memory stick which includes program files, start download.

## (5) Display

### ① Display item



290F3CD154



290F3CD155



290F3CD156

- The center display type of the LCD can be selected by this menu.
- The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

### ② Clock



290F3CD157



290F3CD158

- The first line's three spots "\*\*/\*\*/\*\*\*\*" represent Month/Day/Year each.
- The second line shows the current time. (0:00~23:59)

### ③ Brightness



290F3CD159



290F3CD160



290F3CD139



290F3CD141



290F3CD191



290F3CD192

- If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night. (in bar figure, white area represents night time while orange shows day time)



#### ④ Unit



290F3CD161



210WF3CD162



290F3CD193

- Temperature : °C ↔ °F
- Pressure : bar ↔ MPa ↔ kgf/cm<sup>2</sup>
- Volume : l ↔ gal
- Flow : lpm ↔ gpm
- Distance : km ↔ mile
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-mm-yy

#### ⑤ Language



290F3CD163



290F3CD164

- User can select preferable language and all displays are changed the selected language.

#### ⑥ Screen type



290F3CD165



A Type (Default) 290F3CD166



290F3CD156A



B Type (Option) 290F3CD194



290F3CD167A

## (6) Utilities

### ① Entertainment



290F3CD195



290F3CD196

A



210WF3CD219



290F3CD197

B



210WF3CD220



290F3CD198

C



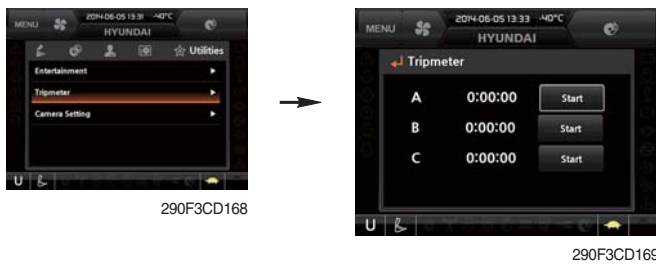
210WF3CD199



210WF3CD22

- Video (A) : This menu operates the video play function.  
mp4, mkv, avi files and so on.
- Audio (B) : This menu operates the play music.  
mp3, mp4 files and so on.
- Smart terminal (C) : The menu features a smartphone and operates the miracast.

## ② Tripmeter



- Maximum 3 kinds of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

## ③ Camera setting

- If the rear camera is not installed on the machine, set disable.
- If the rear camera installed on the machine, set enable.



- In the operation screen, rear camera screen show up when ESC/CAM button is pushed.



#### ④ AAVM (All Around View Monitoring, option)

- The AAVM buttons of the cluster consist of ESC/CAM and AUTO IDLE/Buzzer stop.



#### - Escape button

- It will enter into the AAVM mode from the beginning screen if the AAVM is installed.
- While in the AAVM mode, select the ESC button to return to the beginning screen.



The beginning screen



AAVM mode

#### - Buzzer stop button

- In AAVM mode, it detects surrounding pedestrians or objects and the warning buzzer sounds.
- User can turn OFF the warning sound by pressing buzzer stop button.



290F3CD246

- When the worker or pedestrian go to the blue line (radius 5 m), an external danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the blue rectangular box for the recognition of the worker and pedestrian. At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.



