



2015 Harley-Davidson Street Models Electrical Diagnostic Manual

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2015 Harley-Davidson Street Models Electrical Diagnostic Manual (99612-15)

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Harley-Davidson Motor Company

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Milwaukee, WI USA 53201

NOTES

ABOUT THIS MANUAL

GENERAL

WARNING

The rider's safety depends upon proper motorcycle service and maintenance. If a procedure in this manual is not within your capabilities or you do not have the correct tools, have a Harley-Davidson dealer perform the procedure. Improper service or maintenance could result in death or serious injury. (00627b)

This electrical diagnostic manual has been prepared with two purposes in mind. First, it will acquaint the user with the construction of the Harley-Davidson product and assist in the performance of repair. Secondly, it will introduce to the professional Harley-Davidson Technician the latest field-tested and factory-approved diagnostic methods. We sincerely believe that this manual will make your association with Harley-Davidson products more pleasant and profitable.

HOW TO USE YOUR MANUAL

Refer to the table below for the content layout of this manual.

NO.	CHAPTER
1	Initial Diagnostics
2	Starting and Charging
3	Instruments
4	Electrical Wiring Components
5	Horn, Lighting and Turn Signals
6	Engine Management
A	Appendix A Connector Repair
B	Appendix B Reference

Use the TABLE OF CONTENTS (which follows this FOREWORD) and the INDEX (at the back of this manual) to quickly locate subjects. Chapters and topics in this manual are sequentially numbered for easy navigation.

For example, a cross-reference shown as **2.2 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.2 SPECIFICATIONS.

For quick and easy reference, all pages contain a chapter number followed by a page number. For example, **page 3-5** refers to page 5 in Chapter 3.

A number of acronyms and abbreviations are used in this document. See the B.4 GLOSSARY for a list of acronyms, abbreviations and definitions.

PREPARATION FOR SERVICE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

WARNING

Stop the engine when refueling or servicing the fuel system. Do not smoke or allow open flame or sparks near gasoline. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00002a)

Good preparation is very important for efficient service work. Start each job with a clean work area. This will allow the repair to proceed as smoothly as possible. It will also reduce the incidence of misplaced tools and parts.

Clean a motorcycle that is excessively dirty before work starts. Cleaning will occasionally uncover sources of trouble. Gather any tools, instruments and any parts needed for the job before work begins. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

NOTES

- To avoid unnecessary disassembly, carefully read all related service information before repair work begins.
- In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.
- When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), first disarm the system. Keep the fob close to the vehicle or use DIGITAL TECHNICIAN II (Part No. HD-48650) to disable the system. Activate the system after service is completed.

SERVICE BULLETINS

In addition to the information presented in this manual, Harley-Davidson Motor Company will periodically issue service bulletins to Harley-Davidson dealers. Service bulletins cover interim engineering changes and supplementary information. Consult the service bulletins to keep your product knowledge current and complete.

USE GENUINE REPLACEMENT PARTS

WARNING

Harley-Davidson parts and accessories are designed for Harley-Davidson motorcycles. Using non-Harley-Davidson parts or accessories can adversely affect performance, stability or handling, which could result in death or serious injury. (00001b)

To achieve satisfactory and lasting repairs, carefully follow the service manual instructions and use only genuine Harley-Davidson replacement parts. Behind the emblem bearing the words GENUINE HARLEY-DAVIDSON stand more than 100 years of design, research, manufacturing, testing and inspecting experience. This is your assurance that the parts you are using will fit right, operate properly and last longer.

WARNINGS AND CAUTIONS

Statements in this manual preceded by the following words are of special significance.

WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury. (00119a)

CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. (00139a)

NOTICE

NOTICE indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140b)

NOTE

Refers to important information, and is placed in italic type. It is recommended that you take special notice of these items.

Proper service and repair are important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this manual are effective methods for performing service operations.

⚠ WARNING

Always wear proper eye protection when using hammers, arbor or hydraulic presses, gear pullers, spring compressors, slide hammers and similar tools. Flying parts could result in death or serious injury. (00496b)

Some of these service operations require the use of tools specially designed for the purpose. These special tools should be used when and as recommended. It is important to note that some warnings against the use of specific service methods, which could damage the motorcycle or render it unsafe, are stated in this manual. However, remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Harley-Davidson could not possibly know, evaluate or advise the service trade of all possible ways in which service might be performed, or of the possible hazardous consequences of each method, we have not undertaken any such broad evaluation. Accordingly, anyone who uses a service procedure or tool which is not recommended by Harley-Davidson must first thoroughly satisfy himself that neither his nor the operator's safety will be jeopardized as a result. Failure to do so could result in death or serious injury.

PRODUCT REFERENCES

⚠ WARNING

Read and follow warnings and directions on all products. Failure to follow warnings and directions can result in death or serious injury. (00470b)

When reference is made in this manual to a specific brand name product, tool or instrument, an equivalent product, tool or instrument may be substituted.

Special Tools

All tools mentioned in this manual with a part number beginning with "HD", "J" or "B" must be ordered through your local Harley-

Davidson dealer. Special tools may only be purchased, serviced or warranted through a Harley-Davidson dealer.

LOCTITE Sealing and THREADLOCKING Products

Some procedures in this manual call for the use of LOCTITE products. If you have any questions regarding LOCTITE product usage or retailer/wholesaler locations, contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

Apple, Alcantara S.p.A., Allen, Amp Multilock, Bluetooth, Brembo, Delphi, Deutsch, Dunlop, Dynojet, Fluke, G.E. Versilube, Garmin, Gunk, Hydroseal, Hylomar, iPhone, iPod, Kevlar, Lexan, Loctite, Lubriplate, Keps, K&N, Magnaflux, Marson Thread-Setter Tool Kit, MAXI fuse, Molex, Michelin, MPZ, Multilock, nano, NGK, Novus, Packard, Pirelli, Permatex, Philips, PJ1, Pozidriv, Robinair, S100, Sems, SiriusXM, Snap-on, Teflon, Threadlocker, Torca, Torco, TORX, Tufoil, Tyco, Ultratorch, Velcro, X-Acto, XM Satellite Radio, and zūmo are among the trademarks of their respective owners.

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Bar & Shield, Boom!, Cross Bones, Cruise Drive, CVO, Digital Tech, Digital Technician, Digital Technician II, Dyna, Electra Glide, Evolution, Fat Bob, Fat Boy, Forty-Eight, Glaze, Gloss, H-D, H-Dnet.com, Harley, Harley-Davidson, HD, Heritage Softail, Iron 883, Low Rider, Night Rod, Nightster, Night Train, Profile, Reflex, Revolution, Road Glide, Road King, Road Tech, Rocker, Screamin' Eagle, Seventy-Two, Softail, Sportster, Street Glide, Street Rod, Sun Ray, Sunwash, Super Glide, SuperLow, Switchback, SYN3, TechLink, TechLink II, Tour-Pak, Tri Glide, Twin Cam 88, Twin Cam 88B, Twin Cam 96, Twin Cam 96B, Twin Cam 103, Twin Cam 103B, Twin Cam 110, Twin Cam 110B, Twin-Cooled, Ultra Classic, V-Rod, VRSC and Harley-Davidson Genuine Motor Parts and Genuine Motor Accessories are among the trademarks of H-D U.S.A., LLC.

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All photographs, illustrations and procedures may not necessarily depict the most current model or component, but are based on the latest production information available at the time of publication.

Since product improvement is our continual goal, Harley-Davidson reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

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NOTES

SPECIFICATIONS

Table 1-1. Fuel System Specifications

FUEL SYSTEM	TYPE
Intake	Side draft throttle body
Recommended fuel	87 Octane or higher

Table 1-2. Idle Speed Specifications

ADJUSTMENT	RPM
Normal idle speed	1200 Nominal, non-adjustable

Table 1-3. Battery Specifications

BATTERY	SPECIFICATIONS
Size	12V/12 AH/225CCA
Type	Sealed, AGM

Table 1-4. Spark Plug Specifications

SPARK PLUG	SPECIFICATIONS	
Gap	0.8-0.9 mm	0.031-0.035 in
Torque	10-12 Nm	89-106 in-lbs
Type	RG6HCC	

Table 1-5. Spark Plug Cable Specifications

SPECIFICATION	FRONT	REAR
Length (in)	12.2	18.5
Length (mm)	312	470
Resistance (ohms)	3050-8140	4625-12340

Table 1-6. Starter Specifications

STARTER	SPECIFICATIONS
Cranking current	160A
Free speed	8800 rpm (MIN)
Free current	27A

Table 1-7. Fuel Pump Specifications

MEASUREMENT	VALUE
Pressure	310-379 kPA (45-55 psi)
Flow	70 l/h
Current draw	6A or less

Table 1-8. Alternator Specifications

ALTERNATOR	VALUE
AC voltage output	16-20 VAC per 1000 rpm
Stator coil resistance	0.1-0.3 ohm
Three phase	35 amp system

Table 1-9. Regulator Specifications

REGULATOR	VALUE
Amperes @ 3600 rpm	30-35A
Voltage @ 3600 rpm	14.4-14.6V @ 24 °C (75 °F)
Overheat protection	Approximately 105 °C (221 °F)

Table 1-10. Fuse Specifications

ITEM	RATING (AMPERES)
Battery	5
Fuel pump	10
Fan	15
ACC	5
Lights	10
Lights/instruments	10
Ignition	15

Table 1-11. Ignition Coil Specifications

WINDING	RESISTANCE
Ignition coil primary resistance at room temperature	0.3-0.7 ohms
Ignition coil secondary resistance at room temperature	1500-2400 ohms

Table 1-12. Temperature Specifications

RANGE	VALUE
Fans off at	105 °C (221 °F) and lower
Fans on at	110 °C (230 °F) and higher
Normal operating	66-110 °C (150-230 °F)
Over-temperature threshold	117 °C (243 °F)

DESCRIPTION AND OPERATION

Use initial diagnostics as a starting point to efficiently troubleshoot concerns. A basic understanding of electronics and a general knowledge of the vehicle are necessary to effectively use this manual.

NOTE

Certain diagnostic procedures require part removal. See the service manual for details.

Before diagnosing a concern, perform a general functional test of the vehicle to verify the concern. This will also identify any other issues that may affect diagnostics. Use the procedures in this chapter for initial diagnostics.

NOTE

When working through a diagnostic procedure follow the steps in the order instructed. Never jump to a test in another procedure. All "Go to Test" statements refer to a test in that procedure.

INITIAL DIAGNOSTICS

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

1. Fuse Test

1. Verify all fuses are good.

2. Are all fuses good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace fuse.

2. DTC Test

1. Check DTCs. See 1.2 INITIAL DIAGNOSTICS, Retrieving Trouble Codes.

NOTE

Historic DTCs are not to be diagnosed unless the condition is reoccurring and intermittent.

2. Are any current DTCs present?
 - a. **Yes.** Refer to Table 1-13.
 - b. **No.** Go to Test 3.

3. Communication Test

1. Verify vehicle communicates with DIGITAL TECHNICIAN II (Part No. HD-48650).
2. Does the vehicle communicate?
 - a. **Yes.** Refer to Table 1-14.
 - b. **No.** See 6.27 LOSS OF COMMUNICATION.

DIAGNOSTICS

Diagnostic Tips

For a quick check of instrument function, turn the ignition ON. Background lighting will illuminate, gauge needle will sweep its full range of motion and indicator lamps will illuminate.

Table 1-13. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
P0031	124	Front HO2S low/open	6.7 HO2S DIAGNOSTICS
P0032	127	Front HO2S shorted/high	6.7 HO2S DIAGNOSTICS
P0051	125	Rear HO2S low/open	6.7 HO2S DIAGNOSTICS
P0052	126	Rear HO2S shorted/high	6.7 HO2S DIAGNOSTICS
P0107	86	MAP sensor failed low/open	6.4 TMAP SENSOR DIAGNOSTICS
P0108	87	MAP sensor failed high/open port	6.4 TMAP SENSOR DIAGNOSTICS
P0112	102	IAT sensor shorted low	6.4 TMAP SENSOR DIAGNOSTICS
P0113	104	IAT sensor high/open	6.4 TMAP SENSOR DIAGNOSTICS
P0117	88	ECT sensor shorted low	6.5 ECT SENSOR DIAGNOSTICS
P0118	91	ECT sensor high/open	6.5 ECT SENSOR DIAGNOSTICS
P0122	60	TPS 1 low/open	6.6 TPS DIAGNOSTICS
P0123	61	TPS 1 high	6.6 TPS DIAGNOSTICS
P0131	128	O2 sensor low/engine lean (front)	6.7 HO2S DIAGNOSTICS
P0132	130	Engine running rich (front)	6.7 HO2S DIAGNOSTICS
P0134	132	O2 sensor high/open (front)	6.7 HO2S DIAGNOSTICS
P0151	129	O2 sensor low/engine lean (rear)	6.7 HO2S DIAGNOSTICS

Table 1-13. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
P0152	131	Engine running rich (rear)	6.7 HO2S DIAGNOSTICS
P0154	133	O2 sensor high/open (rear)	6.7 HO2S DIAGNOSTICS
P0261	82	Fuel injector low/open (front)	6.8 FUEL INJECTOR DIAGNOSTICS
P0262	83	Fuel injector shorted high (front)	6.8 FUEL INJECTOR DIAGNOSTICS
P0264	84	Fuel injector low/open (rear)	6.8 FUEL INJECTOR DIAGNOSTICS
P0265	85	Fuel injector shorted high (rear)	6.8 FUEL INJECTOR DIAGNOSTICS
P0371	50	CKP sensor wrong number of pulses	6.9 CKP SENSOR DIAGNOSTICS
P0374	49	CKP sensor no pulses	6.9 CKP SENSOR DIAGNOSTICS
P0444	118	Purge solenoid low/open	6.10 PURGE SOLENOID DIAGNOSTICS
P0445	119	Purge solenoid shorted high	6.10 PURGE SOLENOID DIAGNOSTICS
P0502	114	VSS failed low	6.11 VSS DIAGNOSTICS
P0503	115	VSS failed high	6.11 VSS DIAGNOSTICS
P0506	103	Idle speed control - rpm too low	6.12 IDLE SPEED CONTROL DIAGNOSTICS
P0507	105	Idle speed control - rpm too high	6.12 IDLE SPEED CONTROL DIAGNOSTICS
P0562	106	ECM voltage low	2.6 ECM VOLTAGE DIAGNOSTICS
P0563	373	ECM voltage high	2.6 ECM VOLTAGE DIAGNOSTICS
P0603	14	ECM EEPROM memory error	6.13 ECM INTERNAL DIAGNOSTICS
P0605	13	ECM FLASH memory error	6.13 ECM INTERNAL DIAGNOSTICS
P0641	47	5 Volt reference out of range	6.14 DTC P0641
P0691	92	Fan/cooling relay output low/open	6.15 COOLING FAN DIAGNOSTICS
P0692	95	Fan/cooling relay output high	6.15 COOLING FAN DIAGNOSTICS
P1001	17	System relay coil low/open	6.16 SYSTEM RELAY DIAGNOSTICS
P1002	18	System relay coil shorted high	6.16 SYSTEM RELAY DIAGNOSTICS
P1151	216	Bank angle sensor low	6.17 BANK ANGLE SENSOR DIAGNOSTICS
P1152	217	Bank angle sensor high/open	6.17 BANK ANGLE SENSOR DIAGNOSTICS
P1353	116	No combustion detected (front)	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS
P1356	117	No combustion detected (rear)	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS
P1501	140	JSS low	6.19 JSS DIAGNOSTICS
P1502	141	JSS high/open	6.19 JSS DIAGNOSTICS
P1652	24	Check engine light output high	6.20 CHECK ENGINE LIGHT DIAGNOSTICS
P2300	74	Ignition coil driver low/open (front)	6.21 IGN COIL DRIVER DIAGNOSTICS
P2301	75	Ignition coil driver shorted high (front)	6.21 IGN COIL DRIVER DIAGNOSTICS
P2303	76	Ignition coil driver low/open (rear)	6.21 IGN COIL DRIVER DIAGNOSTICS
P2304	77	Ignition coil driver shorted high (rear)	6.21 IGN COIL DRIVER DIAGNOSTICS

RETRIEVING TROUBLE CODES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

To retrieve trouble codes use a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two types of DTCs: current and historic. If a DTC is stored, it can be read using a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).

NOTES

- *Current DTCs reside in the memory of the ECM until the DTC is resolved.*
- *A historic DTC will be cleared after a total of 20 error free ignition cycles (start and run cycle) have elapsed.*

Current

Current DTCs failed the last time the module ran the parameters to set them. Therefore, the fault that caused them is normally present.

Historic

If a particular problem happens to resolve itself, the active status problem is dropped and it becomes a historic DTC rather than a current DTC. DTCs will also lose their current status when the ignition is turned off. If the problem still exists when the ignition is turned on, the code will show as current.

Historic DTCs are stored for 20 ignition cycles to assist in the diagnosis of intermittent faults. On the 20th error free cycle, the DTC will clear itself.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See 1.2 INITIAL DIAGNOSTICS, Multiple Trouble Codes if multiple DTCs are found.

Diagnostic procedures are designed for use with current DTCs. As a result, they frequently suggest part replacement. When diagnosing a historic DTC, the procedures can be helpful but should not lead to part replacement without verification that the part is faulty.

MULTIPLE TROUBLE CODES

All DTCs are assigned a priority number to determine the order in which they should be diagnosed. In the event there are multiple DTCs present, always diagnose the highest priority first. After a repair is completed, restore connections, clear DTCs and start vehicle. Refer to Table 1-13.

CLEARING DTCS

Clear DTCs after any diagnostic or repair procedure. Once the DTCs are cleared perform a road test to verify DTCs do not return. It is important to perform a road test and not simply start the motorcycle. Some DTCs may require vehicle speed or other inputs in order to validate repair.

CHECK ENGINE LAMP

To diagnose ECM system problems, start by observing the behavior of the check engine lamp.

NOTES

- *"IGN ON" means that the engine stop switch is set to RUN (although the engine is **not** running).*
 - *When the IGN is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.*
 - *If the check engine lamp is not illuminated at IGN ON or if it fails to turn off after the initial four-second period, refer to Table 1-13.*
1. See Figure 1-1. After the check engine lamp turns off following the first four second illumination period, one of two events may occur.
 - a. The lamp remains off. This indicates the ECM did not detect any current fault conditions or stored DTCs.
 - b. If the lamp illuminates again and remains illuminated, a current DTC exists.
 2. See 1.2 INITIAL DIAGNOSTICS, Code Types for a complete description of DTC formats.

NOTE

Some DTCs can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected. The ECM will not know of its resolution until after the coil is exercised by the vehicle start sequence. In this manner, there may sometimes be a false indication of the current DTC.

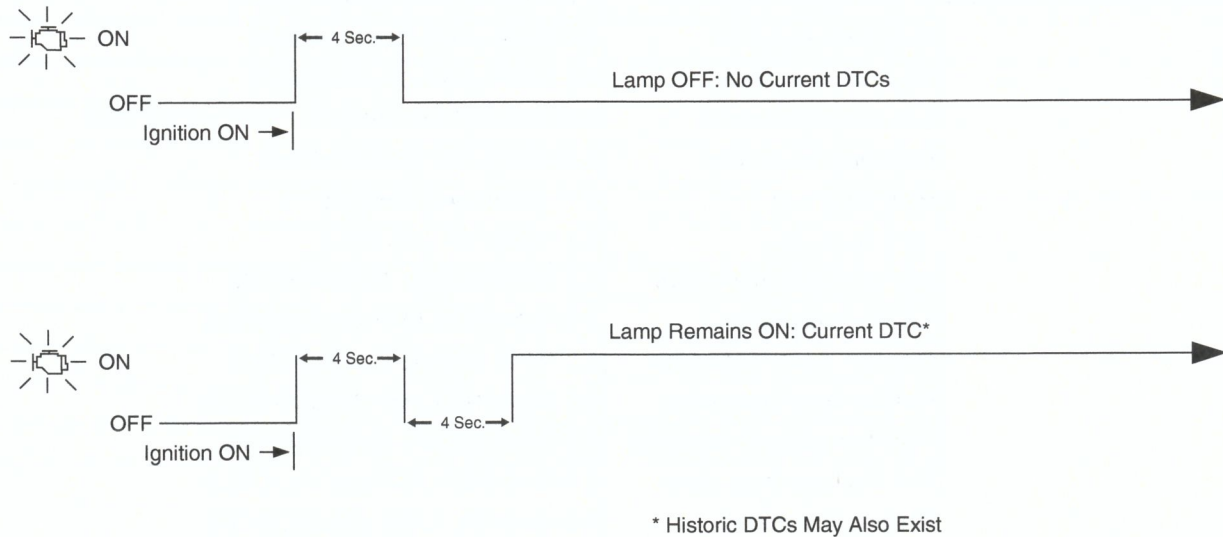


Figure 1-1. Check Engine Lamp and Security Lamp Operation

SYMPTOMS

If no DTCs are present, address any symptoms indicating a malfunction. Refer to Table 1-14.

Table 1-14. Symptom Table

CHAPTER	SYMPTOM	DIAGNOSTIC PROCEDURE
Starting and Charging	Battery runs down during use	2.5 CHARGING SYSTEM
	Low battery after extended IGN OFF	2.5 CHARGING SYSTEM
	Low or no charging	2.5 CHARGING SYSTEM
	Nothing clicks	2.2 STARTING SYSTEM
	Overcharging	2.5 CHARGING SYSTEM
	Starter relay clicks	2.2 STARTING SYSTEM
	Starter solenoid clicks	2.2 STARTING SYSTEM
	Starter spins, but does not engage	2.2 STARTING SYSTEM
	Starter stalls or spins too slowly	2.2 STARTING SYSTEM
Instruments	High beam indicator always on	3.3 INDICATOR LAMPS
	High beam indicator inoperative	3.3 INDICATOR LAMPS
	Low fuel lamp always on	3.3 INDICATOR LAMPS
	Low fuel lamp inoperative	3.3 INDICATOR LAMPS
	Neutral lamp always on	3.3 INDICATOR LAMPS
	Neutral lamp inoperative	3.3 INDICATOR LAMPS
	Oil pressure lamp always on	3.3 INDICATOR LAMPS
	Oil pressure lamp inoperative	3.3 INDICATOR LAMPS
	Speedometer inoperative	3.2 NO SPEEDOMETER POWER
	Turn signal indicator always on	3.3 INDICATOR LAMPS
	Turn signal indicator inoperative	3.3 INDICATOR LAMPS

Table 1-14. Symptom Table

CHAPTER	SYMPTOM	DIAGNOSTIC PROCEDURE
Horn, Lighting and Turn Signals	All turn signals inoperative	5.2 TURN SIGNAL DIAGNOSTICS
	Stop lamp always on	5.4 STOP LAMP DIAGNOSTICS
	Stop lamp inoperative	5.4 STOP LAMP DIAGNOSTICS
	Fuel pump inoperative	6.22 ENGINE CRANKS, BUT WILL NOT START
	Headlamp inoperative	5.3 HEADLAMP DIAGNOSTICS
	Horn always on	5.1 HORN DIAGNOSTICS
	Horn inoperative	5.1 HORN DIAGNOSTICS
	Left turn signal inoperative	5.2 TURN SIGNAL DIAGNOSTICS
	LP lamp inoperative	5.5 RUNNING LAMP DIAGNOSTICS
	One turn signal inoperative	5.2 TURN SIGNAL DIAGNOSTICS
	Position lamp inoperative	5.5 RUNNING LAMP DIAGNOSTICS
	Right turn signals inoperative	5.2 TURN SIGNAL DIAGNOSTICS
	Running lamp inoperative	5.5 RUNNING LAMP DIAGNOSTICS
	Tail lamp inoperative	5.5 RUNNING LAMP DIAGNOSTICS
Engine Management	Check engine lamp always on	6.20 CHECK ENGINE LIGHT DIAGNOSTICS
	Check engine lamp inoperative	6.20 CHECK ENGINE LIGHT DIAGNOSTICS
	Engine cranks, but will not start	6.22 ENGINE CRANKS, BUT WILL NOT START
	Hesitation, loss of power	6.24 ENGINE PERFORMANCE DIAGNOSTICS
	Loss of communication	6.27 LOSS OF COMMUNICATION
	Misfire at idle or under load	6.26 MISFIRE AT IDLE OR UNDER LOAD
	Starts, then stalls	6.25 STARTS, THEN STALLS
	Will only crank in neutral	6.23 WILL ONLY CRANK IN NEUTRAL

HOW TO USE DIAGNOSTIC TOOLS

PART NUMBER	TOOL NAME
GRX-3110 HD	BATTERY DIAGNOSTIC STATION
HD-26792	SPARK TESTER
HD-39617	FLUKE AC/DC CURRENT PROBE
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-41199-3	IAC TEST LIGHT
HD-41404	HARNESS CONNECTOR TEST KIT
HD-48650	DIGITAL TECHNICIAN II
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

GRX-3110 HD Battery Diagnostic Station

See Figure 1-2. Read the BATTERY DIAGNOSTIC STATION (Part No. GRX-3110 HD) instruction manual to perform a battery test. The test results include a decision on the battery condition.

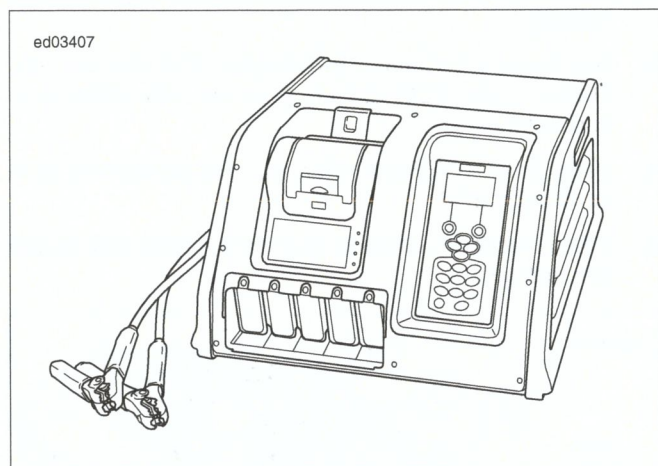


Figure 1-2. GRX-3110 HD Battery Diagnostic Station

HD-26792 Spark Tester

See Figure 1-3. The SPARK TESTER (Part No. HD-26792) is used to verify adequate spark at the spark plug. Attach the tester to the coil top plug and to ground. While cranking the engine, a spark should jump across the gap on the tester leads.

NOTE

The coil will not produce spark voltage with both spark plugs removed. When checking for spark, use SPARK TESTER (Part No. HD-26792) with both plugs installed.

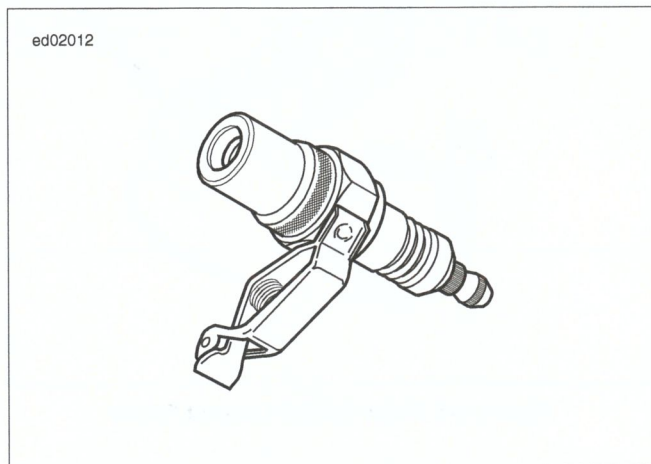


Figure 1-3. Spark Tester

HD-39978 Digital Multimeter (Fluke 78)

See Figure 1-4. The DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) is used for various tests throughout this manual.

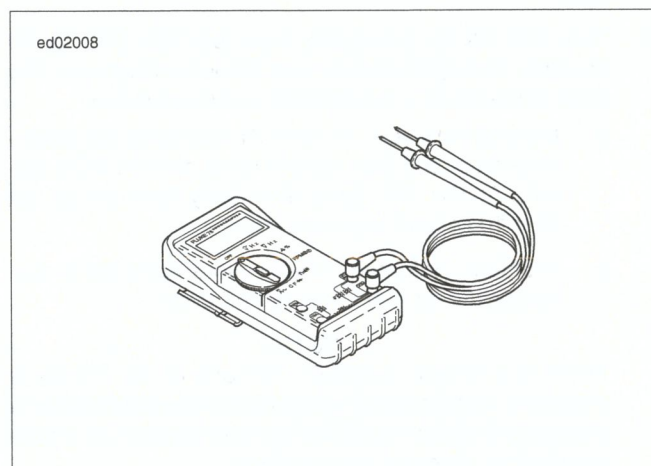


Figure 1-4. Digital Multimeter (Fluke 78)

HD-39617 Fluke AC/DC Current Probe

See Figure 1-5. The FLUKE AC/DC CURRENT PROBE (Part No. HD-39617) is used to measure current draw. Use in conjunction with DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978).

1. Connect the current probe to positive and negative input terminals on the multimeter.
2. Position the rotary switch to mV dc (millivolt direct current).
3. Push the ON/OFF button and the ON indicator will illuminate.
4. With the inductive jaws empty, turn the zero adjust so the multimeter reads 0.000 mV.
5. Clamp the inductive jaws around the conductor being tested.
6. With the circuit activated, read the multimeter display (1 mV=1 A).

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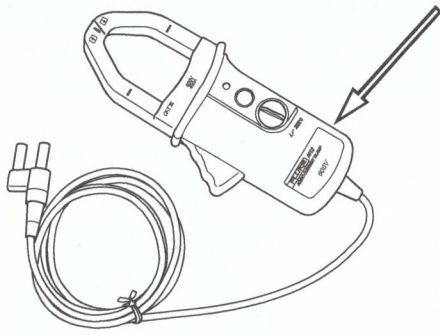


Figure 1-5. Fluke AC/DC Current Probe

HD-41199-3 IAC Test Light

The IAC TEST LIGHT (Part No. HD-41199-3) is used to verify that the electrical circuit from the ECM to the IAC is operating correctly.

1. See Figure 1-6. Disconnect IAC [87B] and connect test light.
2. Turn IGN ON for 2 seconds, then turn IGN OFF for 10 seconds. Test light behavior may follow two patterns. The color of the lights is not relevant to IAC operation.
 - a. **Normal behavior:** At IGN ON, test lights will alternately flash and then remain on to confirm ECM signals. At IGN OFF, lights alternately flash and go out after 10 second reset procedure.
 - b. **Problem indicated:** One or more lights fail to illuminate during IGN ON/IGN OFF cycle.

NOTE

There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn ignition ON. Probe terminals to check for this condition.

3. Disconnect test light and connect IAC [87B].

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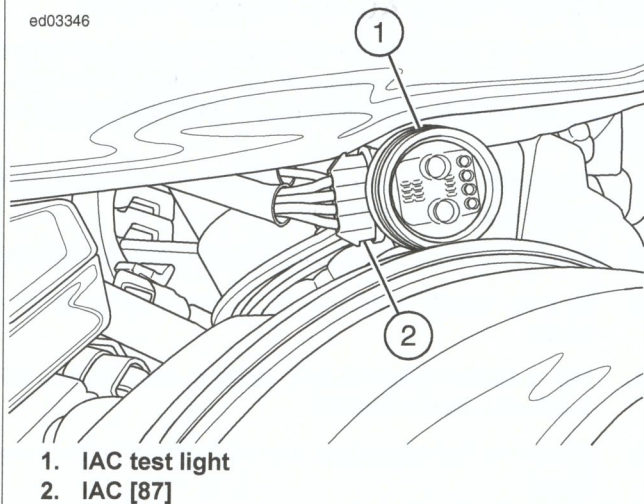


Figure 1-6. IAC Test Light

HD-41404 Harness Connector Test Kit

The HARNESS CONNECTOR TEST KIT (Part No. HD-41404) contains pin and socket terminals and stackable banana jack patch cords used to test circuits. The pin and socket terminals are used to connect to various connectors. See the tool instruction sheet for specific terminal usage.

NOTE

To prevent terminal damage while using the probe tips, insert the probe tip straight into the cavity. Hold it steady during the test. Do not wiggle or move the probe tip once it has been inserted into the terminal. Do not use more than one probe per terminal or cavity at any one time.

HD-50390-1 Breakout Box (ECM)

The BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) splice into the main harness. Used in conjunction with a multimeter, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects. Install breakout box in series as follows:

NOTE

See wiring diagrams for ECM terminal functions. ECM is located under seat.

1. Access the ECM.
2. Press latch and disconnect ECM connectors [78B-1] and [78B-2].
3. See Figure 1-7. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to connectors.
4. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
5. When testing is complete, remove the BOB and restore connections.

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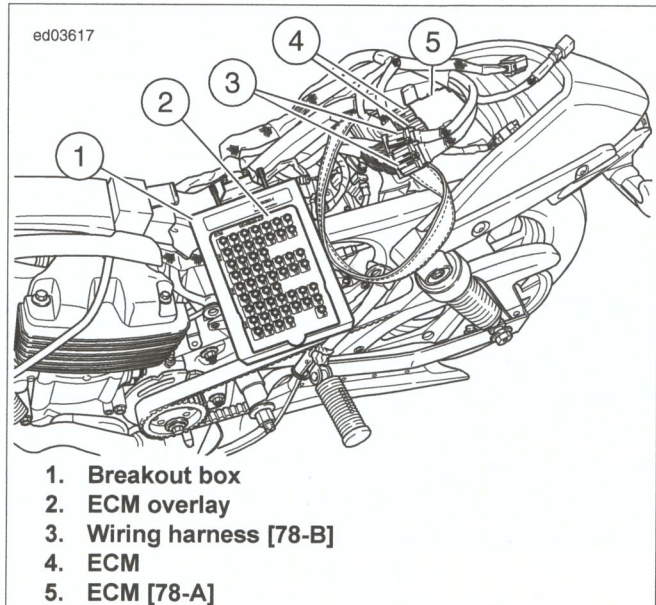


Figure 1-7. ECM Breakout Box Connection

HD-48650 Digital Technician II

DIGITAL TECHNICIAN II (Part No. HD-48650) is a computer based diagnostic device used to communicate/diagnose and

program systems/modules.

Diagnostics in this manual are developed under the assumption that DIGITAL TECHNICIAN II (Part No. HD-48650) is not available.

VOLTAGE DROP

Voltage Drop Test

The voltage drop test:

- Helps locate poor connections or components with excessive voltage drops.
- Measures the difference in potential or the actual voltage dropped between the source and destination.
- Checks the integrity of the wiring, switches, fuses, connectors and contacts between the source and destination.
- Identifies poor grounds.

A voltage drop test measures the difference in voltage between two points in a circuit. The amount of voltage dropped over any part of a circuit is directly related to the amount of resistance in that part of the circuit. A poor connection may cause an ohmmeter to give a good reading, but voltage drop test will locate the problem.

Components such as wires, switches and connectors are designed to have very little resistance and therefore very little voltage drop. A possible fault is indicated when a voltage drop is greater than 1.0V across components. This could indicate a high resistance in that circuit.

The benefits of testing this way are:

- Readings are not as sensitive to real battery voltage.
- Readings show the actual voltage dropped not just the presence of voltage.
- The system is tested as it is actually being used.
- Testing is more accurate and displays hard-to-find poor connections.
- Starting circuits, lighting circuits or ignition circuits can be tested with this approach. (Start from the most positive and go to the most negative destination or component.)

When testing a typical power circuit, place the positive (red) meter lead on the most positive part of the circuit (or the positive battery post). Remember, there is nothing more positive than the positive post of the battery. Place the negative (black) meter lead at the positive side of the connector in question. Activate the circuit. Move the negative meter lead through the circuit until the high voltage drop is found.

When testing a typical ground circuit, place the negative lead on the most negative part of the circuit (or the negative battery post). Remember, there is nothing more negative than the negative post of the battery. Place the positive meter lead at the negative side of the connector in question. Activate the circuit. Move the positive meter lead through the circuit until the high voltage drop is found.

The following steps demonstrate a typical starter circuit voltage drop test:

1. See Figure 1-8. Disconnect the fuel pump connector [86] to prevent the engine from starting. Connect the red meter lead to the positive battery post. Connect the black meter lead to the battery power starter post on the starter and observe the meter reading. Crank the starter and observe

the meter reading. The difference in the voltage is the voltage drop.

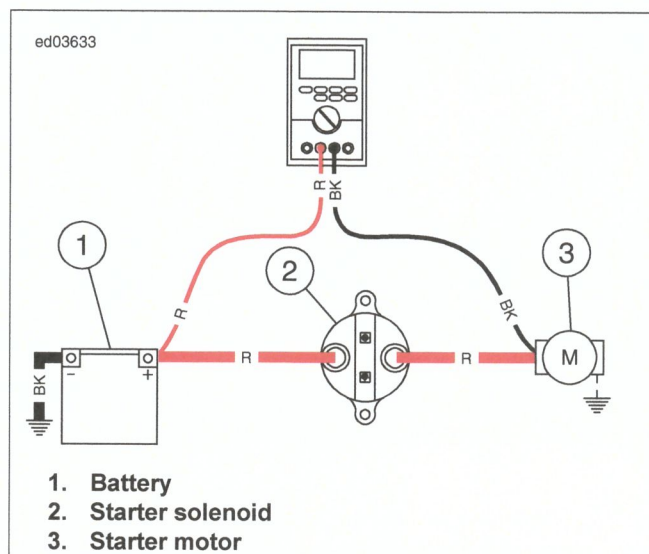


Figure 1-8. To Starter Terminal

2. See Figure 1-9. Move the black meter lead to the starter side post of the starter solenoid. Crank the starter.

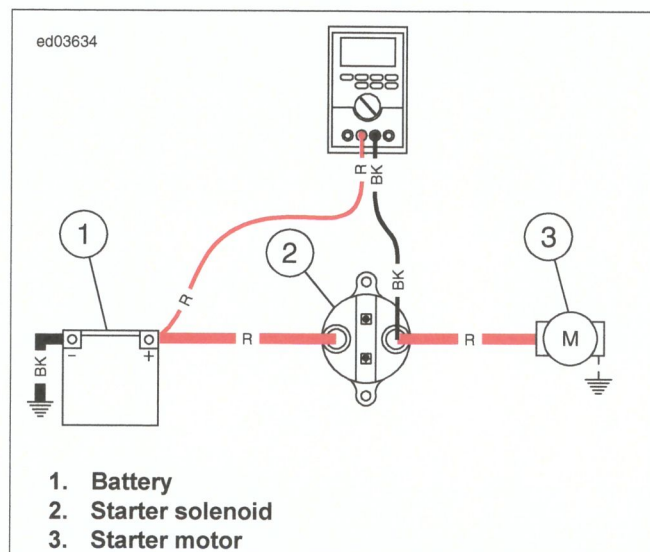


Figure 1-9. To Starter Solenoid Starter Terminal

3. See Figure 1-10. Move the black meter lead to the battery side post on the starter solenoid. Crank the starter.

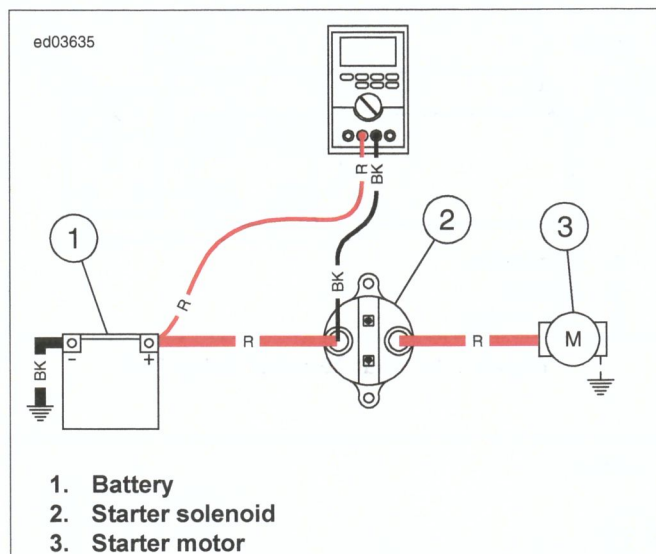


Figure 1-10. To Starter Solenoid Battery Terminal

- See Figure 1-11. Finally move the black meter lead to the negative battery post and the red meter lead to the starter case. Crank the starter.

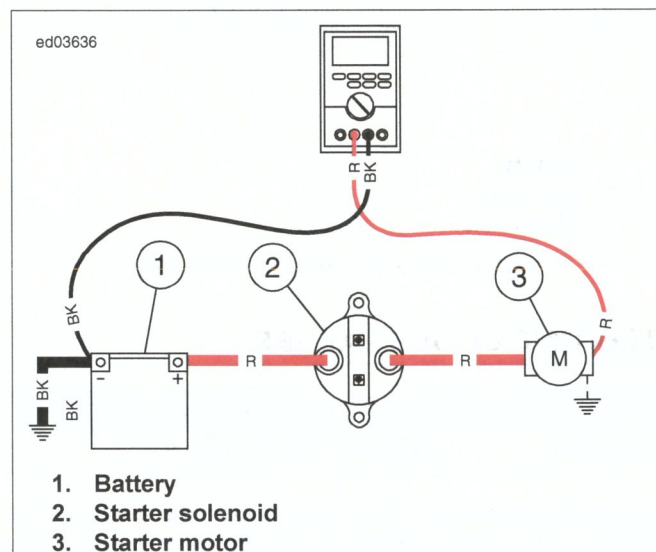


Figure 1-11. Starter Ground Circuit

When testing a typical ground circuit, place the black meter lead on the negative battery post. Place the red meter lead at the negative side of the connector in question. Move the red meter lead through the circuit until the high voltage drop is found.

WIGGLE TEST

PART NUMBER	TOOL NAME
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-48650	DIGITAL TECHNICIAN II
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

The wiggle test checks for the presence of intermittents in a wiring harness. The DIGITAL TECHNICIAN II (Part No. HD-48650) can be used to perform the wiggle test.

- See Figure 1-12. Connect DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) to wiring harness between the suspect connections. When diagnosing ECM connections, use BREAKOUT BOX (Part No. HD-50390-1), ECM CABLE (Part No. HD-50390-4) and ECM OVERLAY (Part No. HD-50390-4-P) to simplify the procedure. See 1.3 DIAGNOSTIC TOOLS.
- Set the multimeter to read voltage changes.
- Start the motorcycle engine and run at idle.
- Shake or wiggle the harness to detect intermittents. If intermittents are present, radical voltage changes register on the multimeter.

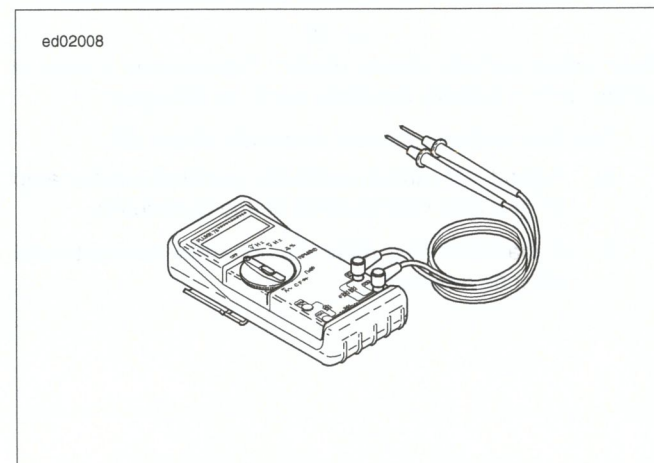


Figure 1-12. Digital Multimeter (Fluke 78)

RELAY DIAGNOSTICS

Relay Variation

See Figure 1-13. Relays normally have four or five terminals. The circuitry inside the relays are very similar with the exception of the normally closed contact being eliminated in the four terminal relay. Some relays have five terminals at the base, even though internally 4 or 87A are not connected. See this topic whenever a relay terminal is referenced in this manual to make sure the proper terminal is being accessed.

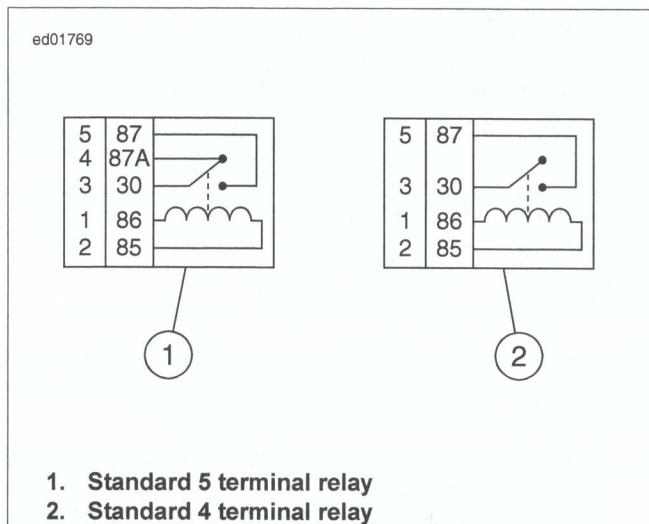


Figure 1-13. Standard Relays

Relay Test

A relay can be tested using the motorcycle's 12V battery and a multimeter.

1. Unplug the relay from relay block.
2. See Figure 1-14 and Figure 1-15 to energize the relay. Connect relay terminal 85 to the negative battery terminal and relay terminal 86 to the positive battery terminal.

NOTE

Some relays contain internal diodes. If the applied voltage is not the correct polarity, the diode could be damaged.

3. Test for continuity between terminals 30 and 87.
 - a. A good relay shows continuity (continuity tester lamp on or a zero Ohm reading on the ohmmeter).
 - b. A malfunctioning relay will not show continuity and must be replaced.

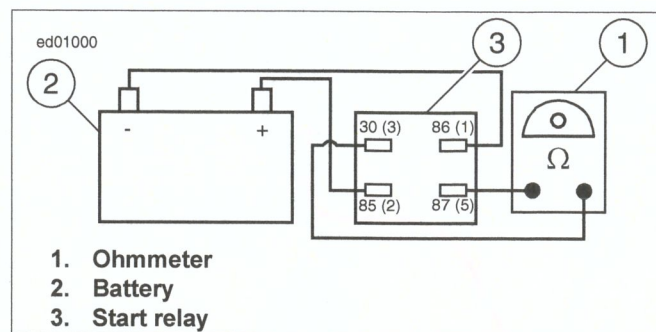


Figure 1-14. Four Terminal Relay Test

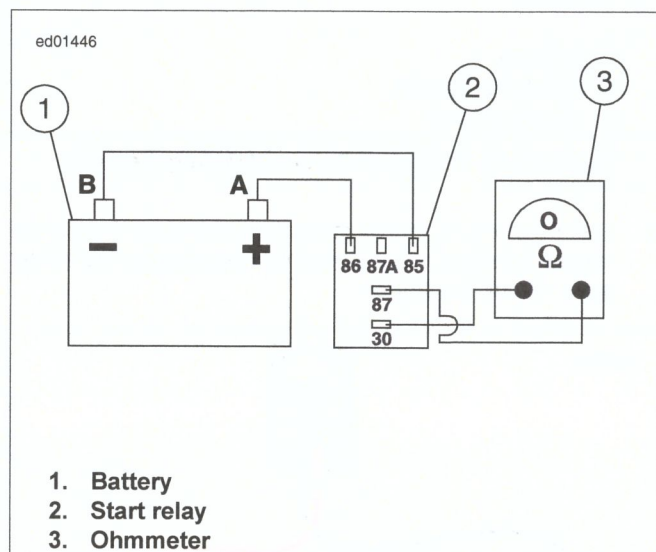


Figure 1-15. Five Terminal Relay Test

JOB/TIME CODES VALUES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Dealership technicians filing warranty claims should use the job/time code values printed in bold text at the end of the appropriate repair. When using DIGITAL TECHNICIAN II (Part No. HD-48650), dealership technicians filling out warranty claims should use the job/time code given by the computer.

SUBJECT	PAGE NO.
2.1 BATTERY TESTING.....	2-1
2.2 STARTING SYSTEM.....	2-3
2.3 TESTING STARTER ON MOTORCYCLE.....	2-12
2.4 TESTING STARTER ON BENCH.....	2-13
2.5 CHARGING SYSTEM.....	2-14
2.6 ECM VOLTAGE DIAGNOSTICS.....	2-20

NOTES

GENERAL

Test battery condition by using a voltage, charging or load test.

Always fully charge battery prior to load testing.

NOTE

An automatic, constant monitoring battery charger/tender with a charging rate of 5 Amps or less at less than 14.6V is recommended. The use of constant current chargers (including trickle chargers) to charge sealed AGM batteries is not recommended. Any overcharge will cause dry-out and premature battery failure.

VOLTMETER TEST

The voltmeter test provides a general indication of battery state of charge or condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. Refer to Table 2-1.

If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform a load test. See 2.1 BATTERY TESTING, Load Test.

Table 2-1. Voltmeter Test For Battery Charge Conditions

VOLTAGE	STATE OF CHARGE
12.7	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

BATTERY DIAGNOSTIC TEST

PART NUMBER	TOOL NAME
GRX-3110 HD	BATTERY DIAGNOSTIC STATION

Test the battery using the BATTERY DIAGNOSTIC STATION (Part No. GRX-3110 HD).

WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

1. Disconnect and remove battery.
2. Read the GRX instruction manual before performing a battery test.
3. Connect the BATTERY DIAGNOSTIC STATION (Part No. GRX-3110 HD) leads to the battery terminals.

The test results will include a decision on the battery condition and the measured state of charge. See Figure 2-1. The GRX printer will provide a printout including the test results:

- GOOD BATTERY - Return the battery to service.
- REPLACE BATTERY - Replace the battery.

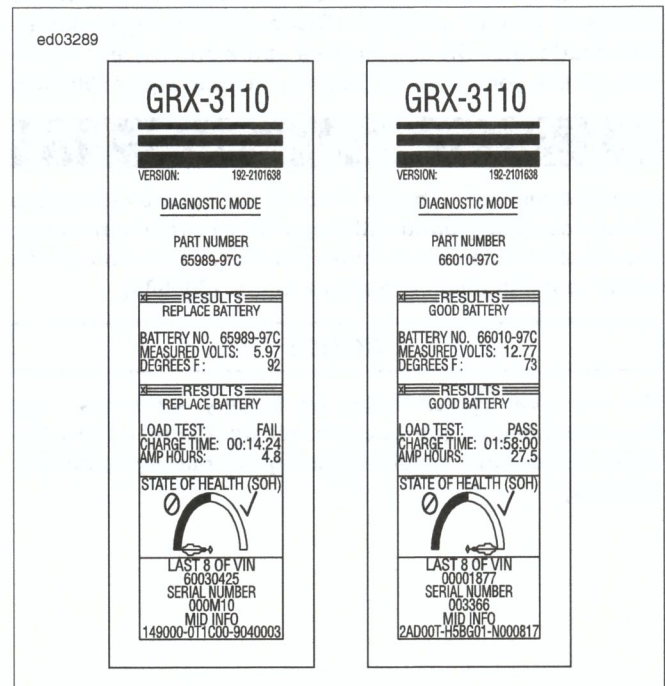


Figure 2-1. Battery Test Results Printout (Typical)

LOAD TEST

WARNING

Disconnect negative (-) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00049a)

1. With vehicle battery on a bench, charge the battery using an automatic, self monitoring battery charger approved for AGM batteries.

NOTE

Always fully charge the battery before testing or test readings will be incorrect. Load testing a discharged battery can also result in permanent battery damage.

WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

2. See Figure 2-2. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

NOTE

To avoid load tester and/or battery damage, do not leave the load tester switch turned ON for more than 20 seconds.

3. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6V or more at 21 °C (70 °F). Refer to Table 2-2.

⚠ WARNING

Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

⚠ WARNING

Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious injury. (00068a)

NOTICE

Do not over-tighten bolts on battery terminals. Use recommended torque values. Over-tightening battery terminal bolts could result in damage to battery terminals. (00216a)

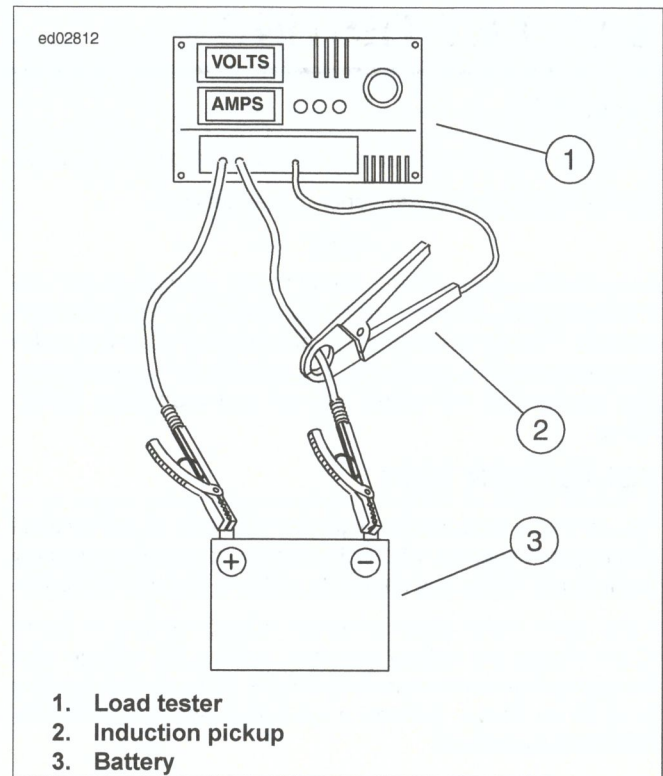


Figure 2-2. Load Test Battery

Table 2-2. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
Street models	225	110

DESCRIPTION AND OPERATION

With IGN ON, battery voltage is supplied to the ignition relay and ignition fuse. The ignition fuse supplies battery voltage to the engine stop switch and start switch.

With engine stop switch to RUN, battery voltage is supplied to the ECM.

When the start switch is pressed, power flows to the coil side of the start relay. The ground is controlled in one of two ways:

- The clutch lever is pulled in and supplies ground through the clutch switch.
- The clutch lever is out and power flows through the diode pack. It is supplied ground at the neutral switch if the vehicle is in neutral.

This supplies ground to the coil side of the start relay allowing power to flow to the starter solenoid. This energizes the solenoid and full battery power is sent to the starter.

COMPONENTS

Starter

See Figure 2-3. The starter receives power from the battery through the starter solenoid and is grounded through the starter case.

- The starter output gear transfers rotation to the idler gear.
- The idler gear transfers rotation to the starter clutch gear.
- The starter clutch gear drives the alternator rotor assembly on the end of the crankshaft.

When the engine starts, the sprag clutch on the backside of the alternator rotor disengages the starter gear and the rotor allowing the starter gear and the rotor to rotate independently of each other.

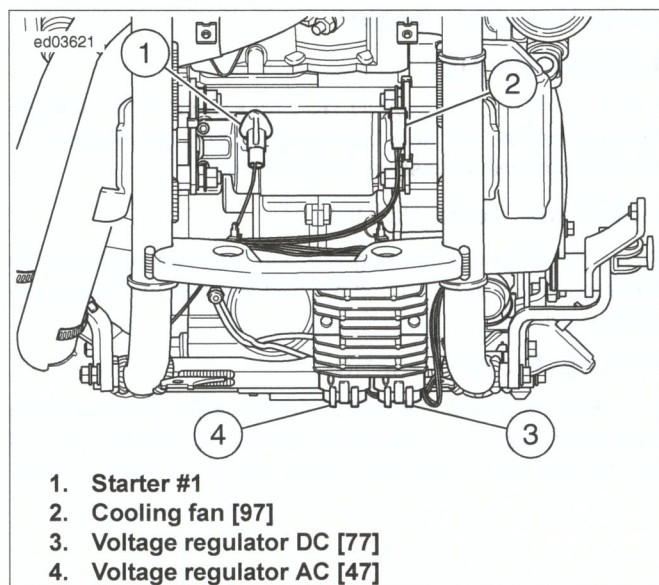


Figure 2-3. Starter Terminal

Starter Solenoid

See Figure 2-4. The starter solenoid provides power to the starter. The solenoid is a means of controlling a high amperage device with a low amperage switch. The low amperage switch in this circuit is the start relay. When the start relay is activated, it sends voltage to the starter solenoid. This makes a magnetic field that pulls a larger circuit closed, allowing voltage to the starter.

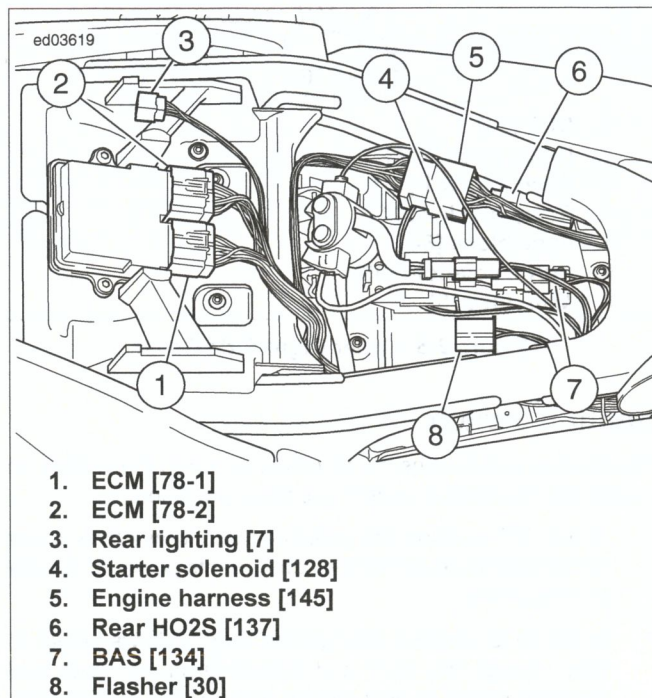


Figure 2-4. Under Seat: Front

Engine Stop Switch

The engine stop switch is located on the right hand controls. With the engine stop switch in the RUN position, battery voltage is supplied to the ECM.

Start Switch

The start switch is a push button switch located in the right hand controls. When the start switch is pressed, power flows to the coil side of the start relay.

Start Relay

See Figure 2-5. The start relay is located in the relay block under the right side cover. With the IGN ON, battery voltage is supplied to the start relay through the ignition fuse. The ignition fuse supplies battery voltage to the engine stop switch and the start switch. With the engine stop switch in the RUN position, battery voltage is supplied to the ECM. When the start switch is pressed, power flows to the coil side of the start relay.

The clutch switch or the neutral switch supplies the ground to the start relay, energizing the start relay. This allows battery voltage from the ignition fuse to flow through the start relay to the starter solenoid.

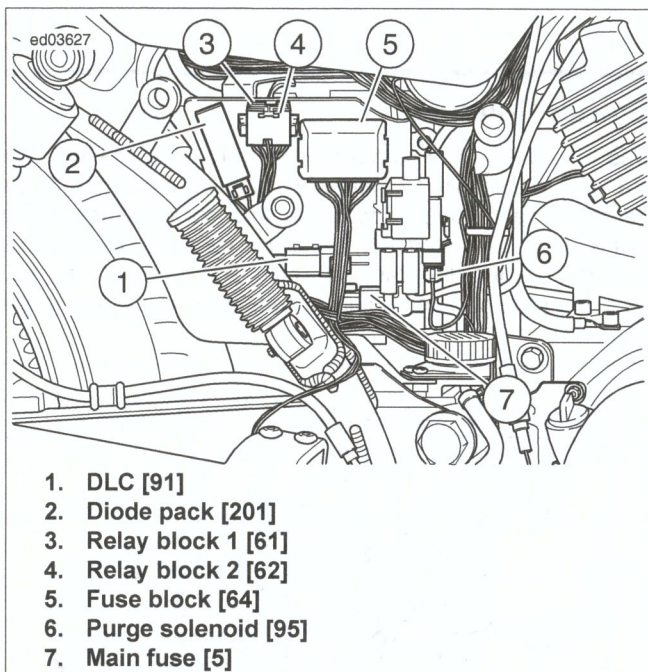


Figure 2-5. Under Right Side Cover

Ignition Switch

The ignition switch turns the electrical power to the vehicle on and/or off. The ignition switch has three positions.

- In the OFF position, the ignition switch turns off all power to the vehicle except for the components powered directly by the battery.
- In the ACC position, the ignition switch allows power to flow through the ACC and lights/instrument fuses and supplies power to only certain parts of the vehicle such as the lights and indicator lamps.
- In the ON or IGN position, the ignition switch supplies power for all the systems on the vehicle.

Battery

⚠ WARNING

Batteries contain sulfuric acid, which could cause severe burns to eyes and skin. Wear a protective face shield, rubberized gloves and protective clothing when working with batteries. **KEEP BATTERIES AWAY FROM CHILDREN.** (00063a)

⚠ WARNING

Never remove warning label attached to top of battery. Failure to read and understand all precautions contained in warning, could result in death or serious injury. (00064a)

⚠ WARNING

Explosive hydrogen gas, which escapes during charging, could cause death or serious injury. Charge battery in a well-ventilated area. Keep open flames, electrical sparks and smoking materials away from battery at all times. **KEEP BATTERIES AWAY FROM CHILDREN.** (00065a)

⚠ WARNING

If battery becomes hot, gassing or spewing of electrolyte can occur, which could cause death or serious injury. Unplug or turn OFF the charger until battery cools. (00412b)

⚠ WARNING

Batteries, battery posts, terminals and related accessories contain lead and lead compounds, and other chemicals known to the State of California to cause cancer, and birth defects or other reproductive harm. Wash hands after handling. (00019e)

NOTICE

If battery releases an excessive amount of gas during charging, decrease the charging rate. Overheating can result in plate distortion, internal shorting, drying out or damage. (00413b)

The AGM batteries are permanently sealed, maintenance-free, valve-regulated, lead/calcium and sulfuric acid batteries.

The battery is recharged by the alternator and kept from overcharging by the regulator during use.

See 2.1 BATTERY TESTING. Battery condition can be determined by a voltage test, a conductance test or a load test.

A battery may be tested, whether fully charged or not, using the conductance test. However, the battery must be fully charged to perform a load test.

Diagnostic Tips

The 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop procedure will help you to locate poor connections or components with excessive voltage drops.

Job/Time Code Values

Dealership Technicians filing warranty claims should use the job/time code values printed in (bold text) beside the appropriate repair.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

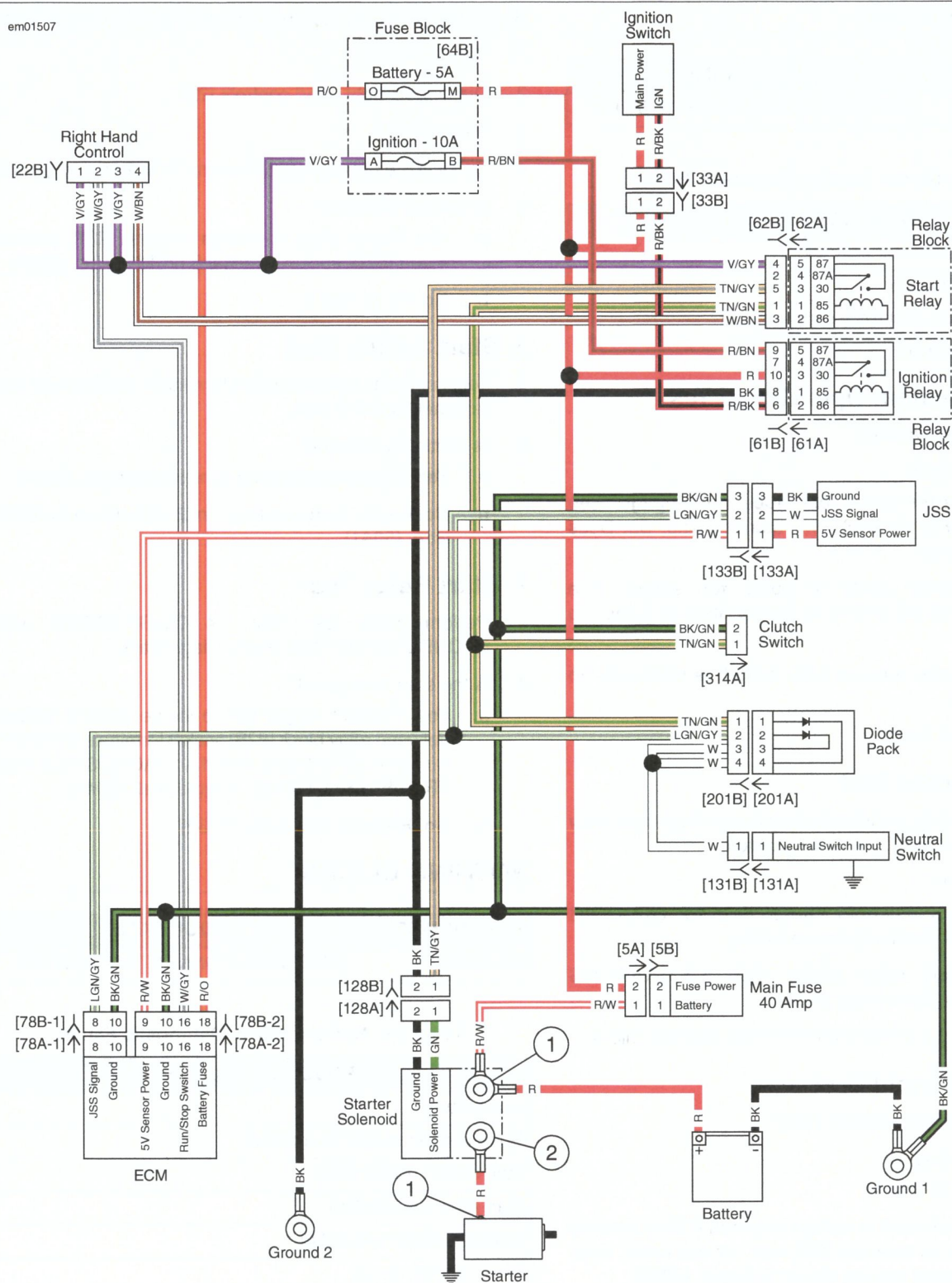


Figure 2-6. Starting Circuit

STARTER TESTING

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 2-3. Starter Testing Diagnostic Faults

POSSIBLE CAUSES
Short to voltage at starter solenoid
Start switch malfunction
Short to voltage on start relay supply circuit
Start relay malfunction

1. Starting System Operational Test

- Attempt to start vehicle.
- Does starter spin?
 - Yes. Starter spins, but does not engage.** See 2.2 STARTING SYSTEM, Starter Spins, But Does Not Engage.
 - Yes. Starter stalls or spins too slowly.** See 2.2 STARTING SYSTEM, Starter Stalls or Spins Too Slowly.
 - Yes. Starter runs on after switch is released.** Go to Test 3.
 - No.** Go to Test 2.

2. Audible Noise Test

- While listening for audible clicking noises from start relay and starter solenoid, press start switch.
- Is there a click?
 - Yes. Start solenoid clicks.** See 2.2 STARTING SYSTEM, Starter Solenoid Clicks.
 - Yes. Start relay clicks.** See 2.2 STARTING SYSTEM, Start Relay Clicks.
 - No.** See 2.2 STARTING SYSTEM, Nothing Clicks.

3. Starter Solenoid Test

- Disconnect starter solenoid [128].
- Does starter stop?
 - Yes.** Go to Test 4.
 - No.** Repair short to voltage between [128B] terminal 1 and starter solenoid (GN) wire, run test again. If run on is present replace starter solenoid. **(5845)**

4. Start Switch Circuit Test

- Turn IGN OFF, remove start relay.
- Turn IGN ON. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between relay block [62B] socket terminal 3 (W/BN) and ground.
- Is battery voltage present?
 - Yes.** Go to Test 5.
 - No.** Go to Test 7.

5. Start Switch Circuit Short to Voltage Test

- Turn IGN OFF.
- Disconnect right hand controls [22].
- Turn IGN ON.
- Test voltage between [22B] terminal 4 (W/BN) and ground.
- Is voltage present?
 - Yes.** Repair short to voltage between [22B] terminal 4 and [62B] socket terminal 3 (W/BN) wire. **(5041)**
 - No.** Go to Test 6.

6. Start Switch Test

- Test continuity between [22A] terminal 4 (W/BN) wire and terminal 3 (V/GY) wire.
- Is continuity present?
 - Yes.** Replace right hand control assembly. **(5818)**
 - No.** Repair short to voltage on [22A] terminal 4 (W/BN) wire. **(5041)**

7. Start Relay Test

- Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
- Is the start relay good?
 - Yes.** Perform wiggle test to locate short to voltage between relay block [62B] socket terminals 5 (TN/GY) wire or 4 (V/GY) wire. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test. **(5041)**
 - No.** Replace start relay. **(5832)**

NOTHING CLICKS

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 2-4. Nothing Clicks Diagnostic Faults

POSSIBLE CAUSES
Low battery
Open ignition switch feed circuit
Start switch malfunction
Start relay malfunction
Ignition switch malfunction
Open ignition circuit
Open start switch circuit
Neutral switch malfunction
Open neutral circuit
Clutch switch malfunction
Open clutch switch circuit
Short to voltage on coil control circuit
Open ignition circuit

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery, attempt to start engine, if nothing clicks, then continue with tests. Go to Test 2.

2. Relay Test

1. Perform relay test on both ignition and start relays. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
2. Are relays good?
 - a. **Yes.** Install both relays. Go to Test 3.
 - b. **No.** Replace bad relay. If problem is still present, continue with tests. Go to Test 3.

