Diagnostic Trouble Codes

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Determining Diagnostic Trouble Codes

SMCS Code: 0785-UE; 7490; 7569

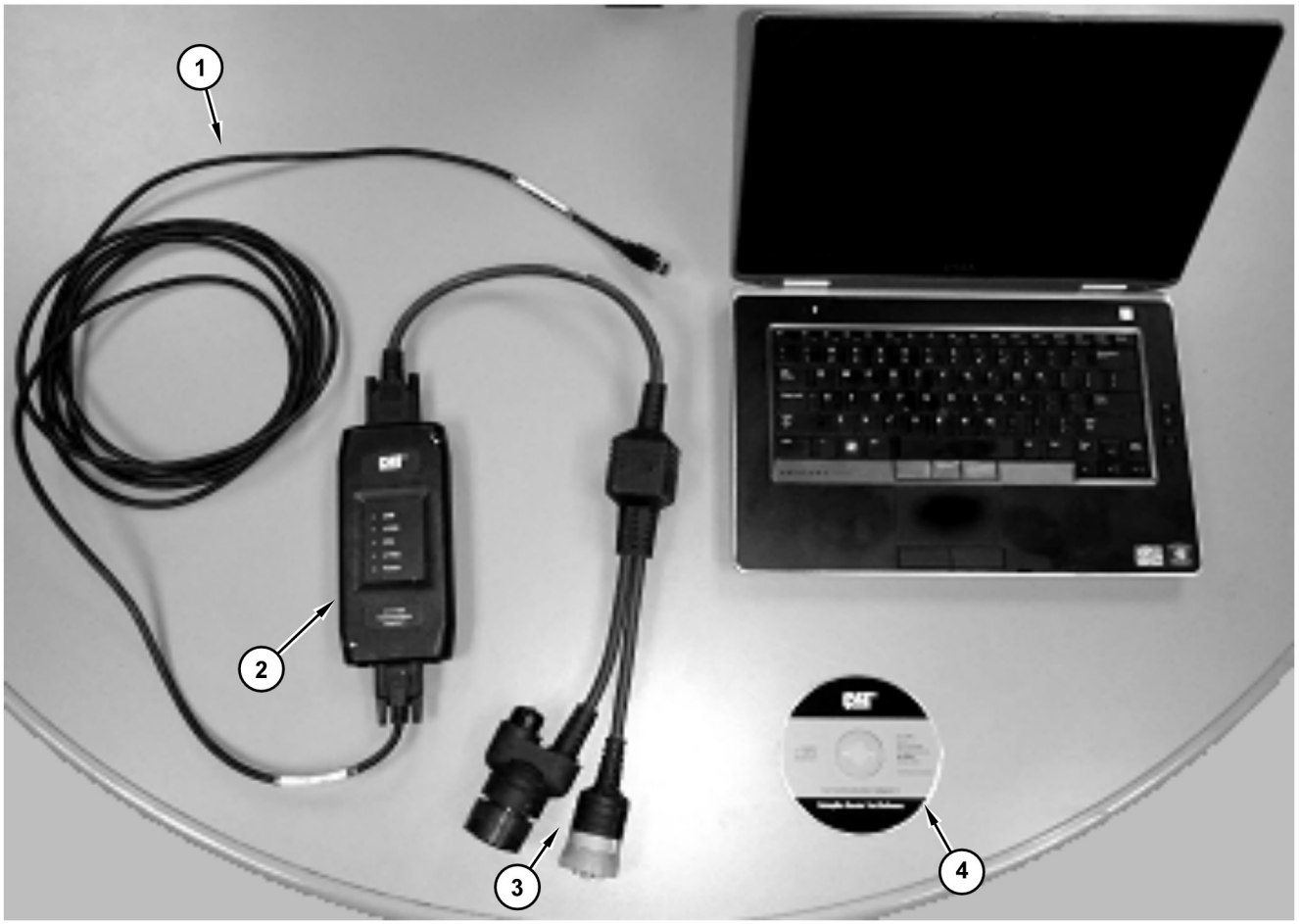

Illustration 10 g03861135

Connections for the Communication Adapter 3 and Cat ® Electronic Technician (Cat ET) Service Tool

The components that are needed to use the Communication Adapter III and Cat ET to determine diagnostic codes are listed:

(1) Cable
(2) 317-7484 Communication Adapter Gp
(3) 457-6114 CA3 Ethernet FLASH Cable
(4) Current version of Cat ET program software and an IBM-COMPATIBLE personal computer

Use Cat ® Electronic Technician (Cat ET) with the following materials:

- Special Publication, JERD2124, “ET Single Use Program License”
- Special Publication, JEHP1026, “Information and Requirements Sheet”
- 7X-1425 Data Link Cable and the Data Subscription

- Special Publication, JERD2142, “Data Subscription”

The following features make Cat ET a valuable tool for troubleshooting:

- Required to determine diagnostic codes
- Displays the history of a diagnostic code
- Displays the diagnostic code parameter status
- Required to clear diagnostic codes

Perform the following steps to determine diagnostic codes with Cat ET:

1. Connect the computer to the machine diagnostic connector.

Note: For locations of the connectors, see Testing and Adjusting, “Electrical Components and Connector Locations” and the machine Electrical Schematic.

2. Turn the keyswitch to the RUN position.

3. Start Cat ET.

Cat ET will initiate communications with the ECMs

4. Cat ET will list the available ECMs on the machine.

5. Follow the Cat ET instructions.

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Diagnostic Trouble Codes

SMCS Code: 7569

Module Identifier (MID)

The electronic control module that has detected a failure is identified by the Module Identifier (MID). Each electronic control module on the machine has a unique MID. The MID for the ECM of the Machine Security System is 436.

Component Identifier (CID)

The Component Identifier (CID) is a code that describes a possible failed component.

Failure Mode Identifier (FMI)

The codes for the Failure Mode Identifier (FMI) are defined by the Society of Automotive Engineers (SAE). The list of codes in Table 7 is used on Caterpillar ® products.

Table 7

Descriptions of the Failure Mode Identifiers (FMI)	
FMI No.	**Description of Failure**
00	“Data is valid, but above normal operating range”
01	“Data valid, but below normal operating range”
02	“Data erratic, intermittent, or incorrect”
03	“Voltage above normal or shorted high”
04	“Voltage below normal or shorted low”
05	“Current below normal or open circuit”
06	“Current above normal or grounded circuit”
07	“Mechanical system not responding properly”
08	“Abnormal frequency, pulse width, or period”
09	“Abnormal update”
10	“Abnormal rate of change”
11	“Failure mode is not identifiable.”
12	“Bad device or component”
13	“Out of calibration”

Detailed FMI Explanations

FMI 00 – “Data Valid But Above Normal Operating Range.” Every electronic control system sets a high limit for the expected operating range of the signal. The limit includes signals that are above the expected range. A sensor that is still working but sending a signal above the expected limit will cause an FMI 00 to be stored.

Some possible causes of FMI 00 are listed here:

- Signal above normal (High pressure or high temperature)
- Calibration is needed. FMI 13 is the preferred code.

For example, a certain PWM sensor is expected to generate a valid signal over 80 percent duty cycle. If the sensor generates a signal of 81 percent duty cycle, the sensor is still working but the signal is above the expected signal limits.

FMI 01 – “Data Valid But Below Normal Operating Range.” Every electronic control system sets a low limit for the expected operating range of the signal. The limit includes signals that are under the expected range. A low engine oil pressure signal from a working sensor could produce this FMI. A sensor that is still working but sending a signal below the expected limit will cause an FMI 01 to be stored.

Some possible causes of FMI 01 are listed here:

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- The signal is below normal. (The voltage, pressure, or temperature is low.)
- Timing is retarded

For example, a certain PWM sensor is not expected to generate a PWM signal below 5 percent duty cycle even with zero air pressure. If the sensor generates a 4 percent duty cycle signal with the engine shutdown, the sensor is still working but below the expected signal limits.

FMI 02 – **"Data Erratic, Intermittent Or Incorrect."** Signal data that is received from a component is valid. The data that is received from the component has become intermittent or erratic. Data can be correct sometimes and the data may be incorrect at other times. The communication that occurs between electronic controls also relates to this condition.

Some possible causes of FMI 02 are listed here:

- Loose connections in switches, harness, and connectors
- Intermittent/erratic signal
- Programmed data has changed
- Noisy signal
- The signal is out of range. FMI 00 or FMI 01 is the preferred code
- A failed power or ground connection to the ECM
- Failed ECM

FMI 03 – **"Voltage Above Normal Or Shorted High."** The voltage that is received from a component is higher than the expected value that is identified by the CID. FMI 03 most often relates to a signal circuit.

Some possible components that can cause an FMI 03 are listed here:

- The sensor (switch)
- The harness
- The related electronic control

Some possible causes of an FMI 03 are listed here:

- A sensor output that is not related to the duty cycle is stuck at the maximum output of the sensor
- A harness that has the sensor signal wire shorted to any voltage that is greater than the voltage of the sensor power supply
- A sensor signal wire is open in the machine harness between the sensor and the control. When a sensor has been disconnected from an electronic control, the input circuit voltage is normally pulled up to a positive level
- A sensor signal contact of a failed control that is internally shorted to a positive voltage source
- A failed control believes that a failure exists in a circuit that is working correctly. This failure is unlikely

FMI 04 – **"Voltage Below Normal Or Shorted Low."** The voltage that is received from a component is lower than the expected value that is identified by the CID. FMI 04 most often relates to a signal circuit. FMI 04 is similar to FMI 06. FMI 04 is sometimes used in the place of FMI 06.

Some possible causes of FMI 04 are listed here:

- The sensor
- The harness
- The related electronic control

Some possible causes of FMI 04 are listed here:

- A sensor output that is not related to the duty cycle is stuck at the minimum output of the sensor
- The signal wire is shorted to ground in the harness
- Electronic control has an internal short to ground on the connector contact of the signal input

FMI 05 – **Current Below Normal Or Open Circuit.** The current of the monitored circuit is below normal. The low current can results from an open circuit. FMI 05 is related to an output of a driver circuit.

Some possible causes of FMI 05 are listed here:

- Open circuit or poor harness connection
- High-resistance circuit in a component (relay coil)
- Component in the open position (switch)

FMI 06 – **"Current Above Normal Or Grounded Circuit."** The current of the monitored circuit is above normal. This code is most commonly caused by a circuit that is shorted to ground. This code is similar to an FMI 04. FMI 06 is sometimes used in the place of FMI 04. FMI 06 can be related to an output of a driver circuit.

Some possible causes of FMI 06 are listed here:

- A short to ground in the harness
- Low resistance (failure) in component coil (relay)

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- Electronic control has an internal short to ground on the connector contact of signal input

FMI 07 – **"Mechanical System Not Responding Properly."** A mechanical system does not respond in the expected manner when electrical commands are received from the electronic control.

For example, a sluggish solenoid valve causes a slow shift.

Some possible causes of FMI 07 are listed here:

- Improper response of a component
- Stuck component
- Component failure
- The engine is shut down
- Improper machine operation

FMI 08 – **"Abnormal Frequency, Pulse Width Or Period. "**The frequency of the signal or the width of a given signal pulse is not in the expected range. This code can also relate to a failed output circuit of a sensor or an open output circuit of a sensor.

Note: The period is the time in seconds for one cycle at a given frequency.

Some possible causes of FMI 08 are listed here:

- Intermittent connection of a signal circuit
- Misfire
- Noisy signals that are caused by a nearby radio or magnetic field

FMI 09 – **"Abnormal Update."** This code relates to the communication that occurs between electronic controls via a data link. This code occurs when given control is unable to receive required information from another control via the data link. This code indicates that the communication link to the ECM has been lost for more than 5 seconds. The ECM is not responding.

Some possible causes of FMI 09 are listed here:

- Loose connections in the harness or switches
- Failed power or ground connections to the ECM
- No communication is available on the data link
- Abnormal update because of a mismatch of software between electronic controls
- Failure of the electronic control

FMI 10 "Abnormal Rate of Change" – This code relates to a signal that changes too fast or too slow. The rate of change is outside of the expected limit.

Some possible causes of FMI 10 are listed here:

- The component has failed
- Poor connections in the circuit.
- The medium or component that is being monitored has failed.
- An ECM has failed. ECM failure is unlikely.

FMI 11 – **"Failure Mode Not Identifiable."** This code is used when an electronic control determines that multiple Failure Mode Identifiers are responsible for a single failure.

Some possible causes of FMI 11 are listed here:

- Mechanical failure
- Machine damage to multiple circuits

FMI 12 – **"Bad Device Or Component."** The code is used for the situations that are listed here: The code is used when an electronic control does not receive an expected response from another electronic control via the data link. The code is also used when an electronic control receives an expected response from another electronic control but the response is not valid. This condition is also used when an electronic control is expected to send data periodically and the control does not send the data.

Some possible causes of FMI 12 are listed here:

- Control failure
- Failure of the data link
- One or more controls with the incorrect software

FMI 13 – **"Out Of Calibration."** This code is used when the electrical signal of a given mechanical condition is not within the expected limits of the electronic control. The sensor needs calibration, adjustment, or replacement.

The possible causes of FMI 13 are listed here:

- Calibration is required
- Data out of range

Troubleshooting Procedures

Go to the procedure that corresponds to the CID and FMI that has been indicated. These procedures are used only for maintenance events (CID and FMI) that originate from the MSS. These procedures are used for CID's that have an MID of 436.

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If the MID is not for the MSS, see the Module Identifier chart on the Electrical System Schematic for the machine that is being serviced. Once you have determined the electronic control modules that detected the event, refer to the Service Manual for that control for troubleshooting information. The Service Manual modules for each control are part of the machine Service Manual.

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Diagnostic Codes

Table 8

Machine Security System (MID 124)		
DTC	**Description**	**Procedure**
168-00	Electrical System Voltage : High	Electrical Power Supply - Test
168-01	Electrical System Voltage : Low	Electrical Power Supply - Test
248-12	Cat Data Link malfunction	Cat Data Link - Test
1391-03	Theft Deterrent Output Driver #1 : Voltage Above Normal	ECM Output Driver - Test
1391-04	Theft Deterrent Output Driver #1 : Voltage Below Normal	ECM Output Driver - Test
1392-03	Theft Deterrent Output Driver #2 : Voltage Above Normal	ECM Output Driver - Test
1392-04	Theft Deterrent Output Driver #2 : Voltage Below Normal	ECM Output Driver - Test
5217-03	300mA Sourcing Driver Output #3 : Short to battery	ECM Output Driver - Test
5217-04	300mA Sourcing Driver Output #3 : Short to ground	ECM Output Driver - Test
5218-03	300mA Sourcing Driver Output #4 : Short to battery	ECM Output Driver - Test
5218-04	300mA Sourcing Driver Output #4 : Short to ground	ECM Output Driver - Test
5219-03	300mA Sourcing Driver Output #5 : Short to battery	ECM Output Driver - Test
5219-04	300mA Sourcing Driver Output #5 : Short to ground	ECM Output Driver - Test
5220-03	300mA Sourcing Driver Output #6 : Short to battery	ECM Output Driver - Test
5220-04	300mA Sourcing Driver Output #6 : Short to ground	ECM Output Driver - Test
247-9	J1939 Data Link	Can Data Link - Test

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Symptom Procedures

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Symptom Troubleshooting

SMCS Code: 7000-035

Use the following guidelines as you troubleshoot a symptom:

Know the Machine

Understand the operation of the machine. Know if the symptom is a characteristic of normal operation or if the symptom is a failure.

