Producto: MOTOR GRADER
Modelo: 140H MOTOR GRADER 5HM
Configuración: 140H Motor Grader 5HM00001-UP (MACHINE) POWERED BY 3306B Engine

Pruebas y Ajustes
TRANSMISSION ELECTRONIC CONTROL FOR COUNTERSHAFT TRANSMISSIO
Número de medio -SENR9167-02 Fecha de publicación -01/04/2006 Fecha de actualización -21/04/2006

SENR91670002

Testing And Adjusting

Set Up Procedures

WARNING

Sudden movement of the machine or release of oil under pressure can cause injury to persons on or near the machine. To prevent possible injury, do the procedure that follows before testing and adjusting the transmission and power train.

1. Move the machine to a smooth horizontal location. Move away from working machines and personnel.

2. Lower all implements to the ground.

3. Put the transmission control lever in the Parking Brake ON position. Stop the engine.

4. Put blocks in front of and behind the wheels.

5. Permit only one operator on the machine. Keep all other personnel either away from the machine or in view of the operator.

6. Make sure all hydraulic pressure is released before any fitting, hose or components is loosened, tightened, removed, or adjusted.

Always make visual checks first. Check the operation of the machine and then check with instruments.

Introduction

(1) Electronic Control Module.

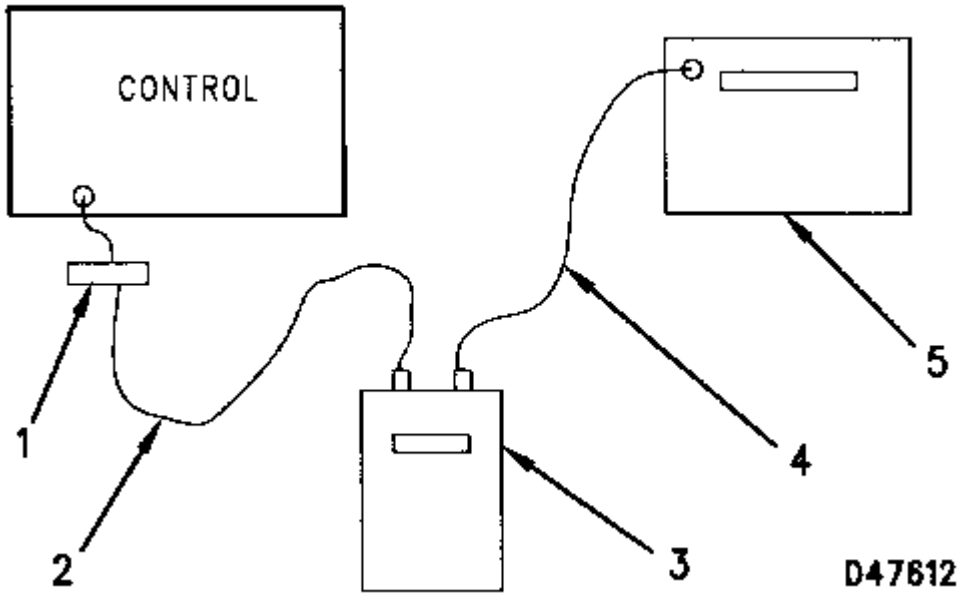
Motor Graders with the countershaft transmission include an onboard electronic controller referred to as an Electronic Control Module (ECM).

The ECM should improve the ability of the mechanic to determine when and where a failure has occurred. Two methods of testing and troubleshooting the transmission system from the ECM are provided.

The first (and the recommended) method of checking system status and diagnostics is with the use of the 8T-8697 Electronic Control Analyzer Programmer (ECAP) or an ET. Both the ECAP and the ET can also be used to program the transmission ECM. With the use of a diagnostic tool, a variety of useful information is readily available. Current operating information can be obtained such as: transmission output speed, gear lever position, battery voltage, etc. Also, from the diagnostics screen, transmission diagnostic codes are available to help identify the source of any electrical failure.

Transmission diagnostics can also be obtained from the transmission ECM without the use of ECAP or ET. This method will provide the same diagnostic codes available from ECAP and ET. This method will not provide current display status capability available from ECAP or ET.

Using Caterpillar Electronic Technician (ET) To Determine Service Codes



ET Connections

(1) Datalink service connector - at fuse panel.

(2) 7X-1570 Cable.

(3) 7X-1700 Communication Adapter (with NEXG4523 Communication Adapter Software installed).

(4) 7X-1688 Cable.

(5) IBM compatible personal computer with Caterpillar Electronic Technician software installed (see note below).

NOTE: Caterpillar Electronic Technician is a software program that runs on an IBM compatible personal computer. To use Caterpillar Electronic Technician (ET), order ET Single Use Program License software, JERD2124; the information and requirements sheet, JEHP1026; the RS232 connection cable, 7X-1688 and the Data Subscription, JERD2142. The requirements and information sheet lists the hardware required and the features of ET.

The service tool ET is not needed to determine or clear service codes, but it makes the tasks easier and faster. ET can also display service code history information. These features make ET a useful troubleshooting tool.

ET connects to the datalink service connector which is round and has 9 contacts. The data link service connector is located next to the key start switch. For more information, see the Electrical System Schematic in the machine Service Manual.

To use the ET service tool, choose the MACHINE FUNCTIONS option from the main menu. The next menu is a list of the Electronic Control Modules (ECM) installed on the machine. Choose the

menu item "Steer/Brake/Transmission". After determining the service codes with CAT ET, see the topic Troubleshooting Detected Faults that correspond to the service codes.

Using The 8T-8697 Electronic Control Analyzer Programmer (ECAP)

Tools Needed		
Qty	**Part No.**	**Description**
1	8T-8697 or 8T-8697-A	Electronic Control Analyzer Programmer (ECAP)
1	7X-1700	Communication Adapter Group
1	7X-1420 or 7X-1851	Cable
1	7X-1570	Cable
1	NEXG4521	Machine Functions Dual Service Program Module
1	NEXG4523	Communication Adapter Memory Chip
1	SEHS9264	Using The 7X-1700 Communication Adapter Group
1	SEHS9343	Using The ECAP NEXG4521 Machine Functions Dual Service

Chart 3
Transmission Diagnostic Code Conversion

Code Flashed	CID - FMI	Description
11	N/A	No diagnostics active
12	N/A	No logged diagnostic codes
21-28	641-648 F05	Transmission Solenoid[1] open circuit
31-38	641-648 F06	Transmission Solenoid[1] short to ground
41-48	641-648 F03	Transmission Solenoid[1] short to battery
52	637 F06	Backup alarm short to ground
58	688 F06	VHP/su2/solenoid short to ground
59	688 F03	VHP/su2/solenoid short to battery
61	688 F02	Shift lever input invalid
62	688 F03	Shift lever open circuit/short to +battery
63	269 F00	Sensor supply voltage above normal
64	269 F01	Sensor supply voltage below normal
65	701 F02	Transmission Output Speed Signal (TOS) incorrect
68	168 F01	System voltage below normal
71	520 F02	Invalid transmission configuration code
72	268 F02	Check programmable parameters
73	764 F05	Transmission indicator lamp open circuit
74	764 F06	Transmission indicator lamp short to ground
75	764 F03	Transmission indicator lamp short to +battery
76	177 F03	Transmission oil temperature sender short to +battery or open circuit
77	177 F04	Transmission oil temperature

77	177 F04	Transmission oil temperature sender short to ground
81	868 F05	Auto/Manual lamp open circuit
82	868 F06	Auto/Manual lamp short to ground
83	868 F03	Auto/Manual lamp short to +battery

[1] The last digit in the CID number identifies the solenoid. Solenoid 1 is Solenoid A, Solenoid 2 is Solenoid B, etc.
[2] VHP (Dual Horsepower)

NOTE: The preceding chart has changed from the former issue.

The ECAP can be used to: program the transmission ECM, check current machine operating status, check abusive events and check diagnostics codes from the transmission ECM.

Prior to connecting the ECAP into the service port on the motor grader, the service equipment must be properly configured. The following steps will configure the ECAP.

1. Install the NEXG4523 Service Program Module (computer chip) into the 7X-1700 Communication Adapter as shown on pages two and three of SEHS9264, Using The 7X-1700 Communication Adapter Group.

2. Install the NEXG4521 Machine Functions Service Program Module (two computer chips) into the 8T-8697 Electronic Control Analyzer Programmer (ECAP) as shown in SEHS9343, Using The ECAP NEXG4521 Machine Functions Service Program Module.

3. Connect 7X-1420 Cable between ECAP and 7X-1700 Communication Adapter as shown in SESH9343, Using The ECAP NEXG4521 Machine Functions Service Program Module.