3. Ignition Circuit Test

1. Turn IGN ON.
2. Do right or left turn signals work?
 - a. **Yes.** Go to Test 9.
 - b. **No.** Go to Test 4.

4. Ignition Switch Supply Voltage Test

1. Turn IGN OFF.
2. Disconnect ignition switch [33].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between ignition switch [33B] terminal 1 (R) wire and ground.
4. Is battery voltage present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open between ignition switch [33B] terminal 1 and main fuse [5A] terminal 2 (R) wire. **(5041)**

5. Ignition Switch Test

1. Turn IGN ON.
2. Test continuity between [33A] terminals 1 and 2.
3. Is continuity present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Replace ignition switch. **(7287)**

6. Ignition Switch IGN Circuit Test

1. Remove ignition relay [61B].
2. Test continuity between [33B] terminal 2 and relay block [61B] socket terminal 6.
3. Is continuity present?
 - a. **Yes.** Go to Test 7.
 - b. **No.** Repair open between [33B] terminal 2 and [61B] socket terminal 6 (R/BK).

7. Ignition Relay Ground Test

1. Test continuity between [61B] socket terminal 8 and ground.
2. Is continuity present?
 - a. **Yes.** Go to Test 8.
 - b. **No.** Repair open between [61B] socket terminal 8 (BK) and ground.

8. Ignition Relay Battery Power Test

1. Test voltage between [61B] socket terminal 10 and ground.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 9.
 - b. **No.** Repair open between main fuse [5A] terminal 2 and [61B] socket terminal 10 (R).

9. Ignition Relay Power Continuity Test

1. Turn IGN OFF.
2. Remove ignition fuse [64B].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [61B] socket terminal 9 and fuse block [64B] socket terminal B.
4. Is continuity present?
 - a. **Yes.** Install ignition relay. Go to Test 10.
 - b. **No.** Repair open between [61B] socket terminal 9 and [64B] socket terminal B (R/BN).

10. Start Switch Circuit Voltage Test

1. Remove start relay.
2. Turn IGN ON.
3. While pressing start switch, test voltage between [62B] socket terminal 3 (W/BN) wire and ground.
4. Is battery voltage present?
 - a. **Yes.** Go to Test 14.
 - b. **No.** Go to Test 11.

11. Start Switch Test

1. Turn IGN OFF.
2. Disconnect right hand controls [22].
3. With start switch pressed, test continuity between [22A] terminals 3 (V/GY) wire and 4 (W/BN) wire.
4. Is continuity present?
 - a. **Yes.** Go to Test 12.
 - b. **No.** Replace right hand control assembly. **(5818)**

12. Start Switch Circuit Continuity Test

1. Test continuity between [22B] terminal 3 and [64B] socket terminal A (V/GY) wire.

2. Is continuity present?
 - a. **Yes.** Go to Test 13.
 - b. **No.** Repair open between [22B] terminal 3 and [64B] socket terminal A (V/GY) wire. **(5041)**

13. Start Relay Switch Circuit Test

1. Test continuity between [64B] socket terminal A and [62B] socket terminal 4 (V/GY) wire.
2. Is continuity present?
 - a. **Yes.** Repair open between [22B] terminal 4 and [62B] socket terminal 3 (W/BN) wire.
 - b. **No.** Repair open between [64B] socket terminal A and [62B] socket terminal 4 (V/GY) wire.

14. Starter Solenoid Voltage Test

1. Install start relay.
2. Install ignition fuse.
3. Disconnect starter solenoid [128].
4. Turn IGN ON.
5. While pressing start switch, test voltage between [128B] terminal 1 (TN/GY) and ground.
6. Is battery voltage present?
 - a. **Yes.** Go to Test 15.
 - b. **No.** Repair open between [128B] terminal 1 and [62B] socket terminal 5 (TN/GY).

15. Starter Solenoid Ground Test

1. While pressing start switch, test voltage between [128B] terminal 1 and 2.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 16.
 - b. **No.** Repair open between [128B] terminal 2 and ground (BK).

16. Neutral Lamp Test

1. Connect [128].
2. Verify vehicle is in neutral.
3. Is neutral lamp illuminated?
 - a. **Yes.** Go to Test 17.
 - b. **No.** Go to Test 18.

17. Diode Pack Test

1. Turn IGN OFF.
2. Disconnect diode pack [201].
3. Jumper [201B] terminals 1 (TN/GN) and 3 (W).
4. Turn IGN ON.
5. Start vehicle.
6. Did starter crank?
 - a. **Yes.** Replace diode pack.
 - b. **No.** Replace starter solenoid.

18. Neutral Switch Ground Test

1. Turn IGN OFF.
2. Disconnect neutral switch [131].
3. Jumper [131] to ground.
4. Is neutral lamp illuminated?
 - a. **Yes.** Replace neutral switch.
 - b. **No.** Repair open in (W) wire.

START RELAY CLICKS

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 2-5. Start Relay Clicks Diagnostic Faults

POSSIBLE CAUSES
Low battery
Starter solenoid malfunction
Open starter solenoid control circuit
Open starter solenoid ground circuit
Start relay malfunction

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery.

2. Start Relay Test

1. Turn IGN OFF.
2. Remove start relay [62B].
3. Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Replace start relay.

3. Starter Solenoid Control Coil Voltage Test

1. Install start relay.
2. Disconnect starter solenoid [128].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [128B] terminal 1 (TN/GY) wire and ground.
5. Is battery voltage present when start switch is pressed?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Go to Test 5.

4. Starter Solenoid Control Coil Ground Circuit Test

1. Test continuity between [128B] terminal 2 (BK) wire and ground.
2. Is continuity present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Repair open between [128A] terminal 2 (BK) wire and ground. **(5041)**

5. Ignition Circuit Test

1. Turn IGN OFF.
2. Remove ignition fuse [64B].
3. Test continuity between [64B] socket terminal A and [62B] socket terminal 4 (V/GY).
4. Is continuity present?
 - a. **Yes.** Repair open between [128B] terminal 1 and [62B] socket terminal 5 (TN/BN).
 - b. **No.** Repair open between [64B] socket terminal A and [62B] socket terminal 4 (V/GY).

6. Start Solenoid Wiring Inspection Test

1. Inspect for corrosion or damage to the wiring from [128A] to starter solenoid.
2. Are there any problems?
 - a. **Yes.** Repair damage or replace starter solenoid. **(5845)**
 - b. **No.** Go to Test 7.

7. Starter Solenoid Test

1. With IGN ON, press the start switch.
2. Does starter solenoid click?
 - a. **Yes.** See 2.2 STARTING SYSTEM, Starter Solenoid Clicks.
 - b. **No.** Replace starter solenoid. **(5845)**

STARTER SOLENOID CLICKS

Table 2-6. Starter Solenoid Clicks Diagnostic Faults

POSSIBLE CAUSES
Low battery
Starter malfunction
Starter solenoid malfunction
Open starter cable
Mechanical binding

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.

2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery. Attempt to start engine. If starter solenoid continues to click and starter does not engage, then continue with tests. Go to Test 2.

2. Starter Voltage Test

1. While start switch is pressed, test voltage at starter stud #1 on starter (R) wire.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Go to Test 4.

3. Starter Ground Test

1. Remove starter attaching bolts.
2. Clean bolts and starter base, install starter bolts.
3. Does engine crank?
 - a. **Yes, engine cranks at normal speed.** Repair complete.
 - b. **Yes, engine cranks, but at a slower speed.** See 2.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
 - c. **No.** Go to Test 6.

4. Starter Solenoid Voltage Drop Starter Side Test

1. While start switch is pressed, perform voltage drop test from battery (+) terminal to starter solenoid terminal 2 (R) wire.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open between starter terminal 1 and starter solenoid terminal 2 (R) wire.

5. Starter Solenoid Battery Side Voltage Drop Test

1. Perform voltage drop test from battery (+) terminal to starter solenoid terminal 1 (R) and (R/W) wires.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Repair or replace (R) wire from starter solenoid terminal 1 to battery (+) terminal. **(5041)**
 - b. **No.** Replace starter solenoid. **(5845)**

6. Starter Ground Circuit Voltage Drop Test

1. Perform voltage drop test from battery (-) terminal to starter attaching bolts.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Repair or replace (BK) wire from battery (-) terminal or ground 1 connections. **(5041)**
 - b. **No.** Go to Test 7.

7. Starter Draw Test

1. Perform Starter Current Draw Test on motorcycle. See 2.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
2. Perform Starter Motor Free Running Current Draw Test (on bench). See 2.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.
3. Are test results within range?
 - a. **Yes.** Go to Test 8.
 - b. **No.** Replace starter. (5817)

8. Mechanical Binding Test

1. Remove spark plugs and place transmission in 6th gear.
2. Raise vehicle.
3. Rotate rear wheel.
4. Check for engine binding in the primary and/or crankshaft or starter limiter assembly.
5. Is engine binding?
 - a. **Yes.** Repair as needed. (Use appropriate code).
 - b. **No.** Replace starter solenoid. (5845)

STARTER SPINS, BUT DOES NOT ENGAGE

Table 2-7. Starter Spins, But Does Not Engage Diagnostic Faults

POSSIBLE CAUSES
Rotor wear
Starter clutch gear wear
Ball clutch wear
Starter malfunction

1. Starter Gear Test

1. Remove main fuse.
2. Disconnect solenoid cable from starter terminal 1.
3. Remove and inspect starter output gear.
4. Is gear damaged?
 - a. **Yes.** Replace starter.
 - b. **No.** Go to Test 2.

2. Starter Clutch Gear Test

1. Remove alternator (left side) cover.
2. Rotate starter clutch gear.
3. Does ball clutch gear engage in one direction and slip in the other?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Remove and inspect the rotor assembly, starter clutch gear and needle bearings for damage. Replace as needed.

3. Idler Gear Test

1. Rotate and inspect idler gear for damage.
2. Is damage present?
 - a. **Yes.** Replace idler gear. (5825)
 - b. **No.** Replace starter. (5837)

STARTER STALLS OR SPINS TOO SLOWLY

Table 2-8. Starter Stalls or Spins Too Slowly Diagnostic Faults

POSSIBLE CAUSES
Low battery
Starter malfunction
Starter solenoid malfunction
Poor connections at starter ground
Open battery cable
Open starter cable

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery. If symptom is still present, continue with tests. Go to Test 2.

2. Starter Stud Voltage Drop Test

1. Perform voltage drop test from battery (+) terminal to starter stud on starter terminal 1 (R) wire. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Go to Test 3.

3. Starter Ground Circuit Voltage Drop Test

1. Perform voltage drop test between battery (-) terminal and starter attaching bolts.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Clean ground connections. (5041)
 - b. **No.** Go to Test 4.

4. Starter Draw Test

1. Perform Starter Current Draw Test on motorcycle. See 2.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
2. Perform Starter Motor Free Running Current Draw Test (on bench). See 2.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.

3. Are test results within range?
 - a. **Yes.** With the spark plugs removed and the transmission in 6th gear, rotate rear wheel. Check for engine, primary and/or crankshaft bind. (Use appropriate code)
 - b. **No.** Replace starter. **(5817)**

5. Starter Solenoid Voltage Drop Starter Side Test

1. Perform voltage drop test between battery (+) terminal to starter solenoid terminal 2.

2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Repair connection or (R) wire between starter solenoid and starter. **(5041)**

6. Starter Solenoid Battery Side Voltage Drop Test

1. Perform voltage drop test between battery (+) terminal and starter solenoid terminal 1 (R) wire.
2. Is voltage drop greater than 1.0V?
 - a. **Yes.** Repair or replace connection between battery (+) terminal and starter solenoid terminal 1 (R) wire. **(5041)**
 - b. **No.** Replace starter solenoid. **(5845)**

STARTER CURRENT DRAW TEST

NOTES

- *Engine temperature should be stable and at room temperature.*
- *Battery should be fully charged.*

Check starter current draw with an induction ammeter before disconnecting battery. Proceed as follows:

1. Verify transmission is in neutral.
2. Turn engine stop switch OFF.
3. Clamp induction ammeter over positive starter cable to starter solenoid.
4. Turn IGN ON. Read ammeter and zero meter or note current amperage reading.
5. Press start switch and read ammeter. Disregard initial high current reading which is normal when engine is first turned over.
 - a. Typical starter current draw will range between 60-100A.
 - b. If starter current draw exceeds 160A minus noted amperage reading, then problem may be in the starter. See 2.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.

FREE RUNNING CURRENT DRAW TEST

PART NUMBER	TOOL NAME
HD-39617	FLUKE AC/DC CURRENT PROBE

1. Place starter in vise. Use a clean shop towel to prevent scratches or other damage.
2. See Figure 2-7. Attach one heavy jumper cable (6 gauge minimum).
 - a. Connect one end to the starter mounting flange.
 - b. Connect the other end to the battery (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
 - a. Connect one end to the battery (+) terminal of the battery.
 - b. Connect the other end to the battery terminal on the starter. Clamp the FLUKE AC/DC CURRENT PROBE (Part No. HD-39617) around the cable.

⚠ CAUTION

Keep fingers and clothing away from starter gear to prevent personal injury. (00613b)

4. Connect a smaller jumper cable (14 gauge minimum).
 - a. Connect one end to positive (+) terminal of battery.
 - b. Connect other end to solenoid relay terminal.

5. Check ammeter reading.
 - a. Ammeter should show 27A maximum.
 - b. If reading is higher, replace starter.
 - c. If starter current draw on vehicle was over 27A and this test was within specification, there may be a problem with engine or primary drive.

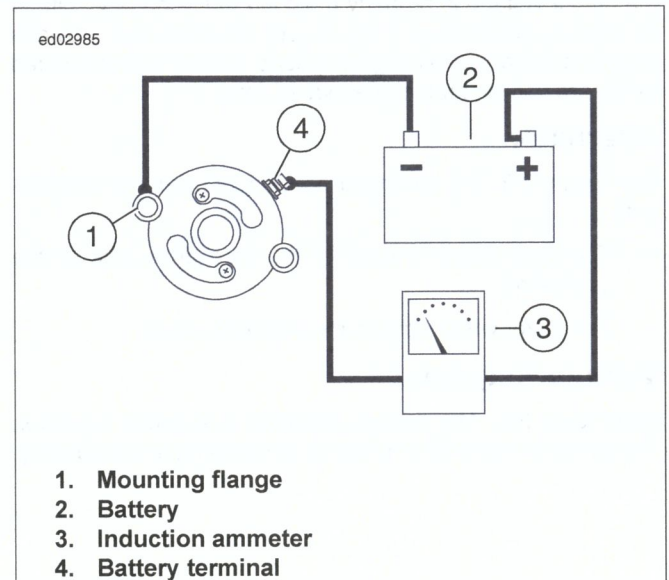


Figure 2-7. Free Running Current Draw Test

DESCRIPTION AND OPERATION

The charging system is the source of electric current that supplies power to run the ignition, lights, accessories and charge the battery. AC voltage is generated by an alternator assembly driven by the crankshaft. A rotor supplied with a magnetic field spins around a stator. A rectifier (located in the regulator) converts the voltage from AC to DC. A regulator ensures that the output voltage is properly matched to the battery voltage as engine speed varies. Even though the alternator provides additional voltage at all engine speeds, it is not recommended to idle the vehicle for long periods of time.

Alternator

See Figure 2-8. The alternator consists of two main components:

- The rotor which mounts to the cam drive side of the crankshaft.
- The stator which bolts to the alternator cover.

Voltage Regulator

See Figure 2-8. The voltage regulator is a series regulator. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

Battery

Test for a weak or dead battery. Battery must be fully charged in order to perform a load test or starting or charging tests. See 2.1 BATTERY TESTING.

Wiring

The stator connections must be clean and tight.

Check for corroded or loose connections in the charging system circuit.

Voltage Regulator Inspection

The voltage regulator must have clean, tight connections for proper operation. Verify both AC and DC connectors are fully inserted and locked with the regulator latch.

Overheat Protection

Overheat protection is built into the regulator to protect the regulator circuits against extreme heat conditions. At approximately 105 °C (221 °F), the overheat protection will limit the current output of the regulator allowing the regulator to cool down and resume normal operation.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

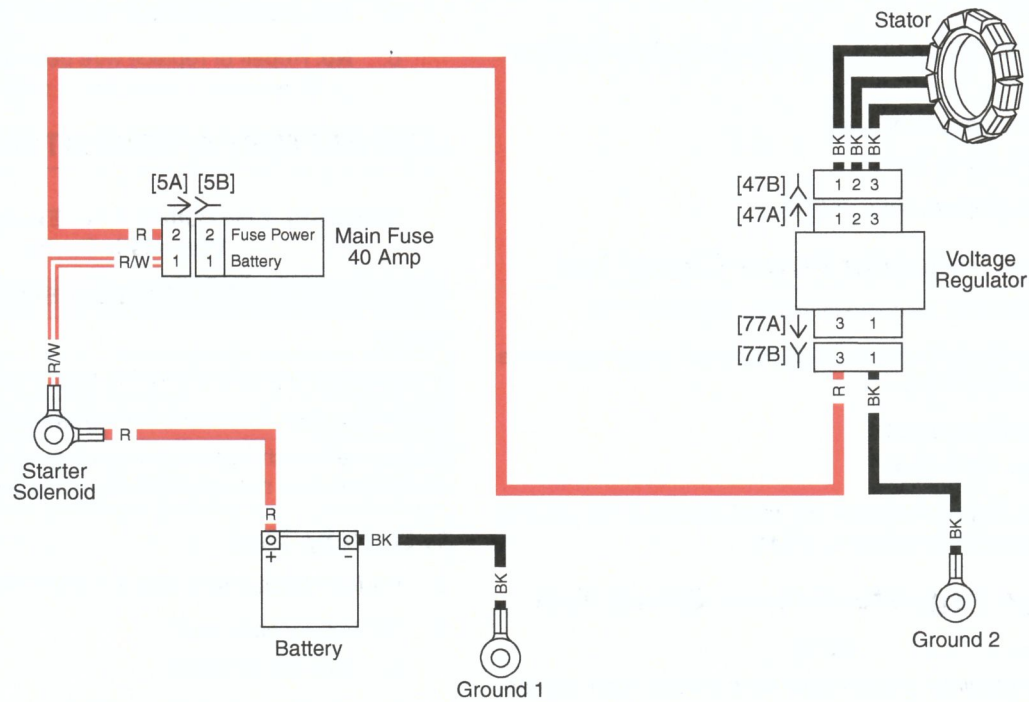


Figure 2-8. Charging System Circuit

LOW OR NO CHARGING

Table 2-9. Low or No Charging Diagnostic Faults

POSSIBLE CAUSES
Low battery
Stator malfunction
Rotor malfunction
Voltage regulator malfunction
Open voltage regulator circuit
Stator shorted to ground
AC wire shorted to ground

1. Battery Test

- Perform battery test. See 2.1 BATTERY TESTING.
- Did battery pass test?
 - Yes.** Go to Test 2.
 - No.** Replace battery. If symptom is still present, continue with tests. Go to Test 2.

NOTE

A discharged battery may show a reading under 13V even though the charging system is working properly.

2. Off Idle Voltage Test

- With vehicle in neutral, start engine and run at 3000 rpm.
- Test battery voltage.
- Is voltage above 13V?
 - Yes.** Charging system working properly.
 - No.** Go to Test 3.

3. AC Output Test

- Perform AC output test. See 2.5 CHARGING SYSTEM, Battery Charging Tests.
- Did the output test pass?
 - Yes.** Go to Test 6.
 - No.** Go to Test 4.

4. Stator Test

- Perform stator test. See 2.5 CHARGING SYSTEM, Battery Charging Tests.
- Is the stator good?
 - Yes.** Go to Test 5.
 - No.** Replace stator. (5309)

5. Rotor Inspection Test

- Inspect rotor for damage.

2. Verify that rotor bolt is not loose and inspect for crankshaft damage.
3. Verify that stator bolts have not backed out and contacted the rotor.
4. Is rotor in good condition?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Replace rotor. **(5319)**

6. Voltage Regulator Power Circuit Test

1. With IGN OFF, disconnect voltage regulator [77].
2. Test continuity between [77B] terminal 3 and main fuse [5A] terminal 2 (R).
3. Is continuity present?
 - a. **Yes.** Go to Test 7.
 - b. **No.** Repair or replace (R) wire between [77B] terminal 3 and [5A] terminal 2. **(5041)**

7. Voltage Regulator Ground Circuit Test

NOTE

The voltage regulator ground must have a clean, tight connection for proper grounding.

1. Test resistance between voltage regulator [77B] terminal 1 and ground.
2. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace voltage regulator. **(5316)**
 - b. **No.** Repair or replace wire between voltage regulator [77B] terminal 1 and GND 2 (BK) wire. **(5041)**

OVERCHARGING

Table 2-10. Overcharging Diagnostic Faults

POSSIBLE CAUSES
Voltage regulator malfunction
Open in GND 2 circuit

1. Battery Voltage Test

1. With vehicle in neutral, start engine and run at 3000 rpm.
2. Test battery voltage.
3. Is voltage above 15.5V?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Charging system working properly.

2. Voltage Regulator Ground Circuit Test

NOTE

The voltage regulator ground must have a clean, tight connection for proper grounding.

1. With IGN OFF, disconnect voltage regulator [77].
2. Test resistance between [77B] terminal 1 and ground.

3. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace voltage regulator. **(5316)**
 - b. **No.** Repair or replace wire between voltage regulator [77B] terminal 1 and GND 2 (BK) wire. **(5041)**

LOW BATTERY AFTER EXTENDED IGN OFF

Table 2-11. Low Battery After Extended IGN OFF Diagnostic Faults

POSSIBLE CAUSES
Battery
Accessories improperly wired to stay on at all times
Excessive draw from electrical component with IGN OFF
Battery self-discharge and/or component draw because motorcycle was not operated for a long period

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery. **(5705)**

2. Amp Draw Test

1. Perform milliampere draw test. See 2.5 CHARGING SYSTEM, Battery Charging Tests.
2. Did the test exceed maximum draw?
 - a. **Yes.** Repair excessive draw and run test again. **(5308)**
 - b. **No.** System is working properly.

BATTERY RUNS DOWN DURING USE

Table 2-12. Battery Runs Down During Use Diagnostic Faults

POSSIBLE CAUSES
Low battery
Excessive accessory draw
Accessories on when idling or low rpm riding for extended period

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery.

2. Total Current Draw Test

1. Perform Total Current Draw and Output Test. See 2.5 CHARGING SYSTEM, Battery Charging Tests.
2. Does charging system exceed current draw by 3.5A?
 - a. **Yes.** System is working properly.
 - b. **No.** System accessory power requirements exceed charging system capability.

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

NOTE

1. Remove main fuse.

NOTE

2. See Figure 2-9. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), connect ammeter to main fuse socket terminals. With this arrangement, you will pick up any drain.

3. With IGN OFF and all lights and accessories off, observe current reading.
 - a. Add voltage regulator draw to appropriate value for ECM. If observed ammeter reading is less than listed in table, draw is within limits. Refer to Table 2-13.
 - b. A higher reading indicates excessive current draw. Any accessories must be considered and checked for excessive drain.

ITEM	MAXIMUM DRAW IN MILLI-AMPERES
Regulator	0.5
ECM	1.0
Speedometer	0.5

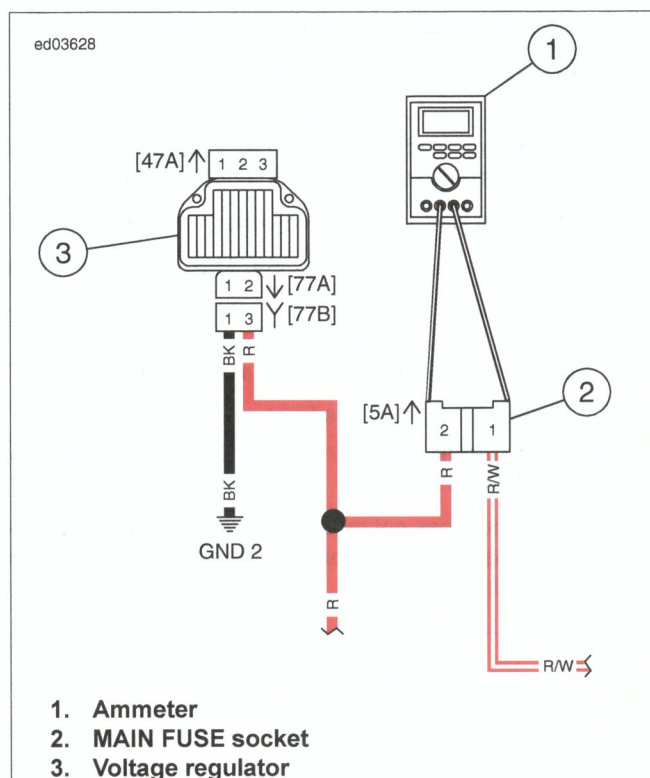


Figure 2-9. Milliampere Draw Test (Ignition Turned to OFF)

If battery runs down during use, the current draw of the motorcycle components and accessories may exceed output of the charging system.

NOTE

If a load tester is unavailable, use an ammeter with current probe.

⚠ WARNING

Turn battery load tester OFF before connecting tester cables to battery terminals. Connecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00252a)

1. See Figure 2-10. Connect load tester.
 - a. Connect negative and positive leads to battery terminals.
 - b. Place load tester induction pickup over battery negative cable.
2. With IGN OFF, disconnect voltage regulator [77].
3. Start engine.
4. Turn all continuously running lights and accessories turned ON (headlamp on high beam).
5. Run at 3000 rpm and make note of the current draw.
6. Turn engine OFF.
7. With IGN OFF, connect voltage regulator [77].
8. Remove the induction pickup from the battery negative cable.

9. Place induction pickup over positive regulator cable.
10. Start engine and run at 3000 rpm.

NOTE

Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

11. Increase the load as required to obtain a constant 13.0V.
12. Current output should be 30-35A. Make note of current output.

NOTE

Rider's habits may require output test at lower rpm.

13. Compare both of these readings.
 - a. The current output should exceed current draw by 3.5A minimum.
 - b. If output does not meet specifications, there may be too many accessories for the charging system to handle.

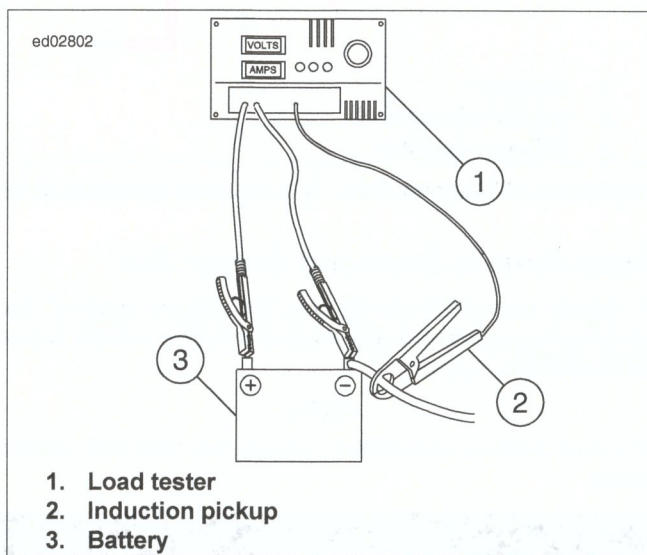


Figure 2-10. Check Current Draw (Ignition Switch On)

Stator Test

1. Turn IGN OFF.
2. See Figure 2-11. Connect an ohmmeter.
 - a. Disconnect voltage regulator [47] from stator wiring.
 - b. Insert one ohmmeter lead into a stator connector socket.
 - c. Attach the other lead to a suitable ground.
3. Test for continuity.
 - a. A good stator will show no continuity (open circuit) between all stator sockets and ground.
 - b. Any other reading indicates a grounded stator which must be replaced.

4. See Figure 2-12. Remove ground lead. Measure resistance across stator [47B] terminals 1-2, 2-3 and 3-1.
 - a. Resistance across all the stator terminals should be 0.1-0.3 Ohm.
 - b. If the resistance is higher, the stator is damaged and must be replaced.
 - c. If resistance is lower, the stator may have a turn-to-turn short and should be replaced.

NOTE

When measuring resistance (Ohms), compensate for test lead resistance before performing the measurement. Select the Ohms position and touch the test leads together. Refer to the multimeter user's manual to either zero the display or manually subtract the test lead resistance from the measured circuit's value.

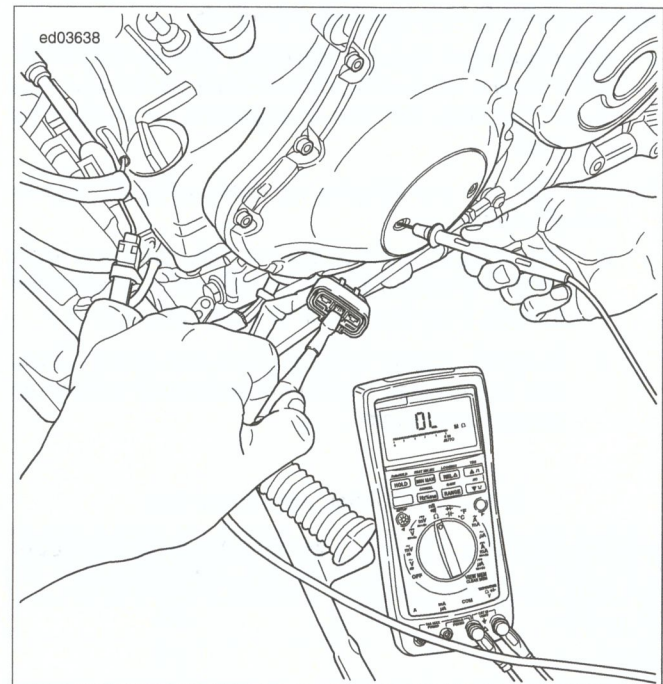


Figure 2-11. Test for Grounded Stator (Typical)

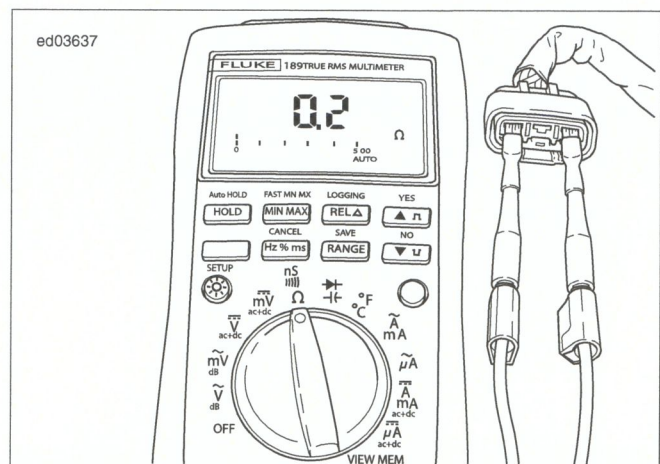


Figure 2-12. Check for Stator Resistance (Typical)

AC Output Test

1. See Figure 2-13. Test AC output.
 - a. Disconnect voltage regulator [47] from alternator stator wiring.
 - b. Test VAC across stator [47B] terminals 1 to 2.
 - c. Run engine at 2000 rpm. The VAC output should be 32-40 VAC (approximately 16-20 VAC per 1000 rpm).
 - d. Repeat test using terminals 2 to 3 and 1 to 3.
2. Compare test results to specifications.
 - a. If the output is below specifications, charging problem could be a faulty rotor or stator.
3. Check the output again as previously described under Total Current Draw and Output Test.

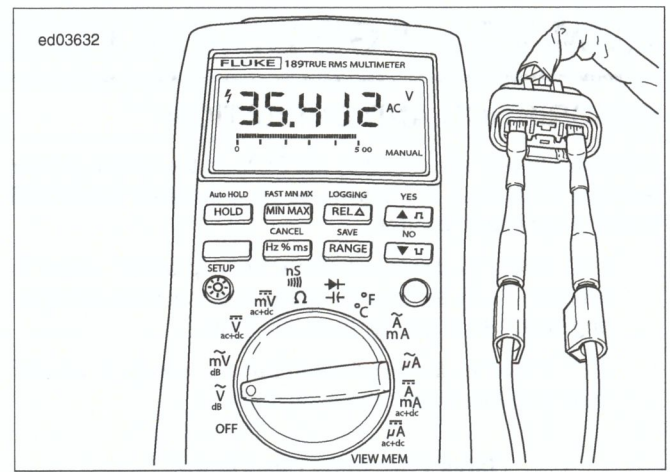


Figure 2-13. Check Stator AC Voltage Output (Typical)

DESCRIPTION AND OPERATION

Battery voltage is monitored by the ECM on the system power terminal 16 of [78-2]. The system power is supplied to the ECM from the right hand control.

- DTC P0562 is displayed when run/stop switch power is less than 12.2V at idle and voltage does not increase when engine speed is greater than 2000 rpm.
- DTC P0563 is displayed when battery voltage is greater than 15.0V for more than 4 seconds.

Table 2-14. Code Description

DTC	DESCRIPTION
P0562	ECM voltage low
P0563	ECM voltage high

Diagnostic Tips

Any of the following conditions could cause this DTC to set:

- The charging system is malfunctioning.
- There is excessive battery draw and/or extended idling in heavy traffic.
- A faulty system ground is present. Low voltage generally indicates a loose wire, corroded connections, battery and/or a charging system problem.

DTC P0562, P0563

Table 2-15. DTC P0562, P0563 Diagnostic Faults

POSSIBLE CAUSES
Low battery
Charging system malfunction

1. Battery Test

1. Perform battery test. See 2.1 BATTERY TESTING.
2. Did battery pass test?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace battery.

2. Charging System Test

1. Perform charging system test. See 2.5 CHARGING SYSTEM, Low or No Charging.
2. Is charging system working properly?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair charging system.

3. Repair Validation Test

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Does code set?
 - a. **Yes.** Replace ECM.
 - b. **No.** System working properly.

SUBJECT	PAGE NO.
3.1 SPEEDOMETER.....	3-1
3.2 NO SPEEDOMETER POWER.....	3-2
3.3 INDICATOR LAMPS.....	3-5

NOTES

DESCRIPTION AND OPERATION

See Figure 3-1. The speedometer consists of the speedometer, odometer, trip odometer reset switch and indicators.

Trip Odometer Reset Switch Operation

Pressing the trip odometer reset switch provides the following capabilities:

- Change the odometer display between mileage and trip values (press and immediately release).
- Reset the trip odometer (press and hold 2-3 seconds).

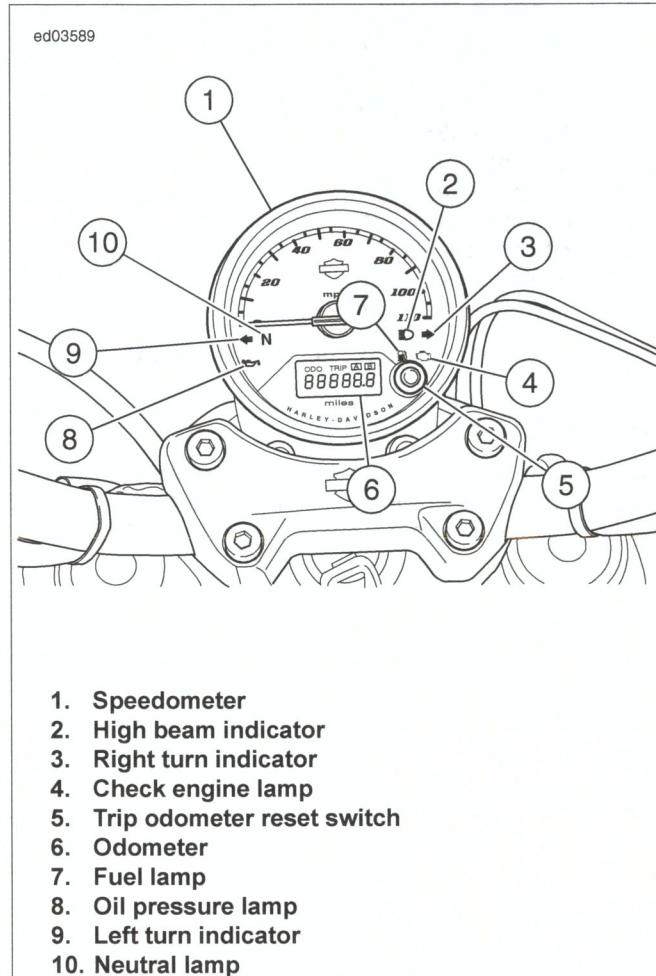


Figure 3-1. Front HO2S [138]

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected.

To zero the trip odometer, have the odometer display visible, press and keep the trip odometer reset switch depressed. The trip odometer mileage will be displayed for 2-3 seconds and then the trip mileage will return to zero miles.

SPEEDOMETER THEORY OF OPERATION

The speed sensor is mounted on the left side of transmission case. The sensor circuitry is that of a Hall-Effect sensor that is triggered by the gear teeth of fifth gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by the ECM and speedometer. The speedometer converts the pulses to control the position of the speedometer needle.

DESCRIPTION AND OPERATION

See Figure 3-2. The speedometer receives battery power at [39] terminal 5 and the ground is supplied through terminal 6. The speedometer receives ACC power at [21] terminal 5.

The speedometer goes through an initialization sequence every time power is applied to terminal 5. The visible part of this sequence is the indicators, backlighting and odometer illuminate and the speedometer sweeps.

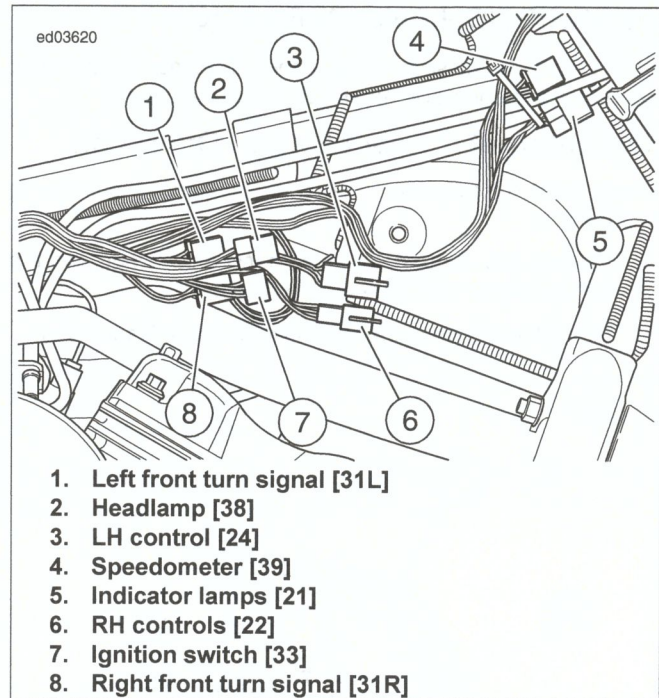


Figure 3-2. Under Fuel Tank Right Side

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

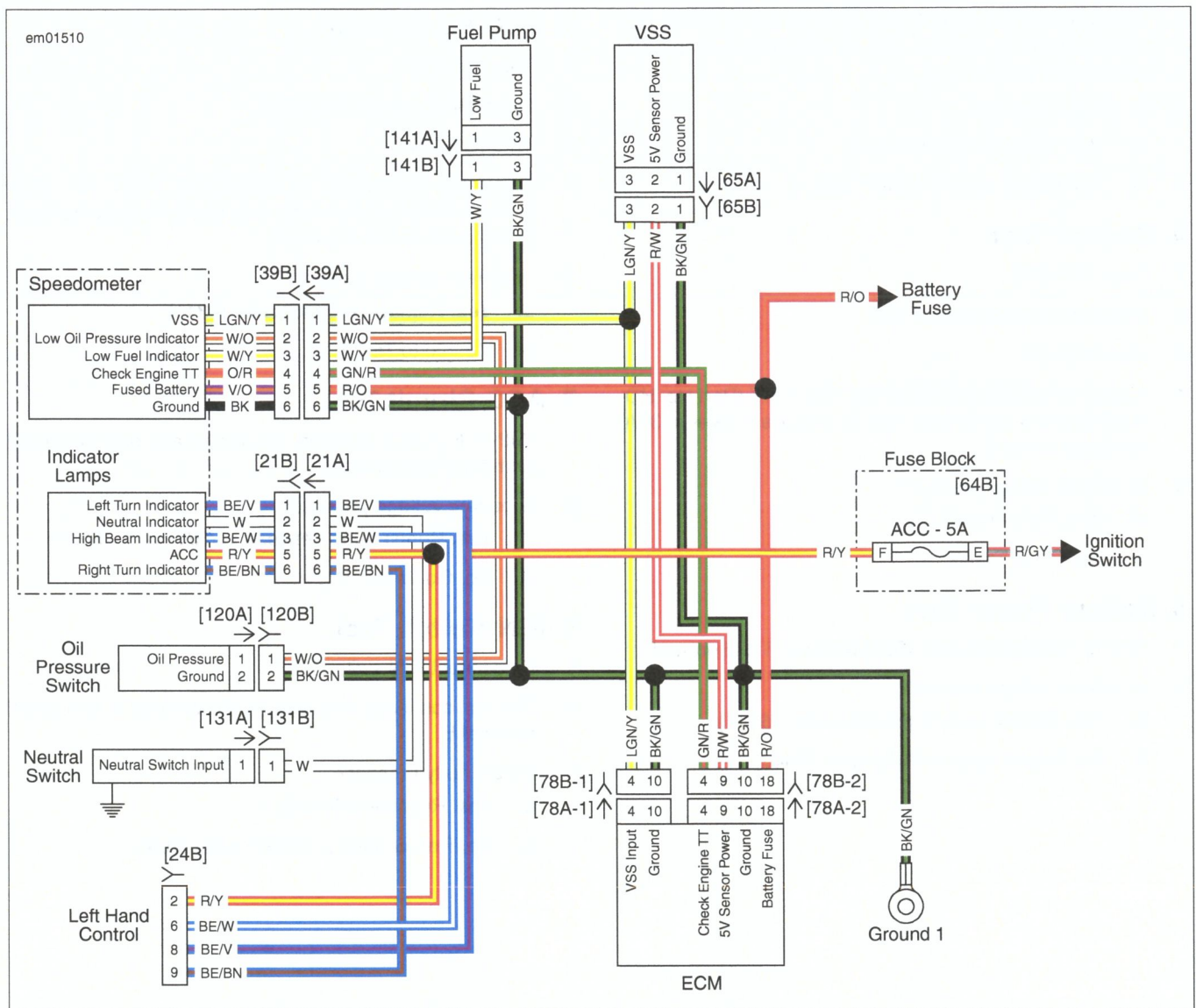


Figure 3-3. Speedometer Circuit Diagram

SPEEDOMETER INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-1. Speedometer Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open accessory circuit
Open battery circuit
Short to ground in battery circuit
Open in VSS circuit
Ignition switch malfunction
Open ground circuit

1. Speedometer Function Test

1. Turn IGN ON.

2. Does the speedometer illuminate?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Go to Test 4.

2. VSS DTC Test

1. Turn the engine stop switch ON.
2. Does the check engine lamp remain on for more than 5 seconds?
 - a. **Yes.** DTC is present. Diagnose DTC. Refer to Table 1-13.
 - b. **No.** Go to Test 3.

3. VSS Open Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Turn IGN ON.

4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [39A] terminals 1 and 6.
5. Is voltage present?
 - a. **Yes.** Replace speedometer.
 - b. **No.** Repair open in LGN/Y wire.

4. Ground Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [39A] terminals 5 and 6.
5. Is battery voltage present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Go to Test 5.

5. Battery Power Test

1. Test for voltage between [39A] terminal 5 and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK/GN) wire. **(5041)**
 - b. **No.** Repair open in (R/O) wire. **(5041)**

6. ACC Power Test

1. Turn IGN OFF.
2. Disconnect speedometer [21].
3. Turn IGN ON.
4. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [21A] terminal 5 and ground.
5. Is battery voltage present?
 - a. **Yes.** Replace speedometer. **(7311)**
 - b. **No.** Go to Test 7.

7. ACC Circuit Test

1. With IGN in ACC position, test for voltage between [64B] terminal F and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open between in (R/Y) wire. **(5041)**
 - b. **No.** Go to Test 8.

8. IGN Switch Test

1. Disconnect IGN switch [33].
2. Test for continuity between [33B] terminal 3 and [64B] terminal E.
3. Is continuity present?
 - a. **Yes.** Replace IGN switch.
 - b. **No.** Repair open in (R/GY) wire. **(5041)**

DESCRIPTION AND OPERATION

See Figure 3-4. The indicators are located in the speedometer and are not serviced separately.

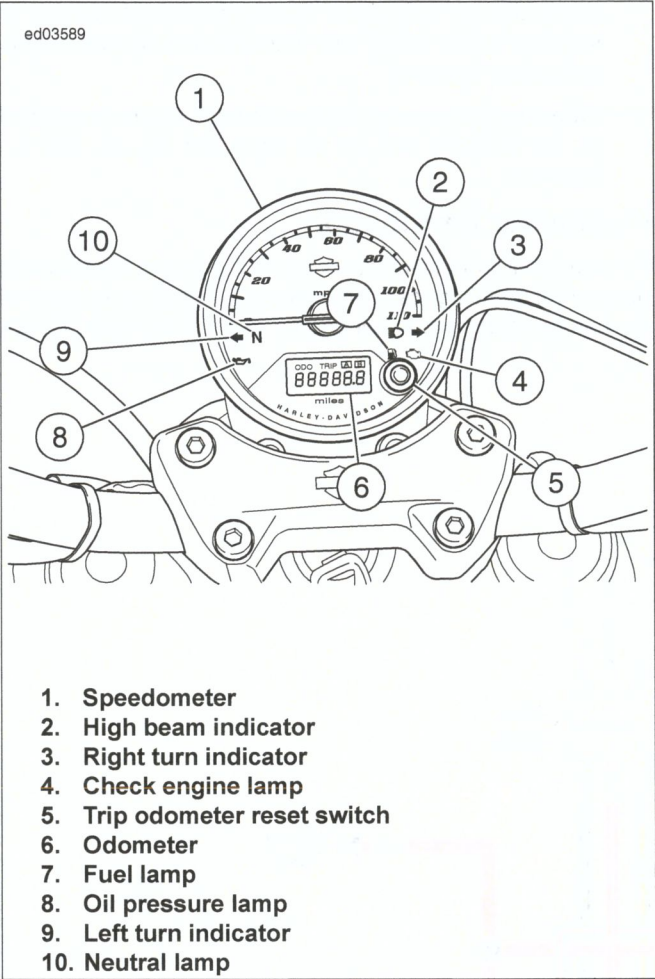


Figure 3-4. Front HO2S [138]

Table 3-2. Indicator Lamp Wiring

INDICATOR LAMP	CONNECTION
Check engine	Ground through ECM
Oil pressure	Ground through switch
Neutral	Ground through switch
High beam	12V when active
Right/left turn	12V when active
Low fuel	Voltage varies through sender, active at 1/4 tank or less

High Beam Indicator

The high beam indicator is connected to the (BE/W) wire at [21] terminal 3. This circuit is powered when the headlamp switch is placed in the high beam position. When voltage is applied to [21] terminal 3, the high beam indicator illuminates.

Low Fuel Indicator

See Figure 3-5. The low fuel indicator lamp is controlled through [39] terminal 3. The low fuel indicator will illuminate when the fuel level in the tank drops below 3.8 L (1.0 gal). It will also illuminate due to a malfunction in the fuel level sensor circuit.

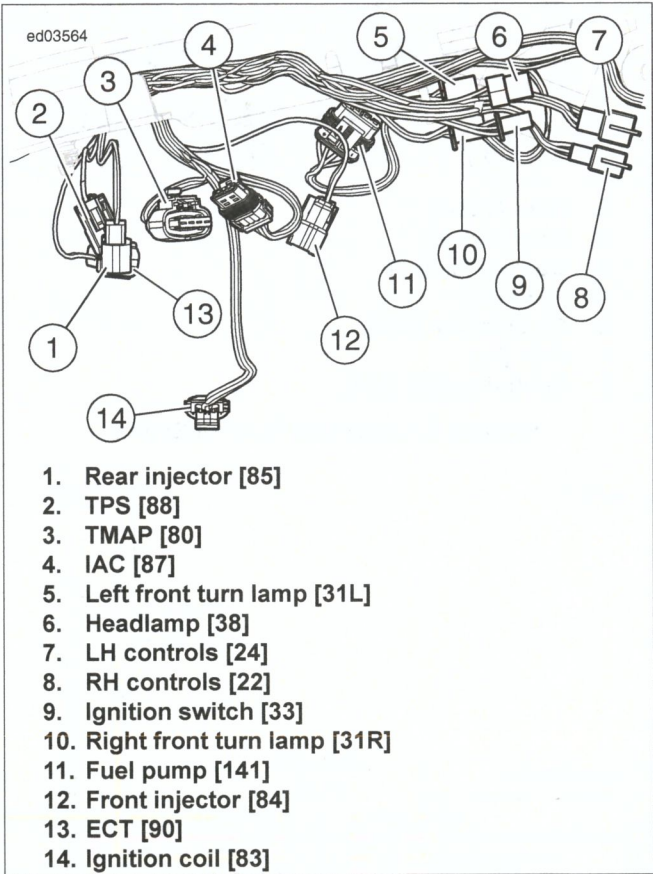


Figure 3-5. Under Fuel Tank

Neutral Indicator

The neutral indicator is connected to the (W) wire at [21] terminal 2. This circuit also connects to the neutral switch and the diode pack. When the vehicle is in neutral, the switch is closed grounding the circuit and illuminating the neutral indicator.

Oil Pressure Indicator

See Figure 3-6. The oil pressure indicator is connected to the (W/O) wire at [39] terminal 2. This circuit is connected to the oil pressure switch. The switch closes when oil pressure is low and illuminates the oil pressure indicator. This is why the oil pressure indicator is illuminated with the IGN ON and the engine OFF.

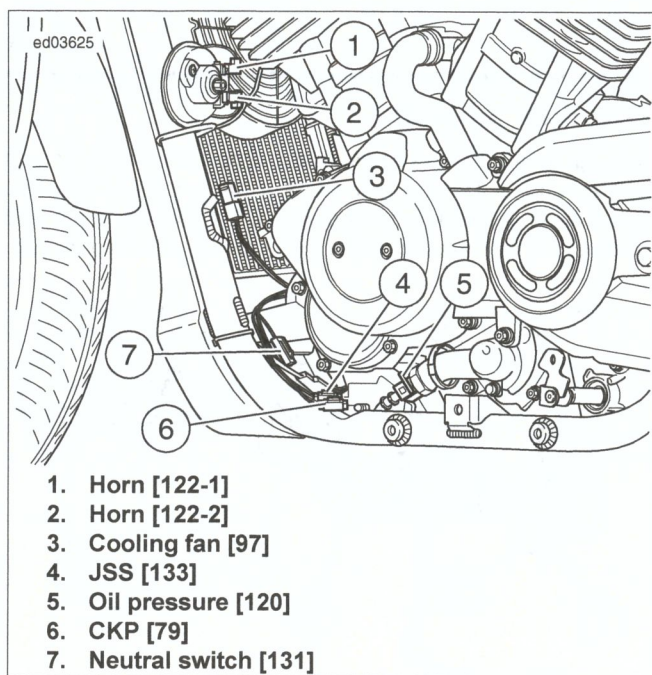


Figure 3-6. Lower Left Front of Engine

Turn Signal Indicators

The turn signal indicators are connected at [21] terminals 1 (left) and 6 (right). The turn signal indicators are controlled by the flasher and turn signal switch. The turn signal switch supplies power from the flasher to the correct turn signal indicator, causing it to flash.

- When the left turn signal switch is pressed, voltage is supplied on the (BE/V) wire to the left turn signals and the turn signal indicator.
- When the right turn signal is pressed, voltage is supplied on the (BE/BN) wire to the right turn signals and the indicator.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

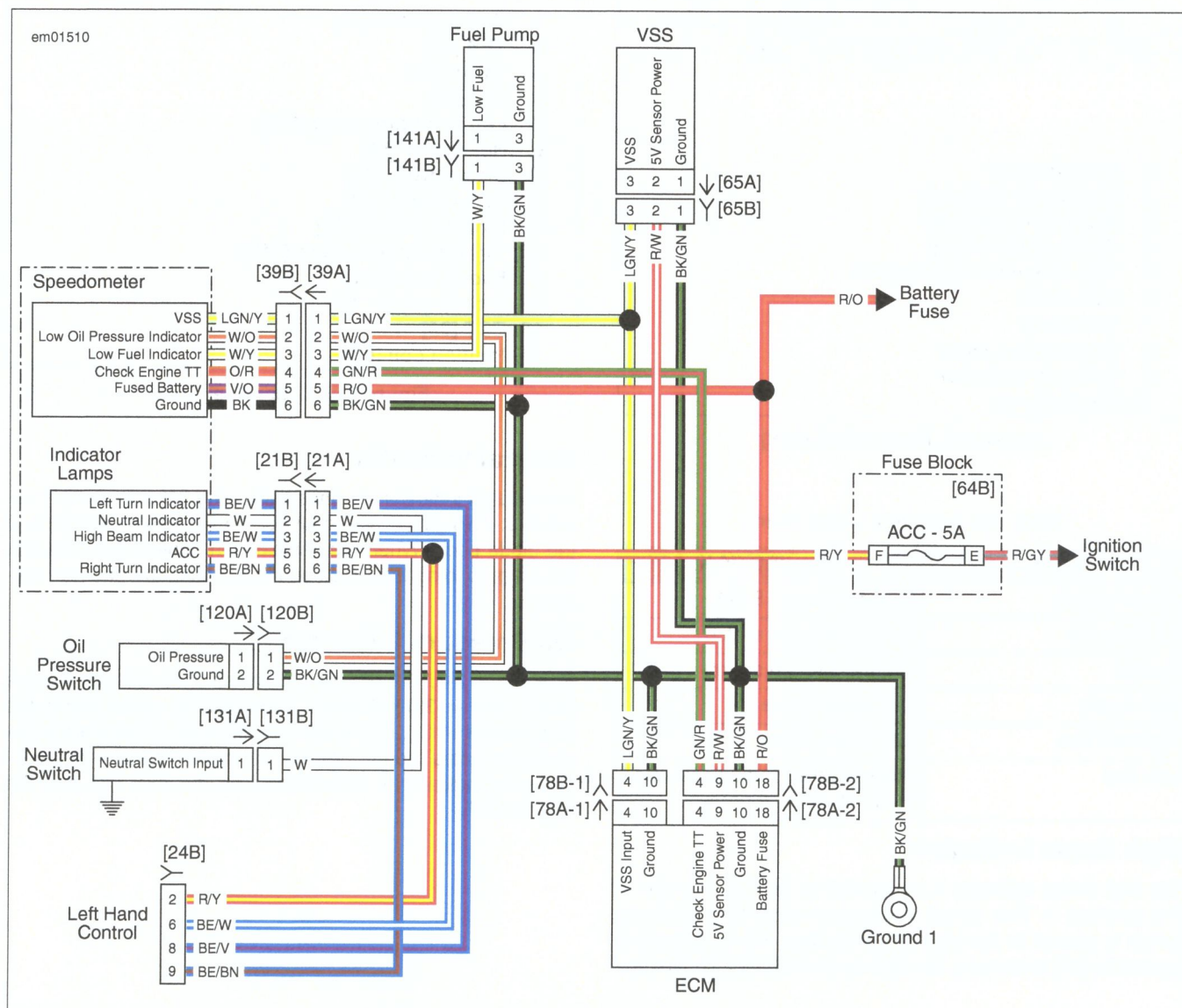


Figure 3-7. Speedometer Circuit Diagram

HIGH BEAM INDICATOR LAMP ALWAYS ON

Table 3-3. High Beam Indicator Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Speedometer malfunction

1. High Beam Indicator Function Test

1. Turn IGN ON.
2. Is the high beam headlamp always on or inoperative?
 - a. **Yes.** See 5.3 HEADLAMP DIAGNOSTICS.
 - b. **No.** Replace speedometer. (7311)

HIGH BEAM INDICATOR LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-4. High Beam Indicator Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open high beam indicator circuit

1. High Beam Indicator Function Test

1. With IGN ON, operate the headlamp switch.
2. Do the high and low beam headlamps function correctly?
 - a. **Yes.** Go to Test 2.
 - b. **No.** See 5.3 HEADLAMP DIAGNOSTICS.

2. High Beam Indicator Circuit Test

1. With IGN OFF, disconnect speedometer [21].
2. With IGN ON, the headlamp switch in the high position and using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [21A] terminal 3 and ground.
3. Is voltage present?
 - a. **Yes.** Replace speedometer. (6006)
 - b. **No.** Repair open in (BE/W) wire. (5041)

LOW FUEL LAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-5. Low Fuel Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Short to ground in low fuel circuit
Fuel level sender malfunction
Speedometer malfunction

1. Fuel Level Sensor Test

1. Verify there is sufficient fuel in the fuel tank.
2. Disconnect [141].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, measure the resistance between [141A] terminal 1 and terminal 3.
4. Is resistance between 750-1100 Ohms?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace the fuel level sender. (6035)

2. Fuel Level Circuit Test

1. Disconnect speedometer [39].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for continuity between [39A] terminals 3 and 6.
3. Is continuity present?
 - a. **Yes.** Repair short to ground in (W/Y) wire. (5041)
 - b. **No.** Replace the speedometer.

LOW FUEL LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT

Table 3-6. Low Fuel Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open in low fuel circuit
Short to voltage in low fuel circuit
Fuel sender malfunction
Speedometer malfunction

1. Low Fuel Lamp Test

1. Disconnect [141].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) jumper between [141B] terminal 1 and ground.
3. Turn IGN ON.
4. Wait a minute for the low fuel lamp to update.

5. Did the low fuel lamp illuminate?
 - a. **Yes.** Replace the fuel level sender. **(6035)**
 - b. **No.** Go to Test 2.

2. Fuel Level Circuit Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [141B] terminal 1 and [39A] terminal 3.
4. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (W/Y) wire. **(5041)**

3. Fuel Level Circuit Short to Voltage Test

1. Turn IGN ON.
2. Test for voltage between [141B] terminal 1 and ground.
3. Is voltage present?
 - a. **Yes.** Repair short to voltage in (W/Y) wire. **(5041)**
 - b. **No.** Replace the speedometer.

NEUTRAL LAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-7. Neutral Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Neutral switch malfunction
Short to ground in neutral circuit

1. Neutral Lamp Function Test

1. With the vehicle in neutral, turn IGN ON with the engine OFF.
2. Does the neutral lamp illuminate?
 - a. **Yes.** Go to Test 2.
 - b. **No.** See 3.3 INDICATOR LAMPS, Neutral Lamp Inoperative.

2. Transmission Operation Test

1. Shift the transmission out of neutral.
2. Does the neutral lamp turn OFF and stay off?
 - a. **Yes.** Neutral lamp is operating properly. Test for intermittent. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
 - b. **No.** Go to Test 3.

3. Neutral Switch Test

1. Disconnect the neutral switch [131].

2. Does the neutral lamp turn OFF?
 - a. **Yes.** Replace the neutral switch. **(5157)**
 - b. **No.** Go to Test 4.

4. Neutral Switch Circuit Test

1. Disconnect the speedometer [21].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, measure resistance between [21A] terminal 2 and ground.
3. Is resistance less than 5 Ohms?
 - a. **Yes.** Repair short to ground (W) wire. **(5041)**
 - b. **No.** Replace speedometer. **(7311)**

NEUTRAL LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-8. Neutral Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Neutral switch malfunction
Open ground circuit
Diode pack malfunction
Open neutral switch circuit

1. Neutral Lamp Function Test

1. With the vehicle in neutral, turn IGN ON with the engine OFF.
2. Does the neutral lamp illuminate?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Go to Test 2.

2. Neutral Switch Test

1. Disconnect the neutral switch [131].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jump [131B] terminal 1 to ground.
3. Does the neutral lamp turn ON?
 - a. **Yes.** Replace the neutral switch. **(5157)**
 - b. **No.** Go to Test 3.

3. Neutral Switch Power Circuit Open Test

1. With IGN OFF, disconnect speedometer [21].
2. Test for continuity between [21A] terminal 4 and [131B] (W) wire.
3. Is continuity present?
 - a. **Yes.** Replace speedometer. **(7311)**
 - b. **No.** Repair open in (W) wire. **(5041)**

4. Neutral Operation Test

1. Shift transmission into gear.

2. Did the neutral lamp turn off?
 - a. **Yes.** Go to Test 5.
 - b. **No.** See 3.3 INDICATOR LAMPS, Neutral Lamp Always On.

5. Diode Test

1. Operate the clutch lever.
2. Raise and lower the kickstand.
3. Does the neutral lamp illuminate at any time?
 - a. **Yes.** Replace diode pack.
 - b. **No.** Test for intermittent. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.

OIL PRESSURE LAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-9. Oil Pressure Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Short to ground in oil pressure circuit
Mechanical issue
Oil pressure switch malfunction

1. Oil Pressure Lamp Function Test

1. Turn IGN ON with the engine OFF.
2. Does the oil pressure lamp illuminate?
 - a. **Yes.** Go to Test 2.
 - b. **No.** See 3.3 INDICATOR LAMPS, Oil Pressure Lamp Inoperative.

2. Engine Running Test

1. Start the engine.
2. Does the oil pressure lamp turn OFF and stay off?
 - a. **Yes.** Oil pressure lamp is operating properly. Test for intermittent. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
 - b. **No.** Go to Test 3.

3. Oil Pressure Sensor Test

1. Disconnect the oil pressure sensor [120].
2. Does the oil pressure lamp turn OFF?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Go to Test 4.

4. Oil Pressure Circuit Test

1. With IGN OFF, disconnect speedometer [39].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for continuity between [39B] terminal 2 and ground.

3. Is continuity present?
 - a. **Yes.** Repair short to ground in (W/O) wire. (5041)
 - b. **No.** Replace speedometer. (7311)

5. Mechanical Test

1. Inspect the engine for any issues that may affect oil pressure. See the service manual.
2. Was the problem found?
 - a. **Yes.** Repair as needed.
 - b. **No.** Replace the oil pressure switch. (5161)

OIL PRESSURE LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-10. Oil Pressure Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Oil pressure switch malfunction
Open in ground circuit
Open oil pressure circuit

1. Oil Pressure Lamp Function Test

1. Turn IGN ON with the engine OFF.
2. Does the oil pressure lamp illuminate?
 - a. **Yes.** Test for intermittent. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
 - b. **No.** Go to Test 2.

2. Oil Pressure Switch Test

1. Disconnect the oil pressure sensor [120].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404), connect [120B] terminal 1 to ground.
3. Does the oil pressure lamp turn ON?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Go to Test 3.

3. Oil Pressure Circuit Test

1. With IGN OFF, disconnect speedometer [39].
2. Test for continuity between [39A] terminal 2 and [120B] terminal 1.
3. Is continuity present?
 - a. **Yes.** Replace speedometer. (7311)
 - b. **No.** Repair open in (W/O) wire. (5041)

4. Ground Circuit Test

1. Test resistance between [120B] terminal 2 and ground.

2. Is resistance less than 0.5 ohms?
 - a. **Yes.** Replace pressure switch. **(5161)**
 - b. **No.** Repair open in (BK/GN) wire. **(5041)**

TURN SIGNAL INDICATOR ALWAYS ON

Table 3-11. Turn Signal Indicator Always On Diagnostic Faults

POSSIBLE CAUSES
Speedometer malfunction

1. Turn Signal Function Test

1. With IGN ON, operate the turn signals.
2. Do the turn signals operate and turn off correctly?
 - a. **Yes.** Replace speedometer. **(7311)**
 - b. **No.** See 5.2 TURN SIGNAL DIAGNOSTICS.

TURN SIGNAL INDICATOR INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 3-12. Turn Signal Indicator Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open turn signal circuit

1. Turn Signal Function Test

1. With ignition ON, operate the turn signals.
2. Do the turn signals operate?
 - a. **Yes.** Go to Test 2.
 - b. **No.** See 5.2 TURN SIGNAL DIAGNOSTICS.

2. Turn Signal Indicator Circuit Test

1. With IGN OFF, disconnect speedometer [21].
2. With the IGN ON and the turn signals activated and using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [21A] terminal 1 (left) and 6 (right) and ground.
3. Is voltage cycling on and off?
 - a. **Yes.** Replace speedometer. **(6006)**
 - b. **No.** Repair open in (BE/V) left or (BE/BN) right wire. **(5041)**

SUBJECT	PAGE NO.
4.1 COMPONENT LOCATION VIEWS.....	4-1
4.2 WIRING DIAGRAMS.....	4-4
4.3 CONNECTORS.....	4-15

NOTES

COMPONENT LOCATIONS

Some components and connectors are not easily located on the motorcycle. The following graphics show locations for these components and connectors. The graphics are generally ordered from front to back around the motorcycle.

