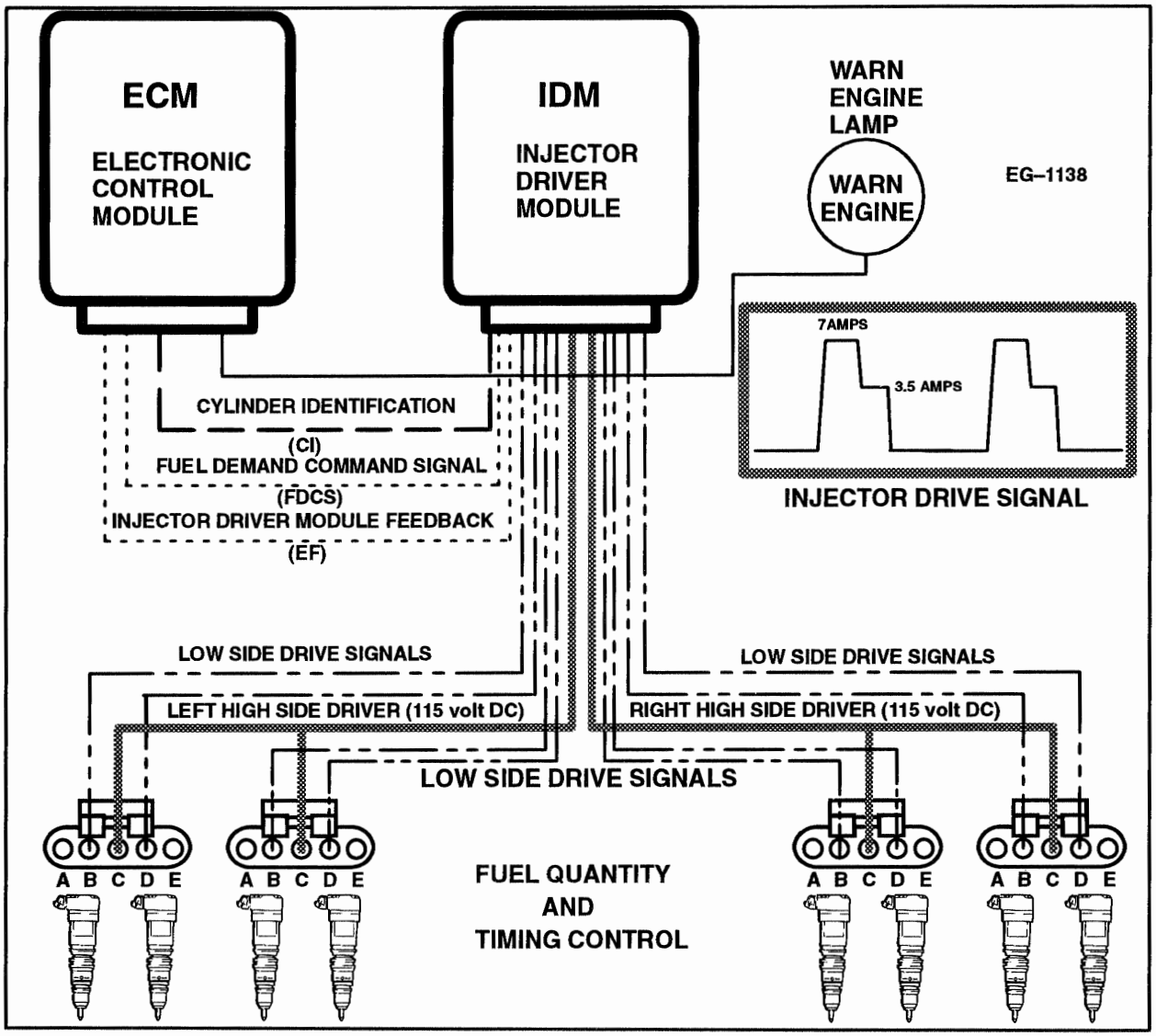
ELECTRONIC CONTROL SYSTEM DIAGNOSTICS

INJECTOR DRIVE CIRCUITS (INJ)

INJECTOR DRIVE CIRCUIT OPERATION



SIGNAL FUNCTIONS

High Side Drive Outputs (Right and Left Bank) – The high side drive output function is to supply to the injectors a power supply of 115 volt DC at a maximum of 10 amps. This power supply is available to the injectors on a continuous basis.

