2009 BUELL® ELECTRICAL DIAGNOSTIC MANUAL

BUELL® 1125 MODELS

OFFICIAL FACTORY MANUAL – 99949-09Y

IMPORTANT NOTICE

Buell motorcycles conform to all applicable U.S.A. Federal Motor Vehicle Safety Standards and U.S.A. Environmental Protection Agency regulations effective on the date of manufacture.

To maintain the safety, dependability, and emission and noise control performance, it is essential that the procedures, specifications and service instructions in this manual are followed.

Any substitution, alteration or adjustment of emission system and noise control components outside of factory specifications may be prohibited by law.

Buell Motorcycle Company

Buell®

AMERICAN MOTORCYCLES

2009 Buell 1125 Electrical Diagnostics Manual

99949-09Y

Printed in the U.S.A.

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http://www.buell.com

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2009 Buell 1125 Electrical Diagnostics Manual (99949-09Y)

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NOTES

ABOUT THIS MANUAL

GENERAL

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

HOW TO USE YOUR SERVICE MANUAL

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

NO.	CHAPTER
1	General Information
2	Initial Diagnostics and Serial Data
3	Starting/Charging
4	Instruments
5	Accessories, Horn, Lights, and Security
6	Engine Management
A	Appendix A Connector Repair
B	Appendix B Wiring
C	Appendix C Conversions
D	Appendix D Glossary

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

For example, a cross-reference shown as **2.1 SPECIFICATIONS** refers to chapter 2 CHASSIS, heading 2.1 SPECIFICATIONS.

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

A number of acronyms and abbreviations are used in this document. See the D.1 GLOSSARY for a list of acronyms, abbreviations and definitions.

PREPARATION FOR SERVICE

⚠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. A clean work area at the start of each job will allow you to perform the repair as easily and quickly as possible, and will reduce the incidence of misplaced tools and parts. A motorcycle that is excessively dirty should be cleaned before work starts. Cleaning will occasionally uncover sources of trouble. Tools, instruments and any parts needed for the job should be gathered before work is started. Interrupting a job to locate tools or parts is a distraction and causes needless delay.

NOTES

- *To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*

SERVICE BULLETINS

In addition to the information presented in this manual, Buell Motor Company will periodically issue Service Bulletins to Buell 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

Do not use aftermarket parts and custom made front forks which can adversely affect performance and handling. Removing or altering factory installed parts can adversely affect performance and could result in death or serious injury. (00001a)

To verify satisfactory and lasting repairs, carefully follow the manual instructions and use only genuine Buell replacement parts. 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)

CAUTION

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage. (00140a)

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 is 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, please remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

Since Buell Motorcycle Company 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 Buell Motorcycle Company 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.

Kent-Moore Products

All tools mentioned in this manual with an "HD", "J" or "B" preface must be ordered through SPX Kent-Moore. For ordering information or product returns, warranty or otherwise, visit www.spx.com.

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, please contact Loctite Corp. at www.loctite.com.

PRODUCT REGISTERED MARKS

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

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1125CR, 1125R, Blast, Buell, Firebolt, Glaze, Gloss, Harley, Harley-Davidson, HD, H-D, Lightning, Sunwash, Tender, Triple Tail, Thunderstorm, Ulysses, Uniplanar, ZTL and ZTL-2 are among the trademarks of H-D Michigan, Inc.

CONTENTS

All photographs, illustrations and procedures in this manual 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, Buell Motorcycle Company reserves the right to change specifications, equipment or designs at any time without notice and without incurring obligation.

GENERAL INFORMATION

1.1 SPECIFICATIONS AND COMPONENT LOCATIONS

1.2 DIAGNOSTIC TOOLS

1.3 DIAGNOSTICS/TROUBLESHOOTING

INITIAL DIAGNOSTICS AND SERIAL DATA

2.1 INITIAL DIAGNOSTICS

2.2 SERIAL DATA COMMUNICATION

STARTING/CHARGING

3.1 STARTING SYSTEM DIAGNOSTICS

3.2 TESTING STARTER ON MOTORCYCLE

3.3 CHARGING SYSTEM DIAGNOSTICS

3.4 BATTERY TESTING

INSTRUMENTS

4.1 INSTRUMENT CLUSTER AND GAUGES

4.2 FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005

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SPECIFICATIONS AND COMPONENT LOCATIONS 1.1

SPECIFICATIONS

Table 1-1. Fuel System Specifications

FUEL SYSTEM	TYPE
Intake	Dual 61 mm down draft throttle bodies
Fuel delivery	DDFI3 Fuel Injection
Recommended fuel	91 Octane

Table 1-2. Idle Speed Specifications

ADJUSTMENT	RPM
Normal idle speed	1250 Nominal, non-adjustable

Table 1-3. Battery Specifications

BATTERY	SPECIFICATIONS
Size	12 VDC/12 AH/200CCA
Type	Sealed, AGM

Table 1-4. Spark Plug Specifications

SPARK PLUG	SPECIFICATIONS	
Size	10 mm	
Type	NGK CR9EKB	
Gap	0.032 in.	0.81 mm
Torque	7-9 ft-lbs	10-12 Nm

Table 1-5. Starter Specifications

STARTER	SPECIFICATIONS
Type	900 W electric with one-way clutch

Table 1-6. Fuel Pump Pressure Specifications

RANGE	VALUE
Normal	58 psi (400 kPA)
Key ON/OFF (20 minutes after key OFF)	75 psi (517 kPA)
100% duty cycle	80 psi (551 kPA)

Table 1-7. Relay Specifications

RELAY	PART NO.
Auxiliary	31522-00C
Ignition	31522-00C
Key Switch	31522-00C
Start	Y0175.1AM

Table 1-8. Alternator Specifications

MEASUREMENT	VALUE
AC voltage output	38 Amp three phase
Stator coil resistance	0.1-0.3 Ohms

Table 1-9. Regulator Specifications

MEASUREMENT	VALUE
Voltage @ 3600 RPM	14.3-14.7 VDC @ 75 °F (24 °C)
Amperes @ 3600 RPM	45 Amps, three phase shunt

Table 1-10. Electrical System Specifications

ELECTRICAL SYSTEM	AMPERES
Main fuse/battery fuse	30
Ignition fuse	15
Light fuse	15
Accessory fuse	10
Brake/horn	10
ECM fuse	10
Key switch fuse	15
Cooling fan fuse	15
Auxiliary power	10
Fuel pump	15
Note: Spare fuses are located in the tool kit.	

Table 1-11. Ignition Coil Specifications

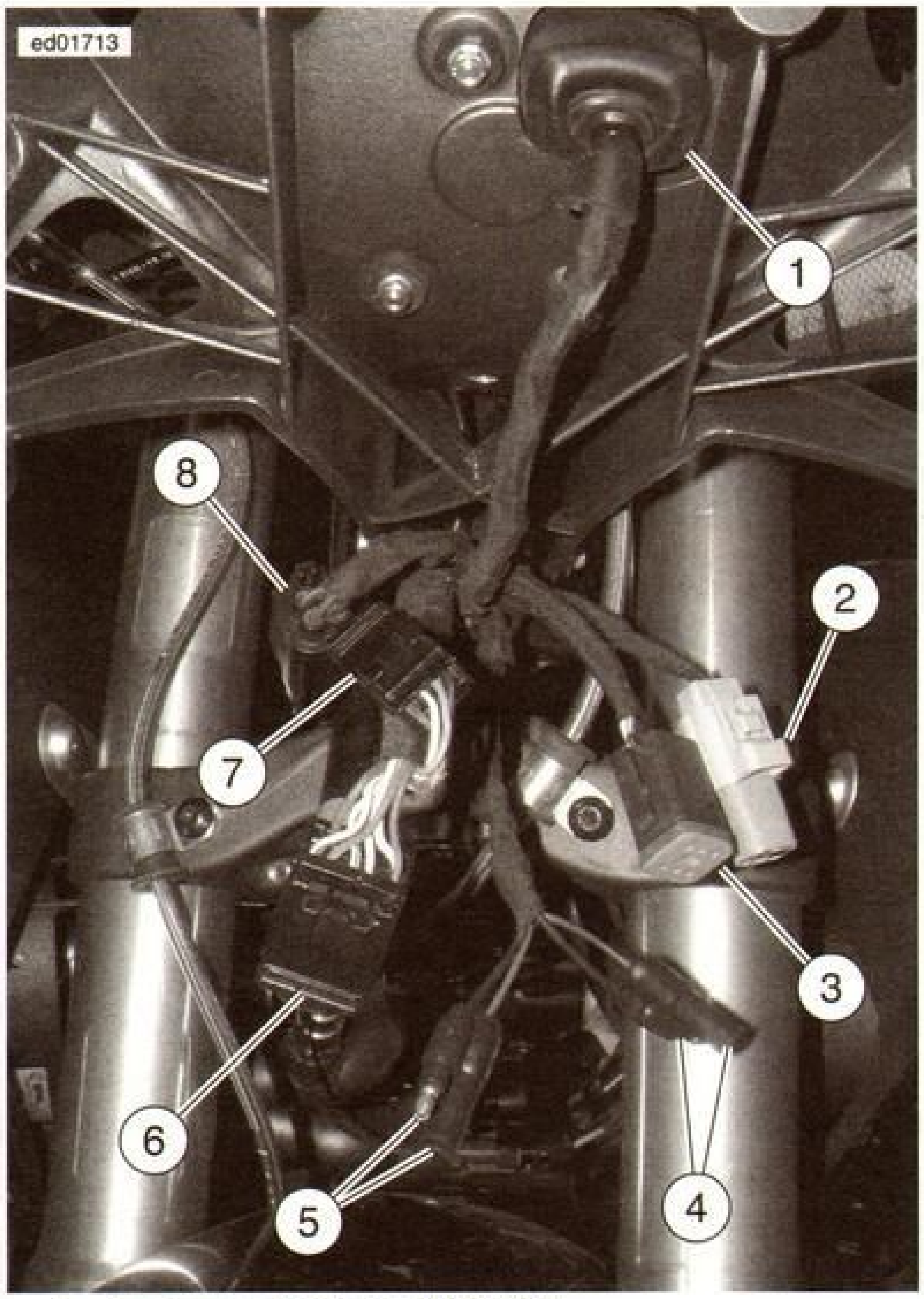
WINDING	RESISTANCE
Primary winding	0.5-1.0 Ohms
Secondary winding	Internal diode not accurately measurable with DVOM

Table 1-12. Temperature Specifications

RANGE	VALUE
Normal operating	140-220 °F (60-104 °C)
Over-temperature threshold (lamp lit)	230 °F (110 °C)
Fans on @	194 °F (90 °C)
Fans off @	140 °F (60 °C)

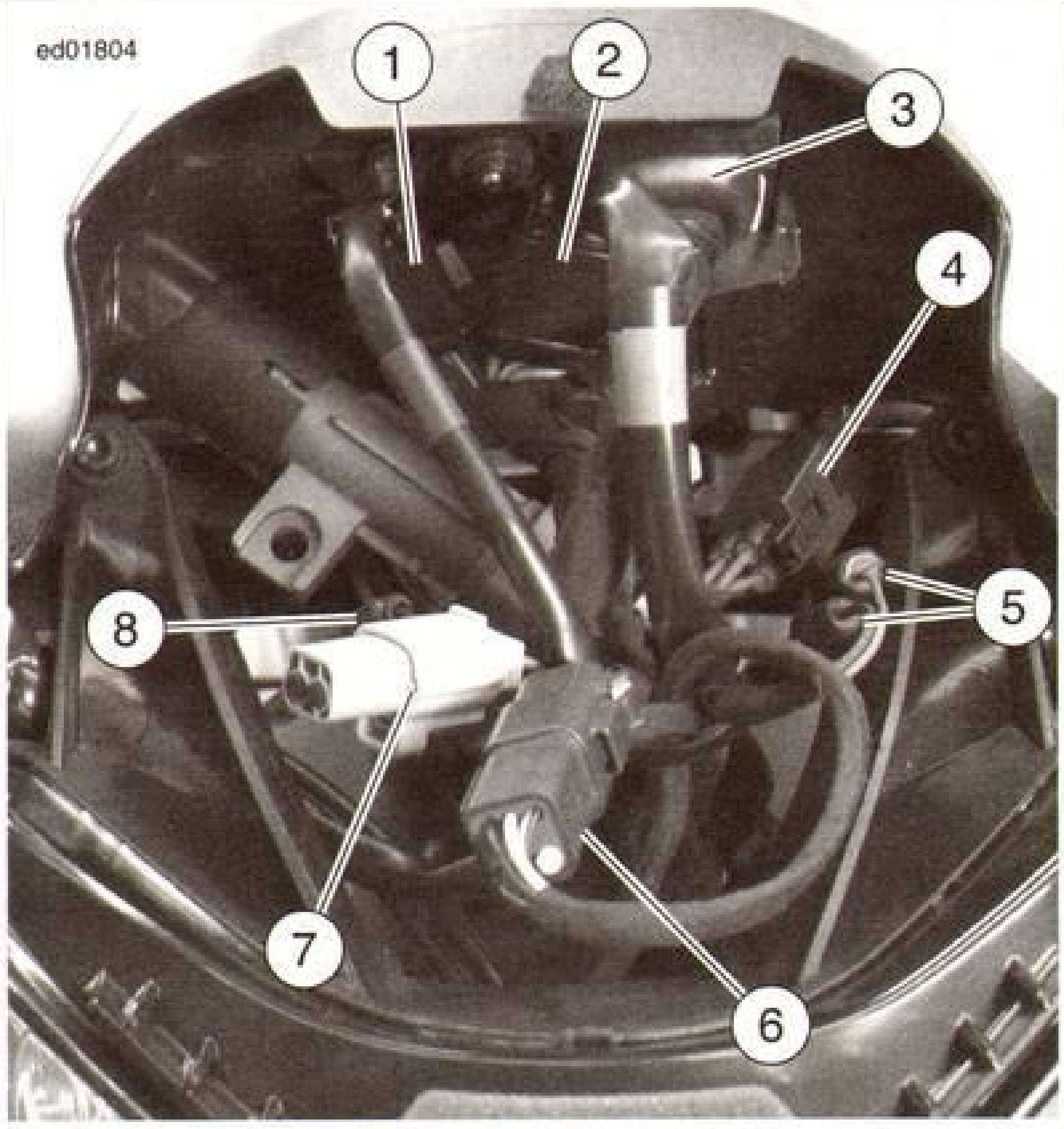
COMPONENT LOCATIONS

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.



1. Instrument Cluster (IC) [39]
2. 12 V auxiliary connector [160]
3. Headlamp [38]
4. Left front turn signal [31L]
5. Right front turn signal [31R]
6. Left hand controls [24]
7. Right hand controls [22]
8. Ignition switch [33]

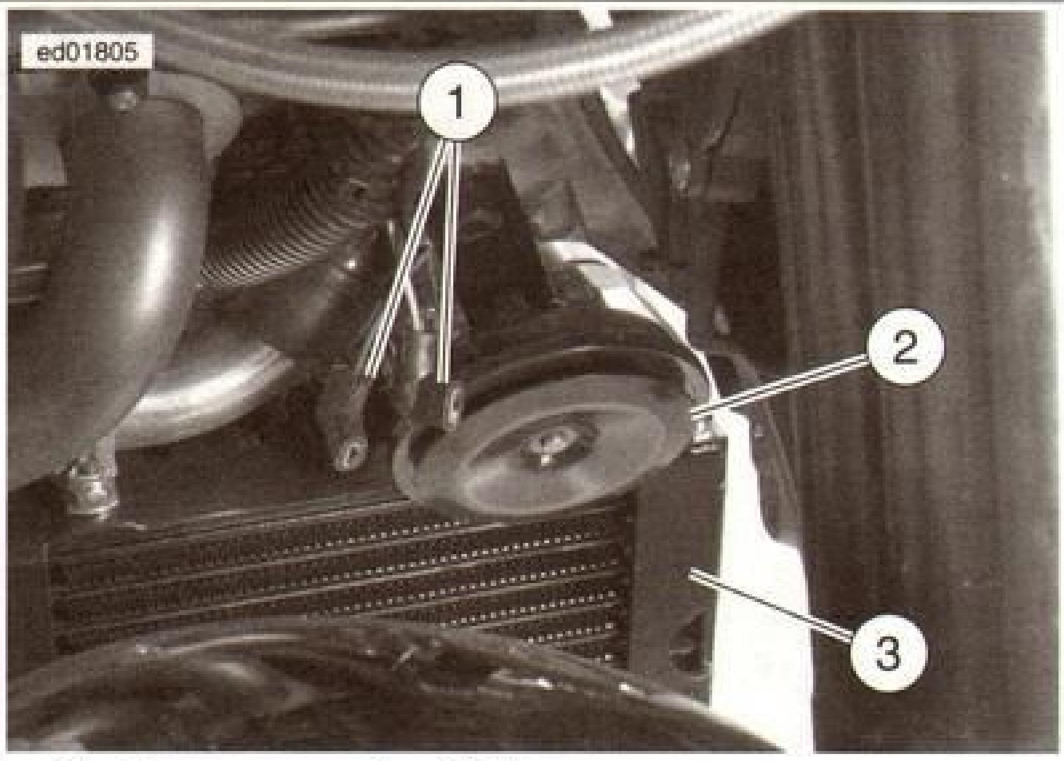
Figure 1-1. Behind Fairing Connectors (1125R)



1. Right hand controls [22]
2. Left hand controls [24]
3. Instrument Cluster (IC) [39]
4. Ignition switch [33]
5. Left front turn signal [31L]
6. Headlamp [38]
7. 12V auxiliary connector [160]
8. Right front turn signal [31R]

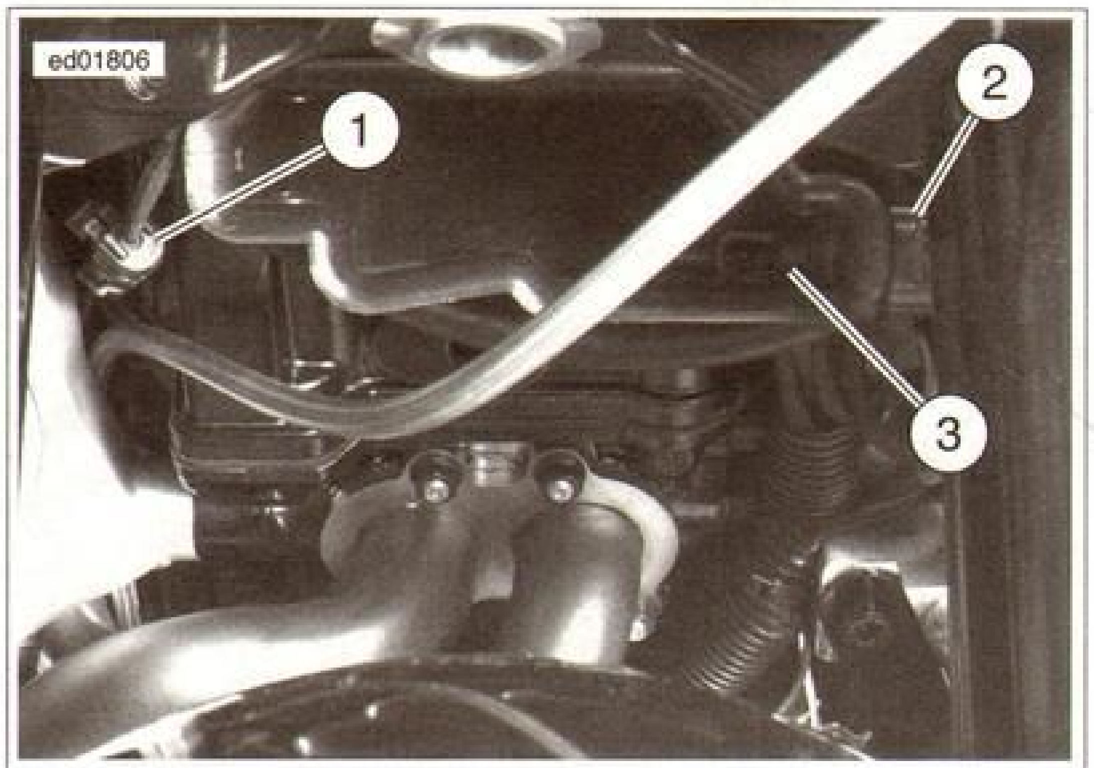
Figure 1-2. Behind Fairing Connectors (1125CR)

Figure 1-3. Clutch Switch Connector [95]



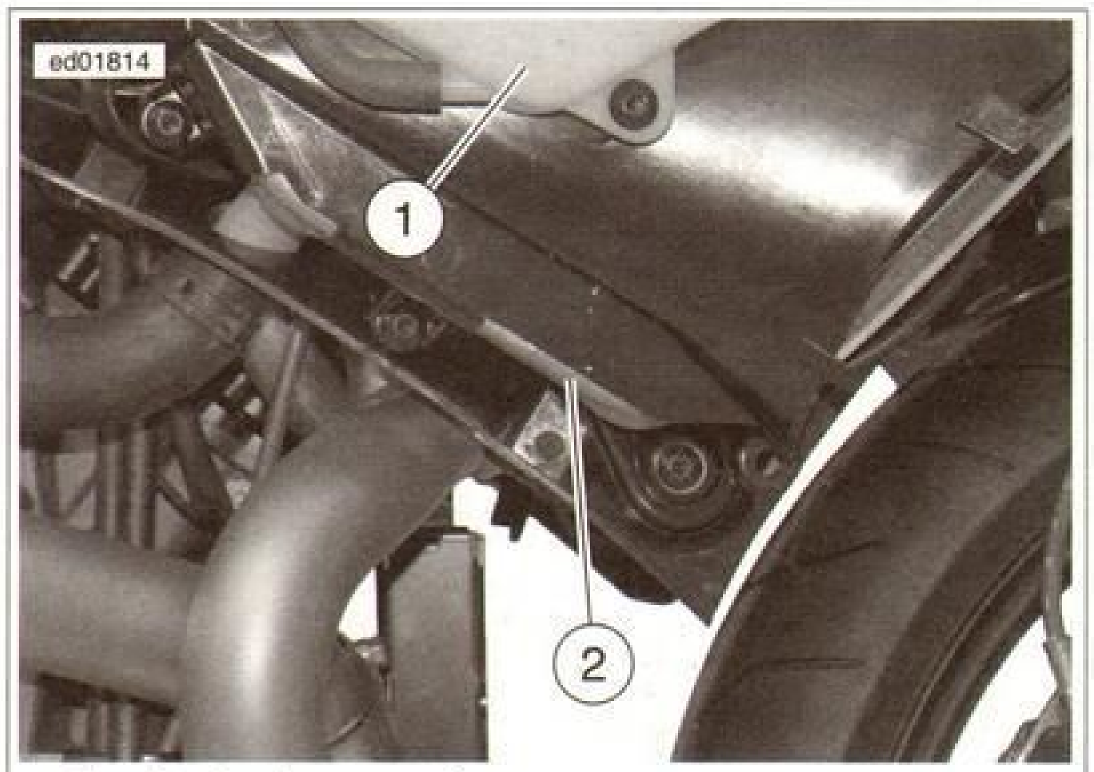
1. Horn connector [122]
2. Horn
3. Oil cooler

Figure 1-4. Horn



1. O2 sensor, front [138]
2. IAT sensor [89]
3. IAT sensor

Figure 1-5. O2 and IAT Connectors



1. Coolant reservoir
2. Cooling fan, right connector [97] (located between radiator and inside shroud)

Figure 1-6. Cooling Fan, Right Connector

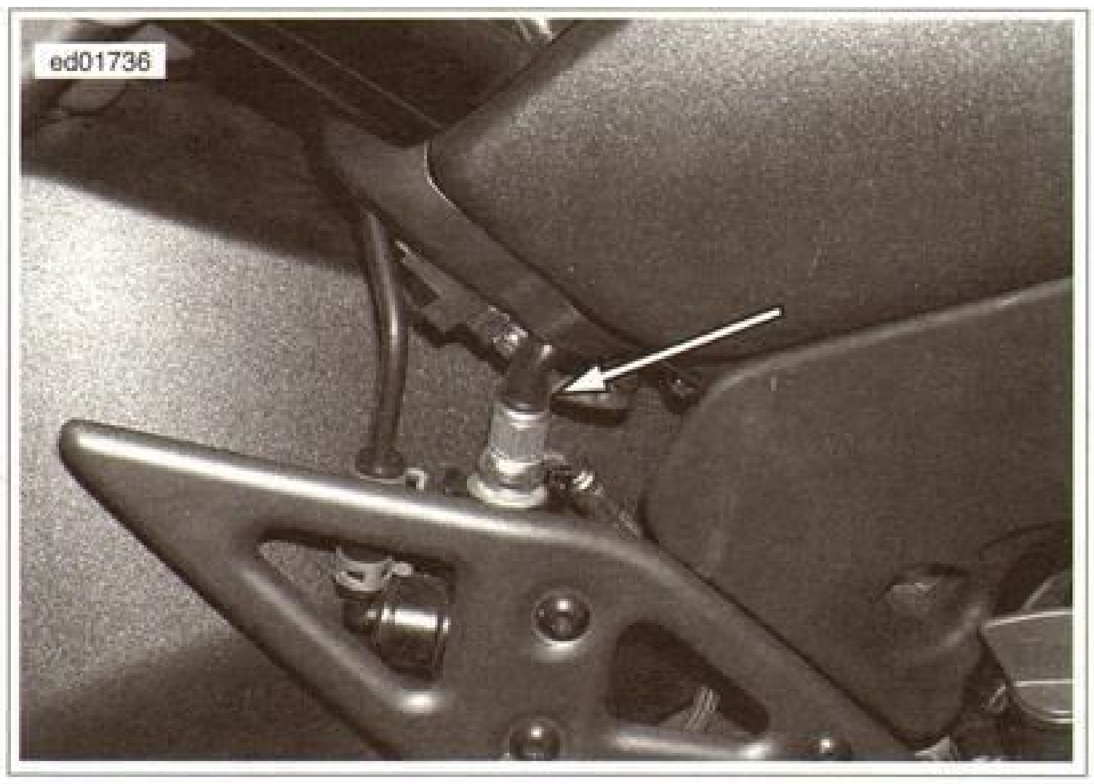


Figure 1-7. Rear Brake Switch Connector [121]

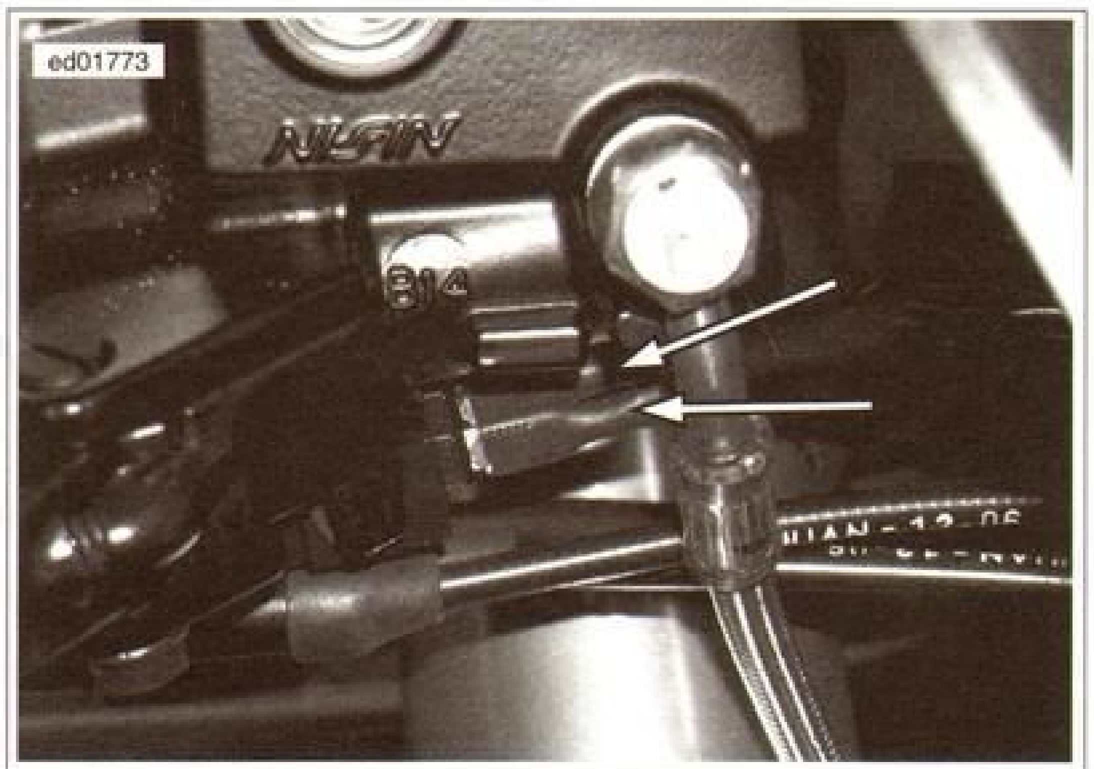
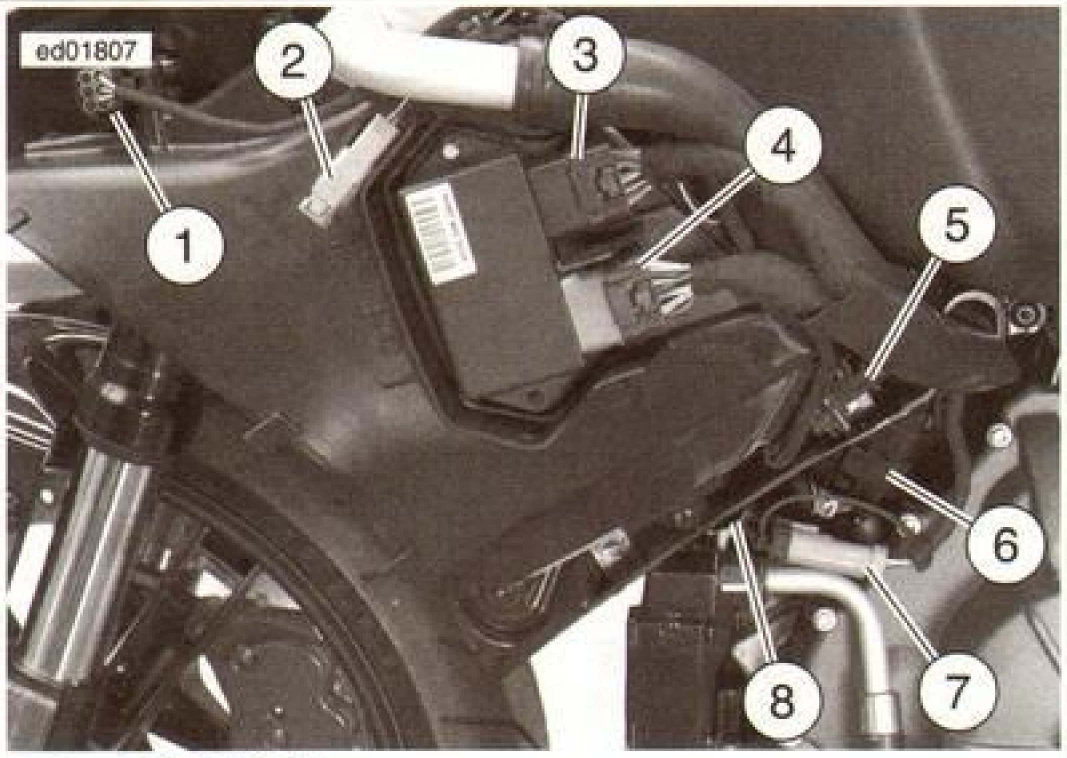
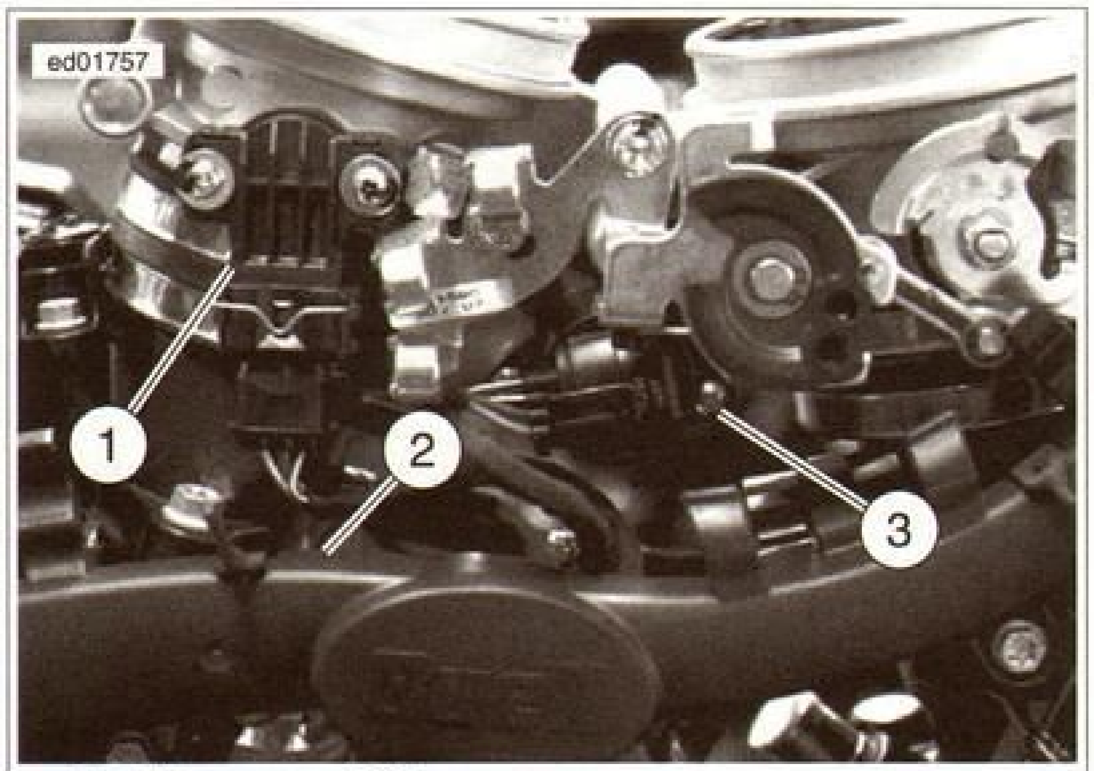


Figure 1-8. Front Brake Switch Connectors [170]



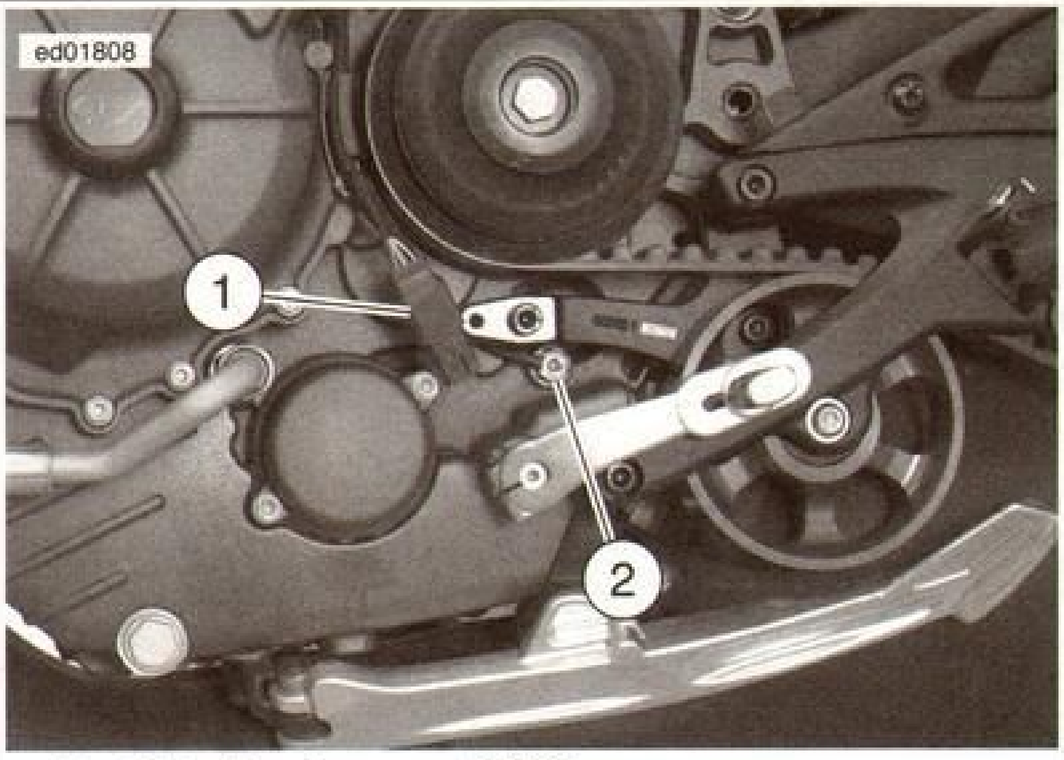
1. BAS [134]
2. CAN connector [243]
3. ECM [10] (BK)
4. ECM [11] (GY)
5. CKP [79]
6. Interface connector [145]
7. DLC [91]
8. Fan sub-harness [234] (if equipped)

Figure 1-9. Left Hand Radiator Shroud Connectors



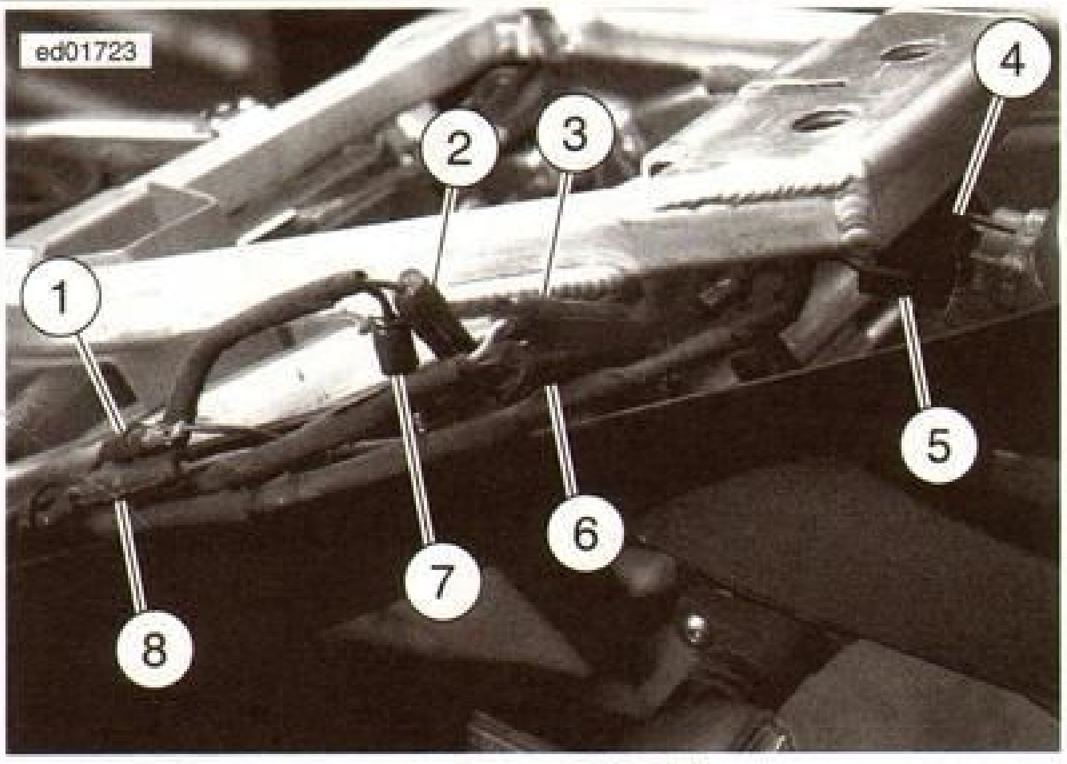
1. TP sensor [88]
2. ECT sensor [90]
3. IAC [87]

Figure 1-10. Throttle Body Connectors



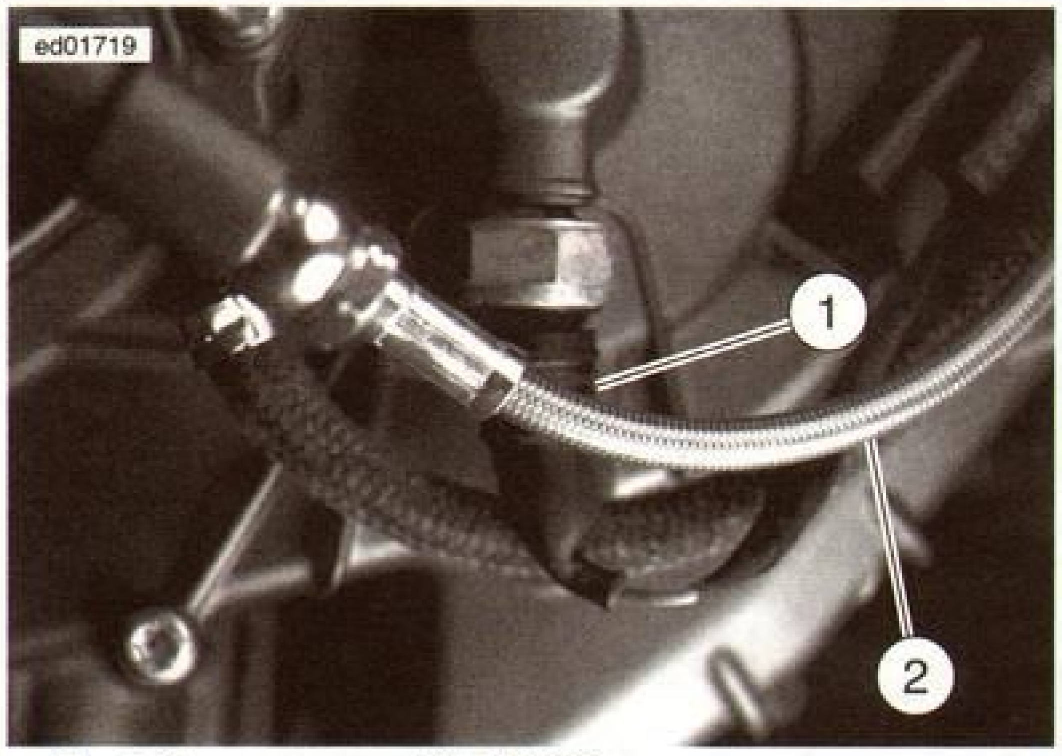
1. Sidestand sensor [133]
2. Neutral switch [131]

Figure 1-11. Lower Left Side of Engine



1. Left rear turn signal [19] (GND)
2. Right rear turn signal [18] (Power)
3. License plate lamp [45] (Power)
4. Tail/stop lamp [93] (Power)
5. Tail/stop lamp [93] (GND)
6. License plate lamp [45] (GND)
7. Right rear turn signal [18] (GND)
8. Left rear turn signal [19] (Power)

Figure 1-12. Rear Lamp Connectors



1. **Oil pressure switch [120]**
2. **Hydraulic clutch pressure hose**

Figure 1-13. Oil Pressure Switch Location

Figure 1-14. ECM Ground

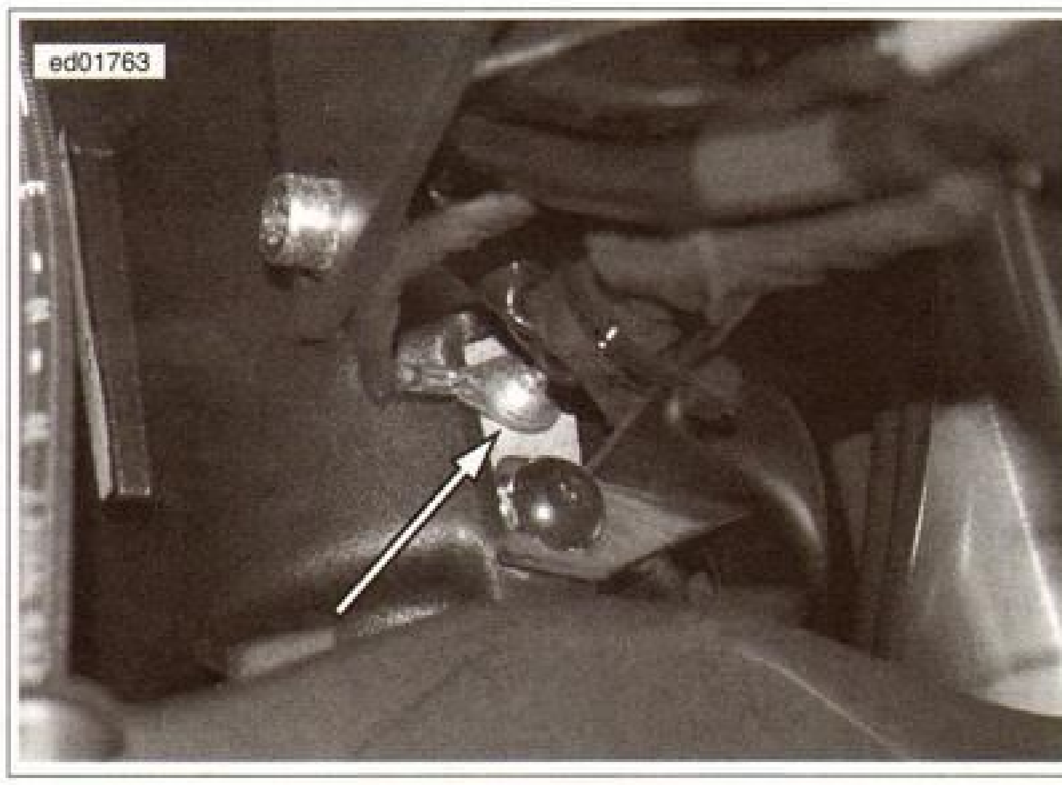


Figure 1-15. Ground 1

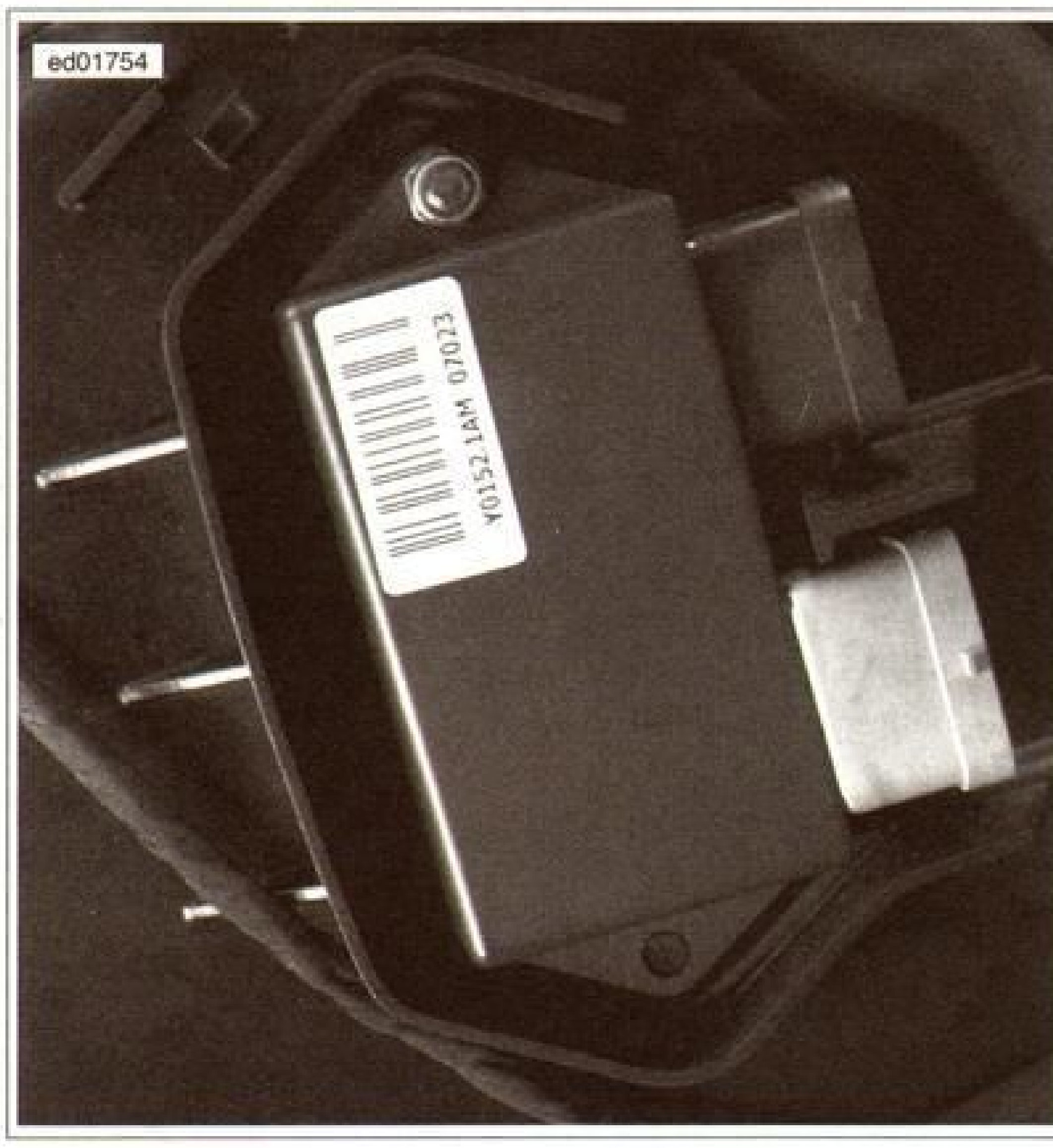
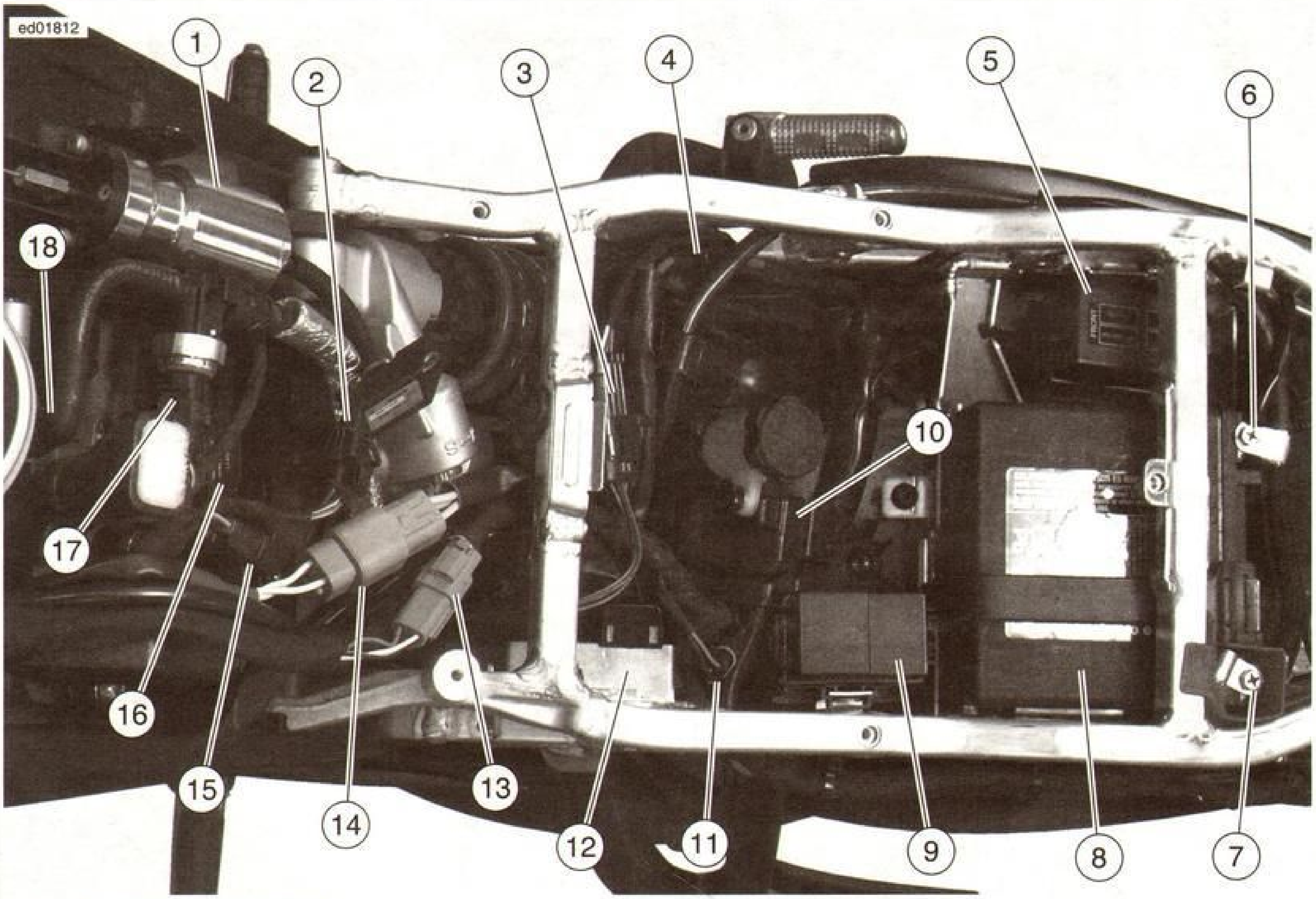


Figure 1-16. ECM



1. Active intake solenoid
2. Baro sensor [228]
3. Fuel pump connector [86]
4. Voltage regulator connector [77]
5. Relay block
6. Battery ground
7. Battery positive
8. Battery
9. Fuse block
10. Starter solenoid
11. Starter solenoid connector [128]
12. Voltage regulator
13. VSS connector [65]
14. Stator/regulator connector [46]
15. Active intake solenoid [178]
16. Rear ignition coil [83R]
17. Fuel pressure sensor connector [227]
18. Rear fuel injector connector [85]

Figure 1-17. Chassis Top View

HOW TO USE DIAGNOSTIC TOOLS

PART NUMBER	TOOL NAME
B-48115	BREAKOUT BOX
HD-26792	SPARK TESTER
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-41354	SPEEDOMETER TESTER
HD-41354-1	INPUT/OUTPUT CABLE
HD-41404-B	HARNESS TEST KIT
HD-48053	ADVANCED BATTERY CONDUCT-ANCE AND ELECTRICAL SYSTEM ANALYZER
HD-48650	DIGITAL TECHNICIAN II

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 DTII is not available.

HD-41404 Harness Test Kit

The HARNESS TEST KIT (Part No. HD-41404-B) 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 used on the vehicle. See the tool instruction sheet for specific terminal usage.

NOTE

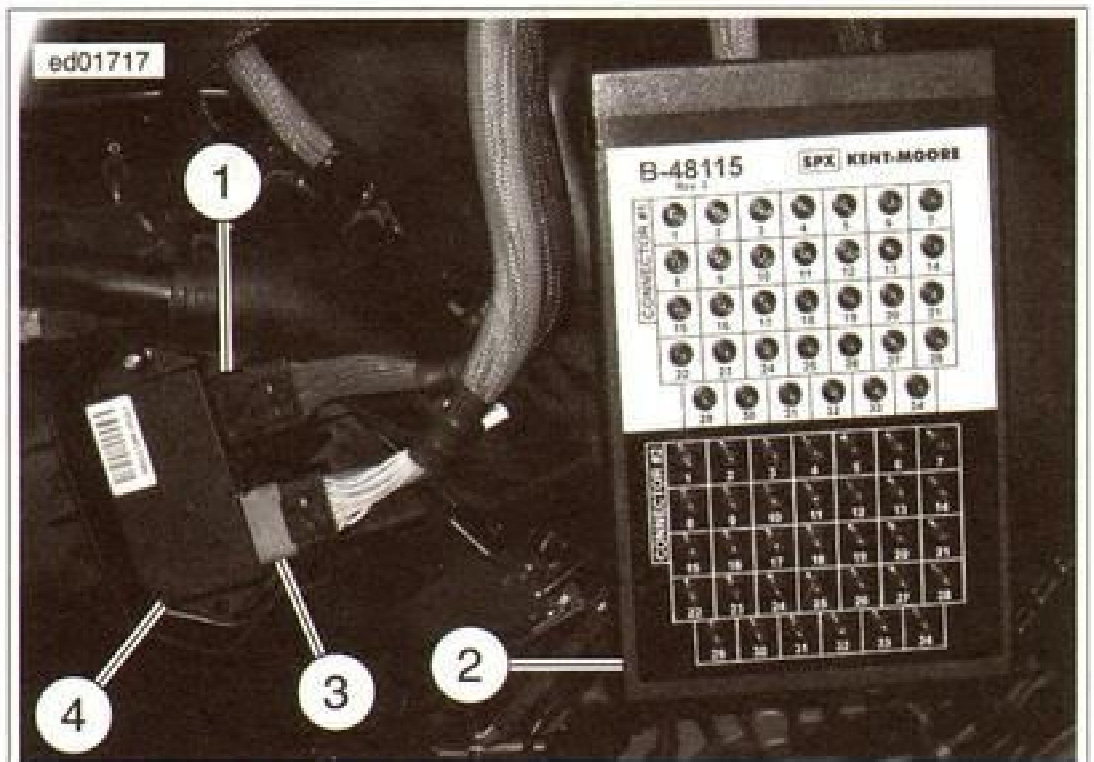
To prevent terminal damage while using the probe tips, insert the probe tip straight into the cavity and keep it stable during the test. Do not wiggle or move the probe tip once it has been inserted into the terminal. Do not use more than one probe per terminal or cavity at any one time.

B-48115 Breakout Box

The BREAKOUT BOX (Part No. B-48115) is spliced into the main harness. Used with a DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978), the Breakout Box allows circuit diagnosis of the wiring harness and connections without having to probe with sharp objects.

To install the Breakout Box, perform the following steps:

1. Disconnect the ECM connectors [10] (black) and [11] (gray) from the ECM.
2. See Figure 1-18. Attach the Breakout Box to the ECM connectors as follows:
   a. Attach black connector from Breakout Box to the [10] (black) ECM connector.
   b. Attach black connector from the wiring harness to the black connector on the Breakout Box.
   c. Attach gray connector from Breakout Box to the [11] (gray) ECM connector.
   d. Attach gray connector from the wiring harness to the gray connector on the Breakout Box.



1. **ECM black connector**
2. **Breakout Box**
3. **ECM gray connector**
4. **ECM**

Figure 1-18. ECM and Breakout Box with Connections

To remove the Breakout Box, perform the following steps:

1. Disconnect the ECM connectors [10] (black) and [11] (gray).
2. Disconnect Breakout Box connectors from ECM connectors.
3. Disconnect Breakout Box connectors from wiring harness.
4. Reconnect harness to ECM.

HD-26792 Spark Tester

1. See Figure 1-19. 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

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

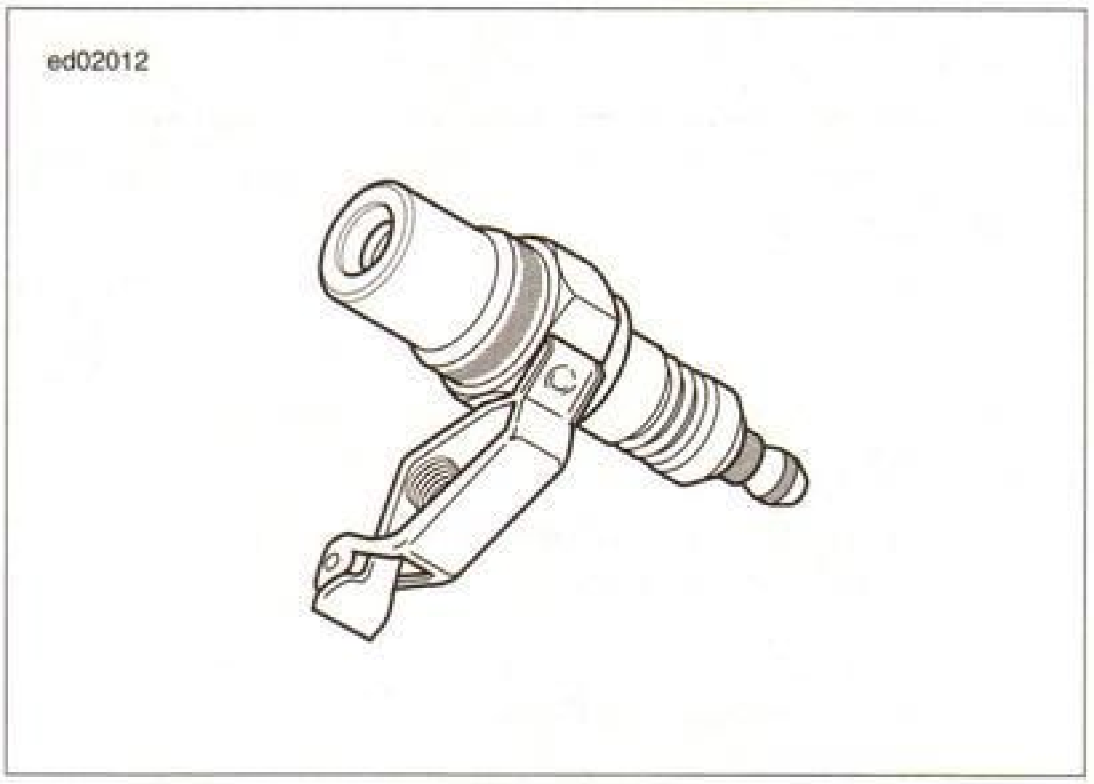


Figure 1-19. Spark Tester

HD-39978 Digital Multimeter (Fluke 78)

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

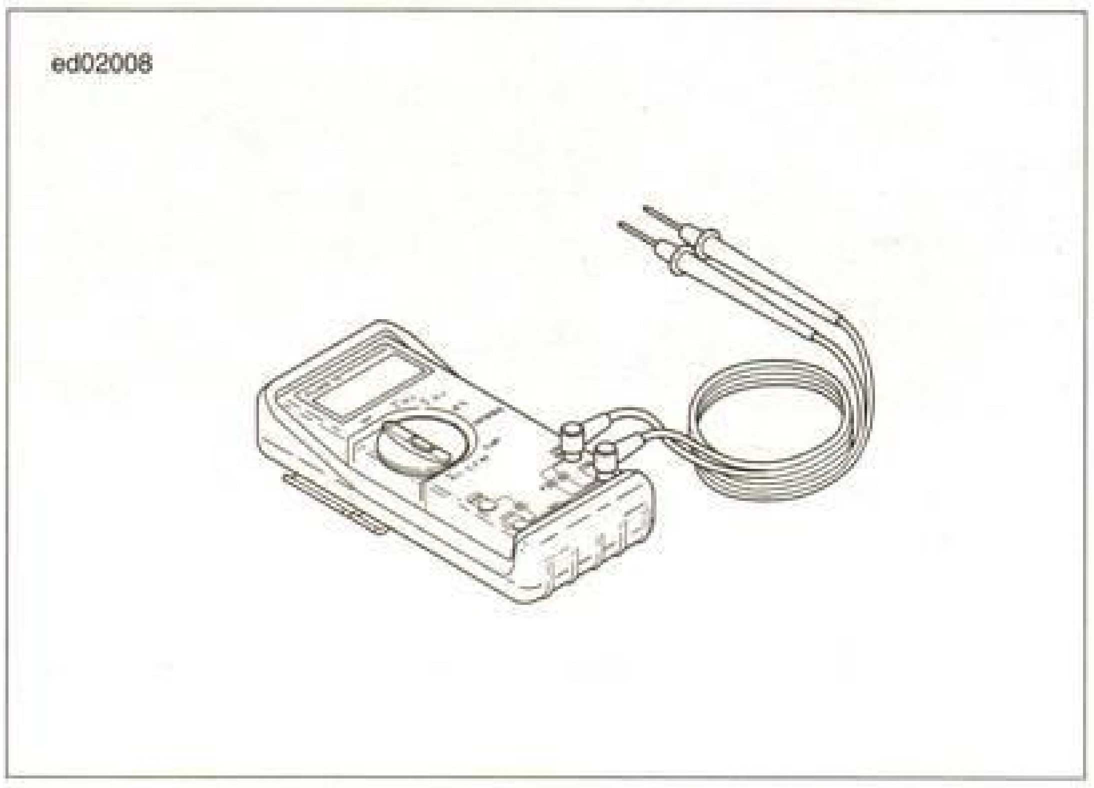


Figure 1-20. Digital Multimeter (Fluke 78) (Part No. HD-39978)

HD-48053 Advanced Battery Conductance and Electrical System Analyzer

Follow the instructions in the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053) instruction manual to perform a battery test. The test results include a decision on the battery condition and the measured state of charge.

Figure 1-21. HD-48053 Advanced Battery Conductance and Electrical System Analyzer Kit

Fuel Injector Test Lamp

The FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) is used to test the fuel injector drivers as well as the ignition coil drivers in the ECM.

1. Connect the BREAKOUT BOX (Part No. B-48115).
2. Disconnect the fuel injector connectors.
3. See Figure 1-22 for typical setup. Connect one side of the fuel injector test lamp to power and the other to the terminal on the ECM for the circuit you are testing.
4. Crank the engine.
5. If the test lamp flashes, the circuit is working properly.

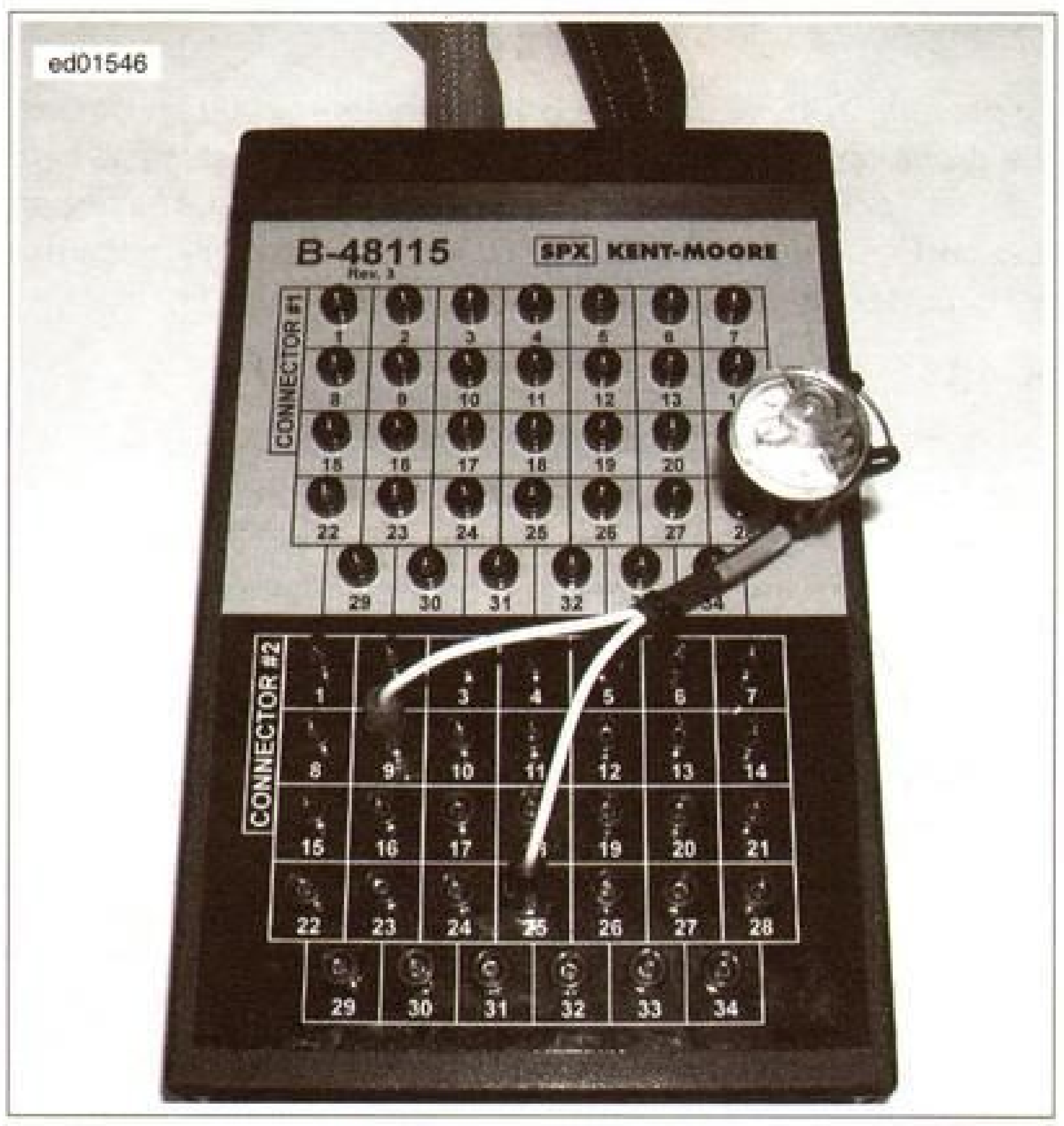


Figure 1-22. Fuel Injector Test Lamp

HD-41354 Speedometer Tester

See Figure 1-23. Connect SPEEDOMETER TESTER (Part No. HD-41354) with the INPUT/OUTPUT CABLE (Part No. HD-41354-1) supplied, or connect point-to-point leads to VSS connector [65B] terminals 2 (signal) and 3 (ground). Turn Speedometer Tester power on and allow the tester to self-test.

On the tester, perform the following:

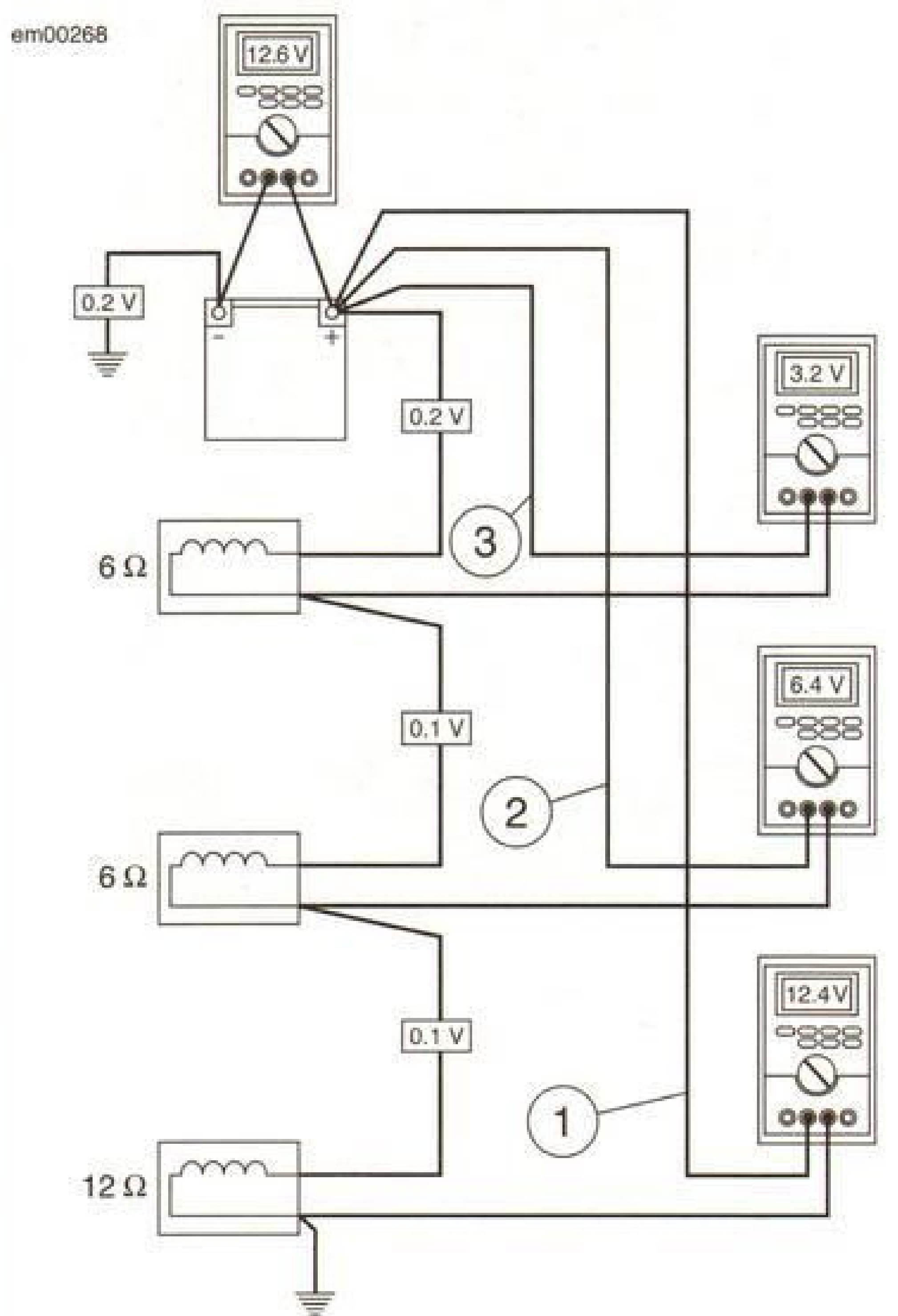
1. Press the CLEAR button.
2. Press "1".
3. Press ENTER.
4. Enter 144 Hz by pressing "144" and then press ENTER.

The speedometer should read approximately 60 mph (97 km/h).

Figure 1-23. Speedometer Tester (Part No. HD-41354)

VOLTAGE DROP

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.



1. **Entire circuit voltage drop through the starter.**
2. **Circuit voltage drop through the solenoid.**
3. **Circuit voltage drop through the relay.**

Figure 1-24. Simplified Starter Circuit

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.

See Figure 1-24 for a simplified circuit diagram of how voltage drops can vary in a circuit. The voltages represent what might be seen if the meter leads were connected at those points on the circuit.

Most of the voltage on a good working circuit drops across the components the circuit is powering. Typically, a good circuit drops less than 1.0 Volt. If the voltage drop is greater, backtrack the connections until the source of the potential difference is found. Always start at the destination, then move upstream if there is an issue. The benefits of doing it 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 starter circuit, measure the voltage drop across the following sections of the circuit. If the voltage drop increases over 1.0 Volt on any of the tests then the wire or connection tested contains the high resistance and should be repaired.

1. 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.
2. Move the black meter lead to the starter side post of the starter solenoid. Crank the starter.
3. Move the black meter lead to the battery side post on the starter solenoid. Crank the starter.
4. Finally move the black meter lead to the negative battery post and the red meter lead to the starter case. Crank the starter.

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
B-48115	BREAKOUT BOX
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-48650	DIGITAL TECHNICIAN II

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.

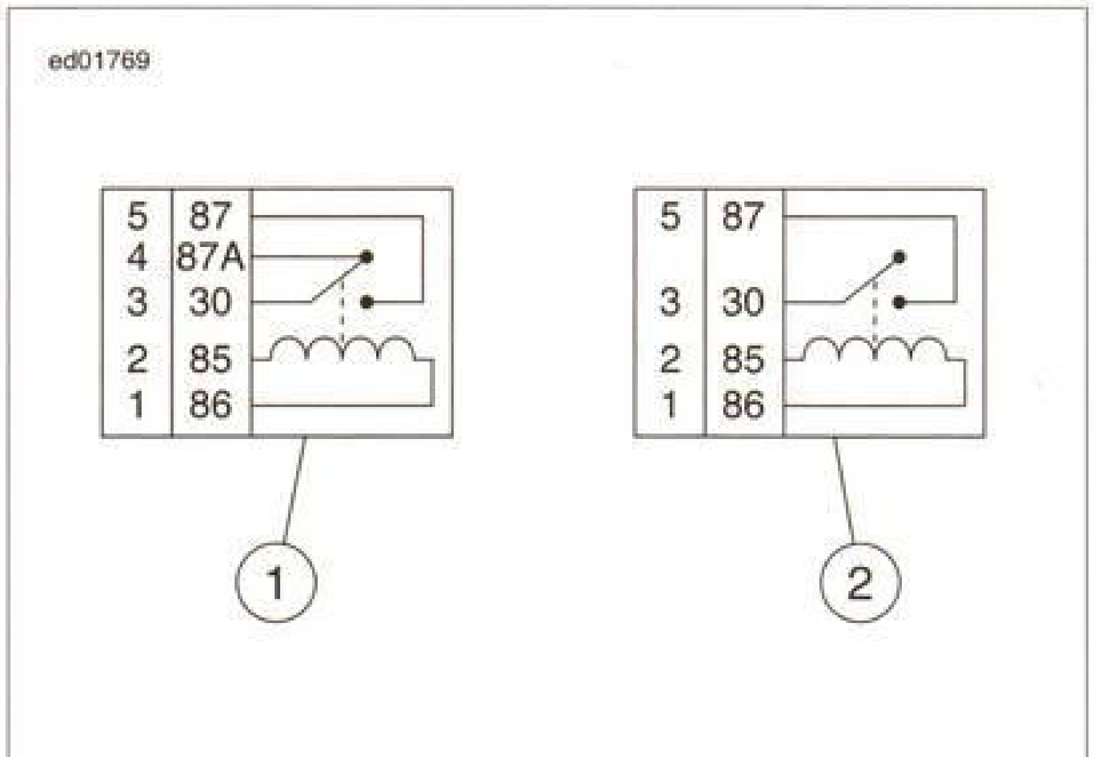
1. See Figure 1-25. Connect DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) to wiring harness between the suspect connections. When diagnosing ECM connections, use BREAKOUT BOX (Part No. B-48115) to simplify the procedure. See 1.2 DIAGNOSTIC TOOLS.
2. Set the DVOM to read voltage changes.
3. Start the motorcycle engine and run at idle.
4. Shake or wiggle the harness to detect intermittents. If intermittents are present, radical voltage changes register on the DVOM.

Figure 1-25. Digital Multimeter (Fluke 78) (Part No. HD-39978)

RELAY DIAGNOSTICS

Relay Variation

See Figure 1-26. Relays used on this vehicle have five terminals. Schematically the relays are very similar with the exception being 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.



1. **Standard 5 terminal relay**
2. **Standard 4 terminal relay**

Figure 1-26. Standard Relays

Relay Test (5 Pin)

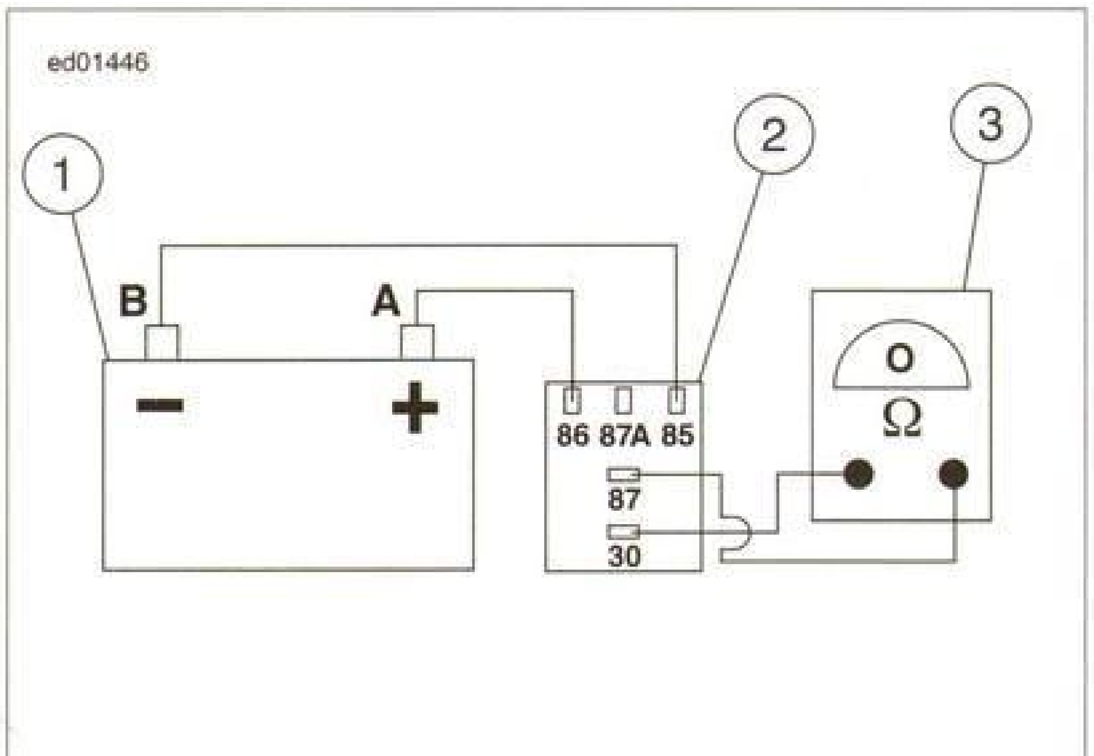
A relay can be tested using the motorcycle's 12-Volt battery and a multimeter.

1. Unplug the relay from relay block.
2. See Figure 1-27 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. Check for continuity between terminals 30 and 87. A good relay shows continuity (continuity tester lamp on or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.



1. **Battery**
2. **Start Relay**
3. **Ohmmeter**

Figure 1-27. 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 underneath 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.

NOTES

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NOTES

DESCRIPTION AND OPERATION

Initial diagnostics are a starting point to navigate through the EDM in a manner to efficiently troubleshoot any concerns. A basic understanding of electronics and a general knowledge of the motorcycle are necessary to effectively use this manual.

Before diagnosing a concern, perform a general functional test of the motorcycle to verify the concern and to make sure there is nothing else that could cause problems with accurately diagnosing the motorcycle. Use the flowcharts in this chapter for initial diagnostics.

CHECKING FOR DIAGNOSTIC TROUBLE CODES (DTCS)

Part of this initial test is checking for DTCs. Some concerns only exhibit a symptom, while others cause a DTC to set along with the symptom. When a DTC is stored, the ECM sends a signal to the Instrument Cluster (IC). The IC illuminates the check engine lamp. If more than one DTC exists, diagnose them in the order of priority, starting with the lowest number. Refer to Table 2-1 for a complete list of DTCs and the order of priority.

RETRIEVING DIAGNOSTIC TROUBLE CODES (DTCS)

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two ways to retrieve DTCs:

- DIGITAL TECHNICIAN II (Part No. HD-48650), a computer-based diagnostics package.
- See Figure 2-1. The Instrument Cluster (IC) to view the DTCs.

In order to view the DTCs on the IC, perform the following procedure.

1. Hold down the MODE and TOGGLE switches at the same time as the ignition is turned on.
2. The IC displays DIAG MODE. Press the TOGGLE switch again to display the first DTC.
3. Continue pressing and releasing the TOGGLE switch to move to the next stored DTC.
4. When all DTCs have been scrolled through, the IC displays the message LIVE DATA.

NOTE

If the security system is armed when entering DIAG MODE, the message ENTER PIN displays when the ignition is turned on. Once the correct pin is entered, the display changes to DIAG MODE. The TOGGLE switch then cycles through the DTCs normally.

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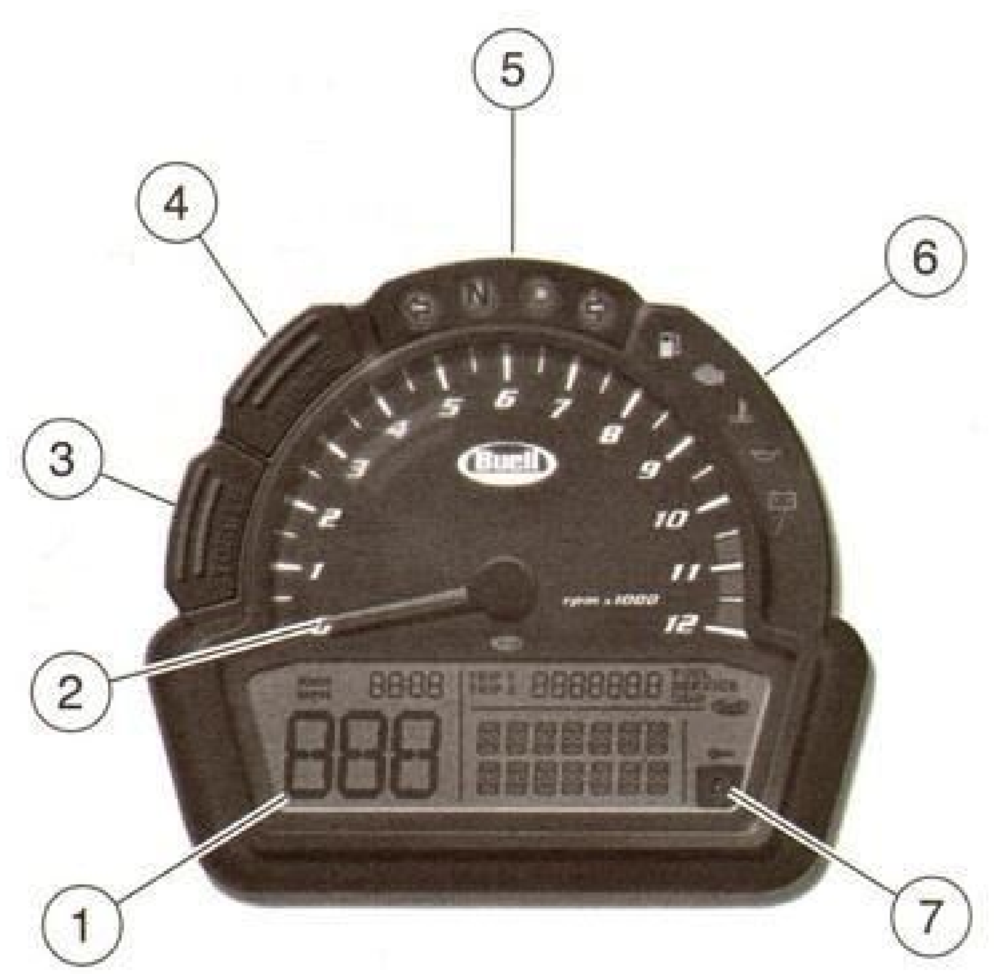


1. **LCD screen**
2. **Tachometer**
3. **TOGGLE switch**
4. **MODE switch**
5. **Indicator lamps**
6. **Warning lamps**
7. **Security LED**

Figure 2-1. Instrument Cluster

Table 2-1. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
B1004	70	Fuel Level Sender Low	4.2 FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005
B1005	69	Fuel Level Sender High/Open	4.2 FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005
P0087	29	Fuel Rail/System Pressure Too Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0107	63	Map Sensor Low/Open	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108
P0108	62	Map Sensor High	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108

Table 2-1. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0112	22	Intake Air Temperature Sensor Voltage Low	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0113	21	Intake Air Temperature Sensor High/Open	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0117	20	Engine Coolant Temperature Sensor Circuit Low	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0118	19	Engine Coolant Temperature Sensor Circuit High	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0122	11	Throttle Position Sensor Circuit Low	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0123	10	Throttle Position Sensor Circuit High	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0131	50	Front Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0132	46	Front Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0134	48	Front Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0151	51	Rear Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0152	47	Rear Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0154	49	Rear Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0192	26	Fuel Pressure Sensor Circuit Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0193	25	Fuel Pressure Sensor Circuit High	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0261	35	Front Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0262	34	Front Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0264	37	Rear Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0265	36	Rear Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0337	7	Crank Position Sensor Circuit Low	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0338	8	Crank Position Sensor Circuit High	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0339	9	Crank Position Sensor Circuit Intermittent	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0502	40	Vehicle Speed Sensor Low	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0503	41	Vehicle Speed Sensor Intermittent / Erratic High	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0506	54	Idle Air Control System - RPM Higher Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511

Table 2-1. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0507	55	Idle Air Control System - RPM Lower Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0511	53	Idle Air Control Circuit Fault	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0562	39	Battery Voltage Low	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0563	38	Battery Voltage High	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0603	3	ECM EEPROM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0604	1	ECM RAM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0605	2	ECM ROM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0607	4	ECM Microprocessor Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0616	61	Starter Relay Circuit Low	6.14 START RELAY: DTC P0617
P0617	60	Starter Relay Circuit High	6.14 START RELAY: DTC P0617
P0628	28	Fuel Pump Circuit Low	6.20 FUEL PUMP: DTC P0628, P0629
P0629	27	Fuel Pump Circuit High	6.20 FUEL PUMP: DTC P0628, P0629
P0691	58	Right Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0692	56	Right Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0693	59	Left Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0694	57	Left Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P1009	6	Security System Fault	5.4 SECURITY SYSTEM
P1047	52	Feedback Fuel Cylinder Difference too Great	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P1110	66	Active Intake Control Circuit Short Low/Open	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1111	65	Active Intake Control Circuit Short High	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1112	64	Active Intake Control Throttle Position Sensor Feedback Failure	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1151	16	Bank Angle Sensor Shorted Low	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1152	15	Bank Angle Sensor Shorted High	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1154	17	Clutch Position Sensor Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1155	18	Neutral Switch Input Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1501	13	Sidestand Sensor Low	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1502	12	Sidestand Sensor High/Open	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1503	14	Sidestand Down at Vehicle Speed	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1601	67	Auxiliary Relay Driver Circuit Fault	5.1 ACCESSORIES

Table 2-1. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P2228	24	BARO Pressure Sensor Circuit Low	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2229	23	BARO Pressure Sensor Circuit High	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2300	31	Front Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2301	30	Front Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2303	33	Rear Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2304	32	Rear Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
U0001	5	High Speed CAN Bus Error	2.2 SERIAL DATA COMMUNICATION

CODE TYPES

DTCs are categorized as current and historic. Both types are stored in the ECM and the IC.

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.

Historic DTCs are stored for 50 run cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC clears itself.

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

MULTIPLE DTCS

There are conditions where one fault may set several DTCs. This is why it is important to follow the DTC priority table. By following the order in the table it reduces the likelihood of performing unnecessary diagnostics and possibly faulting the wrong component. Refer to Table 2-1.

CLEARING DTCS

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The only way to clear DTCs is to use DIGITAL TECHNICIAN II (Part No. HD-48650).

CHECK ENGINE LAMP

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

See Figure 2-2 for check engine lamp location. When the ignition switch is turned on, the check engine lamp illuminates for four seconds. This is a bulb check to verify the lamp is working.

- After the bulb check, the lamp goes out and stays out if there are no DTCs.
- If only historic DTCs are set, then the lamp illuminates for an additional eight seconds.
- If a current DTC is set, the lamp goes through the four second bulb check and then stays on continuously.
- See Figure 2-3. If multiple DTCs are present, use DIGITAL TECHNICIAN II (Part No. HD-48650) to determine which DTCs are current or historic.

Diagnostic Procedure

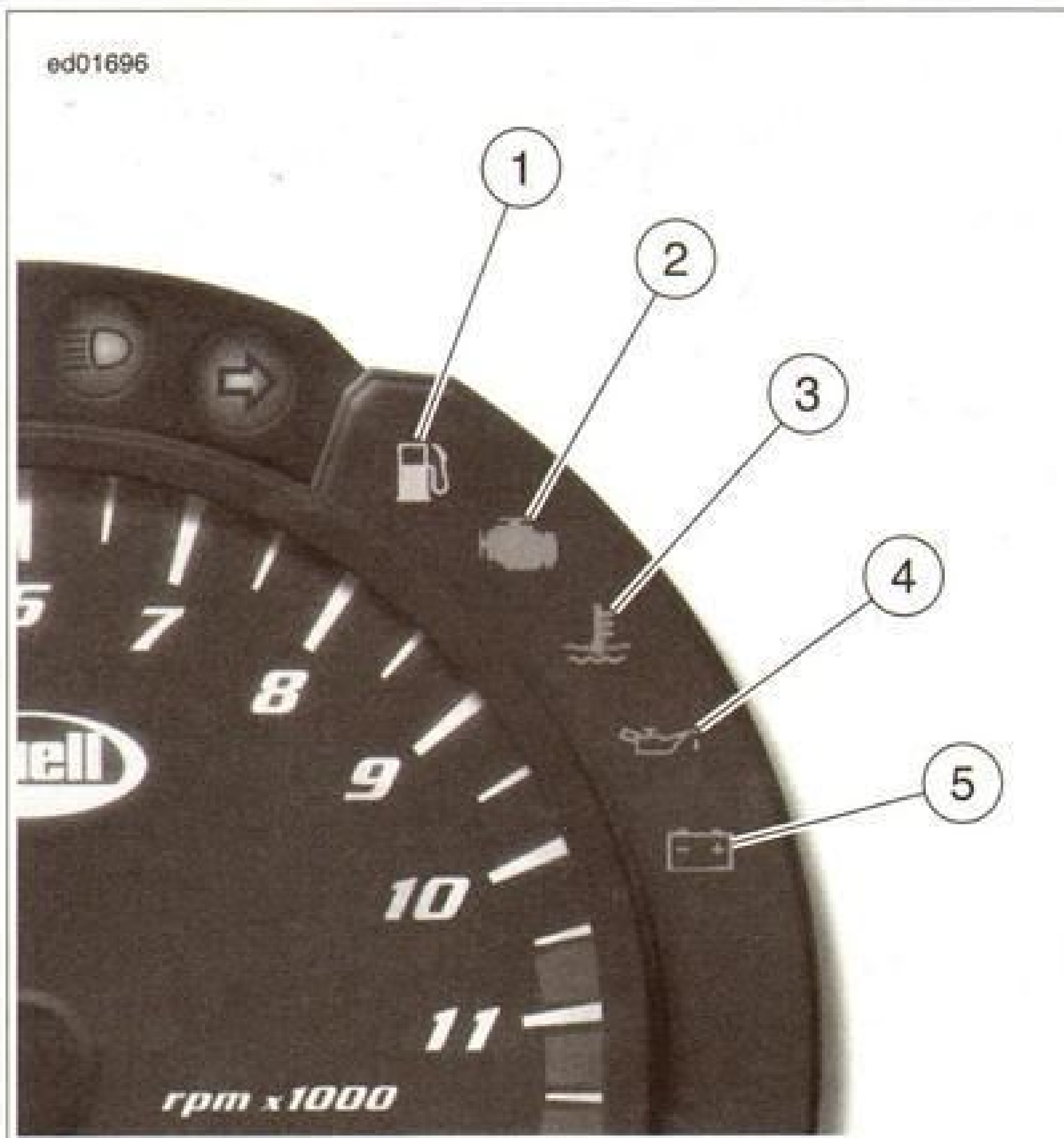
The IC illuminates the check engine lamp when the ignition is turned on for a bulb check. The ECM sends a message to the IC to turn off the lamp. If the IC does not receive this message it continues to illuminate the lamp.

If the check engine lamp does not illuminate even during the bulb check, then see 4.5 INSTRUMENT CLUSTER INOPERATIVE.

NOTE

When the IC is replaced, there is a 30 minute timer that counts down before the information is written to the IC. This is done so the technician has time to test a new cluster to determine whether the fault is within the cluster or not before the cluster matches to the ECM. Once the VIN is written to the IC it cannot be cleared.

If the check engine lamp is always on with the ignition on and no DTCs are present, replace the IC. If the check engine lamp is still on, install original IC and replace the ECM.



1. Low fuel lamp
2. Check engine lamp
3. Engine over temperature lamp
4. Oil pressure lamp
5. Low battery voltage lamp

Figure 2-2. Warning Lamps

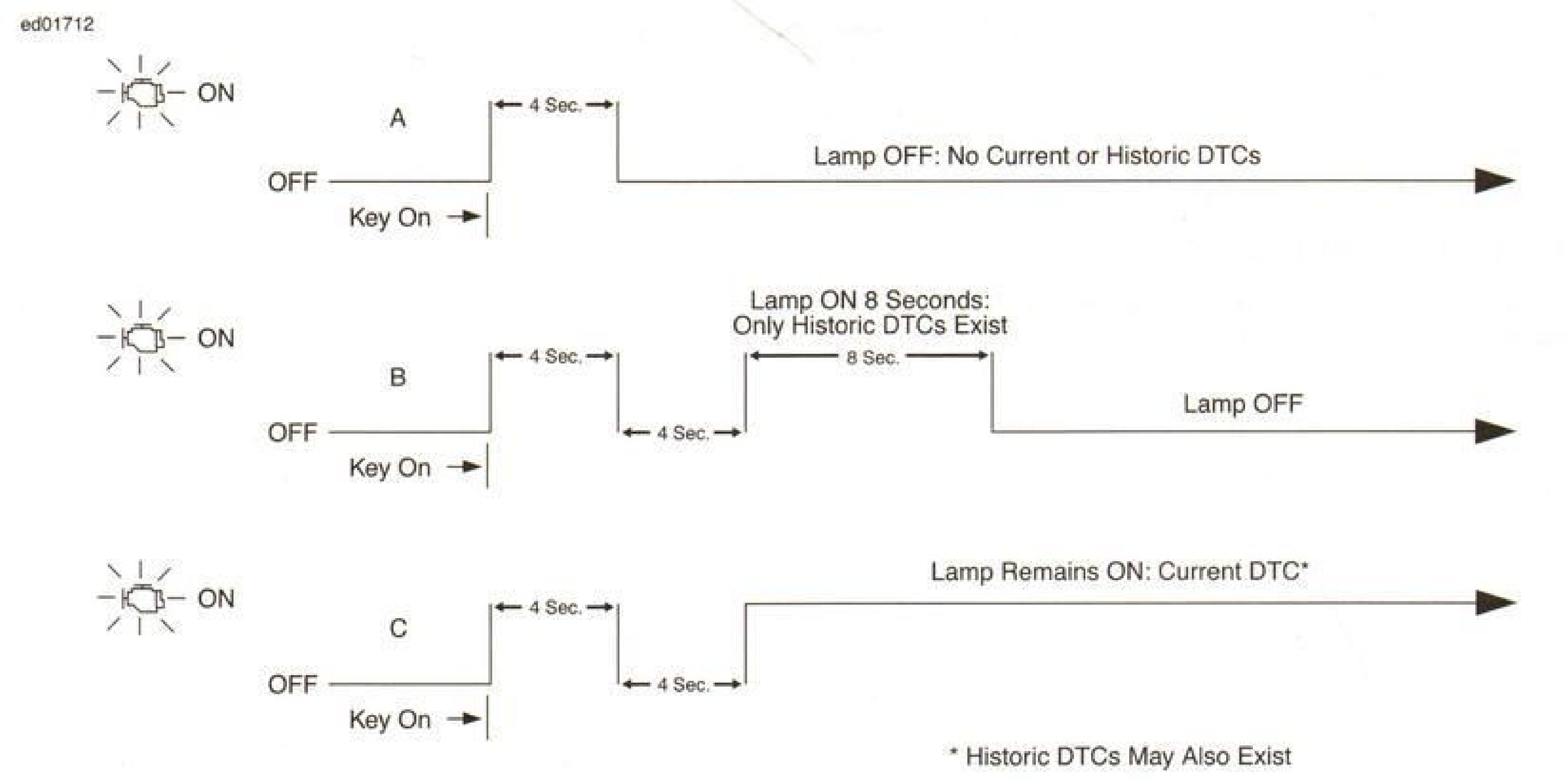


Figure 2-3. Check Engine Lamp Operation

SYMPTOMS

If no DTCs are present but there is a symptom or concern indicating a malfunction, address and repair the symptom if it is not a normal characteristic of the system. Refer to Table 2-2 for a list of symptoms.

Table 2-2. Symptom Table

SYMPTOM	DIAGNOSTIC PROCEDURE
Auxiliary power inoperative	5.1 ACCESSORIES
Charging system inoperative	3.3 CHARGING SYSTEM DIAGNOSTICS
COMM ERROR displayed	2.2 SERIAL DATA COMMUNICATION
Engine cranks, but will not start	6.28 ENGINE CRANKS, BUT WILL NOT START
Headlamp inoperative	5.3 LIGHTS
Horn always on	5.2 HORN
Horn inoperative	5.2 HORN
Instrument Cluster (IC) inoperative	4.5 INSTRUMENT CLUSTER INOPERATIVE
Low fuel lamp always on	4.6 LOW FUEL LAMP ALWAYS ON OR INOPERATIVE
Low fuel lamp inoperative	4.6 LOW FUEL LAMP ALWAYS ON OR INOPERATIVE
Marker lamps inoperative	5.3 LIGHTS
Misfire at idle or under load	6.30 MISFIRE AT IDLE OR UNDER LOAD
Oil pressure lamp always on	4.3 OIL PRESSURE LAMP ALWAYS ON OR INOPERATIVE
Oil pressure lamp inoperative	4.3 OIL PRESSURE LAMP ALWAYS ON OR INOPERATIVE
Starter does not spin	3.1 STARTING SYSTEM DIAGNOSTICS
Starter stalls or spins too slowly	3.1 STARTING SYSTEM DIAGNOSTICS
Starts, then stalls	6.29 STARTS, THEN STALLS
Stop lamp inoperative	5.3 LIGHTS
Tail lamp inoperative	5.3 LIGHTS
THEFT ERROR displayed	5.4 SECURITY SYSTEM
Turn signal indicator inoperative	4.4 TURN SIGNAL INDICATOR INOPERATIVE
Turn signal inoperative	5.3 LIGHTS

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

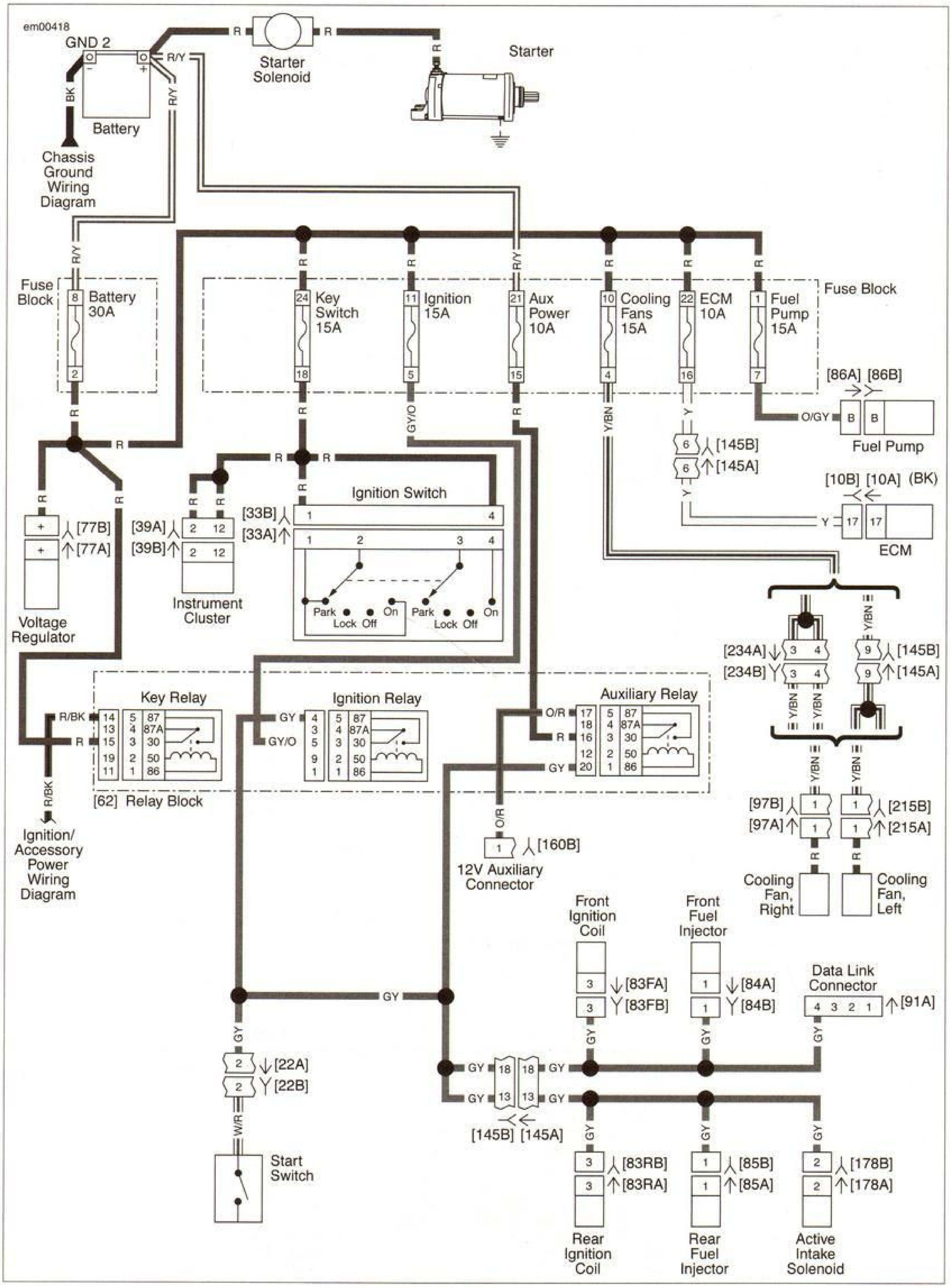


Figure 2-4. Battery Power

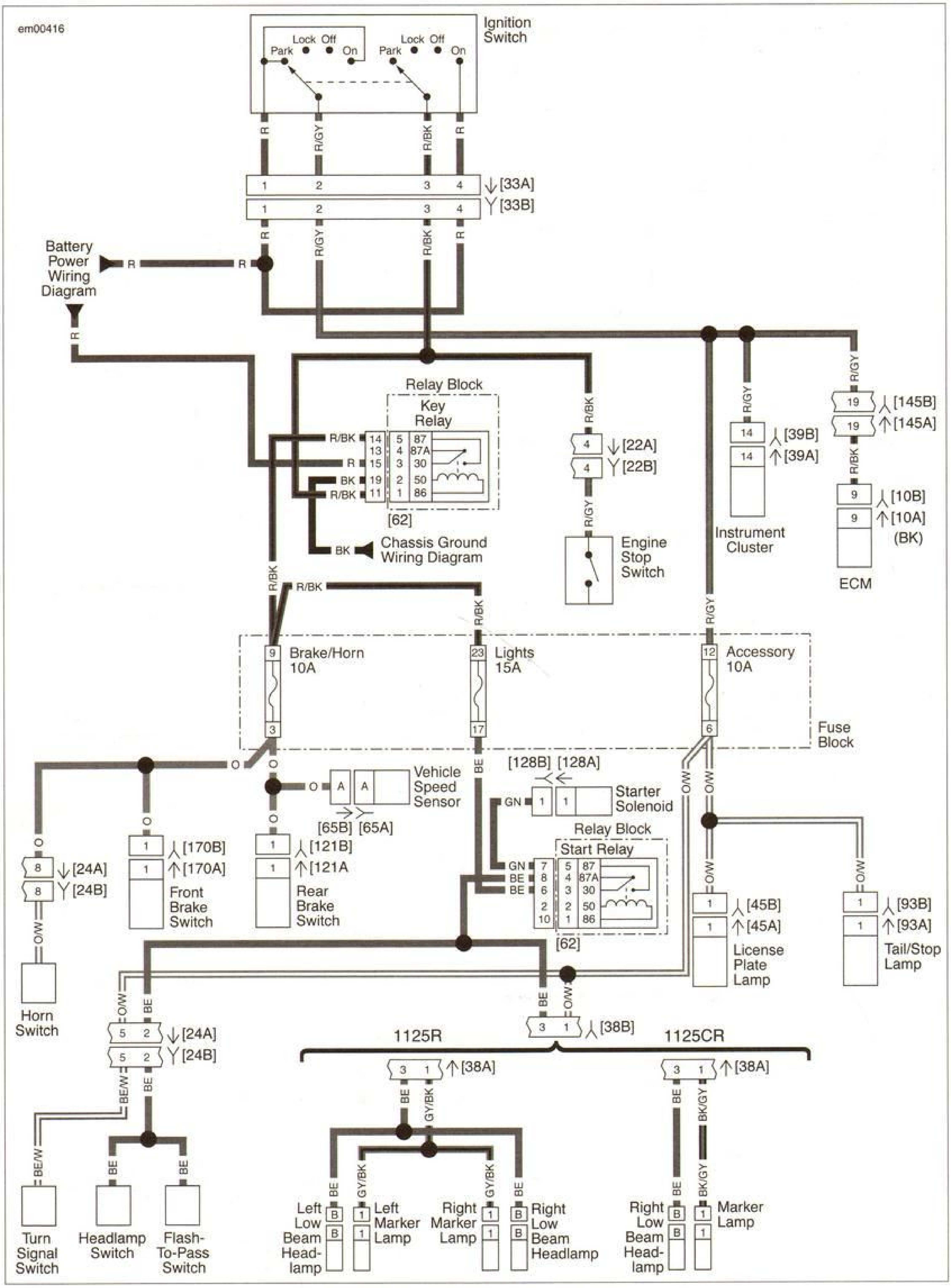


Figure 2-5. Ignition/Accessory Power

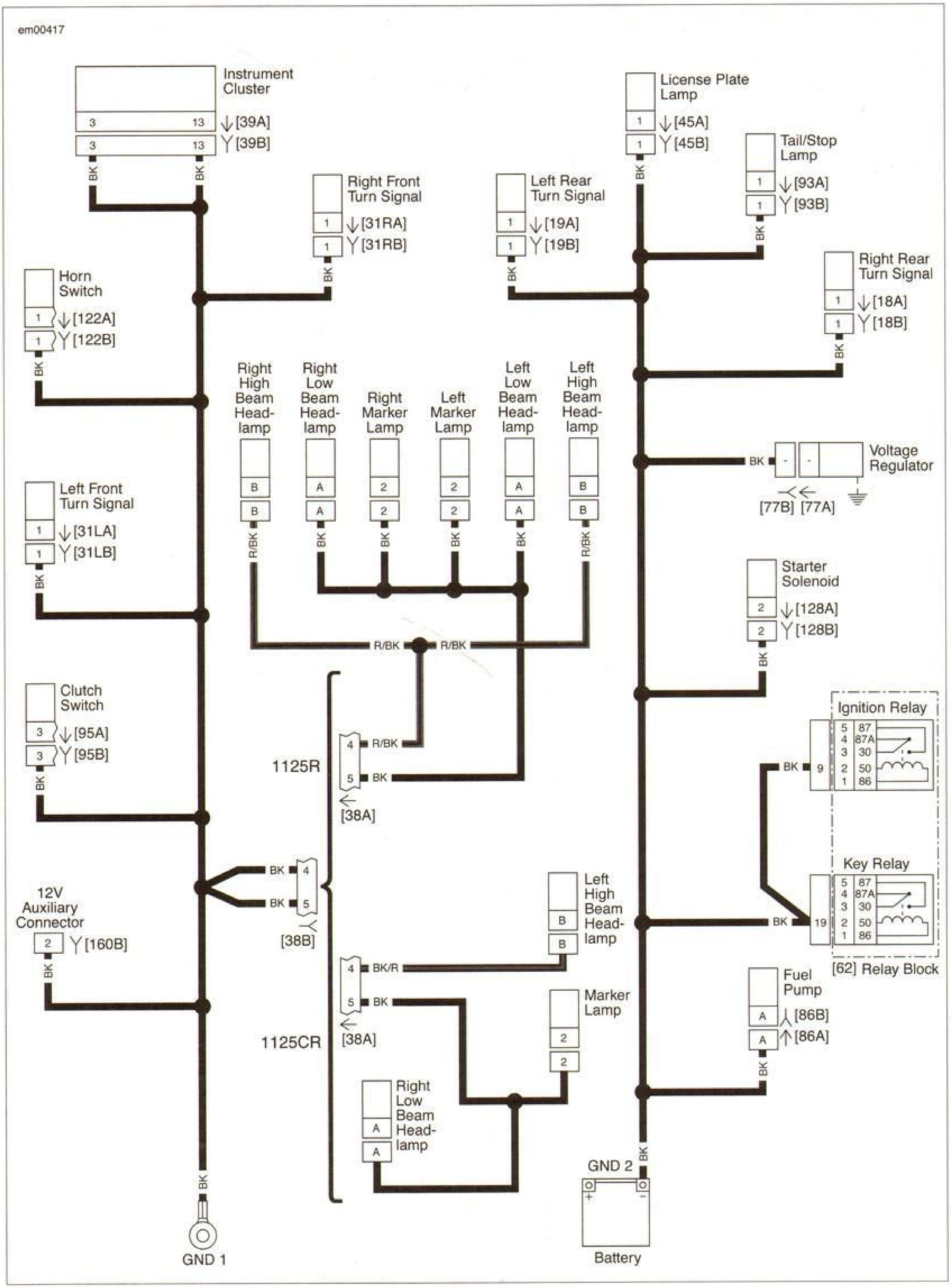
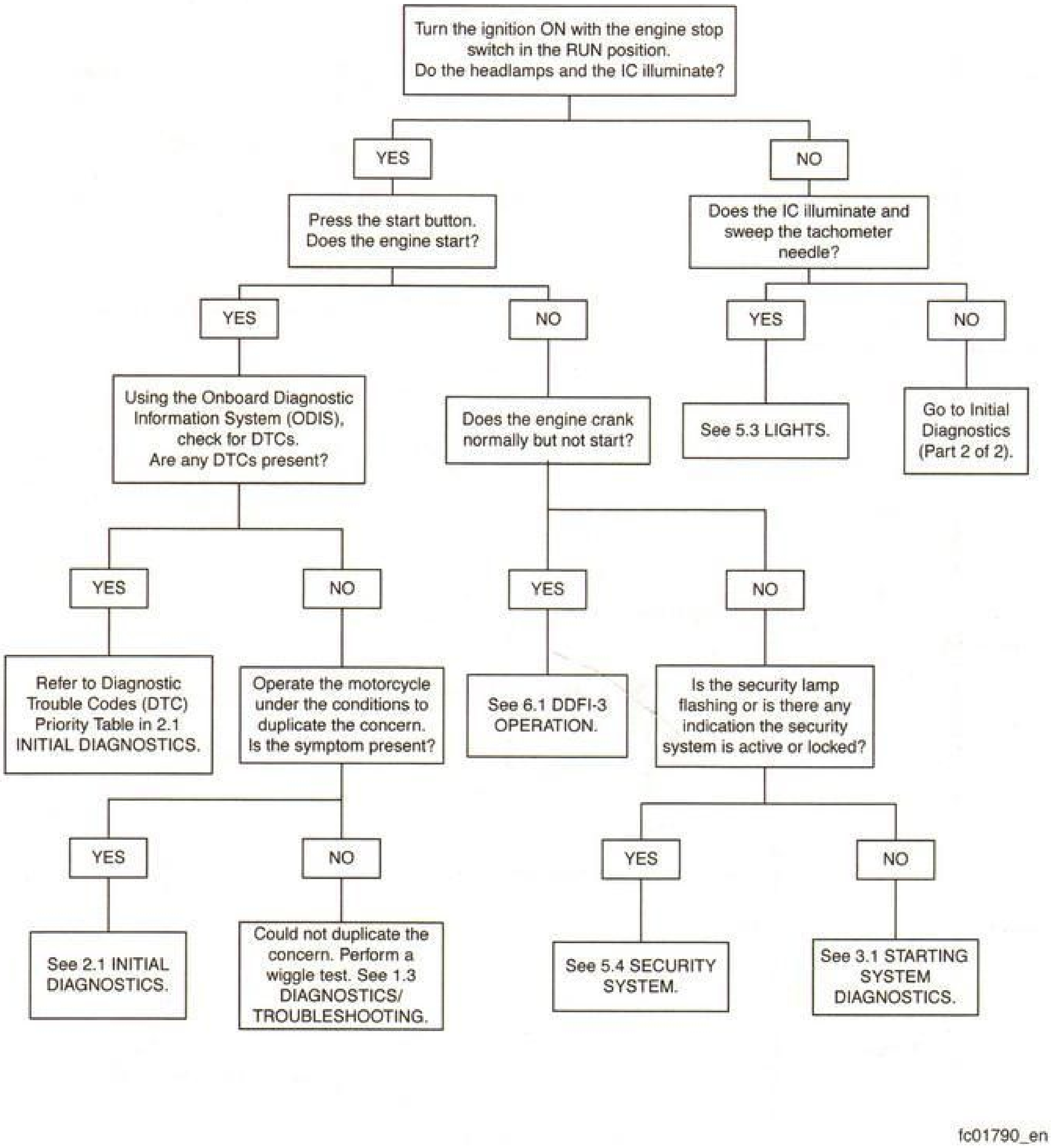
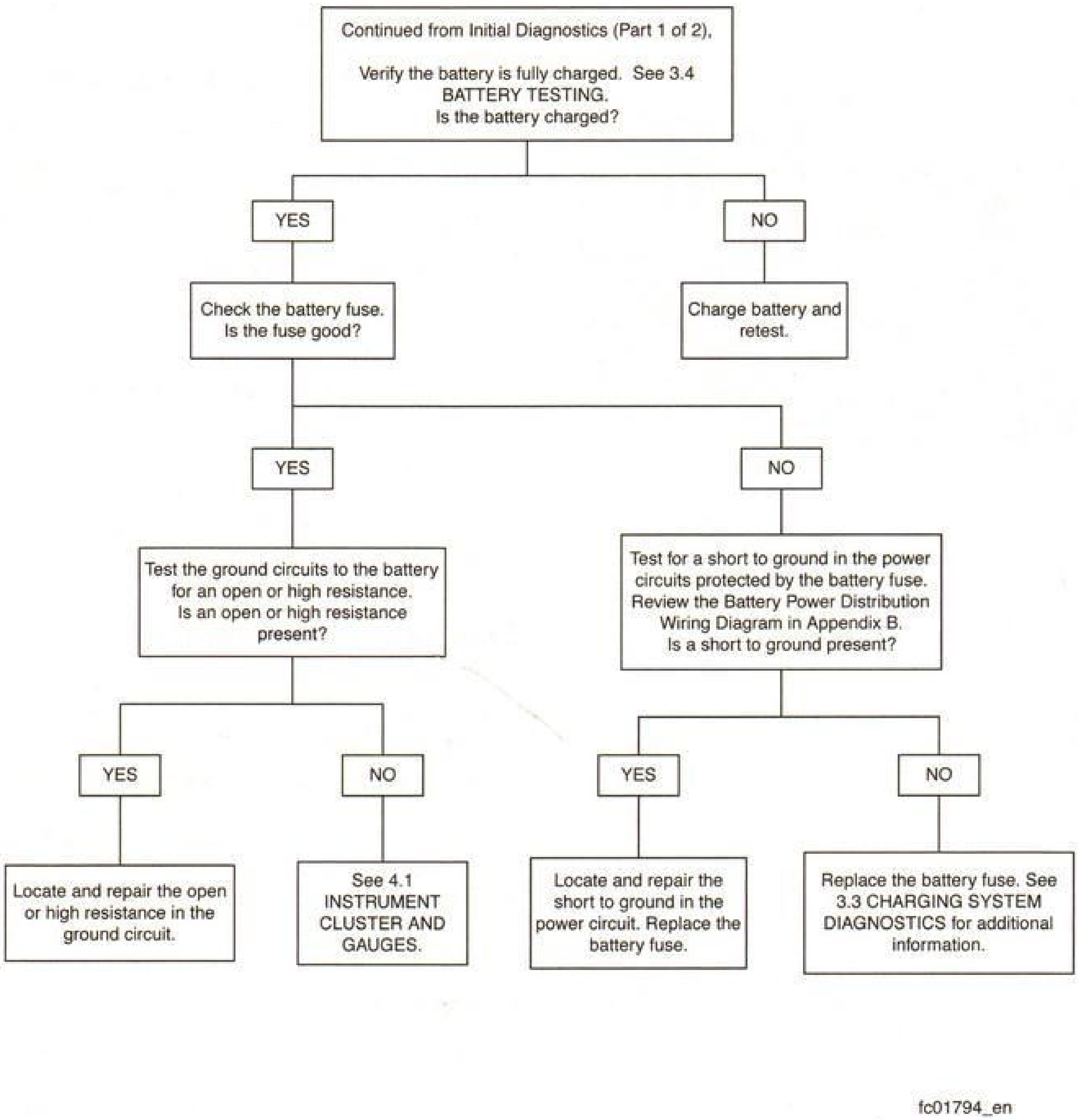


Figure 2-6. Chassis Grounds

Initial Diagnostics (Part 1 of 2)



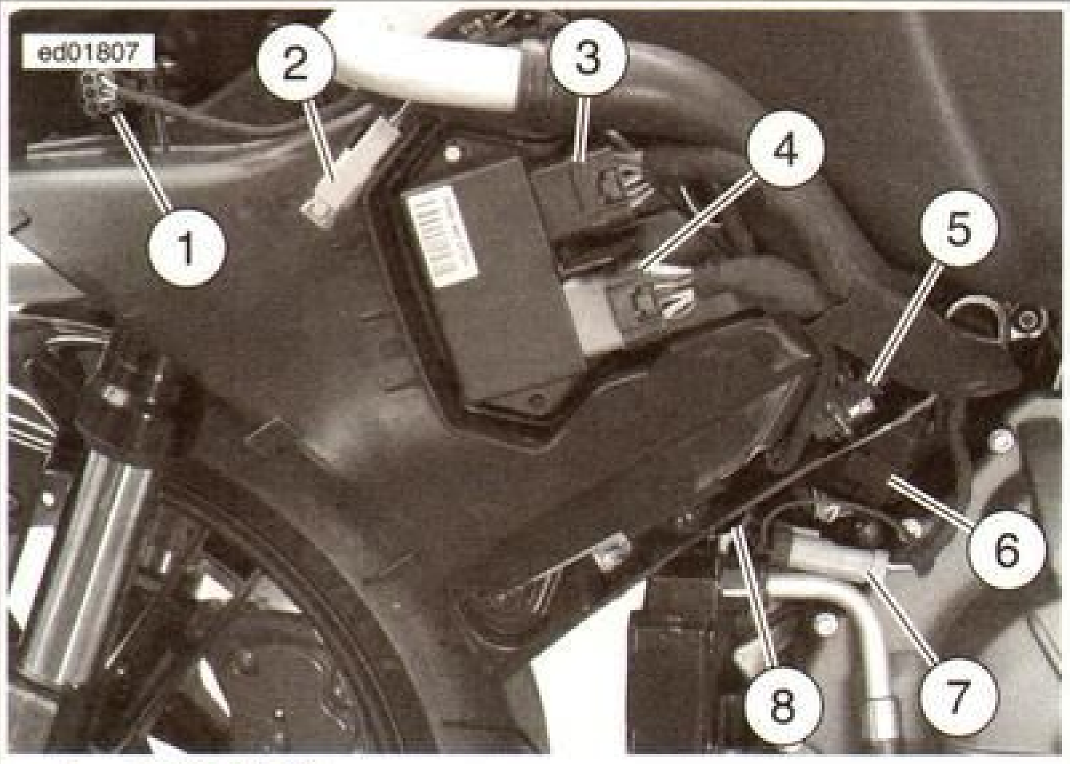
Initial Diagnostics (Part 2 of 2)



DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Serial data communication circuits are used by modules and diagnostic tools to share information.



1. **BAS [134]**
2. **CAN connector [243]**
3. **ECM [10] (BK)**
4. **ECM [11] (GY)**
5. **CKP [79]**
6. **Interface connector [145]**
7. **DLC [91]**
8. **Fan sub-harness [234] (if equipped)**

Figure 2-7. Left Hand Radiator Shroud Connectors

The Instrument Cluster (IC) and ECM share a Controller Area Network (CAN) line. The CAN consists of a low and high circuit. There is also a CAN connector [243] used for initial programming when the motorcycle is built. This connector has a plug in it that is a terminating resistor.

The ECM and IC send information back and forth over the CAN lines. For example, the ECM sends the vehicle speed and engine RPM to the IC over the CAN line. The IC communicates the security code when entered to the ECM. These are just a few examples of the information the ECM and IC share over the CAN.

The ECM also has a transmit and a receive serial data line going to the DLC [91]. This connector is used to connect to the computer based diagnostic system DIGITAL TECHNICIAN II (Part No. HD-48650). The IC is not connected to the serial data line. Therefore, any information going from DIGITAL TECHNICIAN II (Part No. HD-48650) to the motorcycle has to be sent to the ECM and then communicated over the CAN lines to the IC.

COMPONENTS

Electronic Control Module (ECM)

See Figure 2-7. The ECM is located inside the left radiator outer shroud. The ECM monitors the sensors from the engine and fuel systems in order to manage the fuel and spark delivery to the motorcycle which enhances performance and driveability.

Instrument Cluster (IC)

The IC uses the CAN communication to display information to the operator and to communicate to the ECM.

Controller Area Network (CAN) connector

See Figure 2-7. The CAN connector [243] is located inside the left radiator outer shroud next to the ECM. This connector is mainly used for initial programming of the modules when the motorcycle is built. Check that this plug is present to verify proper CAN operation. The CAN connector plug should have a resistance of approximately 120 Ohms.

Data Link Connector (DLC)

See Figure 2-7. The DLC is located under the left radiator shroud. The DLC is used to connect the DIGITAL TECHNICIAN II to the motorcycle.

COMM ERROR OR DTC U0001

The ECM sets U0001 if it loses communication to the IC. When the IC recognizes a loss of communication with the ECM, it displays either a THEFT ERROR message or a COMM ERROR message, depending if there was any communication during that ignition cycle or not.

Diagnostic Tips

The IC sets a THEFT ERROR message if the fault happened when the ignition is off. It sets a COMM ERROR message if the ignition is on and the IC and ECM are communicating when the fault occurs. Once the ignition is cycled off and back on, the COMM ERROR message clears and THEFT ERROR displays.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

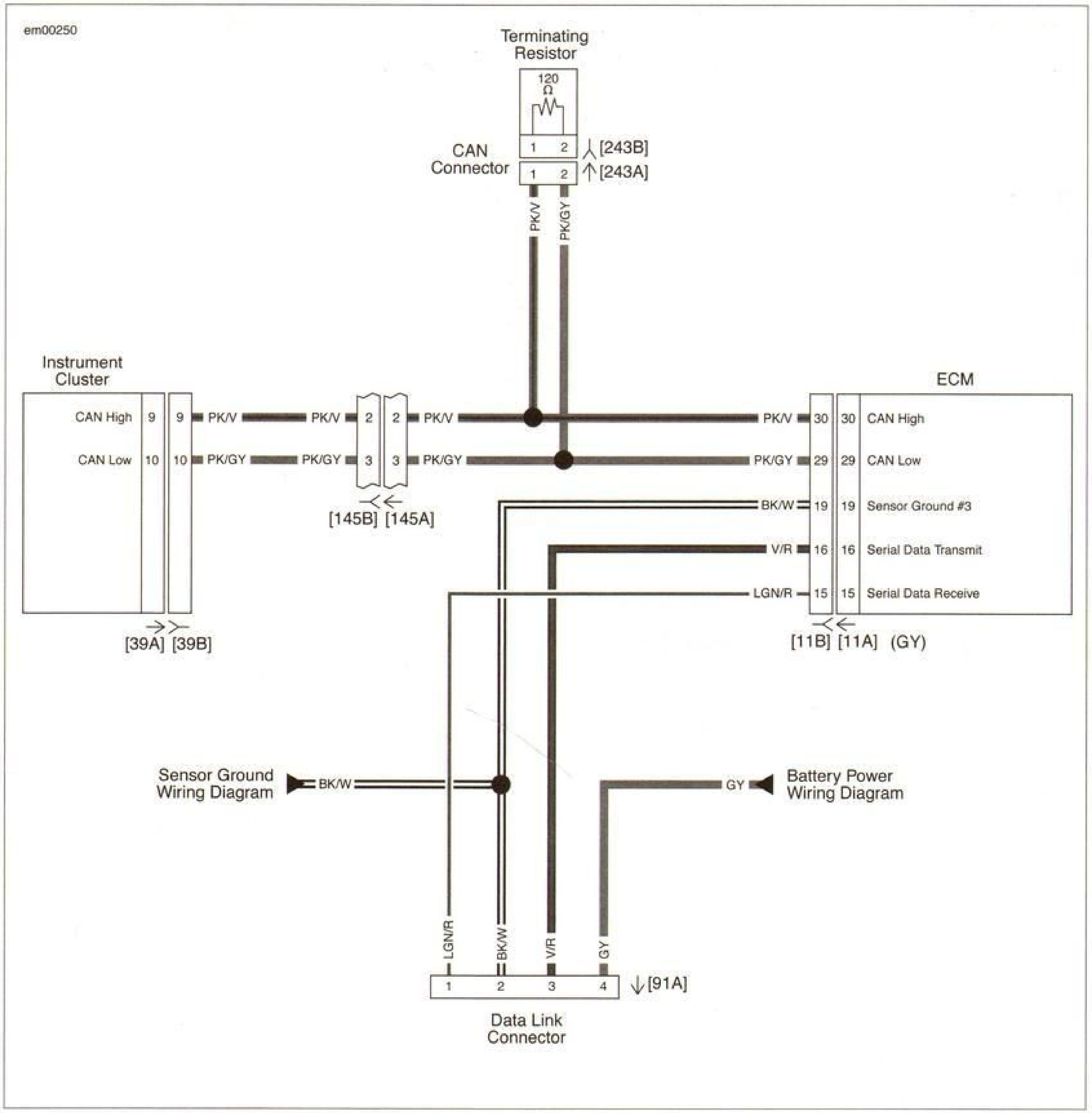
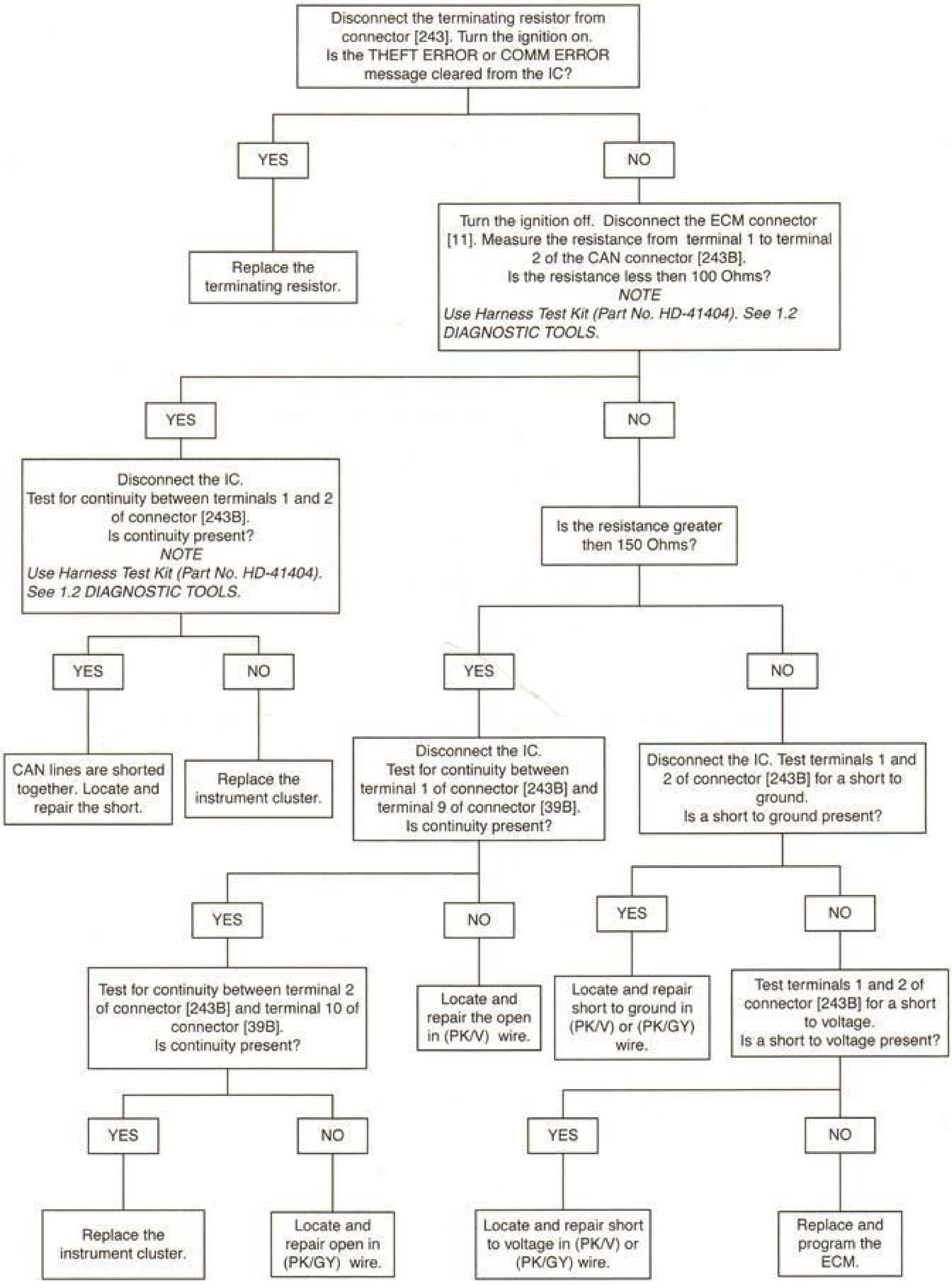


Figure 2-8. Serial Data Communication

COMM ERROR or DTC U0001



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NOTES

DESCRIPTION AND OPERATION

When the ignition switch is turned on, power is supplied to the coil side of the key relay and energizes the relay. This allows battery power to flow through the relay, to the lights fuse, and to the switch side of the start relay.

When the engine stop switch is in the RUN position with the ignition switch turned on, power is supplied to the ignition relay causing the relay to energize. This supplies power to the start switch. When the start switch is pressed, power flows to the coil side of the start relay. The ECM grounds the coil side of the start relay. The ECM monitors the clutch switch, neutral switch, and the state of the security system. If the security system is not locked and either the clutch lever is pulled in or the motorcycle is in neutral, the ECM supplies ground to the coil side of the start relay allowing power to flow to the solenoid. This energizes the solenoid and full battery power is sent to the starter.

Once the engine is running, the alternator starts supplying the power to charge the battery and run all of the electrical components on the motorcycle. The voltage regulator regulates the power coming from the alternator and charges the battery using the circuitry through the battery fuse.

COMPONENTS

Starter

See Figure 3-1. The electric starter is located on the front of the engine.

- The starter drive gear transfers rotation to the limiter assembly.
- The limiter assembly gear transfers rotation to the starter ring gear.
- The starter ring gear drives the alternator rotor on the end of the crankshaft.

