ELECTRICAL

Section 2A – Ignition

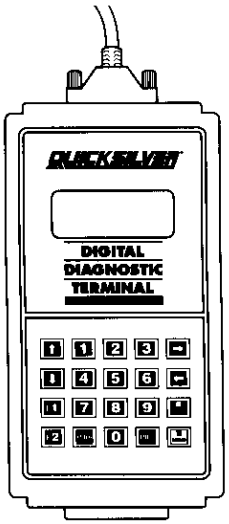
Table of Contents

Specifications

IGNITION SYSTEM	**Type**	Digital Inductive
	Spark Plug Type	NGK PZFR5F-11
	Spark Plug Gap	0.043 in. (1.1 mm)
	Maximum Timing	Not Adjustable; Controlled by ECM
	Idle Timing	Not Adjustable; Controlled by ECM
	Throttle Position Sensor	
	@ Idle	0.4 – 1.3 VDC
	@ WOT	4.0 – 4.7 VDC
	Crank Position Sensor	Not Adjustable

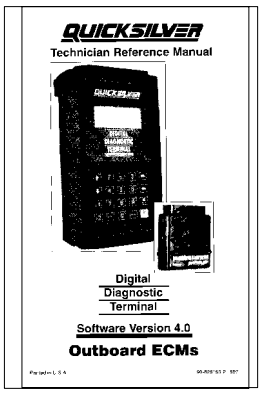
Special Tools

1. Digital Diagnostic Terminal (DDT) 91-823686A2

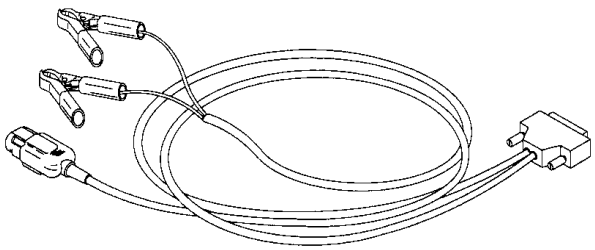


2. Software Cartridge 91-880118A2

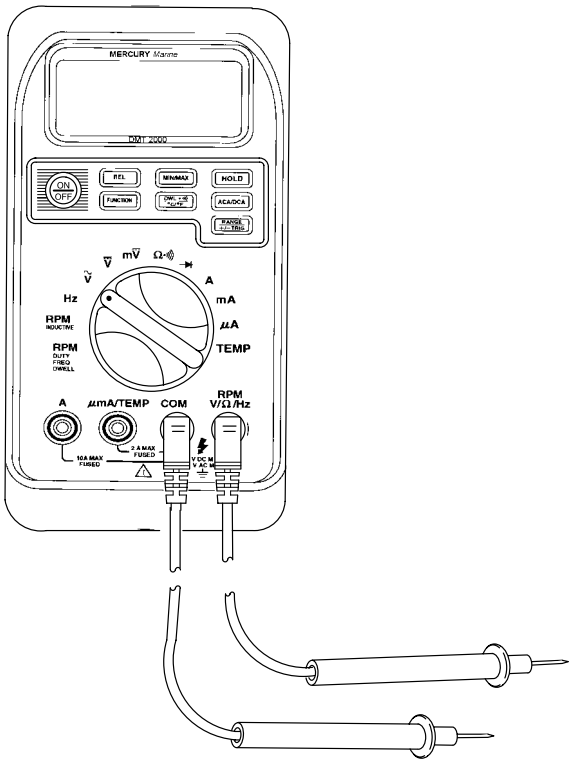
3. DDT Reference Manual 90-881204-1



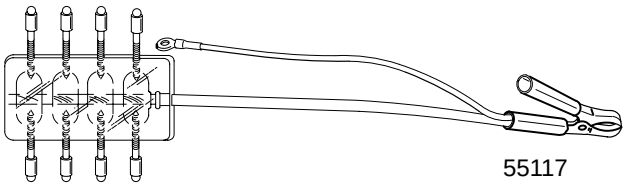
4. Adaptor Harness 84-822560A5



5. DMT 2000A Digital Tachometer Multimeter 91-854009A3



6. Spark Gap Tester 91-850439T1



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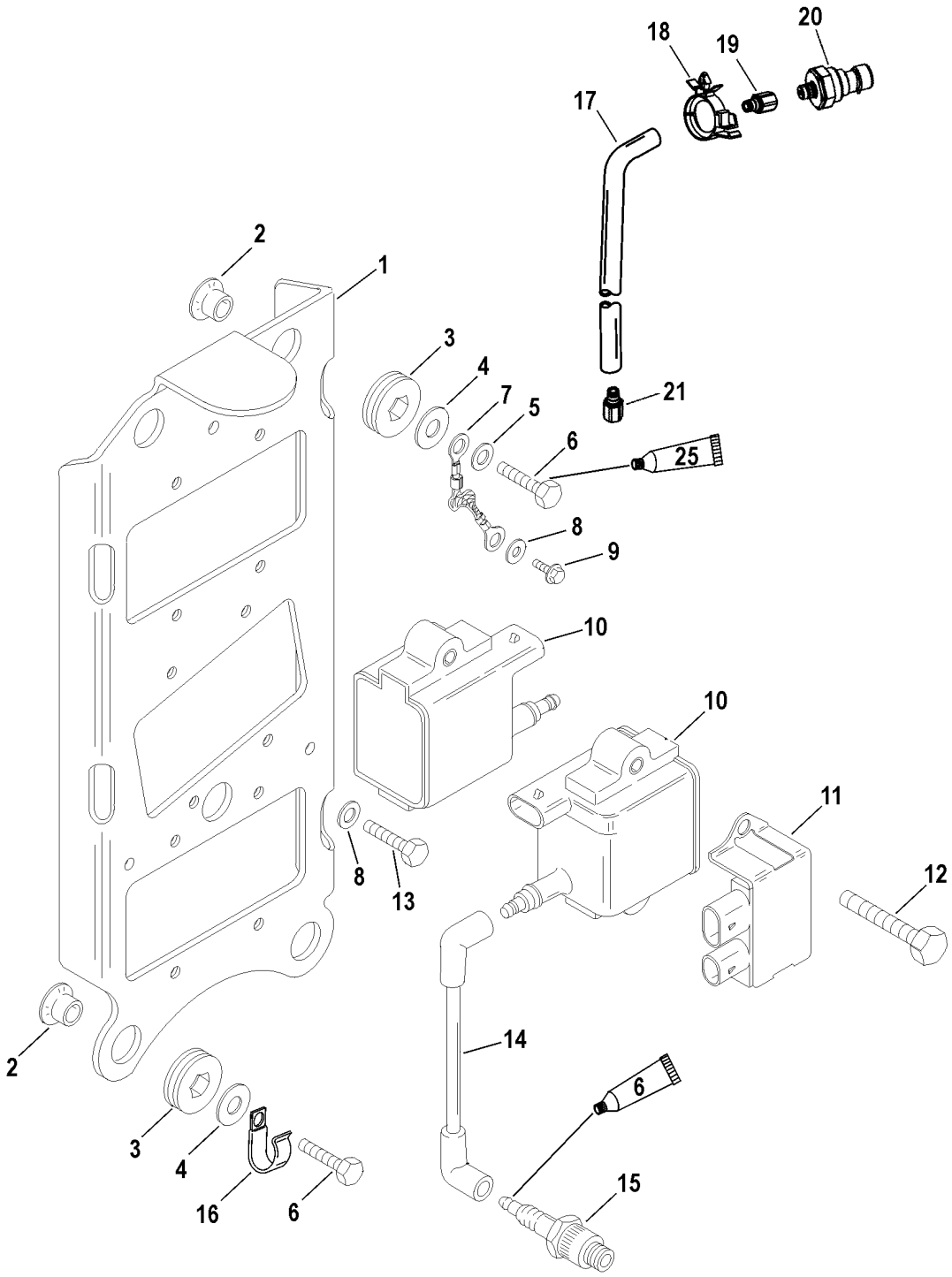
Coil Plate