Low Side Drive Outputs – The low side drive outputs control the injector on time (fuel quantity), timing (in relation to TDC) and sequencing (firing order). The IDM controls (fires) each individual injector by completing the ground circuit to each injector solenoid. A valid Cylinder Identification (CI) and Fuel Demand Command Signal (FDCS) must be sent from the ECM to the IDM before an injector will be allowed to fire.

FAULT DETECTION/MANAGEMENT

The Injector Driver Module (IDM) is capable of detecting, while the engine is running individual injector open and shorts to either ground or battery. It is also capable of detecting right or left bank high side opens or shorts to ground. A special On–Demand Buzz test will also allow the operator to enable all injector solenoids while the engine is off to verify circuit operation. **IDM detected diagnostic fault codes will not be transmitted if the EF line is not functioning, however, the engine will function normally.**

If a short to ground condition is detected on an individual injector, (low side), the IDM will discontinue the power to the bank with the shorted injector, enable the WARN engine lamp and operate the engine on four cylinders.

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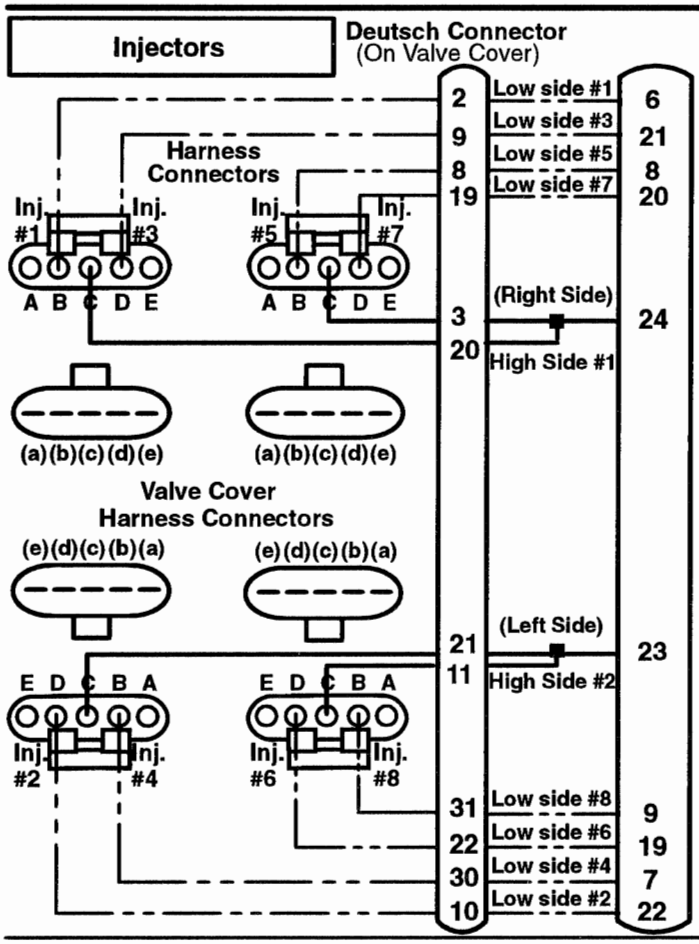

Fault Codes:

NOTE: (Last code digit refers to INJ or Bank #)

421–428 High to low side open inj. #1–#8
431–438 High to low side short inj. #1–#8
441–448 Low side short to B+ inj. #1–#8
451–458 Low side short to grd. inj. #1–#8
511 Multiple faults on bank #1 (right)
512 Multiple faults on bank #2 (left)
513 High side open right group
514 High side open, left group
515 High side #1 (right) short to grd.
521 High side #2 (left) short to grd.
524 High sides shorted together
544 Injector Fault in Bank 2
545 Injector Fault in Bank 1

INJECTION DRIVER MODULE CONNECTOR EG–1139

CAUTION !