290F3CD247

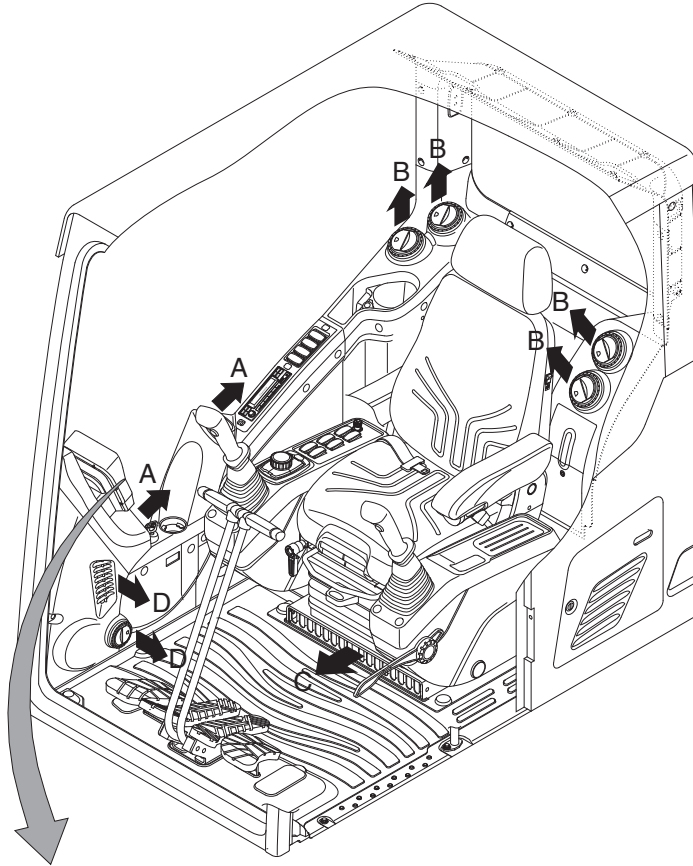
- When the worker or pedestrian go inside of red line (radius 3 m), an internal danger area of equipping on the cluster screen, the warning buzzer sounds and it displays the red rectangular box for the recognition of the worker and pedestrian. At this time, the operator should stop work immediately, and stop the buzzer by pressing the buzzer stop button. And then, please work after you check whether the danger factors are solved.

※ In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the haptic controller is not available.

## 9) AIR CONDITIONER AND HEATER

Full auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

- Location of air flow ducts

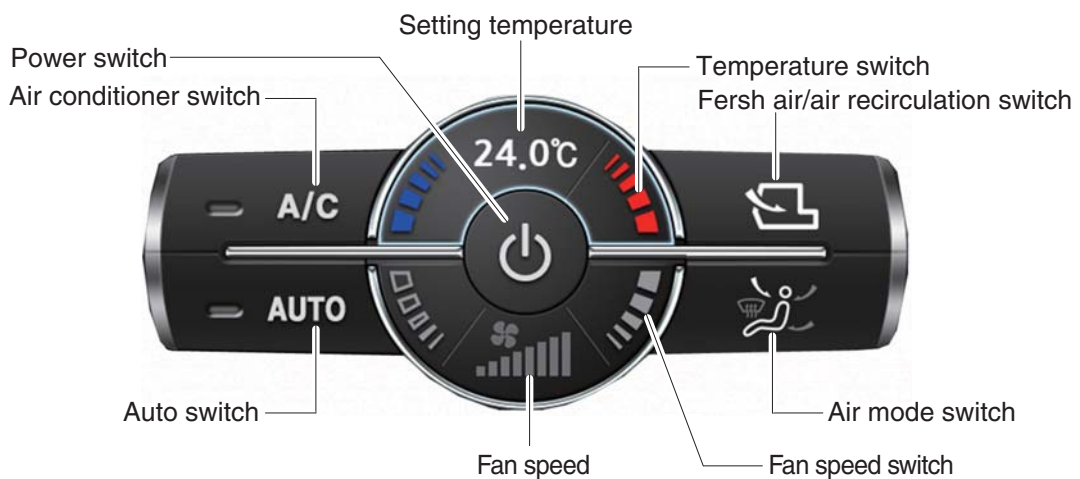


Cluster LCD



Cluster :  or

Haptic controller : 



※ Haptic controller : Refer to the operator's manual page 3-58.

290F3CD201

**(1) Power switch**



- ① This switch makes the system ON/OFF.  
Just before the power OFF, set values are stored.
- ② Default setting values

Function	Air conditioner	In/outlet	LCD	Temperature	Mode
Value	OFF	Inlet	OFF	Previous sw OFF	Previous sw OFF

**(2) Air conditioner switch**



- ① This switch turns the compressor ON/OFF.
- ※ **Air conditioner operates to remove vapor and drains water through a drain hose. Water can be sprayed into the cab in case that the drain cock at the ending point of drain hose has a problem.**  
**In this case, exchange the drain cock.**

**(3) Auto switch**



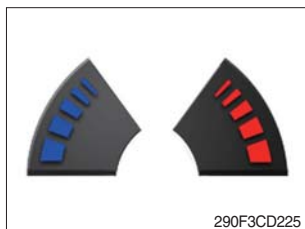
- ① Auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

**(4) Setting temperature**



- ① Display the temperature setting out.

