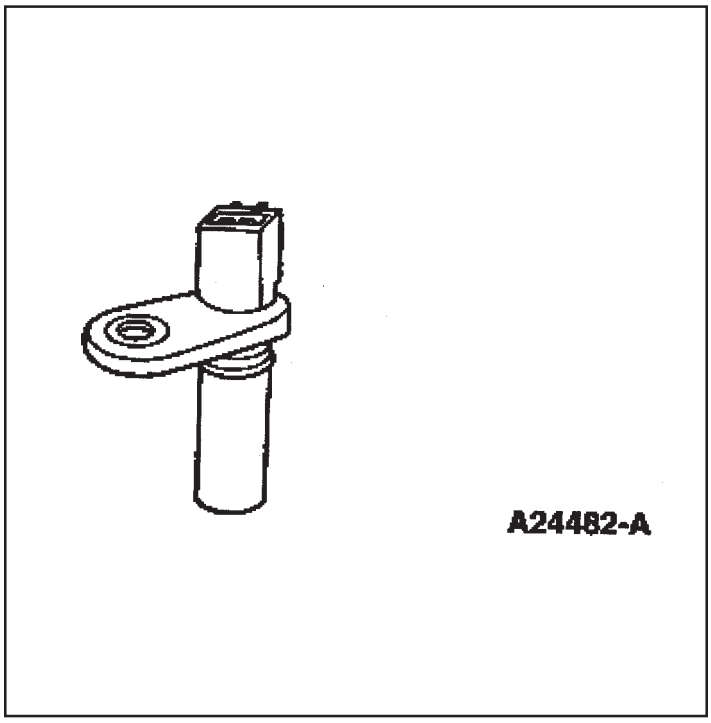
INDEX

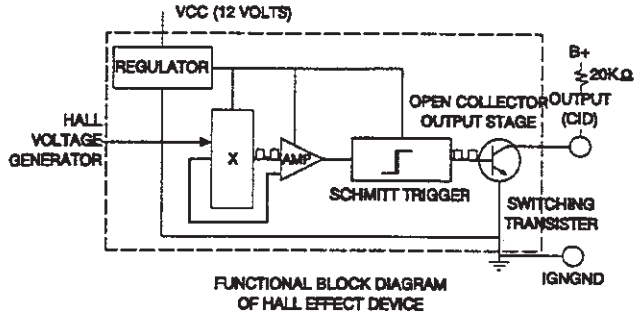
GENERAL INFORMATION

Camshaft Position Sensor (CMP) (HALL EFFECT)

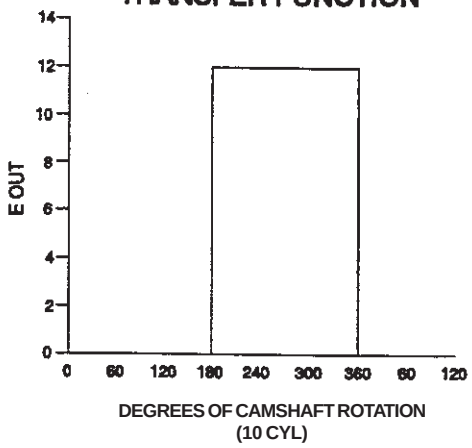
The camshaft position (CMP) sensor detects the position of the camshaft. The CMP sensor identifies when piston No. 1 is on its compression stroke. The Coil On Plug (COP) Ignition application also uses the CMP signal to select the proper ignition coil to fire. The input circuit to the ICM is referred to as the CMP input or circuit



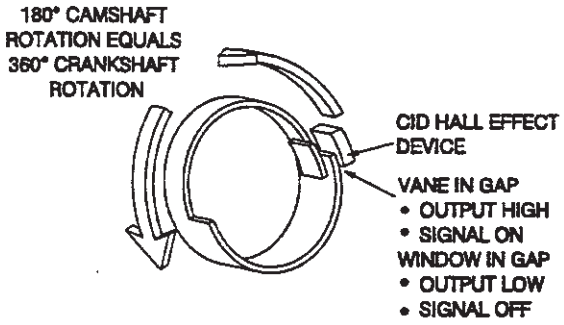
SENSOR OPERATION

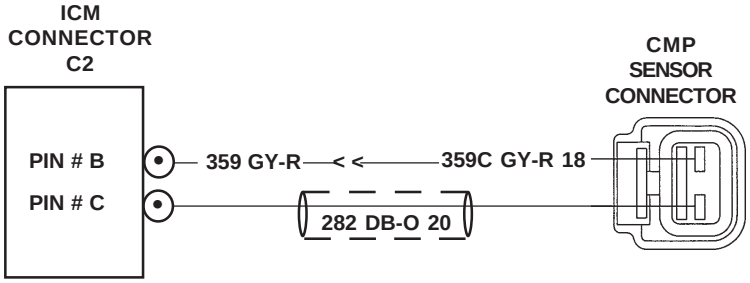


TRANSFER FUNCTION



10 CYLINDER





VOLTAGE: SIGNAL & IGNGND

0-0.4	KOEO WINDOW
B+	KOEO VANE
1/2 B+	KOER

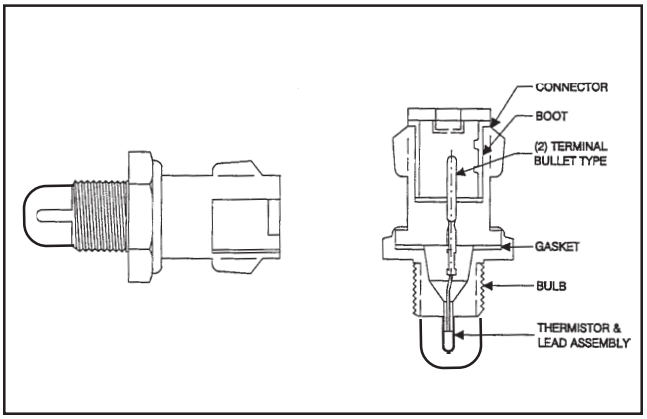
Engine Cylinder Head Temperature (CHT) Sensor

The cylinder head temperature (CHT) sensor is a thermistor device in which resistance changes with temperature. The electrical resistance of a thermistor decreases as temperature increases, and increases as temperature decreases. The varying resistance affects the voltage drop across the sensor terminals and provides electrical signals to the ICM corresponding to temperature.

Thermistor-type sensors are considered passive sensors. A passive sensor is connected to a voltage divider network so that varying the resistance of the passive sensor causes a variation in total current flow.

Voltage that is dropped across a fixed resistor in series with the sensor resistor determines the voltage signal at the ICM. This voltage signal is equal to the reference voltage minus the voltage drop across the fixed resistor.

The cylinder head temperature (CHT) sensor is installed in the aluminum cylinder head and measures the metal temperature. The CHT sensor can provide complete engine temperature information and can be used to infer coolant temperature. If the CHT sensor conveys an overheating condition to the ICM, the ICM would then initiate a fail-safe cooling strategy based on information from the CHT sensor. A cooling system failure such as low coolant or coolant loss could cause an overheating condition. As a result, damage to major engine components could occur. Using both the CHT sensor and fail-safe cooling strategy, the ICM prevents damage by allowing air cooling of the engine and limp home capability.

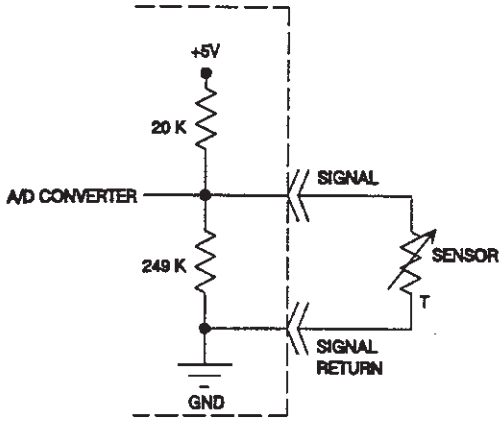


CHT sensor (typical).

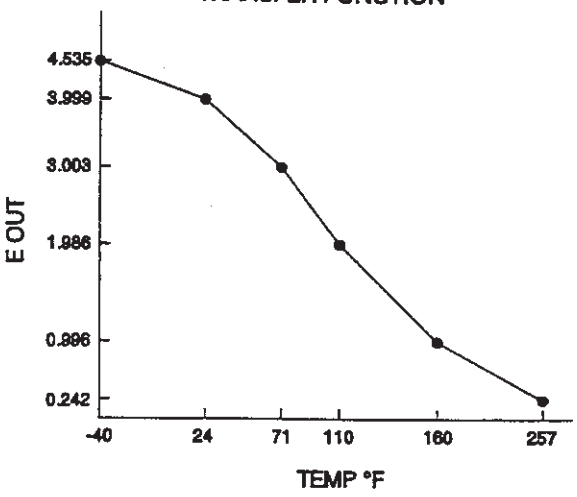
Specifications

- Range of Measurement: -40°C / -40°F to 125°C / 257°F
- Measurement Accuracy: $\pm$ 3°C
- Response Time: 10 sec. max. for full range
- Resolution: 0.6°C max.
- Output Range: 4.8% min. to 91% max. of VREF
- Current Draw: < 5 mA from VREF
- Load Impedance: $\geq$ 100 kohms

