MERCURY

MerCruiser

MAIN MENU

#36 Service Manual

ECM 555 Diagnostics

VIEW

Serial Number
0M300000 and Above

#36 ECM 555 Diagnostics

S/N 0M300000 and Above

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Notice

Throughout this publication, Dangers, Warnings and Cautions (accompanied by the International HAZARD Symbol ⚠) are used to alert the mechanic to special instructions concerning a particular service or operation that may be hazardous if performed incorrectly or carelessly. **OBSERVE THEM CAREFULLY!**

These Safety Alerts alone cannot eliminate the hazards that they signal. Strict compliance to these special instructions when performing the service, plus common sense operation, are major accident prevention measures.

⚠ DANGER

Immediate hazards which will result in severe personal injury or death.

⚠ WARNING

Hazards or unsafe practices which could result in severe personal injury or death.

⚠ CAUTION

Hazards or unsafe practices which could result in minor personal injury or product or property damage.

Notice to Users of This Manual

This service manual has been written and published by the Service Department of Mercury Marine to aid our dealers' mechanics and company service personnel when servicing the products described herein.

It is assumed that these personnel are familiar with marine product servicing procedures. Furthermore, it is assumed that they have been trained in the recommended service procedures of Mercury MerCruiser product, including the use of mechanics' common hand tools and the special Mercury Marine or recommended tools from other suppliers.

We could not possibly know of and advise the marine trade of all conceivable procedures and of the possible hazards and/or results of each method. Therefore, anyone who uses a service procedure and/or tool, which is not recommended by the manufacturer, first must completely satisfy himself that neither his nor the products safety will be endangered.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. As required, revisions to this manual will be sent to all dealers contracted by us to sell and/or service these products.

We reserve the right to make changes to this manual without prior notification.

Refer to dealer service bulletins, operation maintenance and warranty manuals and installation manuals for other pertinent information concerning the products described in this manual.

Precautions

It should be kept in mind, while working on the product, that the electrical system and ignition system are capable of violent and damaging short circuits or severe electrical shocks. When performing any work where electrical terminals could possibly be grounded or touched by the mechanic, the battery cables should be disconnected at the battery.

Any time the intake or exhaust openings are exposed during service they should be covered to protect against accidental entrance of foreign material which could enter the cylinders and cause extensive internal damage when the engine is started.

It is important to note, during any maintenance procedure replacement fasteners must have the same measurements and strength as those removed. Numbers on the heads of the metric bolts and on the surfaces of metric nuts indicate their strength. American bolts use radial lines for this purpose, while most American nuts do not have strength markings. Mismatched or incorrect fasteners can result in damage or malfunction, or possibly personal injury. Therefore, fasteners removed should be saved for reuse in the same locations whenever possible. Where the fasteners are not satisfactory for re-use, care should be taken to select a replacement that matches the original.

Engine Mechanical Components

Many of the engine mechanical components are designed for marine applications. Unlike automotive engines, marine engines are subjected to extended periods of heavy load and wide open throttle operation and, therefore, require heavy-duty components. Special marine engine parts have design and manufacturing specifications that are required to provide long life and dependable performance. Marine engine parts also must be able to resist the corrosive action of salt or brackish water that will rust or corrode standard automotive parts within a short period of time.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durability, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Replacement Parts

⚠ WARNING

Electrical, ignition and fuel system components on MerCruiser Engines and Sterndrives are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire or explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing the electrical, ignition and fuel systems, it is extremely important that all components are properly installed and tightened. If not, any electrical or ignition component opening would permit sparks to ignite fuel vapors from fuel system leaks, if they existed.

Failure to use recommended Quicksilver service replacement parts can result in poor engine performance and/or durability, rapid corrosion of parts subjected to salt water and possibly complete failure of the engine.

Use of parts other than recommended service replacement parts will void the warranty on those parts which are damaged as a result of the use of other than recommended replacement parts.

Models Covered in This Manual

Sterndrive (MCM)	Serial Number
4.3L MPI Alpha and Bravo	0M300000 and Above
5.0L MPI Alpha and Bravo	
350 MAG MPI Alpha and Bravo	
350 MAG MPI Alpha and Bravo Horizon	
MX 6.2 MPI	
MX 6.2 MPI Horizon	

Inboard and Tow Sports (MIE)	Serial Number
350 MAG MPI Inboard	0M310000 and Above
350 MAG MPI Horizon Inboard	
MX 6.2 MPI Inboard	
MX 6.2 MPI Horizon Inboard	
350 MAG MPI Tow Sports	

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Service Manual Outline

Section 1 - General Information

Section 2 - Troubleshooting

Section 3 - Wiring Diagrams

General Information 1

Troubleshooting 2

Wiring Diagrams 3

SECTION 1A - GENERAL INFORMATION

SECTION 2A - TROUBLESHOOTING

SECTION 3A - WIRING DIAGRAMS

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SECTION 1A - GENERAL INFORMATION

1 A

Table of Contents

How To Use This Guide

This diagnostic guide is separated into 3 sections: General Information, Troubleshooting and Wiring Diagrams.

General Information covers:

- General wiring information
- Engine Guardian description
- Warning chart

Troubleshooting covers:

- Basic scan tool information
- Symptom trouble chart
- Fault chart

Wiring diagram covers:

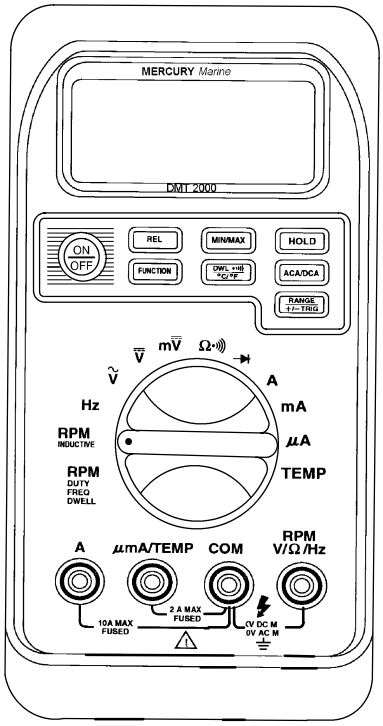
- Engine electrical harness
- Circuit diagrams

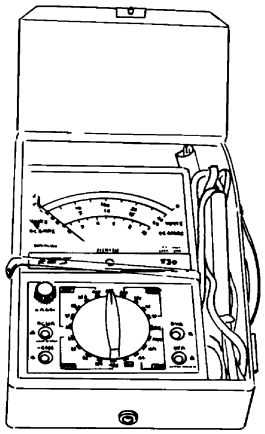
Troubleshooting covers possible electrical and mechanical causes for engine faults on the scan tool. In wiring diagrams, the single circuit diagrams cover each sensor and subset of the electrical system of the engine. These two sections will help the technician pinpoint problems occurring in the electrical system.

Abbreviations

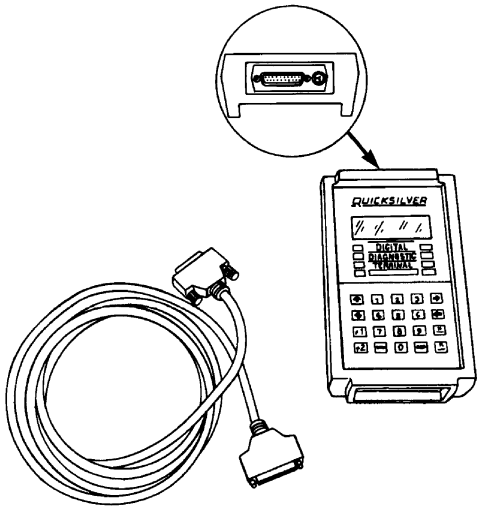
amp	Amperes	in. hg	Inches Of Mercury
BARO	Barometric Pressure	INJ	Injector
Bat	Battery Positive Terminal, Battery or System Voltage	kPa	Kilopascal
B+	Battery Positive Voltage	KS	Knock Sensor System
Bps	Beeps	kV	Kilovolts
CAM	Camshaft	mA	milliamperes
cond	Condition	MPR	Main Power Relay
cont	Continuous	MAP	Manifold Air Pressure
Crank	Crankshaft	MAT	Manifold Air Temperature
CAN	Control Area Network	mohms	Milliohms
CKT	Circuit	mSec	Millisecond
CMP	Camshaft Position Sensor	N/C	Normally Closed
Conn	Connector	N/O	Normally Open
CPS	Crankshaft Position Sensor	OBD	On-Board Diagnostic Test
Cyl	Cylinder	PCM	Propulsion Control Module
DDT	Digital Diagnostic Terminal	RAM	Random Access Memory
Deg	Degrees	REF HI	Reference High
Diag	Diagnostic	REF LO	Reference Low
DIS	Distributorless Ignition System	RFI	Resistance Frequency Interval
DLC	Data Link Connector	ROM	Read Only Memory
Dtc	Diagnostic Trouble Code	RPM	Revolutions per Minute
DMM DMT DVOM	Digital Multimeter	SW	Switch
ECM	Electronic Control Module	TACH	Tachometer
ECT	Engine Coolant Temperature	TERM	Terminal
EFI	Electronic Fuel Injector	TPS	Throttle Position Sensor
EMCT	Exhaust Manifold Coolant Temperature	V	Volts
EST	Electronic Spark Timing	VAC	Vacuum
GND	Ground	VDC	Volt Direct Current
IAC	Idle Air Control	VOA	Volt/Ohm/Amp Meter
IGN	Ignition	WOT	Wide Open Throttle

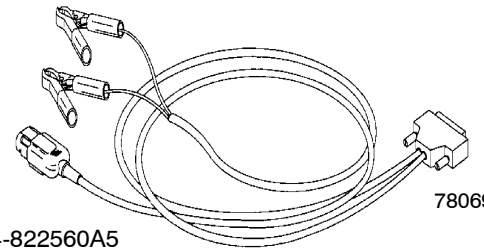
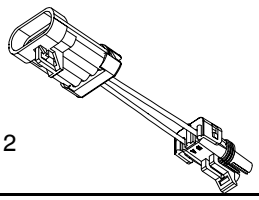
Special Tools

DMT 2000A Tachometer / Multi-Meter Kit	91-854009A3
Description: Measures rpm on both 2 and 4 cycle marine engines, records the maximums and minimums simultaneously and will read accurately in high RFI environments. **Replacement Components:** 91-854010-1 8 ft (2.4 m) Inductive Pick-Up 91-854011-1 Temperature Probe 91-854012 Ferrite Core 91-854013-1 Interface Module 91-854014-1 Hard Carrying Case 91-854015-1 User's Guide 91-802651 Test Leads **Optional Accessories:** 84-854016T 8 ft (2.4 m) Inductive Pick-Up Extension 91-802650 Clamp-On Current Probe 91-89045-1 Direct Voltage Adaptor	 77959

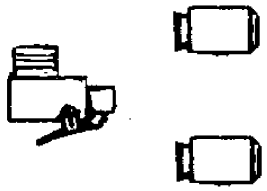
DVA / Multi-Meter Kit	91-99750A1
Description: Tests the electrical and ignition systems; consists of a VOA meter with built-in direct voltage adaptor.	 73609

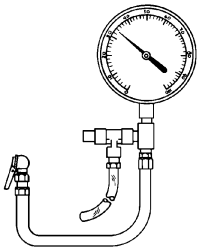
Special Tools (continued)

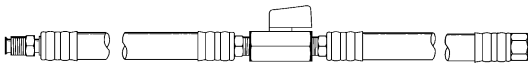
Digital Diagnostic Terminal DDT	91-823686A2
Description: Display problem codes stored in the ECM. It also allows the monitoring of various circuits and components in the fuel injection system. Must order the 91-803999 cartridge for MEFI 1, MEFI 2 and MEFI 3 ECM models 91-880118A2 cartridge for ECM 555 and PCM 555 models. 84-825003A1 Replacement 10 ft (3 m) 25-pin Harness 91-8404805 Optional Heavy Duty Carrying case **Accessories:** An additional harness assembly may be required when using the DDT, refer to the following: 91-822560A13 Harness Assembly / Diagnostic Tester 91-861540A1 Adaptor Harness 91-822560A7 Outboard Adapter Harness 91-84-822560A5 EFI Outboard Adaptor 91-822560T12 Scan Tool Harness Adaptor 91-822560A2 Harness Assembly / Diagnostic Tester	 74214

EFI Outboard Harness Adaptor Scan Tool Harness Adaptor	84-822560A5 84-822560T12
Description: 84-822560A5 Outboard Harness Adaptor may be used with 91-823686A32 DDT Scan Tool for PCM 555 and ECM 555 models. Use the Harness Adaptor 84-822560T12 For PCM 555 Models to adapt the 4-pin Mercury MerCruiser connector to the 2-pin 84-822560A5 Outboard Harness.	 78069 84-822560A5  84-822560T12 78034

Special Tools (continued)

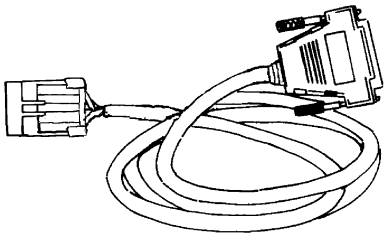
Fuel Pressure Gauge Adaptor Kit	91-803135
Description: Allows updating 91-16850A 2 and older Fuel Pressure Gauge Kits. Adapts the gauge to fit either the Mercury MerCruiser or the GM Shrader valve. This Adaptor Kit is included with the Fuel Pressure Gauge Kit 91-881833A2.	

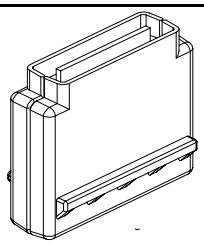
Fuel Pressure Gauge Kit	91-881833A2
Description: Use to test the fuel pump pressure, includes: 91-803135 Fuel Pressure Gauge Adaptor Kit 91-806901 Fuel Pressure T-fitting 91-881833A1 160 psi Gauge	 73814

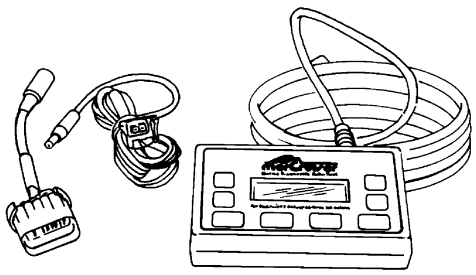
Fuel Shut Off Tool	91-805918A1
Description: Use in fuel system pressure tests on the return line.	 74227

Fuel Shut Off Tool	91-805918A3
Description: Use in fuel system pressure tests at the fuel rail.	Not available at time of printing.

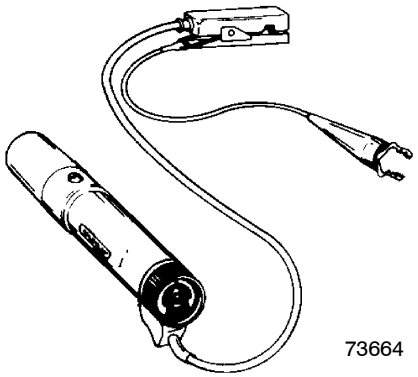
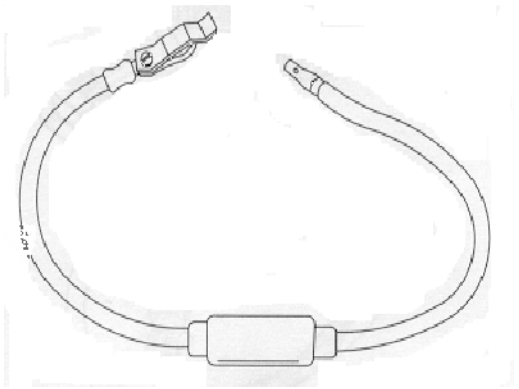
Special Tools (continued)

Harness Assembly / Diagnostic Tester	91-822560A13
Description: 25-pin to 4-pin Adaptor harness. For PCM 555 and ECM 555 models (4-pin connectors, no additional harness required).	 74214

Mercury MerCruiser DDT Cartridge Version 1.2	91-880118A2
Description: Use on PCM 555 and ECM 555 models.	 78036

Scan Tool Kit / Version 4.0	Note in Description
Description: Hand-held Scan Tool updated for 2001. (refer to Service Bulletin 2001-1). Use with models: MCM/MIE EFI (TBI) and MPI Gasoline MCM/MIE 496/8.1S MPI PCM 555 1997 and Newer MCM/MIE Carbureted Models with Thunderbolt Ignition System MCM/MIE D-Tronic Diesel ***NOTE:*** *Tool must be ordered from Rinda Technologies, Inc.*	 72428

Special Tools (continued)

Portable Timing Light	**91-99379**
Description: Checks the ignition timing, powered by 2 D-cell batteries.	 73664
Spark Gap Tester	**91-63998A1**
Description: Spark Gap Tester	

Special Tools (continued)

Rinda Technologies 4563 N. Elston Ave. Chicago, IL 60630 Phone: 773-736-6633 Fax: 773-736-2950 Email: Sales@rinda.com
Mercury Marine W6250 Pioneer Road, P.O. Box 1929 Fond Du Lac, WI 54935-1939 Phone: 920-929-5589, 800-487-8736 www.MERCURYMARINE.com
OTC 28635 Mound Rd. Warren, MI 48092-3499 Phone: 586-574-2332, 800-328-6657 www.servicesolutions.spx.com

Precautions

⚠ WARNING

Electrical, ignition and fuel system components on your Mercury MerCruiser are designed and manufactured to comply with U.S. Coast Guard Rules and Regulations to minimize risks of fire and explosion.

Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

⚠ WARNING

Avoid injury or death and power package damage from an electrical shock, fire or explosion. Always disconnect both battery cables from the battery before servicing the power package.

⚠ WARNING

Be careful when cleaning flame arrestor and crankcase ventilation hose; gasoline is extremely flammable and highly explosive under certain conditions. Ensure that ignition key is OFF. Do NOT smoke or allow sources of spark or open flame in area when cleaning flame arrestor and crankcase ventilation hose.

⚠ WARNING

Be careful when changing fuel system components; gasoline is extremely flammable and highly explosive under certain conditions. Ensure that ignition key is OFF. DO NOT smoke or allow sources of spark or flame in the area while changing fuel filter. Wipe up any spilled fuel immediately.

Precautions (continued)

⚠ WARNING

Make sure no fuel leaks exist, before closing engine hatch.

⚠ WARNING

Avoid gasoline fire or explosion. Improper installation of brass fittings or plugs into fuel pump or fuel filter base can crack casting and/or cause a fuel leak.

- **Apply Loctite 565 Pipe Sealant with Teflon to threads of brass fitting or plug. Do NOT USE TEFLON TAPE.**
- **Thread brass fitting or plug into fuel pump or fuel filter base until finger-tight.**
- **Tighten fitting or plug an additional 1-3/4 to 2-1/4 turns using a wrench. Do NOT OVERTIGHTEN.**
- **Install fuel line. To prevent overtightening, hold brass fitting with suitable wrench and tighten fuel line connectors securely.**
- **Check for fuel leaks.**

⚠ CAUTION

Overheating from insufficient cooling water will cause engine and drive system damage. Ensure that there is sufficient water always available at water inlet holes during operation.

Service Precautions

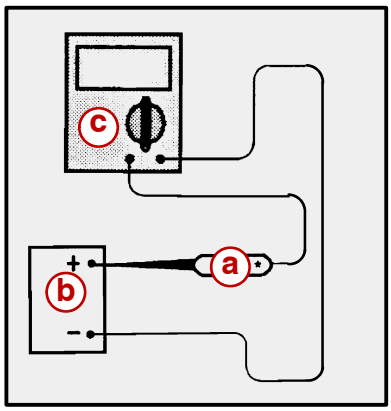
Observe the following:

- Before removing any ECM system component, disconnect both battery cables.
- Never start the engine without the battery being solidly connected.
- Never separate the battery from the on-board electrical system while the engine is operating.
- Never disconnect battery cables from the charging system while the engine is operating.
- When charging the battery, disconnect it from the boat's electrical system.
- Ensure that all cable harnesses are connected and that battery connections are clean.
- Never connect or disconnect the wiring harness at the ECM when the switch is in the ON position.
- Before attempting any electric arc welding, disconnect the battery leads and the ECM connectors.
- When steam cleaning engines, do not direct the steam cleaning nozzle at ECM system components. If this happens, corrosion of the terminals or damage of components can occur.
- Use only the test equipment specified in the diagnostic charts; other test equipment may either give incorrect results or damage good components.
- All voltage measurements using a voltmeter require a digital voltmeter with a rating of 10 megaohms input impedance.
- When using a DMT to perform voltage measurements, switch to the OFF position when connecting the DMT to the circuitry being tested.
- When a test light is specified, a low-power test light must be used. Do NOT use a high-wattage test light.

Service Precautions (continued)

While a particular brand of test light is not suggested, a simple test, as shown below, on any test light will ensure it to be safe for system circuit testing.

1. Connect an accurate ammeter (such as the DMT) in series with the test light being tested and power the test light ammeter circuit with the battery.



a - Test Light
b - Battery
c - Ammeter

IMPORTANT: If the ammeter indicates LESS than 3/10 amp current flow (.3 A or 300 mA), the test light is SAFE to use. If the ammeter indicates MORE than 3/10 amp current flow (.3 A or 300 mA), the test light is NOT SAFE to use.

NOTE: *Using a test light with 100 mA or less rating may show a faint glow when test actually states no light.*

General Specifications

4.3 liter (262 cid)

Displacement		4.3 liter (262 cid)
Bore		101.60 mm (4.012 in.)
Stroke		88.39 mm (3.480 in.)
Firing Order		1-6-5-4-3-2
Compression Ratio		9.2:1
Heads		Cast Iron
Intake Manifold - Two Piece	Upper	Aluminum
	Lower	Cast Iron
Block		Cast Iron (2 Bolt Main Bearing Caps)
Rods		Forged Steel
Crankshaft		Cast Iron
Pistons		Cast Aluminum
Camshaft		Cast Iron

5.0 liter (305 cid)

Displacement		5.0 l (305 cid)
Bore		94.89 mm (3.736 in.)
Stroke		88.39 mm (3.480 in.)
Firing Order		1-8-4-3-6-5-7-2
Compression Ratio		9.4:1
Heads		Cast Iron
Intake Manifold - Two Piece	Upper	Aluminum
	Lower	Cast Iron
Block		Cast Iron (2 Bolt Main Bearing Caps)
Rods		Forged Steel
Crankshaft		Cast Iron
Pistons		Cast Aluminum
Camshaft		Cast Iron

General Specifications (continued)

5.7 liter (350 cid)

Displacement		5.7 l (350 cid)
Bore		101.6 mm (4.00 in.)
Stroke		88.39 mm (3.480 in.)
Firing Order		1-8-4-3-6-5-7-2
Compression Ratio		9.4:1
Heads		Cast Iron
Intake Manifold - Two Piece	Upper	Aluminum
	Lower	Cast Iron
Block		Cast Iron (2 Bolt or 4 Bolt Main Bearing Caps)
Rods		Forged Steel
Crankshaft		Cast Iron
Pistons		Cast Aluminum
Camshaft		Steel

6.2 liter (377 cid)

Displacement		6.2 l (377 cid)
Bore		101.6 mm (4.00 in.)
Stroke		95.25 mm (3.750 in.)
Firing Order		1-8-4-3-6-5-7-2
Compression Ratio		9.0:1
Heads		Cast Iron
Intake Manifold - Two Piece	Upper	Aluminum
	Lower	Cast Iron
Block		Cast Iron (2 Bolt Main Bearing Caps)
Rods		Forged Steel
Crankshaft		Forged Steel
Pistons		Cast Aluminum
Camshaft		Steel

General Information

Electrostatic Discharge Damage

Electronic components are often designed to carry very low voltage and are susceptible to damage caused by electrostatic discharge. It is possible for less than 100 volts of static electricity to cause damage to some electronic components. By comparison, it takes 4,000 volts for a person to even feel the effect of a static discharge.

There are several ways for a person to become statically charged. The most common methods are by friction and by induction. An example of charging by friction is a person sliding across a seat, in which a charge of as much as 25,000 volts can build up. Charging by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily grounds the circuit. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges of either type can cause damage electronic components. Use care when handling and testing electronic components.

Wiring Harness Service

Marine engine control circuits contain many special design features not found in standard land vehicle wiring. Environmental protection is used extensively to protect electrical contacts and proper splicing methods must be used.

IMPORTANT: Before component replacement and/or during normal troubleshooting procedures, visually inspect any questionable mating connector.

The proper operation of low amperage input/output circuits depends upon good continuity between circuit connectors. Mating surfaces should be properly formed, clean and likely to make proper contact. Some typical causes of connector problems are listed below.

2. Improperly formed contacts and/or connector housing.

- Damaged contacts or housing due to improper connection.
- Corrosion, sealer or other contaminants on the contact mating surfaces.

3. Incomplete mating of the connector halves during initial assembly or during subsequent troubleshooting procedures.
4. Tendency for connectors to come apart due to vibration and/or temperature cycling.
5. Terminals not fully seated in the connector body.
6. Inadequate terminal crimps to the wire.

Wiring Harness Service (continued)

Wire harnesses should be replaced with the appropriate replacement part, refer to specified part numbers. When signal wires are spliced into a harness, only use high temp insulated wire the same gauge as the existing harness.

With the low current and voltage levels found in the system, it is important to solder splices and create the best possible connection, refer to Wire Repair.

Use care when probing a connector or replacing connector terminals. It is possible to short between opposite terminals. If this happens, certain components can be damaged. Always use jumper wires with the corresponding mating terminals between connectors for circuit checking. **NEVER** probe through connector seals, wire insulation, secondary ignition wires, boots or covers. Microscopic damage or holes will result in eventual water intrusion, corrosion and/or component or circuit failure.

WIRE REPAIR

1. Locate damaged wire.
2. Remove insulation as required.

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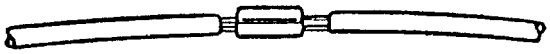
3. Splice two wires together using splice clips and rosin core solder.



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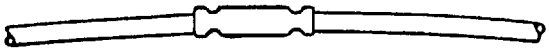
4. Cover splice with heat shrink sleeve to insulate from other wires.



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Wiring Connector Service

Most connectors in the engine compartment are protected against moisture and dirt that could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock that secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may locate the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Some connectors look similar but are serviced differently. Replacement connectors and terminals are listed in the *Mercury Precision Parts / Quicksilver Accessories Guide*.

Ensure that the connector seals are not deformed or crushed when mating the connectors.

Intermittents

IMPORTANT: Intermittent problems may or may not store a fault. The fault must be present to locate the problem.

Most intermittent problems are caused by faulty electrical connections or wiring. Perform a careful visual check for the following conditions:

- Poor mating of the connector halves, or a terminal not fully seated in the connector body.
- Improperly formed or damaged terminals and/or connectors.

All connector terminals in the problem circuit should be carefully checked for proper contact tension.

- Poor terminal-to-wire connection (crimping). Remove the terminal from the connector body to check.

The vessel may be driven with a digital multi-meter connected to a suspected circuit. An abnormal voltage when malfunction occurs is a good indication that there is a fault in the circuit being monitored.

A diagnostic tool can be used to help detect intermittent conditions. The diagnostic tool allows manipulation of wiring harnesses or components with the engine not operating, while observing the scan tool readout. The diagnostic tool can also be plugged in and observed while operating the vessel.

If the problem seems to be related to certain parameters that can be checked on the scan tool, they should be checked while operating the vessel. If there does not seem to be any correlation between the problem and a specific circuit use the diagnostic tool data to see if there is any change in the readings that might indicate intermittent operation.

The diagnostic tool is also an easy way to compare the operating parameters of a poorly operating engine with those of a known good one. For example, a sensor may shift in value but not set a fault. Comparing the sensor's readings with those of the typical scan tool data readings may uncover the problem.

The diagnostic tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the diagnostic tool successfully lies in the technician's ability to understand the system being diagnosed and the diagnostic tool operation and limitations. The technician should read the tool manufacturer's operating manual to become familiar with the tool's operation.

To check loss of fault memory:

1. Disconnect TP sensor and idle engine.
2. Attach diagnostic tool.
3. Turn the ignition OFF and check for the fault TPS1 CKT Lo. If not stored in the memory, the ECM is faulty.
4. Clear the fault.

An intermittent may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- Poor ECM grounds.
- An electrical system interference caused by a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Improper installation of electrical options such as lights, ship to shore radios and sonar.
- Knock sensor wires are routed too close to spark plug wires, ignition system components or charging system components.
- Secondary ignition components shorted to ground or an open ignition coil ground (coil mounting brackets).
- Components internally shorted to ground such as starters, alternators or relays.