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

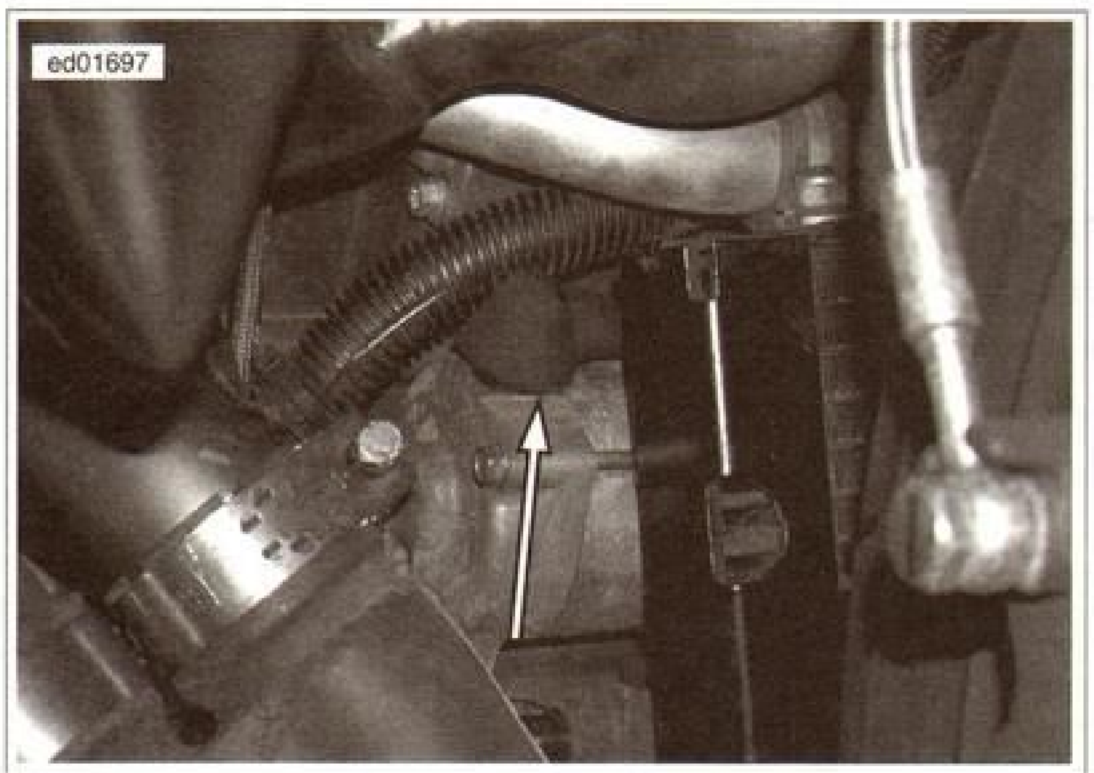
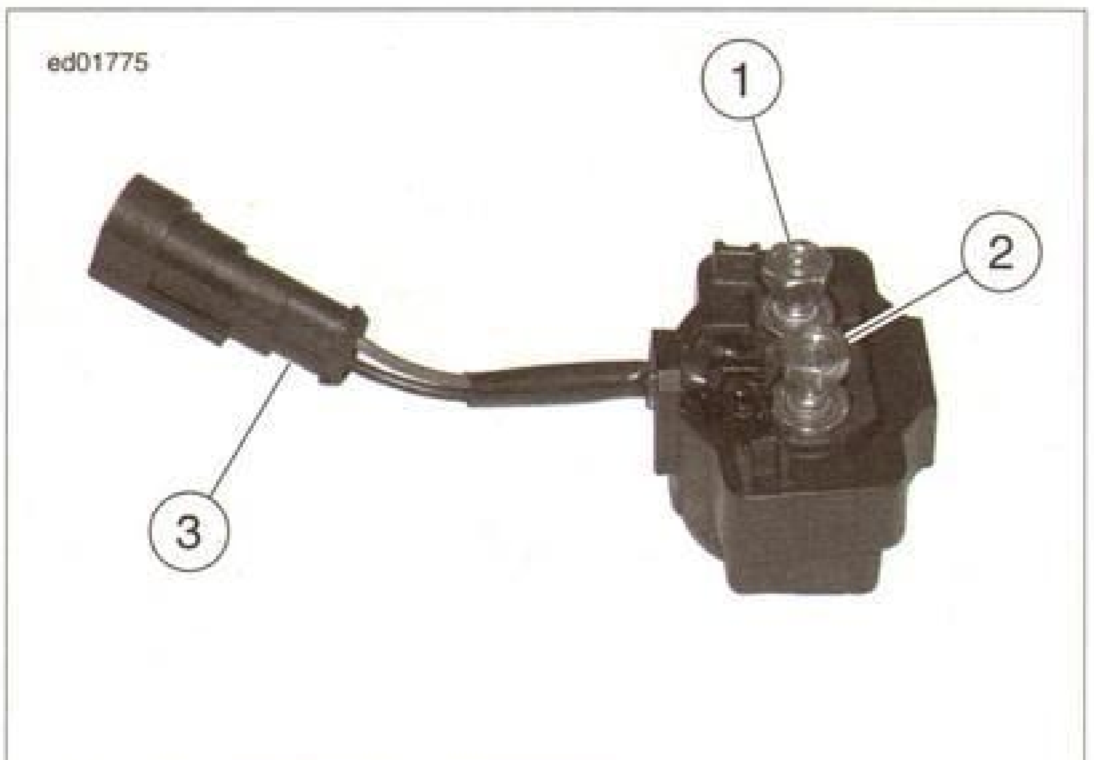


Figure 3-1. Starter Terminal

Starter Solenoid

See Figure 3-2. The starter solenoid is located under the seat and is a switch to open and close the high current circuit to the electric starter motor.



1. **Solenoid stud (to battery)**
2. **Solenoid stud (to starter)**
3. **Starter solenoid connector [128]**

Figure 3-2. Starter Solenoid Terminals (typical)

Engine Stop Switch (Right Hand Controls)

The engine stop switch is located on the right hand controls. When the engine stop switch is in the RUN position, voltage is supplied to the coil side of the ignition relay.

Start Switch (Right Hand Controls)

The start switch is a pushbutton switch located in the right hand controls. When the start switch is pressed, voltage is supplied to the coil of the ignition relay.

Key Relay

See Figure 3-3. The key relay is located in the relay box under the seat. When the ignition switch is turned on, power is supplied to the key relay. The key relay energizes and provides power to the lights fuse.

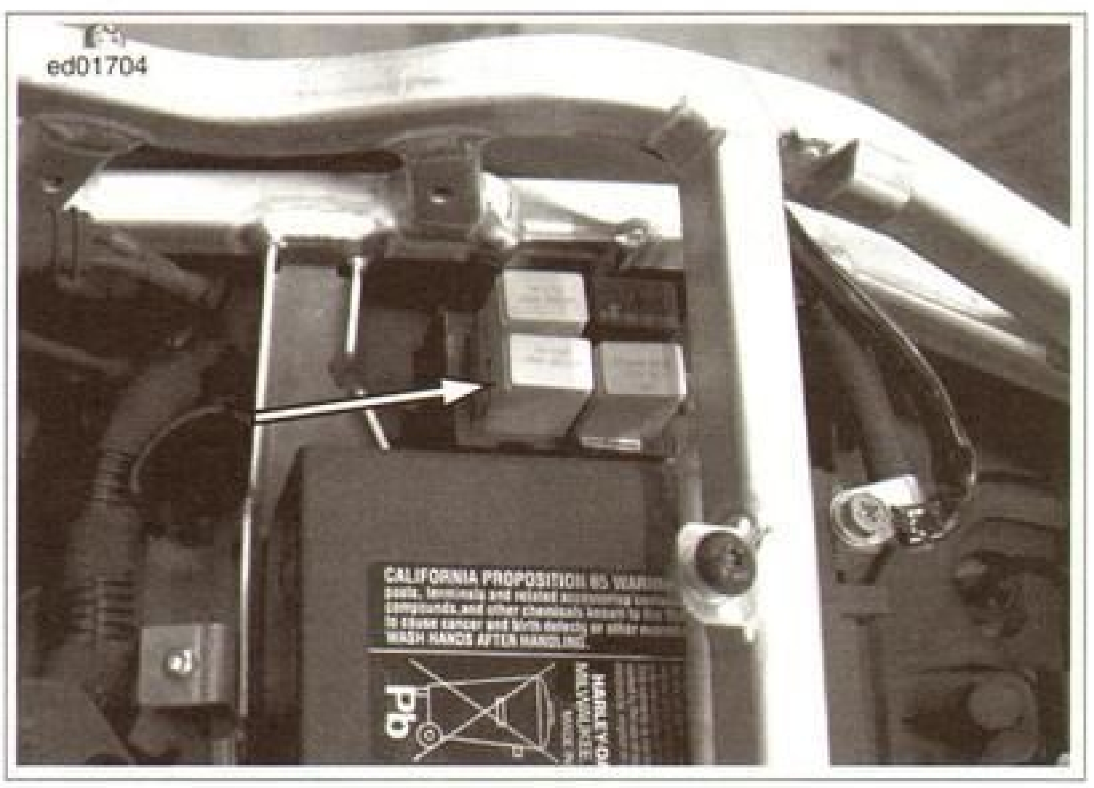


Figure 3-3. Key Relay

Ignition Relay

See Figure 3-4. The ignition relay is located in the relay box under the seat. When the ignition switch is turned on, and the engine stop switch is in the RUN position, the ignition relay is activated.

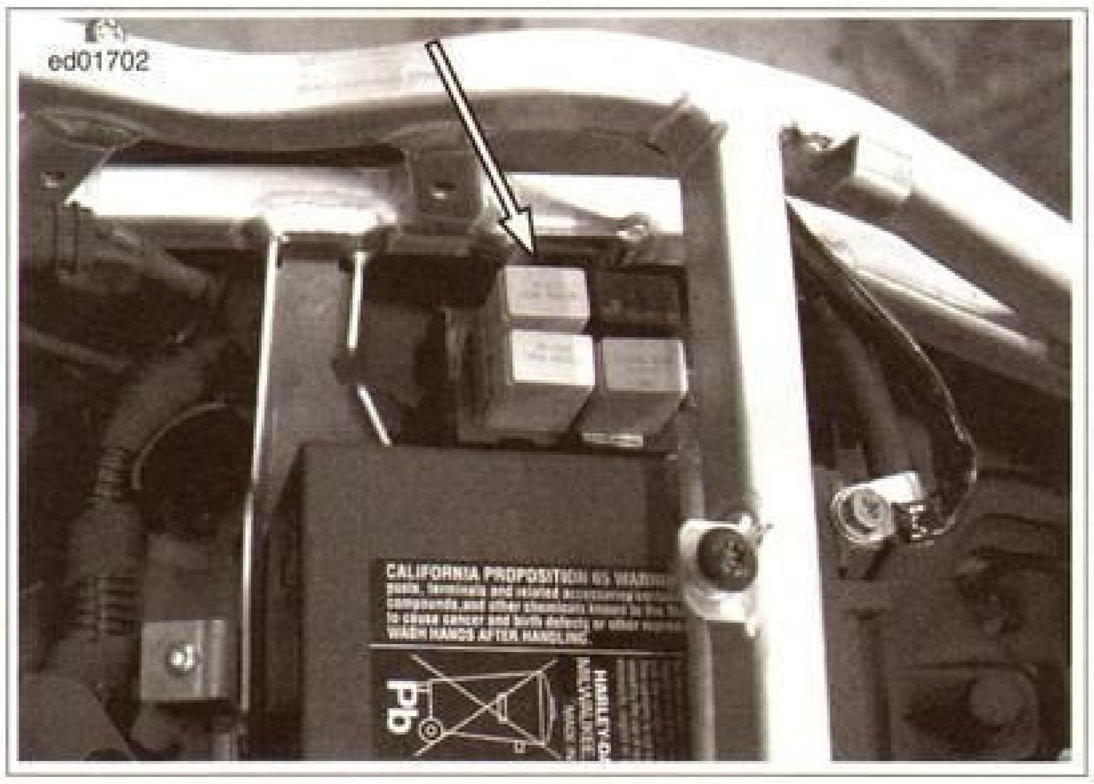


Figure 3-4. Ignition Relay

Start Relay

See Figure 3-5. The start relay is located in the relay box under the seat. When the ignition switch is turned on, and the engine stop switch is in the RUN position, the ignition relay is activated. With the start switch pressed, the ECM verifies the clutch is engaged or the transmission is in neutral. The ECM then supplies the ground circuit, activating the start relay, to transfer power to the starter solenoid. Simultaneously, power is removed from the headlamps for the duration of the start switch activation.

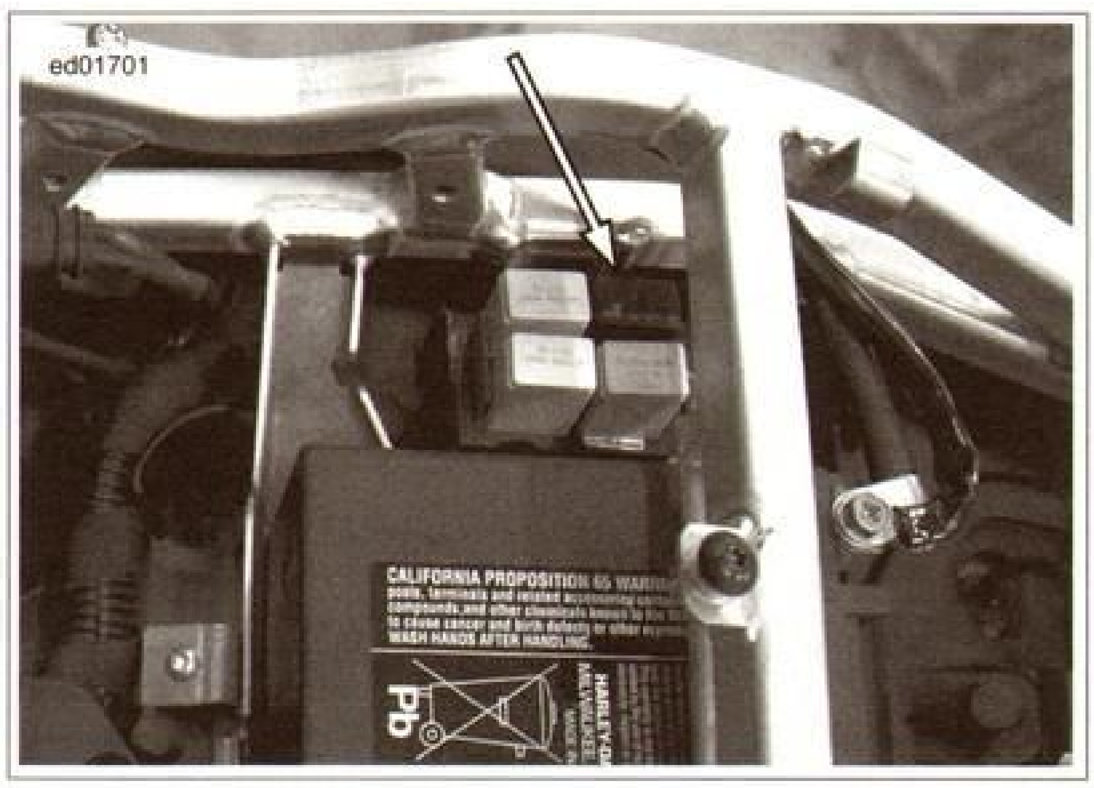


Figure 3-5. Start Relay

Ignition Switch

The ignition switch is located on the handlebars, below the Instrument Cluster (IC). The ignition switch locks the handlebars and turns the electrical power to the motorcycle on and/or off.

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)

CAUTION

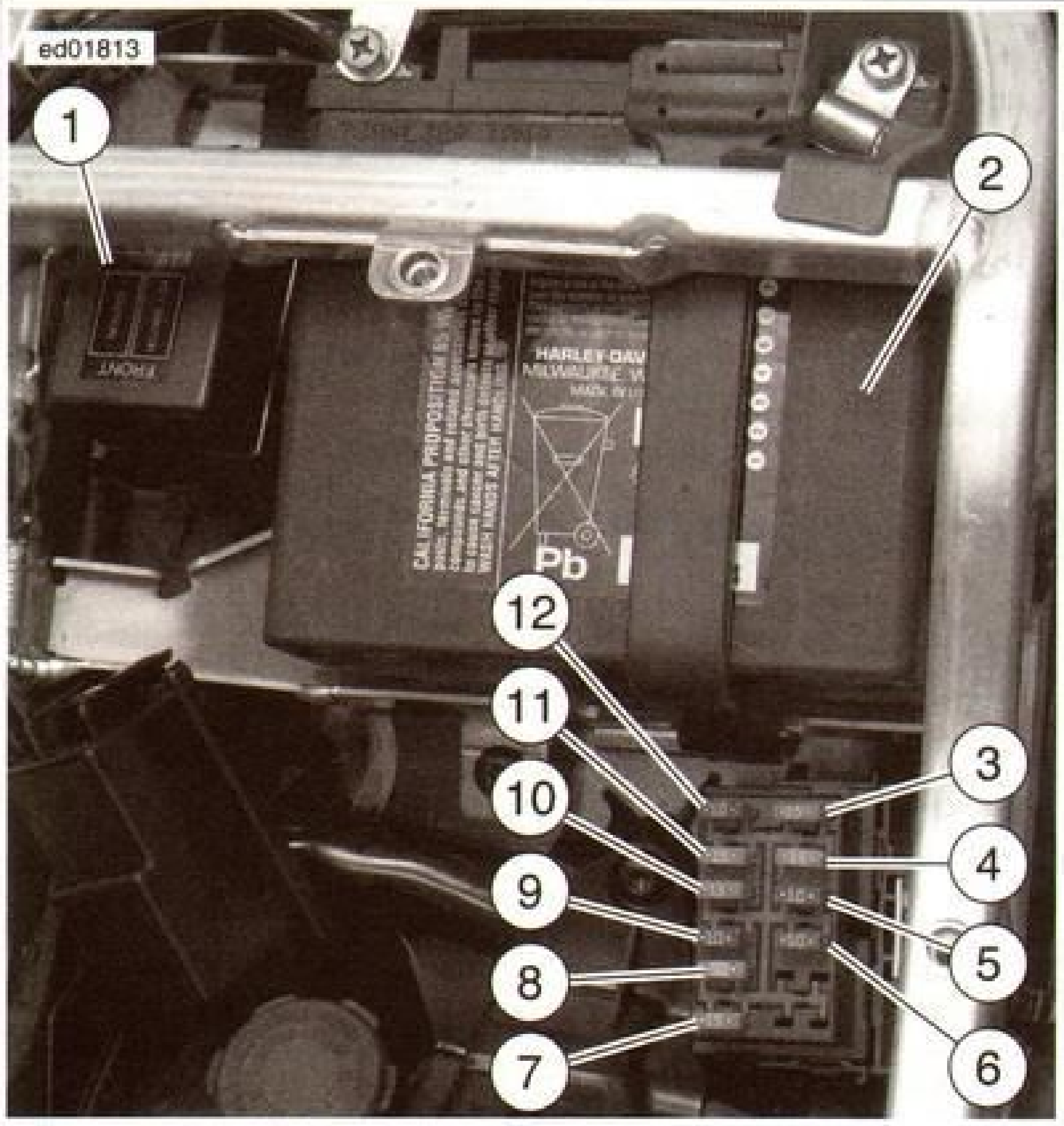
If battery releases an excessive amount of gas during charging, decrease the charging rate. Overheating can result in plate distortion, internal shorting, drying out or damage. (00413b)

See Figure 3-6. The Absorbed Glass Mat (AGM) battery stores energy in chemical form to provide electrical power for the vehicle. 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 3.4 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.



1. **Relay block**
2. **Battery**
3. **Key switch fuse**
4. **Lights fuse**
5. **ECM fuse**
6. **Aux power fuse**
7. **Fuel pump fuse**
8. **Battery fuse**
9. **Brake/horn fuse**
10. **Cooling fan fuse**
11. **Ignition fuse**
12. **Accessory fuse**

Figure 3-6. Under Seat

Alternator

The alternator is located on the left side of the engine, behind the alternator cover. The alternator consists of permanent magnets mounted around the circumference of a rotor and a series of radial wire coils statically mounted in a stator assembly. When rotated by the engine, the rotor magnets cause a voltage in the wire coils of the stator alternately reversing poles.

The rotor of the alternator is bolted to the crankshaft. The stator is bolted to the inside of the alternator cover and delivers voltage to a voltage regulator through a wire harness that passes through a boss in the side of the alternator cover.

Voltage Regulator

See Figure 3-7. The voltage regulator is located under the seat on the left side frame rail. The voltage regulator is a shunt regulator. The circuit combines the functions of rectifying the AC voltage from the alternator stator and regulating the charge voltage to the battery and other vehicle systems. The voltage regulator cannot be repaired, only replaced.

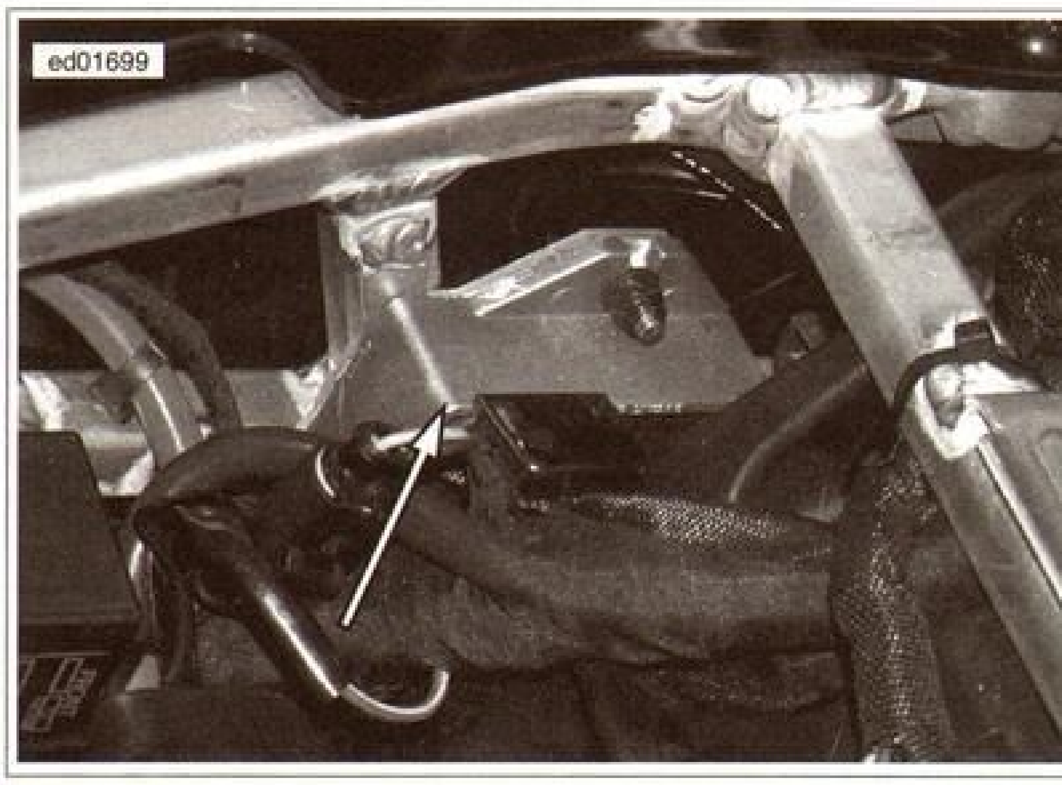


Figure 3-7. Voltage Regulator

Battery Fuse

See Figure 3-6. The 30 Amp battery fuse is located in the fuse box under the seat and is used to protect the circuits to most of the other fuses.

SYMPTOMS

The troubleshooting tables contain detailed procedures to solve and correct problems. Follow 3.1 STARTING SYSTEM DIAGNOSTICS to diagnose starting system problems. The 1.3 DIAGNOSTICS/TROUBLESHOOTING, Voltage Drop procedure helps locate poor connections or circuits with excessive resistance.

Table 3-1. Starter Does Not Run or Runs at Very Low Speeds

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuited or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Wiring	Poor or no connection at either end of the battery positive or negative cable.	Repair or replace cable(s).
	Cracked or corroded battery cable ends.	Clean, tighten or replace cable(s) as needed.
	Open wire(s) or poor connection at handlebar switch or start relay, especially relay ground wire (grounds through ECM).	Tighten connections or repair or replace wire(s).

Table 3-1. Starter Does Not Run or Runs at Very Low Speeds

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Start switch, clutch switch, engine stop switch or neutral switch	Poor switch contacts or open switch.	Replace switch.
Start relay	Open coil winding.	Replace relay.
	Poor or no continuity at relay points.	Replace relay.
	ECM has disabled start relay.	Disarm security system.
Solenoid	Poor contact condition caused by burned contacts.	Replace solenoid assembly.
	Windings open or short-circuited.	Replace solenoid assembly.
Starter motor	Brushes worn below specification.	Replace starter.
	Commutator burnt.	Replace starter.
	Commutator high mica.	Replace starter.
	Field winding grounded.	Replace starter.
	Armature winding grounded or short-circuited.	Replace starter.
	Free running current draw out of range.	Replace starter.
	Insufficient brush spring tension.	Replace starter.
Limiter assembly	Limiter assembly failure.	Replace limiter assembly.
Sprag clutch	Sprag clutch failure.	Replace rotor/sprag clutch assembly.

Table 3-2. Engine Cannot Be Cranked

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuited or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Starter motor	Starter gear teeth worn out.	Replace starter.
Limiter assembly	Limiter assembly malfunction.	Replace limiter assembly.
	Limiter assembly gears damaged.	Replace limiter assembly.
Gear teeth on freewheel gear	Excessively worn teeth.	Replace freewheel gear.
Sprag clutch	Sprag clutch failure.	Replace rotor/sprag clutch assembly.

Table 3-3. Starter Does Not Stop Running

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Start switch or start relay	Unopened contacts.	Replace start switch or start relay.
	Poor return caused by sticky switch or relay contacts.	Replace start switch or start relay.
Solenoid	Coil shorted.	Replace solenoid.
	Contact plate melted and stuck.	Replace solenoid.
Sprag clutch	Sprag clutch seizure.	Replace rotor/sprag clutch assembly.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

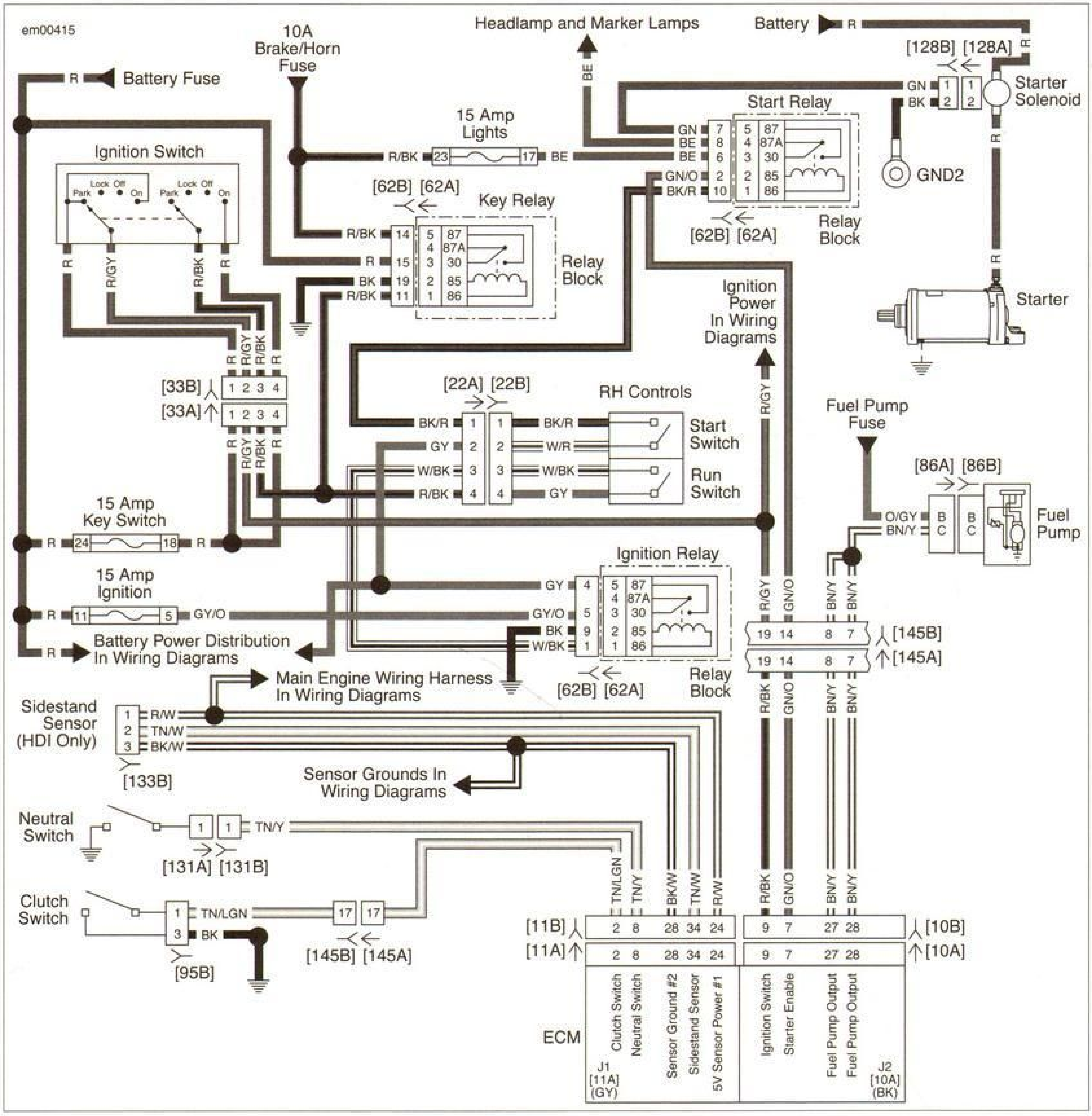
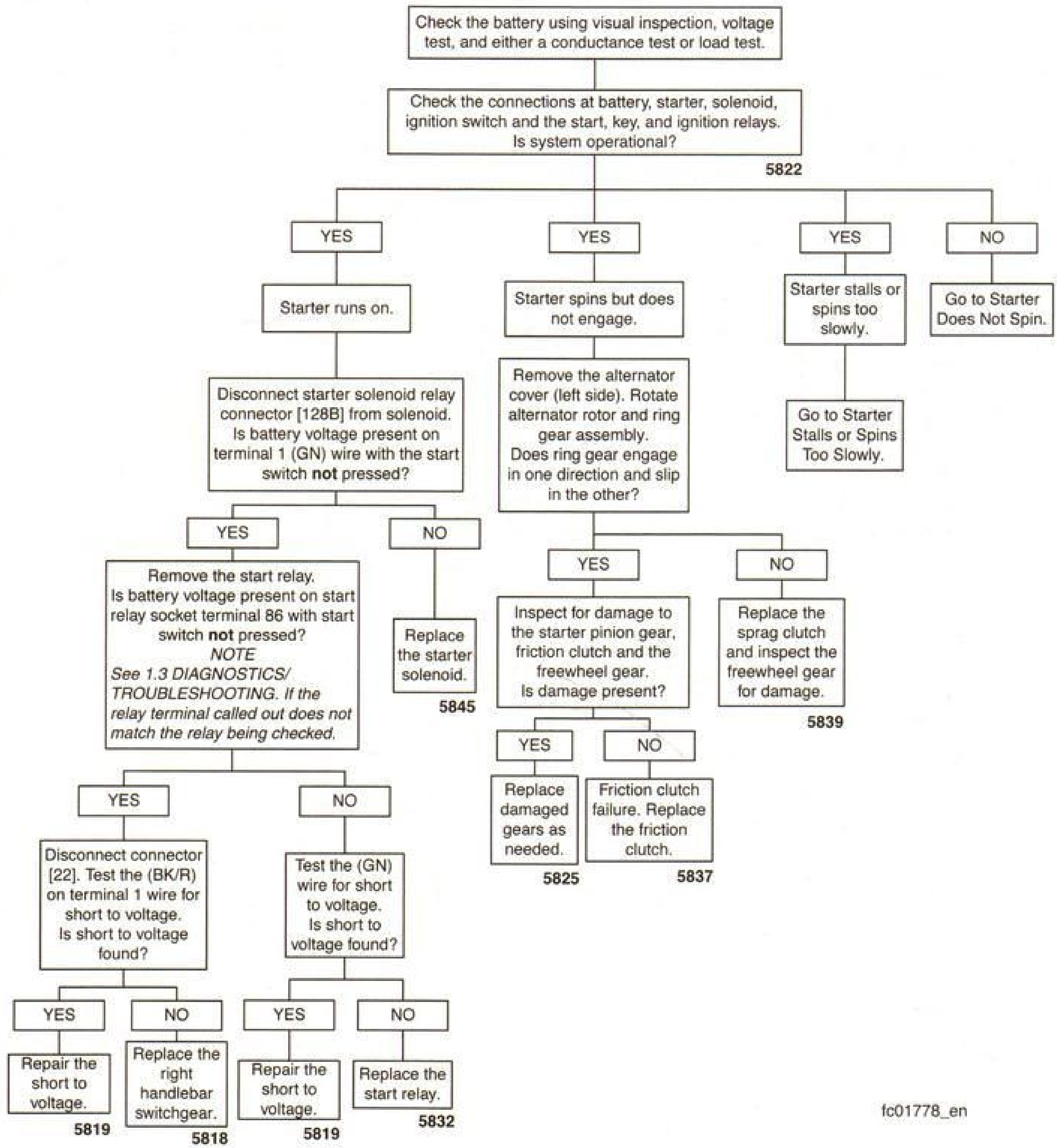
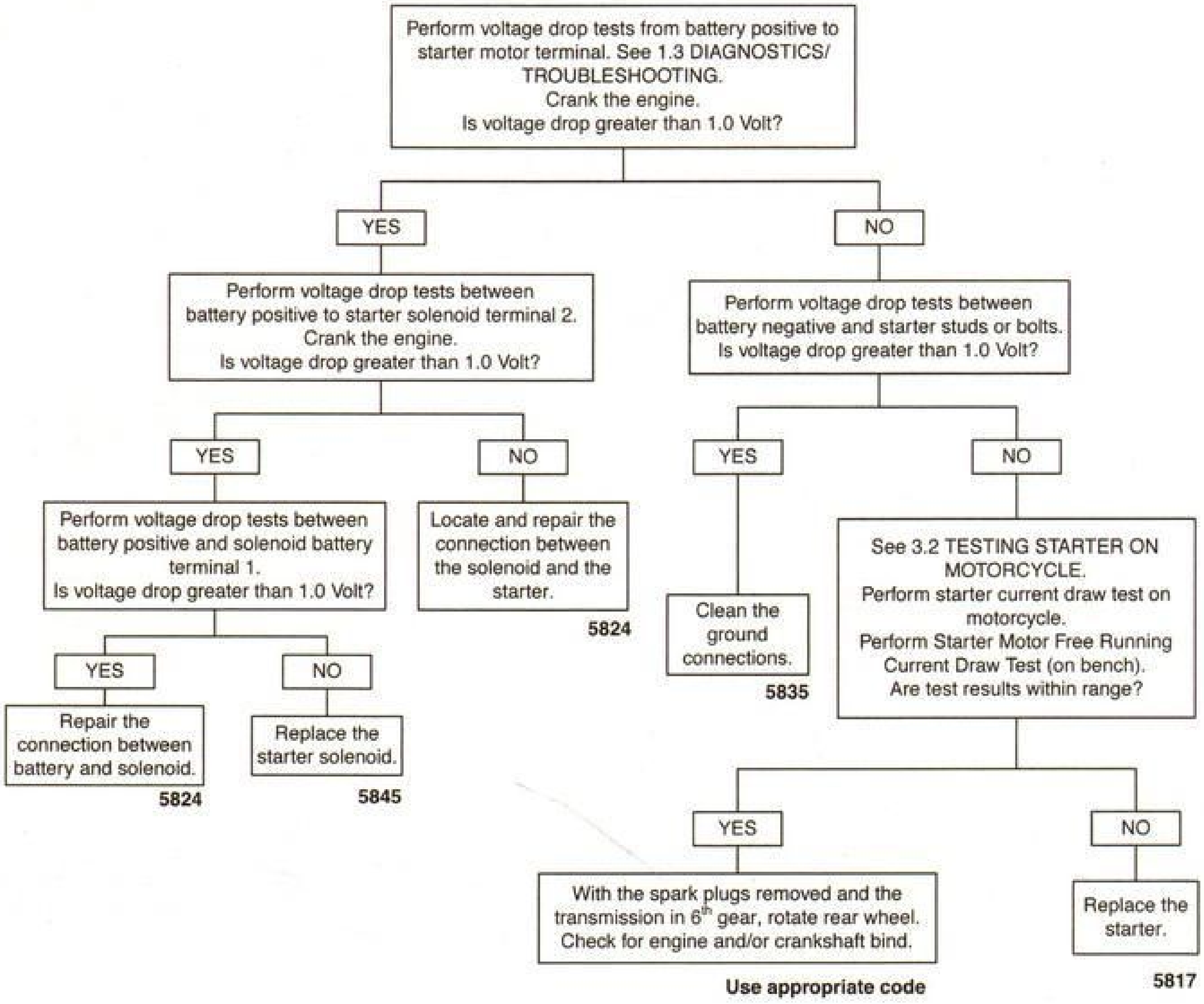


Figure 3-8. Starting Circuit

Starter Testing



Starter Stalls or Spins Too Slowly



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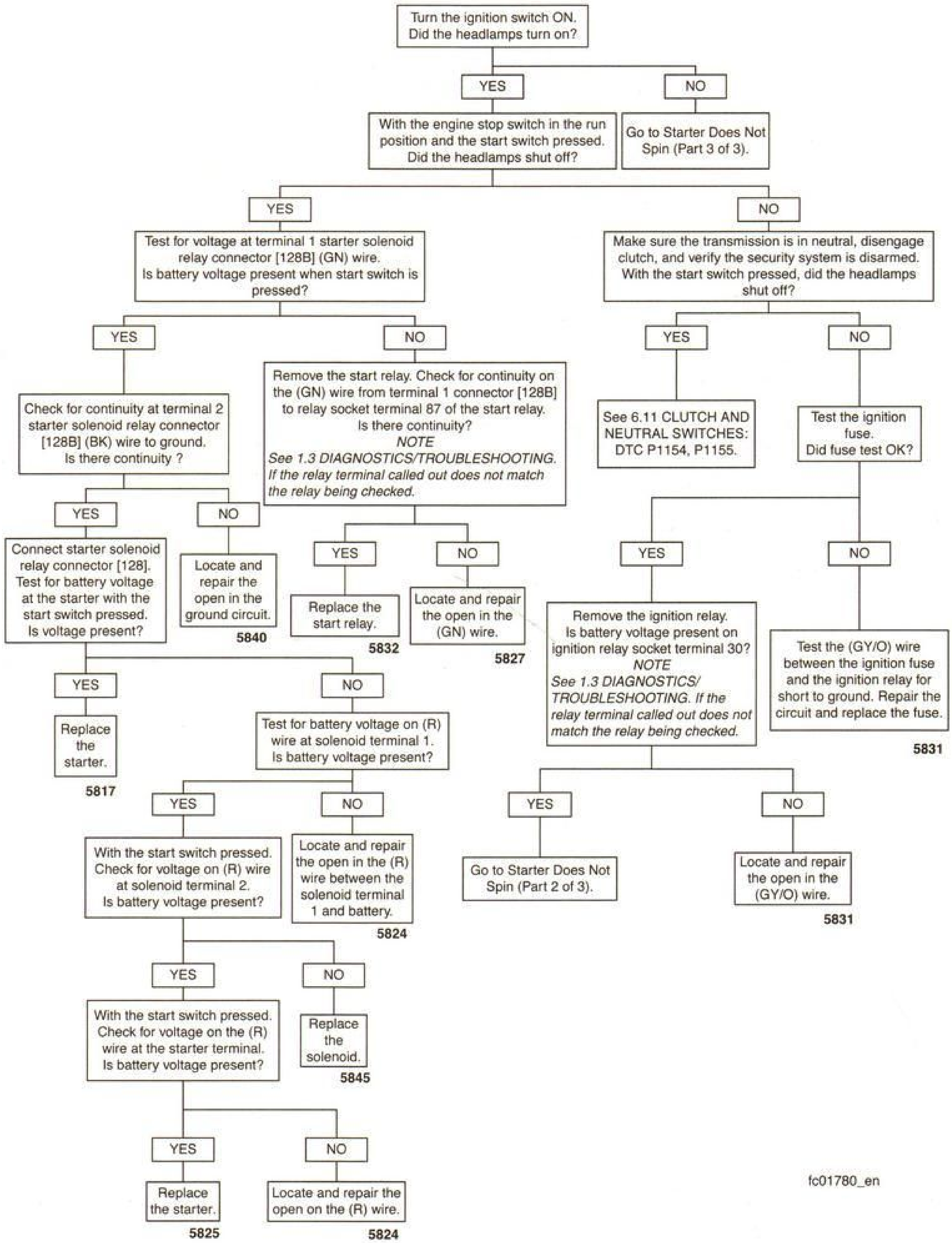
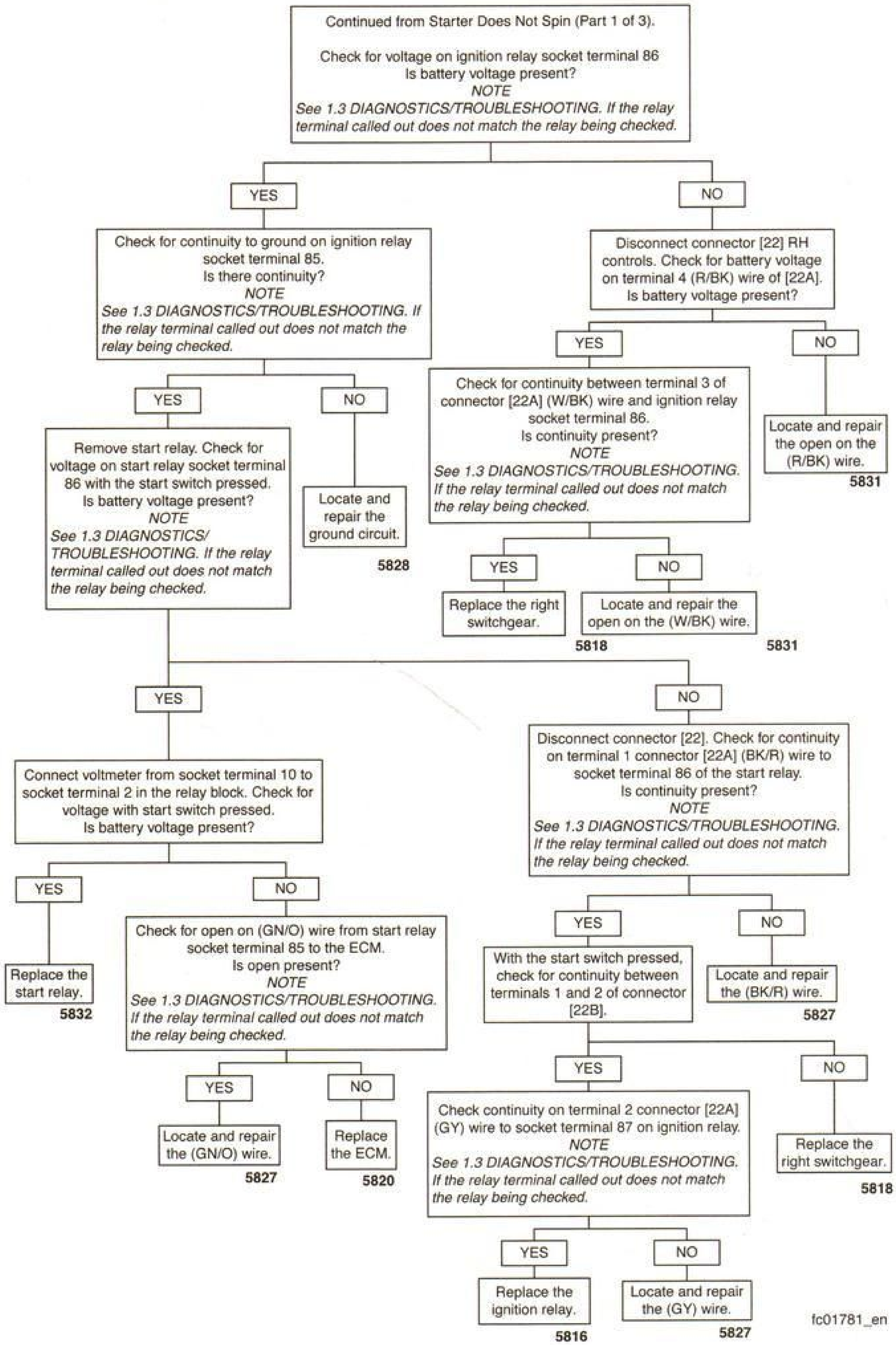
Starter Does Not Spin (Part 1 of 3)





Continued from Starter Does Not Spin (Part 1 of 3).
Check for voltage on ignition relay socket terminal 86
Is battery voltage present?
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
YES
NO
Check for continuity to ground on ignition relay socket terminal 85.
Is there continuity?
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
Disconnect connector [22] RH controls. Check for battery voltage on terminal 4 (R/BK) wire of [22A].
Is battery voltage present?
YES
NO
YES
NO
Check for continuity between terminal 3 of connector [22A] (W/BK) wire and ignition relay socket terminal 86.
Is continuity present?
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
Locate and repair the open on the (R/BK) wire.
5831
Remove start relay. Check for voltage on start relay socket terminal 86 with the start switch pressed.
Is battery voltage present?
NOTE
See 1.3 DIAGNOSTICS/ TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
Locate and repair the ground circuit.
5828
YES
NO
Replace the right switchgear.
5818
Locate and repair the open on the (W/BK) wire.
5831
YES
NO
Connect voltmeter from socket terminal 10 to socket terminal 2 in the relay block. Check for voltage with start switch pressed.
Is battery voltage present?
Disconnect connector [22]. Check for continuity on terminal 1 connector [22A] (BK/R) wire to socket terminal 86 of the start relay.
Is continuity present?
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
YES
NO
Replace the start relay.
5832
Check for open on (GN/O) wire from start relay socket terminal 85 to the ECM.
Is open present?
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
YES
NO
With the start switch pressed, check for continuity between terminals 1 and 2 of connector [22B].
Locate and repair the (BK/R) wire.
5827
YES
NO
YES
NO
Locate and repair the (GN/O) wire.
5827
Replace the ECM.
5820
Check continuity on terminal 2 connector [22A] (GY) wire to socket terminal 87 on ignition relay.
NOTE
See 1.3 DIAGNOSTICS/TROUBLESHOOTING. If the relay terminal called out does not match the relay being checked.
Replace the right switchgear.
5818
YES
NO
Replace the ignition relay.
5816
Locate and repair the (GY) wire.
5827
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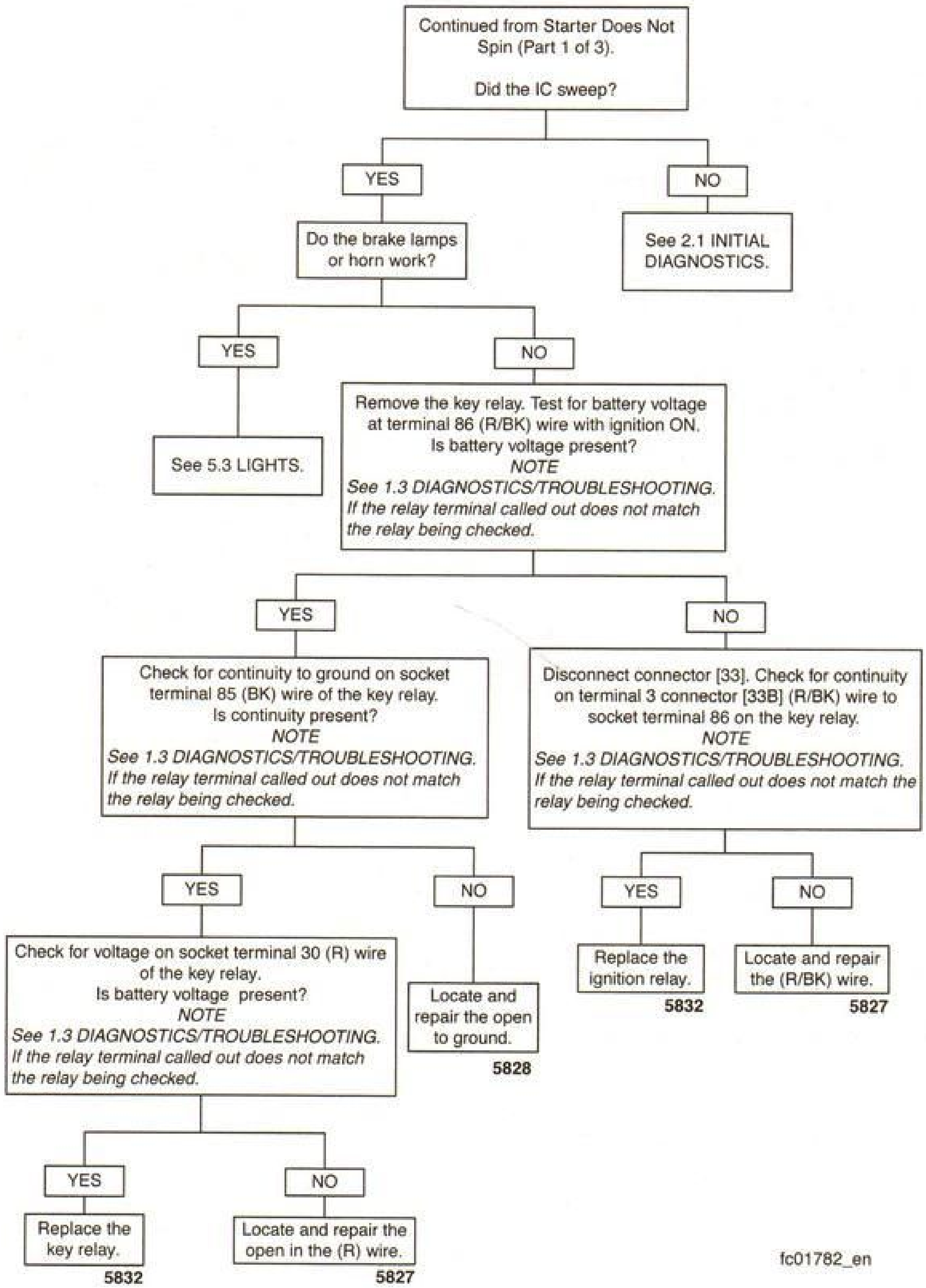
Starter Does Not Spin (Part 3 of 3)



STARTER CURRENT DRAW TEST

1. See Figure 3-9. Disconnect fuel pump connector [86] located under the seat.
2. Verify the transmission is in neutral.
3. Clamp induction ammeter over positive cable from the starter to the solenoid.

NOTE

Engine could start and run until the fuel in the lines is purged.

4. Turn the ignition switch on. While reading the ammeter, push the starter button. Disregard initial high current reading, that is normal when engine is first turned over.
   a. Typical starter current draw ranges between 140-180 amps.
   b. If starter current draw exceeds 180 amps, the problem may be in the starter or the starter drive. Remove the starter for further tests. See 3.2 TESTING STARTER ON MOTORCYCLE, Free Running Current Draw Test.

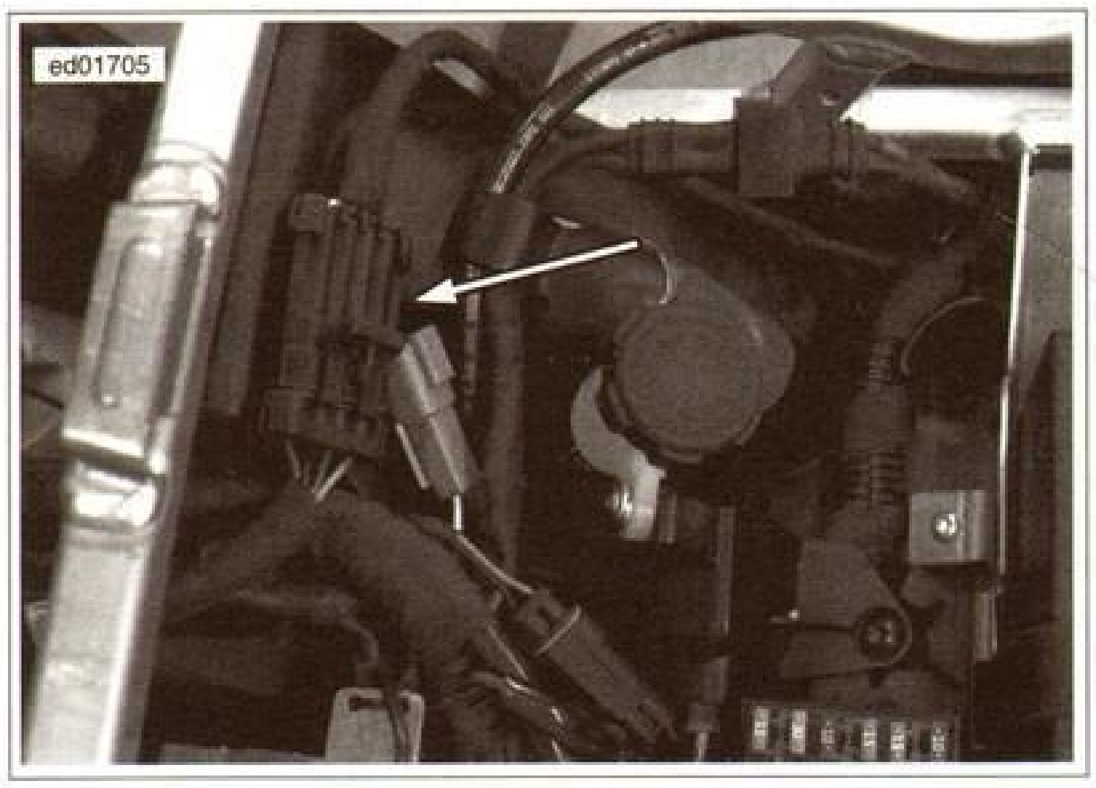
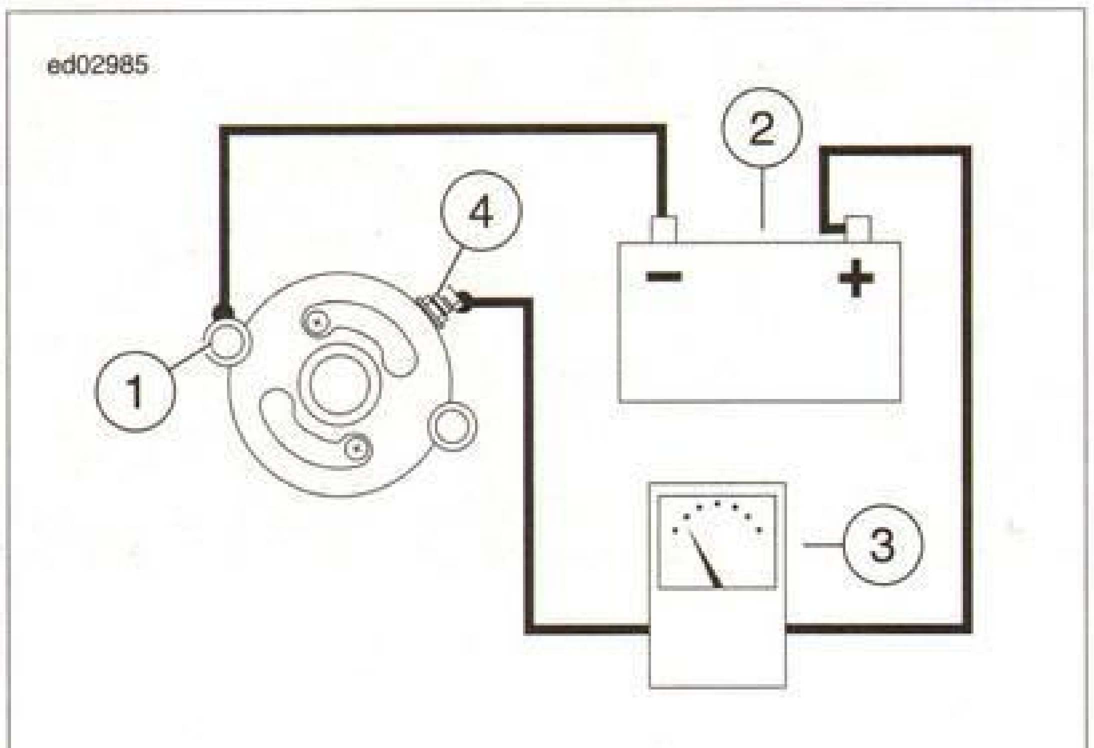


Figure 3-9. Fuel Pump Connector [86]

FREE RUNNING CURRENT DRAW TEST

1. Place the starter in a vise. Use a clean shop towel to prevent scratches or other damage.
2. See Figure 3-10, attach one heavy jumper cable (6 gauge minimum) as follows:
   a. Connect one end to the starter mounting flange.
   b. Connect the other end to the negative (-) terminal of a fully charged battery.
   c. Connect a second heavy jumper cable (6 gauge minimum) to one end to the positive (+) terminal of the battery.
   d. Connect the other end of the second jumper cable to the battery terminal on the starter. Place an induction ammeter over cable.
3. Check ammeter reading.
   a. Ammeter should show 25-40 amps.
   b. If reading exceeds 40 amps, replace the starter motor.
   c. If starter current draw on the vehicle was over 180 amps and this test was within specification, there may be a problem with the engine or primary drive.



1. **Mounting flange**
2. **Battery**
3. **Induction ammeter**
4. **Battery terminal**

Figure 3-10. Free Running Current Draw Test

DESCRIPTION AND OPERATION

See Figure 3-12. The charging system consists of the alternator and regulator.

COMPONENTS

Alternator

The alternator consists of 2 main components:

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

Voltage Regulator

See Figure 3-11. The voltage regulator is a shunt regulator. The circuit combines the functions of rectifying the AC voltage from the alternator stator and regulating the charge voltage to the battery and other vehicle systems.

Figure 3-11. Voltage Regulator Location

TROUBLESHOOTING

PART NUMBER	TOOL NAME
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER

When the charging system fails to charge or does not charge at the normal rate, check the battery, wiring, and voltage regulator.

Battery

Check for a weak or dead battery. See 3.4 BATTERY TESTING for battery testing procedures. Battery must be fully charged in order to perform a load test, and starting or charging tests. However, a partially discharged battery may be tested using the BATTERY TEST function of the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053).

Wiring

The stator's plug and socket connections must be clean and tight.

Check for corroded or loose connections in the charging circuit.

Voltage Regulator Inspection

The voltage regulator ground must have a clean, tight connection for proper grounding. Check by using an ohmmeter with one lead on a known good ground, such as battery ground cable, and the other on the regulator body.

Job/Time Code Values

Dealership technicians filing warranty claims should use the job/time code values printed in **bold text** underneath the appropriate repair.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

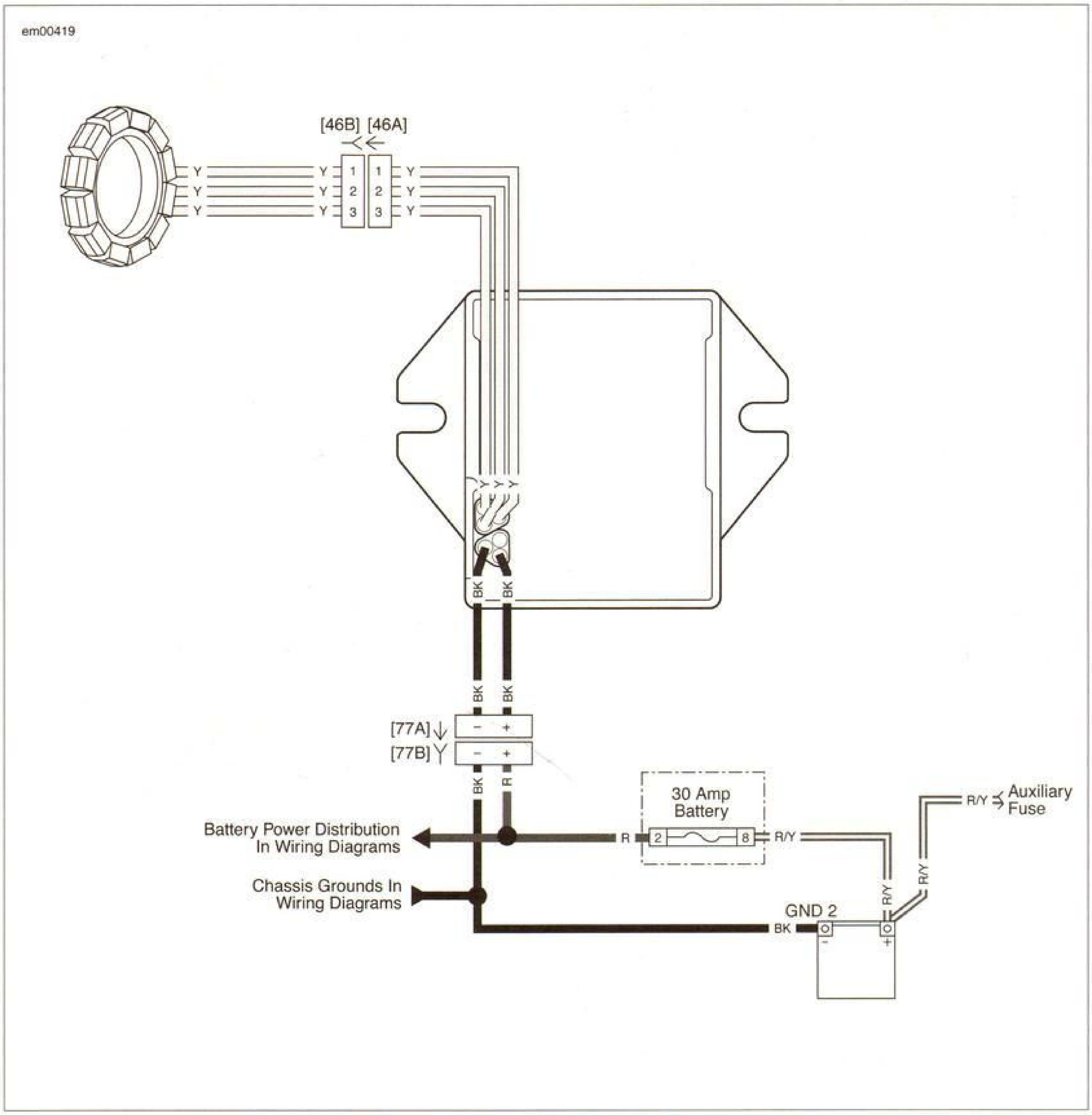
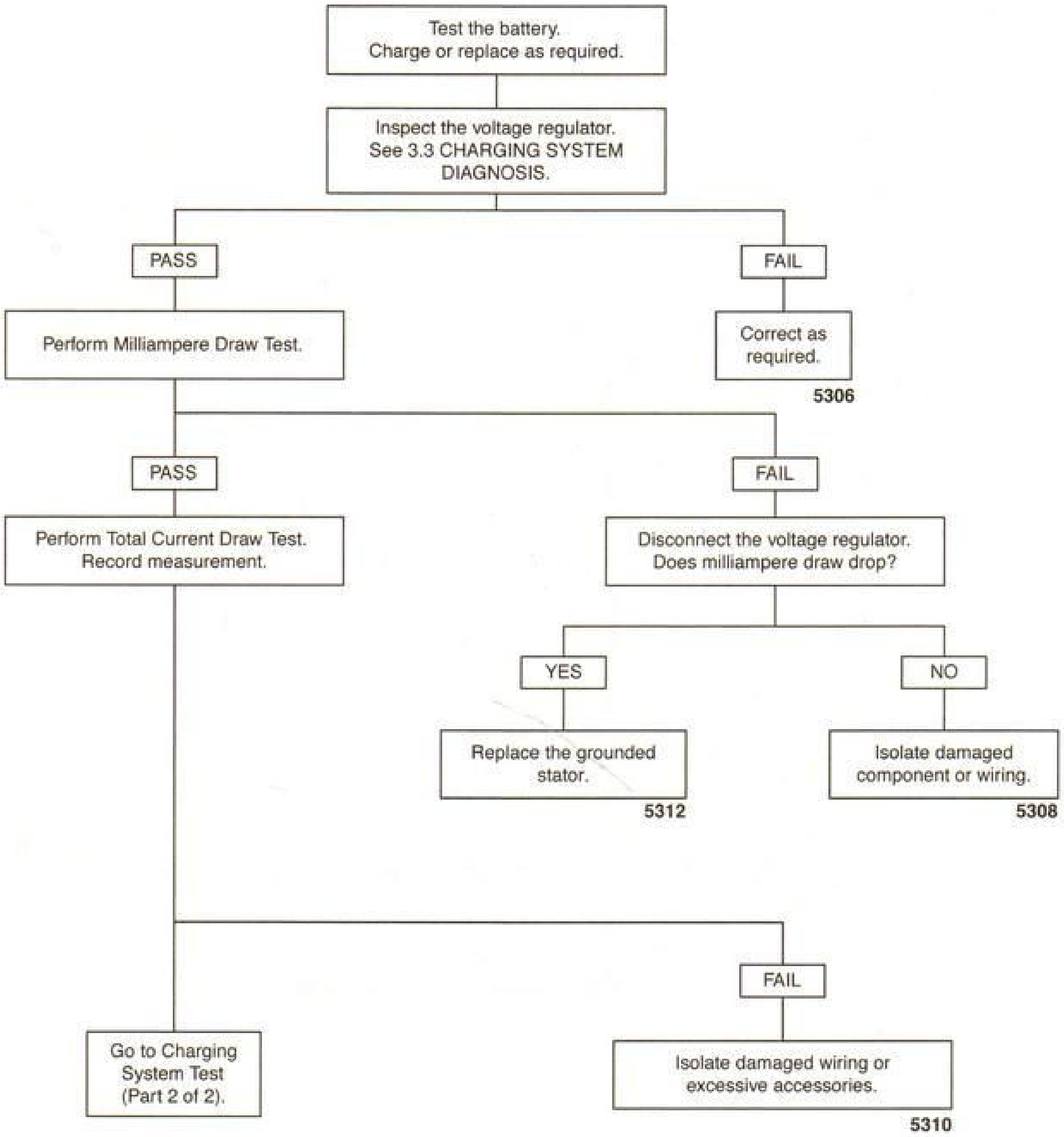


Figure 3-12. Charging System Circuit

Charging System Test (Part 1 of 2)



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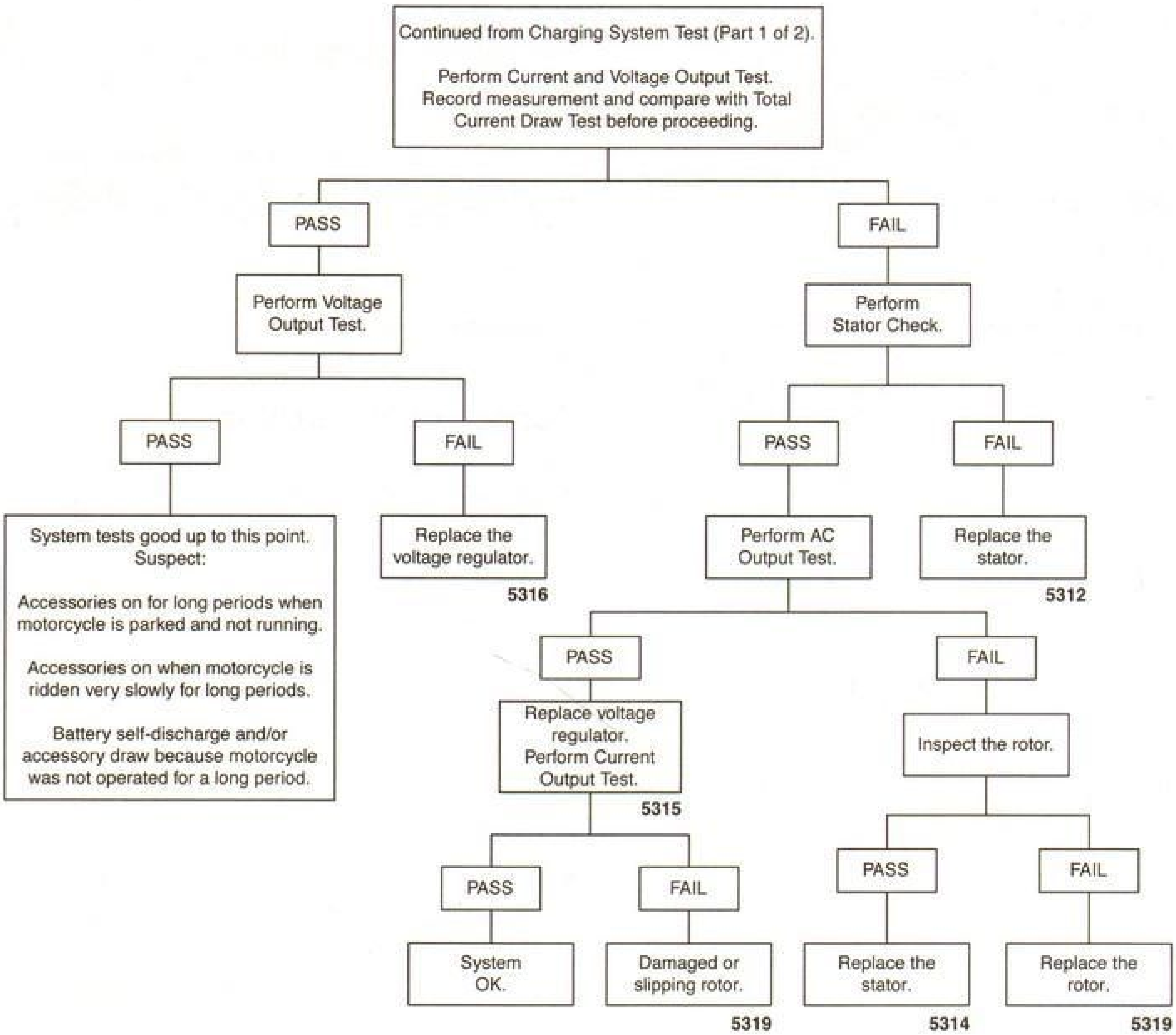
Charging System Test (Part 2 of 2)



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TESTING

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS TEST KIT
HD-48053	ADVANCED BATTERY CONDUCT-ANCE AND ELECTRICAL SYSTEM ANALYZER

Milliampere Draw Test

NOTE

Be sure accessories are not wired so they stay on at all times. This condition could drain the battery completely if the vehicle is parked for a long time. Check for this by connecting ammeter between negative battery terminal and battery.

1. Remove the 30 Amp battery fuse.
2. See Figure 3-13. Using HARNESS TEST KIT (Part No. HD-41404-B) purple male socket probes and patch cords, connect ammeter to battery fuse socket terminals. With this arrangement, any regulator drain is picked up.
3. With the ignition switch turned off and all lights and accessories off, observe current reading.
   a. Add regulator draw to appropriate value for ECM. If observed ammeter reading is less than listed in table, draw is within limits. Refer to Table 3-4.
   b. A higher reading indicates excessive current draw. Check accessories for excessive drain.

NOTE

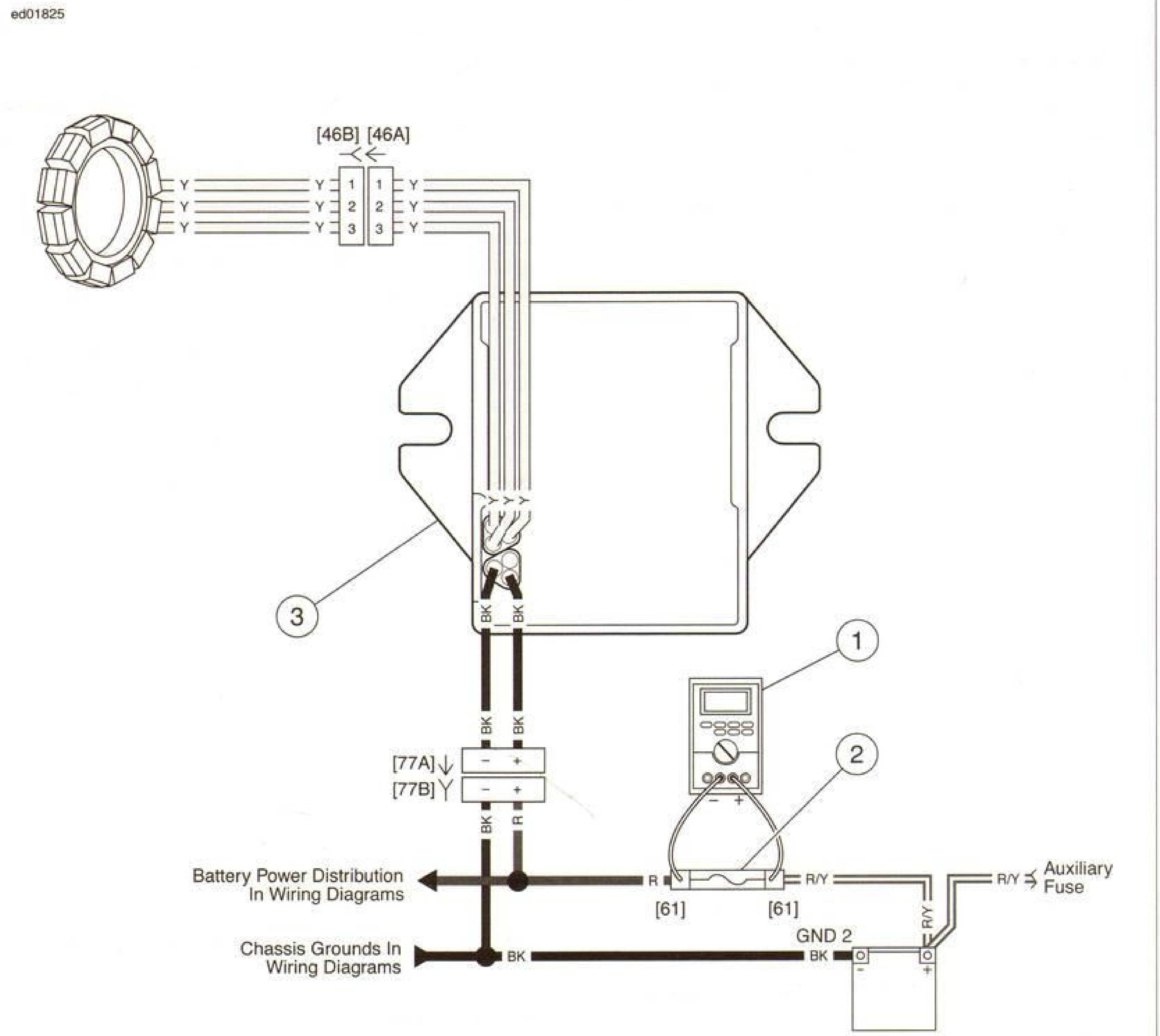
A battery with a surface discharge condition could suffer a static drain. Correct by cleaning battery case.

Table 3-4. Milliampere Draw Test

ITEM	MAXIMUM DRAW IN MILLIAMPERES
Regulator	1.0
ECM	1.0
Instrument Cluster (IC)	1.0

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.



1. **Ammeter**
2. **Battery fuse socket**
3. **Voltage regulator**

Figure 3-13. Milliampere Draw Test (Ignition Turned to OFF)

Total Current Draw Test

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

NOTE

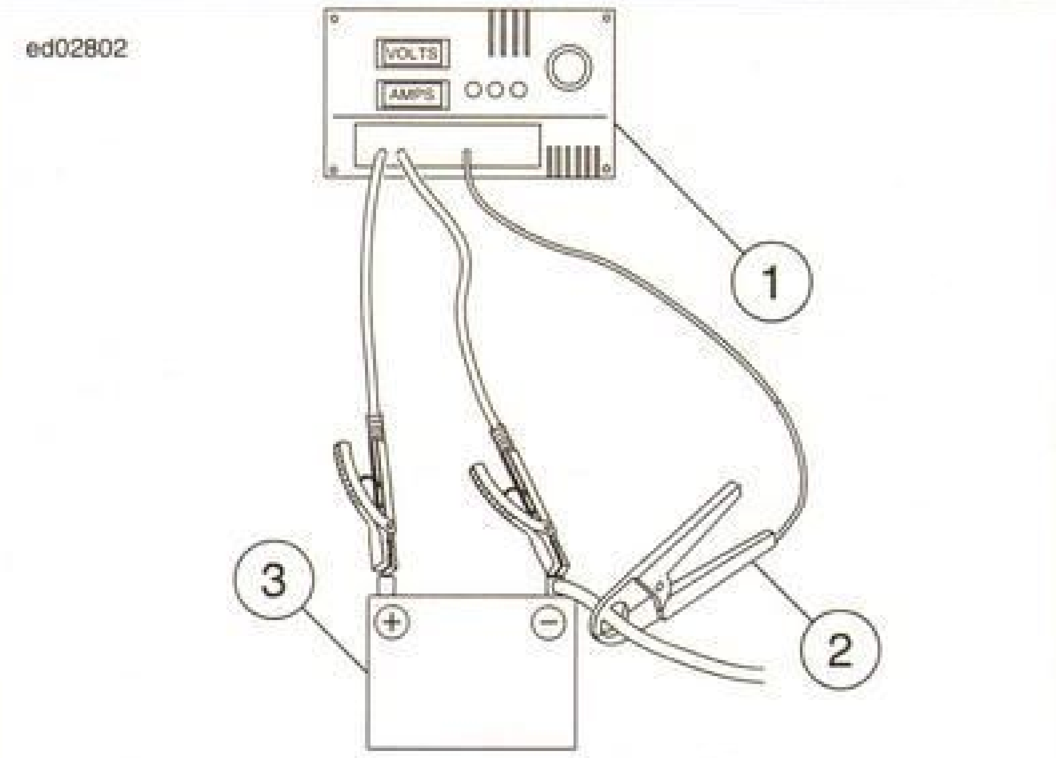
If a load tester is unavailable, use an ammeter with current probe.

⚠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 3-14 to check for this condition, and place load tester induction pickup or current probe pickup over battery negative cable.

2. Disconnect the stator plug from the voltage regulator. Start the motorcycle and run the engine at 3000 RPM.
3. With the ignition and all continuously running lights and accessories turned on (headlamp on high beam), read the total current draw.
4. Compare this reading to the reading obtained after performing a Current and Voltage Output Test.
   a. The current output should exceed current draw by a minimum of 3.5 amps.
   b. If output does not meet specifications, there may be too many accessories for the charging system to handle.
5. Reconnect voltage regulator after testing.



1. **Load tester**
2. **Induction pickup**
3. **Battery**

Figure 3-14. Check Current Draw (Ignition Switch On)

Current and Voltage Output Test: Using HD-48053

1. Connect the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053) leads to the vehicle battery.
2. Perform a charging system test following the instructions in the analyzer instruction manual.

See Figure 3-15 for an example of the analyzer's printout. The test results include a decision on the charging system's condition and the measured voltage at idle and at 3000 RPM. The analyzer provides a printout stating either CHARGING SYSTEM NORMAL (no problem found) or CHARGING TEST PROBLEM.

If the analyzer states CHARGING TEST PROBLEM, one of the following results will be displayed:

- LOW CHARGING VOLTS - The alternator is not supplying sufficient current for the system electrical loads.
- HIGH CHARGING VOLTS - The voltage output from the alternator exceeds the normal regulator limits.
- INVESTIGATE VOLT OUTPUT - The rev voltage is lower than the idle voltage.

Current and Voltage Output Test: Using Load Tester

1. Connect the load tester as follows:
   a. Connect the negative and positive leads to the battery terminals.
   b. Place the load tester induction pickup over the positive regulator cable.
2. Run the engine at 3000 RPM. Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible. Increase the load as required to obtain a constant 13.0 VDC.
3. The current output should be 28-34 Amps. Make a note of the measurement for use in the Total Current Draw Test.

NOTE

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

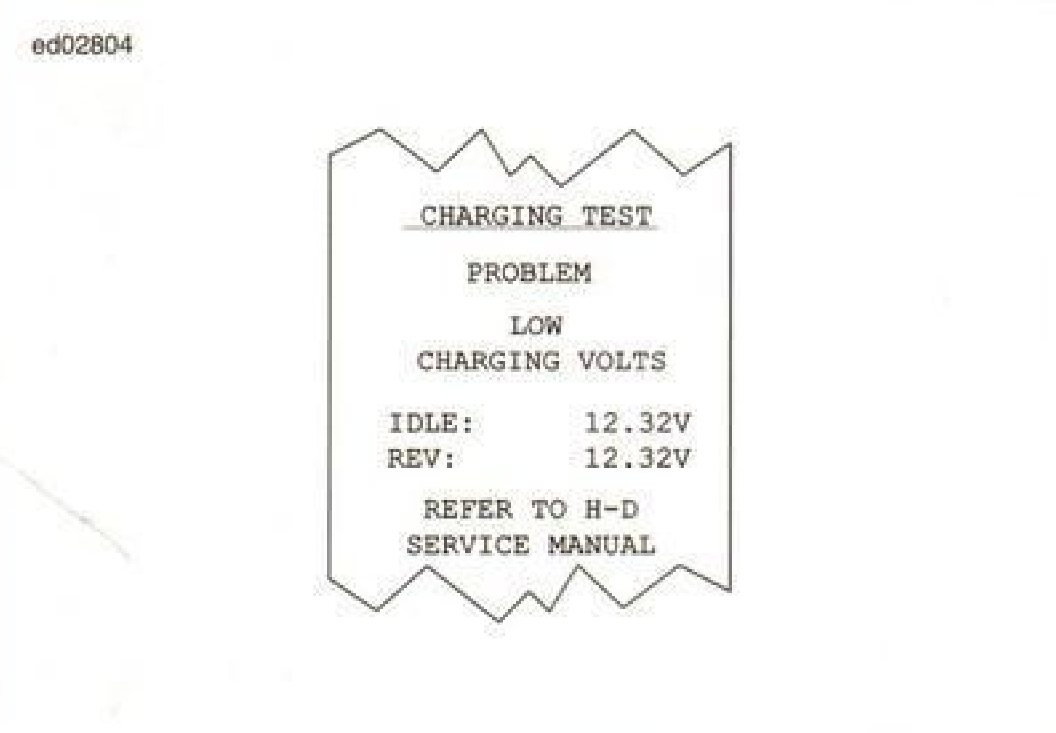


Figure 3-15. Charging System Test Results Printout

Stator Check

1. Turn ignition switch OFF.
2. See Figure 3-16 and connect an ohmmeter as follows:
   a. Disconnect voltage regulator connector [46] from alternator 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 with the ohmmeter set to the ohms scale.
   a. A good stator shows no continuity (open circuit) between any stator sockets and ground.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 3-17. To check the stator for resistance, disconnect voltage regulator connector [46].

5. Test stator sockets 1-2, 2-3, and 3-1 for resistance with the ohmmeter set on the ohms scale.
   a. Resistance across all the stator sockets should be 0.1-0.3 Ohms.
   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 3-16. Test for Grounded Stator (typical)

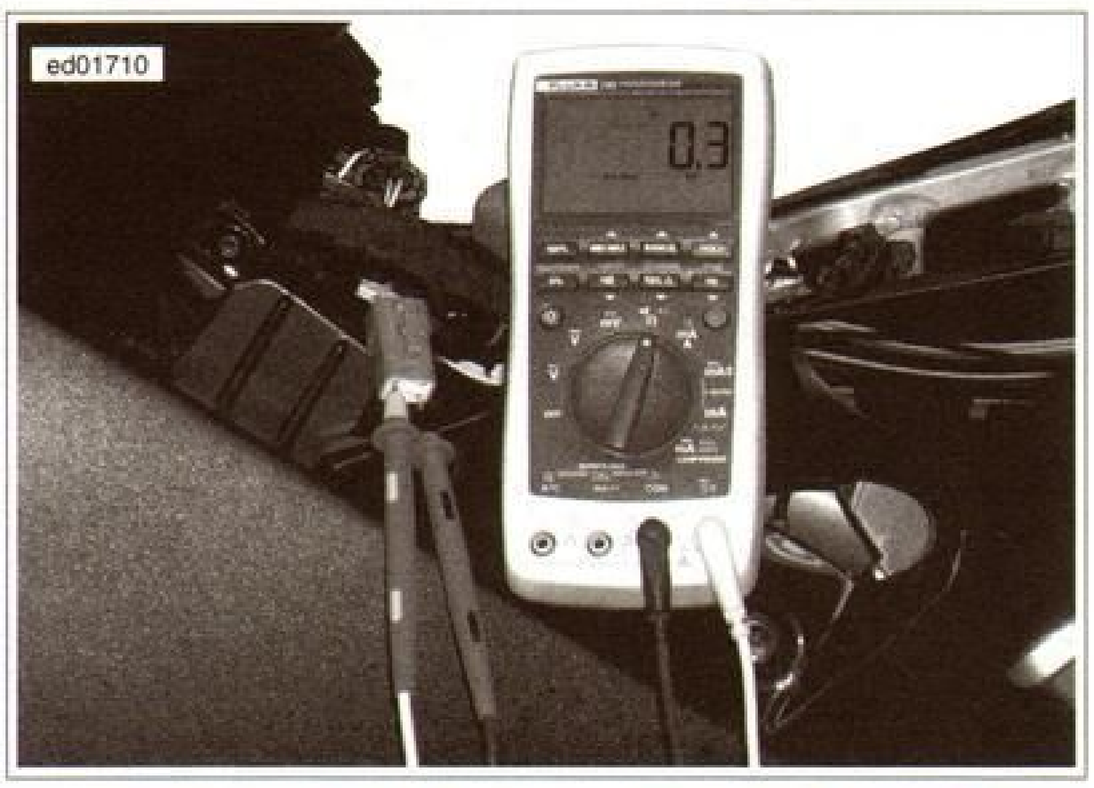


Figure 3-17. Check for Stator Resistance (typical)

AC Output Check

1. Test AC output as follows:
   a. Disconnect voltage regulator connector [46] from alternator stator wiring.
   b. See Figure 3-18. Connect an AC voltmeter across stator connector terminals 1-2.
   c. Run the engine at 3000 RPM. The AC output should be 45-55 Volts AC.
   d. Repeat the test across terminals 2-3 and 1-3.
2. Compare the test results to specifications.
   a. If the output is below specifications, charging problem could be a faulty rotor or stator. Perform Stator Check.
   b. If output is within specifications, charging problem might be faulty regulator. Replace as required.
3. Repeat the Current and Voltage Output Test.

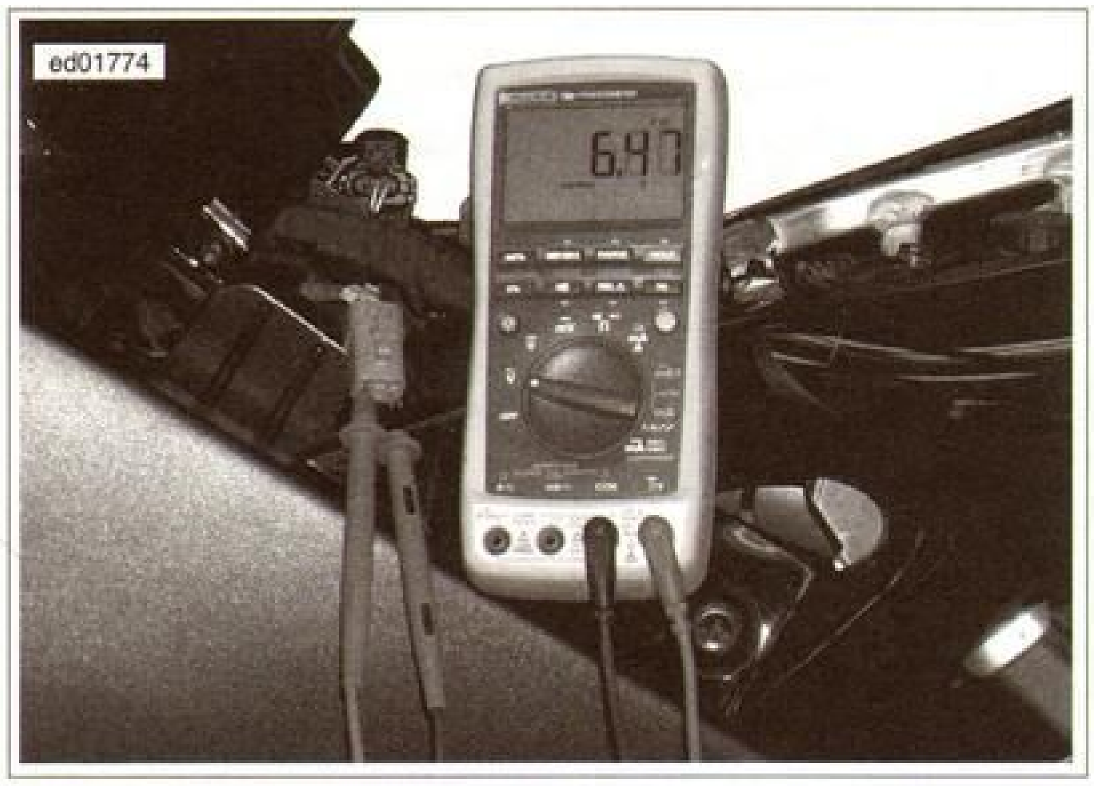


Figure 3-18. Check Stator AC Voltage Output (typical)

DESCRIPTION AND OPERATION

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.

VOLTMETER TEST

The voltmeter test provides a general indication of battery state of charge or condition. Check the voltage of the battery to make sure it is in a 100% fully charged condition. Refer to Table 3-5.

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 the 3.4 BATTERY TESTING, Load Test.

Table 3-5. 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%

CONDUCTANCE TEST

PART NUMBER	TOOL NAME
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER

Use the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053) and perform a battery test as follows:

1. Connect the HD-48053 analyzer directly to the lead terminals of the battery, not to the bolt or wire terminal.
2. Follow the instructions in the analyzer instruction manual to perform a battery test.

The test results include a decision on the battery condition and the measured state of charge.

See Figure 3-19. The analyzer printer provides a printout including one of the following test results.

- GOOD BATTERY - Return the battery to service.
- GOOD-RECHARGE - Fully charge the battery and return to service.
- CHARGE & RETEST - Fully charge the battery and retest.
- REPLACE BATTERY - Replace the battery.
- BAD CELL-REPLACE - Replace the battery and retest.
- BATTERY NOISE - Remove surface charge from battery and retest.

NOTES

- *A REPLACE BATTERY test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.*
- *Connect the tester directly to the lead terminals of the battery, not the bolts.*

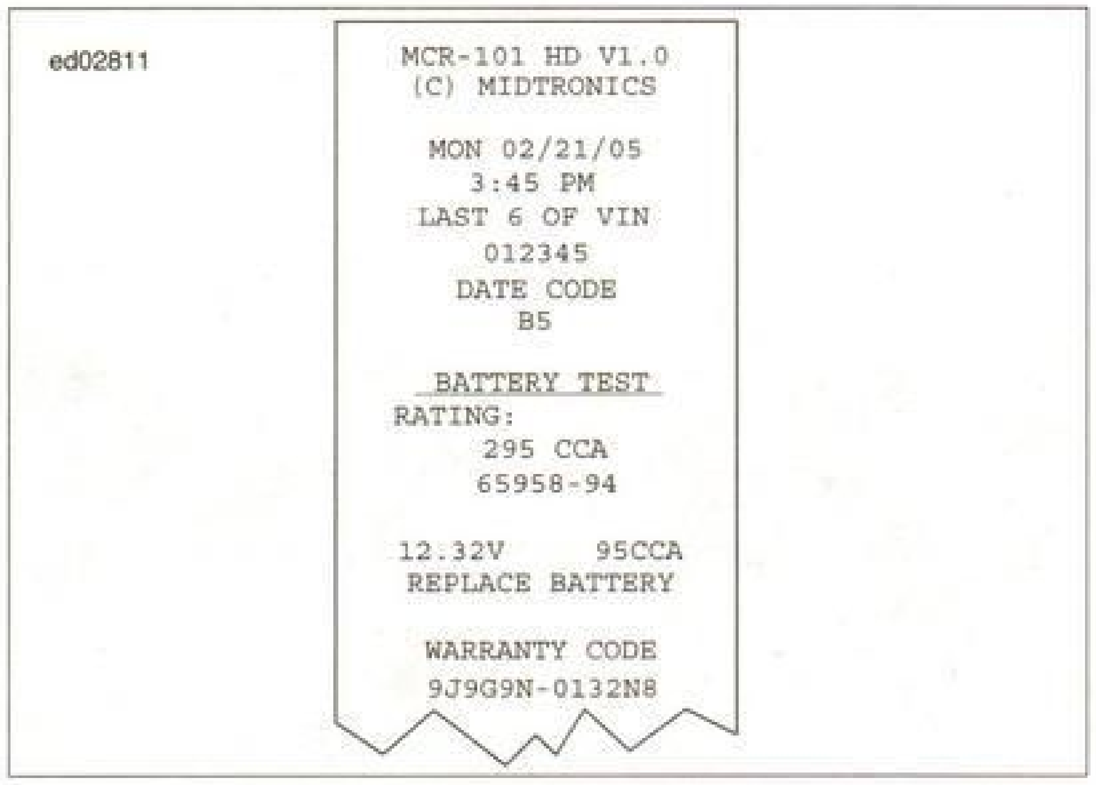


Figure 3-19. Battery Test Results Printout

LOAD TEST

To load test the battery, proceed as follows:

⚠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. Remove the battery from the motorcycle.
2. Always fully charge the battery before testing or test readings will be incorrect. Load testing a discharged battery can result in permanent battery damage.
3. After charging, allow the battery to stand for at least one hour before testing.

⚠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)

4. See Figure 3-20. 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.

5. Load battery at 50% of CCA rating using the load tester. Voltage reading after 15 seconds should be 9.6 V or more at 70° F (21° C). Refer to Table 3-6.

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)

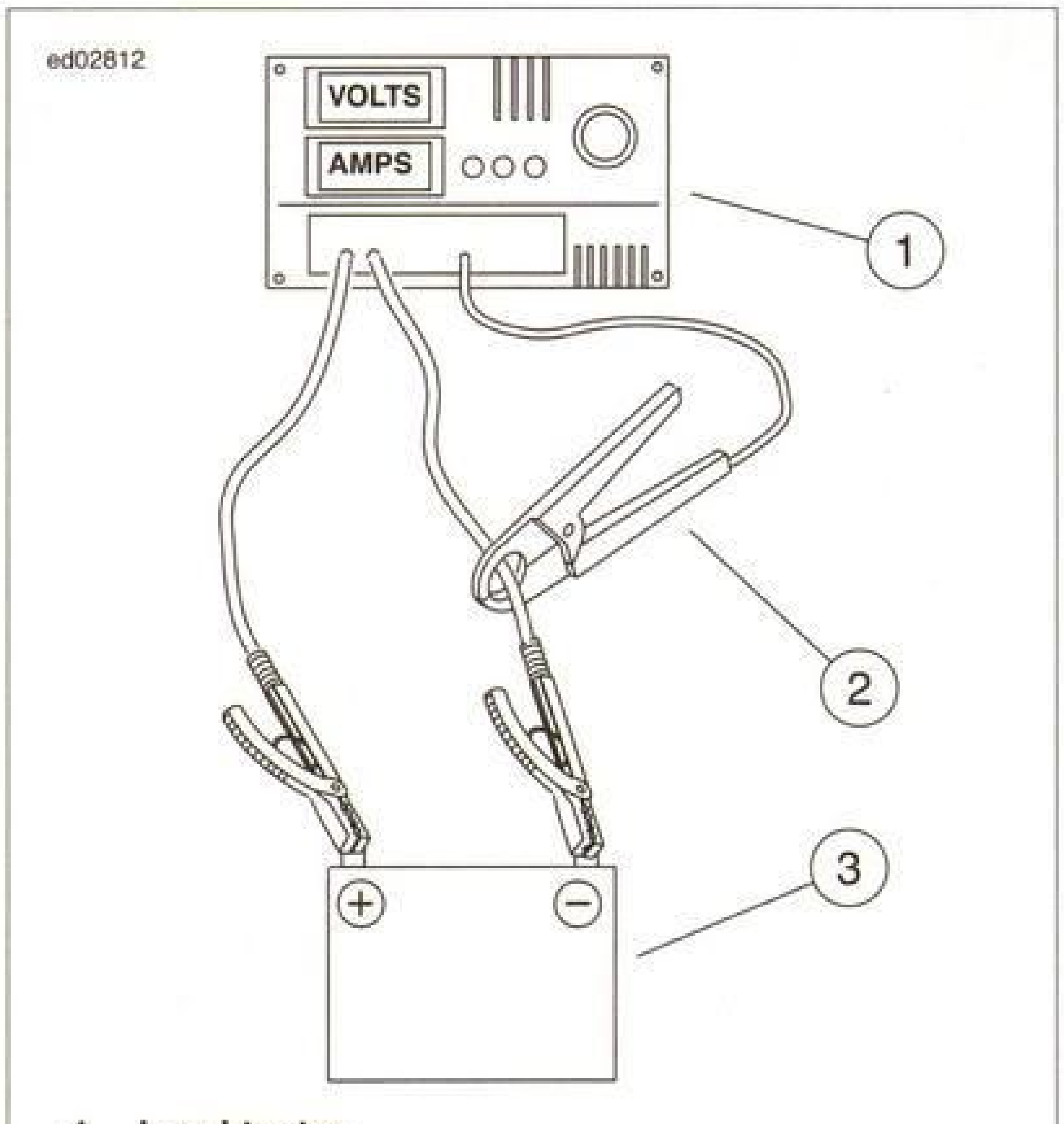
WARNING

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)

CAUTION

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)

6. Install the battery in the motorcycle.



1. **Load tester**
2. **Induction pickup**
3. **Battery**

Figure 3-20. Load Test Battery

Table 3-6. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
1125 models	200	100

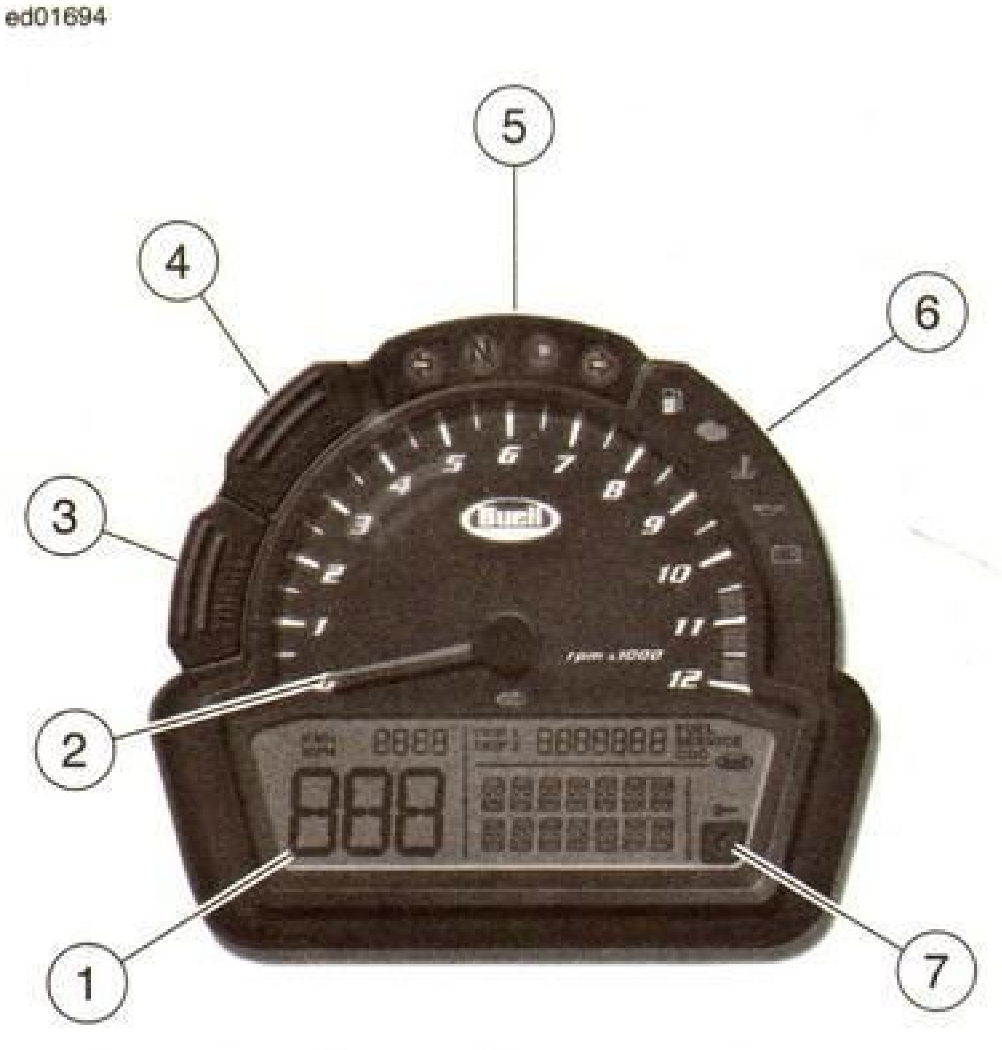
NOTES

NOTES

DESCRIPTION AND OPERATION

The Instrument Cluster (IC) uses direct inputs along with communication from the ECM to display information. The IC receives battery power through terminals 2 and 12. Ground is supplied through terminals 3 and 13. Ignition power comes from the ignition switch to terminal 14. There are two Controller Area Network (CAN) lines going to the ECM from terminals 9 and 10 of the IC.

See Figure 4-1. The TOGGLE and MODE switches are located on the IC along with the tachometer, the theft mode LED, and the indicator and warning lamps. The LCD screen on the IC displays a digital speedometer, odometer, clock, and information messages.



1. **LCD screen**
2. **Tachometer**
3. **TOGGLE switch**
4. **MODE switch**
5. **Indicator lamps**
6. **Warning lamps**
7. **Theft mode LED**

Figure 4-1. Instrument Cluster

COMPONENTS

Speedometer

The speedometer digitally displays the forward speed of the motorcycle in mph or km/h depending on the configuration. The configuration can be changed by using the TOGGLE and MODE switches on the IC. The speedometer receives the vehicle speed data over the CAN lines from the ECM.

Tachometer

The tachometer displays engine RPM. The numbers on the tachometer multiplied by 1000 equals engine RPM. As the tachometer approaches approximately 10,000 RPM the needle illuminates. The IC receives the RPM data over the CAN lines from the ECM.

Odometer

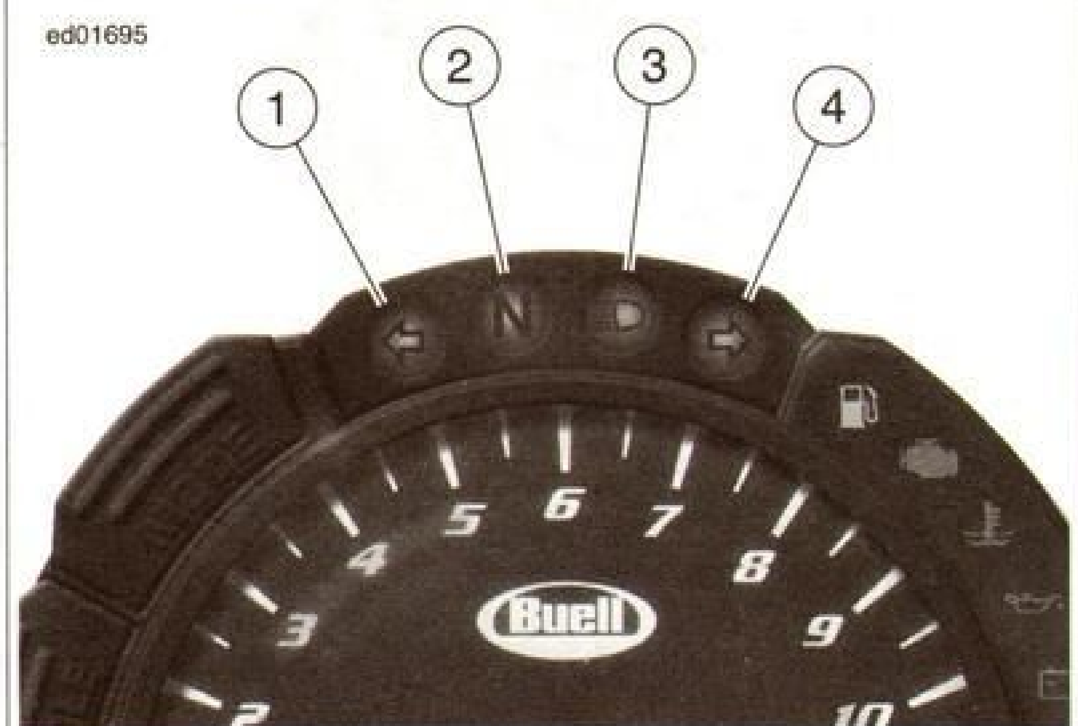
The odometer displays the distance traveled by the motorcycle. There are five different odometer settings that can be displayed by clicking the MODE switch. These include the main odometer (ODO), trip odometer 1 (TRIP 1), trip odometer 2 (TRIP 2), service odometer (SERVICE), and the low fuel odometer (F-trip). The trip odometers record mileage until they are reset and then start over. The fuel odometer is only available when the low fuel light is on and tracks the mileage traveled since the low fuel light came on. The service odometer tracks the number of miles (kilometers) left until the next regular maintenance is due.

Clock

The clock displays the current time and can be set for either a 12 or 24 hour format.

Indicator Lamps

See Figure 4-2. The indicator lamps are located at the top edge of the IC and inform the operator of turn signal, headlamp, and neutral positions.



1. **Left turn signal indicator**
2. **Neutral indicator**
3. **Headlamp high beam indicator**
4. **Right turn signal indicator**

Figure 4-2. Indicator Lamp

Left Turn Signal Indicator: The IC uses a direct input on terminal 4 from the left turn switch to determine when to flash the left turn signal indicator. The IC then supplies the voltage to the left turn signals.

Neutral Indicator: The IC receives a message from the ECM over the CAN lines letting the IC know when the transmission is in neutral and the indicator should be illuminated.

Headlamp High Beam Indicator: The IC uses a direct input on terminal 6 from the headlamp high/low switch to determine when to illuminate the high beam indicator.

Right Turn Signal Indicator: The IC uses a direct input on terminal 5 from the right turn switch to determine when to flash the right turn signal indicator. The IC then supplies the voltage to the right turn signals.

Warning Lamps

See Figure 4-3. The warning lamps are located at the right upper side of the IC. These lamps illuminate to inform the operator of a concern within the different systems of the motorcycle.

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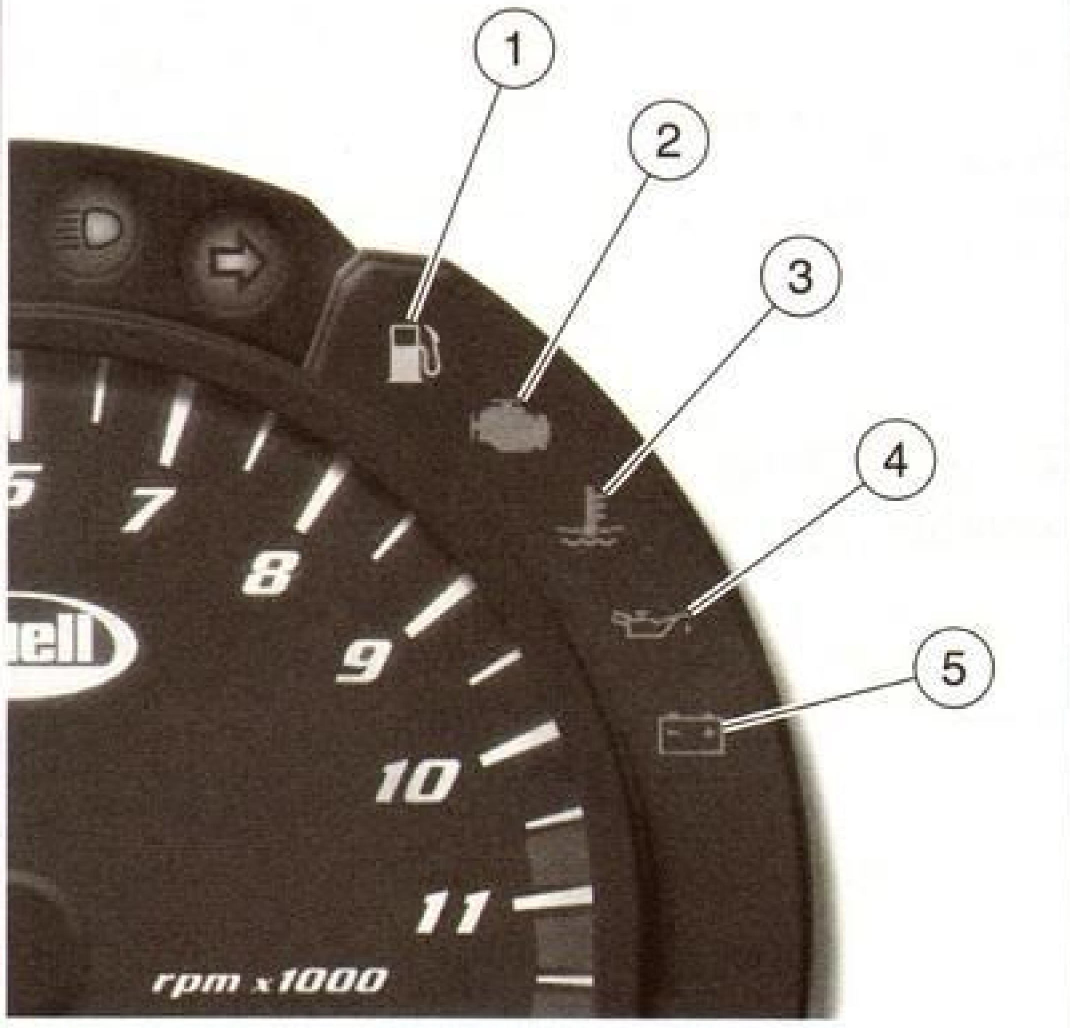


1. **Low fuel lamp**
2. **Check engine lamp**
3. **Engine over temperature lamp**
4. **Oil pressure lamp**
5. **Low battery voltage lamp**

Figure 4-3. Warning Lamps

Low Fuel Lamp: The IC uses a direct input on terminal 15 from the fuel level sender to determine when to illuminate the low fuel warning indicator. The IC also activates the (F-trip) odometer when the low fuel indicator is illuminated. This tracks the number of miles driven since the low fuel warning indicator was illuminated.

Check Engine Lamp: The IC illuminates the check engine lamp when the ignition is turned on or when there is a malfunction with the engine management system. The ECM sends a signal to the IC over the CAN lines to let it know when to illuminate the check engine lamp. See 6.1 DDFI-3 OPERATION for diagnosing the Check Engine Lamp.

Engine Over Temperature Lamp: The ECM sends a communication over the CAN lines to the IC when the engine temperature reaches 230 °F (110 °C). The IC then illuminates the engine over temperature lamp and flashes the coolant temperature on the LCD screen. See 6.1 DDFI-3 OPERATION for diagnosing the engine over temperature lamp.

Oil Pressure Lamp: The IC receives a direct input on terminal 8 from the oil pressure switch. When oil pressure drops, the switch closes and the IC illuminates the oil pressure lamp. The oil pressure lamp comes on when the ignition is turned on.

Low Battery Voltage Lamp: The IC illuminates the low battery voltage lamp when the battery voltage drops below 12V. The IC also displays the message SYSTEM VOLTAGE on the LCD screen. The IC receives the battery voltage signal over the CAN lines from the ECM and monitors the battery circuits to the IC.

Theft Mode LED

The red theft mode LED flashes when the security system is armed. The IC works with the ECM to disable the starter, injectors, and coils.

TOGGLE Switch

The TOGGLE switch is located on the left edge of the IC. With the engine running, the TOGGLE switch changes the display options to:

- Gear position and intake air temperature
- Coolant temperature and battery voltage
- Display brightness
- Average fuel consumption
- Instantaneous fuel consumption

MODE Switch

The MODE switch is located on the left side of the IC. The MODE switch changes the odometer between:

- Main odometer (ODO)
- Trip 1 (TRIP 1)
- Trip 2 (TRIP 2)
- Service odometer (SERVICE)
- Low fuel odometer (F-trip)

Setup Mode

The setup mode allows the operator to change certain settings in the IC. With the ignition on, press and hold the TOGGLE and MODE switch at the same time until SETUP MODE appears on the display. The following functions are located in the setup menu.

- KEY OFF TO EXIT
- TIME SETTING
- SERVICE COUNTER
- PIN SETTING
- THEFT SETTING
- UNIT SETTING
- CLOCK 12/24
- TOGGLE TO EXIT

Pressing and releasing the MODE switch scrolls through the list.

Pressing and releasing the TOGGLE switch allows the operator to select the changes to the functions or exit the setup mode. The different functions that can be set up are:

- Setting the clock (time and 12 or 24 hour formats)
- Service mileage reset
- PIN change
- Security system prompts
- Unit of measure

Lap Timer

To enter the lap timer mode, with the engine running and the vehicle stopped, hold down the TOGGLE switch and press the flash-to-pass switch on the left handlebar three times. See Figure 4-4 for flash-to-pass switch location. Once started, the lap timer restarts a new lap each time the flash-to-pass switch is pressed. The lap timer can store up to 99 lap times. Each time a new lap is started, the timer displays the time for the last completed lap, for 15 seconds. To replay the stored times, hold the flash-to-pass switch for 5 seconds. It replays:

- Individual lap times
- Fastest lap time
- Slowest lap time
- Average lap time

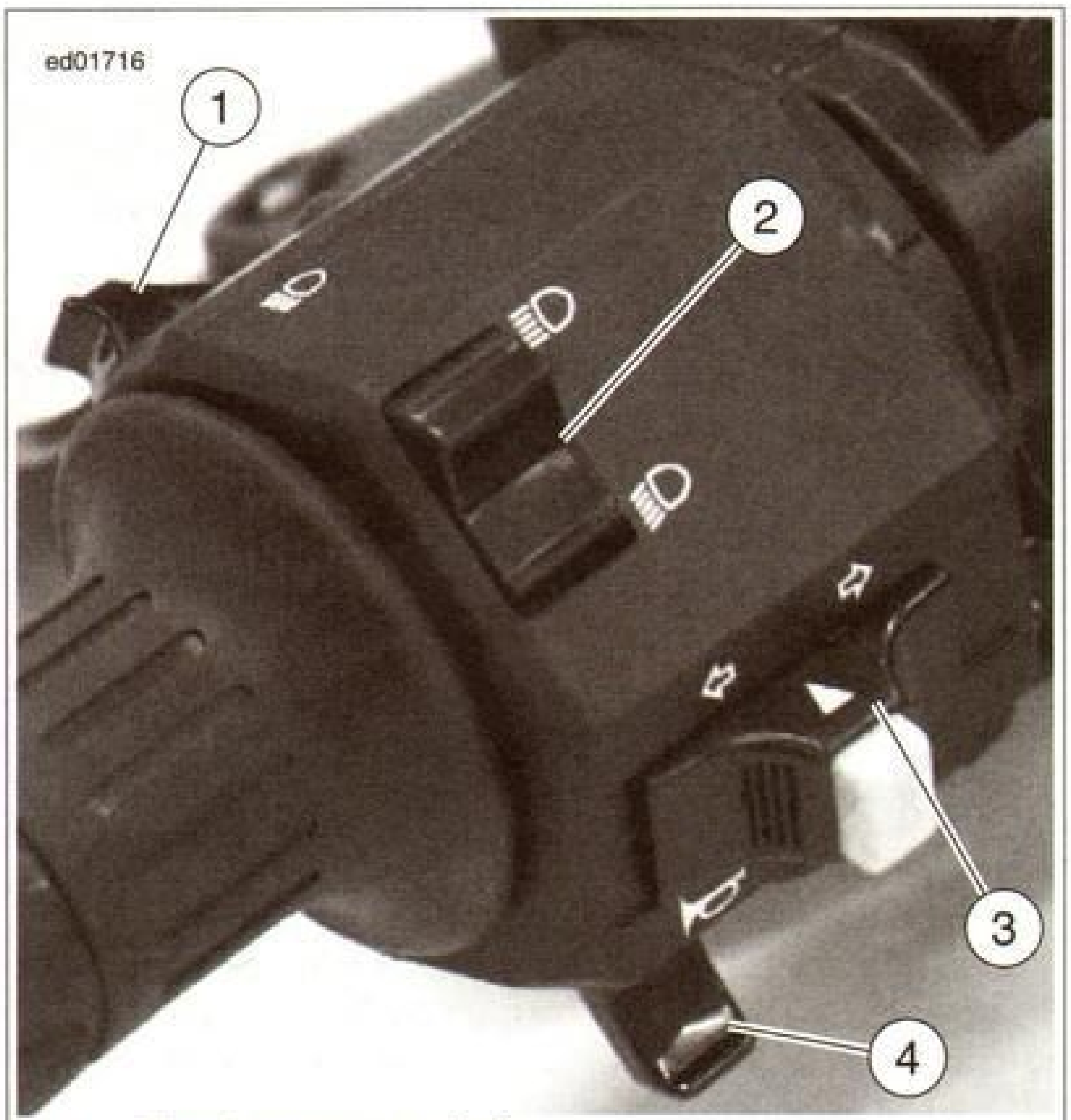
To clear all laps in memory, press and hold the TOGGLE switch for 3 seconds. The LAPS CLEAR message is displayed when lap times are erased.

To exit the lap timer mode:

1. Stop the vehicle.
2. Press and hold TOGGLE switch and quickly press the passing lamp switch three times.

NOTE

Recorded lap times remain in memory until they are cleared. Exiting lap timer mode, turning off the vehicle, or losing battery power will not affect lap times stored in memory.



1. **Flash-to-pass switch**
2. **Headlamp high/low beam switch**
3. **Turn signal switch**
4. **Horn switch**

Figure 4-4. Left Hand Controls

ONBOARD DIAGNOSTIC INFORMATION SYSTEM (ODIS)

The IC displays the ODIS at the bottom of the LCD. The ODIS displays operational data, configuration menus, and messages for other features through the IC. Refer to Table 4-1 for possible messages and their descriptions.

Table 4-1. General LCD Screen Messages

MESSAGE	DESCRIPTION
BUELL WISCONSIN USA	Introductory text displayed when ignition key is turned on.
SYSTEM VOLTAGE	Displayed when the battery voltage is too low, or too high.
CT COLD	The word "COLD" flashes on the screen until the measured temperature is above the normal operating temperature range. The display then changes to the "GEAR X at XXX F/C" screen. The initial intake air temperature displays when the ignition is turned on, and updates once the vehicle maintains a speed above 25 mph (40 km/h) for 1 minute.
SERVICE XXX	Service interval is due at the displayed number of miles (kilometers). This message is displayed on the first startup after the service odometer falls below the 200 mi (322 km) and 1000 mi (1609 km) thresholds.
SERVICE NOW	Service odometer has elapsed. Vehicle is due for regular maintenance. This message is displayed on each startup until the service counter is reset.
SIDESTAND (HDI Models)	The sidestand is not in the fully retracted position. On HDI models, the vehicle shuts off power to the ignition and fuel pump when the sidestand is down while the vehicle is in gear, and the clutch is released.
TIPPED KEY OFF	The bank angle sensor has been tripped. The vehicle shuts off power to the ignition and fuel pump when the tip angle is greater than a predetermined limit. Turn the key switch off, stand the motorcycle upright, and restart.

Table 4-1. General LCD Screen Messages

MESSAGE	DESCRIPTION
ENTER PIN	Displayed when the ignition is first turned on while the security system is armed.
THEFT ERROR	A problem has been detected with the security system or serial communication has been lost.
LOCKED OUT	Twenty consecutive PIN entry failures have been made, causing the instrument cluster to lock out for 30 minutes. A countdown timer is displayed to show the number of remaining minutes until the PIN can be re-entered.
COMM ERROR	A communications error has occurred. The instrument cluster failed to receive messages from the ECM.

To enter the diagnostic part of the ODIS system, hold down the TOGGLE and MODE switches simultaneously while turning the ignition on. If the security system is active the PIN will have to be entered after the ignition is turned on. Once the PIN is entered the message DIAG MODE displays on the LCD. Pressing the TOGGLE switch again displays the current and historic DTCs and live data for the motorcycle. After the last DTC is displayed the message LIVE DATA appears. Pressing the TOGGLE switch scrolls through the list of available live data. For a complete list of DTCs, see Initial Diagnostics and Serial Data. For live data, refer to Table 4-2. The TOGGLE switch changes options and the MODE switch exits the diagnostic mode.

NOTE

The IC automatically exits the DIAG MODE if the speedometer reads vehicle speed greater than 0.

Table 4-2. Live Data Display

LIVE DATA	DISPLAYED UNITS
Battery Voltage	Volts
Coolant Celsius	Temperature Celsius
Coolant Voltage	5 Volt reference
Airtemp Celsius	Temperature Celsius
Airtemp Voltage	Volts
TPS Percent	Percent open
TPS Voltage	Volts
Clutch State	0 or 1
V Speed State	0 or 1
MAP KPA	Pressure KPA
MAP Voltage	Volts
IAC Steps	Steps open
Fuel KPA	Pressure KPA
Fuel Voltage	Volts
FRT 02 Voltage	Volts
Rear 02 Voltage	Volts
Tipover Voltage	Volts
S Stand Voltage	0.6 stand up 2.6 stand down
F adapt fuel	Percent
R adapt fuel	Percent
Starter Relay St	0 or 1
Aux Power State	0 or 1
Software (SW)	Version number
Cal	Version number

Instrument Cluster (IC) Diagnostics

The IC monitors direct inputs from sensors and switches, along with receiving information from the ECM over the CAN lines.

The IC sets codes when the parameters for the inputs are out of range. These codes begin with a B prefix to separate them from an ECM or a communication code. Refer to Table 4-3 for B codes.

Table 4-3. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
B1004	69	Fuel Level Sender Low	4.2 FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005
B1005	68	Fuel Level Sender High/Open	4.2 FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005

Some sensors and switches send direct inputs to the IC and do not have DTCs associated with them. Therefore, symptoms may occur indicating a fault without any DTCs present. Refer to Table 4-4 for a list of symptoms.

Table 4-4. Instrument Cluster (IC) Symptom Table

SYMPTOM	DIAGNOSTIC PROCEDURE
Check Engine Lamp Always On or Inoperative	2.1 INITIAL DIAGNOSTICS
Oil Pressure Lamp Always On	4.3 OIL PRESSURE LAMP ALWAYS ON OR INOPERATIVE
Oil Pressure Lamp Inoperative	4.3 OIL PRESSURE LAMP ALWAYS ON OR INOPERATIVE
Turn Signal Indicators Inoperative	4.4 TURN SIGNAL INDICATOR INOPERATIVE
Instrument Cluster (IC) Inoperative	4.5 INSTRUMENT CLUSTER INOPERATIVE
Low Fuel Lamp Always On	4.6 LOW FUEL LAMP ALWAYS ON OR INOPERATIVE
Low Fuel Lamp Inoperative	4.6 LOW FUEL LAMP ALWAYS ON OR INOPERATIVE

FUEL LEVEL SENDER LOW/HIGH/OPEN, DTC B1004, B1005 4.2

DESCRIPTION AND OPERATION

See Figure 4-5. The IC has a direct input from the fuel level sender. The IC monitors this input and sets a DTC if the input falls out of range.

The IC provides battery voltage to the fuel level sender on the (Y/R) wire. The fuel level sender is a thermistor device that is cooled by fuel in the tank, keeping the resistance value high. As the fuel drops below the sender, the thermistor is allowed to warm, which lowers the resistance value. The IC constantly monitors this signal and when the resistance value changes (at approximately 0.8 gallons (3.0 liters) of fuel is left in the tank), the IC illuminates the low fuel lamp.

Table 4-5. Code Description Table

DTC	DESCRIPTION
B1004	Fuel level sender low
B1005	Fuel level sender high/open

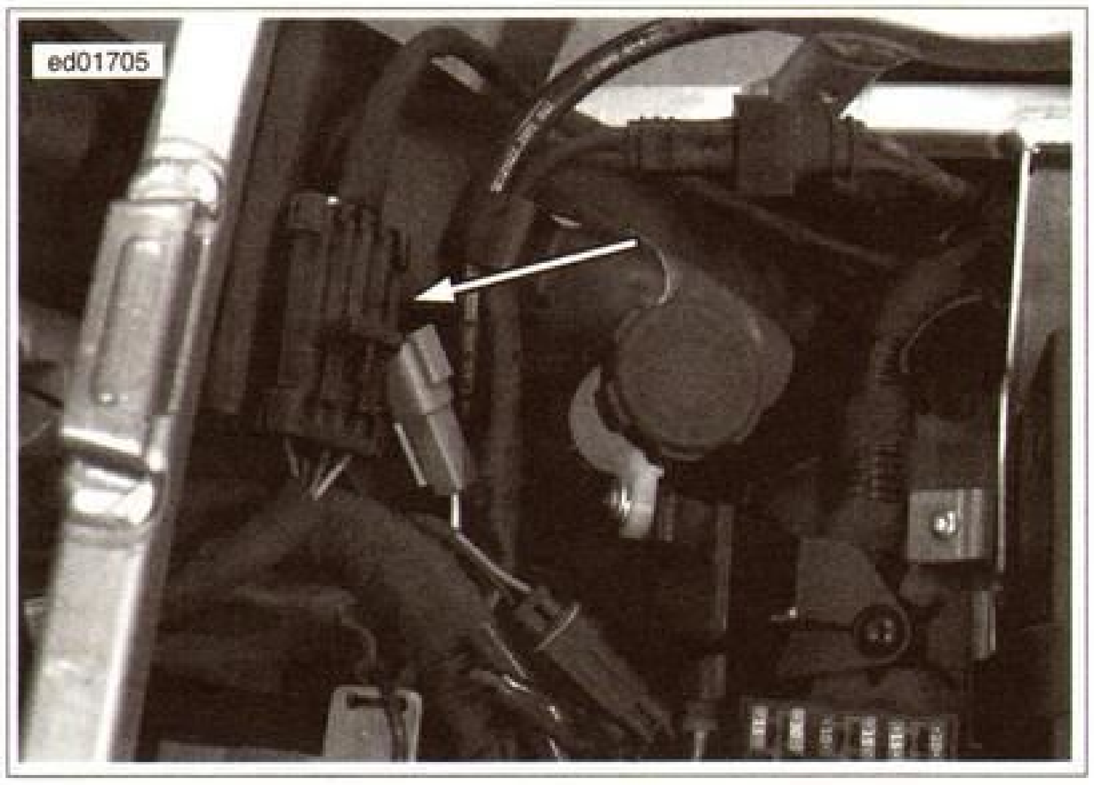


Figure 4-5. Fuel Pump Connector [86]

Diagnostic Tips

The IC may take a few minutes to update. When using a **new** IC to test, wait a few minutes to verify what codes are set. The new IC updates to the ECM after 30 minutes and cannot be restocked. Watch the timer on the IC so it does not update to the ECM before diagnostics are complete.

The IC can only have a VIN written to it once. It cannot learn a new VIN if one has already been written to it. Therefore, when replacing the IC, it must be a new IC.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

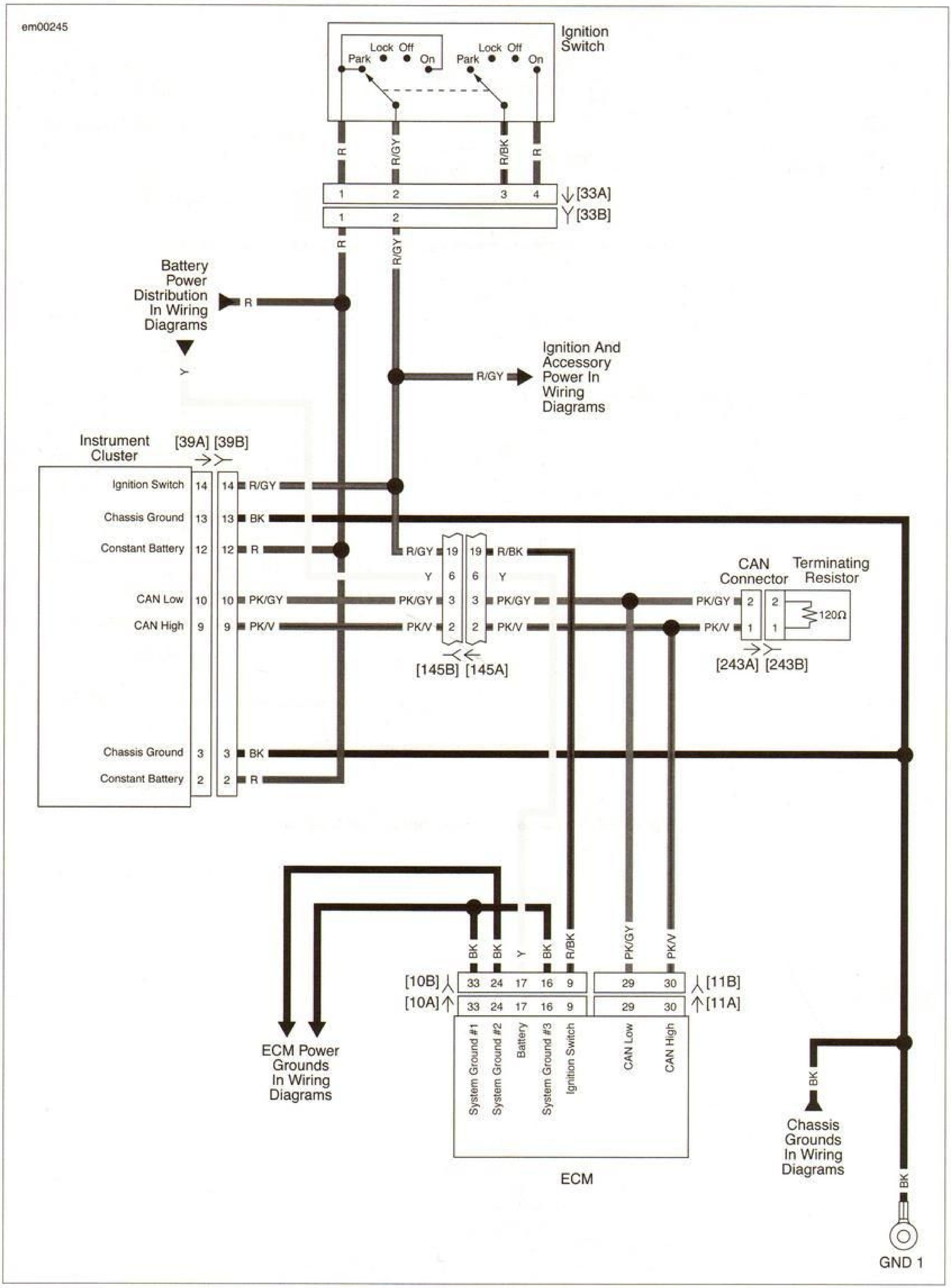


Figure 4-6. Instrument Cluster Power and Communication

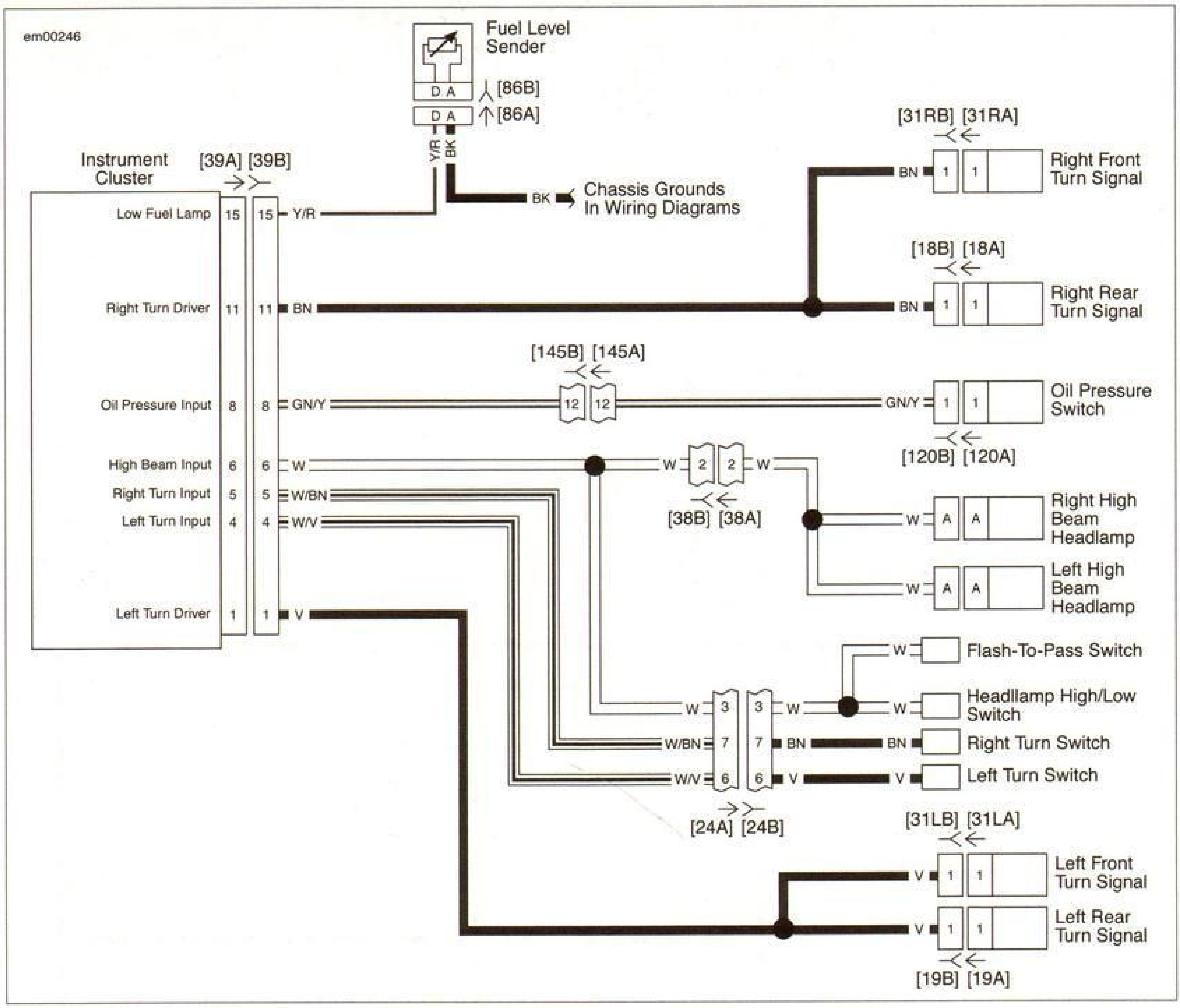
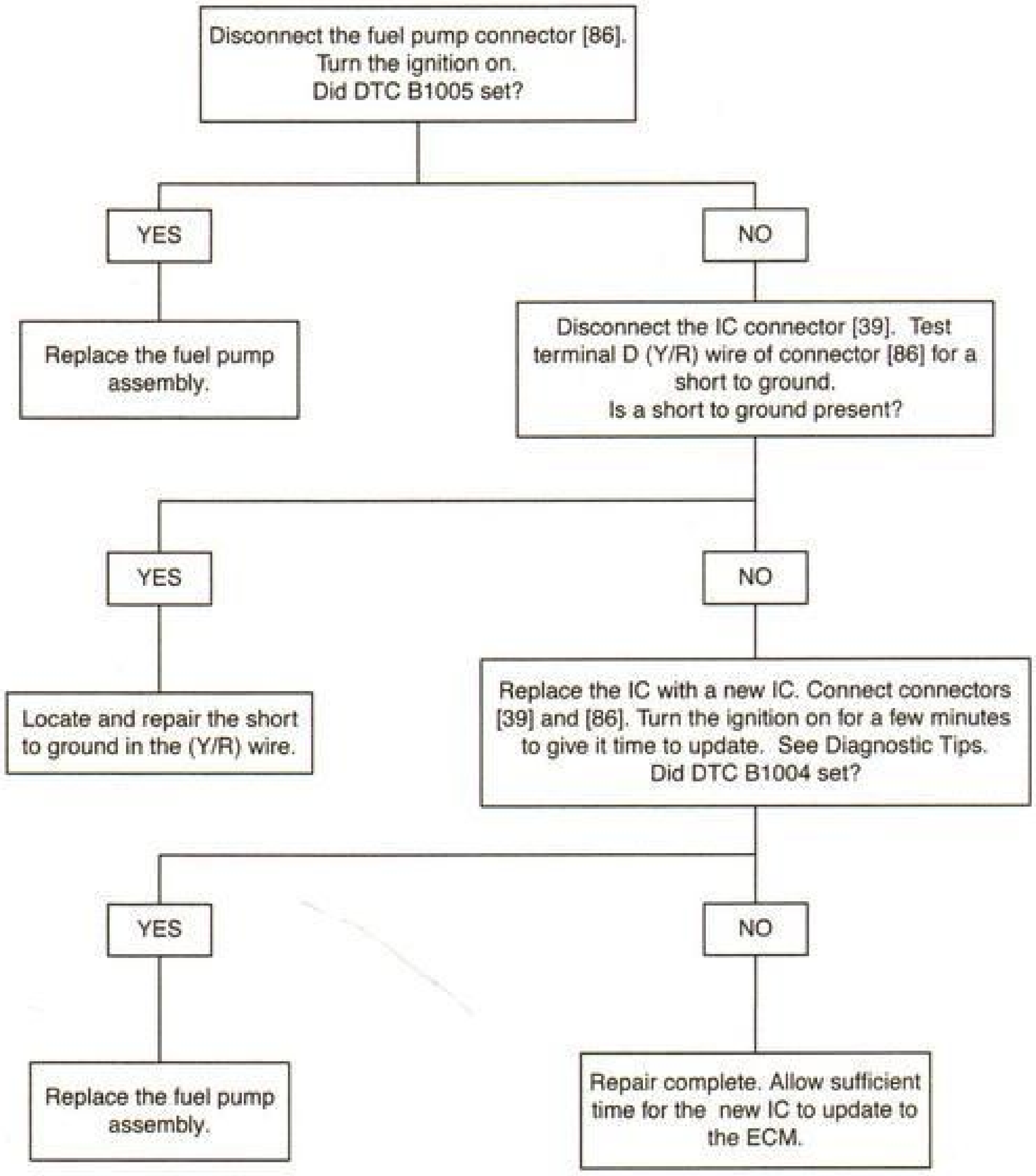


Figure 4-7. Instrument Cluster Inputs and Outputs

DTC B1004



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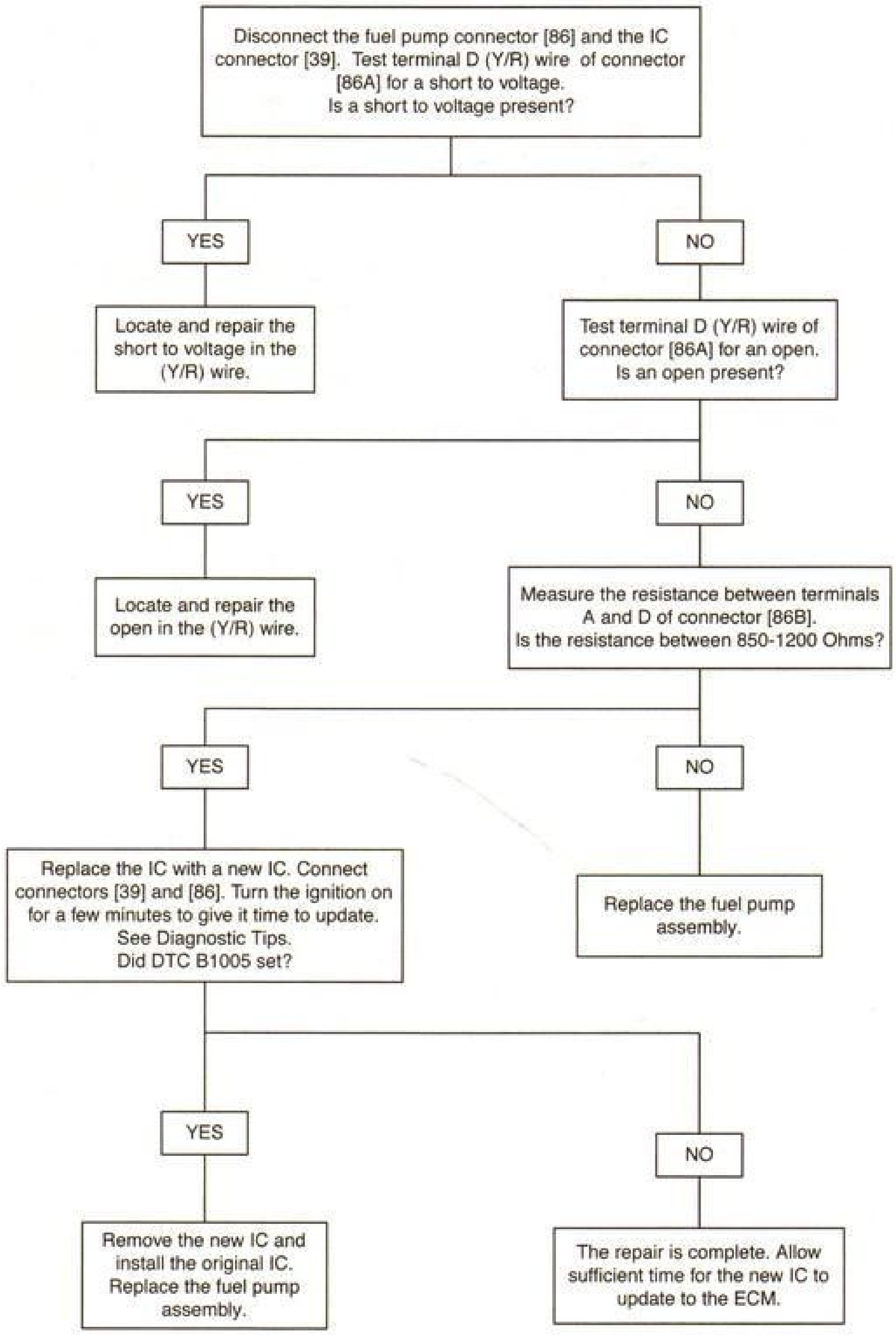
DTC B1005

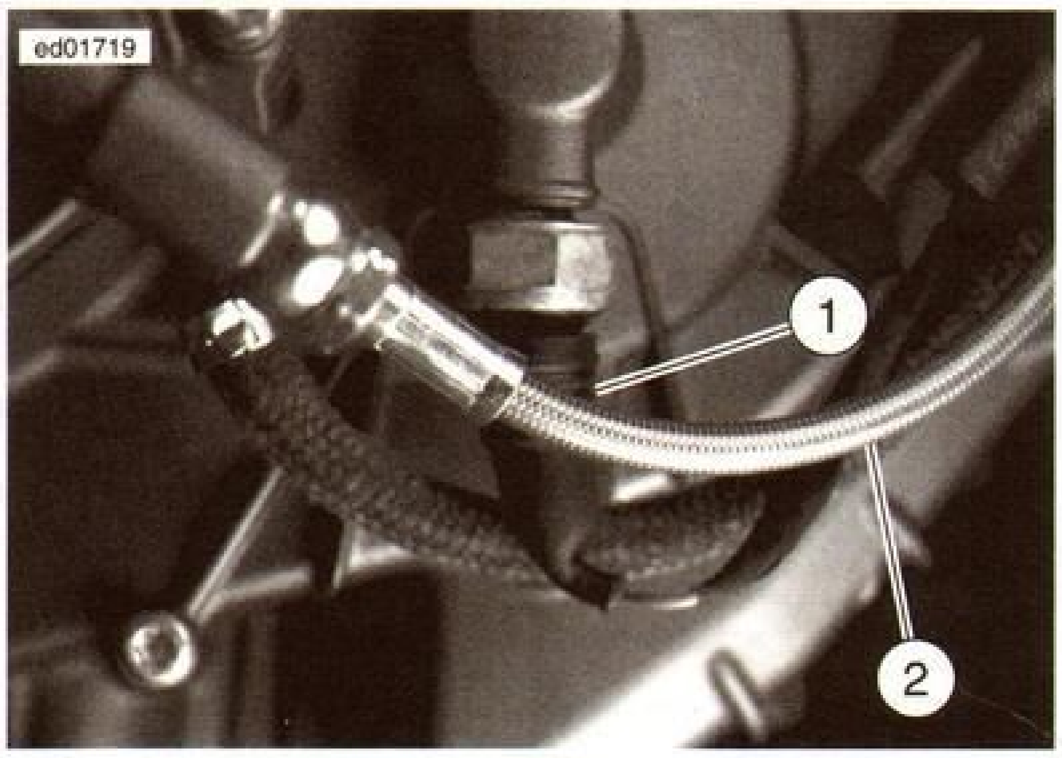


fc01920_en

OIL PRESSURE LAMP ALWAYS ON OR INOPERATIVE 4.3

DESCRIPTION AND OPERATION

See Figure 4-8. The oil pressure lamp illuminates at key on for two seconds when the IC performs the bulb check, and then goes out. It will not stay on under normal conditions if the engine is not running. When the engine is running the IC sends out a voltage on terminal 8 (GN/Y) to the oil pressure switch. When the oil pressure drops, the switch closes, grounding the circuit through the switch. When the IC sees this, it illuminates the oil pressure lamp.