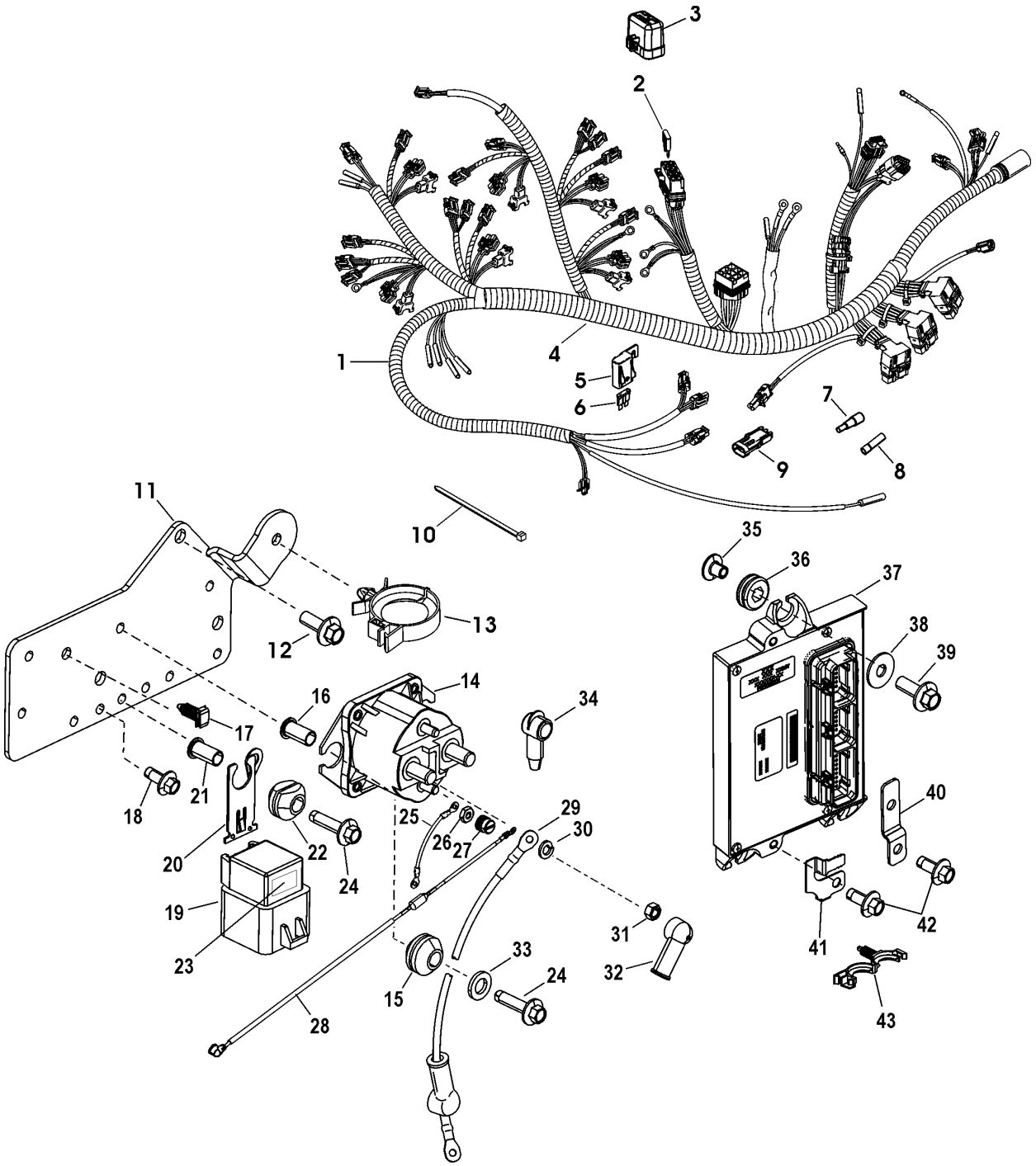
6 Dielectric Grease

25 Liquid Neoprene

Coil Plate

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
1	1	COIL MOUNTING PLATE			
2	4	BUSHING			
3	4	GROMMET			
4	4	WASHER			
5	2	WASHER			
6	4	SCREW (M8 x 35)		19.6	26.6
7	2	CABLE ASSEMBLY Ground			
8	4	WASHER			
9	2	SCREW (M6 x 10)	60		6.8
10	6	IGNITION COIL			
11	3	DUAL COIL DRIVER			
12	12	SCREW (M6 x 30)	60		6.8
13	2	SCREW (M6 x 14) Ground Cables	15		1.7
14	6	HIGH TENSION CABLE			
15	6	SPARK PLUG PZFR5F-11		20.4	27.7
16	2	J CLIP			
17	1	TUBING (18 IN.)			
18	1	CLIP			
19	1	FITTING			
20	1	SENSOR Block Pressure			
21	1	FITTING To Back Of Block-Lower Port Side			

Solenoid Plate Model



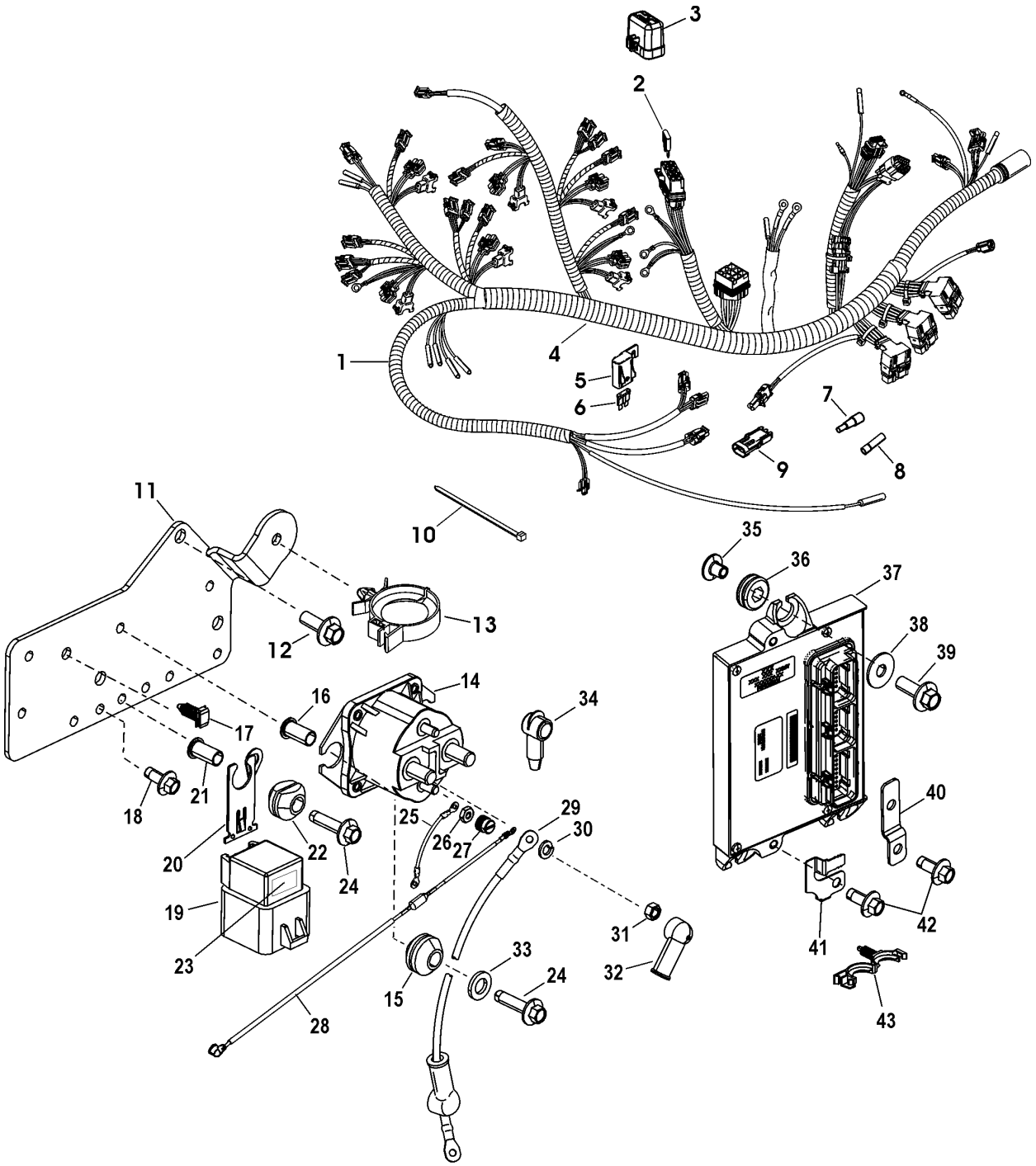
NOTE: *Coat all eyelet wiring terminals with #25 GACO N700.*

NOTE: *Coat all multi-pin electrical connections (except power trim relay connections) with #6DC-4.*

Solenoid Plate

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
1	1	HARNESS ASSEMBLY Engine			
2	4	FUSE-Mini (Yellow-20 AMP)			
2	1	FUSE-Mini (Blue-15 AMP)			
3	1	COVER-Fuse			
4	AR	CONDUIT (.035 ID X 3.00 Feet) Cut As Required			
4	AR	CONDUIT (.050 ID X 3.00 Feet) Cut As Required			
4	AR	CONDUIT (.062 ID X 3.00 Feet) Cut As Required			
4	AR	CONDUIT (1.00 ID X 3.00 Feet) Cut As Required			
5	1	COVER-Fuse			
6	1	FUSE (Tan-5 AMP)			
7	2	PLUG-Male			
8	1	CAP-Female			
9	1	CONNECTOR ASSEMBLY			
10	AR	CABLE TIE (8 IN.)			
11	1	PLATE-Relay/Solenoid Mount			
12	3	SCREW (M6 x 12)	100		11.3
13	1	CLIP			
14	1	SOLENOID ASSEMBLY			
15	2	GROMMET			
16	2	BUSHING			
17	1	CLIP			
18	2	SCREW (M6 x 14) Ground Screws	60		6.8
19	1	RELAY ASSEMBLY			
20	1	BRACKET			
21	1	BUSHING			
22	1	GROMMET			
23	1	DECAL			
24	3	SCREW (M6 x 25)	60		6.8
25	1	CABLE ASSEMBLY			
26	2	NUT (10-32) Brass	40		4.5
27	1	CAP NUT			
28	1	HARNESS ASSEMBLY-Fuse (100 AMP)(34.5 IN.)			
29	1	CABLE ASSEMBLY Starter			
30	2	LOCKWASHER			
31	2	NUT (5/16-18)	60		6.8
32	1	BOOT-Insulator (Red)			
33	1	WASHER			
34	1	BOOT-Insulator (Yellow)			
35	3	BUSHING			
36	3	GROMMET			
37	1	ECU			

Solenoid Plate Model



NOTE: *Coat all eyelet wiring terminals with #25 GACO N700.*

NOTE: *Coat all multi-pin electrical connections (except power trim relay connections) with #6DC-4.*

Solenoid Plate

REF. NO.	QTY.	DESCRIPTION	TORQUE		
			lb-in	lb-ft	Nm
38	3	WASHER			
39	3	SCREW (M6 x 25)	100		11.3
40	1	BRACKET			
41	1	CLIP			
42	2	SCREW (M6 x 14)	100		11.3
43	1	CLIP-Conduit Support			

Theory of Operation

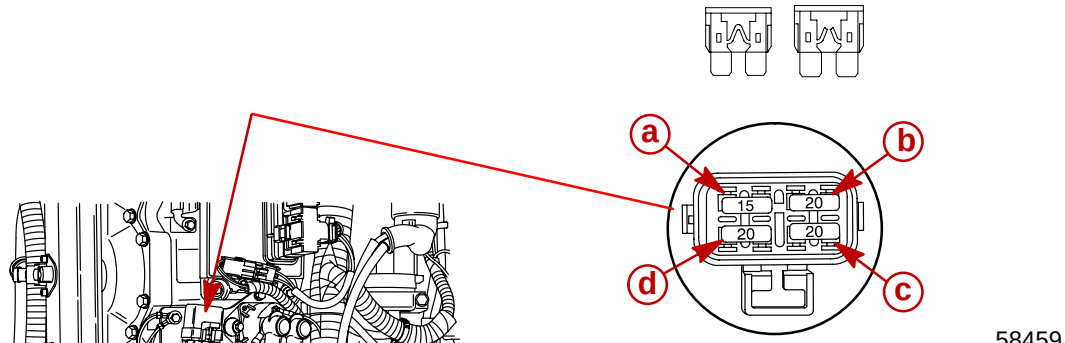
When the ignition key is turned to the RUN position, battery voltage is applied to the main relay through the PURPLE wire. When the Electronic Control Module (ECM) receives a signal from the Crank Position Sensor, the main relay ground circuit is completed through the ECM. The main relay is then closed and D.C. current from the battery or charging system is transferred through the main relay 20 ampere fuse to the positive terminal of all 6 ignition coil primary windings. The negative terminal of the coil primary is connected to engine ground through the Dual Coil Driver which is triggered by the ECM. At this time, when this circuit is closed, a magnetic field is allowed to be built up in the ignition coil. The Crank Position Sensor senses the location of the 54 teeth on the flywheel and supplies a trigger signal to the ECM. ECM provides a signal to the dual coil driver prior to cylinder firing. The Crank Position Signal the ECM receives also determines when the trigger signal is removed from the Coil Driver thus turning off the driver and opening the ground circuit of the coil primary. The magnetic field in the ignition coil primary will then collapse cutting across the coil secondary winding creating a high voltage charge (50,000 volts) that is sent to the spark plug.

Ignition Component Description

Fuses

The electrical wiring circuits on the outboard are protected from overload by fuses in the wiring. If a fuse is blown, try to locate and correct the cause of the overload. If the cause is not found, the fuse may blow again.

