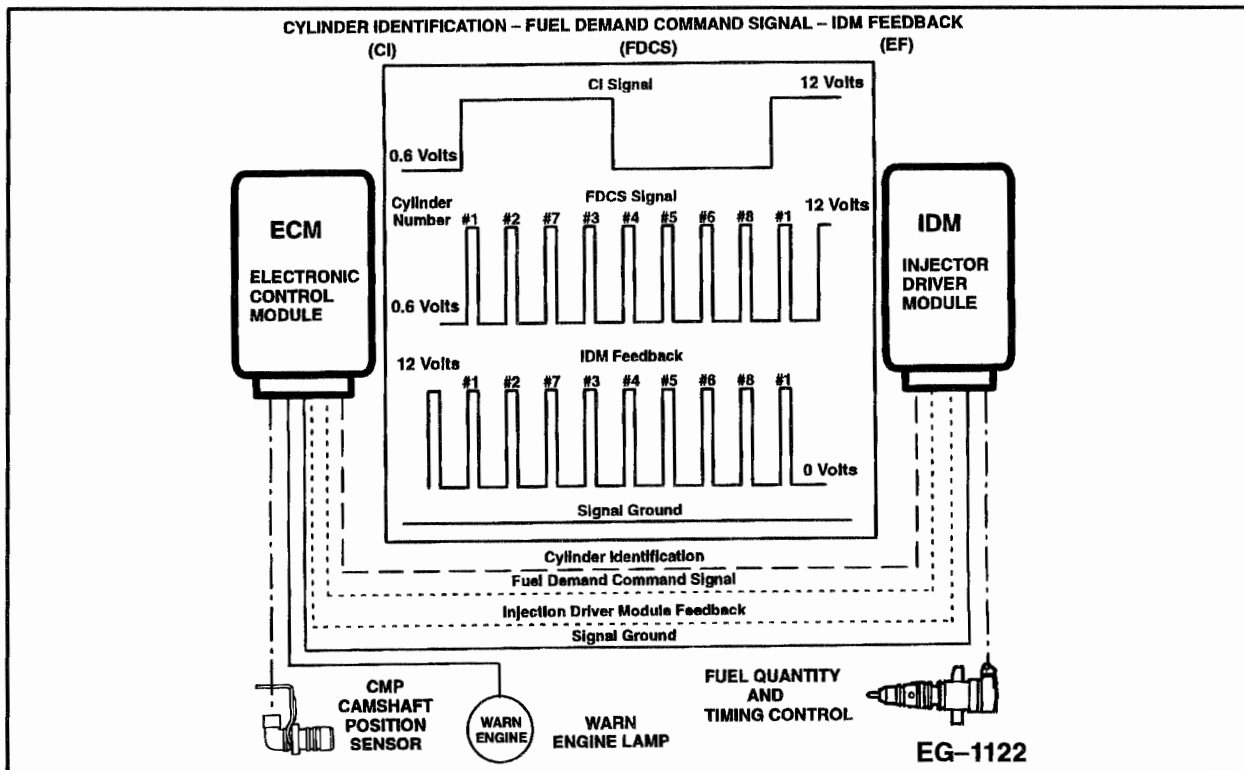


# ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

## ECM/IDM COMMUNICATIONS (ECM/IDM)

### ECM – IDM COMMUNICATIONS



### SIGNAL FUNCTIONS

**Cylinder Identification** – Cylinder Identification (CI) signal is a 0 to 12 volt wave form signal that communicates from the ECM to the IDM the position of cylinder 1. This signal is used by the IDM to synchronize the injector firing sequence. This signal is calculated from the signal generated from the Camshaft Position Sensor (CMP). The CI signal is generated by the ECM by "pulling down" (switching to grd.) a 12 volt communication circuit in the IDM.

**Fuel Demand Command Signal** – Fuel Demand Command Signal is a 0 to 12 volt wave form signal that communicates from the ECM to the IDM the required engine timing and duration of injector firing. The timing and duration of the signal is determined by ECM calibration and the signals of various sensor inputs. The FDCS signal is generated by the ECM by "pulling down" (switching to ground) a 12 volt communication circuit in the IDM.