1. **Oil pressure switch [120]**
2. **Hydraulic clutch pressure hose**

Figure 4-8. Oil Pressure Switch Location

Diagnostic Tips

Verify oil pressure using an oil pressure gauge set.

Several non-electrical problems may cause low oil pressure. It is important to test and rule these out to avoid unnecessary parts replacement. Possible causes include:

- Incorrect oil level or incorrect oil viscosity
- Clogged oil line
- Damaged or improper operation of the bypass valve
- Oil pump malfunction

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

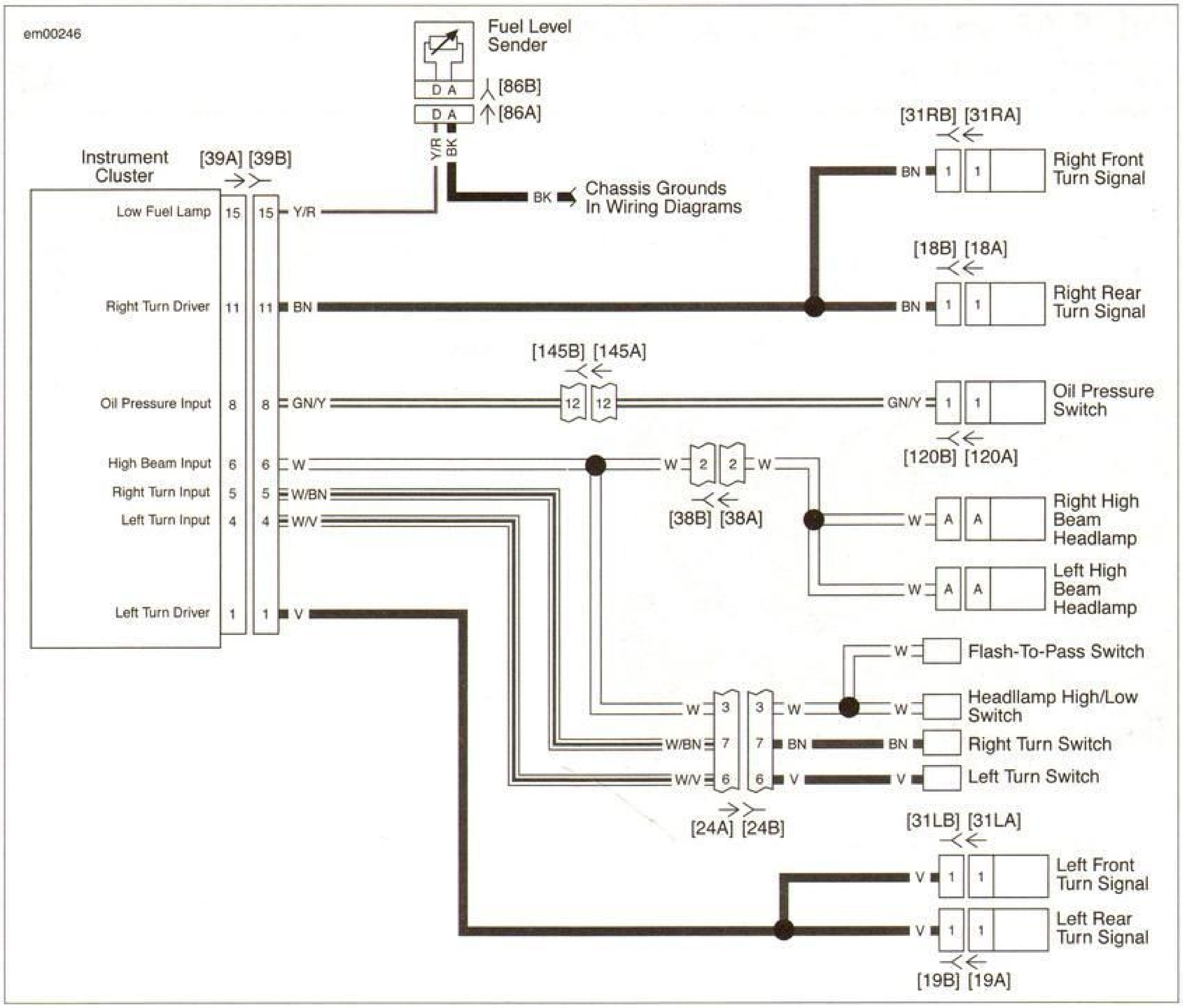
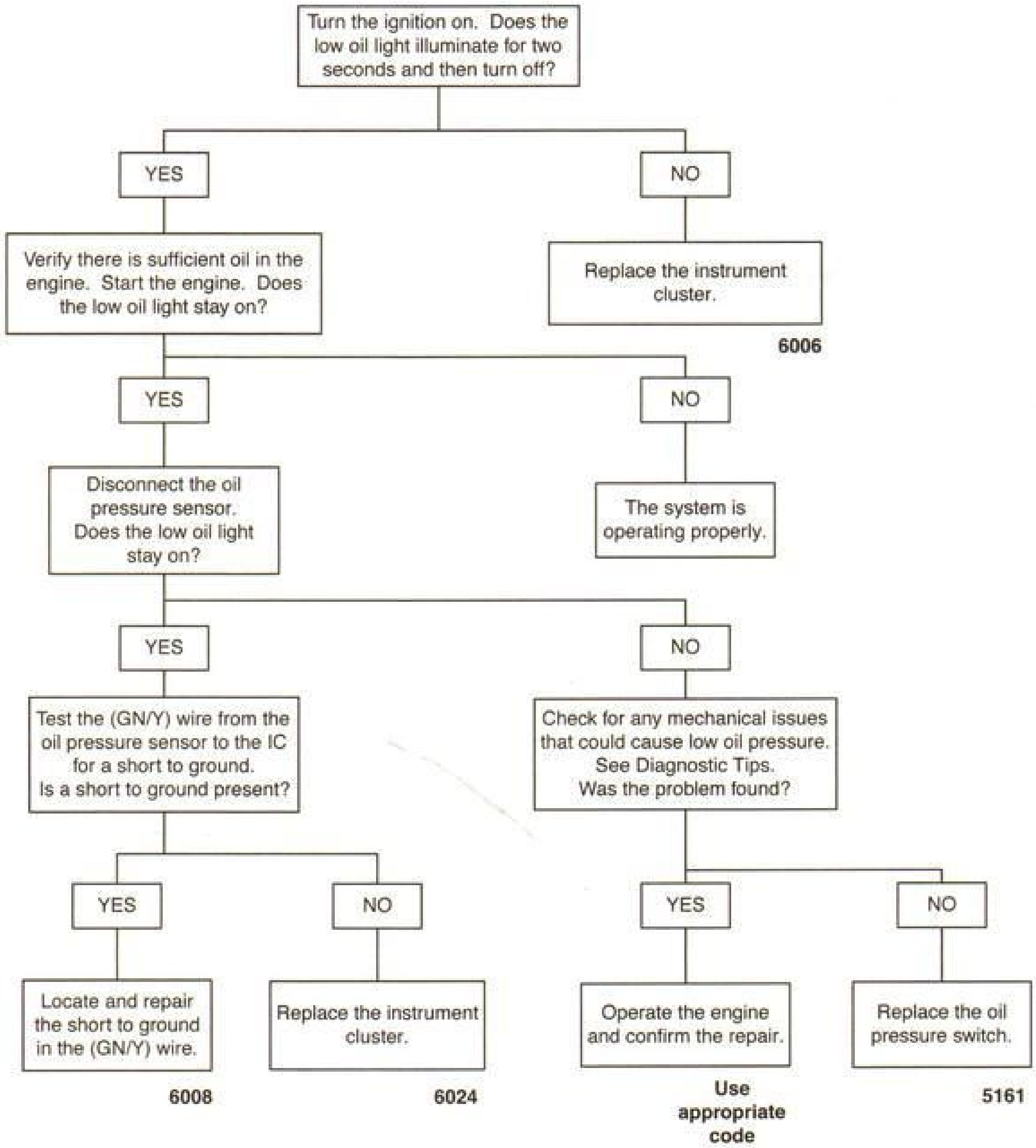
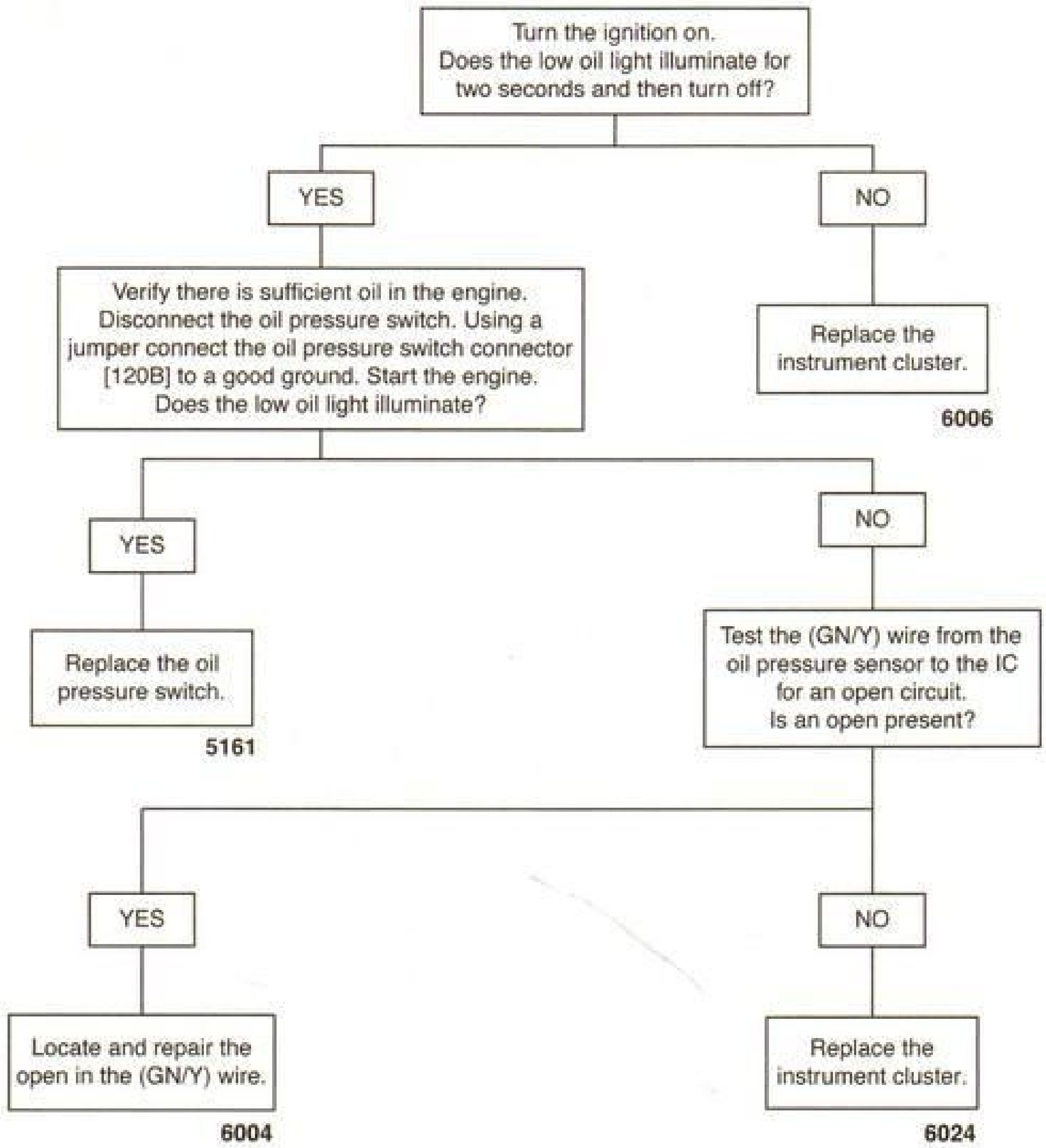


Figure 4-9. Instrument Cluster Inputs and Outputs

Oil Pressure Lamp Always On



Oil Pressure Lamp Inoperative



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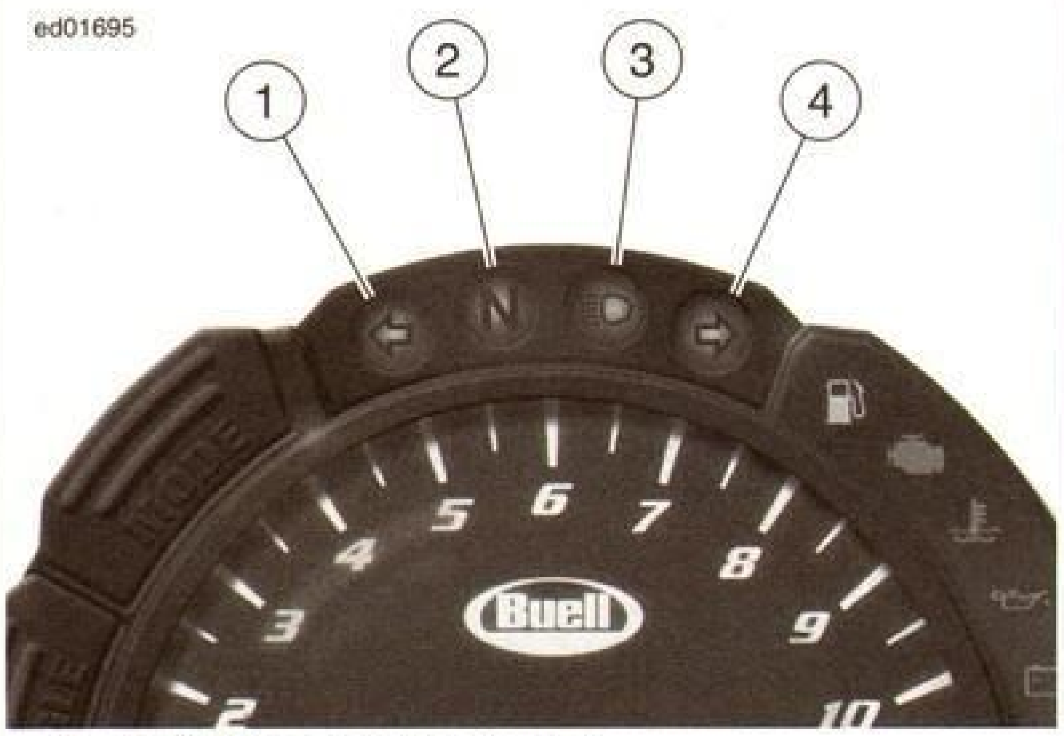
TURN SIGNAL INDICATOR INOPERATIVE

DESCRIPTION AND OPERATION

See Figure 4-10. The IC receives a signal from the left or right turn signal switch on terminal 4 (left) or terminal 5 (right). The IC sends voltage to the right or left turn signal when it receives this signal to flash. The flash for the indicators and the turn signal lamps is controlled internally by the IC. The IC sends voltage through terminal 11 for the right turn signal and through terminal 1 for the left turn signal.



1. **Left turn signal indicator**
2. **Neutral indicator**
3. **Headlamp high beam indicator**
4. **Right turn signal indicator**

Figure 4-10. Indicator Lamp

Diagnostic Tips

The IC controls the flash rate for the turn signals internally. There is no flasher in the wiring to the lamps. If one bulb is inoperative, the remaining bulb flashes at double the normal rate. If both bulbs are inoperative, the turn signal indicator flashes at double the normal rate. The redundant battery and ground wires going to the IC are used to supply the current needed for the turn signal circuits.

Diagnostic Procedure

1. Turn the ignition on.
2. Push the turn signal switch to either the left or right turn signal position.
3. If the turn signals are also inoperative see 5.3 LIGHTS to diagnose the turn signals.
4. If the turn signals operate normally but the indicators do not function, replace the instrument cluster. Use job code 6006.

DESCRIPTION AND OPERATION

The IC has two redundant battery feeds to support the current used to drive the turn signals. The IC also uses an ignition feed that powers up the IC when the ignition switch is turned on. Two redundant ground circuits supply ground for the IC.

Diagnostic Tips

It may appear the backlighting on the IC is not functioning when the display brightness is set to the lowest setting. If this is the only concern, toggle to the "Display Brightness" display option and check the setting.

The IC can only have a VIN written to it once. It cannot learn a new VIN if one has already been written to it. Therefore, when replacing the IC, it must be a **new** IC.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

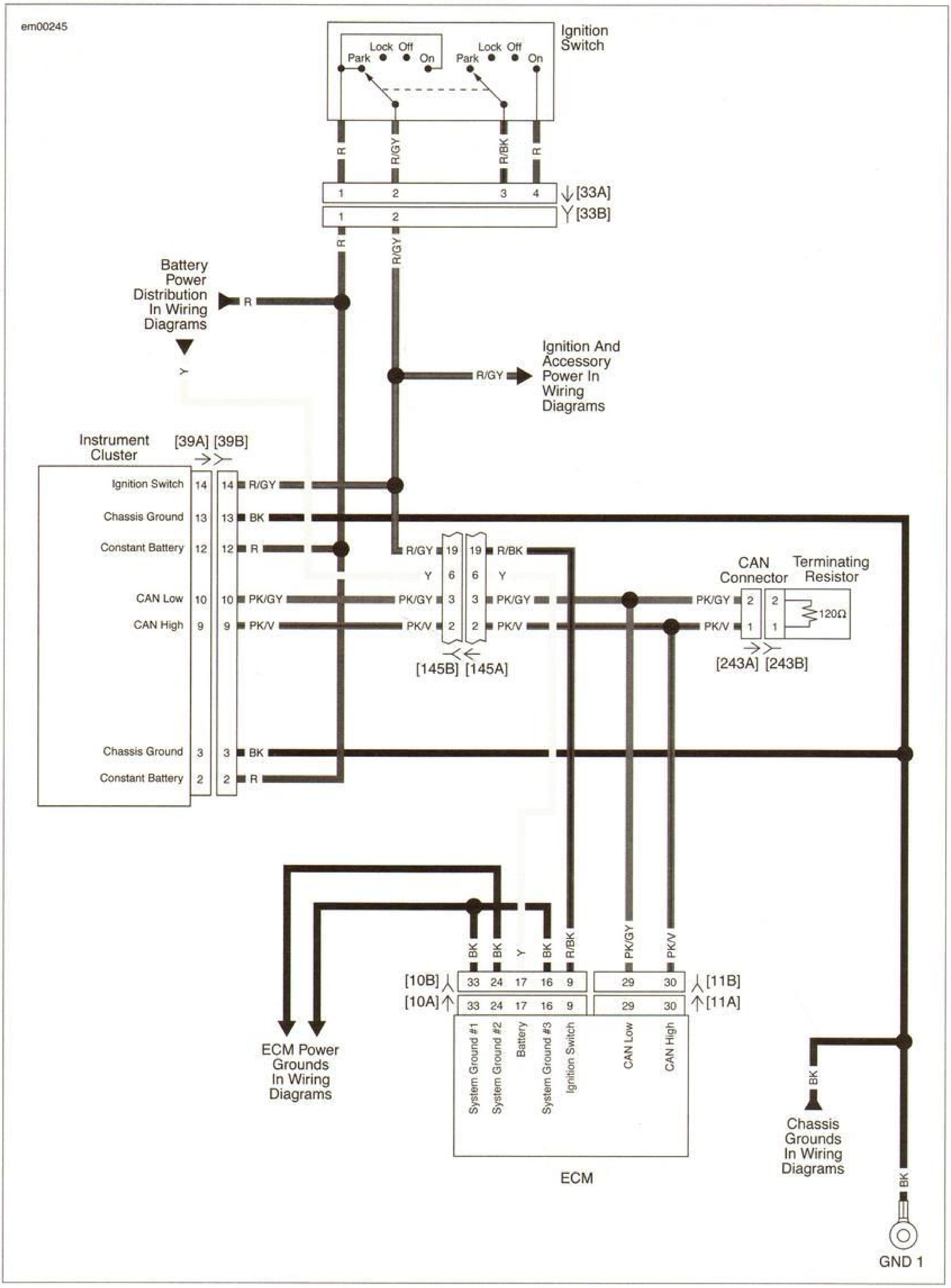
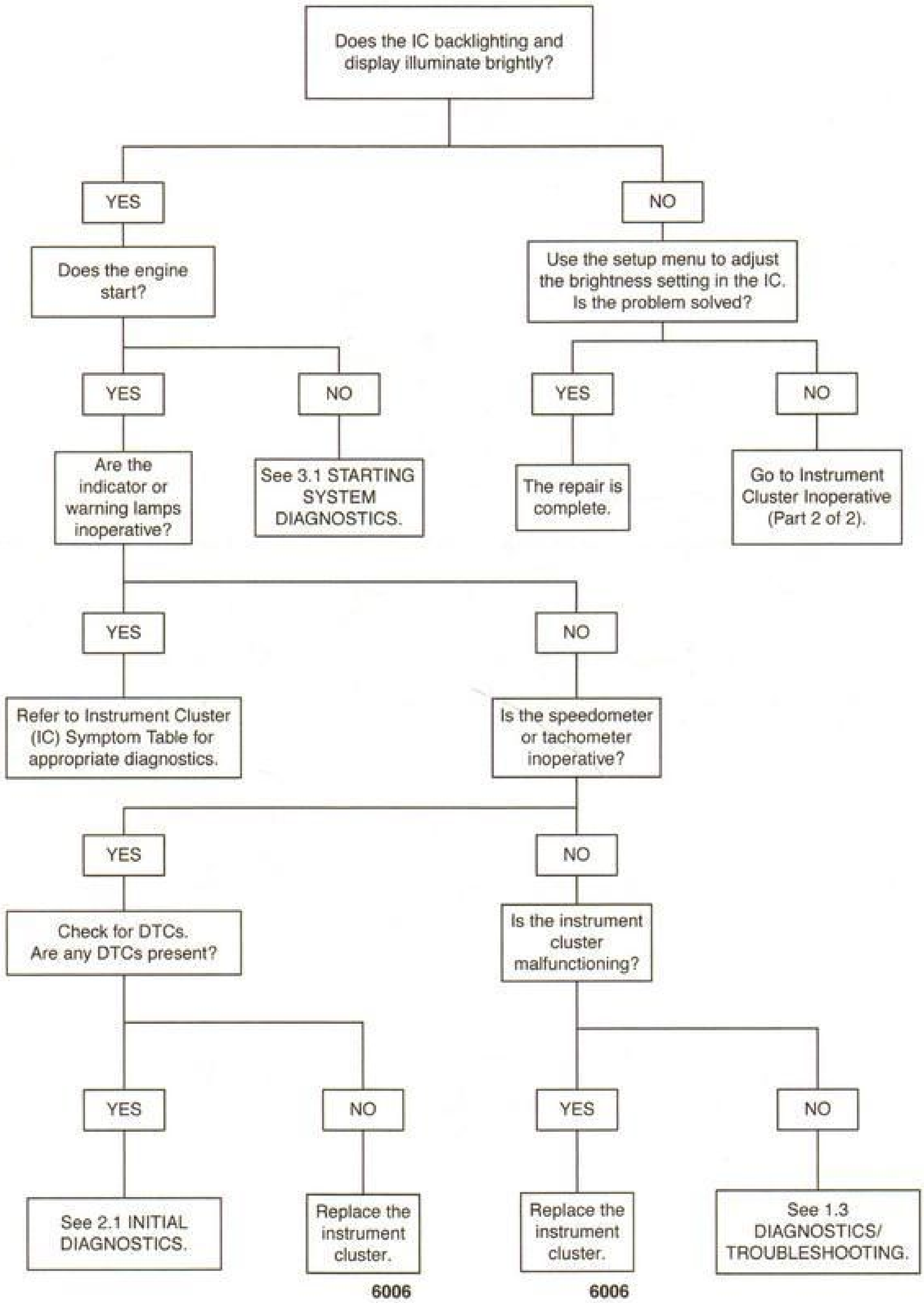


Figure 4-11. Instrument Cluster Power and Communication

Instrument Cluster Inoperative (Part 1 of 2)



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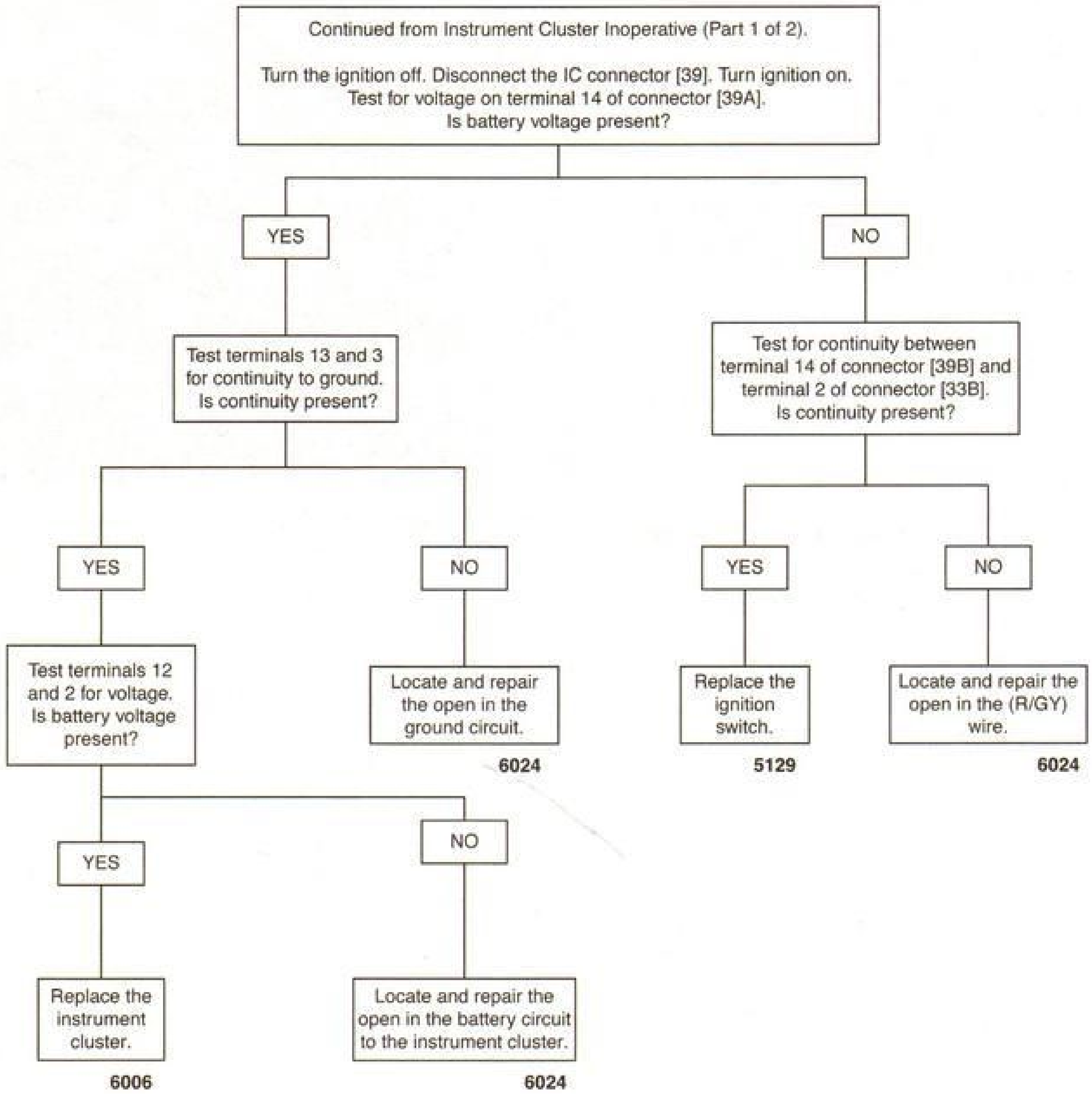
Instrument Cluster Inoperative (Part 2 of 2)



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LOW FUEL LAMP ALWAYS ON OR INOPERATIVE 4.6

DESCRIPTION AND OPERATION

See Figure 4-12. The IC provides battery voltage to the fuel level sender on the (Y/R) wire. The fuel level sender is a thermistor device that is cooled by fuel in the tank, keeping the resistance value high. As the fuel drops below the sender, the thermistor is allowed to warm, lowering the resistance value. The IC constantly monitors this signal and when the resistance value changes (at approximately 0.8 gallons (3.0 liters) of fuel is left in the tank), the IC illuminates the low fuel lamp.

Diagnostic Tips

The fuel level sender will not show a resistance reading if the sensor is working properly and the fuel level is above the sensor.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

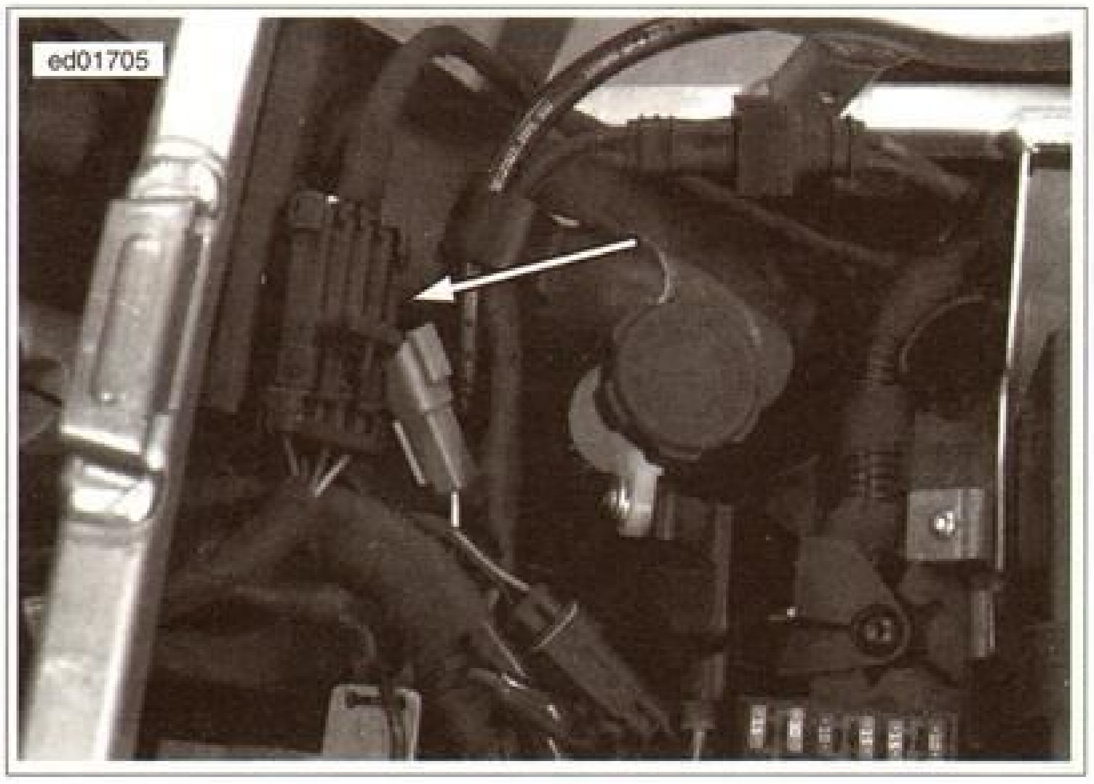


Figure 4-12. Fuel Pump Connector [86]

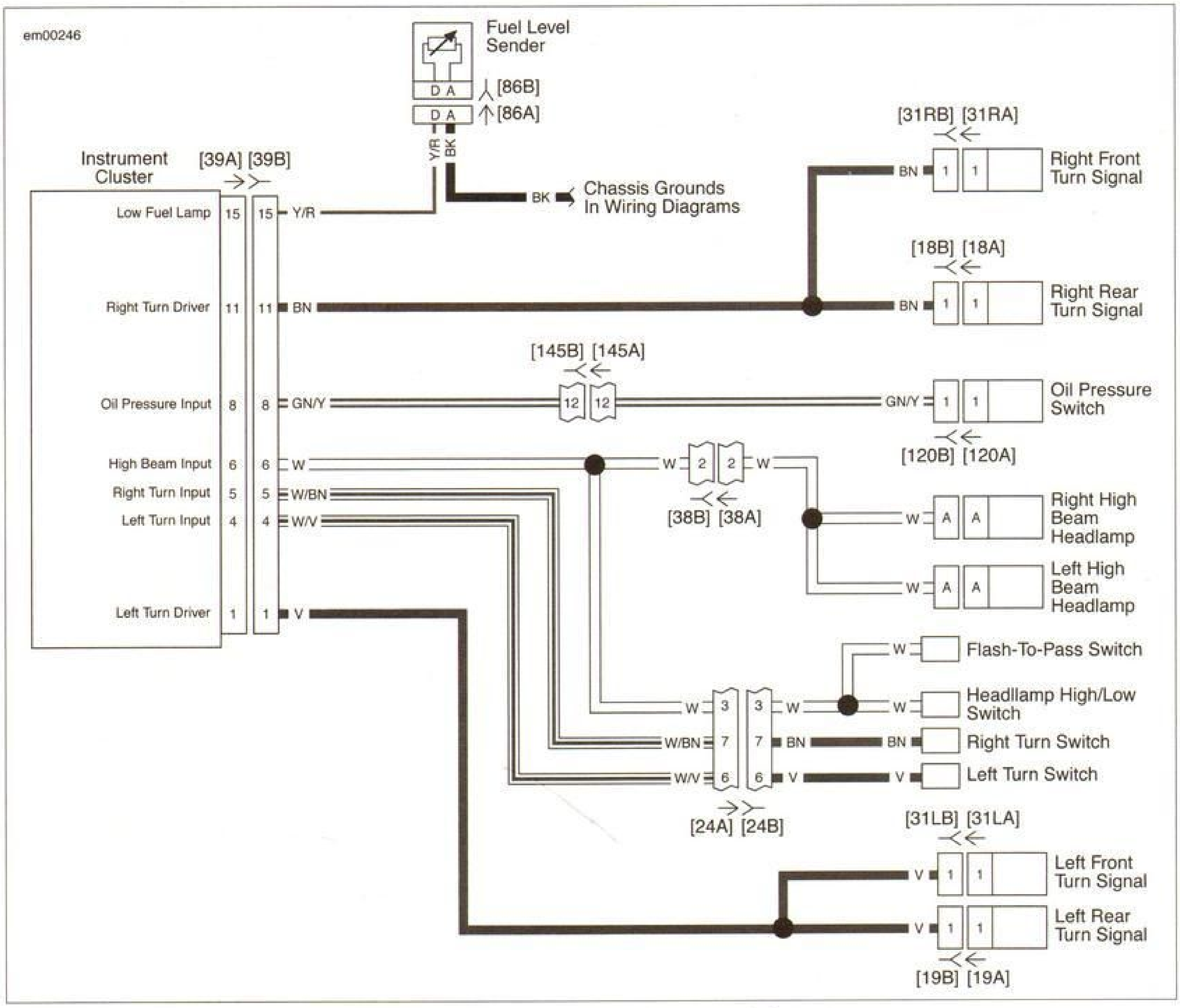
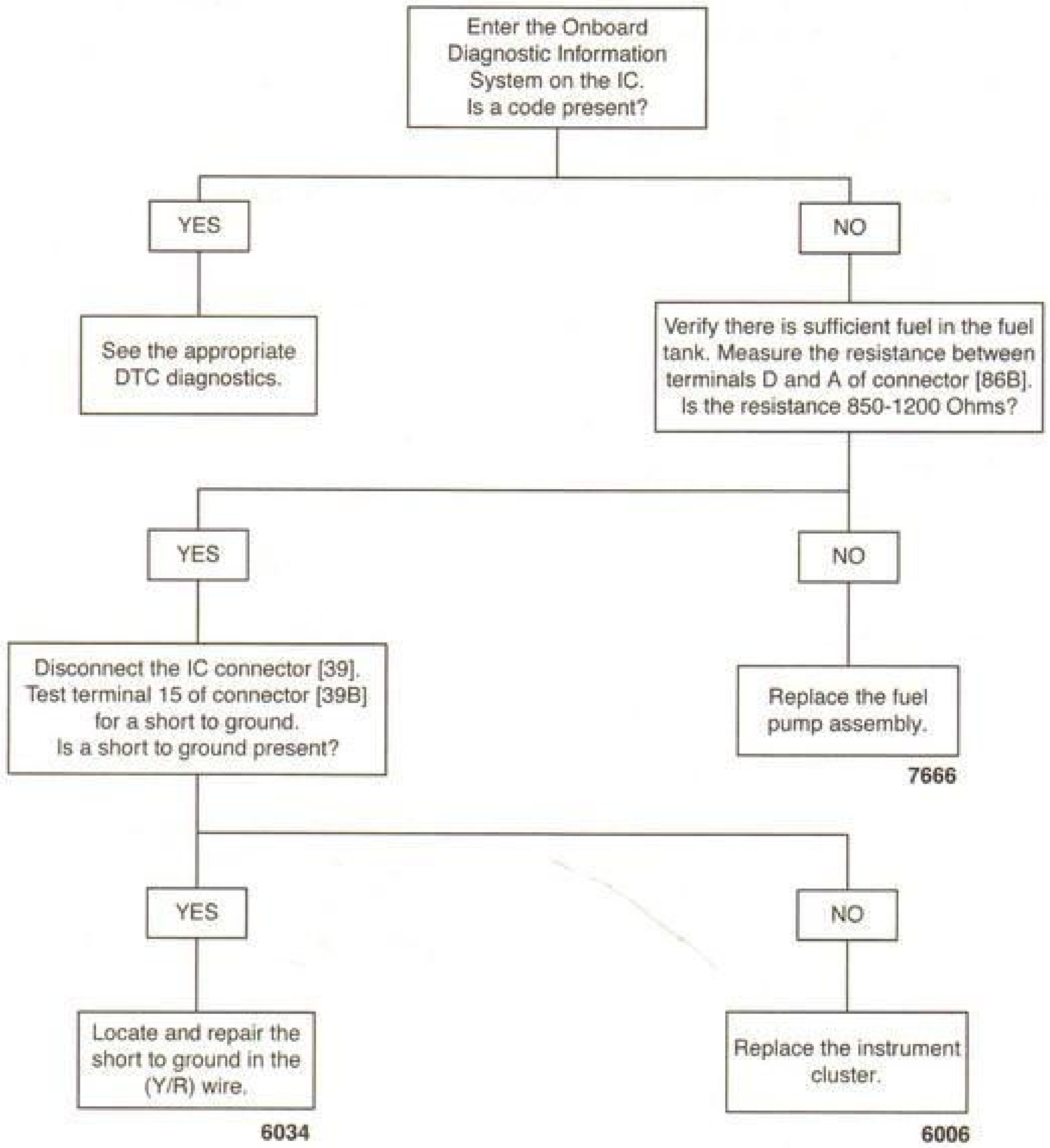


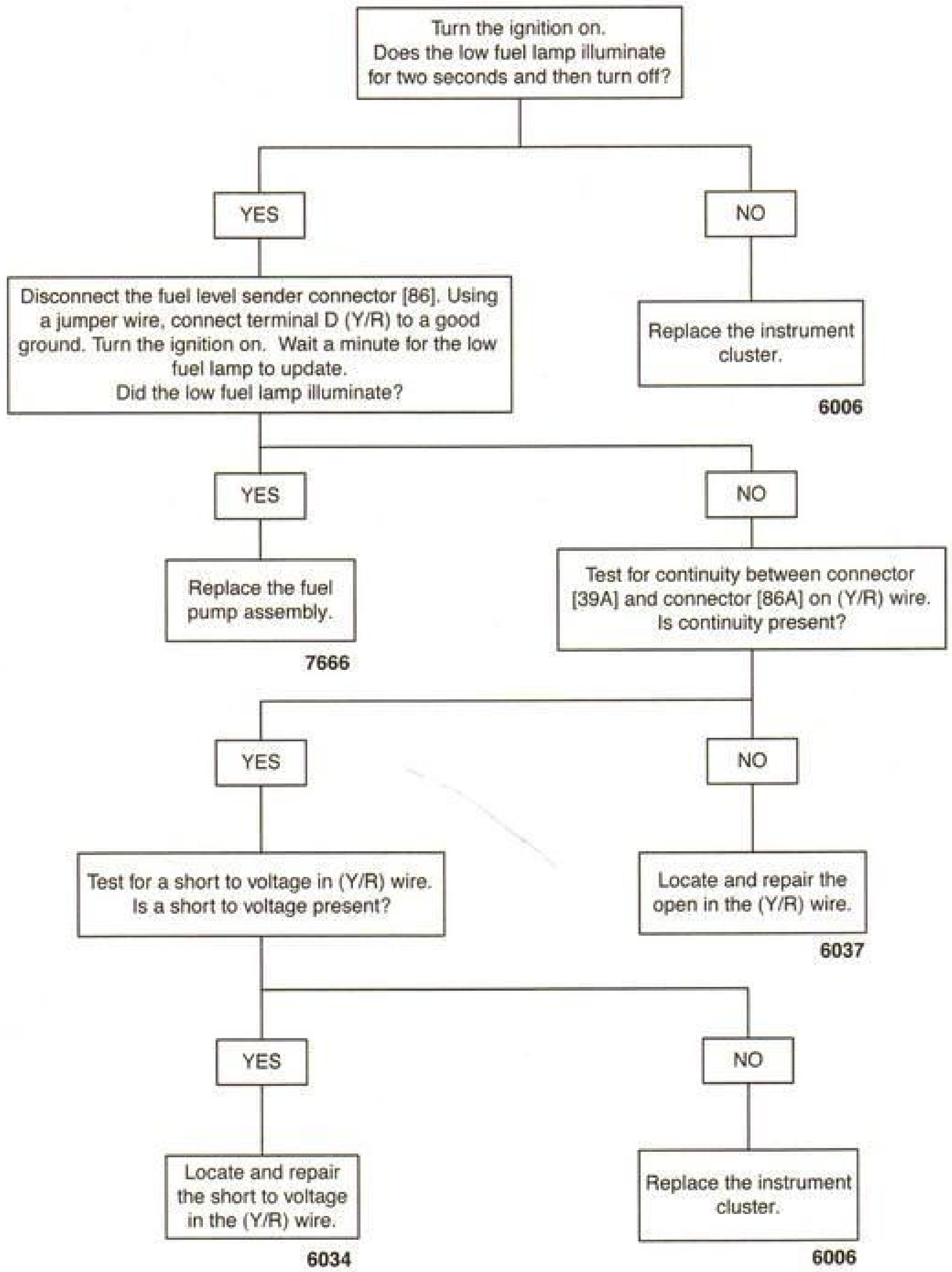
Figure 4-13. Instrument Cluster Inputs and Outputs

Low Fuel Lamp Always On



fc01788_en

Low Fuel Lamp Inoperative



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NOTES

SUBJECT	PAGE NO.

NOTES

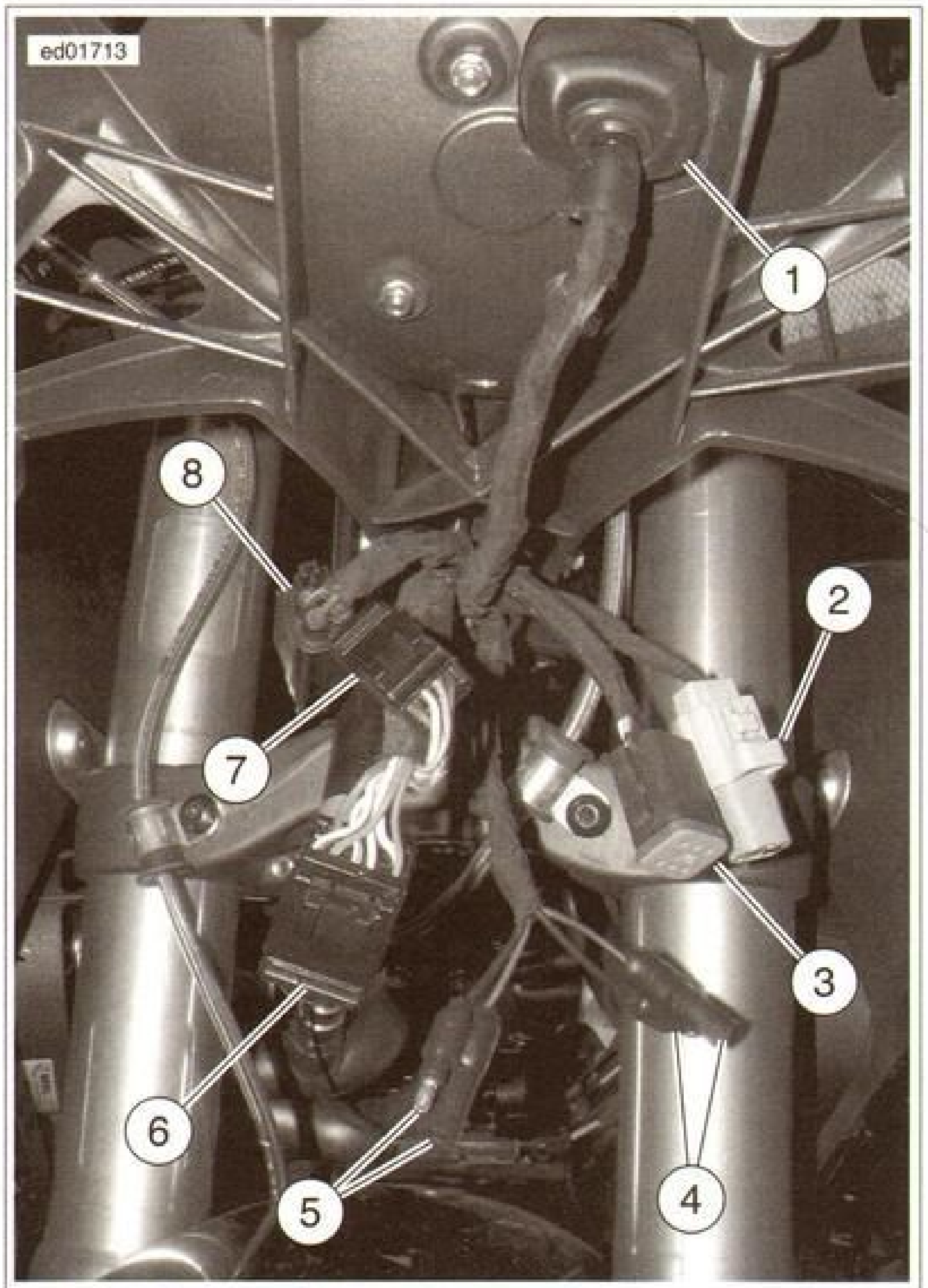
DESCRIPTION AND OPERATION

The auxiliary connector supplies power for accessories that may be added to the motorcycle. This two terminal connector is located behind the fairing below the Instrument Cluster (IC). If the ECM recognizes a low battery voltage condition, it will not energize the auxiliary relay, and therefore, the auxiliary connector will not have power.

COMPONENTS

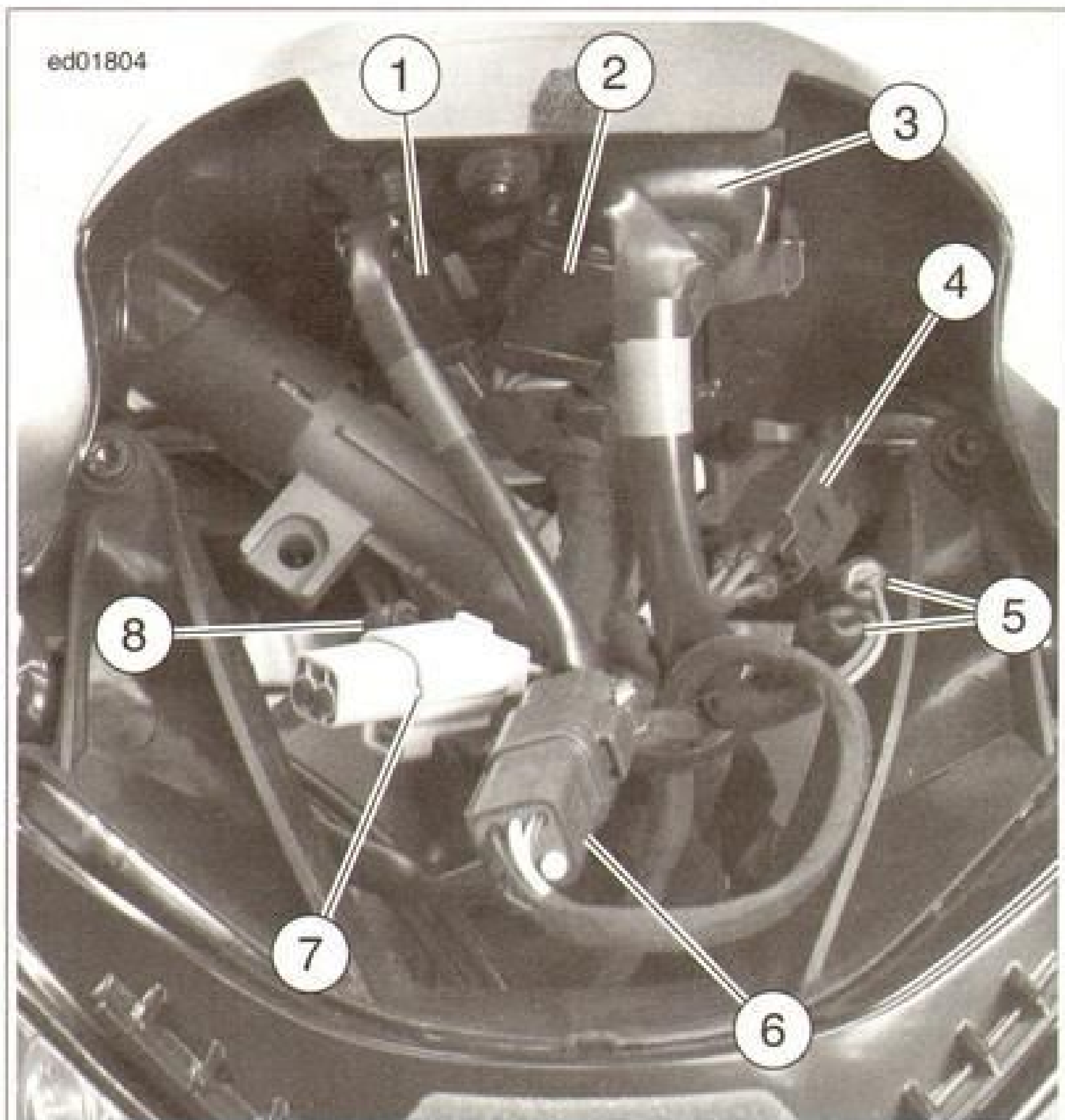
Auxiliary Connector

See Figure 5-1 or Figure 5-2. The auxiliary connector receives power when the auxiliary relay is energized. The connector has a constant ground to GND1.



1. Instrument Cluster (IC) [39]
2. 12 V auxiliary connector [160]
3. Headlamp [38]
4. Left front turn signal [31L]
5. Right front turn signal [31R]
6. Left hand controls [24]
7. Right hand controls [22]
8. Ignition switch [33]

Figure 5-1. Behind Fairing Connectors (1125R)

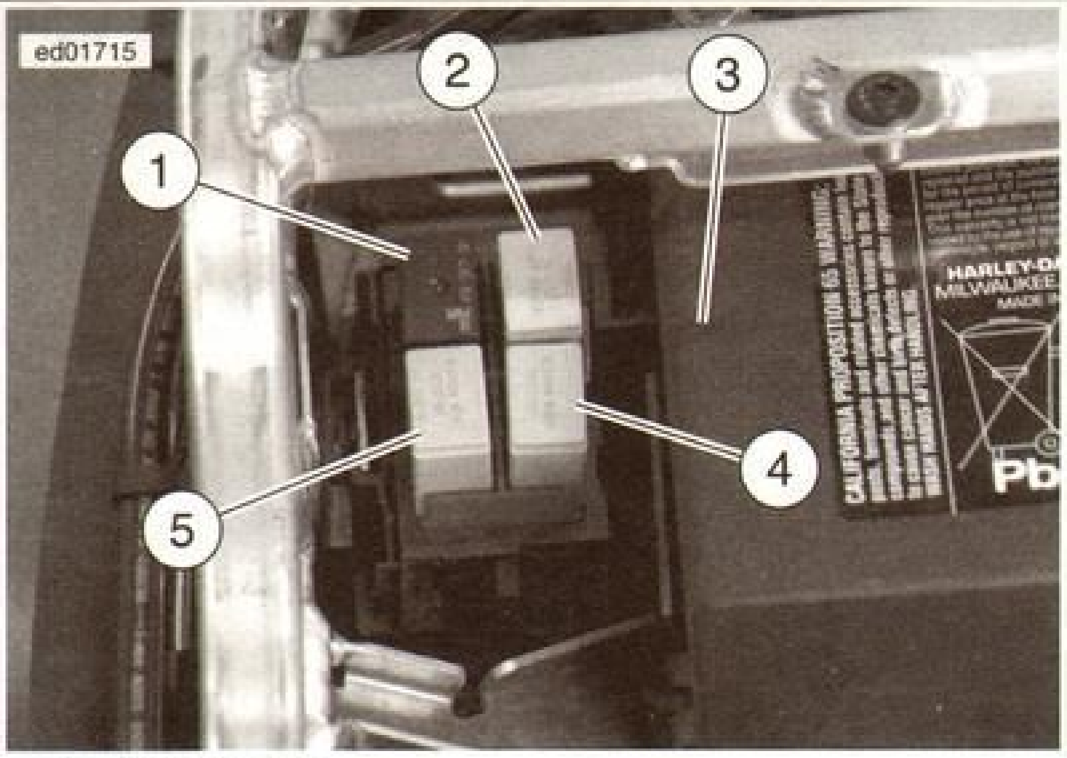


1. Right hand controls [22]
2. Left hand controls [24]
3. Instrument Cluster (IC) [39]
4. Ignition switch [33]
5. Left front turn signal [31L]
6. Headlamp [38]
7. 12V auxiliary connector [160]
8. Right front turn signal [31R]

Figure 5-2. Behind Fairing Connectors (1125CR)

Auxiliary Relay

See Figure 5-3. The auxiliary relay receives power from the auxiliary fuse. The ECM grounds the coil side of the relay causing the relay to energize and supply power to the auxiliary connector. The ECM monitors the ground circuit for an open or shorted condition and sets a code if a condition is present. Refer to Table 5-1.



1. **Start relay**
2. **Auxiliary relay**
3. **Battery**
4. **Key relay**
5. **Ignition relay**

Figure 5-3. Relay Block Location

Table 5-1. Auxiliary Power DTCs

DTC	DESCRIPTION
P1601	Auxiliary Relay Drive Circuit Fault

DTC P1601 Auxiliary Relay Driver Circuit Fault

The ECM controls the ground to the coil side of the auxiliary relay. The ECM monitors this circuit and sets a code if it does not see the expected input.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

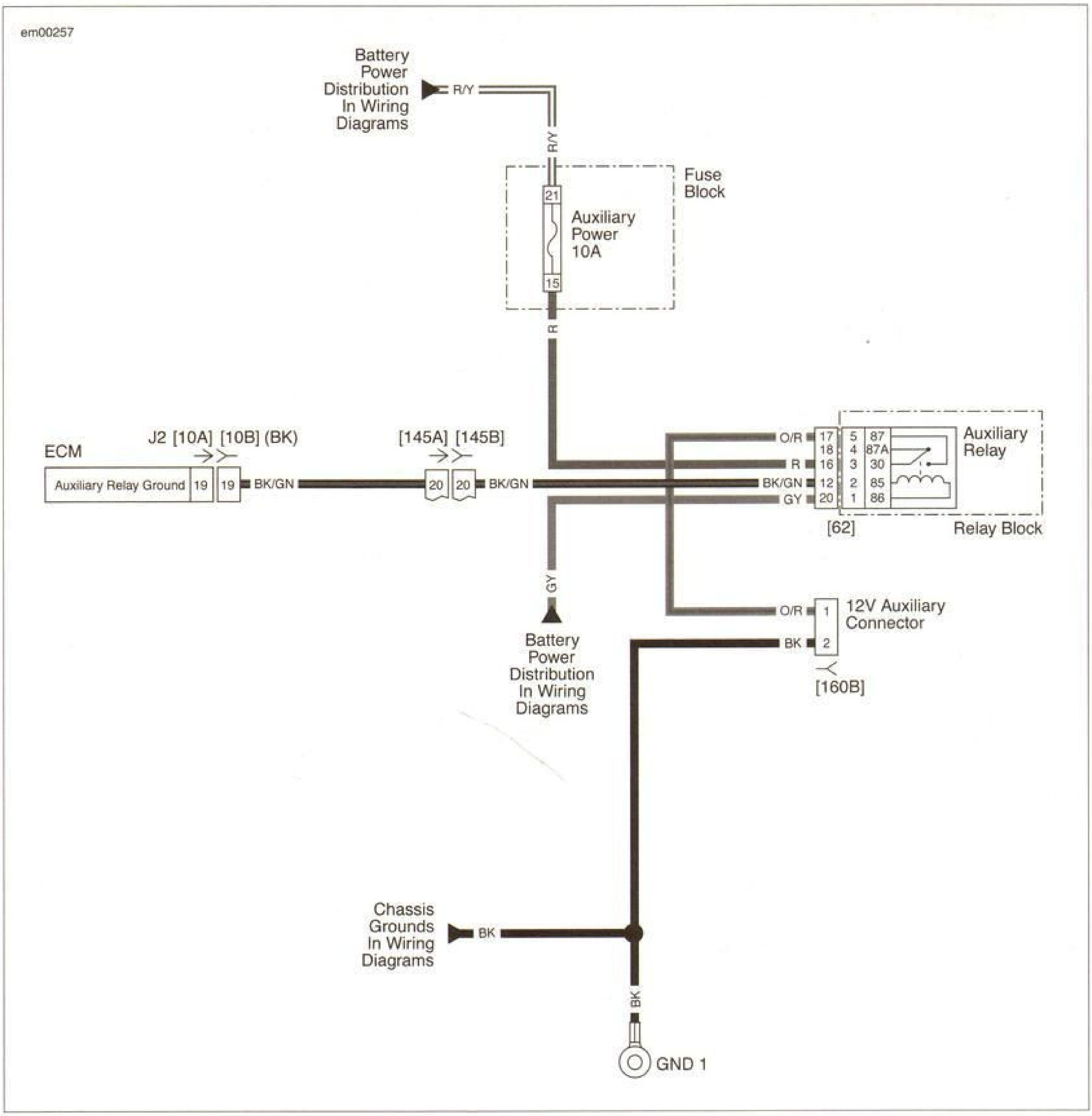
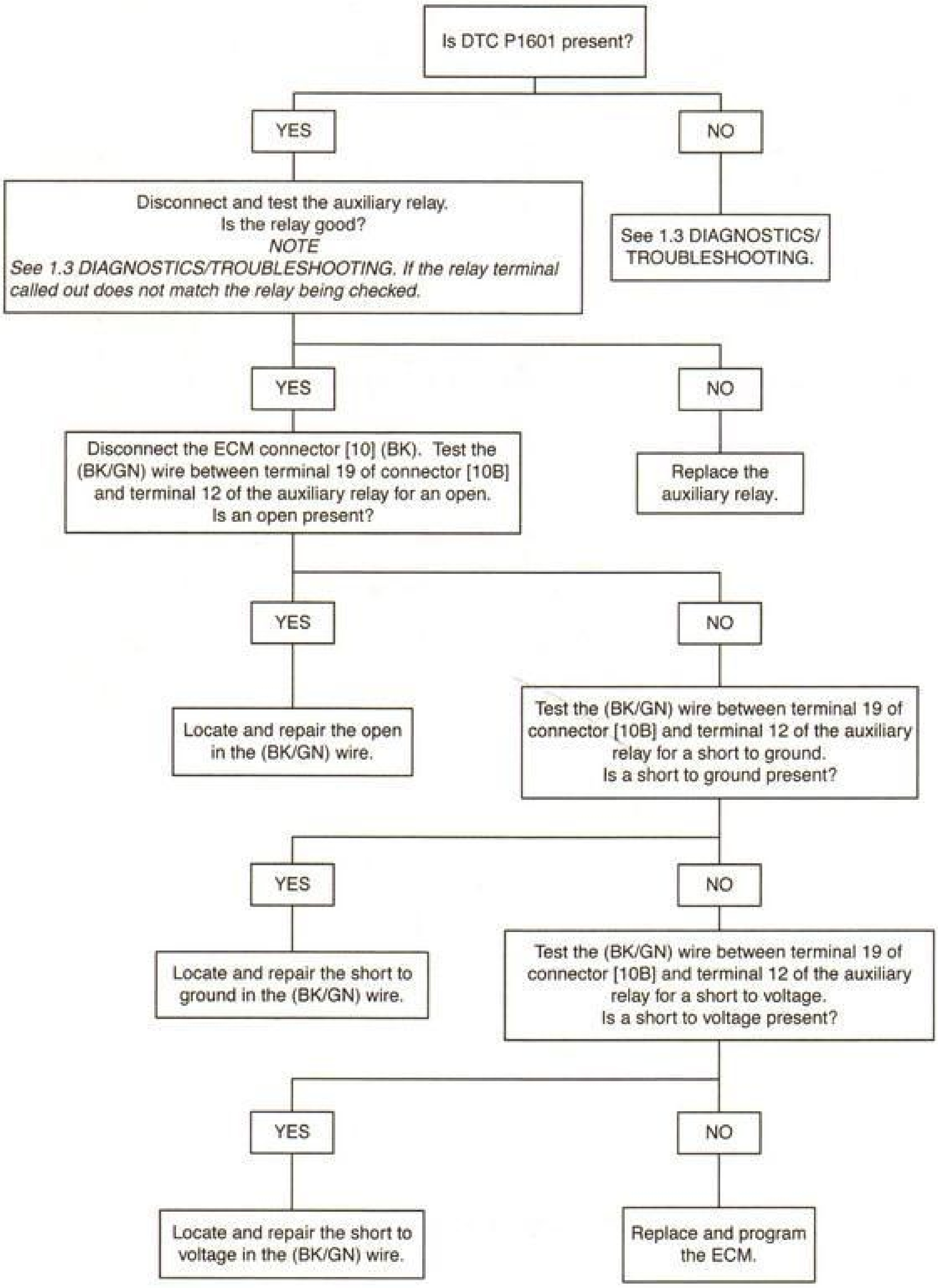


Figure 5-4. Auxiliary Power Connector

DTC P1601



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AUXILIARY POWER INOPERATIVE

The ECM only monitors the ground to the coil side of the auxiliary relay. Therefore, faults could occur that would affect the operation of the auxiliary power circuit without it causing a DTC to set.

Table 5-2. Auxiliary Power Symptom Table

SYMPTOM	COMMON CAUSE
Auxiliary Power Inoperative	Poor ground or open in the switch side circuit of the relay

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

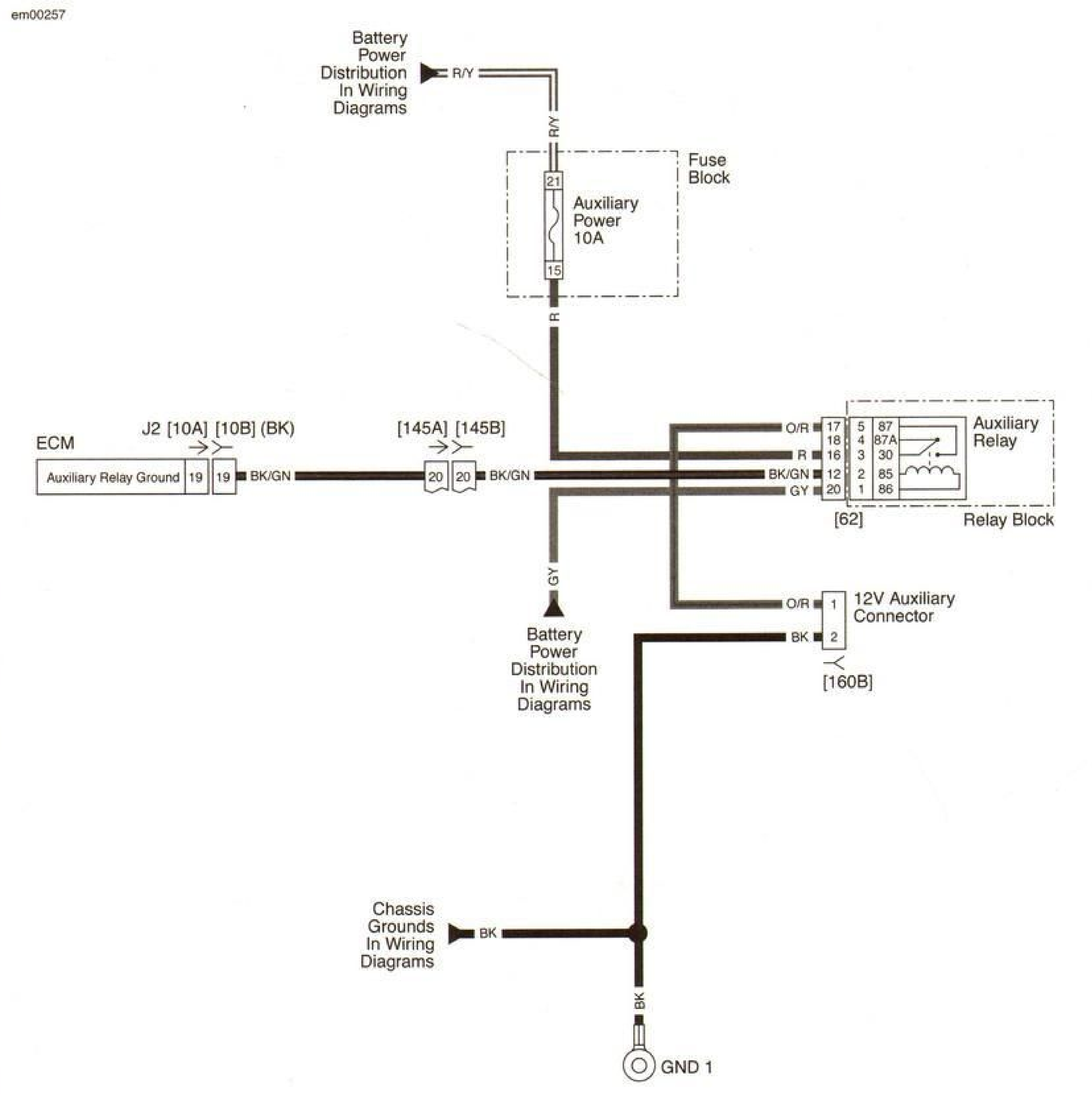
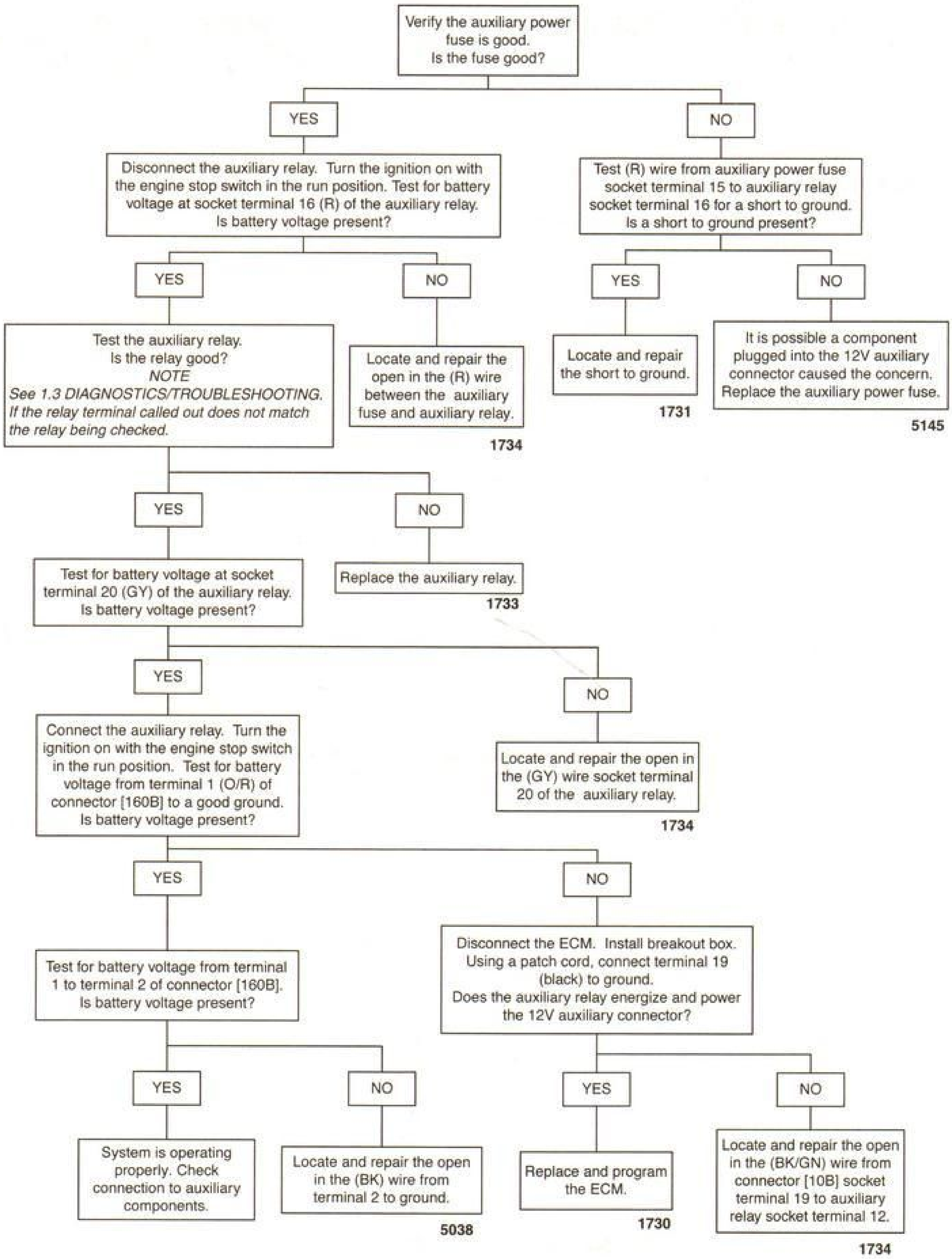


Figure 5-5. Auxiliary Power Connector

Auxiliary Power Inoperative



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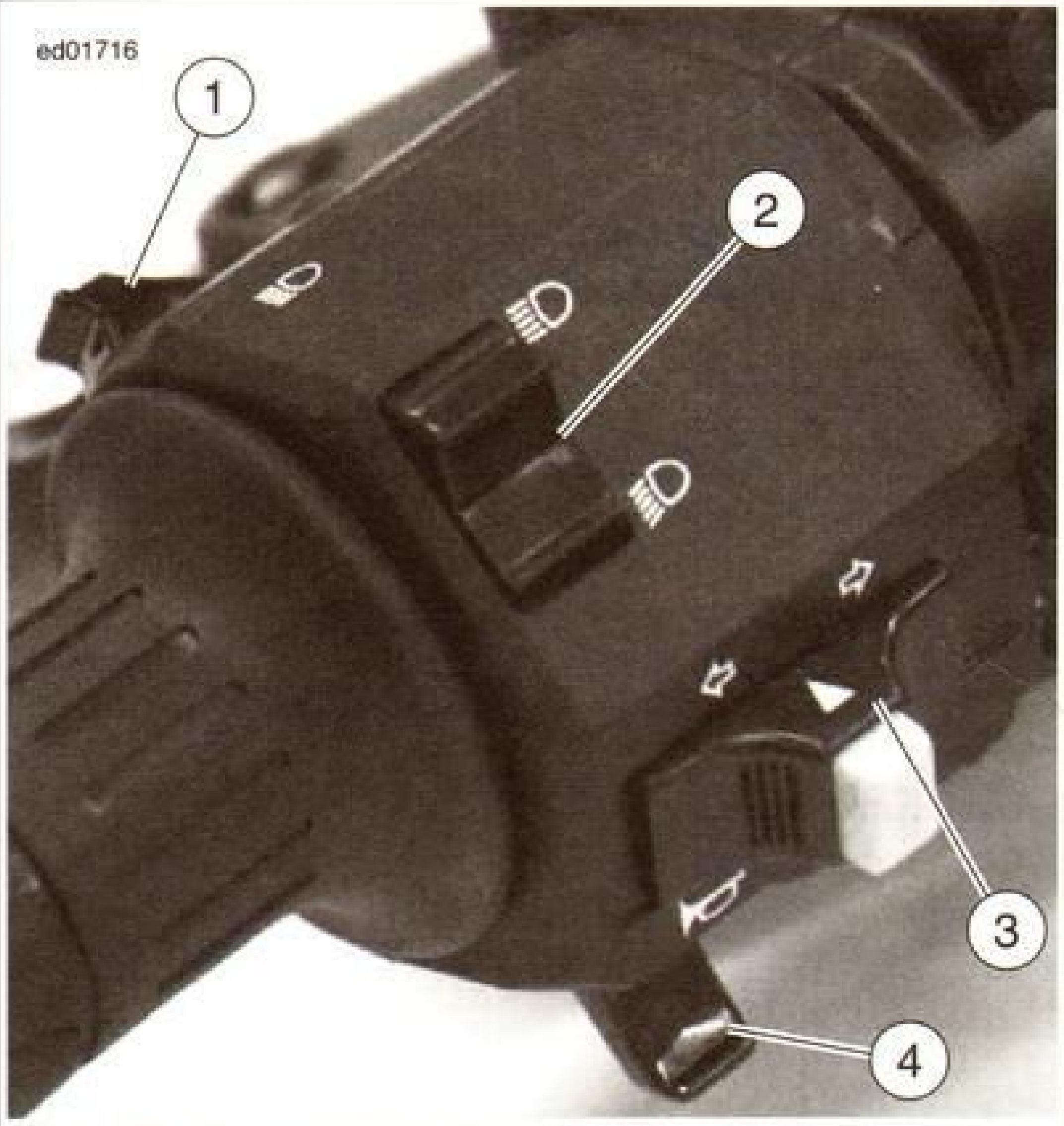
DESCRIPTION AND OPERATION

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

COMPONENTS

Horn Switch

See Figure 5-6. The horn switch is a pushbutton switch on the left handlebar controls.

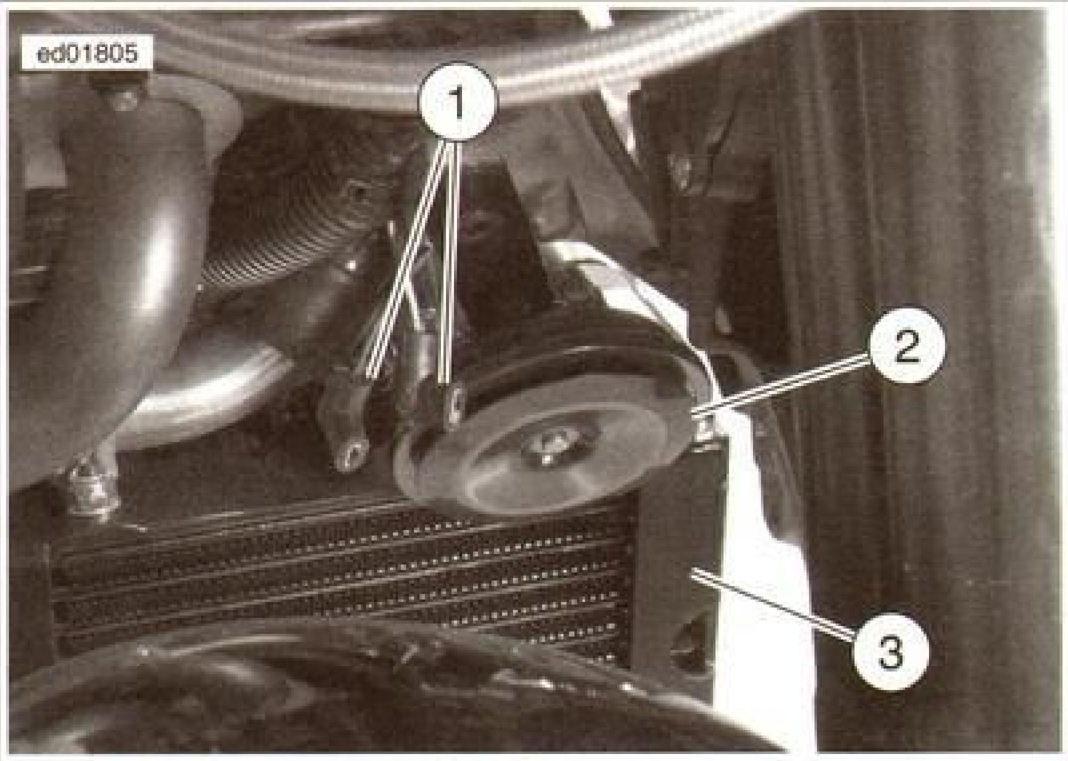


1. **Flash-to-pass switch**
2. **Headlamp switch**
3. **Turn signal switch**
4. **Horn switch**

Figure 5-6. Left Handlebar Controls

Horn

See Figure 5-7. The horn is located behind the left radiator shroud near the oil cooler.



1. **Horn connector [122]**
2. **Horn**
3. **Oil cooler**

Figure 5-7. Horn

SYMPTOMS

The horn circuit does not set DTCs when there is a malfunction. Instead, one of the symptoms shown in Table 5-3 exists to indicate a concern with the system.

Table 5-3. Horn Symptom Table

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. A short in the (R/Y) wire between the brake lamp switches and the tail/stop lamp causes this fuse to blow when the brakes are applied.

The (O) wire from the fuse supplies battery voltage to several components. A short anywhere in the (O) wire causes the fuse to open immediately.

Horn Always On

If the horn is always on, perform the following steps:

1. Disconnect the horn switch.
2. If the horn turns off, replace the left switchgear.

3. If the horn does not turn off, repair the short to voltage in the (Y/BK) wire.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

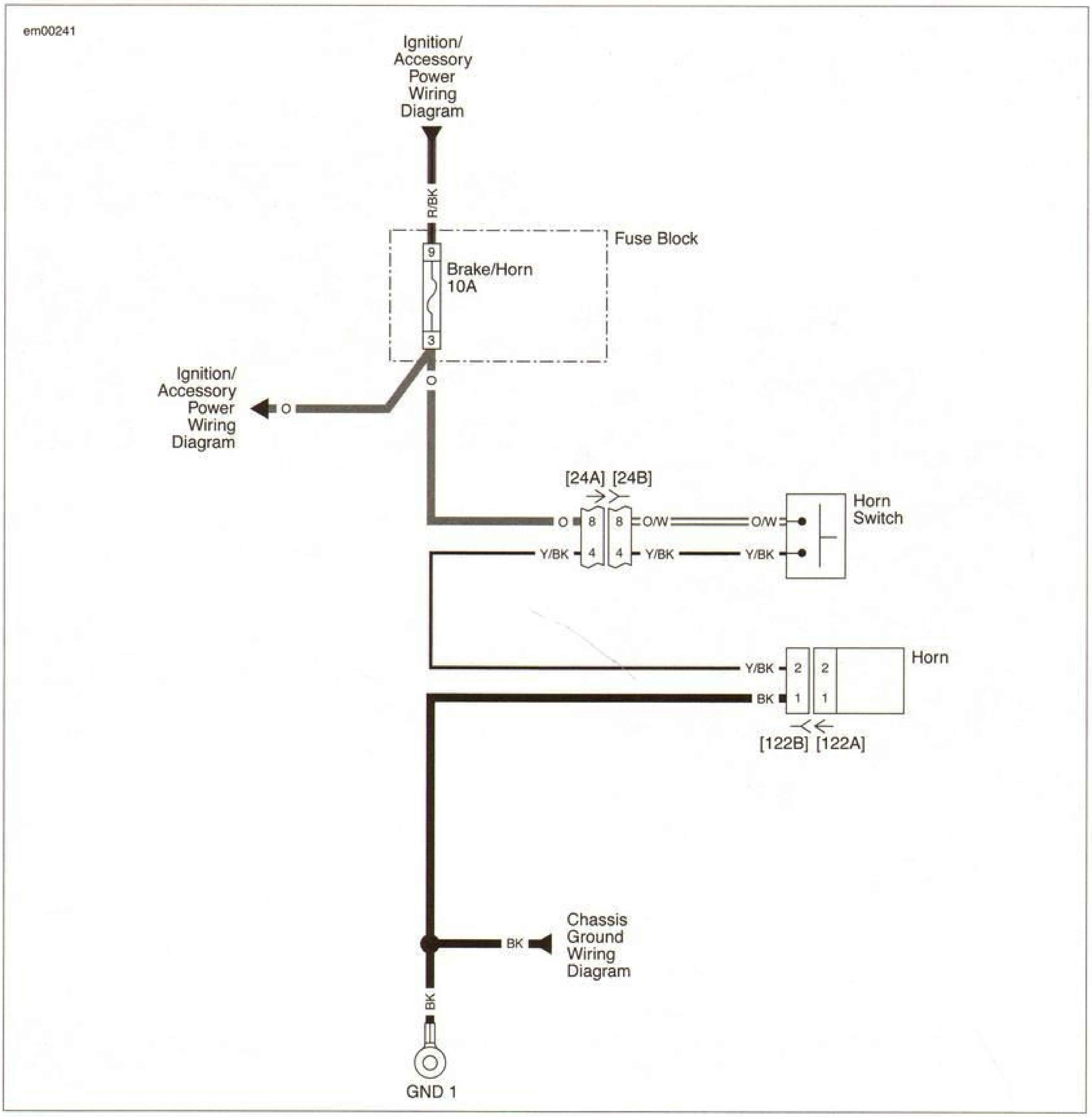
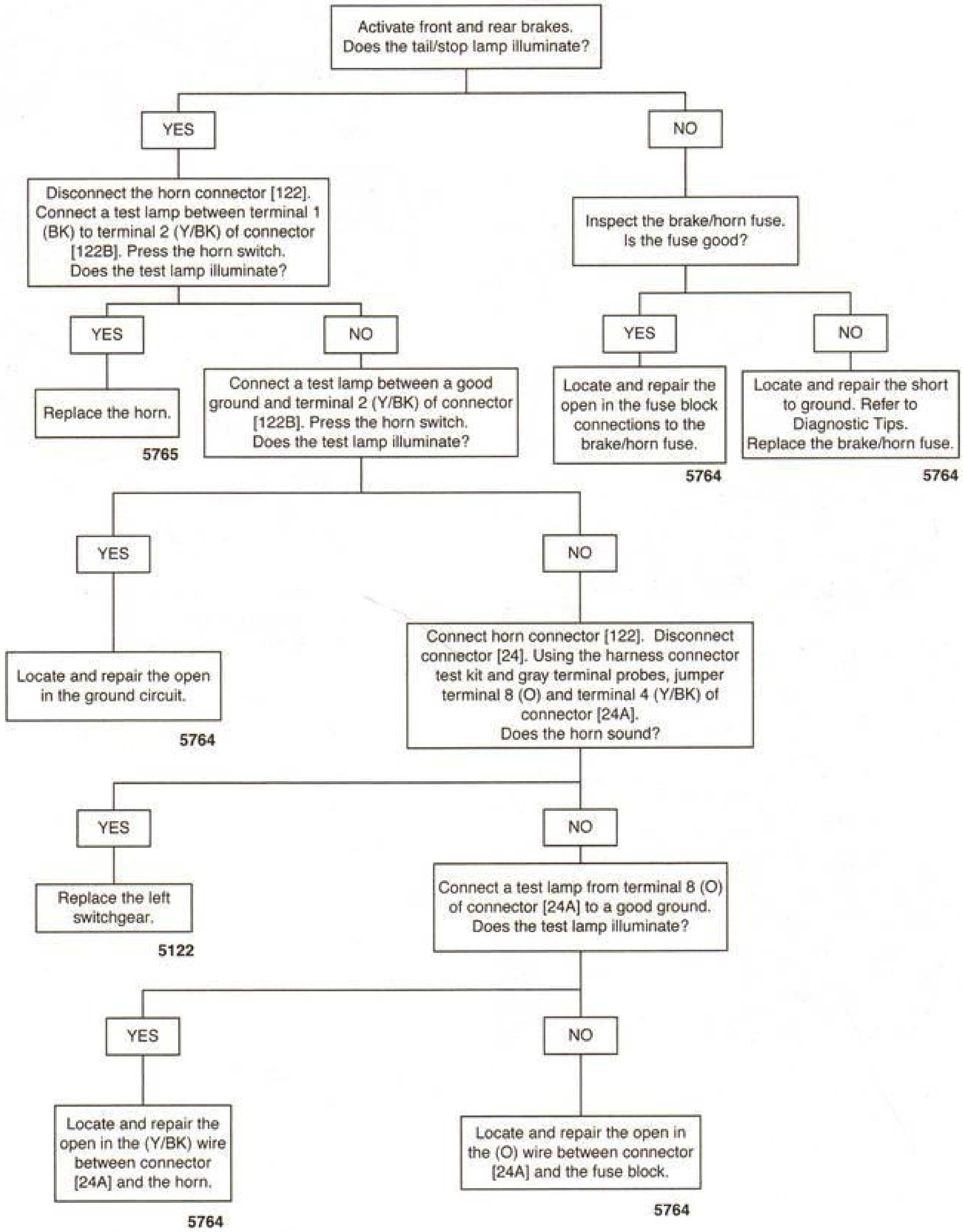


Figure 5-8. Horn

Horn Inoperative



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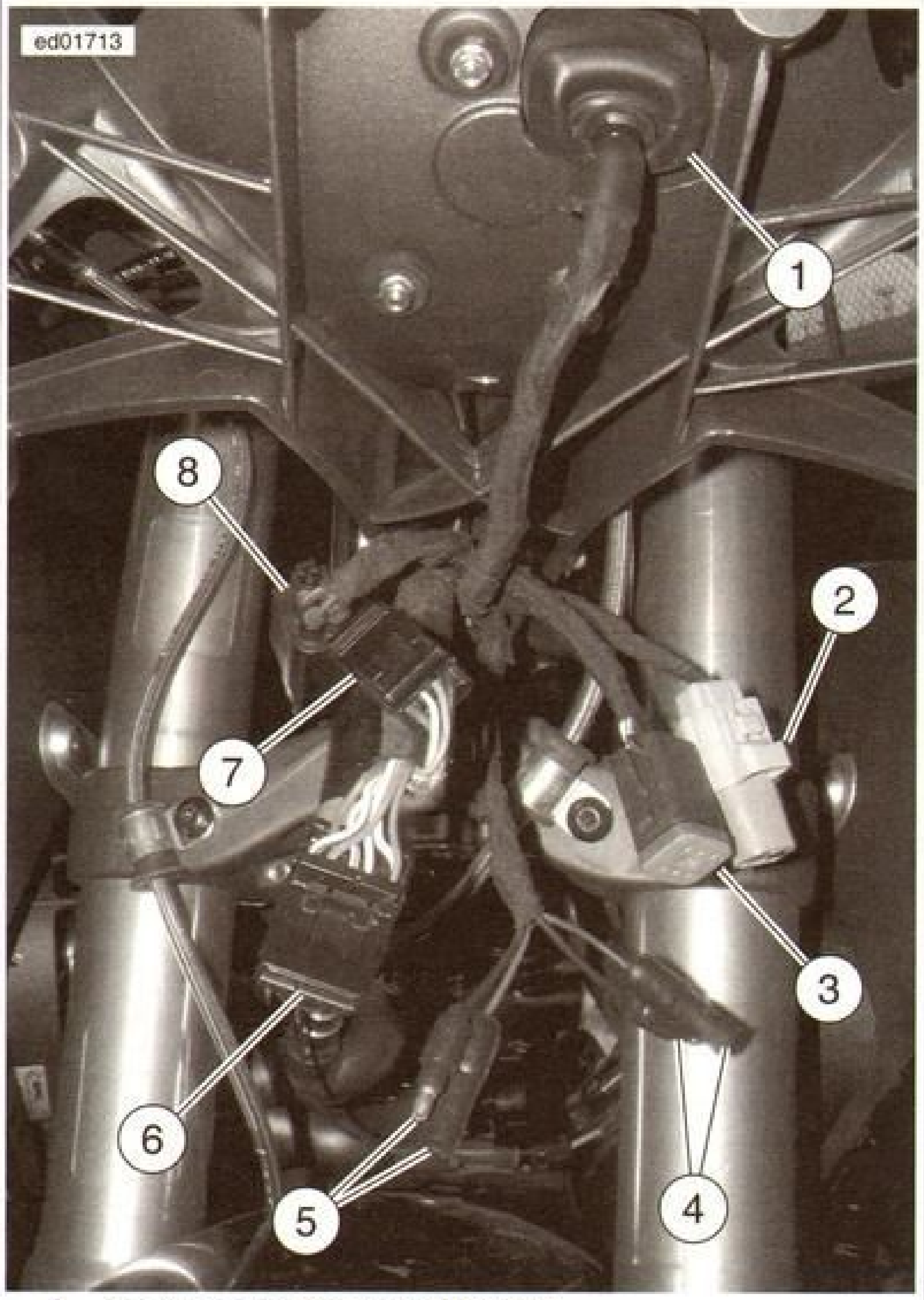
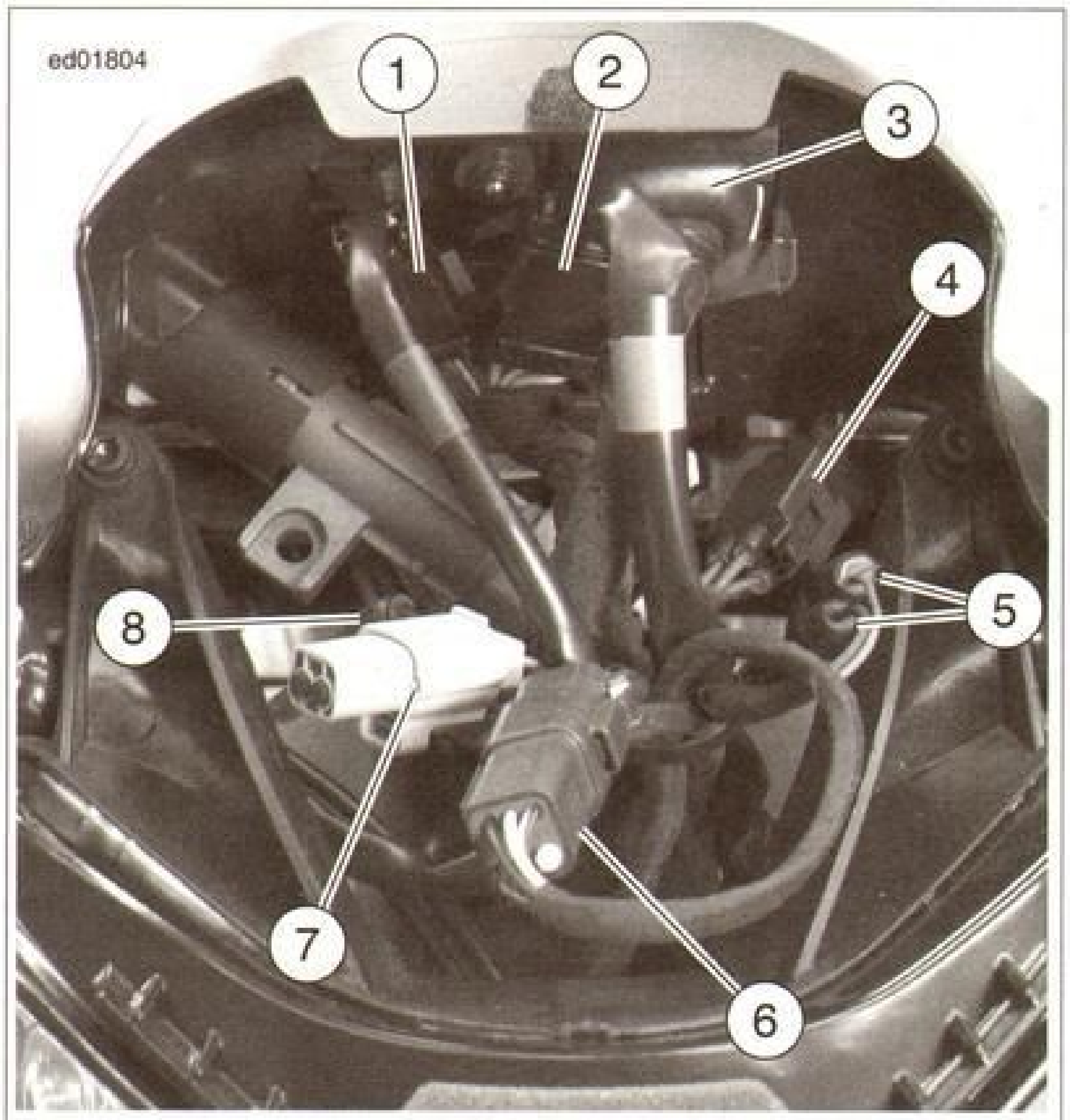
DESCRIPTION AND OPERATION

See Figure 5-9 or Figure 5-10. The lighting system includes the headlamps, turn signals, marker lamps, license plate lamp, tail, and brake lamps. The lights are powered by the accessory, brake/horn, and lights fuse. The accessory fuse circuit supplies power for the front marker lamps, the turn signal switch, the license plate lamp, and the tail lamp. The accessory circuit receives power when the ignition switch is in the ON or the PARK position. The headlamps each have an individual connection that runs through a sub-harness and is attached to the main harness through the headlamp connector [38].



1. Instrument Cluster (IC) [39]
2. 12 V auxiliary connector [160]
3. Headlamp [38]
4. Left front turn signal [31L]
5. Right front turn signal [31R]
6. Left hand controls [24]
7. Right hand controls [22]
8. Ignition switch [33]

Figure 5-9. Behind Fairing Connectors (1125R)



1. Right hand controls [22]
2. Left hand controls [24]
3. Instrument Cluster (IC) [39]
4. Ignition switch [33]
5. Left front turn signal [31L]
6. Headlamp [38]
7. 12V auxiliary connector [160]
8. Right front turn signal [31R]

Figure 5-10. Behind Fairing Connectors (1125CR)

COMPONENTS

Park Lighting

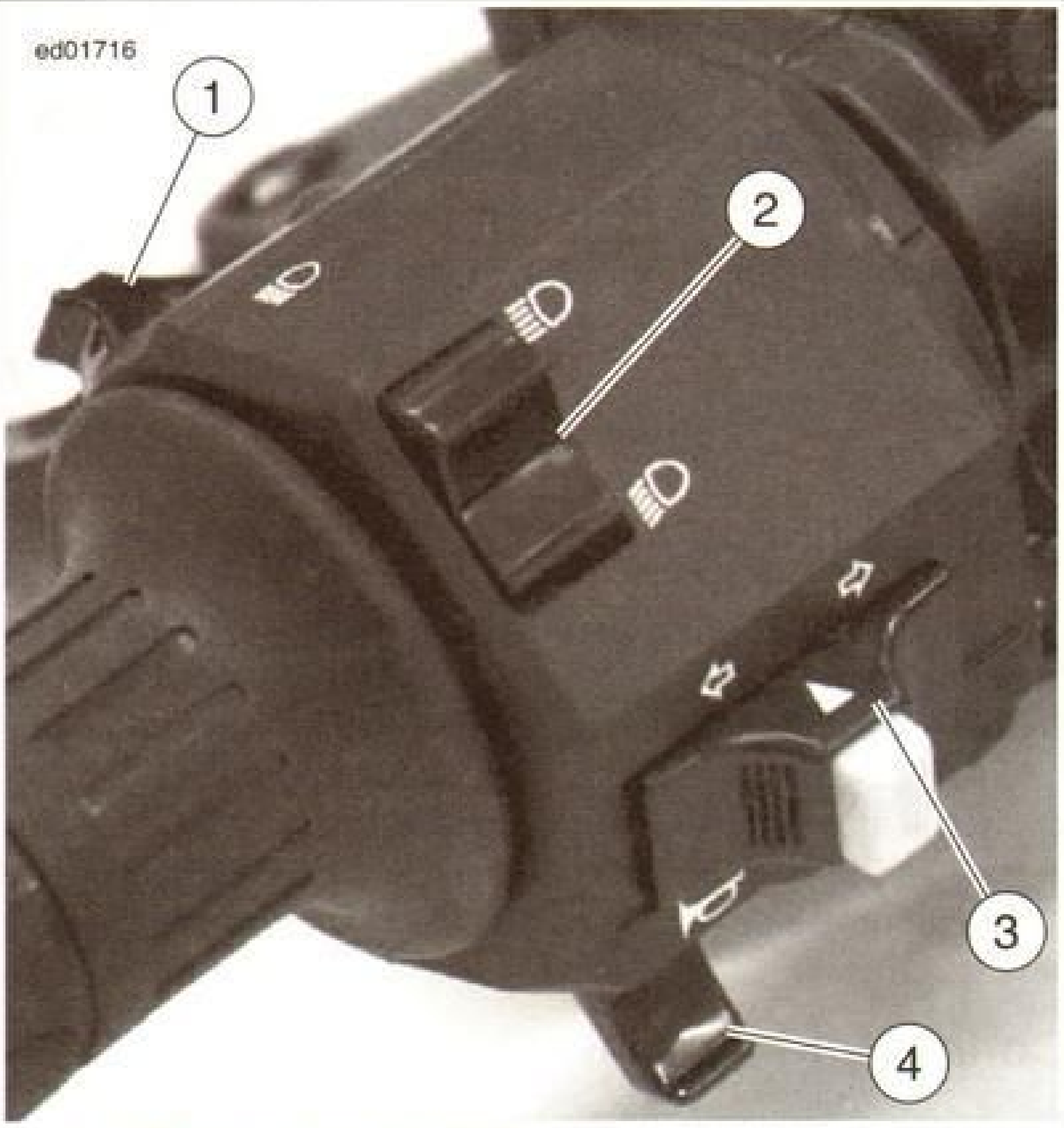
The park position allows the lamps to operate when the motorcycle is parked with the ignition and forks locked. In the park position, the power from the ignition switch is supplied to:

- front marker lamps
- turn signal switch
- IC
- tail lamps
- license plate lamp

The IC backlighting illuminates and the front marker lamps are on. The tail lamp and license plate lamp illuminate and the turn signals flash if the turn signal switch is operated.

Headlamp Switch

See Figure 5-11. The headlamp switch is located on the left handlebar controls. This switch is used to select either the high beam or the low beam headlamps.



1. **Flash-to-pass switch**
2. **Headlamp switch**
3. **Turn signal switch**
4. **Horn switch**

Figure 5-11. Left Handlebar Controls

Flash-to-Pass Switch

See Figure 5-11. The flash-to-pass switch is a momentary switch used to briefly flash the high beam headlamps.

Low Beam Headlamps

The two inner headlamps are the low beam headlamps. When the headlamp switch is in the low beam position, the low beam headlamps and the marker lamps are illuminated.

High Beam Headlamps

The two outer headlamps are the high beam headlamps. When the headlamp switch is in the high position, the high beam headlamps illuminate along with the low beam headlamps and the front marker lamps.

Marker Lamps

The two front marker lamps are located in the fairing on the outside edge of the two high beam headlamps. The license plate lamp and the tail lamp are also used as marker lamps. These lamps illuminate when the ignition is in the ON or PARK position.

Turn Signal Switch

See Figure 5-11. The turn signal switch is located on the left handlebar controls. The turn signal switch is an input to the IC. When the switch is pushed to the right, voltage is supplied through the (W/BN) wire at terminal 5 of the IC. When the turn signal switch is pushed to the left, voltage is supplied through the (W/V) wire at terminal 4 of the IC.

Turn Signals

The front turn signals are located on the housings of the rear-view mirrors. The rear turn signals are located at the sides of the rear fender. The turn signals use LEDs instead of conventional bulbs. The IC controls the turn signals. When the turn signal switch is pressed, voltage is sent to the IC. The IC then drives the turn signals for the appropriate side.

Tail/Stop Lamp

The tail/stop lamp illuminates with the ignition switch in the ON or PARK position. When either the front or rear stop lamp switches are applied, the second filament in the bulb illuminates to light the brake lamp. The tail lamp portion of the lamp is powered by the accessory fuse through the (O/W) wire. The stop lamp portion of the lamp receives power through the (R/Y) wire when either one of the stop lamp switches are applied.

License Plate Lamp

The accessory fuse supplies power to the license plate lamp on the (O/W) wire. The license plate lamp illuminates when the ignition is in the ON or PARK position.

Stop Lamp Switches

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. When the front stop lamp lever is applied, the lever presses a mechanical switch, and closes the contacts on the switch. The rear stop lamp switch is a pressure switch. When the rear stop lamp switch is applied, it generates pressure in the brake fluid. This pressure in the fluid causes the contacts for the rear stop lamp switch to close.

The brake/horn fuse supplies power to the stop lamp switches through the (O) wire. When the front stop lamp switch closes (front brake lever pulled in), power flows through the switch to the tail/stop lamp through the (R/Y) wire. When the rear stop lamp switch is applied (rear brake pedal pressed), power flows through the switch to the tail/stop lamp.

SYMPTOMS

The lighting circuit does not set DTCs when there is a malfunction. Instead, symptoms and common causes are described in Table 5-4.

Table 5-4. Lighting Symptom Table

SYMPTOM	COMMON CAUSE
Headlamps Inoperative	Burned out lamp, open fuse, open power or ground circuits, poor connection at connector [38]
Turn Signals Inoperative	Inoperative relay, inoperative switch, malfunctioning IC, open fuse, open in turn signal circuits
Tail Lamp Inoperative	Burned out lamp, open circuits, open fuse

Table 5-4. Lighting Symptom Table

SYMPTOM	COMMON CAUSE
Stop Lamp Inoperative	Inoperative brake switch, open fuse, open wires
Marker Lamps Inoperative	Burned out lamp, open fuse, open in marker lamp circuits, poor connection at the headlamp connector [38]

HEADLAMPS

See Figure 5-12. The headlamps receive power through the lights fuse and the start relay. The headlamps turn on when the ignition switch is turned on. The start relay energizes and turns off the power to the headlamps when the start switch closes. This allows full battery power to the starter without the drain of the headlamps on the system.

The headlamp switch turns the high beam headlamps on and off. The low beam headlamps and front marker lamps are illuminated in the high or low beam setting. The flash-to-pass switch is a momentary switch that flashes the high beam headlamps as long as the switch is pressed.

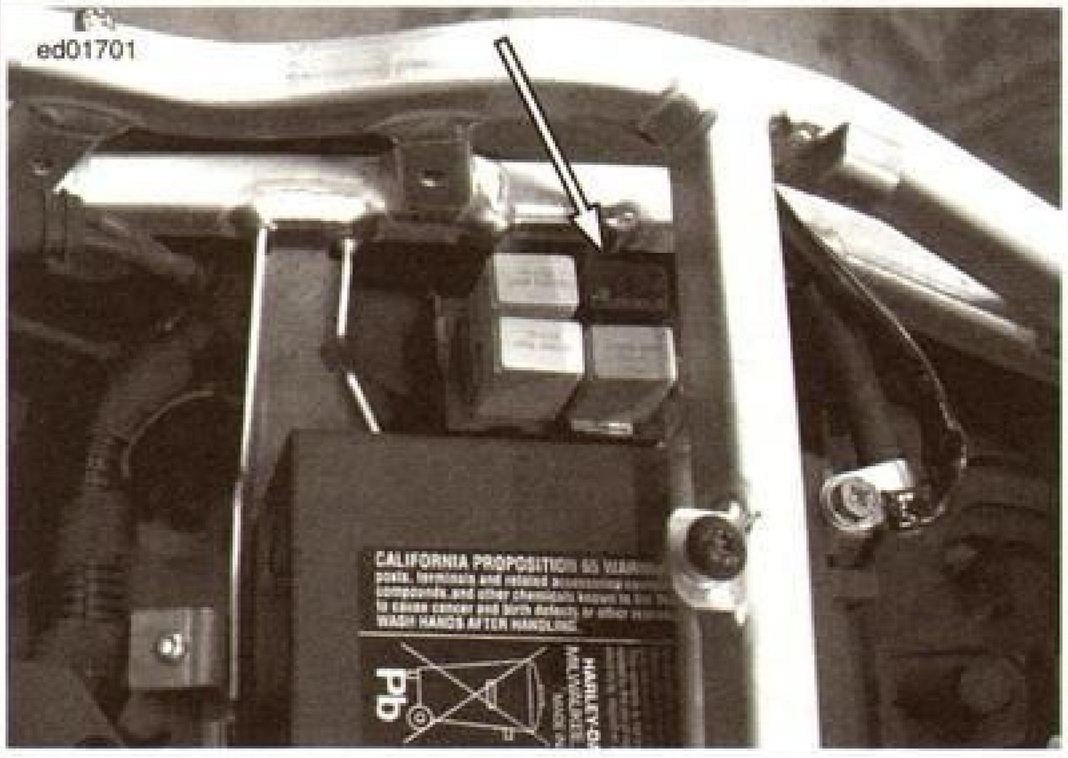


Figure 5-12. Start Relay

Diagnostic Tips

If the lights fuse is open, test for short to ground on (BE) wire from the fuse to the headlamp and flash-to-pass switches. Also, check for a short to ground on the (W) wire from the headlamp and flash-to-pass switches. If this circuit is grounded, it only opens the fuse when the headlamp switch is in the high position or the flash-to-pass switch is pressed. If a headlamp and front marker lamp are out on the same side, test the shared ground wire to that side.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

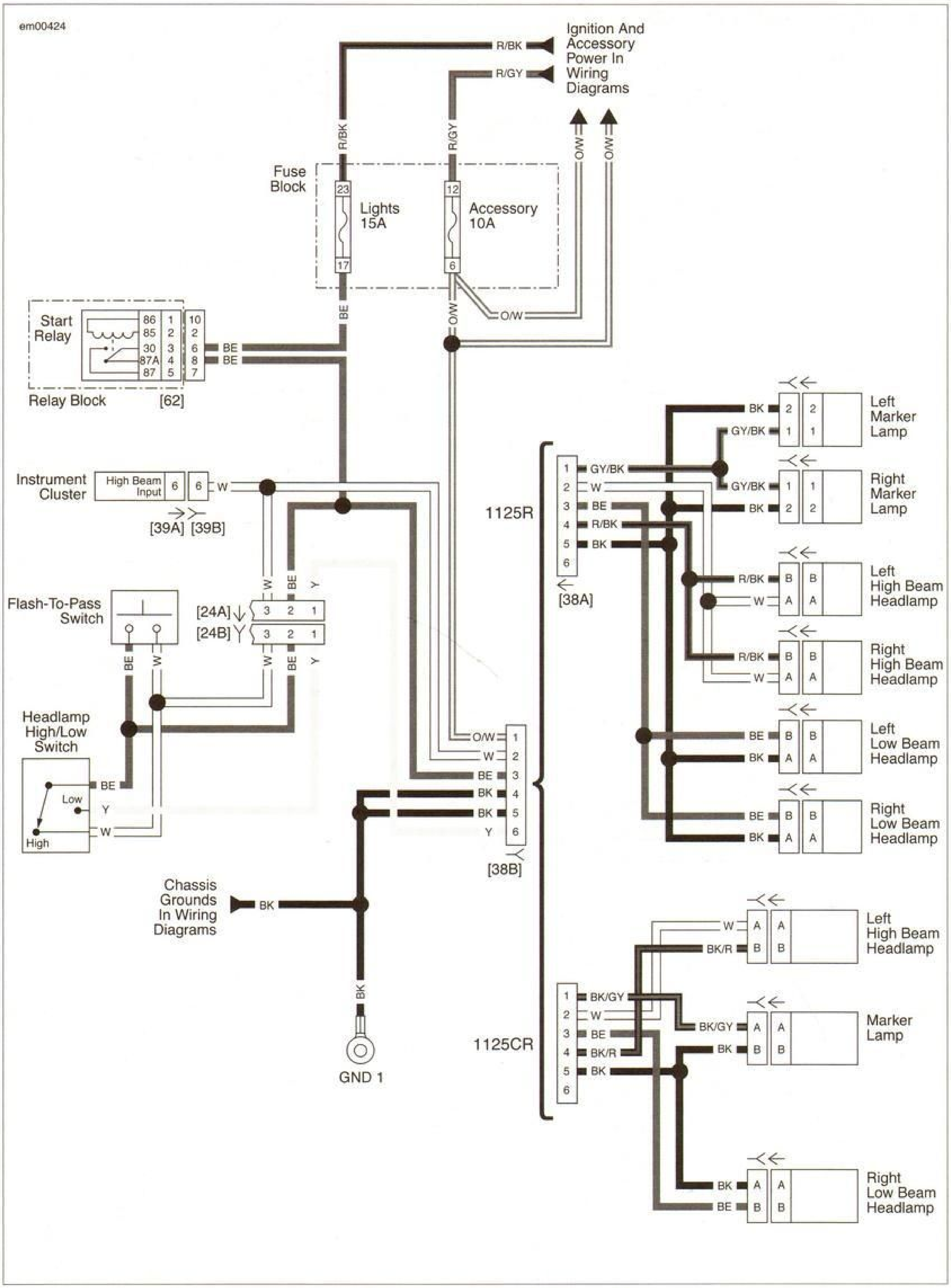
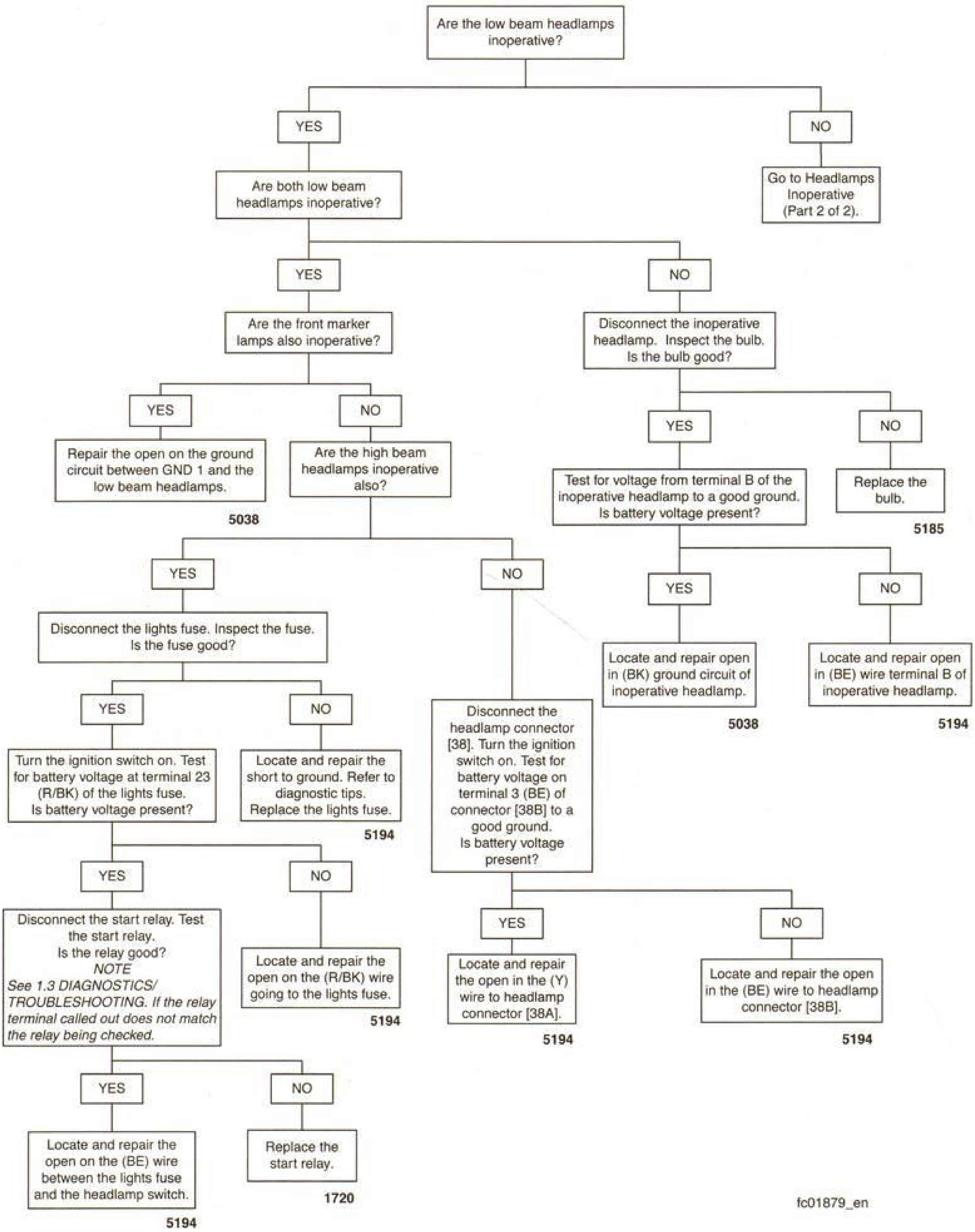
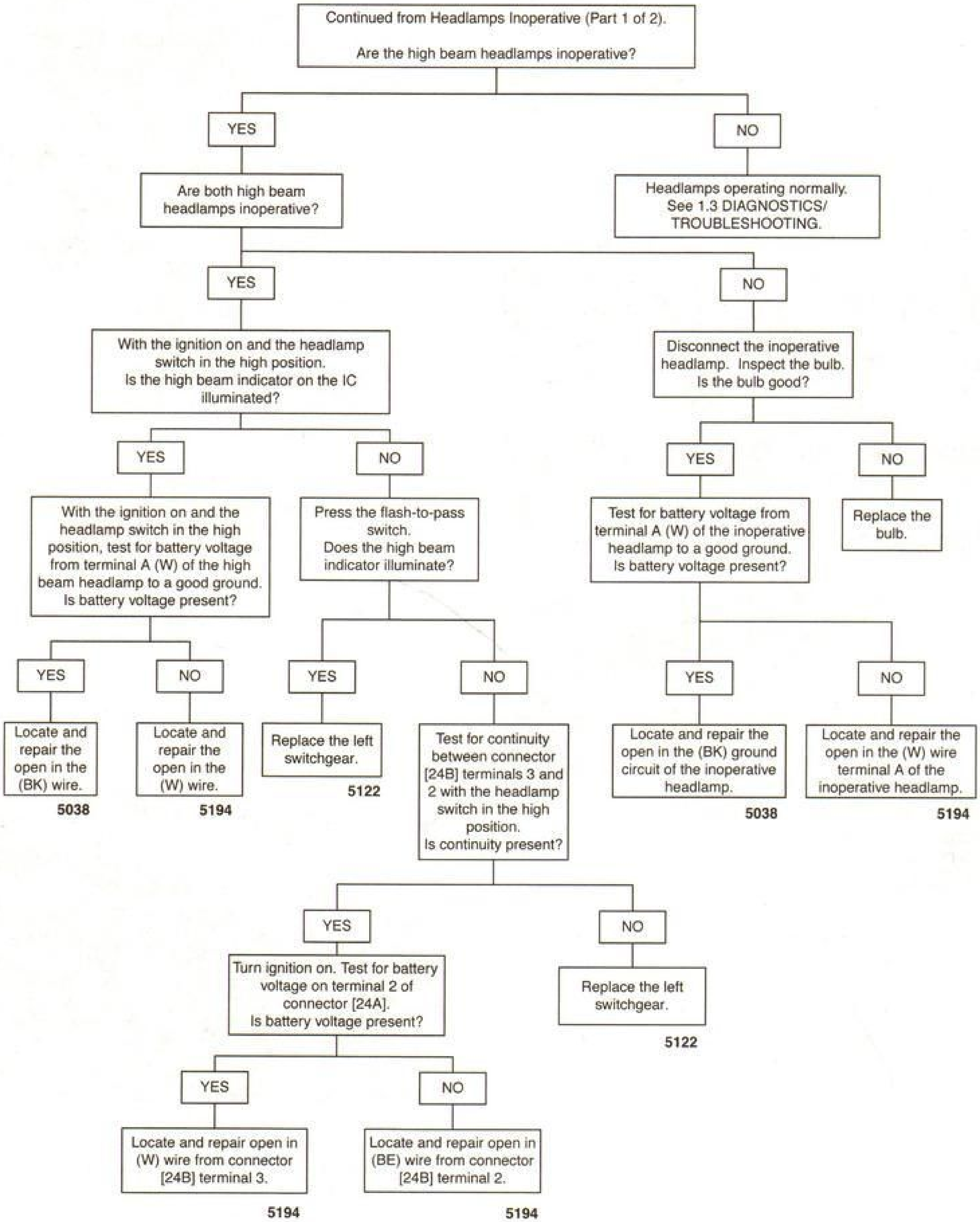


Figure 5-13. Headlamp and Marker Lamps

Headlamps Inoperative (Part 1 of 2)



Headlamps Inoperative (Part 2 of 2)



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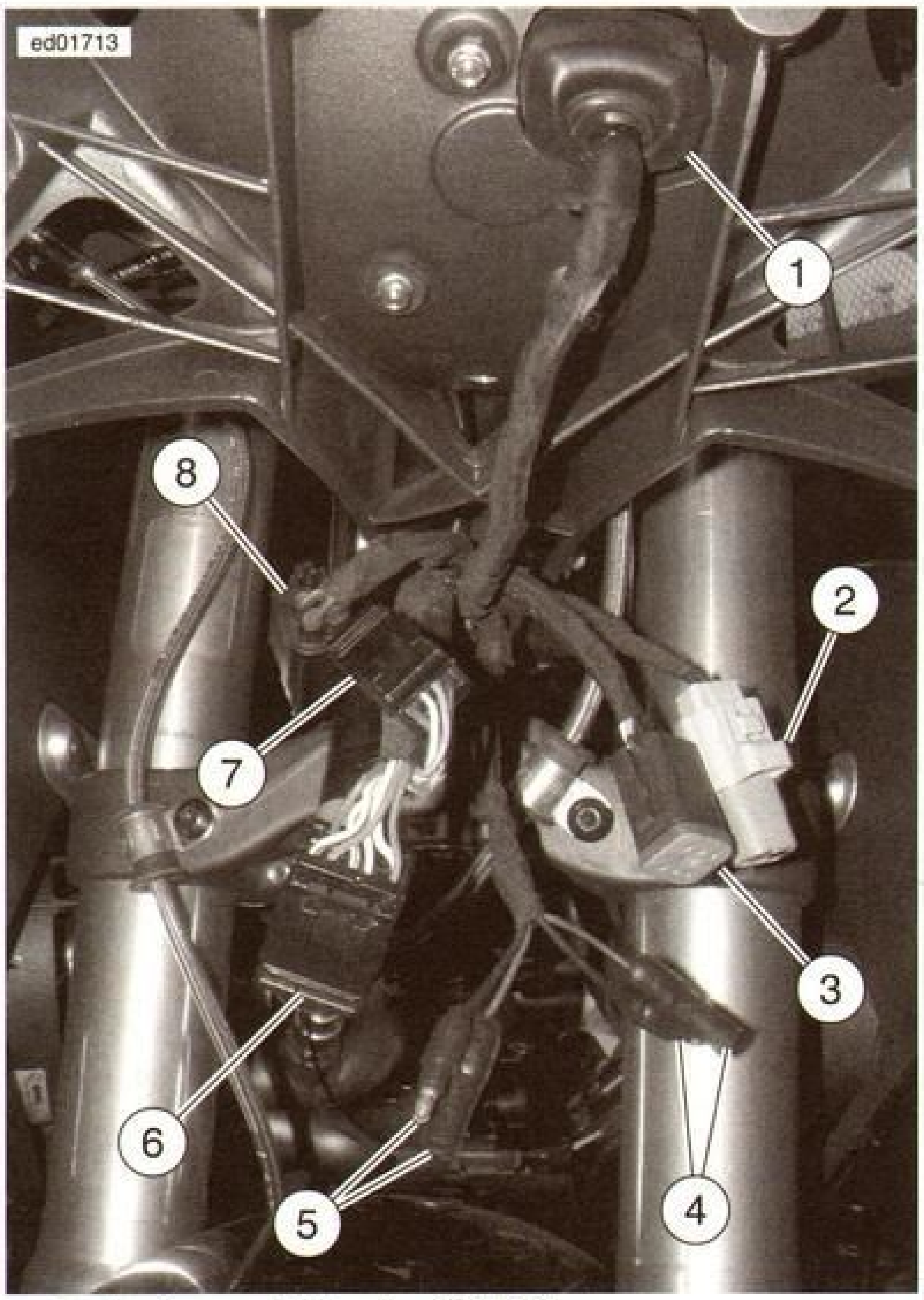
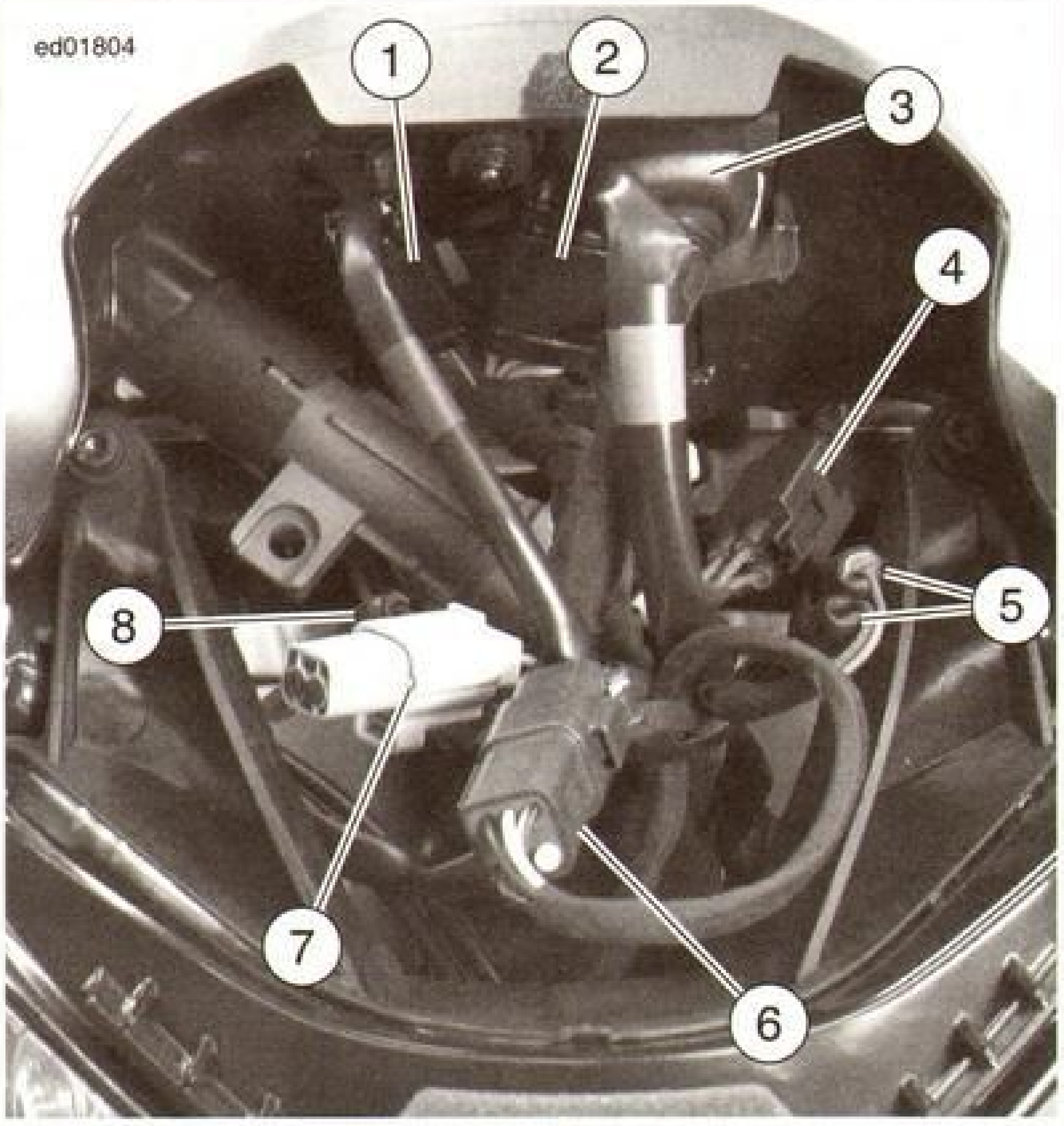
TURN SIGNALS

See Figure 5-14 or Figure 5-15 and Figure 5-16. The turn signals are controlled by the IC. When the turn signal switch is pushed to the left or right, voltage is sent to the IC on either the right input or the left input. The IC then sends voltage to the corresponding turn signal and controls the flash rate of the turn signals.