Use Available Service Literature

Read the systems operation information in order to understand the systems of the machine. Understand the interaction of the machine systems.

Use all available service literature to understand the systems of the machine and perform troubleshooting. Troubleshooting the machine security system (MSS) system may require additional information from the Service Manual of the machine. Following is a list of books that may be useful:

- Electrical Schematic
- Systems Operation / Testing and Adjusting
- Troubleshooting / Systems Operation / Testing and Adjusting
- Systems Operation / Testing and Adjusting

Understand the Symptom

Speak with the operator about the symptom. Acquire the following Information:

- The performance of the machine prior to the failure
- First occurrence of the symptom
- The operating conditions at the time of the failure
- The sequence of events prior to the failure (order of the occurrences)
- The troubleshooting steps that have been taken
- The history of repairs of the machine
- The preventive maintenance of the machine
- Related service information about current problems that affect the serial number of the machine
- Inspect the Machine. Look for problems. Notice any unusual odors in the air. Listen for unusual noises.

Verify the Symptom

When possible, attempt to duplicate the symptom. Operate the machine and repeat the conditions that caused the failure. Check the gauges inside the cab. Notice any unusual odors in the air. Listen for unusual noises.

Determine if the electronic control module (ECM) has detected any faults. A diagnostic code is used to specify each detected fault.

Determine Possible Causes

Use the information from the operator and your inspection. Attempt to identify a common cause if there is more than one symptom.

Test and Repair the System

Use the tests and procedures in this manual to verify the cause of the symptom. Once the cause has been identified, repair the failure. Then, test the system again to verify that the symptom is resolved.

Provide Feedback to Caterpillar

Share your troubleshooting information. Provide Caterpillar feedback after the correct repair has been performed. Use the form in SISweb or CBT feedback to write a brief description about the symptom, testing, and repair of the machine. Include your phone number or your e-mail address so that you can be contacted. This feedback information helps Caterpillar improve service information.

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Emerging Symptom Information

SMCS Code: 7000-035

This space is for new information for this product.

Note: Use the Service Information System (SIS) on the Web to find the most up-to-date information.

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To share your knowledge of symptoms: use the form in SIS Web or CBT feedback to write a brief description about the symptom, testing, and repair of the machine. Your feedback information will help Caterpillar ® improve the service information for this product.

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Engine Does Not Crank and Status Indicator Is Green

SMCS Code: 7631-035

The green LED of the status indicator informs the operator that the machine security system (MSS3s) ECM has recognized a valid key. The problem may be unrelated to the MSS. The source of the problem that is preventing an engine start can come from several sources. Ensure that all of the standard requirements for starting the machine have been met. A few examples of the requirements are listed here:

- Interlocks in the operator seat
- Hydraulic interlocks
- Gear of the machine
- Fuel level

This troubleshooting procedure will eliminate the MSS as a source of the starting problem.

Note: The wires that are identified in this procedure are not present on every machine. If the wire that is identified in this procedure is not present, proceed to the next Test Step.

Table 9

Troubleshooting Test Steps	Values	Results
1. CHECK THE DATA LINKS. A. Connect the Caterpillar Electronic Technician (Cat ET) service tool to the machine. B. Use a valid key to turn the keyswitch to the ON position. C. Use the Cat ET service tool to determine the status of the Cat data-link.	The data links are communicating with all the ECMs that are installed on the machine. **Note:** Some machines are equipped with only the MSS3s ECM.	**Yes -** The data links are communicating with all the ECMs that are installed on the machine. Proceed to Test Step 2. **No -** The data links are not communicating with all the ECMs that are installed on the machine. The Cat data-link has failed. **Repair:**Repair the data link circuits in the harness. **STOP.**

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(Table 9, contd)

2. CHECK THE SYSTEM VOLTAGE AT THE MSS3s ECM. A. Measure the voltage between pin 24 and pin 26 of the MSS3s ECM.	The voltage is approximately system voltage.	**Yes -** The voltage is approximately system voltage. Proceed to Test Step 3. **No -** The voltage is not approximately system voltage. **Repair:** Check the battery and the associated wiring in the machine harness. **STOP.**
3. CHECK THE VOLTAGE FROM THE KEY SWITCH TO THE DRIVER (INPUT No. 1) OF THE ECM. A. Turn the keyswitch to the ON position. B. Measure the voltage between pin 70 and pin 26 if the wires are present. Record the reading.	Voltage should be present for all of the measurements. The voltage should be within 10% of the machine battery voltage.	**Yes -** The voltage is present and the voltage level is correct. The ECM is receiving voltage. Proceed to Test Step 4. **No -** The voltage was not correct, or no voltage was present. **Repair:** Check the harness for signs of damage. Repair or replace the harness. **STOP.**
4. CHECK THE VOLTAGE FROM THE KEY SWITCH TO THE DRIVER (INPUT No. 2) OF THE ECM. A. Turn and hold the keyswitch in the START position. B. Measure the voltage between pin 47 and pin 26 with the wires present. Record the reading.	Voltage should be present for all measurements. The voltage should be within 10% of the battery voltage.	**Yes -** The voltage is present and the voltage level is correct. The ECM is receiving voltage. Proceed to Test Step 5. **No -** The voltage was not correct, or no voltage was present. **Repair:** Check the harness for signs of damage. Repair or replace the harness. **STOP.**
5. CHECK THE DRIVER (OUTPUT No. 1) VOLTAGE. Note: The output drivers of the MSS3s ECM are protected from excessive electrical current. Excessive electrical current is usually the result of a wire or a component that is shorted to ground. If the MSS3s ECM detects an excessive amount of electrical current, the MSS3s ECM will disable the output driver. A. Place the keyswitch in the ON position. With 7X - 1710 Multimeter Probes check for voltage between pin 58 and pin 42 with the wires present. Do not disconnect the connector from the MSS3s ECM.	Voltage should be present. The voltage should be within 10% of the machine battery voltage.	**Yes -** The voltage is present and the voltage level is correct. Proceed to Test Step 6. **No -** The voltage was not correct. Proceed to Test Step 7.
6. CHECK THE DRIVER (OUTPUT No. 2) VOLTAGE. Note: The output drivers of the MSS3s ECM are protected from excessive electrical current. Excessive electrical current is usually the result of a wire or a component that is shorted to ground. If the MSS3s ECM detects an excessive amount of electrical current, the MSS3s ECM will disable the output driver. A. With the keyswitch in the START position, check for voltage between pin 40 and pin 42 with the wires present.	Voltage should be present. The voltage should be within 10% of the machine battery voltage.	**Yes -** The voltage is present and the voltage level is correct. The ECM is sending voltage to the driven components that will start the machine. **Repair:** The MSS has not caused the problem. Verify that the driven components are receiving voltage by measuring at the component. Consult the troubleshooting manual for the engine. **STOP.** **No -** The voltage was not correct. Proceed to Test Step 9.

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(Table 9, contd)

7. CHECK FOR A FAILED COMPONENT ON OUTPUT DRIVER (No. 1). A. Turn the keyswitch and the disconnect switch to the OFF position. If the machine is not equipped with a disconnect switch, remove the negative wire from the battery. B. Disconnect the harness connector from the solenoid or the relay that is controlled by the output driver (No. 1). C. Turn the disconnect switch and the keyswitch to the ON position. If the machine is not equipped with a disconnect switch, reconnect the negative wire to the battery. D. Place the keyswitch in the ON position. With 7X-1710 Multimeter Probes check for voltage between pin 58 and pin 11 with the wires present. Do not disconnect the connector from the MSS3s ECM.	Voltage should be present. The voltage should be within 10% of the machine battery voltage.	**Yes -** The voltage is present and the voltage level is correct. The solenoid or the relay has failed. **Repair:** Replace the solenoid or relay. **STOP.** **No -** The voltage was not correct. Proceed to Test Step 8.
8. CHECK THE WIRES IN THE CIRCUIT OF OUTPUT DRIVER (No. 1). A. Turn the keyswitch and the disconnect switch to the OFF position. If the machine is not equipped with a disconnect switch, remove the negative wire from the battery. B. Verify that the harness connector remains disconnected from the relay that is controlled by the output driver (No. 1). C. Disconnect the 70-pin connector from the MSS3s ECM. D. Measure the resistance between pin 58 and frame ground, with the wires present. E. Measure the resistance between pin 42 and frame ground, with the wires present.	The resistance is greater than 5000 ohms.	**Yes -** The resistance is greater than 5000 ohms. The ECM may have failed, however, ECM failure is unlikely. **Repair:** Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the technical communicator at your Caterpillar dealer. Follow the steps in Troubleshooting, “ECM - Replace” if the ECM needs to be replaced. **STOP.** **No -** The resistance was not correct. **Repair:** There is a problem in the wiring. Check the harness for signs of damage. Repair or replace the harness. **STOP.**

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(Table 9, contd)

9. CHECK FOR A FAILED COMPONENT ON OUTPUT DRIVER (No. 2). A. Turn the keyswitch and the disconnect switch to the OFF position. If the machine is not equipped with a disconnect switch, remove the negative wire from the battery. B. Disconnect the harness connector from the solenoid or the relay that is controlled by the output driver (No. 2). C. Turn the disconnect switch and the keyswitch to the ON position. If the machine is not equipped with a disconnect switch, reconnect the negative wire to the battery. D. Place the keyswitch in the START position. With 7X-1710 Multimeter Probes check for voltage between pin 70 and pin 42 with the wires present. Do not disconnect the connector from the MSS3s ECM.	Voltage should be present. The voltage should be within 10% of the machine battery voltage.	**Yes -** The voltage is present and the voltage level is correct. The solenoid or the relay has failed. **Repair:** Replace the solenoid or the relay. **STOP.** **No -** The voltage was not correct. Proceed to Test Step 10.
10. CHECK THE WIRES IN THE CIRCUIT OF THE OUTPUT DRIVER (No. 2). A. Turn the keyswitch and the disconnect switch to the OFF position. If the machine is not equipped with a disconnect switch, remove the negative wire from the battery. B. The harness connector remains disconnected from the solenoid or the relay that is controlled by the output driver (No. 2). C. Disconnect the 70-pin connector from the MSS3s ECM. D. Measure the resistance between pin 70 and frame ground, with the wires present. E. Measure the resistance between pin 26 and frame ground, with the wires present.	The resistance is greater than 5000 ohms.	**Yes -** The resistance is greater than 5000 ohms. The ECM may have failed, however, ECM failure is unlikely. **Repair:** Exit this procedure and perform this procedure again. If the cause of the failure is not found, contact the technical communicator at your Caterpillar dealer. Follow the steps in Troubleshooting, “ECM - Replace” if the ECM needs to be replaced. **STOP.** **No -** The resistance was not correct. **Repair:** There is a problem in the wiring. Check the wiring harness for signs of damage. Repair or replace the harness. **STOP.**

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Engine Does Not Start and Status Indicator Is Continuously Red

SMCS Code: 7631-035

A solid Red LED in the status indicator indicates that the MSS has not recognized a valid electronic key for that machine. This condition can be caused by several problems. One or more of the problems that are listed here could be responsible for this condition. If the electronic key has been damaged, the MSS will not disarm and the machine will not start. If a problem exists in the exciter coil, the MSS will be unable to read the electronic key. If the wiring for the exciter coil is damaged, the MSS will be unable to read the electronic key.

Note: Ensure that you have only one electronic key near the exciter coil when the MSS reads the key. Do not have more than one electronic key is near the exciter coil. If multiple electronic keys are present, the MSS3s ECM will not be able to read the key and the machine will not start.

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Table 10

Troubleshooting Test Steps	Values	Results
1. CHECK THE KEY. A. Connect the Cat Electronic Technician (Cat ET) to the Service Connector. B. Insert a valid electronic key for the machine in the key start switch. C. Turn the key switch to the ON position. D. Go to the “Service/Security Management” screen. Check the “Current Key Information” . E. Check the “ID1” and “ID2” for the key that is in the key start switch.	The MSS reads the ID1 code and the ID2 code as 0.	**Yes -** The MSS reads the ID1 code and the ID2 code as 0. The key may have failed or the problem may exist in the exciter coil. Proceed to Test Step 2. **No -** The MSS reads the ID1 code and the ID2 code correctly. The key has been read by the MSS3s ECM, but the MSS is still armed. The MSS still armed, indicates that the key in the key start switch is not authorized for that machine. **Repair:** Program that key into the MSS3s ECM or use a different key. **STOP.**
2. CHECK THE EXCITER COIL. A. Disconnect the exciter coil from the wiring harness. B. Measure the resistance on the leads of the exciter coil.	The resistance is approximately 1 ohm.	**Yes -** The resistance is approximately 1 ohm. Proceed to Test Step 3. **No -** The resistance is greater than approximately 1 ohm. The exciter coil has failed. **Repair:** Replace the exciter coil. **STOP.**
3. CHECK THE WIRING OF THE MACHINE HARNESS FOR AN OPEN CIRCUIT. A. The exciter coil remains disconnected from the wiring harness. B. On the harness side of the connector for the exciter coil, install a jumper wire between pin 1 and pin 2 . C. Disconnect the wiring harness connector from the MSS3s ECM. D. Measure the resistance between pin 11 and pin 13 of the connector for the MSS3s ECM.	The resistance is less than 5 ohms.	**Yes -** The resistance is less than 5 ohms between pin 7 and pin 53. The wiring for the exciter coil is correct Proceed to Test Step 4. **No -** The resistance is greater than 5 ohms between pin 11 and pin 13. There is a problem in the wiring for the exciter coil. **Repair:** Check the wiring harness for signs of damage. Repair or replace the machine harness. **Note:** The “ferrite coil” assembly is wired in series with the harness of the exciter coil. Locate the “ferrite coil” assembly. The “ferrite coil” assembly is located near the 70-pin connector of the MSS3s ECM. Continuity should exist through the coil assembly. **STOP.**