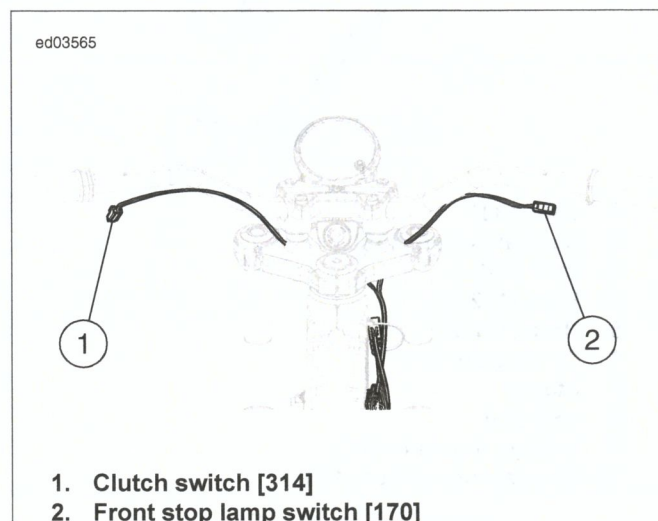


Figure 4-1. Hand Controls

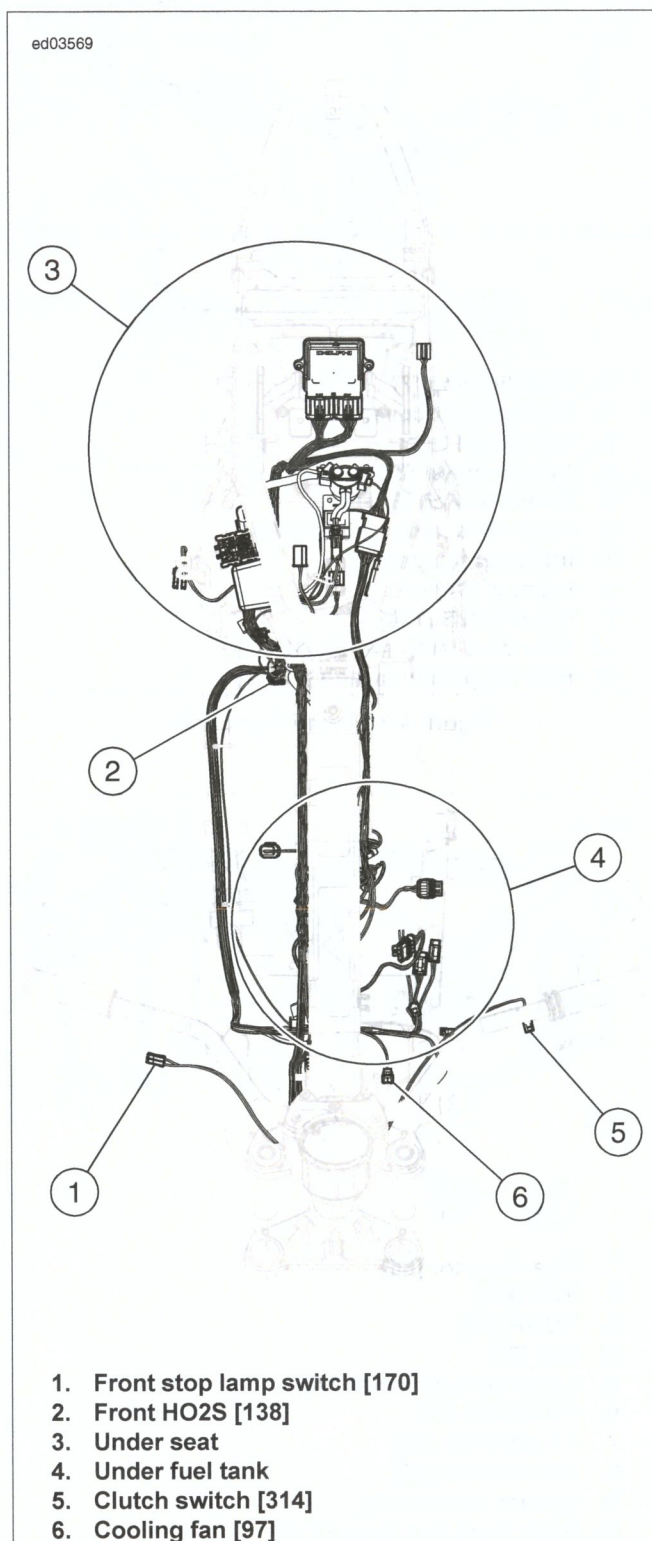


Figure 4-2. Frame Top View

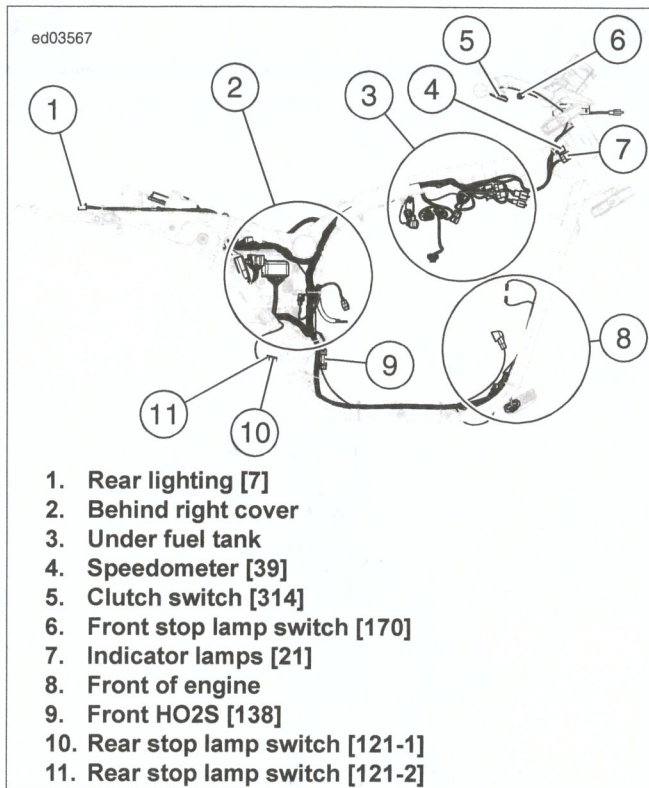


Figure 4-3. Frame Right Side

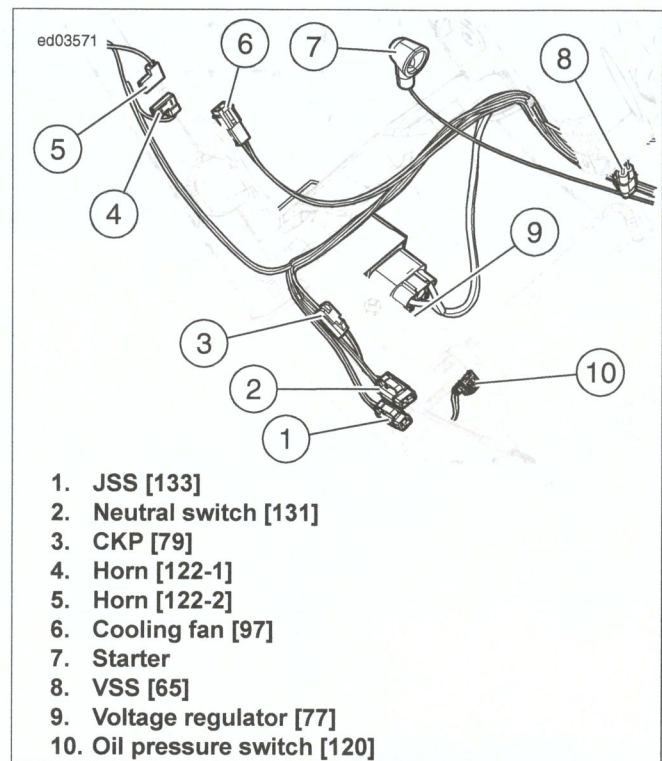


Figure 4-5. Front of Engine

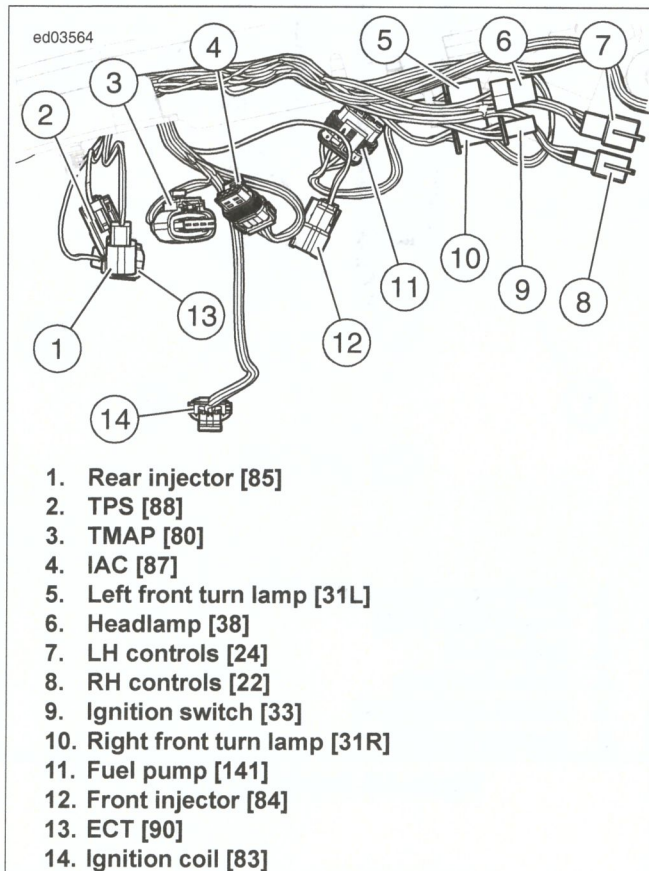


Figure 4-4. Under Fuel Tank

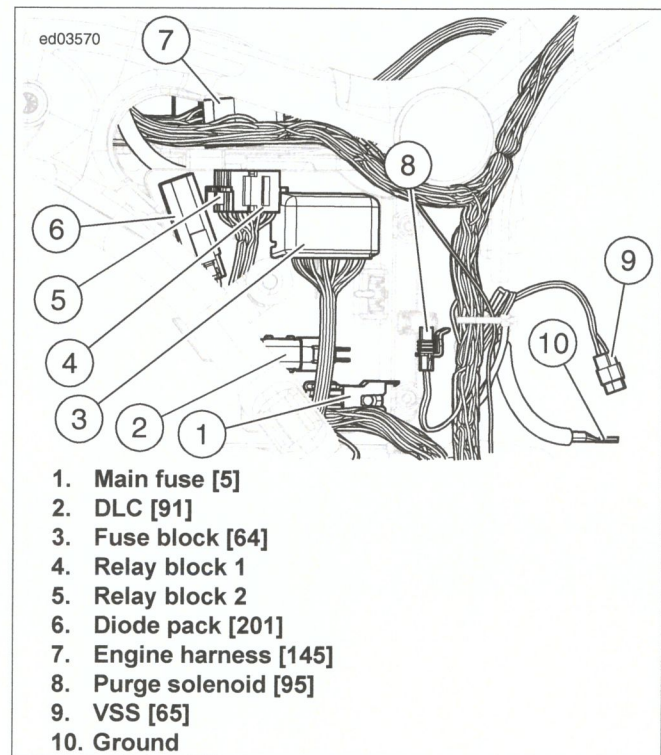


Figure 4-6. Under Right Side Cover

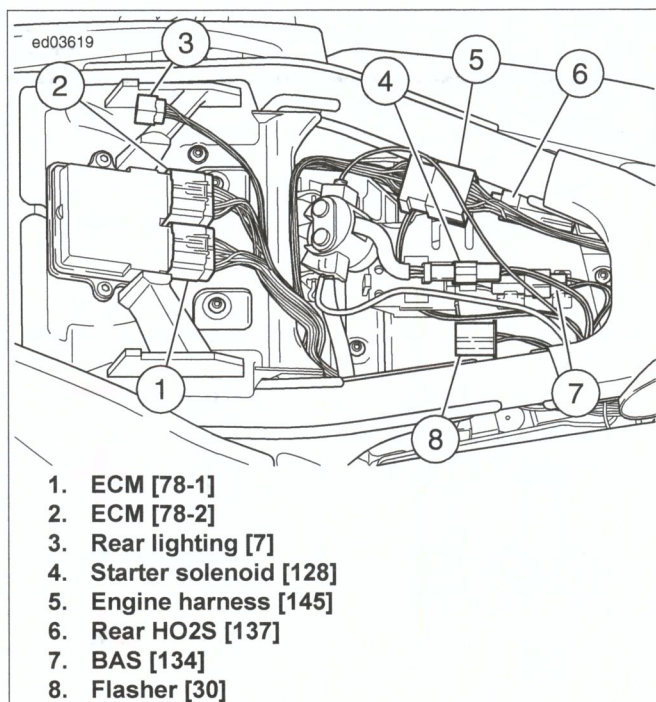


Figure 4-7. Under Seat: Front

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table 4-1.

For Solid Color Wires: See Figure 4-8. The alpha code identifies wire color.

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code. For example, a trace labeled GN/Y is a green wire with a yellow stripe.

Wiring Diagram Symbols

See Figure 4-8. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets []. The letter inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A and the pin symbol after a connector number identifies the pin side of the terminal connectors.

B=Socket: The letter B and the socket symbol after a connector number identifies the socket side of the terminal connectors. Other symbols found on the wiring diagrams include the following:

Diode: The diode allows current flow in one direction only in a circuit.

Wire break: The wire breaks are used to show option variances or page breaks.

No Connection: Two wires crossing over each other in a wiring diagram that are shown with no splice indicating they are not connected together.

Circuit to/from: This symbol indicates a more complete circuit diagram on another page. The symbol is also identifying the direction of current flow.

Splice: Splices are where two or more wires are connected together along a wiring diagram. The indication of a splice only indicates that wires are spliced to that circuit. It is not the true location of the splice in the wiring harness.

Ground: Grounds can be classified as either clean or dirty grounds. Clean grounds are identified by a (BK/GN) wire and are normally used for sensors or modules.

NOTE

Clean grounds usually do not have electric motors, coils or anything that may cause electrical interference on the ground circuit.

Dirty grounds are identified by a (BK) wire and are used for components that are not as sensitive to electrical interference.

Twisted pair: This symbol indicates the two wires are twisted together in the harness. This minimizes the circuit's electromagnetic interference from external sources. If repairs are necessary to these wires they should remain as twisted wires.

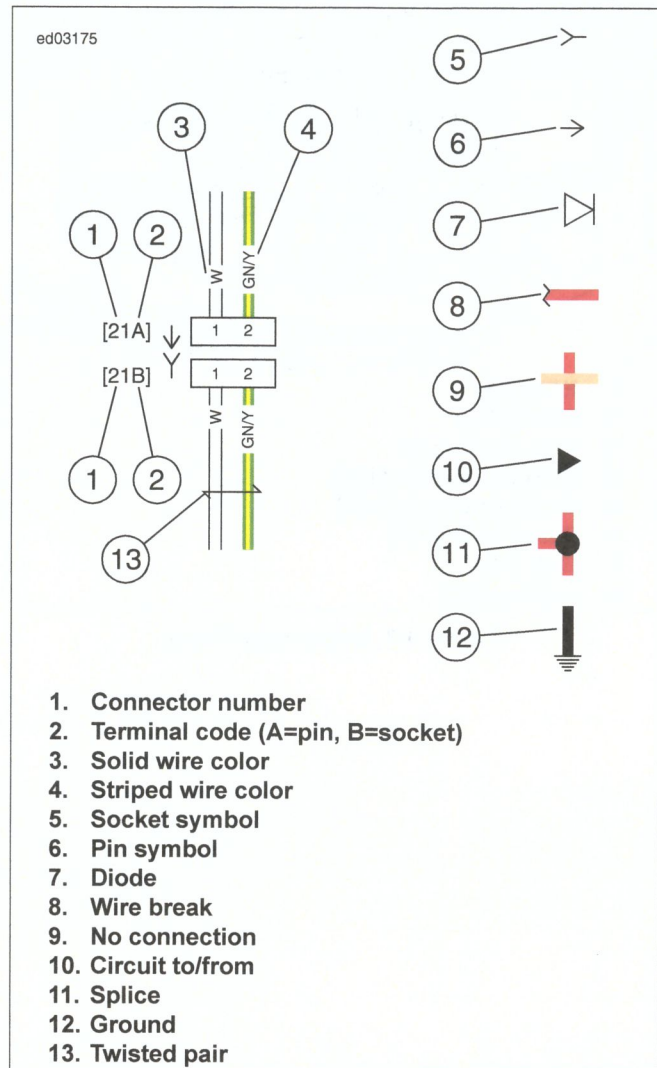
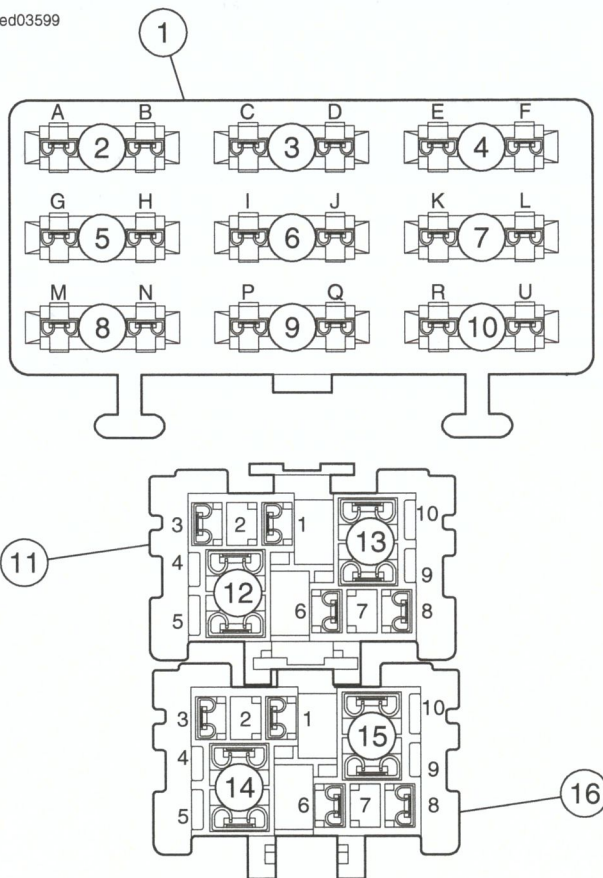


Figure 4-8. Connector/Wiring Diagram Symbols



1. Fuse block [64]
2. Accessory fuse
3. Fan fuse
4. Ignition fuse
5. Lights/instrument fuse
6. Lights fuse
7. Fuel pump fuse
8. Open
9. Open
10. Battery fuse
11. Relay block [61]
12. Start relay
13. Fan relay
14. System relay
15. Ignition relay
16. Relay block [62]

Figure 4-9. Fuse Block and Socket Terminals

Table 4-1. Wire Color Codes

ALPHA CODE	WIRE COLOR
BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Gray
LGN	Light Green
O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

Wiring Diagram List

DIAGRAM	LOCATION
IGN and ACC	Figure 4-10
Grounds	Figure 4-11
Lighting and Hand Controls: 2015 Street	Figure 4-12
Main Harness (1 of 2): 2015 Street	Figure 4-13
Main Harness (2 of 2): 2015 Street	Figure 4-14

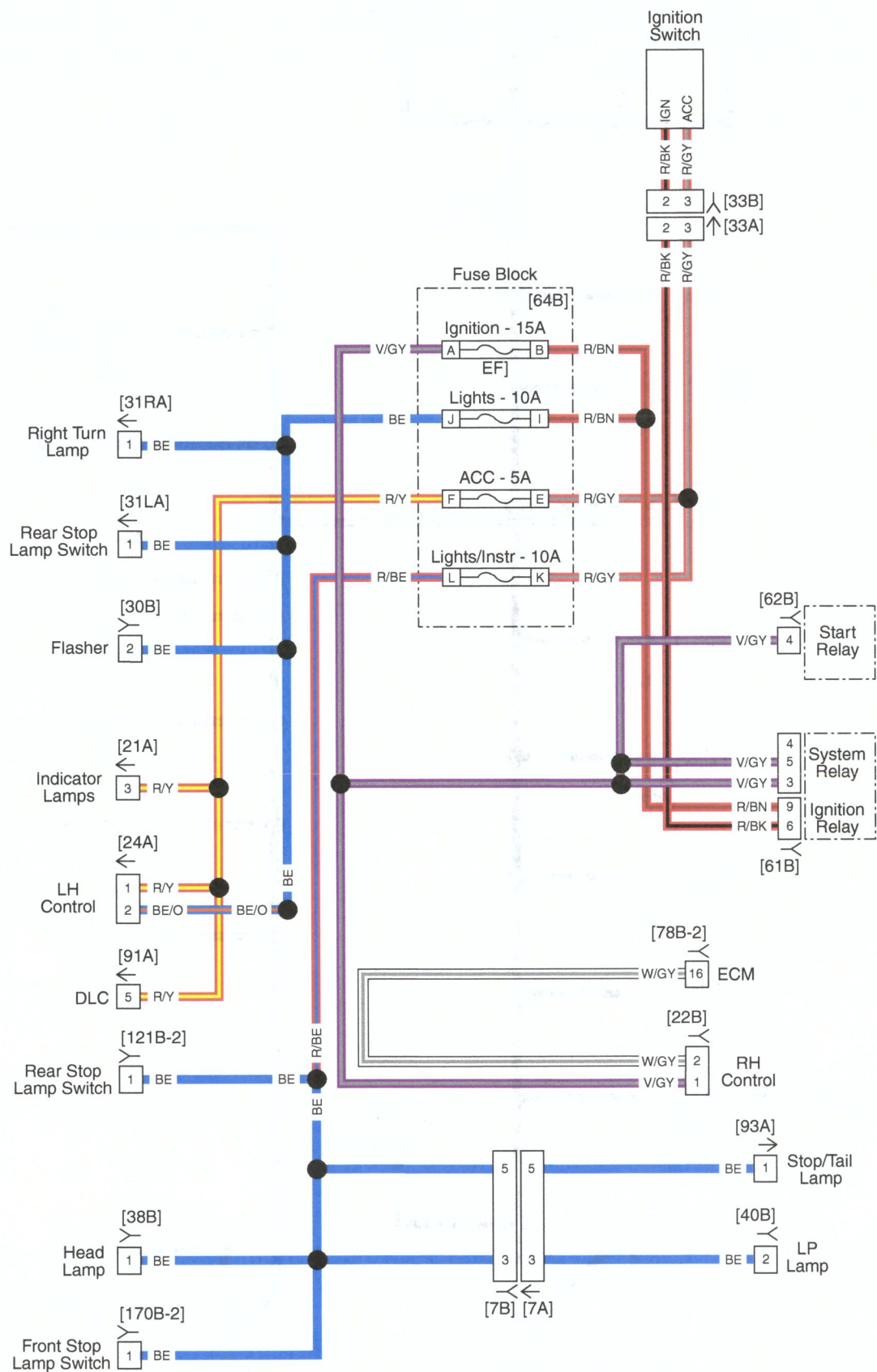


Figure 4-10. IGN and ACC

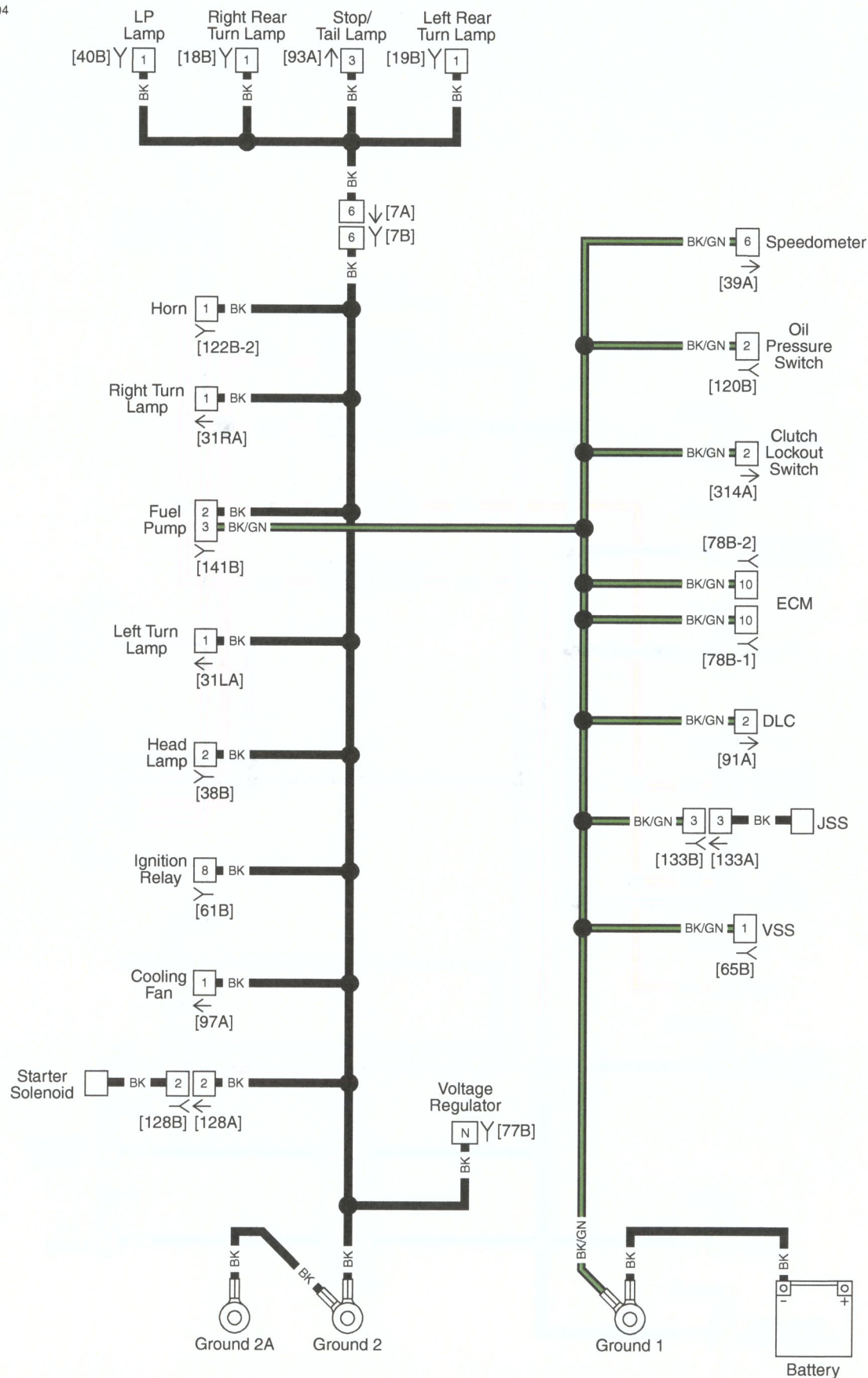


Figure 4-11. Grounds

CONNECTOR LOCATIONS

Function/Location

All vehicle connectors are identified by their function and location. Refer to Table 4-2.

Place and Color

The place (number of wire cavities of a connector housing) and color of the connector can also aid identification.

Connector Number

On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets.

Repair Instructions

The repair instructions in Appendix A are by connector type. Refer to Table 4-2.

Table 4-2. Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[5]	Main fuse	2-place Sumitomo Housing, Unsealed (Y)		Under right side cover
[7]	Rear lighting	6-Place Sumitomo MT series, Unsealed (W)	Purple	Under seat
[18]	Right rear turn lamp	2-Place Sumitomo MTW series, Unsealed (W)	Purple	Under passenger seat
[19]	Left rear turn lamp	2-Place Sumitomo MTW series, Unsealed (R)	Purple	Under passenger seat
[21]	Indicator lamps	6-Place Sumitomo MTW series, Unsealed (W)	Purple	Right side under fuel tank
[22]	Right hand controls	4-Place Sumitomo MTL series, Unsealed (BK)	Purple	Right side under fuel tank
[24]	Left hand controls	9-Place Sumitomo MTL series, Unsealed (BK)	Purple	Right side under fuel tank
[30]	Flasher	2-Place Sumitomo .250, Unsealed (BK)	Red	Under seat
[31L]	Left front turn signals	3-Place Sumitomo MTW series, Unsealed (BK)	Purple	Right side under fuel tank
[31R]	Right front turn signals	3-Place Sumitomo MTW series, Unsealed (BK)	Purple	Right side under fuel tank
[33]	Ignition switch	4-Place Sumitomo MTW series, Unsealed (BK)	Purple	Right side under fuel tank
[38]	Headlamp	4-Place Sumitomo MT series, Unsealed (BK)	Purple [38A] Gray [38B]	Right side under fuel tank
[39]	Speedometer	6-Place Sumitomo MT series, Unsealed (W)	Gray	Right side under fuel tank
[40]	LP lamp	2-Place Sumitomo MTW series, Unsealed (BK)	Purple	Under passenger seat
[47]	Voltage regulator to stator	3-Place Furukawa QLW series, Sealed (GY)	Red	Back of voltage regulator
[61]	Relay block 1	10-place Sumitomo Housing, Unsealed (BK)	Blue	Under right side cover
[62]	Relay block 2	10-place Sumitomo Housing, Unsealed (BK)	Blue	Under right side cover
[64]	Fuse block	18-place Tyco JPT Power Timer series, Unsealed (BK)	Purple	Under right side cover
[65]	VSS	3-Place Sumitomo MT series (BK)	Gray	Left rear of transmission case

Table 4-2. Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[77]	Voltage regulator	3-Place Furukawa QLW series, Sealed (BK)	Red	Back of voltage regulator
[78-1]	ECM	GET 64 sealed	Breakout Box	Under passenger seat
[78-2]	ECM	GET 64 sealed	Breakout Box	Under passenger seat
[79]	CKP sensor	2-Place Sumitomo MT series Unsealed (W)	Purple [79A] Gray [79B]	Under left crankcase cover
[80]	TMAP sensor	4-Place MTA Compact 1.1M Sealed (BK)	Gray	Induction module
[83]	Ignition coil	4-Place Delphi GT 150 series, Sealed (BK)	Gray	Left side of engine
[84]	Front fuel injector	2-place Delphi GT150 Sealed (BK)	Gray	Between cylinders
[85]	Rear fuel injector	2-place Delphi GT150 Sealed (BK)	Gray	Between cylinders
[87]	IAC	4-place Delphi GT 150 Sealed (BK)	Gray	Between cylinders right side
[88]	TPS	SSD series, Sealed	Gray	Between cylinders right side
[90]	ECT sensor	2-Place Sumitomo MT Series, Sealed (BE)	Gray	Between cylinders left side
[91]	DLC	6-Place Deutsch DT Sealed (GY)	Black	Under right side cover
[93]	Stop/tail lamp	3-Place Sumitomo MTW series, Unsealed (BK)	Purple	Under passenger seat
[95]	Purge solenoid	2-place Delphi 150 Metri-Pack Sealed (R)	Gray	In front of battery
[97]	Cooling fan	2-place Tyco 070 Multilock (BK)	Gray	Right frame tube below fan
[120]	Oil pressure switch	2-place Tyco Timer series Sealed (BK)	Purple	Bottom front crankcase left side
[121]	Rear stop lamp switch	Tyco Insulated Spade terminals (BK)	Red	Right side next to rear fork pivot
[122]	Horn	Flag terminals (BK)	Red	Left side by front cylinder
[128]	Start solenoid	2-place Sumitomo MTL series, Unsealed (BK)	Gray	Under seat
[131]	Neutral switch	Right angle push on molded terminal Yazaki (BK)	Red	Bottom front of engine next to left frame tube
[133]	JSS (HDI)	3-Place Molex MX150 series Sealed (GY)	Gray	Front lower left frame tube
[134]	BAS	3-Place Sumitomo MT series (W)	Purple [134A] Gray [134B]	Under seat
[137]	Rear HO2S	4-place Molex MX 150 Sealed (BK)	Gray	Under left side cover
[138]	Front HO2S	4-place Molex MX 150 Sealed (GY)	Gray	Rear of engine right side
[141]	Fuel pump	4-Place Tyco Superseal Sealed (BK)	Gray	Under left side of fuel tank
[145]	Engine harness	16-Place Sumitomo DL series Sealed (GY)	Gray	Under seat
[170]	Front stop lamp switch	1-place Spade, Unsealed	Purple	Right side of handlebars

Table 4-2. Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[201]	Diode pack	4-Place Deutsch DT series (GY)	Black	Under right side cover
[314]	Clutch switch	3-Place Sumitomo MT series (BK)	Purple	Handlebar left side
Battery ground	Negative battery cable connection	Ring terminal		Under left side cover
[GND 1]	Harness ground	Ring terminal		Center of frame above transmission
[GND 2]	Harness ground	Ring terminal		Under left side cover
[GND2A]	Engine ground	Ring terminal		Top of transmission

CONNECTOR END VIEWS

Table 4-3. Main Fuse [5]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/W	Battery
2	R	Fused battery

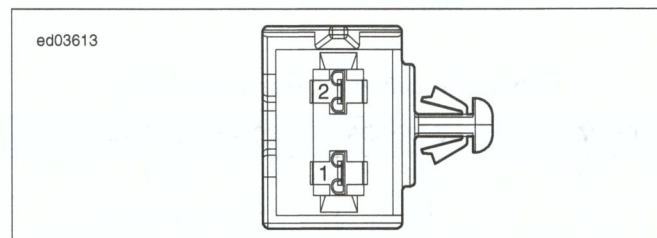


Figure 4-15. Main Fuse [5]

Table 4-4. Rear Lighting [7]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE/V	Left turn signal
2	BE/BN	Right turn signal
3	BE	Lights
4	BE/R	Stop lamp
5	BE	Lights
6	BK	Ground

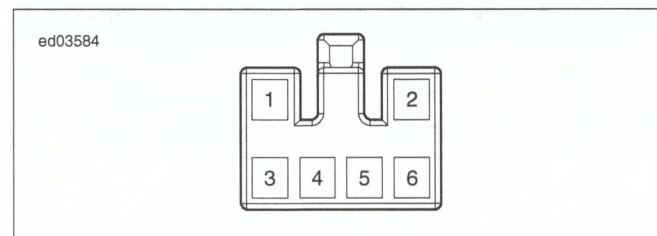


Figure 4-16. Rear Lighting [7]

Table 4-5. Right Rear Turn [18]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE/BN	Right turn signal
2	BK	GND

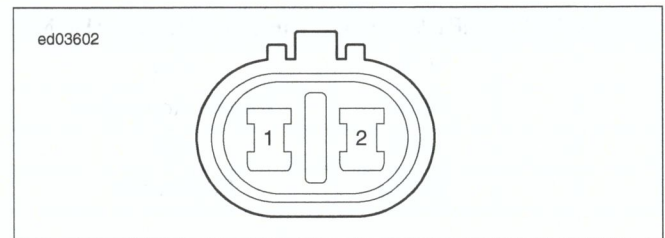


Figure 4-17. Right Rear Turn [18]

Table 4-6. Left Rear Turn [19]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	Left turn signal
2	BE/V	GND

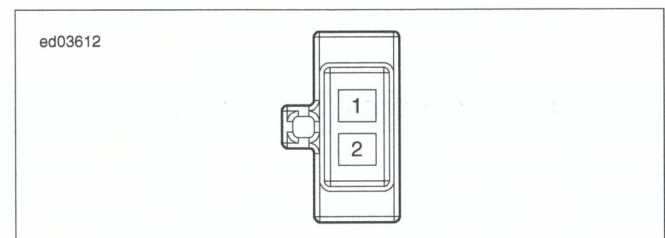


Figure 4-18. Left Rear Turn [19]

Table 4-7. Indicator Lamps [21]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE/V	Left turn indicator
2	W	Neutral indicator
3	BE/W	High beam indicator
4	N/A	N/A
5	R/Y	ACC
6	BE/BN	Right turn indicator

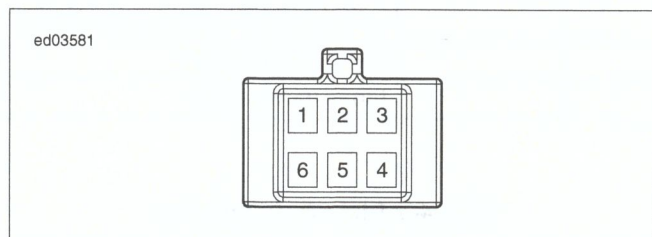


Figure 4-19. Indicator Lamps [21]

Table 4-8. RH Control [22]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	V/GY	IGN
2	W/GY	Engine stop switch
3	V/GY	IGN
4	W/BN	Start switch

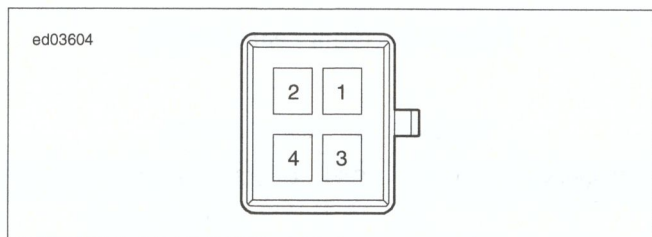


Figure 4-20. RH Control [22]

Table 4-9. LH Control [24]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	N/A	N/A
2	R/Y	ACC
3	R/BE	Flasher output
4	BE/O	Lights/instruments
5	BE/Y	Low beam
6	BE/W	High beam
7	R/V	Horn
8	BE/V	Left turn
9	BE/BN	Right turn

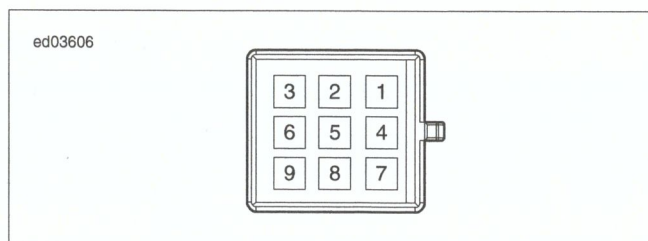


Figure 4-21. LH Control [24]

Table 4-10. Flasher [30]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/BE	Flasher output
2	BE	Lights fuse

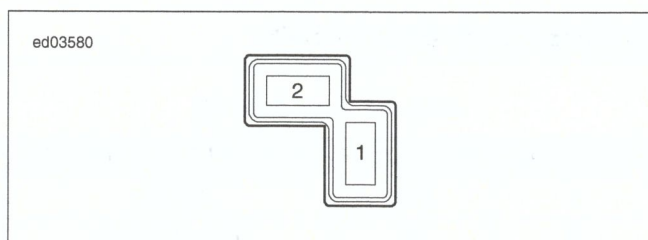


Figure 4-22. Flasher [30]

Table 4-11. Left Front Turn Lamp [31L]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	GND
2	BE	Running lights
3	BE/V	Left turn lamp

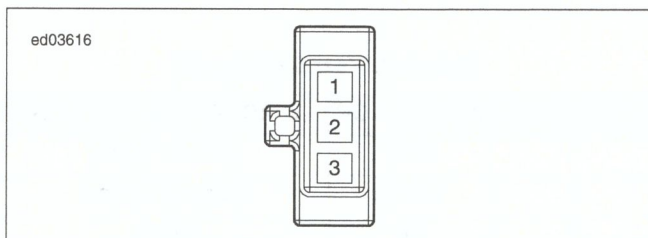


Figure 4-23. Left Front Turn Lamp [31L]

Table 4-12. Right Front Turn Lamp [31R]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	GND
2	BE	Running lights
3	BE/BN	Right turn lamp

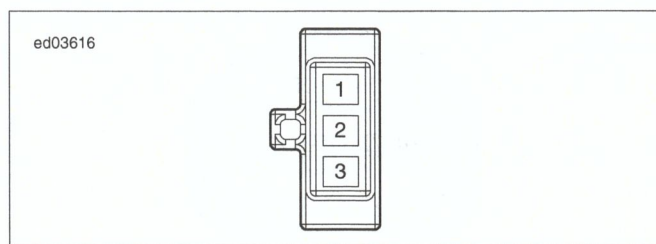


Figure 4-24. Right Front Turn Lamp [31R]

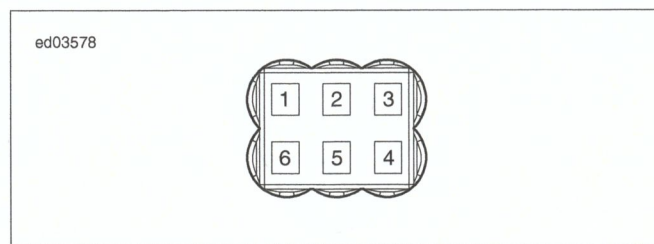


Figure 4-27. Speedometer [39]

Table 4-13. Ignition Switch [33]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R	Battery
2	R/BK	IGN
3	R/GY	ACC
4	N/A	N/A

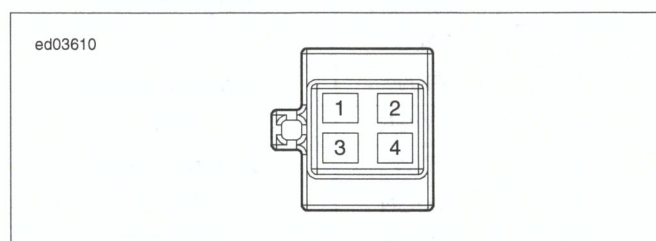


Figure 4-25. Ignition Switch [33]

Table 4-14. Headlamp [38]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE	Running lights
2	BK	GND
3	BE/W	High beam headlamp
4	BE/Y	Low beam headlamp

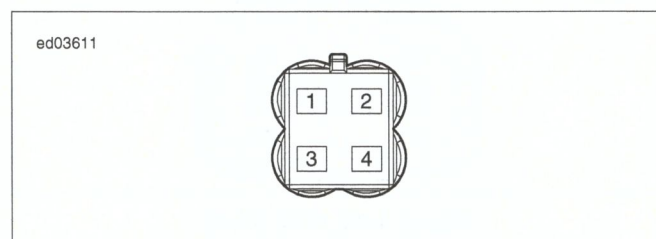


Figure 4-26. Headlamp [38]

Table 4-15. Speedometer [39]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	LGN/Y	VSS
2	W/O	Low oil pressure indicator
3	W/Y	Low fuel level indicator
4	GN/R	Check engine TT
5	R/O	Battery
6	BK/GN	GND

Table 4-16. LP Lamp [40]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	GND
2	BE	Running lamps

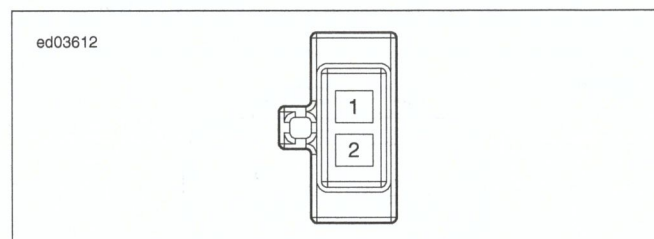


Figure 4-28. LP Lamp [40]

Table 4-17. Stator [47]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	Stator
2	BK	Stator
3	BK	Stator

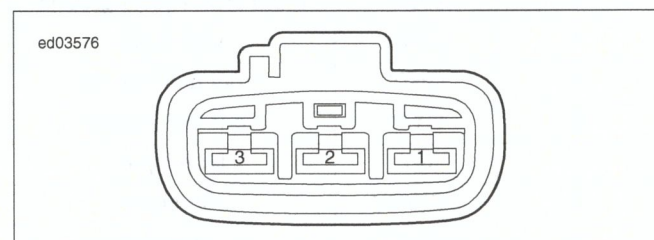


Figure 4-29. Stator [47]

Table 4-18. VSS [65]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK/GN	GND
2	R/W	5V sensor power
3	LGN/Y	VSS

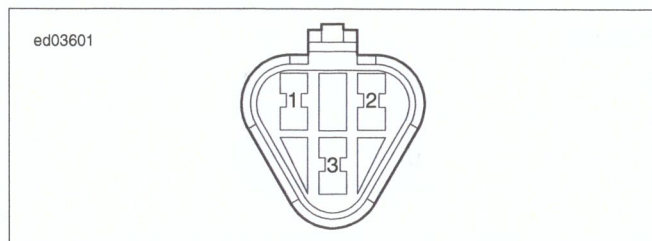


Figure 4-30. VSS [65]

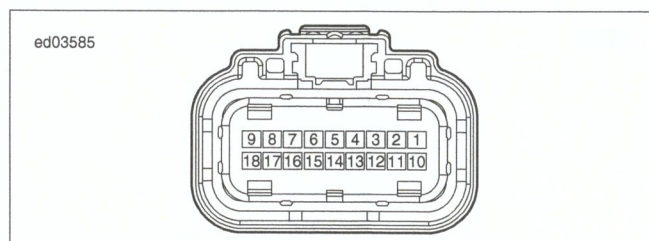


Figure 4-32. ECM [78-1]

Table 4-19. Voltage Regulator [77]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	GND
2	N/A	N/A
3	R	Battery Power

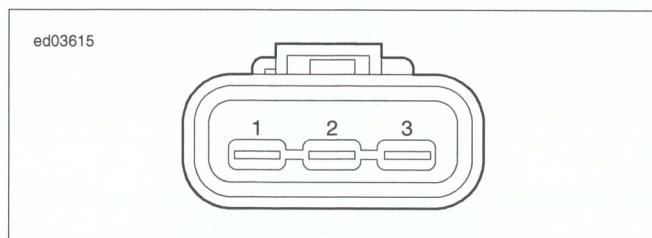


Figure 4-31. Voltage Regulator [77]

Table 4-20. [78B-1] ECM

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	GY/BE	Rear ignition coil
2	GN/BE	Front ignition coil
3	BK/O	Front HO2 heater ground
4	LGN/Y	VSS input
5	GN/Y	Front fuel injector
6	GY/Y	Rear fuel injector
7	GY	Map input
8	LGN/GY	JSS signal
9	LGN/BN	ION sense
10	BK/GN	Ground
11	N/A	N/A
12	N/A	N/A
13	W/BK	CAN low
14	W/R	CAN high
15	BK/PK	Rear HO2 heater ground
16	R	CKP high
17	GN/BN	Front HO2S
18	BK	CKP low

Table 4-21. [78B-2] ECM

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	GN/O	IAC A high
2	GN/BK	Fan relay
3	V/GN	System relay
4	GN/R	Check engine TT
5	LGN/BK	Purge solenoid
6	GN/GY	IAT
7	BK/W	5V sensor ground
8	GY/GN	ECT
9	R/W	5V sensor power
10	BK/GN	Ground
11	GY/O	IAC A low
12	GN/W	IAC B high
13	GY/W	IAC B low
14	TN/BK	TIP sensor
15	GN/V	TPS
16	W/GY	Run/stop switch
17	GY/BN	Rear HO2S
18	R/O	Battery fuse

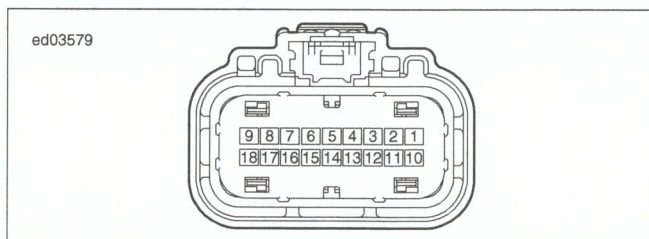


Figure 4-33. ECM [78-2]

Table 4-22. CKP [79]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R	CKP high
2	BK	CKP low

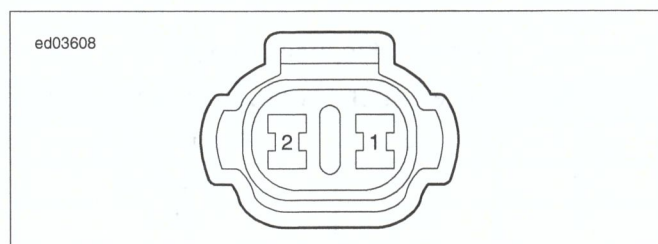


Figure 4-34. CKP [79]

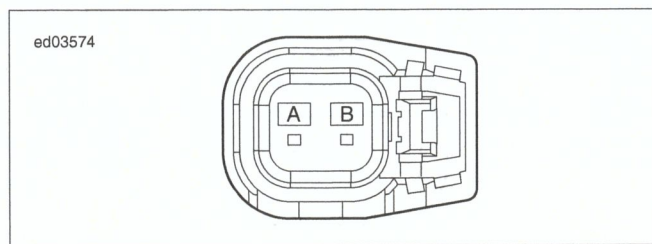


Figure 4-37. Front Injector [84]

Table 4-23. TMAP [80]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK/W	5V sensor ground
2	GN/GY	IAT
3	R/W	5V sensor power
4	GY	MAP sensor

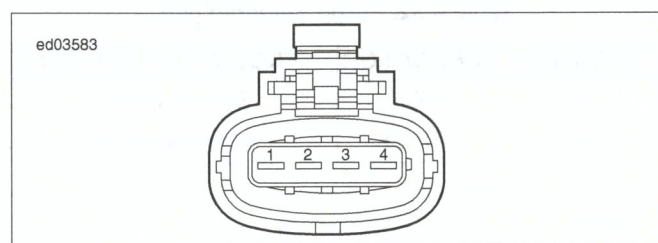


Figure 4-35. TMAP [80]

Table 4-24. Ignition Coil [83]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
A	R/GN	System power
B	LGN/BN	Ion sense
C	GY/BE	Rear IGN coil
D	GN/BE	Front IGN coil

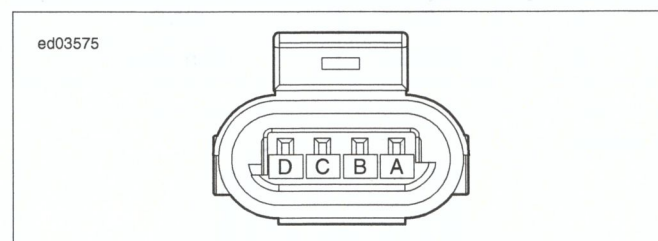


Figure 4-36. Ignition Coil [83]

Table 4-25. Front Injector [84]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
A	R/GN	System power
B	GN/Y	Front fuel injector

Table 4-26. Rear Injector [85]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
A	R/GN	System power
B	GY/Y	Rear fuel injector

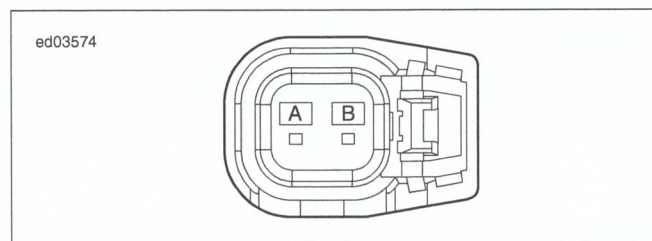


Figure 4-38. Rear Injector [85]

Table 4-27. IAC [87]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
A	GY/O	IAC A low
B	GN/W	IAC B high
C	GY/W	IAC B low
D	GN/O	IAC A high

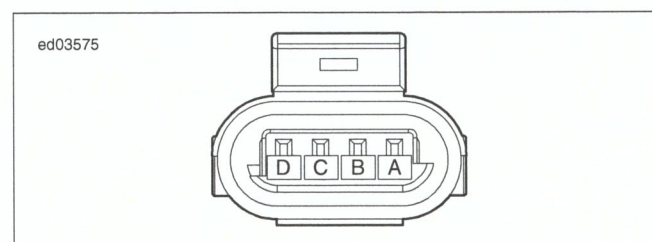


Figure 4-39. IAC [87]

Table 4-28. TPS [88]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK/W	5V sensor ground
2	R/W	5V sensor power
3	GN/V	TPS

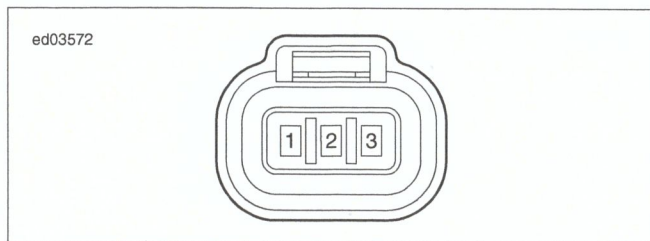


Figure 4-40. TPS [88]

Table 4-29. ECT [90]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	GY/GN	ECT
2	BK/W	5V sensor ground

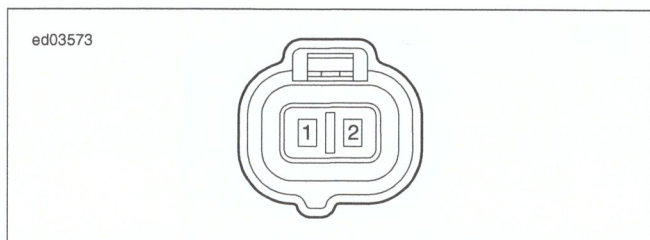


Figure 4-41. ECT Sensor [90]

Table 4-30. DLC [91]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	W/R	CAN high
2	BK/GN	GND
3	W/BK	CAN low
4	N/A	N/A
5	R/Y	ACC
6	N/A	N/A

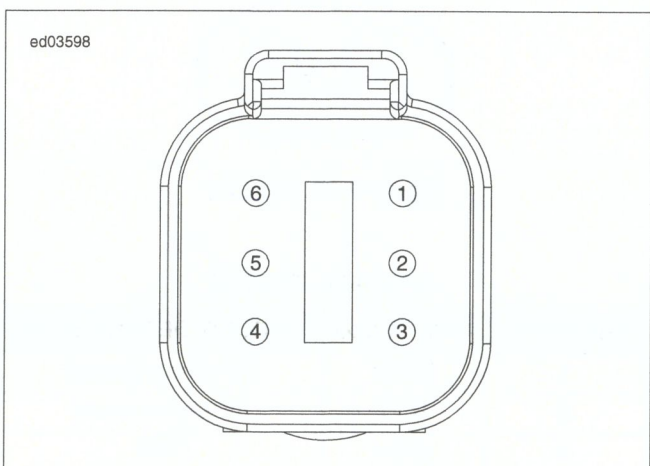


Figure 4-42. DLC [91]

Table 4-31. Stop/Tail Lamp [93]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE	Running lights
2	BE/R	Stop lamp
3	BK	GND

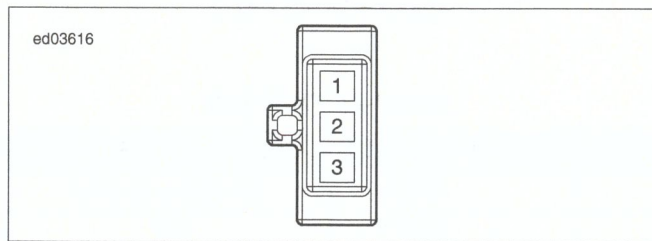


Figure 4-43. Stop/Tail Lamp [93]

Table 4-32. Purge Solenoid [95]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
A	R/GN	System power
B	LGN/BK	Purge solenoid

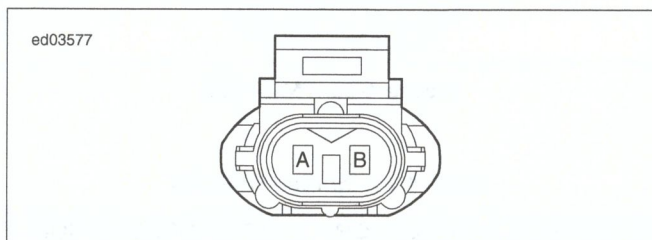


Figure 4-44. Purge Solenoid [95]

Table 4-33. Cooling Fan [97]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK	GND
2	GY/BK	Fan relay

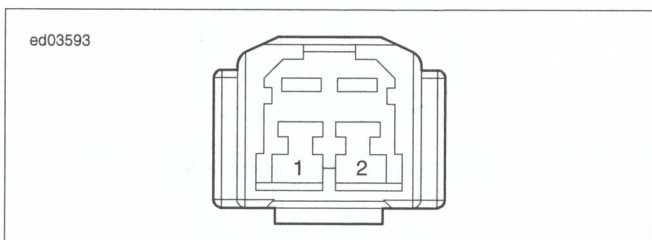


Figure 4-45. Cooling Fan [97]

Table 4-34. Oil Pressure Switch [120]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	W/O	Oil pressure
2	BK/GN	GND

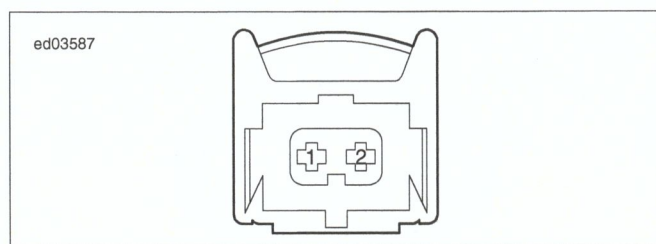


Figure 4-46. Oil Pressure Switch [120]

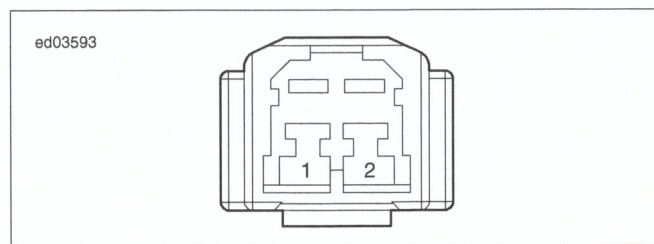


Figure 4-49. Starter Solenoid [128]

Table 4-35. Rear Stop Lamp Switch [121]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE/R	Stop lamp
2	BE	Running lights

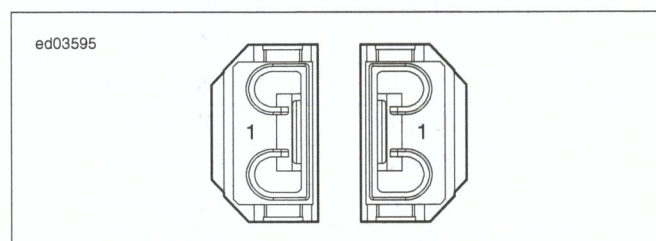


Figure 4-47. Rear Stop Lamp Switch [121]

Table 4-38. Neutral Switch [131]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	W	Neutral switch

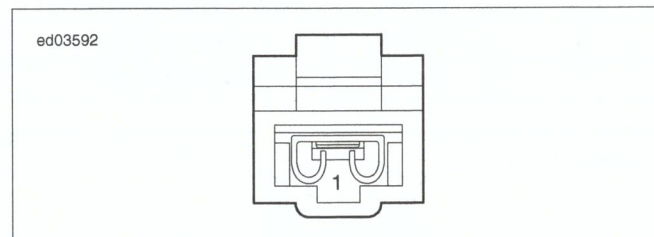


Figure 4-50. Neutral Switch [131]

Table 4-36. Horn [122]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/V	Stop lamp
2	BK	GND

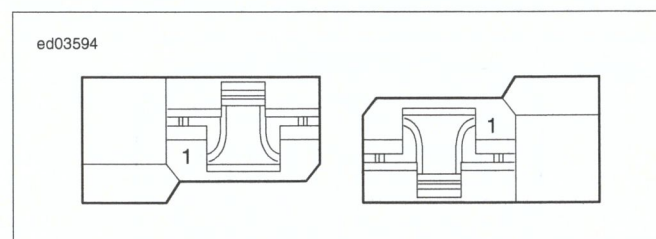


Figure 4-48. Horn [122-1] and [122-2]

Table 4-39. JSS [133]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/W	5V sensor power
2	LGN/GY	JSS
3	BK/GN	GND

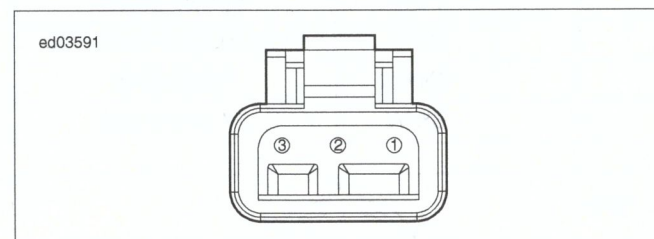


Figure 4-51. JSS [133]

Table 4-37. Starter Solenoid [128]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	TN/GY	Starter solenoid
2	BK	GND

Table 4-40. BAS [134]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BK/W	5V sensor ground
2	R/W	5V sensor power
3	TN/BK	TIP

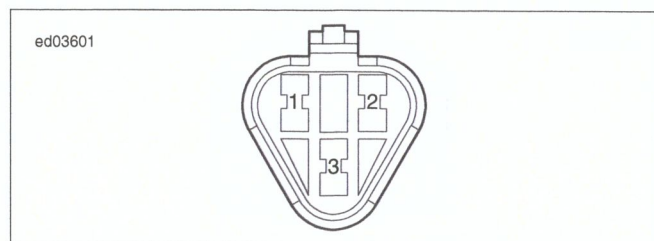


Figure 4-52. BAS [134]

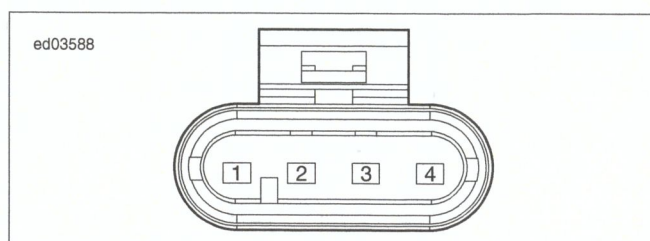


Figure 4-55. Fuel Pump [141]

Table 4-41. Rear HO2S [137]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/GN	System power
2	BK/PK	Rear HO2S heater GND
3	GY/BN	Rear HO2S
4	BK/W	5V sensor gnd

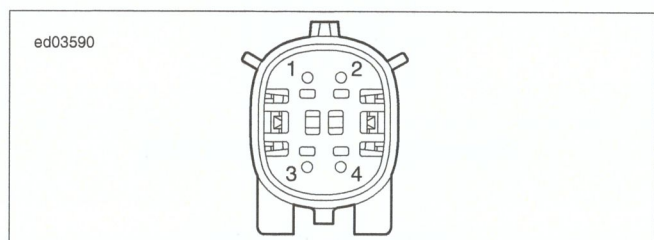


Figure 4-53. Rear HO2S [137]

Table 4-42. Front HO2S [138]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	R/GN	System power
2	BK/O	Front HO2S heater GND
3	GN/BN	Front HO2S
4	BK/W	5V sensor gnd

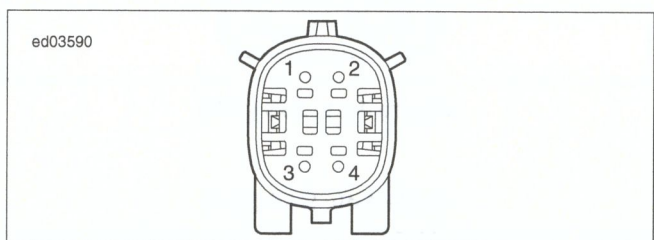


Figure 4-54. Front HO2S [138]

Table 4-43. Fuel Pump [141]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	W/Y	Low fuel
2	BK	GND
3	BK/GN	GND
4	R/GN	System power

Table 4-44. Engine Harness [145]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	GY/W	IAC B low
2	GN/O	IAC A high
3	BK/W	5V sensor ground
4	GN/W	IAC B high
5	R/W	5V sensor power
6	LGN/BN	ION sense
7	R/GN	System power
8	GY/Y	Rear fuel injector
9	GY/O	IAC A low
10	GY/BE	Rear ignition coil
11	GY	MAP input
12	GN/V	TPS
13	GN/Y	Front fuel injector
14	GN/GY	IAT
15	GN/BE	Front ignition coil
16	GY/GN	ECT

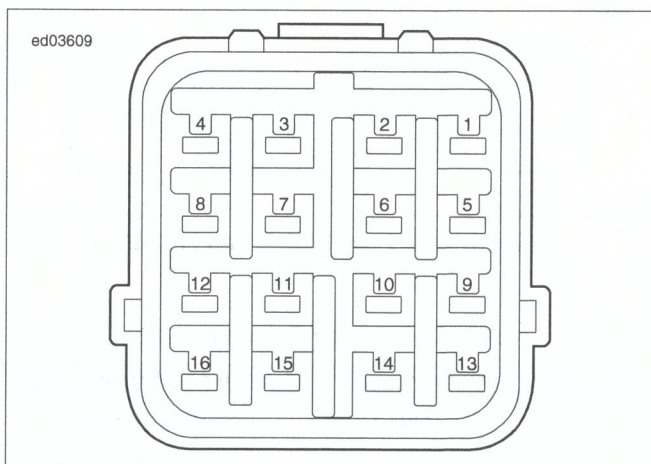


Figure 4-56. Engine Harness [145]

Table 4-45. Front Stop Lamp Switch [170]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	BE/R	Stop lamp
2	BE	Running lights

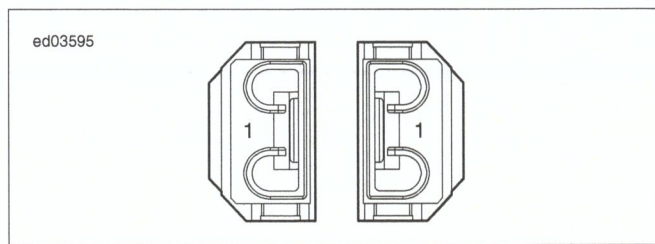


Figure 4-57. Front Stop Lamp Switch [170]

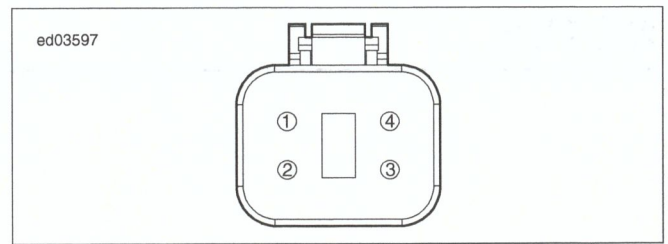


Figure 4-58. Diode Pack [201]

Table 4-46. Diode Pack [201]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	TN/GN	Clutch switch
2	LGN/GY	JSS
3	W	Neutral
4	W	Neutral

Table 4-47. Clutch Switch [314]

TERMINAL	WIRE COLOR	CIRCUIT DESCRIPTION
1	TN/GN	Clutch switch
2	BK/GN	GND

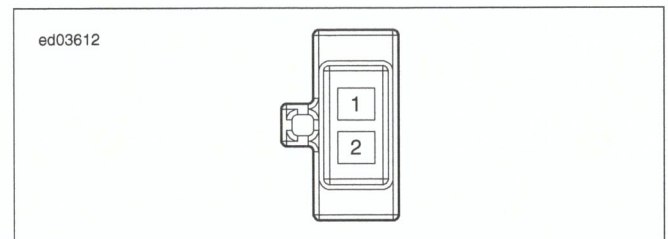


Figure 4-59. Clutch Switch [314]

NOTES

SUBJECT	PAGE NO.
5.1 HORN DIAGNOSTICS.....	5-1
5.2 TURN SIGNAL DIAGNOSTICS.....	5-4
5.3 HEADLAMP DIAGNOSTICS.....	5-8
5.4 STOP LAMP DIAGNOSTICS.....	5-11
5.5 RUNNING LAMP DIAGNOSTICS.....	5-14

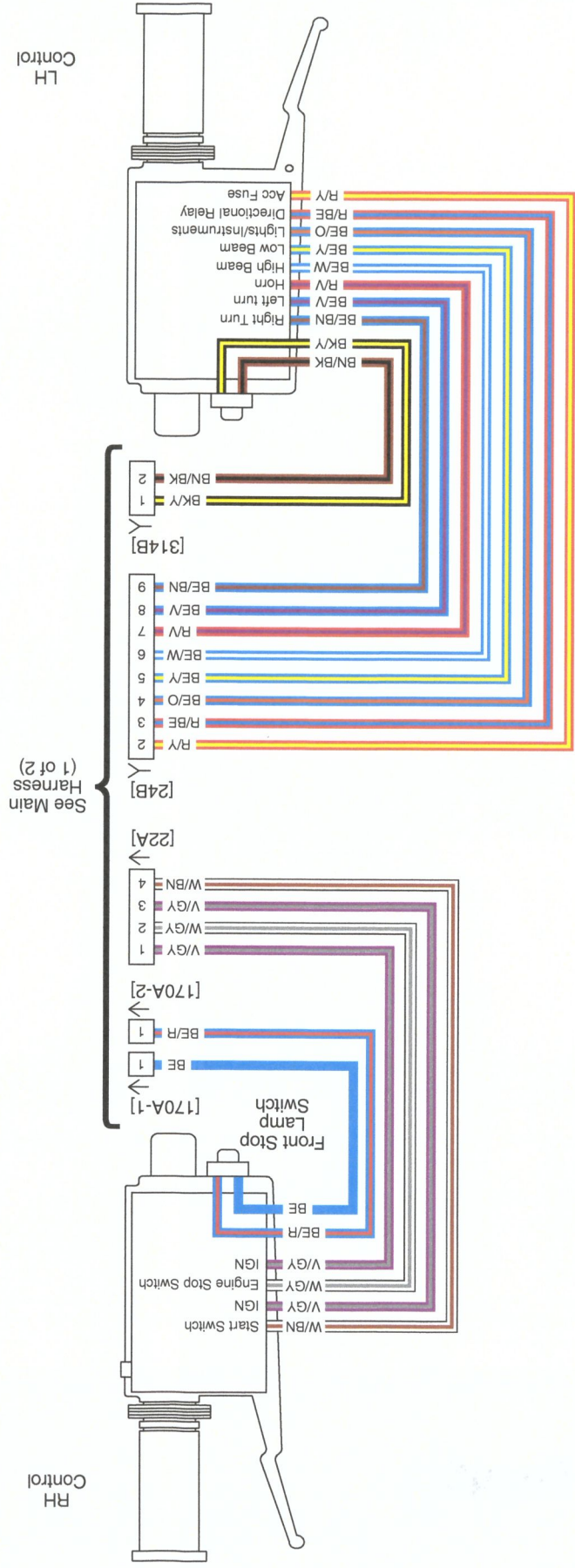
NOTES

Figure 4-12.
Lighting and Hand Controls: 2015 Street



Figure 4-12.
Lighting and Hand Controls: 2015 Street





The diagram illustrates the wiring for the rear of a vehicle, showing the connection of four lamps to a main harness connector labeled [7A]. The main harness connector has six terminals: 1 (BE/BN), 2 (BE/V), 3 (BE), 4 (BE/R), 5 (BE), and 6 (BK). The wiring is as follows:

- Left Rear Turn Lamp:** Terminal 1 (BE/V) connects to the Turn Lamp's terminal 1. Terminal 2 (BK) connects to the Turn Lamp's terminal 2.
- LP Lamp:** Terminal 1 (BK) connects to the LP Lamp's terminal 1. Terminal 2 (BE) connects to the LP Lamp's terminal 2.
- Stop/Tail Lamp:** Terminal 1 (BE) connects to the Stop/Tail Lamp's terminal 1. Terminal 2 (BE/R) connects to the Stop/Tail Lamp's terminal 2. Terminal 3 (BK) connects to the Stop/Tail Lamp's terminal 3.
- Right Rear Turn Lamp:** Terminal 1 (BE/BN) connects to the Right Rear Turn Lamp's terminal 1. Terminal 2 (BK) connects to the Right Rear Turn Lamp's terminal 2.

The diagram also shows the internal wiring of the lamps, with terminals labeled [19A], [19B], [40A], [40B], [93A], [93B], [18A], and [18B].