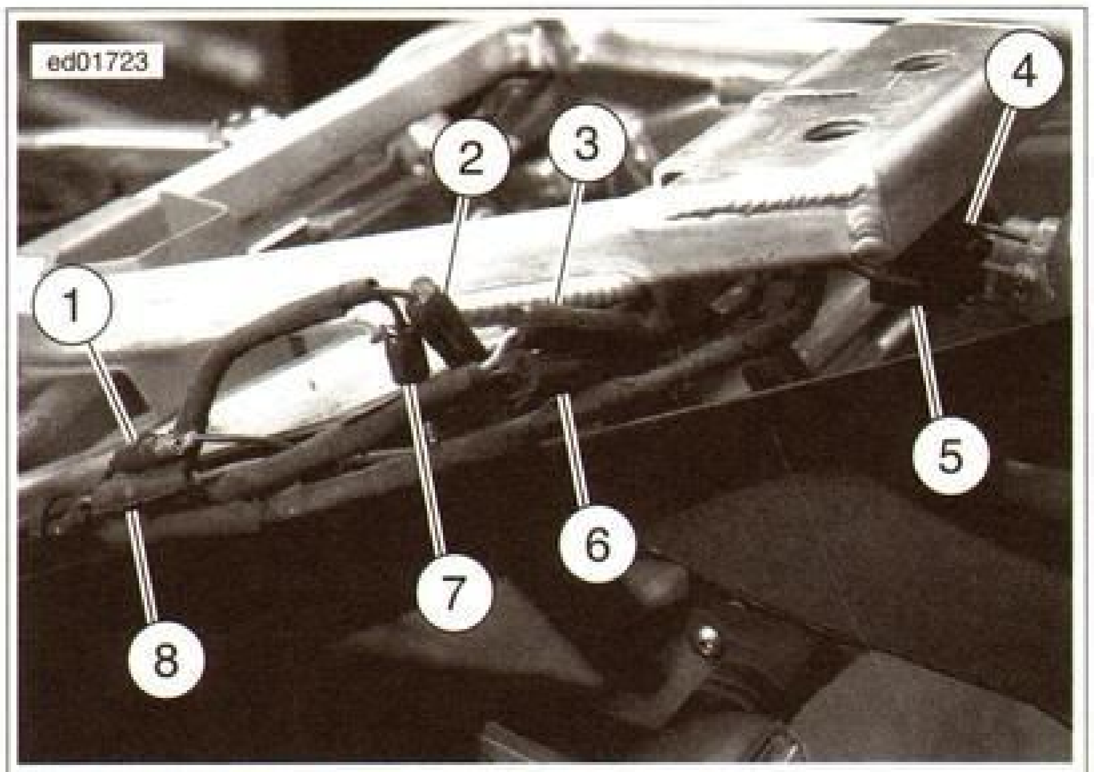
1. Instrument Cluster (IC) [39]
2. 12 V auxiliary connector [160]
3. Headlamp [38]
4. Left front turn signal [31L]
5. Right front turn signal [31R]
6. Left hand controls [24]
7. Right hand controls [22]
8. Ignition switch [33]

Figure 5-14. Behind Fairing Connectors (1125R)



1. Right hand controls [22]
2. Left hand controls [24]
3. Instrument Cluster (IC) [39]
4. Ignition switch [33]
5. Left front turn signal [31L]
6. Headlamp [38]
7. 12V auxiliary connector [160]
8. Right front turn signal [31R]

Figure 5-15. Behind Fairing Connectors (1125CR)



1. Left rear turn signal [19] (GND)
2. Right rear turn signal [18] (Power)
3. License plate lamp [45] (Power)
4. Tail/stop lamp [93] (Power)
5. Tail/stop lamp [93] (GND)
6. License plate lamp [45] (GND)
7. Right rear turn signal [18] (GND)
8. Left rear turn signal [19] (Power)

Figure 5-16. Rear Lamp Connectors

Diagnostic Tips

When testing voltage for LED turn signals, be sure to use a voltmeter. The current used to operate LEDs may not be sufficient to light a test lamp and may cause false diagnostics.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

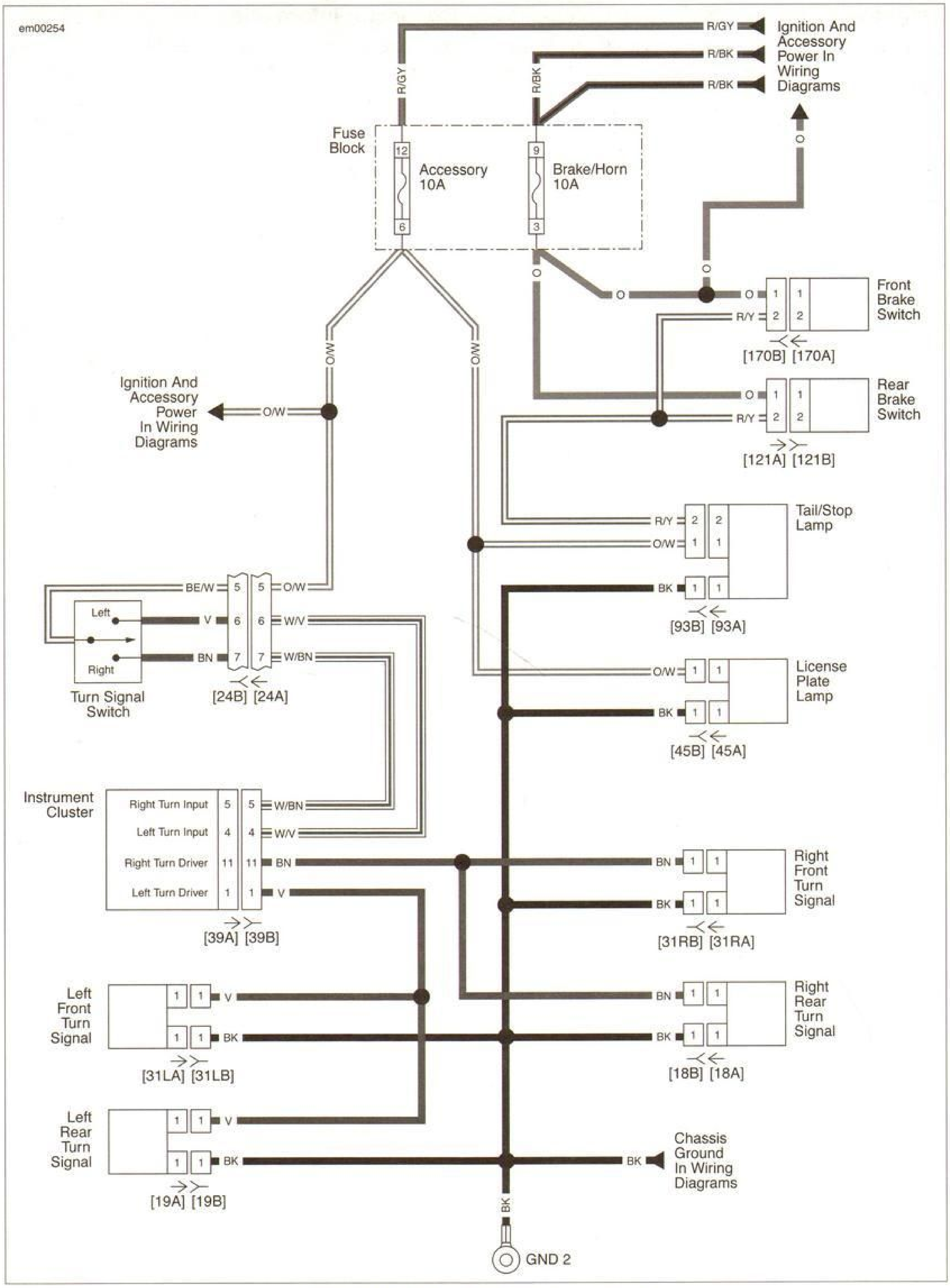
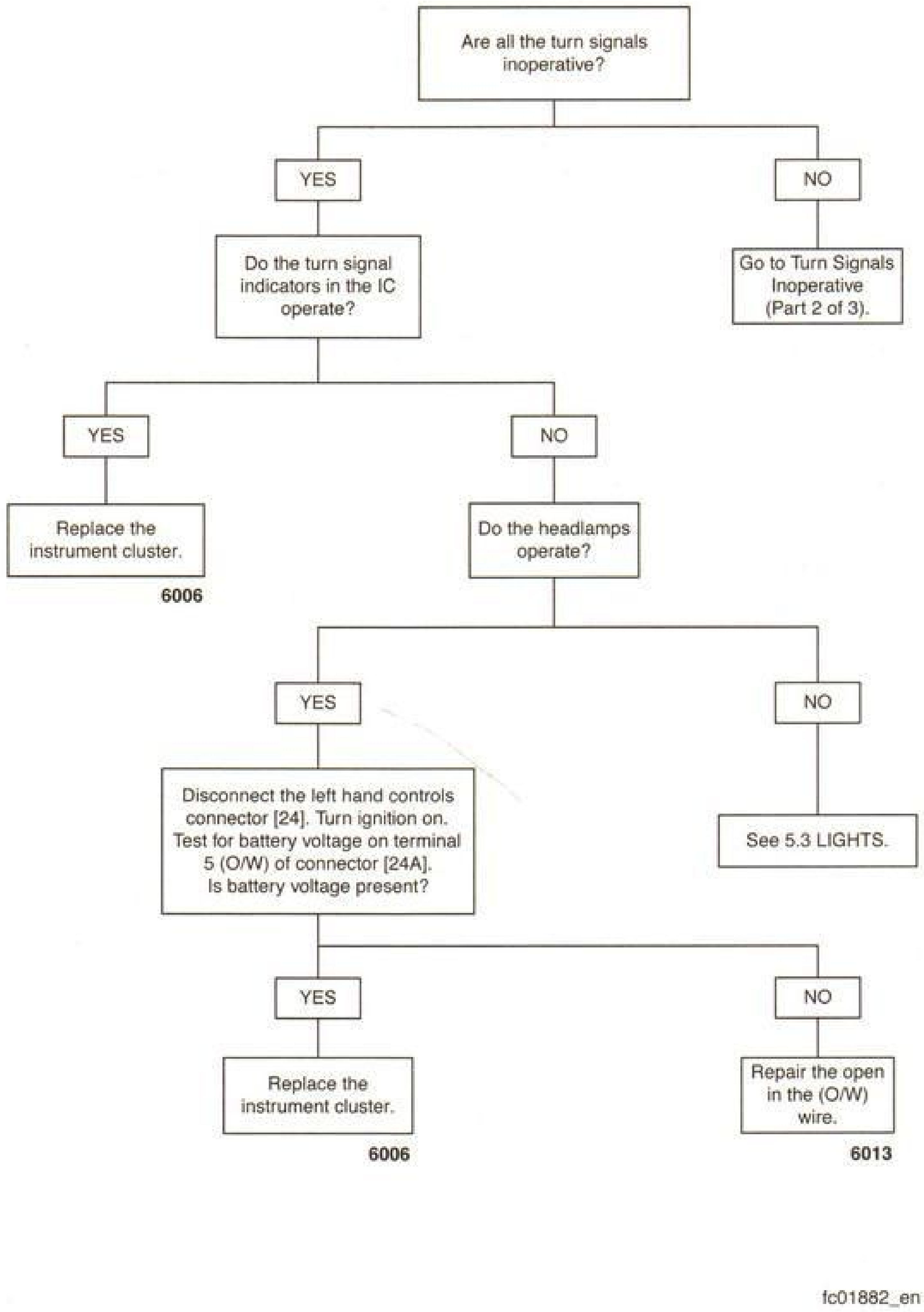
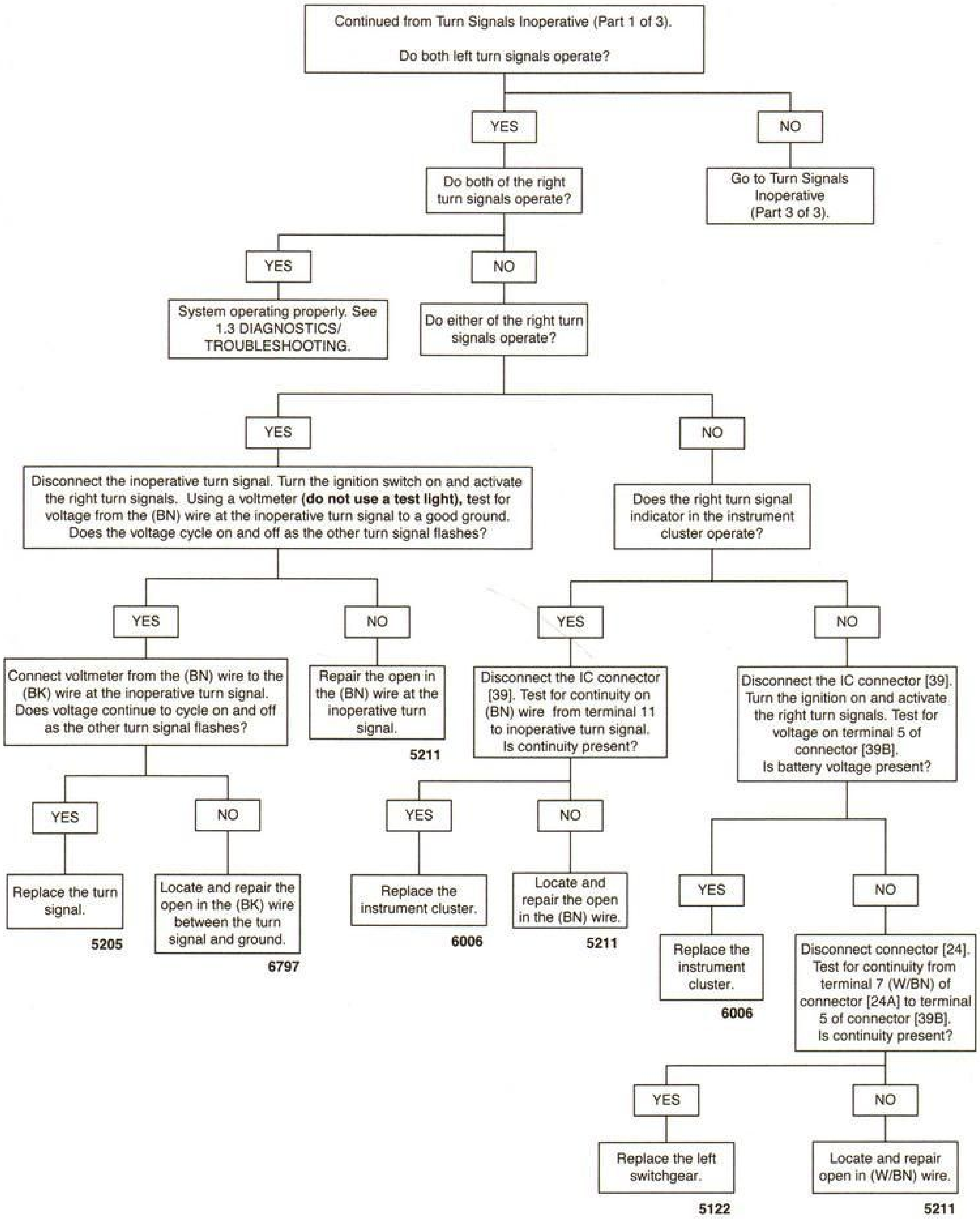


Figure 5-17. Tail/Stop and Turn Signal Lamps

Turn Signals Inoperative (Part 1 of 3)



Turn Signals Inoperative (Part 2 of 3)



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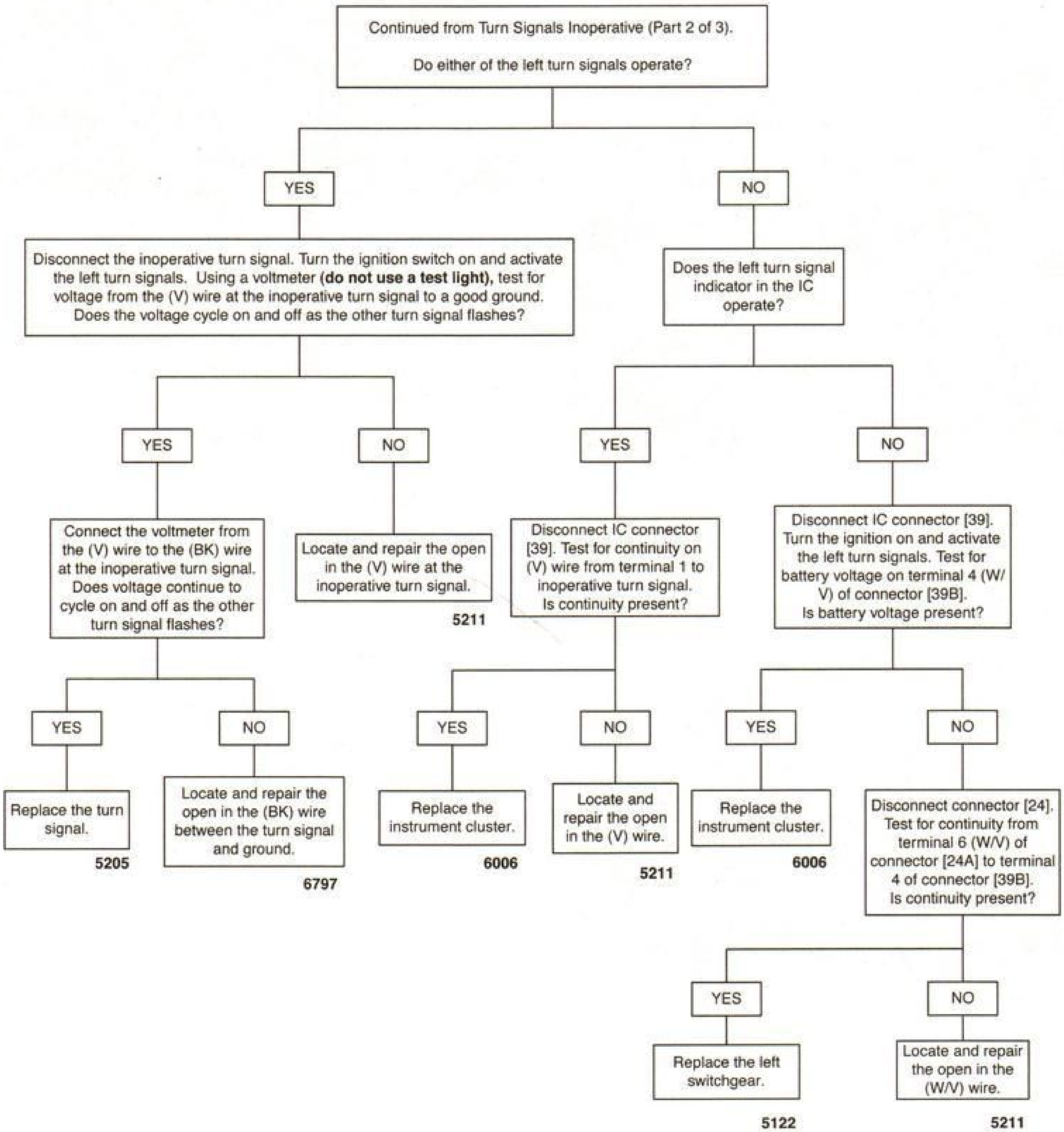
Turn Signals Inoperative (Part 3 of 3)



fc01884_en

STOP LAMPS

See Figure 5-18. The front brake switch is a mechanical switch located under the fluid reservoir on the right handlebar. See Figure 5-19. The rear brake switch is a pressure switch located on the right side to the rear of the footpeg.

See Figure 5-20. The brake switches receive power through the brake/horn fuse. When the front or rear brake switch is applied, voltage travels through the switch to the tail/stop lamp.

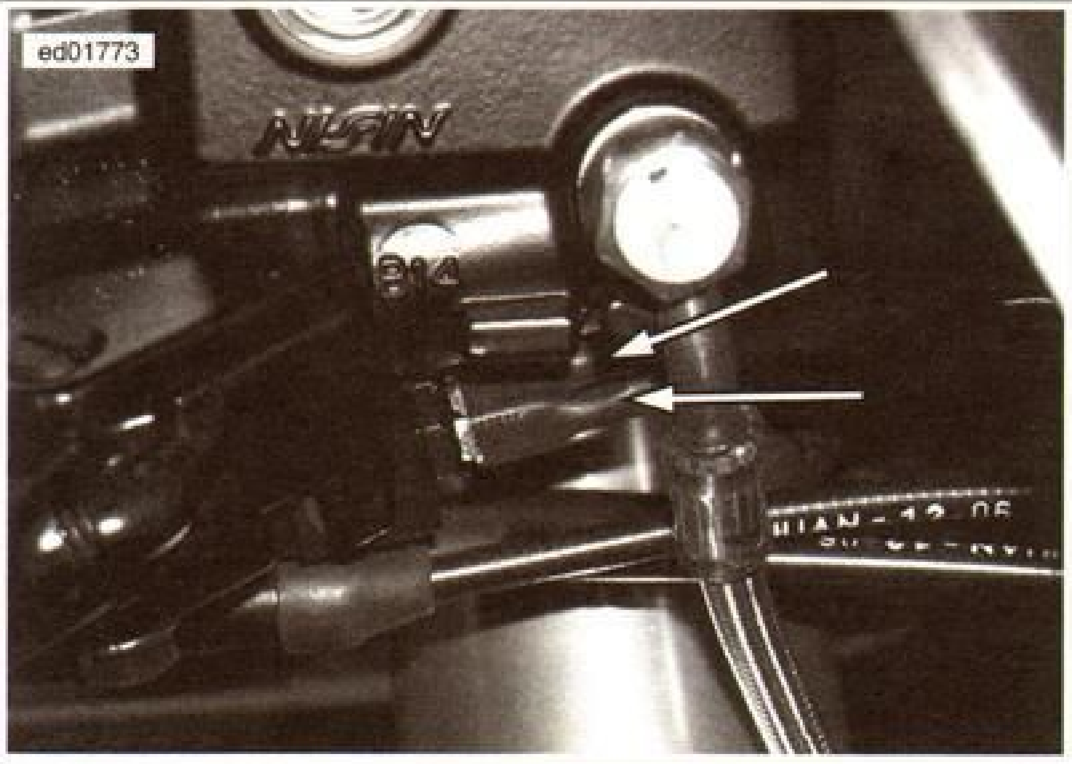
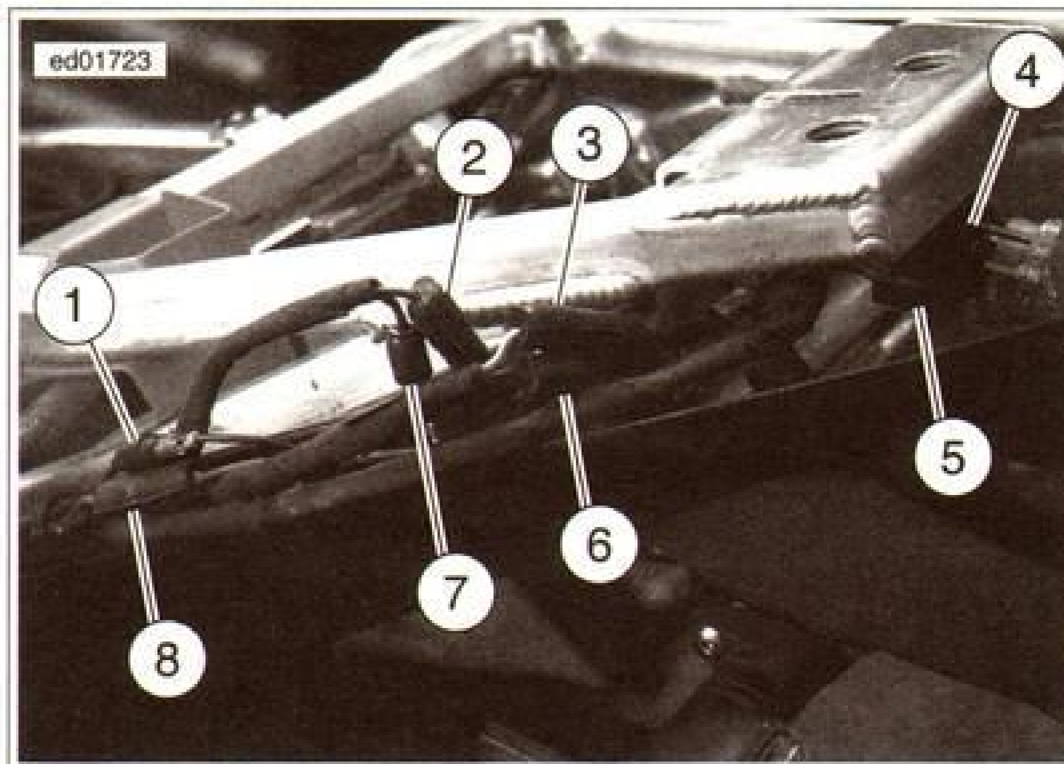


Figure 5-18. Front Brake Switch Connectors [170]

Figure 5-19. Rear Brake Switch Connector [121]



1. **Left rear turn signal [19] (GND)**
2. **Right rear turn signal [18] (Power)**
3. **License plate lamp [45] (Power)**
4. **Tail/stop lamp [93] (Power)**
5. **Tail/stop lamp [93] (GND)**
6. **License plate lamp [45] (GND)**
7. **Right rear turn signal [18] (GND)**
8. **Left rear turn signal [19] (Power)**

Figure 5-20. Rear Lamp Connectors

Diagnostic Tips

When testing for a short to ground due to an open fuse, check the (R/Y) 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. A short to ground in the (Y/BK) wire between the horn switch and the horn causes this fuse to open when the horn switch is pressed and needs to be checked for a short to ground as well.

Connector Locations

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

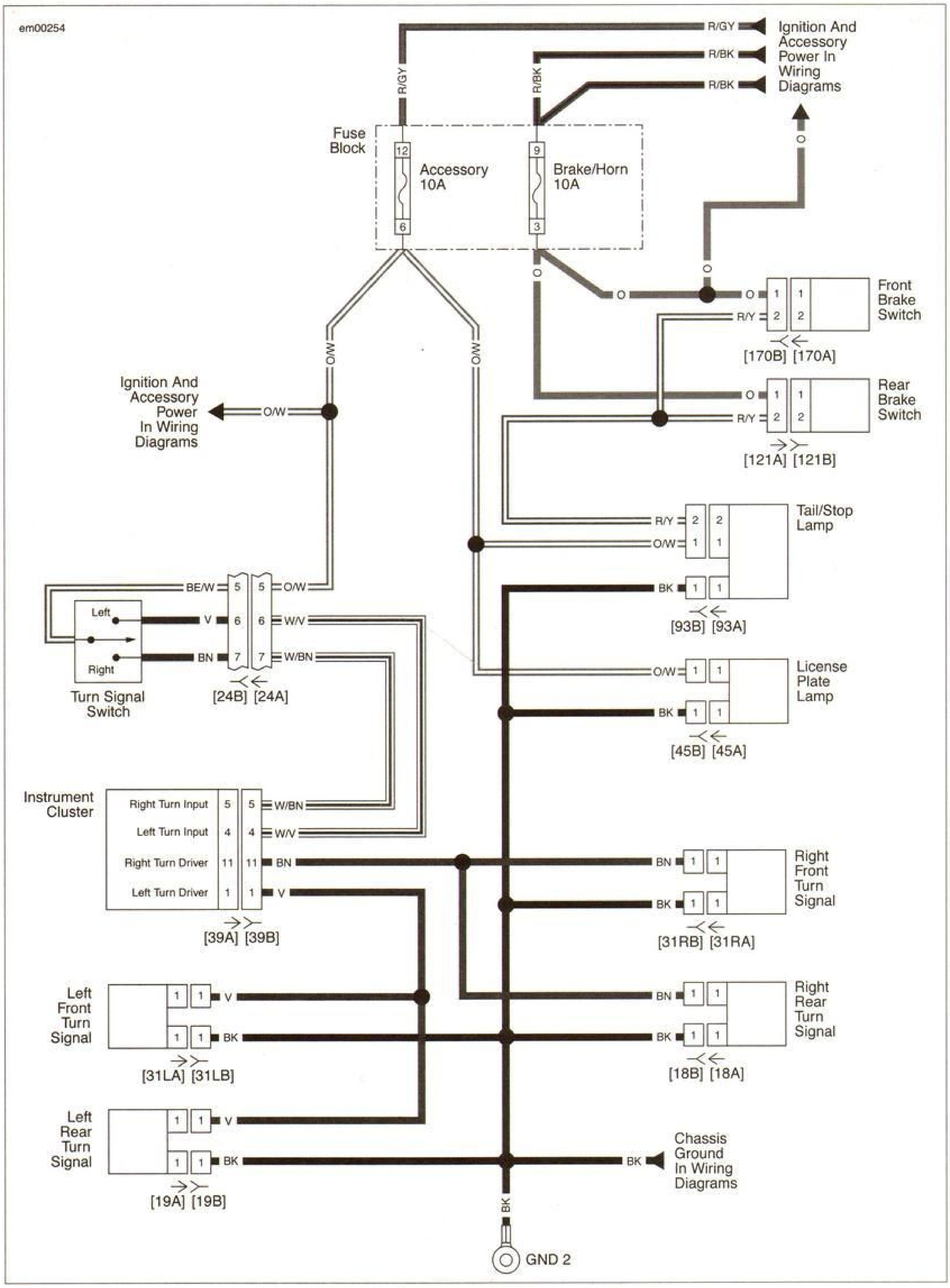
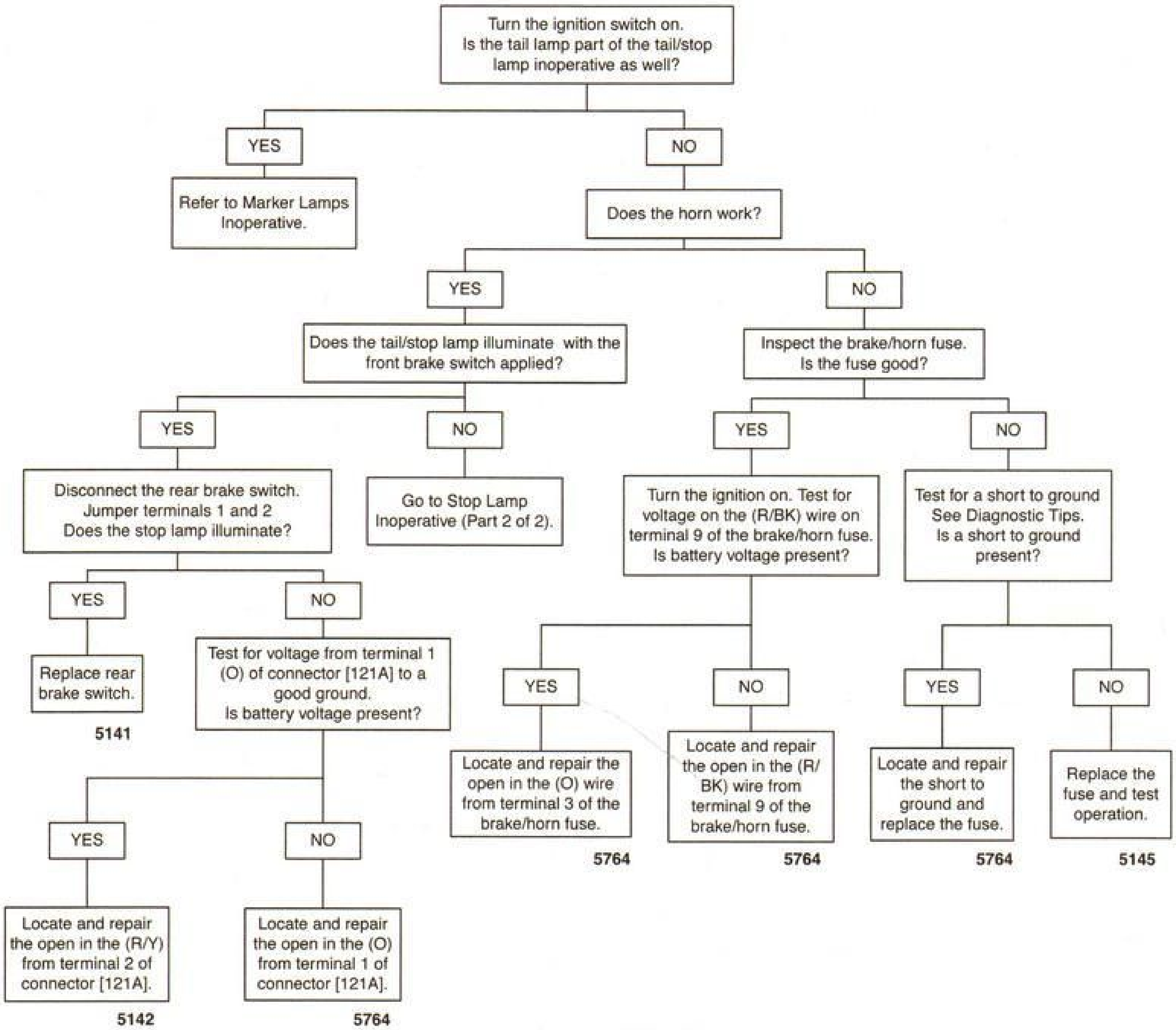


Figure 5-21. Tail/Stop and Turn Signal Lamps

Stop Lamp Inoperative (Part 1 of 2)



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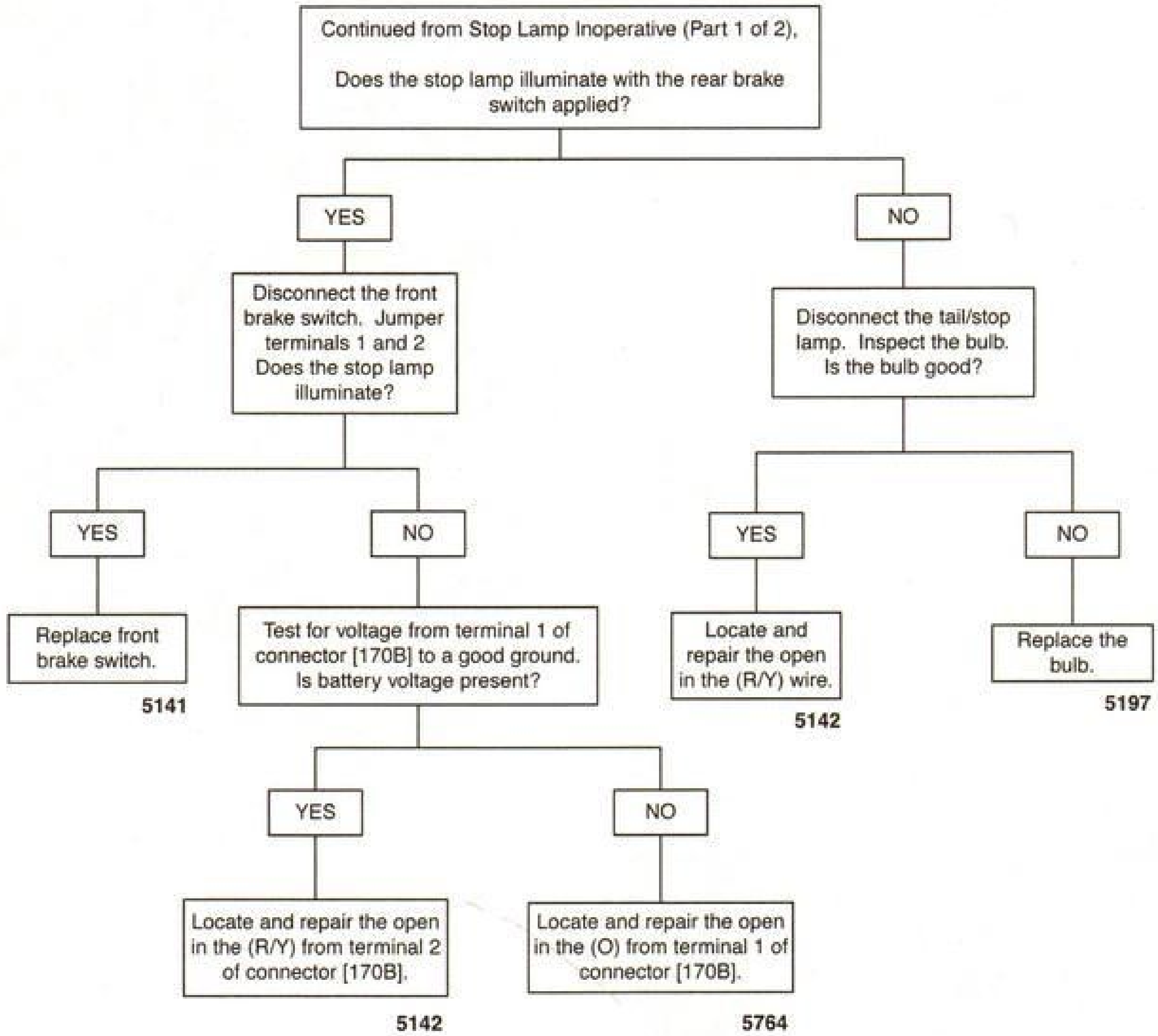
Stop Lamp Inoperative (Part 2 of 2)



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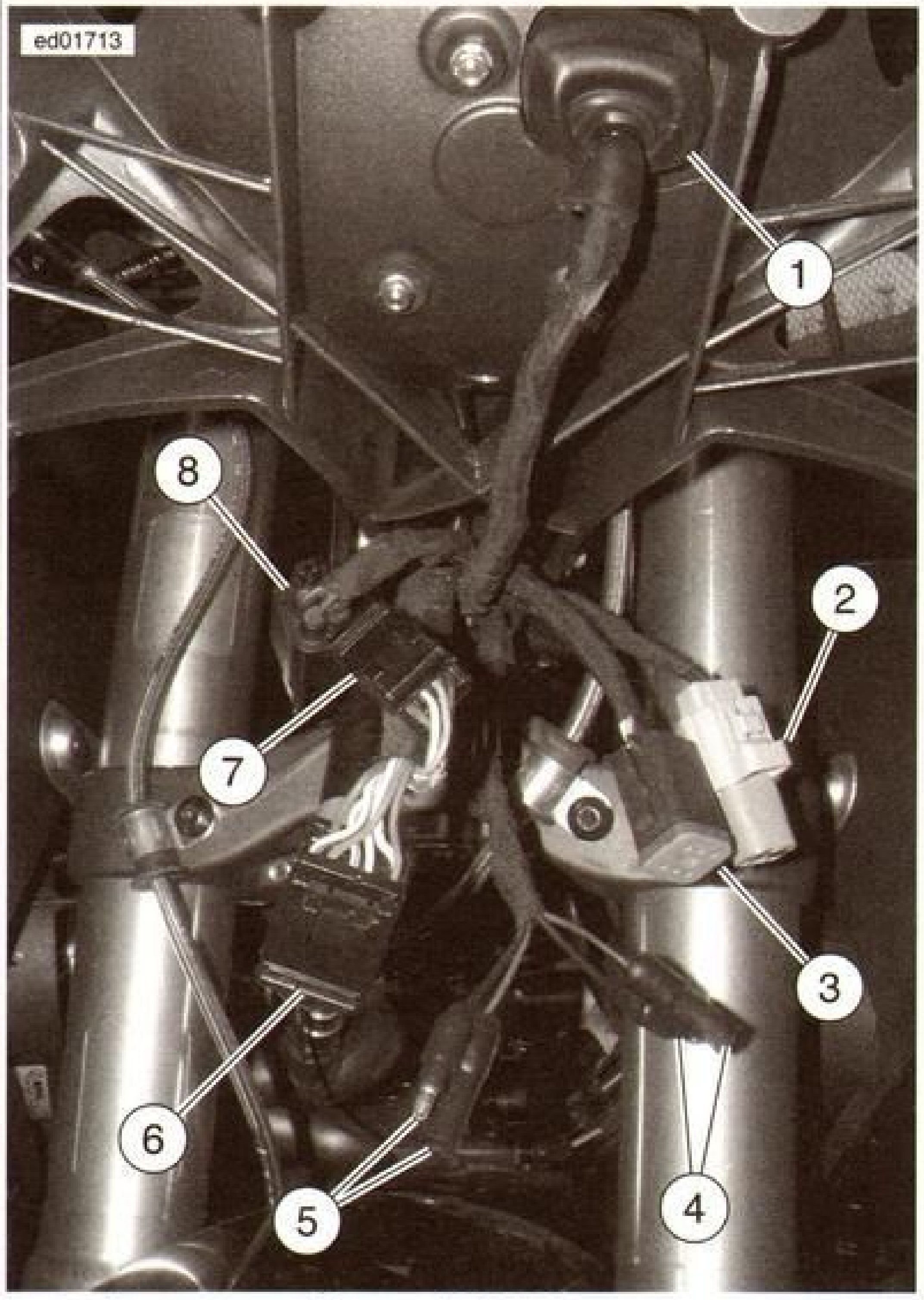
MARKER LAMPS

See Figure 5-22 or Figure 5-23. The headlamp connector is located behind the front fairing. See Figure 5-24. The rear tail/stop lamp and license plate lamp connectors are bullet style connectors located under the passenger seat in the tail section.

The marker lamps consist of the front markers lamps, located on the outside edges of the headlamps, the license plate lamp, and the tail lamp. The marker lamps are powered through the accessory fuse when the ignition switch is in the ON or PARK position.

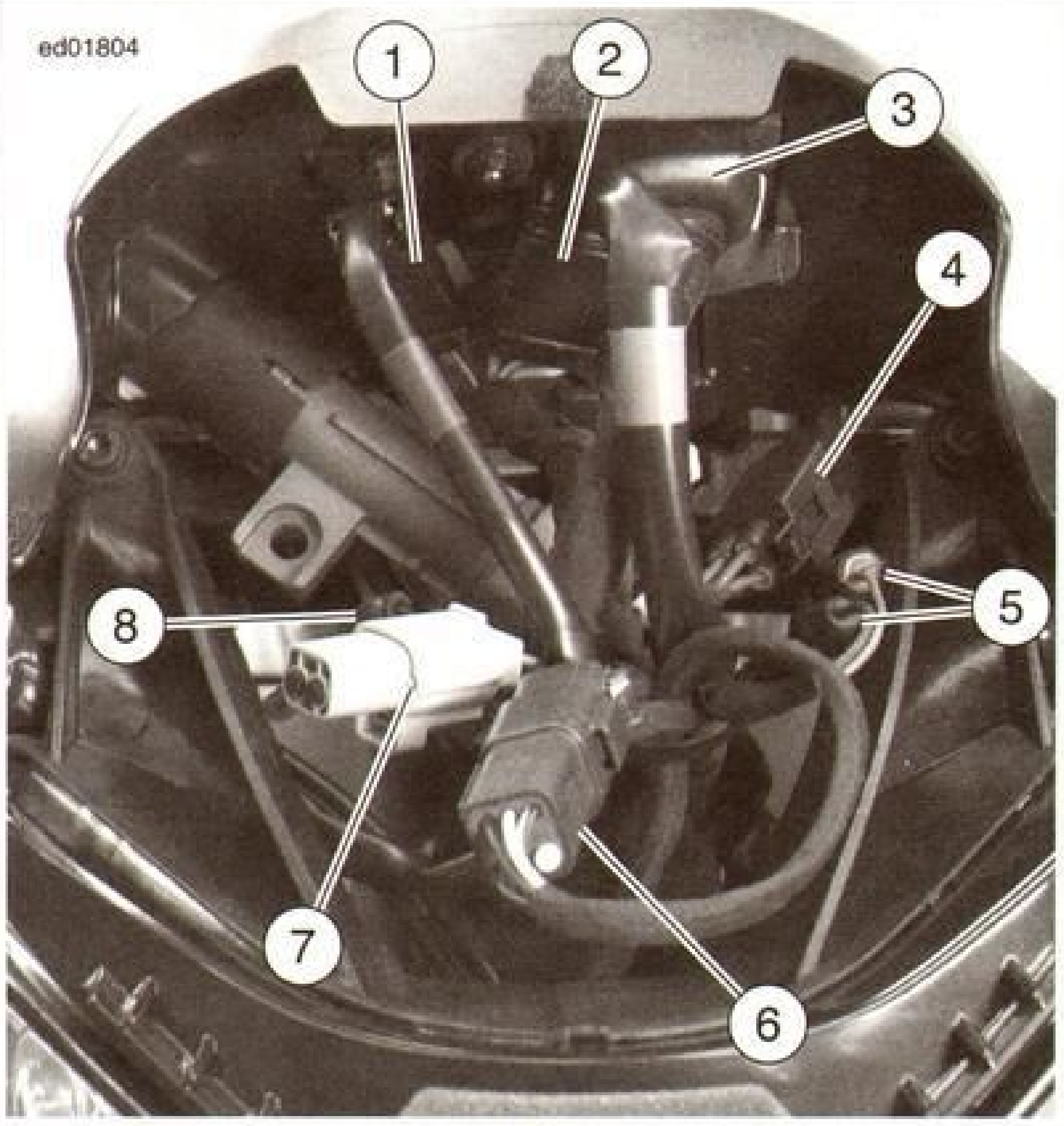
Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.



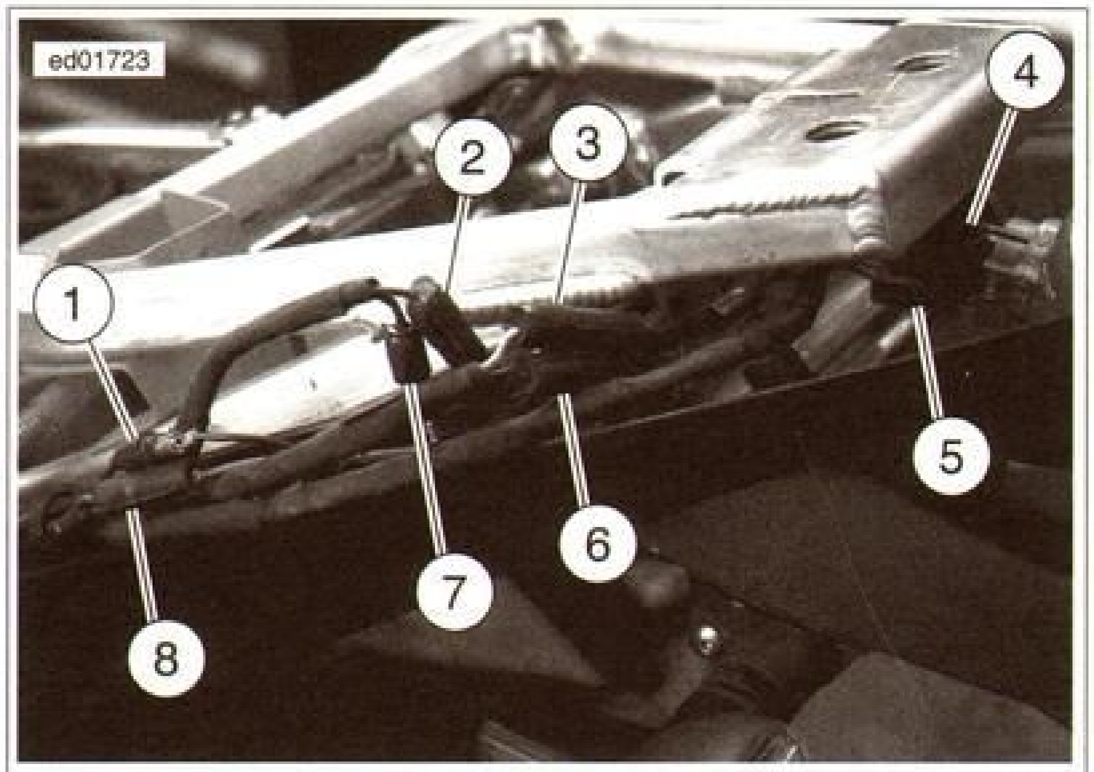
1. Instrument Cluster (IC) [39]
2. 12 V auxiliary connector [160]
3. Headlamp [38]
4. Left front turn signal [31L]
5. Right front turn signal [31R]
6. Left hand controls [24]
7. Right hand controls [22]
8. Ignition switch [33]

Figure 5-22. Behind Fairing Connectors (1125R)



1. Right hand controls [22]
2. Left hand controls [24]
3. Instrument Cluster (IC) [39]
4. Ignition switch [33]
5. Left front turn signal [31L]
6. Headlamp [38]
7. 12V auxiliary connector [160]
8. Right front turn signal [31R]

Figure 5-23. Behind Fairing Connectors (1125CR)



1. Left rear turn signal [19] (GND)
2. Right rear turn signal [18] (Power)
3. License plate lamp [45] (Power)
4. Tail/stop lamp [93] (Power)
5. Tail/stop lamp [93] (GND)
6. License plate lamp [45] (GND)
7. Right rear turn signal [18] (GND)
8. Left rear turn signal [19] (Power)

Figure 5-24. Rear Lamp Connectors

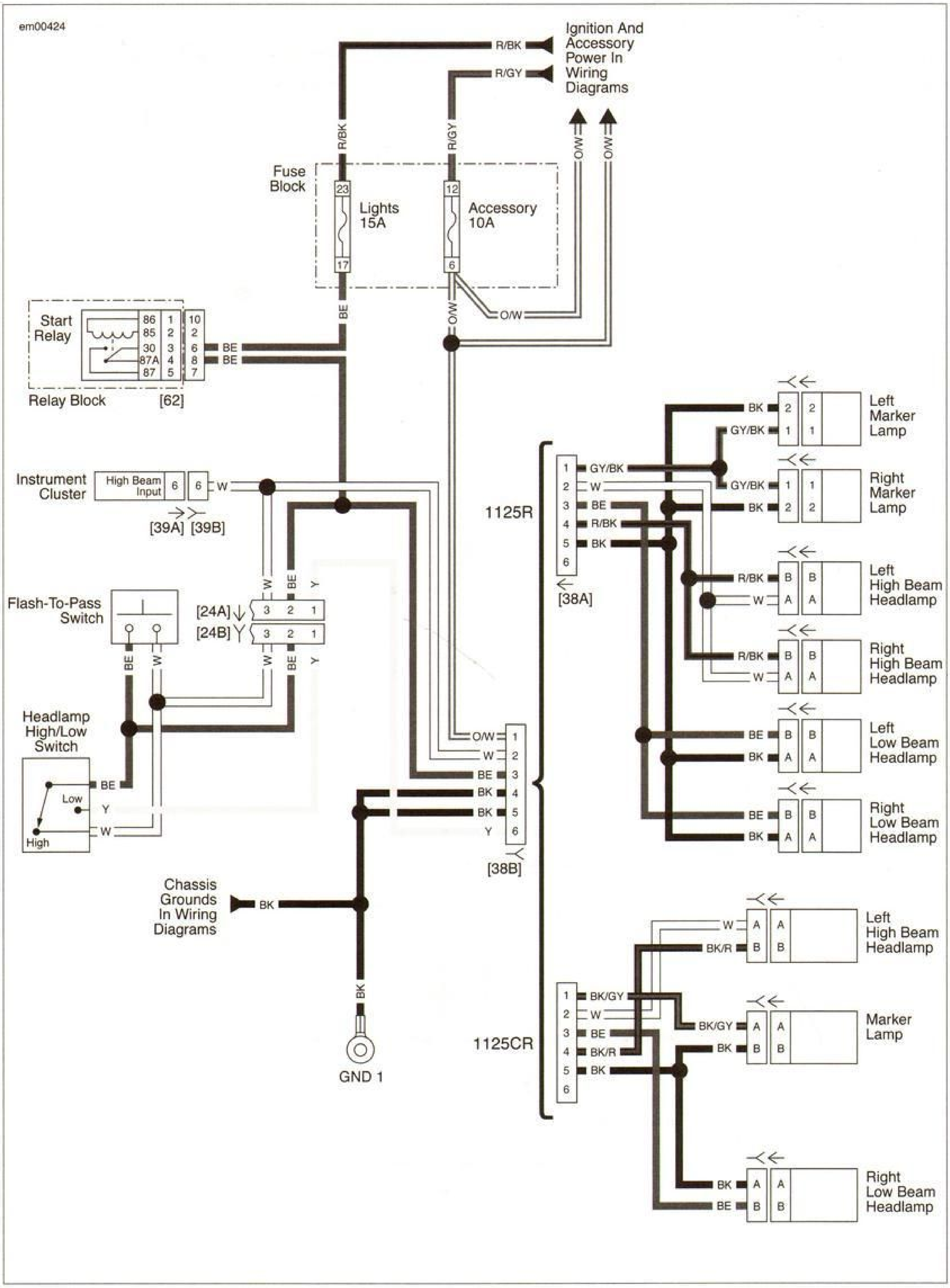


Figure 5-25. Headlamp and Marker Lamps

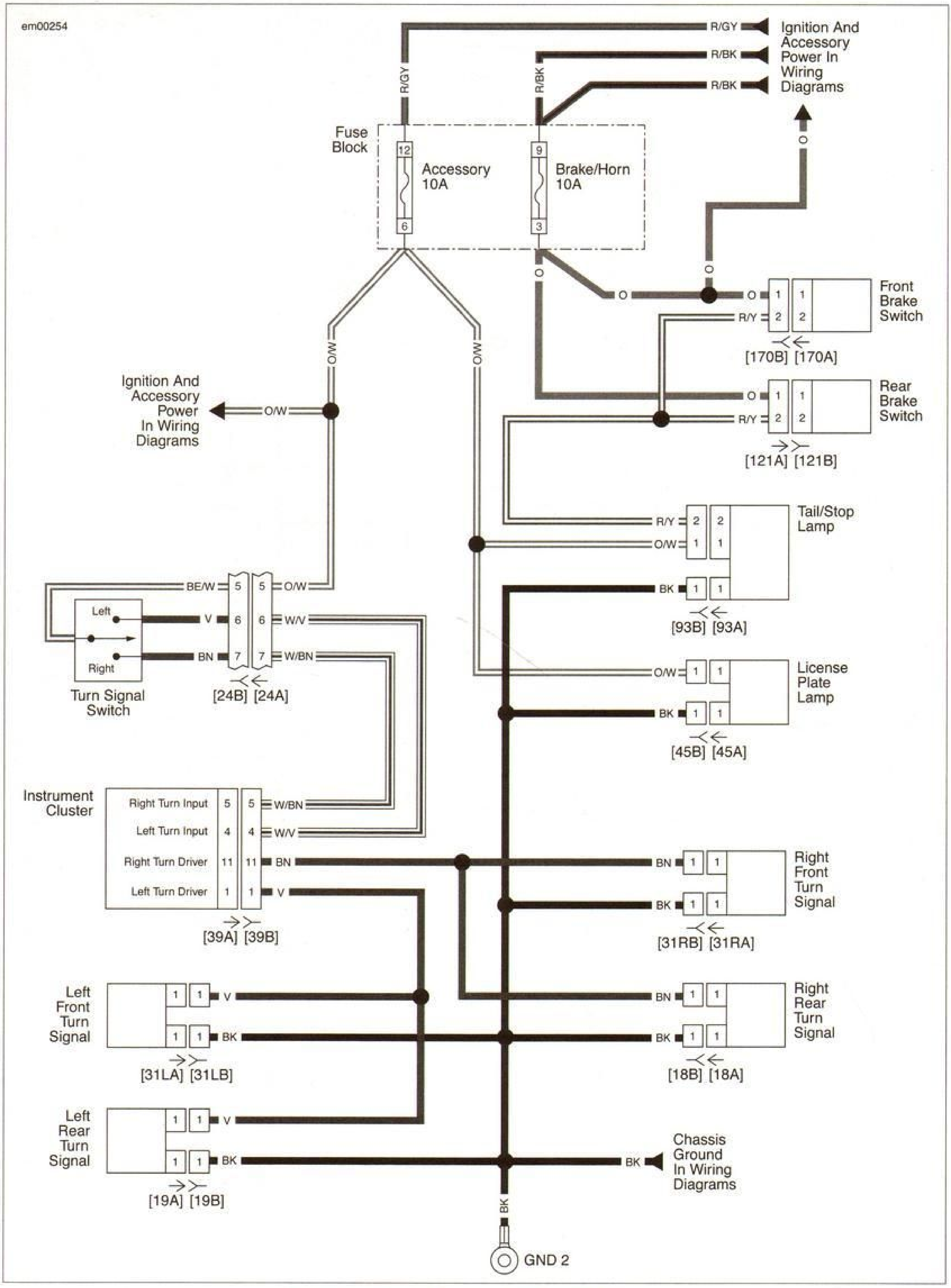
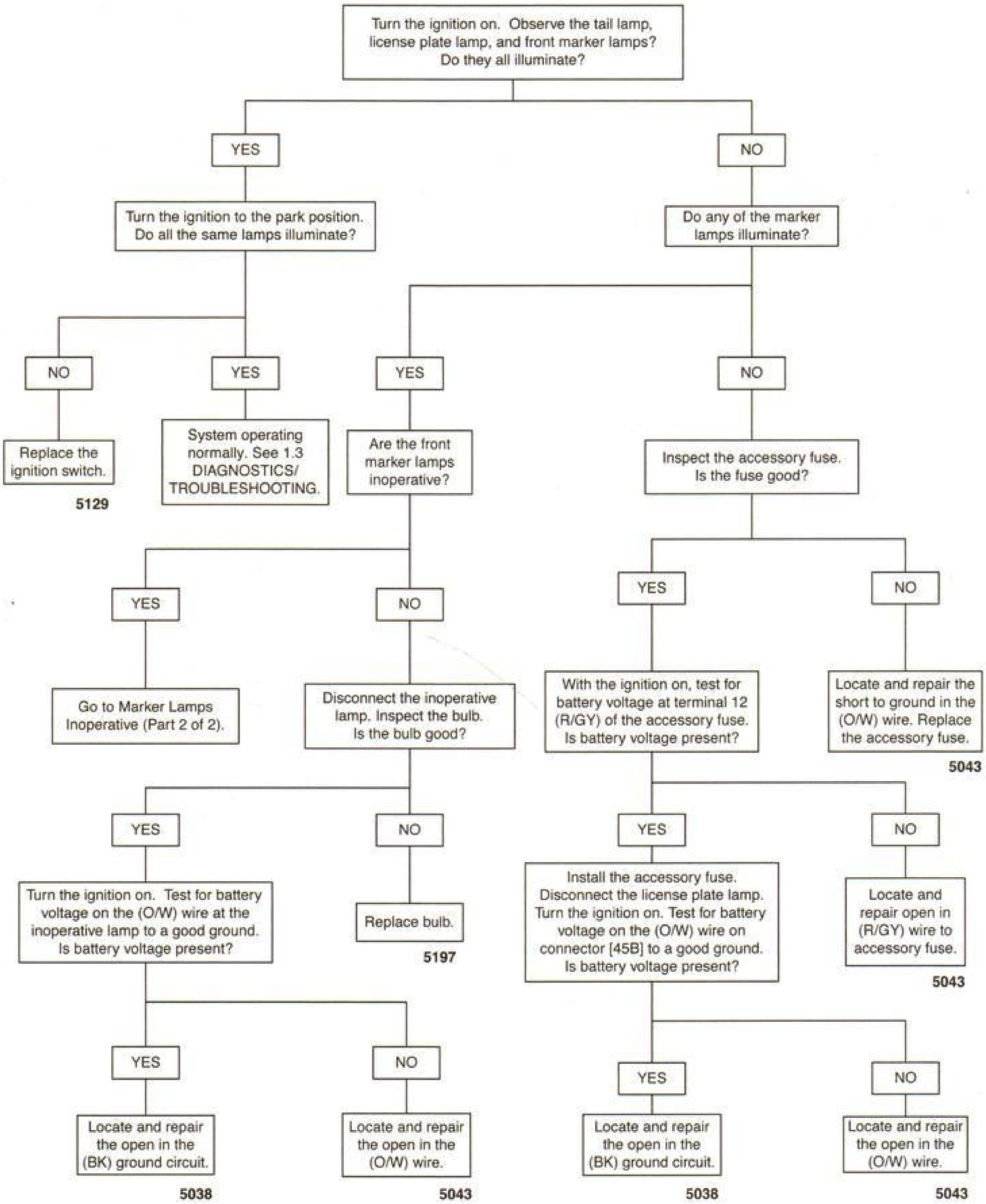


Figure 5-26. Tail/Stop and Turn Signal Lamps

Marker Lamps Inoperative (Part 1 of 2)



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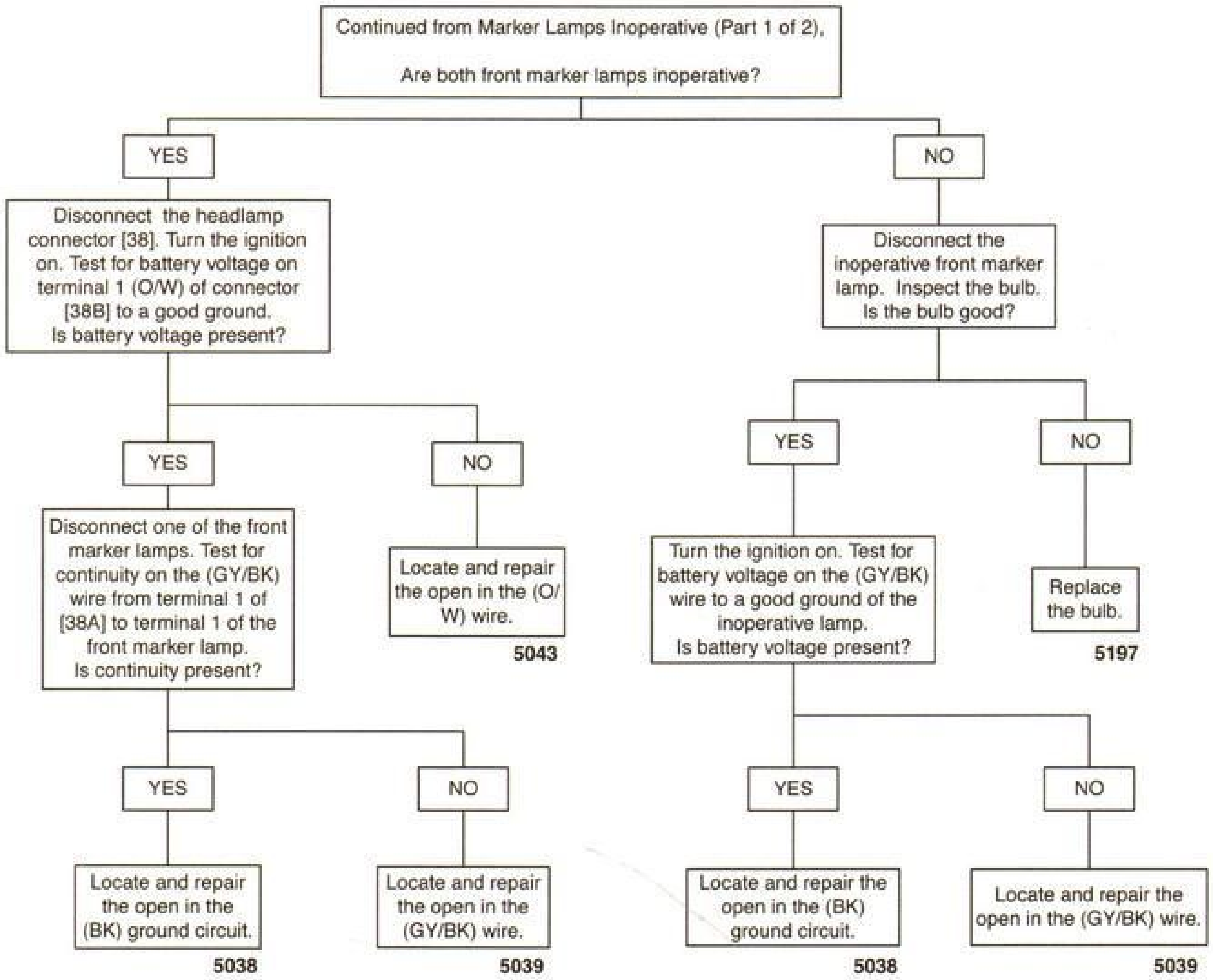
Marker Lamps Inoperative (Part 2 of 2)



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DESCRIPTION AND OPERATION

The security system is a start disable system only. It does not control the lights or the horn. When the security system is active, the ECM does not energize the start relay, the fuel injectors, or the ignition coils unless the correct Personal Identification Number (PIN) is entered in the IC. When the security system is active, the security indicator flashes once every few seconds.

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1. **LCD Screen**
2. **Tachometer**
3. **TOGGLE switch**
4. **MODE switch**
5. **Indicator lamps**
6. **Warning lamps**
7. **Theft mode LED**

Figure 5-27. Instrument Cluster

COMPONENTS

ECM

The ECM controls the start relay, fuel injectors, and ignition coils in order to disable starting the engine.

Instrument Cluster

The IC sends a message to the ECM when the correct PIN is entered, allowing the ECM to enable the start relay, fuel injectors, and ignition coils.

Theft Mode LED

See Figure 5-27. The theft mode LED is the red indicator under the key icon on the IC.

SELECTING THE SECURITY SETTING

The security system can be set up in any one of the following configurations:

- **ON AT KEY OFF:** The security system automatically sets when the ignition switch is turned off. When the ignition is keyed on, the IC requests the PIN be entered before the motorcycle starts.
- **ASK AT KEY OFF:** When the ignition is turned off, the IC requests the PIN to enter the security mode. If the correct PIN is not entered within four minutes, the IC shuts down and the security does not activate. If the correct PIN is entered, then the IC shuts down, and the security system is active and requires a PIN for the motorcycle to start.
- **OFF AT KEY OFF:** The security system is disabled and does not activate. No PIN is needed to start the motorcycle.

To select the desired security setting, perform the following sequence:

1. Turn the ignition switch on.
2. Hold down the MODE and TOGGLE switches until SETUP MENU is displayed.
3. Press and release the MODE switch to scroll through the menu until THEFT SETTING is displayed.
4. Press the TOGGLE switch to access the mode list.
5. Press and release the TOGGLE switch to scroll through the mode list until the IC displays the correct security setting.
6. Press the MODE switch to select the displayed setting. The IC returns to the setup menu.
7. Press and release the MODE switch to continue through the setup menu until TOGGLE TO EXIT is displayed.
8. Press the TOGGLE switch.

ENTERING THE PIN

When activated, a PIN is required to disarm the security system. The PIN is entered using the TOGGLE switch on the IC.

1. Turn the ignition switch on.
2. The IC displays ENTER PIN with four dashes above it.
3. Press and release the TOGGLE switch until the correct number displays for the first digit. If the TOGGLE switch is not pressed for 2 seconds, the IC enters the number currently showing and moves to the next digit.
4. Once the IC moves to the next digit, repeat the above steps until all four digits are selected.
5. The IC either displays WRONG PIN or CORRECT PIN depending whether or not the PIN entered matches. Once the IC communicates the correct PIN was entered, the ECM allows the engine to start.

NOTE

The same process starting with Step 2 is used to enter the PIN when the ignition is turned off and the security is set to ASK AT KEY OFF.

CHANGING THE PIN

The PIN is set to 0000 from the factory. Perform the following procedure to change the PIN:

1. With the ignition on and the security disarmed, press and hold the TOGGLE and MODE switches until the SETUP MENU is displayed.
2. Press and release the MODE switch until PIN SETTING displays.
3. Press and release the TOGGLE switch to select the setting.
4. Enter the current four-digit PIN. See 5.4 SECURITY SYSTEM, Entering the PIN for instructions. The IC displays either CORRECT PIN or WRONG PIN depending if the PIN was entered correctly. After the correct PIN is entered, the IC displays NEW PIN.
5. Enter the **new** PIN.
6. Enter the **new** PIN again to confirm. Both new PIN entries must match to continue.
7. The IC displays PIN CHANGED to confirm the two PIN entries matched and the PIN changed.
8. The SETUP MENU advances to the next item. Continue to press and release the MODE switch until TOGGLE TO EXIT is displayed. Press and release the TOGGLE switch.

ERROR MESSAGES

The IC displays error messages when it detects an issue with the security system.

LOCKED OUT: The LOCKED OUT message displays when 20 incorrect PINs are entered. This message displays for 30 minutes and the IC will not accept a PIN during that time.

THEFT ERROR: The THEFT ERROR message displays when the IC and the ECM Vehicle Identification Numbers (VINs) do not match or when the IC has lost communication with the ECM.

ECM AND INSTRUMENT CLUSTER (IC) MATCHING

The security system is designed to stay active in the event the ECM or the IC has to be replaced. The VIN, the PIN, the security status, and the total mileage are stored in the ECM and the IC. If either one of these components is replaced, it learns the information from the other.

When Replacing the ECM

When the ECM is replaced, the new ECM copies the VIN and the mileage from the existing IC. Once the VINs match, the ECM matches the IC PIN and security setting. This works with a used ECM as long as the ECM security is not active. If the ECM security is active, it sees the IC as an invalid VIN and displays THEFT ERROR on the IC.

When Replacing the Instrument Cluster (IC)

The IC can only have a VIN written to it once. It cannot learn a new VIN if a VIN has already been written to it. Therefore, when replacing the IC, it must be a new IC.

NOTE

When the IC is replaced, there is a 30 minute timer that counts down before the information is written to the IC. This is done so the technician has time to test a new cluster to determine whether the fault is within the cluster or not before the cluster is matched to the ECM. Once the VIN is written to the IC, it cannot be cleared.

If the ECM is in a secure state and a new IC is installed, the ECM will not recognize it and the message THEFT ERROR displays on the IC. Whether or not the ECM is in a secure state, the IC begins to match to the ECM. A 30 minute counter displays instead of the clock on the IC. It counts down and when the 30 minutes are up the VIN is permanently written to the IC. This 30 minute delay is so the new IC can be tested to verify a repair and removed if it did not resolve the issue. If the ignition is turned off, the timer stops but stays where it is and continues to count down when the ignition is turned back on. In order to reset the timer back to 30 minutes, disconnect the battery power completely from the IC.

DTC P1009 Security System Fault or THEFT ERROR Message

The ECM sets a P1009 and THEFT ERROR displays on the IC when the security data shared between the IC and the ECM does not match, or if there is a loss of communication between the IC and the ECM. If there is a loss of communication while the engine is running, COMM ERROR displays until the ignition is turned off. When the ignition is turned back on THEFT ERROR instead of COMM ERROR displays on the IC.

Vehicle Tampering

If modifications have been made to the vehicle to bypass the security system, the vehicle becomes immobilized (unable to start) and the LCD screen displays a THEFT ERROR message when the ignition key is turned to ON. The indicator and warning lamps operate, but the LCD screen functions cannot be accessed.

NOTE

The PIN and theft mode settings are retained in memory when the battery is disconnected from the vehicle.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

Table 5-5. Symptom Table

SYMPTOM	COMMON CAUSE
THEFT ERROR displayed	Loss of communication on CAN BUS or a mismatched VIN

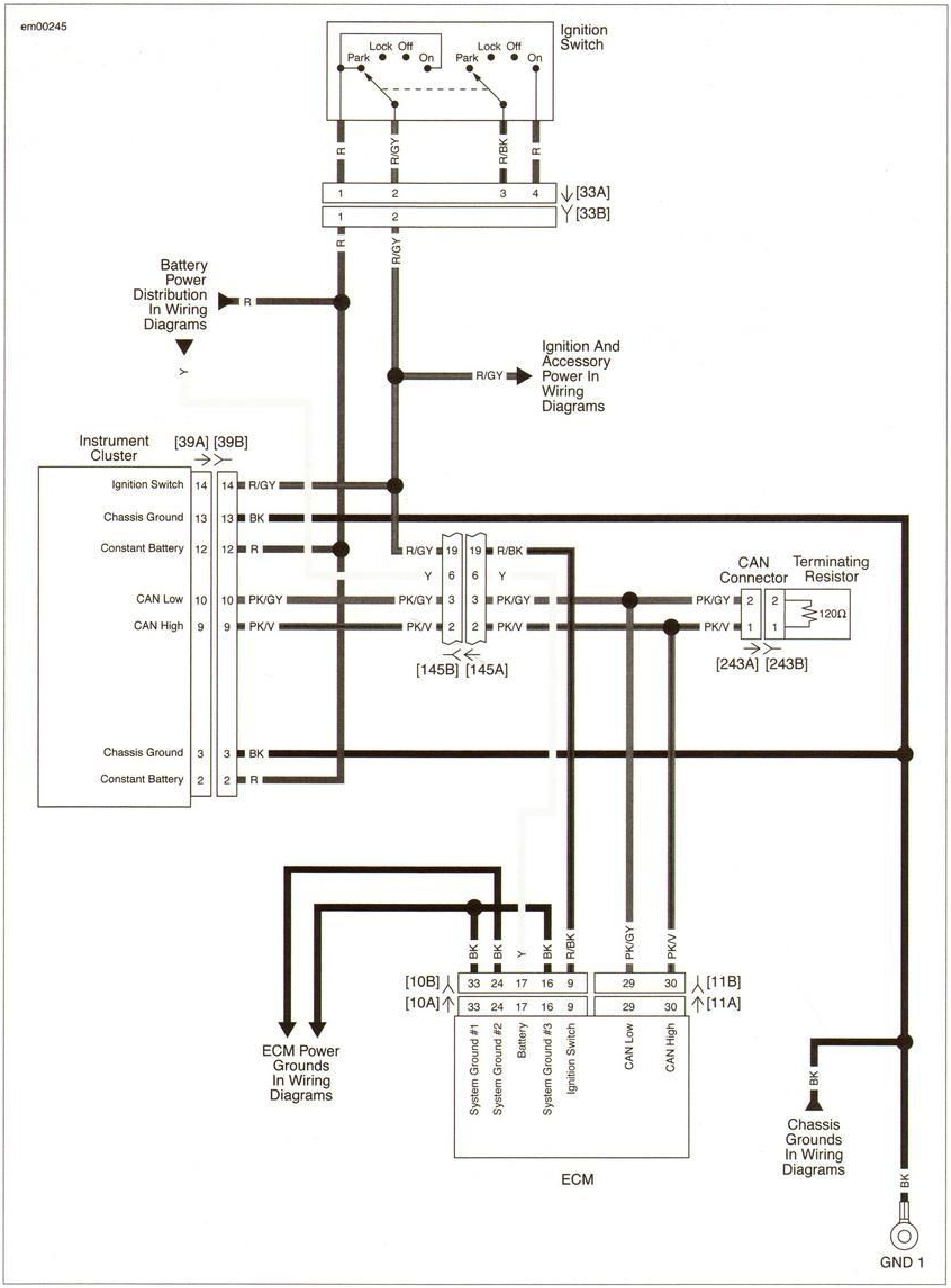
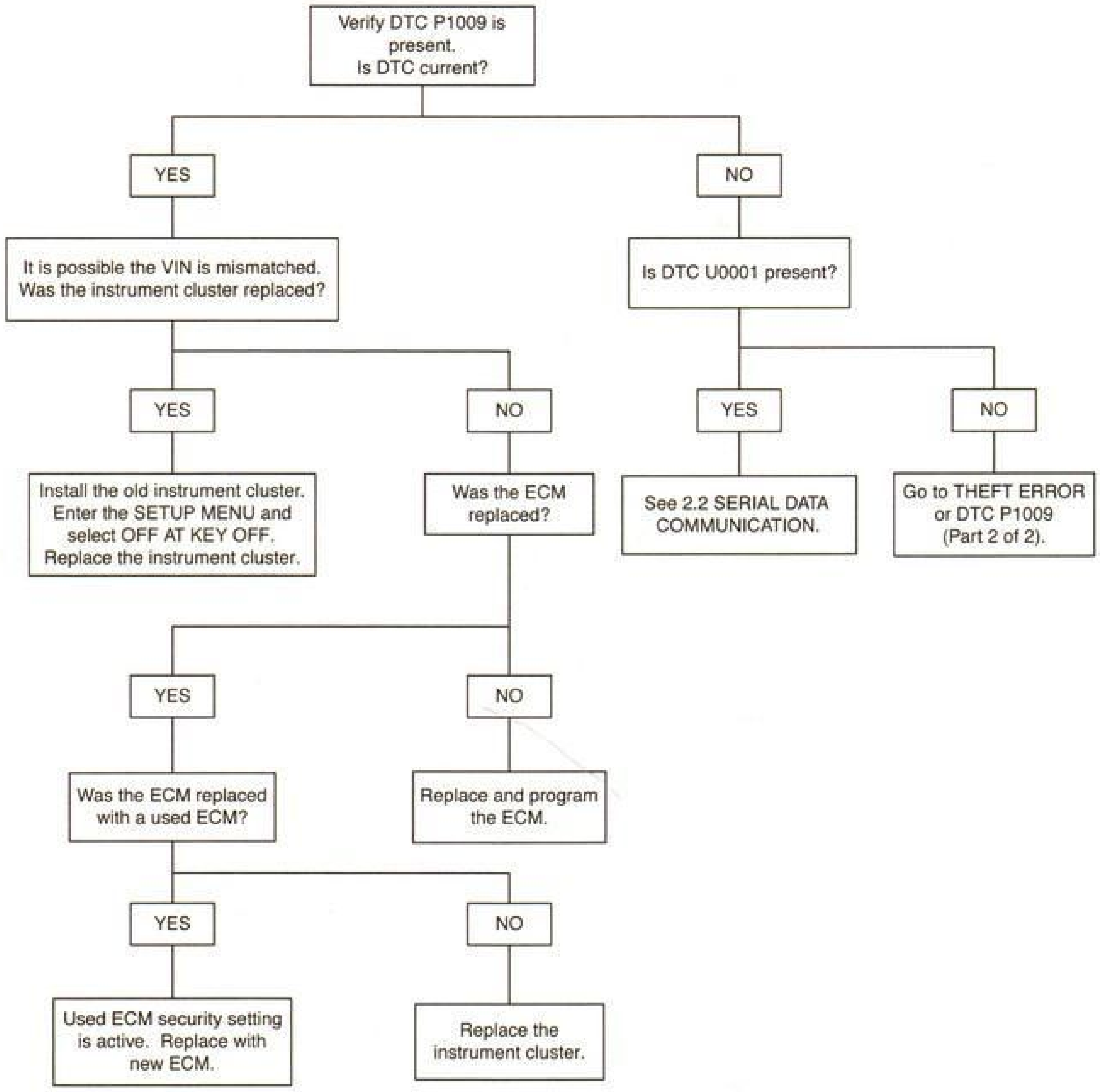


Figure 5-28. Security System

THEFT ERROR or DTC P1009 (Part 1 of 2)



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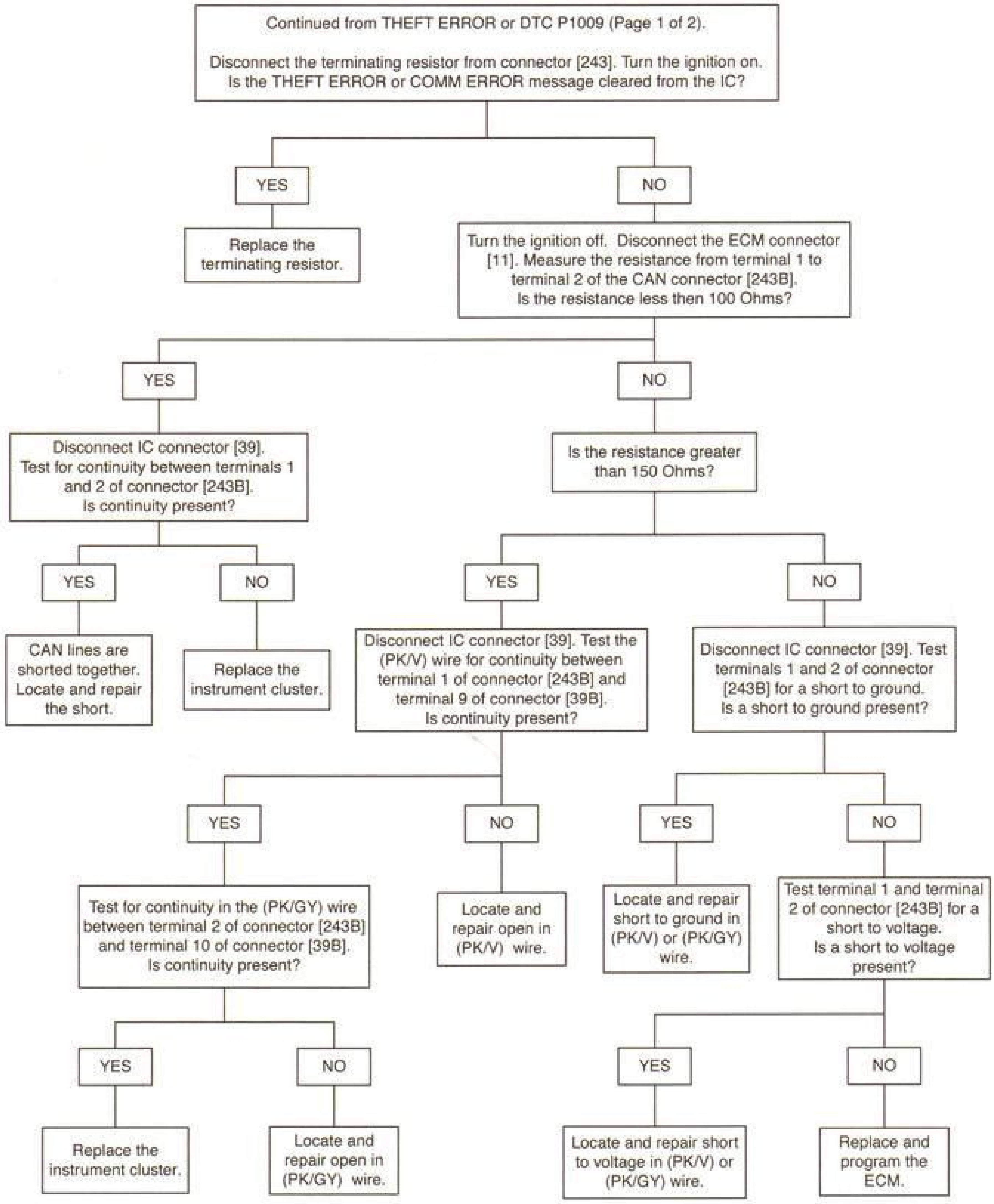
THEFT ERROR or DTC P1009 (Part 2 of 2)



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NOTES

ENGINE MANAGEMENT

SUBJECT	PAGE NO.

NOTES

DDFI-3 OVERVIEW

This chapter describes the operation of the 1125cc engine when coupled with the Buell Dynamic Digital Fuel Injection (DDFI-3) System. It is essential to have a working knowledge of the many components surrounding the engine to accurately troubleshoot and correct problems that may occur. 6.2 ELECTRONIC CONTROL MODULE and 6.3 SENSORS AND DRIVERS briefly explains the operation of the ECM and function of the various sensors and drivers. See 1.2 DIAGNOSTIC TOOLS for instructions on using the test equipment called out in the flowcharts and test procedures in this chapter.

The Buell DDFI-3 System provides microprocessor-based electronic engine management for the 1125cc high performance engine. The DDFI-3 system has the following features:

- Independently mapped spark and fuel control
- Compensated fuel delivery through coolant temperature, intake air temperature, barometric, and manifold air pressure.
- Engine load measurement via throttle position sensing
- Single point spark delivery
- Separate ignition coils for each cylinder
- Sequential port indirect (manifold) fuel injection
- Open/closed loop air/fuel control
- Automatic enrichment at start-up
- Two electric cooling fans for improved thermal management
- Engine speed and position determined by using a single CKP sensor
- Engine idle speed electronically managed with an IAC system
- Returnless fuel system

The DDFI-3 System performance is monitored by an ECM using sensors and switches to regulate engine operation. The ECM makes decisions for enabling ignition, starting, spark, and fuel delivery. Sensors include:

- Crank Position (CKP)
- Throttle Position (TP)
- Sidestand (HDI only)
- Bank Angle Sensor (BAS)
- Clutch switch
- Neutral switch
- Fuel Pressure Sensor (FPS)
- Engine Coolant Temperature (ECT)
- Intake Air Temperature (IAT)
- Barometric Pressure (BARO)
- Vehicle Speed Sensor (VSS)
- Oxygen (O2)
- Manifold Absolute Pressure (MAP)

DDFI-3 OPERATION

The Buell DDFI-3 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 O2 sensors provide input for an optimal air/fuel mixture resulting in reduced emissions, good fuel economy, and smooth power. In order for the system to enter closed loop operation, certain conditions must be met:

- O2 sensors must be at the normal operating temperature of the engine.
- Operating below 4200 RPM with engine under steady or light load conditions.

By using both open and closed loop systems, engine performance is continuously tuned to compensate for changing conditions and providing maximum performance. A simplified signal flow diagram for the DDFI-3 system is shown in Figure 6-1.

For operational explanations of sensors and drivers, see 6.6 STARTING SENSORS AND DRIVERS.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

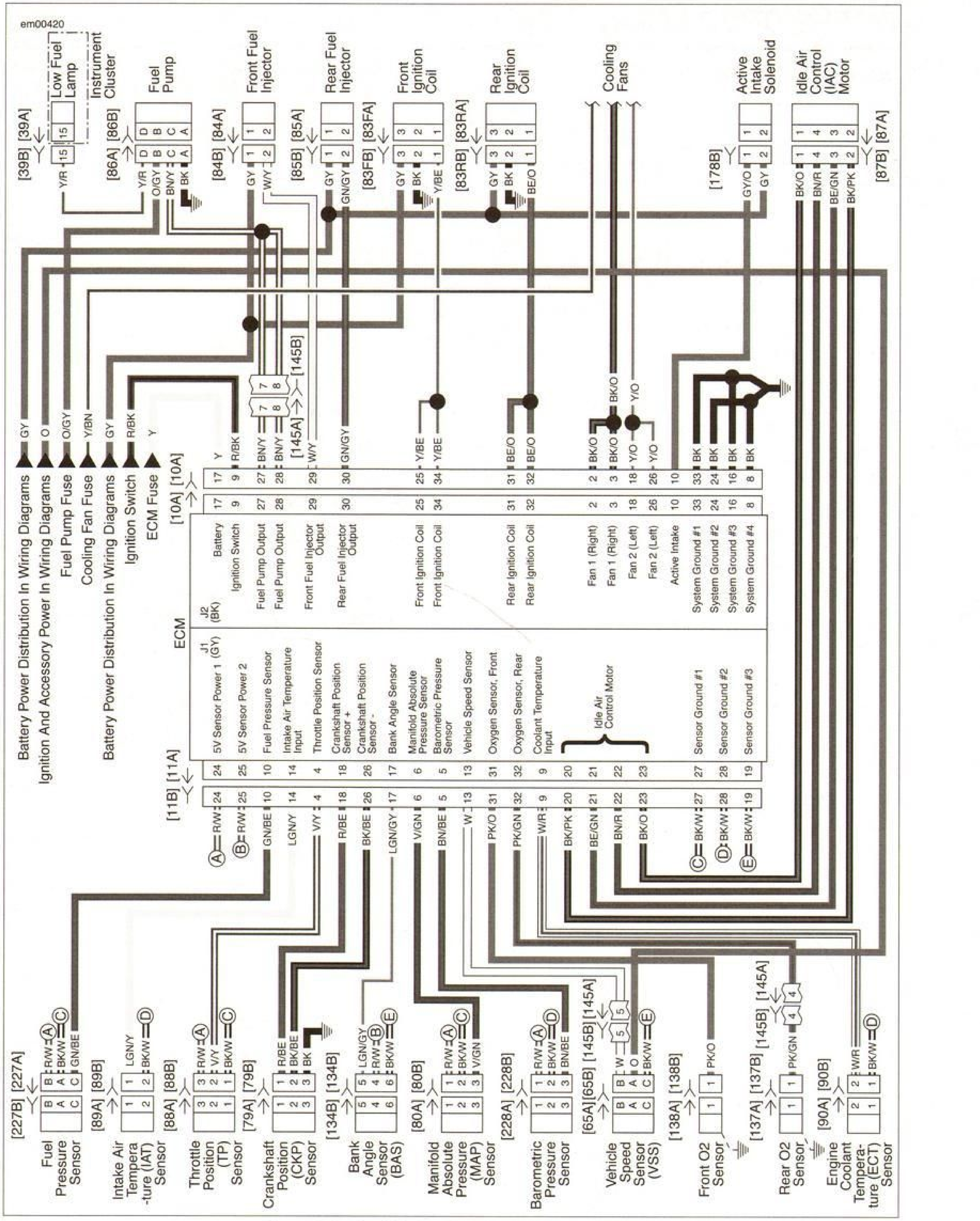


Figure 6-1. Simplified DDFI-3 Signal Flow Diagram

ELECTRONIC CONTROL MODULE

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 topic describes the configuration of the ECM for this vehicle.

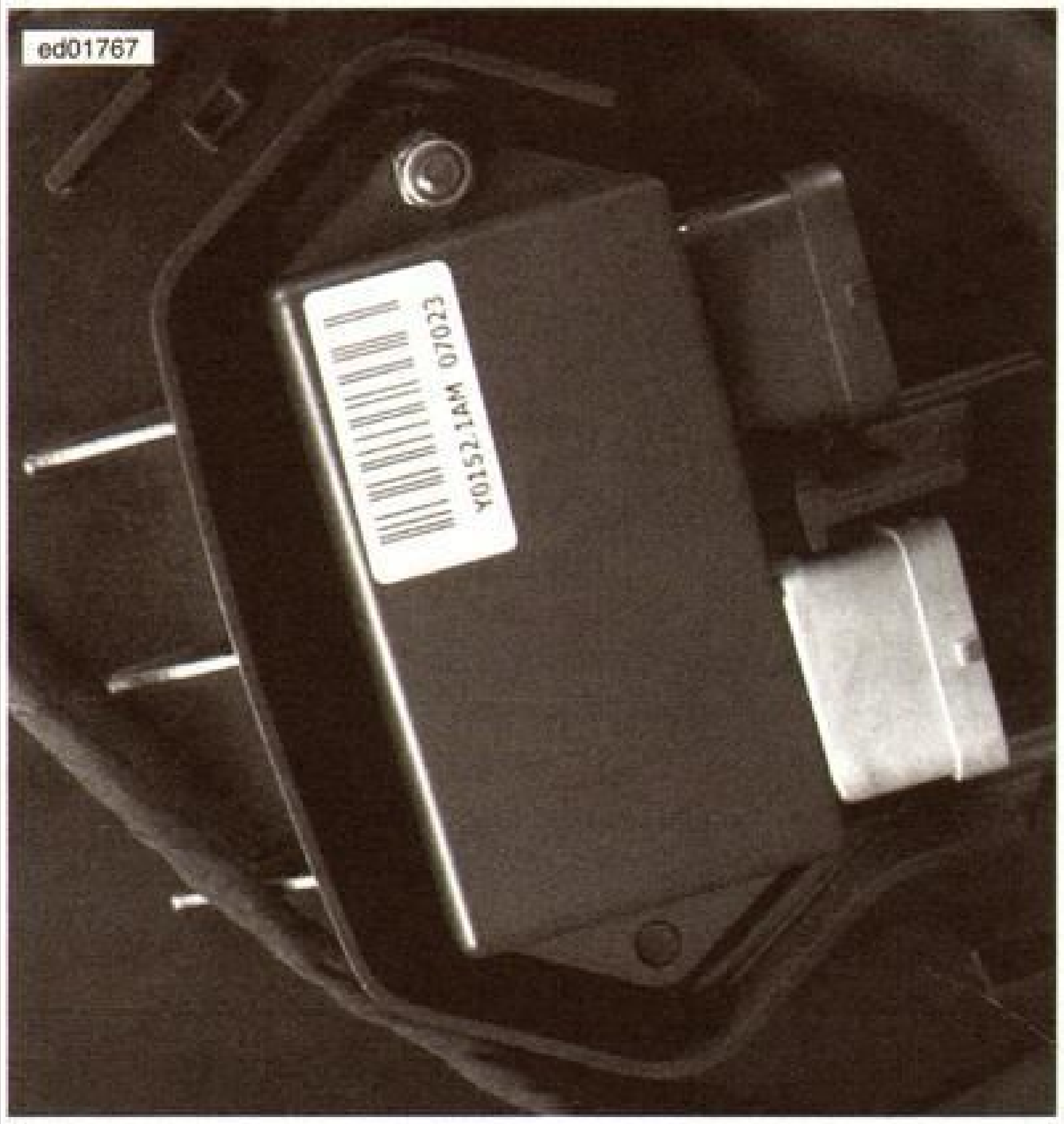


Figure 6-2. ECM

36-2 Alternator Rotor

The alternator rotor has 36 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. The following paragraphs in this section describe synchronization and phasing by the ECM to provide smooth operation of the engine at all speeds.

Crank Position Signal Synchronization

In the 36-2 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.

1. If an engine-not-running (Crank Mode) RPM is detected, the ECM executes the normal start-up phasing process.
2. 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 DDFI-3 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 450 RPM.

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 2.1 INITIAL DIAGNOSTICS.

SENSORS

Not all sensor problems cause an engine shutdown, but sensor failure can seriously degrade overall engine performance. A notable exception is the CKP sensor, which if faulty, completely disables engine operation. The following are brief explanations of sensor types and their functions within the DDFI-3 system.

Crank Position (CKP) Sensor

The CKP sensor is a variable reluctance device that generates AC voltage as the teeth on the alternator rotor 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 (TP) Sensor

The TP sensor is a variable resistor (potentiometer) having a linear resistance range, mounted on the throttle plate shaft. The 1125 uses one sensor, mounted on the left side of the forward cylinder throttle body. The output of the sensor is a voltage, dependent on the position of the throttle plate, and used by the ECM to determine ignition timing and fuel required at any given RPM and engine load. The output of the TP sensor is read by the ECM every 10mS.

In order to function properly, the TP sensor must be mechanically zeroed. This procedure verifies the throttle plates are in their fully closed position, while simultaneously requesting the software to record the electrical value at that position. See the service manual. If the sensor fails, the throttlebody must be replaced.

Sidestand Sensor (HDI Only)

The sidestand sensor uses a Hall-effect device to monitor sidestand position. When the sidestand is fully retracted, the sensor picks up the presence of a metal bolt fastened to the aluminum sidestand. When extended, the engine only starts and runs if the ECM receives a signal from the neutral switch indicating the transmission is in neutral, or a signal from the clutch switch indicating the clutch is engaged. Otherwise, the engine stalls as the clutch is released with the transmission in gear.

Bank Angle Sensor (BAS)

The BAS operates from the ECM 5 Volt 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 set DTC P1152. If a code occurs, the engine continues to run.

A tipped vehicle will not set a DTC.

Clutch Switch

The ECM provides 5 Volts to the clutch switch, which is open when the clutch is disengaged (released). With the clutch engaged (pulled in), the switch closes, allowing voltage to ground. The ECM will not allow the engine to start unless the transmission is in neutral or the clutch is engaged.

Neutral Switch

The ECM provides 5 Volts to the neutral switch, which is open when the transmission is in gear. With the transmission in neutral, the switch is closed, allowing voltage to ground. The ECM will not allow the engine to start unless the transmission is in neutral or the clutch is engaged.

Fuel Pressure Sensor

The duty cycle of the fuel pump is controlled by the ECM which supplies a pulse-width modulated ground to the fuel pump. Voltage for the fuel pump is supplied from the fuel pump fuse through the key switch relay. The ECM can command a fuel pressure range from 58-75 psi (400-517 kPA), depending upon demands of the engine. The ECM provides 5 Volts to the sensor which varies the signal voltage back to the ECM based on fuel rail pressure (low pressure = low voltage signal). Vehicle speed, engine speed, coolant temperature, and atmospheric variables all contribute to determining the desired fuel pressure.

The ECM incorporates automatic compensation for differences of the desired pressure versus the actual pressure. For instance, if the pressure is lower than desired, the ECM opens the injectors for a longer time to adjust the amount of fuel delivered.

Engine Coolant Temperature (ECT) Sensor

The ECT sensor is a thermistor device, which means that 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, which effectively lowers the signal voltage on ECM [11] terminal 9.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 Volts. 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.

At 230 °F (110 °C) the ECM commands the instrument cluster to illuminate the over-temperature lamp.

At the same time, the ECM begins to soft skip spark (1 of 4 removed) and then hard skip spark (1 of 2 removed) when the engine is above a certain RPM and throttle threshold. Spark skips will not occur at idle and lower operating conditions in order to prevent engine stalls.

Intake Air Temperature (IAT) Sensor

The IAT sensor is a thermistor device. As such, it will have a specific resistance across its terminals at a specific temperature. As the temperature varies, the thermistor resistance varies, and so does the voltage on ECM [11] terminal 14.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on ECM [11] terminal 14.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5 Volts. The ECM monitors this voltage to compensate for various operating conditions.

Barometric Pressure (BARO) Sensor

The BARO sensor is supplied 5 Volts from the ECM and sends a signal back to the ECM, which varies according to atmospheric barometric pressure. The BARO sensor is a constantly running direct fuel modifier. It sends continuous information to the ECM, where the signal is processed and the injectors adjusted for variations in ambient barometric pressure. Changes in barometric pressure are influenced by weather and altitude. Air density is a combination of barometric pressure and air temperature. When air is more dense (lower altitudes and lower temperatures), more fuel is needed to maintain the proper air/fuel ratio for efficient engine operation. Intake air temperature combined with barometric pressure is used by the ECM to compensate for these variations.

Vehicle Speed Sensor (VSS)

The VSS is a Hall-effect device mounted close to the teeth of the trigger wheel. The output signal frequency varies with vehicle speed. Output voltage from the sensor is 5V per increment of distance traveled. The ECM processes the vehicle speed signal and transmits it via the CAN bus to the instrument cluster to indicate vehicle speed.

O2 Sensor (Front and Rear)

The O2 sensor detects unburned oxygen in the engine exhaust. The output of the sensor is a voltage having a range of about 0-1.0 Volt. The normal output is 0.5 Volts which represents a balance between a lean (not enough fuel) and rich (too much fuel) air/fuel mixture. An output less than 0.5 Volts represents a lean mixture; greater than 0.5 Volts represents a rich mixture. The change in output level signals the ECM to modify the air/fuel ratio.

It is important to note the O2 sensor does not operate efficiently until it is at vehicle operating temperature. Therefore, before any troubleshooting takes place, bring the sensor to operating temperature. 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.

Manifold Absolute Pressure (MAP) Sensor

The MAP sensor is supplied 5 Volts from the ECM and sends a signal back to ECM. This signal varies in accordance with engine vacuum 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 output of the sensor can also be used to determine if the engine is rotating when a fault with CKP sensor is present.

DRIVERS

Drivers (ECM output devices or system outputs) are the workhorses of the DDFI-3 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 fuel pump, located on the bottom right side of the fuel tank/frame, is provided battery voltage when the RUN/STOP and IGNITION switches are on. The pump is controlled on the ground side by the ECM which is monitoring the fuel pressure sensor. Output pressure from the pump varies from 58-75 psi (400-517 kPA) in response to engine demand.

Ignition Coils and Spark Plugs

The ignition coils, also referred to in the parts list as stick 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.

Each cylinder has its own ignition coil which is provided power by the ignition relay. Each coil is controlled independently by the ECM. In the event of the engine or coolant overheating, the ECM can soft skip spark (1 of 4 removed) or hard skip spark (1 of 2 removed) when the engine is above a certain RPM and throttle threshold.

Fuel Injectors

The ignition 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. If the ECM senses the fuel pressure is less or greater than required for the engine cycle, it increases or decreases the injector open time to maintain the proper air/fuel mixture.

In the event of the engine or coolant overheating, the ECM can skip an injector (hold it closed) when in the skip spark mode. Both injectors are required for proper operation. The ECM monitors the ground signal to provide a diagnostic indication of a failed injector or injector circuit.

Idle Air Control (IAC)

The idle air control 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 Idle Air Control (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.

Cooling Fans

The cooling fans run continuously once the engine operating temperature is reached. The cooling fans are provided battery voltage from the (Y/BN) wire. The ECM controls the fan by providing ground.

Start Relay

When the starter switch is pushed, the start relay is activated and battery voltage is sent to the starter solenoid, and power is interrupted on the light circuit. The ECM controls the ground to the relay, which it disables during security and tip over conditions.

Active Intake

The active intake system uses a solenoid under the airbox which is connected to the throttle valve via a cable. The throttle valve is automatically closed by the solenoid under certain operating conditions to reduce engine noise. The active intake solenoid is provided battery voltage by the ignition relay. The ECM provides ground to activate the solenoid.

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
B-48115	BREAKOUT BOX
HD-39978	DIGITAL MULTIMETER (FLUKE 78)

Symptom Diagnostics identifies problems caused by an electronic control system malfunction that does not generate DTCs. Make sure all current DTCs are corrected before moving to these tests:

- Engine Cranks But Will Not Start
- Engine Starts, Then Stalls
- Misfire
- Fuel Pressure Test
- Intake Leak Test

These symptoms do not generate DTCs but are an indication of system problems. Correcting the DTCs may eliminate the need to perform the tests above.

To locate faulty circuits or other system problems, follow the diagnostic flowcharts in this section. Always begin with 2.1 INITIAL DIAGNOSTICS. Refer to the information there and then work through the applicable flowchart box by box.

When working through a flowchart, refer to the illustrations, associated circuit diagram, and the wire harness connector table in B.1 CONNECTORS as necessary. The wire harness connector table identifies the connector number, description, type, and general location.

To perform the circuit checks efficiently, it is necessary to be familiar with the wire connectors. Use the BREAKOUT BOX (Part No. B-48115) and a DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) when performing diagnostic routines. See 1.2 DIAGNOSTIC TOOLS.

Table 6-1. Engine Starts Hard

CAUSE	SOLUTION
Engine coolant temperature circuit	Repair the circuit. If DTC P0117 or P0118 is present, diagnose and correct DTCs.
Improper fuel pressure	Perform fuel pressure test. If DTCs P0192, P0193, or P0087 are present, diagnose and correct DTCs.
Fuel or Ignition system fault	Perform misfire diagnostics.
Battery discharged	Charge and test the battery. Perform charging system diagnosis if problem continues.
Crank position sensor circuit	Repair the circuit. If DTC P0339 is present, diagnose and correct DTC.
Manifold leak	Perform intake leak test.
Ignition coil circuit	Repair the circuit. If DTCs P2300, P2301, P2303, or P2304 are present, diagnose and correct DTCs.
Leaky injectors	Check for mechanical failures of the fuel injectors. If DTC P0117 or P0118 is present, diagnose and correct them.
Valve sticking	Perform compression test.

Table 6-2. Engine Performance Problems

CAUSE	SOLUTION
Engine coolant temperature circuit	Repair the circuit. If DTC P0117 or P0118 is present, diagnose and correct DTCs.
Crank position sensor circuit	Repair the circuit. If DTC P0339 is present, diagnose and correct DTC.
Fuel or Ignition system fault	Perform misfire diagnostics.
Improper fuel pressure	Perform fuel pressure test. If DTCs P0192, P0193, or P0087 are present, diagnose and correct DTCs.
Manifold Leak **Note:** If manifold leak is large enough, the IAC closes and DTC P0506 sets.	Perform intake leak test.
Throttle plates not opening fully	Perform Throttle Cable Adjustment. See the service manual.

Table 6-2. Engine Performance Problems

CAUSE	SOLUTION
EVAP hose disconnected from induction module (California models only)	Connect
Fuel system contaminated	Drain and refill with fresh fuel.
Cooling fan(s) inoperative	Repair the circuit. If DTC P0691, P0692, P0693, or P0694 are present, diagnose and correct DTCs.

Table 6-3. Engine Emits Black Exhaust or Fouls Plugs

CAUSE	SOLUTION
Engine coolant temperature circuit	Repair the circuit. If DTC P0117 or P0118 is present, diagnose and correct DTCs.
Improper fuel pressure	Repair the circuit. If DTC P0192, P0193, or P0087 are present, diagnose and correct DTCs.
Clogged air filter	Repair the circuit. If DTC P0112 or P0113 is present, diagnose and correct DTCs.
Leaky injectors	Repair the circuit. If DTC P0117 or P0118 is present, diagnose and correct DTCs.

Table 6-4. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0087	29	Fuel Rail/System Pressure Too Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0107	63	Map Sensor Low/Open	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108
P0108	62	Map Sensor High	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108
P0112	22	Intake Air Temperature Sensor Voltage Low	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0113	21	Intake Air Temperature Sensor High/Open	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0117	20	Engine Coolant Temperature Sensor Circuit Low	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0118	19	Engine Coolant Temperature Sensor Circuit High	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0122	11	Throttle Position Sensor Circuit Low	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0123	10	Throttle Position Sensor Circuit High	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0131	50	Front Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0132	46	Front Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0134	48	Front Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047

Table 6-4. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0151	51	Rear Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0152	47	Rear Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0154	49	Rear Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0192	26	Fuel Pressure Sensor Circuit Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0193	25	Fuel Pressure Sensor Circuit High	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0261	35	Front Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0262	34	Front Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0264	37	Rear Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0265	36	Rear Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0337	7	Crank Position Sensor Circuit Low	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0338	8	Crank Position Sensor Circuit High	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0339	9	Crank Position Sensor Circuit Intermittent	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0502	40	Vehicle Speed Sensor Low	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0503	41	Vehicle Speed Sensor Intermittent/Erratic High	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0506	54	Idle Air Control System - RPM Higher Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0507	55	Idle Air Control System - RPM Lower Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0511	53	Idle Air Control Circuit Fault	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0562	39	Battery Voltage Low	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0563	38	Battery Voltage High	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0603	3	ECM EEPROM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0604	1	ECM RAM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0605	2	ECM ROM Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0607	4	ECM Microprocessor Failure	6.5 ECM ERRORS: DTC P0603, P0604, P0605, P0607
P0616	61	Starter Relay Circuit Low	6.14 START RELAY: DTC P0617
P0617	60	Starter Relay Circuit High	6.14 START RELAY: DTC P0617
P0628	28	Fuel Pump Circuit Low	6.20 FUEL PUMP: DTC P0628, P0629
P0629	27	Fuel Pump Circuit High	6.20 FUEL PUMP: DTC P0628, P0629
P0691	58	Right Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694

Table 6-4. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0692	56	Right Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0693	59	Left Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0694	57	Left Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P1047	52	Feedback Fuel Cylinder Difference too Great	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P1110	66	Active Intake Control Circuit Short Low/Open	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1111	65	Active Intake Control Circuit Short High	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1112	64	Active Intake Control Throttle Position Sensor Feedback Failure	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1151	16	Bank Angle Sensor Shorted Low	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1152	15	Bank Angle Sensor Shorted High	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1154	17	Clutch Position Sensor Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1155	18	Neutral Switch Input Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1501	13	Sidestand Sensor Low	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1502	12	Sidestand Sensor High/Open	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1503	14	Sidestand Down at Vehicle Speed	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1601	67	Auxiliary Relay Driver Circuit Fault	5.1 ACCESSORIES
P2228	24	BARO Pressure Sensor Circuit Low	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2229	23	BARO Pressure Sensor Circuit High	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2300	31	Front Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2301	30	Front Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2303	33	Rear Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2304	32	Rear Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304

DESCRIPTION AND OPERATION

The ignition switch supplies power to the ECM. If the ECM does not appear to receive power, check the ground sources. An open ECM fuse can also disable the ECM. When the ignition relay is energized by the run switch, power is applied to the DLC [91A] at terminal 4 (GY) wire.

The flowchart in this section is concerned with an ECM that is either not receiving power or is not operational. For all DTCs listed in Table 6-5, replace the ECM.

Table 6-5. Code Description

DTC	DESCRIPTION	SOLUTION
P0603	ECM EEPROM failure	Replace ECM
P0604	ECM RAM failure	Replace ECM
P0605	ECM ROM failure	Replace ECM
P0607	ECM microprocessor failure	Replace ECM

CONNECTOR INFORMATION

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

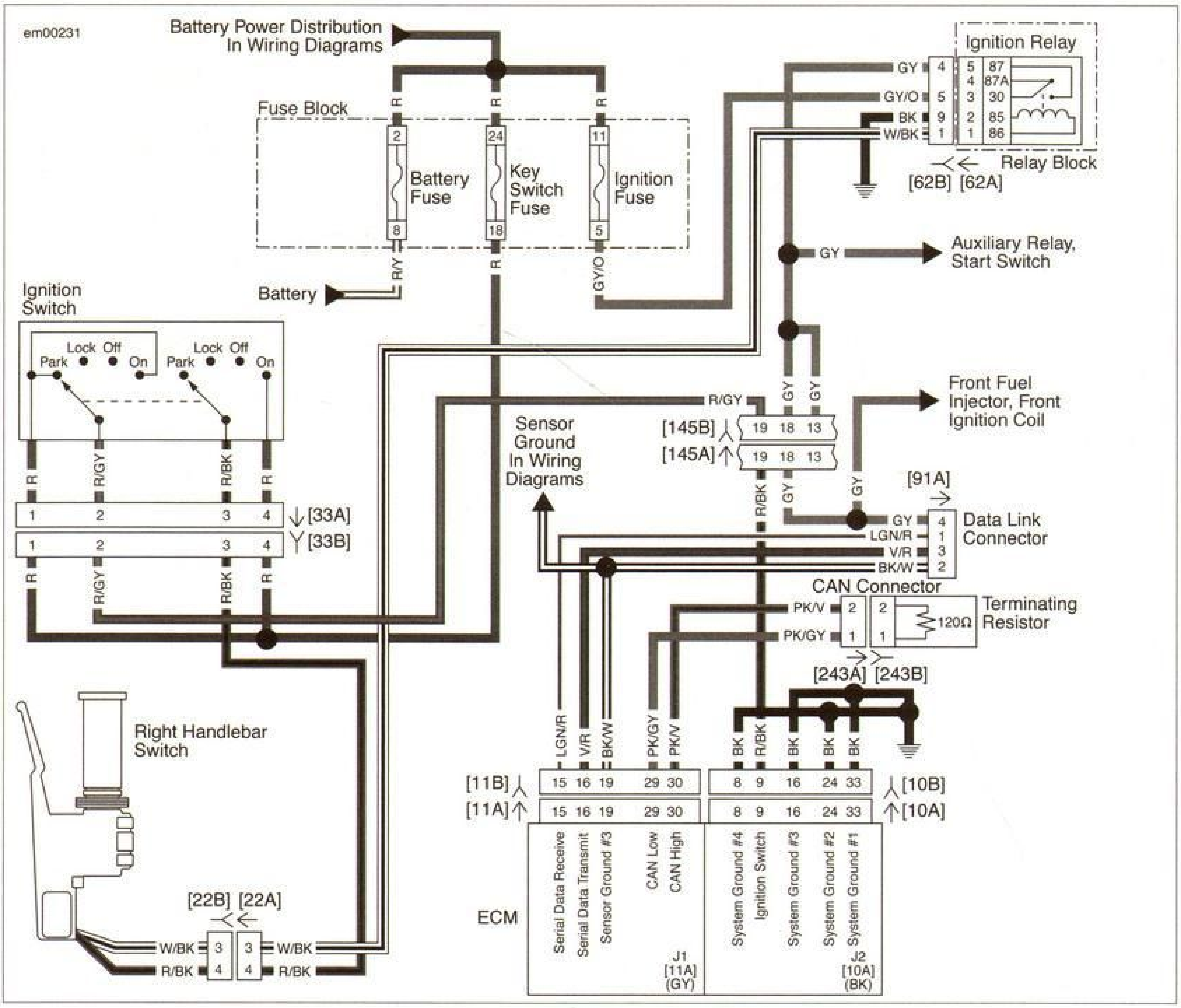
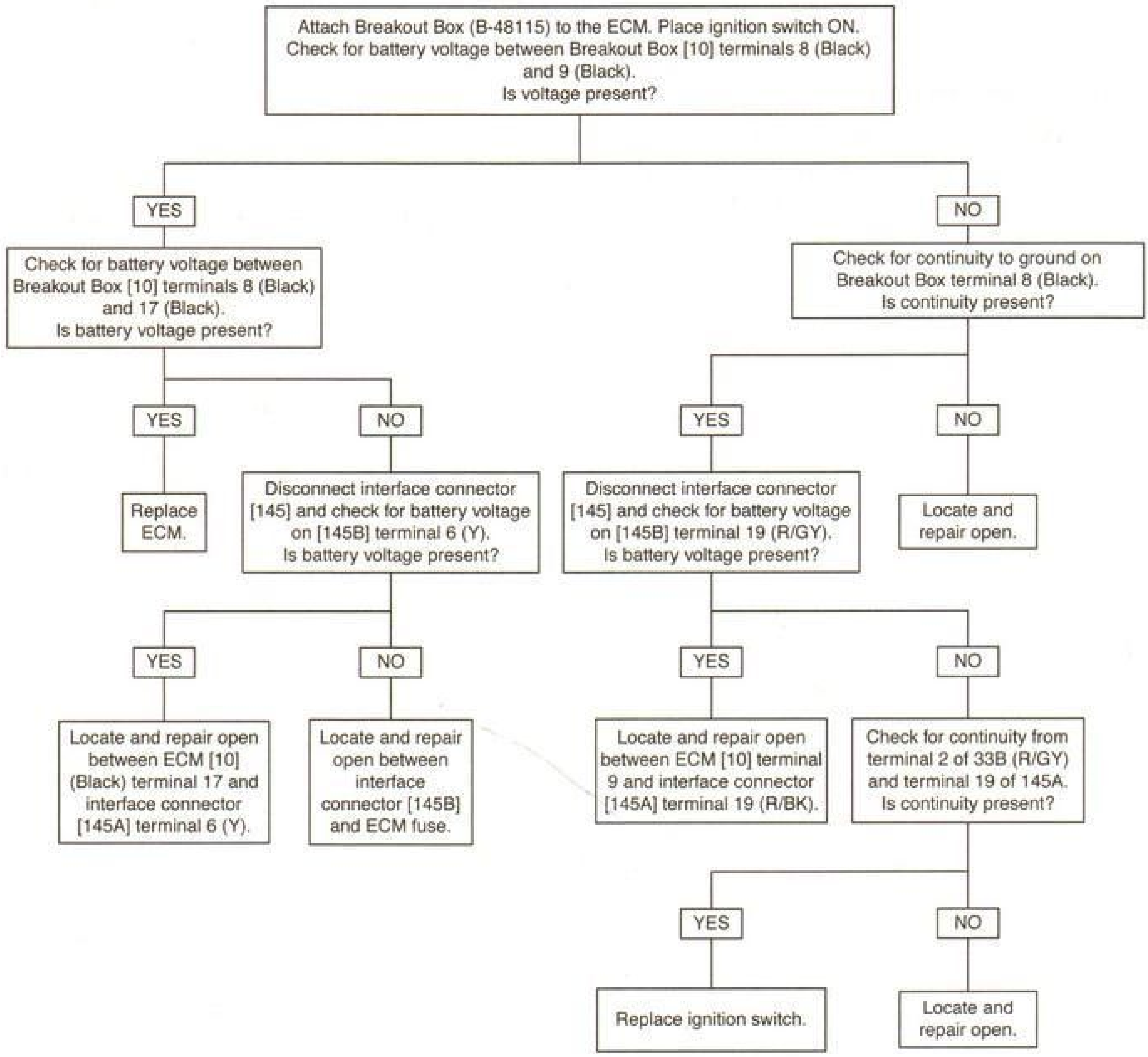


Figure 6-3. ECM Power Circuit

ECM Errors



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DESCRIPTION AND OPERATION

Primary sensors and drivers are the devices that manage engine start-up. If these devices are not in proper operating condition, the engine may not start, may start then stall, or misfire.

Refer to Table 6-6 for devices in this category (listed in DTC ranking order).

Table 6-6. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0112	22	Intake Air Temperature Sensor Voltage Low	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0122	11	Throttle Position Sensor Circuit Low	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0123	10	Throttle Position Sensor Circuit High	6.8 THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112
P0261	35	Front Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0262	34	Front Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0264	37	Rear Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0265	36	Rear Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0337	7	Crank Position Sensor Circuit Low	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0338	8	Crank Position Sensor Circuit High	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0339	9	Crank Position Sensor Circuit Intermittent	6.7 CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339
P0617	60	Starter Relay Circuit High	6.14 START RELAY: DTC P0617
P1151	16	Bank Angle Sensor Shorted Low	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1152	15	Bank Angle Sensor Shorted High	6.10 BANK ANGLE SENSOR (BAS): DTC P1151, P1152
P1154	17	Clutch Position Sensor Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1155	18	Neutral Switch Input Circuit Low	6.11 CLUTCH AND NEUTRAL SWITCHES: DTC P1154, P1155
P1501	13	Sidestand Sensor Low	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1502	12	Sidestand Sensor High/Open	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P1503	14	Sidestand Down at Vehicle Speed	6.9 SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY)
P2300	31	Front Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2303	33	Rear Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2304	32	Rear Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

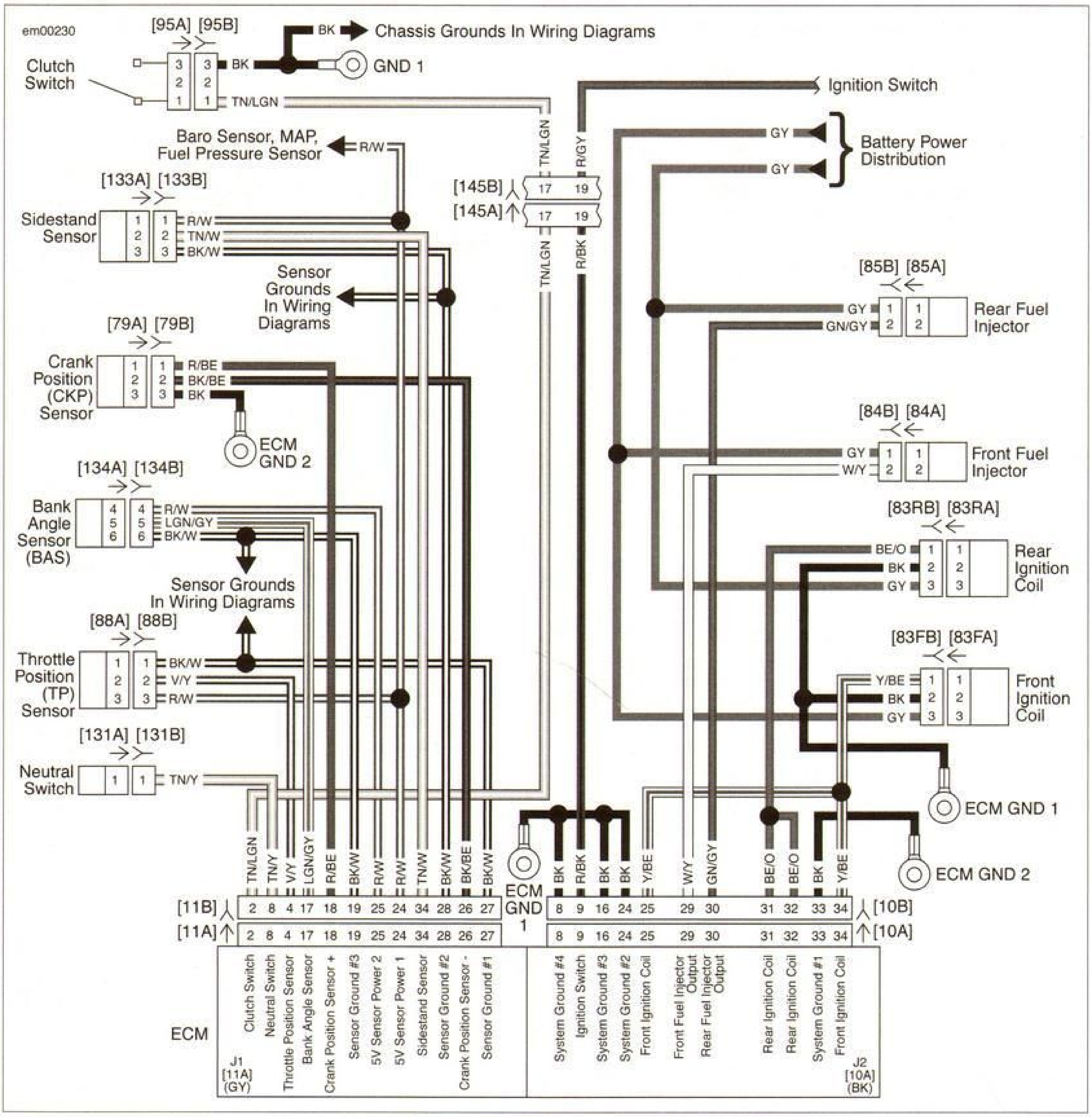


Figure 6-4. Primary Input Sensors and Drivers

CRANK POSITION (CKP) SENSOR: DTC P0337, P0338, P0339 6.7

DESCRIPTION AND OPERATION

See Figure 6-5. The CKP sensor is located on the left side engine cover, below the base of the rear cylinder. The ECM monitors the CKP signal (AC voltage) on terminals 18+ (R/BE) and 26- (BK/BE) of connector [11]. If the CKP signal is not detected or cannot synchronize, the engine will not start and DTC P0339 sets.

NOTE

The engine must be cranked for more than five seconds without CKP signal to set codes.

Table 6-7. Code Description

DTC	DESCRIPTION
P0337	Crank position sensor circuit low
P0338	Crank position sensor circuit high
P0339	Crank position sensor circuit intermittent

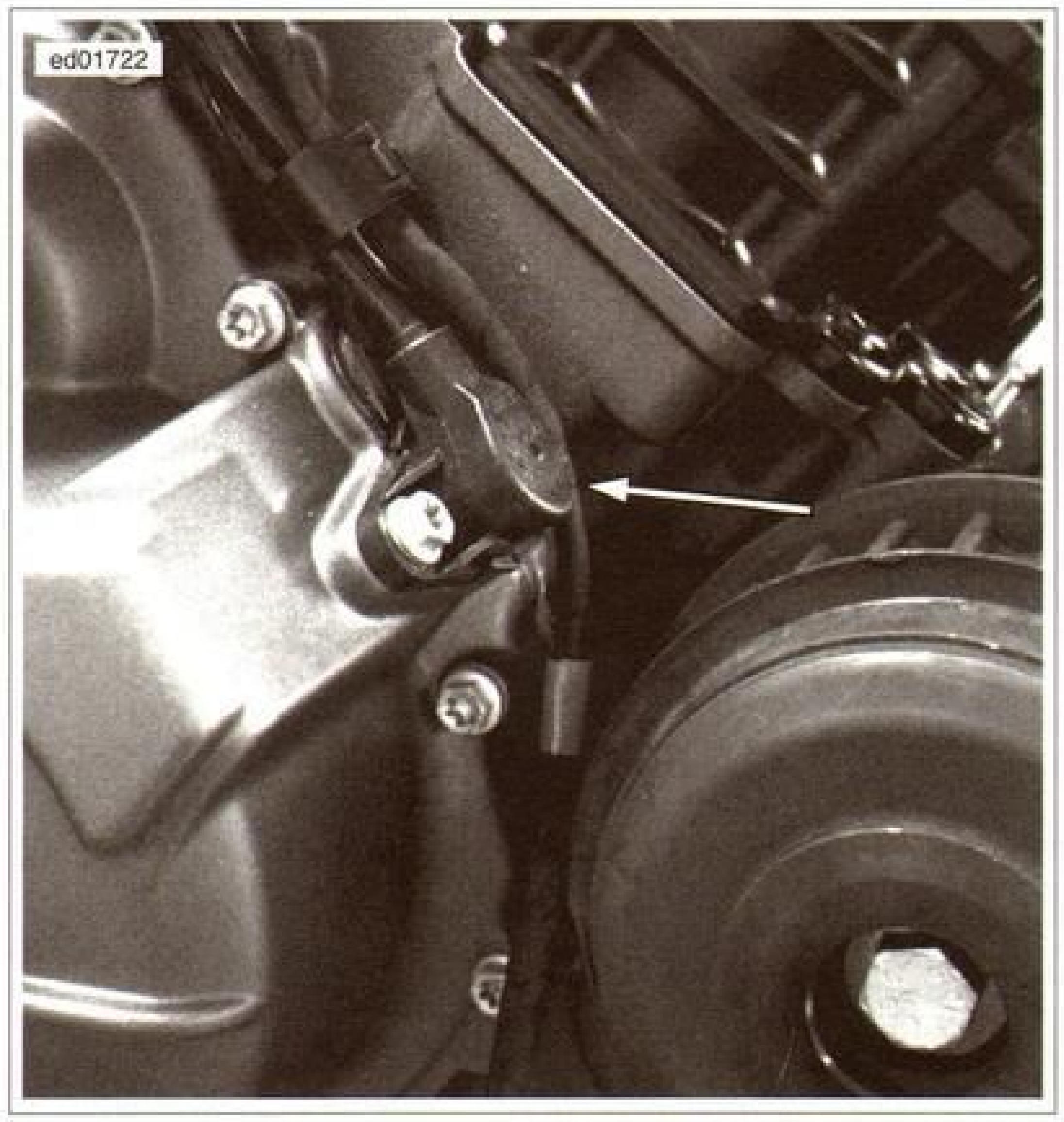


Figure 6-5. CKP Sensor Location (Shroud removed for clarity.)

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

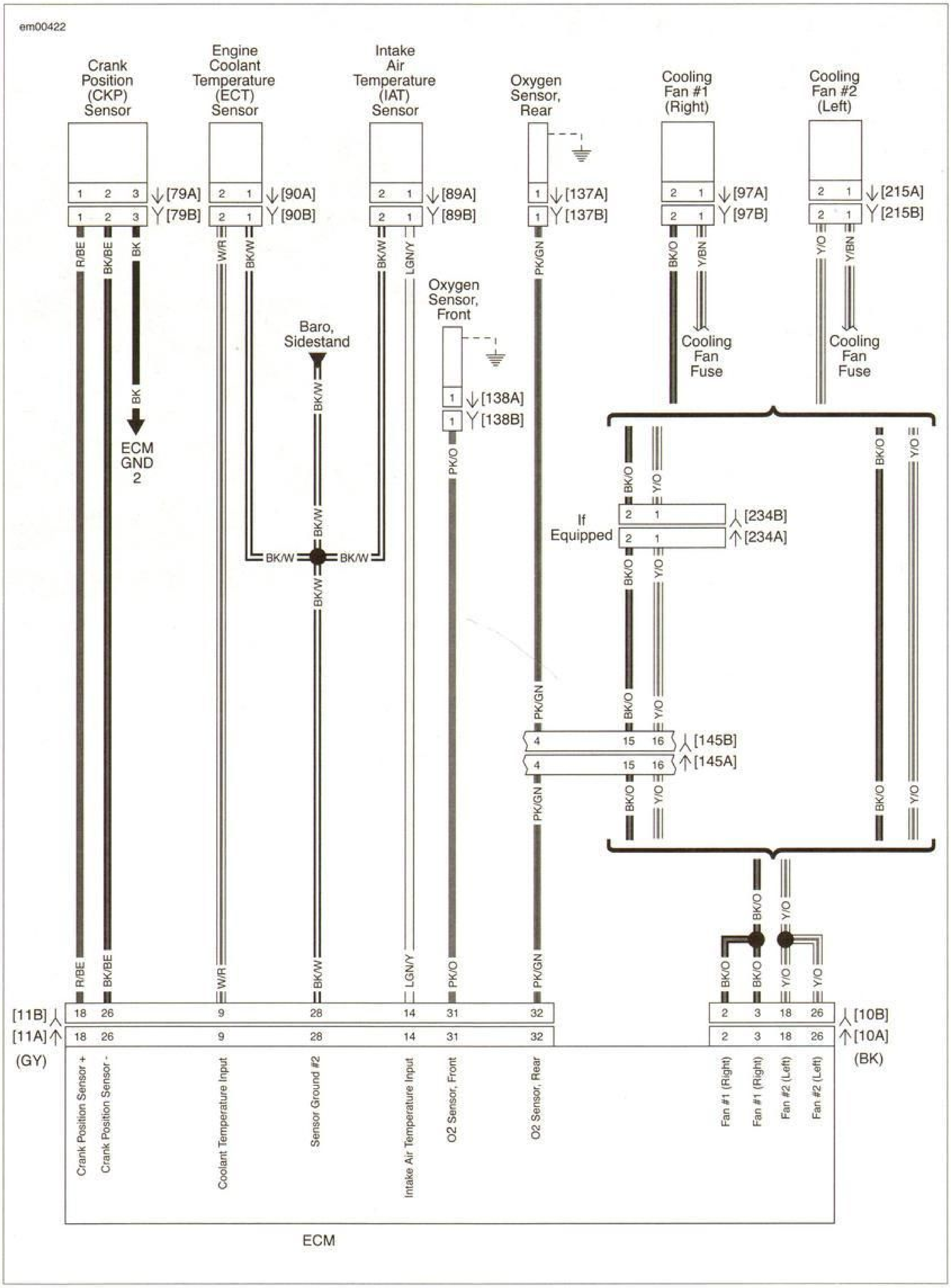
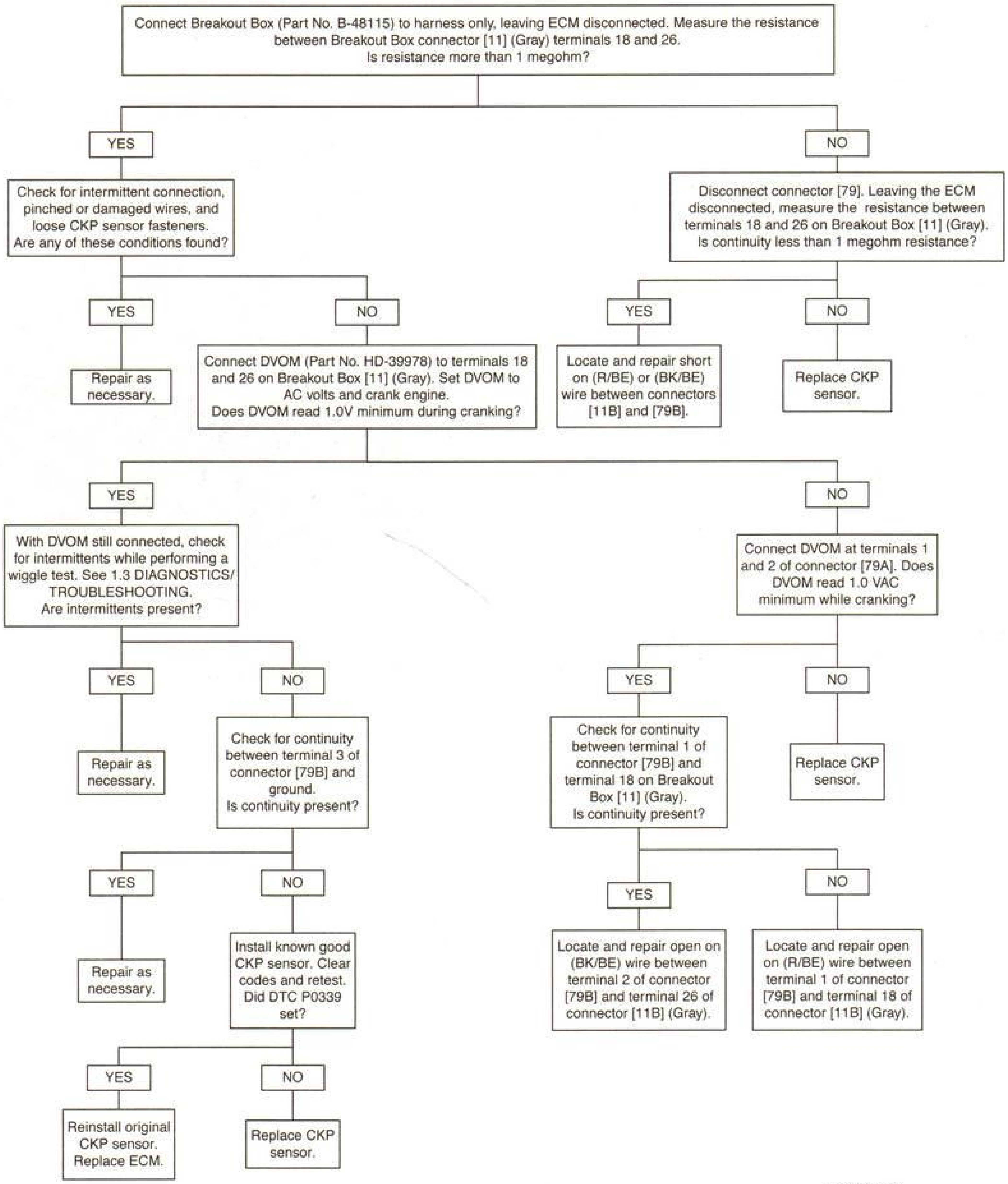


Figure 6-6. CKP, ECT, IAT, O2 sensors, and Cooling Fans


Connect Breakout Box (Part No. B-48115) to harness only, leaving ECM disconnected. Measure the resistance between Breakout Box connector [11] (Gray) terminals 18 and 26. Is resistance more than 1 megohm?
YES
Check for intermittent connection, pinched or damaged wires, and loose CKP sensor fasteners. Are any of these conditions found?
YES
Repair as necessary.
NO
Connect DVOM (Part No. HD-39978) to terminals 18 and 26 on Breakout Box [11] (Gray). Set DVOM to AC volts and crank engine. Does DVOM read 1.0V minimum during cranking?
YES
With DVOM still connected, check for intermittents while performing a wiggle test. See 1.3 DIAGNOSTICS/ TROUBLESHOOTING. Are intermittents present?
YES
Repair as necessary.
NO
Check for continuity between terminal 3 of connector [79B] and ground. Is continuity present?
YES
Repair as necessary.
NO
Install known good CKP sensor. Clear codes and retest. Did DTC P0339 set?
YES
Reinstall original CKP sensor. Replace ECM.
NO
Replace CKP sensor.
NO
Connect DVOM at terminals 1 and 2 of connector [79A]. Does DVOM read 1.0 VAC minimum while cranking?
YES
Check for continuity between terminal 1 of connector [79B] and terminal 18 on Breakout Box [11] (Gray). Is continuity present?
YES
Locate and repair open on (BK/BE) wire between terminal 2 of connector [79B] and terminal 26 of connector [11B] (Gray).
NO
Locate and repair open on (R/BE) wire between terminal 1 of connector [79B] and terminal 18 of connector [11B] (Gray).
NO
Replace CKP sensor.
NO
Disconnect connector [79]. Leaving the ECM disconnected, measure the resistance between terminals 18 and 26 on Breakout Box [11] (Gray). Is continuity less than 1 megohm resistance?
YES
Locate and repair short on (R/BE) or (BK/BE) wire between connectors [11B] and [79B].
NO
Replace CKP sensor.

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THROTTLE POSITION (TP) SENSOR: DTC P0122, P0123, P1112 6.8

DESCRIPTION AND OPERATION

See Figure 6-7. The TP sensor is located on the left side of the forward throttle body. The TP sensor operates from a 5V reference voltage from the ECM and returns a signal to the ECM on the (V/Y) wire. The output signal from the TP sensor varies from:

- Approximately 0.3-1.0 Volts at idle (closed throttle).
- Approximately 3.5-4.5 Volts at WOT.

A DTC sets if the TP sensor output falls outside the acceptable range. See Figure 6-7 the for electrical connection.

NOTE

If the ECM or throttle body is replaced, the zero-set procedure must be performed.

Table 6-8. Code Description

DTC	DESCRIPTION
P0122	Throttle position sensor circuit low
P0123	Throttle position sensor circuit high
P1112	Active intake control throttle position sensor feedback failure

Diagnostic Tips

An intermittent may be caused by any of the following conditions:

- **Poor Connection:** Inspect the ECM harness connector for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection, and damaged harness.
- **TP Sensor Scaling:** Observe the TP sensor voltage display while operating the throttle with engine stopped and ignition switch on. The TP sensor voltage displayed should vary from less than 1 Volt (closed throttle) to greater than 3.5 Volts (WOT). As the throttle is slowly moved, the voltage change should be smooth without any observed spikes or drops in voltage.