**(5) Temperature switch**

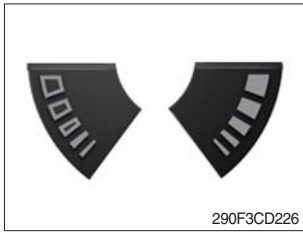


- ① Setting temperature indication  
· Lo (17°C), 17.5~31.5°C, Hi (32°C)
- ② Max cool and max warm beeps 5 times.
- ③ The max cool or the max warm position operates as following table.

Temperature	Compressor	Fan speed	In/outlet	Mode
Max cool	ON	Hi (8 step)	Recirculation	Face
Max warm	OFF	Hi (7 step)	Fresh	Def/Foot

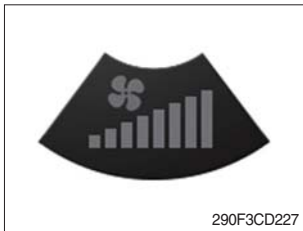
- ④ Temperature unit can be changed between celsius (°C) and fahrenheit (°F)
  - a. Default status (°C)
  - b. Push Up/Down temperature switch simultaneously more than 5 second displayed temperature unit change (°C → °F)

### (6) Fan speed switch



- ① Fan speed is controlled automatically by setted temperature.
- ② This switch controls fan speed manually.
  - There are 8 up/down steps to control fan speed.
  - The maximum step or the minimum step beeps 5 times.

### (7) Fan speed



- ① Steps 1 through 8 to display the amount of wind.

### (8) Fresh air/air recirculation switch



- ① It is possible to change the air-inlet method.
  - a. **Fresh air** (☞)
    - Inhaling air from the outside.
  - b. **Air recirculation** (☞)
    - It recycles the heated or cooled air to increase the energy efficiency.
    - ※ **Change air occasionally when using recirculation for a long time.**
    - ※ **Check out the fresh air filter and the recirculation filter periodically to keep a good efficiency.**

### (9) Air mode switch



- ① Operating this switch, it beeps and displays symbol of each mode in order. (Face → Face/Rear → Face/Rear/Foot → Foot → Def/Foot)

Mode switch	Face	Face/Rear	Face/Rear/Foot	Foot	Def/Foot
Outlet	A	●	●	●	
	B		●	●	
	C			●	●
	D				●

- ② When defroster mode operating, FRESH AIR/AIR RECIRCULATION switch turns to FRESH AIR mode and air conditioner switch turns ON.

## (10) Self diagnosis function

- ① Diagnostic methods : Diagnostic information window, select
- ② Diagnostic indication (Displays fault)

Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20°C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25°C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0°C alternate value control
F06	Evaporate temperature sensor short	
F07	Null	-
F08	Null	-
F09	Mode 1 actuator open/short	The alternate value is face
F10	Mode 1 actuator drive circuit malfunction	If not, the alternate value is Def/Foot
F11	Intake actuator open/short	The alternate value is air recirculation
F12	Intake actuator drive circuit malfunction	The alternate fresh air
F13	Temperature actuator open/short	If opening amount is 0 %, the alternate value is 0 %
F14	Temperature actuator drive circuit malfunction	If not, the alternate value is 100 %
F15	Null	-
F16	Null	-



