CATERPILLAR®

HEX TECHNICIAN SKILL TRAINING

311B-330B Excavators Engine and Pump Electronic Control System

System Operation

Testing & Adjusting

Asia Pacific Learning (China)

Contents

Introduction

REFERENCE: For machine operation information,make reference to OMM for the machine serviced.

REFERENCE: For System operation information of the Hydraulic System,make reference to Hydraulic Systems Testing and Adjusting moudle for the machine serviced.

REFERENCE: For Testing and Adjusting information of the Hydraulic System,make reference to to Hydraulic Systems Testing and Adjusting moudle for the machine serviced.

REFERENCE: For Electrical Circuit Schematics information,make reference to the Electrical System Schematic moudle for the machine being serviced.

General Information (Electronic Control System)

SMCS Code: 1931

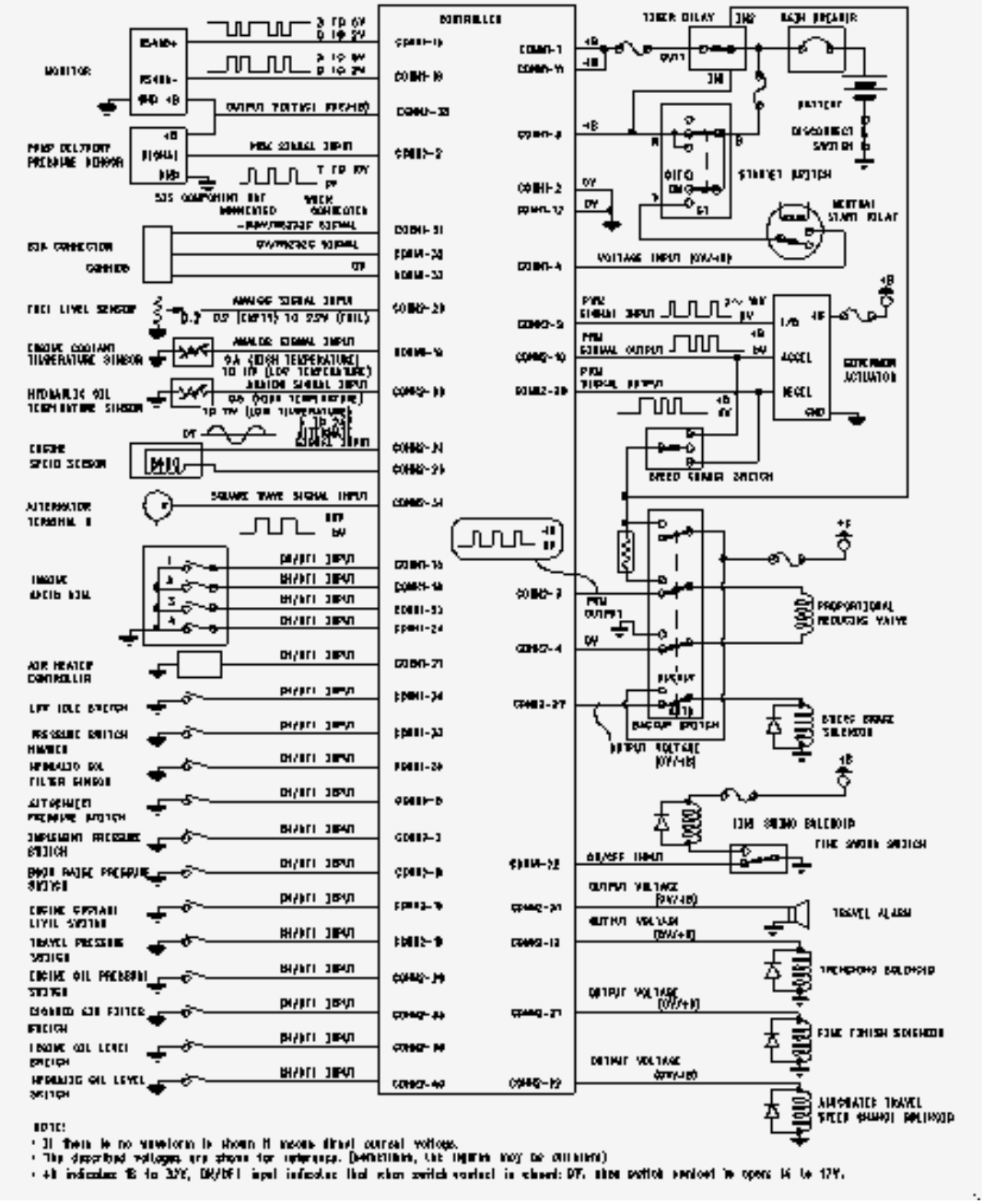

Illustration 1

Block Diagram Of The Engine Control System And Hydraulic Pump Control System

The engine control system and the pump control system monitors continuously. The control will adjust the speed of the engine and the speed of the hydraulic pump according to the machine conditions and the selections of the operator. The control system consists of the following components: engine and pump control (controller), monitor panel, various switches, sensors, relays, solenoids, lamps and alarms.

Table 1

Machine Effectivity								
311B	312B	315B	317B	318B	320B	322B	325B	330B