**Injector Driver Module Feedback** – Injector Driver Module Feedback signal is a 0 to 12 volt wave form signal that communicates from the IDM to the ECM a mirror image of the FDCS signal. Extensions of the EF (Electronic Feedback) signal can indicate to the ECM possible problems with the injectors by the IDM as the engine is running. An EF toggle (100 hz. signal) generated when the key is first turned "ON" and before the engine starts, communicates to the ECM that the IDM is powered up. In an engine off

or engine running diagnostic mode, the EF signal is also used to communicate diagnostic information from the IDM to the ECM. The EF signal is generated by the IDM by "pulling down" (switching to grd.) a 12 volt communications circuit in the ECM.

### FAULT DETECTION/MANAGEMENT

**Cylinder Identification** – Intermittent open or short to ground conditions can be detected by the IDM through IDM stuck high or low codes (532 & 531). Active faults can be detected by an on demand output circuit check performed during Engine Off Tests.

**NOTE: THE ENGINE WILL NOT OPERATE WITHOUT A FUNCTIONING CI CIRCUIT**

**Fuel Demand Command Signal** – Active faults can be detected by an on demand output circuit check performed during Engine Off Tests.

**NOTE: THE ENGINE WILL NOT OPERATE WITHOUT A FUNCTIONING FDCS CIRCUIT**

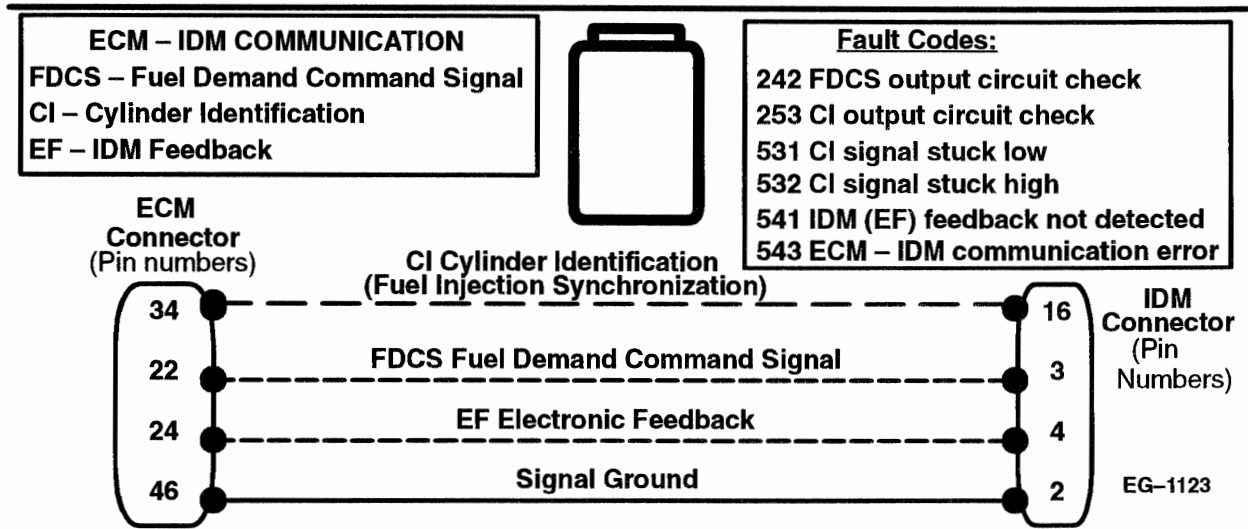
**Injector Driver Module Feedback** – Active faults can be detected by a toggle sequence that the ECM looks for on start up. The WARN lamp will be illuminated if this is detected.

**NOTE: IDM DIAGNOSTIC FAULT CODES WILL NOT BE TRANSMITTED IF THE EF LINE IS NOT FUNCTIONING, HOWEVER, THE ENGINE WILL OPERATE NORMALLY.**

# ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

## ECM/IDM COMMUNICATIONS (ECM/IDM)

Section 3.5  
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### Key On Engine Off – Voltage Checks (Check with breakout box installed with ignition key "ON" engine off).

