MERCURY

MerCruiser

#36 Service Manual

ECM 555 Diagnostics

Notice to Users of This Manual

Throughout this publication, dangers, warnings, cautions, and notices (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. These safety alerts follow ANSI standard Z535.6-2006 for product safety information in product manuals, instructions, and other collateral materials. **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

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, could result in engine or major component failure.

IMPORTANT: Identifies information essential to the successful completion of the task.

NOTE: *Indicates information that helps in the understanding of a particular step or action.*

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

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 Marine Power Products, 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.

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 and ignition systems 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 into the cylinders which could cause extensive internal damage when the engine is started.

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 reuse, care should be taken to select a replacement that matches the original.

Replacement Parts

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

⚠ WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Mercury Marine products comply with U.S. Coast Guard rules to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these rules. When servicing the electrical and fuel systems, properly install and tighten all components.

Cleanliness and Care of Product

A Mercury Marine Power Product is a combination of many machined, honed, polished, and lapped surfaces with tolerances measured in the ten thousands of an inch/mm. When any product component is serviced, care and cleanliness are important. It should be understood that proper cleaning and protection of machined surfaces and friction areas is a part of the repair procedure. This is considered standard shop practice even if not specifically stated.

Whenever components are removed for service, they should be retained in order. At the time of installation, they should be installed in the same locations and with the same mating surfaces as when removed.

Personnel should not work on or under an engine that is suspended. Engines should be attached to work stands, or lowered to ground as soon as possible.

Manual Outline

General Information

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A

Section 1A - General Information

Table of Contents

How To Use This Guide

This diagnostic guide is separated into three 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
- CDS

Wiring diagrams covers:

- Engine electrical harness
- Circuit diagrams
- 14-pin harness

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 help the technician pinpoint problems occurring in the electrical system.

ECM and PCM Abbreviations

NOTE: *Throughout this manual the Computer Diagnostic System is often abbreviated as CDS.*

Abbreviation	Description
5 VDC PWR LO	5-volt ECM internal power supply low
5 VDC PWR 2 LO	5-volt ECM power supply low to SmartCraft Sensors (Not available on all models)
ACT	Air compressor temperature (F or C) sensor
ACT INPUT HI	Air compressor temperature sensor input is high
ACT INPUT LO	Air compressor temperature sensor input is low
ACT TMP Sec	Time spent in air compressor overheat
ACTIVE	Active fault state of sensors, switches, injectors, etc.
AT	Intake manifold air temperature (F or C) sensor
AT I NPUT HI	Air temperature (engine) sensor input is high
AT INPUT LO	Air temperature (engine) sensor input is low
AIR COM TMP	Air compressor temperature sensor (F or C)
AIRFLOW HI	Incoming airflow to engine is higher than expected
AIR TEMP CKTHI	Air temperature (engine) sensor circuit is high
AIR TEMP CKT LO	Air temperature (engine) sensor circuit is low
AIR TMP	Intake manifold air temperature (F or C) sensor
AVAILABLE PWR %	A normally functioning system will allow engine to make 100% power.
B+	Battery positive
BARO	Barometric pressure

Abbreviation	Description
BARO PSI	Barometric pressure (psi or kPa)
BAT	Battery positive terminal, battery or system voltage
BATT VOLT HIGH	Battery voltage is above the allowable limit
BATT VOLT LOW	Battery voltage is below the allowable limit
BLK PSI MIN	Block pressure minimum specification
BLK TEMP CKT HI	Engine block temperature sensor circuit is high
BLK TEMP CKT LO	Engine block temperature sensor circuit is low
BLOCK PRESS LOW	Engine block pressure below acceptable limit
BLOCK PSI	Inlet water pressure to block (PSI or kPa)
BLOCK PSI	Sec time spent with low water pressure to block
BLOCK PSI	Inlet water pressure (PSI or kPa)
BLOCK OVRHEAT	Engine block is overheating
BPSI INPUT HI	Block pressure sensor input is high
BPSI INPUT LO	Block pressure sensor input is low
BREAK-IN	Engine break-in routine
BREAKIN ACTIVE	Engine break-in routine is active
BREAK-IN LEFT	Time remaining in engine break-in routine
BREAKIN STR	Break-in strategy
BUFFER	An area used to temporarily store data
BUS +12 CAN	Bus 12-volt supply for SmartCraft
CALIB ID	Calibration ID of ECM
CAN	Controller area network
CAN ERR1	CAN wiring problem. Check ALL pins and terminators
CAN ERR2	CAN wiring problem. Check ALL pins and terminators
CAN ERR3	CAN wiring problem. Check ALL pins and terminators
CAN ERR4	CAN wiring problem. Check ALL pins and terminators
CAN ERR5	CAN wiring problem. Check ALL pins and terminators
CAN ERR6	CAN wiring problem. Check ALL pins and terminators
CAN ERR7	CAN wiring problem. Check ALL pins and terminators
CAN ERR8	CAN wiring problem. Check ALL pins and terminators
CAN ERR9	CAN wiring problem. Check ALL pins and terminators
CAN ERR10	CAN wiring problem. Check ALL pins and terminators
CHI	Customer helm interface (SC5000)
CKT	Circuit
CODE	Calibration ID of ECM
COOL TMP PRT	Coolant temp port (F or C) sensor
COOL TMP STB	Coolant temp starboard (F or C) sensor
COMP	Air compressor temperature sensor
COMP OVERHEAT	Air compressor temperature is above the allowable limit
COMP TEMP CKT HI	Air compressor temperature sensor circuit is high
COMP TEMP CKT LO	Air compressor temperature sensor circuit is low
COMP TMP	Air compressor temperature (F or C)
COMPRESS OVRHT	Air compressor temperature is above the allowable limit

Abbreviation	Description
CONN	Connector
CTP INPUT HI	Coolant temperature port sensor input is high
CTP INPUT LO	Coolant temperature port sensor input is low
CTP TMP	Sec time spent in overheat on the port bank
CTS INPUT HI	Coolant temperature starboard sensor input is high
CTS INPUT LO	Coolant temperature starboard sensor input is low
CTS TMP	Sec time spent in overheat on the starboard bank
CYL	Cylinder
DDT	Digital diagnostic terminal
DEC	Refers to a decreasing potentiometer reading in the electronic remote control. A decreasing potentiometer reads from high to low volts through its total travel range.
DEG	Degrees
DEMAND %	TPI% or TPS% ; On DTS models, this is ERC demand %
DEMAND DIFF	Faulty potentiometers in ERC
DIAG	Diagnostic
DINJ1 -- DINJ6 OPEN	Direct injector 1-6 circuit is open
DINJ1 -- DINJ6 SHORT	Direct injector 1-6 circuit is short
DIST	Distributor
DLC	Data link connector
DRIVE LUBE LO	Low drive lube reservoir
DRIVER POWER LO	Insufficient battery voltage or wiring problem
DTC	Diagnostic trouble code
DTS	Digital throttle and shift
DUAL CAN ERR	Wiring problem between CAN 1 and CAN 2
DVOM	Digital volt ohm meter
ECM 555	Electronic control module with a power PC 555 microcomputer
ECM ID ECM	Hardware revision level
ECM MEMORY ERR	ECM memory has been corrupted
ECM_TRIG1-8 OPEN	ECM spark trigger signal circuit 1-8 is open
ECM_TRIG1-8 SHORT	ECM spark trigger signal circuit 1-8 is short
ECT	Engine coolant temperature (F or C) sensor
EEPROM	Electronic erasable programmable read only memory
EMI	Electromagnetic interference
ENG	Engine
ENGINE ID	Engine identification
ENGINE RPM	Revolutions per minute of engine
ERC	Electronic remote control handle at the helm
ESC	Electronic shift control (actuator)
ESC CONTROL LOST	ESC cannot maintain in-gear position
ESC - NS POS DIFF	ESC determination of its position and neutral switch position don’t agree
ESC - ERC POS DIFF	ESC position (actuator's determination of its position) and commanded position do not agree.
ESC TIMEOUT	ESC actuator has not physically moved with respect to the ERC lever (demand) position.

Abbreviation	Description
EST	Electronic spark timing
EST 1-8	Electronic spark trigger signal to the ignition coil driver circuit
EST 1-8 OPEN	Electronic spark trigger signal circuit 1-8 is open
EST 1-8 SHORT	Electronic spark trigger signal circuit 1-8 is short
ETC CONTROL	Loss of electronic throttle control circuit
ETC STICKING	Electronic throttle control sticking or binding
ETC IDLE RANGE ETC	Is outside of its expected idle range
ETC MOTOR OPEN	Electronic throttle control motor is open (Not available on all models)
ETC MOTOR SHORT	Electronic throttle control motor is shorted (Not available on all models)
FINJ 1 - FINJ 8 OPEN	Fuel injector circuit 1-8 is open
FINJ 1 - FINJ 8 SHORT	Fuel injector circuit 1-8 is shorted
FPC TOTAL	Fuel per cycle per cylinder. Total fuel amount currently being used by engine.
FREEZE FRAME	A snapshot of captured engine data stored in ECM history
FUEL LEVEL	Boat tank fuel sender data
FUEL LVL CKT HI	Fuel level sensor circuit high (same as FUEL LVL IN HI)
FUEL LVL CKT LO	Fuel level sensor circuit low (same as FUEL LVL IN LO)
FUEL LVL CKT2 HI	Fuel level sensor circuit #2 high (same as FUEL LVL IN HI)
FUEL LVL CKT2 LO	Fuel level sensor circuit #2 low (same as FUEL LVL IN LO)
FUEL LVL IN HI	Fuel level sensor input is high
FUEL LVL IN LO	Fuel level sensor input is low
FUEL PRES CKT LO	Fuel pressure sensor circuit is low (not available on all models)
FUEL PRES CKT HI	Fuel pressure sensor circuit is high (not available on all models)
FUEL PSI CKT HI	Fuel pressure sensor circuit (same as Fuel Pres Input Hi)
FUEL PSI CKT LO	Fuel pressure sensor circuit low (same as Fuel Pres Input Lo)
FUEL PUMP CKT	Fuel pump circuit or relay fault
FUEL PUMP RLY	Fuel pump relay
GEAR POS DIFF ESC	Position sensor doesn’t agree with the shift switch
GND	Ground
GUARDIAN	Engine Guardian strategy is active
GRD LIMIT	Sec time spent in engine guardian
H20 IN FUEL	Water-in-fuel filter
H2O PRES CKT HI	Engine water pressure sensor circuit is high
H2O PRES CKT LO	Engine water pressure sensor circuit is low
HALL SENSOR	Hall effect (encoder/crank position) sensor
HALL SNSR STR	Hall effect (encoder/crank position) sensor strategy is active
HEAD OVRHT	Cylinder head is overheating
HEAD TEMP CKT HI	Cylinder head temperature sensor circuit is high
HEAD TEMP CKT LO	Cylinder head temperature sensor circuit is low
HEI	High energy ignition
HELM ADC CHECK	Command module reliability check or CAN bus problem
HIRES	Indicates a high-resolution potentiometer which has voltage readings that move from high to low to high through its entire range.
HORN	Horn driver (internal to ECM for non DTS models)

Abbreviation	Description
HORN OUTPUT	Warning horn system not functional (same as Warning Horn)
IAC	Idle air control
IAC OUTPUT	Idle air control valve or circuit fault
IAC PWM%	Idle air control valve duty cycle percent
IAT	Intake air temperature
IC	Ignition control
IDLE	Idle TPI=0%
IDLE MAP STR	Idle RPM MAP strategy (same as MAP Idle Check)
IGN	Ignition
IGN 1 -- IGN 8	Ignition coil for cylinders one thru eight
IGN PRI	Ignition coil primary
INC	An increasing potentiometer reading used in the electronic remote control. An increasing potentiometer reads from low to high volts through its total travel range
INJ	Injection
KNOCK SENSOR1	Knock sensor #1 (not available on all models) or KNK SNSR1
KNOCK SENSOR2	Knock sensor #2 (not available on all models) or KNK SNSR2
kPa	Kilopascal
KS	Knock sensor
KV	Kilovolts
LAKE/SEA	Lake or sea water temperature (F or C)
LED	Light emitting diode (Typically red in color)
LOW DRIVE LUBE	Low drive lube reservoir
LOW OIL SEC	Time spent on low oil reserve
MAP	Manifold absolute pressure sensor (psi or kPa)
MAP CKT HI	Manifold absolute pressure sensor circuit high (same as MAP INPUT HI)
MAP CKT LO	Manifold absolute pressure sensor circuit low (same as MAP INPUT LO)
MAP DIFF ERR	Both TPIs are functioning but MAP sensor calculations don’t agree, therefore the MAP sensor is suspected as faulty
MAP INPUT HI	MAP sensor input is high
MAP INPUT LO	MAP sensor input is low
MAP IDLE CHECK MAP	Sensor rationality/loss of vacuum check (not available on all models)
MAT	Manifold air temperature (F or C) (same as AT)
MAT CKT HI	Manifold air temperature circuit high (same as AT Input Hi)
MAT CKT LO	Manifold air temperature circuit low (same as AT Input Lo)
MAP	Manifold absolute pressure
MCM	MerCruiser marine
MDTC	Marine diagnostic trouble code
MIE	Mercury inboard engine
MIL	Malfunction indicator lamp
MPRLY	Main power relay
MPRLY BACKFEED	An external power source has bypassed the main power relay
MPRLY OUTPUT	Main power relay output circuit has a fault
mSec	Millisecond

Abbreviation	Description
NA (N/A)	Not available
NEUTRAL OVERSPD	Neutral gear overspeed
N/C	Normally closed
N/O	Normally open
OBD	On-board diagnostic
OIL INJ CNT	Number of counts of oil pump activation cycles
OIL LEVEL	Main oil tank sender data
OIL LVL BOAT LO	Oil level in boat tank is low
OIL LVL ENG LO	Oil reserve active on engine tank (Low Oil Switch)
OIL LVL CKT HI	Oil level sensor circuit is high
OIL LVL CKT LO	Oil level sensor circuit is low
OIL LVL IN HI	Oil level sensor input is high
OIL LVL IN LO	Oil level sensor input is low
OIL PMP Sec	Time spent with oil pump fault
OIL PRES LO	Oil pressure is low
OIL PRES CKT HI	Oil pressure sensor circuit high
OIL PRES CKT LO	Oil pressure sensor circuit low
OIL PSI	Engine oil pressure (psi or kPa)
OIL PSI CKT HI	Oil pressure sensor circuit high
OIL PSI CKT LO	Oil pressure sensor circuit low
OIL PSI STR)	Oil pressure strategy (not available on all models)
OIL PUMP	Oil pump electrical fault or wiring
OIL PUMP OUTPUT	Oil pump electrical fault or wiring
OIL QLTY CKT HI	Oil quality circuit high (not available on all models)
OIL QLTY CKT LO	Oil quality circuit low (not available on all models)
OIL REMOTE STR	Remote oil tank strategy (not available on all models)
OIL RESERVE STR	Oil reserve strategy is active (low oil switch has been activated)
OIL SYSTEM	Oil system fault
OIL TMP CKT HI	Oil temperature circuit high
OIL TMP CKT LO	Oil temperature circuit low
OIL TMP OVRHT	Oil temperature overheat
OVERSPEED	Overspeed or RPM limit
OVERSPEED	Engine has entered stage 0 of RPM limit (normal rev limit)
OVERSPEED 1	Engine has entered stage 1 of RPM limit (abnormal rev limit)
OVERSPEED 2	Engine has entered stage 2 of RPM limit (abnormal rev limit)
OVER TMP	Sec time in seconds spent in over heat condition
PADDLE WHEEL	Data used to calculate boat speed (frequency in hertz)
PADLE WHEEL STR	Paddle wheel strategy
PCM	Propulsion control module
PCM 555	Propulsion control module with a power PC555 microcomputer
PITOT	Pitot pressure sensor data for boat speed calculations
PITOT CKT HI	Pitot pressure sensor circuit high
PITOT CKT LO	Pitot pressure sensor circuit low

Abbreviation	Description
PITOT INPUT HI	Pitot pressure sensor input is high
PITOT INPUT LO	Pitot pressure sensor input is low
PORT EMCT CKT HI	Port exhaust manifold coolant sensor circuit high
PORT EMCT CKT LO	Port exhaust manifold coolant sensor circuit low
PORT EMCT OVRHT	Port exhaust manifold coolant temperature overheat
PORT HEAD OVRHT	Overheat on the port bank
PORT OVERHEAT	Overheat on the port bank
PROM	Programmable read only memory
PRT EMCT	Port exhaust manifold coolant temp (F or C)
PRT EMCT CKT HI	Port exhaust manifold coolant sensor circuit high
PRT EMCT CKT LO	Port exhaust manifold coolant sensor circuit low
PRT EMCT OVRHT	Port exhaust manifold coolant temperature overheat
PWR 1 VOLTS	Power supply 1 volts (internal to ECM) for sensors
PWR RLY	Main power relay
PWR RELAY OUTPUT	Main power relay output circuit has a fault (see FAQ)
PWR RELAY BACKFD	An external power source has bypassed the main power relay
PWR1 LOW	+5v sensor power supply is low
RAM	Random access memory
REF. HI	Reference high
REF. LO	Reference low
REVERSE OVERSPD	Reverse gear overspeed
ROM	Read only memory
RPM LIMIT SEC	Time spent in RPM limit (seconds)
RUN TIME HR.	Total run time in hours with this ECM
SC5000	Systemview 5000 display (CHI)
SEA PUMP CKT HI	Sea pump pressure sensor circuit high
SEA PUMP CKT LO	Sea pump pressure sensor circuit low
SEA PUMP PSI	Sea pump pressure (PSI or kPa)
SEA PUMP PSI LO	Sea pump pressure low
SEA TMP CKT HI	Sea/Lake temperature circuit high (same as SEA TMP IN HI)
SEA TMP CKT LO	Sea/Lake temperature circuit low (same as SEA TMP IN LO)
SEA TMP IN HI	Sea/Lake temperature sensor input is high
SEA TMP IN LO	Sea/Lake temperature sensor input is low
SEC	Secondary of ignition coil
SEC FINJ1- 6 OPEN	Secondary fuel injector circuit 1-6 is open
SEC FINJ1- 6 SHORT	Secondary fuel Injector circuit 1-6 is shorted
SHIFT	Neutral or in gear position
SHIFT ADAPT ERR	Check ESC components for binding. ESC actuator faulty?
SHIFT ANT SWITCH	Problem with shift anticipate switch or problem with outdrive
SHIFT DRV OVRHT	Internal ECM driver for shift actuator is overheating
SHIFT POS CKT HI	Shift position sensor input circuit is high
SHIFT POS CKT LO	Shift position sensor input circuit is low
SHIFT SWITCH	Faulty neutral switch or wiring

Abbreviation	Description
SMARTSTART ERR	DTS engine failed to see flywheel rotation when commanded to start. No engine RPM detected, no starter engagement?
STAR OVERHEAT	Overheat on the starboard bank
START SOLENOID	Open circuit to start solenoid
STBD HEAD OVRHT	Overheat on the starboard bank
STBD TEMP CKT HI	Coolant temperature starboard sensor input is high
STBD TEMP CKT LO	Coolant temperature starboard sensor input is low
STB EMCT	Starboard exhaust manifold coolant temp (F or C)
STB EMCT CKT HI	Starboard exhaust manifold coolant temperature circuit high
STB EMCT CKT LO	Starboard exhaust manifold coolant temperature circuit low
STB EMCT OVRHT	Starboard exhaust manifold coolant temperature overheat
STBD EMCT CKT HI	Starboard exhaust manifold coolant temperature circuit high
STBD EMCT CKT LO	Starboard exhaust manifold coolant temperature circuit low
STBD EMCT OVRHT	Starboard exhaust manifold coolant temperature overheat
STEER CKT HI	OutDrive steering position sensor circuit high
STEER CKT LO	OutDrive steering position sensor circuit low
STEER INPUT HI	OutDrive steering position sensor input is high (Not available on all models)
STEER INPUT LO	OutDrive steering position sensor input is low (Not available on all models)
SLV	Slave
SW	Switch
TACH	Tachometer
TERM	Terminal
TGAP	Crank position sensor (Trig) air gap
THERMOSTAT FAULT	Check cooling system components
TPS	Throttle position
TPI % or TPS %	Throttle position indicator (demand) percent
TPI or TPS	Throttle position indicator or throttle position sensor
TPI ALL ERR	None of the two TPIs and MAP agree. Faulty wiring?
TPI1 DIFF ERR	MAP Sensor range = TPI2 but TPI1 doesn’t agree
TPI1 CKT HI	TPI #1 sensor circuit is high
TPI1 CKT LO	TPI #1 sensor circuit is low
TPI 1 INPUT HI	TPI #1 sensor circuit is high
TPI 1 INPUT LO	TPI #1 sensor circuit is low
TPI 1 NO ADAPT	Throttle position indicator #1 has a mechanical system, linkage, or connection fault. ECM software will not proroperly adapt.
TPI1 ADAPT ERR	Same as above
TPI 1 RANGE HI	TPI #1 is above the allowable high range
TPI 1 RANGE LO	TPI #1 is below the allowable low range
TPI 1 VOLTS	Throttle position indicator #1 volts
TPS1 CKT HI	Throttle position sensor #1 circuit high (same as TPI 1 input hi)
TPS1 CKT LO	Throttle position sensor #1 circuit low (same as TPI 1 input lo)
TPS1 NO ADAPT	Throttle position sensor #1 has a mechanical system, linkage, or connection fault. ECM software will not properly adapt (same as TPI 1 No Adapt)
TPI2 DIFF ERR	MAP sensor range = TPI1 but TPI2 doesn’t agree

Abbreviation	Description
TPI2 CKT HI	Throttle position indicator #2 circuit high
TPI2 CKT LO	Throttle position indicator #2 circuit low
TPI2 NO ADAPT	Throttle position indicator #2 has a mechanical system, linkage, or connection fault. ECM software will not properly adapt
TPI2 RANGE HI	Throttle position indicator #2 range high
TPI2 RANGE LO	Throttle position indicator #2 range low
TPI2 VOLTS	Throttle position indicator #2 volts
TRANS OVERHEAT	Transmission overheat
TRIM	Trim sender data
TRIM CKT HI	Trim sensor circuit high (same as TRIM INPUT HI)
TRIM CKT LO	Trim sensor circuit low (same as TRIM INPUT LO)
TRIM INPUT HI	Trim sensor input is high
TRIM INPUT LO	Trim sensor input is low
V	Volts
VAC	Vacuum
in.Hg	Inches of mercury
VR SENSOR	Variable reluctance (encoder/crank position) sensor
VR SNSR STR	Variable reluctance (encoder/crank position) sensor strategy
WARNING HORN	Warning horn system not functional (horn output)
WATER IN FUEL	Water-in-fuel filter
WATER PRES LO	Water pressure to engine is low WOT wide open throttle TPI=100%
WOT	Wide-open throttle
XCHK DEMAND DIFF	SC5000 or command module not equal to PCM cross check of demand value (Incorrect positions used when configuring levers at CHI, faulty CHI, or ECM)
XCHK SHIFT DIFF	SC5000 or command module not equal to PCM cross check of shift position

Precautions

⚠ WARNING

Avoid fire or explosion hazard. Electrical, ignition, and fuel system components on Mercury Marine products comply with U.S. Coast Guard rules to minimize risk of fire or explosion. Do not use replacement electrical or fuel system components that do not comply with these rules. When servicing the electrical and fuel systems, properly install and tighten all components.

⚠ WARNING

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

⚠ WARNING

Avoid gasoline fire or explosion. Gasoline is extremely flammable and highly explosive under certain conditions. Be careful when cleaning flame arrestor; ensure that ignition is off. Do not smoke or allow sources of spark or open flame in area when cleaning flame arrestor.

⚠ WARNING

Avoid serious injury or death from a gasoline fire or explosion. When changing fuel system components be sure that the ignition key is "OFF", that the lanyard stop switch is positioned so that the engine cannot start, and that there are no sources of high heat, spark, open flame, or lit smoking materials in use in the area. Wipe up any spilled fuel immediately.

⚠ WARNING

Ensure that no fuel leaks exist before closing the 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.

⚠ 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.

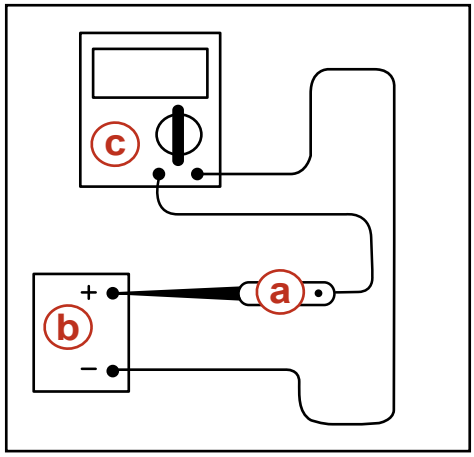
Service Precautions

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. Steam can cause corrosion of the terminals or damage of components.
- 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 MegΩ 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.

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.



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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 (0.3 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 the test actually states no light.*

General Information

Electrostatic Discharge Damage

Electronic components are often designed to carry very low voltage and are susceptible to damage caused by electrostatic discharge. Even less than 100 volts of static electricity can 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.

A person can become statically charged in many ways. 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

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 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.

1. Improperly formed contacts or connector housing.

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

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

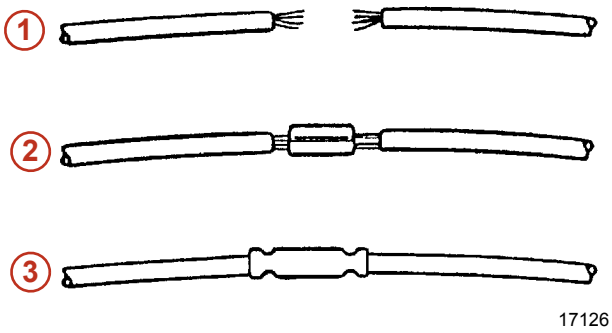
Wire harnesses should be replaced with the appropriate replacement part. For the correct harness, refer to the specified part numbers. When signal wires are spliced into a harness, only use specified wire the same gauge as the existing harness in accordance with ABYC E11.

With the low current and voltage levels found in the system, carefully solder splices and create the best possible connection. Refer to **Wire Repair**.

Use care when probing a connector or replacing connector terminals. Avoid possible shorts 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, or component or circuit failure.

Wire Repair

Locate the damaged wire and repair as shown:



17126

1. Remove insulation as required.
2. Splice two wires together using splice clips and rosin core solder.
3. Cover the splice with a heat-shrink sleeve to insulate.

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. 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 together.

Intermittent Problems

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

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 multimeter 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, such as CDS, can be used to help detect intermittent conditions. The CDS allows manipulation of wiring harnesses or components with the engine not operating, while observing the scan tool readout. The CDS can also be connected 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 CDS 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 readings with those of the typical scan tool data readings may uncover the problem.

Using the CDS tool can save time in diagnosis and prevent the replacement of good parts. To use the tool successfully, the technician must understand the system being diagnosed and the CDS operation and limitations. The technician should read the CDS tool operating manual provided by the manufacturer to become familiar with operation of the tool. Also, an electronic help program is included with the CDS tool.

To check loss of fault memory, disconnect the TP sensor and idle the engine. Attach the CDS tool. The fault TPS1 CKT Lo should be stored and kept in memory when the ignition is turned "OFF." If not, the ECM/PCM is faulty. When this test is completed, clear the fault.

An intermittent problem may be caused by the following:

- Ignition coil shorted to ground and arcing at ignition wires or plugs.
- Poor ECM/PCM 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.

ECM 555 Ignition System

The ECM fires the ignition system by sending a signal to the coil driver on the rear of the engine. The coil driver controls the high-current flow through the primary windings of the smart coil. On the ECM 555 series, one coil driver and one ignition coil are controlled by the ECM. The high-voltage spark from the smart coil is sent to a high-voltage switch (HVS) that distributes the spark to the appropriate cylinder, just like a regular distributor. However, the HVS does not time the spark, it only distributes the spark. A crankshaft position sensor (CPS) is used to tell the ECM crankshaft position and RPM. The ECM doesn't know where the cylinder number 1 is, it only knows the position of a cylinder. The spark plug leads connected to the HVS must be routed to the appropriate spark plug or the wrong cylinder will spark just like in any conventional distributor ignition. However, the ECM can individually control the dwell (charge time) of each ignition event and the ignition timing to provide optimum engine performance. Feedback from the ignition coil helps the ECM (and the coil driver) determine the optimum time to charge the coil for maximum spark energy. Base ignition timing is fixed and cannot be adjusted on this engine, but the HVS must be indexed so that the spark is going to the correct cylinder at the correct time.

ECM 555 controllers do not have cooling fins as found on MEFI controllers previously used on MerCruiser EFI/MPI engines. These fins are not necessary on ECM 555 controlllers as they use a low-amperage coil driver circuit that does not generate as much heat as the MEFI controllers, which have a higher amperage coil driver circuit. The ECM 555 uses its low-current coil driver circuit to control a high-current driver circuit located in a module adjacent to the coil.

NOTE: *A camshaft position sensor (CMP) in the HVS is used on [2005] 350 Mag/ MX6.2L MPI engines (MCM-0W310000, MIE-0W390000 and up).*

Electronic Control Module (ECM) and Sensors

General Description

The Mercury MerCruiser electronic fuel injection system is equipped with a computer that provides the engine 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, but voltage does not flow in circuits. Instead, voltage causes current flow. 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.

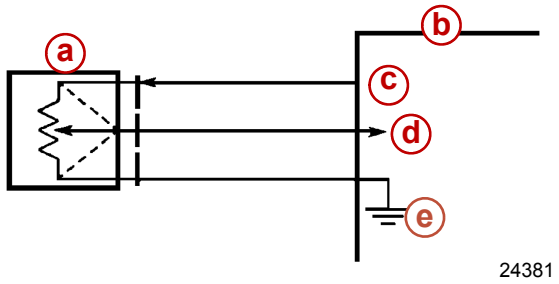
There are two kinds of voltage signals, analog and digital. Both of these are used in computer systems. It's important to understand the difference between them and the different ways they are used.

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.

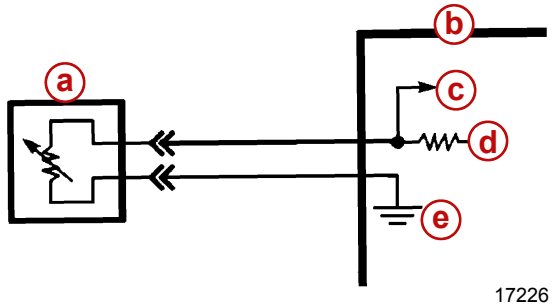


3-Wire Sensor

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.

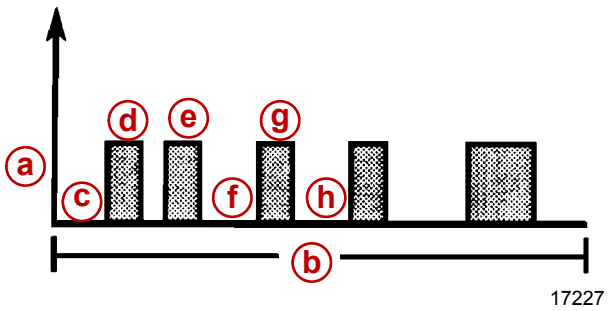


2-Wire Sensor

a - Typical sensor
b - ECM
c - 5 volt
d - Signal sensor
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 are distinct voltages, but 1.27 V or 2.65 V, the values between those distinct voltages are 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 megaohm 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, the system stores a fault description in the ECM/PCM and available power may be reduced. By ensuring that engine output is at a low enough level, the engine is better protected from mechanical failures.

For example, if an open or short is found in any sensor, available power is 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.