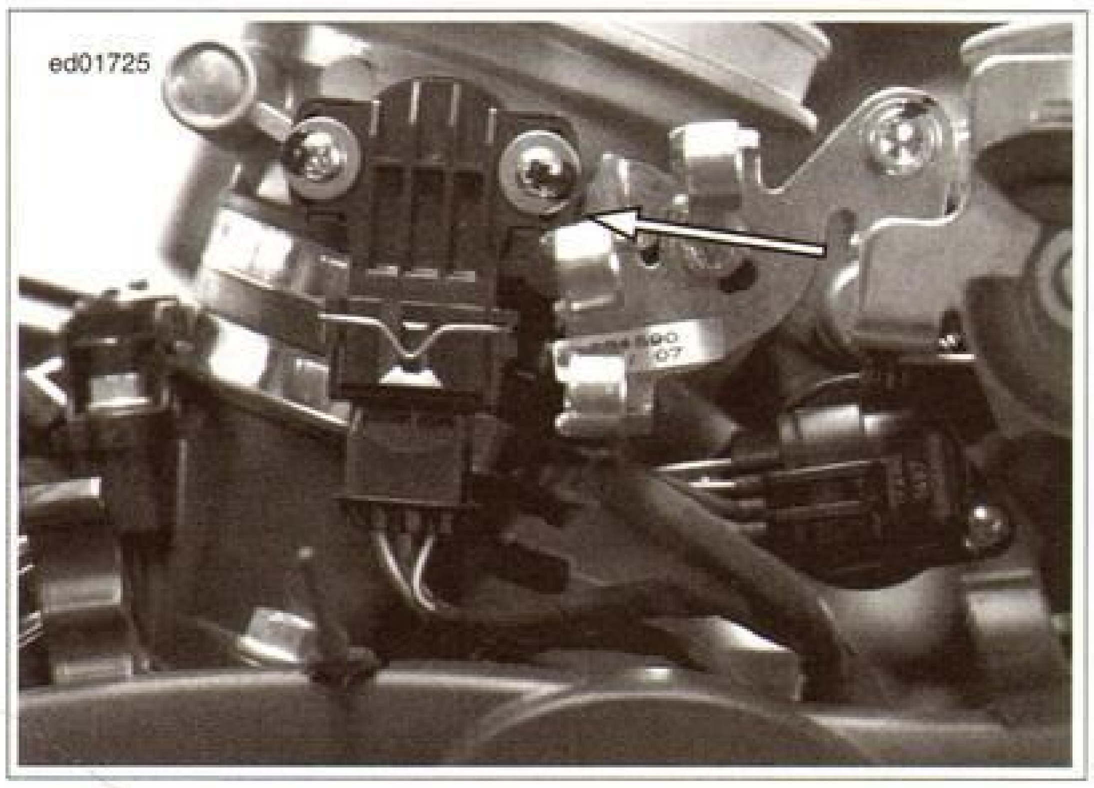


Figure 6-7. Throttle Position (TP) Sensor Location

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

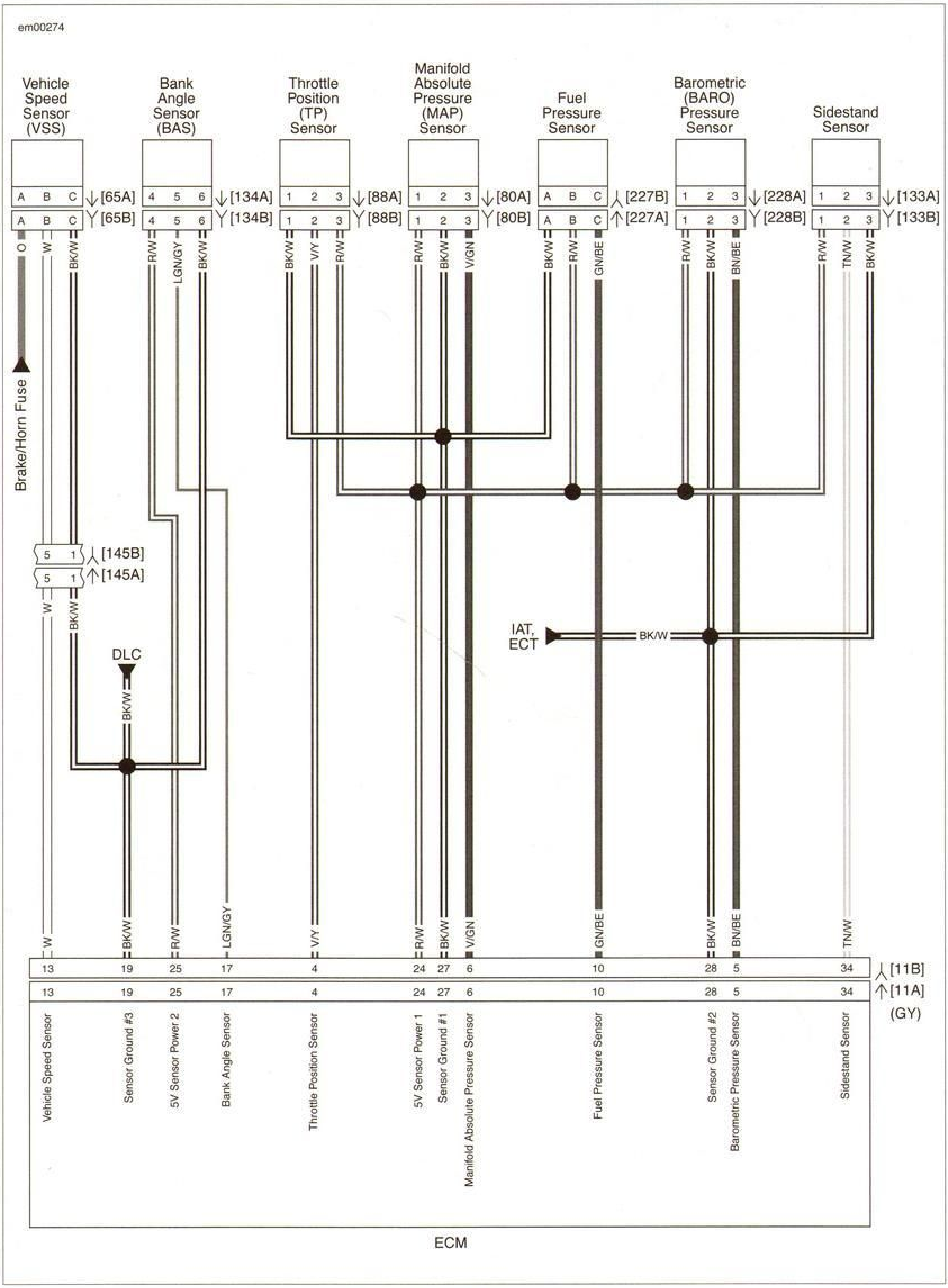
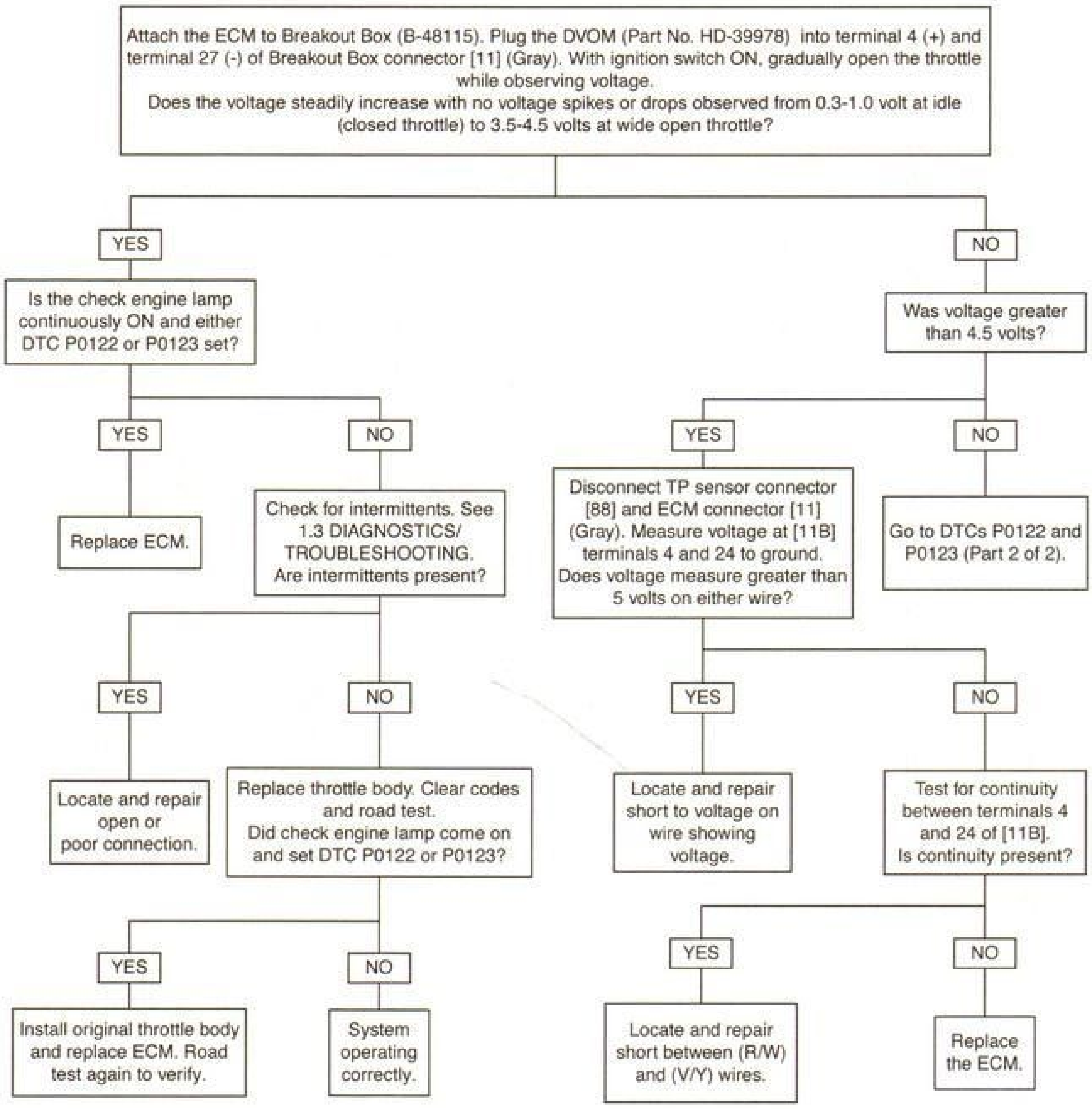


Figure 6-8. 5V Reference Circuit

DTCs P0122 and P0123 (Part 1 of 2)



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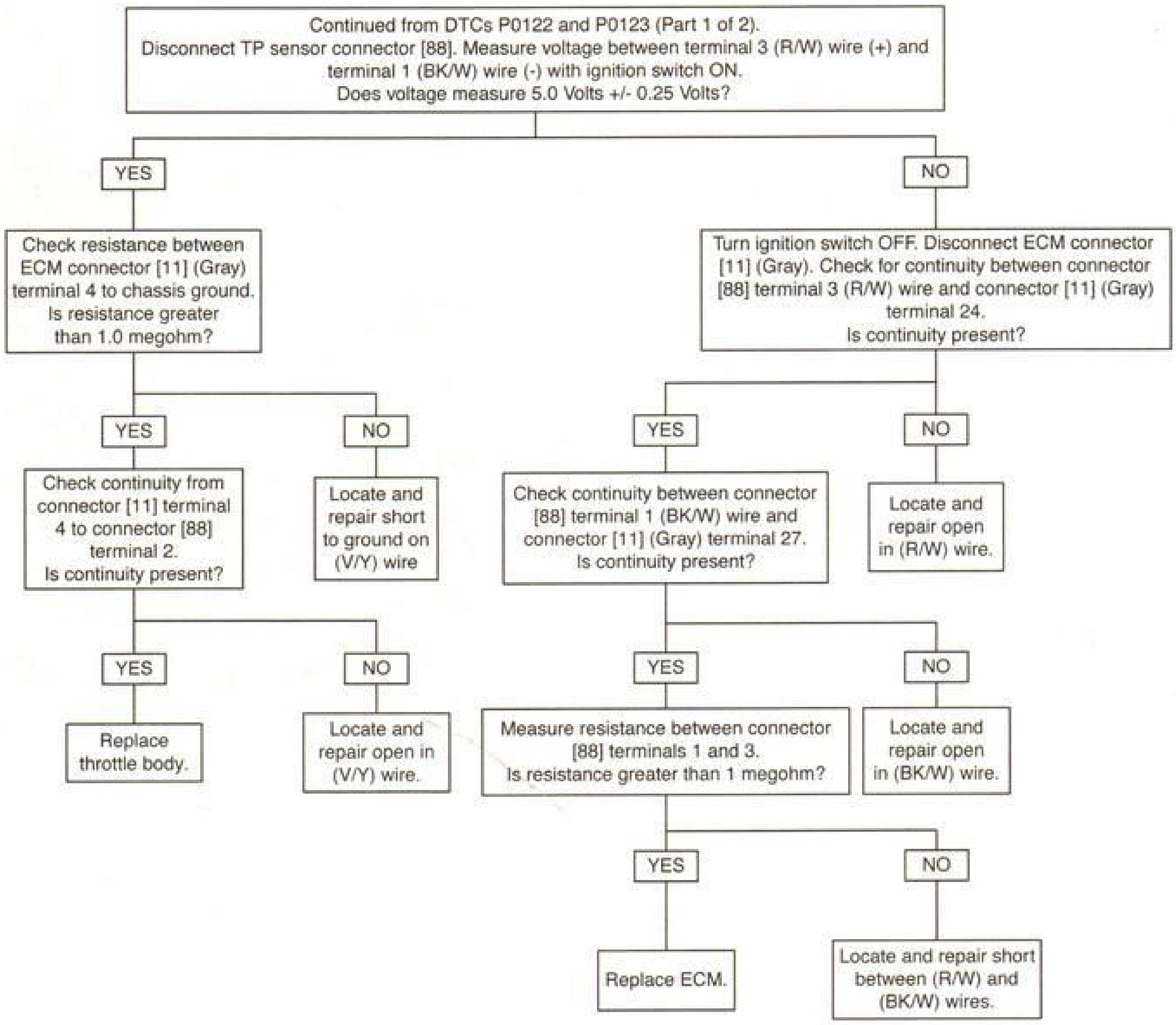
DTCs P0122 and P0123 (Part 2 of 2)



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SIDESTAND SENSOR: DTC P1501, P1502, P1503 (HDI ONLY) 6.9

DESCRIPTION AND OPERATION

See Figure 6-9. The sidestand sensor uses a Hall-effect sensor to monitor sidestand position. When the sidestand is fully retracted, the sensor picks up the presence of the metal bolt fastened to the aluminum sidestand. When the sidestand is extended, the engine starts and runs only if the ECM receives a signal from the neutral switch indicating the transmission is in neutral, or a signal from the clutch switch indicating that the clutch is engaged. Otherwise, the engine stalls as the clutch is released with the transmission in gear.

The ECM provides 5 Volt power and ground to the sidestand sensor. A signal is sent on the (TN/W) wire to the ECM based on the sidestand position. This signal allows the ECM to determine whether the sidestand is retracted or extended.

The sidestand circuit also provides a fail enable mode. This mode allows the engine to start and run if the system recognizes a problem with the sidestand sensor circuit.

Table 6-9. Code Description

DTC	DESCRIPTION
P1501	Sidestand sensor low
P1502	Sidestand sensor high
P1503	Sidestand down at vehicle speed

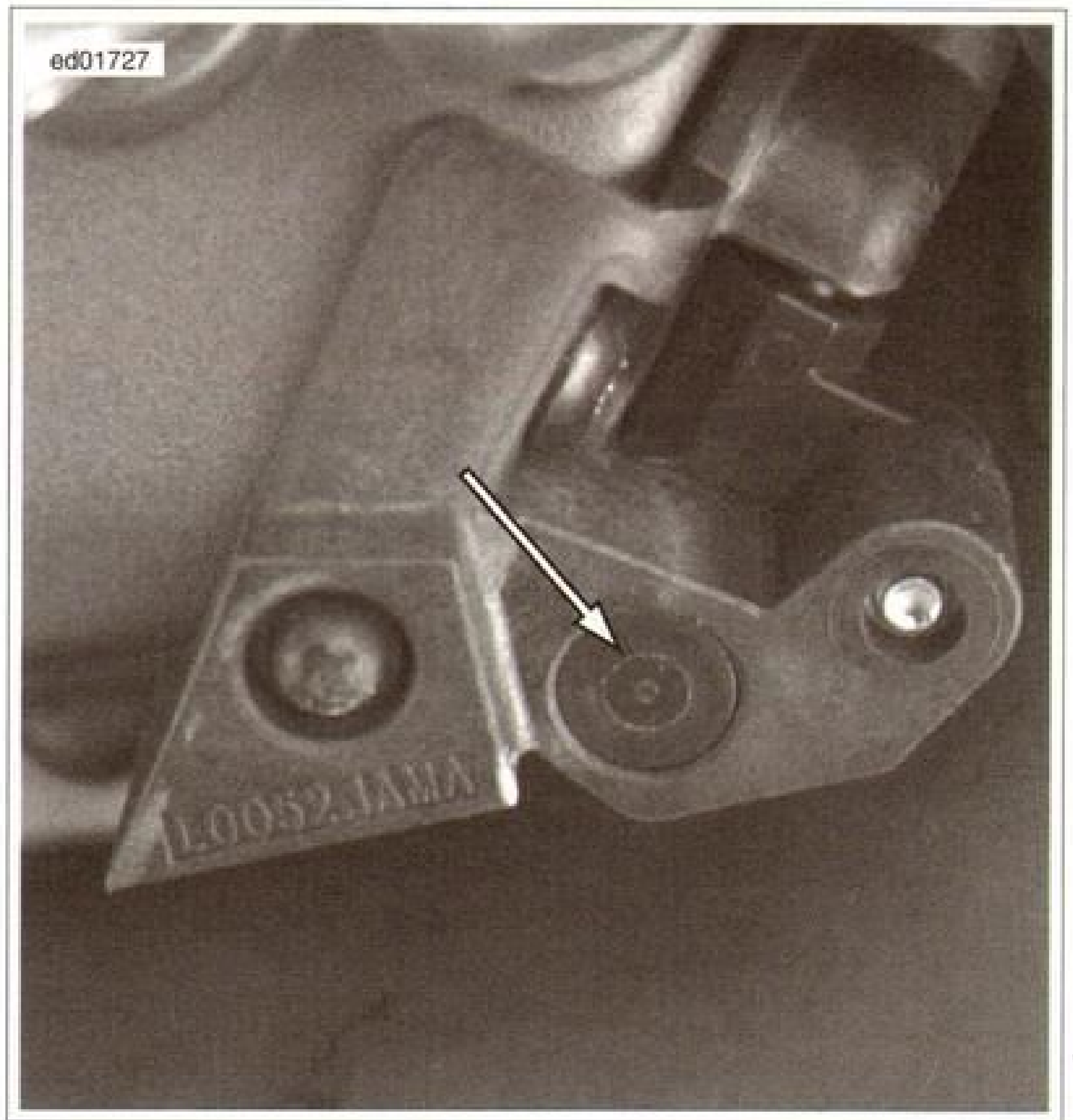


Figure 6-9. Sidestand Sensor

Diagnostic Tips

Unplug the neutral switch connector [131]. Use the DVOM to test for continuity to ground. When in neutral, continuity should exist (can be verified by the neutral light being illuminated on the instrument cluster). When the transmission is in gear, there should be no continuity to ground through the neutral switch (verify by the neutral light on the instrument cluster being extinguished)

When the sidestand is retracted, voltage on the connector [11] terminal 34 (GY) should be approximately 0.6 V. When the sidestand is extended, the voltage should jump to approximately 2.6 V.

Use brown pin probes when taking measurements at the sidestand sensor connector [133].

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

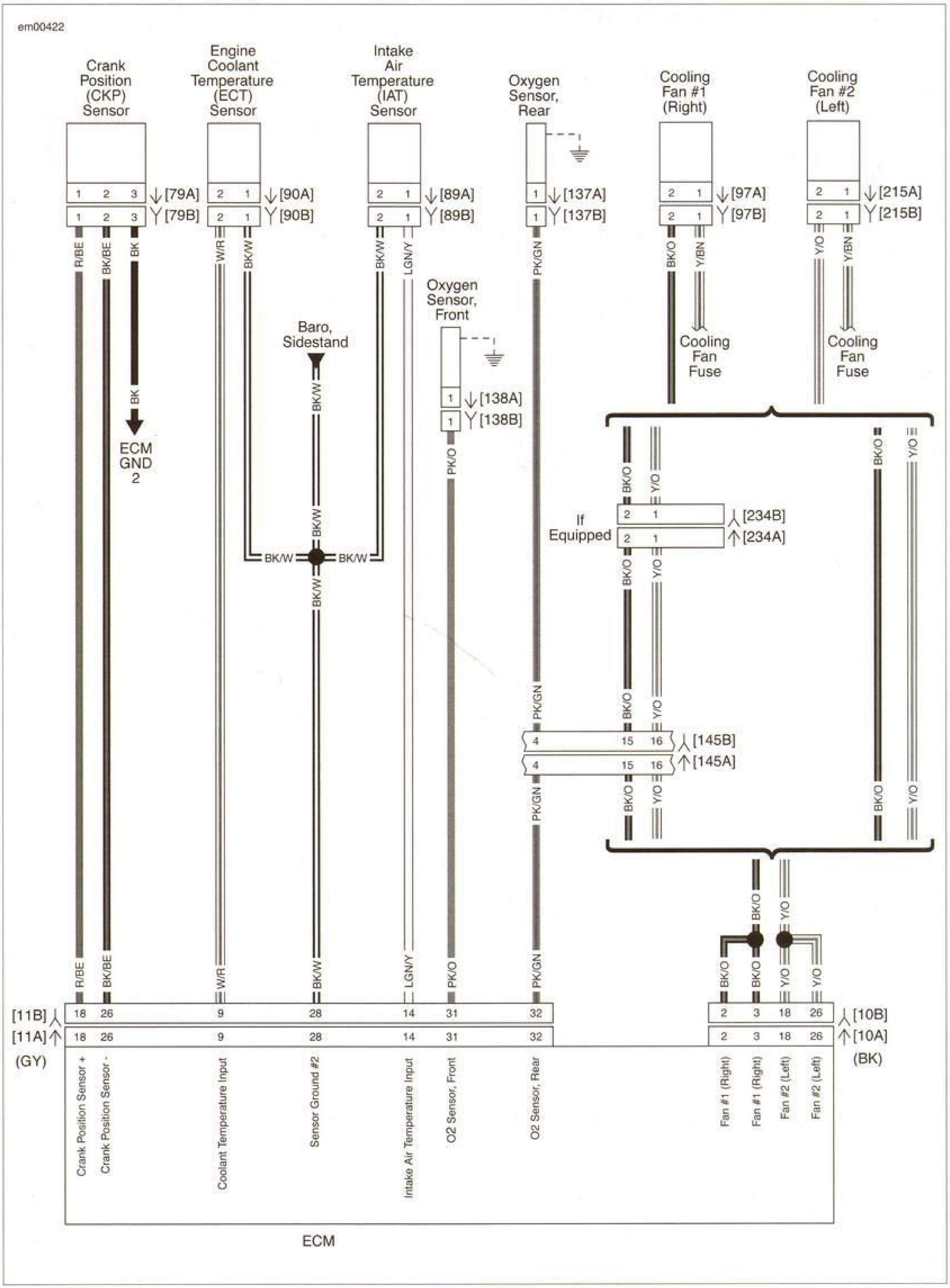
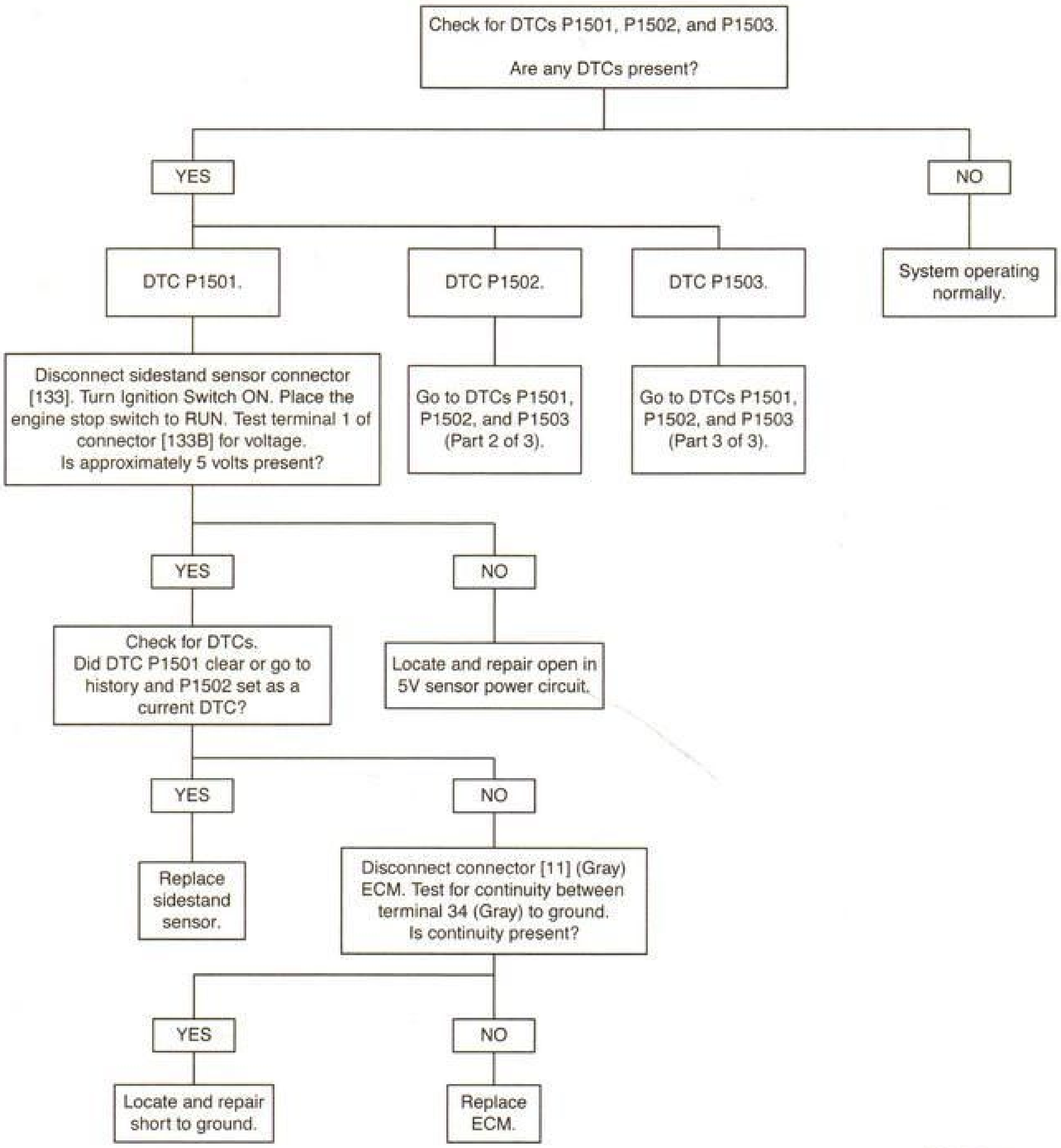


Figure 6-10. CKP, ECT, IAT, O2 sensors, and Cooling Fans

DTCs P1501, P1502, and P1503 (Part 1 of 3)



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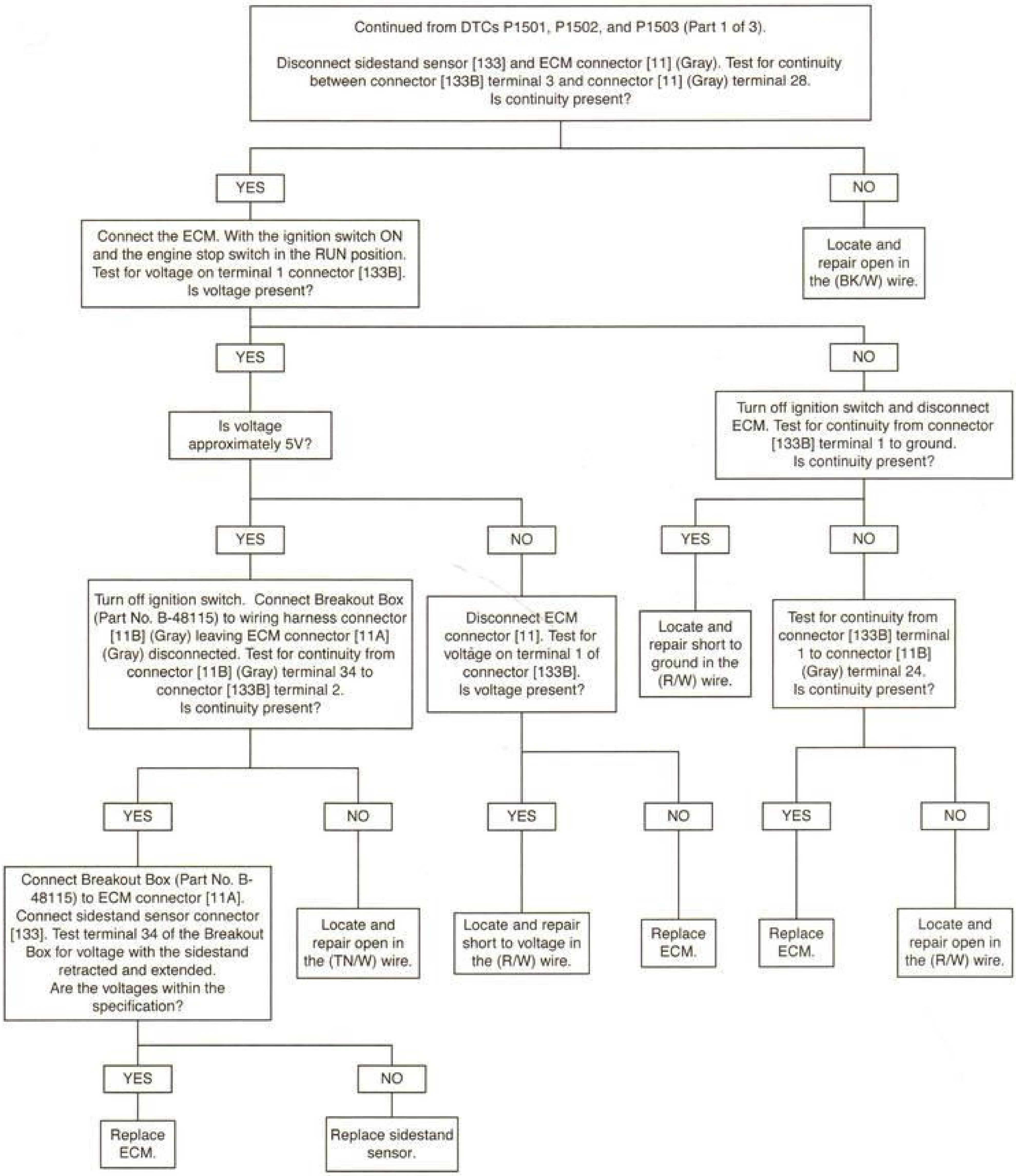
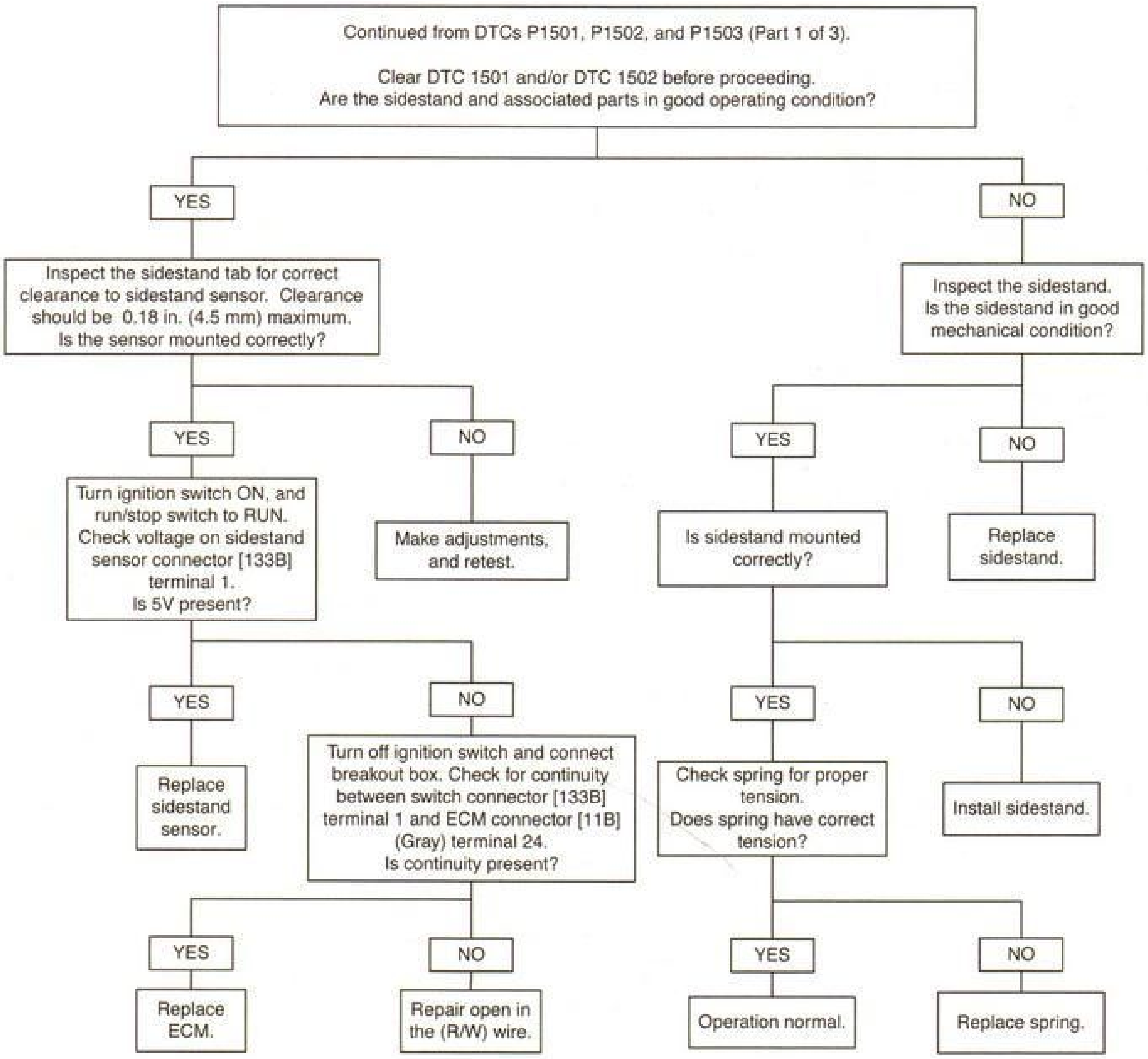
DTCs P1501, P1502, and P1503 (Part 2 of 3)



fc01875_en

DTCs P1501, P1502, and P1503 (Part 3 of 3)



fc01876_en

BANK ANGLE SENSOR (BAS): DTC P1151, P1152 6.10

DESCRIPTION AND OPERATION

See Figure 6-11. The Bank Angle Sensor (BAS) is located above the ECM inside the left radiator shroud. 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 0.24-3.4V under normal operating conditions. A BAS signal between 3.5-4.79V 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 6-10 and Table 6-11. A BAS code will not disable the vehicle and the engine will continue to run. A tipped vehicle will not set a DTC.

Table 6-10. Code Description

DTC	DESCRIPTION
P1151	BAS shorted low
P1152	BAS shorted high

Table 6-11. Bank Angle Sensor Voltage

MODE	VOLTS
Run	0.24-3.4
Disable	3.5-4.79

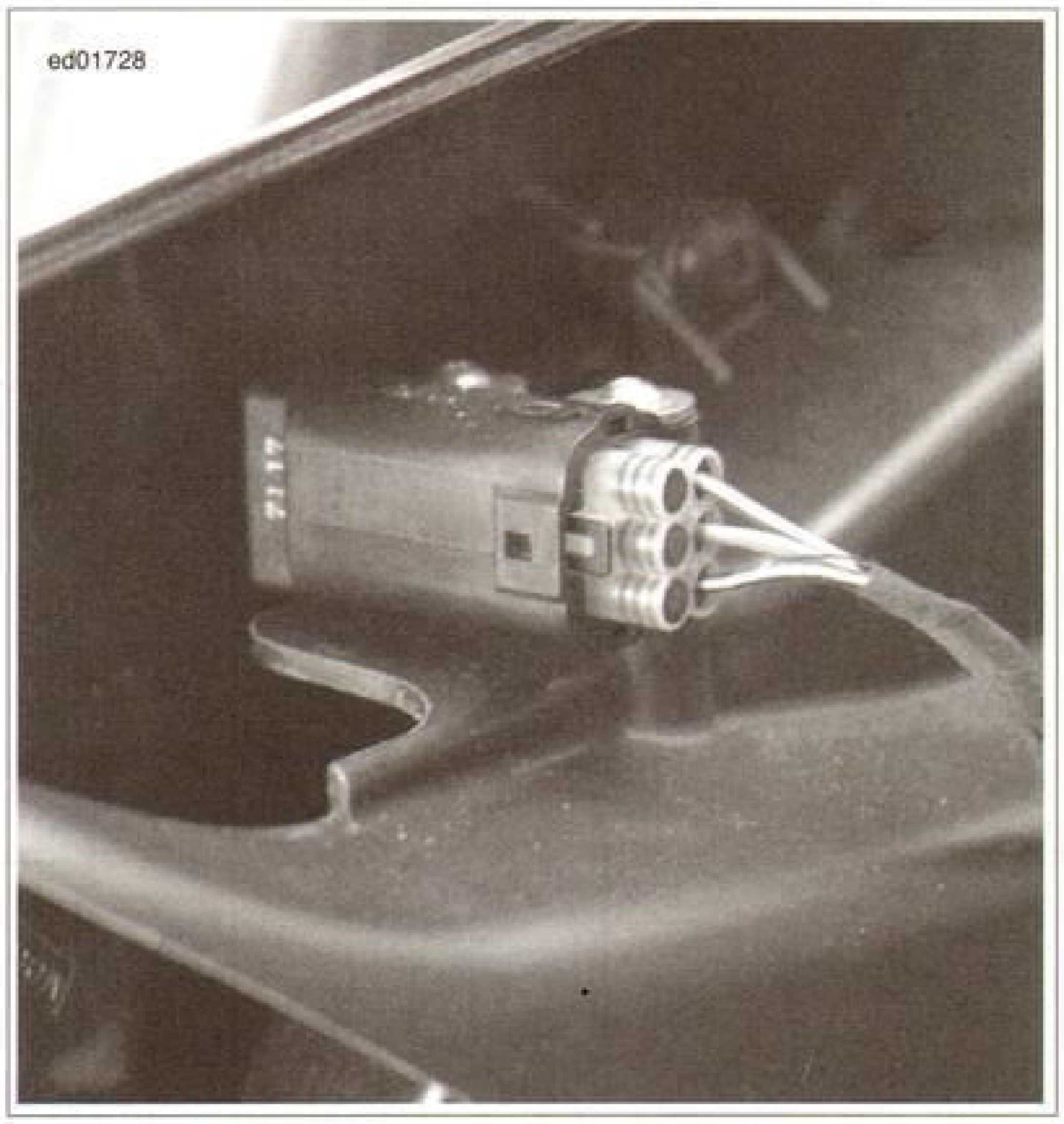


Figure 6-11. Bank Angle Sensor Location (Connector end showing)

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

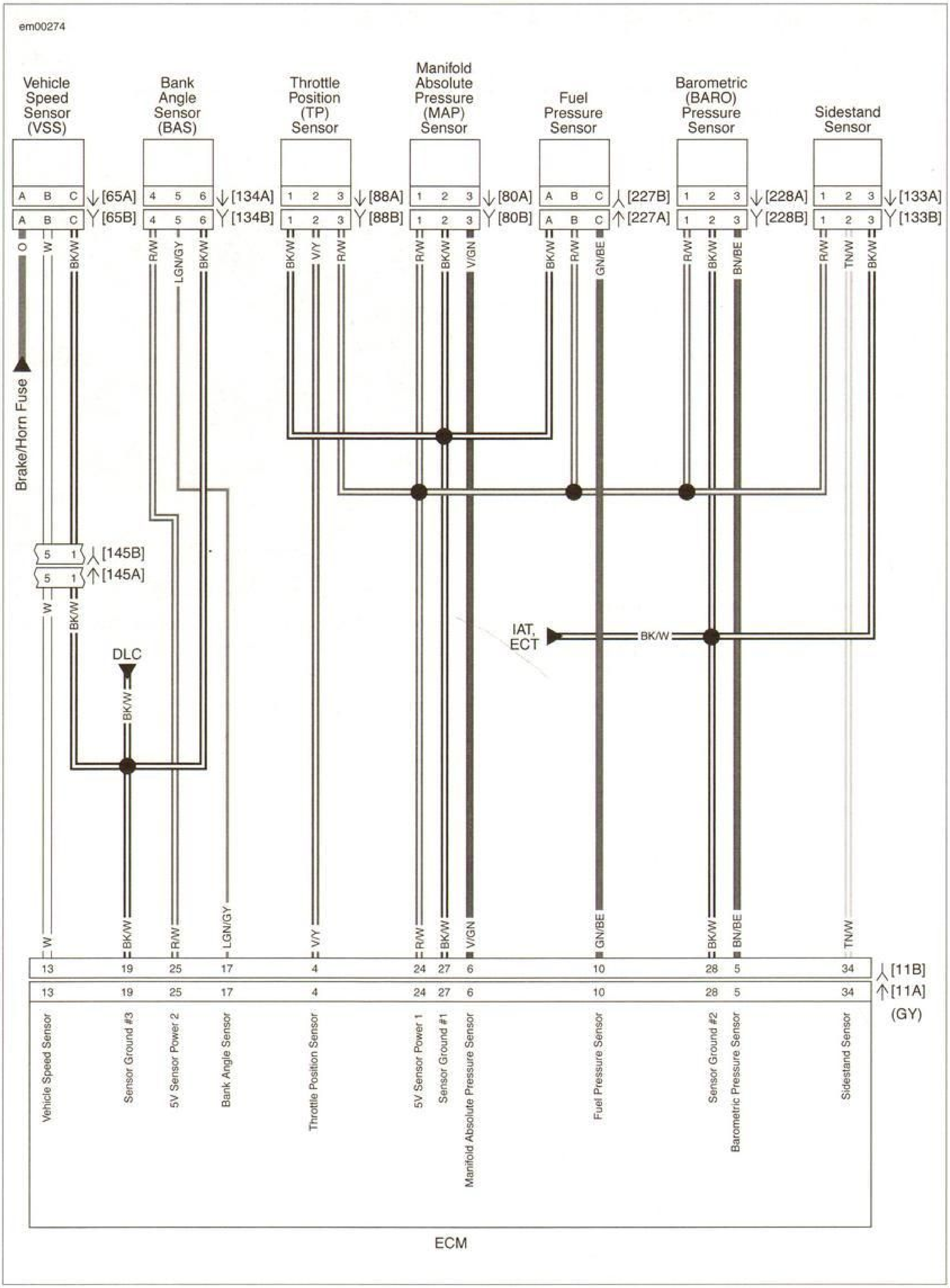
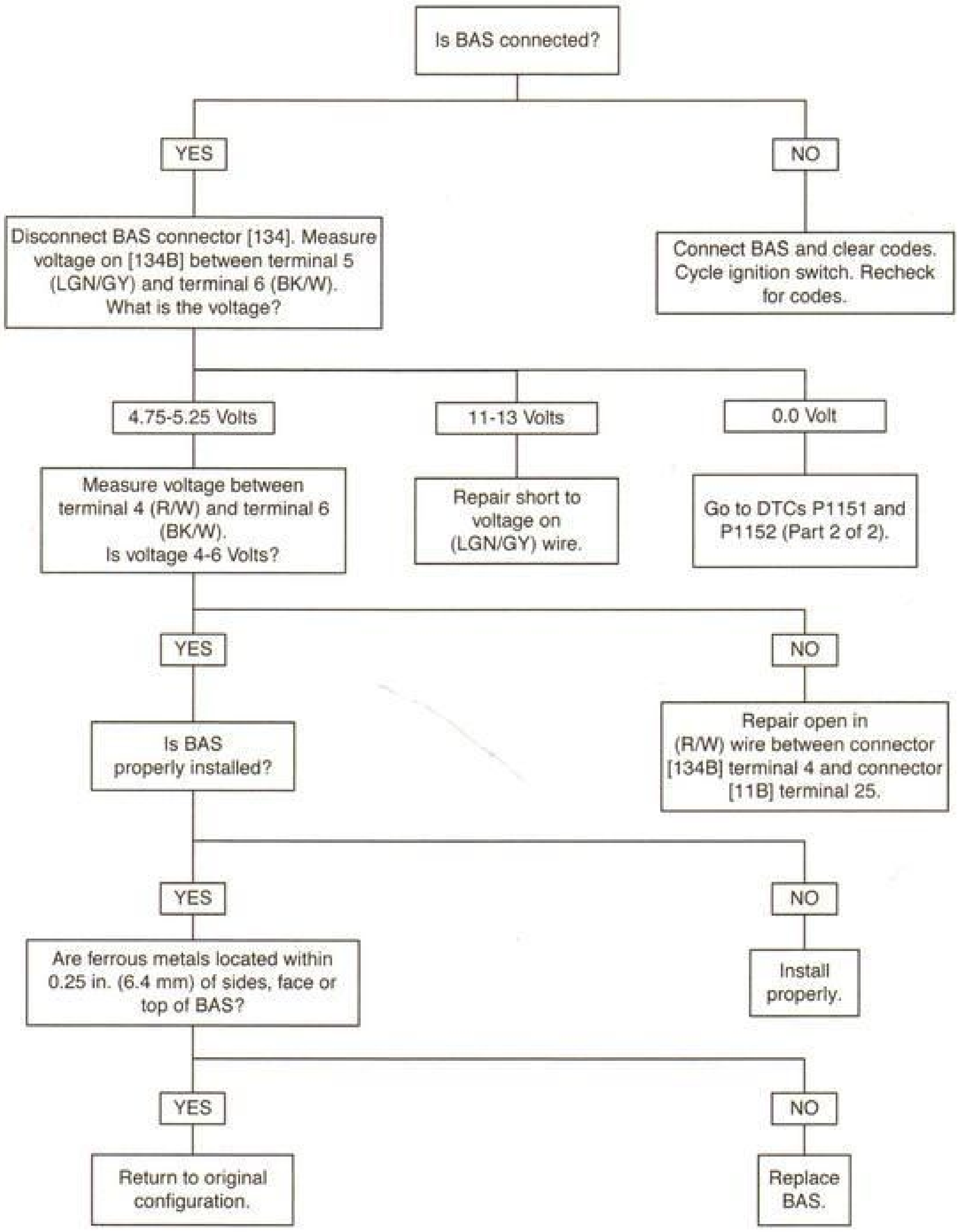
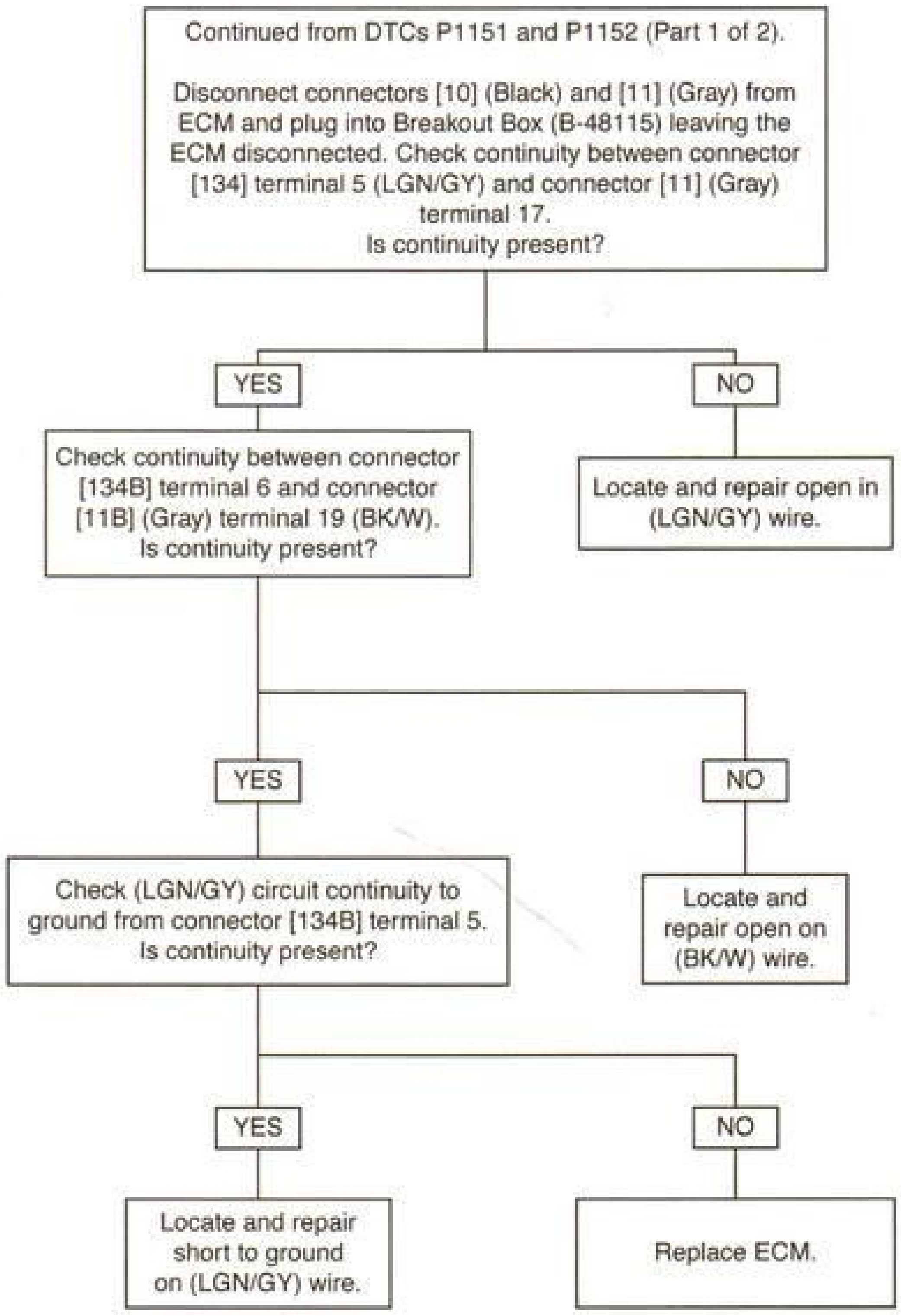


Figure 6-12. Bank Angle Sensor

DTCs P1151 and P1152 (Part 1 of 2)



fc01869_en


Continued from DTCs P1151 and P1152 (Part 1 of 2).
Disconnect connectors [10] (Black) and [11] (Gray) from ECM and plug into Breakout Box (B-48115) leaving the ECM disconnected. Check continuity between connector [134] terminal 5 (LGN/GY) and connector [11] (Gray) terminal 17.
Is continuity present?
YES
NO
Check continuity between connector [134B] terminal 6 and connector [11B] (Gray) terminal 19 (BK/W).
Is continuity present?
Locate and repair open in (LGN/GY) wire.
YES
NO
Check (LGN/GY) circuit continuity to ground from connector [134B] terminal 5.
Is continuity present?
Locate and repair open on (BK/W) wire.
YES
NO
Locate and repair short to ground on (LGN/GY) wire.
Replace ECM.

fc01870_en

DESCRIPTION AND OPERATION

See Figure 6-13. The clutch position sensor is located and attached separately on the backside of the left hand control. The sensor (momentary contact switch) is activated by the clutch lever.

See Figure 6-14. The neutral switch is located on the right side of the engine case, under the front pulley. The switch is activated when the shift lever is in neutral. In addition to providing an interlock function in the starting circuit, activation of the switch also illuminates the neutral (N) lamp on the instrument cluster.

DTCs P1154 and P1155 set when either the clutch switch circuit or neutral switch circuit is shorted to ground at speeds greater than 10 mph (16 km/h) for more than 60 seconds.

Refer to Table 6-12 for the codes and their descriptions.

Table 6-12. Code Description

DTC	DESCRIPTION
P1154	Clutch position sensor circuit low
P1155	Neutral switch input circuit low

Figure 6-13. Clutch Position Sensor Location

Figure 6-14. Neutral Switch Location

Diagnostic Tips

If the DTC is historic, check for intermittents

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

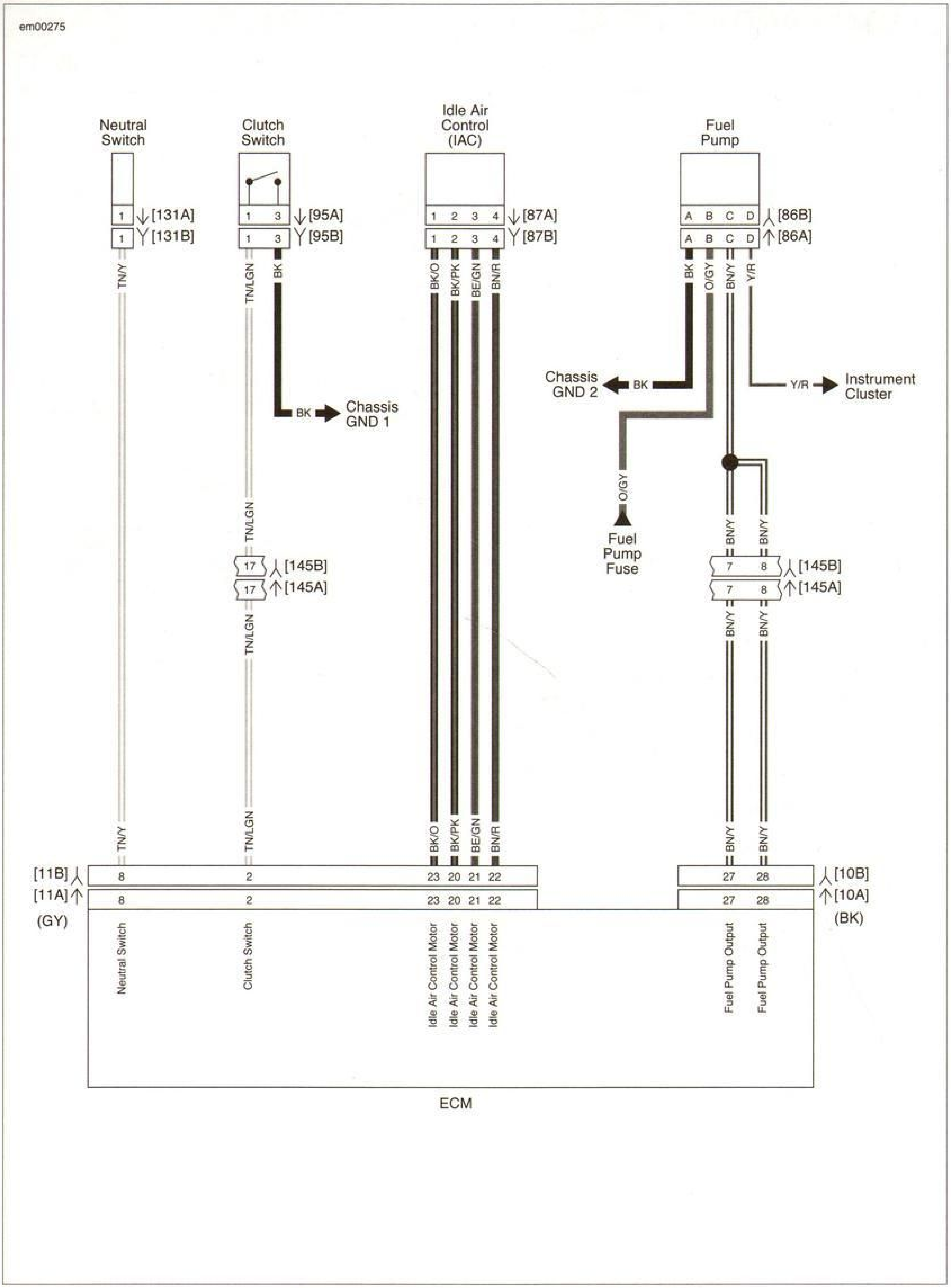
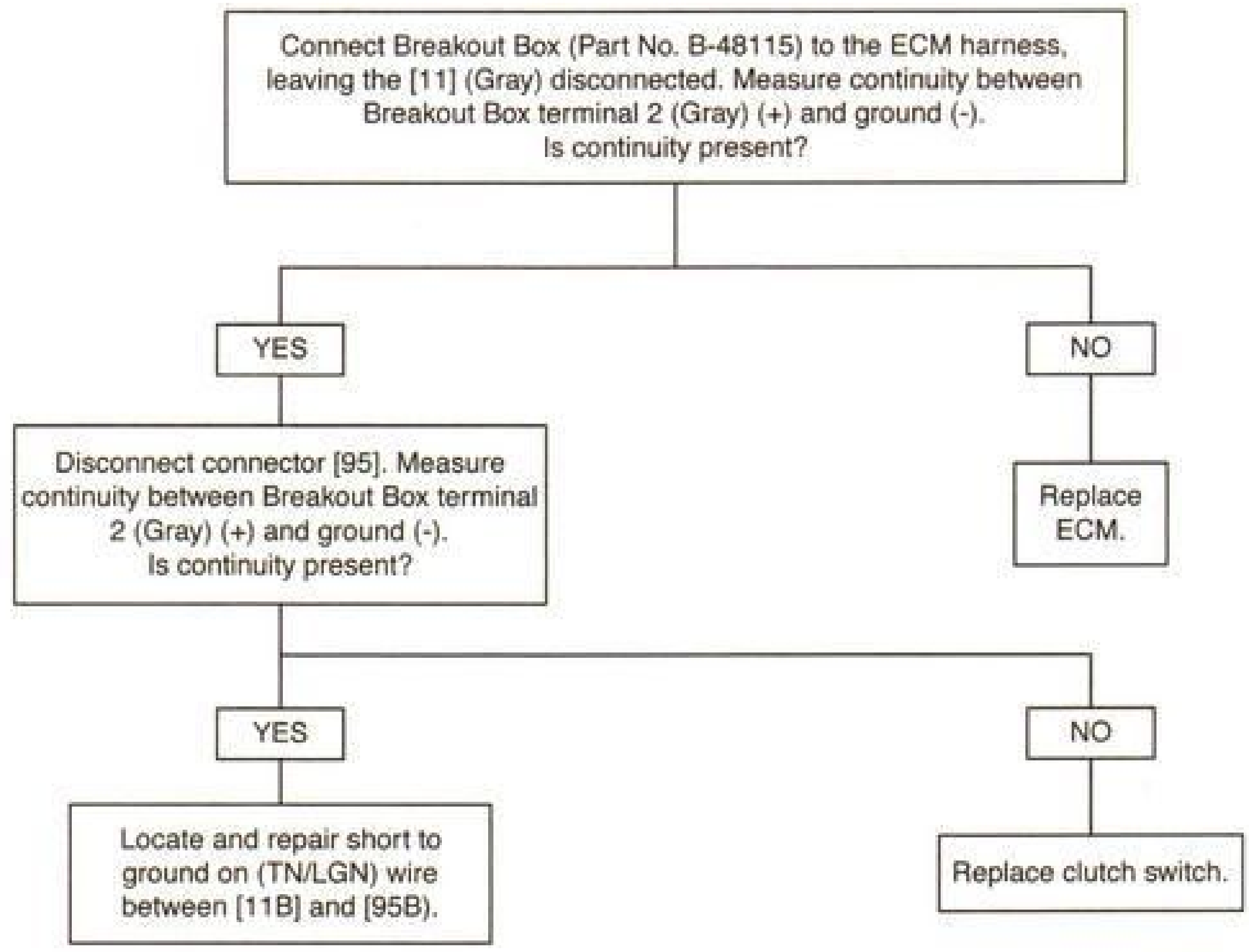
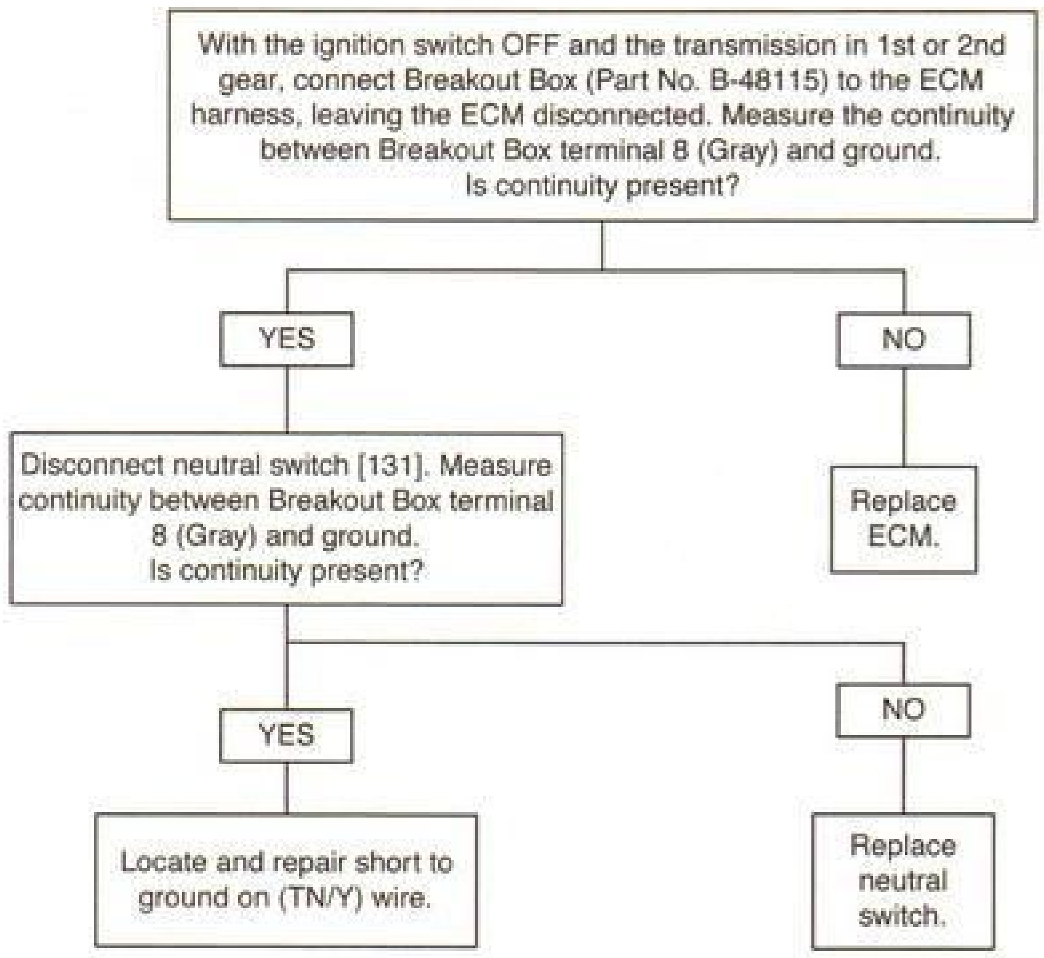


Figure 6-15. Neutral and Clutch Switch, IAC and Fuel Pump

DTC P1154



fc01872_en


With the ignition switch OFF and the transmission in 1st or 2nd gear, connect Breakout Box (Part No. B-48115) to the ECM harness, leaving the ECM disconnected. Measure the continuity between Breakout Box terminal 8 (Gray) and ground. Is continuity present?
YES
NO
Disconnect neutral switch [131]. Measure continuity between Breakout Box terminal 8 (Gray) and ground. Is continuity present?
Replace ECM.
YES
NO
Locate and repair short to ground on (TN/Y) wire.
Replace neutral switch.

fc01873_en

IGNITION COILS: DTC P2300, P2301, P2303, P2304 6.12

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
B-48115	BREAKOUT BOX

See Figure 6-16. There is no traditional spark plug wire when using this coil because the shaft connects directly to the spark plug itself. A combination of codes set if the ignition coil rise-time is out of range. This could occur if there is an open ignition coil or loss of power to the ignition coil. When multiple codes set, the cause may be an ignition coil failure.

See Figure 6-17 and Figure 6-18. The ignition coils receive power on terminal 3 (GY) wire when the ignition relay energizes. Refer to Table 6-13 for possible DTCs and their descriptions.

Table 6-13. Code Description

DTC	DESCRIPTION
P2300	Front ignition coil control circuit low
P2301	Front ignition coil control circuit high
P2303	Rear ignition coil control circuit low
P2304	Rear ignition coil control circuit high

Figure 6-16. Ignition Coil

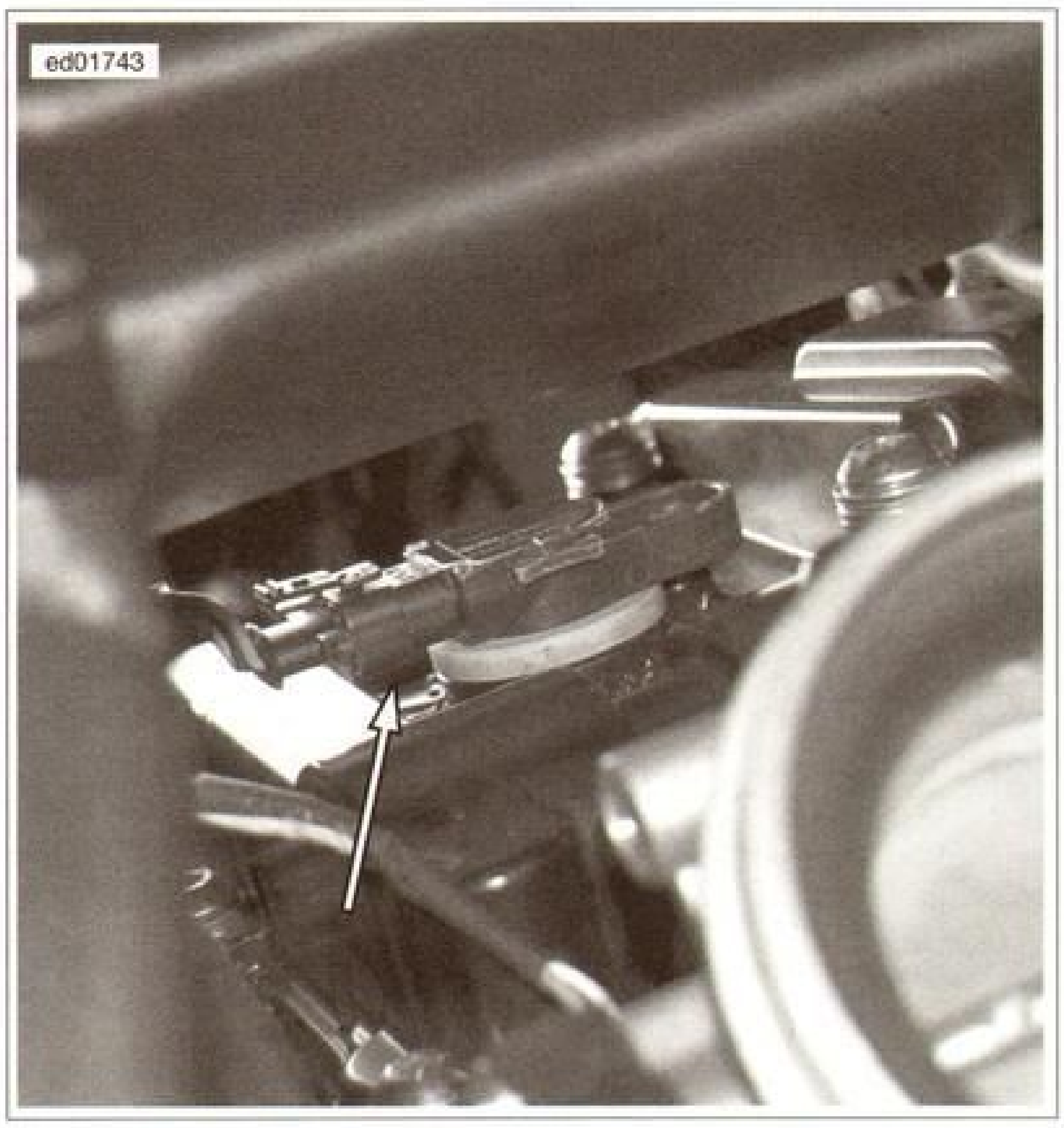


Figure 6-17. Ignition Coil Location (Front)

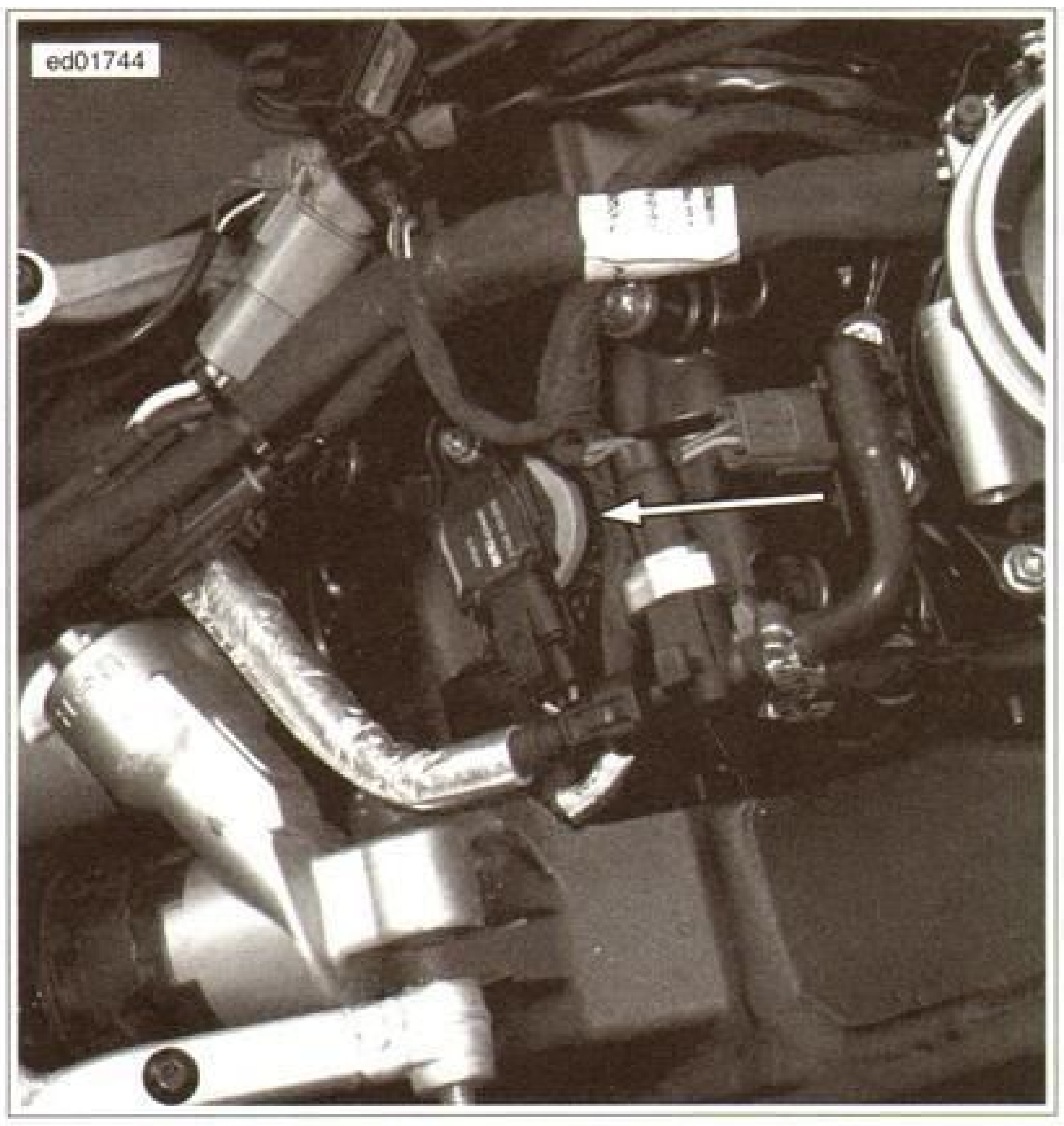


Figure 6-18. Ignition Coil Location (Rear)

Diagnostic Tips

- See Figure 6-19. Cranking the engine with a test lamp in place of the ignition coil may cause DTCs to set. This condition is normal and does not by itself indicate a malfunction. Clear the codes if this condition occurs.

- To isolate the wire harness during testing, disconnect the ignition coil and install the BREAKOUT BOX (Part No. B-48115) to the harness leaving the ECM disconnected.
- Use gray pin probes when checking ignition coil connectors.

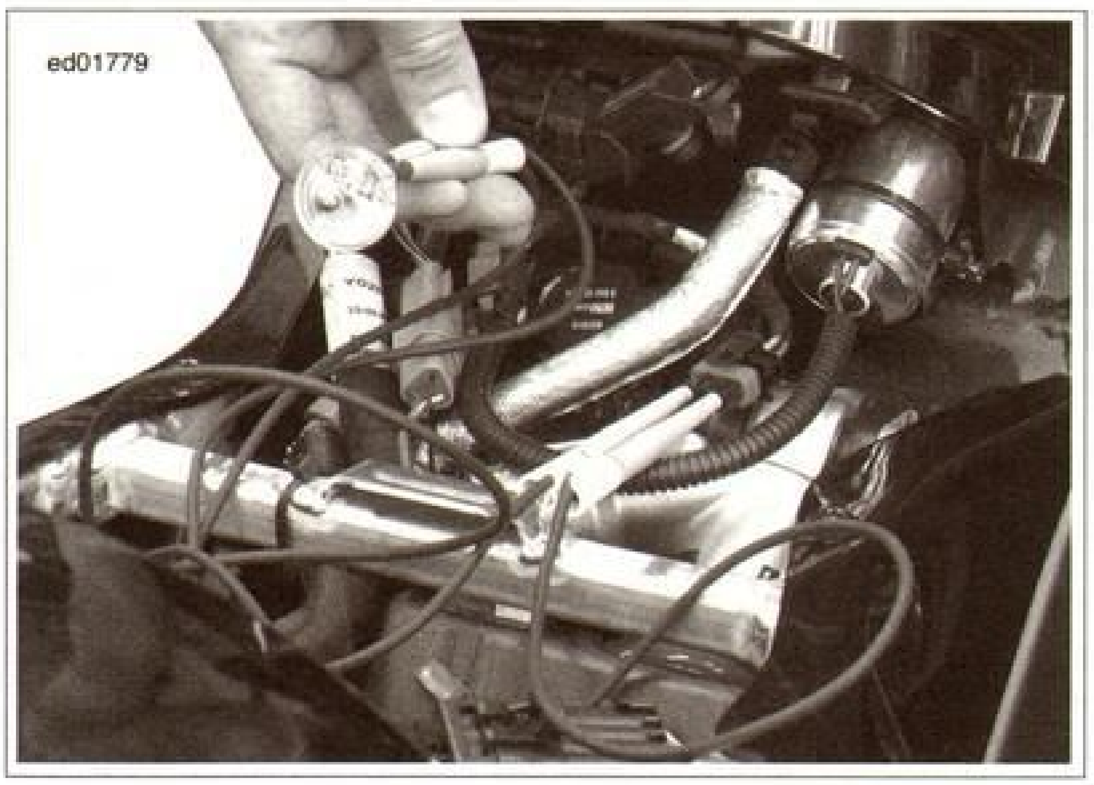


Figure 6-19. Ignition Coil Circuit Test

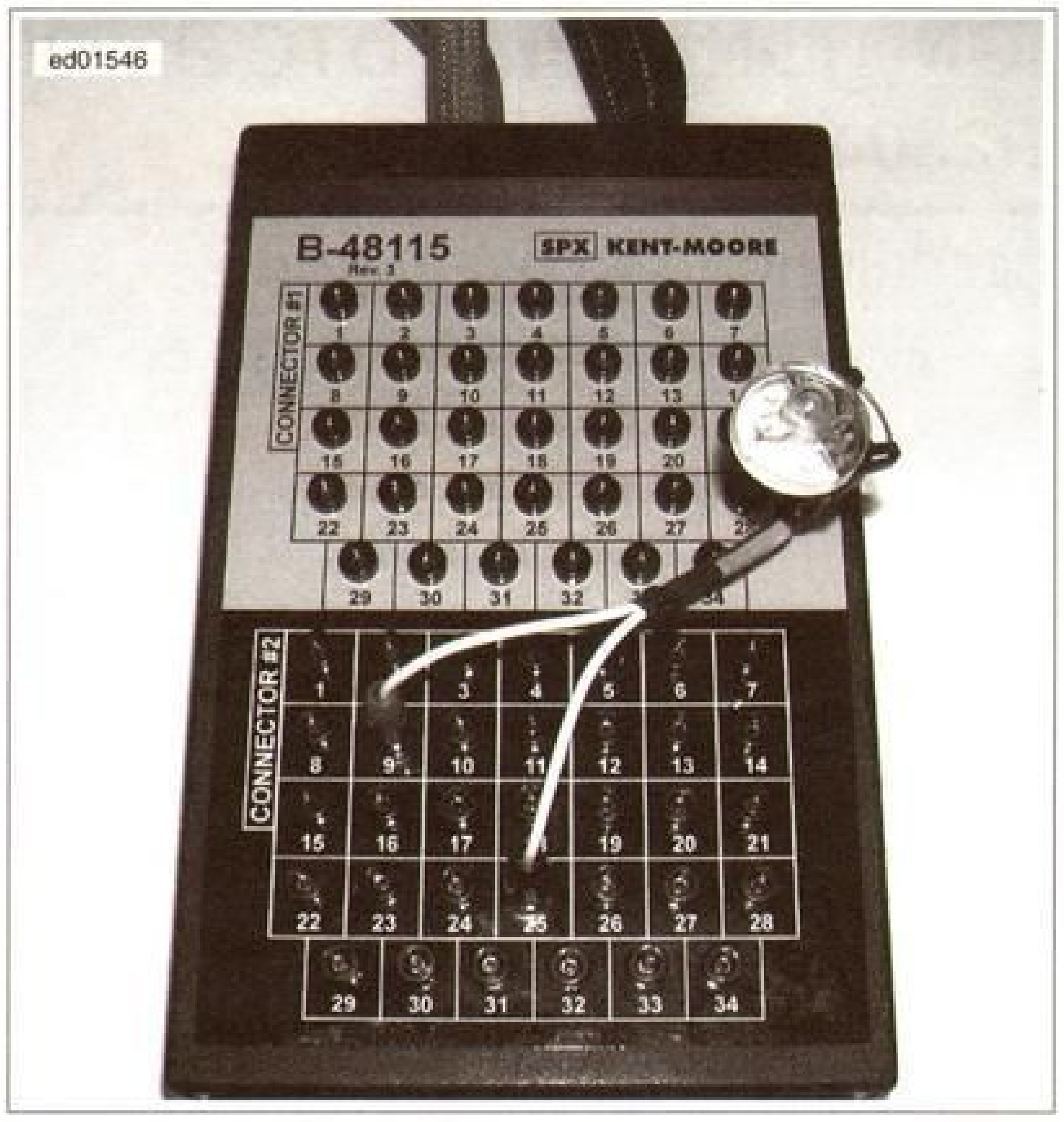


Figure 6-20. ECM Driver Test

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

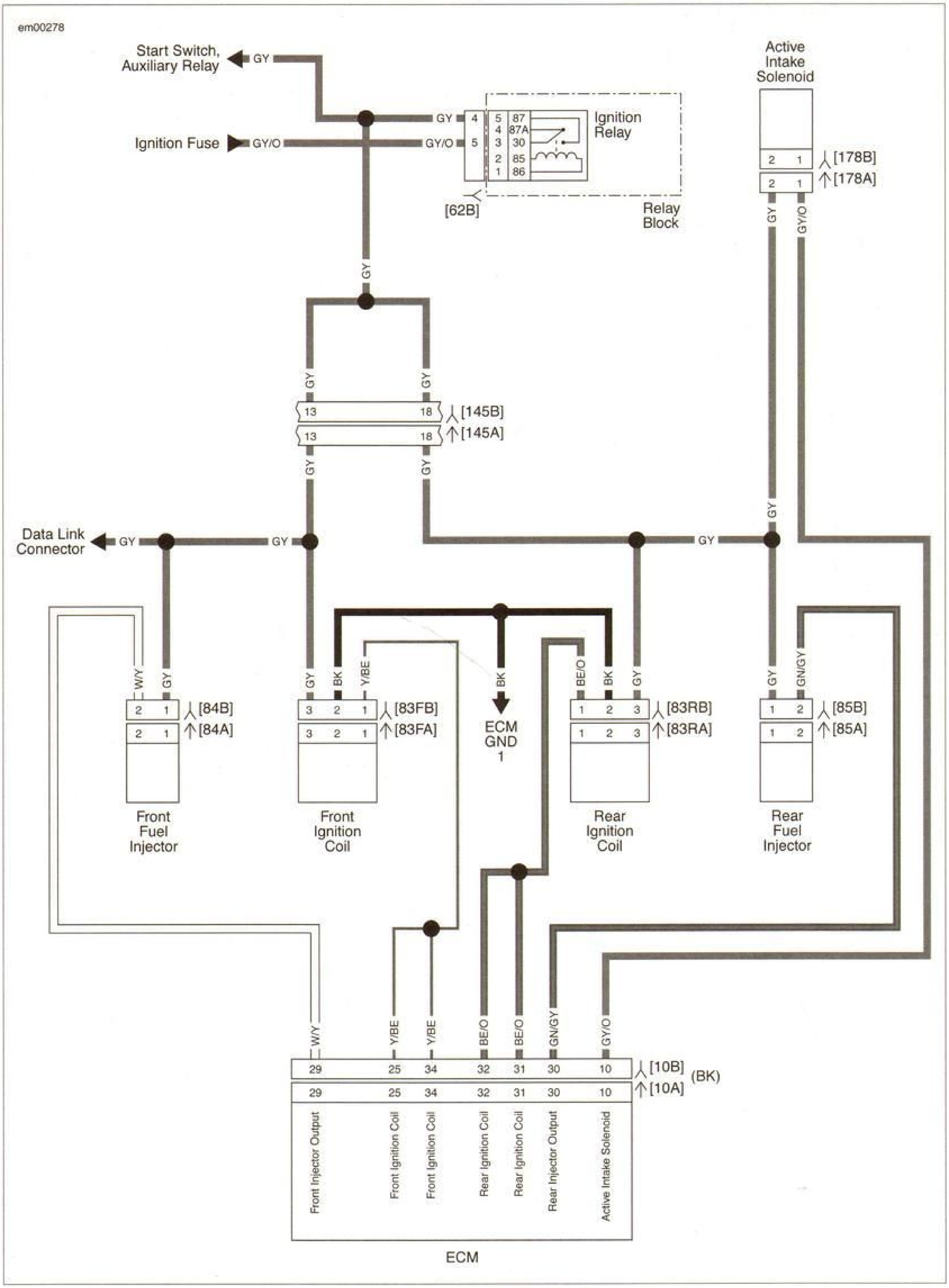
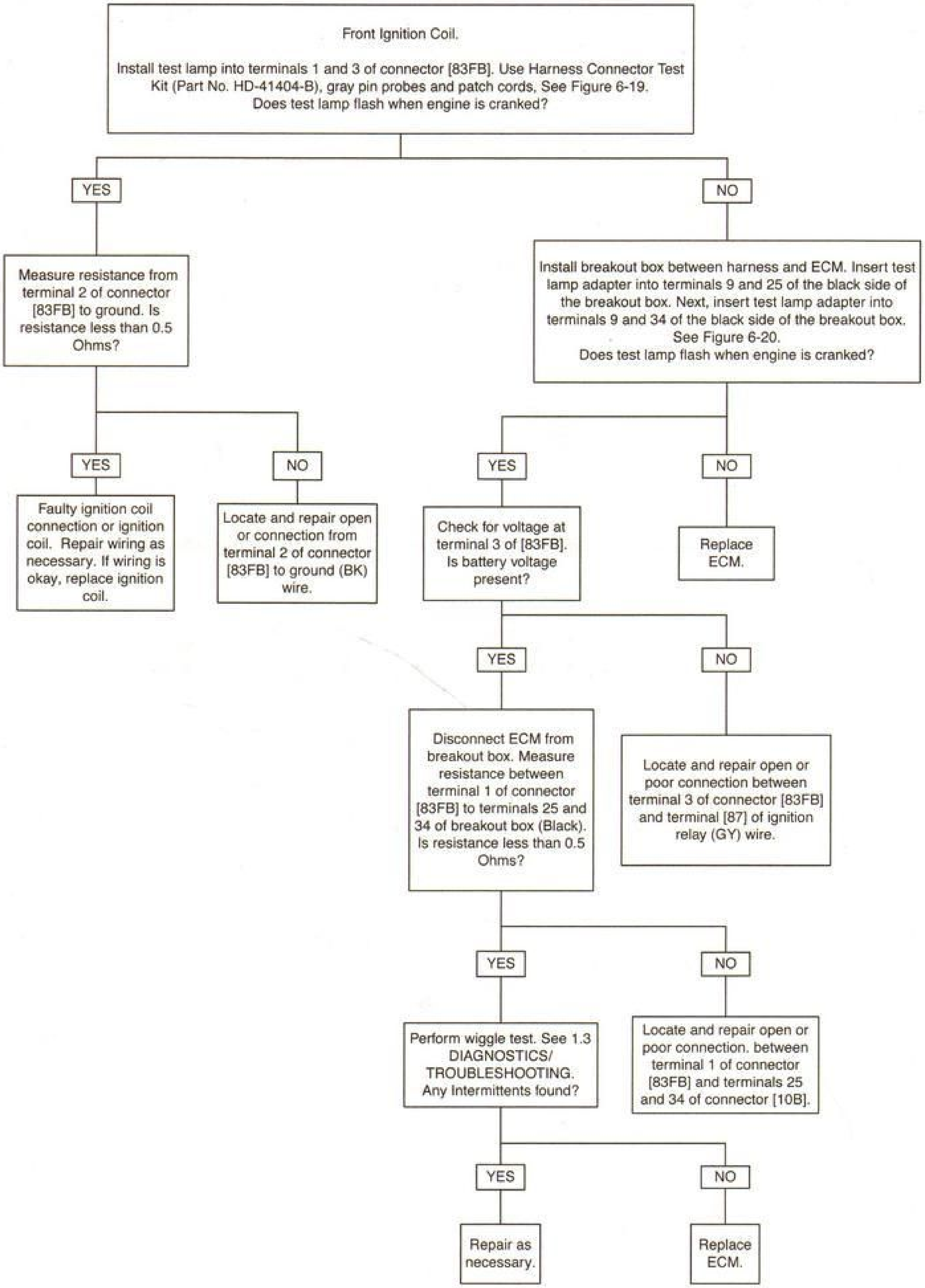


Figure 6-21. Injectors, Coils, and Active Intake


Front Ignition Coil.
Install test lamp into terminals 1 and 3 of connector [83FB]. Use Harness Connector Test Kit (Part No. HD-41404-B), gray pin probes and patch cords, See Figure 6-19.
Does test lamp flash when engine is cranked?
YES
NO
Measure resistance from terminal 2 of connector [83FB] to ground. Is resistance less than 0.5 Ohms?
Install breakout box between harness and ECM. Insert test lamp adapter into terminals 9 and 25 of the black side of the breakout box. Next, insert test lamp adapter into terminals 9 and 34 of the black side of the breakout box. See Figure 6-20.
Does test lamp flash when engine is cranked?
YES
NO
YES
NO
Faulty ignition coil connection or ignition coil. Repair wiring as necessary. If wiring is okay, replace ignition coil.
Locate and repair open or connection from terminal 2 of connector [83FB] to ground (BK) wire.
Check for voltage at terminal 3 of [83FB]. Is battery voltage present?
Replace ECM.
YES
NO
Disconnect ECM from breakout box. Measure resistance between terminal 1 of connector [83FB] to terminals 25 and 34 of breakout box (Black). Is resistance less than 0.5 Ohms?
Locate and repair open or poor connection between terminal 3 of connector [83FB] and terminal [87] of ignition relay (GY) wire.
YES
NO
Perform wiggle test. See 1.3 DIAGNOSTICS/ TROUBLESHOOTING. Any Intermittents found?
Locate and repair open or poor connection. between terminal 1 of connector [83FB] and terminals 25 and 34 of connector [10B].
YES
NO
Repair as necessary.
Replace ECM.

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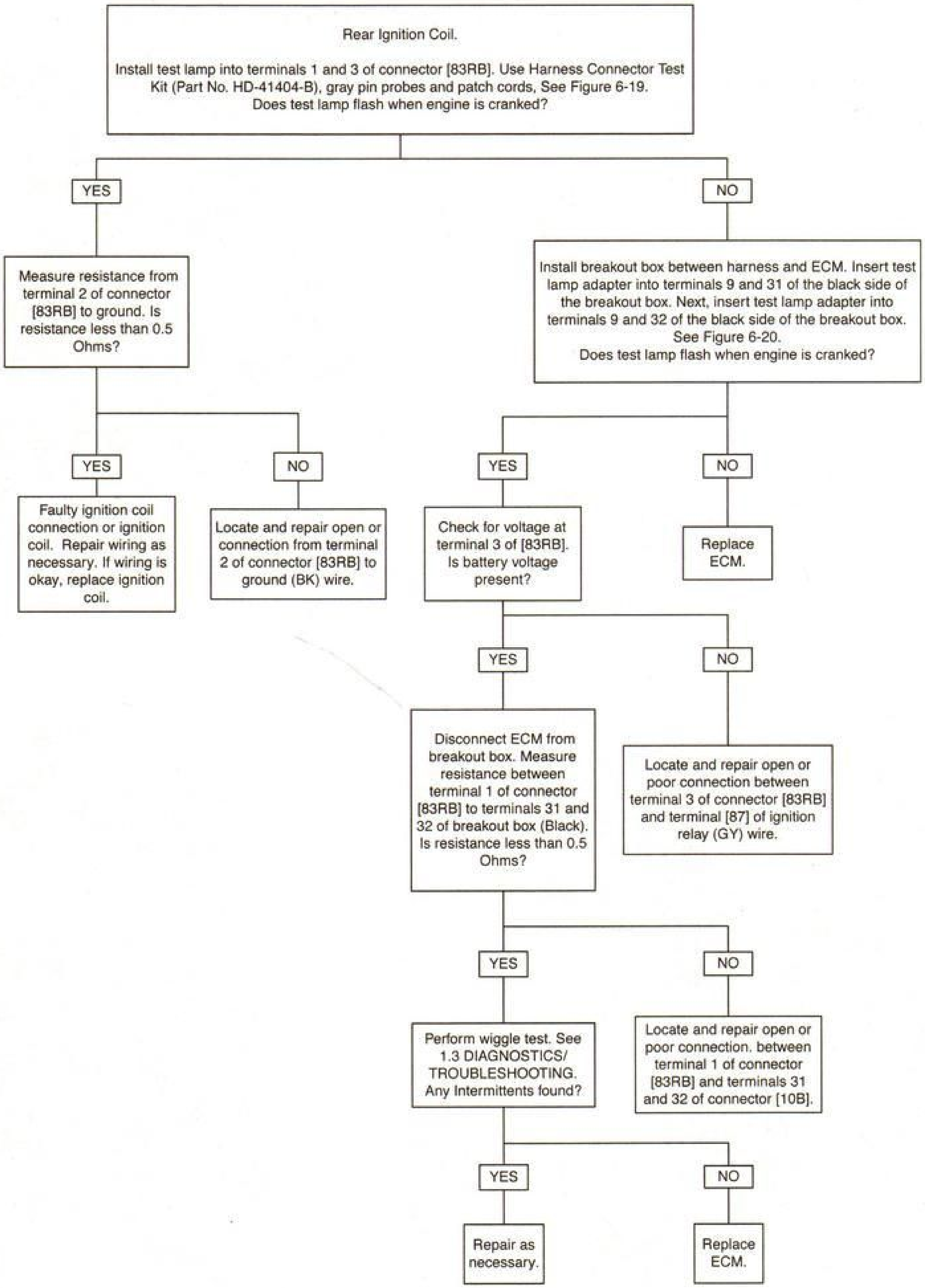
DTCs P2303 and P2304



fc01932_en

FUEL INJECTORS: DTC P0261, P0262, P0264, P0265 6.13

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
B-48115	BREAKOUT BOX

See Figure 6-22 and Figure 6-23. The fuel injectors are solenoids that allow pressurized fuel to be sprayed into the engine combustion chambers through the intake flange. The fuel injectors are timed to the engine cycle and triggered sequentially.

Electrical power for the fuel injectors comes from the ignition relay. The ECM provides the ground path to trigger fuel injector operation. Refer to Table 6-14 for DTCs and explanations.

NOTE

Front and rear fuel injectors are interchangeable on the 1125 engine.

Table 6-14. Code Description

DTC	DESCRIPTION
P0261	Front fuel injector circuit low
P0262	Front fuel injector circuit high
P0264	Rear fuel injector circuit low
P0265	Rear fuel injector circuit high

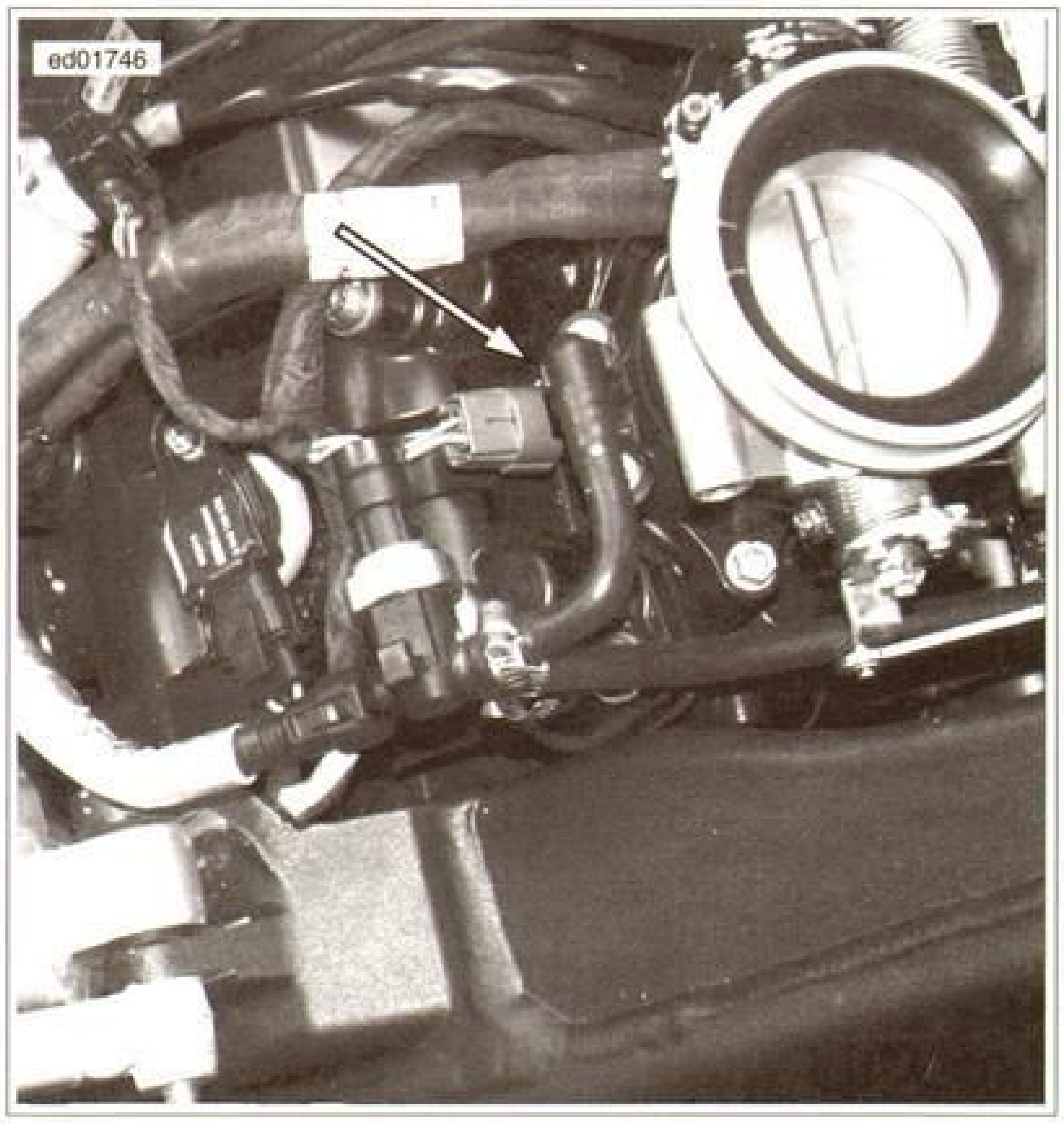


Figure 6-23. Fuel Injector Location (Rear)

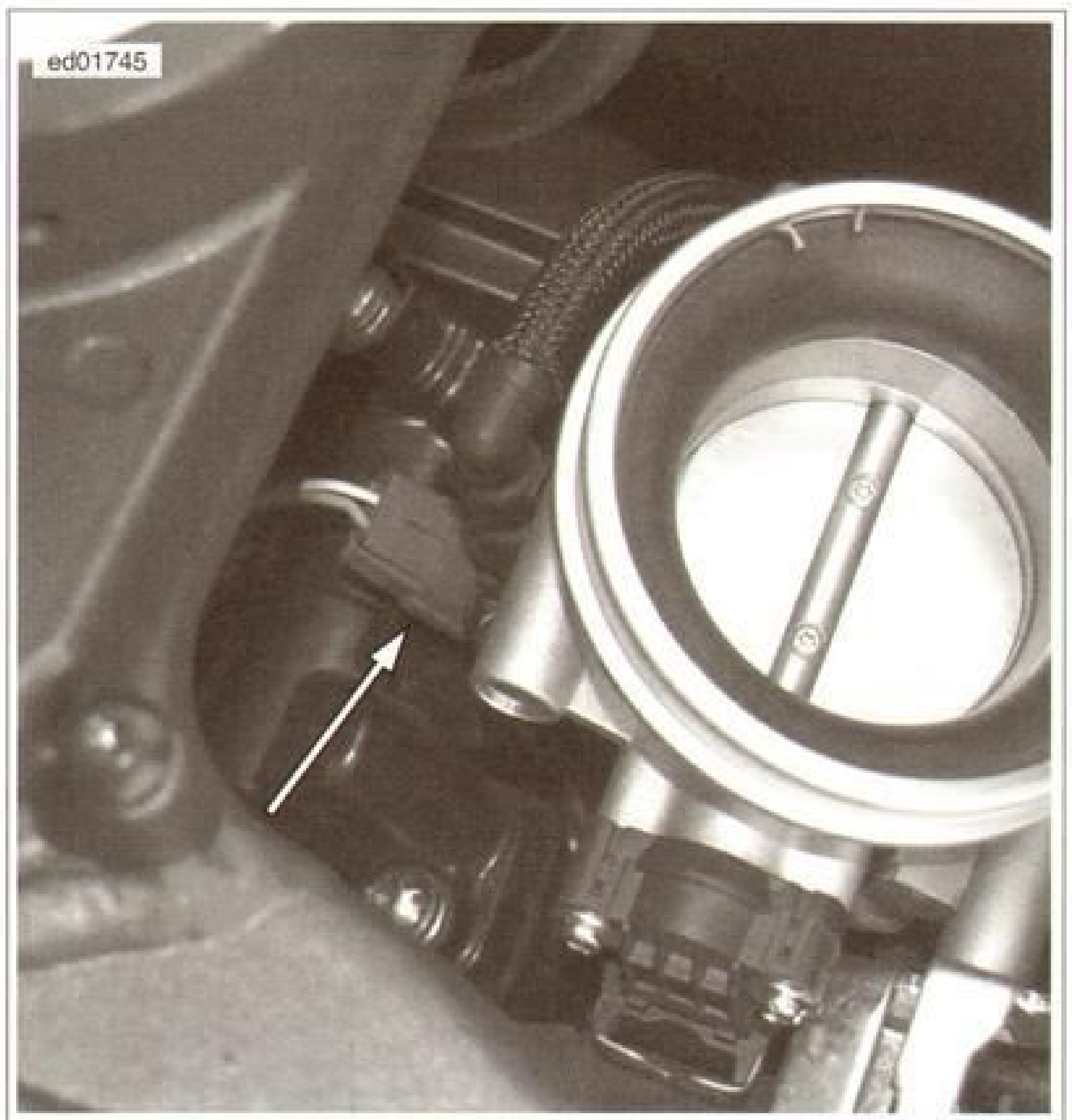


Figure 6-22. Fuel Injector Location (Front)

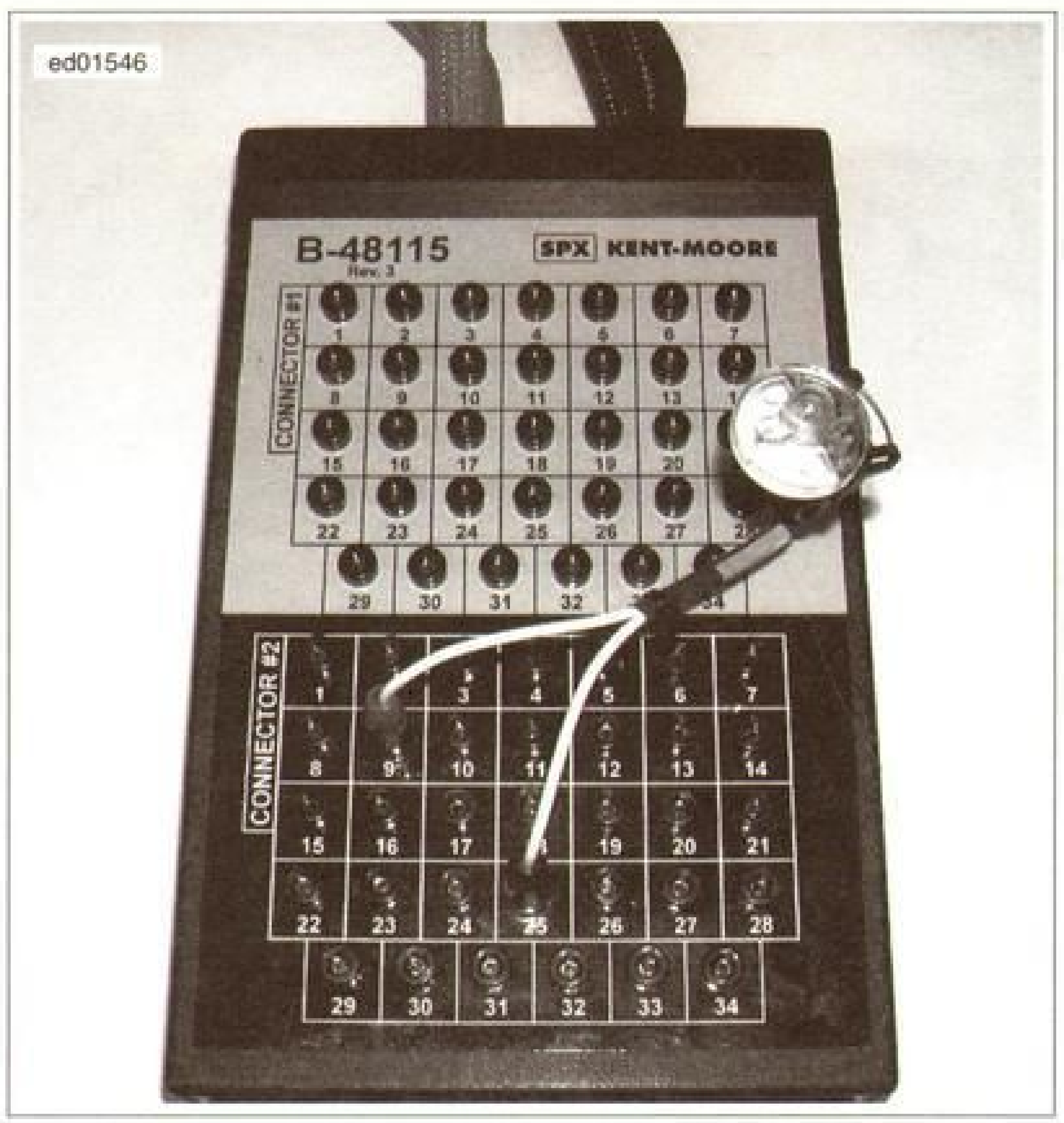


Figure 6-24. Fuel Injector Circuit Tester (Typical Connections)

Diagnostic Tips

Ignition relay failure or certain wiring harness problems causes 12V power to be lost to both fuel injectors, both ignition coils, ECM, and fuel pump

Purge fuel line before testing fuel injector operation. See the service manual.

Use BREAKOUT BOX (Part No. B-48115) as shown in Figure 6-24 but place jumpers in terminals 32 (high) and 33 (low) or 34 (high) and 33 (low) for the rear and front injectors, respectively.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

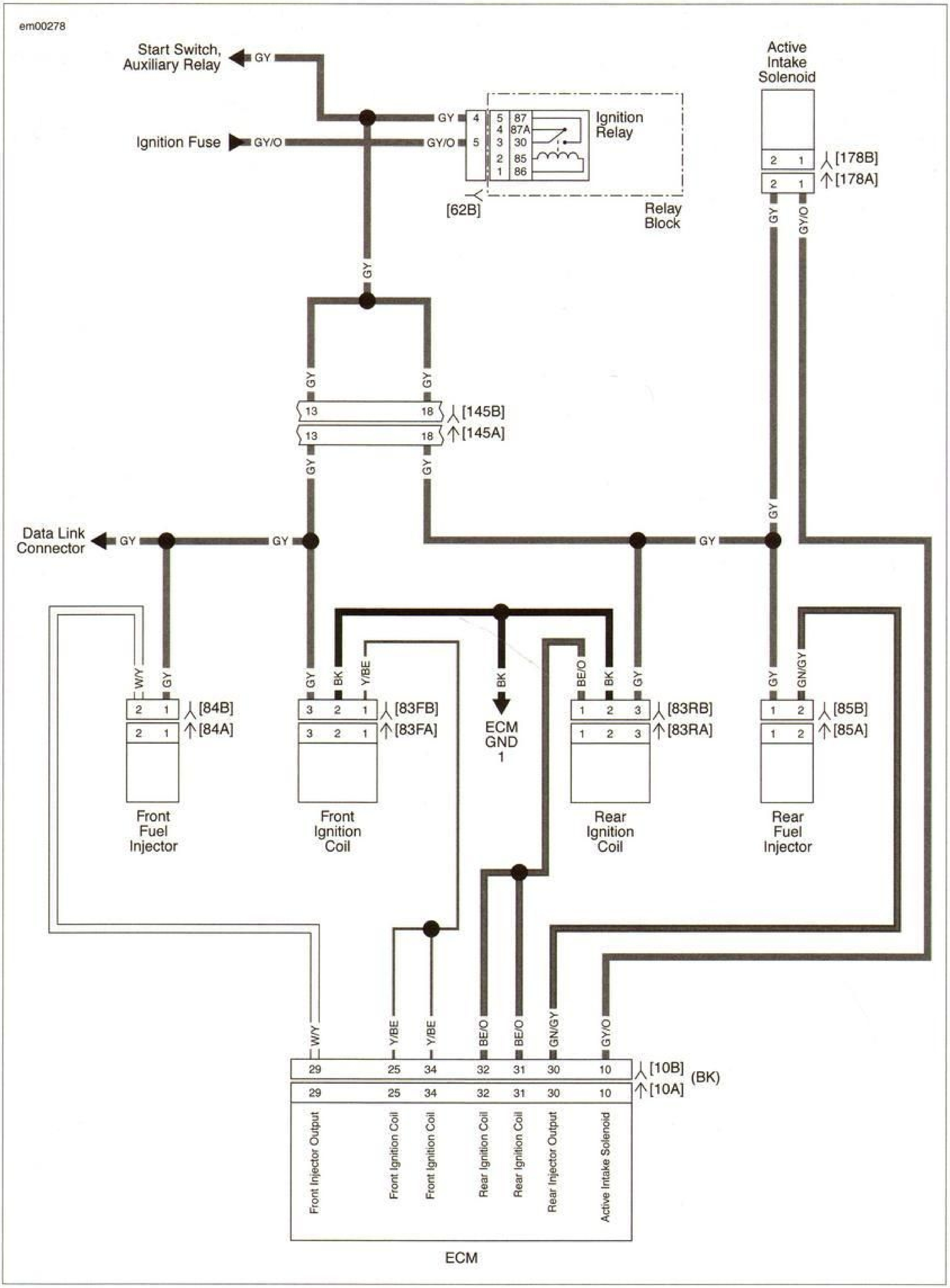
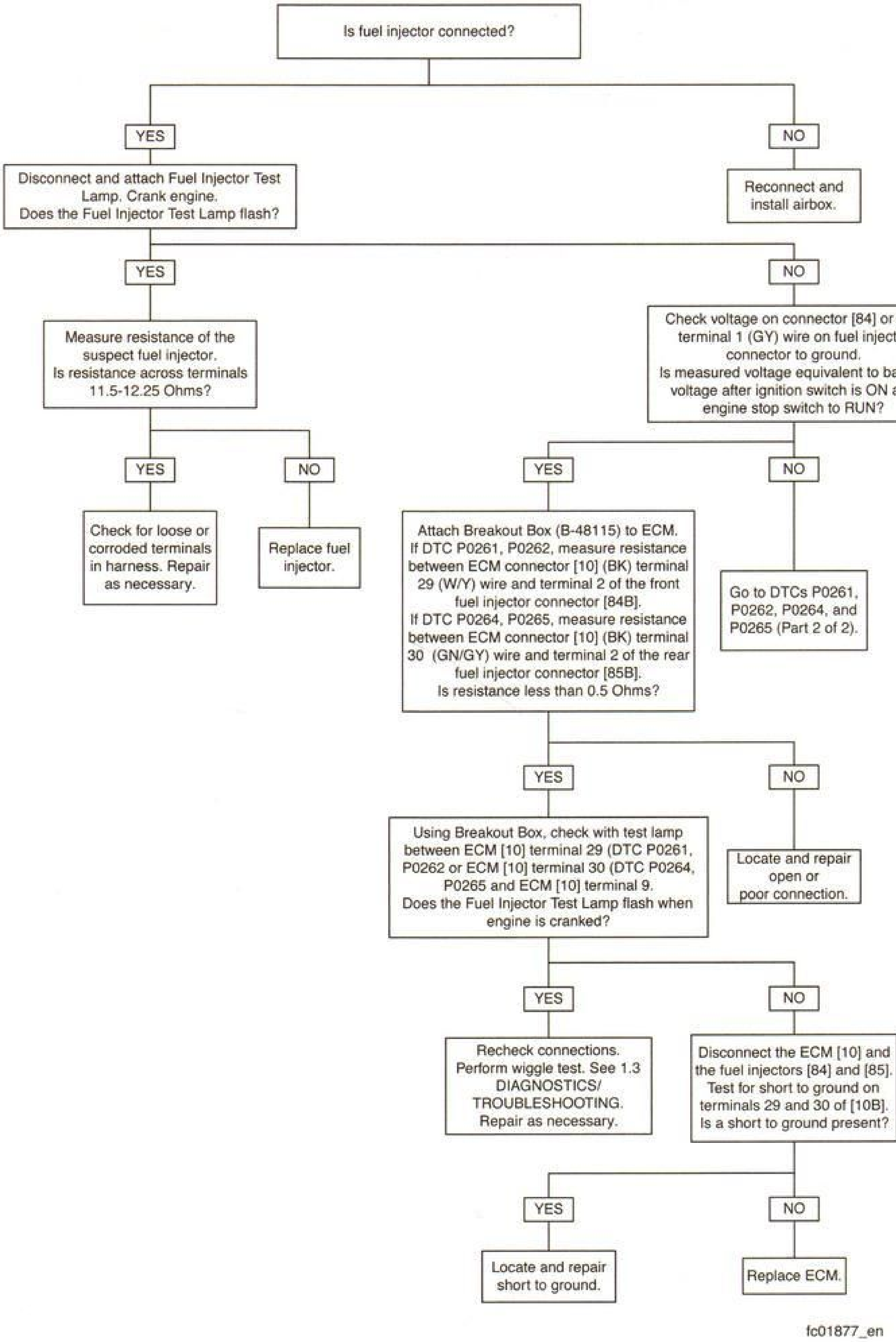
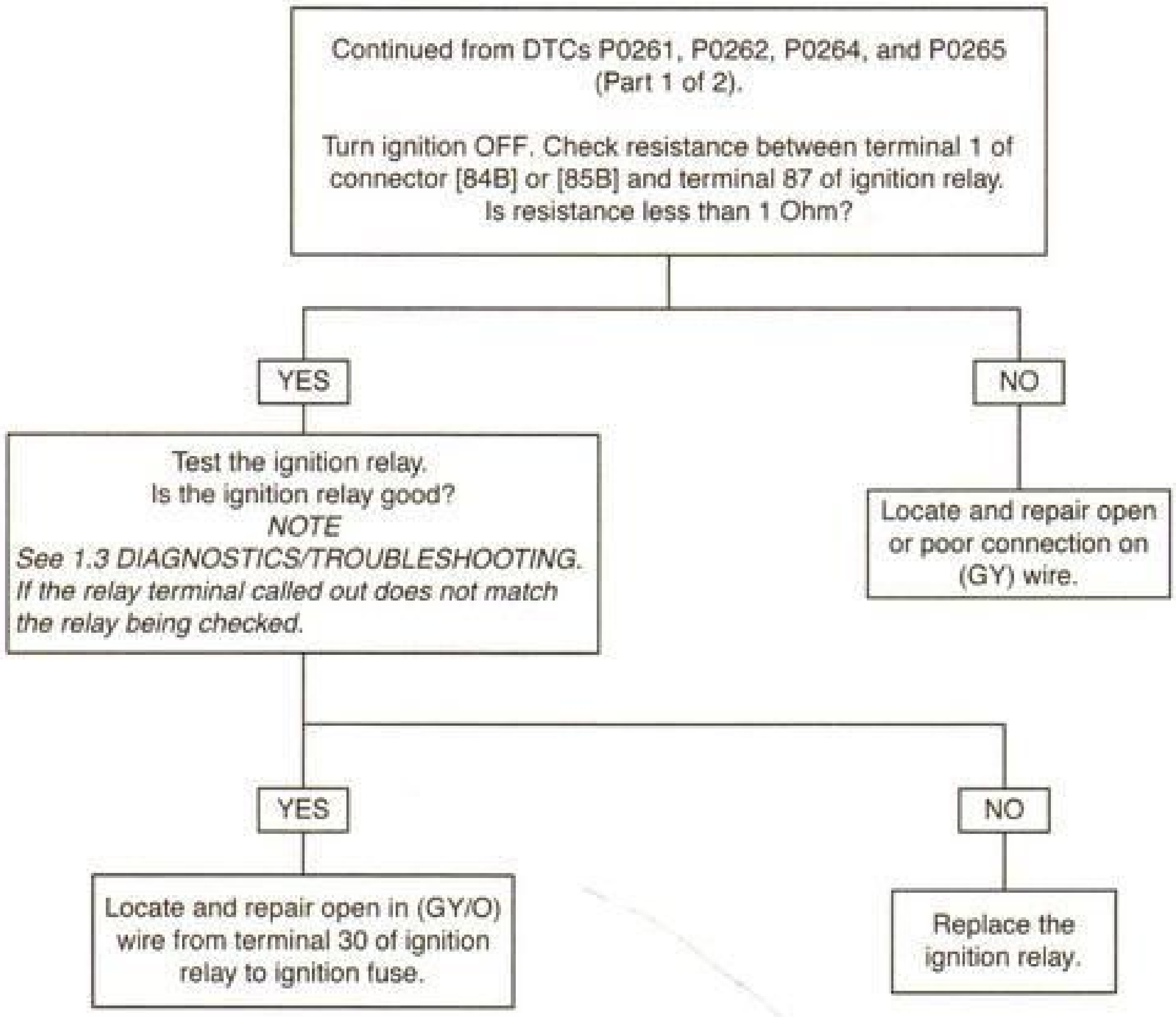


Figure 6-25. Injectors, Coils, and Active Intake

DTCs P0261, P0262, P0264, and P0265 (Part 1 of 2)



DTCs P0261, P0262, P0264, and P0265 (Part 2 of 2)



fc01878_en

DESCRIPTION AND OPERATION

See Figure 6-26. When the starter switch is pushed, the start relay is activated and battery current flows to the starter solenoid and removes power from the lighting circuit, allowing maximum battery current to flow to the starter motor. When the starter switch is released, the start relay de-energizes, the starter solenoid disconnects voltage from the starter motor, and the lighting circuit functions normally. The ECM controls the ground to the relay, which it disables during security and tip over conditions. The ECM sets DTC P0617, when it detects voltage always present on ECM terminal 7 of connector [10].

NOTE

The start relay is not repairable. Replace the unit if it fails.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

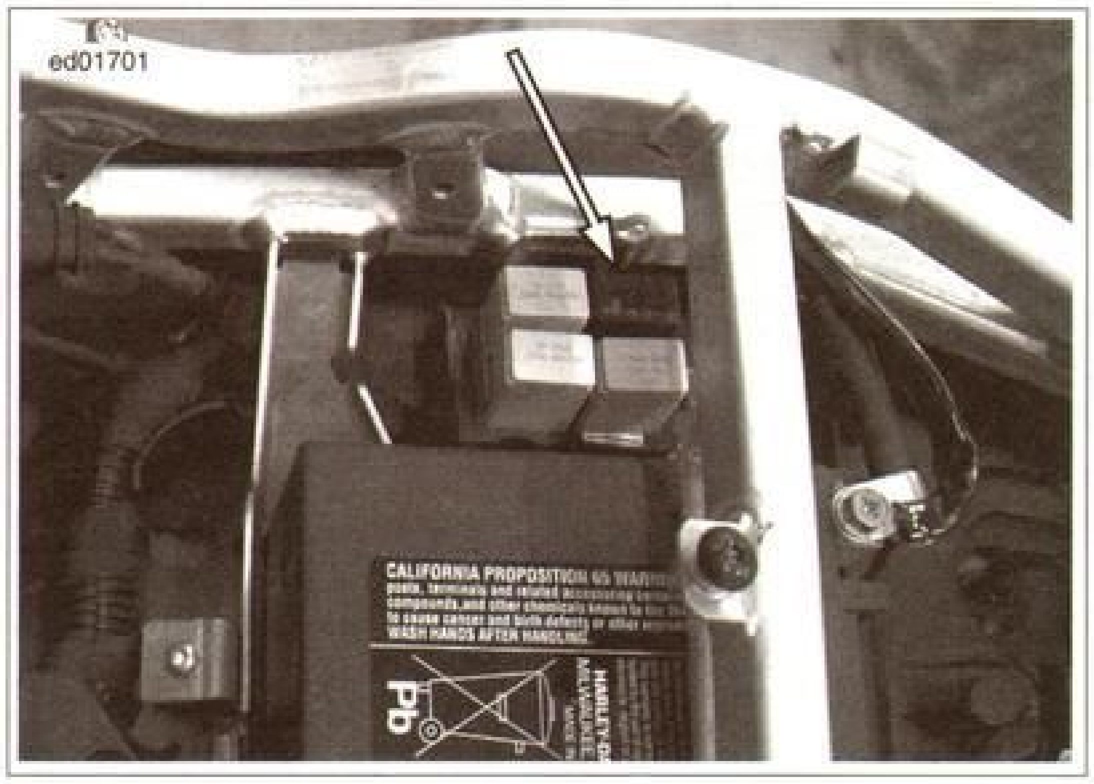


Figure 6-26. Start Relay

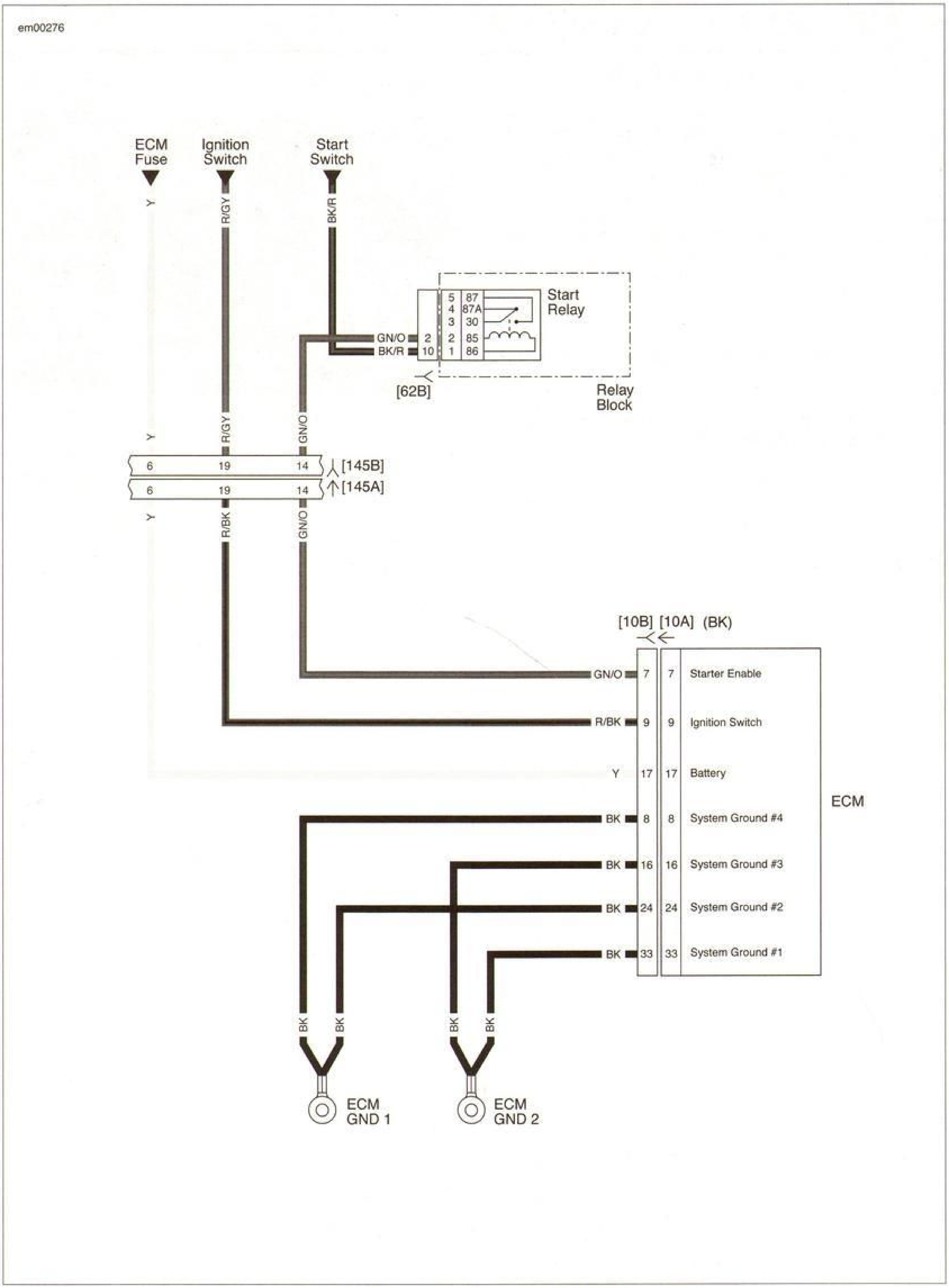
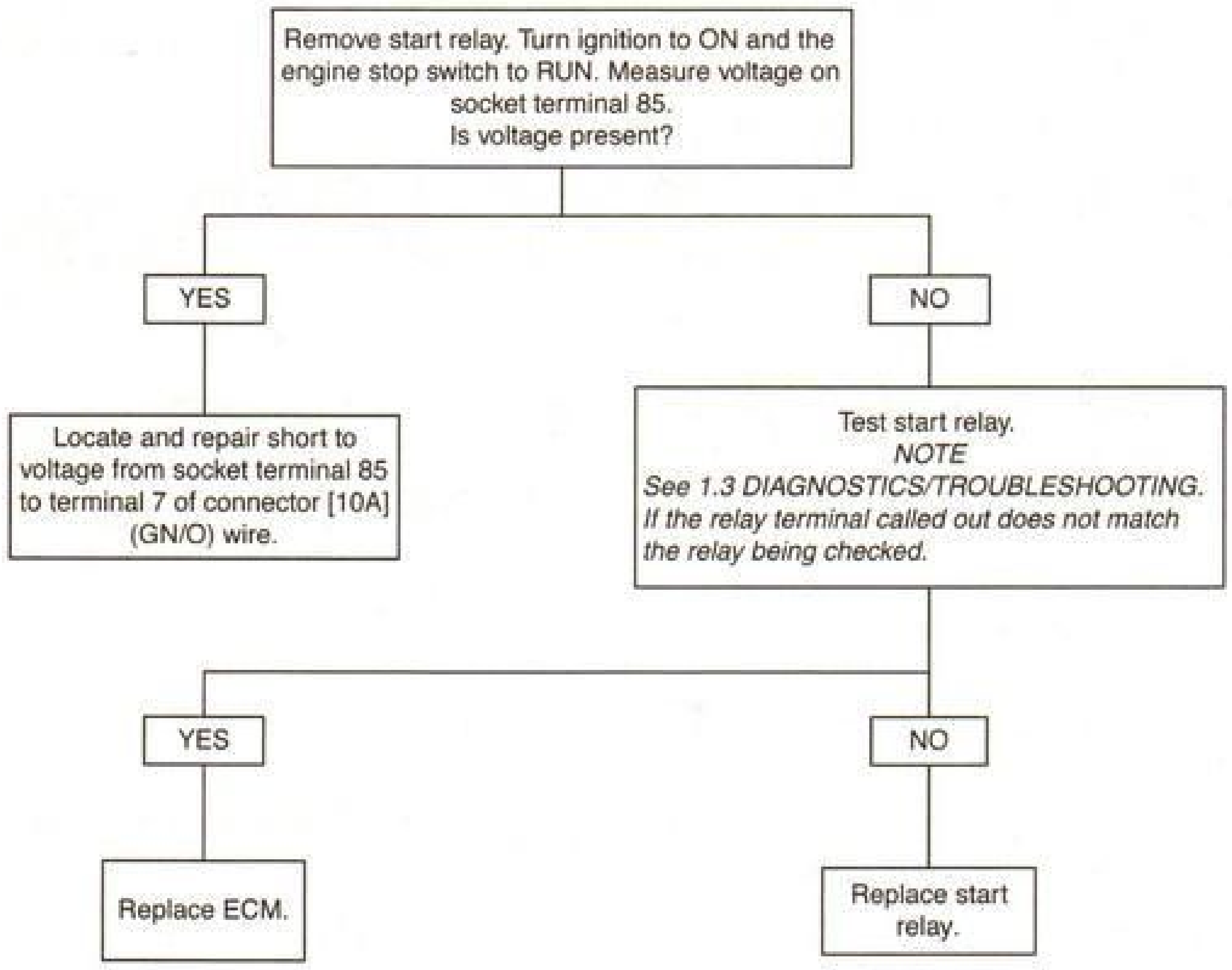


Figure 6-27. ECM Power and Ground

DTC P0617



fc01905_en

DESCRIPTION AND OPERATION

Dynamic sensors and drivers are the devices that manage engine operation between start-up and WOT. If these devices are not in proper operating condition, the engine may idle or run rough, lack power, overheat, or use excessive amounts of fuel.

Refer to Table 6-15 for devices in this category.

Table 6-15. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0087	29	Fuel Rail/System Pressure Too Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0107	63	MAP Sensor Low/Open	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108
P0108	62	MAP Sensor High	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108
P0113	21	Intake Air Temperature Sensor High/Open	6.17 INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113
P0117	20	Engine Coolant Temperature Sensor Circuit Low	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0118	19	Engine Coolant Temperature Sensor Circuit High	6.16 ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118
P0131	50	Front Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0132	46	Front Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0134	48	Front Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0151	51	Rear Oxygen Sensor Circuit Low/Engine Lean	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0152	47	Rear Oxygen Sensor Circuit High/Engine Rich	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0154	49	Rear Oxygen Sensor Open/Inactive	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047
P0192	26	Fuel Pressure Sensor Circuit Low	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0193	25	Fuel Pressure Sensor Circuit High	6.19 FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087
P0261	35	Front Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0262	34	Front Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0264	37	Rear Fuel Injector Circuit Low	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0265	36	Rear Fuel Injector Circuit High	6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265
P0502	40	Vehicle Speed Sensor Low	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0503	41	Vehicle Speed Sensor Intermittent/Erratic High	6.21 VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503
P0506	54	Idle Air Control System - RPM Higher Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511

Table 6-15. Diagnostic Trouble Codes (DTC) Priority Table

DTC	PRIORITY ORDER	FAULT CONDITION	DIAGNOSTIC PROCEDURE
P0507	55	Idle Air Control System - RPM Lower Than Expected	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0511	53	Idle Air Control Circuit Fault	6.23 IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511
P0562	39	Battery Voltage Low	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0563	38	Battery Voltage High	6.26 BATTERY VOLTAGE: DTC P0562, P0563
P0628	28	Fuel Pump Circuit Low	6.20 FUEL PUMP: DTC P0628, P0629
P0629	27	Fuel Pump Circuit High	6.20 FUEL PUMP: DTC P0628, P0629
P0691	58	Right Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0692	56	Right Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0693	59	Left Fan Control Circuit Low	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P0694	57	Left Fan Control Circuit High	6.24 RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694
P1110	66	Active Intake Control Circuit Short Low/Open	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1111	65	Active Intake Control Circuit Short High	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P1112	64	Active Intake Control Throttle Position Sensor Feedback Failure	6.27 ACTIVE INTAKE SYSTEM: DTC P1110, P1111, P1112
P2228	24	BARO Pressure Sensor Circuit Low	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2229	23	BARO Pressure Sensor Circuit High	6.18 BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229
P2300	31	Front Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2301	30	Front Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2303	33	Rear Ignition Coil Control Circuit Low	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304
P2304	32	Rear Ignition Coil Control Circuit High	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304

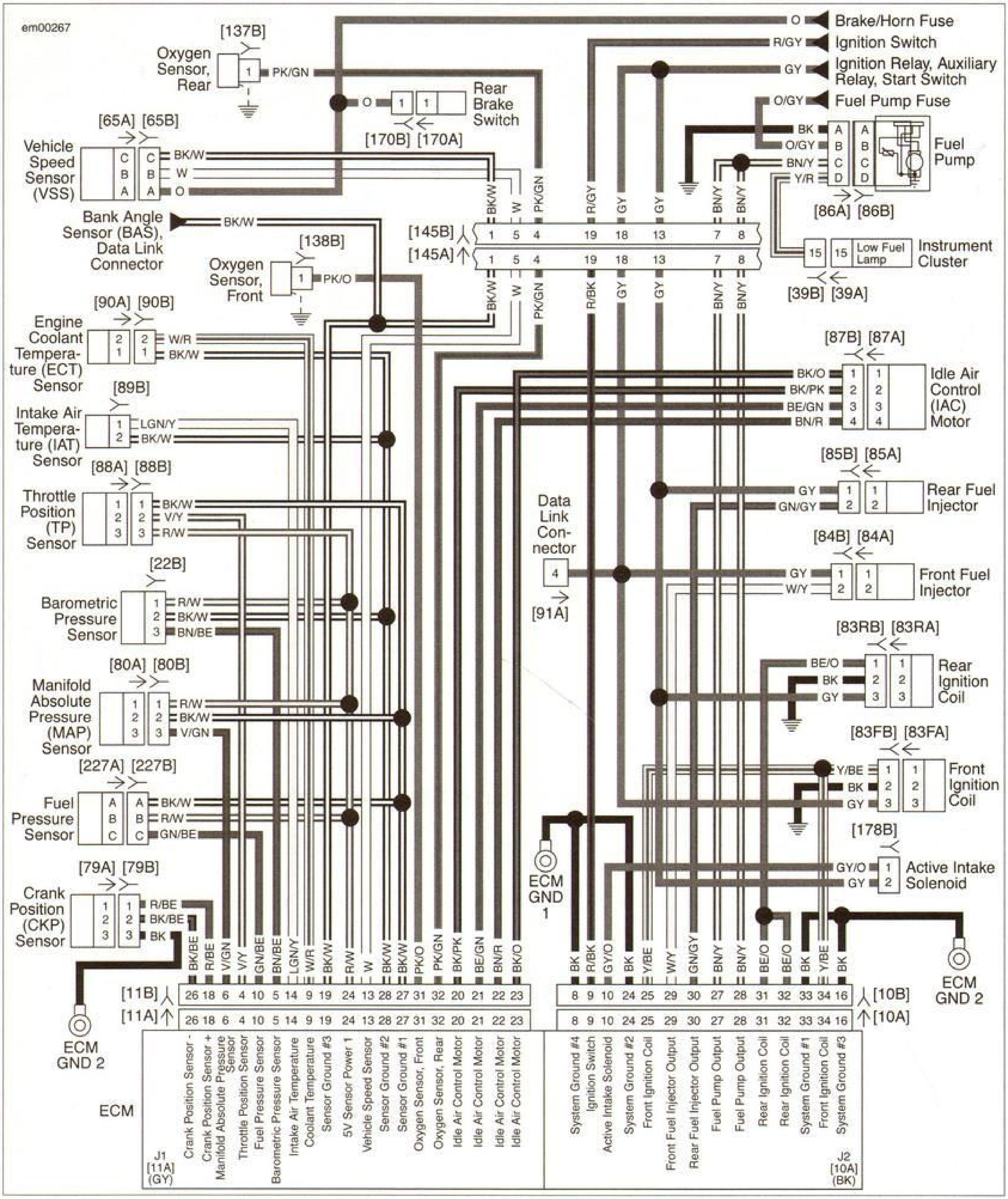


Figure 6-28. Dynamic Input Sensors and Drivers

ENGINE COOLANT TEMPERATURE (ECT): DTC P0117, P0118 6.16

DESCRIPTION AND OPERATION

See Figure 6-29. The ECM supplies and monitors a 5 Volt signal applied to one side of the ECT sensor. The ECT sensor is a thermistor device, meaning that at a specific temperature, the sensor has a specific resistance across its terminals. As this resistance varies, so does the voltage at the temperature sensor input at the ECM. Refer to Table 6-16.

- At high temperatures, the resistance of the sensor is very low, with a corresponding lowering of the signal voltage.
- At low temperatures, the resistance of the sensor is very high. This allows the voltage to rise close to the supplied voltage of 5 Volts. The ECM monitors this voltage to compensate for various operating conditions.

An overheated engine, represented by hot engine coolant temperature, causes the ECM to command a soft skip spark (1 of 4 removed) and then a hard skip spark (1 of 2 removed) when the engine is above a certain RPM and throttle threshold.