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(Table 10, contd)

4. CHECK THE WIRING OF THE MACHINE HARNESS FOR A SHORT TO GROUND. **Note: The output drivers of the MSS3s ECM are protected from excessive electrical current. Excessive electrical current is usually the result of a wire or a component that is shorted to ground. If the MSS3s ECM detects an excessive amount of electrical current, the MSS3s ECM will disable the output driver.** A. The wiring harness connector for the MSS3s ECM and the exciter coil remain disconnected. B. The jumper wire remains installed. C. Measure the resistance between pin 11 of the MSS3s ECM and frame ground. D. Measure the resistance between pin 13 of the MSS3s ECM and frame ground.	The resistance is greater than 5000 ohms.	**Yes -** The resistance is greater than 5000 ohms. The resistance is correct. Proceed to Test Step 5. **No -** The resistance is less than 5 ohms. The wiring harness is shorted to ground. **Repair:** Check the wiring harness for signs of damage. Repair or replace the machine harness. **STOP.**
5. CHECK THE WIRING OF THE MACHINE HARNESS FOR A SHORT TO + BATTERY. A. The wiring harness connector for the MSS3s ECM and the exciter coil remain disconnected. B. The jumper wire remains installed. C. Measure the resistance between pin 11 and pin 24 of the connector for the MSS3s ECM. D. Measure the resistance between pin 13 and pin 24 of the connector for the MSS3s ECM.	The resistance is greater than 5000 ohms.	**Yes -** The resistance is greater than 5000 ohms. The resistance is correct. **Repair:** The ECM has failed. The ECM is unlikely to have failed. Perform the previous Test Steps again. If the cause of the problem is not found, replace the ECM. See Troubleshooting, “ECM - Replace”. **STOP.** **No -** The resistance is less than 5 ohms. The wiring harness is shorted to the + battery circuit. **Repair:** Check the wiring harness for signs of damage. Repair or replace the machine harness. **STOP.**

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Lost Key (MSS)

SMCS Code: 7631-035-KEY

Lost Key (MSS3S)

1. Use another valid key to start the machine.

2. Program another key into the control module. Refer to the Testing and Adjusting, “Key - Program” section of this manual for additional information.

3. Contact your Caterpillar dealer.

Note: If a key is lost, the key should be deleted from the list of authorized keys.

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Circuit Tests

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Cat Data Link - Test

SMCS Code: 1408-038

Theft Deterrent Module ECM

The following is a list of codes that are associated with the Cat ® Data Link of the machine.

Table 11

Theft Deterrent Module ECM (MID 436)		
DTC	**Code Description**	**System Response**
248-12	Cat Data Link malfunction	The service tool cannot detect the ECM. Communication failures are indicated by another ECM.

Each Cat Data Link circuit is an input and output of select electronic control modules. The data link is designed to carry communications between the electronic control modules. The data link is not a visible component. The data link consists of internal control circuits and the connecting harness wiring.

This diagnostic code is recorded when the ECM cannot send information, or the ECM does not receive expected information from the data link (wire 892-BR(Brown)and wire 893-GN(Green)or wire 944-OR(Orange)and wire 945-BR(Brown)).

The diagnostic code is caused by abnormal communications between the ECM and a specific ECM module via the Data Link. If a diagnostic code is present, correct the related diagnostic code.

Possible causes for an FMI 12 diagnostic code are:

- There is an open circuit or a short circuit on the data link.
- There is a failure of the hardware for data link.

The 248-9 DTC is used by the ECM as a companion code and indicates a Cat Data Link problem. This DTC indicates that the ECM has lost all communication with another ECM. This companion code is simultaneously activated with the 590-9 DTC.

Note: The 248-9 DTC will never be activated by the ECM as a stand-alone diagnostic code.

Note: The locations of the components of the MSS will vary between machines. If the MSS was installed by a Caterpillar dealer, consult the installation instructions for component locations. If the MSS was an attachment that was installed at the factory, consult the electrical schematic for that machine.

Diagnostic Trouble Code Procedure

Note: Prior to beginning this procedure, inspect the harness connectors that are involved in this circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure, and in good condition. Check the wiring for pinch points or abrasions. Look for and repair areas that indicate wires are exposed. If a problem with a connection is found, correct the problem and verify that this diagnostic code is active before performing a troubleshooting procedure.

1. Identify the active FMI code associated with the components.
2. Determine which code is present and use the list below to determine which procedure to follow.

- FMI 12 diagnostic code, proceed to Table 12 .

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Table 12

FMI 12 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
1. CLEAR THE DIAGNOSTIC CODES A. Use the ET to clear the logged diagnostic codes. B. Use a valid electronic key to start the machine. Determine if CID 0248 FMI 12 is present.	CID 0248 FMI 12 is present.	**OK -** CID 0248 FMI 12 is present. The problem was not caused by the use of an invalid electronic key. Proceed to Test Step 2. **NOT OK -** CID 0248 FMI 12 is NOT present. The problem was caused by the use of an invalid key in the key start switch. **STOP.**
2. INSPECT THE HARNESS CONNECTORS A. Inspect the connections for the machine harness that are related to the data link. B. Make sure that connectors are clean and tight. C.If necessary, repair the machine harness or replace the machine harness. D. Use the ET to clear the diagnostic codes. E. Use a valid electronic key to start the machine. F. Determine if CID 0248 FMI 12 is present.	CID 0248 FMI 12 is present.	**OK -** The diagnostic code is present. Proceed to Test Step 3. **NOT OK -**The diagnostic code no longer exists and a machine harness connector was faulty. The failure is not present now. An intermittent connection may exist in the data link circuits of the machine harness. **Repair:** Replace any connectors that do not have a tight fitting. Repair any wiring in the harness that appears to be damaged. Watch for a recurrence of this fault. **STOP.**

(continued)

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(Table 12, contd)

FMI 12 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
3. CHECK FOR A SHORTED HARNESS A. Turn the battery disconnect switch to the OFF position. B. Disconnect the connector for the machine wiring harness from the MSS3s ECM. Disconnect the Cat Data Link from all other electronic control modules. C. At the connector for the MSS3s ECM, measure the resistance between contact 42 (wire 892-BR(Brown)or wire 944-OR(Orange)) and contact45 (wire 893-GN(Green)or wire 945-BR(Brown)).	The resistance is greater than 5000 Ohms.	**OK -** The resistance is greater than 5000 Ohms (no continuity). Harness circuit resistance is correct. Proceed to Test Step 4. **NOT OK -** Resistance is less than 5000 Ohms (continuity). The machine harness has failed. There is a short in the machine harness. **Repair:** Repair or replace the machine harness. **Note:** A resistance that is greater than 5 Ω but less than 5K Ω would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5K Ω would indicate an open in the circuit. **STOP.**
4. CHECK FOR AN OPEN HARNESS A. The disconnect switch remains OFF. B. The MSS3s ECM will remain disconnected from the machine harness. a. Locate the connector for the machine harness at the MSS3s ECM. Place a jumper wire between contact 1 (wire 892-BR(Brown)or wire 944-OR(Orange)) and 3 (wire 893-GN(Green)or wire 945-BR(Brown)). b. Locate the machine harness connector of another ECM. Check for continuity in the wiring for the Cat Data Link at the ECM. The pin numbers and the wires will vary between electronic control modules. Each ECM must be checked individually.	There is continuity in the data link wiring.	**OK -** There is continuity in the data link wiring. This circuit is not the cause of the fault. The ECM is possibly bad. **Repair:** If more than one ECM is reporting this fault code, the ECM is unlikely to be bad. If only one ECM has this fault, replace that ECM. **Note:** Prior to replacing the ECM, always contact the Technical Communicator at your dealership for possible consultation with Caterpillar. This consultation may effect repair time. Follow the steps in Troubleshooting, “ECM - Replace” if the ECM needs to be replaced. **STOP.** **NOT OK -** There is NO continuity in the data link wiring. The machine harness is faulty. The data link circuit is open in the machine harness. **Repair:** Repair or replace the machine harness. **STOP.**

i06225996

ECM Output Driver - Test

SMCS Code: 7610-038

Theft Deterrent Module ECM

The following is a list of Diagnostic Trouble Codes (DTCs) that are associated with the Theft Deterrent Output Driver for the ECM.

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Table 13

Theft Deterrent Module ECM (MID 436)		
DTC	**Code Description**	**System Response**
1391-03	Theft Deterrent Output Driver #1 : Voltage Above Normal	
1391-04	Theft Deterrent Output Driver #1 : Voltage Below Normal	
1392-03	Theft Deterrent Output Driver #2 : Voltage Above Normal	
1392-04	Theft Deterrent Output Driver #2 : Voltage Below Normal	
5217-03	300mA Sourcing Driver Output #3 : Short to battery	
5217-04	300mA Sourcing Driver Output #3 : Short to ground	
5218-03	300mA Sourcing Driver Output #4 : Short to battery	
5218-04	300mA Sourcing Driver Output #4 : Short to ground	
5219-03	300mA Sourcing Driver Output #5 : Short to battery	
5219-04	300mA Sourcing Driver Output #5 : Short to ground	
5220-03	300mA Sourcing Driver Output #6 : Short to battery	
5220-04	300mA Sourcing Driver Output #6 : Short to ground	

This diagnostic code is associated with the output driver of the MSS3s ECM. This code is recorded if voltage is present on the output driver circuit when the MSS is armed. **This circuit is not used on all machines.**

Note: For CID 1391 output driver #1 check for the presence of wires at contact 11 and contact 58 before you perform the procedure.

Note: For CID 1392 output driver #2 check for the presence of wires at contact 5 and contact 52 before you perform the procedure.

Possible causes for an FMI 03 diagnostic code are:

- There is a problem with the software in the ECM
- There is a short to the +battery circuit in the wiring harness
- The ECM has failed. A failure of the ECM is unlikely

Possible causes for an FMI 04 diagnostic code are:

- The wiring in the machine harness has failed
- The driven component in the circuit has failed
- The ECM has failed. A failure of the ECM is unlikely

Note: The locations of the components of the MSS will vary between machines. If the MSS was installed by a Caterpillar dealer, consult the installation instructions for component locations. If the MSS was an attachment that was installed at the factory, consult the electrical schematic for that machine.

Diagnostic Trouble Code Procedure

Note: Prior to beginning this procedure, inspect the harness connectors that are involved in this circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure, and in good condition. Ensure that the Charging System is functioning properly. Check the wiring harness for pinch points or abrasions. Look for and repair areas that indicate wires are exposed. If a problem with a connection is found, correct the problem and verify that the diagnostic code is active before performing a troubleshooting procedure.

1. Identify the active FMI code associated with the components.
2. Determine which code is present and use the list below to determine which procedure to follow.

- FMI 03 diagnostic code, proceed to Table 14
- FMI 04 diagnostic code, proceed to Table 15

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Table 14

FMI 03 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
1. FLASH THE ECM A. Load the latest software file for the MSS into the ECM. Refer to Testing and Adjusting, “Electronic Control Module (ECM) - Flash Program”. B. Clear the diagnostic code log. C. Start the machine and operate the machine. D. Determine if FMI 03 is present.	FMI 03 is present.	**OK -** FMI 03 is present. Go to Test Step 2. **NOT OK -** The diagnostic code was caused by a problem in the software. **STOP.**
2. TEST THE MACHINE HARNESS A. The key start switch must be in the OFF position. B. Disconnect the machine harness from the MSS3s ECM. C. Measure the voltage between the pins on the connector for the MSS3s ECM. a. For CID 1391 Driver #1 pins 42 and 58. b. For CID 1392 Driver #2 pins 42 and 40.	Voltage is present.	**OK -** Voltage is present between the pins. The wiring harness is shorted. **Repair:** Repair or replace the machine harness. **STOP.** **NOT OK -** Voltage is not present between the pins. Go to Test Step 3.
3. CHECK THE ECM A. Remove the pin from the 70 pin connector of the MSS3s ECM. a. CID 1391 pin 58. b. CID 1392 pin 40. B. Reconnect the MSS3s ECM to the system. C. Use the Cat ® ET to check the diagnostic codes.	FMI 03 is active.	**OK -** FMI 03 is active. **Repair:** The MSS3s ECM has an internal failure. Replace the ECM. Refer to Testing and Adjusting, “ECM - Replace”. Return the failed ECM to Caterpillar. Enclose a note with the following message: “The ECM has suffered an internal short to battery voltage.” **STOP.** **NOT OK -** FMI 03 is NOT active. **Repair:** The MSS3s ECM has an internal failure. Replace the ECM. Refer to Testing and Adjusting, “ECM - Replace”. Return the failed ECM to Caterpillar. Enclose a note with the following message: “The ECM has suffered a short to battery voltage in the driver (#1 or #2) circuit.” **STOP.**

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Table 15

FMI 04 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
1. CHECK THE WIRING HARNESS A. Disconnect the wiring harness connector from the MSS3s ECM. B. Measure the resistance between the pin in the wiring harness and a ground on the machine. a. CID 1391 pin 58 in the wiring harness and a ground. b. CID 1392 pin 40 in the wiring harness and a ground.	The resistance is greater than 5000 Ohms.	**OK -** The resistance is greater than 5000 Ohms (no continuity). Harness circuit resistance is correct. Go to Test Step 3. **NOT OK -** Resistance is less than 5000 Ohms (continuity). The machine harness is faulty. There is a short between frame ground and the machine harness. The driven component in the circuit may also be bad. Go to Test Step 2.
2. CHECK THE COMPONENT A. Trace the harness to the driven component in the circuit. The component will be a relay or a solenoid. B. Measure the resistance of the component. Measure the resistance from each terminal to the case of the component.	The resistance is greater than 5000 Ohms.	**OK -**The resistance of the driven component is greater than 5000 Ohms (no continuity). The component is good. The machine harness has failed. There is a short between frame ground and the machine harness. **Repair:**Check the harness for signs of damage. Repair or replace the machine harness. **STOP.** **NOT OK -**Resistance is less than 5000 Ohms (continuity). The driven component has failed. **Repair:**Replace the component that has failed. **STOP.**
3. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE A. Remove the connector from the ECM. Inspect the contacts and clean the contacts of the harness connectors. B. Reconnect all harness connectors. C. Turn the key start switch to the ON position. D. Clear all inactive diagnostic codes. E. Operate the machine. F. Determine if FMI 04 is present.	FMI 04 is present.	**OK -** FMI 04 is present. **Repair:** The problem has not been corrected. A failure of the ECM is unlikely. Perform the previous Test Steps again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “ECM - Replace”. **STOP.** **NOT OK -** FMI 04 is not present. **Repair:** The diagnostic code is NOT present. The problem does not exist at this time. The initial problem was probably caused by an intermittent short in the wiring harness. Inspect the harness for any signs of damage. If the harness passes through a hole with a grommet, that area of the harness can become chafed. Chaffing may cause an intermittent short. The harness may also be damaged in locations that could pinch the harness. Repair any wiring that could have caused the problem. Resume normal machine operation. **STOP.**

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Electrical Connector - Inspect

SMCS Code: 1408-040-CY; 7553-040-WW

Reference: Special Instruction, SEHS9615, “Servicing DT Connectors”.