Figure 4-13.
Main Harness (1 of 2): 2015 Street

Figure 4-13.
Main Harness (1 of 2): 2015 Street



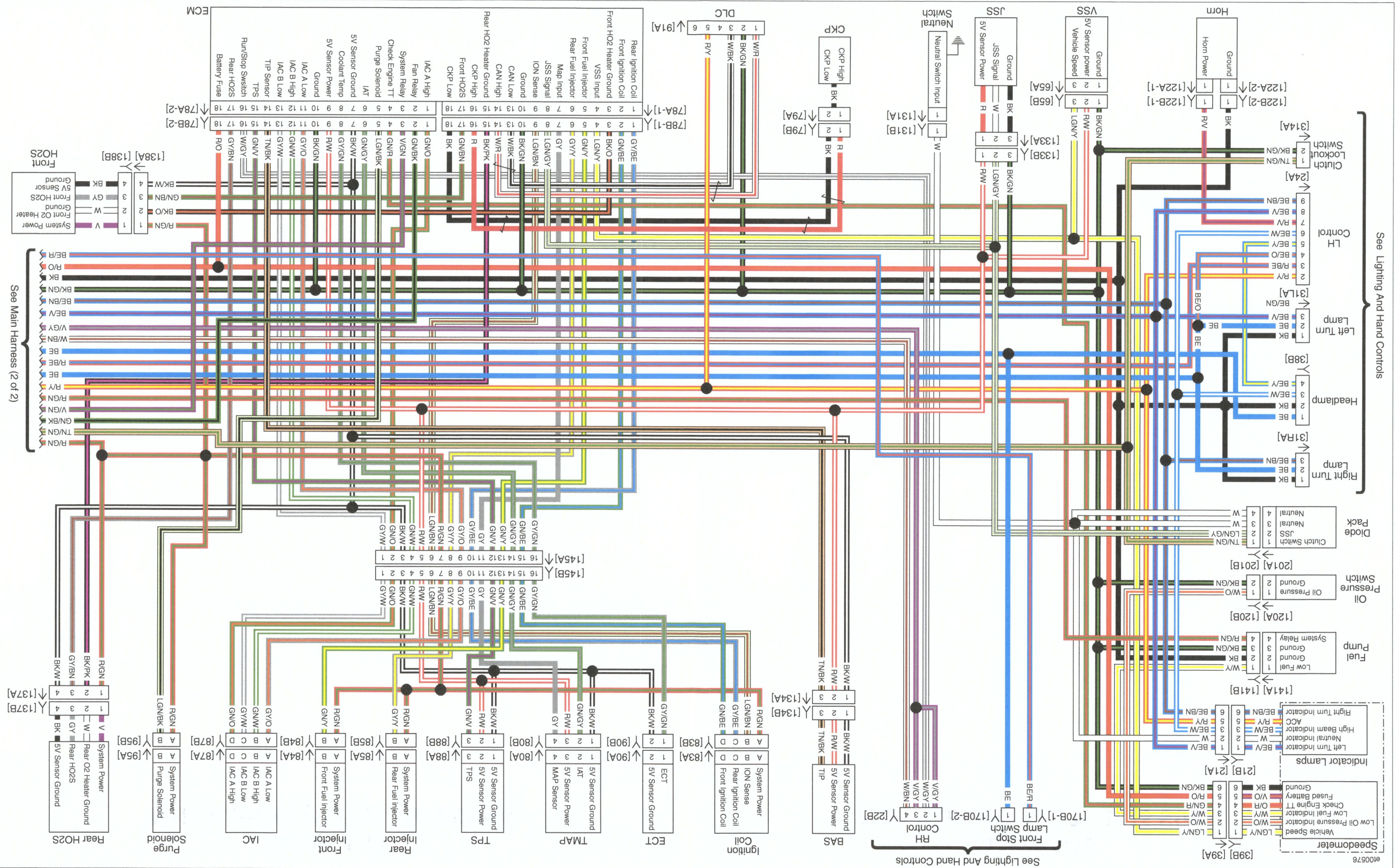
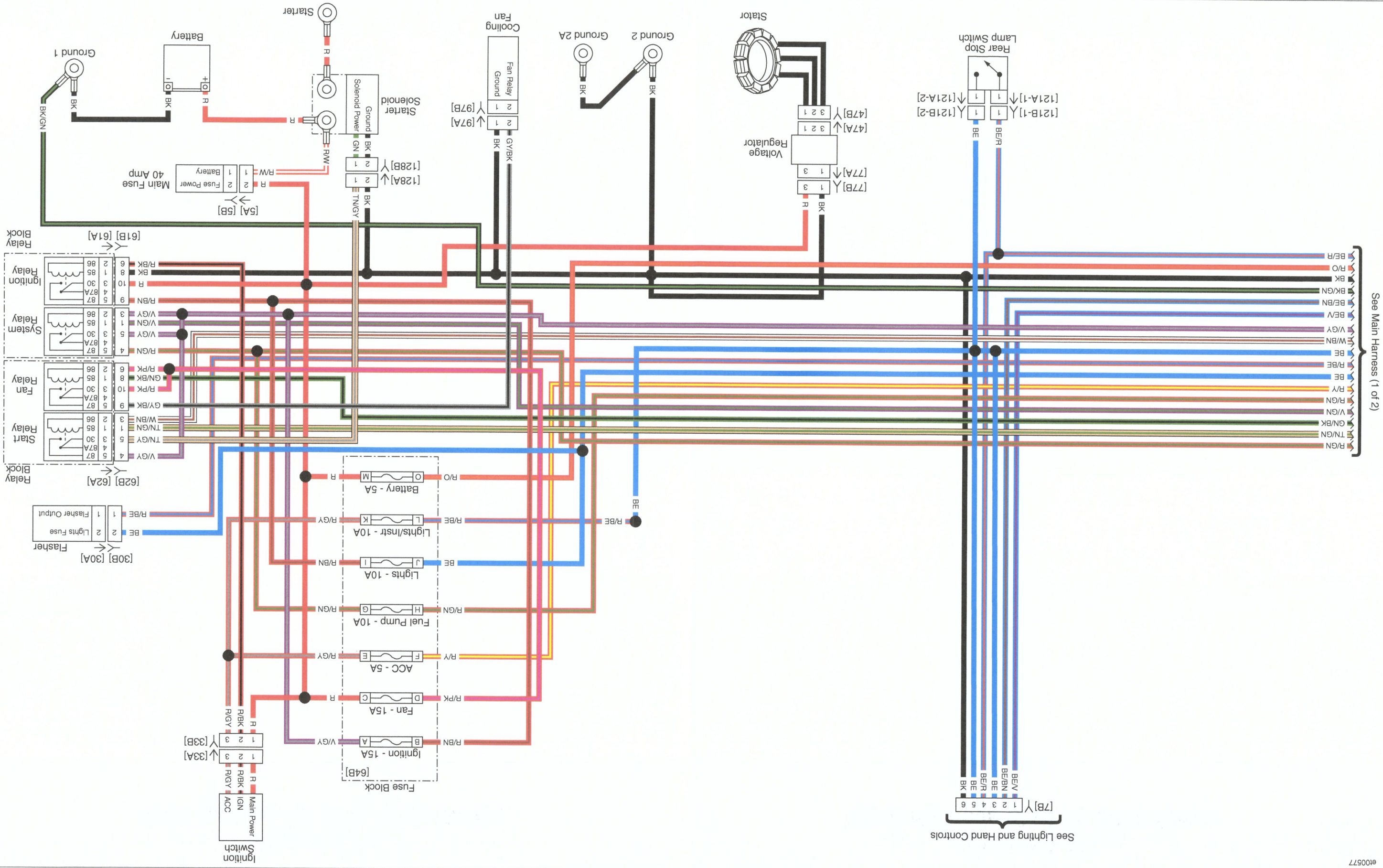


Figure 4-13. Main Harness (1 of 2): 2015 Street

Figure 4-14.
Main Harness (2 of 2): 2015 Street



Figure 4-14.
Main Harness (2 of 2): 2015 Street



DESCRIPTION AND OPERATION

The horn is powered through the horn switch from the ACC fuse. The horn is grounded through GND 2. When the horn switch is pressed, battery voltage is applied to [122-1] terminal 1, causing the horn to sound.

COMPONENTS

Horn Switch

The horn switch is a push button switch on the left handlebar controls.

Horn

See Figure 5-1. The horn is located on the left side of the vehicle beside the front cylinder.

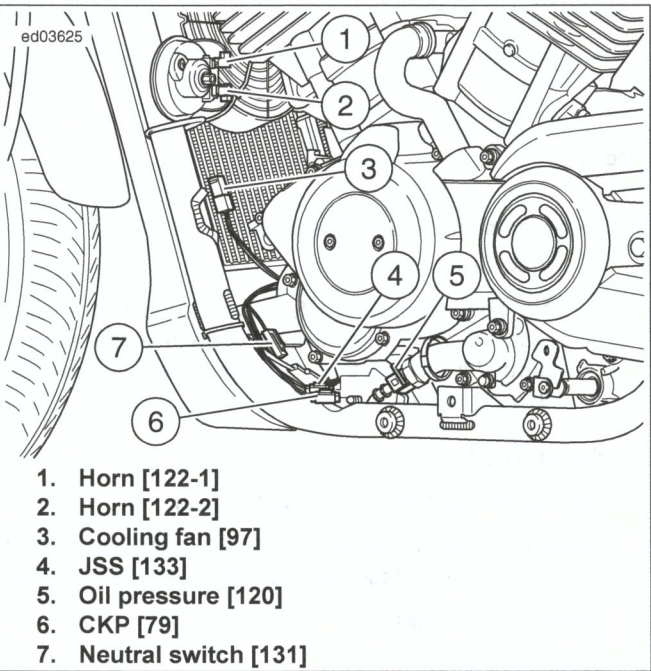


Figure 5-1. Lower Left Front of Engine

SYMPTOMS

The horn circuit does not set DTCs when there is a malfunction. Refer to Table 5-1 for troubleshooting.

Table 5-1. Horn Symptoms

SYMPTOM	COMMON CAUSE
Horn always on	Short to voltage or a stuck switch
Horn inoperative	Open circuit, faulty horn or horn switch

Diagnostic Tips

If the fuse is open, check the circuit between the horn switch and the horn for a short to ground. This would cause the fuse to open only when the horn switch is pressed.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

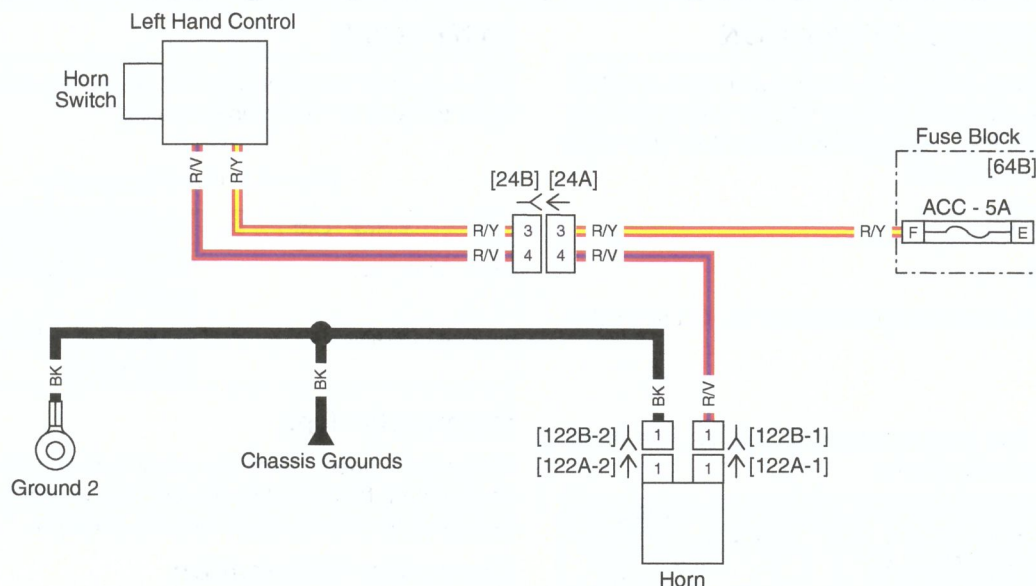


Figure 5-2. Horn

HORN ALWAYS ON

Table 5-2. Horn Always On Diagnostic Faults

POSSIBLE CAUSES
Short to voltage in horn power circuit
Horn switch malfunction

1. Horn Switch Test

1. Disconnect left hand controls [24].
2. Does the horn turn off?
 - a. **Yes.** Replace the left hand control assembly. (5171)
 - b. **No.** Repair short to voltage in the (R/V) wire between horn and left hand controls. (5041)

HORN INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNES CONNECTOR TEST KIT

Table 5-3. Horn Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open accessory circuit
Shorted accessory circuit
Horn malfunction
Open ground circuit
Horn switch malfunction
Open horn power circuit

1. Accessory Circuit Open or Shorted Test

1. Turn IGN ON.

2. Does the speedometer illuminate?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Inspect the fuse. If fuse is good locate and repair open in (R/Y) wire. If fuse is open repair short to ground in circuits that may affect the fuse. See diagnostic tips. (5043)

2. Horn Test

1. Disconnect the horn [122-1] and [122-2].
2. Using HARNES CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [122B-1] and [122B-2].
3. Press the horn switch.
4. Is battery voltage present?
 - a. **Yes.** Replace the horn. (5765)
 - b. **No.** Go to Test 3.

3. Ground Circuit Open Test

1. Test for continuity between [122B-2] and ground.
2. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in the ground circuit. (5041)

4. Horn Switch Malfunction Test

1. Connect the horn [122-1] and [122-2].
2. Disconnect left hand controls [24].
3. With IGN ON, using the HARNES CONNECTOR TEST KIT (Part No. HD-41404) jumper [24A] terminals 2 and 7.
4. Does the horn sound?
 - a. **Yes.** Replace the left hand control assembly. (5171)
 - b. **No.** Go to Test 5.

5. Horn Power Circuit Open Test

1. Test for voltage from [24A] terminal 2 (R/Y) to ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (R/V) wire. **(5041)**
 - b. **No.** Repair open (R/Y) wire. **(5043)**

DESCRIPTION AND OPERATION

See Figure 5-3 and Figure 5-4. The flasher receives battery power through the lights fuse. When the turn signal switch is pressed the switch closes and power flows from the flasher to the turn lamps and indicators.

If you want to stop the turn signals from flashing, briefly press the turn signal release switch. If you are signaling to turn in one direction and you press the switch for the opposite turn signal, the first signal is cancelled and the opposite side begins flashing.

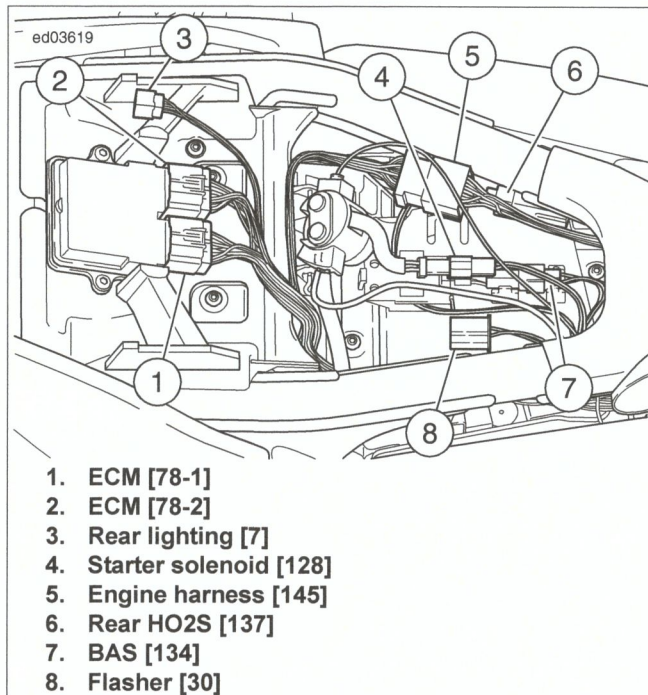


Figure 5-3. Under Seat: Front

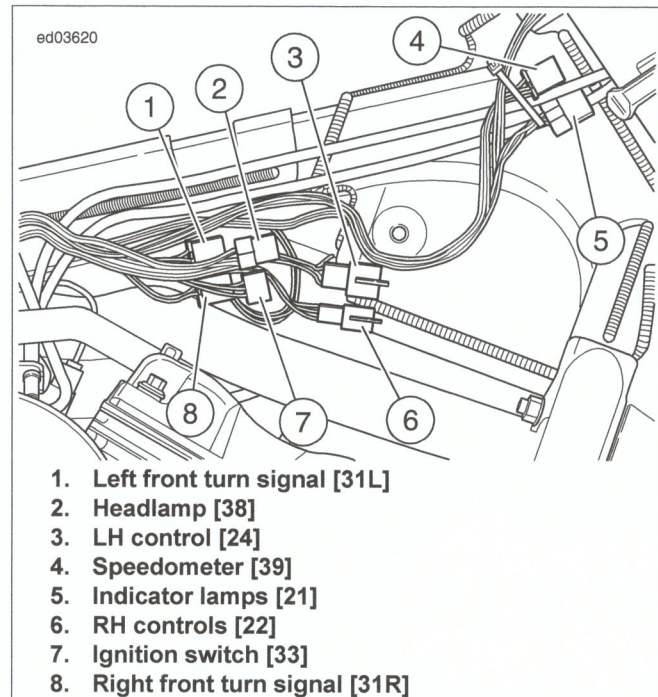


Figure 5-4. Under Fuel Tank Right Side

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

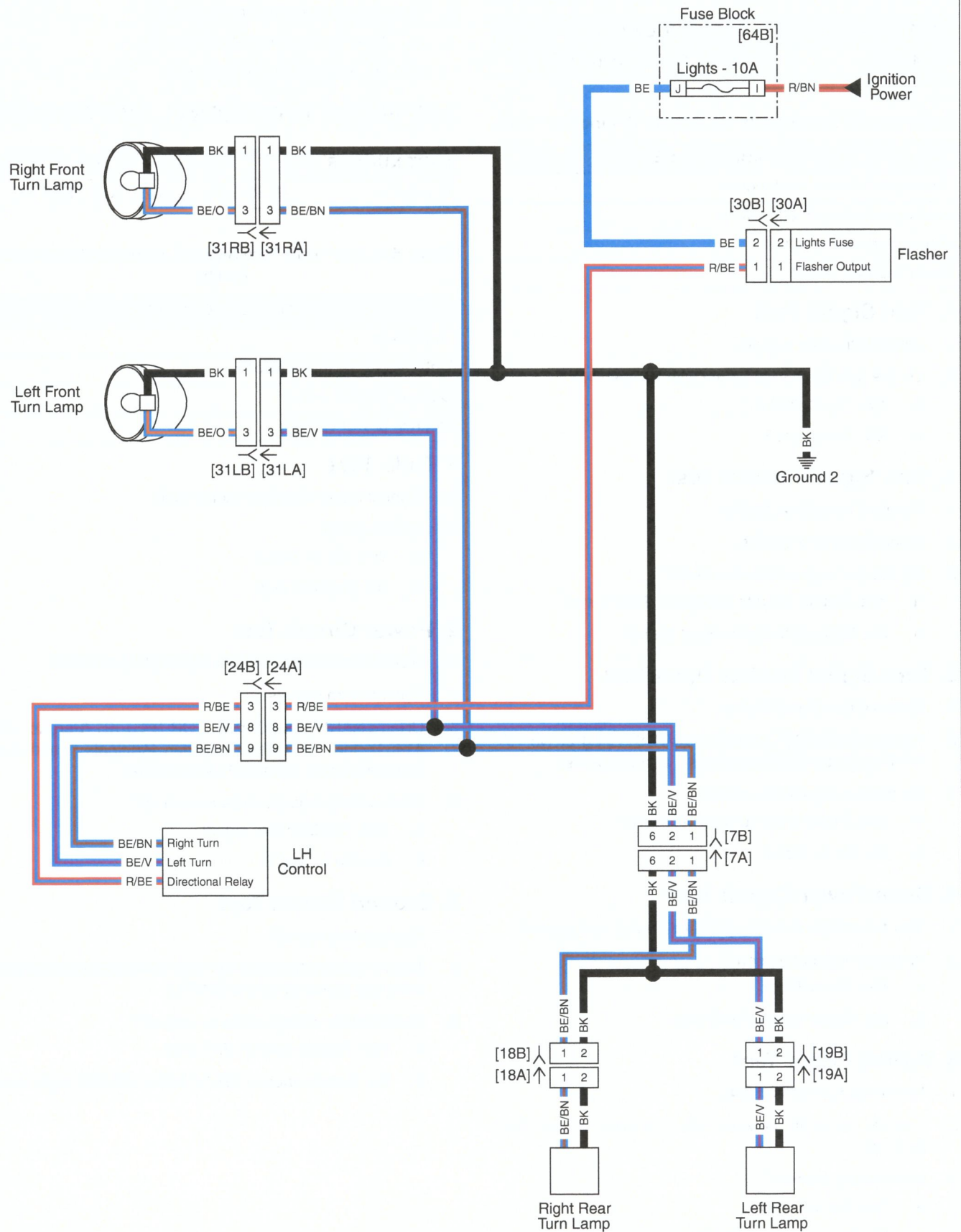


Figure 5-5. Turn Signals

ALL TURN SIGNALS INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-4. All Turn Signals Inoperative Diagnostic Faults

POSSIBLE CAUSES
Turn signal flasher malfunction
Turn signal switch malfunction
Open in ground circuit
Open in power circuit

1. Turn Signal Test

1. Operate the turn signals.
2. Do the turn signals illuminate without flashing?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Go to Test 3.

2. Turn Signal Flasher Test

1. Remove turn signal flasher.
2. Operate the turn signals.
3. Do the turn signals still illuminate?
 - a. **Yes.** Repair short to voltage in (R/BE) wire.
 - b. **No.** Replace the turn signal flasher.

3. Turn Signal Flasher Open Test

1. Remove turn signal flasher.
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [30B] terminals 1 and 2 together.
3. Do the turn signals illuminate?
 - a. **Yes.** Replace the turn signal flasher.
 - b. **No.** Go to Test 4.

4. Open Power Circuit Test

1. Test for voltage between [30B] terminal 2 and ground.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open in (BE) wire.

5. Switch Power Test

1. Disconnect LH control [24].
2. Test for continuity between [24A] terminal 3 and [30B] terminal 1.
3. Is continuity present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Repair open in (R/BE) wire.

6. Turn Signal Switch Test

1. Disconnect rear lighting [7].

2. Test resistance between [7B] terminal 6 and ground.
3. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace turn signal switch.
 - b. **No.** Repair open in (BK) wire.

ANY FRONT TURN SIGNAL INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-5. Any Front Turn Signal Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open bulb
Light assembly malfunction
Open in ground circuit
Open in power circuit

1. Bulb Test

1. Inspect inoperative turn signal bulb.
2. Is bulb good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace bulb.

2. Power Circuit Test

1. Disconnect inoperative turn signal [31L] or [31R].
2. Operate turn signals.
3. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between terminals 1 and 3 of inoperative turn signal [31LA] or [31RA].
4. Does battery voltage cycle on and off?
 - a. **Yes.** Replace turn signal.
 - b. **No.** Go to Test 3.

3. Ground Circuit Test

1. Operate turn signals.
2. Test for voltage between terminal 3 and ground of inoperative turn signal [31LA] or [31RA].
3. Does battery voltage cycle on and off?
 - a. **Yes.** Repair open in (BK) wire.
 - b. **No.** Repair open in (BE/V) left or (BE/BN) right wire.

ANY REAR TURN SIGNAL INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-6. Any Rear Turn Signal Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open bulb
Light assembly malfunction
Open in ground circuit
Open in power circuit

1. Bulb Test

1. Inspect inoperative turn signal bulb.
2. Is bulb good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace bulb.

2. Power Circuit Test

1. Disconnect inoperative turn signal [18] right or [19] left.
2. Operate turn signals.
3. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between terminals 1 and 2 of inoperative turn signal [18B] or [19B].
4. Does battery voltage cycle on and off?
 - a. **Yes.** Replace turn signal.
 - b. **No.** Go to Test 3.

3. Ground Circuit Test

1. Operate turn signals.
2. Test for voltage between terminal 1 and ground of inoperative turn signal [18B] or [19B].
3. Does battery voltage cycle on and off?
 - a. **Yes.** Repair open in (BK) wire.
 - b. **No.** Repair open in (BE/V) left or (BE/BN) right wire.

LEFT TURN SIGNALS INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-7. Left Turn Signals Inoperative Diagnostic Faults

POSSIBLE CAUSES
Turn signal switch malfunction
Open in power circuit from switch

1. Power Circuit Test

1. Disconnect LH control [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [24A] terminals 3 and 8 together.
3. Do the turn signals flash?
 - a. **Yes.** Replace left hand control assembly.
 - b. **No.** Repair open in (BE/V) wire.

RIGHT TURN SIGNALS INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-8. Right Turn Signals Inoperative Diagnostic Faults

POSSIBLE CAUSES
Turn signal switch malfunction
Open in power circuit from switch

1. Power Circuit Test

1. Disconnect LH control [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [24A] terminals 3 and 9 together.
3. Do the turn signals flash?
 - a. **Yes.** Replace left hand control assembly.
 - b. **No.** Repair open in (BE/BN) wire.

DESCRIPTION AND OPERATION

See Figure 5-6. The headlamp switch is used to select either the high beam or the low beam headlamps. When the ignition is turned ON the headlamp switch receives power through the lights/instrument fuse.

- In the low position, the headlamp switch directs voltage to illuminate the low beam headlamp.
- In the high position, the headlamp switch directs voltage to illuminate the high beam headlamp and the high beam indicator.

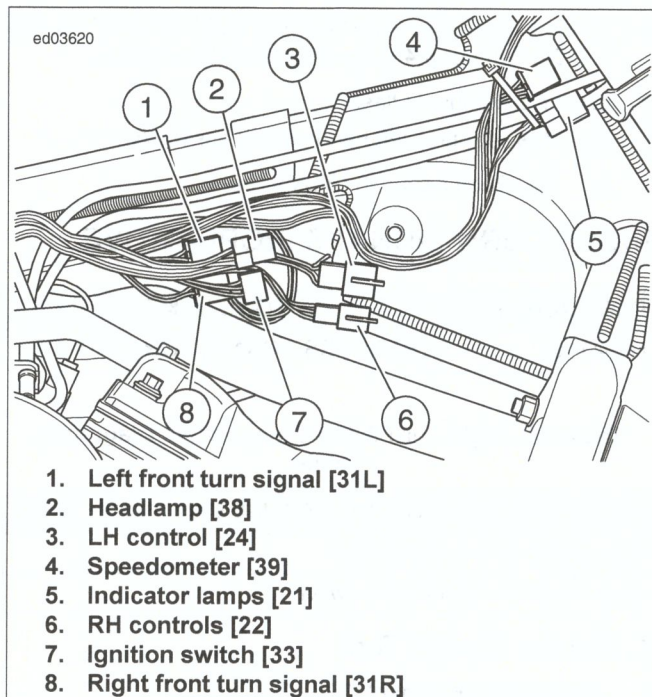


Figure 5-6. Under Fuel Tank Right Side

Diagnostic Tips

If the lights/instrument fuse is open:

- Test for short to ground on (R/BE) wire from the fuse to the headlamp switch.
- Check for a short to ground on the (BE/W) and (BE/Y) wires from the headlamp switch. If these circuits are grounded, it will open the fuse when the headlamp switch is in that position.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

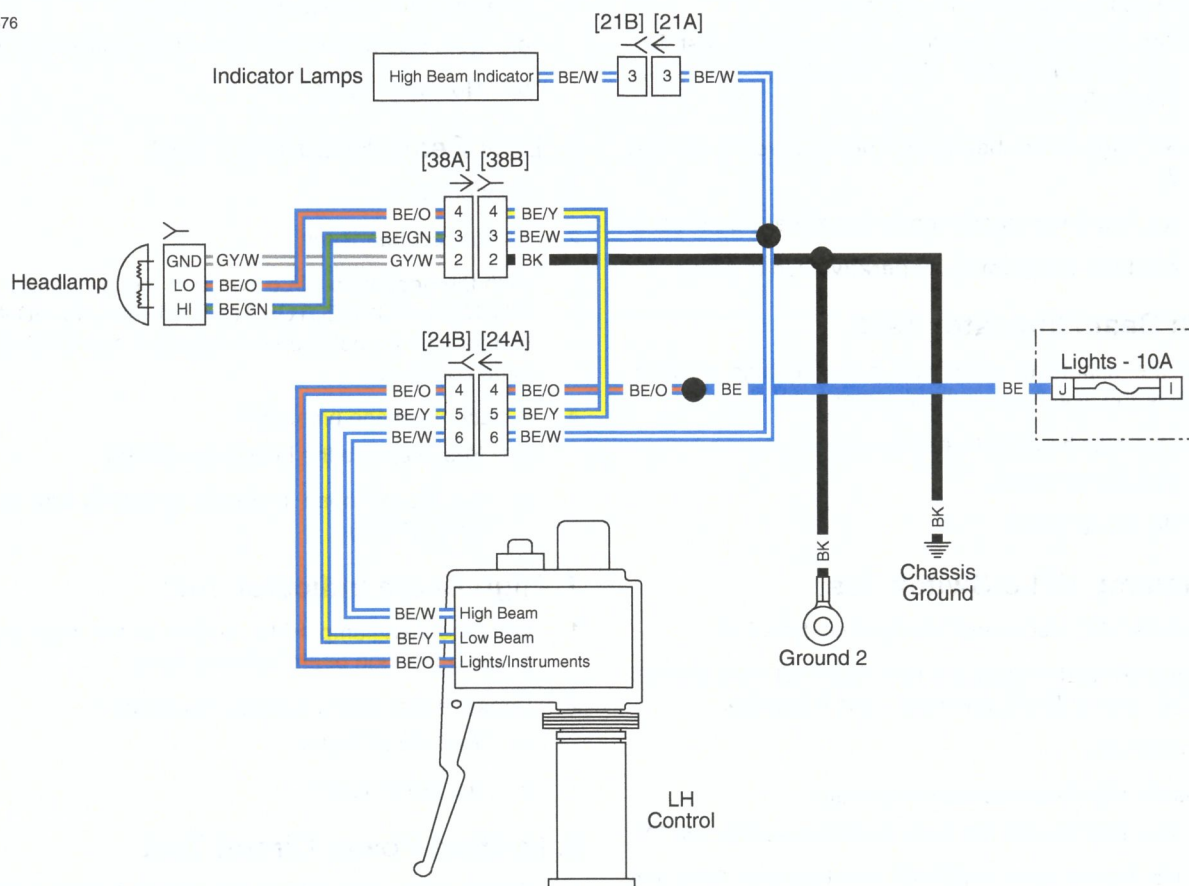


Figure 5-7. Headlamp and Running Lamps

HEADLAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-9. Headlamp Always On Diagnostic Faults

POSSIBLE CAUSES
Short to voltage in headlamp power circuit
Headlamp switch malfunction

1. Headlamp Switch Test

1. Disconnect left hand controls [24].
2. Does the headlamp turn off?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Repair short to voltage in the (BE/Y) low beam or (BE/W) high beam wire. **(5041)**

2. Short to Voltage Test

1. Turn IGN OFF.
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [24A] terminal 4 and ground.

3. Is battery voltage present?
 - a. **Yes.** Repair short to voltage in (BE) wire.
 - b. **No.** Replace headlamp switch.

HEADLAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-10. Headlamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open fuse
Open power to switch circuit
Headlamp Hi/Lo switch malfunction
Open ground circuit
Open high beam power circuit
Open low beam power circuit
Headlamp malfunction

1. Operational Test

1. Turn IGN ON.
2. Move the headlamp switch to the high and low positions.

3. Do the headlamps work in both positions?
 - a. **Yes.** Concern is intermittent. Perform wiggle test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
 - b. **No, high beam headlamp inoperative.** Go to Test 2.
 - c. **No, low beam headlamp inoperative.** Go to Test 5.
 - d. **No, both headlamps inoperative.** Go to Test 7.

2. High Beam Indicator Test

1. With the headlamp Hi/Lo switch in the high position, observe the high beam indicator lamp.
2. Does the high beam indicator illuminate?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Go to Test 3.

3. Headlamp Hi/Lo Switch Test

1. With IGN OFF, disconnect left hand controls [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [24A] terminals 4 and 6 together.
3. Turn IGN ON.
4. Does the high beam headlamp operate?
 - a. **Yes.** Replace the left hand control assembly. (5171)
 - b. **No.** Repair open in (BE/W) wire between [24A] and speedometer. (5041)

4. High Beam Headlamp Test

1. Disconnect headlamp.
2. With the IGN ON and the headlamp Hi/Lo switch in the high position, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between headlamp connector terminals HI and GND.
3. Is battery voltage present?
 - a. **Yes.** Replace the headlamp. (5185)
 - b. **No.** Repair open in (BE/GN) or (BE/W) wire to headlamp. (5041)

5. Headlamp Hi/Lo Switch Test

1. With the IGN OFF, disconnect left hand controls [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [24A] terminals 4 and 5 together.
3. Turn IGN ON.

4. Does the low beam headlamp operate?
 - a. **Yes.** Replace the left hand control assembly. (5171)
 - b. **No.** Go to Test 6.

6. Low Beam Headlamp Test

1. Connect [24].
2. Disconnect headlamp.
3. With the headlamp Hi/Lo switch in the low position using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between terminals LO and GND of headlamp connector.
4. Is battery voltage present?
 - a. **Yes.** Replace the headlamp. (5185)
 - b. **No.** Repair open in (BE/O) or (BE/Y) wire to headlamp. (5041)

7. High Beam Indicator Test

1. With the headlamp Hi/Lo switch in the high position, observe the high beam indicator lamp.
2. Does the high beam indicator illuminate?
 - a. **Yes.** Go to Test 9.
 - b. **No.** Go to Test 8.

8. Ignition Power Circuit Test

1. With the IGN OFF, disconnect left hand controls [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [24A] terminals 4 and 5 together.
3. Turn IGN ON.
4. Does the low beam headlamp operate?
 - a. **Yes.** Replace the left hand control assembly. (5171)
 - b. **No.** Repair open in (BE/O) or (BE) wire to LH control.

9. Headlamp Ground Test

1. Disconnect the high beam headlamp.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between GND terminal on headlamp connector and ground.
3. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace the headlamp. (5185)
 - b. **No.** Repair open in (GY/W) or (BK) ground circuit from headlamp. (5041)

DESCRIPTION AND OPERATION

The front and rear stop lamp switches control the stop lamp portion of the tail/stop lamp. The front stop lamp switch is a mechanical switch. Squeezing the front brake lever closes the switch contacts.

See Figure 5-8 and Figure 5-10. The rear stop lamp switch is a pressure switch. Pressing the rear brake pedal generates brake fluid pressure, closing the switch contacts. The lights/instrument fuse supplies power to the stop lamp switches.

- When the front stop lamp switch closes (front brake lever pulled in), power flows through the switch to the tail/stop lamp.
- When the rear stop lamp switch is applied (rear brake pedal pressed), power flows through the switch to the tail/stop lamp.

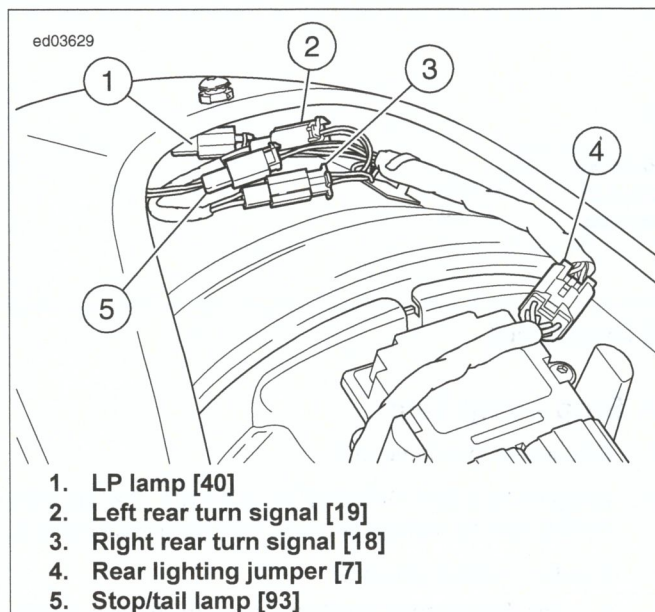


Figure 5-8. Under Passenger Seat

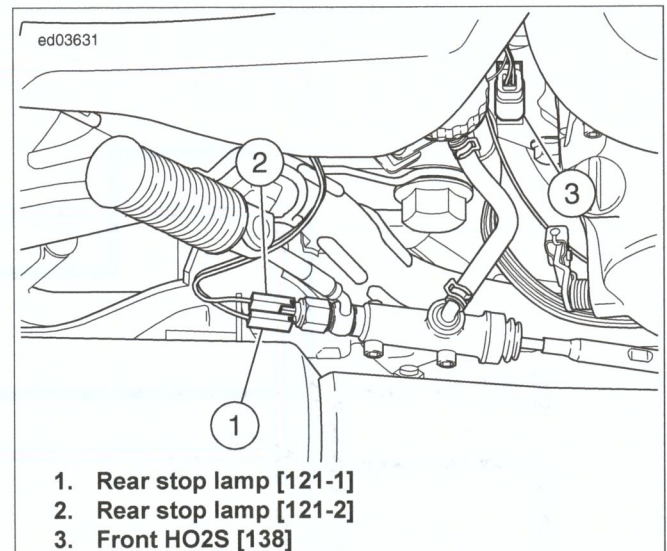


Figure 5-9. Rear of Transmission Right Side

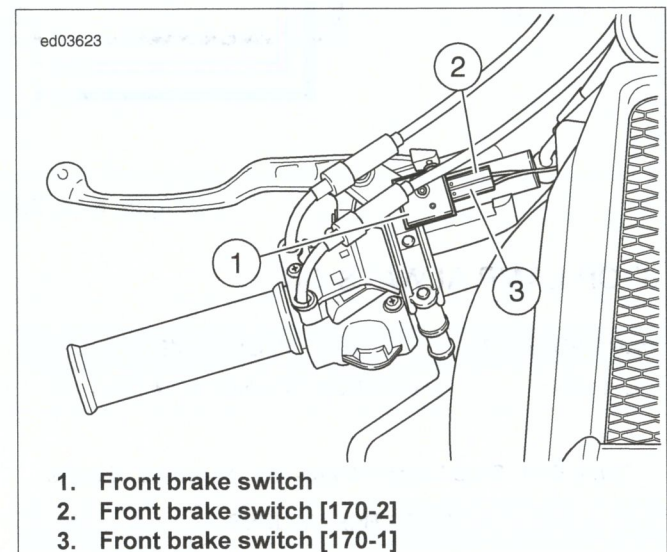


Figure 5-10. Right Front Hand Controls

Diagnostic Tips

When testing for a short to ground due to an open lights/instrument fuse, check the (BE/R) wire between the brake switches and the stop lamp. A short to ground on these wires causes the fuse to open only when the brake switches are closed.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

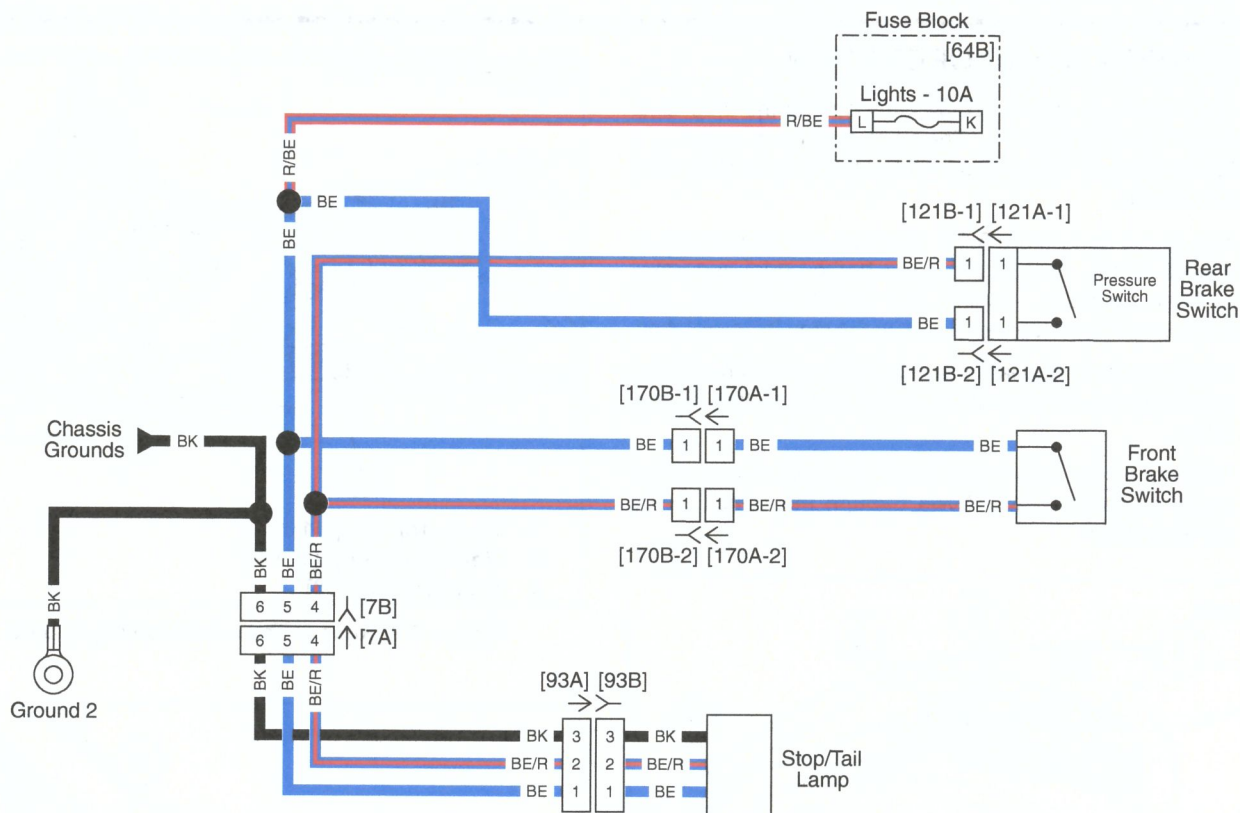


Figure 5-11. Tail/Stop Lamp Circuit

STOP LAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-11. Stop Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Short to voltage in stop lamp power circuit
Front stop lamp switch malfunction
Rear stop lamp switch malfunction

1. Front Stop Lamp Switch Test

1. Disconnect front stop lamp switch [170-2].
2. Does the stop lamp turn off?
 - a. **Yes.** Replace front stop lamp switch.
 - b. **No.** Go to Test 2.

2. Rear Stop Lamp Switch Test

1. Disconnect rear stop lamp switch [121-2].
2. Does the stop lamp turn off?
 - a. **Yes.** Replace rear stop lamp switch.
 - b. **No.** Go to Test 3.

3. Stop Lamp Test

1. Disconnect stop lamp [93].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [93A] terminals 2 and 3.
3. Is battery voltage present?
 - a. **Yes.** Repair short to voltage in the (BE/R) wire. (5041)
 - b. **No.** Replace stop lamp.

STOP LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-12. Stop Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open fuse
Short in stop lamp circuit
Open power to switch circuit
Open ground circuit
Open stop lamp circuit
Stop lamp malfunction
Rear stop lamp switch malfunction
Front stop lamp switch malfunction

1. Lights Circuit Test

1. Turn IGN ON.
2. Does the tail lamp illuminate?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Go to Test 2.

2. Tail Stop Lamp Test

1. Disconnect tail lamp [93].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [93A] terminals 1 and 3.
3. Is battery voltage present?
 - a. **Yes.** Replace stop/tail lamp. **(5215)**
 - b. **No.** Go to Test 5.

3. Stop Lamp Switch Test

1. Apply the front brake lever while observing the stop lamp.
2. Apply the rear brake pedal while observing the stop lamp.
3. Does the stop lamp illuminate?
 - a. **Yes. Stop lamp illuminates only with front brake lever applied.** Go to Test 6.
 - b. **Yes. Stop lamp illuminates only with rear brake pedal applied.** Go to Test 8.
 - c. **No.** Go to Test 4.

4. Tail Stop Lamp Test

1. Disconnect rear lighting [93].

2. With one of the stop lamp switches closed, test for voltage between [93A] terminals 2 and 3.
3. Is battery voltage present?
 - a. **Yes.** Replace the tail/stop lamp. **(5215)**
 - b. **No.** Repair open in the (BE/R) wire. **(5041)**

5. Stop Lamp Ground Test

1. Test for voltage between [93A] terminal 1 and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK) wire. **(5215)**
 - b. **No.** Repair open in (R/BE) wire at fuse block. **(5215)**

6. Rear Stop Lamp Switch Test

1. Disconnect rear stop lamp switch [121].
2. Jumper [121B-1] and [121B-2] together.
3. Turn IGN ON.
4. Does the brake lamp illuminate?
 - a. **Yes.** Replace the rear stop lamp switch. **(5141)**
 - b. **No.** Go to Test 7.

7. Rear Stop Lamp Switch Circuit Test

1. Test for voltage between [121B-2] and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BE/R) wire. **(5041)**
 - b. **No.** Repair open in (BE) wire. **(5043)**

8. Front Stop Lamp Switch Test

1. Disconnect front stop lamp switch [170].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) jumper [170B-1] and [170B-2] together.
3. Turn IGN ON.
4. Does the brake lamp illuminate?
 - a. **Yes.** Replace front stop lamp switch. **(5176)**
 - b. **No.** Go to Test 9.

9. Front Stop Lamp Switch Circuit Test

1. Test for voltage between [170B-1] and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BE/R) wire. **(5041)**
 - b. **No.** Repair open in (BE) wire. **(5043)**

DESCRIPTION AND OPERATION

See Figure 5-12 and Figure 5-13. The headlamp connector is located on the right side under the fuel tank.

The rear tail/stop lamp, rear turn signals and license plate lamp connectors are located under the passenger seat.

The running lamps consist of the front position lamp (if equipped), the license plate lamp and the tail lamp. The running lamps are powered when the ignition switch is in the ON or ACC position.

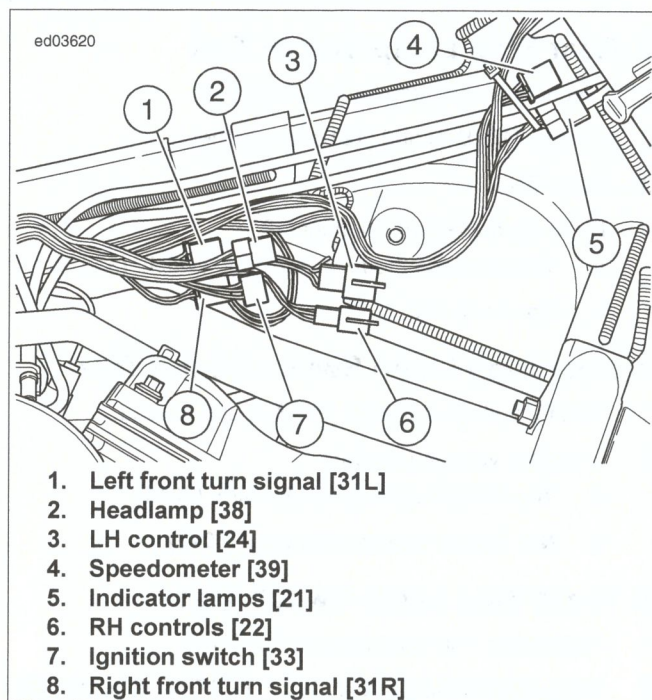


Figure 5-12. Under Fuel Tank Right Side

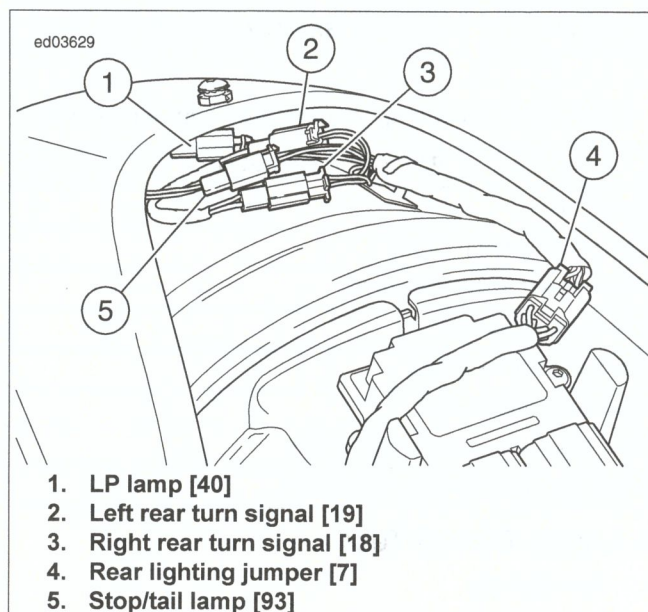


Figure 5-13. Under Passenger Seat

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

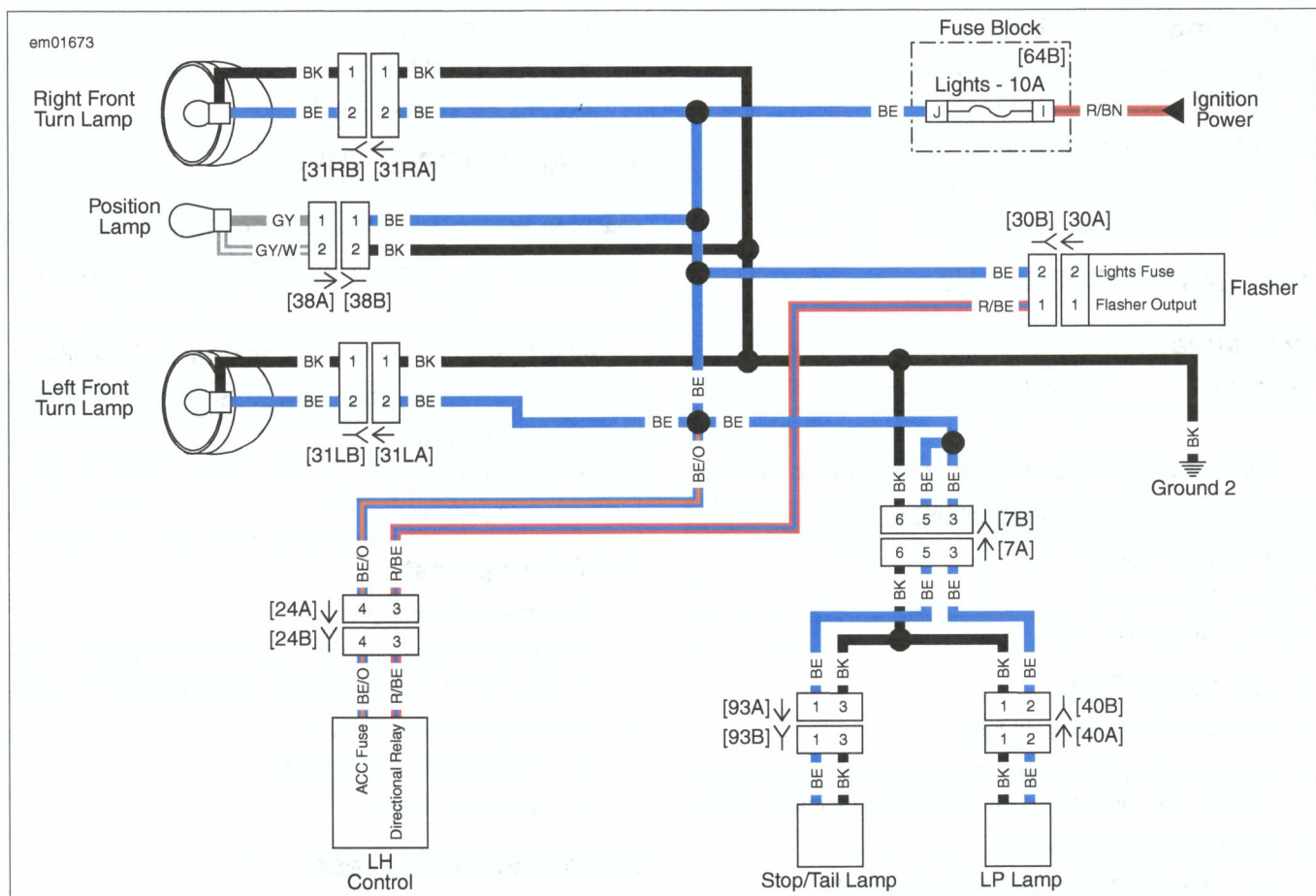


Figure 5-14. Running Lamps Circuit

POSITION LAMP INOPERATIVE: IF EQUIPPED

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-13. Position Lamp Inoperative Diagnostic Faults: If Equipped

POSSIBLE CAUSES
Open lights circuit
Lamp malfunction
Open ground

1. Position Lamp Test

1. Disconnect headlamp [38].
2. With the IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404) and a multimeter, test for voltage between [38B] terminals 1 and 2.
3. Is battery voltage present?
 - a. **Yes.** Replace position lamp. (5143)
 - b. **No.** Go to Test 2.

2. Ground Circuit Test

1. Test for voltage between [38B] terminal 1 and ground.

2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK) wire. (5041)
 - b. **No.** Repair open in (BE) wire. (5043)

FRONT RUNNING LAMPS INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-14. Front Running Lamps Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open lights circuit
Lamp malfunction
Open ground

1. Running Lamp Test

1. Disconnect running lamp [31L] or [31R].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [31LA] or [31RA] terminals 1 and 2.
3. Is battery voltage present?
 - a. **Yes.** Replace the inoperative running lamp.
 - b. **No.** Go to Test 2.

2. Ground Circuit Test

1. Test for voltage between [31LA] or [31RA] terminal 2 and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK) wire.
 - b. **No.** Repair open in (BE) wire.

TAIL LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-15. Tail Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open in ground circuit
Open in power circuit
Tail/stop lamp malfunction

1. Tail Lamp Test

1. Disconnect stop/tail lamp [93].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [93A] terminals 1 and 3.
3. Is battery voltage present?
 - a. **Yes.** Replace the tail/stop lamp. (5215)
 - b. **No.** Go to Test 2.

2. Ground Circuit Test

1. Test for voltage between [93A] terminal 1 and ground.

2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK) wire.
 - b. **No.** Repair open in (BE) wire.

LP LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 5-16. LP Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open in ground circuit
Open in power circuit
LP lamp malfunction

1. LP Lamp Test

1. Disconnect LP lamp [40].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test for voltage between [40B] terminals 1 and 2.
3. Is battery voltage present?
 - a. **Yes.** Replace the LP lamp.
 - b. **No.** Go to Test 2.

2. Ground Circuit Test

1. Test for voltage between [40B] terminal 2 and ground.
2. Is battery voltage present?
 - a. **Yes.** Repair open in (BK) wire.
 - b. **No.** Repair open in (BE) wire.

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NOTES

GENERAL

This chapter describes the operation of the EFI system. A good working knowledge of motorcycle components are required for troubleshooting engine and EFI problems. See 6.2 ELECTRONIC CONTROL MODULE and 6.3 SENSORS AND DRIVERS for the operation of the ECM and function of the various sensors and drivers. See 1.3 DIAGNOSTIC TOOLS for instructions on using the test equipment called out in the diagnostic test procedures in this chapter.

The EFI system provides microprocessor-based electronic engine management for the engine. The EFI system has the following features:

- Independently mapped spark and fuel control.
- Compensated fuel delivery through engine temperature, intake air temperature and manifold air pressure.
- Engine load measurement via throttle position sensing.
- Single point spark delivery.
- Sequential port indirect (manifold) fuel injection.
- Open/closed loop air/fuel control.
- Automatic enrichment at start-up.
- Engine speed and position determined by using a single CKP sensor.
- Engine idle speed electronically managed with an IAC system.

The ECM makes decisions for enabling ignition, starting, spark and fuel delivery. Sensors include:

- CKP sensor
- TPS
- JSS
- BAS
- ECT sensor
- VSS
- HO2 sensor
- TMAP

EFI Operation

The EFI system operates as an open or closed loop system, allowing it to adjust for all possible operating conditions.

- During open loop operation, the system uses programmed fuel and spark maps in the ECM providing easy cold starting and maximum power at Wide Open Throttle (WOT). The adaptive fuel value, learned during closed loop operation, is applied to open loop operation to adjust fuel and spark maps for optimal performance.
- During closed loop operation, the HO2 sensors provide input for an optimal air/fuel mixture resulting in reduced emissions, good fuel economy and smooth power. HO2 sensors must be at the normal operating temperature of the engine.

By using both open and closed loop systems, engine performance is continually adjusted. This compensates for change in conditions and provides maximum performance. A schematic for the EFI system is shown in Figure 6-1.

Symptom Diagnostics

These sections contain diagnostic test procedures for DTCs listed in 1.2 INITIAL DIAGNOSTICS. For symptoms of engine malfunctions not specifically covered by DTCs, refer to Table 1-14.

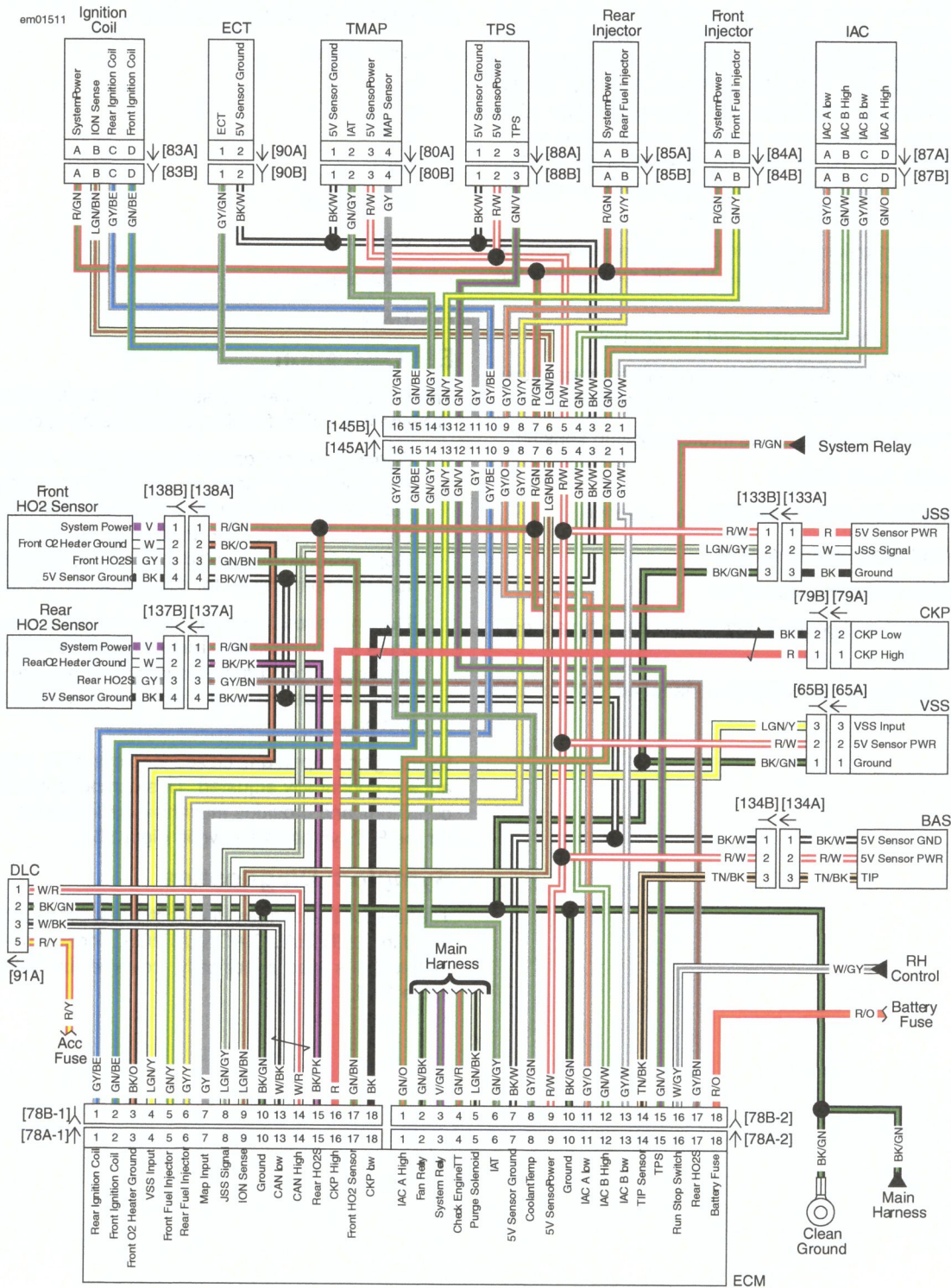


Figure 6-1. ECM Circuit

GENERAL

See Figure 6-2. The ECM receives and processes signals from the sensors and applies output signals to the drivers to crank, start, idle and run the engine. This section describes the configuration of the ECM.

ECM

The ECM is mounted under the seat. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, TMAP and TPS sensors). The ECM controls the circuits for the ignition coils and injectors.

The ECM contains all of the components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell provides adequate spark at all speeds. (The ECM has protection against transient voltages, continuous reverse voltage protection and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

24-2 Crankshaft

The left flywheel has 24 teeth evenly spaced around its circumference with two consecutive teeth missing (sync gap). In this configuration, the ECM determines engine position, engine phase and engine speed from the CKP sensor input. Phase (TDC compression) is determined by the ECM during startup and, when necessary, while running. No engine ignition events can occur until the ECM determines the relationship of piston position to crankshaft position. These continual ECM adjustments allow smooth engine operation at all speeds.

Crank Position Signal Synchronization

In the 24-2 crank configuration, crankshaft position is determined by the ECM finding the two-tooth (sync gap) in the CKP sensor signal. This is usually accomplished the first time the sync gap is encountered. The ECM monitors the CKP signal status every engine revolution. If the ECM determines synchronization is lost, it immediately terminates ignition events and synchronizes on the next occurrence of the sync gap.

Engine Phase

Phasing is accomplished by the ECM identifying a widening in the CKP signal caused by the deceleration of the crankshaft, as a piston approaches TDC on its compression stroke. Since the rear cylinder approaches TDC earlier than the front cylinder, engine phase can be readily discriminated. Phasing is normally

accomplished on the first TDC cycle after engine synchronization. Once phased, the ECM can begin normal ignition events. If the ECM experiences a system reset or loss of synchronization while the engine is running it also loses phase.

When phase is lost one of the following occurs:

- If an engine-not-running (crank mode) rpm is detected, the ECM executes the normal start-up phasing process.
- If engine run mode is detected, the ECM executes a running re-phase sequence.

The front cylinder is fired every engine revolution. The ECM monitors the power stroke after the fire event to determine if sufficient acceleration occurred to indicate the ECM fired on the compression stroke. When two valid power strokes are detected, the ECM locks phase and resumes normal ignition events.

Engine Run Mode

Many functions of the EFI system require an engine run mode determination. Engine run is determined by the level of engine rpm. Generally, the engine is considered to be running when engine rpm exceeds a minimum of 750 rpm.

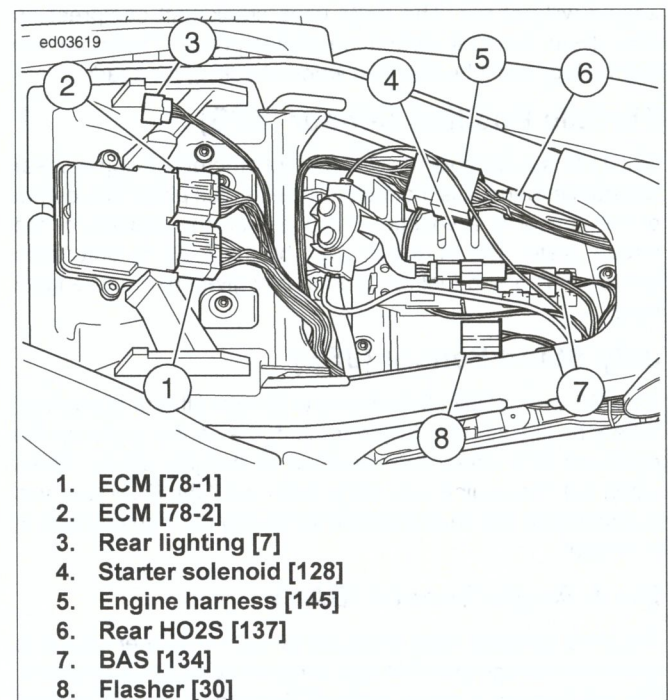


Figure 6-2. Under Seat: Front

DESCRIPTION AND OPERATION

Sensors and drivers play an important part in the ECM's ability to provide the proper operational parameters for engine efficiency, emissions control and fuel economy. When a failure occurs, a DTC is generated by, and stored in, the ECM. These codes help the technician diagnose engine trouble to the proper sensor or driver. See 1.2 INITIAL DIAGNOSTICS.

SENSORS

A failed CKP sensor completely disables the engine. Other sensor problems may cause engine performance issues or complete engine shutdowns. The following are brief explanations of sensor types and their functions within the EFI system.

Crank Position (CKP) Sensor

The CKP sensor, located under the left side outer cover, is a variable reluctance device that generates AC voltage as the teeth on the crankshaft pass by the sensor. The signal is routed to the ECM where it is used to determine crankshaft position, engine speed (rpm) and engine phase (TDC compression). Without the presence of the CKP signal, the ECM will not allow the ignition and fuel injection drivers to operate, and thus the engine will not run. The ECM uses crankshaft compression slow down events to determine engine phase. Therefore, the spark plugs must be installed when checking for spark.

Throttle Position Sensor (TPS)

The TPS is a variable resistor (potentiometer) having a linear resistance range. It is mounted on the throttle plate. The output of the sensor is a voltage dependent on the position of the throttle plate. The output is used by the ECM to determine ignition timing and fuel required at any given rpm and engine load.

Jiffy Stand Sensor (JSS)

The JSS uses a Hall-effect device to monitor jiffy stand position. When the jiffy stand is fully retracted, the sensor picks up the presence of a metal tab mounted to the jiffy stand. When extended, the engine only starts and runs if the ECM receives a signal from the neutral switch indicating the transmission is in neutral.

Bank Angle Sensor (BAS)

The BAS operates from the ECM 5V sensor reference and is grounded through the ECM on a common sensor ground circuit. The BAS sends a signal to the ECM ranging from 0.24-3.4V under normal operating conditions. A signal between 3.5-4.79V causes the ECM to turn off the engine. When the vehicle is righted, the ignition must be switched off and then on in order to restart the engine. If the signal from the BAS is below 0.24V or above 4.79V, the ECM sets a code. DTC P1151 is set when the BAS output is shorted low (to ground); and P1152 is set when the BAS output is shorted high (to voltage). An open circuit output acts like a shorted high and sets DTC P1152. If a code occurs, the engine continues to run. A tipped vehicle will not set a DTC.

Clutch Switch

The clutch switch is located on the left handlebar under the clutch lever. It is one of the components used to energize the start relay.

Neutral Switch

The speedometer provides voltage to the neutral switch, which is open when the transmission is in gear. With the transmission in neutral, the switch is closed, allowing current flow to ground. The ECM will not allow the engine to start unless the transmission is in neutral or the clutch is pulled in.

Engine Coolant Temperature (ECT) Sensor

The ECT sensor is a thermistor device. At a specific temperature it has a specific resistance across its terminals. As this resistance varies, so does the voltage.

- At high temperatures, the resistance of the sensor is very low. This effectively lowers the signal voltage on ECM [78-2] terminal 8.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V. The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining Idle Air Control (IAC) pintle position.

Temperature Manifold Absolute Pressure (TMAP) Sensor

The TMAP sensor combines the MAP and IAT in a single component. The functions of each are described in the following paragraphs. During diagnostics the two parts of the TMAP are tested as separate units.

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is supplied 5V from the ECM and sends a signal back to the ECM. This signal changes with engine vacuum, intake air temperature and atmospheric barometric pressure. The MAP sensor monitors the intake manifold pressure (vacuum) and sends the information to the ECM. The ECM then adjusts the spark and fuel timing advance curves for optimum performance. The sensor output determines if the engine is rotating when a fault with the CKP sensor is present.

Intake Air Temperature (IAT) Sensor

The IAT sensor is a thermistor device. At a specific temperature it has a specific resistance across its terminals. As the temperature varies, the thermistor resistance varies and so does the voltage on ECM [78-2] terminal 6.

- At high temperatures, the resistance of the sensor is very low. This effectively lowers the signal voltage on ECM [78-2] terminal 6.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V. The ECM monitors this voltage to compensate for various operating conditions.

Vehicle Speed Sensor (VSS)

The VSS is a Hall-effect device mounted close to the teeth of the 5th gear in the transmission. The output signal frequency

varies with vehicle speed. The VSS signal is sent to the ECM and the speedometer.

HO2S: Front and Rear

The HO2S detects unburned oxygen in the engine exhaust. The output of the sensor is a voltage having a range of about 0-1.0V.

- The normal output is 0.5V which represents a balance between a lean (not enough fuel) and rich (too much fuel) air/fuel mixture.
- An output less than 0.5V represents a lean mixture; greater than 0.5V represents a rich mixture.
- The change in output level signals the ECM to modify the air/fuel ratio.

The HO2S does not operate efficiently until the engine is at operating temperature. Always warm-up the vehicle prior to troubleshooting the HO2S. The heater elements on the HO2S help bring the HO2S up to operating temperature quicker. Leaks in the exhaust system, leaky exhaust valves, misfires or any engine problem allowing unburned oxygen into the exhaust stream could create a DTC indicating a bad sensor. Look for problems related to an improper air/fuel mixture before replacing the sensor.

DRIVERS

The ECM drivers are the output devices or system outputs of the EFI system. Drivers are provided ground by the ECM to pump, inject and ignite the air/fuel mixture in the engine and to activate relays.

Fuel Pump

The system relay provides battery voltage to the fuel pump which is inside the fuel tank.

Ignition Coils and Spark Plugs

The ignition coils create the energy to fire the spark plugs and ignite the air/fuel mixture in the cylinders. Advancing or retarding the spark is controlled by the ECM to suit load and speed conditions of the engine.

Fuel Injectors

The system relay provides battery power to the fuel injectors. The ECM provides the path to ground to trigger the injectors. The fuel injectors are pulse-width modulated solenoids for metering fuel into the intake tract. The pulse-width of the ground path to the injectors is varied by the ECM in response to inputs from the various sensors, thus varying the length of time the injector is open.

Idle Air Control (IAC)

The IAC motor is a stepper-motor used to regulate the amount of air entering the intake manifold during idle. The ECM controls engine idle speed by moving the IAC pintle to open or close a passage around the throttle plate. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

- To increase idle speed, the ECM retracts the pintle, allowing more air to flow through the throttle body.
- To decrease idle speed, the ECM extends the pintle, allowing less air to flow through the throttle body.

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-23738	VACUUM PUMP

See Figure 6-3. The TMAP sensor provides the functions of both an IAT sensor and a MAP sensor in one unit. The TMAP sensor is supplied 5V from ECM [78-2] terminal 9 and sends MAP and IAT signals back to ECM [78-1] terminal 7 and [78-2] terminal 6 respectively. Refer to Table 6-1.

Table 6-1. Code Description

DTC	DESCRIPTION
P0107	MAP sensor open/low
P0108	MAP sensor high
P0112	IAT sensor voltage low
P0113	IAT sensor open/high

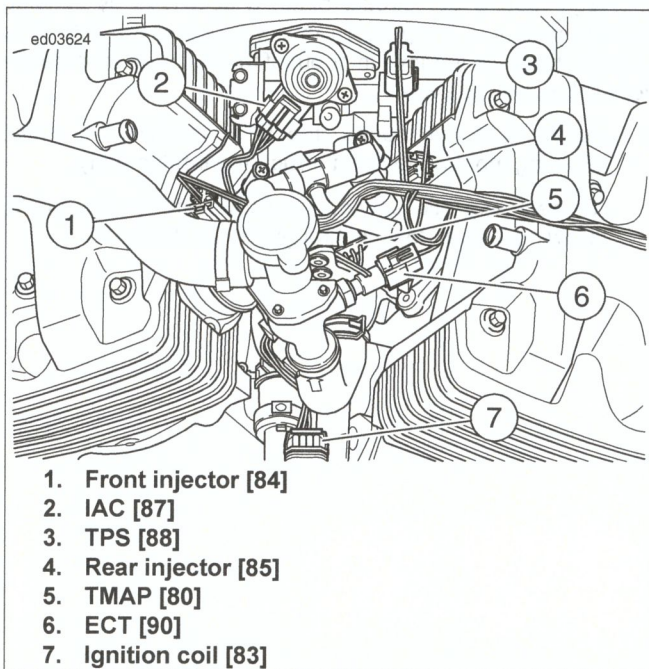


Figure 6-3. Between Cylinders Left Side

TMAP: MAP Signal

The MAP signal varies in accordance with engine vacuum and atmospheric pressure. Changes in atmospheric pressure are influenced by weather and altitude.

TMAP: IAT Signal

The IAT portion of the TMAP sensor is a thermistor device. At a specific temperature, it will have a specific resistance across

its terminals. As this resistance varies, so does the voltage on [78-2] terminal 6 of the ECM.

- At high temperatures, the resistance of the IAT sensor is very low, which effectively lowers the signal voltage on [78-2] terminal 6.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V. The ECM monitors this voltage to compensate for various operating conditions.