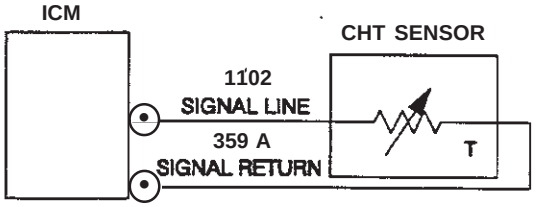
VOLTAGE DIVIDER NETWORK



TRANSFER FUNCTION



TROUBLESHOOTING



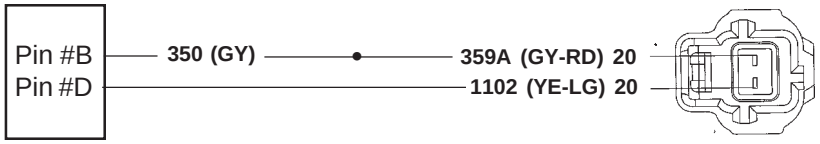
VOLTAGE: SIGNAL & SIGNAL RETURN

0.242 - 4.535	OPERATIONAL
<0.242	SHORTED
>4.535	OPEN

RESISTANCE: SIGNAL & SIGNAL RETURN (ICM DISCONNECTED)

-40 °F	269 KΩ
32 °F	95 KΩ
77 °F	29 KΩ
248 °F	1.2 KΩ

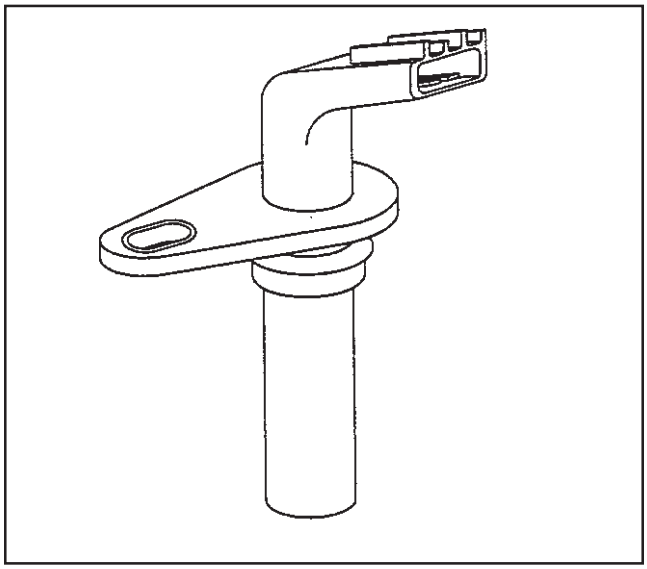
ICM Connector C2



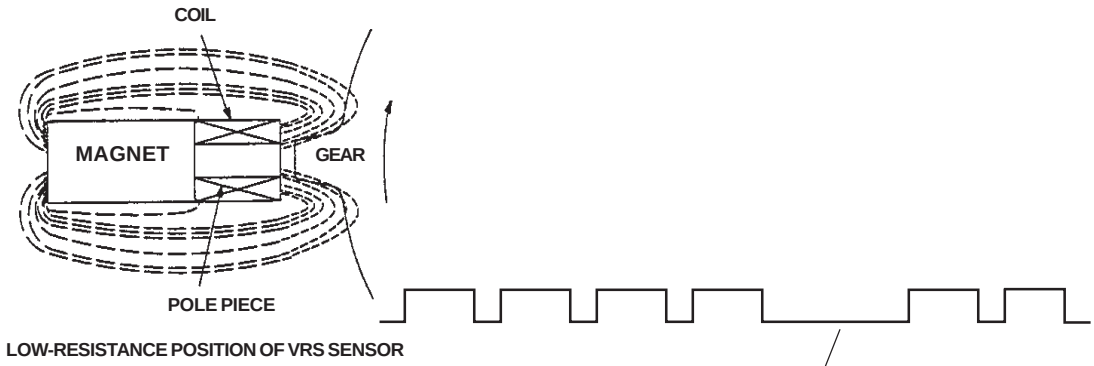
Crankshaft Position Sensor (CKP)

The crankshaft position (CKP) sensor is a magnetic transducer mounted on the engine block adjacent to a pulse wheel located on the crankshaft. By monitoring the crankshaft mounted pulse wheel, the CKP is the primary sensor for ignition information to the ignition control module (ICM). The trigger wheel has a total of 35 teeth spaced 10 degrees apart with one empty space for a missing tooth. The 6.8L ten cylinder pulse wheel has 39 teeth spaced 9 degrees apart and one 9 degree empty space for a missing tooth. By monitoring the trigger wheel, the CKP indicates crankshaft position and speed information to the ICM. By monitoring the missing tooth, the CKP is also able to identify piston travel in order to synchronize the ignition system and provide a way of tracking the angular position of the crankshaft relative to fixed reference.

NOTE: Engine may not start if cranking speed is below 140 RPM.

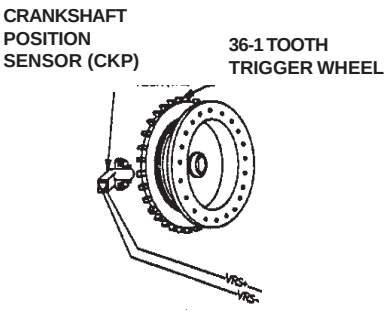


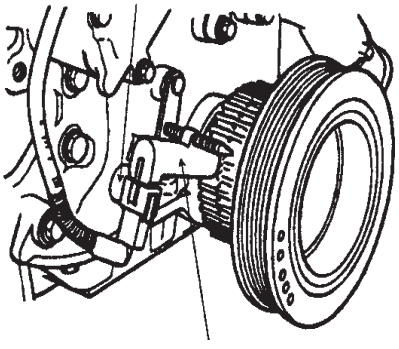
CKP Sensor (typical).

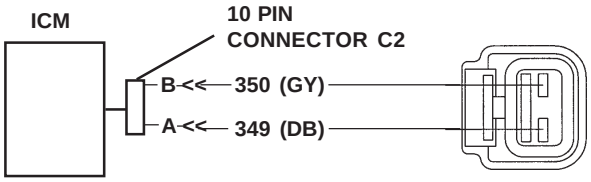


CKP sensor output voltage is 150 millivolts peak-to-peak at a minimum engine speed of 300 RPM.

CKP sensor output voltage is 300 millivolts peak-to-peak at a maximum engine speed of 8000 RPM.

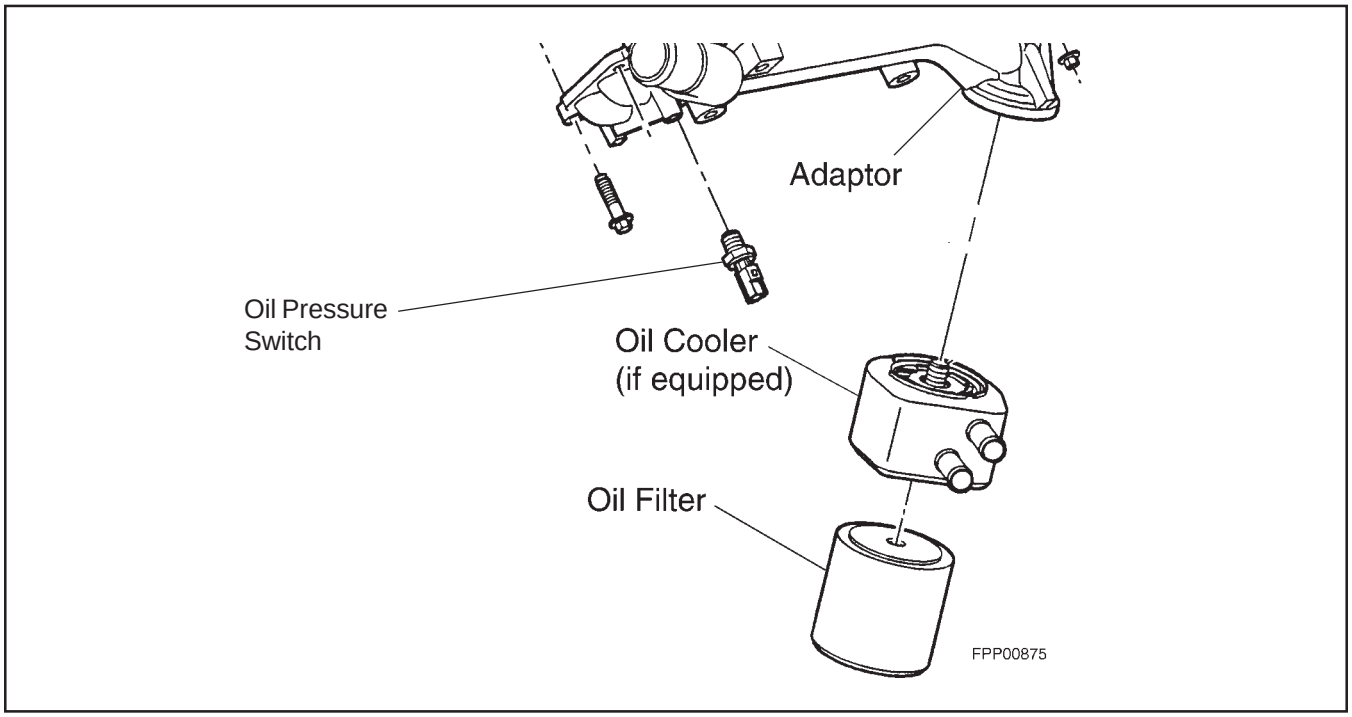






Oil Pressure Switch

It is a normally opened switch. When engine oil pressure falls below 6 psi, the oil pressure switch will close, the ICM will sense ground and immediately remove the ground side of the ignition coils until the ignition has been cycled off and on. The ICM will allow the engine to restart, but will stall again as long as the oil pressure stays below 6 psi.



Electronic Engine Controls

The electronic engine controls consist of the:

- Integrated control module (ICM).
- Camshaft position (CMP) sensor.
- Crankshaft position (CKP) sensor.
- Cylinder heat temperature (CHT) sensor.
- Coil on plug (COP).
- Oil Pressure Switch.

The ICM needs the following inputs to calibrate the engine properly:

- Camshaft position.
- Engine rpm.
- Crankshaft position.
- Cylinder heat temperature.