1. Open the fuse holder and look at the silver colored band inside the fuse. If band is broken, replace the fuse. Replace fuse with a new fuse with the same rating.
2. The fuses and circuits are identified as follows:



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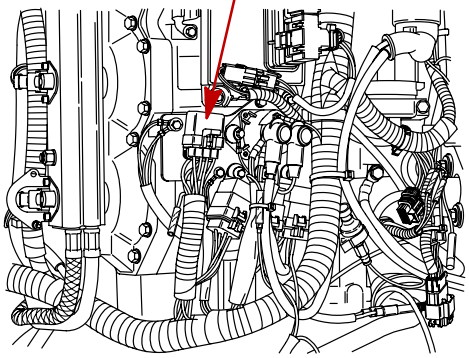

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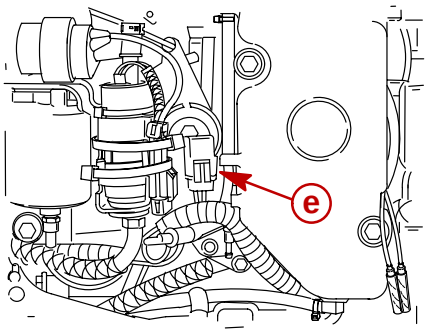


a - Smart Craft Data Bus Circuit – SFE 15 AMP Fuse.
b - Accessories – SFE 20 AMP Fuse.
c - Ignition Coil Circuit – SFE 20 AMP Fuse.
d - Electric Fuel Pump/ECM Driver Power/Oil Pump Circuit – SFE 20 AMP Fuse.
e - Fuel Lift Pump – SFE 5 AMP Fuse.

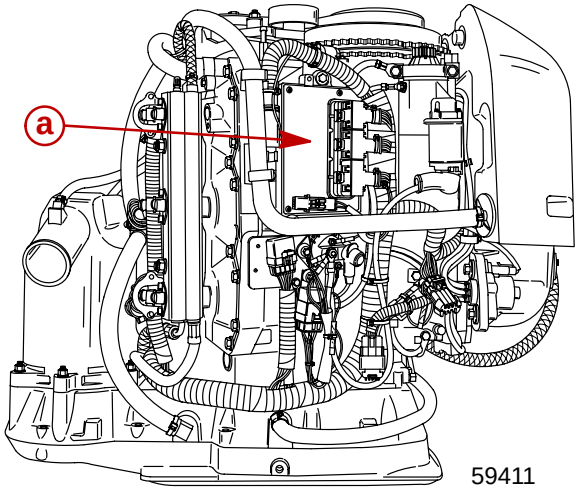
Electronic Control Module (ECM)

The ECM requires 8 VDC minimum to operate. If the ECM should fail, the engine will stop running.

The inputs to the ECM can be monitored and tested by the Digital Diagnostic Terminal 91-823686A2 using adaptor harness 84-822560A5.

The ECM performs the following functions:

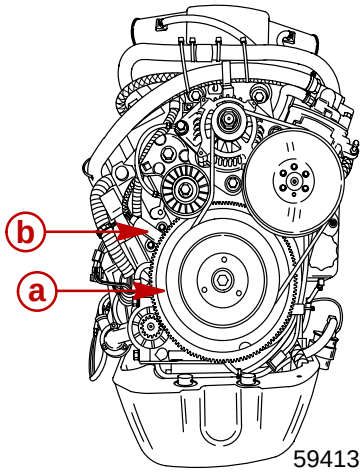
- Calculates the precise fuel and ignition timing requirements based on engine speed, throttle position, manifold pressure and coolant temperature.
- Controls fuel injectors for each cylinder, direct injectors for each cylinder and ignition for each cylinder.
- Controls all alarm horn functions.
- Supplies tachometer signal to gauge.
- Controls RPM limit function.
- Records engine running information.



a - Electronic Control Module (ECM)

Flywheel

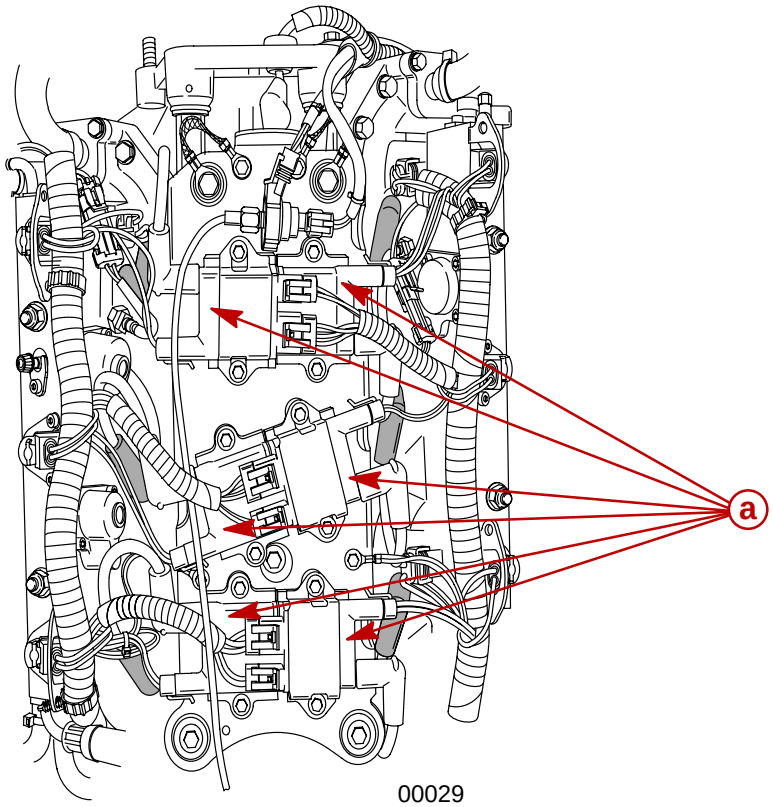
54 teeth under the flywheel ring gear provide engine rpm and crankshaft position information to the ECM through the crank position sensor.



a - Flywheel
b - Crank Position Sensor

Ignition Coils

Inductive type ignition coils are used on the DFI engines. 12 volt DC is supplied to the coils at all times from the boat battery. For a predetermined length of time (dwell), the primary circuit of the coil is completed by closing the electrical circuit within the coil driver. When the coil driver circuit opens, the primary field of the coil collapses inducing high voltage in the secondary windings which produces up to 50000 volts at the spark plugs.



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a - Ignition Coils – 3 coils are mounted behind 3 visible coils

Ignition Coil Ohm Test

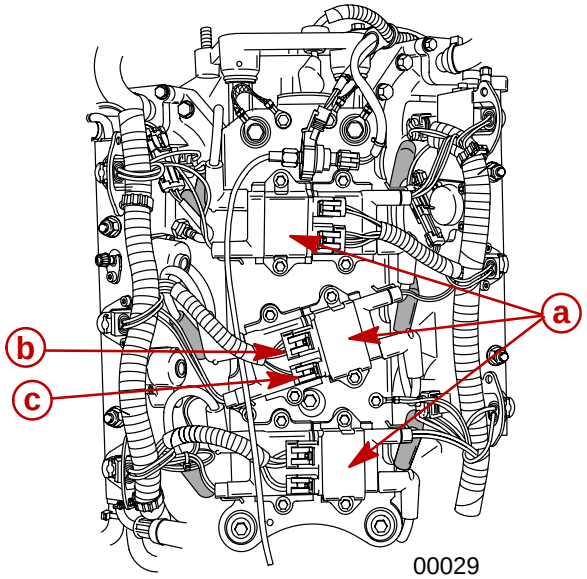
Connect meter leads between primary terminal (GREEN/ Striped) and (RED/YELLOW) terminal pin.	0.38 - 0.78 Ω
Connect meter leads between spark plug wire/high voltage tower and ground terminal pin.	8.1 - 8.9 k Ω

Coil Driver

The ECM sends a 5 VDC pulse to the coil driver mounted on each ignition coil. Which coil driver receives this pulse is determined by the ECM receiving a signal from the crank position sensor.

When the coil driver receives its ECM pulse (signal), it closes its circuit which allows the primary side of the ignition coil to build up energy which it initially receives from the boat battery.

When the ECM pulse (signal) to the coil driver drops below 1.3 volts, the coil driver opens its circuit which causes the primary field of the ignition coil to collapse. This field collapse induces a voltage buildup in the secondary winding of the ignition coil resulting in a potential voltage of up to 50000 volts at the spark plug.



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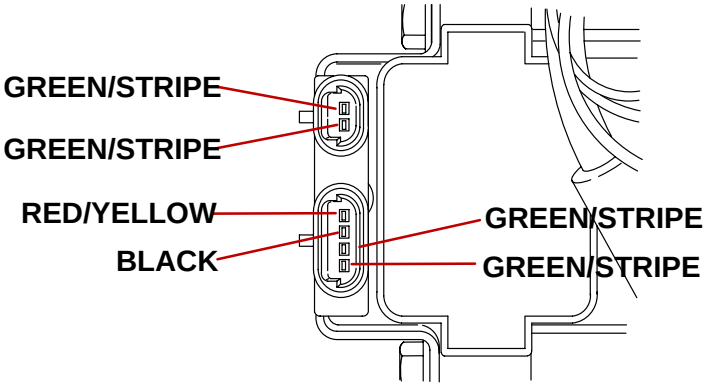
a - Coil Driver
b - 4 Pin Connector
c - 2 Pin Connector

Coil Driver Ohm Test



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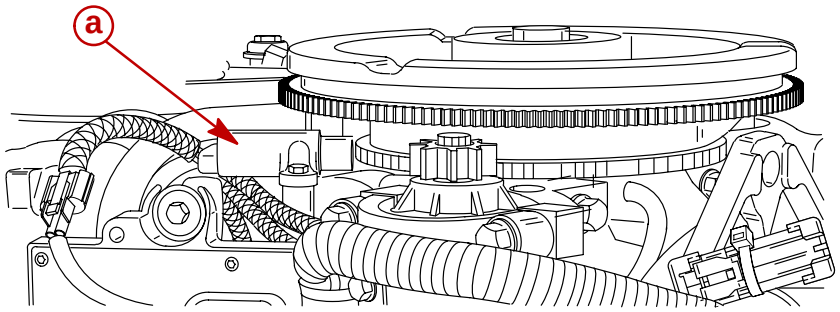
4 Pin Connector – Connect meter leads between RED/YELLOW and BLACK male pins.	85 k Ω ± 10%
4 Pin Connector – Connect meter leads between BLACK male pin and each GREEN STRIPED male pin.	10 k Ω ± 10%
Connect meter leads between BLACK male pin on 4 pin connector and each GREEN STRIPED male pin on the 2 pin connector.	OPEN – No Continuity

Crank Position Sensor

Senses 54 teeth located on flywheel under ring gear.
Supplies the ECM with crank position information and engine speed. If sensor should fail, the engine will stop running.

