4 BASIC KNOWLEDGE REQUIRED

4.1 DDEC DIAGNOSTIC CODE

Troubleshooting of the DDEC III system and the DDEC IV system is identical. At the time of this printing, the available features are the same in both systems. The DDEC IV system allows for an increased processor speed and increased memory. DDEC III ECMs and DDEC IV ECMs are not interchangeable.

A diagnostic code indicates a problem in a given circuit (i.e. diagnostic Code 14 indicates a problem in the oil or coolant temperature sensor circuit). This includes the oil or coolant temperature sensor, connector, harness, and Electronic Control Module (ECM). The procedure for finding the problem can be found in Flash Code 14, refer to section 14.3. Similar sections are provided for each code. Remember, diagnosis should always begin at the start of the section. For an oil or coolant temperature sensor problem, it will quickly lead you to section 14, but first you verify the code or symptom.

Since the self-diagnostics do not detect all possible faults, the absence of a code does not mean there are not problems in the system. If a DDEC problem is suspected, even in the absence of a code, refer to section 9.1, anyway. This section can lead you to other sections that can aid in the troubleshooting process - where DDEC problems may occur, but do not generate a code. Basic mechanical checks are not covered in this manual.

4.2 GENERAL DIAGNOSTIC INFORMATION

As a bulb and system check, the Check Engine Light (CEL) and Stop Engine Light (SEL) will come on for five seconds when the ignition switch is first turned on. If the unit is programmed for the cruise control feature, the "Cruise Active" light (if equipped) will also turn on for five seconds.

If the CEL comes on during vehicle operation, it indicates the self diagnostic system has detected a fault.

When the diagnostic request switch is held, the diagnostic system will flash the yellow or red light located on the dash of the vehicle. The light will be flashing the code(s) indicating the problem areas. If the SEL comes on during vehicle operation, it indicates the DDEC System has detected a potential engine damaging condition. The engine should be shut down immediately and checked for the problem.

Active codes will be flashed on the SEL in numerical flash code order. If there are no active codes, a code 25 will be flashed.

Inactive codes will be flashed on the CEL in most recent to least recent order. If there are no inactive codes, a Code 25 will be flashed.

4.3 READING CODES WITH DIAGNOSTIC DATA READER

Flash codes are used for operator convenience to advise of an engine fault or sensor failure. SAE specific codes are read with the Diagnostic Data Reader (DDR). In some cases, one flash code may be used to cover more than one component fault. For this reason the DDR (or Diagnostic Data Link, DDL) must be used to identify the specific code.

The Diagnostic Code Menu selections are defined as follows.

- ❑ Active codes
- ❑ Inactive codes
- ❑ Clear codes

To read codes, start with the Menu Selection screen.

1. To call up active codes:
   [a] Select ENGINE and ENTER three times.
2. To call up inactive codes:
   [a] Select ENGINE and ENTER twice.
   [b] Select INACTIVE CODES and ENTER.
3. To clear codes:
   [a] Select ENGINE and push ENTER twice.
   [b] Go down and select CLEAR CODES and ENTER.
   [c] Left to YES, and ENTER.
   [d] Wait and then push FUNC three times.
   [e] Go to lines 1 and 2 of the Engine Data List, Active and Inactive Codes, and verify that both lines display NO.

4.3.1 Active Codes

Active codes are conditions that are presently occurring and causing the CEL to be illuminated. All current active codes will be displayed for the entire system, including single, dual and triple ECM applications. The display for each code is as follows:

Line 1:	## MID:XXX XXXXXXXX
Line 2:	PID Description
Line 3:	FMI Description
Line 4:	↑A## PID:XXX FMI:XX↓

Explanation:

##:	Indicates the DDC diagnostic flash code number
MID:	Message Identification Character
PID:	Parameter Identification Character
FMI:	Failure Mode Identifier
A##:	Numerical count of active codes
↑↓:	Indicates additional codes are stored in ECM memory

4.3.2 Inactive Codes

Inactive codes are faults that have occurred previously. All current inactive codes will be displayed for the entire system, including single, dual, and triple ECM applications. The display for each code is as follows:

SCREEN #1		SCREEN #2	
Line 1:	## MID:XXX XXXXXX XX	Line 5:	1st: Last:
Line 2:	PID Description	Line 6:	Total#:
Line 3:	FMI Description	Line 7:	Total Time:
Line 4:	↑|## PID:XXX FMI:XX↓	Line 8:	Min/Max:

Explanation:

##:	Indicates the DDC diagnostic flash code number
|##:	Numerical Count of inactive codes
1st:	First occurrence of the diagnostic code in engine hours
Last:	Last occurrence of the diagnostic code in engine hours
Total#:	Total number of occurrences
Total Time:	Total engine seconds that the diagnostic code was active
Min/Max:	Minimum/Maximum value recorded during diagnostic condition

4.3.3 Clear Codes

This feature allows diagnostic codes stored in the ECMs to be erased. An audit trail of when the codes were last erased will be displayed in engine hours.