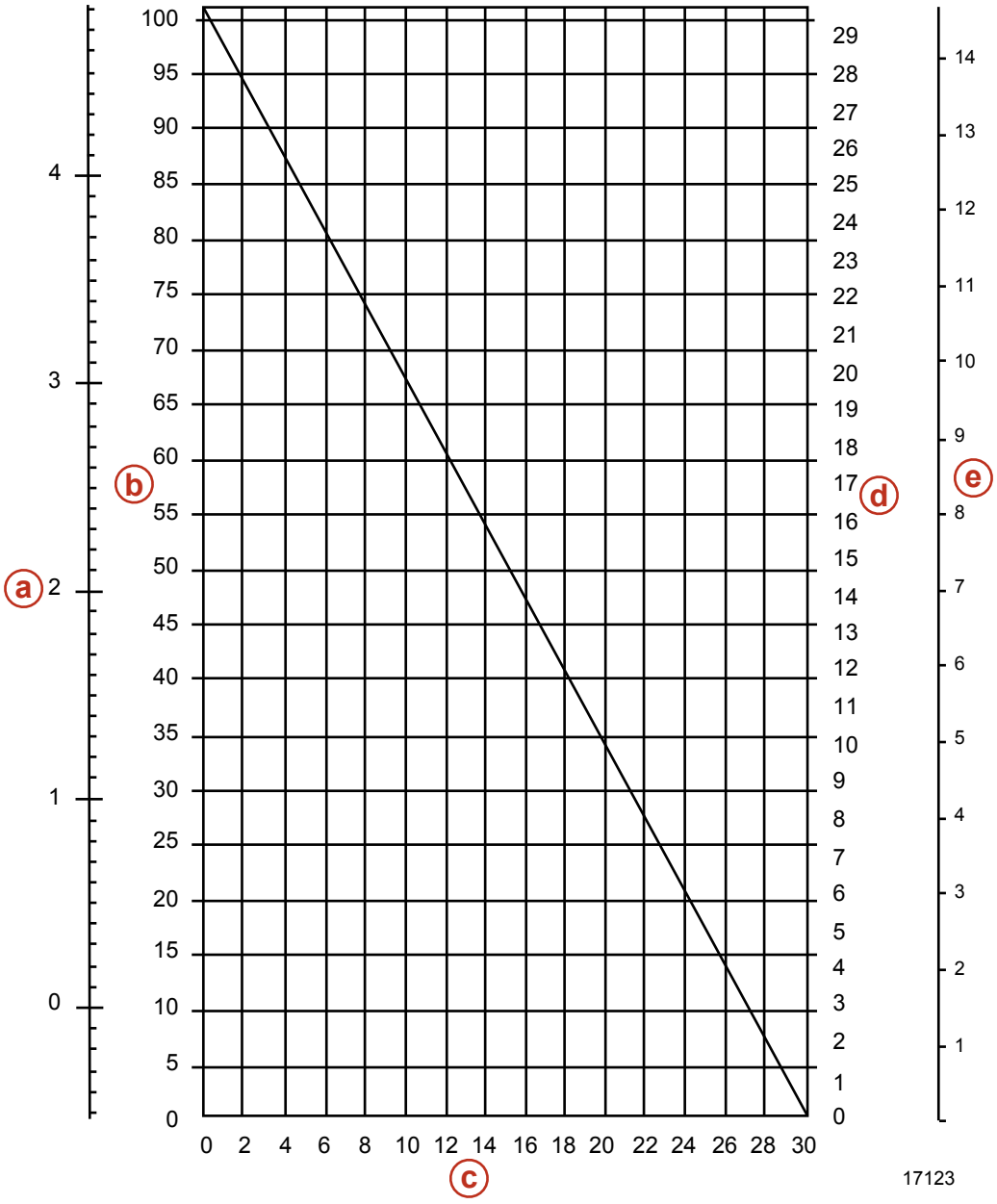
IMPORTANT: Engine Guardian cannot guarantee that engine damage will not occur when adverse operating conditions are encountered. Engine Guardian is designed to warn the operator of an adverse condition and to reduce power by limiting RPM in an attempt to reduce possible engine damage. The boat operator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

General Reference Charts

Manifold Vacuum and 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

a - MAP Sensor (Volt)
b - MAP Sensor (kPa absolute)
c - Hand-Held Vacuum Guage (in.Hg)
d - MAP Sensor (in.Hg absolute)
e - MAP Sensor (psi)

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

Notes:

Troubleshooting

Section 2A - Troubleshooting

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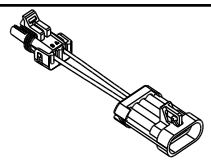
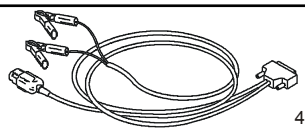
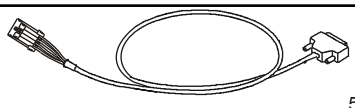
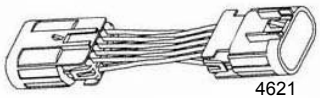
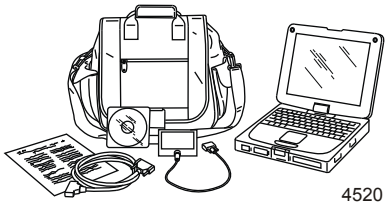
Special Tools

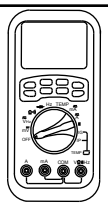
2-Pin to 4-Pin Harness Adapter	84-822560A12
 4679	Adapts the 2-pin Digital Diagnostic Terminal harness to the 4-pin connector on the engine. Use this adapter harness with an 84-822560A05 for MerCruiser product.

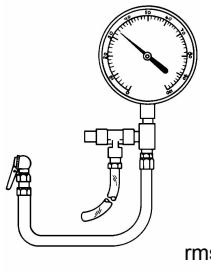
Adapter Harness	84-822560A5
 4009	Data link harness between engine and Computer Diagnostic System (CDS) or Digital Diagnostic Terminal (DDT) on engines with a 2 pin diagnostic connection. Use this adapter harness with an 84-822560A12 for MerCruiser product.

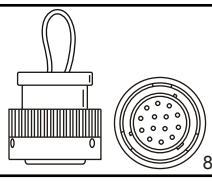
Adapter Harness	84-822560A13
 5826	Data link harness between engine and Computer Diagnostic System (CDS).

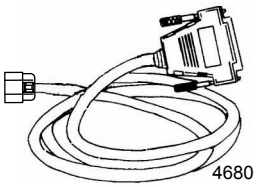
Male to Male 10-Pin Adapter	84-892452A01
 4621	Allows connection between CAN 1 communications cable and Computer Diagnostic System in applications where a junction box is not used.

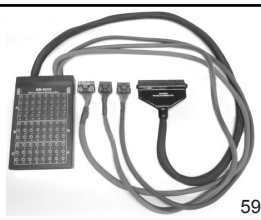
Computer Diagnostic System (CDS)	Order through SPX
 4520	Monitors all electrical systems for proper function, diagnostics, and calibration purposes. For additional information, pricing, or to order the Computer Diagnostic System contact: SPX Corporation 28635 Mound Rd. Warren, MI 48092 or call: USA - 1-800-345-2233 Canada - 800-345-2233 Europe - 49 6182 959 149 Australia - (03) 9544-6222

DMT 2004 Digital Multimeter	91-892647A01
 4516	Measures RPM on spark ignition (SI) engines, ohms, amperes, AC and DC voltages; records maximums and minimums simultaneously, and accurately reads in high RFI environments.

Fuel Pressure Gauge Kit	91-881833A03
 rms32	Tests the fuel pump pressure; can be used to relieve fuel pressure. Replacement seals are available, such as the GM test port large seal (8-4814), the MerCruiser test port small seal (8-4914) and the O-ring seals (8-4614).

12-Volt Connector Tool, PCM/ECM Wake-up	91-889675A01
 8036	Connects to the data harness, allowing operation of the DTS system with the Digital Diagnostic Terminal or CDS.

CAN 1 Diagnostic Cable	84-892663
 4680	Connects into a junction box or male to male adapter cable for Command Module configuration. Not for use with DDT.

Breakout Box	SPX P/N MM-46225
 5974	Connects to the Propulsion Control Module (PCM) to test engine circuits and components without probing wires. May be used with Computer Diagnostic System (CDS).

Terminal Test Probe Kit	SPX P/N MM-46523
 7915	Test probes adapt test meter leads to harness connections without damaging harness terminals. May be used with Computer Diagnostic System (CDS).

ECM 555 Diagnostics

A "Fault" indicates that the ECM/PCM 555 has either sensed that the circuit in question has recorded a sensor value outside of its acceptable window or that a sensor value has gone outside its normal range. For example:

1. A circuit with an open or short would give a fault that is "CKT HI" or "CKT LO." This means that the sensor itself has failed with an open or short circuit, or one of the leads between the sensor and the ECM/PCM is open or shorted. A "CKT HI" fault means that the ECM/PCM is seeing a 5.0 (or nearly 5) volt signal and a "CKT LO" fault means that the ECM/PCM is seeing a 0.0 (or nearly 0) volt signal.

2. A sensor showing a reading outside of its normal range, but not shorted or open, would give a fault identifying an abnormal operating condition, such as "ECT Coolant Overheat", which means the ECT circuit is operating correctly, but the engine is simply overheating.

Abbreviated Procedure

1. The process begins with a customer complaint or when the technician notes an observable symptom.
2. The technician must verify (or duplicate) the complaint (or symptom).
3. The technician should connect a CDS tool and check for faults.
   a. If the fault is a CKT HI or CKT LO, refer to the wiring diagram and check each of the leads between the suspect sensor and the ECM/PCM for open and short circuits. The short circuit does not have to be to ground, it could be to any other wire in the harness. If the leads test good, then the sensor should be replaced.
      i. When troubleshooting active faults (faults displayed under the "Fault Status" screen), the circuit in question is experiencing a failure right now. Look for an open circuit or short circuit in the two or three wires involved with the sensor in question; the sensor itself has actually failed or the connections at the ECM/PCM have failed.
      ii. When troubleshooting intermittent faults (faults displayed under the "Fault History" screens or faults that are NOT active in the "Fault Status" screen), the circuit in question is not experiencing a failure at this time. Look for an intermittent connection or an intermittent short circuit that is not present right now. You must still check circuits for opens and shorts, but you must wiggle wires and connectors during all tests in attempt to locate the poor connection. Carefully look for subtle problems, such as corroded connections and internal wiring harness splices; and for connectors with a loose fit between the male and female pins.
      iii. An excellent way to find an intermittent problem is to use the data monitor function of the CDS tool. While observing the data from the suspect circuit, wiggle the wires and connectors (of the suspect circuit) while the key is on or while the engine is running. When you locate the bad connection or broken or shorted lead, the data reading will fluctuate on the scan tool. Keep in mind that the refresh rate of the scan tool is relatively slow (every 50 milliseconds or so).
      iv. The record (or min/max) function of the DMT 2000 (or equivalent) multimeter can also be used to monitor and record the voltage signals on the suspect circuit. Use the Rinda 94025 Jumper Lead Set (or equivalent) to connect the meter to the suspect sensor's signal lead. Sensor signals must never be 0.0 or 5.0 volts. A multimeter can catch glitches in as little as a micro-second.
   b. If the fault is an abnormal operating condition, repair the system as needed. For example, if the sea pump pressure is low, check the water pickups for obstructions, then replace the water pump impeller (and other parts as needed). Abnormal operating condition faults can be active or intermittent.
   c. Faults rarely indicate a defective ECM/PCM. Assume that the ECM/PCM is working correctly until complete and thorough troubleshooting procedures prove otherwise.
4. If no faults are present, but you still have an observable symptom, then the problem is with a component or system that the ECM/PCM cannot monitor. Carefully perform the **Visual/Physical Check** (in the following section) and check for obvious problems, such as incorrect fuel pressure, engine mechanical problems, exhaust blockage, etc.

a. The problem may be that a sensor is out of calibration or it may be that the problem has nothing to do with the EFI system (clogged fuel supply system, mechanical engine problems, etc.).

b. You can use the CDS tool to fire the ignition coil(s) with or without the spark plugs installed. You can also use the scan tool to drop cylinders (while running) to do power balance tests. On PCM models, each cylinder's injector can be dropped individually. On ECM models, each injector bank (two banks of four injectors each or four banks of two injectors each, depending upon the model) can be dropped individually.

5. After performing **Visual/Physical Check** see **Symptom Charts** for additional information.
6. If there are no faults and no observable symptoms, then troubleshooting is finished.

Visual/Physical Check

1. Verify that the battery is fully charged and is of sufficient capacity for the engine being tested. If necessary, substitute a known good battery.
2. Check the fuses.
3. Check the battery cable connections. Make sure they are clean and tight. If present, discard wing nuts and replace with corrosion resistant hex nuts. A corrosion resistant terminal cable washer nut should be installed between the battery terminal and the cable end (stack up must be battery terminal, washer, cable, nut). Make sure the cable connections are tight at the starter solenoid and that the block fuse on the starter solenoid (if present) is tight and the through bolt is not loose. Also make sure the ground stud is not loose in the engine block and that the nut is tight.
4. If there is any doubt about the mechanical condition of the engine, perform a compression test and a cylinder leak-down test.
5. Make sure the safety lanyard is correctly installed and that the customer understands the correct starting procedure.
6. Check that all grounds are clean and tight. If the negative battery cable is connected to the ground stud that does not contain all of the EFI and engine wiring harness ground leads, consider moving the negative battery cable to that ground stud.

⚠ CAUTION

Rotating propellers can cause serious injury or death. Using a remote key switch harness allows the engine to start in gear, allowing the propeller to rotate. Before performing tests using a remote key switch harness, place the engine in neutral.

7. Unplug and inspect the main harness (10 or 14-pin) connector between the engine and boat harnesses. If there is any doubt about the boat harness, substitute a shop harness and key switch assembly and rerun the boat. If the problem disappears, the problem is in the boat harness, not the MerCruiser engine harness. A suitable non-DTS test harness can be assembled from the following components:

   a. MerCruiser 3-foot instrument harness cable for 10 pin (84-812475A3).

   b. MerCruiser 2-foot instrument harness cable for 14 pin (84-896537K02).

NOTE: *The RED/YELLOW wires for the neutral safety switch on this harness must be tied together to crank the engine and perform this test.*

   c. MerCruiser ignition switch assembly (84-54212A7).

   d. Use suitable machine screws and nuts to join the switch ring terminals to the ring terminals of the harness, then cover the connections with heat shrink tubing.

e. A standard piezo warning horn (such as 816492A6) can also be added to provide audible warning of cooling system overheat, low crankcase oil pressure and low drive oil level (or high transmission temperature).

8. Check for adequate fuel pressure at the fuel rail.
   a. If there is no fuel pressure, check that the fuel pump(s) is (are) actually operating. The pump(s) must run for at least 2 seconds each time the key is turned to the on position. If the fuel pump(s) and the warning horn are not operating as the key is turned on, make sure the ECM/PCM is powering up (check the fuses and the wake-up line).
   b. On ECM/PCM models, fuel pressure varies with engine vacuum. Fuel pressure will be high during cranking, low at idle and increase proportionally as the throttle is opened to the wide-open position. Disconnect the vacuum line (on the cool fuel regulator) to find the regulator's rated pressure, then reconnect the vacuum line to make sure the pressure drops at idle. Pressure specification is 282-310 kPa (41-45 PSI) on all models, except Black Scorpion models which are 193-221 kPa (28-32 PSI). Pressure usually drops about 28-41 kPa (4-6 PSI) at idle (from the regulator's rated specification).
   c. If fuel pressure drops at higher speed and higher engine loads, check the boat's fuel system (the supply system) for restrictions with an accurate vacuum gauge and clear hose at the water separating fuel filter inlet. As the engine is run from idle to wide open throttle and back to idle, the clear hose must not show the presence of any air bubbles and the vacuum gauge must not read higher than 6.7 kPa (2 in. Hg). Refer to **Service Bulletin 99-7** for additional information.
   d. If the supply system tests OK, but the fuel pressure is low at high speeds and loads, replace the water separating fuel filter and retest. If pressure is still low, most likely the fuel pump is defective
   e. All ECM/PCM models use a "dummy" fuel pressure regulator on the fuel rail. This is not used on marine applications (but is a GM supplied part). The vacuum line attached to the "dummy" regulator is a possible vacuum leak and a possible fuel leak (if the "dummy" regulator's diaphragm should fail). Only the Cool Fuel regulator actually controls fuel rail pressure.
9. Check all vacuum lines for splits, kinks and proper connections. The fuel regulator on all ECM/PCM models must be connected to manifold vacuum. The PCV valve is a calibrated air leak, if it is missing or the incorrect valve is installed, engine operation will be effected.
10. Check for any other additional air leaks in the induction system, such as throttle body and intake manifold gaskets. If the normal IAC % for the engine are known, then any air leak will result in a lower IAC % than normal.
11. Unplug and inspect the ECM A and B connectors. Make sure there are no ECM pins bent over and that all of the correct pins are present. Refer to the service manual charts for the pins used and not used. Look for signs of tampering, corrosion, damage to the pin locking mechanisms, melted insulation and any other evidence of shorts or other damage.

12. Unplug and inspect as many of the sensors and actuators as you can reasonably access. Look for signs of tampering, corrosion, damage to the pin locking mechanisms, melted insulation and any other evidence of shorts or other damage. Based on the results of this inspection, further inspection of the harness may be necessary. Remember that there are many internal splices in the harness that may be damaged or defective. If there is damage on the external connections, you will have to inspect several of the internal splices to verify that the damage is not also present at these locations.
13. Check for adequate secondary spark. If an air gap tester is used, make sure it will not ignite any fuel vapors that may be present in the bilge. A KV meter can also be used to check for adequate secondary voltage. Make sure the secondary wires are in good physical shape (correctly routed and that the boots are not split at either end). Remove the distributor cap (ECM models) and check for signs of moisture, corrosion, or carbon tracking.

Clearing Codes

Faults are cleared with a scan tool only, such as CDS. Refer to the appropriate CDS flow chart in the **ECM/PCM Technician Guide** for appropriate menus.

Important Notes

1. When firing the ignition coil(s) under the "Auto Self Test" and "Output Load Test" screens:
   a. You must specify if the spark plugs are installed or not. If the spark plugs are installed, the ECM/PCM will fire the coil(s) at the minimum dwell time to prevent it from actually sparking in the combustion chamber (possibly igniting fuel vapors). If the spark plugs are not installed, the ECM/PCM will fire the coil(s) at the maximum dwell time to allow for visible spark. In either case, the ECM/PCM will monitor the 5 volt trigger circuits to attempt to detect whether the coil has "fired".

NOTE: *If using an air gap tester (instead of a resistor-type spark plug), it may cause RFI that can result in the warning horn chirping or other unusual symptoms to occur. Do not allow open spark to occur if fuel vapors might be present.*

   b. A PCM can individually fire each coil. An ECM only has one coil, so no matter what "cylinder" you attempt to activate, the same coil will fire in each case. However, the spark will attempt to go to wherever the rotor (in the distributor) is pointing. You must test at the coil lead or know where the rotor is pointing and install the test spark plug in that cylinders lead.
2. When performing the "Cylinder Misfire Test", the ECM/PCM will add extra fuel through the fuel injectors at idle and off-idle speeds, but will turn off the fuel injector(s) at higher speeds. The test is best performed under high-load/high-speed conditions. A PCM can individually control each fuel injector. An ECM engine fires the fuel injectors in banks. Older GM Small Block V-8 engines that are 2004 and older have 2 injector drivers that fire injectors in banks of 4. Bank #1 is 1,3 & 5 on a V6 and 1,4,6 & 7 on a V8. Bank #2 is 2, 4 & 6 on a V6 and 2,3,5 & 8 on a V8. 2005 and newer GM Small Block V8 engines with an ECM 555 processor (serial number 0W310000 and above on sterndrive models; serial number 0W390000 and above on inboard models) will have 4 injector selections available on the Active Test screen in the Toolbox. These newer engines have 4 injector drivers to fire the injectors in pairs.
3. When firing the fuel injectors under the "Auto Self Test" and "Output Load Test" screens, the same rules apply as above. PCM fires individual injectors, ECM fires banks.

IMPORTANT: On ECM 555 engines, when the crankshaft is exactly at #1 TDC compression, the HVS distributor rotor must exactly align with the #6 (V6 engines) or #8 (V8 engines) cast into the distributor housing. If not, the spark will jump to the wrong "tower" in the distributor cap.

4. Timing is not adjustable on any ECM/PCM engine. The HVS distributor on ECM engines only decides "where" the spark goes, not "when" it goes. Rotating the HVS distributor from its properly "indexed" position will cause the spark to jump to the wrong tower in the HVS distributor cap.

DTS Faults

Faults relating to the ERC (electronic remote control) are displayed on the System View (SC5000) or CDS. There are 3 potentiometers in an ERC, 1 for shift control and 2 for throttle control, as well as switches for trim control, system view cursor control and other features.

Faults relating to the ETC (electronic throttle control) and the ESC (electronic shift control) are displayed on the DDT, the System View and CDS.

Two TPS sensors are integrated into the ETC. The ETC is replaced as an assembly and is not serviceable. There are 6 wires on an ETC. Sensor Power, Sensor Ground, TP1 signal, TP2 signal and 2 wires to run the servo motor.

The ESC contains one integrated sensor (like a TPS). The ESC is replaced as an assembly and is not serviceable. There are 5 wires on an ESC. Sensor Power, Sensor Ground, Sensor Signal and 2 wires to run the servo motor. A separate 2-wire Neutral Switch is used to cross-check the integrated sensor. The switch is located on the shift bracket (Bravo models) and is the Transmission Neutral Safety switch on Inboard models.

DTS engines use a different PCM 555 controller with a Motorola Base Part Number of 859611.

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 or PCM. Loose connections or mechanical wear are likely at fault.

- Verify that the engine is in good mechanical condition.
- Verify that the PCM grounds and sensor connections are clean, tight, and in their proper locations.
- Check vacuum hoses for splits, kinks, and improper connections. Check thoroughly for any type of leak or restriction.
- Check for air leaks at the throttle body mounting area and intake manifold sealing surfaces.
- Check ignition wires for cracking, hardness, and improper routing.
- Inspect wiring for improper 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 the throttle cable is adjusted properly for the TPS at 0%.

Troubleshooting With a Diagnostic Tool—CDS

The Mercury MerCruiser CDS tool has been developed specifically to help technicians diagnose and repair Mercury MerCruiser engines.

This diagnostic tool enables the technician to monitor sensors and ECM/PCM 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 and 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 tool also has 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.

2-Pin to 4-Pin Harness Adapter	84-822560A12

Adapter Harness	84-822560A5

Adapter Harness	84-822560A13

Male to Male 10-Pin Adapter	84-892452A01

CDS Connection to the Engine

Computer Diagnostic System (CDS)	Order through SPX

For complete information about selecting the appropriate engine interface cables, connecting CDS to the engine, and system program operation, refer to the CDS software help system provided with the CDS program. CDS Help is a quick-access reference tool that provides comprehensive information on all of the various topics related to the Mercury Marine Computer Diagnostic System including proper CDS connection to the engine.

CDS Power Up

1. Ensure that the ignition key switch is in the "RUN" position.

NOTE: *If a red Mercury SmartComms icon is flashing in the lower left corner of the screen, the CDS software cannot communicate with the SmartComm interface box. If a yellow Mercury SmartComms icon is flashing in the lower left corner of the screen, the SmartComms interface box is detected, but the CDS software cannot communicate with the ECM/PCM. Check the connections, ensure that the ignition key is turned on, and verify that the correct engine has been selected (identified in the title bar at the top of the screen).*

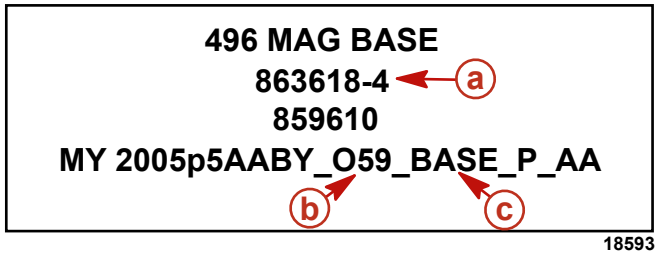
2. Click the Engine Select button to enter engine information. Choose the make, model, and serial number range.
3. Enter an engine serial number. When a valid engine serial number is entered, a green check mark will appear.
4. Click the green check mark to accept the engine information.

ECM Troubleshooting Worksheet

ECM Calibration Label

An ECM can be readily identified by the two wire harness connectors A and B.

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. Alpha ECMs must only be used on Alpha models, Bravo ECMs must only be used on Bravo models, and Inboard ECMs must only be used on inboard models. The second line specifies the simple calibration number and version. In this case it is calibration 863618, version 4. The bottom line lists the model year of the ECM, in this case 2005, followed by detailed identification numbers of the exact calibration. Ensure that you have this information before calling customer service.



Typical ECM Calibration Label

a - Calibration part number

b - Software identification

c - Base engine designation.

Data Collection

Use the following chart to help troubleshoot problems with the engine. With this information, Mercury MerCruiser customer service personnel will be better able to identify the potential problem.

PCM 555 and ECM 555 CDS Worksheet

The CDS creates an electronic file that can be downloaded to a customer service representative if additional help is needed in determining the cause of a problem. A typical printout contains the following types of data:

Mercury Marine Computer Diagnostic System

Vehicle:	MERCRUISER 496 MAG DTS ([Base Model] Digital Throttle/Shift) 0M672221 AND UP PCM03
Serial Number: 0M999999	
XYZ MARINE 123	
SILVER LAKE ROAD	
ANYTOWN	
WI	
Phone:	555-555-1212
Fax:	

Data List

Friday, October 22, 2006	11:31 AM	
Description	**Value**	**Units**
Engine Speed	0	RPM
Battery	12.14	Volts
Power 1	4.99	Volts
Power 2	4.99	Volts
Manifold Pressure	29.21.	In. Hg
Block/Sea Pump Pressure	0.00	kPa
Baro Pressure	29.22	In. Hg
TPS 1	0.830	Volts
TPS 2	0.864	Volts
Throttle Position	8.75	%
Spark Advance	6	BTDC
Available Power	6	%
Guardian due to:	None	
Demand	0.00	%
Load	48	%
Knock 1	0.000	kHz
Knock 2	0.000	kHz
Actual Gear Position	Fwd	
Engine Coolant Temperature	77	F
Starboard EMCT	70	F
Port EMCT	72	F
Manifold Air Temp	79	F
Total FPC	2.09	oz
Oil Pressure	3.9	kPa
Lake/Sea Temperature	73	F
Paddle Wheel	0	Hz
Pitot	25	Counts
Fuel Level	1022	Counts
Trim Position	0.0	%

Symptom Charts

The following symptom charts provide the mechanic a quick method of finding the possible cause of a problem.

DMT 2004 Digital Multimeter	91-892647A01

Chart A-1 Engine Cranks Over but Will Not Start

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. Turn ignition to "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 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	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. Retest system.	Go to the OBD Chart.

Chart A-2 Main Power Relay Test

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Go to the OBD Chart.
3.	Turn ignition to "ON." Listen for the Main Power Relay (MPR). Turn ignition to "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. Turn ignition to "ON." Using the DMT connected to ground, check for B+ MPR harness connector terminal 30 and 86. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 5.	Locate and repair the open or short in the harness. Retest 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. Retest system.	Locate and repair the open or short in the harness. Retest system.

Chart A-3 Fuel System Electrical Test

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

Chart A-4 Fuel System Diagnosis

Before starting fuel system diagnosis, verify that fuel is in the tank.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. Turn ignition to "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 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	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.
5.	With the engine idling, connect an external vacuum source to the fuel pressure regulator and apply 34 kPa (10 in.)Hg of vacuum. **Did fuel pressure decrease by approximately 34.5 kPa (5 PSI)?**	Problem is intermittent or the fuel supply to the engine is low or restricted.	Replace faulty fuel pressure regulator. Retest 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 kPa (0 PSI)?**	Go to step 8.	Retest system
8.	Turn ignition to "OFF." Block fuel pressure line between the fuel pump and the fuel rail. Turn ignition to "ON." **Does fuel pressure remain steady?**	Locate and repair leaking fuel injectors or fuel line connections.	Go to step 9.
9.	Turn ignition to "OFF." Block fuel return line using the fuel shut off valve tool. Turn ignition to "ON." **Does fuel pressure remain steady?**	Replace faulty fuel pressure regulator. Retest system.	Install a known good fuel pump. Retest system.

Chart A-5 Ignition System Test

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.

Step	Action	Yes	No
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 PCM. Try to start the engine. Turn ignition to "OFF." **Was there any tachometer signal on the analog tachometer while cranking the engine?**	Go to step 4.	Confirm tachlink configured correctly. 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. Retest 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.	Turn ignition to "ON." Using the DMT, check for B+ at the coil connector A on 5.0L. 5.7L, and 6.2L, or on connector H on the 8.1L/496 cid. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 8.	Locate and repair the open in the harness. Retest system.
8.	Check for continuity between the coil harness connectors B and C, and the coil driver harness connector D on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 9.	Locate and repair the open in the harness. Retest system.
9.	Turn ignition to "ON." Using DMT, check for B+ at coil driver harness connector A on 5.0L. 5.7L, and 6.2L engines. Turn ignition to "OFF." **With the ignition ON, was B+ present?**	Go to step 10.	Locate and repair the open in the harness. Retest system.
10.	Check continuity between the coil driver harness connector C and the engine ground on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 11.	Locate and repair the open in the harness. Retest system.
11.	Check continuity between the coil driver harness connector B and the ECM connector B-23 on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Replace the coil and coil driver. Retest system.	Locate and repair the open in the harness. Retest system.

Step	Action	Yes	No
12.	Disconnect the harness from the Crankshaft position sensor (CPS). Turn ignition to "ON." Using a DMT connected to ground, check for 5-volt power at harness connector A. Turn ignition to "OFF." **With the ignition ON, was 5-volt power present?**	Go to step 13.	Locate and repair the open in the harness. Retest 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. Retest system.
14.	Check continuity between CPS harness connector C and ECM harness connector B-10 on 5.0L. 5.7L, and 6.2L engines. **Was continuity present?**	Go to step 15.	Locate and repair the open in the harness. Retest system.

Chart A-6 Hard Start Symptom

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

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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 improper 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. Turn ignition to "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 kPa (0 PSI). Turn ignition to "OFF." **Was the fuel pressure within specification when the pump was operating?**	Go to step 6.	Go to Chart A-3.
6.	**Is a scan tool being used?**	Go to step 8.	Go to step 7.

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. See 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. Retest 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° C (10° F) of each other?**	Go to step 9.	Replace the ECT sensor. Retest system.
9.	Using the scan tool, display ECT sensor temperature and record value. Check the resistance of the ECT sensor. See 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. Retest the system.	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.	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. Retest system.	Go to step 12.
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, refer 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 and 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 and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.

Step	Action	Yes	No
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 improper 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. See 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 fouled with gas or oil, 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. Retest system	Go to step 7.
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. Retest system.	Go to step 8.
8.	Check the vacuum hoses for splits, kinks, and improper connections. **Was a problem found?**	Repair or replace the vacuum hoses.	Go to step 9.
9.	Check the fuel injectors wiring harness for improper connections and intermittent opens or shorts. **Was a problem found?**	Repair or replace the fuel injector harness. Retest 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. Retest system.	Go to step 11.
11.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 12.	Review charging system. Refer to the 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 and 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 partially.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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 improper 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. See 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 fouled with gas or oil, 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. Retest system	Go to step 10.
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. Retest system.	Go to Step 12.
12.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 13.	Review charging system. Refer to the 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, refer to the 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.

Step	Action	Yes	No
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-9 Detonation or 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 and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. Retest 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. Retest 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 improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 9.
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. Retest system.	Go to step 11.
11.	**Is a scan tool being used?**	Go to step 13.	Go to step 12.