The CMP sensor:

- Sends the ICM a signal indicating camshaft position used for spark synchronization.

The CKP sensor:

- Sends the ICM a signal indicating crankshaft position.
- Is essential for calculating spark timing.

The cylinder head temperature (CHT) sensor:

- Is mounted into the wall of the cylinder head and is not connected to any coolant passages.
- Sends a signal to the ICM indicating the cylinder head temperature.
  - If the temperature exceeds 126°C (258°F) the ICM disables four coils at a time. The ICM will alternate which four coils are disabled every 32 engine cycles. The four cylinders that are not being powered act as air pumps to aid in cooling the engine.
  - If the temperature exceeds 154°C (310°F) the ICM disables all of the coils until the engine temperature drops below 154°C (310°F).

DIAGNOSIS AND TESTING

General Procedures for Pinpoint Testing

Inspection

The ignition control module (ICM) does not contain internal diagnostics. The symptom based chart will assist in directing the technician in validating component function and operation. The basic diagnostic procedure recommended for most sensor and actuator circuits is to disconnect the harness at the connector and inspect for corrosion, bent pins, spread pins or any condition that could cause a loose or intermittent connection.

Connector Checks to Ground (B-)

Measure the resistance of all wiring harness connectors to ground (preferably the negative battery cable) to determine if a short to ground condition is present. **It is important that during this test all accessories be turned off. Current flow in the system will affect resistance readings. If the reading is fluctuating greatly, disconnect the battery and measure to the negative battery cable.**

- Signal return (marked A on all sensor circuits) should measure less than 5 ohms.
- The VREF and signal lines, with the processor connected, will normally measure greater than 50 k ohms.
- Power ground on an actuator circuit should measure less than 5 ohms. The control side of an actuator circuit will also normally measure greater than 50 k ohms.

Connector Voltage Checks

The next step is to turn the ignition key to the ON position and measure if the expected voltages are present at the connector. On circuits with expected voltages this test will verity the integrity of that circuit. On circuits without an expected voltage this test will determine if that circuit is shorted or miswired to a voltage source.

- Signal return (marked A on all sensor circuits) should measure less than 2.5 volts.
- VREF should measure 4.5-5.5 volts. If this is higher or lower than expected, disconnect sensors one at a time to determine if a sensor is biasing the circuit and refer to VREF pinpoint procedures.
- Signal lines will measure either 0-.25v if the circuit is designed to pull down when disconnected or a higher voltage (normally 4.6-5, or 12v) if it is designed as a pull up circuit. A pull up signal circuit that measures the the expected value normally indicates a good circuit.
- Actuator circuits may be either on/off type circuits (normally 12 volts) or pulse width modulated circuits (12 volts controlled by a % duty cycles).
- Communication circuits are similar to sensor circuits when disconnected in that they will be designed to either pull up or pull down when disconnected. Measuring the expected voltage of a communication circuit when disconnected will often discern its condition.

Harness Resistance Tests

Harness resistance tests are performed when a circuit is suspected of having high resistance or being open. Measure resistance from the sensor connector end to the processor connector. If an open circuit or high resistance is encountered, the problem is most easily isolated by separating the circuit at the interim connectors (normally the 10-pin main connector) and measuring resistance through both halves of the circuit.

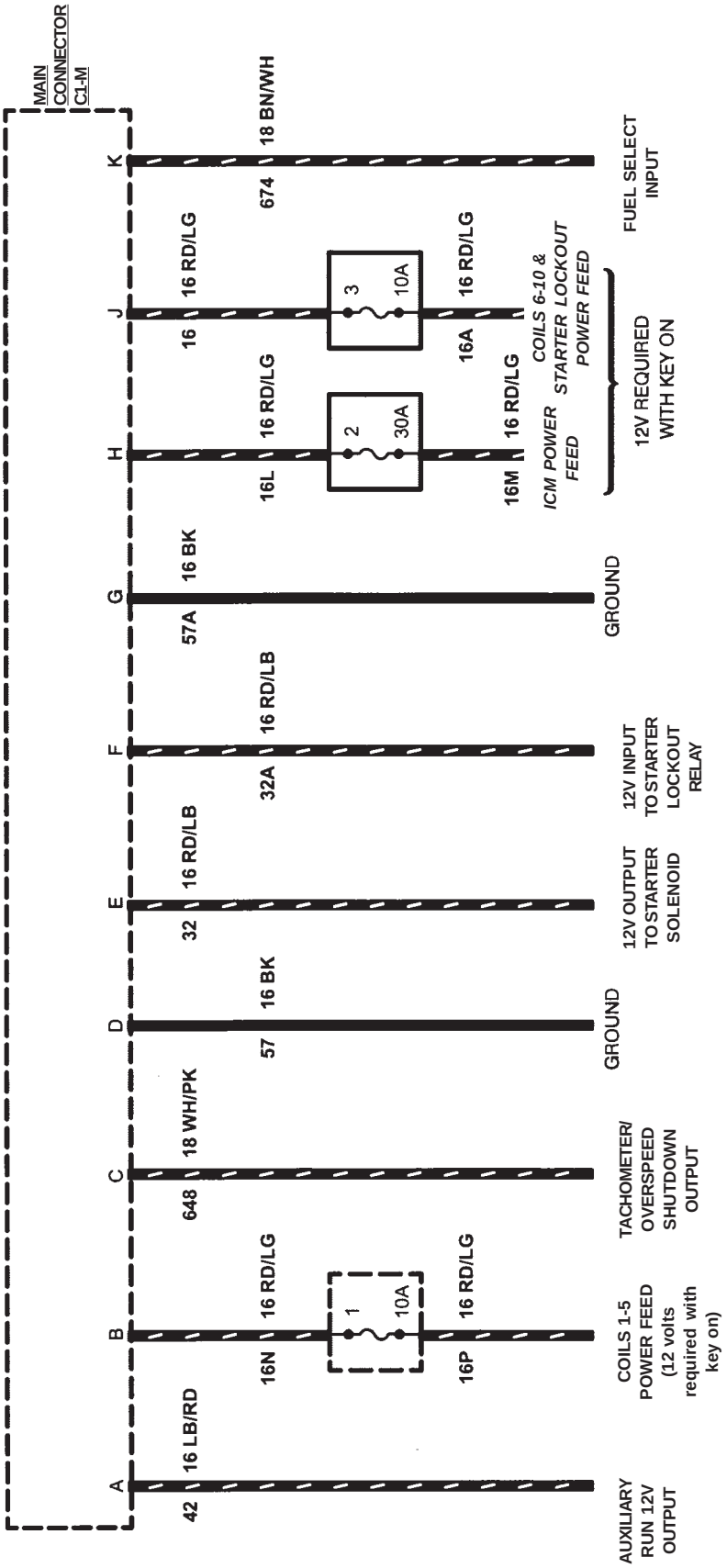
CHT SENSOR DATA

Temperature Sensor Characteristics

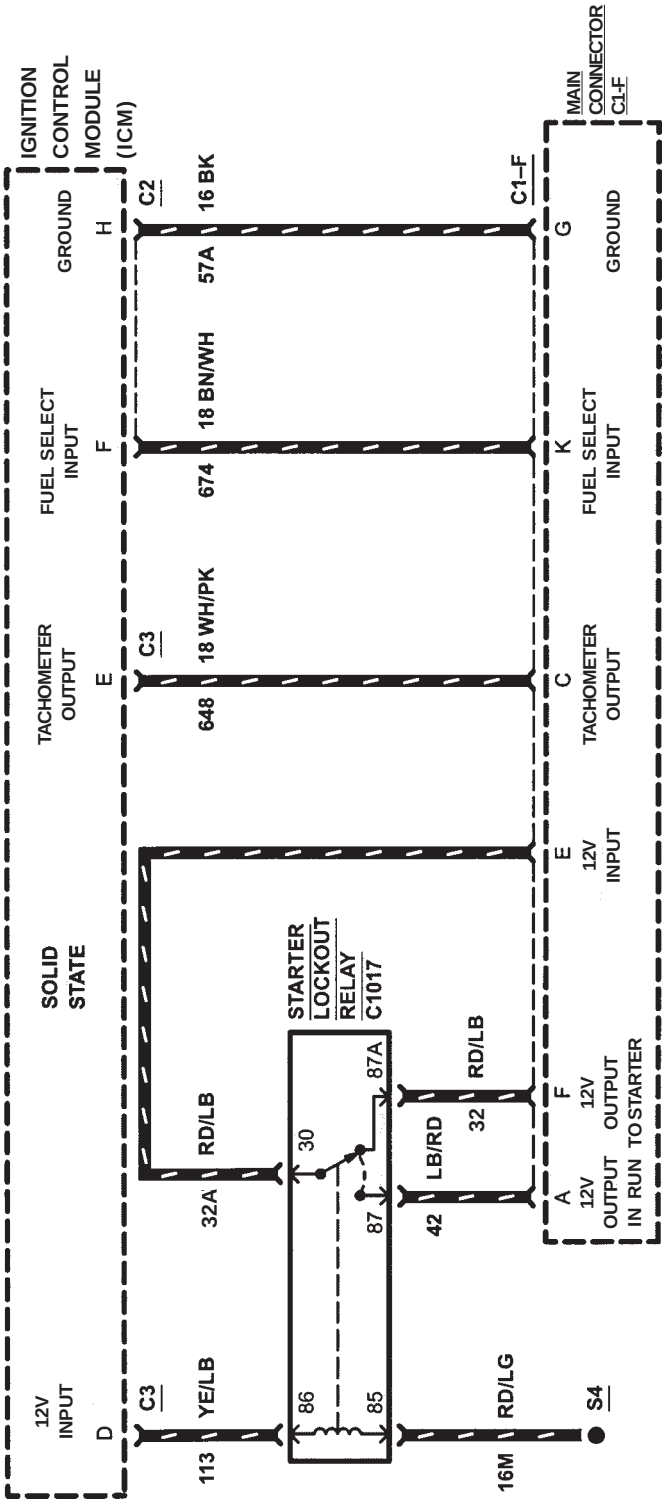
TEMPERATURE (C)	TEMPERATURE (F)	NOM R, (OHMS)	NOM E_{OUT} (VOLTS)
-40	-40	925,021	4.54
-35	-31	673,787	4.50
-30	-22	496,051	4.46
-25	-13	368,896	4.41
-20	-4	276,959	4.34
-15	5	209,816	4.25
-10	14	160,313	4.15
-5	23	123,485	4.02
0	32	95,851	3.88
5	41	74,914	3.71
10	50	58,987	3.52
15	59	46,774	3.32
20	68	37,340	3.09
25	77	30,000	2.86
30	86	24,253	2.62
35	95	19,716	2.39
40	104	16,113	2.15
45	113	13,236	1.93
50	122	10,926	1.72
55	131	9,061	1.52
60	140	7,548	1.34
65	149	6,332	1.18
70	158	5,335	1.04
75	167	4,515	.91
80	176	3,837	.79
85	185	3,274	.70
90	194	2,804	.61
95	203	2,411	.53
100	212	2,080	.47
105	221	1,801	.41
110	230	1,564	.36
115	239	1,363	.32
120	248	1,191	.28
125	257	1,044	.25
130	266	918	.22
135	275	809	.19
140	284	715	.17
145	293	633	.15
150	302	563	.14