Table 6-16. Code Description

DTC	DESCRIPTION
P0117	Engine coolant temperature circuit low
P0118	Engine coolant temperature circuit high

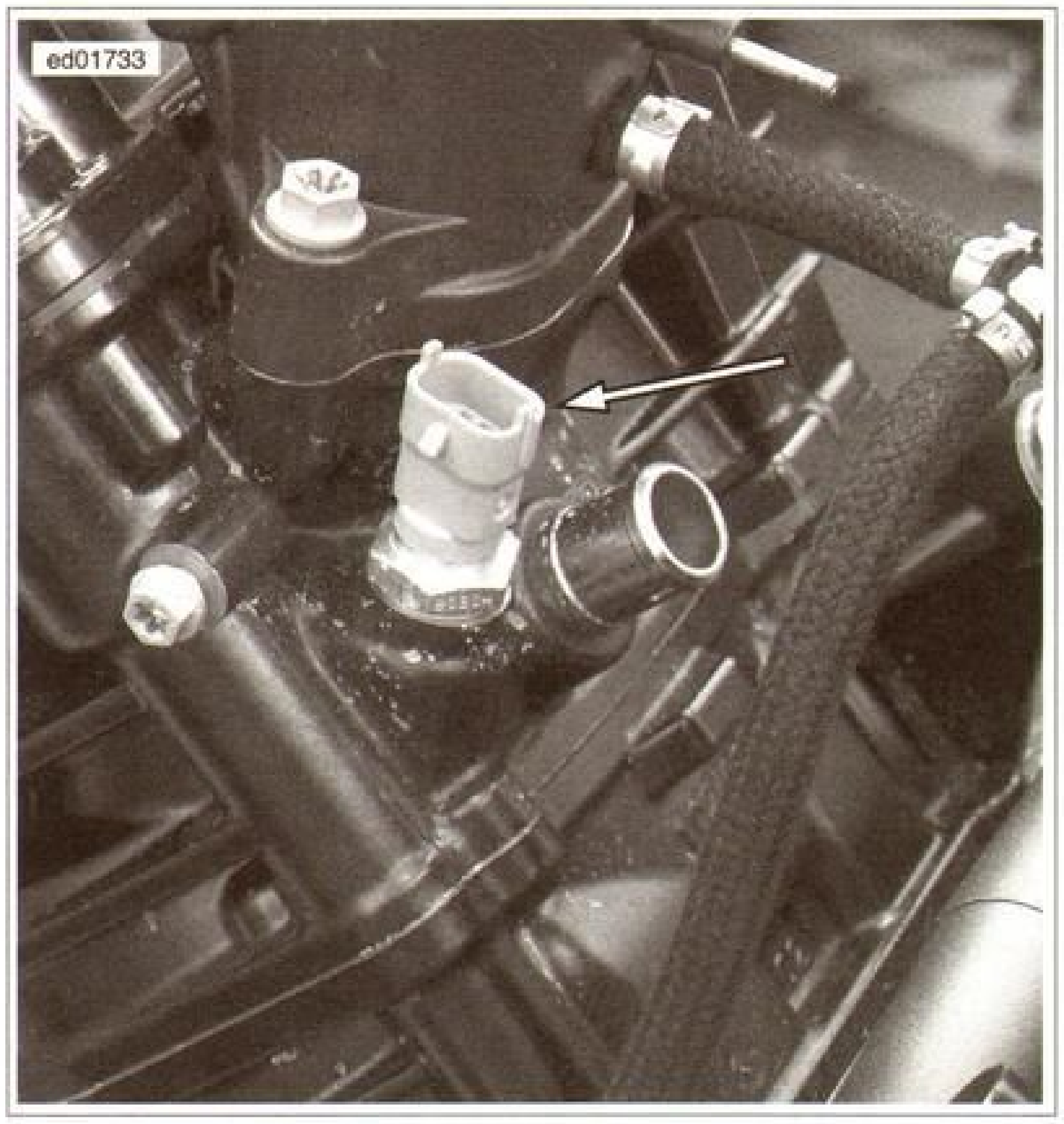


Figure 6-29. ECT Sensor Location (Engine Removed for Clarity)

Diagnostic Tips

An intermittent may be caused by any of the following conditions:

- **Poor Connection:** Inspect ECM harness connector [11] for backed out terminals, improper mating, inoperative locks improperly formed or damaged terminals, poor terminal to-wire connection and damaged harness.
- **Shifted Sensor Resistance Value:** Compare the temperatures of the ECT and IAT sensors with the engine at ambient temperature in order to evaluate the possibility of a shifted (out of calibration) sensor which may result in driveability problems. The sensor temperatures should be within 10 degrees of each other.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

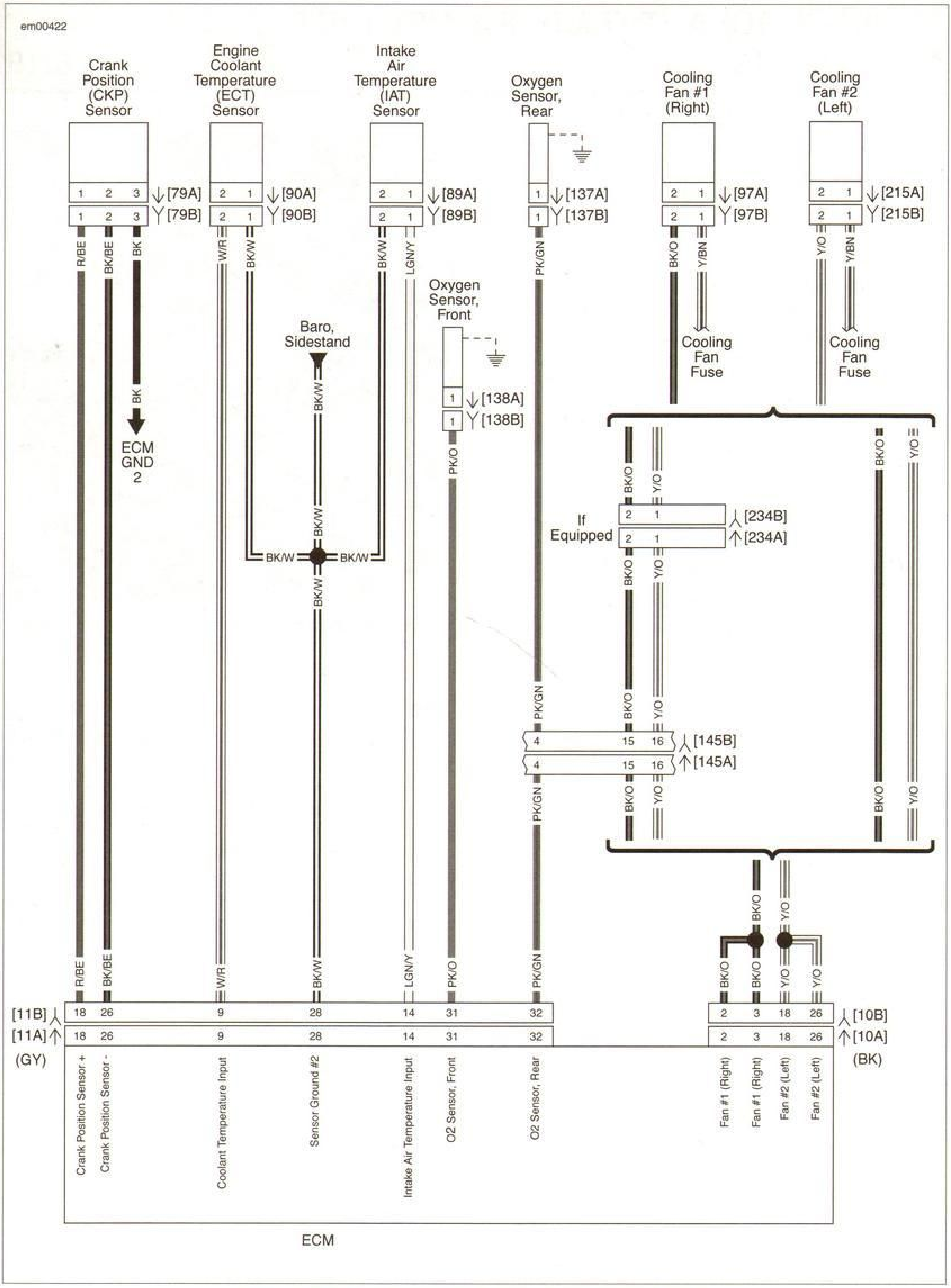
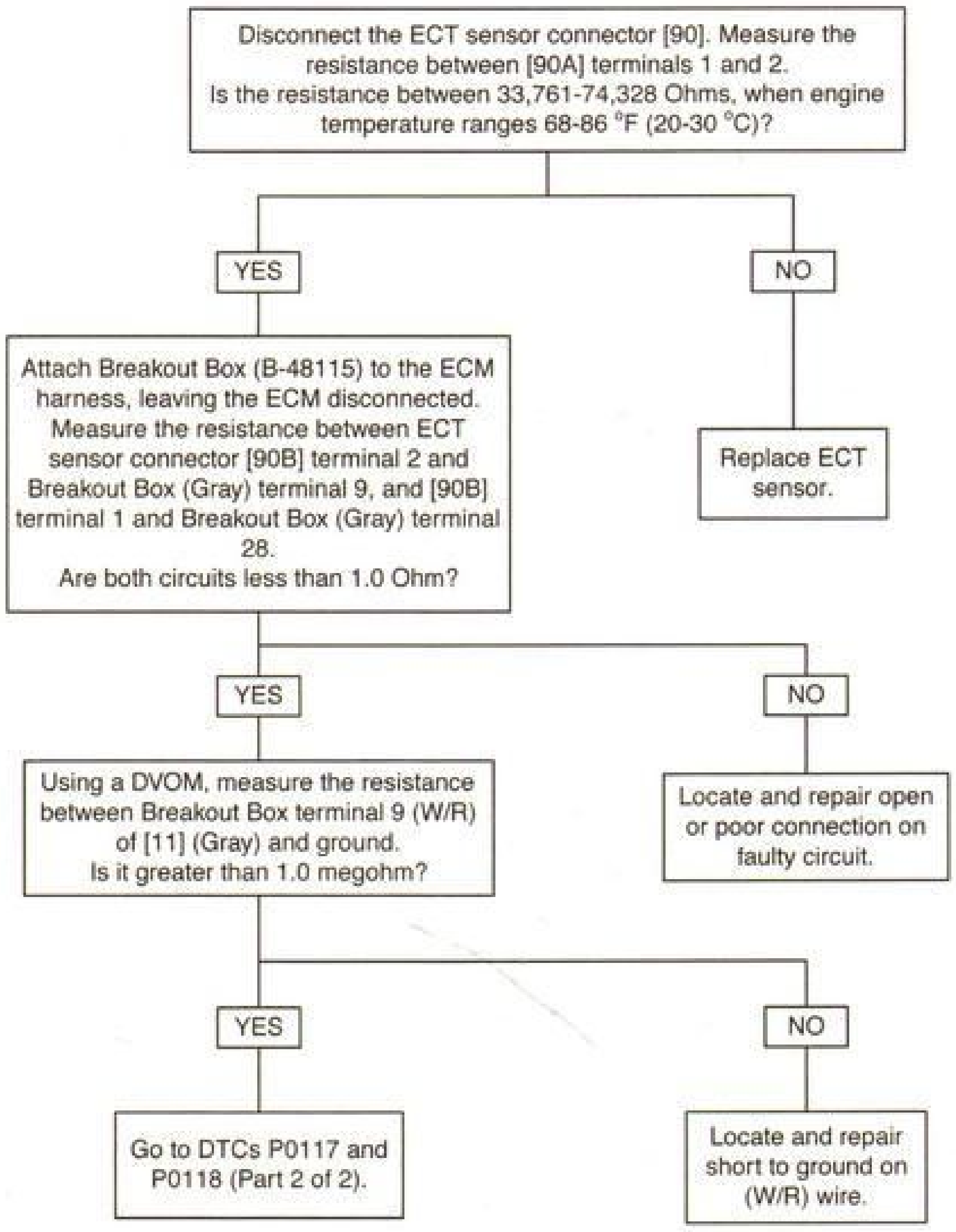


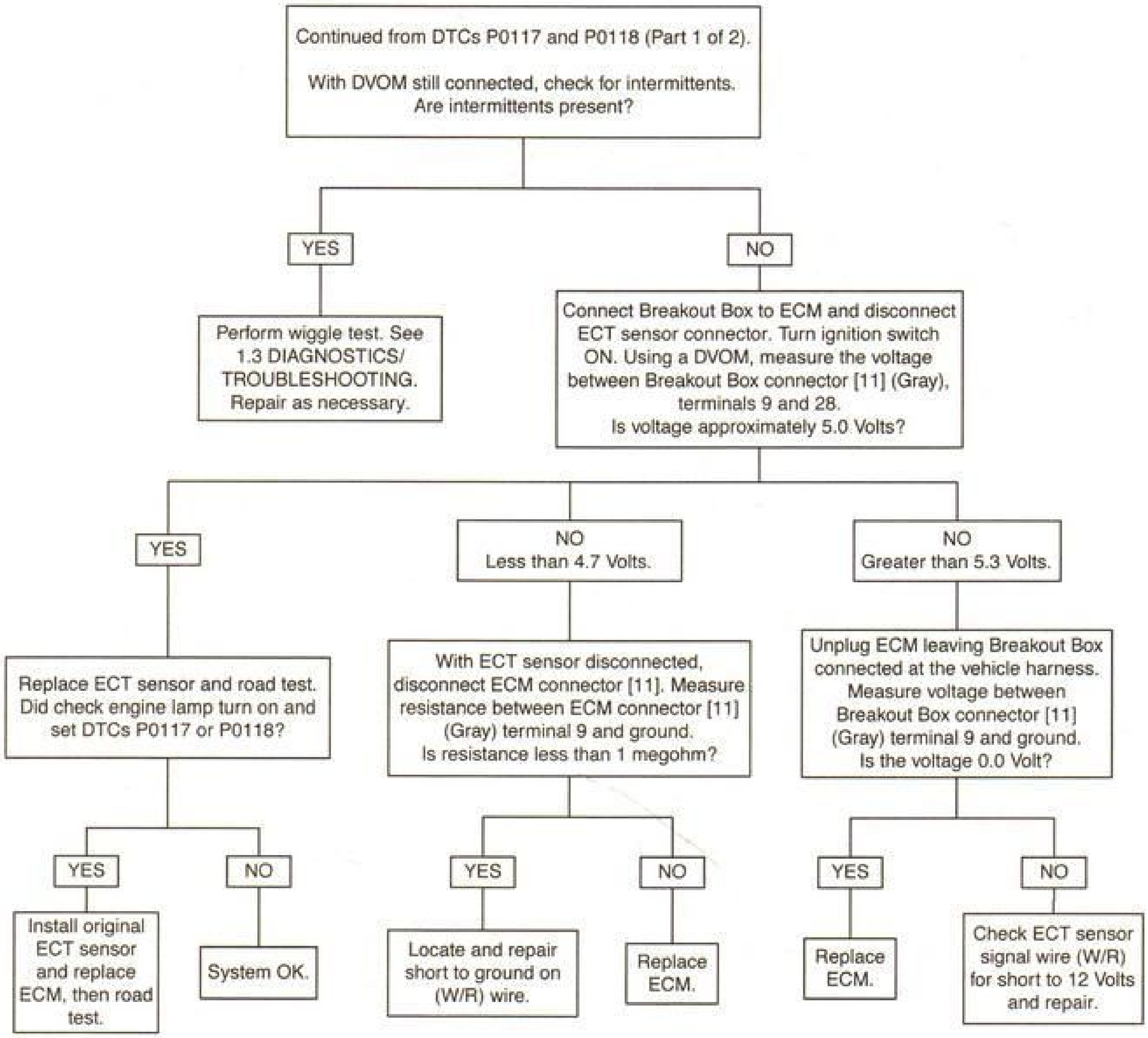
Figure 6-30. CKP, ECT, IAT, O2 sensors, and Cooling Fans

DTCs P0117 and P0118 (Part 1 of 2)



fc01887_en

DTCs P0117 and P0118 (Part 2 of 2)



fc01888_en

INTAKE AIR TEMPERATURE (IAT) SENSOR: DTC P0112, P0113

DESCRIPTION AND OPERATION

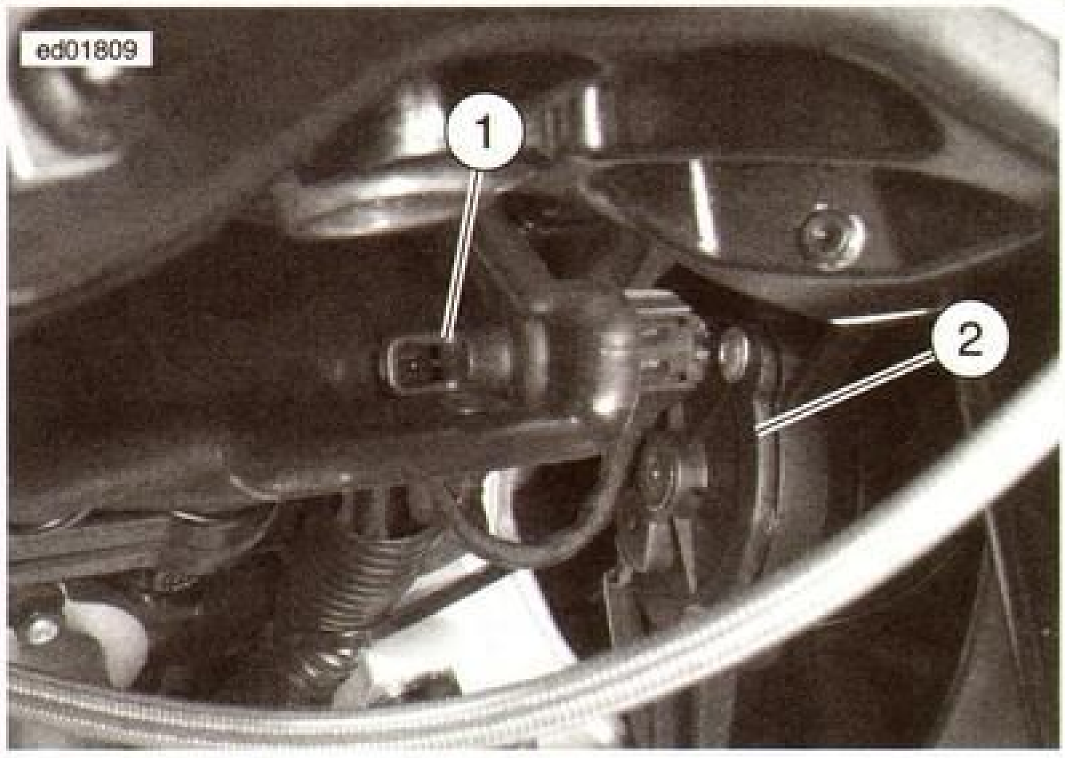
See Figure 6-31. The ECM supplies and monitors a 5 Volt signal applied to one side of the IAT sensor. The IAT sensor is a thermistor device, meaning that at a specific temperature, the sensor has a specific resistance across its terminals. As this temperature varies, so will the voltage vary at the temperature sensor input on the ECM. If the 5V signal goes out of range the ECM sets a DTC. Refer to Table 6-17.

- At high temperatures, the resistance of the sensor is very low, with a corresponding lowering of the signal voltage.
- At low temperatures, the resistance of the sensor is very high. This allows the voltage to rise close to the supplied voltage of 5 Volts.

The ECM monitors this voltage to compensate for various operating conditions.

Table 6-17. Code Description

DTC	DESCRIPTION
P0112	Intake Air Temperature sensor voltage low
P0113	Intake Air Temperature sensor high/open



1. **Intake air temperature sensor**
2. **Cooling fan number 2 (left)**

Figure 6-31. IAT Sensor Location

Diagnostic Tips

An intermittent may be caused by any of the following conditions:

Poor Connection: Inspect ECM harness connector [11] for backed out terminals, improper mating, inoperative locks improperly formed or damaged terminals, poor terminal to-wire connection and damaged harness.

Shifted Sensor Resistance Value: Compare the temperatures of the ECT and IAT sensors with the engine at ambient temperature in order to evaluate the possibility of a shifted (out of calibration) sensor which may result in driveability problems. The sensor temperatures should be within 10 degrees of each other.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

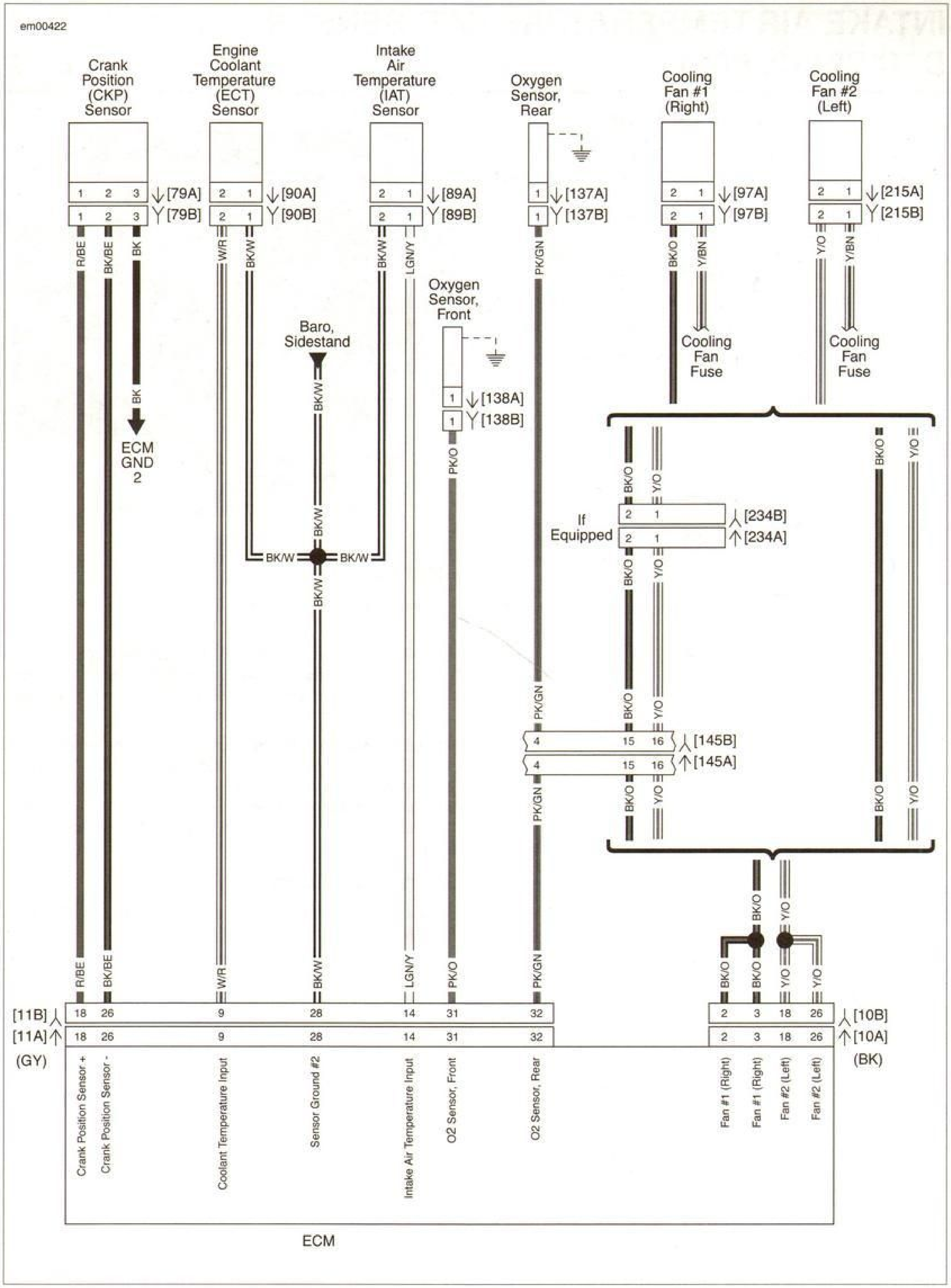
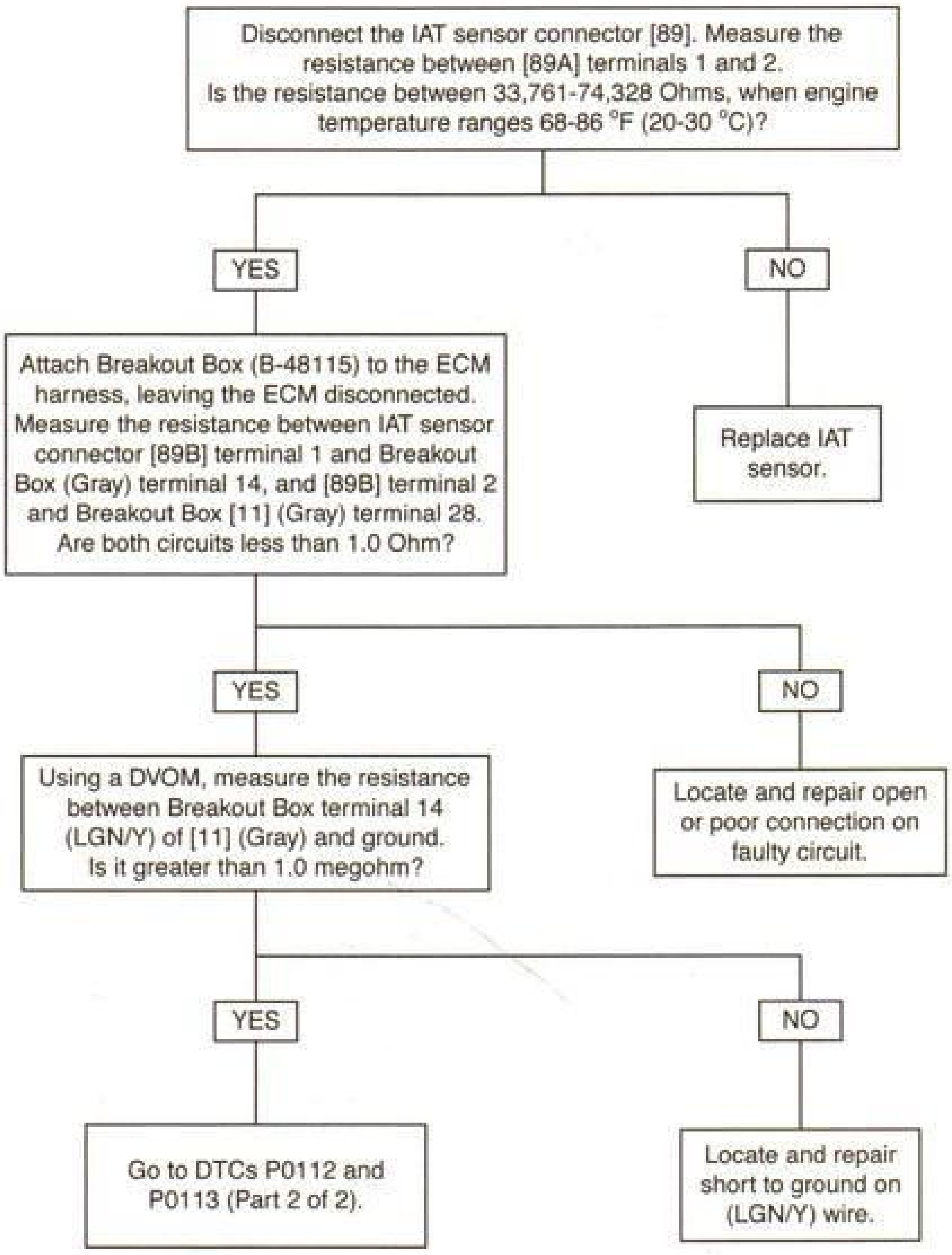


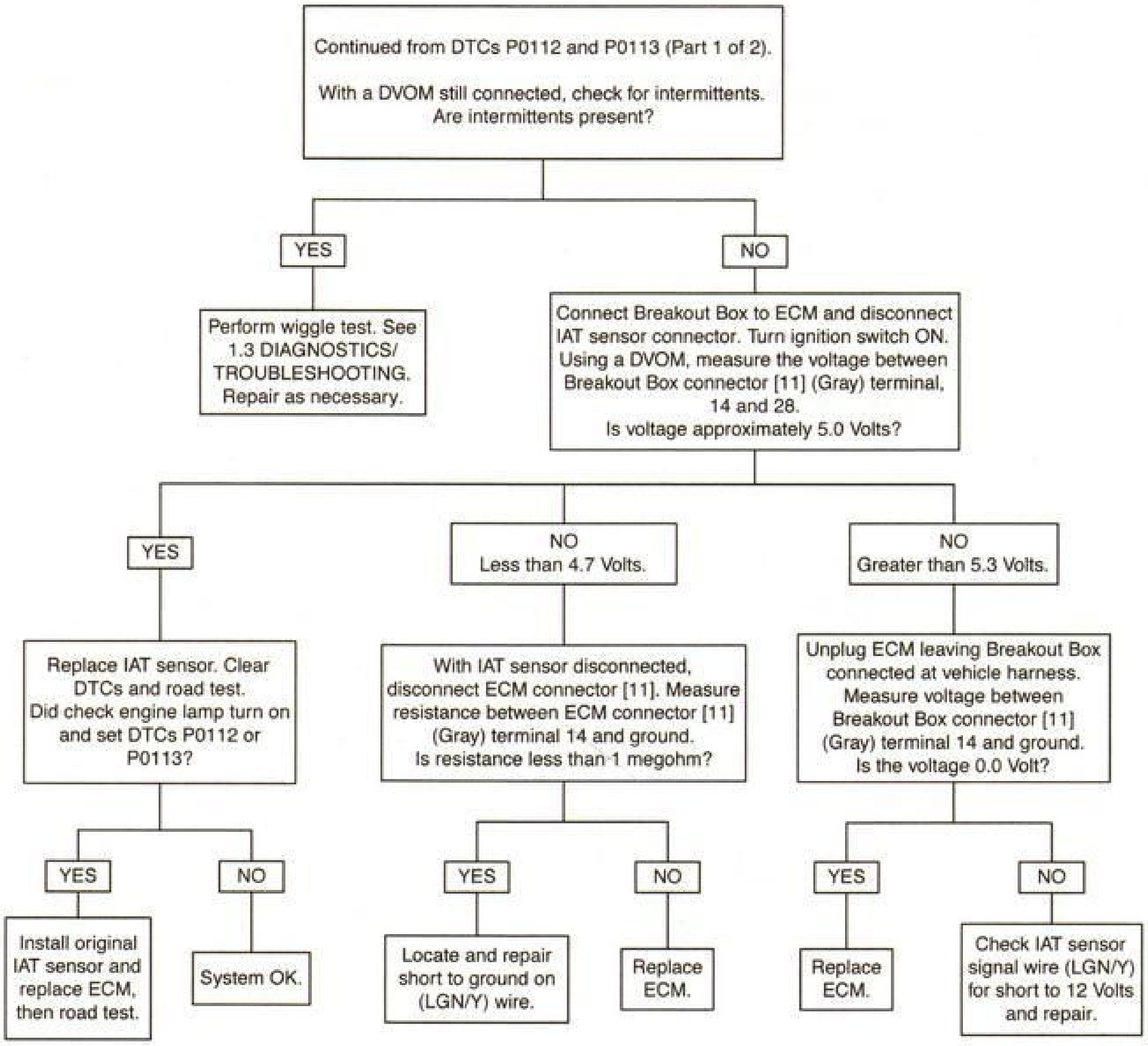
Figure 6-32. CKP, ECT, IAT, O2 sensors, and Cooling Fans

DTCs P0112 and P0113 (Part 1 of 2)



fc01889_en

DTCs P0112 and P0113 (Part 2 of 2)



fc01890_en

BAROMETRIC PRESSURE (BARO) SENSOR: DTC P2228, P2229 6.18

DESCRIPTION AND OPERATION

See Figure 6-33. The BARO sensor functions similar to the manifold absolute pressure sensor. It is located under the seat, at the rear of the throttle body baseplate. In this position, the sensor monitors the ambient air pressure located outside of the airbox. When the ambient air pressure drops, less fuel is needed to maintain the proper air/fuel mixture. The output of the sensor allows the ECM to compensate for changes in barometric pressure due to altitude or weather variations.

Table 6-18. Code Description

DTC	DESCRIPTION
P2228	Barometric pressure sensor circuit low
P2229	Barometric pressure sensor circuit high

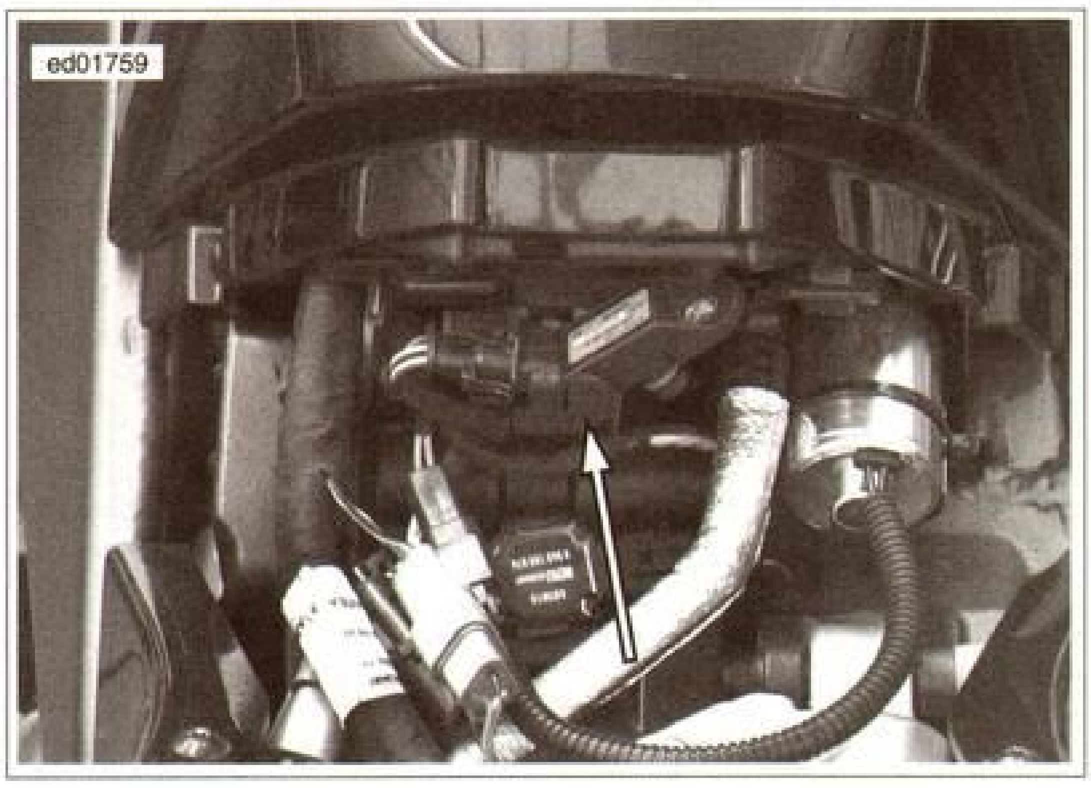


Figure 6-33. Barometric Pressure Sensor

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

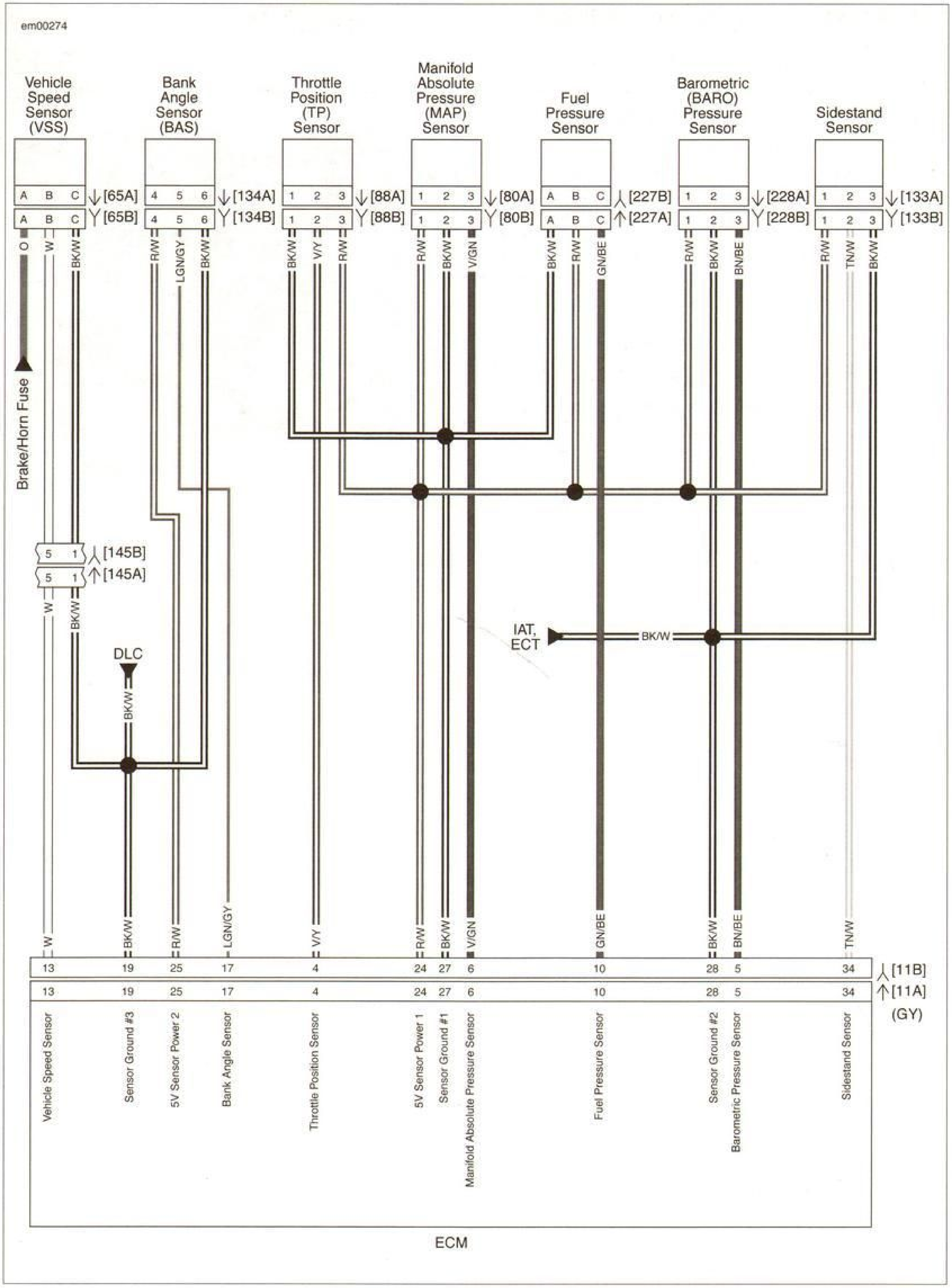
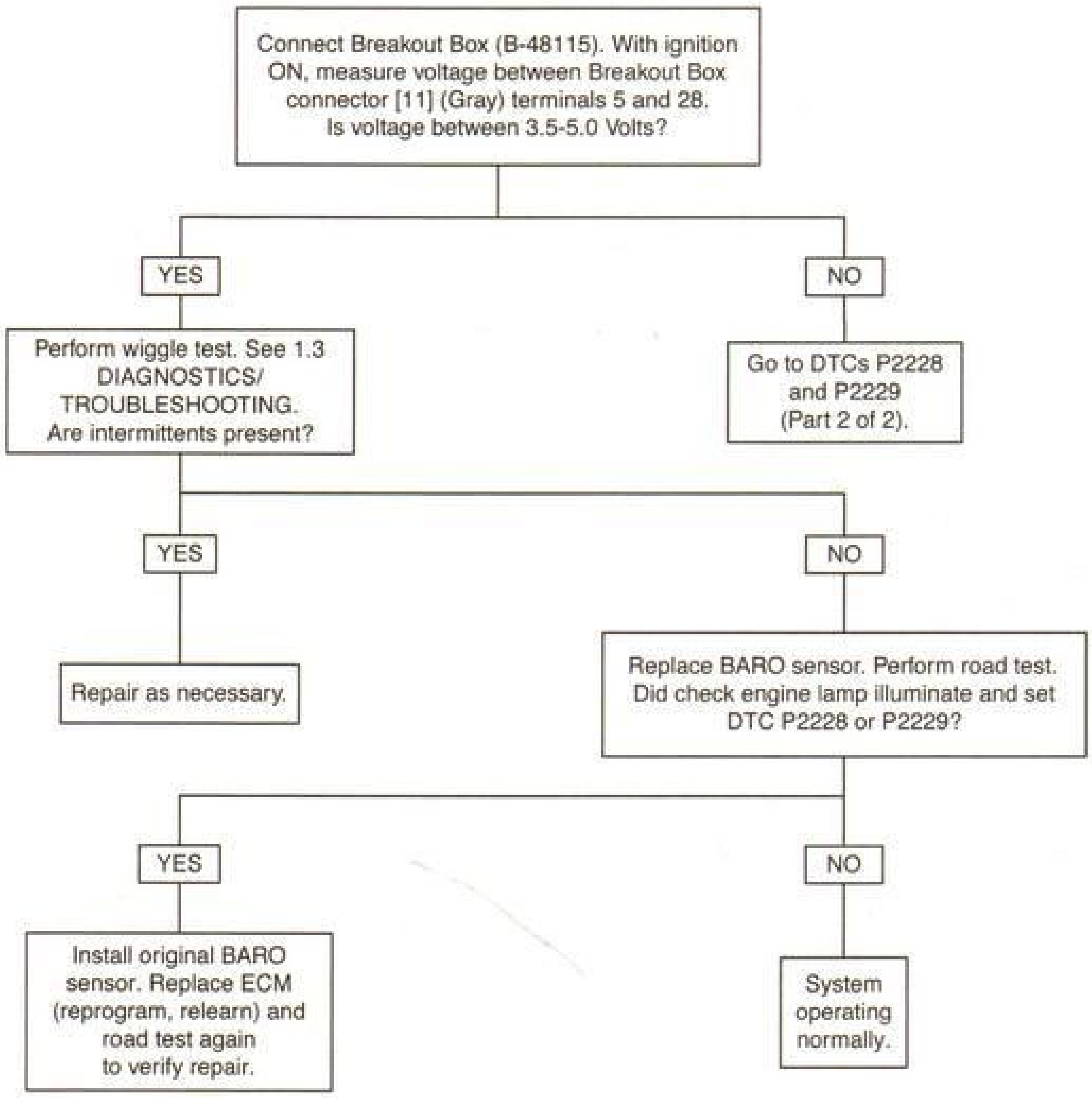


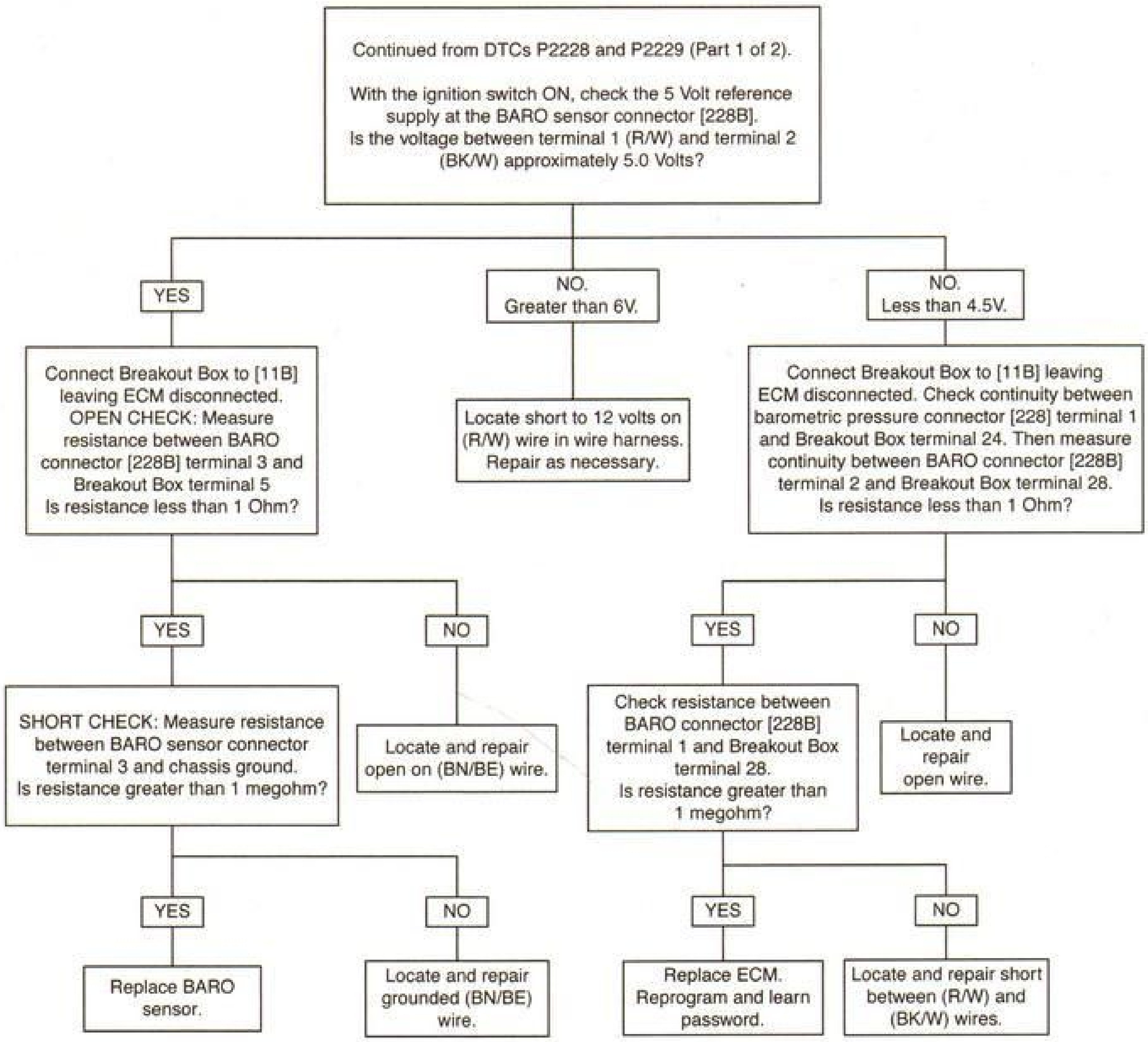
Figure 6-34. 5V Reference Circuit

DTCs P2228 and P2229 (Part 1 of 2)



fc01921_en

DTCs P2228 and P2229 (Part 2 of 2)



fc01922_en

FUEL PRESSURE SENSOR: DTC P0192, P0193, P0087 6.19

DESCRIPTION AND OPERATION

See Figure 6-35. The fuel pressure sensor is mounted in the fuel line feeding the fuel rail. Variations in fuel rail pressure are converted to a voltage output to the ECM for fuel pump control. For all fuel pressure sensor DTCs, the ECM drives the pump to maximum pressure. Refer to Table 6-19. The ECM incorporates automatic compensation for differences of the desired pressure versus the actual pressure. For instance, if the pressure is lower than desired, the ECM opens the injectors for a longer time to adjust the amount of fuel delivered.

NOTE

If the fuel pump fails, or when the vehicle is out of fuel, DTC P0087 sets. The output of the ECM still attempts to drive the fuel pump to maximum output under these conditions.

Table 6-19. Code Description

DTC	DESCRIPTION
P0192	Fuel pressure sensor circuit low
P0193	Fuel pressure sensor circuit high
P0087	Fuel pressure sensor too low

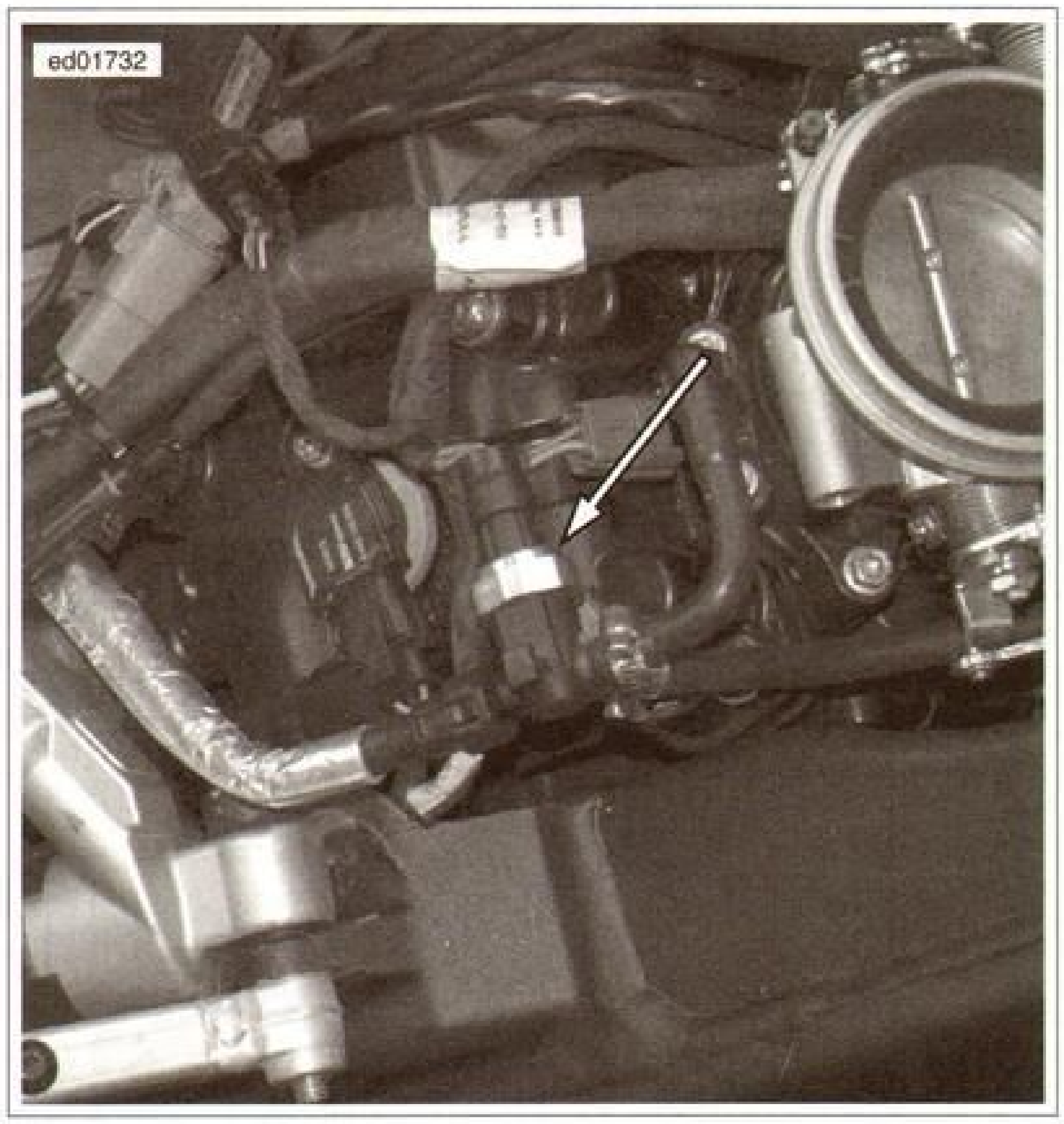


Figure 6-35. Fuel Pressure Sensor Location

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

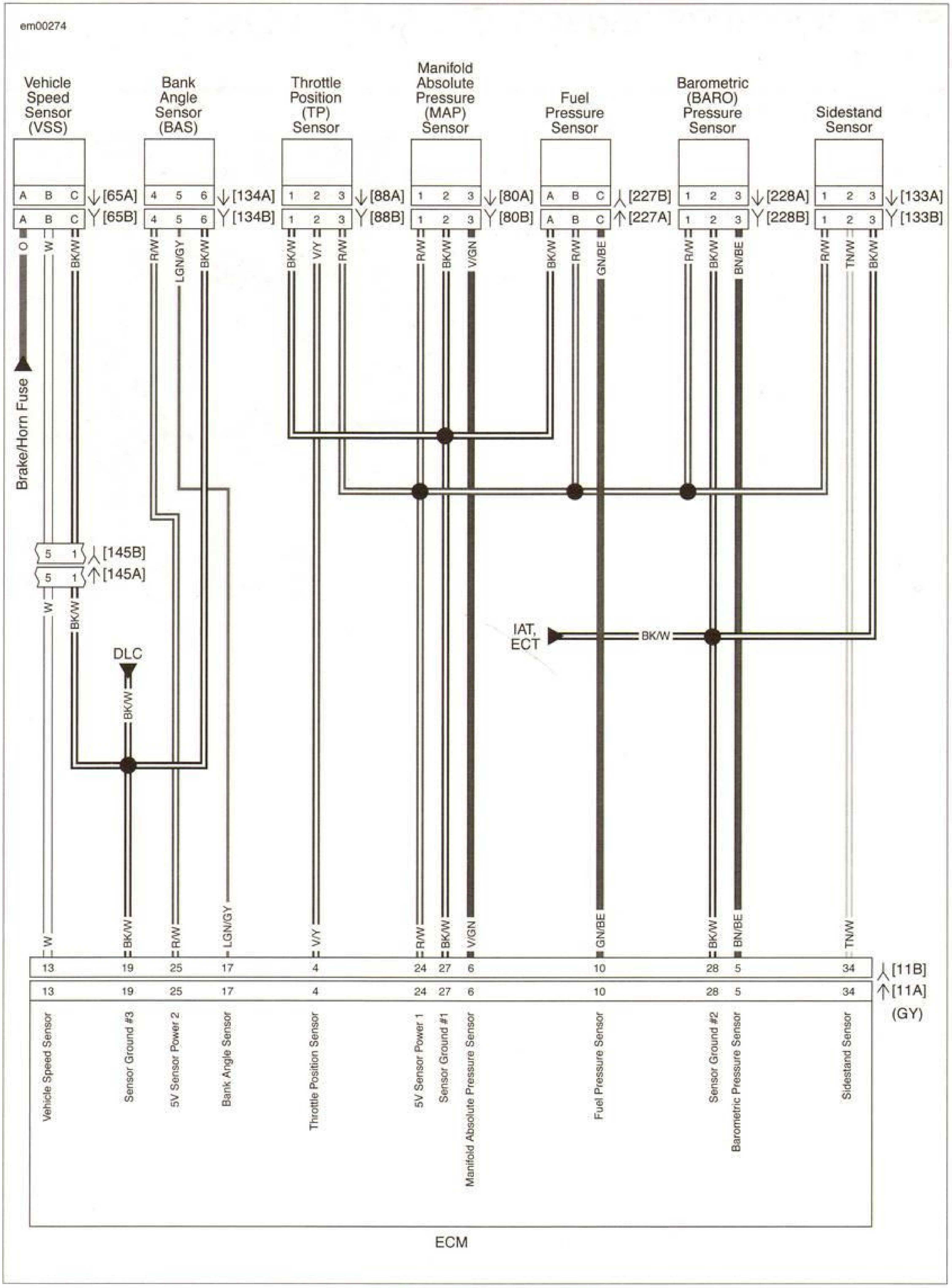
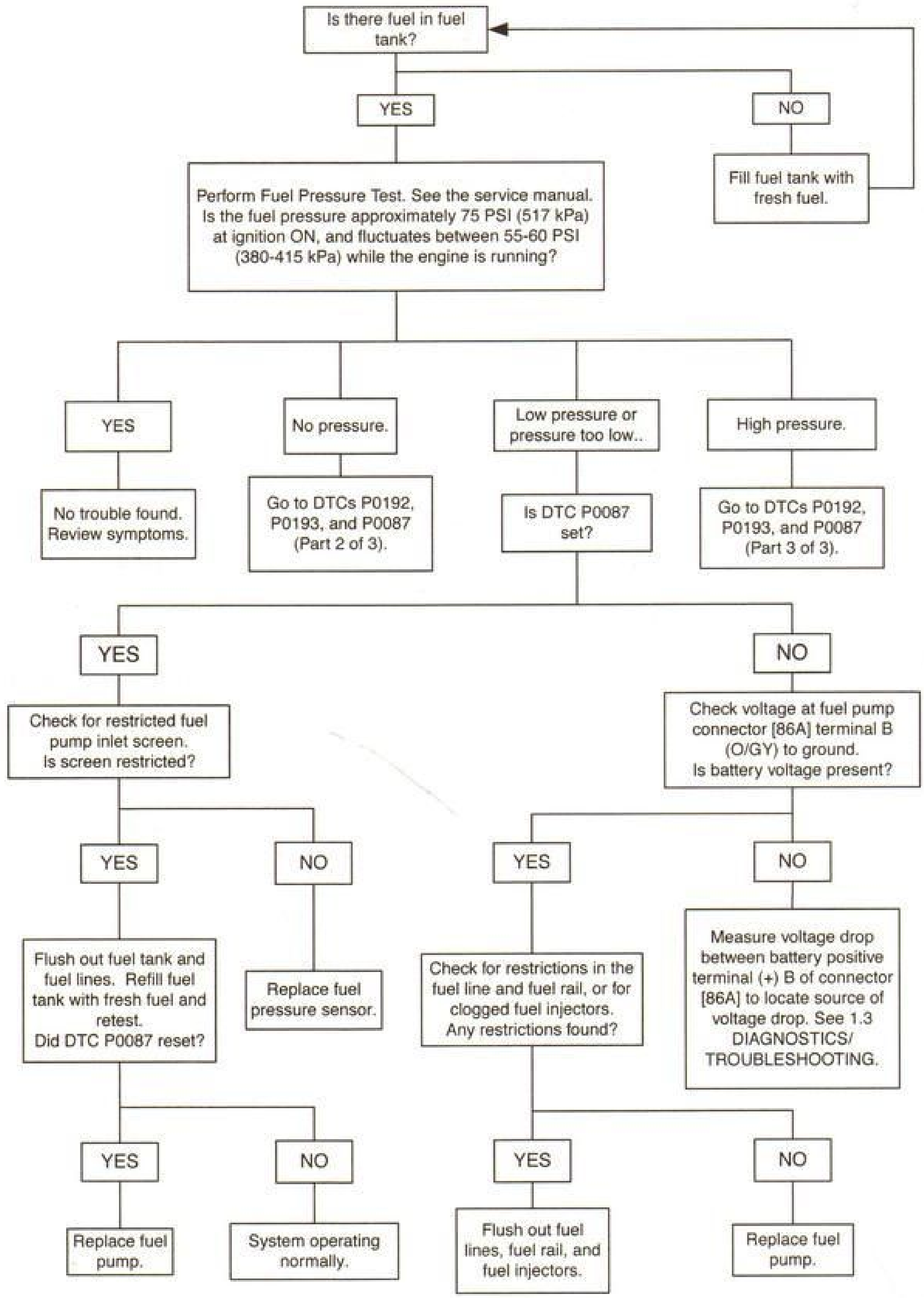
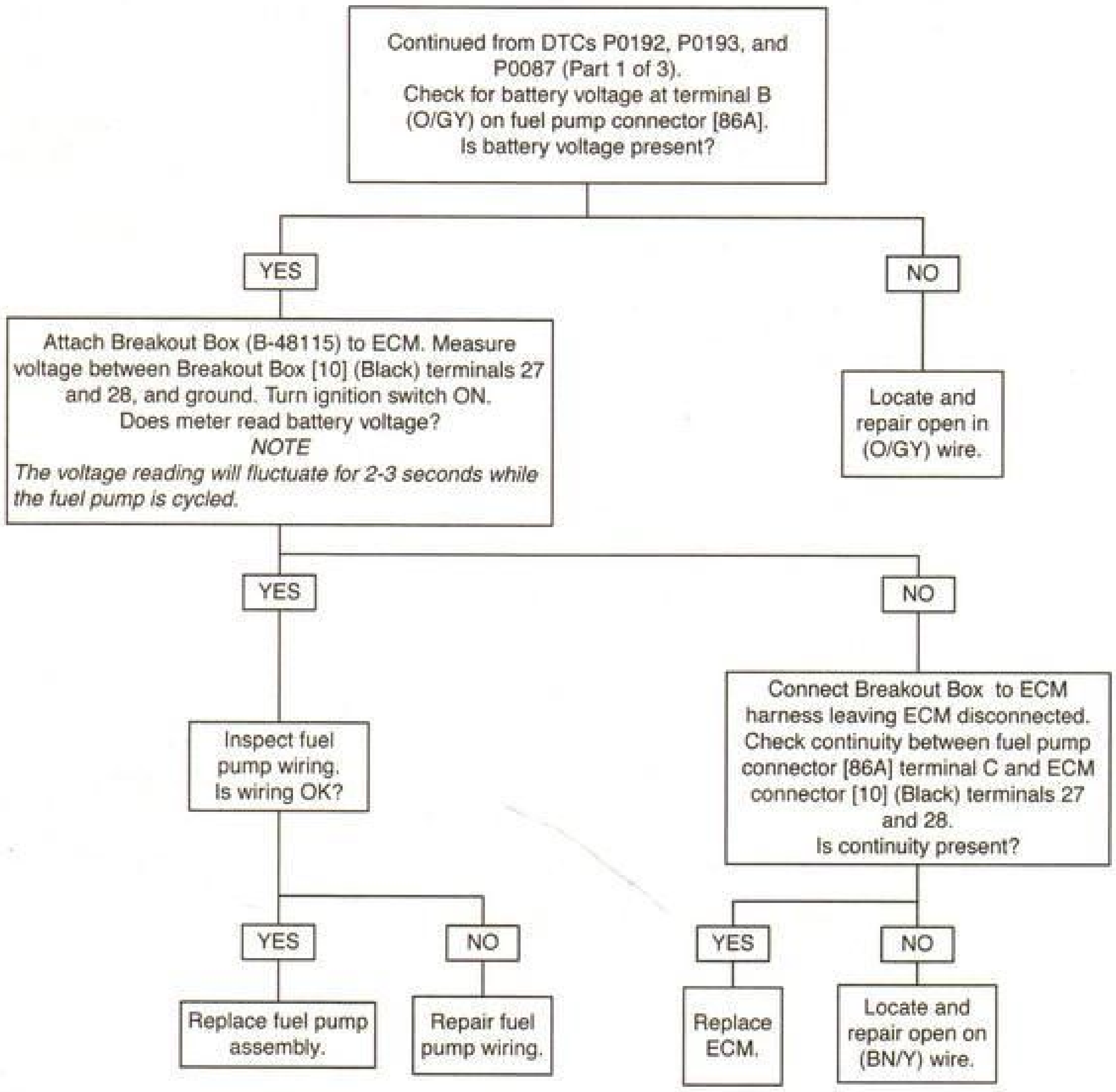


Figure 6-36. 5V Reference Circuit

DTCs P0192, P0193, and P0087 (Part 1 of 3)

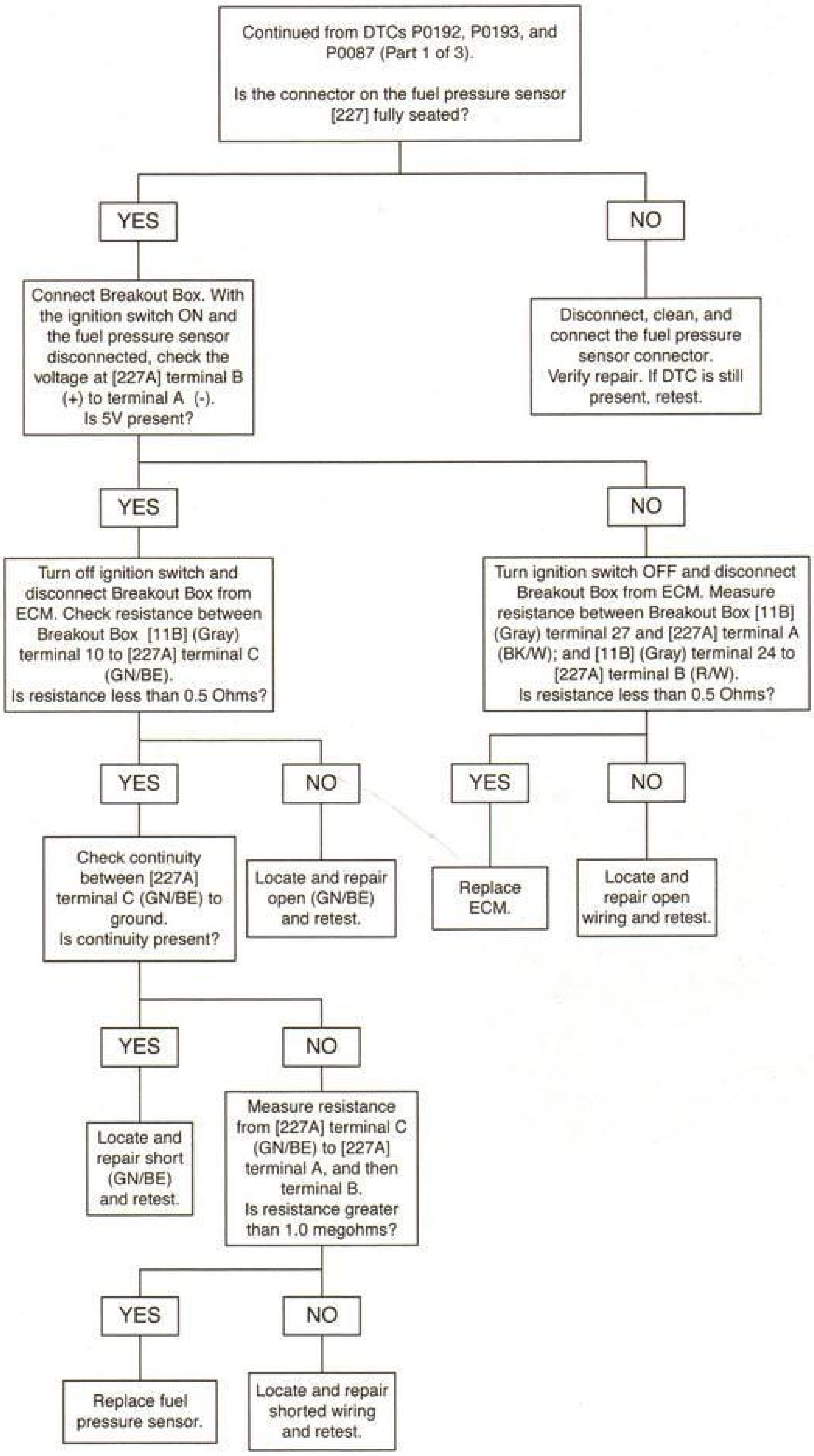


fc01893_en


Continued from DTCs P0192, P0193, and P0087 (Part 1 of 3). Check for battery voltage at terminal B (O/GY) on fuel pump connector [86A]. Is battery voltage present?
YES
NO
Attach Breakout Box (B-48115) to ECM. Measure voltage between Breakout Box [10] (Black) terminals 27 and 28, and ground. Turn ignition switch ON. Does meter read battery voltage? NOTE The voltage reading will fluctuate for 2-3 seconds while the fuel pump is cycled.
Locate and repair open in (O/GY) wire.
YES
NO
Inspect fuel pump wiring. Is wiring OK?
Connect Breakout Box to ECM harness leaving ECM disconnected. Check continuity between fuel pump connector [86A] terminal C and ECM connector [10] (Black) terminals 27 and 28. Is continuity present?
YES
NO
YES
NO
Replace fuel pump assembly.
Repair fuel pump wiring.
Replace ECM.
Locate and repair open on (BN/Y) wire.

fc01894_en

DTCs P0192, P0193, and P0087 (Part 3 of 3)



fc01895_en

DESCRIPTION AND OPERATION

See Figure 6-37. The pump is located inside the fuel tank. The fuel pump provides the means for moving fuel from the fuel tank to the fuel injectors. See Figure 6-38 for major components of the fuel pump. The fuel pump is controlled through a ground in the ECM. Refer to Table 6-20. The DTCs set if:

- (BN/Y) wire is shorted to 12 Volts.
- (BN/Y) wire is shorted to ground. This causes the fuel pump to run continuously even when the motor is not running.
- Fuel pump motor stalls.

NOTE

If the fuel pump is faulty, DTC P0087 sets.

Table 6-20. Code Description

DTC	DESCRIPTION
P0628	Fuel pump control circuit low
P0629	Fuel pump control circuit high

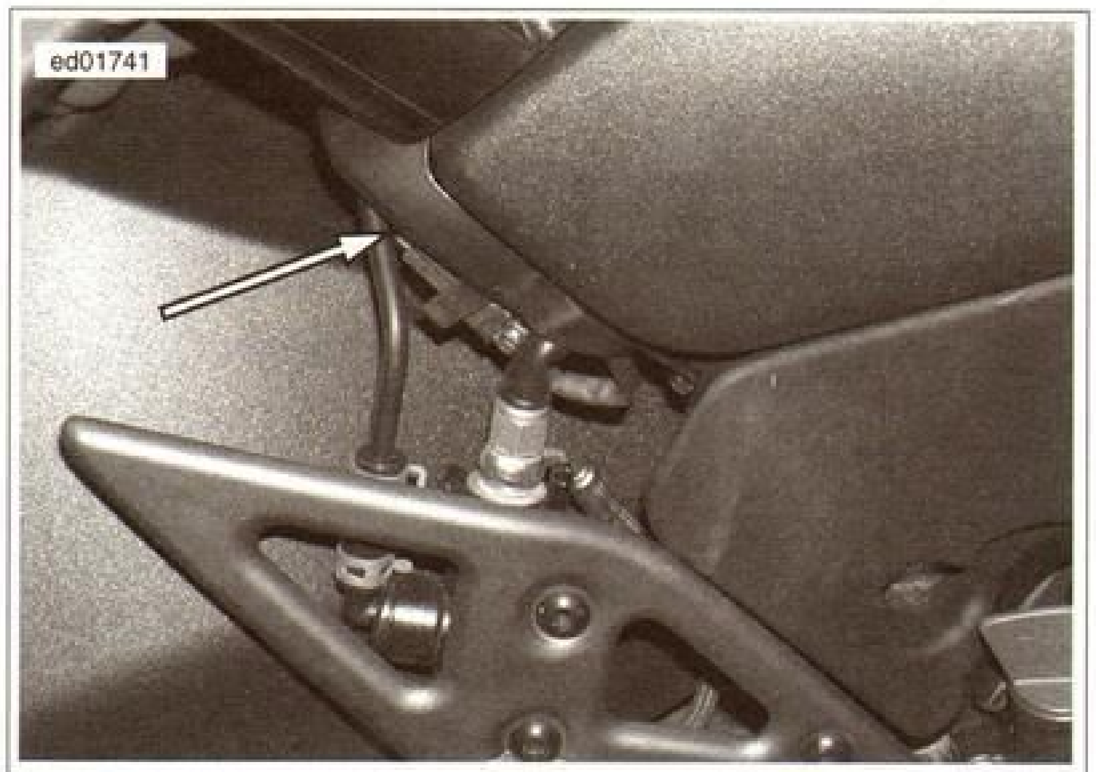
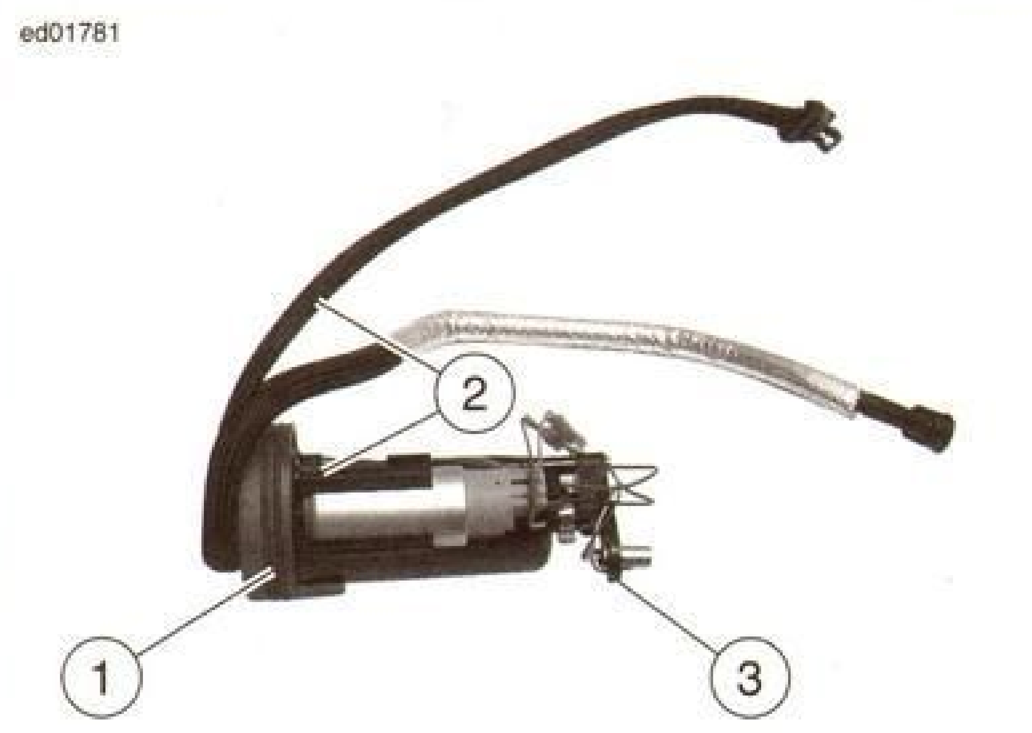


Figure 6-37. Fuel Pump Location



1. **Sealing O-rings**
2. **Wiring harness**
3. **Low fuel level sensor**

Figure 6-38. Fuel Pump Assembly

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

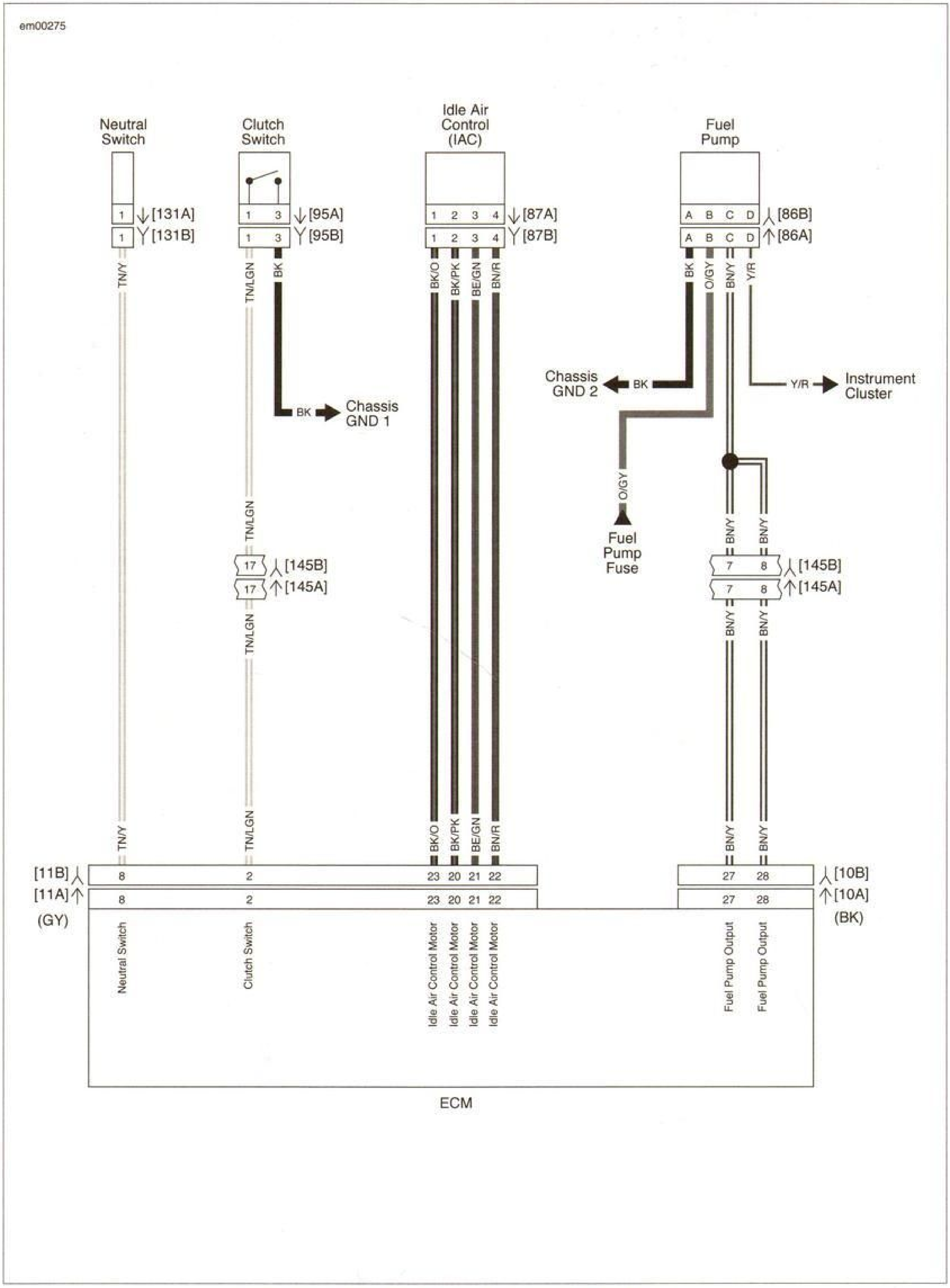
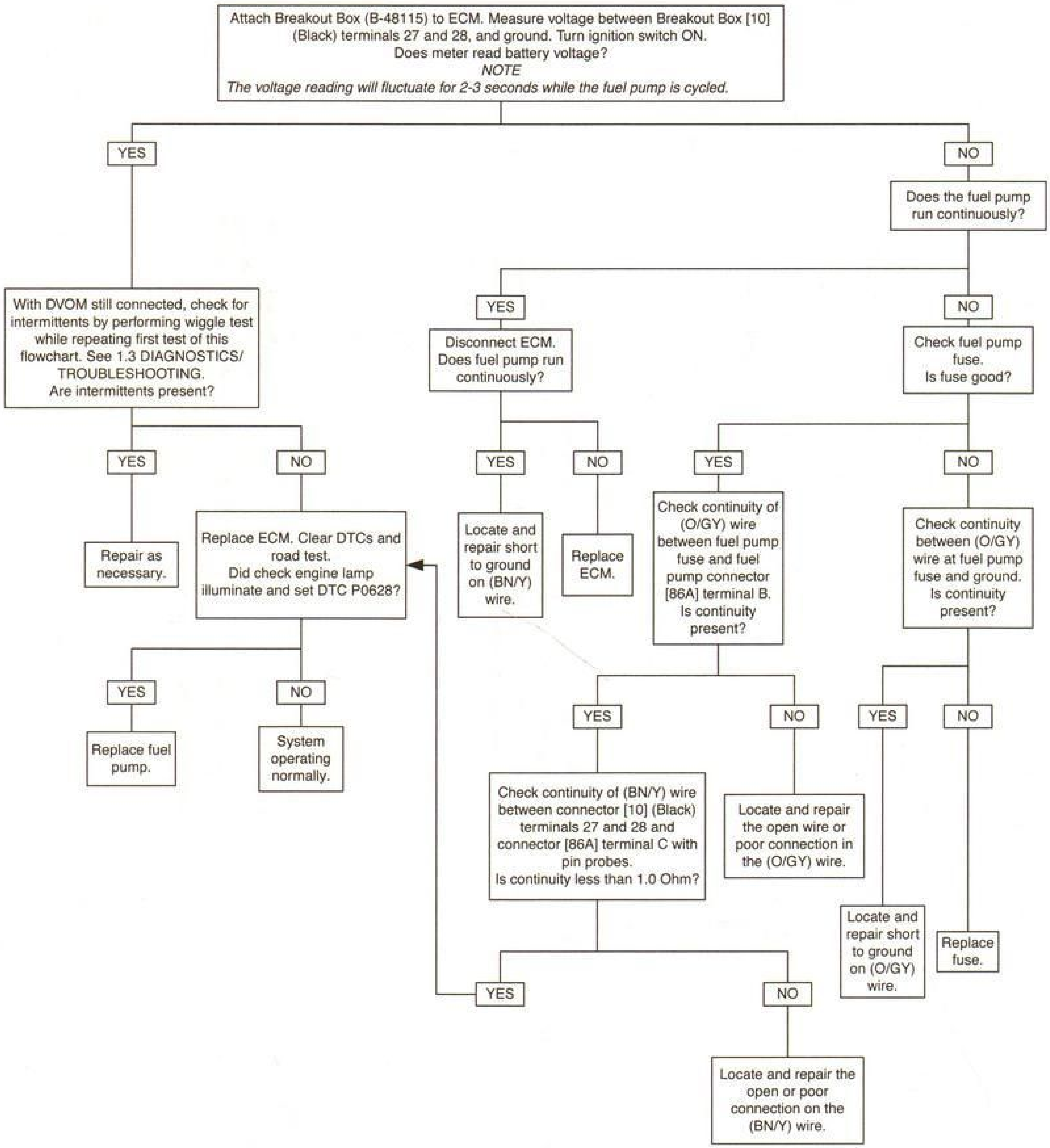


Figure 6-39. Neutral and Clutch Switches, IAC, and Fuel Pump

DTCs P0628 and P0629



fc01896_en

VEHICLE SPEED SENSOR (VSS): DTC P0502 AND P0503 6.21

DESCRIPTION AND OPERATION

See Figure 6-40. The VSS is a Hall-effect device mounted close to the teeth of the trigger wheel. The output signal frequency varies with vehicle speed. Output voltage from the sensor is 5V per increment of distance traveled. The ECM processes the vehicle speed signal and transmits it via the CAN bus to the instrument cluster to indicate vehicle speed. The VSS is supplied battery voltage from the brake/horn circuit (O). The ECM provides ground (BK/W) and receives the speed signal on the (W wire). Refer to Table 6-21.

Table 6-21. Code Description

DTC	DESCRIPTION
P0502	VSS ouput low
P0503	VSS output high

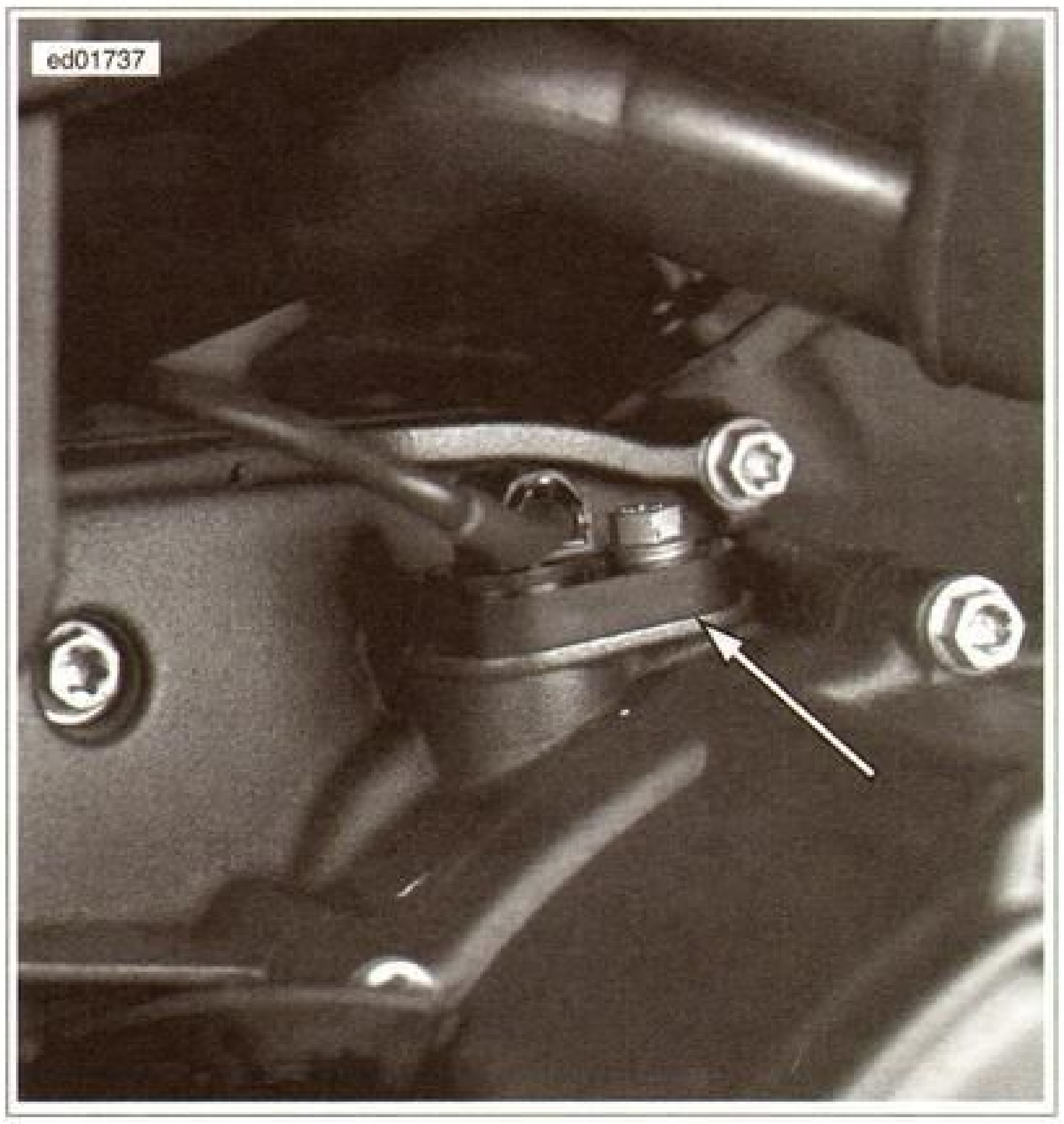


Figure 6-40. VSS Location

Diagnostic Tips

If a short low/open or a short high condition, DTC P0608 sets, reflecting a problem in the VSS, ECM, IC, or wiring harness.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

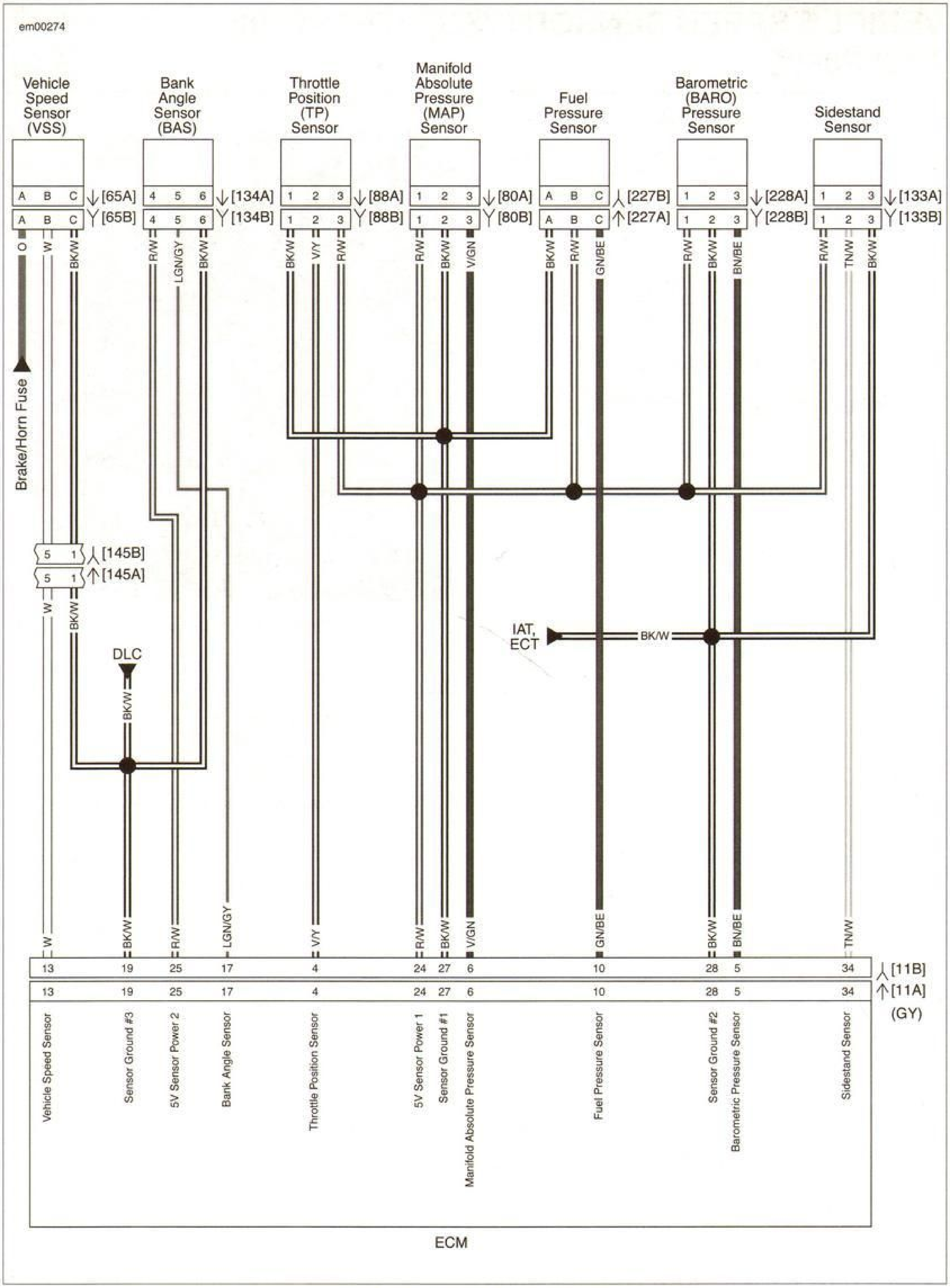
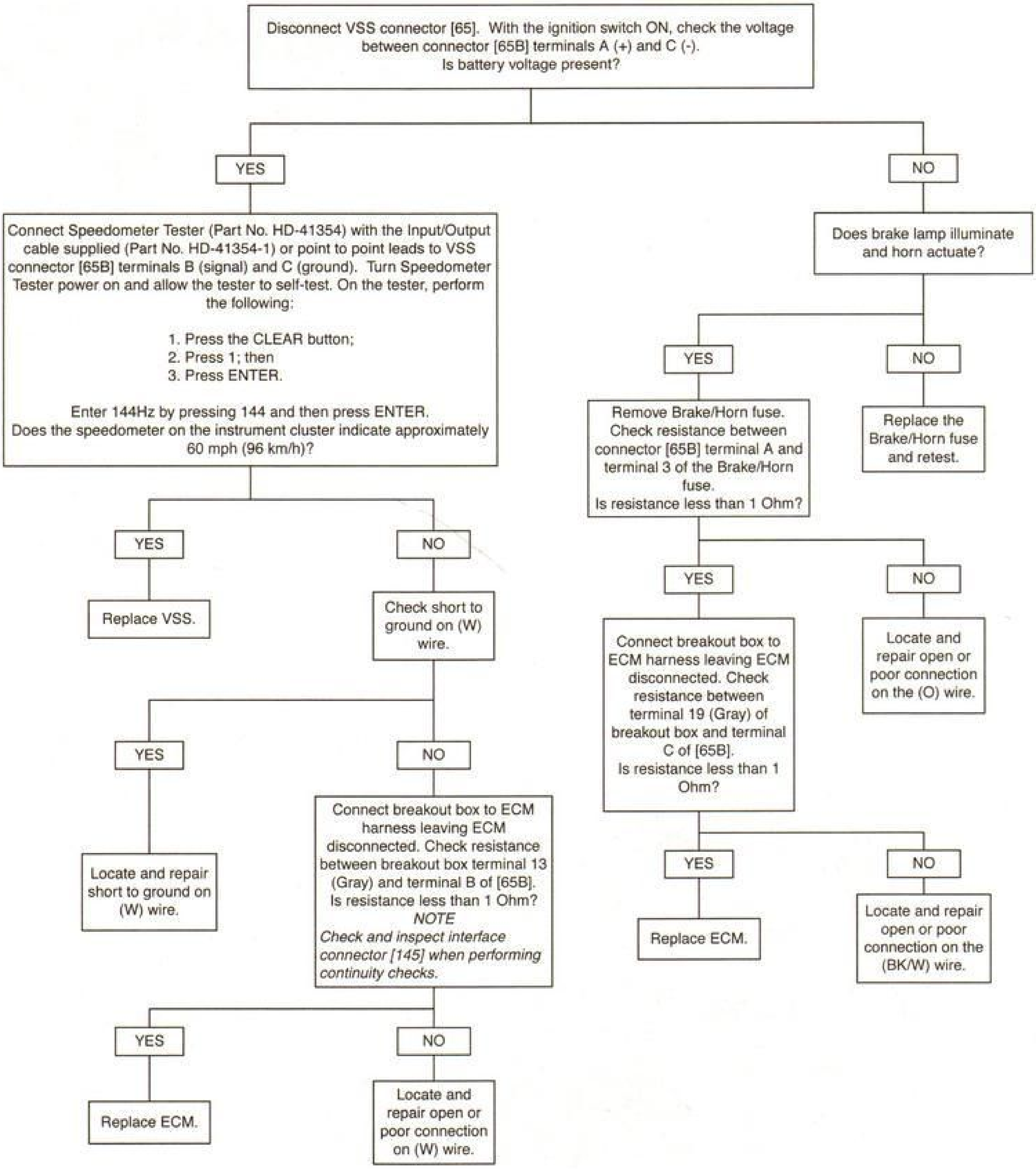


Figure 6-41. Vehicle Speed Sensor


Disconnect VSS connector [65]. With the ignition switch ON, check the voltage between connector [65B] terminals A (+) and C (-). Is battery voltage present?
YES
NO
Connect Speedometer Tester (Part No. HD-41354) with the Input/Output cable supplied (Part No. HD-41354-1) or point to point leads to VSS connector [65B] terminals B (signal) and C (ground). Turn Speedometer Tester power on and allow the tester to self-test. On the tester, perform the following:
1. Press the CLEAR button;
2. Press 1; then
3. Press ENTER.
Enter 144Hz by pressing 144 and then press ENTER. Does the speedometer on the instrument cluster indicate approximately 60 mph (96 km/h)?
Does brake lamp illuminate and horn actuate?
YES
NO
Remove Brake/Horn fuse. Check resistance between connector [65B] terminal A and terminal 3 of the Brake/Horn fuse. Is resistance less than 1 Ohm?
Replace the Brake/Horn fuse and retest.
YES
NO
Replace VSS.
Check short to ground on (W) wire.
YES
NO
Connect breakout box to ECM harness leaving ECM disconnected. Check resistance between terminal 19 (Gray) of breakout box and terminal C of [65B]. Is resistance less than 1 Ohm?
Locate and repair open or poor connection on the (O) wire.
YES
NO
Locate and repair short to ground on (W) wire.
Connect breakout box to ECM harness leaving ECM disconnected. Check resistance between breakout box terminal 13 (Gray) and terminal B of [65B]. Is resistance less than 1 Ohm?
NOTE
Check and inspect interface connector [145] when performing continuity checks.
YES
NO
Replace ECM.
Locate and repair open or poor connection on the (BK/W) wire.
YES
NO
Replace ECM.
Locate and repair open or poor connection on (W) wire.

fc01900_en

OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047 6.22

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-39978	DIGITAL MULTIMETER (FLUKE 78)

See Figure 6-42 and Figure 6-43 for front and rear O2 sensor location. The O2 sensor provides a signal to the ECM, to indicate whether the engine is running rich or lean.

- A low voltage signal (less than 0.41 V) indicates the engine is running lean.
- A high voltage signal (greater than 0.56 V) indicates the engine is running rich.

When the air/fuel mixture is ideal, approximately 14.7 parts air to 1 part fuel, the voltage is approximately 0.48 V. Refer to Table 6-22 for possible DTCs associated with these sensors.

NOTE

DTC P1047 could be caused by a mechanical concern and may cause O2 sensor codes to set.

Table 6-22. Code Description

DTC	DESCRIPTION
P0131	Front oxygen sensor circuit low/engine lean
P0132	Front oxygen sensor circuit high/engine rich
P0134	Front oxygen sensor open/inactive
P0151	Rear oxygen sensor circuit low/engine lean
P0152	Rear oxygen sensor circuit high/engine rich
P0154	Rear oxygen sensor open/inactive
P1047	Feedback fuel cylinder difference too great

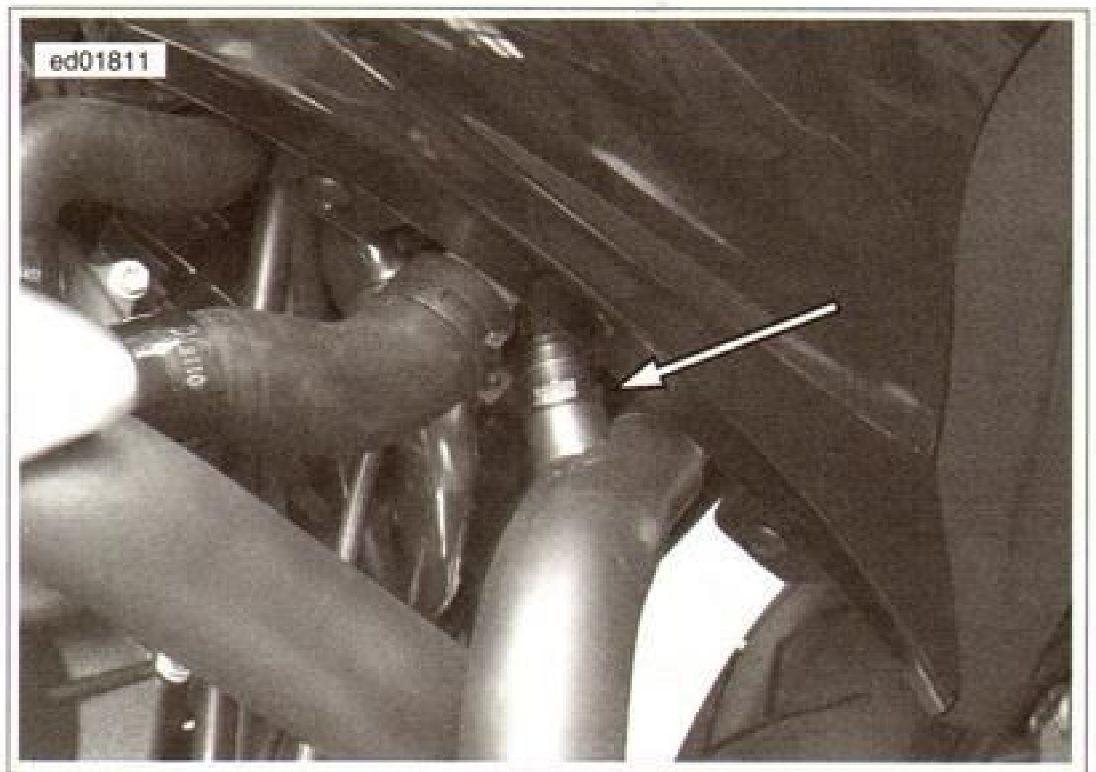


Figure 6-42. Front O2 Sensor Location

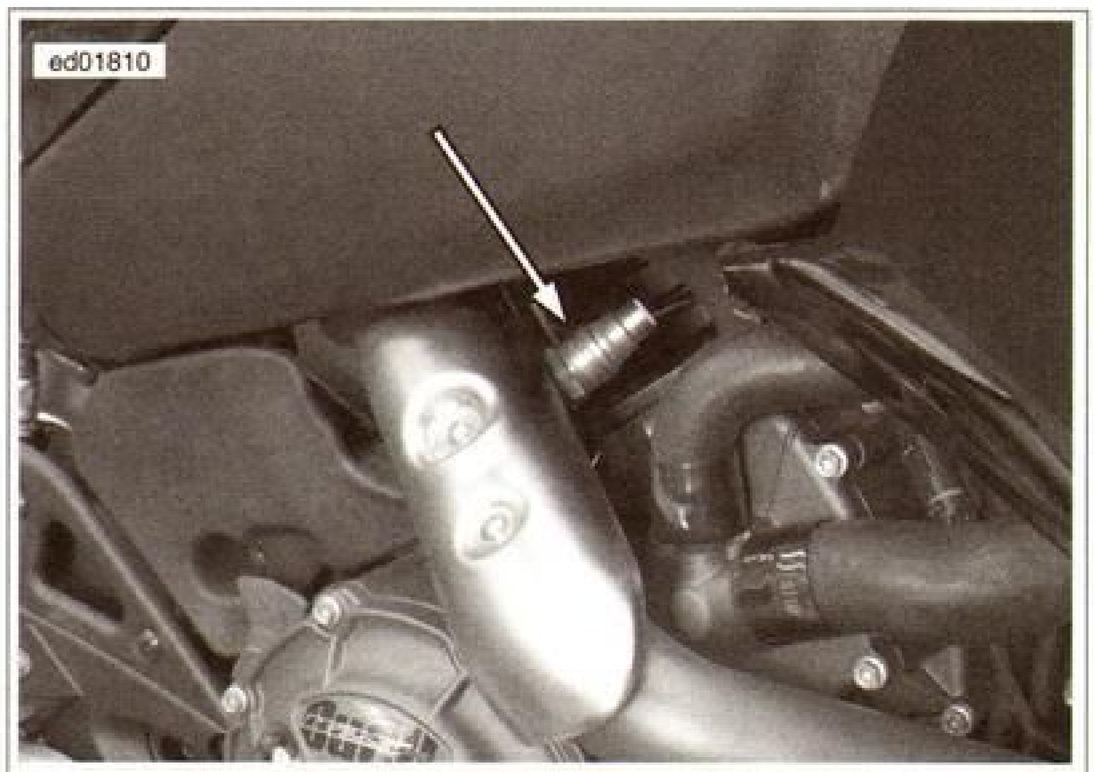


Figure 6-43. Rear O2 Sensor Location

Diagnostic Tips

The DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) displays the signal from the oxygen sensors in volts.

This voltage is an average value tending towards lean, rich, or ideal value depending on the operating temperature of the engine, engine speed, and throttle position. An open/short to voltage or short to ground in the (V/GY) wire causes the engine to run rich (short to ground) or lean (short to voltage). When a fault is detected, the ECM remains in an open loop. The engine must be running below 5000 RPM for the ECM to detect an O2 sensor failure.

Check for the following conditions:

- **Poor Connection:** Inspect ECM harness connector, fuel injector connectors, and O2 sensor connector [137] wiring for backed out terminals, improper mating, inoperative locks improperly formed or with damaged terminals, poor terminal-to-wire connection, and damaged harness.
- **Dirty/Stuck Open Injectors:** The motorcycle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there is an injector problem. This could also cause poor fuel economy and performance.
- **Loose O2 Sensor:** If the O2 sensor is loose, engine performance may be affected. This could also show up as a slow changing O2 sensor voltage.
- **Loose/Leaking Exhaust or Cracked/Leaking Intake Manifolds:** This can cause a poor ground connection for the sensor, or allow fresh air into the exhaust system or excessive air into the intake system. If fresh air enters either system, the O2 sensor reads a lean condition, causing the system to go rich.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

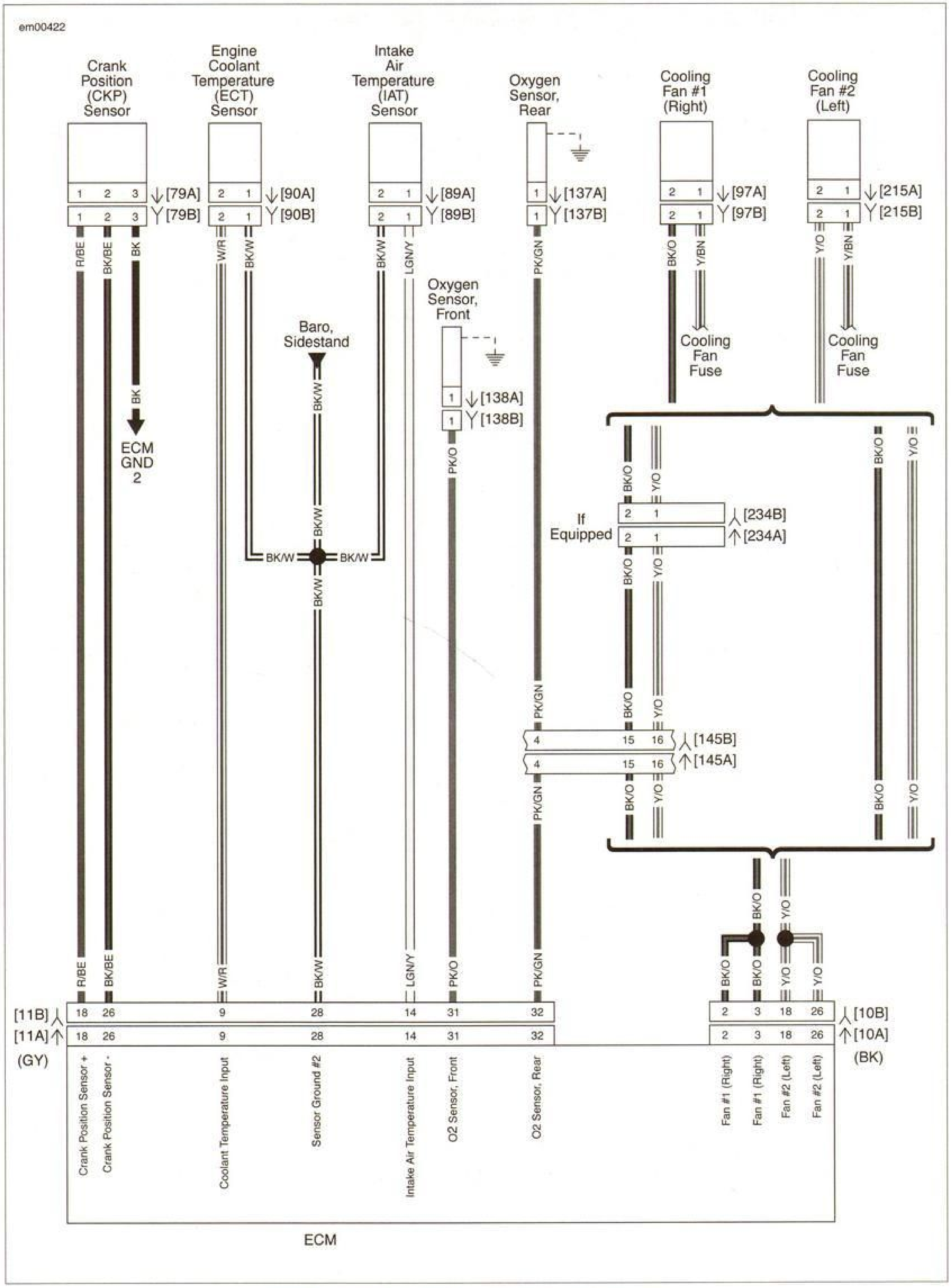
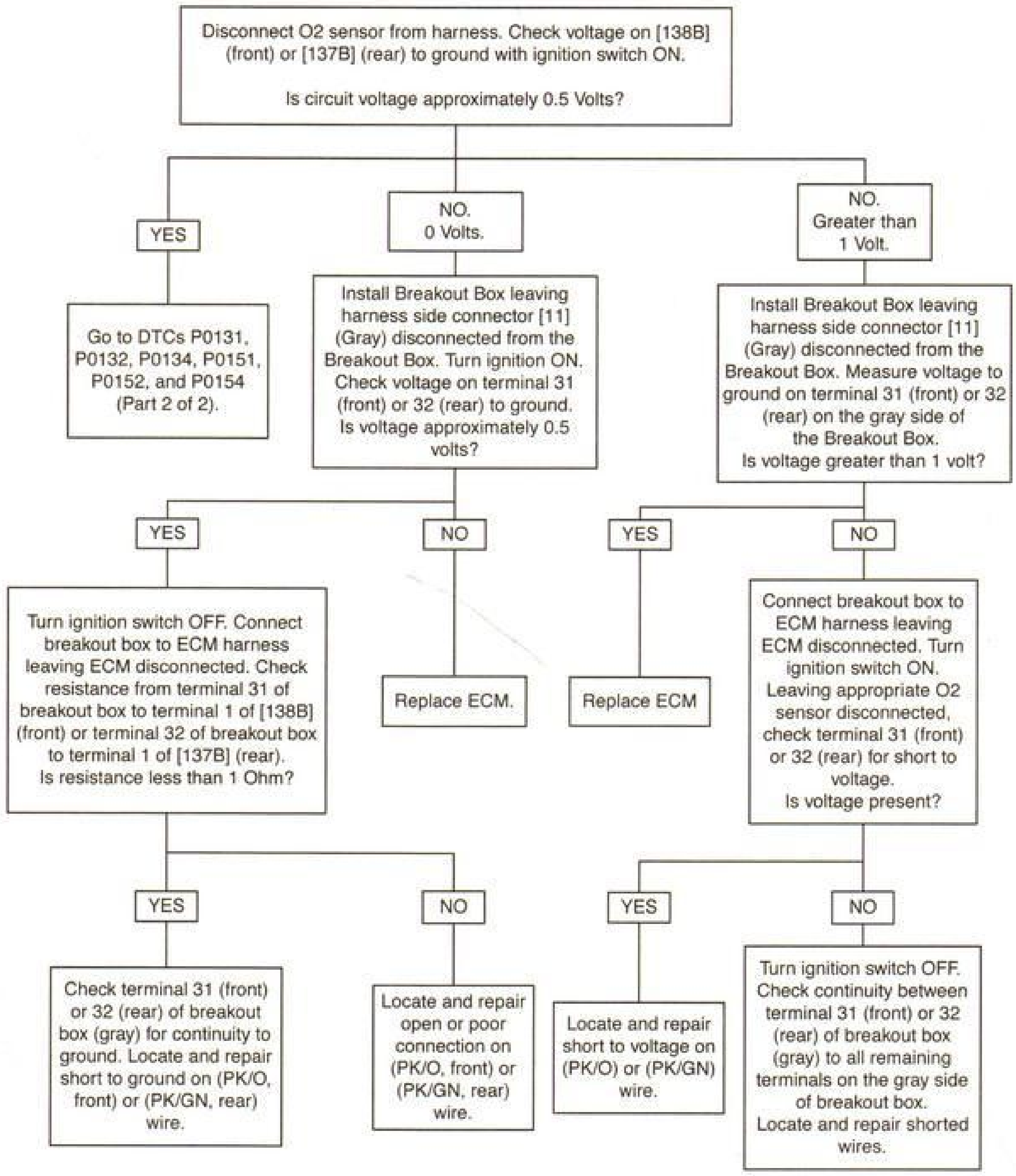
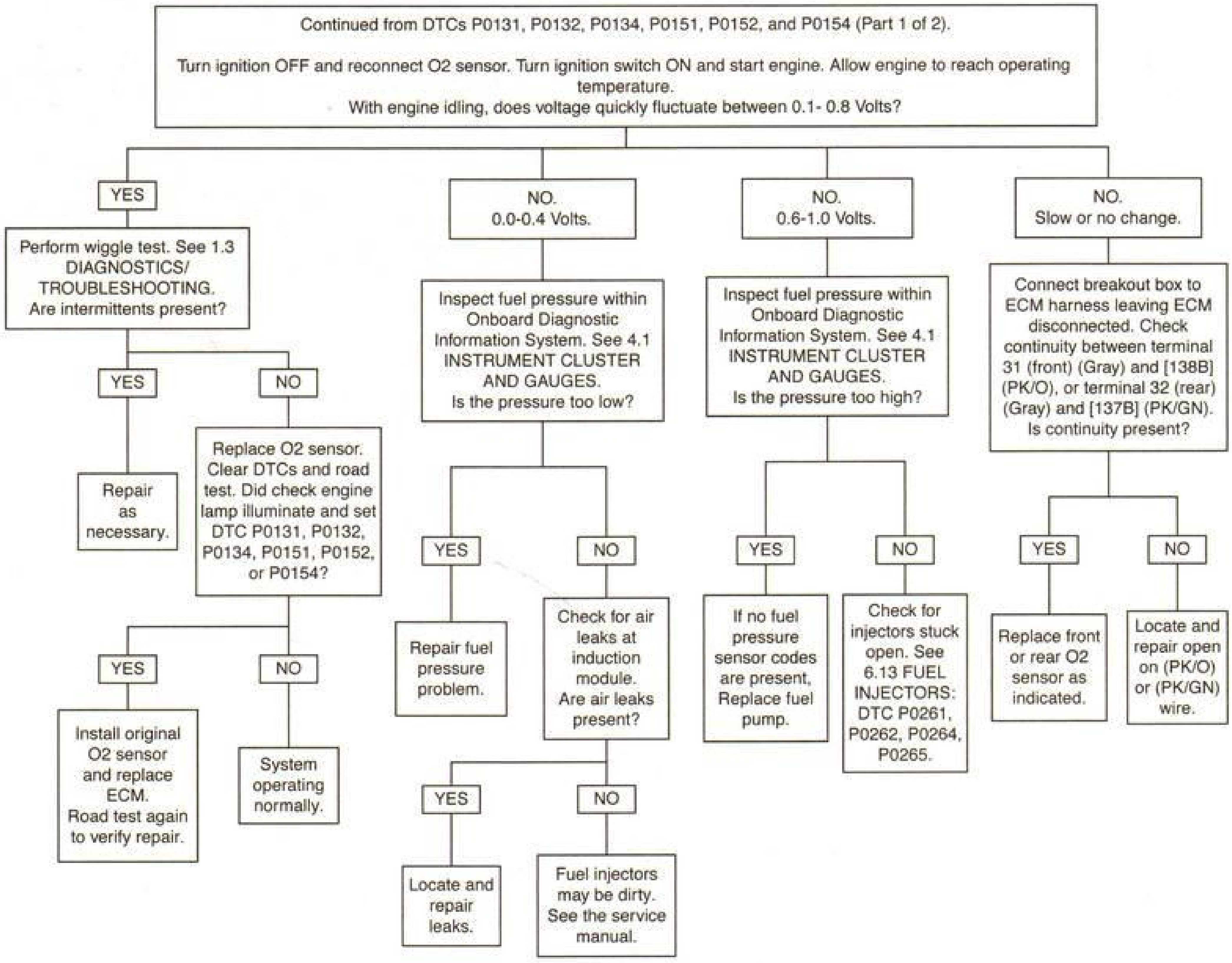


Figure 6-44. CKP, ECT, IAT, O2 sensors, and Cooling Fans


Disconnect O2 sensor from harness. Check voltage on [138B] (front) or [137B] (rear) to ground with ignition switch ON.
Is circuit voltage approximately 0.5 Volts?
YES
NO. 0 Volts.
NO. Greater than 1 Volt.
Go to DTCs P0131, P0132, P0134, P0151, P0152, and P0154 (Part 2 of 2).
Install Breakout Box leaving harness side connector [11] (Gray) disconnected from the Breakout Box. Turn ignition ON. Check voltage on terminal 31 (front) or 32 (rear) to ground. Is voltage approximately 0.5 volts?
Install Breakout Box leaving harness side connector [11] (Gray) disconnected from the Breakout Box. Measure voltage to ground on terminal 31 (front) or 32 (rear) on the gray side of the Breakout Box. Is voltage greater than 1 volt?
YES
NO
YES
NO
Turn ignition switch OFF. Connect breakout box to ECM harness leaving ECM disconnected. Check resistance from terminal 31 of breakout box to terminal 1 of [138B] (front) or terminal 32 of breakout box to terminal 1 of [137B] (rear). Is resistance less than 1 Ohm?
Replace ECM.
Replace ECM
Connect breakout box to ECM harness leaving ECM disconnected. Turn ignition switch ON. Leaving appropriate O2 sensor disconnected, check terminal 31 (front) or 32 (rear) for short to voltage. Is voltage present?
YES
NO
YES
NO
Check terminal 31 (front) or 32 (rear) of breakout box (gray) for continuity to ground. Locate and repair short to ground on (PK/O, front) or (PK/GN, rear) wire.
Locate and repair open or poor connection on (PK/O, front) or (PK/GN, rear) wire.
Locate and repair short to voltage on (PK/O) or (PK/GN) wire.
Turn ignition switch OFF. Check continuity between terminal 31 (front) or 32 (rear) of breakout box (gray) to all remaining terminals on the gray side of breakout box. Locate and repair shorted wires.

fc01901_en


Continued from DTCs P0131, P0132, P0134, P0151, P0152, and P0154 (Part 1 of 2).
Turn ignition OFF and reconnect O2 sensor. Turn ignition switch ON and start engine. Allow engine to reach operating temperature.
With engine idling, does voltage quickly fluctuate between 0.1- 0.8 Volts?
YES
Perform wiggle test. See 1.3 DIAGNOSTICS/ TROUBLESHOOTING. Are intermittents present?
YES
Repair as necessary.
NO
Replace O2 sensor. Clear DTCs and road test. Did check engine lamp illuminate and set DTC P0131, P0132, P0134, P0151, P0152, or P0154?
YES
Install original O2 sensor and replace ECM. Road test again to verify repair.
NO
System operating normally.
NO. 0.0-0.4 Volts.
Inspect fuel pressure within Onboard Diagnostic Information System. See 4.1 INSTRUMENT CLUSTER AND GAUGES. Is the pressure too low?
YES
Repair fuel pressure problem.
NO
Check for air leaks at induction module. Are air leaks present?
YES
Locate and repair leaks.
NO
Fuel injectors may be dirty. See the service manual.
NO. 0.6-1.0 Volts.
Inspect fuel pressure within Onboard Diagnostic Information System. See 4.1 INSTRUMENT CLUSTER AND GAUGES. Is the pressure too high?
YES
If no fuel pressure sensor codes are present, Replace fuel pump.
NO
Check for injectors stuck open. See 6.13 FUEL INJECTORS: DTC P0261, P0262, P0264, P0265.
NO. Slow or no change.
Connect breakout box to ECM harness leaving ECM disconnected. Check continuity between terminal 31 (front) (Gray) and [138B] (PK/O), or terminal 32 (rear) (Gray) and [137B] (PK/GN). Is continuity present?
YES
Replace front or rear O2 sensor as indicated.
NO
Locate and repair open on (PK/O) or (PK/GN) wire.

fc001902_en

IDLE AIR CONTROL (IAC): DTC P0506, P0507, P0511 6.23

DESCRIPTION AND OPERATION

See Figure 6-45. The ECM controls engine idle speed by moving the IAC motor 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 motor, causing the pintle to move in or out of the IAC motor a given distance for each pulse received. Refer to Table 6-23.

- 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.

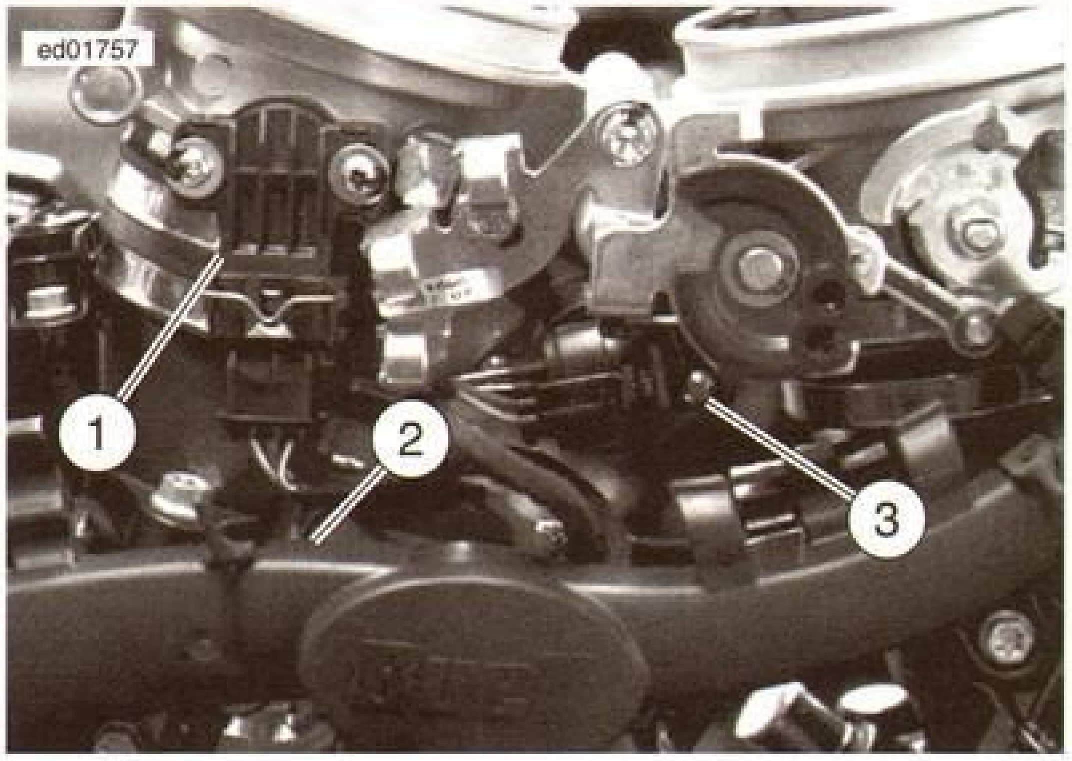
The IAC motor position in steps can be observed by using the Onboard Diagnostic Information System (ODIS). See 4.1 INSTRUMENT CLUSTER AND GAUGES.

- A high number of steps represents a retracted pintle and an open passage around throttle plates. This correlates with an increase in the amount of air flowing through the throttle body.
- Five steps represents a fully extend pintle. A five reading indicates an abnormal condition in which the pintle has been fully extended and has consequently closed the passage around the throttle plates.

Each time the ignition switch is turned ON, the ECM resets the IAC motor by sending enough pulses to extend the pintle and effectively close the air passage around the throttle plates. 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.

Table 6-23. Code Description

DTC	DESCRIPTION
P0506	Idle Air Control system - RPM higher than expected
P0507	Idle Air Control system - RPM lower than expected
P0511	Idle Air Control circuit fault



1. **TP sensor [88]**
2. **ECT sensor [90]**
3. **IAC [87]**

Figure 6-45. Throttle Body Connectors

Diagnostic Tips

When the ignition is keyed ON, the IAC motor pintle extends and then retracts to a fixed position for increased airflow and idle speed during the engine start sequence. This ON reset procedure takes 2 seconds to perform.

Test lamp behavior may follow two patterns. The color of the lights is not relevant to IAC motor operation:

- **Normal behavior:** At ignition switch ON, test lights alternately flash to confirm ECM signals.
- **Problem indicated:** One or more lights fail to illuminate during ignition switch ON/OFF cycle.

Engine idle speed can be adversely affected by the following:

- A loss of idle speed control does not necessarily imply the IAC motor or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle stop (factory set) or a misfiring cylinder.
- Leaking injectors 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 cleaner. Refer to Air Cleaner in the service manual. Turn key ON for two seconds, five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See the service manual.
- To confirm IAC function, disconnect the fuel pump. Turn engine stop and ignition switch on and listen for IAC

movement (clicking or humming noise) for a few seconds after the ignition switch is turned on.

- Vacuum leaks. To check for vacuum, see the service manual.
- Contaminated fuel.
- Excessive oil in crankcase (oil sumping).
- TP sensor reading of greater than 5% (possible throttle cable misadjustment) or battery voltage reading of less than 9 Volts will disable idle speed control.

NOTE

It is possible that one of the circuits is shorted to voltage which should have been indicated by a steady light. Disconnect the IAC connector and test for voltage at the harness terminals with the ignition switch ON, after IAC has reset.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

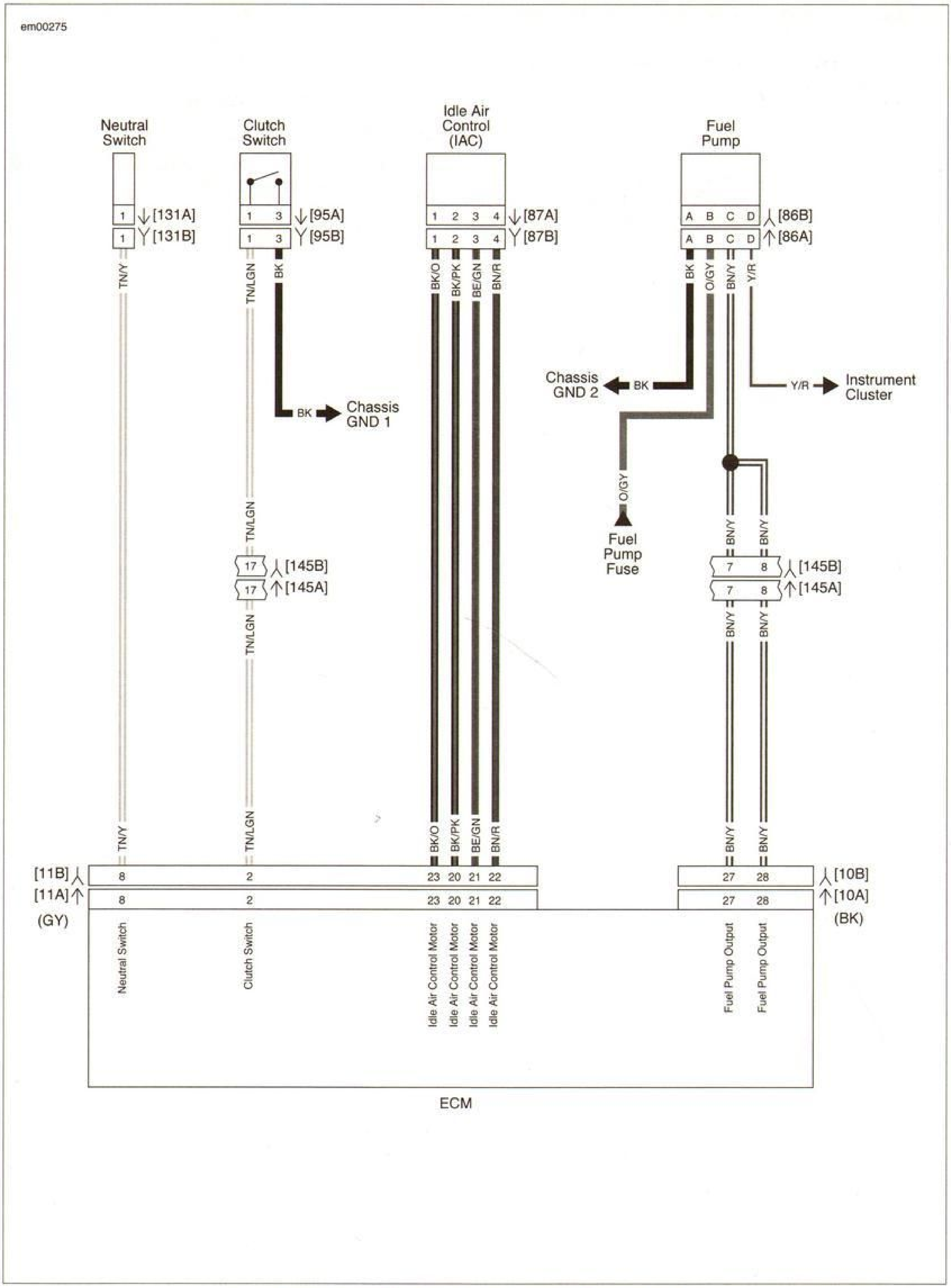
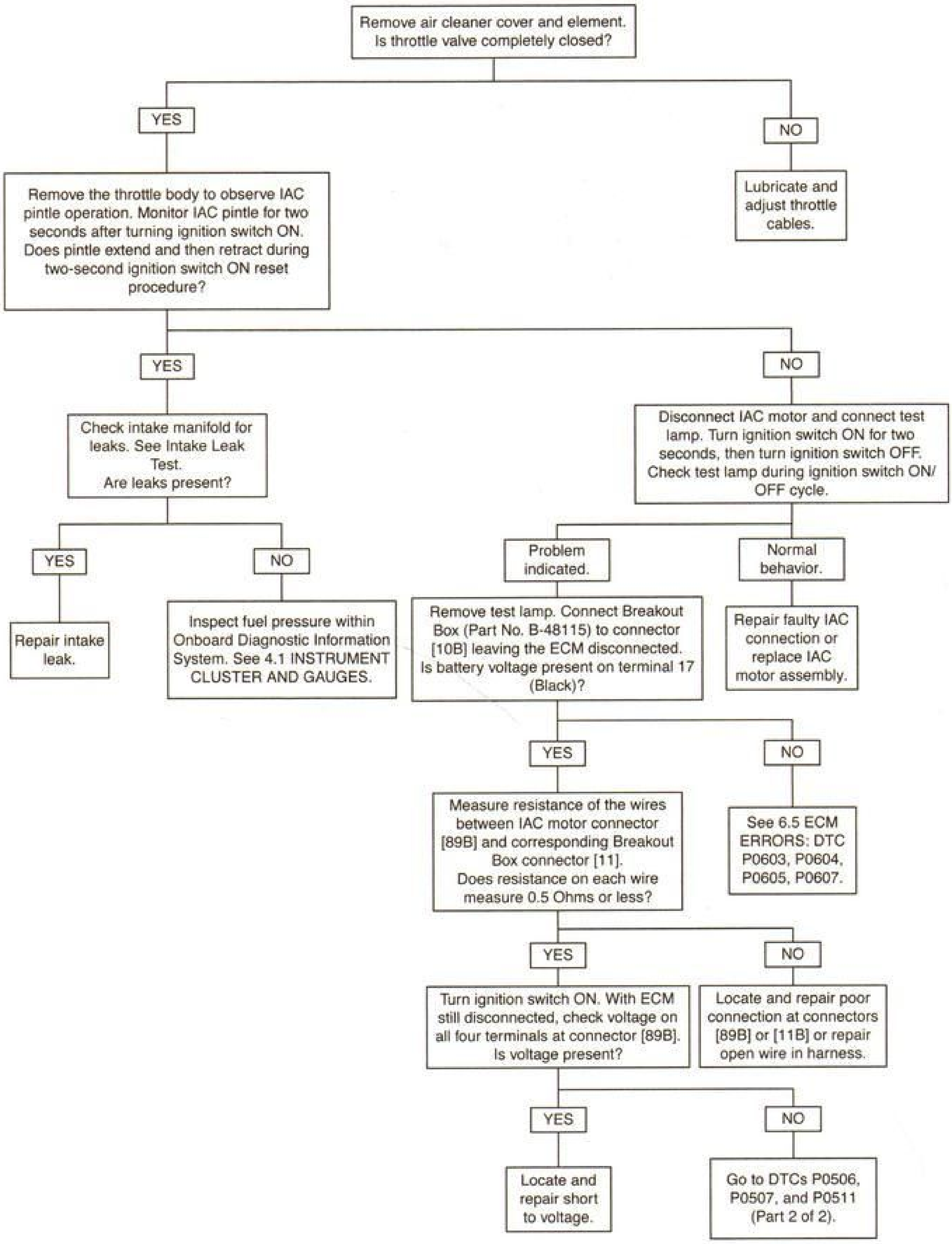


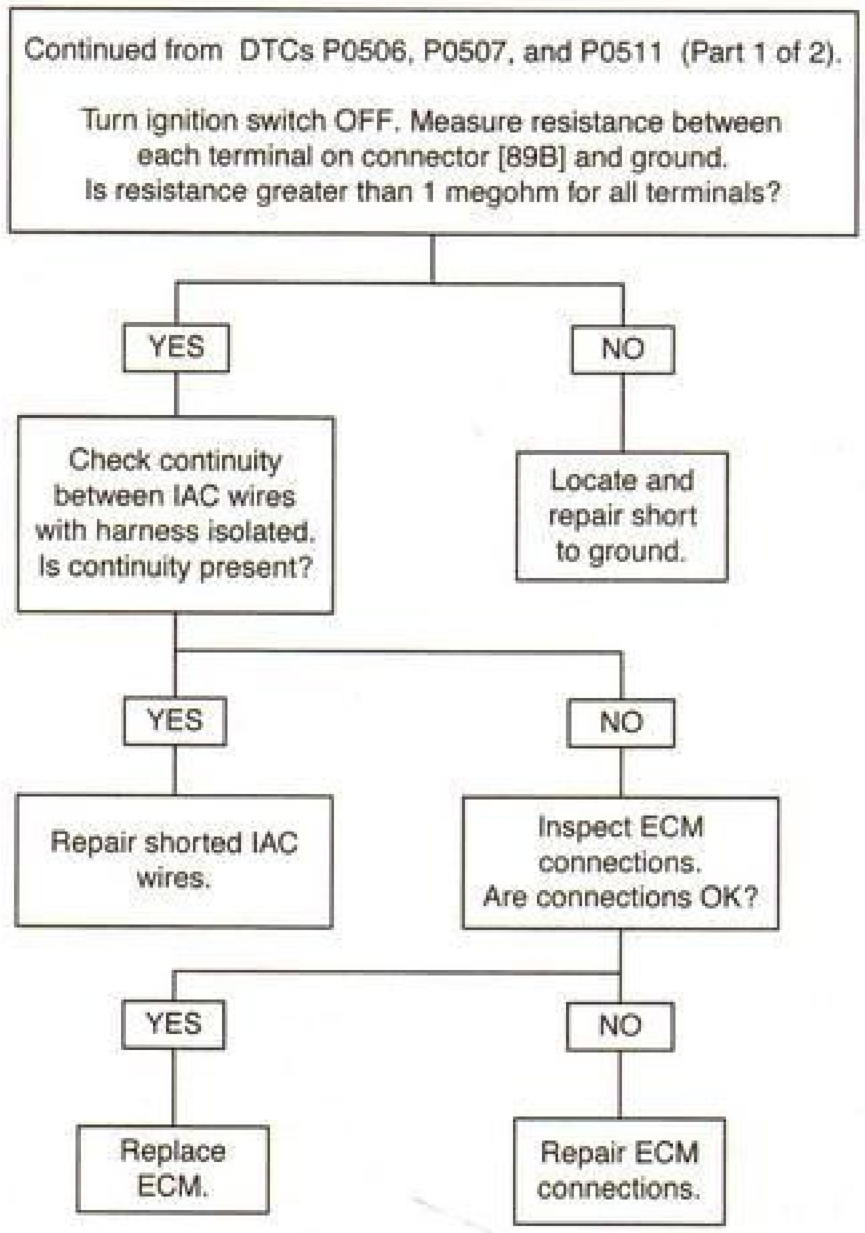
Figure 6-46. Neutral and Clutch Switches, IAC, and Fuel Pump

DTCs P0506, P0507, and P0511 (Part 1 of 2)



fc01903_en

DTCs P0506, P0507, and P0511 (Part 2 of 2)



fc01904_en

RIGHT AND LEFT FAN CONTROL: DTC P0691, P0692, P0693, P0694 6.24

DESCRIPTION AND OPERATION

Cooling Fan

An ECT sensor signal, indicating the engine coolant temperature is above a preset temperature, causes the ECM to command the fans on. The cooling fans run continuously once the engine operating temperature is reached. The cooling fans are provided battery voltage from the (Y/BN) wire. The ECM controls the fan by providing ground. When the ignition is off, the fans may run for approximately two and a half minutes depending on the temperature of vehicle when ignition was turned OFF. Refer to Table 6-24.

Table 6-24. Cooling Fan Specifications

KEY	FAN ON	FAN OFF
ON	170 °F (77 °C)	160 °F (71 °C)
OFF	189 °F (87 °C)	169 °F (76 °C)

DTCs occur when the ECM detects an open or short in the fan driver circuits. DTCs can also set if the ECM detects high current when the fans are turned on. This can be caused by blocked fan blades or a fan motor issue. Refer to Table 6-25 for possible DTCs.