DO NOT PERFORM VOLTAGE CHECKS WITH THE ENGINE RUNNING

INJECTOR SOLENOID OPERATING VOLTAGE 115 V DC. @ 10 AMPS PRESENT ON INJECTOR CIRCUITS.

After removing connectors always check for damaged pins, corrosion, loose terminals etc.

NOTE: Test all injector harness and valve cover connectors at Test Points indicated.

Engine Harness Connector Check to Chassis Ground

Test Points	Spec.	Comments
B	> 1000 ohms	Injector low side – codes 451–458 may be set if shorted to grd.
C	> 1000 ohms	Injector power feed high side – codes 515 or 521 may be set if shorted to grd.
D	> 1000 ohms	Injector low side – codes 451–458 may be set if shorted to grd.

Valve Cover Gasket Connector to Chassis Ground
(Check with pigtail connector installed on gasket connector)

Test Points	Spec.	Comments
B	> 1000 ohms	Injector low side – codes 451–458 may be set if shorted to grd.
C	> 1000 ohms	Injector power feed high side – codes 515 or 521 may be set if shorted to grd.
D	> 1000 ohms	Injector low side – codes 451–458 may be set if shorted to grd.

Under Valve Cover Harness and Injector Solenoid Resistance Checks
(Check with pigtail connector installed on gasket connector)

Test Points	Spec.	Comments
B to C	3.4 ± 2 ohms	Resistance thru injector solenoid and UVC harness – codes 421–428 may be present if open, codes 431–438 may be present if injector or harness shorted together.
C to D	3.4 ± 2 ohms	

Engine Harness to IDM connector checks (measure to appropriate pin)

Test Points	Spec.	Comments
B to IDM	< 5 ohms	Injector low side – code(s) 421–428 present if open present.
C to IDM	< 5 ohms	Injector pwr. feed high side–code(s) 513 or 514 present if open, code 524 indicates sides shorted together.
D to IDM	< 5 ohms	Injector low side – code(s) 421–428 present if open present.

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INJECTOR DRIVE CIRCUIT EXTENDED SYSTEM DESCRIPTION

FUNCTION

SYSTEM DESCRIPTION

The Navistar engine control system includes an ECM (Electronic Control Module) and an IDM (Injector Drive Module). The ECM provides the IDM with two important output signals which control fuel injector operation. The ECM uses the fuel quantity control strategy and input from the engine sensors to determine how long each fuel injector is actuated in order to provide the proper fuel quantity at any given engine operating condition. The ECM determines and provides a fuel output signal, FDCS (Fuel Demand Command Signal), by combining the desired length of each injection with the result of the injection timing control strategy which determines when each injection will occur. The second output signal, (CI) Cylinder Identification, enables the IDM to determine the correct injector firing order.

The IDM processes the FDCS and CI signals sent by the ECM to control injector operation. It amplifies the FDCS signal to make it powerful enough to operate the injectors and distributes it to each injector according to the CI signal.

OPERATION

The IDM contains two solid state high side drivers. Each driver supplies a continuous 115 volts DC. Right bank high side driver supplies cylinders 1,3,5 and 7 with 115 volts at terminal 24 of the IDM to terminals 3 and 20 of the valve cover connector. Left bank high side driver supplies cylinders 2,4,6 and 8 with 115 volts at terminal 23 of the IDM to terminals 21 and 11 of the valve cover connector. The IDM turns each injector on by switching on a solid state device (Low Side Driver) to ground the injector solenoid return circuit. The IDM contains a low side driver for each of the injectors.

IDM DIAGNOSTICS

The IDM monitors the voltage on the driver circuits and is capable of detecting an open or shorted circuit. If the IDM detects a short to ground or a multiple fault in a driver, the IDM will discontinue operation of that driver which would cause the engine to operate on the remaining bank of 4 cylinders. The IDM will transmit a message to the ECM that a fault has been detected. The ECM will respond by illuminating the Engine Warning Light and compensating for inoperative cylinders to keep the engine running if mechanically possible.

