2018 HARLEY-DAVIDSON® ELECTRICAL DIAGNOSTIC MANUAL: SOFTAIL® MODELS

WARNING

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

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

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

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

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

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

A number of acronyms and abbreviations are used in this document. See the **Acronyms and Abbreviations** for a list of acronyms, abbreviations and definitions.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

WARNING

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

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

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

NOTE

- To avoid unnecessary disassembly, carefully read all related service information before repair work begins.
- In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.
- When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), first disarm the system. Keep the fob close to the vehicle or use **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to disable the system. Activate the system after service is completed.

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

WARNING

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

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

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

WARNING

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

CAUTION

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

NOTICE

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

NOTE

Refers to important information. It is recommended that you take special notice of these items.

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

WARNING

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

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

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

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.

All tools mentioned in this manual with a part number beginning with "HD", "J" or "B" must be ordered through your local Harley-Davidson dealer. Special tools may only be purchased, serviced or warrantied through a Harley-Davidson dealer.

Specific use of special tools is not discussed in this manual. Refer to the tool instruction sheet for instructions. If the tool instructions are misplaced, a copy can be obtained online at H-Dnet.com > My Toolbox > Edit > Bosch Tool Site.

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

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

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

Table 1. Fuel System Specifications

Recommended fuel	91 Octane

Table 2. Fuel Pump Pressure Specifications

Normal	376–425 kPa (54–62 psi)

Table 3. Idle Speed Specifications

Normal idle speed	850 Nominal, non-adjustable

Table 4. Battery Specifications

Size	12 V/ 17.5 Ah/315 CCA
Type	Sealed, **AGM** (Absorbed glass mat) battery

Table 5. Spark Plug Specifications

Gap	.031-.035 in.	.80-.90 mm

Table 6. Spark Plug Cables

Left front and rear	187–194 mm (7.36–7.64 in)	1,840–5,085 Ω
Right front and rear	381–387 mm (15.00–15.24 in)	3,750–10,070 Ω

Table 7. Ignition Coil Specifications

Primary resistance	0.2–0.5 Ω
Secondary resistance	5,500–8,000 Ω

Table 8. Starter Specifications

Cranking current	250 A maximum
Free current	90 A maximum

Table 9. Alternator Specifications

Three phase	42 A system
AC voltage output	16-28 VAC per 1,000 rpm
Stator coil resistance	0.1–0.3 Ω

Table 10. Regulator Specifications

Amperes @ 3,600 rpm	40–44 A
Voltage @ 3,600 rpm	14.1–14.5 V @ 24 °C (75.2 °F)

Table 11. Fuse Specifications

Main	40 A
Battery	5 A
Battery tender	7.5 A
System	7.5 A

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

NOTE

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

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

NOTE

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

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Verify all fuses are good.
2. Are all fuses good?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace fuse. If fuse opens again, repair short to ground in that circuit.

1. Check for current DTCs. See **Odometer Self-Diagnostics**.

NOTE

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

2. Are current DTCs present?
    a. **Yes.** Refer to **Diagnostics**.
    b. **No.** **Go to Test 3.**

1. Enter odometer self-diagnostics.
2. Did odometer self-diagnostics mode function properly?
    a. **Yes.** Refer to **Diagnostics**.
    b. **No.** **Go to Test 4.**

1. Turn IGN ON.
2. Does the odometer display illuminate?
    a. **Yes.** **Go to Test 7.**
    b. **No.** **Go to Test 5.**

1. Turn engine stop switch ON.
2. Does headlamp and/or tail lamp illuminate?
    a. **Yes.** **Go to Test 6.**

b. **No.** Verify battery condition and connections. If all are good, see **No Vehicle Power: DTC U0140**.

1. Attempt to start vehicle.
2. Does starter crank?
    a. **Yes.** See **Description and Operation**.
    b. **No.** See **Description and Operation**.

1. With IGN ON, operate all left hand control functions.
2. Do any left hand controls function properly?
    a. **Yes.** All controls are operational except the trip switch. See **Description and Operation**.
    b. **No.** All left hand control functions are inoperative. See **Left Hand Controls Inoperative: DTC U0141**.

- The trip odometer reset switch is located in the left hand control module. The switch signal is sent to the speedometer over the CAN bus. If there is a problem with the CAN bus, the odometer self-diagnostic mode may not function.
- For a quick check of instrument function, perform a "WOW" test by entering odometer self-diagnostics. Background lighting will illuminate, gauge needles will sweep their full range of motion and all indicator lamps controlled by the CAN circuit will illuminate.
- If the instrument fails "WOW" test, check for battery power and ground to the instrument. If any feature in the IM is non-functional, see **Description and Operation**.

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

B1101	206	LHCM turn signal bulb out	**Description and Operation**
B1103	47	LHCM internal error	**Description and Operation**
B1151	205	RHCM turn signal bulb out	**Description and Operation**
B1153	46	RHCM internal error	**Description and Operation**
B1200	37	IM internal fault	**Description and Operation**
B1201	40	Internal fault - default cal	**Description and Operation**
B1214	316	External indicator bar short to battery	**Description and Operation**
B1215	317	External indicator bar open load	**Description and Operation**
B1216	318	External indicator bar short to ground	**Description and Operation**
B2102	4	System power output shorted high	**Description and Operation**
B2103	5	System power output shorted low	**Description and Operation**
B2104	6	System power output overloaded	**Description and Operation**
B2106	257	L4 output open	**Description and Operation**

B2107	225	L4 output shorted high	**Description and Operation**
B2108	226	L4 output shorted low	**Description and Operation**
B2109	227	L4 output overloaded	**Description and Operation**
B2112	132	ACC output shorted high	**Description and Operation**
B2113	134	ACC output shorted low	**Description and Operation**
B2114	136	ACC output overloaded	**Description and Operation**
B2116	92	Fuel pump output open	**Description and Operation**
B2117	93	Fuel pump output shorted high	**Description and Operation**
B2118	94	Fuel pump output shorted low	**Description and Operation**
B2119	95	Fuel pump output overloaded	**Description and Operation**
B2121	58	Starter output open	**Description and Operation**
B2122	59	Starter output shorted high	**Description and Operation**
B2123	60	Starter output shorted low	**Description and Operation**
B2124	61	Starter output overloaded	**Description and Operation**
B2127	243	E4 output shorted high	**Description and Operation**
B2128	244	E4 output shorted low	**Description and Operation**
B2129	245	E4 output overloaded	**Description and Operation**
B2131	233	High beam output open	**Description and Operation**
B2132	234	High beam output shorted high	**Description and Operation**

B2133	235	High beam output shorted low	**Description and Operation**
B2134	236	High beam output overloaded	**Description and Operation**
B2136	229	Low beam output open	**Description and Operation**
B2137	230	Low beam output shorted high	**Description and Operation**
B2138	231	Low beam output shorted low	**Description and Operation**
B2139	232	Low beam output overloaded	**Description and Operation**
B2141	207	Left front turn signal output open	**Description and Operation**
B2143	214	Left front turn signal output shorted low	**Description and Operation**
B2144	215	Left front turn signal output overloaded	**Description and Operation**
B2146	216	Right front turn signal output open	**Description and Operation**
B2148	217	Right front turn signal output shorted low	**Description and Operation**
B2149	218	Right front turn signal output overloaded	**Description and Operation**
B2151	219	Left rear turn signal output open	**Description and Operation**
B2153	220	Left rear turn signal output shorted low	**Description and Operation**
B2154	221	Left rear turn signal output overloaded	**Description and Operation**
B2156	222	Right rear turn signal output open	**Description and Operation**
B2158	223	Right rear turn signal output shorted low	**Description and Operation**
B2159	224	Right rear turn signal output overloaded	**Description and Operation**
B2161	198	Brake lamp output open	**Description and Operation**

B2163	199	Brake lamp output shorted low	**Description and Operation**
B2164	200	Brake lamp output overloaded	**Description and Operation**
B2168	172	Running lights output shorted low	**Description and Operation**
B2169	173	Running lights output overloaded	**Description and Operation**
B2172	237	H2 output shorted high	**Description and Operation**
B2173	238	H2 output shorted low	**Description and Operation**
B2176	239	Security antenna output open	**Description and Operation**
B2177	240	Security antenna output shorted high	**Description and Operation**
B2178	241	Security antenna output shorted low	**Description and Operation**
B2183	249	G2 output shorted low	**Description and Operation**
B2188	254	G3 output shorted low	**Description and Operation**
B2193	257	H4 output shorted low	**Description and Operation**
B2198	259	H3 output shorted low	**Description and Operation**
B2206	51	Run/stop switch input open/shorted high	**Description and Operation**
B2208	54	Run/stop switch input shorted low	**Description and Operation**
B2210	55	Run/stop switch inputs both open	**Description and Operation**
B2212	56	Run/stop switch inputs both closed	**Description and Operation**
B2218	131	Neutral switch shorted low	**Description and Operation**
B2223	197	Rear brake switch shorted low (light on)	**Description and Operation**

B2226	247	BAS input open	BCM not configured properly.
B2228	250	BAS input shorted low	BCM not configured properly.
B2250	128	Clutch switch stuck	**Description and Operation**
B2251	242	Horn switch stuck	**Description and Operation**
B2253	228	FTP switch stuck	**Description and Operation**
B2254	203	Left turn switch stuck	**Description and Operation**
B2255	246	Trip switch stuck	**Description and Operation**
B2259	206	Aux lamp switch stuck	**Description and Operation**
B2260	57	Start switch stuck	**Description and Operation**
B2261	204	Right turn switch stuck	**Description and Operation**
B2262	196	Front brake switch stuck	**Description and Operation**
B2263	202	Hazard switch stuck	**Description and Operation**
B2270	27	BCM internal error	**Description and Operation**
B2271	26	BCM voltage low	**Description and Operation**
B2272	33	BCM/IM voltage high	**Description and Operation**
B2274	49	Constant battery line error	**Description and Operation**
C0562	38	ABS voltage low	**Description and Operation**
C0563	40	ABS voltage high	**Description and Operation**
C1014	183	ABS ECU relay error	**Description and Operation**

C1021	191	ABS front WSS always zero	**Description and Operation**
C1023	192	ABS rear WSS always zero	**Description and Operation**
C1025	194	ABS front wheel speed intermittent	**Description and Operation**
C1027	195	ABS rear wheel speed intermittent	**Description and Operation**
C1029	193	ABS wheel speed difference too high	**Description and Operation**
C1032	189	ABS front wheel speed circuit open/shorted	**Description and Operation**
C1034	190	ABS rear wheel speed circuit open/shorted	**Description and Operation**
C1040	184	ABS pump/motor error	**Description and Operation**
C1055	39	ABS ECU internal error	**Description and Operation**
C1061	185	ABS front apply solenoid circuit open/high resistance	**Description and Operation**
C1062	187	ABS front release solenoid circuit open/high resistance	**Description and Operation**
C1065	186	ABS rear apply solenoid circuit open/high resistance	**Description and Operation**
C1066	188	ABS rear release solenoid circuit open/high resistance	**Description and Operation**
C1159	43	ABS invalid stored VIN	**Description and Operation**
C1178	41	ABS no VIN received from ECM	**Description and Operation**
C1184	42	ABS invalid VIN from ECM	**Description and Operation**
P0031	153	Front HO2S low/open	**Description and Operation**
P0032	156	Front HO2S shorted high	**Description and Operation**
P0051	154	Rear HO2S low/open	**Description and**