Table 6-25. Code Description

DTC	DESCRIPTION
P0691	Right fan control circuit low
P0692	Right fan control circuit high
P0693	Left fan control circuit low
P0694	Left fan control circuit high

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

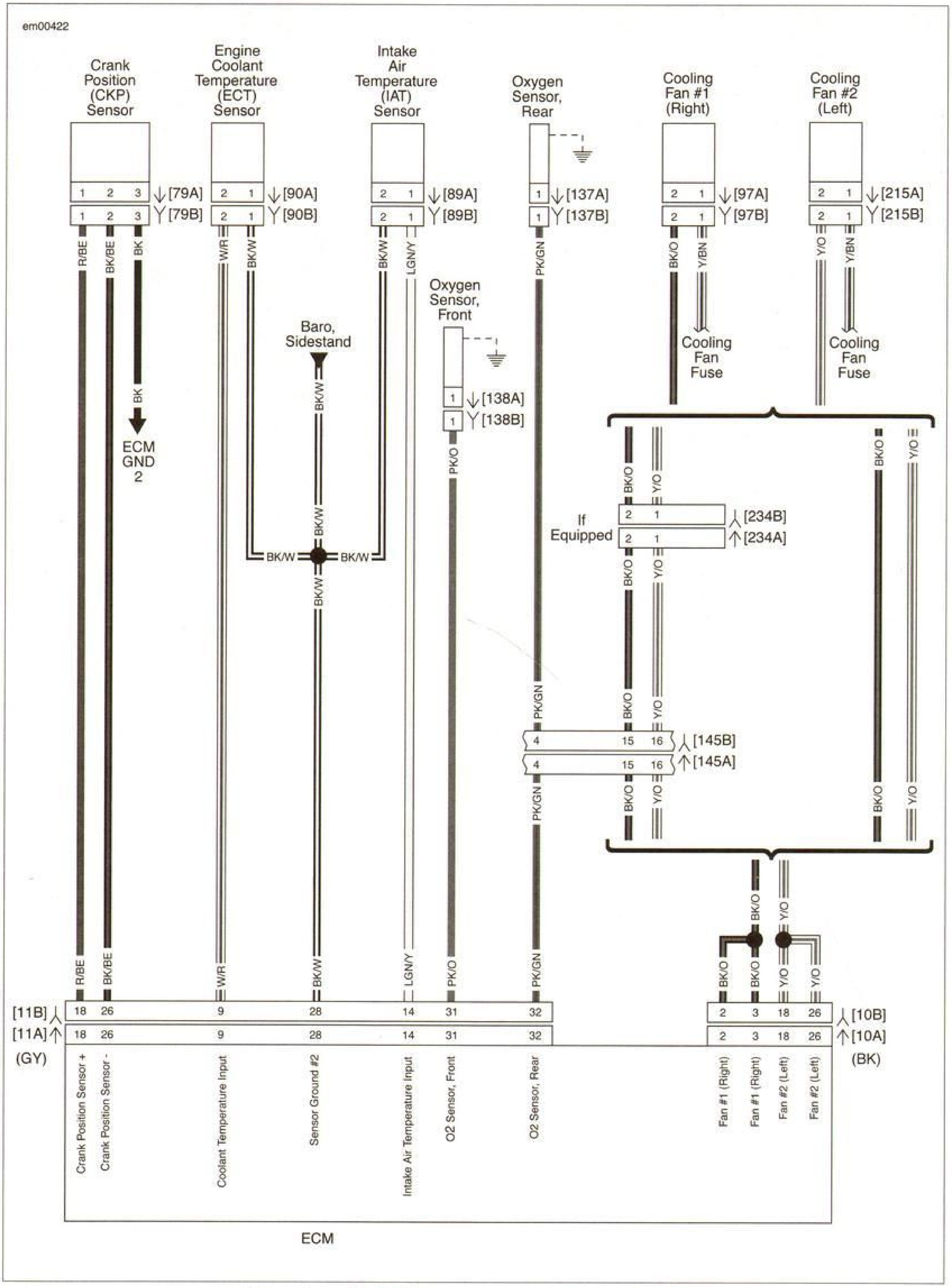
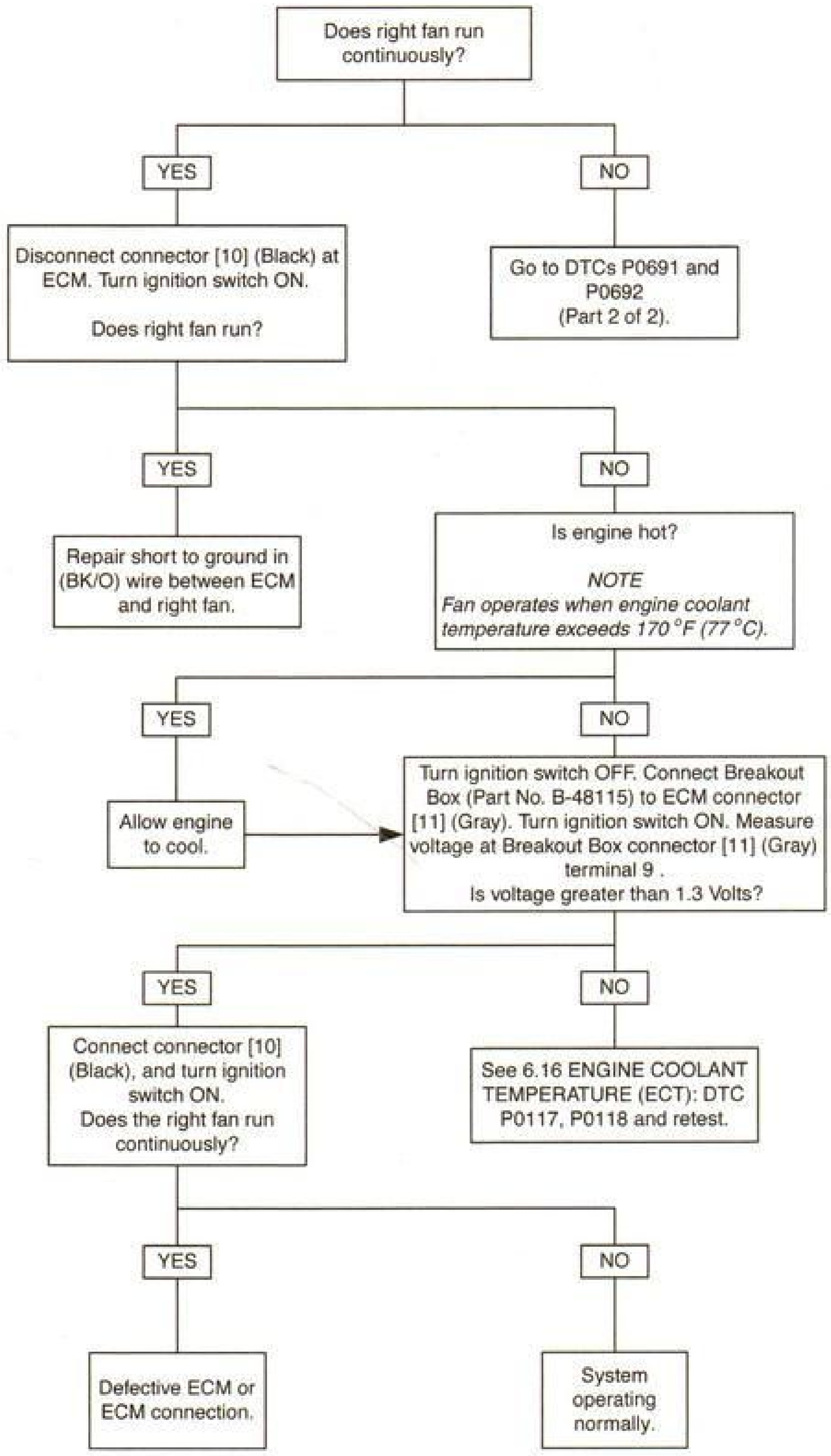


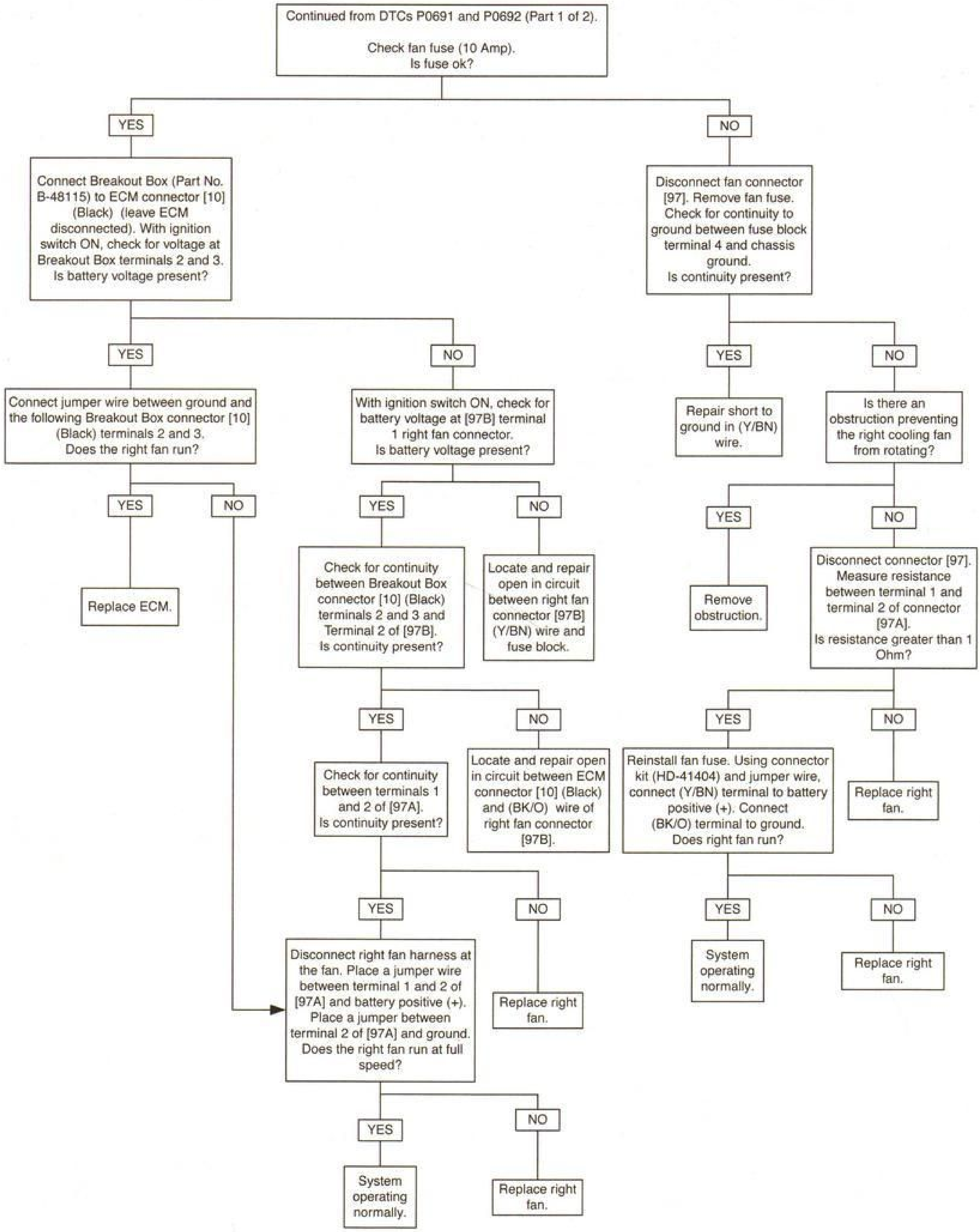
Figure 6-47. CKP, ECT, IAT, O2 sensors, and Cooling Fans

DTCs P0691 and P0692 (Part 1 of 2)



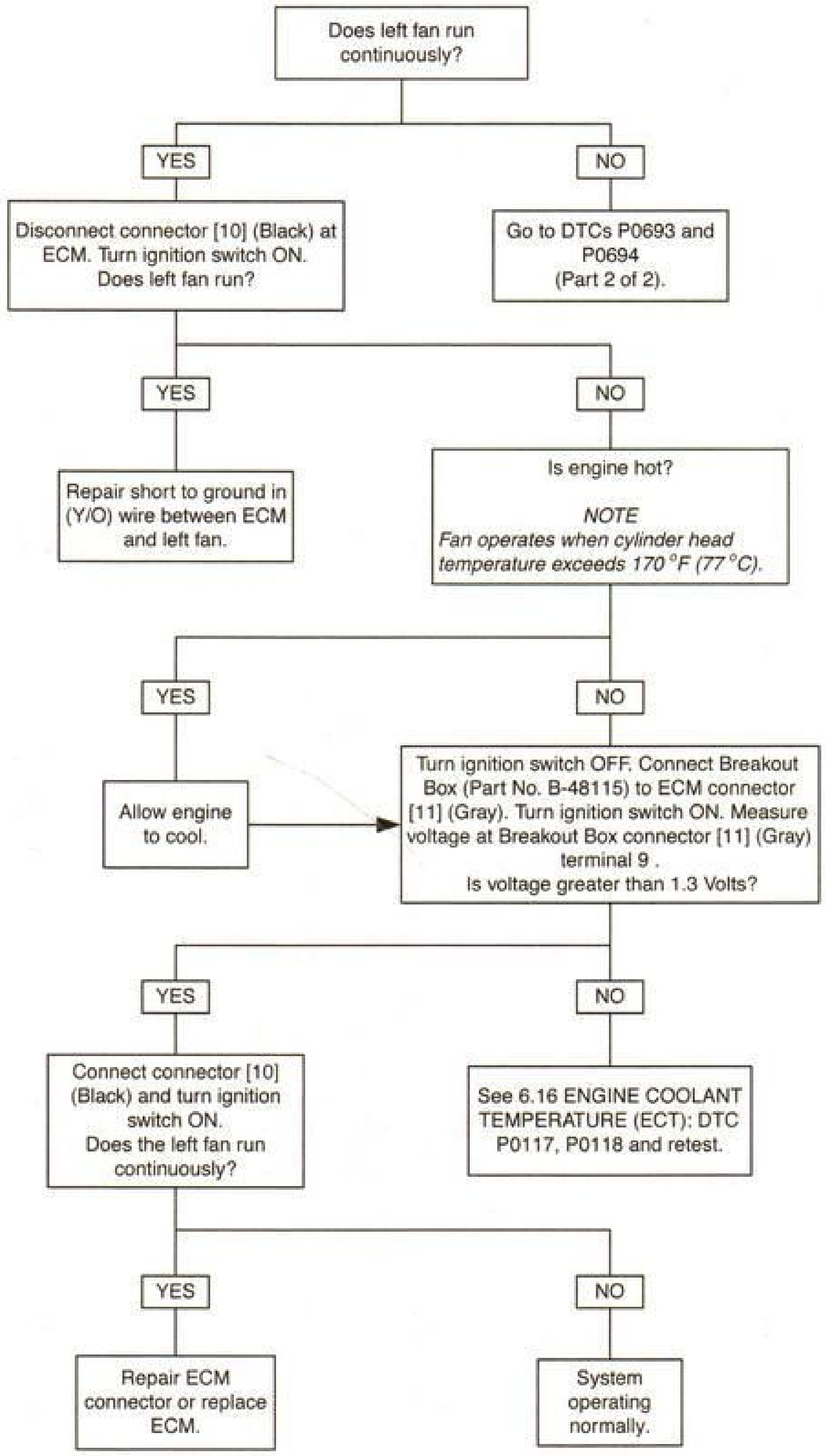
fc01910_en

DTCs P0691 and P0692 (Part 2 of 2)



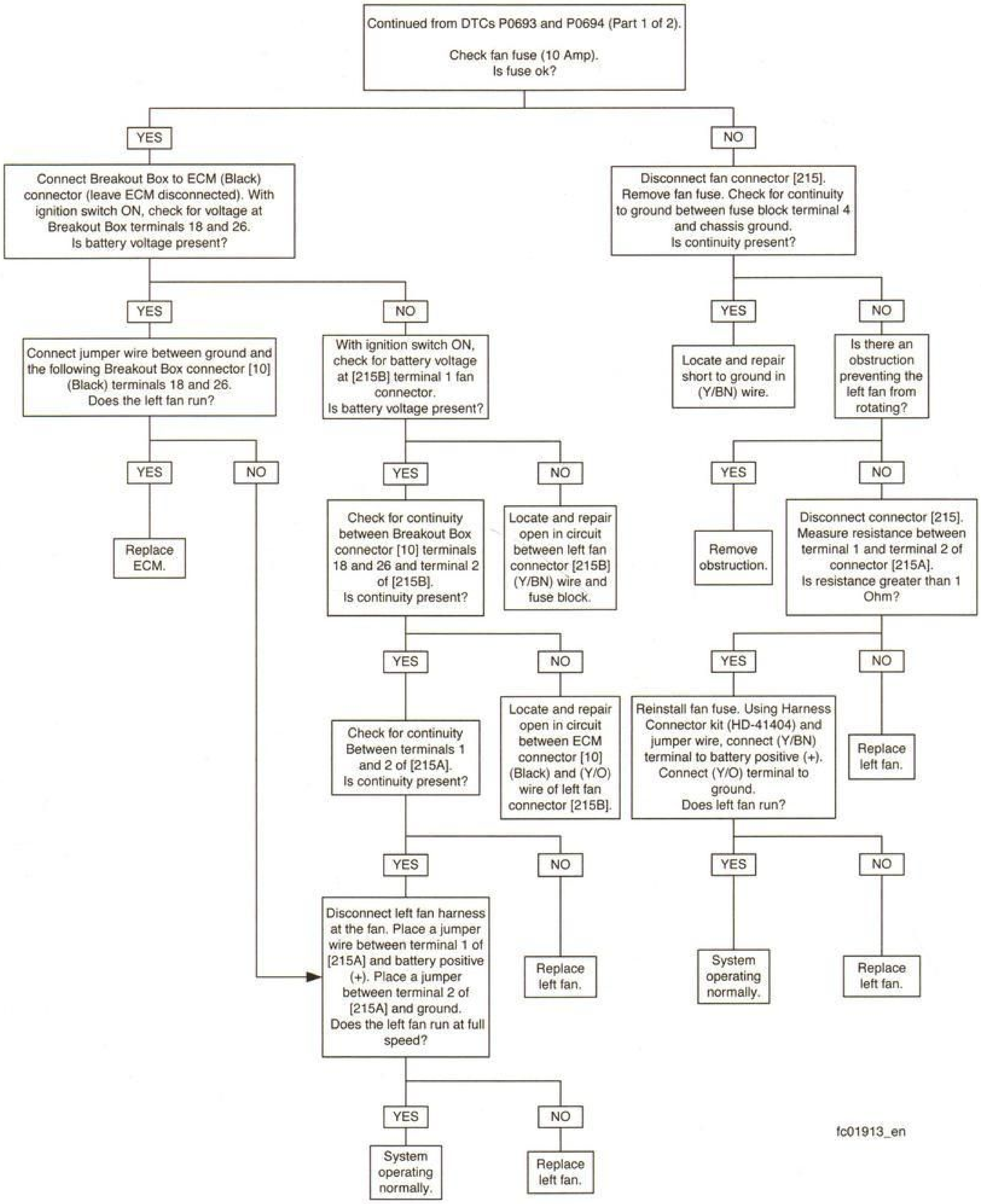
fc01911_en

DTCs P0693 and P0694 (Part 1 of 2)



fc01912_en

DTCs P0693 and P0694 (Part 2 of 2)



DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-23738	VACUUM PUMP

See Figure 6-48. The MAP sensor is supplied 5 Volts from the ECM and sends a signal back to the ECM. The signal varies with engine vacuum (more vacuum, lower signal output) and atmospheric barometric pressure. Barometric pressure is influenced by weather and altitude.

Table 6-26. Code Description

DTC	DESCRIPTION
P0107	MAP sensor low/open
P0108	MAP sensor high

Diagnostic Tips

Codes set if the MAP sensor is out of range. P0108 can only be set when the engine is running. The MAP sensor uses the same power circuit as the fuel pressure, barometric, sidestand, and throttle position sensors. Therefore, if the 5 V power circuit is open or shorted to ground, other codes set. Refer to Table 6-26 for DTCs applicable to the MAP sensor.

NOTE

Do not over-pump vacuum pump when performing the MAP sensor output check. Sensor damage could result.

Use a VACUUM PUMP (Part No. HD-23738) to apply a vacuum to the pressure port of the sensor. The signal voltage should drop as vacuum is increased.

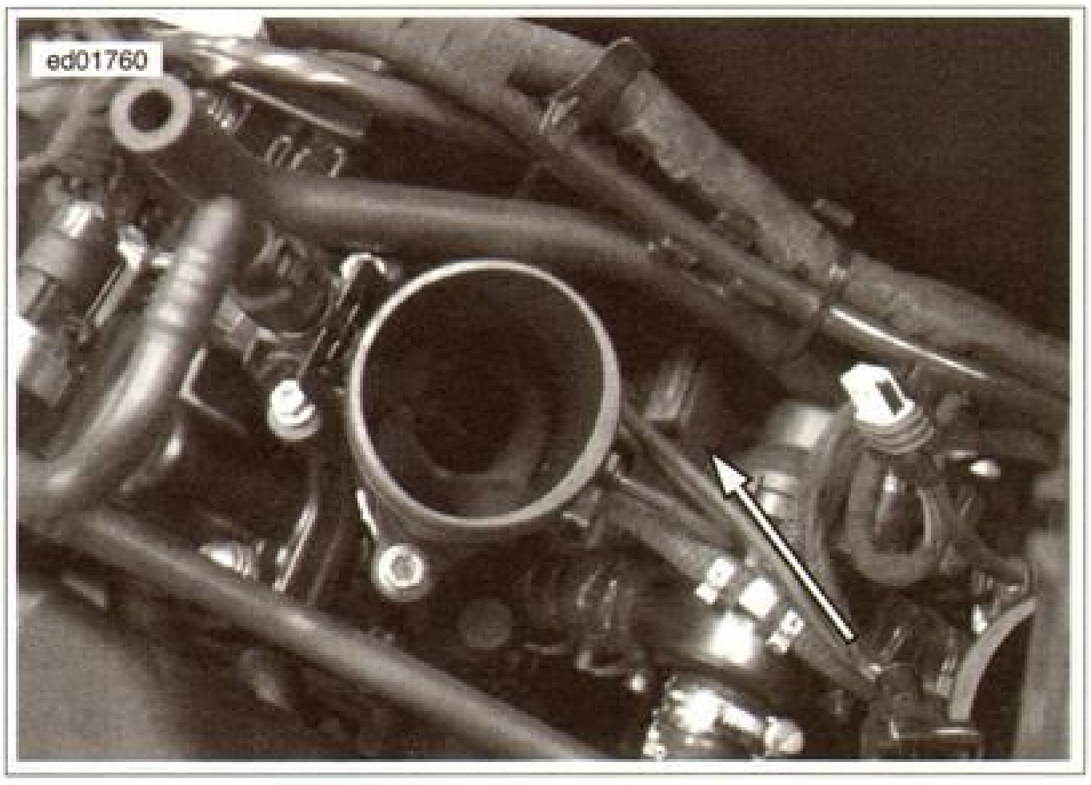


Figure 6-48. MAP Sensor Location

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

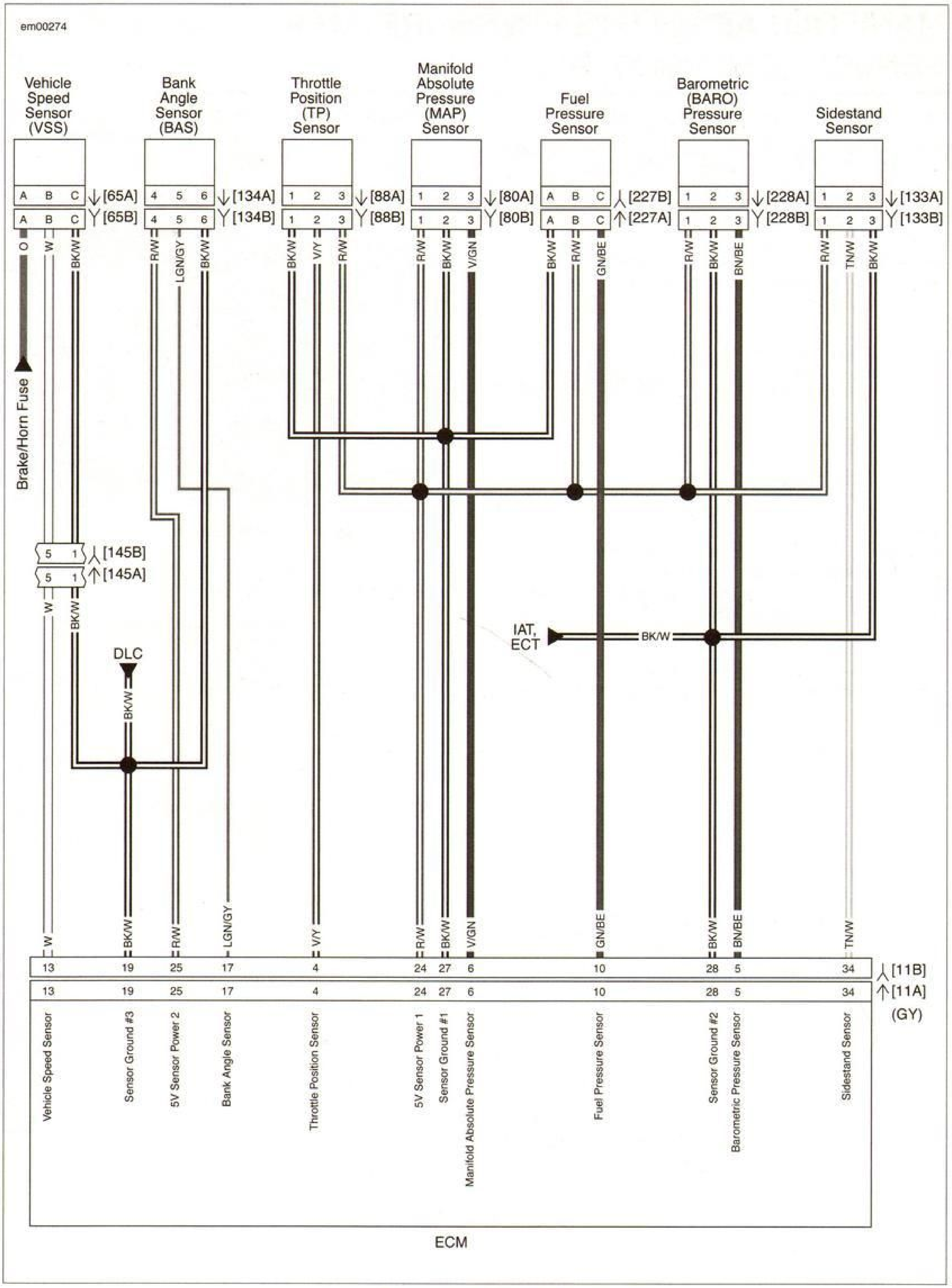
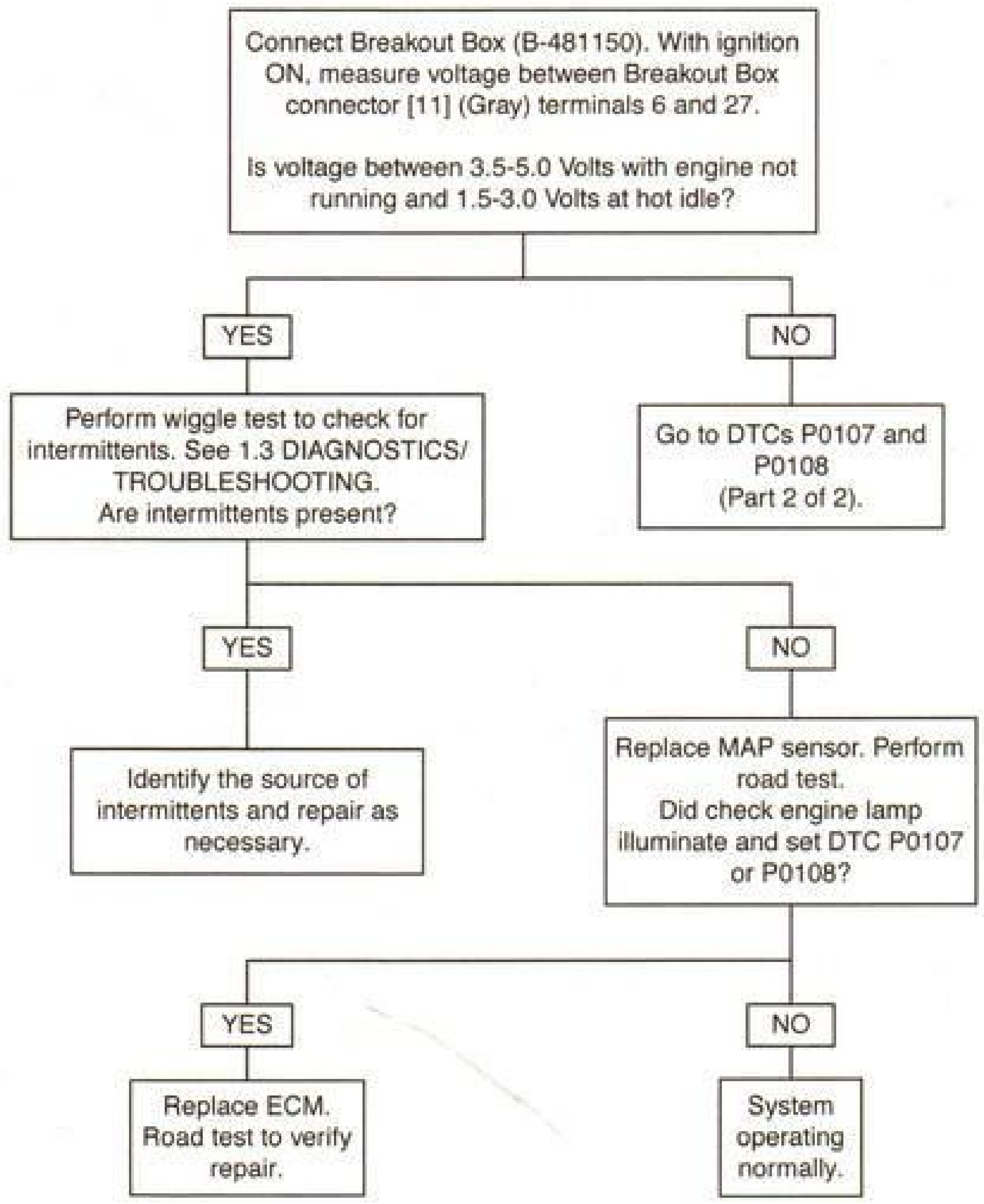


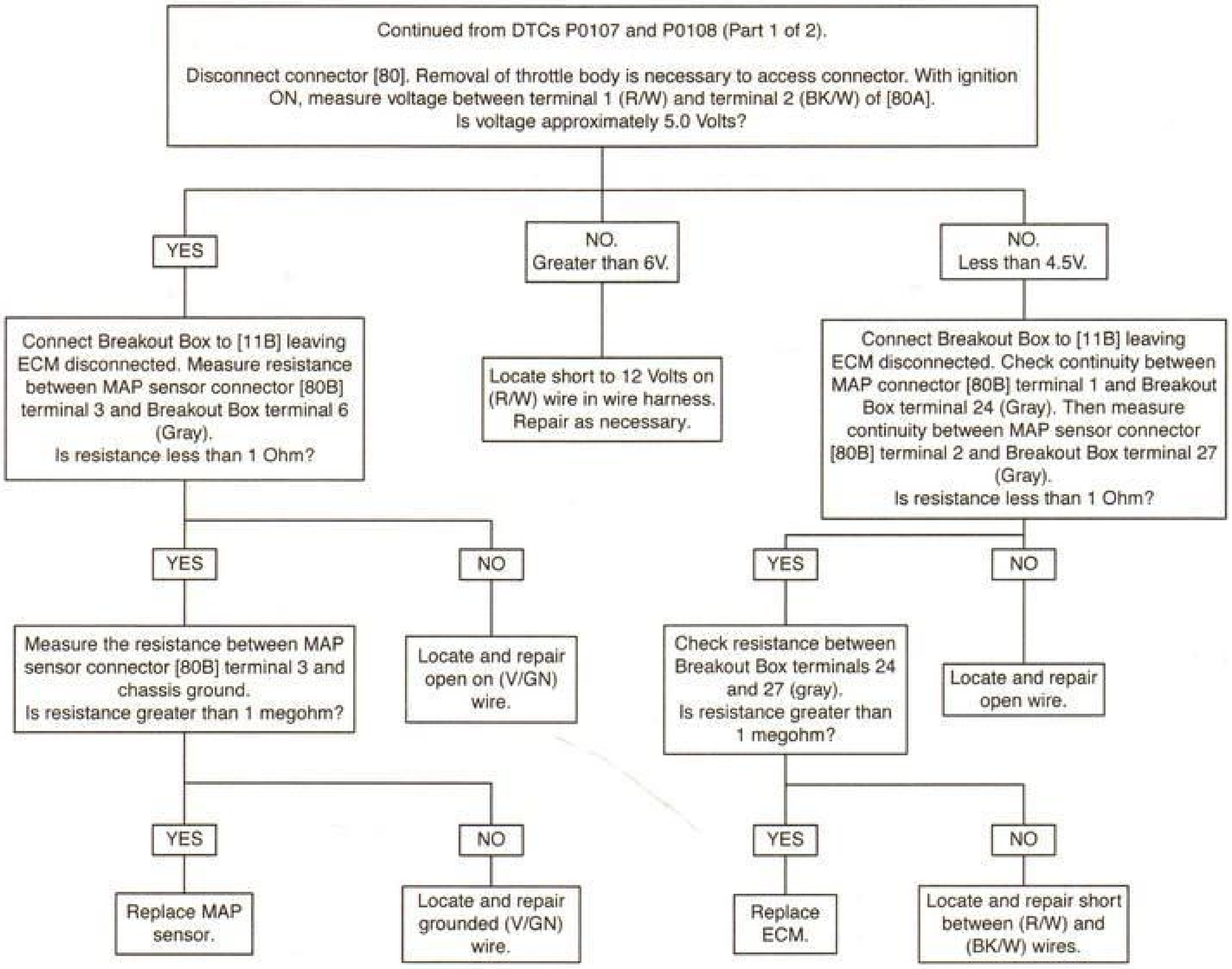
Figure 6-49. 5V Reference Circuit

DTCs P0107 and P0108 (Part 1 of 2)



fc01917_en

DTCs P0107 and P0108 (Part 2 of 2)



fc01918_en

DESCRIPTION AND OPERATION

See Figure 6-50. The DTCs set if the ECM detects battery positive voltage less than 9.6 Volts or greater than 16 Volts. Refer to Table 6-27 for DTC descriptions.

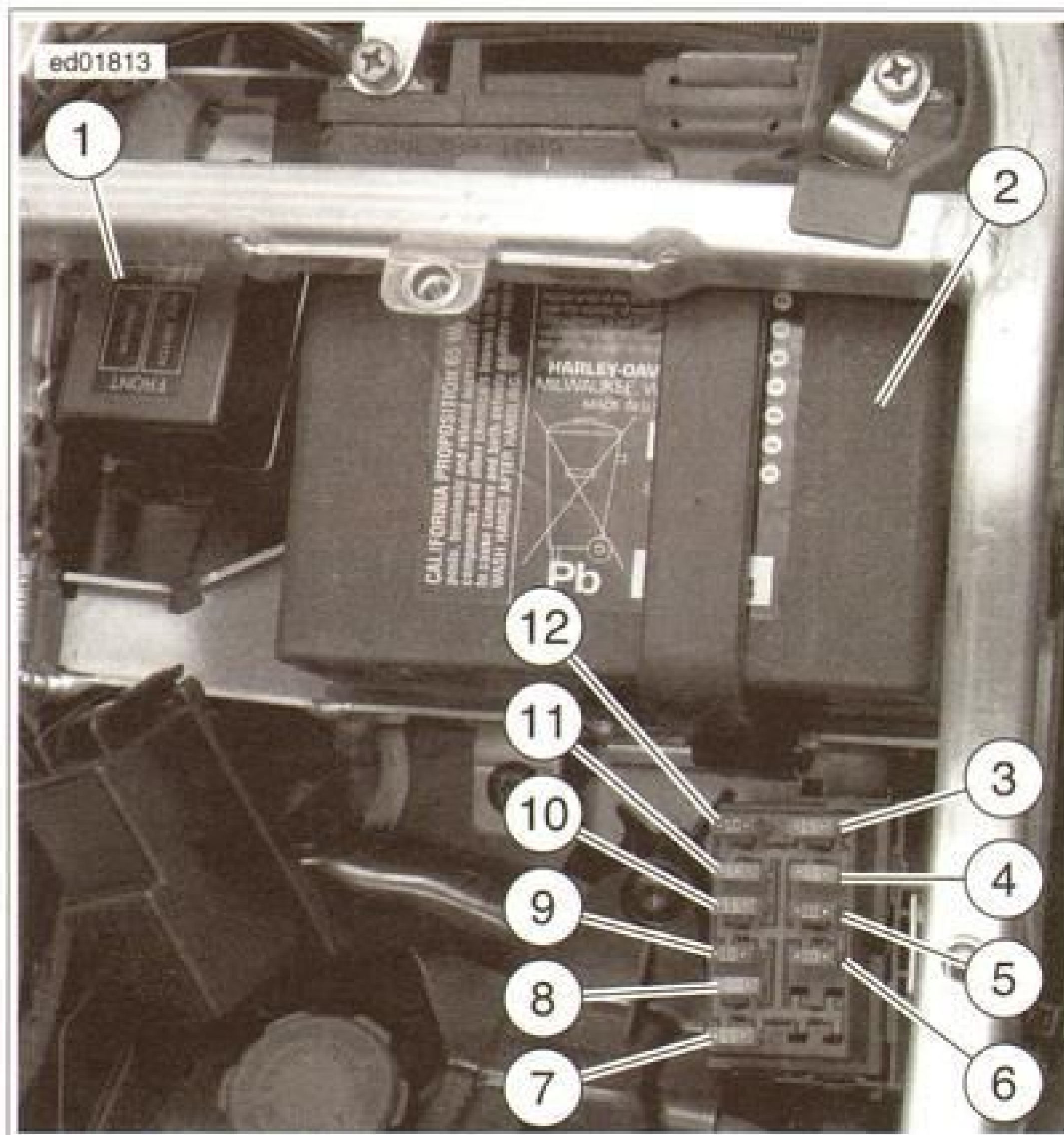
- A low voltage condition typically occurs during the first 10 seconds of starter activation and the ECM does not detect a voltage rise as engine RPM increases. This could also indicate a charging system fault and loose wire connections.
- A high voltage condition is usually caused by a faulty voltage regulator.

Table 6-27. Code Description

DTC	DESCRIPTION
P0562	Battery voltage low
P0563	Battery voltage high

Diagnostic Tips

This test checks for voltage drops in the ECM power circuit. If a significant voltage drop is not present, the condition may be caused by excessive starter current draw.



1. Relay block
2. Battery
3. Key switch fuse
4. Lights fuse
5. ECM fuse
6. Aux power fuse
7. Fuel pump fuse
8. Battery fuse
9. Brake/horn fuse
10. Cooling fan fuse
11. Ignition fuse
12. Accessory fuse

Figure 6-50. Under Seat

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

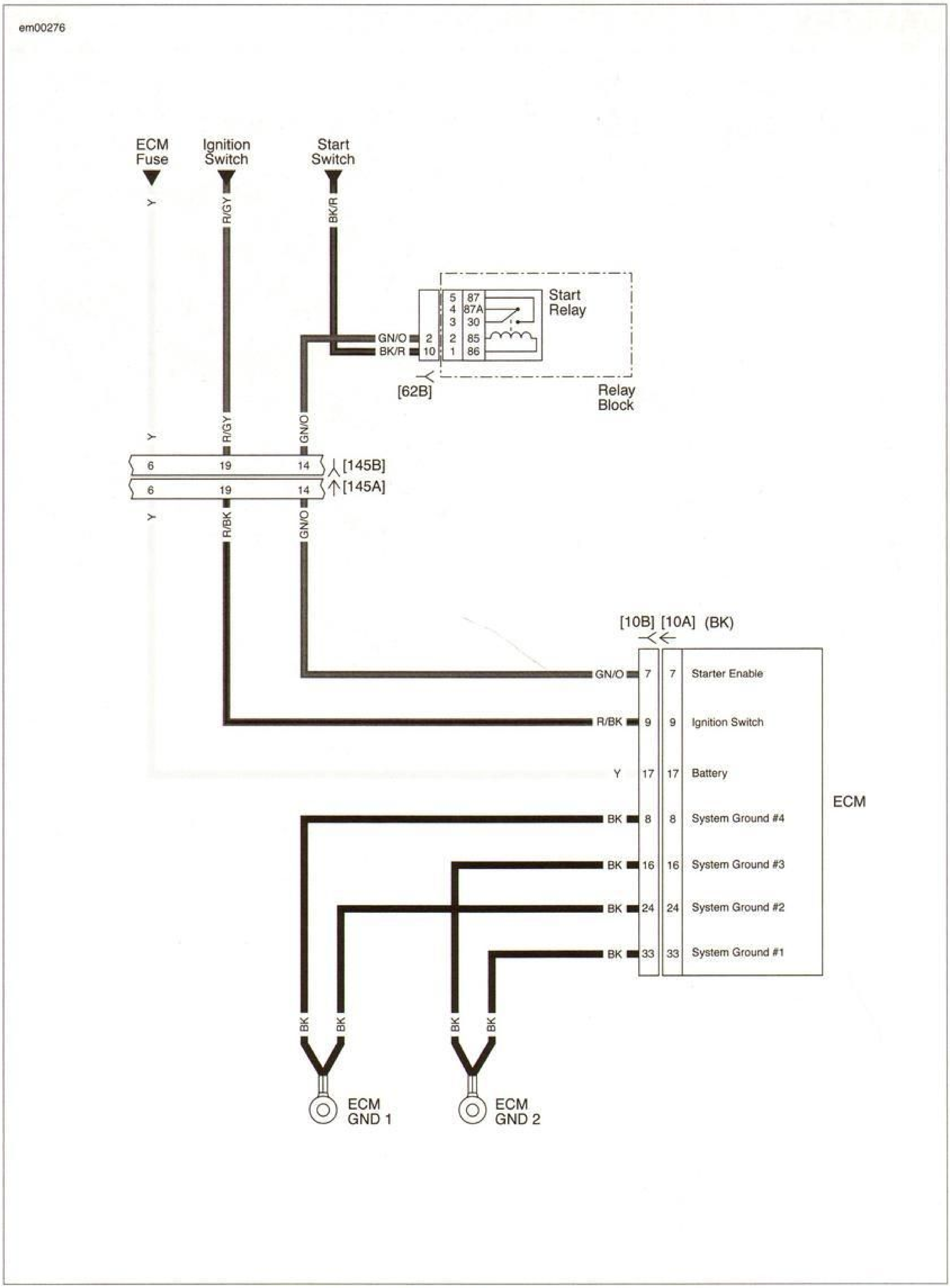
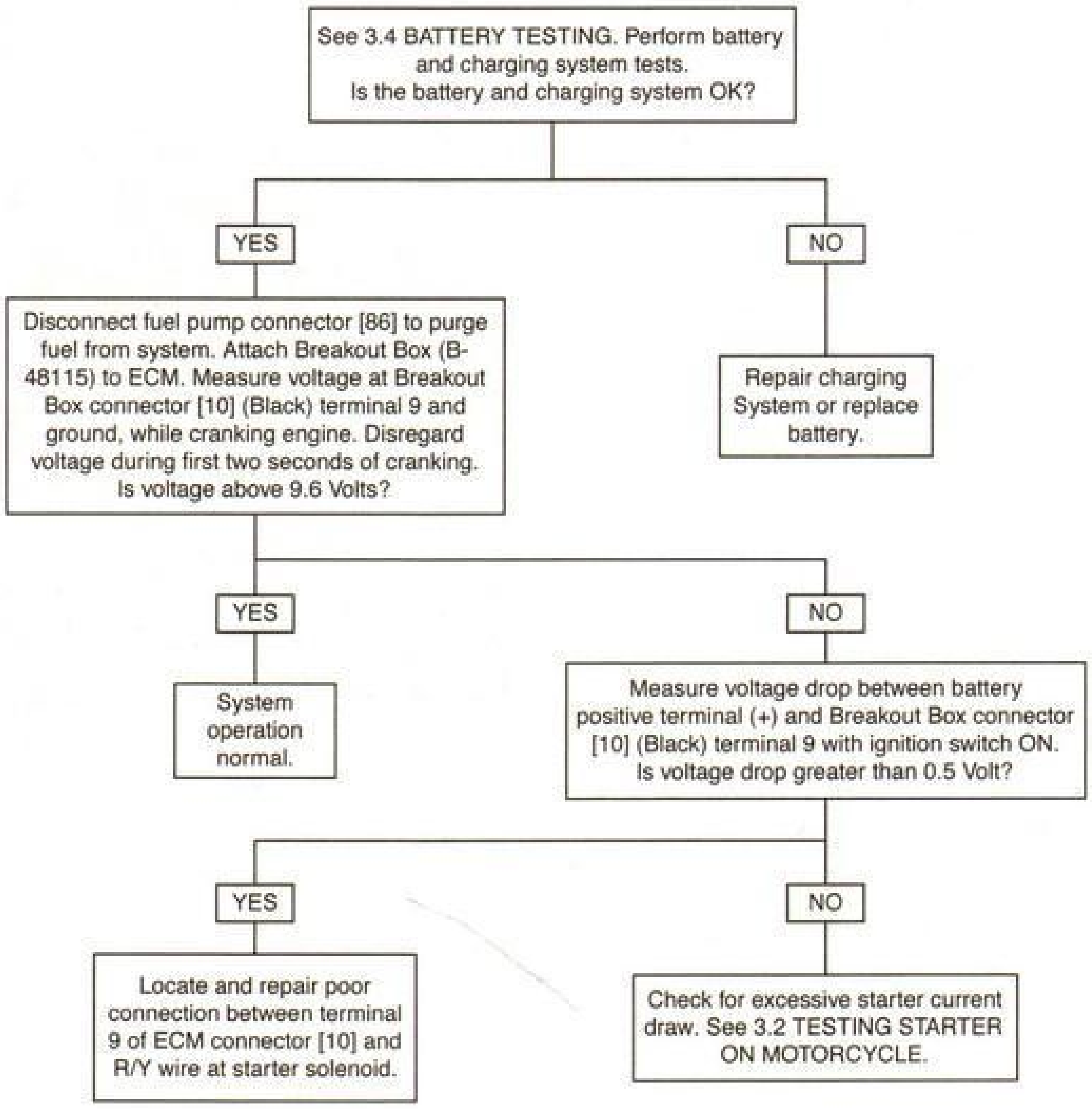


Figure 6-51. ECM Power and Ground


See 3.4 BATTERY TESTING. Perform battery and charging system tests. Is the battery and charging system OK?
YES
NO
Disconnect fuel pump connector [86] to purge fuel from system. Attach Breakout Box (B-48115) to ECM. Measure voltage at Breakout Box connector [10] (Black) terminal 9 and ground, while cranking engine. Disregard voltage during first two seconds of cranking. Is voltage above 9.6 Volts?
Repair charging System or replace battery.
YES
NO
System operation normal.
Measure voltage drop between battery positive terminal (+) and Breakout Box connector [10] (Black) terminal 9 with ignition switch ON. Is voltage drop greater than 0.5 Volt?
YES
NO
Locate and repair poor connection between terminal 9 of ECM connector [10] and R/Y wire at starter solenoid.
Check for excessive starter current draw. See 3.2 TESTING STARTER ON MOTORCYCLE.

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DESCRIPTION AND OPERATION

See Figure 6-52. The active intake system uses a solenoid, which is connected to the throttle valve via a cable. The throttle valve is automatically closed by the solenoid under certain conditions to reduce engine noise. Refer to Table 6-28 for DTCs that set if the ECM detects the output for the active intake control is not in agreement with the feedback circuit (minimum TP sensor voltage when actuated).

Likely causes for a DTC are:

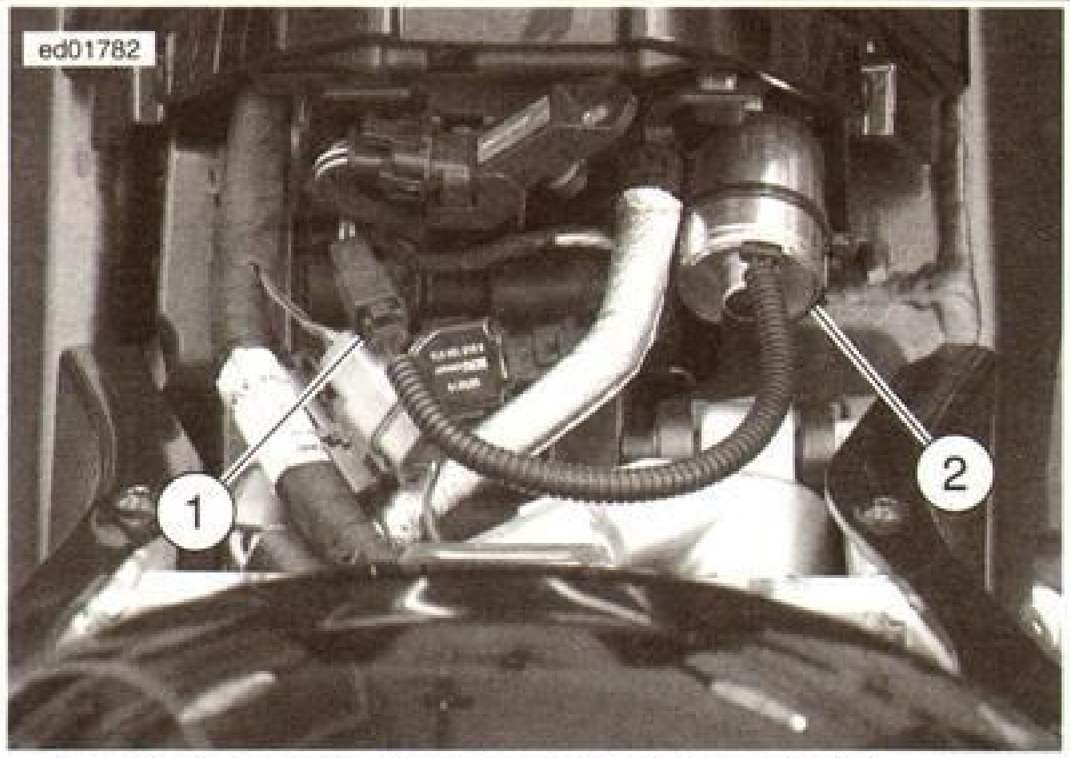
- Mechanical fault in the active intake solenoid, throttle valve, or cable.
- Electrical fault in the solenoid circuit.
- Electrical fault in the throttle position sensor circuit.
- TPS reading not changing to low voltage when the solenoid is activated.

Table 6-28. Code Description

DTC	DESCRIPTION
P1110	Active intake control circuit short low/open
P1111	Active intake control circuit short high
P1112	Active intake control throttle position sensor feedback failure

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.



1. **Active Intake Solenoid Connector [178]**
2. **Active Intake Solenoid**

Figure 6-52. Active Intake Solenoid and Connector Location

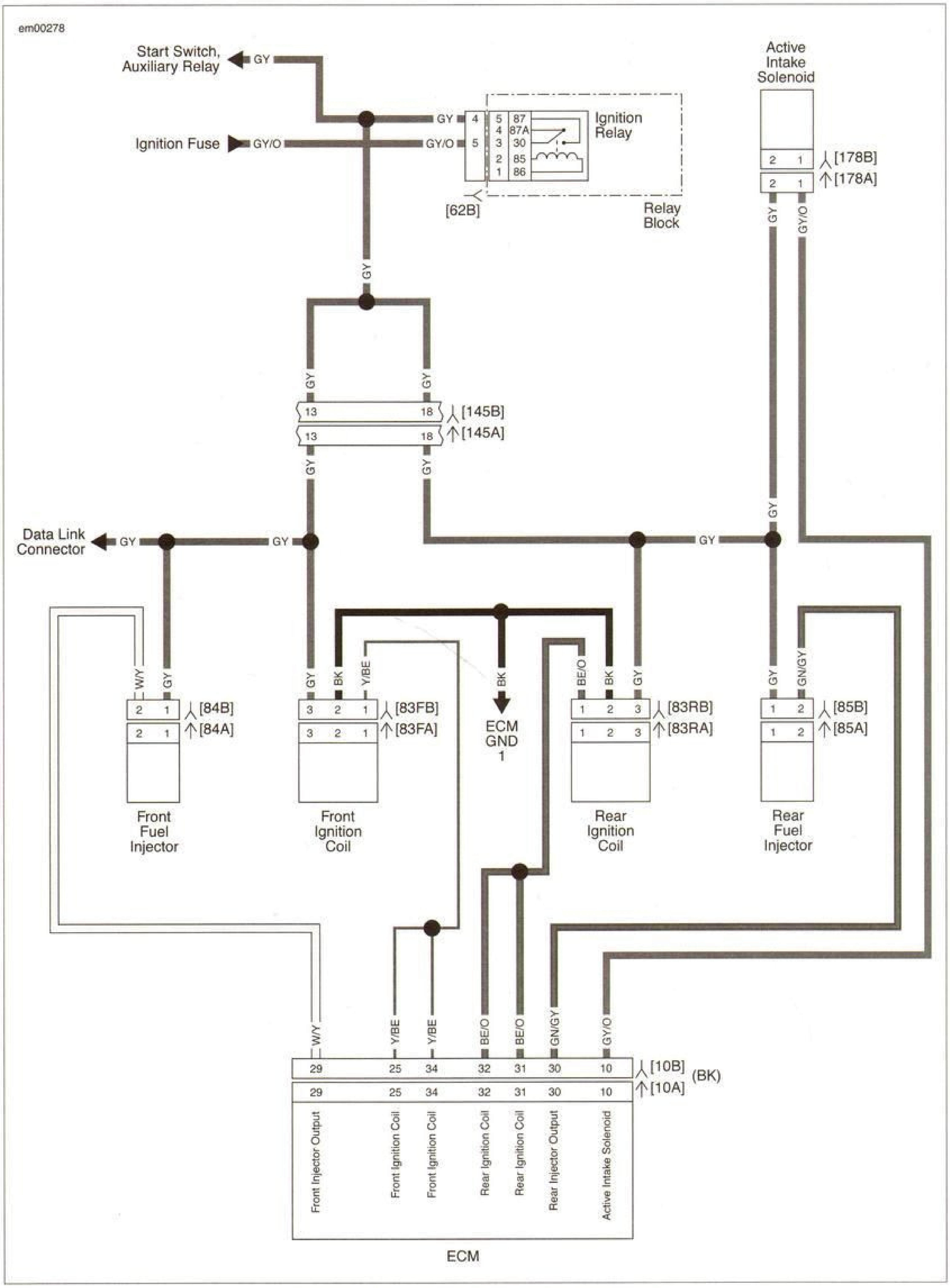
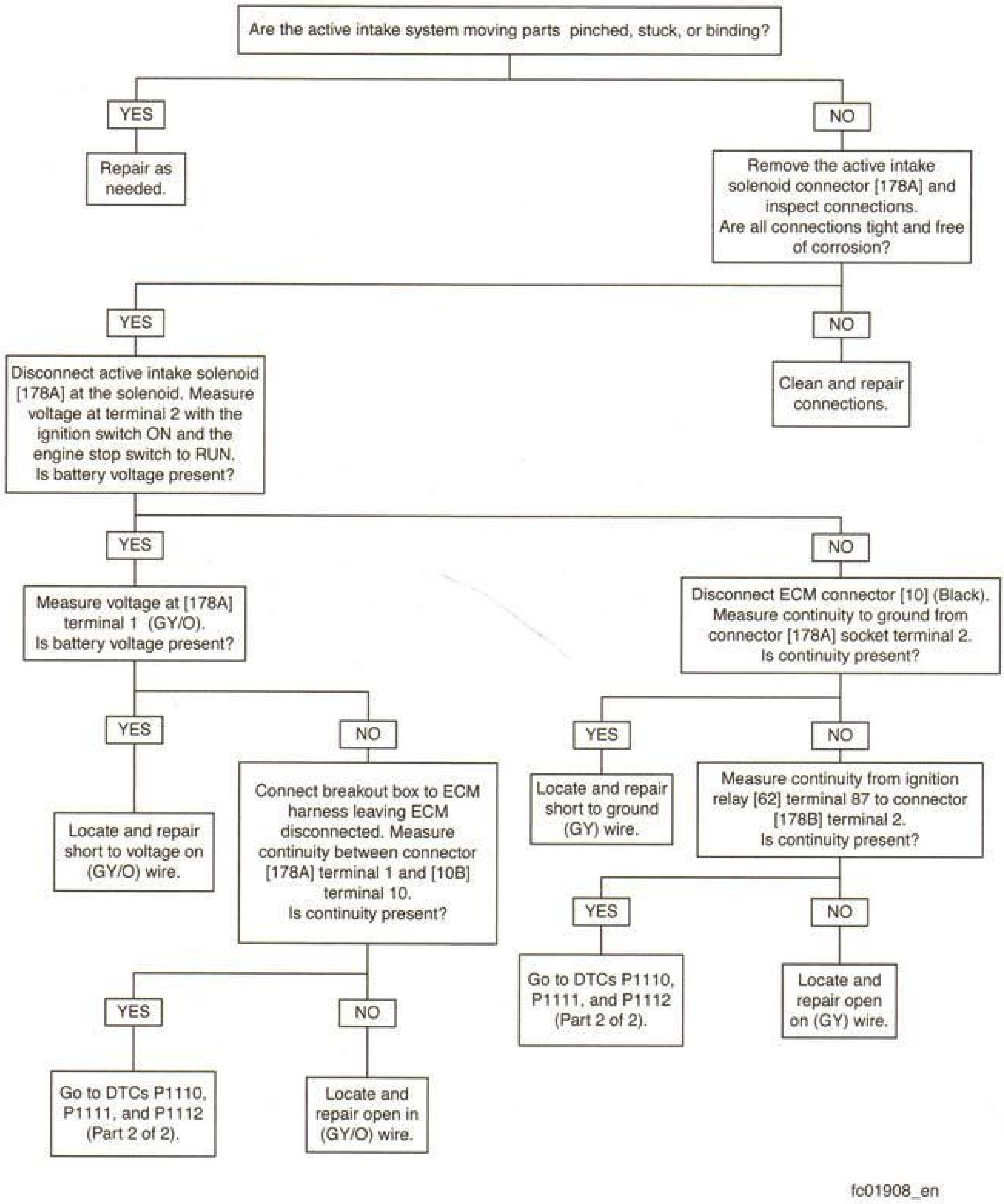
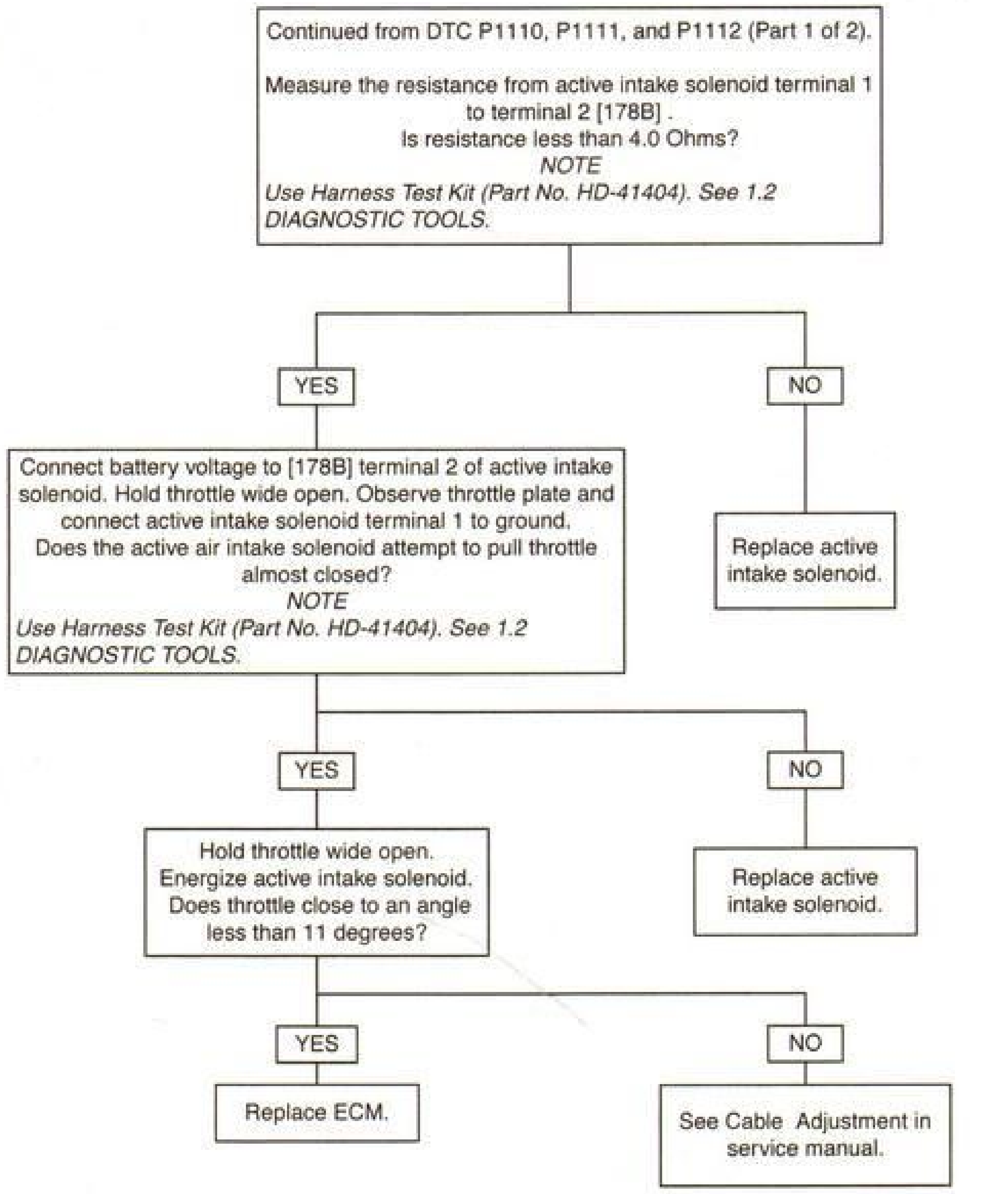


Figure 6-53. Injectors, Coils, and Active Intake

DTCs P1110, P1111, and P1112 (Part 1 of 2)



DTCs P1110, P1111, and P1112 (Part 2 of 2)



fc01909_en

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER

If the starter will not crank engine, the problem is not ignition related. See 3.1 STARTING SYSTEM DIAGNOSTICS.

Diagnostic Tips

There may be trouble codes associated with this problem. Check for DTCs and clear them before proceeding to Spark and Fuel Injector tests.

Spark Plug Cleaning

If the engine is run repeatedly for short periods of time, the spark plugs can become fouled. The ECM monitors recent run events, and enables Spark Plug Cleaning if two out of the last four run events did not bring the engine to operating temperature. When the ECM enters Spark Plug Cleaning mode, it alternately rapid fires the spark plugs when the ignition switch is turned ON. This mode can also be manually enabled by holding the throttle wide open and turning the ignition ON.

Spark Test

1. Remove ignition coil from spark plug.
2. Visually check condition of plug and ignition coil.
3. See Figure 6-54. Attach ignition coil to SPARK TESTER. Clip tester to cylinder head bolt.

NOTE

Cranking the engine with the SPARK TESTER (Part No. HD-26792) in place of an ignition coil can sometimes cause DTC P2300, P2301, P2303, or P2304 to set. This condition is normal and does not by itself indicate a malfunction. Codes must be cleared if this condition occurs.

4. While cranking starter, look for spark.
5. Repeat procedure on other ignition coil.

NOTE

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

If spark is evident, check the actual spark plugs for problems (cracks, open electrode, inoperative insulator, and others). Replace questionable spark plugs.

Fuel Injector Test

⚠WARNING

To prevent spray of fuel, purge system of high-pressure fuel before supply line is disconnected. Gasoline is extremely flammable and highly explosive, which could result in death or serious injury. (00275a)

1. Purge fuel line of high pressure gasoline.
2. Access fuel injectors by removing the airbox and throttle cover plate. See the service manual.

NOTE

Cranking the engine with a test lamp in place of a fuel injector can sometimes cause DTC P0261 or P0264. This condition is normal and does not by itself indicate a malfunction. Clear DTCs if this condition occurs.

3. Remove connector from suspect injector and connect test lamp.
4. See Figure 6-55. The test lamp should flash as the engine is cranked.

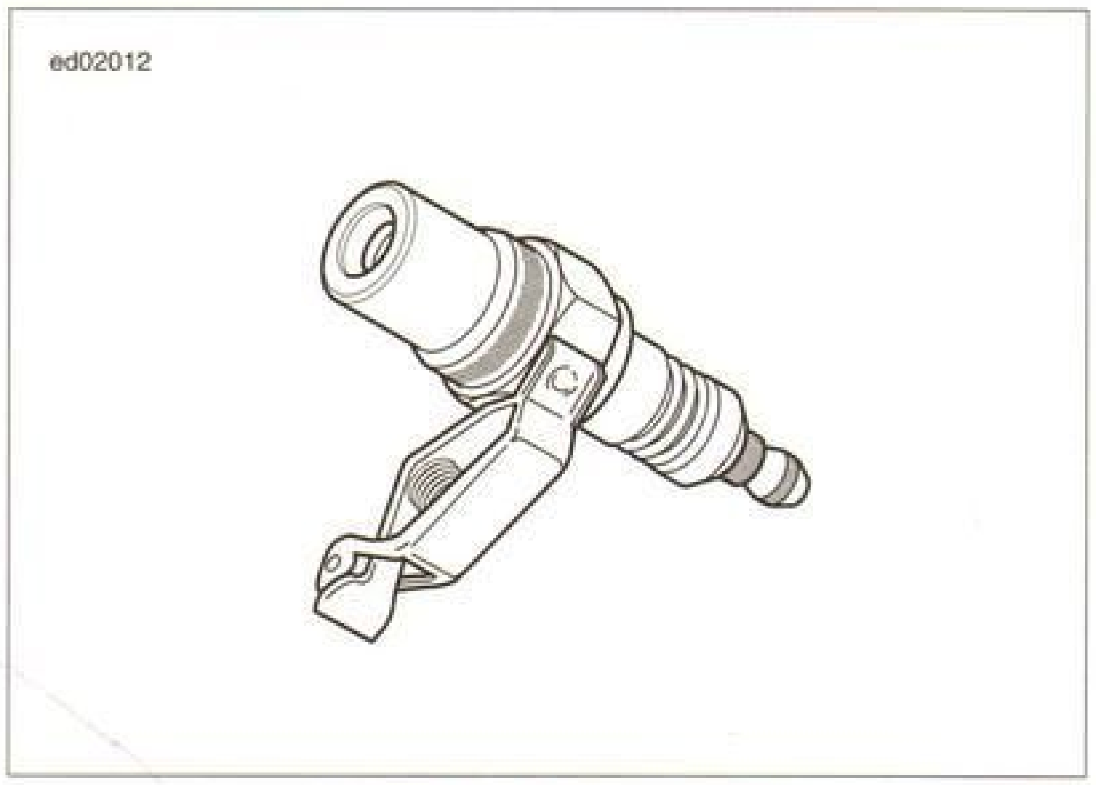


Figure 6-54. Spark Tester

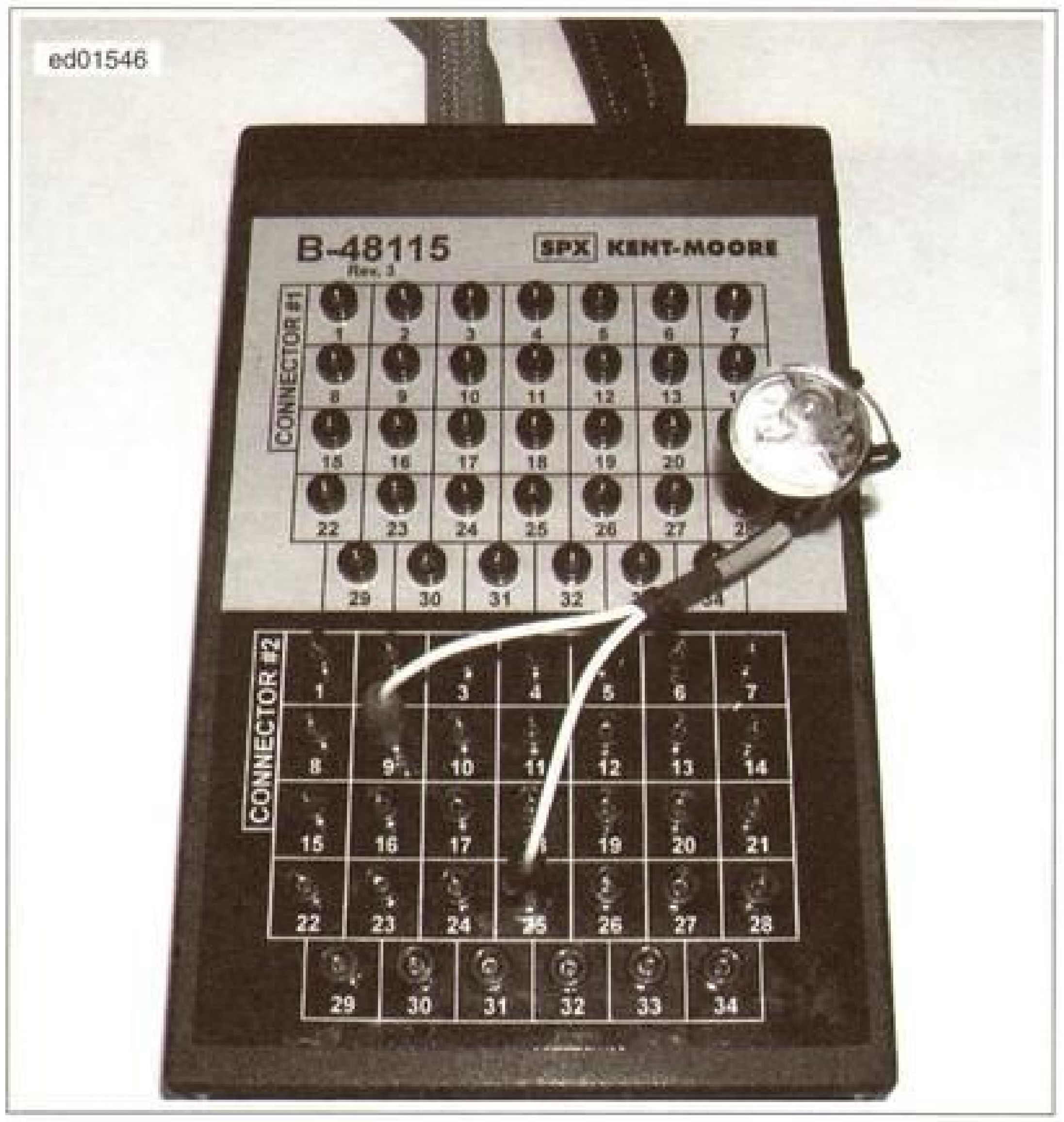
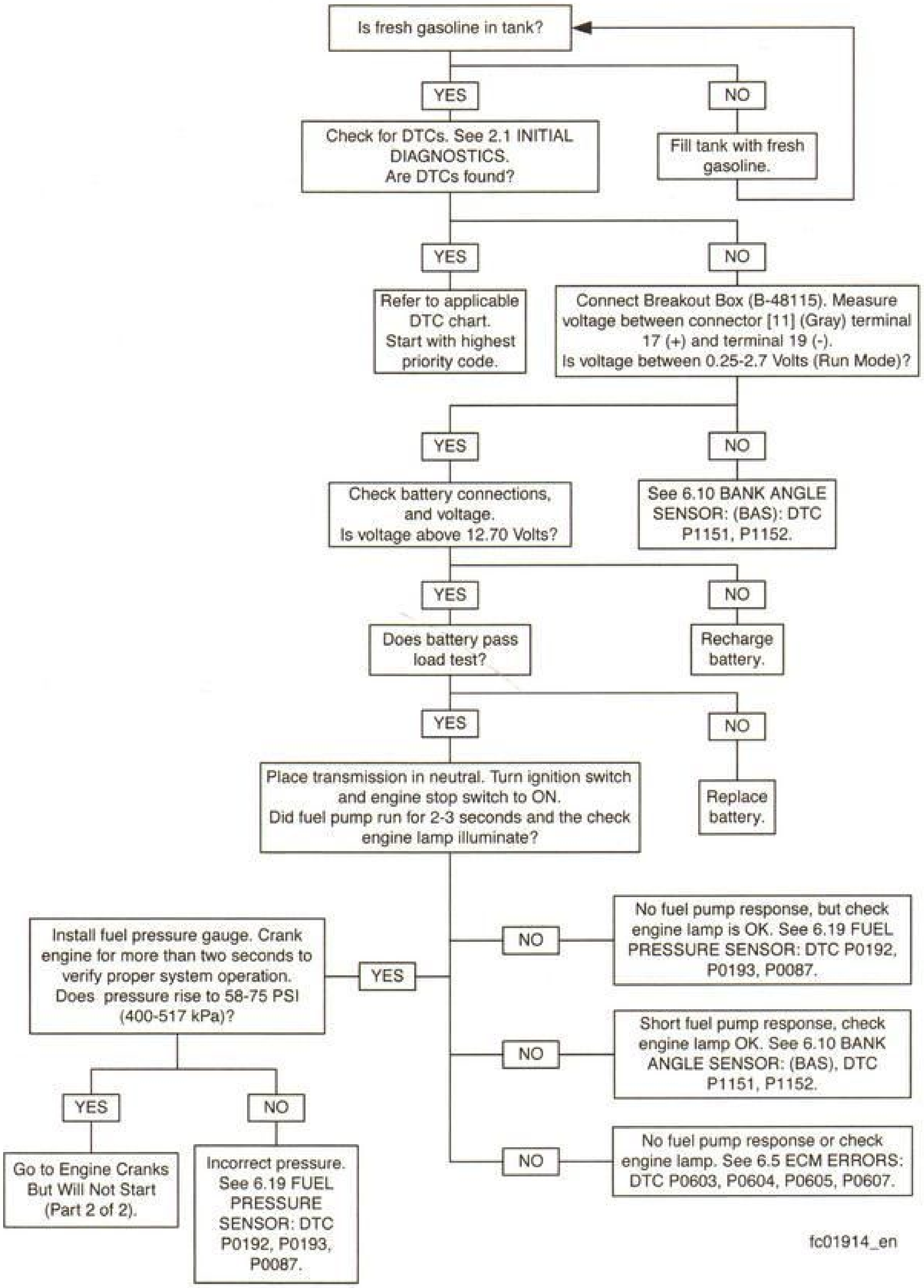
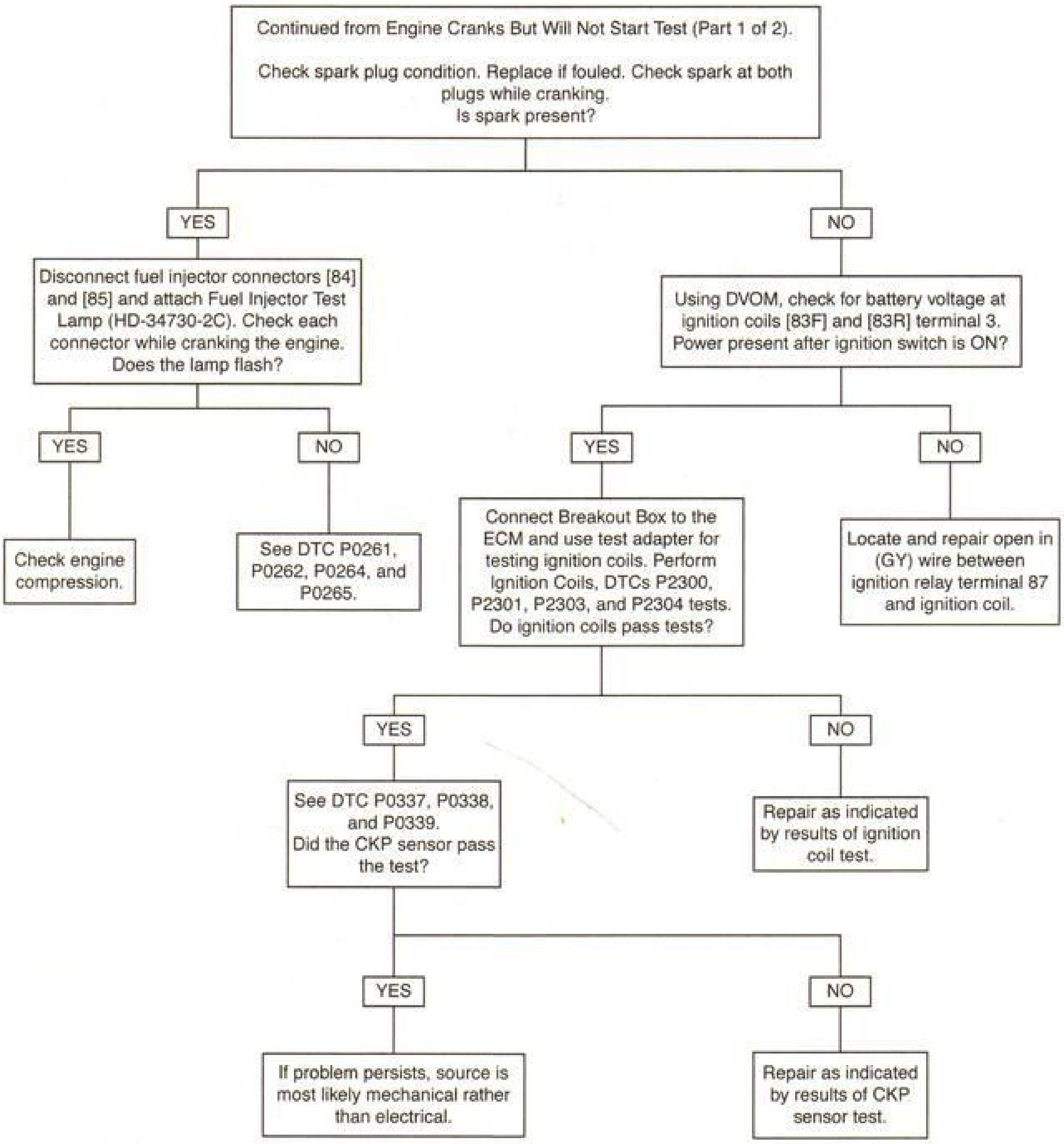


Figure 6-55. Fuel Injector Test Lamp

Engine Cranks But Will Not Start (Part 1 of 2)



Engine Cranks But Will Not Start (Part 2 of 2)



fc01915_en

STARTS, THEN STALLS

DESCRIPTION AND OPERATION

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, P0264, and P0265
- Fuel pump: DTCs P0628 and P0629
- Fuel pressure sensor: DTCs P0087, P0192, and P0193
- Ignition coils: DTCs PP2300, P2301, P2303, and P2304
- Idle air control actuator: DTCs P0506, P0507, and P0511
- All modes: DTCs P0603, P0604, P0605, and P0607

Diagnostic Tips

The vehicle will stall on HDI models, if the sidestand is extended when the transmission is in gear and the clutch is released.

Connector Information

For additional information on the connectors in the following diagram(s), see B.1 CONNECTORS.

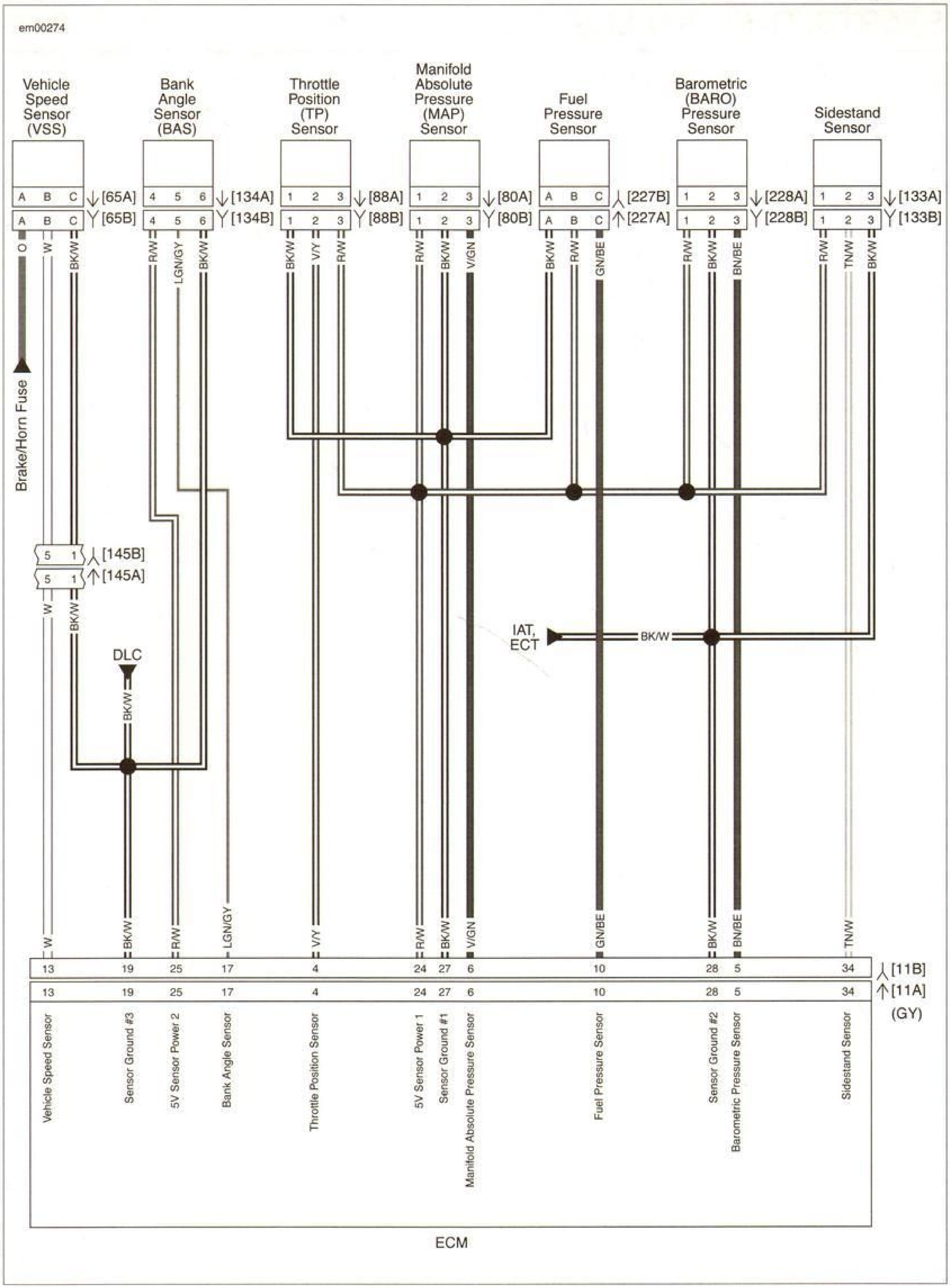


Figure 6-56. 5V Reference Circuit

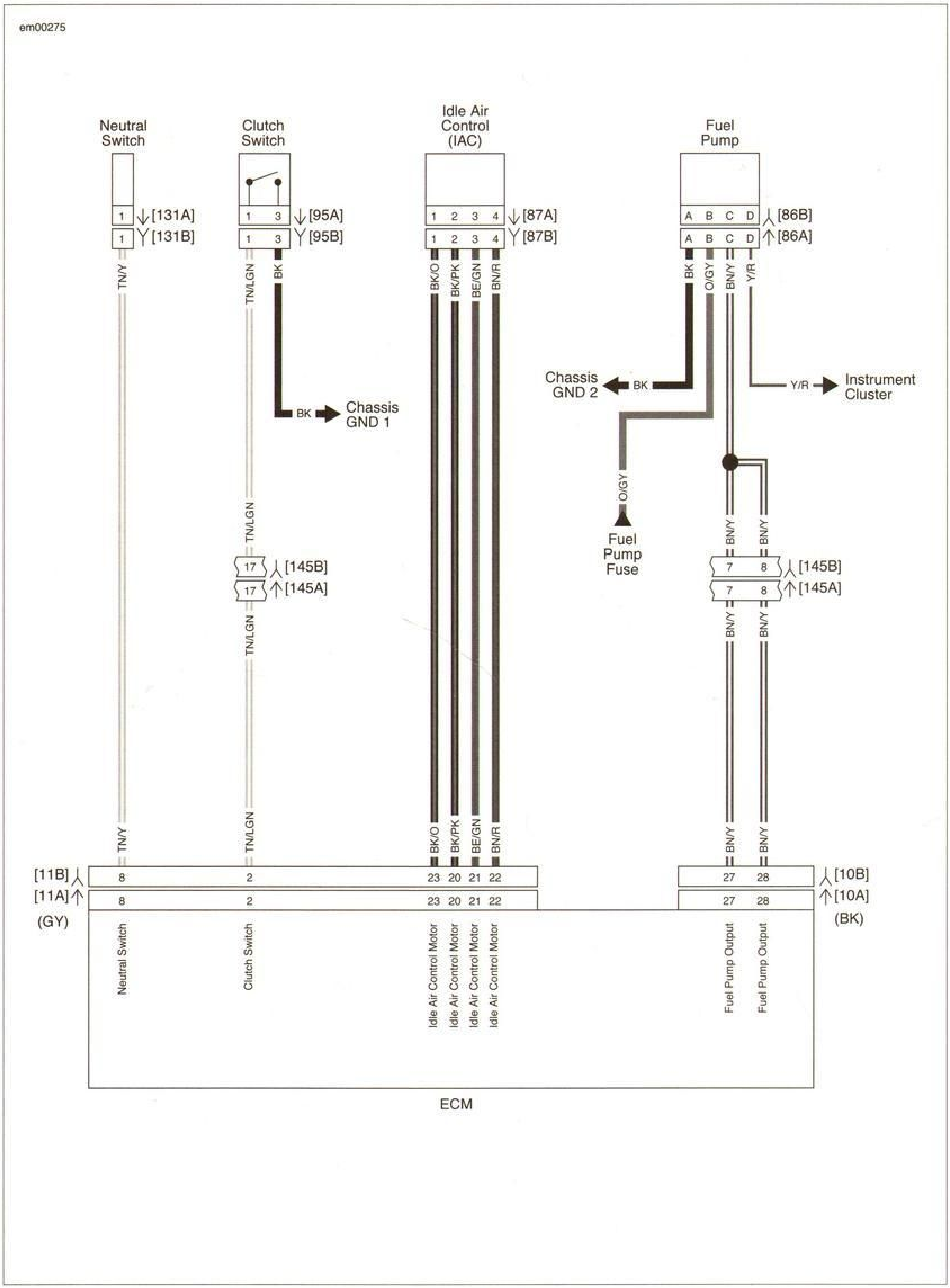
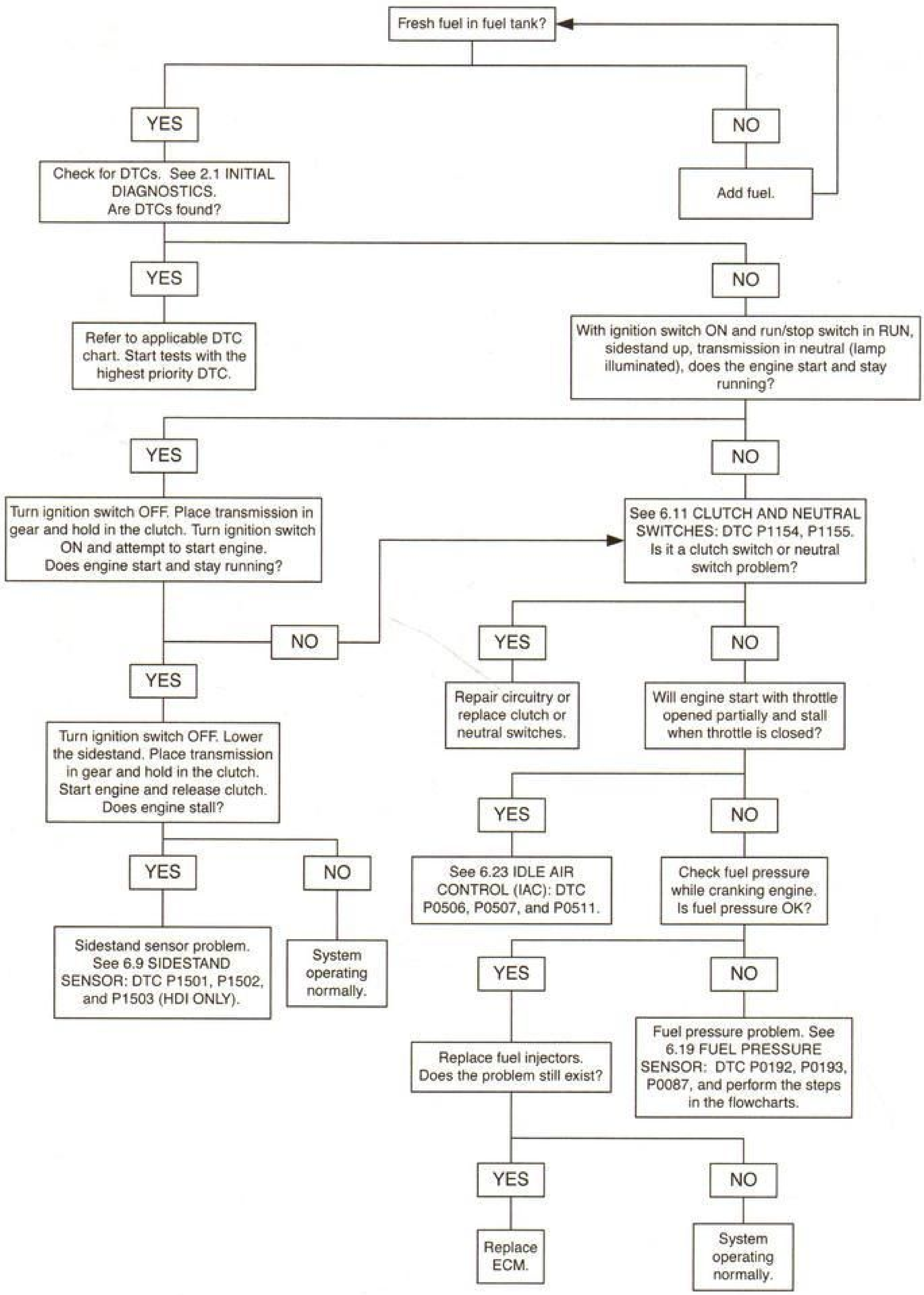


Figure 6-57. Neutral and Clutch Switches, IAC, and Fuel Pump

Engine Starts Then Stalls



fc01923_en

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
YA840	IN-LINE SPARK TESTER

Misfire conditions may be caused by:

- Battery condition and connections.
- Fuel system problems. Refer to tables in 2.1 INITIAL DIAGNOSTICS.
- Ignition system faults.

Diagnostic Tips

If the engine is run repeatedly for short periods of time, the spark plugs can become fouled. The ECM monitors recent run events, and enables Spark Plug Cleaning if two out of the last four run events did not bring the engine to operating temperature. When the ECM enters Spark Plug Cleaning mode, it alternately rapid fires the spark plugs when the ignition switch is turned ON. This mode can also be manually enabled by holding the throttle wide open and turning the ignition to ON.

⚠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)

Spark Test

See Figure 6-58. Use SPARK TESTER (Part No. HD-26792) to verify adequate spark. Perform the following pretest:

1. Turn ignition switch OFF.
2. Remove rear ignition coil and spark plug. Visually check plug condition. Check the spark plug and ignition coil for carbon tracking. If evident, replace spark plug(s) or ignition coil as required.
3. Attach spark tester to ignition coil. Clip tester to cylinder head bolt.
4. While cranking engine, watch for spark to jump spark tester gap on leads.
5. Reinstall and repeat procedure on front ignition coil and spark plug.

NOTE

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

When performing the steps in the flowcharts, a known good part can be used to verify whether a suspected part is faulty. The ignition coils do not require full installation to be functional. Verify faulty ignition coil by performing resistance test. See 6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304.

ed02012

Figure 6-58. Spark Tester

In-line Spark Tester

See Figure 6-59. The use of a SNAP-ON IN-LINE SPARK TESTER (Part No. YA840), or equivalent, can help determine whether the problem exists in the ignition or fuel systems.

1. Turn ignition switch OFF.
2. Remove ignition coil and install SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) between coil and spark plug.
3. Start engine and inspect tester light. The light will flash on each spark event if power is transmitted to the plug.
4. Reinstall and repeat procedure on front ignition coil and spark plug.

If the tester lamp 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 lamp does not flash, or the flash is interrupted during the misfire event, the problem is ignition related.

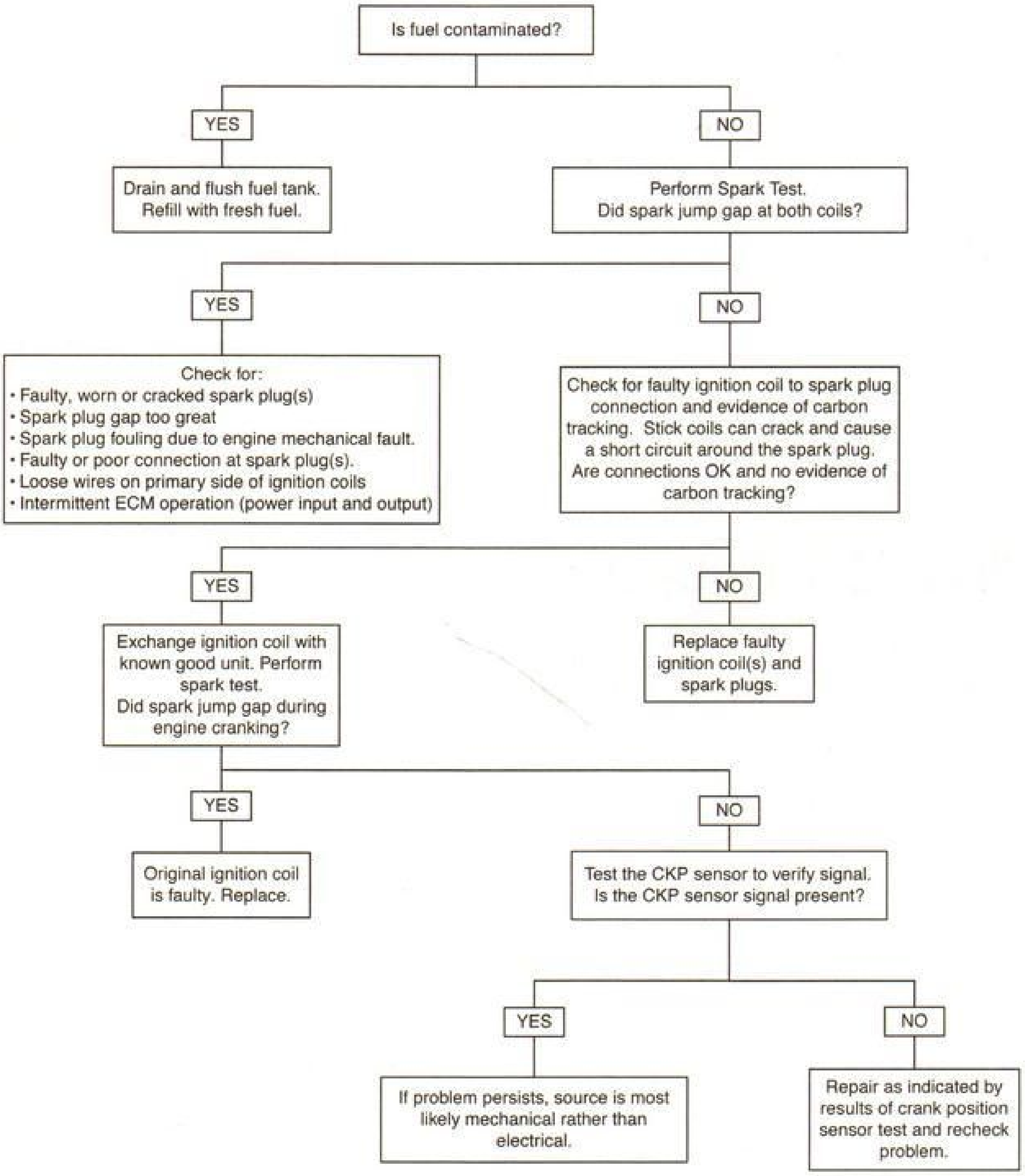
NOTE

An SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) can also be used in conjunction with a load-able dynamometer to diagnose misfire under load.

ed01780

Figure 6-59. Inline Spark Tester

Misfire at Idle or Under Load



fc01924_en

NOTES

AMP MULTILOCK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41609	AMP MULTILOCK CRIMPER
TT600-3	SNAP-ON PICK

General

AMP Multilock connectors are found between wire harnesses and component wiring and may be either floating or anchored to the frame with attachment clips.

See Figure A-1. Attachment clips (1) on the pin housings are fitted to T-studs on the motorcycle frame. The T-studs identify OE connector locations. To maintain serviceability, always return connectors to OE locations after service.

Obtain the necessary tools to repair the connector and terminals.

NOTE

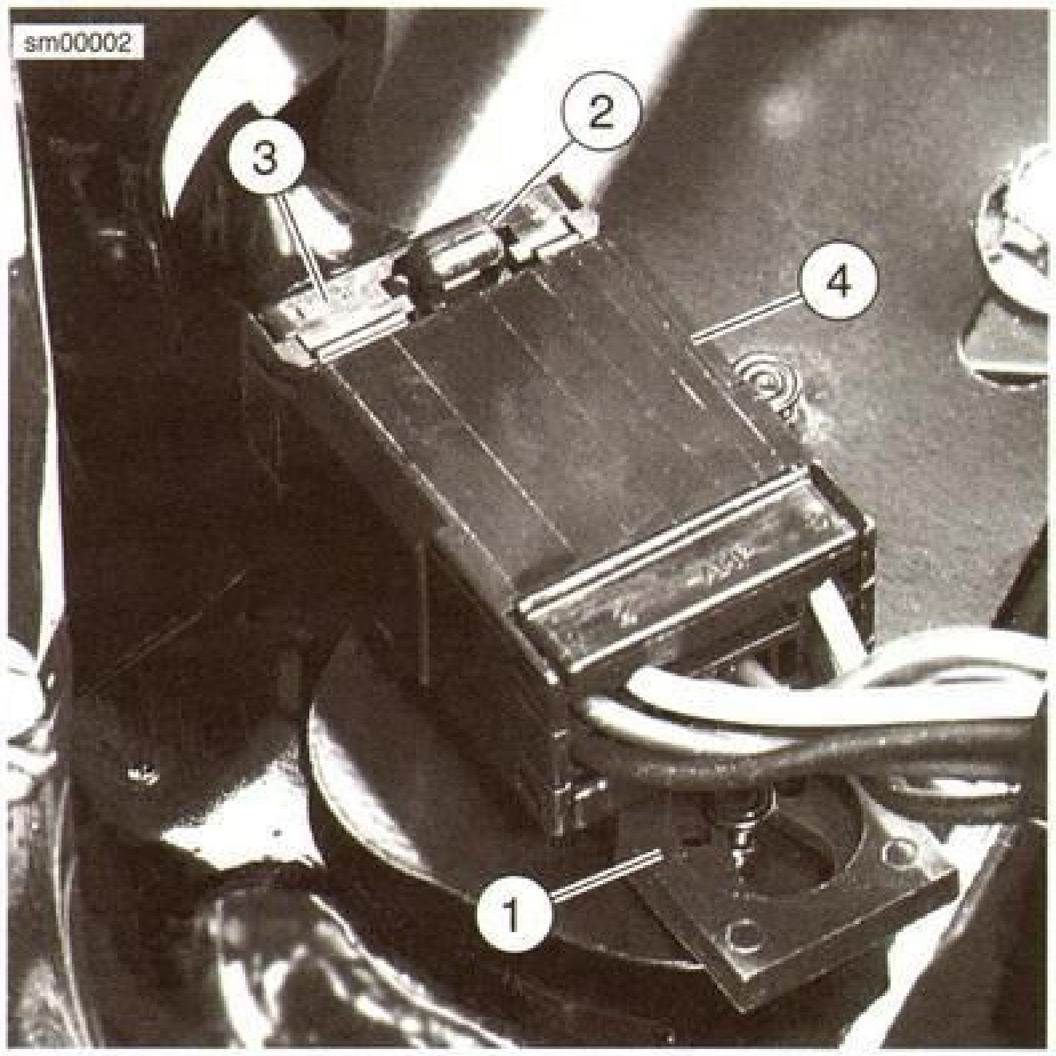
For terminal crimping use the AMP MULTILOCK CRIMPER (Part No. HD-41609).

Separating Pin and Socket Housings

1. If necessary, slide connector attachment clip T-stud to the large end of the opening.
2. See Figure A-1. Depress the release button (2) on the socket terminal side of the connector and pull the socket housing (3) out of the pin housing (4).

Mating Pin and Socket Housings

1. Hold the housings to match wire color to wire color.
2. Insert the socket housing into the pin housing until it snaps in place.
3. If OE location is a T-stud, fit large opening end of attachment clip over T-stud and slide connector to engage T-stud to small end of opening.



1. **Attachment clip**
2. **Release button**
3. **Socket housing**
4. **Pin housing**

Figure A-1. AMP Multilock Connector

Removing Terminals from Housing

1. See Figure A-2. Bend back the latch (1) to free one end of secondary lock (2) then repeat on the opposite end. Hinge the secondary lock outward.
2. Look in the terminal side of the connector (opposite the secondary lock) and note the cavity next to each terminal.
3. Insert a pick or pin into the terminal cavity until it stops.

NOTE

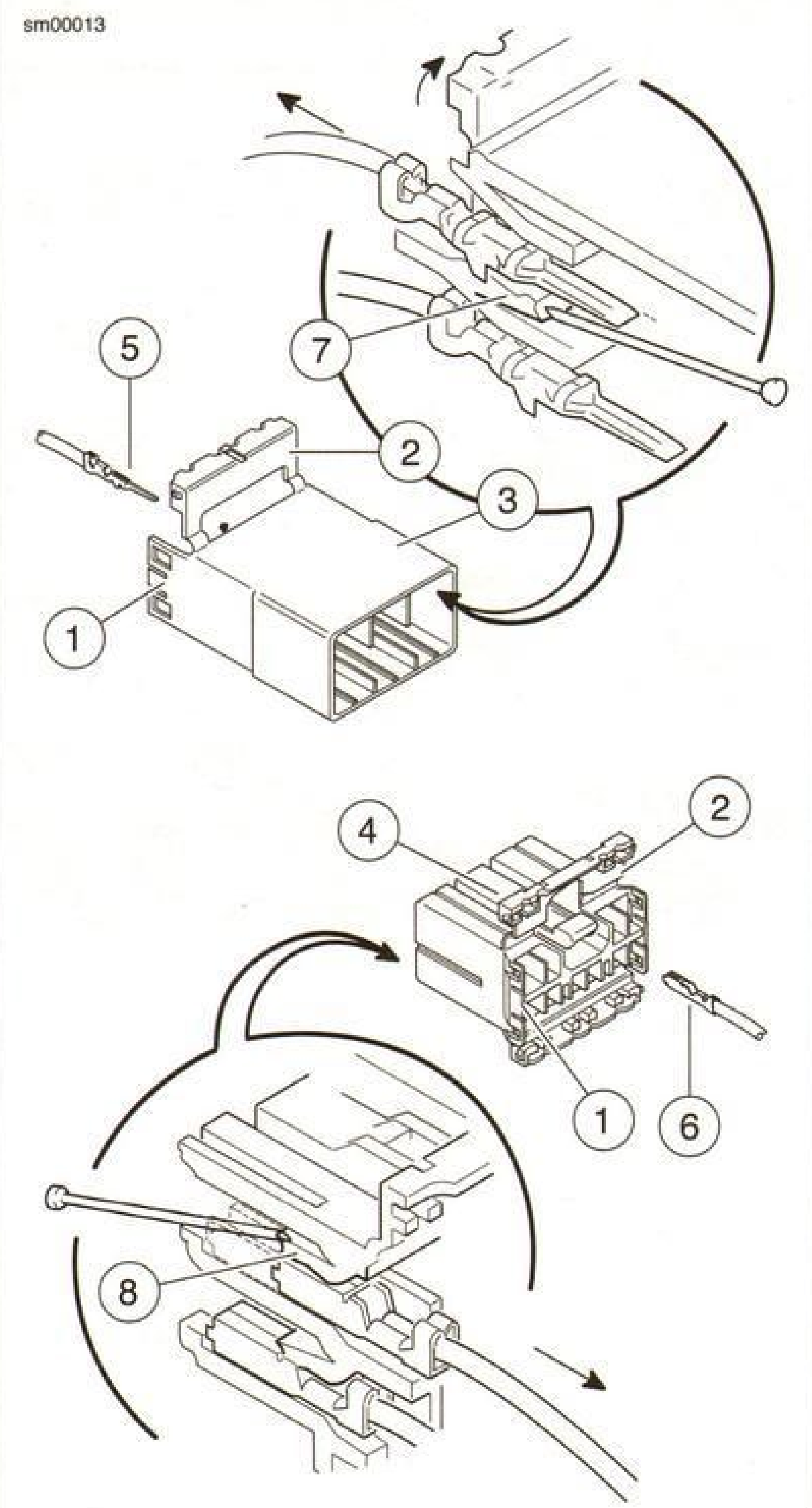
If socket/pin terminal tool is not available, a push pin/safety pin or a SNAP-ON PICK (Part No. TT600-3) may be used.

4. Press the tang in the housing to release the terminal.
   a. **Socket:** Lift the socket tang (8) up.
   b. **Pin:** Press the pin tang (7) down.

NOTE

A "click" is heard if the tang is released.

5. Gently tug on wire to pull wire and terminal from cavity.



1. **Latch**
2. **Secondary lock open**
3. **Pin housing**
4. **Socket housing**
5. **Pin terminal**
6. **Socket terminal**
7. **Tang (pin)**
8. **Tang (socket)**

Figure A-2. AMP Multilock Connector: Socket and Pin Housings

Inserting Terminals into Housing

NOTE

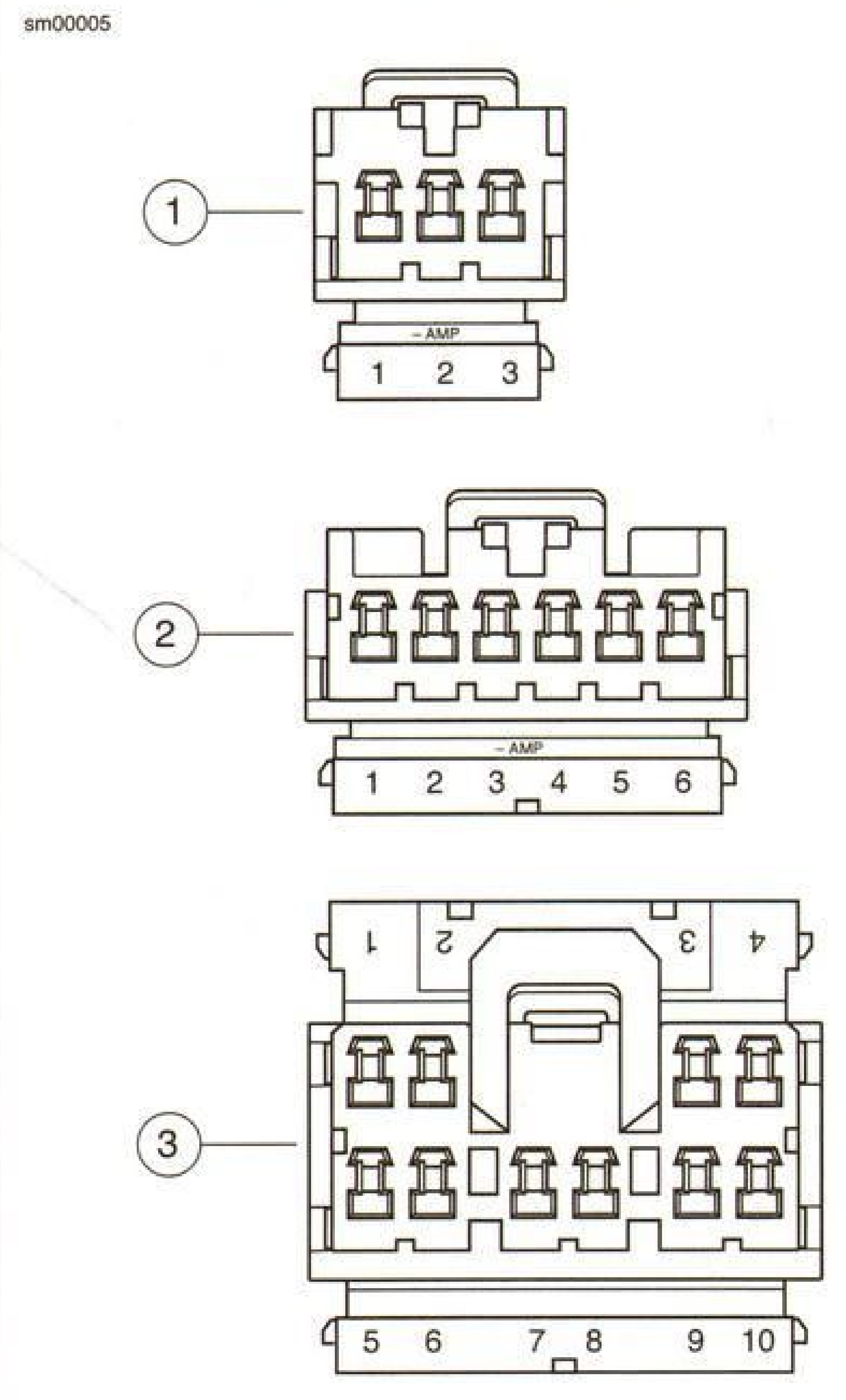
See Figure A-3. Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

1. Hold the terminal so the catch faces the tang in the chamber. Insert the terminal into its numbered cavity until it snaps in place.

NOTES

- *Up and down can be determined by the position of the release button, the button is the top of the connector.*
- *On the pin side of the connector, tangs are positioned at the bottom of each cavity, so the slot in the pin terminal (on the side opposite the crimp tails) must face downward.*
- *On the socket side, tangs are at the top of each cavity, so the socket terminal slot (on the same side as the crimp tails) must face upward.*

2. Gently tug on wire end to verify that the terminal is locked in place.
3. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.



1. **3-place housing**
2. **6-place housing**
3. **10-place housing**

Figure A-3. AMP Multilock Connector: Cavity Numbers on Secondary Locks (Socket Housings Shown)

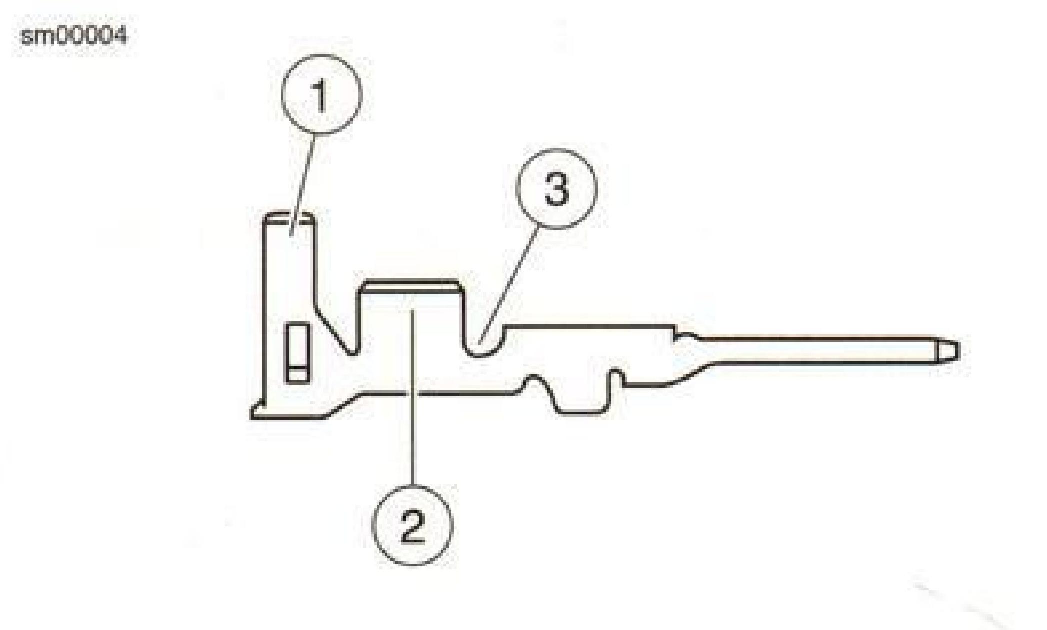
Preparing Wire Leads for Crimping

1. Strip 5/32 in. (4.0 mm) of insulation from the wire lead.

2. See Figure A-4 and Figure A-5. Select the pin/socket terminals from the parts catalog and identify the insulation crimp tails (1) and the wire crimp tails (2) and the groove for the crimp tool locking bar (3).
3. Identify the wire lead gauge and the corresponding crimper tool and nesting die. Refer to Table A-1.

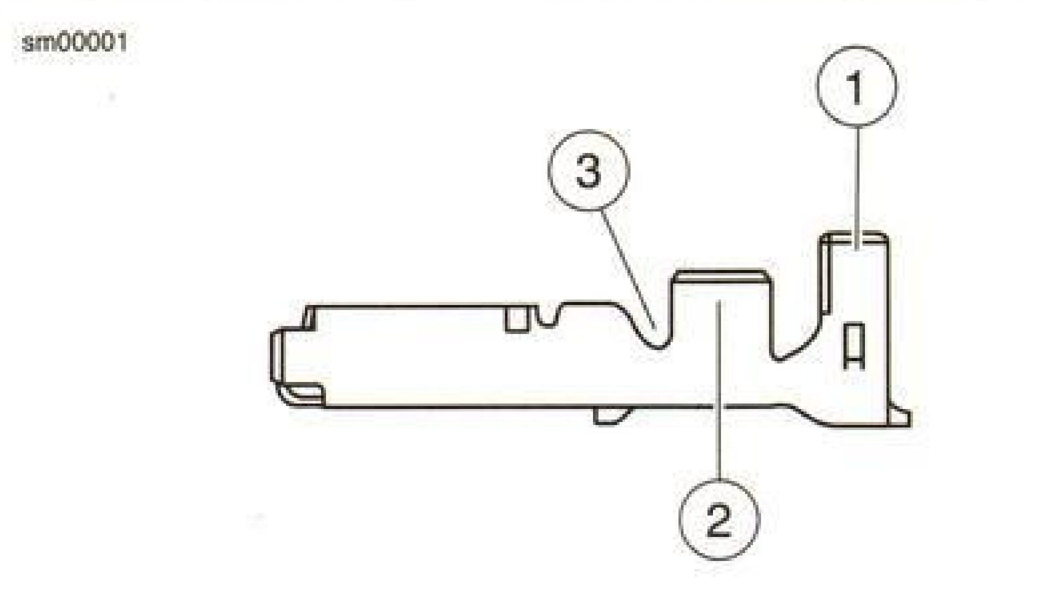
Table A-1. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest

WIRE GAUGE	NEST
20	Front
16	Middle
18	Rear



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure A-4. AMP Multilock Connector: Pin Terminal



1. **Insulation crimp tail**
2. **Wire crimp tail**
3. **Locking bar groove**

Figure A-5. AMP Multilock Connector: Socket Terminal

Crimping Terminals to Leads

NOTE

Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.

1. See Figure A-6. Squeeze the handles to cycle the AMP MULTILOCK CRIMPER (Part No. HD-41609) to the fully open position (1).
2. Raise locking bar by pushing up on bottom flange (2).

NOTE

See Figure A-4 and Figure A-5. Hold the terminal with the insulation crimp tail (1) facing up. The tool will hold the terminal by the locking bar groove (3) and crimp the wire crimp tail (2) around the bare wire of the stripped lead and the insulation crimp tail around the insulation.

3. See Figure A-6. With the insulation crimp tail facing upward, insert terminal (pin or socket) (3) through the locking bar, so that the closed side of the terminal rests on the nest of the crimp tool.
4. Release locking bar to lock position of contact (4). When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails.
5. Insert stripped end of lead (5) until ends make contact with locking bar.
6. Verify that wire is positioned so that wire crimp tails squeeze bare wire strands, while insulation crimp tails fold over the wire lead insulation.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
8. Raise up locking bar (7) and remove crimped terminal.

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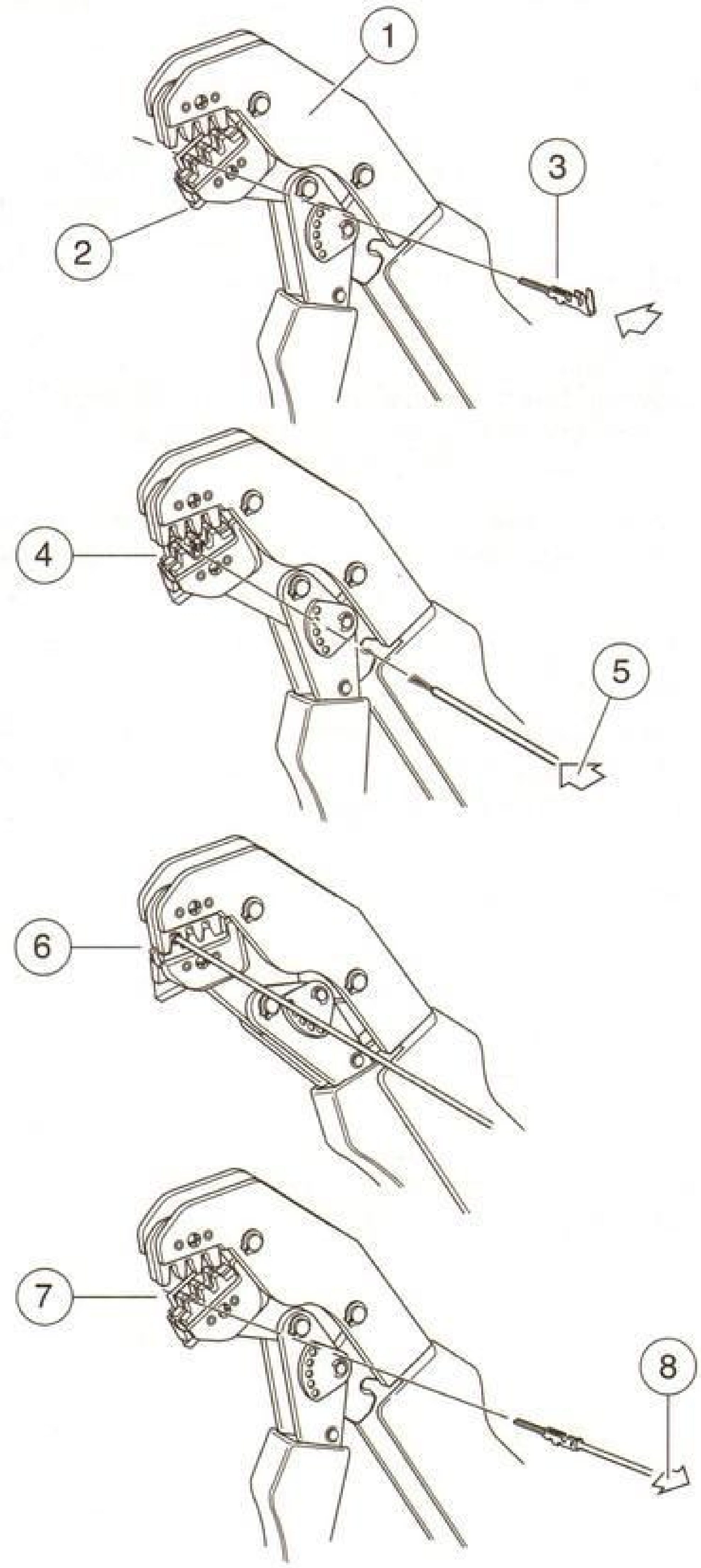

1. Open position
2. Locking bar flange
3. Insert contact
4. Release locking bar
5. Insert lead
6. Squeeze
7. Raise locking bar
8. Remove crimped terminal

Figure A-6. AMP Multilock Connector: Terminal Crimping Procedure

Inspecting Crimped Terminals

See Figure A-7. Inspect the wire core crimp (2) and insulation crimp (1). Distortion should be minimal.

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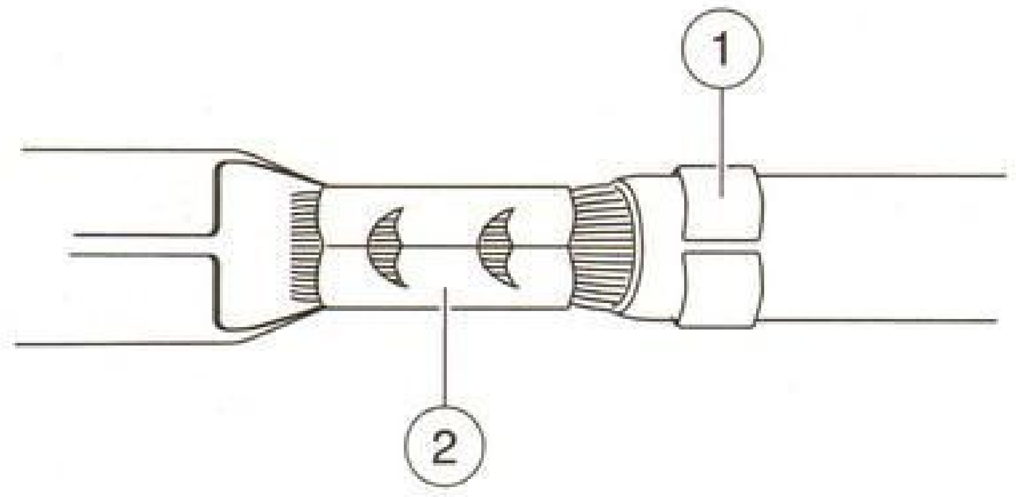


1. Insulation crimp
2. Wire core crimp

Figure A-7. AMP Multilock Connector: Terminal Crimp

DELPHI CONNECTOR REPAIR

General

Delphi connectors are embossed with the brand name, Delphi, on the housing latch.

Separating Pin and Socket Housings

See Figure A-8. Bend back the external latch(es) slightly and separate pin and socket halves of connector.

Mating Pin and Socket Housings

Push pin and socket halves of connector together until external latch(es) engage.

Removing Socket Terminals

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all. The only exception is the oil pressure sender connector [139B], the terminals of which are removed like the Packard push-to-seat connectors. Therefore, see A.6 150 METRI-PACK CONNECTORS to remove/install terminals in this connector.

1. See Figure A-9. If present, free one side of wire lock (1) from ear on wire end of socket housing, then release the other side. Release wires from channels in wire lock and remove from socket housing.
2. Use a fingernail to pry colored terminal lock (2) loose and then remove from mating end of socket housing.
3. Using a thin flat blade, like the unsharpened edge of a hobby knife, gently pry tang (3) outward away from terminal, and then tug on wire to back terminal out wire end of chamber. Do not pull on wire until tang is released or terminal will be difficult to remove.

Installing Socket Terminals

NOTE

For wire location purposes, alpha or numeric characters are stamped into the wire end of each socket housing.

1. Gently push tang on socket housing inward toward chamber. With the open side of the terminal facing the tang, push terminal into chamber at wire end of socket housing.
2. Gently tug on wire to verify that terminal is locked and will not back out of chamber. If necessary, use fingernail to push tang into engagement with terminal.
3. Install colored terminal lock onto mating end of socket housing.
4. If present, seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

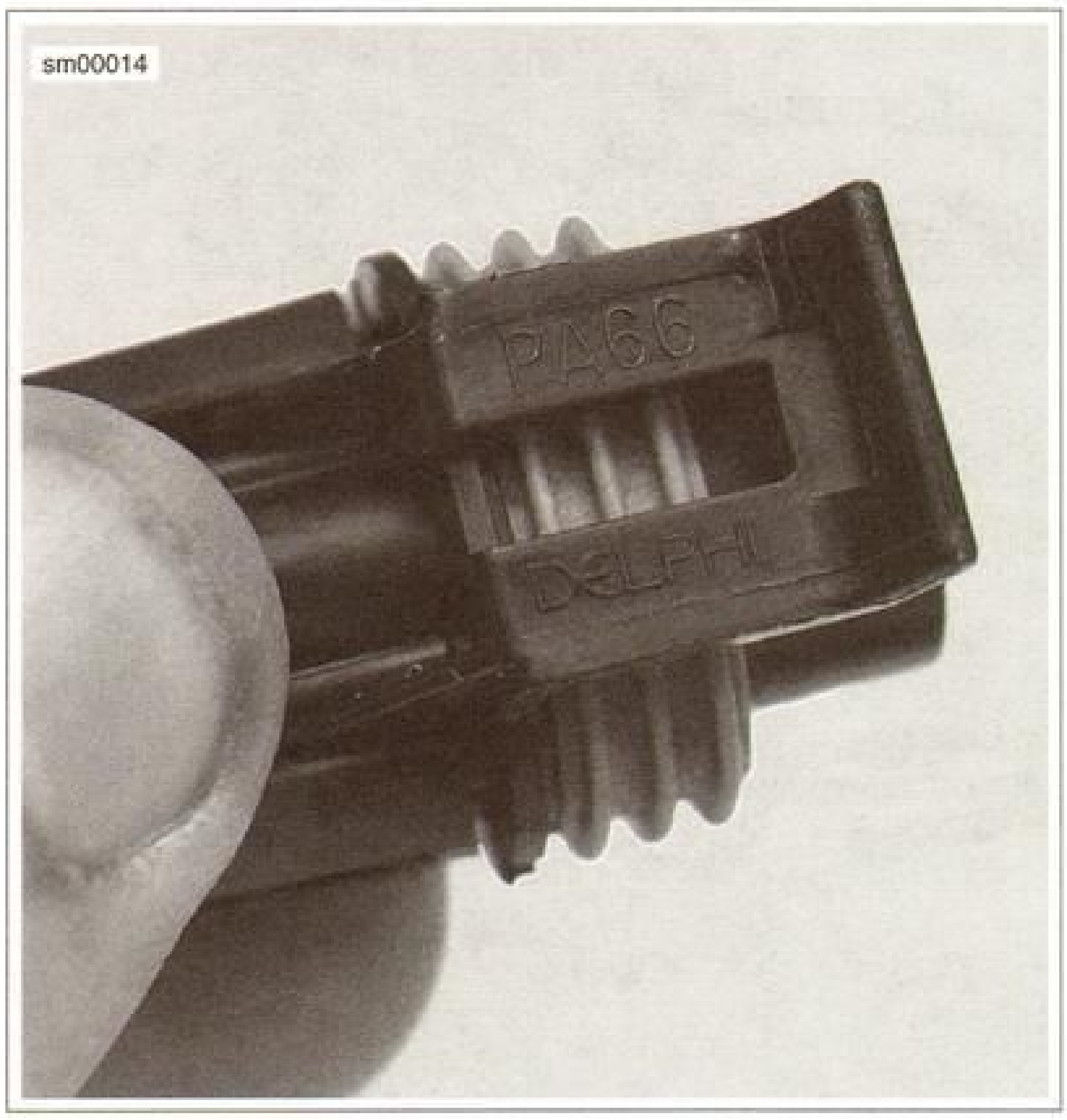
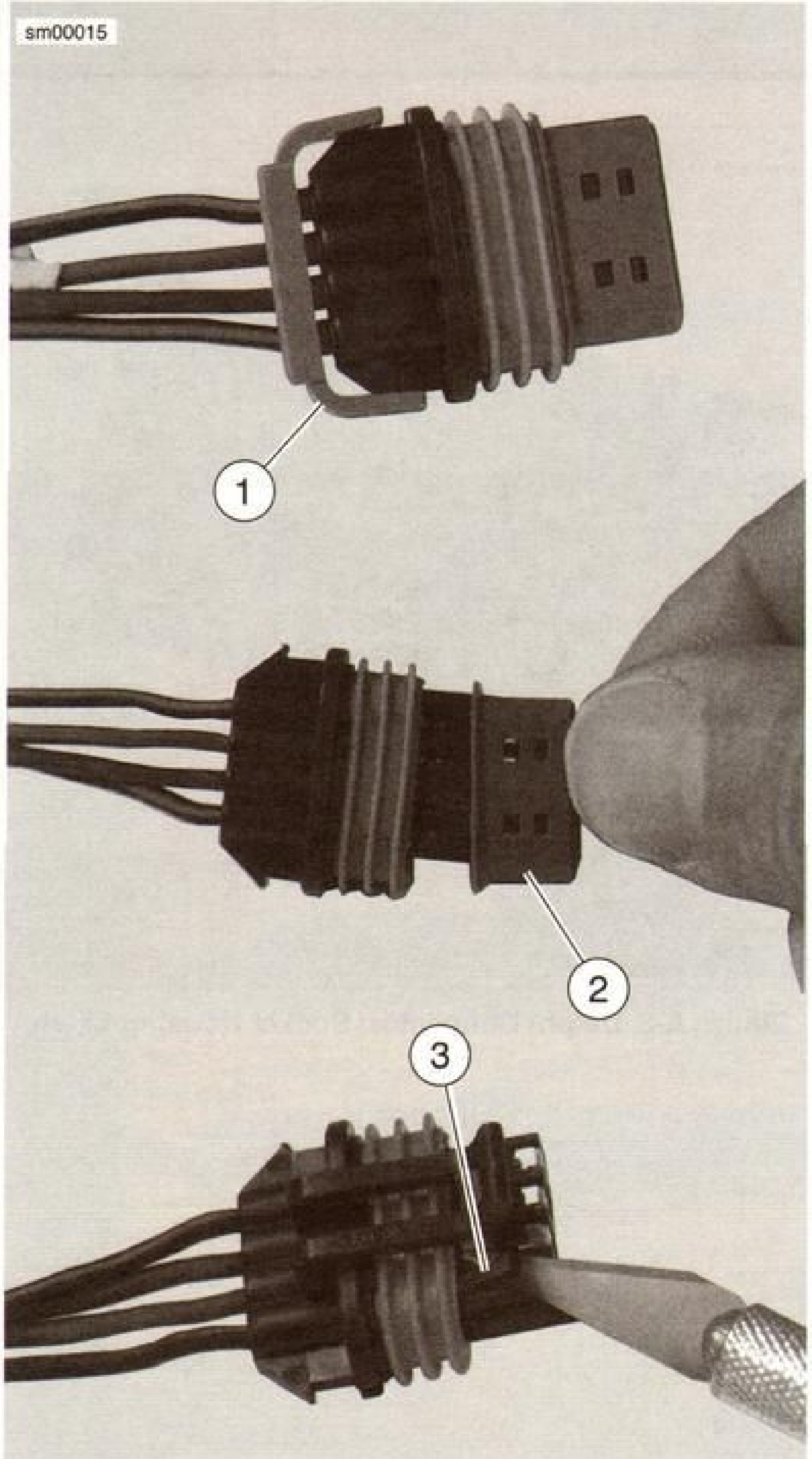


Figure A-8. Delphi Connector: Socket Housing Latch



1. Remove wire lock
2. Remove terminal lock
3. Pry tang outward

Figure A-9. Delphi Connector: Removing Socket Terminals

DEUTSCH CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-41475	DEUTSCH CONNECTOR SERVICE KIT
HD-41475-100	FLAT BLADE L-HOOK

General

Deutsch connectors are colored coded for location purposes. Those connectors associated with **left** side accessories, such as the front and rear **left** turn signals, are **gray**. All other connectors, including those associated with right side accessories, are **black**.

NOTE

A DEUTSCH CONNECTOR SERVICE KIT (Part No. HD-41475) contains a selection of wire seals, internal seals, seal plugs, secondary locking wedges, attachment clips and socket/pin terminals. Also included is a compartmented storage box, carrying case and a FLAT BLADE L-HOOK (Part No. HD-41475-100) is used for the removal of all types of locking wedges.

Separating Pin and Socket Housings

See Figure A-10. To separate the connector halves, depress the external latch(es) (1) on the socket housing (2) while rocking the pin (3) and socket housings.

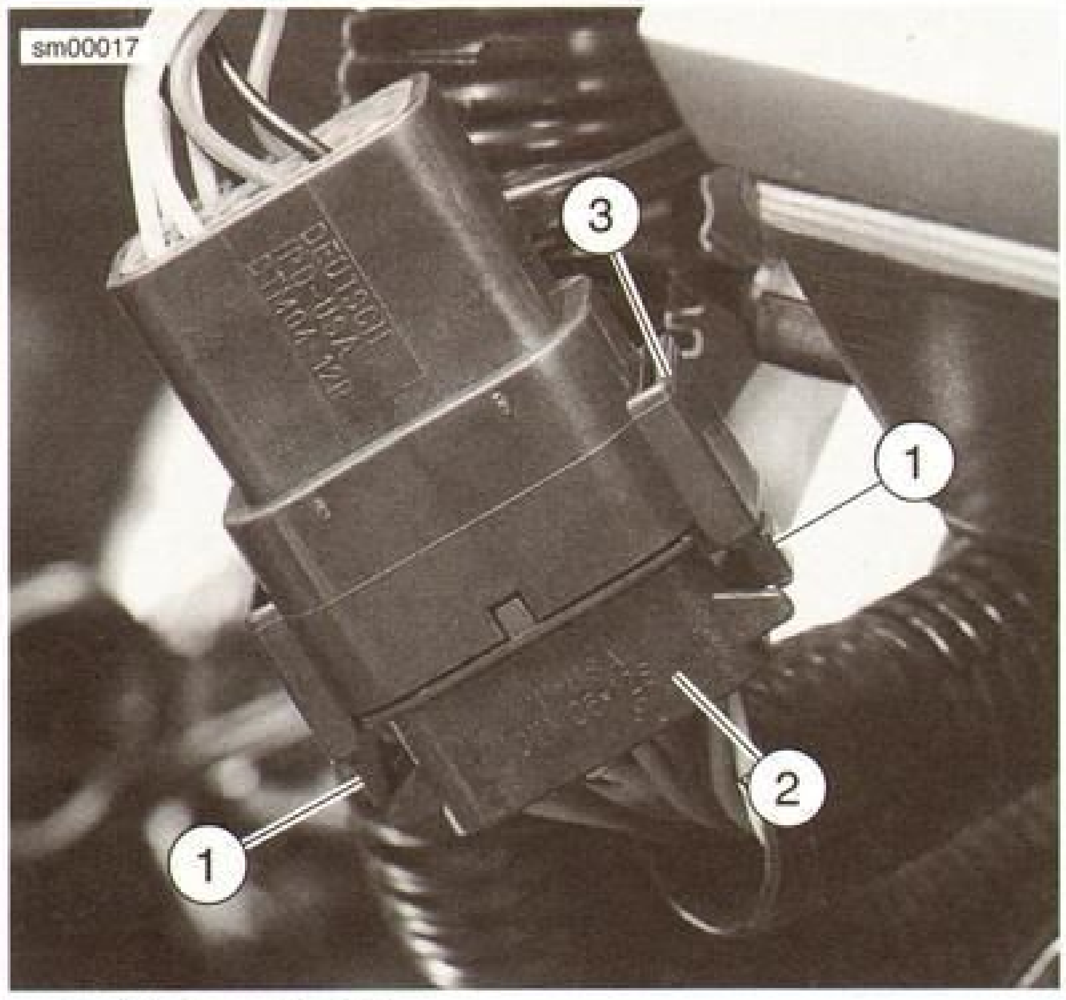
NOTES

- *Generally, the socket housing is found on the accessory side, while the pin housing is plumbed to the wiring harness.*
- *Two-, three-, four- and six-place Deutsch connectors have one latch on the connector.*
- *Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.*

Mating Pin and Socket Housings

1. Align the connectors to match the wire lead colors.
   a. **For One External Latch:** Two-, three-, four- and six-place Deutsch connectors have one external latch on the socket half of the connector. To fit the halves of the connector together, the latch on the socket side must be aligned with the latch cover on the pin side.
   b. **For Two External Latches:** (8-place and 12-place) Align the tabs on the socket housing with the grooves on the pin housing.
2. Insert socket housing into pin housing until it snaps or clicks into place.

   For Two External Latches: (8-place and 12-place) If latches do not click (latch), press on one side of the connector until that latch engages, then press on the opposite side to engage the other latch.
3. If necessary, fit the attachment clip to the pin housing.
4. Place large end of slot on attachment clip over T-stud on frame. Push assembly forward to engage small end of slot.



1. **External latch**
2. **Socket housing**
3. **Pin housing**

Figure A-10. Deutsch Connector

Removing Socket Terminals

1. See Figure A-11. Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. See Figure A-14. Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

*If wire leads require **new** terminals, see the instructions for crimping terminals.*

Installing Socket Terminals

1. Match wire lead color to connector cavity.
2. See Figure A-13. Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead (3) approximately 1.0 in. (25.4 mm) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
4. A tug on the wire will confirm that it is properly locked in place.

NOTE

Seal plugs (6) are installed through the wire seals of unused chambers. If removed, seal plugs must be replaced to seal the connector.

5. Install internal seal (4) on lip of socket housing, if removed.
6. Insert tapered end of secondary locking wedge (5) into socket housing and press down until it snaps in place. The wedge fits into the center groove within the socket housing and holds the terminal latches tightly closed.