Faults detected by the IDM will be stored in the IDM and transmitted to the ECM during an "Engine Off Standard Test". These faults will be transmitted as Inactive faults. Faults can be retrieved using the Electronic Service Tool or the STI Self Test Input Diagnostic Switch located on the vehicle dash.

NOTE: THE LAST DIGIT OF THE FLASH CODE INDICATES THE AFFECTED CYLINDER NUMBER. FOR EXAMPLE, CODE 421 INDICATES CYLINDER NO. 1 HAS AN OPEN CIRCUIT BETWEEN THE IDM HIGH SIDE DRIVER AND THE LOW SIDE (SIGNAL RETURN) TO THE IDM. THE SID NO.S 1–8, INDICATE CYLINDER NO.S IN A SIMILAR MANNER.

FLASH CODE *421 THROUGH 428* ATA CODE SID 1 THROUGH 8 FMI 5 *HIGH SIDE TO LOW SIDE OPEN*

Flash Codes for High Side to Low Side Open indicate an open circuit between the IDM high side driver and the low side (Signal return) to the IDM.

The ECM will compensate for engine misfire to keep the engine operating. The ECM will not illuminate the Engine Warning light when this situation occurs.

Possible causes: Open wire in injector harness, open injector return circuit or injector solenoid.

FLASH CODE *431 THROUGH 438* ATA CODE SID 1 THROUGH 8 FMI 4 *HIGH SIDE SHORTED TO LOW SIDE*

Flash codes for High Side Shorted to Low Side indicate the return voltage is too high due to a short circuit between the high side driver and return circuit.

The ECM will compensate for engine misfire to keep the engine operating. The ECM will not illuminate the Engine Warning light when this situation occurs.

Possible causes: Shorted injector solenoid or wiring harness.

FLASH CODE *441 THROUGH 448* ATA CODE SID 1 THROUGH 8 FMI 3 *LOW SIDE SHORTED TO B+*

Low Side Shorted to B+ indicates the IDM has detected continuous battery voltage on the signal return circuit.

The ECM will compensate for engine misfire to keep the engine operating. The ECM will not illuminate the Engine Warning light when this situation occurs.

A short circuit in the injector wiring harness will set these codes.

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INJECTOR DRIVE CIRCUIT
EXTENDED SYSTEM DESCRIPTION (Continued)

FLASH CODE *451 THROUGH 458*
ATA CODE SID 1 THROUGH 8 FMI 6
LOW SIDE SHORTED TO GROUND

Flash codes for Low Side Shorted to Ground indicate the return circuit shorted to ground.

If the IDM detects this fault, it will disable the entire bank of cylinders associated with the cylinder indicated.

Possible causes: Shorted injector solenoid or wiring harness to ground.

FLASH CODE *511*
ATA CODE SID 151 FMI 11
BANK 1 HAS MULTIPLE FAULTS

Multiple Faults indicates more than one fault was detected by the IDM, such as an open and a short circuit in cylinders 1,3,5, and 7.

With flash code 511 active, the IDM will disable the drivers for cylinders 1,3,5 and 7. The ECM will compensate for misfire to keep the engine operating and will illuminate the Engine Warning Light.

FLASH CODE *512*
ATA CODE SID 152 FMI 11
BANK 2 HAS MULTIPLE FAULTS

Multiple Faults indicates more than one fault was detected by the IDM, such as an open and a short circuit in cylinders 2,4,6 and 8.

With flash code 512 active, the IDM will disable the drivers for cylinders. 2,4,6 and 8. The ECM will compensate for misfire to keep the engine operating and will illuminate the Engine Warning Light.

FLASH CODE *513*
ATA CODE SID 151 FMI 5
HIGH SIDE OPEN, RIGHT GROUP

With High Side Open Right Group (Bank 1), the IDM has detected an open circuit to the injectors on cylinders 1, 3, 5, or 7.