			Operation
P0052	155	Rear HO2S shorted high	**Description and Operation**
P0107	100	MAP sensor failed low/open	**Description and Operation**
P0108	101	MAP sensor failed high/open port	**Description and Operation**
P0112	123	IAT sensor shorted low	**Description and Operation**
P0113	125	IAT sensor high/open	**Description and Operation**
P0117	102	ET sensor shorted low	**Description and Operation**
P0118	107	ET sensor high/open	**Description and Operation**
P0120	76	TPS 1 range error	**Description and Operation**
P0122	74	TPS 1 low	**Description and Operation**
P0123	75	TPS 1 high/open	**Description and Operation**
P0131	157	O2 sensor low/engine lean (front)	**Description and Operation**
P0132	159	Engine running rich (front)	**Description and Operation**
P0134	161	Oxygen sensor high/open (front)	**Description and Operation**
P0151	158	O2 sensor low/engine lean (rear)	**Description and Operation**
P0152	160	Engine running rich (rear)	**Description and Operation**
P0154	162	O2 sensor high/open (rear)	**Description and Operation**
P0220	79	TPS 2 range error	**Description and Operation**
P0222	77	TPS 2 low/open	**Description and Operation**

P0223	78	TPS 2 high	**Description and Operation**
P0261	96	Fuel injector low/open (front)	**Description and Operation**
P0262	97	Fuel injector shorted high (front)	**Description and Operation**
P0264	98	Fuel injector low/open (rear)	**Description and Operation**
P0265	99	Fuel injector shorted high (rear)	**Description and Operation**
P0325	139	Knock sensor front open circuit	**Description and Operation**
P0327	140	Knock sensor front circuit low	**Description and Operation**
P0328	141	Knock sensor front circuit high	**Description and Operation**
P0330	142	Knock sensor rear open circuit	**Description and Operation**
P0332	143	Knock sensor rear circuit low	**Description and Operation**
P0333	144	Knock sensor rear circuit high	**Description and Operation**
P0371	65	CKP sensor wrong number of pulses	**Description and Operation**
P0374	64	CKP sensor no pulses	**Description and Operation**
P0444	147	Purge solenoid low/open	**Description and Operation**
P0445	148	Purge solenoid shorted high	**Description and Operation**
P0462	174	Fuel sender shorted low	**Description and Operation**
P0463	175	Fuel sender shorted high/open	**Description and Operation**
P0502	137	VSS failed low	**Description and Operation**
P0503	138	VSS failed high	**Description and Operation**

P0505	148	Idle speed control - unstable	**Loss of Idle Speed Control**
P0522	168	Engine oil pressure sensor/switch shorted low	**Description and Operation**
P0523	169	Engine oil pressure sensor/switch shorted high/open	**Description and Operation**
P0562	127	ECM voltage low	**Description and Operation**
P0563	34	ECM voltage high	**Description and Operation**
P0572	202	Brake switch low	**Description and Operation**
P0577	163	Cruise control input error	**Description and Operation**
P0603	29	ECM EEPROM memory error	**Description and Operation**
P0605	28	ECM FLASH memory error	**Description and Operation**
P0641	62	5 Volt reference out of range	**Description and Operation**
P0651	63	5 Volt reference 2 out of range	**Description and Operation**
P1009	32	VTD disabled fuel due to bad password	**General**
P1270	67	TGS 2 A/D validation error	**Description and Operation**
P1501	166	JSS low	**Description and Operation**
P1502	167	JSS high/open	**Description and Operation**
P1505	445	Power limit violation	**Description and Operation**
P1510	447	ETC limited performance mode	**Description and Operation**
P1511	448	ETC power management mode	**Description and Operation**
P1512	449	ETC forced idle mode	**Description and Operation**

P1514	87	ETC airflow error	**Description and Operation**
P1600	66	ETC watchdog error	**Description and Operation**
P1655	164	ACR solenoid low/open	**Description and Operation**
P1656	165	ACR solenoid shorted high	**Description and Operation**
P2100	82	ETC driver open circuit	**Description and Operation**
P2101	83	ETC actuation error	**Description and Operation**
P2102	84	ETC driver shorted low	**Description and Operation**
P2103	85	ETC driver shorted high	**Description and Operation**
P2105	446	ETC forced shutdown mode	**Description and Operation**
P2107	68	ETC driver internal error	**Description and Operation**
P2119	81	ETC actuator return error	**Description and Operation**
P2122	69	TGS 1 low/open	**Description and Operation**
P2123	70	TGS 1 high	**Description and Operation**
P2127	71	TGS 2 low/open	**Description and Operation**
P2128	72	TGS 2 high	**Description and Operation**
P2135	80	TPS correlation error	**Description and Operation**
P2138	73	TGS correlation error	**Description and Operation**
P2176	86	ETC zero position learning error	**Description and Operation**
P2300	88	Ignition coil driver low/open (front)	**Description and Operation**

P2301	89	Ignition coil driver shorted high (front)	**Description and Operation**
P2303	90	Ignition coil driver low/open (rear)	**Description and Operation**
P2304	91	Ignition coil driver shorted high (rear)	**Description and Operation**
U0001	1	CAN BUS error	**Description and Operation**
U0002	16	CAN comm bus perf error	**Description and Operation**
U0003	13	Network management monitoring	**Description and Operation**
U0011	2	CAN bus low shorted to CAN bus high	**Description and Operation**
U0100	7	Lost comm w/ECM	**Description and Operation**
U0121	11	Lost comm w/ABS	**Description and Operation**
U0140	3	Lost comm w/BCM	**Description and Operation**
U0141	9	Lost comm w/LHCM	**Description and Operation**
U0142	8	Lost comm w/RHCM	**Description and Operation**
U0156	10	Lost comm w/speedo	**Description and Operation**
U0157	14	Lost comm w/tach	**Description and Operation**
U0300	15	Internal control module software incompatibility	**Description and Operation**

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

There are two levels of diagnostics.

- The most sophisticated mode uses a computer-based diagnostic package called **DIGITAL TECHNICIAN II (Part Number:HD-48650)**.
- The second mode requires using the odometer self-diagnostics. Speedometer, BCM, ECM and ABS (if equipped) DTCs can be accessed and cleared.

See **Figure 1** and **Figure 2**. All codes will be displayed with either a "c" or a "h" after them. This indicates a current or historic code. Diagnostic procedures are designed for use with current DTCs. Current DTCs will frequently suggest part replacement. When diagnosing a historic DTC, the procedures can be helpful but should not lead to part replacement without verification that the part is faulty.

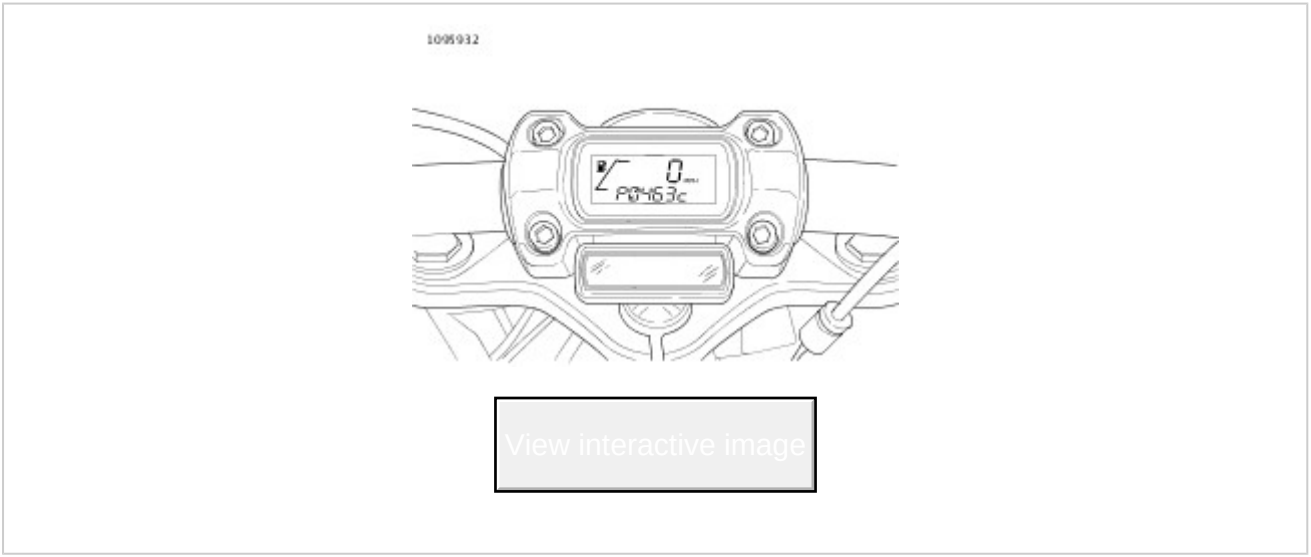

Figure 1. Current Code

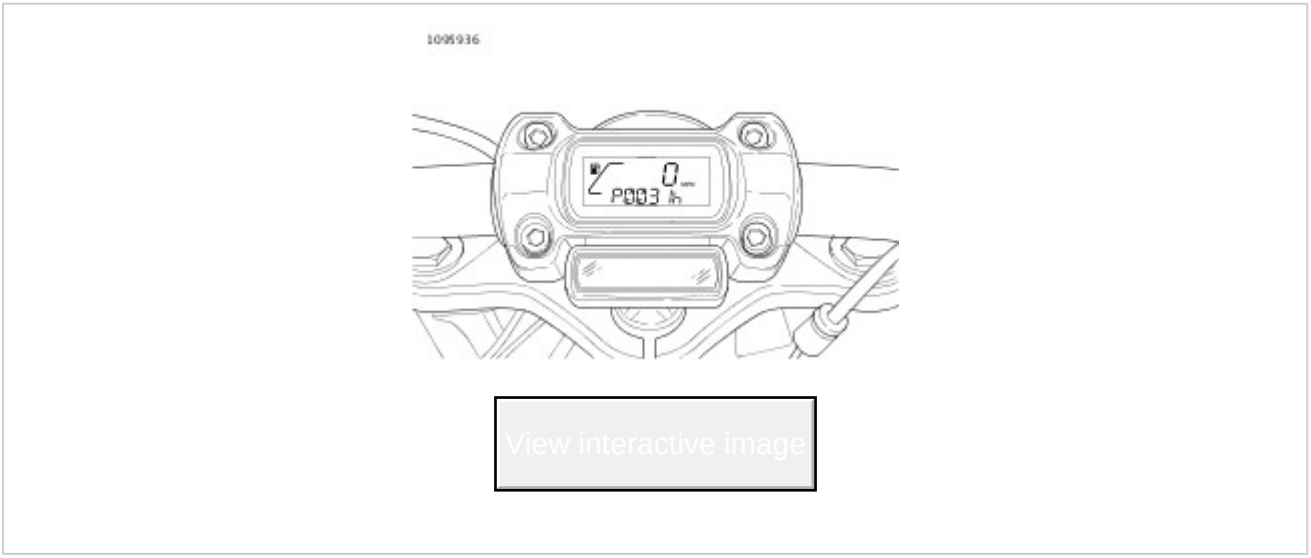

Figure 2. Historic Code

1. To enter diagnostic mode, press and hold the trip odometer reset switch located on the left handlebar controls, while turning the IGN ON.

NOTE

- "IGN ON" means that the engine stop switch is set to RUN (although the engine is not running).
- The trip odometer reset switch is located in the left hand control module. The switch signal is sent to the speedometer over the CAN bus. Any CAN bus issues may interrupt odometer self-diagnostics.

2. Release the trip odometer reset switch. "diag" will appear on the odometer display.
3. Press and release the trip odometer reset switch. ECM will appear on the odometer display. It will have either a "Y" or an "N" after it, depending if there are any ECM codes or not.
4. Quickly press and release the trip odometer reset switch to cycle through the modules. The modules include the BCM, SPDO and ABS.
5. Once the desired module is displayed, press and hold the trip odometer reset switch.
6. If any DTCs are stored in the module, the odometer will display the DTC. Quickly pressing and releasing the trip odometer reset switch will cycle through the stored DTCs.

NOTE

When reading DTCs be sure to note whether there is a "c" or a "h" behind the code.