NOTES

- *See Figure A-12. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

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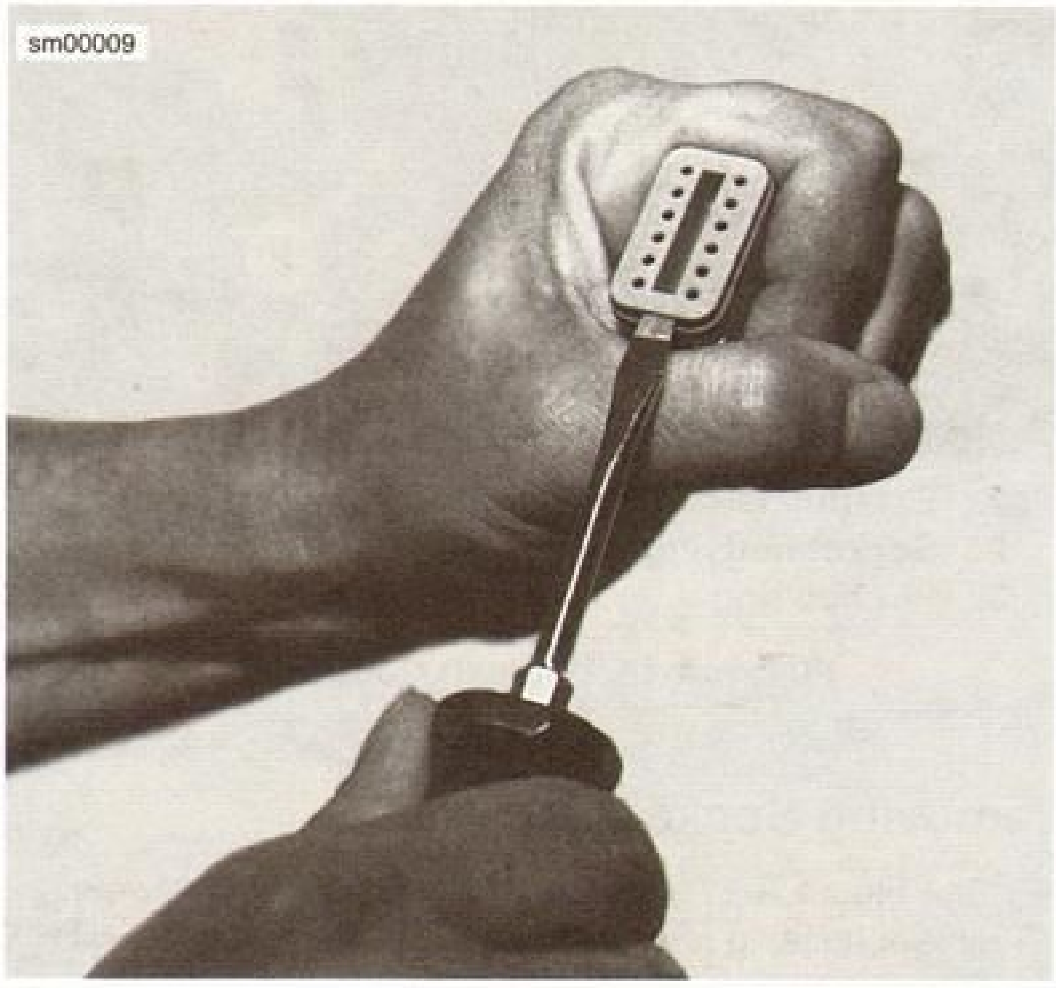

Figure A-11. Deutsch Connector: Remove Secondary Locking Wedge

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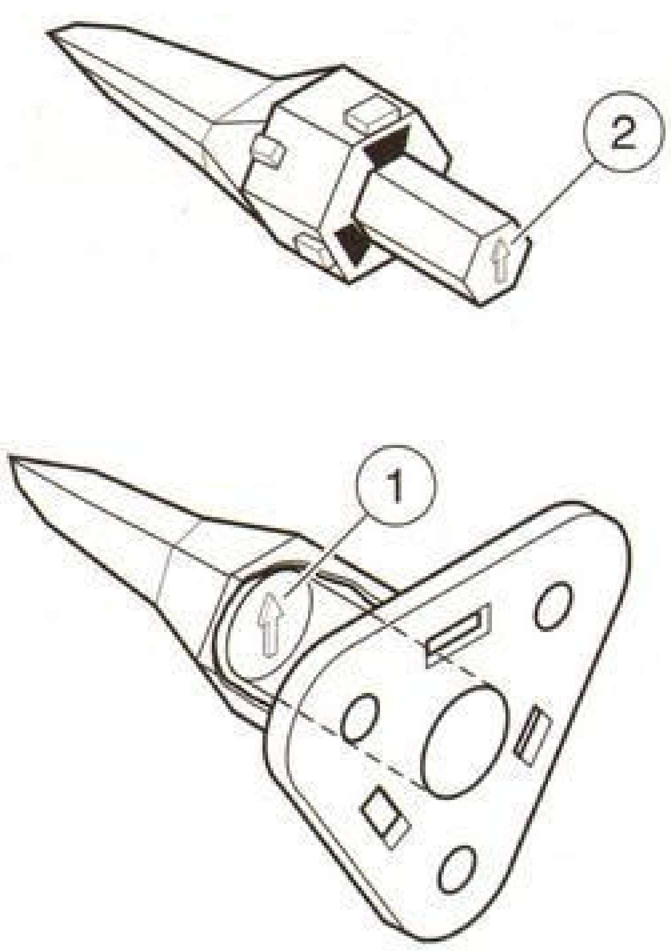
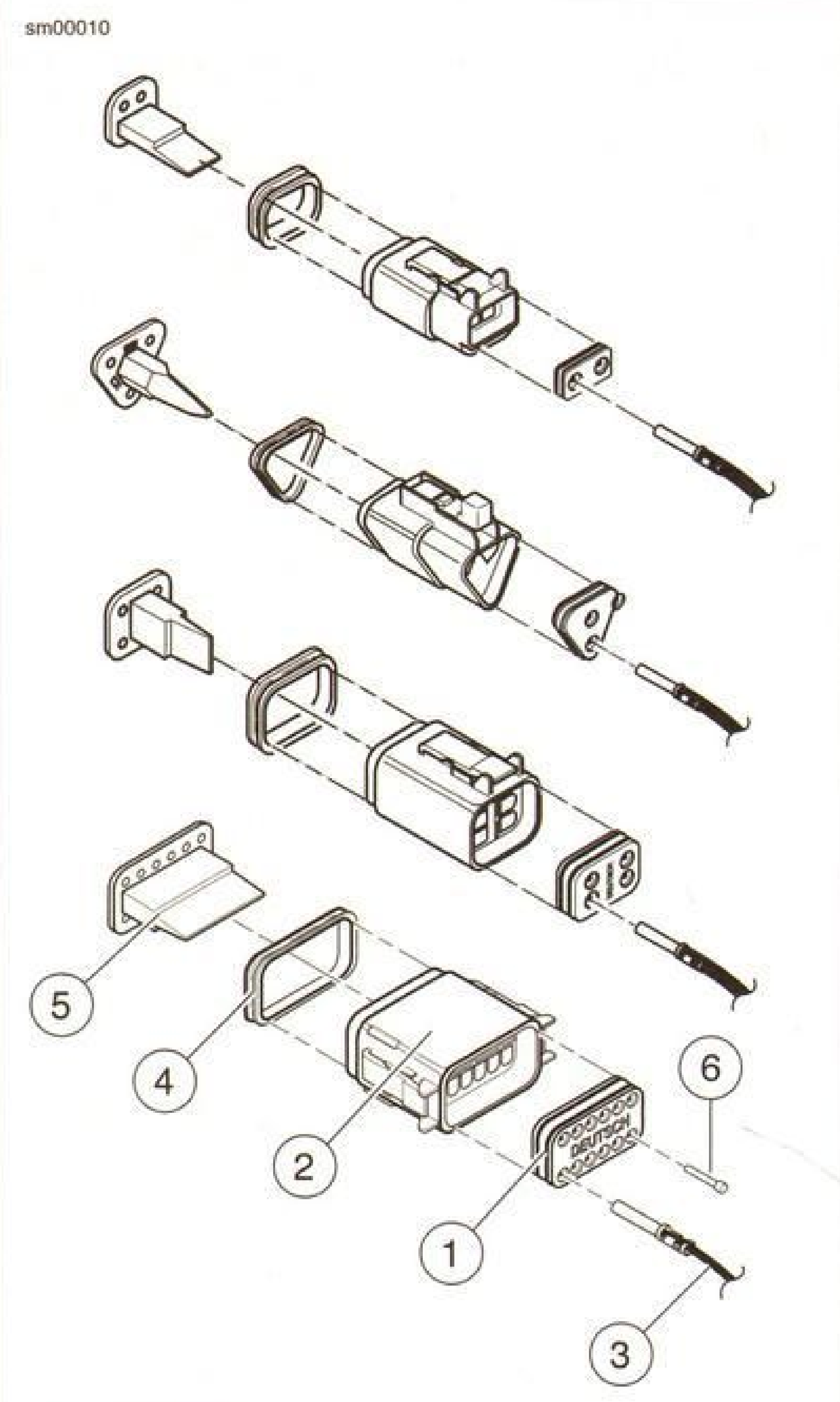


1. **Arrow on socket locking wedge**
2. **Arrow on pin locking wedge**

Figure A-12. Deutsch Connector: 3-Place Locking Wedges



1. **Wire seal**
2. **Socket housing**
3. **Wire lead**
4. **Internal seal**
5. **Secondary locking wedge**
6. **Seal plug**

Figure A-13. Deutsch Connector: 2, 3, 4 and 12-Place Socket Housings

Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.

2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

- *If wire leads require **new** terminals, see the instructions for crimping terminals.*
- *If it should become necessary to replace a pin or socket housing, please note that the 8-place and 12-place gray and black connectors are not interchangeable. Since location of the alignment tabs differ between the black and gray connectors, plugs or receptacles must be replaced by those of the same color.*
- *When replacing both socket and pin housings, then the black may be substituted for the gray, and vice versa. The socket and pin housings of all other connectors are interchangeable, that is, the black may be mated with the gray, since the alignment tabs are absent and the orientation of the external latch is the same.*

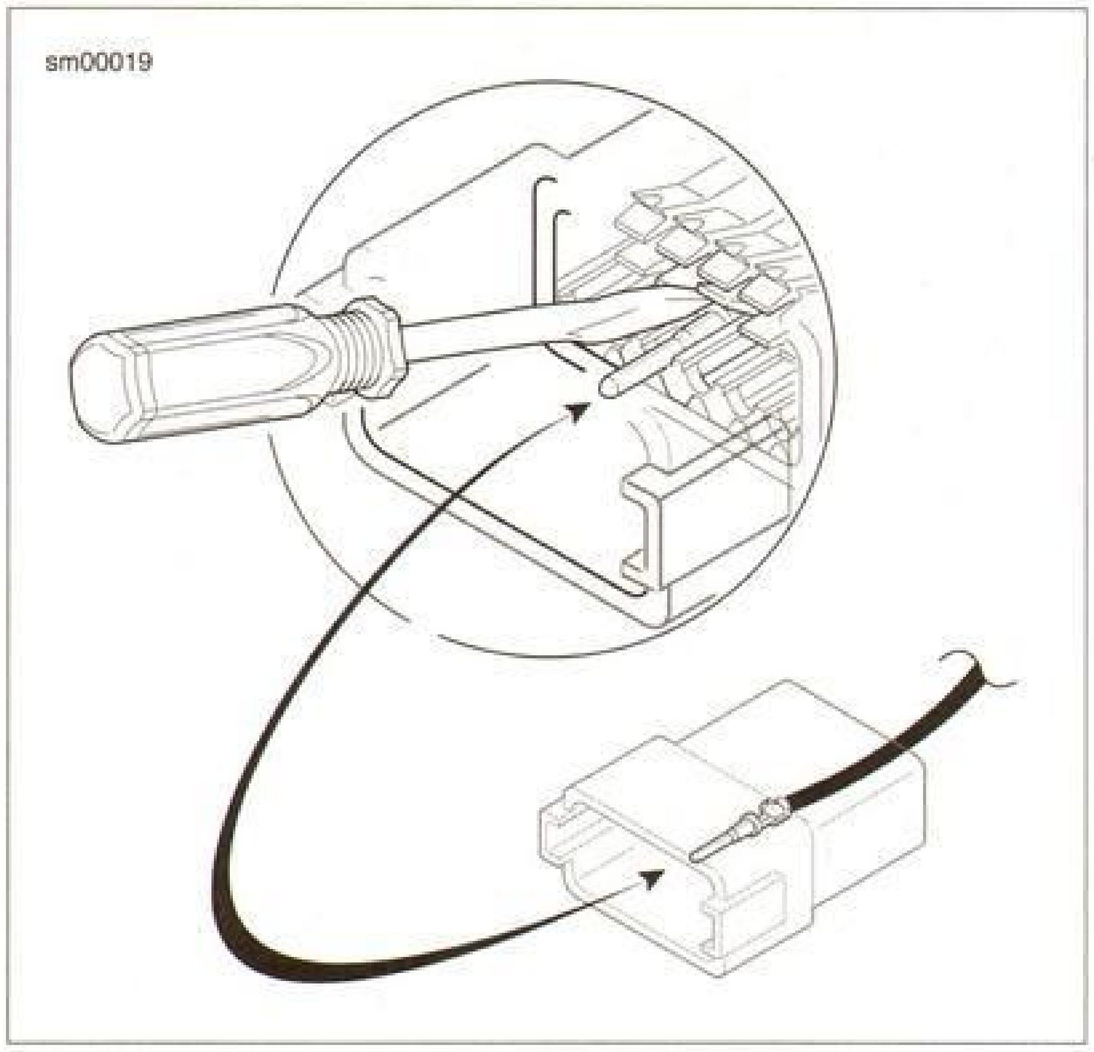


Figure A-14. Deutsch Connector: Depress Terminal Latch and Back Out Pin

Installing Pin Terminals

1. See Figure A-15. Fit wire seal (1) into back of pin housing (2).

2. Grasp wire lead approximately 1.0 in. (25.4 mm) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

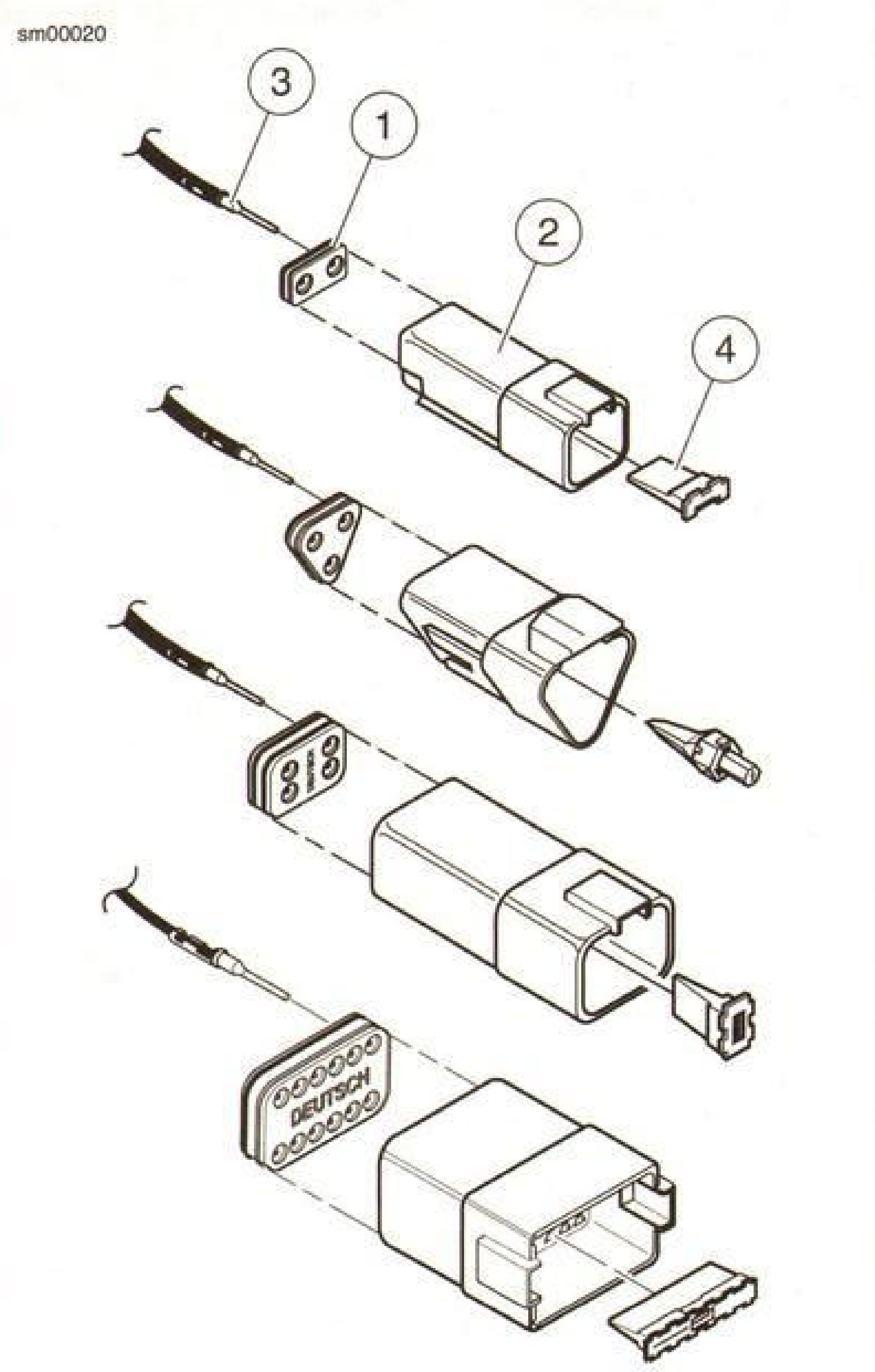
NOTE

A tug on the wire lead will confirm that a pin is locked in place.

3. Insert tapered end of secondary locking wedge (4) into pin housing and press down until it snaps in place.

NOTES

- *The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.*
- *See Figure A-12. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*



1. Wire seal
2. Pin housing
3. Pin terminal
4. Locking wedge

Figure A-15. Deutsch Connector: 2, 3, 4 and 12-Place Pin Housings

Crimping Terminals

Identify which of the types of Deutsch terminals are used with the connector and follow the corresponding crimping instructions. Refer to Table A-2.

Table A-2. Deutsch Connector: Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
Standard (with crimp tails)	A.4 DEUTSCH STANDARD TERMINAL REPAIR

DEUTSCH STANDARD TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL

Preparing Wire Leads for Crimping

1. Use a shop gauge to determine gauge of wire lead.
2. Strip lead removing 5/32 in. (4.0 mm) of insulation.

Crimping Terminal to Lead

1. See Figure A-16. Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to Table A-3.
3. Release locking bar to lock terminal in die.

NOTE

If the crimp tails are slightly out of vertical alignment, the crimp tool automatically rotates the terminal so that the tails face straight upward. When positioned, the locking bar fits snugly in the space between the contact band and the core crimp tails.

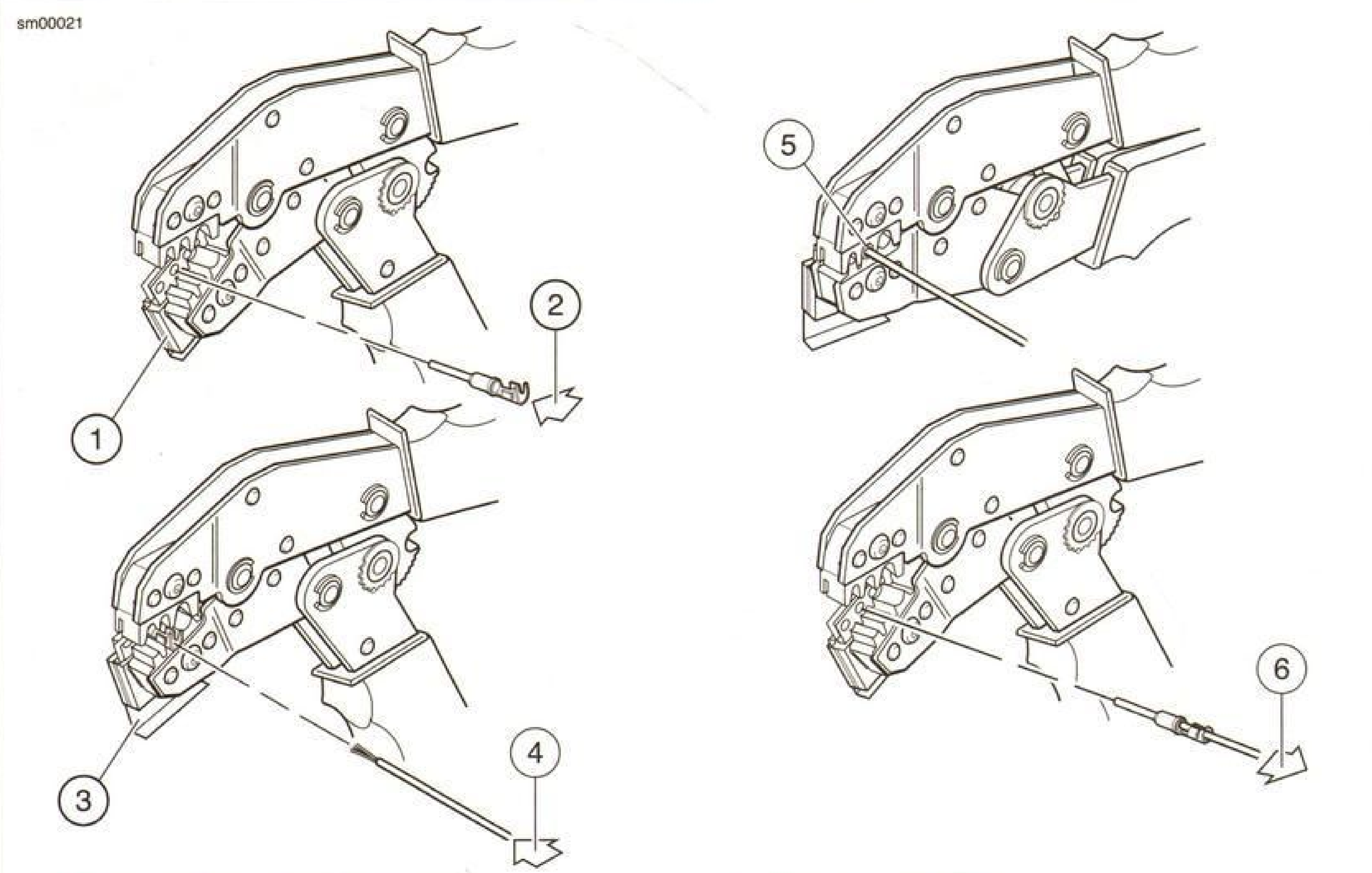
4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens after the terminal is crimped.
6. Raise locking bar up and remove wire lead and terminal.

Inspecting Crimps

Inspect the wire core and insulation crimps. Distortion should be minimal.

Table A-3. Deutsch Standard Terminal Crimp: Wire Gauge To Die

WIRE GAUGE (AWG)	CRIMP TOOL DIE
20	Front
16-18	Middle



1. **Open jaws and raise locking bar**
2. **Insert terminal in locking bar**
3. **Release locking bar to lock terminal in die**
4. **Insert stripped lead**
5. **Squeeze crimper**
6. **Raise locking bar and remove terminal**

Figure A-16. Crimping a Deutsch Standard Terminal

METRI-PACK TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-6	PACKARD TERMINAL CRIMP TOOL
HD-38125-7	PACKARD TERMINAL CRIMPER
HD-38125-8	PACKARD CRIMPING TOOL

Matching Terminal To Crimper

Metri-Pack connectors embossed with the initials P.E.D. require Packard crimp tools to crimp terminals to wire leads.

Terminals are crimped twice to a wire lead, once over the wire core and a second time over the insulation/seal.

See Figure A-17. A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

The PACKARD CRIMPING TOOL (Part No. HD-38125-8) will also crimp sealed splice connectors in wire gauge sizes 18-20, 14-16 and 10-12.

Preparing Wire Lead

Use a wire striper to strip off the insulation and expose 5/32 in. (4.0 mm) of wire core.

Crimping Wire Core

NOTE

*Metri-Pack terminal crimps require two steps. Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. Squeeze and release handles until ratchet automatically opens.
2. Identify the corresponding sized nest for the core crimp.
3. Position the core crimp in the die. Be Sure the core crimp tails are facing the forming jaws.
4. Gently squeeze the handles until crimpers just secure the core crimp tails.
5. Insert stripped wire between crimp tails. Verify that wire is positioned so that short pair of crimp tails squeeze core wire strands, while long pair is positioned over the insulation or seal material.
6. Squeeze handles tightly closed. Release grip and the tool will automatically open.

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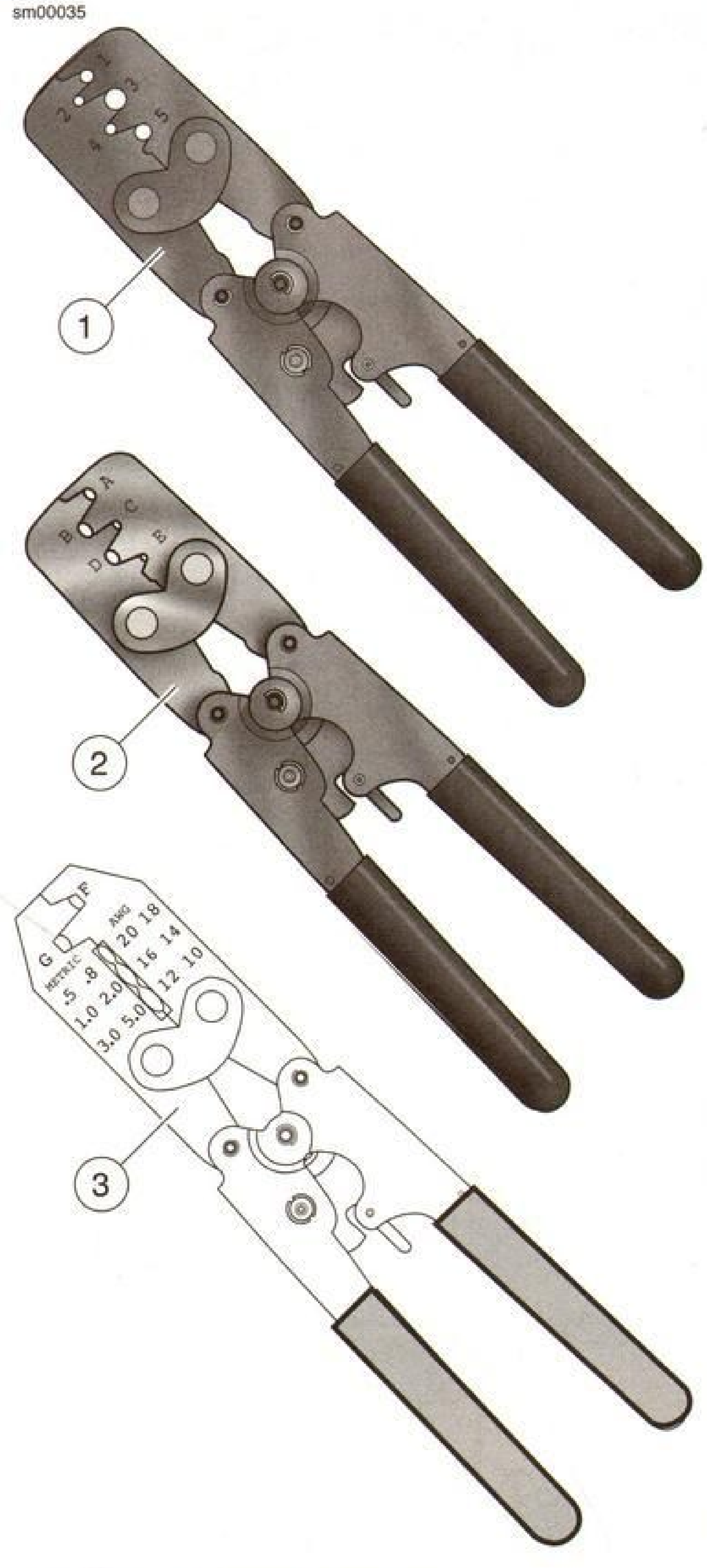


1. **HD-38125-6 sealed terminals**
2. **HD-38125-7 non-sealed terminals**
3. **HD-38125-8 non-sealed terminals**

Figure A-17. Metri-Pack Terminal Crimp Tools

Crimping Insulation/Seal

NOTE

*Always perform **Crimping Wire Core** before **Crimping Insulation/Seal**.*

1. See Figure A-18. Identify the correct die for the insulation/seal crimp (2).

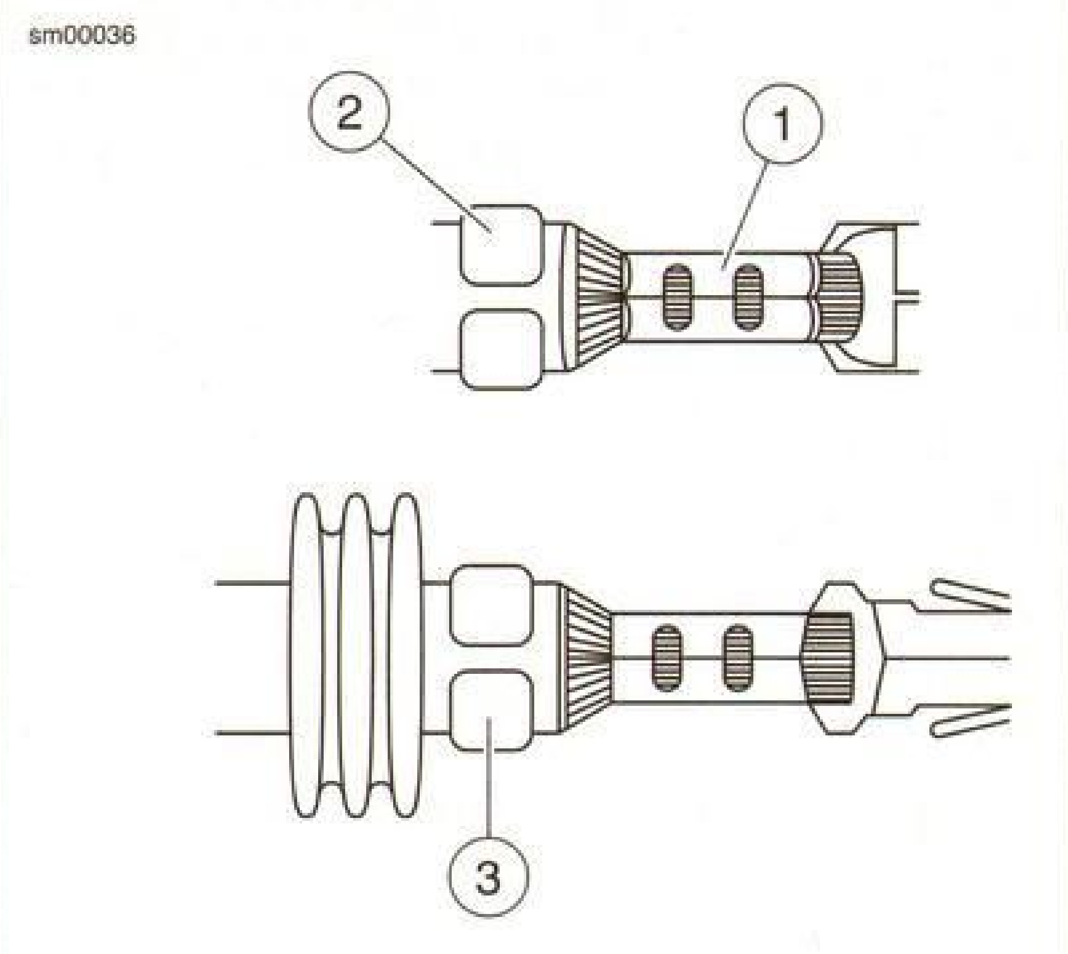
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.

3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

Inspecting Crimps

1. See Figure A-18. Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.

2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.



1. **Wire core crimp**
2. **Insulation crimp**
3. **Seal crimp**

Figure A-18. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps

150 METRI-PACK CONNECTOR REPAIR

General

Metri-Pack connectors are embossed with the initials (P.E.D.).

There are two types of connectors in this series:

- Pull-to-Seat
- Push-to-Seat

Separating Pin and Socket Housings

Bend back the external latch slightly and separate the pin and socket halves of the connector.

Mating Pin and Socket Housings

Align the wire colors and push the pin and socket halves of the connector together.

Removing Socket Terminal

1. See Figure A-19 for pull-to-seat connector or Figure A-20 for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

For best results, free one side of wire lock first and then release the other side.

2. Find the locking tang in the mating end of the connector.

NOTE

The tangs are always positioned in the middle of the chamber and are on the same side as the external latch.

3. Gently insert a safety pin into the chamber about 1/8 in. (3.2 mm).
   a. **For pull-to-seat:** Stay between the terminal and the chamber wall and pivot the end of the pin toward the terminal body.
   b. **For push-to-seat:** There is a small opening for the pin.
4. When a click is heard, remove the pin and repeat the procedure.

NOTE

The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

5. Pick at the tang until the clicking stops and the pin seems to slide in deeper than it had previously. This is an indication that the tang has been depressed.

NOTE

On those terminals that have been extracted on multiple occasions, the click may not be heard, but pivot the pin as if the click was heard at least 3 times.

6. Remove the pin.
   a. **For pull-to-seat:** Push on the lead to extract the terminal from the mating end of the connector.
   b. **For push-to-seat:** Pull on the lead to draw the terminal out the wire end.

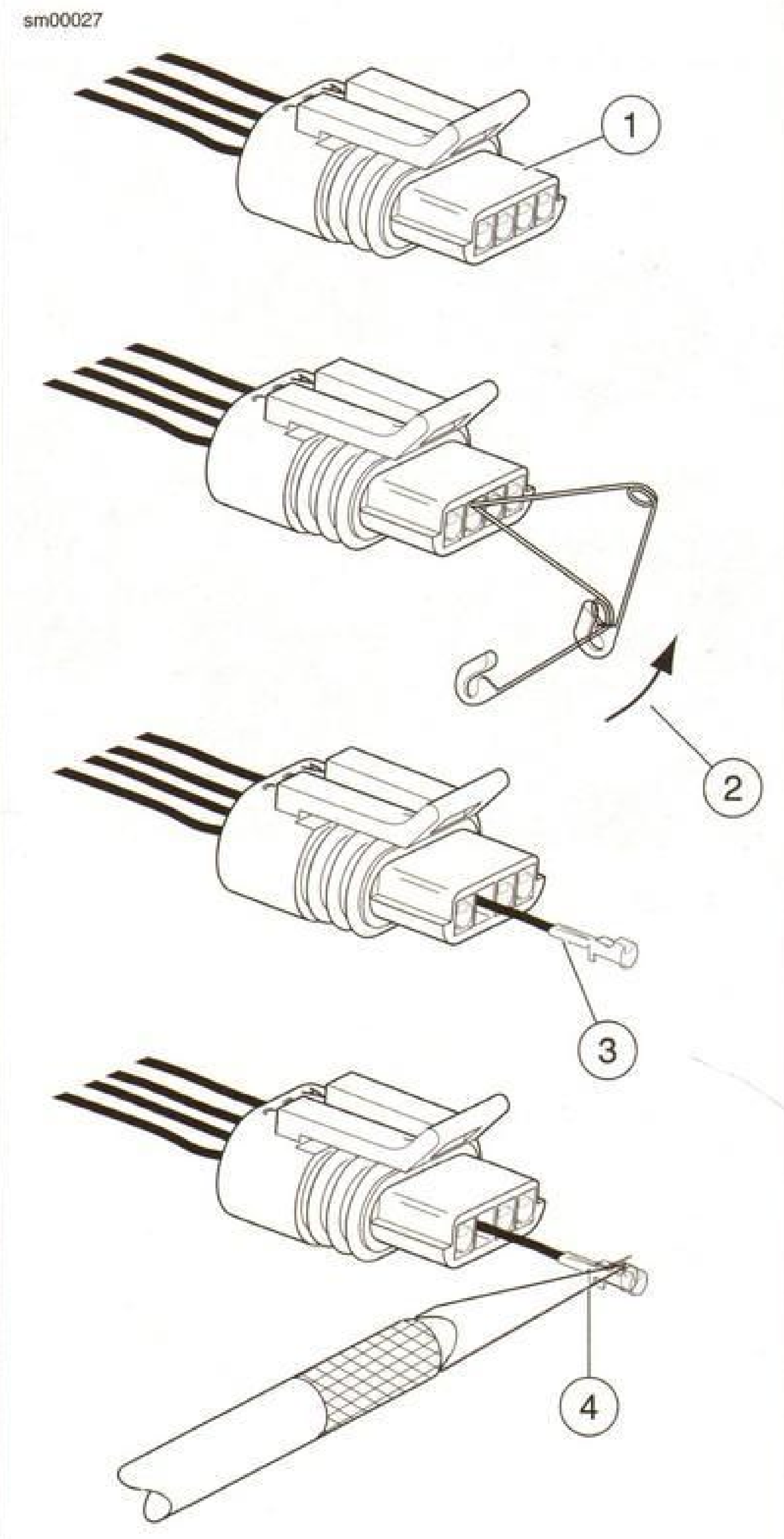
Inserting Socket Terminal

NOTE

For wire location purposes, alpha characters are stamped into the socket housings.

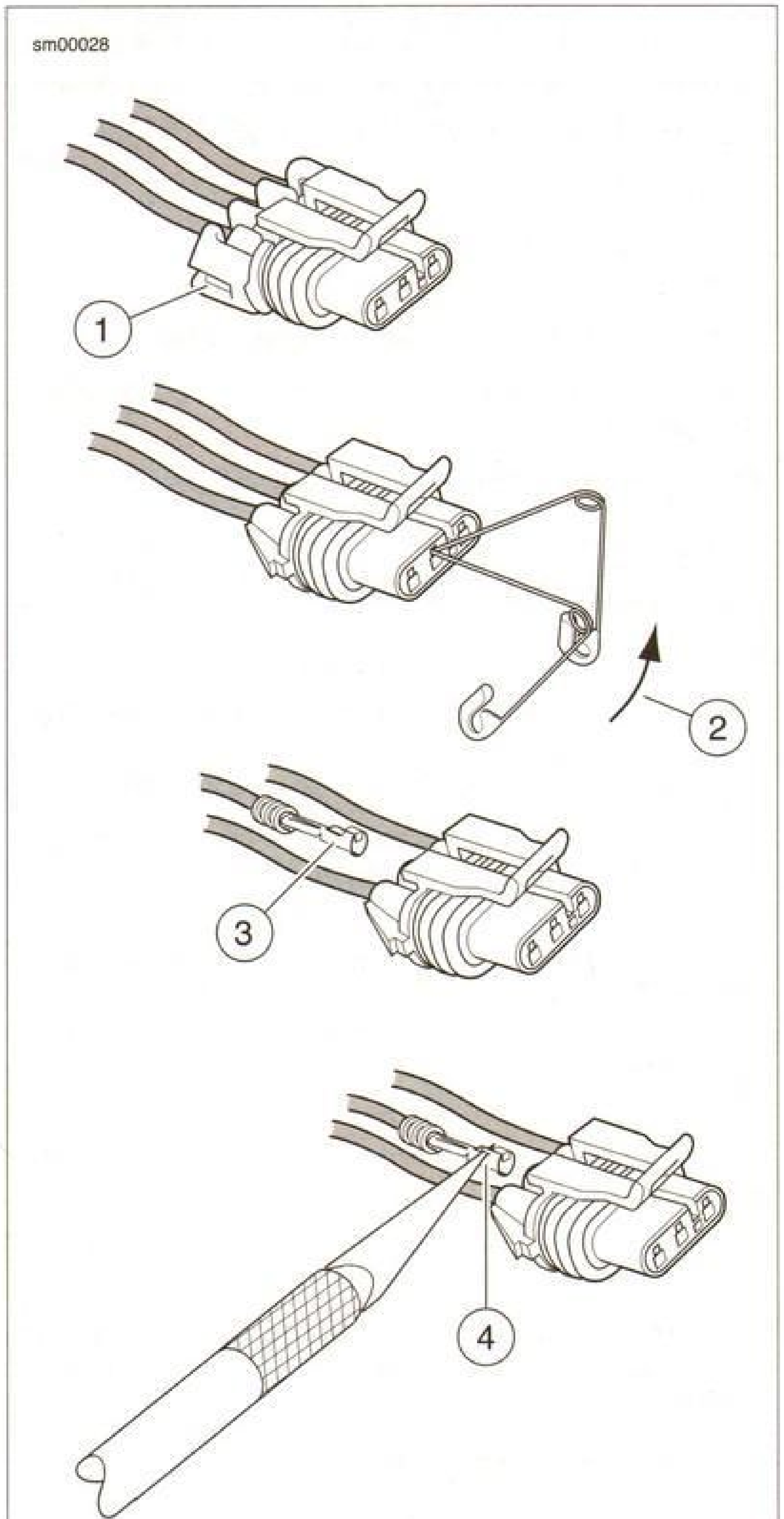
1. See Figure A-19 for pull-to-seat connector or Figure A-20 for push to seat connector. Using a thin flat blade, like that on a hobby knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

   For push-to-seat: See Figure A-20. Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.



1. Locate tang in chamber
2. Pivot pin to depress tang
3. Push to remove
4. Raise tang to install

Figure A-19. 150 Metri-Pack Connector: Pull-to-Seat



1. Remove wire lock
2. Pivot pin to depress tang
3. Pull to remove
4. Raise tang to install

Figure A-20. 150 Metri-Pack Connector: Push-to-Seat

280 METRI-PACK CONNECTOR REPAIR

General

See Figure A-21. Called Packard connectors, Metri-Pack series connectors are embossed with the initials (P.E.D.)

Separating Pin and Socket Housings

Depress the wireform and use a rocking motion to detach the socket connector half.

Mating Pin and Socket Housings

Align the groove in the socket housing with the tab in the pin housing. Push the pin and socket halves of the connector together until the latch clicks.

Removing Socket Terminals

1. See Figure A-22. Pry rubber seal from wire end of connector and move seal down wires (1) toward conduit. Hold the connector so that the wireform is facing down.
2. Looking into the wire end of the connector, insert the point of a safety pin (2) between the top of the terminal and the inside chamber wall.
3. Push safety pin completely into chamber while watching terminal on mating end of connector. When terminal is observed moving forward slightly, tang is depressed. Remove safety pin.

NOTE

Repeat as necessary until the terminal can be pushed out of the connector.

4. Push on wire end of the lead to extract the terminal from the mating end of the connector.
5. If necessary, crimp new terminals on wires. See A.5 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps.

Installing Socket Terminals

NOTE

Terminal cavities are lettered on the socket housing. To match the wire lead colors to the terminal cavity, refer to the wiring diagram.

1. See Figure A-22. Using a thin flat blade, like a hobby knife (4), carefully bend the tang outward away from the terminal body.
2. Gently pull on the wire lead (5) to draw the terminal back into the chamber. The tang faces opposite the wireform as it enters the chamber.

NOTE

A "click" is heard when the terminal is properly seated.

3. Push on lead to verify that terminal is locked in place.
4. Fit rubber wire seal back into wire end of connector.

Crimping Terminals

If necessary, crimp new terminals on the wire leads. Refer to A.5 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps.

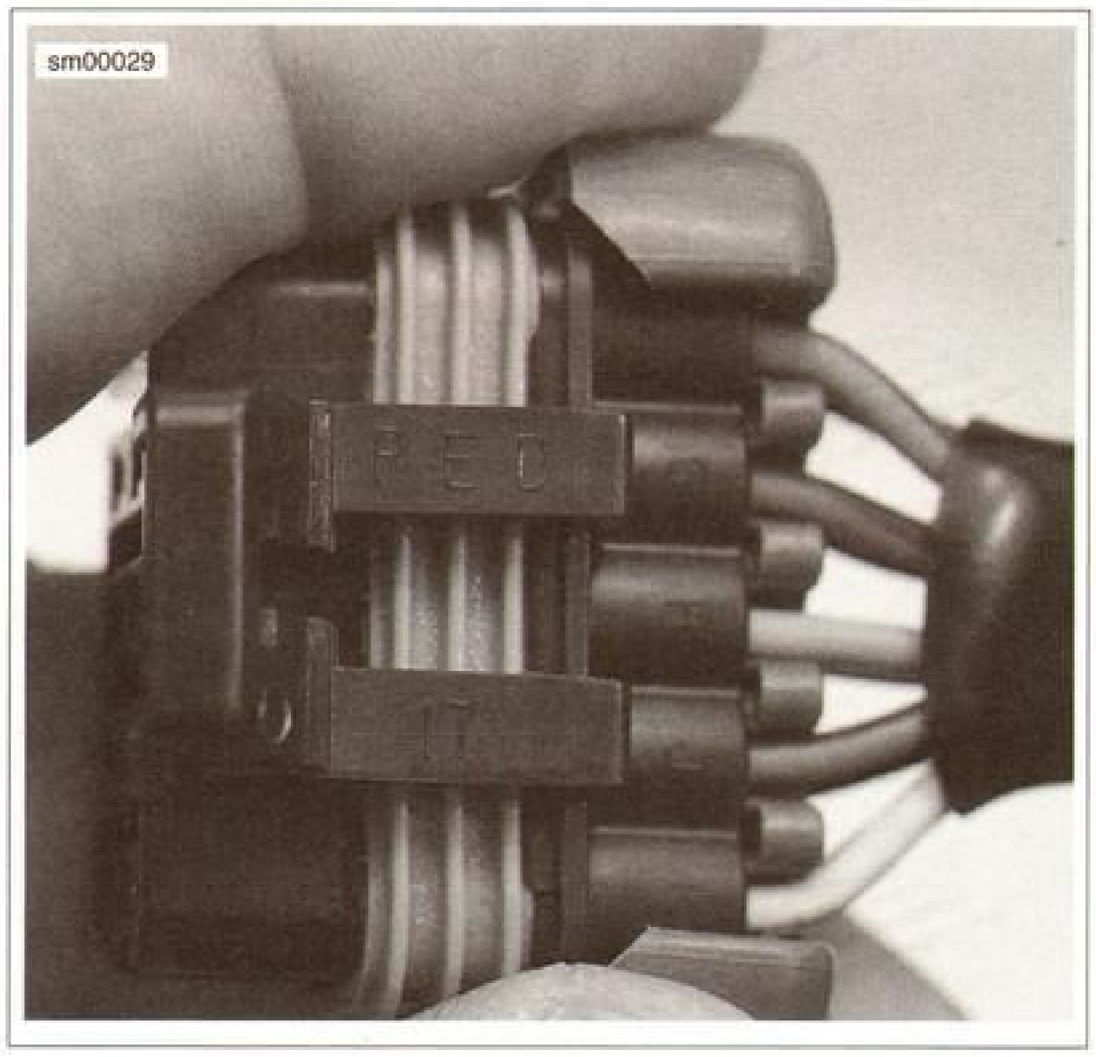
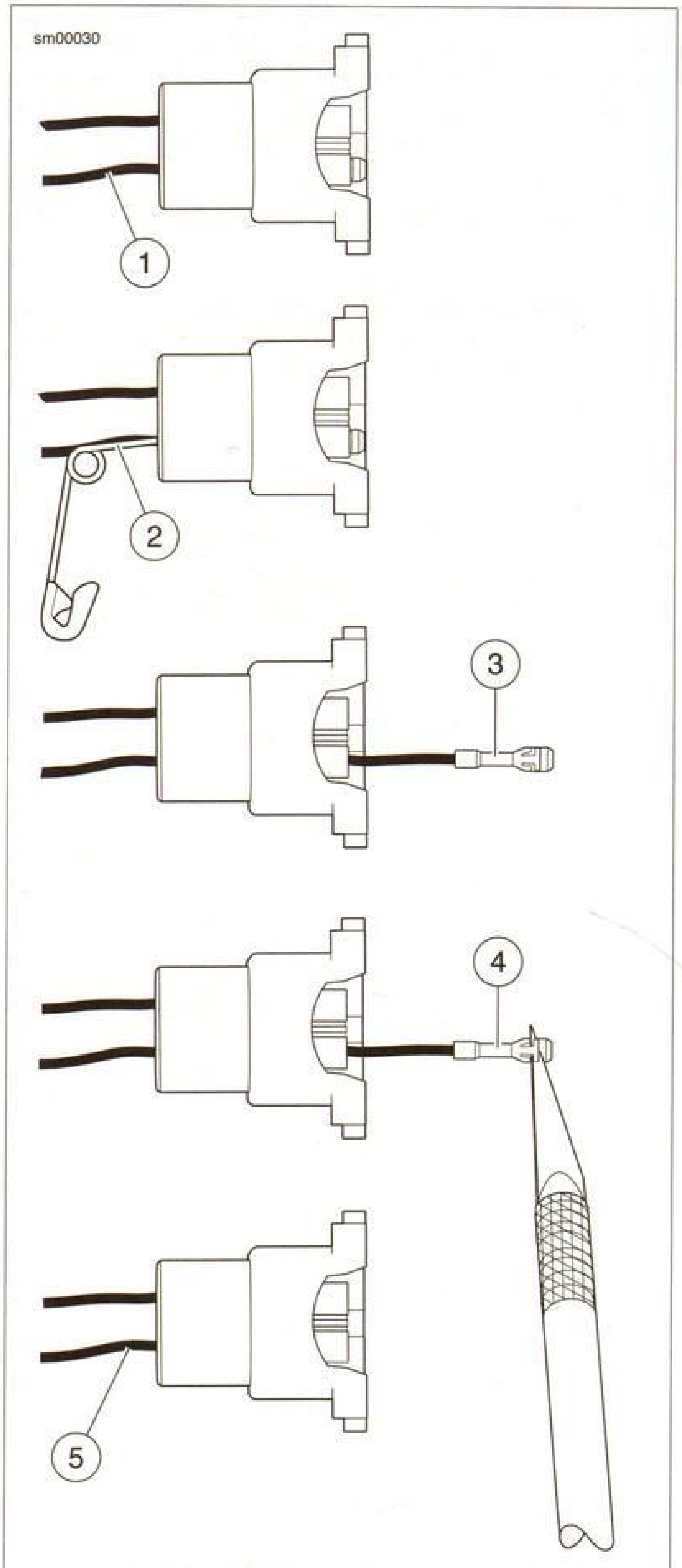


Figure A-21. 280 Metri-Pack Connector (P.E.D.)



1. Pry rubber seal from connector
2. Insert safety pin to depress tang
3. Push on lead to remove terminal
4. Raise tang with hobby knife
5. Pull on lead to draw terminal into chamber

Figure A-22. 280 Metri-Pack Connector: Remove/Install Socket Terminal

480 METRI-PACK CONNECTOR REPAIR

General

A 480 Metri-Pack (P.E.D.) connector is frequently used for the B+ (battery voltage) connector to power P&A accessories.

Referred to as Packard connectors, Metri-Pack connectors are embossed with the initials P.E.D.

See Figure A-23. An AFL housing (5) is used on many ignition/light switches. The secondary lock (4) must be opened before removing the terminal from the housing.

Separating Pin and Socket Housings

NOTE

Cut any cable strap anchoring the wire conduits of the pin (accessory connector housing) and the socket (B+) housing.

See Figure A-23. Using small flat blade screwdriver, press button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

Mating Pin and Socket Housings

Orient the latch on the socket housing to the button catch on the pin housing and press the housings together.

Removing Socket Terminals

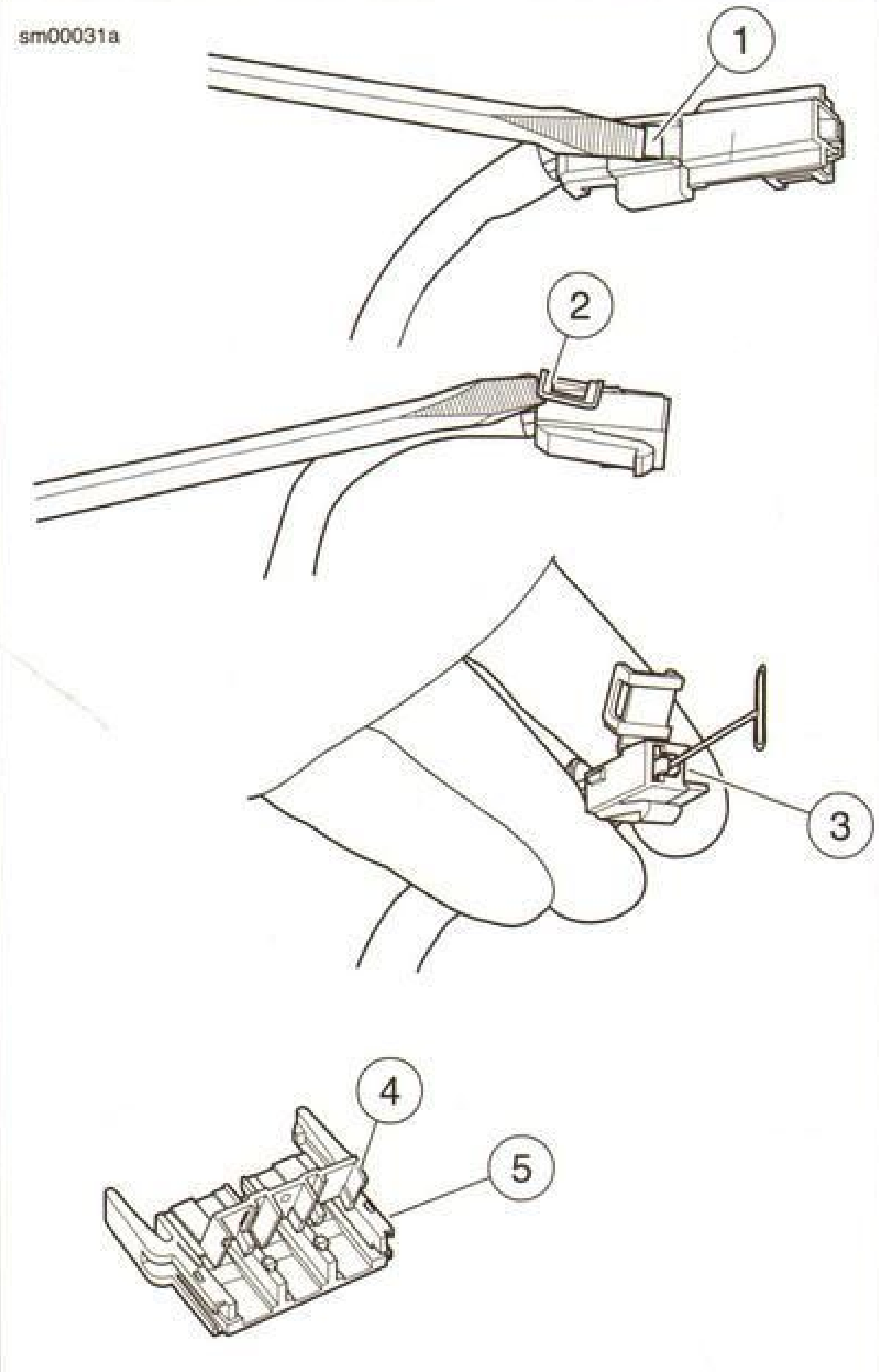
1. See Figure A-23. Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to press the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See A.5 METRI-PACK TERMINALS.

Installing Socket Terminals

1. Carefully bend the tang outward away from the terminal body.
2. With the tang on the same side as the square shaped opening in the mating end of the connector housing, feed terminal into wire end of connector housing until it "clicks" in place.
3. Verify that terminal will not back out of the chamber. A slight tug on the cable will confirm that it is locked.
4. Rotate the hinged secondary lock inward until latches fully engage tabs on both sides of connector housing.

NOTE

*If removed, install **new** anchored cable strap in O.E. location. Tighten cable strap to capture conduit of both accessory connector and B+ connector approximately 1.0 in. (25.4 mm) from housings.*



1. **Button on pin housing**
2. **Secondary lock latch**
3. **Opening between tang and chamber wall**
4. **Secondary Lock (shown open)**
5. **AFL housing**

Figure A-23. 480 Metri-Pack Connector: Remove Socket Terminal

630 METRI-PACK CONNECTOR REPAIR

PART NUMBER	TOOL NAME
SNAP-ON TT600-3	SNAP-ON PICK

General

Referred to as Packard connectors, Metri-Pack 630 series connectors are embossed with the initials P.E.D.

Separating Pin and Socket Housings

NOTE

If necessary, remove connector from barbed anchor or other retaining device.

Bend back the external latch slightly and separate pin and socket halves of the connector.

Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and engages a rib in the chamber wall to lock the terminal in place.
3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to A.5 METRI-PACK TERMINALS.

Installing Socket Terminal

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Using a thin flat blade, like that of a hobby knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

MOLEX CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER

Separating Pin and Socket Housings

See Figure A-24. Depress the latch while pulling the pin and socket housings apart.

Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

Removing Terminals

1. Pull the secondary lock up, approximately 3/16 in. (4.8 mm), until it stops.
   a. **Socket Housing:** See Figure A-25. 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-26. 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-27. Insert MOLEX ELECTRICAL CONNECTOR 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. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

Installing Terminals

1. See Figure A-28. From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE

Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.
5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

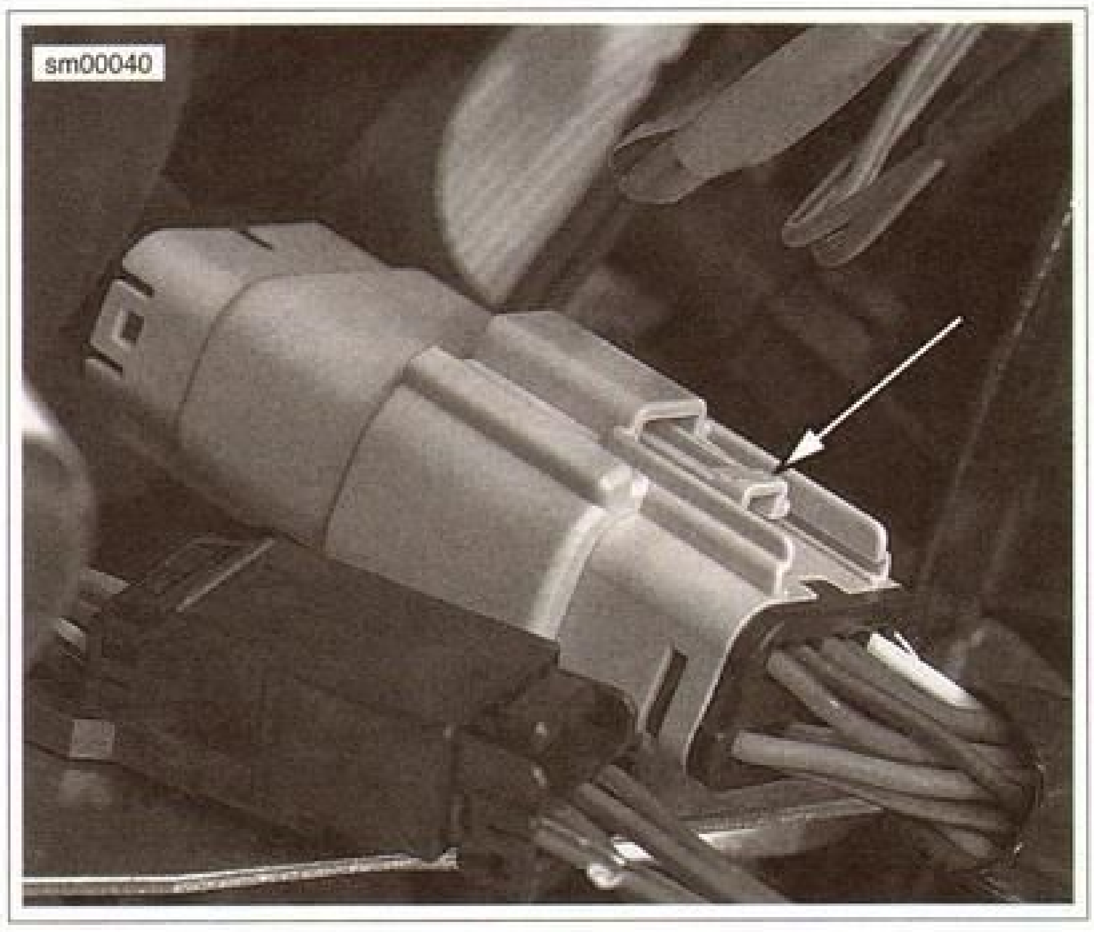


Figure A-24. Molex Connector: Latch

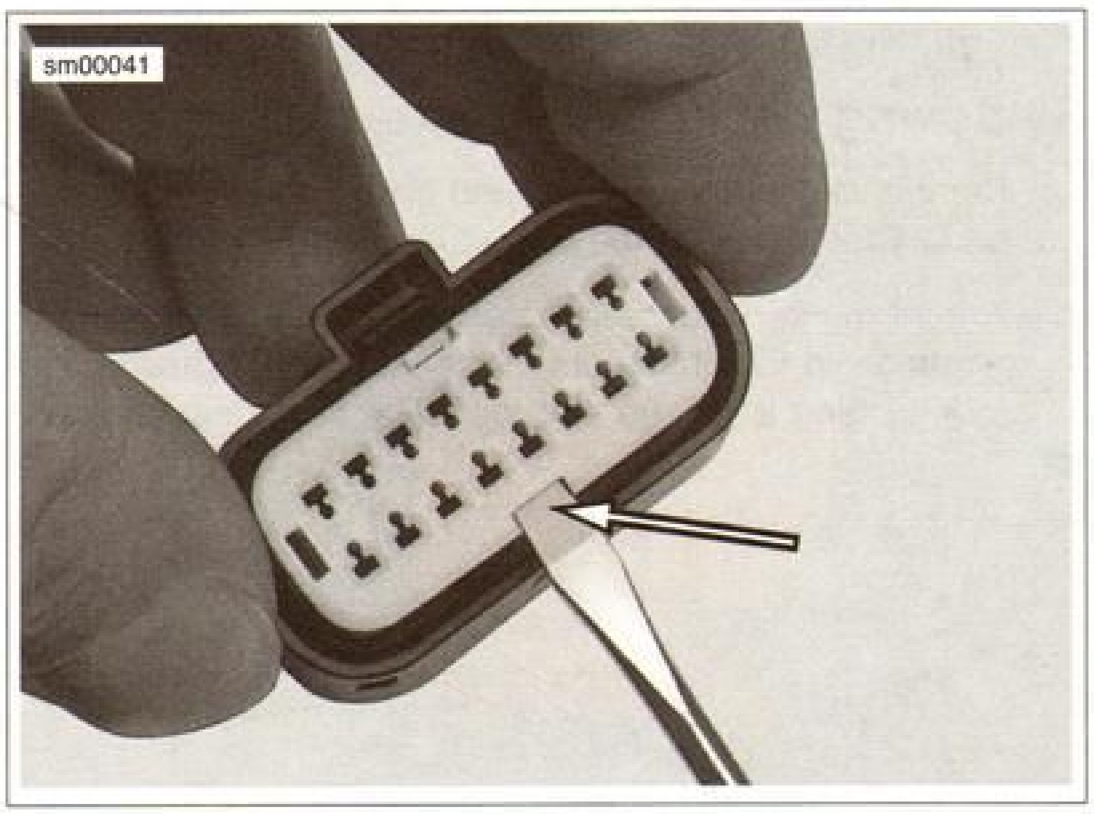


Figure A-25. Molex Connector: Secondary Lock Pry Slot (Socket Housing)

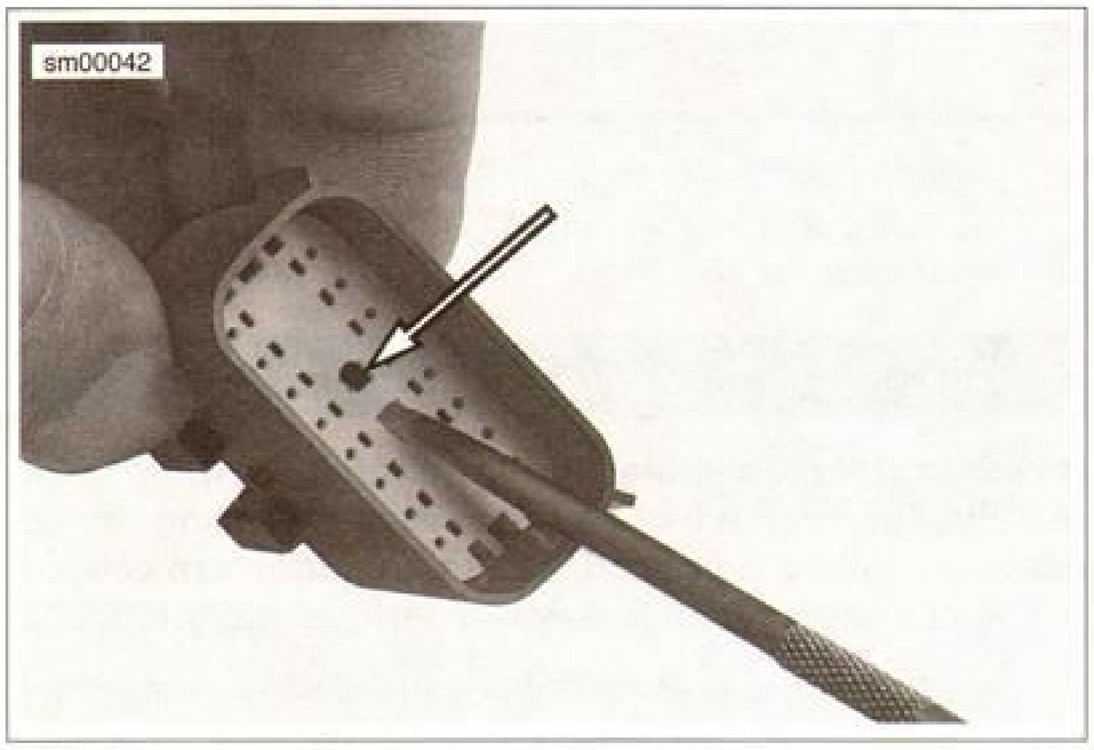


Figure A-26. Molex Connector: Secondary Lock D-Holes (Pin Housing)

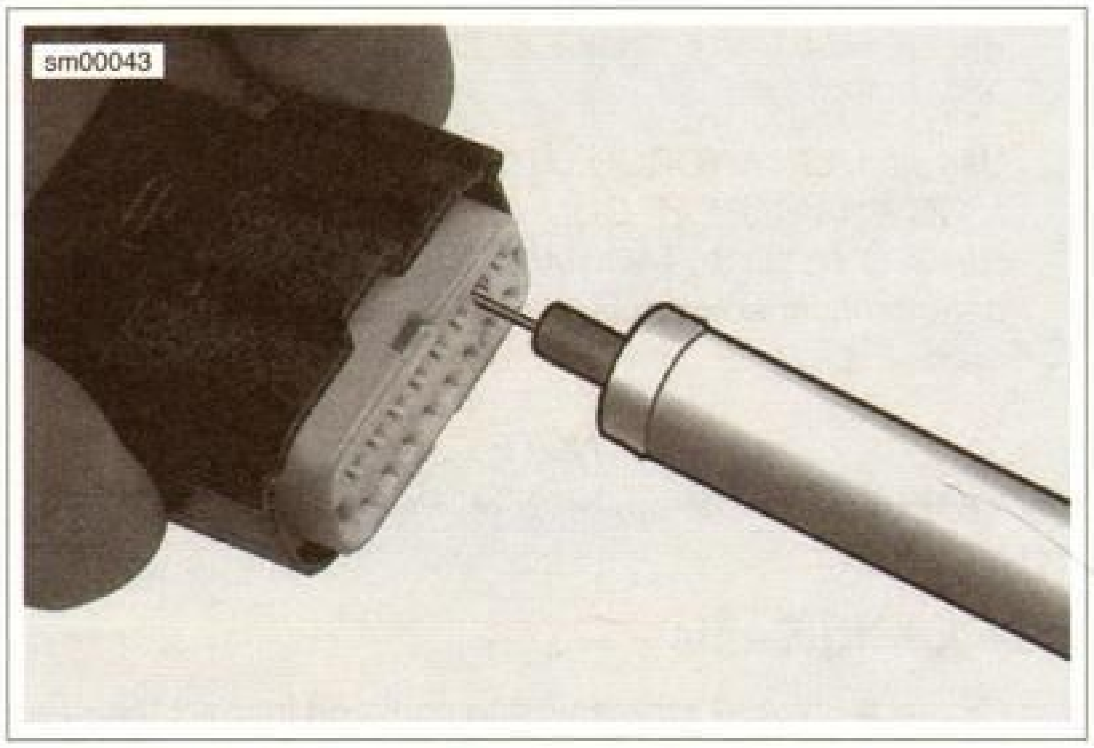
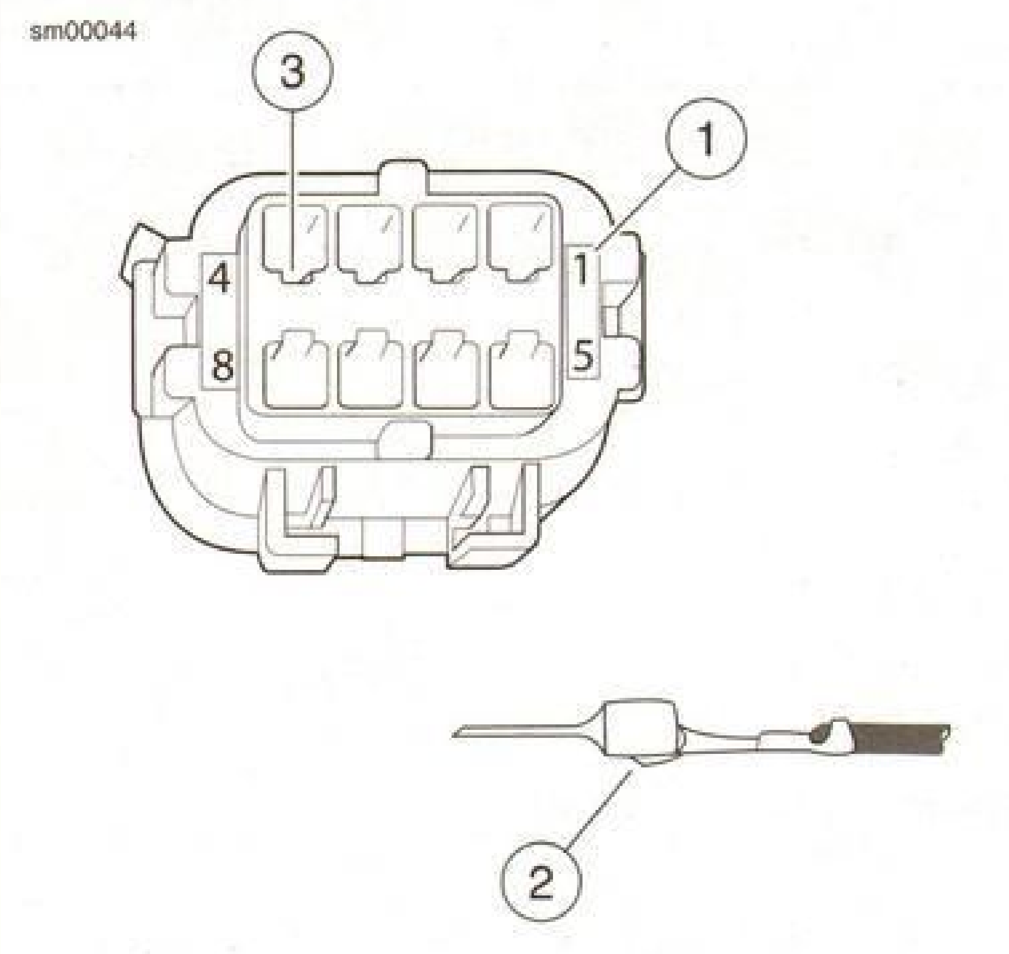


Figure A-27. Molex Connector: Terminal Remover (HD-48114)



1. Cavity number
2. Tang
3. Cavity slot

Figure A-28. Molex Connector: Pin Cavities and Wire Terminal

SEALED SPLICE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-38125-8	PACKARD CRIMPING TOOL
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

Preparing Wire Leads

NOTE

If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.

1. Using a shop gauge, identify the gauge of the wire.
2. Match the wire gauge to a sealed splice connector by color and part number. Refer to Table A-4.
3. Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to Table A-4 for the strip length.

Table A-4. Sealed Splice Connectors

WIRE GAUGE	COLOR	PART NO.	STRIP LENGTH
18-20 (0.5-0.8 mm)	Red	70585-93	3/8 in. (9.5 mm)
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8 in. (9.5 mm)
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8 in. (9.5 mm)

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.

Splicing Wire Leads

NOTE

See Figure A-30. The connector is crimped twice - one side and then the other.

1. See Figure A-29. Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See Figure A-30. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).
5. Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
6. Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

⚠WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

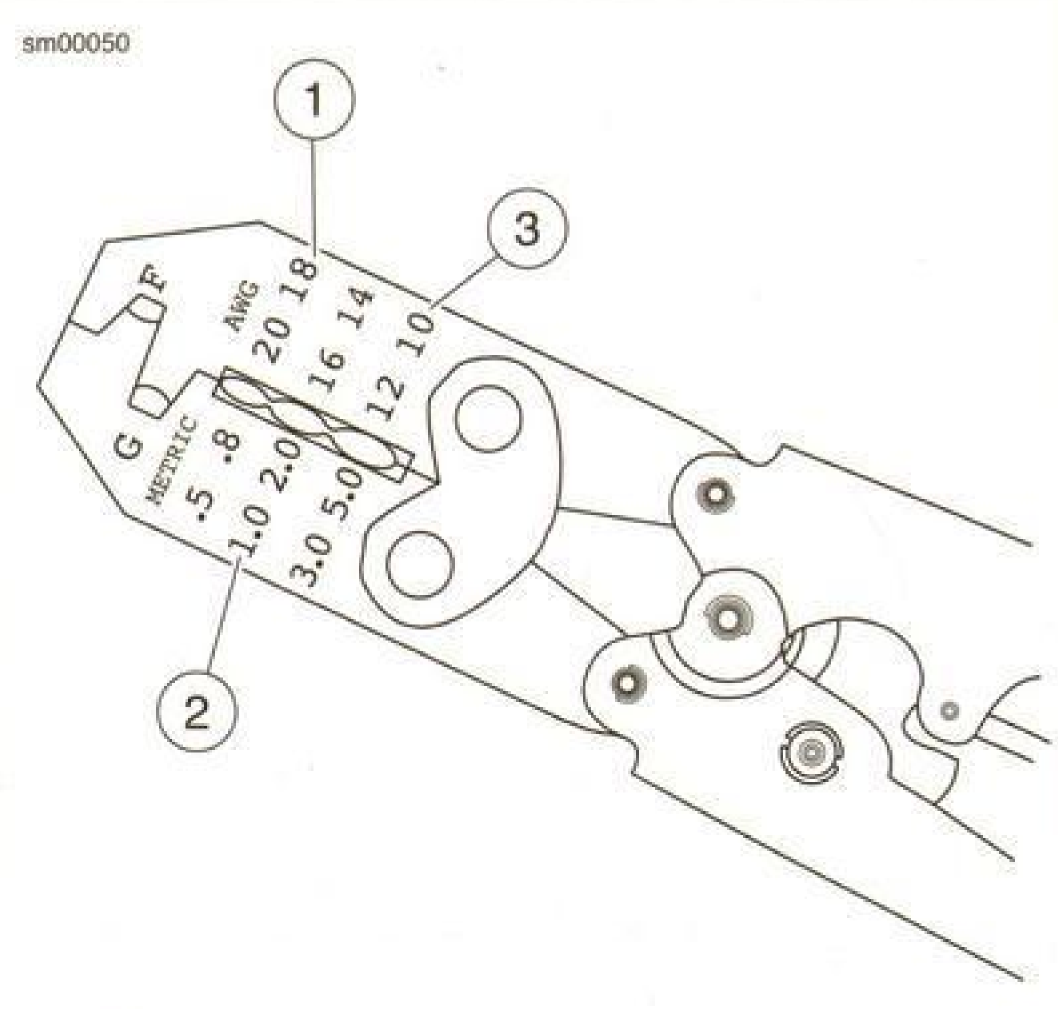
7. Use an ULTRA TORCH UT-100 (Part No. HD-39969), or a ROBINAIR HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

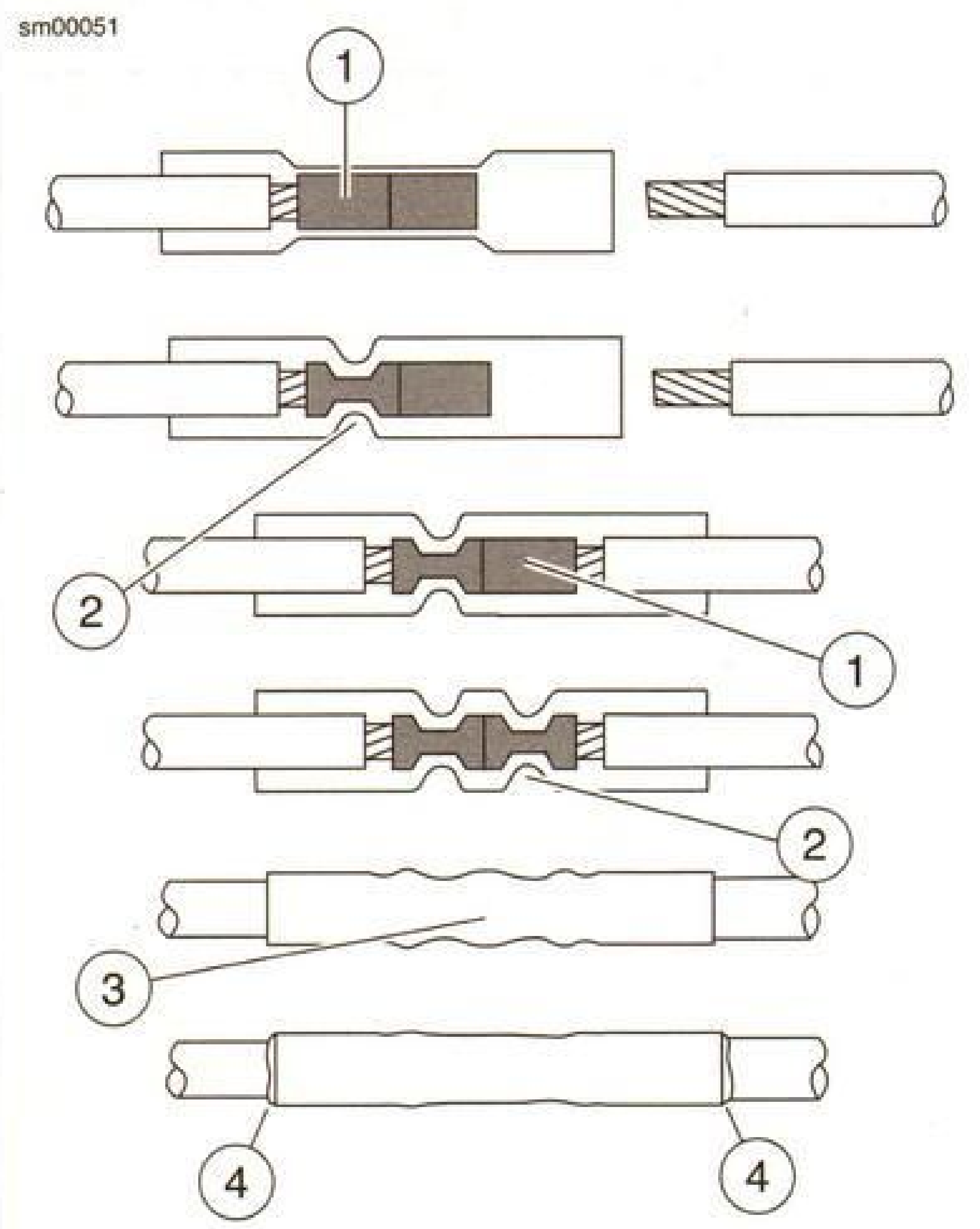
Inspecting Seals

See Figure A-30. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.



1. **Red connector die**
2. **Blue connector die**
3. **Yellow connector die**

Figure A-29. Packard Crimping Tool (HD-38125-8)



1. Wire lead in metal insert
2. Crimp metal insert
3. Center of crimp
4. Melted sealant

Figure A-30. Sealed Splice Connector

NOTES

NOTES

CONNECTOR LOCATIONS

Function/Location

On the motorcycle, a connector can be identified by its function and location. Refer to Table B-1.

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 B-1.

Table B-1. 2009 1125 Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[10]	Electronic Control Module (ECM) (black)	34-place Amp (Tyco)	Inside left radiator shroud
[11]	Electronic Control Module (ECM) (gray)	34-place Amp (Tyco)	Inside left radiator shroud
[18]	Right rear turn signal	2 1-place bullet	Under tail section
[19]	Left rear turn signal	2 1-place bullet	Under tail section
[22]	Right hand controls	4-place Amp (Tyco)	Behind fairing
[24]	Left hand controls	8-place Amp (Tyco)	Behind fairing
[31R]	Right front turn signal	2 1-place bullet	Behind fairing
[31L]	Left front turn signal	2 1-place bullet	Behind fairing
[33]	Ignition switch	4-place Amp (Tyco)	Behind fairing
[38]	Headlamp connector	6-place Deutsch	Behind fairing
[39]	Instrument cluster	20-place Amp (Tyco)	Behind fairing
[45]	License plate lamp	2 1-place bullet	Under tail section
[46]	Stator	4-place Deutsch	Under seat
[61]	Fuse block	Socket terminals	Under seat
[62]	Relay block	Spade terminals	Under seat
[65]	Vehicle Speed Sensor (VSS)	3-place Deutsch	Under seat
[77]	Voltage regulator	2-place Dekko	Under seat
[79]	Crankshaft Position (CKP) sensor	2-place Amp (Tyco)	Inside left radiator shroud
[80]	Manifold Absolute Pressure (MAP) sensor	3-place Bosch	Under throttle body, between cylinders
[83F]	Front ignition coil	3-place Bosch	Front cylinder head
[83R]	Rear ignition coil	3-place Bosch	Rear cylinder head
[84]	Front fuel injector	2-place Sumitomo	Front intake flange
[85]	Rear fuel injector	2-place Sumitomo	Rear intake flange
[86]	Fuel pump	4-place Delphi	Right side of frame
[87]	Idle Air Control (IAC)	4-place Delphi	Left side of throttle body
[88]	Throttle Position (TP) sensor	3-place Bosch	Left side of throttle body
[89]	Intake Air Temperature (IAT) sensor	2-place Amp (Tyco)	Left side of intake snorkel
[90]	Engine Coolant Temperature (ECT) sensor	2-place Bosch	Front cylinder head, under throttle body
[91A]	Data link connector	4-place Deutsch	Behind left radiator shroud
[93]	Tail/stop lamp	2-place Amp (Tyco) and 1-place Amp (Tyco)	Back of tail lamp, under tail section
[95]	Clutch switch	2-place Sumitomo	Underside of clutch lever assembly
[97]	Cooling fan #1 (right)	2-place Sumitomo	Inside right radiator shroud
[120]	Oil pressure switch	Spade terminal	Right side of engine
[121]	Rear brake switch	2-place Amp (Tyco)	Right side forward of rear wheel

Table B-1. 2009 1125 Connector Locations

NO.	DESCRIPTION	TYPE	LOCATION
[122]	Horn	2 1-place Fargo	Behind left radiator shroud, under fan
[128]	Starter solenoid	2-place Amp (Tyco)	Under seat
[131]	Neutral switch	1-place slotted spade	Under sprocket cover
[133]	Sidestand sensor	3-place Deutsch	Under sprocket cover
[134]	Bank Angle Sensor (BAS)	6-place Sumitomo	Inside left radiator shroud
[137]	Oxygen sensor, rear	1-place Delphi	Right side of engine, above water pump
[138]	Oxygen sensor, front	1-place Delphi	Behind right fan
[145]	Interface connector	20-place Molex	Behind left radiator shroud
[160]	12V Auxiliary Connector	2-place Sumitomo	Behind fairing
[170]	Front brake switch	2 1-place spade	Underside of front brake assembly
[178]	Active intake solenoid	2-place Deutsch	Under seat
[215]	Cooling fan #2 (left)	2-place Sumitomo	Inside left radiator shroud
[227]	Fuel pressure sensor	3-place Delphi	Fuel line aft of throttle body
[228]	Barometric (BARO) pressure sensor	3-place Bosch	Under seat, rear of airbox
[234]	Fan sub-harness connector	4-place Deutsch	Behind left radiator shroud
[243]	CAN connector	2-place Deutsch	Behind left radiator shroud

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table B-2.

For Solid Color Wires: See Figure B-1. The alpha code identifies wire color (3).

For Striped Wires: The code is written with a slash (/) between the solid color code and the stripe code (4). For example, a trace labeled GN / Y is a green wire with a yellow stripe.

Wiring Diagram Symbols

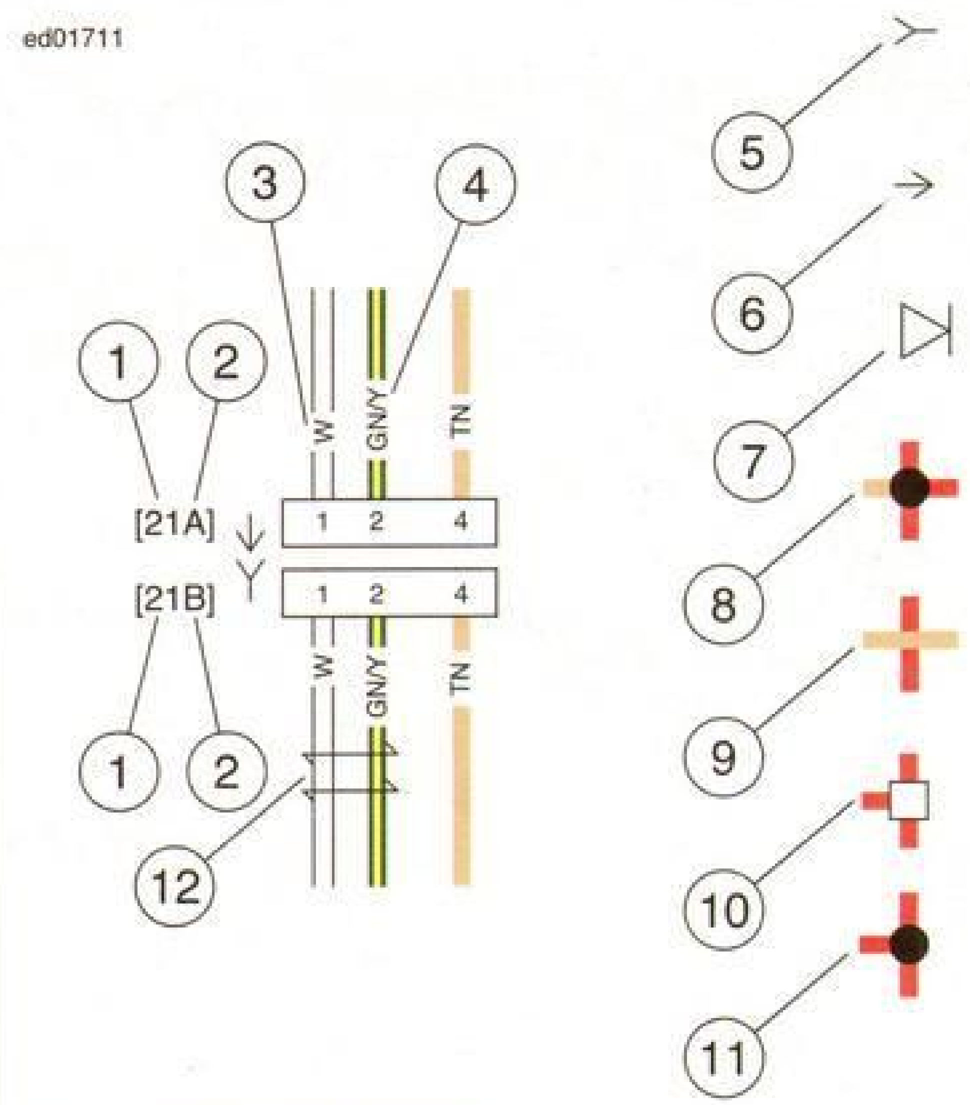
See Figure B-1. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets (1). The letter (2) inside the brackets identifies whether the housing is a socket or pin housing.

A=Pin: The letter A after a connector number and the pin symbol (6) identifies a pin housing.

B=Socket: The letter B after a connector number and the socket symbol (5) identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode (7), a symbol for a wire-to-wire connection (8), a symbol verifying that no connection (9) between two wire traces exists, symbols for actual (10) and virtual (11) splices, and a symbol identifying two wires that are twisted together (12).

Actual splices (10) are splices where two wires are connected together at a specific location along a wire. Virtual splices (11) are splices shown connected anywhere along a wire, usually used in a wiring or schematic diagram for clarity.



1. Connector number
2. Terminal code (A=pin, B=socket)
3. Solid wire color
4. Striped wire color
5. Socket symbol
6. Pin symbol
7. Diode
8. Connection
9. No connection
10. Virtual splice
11. Physical splice
12. Twisted pair

Figure B-1. Connector/Wiring Diagram Symbols (typical)

Table B-2. 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

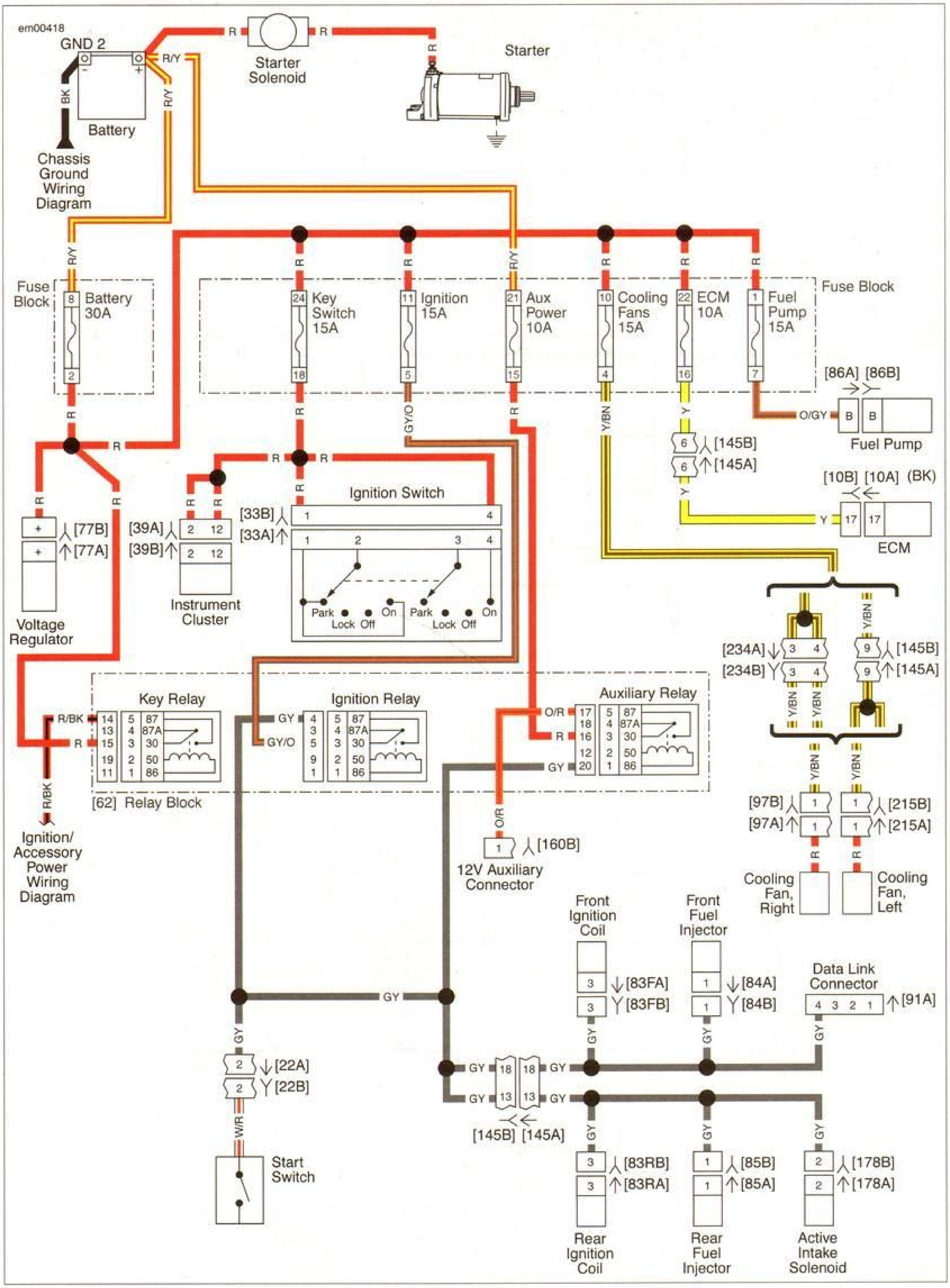


Figure B-2. Battery Power Distribution: 2009 1125 Models

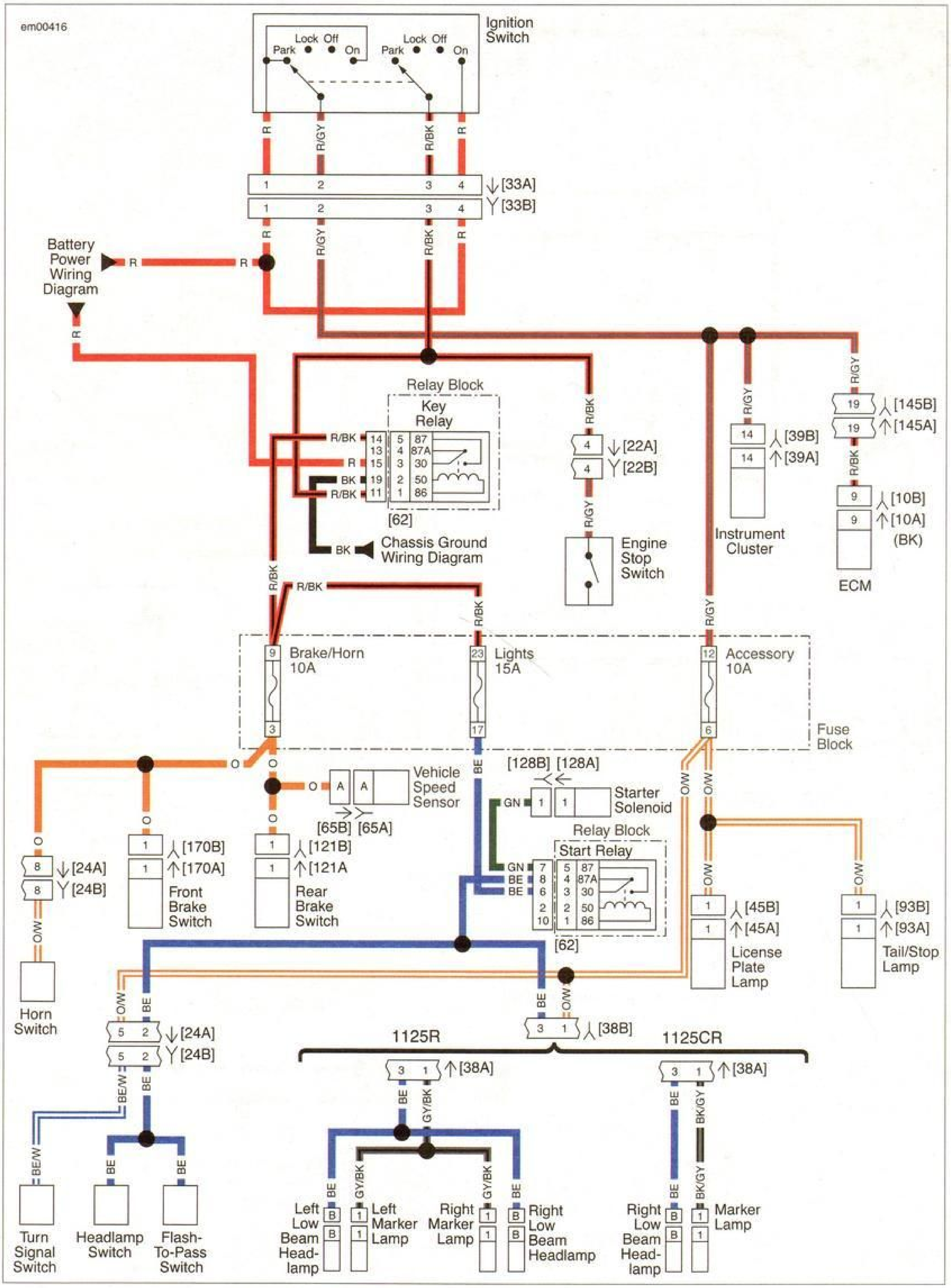


Figure B-3. Ignition and Accessory Power: 2009 1125 Models

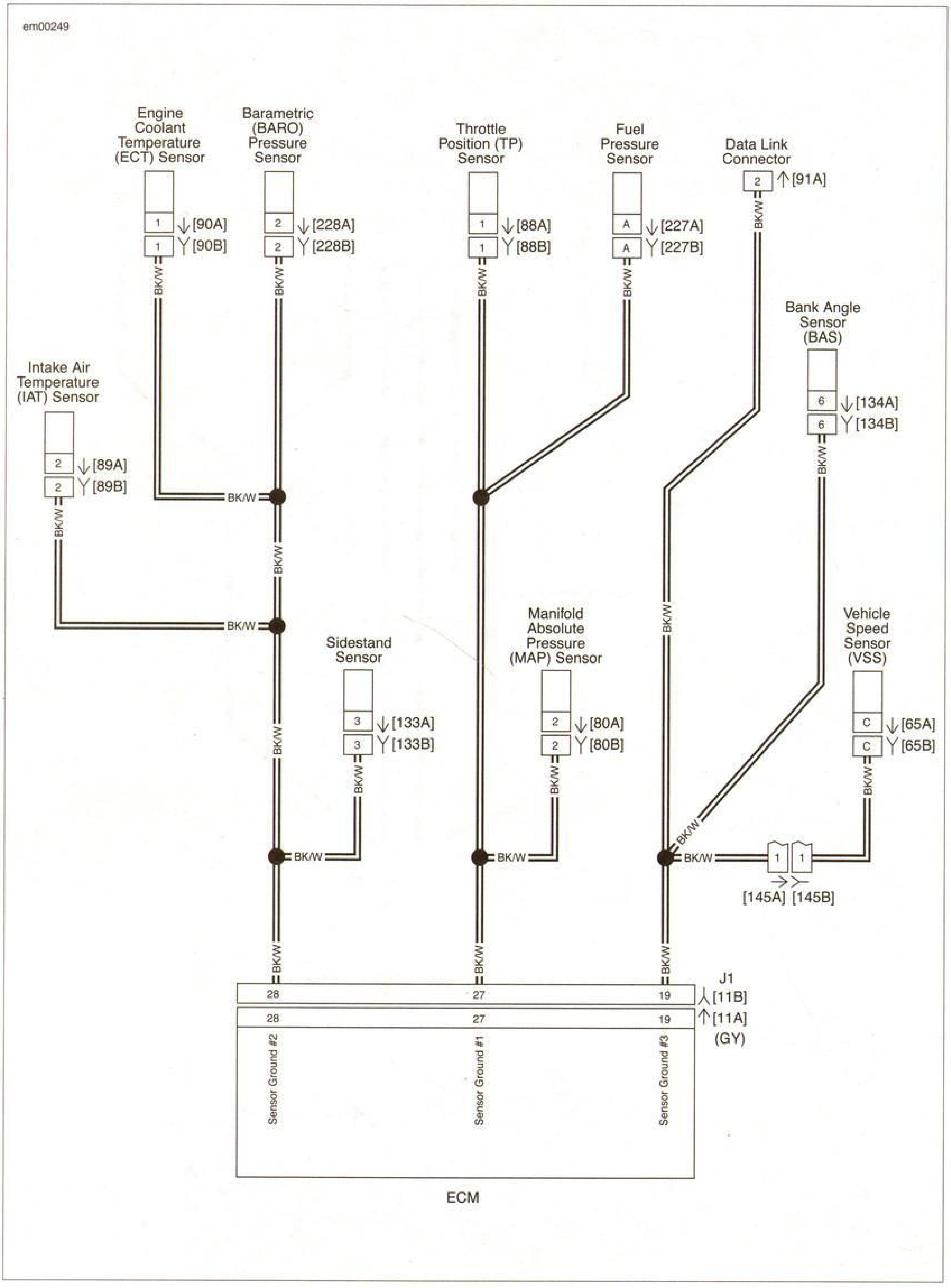


Figure B-4. Sensor Grounds: 2009 1125 Models

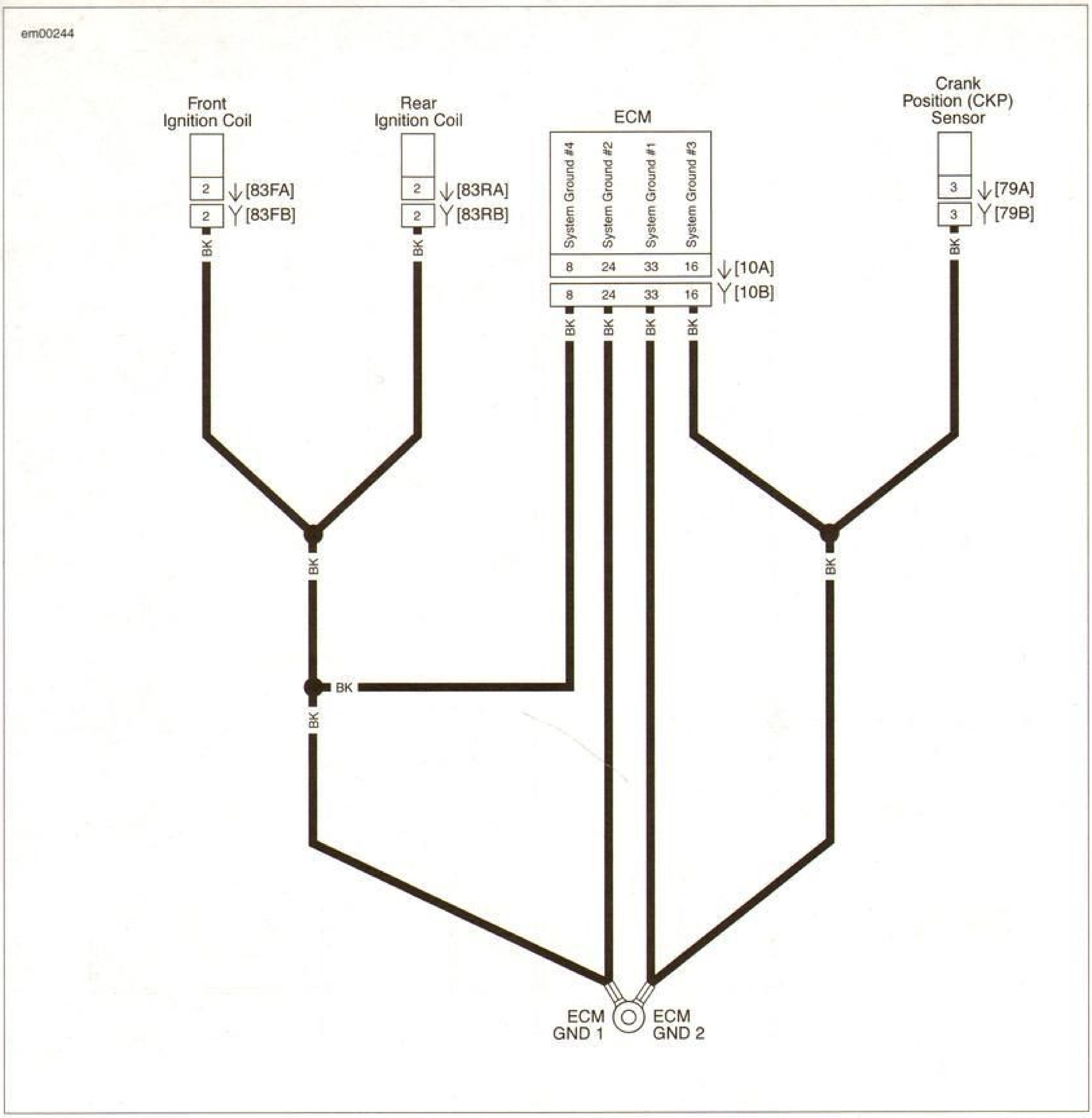


Figure B-5. ECM Power Grounds: 2009 1125 Models

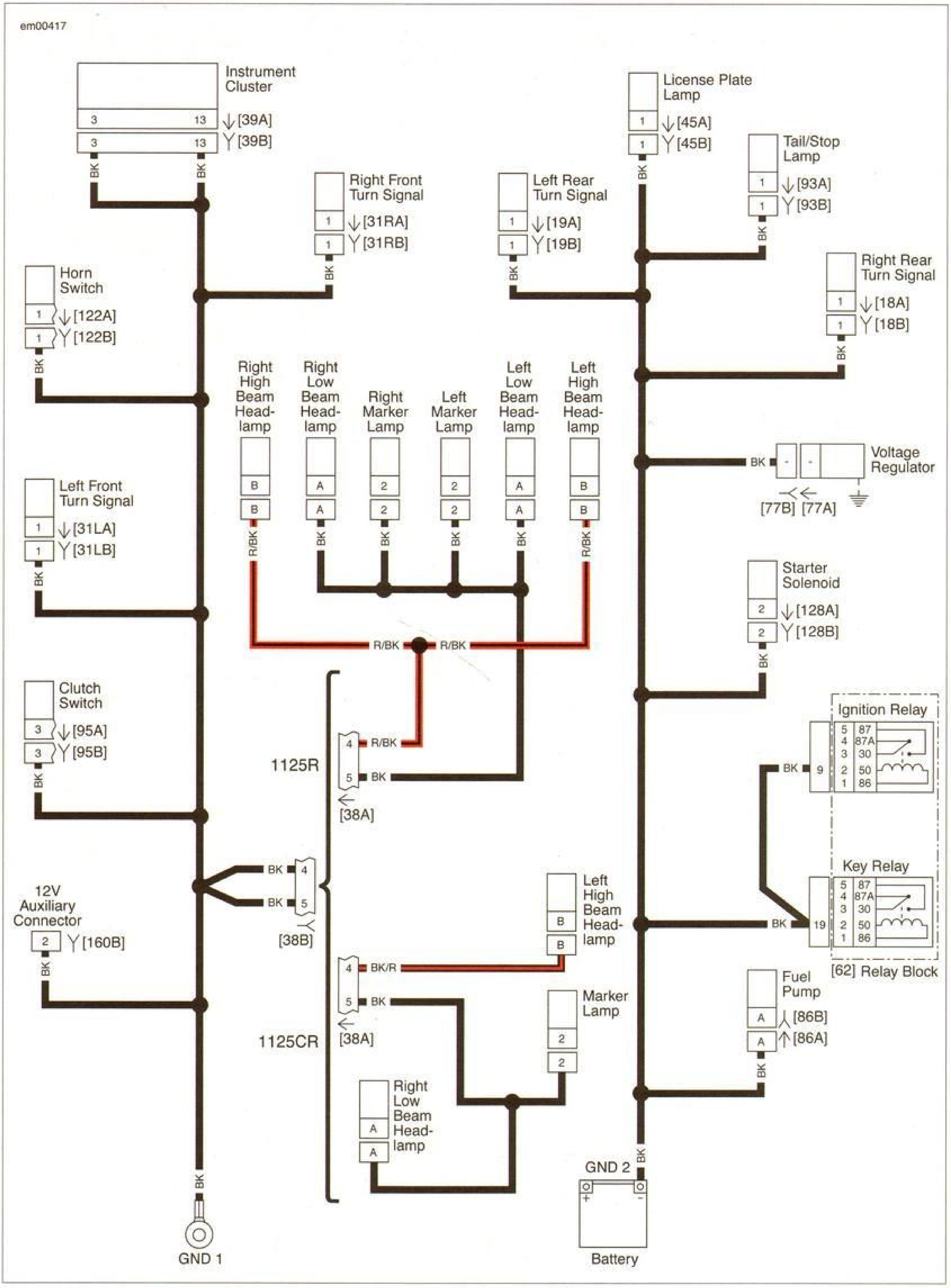


Figure B-6. Chassis Grounds: 2009 1125 Models

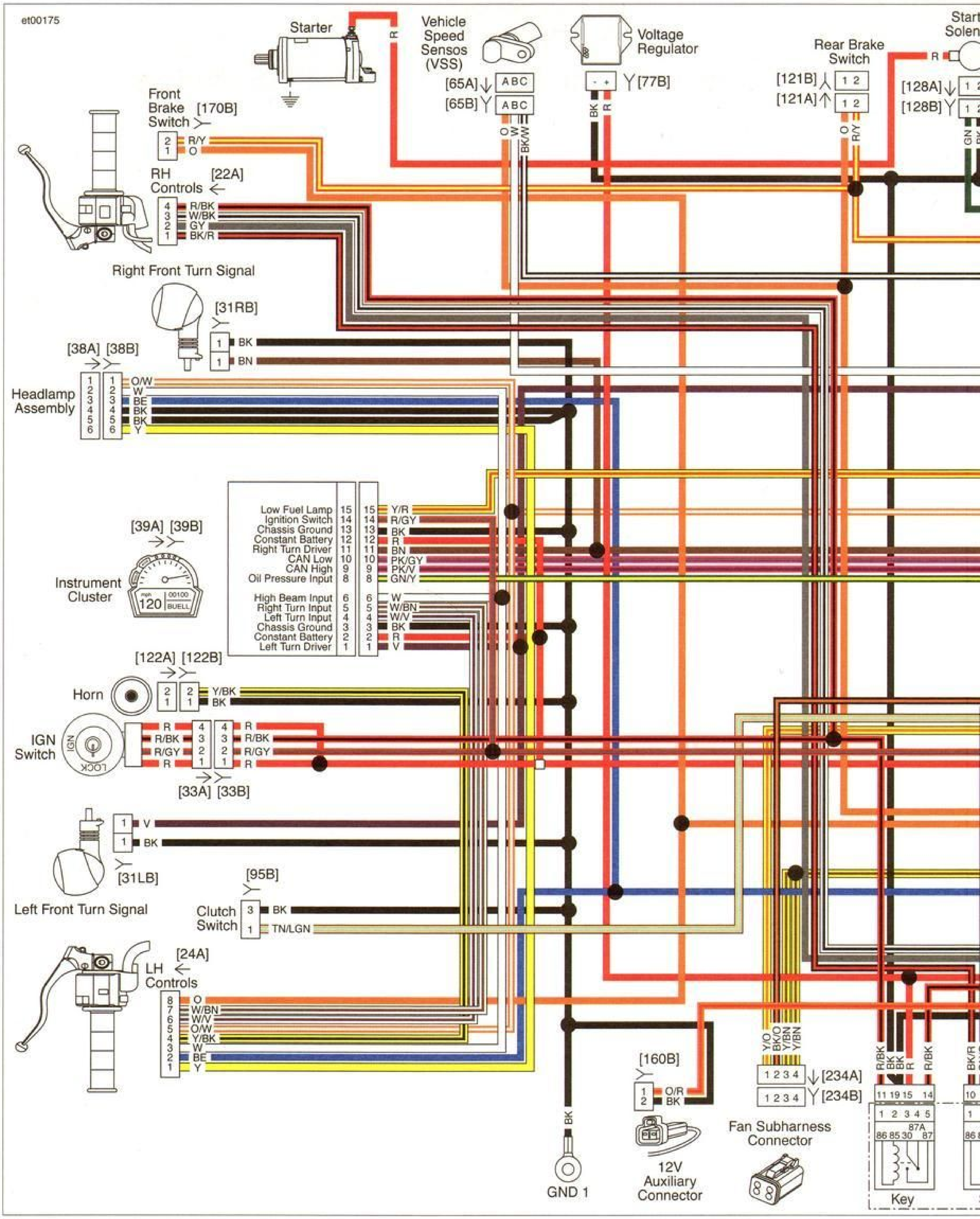
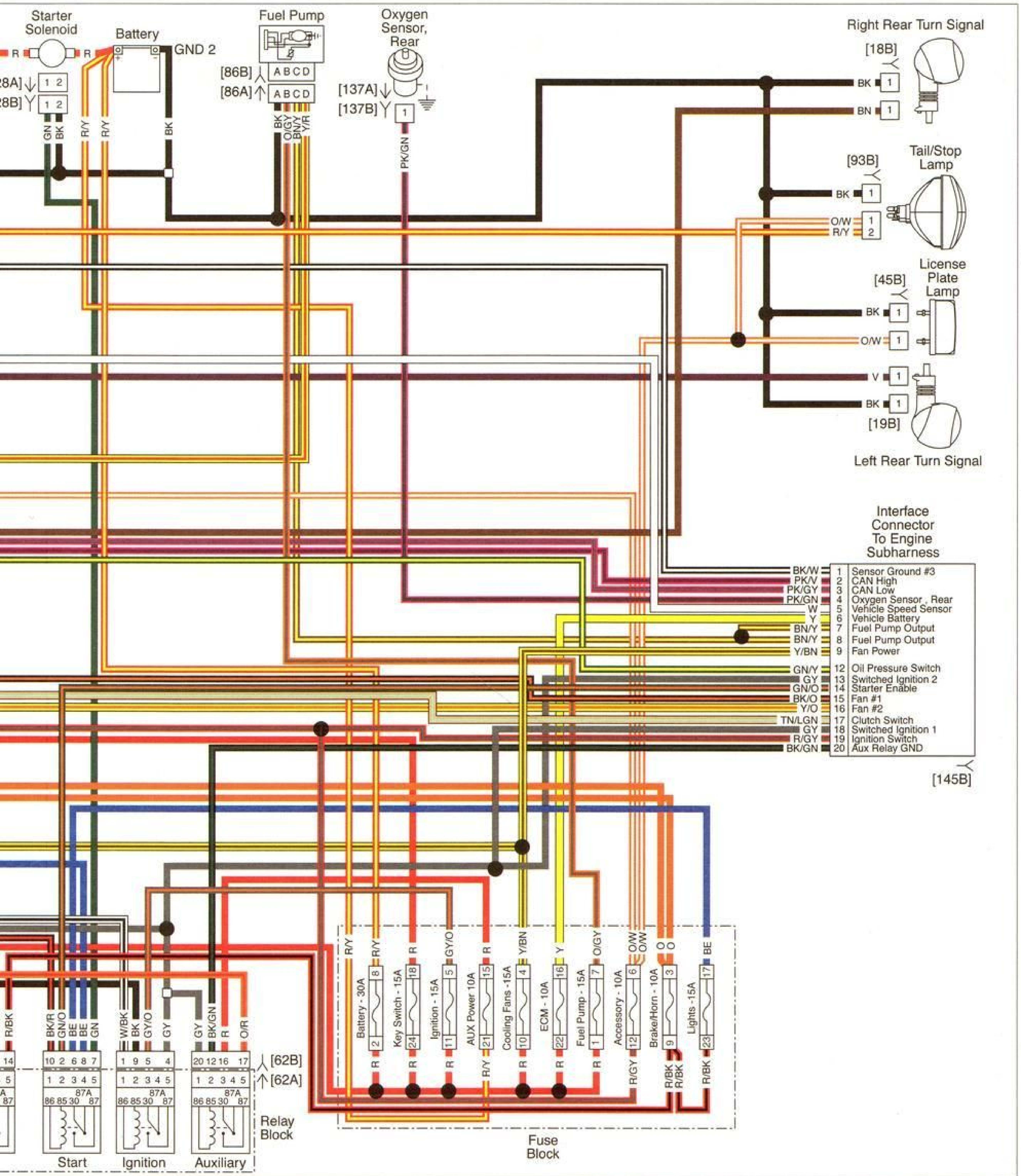


Figure B-7. Main Chassis Wiri



ssis Wiring Harness: 2009 1125 Models

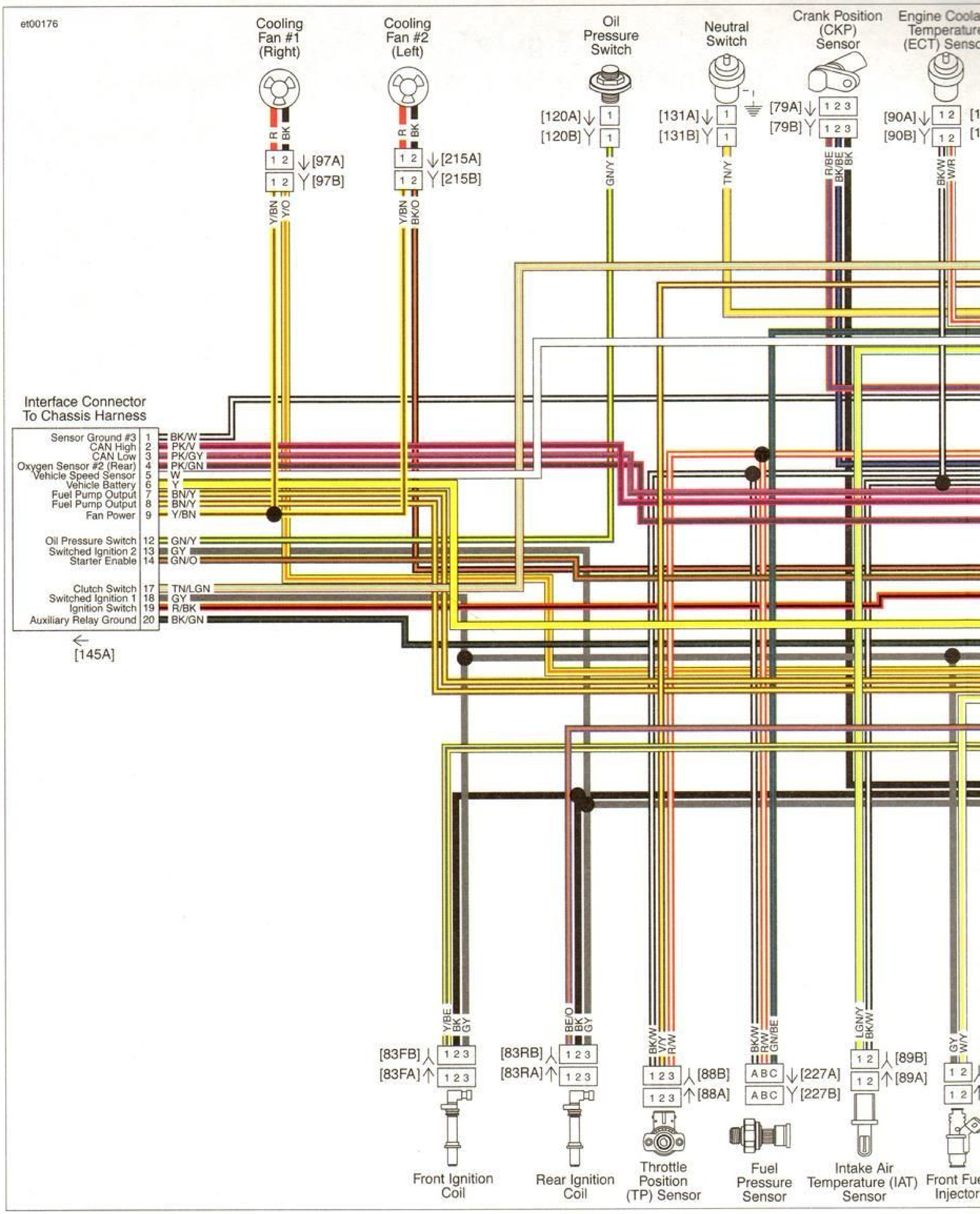
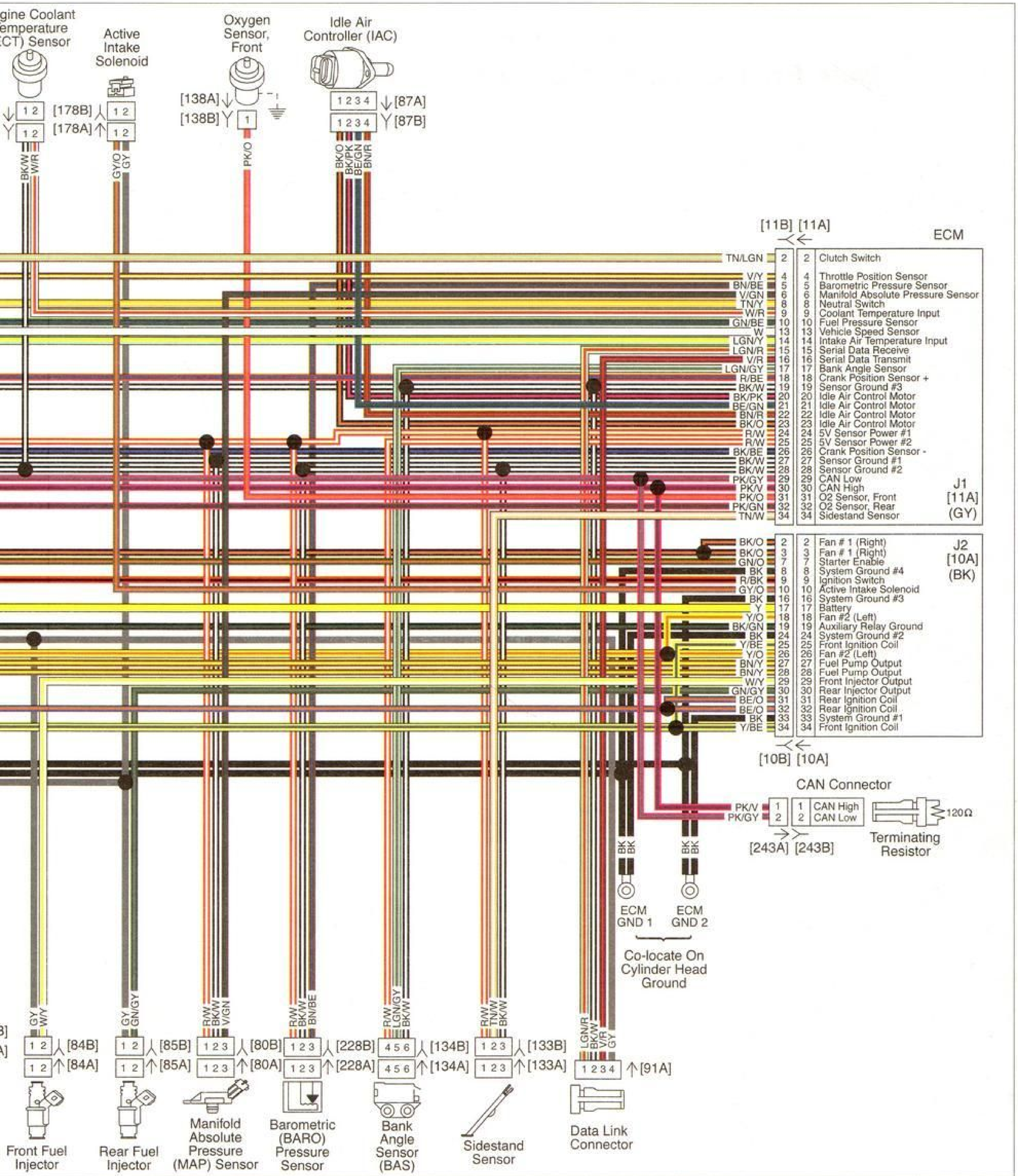


Figure B-8. Main Engine Wirir



ine Wiring Harness: 2009 1125 Models

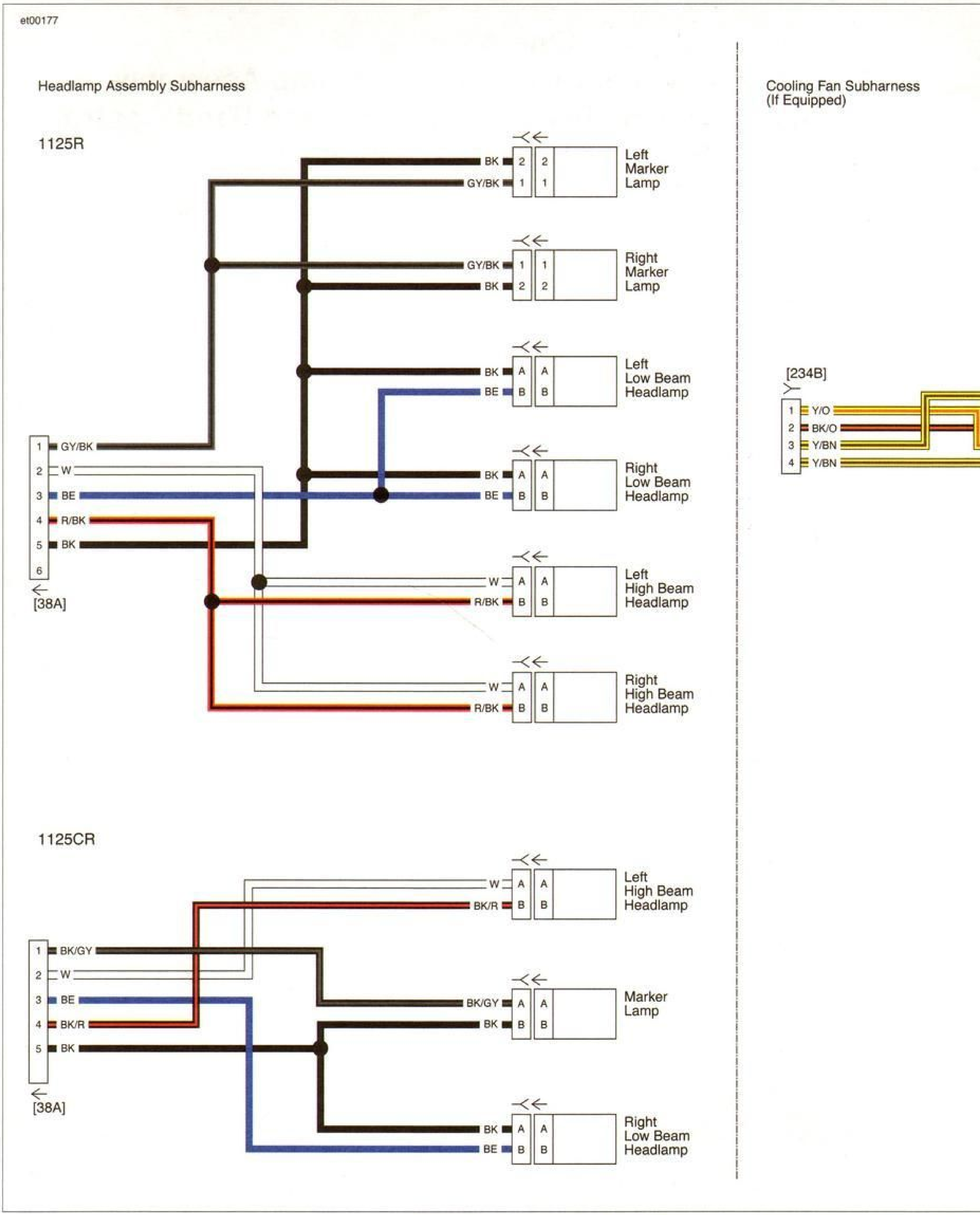
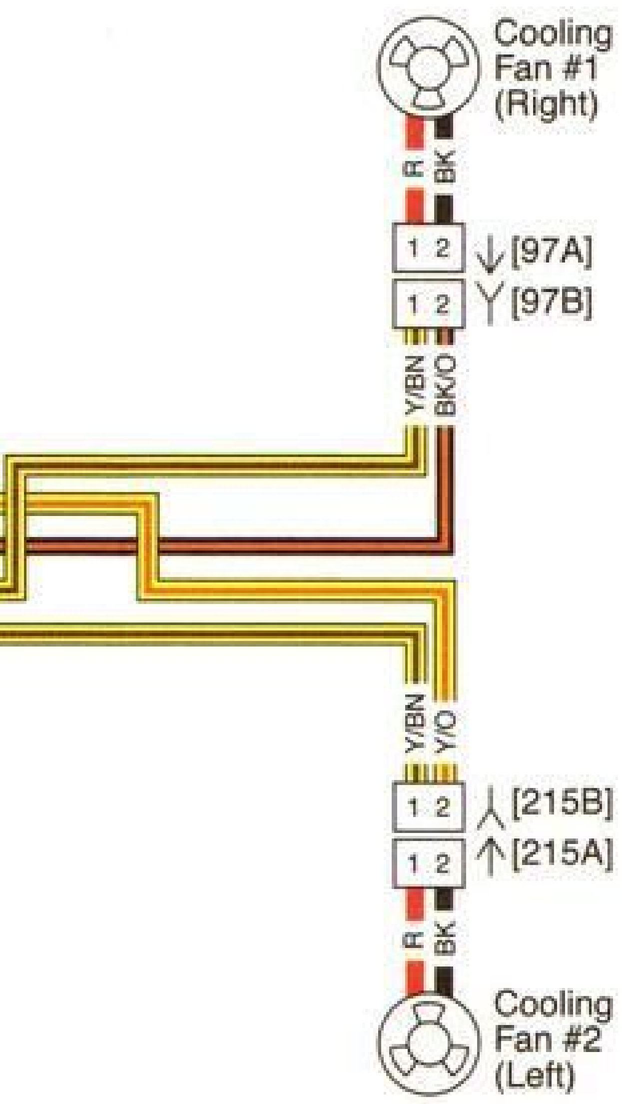
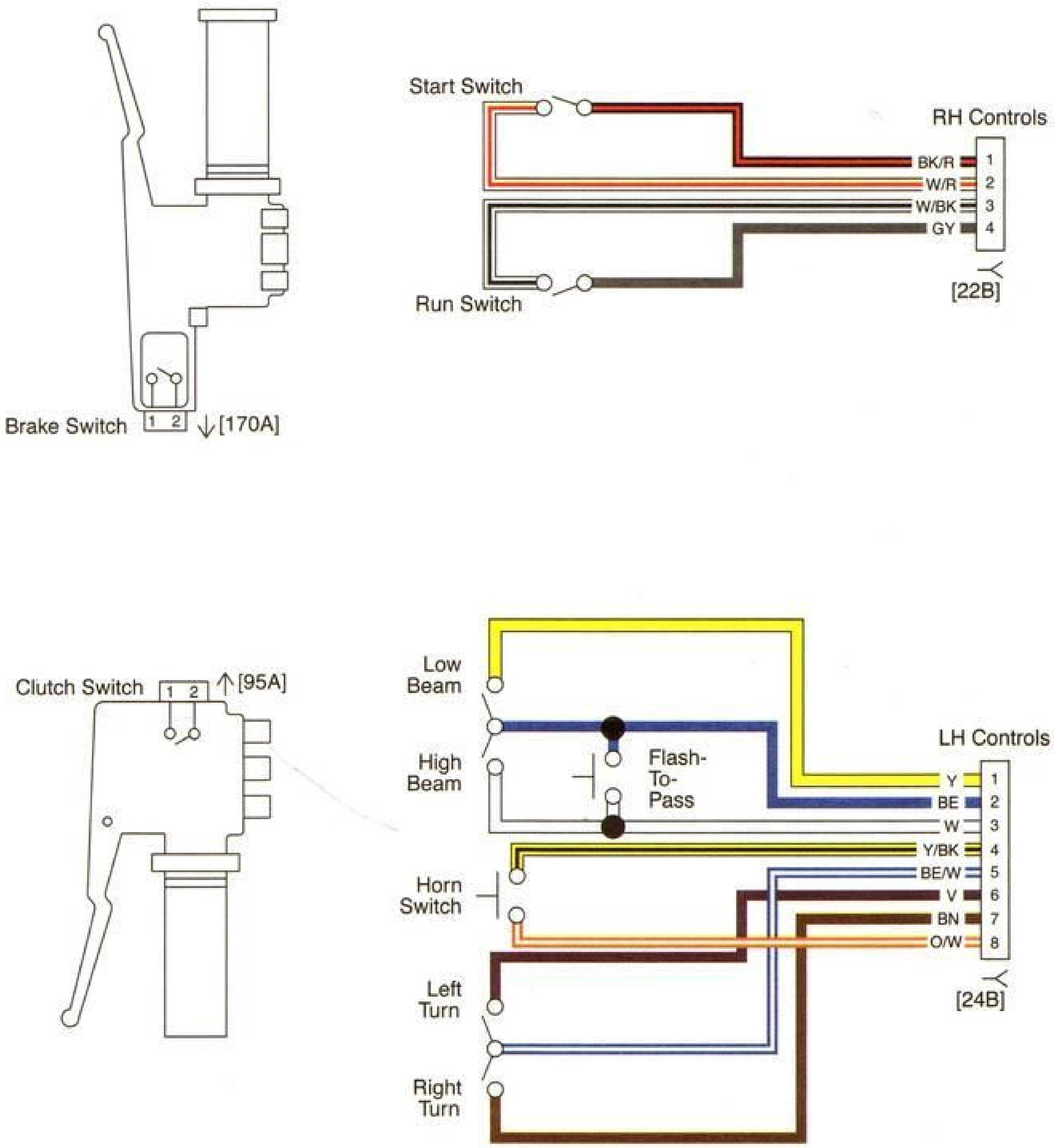


Figure B-9. Component Wiring Diagrams (Headlamp Assembly Sub-Harnes



Hand Control Switches



-Harness, Cooling Fan Sub-Harness, and Hand Control Switches): 2009 1125 Models

NOTES

CONVERSION TABLE

Table C-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

FLUID CONVERSIONS

UNITED STATES SYSTEM

Unless otherwise specified, all fluid volume measurements in this Service 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 Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service 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. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

TORQUE CONVERSION

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).

NOTES

NOTES

ACRONYMS AND ABBREVIATIONS

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
AC	Alternating Current
ACC	Accessory
ACR	Automatic Compression Release
AGM	Absorbed Glass Mat (battery)
Amp	Ampere
AWG	American Wire Gauge
B+	Battery Voltage
BAS	Bank Angle Sensor
BTDC	Before Top Dead Center
C	Celsius (Centigrade)
CA	California
CAL	Calibration
CC	Cubic Centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft Position
cm	Centimeter
DC	Direct Current
DLC	Data Link Connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DVOM	Digital Volt Ohm Meter
ECM	Electronic Control Module
ECT	Engine Coolant Temperature
EEPROM	Electrically Erasable Programmable Read Only Memory
EFI	Electronic Fuel Injection
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
F	Fahrenheit
ft-lbs	Foot-Pounds
fl oz.	Fluid Ounce
g	Gram
GAL	Gallon
GAWR	Gross Axle Weight Rating
GND	Ground (electrical)
GVWR	Gross Vehicle Weight Rating
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson Smart Security System
HFSM	Hands Free Security Module
Hg	Mercury
IAC	Idle Air Control

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
IAT	Intake Air Temperature
IC	Instrument Cluster
ID	Inside Diameter
IGN	Ignition Light/Key Switch
In.	Inch
INJ PW	Injector Pulse Width
in-lbs	Inch-Pounds
Kg	Kilogram
Km	Kilometer
kPa	Kilopascal
km/hr	Kilometers Per Hour
L	Liter
LCD	Liquid Crystal Display
LED	Light Emitting Diode
mA	Milliampere
MAP	Manifold Absolute Pressure
ml	milliliter
mm	millimeter
MPH	Miles Per Hour
ms	millisecond
Nm	Newton-Meter
N/A	Not Applicable
no.	Number
O2	Oxygen
OD	Outside Diameter
OEM	Original Equipment Manufacturer
oz	Ounce
P&A	Parts and Accessories
PN	Part Number
PSI	Pounds per Square Inch
PWM signal	Pulse Width Modulated signal
RES	Reserve
RPM	Revolutions Per Minute
SCFH	Cubic Feet per Hour at Standard Conditions
TCA	Throttle Control Actuator
TDC	Top Dead Center
TGS	Twist Grip Sensor
TP	Throttle Position
TMAP	Intake Air Temperature/Manifold Absolute Pressure
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of Alternating Current
VDC	Volts of Direct Current

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
VIN	Vehicle Identification Number
VSS	Vehicle Speed Sensor

NOTES

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
B-48115	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
B-48115	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
B-48115	BREAKOUT BOX	1.3 DIAGNOSTICS/TROUBLESHOOTING, Wiggle Test
B-48115	BREAKOUT BOX	6.4 SYMPTOM DIAGNOSTICS, Description and Operation
B-48115	BREAKOUT BOX	6.12 IGNITION COILS: DTC P2300, P2301, P2303, P2304, Description and Operation
HD-23738	VACUUM PUMP	6.25 MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR: DTC P0107, P0108, Description and Operation
HD-25070	ROBINAIR HEAT GUN	A.11 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-26792	SPARK TESTER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-26792	SPARK TESTER	6.28 ENGINE CRANKS, BUT WILL NOT START, Description and Operation
HD-34730-2D	FUEL INJECTOR TEST LIGHT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-38125-6	PACKARD TERMINAL CRIMP TOOL	A.5 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.5 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.5 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.11 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.4 DEUTSCH STANDARD TERMINAL REPAIR, Deutsch Standard Terminal Crimps
HD-39969	ULTRA TORCH UT-100	A.11 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.3 DIAGNOSTICS/TROUBLESHOOTING, Wiggle Test
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	6.4 SYMPTOM DIAGNOSTICS, Description and Operation
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	6.22 OXYGEN (O2) SENSOR: DTC P0131, P0132, P0134, P0151, P0152, P0154, P1047, Description and Operation
HD-41183	HEAT SHIELD ATTACHMENT	A.11 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41354	SPEEDOMETER TESTER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41354-1	INPUT/OUTPUT CABLE	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41404-B	HARNESS TEST KIT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41404-B	HARNESS TEST KIT	3.3 CHARGING SYSTEM DIAGNOSTICS, Testing
HD-41475	DEUTSCH CONNECTOR SERVICE KIT	A.3 DEUTSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41475-100	FLAT BLADE L-HOOK	A.3 DEUTSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER	3.3 CHARGING SYSTEM DIAGNOSTICS, Troubleshooting
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER	3.3 CHARGING SYSTEM DIAGNOSTICS, Testing
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER	A.10 MOLEX CONNECTORS, Molex Connector Repair
HD-48650	DIGITAL TECHNICIAN II	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-48650	DIGITAL TECHNICIAN II	1.3 DIAGNOSTICS/TROUBLESHOOTING, Wiggle Test
HD-48650	DIGITAL TECHNICIAN II	1.3 DIAGNOSTICS/TROUBLESHOOTING, Job/Time Codes Values
SNAP-ON TT600-3	SNAP-ON PICK	A.9 630 METRI-PACK CONNECTORS, 630 Metri-Pack Connector Repair
TT600-3	SNAP-ON PICK	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
YA840	IN-LINE SPARK TESTER	6.30 MISFIRE AT IDLE OR UNDER LOAD, Description and Operation

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FASTENER	TORQUE VALUE	NOTES
No torque values were found in this manual.		

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BUELL® 1125 MODELS

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