Diagnostic Tips: MAP Portion of TMAP Sensor

- DTCs P0107 or P0108 will set if the MAP sensor signal is out of range. DTC P0108 can only be detected with the engine running.
- Using the VACUUM PUMP (Part No. HD-23738), apply a vacuum to the pressure port of the TMAP sensor. The MAP signal voltage should lower as the vacuum is applied.
- The TMAP and TGS are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTCs P0107, P0108, P0122, P0123, P1501 and P1502).

Diagnostic Tips: IAT Portion of TMAP Sensor

An intermittent may be caused by a poor connection, rubbed through wire insulation or an open wire inside the insulation. Check the following conditions:

- Poor connection:** Inspect ECM and harness connector [78-1] and [78-2] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- Perform 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test to locate intermittents:** If connections and harness check out OK, use a multimeter to check the IAT sensor voltage while moving related connectors and wiring harness. If the failure is induced, the IAT voltage will change.
- Shifted sensor resistance value:** Measure ECT and IAT sensor temperatures with a cool engine. The sensor temperatures should be within 5.6 °C (10 °F) of each other. If the two sensors are not within the specified range, replace the inaccurate sensor.
- A faulty sensor can negatively affect the signal voltage of the other sensors sharing the same 5V reference. If the wiring passes the following tests, disconnect one sensor at a time on the 5V reference and verify the DTC is still present. Additional DTCs will be set as each sensor is disconnected, clear DTCs after this test. Be sure to perform this test before replacing a component.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.



PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

POSSIBLE CAUSES
TMAP sensor malfunction
Open or shorted to ground signal wire
Open or shorted to ground 5V reference circuit

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].

3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper between [80B] terminals 4 (GY) wire and 3 (R/W) wire.
4. Clear DTCs.
5. Start engine.
6. Turn IGN OFF.
7. Check DTCs.
8. Did DTC reset?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace TMAP sensor.

1. Turn IGN OFF.
2. Remove test wire.
3. Turn IGN ON.
4. Test voltage between [80B] terminal 3 (R/W) wire to ground.

5. Is voltage approximately 5V?

a. **Yes.** Go to Test 3.

b. **No.** Go to Test 6.

3. Signal Wire Continuity Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Test continuity between [80B] terminal 4 (GY) wire and BOB [78-1] terminal 7.

5. Is continuity present?

a. **Yes.** Go to Test 4.

b. **No.** Repair open in (GY) wire.

4. Signal Wire Shorted to Ground Test

1. Test continuity between BOB [78-1] terminal 7 and ground.

2. Is continuity present?

a. **Yes.** Repair short to ground in (GY) wire.

b. **No.** Go to Test 5.

5. Signal Wire Shorted to Sensor Ground Test

1. Test continuity between BOB [78-1] terminal 7 and [78-2] terminal 7.

2. Is continuity present?

a. **Yes.** Repair short between (GY) and (BK/W) wires.

b. **No.** Replace ECM.

6. 5V Reference Wire Open Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Test continuity between [80B] terminal 3 (R/W) wire and BOB [78-2] terminal 9.

5. Is continuity present?

a. **Yes.** Go to Test 7.

b. **No.** Repair open in (R/W) wire.

7. 5V Reference Shorted to Signal Ground Test

1. Test resistance between BOB [78-2] terminals 9 and 7.

2. Is resistance less than 1.0 Ohm?

a. **Yes.** Repair short between the (R/W) and (BK/W) wires.

b. **No.** See diagnostic tips before replacement. Replace ECM.

DTC P0108

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-3. DTC P0108 Diagnostic Faults

POSSIBLE CAUSES
MAP sensor malfunction
Short to voltage
Open ground circuit

1. MAP Sensor Test

1. Turn IGN OFF.

2. Disconnect TMAP sensor [80].

3. Clear DTC.

4. Start engine.

5. Turn IGN OFF.

6. Check DTCs.

7. Did DTC reset?

a. **Yes.** Go to Test 2.

b. **No.** Replace TMAP sensor.

2. Signal Wire Short to 5V Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wire harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [78-1] terminal 7 and [78-2] terminal 9.

5. Is continuity present?

a. **Yes.** Repair short between (R/W) and (GY) wires.

b. **No.** Go to Test 3.

3. Signal Wire Short to Voltage Test

1. Turn IGN ON.

2. Test voltage between BOB [78-1] terminal 7 and ground.

3. Is voltage present?
 - a. **Yes.** Repair short to voltage in (GY) wire.
 - b. **No.** Go to Test 4.

4. Ground Wire Open Test

1. Turn IGN OFF.
2. Test resistance between [80B] terminal 1 and BOB [78-2] terminal 7.
3. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open in (BK/W) wire.

5. 5V Reference Shorted to Battery Voltage Test

1. Connect [78A-1] and [78A-2].
2. Turn IGN ON.
3. Test voltage between BOB [78-2] terminal 9 and ground.
4. Is voltage greater than 5.25V?
 - a. **Yes.** Repair short to voltage in (R/W) wire.
 - b. **No.** Replace TMAP sensor.

DTC P0112

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-4. DTC P0112 Diagnostic Faults

POSSIBLE CAUSES
IAT sensor malfunction
Short to ground in 5V reference circuit

NOTE

Vehicle and sensor must be at ambient room temperature before starting diagnostic test.

1. IAT Sensor Test

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [80A] terminals 1 and 2.
4. Is resistance between 500-5000 Ohms?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace TMAP sensor.

2. Signal Wire Shorted to Ground Test

1. Test resistance between [80B] terminal 2 (GN/GY) and ground.

2. Is resistance reading less than 1 Ohm?
 - a. **Yes.** Repair short to ground on (GN/GY) wire.
 - b. **No.** Go to Test 3.

3. Signal Grounded Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-2] terminals 6 and 10.
4. Is continuity present?
 - a. **Yes.** Repair short to ground on (GN/GY) wire.
 - b. **No.** Go to Test 4.

4. Signal Wire Shorted to Sensor Ground Test

1. Test continuity between BOB [78-2] terminals 6 and 7.
2. Is continuity present?
 - a. **Yes.** Repair short between [80B] terminals 1 and 2 (GN/GY and BK/W) wires.
 - b. **No.** Replace ECM.

DTC P0113

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-5. DTC P0113 Diagnostic Faults

POSSIBLE CAUSES
IAT sensor malfunction
Open or short to voltage in 5V reference circuit

1. IAT Sensor Shorted High Test

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [80B] terminal 2 (GN/GY) and ground.
5. Is voltage greater than 6V?
 - a. **Yes.** Repair short to voltage on (GN/GY) wire.
 - b. **No.** Go to Test 2.

2. Signal Wire Open Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2] leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test resistance between [80B] terminal 2 (GN/GY) and BOB [78-2] terminal 6.
5. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open circuit in (GN/GY) wire.

3. Open Ground Wire Test

1. Test resistance between BOB [78-2] terminal 7 and [80B] terminal 1 (BK/W).

2. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (BK/GY) wire.

4. Signal Wire Shorted to Sensor Power Test

1. Test continuity between BOB [78-2] terminal 6 and [78-2] terminal 9.
2. Is continuity present?
 - a. **Yes.** Repair short between (GN/GY) and (R/W) wires. Verify IAT sensor resistance value and if incorrect replace TMAP sensor.
 - b. **No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-5. The ECM supplies and monitors a voltage signal from [78-2] terminal 8 to one side of the ECT sensor. The other side of the ECT sensor is connected to a common sensor ground. The ground is also connected to the ECM [78-2] terminal 7.

The ECT sensor is a thermistor device. At a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on ECM [78-2] terminal 8.

- At high temperatures, the resistance of the sensor is very low. This lowers the signal voltage on ECM [78-2] terminal 8.
- At low temperatures, the resistance is very high. This allows the voltage to rise close to 5V.

The ECM monitors this voltage to compensate for various operating conditions. The ECM also uses the sensor input as a reference for determining IAC pintle position.

Table 6-6. Code Description

DTC	DESCRIPTION
P0117	ECT sensor shorted low
P0118	ECT sensor high/open

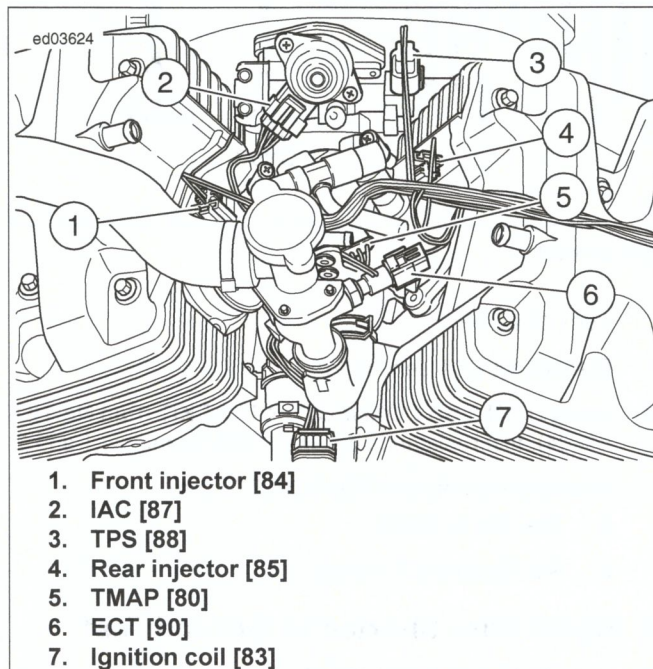


Figure 6-5. Between Cylinders Left Side

Diagnostic Tips

Once the engine is started, the temperature should rise steadily to operating temperature.

An intermittent may be caused by a poor connection, rubbed through wire insulation or an inoperative wire inside the insulation.

Check the following conditions:

- **Poor connection:** Inspect ECM harness connector [78-1] and [78-2] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test to locate intermittents:** If connections and harness check out OK, use a multimeter to check the engine temperature reading while moving related connectors and wiring harness. If the failure is induced, the engine temperature display will change.
- **Shifted sensor resistance value:** Measure ECT and IAT sensor temperatures with a cool engine. The sensor temperatures should be within 5.6 °C (10 °F) of each other. If the two sensors are not within the specified range replace the inaccurate sensor.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

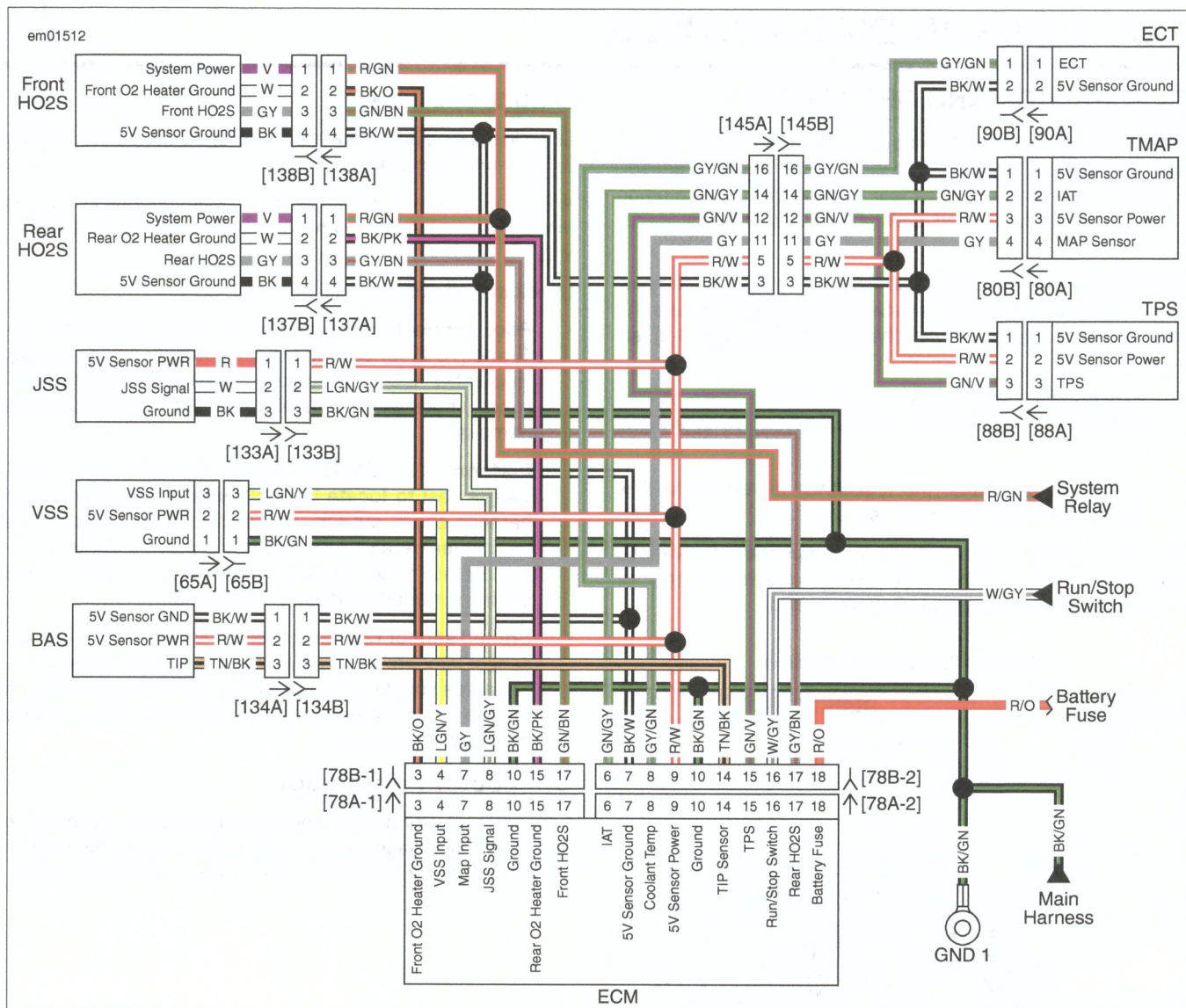


Figure 6-6. Sensor Circuit

DTC P0117

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-7. DTC P0117 Diagnostic Faults

POSSIBLE CAUSES
ECT sensor malfunction
Short to ground in 5V reference circuit

1. ECT Sensor Test

NOTE

Vehicle and sensor must be at ambient temperature before starting diagnostic test.

- Turn IGN OFF.
- Disconnect ECT sensor [90].
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [90A] terminals 1 and 2.
- Is resistance between 900-10,000 Ohms?
 - Yes.** Go to Test 2.
 - No.** Replace ET sensor.

2. Signal Wire Shorted to Ground Test

- Test resistance between [90B] terminal 1 (GY/GN) wire and ground.
- Is resistance less than 1 Ohm?
 - Yes.** Repair short to ground in (GY/GN) wire.
 - No.** Go to Test 3.

3. Signal Wire Shorted to Sensor Ground Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-2] terminals 8 and 7.
4. Is continuity present?
 - a. **Yes.** Repair short between [90B] terminals 1 (GY/GN) wire and 2 (BK/W) wire.
 - b. **No.** Replace ECM.

DTC P0118

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-8. DTC P0118 Diagnostic Faults

POSSIBLE CAUSES
ECT sensor malfunction
Open or short to voltage in 5V reference circuit

1. ECT Signal Voltage Test

1. Turn IGN OFF.
2. Disconnect ECT sensor [90].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [90B] terminal 1 (GY/GN) wire and ground.

4. Turn IGN ON.
5. Is voltage greater than 6V?
 - a. **Yes.** Repair short to voltage on (GY/GN) wire.
 - b. **No.** Go to Test 2.

2. Signal Wire Open Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between [90B] terminal 1 (GY/GN) wire and BOB [78-2] terminal 8.
5. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (GY/GN) wire.

3. Open Ground Wire Test

1. Test continuity between [90B] terminal 2 (BK/W) wire and BOB [78-2] terminal 7.
2. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (BK/W) wire.

4. Signal Wire Shorted to Sensor Power Test

1. Test continuity between BOB [78-2] terminals 8 and 9.
2. Is continuity present?
 - a. **Yes.** Repair short between (GY/GN) and (R/W) wires.
 - b. **No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-7. The ECM supplies a 5V signal on [78-2] terminal 9 to terminal 2 of the TPS. The TPS sends a signal back to the ECM on [78-2] terminal 15. The returned signal varies in voltage according to throttle position.

- At idle (closed throttle), the signal is typically in the range of 0.2-0.8V.
- At wide open throttle, the signal is normally 4.0-4.9V.

DTC P0122 or P0123 will set if the TPS voltage signal does not fall within the acceptable range.

Table 6-9. Code Description

DTC	DESCRIPTION
P0122	TPS 1 low/open
P0123	TPS 1 high

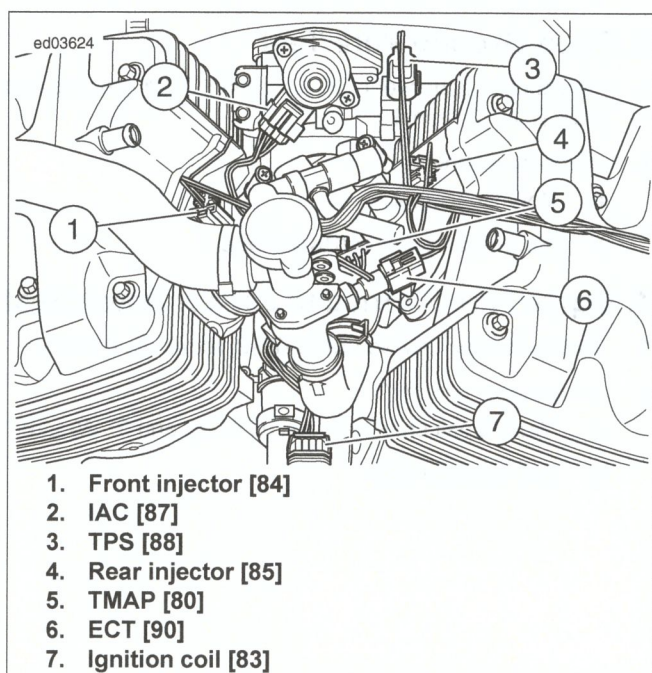


Figure 6-7. Between Cylinders Left Side

Diagnostic Tips

The multimeter reads throttle position in Volts. Voltage should increase at a steady rate as the throttle is moved from idle to wide open. A short to ground or open on the (GN/V) or (R/W) wires also will result in a DTC P0122. A short to ground or open on the (R/W) wire (+5V REF) sets multiple codes.

NOTE

The TMAP, JSS, VSS, BAS, and TPSs are connected to the same reference line (+5V REF). If the line goes to ground or open, multiple trouble codes will be set (DTCs P0107, P0108 and P0122, P0123, P1501 or P1502). Start with the DTC having the highest priority ranking.

Check for the following conditions:

- **Poor connection:** Inspect ECM harness connector [78B-1] and [78B-2] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test to locate intermittents:** If connections and harness check out OK, monitor TPS voltage using a multimeter while moving related connectors and wiring harness. A TPS voltage change when a part is moved indicates an intermittent.
- **TPS scaling:** Observe the TPS voltage display while opening the throttle with engine stopped and ignition switch ON. Display should vary from closed throttle TPS voltage (when throttle is closed) to greater than 4.0V (when throttle is held wide open). As the throttle is **slowly** moved, the voltage should change gradually without spikes or low voltages being observed.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

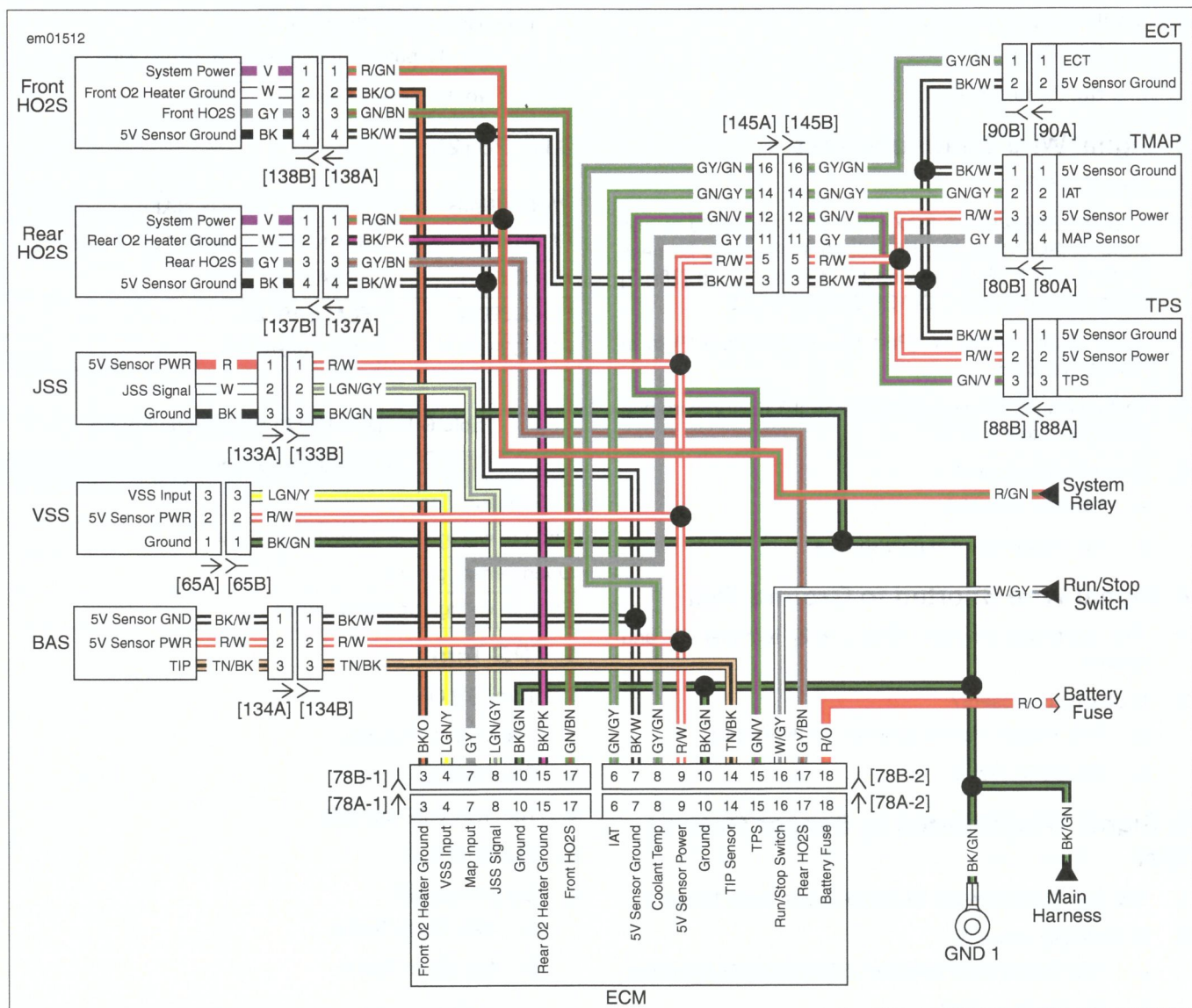


Figure 6-8. Sensor Circuit

DTC P0122

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-10. DTC P0122 Diagnostic Faults

POSSIBLE CAUSES
TPS malfunction
Open or short to ground in 5V reference circuit
Open or short to ground in signal circuit

1. TPS Circuit Test

1. Turn IGN OFF.
2. Disconnect TPS [88].

3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper between [88B] terminals 2 (R/W) wire and 3 (GN/V) wire.
4. Clear DTCs.
5. Turn IGN OFF and ON.
6. Check DTCs.
7. Did DTC reset?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace TPS.

2. Signal Voltage Test

1. Turn IGN OFF.
2. Remove test wire.
3. Turn IGN ON.
4. Test voltage between [88B] terminal 2 (R/W) wire and ground.

5. Is voltage approximately 5V?

a. **Yes.** Go to Test 3.

b. **No.** Go to Test 6.

3. Signal Wire Continuity Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Test continuity between [88B] terminal 3 (GN/V) wire and BOB [78-2] terminal 15.

5. Is continuity present?

a. **Yes.** Go to Test 4.

b. **No.** Repair open in (GN/V) wire.

4. Signal Wire Shorted to Ground Test

1. Test continuity between BOB [78-2] terminal 15 and ground.

2. Is continuity present?

a. **Yes.** Repair short to ground in (GN/V) wire.

b. **No.** Go to Test 5.

5. Signal Wire Shorted to Sensor Ground Test

1. Test continuity between BOB [78-2] terminals 15 and 7.

2. Is continuity present?

a. **Yes.** Repair short between (GN/V) and (BK/W) wires.

b. **No.** Replace ECM.

6. 5V Sensor Power Open Wire Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Test continuity between [88B] terminal 2 (R/W) wire and BOB [78-2] terminal 9.

5. Is continuity present?

a. **Yes.** Go to Test 7.

b. **No.** Repair open in (R/W) wire.

7. Sensor Power Shorted To Ground Test

1. Test resistance between BOB [78-2] terminal 9 and ground.

2. Is resistance less than 0.5 Ohms?

a. **Yes.** Repair short to ground on (R/W) wire.

b. **No.** Replace ECM.

DTC P0123

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-11. DTC P0123 Diagnostic Faults

POSSIBLE CAUSES
TPS malfunction
Short to voltage in 5V reference circuit
Open sensor ground
Short to voltage on signal circuit

1. TPS Test

1. Turn IGN OFF.

2. Disconnect TPS [88].

3. Clear DTCs.

4. Turn IGN OFF and ON.

5. Check DTCs.

6. Did DTC reset?

a. **Yes.** Go to Test 2.

b. **No.** Go to Test 4.

2. Signal Wire Short to 5V Test

1. Turn IGN OFF.

2. Disconnect ECM [78-1] and [78-2].

3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [88B] terminals 2 and 3.

4. Is continuity present?

a. **Yes.** Repair short between (R/W) and (GN/V) wires.

b. **No.** Go to Test 3.

3. Signal Wire Short to Voltage Test

1. Connect [78-1] and [78-2].

2. Turn IGN ON.

3. Test voltage between [88B] terminal 3 (GN/V) wire and ground.

4. Is voltage present?

a. **Yes.** Repair short to voltage in (GN/V) wire.

b. **No.** Replace ECM.

4. 5V Shorted to Battery Voltage Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [88B] terminal 2 (R/W) wire and ground.
2. Is voltage greater than 5.25V?
 - a. **Yes.** Repair short to voltage in (R/W) wire.
 - b. **No.** Go to Test 5.

5. Ground Wire Open Test

1. Turn IGN OFF.

2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between [88B] terminal 1 (BK/W) wire and BOB [78-2] terminal 7.
5. Is continuity present?
 - a. **Yes.** Replace TPS.
 - b. **No.** Repair open in (BK/W) wire.

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The HO2S provides a signal to the ECM which indicates whether the engine is running rich or lean.

- A P0131 (front) or P0151 (rear) is set when the ECM detects an excessively lean condition for a specified length of time. DTCs may also set if HO2S fails.
- A P0132 (front) or P0152 (rear) is set when the ECM detects an excessively rich condition for a specified length of time. This can be caused by oil contamination or fuel injector malfunctions. DTCs may also set if HO2S fails.
- A P0134 (front) or a P0154 (rear) is set when the sensor circuit is open or too cold to respond.
- When the air/fuel mixture is ideal, approximately 14.6 parts air to 1 part fuel, the voltage will be approximately 0.45V when measuring across the sensor.

The heater portion of the HO2S is powered by the system relay. The front and rear HO2S heaters have separate control circuits monitored by the ECM.

Table 6-12. Code Description

DTC	DESCRIPTION
P0031	Front HO2S low/open
P0032	Front HO2S shorted high
P0051	Rear HO2S low/open
P0052	Rear HO2S shorted high
P0131	O2 sensor low/engine lean (front)
P0132	Engine running rich (front)
P0134	O2 sensor high/open (front)
P0151	O2 sensor low/engine lean (rear)
P0152	Engine running rich (rear)
P0154	O2 sensor high/open (rear)

Diagnostic Tips

The HO2S DTCs will not illuminate the check engine lamp for current or historic codes and will only be indicated by DIGITAL

TECHNICIAN II (Part No. HD-48650). All historic HO2S DTCs are to be ignored and cleared. The multimeter displays the signal from the HO2S in Volts. This voltage will have an average value tending towards lean, rich or ideal value depending on operating temperature of the engine, engine speed and throttle position. An open/short to voltage or short to ground in the (GN/BN) wire (front) and (GY/BN) wire (rear) will cause the engine to run rich (short to ground) or lean (short to voltage) until the fault is detected. Once fault is detected, vehicle will run in open loop.

Check for the following conditions:

- **Poor connection:** Inspect the ECM [78-1] and [78-2], fuel injector [84, 85] and HO2S [137, 138] connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses.
- **Dirty/stuck open injectors:** The vehicle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there are injector problems. This could also cause poor fuel economy and performance.
- **Loose HO2S:** If an HO2S is loose, engine performance may be affected. This could also show up as a slow changing HO2S voltage.
- **Loose/leaking exhaust:** This can cause a poor ground connection for the sensor or allow fresh air into the exhaust system. If fresh air enters exhaust system, the HO2S will read a lean condition, causing the system to go rich.
- **Engine misfire:** See 6.26 MISFIRE AT IDLE OR UNDER LOAD.
- **Leaking injectors:** This causes fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air box and air filter. Then, with the throttle wide open, turn IGN ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors in the service manual.
- **Intake leaks:** This may cause a lean sensor readings.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

5. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (BK/O) wire.

3. Short to Ground Test

1. Test continuity between BOB [78-1] terminal 3 and ground.
2. Is continuity present?
 - a. **Yes.** Repair short to ground in (BK/O) wire.
 - b. **No.** Go to Test 4.

4. Resistance Test

1. Test resistance between [138B] terminals 1 (V) wire and 2 (W) wire.
2. Is resistance between 13.5-23.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace front HO2S.

DTC P0032

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-14. DTC P0032 Diagnostic Faults

POSSIBLE CAUSES
Front HO2 circuit shorted to 12V
HO2 malfunction

1. Front HO2S Shorted to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Turn IGN ON.
5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between BOB [78-1] terminal 3 and ground.
6. Is voltage present?
 - a. **Yes.** Repair short to voltage on (BK/O) wire.
 - b. **No.** Go to Test 2.

2. Resistance Test

1. Turn IGN OFF.
2. Disconnect front HO2S [138].
3. Test resistance between [138B] terminals 1 (V) wire and 2 (W) wire.

4. Is resistance between 13.5-23.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace front HO2S.

DTC P0051

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-15. DTC P0051 Diagnostic Faults

POSSIBLE CAUSES
Open or short to ground on rear HO2 circuit
HO2 malfunction
Open in sensor power circuit

1. Rear HO2S Voltage Test

1. Turn IGN OFF.
2. Disconnect rear HO2S [137].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [137A] terminal 1 (R/GN) wire and ground.
5. Is battery voltage present?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Repair open in (R/GN) wire.

2. Open Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between BOB [78-1] terminal 15 and [137A] terminal 2 (BK/PK) wire.
5. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (BK/PK) wire.

3. Short to Ground Test

1. Test continuity between BOB [78-1] terminal 15 and ground.
2. Is continuity present?
 - a. **Yes.** Repair short to ground in (BK/PK) wire.
 - b. **No.** Go to Test 4.

4. Resistance Test

1. Test resistance between [137B] terminals 1 (V) wire and 2 (W) wire.
2. Is resistance between 13.5-23.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace rear HO2S.

DTC P0052

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-16. DTC P0052 Diagnostic Faults

POSSIBLE CAUSES
Rear HO2 circuit shorted to voltage
Rear HO2 malfunction

1. Rear HO2S Shorted to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Turn IGN ON.
5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between BOB [78-1] terminal 15 and ground.
6. Is voltage present?
 - a. **Yes.** Repair short to voltage on (BK/PK) wire.
 - b. **No.** Go to Test 2.

2. Resistance Test

1. Turn IGN OFF.
2. Disconnect rear HO2S [137].
3. Test resistance between [137B] terminals 1 (V) wire and 2 (W) wire.
4. Is resistance between 13.5-23.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace rear HO2S.

DTC P0131

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-17. DTC P0131 Diagnostic Faults

POSSIBLE CAUSES
Front HO2S malfunction
Short to ground in signal circuit
Fuel system malfunction

NOTE

Vehicle and sensor must be at ambient temperature before starting diagnostic test.

1. Front HO2S Voltage Test

1. Turn IGN OFF.
2. Disconnect front HO2S [138].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [138A] terminal 3 (GN/BN) wire, to ground.
5. Is voltage approximately 5V?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Go to Test 2.

2. HO2S Test

1. Test continuity between [138B] terminal 3 (GY) wire and ground.
2. Is continuity present?
 - a. **Yes.** Replace HO2S.
 - b. **No.** Go to Test 3.

3. Signal Wire Shorted to Sensor Ground Test

1. Turn IGN OFF.
2. Disconnect ECM [78-1] and [78-2].
3. Test continuity between [138A] terminals 3 (GN/BN) wire and 4 (BK/W) wire.
4. Is continuity present?
 - a. **Yes.** Repair short between (GN/BN) and (BK/W) wires.
 - b. **No.** Go to Test 4.

4. Signal Wire Shorted to Ground Test

1. Test continuity between [138A] terminal 3 (GN/BN) wire and ground.

2. Is continuity present?
 - a. **Yes.** Repair short between (GN/BN) wire and ground.
 - b. **No.** Replace ECM.

5. Operation Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Connect [138].
4. Start engine and allow it to reach operating temperature.
5. With engine speed at a steady rpm, test voltage between BOB [78-1] terminal 17 and [78-2] terminal 7.
6. Is voltage approximately 0.45V?
 - a. **Yes.** Replace ECM.
 - b. **No.** (0.0-0.4V). Perform fuel pressure test. Look for incorrect ECM calibration, low fuel pressure, air leaks and dirty injectors. If no issues are found, replace HO2S.

DTC P0132

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-18. DTC P0132 Diagnostic Faults

POSSIBLE CAUSES
Front HO2S malfunction
Fuel system malfunction

1. Front HO2S Operation Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Start engine and allow it to reach operating temperature.
5. With engine speed at a steady rpm, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between BOB [78-1] terminal 17 and [78-2] terminal 7.

6. Is voltage approximately 0.45V?
 - a. **Yes.** Replace ECM.
 - b. **No.** (0.6-1.0V) Perform fuel pressure test. Look for incorrect ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace the HO2S.

DTC P0134

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-19. DTC P0134 Diagnostic Faults

POSSIBLE CAUSES
Front O2 sensor malfunction
Open or short to voltage in signal circuit
Open sensor ground

1. Front HO2S Signal Wire Short Circuit Voltage Test

1. Turn IGN OFF.
2. Disconnect front HO2S [138].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [138A] terminal 3 (GN/BN) wire to ground.
5. Is voltage greater than 5V?
 - a. **Yes.** Repair short to voltage on (GN/BN) wire.
 - b. **No. Greater than 4V.** Go to Test 2.
 - c. **No. Less than 4V.** Go to Test 3.

2. Open Sensor Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between [138A] terminal 4 (BK/W) wire and BOB [78-2] terminal 7.
5. Is continuity present?
 - a. **Yes.** Replace front O2 sensor.
 - b. **No.** Repair open on (BK/W) wire.

3. Signal Wire Open Test

1. Test continuity between [138A] terminal 3 (GN/BN) wire and BOB [78-1] terminal 17.

2. Is continuity present?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (GN/BN) wire.

DTC P0151

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-20. DTC P0151 Diagnostic Faults

POSSIBLE CAUSES
Rear O2 sensor malfunction
Short to ground in signal circuit
Fuel system malfunction

NOTE

Vehicle and sensor must be at ambient temperature before starting diagnostic test.

1. Rear HO2S Test

1. Turn IGN OFF.
2. Disconnect rear HO2S [137].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [137A] terminal 3 (GY/BN) wire to ground.
5. Is voltage approximately 5V?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Go to Test 2.

2. HO2S Test

1. Test continuity between [137B] terminal 3 (GY) wire and ground.
2. Is continuity present?
 - a. **Yes.** Replace HO2S.
 - b. **No.** Go to Test 3.

3. Signal Wire Shorted to Sensor Ground Test

1. Turn IGN OFF.
2. Disconnect ECM [78-1] and [78-2].
3. Test continuity between [137A] terminals 3 (GY/BN) wire and 4 (BK/W) wire.
4. Is continuity present?
 - a. **Yes.** Repair short between (GY/BN) and (BK/W) wires.
 - b. **No.** Go to Test 4.

4. Signal Wire Shorted to Ground Test

1. Test continuity between [137A] terminal 3 (GY/BN) wire and ground.
2. Is continuity present?
 - a. **Yes.** Repair short between (GY/BN) wire and ground.
 - b. **No.** Replace ECM.

5. Operation Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Start engine and allow it to reach operating temperature.
4. With engine speed at a steady rpm, test voltage between BOB [78-2] terminal 17 and [78-2] terminal 7.
5. Is voltage approximately 0.45V?
 - a. **Yes.** Replace ECM.
 - b. **No.** (0.0-0.4V). Perform fuel pressure test. Look for incorrect ECM calibration, low fuel pressure, air leaks and dirty injectors. If no issues are found, replace HO2S.

DTC P0152

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-21. DTC P0152 Diagnostic Faults

POSSIBLE CAUSES
Rear O2 sensor malfunction
Fuel system malfunction

1. Rear HO2S Operation Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Start engine and allow it to reach operating temperature.
5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), with engine speed at a steady rpm, test voltage between BOB [78-2] terminal 17 and [78-2] terminal 7.

6. Is voltage approximately 0.45V?
 - a. **Yes.** Replace ECM.
 - b. **No.** (0.6-1.0V). Perform fuel pressure test. Look for incorrect ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace the HO2S.

DTC P0154

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-22. DTC P0154 Diagnostic Faults

POSSIBLE CAUSES
Rear O2 sensor malfunction
Open or short voltage in signal circuit
Open sensor ground

1. Rear HO2S Signal Wire Short Circuit Voltage Test

1. Turn IGN OFF.
2. Disconnect rear HO2S [137].
3. Turn IGN ON.

4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [137A] terminal 3 (GY/BN) wire to ground.
5. Is voltage greater than 5V?
 - a. **Yes.** Repair short to voltage on (GY/BN) wire.
 - b. **No. Greater than 4V.** Go to Test 2.
 - c. **No. Less than 4V.** Go to Test 3.

2. Open Sensor Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test resistance between [137A] terminal 4 (BK/W) wire and BOB [78-2] terminal 7.
5. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace rear HO2S.
 - b. **No.** Repair open on (BK/W) wire.

3. Signal Wire Open Test

1. Test resistance between [137A] terminal 3 (GY/BN) wire and BOB [78-2] terminal 17.
2. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (GY/BN) wire.

DESCRIPTION AND OPERATION

See Figure 6-10. The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the system relay. The ECM provides the path to ground to trigger the injectors.

NOTE

System power failures or wiring harness problems will cause 12V power to be lost to both injectors and the ignition coils.

Table 6-23. Code Description

DTC	DESCRIPTION
P0261	Fuel injector low/open (front)
P0262	Fuel injector shorted high (front)
P0264	Fuel injector low/open (rear)
P0265	Fuel injector shorted high (rear)

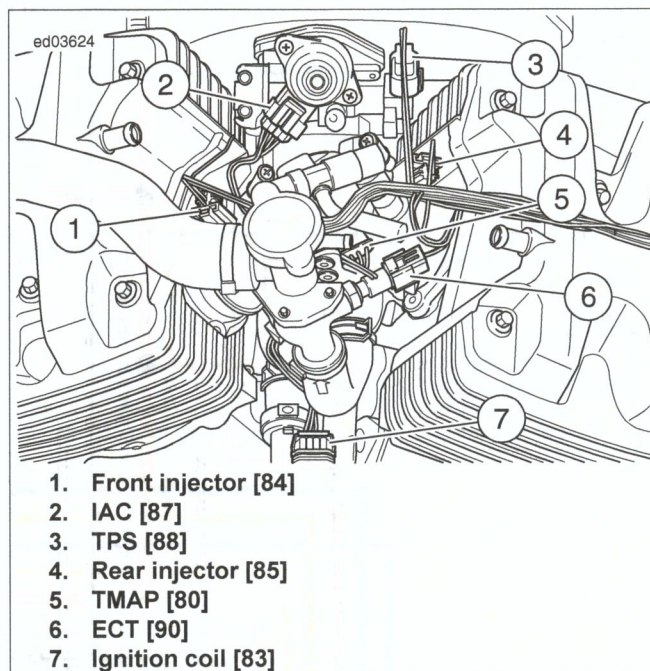


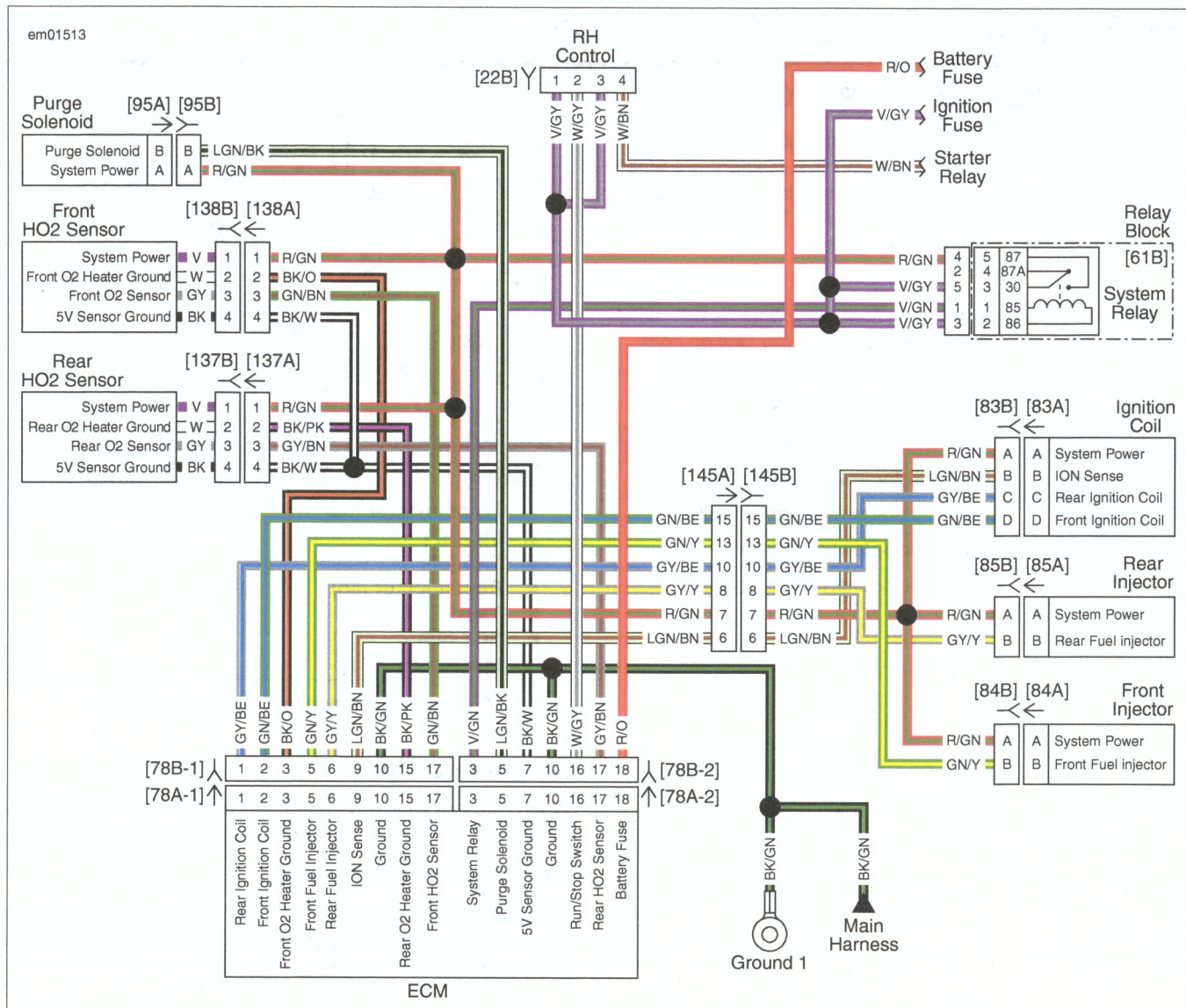
Figure 6-10. Between Cylinders Left Side

Diagnostic Tips

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.



DTC P0261

PART NUMBER	TOOL NAME
HD-34730-2E	FUEL INJECTOR TEST LIGHT
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-24. DTC P0261 Diagnostic Faults

POSSIBLE CAUSES
Front fuel injector malfunction
Open signal circuit
Open power circuit

1. Front Fuel Injector Test

1. Turn IGN OFF.

2. Disconnect front fuel injector [84].
3. Connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2E) to [84B].
4. Crank engine.
5. Does light flash when engine is cranking (or running)?
 - a. **Yes.** Go to Test 4.
 - b. **No, lamp does not illuminate.** Go to Test 2.
 - c. **No, lamp is on steady.** Go to Test 5.

2. Power Circuit Open Test

1. Turn IGN OFF.
2. Remove fuel injector test light.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between relay block [61B] socket terminal 4 and [84B] terminal A (R/GN) wire.

4. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (R/GN) wire.

3. Control Circuit Open Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-1] terminal 5 and [84B] terminal B (GN/Y) wire.
4. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (GN/Y) wire.

4. Injector Resistance Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [84A] terminals A and B.
2. Is resistance between 10-20 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace front injector.

5. Driver Short to Ground Test

1. Turn IGN OFF.
2. Remove fuel injector test light.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [84B] terminal B and ground.
4. Is continuity present?
 - a. **Yes.** Repair short to ground on (GN/Y) wire.
 - b. **No.** Replace ECM.

DTC P0262

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-25. DTC P0262 Diagnostic Faults

POSSIBLE CAUSES
Front fuel injector malfunction
Short to ground in signal circuit

1. Front Fuel Injector Control Circuit Shorted to Voltage Test

1. Turn IGN OFF.
2. Disconnect front injector [84].
3. Turn IGN ON.

4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [84B] terminal B (GN/Y) wire and ground.
5. Is voltage less than 5.0V?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Go to Test 2.

2. Control Circuit Shorted to System Test

1. Turn IGN OFF.
2. Test continuity between [84B] terminals A (R/GN) wire and B (GN/Y) wire.
3. Is continuity present?
 - a. **Yes.** Repair short between (R/GN) and (GN/Y) wires.
 - b. **No.** Repair short to voltage on (GN/Y) wire.

3. Injector Resistance Test

1. Test resistance between [84A] terminals A and B.
2. Is resistance between 10-20 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace front injector.

DTC P0264

PART NUMBER	TOOL NAME
HD-34730-2E	FUEL INJECTOR TEST LIGHT
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-26. DTC P0264 Diagnostic Faults

POSSIBLE CAUSES
Rear fuel injector malfunction
Open signal circuit
Open power circuit

1. Rear Fuel Injector Test

1. Turn IGN OFF.
2. Disconnect rear fuel injector [85].
3. Connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2E) to [85B].
4. Crank engine.
5. Does lamp flash when engine is cranking (or running)?
 - a. **Yes.** Go to Test 4.
 - b. **No, lamp does not illuminate.** Go to Test 2.
 - c. **No, lamp is on steady.** Go to Test 5.

2. Power Circuit Open Test

1. Turn IGN OFF.

2. Remove fuel injector test light.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between relay block [61B] socket terminal 4 and [85B] terminal A (R/GN) wire.
4. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (R/GN) wire.

3. Control Circuit Open Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-1] terminal 6 and [85B] terminal B (GY/Y) wire.
4. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (GY/Y) wire.

4. Injector Resistance Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [85A] terminals A and B.
2. Is resistance between 10-20 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace rear injector.

5. Driver Short to Ground Test

1. Turn IGN OFF.
2. Remove fuel injector test light.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [85B] terminal B and ground.
4. Is continuity present?
 - a. **Yes.** Repair short to ground on (GY/Y) wire.
 - b. **No.** Replace ECM.

DTC P0265

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-27. DTC P0265 Diagnostic Faults

POSSIBLE CAUSES
Rear fuel injector malfunction
Short to ground in signal circuit

1. Rear Fuel Injector Control Circuit Shorted to Voltage Test

1. Turn IGN OFF.
2. Disconnect rear injector [85].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [85B] terminal B (GY/Y) wire and ground.
5. Is voltage less than 5.0V?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Go to Test 3.

2. Injector Resistance Test

1. Test resistance between [85A] terminals A and B.
2. Is resistance between 10-20 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace rear injector.

3. Control Circuit Shorted to System Test

1. Turn IGN OFF.
2. Test continuity between [85B] terminals A (R/GN) wire and B (GY/Y) wire.
3. Is continuity present?
 - a. **Yes.** Repair short between (R/GN) and (GY/Y) wires.
 - b. **No.** Repair short to voltage on (GY/Y) wire.

DESCRIPTION AND OPERATION

See Figure 6-12. If the CKP sensor signal is weak or absent, DTCs P0371 or P0374 will be set. DTC P0371 is usually set when several attempts to crank the engine have failed.

NOTE

If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

Table 6-28. Code Description

DTC	DESCRIPTION
P0371	CKP sensor wrong number of pulses
P0374	CKP sensor no pulses

Diagnostic Tips

Engine must be cranked for more than five seconds without CKP signal to set P0374 code. Intermittent TMAP wiring or sensor issues may cause these codes to set prior to setting TMAP codes. Verify TMAP wiring and sensor prior to replacing the ECM.

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

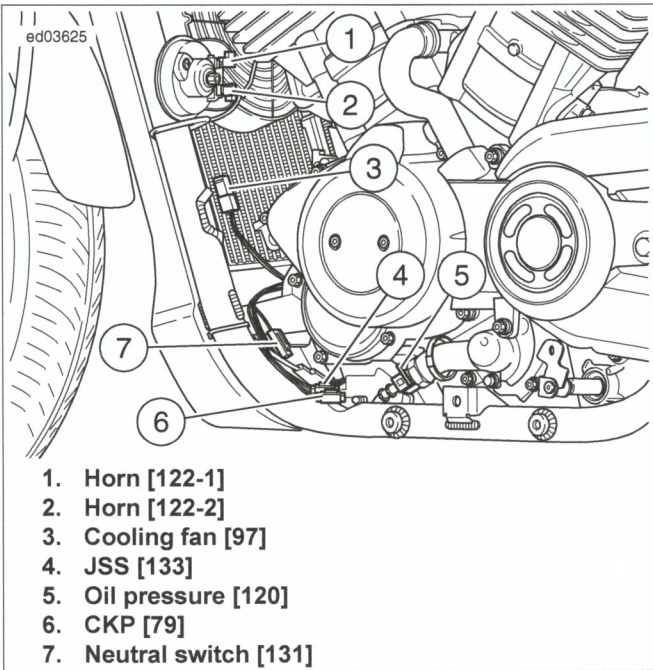


Figure 6-12. Lower Left Front of Engine

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

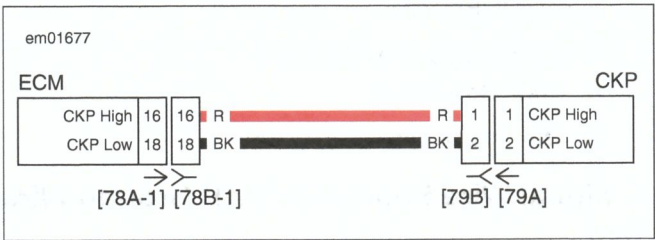


Figure 6-13. CKP Circuit

DTC P0371, P0374

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-29. DTC P0371, P0374 Diagnostic Faults

POSSIBLE CAUSES
CKP sensor malfunction
Open or short to ground in signal circuit
May be set if there are incorrect fluctuations from TMAP that does not set TMAP codes (examples - intermittent sensor or wiring issue)

1. CKP Sensor Connections Test

1. Turn IGN OFF.
2. Disconnect ECM [78-1] and [78-2].
3. Are terminal problems present?
 - a. **Yes.** Repair terminals as required.
 - b. **No.** Go to Test 2.

2. Signal Wire Continuity Test

1. Disconnect CKP sensor [79].
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between BOB [78-1] terminal 16 to [79B] terminal 1 (R) wire.
5. Is resistance less than 0.5 Ohm?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open on (R) wire.

3. Ground Wire Continuity Test

1. Test continuity between BOB [78-1] terminal 18 to [79B] terminal 2 (BK) wire.
2. Is resistance less than 0.5 Ohm?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open on (BK) wire.

4. Signal Wire Shorted to CKP Ground Wire Test

1. Test continuity between BOB [78-1] terminals 16 and 18.

2. Is continuity present?

- a. **Yes.** Repair short between [79B] terminals 1 (R) and 2 (BK).
- b. **No.** Go to Test 5.

5. Output Test

1. Connect CKP sensor [79].
2. Test AC voltage between BOB [78-1] terminals 16 and 18.
3. Crank engine for 5 seconds while observing multimeter.
4. Is AC voltage greater than 2V?
 - a. **Yes.** See diagnostic tips. If TMAP sensor is good, replace ECM.
 - b. **No.** Replace CKP sensor.

DESCRIPTION AND OPERATION

Purge Solenoid (If Equipped)

See Figure 6-14. The purge solenoid is mounted under the right side cover. The solenoid connects to a fuel tank vent line and a vent canister.

A return line from the canister reconnects to the air intake manifold allowing vented fumes to be recirculated, for emission efficiency. The purge solenoid is timed to the throttle position and is disabled during startup, low engine temperature, low engine speed or low vehicle speed.

Power for the purge solenoid is supplied by the system relay. The system relay also provides power for the HO2S, fuel injectors, ECM and the ignition coil.

The ECM provides a path to ground to trigger the purge solenoid.

NOTES

- System relay or wiring harness problems will cause 12V power to be lost to the HO2S, fuel injectors, ECM, ignition coil and purge solenoid.
- Purge solenoid is not installed on non-emission vehicles and DTCs P0444 and P0445 are not available. If these DTCs appear, the ECM should be reprogrammed.

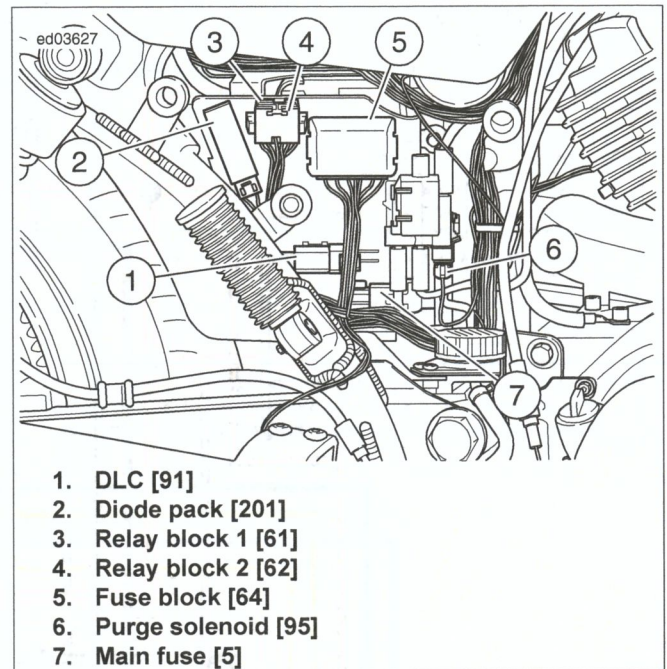


Figure 6-14. Under Right Side Cover

Table 6-30. Code Description

DTC	DESCRIPTION
P0444	Purge solenoid low/open
P0445	Purge solenoid shorted high

Diagnostic Tips

The purge solenoid is powered from the system power circuit. This circuit voltage is supplied by the system relay through the ignition fuse and ignition relay.

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

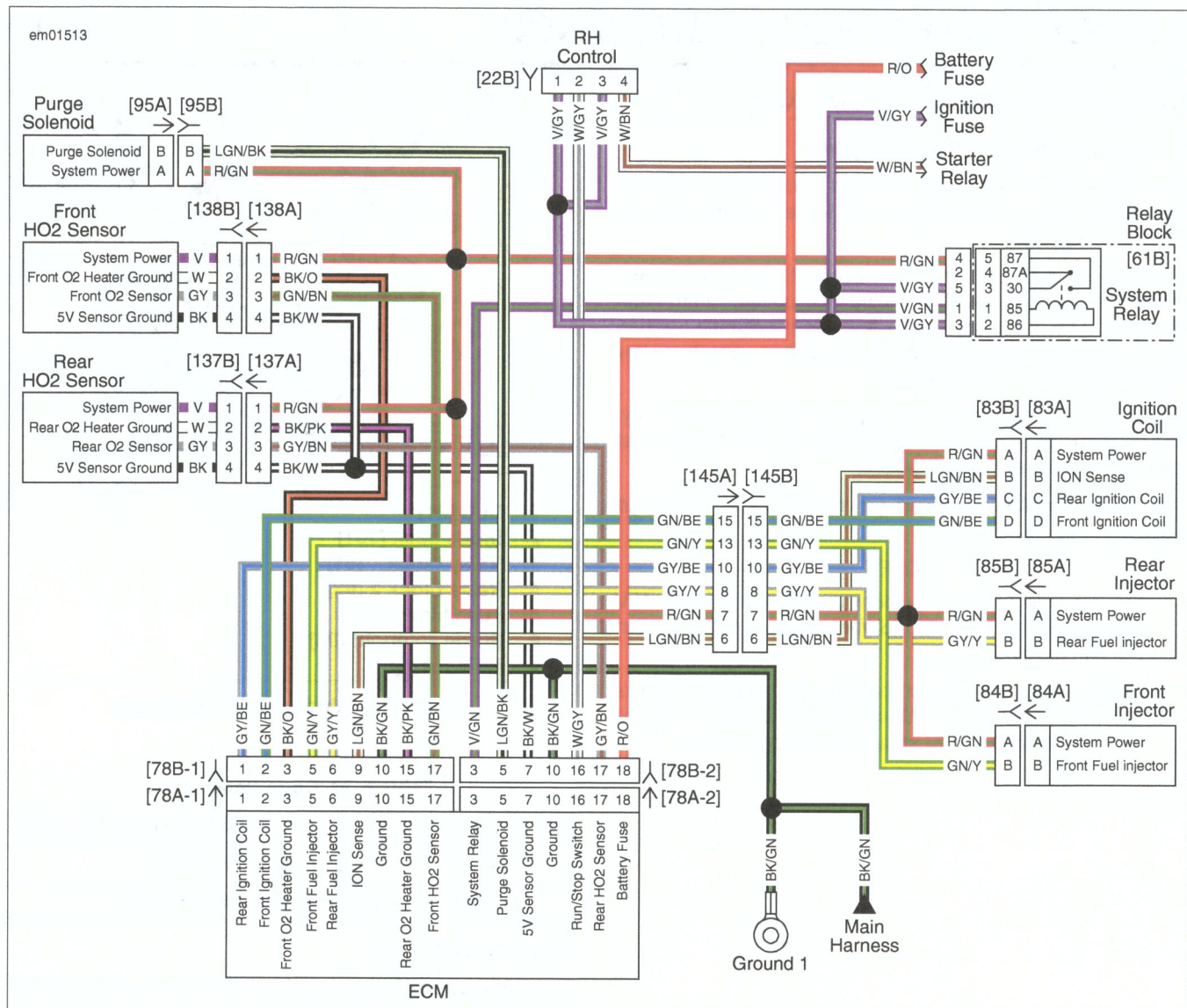


Figure 6-15. System Power Circuit

DTC P0444

PART NUMBER	TOOL NAME
HD-41404	HARNES CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-31. DTC P0444 Diagnostic Faults

POSSIBLE CAUSES
Purge solenoid malfunction
Short to ground in signal circuit
System power open

1. Purge Solenoid Test

- Turn IGN OFF.
- Disconnect purge solenoid [95].

- Using HARNES CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [95A] terminals A and B.
- Is resistance between 4-21 Ohms?
 - Yes.** Go to Test 2.
 - No.** Replace purge solenoid.

2. Purge Solenoid Voltage Test

- Test voltage between [95B] terminal A (R/GN) wire and ground.
- Turn IGN ON.
- Is battery voltage present?
 - Yes.** Go to Test 3.
 - No.** Go to Test 5.

3. Control Wire Shorted to Ground Test

- Turn IGN OFF.
- Disconnect ECM [78-1] and [78-2].

3. Test continuity between [95B] terminal B (LGN/BK) wire and ground.
4. Is continuity present?
 - a. **Yes.** Repair short to ground on (LGN/BK) wire.
 - b. **No.** Go to Test 4.

4. Control Wire Open Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test resistance between [95B] terminal B (LGN/BK) wire and BOB [78-2] terminal 5.
4. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (LGN/BK) wire.

5. Power Wire Open Test

1. Test resistance between [95B] terminal A and relay block [61B] socket terminal 4 (R/GN).
2. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (R/GN) wire.

DTC P0445

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-32. DTC P0445 Diagnostic Faults

POSSIBLE CAUSES
Purge solenoid malfunction
Short to voltage in signal circuit

1. Purge Solenoid Test

1. Turn IGN OFF.
2. Disconnect purge solenoid [95].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [95A] terminals A and B.
4. Is resistance between 4-21 Ohms?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace purge solenoid.

2. Purge Solenoid Short to Voltage Test

1. Turn IGN ON.
2. Test voltage between [95B] terminal B (LGN/BK) wire and ground.
3. Is voltage greater than 5.0V?
 - a. **Yes.** Repair short to voltage on (LGN/BK) wire.
 - b. **No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-16. The VSS is powered and monitored by the ECM. The ECM and speedometer process the vehicle speed sensor signal.

NOTES

- The ECM uses VSS input to calculate idle air control position. Therefore problems with the vehicle speed signal can lead to improper operation of the idle air control.
- The TMAP, JSS, TPS, BAS and VSS sensors are connected to the same reference line (+5V REF). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123, P0502, P0503, P1501, P1502). Start with the trouble code having the highest priority ranking. Refer to Table 1-13.
- A faulty sensor can negatively affect the signal voltage of the other sensors sharing the same 5V reference. If the wiring passes the following tests, disconnect one sensor at a time on the 5V reference and verify the DTC is still present. Additional DTCs will be set as each sensor is disconnected, clear DTCs after this test. Be sure to perform this test before replacing a component.

Table 6-33. Code Description

DTC	DESCRIPTION
P0502	VSS failed low
P0503	VSS failed high

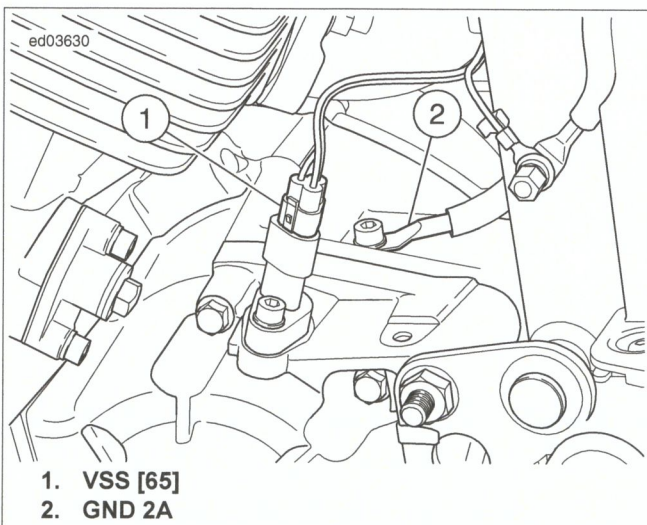


Figure 6-16. Right Side Above Transmission

Diagnostic Tips

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

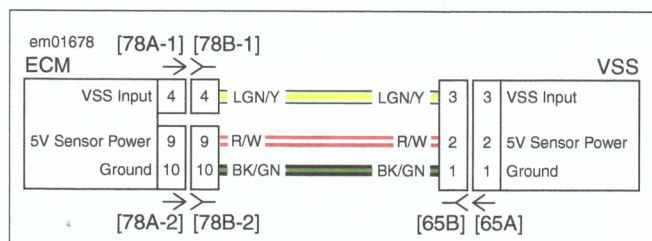


Figure 6-17. VSS Circuit

DTC P0502

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-34. DTC P0502 Diagnostic Faults

POSSIBLE CAUSES
VSS malfunction
Open or short to ground in signal circuit
Open or short to ground in 5V reference circuit

1. VSS Connections Test

- Turn IGN OFF.
- Disconnect VSS [65].
- Turn IGN ON.
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [65B] terminal 2 (R/W) wire and ground.
- Is voltage approximately 5.0V?
 - Yes.** Go to Test 2.
 - No.** Repair open on (R/W) wire.

2. Signal Wire Short to Ground Test

- Turn IGN OFF.
- Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
- Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
- Test continuity between BOB [78-1] terminals 4 and 10.
- Is continuity present?
 - Yes.** Repair short to ground on (LGN/Y) wire.
 - No.** Go to Test 3.

3. Signal Wire Open Test

1. Test continuity between BOB [78-1] terminal 4 and [65B] terminal 3 (LGN/Y) wire.
2. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open on (LGN/Y) wire.

4. Dirty or Damaged Test

1. Remove VSS.
2. Check for debris on sensor tip.
3. Is debris present?
 - a. **Yes.** Clean debris from VSS and install.
 - b. **No.** Replace VSS.

DTC P0503

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-35. DTC P0503 Diagnostic Faults

POSSIBLE CAUSES
VSS malfunction
Short to voltage in signal circuit
Open ground
5V reference shorted to battery voltage

1. VSS Power Shorted to Voltage Test

1. Turn IGN OFF.
2. Disconnect VSS [65].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [65B] terminals 2 (R/W) wire and 1 (BK/GN) wire.

5. Is voltage greater than 6.0V?
 - a. **Yes.** Repair short to voltage on (R/W) wire.
 - b. **No.** Go to Test 2.

2. Signal Wire Short to Voltage Test

1. Test voltage between [65B] terminal 3 (LGN/Y) wire and ground.
2. Is voltage above 6.0V?
 - a. **Yes.** Repair short to voltage on (LGN/Y) wire.
 - b. **No.** Go to Test 3.

3. Ground Wire Open Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-1] terminal 10 and [65B] terminal 1 (BK/GN) wire.
4. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open on (BK/GN) wire.

4. Signal Wire Shorted to Sensor Power Test

1. Test continuity between BOB [78-1] terminal 4 and [78-2] terminal 9.
2. Is continuity present?
 - a. **Yes.** Repair short between (LGN/Y) and (R/W) wires.
 - b. **No.** Go to Test 5.

5. VSS Test

1. Connect [78A-1] and [78A-2].
2. Clear DTC.
3. Did DTC reset?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace VSS.

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

See Figure 6-18. The ECM controls engine idle speed by moving the IAC to open or close a passage around the throttle plates. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

- To increase idle speed, the ECM retracts the pintle, allowing more air to flow through the throttle body.
- To decrease idle speed, the ECM extends the pintle, allowing less air to flow through the throttle body. The IAC position can be measured in steps. This can only be done with DIGITAL TECHNICIAN II (Part No. HD-48650).
- A high number of steps represents a fully retracted pintle and open passage around throttle plate. This correlates with an increase in the amount of air flowing through the throttle body.
- Zero steps represents a fully extended pintle. A zero reading indicates an abnormal condition in which the pintle has been fully extended and has consequently closed the passage around throttle plate. Each time the ignition is turned OFF, the ECM resets the IAC by sending enough pulses to extend the pintle and effectively close the throttle body. The fully extended value is the ECM reference point. A given number of steps are then calculated by the ECM for use in setting the proper idle speed and IAC position for the next start event.

NOTE

Idle speed is controlled by the ECM and cannot be adjusted.

Loss of idle speed control will result if the idle rpm is ± 200 from preset idle speed and IAC motor is at zero or maximum for greater than 5 seconds. These DTCs may occur with others for a multiple code situation. Resolve the other codes first to correct. A misfire condition or similar symptom affecting idle can cause P0506 to set. Inspect for these conditions before diagnosing DTCs.

Table 6-36. Code Description

DTC	DESCRIPTION
P0506	Idle speed control - rpm too low
P0507	Idle speed control - rpm too high

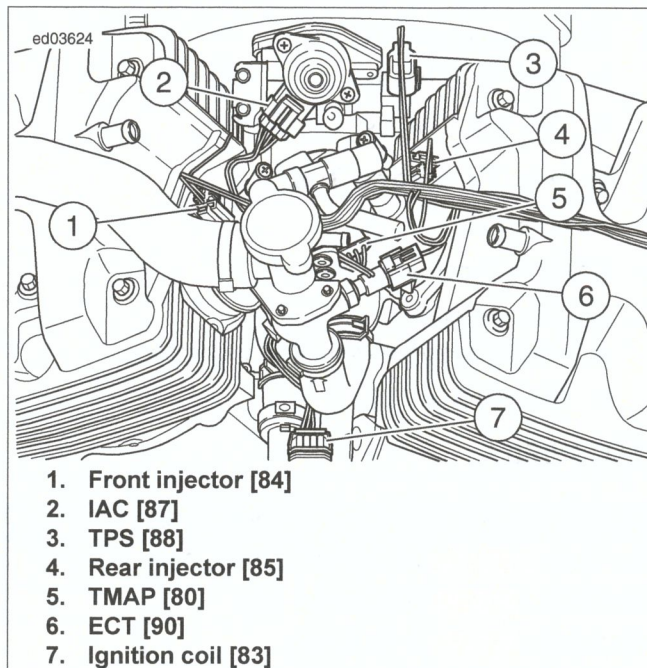


Figure 6-18. Between Cylinders Left Side

Diagnostic Tips

The following items may impact engine idle speed:

- A loss of idle speed control does not necessarily imply the IAC actuator or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle stop or a misfiring cylinder.
- A non-OE engine configuration can lead to idle instability and could generate a DTC.
- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air box and air filter. Then, with the throttle wide open, turn IGN ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores.
- Intake leaks.
- Contaminated fuel.
- TPS reading of greater than 1% (possible throttle cable misadjustment) or battery voltage reading of less than 9V or a VSS greater than 0 will disable idle speed control.