Reference: Special Instruction, REHS0148, “Listing Of Deutsch Connector Components”

Reference: Special Instruction, SEHS9065, “Use Of CE Connector Tools”.

Reference: Service Magazine, SEPD0342,27 January 97, “Field Repair Of Single Wire Breaks In Harnesses (Sealed Splice)”.

Reference: Service Magazine, SEPD0371,28 July 97, “Protection Of Unsealed Electrical Terminations For Machines In Corrosive Applications”.

Reference: Service Magazine, SEPD0473,24 May 99, “New DT Connector Plugs With Improved Seal Retention”.

Reference: Service Magazine, SEPD0545,09 October 00, “Dielectric Grease Should Not Be Used In Electrical Connectors”.

Reference: Pocket Guide, SEBD0402, “Guidelines For Routing And Installing Wire Harness Assemblies”.
This information will assist in detecting problems with connectors and with wiring. If a problem is found, correct the condition and verify that the problem is resolved.

Disconnecting and reconnecting connectors sometimes resolve intermittent electrical problems. Check for diagnostic codes immediately before disconnecting a connector. Also check for diagnostic codes after reconnecting the connector. If the status of a diagnostic code is changed due to disconnecting and reconnecting a connector, there are several possible reasons. The likely reasons are loose terminals, improperly crimped terminals, moisture, corrosion, and inadequate mating of a connection.

Important Safety Information

Work safely. Most accidents that involve product operation, maintenance, and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs.

A person must be alert to potential hazards. This person should also have the necessary training, skills, and tools to perform these functions properly.

Safety precautions and warnings are provided in this instruction and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons. Caterpillar cannot anticipate every possible circumstance that might involve a potential hazard.

Therefore, the warnings in this publication and the warnings that are on the product are not all inclusive. If any of the following are not recommended by Caterpillar, but are used, ensure the safety of all people involved:

- A tool
- A procedure
- A work method
- An operating technique

Ensure that the product will not be damaged or made unsafe by the operation, lubrication, maintenance, or the repair procedures that are used.

Guidelines

- Use a 1U-5804 Crimp Tool (12-GA TO 18-GA) to service Deutsch HD and DT connectors. Never solder the terminals onto the wires. Refer to Tool Operating Manual, SEHS9615, “Servicing Deutsch HD and DT Style Connectors”.
- Use a 147-6456 Wedge Removal Tool to remove wedges from DT connectors. Never use a screwdriver to pry a wedge from a connector.
- Use a breakout harness for a voltmeter probe or a test light. Never break the insulation of a wire to access to a circuit for measurements.
- If a wire is cut, install a new terminal for the repair.

Tests

Check Connectors for Moisture and Corrosion

Inspect all wiring harnesses. Ensure that the routing of the wiring harness allows the wires to enter the face of each connector at a perpendicular angle. Otherwise, the wire will deform the seal bore. This deformation will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly.

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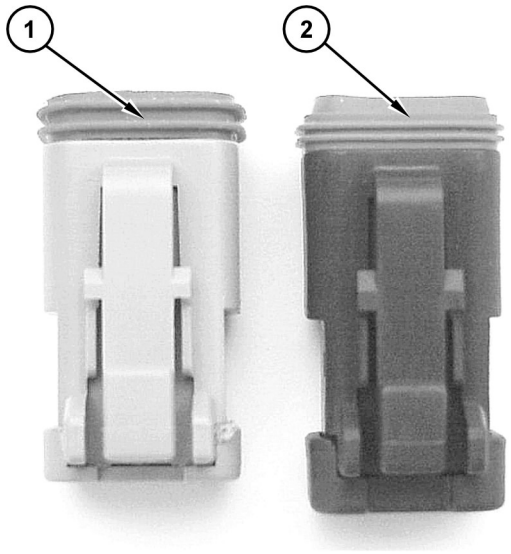

Illustration 11 g03870168

(1) Former seal design
(2) Current seal design

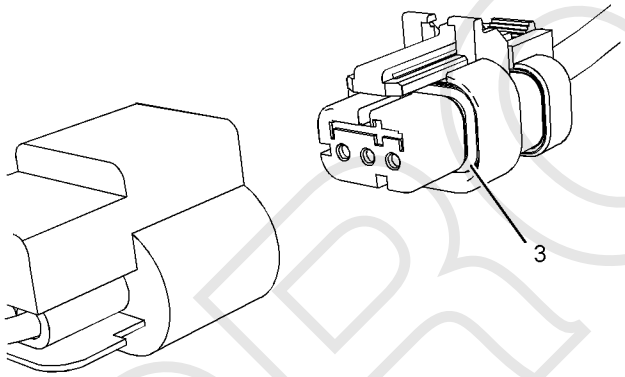

Illustration 12 g03870171

(3) Seal for a three-pin connector (typical example)

The plug end of the DT connector has a seal at the end of the connector. This seal has been improved on black connectors to help prevent slipping. Additionally, this seal is replaceable. This improvement will help keep moisture and dirt from entering the connector.

The current seal design (2) is not interchangeable with the former design (1). The receptacle has also changed to the new colors.

1. Inspect all wiring harnesses. Ensure that the routing of the wiring harness allows the wires to enter the face of each connector at a perpendicular angle. Otherwise, the wire will deform the seal bore. This deformation will create a path for the entrance of moisture. Verify that the seals for the wires are sealing correctly.
2. Disconnect the suspect connector and inspect the connector seal. Ensure that the seals are in good condition. If necessary, replace the connector.
3. Thoroughly inspect the connectors for evidence of moisture entry.

   Some minor seal abrasion on connector seals is normal. Minor seal abrasion will not allow the entry of moisture. If moisture or corrosion is evident in the connector, the source of the moisture entry must be found and repaired. If the source of the moisture entry is not repaired, the problem will recur. Simply drying the connector will not fix the problem. Check the following items for the possible moisture entry path:

   - Missing seals
   - Improperly installed seals
   - Nicks in exposed insulation
   - Improperly mated connectors

Moisture can also travel to a connector through the inside of a wire. If moisture is found in a connector, thoroughly check the connector harness for damage. Also check other connectors that share the harness for moisture.

Expected Result

The harness wiring, connectors, and seals are in good condition. There is no evidence of moisture in the connectors.

Results

OK – The harness wiring, connectors, and seals are in good condition. Proceed to “Check the Wires for Damage to the Insulation”.

Not OK – A problem has been found with the harness or the connectors.

Repair

Repair the connectors or the wiring, as required. Ensure that all of the seals are properly in place. Ensure that the connectors have been reattached. If corrosion is evident on the pins, sockets or the connector, use only denatured alcohol to remove the corrosion. Use a cotton swab or a soft brush to remove the corrosion. If moisture was found in the connectors, run the engine for several minutes and check again for moisture. If moisture reappears, the moisture is wicking into the connector. Even if the moisture entry path is repaired, replacing the wires may be necessary. Verify that the repair eliminates the problem.

STOP

PROOF

Check the Wires for Damage to the Insulation

1. Carefully inspect each wire for signs of abrasion, of nicks, and of cuts. Inspect the wires for the following conditions:
   - Exposed insulation
   - Rubbing of a wire against the chassis
   - Rubbing of a wire against a sharp point
2. Check all of the wiring harness fasteners to verify that the harness is properly secured. Also check all of the fasteners to verify that the harness is not compressed. Pull back the harness sleeves to check for a flattened portion of wire. A fastener that has been overtightened will flatten the harness. This damages the wires that are inside the harness.

Expected Result

The wires are free of abrasion, of nicks, and of cuts and the harness is properly clamped.

Results

OK – The harness is OK. Proceed to “Inspect the Connector Terminals”.

Not OK – There is damage to the harness.

Repair

Repair the wires or replace the wires, as required. Verify that the repair eliminates the problem.

STOP

Inspect the Connector Terminals

A. Visually inspect each terminal in the connector. Verify that the terminals are not damaged. Verify that the terminals are properly aligned in the connector and verify that the terminals are properly located in the connector.

Expected Result

The terminals are properly aligned and the terminals appear undamaged.

Results

OK – The terminals are OK. Proceed to “Perform a Pull Test on Each Wire Terminal Connection”.

Not OK – The terminals of the connector are damaged.

Repair

Repair the terminals and/or replace the terminals, as required. Verify that the repair eliminates the problem.

STOP

Perform a Pull Test on Each Wire Terminal Connection

1. Ensure that the locking wedge for the connector is installed properly. Terminals cannot be retained inside the connector if the locking wedge is not installed properly. Refer to Illustration 12 .
2. Perform the 45 N (10 lb) pull test on each wire.

   Each terminal and each connector should easily withstand 45 N (10 lb) of tension and each wire should remain in the connector body. This test checks whether the wire was properly crimped in the terminal and whether the terminal was properly inserted into the connector.

Expected Result

Each terminal and each connector can withstand 45 N (10 lb) of pull and each wire remains in the connector body.

Results

OK – All terminals pass the pull test. Proceed to “Check Individual Pin Retention into the Socket”.

Not OK – A wire has been pulled from a terminal or a terminal has been pulled from the connector.

Repair

Use the 1U-5804 Crimp Tool (12-GA TO 18-GA) to replace the terminal. Replace damaged connectors, as required. Verify that the repair eliminates the problem.

STOP

Check Individual Pin Retention into the Socket

A. Verify that the sockets provide good retention for the pins. Disconnect the harness and insert a new pin into each socket of the mating plug. Insert the pins one at a time. Check for a good grip on the pin by the socket.

BROOKE

Expected Result

The sockets provide good retention for the new pin.

Results

OK – The terminals are OK. Proceed to “Check the Locking Mechanism of the Connectors”.

Not OK – Terminals are damaged.

Repair

Use a calibrated 1U-5804 Crimp Tool (12-GA TO 18-GA) to replace the damaged terminals. Verify that the repair eliminates the problem.

STOP

Check the Locking Mechanism of the Connectors

1. Ensure that the connectors lock properly. After locking the connectors, ensure that the two halves cannot be pulled apart.
2. Verify that the latch tab of the connector is properly latched. Also verify that the latch tab of the connector returns to the locked position

Expected Result

The connector will securely lock. The connector and the locking mechanism are without cracks or breaks.

Results

OK – The connectors are in good repair. Proceed to “Perform the Wiggle Test on the Cat ® Electronic Technician (Cat ® ET) Service Tool, Cat, ®, Cat, and ®”.

Not OK – The locking mechanism of the connector is damaged or missing.

Repair

Repair the connector or replace the connector, as required. Verify that the repair eliminates the problem.

STOP

Perform the Wiggle Test on the Cat ® Electronic Technician (Cat ® ET) Service Tool

1. Select the “Wiggle Test” from the diagnostic tests on the Cat ® ET.
2. Choose the appropriate group of parameters to monitor.
3. Press the “Start” button. Wiggle the wiring harness to reproduce intermittent problems

   If an intermittent problem exists, the status will be highlighted and an audible beep will be heard.

Expected Result

No intermittent problems were indicated during the wiggle test.

Results

OK – No intermittent problems were found. The harness and connectors appear to be OK. If another procedure recommended this test, return to that procedure and continue testing. If the problem has been resolved, return the machine to service.

STOP

Not OK – At least one intermittent problem was indicated.

Repair

Repair the harness or the connector. Verify that the repair eliminates the problem.

STOP

i06225305

Electrical Power Supply - Test

SMCS Code: 1401-038

Theft Deterrent Module ECM

The following is a list of Diagnostic Trouble Codes (DTCs) that are associated with the electrical power supply for the ECM.

PROOF

Table 16

Theft Deterrent Module ECM (MID 127)		
DTC	**Code Description**	**System Response**
168-00	Electrical System Voltage : High	
168-01	Electrical System Voltage : Low	

The electrical power supply connections are the connections between the alternator and battery that power the control modules.

The diagnostic code should be ACTIVE only if the engine is running.

Possible causes for an FMI 00 diagnostic code are:

- The alternator is producing too much voltage.
- A charging system component has failed.
- The ECM has failed. A failure of the ECM is unlikely.

Possible causes for an FMI 01 diagnostic code are:

- The wiring in the machine harness has failed.
- A poor connection in the ground circuit.
- A charging system component has failed.
- The alternator or charging system has failed.
- The ECM has failed. A failure of the ECM is unlikely.

Note: The locations of the components of the MSS will vary between machines. If the MSS was installed by a Caterpillar dealer, consult the installation instructions for component locations. If the MSS was an attachment that was installed at the factory, consult the electrical schematic for that machine.

Diagnostic Trouble Code Procedure

Note: Prior to beginning this procedure, inspect the harness connectors that are involved in this circuit. Poor connections can often be the cause of a problem in an electrical circuit. Verify that all connections in the circuit are clean, secure, and in good condition. Ensure that the Charging System is functioning properly. Check the wiring harness for pinch points or abrasions. Look for and repair areas that indicate wires are exposed. If a problem with a connection is found, correct the problem and verify that the diagnostic code is active before performing a troubleshooting procedure.

1. Identify the active FMI code associated with the components.
2. Determine which code is present and use the list below to determine which procedure to follow.

- FMI 00 diagnostic code, proceed to Table 17 .
- FMI 01 diagnostic code, proceed to Table 18 .