7. When all the DTCs have been cycled the odometer will display "end".
8. To clear all the DTCs in that module press and hold the trip odometer reset switch, while a DTC is displayed. If DTCs are not to be cleared quickly press and release the trip odometer reset switch. The part number of the module will be displayed.
9. Press and release the trip odometer reset switch again to continue to the next module.
10. Make note of all DTCs. Clear all the DTCs and operate the vehicle to verify DTCs set and are current. Historic DTCs are not to be diagnosed unless the condition is reoccurring and intermittent.
11. Turn the IGN OFF to exit diagnostic mode. If IGN is not turned off, vehicle will exit diagnostics mode when vehicle starts moving.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

There are two types of DTCs: current and historic. The odometer self-diagnostics displays all codes and differentiates between current and historic with a "c" for current and an "h" for historic. The computer-based diagnostic package called **DIGITAL TECHNICIAN II (Part Number:HD-48650)** differentiates between these two types.

NOTE

- Current DTCs reside in the memory of the ECM, BCM, instruments or ABS module (if equipped) until the DTC is resolved.
- DTCs are designated by a P, C, B or U depending on the type of code and what module sets them. The ECM sets "P" codes to indicate issues monitored by the ECM. The ABS module sets "C" codes indicating an issue with the ABS on the vehicle. The instruments or BCM can all set "B" codes. All the modules set "U" codes when there is an issue causing the modules not to communicate properly.

Current DTCs are those which presently disrupt motorcycle operation and are set during the current ignition cycle. To determine if current DTCs are present, clear the DTCs and operate the vehicle within the parameters for setting the DTC. See the appropriate diagnostic procedures for solutions.

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

A historic DTC can be cleared by use of the odometer self-diagnostics or after a total of 40 error-free ignition cycles (start and run cycle) have elapsed.

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

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

All DTCs are assigned a priority number to determine the order in which they should be diagnosed. If there are multiple DTCs present, always diagnose the highest priority first. Refer to **Diagnostics**.

1. Complete the repair.
2. Restore connections.
3. Clear DTCs.
4. Start vehicle. Perform several cycles to verify a code did not return.
5. Perform odometer self-diagnostics test to verify repair and DTCs have been cleared. If any DTCs are still present, refer to **Diagnostics**.

Clear DTCs after any diagnostic or repair procedure. The odometer is capable of displaying and clearing ECM, BCM, IM, tachometer and ABS DTCs. Once the DTCs are cleared perform a road test to verify DTCs do not return. It is important to perform a road test and not simply start the motorcycle since some DTCs may require vehicle speed or other inputs in order to validate repair.

See **Figure 1**. The security lamp is controlled by the BCM. The security lamp will be turned on when non-emmisions related current codes are present.

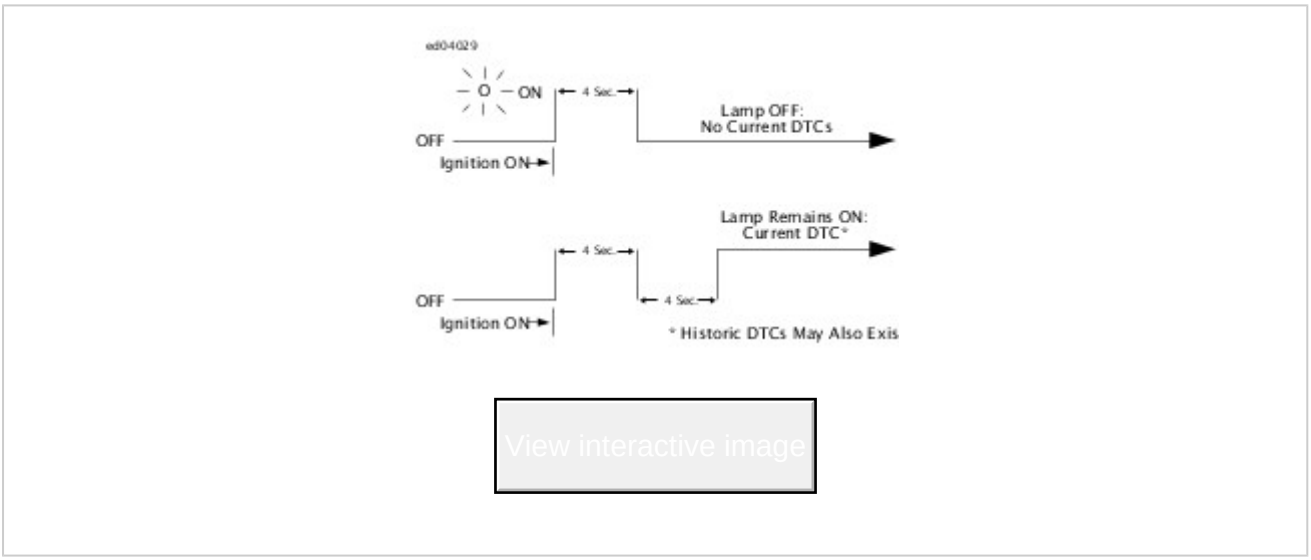

Figure 1. Security Lamp Operation

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

NOTE

- "IGN ON" means that the engine stop switch is set to RUN (although the engine is not running).
- When the IGN is turned ON, check engine lamp will illuminate.
- Start engine, if it fails to turn off after start up, DTC exists.
- Emissions related DTCs illuminate the check engine lamp for three warm up cycles after the DTC has transitioned from current to historic.

1. See **Figure 1**. After engine startup, one of two events may occur.
   a. The lamp turns off, which indicates there are no current fault conditions or stored DTCs currently detected by the ECM.
   b. If the lamp continues to illuminate and remains illuminated, a current or historic DTC exists.
2. See **Code Types** for a complete description of DTC formats.

NOTE

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

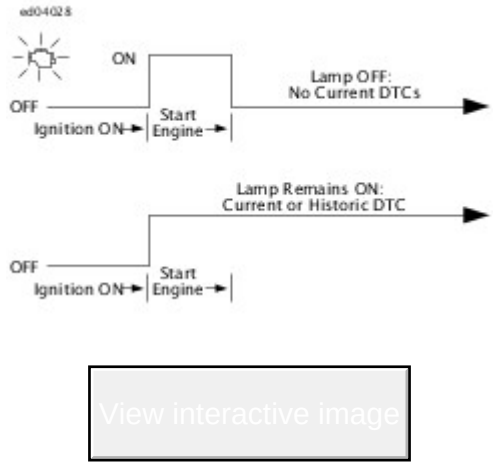

Figure 1. Check Engine Lamp

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

Table 1. Symptom Table

Serial Data	IM inoperative	**Description and Operation**
	Left hand controls inoperative	**Description and Operation**
	No vehicle power	**Description and Operation**
	Odometer self-diagnostics inoperative	**Description and Operation**
Starting and Charging	Battery runs down during use	**Description and Operation**
	Low battery after extended IGN OFF	**Description and Operation**
	Low or no charging	**Description and Operation**
	Nothing clicks	**Description and Operation**
	Overcharging	**Description and Operation**
	Starter solenoid clicks	**Description and Operation**
	Starter spins but does not engage	**Description and Operation**
	Starter stalls or spins too slowly	**Description and Operation**
Instruments	High beam indicator always on	**Description and Operation**
	High beam indicator inoperative	**Description and Operation**
	Low fuel lamp always on	**Description and Operation**
	Low fuel lamp flashes at steady rate	Fuel sender DTC set. See **Description and Operation**.
	Low fuel lamp inoperative	**Description and Operation**
	Neutral lamp always on	**Description and Operation**
	Neutral lamp inoperative	**Description and Operation**
	No instrument power	**Description and Operation**
	Odometer displays "DIAG" at IGN ON	**Description and Operation**
	Oil pressure lamp always on	**Description and Operation**
	Oil pressure lamp inoperative	**Description and Operation**
	One or all indicator lamps	**Description and Operation**

	inoperative	
	Trip odometer functions inoperative	**Description and Operation**
	Turn signal indicator always on	**Description and Operation**
	Turn signal indicator inoperative	**Description and Operation**
Accessories, Horn, Lighting and Security	ACC power inoperative	**Description and Operation**
	Any hand control switch inoperative	**Description and Operation**
	Auxiliary lamps inoperative	**Description and Operation**
	Front running lamps inoperative	**Description and Operation**
	High beam headlamp inoperative	**Description and Operation**
	Horn always on	**Description and Operation**
	Horn inoperative	**Description and Operation**
	License plate lamp inoperative	**Description and Operation**
	Low beam headlamp inoperative	**Description and Operation**
	Rear running lamps inoperative	**Description and Operation**
	Signature headlamp inoperative	**Description and Operation**
	Stop lamp always on	**Description and Operation**
	USB port inoperative	**Description and Operation**
	Will not cancel upon turn completion, no DTCs	**Description and Operation**
Engine Management	Engine cranks but will not start	**Description and Operation**
	Erratic idle	**Description and Operation**
	Hesitation or loss of power	**Description and Operation**
	Misfire at idle or under load	**Description and Operation**
	Side stand displayed on speedometer	**Description and Operation**
	Starts hard or emits black smoke	**Description and Operation**
	Starts, then stalls	**Description and Operation**
ABS	ABS indicator always on or inoperative	**Description and Operation**

Special Tools

Description	Part Number	Qty.
HD BATTERY DIAGNOSTIC STATION	GRX-3110HD	1
FLUKE AC/DC CURRENT PROBE	HD-39617	1
DIGITAL MULTIMETER (FLUKE 78)	HD-39978	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1
ABS BREAKOUT BOX	HD-48642	1
DIGITAL TECHNICIAN II	HD-48650	1
WHEEL SPEED SENSOR TEST LEAD	HD-50341	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1
INLINE SPARK TESTER KIT	HD-51724	1

Follow the instructions in the **HD BATTERY DIAGNOSTIC STATION (Part Number:GRX-3110HD)** instruction manual to perform a battery test. The test results include a decision on the battery condition.

View interactive image

Figure 1. Advanced Battery Conductance and Electrical System Analyzer Kit

See **Figure 2**. The **INLINE SPARK TESTER KIT (Part Number:HD-51724)** is used to verify adequate spark at the spark plug. Install the inline spark tester between front ignition coil cable and spark plug. Start engine and inspect tester light. The light will flash on each spark event if power is transmitted to the plug. Remove inline spark tester and install cable on plug. Repeat procedure for rear cylinder.

NOTE

The coil will not produce spark voltage with both spark plugs removed. When checking for spark, use the inline spark tester with both plugs installed.

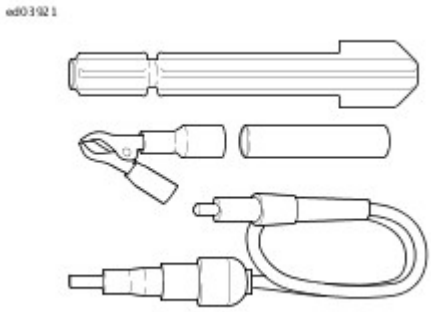

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Figure 2. Spark Tester

The **DIGITAL MULTIMETER (FLUKE 78) (Part Number:HD-39978)** is used for various tests throughout this manual.

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Figure 3. Digital Multimeter (Fluke 78)

The **FLUKE AC/DC CURRENT PROBE (Part Number:HD-39617)** is used to measure current draw. Used in conjunction with **DIGITAL MULTIMETER (FLUKE 78) (Part Number:HD-39978)**. Connect the current probe to positive (+) and negative (-) input terminals on the multimeter. Position the rotary switch to mV dc (millivolt direct current). Push the ON/OFF button and the ON indicator will illuminate. With the inductive jaws empty, turn the zero adjust so that the multimeter reads 0.000 mV. Clamp the inductive jaws around the conductor that is being tested. With the circuit activated read the multimeter display, 1 mV = 1 A.

View interactive image

Figure 4. Fluke AC/DC Current Probe

The **TEST CONNECTOR KIT (Part Number:HD-41404)** contains pin and socket terminals and stackable banana jack patch cords used to test circuits. The pin and socket terminals are used to connect to various connectors used on the vehicle. See the tool instruction sheet for specific terminal usage.