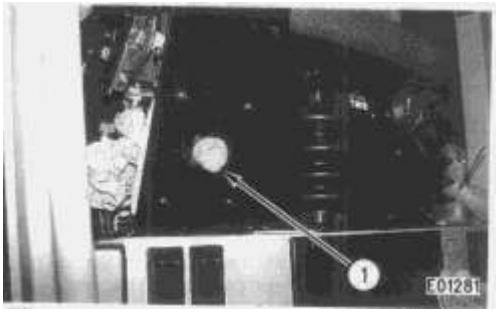
NOTE: Newer ECAP units with a Caterpillar part number ending in -A (i.e.. 8T8697-A) will use 7X-1851 Cable instead of 7X-1420 Cable.

4. Install 7X-1570 Cable to 7X-1700 Communications Adapter as shown on page five of SESH9343, Using The ECAP NEXG4521 Machine Functions Service Program Module.

At this point ECAP is ready to be connected to the motor grader.

NOTE: ECAP receives operating power from the Electronic Control Module (ECM) through the 9-pin CAT Data Link Connector.

The following procedure can be used to program the transmission ECM as well as obtain operating status and diagnostics.

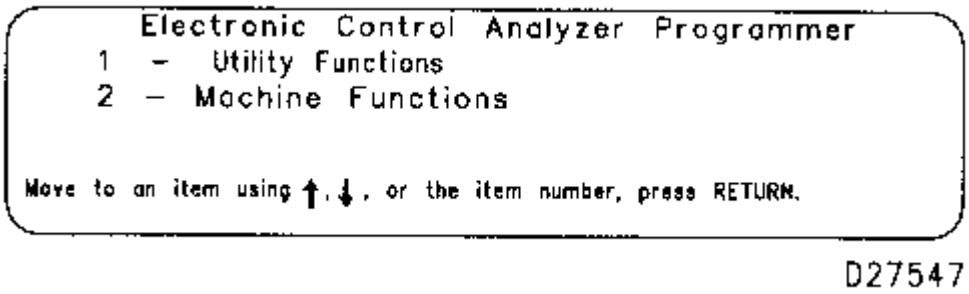


(1) Service port. (Remove the cap.)

1. Connect the 7X-1570 Cable to the service port (1) which is the 9-pin, gray plastic, Deutsch® connector located on the front of the seat on the drivers right hand side.

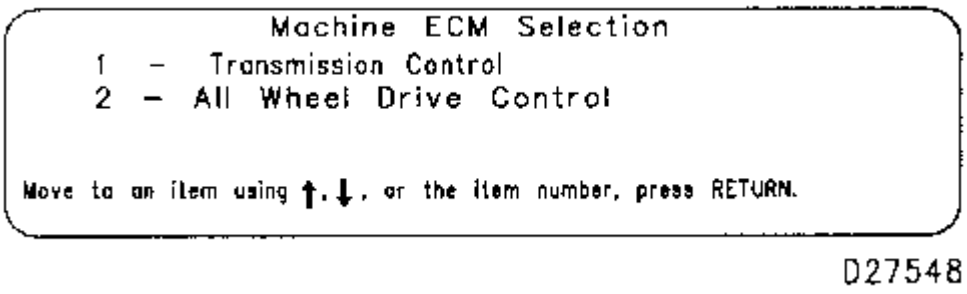
2. Either start the engine or turn the Start/Stop Key Switch to the Run position.

3. At this point the first ECAP screen will appear entitled "Electronic Control Programmer Analyzer". Select "Machine Functions" and press Return in order to direct ECAP to the next screen entitled "Machine ECM Selection" screen.



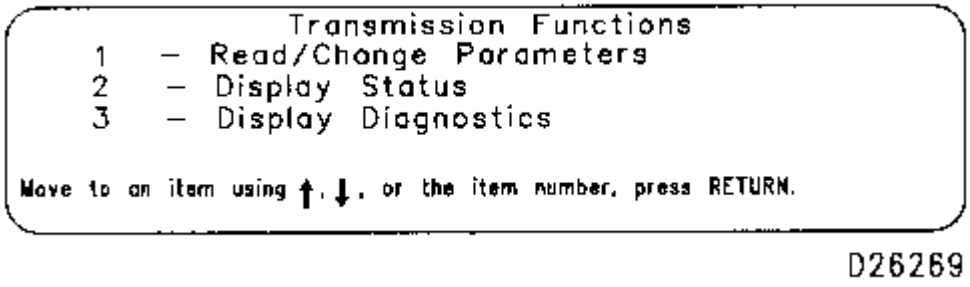
Electronic Control Analyzer Programmer Screen

4. From the "Machine ECM Selection" screen select "Transmission Control" and press Return to obtain the "Transmission Functions" screen. At this point the ECAP has been directed to communicate with the transmission ECM. See SEHS9343, Using The ECAP NEXG4521 Machine Functions Service Program Module, for further instructions regarding Steps 3 and 4 of this procedure.

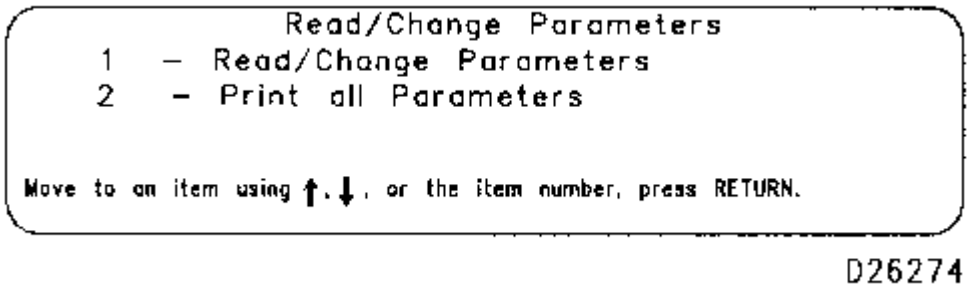


Machine ECM Selection Screen

5. Select either Item 1 to read or change parameters, Item 2 for Current Status of the transmission or Item 3 for transmission Diagnostics and press Return.



Transmission Functions Screen

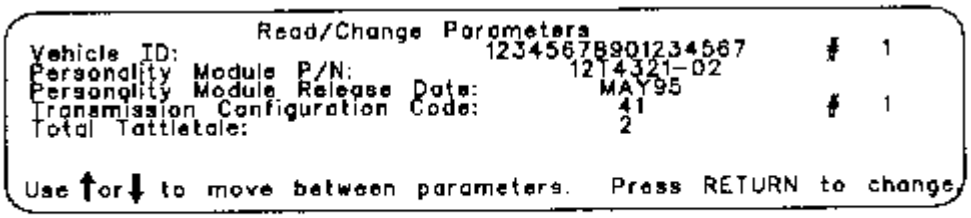


Read/Change Parameters Screen

6. If Item 1 was selected in Step 5, then the "Read/Change Parameters" screen will be displayed. From this screen two choices are available:

Item 1 for reading or changing parameters.

Item 2 for printing parameters.



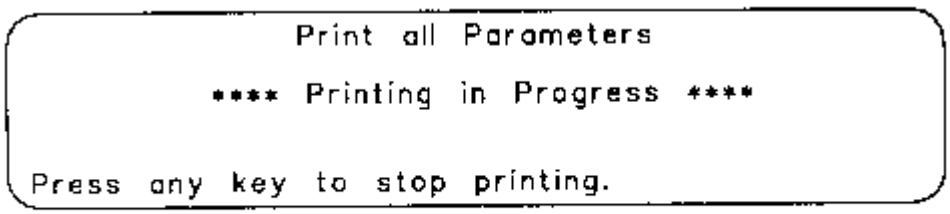
Read/Change Parameters Screen

7. If Item 1 was selected in Step 6, then another "Read/Change Parameters" screen will be displayed. From this screen two parameters can be programmed. "The Vehicle ID" is the first option. This input field is provided strictly for customer use and does not have any other function.

Chart 4
Transmission Configuration Codes

Trans. Config. Code	ECAP Description	Model Description
13	12H Transmission	12H
21	120H Transmission	120H
23	120H Standard Transmission	120H Standard
36	135H Transmission	135H
38	135H Standard Transmission	135H Standard
41	140H Transmission	140H
42	140H AUTO Transmission	140H Autoshift
43	140H VHP AUTO Transmission	140H VHP Autoshift
44	143H Transmission	143H
45	143H AUTO Transmission	143H Autoshift
61	160H VHP Transmission	160H
62	160H VHP AUTO Transmission	160H VHP Autoshift
64	163H VHP Transmission	163H
65	163H VHP Auto Transmission	163H VHP Autoshift

The "Transmission Configuration Code" is the second option. This is a critical parameter without which the machine will NOT operate (see Chart 4). The "Total Tattletale" field is not programmable. This field indicates how many times any of the parameters in the list have been changed.