Electronic Control Module (ECM) and Sensors

General Description

The Mercury MerCruiser Electronic Fuel Injection system is equipped with a computer that provides the operator with state-of-the-art control of fuel and spark delivery. Computers use voltage to send and receive information.

Computers and Voltage Signals

Voltage is electrical pressure. Voltage does not flow in circuits. Instead, voltage causes current. Current does the real work in electrical circuits. It is current, the flow of electrically charged particles, that energizes solenoids, closes relays and lights lamps.

Besides causing currents in circuits, voltage can be used as a signal. Voltage signals can send information by changing levels, changing waveform (shape), or changing the speed at which the signal switches from one level to another. Computers use voltage signals to communicate with one another. The different sections inside computers also use voltage signals to communicate with each other.

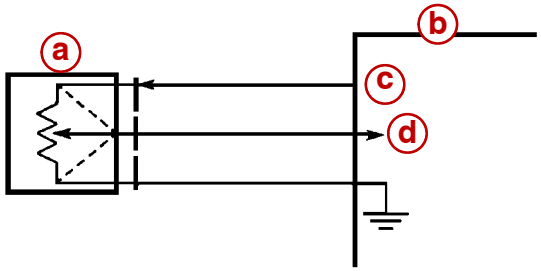
There are two kinds of voltage signals, analog and digital. Both of these are used in computer systems. It's important to understand the difference between them and the different ways they are used.

Analog Signals

An analog signal is continuously variable. This means that the signal can be any voltage within a certain range. An analog signal usually gives information about a condition that changes continuously over a certain range. For example, in a marine engine, temperature is usually provided by an analog signal. There are two general types of sensors that produce analog signals: the 3-wire and the 2-wire sensor.

THREE-WIRE SENSORS

The following figure shows a schematic representation of a 3-wire sensor. All 3-wire sensors have a reference voltage, a ground and a variable wiper. The lead coming off of the wiper will be the signal to the Engine Control Module (ECM). As this wiper position changes, the signal voltage returned to the computer also changes.

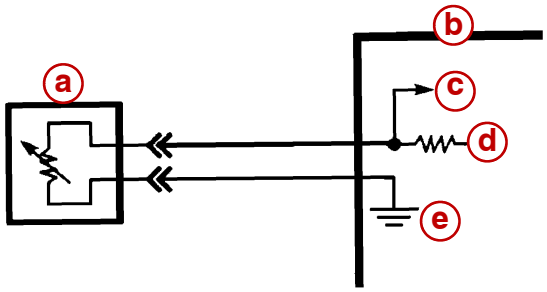


3-Wire Sensor

- **a** - Typical Sensor
- **b** - ECM
- **c** - Voltage Out
- **d** - Signal Input
- **e** - Sensor Ground

TWO-WIRE SENSOR

The following figure is the schematic of a 2-wire type sensor. This sensor is basically a variable resistor in series with a fixed-known resistor within the computer. By knowing the values of the input voltage and the voltage drop across the known resistor, the value of the variable resistor can be determined. The variable resistors that are commonly used are called thermistors. A thermistor's resistance varies inversely with temperature.

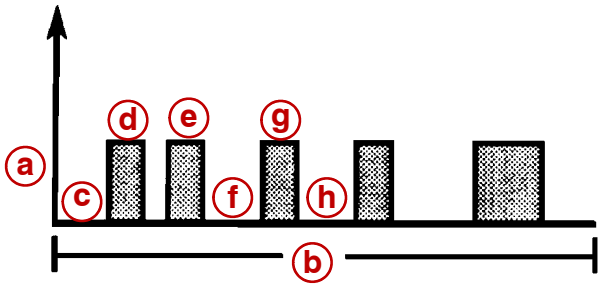


2-Wire Sensor

- **a** - Typical Sensor
- **b** - ECM
- **c** - Signal Sensor
- **d** - 5 Volt
- **e** - Sensor Ground

Digital Signals

Digital signals are also variable, but not continuously. They can only be represented by distinct voltages within a range. For example, 1 V, 2 V or 3 V would be allowed, but 1.27 V or 2.65 V would not. Digital signals are especially useful when the information can only refer to two conditions - YES and NO, ON and OFF, or HIGH and LOW. This would be called a digital binary signal. A digital binary signal is limited to two voltage levels. One level is a positive voltage, the other is no voltage (zero volts). As you can see in the following figure, a digital binary signal is a square wave.



Digital Binary Signal

- **a** - Voltage
- **b** - Time
- **c** - Lo
- **d** - Hi
- **e** - On
- **f** - Off
- **g** - Yes
- **h** - No

The computer uses digital signals in a code that contains only ones and zeros. The high voltage of the digital signal represents a one (1), and no voltage represents a zero (0). Each zero and each one is called a bit of information, or just a bit. Eight bits together are called a word. A word, therefore, contains some combination of eight binary code bits: eight ones, eight zeros, five ones and three zeros, and so on.

Binary code is used inside a computer and between a computer and any electronic device that understands the code. By stringing together thousands of bits, computers can communicate and store an infinite variety of information. To a computer that understands binary, 11001011 might mean that it should reset engine rpm at a lower level. Although the computer uses 8-bit digital codes internally and when talking to another computer, each bit can have a meaning.

SWITCH TYPES

Switched inputs (also known as discretes) to the computer can cause one bit to change, resulting in information being communicated to the computer. Switched inputs can come in two types: they are pull-up and pull-down types. Both types will be discussed.

With a pull-up type switch, the ECM will sense a voltage when the switch is CLOSED. With the pull-down switch, the ECM recognizes the voltage when the switch is OPEN.

Discretes can also be used to inform a computer of FREQUENCY information.

PULSE COUNTERS

For the computer to determine frequency information from a switched input, the computer must measure the time between voltage pulses. As a number of pulses are recorded in a set amount of time, the computer can calculate the frequency. The meaning of the frequency number can have any number of meanings to the computer.

An example of a pulse counter type of input is the distributor reference pulse input. The computer can count a train of pulses, a given number of pulses per engine revolution, and determine the rpm of the engine.

Engine Control Module (ECM)

The Engine Control Module (ECM) is the control center of the fuel injection system. It constantly monitors information from various sensors, and controls the systems that affect engine performance.

The ECM also performs a diagnostic function check of the system. It can recognize operational problems and store a code or codes which identify the problem areas to aid the technician in making repairs.

ECM FUNCTION

The ECM supplies 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, the use of a **10 megohm input impedance digital voltmeter** is required to assure accurate voltage readings.

Engine Guardian System

General Description

Engine Guardian is the focal point of the self-diagnostic strategy on these engines. It helps protect the engine from possible damage that could result from several faulty conditions. The system monitors the sensors incorporated on the engine and if a malfunction is discovered, a fault description is stored in the PCM and available power is normally reduced. By ensuring that engine output is at a low enough level, the engine is better protected from thermally induced failures.

For example, if an open or short is found in any sensor, available power will be reduced to 90% of total, the Audio Warning System Alarm will sound 2 beeps per minute (2 Bp/min) and the Smartcraft gauges will display a warning lamp. In a seawater pump pressure low condition, the maximum rpm will vary with the pressure and temperature of the engine and could be limited to idle in extreme cases of overheating, a constant beep will sound and Smartcraft gauges will display a warning lamp.

IMPORTANT: Engine Guardian cannot guarantee that engine damage will not occur when adverse operating conditions are encountered. Engine Guardian is designed to warn the operator of an adverse condition and to reduce power by limiting rpm in an attempt to reduce possible engine damage. The boat operator is ultimately responsible for proper engine operation.

Warning Chart

The engine warning system incorporates an audio alarm and, if installed, Smartcraft Gauges System. When the key switch is turned to the ON position, the audio alarm will momentarily activate to test the warning system. The alarm should sound once if the system is operable. This table is a guick guide, showing what warning output will accompany a fault.

Fault	Smartcraft Gauges	Audio Alarm	Available Power	Description
ECT CKT HI	Yes	2 Bp/min	90%	Open
ECT CKT LO	Yes	2 Bp/min	90%	Short
ECT Coolant Overheat	Yes	Constant	6 - 100 %	Engine guardian overheat condition
EST 1 Open [1]	Yes	2 Bp/min	100%	Coil harness wire open
EST 1 Short [1]	Yes	2 Bp/min	100%	Coil harness wire short
Fuel Injector 1-7-4-6 Open	Yes	2 Bp/min	100%	Fuel injector wire open
Fuel Injector 3-5-2-8 Open	Yes	2 Bp/min	100%	Fuel injector wire open
Guardian Strategy	Yes	Constant	0% - 100%	Protection Strategy
IAC Output LO/HI [2]	Yes	2 Bp/min	90%	Open
Knock Sensor 1 Lo	Yes	2 Bp/min	90%	Open
Knock Sensor 1 Hi	Yes	2 Bp/min	90%	Short
Low Drive Lube Strategy	Yes	Constant	100%	Low oil in sterndrive
Low Oil Pressure Strategy	Yes	Constant	0 - 100%	Low oil pressure strategy

NOTE: *If any 5v sensor becomes shorted to ground the engine will not start. If the engine is operating when the short occurs the engine may stop operating and will not start.*

NOTE: *[1] GM EFI ignition system failure open or shorted, driver will flag EST 1 fault.*

NOTE: *[2] TPS must see 5% throttle then back to 0% to flag IAC fault.*

NOTE: *[3] 2-wire sensor open will read sensor Hi on scan tool.*

NOTE: *[4] VDC PWR Low - if shorted or no voltage engine will not start; if VDC PWR voltage falls velow 22 volts will set sensor faults.*

NOTE: *[5] Shift Switch - will activate code when engine rpm are above 3500 rpm and 40% load.*

Warning Chart (continued)

Fault	Smartcraft Gauges	Audio Alarm	Available Power	Description
Main Power Relay Output	Yes	No	N/A	Engine will not start
Main Power Relay Backfeed	Yes	No	N/A	Engine will not start
MAP Sensor 1 Input High	Yes	2 Bp/min	90%	High voltage or short
MAP Sensor 1 Input Low	Yes	2 Bp/min	90%	Open, no visual on SC1000
Oil PSI CKT Hi	Yes	2 Bp/min	90%	Open, defaults to 50.7 psi
Oil PSI CKT Lo	Yes	2 Bp/min	90%	Short, defaults to 50.7 psi
Overspeed	Yes	Constant	rpm limit	Engine over rpm limit
Pitot CKT Hi	No	No	100%	Short or high voltage
Pitot CKT Lo	No	No	100%	Open
Sea Pump PSI Lo	Yes	Constant	6-100%	Guardian Strategy
Sea Pump CKT Hi	Yes	2 Bp/min	90%	Open - 0 psi reading
Sea Pump CKT Lo	Yes	2 Bp/min	90%	Voltage high or short
Sea Water Temp	No	No	N/A	Defaults to –31 degrees C
Fuel Level #1	No	No	N/A	Only if turned on
STB EMCT CKT Hi	N/A	N/A	N/A	N/A
STB EMCT CKT Lo	N/A	N/A	N/A	N/A
STB EMCT CKT Overheat	N/A	N/A	N/A	N/A

NOTE: *If any 5v sensor becomes shorted to ground the engine will not start. If the engine is operating when the short occurs the engine may stop operating and will not start.*

NOTE: [1] *GM EFI ignition system failure open or shorted, driver will flag EST 1 fault.*

NOTE: [2] *TPS must see 5% throttle then back to 0% to flag IAC fault.*

NOTE: [3] *2-wire sensor open will read sensor Hi on scan tool.*

NOTE: [4] *VDC PWR Low - if shorted or no voltage engine will not start; if VDC PWR voltage falls velow 22 volts will set sensor faults.*

NOTE: [5] *Shift Switch - will activate code when engine rpm are above 3500 rpm and 40% load.*

Warning Chart (continued)

Fault	Smartcraft Gauges	Audio Alarm	Available Power	Description
Steer CKT Hi	No	No	100%	Short or high voltage
Steer CKT Lo	No	No	100%	Open
TPS1 CKT or Range Hi	Yes	2 Bp/min	90%	Short or high voltage
TPS1 CKT or Range Lo	Yes	2 Bp/min	90%	Open or low voltage
Trim CKT or Range Hi	Yes	No	100%	Open or high voltage
Trim CKT or Range Lo	Yes	No	100%	Short
5 VDC PWR Low [4]	Yes	2 Bp/min	90%	Short or low - engine may not start
MAT Sensor Hi	Yes	2 Bp/min	90%	Open - default to –32 degrees F
MAT Sensor Lo	Yes	2 Bp/min	90%	Short - default to –32 degrees F
Shift Switch [5]	Yes	2 Bp/min	90%	Open Circuit

NOTE: *If any 5v sensor becomes shorted to ground the engine will not start. If the engine is operating when the short occurs the engine may stop operating and will not start.*

NOTE: [1] *GM EFI ignition system failure open or shorted, driver will flag EST 1 fault.*

NOTE: [2] *TPS must see 5% throttle then back to 0% to flag IAC fault.*

NOTE: [3] *2-wire sensor open will read sensor Hi on scan tool.*

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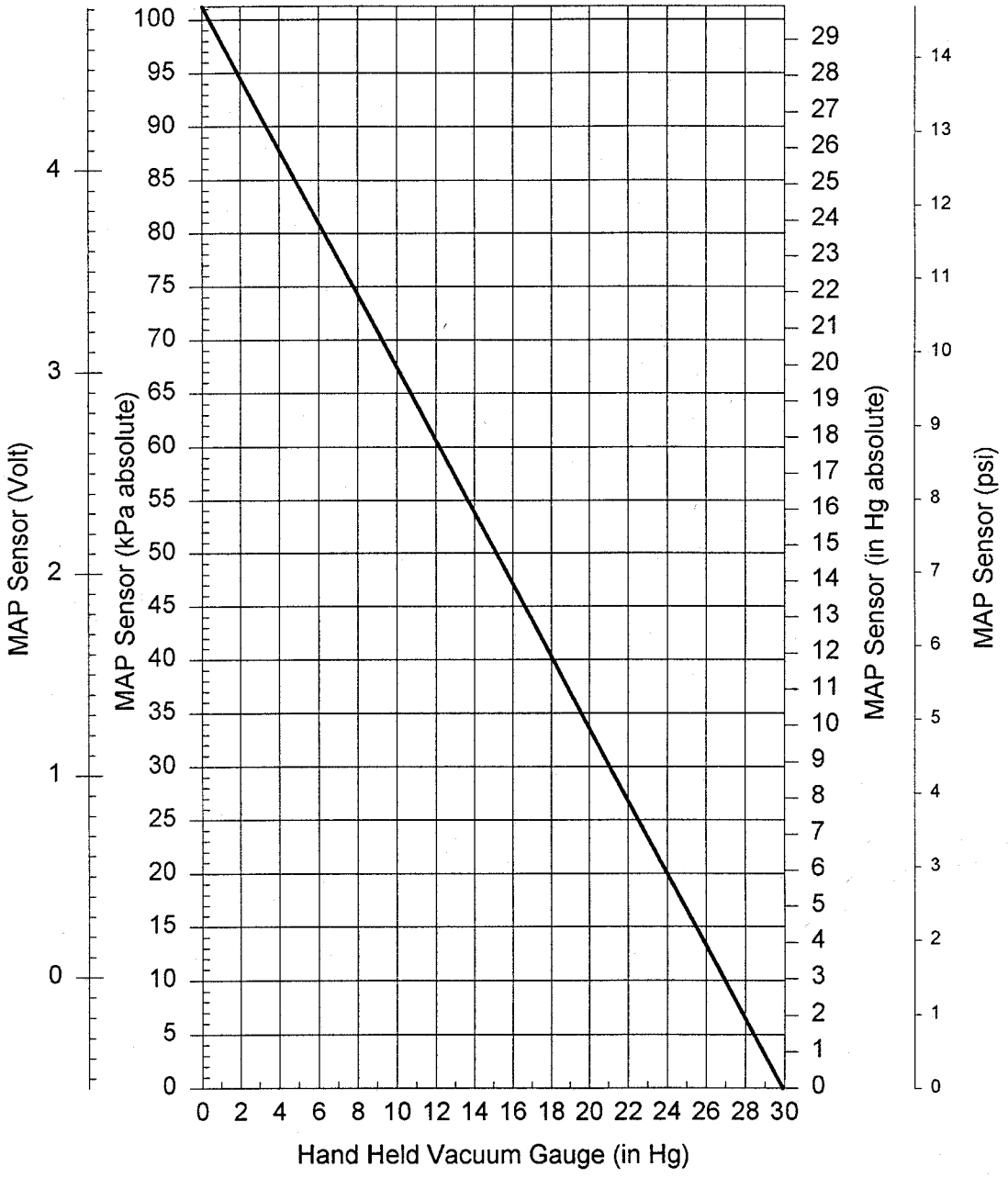
NOTE: [5] *Shift Switch - will activate code when engine rpm are above 3500 rpm and 40% load.*

General Reference Charts

Manifold Vacuum / Pressure

Manifold Vacuum	Absolute Pressure		Manifold Vacuum	Absolute Pressure	
psi	psi	kPa	psi	psi	kPa
0	14.7	101.3	**7 1/4**	7.45	51.4
1/4	14.45	99.6	**7 1/2**	7.2	49.6
1/2	14.2	97.9	**7 3/4**	6.95	47.9
3/4	13.95	96.2	**8**	6.7	46.2
1	13.7	94.4	**8 1/4**	6.45	44.5
1 1/4	13.45	92.7	**8 1/2**	6.2	42.7
1 1/2	13.2	91.0	**8 3/4**	5.95	41.0
1 3/4	12.95	89.3	**9**	5.7	39.3
2	12.7	87.5	**9 1/4**	5.45	37.6
2 1/4	12.45	85.8	**9 1/2**	5.2	35.8
2 1/2	12.2	84.1	**9 3/4**	4.95	34.1
2 3/4	11.95	82.4	**10**	4.7	32.4
3	11.7	80.6	**10 1/4**	4.45	30.7
3 1/4	11.45	78.9	**10 1/2**	4.2	29.0
3 1/2	11.2	77.2	**10 3/4**	3.95	27.2
3 3/4	10.95	75.5	**11**	3.7	25.5
4	10.7	73.8	**11 1/4**	3.45	23.8
4 1/4	10.45	72.0	**11 1/2**	3.2	22.1
4 1/2	10.2	70.3	**11 3/4**	2.95	20.3
4 3/4	9.95	68.6	**12**	2.7	18.6
5	9.7	66.9	**12 1/4**	2.45	16.9
5 1/4	9.45	65.1	**12 1/2**	2.2	15.2
5 1/2	9.2	63.4	**12 3/4**	1.95	13.4
5 3/4	8.95	61.7	**13**	1.7	11.7
6	8.7	60.0	**13 1/4**	1.45	10.0
6 1/4	8.45	58.2	**13 1/2**	1.2	8.3
6 1/2	8.2	56.5	**13 3/4**	0.95	6.5
6 3/4	7.95	54.8	**14**	0.7	4.8
7	7.7	53.1	**14 1/4**	0.45	3.1
			14 1/2	0.2	1.4

Vacuum Gauge vs MAP Sensor



This graph is correct at sea level only.

Centigrade to Fahrenheit Conversion

Centigrade	Fahrenheit	Centigrade	Fahrenheit
-55	-67	85	185
-50	-58	90	194
-45	-49	95	203
-40	-40	100	212
-35	-31	105	221
-30	-22	110	230
-25	-13	115	239
-20	-4	120	248
-15	5	125	257
-10	14	130	266
-5	23	135	275
0	32	140	284
5	41	145	293
10	50	150	302
15	59	155	311
20	68	160	320
25	77	165	329
30	86	170	338
35	95	175	347
40	104	180	356
45	113	185	365
50	122	190	374
55	131	195	383
60	140	200	392
65	149	205	401
70	158	210	410
75	167	215	419
80	176	220	428

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SECTION 2A - TROUBLESHOOTING

Table of Contents

Troubleshooting Without A Diagnostic Tool

Troubleshooting without a diagnostic tool is limited to checking resistance on the sensors. Typical failures usually do not involve the ECM. Loose connections or mechanical wear are likely at fault.

- Verify engine is in good mechanical condition.
- Verify ECM grounds and sensor connections are clean, tight and in their proper location.
- Check vacuum hoses for splits, kinks and proper connections. Check thoroughly for any type of leak or restriction.
- Check for air leaks at throttle body mounting area and intake manifold sealing surfaces.
- Check ignition wires for cracking, hardness and proper routing.
- Inspect wiring for proper connections, pinches and cuts.
- Check for moisture in primary or secondary ignition circuit connections.
- Check for salt corrosion on electrical connections and exposed throttle body linkages.
- Check fuel pump terminals and fuel pump pressure.
- Verify that throttle cable is adjusted properly for the TPS at 0 degrees.

Troubleshooting With A Diagnostic Tool

The Quicksilver Digital Diagnostic Terminal (DDT) and the Mercury MerCruiser Scan Tool have been developed specifically to help technicians diagnose and repair Mercury MerCruiser engines.

These diagnostic tools enable the technician to monitor sensors, ECM/ECM data values and also retrieve stored fault information. The data that can be monitored in real time includes:

Engine rpm	Fuel level
Battery voltage	Manifold air pressure
Available power	Trim
Lake / Sea temperature	Idle air control (IAC) pwm percent
Barometric pressure	Oil pressure
Engine coolant temperature	seawater pump pressure
Throttle position sensor voltage and percent	Manifold air temperature
Pitot	

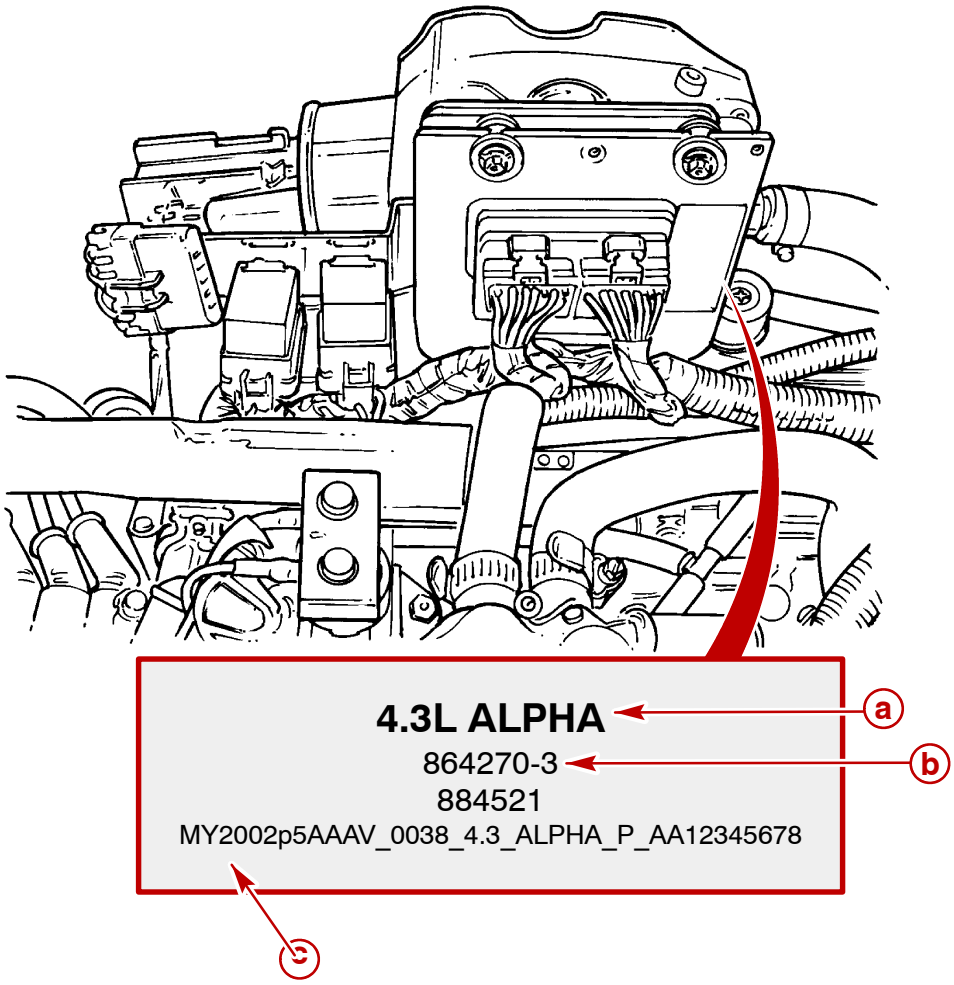
The diagnostic tools also have the capability of performing several diagnostic tests such as cylinder misfire, injector, IAC, fuel pump relay and main power relay output or load tests.

Refer to the appropriate reference manual for complete diagnostic tool instructions.

Troubleshooting Worksheet

ECM Calibration Label

An ECM can be readily identified by the two wire harness connectors (A–B).



Typical ECM Calibration Label

- **a** - Engine Model
- **b** - Calibration Part Number
- **c** - Model Year

The ECM Calibration label includes the information necessary to determine the calibration that an engine is equipped with from the factory. The top line is the engine model designation. It is important that Alpha ECM's are only used on Alpha models, Bravo ECM's are only used on Bravo models and Inboard ECM's are used only inboard models. The second line specifies the simple calibration number and version. In this case it is calibration 864270, version 3. The bottom line lists the model year of the ECM, in this case 2002, followed by detailed identification numbers of the exact calibration. Ensure that you have this information before calling Customer Service.

Data Collection

The following charts can be filled out to help troubleshoot problems with the engine. With this information the Mercury MerCruiser Customer Service personnel will be better able to identify the potential problem.

PCM 555/ECM 555 Scan Tool Worksheet

Dealer #		Seawater Temperature		
Engine S/N		Ambient Air Temperature		
Engine Type		Engine Run Time		
ECM Part #		Altitude		
Exhaust		Propeller Pitch		
Drive Type And Ratio		Propeller Type	Stainless Steel	Aluminum

Idle / Closed Throttle / Neutral					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kpa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kpa	psi	OIL (pressure)	kpa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kpa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kpa	psi
SPARK ANG BTDC					
NOTES					

PCM 555/ECM 555 Scan Tool Worksheet (continued)

Idle / Closed Throttle / In Gear					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO (pressure)	kpa	psi
BATTERY VOLTAGE	volts	volts	STB EMCT	C	F
PWR 1 VOLTS	volts	volts	PORT EMCT	C	F
MAP (pressure)	kpa	psi	OIL (pressure)	kpa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kpa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kpa	psi
SPARK ANG BTDC					
NOTES					

In Gear 2000 rpm					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO PSI	kpa	psi
Battery Voltage	volts	volts	STB EMCT	C	F
PWR 1 Volts	volts	volts	PORT EMCT	C	F
MAP PSI	kpa	psi	OIL PSI	kpa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER	%	%	SEAPUMP PRESSURE	kpa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS %	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP	C	F	FPC TOTAL OZ.	mg	oz
IAC PWM	%	%	FUEL PRESSURE	kpa	psi
SPARK ANG BTDC					
NOTES					

ECM 555/ECM 555 Scan Tool Worksheet (continued)

In Gear 3000 rpm					
Engine Conditions	**Metric**	**SAE**	**Engine Conditions**	**Metric**	**SAE**
RPM			BARO PSI	kpa	psi
Battery Voltage	volts	volts	STB EMCT	C	F
PWR 1 Volts	volts	volts	PORT EMCT	C	F
MAP PSI	kpa	psi	OIL PSI	kpa	psi
FUEL LEVEL			ECT	C	F
AVAILABLE POWER %	%	%	SEAPUMP PRESSURE	kpa	psi
TRIM			TPS 1 VOLTS	volts	volts
PITOT			TPS %	%	%
PADDLE WHEEL			MAT	C	F
LAKE/SEA TEMP.	C	F	FPC TOTAL OZ.	mg	oz
IAC PWM %	%	%	FUEL PRESSURE	kpa	psi
SPARK ANG BTDC					
NOTES					

WOT/In Gear/Trim									
Engine Conditions	**Metric**	Scale	**SAE**	Scale	**Engine Conditions**	**Metric**	Scale	**SAE**	Scale
RPM					BARO PSI		kpa		psi
Battery Voltage		volts		volts	STB EMCT		C		F
PWR 1 Volts		volts		volts	PORT EMCT		C		F
MAP PSI		kpa		psi	OIL PSI		kpa		psi
FUEL LEVEL					ECT		C		F
AVAILABLE POWER %		%		%	SEAPUMP PRESSURE		kpa		psi
TRIM					TPS 1 VOLTS		volts		volts
PITOT					TPS %		%		%
PADDLE WHEEL					MAT		C		F
LAKE/SEA TEMP.		C		F	FPC TOTAL OZ.		mg		oz
IAC PWM %		%		%	FUEL PRESSURE		kpa		psi
SPARK ANG BTDC									
NOTES									

Preliminary Checks

Several of the diagnostic procedures call for the completion of a Visual / Physical Checklist. The importance of this step cannot be stressed too strongly. It can lead to correcting a problem without further checks and can save valuable time. This check is outlined below:

Visual / Physical Checklist

Step	Action	Yes	No
1.	**Is the battery fully charged?**	Go to Step 2.	Recharge or replace battery. Restart checklist.
2.	**Are the battery cable connections clean and tight?**	Go to Step 3.	Clean or tighten battery cable connections. Go to Step 3.
3.	**Are the external engine grounds tight and clean?**	Go to Step 4.	Clean or tighten engine grounds. Go to Step 4.
4.	Check fuel line and fuel line connections for leaks, corrosion and blockage. **Was a problem found?**	Repair problem. Go to Step 5.	Go to Step 5.
5.	Check the 3 fuses located next to the ECM on the engine. **Are the fuses good?**	Go to Step 6.	Replace fuse. Go to Step 6.
6.	Check the 50 amp circuit breaker located on the engine to ensure that the circuit is closed. **Was the circuit breaker tripped?**	Reset the circuit breaker. Go to Step 7.	Go to Step 7.
7.	**Is the Lanyard Stop Switch in the wrong position?**	Toggle switch. Go to Step 8.	Go to Step 8.
8.	**Are you using the correct version of scan tool software for the engine in question?**	Go to OBD System Chart.	Obtain appropriate version of software. Go to OBD System Chart.