PROOF

Table 17

FMI 00 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
1. CHECK THE BATTERY VOLTAGE A. Start the engine and run the engine at high idle for several minutes. Make sure that no battery charger is connected to the engine. B. Measure the battery voltage at the battery posts.	The battery voltage should be less than 32.5 VDC for a 24V system, and less than 16 VDC for a 12V system.	**OK -** The battery voltage is correct. Proceed to Test Step 2. **NOT OK -** The battery voltage is too high. **Repair:** The charging system is not correct. Check the charging system. See Special Instruction, REHS0354, “Charging System Troubleshooting”. **STOP.**
2. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE A. Stop the engine. Make sure that no battery charger is connected to the engine. B. Remove the connector from the ECM. Inspect the contacts and clean the contacts of the harness connectors. C. Reconnect all harness connectors. D. Turn the key start switch to the ON position. E. Use the Caterpillar Electronic Technician and clear all inactive diagnostic codes. F. Operate the machine. G. Determine if CID 0168 FMI 00 is present.	Each resistance is less than 5.0 Ω.	**OK -** CID 0168 FMI 00 is present. **Repair:** The problem has not been corrected. A failure of the ECM is unlikely. Perform the previous Test Steps again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “ECM - Replace”. **STOP.** **NOT OK -** CID 0168 FMI 00 is not present. **Repair:** the diagnostic code is NOT present. The problem does not exist at this time. The initial problem was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation. **STOP.**

PROOF

Table 18

FMI 01 Troubleshooting		
Troubleshooting Test Steps	**Values**	**Results**
1. CHECK THE BATTERY VOLTAGE A. Start the engine and run the engine at high idle for several minutes. Make sure that no battery charger is connected to the engine. B. Measure the battery voltage at the battery posts.	The battery voltage should be greater than 9 VDC for a 12V system. The battery voltage should be greater than 21.3 VDC for a 24V system.	**OK -** The battery voltage is good. Proceed to Test Step 2. **NOT OK -** The battery voltage is too low. **Repair:** The charging system is not correct. Check the charging system. See Special Instruction, REHS0354, “Charging System Troubleshooting”. **STOP.**
2. CHECK THE SYSTEM VOLTAGE AT THE ECM A. The engine must still be running at high idle. B.DO NOT DISCONNECT the machine harness from the ECM. At the connector of the ECM, prepare to make a voltage measurement by using the 7X-1710 Multimeter Probe. C. At the machine harness for the ECM, insert the probe into the back of connector. Measure the voltage (VDC) between pin 24 and pin 26.	The battery voltage should be greater than 9 VDC for a 12V system. The battery voltage should be greater than 21.3 VDC for a 24V system.	**OK -** The battery voltage is correct. Proceed to Test Step 3. **NOT OK -**The battery voltage is too low. **Repair:**The machine harness is not correct. Repair the machine harness or replace the machine harness. **STOP.**
3. CHECK IF THE DIAGNOSTIC CODE IS STILL ACTIVE A. Remove the connector from the ECM. Inspect the contacts and clean the contacts of the harness connectors. B. Reconnect all harness connectors. C. Turn the key start switch to the ON position. D. Clear all inactive diagnostic codes. E. Operate the machine. F. Determine if CID 0168 FMI 01 is present.	CID 0168 FMI 01 is present.	**OK -** ECID 0168 FMI 01 is present. **Repair:**The problem has not been corrected. A failure of the ECM is unlikely. Perform the previous Test Steps again. If the cause of the diagnostic code is not found, replace the ECM. See Testing and Adjusting, “ECM - Replace”. **STOP.** **NOT OK -** CID 0168 FMI 01 is not present. **Repair:**The diagnostic code is NOT present. The problem does not exist at this time. The initial problem was probably caused by a poor electrical connection or a short at one of the harness connectors that was disconnected and reconnected. Resume normal machine operation. **STOP.**

i06229336

Wiring Harness (Open Circuit) - Test

SMCS Code: 1408-038

An open circuit is a failure of an electrical circuit that results in no flow of electrical current. An open circuit can be caused by a broken wire within the circuit. Most often, an open circuit is caused by a poor connection. An open circuit can also be caused by a failed connection in one of the electrical connectors that is used in a circuit.

The following procedure is a way to check for an open or a poor connection in a circuit.

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Test For An Open Circuit

Table 19

Troubleshooting Test Steps	Values	Results
1. Identify Open Circuit A. Identify the connectors and the wire numbers of the suspect circuits. Use the Electrical System Schematic of the machine to identify the circuits. B. Turn the key start switch and the disconnect switch OFF. C. Disconnect the component and the ECM from the wiring harness. D. At one of the disconnected harness connections, place a jumper wire from the contact of the suspect wire to frame ground. E. At the other connector of the machine harness, use the multimeter probes to measure the resistance. Measure the resistance from the contact of the suspect wire to frame ground.	The resistance is less than 5 Ω.	**OK -** The harness circuit is correct. STOP **NOT OK -** The resistance is greater than 5K Ω. There is an open in the machine harness. **Repair:** Repair or replace the machine harness. **Note:** A resistance that is greater than 5 Ω but less than 5K Ω would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5K Ω would indicate an open in the circuit. STOP

i06229337

Wiring Harness (Short Circuit) - Test

SMCS Code: 1408-038

A short circuit is a failure of an electrical circuit that results in undesired electrical current. Usually, a short circuit is a bypass of the circuit across a load. A short across the wires in a circuit for a lamp produces too much current in the wires but no current at the lamp. The lamp is shorted out. The resistance in a normal circuit can vary, but the resistance between a particular circuit and other unrelated circuits is always greater than 5000 ohms. The following procedure explains the test for a short circuit:

Reference: For a complete electrical schematic, refer to Electrical System Schematic for the machine that is being serviced.

PROOF

Test For A Short Circuit

Table 20

Troubleshooting Test Steps	Values	Results
1. Identify Short Circuit. A. Identify the connectors and the wire numbers of the suspect circuits. Use the Electrical System Schematic of the machine to identify the circuits. B. Turn the key start switch and the disconnect switch to OFF. C. Disconnect the component and the ECM from the wiring harness. D. At the machine harness connector for the ECM, place one of the multimeter probes on the contact of the suspect wire. E. Use the other multimeter probe to check the resistance across all other contacts in the connectors of the ECM and frame ground.	The resistance is greater than 5K Ω for all the readings.	**OK -** The harness circuits are correct. STOP **NOT OK -** The resistance is less than 5 Ω. There is a short in the machine harness. The short is between the suspected wire and the wire with the lowest resistance measurement. **Repair:** Repair or replace the machine harness. **Note:** A resistance that is greater than 5 Ω but less than 5K Ω would indicate a loose connection or a corroded connection in the circuit. A resistance measurement that is greater than 5K Ω would indicate an open in the circuit. STOP

PROOF

Service

i06229138

ECM Software - Install

SMCS Code: 7620-012-MCH

Perform the following procedure to flash program the ECM. The ECM is flashed to upgrade the software. Flash programming of the ECM must also be done if the ECM has been replaced. The Caterpillar ® Electronic Technician (Cat ® ET) service tool contains the program WinFlash. WinFlash is used to load software into the ECM. The following procedure is used to flash software into the MSS3s ECM.

Procedure

1. Connect the data-link cable between the communication adaptor and the Cat ® ET service tool.
2. Connect the data-link cable between the communication adaptor and the diagnostic connector of the machine.
3. Use WinFlash to load the software.

i06229307

ECM - Configure

SMCS Code: 7610-025-MCH

A Machine Electronic Control Module (ECM) must be configured at the time of installation. The ECM will not function properly if the control module has not been configured. When the ECM is configured, the model number of the machine is set.

Cat ® Electronic Technician (Cat ® ET) Service Tool is used to access the configuration screen . A message on the Cat ET screen will give instructions that guide the user through the procedure.

Cat ® Electronic Technician (Cat ET) Service Tool Configuration Procedure

1. Turn the keyswitch to the OFF position.
2. Connect Cat ET.
3. Turn the keyswitch to the ON position.
4. Select the ECM that will be configured.
5. You are on the main menu. Select the “Service Configuration” menu item. Double click to select the appropriate sales model.
6. Select a sales model.

Note: After selecting the correct sales model, Cat ET will exit out of the configuration menu.

7. Cycle power with the keyswitch. Leave the keyswitch in the OFF position for a minimum of 10 seconds.
8. With the key start switch returned to the ON position, Cat ET will initiate communications with all ECM modules on the machine.
9. Select the ECM that is being configured.
10. From the main menu, select the “Service Configuration” menu item.
11. Click on the “Data Link Disconnect” button.
12. Disconnect Cat ET from the service tool connector.
13. Turn the keyswitch to the OFF position.

i06229150

ECM - Replace

SMCS Code: 7610-510-MCH

Follow this procedure to replace the MSS3s ECM without deleting the original configuration and/or the information from the key database.

Note: This procedure assumes that the failed MSS3s ECM is able to communicate via the communication adapter. That adapter communicates with the Caterpillar ® Electronic Technician (Cat ® ET) service tool.

1. Turn the disconnect switch to the ON position.
2. Connect the communications adapter between the machine and the PC.
3. Use a master access level key to turn the keyswitch to the ON position. Verify the status LED is green.
4. Start the Cat ET service tool. Allow Cat ET service tool to connect with the Cat data-link. If the Cat ET service tool detects more than one ECM, select the ECM for the machine security system.

PROOF

5. From the menu bar of the Cat ET service tool, select the following: “Service” , “Copy Configuration” , and then Fleet/Key Configuration from the submenu. If there is no recently loaded data available, the “No data is available...” message box displays. Click on the “Yes” button to load the data from the ECM. The “ECM Selector” dialog box is displayed. If necessary, highlight the Machine Security System ECM and Click on “OK” . As the data is loading from the ECM, the “Please wait.” message is displayed. Then, the “Loading data from ECM.” progress bar is displayed. When the data has been successfully loaded from the ECM, the “The data has been successfully loaded.” message is displayed. Click on “OK” . The “Fleet/Key Configuration” screen displays with the “Program ECM” and “Save to File” push buttons are enabled.

Note: The data must be saved to a file before you disconnect from the service tool or the data will be lost.

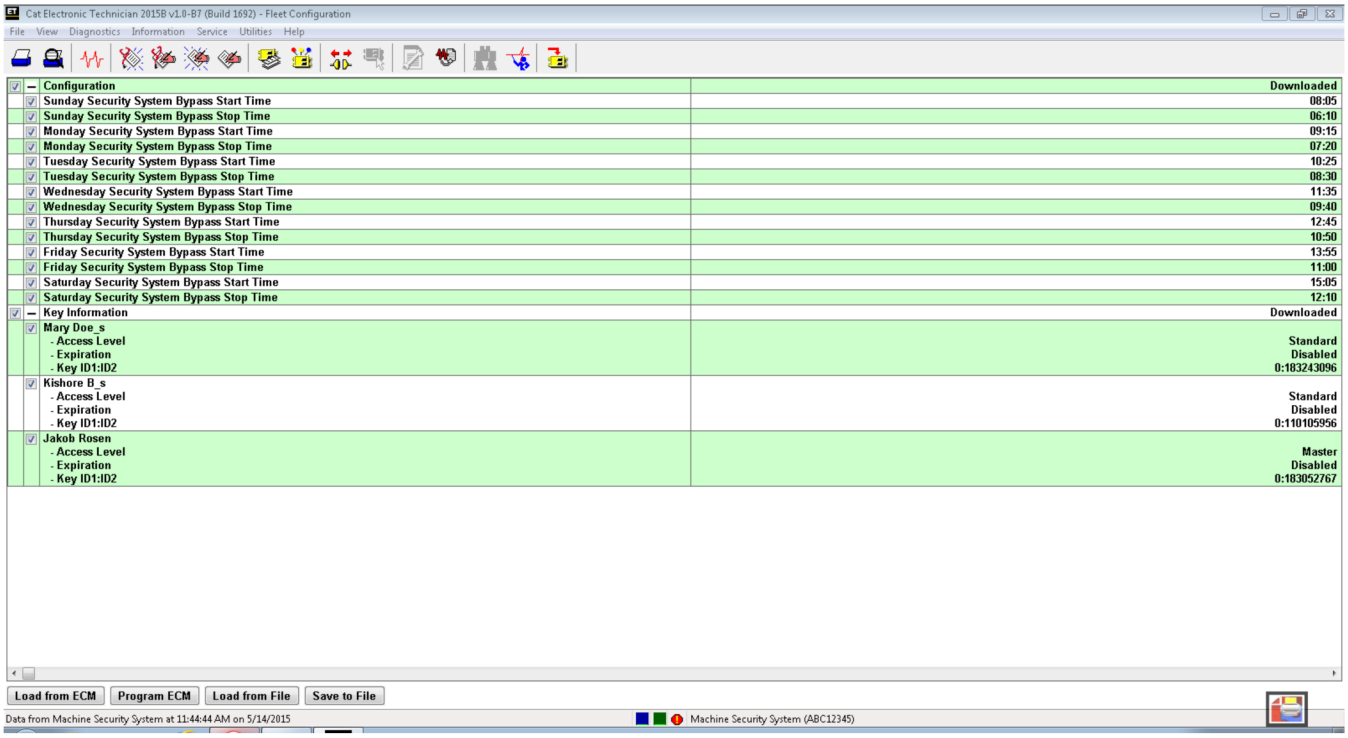

Illustration 13 g03866628
Fleet Configuration Screen

6. Click on the “Save to File” push button. The “Print New Document to File” dialog box is displayed. If you do not have a file open, a dialog box will ask you to choose one of the following options: open a file, create a file and cancel. Choose the “New” button to continue. Enter a document name and description in the appropriate text boxes. Click on “OK” . The “Fleet/Key Configuration saved successfully” message box should display. Click on “OK” . You will return to the “Fleet Configuration” screen. Record the saved file name in the space provide below as the file will be used in Step 14.

Table 21

Filename	

7. Select the “Machine Security System Uninstall” option from the “Service” menu. This option will cause the Cat ET service tool to display the message that is shown in Illustration 14 .