Test Points	Spec.	Signal	Comments
#34 to #46	0.6 ± 0.1 v	CI signal	Less than .5v indicates an open between the ECM and IDM.
#22 to #46	0.6 ± 0.1 v	FDCS signal	12 volts indicates an open in the ECM or breakout box.
#24 to #46	1 to 4 volts	EF feedback	With the key on, EF has a 100 hz. digital signal that will measure 1–4 volts w / DVOM.

### Connector Checks to Ground (Check with breakout box installed, ignition key should be in the OFF position.)

Test Points	Spec.	Signal	Comments
#34 to #46	> 1000 ohms	CI signal	Less than 1000 ohms indicates a short to ground either thru the harness or internal in the ECM or IDM. Disconnect the IDM and measure to ground. If short still present, disconnect the ECM and measure to ground. If short still present, repair harness.
#22 to #46	> 1000 ohms	FDCS signal	
#24 to #46	> 1000 ohms	EF feedback	

### Harness Resistance Checks (Check with breakout box installed, ignition key should be in the OFF position.)

Test Points	Spec.	Signal	Comments
#34 to #16	< 5 ohms	CI signal	Resistance from ECM connector to IDM connector.
#22 to #3	< 5 ohms	FDCS signal	Resistance from ECM connector to IDM connector.
#24 to #4	< 5 ohms	EF feedback	Resistance from ECM connector to IDM connector.
#46 to #2	< 5 ohms	SIG Grd	Resistance from ECM connector to IDM connector.

### Key On Engine Running (at low idle) – Voltage Checks – Intermittent Faults (Check with breakout box installed and engine at low idle.)

(Monitor suspect lines with voltmeter and wiggle appropriate wires and connectors while engine is idling)

Test Points	Spec.	Comments
#34 to #46	5 – 8 volts	CI signal (0 to 12 volt digital signal), Monitor engine RPM w/Fluke 88 in TACH mode.
#22 to #46	1–1.5 volts	FDCS signal, 40 – 50hz. – 0 to 12 volt signal.
#24 to #46	.5 – 1.5 volts	EF signal, 40hz. – 0 to 12 volt signal.

### Fault Code Descriptions

242 = FDCS high or low resistance in the circuit detected during engine off test, OCC\* test (REPAIR THIS FAULT FIRST).

253 = CI high or low resistance in the circuit detected during engine off test. OCC\* test (REPAIR THIS FAULT FIRST).

531 = CI signal stuck low, harness or internal circuits of IDM shorted to ground (intermittent problem, historical fault only)

532 = CI signal stuck high, harness or internal circuits of IDM shorted to voltage source (intermittent problem, historical fault only)

541 = IDM feedback (EF) (100 hz frequency transmitted during key ON, engine OFF) not detected.

543 = ECM-IDM communication error, no communication, detected on EF or wrong part number IDM.

\* – OCC = Output Circuit Check

# ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

## ECM/IDM COMMUNICATIONS (ECM/IDM)

### ECM / IDM COMMUNICATIONS EXTENDED EXTENDED SYSTEM DESCRIPTION

#### FUNCTION

The Navistar engine control system includes an Electronic Control Module (ECM) and an Injector Drive Module (IDM). The IDM's primary functions are to supply high current and voltage to power the injectors and to electrically "turn on" individual injectors upon command by the ECM. The ECM communicates and controls injector timing and fuel quantity and communicates engine position to the IDM to insure correct fueling timing, quantity and firing sequence. The IDM is also capable of feeding back or handshaking information received from the ECM and of communicating diagnostic information pertinent to injector or IDM operation to the ECM. Information is transmitted between the IDM and ECM on three circuits; (CI) Cylinder Identification, (FDCS) Fuel Demand Command Signal and (EF) Electronic Feedback.