On-Board Diagnostic (OBD) System Chart

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	Connect scan tool to the engine. Ignition ON. **Is the scan tool communicating with the ECM?**	Go to Step 10.	Go to Step 3.
3.	Ignition ON. Check for battery voltage (B+) at Pin 5 of the 10-pin connector coming from the helm. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 4.	Locate and repair problem from the keyswitch to the engine ten pin connector. Re-test system.
4.	Ignition ON. Check for B+ at ECM Connector B-18. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 6.	Go to Step 5.
5.	Check for continuity between Pin 5 of the 10-pin Connector of the engine harness and ECM Connector B-18. **Was continuity present?**	Go to Step 6.	Locate and repair the open in the harness. Re-test system.

On-Board Diagnostic (OBD) System Chart (continued)

6.	Ignition ON. Check for B+ at Diagnostic connector Pin D. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 7.	Repair or replace harness. Re-test system.
7.	Check continuity of the ground wire, Diagnostic connector Pin A and Pin 1 of the 10-pin Connector. **Was continuity present?**	Go to Step 8.	Locate and repair the open in the harness. Re-test system.
8.	Check continuity between Diagnostic connector Pin B and ECM connector A-12. **Was continuity present?**	Go to Step 9.	Locate and repair the open in the harness. Re-test system.
9.	Check continuity between Diagnostic connector Pin C and ECM connector A-5. **Was continuity present?**	Replace ECM.	Locate and repair the open in the harness. Re-test system.
10.	Using the scan tool, check for faults stored in the ECM. **Were any faults present?**	Inspect and repair fault. Re-test system.	Go to appropriate symptom chart.

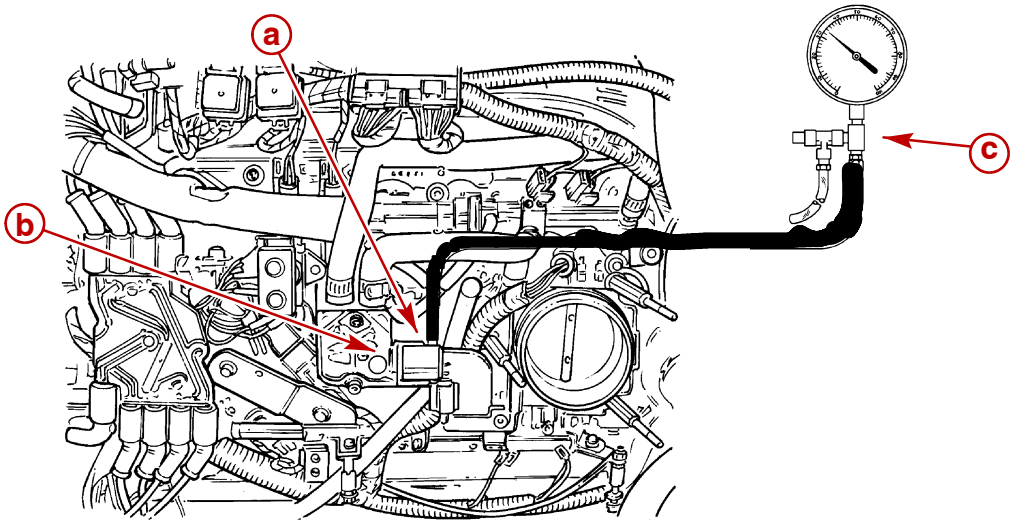
Fuel Pressure Gauge Setup

⚠ WARNING

Avoid Fire or Explosion: The fuel injection system is pressurized during operation. Fuel could spray on the hot engine causing fire or explosion. Allow the engine to cool down before attempting to attach or remove a fuel pressure gauge to the Schrader Valve.

⚠ WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Ensure that the ignition key is OFF. Do not smoke or allow spark or open flame in the area when servicing the fuel system. Wipe up any spilled fuel immediately.



a - Schrader Valve Location
b - IAC
c - Fuel Pressure Gauge

INSTALLATION

IMPORTANT: Wipe up spilled fuel immediately.

1. Activate the Schrader valve located on the fuel rail to relieve pressure.
1. Remove Schrader valve cap.
2. Using proper adapter, attach the fuel pressure gauge to the Schrader valve.
3. Turn key to the On position to purge all of the air from the fuel pressure gauge line.

NOTE: *It will take several key ONs to purge the air from the line.*

REMOVAL

IMPORTANT: Follow the fuel pressure gauge manufacturer for the correct procedure for relieving pressure from the system.

1. Relieve the pressure from the fuel system.
2. Remove the fuel pressure gauge from the engine.
3. Install the Schrader valve cap.

Symptom Charts

Chart A-1 Engine Cranks Over But Will Not Start

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Go to the OBD Chart.
3.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 4.	Go to Chart A-2.
4.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Ignition ON. Fuel pump will operate for 3-5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 psi. Ignition OFF. **Was the fuel pressure with the pump operating above 35 psi?**	Go to Step 5.	Go to Chart A-3.
5.	Complete a compression test on the engine. See compression test procedures. **Was a problem found?**	Locate and repair. Re-test system.	Go to the OBD Chart.

Chart A-2 Main Power Relay Test

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Go to the OBD Chart.
3.	Ignition ON. Listen for the Main Power Relay (MPR). Ignition OFF. **With initial ignition ON, did the Main Power Relay turn on (should hear a click)?**	Go to Chart A-5.	Go to Step 4.
4.	Remove the MPR. Ignition ON. Using the DMT connected to ground, check for B+ MPR harness connector terminal 30 and 86. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 5.	Locate and repair the open or short in the harness. Re-test system.
5.	Check for continuity between the MPR harness connector terminal 85 and the ECM harness connector A-22. **Was continuity present?**	Install a known good MPR onto the engine. Re-test system.	Locate and repair the open or short in the harness. Re-test system.

Chart A-3 Fuel System Electrical Test

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Ignition ON. Listen for the Fuel Pump to operate. Ignition OFF. **Did the fuel pump operate for 3-5 seconds?**	Go to Chart A-4.	Go to Step 4.
4.	Ignition ON. Using the DMT connected to ground, check for B+ at the fuel pump harness connector A. Ignition OFF. **With the ignition ON, was B+ present?**	Install a known good fuel pump. Re-test system.	Go to Step 5.
5.	Remove Fuel Pump Relay (FPR). Ignition ON. Using the DMT connected to ground, check for B+ at FPR harness connector terminal 30. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 6.	Locate and repair the open or short in the harness. Re-test system.
6.	Check for continuity between FPR harness connector terminal 86 and ECM harness connector A-19. **Was continuity present?**	Install a known good FPR. Re-test system.	Locate and repair the open or short in the harness. Re-test system.

Chart A-4 Fuel System Diagnosis

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Ignition ON. Fuel pump will operate for 3-5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 psi. Ignition OFF. **Was the fuel pressure with the pump operating above 35 psi?**	Go to Step 4.	Go to Step 6.
4.	Attempt to start the engine and idle at normal operating temperatures. **Did the engine start?**	Go to Step 5.	Go to Step 7.

Chart A-4 Fuel System Diagnosis (continued)

Step	Action	Yes	No
5.	With the engine idling, connect an external vacuum source to the fuel pressure regulator and apply 10 in. of vacuum. **Did fuel pressure decrease by approximately 5 psi?**	Problem is intermittent or the fuel supply to the engine is low or restricted.	Replace faulty fuel pressure regulator. Re-test system.
6.	**Was fuel pressure present?**	Go to Step 7.	Go to Chart A-3.
7.	**Does the system establish fuel pressure and then quickly decrease to 0 psi?**	Go to Step 8.	Re-test system
8.	Ignition OFF. Block fuel pressure line between the fuel pump and the fuel rail. Ignition ON. **Does fuel pressure remain steady?**	Locate and repair leaking fuel injectors or fuel line connections.	Go to Step 9.
9.	Ignition OFF. Block fuel return line using the fuel shut off valve tool. Ignition ON. **Does fuel pressure remain steady?**	Replace faulty fuel pressure regulator. Re-test system.	Install a known good fuel pump. Re-test system.

Chart A-5 Ignition System Test

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Install an analog tachometer to the auxiliary tachometer lead located near the ECM. Try to start the engine. Ignition OFF. **Was there any tachometer signal on the analog tachometer while cranking the engine?**	Go to Step 4.	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.
4.	Check spark plug wires for open circuits, cracks in the insulation or improper seating of the terminals at the spark plugs, distributor cap and coil tower. **Was a problem found?**	Locate and repair or replace. Re-test system.	Go to Step 5.
5.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 6.	Go to Step 7.
6.	Check spark plugs for damage and wear. **Was a problem found?**	Replace with a new spark plug gapped correctly.	Go to Step 12.
7.	Ignition ON. Using the DMT, check for B+ at the coil connector A. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 8.	Locate and repair the open in the harness. Re-test system.
8.	Check for continuity between the coil harness connectors B and C, and the coil driver harness connector D. **Was continuity present?**	Go to Step 9.	Locate and repair the open in the harness. Re-test system.

Chart A-5 Ignition System Test (continued)

Step	Action	Yes	No
9.	Ignition ON. Using DMT, check for B+ at coil driver harness connector A. Ignition OFF. **With the ignition ON, was B+ present?**	Go to Step 10.	Locate and repair the open in the harness. Re-test system.
10.	Check continuity between the coil driver harness connector C and the engine ground. **Was continuity present?**	Go to Step 11.	Locate and repair the open in the harness. Re-test system.
11.	Check continuity between the coil driver harness connector B and the ECM connector B-23. **Was continuity present?**	Replace the coil and coil driver. Re-test system.	Locate and repair the open in the harness. Re-test system.
12.	Disconnect the harness from the Crankshaft position sensor (CPS). Ignition ON. Using a DMT connected to ground, check for 5 volt power at harness connector A. Ignition OFF. **With the ignition ON, was 5 volt power present?**	Go to Step 13.	Locate and repair the open in the harness. Re-test system.
13.	Check continuity between CPS harness connector B and engine ground. **Was continuity present?**	Go to Step 14.	Locate and repair the open in the harness. Re-test system.
14.	Check continuity between CPS harness connector C and ECM harness connector B-10. **Was continuity present?**	Go to Step 15.	Locate and repair the open in the harness. Re-test system.
15.	Check the normal resistance values for the CPS. See Normal Sensor Resistance Chart. **Was the resistance values the same or similar to the chart values?**	Go to Visual / Physical Checklist.	Replace the CPS. Re-test system.

Chart A-6 Hard Start Symptom

Definition: Engine cranks OK, but takes a long time to start.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter**.** Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 4.
4.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 5.	Go to Chart A-2.
5.	Disconnect both battery cables from the battery. Install fuel pressure gauge. Connect the battery cables to the battery. Ignition ON. Fuel pump will operate for 3-5 seconds. Note the fuel pressure while the pump is operating. The pressure may drop after the pump stops, but should not drop immediately to 0 psi. Ignition OFF. **Was the fuel pressure with the pump operating above 35 psi?**	Go to Step 6.	Go to Chart A-3.
6.	**Is a scan tool being used?**	Go to Step 8.	Go to Step 7.

Chart A-6 Hard Start Symptom (continued)

Step	Action	Yes	No
7.	Check for an ECT sensor shifted in value. With the engine completely cool, measure the resistance of the ECT sensor. Refer to the ECT single circuit diagram in SECTION 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Are the readings similar?**	Go to Step 10.	Replace the ECT sensor. Re-test system.
8.	Check for an ECT sensor shifted in value. Using the scan tool with the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature. **Are the temperatures within 5.5 degrees C (10 degrees F) of each other?**	Go to Step 9.	Replace the ECT sensor. Re-test system.
9.	Using the scan tool, display ECT sensor temperature and note value. Check the resistance of the ECT sensor. Refer to the ECT single circuit diagram in SECTION 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Is the ECT sensor temperature near the resistance temperature?**	Go to Step 10.	Locate and repair high resistance or poor connection in the ECT signal circuit or the ECT sensor ground.
10.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness. Re-test the system.	Go to Step 11.
11.	Using the scan tool, check for proper operation of the TP sensor. Check throttle linkage for sticking, binding or wear. **Was a problem found?**	Locate and repair the problem with the TP sensor or the throttle linkage. Re-test system.	Go to Step 12.

Chart A-6 Hard Start Symptom (continued)

Step	Action	Yes	No
12.	Check for the following: • Low compression • Leaking cylinder head gaskets • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 13.
13.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-7 Engine Surges Symptom

Definition: Engine power variation under steady throttle. Feels like the engine speeds up or slows down with no change in the throttle lever position.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter**.** Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 4.
4.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 5.
5.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Were the spark plugs damaged?**	Replace the spark plugs.	Go to Step 6.
6.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Re-test system	Go to Step 7.

Chart A-7 Engine Surges Symptom (continued)

7.	Check the integrity of the primary and secondary wiring. Check wire routing. Check the condition of the distributor, distributor cap and spark plug wires. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace bad distributor or spark plug wires. Re-test system.	Go to Step 8.
8.	Check the vacuum hoses for splits, kinks and proper connections. **Was a problem found?**	Repair or replace the vacuum hoses.	Go to Step 9.
9.	Check the fuel injectors wiring harness for proper connections and intermittent opens or shorts. **Was a problem found?**	Repair or replace the fuel injector harness. Re-test system.	Go to Step 10.
10.	Inspect ECM harness connections and ground connections for being tight, clean and connected properly. **Was a problem found?**	Repair. Re-test system.	Go to Step 11.
11.	Check alternator voltage output. **Is voltage between 13.9 - 14.7 volts?**	Go to Step 12.	Review charging system. See appropriate Mercury MerCruiser Service Manual.
12.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-8 Lack Of Power, Sluggish or Spongy Symptom

Definition: Engine delivers less than expected power. Little or no increase in speed when throttle lever is advanced part way.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	**Is engine in Guardian Strategy?**	Verify engine fault and repair.	Go to Step 4.
4.	If possible compare engine performance with a engine of the same model. **Is the engine performance similar?**	No problem found.	Go to Step 5.
5.	Check flame arrestor for dirt, damage or any restriction. **Was a problem found?**	Clean or replace the flame arrestor.	Go to Step 6.
6.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter. Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 7.
7.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 8.
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Were the spark plugs damaged?**	Replace the spark plugs.	Go to Step 9.
9.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Re-test system	Go to Step 10.

Chart A-8 Lack Of Power, Sluggish or Spongy Symptom (continued)

Step	Action	Yes	No
10.	Check for intermittent open or shorts in the ECT sensor, MAP sensor, TP sensor and KS sensor. **Was a problem found?**	Locate and repair the open or short in the harness.	Go to Step 11.
11.	Inspect ECM harness connections and ground connections for being tight, clean and connected properly. **Was a problem found?**	Repair. Re-test system.	Go to Step 12.
12.	Check alternator voltage output. **Is voltage between 13.9 - 14.7 volts?**	Go to Step 13.	Review charging system. See appropriate Mercury MerCruiser Service Manual.
13.	Check for the following: • Low compression • Leaking cylinder head gaskets • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 14.
14.	Check for excessive resistance on the bottom of the boat such as dirt or barnacles. Check for proper propeller size and pitch for the boat application. **Was a problem found?**	Clean the boat bottom. Retest system.	Go to Step 15.
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-9 Detonation / Spark Knock Symptom

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	**Is the engine propped to operate in the recommended operating rpm range?**	Go to Step 4.	Check propping procedures.
4.	Check for correct spark plug number. Check the spark plugs for the correct gap, heat range and damage. **Was a problem found?**	Replace with specified spark plugs.	Go to Step 5.
5.	Check the spark plug wires for continuity or damage. **Was a problem found?**	Replace the questionable spark plug wire. Re-test system.	Go to Step 6.
6.	Check for cracks, damage or breaks of the distributor, distributor cap or rotor. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 7.
7.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter**.** Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 8.
8.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 9.

Chart A-9 Detonation / Spark Knock Symptom (continued)

Step	Action	Yes	No
9.	**Is the engine operating above the normal temperature range?**	Go to Step 10.	Go to Step 11.
10.	Check for obvious overheating issues: • Loose serpentine belt • Faulty or incorrect seawater pump • Restriction in the cooling system • Faulty or incorrect thermostat **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 11.
11.	**Is a scan tool being used?**	Go to Step 13.	Go to Step 12.
12.	Check for an ECT sensor shifted in value. With the engine completely cool, measure the resistance of the ECT sensor. Refer to the ECT single circuit diagram in SECTION 3. Compare the approximate temperature of the ECT sensor to an accurate reading of ambient air temperature. **Are the readings similar?**	Go to Step 14.	Replace the ECT sensor. Re-test system.
13.	Check for an ECT sensor shifted in value. Using the scan tool with the engine completely cool, compare the ECT sensor temperature with an accurate reading of ambient air temperature. **Are the temperatures within 5.5 degrees C (10 degrees F) of each other?**	Go to Step 14.	Replace the ECT sensor. Re-test system.

Chart A-9 Detonation / Spark Knock Symptom (continued)

Step	Action	Yes	No
14.	Check for the following: • Low compression • Leaking cylinder head gaskets • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 15.
15.	Using an engine cleaner, remove excessive carbon buildup from the combustion chambers. Refer to instructions on the engine cleaner. Re-test system. **Is detonation still present?**	Go to Step 16.	-
16.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-10 Hesitation, Sag or Stumble Symptom

Definition: Momentary lack of response as the throttle lever is advanced. Can occur at all engine speeds, but usually more severs when first starting out. May cause engine to stall in severe cases.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Inspect flame arrestor for restrictions, dirt or damage. **Was a problem found?**	Clean or replace flame arrestor. Re-test system.	Go to Step 4.
4.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness. Re-test the system.	Go to Step 5.
5.	Using the scan tool, check for proper operation of the TP sensor. Check throttle linkage for sticking, binding or wear. **Was a problem found?**	Locate and repair the problem with the TP sensor or the throttle linkage. Re-test system.	Go to Step 6.
6.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter**.** Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 7.
7.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 8.
8.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 9.

Chart A-10 Hesitation, Sag or Stumble Symptom (Continued)

Step	Action	Yes	No
9.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 10.
10.	Check alternator voltage output. **Is voltage between 13.9 - 14.7 volts?**	Go to Step 11.	Review charging system. See appropriate Mercury MerCruiser Service Manual.
11.	Check for obvious overheating issues: • Loose serpentine belt • Faulty or incorrect seawater pump • Restriction in the cooling system • Faulty or incorrect thermostat **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 12.
12.	Check for the following: • Low compression • Deposits on the intake valves **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 13.
13.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-11 Cuts Out or Misses Symptom

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle, low speed or on hard acceleration. Fuel starvation can cause engine to cutout.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Verify that the high voltage switch (distributor) is aligned properly. See appropriate Mercury MerCruiser Service Manual for instructions. **Was a problem found?**	Align properly. Re-test system.	Go to Step 4.
4.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter. Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 5.
5.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 6.
6.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 7.
7.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 8.	Go to Chart A-2
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 9.

Chart A-11 Cuts Out or Misses Symptom (continued)

Step	Action	Yes	No
9.	Check for the following: • Low compression • Sticking or leaking valves • Bent push rods • Worn rocker arms • Broken valve springs • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 10.
10.	Check intake and exhaust manifolds for casting flash. **Was a problem found?**	Repair or Replace. Re-test system.	Go to Step 11.
11.	Check for Electromagnetic Interference (EMI). A missing condition can be caused by EMI on the reference circuit. EMI can usually be detected by monitoring engine rpm with a scan tool or tachometer. A sudden increase in rpm with little change in actual engine rpm change, indicates EMI is present. **Was a problem found?**	Locate and correct the EMI source. Re-test system.	Go to Step 12.
12.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-12 Rough, Unstable or Incorrect Idle and Stalling Symptom

Definition: Engine operates unevenly at idle. If severe, the engine or vessel may shake. Engine idle speed may vary in rpm. Either condition may be severe enough to stall the engine.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter. Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 4.
4.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 5.
5.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 6.
6.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 7.	Go to Chart A-2
7.	Check for cracks, damage or breaks of the distributor, distributor cap or rotor. Check for the proper alignment of the distributor. **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 8.

Chart A-12 Rough, Unstable or Incorrect Idle and Stalling Symptom (continued)

Step	Action	Yes	No
8.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 9.
9.	Check for the following: • Low compression • Vacuum leaks • Sticking or leaking valves • Bent push rods • Worn rocker arms • Broken valve springs • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 10.
10.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-13 Poor Fuel Economy Symptom

Definition: Fuel economy is noticeably lower than expected. Also, economy is now lower than it was on this engine at one time.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check operators driving habits. Are excessively heavy loads being carried? Is operator accelerating too much, too often? **Was a problem found?**	System normal	Go to Step 4.
4.	Check all fuel lines and connections for leaks. **Was a problem found?**	Repair or replace.	Go to Step 5.
5.	Check for excessive resistance on the bottom of the boat such as dirt or barnacles. Check for proper propeller size and pitch for that application. **Was a problem found?**	Clean boat bottom. Repair or replace the propeller.	Go to Step 6.
6.	Check flame arrestor for dirt, damage or any restriction? **Was a problem found?**	Clean or replace the flame arrestor.	Go to Step 7.
7.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter. Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 8.
8.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 9.

Chart A-13 Poor Fuel Economy Symptom (continued)

Step	Action	Yes	No
9.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 10.
10.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 11.	Go to Chart A-2.
11.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 12.
12.	Check the vacuum hoses for splits, kinks and proper connections. **Was a problem found?**	Repair or replace the vacuum hoses.	Go to Step 13.
13.	Check engine compression. **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 14.
14.	Check exhaust system for possible restriction. Inspect exhaust system for damaged or collapsed pipes. **Was a problem found?**	Repair or replace.	Go to Step 15.
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-14 Dieseling or Run-On Symptom

Definition: Engine continues to operate very roughly after the key is moved to the OFF position. If engine operates smoothly, check ignition switch and adjustment.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 4.
4.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 5.
5.	Check for obvious overheating issues: • Loose serpentine belt • Faulty or incorrect seawater pump • Restriction in the cooling system • Faulty or incorrect thermostat **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 6.
6.	Check the fuel pump relay for proper operation. Refer to Chart A-3. **Was a problem found?**	Repair or replace. Re-test system.	Go to Step 7.
7.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Chart A-15 Backfire Symptom

Definition: Fuel ignites in the intake manifold or in the exhaust system, making a loud popping noise.

Step	Action	Yes	No
1.	**Was the Visual / Physical Checklist completed?**	Go to Step 2.	Go to Visual / Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to Step 3.	Complete the OBD.
3.	Check flame arrestor for dirt, damage or any restriction? **Was a problem found?**	Clean or replace the flame arrestor.	Go to Step 4.
4.	Check for contaminated fuel. Check fuel filters and the water separating fuel filter. Check for poor fuel quality and proper octane rating. **Was a problem found?**	Use known good fuel. Replace fuel filters.	Go to Step 5.
5.	Check for proper fuel pressure while the condition exists. Refer to Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to Step 6.
6.	Check fuel injectors. Refer to Injector Balance Test. **Was a problem found?**	Repair or replace faulty injector.	Go to Step 7.
7.	Check spark plug wires for open circuits, cracks in the insulation or improper seating of the terminals at the spark plugs, distributor cap and coil tower. **Was a problem found?**	Locate and repair or replace. Re-test system.	Go to Step 8.
8.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Re-test system	Go to Step 9.
9.	Check for adequate spark at all of the spark plugs. **Was adequate spark present?**	Go to Step 10.	Go to Chart A-2.

Chart A-15 Backfire Symptom (continued)

Step	Action	Yes	No
10.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes or heavy deposits. If the spark plugs are gas or oil fouled, the cause of the fouling must be determined before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to Step 11.
11.	Check for intermittent opens or shorts to ground in the MAP sensor circuit. **Was a problem found?**	Locate and repair the open in the harness. Re-test the system.	Go to Step 12.
12.	Check for proper operation of the TP sensor. Check for throttle linkage sticking, binding or wear causing TP sensor voltage to be higher than normal. **Is TP sensor operating improperly or is the voltage higher than normal?**	Locate and repair the problem with the TP sensor or the throttle linkage. Re-test system.	Go to Step 13.
13.	Check for the following: • Low compression • Sticking or leaking valves • Worn rocker arms • Broken valve springs • Worn camshaft • Improper valve timing or valve train problem • Restricted exhaust system **Was a problem found?**	Engine mechanical problem, go to appropriate Mercury MerCruiser Service Manual.	Go to Step 14.
14.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: • Visual / Physical Checklist • Scan tool data • All of the electrical connections within a suspect circuit or system.	-	-

Symptom Quick Reference Chart

Symptom	Possible Cause	Action
1. Engine cranks but will not start	**1.0** Lanyard Stop Switch in wrong position	**1.0** Reset lanyard stop switch
	1.1 Weak battery or bad starter motor. Battery voltage drops below 8 volts while cranking.	**1.1** Replace or recharge battery. Inspect condition of starter motor. Inspect condition of battery connections.
	1.2 No fuel	**1.2** Key ON engine to verify fuel pump operates for 3 seconds. Check fuel tank for fuel. Verify fuel pressure is 43 psi. Listen for fuel pump relay to click.
	1.3 Blown fuse	**1.3** Inspect engine harness and electrical components. Replace fuse.
	1.4 Main Power Relay (MPR) malfunction	**1.4** Listen for MPR to click when the key switch is turned ON.
	1.5 Crankshaft Position Sensor (CPS) malfunction	**1.5** Inspect for loose connection or corrosion. Inspect continuity between sensors and ECM.
	1.6 ECM malfunction	**1.6** Check battery voltage. Check for blown fuse. Check battery voltage to the fuse from the MPR. Inspect harness connections.
2. Engine overheat	**2.0** Reduced or no water flow	**2.0** Verify water inlet valve is open. Inspect seawater strainer for debris. Clogged water hose.
	2.1 Bad seawater pump impeller	**2.1** Replace impeller.
	2.2 Faulty thermostat	**2.2** Replace thermostat.
	2.3 Faulty seawater pump	**2.3** Replace seawater pump.

Symptom Quick Reference Chart (continued)

Symptom	Fault Cause	Action
3. Engine cranks, starts and stalls	**3.0** Low fuel pressure	**3.0** Key on engine to verify fuel pump operates for 3 seconds. Check fuel tank for fuel. Check fuel pressure is 43 psi. Listen for fuel pump relay to click.
	3.1 Contaminated fuel	**3.1** Change water separating fuel filter.
	3.2 TPS sensor range	**3.2** Inspect throttle linkage for wear and binding.
	3.3 Engine mechanical malfunction	**3.3** Check for low compression, cylinder head gasket leaks, worn camshaft, valve train problem or restricted exhaust system.
4. Engine lacks power, sluggish	**4.0** Extremely dirty flame arrestor	**4.0** Clean or replace flame arrestor.
	4.1 Contaminated fuel	**4.1** Change water separating fuel filter.
	4.2 Improper ignition voltage	**4.2** Check ignition voltage.
	4.3 Fouled spark plugs	**4.3** Change spark plugs.
	4.4 Engine mechanical problems	**4.4** Check for low compression, cylinder head gasket leaks, worn camshaft, valve train problem or restricted exhaust system.
	4.5 Engine Guardian	**4.5** Read fault descriptions.