NOTE

- Insert probe tip straight into the terminal cavity.
- Do not wiggle or move the probe tip once it is inserted into the terminal.
- Do not use more than one probe per terminal or cavity at one time.

The **WHEEL SPEED SENSOR TEST LEAD (Part Number:HD-50341)** is a stackable banana jack patch cord with a built in resistor to test the wheels speed sensor circuit. Used in conjunction with **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect the test lead in place of the WSS when required during diagnostics.

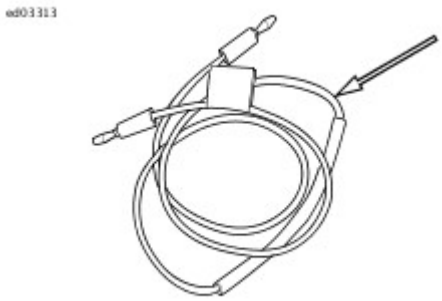

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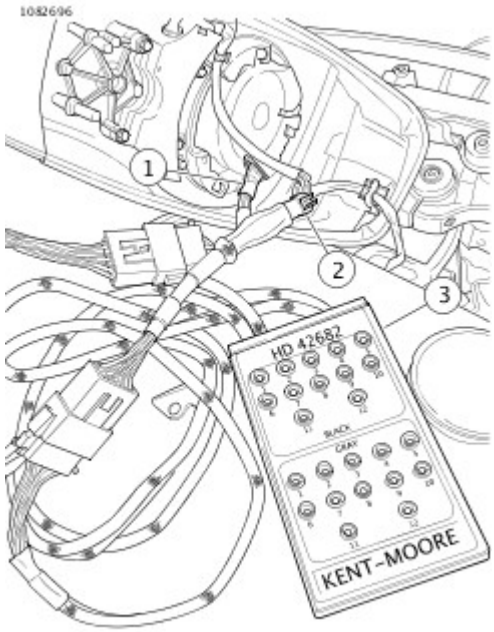
Figure 5. Wheel Speed Sensor Test Lead

The **BREAKOUT BOX (Part Number:HD-42682)** and **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** connect to the speedometer [39]. Used in conjunction with a multimeter, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects. Install breakout box in series using the black connectors as follows:

1. Access the speedometer [39].
2. See **Figure 6**. Press latch and disconnect [39B].
3. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39A] and [39B].
4. Attach black connectors from **BREAKOUT BOX (Part Number:HD-42682)** to **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)**. All tests will be performed using the black side of the breakout box.
5. When testing is completed, remove the breakout box and jumper harness and restore connections.



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1	Speedometer [39]
2	Breakout box adapter
3	Breakout box (BOB)

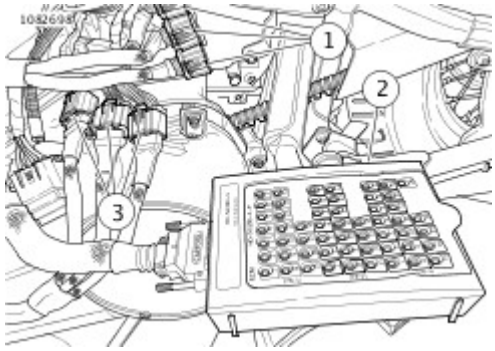
Figure 6. Breakout Box Connection

The **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** splice into the main harness. Used in conjunction with a multimeter, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects. Install breakout box in series as follows:

NOTE

See wiring diagrams for ECM terminal functions. ECM is located under the left side cover.

1. Access the ECM.
2. Press latch and disconnect ECM connectors [78B-1], [78B-2] and [78B-3].
3. See **Figure 7**. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to connectors.
4. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on breakout box.
5. When testing is completed, remove the breakout box and restore connections.



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1	ECM [78A-1], [78A-2] and [78A-3]
2	Breakout box (BOB)
3	Wire harness [78B-1], [78B-2] and [78B-3]

Figure 7. ECM Breakout Box Connection

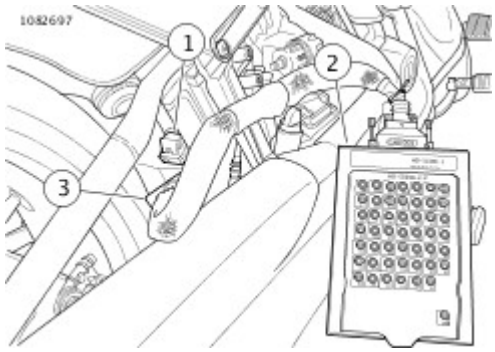
The **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** splice into the

main harness. Used in conjunction with a multimeter, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects. Install breakout box in series as follows:

NOTE

See wiring diagrams for BCM terminal functions. BCM is located in front of the rear tire.

1. Access the BCM.
2. Press latch and disconnect BCM [242B].
3. See **Figure 8**. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to connectors.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on breakout box.
5. When testing is completed, remove the breakout box and restore connections.



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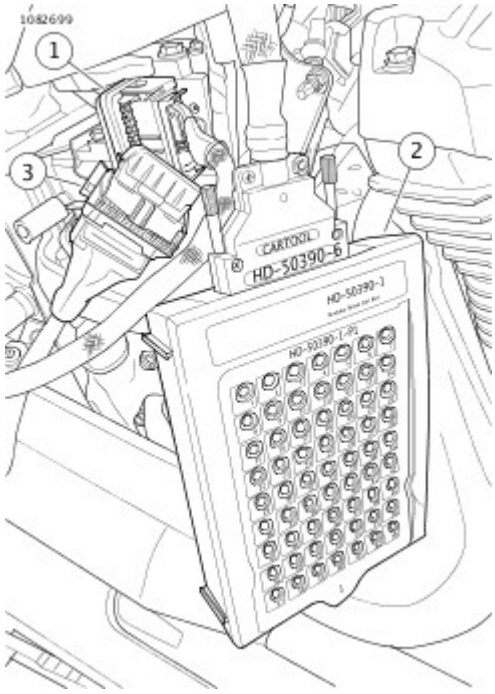
1	BCM [242A]
2	Breakout box (BOB)
3	Wiring harness [242B]

Figure 8. BCM Breakout Box Connection

The **ABS BREAKOUT BOX (Part Number:HD-48642)** connects to the ABS module [166]. Used in conjunction with a multimeter, it allows circuit diagnosis of wiring harness and connections without having to probe with sharp objects. Install breakout box in series as follows:

1. Access the ABS module.
2. Press latch and disconnect ABS module [166B].
3. See **Figure 9**. Connect **ABS BREAKOUT BOX (Part Number:HD-48642)** to connectors.
4. When testing is completed remove the breakout box and restore connections.



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1	ECU [266A]
2	Breakout box (BOB)
3	ECU harness [266B]

Figure 9. ABS Breakout Box Connection

DIGITAL TECHNICIAN II (Part Number: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.

Voltage drop test:

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

A voltage drop test measures the difference in voltage between two points in a circuit. The amount of voltage dropped over any part of a circuit is directly related to the amount of resistance in that part of the circuit and the current flowing through it.

Components such as wires, switches and connectors are designed to have very little resistance and very little voltage drop. A voltage drop greater than 1.0V across these components indicates a high resistance and possible fault.

The benefits of testing this way are:

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

When testing a typical power circuit, place positive (red) meter lead on most positive part of circuit or positive battery post. There is nothing more positive than the positive post of the battery.

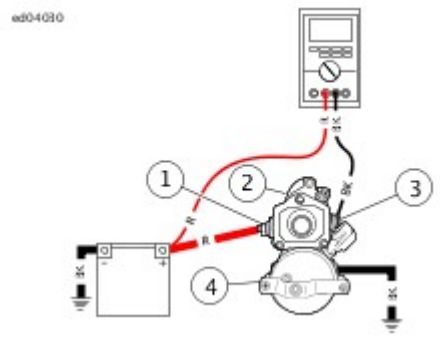
Place negative (black) meter lead at positive side of connector in question. Activate circuit. Move negative meter lead through the circuit until high voltage drop is found.

When testing a typical ground circuit, place negative lead on most negative part of circuit or negative battery post. There is nothing more negative than the negative post of the battery.

Place positive meter lead at negative side of connector in question. Activate circuit. Move positive meter lead through the circuit until high voltage drop is found.

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

1. Disconnect CKP [79] to prevent engine from starting.
    a. See **Figure 1**. Set meter to VDC. Connect red meter lead to positive battery post.
    b. Connect black meter lead to terminal 2 of starter solenoid. Observe meter reading.
    c. Crank starter and observe meter reading. A reading higher than 1V indicates excessive voltage drop.



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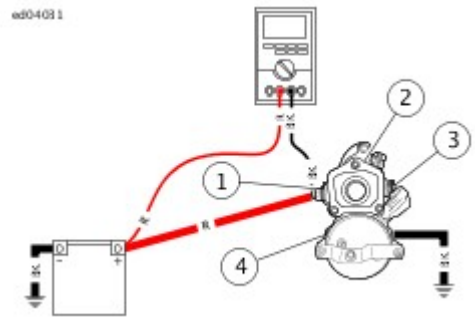
1	Terminal 1

2	Starter solenoid
3	Terminal 2
4	Starter motor

Figure 1. To Starter Solenoid Starter Terminal

2. See **Figure 2**. Move black meter lead to terminal 1 on starter solenoid. Crank starter. Observe voltage drop.



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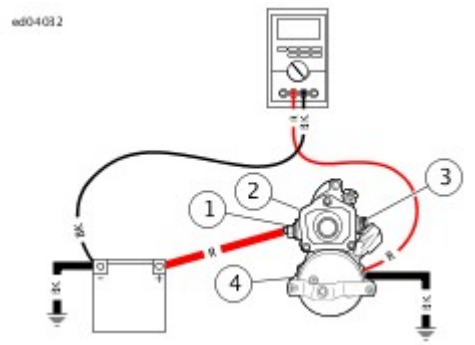
1	Terminal 1
2	Starter solenoid
3	Terminal 2
4	Starter motor

Figure 2. To Starter Solenoid Battery Terminal

3. See **Figure 3**. Move black meter lead to negative battery post and red meter lead to starter mounting bolt. Crank starter. Observe voltage drop.



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1	Terminal 1
2	Starter solenoid
3	Terminal 2
4	Starter motor

Figure 3. Starter Ground Circuit

Special Tools

Description	Part Number	Qty.
DIGITAL MULTIMETER (FLUKE 78)	HD-39978	1
DIGITAL TECHNICIAN II	HD-48650	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Wiggle test checks for the presence of intermittents in a wiring harness. If available, use **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to perform wiggle test.

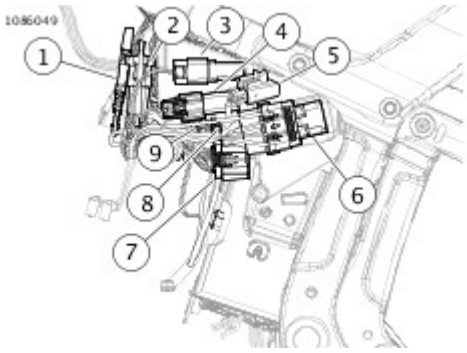
1. See **Figure 1**. Connect **DIGITAL MULTIMETER (FLUKE 78) (Part Number:HD-39978)** to wiring harness between suspect connections. When diagnosing ECM connections, use **BREAKOUT BOX (Part Number:HD-50390-1)**, **ECM CABLE (Part Number:HD-50390-4)** and **ECM OVERLAY (Part Number:HD-50390-4-P)** to simplify the procedure. See **How To Use Diagnostic Tools**.
2. Set the multimeter to read voltage changes.
3. Start motorcycle engine and run at idle.
4. Shake or wiggle harness to detect intermittents. If intermittents are present, radical voltage changes register on multimeter.

Figure 1. Digital Multimeter (Fluke 78)

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

CAN bus circuits are used by modules and diagnostic tools to share information. The IM, ECM, BCM, hand controls and ABS (if equipped) all communicate on the CAN bus. The CAN communication uses a (W/BK) and (W/R) wire in a twisted pair that runs to all the modules. It is used to transfer data from one module to the other. It also runs to the DLC [91] and is used to communicate with the modules using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**.