Cylinder Identification (CI) is the signal from the ECM to the IDM to indicate the beginning of the firing order. This signal is generated by the ECM to indicate to the IDM the position of #1 cylinder and synchronize injector firing order to engine position. Engine position is detected by the Camshaft Position (CMP) sensor by identifying the sync window in the timing disk. (Refer to CMP sensor for complete function)

Fuel Demand Command Signal (FDCS) is the signal sent by the ECM to the IDM to indicate the beginning and ending of each injection cycle. This precise "On/Off" signal controls the fuel timing and rate by varying the beginning and ending of injection.

Electronic Feedback (EF) signal is sent from the IDM to the ECM to verify IDM operation and communicate diagnostic information.

- On initial power up, the IDM will signal the ECM with a constant 100 Hz signal that it has successfully initialized.
- During engine operation, the EF signal mirrors the FDCS signal to the ECM to verify FDCS reception by the IDM and will modify the EF signal if certain injector faults are detected during engine operation.

- After an "Engine Off Standard Test" is performed, the EF signal will communicate diagnostic information stored in the IDM pertaining to IDM function or injector operation to the ECM.

#### OPERATION

##### CYLINDER IDENTIFICATION (CI)

When the IDM is powered up, 12 volts is supplied from pin 16 of the IDM to pin 34 of the ECM. The ECM will "pull down" this 12 volts low to approximately .6 volts (the voltage drop across an internal transistor in the ECM). After the ECM has received a sync signal from the CMP sensor and can identify the position of cylinder #1, it will toggle CI and allow it to go high (12 volts), 180° of camshaft rotation later or 360° of crankshaft rotation the ECM will again pull the CI signal low (.6 volts). This indicates to the IDM to initiate the firing sequence 1-2-7-3 when it receives the high signal and 4-5-6-8 when it receives the low signal. This signal will be repeated every camshaft revolution.

##### FUEL DEMAND COMMAND SIGNAL (FDCS)

When the IDM is powered up, 12 volts is also supplied from pin 12 of the IDM to pin 22 of the ECM, the ECM will "pull down" this 12 volts low to approximately .6 volts (the voltage drop across an internal transistor in the ECM). After the IDM has received the CI signal, the ECM will toggle the FDCS signal high and low to indicate to the IDM the beginning and ending of injector operation for each cylinder.

**NOTE: THE ENGINE REQUIRES A FUNCTIONING CI AND FDCS SIGNAL TO OPERATE.**

##### ELECTRONIC FEEDBACK (EF)

After the ignition key is turned "ON" and the ECM and IDM relays are enabled, the IDM is powered up and performs its internal self checks. To signal that the IDM is initialized, a 100 Hz signal is transmitted on the EF circuit to the ECM.

During engine operation, the EF signal mirrors the FDCS signal to the ECM to verify FDCS reception by the IDM and will modify the EF signal if certain injector faults are detected during engine operation.

After an "Engine Off Standard Test" is performed, the EF signal will communicate diagnostic information stored in the IDM pertaining to IDM function or injector operation to the ECM.

**ECM/IDM COMMUNICATIONS (ECM/IDM)****ECM/IDM COMMUNICATIONS EXTENDED  
SYSTEM DESCRIPTION (Continued)****IDM DIAGNOSTICS**

The IDM monitors operation of output circuits during engine operation. Output circuits that are shorted or open are detected by the IDM and are subsequently disabled if necessary to prevent damage to the output drivers. This will set a fault code. When a fault is detected during operation an EF "extension", transfers fault information to the ECM. Not all faults can be transferred during engine operation. However, faults are stored in the IDM when they are detected. These faults are transmitted during the "Engine Off Tests", as inactive faults.

At start up, the IDM performs a Self Test of internal components to determine if they are operating satisfactorily. The IDM compares the signal inputs to determine if the signal voltages are within specification, if not a fault code will be set. These faults are also transferred to the ECM on command as inactive faults.

**ECM DIAGNOSTICS**

The ECM monitors the timing of the EF signal while the engine is running. When it detects a fault sent from the IDM, it will log the transfer. However, it will be necessary to perform an Engine Off Standard Test to determine most fault codes stored in the IDM. The Engine Off Test may be initiated by the Electronic Service Tool or the STI Self Test Input switch located on the vehicle dash.