Symptom Quick Reference Chart (continued)

Symptom	Fault Cause	Action
5. Engine idle is rough	**5.0** Fouled spark plugs	**5.0** Check ignition voltage.
	5.1 Weak spark	**5.1** Inspect coil, spark plug wires and harness connections.
	5.2 IAC faulty	**5.2** Listen for IAC motor upon key ON. Read fault descriptions.
	5.3 Faulty injectors	**5.3** Perform injector balance test.
	5.4 Engine mechanical malfunction	**5.4** Check for low compression, cylinder head gasket leaks, worn camshaft, valve train problem or restricted exhaust system.
	5.5 Faulty motor mounts	**5.5** Inspect motor mounts.
	5.6 Vacuum leak	**5.6** Check vacuum lines and gaskets for leaks and wear. Replace.
	5.7 Throttle cable not adjusted properly	**5.7** Adjust throttle cable.
6. Detonation or spark knock	**6.0** Faulty knock sensor circuit	**6.0** Inspect both knock sensor circuits.
	6.1 Poor ignition system ground	**6.1** Inspect ignition system connections.
	6.2 Contaminated fuel	**6.2** Replace fuel with known high quality fuel.

Engine Fault Quick Reference Chart

This chart correlates with the fault list of the diagnostic tool. After displaying the faults stored in a ECM, the fault can be referenced on this chart for possible causes and checks to fix the problem. The single circuit diagrams in SECTION 3A correlate most of these faults with the sensor circuit schematics to help locate wiring problems.

Faults	Possible Causes	Action
1. ECT CKT Hi or Lo	**1.0** Open(Hi) or Short (Lo) in harness wiring, faulty connection	**1.0** Repair harness connection or cut in wire.
	1.1 Open(Hi) or Short (Lo) sensor	**1.1** Replace sensor.
	1.2 Water in the connector	**1.2** Dry connector and inspect for cracks or wear. Replace.
2. ECT Coolant Overheat	**2.0** Coolant leak	**2.0** Inspect closed cooling system.
	2.1 Restricted waterflow	**2.1** Check for blockage in inlet and outlet water hoses.
	2.2 Faulty seawater pump	**2.2** Inspect seawater pump water ports, impeller and seals for damage. Replace damaged parts.
	2.3 Faulty thermostat	**2.3** Replace thermostat.
	2.4 Faulty seawater pump	**2.4** Replace seawater pump.
	2.5 Worn or broken drive belt	**2.5** Replace drive belt.
3. EST 1 Open or Short	**3.0** Loose spark plug wire connection.	**3.0** Verify spark plug boot firmly connected.
	3.1 Broken spark plug	**3.1** Inspect spark plug for damage. Replace.
	3.2 Open or Short in harness wiring, bad harness connection	**3.2** Inspect coil harness. Repair or replace.
	3.3 Faulty coil	**3.3** Replace coil.
	3.4 Water in connection	**3.4** Dry connector and inspect for cracks or wear. Replace.
4. Fuel Injector 1-8 Open or Short	**4.0** Open or short in harness wire, bad harness connection or corroded terminals	**4.0** Inspect fuel injector harness. Repair or replace.
	4.1 Faulty fuel injector	**4.1** Replace fuel injector.
	4.2 12 volt fuel injector wire shorted to ground	**4.2** Inspect fuel injector harness. Repair or replace.
	4.3 Corroded harness terminals	**4.3** Inspect fuel injector harness. Repair or replace.

Engine Fault Quick Reference Chart (continued)

Faults	Possible Causes	Action
5. Guardian Strategy	**5.0** Engine block pressure, map sensor, oil pressure, starboard exhaust temperature, engine coolant temperature or overspeed readings are out of normal ranges	**5.0** Other fault codes will appear on the diagnostic tool. Verify repairs associated with the other faults. Scan for faults again.
6. IAC Output Lo or Hi	**6.0** Cut harness wire, bad harness connection, short in harness	**6.0** Inspect IAC wiring circuit. Repair.
	6.1 Faulty IAC, pindle stuck	**6.1** Replace IAC.
7. Knock Sensor 1 Hi or Lo	**7.0** Corrosion or wear on the sensor	**7.0** Replace sensor.
	7.1 Open or short in circuit	**7.1** Inspect harness. Repair or replace harness.
8. Low Drive Lube Strategy MCM engines only.	**8.0** Improper hose routing	**8.0** Route hose as shown in installation manual.
	8.1 Float in bottle stuck	**8.1** Replace bottle.
	8.2 Short in circuit	**8.2** Inspect circuit. Repair or replace harness.
	8.3 Incorrect gear lube level	**8.3** Fill drive lube monitor. Refer to appropriate service manual for filling instructions.
	8.4 System leak	**8.4** Inspect drive lube system. Repair or replace any worn parts.
9. Low Oil Pressure Strategy	**9.0** Faulty sensor readings	**9.0** Replace sensor with a known good sensor.
	9.1 Faulty oil pump	**9.1** Replace oil pump.
	9.2 Low oil level	**9.2** Check oil level, add oil.
10. Main Power Relay Output	**10.0** Short in MPR circuit	**10.0** Inspect MPR circuit. Repair or replace harness.
	10.1 Low battery voltage	**10.1** Charge battery or replace battery.
	10.2 Faulty MPR	**10.2** Replace MPR.
11. Main Power Relay Backfeed	**11.0** Driver power from some other source	**11.0** Test for voltage at 87 of the MPR with key OFF.
	11.1 Short in circuit at splice 105	**11.1** Inspect wiring harness. Repair or replace harness.

Engine Fault Quick Reference Chart (continued)

Faults	Possible Causes	Action
12. MAP Sensor 1 Input Hi or Lo	**12.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**12.0** Inspect circuit. Repair or replace harness.
	12.1 Faulty sensor	**12.1** Replace sensor.
13. MAT Sensor Hi or Lo	**13.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**13.0** Inspect circuit. Repair or replace harness.
	13.1 Faulty sensor	**13.1** Replace sensor.
14. Oil PSI CKT Hi or Lo	**14.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**14.0** Inspect circuit. Repair or replace harness.
	14.1 Faulty sensor	**14.1** Replace sensor.
15. Overspeed	**15.0** Underpropped	**15.0** Change propeller.
	15.1 Over trimmed condition	**15.1** Trim drive properly.
	15.2 Rev-limit out of range	**15.2** Check rev-limit.
16. Pitot CKT Hi or Lo	**16.0** Loose connection, open (Lo) or short (Hi) in wiring circuit	**16.0** Inspect wiring harness. Repair or replace harness.
	16.1 Corroded or faulty sensor	**16.1** Check sensor for damage. Replace seals or sensor.
	16.2 Loose hose connection	**16.2** Tighten hose connection.
17. seawater pump PSI Lo	**17.0** Restricted waterflow	**17.0** Check for blockage in inlet and outlet water hoses.
	17.1 Faulty seawater pump	**17.1** Inspect seawater pump water ports, impeller and seals for damage. Replace damaged parts.
	17.2 Faulty thermostat	**17.2** Replace thermostat.
	17.3 Faulty seawater pump	**17.3** Replace seawater pump.
	17.4 Worn or broken drive belt	**17.4** Replace drive belt.
18. seawater pump CKT Hi or Lo	**18.0** Loose connection, corrosion, open (Hi) or short (Lo) in circuit	**18.0** Inspect circuit. Repair or replace harness.
	18.1 Faulty sensor	**18.1** Replace sensor.

Engine Fault Quick Reference Chart (continued)

Faults	Possible Causes	Checks
19. Steer CKT Hi or Lo	**19.0** Loose connection, corrosion, open (Hi) or short (Lo) in circuit	**19.0** Inspect circuit. Repair or replace harness.
	19.1 Faulty sensor	**19.1** Replace sensor.
20. TPS1 CKT Hi or Lo	**20.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**20.0** Inspect circuit. Repair or replace harness.
	20.1 Faulty sensor	**20.1** Replace sensor.
21. TPS1 Range Hi or Lo	**21.0** Worn or damaged sensor, count reading over 990 for Hi, under 45 for Lo	**21.0** Inspect sensor for damage. Replace TPS.
	21.1 Short in transducer ground circuit	**21.1** Inspect harness for short to ground. Repair or replace harness.
	21.2 Worn, bent or corroded throttle lever	**21.2** Inspect throttle lever. Repair any damage.
22. Transmission Overtemp	**22.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**22.0** Inspect circuit. Repair or replace harness.
	22.1 Faulty sensor	**22.1** Inspect circuit. Repair or replace harness.
23. Trim CKT Hi or Lo	**23.0** Loose connection, corrosion, open (Lo) or short (Hi) in circuit	**23.0** Inspect circuit, repair or replace harness.
	23.1 Faulty sensor	**23.1** Replace sensor.
24. VDC PWR Lo	**24.0** Short to ground in the 5 volt system, harness or 3-wire sensor	**24.0** Read other faults for a starting point for finding the short. Repair or replace harness or faulty sensor.

Injector Balance Test

Test Procedure

The injector balance tester is a tool used to turn the injector ON for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop. Injector testers are available for various manufacturers. A pulse width that drops the fuel rail pressure to half the normal operating pressure should be used.

SET-UP

1. Engine cool down period (ten minutes) is necessary to avoid irregular readings due to heat soak fuel boiling.
2. Relieve fuel pressure in the fuel rail.
3. With ignition OFF, connect fuel pressure gauge to fuel pressure tap.
4. Disconnect harness connectors at all injectors.
5. Connect injector tester to one injector.
6. Use adaptor harness furnished with injector tester to energize injectors. Follow manufacturer's instructions for use of adaptor harness.
7. Ignition must be OFF at least ten seconds to complete ECM shutdown cycle.
8. Fuel pump should run about two seconds after ignition is turned ON.
9. Insert clear tubing attached to vent valve into a suitable container and purge air from gauge and hose to ensure accurate gauge operation.
10. Repeat Step 9. until all air is purged from the gauge.

Injector Balance Test (continued)

TESTING

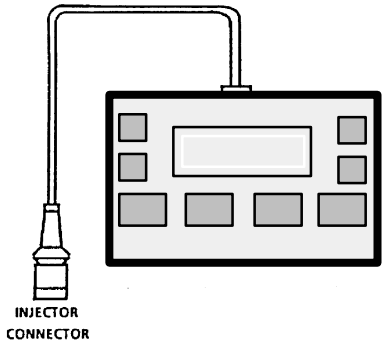
NOTE: *The entire test should not be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors.)*

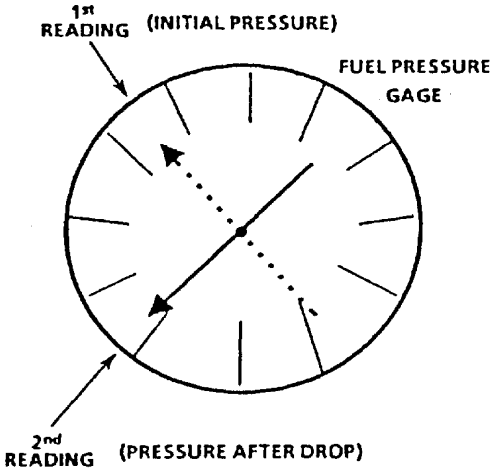
1. Turn ignition OFF for ten seconds and then ON again several times to get maximum fuel pressure.
2. Record the maximum fuel pressure reading.
3. Energize tester one time and note pressure drop at its lowest point. Disregard any slight pressure increase after drop hits low point.
4. Subtract the second pressure reading from the maximum fuel pressure to get the amount of injector pressure drop.
5. Repeat testing for each injector and compare the amount of drop. Usually, good injectors will have approximately the same amount of fuel pressure drop.

NOTE: *If the pressure drop of all injectors is within 1.5 psi (10 kPa) of the average, the injectors have proper flow.*

6. Re-test any injector that has a pressure difference of 1.5 psi (10 kPa), more or less than the average fuel pressure drop of the other injectors on the engine.
7. Replace any injector that retests outside the pressure difference of 1.5 psi (10 kPa), more or less than the average fuel pressure drop of the other injectors on the engine.

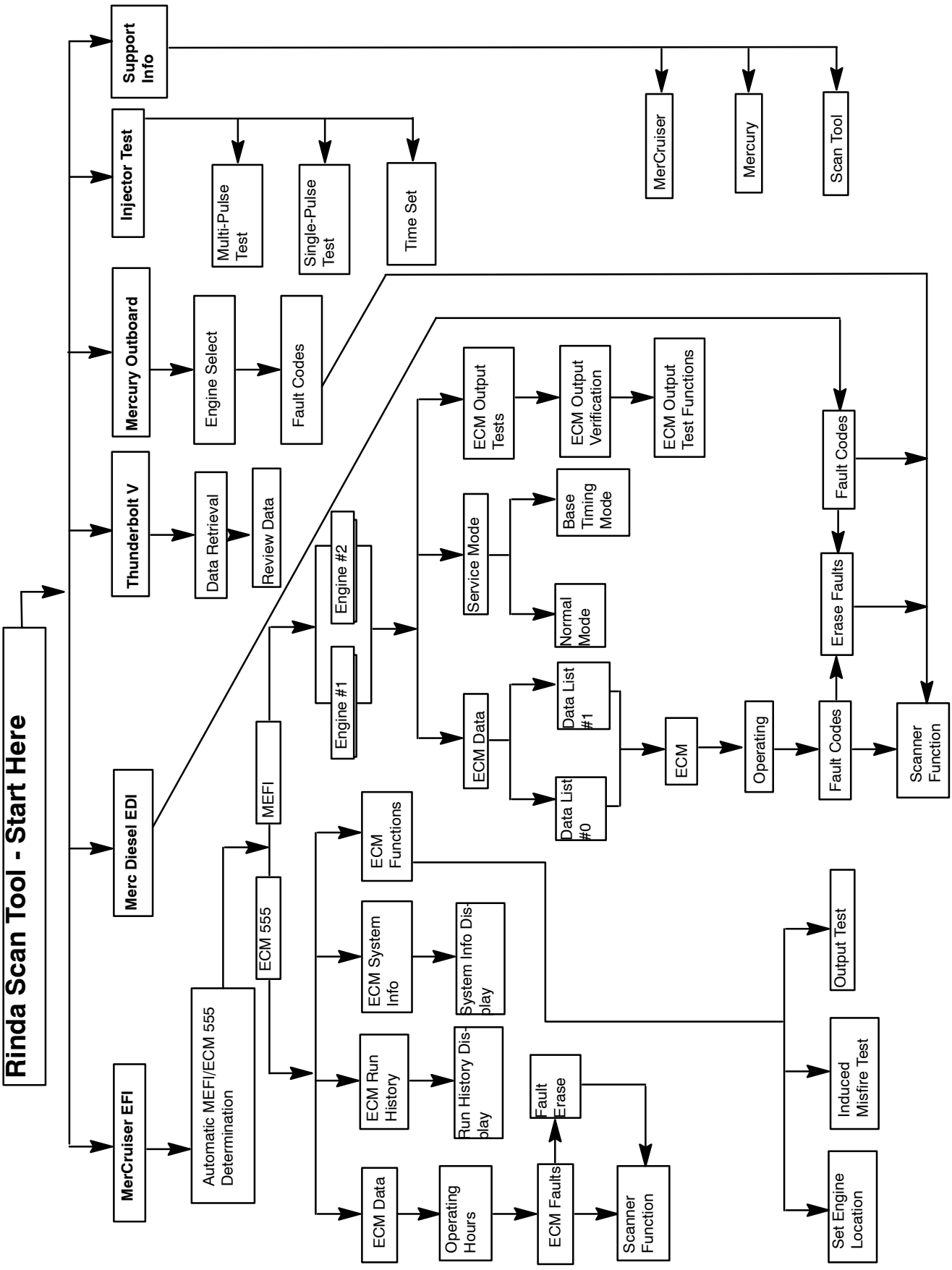
Test Example



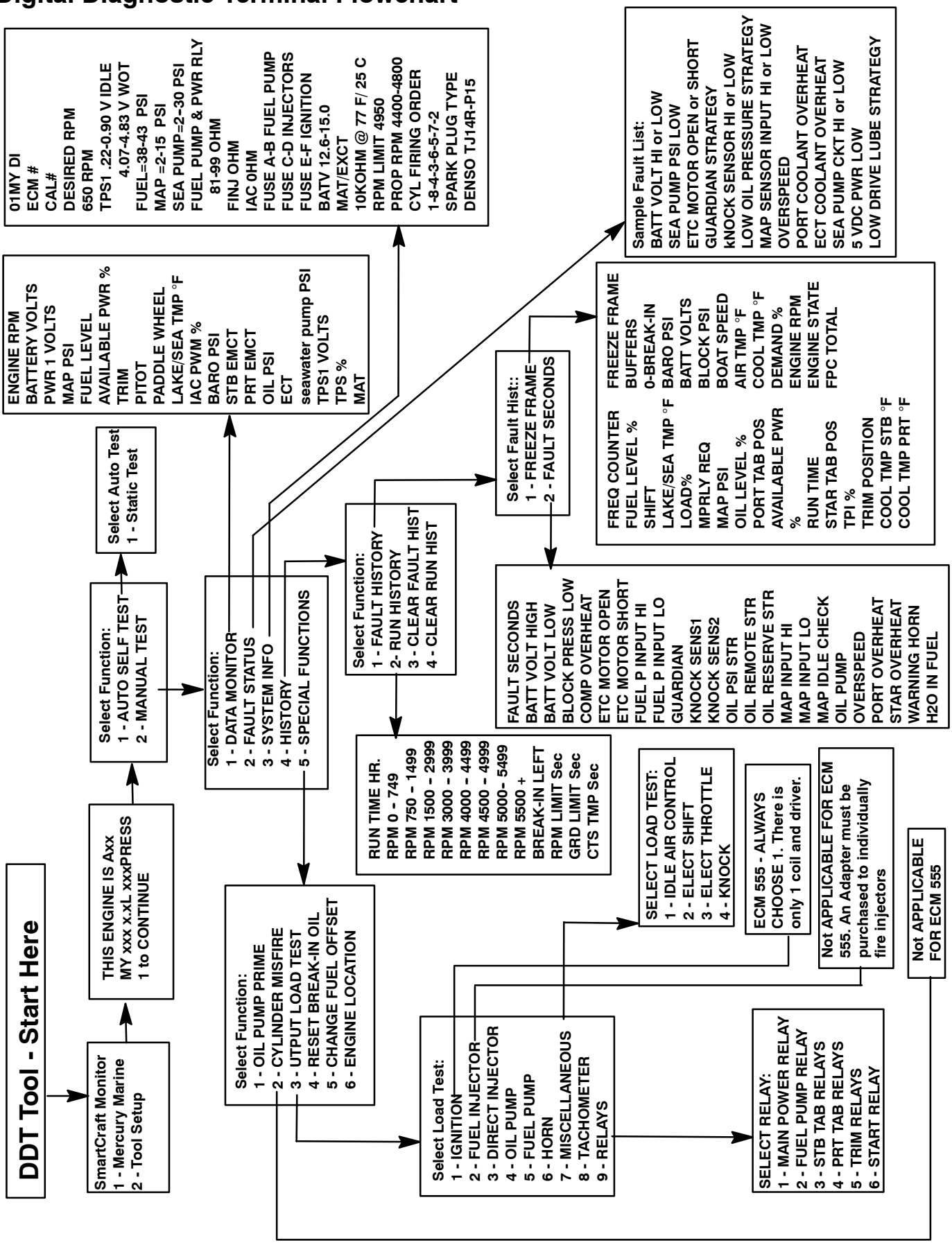


Example								
Cylin-der	1	2	3	4	5	6	7	8
1st. Reading	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)
2nd Reading	19 psi (131 kPa)	17 psi (117 kPa)	21 psi (145 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)
Amount of Drop	19 psi (131 kPa)	21 psi (145 kPa)	17 psi (117 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)	19 psi (131 kPa)
	OK	Rich (Too Much Fuel Drop)	Lean (Too Little Fuel Drop)	OK	OK	OK	OK	OK

Mercury MerCruiser Scan Tool Flowchart



Digital Diagnostic Terminal Flowchart



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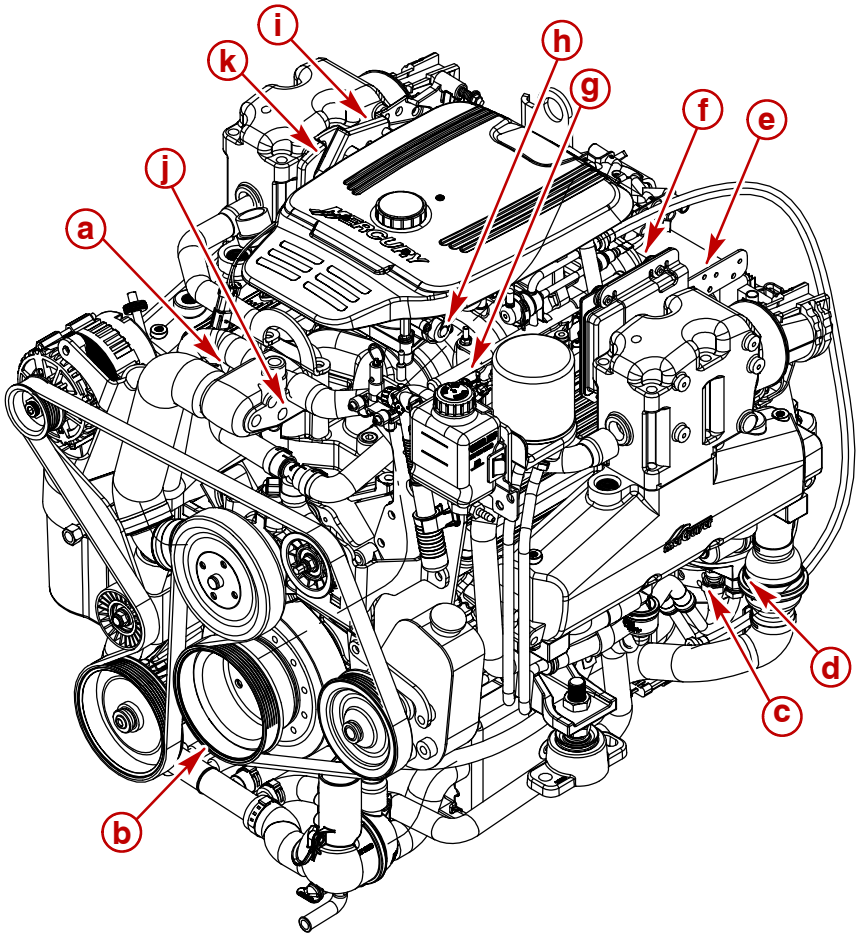
SECTION 3A - WIRING DIAGRAMS

Table of Contents

3 A

Sensor Locations



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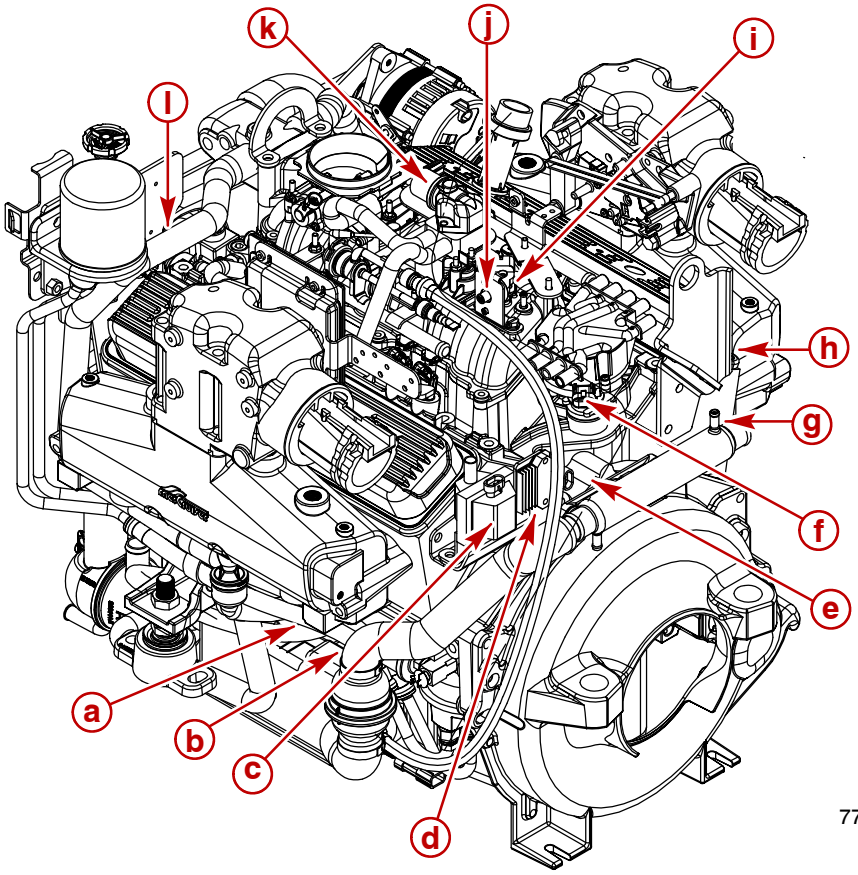
a - Water Temperature Switch
b - Crank Position Sensor (CPS)
c - Oil Pressure Switch
d - Oil Pressure Sender
e - Relays
f - ECM
g - DLC
h - Throttle Position Sensor (TP)
i - Shift Interrupt Switch (Alpha Models)
j - Engine Coolant Temperature (ECT)
k - Gear Indication Switch (Alpha And Bravo)

Sensor Locations (continued)



a - Cool Fuel Harness Connector
b - Knock Sensor (KS)
c - Ignition Coil
d - Ignition Module
e - Transmission Temperature Connectors (If Equipped)
f - Distributor Connector (Should Be Capped)
g - Water Pressure Sender
h - Knock Sensor
i - Manifold Absolute Pressure / Temperature (MAPT)
j - Circuit Breaker
k - Idle Air Control (IAC)
l - MerCathode Controller

Engine Harness Legend

Wire Splice Description

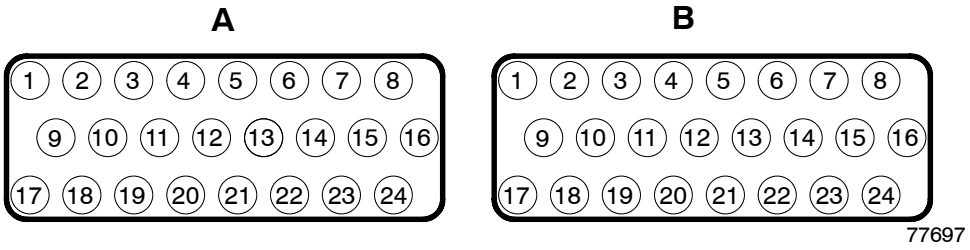
Splice Number	Description
100	5 Volt Transducer Ground
101	5 Volt Transducer Power
102	Wake Line
103	12 Volt 50 amp Protected
104	12 Volt Engine Ground
105	12 Volt From MPR
106	Switched 12 Volt Fused
107	12 Volt Fused
108	12 Volt Fused to All Injectors
109	Transmission and Drive Lube
110	Injectors 1, 4, 6, 7
111	Injectors 2, 3, 5, 8
113	Tachometer Lead
114	Ignition Coil and Coil Driver

Wire Color Code Abbreviations

	BLK	Black		ORN	Orange
	BLU	Blue		PNK	Pink
	BRN	Brown		PPL/PUR	Purple
	GRY	Gray		RED	Red
	GRN	Green		TAN	Tan
	LT BLU	Light Blue		WHT	White
	LT GRN	Light Green		YEL	Yellow
	DRK	Dark		LT	Light

ECM Pinout

This is a quick reference guide to the pins of the ECM. It can be used to verify broken pins and what they control and to help in checking wire continuity for suspect sensors.