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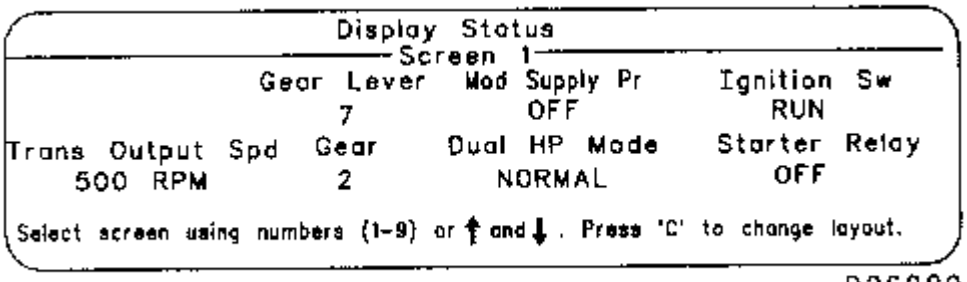
Print All Parameters Screen

8. If Item 2 was selected in Step 6, the "Print All Parameters" screen will be displayed. The transmission parameters will print to the local printer if connected.



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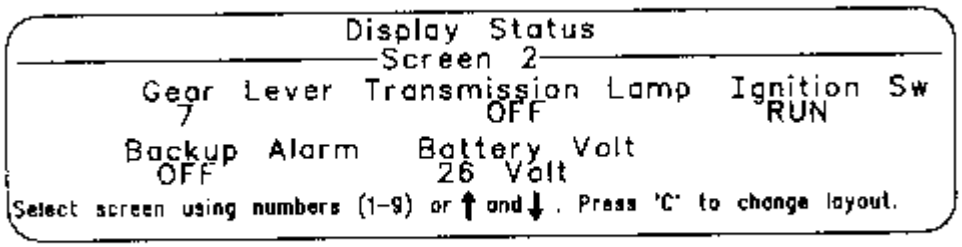
Display Status - Screen 1



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Display Status - Screen 2

9. If Item 2 was selected in Step 5, then Status Screen # 1 will appear. The other status screen can be obtained by using the up and down arrows or by selecting a screen number and pressing Return. From the status screens all of the status items listed can be observed while the machine is operating.

***** Gear Lever - This is a 13 wire input which provides the shift lever position to the ECM. This shows the position of the shift lever. Positions are Neutral, First Forward through Eighth Forward, First Reverse through Sixth Reverse and Park.

* Modulator Supply Pressure - This shows the value of the modulation supply pressure switch as read by the control.

On: The directional clutches have pressure.

Off: The directional clutches so not have pressure.

* Ignition Switch - This is a single wire input that provides a battery voltage signal when turned in the Start position.

Run: Key is in the normal run position.

Start: Key is in the crank position (only active when the operator is trying to start the machine).

* Transmission Output Speed - This is a single wire frequency input which receives a signal from a magnetic pickup speed sensor on the transmission output. It shows revolutions per minute on the output shaft of the transmission.
* Gear - This shows the actual gear that the transmission ECM is engaging. Most of the time it will be the same as selected with the gear lever.
* Dual Horsepower Mode - This shows the state of the dual horsepower solenoid (also referred to as VHP). It is engaged in Fourth through Eighth Forward and Fourth through Sixth Reverse or when the all wheel drive system is engaged. This status is only meaningful on motor graders that are equipped with the dual horsepower solenoid.

Normal: Solenoid is Off.

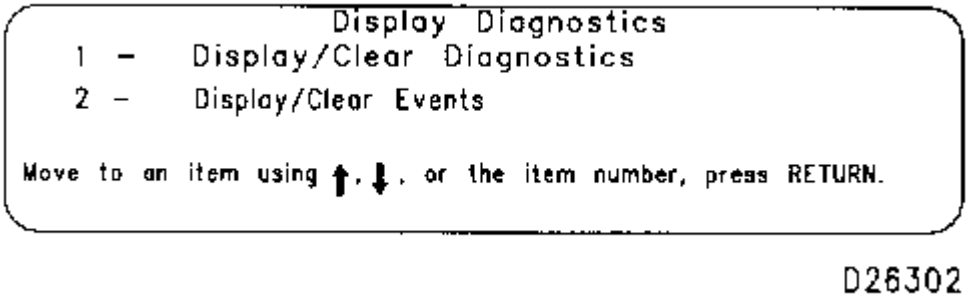
High: Solenoid is On.

* Transmission Lamp - This is used in conjunction with the diagnostic connector to visually flash light code sequences when diagnosing transmission electrical system faults. On: Transmission lamp is illuminated. Off: Transmission lamp is not illuminated.
* Backup Alarm - When the transmission shift lever is Moved to a Reverse speed, the ECM provides power for the backup alarm.

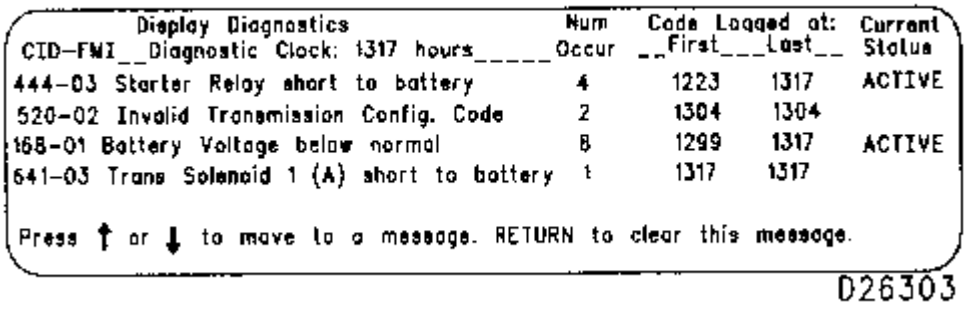
On: The backup alarm is On.

Off: The backup alarm is Off.

* Battery Volt - This is a two wire input which provides 24 DCV nominal to drive the electronic circuits within the ECM and all of the external solenoids. It indicates the voltage the control measures between Pins J1-1 and J1-2 at the transmission ECM connector.



Display Diagnostics Screen



Display Diagnostics Screen

10. If Item 3 was selected in Step 5, then "Display Diagnostics" screen will appear. Select either Item 1 for Display/Clear Diagnostics or Item 2 for Display/Clear Events and press Return.

11. If Item 1 was selected, then another screen which is also entitled "Display Diagnostics" will be displayed. Any of the diagnostic codes can be listed in this screen depending on the operating condition of the machine.

From this screen the user can find:

* The number and type of faults which have occurred
* When the particular fault first occurred
* When the fault last occurred
* Whether the fault is currently active

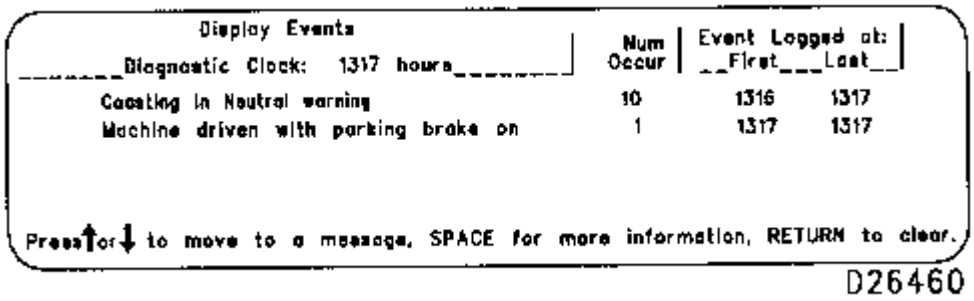
Faults which are not currently active may be cleared. Chart 3 provides a complete list of the Transmission Diagnostic Codes. To clear faults, follow the steps listed:

a. Use the arrow up or down to highlight the fault to be cleared.

b. Press Return.

c. You will be asked to confirm that you really want to clear this fault. Answer Yes or No.

Active faults may not be cleared until the problem causing the fault has been corrected.



Display Events Screen

12. If Item 2 was selected in Step 10, then a screen which is entitled "Display Events" will be displayed. Either of the two events listed below could be displayed here:

* Coasting in Neutral warning - When the transmission control lever is in neutral with the transmission modulator pedal released with a ground speed greater than 23 km/h (14 mph).
* Machine driven with parking brake on - When the transmission control lever is in Park with a ground speed greater than 3 km/h (1.8 mph).

From this screen the user can find:

* The number and type of events which have occurred
* When the particular event first occurred
* When the event last occurred

To clear events, follow the steps listed:

a. Use the arrow up or down to highlight the event to be cleared.