The ECM continually measures the communication signal voltage levels. If the voltage levels are lower or higher than expected, a fault code will be set to identify the circuit or component. The fault will be automatically recorded as an active code. If the ignition key is turned off, the fault will be stored as an inactive code.

**FLASH CODE 242**  
**ATA CODE SID 154 FMI 11**  
***FDCS CIRCUIT TO IDM OCC SELF TEST***  
***FAILED***

During the Engine Off Standard Output Circuit Check test, Code 242 will be set by the ECM, if the ECM did not detect a voltage transition on the FDCS circuit. This code will not cause the Engine Warning light to be illuminated.

Code 242 may be caused by a shorted high or low or open FDCS circuit. If accompanied by other communication codes could indicate the IDM is not powered up. This fault must be repaired for the engine to operate.

**FLASH CODE 253**  
**ATA CODE SID 153 FMI 11**  
***FUEL INJ SYNC CIRCUIT OCC SELF TEST***  
***FAILED***

Flash code 253 will be set during the Engine Off Standard Output Circuit Check test. This code is set by the ECM and indicates no voltage transition detected on the Cylinder Identification circuit. This fault will not cause the Engine Warning light to be illuminated.

Possible causes are a shorted (high or low) or open CI circuit. If accompanied by other communication codes could indicate the IDM is not powered up. This fault must be repaired for the engine to run.

**FLASH CODE 531**  
**ATA CODE SID 153 FMI 4**  
***FUEL INJ. SYNC SIGNAL LOW***

Flash code 531 is set by the IDM and is transmitted to the ECM on command from the ECM during the Engine Off Standard Test. This code indicates that the IDM has detected that the FDCS signal and the CI signal have remained at 0 volts. This code will cause the Engine Warning light to be illuminated.

Possible cause may be a short to ground in the CI circuit. This fault must be repaired for the engine to run.

**FLASH CODE 532**  
**ATA CODE SID 153 FMI 3**  
***FUEL INJ. SYNC SIGNAL HIGH***

Flash code 532 is set by the IDM and is transmitted to the ECM on command from the ECM during the Engine Off Standard Test. This code indicates the IDM has detected that the FDCS signal and CI signal have remained at 12 volts. This code will cause the Engine Warning light to be illuminated.

Possible causes are a short to a voltage source or an open CI circuit. This fault must be repaired for the engine to run.

## ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

### ECM/IDM COMMUNICATIONS (ECM/IDM)

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#### ECM/IDM COMMUNICATIONS EXTENDED SYSTEM DESCRIPTION (Continued)

##### **FLASH CODE 541**

**ATA CODE SID 155 FMI 11**

**IDM FEEDBACK TOGGLE NOT DETECTED BY  
ECM**

Flash code 541 is set by the ECM. The ECM monitors the CI, FDCS and EF signals for voltage levels. If the ECM detects that the CI or FDCS is open or if the EF signal is not sending a 100 Hz signal, this code will be set. This code will cause the Engine Warning light to be illuminated.

Possible causes are a short or open on the EF circuit if this code is the only code present. If accompanied by other IDM circuit faults the IDM may not be powered or operational. If displayed during an Engine Off Standard Test it will be accompanied by code 543. This code may be set due to other faults in the ECM due to a reset condition. If other codes are present repair them first in the order of importance for engine operation. This code should not prevent engine operation by itself.