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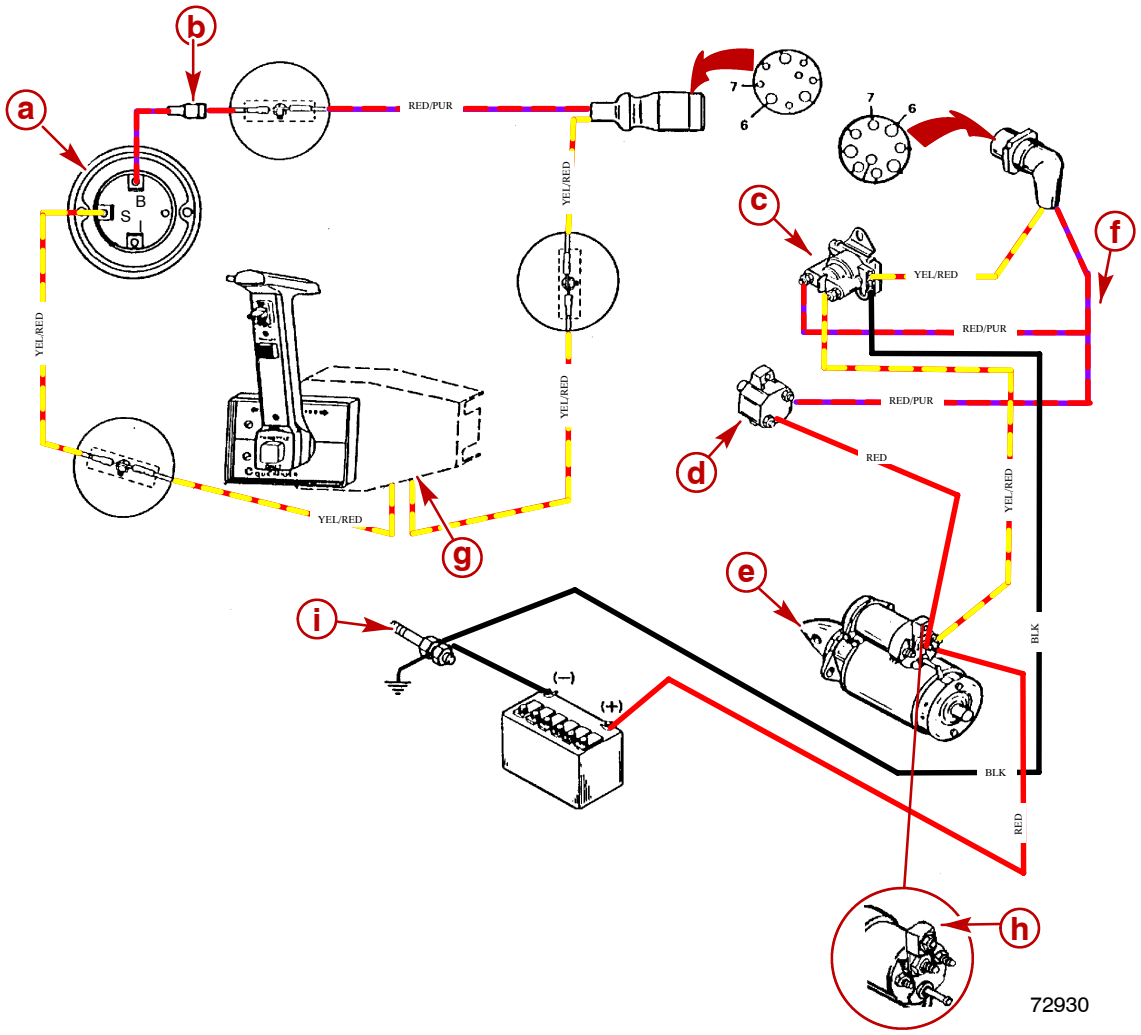
Connector A	Connector B
1 -Empty	1 -Splice 100
2 -Fuel Injector Circuit, Injectors 2, 3, 5, 8	2 -MAPT Connector Pin 2
3 -Empty	3 -MAPT Connector Pin 4
4 -CAN Line Connector Pin J	4 -Fuel Level Connector Pin C
5 -Diagnostic Connector Pin C	5 -Empty
6 -Odd Knock Connector Pin B	6 -Empty
7 -Even Knock Connector Pin B	7 -Oil Presure Connector Pin C
8 -Splice109	8 -Transom Connector Pin E
9 -!0-Pin Connector Pin 4	9 -Paddle Wheel Connector Pin C
10 - 10-Pin Connector 2	10 - Crankshaft Connector Pin C
11 - CAN Line Connector Pin K	11 - Seapump Pressure Connector Pin C
12 - Diagnostic Connector Pin B	12 - Transom Connector Pin D
13 - Odd Knock Connector Pin A	13 - Digital Trim
14 - Even Knock Connector A	14 - Coolant Connector Pin B
15 - CAN Line Connector E	15 - Empty
16 - Splice 104	16 - Empty
17 - Fuel Injector Circuit, Injectors 1,4 6, 7	17 - Empty
18 - Empty	18 - Splice 102
19 - Fuel Pump Relay Pin 86	19 - Shift Interupt Connector Pin C
20 - IAC Connector Pin 1	20 - Throttle Position Connector Pin C
21 - Gear Indicator Connector Pin B	21 - Splice 101
22 - Main Power Relay Pin 85	22 - Paddlwe Wheel Connector Pin D
23 - Splice 106	23 - Coil Driver Connector Pin B
24 - Splice 104	24 - Empty

ECM 555 EFI System Engine Wiring Diagrams

Typical Starting System



a - Ignition Switch
b - 20 Amp Fuse
c - Starter Slave Solenoid
d - Circuit Breaker
e - Starter Motor
f - Wire Junction
g - Neutral Safety Switch
h - 90 Amp Fuse
i - Engine Ground (–)

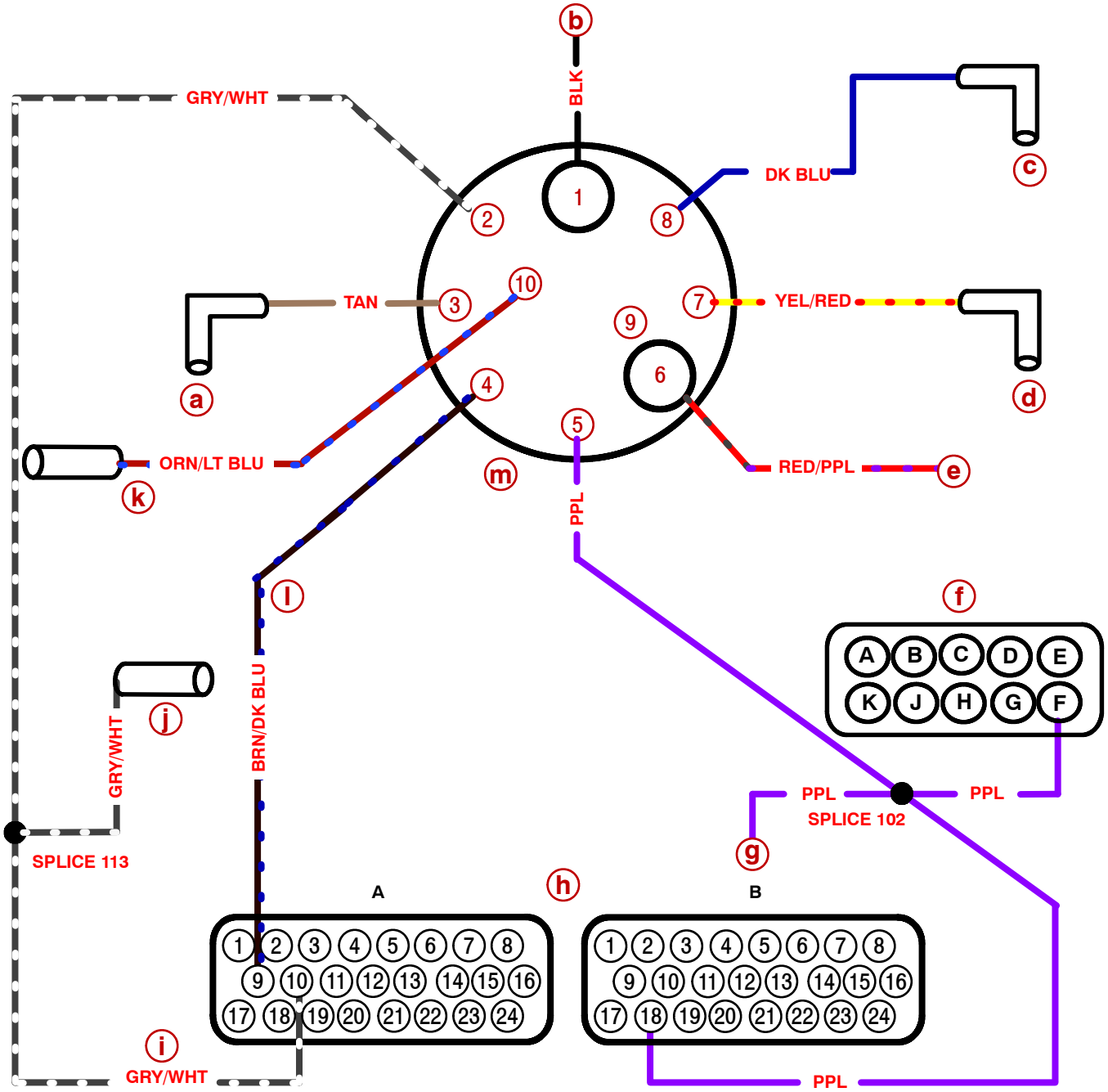
Typical Starting System (continued)

This is a general description of the positive current flow from the battery through the starting system until the starter motor cranks.

NOTE: *Ensure that all connections are tight and have the required resistance.*

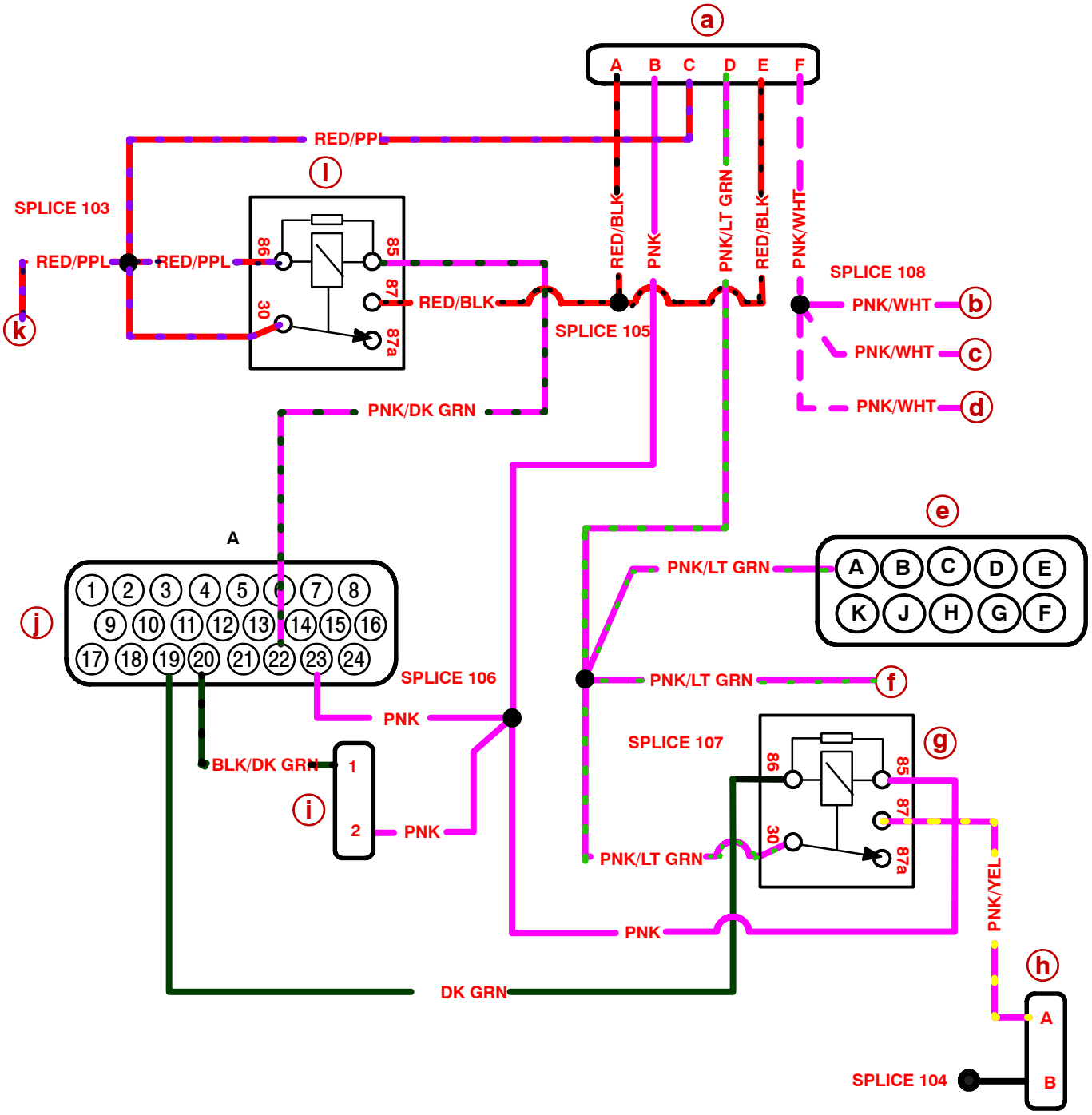
- Battery to the solenoid switch on the starter (RED battery cable).
- Solenoid switch to the circuit breaker (RED).
- Circuit breaker to the wire junction (RED/PPL).
- Wire junction to the wiring harness plug Terminal 6 (RED/PPL).
- Wiring harness plug to the 20 amp fuse (RED/PPL).
- 20 amp fuse to the ignition switch Terminal B (RED/PPL). At this point the ignition switch is turned to the START position.
- Ignition switch Terminal B to Terminal S.
- Ignition switch Terminal C to the neutral start switch (YEL/RED). NEUTRAL START SWITCH MUST BE AT NEUTRAL POSITION.
- Neutral start switch to the wiring harness plug Terminal 7 (YEL/RED).
- Wiring harness plug to the starter solenoid (small terminal) (YEL/RED). Also, ensure that the small terminal (BLK) wire is grounded.
- Starter solenoid is now CLOSED, completing circuit between the large terminal (RED/PPL) and the other large terminal (YEL/RED), causing the starter motor to crank.

Wake, Horn and Tachometer Circuits



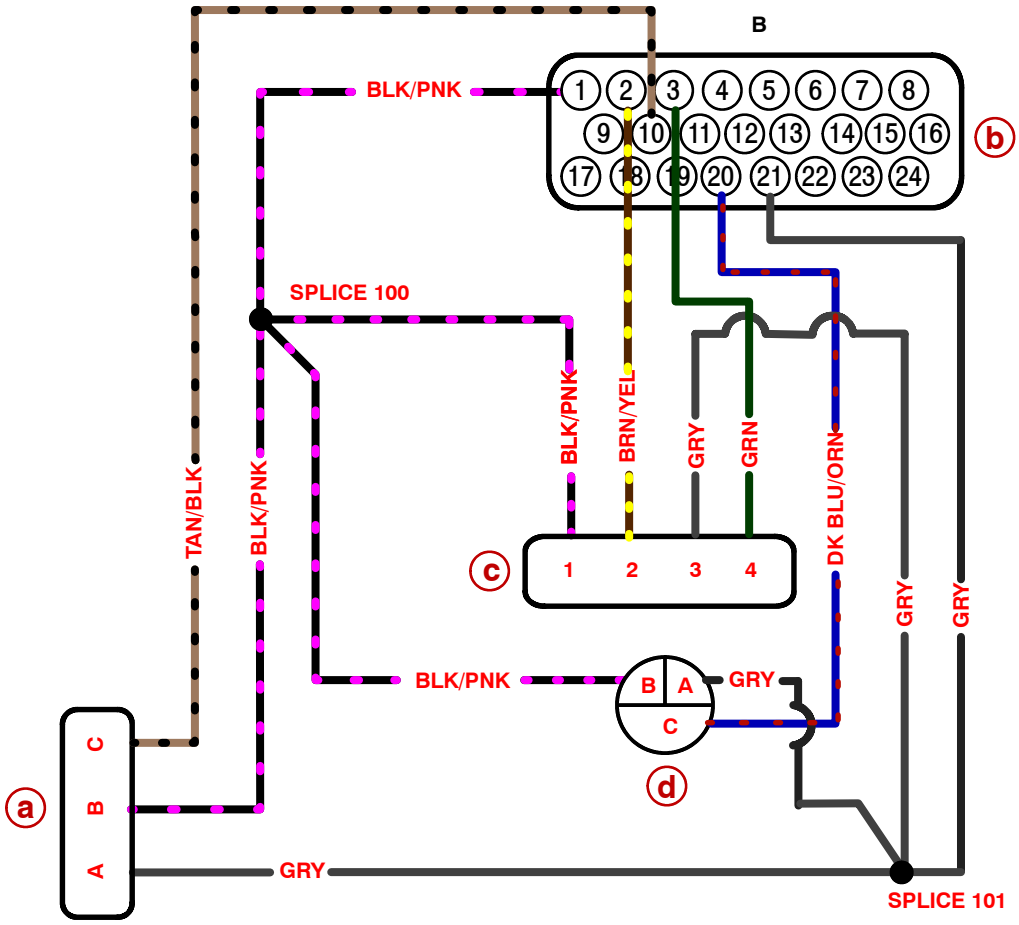
a - Analog Coolant Sender
b - To Splice 104 - Ground
c - Analog Oil Pressure Sender
d - To Slave Solenoid
e - To Splice 103 - B+ From 50 Amp Circuit Breaker
f - CAN Connector
g - To Alternator Excite
h - ECM 555
i - Tachometer Signal
j - Tachometer Connector
k - To Analog Trim Sender
l - Warning Horn Circuit
m - 10-pin Harness Connector

Fuses, IAC and Relays



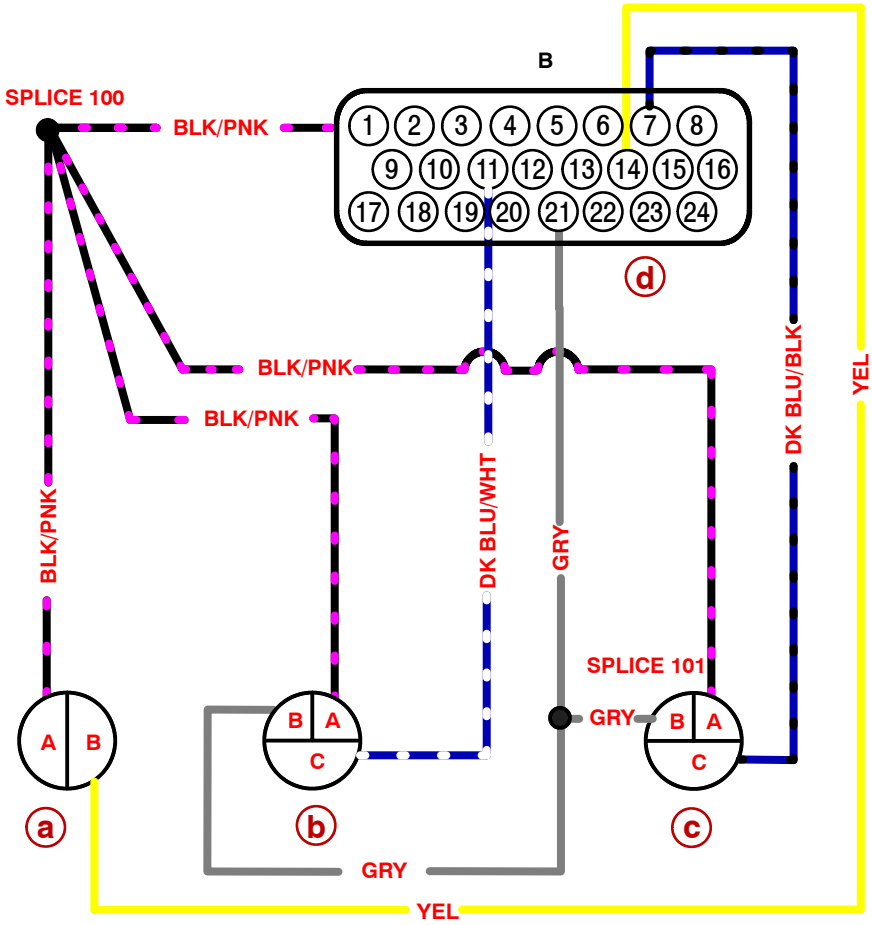
a - Fuse Holder
b - To Pin A Of All Fuel Injectors
c - To Pin A Of Ignition Coil
d - To Pin A Of Coil Driver
e - CAN Connector
f - To Alternator Pin B Sensing Wire
g - Fuel Pump Relay
h - Cool Fuel Pump
i - IAC Valve
j - ECM 555
k - To 50 Amp Circuit Breaker
l - Main Power Relay (MPR)

Manifold Air Pressure and Temperature, Crankshaft Position and Throttle Position Sensors



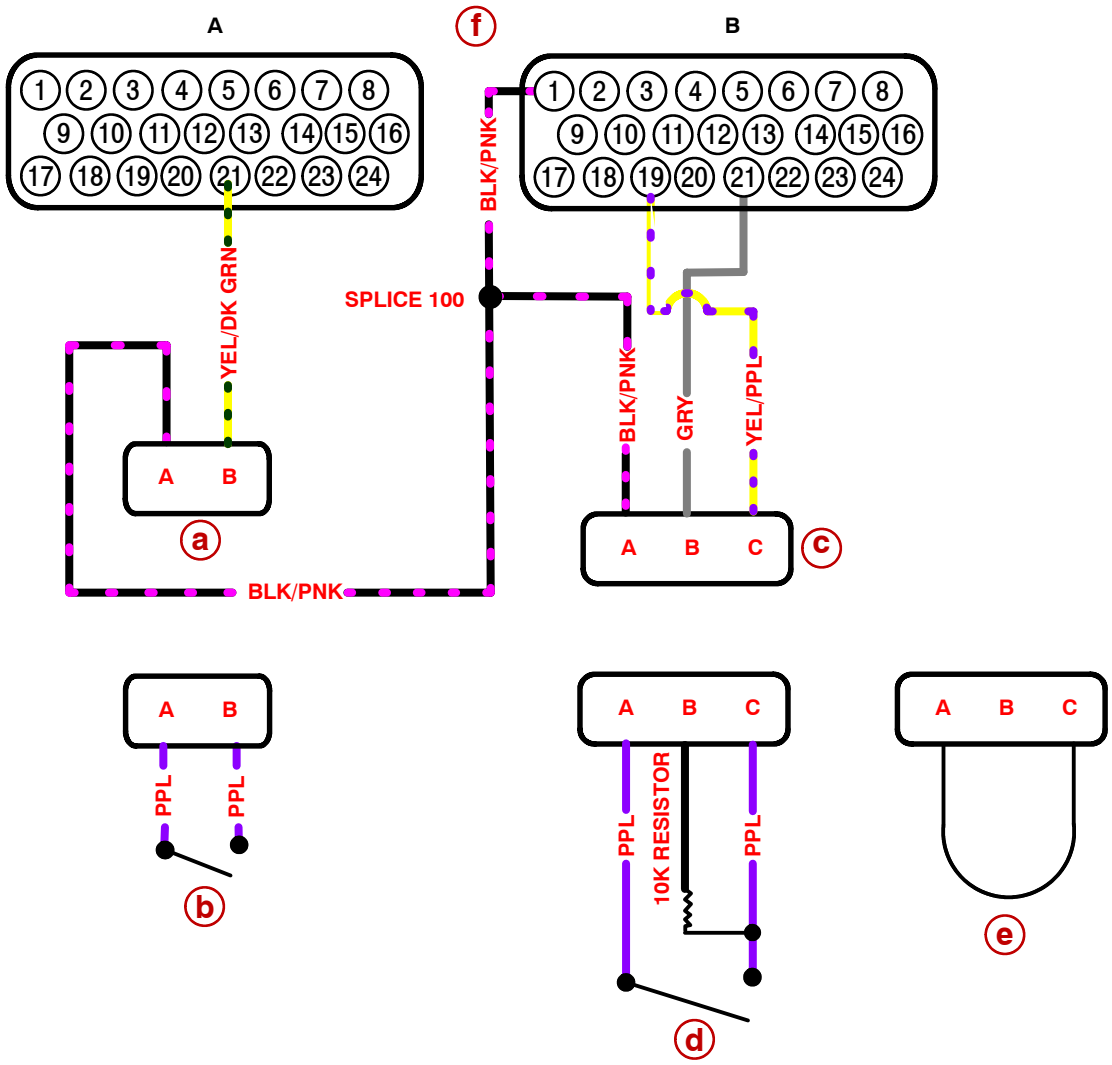
a - CPS
b - ECM 555
c - MAP/MAT
d - TPS

Engine Coolant Temperature, Seawater Pump and Oil Pressure Sensors



a - ECT
b - Seawater Pump Pressure
c - Oil Pressure
d - ECM 555

Gear Indicator and Shift Interrupt



a - Gear Indicator

b - Gear Indicator Switch –
Closed in Neutral
Open in Gear
Normally Closed Switch

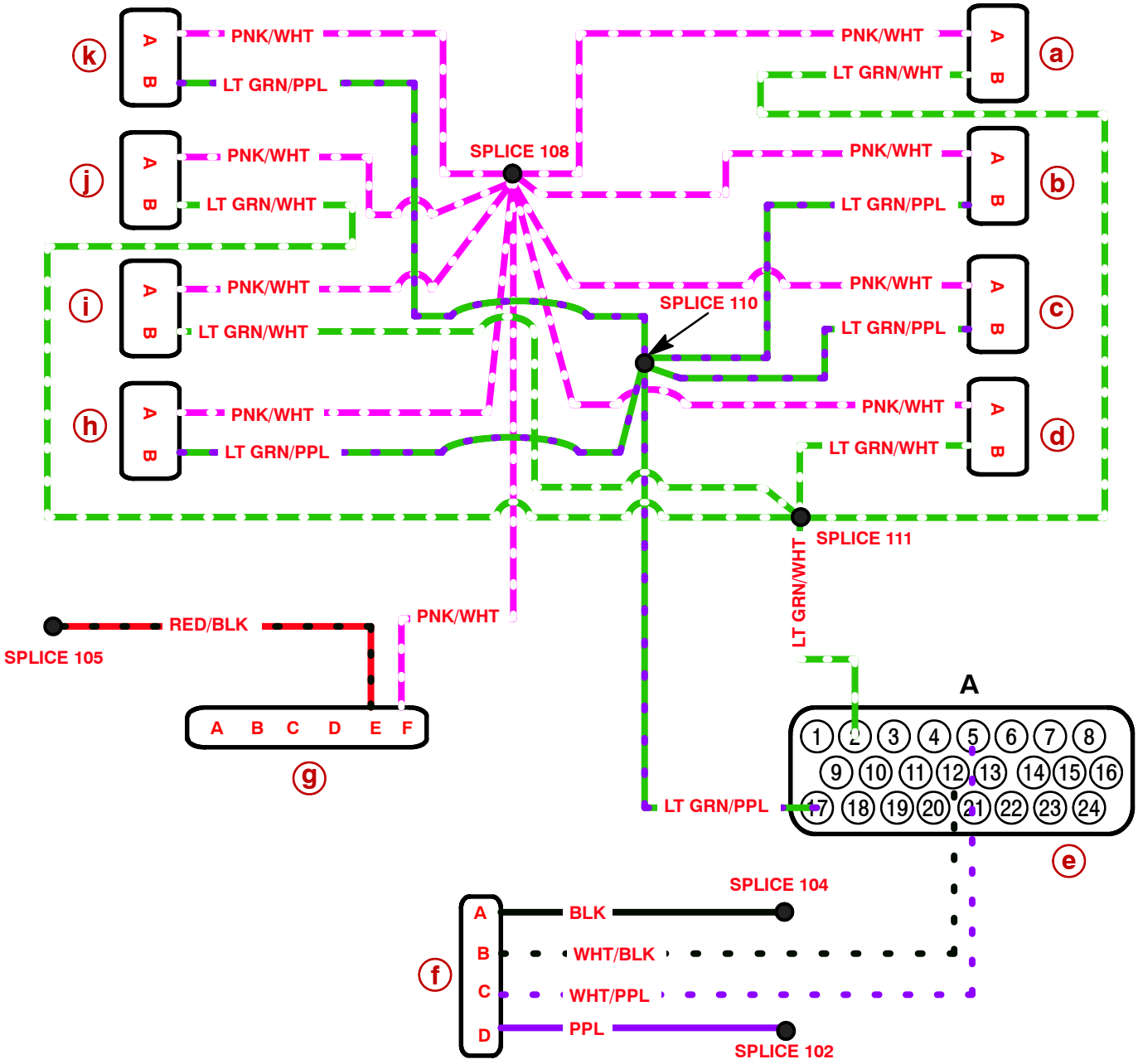
c - Shift Interrupt Switch

d - Shift Interrupt Switch (Alpha Models)
A to C Normally Closed
A to C Open When Activated
A to B 10K Ω Released
A to B ∞ When Activated
B to C Always 10K Ω

e - Jumper Plug (Bravo Models)