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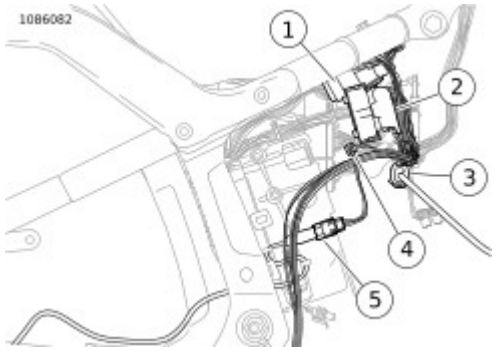
1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover



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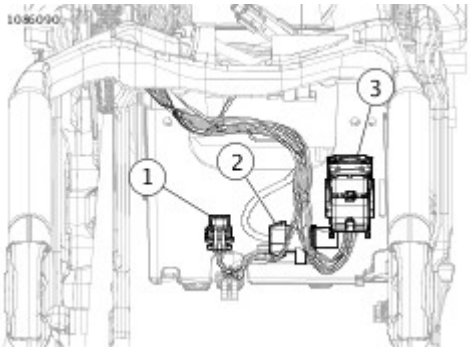
1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]
5	Rear WSS [168]

Figure 2. Behind Right Side Cover



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1	Security siren [142]
2	BCM power [259]
3	BCM [242]

Figure 3. Front of Rear Tire

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

See **Behind Left Side Cover**. The ECM is located under the left side cover. The ECM monitors the engine sensors to enhance performance and driveability. This is done by adjusting the fuel and spark delivery based on the information provided by the sensors.

The IM contains part of the indicator and warning lamps for the motorcycle. It uses the CAN communication to receive information from the other modules to know which lamps to illuminate at any given time. Vehicle speed is also sent to the IM over the CAN bus. The LEDs in the indicator bar (if equipped) are directly wired to the IM. The IM turns the indicators on and off based off commands from the other modules over the CAN bus.

See **Behind Right Side Cover**. The BCM is located on the electrical panel behind the fender extension. The BCM supplies ignition and accessory power to most of the vehicle and controls the power mode of the electrical system. It controls the lighting along with other functions on the vehicle by using the switches as inputs and the power circuits for the lights as outputs. The BCM is also connected to the CAN bus and shares information with the other modules on the vehicle.

See **Front of Rear Tire**. The ABS ECU is located behind the right side panel. The ECU receives input from the front and rear WSS, and controls the HCU accordingly. The ABS ECU communicates over the CAN bus to the IM to control the ABS indicator.

The left and right hand control modules control all the switches and controls on the handlebars. The engine stop switch has a redundant wire directly to the BCM. In the event of a communication malfunction, this redundant circuit is used to keep the engine from shutting off until the switch is turned off.

The hand controls also control the turn signals and running lights (DOM) on vehicles where the front turn signals are wired to the hand controls.

The DLC is located under the left side cover. The DLC is used to connect the **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to the motorcycle.

There are several DTCs that may set due to an issue with the CAN bus communication. Different DTCs are set by different modules. If a module loses communication with the rest of the system it will set DTC U0001, but the DTC cannot be retrieved until the CAN lines to that module are restored. If a module goes offline due to loss of PWR or GND or a loss of communication to that module, the module will not set a code, but the other modules will set DTCs indicating they are not able to communicate with it. When the IM recognizes a problem on the CAN bus it may display "BUS Err" on the odometer.

"VINERR" may also be displayed in the odometer if the IM and ECM are not seeing the same VIN in both modules. This will usually occur after replacing one of the two modules. The two modules must have the VINs match before they can share odometer mileage.

Both the ECM and IM retain the odometer value. If the IM is replaced, it will display the odometer value stored in the ECM. The replacement IM will become locked to the ECM after 50 km (31.1 mi) have been accumulated. The trip B odometer will display the countdown mileage. Once the countdown reaches zero, the IM is locked to the ECM. If installed on another vehicle, the odometer will display "VINERR". If the IM is removed from the vehicle before the countdown reaches zero, it has not been locked to the ECM. This mileage countdown allows for a road test to verify that IM replacement was the proper repair.

Modules must have power and be grounded in order to communicate. Therefore, when checking any communication DTC be sure to check the power and ground connections on the suspected module. BUS Err may show on the odometer if the following are present:

- CAN wires shorted together.
- CAN wire shorted to PWR or GND.
- CAN transceiver on some module failed shorted.
- Non-compliant module connected to the CAN bus.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

CAN communication uses a set of wires in a twisted pair. These two wires are designated as CAN low and CAN high circuits. Both circuits are connected to the ECM, BCM, instruments, both hand control modules and the ABS ECU (if equipped). The main harness and the right hand control module contain 120 ohm terminating resistors. Typical resistance between the two circuits is approximately 60 ohms.

- DTC U0001 indicates there is a fault on the CAN bus circuits. This code can be set by the ECM, BCM, instruments and ABS ECU (if equipped). This code is usually accompanied by other "U" codes, due to it causing a loss of communication between the modules on the CAN bus.
- DTC U0011 indicates the high and low CAN circuits are shorted together. This fault will be accompanied by other "U" codes and may cause the odometer display not to function.
- DTC B2274 indicates there is a fault with the battery fuse or the (R/O) wire.

NOTE

Always start from **Description and Operation** before proceeding with this test.

Table 1. Code Description

U0001	CAN bus error
U0011	CAN bus low shorted to CAN bus high
B2274	Constant battery line error

The IM does not have an ignition input. Instead, it receives a message over the CAN bus, indicating the IGN is ON. Also, the trip odometer reset switch is a CAN communication to the IM. Therefore, CAN bus errors can cause the odometer self-diagnostics to be completely inoperative or to only partially function. The IM backlighting may not function along with the hand control switches and the indicators. The odometer may read "BUS Err" in this condition, prior to the odometer becoming inoperative.

NOTE

If **DIGITAL TECHNICIAN II (Part Number:HD-48650)** is connected to the DLC [91] and communicating with the vehicle, then the odometer self-diagnostics will not function properly. Disconnect **DIGITAL TECHNICIAN II (Part Number:HD-48650)** before entering odometer self-diagnostics.

The BCM supplies power to several systems on the vehicle. When testing for a short to voltage, perform all tests before disconnecting the BCM to keep from powering down systems on the vehicle. If the short to voltage goes away when the BCM is disconnected, test for continuity between the circuit in question and BCM [242B] terminals F4, J3, L3, L4 and M2 to verify the tested circuit is not shorted to one of these circuits. If continuity is present, repair short to

circuit instead of replacing the BCM.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

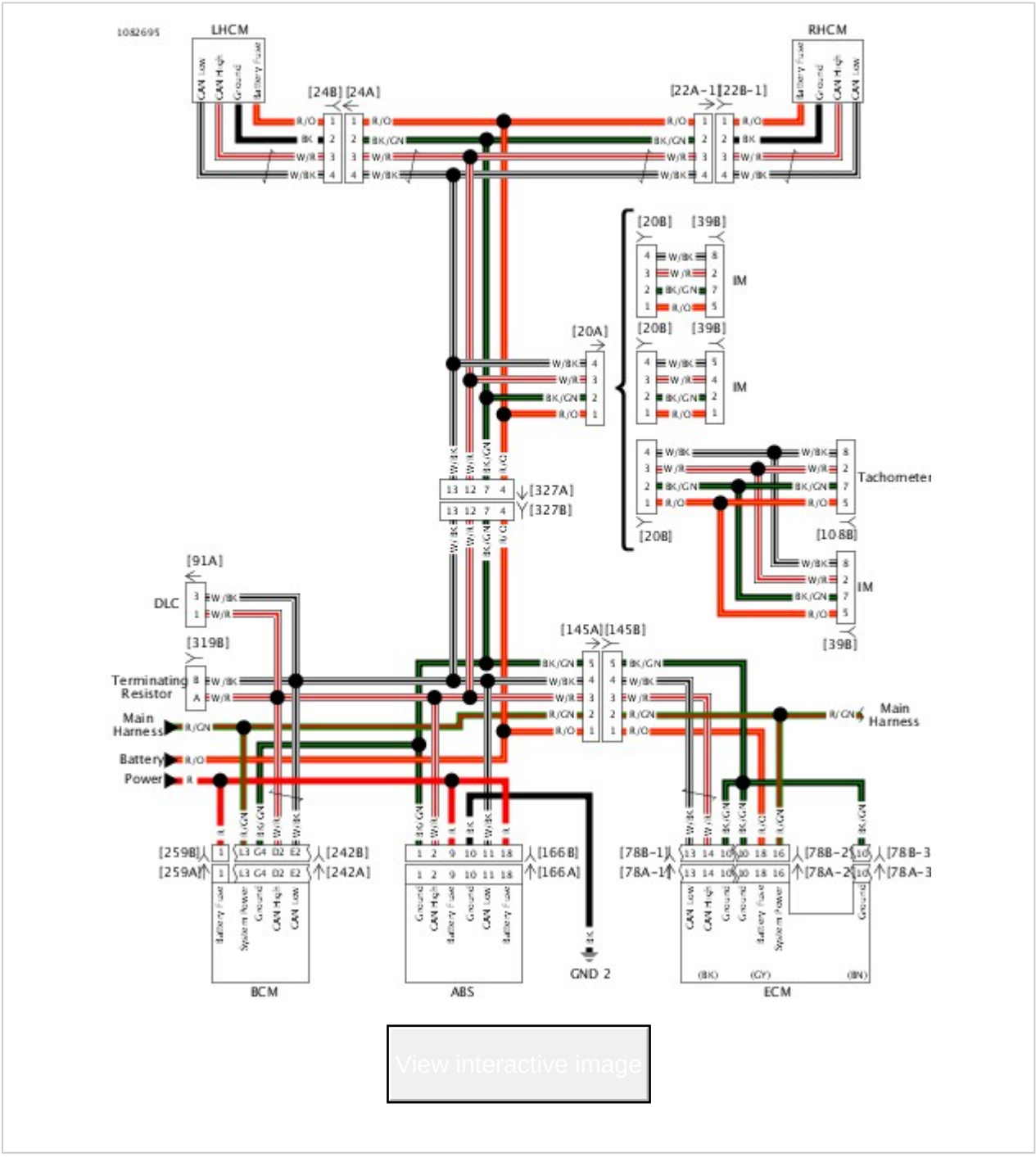


Figure 1. CAN Bus Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
ABS CABLE	HD-50390-6	1

Table 1. Odometer Self-Diagnostic Inoperative Diagnostic Faults: DTC U0001, U0011, B2274

Short between CAN low and high circuits
Open in CAN high circuit
Open in CAN low circuit
Short to ground on CAN high circuit
Short to ground on CAN low circuit
Short to voltage on CAN high circuit
Short to voltage on CAN low circuit

1. Turn IGN OFF.
2. Remove main fuse.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between DLC [91A] terminals 1 and 3.
4. Is resistance between 50-70 ohms?
    a. **Yes.** **Go to Test 15.**
    b. **No. Resistance less than 50 ohms.** **Go to Test 2.**
    c. **No. Resistance greater than 70 ohms.** **Go to Test 10.**

1. Disconnect IM [39].
2. Is resistance between [91A] terminals 1 and 3 between 50-70 ohms?
    a. **Yes.** Replace IM.
    b. **No.** **Go to Test 3.**

1. Disconnect BCM [242].
2. Is resistance between [91A] terminals 1 and 3 between 50-70 ohms?
    a. **Yes.** Replace BCM.
    b. **No, with ABS.** **Go to Test 4.**
    c. **No, without ABS.** **Go to Test 5.**

1. Disconnect ABS module [166].
2. Is resistance between [91A] terminals 1 and 3 between 50-70 ohms?
    a. **Yes.** Replace ABS module.
    b. **No.** **Go to Test 5.**

1. Disconnect LHCM [24].
2. Is resistance between [91A] terminals 1 and 3 between 50-70 ohms?
    a. **Yes.** Replace LHCM.
    b. **No, with tachometer.** **Go to Test 6.**
    c. **No, without tachometer.** **Go to Test 7.**

1. Disconnect tachometer [108].
2. Is resistance between [91A] terminals 1 and 3 between 50-70 ohms?
    a. **Yes.** Replace tachometer.
    b. **No.** **Go to Test 7.**

1. Disconnect ECM [78B-1].
2. Test resistance between [91A] terminals 1 and 3.
3. Is resistance between 50-70 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** **Go to Test 8.**

1. Disconnect terminating resistor [319].
2. Test resistance between [91A] terminals 1 and 3.
3. Is resistance between 110-130 ohms?
    a. **Yes.** Replace terminating resistor.
    b. **No.** **Go to Test 9.**

1. Disconnect RHCM [22-1].
2. Test continuity between [91A] terminals 1 and 3.
3. Is continuity present?
    a. **Yes.** Repair short between (W/R) and (W/BK) wires.
    b. **No.** Replace RHCM.