Voltage values calculated for VREF=5 volts (may vary 15% due to sensor and VREF variations).

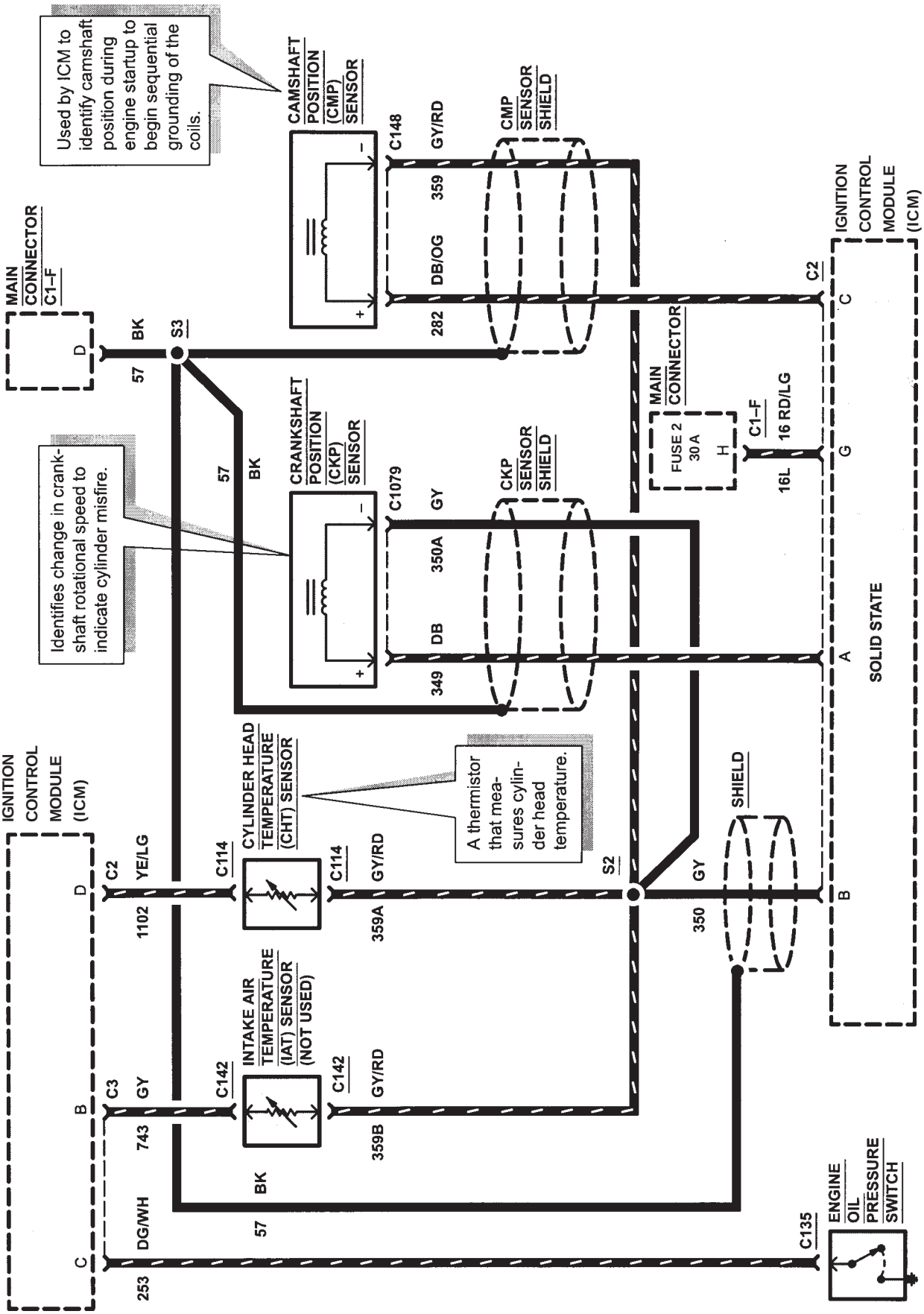
Main Jumper Connector C1-M (XU1L-14324-BB)



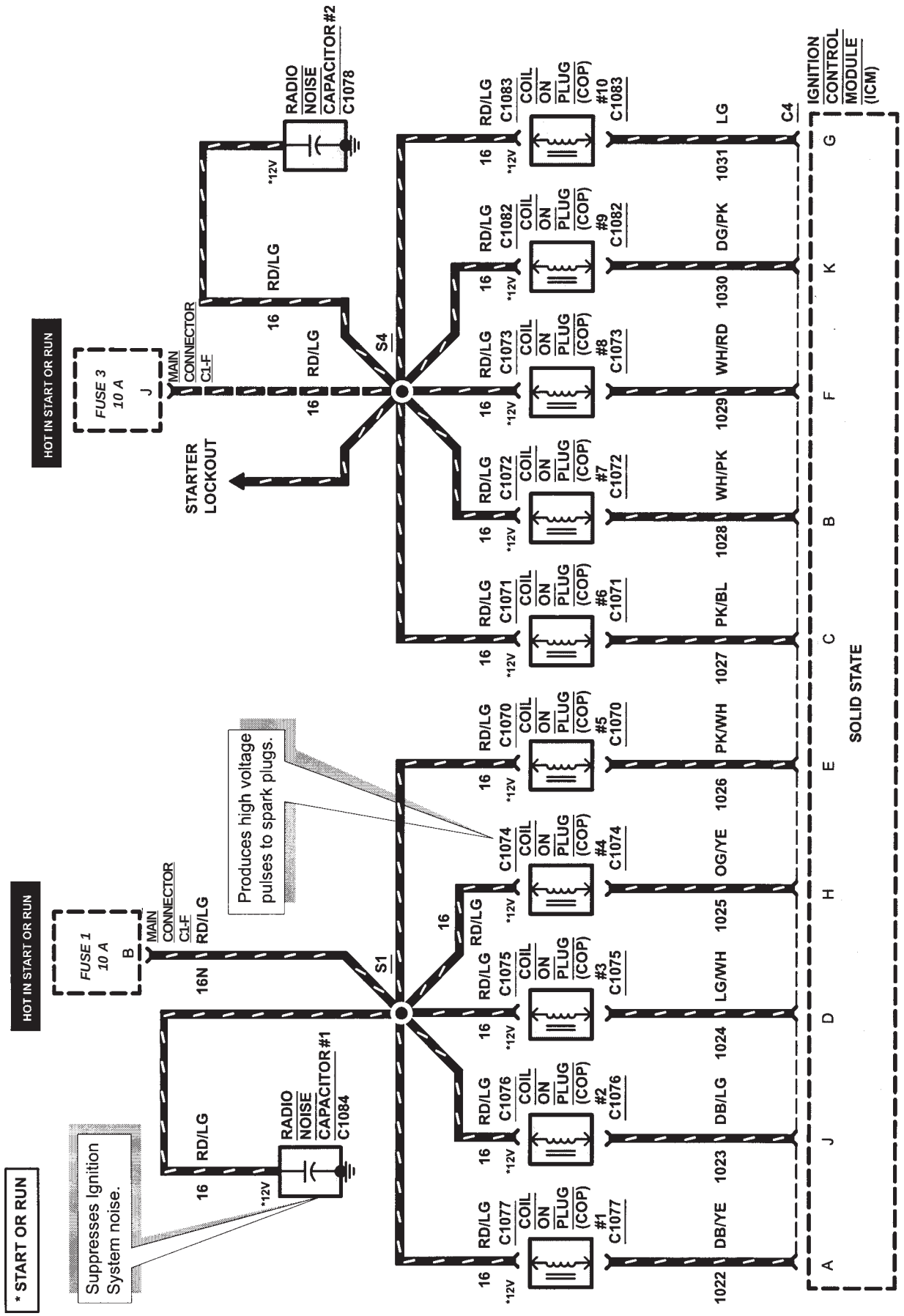
Starter Lockout (part of SK2U1L-12A200-BA)



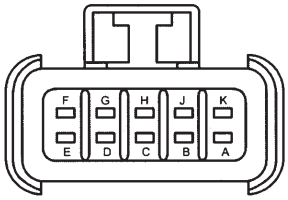
Sensors (part of SK2U1L-12A200-BA)



Engine Controls (part of SK2U1L-12A200-BA)