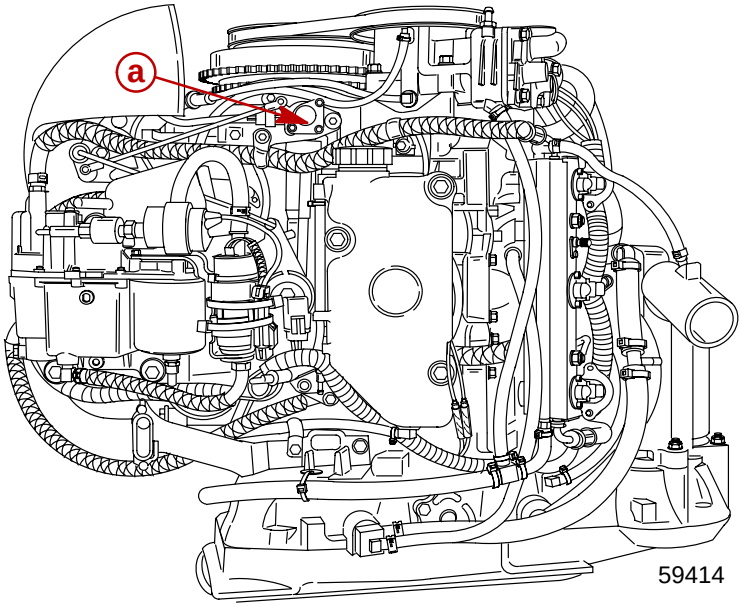


58323

a - Crank Position Sensor

Throttle Position Sensor (TPS)

The TPS transmits throttle angle information to the ECM which varies the injector pulse width accordingly. Should the sensor fail, the warning horn will sound. RPM will be reduced by the ECM. TPS settings are not adjustable. TPS settings can be monitored with the Digital Diagnostic Terminal through the ECM. Voltage change should be smooth from idle to wide open throttle. If voltage change is erratic, TPS is defective.



59414

a - Throttle Position Sensor (TPS)

Throttle Position Sensor Specifications	
Idle	0.4 – 1.3 VDC
Wide Open Throttle	4.0 – 4.7 VDC

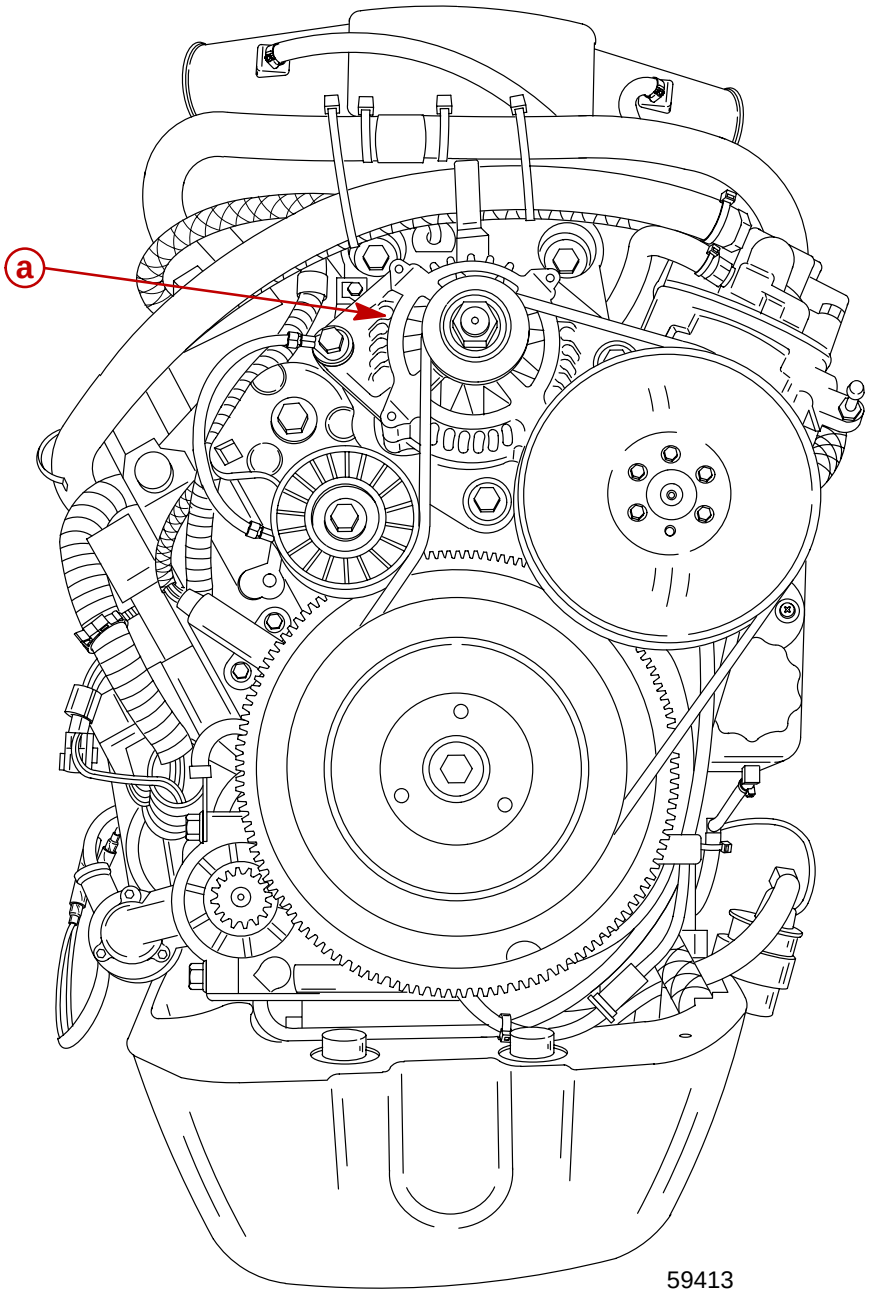
Throttle Position Sensor (TPS) Troubleshooting

If the throttle position sensor is out of the intended operating range when the engine is started, the Electronic Control Module (ECM) will sense that the Throttle Position Sensor (TPS) has failed. The warning horn will sound, DDT will indicate failed TPS and the engine will go into RPM reduction. When the engine is started, the throttle arm on the engine must be against the throttle stop screw. Do not move throttle lever forward.

- Check throttle cable adjustment. The throttle stop screw on the throttle arm must be against the throttle stop on the cylinder block when the engine is started. Pre-load the throttle cable barrel 1 or 2 turns if necessary.
- Verify driver is not pushing on throttle (if foot throttle is used) or advancing the throttle only on the control box.
- Check throttle cam to roller adjustment. If the roller is not down in the pocket/valley area on the cam, there is a tendency for the roller to ride up or down on the cam which causes the TPS link arm to push/pull on the TPS lever resulting changing values.

Charging System Alternator

Battery charging system is contained within the belt driven alternator, including the regulator. At cranking speeds, electrical power for the engine is provided by the boat battery – minimum recommended size is 750 CCA, 1,000 MCA, cold cranking amperes or 105 (Minimum) Ampere Hours. Above 900 RPM, all electrical power is provided by the alternator. Should engine rpm drop below 900 RPM, the alternator is not capable of providing sufficient output and the battery becomes the primary source of electrical power.
Alternator output (when hot) to the battery @ 2000 RPM is approximately 33 - 38 amperes.



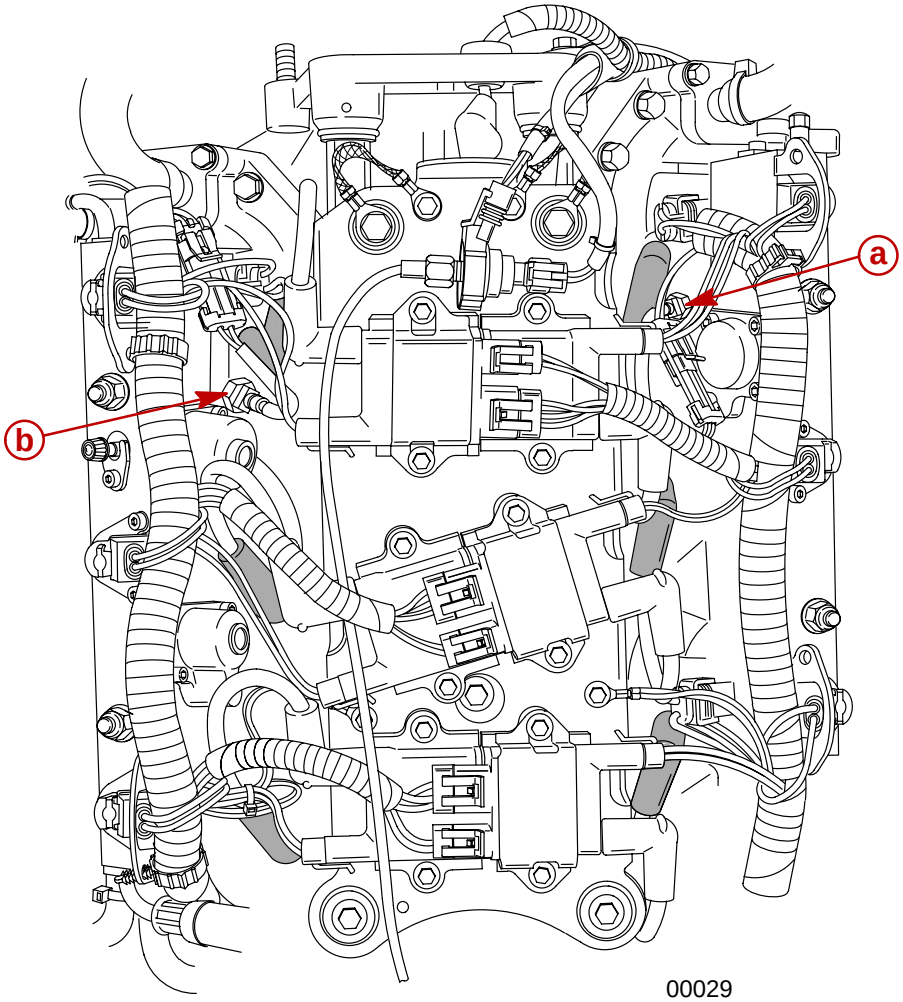
59413

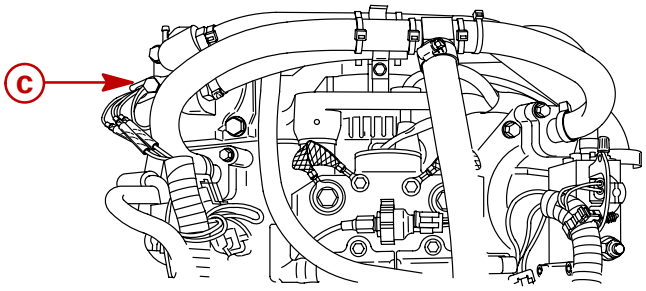
a - Alternator

Temperature Sensor

Three (3) temperature sensors are used to provide temperature information to the ECM. One sensor is mounted in each cylinder head and one sensor is mounted in the air compressor cylinder head.