2MS1-UP	2KW1-UP	1SW1-UP	6DZ1-UP	5BJ1-UP	6CR1-UP	5CR1-UP	8GM1-UP	2RR1-UP
2LS1-UP	3FS1-UP	2DW1-UP	9WW1-UP	7KZ1-UP	AED1-UP	3NR1-UP	7EN1-UP	1KS1-UP
3HR1-UP	2NS1-UP	3AW1-UP		AEJ1-UP	3MR1-UP	1BS1-UP	8PR1-UP	1JS1-UP
3GR1-UP	3ES1-UP	5SW1-UP		3LR1-UP	4MR1-UP	1AS1-UP	2JR1-UP	4RS1-UP
9MR1-UP	9NW1-UP	7RZ1-UP		ADC1-UP	5BR1-UP	8MR1-UP	6DN1-UP	5LS1-UP
	9FS1-UP				5GW1-UP	1YS1-UP	8RR1-UP	5EZ1-UP
	8JR1-UP				8ES1-UP	2ES1-UP	8FN1-UP	AME1-UP
	6SW1-UP				6LW1-UP	8NR1-UP	4DS1-UP	9YR1-UP
	9HR1-UP				2WZ1-UP	1ZS1-UP	1GS1-UP	6DR1-UP
	9GR1-UP				BBG1-UP		5BS1-UP	8TR1-UP
					7ZZ1-UP		1HS1-UP	5LR1-UP
					8GZ1-UP		BGN1-UP	9HN1-UP
					1XS1-UP			
					7JR1-UP			
					2AS1-UP			
					1CS1-UP			
					1DS1-UP			
					1ES1-UP			
					9WS1-UP			
					6LS1-UP			
					5MS1-UP			
					9JS1-UP			
					4NR1-UP			
					4XW1-UP			

The controller communicates with the monitor panel via a data link. The monitor panel will provide the following information to the operator and/or service persons: warnings for an occurrence of problem (s), the conditions of the machine systems, diagnostic information and adjustment information. The monitor panel is also used by the operator to select operational functions: power mode, travel speed and et cetera.

Engine and Hydraulic Pump Controller

SMCS Code: 1931

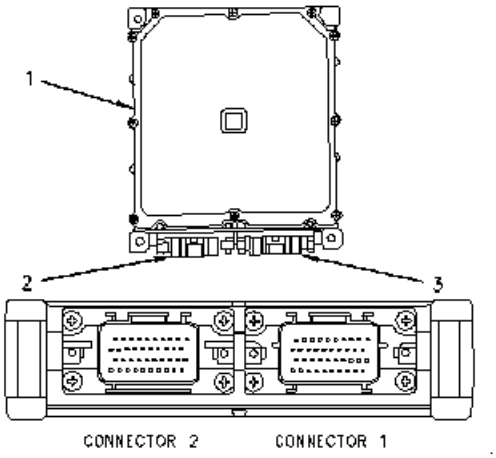

Illustration 6

Diagram Of The Engine Control and Hydraulic Pump Control
(1) Controller (2) Connector 2 (3) Connector 1