PROOF

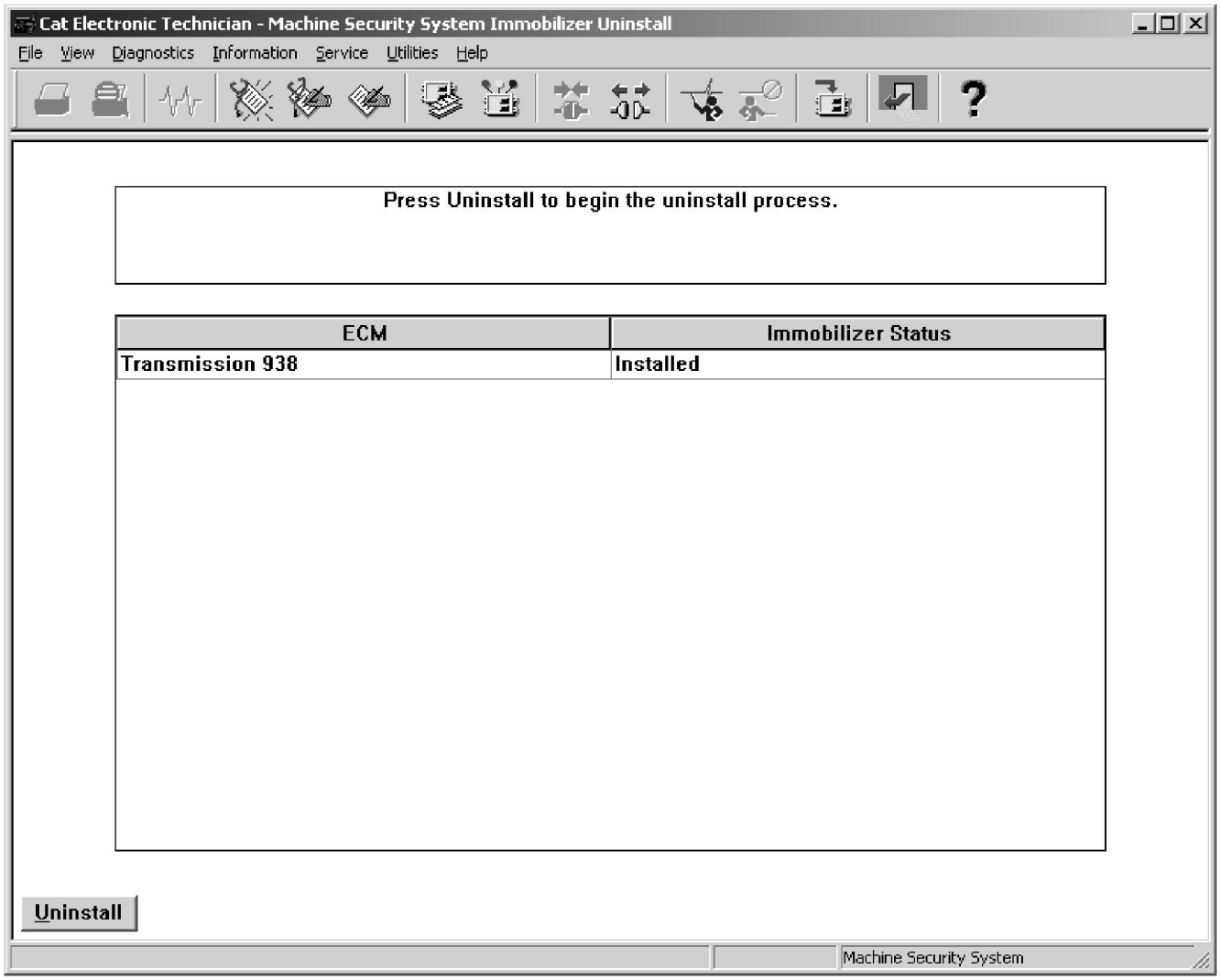

Illustration 14 g03863141

8. Click on the “Uninstall” button that is located at the lower left-hand corner of the “Machine Security System Uninstall” screen. This action will cause the Cat ET to display the message that is shown in Illustration 15 .

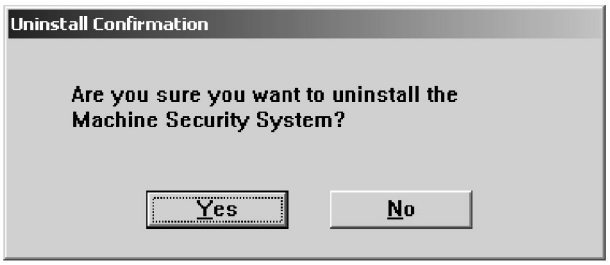

Illustration 15 g03863143

9. Click on the “Yes” button if you want to proceed with the “uninstall” of the Machine Security System.

Note: Pressing the “No” button aborts the “uninstall” of the Machine Security System.

10. Turn the keyswitch and disconnect switch to the “OFF” position. If the machine does not have a disconnect switch, remove the ground cable from the battery.

11. Remove and retain the tagged master keys from the new ECM. Replace the original MSS3s ECM with the new ECM supplied in the kit.

12. Turn the disconnect switch to the “ON” position or reattach the ground cable to the battery. Using one of the two new MASTER keys, turn the keyswitch to the “ON” position. Verify the status LED is green. If necessary, re-establish communication between the service tool and the MSS3s ECM.

13. Select “Copy Configuration” from the “Service” menu, and then select “Fleet/Key Configuration” from the submenu.

14. Open the document. As the data loads, a progress bar displays. Then, the “Fleet Configuration” message box displays.

15. Press “OK” . The “Fleet/Key Configuration” screen displays with the file data.

16. Click on the “Program ECM” button. This action displays the fleet key information box.

PROOF

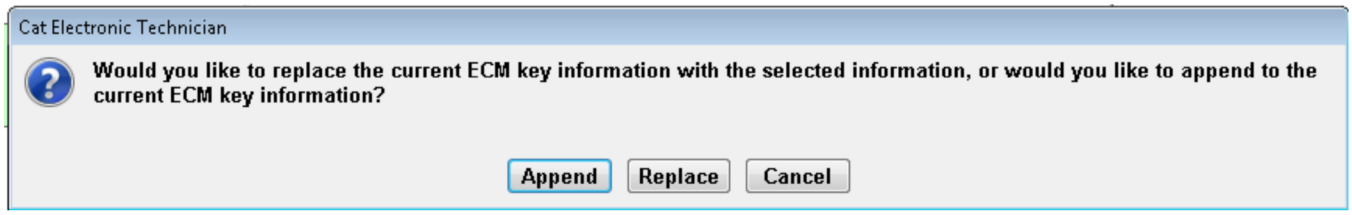

Illustration 16 g03866637

Append

17. Click on the “Append” button.

Note: Replacing the key list adds the current master access level key to key list. The additional master access level key supplied will not be added. Appending the list adds both master access level keys that came with the MSS3s ECM to the key list that copied to the MSS3s ECM.

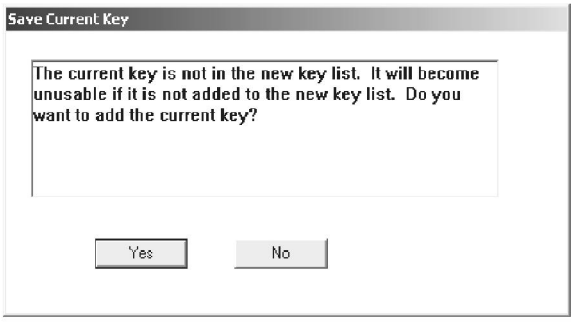

Illustration 17 g03863151

18. Click on the “Yes” button if you are prompted.

PROOF

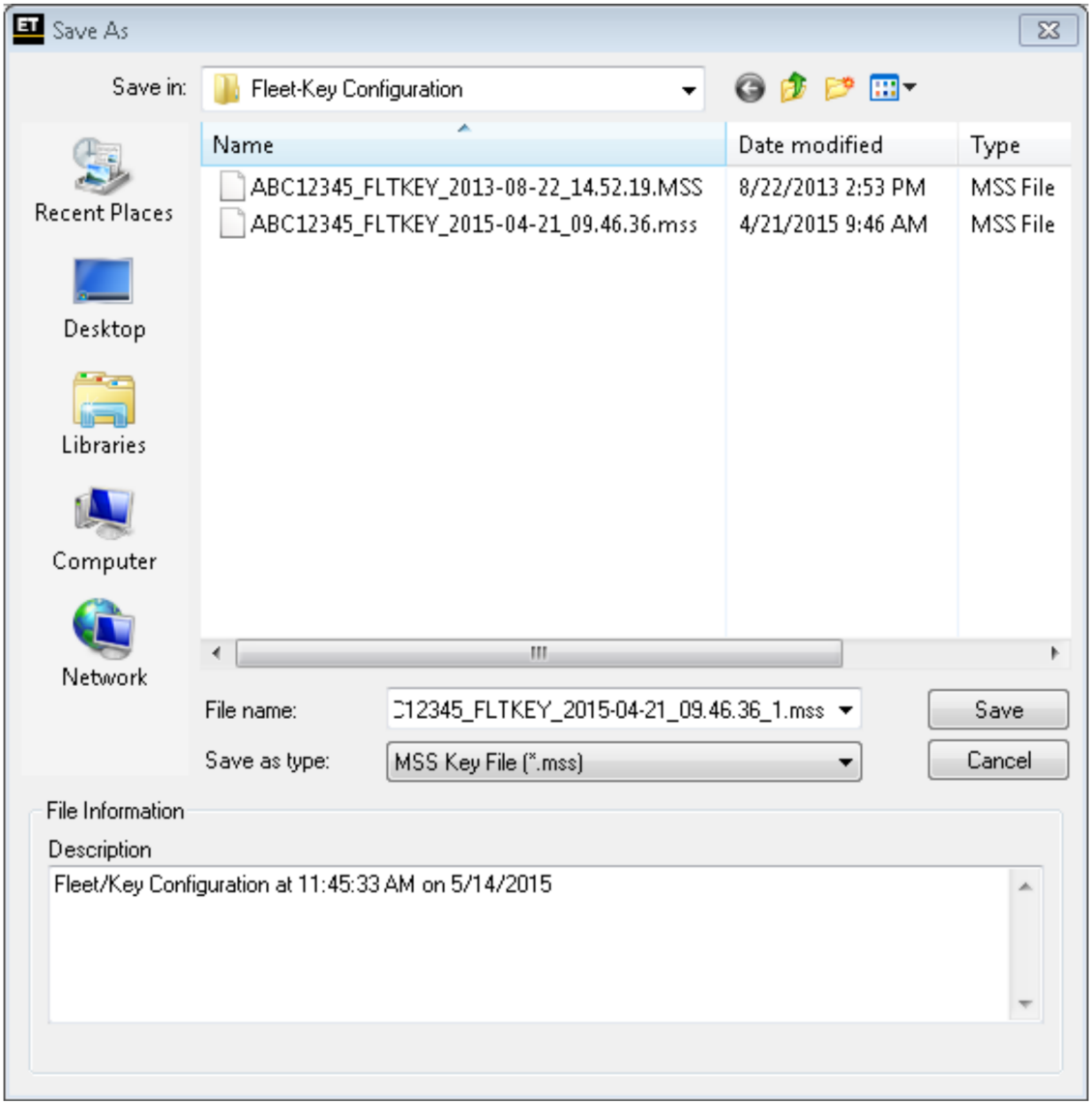

Illustration 18 g03866642

ECM Selector dialog box

Note: MSS has a maximum of 255 keys that can be stored at one time. The replacement ECM has two master access level keys pre-programmed into the ECM. Fleet/Key Configuration determines the number of keys slots not programmed on the MSS. You cannot program more keys than the maximum number allowed. If more than 253 keys from the saved file, a message box displays informing you of the number of key slots available.

19. Perform the following steps:

a. On the main menu bar, select “Service”

b. Select “Configuration” .

c. Enter the serial number of the machine in the “Product ID field” .

d. To enter the “PID” , highlight the “ Product ID bar” .

e. Enter the correct value by clicking the “Change” button in the lower left-hand corner of the screen. If this machine has one of the newer 17 character “PID's” , use the last eight (8) characters.

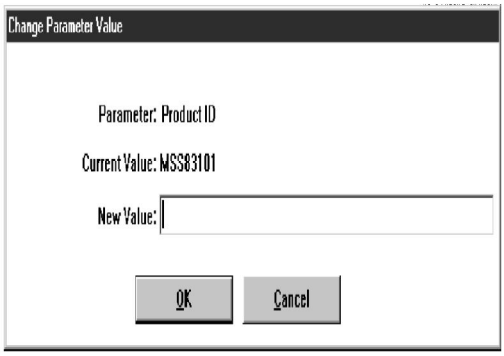

Illustration 19 g03863156

20. On the main menu bar, select “Service” and then “ECM Date/Time” . Verify that correct date, time, and time zone are displayed for your location. Click on the “Change” button to adjust the settings.

21. Check the bypass times to ensure that the times are set correctly.

22. The ECM replacement procedure is now complete. You may choose to remove the two pre-installed master access level keys from the key list. To remove these keys, select “Service” and then “Security Management” from the menu bar. The list of keys will be displayed. In the “Description” field, located and highlight (one at a time) keys M1 and M2. Click on the “Delete” button. Confirm the “Are you sure.” by clicking “OK” .

i06229371

Connector Contact Description

SMCS Code: 1408-CY; 7553-WW

The decisions that the ECM makes are based on input data information and programming parameters that have been flashed to the ECM memory. After the ECM receives the input information, the ECM determines the correct response and sends an output signal to the appropriate device. The internal input and output circuits of the ECM are connected to the machine wiring harness by two contact connectors (J1 and J2).

Note: The ECM is not serviceable. If the ECM is damaged, the ECM must be replaced. The ECM failure is unlikely. If the ECM failure is suspected, contact the Technical Communicator at a local dealership for possible consultation with Caterpillar before replacing the ECM. Replace the ECM only after all of the other possible causes of a particular problem have been investigated.

ECM Pull Up Voltage

To aid in diagnostics of certain electrical circuits, an internal “pull up voltage” is connected to the ECM switch and sensor signal input contacts. An above normal voltage is internally connected to the ECM signal input circuit through a resistor.

During normal operation, the switch or sensor signal will hold the circuit low or at a certain signal amplitude. When circuit conditions such as a loss of power to the component, a disconnection, or an open circuit, the ECM circuit will be puled high by the pull up voltage. The pull up voltage will result in an above normal voltage condition at the ECM contact. As a result, the ECM will activate an FMI 03 (voltage above normal) diagnostic code for the affected circuit.

The types of ECM input circuits that have pull up voltage present are:

- Pulse Width Modulated (PWM) sensor input circuits
- Switch to ground switch input circuits
- Active analog (voltage) input signal circuits
- Passive analog (resistance) input signal circuits

ECM Pull Down Voltage

In order to aid in diagnostics of electrical circuits controlled by the ECM, an internal “pull down voltage” is connected to the ECM switch to battery input circuits.

During normal operation, the switch contacts that are allowing the connection to a voltage source will hold the circuit high. When conditions like a loss of power to the switch supply, switch circuit disconnection, or an open circuit, will allow the ECM circuit to be pulled low by the pull down voltage. The pull down voltage will result in a below normal voltage condition at the ECM contact. As a result, the ECM will activate an FMI 04 (voltage below normal) diagnostic code for the affected circuit.

Inputs

The machine has several different types of input devices. The ECM receives machine status information from the input devices. The ECM determines the correct output action that is needed in order to control machine operations based on memory and software parameters. The machine utilizes the following types of inputs: switch type and sensor type.

Switches provide signals to the switch inputs of the ECM. The possible outputs of a switch are listed: an open signal, a grounded signal and + battery signal.

PROOF

Sensors provide an electrical signal to the ECM that constantly changes. The sensor input to the ECM can be one of several different types of electrical signals such as: pulse width modulated (PWM) signals, voltage signals and frequency input signals. Refer to the correct pilot machine schematic to verify each input to the ECM.