The ECM uses this information to increase injector pulse width for cold starts and to retard timing in the event of an over-heat condition. The ECM will also use the information to increase idle speed to regulate cooling on hot and cold starts.





a - Cylinder Temperature Sensor (STARBOARD)
b - Cylinder Temperature Sensor (PORT)
c - Air Compressor Temperature Sensor

AIR COMPRESSOR TEMPERATURE SENSOR TEST

Between TAN/BLACK and each TAN/BLACK wire.	No Continuity
Between each lead and ground	No Continuity

Temperature Sensor Specifications		
Fahrenheit	**Centigrade**	**OHMS (± 10%)**
–22	–30	18230
–13	–25	13420
–4	–20	9966
5	–15	7465
14	–10	5636
23	–5	4288
32	0	3287
41	5	2551
50	10	1996
59	15	1574
68	20	1250
77	25	1000
86	30	805
95	35	653
104	40	532
113	45	437
122	50	360
131	55	299
140	60	249
149	65	209
158	70	176
167	75	148
176	80	126
185	85	107

PORT AND STARBOARD CYLINDER TEMPERATURE SENSORS
AIR TEMPERATURE SENSOR

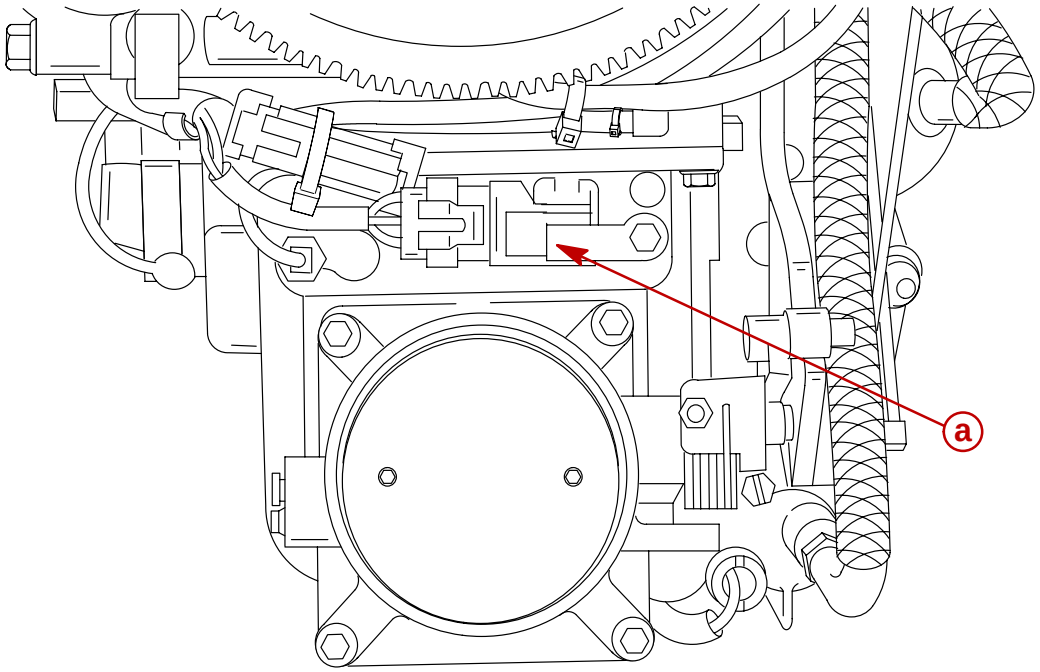
An ohms test of the temperature sensors would be as follows:

Disconnect temperature sensor harness and check continuity with digital or analog ohmmeter test leads between both connector pins. With engine at temperature (F°) indicated, ohm readings should be as indicated ±10%. There should be no continuity between each connector pin and ground.

Temperature Sensor Specifications		
Fahrenheit	**Centigrade**	**OHMS**
257	125	340
248	120	390
239	115	450
230	110	517
221	105	592
212	100	680
203	95	787
194	90	915
185	85	1070
176	80	1255
167	75	1480
158	70	1752
149	65	2083
140	60	2488
131	55	2986
122	50	3603
113	45	4370
104	40	5327
95	35	6530
86	30	8056
77	25	10000
68	20	12493
59	15	15714
50	10	19903
41	5	25396
32	0	32654
14	–10	55319
5	–15	72940

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is mounted on top of the air plenum. The ECM regulates fuel flow, in part, based on manifold absolute pressure.



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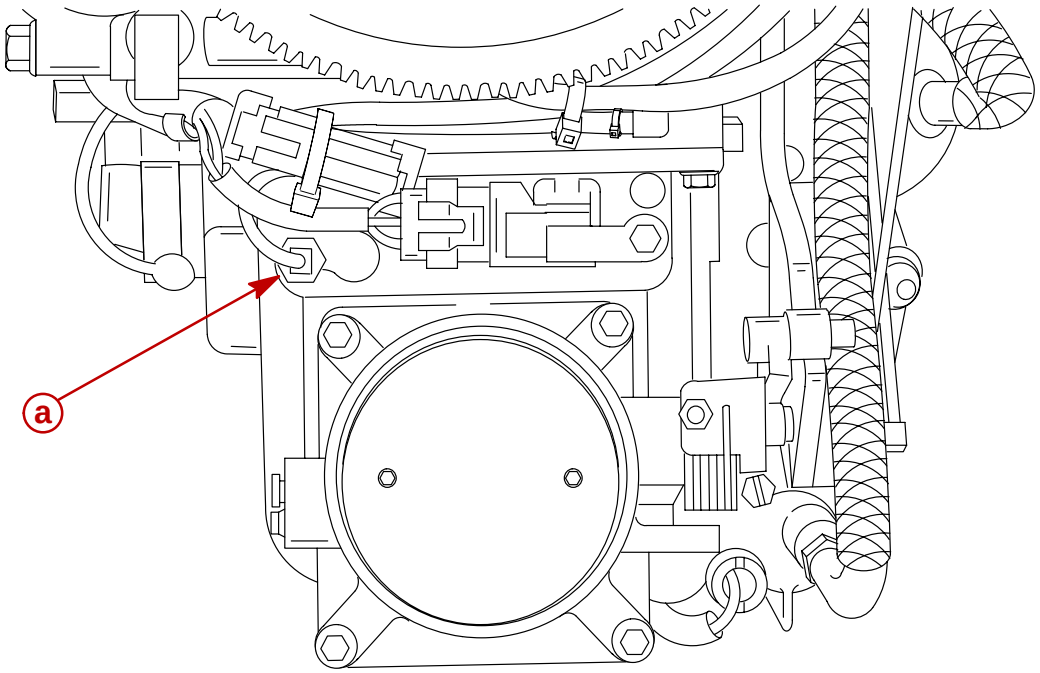
a - MAP Sensor

Air Temperature Sensor

The air temperature sensor is mounted on top of the air plenum. The ECM regulates fuel flow, in part, based on manifold air temperature. As air temperature increases, the ECM decreases fuel flow.



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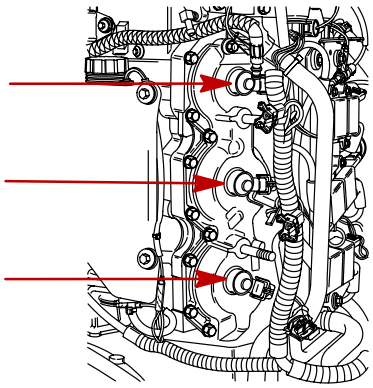
a - Air Temperature Sensor

Direct Injectors

6 direct injectors (1 per cylinder) are used to inject a fuel/air mix into cylinders. Injectors are mounted between fuel rails and cylinder heads.



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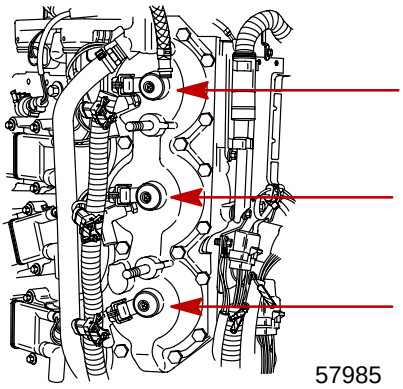

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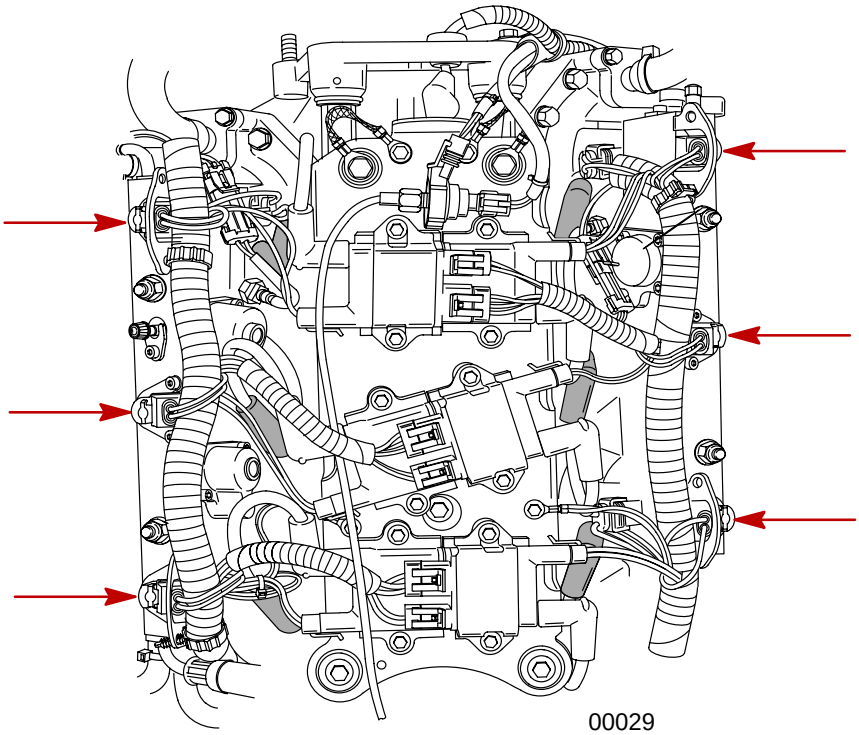
Direct Injector Ohm Test (Injector Lead Disconnected)	
Connect meter leads between each injector terminal pin.	1 - 1.6 Ω
Connect 1 meter lead to either injector pin while touching the other meter lead to the injector metal case.	No continuity

Fuel Injectors

6 fuel injectors (1 per cylinder) are used to provide fuel from the fuel rail to the direct injectors. The fuel injectors are mounted in the fuel rail.



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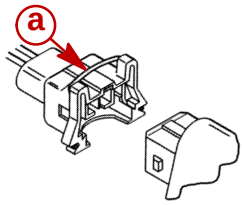
Fuel Injector Ohm Test (Injector Lead Disconnected)	
Connect meter leads between each injector terminal pin.	1.7 - 1.9 Ω

Disconnecting Harness Connectors from Ignition Coils and/or Injectors



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a - Wire Clip (push center down to remove)

Troubleshooting

The ECM is designed such that if a sensor fails, the ECM will compensate so that the engine does not go into an over-rich condition.

Disconnecting a sensor for troubleshooting purposes may have no noticeable effect.

Troubleshooting Without Digital Diagnostic Terminal

Troubleshooting without the DDT is limited to checking resistance on some of the sensors.

Typical failures usually do not involve the ECM. Connectors, set-up, and mechanical wear are most likely at fault.