Table 2

Engine And Hydraulic Pump Control (Connector 2)[1]		
No.1	Function	Type
2	Front Pump Pressure Sensor	Sensor Input (Freq.)
3	Proportional Reducing Valve (+)	Solenoid Output (Pulsed)
4	Proportional Reducing Valve (-)	Solenoid Output (Pulsed)
6	AUX Pressure	Switch Input (Operational)
7	Implement Pressure	Switch Input (Operational)
9	Boom Raise Pressure	Switch Input (Operational)
9	GCV Actuator Feedback	Sensor Input (PWM)
10	Governor Actuator (+)	Solenoid Output (Pulsed)
12	Trenching Solenoid	Solenoid Output (On/Off)
13	Engine Coolant Temp.	Sensor Input (PWM)
15	Coolant Level	Switch Input (Operational)
18	Travel Pressure	Switch Input (Operational)
20	Governor Actuator (-)	Solenoid Output (Pulsed)
21	Level Finish Solenoid	Solenoid Output (On/Off)
22	Travel Speed Solenoid	Solenoid Output (On/Off)
24	Engine Speed (+)	Sensor Input (Freq.)
25	Engine Speed (-)	Sensor Return
26	Engine Oil Pressure	Switch Input (Operational)
27	Swing Brake Solenoid	Solenoid Output (Pulsed)
29	Fuel Level	Sensor Input (PWM)
30	Hydraulic Oil Temp.	Sensor Input (PWM)
31	Travel Alarm	Solenoid Output (On/Off)
34	Alternator R Terminal	Sensor Input (Voltage)
35	Air Cleaner	Switch Input (Operational)
36	Engine Oil Level	Switch Input (Operational)

Table 3

Engine And Hydraulic Pump Control (Connector 1)(1)		
No.1	**Function**	**Type**
1	+Battery (Unswitched)	Power
2	Ground	Ground
3	+Battery (Switched)	Switch Input (Keystart)
4	Key start	Switch Input (Operational)
11	+Battery (Unswitched)	Power
12	Ground	Ground
13	Engine Speed Dial 1	Switch Input (Operational)
14	Engine Speed Dial 2	Switch Input (Operational)
15	Data Link (+)	Input/Output
16	Data Link (-)	Input/Output
21	AIH Indicator (2)	Switch Input (Operational)
22	Fine Swing	Switch Input (Operational)
23	Engine Speed Dial 3	Switch Input (Operational)
24	Enging Speed Dial 4	Switch Input (Operational)
31	RS232C (TX)	Input/Output
32	RS232C (RX)	Input/Output
33	RS232C (GND)	Input/Output
34	Low Idle	Switch Input (Operational)
39	Hydraulic Oil Filter	

(1) The connector contacts that are not listed are not used. The connector has 40 contacts.
(2) Not available on the 330B.

(Table 2, contd)

38	Monitor (+)	Power
40	Hydraulic Oil Level	Switch Input (Operational)

(1) The connector contacts that are not listed are not used. The connector has 40 contacts.

When the controller determines that it is necessary to change the speed of the engine and the output of the hydraulic pump, the controller will actuate the governor actuator and the proportional reducing valve. Each input and output of the controller is connected to the machine harness through two 40-pin connectors.

Input/Output

The data link is a bidirectional component. The data link allows the controller to receive information and the controller can send information. The data link is designed to allow communication between the controller and the monitor. The data link is not a visible component. The data link consists of internal control circuits and the connecting harness wiring. The controller sends information through the data link. The following list contains some examples: fuel level, engine coolant temperature and the power mode that is selected to the monitor panel. The controller also receives requested information from the monitor panel.

The following list contains some examples: power mode and fine control mode.

Input

Each input will describe the status of the machine system. Two types of inputs exist: switch type and sensor type. Switches and harnesses provide an open or ground to the controller. Sensors and harnesses provide a signal that changes to the controller.

Switch Input (Keyswitch)

The input of the key start switch connects to the controller through connector 1 and contact 4. The key start switch will provide input information to the controller about the status of the key start switch. When the key start switch is ON this input is at +battery.

Switch Input (Operational Type)

The operational switch inputs include the following connector contacts: 2-6, 2-7, 2-8, 2-15, 2-18, 2-26, 2-36, 2-40, 1-13, 1-14, 1-22, 1-23, 1-24, 1-34 and 1-39. Each switch input will provide information about operator requests and machine systems. The condition of the system is sent to the controller through each input. The status of each input will be grounded, open or +battery. Each input of the controller will receive information from the switches that are located in the machine systems (pressure and temperature).