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

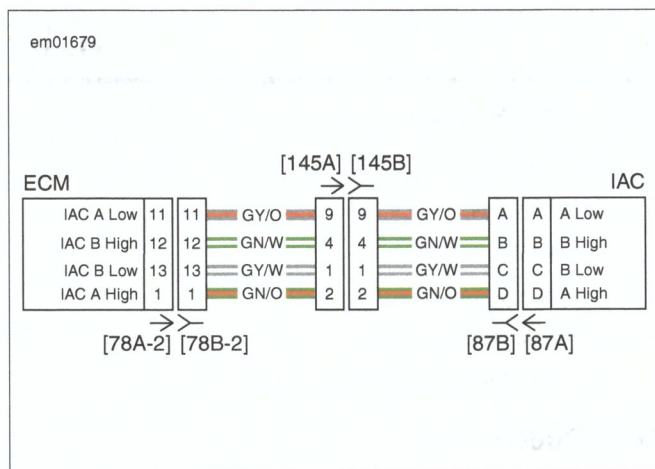


Figure 6-19. IAC Circuit

DTC P0506, P0507

PART NUMBER	TOOL NAME
HD-41199-3	IAC TEST LIGHT
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-37. DTC P0506, P0507 Diagnostic Faults

POSSIBLE CAUSES
IAC malfunction
Short to voltage in circuits
Short to ground in circuits
Open in system power circuit
Short between IAC circuits
Open circuits
Vacuum/air leaks
Fuel system problems

1. IAC Operational Test

- While watching the IAC pintle for movement turn IGN OFF, ON, then OFF.
- Did pintle move?
 - Yes.** IAC system operating properly. Check for improperly adjusted throttle stop, vacuum leaks, cylinder misfire, contaminated fuel, leaking injectors and engine mechanical failure.
 - No.** Go to Test 2.

2. Connector Test

- Disconnect IAC [87].
- Connect IAC TEST LIGHT (Part No. HD-41199-3) to [87B].
- Turn IGN ON.
- While observing test light, turn IGN OFF.

- Did both IAC test lights flash alternately?
 - Yes.** Replace IAC.
 - No.** Go to Test 3.

Table 6-38. IAC, Wire Color, ECM

IAC [87B]	WIRE COLOR	ECM [78-2]
A	GY/O	11
B	GN/W	12
C	GY/W	13
D	GN/O	1

3. Circuits Open Test

- Turn IGN OFF.
- Remove test light.
- Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
- Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity on each IAC wire between BOB and [87B]. Refer to Table 6-38.
- Is continuity present on all circuits?
 - Yes.** Go to Test 4.
 - No.** Repair open in appropriate circuit.

4. Circuits Shorted to Ground Test

- Test continuity on each IAC wire between BOB and ground. Refer to Table 6-38.
- Is continuity present on any circuits?
 - Yes.** Repair short to ground on appropriate circuit.
 - No.** Go to Test 5.

5. Circuits Short to Voltage Test

- Turn IGN ON.
- Test voltage between BOB and ground on each IAC wire. Refer to Table 6-38.
- Is voltage present on any circuit?
 - Yes.** Repair short to voltage in appropriate circuit.
 - No.** Go to Test 6.

6. Short Between Circuits Test

- Turn IGN OFF.
- Test continuity between each IAC circuit and the other IAC circuits. Refer to Table 6-38.
- Is continuity present between any two IAC circuits?
 - Yes.** Repair short between IAC circuits.
 - No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-20. The DTCs listed indicate a failure which requires replacement of the ECM. Refer to Table 6-39.

Table 6-39. Code Description

DTC	DESCRIPTION
P0603	ECM EEPROM memory error
P0605	ECM flash memory error

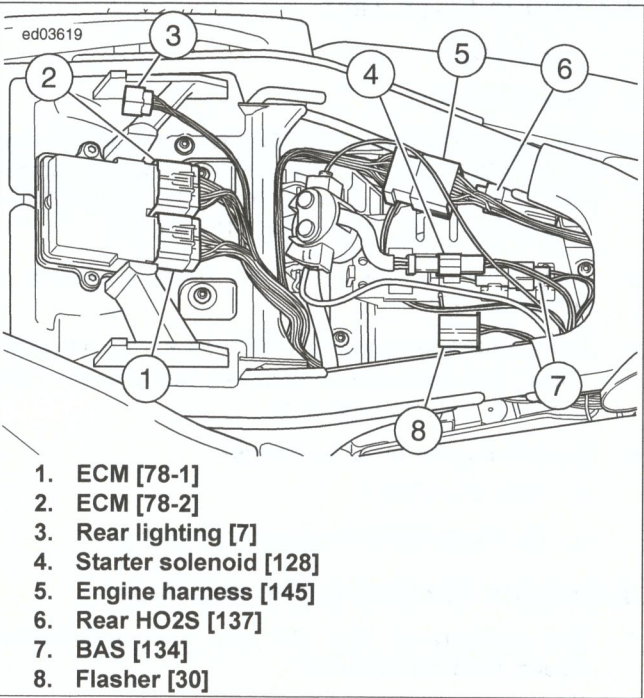


Figure 6-20. Under Seat: Front

DTC P0603 Test

1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
 - a. **Yes.** Replace ECM.
 - b. **No.** System operating properly.

DTC P0605 Test

1. Clear DTCs.
2. Attempt to program ECM using correct calibration.
3. Start engine.
4. Check DTCs.
5. Did DTC reset?
 - a. **Yes.** Replace ECM.
 - b. **No.** System operating properly.

DESCRIPTION AND OPERATION

See Figure 6-21 and Figure 6-22. The ECM supplies 5V to the VSS, TMAP, TPS, BAS and JSS from [78-2] terminal 9. These sensors may have individual codes along with this code since they all share the 5V ref circuit. If the ECM sees a voltage of less than 4V or greater than 6V on the 5V ref circuit, P0641 will be set.

Table 6-40. Code Description

DTC	DESCRIPTION
P0641	5V Vref out of range

Any of these conditions will set a DTC P0641:

- Short to ground on the 5V sensor power circuit.
- Short to voltage on the 5V sensor power circuit.
- VSS fault or malfunction.
- TMAP sensor fault or malfunction.
- TPS fault or malfunction.
- JSS (HDI) fault or malfunction.
- ECM fault or malfunction.
- BAS fault or malfunction.

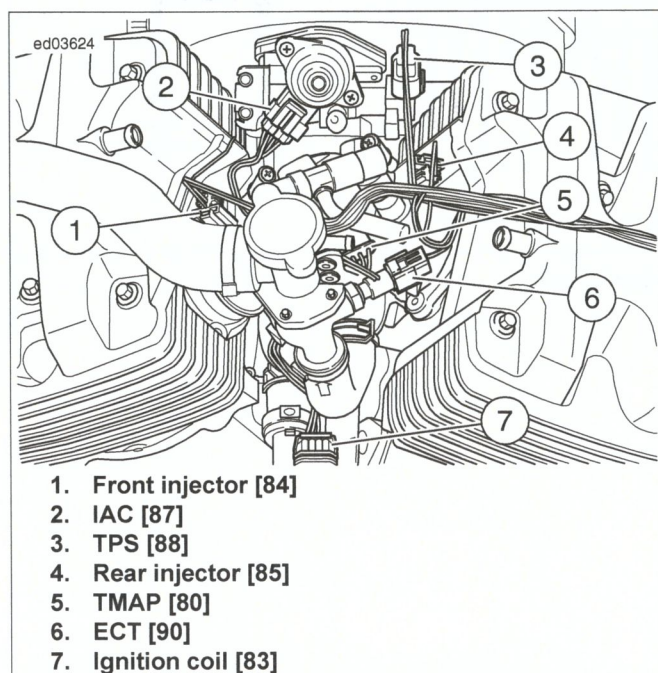


Figure 6-21. Between Cylinders Left Side

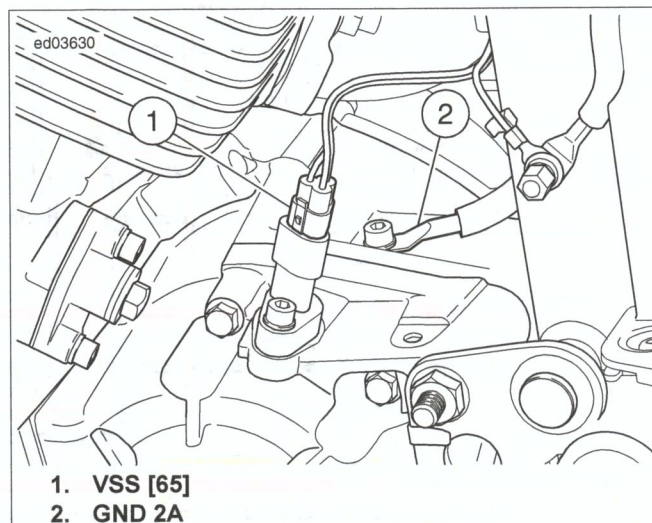


Figure 6-22. Right Side Above Transmission

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

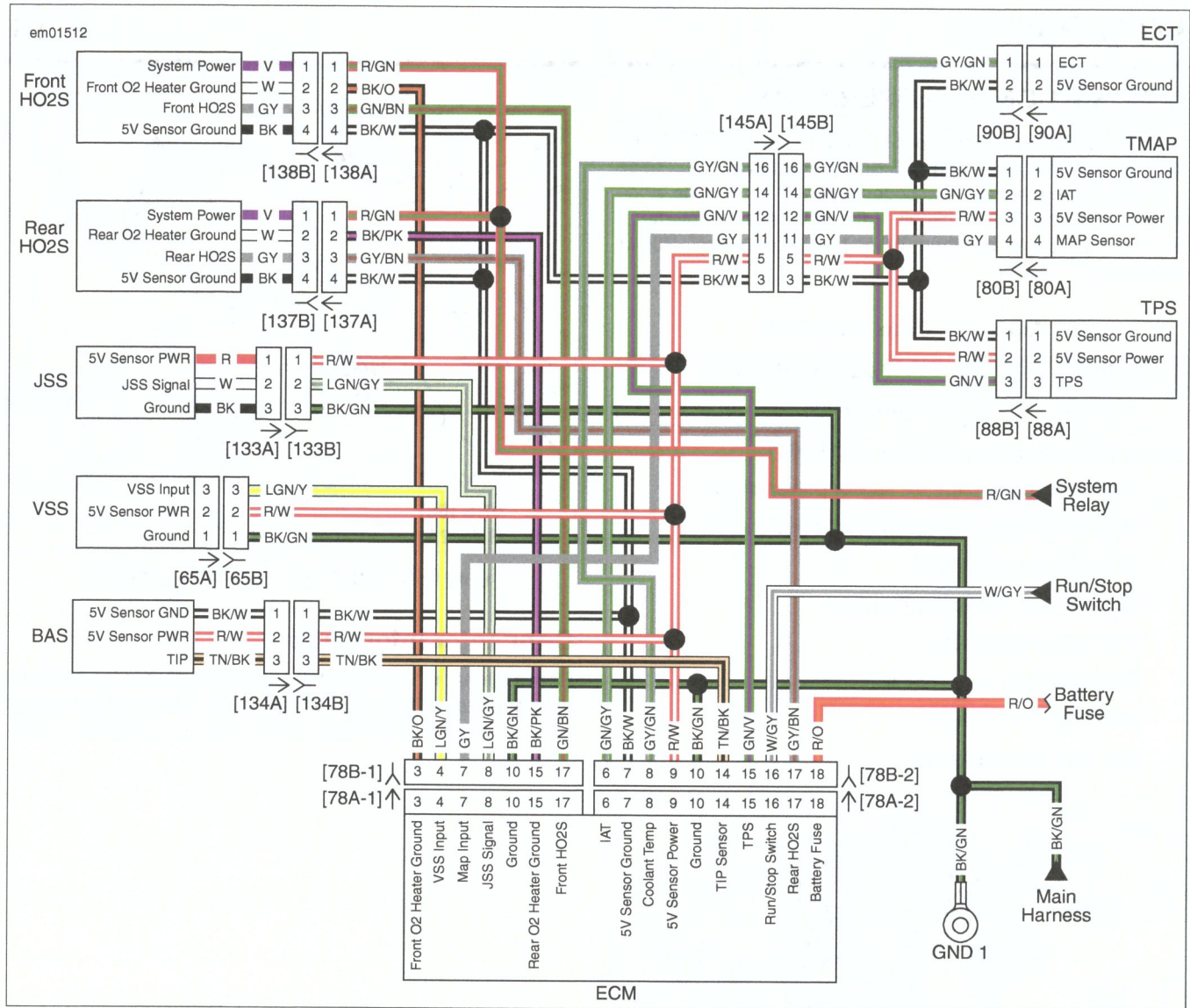


Figure 6-23. Sensor Circuit

DTC P0641

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-41. DTC P0641 Diagnostic Faults

POSSIBLE CAUSES
Short to ground on the 5V sensor power circuit
Short to voltage on the 5V sensor power circuit
VSS fault or malfunction
TMAP sensor fault or malfunction
TPS fault or malfunction
JSS (HDI) fault or malfunction
BAS fault or malfunction

1. 5V Sensor Short to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Turn IGN ON.
5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between BOB [78-2] terminal 9 and ground.
6. Is voltage between 4-6V?
 - a. **Yes.** Concern is intermittent. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
 - b. **No. Greater than 6V.** Repair short to voltage on (R/W) wire.
 - c. **No. Less than 4V.** Go to Test 2.

2. TPS Circuit Below Range Test

1. Turn IGN OFF.
2. Disconnect TPS [88].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Replace TPS.

3. TMAP Power Circuit Below Range Test

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].

3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Replace TMAP sensor.

4. VSS Circuit Below Range Test

1. Turn IGN OFF.
2. Disconnect VSS [65].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
 - a. **Yes, with JSS.** Go to Test 5.
 - b. **Yes, without JSS.** Go to Test 6.
 - c. **No.** Replace VSS.

5. JSS Circuit Below Range Test

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Replace JSS.

6. BAS Circuit Below Range Test

1. Turn IGN OFF.
2. Disconnect BAS [134].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
 - a. **Yes.** Go to Test 7.
 - b. **No.** Replace BAS.

7. Circuit Short to Ground Test

1. Disconnect [78A-1] and [78A-2].
2. Test continuity between BOB [78-2] terminal 9 and ground.
3. Is continuity present?
 - a. **Yes.** Repair short to ground in (R/W) wire.
 - b. **No.** Go to Test 8.

8. Circuit Shorted to Sensor Ground Circuit Test

1. Test continuity between BOB [78-2] terminals 9 and 7.
2. Is continuity present?
 - a. **Yes.** Repair short between (R/W) and (BK/W) wires.
 - b. **No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-24 and Figure 6-25. The ECM will energize the fan relay when coolant temperature rises to 103 °C (217 °F) and shut off when coolant temperature falls to 98 °C (208 °F). The ECM may continue this function for up to one minute when engine is off if engine temperature is above 98 °C (208 °F).

Table 6-42. Code Description

DTC	DESCRIPTION
P0691	Fan relay coil open/low
P0692	Fan relay coil high

The fan relay is located in the relay block under the right side cover. Power is supplied from the battery to the coil and switch sides of the fan relay. The ECM controls the ground for the coil side of the relay. When the fan relay energizes battery power is supplied to the cooling fan.

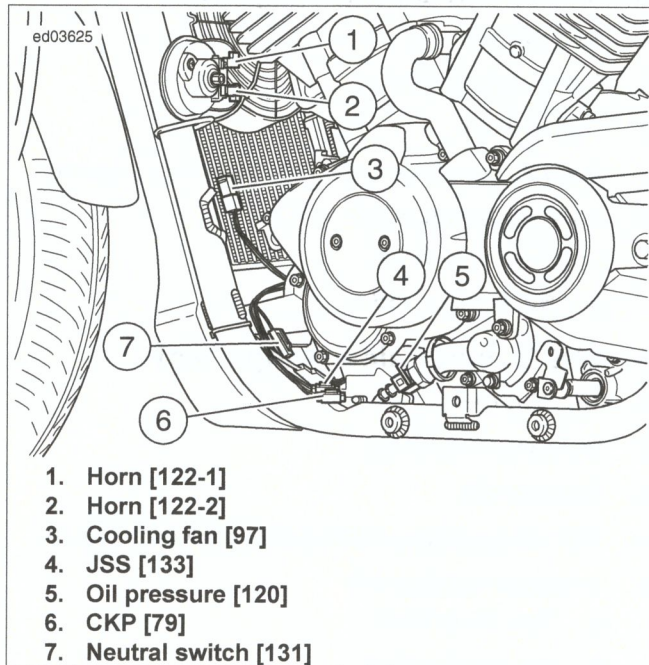


Figure 6-24. Lower Left Front of Engine

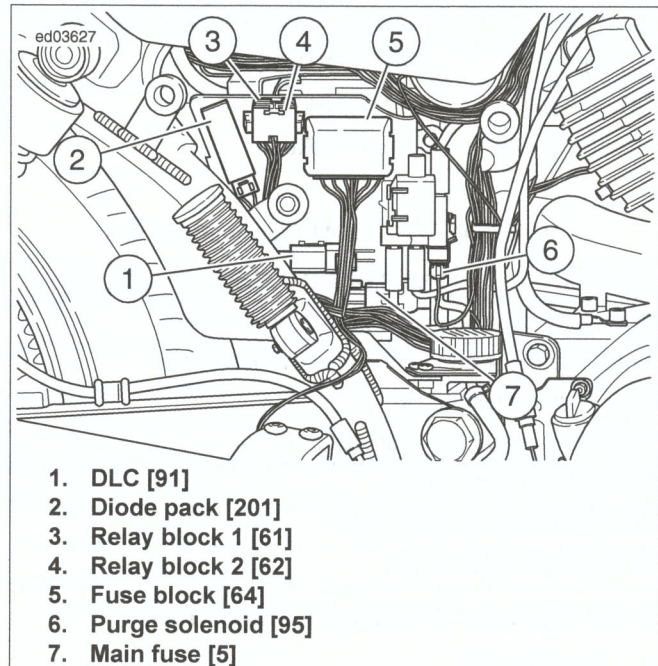


Figure 6-25. Under Right Side Cover

Diagnostic Tips

DTCs P0691 and P0692 can only set when engine is at normal operating temperature.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

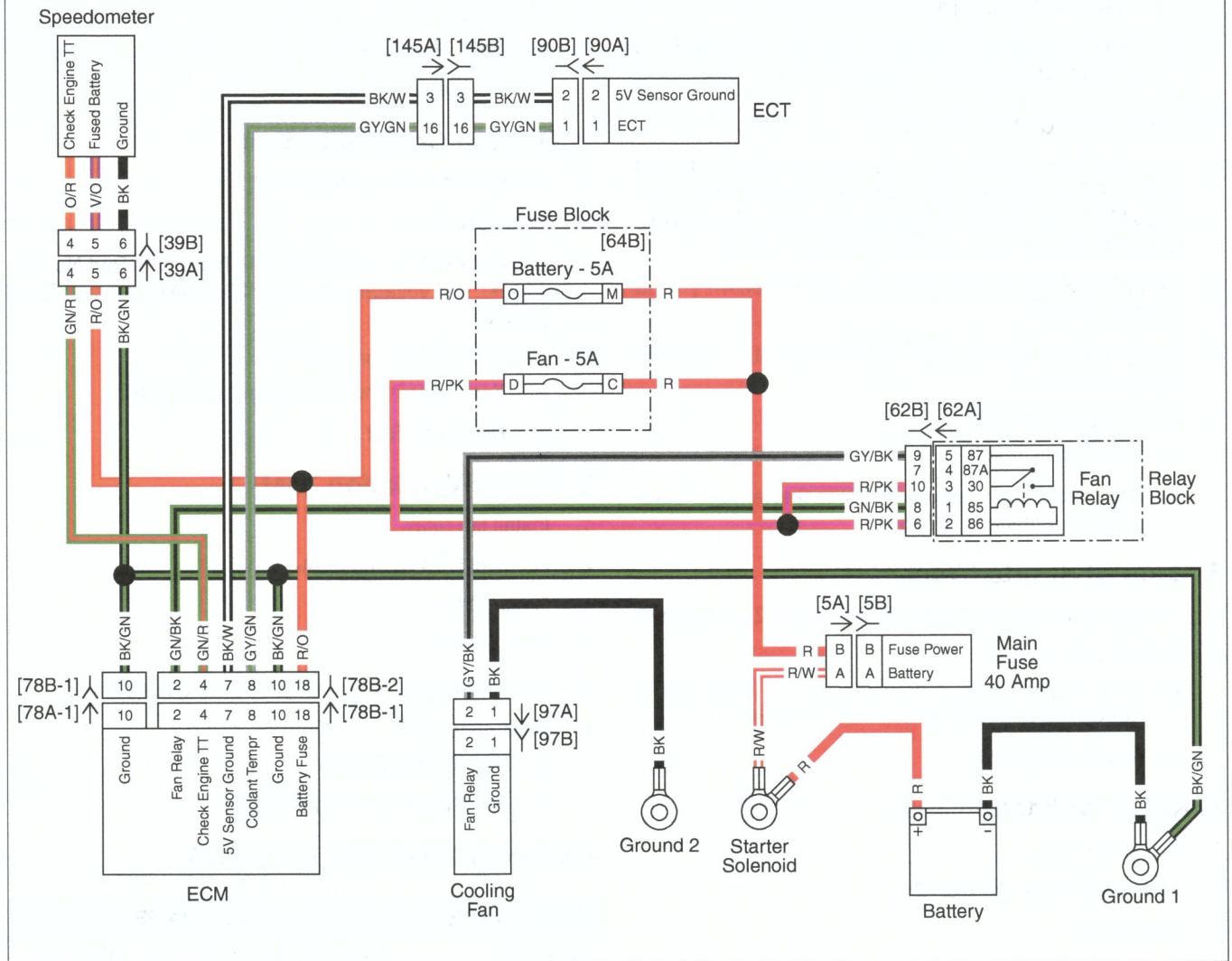


Figure 6-26. Fan Relay Circuit

DTC P0691

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-43. DTC P0691 Diagnostic Faults

POSSIBLE CAUSES
Fan relay malfunction
Short to ground in fan relay control circuit
Open in fan relay supply circuit

1. Relay Test

1. Turn IGN OFF.
2. Remove fan relay [62].

3. Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.

4. Is relay good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace relay.

2. Relay Coil Power Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between relay block [62B] socket terminal 6 and ground.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Go to Test 3.

3. Power Continuity Test

1. Remove fan fuse [64B].
2. Test continuity between [62B] socket terminal 6 and fuse block [64B] socket terminal D.

3. Is continuity present?
 - a. **Yes.** Repair open between [64B] socket terminal C and main fuse [5A] socket terminal B (R).
 - b. **No.** Repair open between [62B] socket terminal 6 and [64B] socket terminal D (R/PK).

4. Ground Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-2] terminal 2 and [62B] socket terminal 8.
4. Is continuity present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open between [62B] socket terminal 6 and [78B-2] terminal 2 (GN/BK).

5. Ground Shorted Test

1. Test continuity between BOB [78-2] terminal 2 and ground.
2. Is continuity present?
 - a. **Yes.** Repair short to ground between [62B] socket terminal 6 and [78B-2] terminal 2 (GN/BK).
 - b. **No.** Go to Test 6.

6. Repair Validation Test

1. Install fan relay.
2. Connect [78A-1] and [78A-2].
3. Clear DTCs.
4. Start vehicle.
5. Run until engine is at normal operating temperature.
6. Does DTC set?
 - a. **Yes.** Replace ECM.
 - b. **No.** System working properly.

DTC P0692

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-44. DTC P0692 Diagnostic Faults

POSSIBLE CAUSES
Fan relay malfunction
Short to voltage in fan relay control circuit

1. Relay Test

1. Turn IGN OFF.
2. Remove fan relay [62].

3. Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace relay.

2. Ground Continuity Test

1. Disconnect [78A-1] and [78A-2].
2. Turn IGN ON.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [62B] socket terminal 8 and ground.
4. Is battery voltage present?
 - a. **Yes.** Repair short to voltage on (GN/BK).
 - b. **No.** Go to Test 3.

3. Repair Validation Test

1. Install fan relay.
2. Connect [78A-1] and [78A-2].
3. Clear DTCs.
4. Start vehicle.
5. Run until engine is at normal operating temperature.
6. Does code set?
 - a. **Yes.** Replace ECM.
 - b. **No.** System working properly.

FAN INOPERATIVE, NO DTCS

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-45. Fan Inoperative, No DTCs Diagnostic Faults

POSSIBLE CAUSES
Open power circuit
Shorted power circuit
Open ground circuit
Relay malfunction
Fan malfunction

1. Fan Relay Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.

4. Turn IGN ON.
5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper between BOB [78-2] terminals 2 and 10.
6. Is fan running?
 - a. **Yes.** Replace ECM.
 - b. **No.** Go to Test 2.

2. Relay Test

1. Turn IGN OFF.
2. Remove fan relay [62B].
3. Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Replace relay.

3. Relay Switched Power Test

1. Test voltage between relay block [62B] socket terminal 10 and ground.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open between [62B] socket terminal 10 and fuse block [64B] socket terminal D.

4. Cooling Fan Power Continuity Test

1. Disconnect cooling fan [97].
2. Test resistance between [97A] terminal 2 (GY/BK) and [62B] socket terminal 9.
3. Is resistance greater than 0.5 Ohm?
 - a. **Yes.** Repair open or high resistance in (GY/BK).
 - b. **No.** Go to Test 5.

5. Cooling Fan Short to Ground Test

1. Test continuity between [97A] terminal 2 (GY/BK) and ground.

2. Is continuity present?
 - a. **Yes.** Repair short to ground in (GY/BK).
 - b. **No.** Go to Test 6.

6. Ground Test

1. Test continuity between [97A] terminal 1 (BK) and ground.
2. Is continuity present?
 - a. **Yes.** Replace cooling fan.
 - b. **No.** Repair open in (BK).

FAN RUNS CONTINUALLY, NO DTCS

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-46. Fan Runs Continually, No DTCs Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Shorted fan power circuit

1. Relay Test

1. Turn IGN OFF.
2. Remove fan relay [62].
3. Perform relay test. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace relay.

2. Power Test

1. Turn IGN ON.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [62B] terminal 9 and ground.
3. Is continuity present?
 - a. **Yes.** Repair short to voltage on (GY/BK).
 - b. **No.** Repair short to ground on (GN/BK).

DESCRIPTION AND OPERATION

See Figure 6-27. With IGN ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump, ignition coils and fuel injectors. They will remain powered as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP sensor. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

Table 6-47. Code Description

DTC	DESCRIPTION
P1001	System relay coil open/low
P1002	System relay coil high

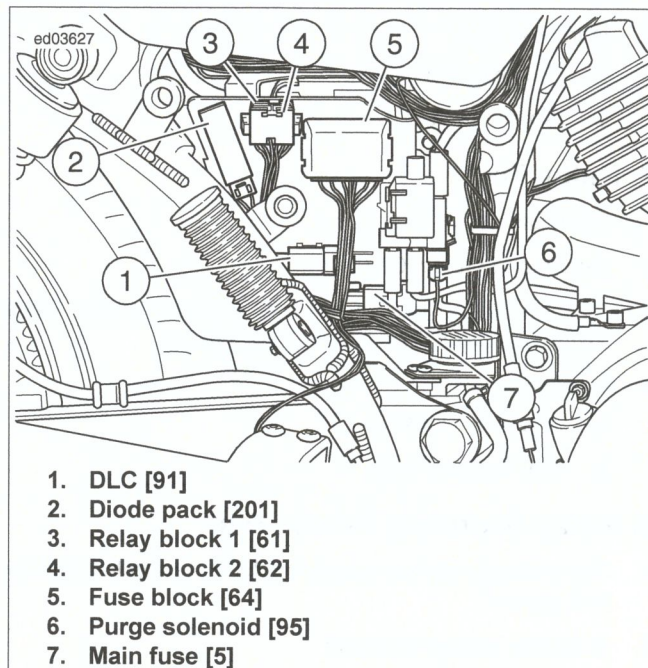


Figure 6-27. Under Right Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

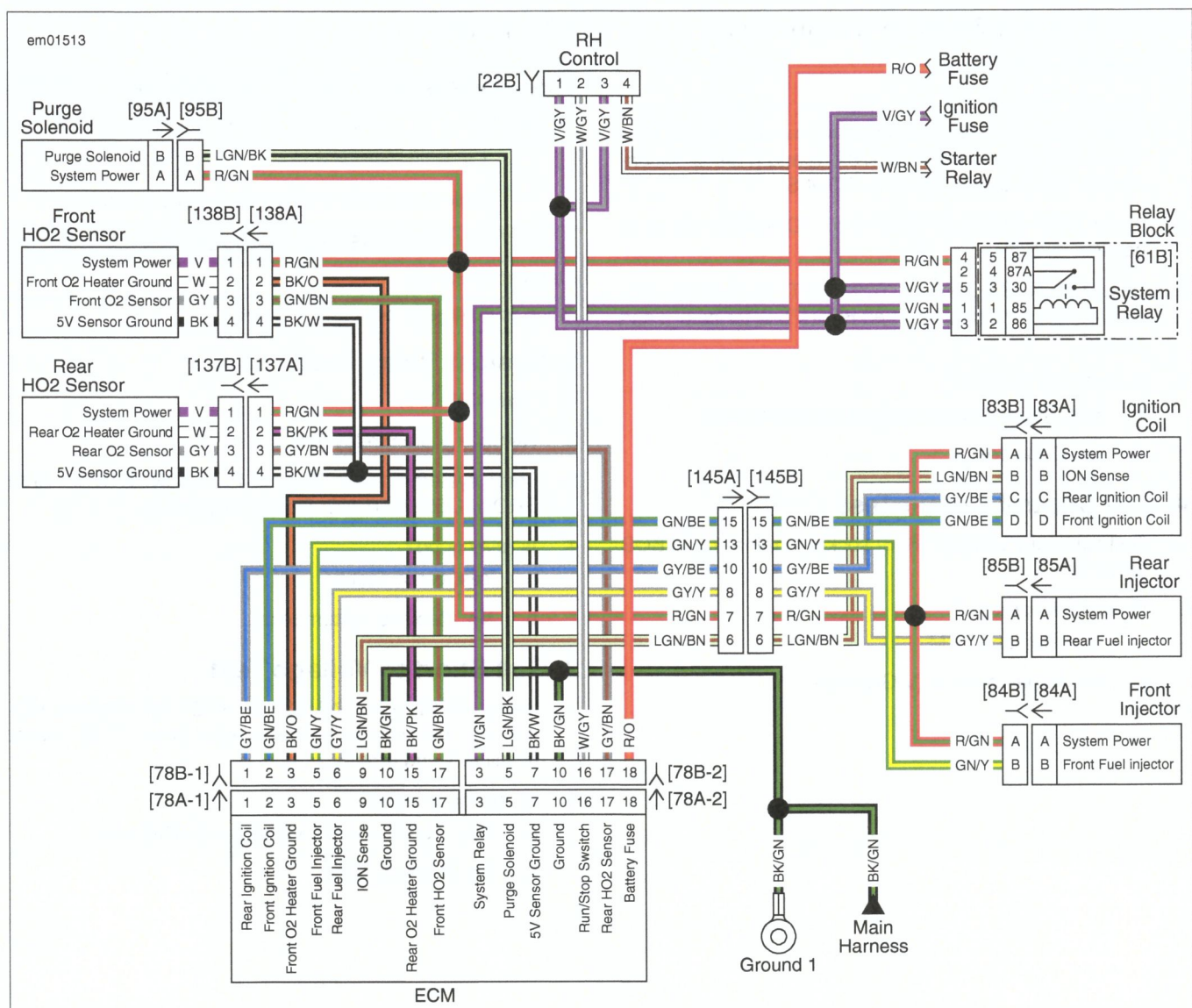


Figure 6-28. System Power Circuit

DTC P1001

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-48. DTC P1001 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Open in coil supply circuit
Short to ground in coil control circuit
Open in coil control circuit

1. System Relay Test

1. Turn IGN OFF.

2. Remove system relay [61].
3. Test system relay. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace system relay.

2. Coil Power Circuit Test

1. Turn IGN ON.
2. Verify run/stop switch is in RUN.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between relay block [61B] socket terminal 3 and ground.
4. Is battery voltage present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (V/GY) wire.

3. Coil Control Short to Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wire harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [78-2] terminal 3 and ground.
5. Is continuity present?
 - a. **Yes.** Repair short to ground on (V/GN) wire.
 - b. **No.** Go to Test 4.

4. Coil Control Circuit Test

1. Test continuity between [61B] socket terminal 1 and BOB terminal 3.
2. Is continuity present?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (V/GN) wire.

DTC P1002

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-49. DTC P1002 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Short to voltage in coil control circuit

1. System Relay Test

1. Turn IGN OFF.
2. Remove system relay [61].
3. Test system relay. See 1.4 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
4. Is relay good?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Replace system relay.

2. Coil Short to Voltage Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between relay block [61B] socket terminal 1 and ground.
2. Is voltage present?
 - a. **Yes.** Repair short to voltage in (V/GN) wire.
 - b. **No.** Replace ECM.

DESCRIPTION AND OPERATION

See Figure 6-29. The Bank Angle Sensor (BAS) is located under seat. The BAS operates from a 5V sensor reference voltage and sensor ground provided by the ECM.

The BAS sends a signal to the ECM ranging from 3.5-4.79V under normal operating conditions. A BAS signal between 0.24-3.4V indicates to the ECM that the vehicle has tipped over and will turn off the engine. When the vehicle is righted, turn the ignition OFF and then ON again to restart the engine.

If the signal from the BAS is below 0.24V or above 4.79V, the ECM sets a code. Refer to Table 6-50. A BAS code will not disable the vehicle and the engine will continue to run. A tipped vehicle will not set a DTC.

Table 6-50. Code Description

DTC	DESCRIPTION
P1151	Bank angle sensor low
P1152	Bank angle sensor high

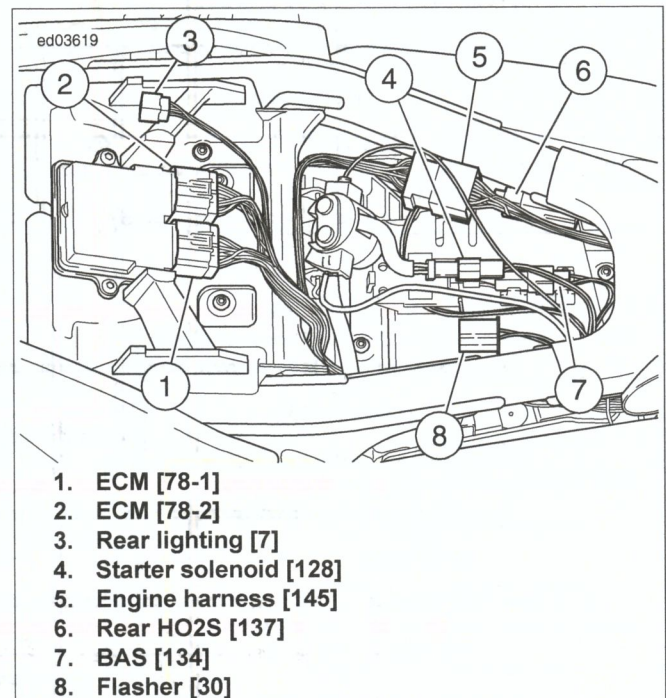


Figure 6-29. Under Seat: Front

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

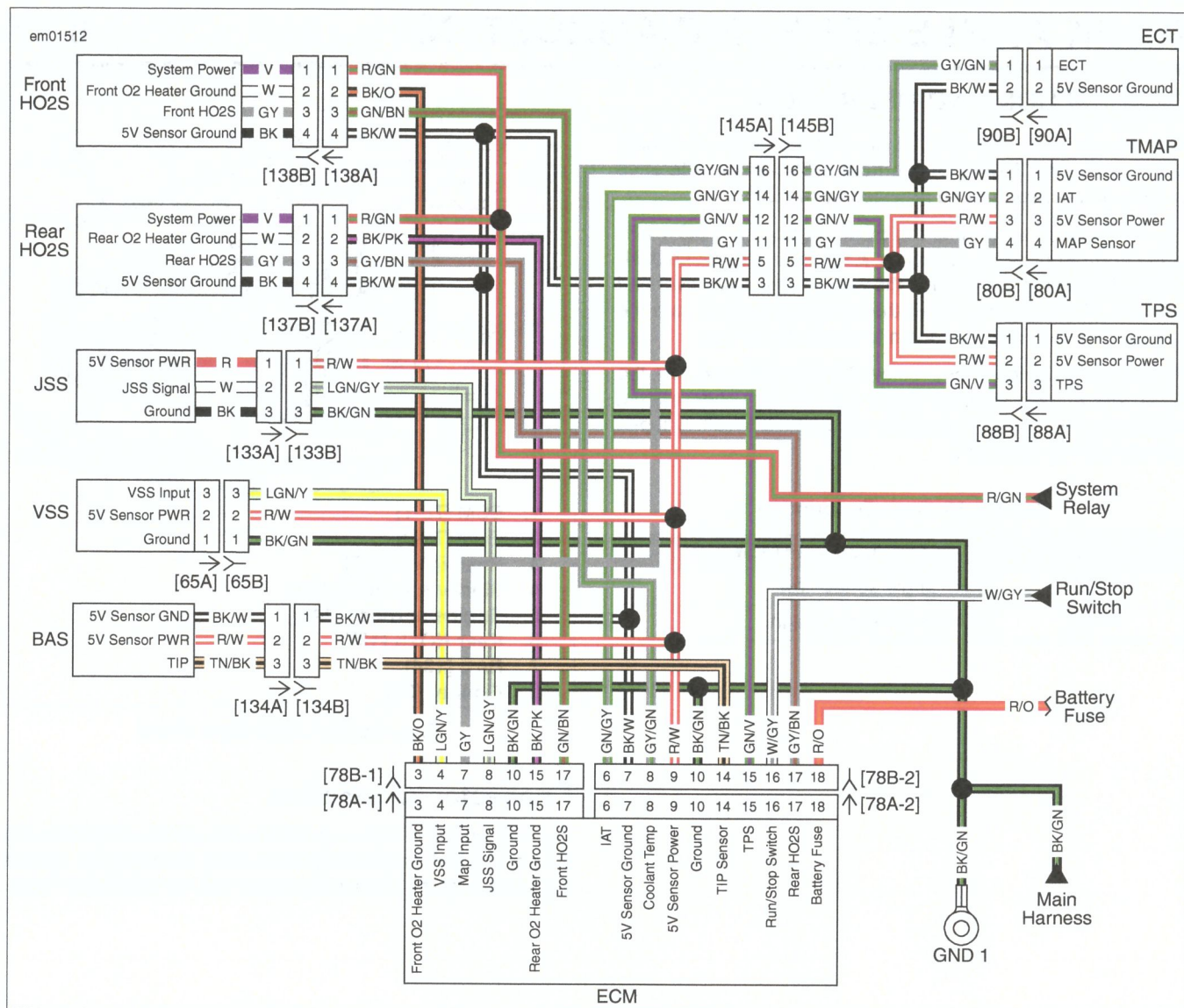


Figure 6-30. Sensor Circuit

DTC P1151

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-51. DTC P1151 Diagnostic Faults

POSSIBLE CAUSES
Sensor signal short to ground
Sensor stuck in tip mode

1. BAS Circuit Short to Ground Test

- Turn IGN OFF.
- Disconnect BAS [134].

- Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
- Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [134B] terminal 3 and ground.
- Is continuity present?
 - Yes.** Repair short to ground in (TN/BK) wire.
 - No.** Go to Test 2.

2. Short to Sensor Ground Test

- Test continuity between [134] terminals 1 and 3.
- Is continuity present?
 - Yes.** Repair short between (TN/BK) and (BK/W) wires.
 - No.** Go to Test 3.

3. BAS Test

1. Connect [78A-1] and [78A-2].
2. Turn IGN ON.
3. Test voltage between BOB [78-2] terminals 7 and 14.
4. Is voltage between 3.5-4.79V?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace BAS.

DTC P1152

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-52. DTC P1152 Diagnostic Faults

POSSIBLE CAUSES
Short to voltage in signal circuit
Open in ground circuit
Open in signal circuit
BAS malfunction

1. BAS Circuit Short to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404)
5. Turn IGN ON.
6. Test voltage between BOB [78-2] terminals 7 and 14.
7. Is voltage greater than 5.25V?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Go to Test 3.

2. BAS Test

1. Turn IGN OFF.
2. Disconnect BAS [134].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 7 and 14.
5. Is voltage greater than 5.25V?
 - a. **Yes.** Repair short to voltage in (TN/BK) wire.
 - b. **No.** Replace BAS.

3. Sensor Ground Continuity Test

1. Turn IGN OFF.
2. Disconnect BAS [134].
3. Test continuity between BOB [78-2] terminal 7 and [134B] terminal 1.
4. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (BK/W) wire.

4. Circuit Continuity Test

1. Test continuity between BOB [78-2] terminal 14 and [134B] terminal 3.
2. Is continuity present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open in (TN/BK) wire.

5. Short to 5V Circuit Test

1. Test continuity between BOB [78-2] terminals 14 and 9.
2. Is continuity present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Repair short between (TN/BK) and (R/W) wires.

6. BAS Circuit Test

1. Connect [78A-1] and [78A-2].
2. Turn IGN ON.
3. Test voltage between BOB [78-2] terminals 7 and 14.
4. Is voltage between 3.5-4.79V?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace BAS.

DESCRIPTION AND OPERATION

See Figure 6-31. A feedback voltage signal in the secondary ignition circuit (terminal B) detects the presence of combustion each time a cylinder fires on ECM [78-1] terminal 9. For diagnostic purposes, this signal is only analyzed at high speed and load conditions where it may be easily measured. Failure to detect combustion at high speed and load means one of following conditions is true:

- Cylinder is truly misfiring.
- There is a lack of continuity in the ignition coil secondary circuit.

NOTES

- Check for non-OE spark plugs and cables before testing. The incorrect resistance values of non-original equipment components will set these DTCs.
- Make sure vehicle is running properly before performing the tests in this section. Perform fuel pressure tests if required.

Table 6-53. Code Description

DTC	DESCRIPTION
P1353	No combustion detected (front)
P1356	No combustion detected (rear)

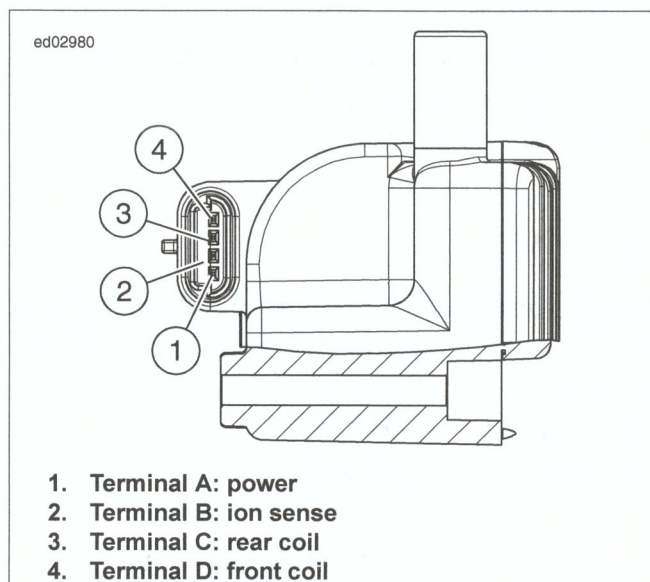


Figure 6-31. Ignition Coil: Typical

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

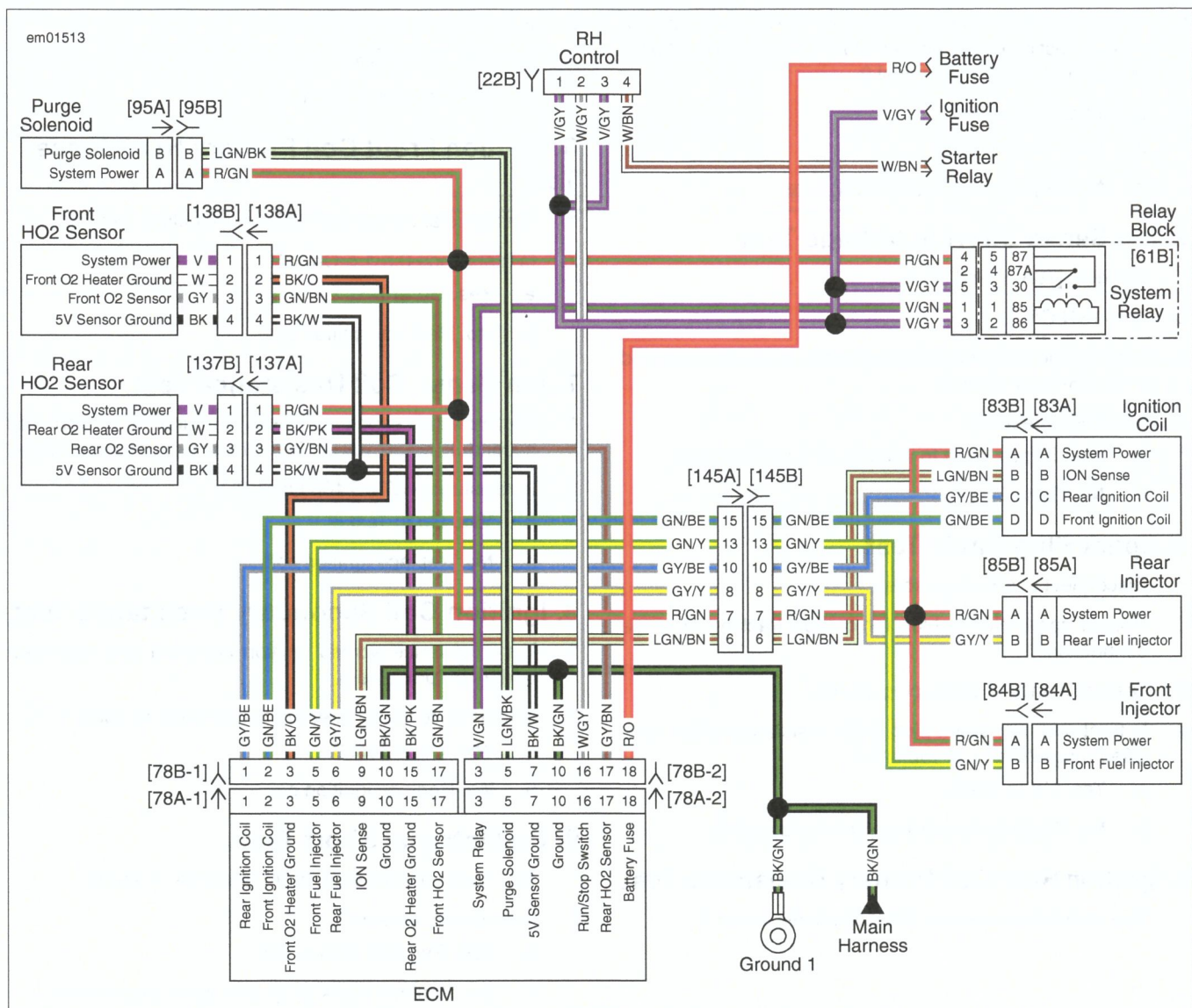


Figure 6-32. System Power Circuit

DTC P1353, P1356

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-54. DTC P1353, P1356 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
Fuel system problems
Open or short to voltage in signal circuit
Spark plug wire connections faulty
Spark plug cables
Spark plug

1. Absence of Fuel Test

1. Verify vehicle has fuel.
2. Has vehicle run out of fuel recently?
 - a. **Yes.** Clear DTCs. Fill with fresh fuel and restart. If code returns, then continue with tests. Go to Test 2.
 - b. **No.** Go to Test 2.

2. Ion Sense Continuity Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Disconnect ignition coil [83].

5. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [83B] terminal B (LGN/BN) wire and BOB [78-1] terminal 9.
6. Is continuity present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (LGN/BN) wire.

3. Ion Sense Short to Voltage Test

1. Connect [78A-1] and [78A-2].
2. Turn IGN ON.
3. Test voltage between [83B] terminal B (LGN/BN) wire and BOB [78-1] terminal 10.
4. Is voltage present?
 - a. **Yes.** Repair short to voltage on (LGN/BN) wire.
 - b. **No.** Go to Test 4.

4. Spark Plug Cable Test

1. Disconnect spark plug cables.
2. Inspect spark plug cables for carbon tracking or loose connections.
3. Test resistance of spark plug cables.
4. Is front and rear spark plug cable resistance within specified range? Refer to Table 1-4.
 - a. **Yes.** Go to Test 5.
 - b. **No.** Replace out of range spark plug cable.

5. Ignition Rear Coil Primary Resistance Test

1. Test resistance between [83A] terminals A and C.

2. Is resistance 0.3-1.5 Ohms?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Replace ignition coil.

6. Ignition Front Coil Primary Resistance Test

1. Test resistance between [83A] terminals A and D.
2. Is resistance 0.3-1.5 Ohms?
 - a. **Yes.** Go to Test 7.
 - b. **No.** Replace ignition coil.

7. Ion Sense Coil Resistance Test

1. Test resistance between [83A] terminal B to front coil secondary output tower. Repeat test for rear output tower.
2. Is resistance 1500-2400 Ohms?
 - a. **Yes.** Go to Test 8.
 - b. **No.** Replace ignition coil.

8. Ignition Coil Secondary Resistance Test

1. Test resistance across ignition coil front and rear secondary output towers.
2. Is resistance within specifications? Refer to Table 1-11.
 - a. **Yes.** Go to Test 9.
 - b. **No.** Replace ignition coil.

9. Coil Internal Short Test

1. Test continuity between [83A] terminals A and B.
2. Is continuity present?
 - a. **Yes.** Replace ignition coil.
 - b. **No.** Replace spark plugs and spark plug cables.

DESCRIPTION AND OPERATION

See Figure 6-33. The Jiffy Stand Sensor (JSS) uses a Hall-effect sensor to monitor jiffy stand position.

- When the jiffy stand is fully retracted the sensor picks up the presence of the metal tab mounted to the jiffy stand. The metal tab is moved away from the sensor as the jiffy stand is extended.
- When the jiffy stand is extended the engine will only start and run if the ECM determines the transmission is in neutral. This is done by monitoring the neutral switch input to the ECM.

The JSS is powered and monitored by the ECM. The ECM supplies the 5V reference to the JSS. The JSS sends a signal back to the ECM. This signal is used by the ECM to determine when the jiffy stand is retracted or extended. The JSS is grounded through the ECM.

The JSS also has a Fail Enable Mode. This mode allows the engine to start and run if the system recognizes a problem with the JSS circuit. DTC P1501 or P1502 will set if the JSS circuits are out of range.

NOTE

The ECM supplies 5V reference voltage to the VSS, TPS, BAS and TMAP sensors in addition to the JSS. Problems on the 5V reference will cause other DTCs.

Table 6-55. Code Description

DTC	DESCRIPTION
P1501	JSS low
P1502	JSS high/open

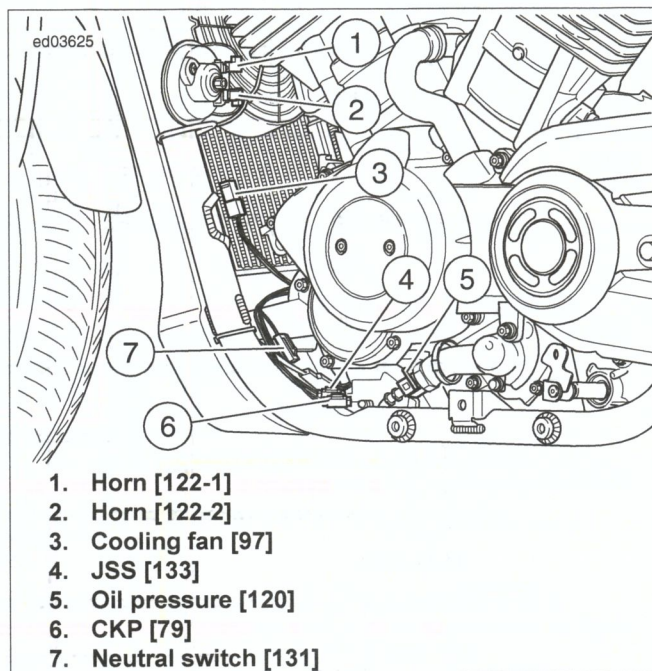


Figure 6-33. Lower Left Front of Engine

Diagnostic Tips

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

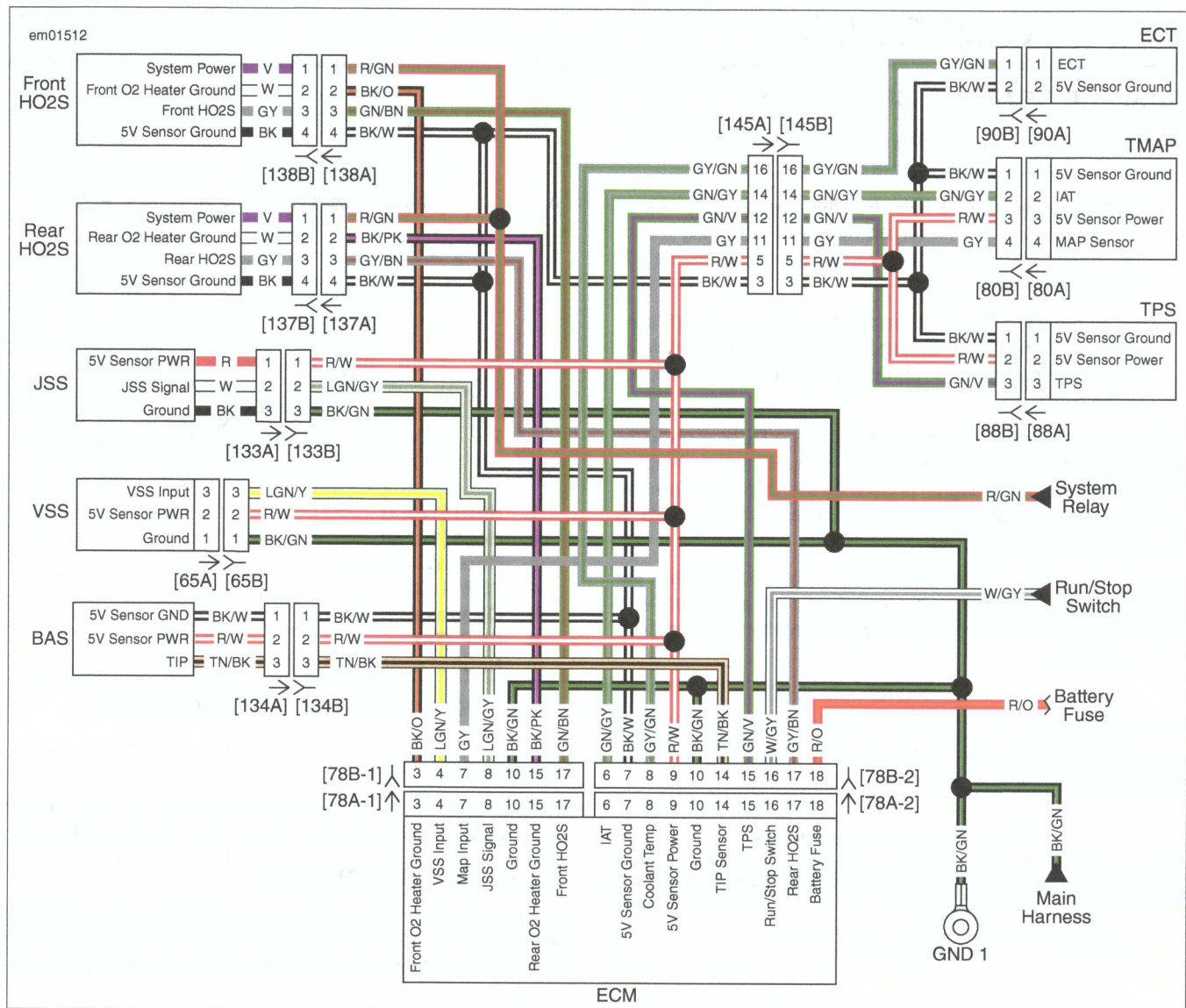


Figure 6-34. Sensor Circuit

DTC P1501

Table 6-56. DTC P1501 Diagnostic Faults

POSSIBLE CAUSES
JSS malfunction
Short to ground in signal circuit

1. Signal Wire Shorted to Ground Test

- Turn IGN OFF.
- Disconnect JSS [133].
- Test continuity between [133B] terminal 2 (LGN/GY) wire and ground.
- Is continuity present?
 - Yes.** Repair short to ground on (LGN/GY) wire.
 - No.** Replace JSS.

DTC P1502

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-57. DTC P1502 Diagnostic Faults

POSSIBLE CAUSES
JSS malfunction
Short to voltage in signal circuit
Open ground
Short between 5V reference circuit and signal circuit
Open in signal circuit

1. JSS Ground Wire Test

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [133B] terminal 3 and ground.
4. Is continuity present?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Repair open in (BK/GN) wire.

2. Signal Wire Short to Voltage Test

1. Turn IGN ON.
2. Test voltage between [133B] terminal 2 (LGN/GY) wire and ground.
3. Is voltage greater than 5V?
 - a. **Yes.** Repair short to voltage in (LGN/GY) wire.
 - b. **No.** Go to Test 3.

3. 5V Reference and Signal Shorted Together Test

1. Turn IGN OFF.

2. Disconnect ECM [78-1] and [78-2].
3. Test continuity between [133B] terminals 1 (R/W) wire and 2 (LGN/GY) wire.
4. Is continuity present?
 - a. **Yes.** Repair short between (R/W) and (LGN/GY) wires.
 - b. **No.** Go to Test 4.

4. Signal Wire Open Circuit Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Test continuity between BOB [78-1] terminal 8 and [133B] terminal 2 (LGN/GY) wire.
4. Is continuity present?
 - a. **Yes.** Replace JSS.
 - b. **No.** Repair open on (LGN/GY) wire.

DESCRIPTION AND OPERATION

See Figure 6-35. If the engine stop switch is set to RUN with the engine off, and the ignition switch is turned ON, the check engine lamp should illuminate for four seconds.

Following the initial period of illumination, the lamp should turn off for four seconds. If the lamp illuminates again and remains illuminated, a current DTC exists.

If the engine stop switch is set to RUN with the engine off, and the ignition switch is turned ON, the check engine lamp should illuminate for four seconds.

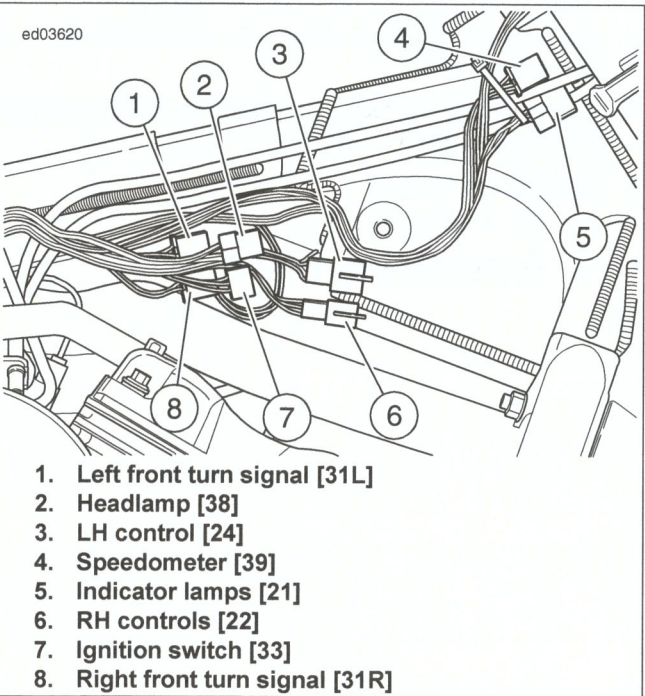


Figure 6-35. Under Fuel Tank Right Side

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

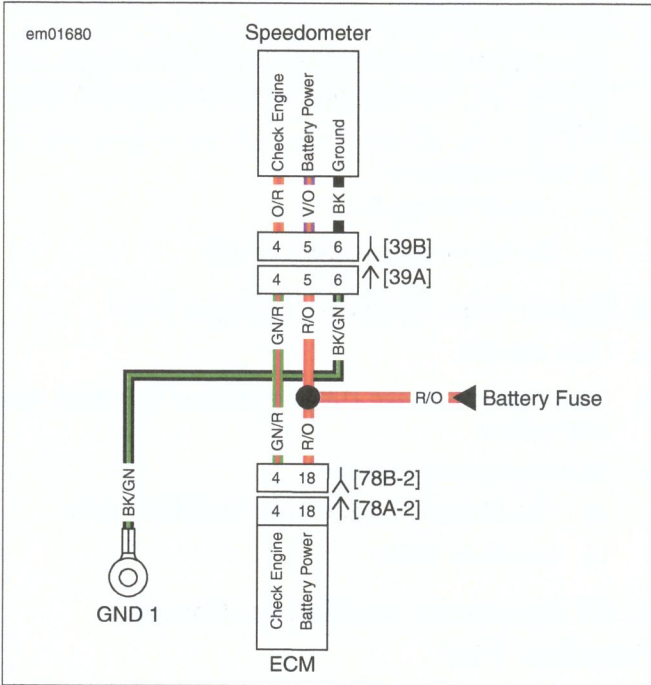


Figure 6-36. Check Engine Lamp Circuit

DTC P1652, CHECK ENGINE LAMP ALWAYS ON

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-58. Check Engine Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Check engine circuit shorted to ground
Check engine circuit open

1. Test Lamp Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [78-2] terminals 4 and 10.

5. Is continuity present?
 - a. **Yes.** Repair short to ground in (GN/R).
 - b. **No.** Go to Test 2.

2. Test Lamp Voltage Test

1. Connect [78A-1] and [78A-2] to BOB.
2. Turn IGN ON.
3. Test voltage between BOB [78-2] terminals 4 and 10.
4. Is voltage between 4-5V?
 - a. **Yes.** Replace ECM.
 - b. **No.** Go to Test 3.

3. Test Lamp Resistance Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Test resistance between BOB [78-2] terminal 4 and [39A] terminal 4 (GN/R).
4. Is resistance greater than 0.5 Ohm?
 - a. **Yes.** Repair open in (GN/R).
 - b. **No.** Replace speedometer.

CHECK ENGINE LAMP INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-59. Check Engine Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Battery circuit open
Ground circuit open

1. Test Lamp Voltage Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [39A] terminal 5 (R/O) and ground.
4. Is battery voltage present?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Repair open in (R/O).

2. Test Lamp Ground Test

1. Test resistance between [39A] terminal 6 (BK/GN) and ground.
2. Is resistance greater than 0.5 Ohms?
 - a. **Yes.** Repair open in (BK/GN).
 - b. **No.** Replace speedometer.

DESCRIPTION AND OPERATION

See Figure 6-37 and Figure 6-38. Ignition coil DTCs will set if the ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to the coil. If front and rear DTCs are set simultaneously, it is likely a coil power failure or a coil failure. The coil receives power from the system relay at the same time the HO2S, purge solenoid and injectors are activated.

Table 6-60. Code Description

DTC	DESCRIPTION
P2300	Ignition coil driver low/open (front)
P2301	Ignition coil driver shorted high (front)
P2303	Ignition coil driver low/open (rear)
P2304	Ignition coil driver shorted high (rear)

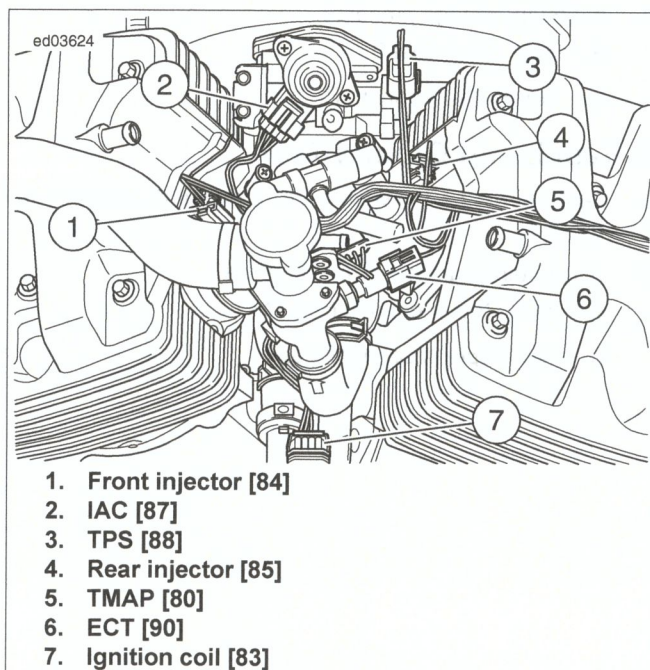


Figure 6-37. Between Cylinders Left Side

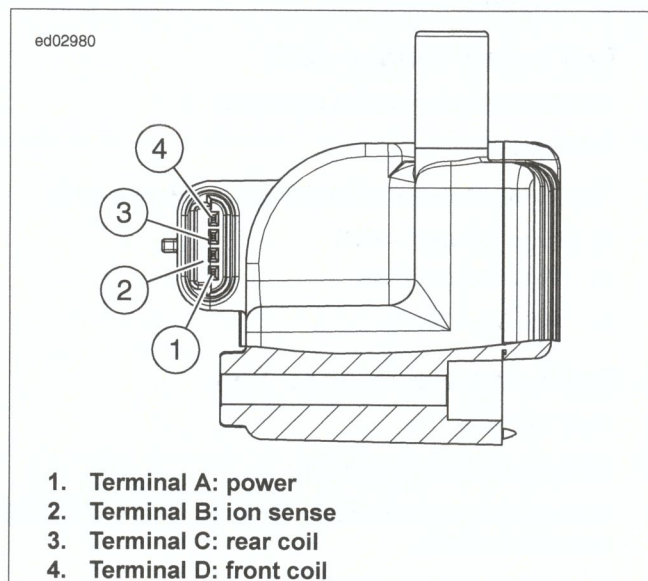


Figure 6-38. Ignition Coil: Typical

Diagnostic Tips

When disconnecting any connectors always inspect connector for corrosion or backed out terminals and repair as required.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

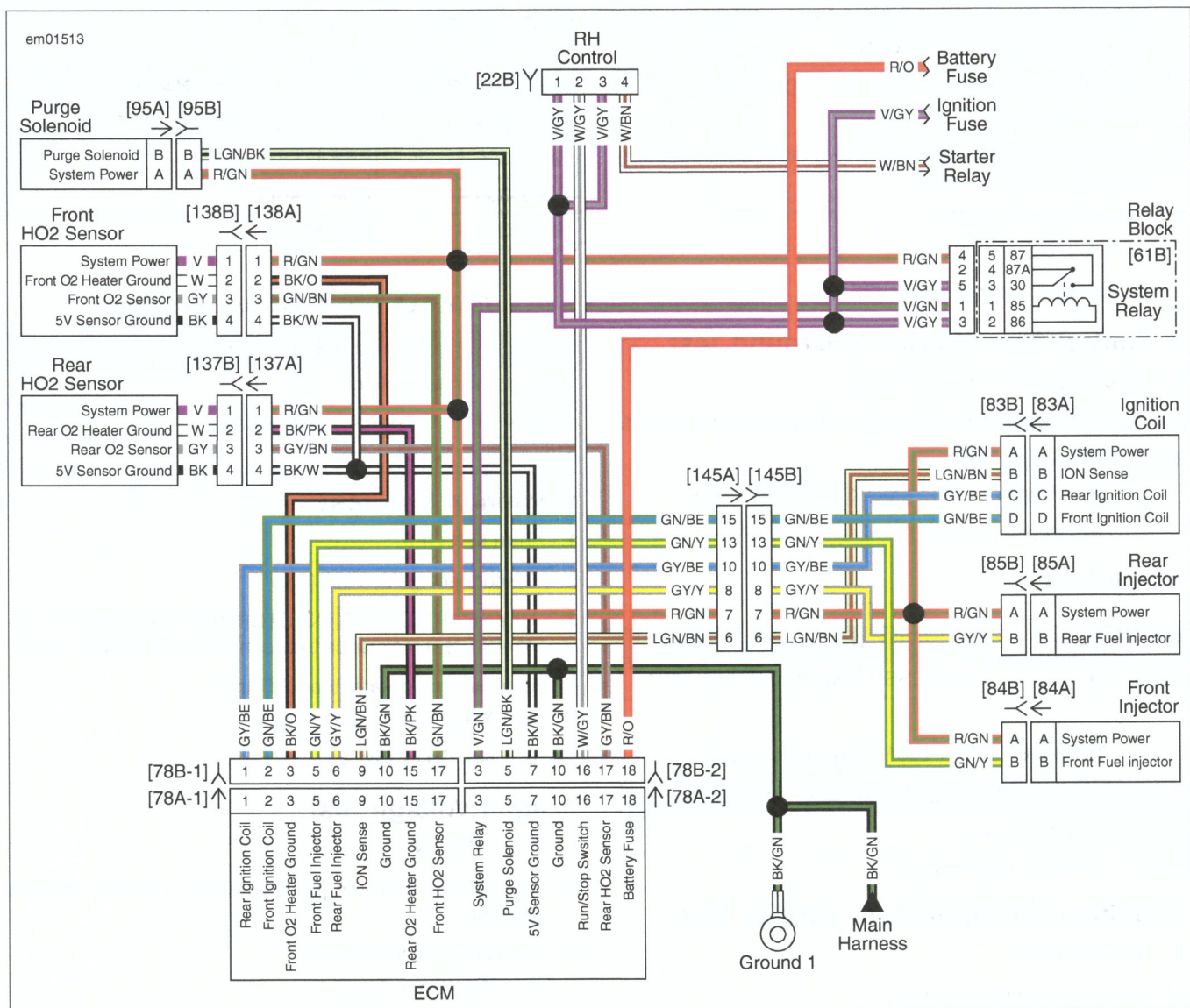


Figure 6-39. System Power Circuit

DTC P2300

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-61. DTC P2300 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
Open or short to ground in signal circuit
Open power circuit

1. Ignition Coil Test

- Turn IGN OFF.
- Disconnect ignition coil [83].

- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [83A] terminals A and D.
- Is resistance greater than 2 Ohms?
 - Yes.** Replace ignition coil.
 - No.** Go to Test 2.

2. Input Voltage Test

- Turn IGN ON.
- Test voltage between [83B] terminal A (R/GN) wire and ground.
- Is battery voltage present?
 - Yes.** Go to Test 3.
 - No.** Repair open on (R/GN) wire.

3. Control Wire Continuity Test

- Turn IGN OFF.
- Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring har-

ness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.

3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between BOB [78-1] terminal 2 and [83B] terminal D (GN/BE) wire.
5. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (GN/BE) wire.

4. Control Wire Shorted to Ground Test

1. Disconnect [78A-1] and [78A-2].
2. Test continuity between BOB [78-1] terminal 2 and ground.
3. Is continuity present?
 - a. **Yes.** Repair short to ground in (GN/BE) wire.
 - b. **No.** Replace ECM.

DTC P2301

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-62. DTC P2301 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
Short to voltage in signal circuit

1. Ignition Coil Shorted to Voltage Test

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [83B] terminal D (GN/BE) wire and ground.
5. Is voltage greater than 5.0V?
 - a. **Yes.** Repair short to voltage in (GN/BE) wire.
 - b. **No.** Go to Test 2.

2. Open Test

1. Test resistance between [83A] terminals A and D.
2. Is resistance greater than 0.4 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace ignition coil.

DTC P2303

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-63. DTC P2303 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
Open or short to ground in signal circuit
Open power circuit

1. Ignition Coil Test

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [83A] terminals A and C.
4. Is resistance greater than 2 Ohms?
 - a. **Yes.** Replace ignition coil.
 - b. **No.** Go to Test 2.

2. Input Voltage Test

1. Turn IGN ON.
2. Test voltage between [83B] terminal A (R/GN) wire and ground.
3. Is battery voltage present?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair open in (R/GN) wire.

3. Control Wire Continuity Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and to ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
3. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
4. Test continuity between BOB [78-1] terminal 1 and [83B] terminal C (GY/BE) wire.
5. Is continuity present?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair open in (GY/BE) wire.

4. Control Wire Shorted to Ground Test

1. Disconnect [78A-1] and [78A-2].
2. Test continuity between BOB [78-1] terminal 1 and ground.

3. Is continuity present?
 - a. **Yes.** Repair short to ground in (GY/BE) wire.
 - b. **No.** Replace ECM.

DTC P2304

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-64. DTC P2304 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
Short to voltage in signal circuit

1. Ignition Coil Shorted to Voltage Test

1. Turn IGN OFF.

2. Disconnect ignition coil [83].
3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [83B] terminal C (GY/BE) wire and ground.
5. Is voltage more than 5.0V?
 - a. **Yes.** Repair short to voltage in (GY/BE) wire.
 - b. **No.** Go to Test 2.

2. Open Test

1. Test resistance between [83A] terminals A and C.
2. Is resistance greater than 0.4 Ohms?
 - a. **Yes.** Replace ECM.
 - b. **No.** Replace ignition coil.

DESCRIPTION AND OPERATION

If the starter will not crank the engine, the problem is not EFI related. See 2.2 STARTING SYSTEM.

There may be DTCs associated with this problem. Check for DTCs and clear them before proceeding with this test.

NOTE

To set a CKP DTC, a start attempt must last at least five seconds.

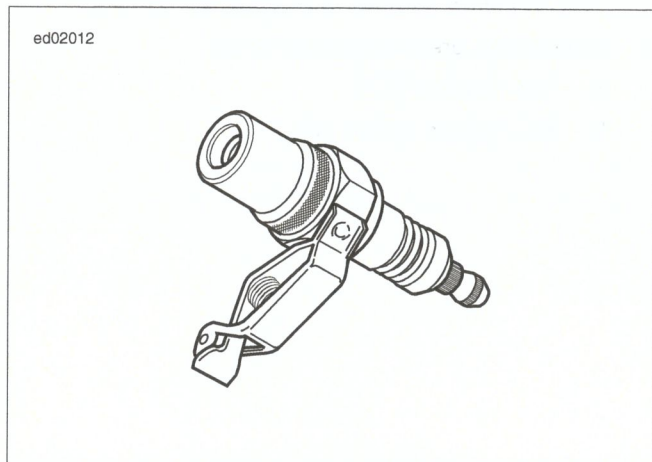


Figure 6-40. Spark Tester

ENGINE CRANKS BUT WILL NOT START

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-65. Engine Cranks But Will Not Start Diagnostic Faults

POSSIBLE CAUSES
Battery voltage too low
Ignition system issues
Fuel system issues
Electrical system issues
No or low compression
Open ground circuit

1. Preliminary Engine Tests

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected to the coil and plugs.
4. Verify fuel injectors are not clogged.
5. Verify battery condition. See 2.1 BATTERY TESTING.

6. Does battery pass tests?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Charge or replace battery.

2. Check Engine Lamp Test

1. Turn IGN ON and engine stop switch to RUN.
2. Does check engine lamp illuminate for 4 seconds immediately after key ON?
 - a. **Yes.** Go to Test 3.
 - b. **No.** See 1.2 INITIAL DIAGNOSTICS, Initial Diagnostics.

3. Spark Present Test

1. Check spark plug condition. Replace if fouled.
2. Using SPARK TESTER (Part No. HD-26792), check spark at both plugs while cranking engine.
3. Is spark present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Go to Test 4.

4. Compression Test

1. Perform compression test.
2. Does engine pass compression test?
 - a. **Yes.** Check condition of ignition coils, coil primary wiring and spark plug boots. See 6.9 CKP SENSOR DIAGNOSTICS or 6.18 COMBUSTION EFFICIENCY DIAGNOSTICS. If good, continue with tests. Go to Test 5.
 - b. **No.** Repair engine loss of compression.

5. Fuel Pump Voltage Test

1. Disconnect fuel pump connector [141].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [141B] terminals 2 and 4 during the first 2-3 seconds after IGN ON.
3. Is battery voltage present?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Go to Test 7.

6. Fuel System Test

1. Check fuel system and perform fuel pressure test.
2. Does fuel pressure meet specification?
 - a. **Yes.** Inspect and clean throttle body and repair as needed.
 - b. **No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

7. Fuel Pump Open Circuit Test

1. Turn IGN OFF.

2. Remove system relay.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between [141B] terminal 4 and [61B] terminal 4.
 4. Is resistance less than 0.5 Ohms?
 - a. **Yes.** Repair open on (BK) wire to ground.
 - b. **No.** Repair open (R/GN) wire.

DESCRIPTION AND OPERATION

The only crank in neutral conditions may be caused by and open in the clutch switch circuit. When the clutch lever is pulled in the clutch switch is released and making continuity with ground, this allows current flow through the coil side of the start relay.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

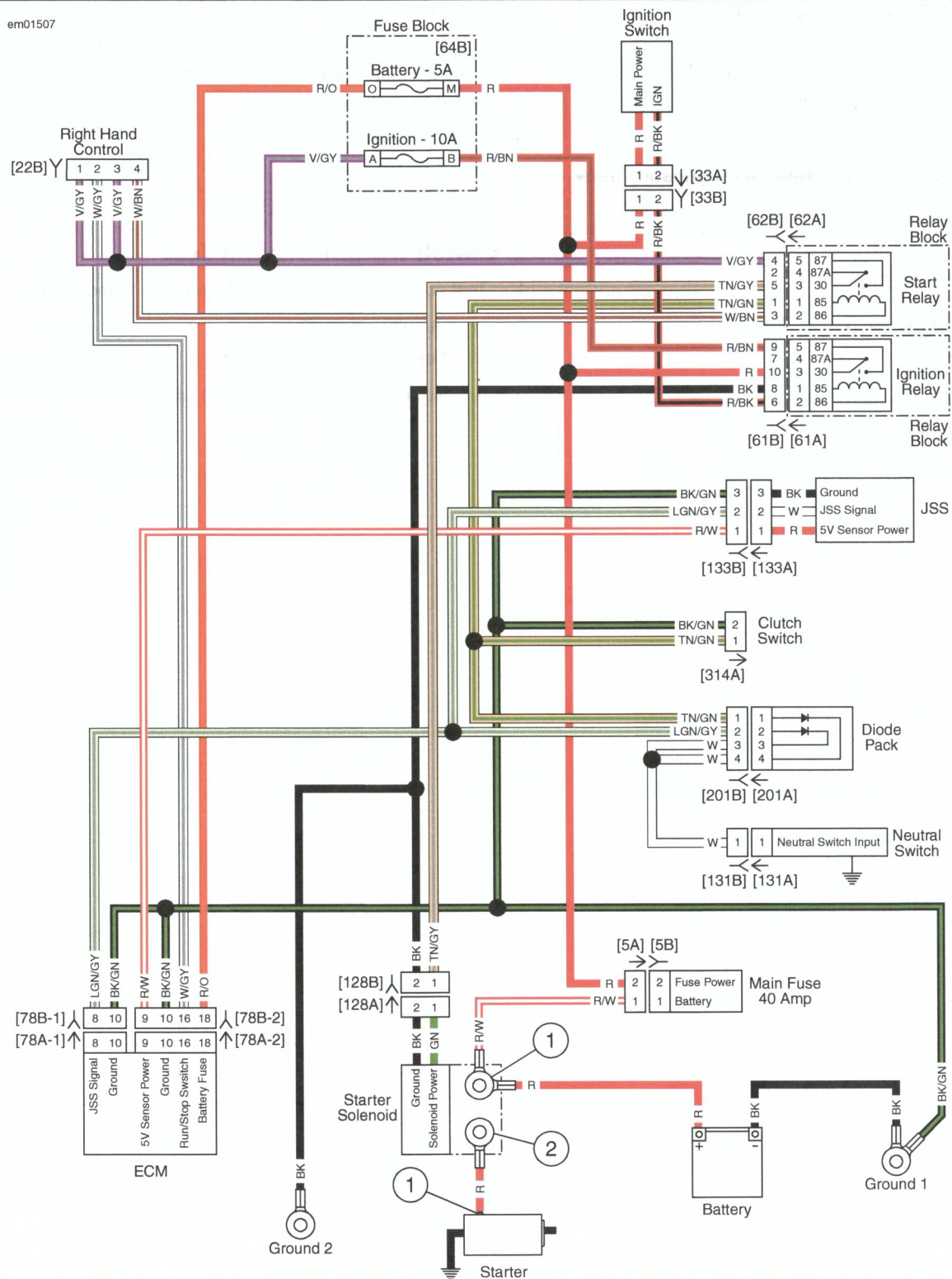


Figure 6-41. Starting Circuit

WILL ONLY CRANK IN NEUTRAL

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-66. Will Only Crank In Neutral Diagnostic Faults

POSSIBLE CAUSES
Clutch switch circuit open
Clutch switch malfunction

1. Clutch Switch Voltage Test

1. Turn IGN OFF.
2. Disconnect clutch switch [314].

3. Turn IGN ON.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test voltage between [314A] terminal 1 and ground.
5. Is battery voltage present?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Repair open in (TN/GN) wire.

2. Clutch Switch Ground Test

1. Test continuity between [314A] terminal 1 and ground.
2. Is continuity present?
 - a. **Yes.** Replace clutch switch.
 - b. **No.** Repair open in (BK/GN) wire.

DESCRIPTION AND OPERATION

See Figure 6-42. Improper fuel system pressure may contribute to hesitation or loss of power.

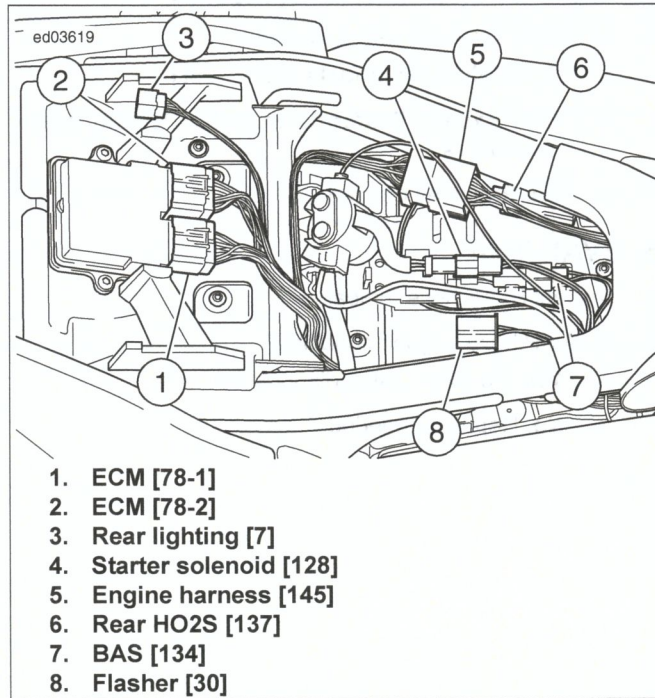


Figure 6-42. Under Seat: Front

HESITATION OR LOSS OF POWER TEST

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER

Table 6-67. Hesitation or Loss of Power Test Diagnostic Faults

POSSIBLE CAUSES
Loss of engine compression
Fuel system issues

1. Preliminary Engine Tests

- Verify battery connections are in good condition.
- Verify fuel in the tank is fresh and not contaminated.
- Verify spark plug wires are firmly connected the coil and plugs.
- Verify fuel injectors are not clogged.
- Verify battery condition. See 2.1 BATTERY TESTING.
- Does battery pass tests?
 - Yes.** Go to Test 2.
 - No.** Charge or replace battery.

2. Vacuum Leak Test

- Start engine. Check for vacuum leaks.
- Were any leaks found?
 - Yes.** Repair vacuum leak.
 - No.** Go to Test 3.

3. Spark Present Test

- Check spark plug condition. Replace if fouled.
- Using SPARK TESTER (Part No. HD-26792), check spark at both plugs while cranking engine.
- Is spark present?
 - Yes.** Go to Test 5.
 - No.** Go to Test 4. The spark plugs will not spark if there is low or no compression. If spark is not present, test compression before troubleshooting ignition circuit. Once good compression is confirmed, check condition of ignition coils, coil primary wiring and spark plug boots. See .

4. Compression Test

- Perform compression test.
- Does engine pass compression test?
 - Yes.** Check condition of ignition coils, coil primary wiring and spark plug boots. See 6.9 CKP SENSOR DIAGNOSTICS or 6.18 COMBUSTION EFFICIENCY DIAGNOSTICS. If good, continue with tests. Go to Test 5.
 - No.** Repair engine loss of compression.

5. Fuel System Test

- Check fuel system and perform fuel pressure test. See 1.1 SPECIFICATIONS.
- Does fuel pressure meet specification?
 - Yes.** Inspect and clean throttle body and repair as needed.
 - No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

STARTS HARD OR EMITS BLACK SMOKE

Table 6-68. Starts Hard or Emits Black Smoke Diagnostic Faults

POSSIBLE CAUSES
Clogged air filter
Poor compression
Leaking injectors
Manifold leak

1. Air Filter Inspection

- Inspect air filter.

2. Is air filter clean and in good condition?

- a. **Yes.** Go to Test 2.
- b. **No.** Replace air filter.

2. Compression Test

- 1. Perform compression test.
- 2. Is compression within normal specifications?
 - a. **Yes.** Go to Test 3.
 - b. **No.** Repair as needed.

3. Intake Leak Test

- 1. Perform intake leak test.
- 2. Did leak test pass?
 - a. **Yes.** Go to Test 4.
 - b. **No.** Repair as needed.

4. Fuel Injector Test

- 1. Inspect fuel injectors for mechanical failure.

2. Were any issues found?

- a. **Yes.** Repair as needed.
- b. **No.** Go to Test 5.

5. Throttle Cable Adjustment

- 1. Inspect throttle cable for correct adjustment.
- 2. Is throttle cable properly adjusted?
 - a. **Yes. California models.** Go to Test 6.
 - b. **Yes. Except California models.** Perform misfire diagnostics.
 - c. **No.** Repair as needed.

6. EVAP Test

- 1. Inspect EVAP hose for leak.
- 2. Is EVAP hose in good condition?
 - a. **Yes.** Perform misfire diagnostics
 - b. **No.** Repair as needed.

DESCRIPTION AND OPERATION

See Figure 6-43. The starts, then stalls condition may be created by the fuel system, the idle air control system or an ECM failure.

There may be DTCs set causing this condition. Solve the problems with the DTCs before performing the tests in this section. The DTCs that may be involved with starts, then stalls are:

- **Fuel injectors:** DTCs P0261, P0262 and P0264
- **TPS1:** DTCs P0122 and P0123
- **ECM errors:** DTCs P0603 and P0605
- **IAC errors:** DTCs P0506 and P0507

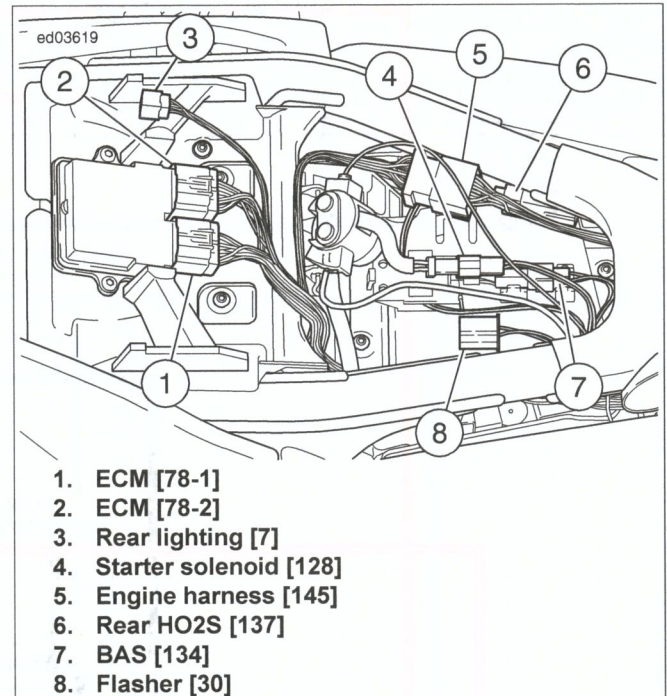


Figure 6-43. Under Seat: Front

Diagnostic Tips

- The vehicle will stall if the jiffy stand is extended when the transmission is in gear.
- If this condition is fuel related, perform fuel pressure test.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

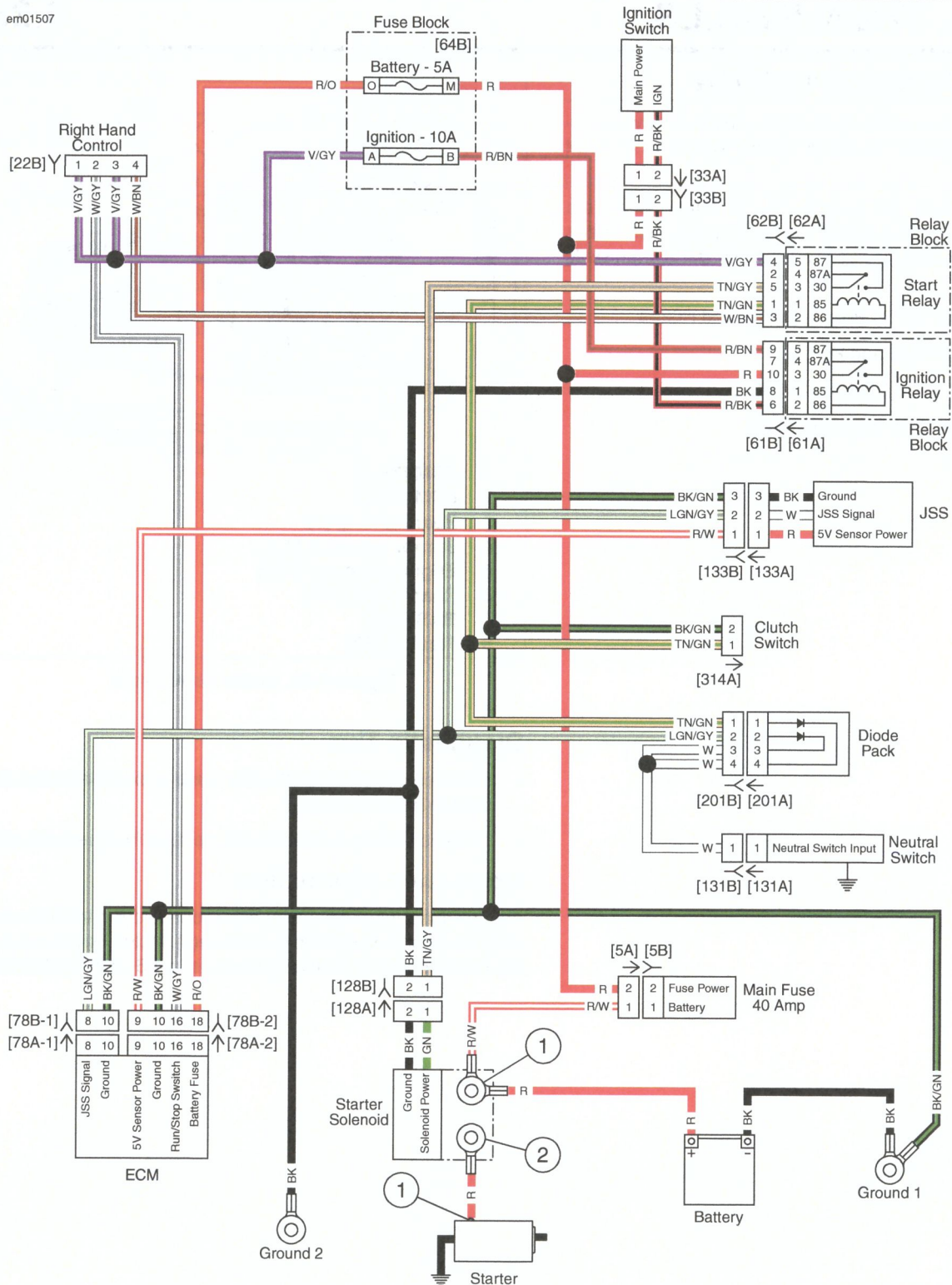


Figure 6-44. Starting Circuit

STARTS, THEN STALLS

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT

Table 6-69. Starts, Then Stalls Diagnostic Faults

POSSIBLE CAUSES
Fuel system malfunction
Idle air control system malfunction

1. Throttle Test

- Will engine start with the throttle partially opened and then stall when closed?
 - Yes.** See 6.12 IDLE SPEED CONTROL DIAGNOSTICS and perform IAC diagnostic procedure.
 - No.** Go to Test 2.

2. Fuel System Test

- Perform fuel pressure test. See 1.1 SPECIFICATIONS.
- Is fuel pressure normal?
 - Yes.** If fuel injectors are okay, then continue with tests. Go to Test 3.
 - No.** Repair fuel pressure problem.

3. ECM Connector Test

- Turn IGN OFF.
- Disconnect ECM [78-1] and [78-2].
- Inspect [78-1] and [78-2].
- Are both A and B sides of connectors good?
 - Yes. Without JSS.** Perform a wiggle test. Issue may be intermittent. If no intermittent is found, replace ECM.
 - Yes. With JSS.** Go to Test 4.
 - No.** Repair connectors.

4. Neutral Lamp Test

- Verify vehicle is in neutral.
- Turn IGN ON.
- Is neutral lamp illuminated?
 - Yes.** Go to Test 5.
 - No.** Go to Test 8.

5. Diode Pack Ground Test

- Turn IGN OFF.
- Disconnect diode pack [201].
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [201B] terminal 3 and ground.

- Is continuity present?
 - Yes.** Go to Test 6.
 - No.** Repair open in (W) wire.

6. JSS Signal Open Test

- Disconnect JSS [133].
- Test continuity between [201B] terminal 2 and [133B] terminal 2 (LGN/GY) wire.
- Is continuity present?
 - Yes.** Go to Test 7.
 - No.** Repair open in (LGN/GY) wire.

7. JSS Signal Shorted High Test

- Connect [133].
- Connect [78-2].
- Turn IGN ON.
- Test voltage between [201B] terminal 1 and ground.
- Is voltage greater than 2.5V?
 - Yes.** Repair short to voltage on (LGN/GY) wire.
 - No.** Replace diode pack.

8. Neutral Switch Test

- Disconnect neutral switch [131].
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [131B] terminal 1 (W) wire to ground.
- Is neutral lamp illuminated?
 - Yes.** Replace neutral switch.
 - No.** Go to Test 9.

9. Neutral Switch Ground Test

- Disconnect neutral switch [131].
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), jumper [131B] terminal 1 (W) wire to ground.
- Is neutral lamp illuminated?
 - Yes.** Replace neutral switch.
 - No.** Go to Test 10.

10. Diode Pack Continuity Test

- Turn IGN OFF.
- Disconnect diode pack [201].
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between [201B] terminal 3 and [131B] terminal 1 (W) wire.
- Is continuity present?
 - Yes.** Perform a wiggle test. Issue may be intermittent. If no intermittent is found, replace ECM.
 - No.** Repair open in (W) wire.

DESCRIPTION AND OPERATION

Misfire conditions may be caused by:

- Battery condition and connections.
- Fuel system problems. See 6.24 ENGINE PERFORMANCE DIAGNOSTICS.
- Ignition system faults.

Diagnostic Tips

⚠ WARNING

Wipe up spilled fuel and dispose of rags in a suitable manner. An open spark around gasoline could cause a fire or explosion, resulting in death or serious injury. (00518b)

- When performing the steps in the diagnostic tests, use a known good part to verify whether a suspected part is faulty.
- The ignition coil does not require full installation to be functional.
- Verify faulty ignition coil by performing resistance test. See 6.18 COMBUSTION EFFICIENCY DIAGNOSTICS.

IN-LINE SPARK TESTER

PART NUMBER	TOOL NAME
YA840	SNAP-ON IN-LINE SPARK TESTER

See Figure 6-45. Using a SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) or equivalent can help determine whether a problem exists in the ignition or fuel systems.

- If the test light flashes without interruption on both cylinders during the misfire event, verify spark plug condition and gap and inspect the fuel system for proper operation.
- If the test light does not flash or the flash is interrupted during the misfire event, the problem is ignition related.

1. Turn IGN OFF.
2. Remove front spark plug wire.
3. Install SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) between spark plug wire and spark plug.
4. Start engine and inspect tester light. The light will flash on each spark event if power is transmitted to the plug.
5. Install and repeat procedure on rear cylinder.

NOTE

Use a SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) and a load applying dynamometer to diagnose misfire under load.

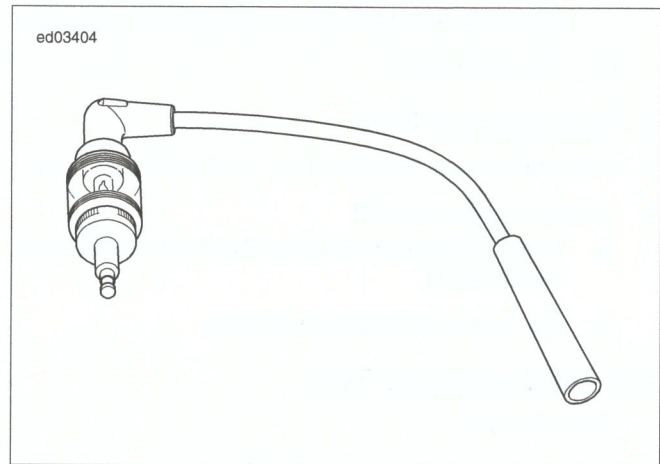


Figure 6-45. In-line Spark Tester

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

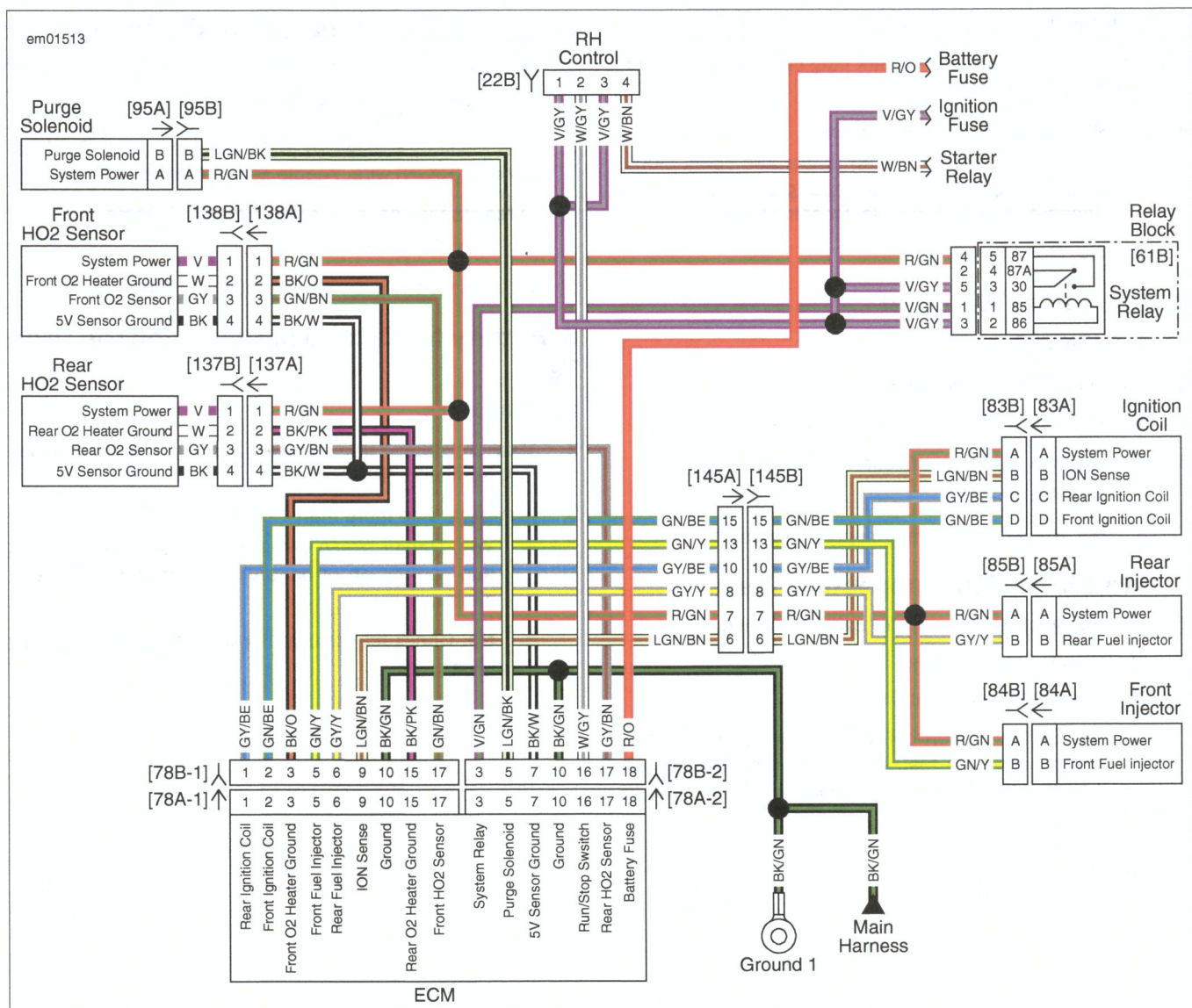


Figure 6-46. System Power Circuit

MISFIRE AT IDLE OR UNDER LOAD

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-70. Misfire At Idle or Under Load Diagnostic Faults

POSSIBLE CAUSES
Ignition system malfunction
Fuel system malfunction
IAC malfunction
Electrical system malfunction

1. Power Ground Continuity Test

- Turn IGN OFF.
- Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1], [78B-2] and to ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
- Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
- Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [78-1] terminal 10 and then [78-2] terminal 10 to ground.
- Is continuity present?
 - Yes.** Go to Test 2.
 - No.** Repair open on (BK/GN) wire.

2. Spark Test

- Connect SPARK TESTER (Part No. HD-26792) between front spark plug cable and ground. See 1.3 DIAGNOSTIC TOOLS.

2. Crank engine for a few seconds.
3. Remove tester from front spark plug cable. Connect rear spark plug cable and ground.
4. Did spark jump gap on both cables?
 - a. **Yes.** Check for faulty, worn or cracked spark plugs, plug fouling due to mechanical problems or faulty connection at plug or coils. Repair as required.
 - b. **No.** Go to Test 3.

3. Spark Plug Wire Test

1. Turn IGN OFF.
2. Disconnect spark plug cables.
3. Test resistance of both spark plug cables.
4. Is resistance within specifications? Refer to Table 1-4.
 - a. **Yes.** Go to Test 4.
 - b. **No.** Replace out of range spark plug cable.

4. Carbon Tracking Inspection Test

1. Inspect top of ignition coils for carbon tracking.
2. Is carbon tracking present?
 - a. **Yes.** Replace ignition coil.
 - b. **No.** Switch ignition coil with known good unit and perform previous test. If spark jumps gap, replace ignition coil. If not, then continue with tests. Go to Test 5.

5. Ignition Coil Primary Wire Continuity Test

1. Disconnect ignition coil [83].
2. Disconnect system relay [61].
3. Test resistance between [61B] terminal 4 and [83B] terminal A (R/GN) wire. Wiggle connectors while measuring.
4. Is resistance continuously less than 0.5 Ohms?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Repair intermittent on (R/GN) wire.

6. Battery to Main Fuse Block Voltage Drop Test

1. Start engine.
2. Measure voltage drop between battery (+) and main fuse [5A] terminal 1 (R/W) wire.
3. Is voltage drop more than 1.0V?
 - a. **Yes.** Repair (R/W) wire between terminal 1 of [5A] and connection at battery including connections at starter.
 - b. **No.** Check for corrosion or damage at system relay [61B].

DESCRIPTION AND OPERATION

See Figure 6-47. CAN communication uses a set of wires in a twisted pair. These two wires are designated as CAN low and CAN high circuits. Both circuits are connected to the ECM and DLC. The ECM contains a 120 Ohm terminating resistor.

NOTE

Always start from 1.2 INITIAL DIAGNOSTICS before proceeding.

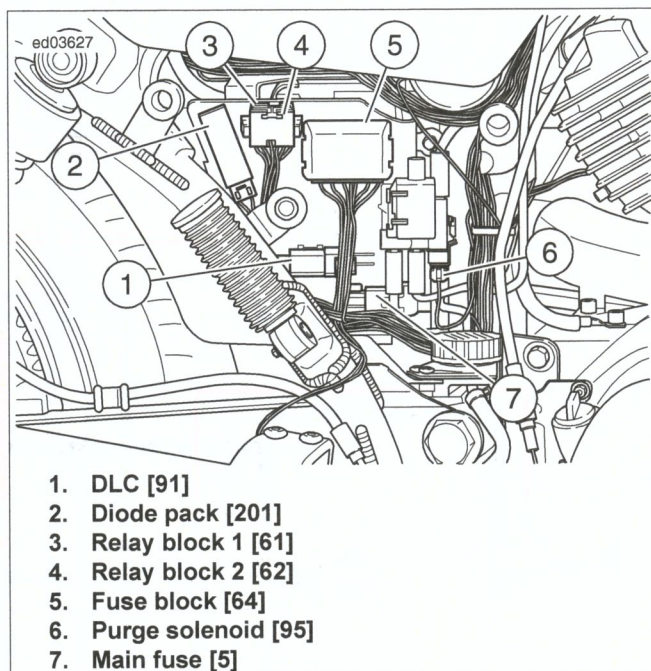


Figure 6-47. Under Right Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see 4.3 CONNECTORS.

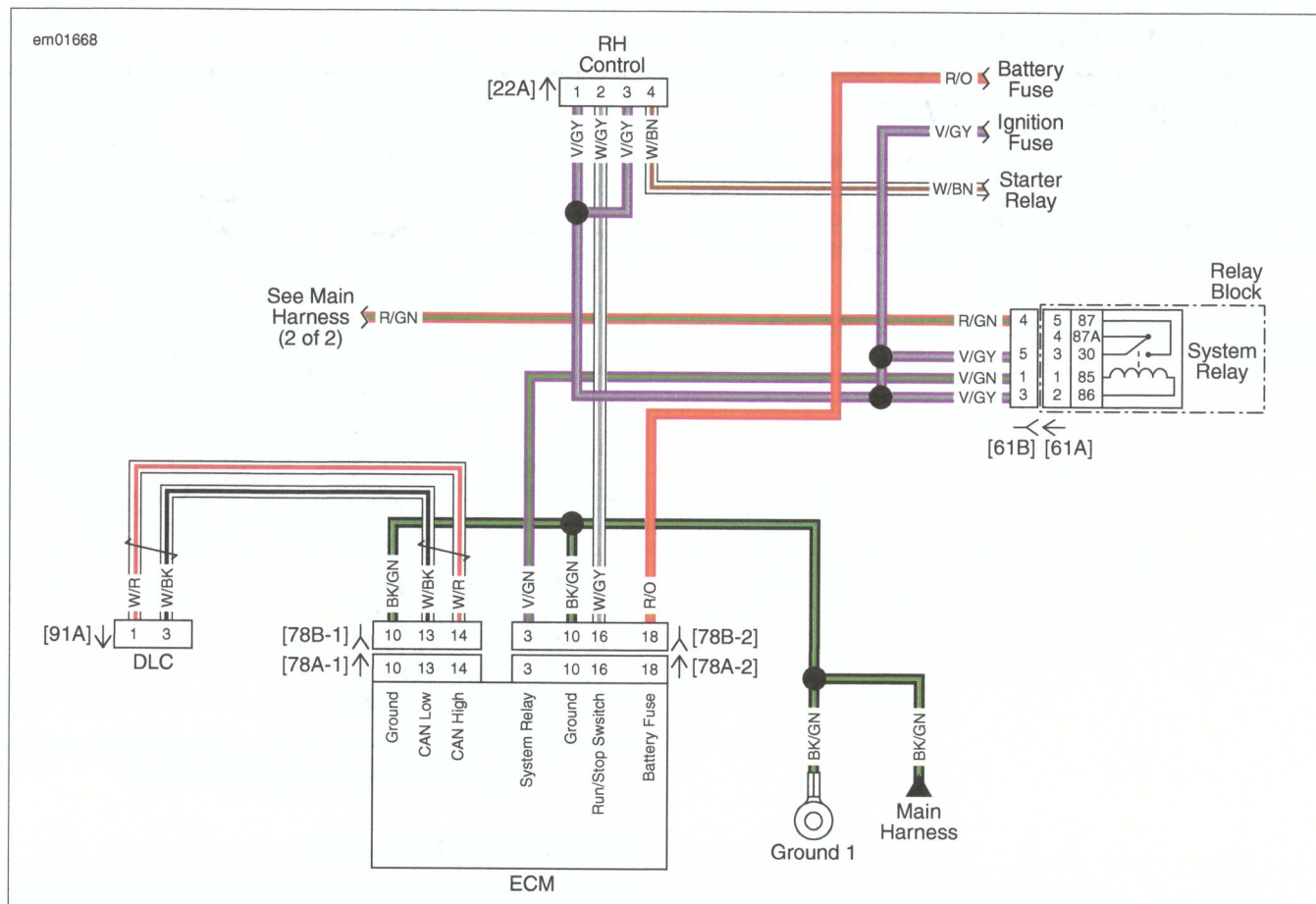


Figure 6-48. CAN Bus Circuit

LOST COMMUNICATION

PART NUMBER	TOOL NAME
HD-41404	HARNESS CONNECTOR TEST KIT
HD-50390-1	BREAKOUT BOX
HD-50390-4	ECM CABLE
HD-50390-4-P	ECM OVERLAY

Table 6-71. Lost Communication

POSSIBLE CAUSES
Short to ground in IGN switch circuit
Open in IGN switch circuit
IGN switch malfunction
Short between CAN low and high circuits
Open in CAN high circuit
Open in CAN low circuit
Short to ground on CAN high circuit
Short to ground on CAN low circuit
Short to voltage on CAN high circuit
Short to voltage on CAN low circuit
ECM loss of power
ECM loss of ground

1. Engine Stop Switch Test

1. Verify IGN and run/stop switches are ON.
2. Is engine stop switch ON?
 - a. **Yes.** Go to Test 2.
 - b. **No.** Turn engine stop switch ON.

2. CAN Bus Test

1. Turn IGN OFF.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test resistance between DLC [91A] terminals 1 and 3.
3. Is resistance between 110-130 Ohms?
 - a. **Yes.** Go to Test 6.
 - b. **No.** Go to Test 3.

3. CAN Circuit Shorted Test

1. Disconnect ECM [78B-1].
2. Test continuity between [91A] terminals 1 and 3.
3. Is continuity present?
 - a. **Yes.** Repair short between (W/R) and (W/BK) wires.
 - b. **No.** Go to Test 4.

4. CAN High Circuit Open Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) to wiring harness [78B-1] [78B-2], leaving ECM [78A-1] and [78A-2] disconnected. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404), test continuity between BOB [78-1] terminal 14 and (91A) terminal 1.
4. Is continuity present?
 - a. **Yes.** Go to Test 5.
 - b. **No.** Repair open in (W/R) wire.

5. CAN Low Circuit Open Test

1. Test continuity between BOB [78-1] terminal 13 and (91) terminal 3.
2. Is continuity present?
 - a. **Yes.** Replace ECM.
 - b. **No.** Repair open in (W/BK) wire.

6. CAN High Circuit Short to Ground Test

1. Turn IGN OFF.
2. Disconnect ECM [78-1].
3. Test resistance between [91A] terminal 1 and ground.
4. Is resistance less than 1000 Ohms?
 - a. **Yes.** Repair short to ground in (W/R) wire.
 - b. **No.** Go to Test 7.

7. CAN Low Circuit Short to Ground Test

1. Test resistance between [91A] terminal 3 and ground.
2. Is resistance less than 1000 Ohms?
 - a. **Yes.** Repair short to ground in (W/BK) wire.
 - b. **No.** Go to Test 8.

8. CAN High Circuit Short to Voltage Test

1. Connect BREAKOUT BOX (Part No. HD-50390-1), BREAKOUT BOX (Part No. HD-50390-1) and ECM CABLE (Part No. HD-50390-4) between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See 1.3 DIAGNOSTIC TOOLS.
2. Verify ECM OVERLAY (Part No. HD-50390-4-P) is in position on BOB.
3. Turn IGN ON.
4. Test voltage between [91A] terminal 1 and ground.

5. Is voltage greater than 4V?
 - a. **Yes.** Repair short to voltage in (W/R) wire.
 - b. **No.** Go to Test 9.

9. CAN Low Circuit Short to Voltage Test

1. Test voltage between [91A] terminal 3 and ground.
2. Is voltage greater than 4V?
 - a. **Yes.** Repair short to voltage in (W/BK) wire.
 - b. **No.** Go to Test 10.

10. ECM Ground Test

1. Turn IGN OFF.
2. Test resistance between [78B-1] terminal 10 and ground.
3. Is resistance greater than 1 Ohm?
 - a. **Yes.** Repair open in (BK/GN) wire.
 - b. **No.** Go to Test 11.

11. ECM Power Test

1. Test voltage between [78B-2] terminal 18 and ground.
2. Is battery voltage present?
 - a. **Yes.** Go to Test 12.
 - b. **No.** Repair open in (R/O) wire.

12. Engine Stop Switch Voltage Test

1. Turn engine stop switch ON.
2. Test voltage between BOB [78B-2] terminal 16 and ground.
3. Is battery voltage present?
 - a. **Yes.** Replace ECM.
 - b. **No.** Go to Test 13.

13. Engine Stop Switch Circuit Test

1. Disconnect [22].
2. Test continuity between BOB [78B-2] terminal 16 and [22B] terminal 2.
3. Is continuity present?
 - a. **Yes.** Go to Test 14.
 - b. **No.** Repair open (W/BK) wire.

14. IGN Voltage Test

1. Test voltage between [22B] terminal 1 and ground.
2. Is battery voltage present?
 - a. **Yes.** Replace engine stop switch.
 - b. **No.** Repair open in (V/GY) wire.

NOTES

SUBJECT	PAGE NO.
A.1 BOSCH COMPACT 1.1M CONNECTORS.....	A-1
A.2 DELPHI GT 150 SEALED CONNECTORS.....	A-2
A.3 DEUTSCH DT SEALED CONNECTORS.....	A-4
A.4 FURUKAWA QLW SEALED CONNECTORS.....	A-8
A.5 MOLEX MX 150 SEALED CONNECTORS.....	A-9
A.6 SUMITOMO DL SEALED AND MT CONNECTORS.....	A-13
A.7 SUMITOMO MTW AND MTL UNSEALED CONNECTORS.....	A-14
A.8 TYCO 070 MULTILOCK UNSEALED CONNECTOR.....	A-15
A.9 TYCO GET 64 UNSEALED CONNECTORS.....	A-17
A.10 TYCO JUNIOR POWER TIMER UNSEALED CONNECTOR.....	A-19
A.11 TYCO SEALED TIMER CONNECTOR.....	A-20
A.12 TYCO SUPER SEAL 1.5 SEALED CONNECTOR.....	A-21
A.13 YAZAKI SSD SEALED CONNECTOR.....	A-22

NOTES

DISCONNECT AND CONNECT

Disconnect

1. Pull back the secondary lock.
2. Press the locking latch.
3. Pull the connector from the sensor.

Connect

1. Align the connector housings.
2. Press the housings together until the latch snaps into place.
3. Snap in the secondary lock.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
GA500A	SNAP-ON TERMINAL PICK

1. See Figure A-1. Slide the locking bar off the terminal housing.
2. Insert the smallest pins of the SNAP-ON TERMINAL PICK (Part No. GA500A) into the gaps on each side of the socket to compress the tangs on each side of the terminal.
3. Gently pull on the wire to remove the terminal.

INSTALL TERMINAL

1. See Figure A-2. Bend the tangs on each side of the terminal outward.
2. Align terminal to the housing.
3. Install the terminal into housing. Terminal will snap into place.

NOTE

The teeth of the locking bar face down.

4. Install the locking bar onto the connector.

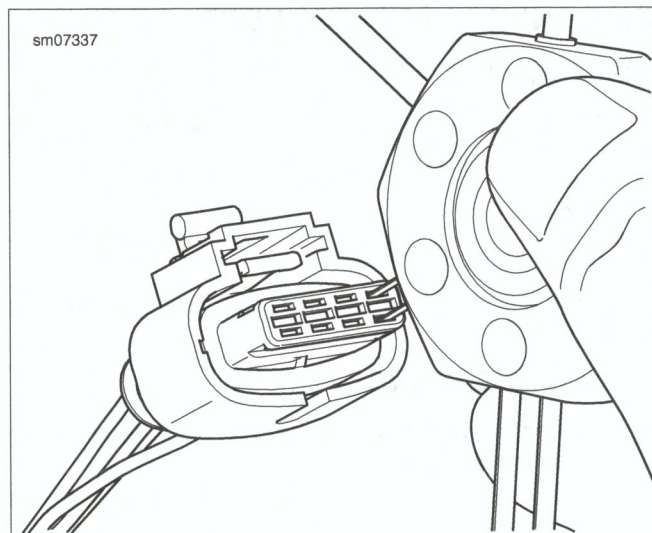


Figure A-1. Terminal Removal: Bosch Compact 1.1M Connector

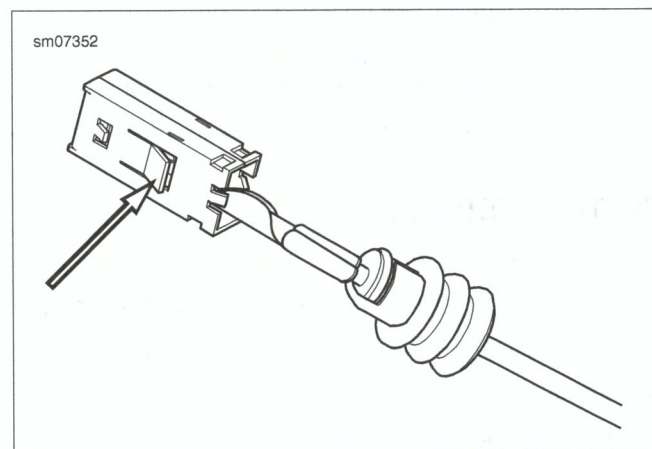


Figure A-2. Tangs: Bosch Compact 1.1M Socket Terminal

DISCONNECT AND CONNECT

Disconnect

1. See Figure A-3. Lift the external locking latch.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until external latch(es) engage.

REMOVE TERMINAL

1. **Connectors with wire lock:** See Figure A-4. Remove the wires from wire lock.
 - a. Pry loose one side of wire lock (1) from socket housing.
 - b. Pry loose the other side, if necessary.
 - c. Remove the wires from wire lock.
2. Remove terminal lock (2) from housing.

NOTE

Terminal will be difficult to remove if the tang is not released.

3. Pry tang (3) away from terminal. Pull on wire to back terminal out of chamber.

INSTALL TERMINAL

1. Push in tang on housing.
2. Push terminal into the cavity of the connector housing.
3. Gently pull wire to verify that terminal is secure.
4. Install colored terminal lock into housing.
5. **Connectors with wire lock:** Install wires in wire lock.
 - a. Seat wires in separate channels of wire lock.
 - b. Push channels inside chambers at wire end of housing until lock fully engages housing.

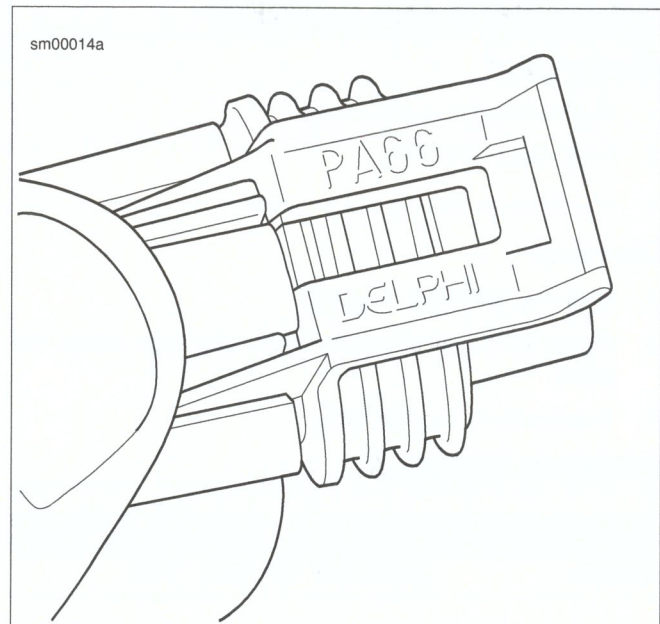


Figure A-3. Delphi GT 150 Sealed Connector: Socket Housing Latch

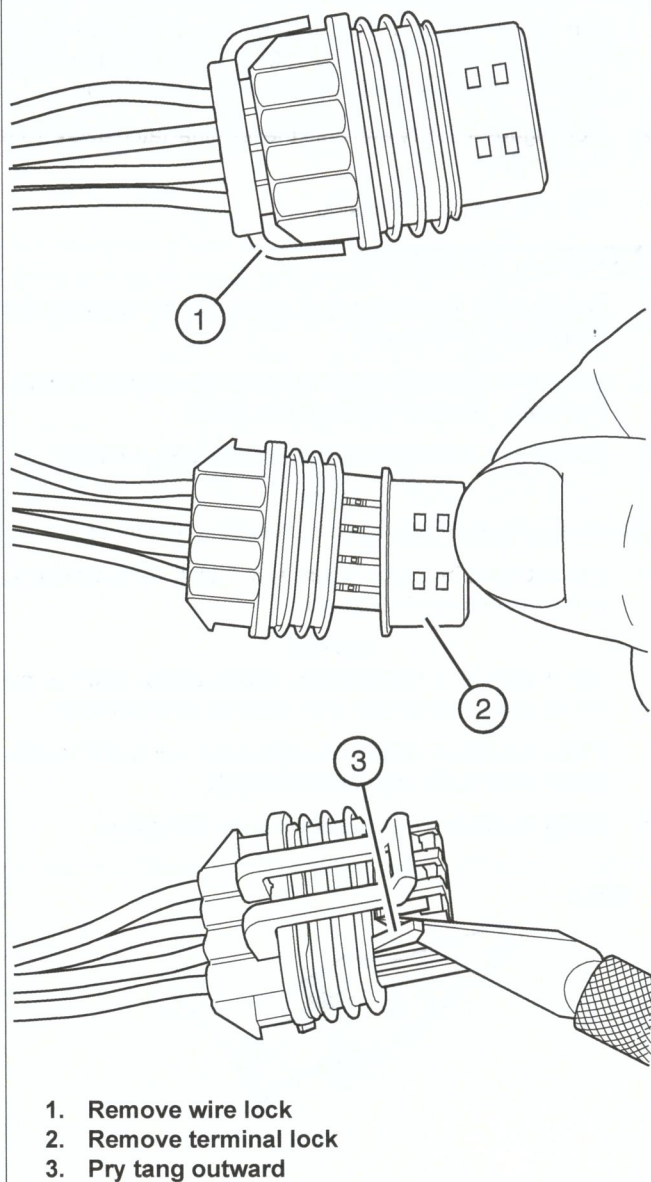


Figure A-4. Delphi GT 150 Sealed Connector: Removing Socket Terminals

DISCONNECT AND CONNECT

PART NUMBER	TOOL NAME
HD-41475	DEUTSCH TERMINAL REPAIR KIT
HD-41475-100	FLAT BLADE L-HOOK

NOTES

- A DEUTSCH TERMINAL REPAIR KIT (Part No. HD-41475) contains a selection of seals and seal plugs, locking wedges, attachment clips and terminals.
- Also included is a FLAT BLADE L-HOOK (Part No. HD-41475-100) used to remove locking wedges, compartmented storage box and carrying case.

Disconnect

- See Figure A-5. Press the latch(es) (1).
- Pull the connector housings apart.

Connect

- Align the connector housings.
- Press the housings together until the latches snap into place.

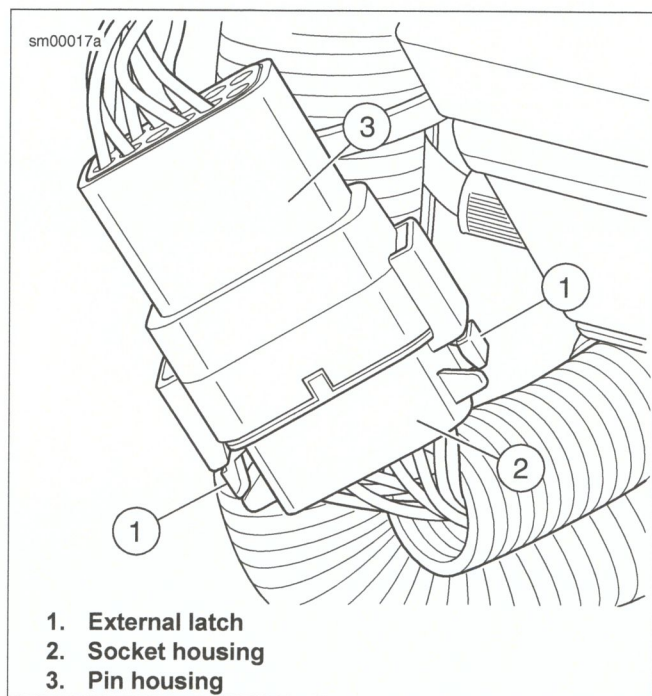


Figure A-5. Deutsch DT Sealed Connector

REMOVE TERMINAL

PART NUMBER	TOOL NAME
HD-41475-100	FLAT BLADE L-HOOK

- Socket terminals:** See Figure A-8. Pry the secondary locking wedge (5) out of the socket housing.

Pin terminals: See Figure A-9. Use FLAT BLADE L-HOOK (Part No. HD-41475-100) or similar tool to pull the secondary locking wedge (4) from the pin housing.

- See Figure A-7. Pry and hold the terminal latch away from the terminal.
- Pull wire lead from housing.

INSTALL TERMINAL

- See Figure A-8 or Figure A-9. Install rear wire seal (1) into housing (2), if removed.
- Insert the terminal through the hole in wire seal and into the cavity. Terminal will snap into place.
- Pull wire to confirm that terminal is properly seated.

NOTE

Install seal plugs (6) into unused chambers, if removed.

- Socket Housing:** See Figure A-8. Install internal seal (4) on lip of housing, if removed.

NOTES

- See Figure A-6. **Three-place connectors:** Align arrow (1) on conical secondary lock towards external latch.
 - If the secondary locking wedge does not install easily, check housing for unseated terminals.
- Install secondary lock. Lock will snap into place.

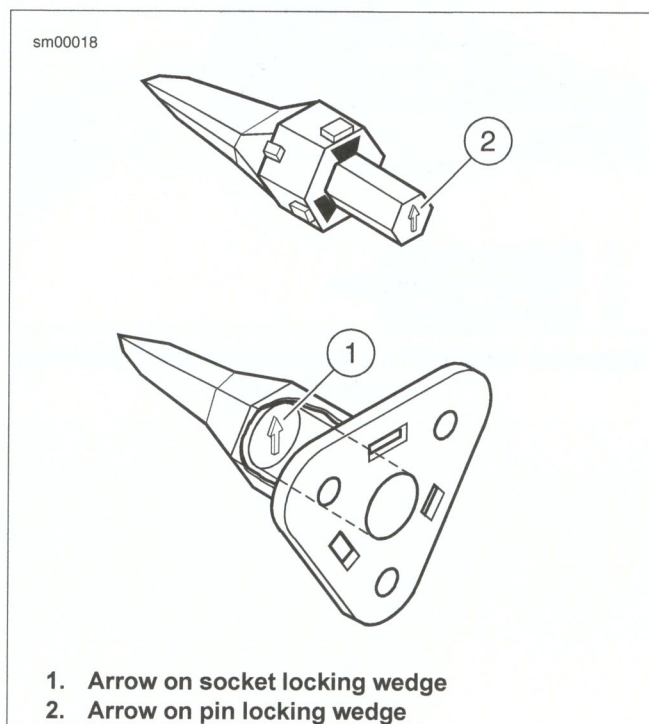


Figure A-6. Deutsch DT Sealed Connector: 3-Place Locking Wedges

sm00019

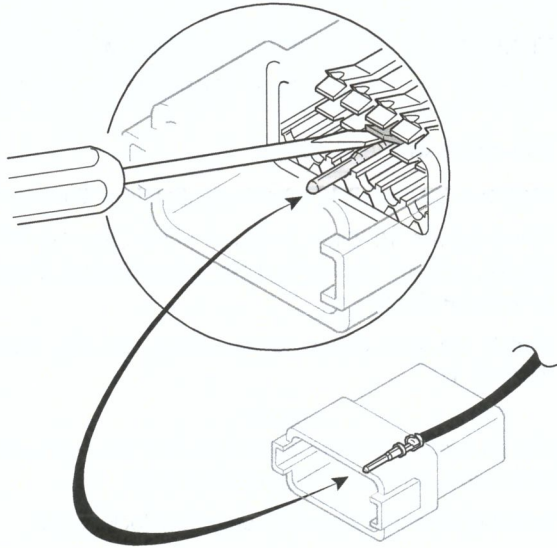
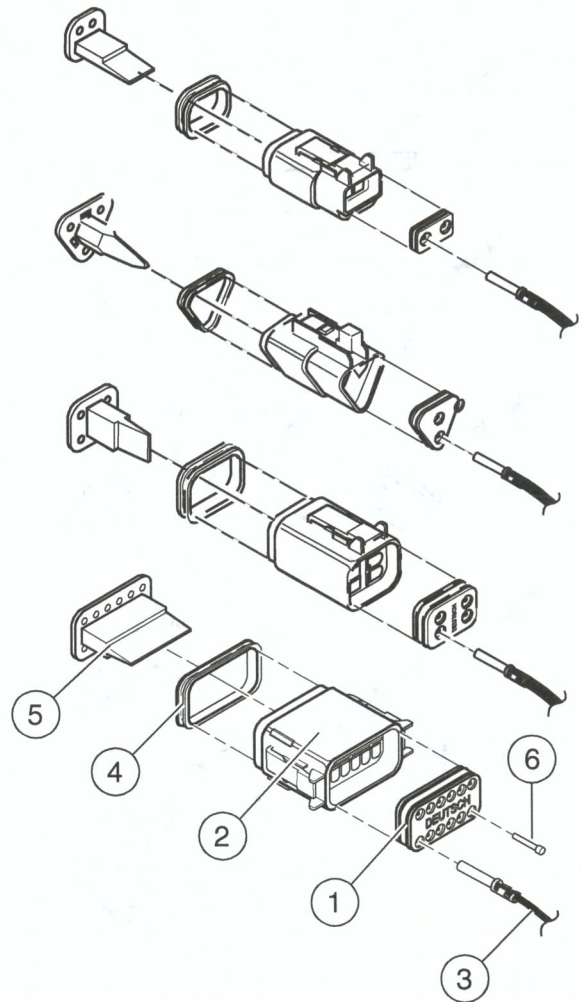


Figure A-7. Deutsch DT Sealed Connector: Press Terminal Latch and Pull Out Pin

sm00010



1. Wire seal
2. Socket housing
3. Wire lead
4. Internal seal
5. Secondary locking wedge
6. Seal plug

Figure A-8. Deutsch DT Sealed Connector: 2, 3, 4 and 12-Place Socket Housings

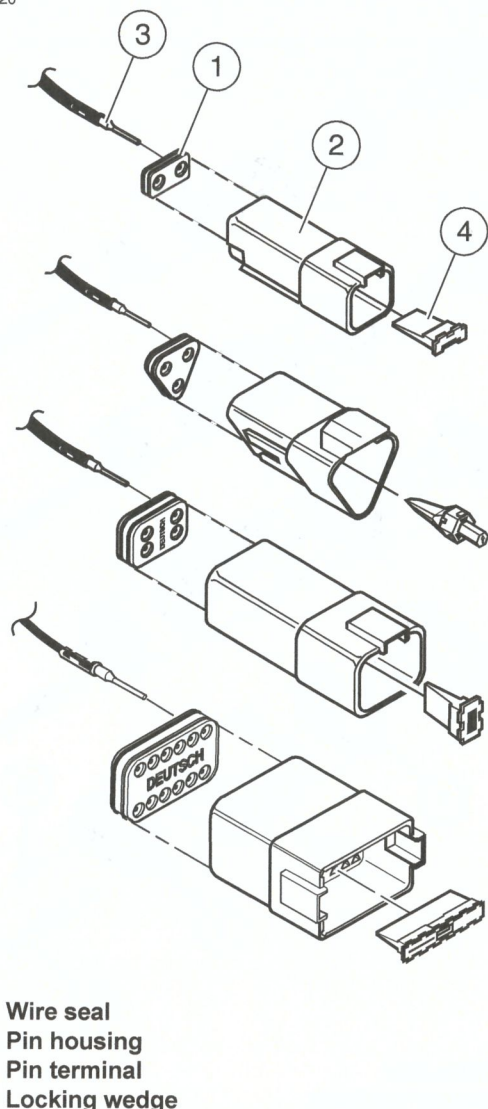


Figure A-9. Deutsch DT Sealed Connector: 2, 3, 4 and 12-Place Pin Housings

CRIMP TERMINAL

PART NUMBER	TOOL NAME
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL

1. Determine wire lead gauge.
2. Remove 4.0 mm (0.15 in) of insulation from the wire lead.
3. See Figure A-10. Open the jaws of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A). Push the locking bar (1) up.
4. Match the wire gauge to the crimp tool die. Refer to Table A-1.

NOTE

Rest the rounded side of the contact barrel in the nest (concave split level area) with the crimp tails facing up.

5. Insert (2) terminal through hole of the locking bar.
6. Release locking bar to lock terminal in die.

NOTE

If the crimp tails are slightly out of alignment, the crimp tool rotates the terminal to face the tails up. When positioned, the locking bar fits in the space between the contact band and the core crimp tails.

7. Insert stripped wire core between crimp tails until ends make contact with locking bar. Position wire so that the wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
8. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
9. Raise locking bar up to remove wire lead and terminal.
10. Inspect the wire core and insulation crimps. Distortion should be minimal.

Table A-1. Deutsch DT Sealed Terminal Crimp: Wire Gauge To Die

WIRE GAUGE (AWG)	CRIMP TOOL DIE
20	Front
16-18	Middle

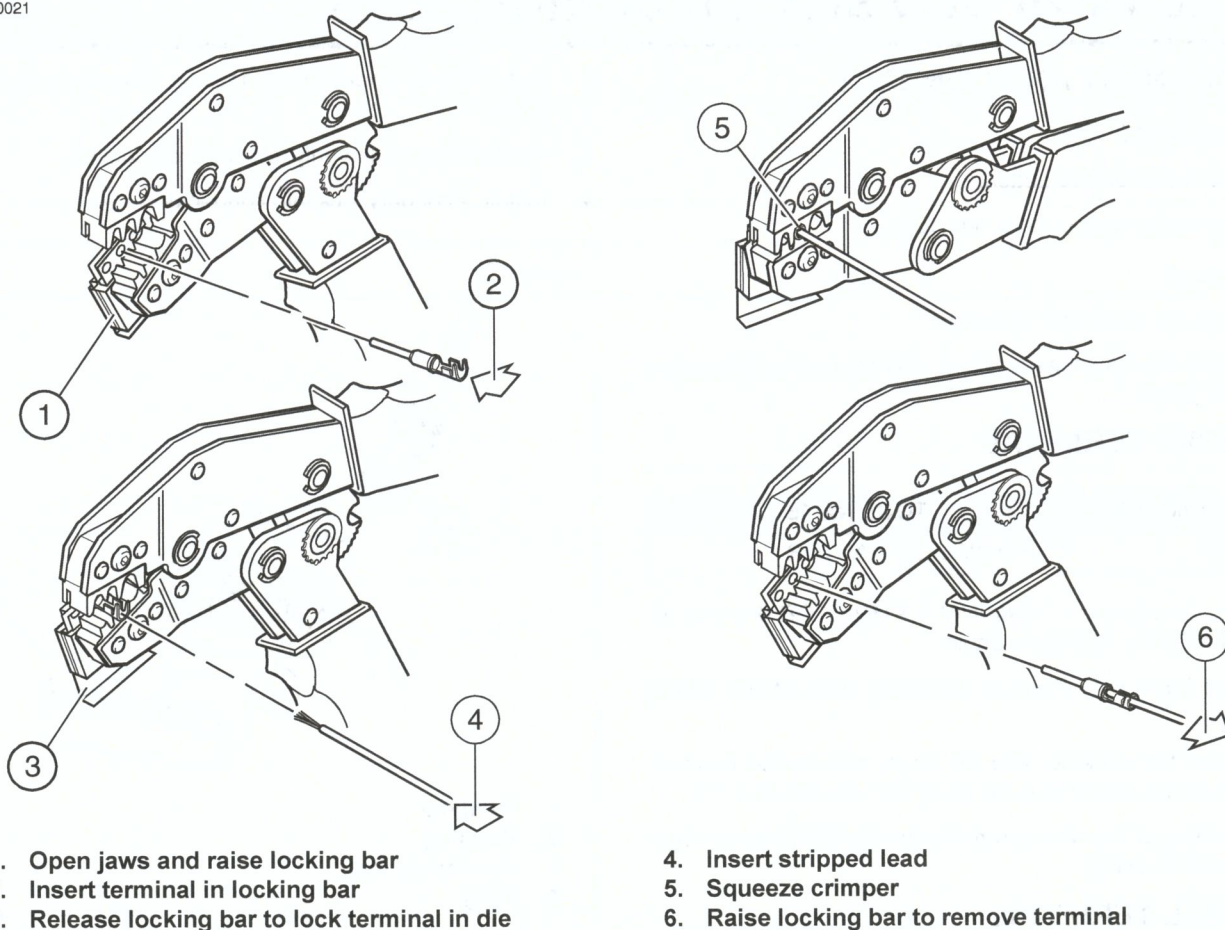


Figure A-10. Crimping a Deutsch DT Sealed Terminal

DISCONNECT AND CONNECT

Disconnect

1. Press the release button.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the locking tab snaps into place.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. File the edge of a TERMINAL EXTRACTOR (Part No. B-50085) to a 45 degree angle.
2. See Figure A-11. Remove secondary lock (3) from housing (2).
3. Insert the extractor into the cavity next to the terminal. Press the plastic tang (4) away from the terminal (1).
4. Gently pull the wire to remove the terminal from the connector housing.

INSTALL TERMINAL

1. Align terminal to the housing.

2. Install the terminal into the housing. Terminal snaps into place.
3. Gently pull wire to verify terminals are locked.
4. Install secondary lock into connector.