Step	Action	Yes	No
12.	Check for an ECT sensor shifted in value. With the engine completely cool, measure the resistance of the ECT sensor. See 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. Retest 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° C (10° F) of each other?**	Go to step 14.	Replace the ECT sensor. Retest system.
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, refer to the appropriate Mercury MerCruiser service manual.	Go to step 15.
15.	Check for loose fasteners, sensors, and connections.	Tighten and secure.	Go to step 16
16.	Using an engine cleaner, remove excessive carbon buildup from the combustion chambers. Refer to instructions on the engine cleaner. Retest system. **Is detonation still present?**	Go to step 17.	--
17.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and 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 severe when first starting out. May cause engine to stall in severe cases.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. Retest 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. Retest system.	Go to step 5.

Step	Action	Yes	No
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. Retest 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 improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 8.
8.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 9.
9.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, determine the cause of the fouling before replacing the spark plugs. **Was a problem found?**	Replace the spark plugs.	Go to step 10.
10.	Check alternator voltage output. **Is voltage 13.9–14.7 volts?**	Go to step 11.	Review charging system. Refer to the 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. Retest system.	Go to step 12.
12.	Check for the following: ☐ Low compression ☐ Deposits on the intake valves **Was a problem found?**	Engine mechanical problem, refer to the 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 and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

Chart A-11 Engine 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 miss.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and Physical Checklist.
2.	**Was the On-Board Diagnostic (OBD) System Check performed?**	Go to step 3.	Complete the OBD.

Step	Action	Yes	No
3.	Verify that the high-voltage switch (distributor) is aligned properly. Refer to the appropriate Mercury MerCruiser service manual for instructions. **Was a problem found?**	Align properly. Retest system.	Go to step 4.
4.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for fuel quality and improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 6.
6.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the 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 fouled with gas or oil, 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 ☐ 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, refer 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. Retest 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, indicates EMI is present. **Was a problem found?**	Locate and correct the EMI source. Retest 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 and 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 and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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 improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 5.
5.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the 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. Retest system.	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 fouled with gas or oil, determine the cause of the fouling 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, refer to the 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 and 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 and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. Retest system	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 improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 9.
9.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the 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 improper 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, refer 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.

Step	Action	Yes	No
15.	Review all of the procedures in this table. If all procedures have been completed and no problem found, inspect the following: ☐ Visual and 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 the ignition switch and adjustment.

Step	Action	Yes	No
1.	**Was the Visual and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 4.
4.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the 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. Retest system.	Go to step 6.
6.	Check the fuel pump relay for proper operation. See Chart A-3. **Was a problem found?**	Repair or replace. Retest 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 and 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 and Physical Checklist completed?**	Go to step 2.	Go to the Visual and 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.

Step	Action	Yes	No
4.	Check for contaminated fuel. Check fuel filters and the water-separating fuel filter. Check for poor fuel quality and improper 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. See Chart A-4. **Was a problem found?**	Go to Chart A-3.	Go to step 4
6.	Check fuel injectors. See the Injector Balance Test. **Was a problem found?**	Repair or replace the faulty injector.	Go to step 5.
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. Retest system	Go to step 8.
8.	Check ignition coil for cracks or carbon tracking. **Was a problem found?**	Repair or replace the ignition coil. Retest 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.
10.	Remove spark plugs. Check spark plugs for moisture, cracks, wear, improper gap, burned electrodes, or heavy deposits. If the spark plugs are fouled with gas or oil, 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. Retest 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. Retest 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, refer to the 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 and Physical Checklist ☐ Scan tool data ☐ All of the electrical connections within a suspect circuit or system.	--	--

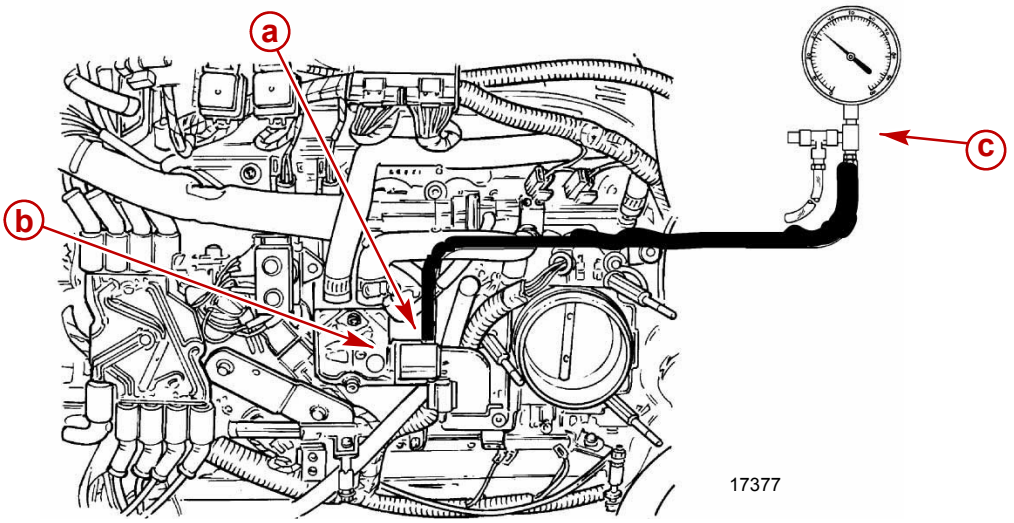
Fuel Pressure Gauge Setup for ECM Engines

⚠ 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 and then depressurize the fuel system properly before attaching or removing a fuel pressure gauge.

⚠ WARNING

Avoid fire or explosion. Gasoline is extremely flammable and highly explosive. Ensure key switch is "OFF." Do not smoke or allow a spark or open flame in area when removing or installing fuel components. Wipe up any spilled fuel immediately.



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

Installation

IMPORTANT: Wipe up spilled fuel immediately.

1. Remove Schrader valve cap.
2. Activate the Schrader valve located on the fuel rail to relieve pressure. Catch fuel in a suitable container.
3. Using a proper adapter, attach the fuel pressure gauge to the Schrader valve.

Fuel Pressure Gauge Kit	91-881833A03

Description	Part Number
Fuel Line Adapter Fitting Set Adapts the fuel pressure gauge to the various fuel lines and fittings.	91-803135 (Snap-On part number MT337-300)

4. Turn key to the "ON" position to purge all of the air from the fuel pressure gauge line.

NOTE: *Turn the key on and off several times to purge the air from the line. Be careful to catch the fuel each time.*

Test

1. Disconnect the reference (vacuum) line.

2. Turn key to the "ON" position.
3. Observe reading on gauge. Reading should be within specification.

Fuel pressure with reference (vacuum) line removed	Reading on Fuel Pressure Gauge
All models, except Black Scorpion	282-310 kPa (41-45 PSI)
Black Scorpion models	198-221 kPa (28-32 PSI)

4. Correct the problem if not within specification.
5. Connect the reference (vacuum) line.

Removal

IMPORTANT: Follow the recommendations of 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.

Injector Balance Test

Test Procedure

NOTE: *The CDS tool can be used to perform this test. Refer to the CDS tool for additional information on the procedure and any required harness or adapters.*

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 from various manufacturers. A pulse width that drops the fuel rail pressure to half the normal operating pressure should be used.

SET-UP

1. Allow the engine to cool for 10 minutes to avoid irregular readings as a result of fuel boiling due to heat soak.
2. Relieve the fuel pressure in the fuel rail.
3. With the ignition off, connect the fuel pressure gauge to the fuel pressure tap.
4. Disconnect the harness connectors at all injectors.
5. Connect the injector tester to one injector.
6. Use the adapter harness furnished with the injector tester to energize the injectors. Follow the instructions provided by the manufacturer for use of the adapter harness.
7. To complete the ECM shutdown cycle, ensure that the ignition remained in the off position for at least 10 seconds.
8. Turn the ignition on and allow the fuel pump to run for about 2 seconds.
9. Insert clear tubing attached to a vent valve into a suitable container and purge air from the gauge and hose to ensure accurate gauge operation.
10. Repeat step 9 until all the air is purged from the gauge.

TESTING

NOTE: *To prevent flooding, do not repeat the entire test more than once without running the engine. This includes any retest on faulty injectors.*

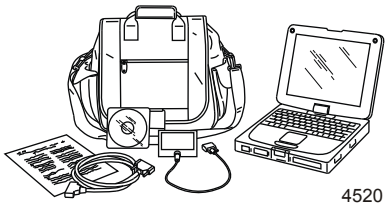
1. Turn the ignition off for 10 seconds and then on and off again several times to get maximum fuel pressure.
2. Record the maximum fuel pressure reading.

3. Energize tester one time and note the pressure drop at its lowest point. Disregard any slight pressure increase after the drop hits its 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.

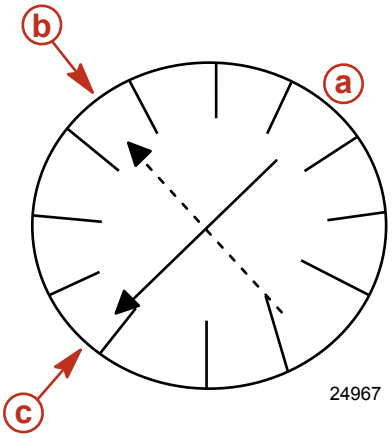
NOTE: *If the pressure drop of all injectors is within 10 kPa (1.5 psi) of the average, the injectors have proper flow.*

6. Retest any injector that has a pressure difference of 10 kPa (1.5 psi) 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 10 kPa (1.5 psi) more or less than the average fuel pressure drop of the other injectors on the engine.

TEST EXAMPLE



CDS System



Fuel Pressure Gauge

a - Fuel pressure gauge
b - Second reading of the pressure after drop
c - First reading of initial pressure

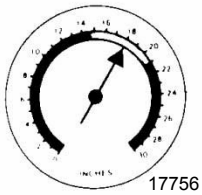
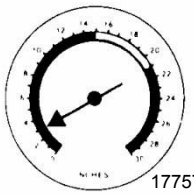
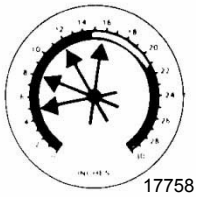
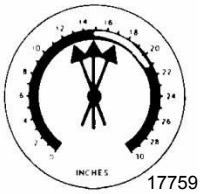
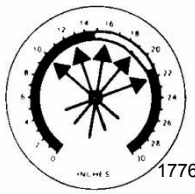
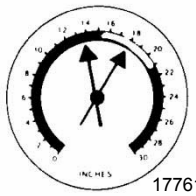
Example								
Cylinder	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1st. Reading	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)	38 psi (262 kPa)
2nd Reading	19 psi (131 kPa)	17 psi (117 kPa)	21 psi (145 kPa)	19 psi (131 kPa)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

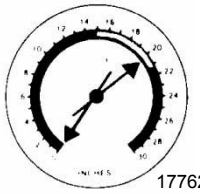
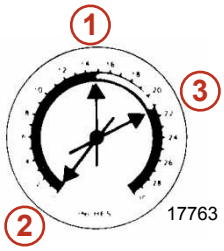
Troubleshooting With a Vacuum Gauge

Most engines have a normal gauge reading of 51–71 kPa (15–21 in. Hg) vacuum. Before using the vacuum gauge the engine must be at normal operating temperature. Use a tachometer to be certain that the engine is running at the specified RPM. The vacuum gauge must be connected to the intake manifold at a manifold vacuum source.

The following table indicates possible malfunctions of various vacuum readings.

Vacuum Gauge Troubleshooting Guide

Gauge Reading	Symptom	Cause	Action
 17756	**Steady reading 51-71 kPa (15–21 in. Hg) at idle RPM**	Normal	No action necessary.
 17757	**Extremely low reading, but indicator steady at idle RPM**	Vacuum leak at intake manifold or carburetor, incorrect timing, or underpowered boat.	Determine the source of the vacuum leak and repair. Replace the propeller. If the problem persists, contact the manufacturer about the correct power package.
 17758	**Indicator fluctuates between high and low at idle RPM**	Blown cylinder head gasket between two adjacent cylinders. (Check with compression test.)	Determine the cause and replace the cylinder head gasket.
 17759	**Indicator fluctuates 13.5–17 kPa (4–5 in. Hg) very slowly at idle RPM**	Valves are sticking or spark plug gap is too narrow.	Adjust carburetor. Inspect the spark plugs and service or replace if necessary. Correct sticking valve.
 17760	**Indicator fluctuates rapidly at idle, steadies as RPM is increased**	Valve guides may be worn.	Ream the valve guides and install a valve with an oversized stem or replace the cylinder head.
 17761	**Continuously fluctuates between low and normal reading at regular intervals at idle RPM**	Burned or leaking valve.	Replace the valve.

Gauge Reading	Symptom	Cause	Action
 17762	**Indicator drops to zero as engine RPM is increased**	Exhaust system is restricted.	Clear exhaust system.
 17763	**Indicator holds steady at 41–54 kPa (12–16 in. Hg) (1) Drops back to zero (2) and back to about 71 kPa (21 in. Hg) (3) as the throttle is engaged and released**	Possible piston ring leak (Check the compression)	Repair or replace as needed.

Engine Fault Quick Reference Chart

This chart correlates with the fault list of the diagnostic tool. After displaying the faults stored in an 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.

MerCruiser ECM/PCM Fault List

NOTE: *All of the following faults are determined by the calibration of the ECM/PCM. Not all faults are used on each engine. This information is accurate as of the date of printing. Fault information is subject to change at any time.*

Use the diagnostic tools to collect fault messages, and use the following chart to interpret the faults and their possible causes.

12-Volt Connector Tool, PCM/ECM Wake-up	91-889675A01
2- to 4-Pin Harness Adapter	84-822560A12
Adapter Harness	84-822560A13
Male-to-Male 10-Pin Adapter	84-892452A01
CAN 1 Diagnostic Cable	84-892663
Computer Diagnostic System (CDS)	Order through SPX
Breakout Box	SPX P/N MM-46225
Terminal Test Probe Kit	SPX P/N MM-46523

ECM/PCM Fault List Information

NOTE: *All of the following are determined by the calibration of the ECM/PCM. Upgrading the calibration can result in changes to these settings.*

FAULT CONDITIONS

Most faults can be detected with the engine running, or with the key on and engine off. However, some faults require the presence of engine RPM, and cannot be detected with the key on but the engine off. Examples of this type of fault are EST (cylinders 1 through 8) shorted circuit and all injector faults (fuel and direct).

Some faults are only detected with the key on and engine off. Examples of the type of fault are EST (cylinders 1 through 8) open circuit.

In addition, some faults are programmed to ignore certain engine speeds. For example, the low block pressure sensor fault (sea pump pressure on a MerCruiser sterndrive) is typically not enabled until enough load has been achieved to develop a reasonable amount of water pressure. Therefore, this fault will not be set at idle.

Faults also take a certain time to set. The time it takes to set a fault varies greatly and can also vary with engine RPM. Faults generally set faster at higher engine speed.

STICKY AND NON-STICKY FAULTS

All faults are classified as either sticky or non-sticky. Sticky means that the fault, once set, will continue to show up as active, even if the circuit or problem has corrected itself. A key switch cycle is required to reset a sticky fault.

A non-sticky fault is a fault that will change its status from active to inactive without requiring a key switch cycle.

The CDS diagnostic tool will continue to display a sticky fault as active even though the cause of the fault has been corrected. Cycle the key to reset all faults if there is difficulty correcting a fault.

DEFAULT SENSOR VALUES

Default sensor values are preprogrammed amounts used by the PCM to calculate fuel and ignition values, when the sensor in question has exceeded its preprogrammed diagnostic limits. Default sensor values typically are used when the sensor has a circuit high or circuit low fault.

Most temperature sensors default to 0 °C (32 °F). This can be verified by unplugging the sensor in question and watching the data stream value with the CDS.

Most pressure sensors default to a preprogrammed number also. MAP sensors usually default to 70 kPa (20.7 in. Hg). This can be verified by unplugging the sensor in question and watching the data stream value. Other pressure sensors will have their own default values which may be determined as described previously.

MerCruiser ECM/PCM Fault List Table Columns

FAULT

The "Fault #" is a number given to the fault for quick reference only.

CDS FAULT MESSAGE

This is how the fault would appear on the CDS screen.

DDT FAULT STATUS MESSAGE

This is how the fault would appear on the DDT screen.

ICON/HORN/GUARDIAN COLUMN

NOTE: *Each box contains three pieces of information, each of which corresponds to the reference number in front of it. For example, all items preceded by "♠-" give the system view icon, all items preceded by "♥-" give the warning horn condition, and all information preceded by "♦- " gives the percentage of power available from the engine guardian.*

♠- SYSTEM VIEW ICON

Depending on the gauge package, warning icons and fault messages appear on the dash mounted gauges. Generally, an alarm is displayed on the gauge as a bell icon. This icon indicates that a fault has occurred.

♥- WARNING HORN SIGNALS

Most faults will cause the warning horn circuit to activate. How the warning horn activates depends on how serious the problem is. There are five warning horn states:

- None. The horn is silent
- Caution. The horn signal varies with product line and calibration. Minimal guardian.
- Warning. The horn signal varies with product line and calibration.
- Severe. The horn beeps constantly.
- Critical. The horn beeps constantly and guardian will be at forced idle.

♦- ENGINE GUARDIAN

Almost every fault will cause the Guardian program (within the PCM) to become active. The amount of Guardian protection is expressed as a percentage. The higher the percentage, the more power the engine is allowed to produce. If available power (on the CDS or DDT) is 100%, then Guardian is not currently active and the engine is capable of producing full power. On a DTS engine, Guardian closes the ETC to reduce engine power. Non-DTS engines reduce engine power by changing injector and ignition operation.

Guardian is always accompanied by another fault or faults that actually caused the Guardian to become active. The more severe the fault, the more the Guardian reduces available power. A small problem, such as a non-critical sensor going circuit high or circuit low, will result in available power of 90% depending on product line. A severe problem such as low oil pressure or a DTS shift or throttle actuator failing will result in forced idle which is usually displayed as 5–6% available power. Several minor faults occurring at the same time will cause the PCM to treat the faults as a more severe situation.

FAULT EXPLANATION

Fault Explanation gives the most probable reasons for the fault occurring.

POSSIBLE ROOT CAUSE

The possible root cause is the most likely area or part that would cause the fault. Time can be saved by checking these areas first to find the source of the problem.

MerCruiser ECM/PCM Fault List Table

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
1	Battery Voltage High	BAT VOLTS HI	♠-Bell ♥- Critical ♦- Varies	Battery voltage above allowable threshold. The further threshold is exceeded, the more Guardian reduces power.	Alternator. Alternator sense wire.
2	Battery Voltage Low	BAT VOLTS LO	♠-Bell ♥- Critical ♦- Varies	Battery voltage below allowable threshold. Poor connections. The further threshold is exceeded, the more Guardian reduces power.	Alternator. Belt slipping. Defective battery (shorted cells). Too much electrical load. Clean power fuse and battery connections.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
3	Sea Pump Pressure is Low	BLK PSI LO	♠-Bell ♥- Critical ♦-Varies	Water pressure in engine block low. Guardian is active. Variable power limit depends on block pressure, port and starboard coolant temperature, and RPM.	Blockage at gearcase inlets. Failed water pump. Failed water tube. Leak between block and sensor. Sensor bad but not open or short.
5	ETC Loss of Control	ETC CONTROL	♠-Bell ♥-Critical ♦-5%	Feedback from ETC indicates actual throttle blade position does not match ERC position.	Faulty ETC; check TPS voltage readings with CDS. Check connection to ETC. Faulty ERC.
6	ETC Sticking	ETC STICKING	♠-Bell ♥-Critical ♦-5%	Throttle blade not responding to ETC. Blade is stuck or obstructed.	ETC failed. Obstruction in throttle bore. Wiring problem.
9	Guardian Strategy	GUARDIAN	♠-Bell ♥-Critical ♦-Varies	Guardian is trying to protect engine by reducing power.	Check for other faults. The Guardian is a result of other faults. Failed sensor.
10	Knock Sensor 1	KNK SNSR1	♠-Bell ♥-Warning ♦-90%	The knock sensor is expected to sense a minimum amount of vibration. Too little of a signal will cause this fault. Too much and the knock control becomes active.	Failed sensor. Bad wiring. Poor mounting.
11	Knock Sensor 2	KNK SNSR2	♠-Bell ♥-Warning ♦-90%	The knock sensor is expected to sense a minimum amount of vibration. Too little of a signal will cause this fault. Too much and the knock control becomes active.	Failed sensor. Bad wiring. Poor mounting.
12	Oil Pressure Low	LOW OIL PSI STR	♠-Bell ♥-Critical ♦-Varies	Oil pressure low. Guardian is active. Variable power limit depends on RPM.	Low oil level. Blockage in oil system. Sensor is bad but not open or short. Sensor is open or short.
15	MAP Sensor Circuit High	MAP INPUT HI	♠-None ♥-Warning ♦-90%	MAP circuit shorted. Airflow calculation is no longer valid. Power limit is active. Fueling level is a straight lookup based on demand (or TPI) and RPM.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
16	MAP Sensor Circuit Low	MAP INPUT LO	♠-None ♥-Warning ♦-90%	MAP circuit open. Airflow calculation is no longer valid. Power limit is active. Fueling level is a straight lookup based on demand (or TPI) and RPM.	Wiring problem. Sensor problem.
17	MAP Sensor Idle Fault	MAP IDLE ERR	♠-None ♥-None ♦-100%	The engine is expected to pull some vacuum on the inlet at idle. If there is no difference in PSI drop from key on to running, the MAP sensor may be bad or airflow disrupted in the intake system.	MAP sensor failed. Throttle bore missing or oversized.
19	Overspeed	OVERSPEED	♠-Bell ♥-Critical ♦-100%	Recommended RPM range exceeded. First, horn sounds. Second, cylinders stop firing. Third, more cylinders stop firing. Typically next fault is Overspeed1 which causes power limit.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.
21	ECT Overheat	ECT OVRHT	♠-Bell ♥-Critical ♦-Varies	1. Water temperature in head high. Guardian is active. Variable power limit depends on block pressure, port and starboard coolant temperature, and RPM. 2. Engine coolant sensor exceeds a specified threshold.	Blockage at water inlets. Failed or weak sea pump. Blockage in engine. Sensor out of specification.
22	Warning Horn Output	HORN OUTPUT	♠-Bell ♥-Off ♦-100%	Warning horn in boat not operating. No audible alarm will be heard in event of engine malfunction.	Horn failed or missing. Horn not connected. Horn circuit open.
36	Sea Pump Pressure Circuit High	BLK PSI CKT HI	♠-Bell ♥-Warning ♦-90%	Block pressure sensor circuit shorted.	Wiring problem. Sensor problem.
37	Sea Pump Pressure Circuit Low	BLK PSI CKT LO	♠-Bell ♥-Warning ♦-90%	Block pressure sensor circuit is open.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
39	Manifold Air Temp Circuit High	MAT CKT HI	♠-Bell ♥-Warning ♦-90%	Air temperature sensor circuit open. Airflow calculation is using the default temperature.	Wiring problem. Sensor problem.
40	Manifold Air Temp Circuit Low	MAT CKT LO	♠-Bell ♥-Warning ♦-90%	Air temperature sensor circuit shorted. Airflow calculation is using the default temperature.	Wiring problem. Sensor problem.
43	EST 1 Open Circuit	EST1 OPEN	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only with the key on and engine off.	Wiring problem. Coil problem.
44	EST 1 Shorted Circuit	EST1 SHORT	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only with engine running	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
45	EST 2 Open Circuit	EST2 OPEN	♠-Bell ♥-Warning ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
46	EST 2 Shorted Circuit	EST2 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
47	EST 3 Open Circuit	EST3 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
48	EST 3 Shorted Circuit	EST3 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
49	EST 4 Open Circuit	EST4 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
50	EST 4 Shorted Circuit	EST4 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
51	EST 5 Open Circuit	EST5 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
52	EST 5 Shorted Circuit	EST5 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
53	EST 6 Open Circuit	EST6 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
54	EST 6 Shorted Circuit	EST6 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
55	EST 7 Open Circuit	EST7 OPEN	♠-Bell ♥-Warning or Caution ♦-90%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
56	EST 7 Shorted Circuit	EST7 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
57	EST 8 Open Circuit	EST8 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module open. Detectable only at zero RPM.	Wiring problem. Coil problem.
58	EST 8 Shorted Circuit	EST8 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Ignition fault. Signal from ECM to ignition driver module shorted. Detectable only at RPM.	Wiring problem. Coil problem. May see this fault during overspeed as ignition trigger signal is being turned off.
59	Fuel Injector 1 Open Circuit	FINJ1 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
60	Fuel Injector 1 Shorted Circuit	FINJ1 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
61	Fuel Injector 2 Open Circuit	FINJ2 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
62	Fuel Injector 2 Shorted Circuit	FINJ2 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
63	Fuel Injector 3 Open Circuit	FINJ3 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
64	Fuel Injector 3 Shorted Circuit	FINJ3 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
65	Fuel Injector 4 Open Circuit	FINJ4 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
66	Fuel Injector 4 Shorted Circuit	FINJ4 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
67	Fuel Injector 5 Open Circuit	FINJ5 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
68	Fuel Injector 5 Shorted Circuit	FINJ5 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
69	Fuel Injector 6 Open Circuit	FINJ6 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
70	Fuel Injector 6 Shorted Circuit	FINJ6 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
71	Fuel Injector 7 Open Circuit	FINJ7 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
72	Fuel Injector 7 Shorted Circuit	FINJ7 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.
73	Fuel Injector 8 Open Circuit	FINJ8 OPEN	♠-Bell ♥-Warning or Caution ♦-100%	Insufficient current draw on fuel injector circuit.	Open connection to injector on harness. Bad fuel injector.
74	Fuel Injector 8 Shorted Circuit	FINJ8 SHORT	♠-Bell ♥-Warning or Caution ♦-100%	Current draw of fuel injector has exceeded its limit.	Shorted connection to injector on harness. Bad fuel injector.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
75	Fuel Level 1 Circuit High	FUEL LVL CKT HI	♠-None ♥-Off ♦-100%	Fuel level sensor circuit open. This is primary fuel tank if two tanks are used.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
76	Fuel Level 1 Circuit Low	FUEL LVL CKT LO	♠-None ♥-Off ♦-100%	Fuel level sensor circuit shorted. This is primary fuel tank if two tanks are used.	Wiring problem. Sensor problem.
77	Camshaf t Sensor Fault	CAM SNSR	♠-Bell ♥-Warning or Caution ♦-90%	Cam position sensor circuit is faulty. Fuel and ignition strategies will be modified.	Wiring problem. Sensor problem.
80	Main Power Relay Output	MPRLY OUTPUT	♠-Bell ♥-Off ♦-100%	Key switch +12v and driver power do not agree within calibrated limits.	Low battery voltage is the typical problem. Open coil on the relay.
81	Main Power Relay Backfee d	MPRLY BACKFEED	♠-Bell ♥-Off ♦-100%	Unintended voltage supplied to ECU. Fault declared if voltage regulator in ECU is off, but ECU senses voltage on driver power.	Wiring problem. Relay problem.
84	Oil Pressure Circuit High	OIL PSI CKT HI	♠-Bell ♥-Warning or Caution ♦-90%	Oil pressure sensor circuit shorted.	Wiring problem. Sensor problem.
85	Oil Pressure Circuit Low	OIL PSI CKT LO	♠-Bell ♥-Warning or Caution ♦-90%	Oil pressure sensor circuit open.	Wiring problem. Sensor problem.
89	Oil Tempera ture Circuit High	OIL TEMP CKT HI	♠-None ♥-Off ♦-100%	Oil temperature sensor circuit open.	Wiring problem. Sensor problem.
93	Pitot Pressure Circuit High	PITOT CKT HI	♠-None ♥-Off ♦-100%	Pitot pressure sensor (used for boat speed) circuit shorted.	Wiring problem. Sensor problem.
94	Pitot Pressure Circuit Low	PITOT CKT LO	♠-None ♥-Off ♦-100%	Pitot pressure sensor (used for boat speed) circuit open.	Wiring problem. Sensor problem.
101	CAN Circuit Fault 1	CAN ERR1	♠-Bell ♥-Severe ♦-90%	CAN bus circuit damaged or faulty	Wiring problem on the CAN 2 (primary control data) system. CAN bus resistor missing.
102	CAN Circuit Fault 2	CAN ERR2	♠-Bell ♥-Caution ♦-90%	CAN bus	Wiring problem on the CAN 3 system.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
103	CAN Circuit Fault 3	CAN ERR3	♠-Bell ♥-Severe ♦-90%	CAN bus	Wiring problem on the CAN 1 (redundant control data) system.
104	Lake/ Sea Temp Circuit High	SEA TMP CKT HI	♠-None ♥-Off ♦-100%	Boat mounted water temperature sensor circuit open.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
105	Lake/ Sea Temp Circuit Low	SEA TMP CKT LO	♠-None ♥-Off ♦-100%	Boat mounted water temperature sensor circuit shorted.	Wiring problem. Sensor problem.
106	Shift Actuator Driver Overtemp	SHIFT DRV OVRTMP	♠-Bell ♥-Caution ♦-100%	Shift actuator driver (within PCM) temperature high.	Wiring problem. Shift actuator faulty. Binding linkage.
107	Shift Actuator Feedback High	SHIFT POS CKT HI	♠-Bell ♥-Warning ♦-90%	Shift position sensor circuit faulty.	Wiring problem. Sensor problem.
108	Shift Actuator Feedback Low	SHIFT POS CKT LO	♠-Bell ♥-Warning ♦-90%	Shift position sensor circuit faulty.	Wiring problem. Sensor problem.
109	Shift Actuator No Adapt	SHIFT NO ADAPT	♠-None ♥-Off ♦-100%	Actuator stalled but not within a valid range.	Check linkage. Shift actuator faulty.
110	Shift Position Switch Fault	SHIFT SWITCH	♠-Bell ♥-Critical ♦-5%	Switch indicates neutral at high speed and high loads. Neutral rational.	Wiring problem. Switch faulty. Check linkage.
111	ECT Circuit High	ECT TMP CKT HI	♠-Bell ♥-Warning ♦-90%	Engine coolant temperature sensor circuit open.	Wiring problem. Sensor problem.
112	ECT Circuit Low	ECT TMP CKT LO	♠-Bell ♥-Warning ♦-90%	Engine coolant temperature sensor circuit shorted.	Wiring problem. Sensor problem.
117	Start Solenoid Output	START SOL	♠-Bell ♥-Off ♦-100%	Open circuit to or insufficient current draw on start relay.	Wiring problem between ECM and start relay. Faulty solenoid.
118	Steering Position Circuit High	STEER CKT HI	♠-None ♥-Off ♦-100%	Steering sensor circuit shorted.	Wiring problem. Sensor problem. Fault will appear in freeze frame if sensor is not wired into SmartCraft.
119	Steering Position Circuit Low	STEER CKT LO	♠-None ♥-Off ♦-100%	Steering sensor circuit open.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
120	TPS 1 Circuit High	TPI1 CKT HI	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit shorted.	Wiring problem. Faulty sensor inside of ETC.
121	TPS 1 Circuit Low	TPI1 CKT LO	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit open.	Wiring problem. Faulty sensor inside of ETC.
122	TPS 1 Range High	TPI1 RANGE HI	♠-Bell ♥-Warning ♦-90%	TPI above the normal expected range.	Faulty sensors inside of ETC.
123	TPS 1 Range Low	TPI1 RANGE LO	♠-Bell ♥-Warning ♦-90%	TPI below the normal expected range.	Faulty sensors inside of ETC.
124	TPS 1 No Adapt	TPI1 NO ADAPT	♠-None ♥-Warning ♦-100%	Outside valid range when trying to adapt. Adapt occurs when exiting crank on way to run.	Faulty sensors inside of ETC.
125	TPS 2 Circuit High	TPI2 CKT HI	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit shorted.	Wiring problem. Faulty sensor inside of ETC.
126	TPS 2 Circuit Low	TPI2 CKT LO	♠-Bell ♥-Warning ♦-90%	TPI sensor circuit open.	Wiring problem. Faulty sensor inside of ETC.
127	TPS 2 Range High	TPI2 RANGE HI	♠-Bell ♥-Warning ♦-90%	TPI above the normal expected range.	Faulty sensors inside of ETC.
128	TPS 2 Range Low	TPI2 RANGE LO	♠-Bell ♥-Warning ♦-90%	TPI below the normal expected range.	Faulty sensors inside of ETC.
129	TPS 2 No Adapt	TPI2 NO ADAPT	♠-Bell ♥-Warning ♦-100%	Outside valid range when trying to adapt. Adapt occurs when exiting crank on way to run.	Faulty sensors inside of ETC.
130	Trim Sensor Circuit High	TRIM CKT HI	♠-None ♥-Off ♦-100%	Trim sensor circuit shorted.	Wiring problem. Sensor problem.
131	Trim Sensor Circuit Low	TRIM CKT LO	♠-None ♥-Off ♦-100%	Trim sensor circuit open.	Wiring problem. Sensor problem.
132	Crank Position Sensor Fault	VR SNSR STR	♠-Bell ♥-Warning ♦-90%	Variable reluctance sensor (crank position sensor).	Crankshaft sensor. Noise on circuit. With this failure, engine will not run. Wiring problem. Sensor problem.
133	Power 1 Volts (5VDC) Low	5 VDC PWR LO	♠-Bell or None ♥-Caution ♦-100%	Supplies power to all engine sensors (+5v).	Excessive current draw on the +5 VDC circuit. Circuit or sensor shorted to ground.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
134	Overspeed 1	OVERSPEED 1	♠-None ♥-Critical ♦-100%	Level 1 of overspeed exceeded.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.
135	Overspeed 2	OVERSPEED 2	♠-None ♥-Critical ♦-5%	Level 2 of overspeed exceeded.	Prop too small. Too much trim. Too much vent in prop. Too much throttle in neutral. Broken drive.
138	ECM Memory Fault	ECM MEMORY ERR	♠-Bell ♥-Critical ♦-5%	ECM memory is corrupted.	ECM faulty.
148	ESC and Neutral Switch Position Fault	ESC-NS POS DIFF	♠-Bell ♥-Critical ♦-5%	ESC actuator's determination of its position and neutral switch position do not agree.	Harness connection to neutral switch faulty, or faulty neutral switch.
149	ETC Idle Range Fault	ETC IDLE RANGE	♠-Bell ♥-Caution ♦-100%	ETC out of range for the idle position.	Wiring problem. Debris in ETC. Faulty ETC. Air leak in induction system.
150	Dual Engine CAN Circuit Fault	DUAL CAN SOH	♠-Bell ♥-Critical ♦-5%	Communication between System View and PCM has been lost. Discrepancy between CAN 1 and CAN 2.	Wiring problem CAN1 & CAN2. Lost terminator connection.
151	Fuel Pump Relay Circuit	FUEL PUMP RLY CKT	♠-Bell ♥-Warning ♦-90%	Open circuit in fuel pump relay circuit. This fault cannot detect any problems in fuel pump circuit.	Wiring problem. Connector problem. Relay problem.
152	IAC Output	IAC OUTPUT	♠-Bell ♥-Caution ♦-90%	Open circuit to IAC.	Wiring problem. Connector problem. Bad IAC.
153	Drive Lube Bottle Low	LOW DRIVE LUBE	♠-Bell ♥-Severe ♦-100%	Drive lube switch goes active	Drive lube low. Faulty low lube switch. Transmission temp high.
158	Port EMCT Circuit High	PRT EMCT CKT HI	♠-Bell ♥-Warning ♦-90%	Port exhaust manifold temperature circuit open.	Wiring problem. Sensor problem.
159	Port EMCT Circuit Low	PRT EMCT CKT LO	♠-Bell ♥-Warning ♦-90%	Port exhaust manifold temperature circuit shorted.	Wiring problem. Sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
160	Port EMCT Overheat	PRT EMCT OVRHT	♠-Bell ♥-Critical ♦-Varies	Port exhaust manifold temperature high.	Cooling problem.
163	CAN Circuit Fault 5	CAN ERR5	♠-Bell ♥-Critical ♦-3%	CAN bus.	Wiring problem on the CAN system.
176	Shift Actuator Position Sensor Fault	ESC-ERC POS DIFF	♠-Bell ♥-Critical ♦-5%	ESC actuator's determination of its position and commanded position do not agree.	Worn linkage. Faulty ESC. Faulty ERC.
177	Starboard EMCT Circuit High	STB EMCT CKT HI	♠-Bell ♥-Warning ♦-90%	Starboard exhaust manifold temperature circuit open.	Wiring problem. Sensor problem.
178	Starboard EMCT Circuit Low	STB EMCT CKT LO	♠-Bell ♥-Warning ♦-90%	Starboard exhaust manifold temperature circuit shorted.	Wiring problem. Sensor problem.
179	Starboard EMCT Overheat	STB EMCT OVRHT	♠-Bell ♥-Critical ♦-Varies	Starboard exhaust manifold temperature high.	Cooling problem.
180	MAP/TPI Difference Fault	MAP DIFF ERR	♠-Bell ♥-Critical ♦-5%	Both TPIs are functioning, but MAP sensor calculations do not agree. Suspect MAP sensor to be faulty.	MAP sensor outside of expected operating range. Abnormal airflow in intake.
181	TPI Sensors (All)	ALL TPS ERR	♠-Bell ♥-Critical ♦-5%	MAP does not agree with either TPI. Power off the ETC.	Wiring problem to ETC. Sensor problem.
182	TPS 1 Difference Fault	TPI1 DIFF ERR	♠-Bell ♥-Warning ♦-90%	MAP sensor range = TPI2, but TPI1 does not agree.	Wiring problem to ETC. Sensor problem.
183	TPS 2 Difference Fault	TPI2 DIFF ERR	♠-Bell ♥-Warning ♦-90%	MAP sensor range = TPI1, but TPI2 does not agree.	Wiring problem to ETC. Sensor problem.
184	Trim Down Relay Output	TRIM DOWN SOL	♥-Warning ♦-100%	Trim down circuit faulty.	Wiring problem. Faulty relay coil.
185	Trim Up Relay Output	TRIM UP SOL	♠-Bell ♥-Warning ♦-100%	Trim up circuit faulty.	Wiring problem. Faulty relay coil.
186	CAN Circuit Fault 7	CAN ERR7	♠-Bell ♥-Caution ♦-100%	CAN bus.	Problem on the CAN system.
187	CAN Circuit Fault 8	CAN ERR8	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
188	Primary Demand to Redundant Diff	DEMAND DIFF	♠-Bell ♥-Critical ♦-5%	CAN1 not equal to CAN2 cross check failure.	Faulty pots in ERC.
189	Demand Cross Check Difference	XCHK DEMAND DIFF	♠-Bell ♥-Critical ♦-5%	Command module not equal to PCM cross check of demand value.	Incorrect positions used when configuring levers at command module, faulty command module or ECM.
190	Shift Cross Check Difference	XCHK SHIFT DIFF	♠-Bell ♥-Critical ♦-5%	Command module not equal to PCM cross check of shift position.	Incorrect positions used when configuring levers at command module, faulty command module or ECM.
191	Fuel Level 2 Circuit High	FUEL LVL2 CKT HI	♠-None ♥-Off ♦-100%	Secondary boat mounted fuel tank sensor circuit open.	Wiring problem. Sensor problem.
192	Fuel Level 2 Circuit Low	FUEL LVL2 CKT LO	♠-None ♥-Off ♦-100%	Secondary boat-mounted fuel tank sensor circuit shorted.	Wiring problem. Sensor problem.
193	Shift Anticipate Switch Fault	SHIFT ANT SWITCH	♠-Bell ♥-Critical Engine dies	Shift anticipate (interrupt) switch active at incorrect time.	Wiring problem. Mechanical linkage problem. Faulty shift switch.
194	ESC Timeout Fault	ESC TIMEOUT	♠-Bell ♥-Warning ♦-90%	Shift actuator cannot reach desired position, or actuator moves back and forth when it should be steady.	Bad shift actuator or shift actuator position sensor. Maladjusted shift cable. Excess friction in shift cable or drive.
196	Transmission Overheat	TRANS OVERHEAT	♠-Bell ♥-Severe ♦-100%	Transmission temperature high.	Not available at time of print
209	Driver Power 2 Low	DRIVER POWER LO	Not available at time of print.	Supplies power to all drivers (+12v).	Faulty or low battery condition.
210	Overspeed in Neutral	NEUTRAL OVERSPD	♠-Bell ♥-Critical ♦-100%	Allowable overspeed limit in neutral exceeded.	Bad shift switch. Engine exceeded specified RPM in neutral.
211	Overspeed in Reverse	REVERSE OVERSPD	♠-Bell ♥-Critical ♦-100%	Allowable overspeed limit in reverse exceeded.	Engine exceeded specified RPM limit in reverse gear.
212	SmartStart Aborted	SMART START ERR	♠-Bell ♥-Caution ♦-100%	No engine RPM detected, no starter engagement.	Starter failed to engage. Weak battery. Open circuit to start solenoid. CPS circuit problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
215	CAN Circuit Fault 9	CAN ERR9	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.
216	CAN Circuit Fault 10	CAN ERR10	♠-Bell ♥-Caution ♦-100%	CAN bus.	Wiring problem on the CAN system.
217	Power 2 (5 VDC) Volts Low	5 VDC PWR 2 LO	♠-Bell ♥-Caution ♦-100%	Supplies power to all SmartCraft sensors (+5v).	Excessive current draw on the +5 VDC circuit. Paddle wheel harness shorted. SmartCraft connector corroded.
218	Helm ADC Check	HELM ADC ERR	♠-Bell ♥-Critical ♦-5%	Discrepancy between DTS Command Module and PCM.	Wrong DTS Command Module for engine model. Bad DTS Command Module. Incorrect PCM hardware.
219	ESC Loss of Control	ESC CONTROL LOST	♠-Bell ♥-Caution ♦-5%	ESC in gear position other than commanded by ERC.	Potentiometers in electronic shift actuator are questionable. Wiring to actuator could be bad.
226	CAN Circuit Fault 11	CAN ERR11	♠-Bell ♥-Critical ♦-5%	CAN bus	Communication problem on the CAN system.
227	Hydraulic Shift Pressure Sensor A Circuit Low	HSHIFT PSI A LO	♠-None ♥-Off ♦-100%	Pressure Sensor A open. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
228	Hydraulic Shift Pressure Sensor A Circuit High	HSHIFT PSI A HI	♠-None ♥-Off ♦-100%	Pressure Sensor A shorted. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
229	Hydraulic Shift Pressure Sensor A Circuit Undefined	HSHIFT PSI A	♠-Bell ♥-Critical ♦-100%	Pressure Sensor A detects that the transmission is not in neutral or in-gear. This fault will also detect if the transmission is in-gear while attempting to start engine.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.