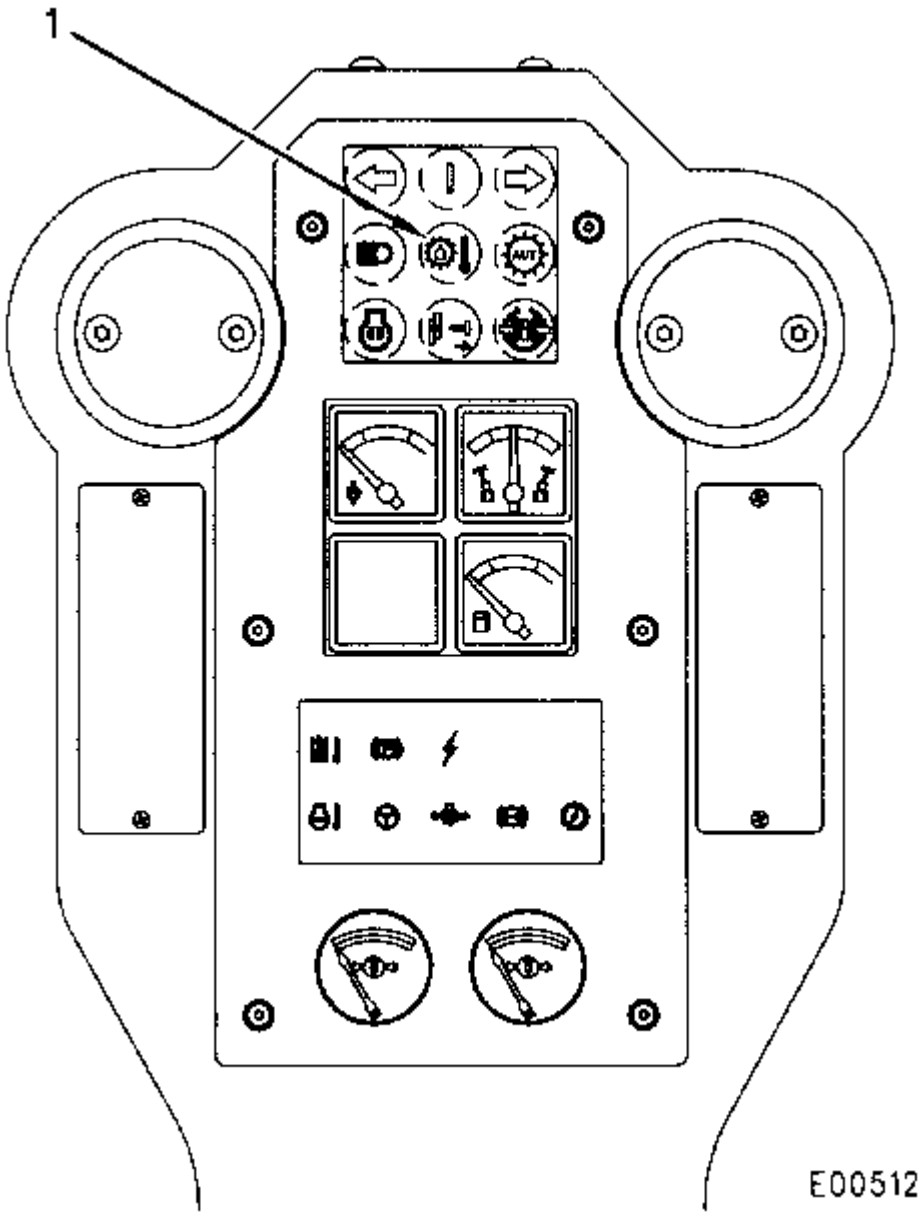
b. Press Return.

c. You will be asked to confirm that you really want to clear this event. Answer Yes or No.

13. To remove the ECAP from use, disconnect 7X-1570 Cable from the service port.

Obtaining Transmission DiagnosticsFrom The Transmission ECM Without The Use Of An ECAP

From the transmission ECM the diagnostic codes can be obtained and cleared (if not active) without the use of the ECAP. The following process will entail disconnecting a transmission wiring harness and jumpering specific wires in order to prompt the transmission ECM to display coded messages to the transmission indicator lamp (1) on the EMS panel.



(1) Transmission indicator lamp.

NOTICE

While using this procedure to retrieve transmission diagnostics from the transmission ECM, the machine must be parked with parking brake Applied.

This process is not as easy to use as the ECAP nor is the capability as complete. This capability has been provided for the user who does not have ready access to an ECAP.

Follow the steps to obtain transmission diagnostics from the ECM.

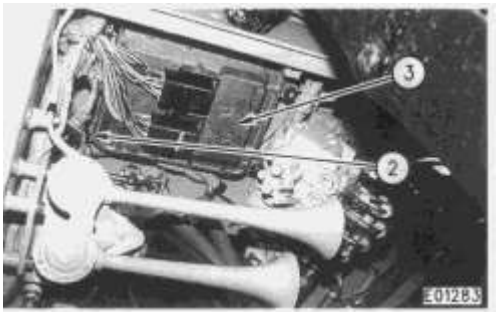
Chart 3
Transmission Diagnostic Code Conversion

Code Flashed	CID - FMI	Description
11	N/A	No diagnostics active
12	N/A	No logged diagnostic codes
21-28	641-648 F05	Transmission Solenoid[1] open circuit
31-38	641-648 F06	Transmission Solenoid[1] short to ground
41-48	641-648 F03	Transmission Solenoid[1] short to battery
52	637 F06	Backup alarm short to ground
58	688 F06	VHP/su2/solenoid short to ground
59	688 F03	VHP/su2/solenoid short to battery
61	688 F02	Shift lever input invalid
62	688 F03	Shift lever open circuit/short to +battery
63	269 F00	Sensor supply voltage above normal
64	269 F01	Sensor supply voltage below normal
65	701 F02	Transmission Output Speed Signal (TOS) incorrect
68	168 F01	System voltage below normal
71	520 F02	Invalid transmission configuration code
72	268 F02	Check programmable parameters
73	764 F05	Transmission indicator lamp open circuit
74	764 F06	Transmission indicator lamp short to ground
75	764 F03	Transmission indicator lamp short to +battery
76	177 F03	Transmission oil temperature sender short to +battery or open circuit

77	177 F04	Transmission oil temperature sender short to ground
81	868 F05	Auto/Manual lamp open circuit
82	868 F06	Auto/Manual lamp short to ground
83	868 F03	Auto/Manual lamp short to +battery

[1] The last digit in the CID number identifies the solenoid. Solenoid 1 is Solenoid A, Solenoid 2 is Solenoid B, etc.
[2] VHP (Dual Horsepower)

NOTE: The preceding chart has changed from the former issue.



(2) Diagnostic plug. (3) ECM.

1. The transmission ECM (3) and the diagnostic plug are under the right side of the cab.

2. Locate the transmission indicator lamp (1) located in front of the steering wheel.

3. Place the Start/Stop Key Switch in the Run position with engine off. When the machine Start/Stop Key Switch is turned to the ON position, the machine will display the Transmission Configuration Code as part of normal operation. For example, when the Start/Stop Key of a 140H is turned to ON, a "41" code will be displayed on the EMS transmission indicator lamp (1). The lamp will flash four times in rapid succession followed with a one second pause followed by one additional flash.

4. To enter the Diagnostic Mode of the transmission ECM, uncouple the diagnostic plug (2). At this point the ECM automatically defaults to the Active Diagnostic Mode. In the Active Diagnostic Mode the ECM will flash out the first Active Fault in memory followed by a three second pause and then repeating the original fault. The original fault will continue to be repeated until the diagnostic plug (2) is reconnected.

5. To enter the Active Diagnostic Scroll Mode, jumper sockets 1 and 2 of the diagnostic receptacle of the diagnostic plug (2). The control will display all diagnostics that are presently active on the system. A three second pause separates the codes as they are displayed. Removing the jumper while the control is displaying a diagnostic code will cause the control to repeatedly display that code. Replacing the jumper resumes scrolling.

6. To enter the Logged Diagnostic Scroll Mode, jumper sockets 1 and 3 of the diagnostic receptacle. The ECM will now display any faults which have occurred which are not presently active. A

Diagnostic Code of "12" indicates there are no Logged Faults present. Removing the jumper wire while the control is displaying a Diagnostic Code will cause the control to repeatedly display that code. Replacing the 1 to 3 jumper resumes scrolling.