1. Watch the resistance between DLC [91A] terminals 1 and 3, disconnect terminating resistor [319].
2. Did resistance change?
    a. **Yes.** **Go to Test 11.**
    b. **No.** **Go to Test 13.**

1. Disconnect RHCM [22-1].
2. Test resistance between [91A] terminal 1 (W/R) wire and [22A-1] terminal 3.
3. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire.
    b. **No.** **Go to Test 12.**

1. Test resistance between [91A] terminal 3 (W/BK) wire and [22A-1] terminal 4.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire.
    b. **No.** Replace RHCM.

1. Test resistance between [91A] terminal 3 (W/BK) wire and [319B] terminal B.

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.

2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire.
    b. **No.** **Go to Test 14.**

1. Test resistance between [91A] terminal 1 (W/R) wire and [319B] terminal A.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire.
    b. **No.** Replace terminating resistor.

1. Turn IGN OFF.
2. Test resistance between [91A] terminal 1 and ground.
3. Is resistance less than 1000 ohms?
    a. **Yes.** **Go to Test 16.**
    b. **No.** **Go to Test 25.**

1. Disconnect IM [39].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes.** **Go to Test 17.**
    b. **No.** Replace IM.

1. Disconnect ECM [78B-1].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes.** **Go to Test 18.**
    b. **No.** Replace ECM.

1. Disconnect terminating resistor [319].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes.** **Go to Test 19.**
    b. **No.** Replace terminating resistor.

1. Disconnect LHCM [24].

2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes, with tachometer.** **Go to Test 20.**
    b. **Yes, without tachometer.** **Go to Test 21.**
    c. **No.** Replace LHCM.

1. Disconnect tachometer [108].
2. Is resistance between [91A] terminals 1 and ground less than 1000 ohms?
    a. **Yes.** **Go to Test 21.**
    b. **No.** Replace tachometer.

1. Disconnect BCM [242].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes, with ABS.** **Go to Test 22.**
    b. **Yes, without ABS.** **Go to Test 23.**
    c. **No.** Replace BCM.

1. Disconnect ABS module [166].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes.** **Go to Test 23.**
    b. **No.** Replace ABS module.

1. Disconnect RHCM [22-1].
2. Is resistance between [91A] terminal 1 and ground less than 1000 ohms?
    a. **Yes.** Repair short to ground in (W/R) wire.
    b. **No.** **Go to Test 24.**

1. Test resistance between [91A] terminal 3 and ground.
2. Is resistance less than 1000 ohms?
    a. **Yes.** Repair short to ground in (W/BK) wire.
    b. **No.** Replace RHCM.

1. Install main fuse.

2. Turn IGN ON.
3. Test voltage between [91A] terminal 1 and ground.
4. Is voltage greater than 4V?
    a. **Yes.** **Go to Test 26.**
    b. **No.** **Go to Test 34.**

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Turn IGN ON.
4. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes.** **Go to Test 27.**
    b. **No.** Replace IM.

1. Turn IGN OFF.
2. Disconnect ECM [78B-1].
3. Turn IGN ON.
4. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes.** **Go to Test 28.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect LHCM [24].
3. Turn IGN ON.
4. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes, with ABS.** **Go to Test 29.**
    b. **Yes, without ABS.** **Go to Test 30.**
    c. **No.** Replace LHCM.

1. Turn IGN OFF.
2. Disconnect ABS module [166].
3. Turn IGN ON.
4. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes.** **Go to Test 30.**
    b. **No.** Replace ABS module.

1. Turn IGN OFF.

2. Disconnect BCM power [259].
3. Disconnect BCM [242].
4. Turn IGN ON.
5. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes, with tachometer.** **Go to Test 31.**
    b. **Yes, without tachometer.** **Go to Test 32.**
    c. **No.** Replace BCM. Refer to diagnostic tips.

1. Turn IGN OFF.
2. Disconnect tachometer [108].
3. Turn IGN ON.
4. Is voltage between [91A] terminals 1 and ground greater than 4V?
    a. **Yes.** **Go to Test 32.**
    b. **No.** Replace tachometer.

1. Turn IGN OFF.
2. Disconnect RHCM [22-1].
3. Turn IGN ON.
4. Is voltage between [91A] terminal 1 and ground greater than 4V?
    a. **Yes.** Repair short to voltage in (W/R) wire.
    b. **No.** **Go to Test 33.**

1. Test voltage between [91A] terminal 3 and ground.
2. Is voltage present?
    a. **Yes.** Repair short to voltage in (W/BK) wire.
    b. **No.** Replace RHCM.

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wiring harness [242B], leaving [242A] disconnected.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Test resistance between [91A] terminal 3 (W/BK) wire and BOB terminal E2.
6. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire between [91A] terminal 3 and [242B] terminal E2.
    b. **No.** **Go to Test 35.**

1. Test resistance between [91A] terminal 1 (W/R) wire and BOB terminal D2.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire between [91A] terminal 1 and [242B] terminal D2.
    b. **No, with ABS.** **Go to Test 36.**
    c. **No, without ABS.** **Go to Test 38.**
    d. **No, without ABS or tachometer.** **Go to Test 40.**

1. Remove cables and BCM BOB.
2. Connect BCM.
3. Disconnect ABS [166].
4. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** to wiring harness connector [166B]. Leaving [166A] disconnected, test resistance between [91A] terminal 3 (W/BK) wire and BOB terminal 11.
5. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire between [91A] terminal 3 and [166B] terminal 11.
    b. **No.** **Go to Test 37.**

1. Test resistance between [91A] terminal 1 (W/R) wire and BOB terminal 2.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire between [91A] terminal 1 and [166B] terminal 2.
    b. **No, with tachometer** **Go to Test 38.**
    c. **No, without tachometer.** **Go to Test 40.**

1. Remove cables and ABS BOB. Connect ABS module.
2. Disconnect tachometer [108].
3. Connect **BREAKOUT BOX (Part Number:HD-42682)** and **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to wiring harness connectors [108B]. Leaving [108A] disconnected, test resistance between [91A] terminal 3 (W/BK) wire and BOB terminal 8.
4. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire between [91A] terminal 3 and [108B] terminal 8.
    b. **No.** **Go to Test 39.**

1. Test resistance between [91A] terminal 1 (W/R) wire and BOB terminal 2.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire between [91A] terminal 1 and [108B] terminal 2.
    b. **No.** **Go to Test 40.**

1. Remove cables and ABS BOB, connect ABS module.
2. Remove tachometer BOB and connect tachometer.
3. Disconnect IM [39].
4. Inspect [39].
5. Is [39] a 12 place connector?
    a. **Yes. Go to Test 42.**
    b. **No. Go to Test 41.**

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between DLC [91A] terminal 3 and IM [39B] terminal 5.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire between [91A] terminal 3 and [39B] terminal 5.
    b. **No. Go to Test 44.**

1. Connect **BREAKOUT BOX (Part Number:HD-42682)** and **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to wiring harness connectors [39B].
2. Leaving [39A] disconnected, test resistance between [91A] terminal 3 (W/BK) wire and BOB terminal 8.
3. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/BK) wire between [91A] terminal 3 and [39B] terminal 8.
    b. **No. Go to Test 43.**

1. Test resistance between [91A] terminal 1 (W/R) wire and BOB terminal 2.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire between [91A] terminal 1 and [39B] terminal 2.
    b. **No.** Concern is intermittent. Perform wiggle test and verify all connectors are properly connected. See **Wiggle Test**.

1. Test resistance between [91A] terminal 1 (W/R) wire and IM [39] terminal 4.
2. Is resistance greater than 0.5 ohm?
    a. **Yes.** Repair (W/R) wire between [91A] terminal 1 and [39B] terminal 4.
    b. **No.** Concern is intermittent. Perform wiggle test and verify all connectors are properly connected. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

The CAN bus circuit provides a means for the ECM, IM, BCM, hand control modules and the ABS ECU (if equipped) to communicate their current status. When all operating parameters on the CAN bus are within specifications, a state of health message is sent between the components.

The CAN bus is made up of two circuits. The (W/R) is the CAN bus high circuit and the (W/BK) is the CAN bus low circuit. Both of these circuits show approximately 2.5V when measured between each of the circuits and ground with the IGN ON. These circuits are connected to each module on the CAN bus network. A fault on either one of these circuits will cause several modules to set "U" codes and may cause a complete loss of communication between all modules.

Table 1. Code Description

U0100	Lost comm w/ECM
U0121	Lost comm w/ABS
U0140	Lost comm w/BCM
U0141	Lost comm w/LHCM
U0142	Lost comm w/RHCM
U0156	Lost comm w/speedo
U0300	Internal control module software incompatibility

Modules must have power in order to communicate on the CAN bus. It is important to check for good power and ground on any module that is not communicating effectively on the CAN bus network.

- At least two modules will set a DTC when one module loses the ability to communicate on the CAN bus.
- When two or more modules set the same U code it indicates a problem with the device or wiring at the device the codes are set against.
- Two or more modules setting the same U code intermittently indicates an intermittent problem with the device or wiring.

See **Wiggle Test** to test wiring to the component.

The BCM supplies power to several systems on the vehicle.

- When testing for a short to voltage, perform all tests before disconnecting the BCM to keep from powering down systems on the vehicle.
- If the short to voltage goes away when the BCM is disconnected, test for continuity between the circuit in question and BCM [242B] terminals F4, J3, L3, L4 and M2 to verify the tested circuit is not shorted to one of these circuits.
- If continuity is present, repair shorted circuit instead of replacing the BCM.