Engine Harness Connectors

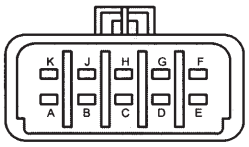


C1-F

Engine Harness 10 Pin Connector

12A200-CG

PIN	CIRCUIT	CIRCUIT FUNCTION
A	42 (LB/RD)	12V Run Output (above 600 RPM)
B	16N (RD/LG)	Coils 6 - 10 and Starter Lockout Power
C	648 (WH/PK)	Tachometer/Overspeed Shutdown Output
D	57 (BK)	Ground
E	32 (RD/LB)	Lockout Relay Power to Starter
F	32A (RD/LB)	12V in Start Position
G	57A (BK)	Ground
H	16L (RD/LG)	12V ICM Power with Key On
J	16 (RD/LG)	12V Coils 1 - 5 Power with Key On
K	674 (BR/WH)	Fuel Select Input

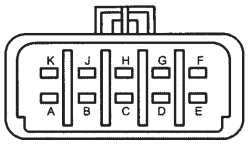


C1-M

Jumper Harness 10 Pin Connector

14324-BB

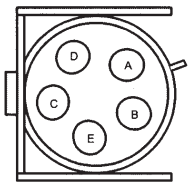
PIN	CIRCUIT	CIRCUIT FUNCTION
A	42 (LB/RD)	12V Run Output (above 600 RPM)
B	16N (RD/LG)	12V Required with Key On
C	648 (WH/PK)	Tachometer/Shutdown Output
D	57 (BK)	Ground
E	32 (RD/LB)	12V Output to Starter
F	32A (RD/LB)	12V in Start Position
G	57A (BK)	Ground
H	16L (RD/LG)	12V Required with Key On
J	16 (RD/LG)	12V Required with Key On
K	674 (BR/WH)	Fuel Select Input



C2

ICM 10 PIN CONNECTOR

PIN	CIRCUIT	CIRCUIT FUNCTION
A	349 (DB)	Crank Position Sensor Input
B	350 (GY)	Signal Return (-)
C	282 (DB/OG)	Cam Sensor (+) 5V
D	1102 (YE/LG)	Cylinder Head Temp Sensor (+) 5V
E	–	NOT USED
F	674 (BN/WH)	Fuel Select Input
G	16L (RD/LG)	Power (+) 12V Input
H	57A (BK)	Ground
J	–	NOT USED
K	–	NOT USED

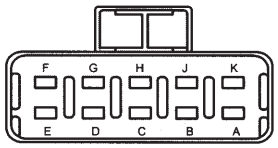


C3

ICM 5 PIN CONNECTOR

PIN	CIRCUIT	CIRCUIT FUNCTION
A	–	NOT USED
B	743 (GY)	IAT Sensor (NOT USED)
C	253 (DG/WH)	Oil Pressure Switch Input
D	113 (YE/LB)	Starter Lockout
E	648 (WH/PK)	Aux. Out 2/ Overspeed Ground

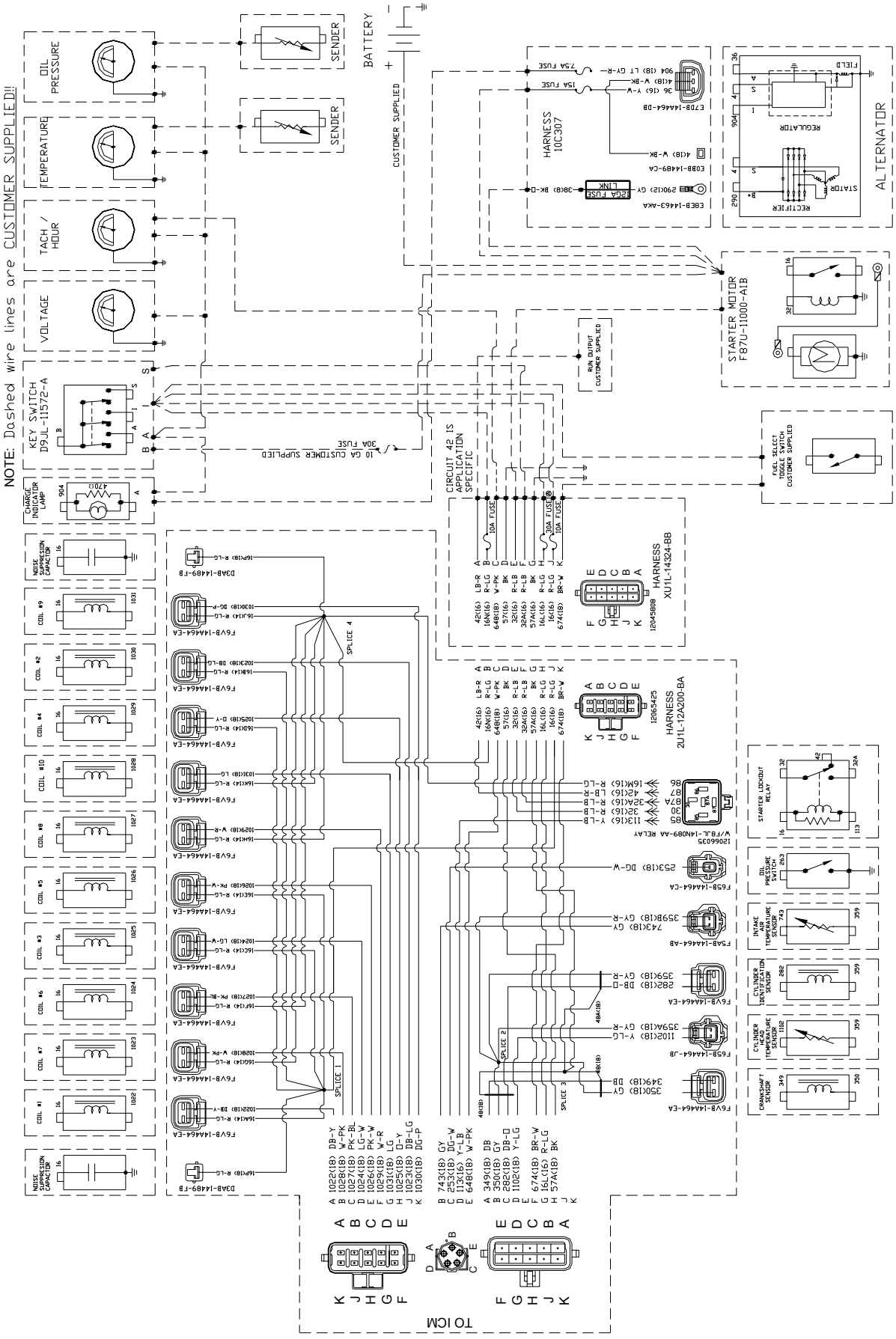
ICM Connectors



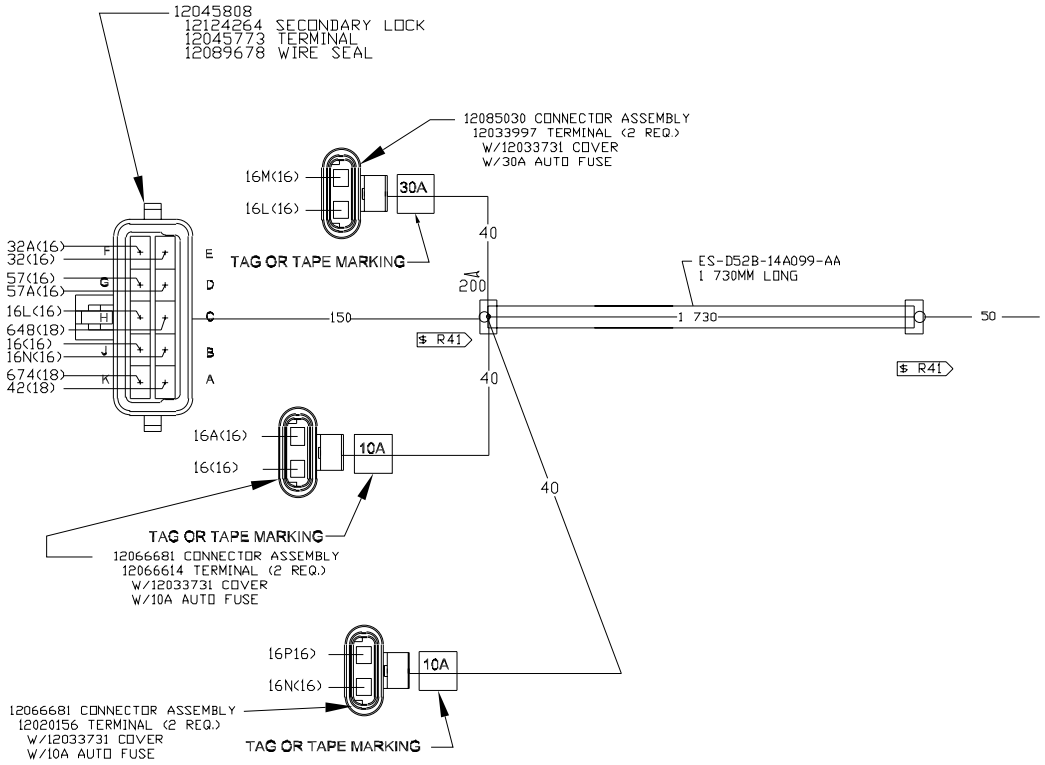
C4
ICM 10 PIN CONNECTOR

PIN	CIRCUIT	CIRCUIT FUNCTION
A	1022 (DB/YE)	Coil #1
B	1028 (WH/PK)	Coil #7
C	1027 (PK/BU)	Coil #6
D	1024 (LG/WH)	Coil #3
E	1026 (PK/WH)	Coil #5
F	1029 (WH/RD)	Coil #8
G	1031 (LG)	Coil #10
H	1025 (OG/YE)	Coil #4
J	1023 (DB/LG)	Coil #2
K	1030 (DG/PK)	Coil #9