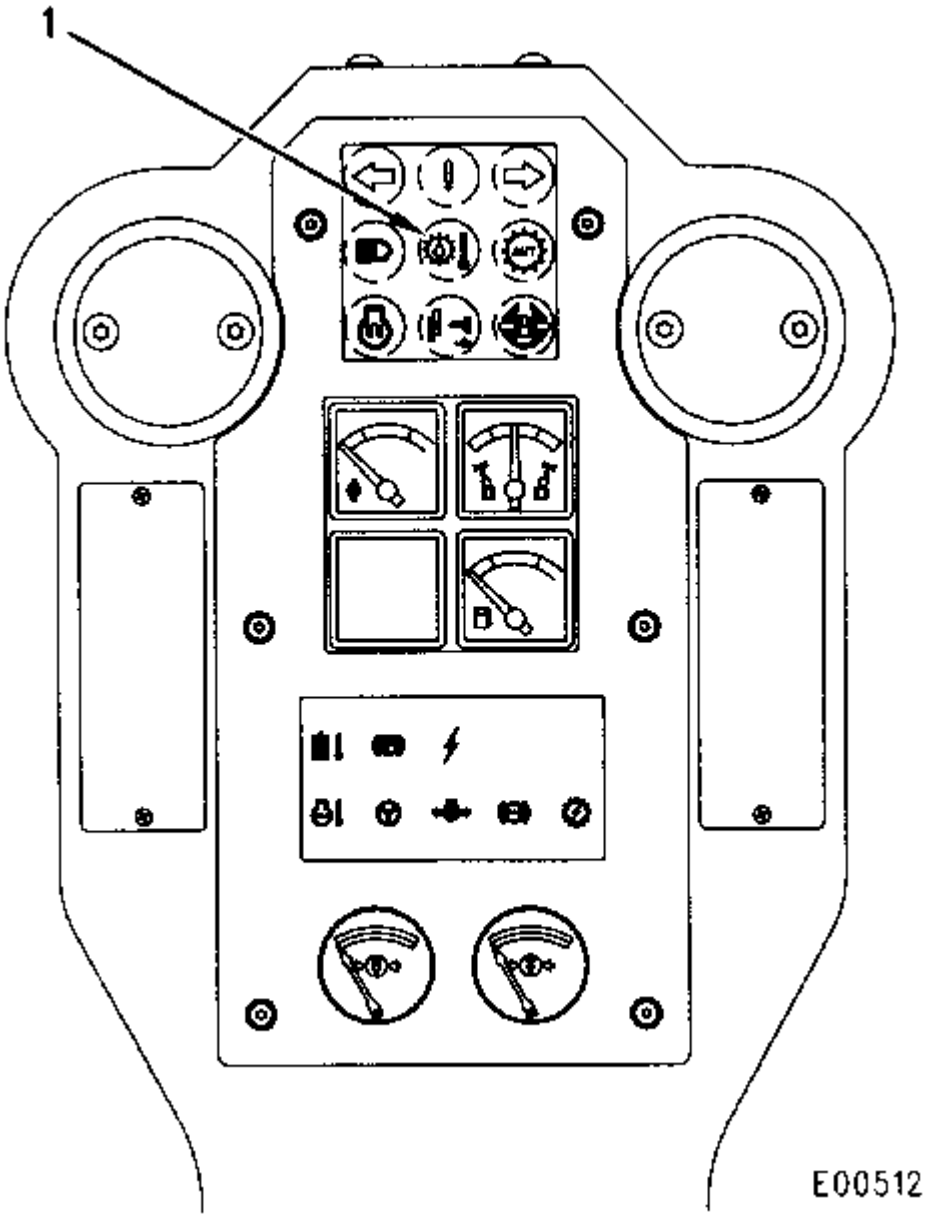
7. This mode is used to clear Logged Diagnostics from memory. To erase a code, put the control in the Logged Diagnostic Scroll Mode until the desired code is displayed and then remove the jumper. The ECM will continue to display the desired code. Jumper receptacle socket 1 to 4. The transmission indicator lamp (1) will turn off indicating the code has been erased. The lamp will remain off until either the Logged Diagnostic Scroll Mode or the Active Diagnostic Scroll Mode is re-entered. The above process can be repeated until there are no codes stored in memory. An active diagnostic code cannot be erased from memory.

8. Reconnect diagnostic plug (2) to the receptacle when servicing is complete. Transmission indicator lamp (1) will stop flashing.

Programming The Transmission ECM Transmission Configuration Code Without An ECAP

Chart 4
Transmission Configuration Codes

Trans. Config. Code	ECAP Description	Model Description
13	12H Transmission	12H
21	120H Transmission	120H
23	120H Standard Transmission	120H Standard
36	135H Transmission	135H
38	135H Standard Transmission	135H Standard
41	140H Transmission	140H
42	140H AUTO Transmission	140H Autoshift
43	140H VHP AUTO Transmission	140H VHP Autoshift
44	143H Transmission	143H
45	143H AUTO Transmission	143H Autoshift
61	160H VHP Transmission	160H
62	160H VHP AUTO Transmission	160H VHP Autoshift
64	163H VHP Transmission	163H
65	163H VHP Auto Transmission	163H VHP Autoshift



(1) Transmission indicator lamp.

(2) Diagnostic plug. (3) ECM.

1. The transmission ECM (3) and the diagnostic plug are under the right side of the cab.

2. Locate the transmission indicator lamp (1) located in front of the steering wheel.

3. Place the Start/Stop Key Switch in the Run position with engine off.

4. Uncouple the diagnostic plug (2).

5. Determine the right transmission configuration code from Chart 4 for the model of motor grader the control is installed on. (For illustration purposes, assume that the model is a 140H. Therefore the transmission configuration code would be "41".

6. Jumper Sockets 1,2 and 3 on the diagnostic receptacle. Place the transmission control lever in the Forward gear which corresponds to the first digit of the desired transmission configuration code. For this example, place the transmission control lever in Fourth Forward. Wait until the transmission indicator lamp (1) flashes out this digit. Place the transmission control lever in the neutral position. Remove jumpers completely out of the diagnostic receptacle. The first digit is programmed.

7. Jumper Sockets 1, 2 and 4 on the diagnostic receptacle. Place the transmission control lever in the Forward gear which corresponds to the second digit of the desired transmission configuration code. For this example, place the transmission control lever in First Forward. Wait until the transmission indicator lamp (1) flashes out this digit. Place the transmission control lever in the neutral position. Remove jumpers completely out of the diagnostic receptacle. The second digit is programmed.

8. Replace the diagnostic receptacle. Turn the Start/Stop Key Switch to the OFF position.

9. Turn the Start/Stop Key Switch to the ON position. Watch the transmission indicator lamp (1). Make sure that it flashes out the desired transmission configuration code. In our example, you should see a "41" flash code displayed on power up.

Troubleshooting

Troubleshooting Without An ECAP Or ECM Diagnostics

Operate the machine in each direction and in all speeds. Note the noises that are not normal and find their source. If the operation is not correct, refer to the following problems and procedures.

The following procedure has been designed without the benefit of using diagnostics from the transmission ECM. However, using an ECAP in combination with this troubleshooting guide should improve the efficiency in resolving the problem.

Problem:

Motor Grader Will Not Key Start/Stop

Corrective Procedure:

1. Check the transmission control fuse (10 amp) located in fuse panel at the base of the steering console. Replace if necessary.

2. Remove the transmission ECM from under the cab and disconnect the 40-pin Deutch® connectors. Measure voltage between Pins J1-1 and J1-2.

3. If the voltage measured in Step 2 is above 20 DCV, the transmission ECM is inoperative. If some voltage is measured and the voltage is less the 20 DCV, the batteries are undercharged. If no voltage was measured in Step 2, proceed to Step 4.

4. Check Pin J1-1 of the 40 pin Deutch® connector to determine the voltage between the pin and frame. If Pin J1-1 has voltage, repair 202 Black ground wire in machine harness. If Pin J1-1 does not have voltage, repair 126 Pink wire in machine harness.

Problem:

"First Gear Out Of Neutral" Only Working Gear

Corrective Procedure:

1. Start engine and operate the machine in order to determine which gears are operable.

2. Stop the machine, engage the parking brake and turn off the engine.

3. Jumper the manual modulation pressure switch in order to determine if this pressure switch is working. The manual modulation pressure switch is located on the Hydraulic Clutch Modulation Control (HCM). Disconnect the 2 pin connector and jumper Pins 1 and 2 of the receptacle.

4. Start the machine and attempt to operate the machine in all gears. If the machine has more than one gear out of neutral then the manual modulation pressure switch has failed. If the first gear out of neutral is still the only gear available, proceed to Step 5.

5. From Step 4, the wiring harness between the manual modulation pressure switch and the transmission ECM is suspect. Remove the transmission ECM from under the cab and disconnect both 40 pin Deutch® connectors. Check continuity between Pins J1-2 and J2-11 of the machine harness. If continuity is obtained while the jumper is in place, the transmission ECM has failed. If continuity is not obtained, the wiring harness between the transmission ECM and the manual modulation pressure switch has failed.

Troubleshooting Faults Detected By The ECM

NOTE: The transmission solenoids are identified with letters (A through H) in this publication. The solenoids may also be identified with numbers (1 through 8). Solenoid 1 is Solenoid A, Solenoid 2 is Solenoid B, etc.

NOTE: P is used as an abbreviation for Pin. Example: P3 is Pin 3.

NOTE: When Harness with a letter (example: Harness F) is used, the Harness F can be identified on the electrical schematic.

NOTE: The transmission ECM is seldom the cause of a problem. If the "Troubleshooting With An ECAP" guide directs you to replace the ECM, then double check your steps to be sure that no mistake was made before replacing the ECM.