##### **FLASH CODE 543**

**ATA CODE SID 155 FMI 7**

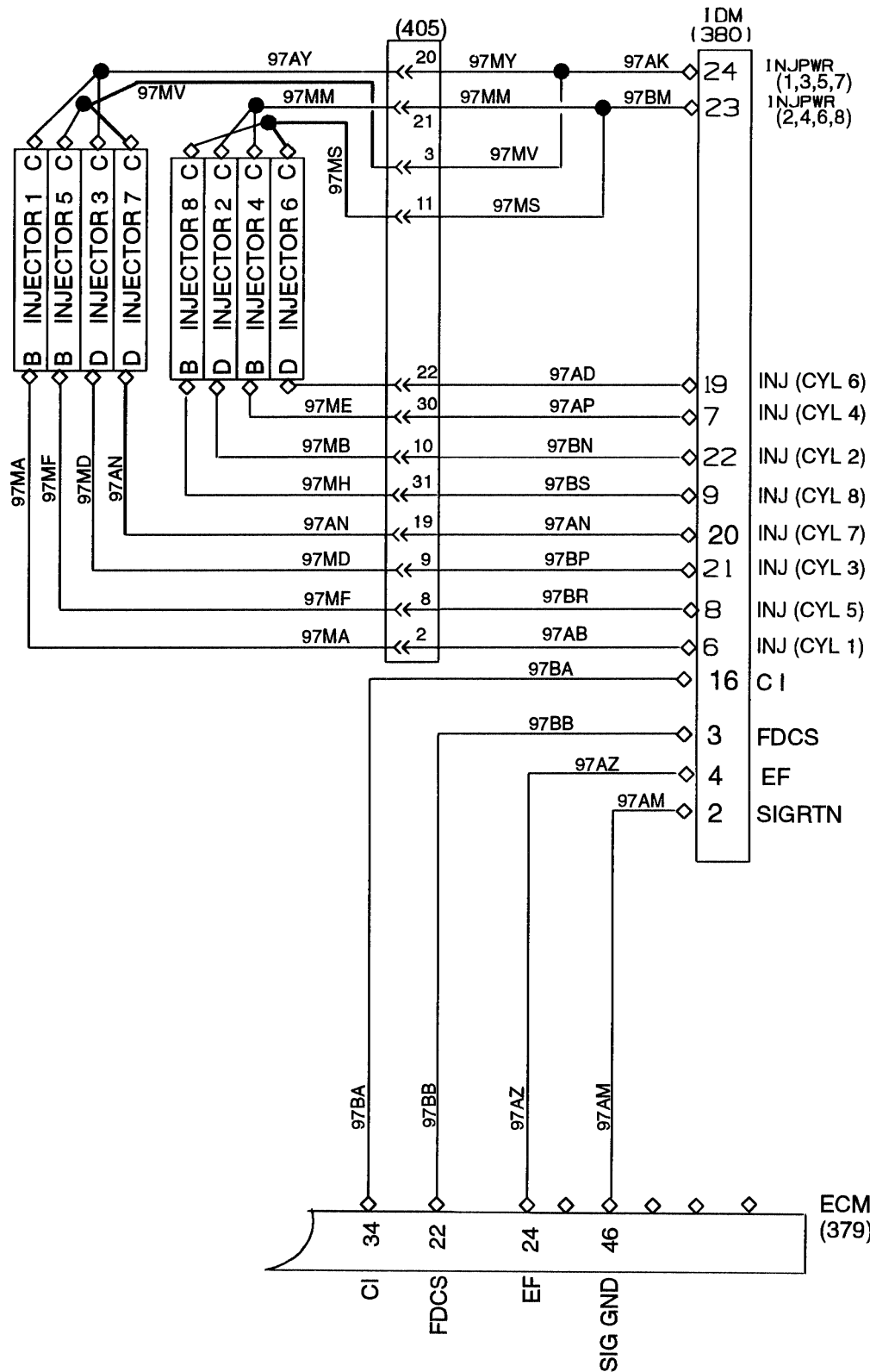
**IDM FAULTS NOT RECEIVED**

Flash code 543 is set by the ECM during an Engine Off Standard Output Circuit Check test. This indicates that the ECM has commanded the transmission of fault codes from the IDM and has not received the codes. If this code occurs, first record any active or inactive codes. Then clear the codes and rerun the Engine Off Standard Test. This code will cause the Engine Warning light to be illuminated.

Possible causes for this code would be opens or shorts in the IDM / ECM communications circuits or an IDM not powered. If accompanied by other faults repair the other faults first in the order of importance for engine operation. This code should not prevent engine operation by itself.