Fault #	CDS Fault Message	DDT Fault Status Message	♠-System View Icon ♥- Horn ♦- Guardian %	Fault Explanation	Possible Root Cause
230	Hydraulic Shift Pressure Sensor B Circuit Low	HSHIFT PSI B LO	♠-None ♥-Off ♦-100%	Pressure Sensor B open. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
231	Hydraulic Shift Pressure Sensor B Circuit High	HSHIFT PSI B HI	♠-None ♥-Off ♦-100%	Pressure Sensor B shorted. PCM cannot use pressure sensor A to determine neutral or in-gear state of transmission.	Wiring problem, sensor problem.
232	Hydraulic Shift Pressure Sensor B Undefined	HSHIFT PSI B	♠-Bell ♥-Critical ♦-100%	Pressure Sensor B detects that the transmission is not in neutral or in-gear. This fault will also detect if the transmission is in-gear while attempting to start engine.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.
233	Hydraulic Shift System Fault	HSHIFT ERROR	♠-Bell ♥-Critical ♦-100%	Both pressure sensors determine an in-gear state.	Low transmission fluid, sticky valve in transmission, bad electrical solenoid on valve body, wiring problem, sensor problem.
234	Hydraulic Shift System Pressure too High	HSHIFT PSI HI	♠-Bell ♥-Critical ♦-5%	The pressure sensor determine that the fluid pressure in the transmission is too high.	Dirty filter in transmission, high transmission fluid, sticky valve in transmission, wiring problem, sensor problem.
235	Hydraulic Shift System Position Fault	HSHIFT POS DIFF	♠-Bell ♥-Critical ♦-5%	The pressure sensors determine that the solenoid being activated is incorrect.	Helm not set correctly, the wiring for the solenoids are switched, the wiring for the pressure sensors are switch, wiring problem, sensor problem.
236	Emergency Stop Activated	STOP CKT ACTIVE	♠-Bell ♥-Warning ♦-100%	Emergency stop performed.	Reattach lanyard and restart engine.

ECM Frequently Asked Questions

What is a circuit (CKT) high or low fault?

A circuit fault can be due to an open or short condition, which may include a damaged sensor, a connector or wiring harness problem. The ECM has detected that its sensor input has either gone to a high or low input condition. Depending on the sensor type used, a low may not necessarily indicate a short circuit or a high may not necessarily indicate an open circuit condition. In either case there is a problem detected by the ECM.

What is a STR (Strategy)?

A strategy is a method of control that involves ECM reaction to various engine conditions normally based on inputs from various sensors or switches. Example: If a critical engine sensor, like the engine coolant sensor or oil pressure sensor is disconnected, the ECM control strategy may only allow the engine to operate at some reduced level of engine power in an attempt to protect the engine from damage.

What is a TPI/TPS High or Low Range fault?

The TPI/TPS sensor diagnostic fault calibration within the ECM, can alert the technician of a fault condition where the sensor is above or below the normal operating range. This fault is not the same as an open or short circuit fault. Possible causes may be loose or maladjusted throttle linkage and excessive wear on components connected to the TPI/TPS.

Why do we use the loaded volts lead on some pinpoint tests?

The lead provides a current draw on the circuit, allowing us to diagnose instances where a single strand of wire may still be connected. The single strand will allow the circuit to pass the traditional ohms test but may not be able to pass enough current.

How can I switch between the data screens and the service manual?

Open the service manuals by clicking on the book icon and selecting the correct manual. Use the ALT and TAB buttons simultaneously to toggle between the CDS program and the service manual program.

Why do some faults take longer to set than others?

The ECM has individual fault calibrations for every sensor or device that is controlled by the ECM. The way in which the faults are calibrated will appear to the user as fast or slower responding fault messages.

What is a Main Power Relay (MPR) Output Fault?

If the battery voltage available at the engine is less than 7.5 volts, for example, during cranking, the MPR may not close or even remain closed during cranking, resulting in no spark, no injector activity, or no voltage to the electric fuel pump. The ECM decides the MPR output circuit is at fault and sets a fault code, which is stored in the Freeze Frame buffer. A MPR output fault can either be one of two types: the voltage being transferred across its relay contacts is below allowable limits, the relay coil itself is faulty, its connection to the relay coil socket, or the associated harness wire is open circuit. Other typical problems that may cause MPR Output faults:

- Incorrect battery type and capacity
- Use of a deep cycle battery as the primary cranking battery
- Loose or corroded battery cable connections (at the battery or the engine)
- Discharged battery (shorted or dead cells)
- Faulty battery switch contacts or loose connections
- Short extension wires from battery switches that have excessive amounts of shrink sleeve partially covering the ring terminals
- Incorrectly sized battery cables if longer battery cables are required
- 12-volt power buss-bar connection problem

What is wrong when I see a PWR1 or 5VDC Power Low fault?

The ECM has detected a problem with its internal 5-volt power supply. Usually this results from a short circuit between the +5VDC wiring to ground. Any external engine sensors or accessory SmartCraft sensors, if improperly connected, can result in overloading the 5-volt supply.

NOTE: *If the 5VDC supply is low enough the engine may be impossible to even start.*

Typical problems include:

- SmartCraft accessory harness missing the protective waterproof cap and pins are corroding
- Damaged paddle wheel sensor has allowed the sensor wiring to be exposed to water

Service Hint: While monitoring the +5 volt supply reading, disconnect the main SmartCraft accessory harness to see if the voltage problem is corrected. If not, continue disconnecting engine sensors one at a time until problem is corrected. Repair or replace the faulty components.

NOTE: *After repairs are completed make sure to clear fault history in order to clear any faults created during the testing process.*

Why does an EST or ECM Trigger Open not register as a fault when the engine is running?

The ECM signal that triggers the ignition coil driver can only be detected as an open circuit when there is no engine speed. Likewise, a short circuit can only be detected with engine speed.

What are MAP Diff or TPI Diff errors?

ECM system strategies allow the MAP pressure readings to be correlated to typical TPI readings for any given RPM and boat load. The ECM calculates the differences between nominal MAP readings and the current TPI readings. If there are any differences outside the typical operating range, then MAP differences or TPI difference errors are stored in the ECM Freeze Frame history buffers. Either the MAP sensor or TPI may be unplugged, intermittent or having a harness connection problem resulting in these errors.

What is a MAP Idle Check or MAP Idle Err?

The engine is expected to pull a little vacuum on the inlet at idle. If there is no pressure difference between the ambient barometer at key-up to the pressure (MAP) in the intake, the throttle bore must be missing, a very large air leak exists, a possible fault in the wiring harness exists, or the sensor has failed.

What do Overspeed Fault and Engine Guardian Fault indicate?

On an EFI engine, overspeed and Engine Guardian are used as methods for controlling engine power and protecting the engine from mechanical damage. For example: If the engine block temperature is running too warm, but not at a critical level, the PCM/ECM analyzes all sensor inputs and engine load. Once the calculations are made, then the Engine Guardian strategy determines what appropriate engine RPM can be achieved under those given operating conditions and reduces RPM based on the sensor inputs and the current engine load. If the engine temperature reaches a critical condition, then the only remaining option is to sound the overheat alarm and reduce power to a minimum level. Overheat seconds are only logged when the critical overheat temperature is reached and the alarm is sounded.

What is a Main Power Relay Request (MPRLY REQ) in the Freeze Frame buffer?

The PCM/ECM can request the main power relay be turned on for various reasons. For example: When the key switch is turned to the "ON" position, the PCM/ECM requests the fuel pump to also be turned on. During the time the relay is active, a number code is displayed in the Freeze Frame buffer, which represents that the relay was on for various reasons. Depending on the requirements at the time a fault was recorded, seeing a number for MPRLY REQ only indicates the relay was on. If the number displayed is zero, this means the relay was off at the time the fault was recorded. **Do not interpret this number as an indication of the number of times the relay was faulty. If the number is greater than zero then the relay was turned on.**

Why is the engine slowing down and how do I know if Engine Guardian is active?

View the parameter called AVAILABLE PWR% on the Data List Screen. If everything is normal, 100% will be displayed. If 100% is displayed then Engine Guardian is not responsible for the reduction in RPM. Anything less than 100% indicates a problem and Guardian is or soon will be active. For example, look at the various engine temperature sensors to see if anything seems warmer than normal.

NOTE: *As a general rule consider the normal operating temperature to be the same as the operating specification of the thermostats installed on the engine.*

I see the following faults: OIL LVL IN (CKT) HI, FUEL LVL IN (CKT) HI or SEA TEMP IN (CKT). Is there a problem and how can I eliminate these faults?

If no paddle wheel (contains the lake or sea temp sensor) or SmartCraft fuel or oil level sensors installed, the ECM will record and store these fault codes by default. These faults can be ignored if the sensors are not installed. If the engine is equipped with any of these sensors, this fault indicates that a sensor is faulty or the wiring connected to the sensor has a connection problem.

What is a good tool to use to diagnose boat wiring problems?

A key switch test harness with horn will quickly help you isolate a problem. Use for most outboard applications.

Why can I not get the active data screen to list any values?

Typically it is one of three reasons.

- First, do you have the correct engine model selected? This is usually indicated by a yellow flashing SmartComms logo in the bottom display bar.
- Second, the SmartComms box may need rebooted (or reflashed, if the CDS version has changed). Disconnect the engine communication cable from the box, let it power down and then reattach the cable.
- Third, you may have to restart the CDS program. Follow the instructions listed under question "What should I do if the system locks up?"

What should I do if the CDS system locks up?

First, try closing the program using the exit button on the top right hand side of the screen. If the exit button is not active, move the curser over the Start button tool bar. Right click and select Task Manager from the pop-up menu. One by one, select all the tasks and click on the End Task button. Once all the tasks are stopped, shut the computer down and restart the computer.

Why do I have to connect the ohm meter leads together at the start of the pinpoint tests?

This step is used to verify operation of the meter and continuity of the meter leads. If the reading is higher than expected, the system will inform you about defective meter leads. Normal readings are less than 0.7 ohms.

Why do the pinpoint tests ask me if I have started the engine?

To properly run the pinpoint test, the diagnostic system needs to determine if the engine is capable of running. If a "No Start" condition exists, the software will use this information in some tests to make diagnostic decisions. The software allows the technician to continue past the Start Engine prompt if desired. The question is asked to determine if a "No Start" condition exists or if the technician elected to NOT start the engine.

Why am I not able to get past the ohmmeter verification screen during the pinpoint tests?

The CDS system is receiving higher than normal readings from the VOM meter. First, check the meter leads on the VOM meter. Connect the two leads together with the meter set to ohms and verify the resistance reading. The reading must be below 0.7 ohms to continue with the test. If the reading is above normal, wiggle the leads for better contact and clean the surfaces if necessary. Second, verify the battery condition inside the VOM. A marginal battery will cause the resistance reading to be above normal, try a new battery.

Why am I not able to get the VOM meter to communicate with the CDS system?

Check that the PCMCIA card is installed into the computer correctly and the VOM meter communication cable connections are correct. Remember to press and hold the REL% button on the meter to activate the communication port each time you turn on the meter or the meter will not communicate with the CDS computer.

I have multiple engines on the boat, but do not have the ability to view data from all the engines from a single connection with the CDS system. Why?

Some models do not have the ECMs connected together into a single system; the CDS must be connected to these engines individually. Typically GM-based fuel injection systems and CAN-based system may allow the single connection point.

How does the cylinder misfire test work?

The cylinder misfire test increases the fuel delivery for the selected cylinder when under idle control (throttle closed). When the throttle has opened far enough for the engine to leave idle control (between 1% and 9%, depending on model), the cylinder misfire test will turn off the fuel injector for the selected cylinder. On some models (usually large 4-strokes), this may not be noticeable when idling. If the test is performed at higher speeds and loads, the results will be clearer.

Why do I need to run the cylinder misfire test at a higher RPM or under load?

While cylinder misfire test can be performed under any RPM and load condition, test results may not be noticeable at idle speed on all models. Results may be clearer when performed under high load or higher RPM conditions.

Why do I need to disconnect power to both fuel pumps?

In addition to the high-pressure fuel pump, MerCruiser models usually have a boost pump that pressurizes the system to around 10 psi. If you only disconnect the high pressure pump, the fuel injectors are fired at 10 psi and will still deliver a considerable amount of fuel into the cylinders.

NOTE: *If the fuel pump connectors are difficult to reach, removing the fuel pump relay will disable both fuel pumps. Disregard the resulting Fuel Pump Relay fault code if the relay is removed.*

How do I perform a fuel injector test on a MerCruiser ECM555 system?

After disabling the fuel pump, an ECM555 MerCruiser fuel system can only be tested by selecting the appropriate bank of injectors. On MerCruiser models equipped with the ECM555 processor, the fuel injectors are controlled in banks of two to four injectors, depending on the engine. 2005 and newer GM 5.0L, 5.7L, and 6.2L V-8 engines with an ECM555 processor will have four injector selections available on the Active Test screen in the Toolbox. These newer engines have four injector drivers to fire the injectors in pairs. Older GM 5.0L, 5.7L, and 6.2L V-8 engines that are 2004 and older have two injector drivers that fire injectors in banks of four. The 4.3L V-6 has two banks of three injectors. Selecting cylinder 1 on these models will effect bank 1. Selecting cylinder 2 on these models will effect bank 2, and so on.

How do I test a MerCruiser ECM555 system with one ignition coil?

An ECM555 MerCruiser ignition system has one ignition coil and an HVS distributor. To test this system, the coil wire must be removed from the HVS distributor and a spark plug installed on end of the coil wire. Ground the spark plug to the engine block and then perform the test while watching for spark across the gap. Since there is only one coil the system will operate the same way for any cylinder selected.

How do I configure a digital throttle and shift helm station?

Refer to the following help topics for step-by-step procedures:

- How to Perform DTS Vessel Configuration
- How to Perform DTS Lever Adaptation

How do I calibrate the cursor or screen on my Panasonic touch-screen PCs?

Click the Windows Start button, then click: Settings, Control Panel, Mouse, Touch Screen, and Calibration. Follow the prompts to calibrate the touch screen.

What does IAT mean?

IAT stands for intake air temperature. Some systems include an IAT sensor.

What does DTS mean?

DTS stands for digital throttle and shift. This type of system is on late-model engines. **DTS** requires engine and helm station configuration.

Refer to the following help topics for step-by-step procedures:

- How to Perform DTS Vessel Configuration
- How to Perform DTS Lever Adaptation

Why is my laptop battery charge low after long-term storage?

Laptop batteries are designed for regular and frequent (daily or weekly) use, NOT for extended storage periods. For optimal battery performance, you should discharge the battery regularly through normal use and recharge it as necessary. You can also leave the laptop connected to the 110-volt power supply to keep the battery fully charged.

Dealers who choose to store the computer for extended periods should consider the following:

- Long-term storage weakens the battery cell lining. The longer the storage period, the weaker the lining becomes.

- The battery cells will eventually begin to break down, resulting in reduced charging capacity. You will likely notice that the charge capacity progressively falls off: 90 percent, 80 percent, etc.
- If you have no other choice than to store the battery for extended lengths of time, charge the battery to approximately 30 percent and no more.

IMPORTANT: Do NOT allow the battery get to an absolute zero charge or it may become difficult to bring back up to full charge (This caution only applies to a storage situation where the battery drop to zero and stays there for a week or more).

- The battery will always leak current during its storage period. The rate of leakage depends upon many factors such as temperature, humidity, and elevation. In ideal conditions, you can probably expect a battery with a 30 percent charge to store for a month or so.

How do I connect to a MEFI 4 engine system?

The CDS treats MEFI 4 engine conversions just like a MEFI 3 system. Use the **diagnostic cable** for all MEFI systems, including MEFI 1, 2, 3, and 4. When testing a MEFI 4-converted system, you must enter the engine's original (MEFI 3) information and install the **MEFI 4 Conversion Kit.** The system will automatically detect that the engine has been converted to MEFI 4. If a MEFI 4 is detected, the engine ID heading at the top of the screen changes to display the MEFI 4 system. The same type of data, faults, and active tests are available for the MEFI 4 converted engine as were available for the MEFI 3.

MEFI 3 engines with Thunderbolt ignition uses a coil driver module to control the ignition coil. MEFI 3 engines with the Delco EST ignition will use the ignition module located inside the EST distributor.

MEFI 4 systems can only operate in single engine mode. There are no dual-engine systems available for MEFI 4 conversions.

Refer to the **How to Select and Connect Cables** topic for more information on the MEFI 4 system.

Why am I having trouble zeroing the ohms reading on my multimeter?

The multimeter will not properly zero on the ohms scale if the internal battery is low. If you cannot get past the meter zero screen in Pinpoint Diagnostics, verify that the internal battery is good and make sure the leads are not visibly damaged or otherwise defective. To optimize battery life, remember to turn the multimeter power off when it is not in use. The multimeter also has a sleep mode that powers down the screen after 30 minutes of inactivity. This mode allows the instrument to continue to acquire data with minimal power requirements. However, over a period of time, these minimal power requirements will draw the battery down.

NOTE: *If the battery is low, voltmeter readings may be inaccurate.*

Why does the DMT 2004 voltmeter report high readings for the 5-volt reference signal?

Occasionally, we receive reports of high readings on the 5-volt reference signal when using the DMT 2004 voltmeter. Higher than normal reference voltage readings are NOT typical of PCMs or ECMs used on Mercury products. Refer to the CDS Toolbox **DATA ITEMS** and compare the PCM/ECM POWER 1 reading to the voltmeter reading. Allowing for resistance in the wires and test leads, the readings should be within two tenths to three tenths of each other. Wide-spread differences are usually the result of a low 9-volt battery inside the DMT 2004 voltmeter. In many cases, technicians do not notice the low battery (BAT) indicator, flashing on the meter display. This indicator begins to flash when battery voltage drops below a acceptable level. The flashing BAT icon appears on the center, left side of the display.

To optimize battery life, remember to turn the multimeter power off when it's not in use. The multimeter also has a sleep mode that powers down the screen after 30 minutes of inactivity. This mode allows the instrument to continue to acquire data with minimal power requirements. However, over a period of time, these minimal power requirements will draw the battery down.

NOTE: *If the battery is low, voltmeter readings may be inaccurate.*

What is the difference between a sticky and non-sticky fault?

All faults for ECM555, PCM555, PCM03, and DTS command modules are classified as sticky or non-sticky.

- A **sticky fault**, once set, continues to show up as active even if the circuit or problem has corrected itself. You must perform a key switch cycle to reset a sticky fault.
- A **non-sticky fault** changes its status from active to inactive without requiring a key switch cycle.

Note that the CDS will continue to display sticky faults as active, even though the cause of the fault has been corrected. Cycle the key to reset all faults if you are having difficulty correcting a fault.

What is Engine Guardian?

On DTS engines, **Engine Guardian** closes the electronic throttle control (DTC) to reduce engine power. This operation is very smooth and not usually noticeable to the operator. The engine seems to be down on power and does not shake, vibrate or buck.

Non-DTS engines reduce engine power by changing injector and ignition operation, which is quite obvious to the operator. The engine shakes, vibrates, and bucks at the guardian limit, similar to the rev-limit function but at lower RPM.

What does Fault Seconds information tell me?

Fault Seconds is a list of data, available for ECM555, PCM555, and PCM03 command modules on 2001 and newer engines. The **Fault Seconds** list shows the first 23 possible faults for these processors. Not all of these faults are applicable to all product lines. For example, air compressor overheat fault seconds only apply to Optimax models. These 23 faults are hard-coded into the processor and, if any fault seconds are logged, all 23 faults will be displayed with applicable seconds listed by each one.

NOTE: *The Port Head Overheat reading applies to V6 outboards only. The Starboard Head Overheat reading applies to V6 outboards and is also the ECT reading on MerCruiser models. Cylinder Head and Block Overheat Fault Seconds for all Verado models are NOT logged in this list.*

How do I tell the difference between 2004, 2005, and 2006 and Newer DTS systems?

Model Year 2004 Systems:

- Display version number "0" in the **Command Module City ID grid** on the System Information screen.
- Require you to manually select their current locations before CDS establishes communication with the system. Once communication is established, you can assign one of two locations, then calibrate the control handles.

Model Year 2005 Systems:

- Display version number "60" through "69" in the **Command Module City ID grid** on the System Information screen.

- Allow the CDS system to establish communication by auto-detecting their current location. Communication allows you to assign one of twelve locations using the **Vessel Configuration** tab on the System Information screen. Once the location is set, you must switch to DTS Handle Configuration. DTS Handle Configuration allows you to calibrate the control handles with the command module.

Model Year 2006 and Newer Systems:

- Display version number "70" and higher in the **Command Module City ID grid** on the System Information screen.
- Allow the CDS system to establish communication by auto-detecting their current location. Communication allows you to assign one of twelve locations using the Vessel Configuration tab on the System Information screen. Once the location is set, you must switch to DTS Handle Configuration. DTS Handle Configuration allows you to calibrate the control handles with the command module.