- Verify spark plug wires are securely installed (pushed in) into the coil tower.
- The engine may not run or may not run above idle with the wrong spark plugs installed.
- Swap ignition coils to see if the problem follows the coil or stays with the particular cylinder.

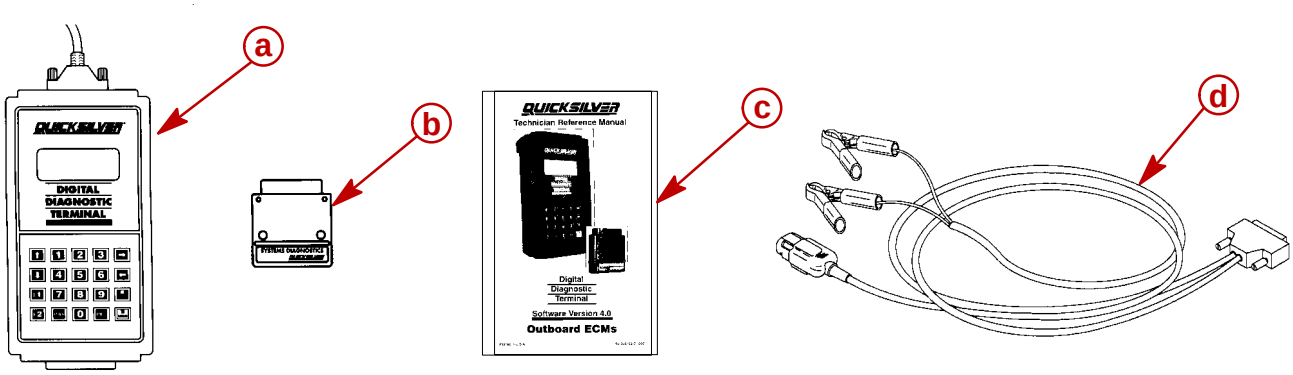
NOTE: *ECMs are capable of performing a cylinder misfire test to isolate problem cylinders. Once a suspect cylinder is located, an output load test on the ignition coil, fuel injector and direct injector may be initiated through use of the DDT.*

- Any sensor or connection can be disconnected and reconnected while the engine is operating without damaging the ECM. Disconnecting the crank position sensor will stop the engine.

IMPORTANT: Any sensor that is disconnected while the engine is running will be recorded as a Fault in the ECM Fault History. Use the DDT to view and clear the fault history when troubleshooting/repair is completed.

- If all cylinders exhibit similar symptoms, the problem is with a sensor or harness input to the ECM.
- If problem is speed related or intermittent, it is probably connector or contact related. Inspect connectors for corrosion, loose wires or loose pins. Secure connector seating; use dielectric compound.
- Inspect the harness for obvious damage: pinched wires, chaffing.
- Secure grounds and all connections involving ring terminals (coat with Liquid Neoprene).
- Check fuel pump connections and fuel pump pressure.
- Check air compressor pressure.

Troubleshooting With the Digital Diagnostic Terminal



a - Digital Diagnostic Terminal (91-823686A2)
b - Software Cartridge (91-880118A2)
c - DDT Reference Manual (90-881204–1)
d - Adapter Harness (84-822560A5)

The Quicksilver Digital Diagnostic Terminal (DDT) has been developed specifically to help technicians diagnose and repair Mercury Marine 2 and 4 cycle engines.

Attach the diagnostic cable to the ECM diagnostic connector and plug in the software cartridge. You will be able to monitor sensors and ECM data values including status switches.

The ECM program can help diagnose intermittent engine problems. It will record the state of the engine sensors and switches for a period of time and then can be played back to review the recorded information.

Refer to the Digital Diagnostic Terminal Reference Manual for complete diagnostic procedures.

Notes:

DDT Functions – Optimax Models
Software Version 1.0 (P/N 880118)

SmartCraft Monitor
1 – Mercury Marine
2 – Tool Setup

THIS ENGINE IS A
xx MY xxx x.xL xxx
PRESS 1 to CONTINUE

Select Function:
1 - AUTO SELF TEST
2 - MANUAL TEST

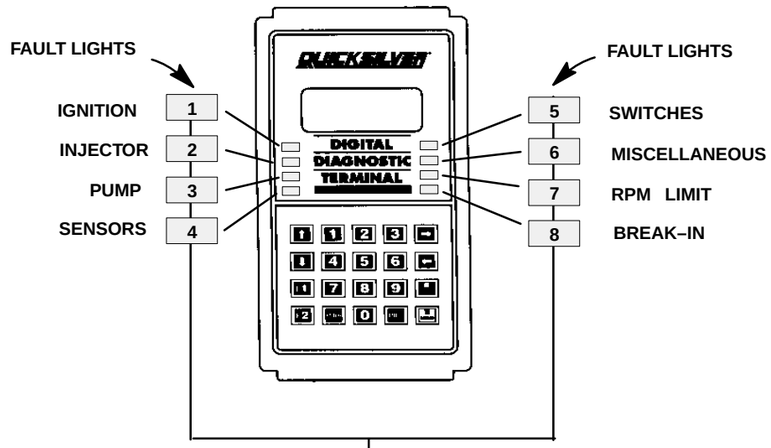
Select Auto Test:
1 – STATIC TEST

Select Function:
1 - DATA MONITOR
2 - FAULT STATUS
3 - SYSTEM INFO
4 - HISTORY
5 - SPECIAL FUNCTIONS

ENGINE RPM
TPI 1 VOLTS
BATTERY VOLTS
PWR 1 VOLTS
COOL TMP STB °F
COOL TMP PRT °F
MAP PSI
AIR TMP °F
BLOCK PSI
OIL INJ CNT
TPI %
AIR COM TMP °F
OIl LEVEL
FUEL LEVEL
AVAILABLE PWR %
SHIFT
TRIM
PITOT
PADDLE WHEEL
LAKE/SEA TMP °F

01MY DI 2.5L J200
ECM #
CODE
IGN PRI .38-.78 ohm
SEC 8.1-8.9 Kohm
DINJ 1.0-1.6 ohm
FINJ 1.7-1.9 ohm
TYPICAL TPI RANGE
TPI 1 0.19-1.0v IDLE
3.45-4.63v WOT
TGAP 0.025-.04in
PWR RLY 81-99 ohm
RPM LIMIT 6200
PROP RPM 5150-5650
AIR COMPRESSOR
1Kohm @ 77F/25C
AIRTEMP/COOLANT
10 Kohm @ 77F/25C
BATV 12.6-15.0
MAP 7-15 psi
FUEL AIR +10 psi
AIR 77-82 psi
OIL PUMP COIL
1.8-2.0 ohms
1 FUSE-FUEL PUMP
2 FUSE-BUS +12V
3 FUSE-ACCESSORY
4 FUSE-IGNITION
OVERTEMP/BLOCK
PRESSURE LIMITS ARE
CONTROLLED BY
ENGINE GUARDIAN
SEE SERVICE MANUAL
FOR GUARDIAN INFO

Any fault will turn on fault light. Refer to
Fault Status to identify fault



Fault Status List

ACT INPUT HI or LO	Air compessor temperature sensor input is high or low
AT INPUT HI or LO	Air temperatrure (engine) sensor input is high or low
BATT VOLT HI or LOW	Battery voltage is high or low
BLOCK PRESS LOW	Block pressure is low
BPSI INPUT HI or LO	Block Pressure Sensor input is high or low
BREAK-IN	Engine Break-In In Progess
COMP OVERHEAT	Compressor overheat
CTP INPUT HI or LO	Coolant temp port sensor input is high or low
CTS INPUT HI or LO	Coolant temp starboard sensor input is high or low
DINJ 1 thru 6 SHORT or OPEN	Direct injector (1 thru 6) is short or open circuit
EST 1 thru 6 SHORT or OPEN	Electronic spark trigger signal (1 thru 6) is short or open circuit
FINJ 1 thru 6 SHORT or OPEN	Fuel injector (1 thru 6) is short or open circuit
FUEL LVL IN HI or LO	Fuel level sensor input is high or low
GUARDIAN	Guardian system activated
H2O IN FUEL	Water in fuel
MAP INPUT HI or LO	MAP sensor input high or low
MPRLY BACKFEED	Main Power Relay is Receiving a Current Back feed
MPRLY OUTPUT	Main Power Relay Output
OIL LVL IN HI or LO	Oil level sensor input is high or low
OIL PUMP	Oil pump electrical failure
OIL RESERVE STR	Oil reserve strategy is active
OVERSPEED	Overspeed is activated
PITOT INPUT HI or LO	Pilot Pressure Sensor input is high or low
PORT OVERHEAT	Port cylinder head overheat
SEA TMP IN HI or LO	Sea or lake temperature sensor input is high or low
STAR OVERHEAT	Starboard cylinder head overheat
TPI1 INPUT HI or LO	TPI #1 sensor input is high or low
TPI1 NO ADAPT	ECM is unable to adapt to the current position of the TPI
TPI1 RANGE HI or LO	TPI #1 is above or below the allowable range
TRIM INPUT HI or LO	Trim sensor input is high or low
WARNING HORN	Warning horn fault

Select Function:
1 - FAULT HISTORY
2 - RUN HISTORY
3 - CLEAR FAULT HIST
4 - CLEAR RUN HIST

Select Fault Hist:
1 – FREEZE FRAME
2 – FAULT SECONDS

Select Function:
1 - OIL PUMP PRIME
2 - CYLINDER MISFIRE
3 - OUTPUT LOAD TEST
4 - RESET BREAK-IN OIL
5 - CHANGE FUEL OFFSET
6 - ENGINE LOCATION

Select Load Test:
1 - IGNITION
2 - FUEL INJECTOR
3 - DIRECT INJECTOR
4 - OIL PUMP
5 - FUEL PUMP
6 - HORN
7 - Reserve
8 - TACHOMETER
9 - MAIN POWER RELAY

RUN TIME HR.
RPM 0 – 749
RPM 750 – 1499
RPM 1500 – 2999
RPM 3000 – 3999
RPM 4000 – 4499
RPM 4500 – 4999
RPM 5000– 5499
RPM 5500 – 6249
RPM 6250 +
BREAK-IN LEFT
RPM LIMIT Sec
GRD LIMIT Sec
ACT TEMP Sec
BLOCK PSI Sec
CTS TMP Sec
CTP TEMP Sec
LOW OIL Sec
OIL PMP Sec

FAULT SECONDS
BATT VOLT HIGH
BATT VOLT LOW
BLOCK PRESS LOW
COMP OVERHEAT
ETC MOTOR OPEN
ETC MOTOR SHORT
FUEL P INPUT HI
FUEL P INPUT LO
GUARDIAN
KNOCK SENS1
KNOCK SENS2
OIL PSI STR
OIL REMOTE STR
OIL RESERVE STR
MAP INPUT HI
MAP INPUT LO
MAP IDLE CHECK
OIL PUMP
OVERSPEED
PORT OVERHEAT
STAR OVERHEAT
WARNING HORN
H2O IN FUEL