## ECM/IDM COMMUNICATIONS (ECM/IDM)

## INJECTOR DRIVE CIRCUIT

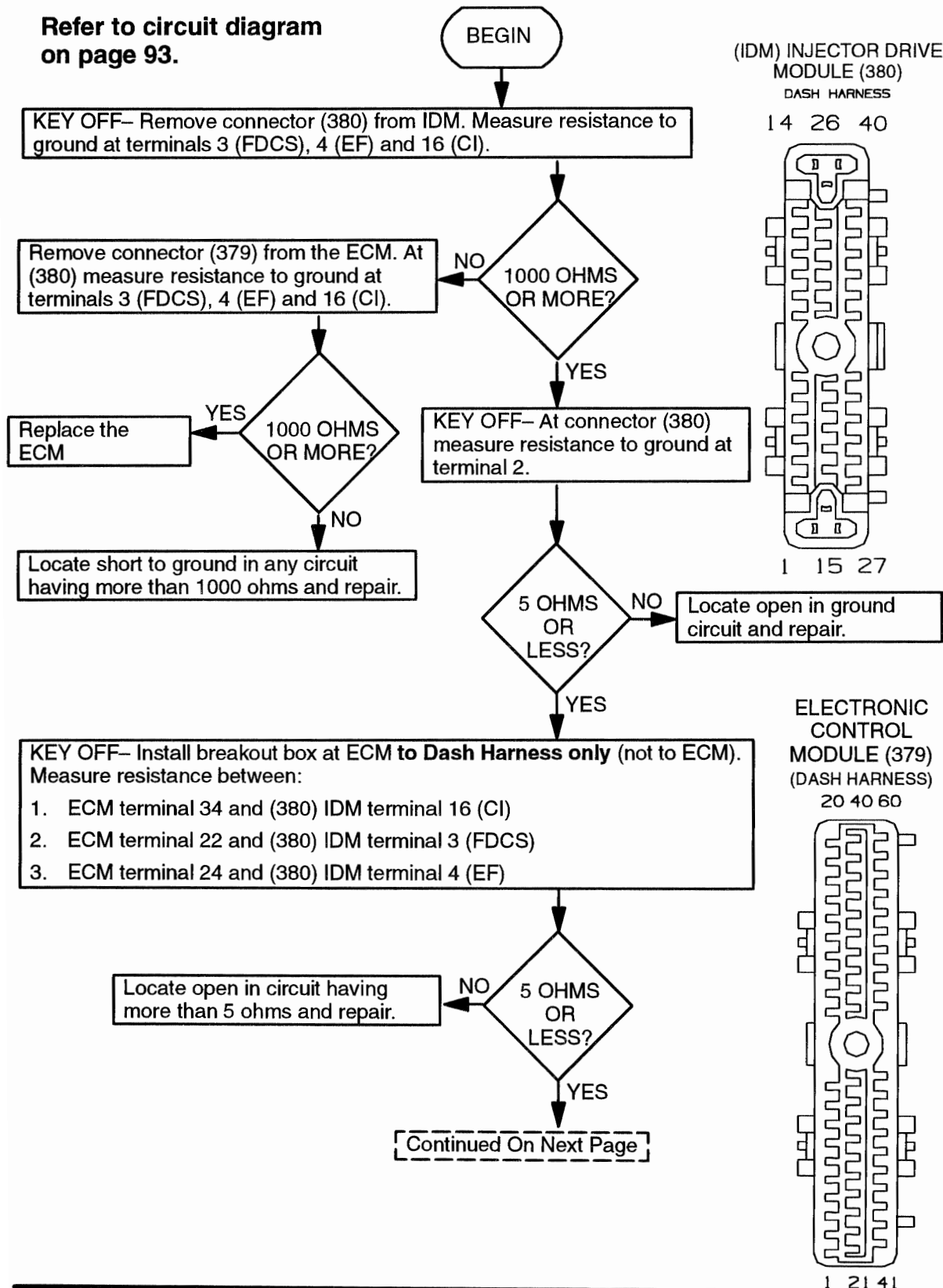


# ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

## ECM/IDM COMMUNICATIONS (ECM/IDM)

### ECM ↔ IDM COMMUNICATIONS

Refer to circuit diagram  
on page 93.



## ECM/IDM COMMUNICATIONS (ECM/IDM)

## ECM ↔ IDM COMMUNICATIONS (Continued)