NOTE: *Mismatched engine PCM's and Command Modules will interfere with system communication which prevents proper system configuration.*

For more information, refer to **"How to View DTS Command Module City ID Locations."**

What does the Unit of Measurement Counts stand for?

Analog-Digital (AD) counts (sometimes referred to as raw counts), refer to a method of measuring a sensor signal in steps called "counts." Counts are used on 2-wire and 3-wire sensors that, depending upon the specific engine application, monitor conditions such as fuel level, trim, and remote oil tank level. The typical count range for a sensor is between 0 and 1023 counts (actually 1024 separate counts). In each case, 0 is the lowest possible reading and 1023 is the highest possible reading. The AD count signal can be related to sensor voltage. 0 counts equals 0 volts and 1023 counts equals 5.0 volts. Everything in between is proportional and can be calculated if so desired for diagnostic purposes.

While counts can be directly related to sensor voltage, they are NOT directly related to a quantity of fuel, angle of trim, or oil tank level. Rather, counts indicate the relative condition of a sensor signal. A sensor circuit showing 0 counts or 1023 counts is either shorted or open and is not functioning correctly, and should trigger the appropriate "Circuit Lo or Circuit Hi" fault. The exact count measurement that sets a "circuit high" condition can vary from calibration to calibration, but is usually around 1015. 10 counts usually sets a "circuit low" condition.

NOTE: *Some PCMs are programmed to communicate with the CDS to display some sensors in a range of 0 to 255 (256 separate counts), which is 1/4 of the value of the 0 to 1023 sensor range (256 × 4 = 1024).*

How do I detect a COM port setting for my multimeter?

1. Insert your PCMCIA card into the card slot on the CDS host computer and listen for the an audible tone that indicates the computer has recognized the card.
2. Click the Setup, then the Utilities tab in CDS.
3. Click the Multimeter Available box to turn on the multimeter in CDS.
4. Click the Detect button for the COM Port setting.
5. Follow the prompts on the screen asking you to connect your multimeter to the PC and turn on the meter.
6. Click the Start button.
7. After the COM Port has been detected, click the green check box.
8. Your COM Port has been successfully configured and you can use your multimeter in CDS.

NOTE: *The PCMCIA card must be installed before running the CDS application. This allows CDS to detect the card and the multimeter to properly function.*

What is a trim delta test?

Trim Delta is a new active test for MerCruiser DTS (digital throttle shift) Bravo Engines with MY06 or newer calibrations. Trim Delta allows the technician to set the maximum amount of difference (delta) between the trim settings of all drives on a multiple engine boat. The higher the setting, the greater the difference (delta) between the drive trim angles.

Excessive Delta can cause damage to the Steering Tie Bar connecting the drives together. By Default, Trim Delta is turned OFF and must be enabled by the boat manufacturer (or technician). Trim Delta must be individually configured for each engine (PCM) in the boat.

What is shadow mode?

Shadow mode is used when three or four engines are controlled with two helm stations.

- **Three-engine system:** The center engine is controlled by the average throttle position output of the two outside engines. If only one of the outside engines is running, shadow mode mimics the throttle position output of that outside engine.
- **Four-engine system:** The starboard and port inner engines will mimic the output of the corresponding outer engines. See **How to Perform Shadow Mode DTS Vessel Configuration** for more information.

Why do my Freeze Frame buffers and FPC (Fuel per Cylinder) data items display incorrectly?

If you experience trouble reading **FPC** or **Freeze Frame buffers**, make sure you have selected the correct model year engine calibration. If you have selected a MY05 (or earlier) calibration, and you are connected to a MY06 calibration, you will not be able to read the **FPC** data item or **Freeze Frame buffers**.

If you have selected a MY06 (or newer) calibration, and are connected to a MY05 (or earlier) calibration, you will not be able to read the **FPC** data item or **Freeze Frame buffers**. Generic engine selections have been created to allow you to quickly try either MY selection if the MY of the calibration is not self-evident. The model year of the calibration can be determined by selecting the Calibration and System Info Icon in the CDS Toolbox and reading the calibration of the PCM from that screen.

Wiring Diagrams

Section 3A - Wiring Diagrams–ECM with 10-Pin Harness

Table of Contents

Engine Harness Legend

Wire Splice Description

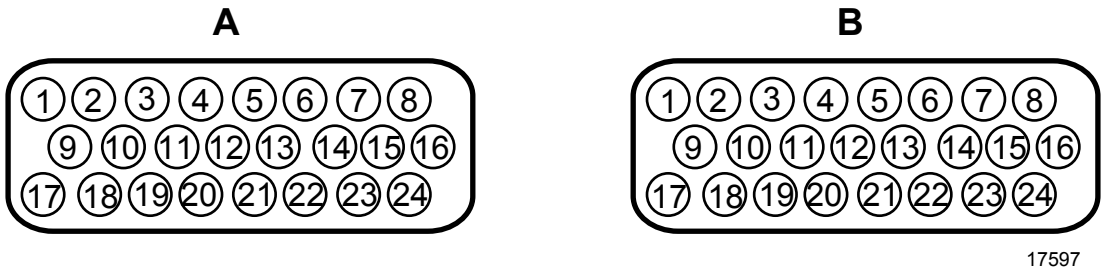
Splice Number	Description
100	5-Volt Transducer Ground
101	5-Volt Transducer Power
102	Wake Line
103	12-Volt 50-amp Protected
104	12-Volt Engine Ground
105	12-Volt From MPR
106	Switched 12-Volt Fused
107	12-Volt Fused
108	12-Volt Fused to All Injectors
109	Transmission and Drive Lube
110	Injectors 1,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

Wire Color Code Abbreviations

Wire Color Abbreviations				
BLK	Black		BLU	Blue
BRN	Brown		GRY or GRA	Gray
GRN	Green		ORN or ORG	Orange
PNK	Pink		PPL or PUR	Purple
RED	Red		TAN	Tan
WHT	White		YEL	Yellow
LT or LIT	Light		DK or DRK	Dark

10-Pin ECM 555 Pinouts

Use this quick reference guide to the pins of the ECM to verify broken pins, determine what each pin controls, and to check wire continuity.



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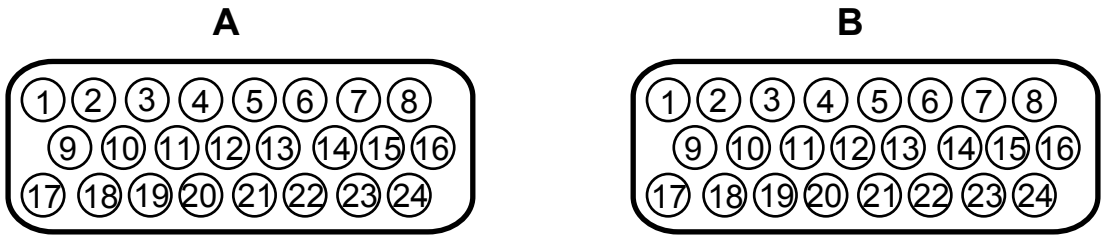
Connector A

	Mercury Part Number	865456A01	865454A01 865454A02	84-865245A02 84-865455A01 84-865455A02 84-865455A04	84-865454A03 Bravo 84-865454A04 Alpha 84-865454A05 Alpha 84-865454A06 Bravo 84-865455A03 Inboard
Pin	**ECM555SD**	**4.3 MPI Sterndrive**	**V8 Sterndrive**	**V8 Inboard**	**V8 Sterndrive and Inboard**
A1	Empty	Empty	Empty	Empty	LT-GRN/RED
A2	Fuel Injector Bank 2	LT-GRN/WHT	LT-GRN/WHT	LT-GRN/WHT	LT-GRN/WHT
A3	Empty	Empty	Empty	Empty	Empty
A4	CAN 1 (+)	WHT	WHT	WHT	WHT
A5	Scan (–)	WHT/PPL	WHT/PPL	WHT/PPL	WHT/PPL
A6	Knock Odd (–) V8	Empty	ORN/BLK	ORN/BLK	ORN/BLK
A7	Knock Even (–) V8	YEL/DK-BLU	Empty	Empty	BRN
A8	Trans Temp/Lube Bottle	DK-BLU/BRN	DK-BLU/BRN	DK-BLU/BRN	DK-BLU/BRN
A9	Warning Horn	BRN/DRK- BLU	BRN/DRK- BLU	BRN/DRK- BLU	BRN/DRK- BLU
A10	Tach Sig Out	GRY/WHT	GRY/WHT	GRY/WHT	GRY/WHT
A11	CAN 1 (–)	LT-BLU	LT-BLU	LT-BLU	LT-BLU
A12	Scan (+)	WHT/BLK	WHT/BLK	WHT/BLK	WHT/BLK
A13	Knock Odd (+) V8	Empty	BLK/ORN	BLK/ORN	BLK/ORN
A14	Knock Even (–) V8	DK-BLU/YEL	Empty	Empty	YEL/WHT
A15	E-stop (thru CAN)	DK-GRN/YEL	DK-GRN/YEL	DK-GRN/YEL	DK-GRN/YEL
A16	Ground	BLK	BLK	BLK	BLK
A17	Fuel Injector Bank 1	LT-GRN/PPL	LT-GRN/PPL	LT-GRN/PPL	LT-GRN/PPL
A18	Empty	Empty	Empty	Empty	LT GRN/ORN
A19	Fuel Pump Relay Control	DK-GRN	DK-GRN	DK-GRN	DK-GRN
A20	IAC Valve Control	BLK/DK-GRN	BLK/DK-GRN	BLK/DK-GRN	BLK/DK-GRN
A21	Gear Position Switch	YEL/DK-GRN	YEL/DK-GRN	YEL/DK-GRN	YEL/DK-GRN
A22	MPR Control	PPL/DK-GRN	PPL/DK-GRN	PPL/DK-GRN	PPL/DK-GRN
A23	MPR Output (to ECM)	PNK	PNK	PNK	PNK
A24	Ground	BLK	BLK	BLK	BLK



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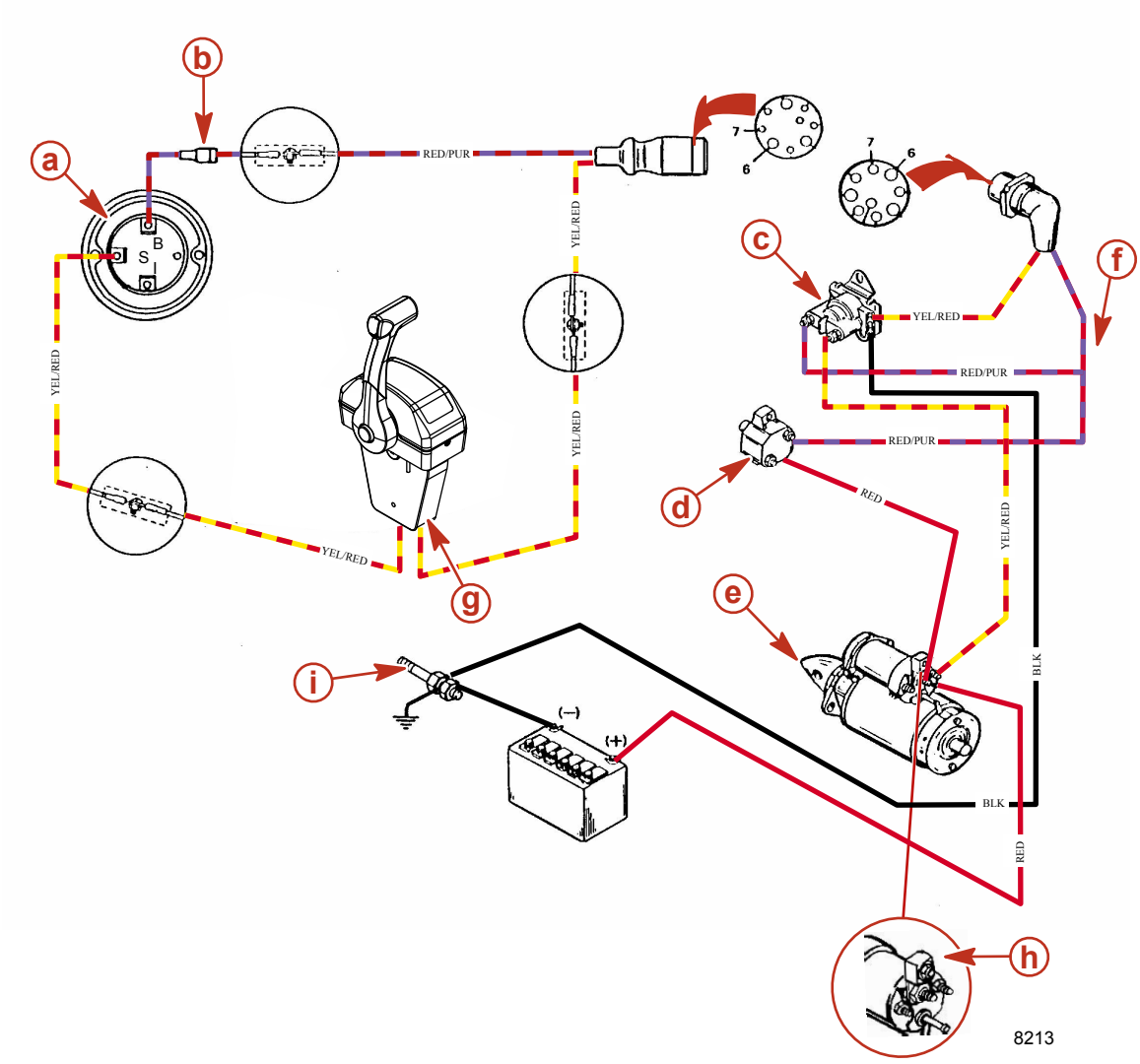
Connector B

	Mercury Part Number	865456A01	865454A01 865454A02	84-865245A02 84-865455A01 84-865455A02 84-865455A04	84-865454A03 Bravo 84-865454A04 Alpha 84-865454A05 Alpha 84-865454A06 Bravo 84-865455A03 Inboard
Pin	**ECM555SD**	**4.3 MPI Sterndrive**	**V8 Sterndrive**	**V8 Inboard**	**V8 Sterndrive and Inboard**
B1	Sender Ground	BLK/PNK	BLK/PNK	BLK/PNK	BLK/PNK
B2	MAT Signal	BRN/YEL	BRN/YEL	BRN/YEL	BRN/YEL
B3	MAP Signal	LT-GRN	LT-GRN	LT-GRN	LT-GRN
B4	Fuel Level 1 Signal	LT-BLU/BLK	LT-BLU/BLK	LT-BLU/BLK or PNK/BLK)	LT-BLU/BLK
B5	Empty	Empty	Empty	Empty	TAN/BLK
B6	Empty	Empty	Empty	Empty	Empty
B7	Oil Pressure Signal	DK-BLU/BLK	DK-BLU/BLK	DK-BLU/BLK	DK-BLU/BLK
B8	Steering Angle Signal	PNK/DK-BLU	PNK/DK-BLU	PNK/DK-BLU	PNK/DK-BLU
B9	Paddle Wheel Signal	YEL/GRY	YEL/GRY	YEL/GRY	YEL/GRY
B10	CPS Signal	TAN/BLK	TAN/BLK	TAN/BLK	ORN/GRA
B11	Sea Pump Signal	DK-BLU/WHT	DK-BLU/WHT	DK-BLU/WHT	DK-BLU/WHT
B12	Pilot Signal	WHT/LT-BLU	WHT/LT-BLU	WHT/LT-BLU	WHT/LT-BLU
B13	Digital Trim Signal	ORN/WHT	ORN/WHT	LT-BLU/BLK	EMPTY or ORN/WHT
B14	ECT Signal	YEL	YEL	YEL	YEL
B15	Empty	Empty	Empty	Empty	Empty
B16	Empty	Empty	Empty	Empty	Empty
B17	Empty	Empty	Empty	Empty	Empty
B18	Wakeup	PPL	PPL	PPL	PPL
B19	Shift Interrupt Signal	YEL/PPL	YEL/PPL	Empty	Empty or YEL/PPL
B20	TPS Signal	DK-BLU/ORN	DK-BLU/ORN	DK-BLU/ORN	DK-BLU/ORN or YEL/PPL
B21	Sender Power	GRY	GRY	GRY	GRY
B22	Sea Temp Signal	WHT/YEL	WHT/YEL	WHT/YEL	WHT/YEL
B23	EST (Coil Control)	WHT/DK-GRN	WHT/DK-GRN	WHT/DK-GRN	WHT/DK-GRN
B24	Empty	Empty	Empty	Empty	Empty

EFI System Engine Wiring Harness Diagrams

10-Pin Engine Harness Starting System



Typical

a - Ignition switch
b - 20-amp fuse
c - Starter slave solenoid
d - 50-amp circuit breaker
e - Starter motor
f - Wire junction
g - Neutral safety switch
h - 90-amp fuse

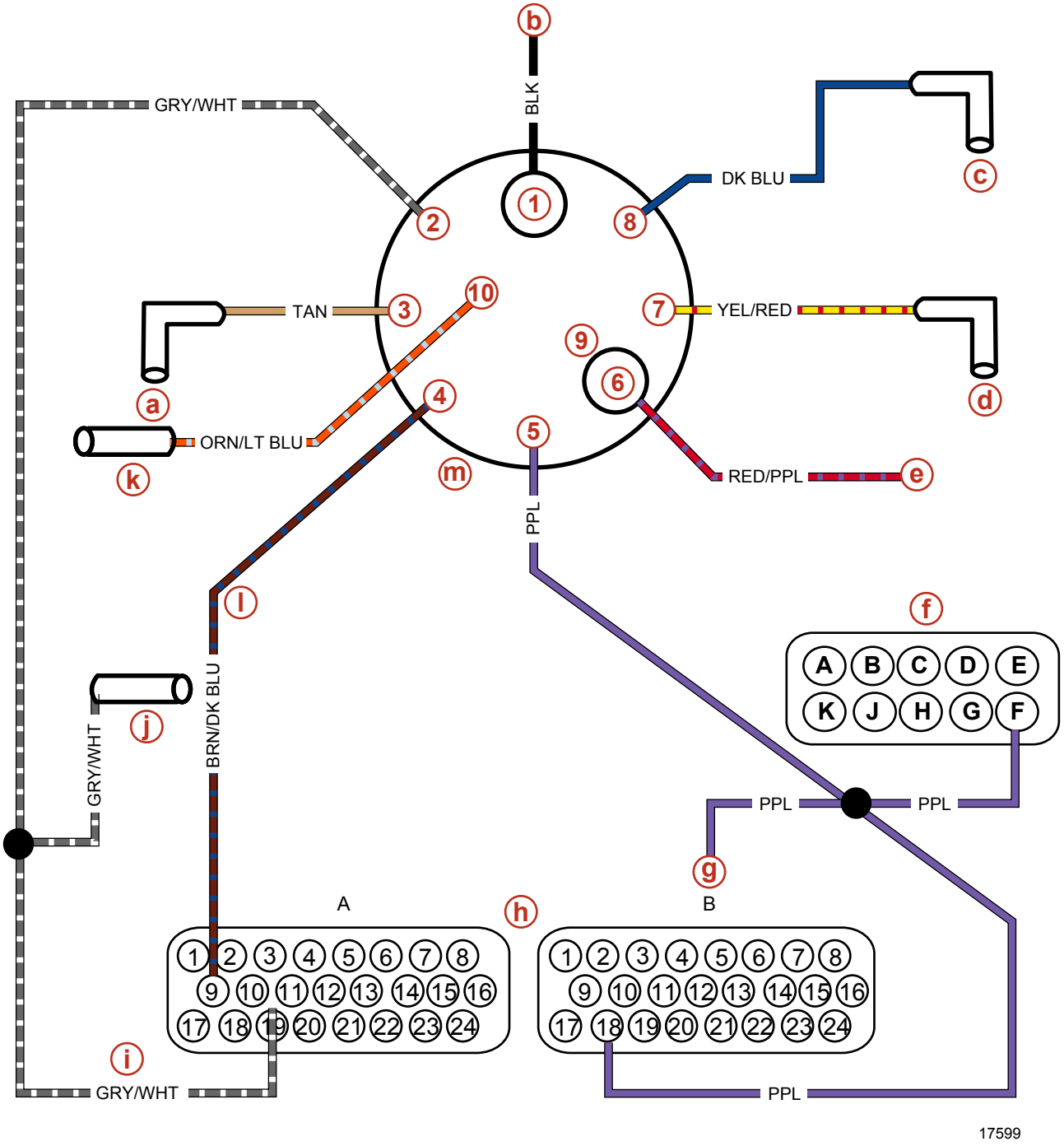
This is a general description of the positive current flow from the battery through the starting system until the starter motor cranks.

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

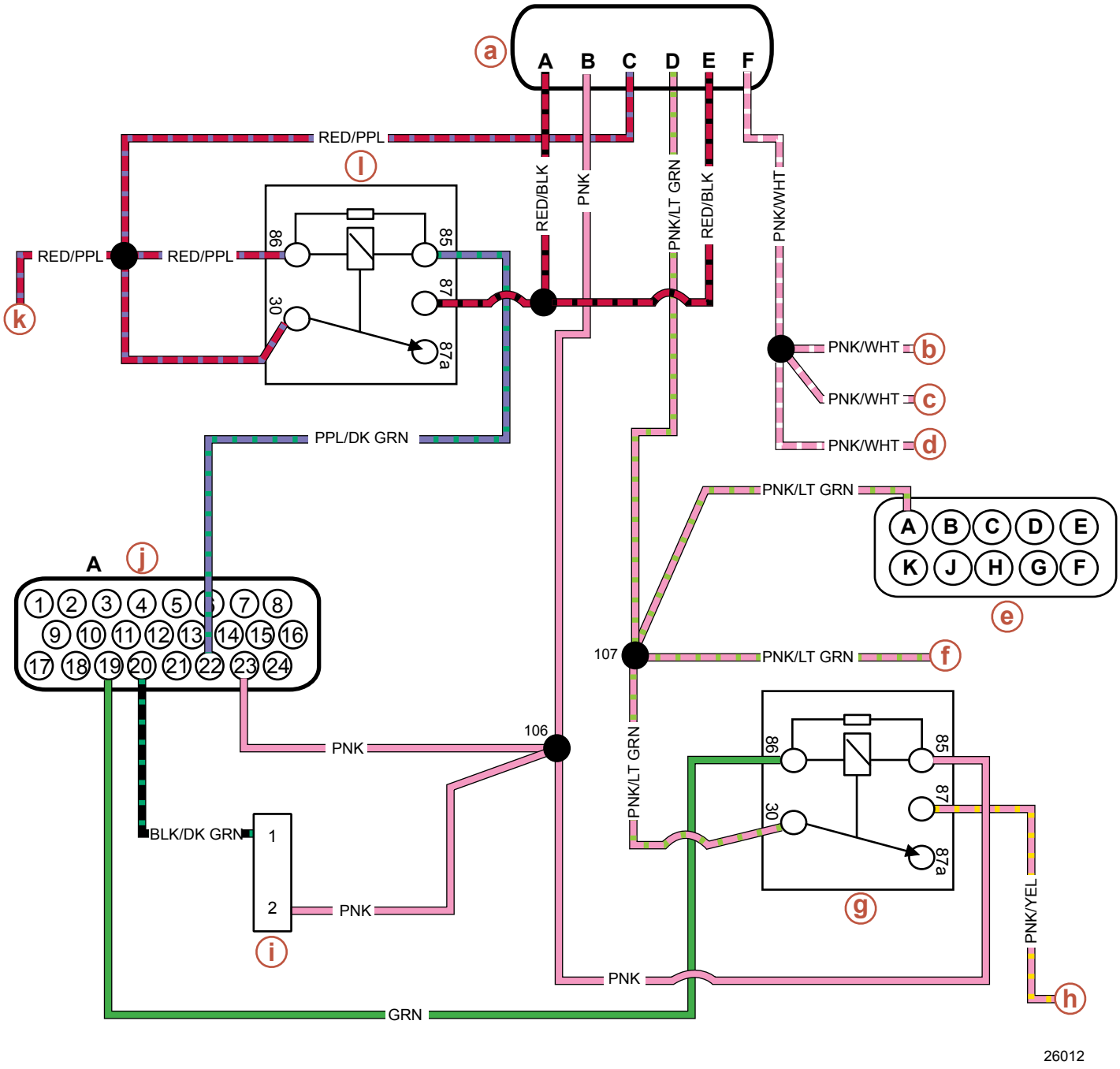
- Ignition switch Terminal B to Terminal S
- Ignition switch Terminal C to the neutral start switch (YEL/RED); NEUTRAL START SWITCH MUST BE AT NEUTRAL POSITION
- Neutral start switch to the wiring harness plug Terminal 7 (YEL/RED)
- Wiring harness plug to the starter solenoid (small terminal) (YEL/RED); 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



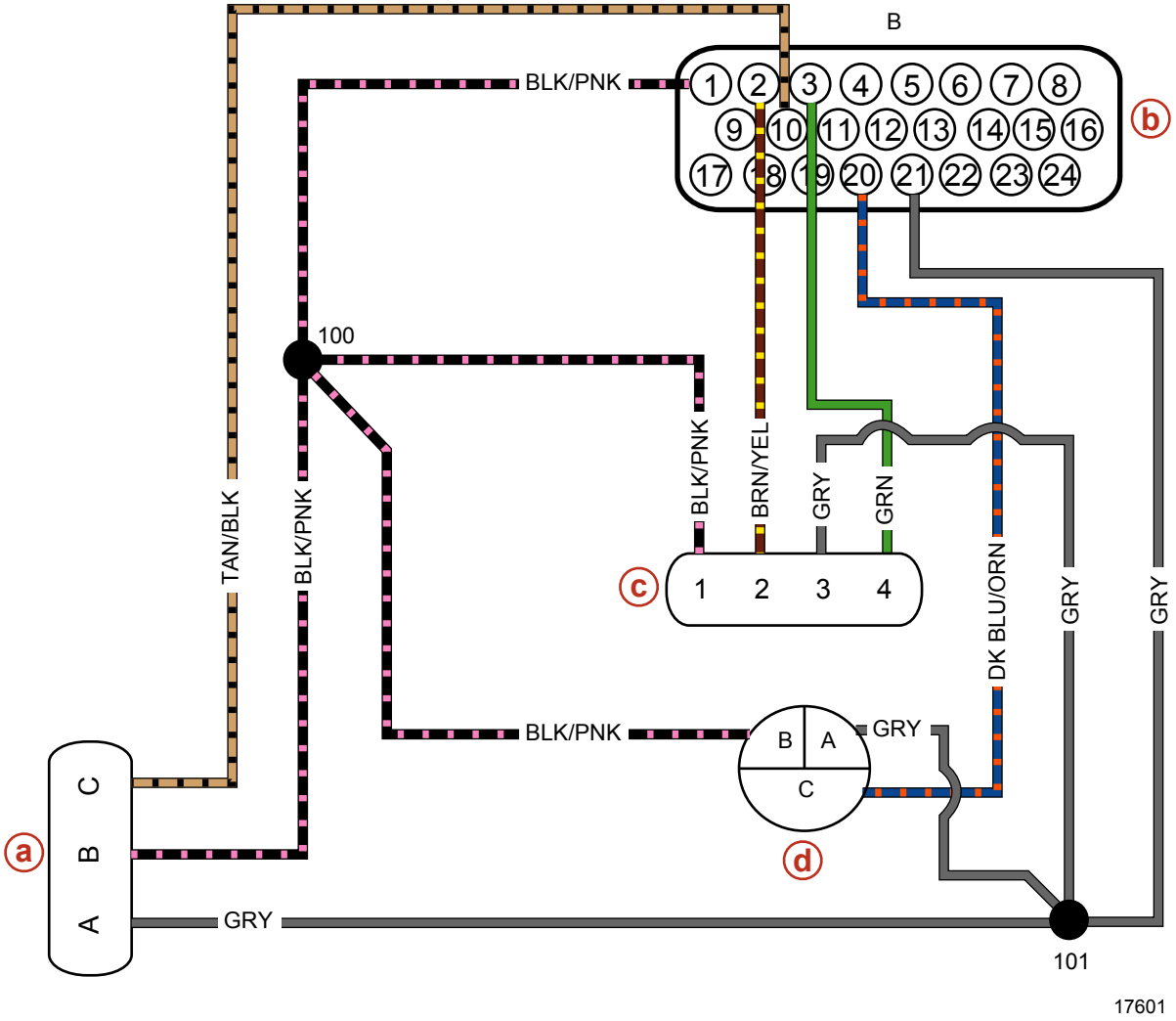
a - Analog coolant sender
b - To Splice 104 (ground)
c - Analog oil pressure sender
d - To crank solenoid
e - To Splice 103 B+ (from 50-amp circuit breaker)
f - ECM 555
g - Tachometer signal (gray on early models)
h - Tachometer connector
i - To analog trim sender
j - Warning horn circuit
k - 10-pin 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
j - ECM 555 connector A
k - To 50-amp circuit breaker
l - Main power relay (MPR)

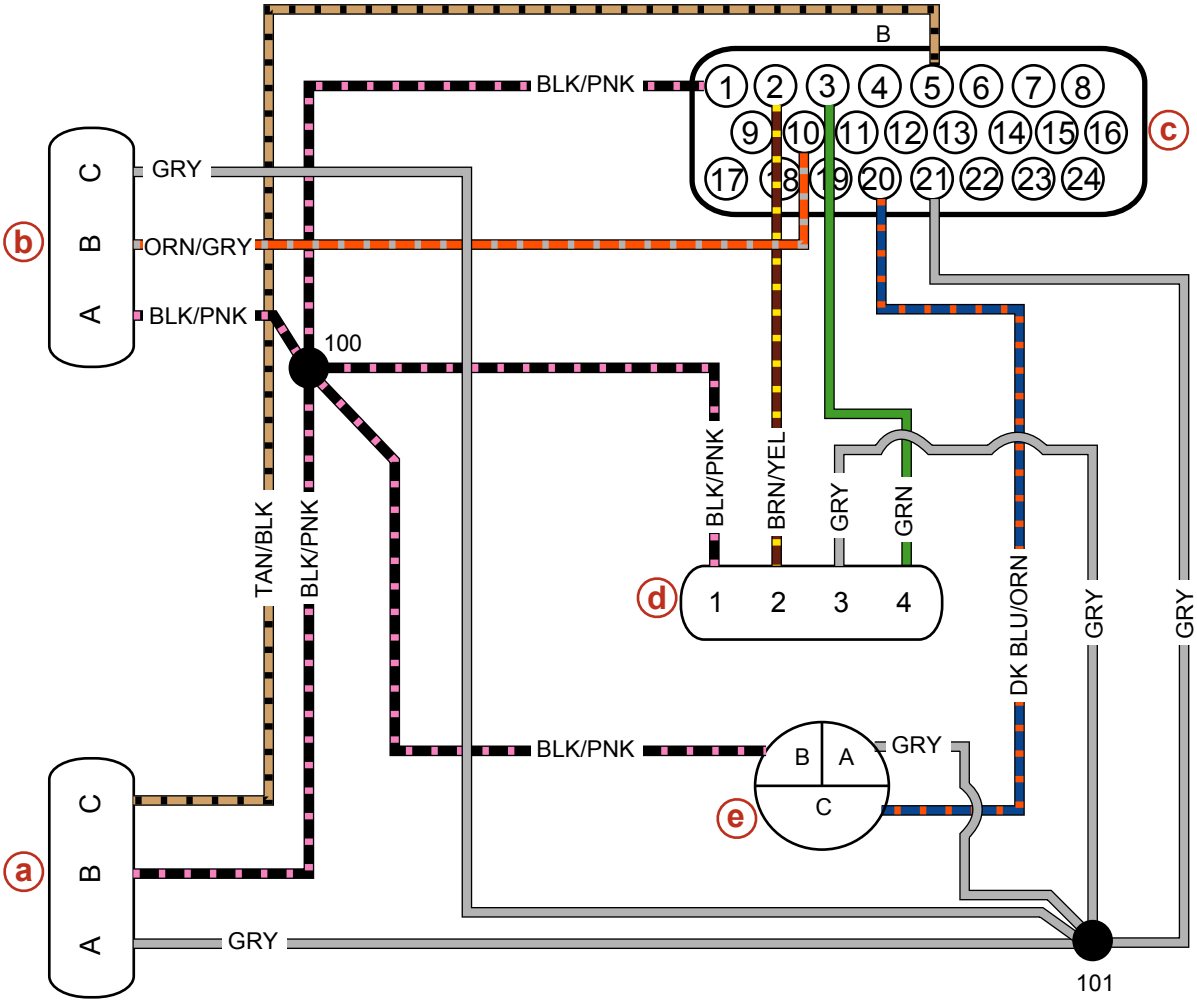
Manifold Air Pressure and Temperature, Crankshaft Position, and Throttle Position Sensors: V6 Engines



a - Crankshaft position sensor
b - ECM 555
c - Manifold air pressure/Manifold air temperature
d - Throttle position sensor