Outputs

The ECM sends electrical signals through the outputs. The outputs can create an action or the outputs can provide information to the ECM. The ECM can send output signals to the system components in one of several different electrical signal types such as: driver outputs, sinking driver outputs, sensor power supply outputs and data link outputs. Refer to the correct pilot machine schematic to verify each output to the ECM.

Input/Output

Communication between the ECM and the other control modules on the machine is conducted over data link circuits. The data link circuits allow the sharing of information with other electronic control modules. The data link circuits are bidirectional. The data link circuit allows the ECM to send information and to receive information.

The ECM supports two types of data link systems.

- Cat ® Data Link
- SAE J1939 Data Link

The two types of data links are the main structure for communication between all of the control modules on the machine. More than one CAN data link system can be present on a machine. Dedicated CAN data link circuits can be used for communication between specific controls on the machine.

Communication between the ECM and the other control modules on the machine are conducted over the J1939 Data Link circuit. The J1939 Data Link circuit is connected to each control module. The ECMs use the Cat Data Link to send and receive information from the Cat ® Electronic Technician (Cat ET) Service Tool.

A module identifier (MID) is assigned to each ECM on a machine. For example, the MID for the Machine ECM is 299.

PROOF

Testing And Adjusting Section

Testing and Adjusting

i06226719

General Information

SMCS Code: 7631

Cat ® Electronic Key

The machine security system (MSS) uses a Cat ® electronic key. The key contains an electronic chip that is embedded in the head of the key. This chip contains a unique identification number. No two keys have the same ID. The electronic key uses the same key cut as the standard Cat ® key. The electronic key can be used to operate machines that are not equipped with the MSS. The head of the electronic key is gray or yellow in color.

The machine can be started when none of the valid keys are available. Any Cat ® key and the access code for the MSS is required to enable this function.

A system disarm feature will allow a machine to operate with any key. Refer to the Testing and Adjusting, “System Disarm - Program” for additional information.

Security Management using Cat ® Electronic Technician (Cat ® ET)

The machine security system uses the Cat® Electronic Technician (Cat® ET) service tool to manage the settings of the system. There are restrictions on accessing the settings. The security management feature of the MSS controls the access to the settings.

i06226733

Product Identification Number - Program

SMCS Code: 7631-591

This procedure allows you to input or change the Product Identification Number (“Product ID”).

Note: If the correct “product ID” has not been entered into the MSS, you will be unable to obtain a factory password.

1. Connect a laptop computer with the Caterpillar ® ET to the machine via the communication adapter.
2. Place an electronic key with master level access in the key start switch.
3. Turn the electronic key to the “ON” position.
4. Start the Electronic Technician and establish communications with the MSS3s ECM.
5. Select the “Configuration” option from the “Service” Menu or press the “F5” key. This selection will display the “Configuration” screen.

PROOF

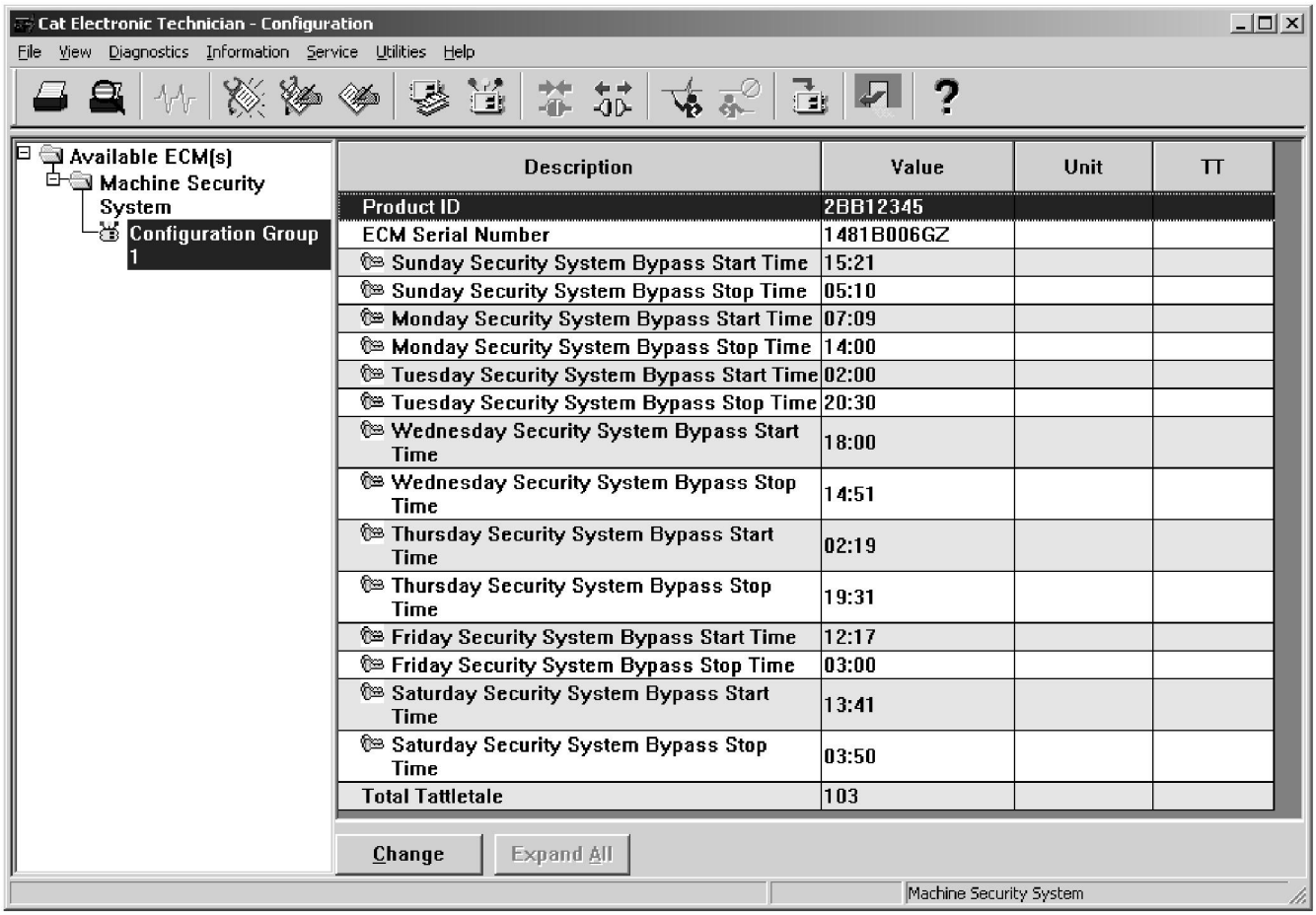

Illustration 20 g01097217

6. Select the “Product ID” selection that is displayed on the “Configuration” screen.

7. Click on the “Change” button that is located on the “Configuration” screen. This button will display a dialog box.

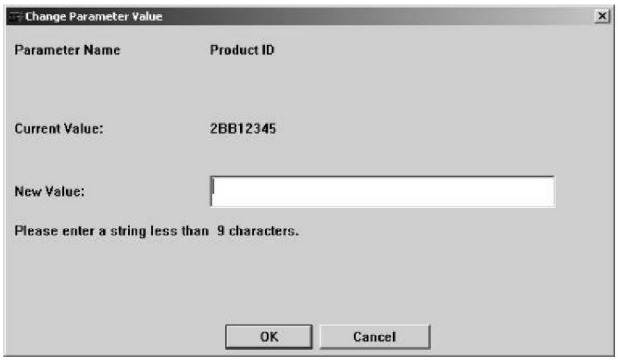

Illustration 21 g01097232

8. Enter the “Product ID” of the machine. The “Product ID” must have 8 digits. The “Product ID” must be formatted as 3 alphanumeric characters and 5 numbers for a total of 8 digits. Refer to item (4) in Illustration 22 .

Note: Use the “Product ID” of MSS99999 for Non-Caterpillar machines.

Note: First Quarter 2001, the Caterpillar Product Identification Number (PIN) changed from 8 characters to 17 characters. The “Product ID” that is required by the Machine Security System is the last 8 digits. Refer to Item (4) in illustration 22 .

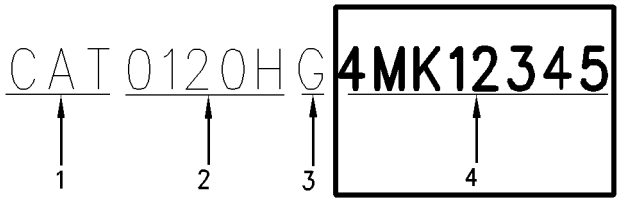

Illustration 22 g00860618

(1) Caterpillar's World Manufacturing Code (characters 1 - 3)
(2) Machine description (characters 4 - 8)
(3) Check character (character 9)
(4) Machine Indicator Section (MIS) or Product Sequence Number (characters 10 - 17). These characters were previously referred to as the Serial Number.

9. Click on the “OK” button. This button will cause the ET to display the following message.

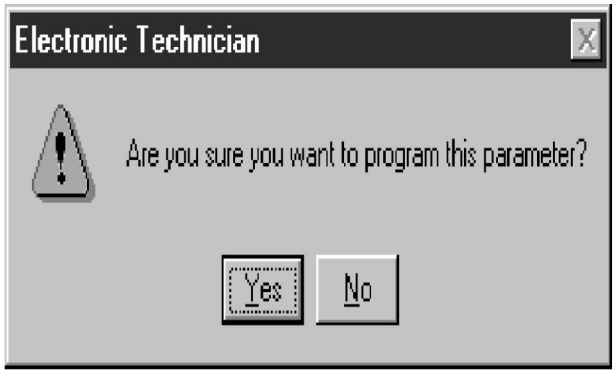

Illustration 23 g01097279

10. Click on the “Yes” button in order to change the “Product ID” . Or you can click the “No” button to cancel the change of the “Product ID” .

If you enter an invalid “product ID” , The ET will display the following message.

Illustration 24 g01097220

i06226745

Key - Program

SMCS Code: 7631-591

The MSS3s ECM may be programmed to accommodate a maximum of 255 keys. A new key is programmed into the MSS with the service tool.

Programming with a Service Tool

The “Security Management” function of the Caterpillar ET allows you to view information on the key currently in the key switch. You may also view a list of authorized keys. The authorized keys are the keys that have been programmed into the MSS.

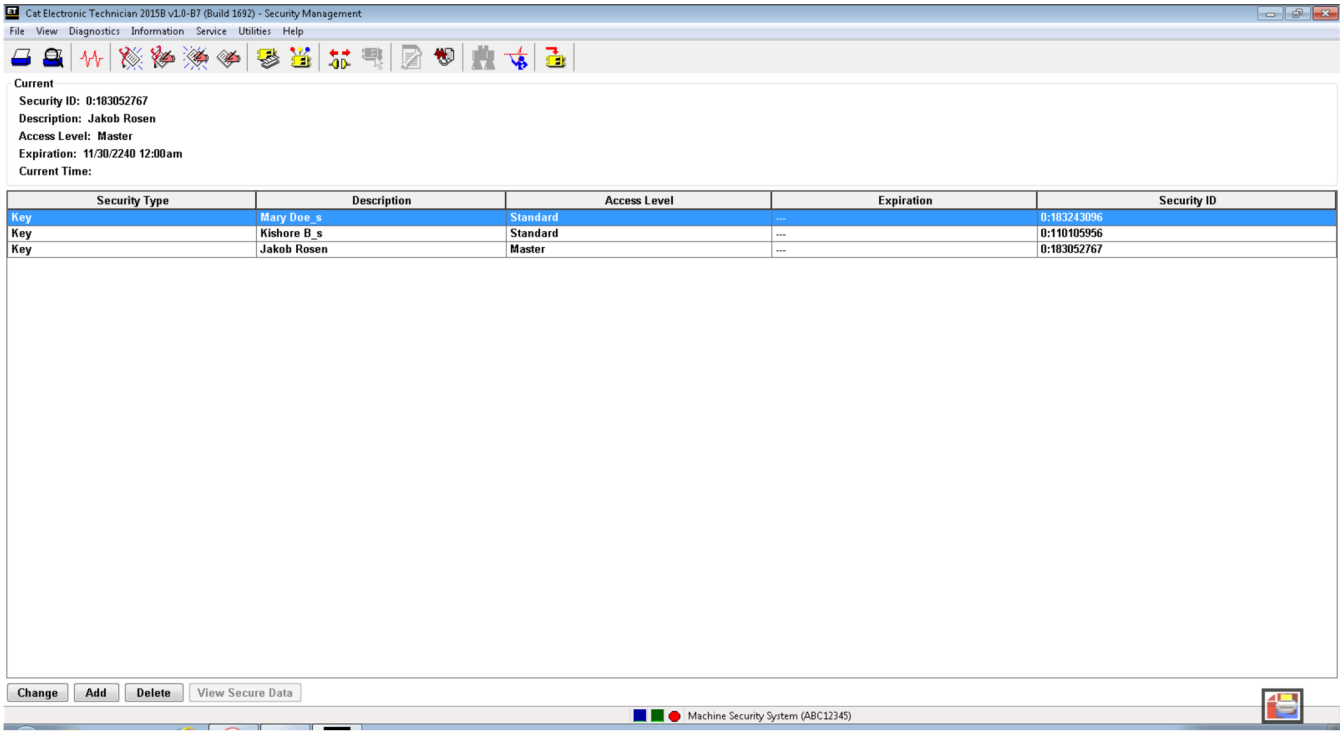

Illustration 25 g03866141

Security Management

Connect a laptop computer with the Caterpillar ET to the machine that will be programmed. After the laptop computer is connected to the machine, start the ET. Select the “Security Management” option from “Service” menu. The “Security Management” screen will be displayed. Refer to Illustration 25 .

Layout of the Screen

The “Security Management” screen has the following areas:

“Current Key Information” – The “Current Key Information” area displays information of the key currently in the keyswitch. If the “Description” , “Access Level” and “Expiration” information was not entered for the current key, these areas will be blank.

“Display Area” – The “Security Management” display area has five columns: “Description” , “Access Level” , “Expiration” , “ID1” and “ID2” . The information in a column can be sorted by that column. Click on a column heading in order to sort by the information in that column. The “Description” column is the name for the key. The “Access Level” column displays the access level for the key. There are two access levels: Master and Standard. The Master Access Level gives the user the capability to modify information without a factory password. Standard Access Level requires factory passwords to add information on keys. A key can expire at a predetermined date and time. The “Expiration” column will show that when the key is set to expire. Keys expire in 6 hour increments. “ID1” and “ID2” are the unique identification numbers for the key.

Push Buttons – The following push buttons are available in the “Security Management” screen: “Change” , “Add” and “Delete” .