Engine Hours of Last Clear Codes: XXXX

4.3.4 Message Identification Descriptions

MID:	128 ENGINE	Single ECM applications
MID:	175 ENGINE R1	Dual ECM application – engine #2 with first receiver ECM
MID:	183 ENGINE R2	Triple ECM application – engine #3 w/second receiver ECM
MID:	184 PING	Pilot Injection Natural Gas ECM application

Diagnostic codes with Subsystem Identification Characters (SIDs) that reference Auxiliary Outputs # 1–8 (SIDs: 26, 40, 51, 52, 53, 54, 55, 56) will look up the parameter text description in a table to identify the function assigned to the auxiliary output channel.

Diagnostic codes with SIDs that reference PWM Outputs #1 through #4 (SIDs: 57, 58, 59 & 60) will look up the parameter text description in a table to identify the function assigned to the PWM output channel.

Injector Response Time Codes Long and Injector Response Time Codes Short will use a table of injector numbering to identify the appropriate engine cylinder number.

4.4 ELECTRICAL CIRCUITS

Before using this manual, you should understand the theory of electricity and know the meaning of voltage and ohms. You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

You should be able to use jumper wires to make circuit checks.

4.5 USE OF DIGITAL VOLT–OHM METER

Before using this manual, you should be familiar with the digital volt–ohm meter (VOM). You should be able to measure voltage and resistance. You should be familiar with the controls of the meter and how to use it correctly.

For use of a typical digital volt–ohm meter, refer to section 4.5.1, refer to section 4.5.2, and refer to section 4.5.3.

4.5.1 Resistance Measurements

Perform the following steps to measure resistance:

1. Connect the red test lead to the V–Ω (Volt–Ohm) input connector and the black lead to the com input connector on the meter.
2. Set the function/range switch to the desired Ω position. If the magnitude of the resistance is not known, set the switch to the highest range, then reduce until a satisfactory reading is obtained.
3. If the resistance being measured is connected to a circuit, turn off the power to the circuit being tested. Turn off the ignition.
4. Connect the test leads to the circuit being measured. When measuring high resistance, be careful not to contact adjacent points, even if they are insulated. Some insulators have a relatively low insulation resistance which can affect the resulting measurement.
5. Read the resistance value on the digital display.

4.5.2 Continuity Checks

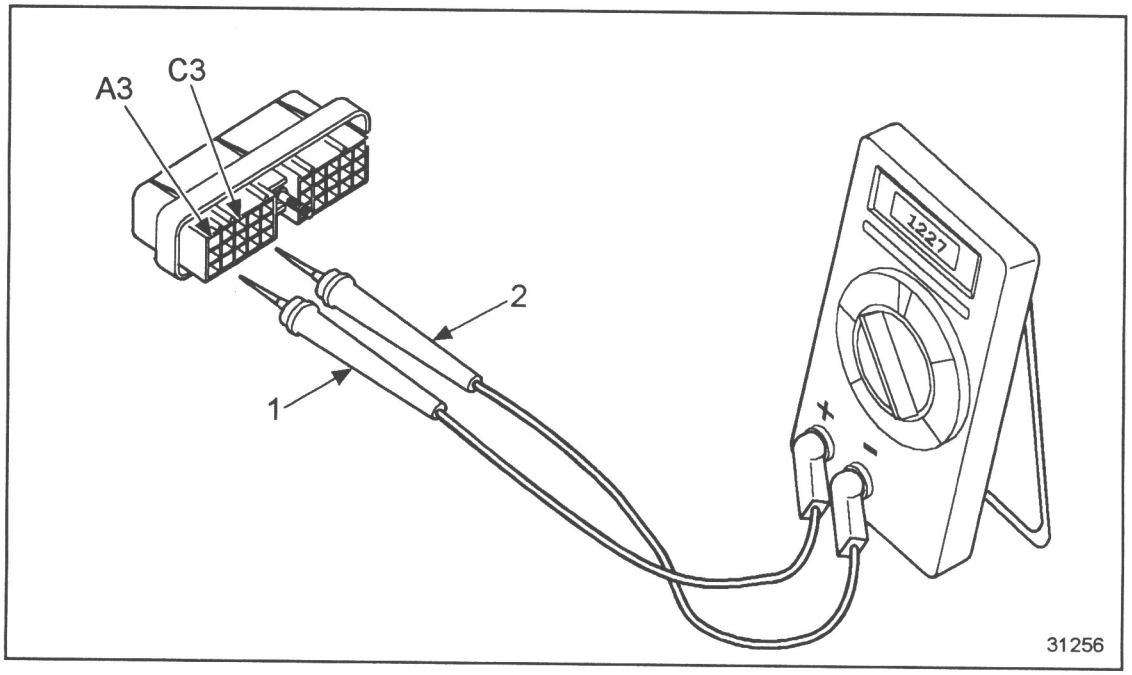
In addition to measuring the specific resistance value of a circuit, some meters will also register if a continuous electrical path exists. If a path exists, the circuit is said to have continuity. (This continuity check can be used in any section of this troubleshooting guide where the test is looking for greater than, less than, or equal to 5 ohms.) An open circuit (broken electrical path) would have ∞ resistance and would not have continuity. To utilize the continuity feature of certain meters:

1. Place the function/range switch in any Ω range.
2. Connect the red lead to the V–Ω connector and the black lead to the com connector on the meter. With the test leads separated or measuring an out–of–range resistance, the digital display will indicate OL (over limit) Some meters show "1 +, 1, or ↑."
3. Put one test probe at one end of the wire or circuit to be tested. Use the other test lead to trace the circuit. When continuity is established, an Ω symbol will display in the upper left corner of the digital display. If contact in the wire is maintained long enough (about 1/4 second), the OL will disappear and the resistance value of the wire or circuit will display next to the symbol.
4. If your VOM does not work in the manner described above, you must know how your VOM operates in order to use this troubleshooting guide.

4.5.3 Voltage Measurements

Perform the following steps to measure voltage.

1. Connect the red test lead to the V–Ω connector and the black lead to the com input on the meter. If a DC–AC switch is present, ensure it is switched to the DC position.
2. Set the function range/switch to the desired volts position. If the magnitude of the voltage is not known, set the switch to a range that will be able to read most voltages seen on a vehicle. Typically, a 20V range will do. Then, reduce the range until a satisfactory reading is obtained.
3. Connect the test leads to the circuit being measured. In the DDEC system diagnostic procedures, voltage measurements are always given as being taken at pins, sockets, battery +, or ground. Following the voltage measurement point, the color test lead to be used is given in parenthesis (red is the V–Ω connection, and black is the com connection). Example: If the procedure says, "Take voltage reading at socket A3 (red lead) to socket C3 (black lead)", see Figure 4–1 for the hook–up.



1. Red Lead
2. Black Lead

Figure 4–1 Voltage Measurement Hook–up

4.6 IMPORTANT INFORMATION

The following items must be read and thoroughly understood before using this manual.

1. The engine and ignition should always be off before the harness connectors are disconnected or reconnected.

NOTICE:
To avoid damage to the harness and connectors when disconnecting harness connectors, ensure the pulling force is applied to the connectors and not to the wires extending from the connectors.

2. When disconnecting harness connectors, ensure the pulling force is applied to the connectors themselves and not the wires extending from them.
3. After harness connectors are reconnected to the DDEC system, the codes logged should be ignored and cleared.
4. In most all areas of repair/troubleshooting, a DDR will be required.
5. In diagnosing an intermittent problem, wiggling wires or harnesses may allow the fault to be repeated. This may allow a technician to better isolate the problem area.

4.7 EXPLANATION OF ABBREVIATIONS AND TERMS

The following abbreviations and terms listed in Table 4–1, will be used throughout the electrical flowcharts.