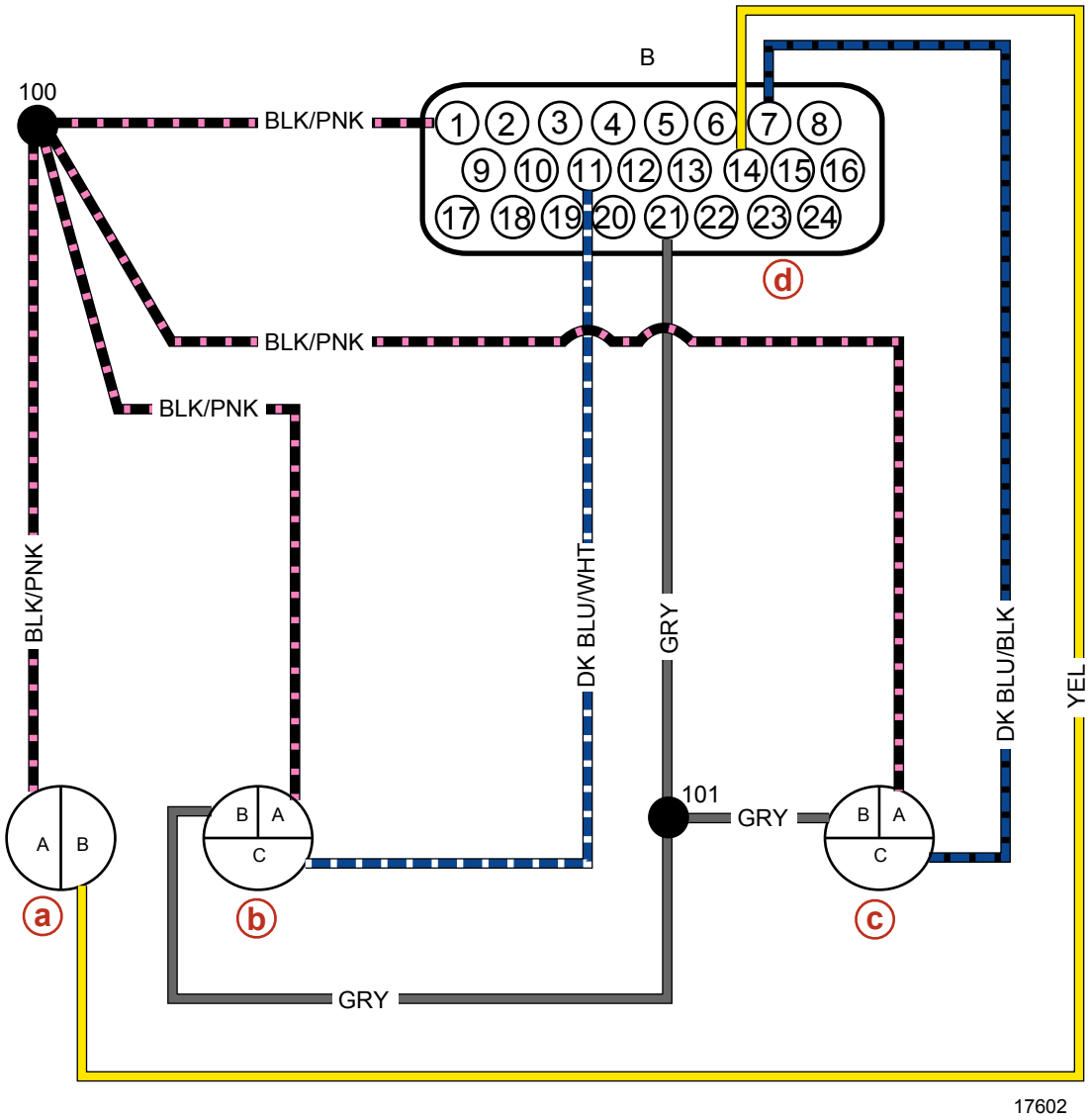
NOTE: *The* ***green*** *wire coming from ECM555 connector B pin 3 may be* ***light green*** *on some models.*

Manifold Air Pressure and Temperature, Crankshaft Position, Camshaft Position, and Throttle Position Sensors—V8 Engines



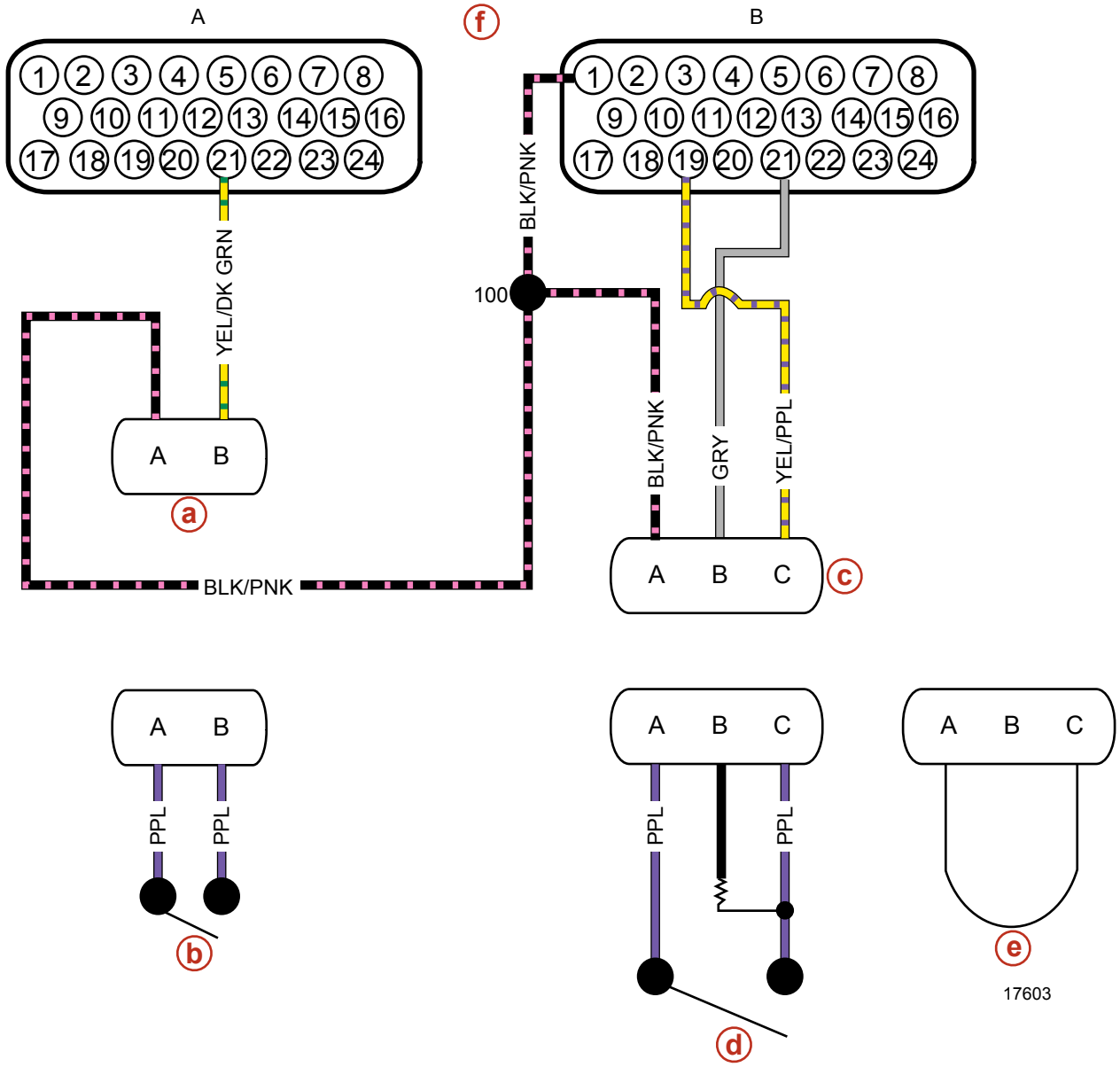
a - Crankshaft position sensor
b - Camshaft position sensor
c - ECM 555 connector B
d - Manifold air pressure and manifold air temperature
e - Throttle position sensor

Engine Coolant Temperature, Seawater Pump, and Oil Pressure Sensors



a - Engine coolant temperature
b - Seawater pump pressure
c - Oil pressure
d - ECM 555 connector B

Gear Indicator and Shift Interrupt—Sterndrive



a - Gear indicator connector

b - Gear indicator switch (closed in neutral, open in gear, normally closed switch)

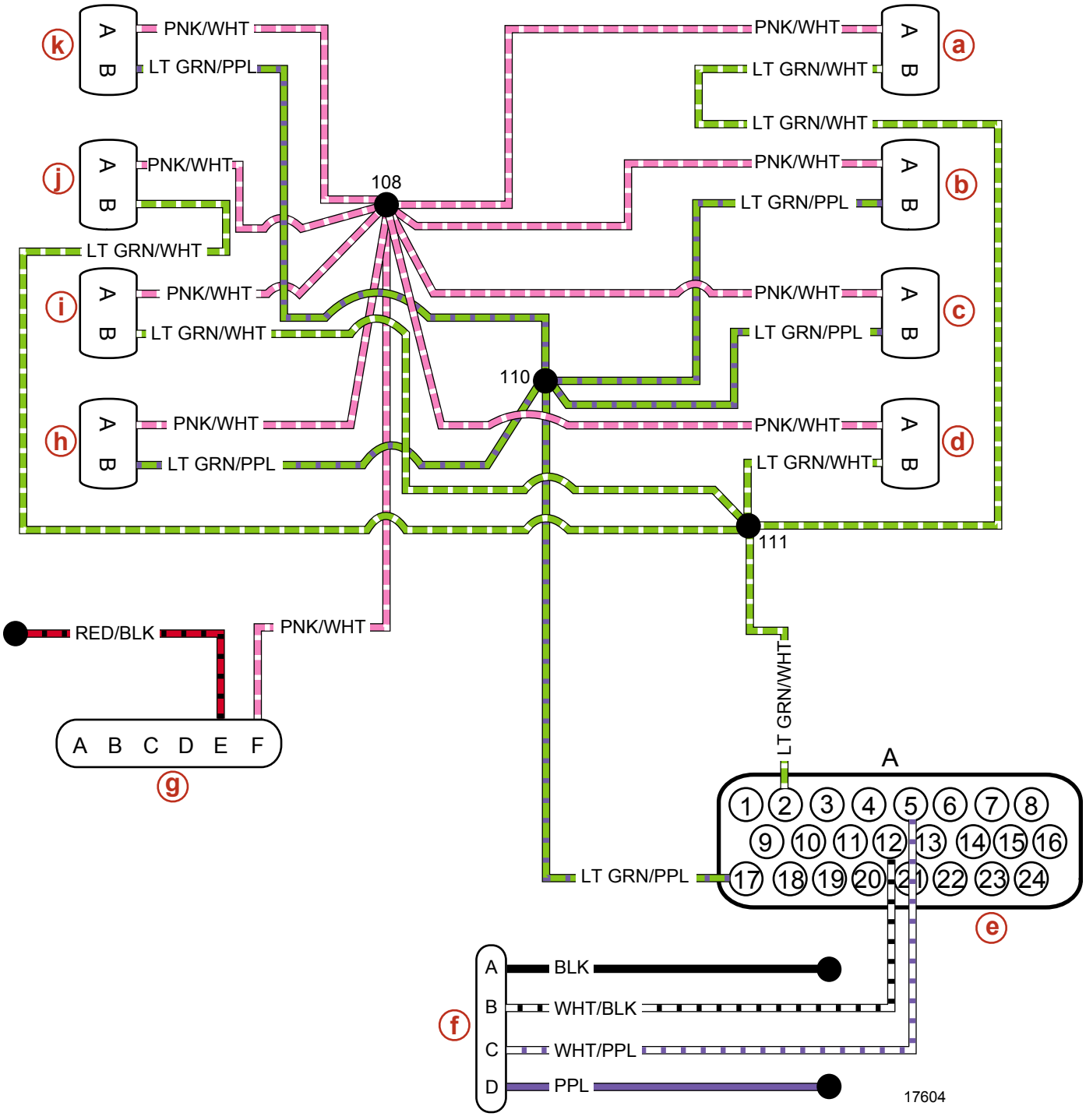
c - Shift interrupt switch connector

d - Shift interrupt switch—Alpha models (A to C normally closed, A to C open with switch engaged, A to B 10K ohms with switch released, A to B 8K ohms with switch engaged, B to C always 10K ohms)

e - Jumper plug (Bravo models)

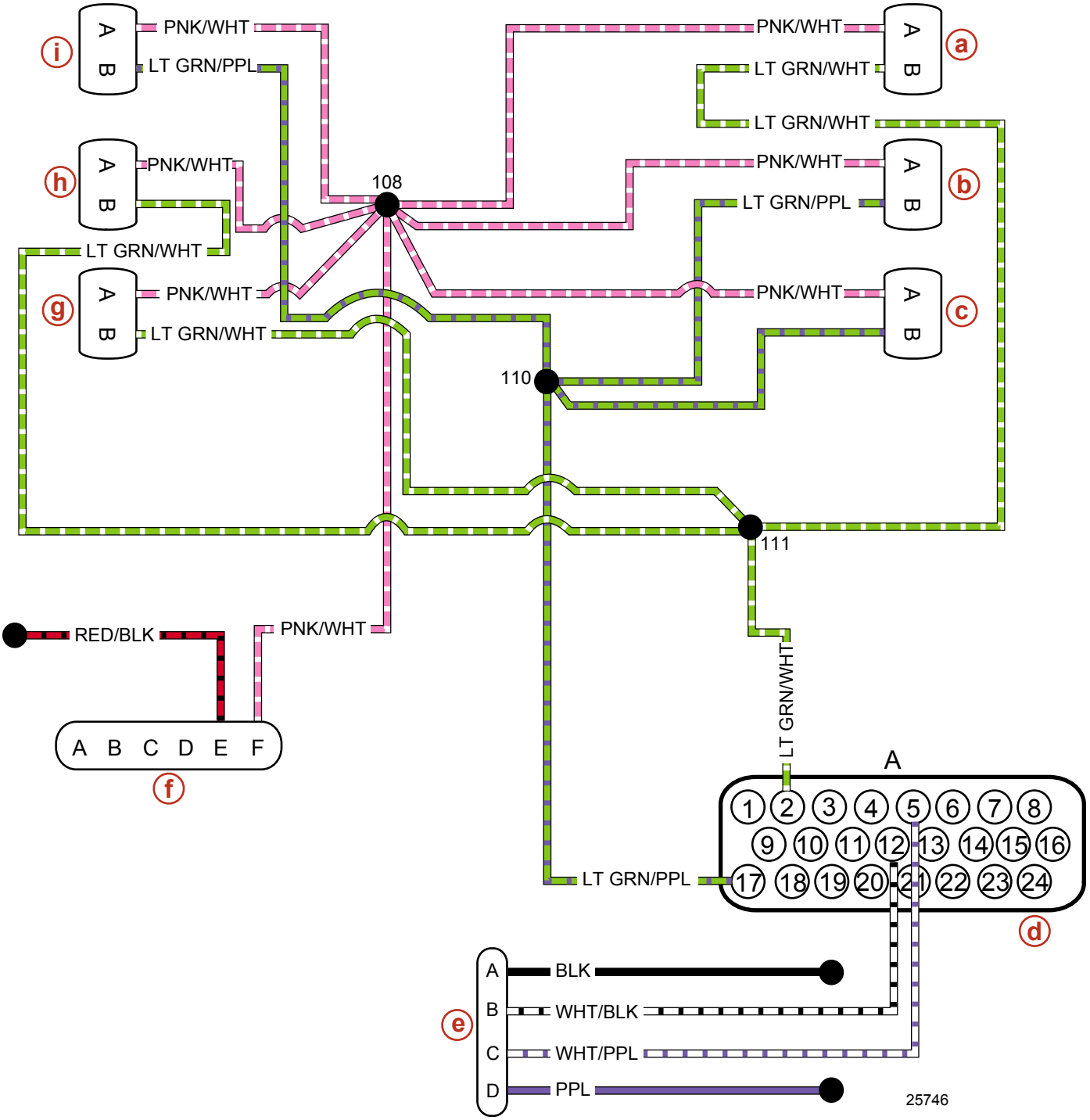
f - ECM 555 connectors A and B

Fuel Injector Control Circuits and Diagnostic Circuits–Batch-Fired Injector System



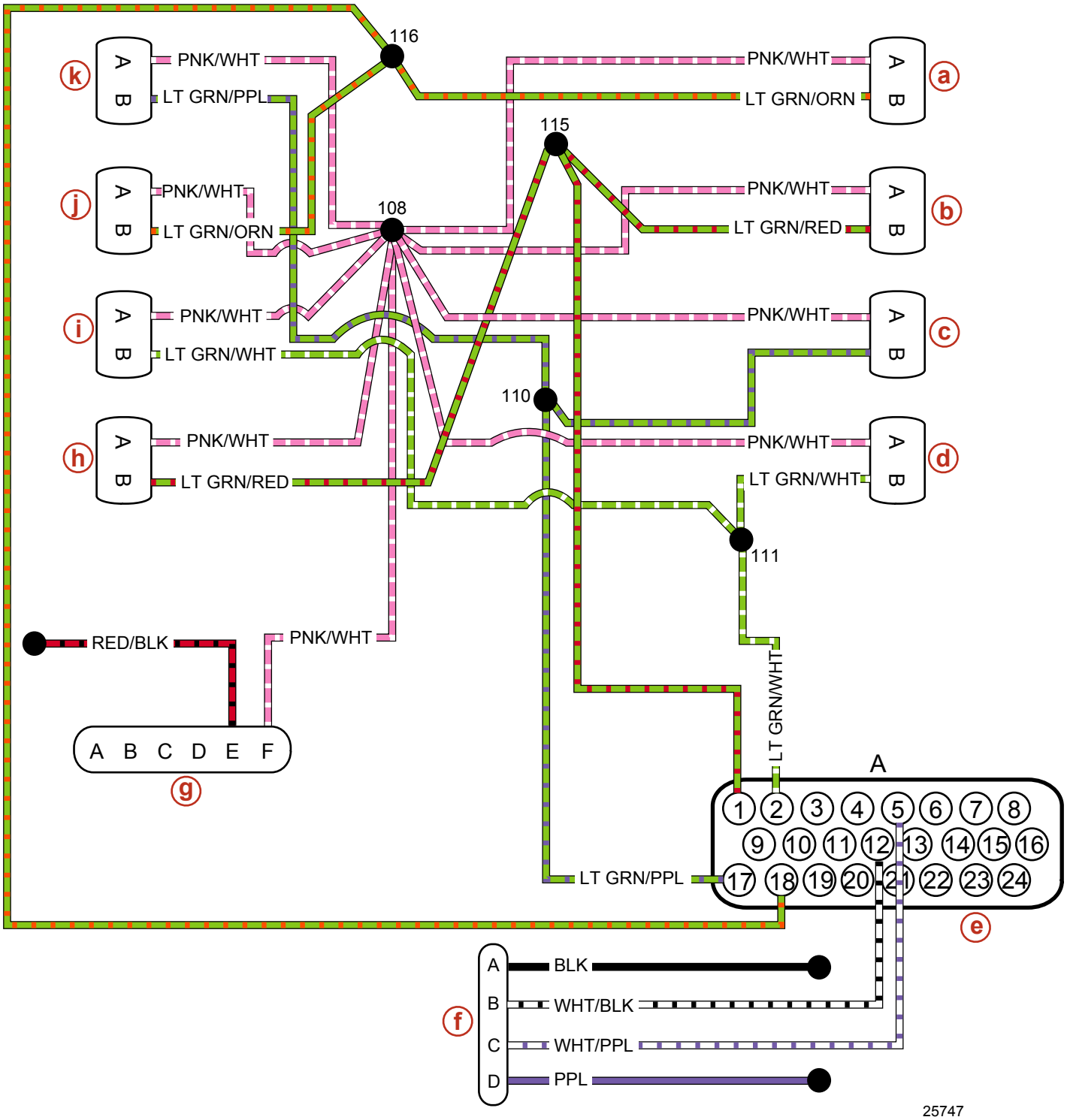
a - Injector 2
b - Injector 4
c - Injector 6
d - Injector 8
e - ECM 555 connector A
f - Diagnostic connector
g - Fuse holder
h - Injector 7
i - Injector 5
j - Injector 3
k - Injector 1

Fuel Injector Control Circuits and Diagnostic Circuits—Batch-Fired Injector System (V6 Sterndrive)



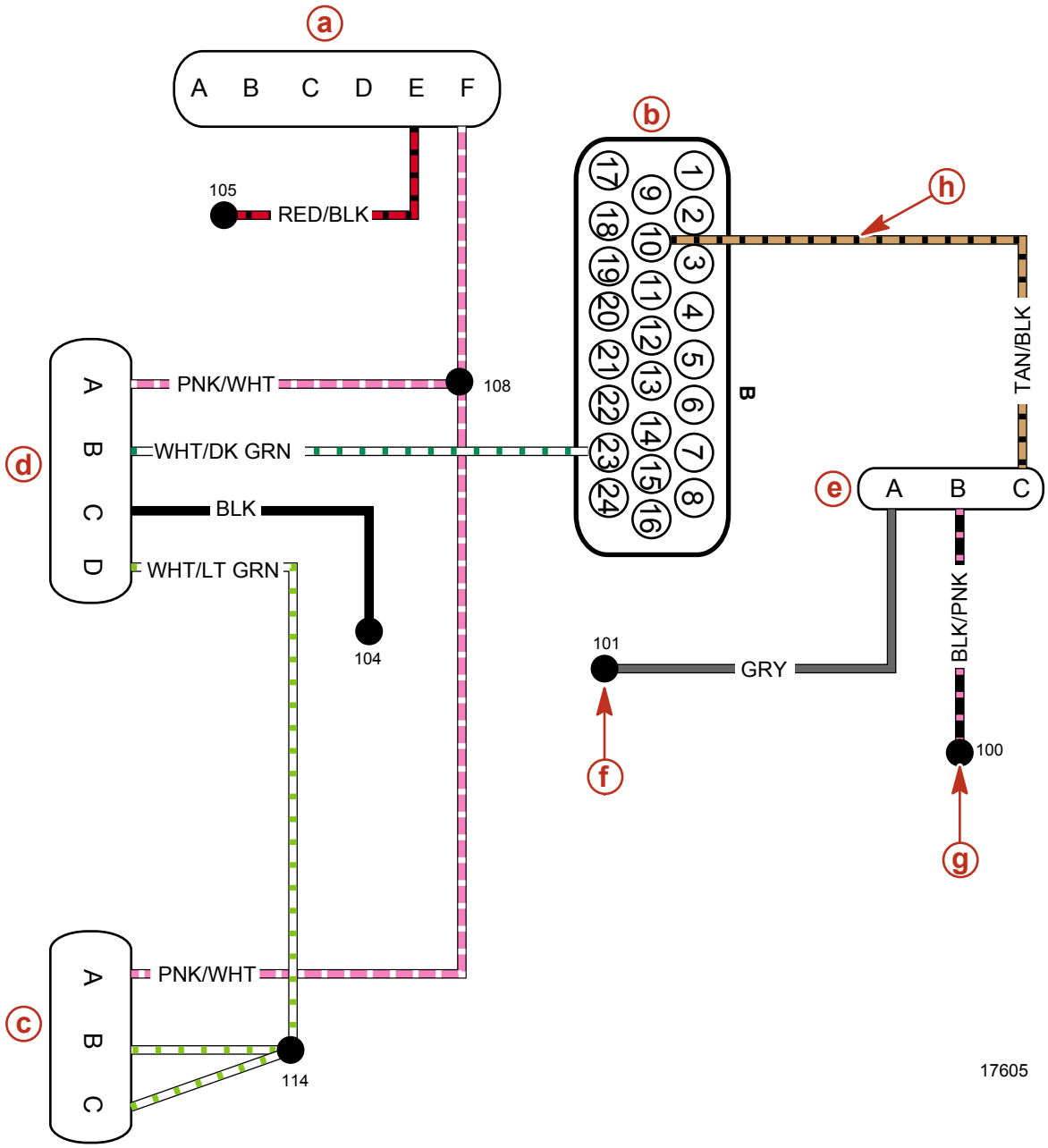
a - Injector 2
b - Injector 3
c - Injector 5
d - ECM 555 connector A
e - Diagnostic connector
f - Fuse holder
g - Injector 6
h - Injector 4
i - Injector 1

Fuel Injector Control Circuits and Diagnostic Circuits—Semi–Batch-Fired (V8)



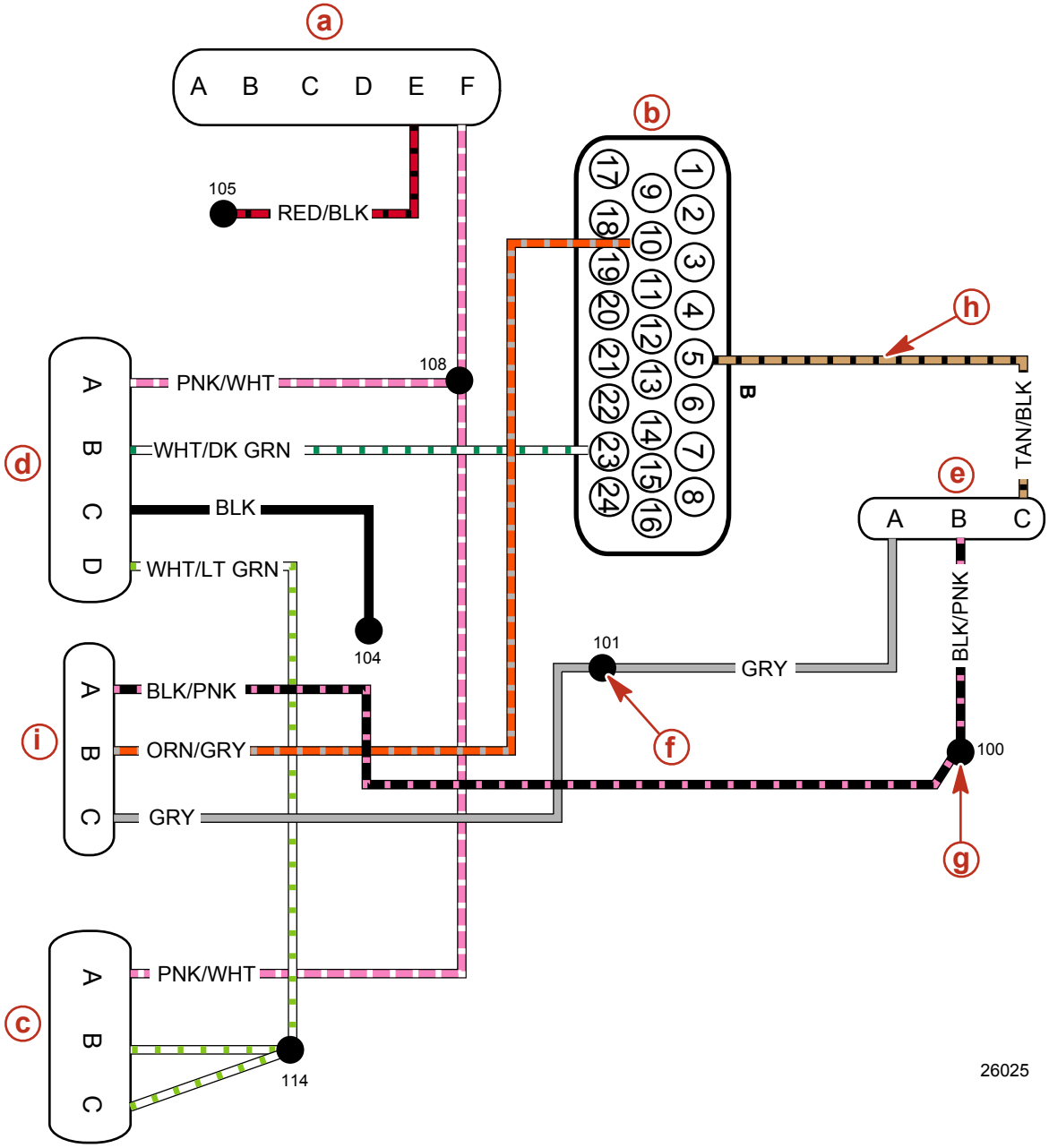
a - Injector 2
b - Injector 4
c - Injector 6
d - Injector 8
e - ECM 555 connector A
f - Diagnostic connector
g - Fuse holder
h - Injector 7
i - Injector 5
j - Injector 3
k - Injector 1

Ignition System Without Cam Position Sensor



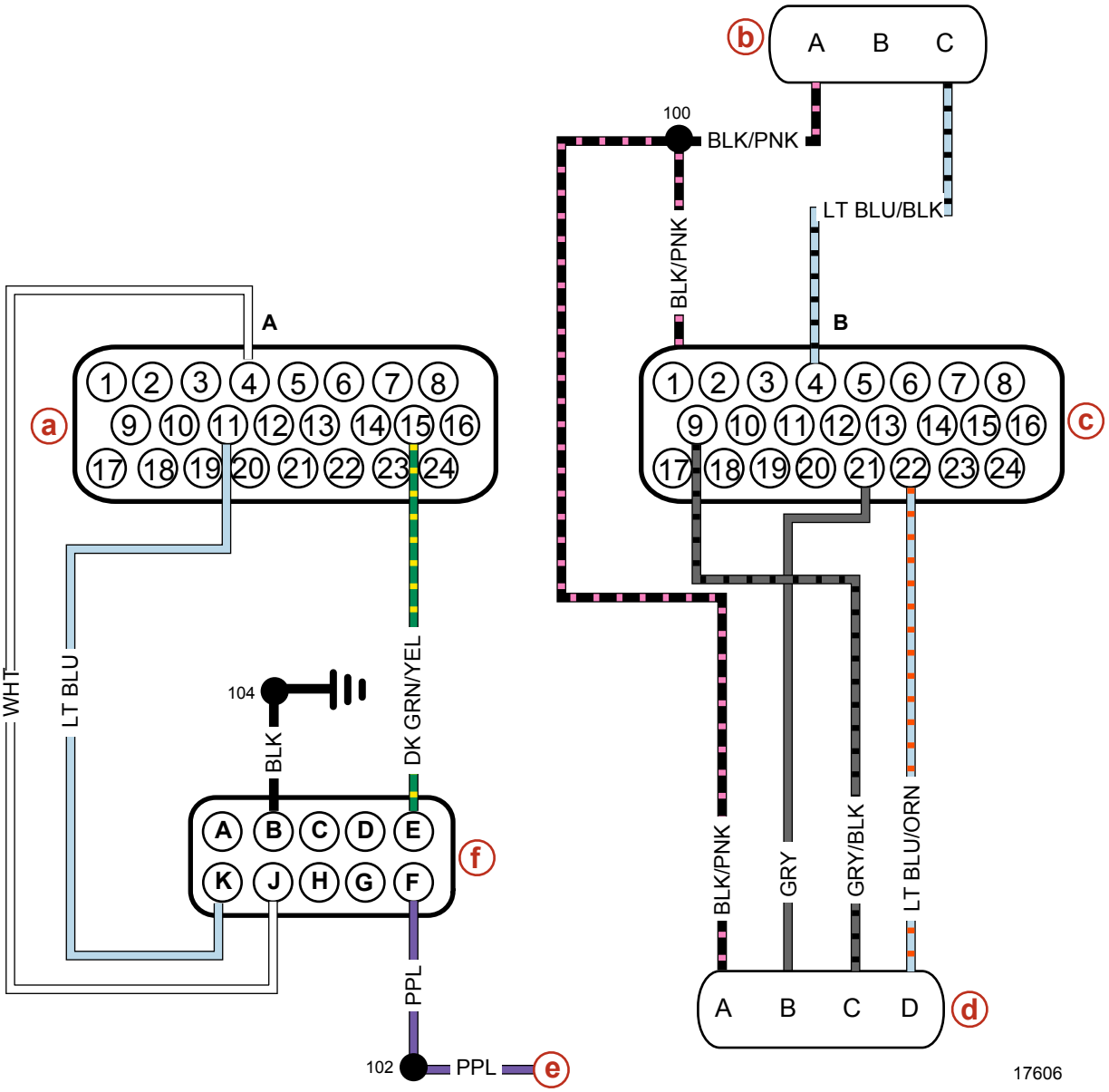
a - Fuse holder
b - ECM 555 connector B
c - Ignition coil
d - Ignition coil driver module
e - CPS connector
f - 5-volt power
g - 5-volt ground
h - CPS signal