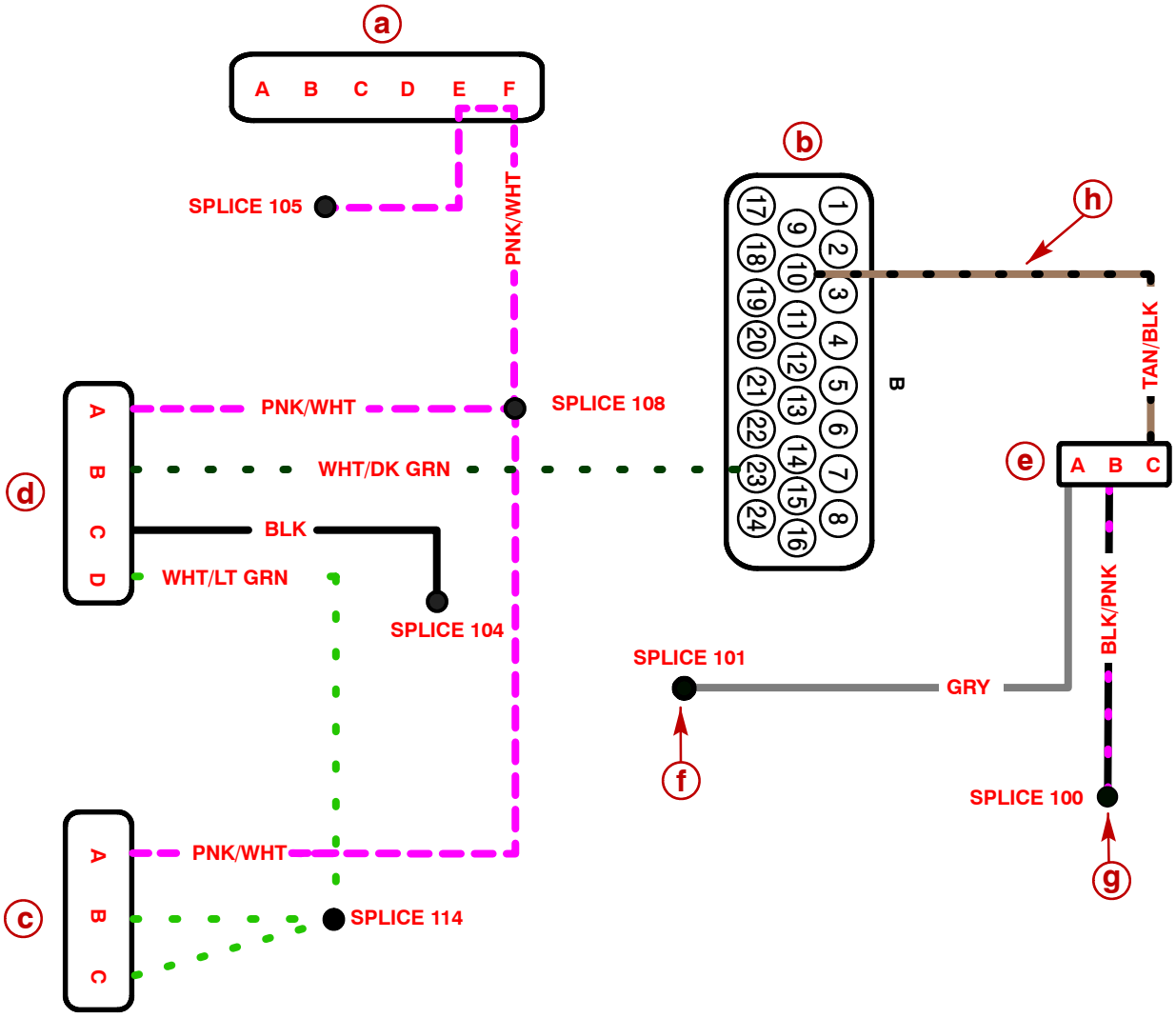
f - ECM 555

Fuel Injector Control Circuits and Diagnostic Circuits



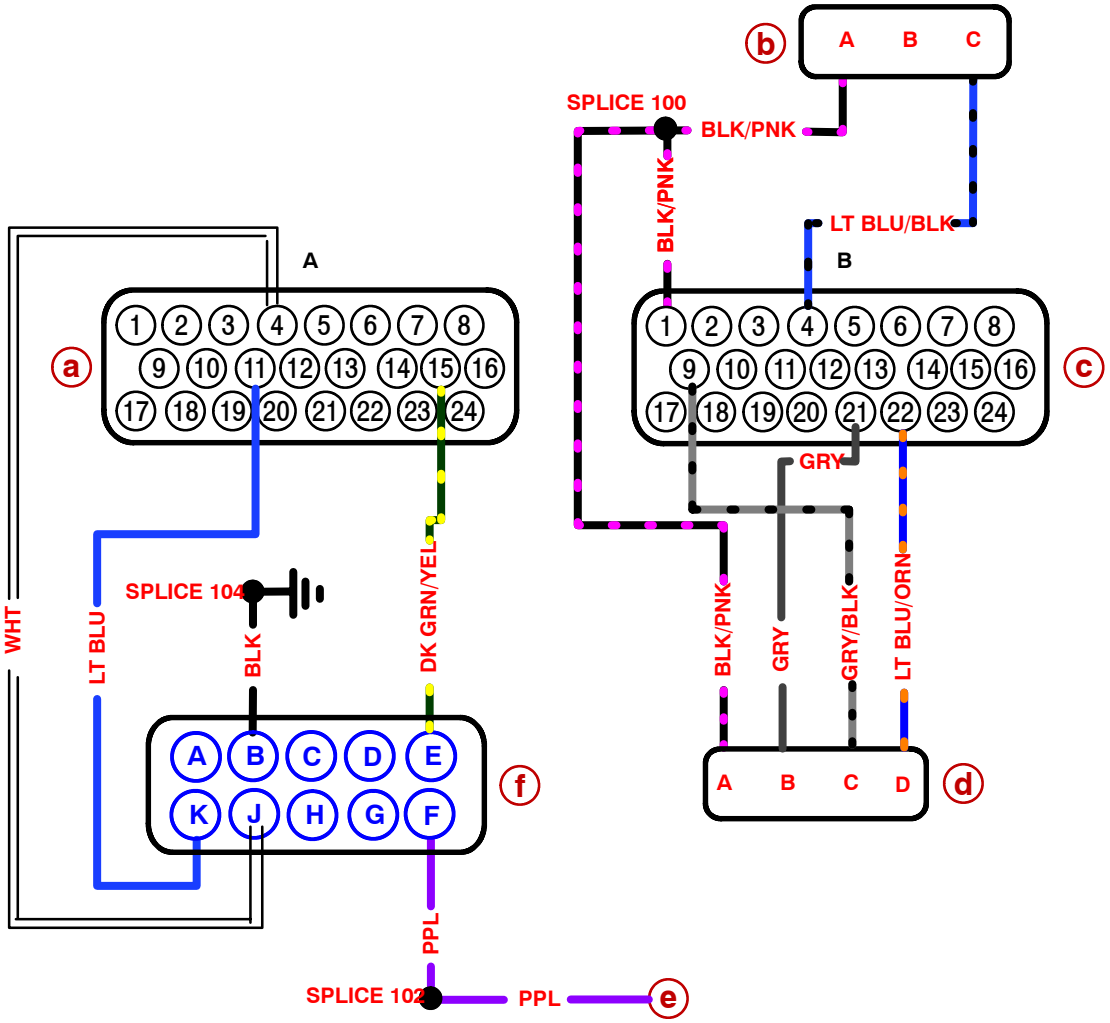
a - Injector 2
b - Injector 4
c - Injector 6
d - Injector 8
e - ECM 555
f - Diagnostic Connector
g - Fuse Holder
h - Injector 7
i - Injector 5
j - Injector 3
k - Injector 1

Ignition System



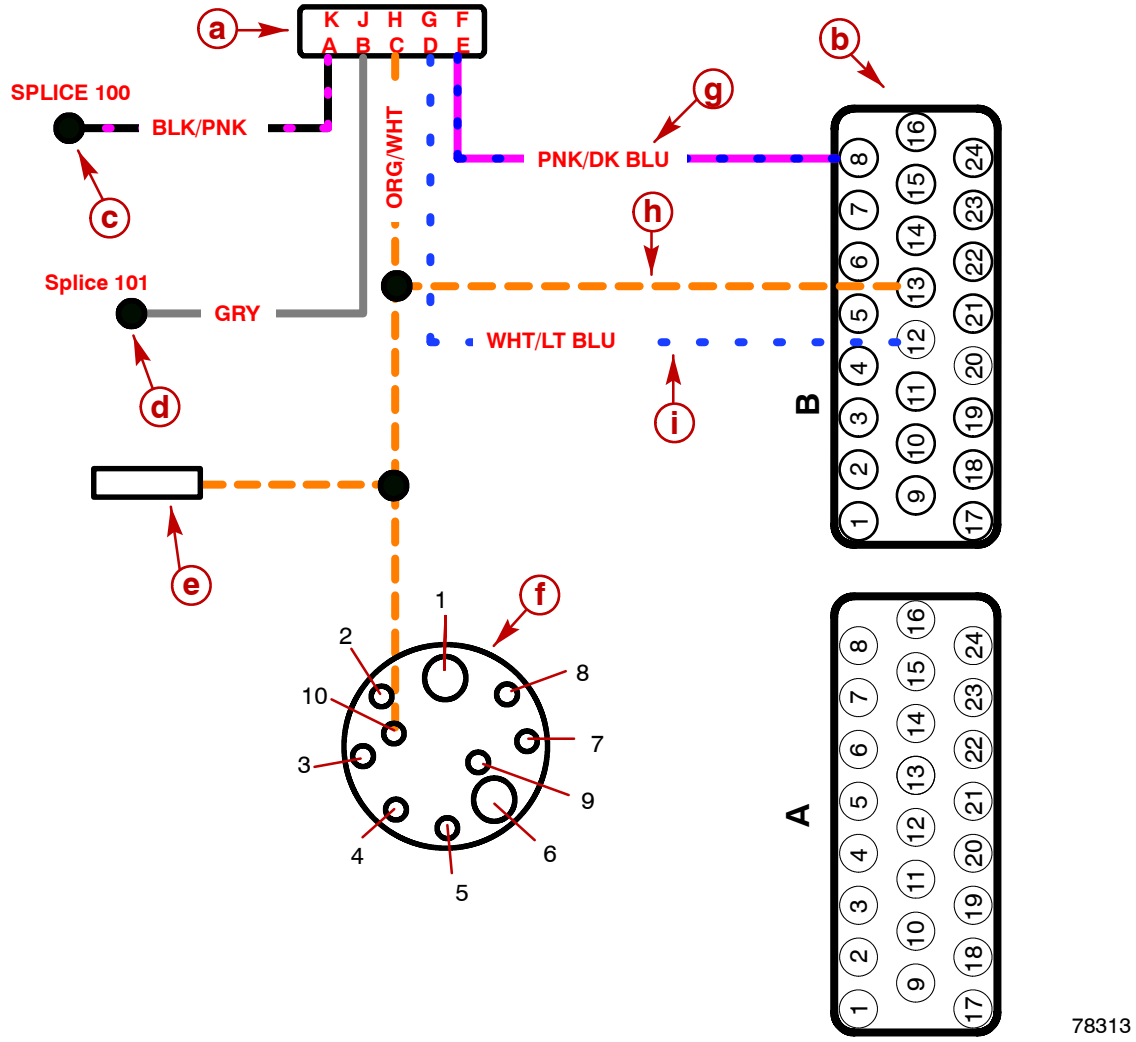
a - Fuse Holder
b - ECM 555
c - Ignition Coil
d - Ignition Coil Driver Module
e - CPS Connector
f - 5 Volt Power
g - 5 Volt Ground
h - CPS Signal

CAN, Fuel Level, Paddle Wheel and Temperature Circuit



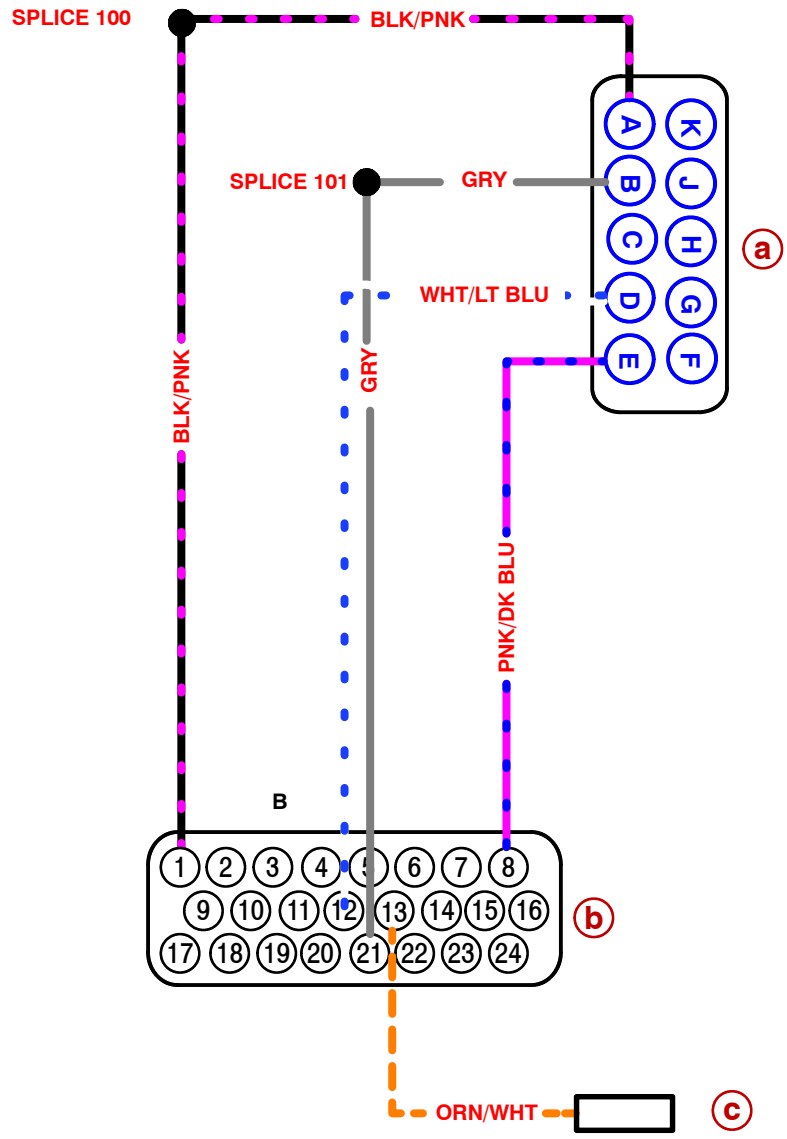
a - ECM 555
b - Fuel Level Connector
c - ECM 555
d - Paddle Wheel/Seawater Temp Connector
e - To 10-pin Connector Key Switch
f - CAN Connector

Transom Harness



a - Transom Harness Connector
b - ECM
c - 5 Volt Ground
d - 5 Volt Power
e - Trim Bullet Connector
f - 10-pin Connector
g - Steering Postition
h - Digital Trim
i - Pitot Pressure

Transom Connector (Engine Side)

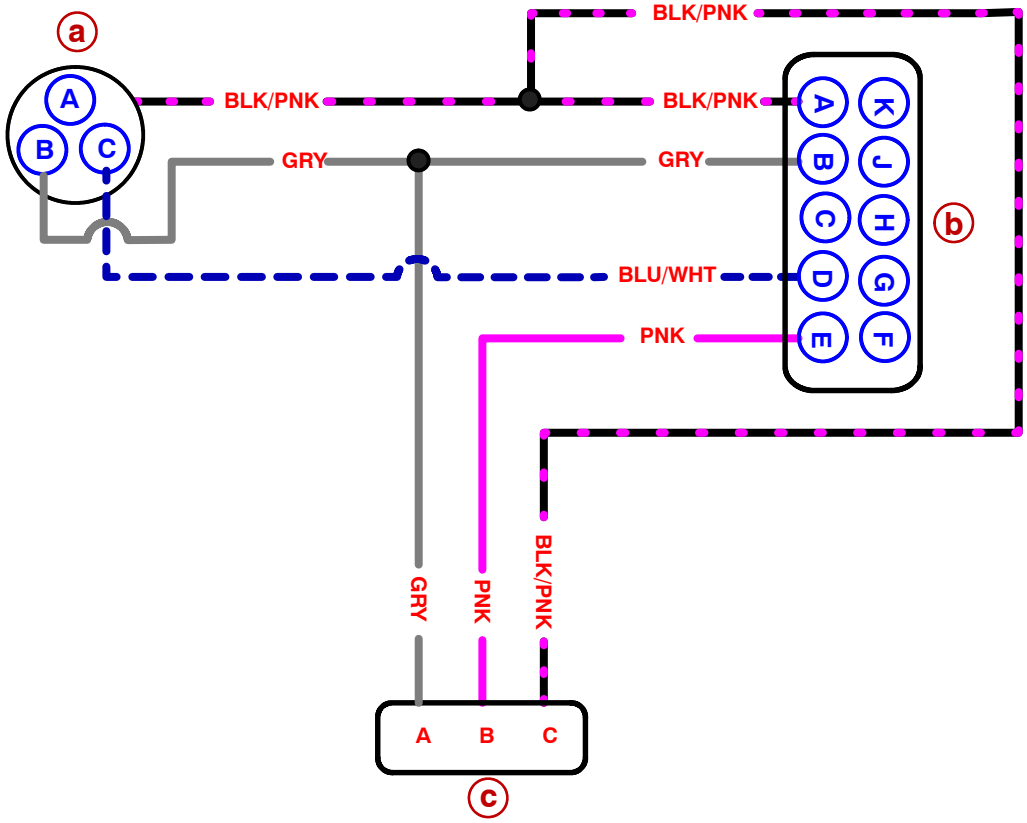


a - Transom Harness Connector (Engine Side)
Pin D - Pitot Signal
Pin E - Steering Signal

b - ECM 555

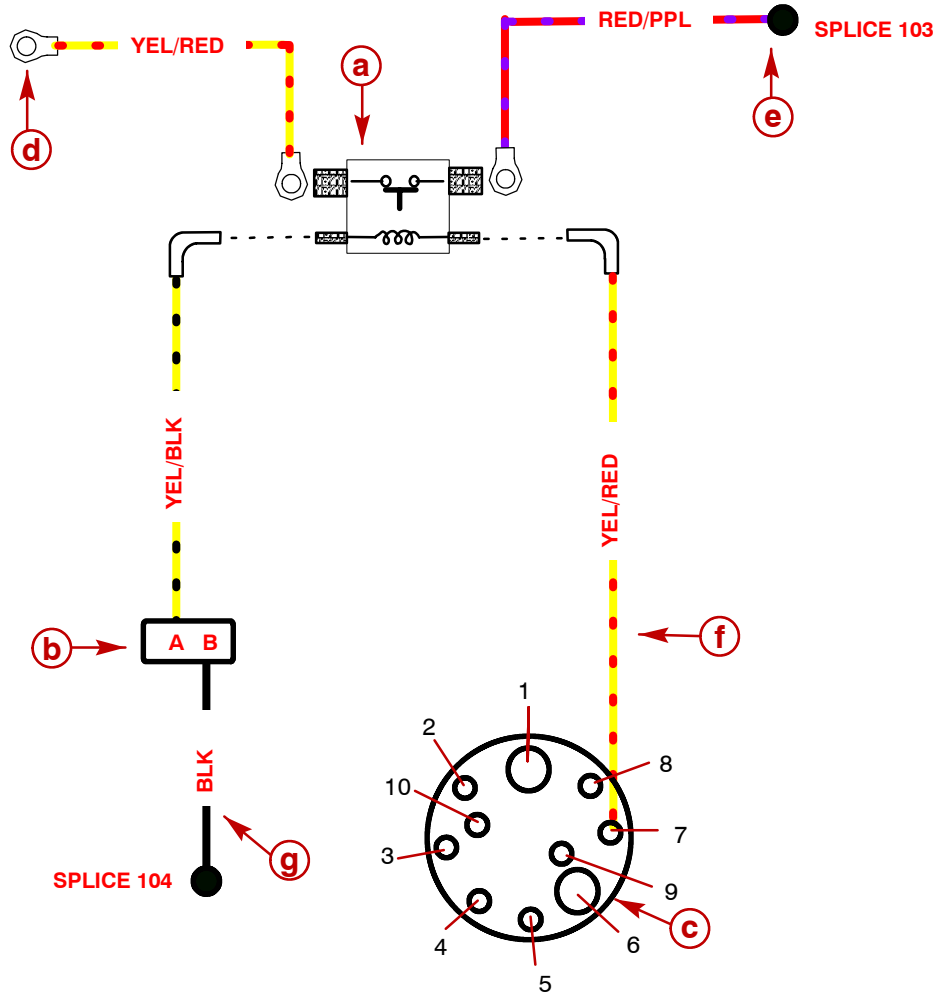
c - Digital Trim

Transom Harness (Transom Side)



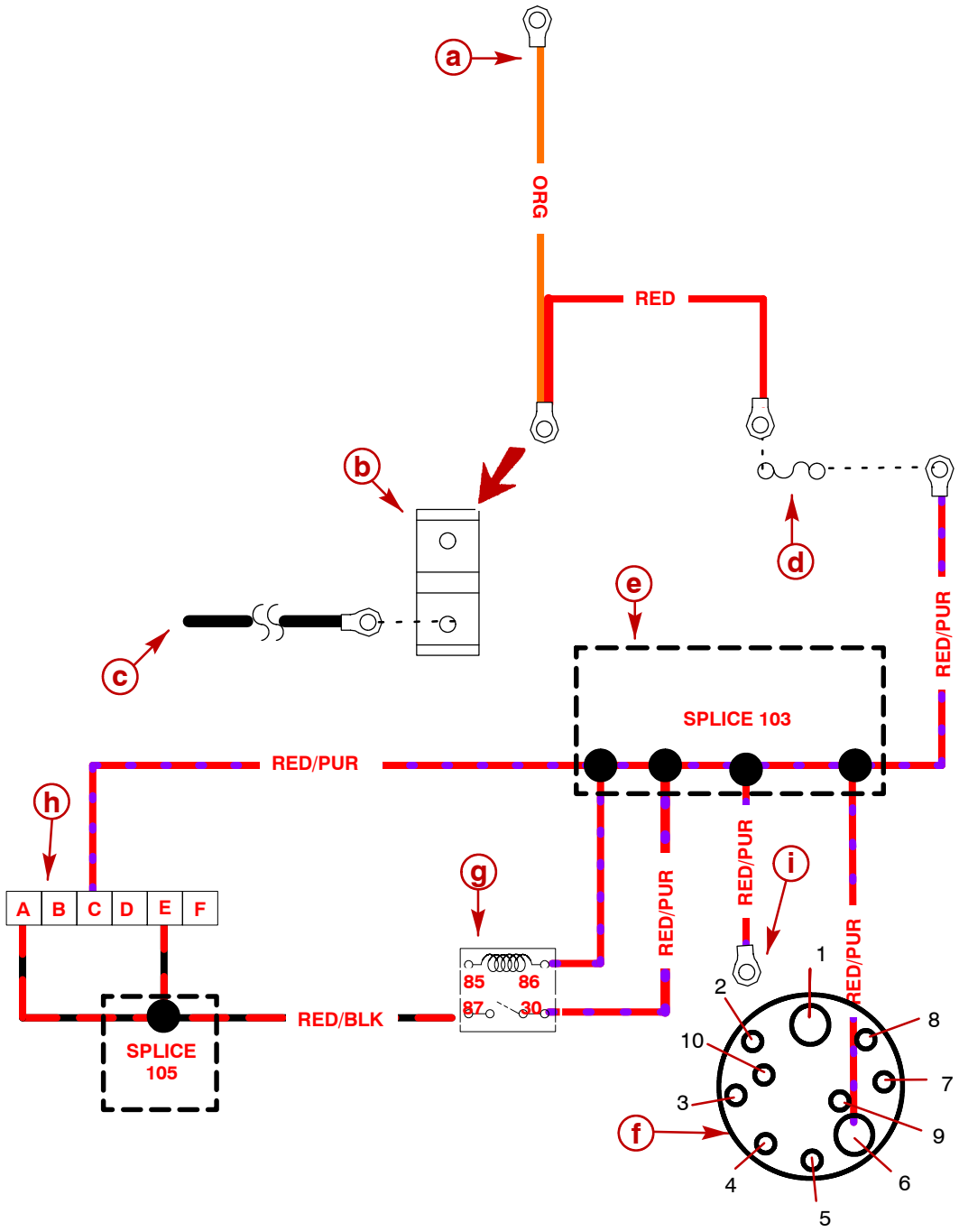
a - Pitot
b - Transom Harness Connector (Transom Side)
c - Steering Angle Position

Slave Solenoid Circuit



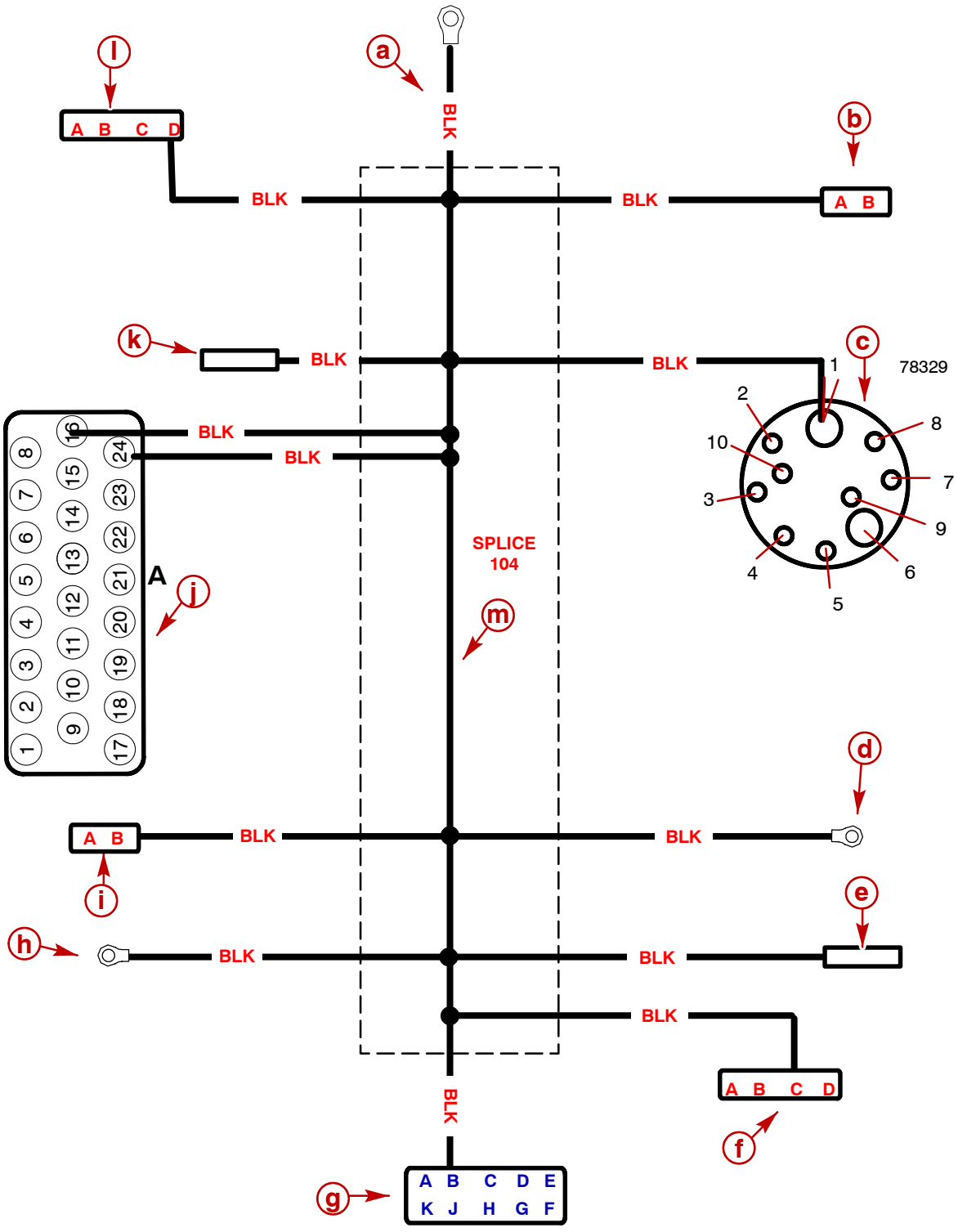
a - Slave Solenoid
b - Neutral Safety Switch
c - 10-pin Connector
d - Starter Solenoid
e - 12 Volt Power
f - Keyswitch / Start
g - 12 Volt Ground

Altenator Output Circuit



a - From Altenator
b - Fuse On Starter
c - To Battery
d - 50 Amp Circuit Breaker
e - Splice 103
f - 10-pin
g - MPR
h - Fuses
i - Slave Power

Engine 12 Volt Ground Circuit

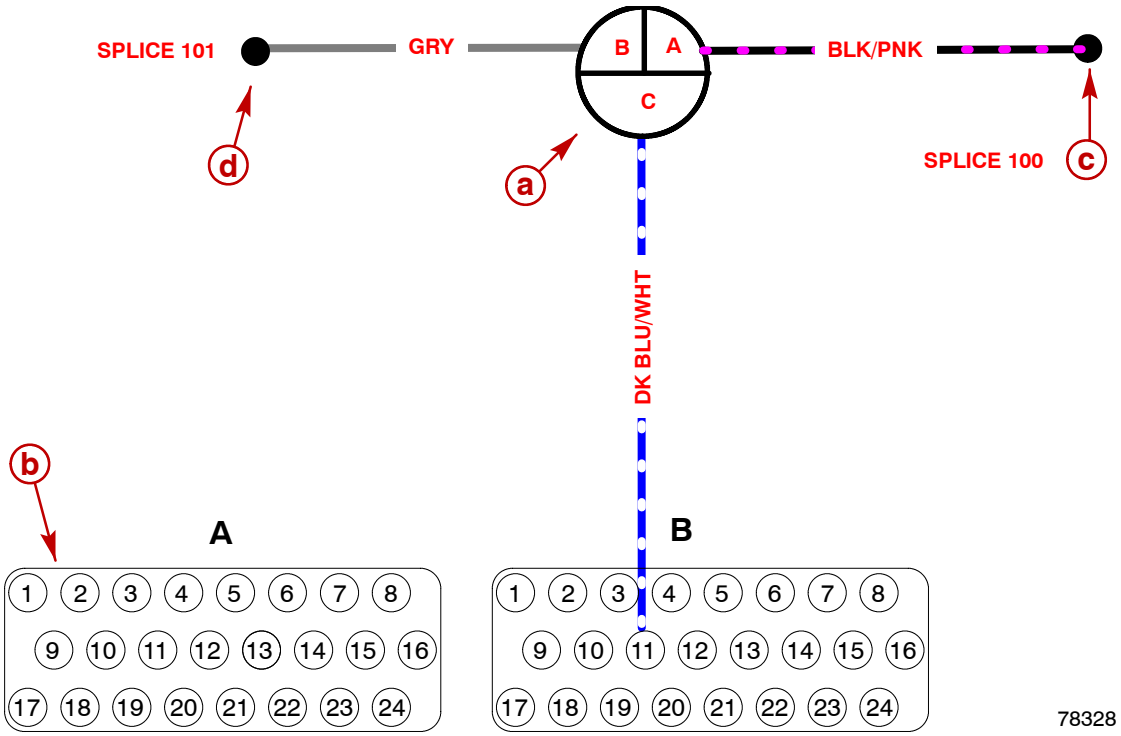


a - Engine Ground
b - Neutral Safety Switch
c - 10-pin
d - Alternator
e - Transmission Overtemperature
f - Coil Driver
g - Can Line
h - Mercathode
i - Fuel Pump
j - ECM
k - Drive Lube
l - Diagnostics
m - Splice 104

Single Circuit Diagrams

This section outlines the circuitry the wiring harness and sensors as individual systems. This allows for a quick reference point when trying to detect a faulty connection. However, the complete system wiring diagram should be referenced if multiple electrical faults are occurring.