Detected Faults

Chart 5 - Detected Faults

Flash Codes	CID-FMI	Description Of Diagnostic Codes	Result Of Fault	Possible Causes
11	N/A	No diagnostics active	N/A	N/A
12	N/A	No logged diagnostic codes	N/A	N/A
21-26	641-648 F05	Transmission Solenoid[1] open circuit	Loss of gears which use this solenoid	• Trans. solenoid faulty • Wiring harness faulty • Trans. ECM faulty
31-38	641-648 F06	Transmission Solenoid[1] short to ground	Loss of gears which use this solenoid	• Trans. solenoid faulty • Wiring harness faulty • Trans. ECM faulty
41-48	641-648 F03	Transmission Solenoid[1] short to battery	Loss of gears which DO NOT use this solenoid	• Wiring harness faulty • Trans. ECM faulty
52	637 F06	Backup alarm short to ground	No sound from backup alarm while in reverse	• Backup alarm faulty • Wiring harness faulty • Trans. ECM faulty
58	688 F06	VHP solenoid short to ground	Low engine power mode only	• VHP solenoid faulty • Wiring harness faulty • Trans. ECM faulty
59	688 F03	VHP solenoid short to battery	High engine power mode only	• Wiring harness faulty • Trans. ECM faulty
61	668 F02	Shift lever input invalid	Holds present gear until the next valid gear or neutral is reached	• Shift lever faulty • Wiring harness faulty • Trans. ECM faulty
62	668 F03	Shift lever open circuit/short to +battery	Forced to Neutral. Lever must be returned to neutral before valid gears are allowed	• Shift lever faulty • Wiring harness faulty • Trans. ECM faulty
63	269 F00	Sensor supply voltage above normal	Possible damage to sensors	• Trans. ECM faulty
64	269 F01	Sensor supply voltage below normal	Possible loss of sensor signal	• Trans. ECM faulty
65	701 F02	Transmission Output Speed Signal (TOS) incorrect	EMS warning lamp flashing	• TOS sensor incorrectly installed • TOS sensor faulty • Wiring harness faulty • Trans. ECM faulty
68	168 F01	System voltage below normal	No shifts	• Charging system component faul • Wiring harness faulty • Trans. ECM faulty
71	520 F02	Invalid transmission configuration code	Engine will not crank	• Trans. ECM not programmed • Trans. ECM faulty
72	268 F02	Check programmable parameters	Engine will not crank	• Trans. ECM not programmed • Trans. ECM faulty
73	764 F05	Transmission indicator lamp open circuit	Loss of cold transmission oil warning	• Lamp burnt out • Wiring harness faulty • Trans. ECM faulty
74	764 F06	Transmission indicator lamp short to ground	Loss of cold transmission oil warning	• Wiring harness faulty • Trans. ECM faulty
75	764 F03	Transmission indicator lamp short to battery	Loss of cold transmission oil warning	• Wiring harness faulty • Trans. ECM faulty
76	177 F03	Transmission oil temperature sender short to battery or open circuit	Transmission oil warning system activated	• Temperature switch faulty • Wiring harness faulty • Trans. ECM faulty
77	177 F04	Transmission oil temperature switch short to ground	Transmission oil warning system activated	• Temperature switch faulty • Wiring harness faulty • Trans. ECM faulty
81	868 F05	Auto/Manual Lamp open circuit	Loss of Autoshift status	• Lamp burnt out • Wiring harness faulty • Trans. ECM faulty
82	868 F06	Auto/Manual Lamp short to ground	Loss of Autoshift status	• Wiring harness faulty • Trans. ECM faulty
83	868 F03	Auto/Manual Lamp short to +battery	Loss of Autoshift status	• Wiring harness faulty • Trans. ECM faulty

[1] The last digit in the CID number identifies the solenoid. Solenoid 1 is Solenoid A, Solenoid 2 is Solenoid B, etc.

Troubleshooting Detected Faults

Use the following charts to troubleshoot the faults identified in Chart 5.

Flash Codes: 21-28, CID-FMI: 641-648 F05, Transmission Solenoid Open Circuit

Check: Open Circuit Solenoid (OCS)	Specification	Pass	Fail	Location
1. Resistance between 921-WH (P2) and OCS in transmission frame Harness F	29-34 ohms	See Step 2	See Step 3	Frame under right side of cab
2. Continuity between 921-WH (P2) and OCS in platform Harness A	Less than 5 ohms	See Step 4	Repair/replace A Harness	Frame under right side of cab
3. Resistance between leads on OCS	29-34 ohms	Repair/replace N or F Harness	Repair/replace solenoid	Left side of transmission
4. Resistance between 921-WH J2-3 and OCS at transmission console Harness G at transmission ECM end	29-34 ohms	Replace transmission ECM	Repair/replace G Harness	Under cab

Flash Codes: 31-38, CID-FMI: 641-648 F06, Transmission Solenoid Short To Ground

Check: Short To Ground Solenoid (SGS)	Specification	Pass	Fail	Location
1. Resistance between 921-WH (P2) and SGS in transmission frame Harness F	29-34 ohms	See Step 2	See Step 3	Frame under righ side of cab
2. Open circuit between SGS and frame ground in platform Harness A	Greater than 5000 ohms	See Step 4	Repair/replace SGS wire	Frame under righ side of cab
3. Resistance between leads on SGS	29-34 ohms	Repair/replace N or F Harness	Repair/replace solenoid	Left side of transmission
4. Resistance between 921-WH (J2-3) and SGS at the transmission console Harness G at transmission ECM end	29-34 ohms	Replace transmission ECM	Repair/replace G Harness	Under cab

Flash Codes: 41-48, CID-FMI: 641-648 F03, Transmission Solenoid Short To Battery

Check: Short To Battery Solenoid (SBS)	Specification	Pass	Fail	Location
1. Open circuit between SBS and any of the other seven solenoid wires in the transmission frame Harness F	Greater than 5000 ohms	See Step 2	Repair/replace N or F Harness	Frame under right side of cab
2. Open circuit between SBS and any of the other seven solenoid wires in the platform Harness A	Greater than 5000 ohms	Replace transmission ECM	Repair/replace G Harness	Frame under right side of cab

Flash Code: 52, CID-FMI: 637 F06, Backup Alarm Short To Ground

Check: Backup Alarm Short To Ground	Specification	Pass	Fail	Location
1. Open circuit between 321-BR (P1) and frame ground in frame Harness E	Greater than 5000 ohms	See Step 2	See Step 3	Frame under righ side of cab
2. Open circuit between 321-BR (P1) and frame ground in platform Harness A	Greater than 5000 ohms	Replace trans-mission ECM	Repair/replace A Harness	Frame under righ side of cab
3. Open circuit between 321-BR (J2-37) and frame ground in radiator grill Harness D at the backup alarm	Greater than 5000 ohms	Repair/replace backup alarm	Repair/replace D or E Harness	Behind radiator guard

Flash Code: 58, CID-FMI: 688 F06, VHP Solenoid Short To Ground

Check: VHP Solenoid Short To Ground	Specification	Pass	Fail	Location
1. Resistance between 795-YL (P6) and frame ground in engine frame Harness C	3E-6424: 14-18 ohms 104-9258: 19-24 ohms 111-0570: 29-34 ohms	See Step 2	See Step 3	Frame under lef side of cab
2. Resistance between 795-YL (P6) and frame ground in platform Harness A	Greater than 5000 ohms	Replace trans-mission ECM	Repair/replace A Harness	Frame under lef side of cab
3. Resistance between leads on VHP solenoid	3E-6424: 14-18 ohms 104-9258: 19-24 ohms 111-0570: 29-34 ohms	Repair/replace B or C Harness	Repair/replace solenoid	Right side of 3306 Engine Left side of 3116 Engine

Flash Code: 59, CID-FMI: 688 F03, VHP Solenoid Short To Battery

Check: VHP Solenoid Short To +Battery	Specification	Pass	Fail	Location
1. Open circuit between 795-YL (P6) and other wires in engine frame Harness C (excluding 202-BK)	Greater than 5000 ohms	See Step 2	Repair/replace B or C Harness	Frame under left side of cab
2. Open circuit between 795-YL (P6) and other wires in platform Harness A (excluding 202-BK)	Greater than 5000 ohms	Replace trans-mission ECM	Repair/replace A Harness	Frame under left side of cab

Flash Code: 61, CID-FMI: 668 F02, Shift Lever Input Invalid

Check: Shift Lever Input Invalid (for active faults)	Specification	Pass	Fail	Location
1. Continuity between 202-BK (J1-2) and E937-PU and E949-YL (J1-26, J1-37) in transmission console Harness G at the transmission ECM. SHIFT LEVER MUST BE IN NEUTRAL.	Less than 5 ohms	See Step 2	See Step 3	Under cab
2. Open circuit between 202-BK (J1-2) and Pins J1-13, J1-19, J1-20, J1-23, J1-24, J1-29, J1-30, and J1-35 on transmission console Harness G at the transmission ECM. SHIFT LEVER MUST BE IN NEUTRAL	Greater than 5000 ohms	See Step 4	See Step 5	Under cab
3. Continuity between Pin J1-2 and Pins 11 & 12 on the shift lever input. SHIFT LEVER MUST BE IN NEUTRAL.	Less than 5 ohms	Repair/replace G Harness	Replace shift lever	Shift console
4. Shift between Forward and Reverse. Monitor circuit between 202-BK (P2) and Forward line (P11) and Reverse line (P12) on shift lever.	Forward: P11 less than 5 ohms. P12 greater than 5000 ohms. Reverse: P11 greater than 5000 ohms. P12 less than 5 ohms.	See Step 6	Replace shift lever	Shift console
5. Open circuit between Pin 2 and Pins 3 through 10 on the shift lever input. SHIFT LEVER MUST BE IN NEUTRAL	Greater than 5000 ohms	Repair/replace G Harness	Replace shift lever	Shift console
6. Shift between Forward and Reverse. Monitor circuit between 202-BK (J1-2) and Forward line E946-OR (J1-39) and Reverse line E947-WH (J1-31) in transmission console Harness G at the transmission ECM.	Forward: P37 less than 5 ohms. P38 greater than 5000 ohms. Reverse: P37 greater than 5000 ohms. P38 less than 5 ohms.	Replace Transmission ECM	Repair/replace G Harness	Under cab