Sensor Input (Frequency)

An AC signal is present for the input of the frequency sensor (connector contact 2-24). The AC signal is used to represent the speed of a machine system. The engine speed sensor provides an AC signal to the controller. The controller measures the frequency (Hz) of the AC signals. The resulting speed is used by the controller to make decisions.

Sensor Input (Alternator)

The sensor input for the alternator connects to connector contact 2-34. A square wave signal is present at this input. The signal is used to represent the speed of the alternator. The controller measures the frequency (Hz) of the square wave signal. The controller uses this information to make determinations and the controller uses this information to monitor the output of the alternator. When an abnormal condition exists, the controller will alert the operator.

Sensor Input (PWM)

Each of the following contacts are a sensor input to the controller: 2-9, 2-13, 2-21 and 2-30. A PWM signal is present at these contacts. This signal will represent the condition of a machine system. For example, the controller can monitor temperature. PWM sensors provide this information. The controller measures the duty cycle of the PWM signal. This signal will represent the information that is measured. The controller will use this information to perform decisions. When an abnormal condition exists, the controller will alert the operator.

Sensor Input (Voltage)

Contact 2-29 is an input for voltage sensing. A voltage is present. This voltage will represent the condition of a machine system. For example, the level of voltage is a condition that is monitored by the controller. Analog sensors or senders provide this information. The controller measures the voltage, which represents the measured information. The controller uses this information to make decisions. The controller also uses this information to monitor machine systems. When an abnormal condition exists the controller alerts the operator.

Output

The controller responds to decisions by sending electrical signals through the various outputs. The outputs will create an action or the outputs will provide information. Three status indicators inside the controller that are connected to the monitor panel are outputs of the controller. These outputs are additional to the outputs that are listed in the table for Connector Contact Description. The monitor panel shows the operating status of the engine and pump control system and diagnostic information. The following solenoid outputs are used by the controller to cause an action: 2-3, 2-4, 2-10, 2-12, 2-20, 2-21, 2-22, 2-27 and . This action could be energizing a solenoid, sounding an alarm or activating a motor.

Switches

SMCS Code: 1435; 7332

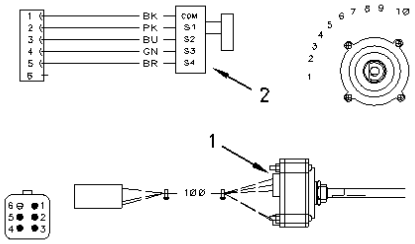

Illustration 9

Engine Speed Dial Switch

The engine speed dial switch is designed to inform the controller about the speed that is desired by the operator. The engine speed dial switch has ten positions: 1-10. Each position of the switch has a unique combination of connector contacts that close to contact 1. A combination of contact 2 through contact 5 will close to contact 1. This switch will ground a unique combination of inputs for the engine speed dial to the controller.

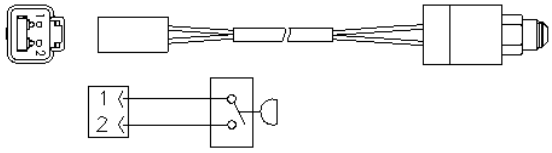

Illustration 10

Travel Pressure Switch And Implement/Swing Pressure Switch

The travel pressure switch and the implement/swing pressure switch will monitor the hydraulic system. These switches will inform the controller about the status of the hydraulic demands. When there is no hydraulic demand these switches are open. The function of the automatic engine speed control (AEC) of the controller will use these switches to determine operation. These switches are in the normally open position, when the switches are not installed on the machine.

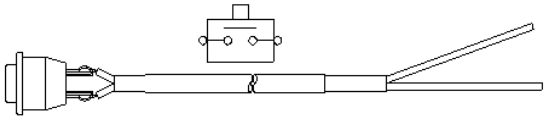

Illustration 11

Low Idle Switch

The low idle switch is located on the top of the right control lever. During normal operation, the low idle switch is open. When the low idle switch is pressed, the switch will close. This action will ground the input to the controller. If the low idle switch is pressed one time and a hydraulic load is not present, the engine speed will be reduced. If the low idle switch is pressed again or the hydraulic system is being activated, the engine will return to the engine speed that was selected by the operator by using the engine speed dial switch.