Seawater Pump Circuit

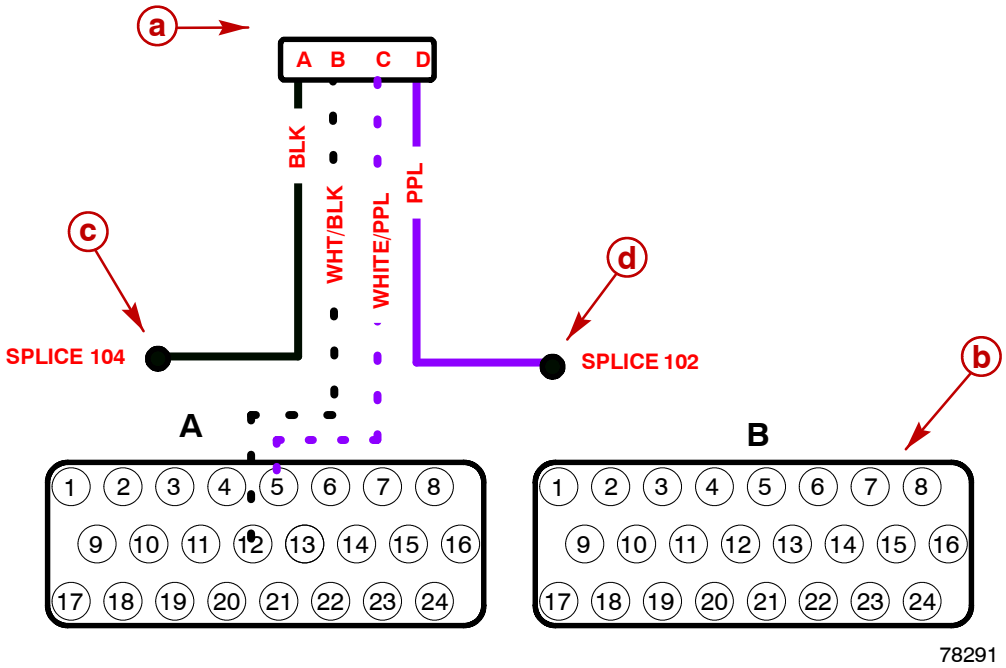


a - Seawater Pump Sensor Connector
b - ECM
c - 5 Volt Ground
d - 5 Volt Power

The seawater pump sensor measures water inlet pressure or water block pressure. It is located at the seawater pump inlet hose. Normal pressure ranges are 7-34 kPa (1-5 psi) at idle and 48-117 kPa (7-17 psi) at WOT. To check if sensor is within range, the diagnostic tool reading with key ON should be approximately 0.

A malfunction of the seawater pump sensor will set the fault of Seapump CKT Hi, Seapump CKT Lo or Seapump PSI Lo.

Diagnostics Circuit



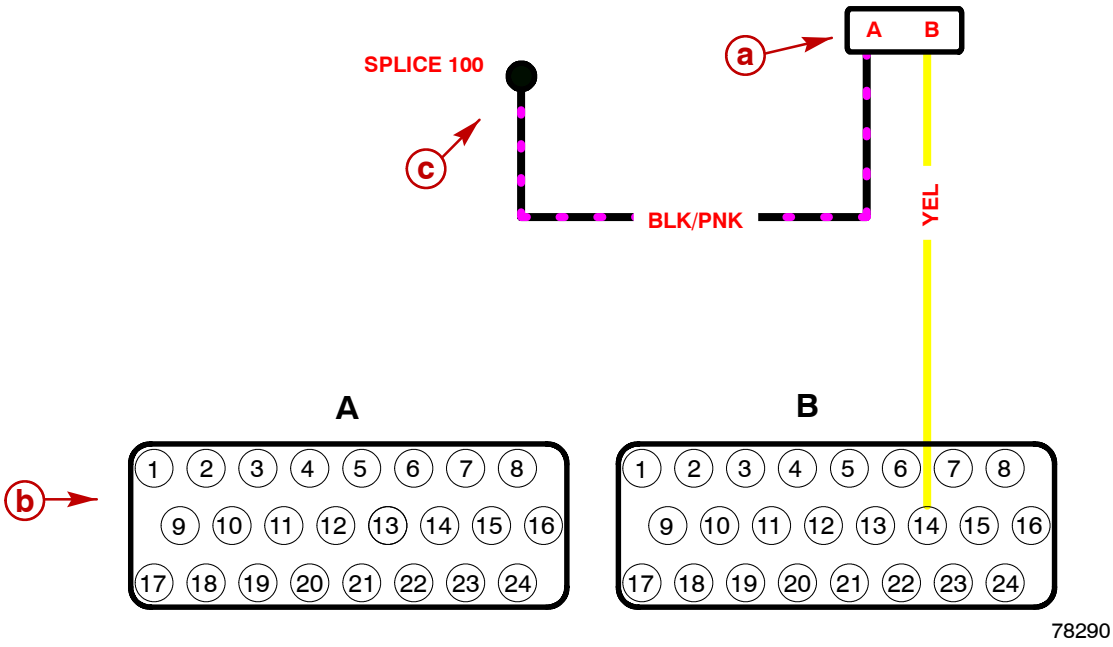
a - Diagnostic Connector
b - ECU
c - 12 Volt Ground
d - 12 Volt Power

The data link connector (DLC) is a 4-pin circuit for attaching the diagnostic tool to the PCM. It is located on the port side of the engine next to the oil filter. Before attaching a diagnostic tool to the engine, verify that the key is OFF and the pins are clean of corrosion and debris. Pin A is the 12 volt ground connected to the engine harness at splice 104. Pins B and C are data retrieval lines from the PCM. Pin D is the 12 volt supply to the diagnostic tool.

IMPORTANT: Diagnostic tools can only receive data with key ON or engine operating. Diagnostic tools need a minimum of 8 volts. If the diagnostic tool does not respond, verify the connection, verify that the key is ON and check the battery voltage.

A malfunction of the data link connector will not set a fault.

Engine Coolant Temperature Circuit



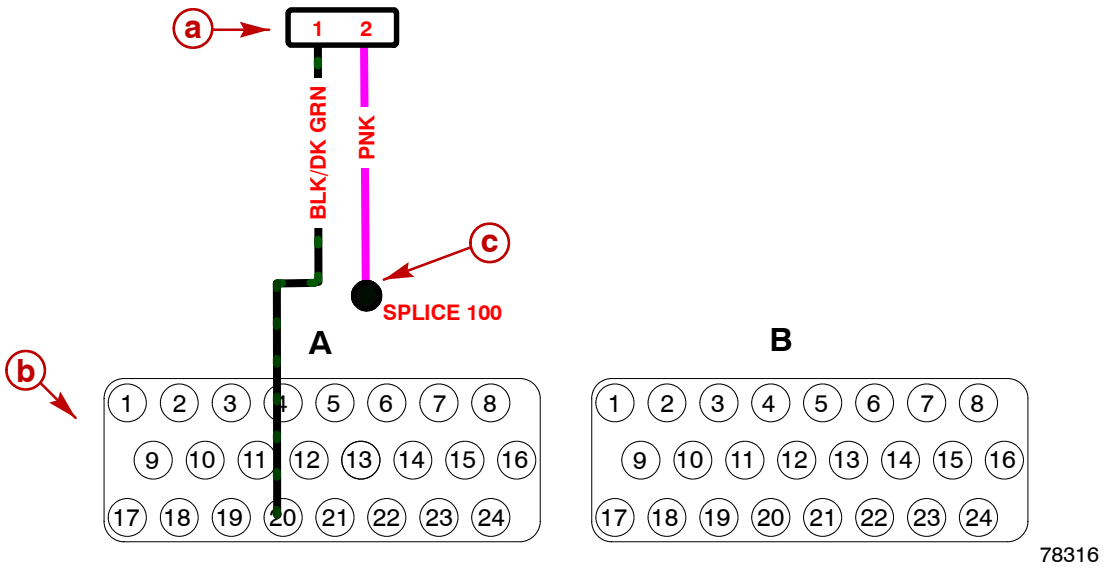
a - ECT Sensor Connector
b - ECM
c - 5 Volt Ground

The engine coolant temperature (ECT) sensor is a thermistor immersed in the engine coolant stream. It is located in the thermostat housing of the engine. Low coolant temperature produces high resistance, while high temperature causes low resistance.

A malfunction of the ECT sensor will set a fault of ECT CKT Hi, ECT CKT Lo or ECT Coolant Overheat.

Approximate Temperature - to - Resistance Values		
Degrees F	**Degrees C**	**ohms**
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

IAC Circuit

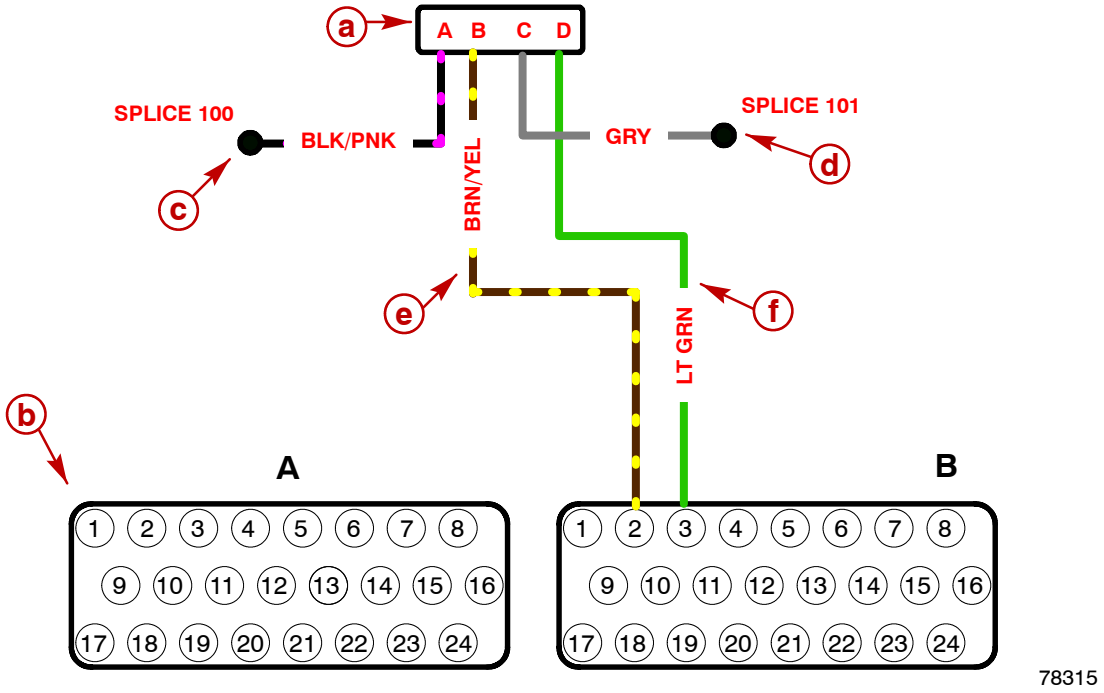


a - IAC Sensor Connector
b - ECM
c - 5 Volt Ground

The idle air control (IAC) valve is a 12 volt circuit powered by the MPR. It is located at the top rear of the engine.

A malfunction of the IAC will set a fault of IAC Output.

MAP/T Circuit



a - MAP/T Sensor Connector
b - ECM
c - 5 Volt Ground
d - 5 Volt Power
e - MAT Signal
f - MAP Signal

The MAP/T sensor measures both manifold air temperature and manifold air pressure. The two measures can be seen as two separate circuits.

MAT CIRCUIT

The MAT portion of the sensor is a thermistor that controls signal voltage to the ECM. It is located at the rear of the engine in the intake manifold plenum. When intake air is cold, the sensor resistance is high. As the air temperature rises, resistance lowers. At normal engine operating temperature.

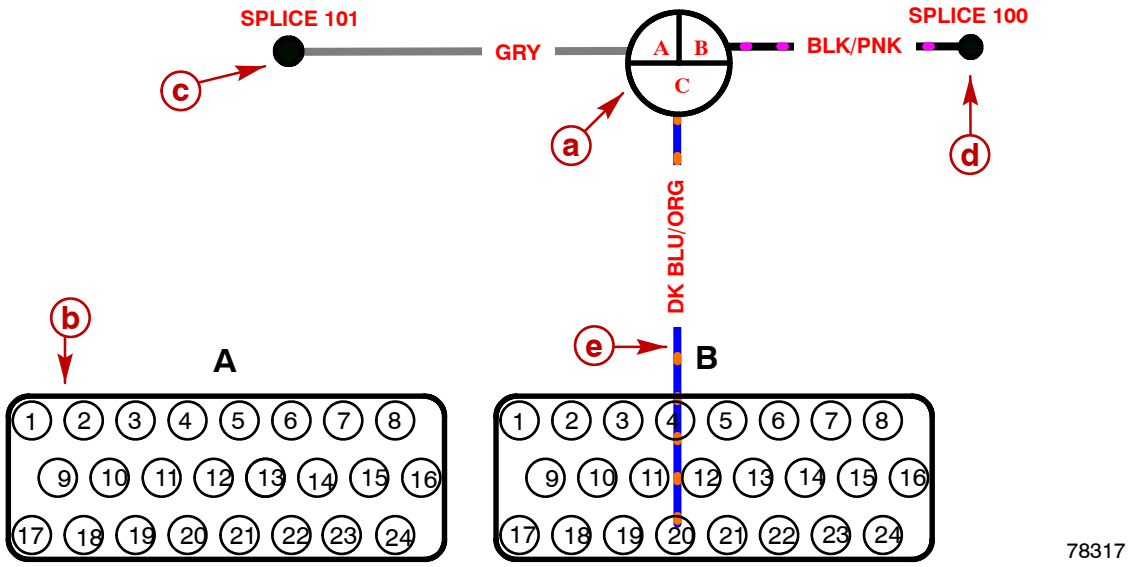
A malfunction in the MAT will set the fault of AIR TMP CKT Hi or AIR TMP CKT Lo.

MAP CIRCUIT

The MAP portion of the sensor measures the changes in the intake manifold pressure. It is located on the intake manifold on the top of the engine. At key ON, the MAP is equal to atmospheric pressure. This information is used by the ECM as an indication of altitude and is referred to as BARO. Comparison of this BARO reading with a known good MAP sensor is a good check of a suspect sensor. The pressure changes as a result of engine load and speed change. The ECM receives this information as a signal voltage that will vary from about 1.0-2.0 volts at idle to about 4.0-5.0 volts at WOT.

A malfunction in the MAP sensor circuit could set the fault of MAP Sensor Input HI, or MAP Sensor Input Lo.

Throttle Position Circuit

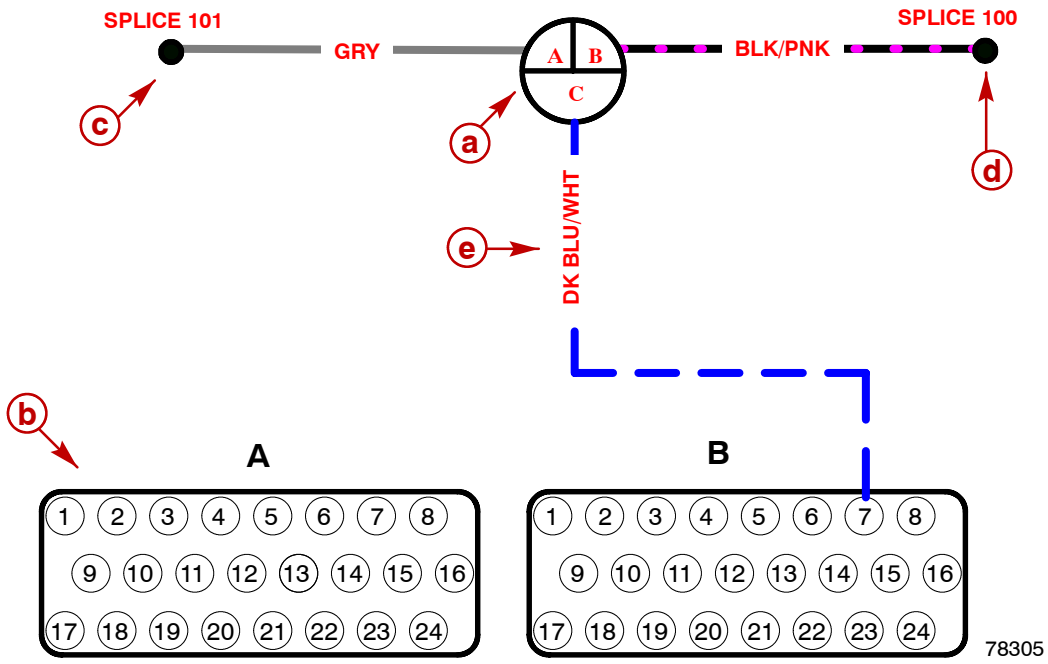


a - TPS Connector
b - ECM
c - 5 Volt Power
d - 5 Volt Ground
e - TPS Signal

The throttle position sensor (TPS) sends throttle plate angle information to the PCM. It is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.7 volts at WOT. If the TPS malfunctions, the ECM will reset to a default value.

A malfunction in the TPS circuit will set the fault of TPS Input Hi, TPS Input Lo, TPS Range Hi, TPS Range Lo or TPS No Adapt.

Oil Pressure Circuit

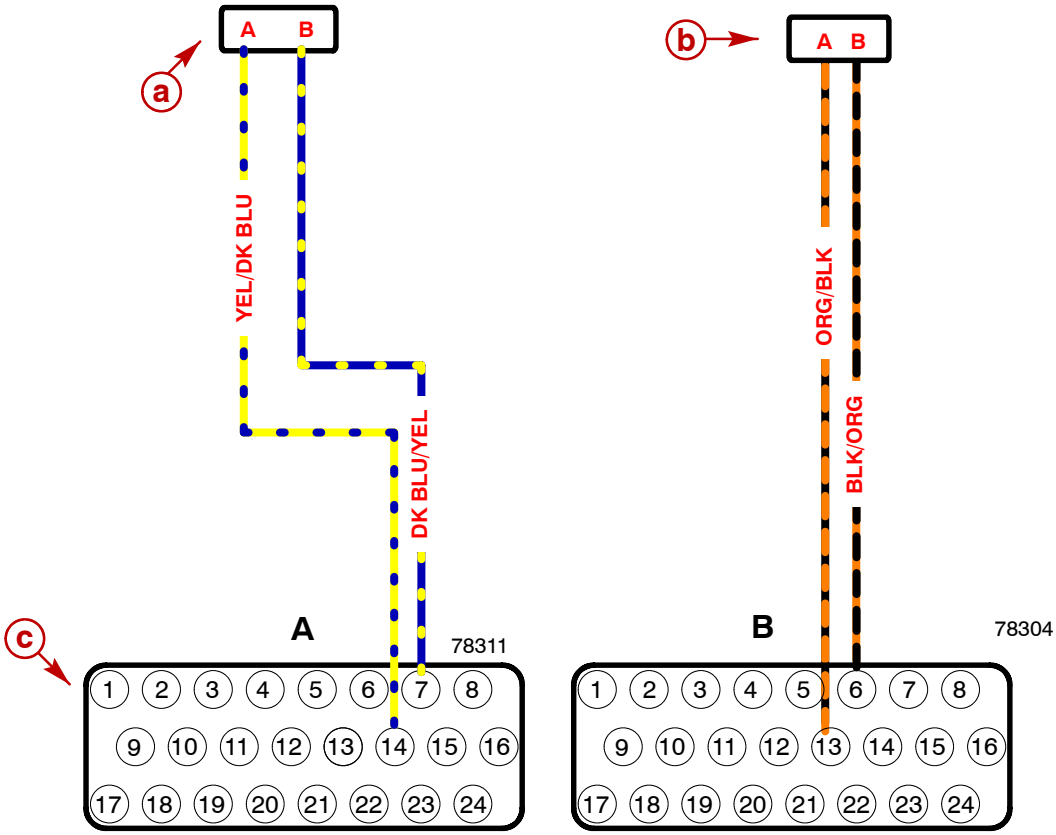


a - Oil Pressure Sensor Connector
b - ECM
c - 5 Volt Power
d - 5 Volt Ground
e - Signal

The oil pressure sensor measures oil flow through the oil galleries. It is located on the rear port side of the engine.

A malfunction of the oil pressure sensor will set the fault Oil PSI CKT Hi, Oil PSI CKT Lo or Oil PSI Lo.

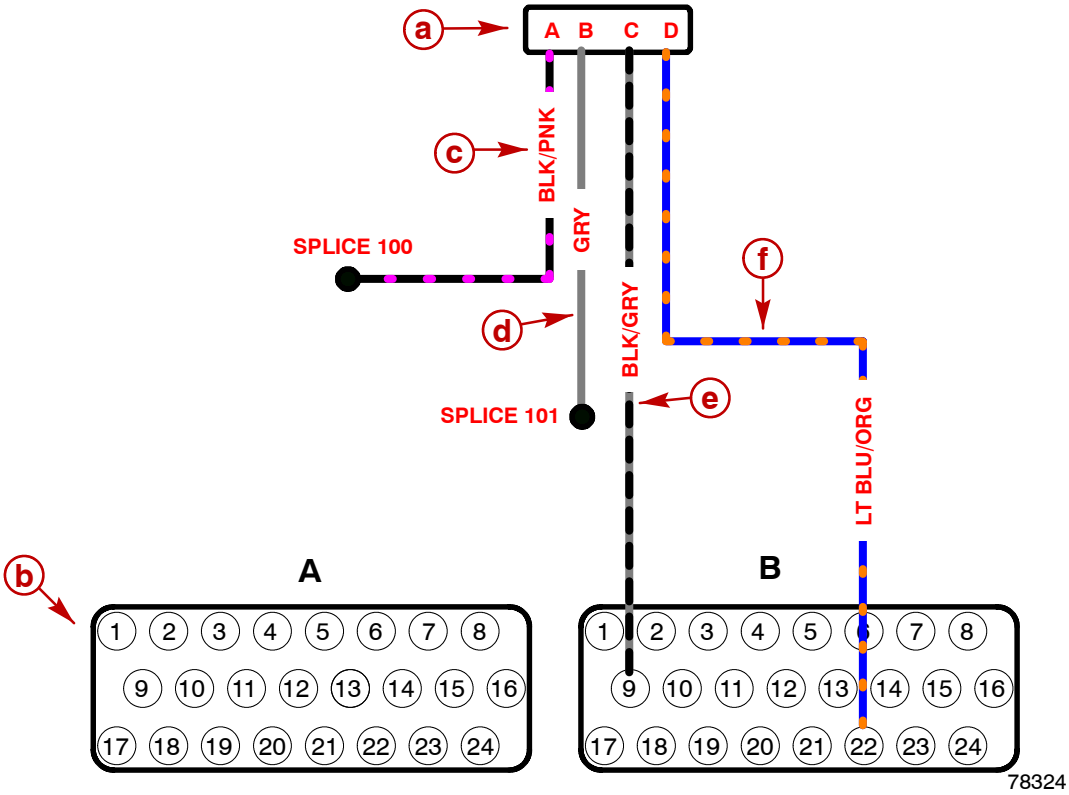
Port And Starboard Knock Sensor Circuits



a - Knock Sensor 1-3-5-7
b - Knock Sensor 2-4-6-8
c - ECM

The knock sensors detect engine detonation or spark knock and send a voltage signal to the ECM. They are located on the lower half of the engine on both the port and starboard sides. As the sensor detects knock, the voltage output level increases and signals the ECM of the problem.