Flash Code: 62, CID-FMI: 668 F03, Shift Lever Open Circuit/Short To +Battery

Check: Shift Lever Open Circuit/Short To +Battery	Specification	Pass	Fail	Location
1. Continuity between 202-BK (J1-2) and E946-OR (J1-39) in transmission console Harness G at the transmission ECM. SHIFT LEVER MUST BE IN A FORWARD GEAR.	Less than 5 ohms	See Step 2	See Step 3	Under cab
2. Continuity between 202-BK (J1-2) and E947-WH (J1-31) in transmission console Harness G at the transmission ECM. SHIFT LEVER MUST BE IN A REVERSE GEAR.	Less than 5 ohms	See Step 4	See Step 5	Under cab
3. Continuity between Pin 2 and Pin 11 on the shift lever input. SHIFT LEVER MUST BE IN A FORWARD GEAR.	Less than 5 ohms	Repair/replace G Harness	Replace shift lever	Shift console
4. Continuity between 202-BK (J1-2) and the pin which corresponds to the shift lever selection. Check each lever position in First through Eighth. Complete check on the transmission control Harness G at the transmission ECM end. Only one of the gear pins should have continuity at one time.	Less than 5 ohms	Replace transmission ECM	See Step 6	Under cab
5. Continuity between Pin 2 and Pin 12 on the shift lever input. SHIFT LEVER MUST BE IN A REVERSE GEAR.	Less than 5 ohms	Repair/replace G Harness	Replace shift lever	Shift console
6. Continuity between Pin 2 and the pin which corresponds to the shift lever selection. Check each lever position in First through Eighth. Complete check on the shift lever input. Only one of the gear pins should have continuity at one time.	Less than 5 ohms	Replace transmission ECM	Repair/replace G Harness	Shift console

Flash Code: 65, CID-FMI: 701 F02, Transmission Output Speed Signal Incorrect

Check: Transmission Output Speed (TOS) Signal Incorrect	Specification	Pass	Fail	Location
1. Resistance between M917-PK (P4) and M918-GN (P1) in transmission frame Harness V	1000-2000 ohms	See Step 2	See Step 3	Left rear side of transmission
2. Check resistance between M917-PK (J2-29) and M918-GN (J2-23) at transmission ECM.	1000/uh2000 ohms	See Step 4	Repair/replace Harness F	Left rear engine
3. Check resistance between M917-PK (P2) and M918-GN (P1) at TOS sensor	1000-2000 ohms	Replace transmission ECM	Replace TOS sensor	ECM under cab
4. TOS signal voltage at sensor with motor grader in First gear and engine at High Idle	Greater than 10 VAC	See Step 5	Replace TOS sensor	ECM under cab
5. TOS signal on ECAP or ET with motor grader in First gear and engine at High Idle	Greater than 250 rpm	Problem corrected	Replace transmission ECM	ECM under cab

Flash Code: 68, CID-FMI: 168 F01, System (+Battery) Voltage Below Normal

Check: System (+Battery) Voltage Below Normal	Specification	Pass	Fail	Location
1. +Battery voltage normal (J1-1)	Greater than 20 volts	See Step 2	Replace faulty charging system component	Right side battery
2. +Battery at 126-PK (J1-1)	Greater than 20 volts	See Step 3	Repair/replace fuse junction	Fuse block inside cab
3. +Battery at 126-PK (J1-1) on transmission console Harness G at transmission ECM	Greater than 20 volts	Replace transmission ECM	Repair/replace A, G, or J Harness	Under cab

Flash Code: 71, CID-FMI: 520 F02, Invalid Transmission Configuration Code; Flash Code: 72, CID-FMI: 268 F02, Check Programmable Parameters

Check: For Active Faults (71 And 72)	Specification	Pass	Fail	Location
Use the ECAP to check the transmission configuration code in the Read/Change Parameters screen. An alternative is to check the flash code displayed on the transmission indicator lamp when the key is turned ON. The code will be flashed out with a brief pause between the numbers. Four flashes, a pause, and a single flash would be a 41 code.	13 – 12H 21 – 120H 23 – 120H Standard 36 – 135H 38 – 135H Standard 41 – 140H 44 – 143H 61 – 160H 64 – 163H	Replace transmission ECM	Program correct transmission configuration code	Under cab

Chart 4 Transmission Configuration Codes		
Trans. Config. Code	ECAP Description	Model Description
13	12H Transmission	12H
21	120H Transmission	120H
23	120H Standard Transmission	120H Standard
36	135H Transmission	135H
38	135H Standard Transmission	135H Standard
41	140H Transmission	140H
42	140H AUTO Transmission	140H Autoshift
43	140H VHP AUTO Transmission	140H VHP Autoshift
44	143H Transmission	143H
45	143H AUTO Transmission	143H Autoshift
61	160H VHP Transmission	160H
62	160H VHP AUTO Transmission	160H VHP Autoshift
64	163H VHP Transmission	163H
65	163H VHP Auto Transmission	163H VHP Autoshift

Flash Code: 73, CID-FMI: 764 F05, Transmission Indicator Lamp Open Circuit

Check: Open Circuit Lamp (OCL)	Specification	Pass	Fail	Location
1. Resistance between E975-PU (P5) and OCL in transmission platform Harness A	10-50 ohms	See Step 2	See Step 3	Frame under right side of cab
2. Continuity between E975-PU (P3) and OCL in gage console Harness M	Less than 5 ohms	See Step 4	Repair/replace M Harness	Frame under right side of cab
3. Resistance between leads on OCL	10-50 ohms	Repair/replace A or M Harness	Repair/replace solenoid	Left side of transmission
4. Resistance between E975-PU (J1-1B) and OCL at transmission console Harness G at transmission ECM end	10-50 ohms	Replace transmission ECM	Repair/replace G Harness	Under cab

Flash Code: 74, CID-FMI: 764 F06, Transmission Indicator Lamp Short To Ground

Check: Short To Ground Lamp (SGL)	Specification	Pass	Fail	Location
1. Resistance between E975-PU (P5) and SGL in transmission platform Harness A	10-50 ohms	See Step 2	See Step 3	Frame under right side of cab
2. Open circuit between SGL and frame ground in gage console Harness M	Greater than 5000 ohms	See Step 4	Repair/replace SGL wire	Frame under right side of cab
3. Resistance between leads on SGL	10-50 ohms	Repair/replace A or M Harness	Repair/replace solenoid	Left side of transmission
4. Resistance between E975-PU (J1-18) and SGL at the transmission console Harness G at transmission ECM end	10-50 ohms	Replace transmission ECM	Repair/replace G Harness	Under cab

Flash Code: 75, CID-FMI: 764 F03, Transmission Indicator Lamp Short To Battery

Check: Short To Battery Lamp (SBL)	Specification	Pass	Fail	Location
1. Open circuit between SBL and any of the in the transmission platform Harness A	Greater than 5000 ohms	See Step 2	Repair/replace A or M Harness	Frame under right side of cab
2. Open circuit between SBL and any of the other in the gage console Harness M	Greater than 5000 ohms	Replace transmission ECM	Repair/replace G Harness	Frame under right side of cab

Flash Code: 76, CID-FMI: 177 F03, Transmission Oil Temperature Sensor short to Battery or Open Circuit

Check: PWM Sensor Voltage[1]	Specification	Pass	Fail	Location
1. Check sensor power voltage between 126-PK (Pin A) (power) and 202-BK (Pin B) (ground)	24.0-29.5 Volts	See Step 2	Repair/replace	Left rear of engin
2. Check sensor signal voltage between G460-GN (Pin C) (signal) and 202-BK (Pin B) (ground)	Reference Chart 6	See Step 3	Repair/replace Sensor	Left rear of engin
3. Check machine harness signal voltage at ECM between G460-GN (J2-18) (signal) and 202-BK (J1-2) (ground) DO NOT DISCONNECT THE HARNESS	Reference Chart 6	Replace Transmission ECM	Repair/replace Harness	Under cab

[1] PROCEDURE: Locate the suspect sensor. DO NOT DISCONNECT ANY HARNESS AT THE TIME. Turn the key start switch to the position. DO NOT START THE ENGINE. Tools needed: 6v-7070 Voltmeter (or equivalent) and 7X-1710 cable probes.