FREEZE FRAME BUFFERS
0-BREAK-IN
BARO PSI
BATT VOLTS
BLOCK PSI
BOAT SPEED
AIR TMP °F
COOL TMP °F
DEMAND %
ENGINE RPM
ENGINE STATE
FPC TOTAL
FREQ COUNTER
FUEL LEVEL %
SHIFT
LAKE/SEA TMP °F
LOAD%
MPRLY REQ
MAP PSI
OIL LEVEL %
PORT TAB POS
AVAILABLE PWR %
RUN TIME
STAR TAB POS
TPI %
TRIM POSITION
COOL TMP STB °F
COOL TMP PRT °F

DFI Troubleshooting Guide		
Symptom	**Cause**	**Action**
1. Engine cranks but won't start	**1.0** Lanyard stop switch in wrong position.	Reset lanyard stop switch.
	1.1 Weak battery or bad starter motor, battery voltage drops below 8 volts while cranking (ECM cuts out below 8 volts) (Fuel pump requires 9 volts).	Replace/charge battery. Inspect condition of starter motor. Check condition of battery terminals and cables.
	1.2 Low air pressure in rail (less than 70 psi at cranking)	Inspect air system for leaks. Inspect air filter for plugging (air pressure measured on port rail). Inspect air compressor reed valves if necessary.
	1.3 No fuel	Key-on engine to verify that fuel pump runs for 2 seconds and then turn off. Measure fuel pressure (valve on starboard rail). Fuel pressure should be 10 ± 1 psi greater than the air pressure.
	1.4 Low fuel pressure	Check fuel pressure from low pressure electric fuel pump (6–10 psi). Check for fuel leaks. If fuel pressure leaks down faster than air pressure, seals on fuel pump may be leaking. Check air system pressure, see **1.2**.
	1.5 Flywheel misaligned during installation	Remove flywheel and inspect.
	1.6 Blown fuse	Replace fuse. Inspect engine harness and electrical components.
	1.7 Main Power Relay not functioning	Listen for relay to "click" when the key switch is turned on.
	1.8 Spark Plugs	Remove fuel pump fuse. Unplug all direct injector connectors. Remove spark plugs from each cylinder. Connect spark plug leads to Spark Gap Tester 91-850439T. Crank engine or use DDT output load test for each ignition coil and observe spark. If no spark is present, replace appropriate ignition coil. If spark is present, replace spark plugs.

DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
1. Engine cranks but will not start (continued)	**1.9** ECM not functioning	Injection System: Listen for injector “ticking” when cranking or connect spare injector to each respective harness. Ticking should start after 2 cranking revolutions. Ignition System: – Check for proper operation by using Inductive Timing Light 91-99379. – Check battery voltage (RED/YEL Lead) @ ignition coils. – Check for blown fuse (C15). – Check battery voltage to fuse from main power relay (PURPLE Lead). – Check for shorted stop wire (BLK/YEL). – Check crank position sensor setting [0.025 in. – 0.040 in. (0.64 mm – 1.02 mm)] from flywheel or for defective crank position sensor. – Defective ECM. Power Supply: Clean and inspect remote control male and female harness connectors.
	1.9A Crank Position Sensor not functioning	– Sensor faulty. – Bad connection – Air gap incorrect
2. Engine cranks, starts and stalls	**2.0** Low air pressure in rail	See **1.2**
	2.1 Low fuel pressure in rail	See **1.2** and **1.3**
	2.2 Abnormally high friction in engine	Check for scuffed piston or other sources of high friction.
	2.3 Air in fuel system/lines	See **1.3** Crank and start engine several times to purge.
	2.4 TPS malfunction	Check motion of throttle arm. Stop nuts should contact block at idle and WOT. Check TPS set-up. Must connect DDT with adapter harness (84-822560A5) to ECM.
	2.5 Remote control to engine harness connection is poor	Clean and inspect male and female connectors.

DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
3. Engine idle is rough	**3.1** Low air pressure in rail (less than 79 ± 2 psi while running)	See **1.2**
	3.2 Fouled spark plug	Replace spark plug: –If carbon bridges electrode gap or if it is completely black. –If it is not firing and is wet with fuel. *Note: If spark plug is grey or completely black with aluminum specs, this indicates a scuffed piston.*
	3.3 Failed direct injector	Refer to ohm test.
	3.4 Failed fuel injector	Refer to ohm test.
	3.5 Bad coil/weak spark	Refer to ohm test.
	3.6 Bad dual coil driver	Replace dual coil driver.
	3.7 Flywheel misaligned during installation	Remove flywheel and inspect.
4. Engine idles fast (rpm >1300) or surges	**4.1** Broken fuel pressure regulator or tracker diaphragm	Measure fuel pressure. Remove and inspect diaphragms (a special tool is required for assembly).
	4.2 Fuel leak	Check for fuel entering induction manifold or air compressor inlet. Vapor Separator flooding over.
	4.3 Tracker Valve spring missing	Inspect tracker valve for proper assembly.
	4.4 Improper set-up	Check throttle cable & cam roller adjustment.
	4.5 TPS malfunction	See **2.4**
5. Engine runs rough below 3000 rpm	**5.1** Fouled spark plug	See **3.2**
	5.2 Low air pressure in rail	See **1.2**
	5.3 Throttle misadjusted	Check throttle cam setup on induction manifold. Inspect linkage and roller. If throttle plate stop screws have been tampered with, contact Mercury Marine Service Department for correct adjustment procedures.
	5.4 Bad coil/weak spark	See **3.5**
	5.5 Bad dual coil driver	Replace dual coil driver
	5.6 TPS malfunction	See **2.4**
6. Engine runs rough above 3000 rpm	**6.1** Fouled spark plug	See **3.2**
	6.2 Speed Reduction	See **7**
	6.3 Low air pressure in rails	See **1.2**
	6.4 TPS malfunction	See **2.4**

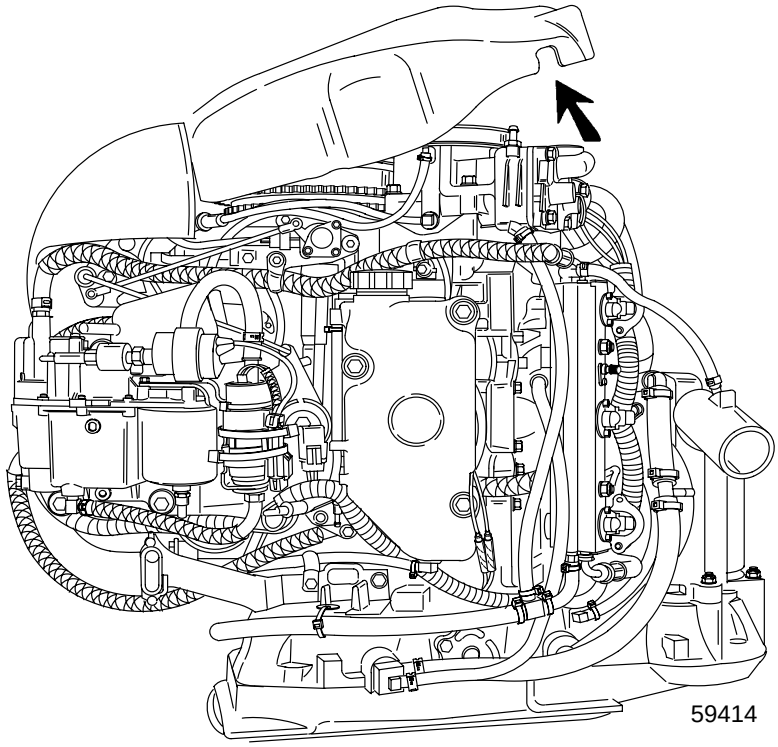
DFI Troubleshooting Guide (continued)		
Symptom	**Cause**	**Action**
7. Speed Reduction (RPM reduced)	**7.1** Low battery voltage ECM requires 8 volts minimum Fuel Pump requires 9 volts	Check battery and/or alternator. Check electrical connections.
	7.2 Overheat condition (engine and/or air compressor)	Check water pump impeller/cooling system.
	7.3 Oil pump electrical failure	Check electrical connection.
	7.4 TPS failure If TPS and MAP Sensor fails, rpm is reduced to idle	Check electrical connections.
8. Engine RPM reduced to idle only	**8.1** TPS and MAP Sensor failed	See **2.4**
	8.2 Battery voltage below 9.5 volts	Use DDT to monitor system
9. Loss of spark on 1 cylinder	**9.1** Loose wire or pin in connectors between ECM and coil primary.	Check connectors.
	9.2 Faulty ignition coil.	Replace coil.
	9.3 Faulty dual coil driver	Replace dual coil driver
	9.4 Faulty spark plug.	Replace spark plug.
	9.5 Faulty spark plug wire	Replace spark plug wire.

Ignition Components Removal and Installation

Flywheel Cover Removal and Installation

REMOVAL

Remove flywheel cover by lifting off.

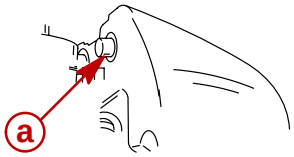


INSTALLATION

Install flywheel cover as follows:

a. Place cover onto the air attenuator mounting pins.

b. Push rear of the cover down onto the rear pins.



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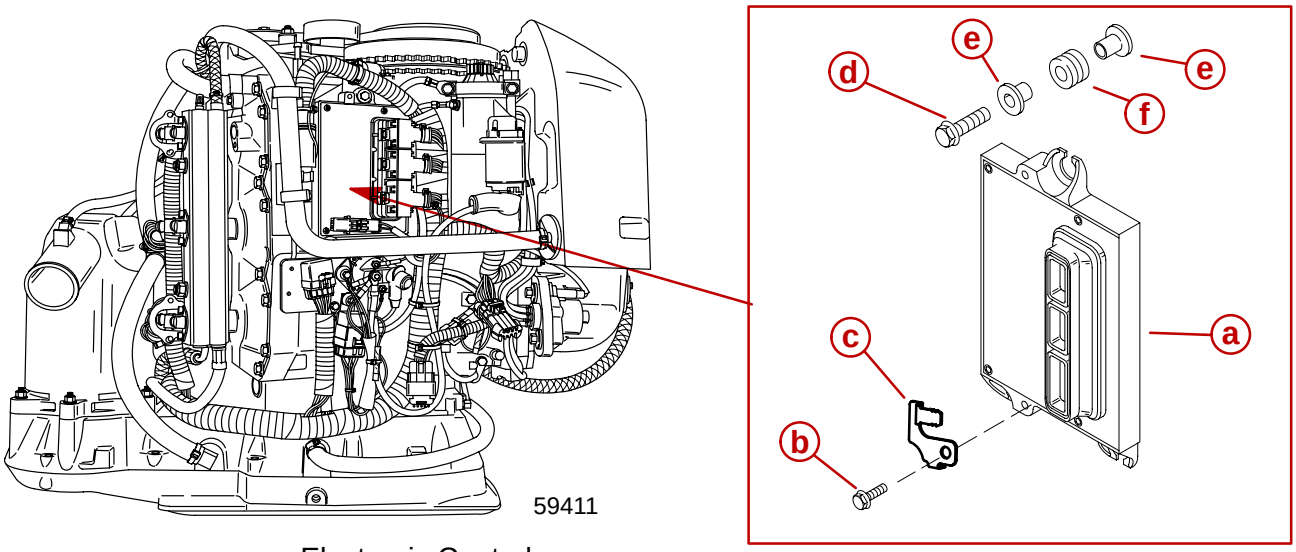
Electronic Control Module (ECM)