Ignition System With Cam Position Sensor



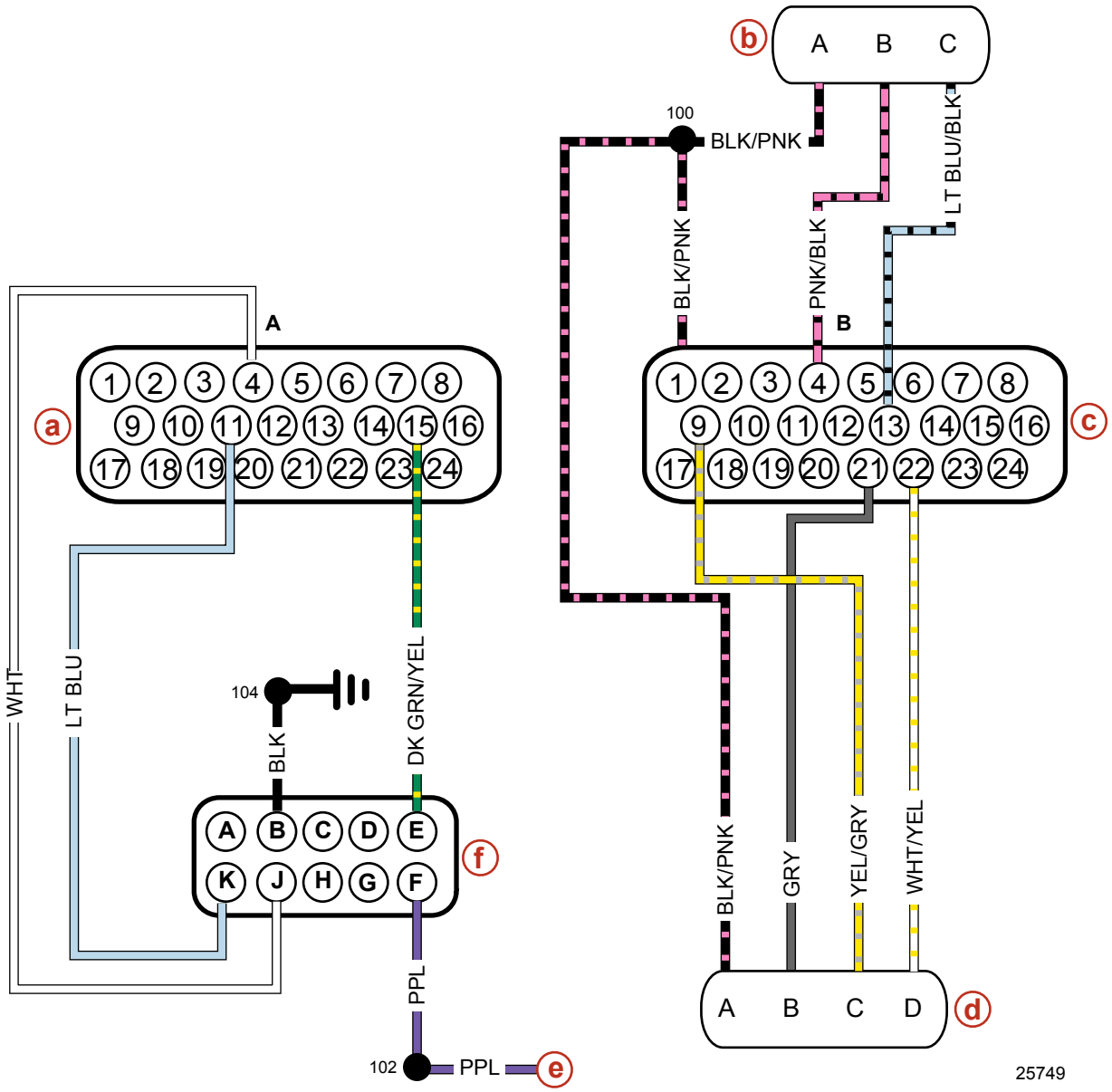
a - Fuse holder
b - ECM 555 connector B
c - Ignition coil
d - Ignition coil driver module
e - CPS connector
f - 5-volt power
g - 5-Volt ground
h - CPS signal
i - Cam sensor

CAN, Fuel Level, Paddle Wheel, and Temperature Circuits—V6 Sterndrive



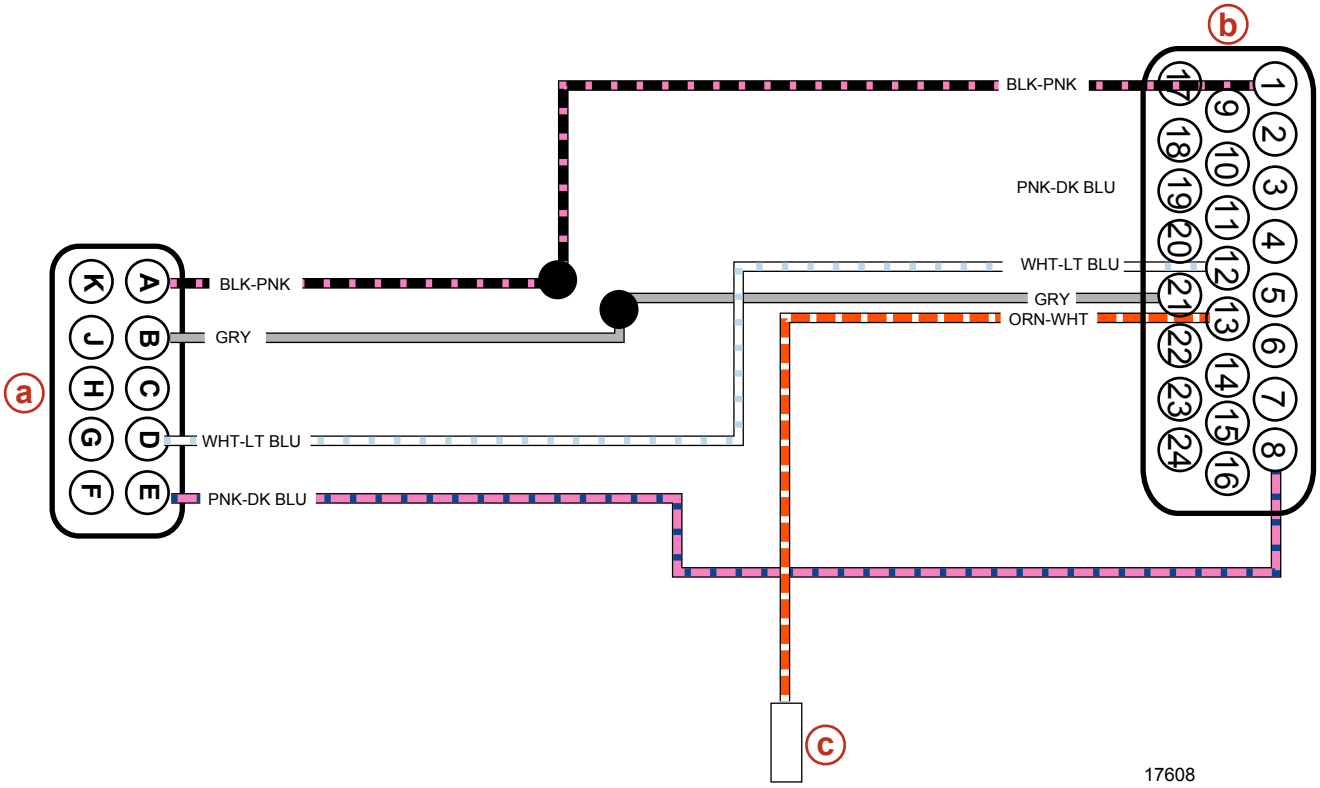
a - ECM 555 connector A
b - Fuel level connector
c - ECM 555 connector B
d - Paddle wheel/seawater temp connector
e - To 10-pin connector key switch
f - CAN connector

CAN, Fuel Level, Paddle Wheel, and Temperature Circuits—V8 Sterndrive and Inboard



a - ECM 555 connector A
b - Fuel level connector
c - ECM 555 connector B
d - Paddle wheel and seawater temperature connector
e - To 10-pin connector key switch
f - CAN connector

Transom Harness Connector (to Engine)

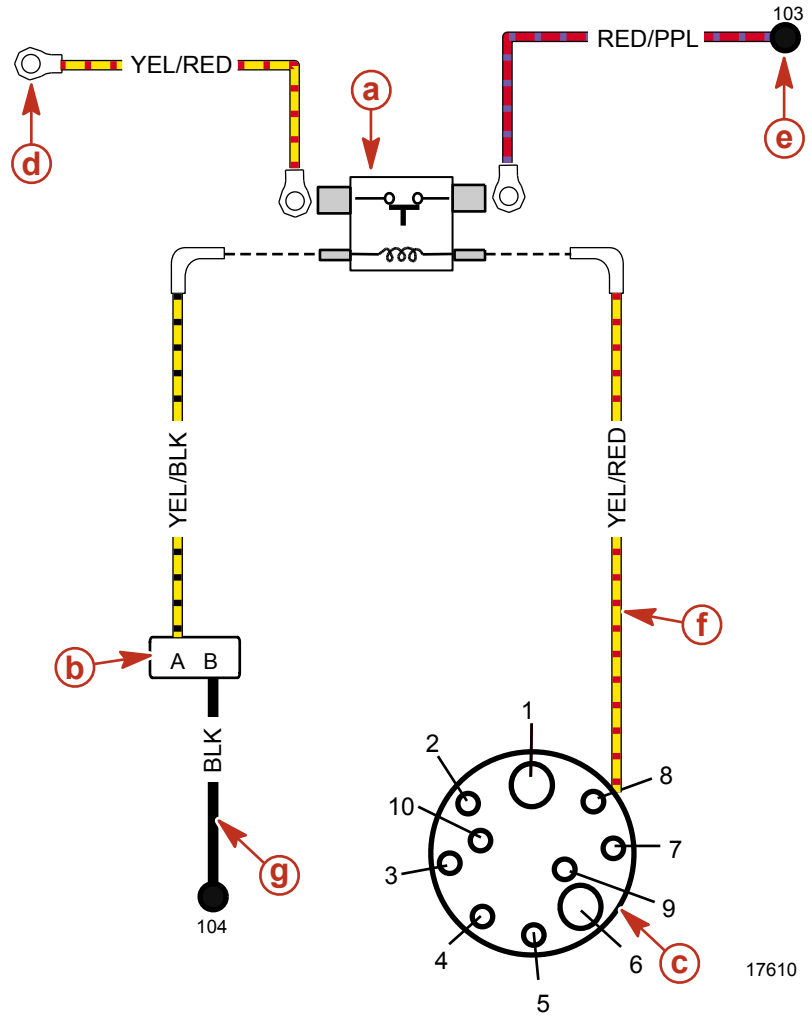


a - Transom harness connector (on engine harness); Pin D (pitot signal), Pin E (steering signal)

b - ECM 555 connector B

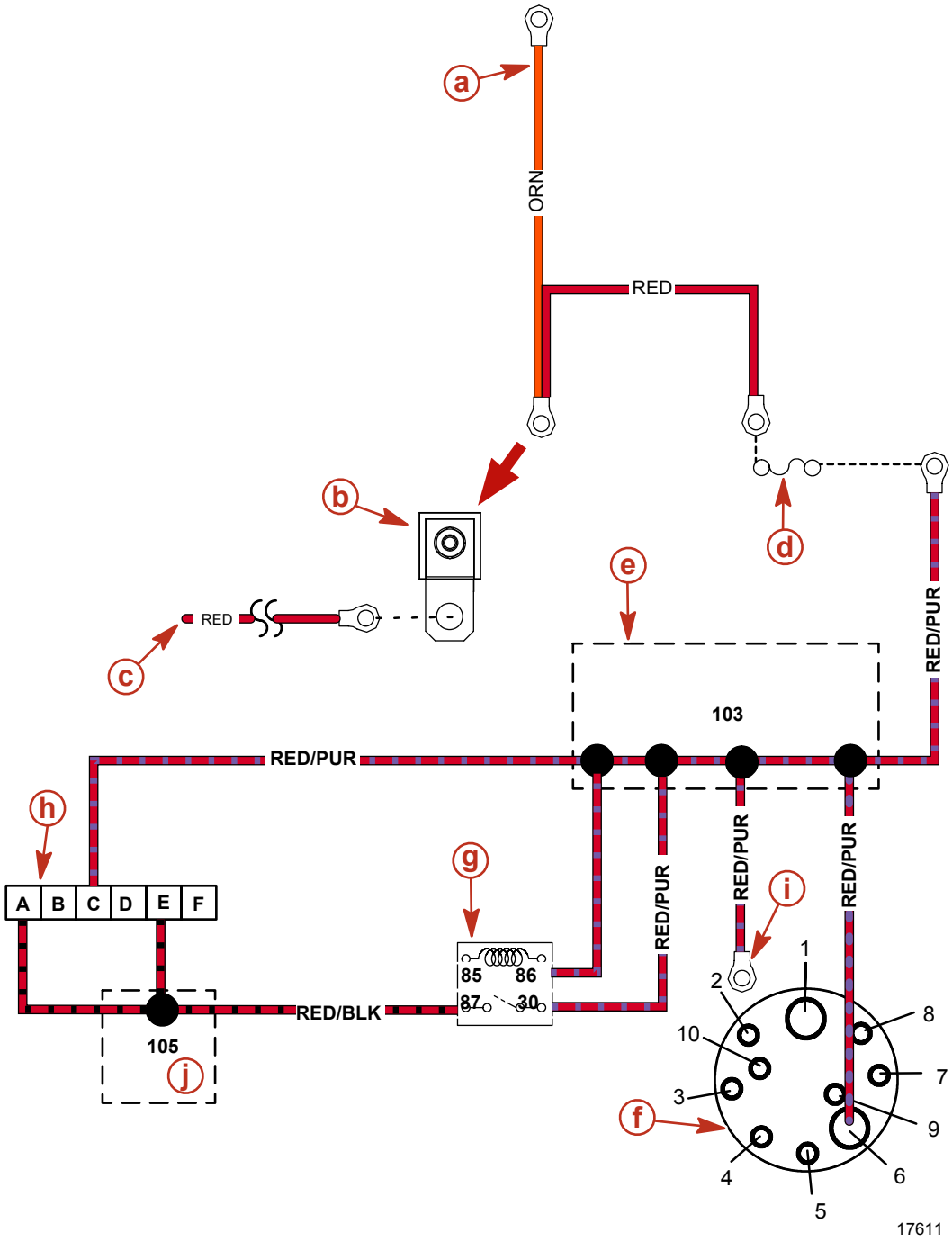
c - Digital trim

Starter Solenoid Circuit



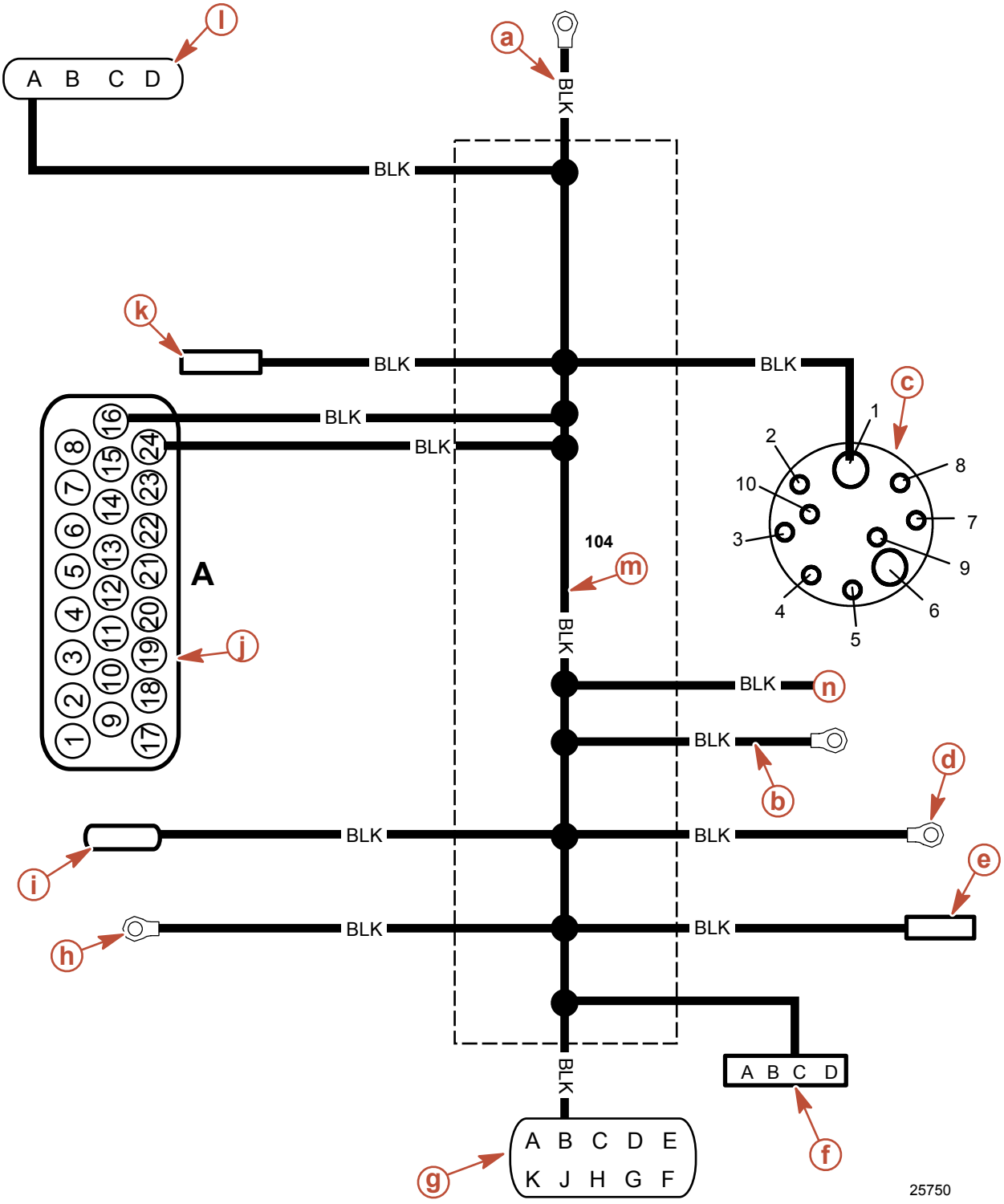
a - Starter solenoid
b - Neutral safety switch (inboard)
c - 10-pin connector
d - Starter solenoid "S" terminal
e - 12-volt power
f - Key switch–start
g - 12-volt ground (inboard)

Alternator Output Circuit



a - From alternator
b - Fuse on starter
c - To battery
d - 50-amp circuit breaker
e - Splice 103
f - 10-pin
g - Main power relay
h - Fuses
i - Starter solenoid power
j - Splice 105

Engine 12-Volt Ground Circuit—All engines

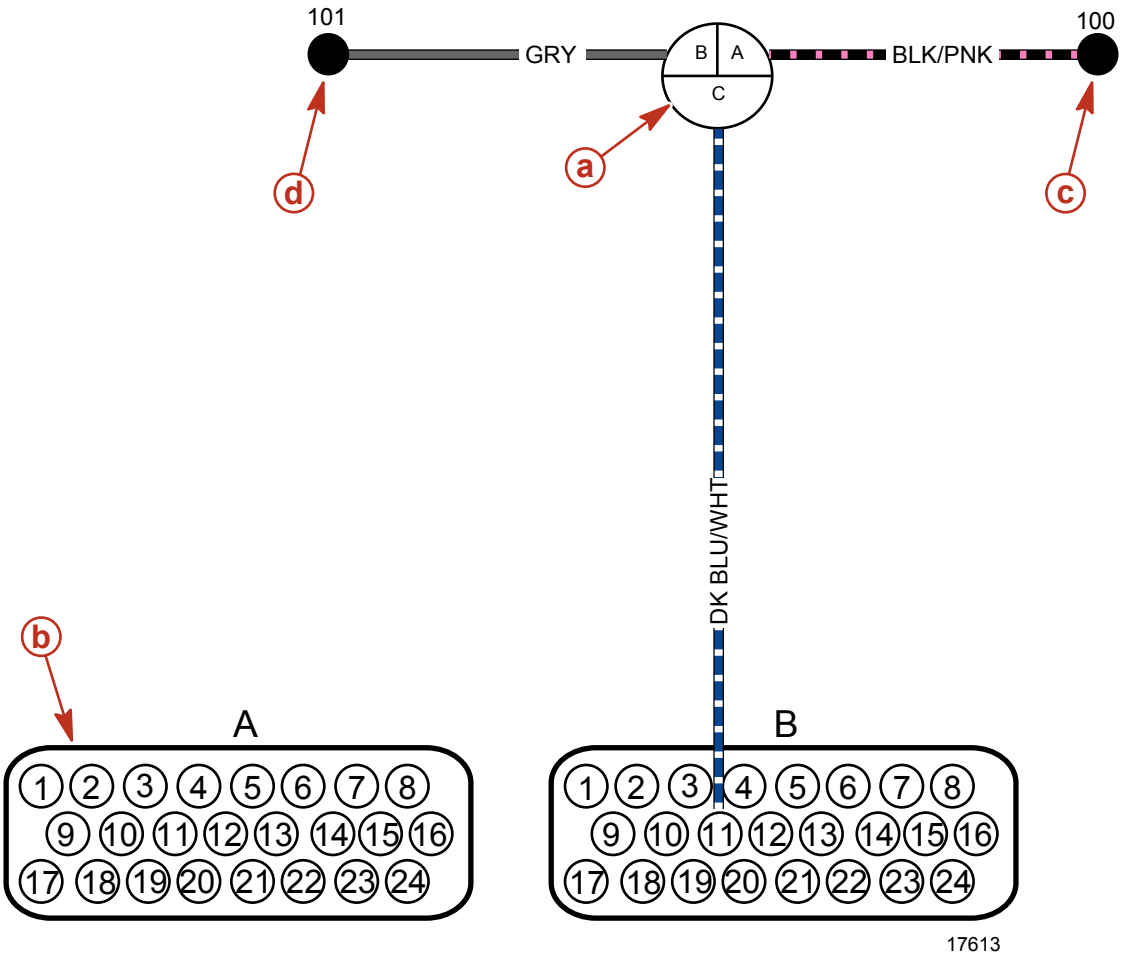


a - Engine ground
b - Neutral safety switch (inboard)
c - 10-pin connector
d - Alternator
e - Transmission over-temperature and trim
f - Coil driver
g - CAN line
h - Mercathode
i - Starter solenoid ground (inboard)
j - ECM connector A
k - Lube monitor ground
l - Diagnostic
m - Splice 104
n - To fuel pump

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

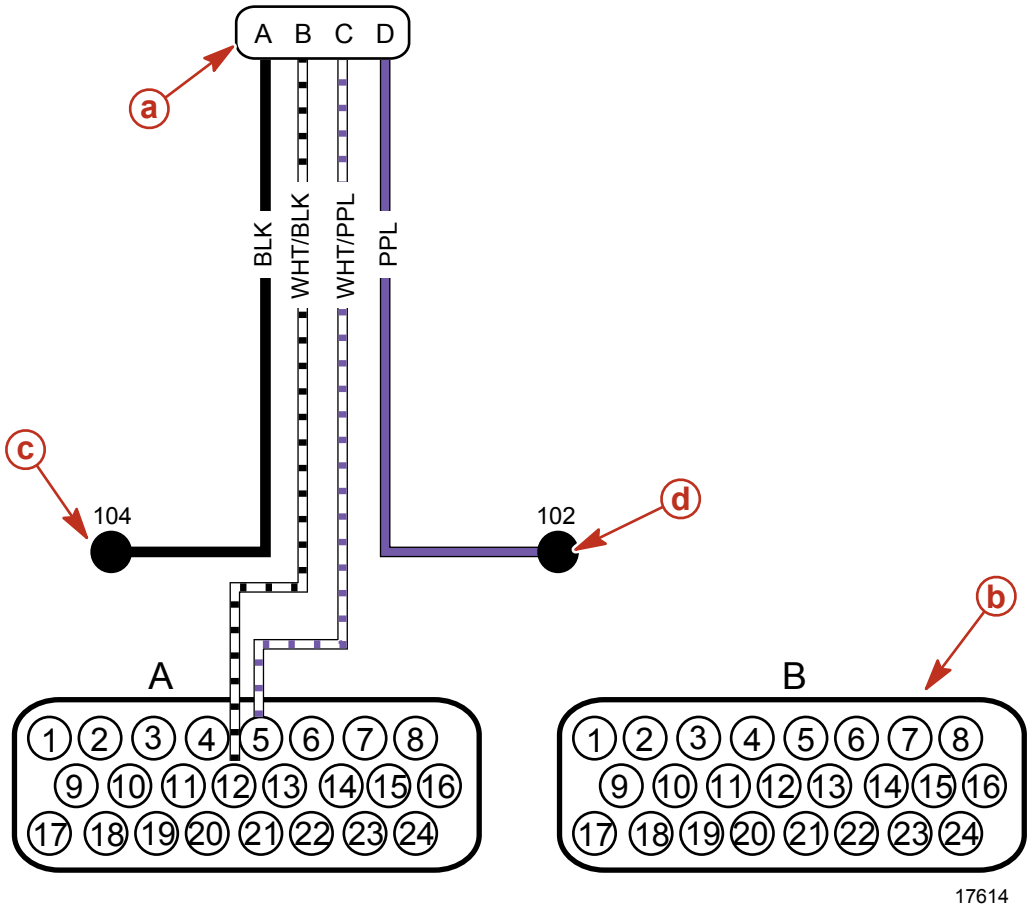


a - Seawater pump sensor connector
b - ECM
c - 5-volt ground
d - 5-volt power

Seawater pump pressure sensor and water inlet pressure specifications are in the ECM Diagnostics Systems Information file. To check if the 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



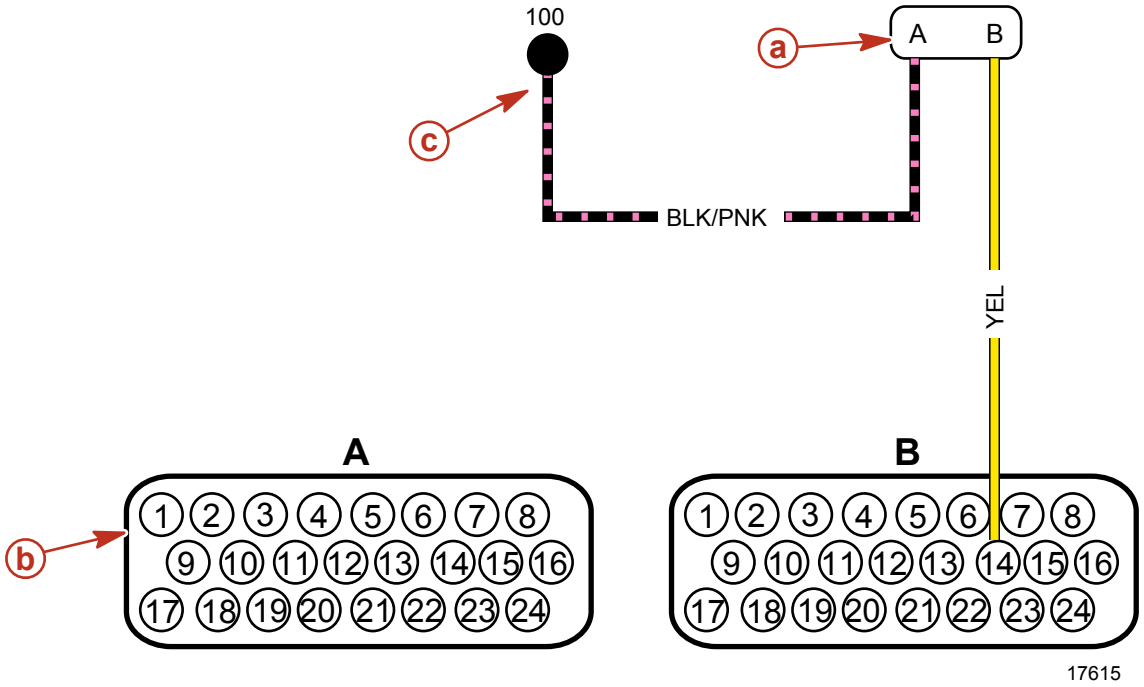
a - Diagnostic connector
b - ECM connectors A and B
c - 12-volt ground
d - 12-volt power

The data link connector (DLC) is a 4-pin circuit for attaching the diagnostic tool to the ECM. The DLC 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 ECM. Pin D is the 12-volt supply to the diagnostic tool.