With flash code 513 active, the drivers for cylinders 1, 3, 5, and 7 are inoperative . The ECM will compensate for misfire to keep the engine operating and will illuminate the Engine Warning light.

FLASH CODE *514*
ATA CODE SID 152 FMI 5
HIGH SIDE OPEN LEFT GROUP

With the High Side Open Left Group (Bank 2), the IDM has detected an open circuit to the injectors on cylinders 2,4,6 and 8.

With flash code 513 active, the drivers for cylinders 2,4,6 and 8 are inoperative . The ECM will compensate for misfire to keep the engine operating and will illuminate the Engine Warning light.

FLASH CODE *515*
ATA CODE SID 151 FMI 6
HIGH SIDE BANK 1 SHORT TO GROUND OR B+

Flash code 515 indicates the IDM has detected the high side driver for cylinders 1, 3, 5 and 7 has excessive current draw.

With flash code 515 active, the driver for cylinders 1, 3, 5 and 7 will be disabled. The ECM will compensate for engine misfire to keep the engine running. This code will cause the Engine Warning light to be illuminated.

FLASH CODE *521*
ATA CODE SID 152 FMI 6
HIGH SIDE BANK 2 SHORT TO GROUND OR B+

Flash code 521 indicates the IDM has detected excessive current draw on high side driver for cylinders 2, 4, 6 and 8.

With flash code 521 active, the driver for cylinders 2, 4, 6 and 8 will be disabled. The ECM will compensate for engine misfire to keep the engine operating and will illuminate the Engine Warning light.

FLASH CODE *524*
ATA CODE SID 151 FMI 3
BOTH HIGH SIDE SWITCHES SHORTED TOGETHER

Flash code 524 indicates a short circuit between the two high side drivers.

With this code active, the Engine Warning light will be illuminated.

INJECTOR DRIVE CIRCUIT
EXTENDED SYSTEM DESCRIPTION (Continued)

FLASH CODE *544*
ATA CODE SID 152 FMI 14
INJECTOR FAULT BANK #2

Flash code 544 indicates ECM has detected more than one injector in Bank #2 (Left Bank) with low voltage.

FLASH CODE *545*
ATA CODE SID 151 FMI 14
INJECTOR FAULT BANK #1

Flash code 545 indicates ECM has detected more than one injector in Bank #1 (Right Bank) with low voltage.