Recommended Wiring (MS-2UIL-3458-BA)



Main Jumper Harness (XU1L-14324-BB)



674	18	BR-W	AZ	OCTANE SELECT	1 930
648	18	W-PK	AZ	TECH.	1 930
57A	16	BK	AZ	GROUND	1 930
57	16	BK	AZ	GROUND	1 930
42	18	LB-R	AZ	STATOR LOCKOUT AUXILIARY OUT	1 930
32A	16	R-LB	AZ	STARTER IN FROM SWITCH	1 930
32	16	R-LB	AZ	STARTER LOCKOUT TO RELAY	1 930
16P	16	R-LG	AZ	POWER (KEY ON)	1 820
16N	16	R-LG	AZ	POWER (KEY ON)	190
16M	16	R-LG	AZ	POWER (KEY ON)	1 820
16L	16	R-LG	AZ	POWER (KEY ON)	190
16A	16	R-LG	AZ	POWER (KEY ON)	1 820
16	16	R-LG	AZ	POWER (KEY ON)	190
CIRCUIT NUMBER	WIRE SIZE	COLOR	MAT	CIRCUIT DESCRIPTION	CIRCUIT LENGTH

Symptom Chart

Engine Performance No Load

SYMPTOM	POSSIBLE CAUSE	ACTION
Engine Runs Briefly and Shuts Down	• Low Fuel Pressure • Electronic Actuator Instability • Overspeed Shutdown • Low Oil Pressure • Oil Pressure Switch Failure • CHT Switch Failure • Wiring Failure • Engine Overheating • ICM Failure	Go to Section 04 Go to Section 04 Go to Pinpoint Test A Go to Pinpoint Test E Go to Pinpoint Test E Go to Pinpoint Test F Go to Pinpoint Test A Go to Section 05 Go to Pinpoint Test A
Engine Cranks But No Start	• Electronic Actuator Not Open • Low Fuel Pressure • Fuel Lockout not operating • Coil on Plug Power Loss • Crankshaft Position Sensor Failure • Camshaft Position Sensor Failure • ICM Ground Loss • Wiring Failure • Engine Overheating	Go to Section 04 Go to Section 04 Go to Section 04 Go to Pinpoint Test D Go to Pinpoint Test C Go to Pinpoint Test B Go to Pinpoint Test A Go to Pinpoint Test A Go to Section 05
Engine Runs Poorly	• Actuator or Air Blockage • Fuel Contaminated • Low Fuel Pressure • Incorrect Fuel Select Table Selected • Noise Suppression Capacitor Failure • Harness Ground Shielding Failure • Coil on Plug Failure • New ICM Installed	Go to Section 04 Go to Section 04 Go to Section 04 Go to Pinpoint Test A Go to Pinpoint Test D Go to Pinpoint Test F Go to Pinpoint Test D Verify part number.
Engine Cranks Slowly	• Low Battery Voltage • Starter Solenoid • Starter Failure • Auxiliary Failure	Go to Section 07 Go to Section 07 Go to Section 07 Inspect auxiliary drive components
Engine Does Not Crank	• OEM Shutdown- Engine Temp Safety • Starter Lockout Relay • ICM Power Fuse Open	Go to Pinpoint Test F Go to Section 07 Go to Pinpoint Test A

Engine Performance While Under Load

SYMPTOM	POSSIBLE CAUSE	ACTION
Engine Stalls/Quits	• Low Fuel Pressure • Low Battery Voltage • OEM Safety Shutdowns	Go to Section 04 Go to Section 07 Go to Pinpoint Test A
Runs Rough	• Low Fuel Pressure • Vacuum Loss • Ground Loss • Spark Plugs Fouled • Coil on Plug Power Loss • Wiring Failure	Go to Section 04 Inspect vacuum hose Go to Pinpoint Test G Go to Section 04 Go to Pinpoint Test D Go to Pinpoint Test A
Misses	• Spark Plugs Fouled • Spark Plug Gap to High • Cracked Spark Plug Insulator • Harness Ground Shielding Failure • Coil on Plug Power Loss	Go to Pinpoint Test A Inspect Spark Plugs Inspect Spark Plugs Go to Pinpoint Test G Go to Pinpoint Test D
Buck/Jerk *	• Low Fuel Pressure • Electronic Actuator Sticking • Vacuum Leak • Not All Coils Operational	Go to Section 04 Go to Section 04 Inspect vacuum hose Go to Pinpoint Test D
Hesitation/Stumble *	• Low Fuel Pressure	Go to Section 04
Surge *	• Low Fuel Pressure • Electronic Actuator Sticking • Not All Coils Operational	Go to Section 04 Go to Section 04 Go to Pinpoint Test D
Backfires *	• Excess Lean Condition • Fouled Spark Plugs • Cylinder Head Temperature (CHT) Sensor • Coil on Plug Power Loss • Intake Manifold Leak • Dry Fuel Lockout Inoperative	Go to Section 04 Inspect Spark Plugs Go to Pinpoint Test F Go to Pinpoint Test D Inspect manifold Go to Section 04
Lack/Loss of Power	• Low Fuel Pressure • Electronic Actuator Sticking • Aux. Component • Camshaft Position (CMP) Sensor Ground Shielding Lost • Crankshaft Position (CRK) Sensor Ground Shielding Lost • Low Cylinder Compression • Engine is in Limp Home Mode • Binding Auxiliary Equipment	Go to Section 04 Go to Section 04 Inspect for auxiliary engine component binding condition Go to Pinpoint Test B Go to Pinpoint Test G Go to Section 02 Go to Pinpoint Test G Inspect for auxiliary binding components

SYMPTOM	POSSIBLE CAUSE	ACTION
Spark Knock	• Fuel Delivery System • Fuel Selection Timing • Wrong Spark Plugs (Too High Heat Range) • High Intake Air Temperature • High Engine Temperature	Go to Section 04 Go to Section 04 Inspect spark plugs Go to Section 04 Go to Section 05

Performance Concerns

SYMPTOM	POSSIBLE CAUSE	ACTION
Diesels/Runs On	• Faulty Fuel Delivery System • Hot Spots In Cylinders - Spark Plugs - Carbon Build-up - High Idle Speed • Damaged Ignition System • Improper Sealing of Intake Manifold	Go to Section 04 Go to Pinpoint Test A Go to Section 03 Go to Section 02
Poor Fuel Economy	• Low Fuel Pressure • High Engine Temperature • ICM	Go to Section 04 Go to Section 05 Go to Pinpoint Test A

Engine

SYMPTOM	POSSIBLE CAUSE	ACTION
Oil System Concerns • High Oil Consumption	• Oil Viscosity • External Leaks • Improper Oil dipstick • Low Cylinder Compression • Valve Seals • Cylinder Wall Taper Excessive	Go to Section 02
Poor Fuel Economy	• Restricted Air Filter Element	Inspect for clogged air system
Cooling System Concerns	• Trapped Air Pocket • Worn Drivebelt • Worn Waterpump • Stuck Thermostat • Plugged Radiator (Internal & External)	Go to Section 05 Go to Section 05 Go to Section 05 Go to Section 05 Go to Section 05
Exhaust System Concerns- Visible Smoke		Go to Section 04
Fuel System Concerns	• Leaky Lines	Go to Section 04
Engine Noise	• Coil on Plug Spark	Go to Pinpoint Test D

Pinpoint Test A - ICM Check

The ICM check will verify the required inputs and outputs of the module. Always inspect the integrity of the systems the engine controls prior to the start of this test as failures and faults associated within these can adversely affect the engine to operate properly.

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Check the battery is fully charged.
3. Inspect for bent or broken connector terminals.
4. Inspect battery and starter power feed terminals for loose or corroded connections.
5. Inspect all ground connections for loose or corroded connections.
6. Visually inspect for and note auxiliary system connections not shown on the **Recommended Customer Connections Wiring Schematic**.

NOTE: Auxiliary applications may time out and remove voltage to the ICM, cycle key off and on to verify this application is present.

Normal Operation

A constant 12-volt input with the key on, and a good solid ground is required. Under certain equipment applications, the 12-volt input may time out with-in 15 seconds after the ignition switch is placed into the ON position, due to the dry fuel safety shut-off system.

<table>
<tr><th>Step</th><th>Action</th><th>Values</th><th>Yes</th><th>No</th></tr>
<tr><td>1</td><td>1. KOEO.
2. Disconnect the ICM connector C2.
3. Using a voltmeter, check pin G circuit 16L RD/LG.

Is the voltage within the specified value?</td><td>Battery Voltage</td><td>GO to Step 2</td><td>GO to Step 9</td></tr>
<tr><td>2</td><td>1. Disconnect the ICM connector C4.
2. KOEO.
3. Using a voltmeter, check pins A thru K of the harness connector.

Is the voltage within the specified value?</td><td>Battery Voltage</td><td>GO to Step 3</td><td>Inspect Fuse 1 and 3 for OPEN and RETEST. If FPP fuses are not present, Go to Pinpoint Test D</td></tr>
<tr><td>3</td><td>1. KOEO.
2. Disconnect the ICM connector C3.
3. Using a voltmeter, check pin D circuit 113 YL/LB.

Is the voltage within the specified value?</td><td>Battery Voltage</td><td>GO to Step 4</td><td>Go to Section 07</td></tr>
<tr><td>4</td><td>1. KOEO.
2. Disconnect connector C2.
3. Using a voltmeter/ohmmeter, compare the value of pin F circuit 674 BR/WH to the fuel select table below.