Flash Code: 77, CID-FMI: 177 F04, Transmission Oil Temperature Sensor short to Ground

Check: PWM Sensor Voltage[1]	Specification	Pass	Fail	Location
1. Check sensor power voltage between 126-PK (Pin A) (power) and 202-BK (Pin B) (ground)	24.0-29.5 Volts	See Step 2	Repair/replace Harness	Left rear of engine
2. Check sensor signal voltage between G460-GN (Pin C) (signal) and 202-BK (Pin B) (ground)	Reference Chart 6	See Step 3	Repair/replace Sensor	Left rear of engine
3. Check machine harness signal voltage at ECM between G460-GN (J2-18) (signal) and 202-BK (J1-2) (ground) DO NOT DISCONNECT THE HARNESS	Reference Chart 6	Replace Transmission ECM	Repair/replace Harness	Under cab

[1] PROCEDURE: Locate the suspect sensor. DO NOT DISCONNECT ANY HARNESS AT THE TIME. Turn the key start switch to the position. DO NOT START THE ENGINE. Tools needed: 6v-7070 Voltmeter (or equivalent and 7X-1710 cable probes.

Flash Code: 81, CID-FMI: 868 F05, Auto/Manual Lamp Open Circuit

Check: Open Circuit Lamp (OCL)	Specification	Pass	Fail	Location
1. Check resistance between M998-OR (J1-12) and OCL in transmission platform harness	10-50 ohms	See Step 2	See Step 3	Frame under right side of cab
2. Check continuity between M998-OR (J1-12) and OCL in gauge console harness	Less than 5 ohms	See Step 4	Repair/replace harness	Frame under right side of cab
3. Check resistance between leads on OCL	10-50 ohms	Repair/replace harness	Repair/replace solenoid	Left side of transmission
4. Check resistance between M998-OR (J1-12) and OCL at transmission console harness at transmission ECM end	10-50 ohms	Replace transmission ECM	Repair/replace harness	Under cab

Flash Code: 82, CID-FMI: 868 F06, Auto/Manual Lamp Short to Ground

Check: Short To Ground Lamp (SGL)	Specification	Pass	Fail	Location
1. Check resistance between M998-OR (J1-12) and SGL in transmission platform harness	10-50 ohms	See Step 2	See Step 3	Frame under right side of cab
2. Check continuity between M998-OR (J1-12) and SGL in gauge console harness	Greater than 5000 ohms	See Step 4	Repair/replace SGL wire	Frame under right side of cab
3. Check resistance between leads on SGL	10-50 ohms	Repair/replace harness	Repair/replace solenoid	Left side of transmission
4. Check resistance between M998-OR (J2-12) and SGL at transmission console Harness G at transmission ECM end	10-50 ohms	Replace transmission ECM	Repair/replace Harness G	Under cab

Flash Code: 83, CID-FMI: 868 F03, Auto/Manual Lamp Short to Battery

Check: Short To Battery Lamp (SBL)	Specification	Pass	Fail	Location
1. Open circuit between SBL and any of the transmission platform harnesses	Greater than 5000 ohms	See Step 2	Repair/Replace harness	Frame under right side of cab
2. Open circuit between SBL and any of the gauge console harnesses	Greater than 5000 ohms	Replace transmission ECM	Repair/replace harness	Frame under right side of cab

Sensor Signal Voltage Test

Chart 6
(ECM Connected)

Sensor Voltage Specifications[1]
(For Sensor Voltage Test)

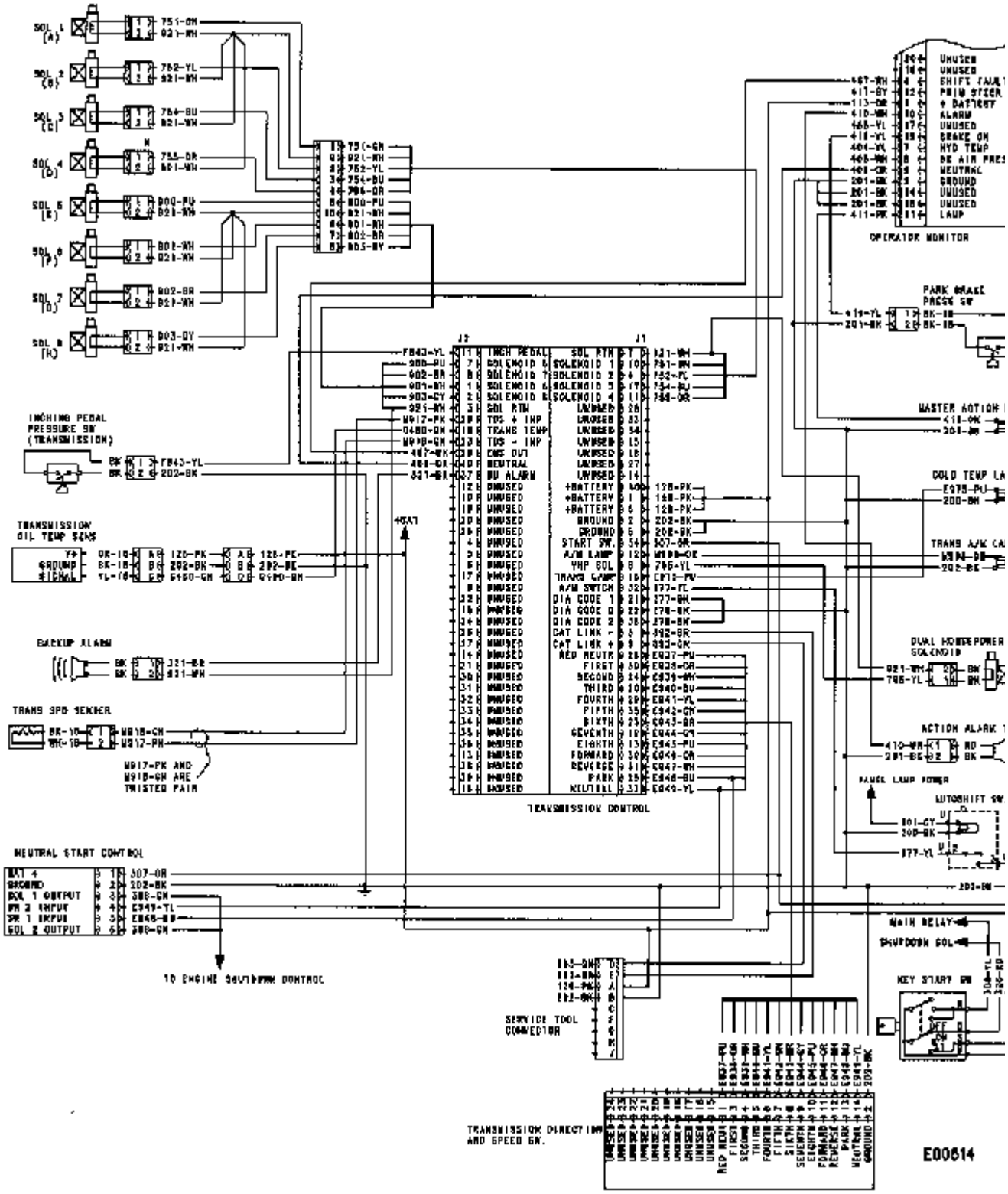
Temperature Sensor

Temperature	Signal Voltage[2] (DCV)	Duty Cycle[2] %
40 to -20°C (-40 to -4°F)	1.1 to 1.1	10 to 11
20 to 0°C (-4 to 32°F)	1.1 to 1.4	11 to 15
0 to 20°C (32 to 68°F)	1.4 to 1.9	15 to 23
20 to 40°C (68 to 104°F)	1.9 to 2.9	23 to 37
40 to 60°C (104 to 140°F)	2.9 to 4.0	37 to 55
60 to 80°C (140 to 176°F)	4.0 to 5.1	55 to 71
80 to 100°C (176 to 212°F)	5.1 to 5.8	71 to 82
100 to 120°C (212 to 248°F)	5.8 to 6.3	82 to 89
120 to 135°C (248 to 275°F)	6.3 to 6.5	89 to 93

[1] If desired, use these specifications with Step 2 of the following procedure.

[2] These values are guidelines for troubleshooting and are not considered exact. The tolerance is ± 10%, depending on the condition of the system. Most important is that the value changes smoothly as the pressure or temperature changes.

Schematic


INCHING PEDAL PRESSURE SW (TRANSMISSION)
TRANSMISSION OIL TEMP SENS
BACKUP ALARM
TRANS SPD SENSOR
MB17-PK AND MB18-GN ARE TWISTED PAIR
NEUTRAL START CONTROL
TO ENGINE GOVERNOR CONTROL
TRANSMISSION CONTROL
OPERATOR MONITOR
PARK BRAKE PRESS SW
MASTER ACTION
COLD TEMP
TRANS A/M
DUAL HORSEPOWER SOLENOID
ACTION ALARM
PANEL LAMP POWER
AUTOSHIFT SW
MAIN RELAY
SHUTDOWN SOL
KEY START SW
SERVICE TOOL CONNECTOR
TRANSMISSION DIRECTIONAL AND SPEED SW.
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