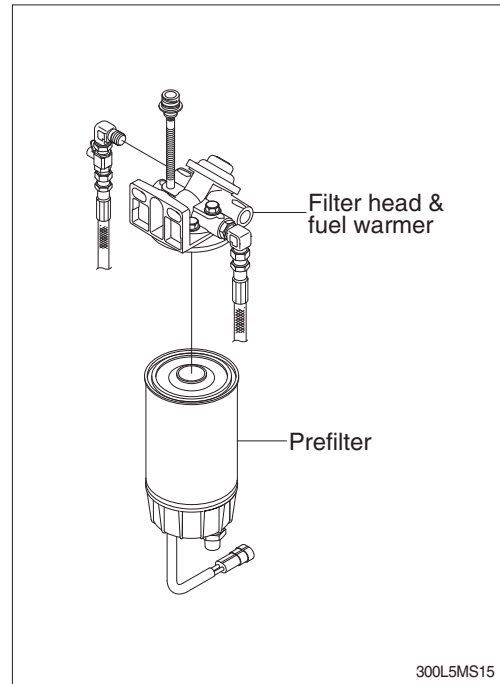
# GROUP 16 FUEL WARMER SYSTEM

## 1. SPECIFICATION

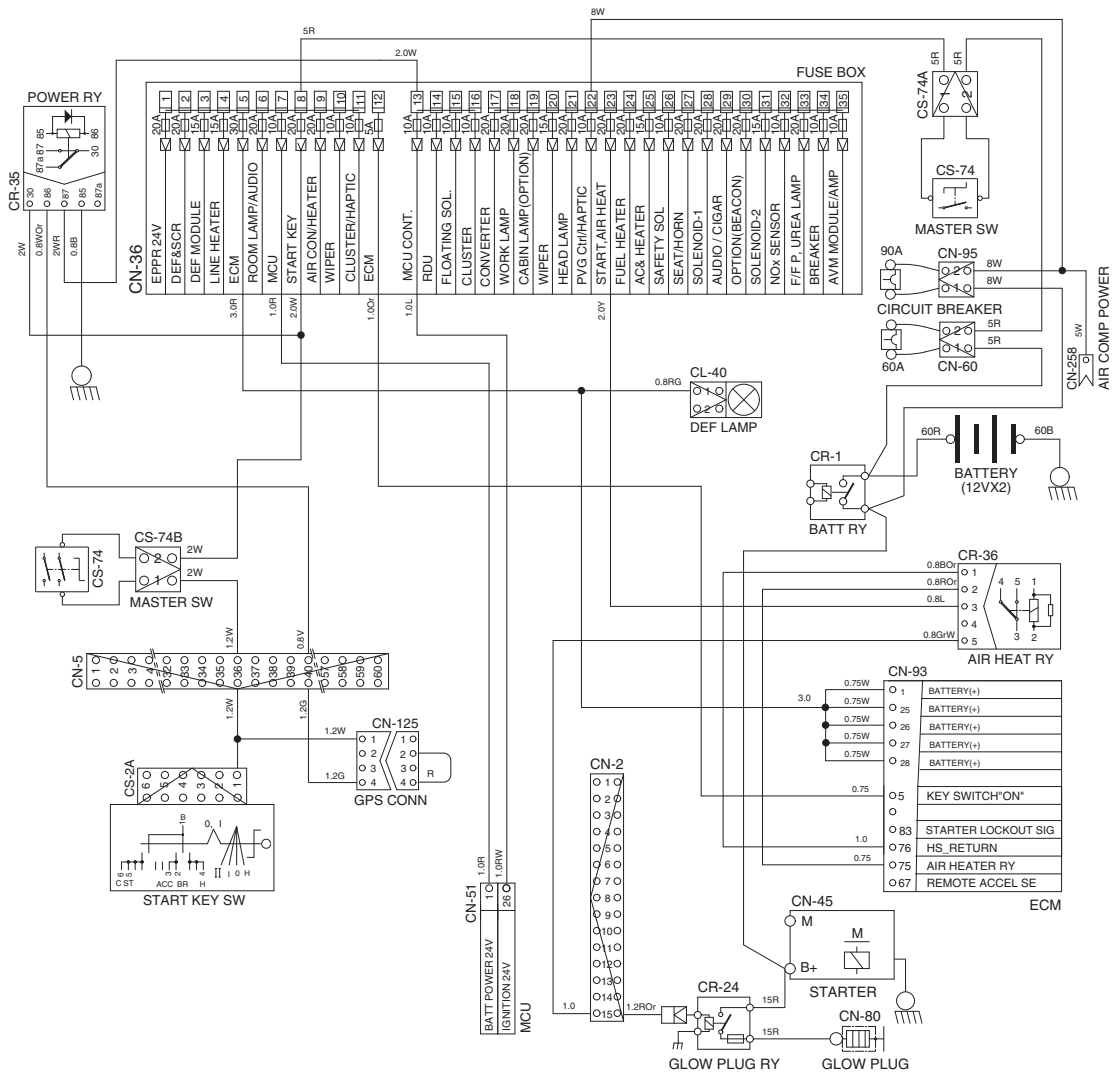
- 1) Operating voltage :  $24 \pm 4$  V
- 2) Power :  $350 \pm 50$  W
- 3) Current : 15 A

## 2. OPERATION

- 1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
  - 2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
  - 3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
- So, fuel is protected from overheating by this mechanism.



## 3. ELECTRIC CIRCUIT



140L5MS03