<table><tr><th>FUEL SELECT</th><th>CIRCUIT 674 BR/WH VALUE</th></tr><tr><td>LPG</td><td>GROUND</td></tr><tr><td>NG</td><td>12 VOLTS</td></tr><tr><td>NG</td><td>OPEN</td></tr></table>
Does the measured value match the fuel application?</td><td></td><td>GO to Step 5</td><td>REPAIR the circuit(s) in question. TEST the system for normal operation.</td></tr>
</table>

5	1. Disconnect the ICM connector C2. 2. KOEO 3. Using a voltmeter, check pin H circuit 57A BK. Is the voltage present?	0 volts	GO to Step 6	REPAIR the circuit(s) for a short to power and RETEST the system for normal operation.
6	1. Key Off, Engine Off. 2. Inspect the ICM ground terminal location (s) for clean and tight connections. 3. Disconnect ICM connector C2. 4. Using an ohmmeter, measure the resistance of terminal C2 pin H to a known good ground. Is the resistance within the specified value?	0.00 ohms or **Ω**	GO to Step 7	REPAIR the circuit(s) for an OPEN and RETEST the system for normal operation.
7	1. Key Off 2. Disconnect ICM Connector C3. 3. Using an ohmmeter, check the resistance of circuit 253 DG/WH between connector C3 pin C and the oil pressure switch connector. Is the resistance less than 5 ohms?		GO Pinpoint Test E	GO to Step 8
8	1. Key Off 2. Reconnect ICM Connector C3. 3. Disconnect the oil pressure switch. 4. Using an ohmmeter, check the resistance of circuit 253 DG/WH to a known ground. Is the resistance less than 5 ohms?		Replace the ICM and RETEST the system.	System OK. Check for a stuck throttle, loose or binding throttle linkage.
9	1. Check the 30A Fuse in the main jumper harness. Is the fuse open?		GO to Step 10	GO to Section 03
10	1. Key Off. 2. Remove the 30A fuse. 3. Using a voltmeter, check both side of the fuse terminal for battery voltage. Is battery voltage present?		REPAIR the circuit(s) for short to power and RETEST the system for normal operation.	GO to Step 11
11	1. Key Off 2. Using an ohmmeter, check both side of the fuse terminal for resistance to ground. Is the resistance less than 5 ohms?		REPAIR the circuit(s) for short to ground and RETEST the system for normal operation.	System OK

Pinpoint Test B - Camshaft Position (CMP) Sensor Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Inspect for bent or broken connector terminals.
3. Inspect for a loose or damaged sensor.
4. Visually inspect for and note auxiliary system connections not shown on the **Recommended Customer Connections Wiring Schematic**.

Normal Operation

The camshaft position (CMP) sensor detects the position of the camshaft. The CMP sensor identifies Piston No. 1 is on its compression stroke. The Coil On Plug (COP) Ignition application also uses the CMP signal to select the proper ignition coil to fire. The ICM monitors the VREF output for current drop.

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Step	Action	Values	Yes	No
1	1. Start the engine. Does the engine start and shut down above 400 RPM or after 3 or 4 seconds of operation?		Check for a stuck throttle, loose or binding throttle linkage.	Engine does not start, GO to Step 2
2	1. Key Off. 2. Disconnect the camshaft position CMP sensor. 3. KOEO 4. Using a voltmeter, measure the voltage at the CMP connector circuit 282 DB/OG. NOTE: Auxiliary applications may time out and remove voltage to the ICM, cycle key off and on to verify this application is present. Is the voltage within the specified value?	4.5-5.0V	GO to Step 3	GO to Step 6
3	1. Key ON. 2. Using a voltmeter, check for voltage at the CMP connector circuit 359 GY/RD and ground. Is the voltage within the specified value?	0 volts	REPAIR Short to power, and RETEST the system for normal operation.	GO to Step 4
4	1. Key Off. 2. Using a ohmmeter, check the resistance at the CMP connector circuit 359 GY/RD and ground. Is the resistance less than 5 ohms?	< 5 Ohms	GO to Step 5	REPAIR the circuit(s) in question. TEST the system for normal operation.
5	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, measure the resistance between pin B circuit 350 GY and pin C circuit 282 DB/OG. Is resistance between 250 and 1K ohms?		System OK If you have been directed to perform a system check Go to the next test.	Replace the camshaft position sensor. And RETEST
6	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin B circuit 350 GY and the CMP connector circuit 282 DB/OG. Is the resistance less than 5 ohms?	< 5 Ohms	If PP Test A ICM Check has been previously preformed, Replace the ICM and Retest the system	REPAIR the circuit(s) for OPEN and RETEST the system for normal operation.

Step	Action	Values	Yes	No
7	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin B circuit 350 GY and the CMP connector circuit 359 GY/RD. Is the resistance less than 5 ohms?	< 5 Ohms	Replace the ICM and Retest the system	REPAIR the circuit(s) for an OPEN and RETEST the system for normal operation.
8	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin B circuit 350 GY and the CMP connector circuit 359 GY/RD. Is the resistance less than 5 ohms?	< 5 Ohms	Replace the ICM and Retest the system	REPAIR the circuit(s) for an OPEN and RETEST the system for normal operation.

Pinpoint Test C - Crankshaft Position (CKP) Sensor Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Inspect for bent or broken connector terminals.
3. Inspect for a loose or damaged sensor.
4. Visually inspect for and note auxiliary system connections not shown on the **Recommended Customer Connections Wiring Schematic**.

Normal Operation

The crankshaft position (CKP) sensor is a magnetic transducer mounted on the engine block adjacent to an pulse wheel located on the crankshaft. By monitoring the crankshaft mounted pulse wheel, the CKP is the primary sensor for ignition information to the ignition control module (ICM). The trigger wheel has a total of 39 teeth spaced 9 degrees apart and one 9 degree empty space for a missing tooth. By monitoring the trigger wheel, the CKP indicates crankshaft position and speed information to the ICM. By monitoring the missing tooth, the CKP is also able to identify piston travel in order to synchronize the ignition system and provide a way of tracking the angular position of the crankshaft relative to fixed reference.

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Step	Action	Values	Yes	No
1	1. Start the engine. Does the engine start and shut down above 400 RPM or after 3 or 4 seconds of operation?		Check for a stuck throttle, loose or binding throttle linkage.	Engine does not start, GO to Step 2
2	1. Key Off. 2. Disconnect the crankshaft position CKP sensor. 3. KOEO 4. Using a voltmeter, measure the voltage at the CKP connector circuit 349 DB. NOTE: Auxiliary applications may time out and remove voltage to the ICM, cycle key off and on to verify this application is present. Is the voltage within the specified value?	4.5-5.0V	GO to Step 3	GO to Step 6
3	1. KOEO. 2. Using a voltmeter, check for voltage at the CKP connector circuit 350A GY and ground. Is the voltage within the specified value?	0 volts	GO to Step 4	REPAIR Short to power and RETEST the system for normal operation.
4	1. KOEO. 2. Using an ohmmeter, check the resistance at the CKP connector circuit 350A GY and ground. Is the resistance less than 5 ohms?	< 5 Ohms	GO to Step 5	GO to Step 7
5	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, measure the resistance between pin B circuit 350A GY and pin A circuit 349 DB. Is resistance between 250 and 1K ohms?		System OK If you have been directed to perform a system check Go to the next test.	Replace the crankshaft position sensor. And RETEST
6	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin A circuit 349 DB and the CKP connector circuit 349 DB. Is the resistance less than 5 ohms?	< 5 Ohms	Replace the ICM and Retest the system	REPAIR the circuit(s) for an OPEN and RETEST the system for normal operation.

Step	Action	Values	Yes	No
7	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin B circuit 350 GY and the CKP connector circuit 350A GY. Is the resistance less than 5 ohms?	< 5 Ohms	Replace the ICM and Retest the system	REPAIR the circuit(s) for an OPEN and RETEST the system for normal operation.

Pinpoint Test D - Coil on Plug Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Visually inspect for and note auxiliary system connections not shown on the **recommended wiring schematic**.
3. Visually inspect for and note auxiliary mechanical or hydraulic systems that could be binding which may cause the engine not to reach 100rpm and energize the ignition coils.
4. Inspect for a stuck, loose or binding throttle linkage.

Ω = Infinity or no resistance.

Normal Operation

All coils work as individual units and are mounted on top of each sparkplug. B+ is supplied to all coils when the ignition switch is in the run or crank position. During crank mode the ICM reads the pulse from the Camshaft Position sensor and Crankshaft sensor. When these two inputs are correct and the engine has reached or is above 100 rpm the ICM will start grounding/firing the individual coil. Refer to **Section 03 Ignition System** for the firing order.