Adding Key Information

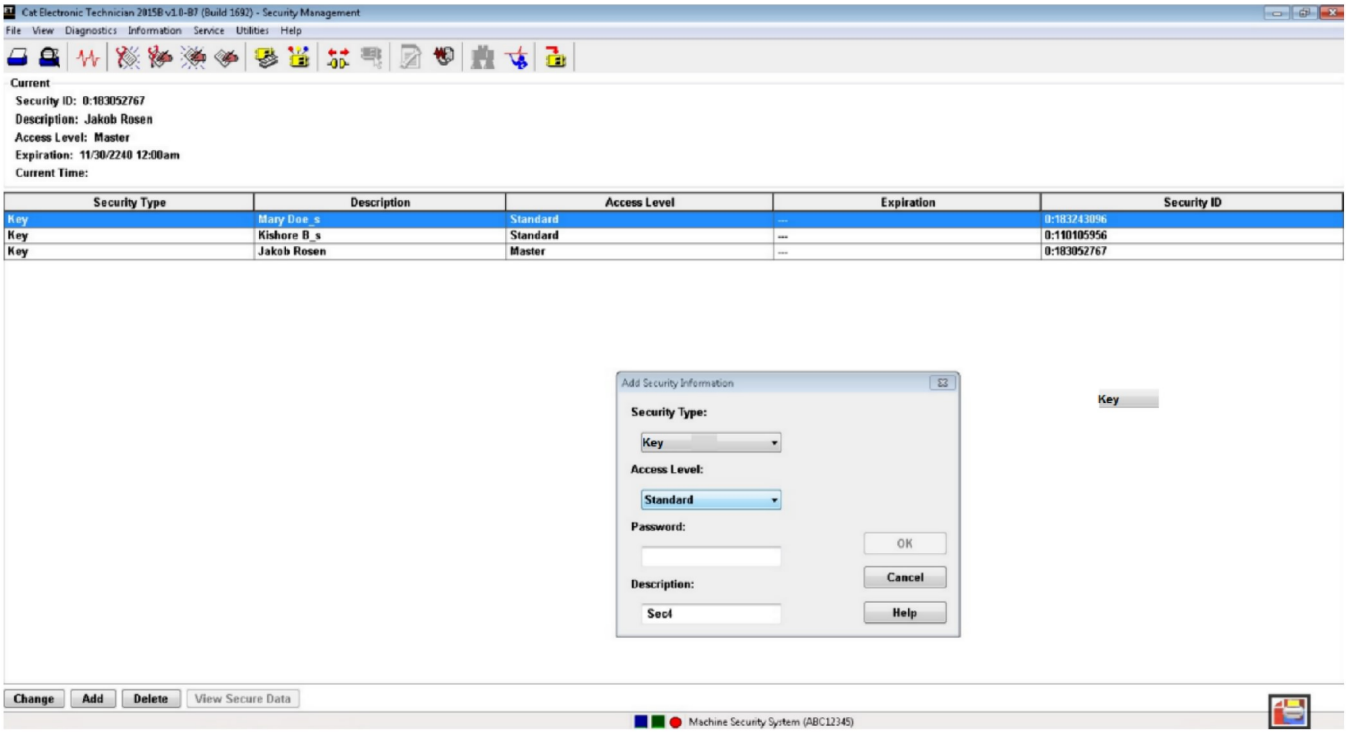

Illustration 26 g06105900

Add key information

The “Add” push button allows you to add a key to the list of Authorized Keys.

Note: When a function requires a factory password, the “Enter Factory Passwords” box is displayed.

To add a key, perform the following steps:

Note: Adding Keys requires a key with the master access level or a factory password.

1. Insert a master key for that machine in the key start switch. Turn the key to the ON position. If a master key is not used, then a factory password is required.

Note: The MSS indicator should be green.

2. Turn the key to the OFF position.

Note: The MSS indicator should remain green.

3. Insert the new key into the key start switch. This insertion must be done within 30 seconds of step 4. Turn the key to the ON position before the MSS indicator turns off.

4. Connect a laptop computer with the Caterpillar Electronic Technician to the ECM on the machine. Select the “Machine Security System” from the menu in the ET.

5. Select the “Security Management Option” under the Service Menu in the ET.

6. Press the “Add” push button. The “Add Key Information” dialog box is displayed.

7. Press the “Read” push button. ID1 and ID2 will be filled with the information for the key that is in the ignition.

Note: The “ID1” field may contain a “0” .

8. Enter the name for the key in the “Description” box, if desired. As many as 11 characters may be used for the description. If no description is entered, the description will default to “Key #” . The # sign indicates a number. For example, “Key 1” , “Key 2” , “Key...” .

Note: Making duplicate key names is not advisable for the keys in the list of keys.

9. Select the access level of the key from the “Access Level” menu.

10. Select an “Expiration” button: “Disable” or “Enable”

“Disable” does not have an “Expiration Date” . If “Enable” is selected, enter the “Expiration Date” and “Expiration Time” for that key.

Note: Setting a Key with “Master Level Access” to the “Enable” status with an expiration date will cause the Key with “Master Level Access” to expire. If this key expires, you will no longer be able to use the key as a Master Level Access Key.

11. Press the “OK” button in order to add the information for the key. The “Are you sure?” box is displayed. Press “OK” in order to add the key. Press “Cancel” in order to exit the “Add Key Information” dialog box without adding the information. Press “Help” to open on-line help for assistance.

PROOF

Changing the Key Information

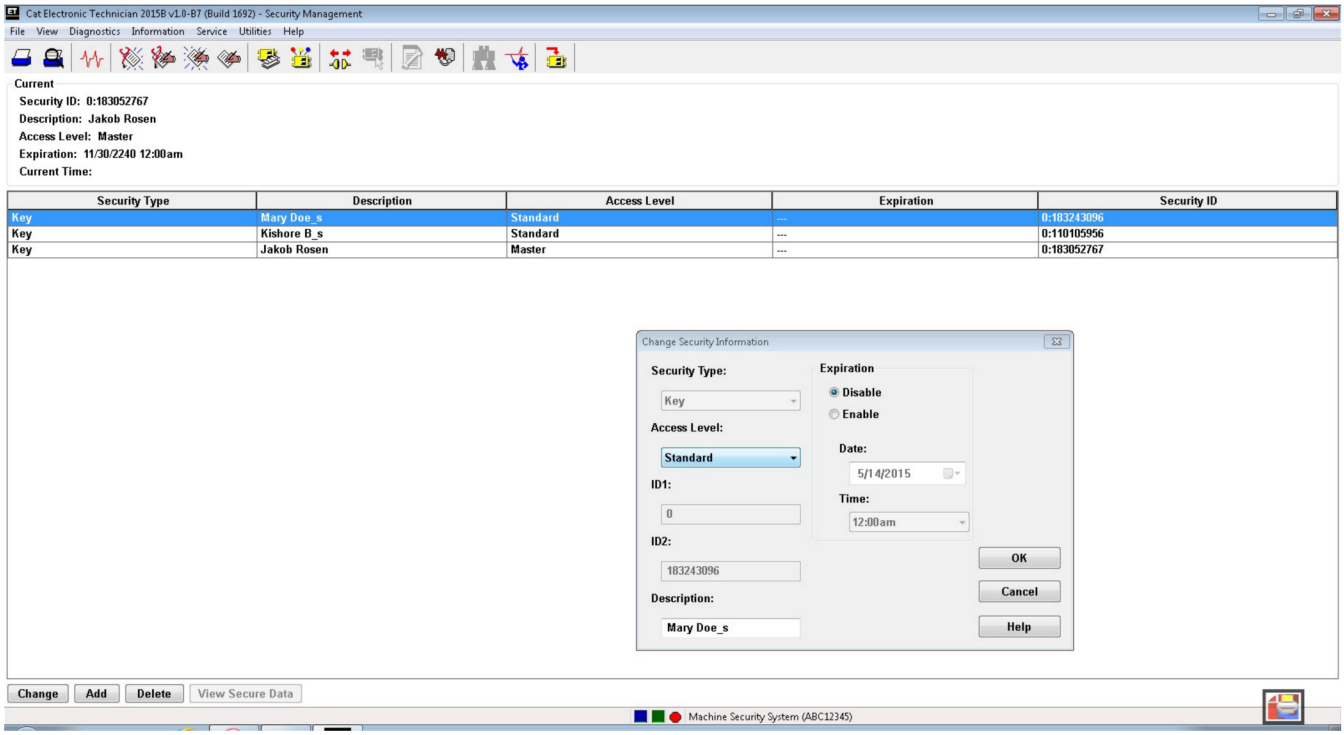

Illustration 27 g03866149

Change key information

The “Change” push button allows you to change the “Description” , “Access Level” or “Expiration” of a key. ID1 and ID2 cannot be changed.

Note: The “Change” push button is disabled until a key is selected from the authorized list.

Note: When a function requires a factory level security password, the “Enter Factory Passwords” dialog box is displayed.

Note: Changing Keys requires a key with the master access level or a factory password.

Perform these steps in order to change the information regarding a particular key:

1. Choose a key and highlight that key in the list. Press the “Change” push button. The “Change Key Information” dialog box is displayed.

OR

Doubleclickon the key you want to change. The “Change Key Information” dialog box is displayed.

2. Enter the changes in the key information. See “Adding Key Information” for more detail.

Deleting Key Information

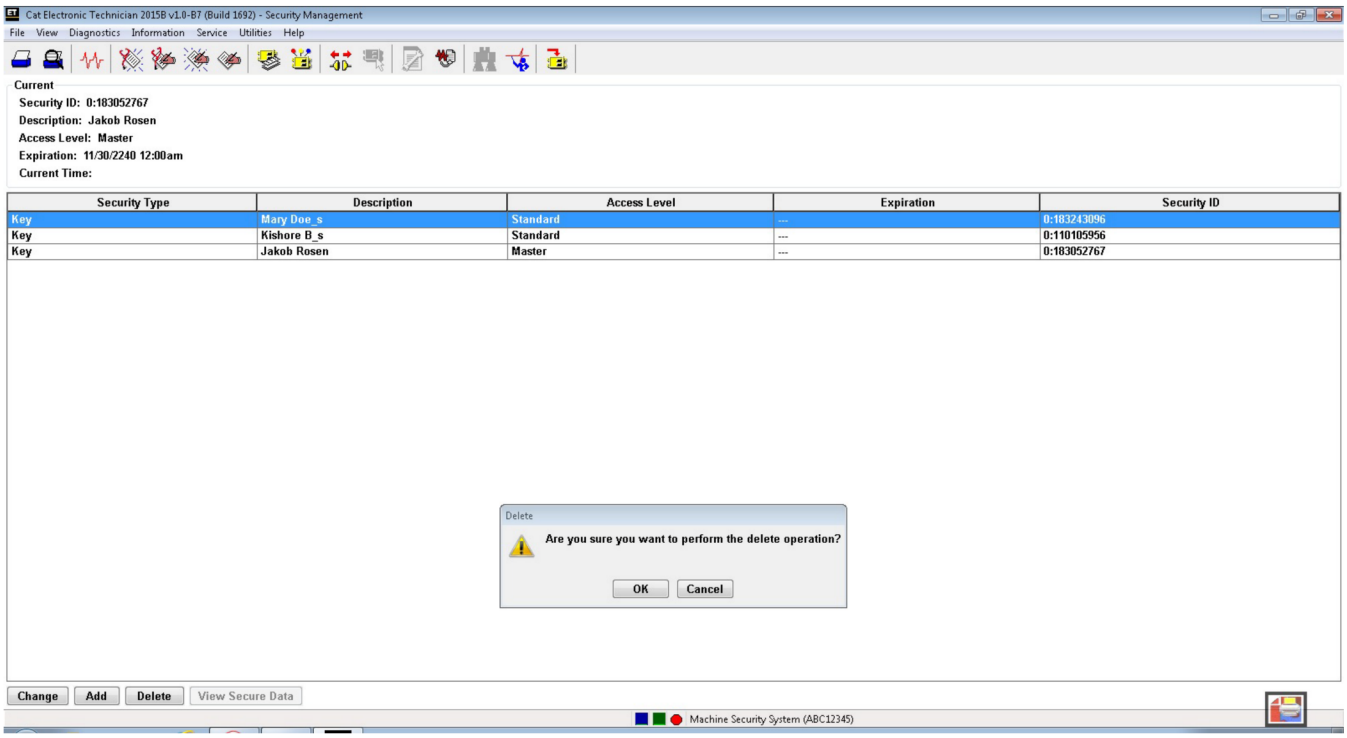

Illustration 28 g03866151

Delete Key

Note: You cannot delete the last Master key. An error message will display if deletion of the last master access level key is attempted.

Note: Deleting Keys requires a key with master access level or a factory password.

To delete a key:

1. Highlight the key you want to delete. Press the “Delete” push button. The “Are you sure?” box is displayed.
2. Press “OK” if you want to delete the key. Press “Cancel” if you do not want to delete the key. You automatically return to the “Security Management” screen.

Printing Key Information

Illustration 29 g03866152

The “Print Document” dialog box allows you to send a report to a file, to a printer, or to the screen. The report includes the following information:

- Source of data
- Time
- Date of report generation

- ECM connection
- List of parameter values
- Information that is unique to the function that you are printing

To print a report to a file:

1. Press the “Print” icon in the menu bar. The “Print Document” box is displayed.

2. Press the “Print to File” button. Press “OK” in order to print the report. Press “Cancel” in order to exit the “Print Document” box without saving the file.

Note: If you do not have a file open, the “Printing” box asks you to open a file, create a new file, or cancel. Choose the appropriate button in order to continue.

Open: Press the “Open” push button. The “Open File Dialog” box is displayed. Highlight a file and press the “Open” push button. The “Print New Document To File” box is displayed.

New: Press the “New” push button. Enter a new file name into the “new file name” box. Press “OK” . The “Print New Document To File” dialog box is displayed.

Cancel: Press “Cancel” in order to exit the box. You return to the “Print Document” box.

3. In the “Print New Document To File” , enter a name for the document. Press “OK” . The “Print to File is complete” box is displayed. Press “OK” in order to return to the last active screen. Press “Cancel” in order to exit the “Print New Document To File” box.

To print a report to the printer:

1. Press the “Print” icon in the menu bar. The “Print Document” dialog box is displayed.

2. Press the “Print to Printer” button and then press “OK” . The “Print to Printer is Complete” box is displayed. Press “OK” in order to return to the last active screen. Press “Cancel” in order to exit the “Print Document” box.

To print a report to the screen:

1. Press the “Print” icon in the menu bar. The “Print Document” box is displayed.

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