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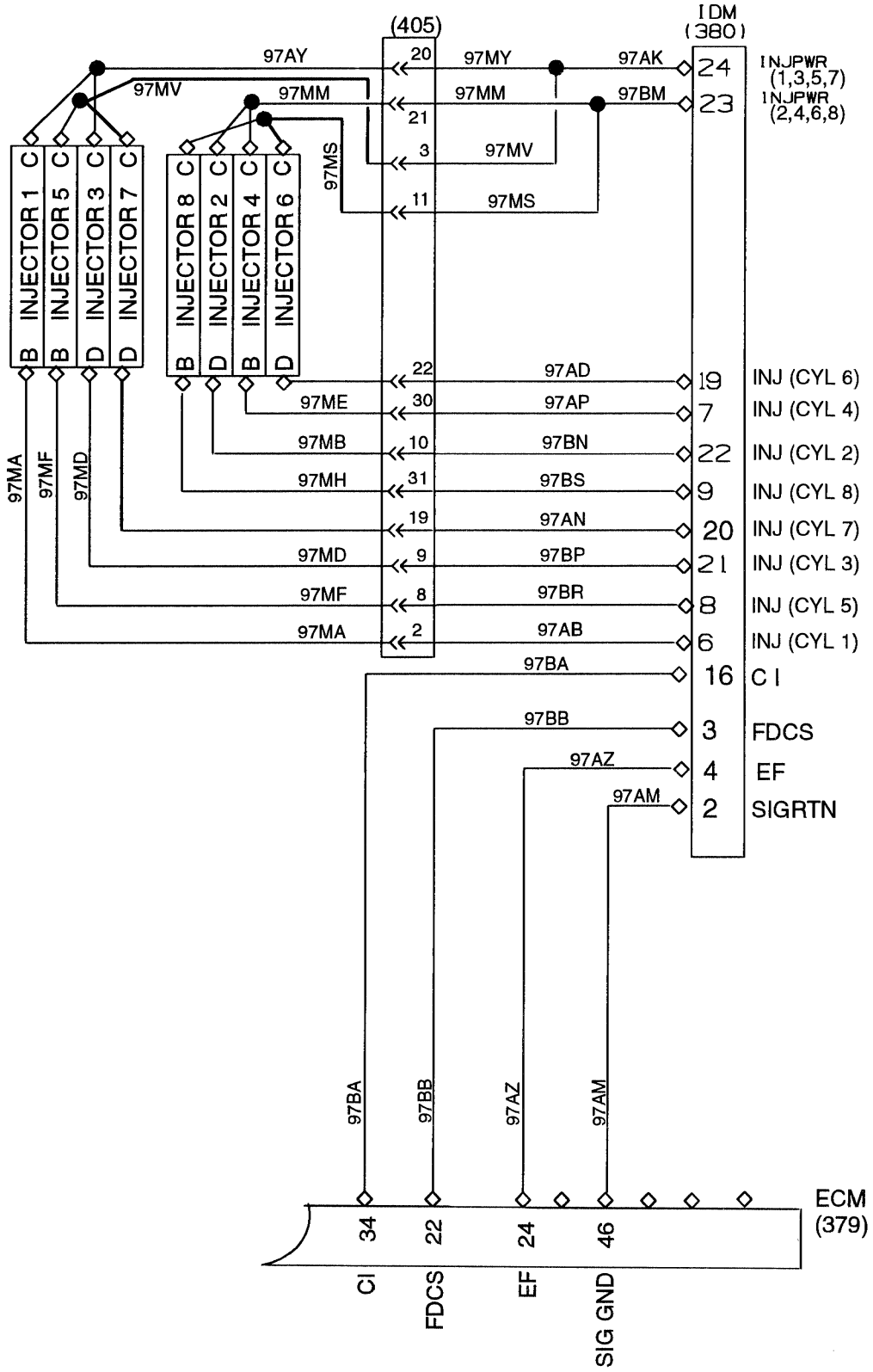
INJECTOR DRIVE CIRCUIT



INJECTOR DRIVE CIRCUITS

Refer to circuit diagram on page 163.

BEGIN

KEY OFF– Remove connector (380) from IDM. Measure resistance to ground at terminals 6, 7, 8, 9, 19, 20, 21, 22, 23, 24.

1000 OHMS OR MORE?

NO → Locate short to ground in circuit having less than 1000 ohms and repair.

YES

Disconnect positive battery terminal and measure resistance between negative battery terminal and connector (380) terminals 6, 7, 8, 9, 19, 20, 21, 22, 23, 24.

1000 OHMS OR MORE?

NO → Locate short to ground in circuit having less than 1000 ohms and repair.

YES

At IDM connector (380), measure resistance from terminal 24 (high side) to terminals 6, 8, 20 & 21, (low side). Then measure resistance from terminal 23 (high side) to terminals 7, 9, 19 and 22 (low side).

MORE THAN 10.5 OHMS?

YES → Measure resistance (at the injector) of any injector and circuit having more than 10.5 ohms.

NO

1.4 OHMS OR LESS?

NO → Replace the IDM

YES

3.4 + 2 OHMS?

NO → Replace the injector

YES → Repair open in circuit between injector and connector (380).

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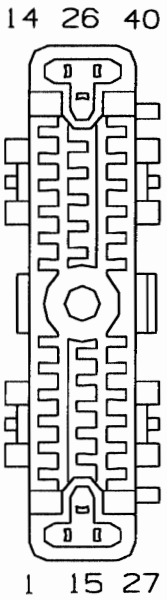
(IDM) INJECTOR DRIVE MODULE (380)
DASH HARNESS



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INJECTOR DRIVE CIRCUITS (Continued)