Step	Action	Values	Yes	No
1	1. Key OFF Engine OFF. 2. Disconnect connector C1. 3. KOEO. 4. Using a DVOM, check for battery voltage at pins B and H. Is the voltage within the specified value?	Battery Voltage	GO to Step 2	If the FPP jumper harness has fuse protection and either fuse is OPEN, GO to Step 8 If the FPP harness has no Fuse protection or both fuses are OK GO to Ignition System Check
2	1. Key OFF 2. Using a DVOM, check the resistance to ground of pins D and G of the jumper harness. Is the resistance within the specified value?	5 ohms or less	GO to Step 3	REPAIR the circuit(s) in question. TEST the system
3	1. Reconnect connector C1. 2. NOTE: Fuse 1 supplies B+ to the right side COP BANK 1 thru 5. Disconnect (right bank) COP connectors 1 thru 5. 3. Key On. 4. Using a DVOM, measure the voltage of circuit 16N RD/LG at each connector. Is the voltage within the specified value?	Battery Voltage	GO to Step 4	REPAIR the circuit(s) in question. TEST the system
4	1. Reconnect connector C1. 2. NOTE: Fuse 3 supplies B+ to the left side COP BANK 6 thru 10. Disconnect (left side) COP connectors 6 thru 10. 3. Key On. 4. Using an ohmmeter, measure the voltage of circuit 16 RD/LG at each connector. Is the voltage within the specified value?	Battery Voltage	GO to Step 5	REPAIR the circuit(s) in question. TEST the system
5	1. Key Off. 2. COP connectors disconnected. 3. Disconnect noise capacitors 1 and 2. 4. Using a DVOM measure each COP and capacitor connector for resistance to ground. Is the resistance within the specified value?	**Ω**	GO to Step 6	REPAIR the circuit(s) in question. TEST the system

Step	Action	Values	Yes	No
6	1. Reconnect COP and capacitor connectors. 2. Disconnect ICM connector C2. 3. Using an ohmmeter, check the resistance of circuit 57A BK from connector C2 pin H and a known ground. Is the resistance within the specified value?	5 ohms or less	GO to Step 7	REPAIR the circuit(s) in question. TEST the system
7	1. Reconnect connector C2. 2. Start the engine, run for 30 seconds or less at minimum 800 RPM. Does the engine shut down after running for 4-5 seconds?		Coil On Plug System OK Return to the Symptom Chart	Return to Symptom Chart
8	1. Key OFF 2. Connector C1 disconnected. 3. Replace the OPEN fuse. Does the fuse OPEN?		Inspect the auxiliary wiring for a short to ground. Repair and Retest.	GO to Step 9
9	1. Key OFF 2. Reconnect connector C1. 3. Disconnect all COP connectors. 4. Disconnect the ignition capacitors. 5. KOEO 6. Reconnect each COP connector. 7. Monitor the fuse and reconnect each COP connector. Does the fuse OPEN?		REPAIR the circuit(s) in question for a short to ground. RETEST the system	GO to Step 10
10	1. KOEO 2. Monitor the fuse and reconnect each ignition capacitor connector. Does the fuse OPEN?		Replace the failed capacitor and fuse.	Intermittent condition, carefully inspect the harness, coils and connectors for cracks or damage.

Pinpoint Test E - Oil Pressure Sensor Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Visually inspect for and note auxiliary system connections not shown on the **Recommended Customer Connections Wiring Schematic**.

Normal Operation

The oil pressure is monitored at engine rpm above 800rpm and after the first 100 crankshaft rotations. When the oil switch closes to ground, (pressure drops below 6psi) the ICM will protect the engine by removing the ground-side of the ignition coils. The engine can be restarted, but will stall again as long as the oil pressure stays below 6 psi.

Step	Action	Values	Yes	No
1	1. Check the engine oil level and oil change maintenance records. Is the engine operating at the correct oil level and has not been operating past the specified oil change interval?	300 Hours	GO to Step 2	Top off the engine oil or Replace the oil and filter if the oil change interval is past 300 Hours.
2	1. Start the engine. Does the engine shut down above 400 RPM or 3-4 seconds of operation?		GO to Step 3	System OK
3	1. Key Off, Engine Off. 2. Disconnect the oil pressure switch connector. 3. Key On. 4. Using an ohmmeter, measure the voltage of circuit 253 DG/WH. Is the voltage within the specified value?	Battery Voltage	GO to Step 4	GO to Step 6
4	1. Key Off, Engine Off 2. With the oil pressure switch disconnected. 3. Using an ohmmeter, check the resistance of the oil pressure switch terminal to ground. Is the resistance within the specified value?	**Ω**	GO to Step 5	Remove and Replace the Oil Pressure Switch And Retest
5	1. Note: This test may require an assistant depending on the application. 2. Disconnect and remove the oil pressure switch. 3. Install an auxiliary analog oil pressure gauge. **4. Note: Do not allow the engine to run for more than 15 seconds** 5. Start the engine, run for 30 seconds or less at minimum 800 RPM. Does the engine shut down after running for 4-5 seconds and the oil pressure is within the specified value?	30-80 PSI	Oil Pressure System OK Check for a stuck throttle plate, and loose or binding throttle linkage. If OK, return to the Symptom Chart	0-29 PSI GO to Section 1 Replace the Oil Pump 31-80 PSI GO to Section 1 Check for stuck Oil Pump Relief Valve.
6	1. Key Off 2. Disconnect ICM Connector C3. 3. Disconnect the oil pressure switch. 4. Using an ohmmeter, check the resistance of circuit 253 DG/WH between connector C3 pin C and the oil pressure switch connector. Is the resistance less than 5 ohms?		GO to Step 7	REPAIR the circuit(s) in question. TEST the system for normal operation.
7	1. Reconnect ICM Connector C3. 2. Disconnect the oil pressure switch. 3. KOEO. 4. Using an ohmmeter, check the resistance of circuit 253 DG/WH from connector C3 pin C and a known ground. Is the resistance less than 5 ohms?		Replace the ICM and Retest the system	System OK

Pinpoint Test F - Cylinder Head Temperature Sensor Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Inspect for bent or broken connector terminals.
3. Visually inspect for and note auxiliary system connections not shown on the **Recommended Customer Connections Wiring Schematic**.

Normal Operation

The factory installed thermostat provides engine cooling @ 194 degrees F (90 Celsius) through all operating ranges. In the event the engine temperature rises above 250 degrees F (121 C), the ICM will protect the engine by removing the groundside of the ignition coils. The engine can be restarted, but will stall again as long as the ICM reads the engine temperature is staying below –40 degrees F (-40 C) or above 250 degrees F (121 C).

Step	Action	Values	Yes	No
1	1. Check for an auxiliary temperature gauge. Does the gauge reflect a temperature above 250 degrees F?		Go to Step 2	Go to Step 3
2	1. Check the engine coolant level. Does the engine have the correct coolant level?		GO to Step 3	Top off the engine coolant and check for coolant circulation and RETEST
3	1. Start the engine. Does the engine shut down above 400 RPM or after 3 or 4 seconds of operation?		Check for a stuck throttle, loose or binding throttle linkage. If fuel system is OK, GO to Step 4	System OK
4	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, measure the voltage of pin G circuit 16L. 4. KOEO. NOTE: Auxiliary applications will time out and remove voltage to the ICM, cycle key off and on to verify this application is present. Is the voltage within the specified value?	Battery Voltage	GO to Step 5	Inspect 30A Fuse REPAIR the circuit(s) in question. RETEST the system for normal operation.
5	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, measure the resistance between pins B circuits 350 GY and D 1102 YE/LG. Is the resistance within the specified value?	Refer to the CHT Sensor Data Chart	System OK If you have been directed to perform a system check Go to the next test.	GO to Step 6
6	1. Reconnect ICM connector C2. 2. Remove the Generator, Go to Section 06. 3. Disconnect the CHT sensor connector. 4. KOEO. 5. Using a Voltmeter, measure the voltage of CHT connector circuit 359A GY/RD. Is the voltage within the specified value?	5.0 Volts	GO to Step 8	GO to Step 7

Step	Action	Values	Yes	No
7	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin B circuit 350 GY and the CHT connector circuit 359A GY/RD. Is the resistance less than 5 ohms?		Replace the ICM and Retest the system	REPAIR the circuit(s) in question. TEST the system for normal operation.
8	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin D circuit 1102 YE/LG and ground. Is the resistance less than 5 ohms?		REPAIR the circuit(s) for a short to ground. RETEST the system for normal operation.	Go to Step 9
9	1. Key Off. 2. Disconnect ICM Connector C2. 3. Using an ohmmeter, check the resistance between the ICM Connector C2 pin D circuit 1102 YE/LG and the CHT connector circuit 1102 YE/LG. Is the resistance less than 5 ohms?		GO to Step 10	REPAIR the circuit(s) in question. TEST the system for normal operation.
10	1. Key Off 2. Disconnect the CHT sensor. 3. Using an ohmmeter, check the terminals of the CHT sensor. Is the resistance within the specified value?	Refer to the CHT Sensor Data Chart	Check for a stuck throttle, loose or binding throttle linkage.	Remove and replace the CHT sensor, refer to Section 05

Pinpoint Test G - Ground Shield Check

Inspection and Verification

1. Visually inspect for obvious signs of mechanical and electrical damage.
2. Visually inspect for and note auxiliary system connections not shown on the **recommended wiring schematic**.

Normal Operation

The Camshaft and the Crankshaft Position Sensor harness circuits are wrapped with a grounding shield to eliminate electro magnetic interference.

Step	Action	Values	Yes	No
1	Have you preformed Ignition Check?		GO to Step 2	Go to Section 03 Pin Point Test A
2	1. Key Off, Engine Off. 2. Inspect the ICM ground terminal location (s) for clean and tight connections. 3. Disconnect the Main 10-Pin connector C1. 4. Using an ohmmeter, measure the resistance of terminal C2 pin D of the equipment side of the harness to a known good ground. Is the resistance less than 5 ohms?		Re-tape the harness and GO to Step 3	REPAIR the circuit(s) in question. TEST the system for normal operation.
3	1. Key Off, Engine Off. 2. Disconnect the Camshaft Position (CMP) Sensor. 3. Carefully remove the harness tape 50mm back from the CMP connector. 4. Open the confluent exposing the grounding shield. 5. Using an ohmmeter, gently touch the foil shielding and measure the resistance between the foil and terminal C2 pin D, circuit 57BK of the engine harness to a known good ground. Is the resistance less than 5 ohms?		Re-tape the harness and GO to Step 4	REPAIR the circuit(s) in question. TEST the system for normal operation.
4	1. Key Off, Engine Off. 2. Disconnect the Crankshaft Position (CKP) Sensor. 3. Carefully remove the harness tape 50mm back from the CKP connector. 4. Open the confluent exposing the grounding shield. 5. Using an ohmmeter, gently touch the foil shielding and measure the resistance between the foil and terminal C2 pin D, circuit 57BK of the engine harness to a known good ground. Is the resistance less than 5 ohms?		Return to the Symptom Chart	REPAIR the circuit(s) in question. TEST the system for normal operation.

SPECIFICATIONS

Special Tools

Rotunda Equipment	
105-ROO57	73111 Automotive Meter