Harness To Paddle Wheel Connector Circuit

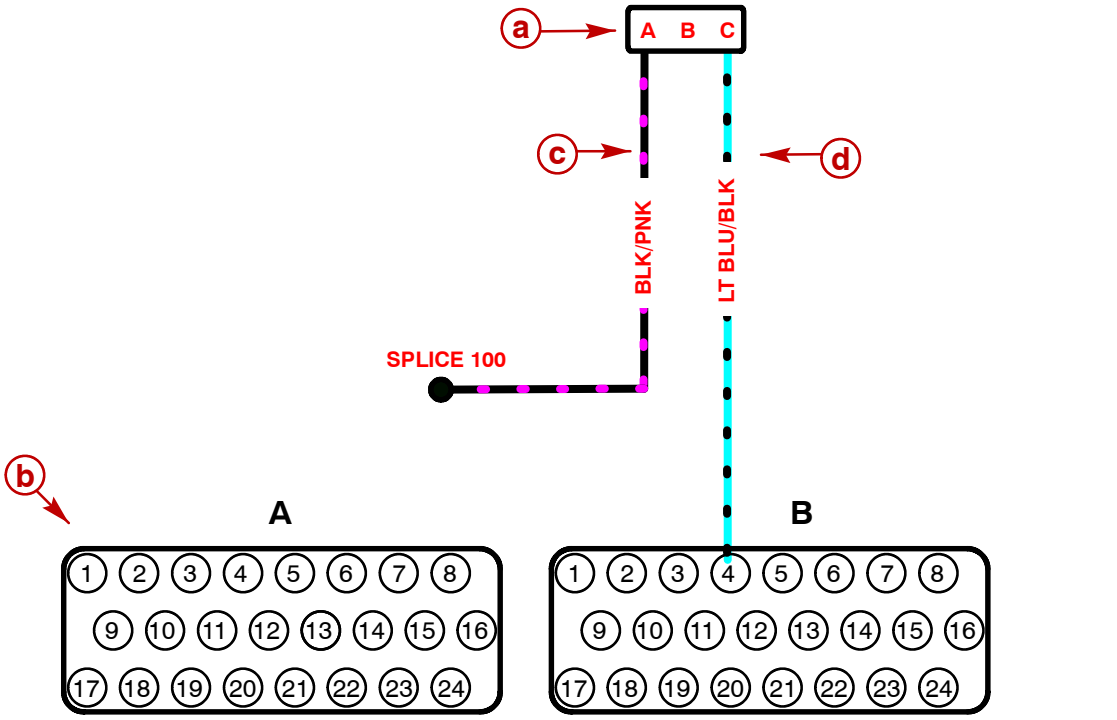


a - Paddle Wheel Connector
b - ECM
c - 5 Volt Ground
d - 5 Volt Power
e - Paddle Wheel
f - Water Temperature

The paddle wheel circuit supplies the ECM with boat speed and seawater temperature readings, it is much more precise than the pitot circuit at lower speeds. It is located on the rear of the engine.

A malfunction in the paddle wheel circuit will not set a fault.

Fuel Level Circuit

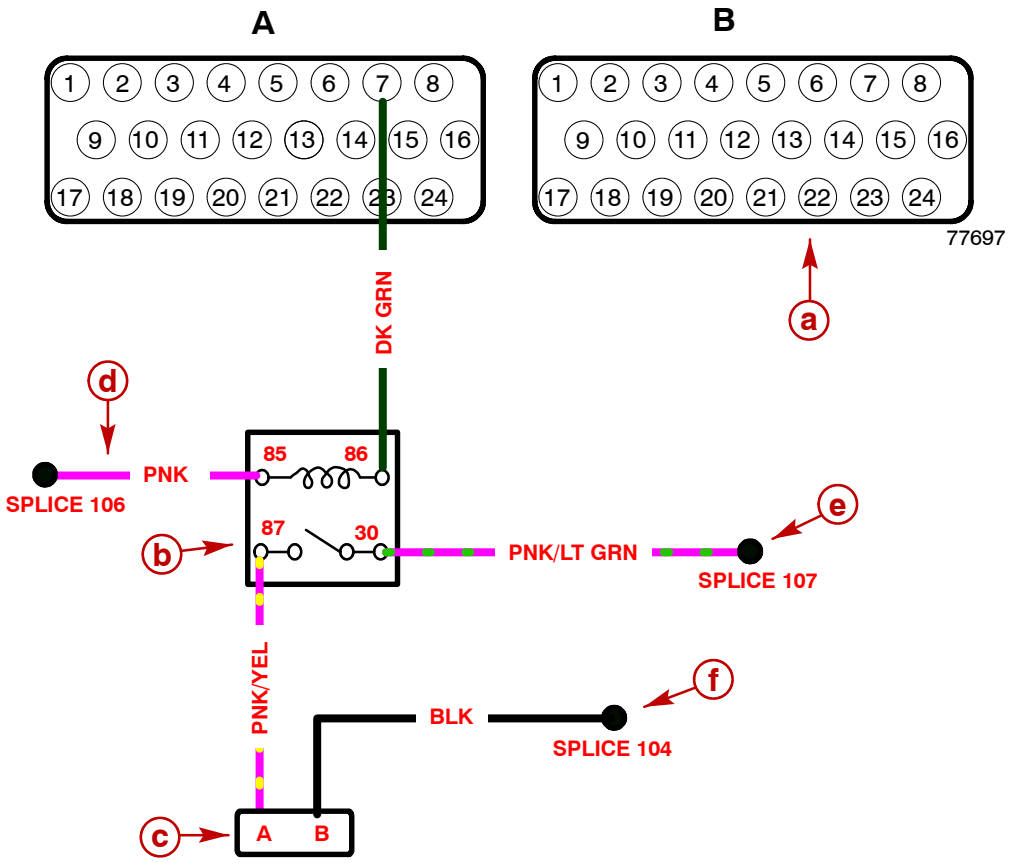


a - Fuel Level Connector
b - ECM
c - 5 Volt Ground
d - Signal

The fuel level sensor circuit supplies the ECM with the fuel level. It is located on the port rear of the engine.

A malfunction in the fuel level circuit will not set a fault.

Fuel Pump Relay Circuit

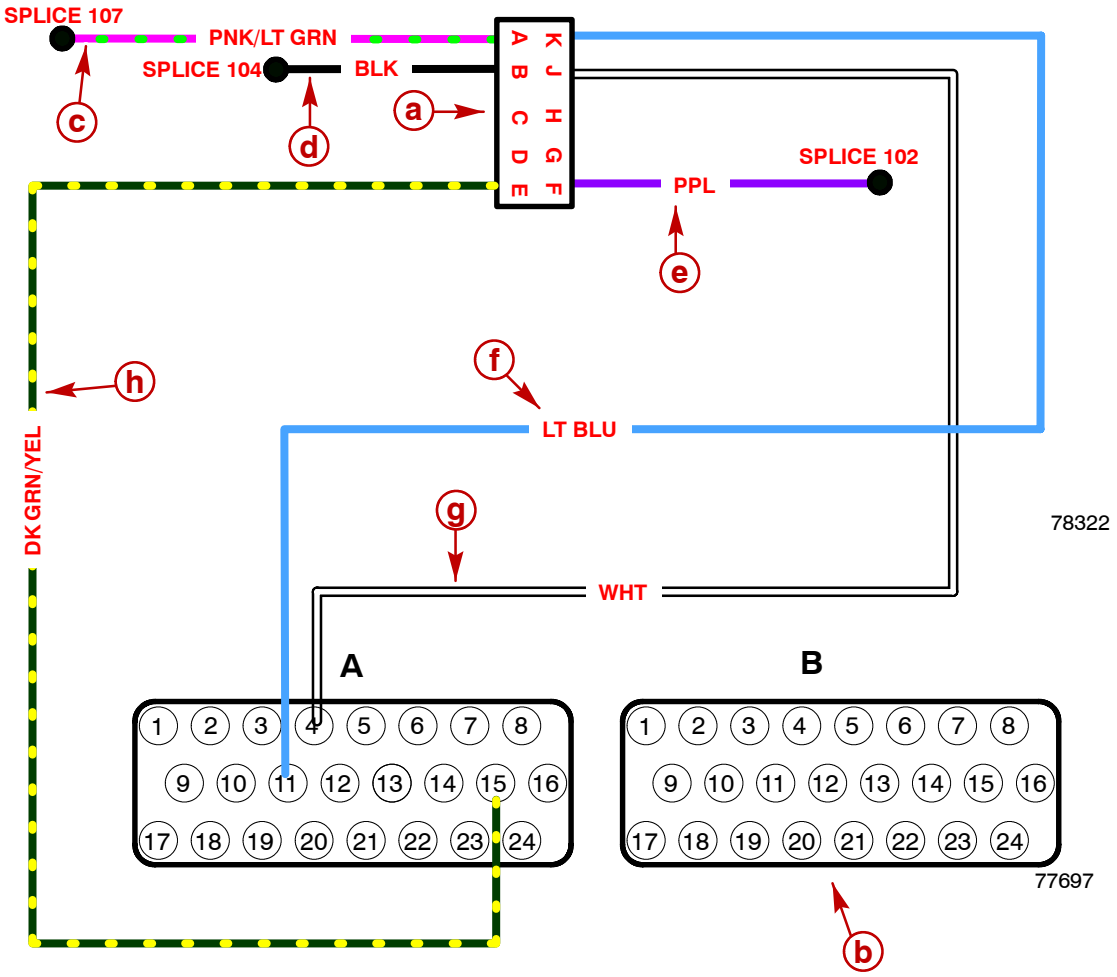


a - ECM
b - Fuel Pump Relay
c - Fuel Pump Connector
d - Ignition(Key) On 12 Volt Power
e - 12 Volt Fused Power
f - 12 Volt Ground

Upon key ON, the fuel pump relay receives 12 v battery power through the fuses at terminal 30. The relay powers both fuel pumps and signals the ECM that the engine is ready to start. Listen at key ON for both fuel pumps to operate.

A malfunction in the fuel pump relay circuit will not set a fault.

Control Area Network (CAN) Circuit

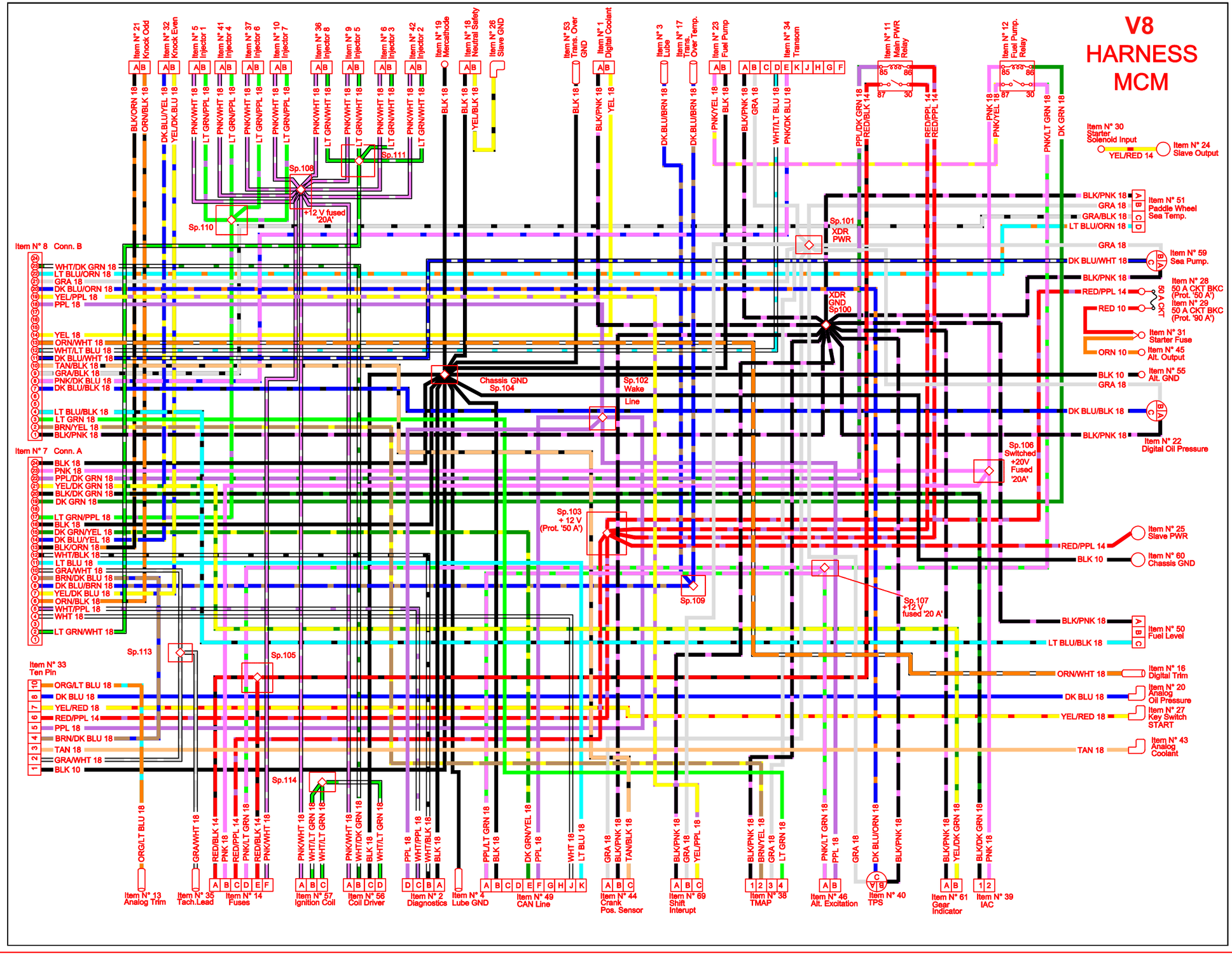


a - CAN Line Connector
b - ECM
c - Fuse 12 Volt Power
d - 12 Volt Ground
e - Wake Line
f - Cam Line (–)
g - Cam Line (+)
h - Stop

The CAN circuit powers the Smartcraft gauges on mechanical throttle and shift engines. It is located on the rear of the engine on the upper port side. The gauges receive power through the BUS power and ground. Gauge information (RPM, TEMP, TRIM) is sent through the CAN leads.

A malfunction in the CAN circuit will not set a fault.

Wiring Diagrams


V8
HARNESS
MCM
Item N° 21 Knock Odd
Item N° 32 Knock Even
Item N° 5 Injector 1
Item N° 41 Injector 4
Item N° 37 Injector 6
Item N° 10 Injector 7
Item N° 36 Injector 8
Item N° 9 Injector 5
Item N° 6 Injector 3
Item N° 42 Injector 2
Item N° 19 Mercathode
Item N° 18 Neutral Safety
Item N° 26 Slave GND
Item N° 53 Trans. Over GND
Item N° 1 Digital Coolant
Item N° 3 Lube
Item N° 17 Trans. Over Temp.
Item N° 23 Fuel Pump
Item N° 34 Transom
Item N° 11 Main PWR Relay
Item N° 12 Fuel Pump. Relay
Item N° 30 Starter Solenoid Input
Item N° 24 Slave Output
Item N° 51 Paddle Wheel Sea Temp.
Item N° 59 Sea Pump.
Item N° 28 50 A CKT BKC (Prot. '50 A')
Item N° 29 50 A CKT BKC (Prot. '90 A')
Item N° 31 Starter Fuse
Item N° 45 Alt. Output
Item N° 55 Alt. GND
Item N° 22 Digital Oil Pressure
Item N° 25 Slave PWR
Item N° 60 Chassis GND
Item N° 50 Fuel Level
Item N° 16 Digital Trim
Item N° 20 Analog Oil Pressure
Item N° 27 Key Switch START
Item N° 43 Analog Coolant
Item N° 8 Conn. B
Item N° 7 Conn. A
Item N° 33 Ten Pin
Sp.108
Sp.110
Sp.111
+12 V fused '20A'
Sp.101 XDR PWR
XDR GND Sp100
Chassis GND Sp.104
Sp.102 Wake Line
Sp.103 + 12 V (Prot. '50 A')
Sp.106 Switched +20V Fused '20A'
Sp.107 +12 V fused '20 A'
Sp.109
Sp.105
Sp.113
Sp.114
Item N° 13 Analog Trim
Item N° 35 Tach.Lead
Item N° 14 Fuses
Item N° 57 Ignition Coil
Item N° 56 Coil Driver
Item N° 2 Diagnostics
Item N° 4 Lube GND
Item N° 49 CAN Line
Item N° 44 Crank Pos. Sensor
Item N° 69 Shift Interupt
Item N° 38 TMAP
Item N° 46 Alt. Excitation
Item N° 40 TPS
Item N° 61 Gear Indicator
Item N° 39 IAC

NOTES

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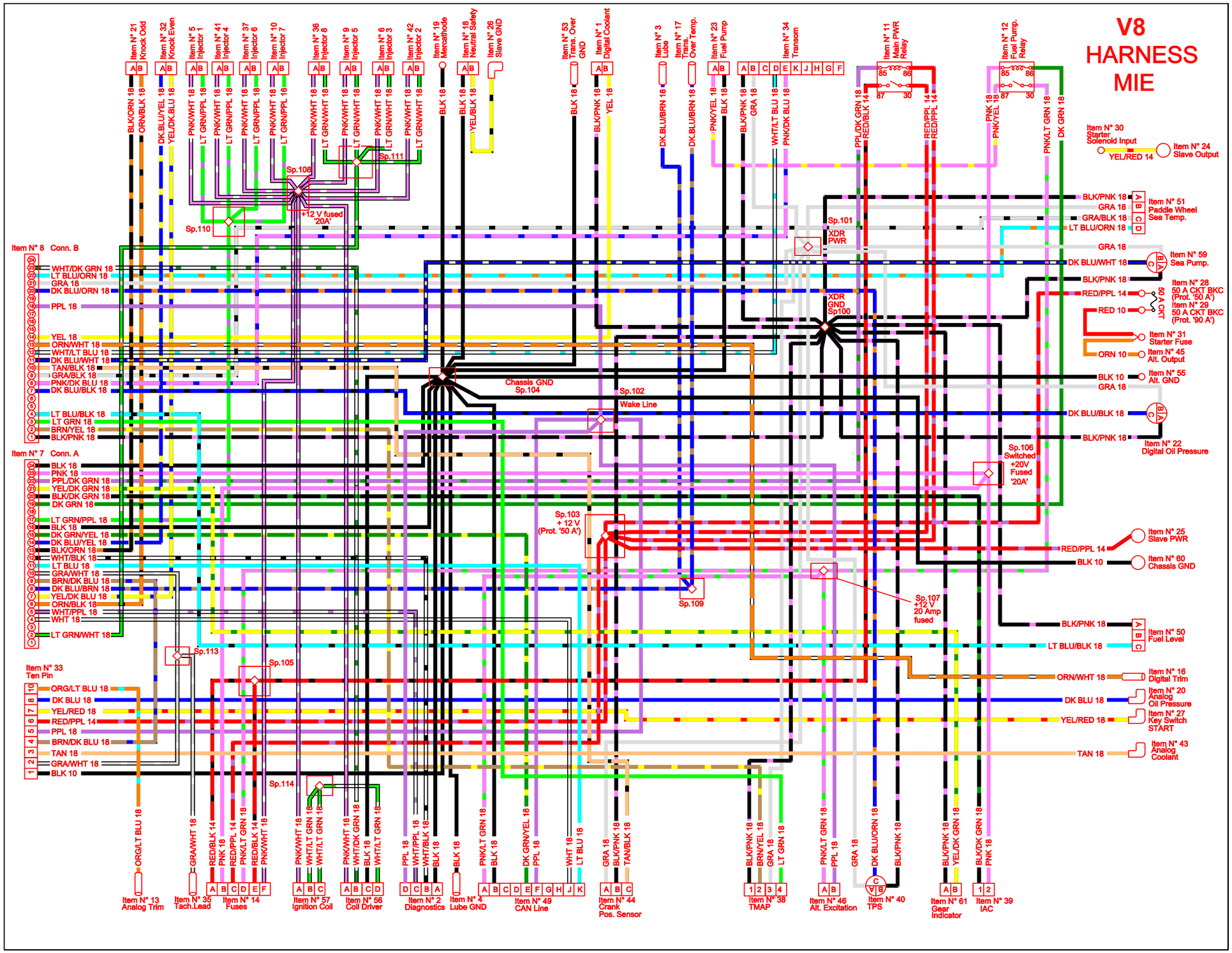
V8
HARNESS
MIE
Item N° 21 Knock Odd
Item N° 32 Knock Even
Item N° 5 Injector 1
Item N° 41 Injector 4
Item N° 37 Injector 6
Item N° 10 Injector 7
Item N° 36 Injector 8
Item N° 9 Injector 5
Item N° 6 Injector 3
Item N° 42 Injector 2
Item N° 19 Mercathode
Item N° 18 Neutral Safety
Item N° 26 Slave GND
Item N° 53 Trans. Over GND
Item N° 1 Digital Coolant
Item N° 3 Lube
Item N° 17 Trans. Over Temp.
Item N° 23 Fuel Pump
Item N° 34 Transom
Item N° 11 Main PWR Relay
Item N° 12 Fuel Pump. Relay
Item N° 30 Starter Solenoid Input
YEL/RED 14
Item N° 24 Slave Output
Sp.108
Sp.111
Sp.110
+12 V fused '20A'
Sp.101 XDR PWR
XDR GND Sp100
Item N° 8 Conn. B
Item N° 7 Conn. A
Chassis GND Sp.104
Sp.102 Wake Line
Sp.103 + 12 V (Prot. '50 A')
Sp.109
Sp.106 Switched +20V Fused '20A'
Sp.107 +12 V 20 Amp fused
Item N° 51 Paddle Wheel Sea Temp.
Item N° 59 Sea Pump.
Item N° 28 50 A CKT BKC (Prot. '50 A')
Item N° 29 50 A CKT BKC (Prot. '90 A')
Item N° 31 Starter Fuse
Item N° 45 Alt. Output
Item N° 55 Alt. GND
Item N° 22 Digital Oil Pressure
Item N° 25 Slave PWR
Item N° 60 Chassis GND
Item N° 50 Fuel Level
Item N° 16 Digital Trim
Item N° 20 Analog Oil Pressure
Item N° 27 Key Switch START
Item N° 43 Analog Coolant
Item N° 33 Ten Pin
Sp.113
Sp.105
Sp.114
Item N° 13 Analog Trim
Item N° 35 Tach.Lead
Item N° 14 Fuses
Item N° 57 Ignition Coil
Item N° 56 Coil Driver
Item N° 2 Diagnostics
Item N° 4 Lube GND
Item N° 49 CAN Line
Item N° 44 Crank Pos. Sensor
Item N° 38 TMAP
Item N° 46 Alt. Excitation
Item N° 40 TPS
Item N° 61 Gear Indicator
Item N° 39 IAC

NOTES

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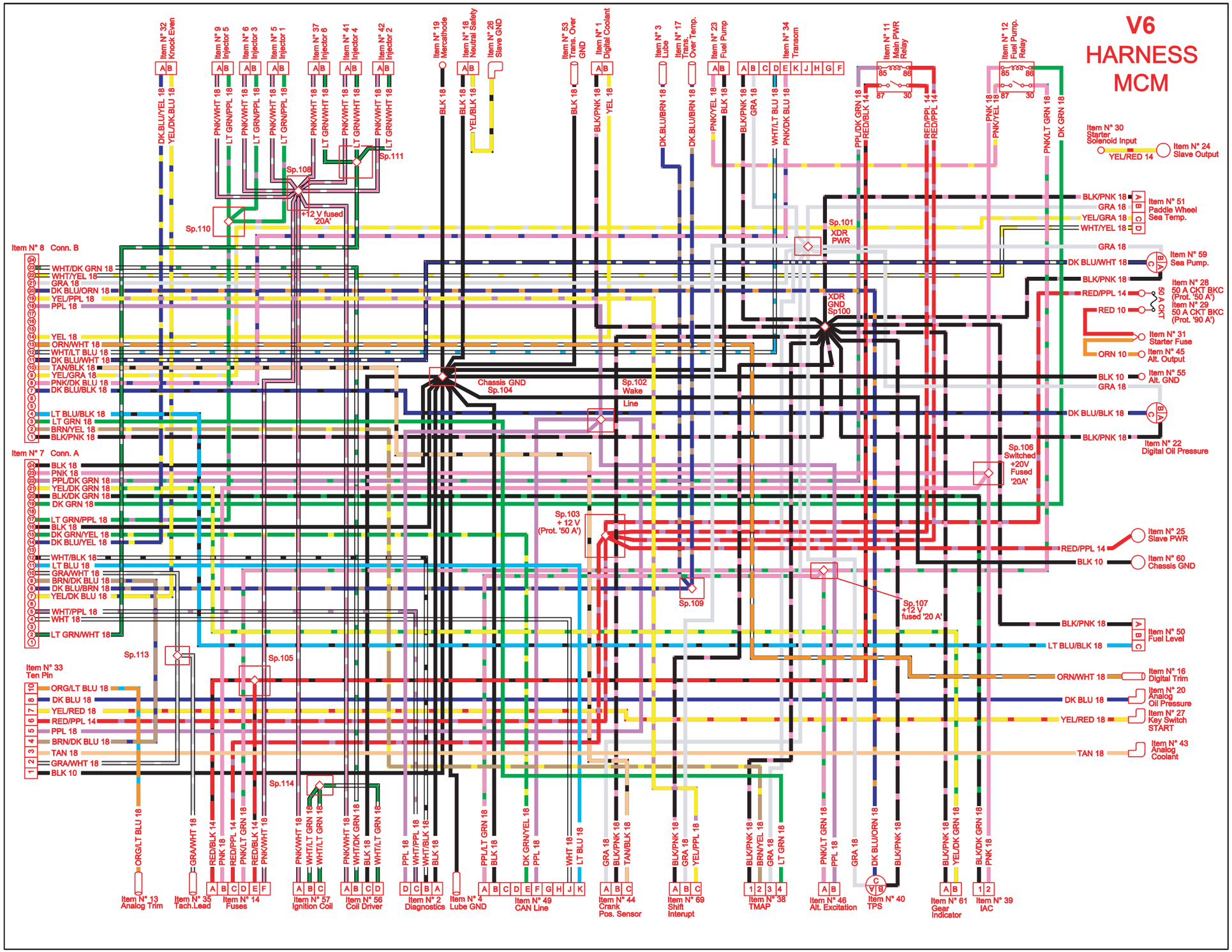
V6
HARNESS
MCM
Item N° 32 Knock Even
Item N° 9 Injector 5
Item N° 6 Injector 3
Item N° 5 Injector 1
Item N° 37 Injector 6
Item N° 41 Injector 4
Item N° 42 Injector 2
Item N° 19 Mercathode
Item N° 18 Neutral Safety
Item N° 26 Slave GND
Item N° 53 Trans. Over GND
Item N° 1 Digital Coolant
Item N° 3 Lube
Item N° 17 Trans. Over Temp.
Item N° 23 Fuel Pump
Item N° 34 Transom
Item N° 11 Main PWR Relay
Item N° 12 Fuel Pump. Relay
Item N° 30 Starter Solenoid Input
YEL/RED 14
Item N° 24 Slave Output
Sp.108
Sp.111
Sp.110
+12 V fused '20A'
Sp.101 XDR PWR
XDR GND Sp100
Chassis GND Sp.104
Sp.102 Wake Line
Sp.103 + 12 V (Prot. '50 A')
Sp.109
Sp.107 +12 V fused '20 A'
Sp.106 Switched +20V Fused '20A'
Sp.105
Sp.113
Sp.114
Item N° 8 Conn. B
WHT/DK GRN 18
WHT/YEL 18
GRA 18
DK BLU/ORN 18
YEL/PPL 18
PPL 18
YEL 18
ORN/WHT 18
WHT/LT BLU 18
DK BLU/WHT 18
TAN/BLK 18
YEL/GRA 18
PNK/DK BLU 18
DK BLU/BLK 18
LT BLU/BLK 18
LT GRN 18
BRN/YEL 18
BLK/PNK 18
Item N° 7 Conn. A
BLK 18
PNK 18
PPL/DK GRN 18
YEL/DK GRN 18
BLK/DK GRN 18
DK GRN 18
LT GRN/PPL 18
BLK 18
DK GRN/YEL 18
DK BLU/YEL 18
WHT/BLK 18
LT BLU 18
GRA/WHT 18
BRN/DK BLU 18
DK BLU/BRN 18
YEL/DK BLU 18
WHT/PPL 18
WHT 18
LT GRN/WHT 18
Item N° 33 Ten Pin
ORG/LT BLU 18
DK BLU 18
YEL/RED 18
RED/PPL 14
PPL 18
BRN/DK BLU 18
TAN 18
GRA/WHT 18
BLK 10
Item N° 51 Paddle Wheel Sea Temp.
Item N° 59 Sea Pump.
Item N° 28 50 A CKT BKC (Prot. '50 A')
Item N° 29 50 A CKT BKC (Prot. '90 A')
Item N° 31 Starter Fuse
Item N° 45 Alt. Output
Item N° 55 Alt. GND
Item N° 22 Digital Oil Pressure
Item N° 25 Slave PWR
Item N° 60 Chassis GND
Item N° 50 Fuel Level
Item N° 16 Digital Trim
Item N° 20 Analog Oil Pressure
Item N° 27 Key Switch START
Item N° 43 Analog Coolant
Item N° 13 Analog Trim
Item N° 35 Tach.Lead
Item N° 14 Fuses
Item N° 57 Ignition Coil
Item N° 56 Coil Driver
Item N° 2 Diagnostics
Item N° 4 Lube GND
Item N° 49 CAN Line
Item N° 44 Crank Pos. Sensor
Item N° 69 Shift Interupt
Item N° 38 TMAP
Item N° 46 Alt. Excitation
Item N° 40 TPS
Item N° 61 Gear Indicator
Item N° 39 IAC

NOTES