IMPORTANT: Diagnostic tools can only receive data with the key on or engine operating. Diagnostic tools need a minimum of 9.5 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



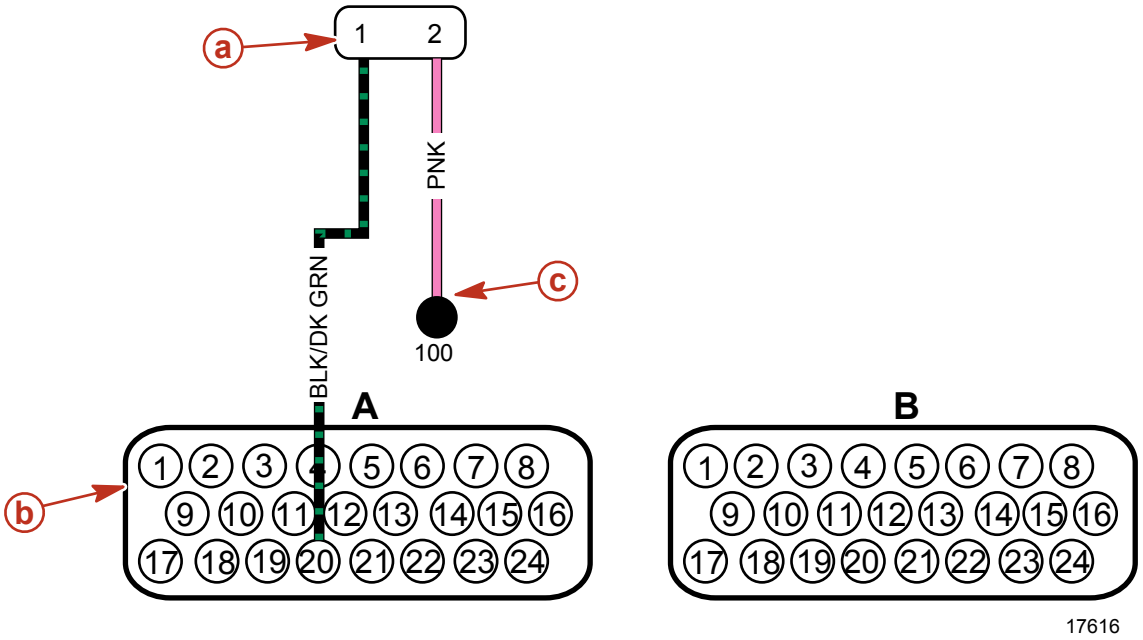
a - ECT sensor connector
b - ECM
c - 5-volt ground

The engine coolant temperature (ECT) sensor is a thermistor immersed in the engine coolant stream. The ECT 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

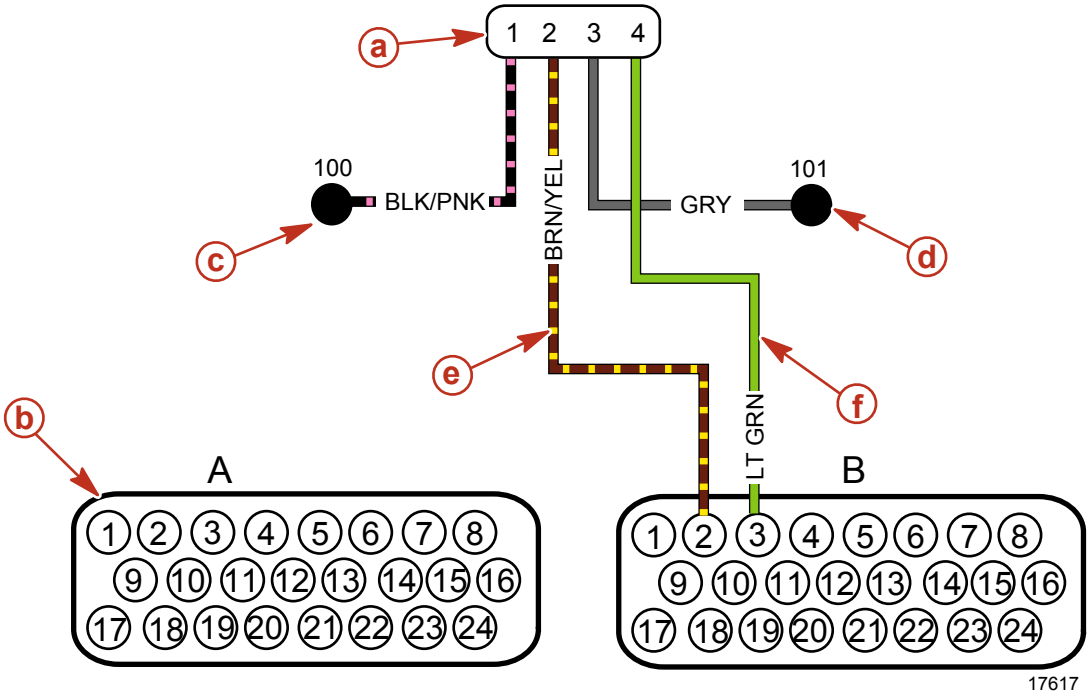


a - IAC sensor connector
b - ECM connector A and B
c - 12-volt key power

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

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

TMAP Circuit



a - TMAP sensor connector
b - ECM connector A and B
c - 5-volt ground
d - 5-volt power
e - MAT signal
f - MAP signal

The MAP/MAT sensor measures both manifold air temperature and manifold air pressure. The two measures function 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.

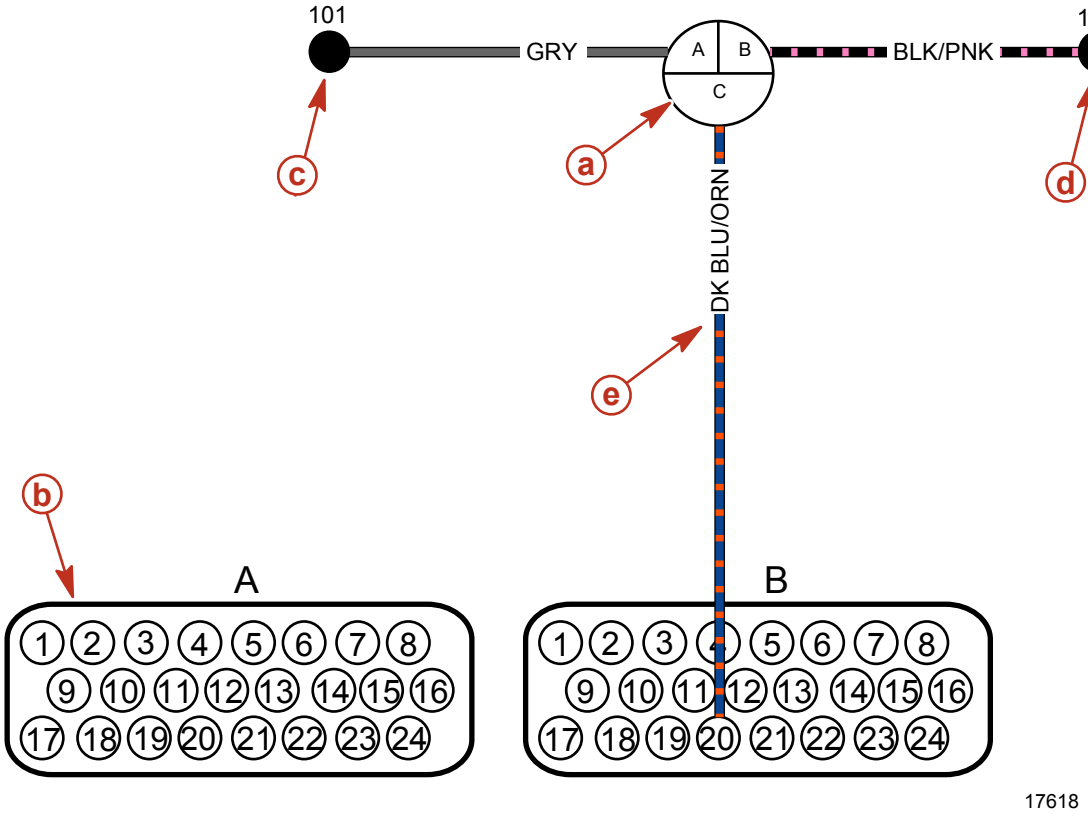
A malfunction in the MAT will set the fault of AIR TMP CKT Hi or AIR TMP CKT Lo.

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 recorded 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 to 2.0 volts at idle to about 4.0 to 5.0 volts at WOT.

A malfunction in the MAP sensor circuit sets the fault of MAP Sensor Input HI or MAP Sensor Input Lo.

Throttle Position Circuit

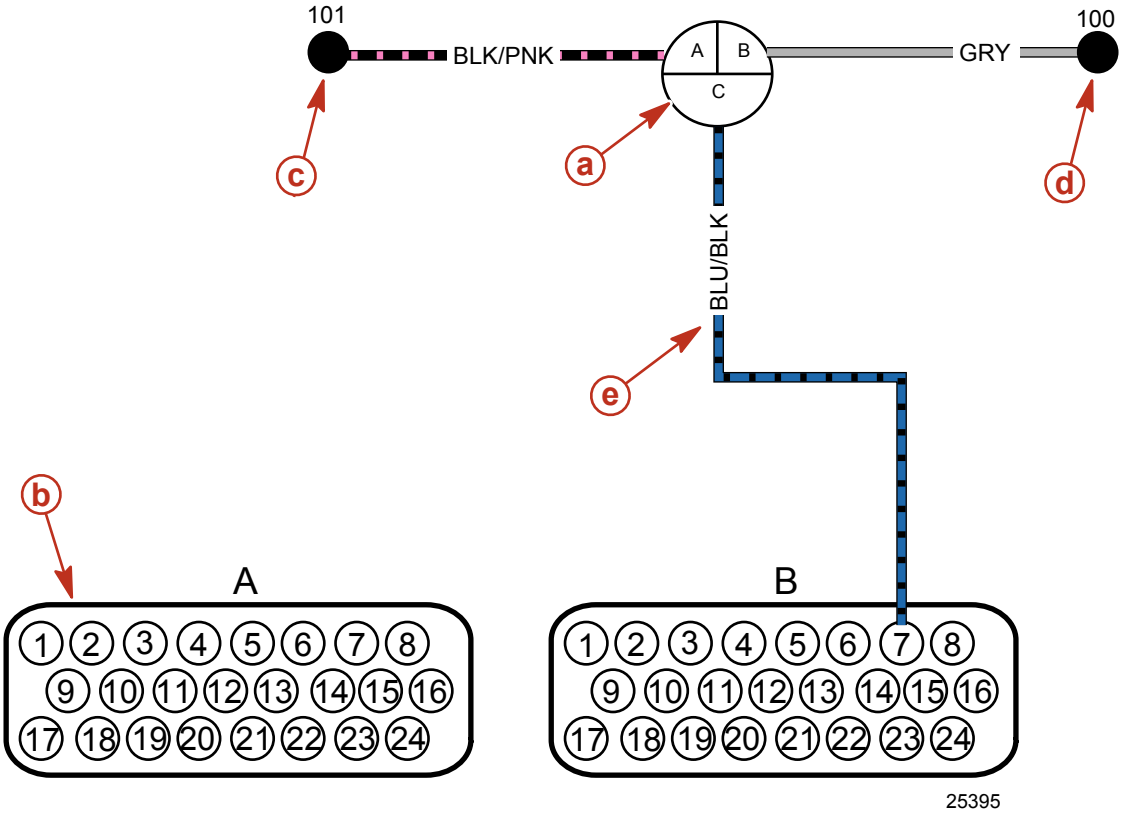


a - TPS connector
b - ECM connector A and B
c - 5-volt power
d - 5-volt ground
e - TPS signal

The throttle position sensor (TPS) sends throttle plate angle information to the ECM. The TPS is located on the throttle body. Signal voltage should vary from 0.5 volts at idle to 4.8 volts at WOT, although these numbers can vary by model. If the TPS malfunctions, the ECM will reset to a default value.

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

Oil Pressure Circuit

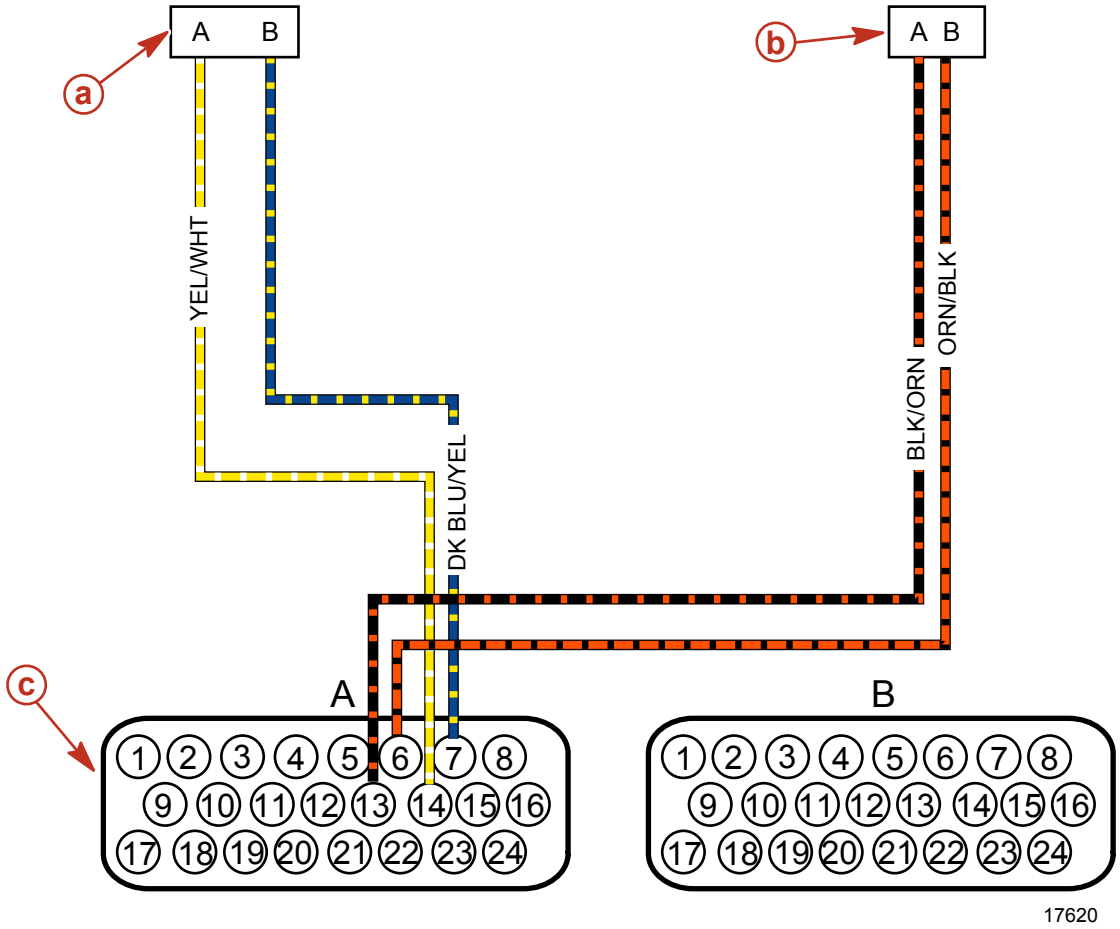


a - Oil pressure sensor connector
b - ECM connector A and B
c - 5-volt power
d - 5-volt ground
e - Signal

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 sets the fault Oil PSI CKT Hi, Oil PSI CKT Lo, or Oil PSI Lo.

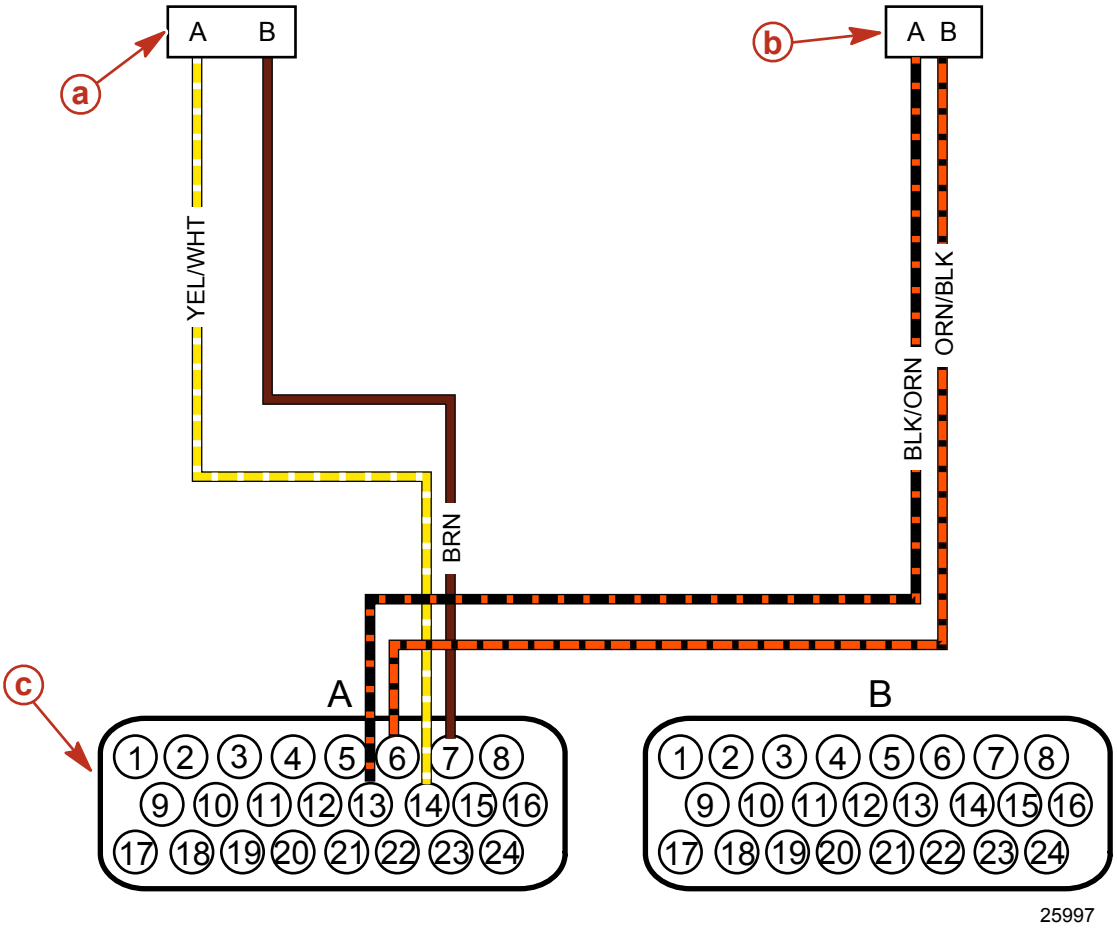
ECM Single Knock Sensor Signal—V6



a - V-6 knock sensor
b - Not used
c - ECM connector A

The knock sensor detects engine detonation, or spark knock, and sends a voltage signal to the ECM. It is located on the lower half of the engine on the port side near the oil sending transducer. As the sensor detects knock, the voltage output level increases and signals the ECM of the problem.

ECM Dual Knock Sensor Signal—V8



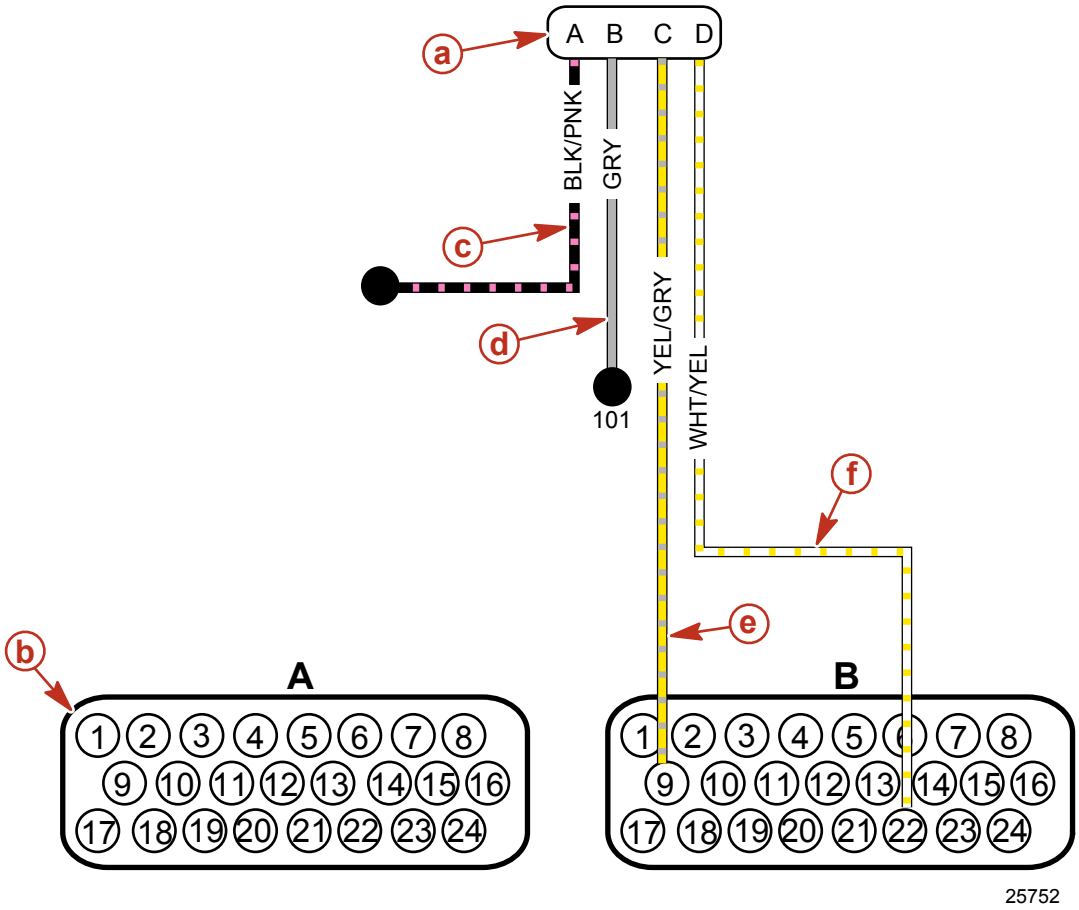
a - Starboard knock sensor (cylinders 2,4,6, and 8)

b - Port knock sensor (cylinders 1,3,5, and 7)

c - ECM connector A

The knock sensor detects engine detonation, or spark knock, and sends a voltage signal to the ECM. It is located on the lower half of the engine on the port side near the oil sending transducer. As the sensor detects knock, the voltage output level increases and signals the ECM of the problem.

Paddle Wheel Connector Circuit—All Engines

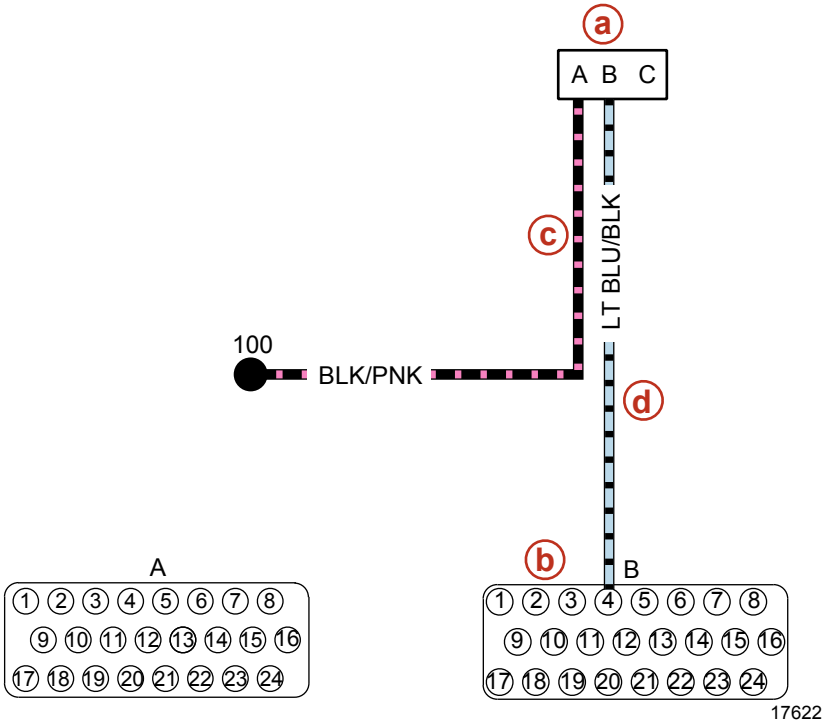


a - Paddle wheel connector
b - ECM connector A and B
c - 5-volt ground
d - 5-volt power
e - Paddle wheel
f - Water temperature

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. The paddle wheel circuit is located on the rear of the engine.

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

Fuel Level Circuit—V6 and V8 Sterndrive



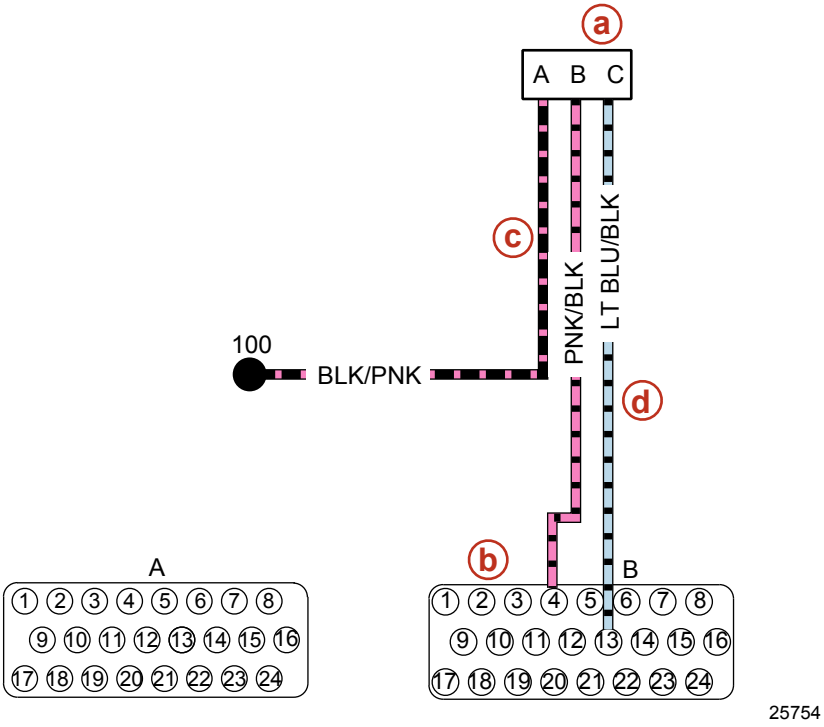
a - Fuel level connector
b - ECM connector B
c - 5-volt ground
d - Signal

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 does not set a fault.

A second tank is added on Scorpion models.

Fuel Level Circuit—V8 Inboard



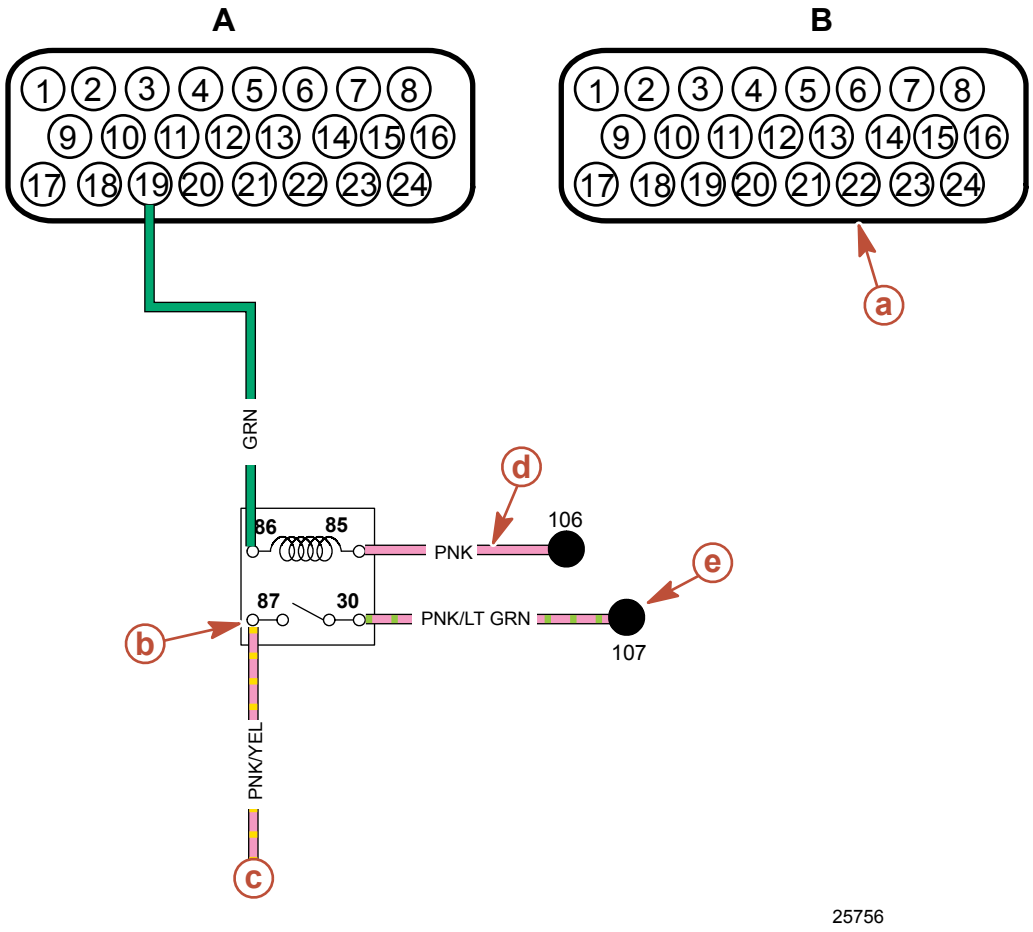
a - Fuel level connector
b - ECM connector B
c - 5-volt ground
d - Signal

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 does not set a fault.

A second tank is added on Scorpion models.

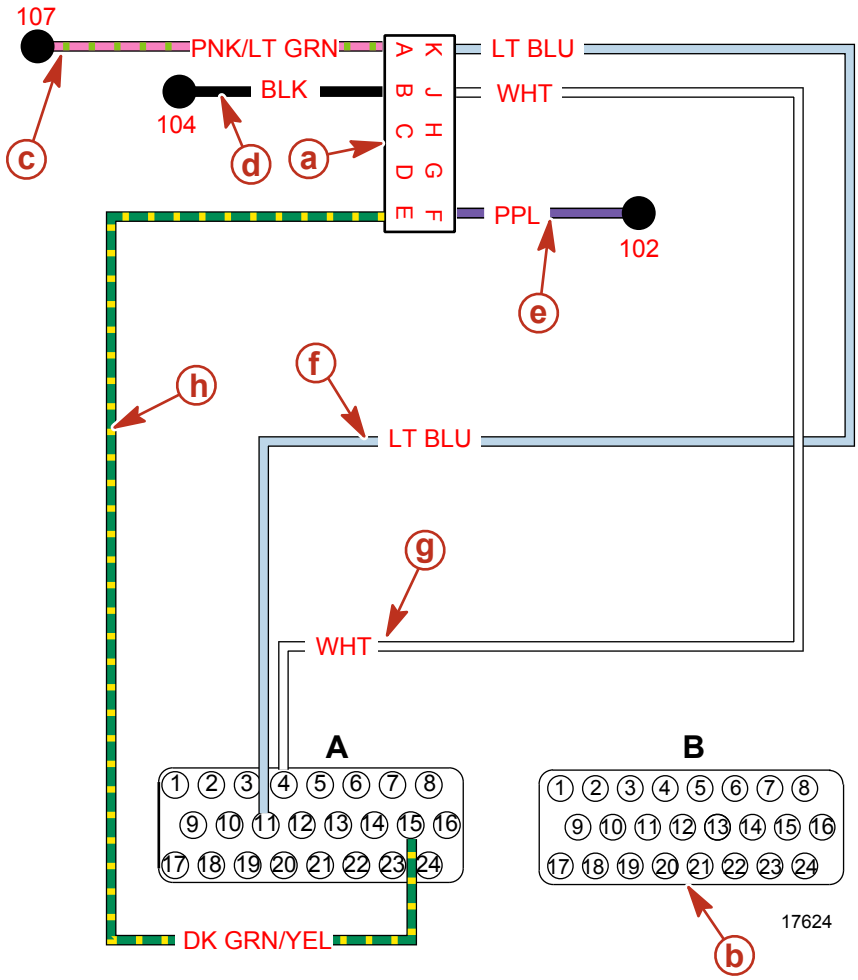
Fuel Pump Relay Circuit—All Engines



a - ECM connectors A and B
b - Fuel pump relay
c - To fuel pump
d - Switched fused 12-volt power
e - 12-volt fused power

When the key is turned to the on position the fuel pump relay receives 12-volt 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 for both fuel pumps to operate when the key is first turned to the on position.

Control Area Network (CAN) Circuit—V6 and V8



a - CAN line connector
b - ECM connectors A and B
c - Fuse 12-volt power
d - 12-volt ground
e - Wake line
f - CAN line (–)
g - CAN 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 set a fault.