REMOVAL

1. Disconnect ECM harness connectors (3).
2. Remove 3 bolts securing ECM.



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a - Electronic Control Module
b - Screw [Torque to 100 lb in. (11.5 Nm)]
c - Bracket
d - Screw [Torque to 70 lb in. (8.0 Nm)]
e - Bushing
f - Grommet

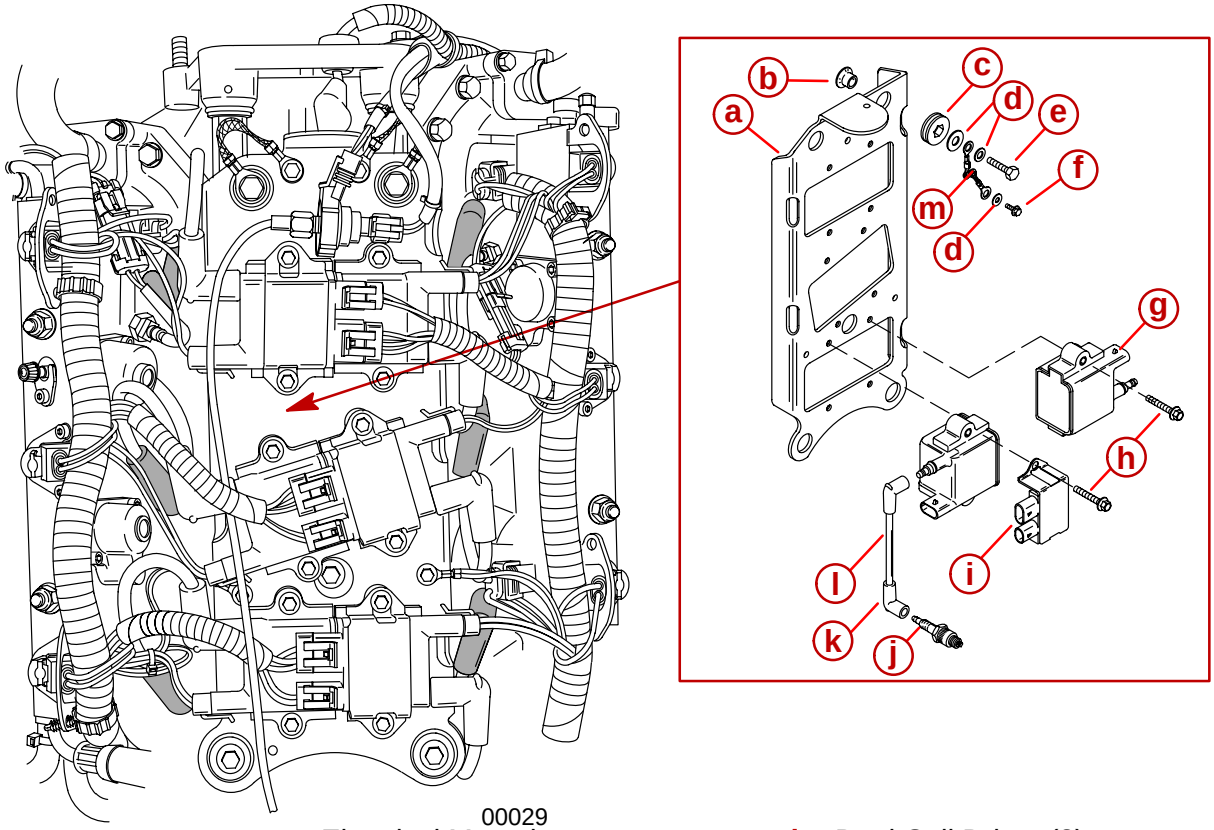
INSTALLATION

1. Secure ECM to powerhead with 3 bolts.
2. Reconnect harness connectors.

Ignition Module (Coil)

REMOVAL

1. Disconnect coil harness and spark plug lead.
2. Loosen the electrical mounting plate to gain access to the rear locknuts.
3. Remove module attaching bolts.



00029

a - Electrical Mounting Plate
b - Bushing
c - Rubber Grommet
d - Washer
e - Bolts (4) – Torque to 20 lb. ft. (27 Nm).
f - Screw [Torque to 60 lb. in. (7 Nm)
g - Ignition Coils (6)
h - Screw [Torque to 60 lb. in. (7 Nm)
i - Dual Coil Driver (3)
j - Spark Plug
k - Spark Plug Boot
l - Spark Plug Lead
m - Ground Strap

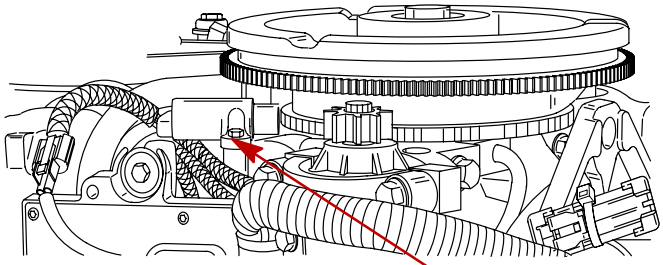
INSTALLATION

1. Fasten coils to electrical mounting plate as shown.
2. Reinstall electrical mounting plate.
3. Reconnect spark plug lead and coil harness.

Crank Position Sensor

REMOVAL

1. Disconnect harness.
2. Remove screws securing sensor to engine.



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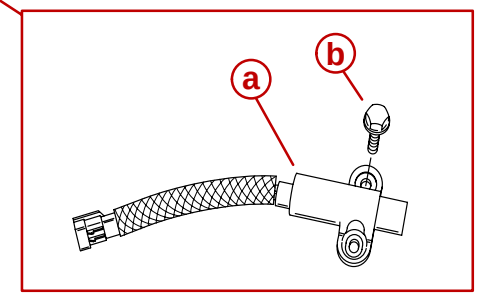


58613

a - Crank Position Sensor
b - Screws – Torque to 45 lb. in (5.0 Nm)

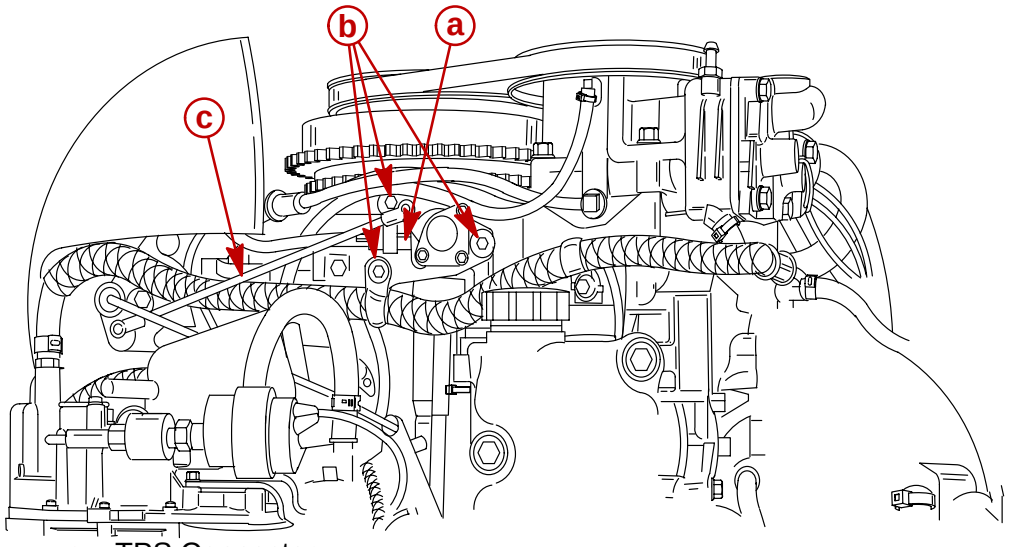
INSTALLATION

1. Fasten sensor to engine with screws. Torque screws to 45 lb. in. (5.0 Nm).
2. Reconnect sensor harness.

Throttle Position Sensor (TPS)

REMOVAL

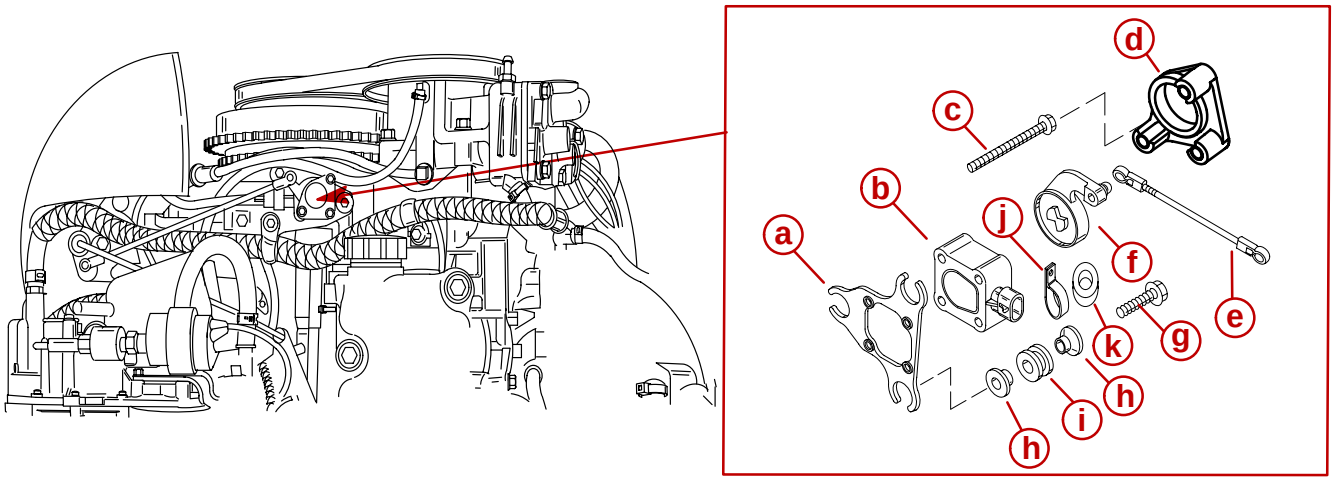
3. Disconnect TPS connector.
4. Remove 3 screws securing TPS and remove TPS.



a - TPS Connector
b - Screws
c - TPS Link Arm – Disconnect

INSTALLATION

1. Fasten sensor and bracket to engine as shown.
2. Reconnect wiring harness.



a - Bracket
b - Sensor
c - Screw (3) – Torque to 20 lb. in (2.5 Nm).
d - TPS Cover
e - Throttle Link
f - TPS Lever
g - Screw [Torque to 70 lb. in. (8.0 Nm)]
h - Bushing (2)
i - Grommet
j - Clip
k - Washer