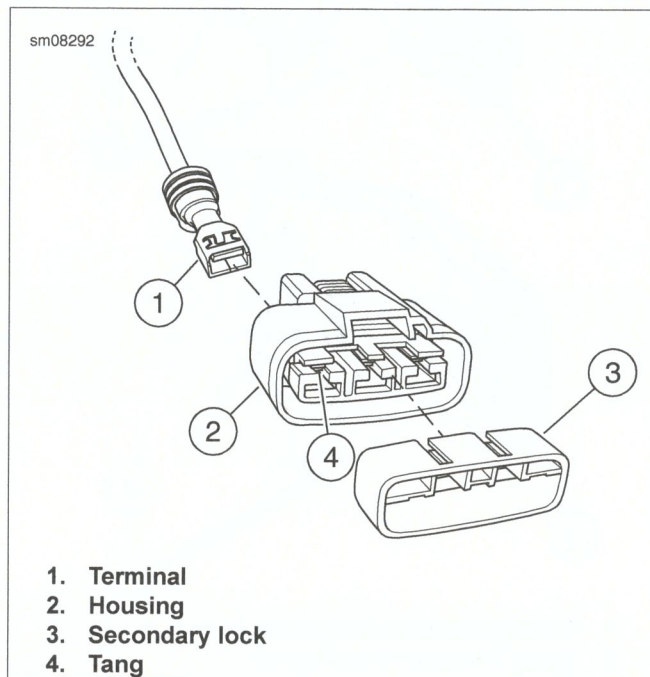


Figure A-11. Furukawa QLW Sealed Connector

DISCONNECT AND CONNECT

Disconnect

1. See Figure A-12. Press the latch.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the latch snaps into place.

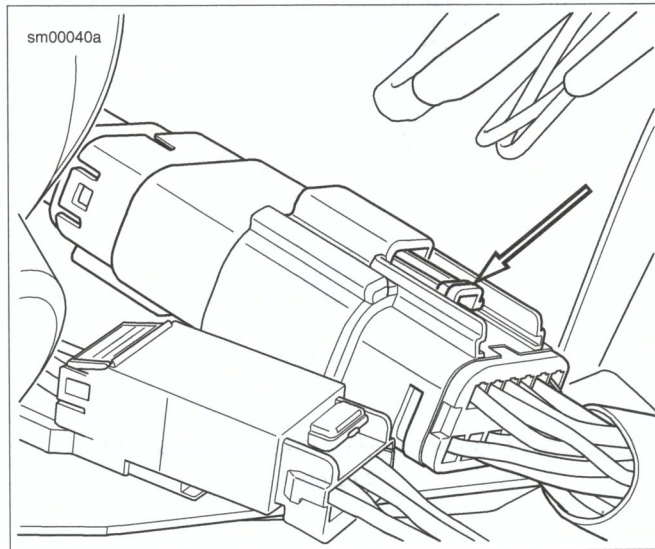


Figure A-12. Molex MX 150 Sealed Connector: Latch

REMOVE TERMINAL

PART NUMBER	TOOL NAME
HD-48114	TERMINAL REMOVER

1. Pull the secondary lock up, approximately 4.8 mm (0.2 in), until it stops.
 - a. **Socket housing:** See Figure A-13. Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
 - b. **Pin housing:** See Figure A-14. Use needle nose pliers to engage the D-holes in the center of the secondary lock.

NOTE

Do not remove the secondary lock from the connector housing.

2. See Figure A-15. Insert TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
 - a. **Socket housing:** The pin holes are inside the terminal openings.
 - b. **Pin housing:** The pin holes are outside the pins.

3. Remove terminal.
 - a. Push terminal remover into pin hole.
 - b. Gently pull on the wire to remove wire terminal from the chamber.

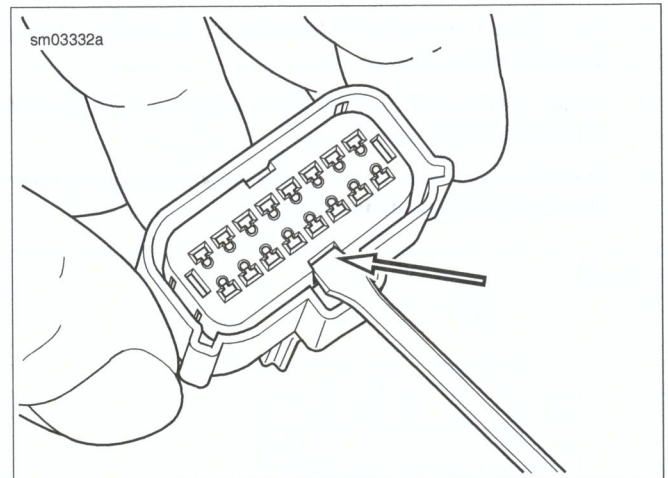


Figure A-13. Secondary Lock Pry Slot (Socket Housing)

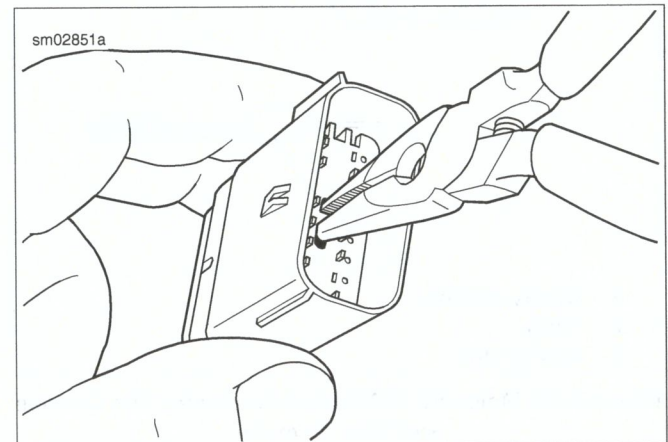


Figure A-14. Pull Up Secondary Lock

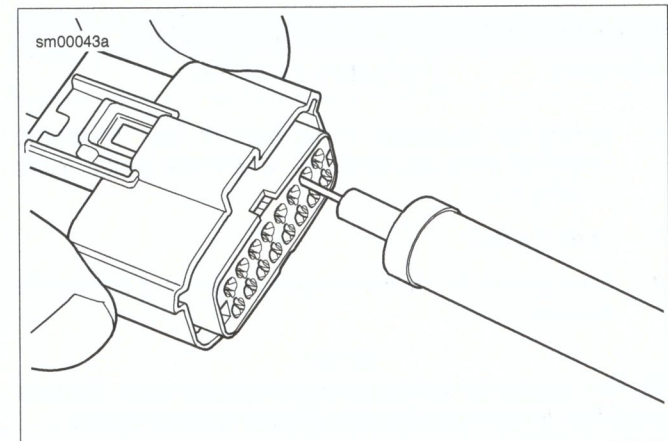


Figure A-15. Molex MX 150 Sealed Connector: Terminal Remover (HD-48114)

INSTALL TERMINAL

NOTE

See Figure A-16. Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. Determine the cavity number by counting the cavities up or down along the row from each stamped number.

1. Align terminal to the housing.
2. See Figure A-16. Install the terminal into the housing. Tang (2) engages slot (3).
3. Gently pull on wire to verify that the terminal is captured by the secondary lock.
4. Push the secondary lock into the socket housing to lock the wire terminals into the housing.

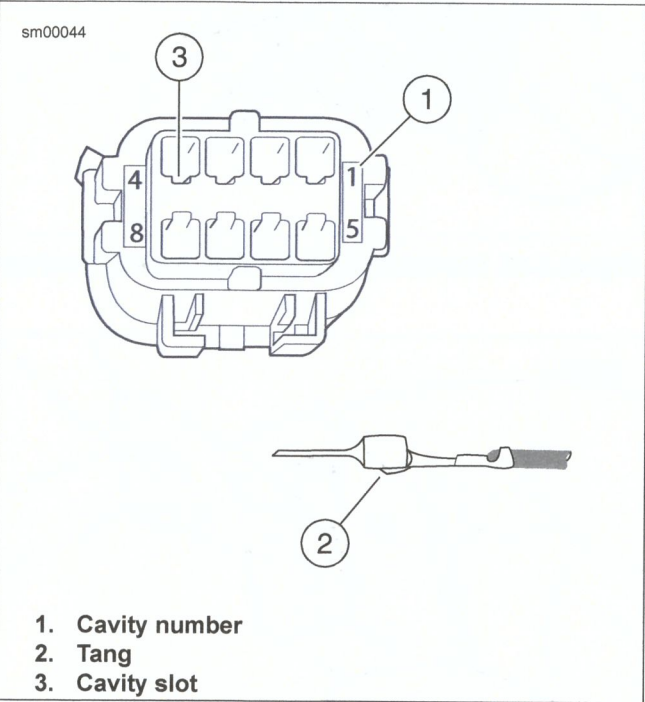


Figure A-16. Molex MX 150 Sealed Connector: Pin Cavities and Wire Terminal

CRIMP TERMINAL

PART NUMBER	TOOL NAME
HD-48119	TERMINAL CRIMPER

1. Identify the punch/die in the jaws of the TERMINAL CRIMPER (Part No. HD-48119) for the wire gauge. Refer to Table A-2.
2. Open the tool.
3. See Figure A-17. Hold fully open tool at approximately 45 degrees.

NOTE

Do NOT tighten the locknut holding the locator bars. The bars must float to accommodate the different terminal gauges.

Table A-2. Crimp Tool Wire Gauge Punch/Die

AWG (WIRE GAUGE)	PUNCH/DIE
22	Left
18-20	Middle
14-16*	Right
* Crimp 16 AWG pin terminals in the 18-20 middle die.	

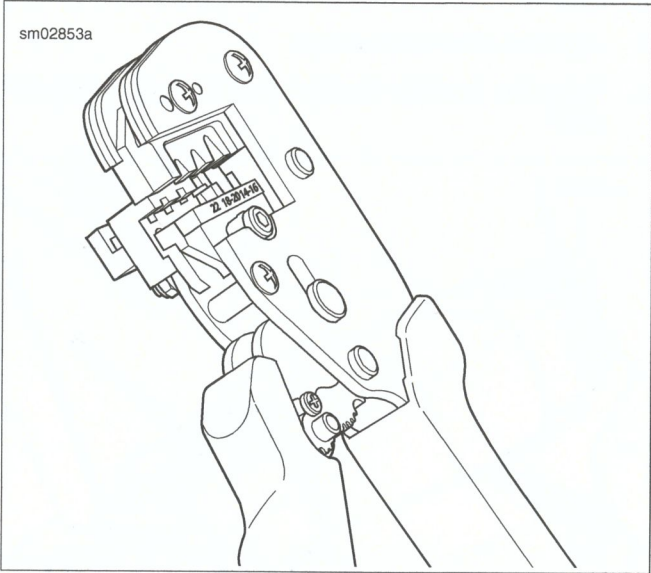


Figure A-17. Open Terminal Crimper (HD-48119) at 45 Degrees

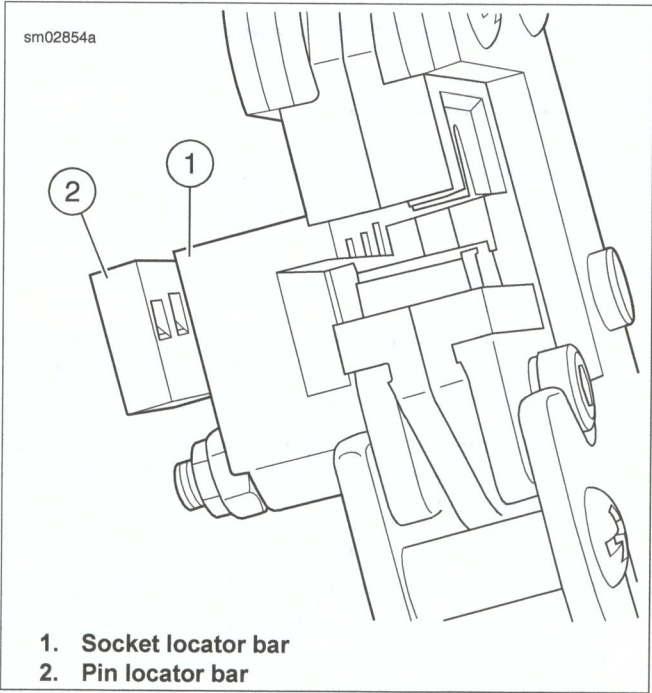


Figure A-18. Terminal Locator Bars

4. Remove 4.7-5.6 mm (0.2 in) of insulation from the wire lead.

5. See Figure A-19. With the crimp tails up, place the terminal through the punch/die into the square opening in the socket locator bar.
 - a. **Socket terminal:** See Figure A-18. A socket terminal stops against the back face of the socket locator bar (1).
 - b. **Pin terminal:** See Figure A-20. The tip of a pin terminal passes through the socket locator bar and stops in the notch in the face of the pin locator bar.
6. See Figure A-21. Ratchet the handles together until the crimp tails are held in vertical alignment between the punch and the die.

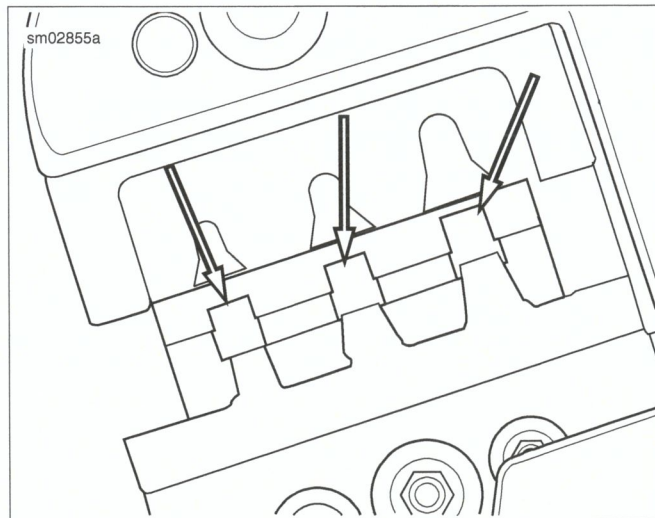


Figure A-19. Square Openings in Socket Locator Bar

See Figure A-22. Insert the wire lead between the crimp tails, angled up until the wire core touches the face of the socket locator bar above the square opening.

NOTES

- The insulation must extend through the insulation crimp tails.
- Insert the wire with little or no pressure. Pressing on the lead will bend the wire core.

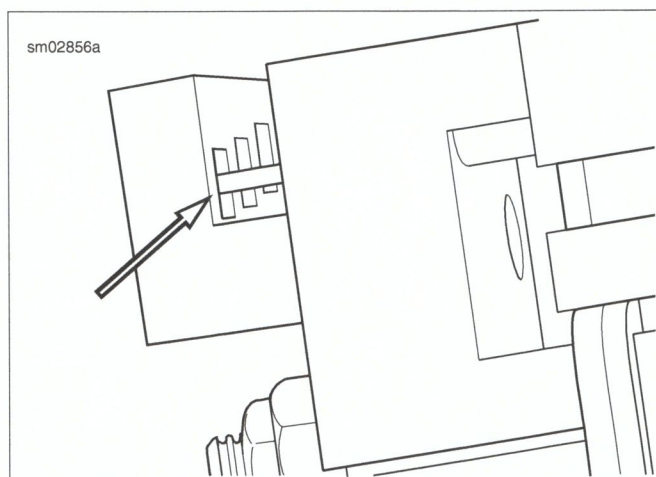


Figure A-20. Pin Terminal against Pin Locator Bar

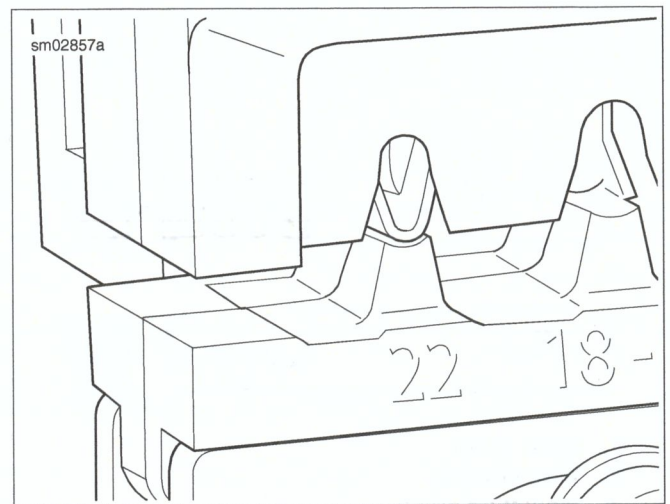


Figure A-21. Crimp Tails in Vertical Alignment between Punch and Die

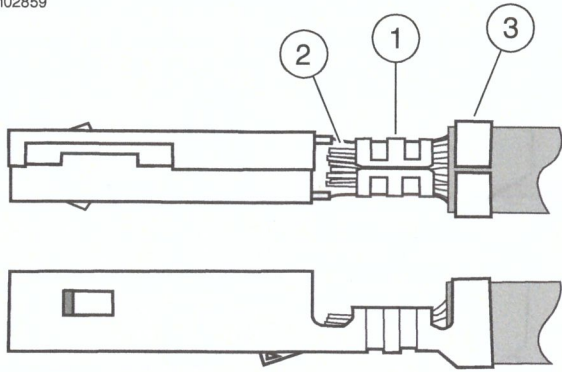
7. Holding the wire lead in position touching the locator face at an angle, quickly and smoothly squeeze the crimp tool closed.
8. Squeeze the handles to open the tool and release the terminal.



Figure A-22. Stripped Lead at Up Angle

1. **Inspect crimp:** Inspect the core and insulation crimp.
 - a. See Figure A-23. The core tails should be creased into the wire strands at the core crimp (1).
 - b. Wire strands (2) should extend beyond the core crimp but not into the terminal shell.
 - c. The insulation tails should be folded into the insulation crimp (3) without piercing or cutting the insulation.
 - d. Distortion should be minimal.
2. **Test crimp:** Hold the terminal. Pull the lead.

sm02859



1. Core crimp
2. Wire strands
3. Insulation crimp

Figure A-23. Terminal Crimp

DISCONNECT AND CONNECT

Disconnect

1. Press the release button.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the lock clicks into place.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. File the edge of a TERMINAL EXTRACTOR (Part No. B-50085) to a 45 degree angle.
2. **Sumitomo DL sealed connectors:** Pry secondary lock away from connector.
3. See Figure A-24. Remove terminal from housing.
 - a. Insert the extractor into the cavity next to the terminal.
 - b. Press and hold the plastic tang (1) away from the terminal (3).
 - c. Gently pull the wire to remove the terminal from the connector housing (2).

INSTALL TERMINAL

1. Align terminal to the housing. Install the terminal into the housing. Terminal snaps into place.
2. Gently pull wire to verify terminals are locked.
3. **Sumitomo DL sealed connectors:** Install secondary lock into connector.

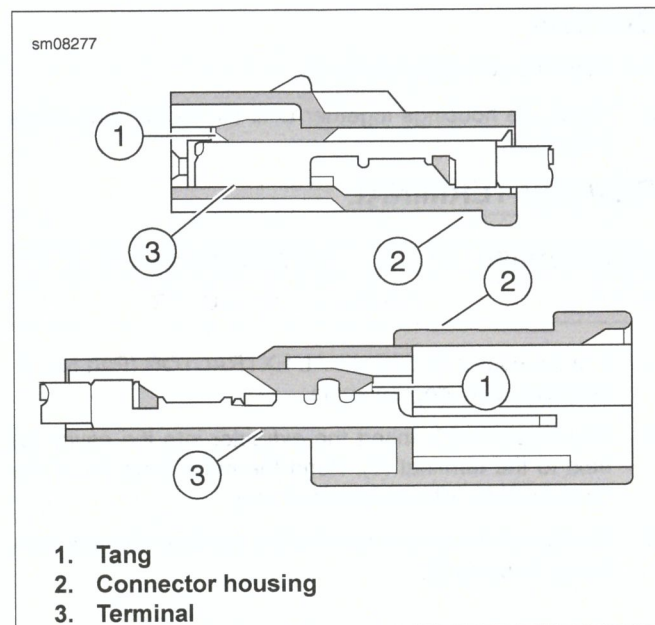


Figure A-24. Sumitomo MT Unsealed Connector

SUMITOMO MTW AND MTL UNSEALED CONNECTORS

A.7

DISCONNECT AND CONNECT

Disconnect

1. Press the locking tab.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the locking tab snaps into place.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. File the edge of a TERMINAL EXTRACTOR (Part No. B-50085) to a 45 degree angle.
2. See Figure A-25. Insert the extractor into the cavity (3) next to the terminal (1). Bend the metal tang (4) of the terminal flush with the terminal body.
3. Gently pull the wire to remove the terminal from the connector housing (2).

INSTALL TERMINAL

1. See Figure A-25. Bend metal tang (4) of terminal (1) up.
2. Align terminal to the housing. Install the terminal into the housing. Terminal will snap into place.
3. Gently pull wire to verify terminals are locked.

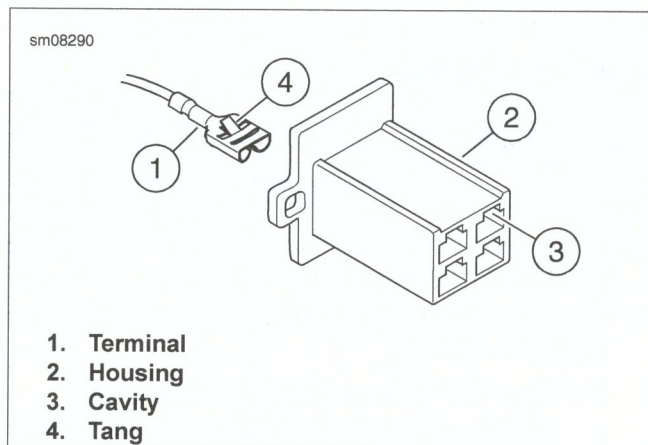


Figure A-25. Sumitomo MTW and MTL Unsealed Connector

DISCONNECT AND CONNECT

Disconnect

1. See Figure A-26. Press the release button (2).
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the connector clicks.

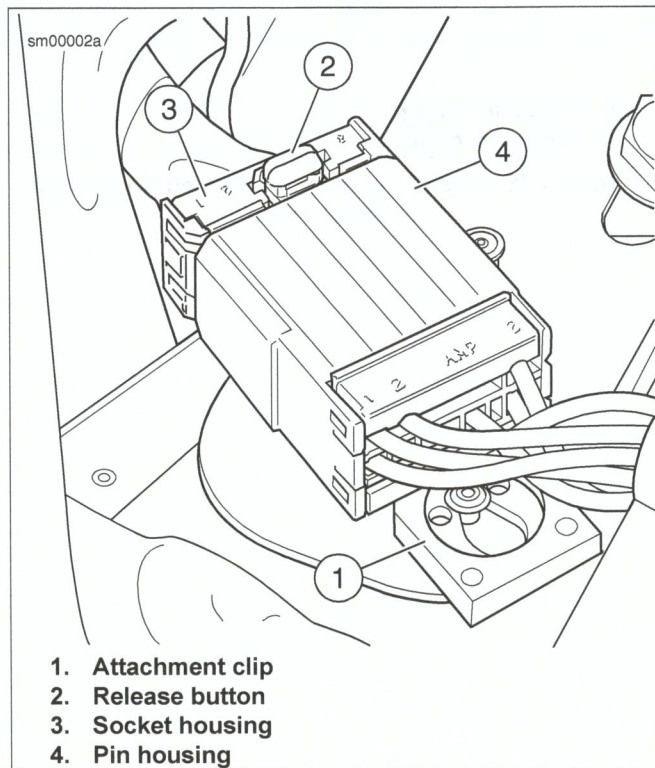


Figure A-26. Tyco 070 Multilock Unsealed Connector

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. See Figure A-27. Open secondary lock.
 - a. Lift latch (1) to free tab of secondary lock (2).
 - b. Repeat on the opposite latch.
 - c. Open the secondary lock.
2. Look in the terminal side of the connector (opposite the secondary lock). Note the cavity next to each terminal.

NOTE

When the tang is released, a click is heard.

3. Using TERMINAL EXTRACTOR (Part No. B-50085), press the tang (7 or 8) in the housing away from the terminal to release the terminal.
4. Gently pull on wire to remove terminal.

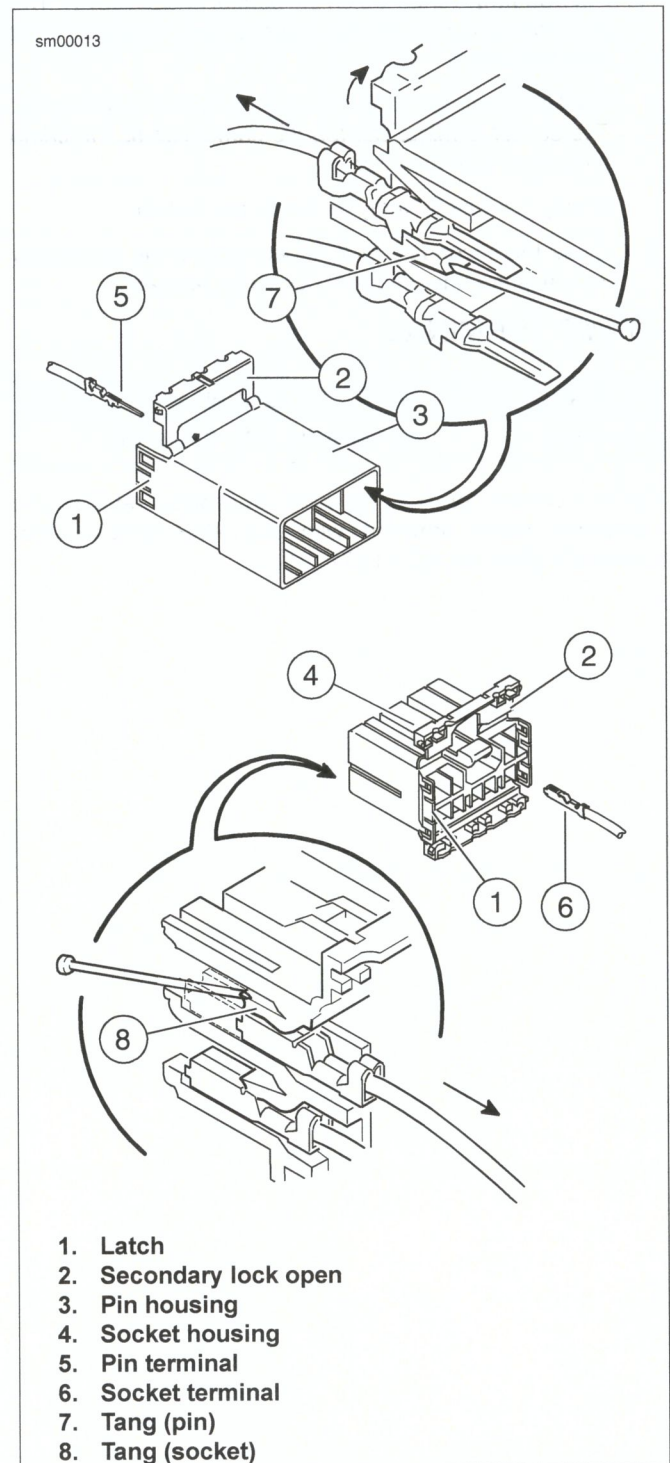


Figure A-27. Tyco 070 Multilock Unsealed Connector: Socket and Pin Housings

INSTALL TERMINAL

NOTE

Cavity numbers are stamped into the secondary locks of connector housings.

1. Align terminal to the housing. Install the terminal into housing. Terminal will snap into place.

NOTES

- The release button is always on the top of the connector.
 - **Pin housing:** Tangs are on the bottom of each cavity. The pin terminal slot (on the side opposite the crimp tails) must face the tang.
 - **Socket housing:** Tangs are on the top of each cavity. The socket terminal slot (on the same side as the crimp tails) must face the tang.
2. Gently pull wire to verify terminals are locked.
 3. Close the secondary lock. When locked, the secondary lock tabs are engaged with connector latches.

CRIMP TERMINAL

PART NUMBER	TOOL NAME
HD-41609	AMP MULTI-LOCK CRIMPER

For the correct terminal crimping procedure, refer to the instruction sheet provided with the AMP MULTI-LOCK CRIMPER (Part No. HD-41609).

See Figure A-28. Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.

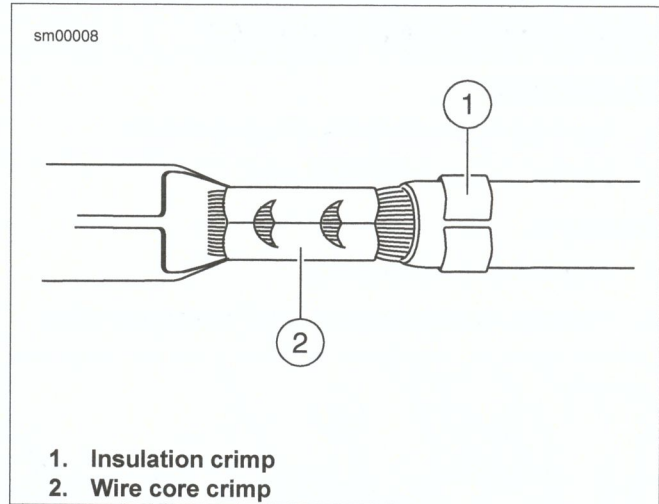


Figure A-28. Tyco 070 Multilock Unsealed Connector: Terminal Crimp

DISCONNECT AND CONNECT

Disconnect

1. See Figure A-29. Pull the latch lock open (1).
2. While pressing the latch (3), pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together.
3. Push the latch lock closed (2).

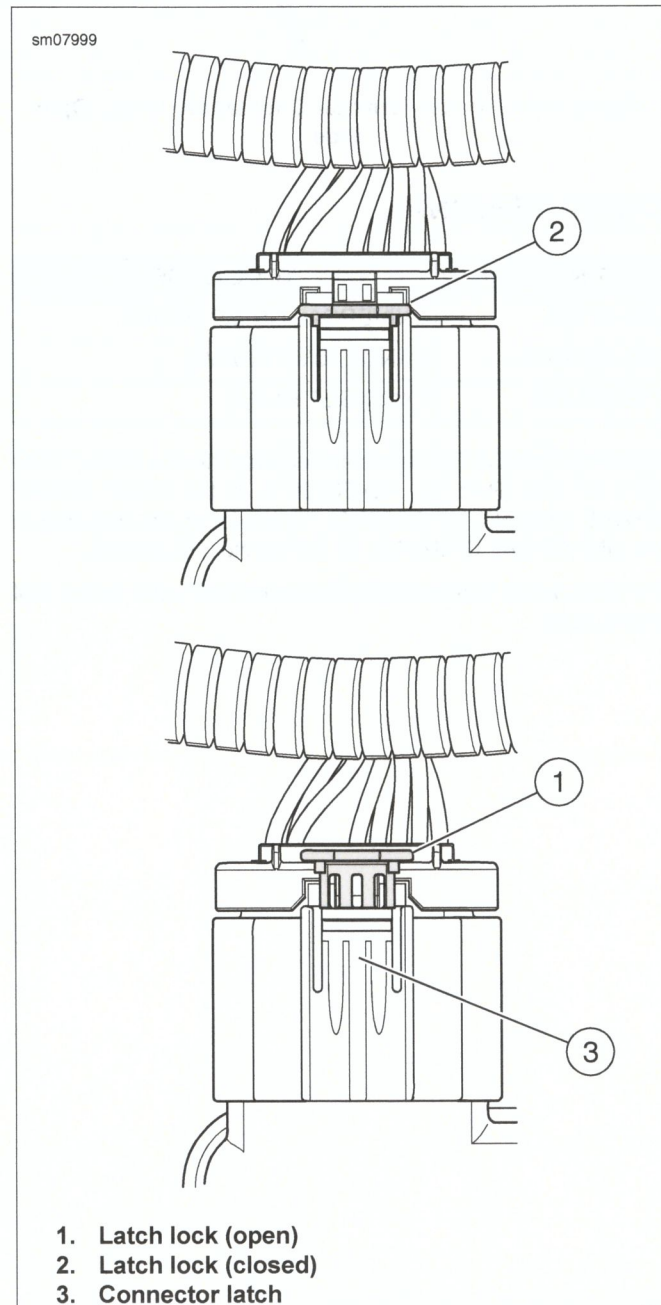


Figure A-29. Tyco GET 64 Sealed Connector Latch and Lock

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. See Figure A-30. Remove secondary lock from the housing.
2. See Figure A-31. Insert TERMINAL EXTRACTOR (Part No. B-50085) into the cavity next to the terminal.
3. Pry and hold the plastic tang away from the terminal.
4. Pull on the wire lead to remove the terminal.

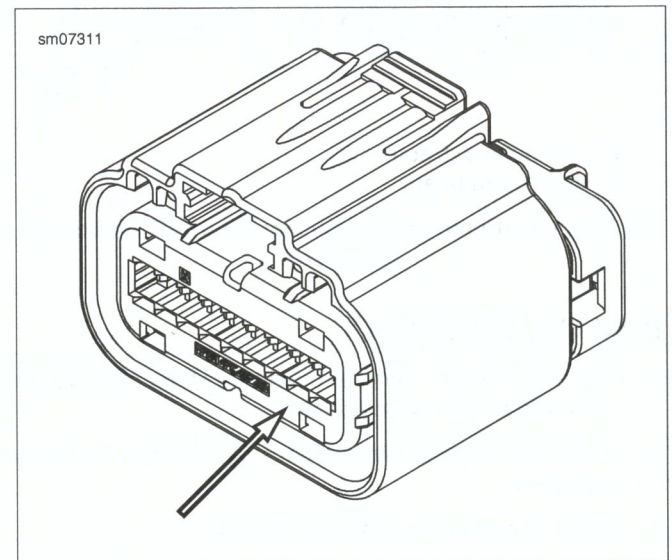


Figure A-30. Tyco GET 64 Secondary Lock

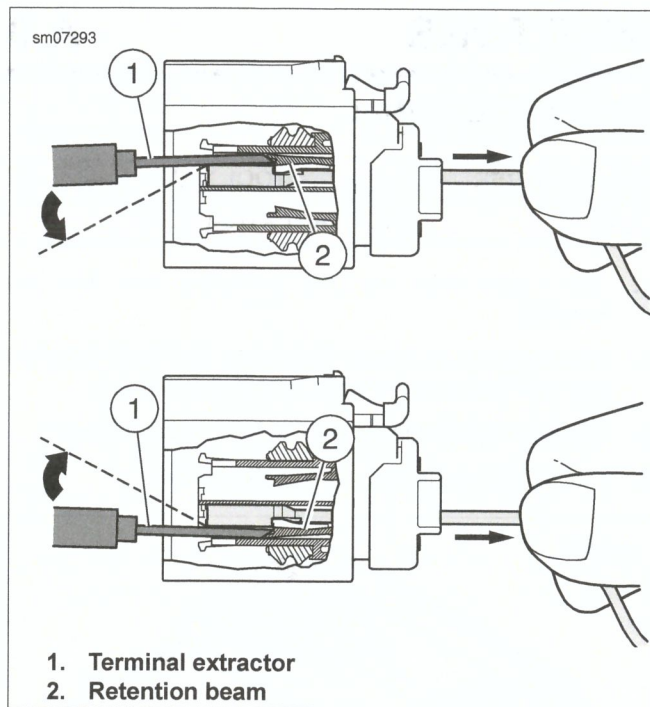


Figure A-31. Removing Terminals: Tyco GET 64 Sealed Connector

INSTALL TERMINAL

1. See Figure A-32. Align the open side of the crimp to the tang side of the housing cavity.
2. Install the terminal into the housing. Terminal will snap into place.
3. Install secondary lock into the housing.

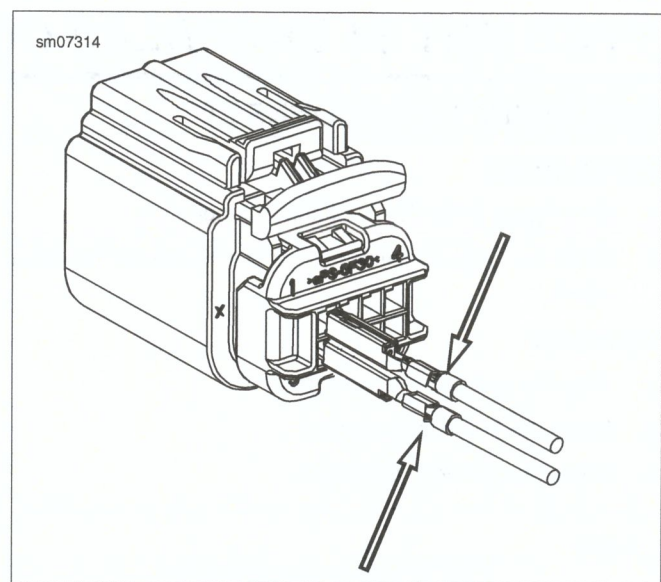


Figure A-32. Socket Terminal Orientation: Crimp Open Side

CRIMP TERMINAL

PART NUMBER	TOOL NAME
HD-50120	UNIVERSAL CRIMPER SET
HD-50120-2	HAND CRIMP FRAME
HD-50120-7	TYCO GET 64 DIE

Crimping Tyco GET 64 terminals requires the use of the TYCO GET 64 DIE (Part No. HD-50120-7) in the HAND CRIMP FRAME (Part No. HD-50120-2). These items are included in the UNIVERSAL CRIMPER SET (Part No. HD-50120).

For the correct terminal crimping procedure, refer to the tool instructions.

TYCO JUNIOR POWER TIMER UNSEALED CONNECTOR

A.10

DISCONNECT AND CONNECT

Remove fuses to access the terminals, as necessary.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
GA500A	SNAP-ON TERMINAL PICK

1. See Figure A-33. Insert smallest pair of pins on the SNAP-ON TERMINAL PICK (Part No. GA500A) into cavity on either side of terminal to press tangs on each side of terminal simultaneously.
2. Gently pull on wire to remove terminal from housing.

INSTALL TERMINAL

1. Bend tang on each side of terminal away from terminal body.
2. Install terminal into housing.
 - a. Align terminal to the housing. The open side of the terminal should face the wire lead that it will be connected to by fuse.
 - b. Install the terminal into housing until the terminal snaps into place.

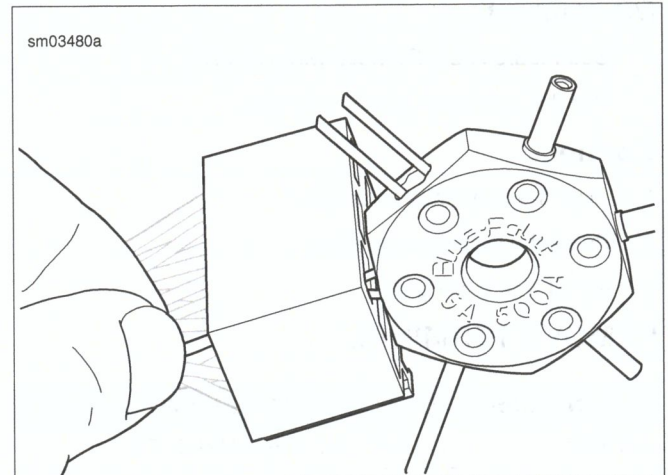


Figure A-33. Removing Autofuse Unsealed Terminal from Fuse Block

DISCONNECT AND CONNECT

Disconnect

1. See Figure A-34. Remove wire clip (1).
2. Pull the connector from the sensor.

Connect

1. Align the connector housings.
2. Press the housings together.
3. Install wire locking clip.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
GA500A	SNAP-ON TERMINAL PICK

1. See Figure A-34. Remove sealing boot (2) from housing (5).
2. Insert the smallest pins of the SNAP-ON TERMINAL PICK (Part No. GA500A) into the cavities (3) on each side of the terminal to compress the tangs (6) on each side of the terminal (4).
3. Gently pull on the wire to remove the terminal.

INSTALL TERMINAL

1. See Figure A-34. Bend the tangs (6) on each side of the terminal outward.

2. Align terminal (4) to the housing (5). Install the terminal into housing. Terminal will snap into place.

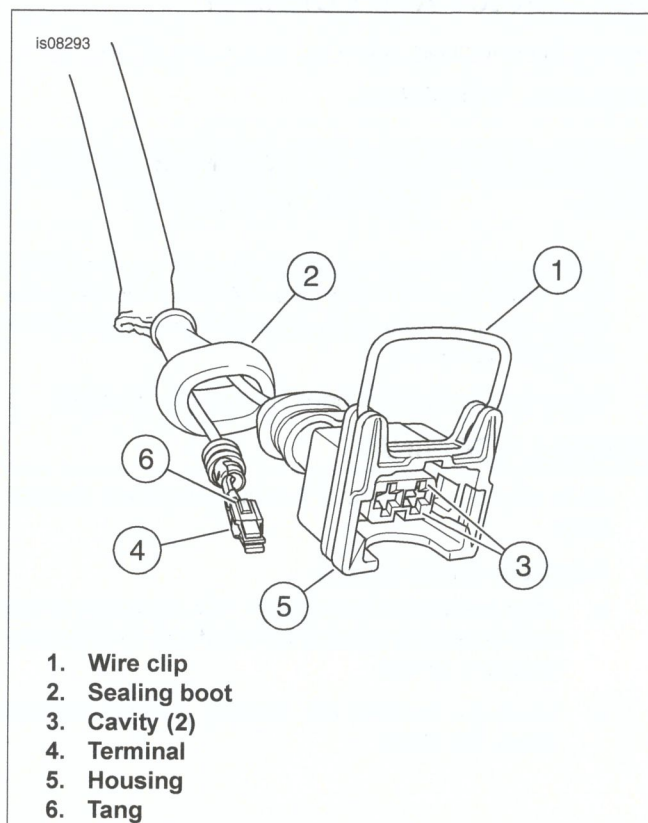


Figure A-34. Tyco Sealed Timer Connector

DISCONNECT AND CONNECT

Disconnect

1. Lift locking tab.
2. Pull the connector housings apart.

Connect

1. Align housings.
2. Press connector housings together until the locking tab clicks.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. File the edge of a TERMINAL EXTRACTOR (Part No. B-50085) to a 45 degree angle.
2. **Male connector:** See Figure A-35. Remove seal (4) from connector housing (2).
3. Lift locking tab on either side of housing and remove secondary lock (3) from connector housing (2).
4. See Figure A-35. Insert the extractor into the cavity next to the terminal. Press the plastic tang away from the terminal.
5. Gently pull the wire to remove the terminal from the connector housing (2).

INSTALL TERMINAL

1. Align terminal to the housing. Install the terminal into the housing. Terminal snaps into place.

2. Gently pull wire to verify terminals are locked.
3. See Figure A-35. Install secondary lock (4) into connector housing (2).
4. **Male connector:** Install seal (4).

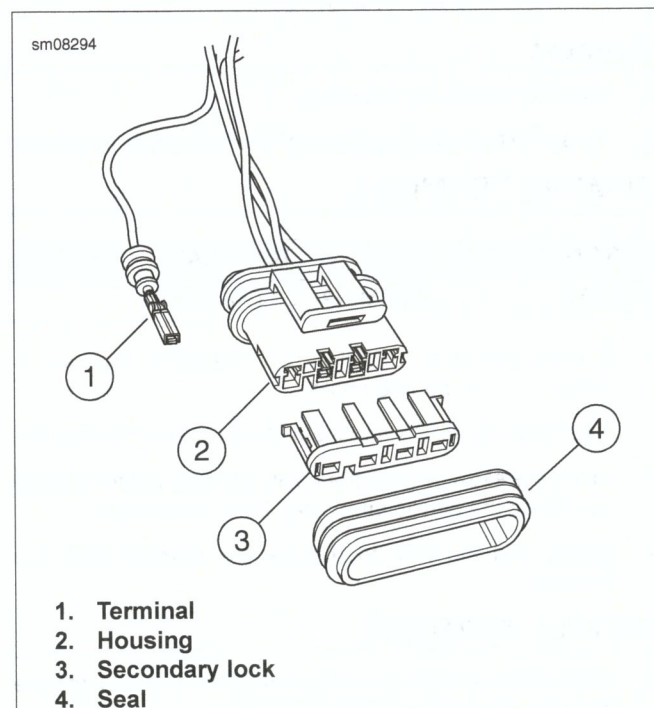


Figure A-35. Tyco Super Seal 1.5 Sealed Connector

DISCONNECT AND CONNECT

Disconnect

1. Press the release button.
2. Pull the connector housings apart.

Connect

1. Align the connector housings.
2. Press the housings together until the lock clicks into place.

REMOVE TERMINAL

PART NUMBER	TOOL NAME
B-50085	TERMINAL EXTRACTOR

1. File the edge of a TERMINAL EXTRACTOR (Part No. B-50085) to a 45 degree angle.
2. See Figure A-36. Pry secondary lock (1) from housing (3).
3. Insert the extractor into the cavity (4) next to the terminal (2). Press the plastic tang away from the terminal.
4. Gently pull the wire to remove the terminal from the housing.

INSTALL TERMINAL

1. Align terminal to the housing. Install the terminal into the housing. Terminal will snap into place.

2. Gently pull wire to verify terminals are locked.
3. See Figure A-36. Install secondary lock into connector (1).

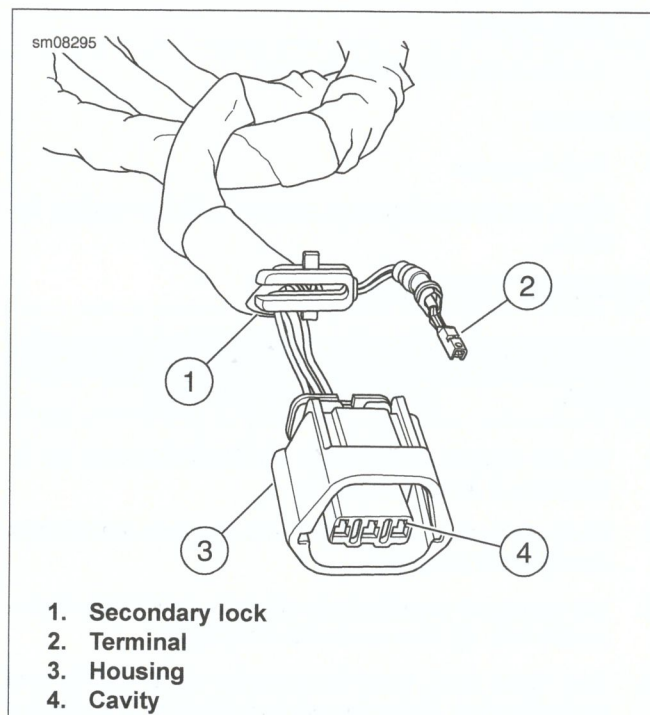


Figure A-36. Yazaki SSD Sealed Connector

SUBJECT	PAGE NO.
B.1 LENGTH CONVERSION.....	B-1
B.2 FLUID CONVERSION.....	B-2
B.3 TORQUE CONVERSION.....	B-3
B.4 GLOSSARY	B-4

NOTES

LENGTH CONVERSION

B.1

CONVERSION TABLE

Table B-1. Metric Conversions

MILLIMETERS to INCHES (MM x 0.03937 = IN)								INCHES to MILLIMETERS (IN x 25.40 = MM)							
mm	in	mm	in	mm	in	mm	in	in	mm	in	mm	in	mm	in	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1-15/16	49.21	3-5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3-3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2-1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3-7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2-1/8	53.97	3-1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2-3/16	55.56	3-9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2-1/4	57.15	3-5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3-11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2-5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2-3/8	60.32	3-3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1-1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2-7/16	61.91	3-13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1-1/8	28.57	2-1/2	63.50	3-7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1-3/16	30.16	2-9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3-15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1-1/4	31.75	2-5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2-11/16	68.26	4-1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1-5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1-3/8	34.92	2-3/4	69.85	4-1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4-3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1-7/16	36.51	2-13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1-1/2	38.10	2-7/8	73.02	4-1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1-9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2-15/16	74.61	4-5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1-5/8	41.27	3	76.20	4-3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1-11/16	42.86	3-1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4-7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1-3/4	44.45	3-1/8	79.37	4-1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3-3/16	80.96	4-9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1-13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1-7/8	47.62	3-1/4	82.55	4-5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4-11/16	119.06

UNITED STATES SYSTEM

Unless otherwise specified, all fluid volume measurements in this manual are expressed in United States (U.S.) units-of-measure. See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). To convert between U.S. units-of-measure and metric units-of-measure, refer to the following:

- fluid ounces (U.S.) $\times$ 29.574 = milliliters
- pints (U.S.) $\times$ 0.473 = liters
- quarts (U.S.) $\times$ 0.946 = liters
- gallons (U.S.) $\times$ 3.785 = liters
- milliliters $\times$ 0.0338 = fluid ounces (U.S.)
- liters $\times$ 2.114 = pints (U.S.)
- liters $\times$ 1.057 = quarts (U.S.)
- liters $\times$ 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. To convert between U.S. units and British Imperial units, refer to the following:

- fluid ounces (U.S.) $\times$ 1.042 = fluid ounces (Imp.)
- pints (U.S.) $\times$ 0.833 = pints (Imp.)
- quarts (U.S.) $\times$ 0.833 = quarts (Imp.)
- gallons (U.S.) $\times$ 0.833 = gallons (Imp.)
- fluid ounces (Imp.) $\times$ 0.960 = fluid ounces (U.S.)
- pints (Imp.) $\times$ 1.201 = pints (U.S.)
- quarts (Imp.) $\times$ 1.201 = quarts (U.S.)
- gallons (Imp.) $\times$ 1.201 = gallons (U.S.)

UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) X 12.00000 = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) X 0.08333 = foot pounds (ft-lbs).

METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) X 0.737563 = foot pounds (ft-lbs).
- Newton meters (Nm) X 8.85085 = inch pounds (**in-lbs**).
- foot pounds (ft-lbs) X 1.35582 = Newton meters (Nm).
- inch pounds (**in-lbs**) X 0.112985 = Newton meters (Nm).

ACRONYMS AND ABBREVIATIONS

Table B-2. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AAT	Ambient air temperature
ABS	Anti-lock braking system
AC	Alternating current
ACC	Accessory position on ignition switch
ACR	Automatic compression release
AGM	Absorbed glass mat (battery)
Ah	Ampere-hour
AIS	Active Intake Solenoid
AWG	American wire gauge
B+	Battery voltage
bar	Bar
BAS	Bank angle sensor
BCM	Body control module
BOB	Breakout box
BTDC	Before top dead center
°C	Celsius (Centigrade)
CA	California
CAL	Calibration
CAN	Controller area network
CB Tx	CB send transmission
CB Rx	CB receive transmission
cc	Cubic centimeters
CCA	Cold cranking amps
CCW	Counterclockwise
CKP	Crankshaft position
cm	Centimeters
cm ³	Cubic centimeters
CW	Clockwise
DC	Direct current
DLC	Data link connector
DOM	Domestic
DOT	Department of Transportation
DTC	Diagnostic trouble code
DVOM	Digital volt ohm meter
ECM	Electronic control module
ECT	Engine coolant temperature
ECU	Electronic Control Unit
EEPROM	Electrically erasable programmable read only memory
EFI	Electronic fuel injection
EHCU	Electro Hydraulic Control Unit

Table B-2. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
ET	Engine temperature
ETC	Electronic throttle control
EVAP	Evaporative emissions control system
°F	Fahrenheit
fl oz	Fluid ounce
FPS	Fuel pressure sensor
ft	Feet
ft-lbs	Foot pounds
FTP	Flash to pass
g	Gram
gal	Gallon
GAWR	Gross axle weight rating
GND	Ground (electrical)
GPS	Global positioning system
GVWR	Gross vehicle weight rating
HCU	Hydraulic control unit
HDI	Harley-Davidson International
HD-Link	Networking system
H-DSSS	Harley-Davidson smart security system
HFM	Hands-free mode
HFSM	Hands-free security module
Hg	Mercury
H02S	Heated oxygen sensor
hp	Horsepower
hr	Hour
IAC	Idle air control
IAT	Intake air temperature
IC	Instrument cluster
ID	Inside diameter
IGN	Ignition light/key switch position
in	inch
in ³	Cubic inch
INJ PW	Injector pulse width
INTCM	Intercom
in-lbs	Inch pounds
JSS	Jiffy stand sensor
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour
kPa	Kilopascal
kW	Kilowatt
L	Liter
lb	Pounds
LCD	Liquid crystal display

Table B-2. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
LED	Light emitting diode
LH	Left hand
LHCM	Left hand control module
LP	License plate
LT	Left
mA	Milliampere
MAP	Manifold absolute pressure
max	Maximum
mi	Mile
min	Minimum
mL	Milliliter
mm	Millimeter
mph	Miles per hour
ms	Millisecond
Nm	Newton-meter
NIM	Navigation interface module
NiMH	Nickel metal hydride
N/A	Not applicable
O ₂	Oxygen
OD	Outside diameter
OEM	Original equipment manufacturer
oz	Ounce
P&A	Parts and Accessories
Part No.	Part number
PIN	Personal identification number
PND	Personal navigation device
psi	Pounds per square inch
PWM signal	Pulse width modulated signal
qt	Quart
RAD	Radio
RCM	Reverse control module
RDS	Radio data system
RES	Reserve mark on fuel supply valve
RH	Right hand
RHCM	Right hand control module
rpm	Revolutions per minute
RT	Right
s	Seconds
SCFH	Cubic feet per hour at standard conditions
SDARS	Satellite digital audio radio service
SPDO	Speedometer
SPKR	Speaker
STT	Stop/tail/turn
TA	Traffic announcement

Table B-2. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
TCA	Throttle control actuator
TDC	Top dead center
TGS	Twist grip sensor
TPS	Throttle position sensor
TSM	Turn signal module
TSSM	Turn signal/security module
USB	Universal serial bus
V	Volt
VAC	Volts of alternating current
VDC	Volts of direct current
VIN	Vehicle identification number
VR	Voice recognition
VSS	Vehicle speed sensor
W	Watt
WA	Weather alert
WSS	Wheel speed sensor

NOTES

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
B-50085	TERMINAL EXTRACTOR	A.4 FURUKAWA QLW SEALED CONNECTORS, Remove Terminal
B-50085	TERMINAL EXTRACTOR	A.6 SUMITOMO DL SEALED AND MT CONNECTORS, Remove Terminal
B-50085	TERMINAL EXTRACTOR	A.9 TYCO GET 64 UNSEALED CONNECTORS, Remove Terminal
B-50085	TERMINAL EXTRACTOR	A.12 TYCO SUPER SEAL 1.5 SEALED CONNECTOR, Remove Terminal
GA500A	SNAP-ON TERMINAL PICK	A.1 BOSCH COMPACT 1.1M CONNECTORS, Remove Terminal
GA500A	SNAP-ON TERMINAL PICK	A.10 TYCO JUNIOR POWER TIMER UNSEALED CONNECTOR, Remove Terminal
GRX-3110 HD	BATTERY DIAGNOSTIC STATION	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
GRX-3110 HD	BATTERY DIAGNOSTIC STATION	2.1 BATTERY TESTING, Battery Diagnostic Test
HD-23738	VACUUM PUMP	6.4 TMAP SENSOR DIAGNOSTICS, Description and Operation
HD-26792	SPARK TESTER	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-26792	SPARK TESTER	6.22 ENGINE CRANKS, BUT WILL NOT START, Engine Cranks but Will Not Start
HD-26792	SPARK TESTER	6.24 ENGINE PERFORMANCE DIAGNOSTICS, Hesitation or Loss of Power Test
HD-26792	SPARK TESTER	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-34730-2E	FUEL INJECTOR TEST LIGHT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-34730-2E	FUEL INJECTOR TEST LIGHT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-39617	FLUKE AC/DC CURRENT PROBE	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39617	FLUKE AC/DC CURRENT PROBE	2.4 TESTING STARTER ON BENCH, Free Running Current Draw Test
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.3 DEUTSCH DT SEALED CONNECTORS, Crimp Terminal
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-41199-3	IAC TEST LIGHT	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41199-3	IAC TEST LIGHT	6.12 IDLE SPEED CONTROL DIAGNOSTICS, DTC P0506, P0507
HD-41404	HARNESS CONNECTOR TEST KIT	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41404	HARNESS CONNECTOR TEST KIT	2.2 STARTING SYSTEM, Starter Testing
HD-41404	HARNESS CONNECTOR TEST KIT	2.5 CHARGING SYSTEM, Battery Charging Tests
HD-41404	HARNESS CONNECTOR TEST KIT	3.3 INDICATOR LAMPS, Neutral Lamp Always On
HD-41404	HARNESS CONNECTOR TEST KIT	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-41404	HARNESS CONNECTOR TEST KIT	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0108
HD-41404	HARNESS CONNECTOR TEST KIT	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0113
HD-41404	HARNESS CONNECTOR TEST KIT	6.5 ECT SENSOR DIAGNOSTICS, DTC P0117
HD-41404	HARNESS CONNECTOR TEST KIT	6.5 ECT SENSOR DIAGNOSTICS, DTC P0118
HD-41404	HARNESS CONNECTOR TEST KIT	6.6 TPS DIAGNOSTICS, DTC P0122
HD-41404	HARNESS CONNECTOR TEST KIT	6.6 TPS DIAGNOSTICS, DTC P0123
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0031

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0032
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0052
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0132
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0151
HD-41404	HARNESS CONNECTOR TEST KIT	6.7 HO2S DIAGNOSTICS, DTC P0152
HD-41404	HARNESS CONNECTOR TEST KIT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-41404	HARNESS CONNECTOR TEST KIT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-41404	HARNESS CONNECTOR TEST KIT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-41404	HARNESS CONNECTOR TEST KIT	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-41404	HARNESS CONNECTOR TEST KIT	6.9 CKP SENSOR DIAGNOSTICS, DTC P0371, P0374
HD-41404	HARNESS CONNECTOR TEST KIT	6.10 PURGE SOLENOID DIAGNOSTICS, DTC P0445
HD-41404	HARNESS CONNECTOR TEST KIT	6.11 VSS DIAGNOSTICS, DTC P0503
HD-41404	HARNESS CONNECTOR TEST KIT	6.12 IDLE SPEED CONTROL DIAGNOSTICS, DTC P0506, P0507
HD-41404	HARNESS CONNECTOR TEST KIT	6.14 DTC P0641, DTC P0641
HD-41404	HARNESS CONNECTOR TEST KIT	6.15 COOLING FAN DIAGNOSTICS, DTC P0692
HD-41404	HARNESS CONNECTOR TEST KIT	6.15 COOLING FAN DIAGNOSTICS, Fan Inoperative, No DTCs
HD-41404	HARNESS CONNECTOR TEST KIT	6.16 SYSTEM RELAY DIAGNOSTICS, DTC P1001
HD-41404	HARNESS CONNECTOR TEST KIT	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1151
HD-41404	HARNESS CONNECTOR TEST KIT	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1152
HD-41404	HARNESS CONNECTOR TEST KIT	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS, DTC P1353, P1356
HD-41404	HARNESS CONNECTOR TEST KIT	6.20 CHECK ENGINE LIGHT DIAGNOSTICS, DTC P1652, Check Engine Lamp Always On
HD-41404	HARNESS CONNECTOR TEST KIT	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2301
HD-41404	HARNESS CONNECTOR TEST KIT	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2304
HD-41404	HARNESS CONNECTOR TEST KIT	6.22 ENGINE CRANKS, BUT WILL NOT START, Engine Cranks but Will Not Start
HD-41404	HARNESS CONNECTOR TEST KIT	6.25 STARTS, THEN STALLS, Starts, Then Stalls
HD-41404	HARNESS CONNECTOR TEST KIT	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-41404	HARNESS CONNECTOR TEST KIT	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-41404	HARNESS CONNECTOR TEST KIT	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.3 INDICATOR LAMPS, Low Fuel Lamp Inoperative
HD-41475	DEUTSCH TERMINAL REPAIR KIT	A.3 DEUTSCH DT SEALED CONNECTORS, Disconnect and Connect
HD-41475-100	FLAT BLADE L-HOOK	A.3 DEUTSCH DT SEALED CONNECTORS, Disconnect and Connect
HD-41609	AMP MULTI-LOCK CRIMPER	A.8 TYCO 070 MULTILOCK UNSEALED CONNECTOR, Crimp Terminal
HD-48114	TERMINAL REMOVER	A.5 MOLEX MX 150 SEALED CONNECTORS, Remove Terminal

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-48119	TERMINAL CRIMPER	A.5 MOLEX MX 150 SEALED CONNECTORS, Crimp Terminal
HD-48650	DIGITAL TECHNICIAN II	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-48650	DIGITAL TECHNICIAN II	1.4 DIAGNOSTICS AND TROUBLESHOOTING, Job/Time Codes Values
HD-48650	DIGITAL TECHNICIAN II	6.7 HO2S DIAGNOSTICS, Description and Operation
HD-48650	DIGITAL TECHNICIAN II	6.12 IDLE SPEED CONTROL DIAGNOSTICS, Description and Operation
HD-50120	UNIVERSAL CRIMPER SET	A.9 TYCO GET 64 UNSEALED CONNECTORS, Crimp Terminal
HD-50120-2	HAND CRIMP FRAME	A.9 TYCO GET 64 UNSEALED CONNECTORS, Crimp Terminal
HD-50120-7	TYCO GET 64 DIE	A.9 TYCO GET 64 UNSEALED CONNECTORS, Crimp Terminal
HD-50390-1	BREAKOUT BOX	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-50390-1	BREAKOUT BOX	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-50390-1	BREAKOUT BOX	1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-50390-1	BREAKOUT BOX	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-1	BREAKOUT BOX	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-1	BREAKOUT BOX	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0108
HD-50390-1	BREAKOUT BOX	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0112
HD-50390-1	BREAKOUT BOX	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0113
HD-50390-1	BREAKOUT BOX	6.5 ECT SENSOR DIAGNOSTICS, DTC P0117
HD-50390-1	BREAKOUT BOX	6.5 ECT SENSOR DIAGNOSTICS, DTC P0118
HD-50390-1	BREAKOUT BOX	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-1	BREAKOUT BOX	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-1	BREAKOUT BOX	6.6 TPS DIAGNOSTICS, DTC P0123
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0031
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0032
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0051
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0052
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0131
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0132
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0134
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0151
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0152
HD-50390-1	BREAKOUT BOX	6.7 HO2S DIAGNOSTICS, DTC P0154
HD-50390-1	BREAKOUT BOX	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-50390-1	BREAKOUT BOX	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-50390-1	BREAKOUT BOX	6.9 CKP SENSOR DIAGNOSTICS, DTC P0371, P0374
HD-50390-1	BREAKOUT BOX	6.10 PURGE SOLENOID DIAGNOSTICS, DTC P0444
HD-50390-1	BREAKOUT BOX	6.11 VSS DIAGNOSTICS, DTC P0502
HD-50390-1	BREAKOUT BOX	6.11 VSS DIAGNOSTICS, DTC P0503

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-50390-1	BREAKOUT BOX	6.12 IDLE SPEED CONTROL DIAGNOSTICS, DTC P0506, P0507
HD-50390-1	BREAKOUT BOX	6.14 DTC P0641, DTC P0641
HD-50390-1	BREAKOUT BOX	6.15 COOLING FAN DIAGNOSTICS, DTC P0691
HD-50390-1	BREAKOUT BOX	6.15 COOLING FAN DIAGNOSTICS, Fan Inoperative, No DTCs
HD-50390-1	BREAKOUT BOX	6.16 SYSTEM RELAY DIAGNOSTICS, DTC P1001
HD-50390-1	BREAKOUT BOX	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1151
HD-50390-1	BREAKOUT BOX	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1152
HD-50390-1	BREAKOUT BOX	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS, DTC P1353, P1356
HD-50390-1	BREAKOUT BOX	6.19 JSS DIAGNOSTICS, DTC P1502
HD-50390-1	BREAKOUT BOX	6.20 CHECK ENGINE LIGHT DIAGNOSTICS, DTC P1652, Check Engine Lamp Always On
HD-50390-1	BREAKOUT BOX	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2300
HD-50390-1	BREAKOUT BOX	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2303
HD-50390-1	BREAKOUT BOX	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-50390-1	BREAKOUT BOX	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-50390-1	BREAKOUT BOX	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-50390-4	ECM CABLE	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-50390-4	ECM CABLE	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-50390-4	ECM CABLE	1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-50390-4	ECM CABLE	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-4	ECM CABLE	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-4	ECM CABLE	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0108
HD-50390-4	ECM CABLE	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0112
HD-50390-4	ECM CABLE	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0113
HD-50390-4	ECM CABLE	6.5 ECT SENSOR DIAGNOSTICS, DTC P0117
HD-50390-4	ECM CABLE	6.5 ECT SENSOR DIAGNOSTICS, DTC P0118
HD-50390-4	ECM CABLE	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-4	ECM CABLE	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-4	ECM CABLE	6.6 TPS DIAGNOSTICS, DTC P0123
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0031
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0032
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0051
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0052
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0131
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0132
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0134
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0151

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0152
HD-50390-4	ECM CABLE	6.7 HO2S DIAGNOSTICS, DTC P0154
HD-50390-4	ECM CABLE	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-50390-4	ECM CABLE	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-50390-4	ECM CABLE	6.9 CKP SENSOR DIAGNOSTICS, DTC P0371, P0374
HD-50390-4	ECM CABLE	6.10 PURGE SOLENOID DIAGNOSTICS, DTC P0444
HD-50390-4	ECM CABLE	6.11 VSS DIAGNOSTICS, DTC P0502
HD-50390-4	ECM CABLE	6.11 VSS DIAGNOSTICS, DTC P0503
HD-50390-4	ECM CABLE	6.12 IDLE SPEED CONTROL DIAGNOSTICS, DTC P0506, P0507
HD-50390-4	ECM CABLE	6.14 DTC P0641, DTC P0641
HD-50390-4	ECM CABLE	6.15 COOLING FAN DIAGNOSTICS, DTC P0691
HD-50390-4	ECM CABLE	6.15 COOLING FAN DIAGNOSTICS, Fan Inoperative, No DTCs
HD-50390-4	ECM CABLE	6.16 SYSTEM RELAY DIAGNOSTICS, DTC P1001
HD-50390-4	ECM CABLE	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1151
HD-50390-4	ECM CABLE	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1152
HD-50390-4	ECM CABLE	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS, DTC P1353, P1356
HD-50390-4	ECM CABLE	6.19 JSS DIAGNOSTICS, DTC P1502
HD-50390-4	ECM CABLE	6.20 CHECK ENGINE LIGHT DIAGNOSTICS, DTC P1652, Check Engine Lamp Always On
HD-50390-4	ECM CABLE	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2300
HD-50390-4	ECM CABLE	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2303
HD-50390-4	ECM CABLE	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-50390-4	ECM CABLE	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-50390-4	ECM CABLE	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-50390-4-P	ECM OVERLAY	1.3 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-50390-4-P	ECM OVERLAY	1.4 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-50390-4-P	ECM OVERLAY	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-4-P	ECM OVERLAY	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0107
HD-50390-4-P	ECM OVERLAY	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0108
HD-50390-4-P	ECM OVERLAY	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0112
HD-50390-4-P	ECM OVERLAY	6.4 TMAP SENSOR DIAGNOSTICS, DTC P0113
HD-50390-4-P	ECM OVERLAY	6.5 ECT SENSOR DIAGNOSTICS, DTC P0117
HD-50390-4-P	ECM OVERLAY	6.5 ECT SENSOR DIAGNOSTICS, DTC P0118
HD-50390-4-P	ECM OVERLAY	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-4-P	ECM OVERLAY	6.6 TPS DIAGNOSTICS, DTC P0122
HD-50390-4-P	ECM OVERLAY	6.6 TPS DIAGNOSTICS, DTC P0123
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0031

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0032
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0051
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0052
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0131
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0132
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0134
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0151
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0152
HD-50390-4-P	ECM OVERLAY	6.7 HO2S DIAGNOSTICS, DTC P0154
HD-50390-4-P	ECM OVERLAY	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0261
HD-50390-4-P	ECM OVERLAY	6.8 FUEL INJECTOR DIAGNOSTICS, DTC P0264
HD-50390-4-P	ECM OVERLAY	6.9 CKP SENSOR DIAGNOSTICS, DTC P0371, P0374
HD-50390-4-P	ECM OVERLAY	6.10 PURGE SOLENOID DIAGNOSTICS, DTC P0444
HD-50390-4-P	ECM OVERLAY	6.11 VSS DIAGNOSTICS, DTC P0502
HD-50390-4-P	ECM OVERLAY	6.11 VSS DIAGNOSTICS, DTC P0503
HD-50390-4-P	ECM OVERLAY	6.12 IDLE SPEED CONTROL DIAGNOSTICS, DTC P0506, P0507
HD-50390-4-P	ECM OVERLAY	6.14 DTC P0641, DTC P0641
HD-50390-4-P	ECM OVERLAY	6.15 COOLING FAN DIAGNOSTICS, DTC P0691
HD-50390-4-P	ECM OVERLAY	6.15 COOLING FAN DIAGNOSTICS, Fan Inoperative, No DTCs
HD-50390-4-P	ECM OVERLAY	6.16 SYSTEM RELAY DIAGNOSTICS, DTC P1001
HD-50390-4-P	ECM OVERLAY	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1151
HD-50390-4-P	ECM OVERLAY	6.17 BANK ANGLE SENSOR DIAGNOSTICS, DTC P1152
HD-50390-4-P	ECM OVERLAY	6.18 COMBUSTION EFFICIENCY DIAGNOSTICS, DTC P1353, P1356
HD-50390-4-P	ECM OVERLAY	6.19 JSS DIAGNOSTICS, DTC P1502
HD-50390-4-P	ECM OVERLAY	6.20 CHECK ENGINE LIGHT DIAGNOSTICS, DTC P1652, Check Engine Lamp Always On
HD-50390-4-P	ECM OVERLAY	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2300
HD-50390-4-P	ECM OVERLAY	6.21 IGN COIL DRIVER DIAGNOSTICS, DTC P2303
HD-50390-4-P	ECM OVERLAY	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-50390-4-P	ECM OVERLAY	6.27 LOSS OF COMMUNICATION, Lost Communication
HD-50390-4-P	ECM OVERLAY	6.27 LOSS OF COMMUNICATION, Lost Communication
YA840	SNAP-ON IN-LINE SPARK TESTER	6.26 MISFIRE AT IDLE OR UNDER LOAD, In-line Spark Tester

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FASTENER	TORQUE VALUE	NOTES
No torque values were found in this manual.		

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