Abbreviations	Terms
A/C	Air Conditioning
ACG	Air Compressor Governor
A/D	Analog to Digital: The computer inside the ECM uses an A/D converter to convert a sensor voltage into a number with which the computer can work.
ASR	Anti–Skid Regulation: Data supplied by the ECM for use with ABS (anti–lock braking system).
ATI	Auxiliary Timed Input
ATS	Air Temperature Sensor: Monitors engine air temperature.
BAT	Battery
BOI	Beginning of Injection: The number of crank angle degrees, before top–dead–center (TDC), where the ECM is requesting the injectors be turned on.
BPS	Bypass Position Sensor
CAN	Controller Area Network: J 1939 high speed control data link.
CCM	Crankcase Monitor Sensor: Monitors crankcase pressure (currently on 149 engines only).
CCPS	Crankcase Pressure Sensor
CEL	* Check Engine Light: Typically mounted on the instrument panel. The CEL has two functions: 1. It is used as a warning lamp to inform the operator of the vehicle that a fault has occurred and the unit should be taken in for service as soon as possible. 2. It is used by the operator or technician to "flash out inactive trouble codes to help diagnose a problem.
CKT	Circuit
CLS	Coolant Level Sensor: Monitors coolant level at the radiator top tank or heat exchanger.
COM	Common
CPS	Coolant Pressure Sensor: Monitors coolant presssure.
CTS	Coolant Temperature Sensor: Monitors coolant temperature.
DDEC	Detroit Diesel Electronic Controls
DDEC III	Third generation Detroit Diesel Electronic Controls
DDEC IV	Fourth generation Detroit Diesel Electronic Controls
DDL	Diagnostic Data Link: The lines (wires) over which the ECM transmits information that can be read by a Diagnostic Data Reader.
DDL+	Data Link, positive side: J 1587 data link.
DDL–	Data Link, negative side: J 1587 data link.
DDR	Diagnostic Data Reader: The hand held tool used for troubleshooting the DDEC system. MPSI PRO–LINK 9000.
ECM	Electronic Control Module: The controller of DDEC system. It reads the engine and vehicle inputs, sensors and switches, calculates injector firing and duration, and fires injectors at appropriate times.
EEPROM	Electrically Erasable Programmable Read Only Memory.
EFC	Electronic Fire Commander
EFPA	Electronic Foot Pedal Assembly: Contains the throttle position sensor.

Abbreviations	Terms
EOP	Engine Over–temperature Protection
ESH	Engine Sensor Harness
ESS	Engine Synchro Shift
EUI	Electronic Unit Injector
FEI	Fuel Economy Incentive
FPS	Fuel Pressure Sensor: Monitors fuel pressure.
FTS	Fuel Temperature Sensor: Monitors fuel temperature.
GND	Ground
INJ	Injector (fuel)
ISD	Idle Shutdown: Programmable feature of the DDEC system.
IVS	Idle Validation Switch: A switch used to establish the idle speed position.
LSG	Limiting Speed Governor.
MPG	Miles Per Gallon
N/A	Not Applicable.
OEM	Original Equipment Manufacturer
OI	Optimized Idle
OLS	Oil Level Sensor: Monitors oil level.
OPS	Oil Pressure Sensor: Monitors oil pressure.
OTS	Oil Temperature Sensor: Monitors oil temperature.
PGS	Pressure Governor System: Regulates engine speed to maintain a selected external pump pressure.
PTO	Power Take–Off. Also, referred to as VSG (Variable Speed Governor).
PW	Pulsewidth
PWM	Pulsewidth Modulated: Modulated signal provided by the DDEC system.
RES/ACCEL	Resume/Accelerate Switch used for cruise control.
SEL	† Stop Engine Light: Typically mounted on the instrument panel. It has two functions: 1. It is used as warning to the operator that a potential engine damaging condition has been detected. If the DDEC system is programmed for shutdown, the engine will shutdown on its own within 30 seconds. The engine should not be run until the condition is corrected. 2. It is used by the operator or technician to "flash" out active trouble codes.
SEO	Stop Engine Override: Allows the stop engine condition to be overridden in case it is required.
SET/COAST	Set/Coast Switch: Used in cruise control.
SRS	Synchronous Reference Sensor: Indicates a specific cylinder in the firing order.
TBS	Turbocharger Boost Sensor: Monitors turbo boost.
TBD	To be determined.
TD	Tachometer Driver: An output from the ECM for electronic tachometers and or data loggers.
TPS	Throttle Position Sensor: Used to detect throttle request (a component of the EFPA). Also, referred to as LSG.
TRS	Timing Reference Sensor: Used to detect whenever any cylinder is about to be fired.
VIH	Vehicle Interface Harness (OEM Wiring)
VIN	Vehicle Identification Number

Abbreviations	Terms
VSG	Variable Speed Governor. Also, referred to as PTO (Power Take–Off).
VSS	Vehicle Speed Sensor: Used to detect vehicle speed.
VSS OC	Vehicle Speed Sensor Open Collector: An ECM input which must be used in addition to the VSS positive input when certain types of vehicle speed sensors are used. Refer to the Application and Installation manual for installation.

* As a light bulb check and system check, the check engine light will come on for about 5 seconds when the ignition is turned on. If the CEL remains on, or comes back on, the self diagnostic system has detected a problem. If the problem goes away, the light will go out, but a trouble code will be stored in the ECM as an inactive code.

† As a light bulb check and system check, the stop engine light will come on for about 5 seconds when the ignition is turned on.

Table 4–1 Abbreviations and Terms