Note: If the low idle switch is pressed and a hydraulic load is present on the engine, the speed of the engine will not be affected.

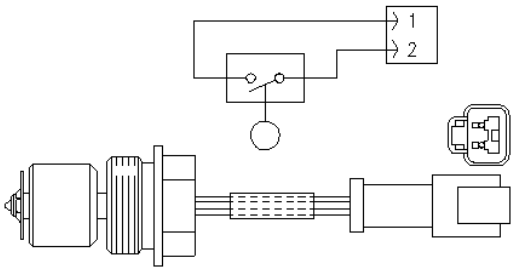

Illustration 12

Hydraulic Oil Level Switch

The hydraulic oil level switch monitors the hydraulic oil level after the starter key switch is kept at the ON position for 2 seconds or more. The controller checks hydraulic oil level with the switch. The switch opens when the hydraulic oil level is below the normal operating level. This switch is in the normally open position, when the switch is not installed on the machine.

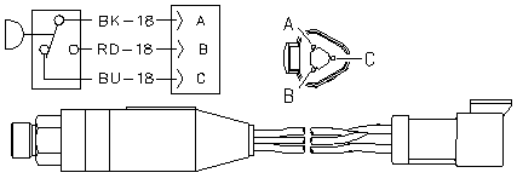

Illustration 13

Engine Oil Pressure Switch

During normal operation, the engine oil pressure switch is closed to ground. The switch opens when engine oil pressure is less than the specified value for the switch. If the switch is in the open position, the controller will notify the operator that the engine oil pressure is insufficient. This switch is normally open, when the switch is not installed on the machine.

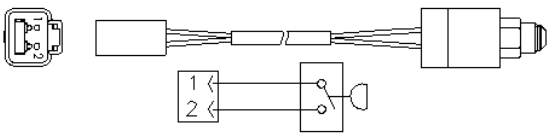

Illustration 14

Boom RAISE Pressure Switch

If the control lever for the boom is moved to the full boom RAISE position, the boom RAISE pressure switch will close. If "BOOM PRIORITY" is selected in the power mode, the controller will activate the fine control solenoid. This solenoid valve then causes front pump oil to go to the boom circuit only. The boom is capable of faster movements even if the operation is a combination of boom and stick.

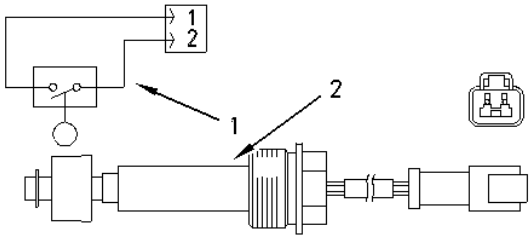

Illustration 15

Engine Oil Level Switch

The engine oil level switch monitors the engine oil level after the starter key switch is kept at the ON position for 2 seconds or more. The controller checks oil level with the switch. The switch opens when the engine oil level is below the normal operating level. This switch is in the normally open position when the switch is not installed on the machine.

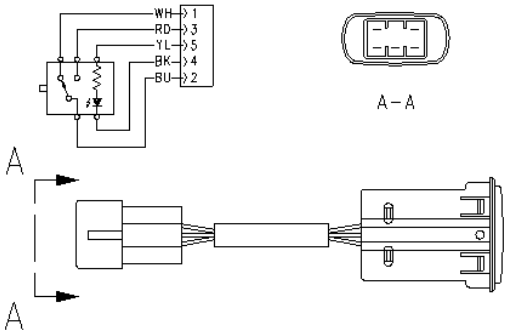

Illustration 16

Fine Swing Control Switch

The operation of fine swing will perform smooth start operations and stop operations of swing by controlling the ON/OFF solenoid valve that is connecting the "A" port and "B" port of the swing motor. When the fine swing control switch is turned to the ON position, the fine swing solenoid valve is activated. The controller will release the swing park brake, when the controller detects the switch in the ON position.

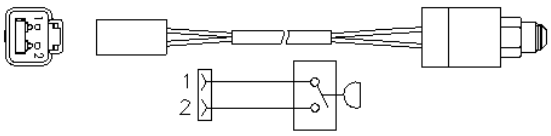

Illustration 17

Attachment Pedal Pressure Switch