Historic U codes may be found if battery power has been lost for any reason or if the main or battery fuses have been

disconnected and reconnected. This may also happen during diagnostics using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**. The diagnostics connector has been disconnected before vehicle has been powered down. This is not an indication of a problem and does not cause any loss of functionality.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

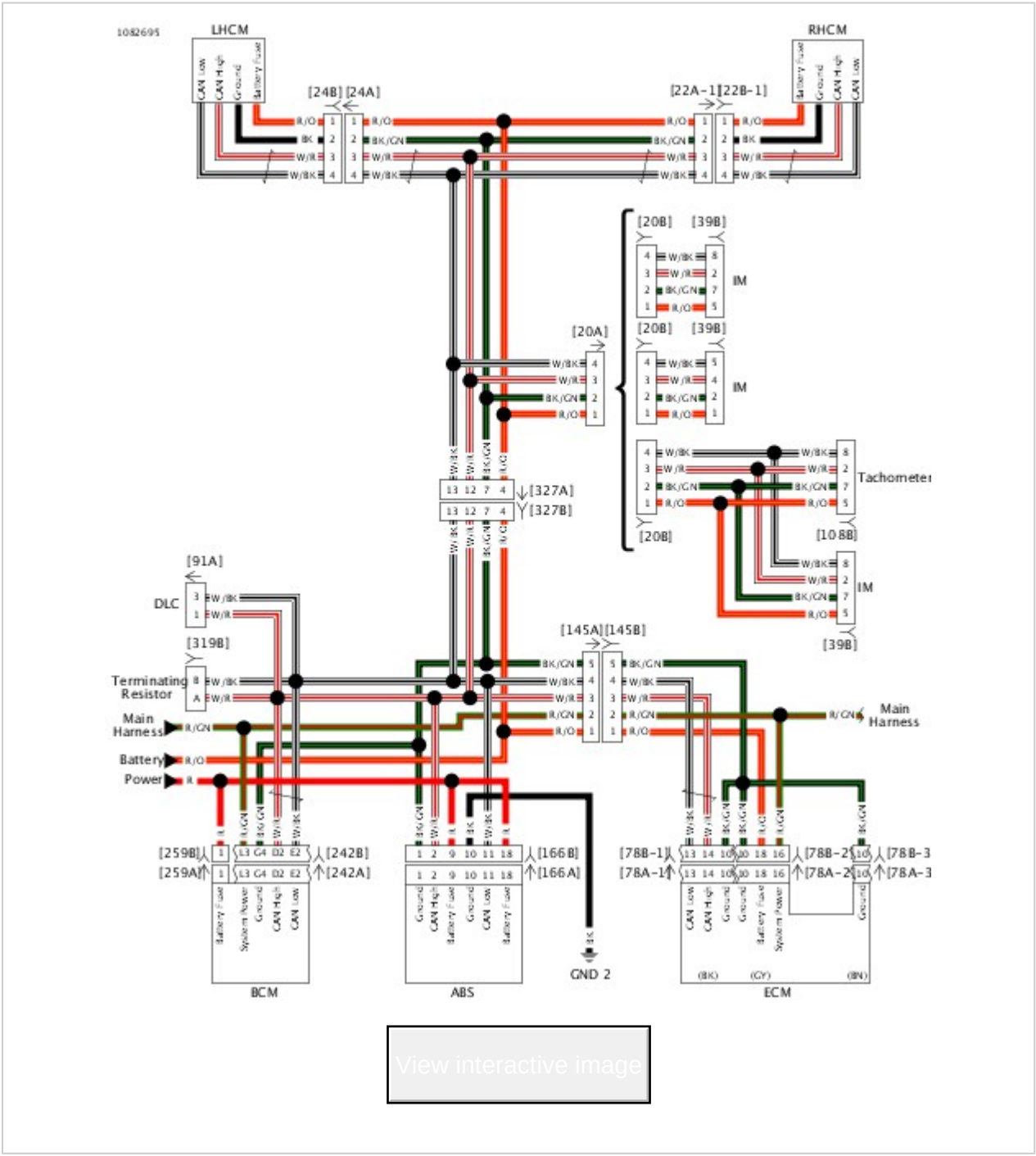


Figure 1. CAN Bus Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC U0100 Diagnostic Faults

Open in CAN high circuit to the ECM
Open in CAN low circuit to the ECM
Open in ECM system power circuit
Open in ECM ground circuit

1. View odometer.
2. Is only the BCM setting DTC?
    a. **Yes. Go to Test 10.**
    b. **No, ABS ECU only. Go to Test 7.**
    c. **No, IM only. Go to Test 8.**
    d. **No, tachometer only. Go to Test 9.**
    e. **No, multiple modules. Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to [78B-1], 78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 16 and ground.
6. Is battery voltage present?
    a. **Yes. Go to Test 3.**
    b. **No. Go to Test 11.**

1. Turn IGN OFF.
2. Test resistance between BOB [78-1] terminal 10 and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between BOB [78-2] terminal 10 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between BOB [78-1] terminal 14 and DLC [91A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between BOB [78-1] terminal 13 and [91A] terminal 3.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (W/BK) wire.

1. Turn IGN OFF.
2. Replace ABS ECU with a known good ABS ECU.
3. Turn IGN ON.
4. Attempt to start vehicle.
5. Check DTC.
6. Is DTC U0100 present?
    a. **Yes.** Check vehicle for any accessories connected to the CAN bus.
    b. **No.** Replace ABS ECU.

1. Turn IGN OFF.
2. Replace IM with a known good IM.
3. Turn IGN ON.

4. Attempt to start vehicle.
5. Check DTC.
6. Is DTC U0100 present?
    a. **Yes.** Check vehicle for any accessories connected to the CAN bus.
    b. **No.** Replace IM.

1. Turn IGN OFF.
2. Replace tachometer with a known good tachometer.
3. Turn IGN ON.
4. Attempt to start vehicle.
5. Check DTC.
6. Is DTC U0100 present?
    a. **Yes.** Check vehicle for any accessories connected to the CAN bus.
    b. **No.** Replace tachometer.

1. Replace BCM with a known good BCM.
2. Turn IGN ON.
3. Attempt to start vehicle.
4. Check DTC.
5. Is DTC U0100 present?
    a. **Yes.** Check vehicle for any accessories connected to the CAN bus.
    b. **No.** Replace BCM.

1. Remove BOB.
2. Connect [78A-1], [78A-2] and [78A-3].
3. Verify DTCs.
4. Is B2102, B2103 or B2104 setting?
    a. **Yes.** See **Description and Operation**.
    b. **No.** Repair open in (R/GN) wire.

Special Tools

Description	Part Number	Qty.
ABS BREAKOUT BOX	HD-48642	1

Table 1. DTC U0121 Diagnostic Faults

Open in CAN high circuit to the ABS ECU
Open in CAN low circuit to the ABS ECU
Open in ABS system power circuit
Open in ABS ground circuit

1. Turn IGN OFF.
2. Connect **ABS BREAKOUT BOX (Part Number:HD-48642)** to wiring harness [166B], leaving [166A] disconnected. See **How To Use Diagnostic Tools**.
3. Test voltage between BOB terminal 18 and ground.
4. Test voltage between BOB terminal 9 and ground.
5. Is battery voltage present at both?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (R) wire.

1. Test voltage between BOB terminals 18 and 10.
2. Is battery voltage present?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK) wire.

1. Turn IGN OFF.
2. Test resistance between BOB terminal 2 and DLC [91A] terminal 1.
3. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between BOB terminal 11 and [91A] terminal 3.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace ABS ECU.
    b. **No.** Repair open in (W/BK) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. No Vehicle Power Diagnostic Faults: DTC U0140

Open in CAN high circuit to the BCM
Open in CAN low circuit to the BCM
Open in ignition switch circuit
Short to ground in ignition switch circuit
Short to voltage in ignition switch circuit
Ignition switch malfunction
Open in BCM battery power circuit
Open in BCM ground circuit

1. Turn IGN OFF.
2. Connect **BCM OVERLAY (Part Number:HD-50390-2-P)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving BCM [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Disconnect BCM [259].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BCM [259B] terminal 1 and BOB terminal G4.
6. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 11.**

1. Disconnect RHCM [22A-1].
2. Test resistance between BOB terminal D2 and [22A-1] terminal 3.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 3.**

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

1. Test continuity between BOB terminal D2 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (W/R) wire.
    b. **No.** **Go to Test 4.**

1. Connect [259].
2. Connect [242A].
3. Turn IGN ON.
4. Test voltage between BOB terminal D2 and ground.
5. Is battery voltage present?
    a. **Yes.** Repair short to voltage in (W/R) wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Test resistance between BOB terminal E2 and [22A-1] terminal 4.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (W/BK) wire.

1. Test continuity between BOB terminal E2 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (W/BK) wire.
    b. **No.** **Go to Test 7.**

1. Turn IGN ON.
2. Test voltage between BOB terminal E2 and ground.
3. Is battery voltage present?
    a. **Yes.** Repair short to voltage in (W/BK) wire.
    b. **No.** **Go to Test 8.**

1. Test voltage between [22A-1] terminals 1 and 2.
2. Is battery voltage present?
    a. **Yes.** **Go to Test 10.**
    b. **No.** **Go to Test 9.**

1. Test voltage between [22A-1] terminal 1 and ground.
2. Is battery voltage present?
    a. **Yes.** Repair open in (BK/GN) wire.
    b. **No.** Repair open in (R/O) wire.

1. Turn IGN OFF.
2. Remove main fuse [5].
3. Replace RHCM with a known good RHCM without installing it on the vehicle.
4. Install main fuse.
5. Push engine stop switch to RUN.
6. Turn IGN ON.
7. Does vehicle power up?
    a. **Yes.** Replace RHCM.
    b. **No.** Replace BCM.

1. Test voltage between [259B] terminal 1 and ground.
2. Is battery voltage present?
    a. **Yes.** Repair open in (BK/GN) wire.
    b. **No.** Repair open in (R) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. Left Hand Controls Inoperative, DTC U0141 Diagnostic Faults

Open in CAN high circuit to the LHCM
Open in CAN low circuit to the LHCM
Open in LHCM battery power circuit
Open in LHCM ground circuit

1. Turn IGN OFF.
2. Disconnect LHCM [24A].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [24A] terminal 1 and ground.
4. Is battery voltage present?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between [24A] terminals 1 and 2.
2. Is battery voltage present?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between [24A] terminal 3 and DLC [91A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between [24A] terminal 4 and [91A] terminal 3.
2. Is resistance less than 0.5 ohm?

a. **Yes.** Replace LHCM.
b. **No.** Repair open in (W/BK) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC U0142 Diagnostic Faults

Open in CAN high circuit to the RHCM
Open in CAN low circuit to the RHCM
Open in RHCM battery power circuit
Open in RHCM ground circuit

1. Turn IGN OFF.
2. Disconnect RHCM [22A-1].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [22A-1] terminal 1 and ground.
4. Is battery voltage present?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between [22A-1] terminals 1 and 2.
2. Is battery voltage present?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between [22A-1] terminal 3 and DLC [91A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between [22A-1] terminal 4 and [91A] terminal 3.

2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace RHCM.
    b. **No.** Repair open in (W/BK) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. IM Inoperative: DTC U0156 Diagnostic Faults

Open in CAN high circuit to the IM
Open in CAN low circuit to the IM
Open in IM battery power circuit
Open in IM ground circuit

1. Turn IGN OFF.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [20A] terminal 1 and ground.
3. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between [20A] terminals 1 and 2.
2. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between [20A] terminal 3 and DLC [91A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between [20A] terminal 4 and [91A] terminal 3.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace IM.

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

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. Tachometer Inoperative: DTC U0157 Diagnostic Faults

Open in CAN high circuit to the tachometer
Open in CAN low circuit to the tachometer
Open in tachometer battery power circuit
Open in tachometer ground circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-42682)** and **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to the wiring harness [108B], leaving the [108A] disconnected.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal 5 and ground.
4. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between BOB terminals 5 and 7.
2. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between BOB terminal 2 and DLC [91A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Test resistance between BOB terminal 8 and [91A] terminal 3.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace the tachometer.
    b. **No.** Repair open in (W/BK) wire.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Table 1. DTC U0300 Diagnostic Faults

ECM software error

1. Clear DTC.
2. Turn IGN OFF for 30 seconds.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** System working properly.

1. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)** reflash ECM.
2. Clear DTCs.
3. Turn IGN OFF for 30 seconds.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System working properly.

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

Always fully charge battery prior to load testing.

NOTE

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

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

If the open circuit (disconnected) voltage reading is below 12.6V, charge battery and then check voltage after battery has set for 1-2 hours. If voltage reading is 12.7V or above, perform a load test. See **Load Test**.

Table 1. Voltmeter Test For Battery Charge Conditions

12.7	100%
12.6	75%
12.3	50%
12.0	25%
11.8	0%

Special Tools

Description	Part Number	Qty.
HD BATTERY DIAGNOSTIC STATION	GRX-3110HD	1

Test battery using the **HD BATTERY DIAGNOSTIC STATION (Part Number:GRX-3110HD)**.

WARNING

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

1. Disconnect and remove battery.
2. Read GRX instruction manual before performing a battery test.
3. Connect **HD BATTERY DIAGNOSTIC STATION (Part Number:GRX-3110HD)** leads to the battery terminals.
4. Test results will include a decision on battery condition and measured state of charge. See **Figure 1**. The GRX printer will provide a printout including test results:
    a. GOOD BATTERY - Return battery to service.
    b. REPLACE BATTERY - Replace battery.

View interactive image

Figure 1. Battery Test Results Printout (Typical)

WARNING

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

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

NOTE

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

WARNING

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

2. See **Figure 1**. 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 load tester switch turned ON for more than 20 seconds.

WARNING

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

WARNING

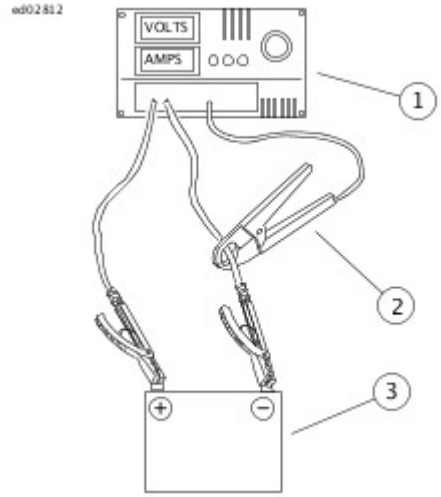
Connect positive (+) battery cable first. If positive (+) cable should contact ground with negative (-) cable connected, the resulting sparks can cause a battery explosion, which could result in death or serious

injury. (00068a)

NOTICE

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

3. Load battery at 50 percent of CCA rating using load tester. Voltage reading after 15 seconds should be 9.6V or more at 21 °C (70 °F). Refer to **Table 1**.



View interactive image

1	Load tester
2	Induction pickup
3	Battery

Figure 1. Load Test Battery

Table 1. Battery Load Test

Softail models	315	155

Battery voltage is supplied to the BCM at all times through the main fuse. The engine stop switch also functions as the ignition switch.

When the engine stop switch is in the RUN position, a CAN message is sent, signaling the BCM that the switch is in the RUN position. If CAN communication is interrupted while the engine is running, the BCM checks for the signal from the redundant engine stop switch circuit.

When the start switch is pressed, a CAN message is sent to the BCM. The BCM provides power to the starter solenoid. This energizes the solenoid and full battery power is sent to the starter. The BCM disables the starter solenoid if the start switch is pressed for more than 10 seconds.

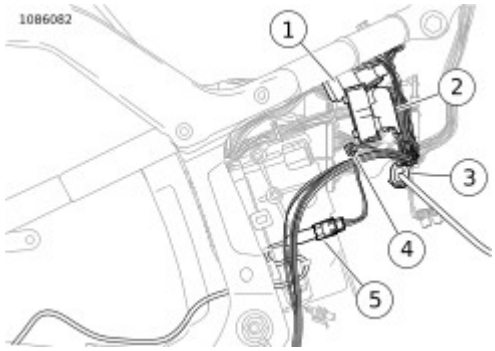
The starter receives power from the battery through the starter solenoid and is grounded through the starter case. When the starter solenoid is energized, two events happen:

- The plunger pulls inward which allows current to flow to the starter motor.
- The pinion gear engages with the ring gear on the clutch shell.

With the starter motor turning, the rotation is transferred:

- The starter armature gear transfers rotation to the idler gear.
- The idler gear transfers rotation to the starter clutch.
- The starter clutch transfers rotation through a spline gear to the starter drive shaft which also drives the pinion gear.
- The pinion gear transfers its rotation to the ring gear on the clutch shell.
- The primary chain drives the alternator rotor sprocket on the end of the crankshaft.

The starter clutch has a one-way clutch. When the engine starts, it allows the clutch shell and sprocket to spin freely without causing any damage to the starter motor. After the engine starts and the start switch is released, the plunger returns to its normal position, disengaging the pinion gear from the clutch shell and sprocket.



View interactive image

1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]
5	Rear WSS [168]

Figure 1. Behind Right Side Cover

See **Figure 1**. The starter solenoid provides power to the starter. The solenoid is a means of controlling a high amperage device with a low amperage switch. The low amperage switch in this circuit is the BCM. The BCM sends voltage to the starter solenoid making a magnetic field that pulls a larger circuit closed, allowing voltage to the starter.

The engine stop switch is located on the right hand controls. The engine stop switch also functions as the ignition switch. With the engine stop switch in the RUN position, a CAN message is sent, signaling the BCM that the switch is in the RUN position. If CAN communication is interrupted while engine is running, a redundant engine stop switch circuit allows communication to the BCM.

The start switch is a push button switch located in the right hand controls. When the start switch is pressed, a CAN message is sent to the BCM.

The BCM supplies ignition and accessory power to most of the vehicle. It controls the lighting along with other functions by using the switches as inputs and the power circuits for the lights and other electrical loads as outputs.

WARNING

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

WARNING

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

WARNING

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

WARNING

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

WARNING

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

NOTICE

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

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

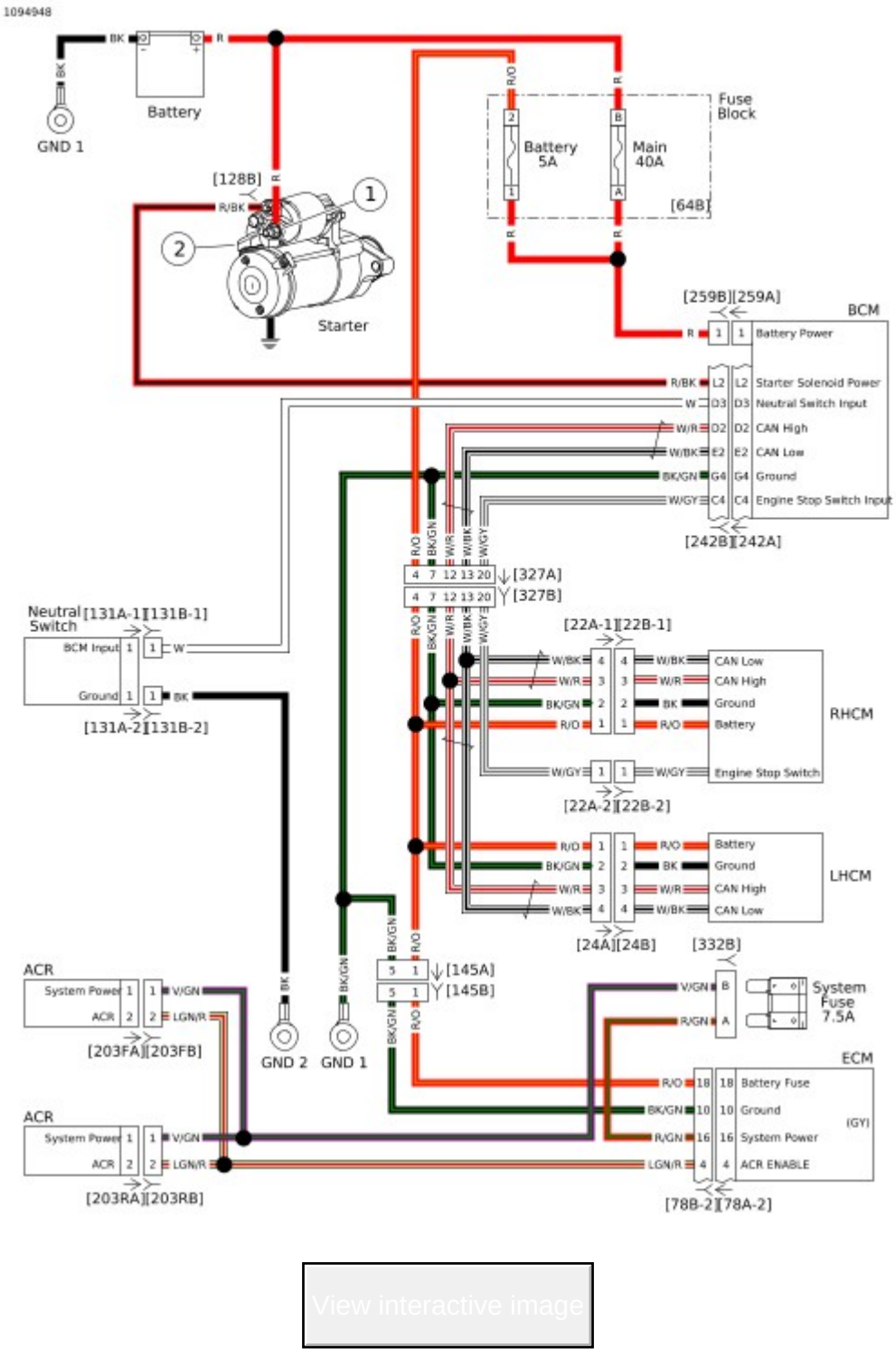
The battery is recharged by the alternator and kept from overcharging by the regulator during use.

Battery condition can be determined by a voltage test, a charging and a load test. See **General**.

The battery must be fully charged to perform a conductance test or a load test.

1. Remove starter.
2. Inspect the starter mounting surface and mating area on inner primary for arcing and pitting. This condition is caused by insufficient ground and or clamp load.
3. Clean mating surfaces.
4. Inspect starter pinion gear. Replace starter if damaged.
5. Install starter.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



View interactive image

Figure 2. Starting Circuit

Troubleshooting tables contain detailed procedures to solve and correct problems. Follow **Description and Operation** to diagnose starting system problems. The **Voltage Drop** procedure will help you to locate poor connections or components with excessive voltage drops.

Table 1. Starter Testing Diagnostic Faults

Short to voltage at starter solenoid
Start switch malfunction
Short to voltage on BCM supply circuit

1. Press start switch.
2. Does starter spin?
    a. **Yes, starter spins but does not engage.** See **Starter Spins But Does Not Engage**.
    b. **Yes, starter stalls or spins too slowly.** See **Starter Stalls or Spins Too Slowly**.
    c. **Yes, starter runs on. Go to Test 3.**
    d. **No. Go to Test 2.**

1. While listening for clicking noise from starter solenoid, press start switch.
2. Is there a click?
    a. **Yes, starter solenoid clicks.** See **Starter Solenoid Clicks**.
    b. **No.** See **Nothing Clicks**.

1. Disconnect starter solenoid [128].
2. Does starter stop?
    a. **Yes. Go to Test 4.**
    b. **No.** Replace starter assembly.

1. Check DTCs.
2. Is DTC B2122 present?
    a. **Yes.** See **Description and Operation**.
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Nothing Clicks Diagnostic Faults

Low battery
Open fuse
Neutral switch malfunction
Open neutral circuit
Open ignition switch circuit
Open starter solenoid power circuit
Poor starter housing ground

NOTE

- Verify that vehicle is in neutral.
- Check that key fob is present and in working order (if security equipped).
- Verify the engine stop switch is in RUN position.

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Turn IGN ON.
2. Do odometer, headlamp and tail lamps illuminate?

a. **Yes.** **Go to Test 3.**
b. **No. Odometer is inoperative, but headlamp and tail lamps illuminate.** See **Description and Operation**.
c. **No. Odometer, headlamp and tail lamps inoperative.** See **No Vehicle Power: DTC U0140**.

1. Turn IGN OFF.
2. Disconnect starter solenoid [128].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, during the first 4-5 seconds, while start button is pressed, test voltage between [128B] (R/BK) wire and ground.
5. Is battery voltage present?
   a. **Yes.** **Go to Test 4.**
   b. **No.** **Go to Test 5.**

1. Remove starter attaching bolts.
2. Clean bolts and starter base, install starter bolts.
3. Does engine crank?
   a. **Yes. Engine cranks at normal speed.** Repair complete.
   b. **Yes. Engine cranks, but at a slower speed.** See **Starter Current Draw Test**.
   c. **No.** Replace starter assembly.

1. Observe neutral lamp.
2. Is neutral lamp illuminated?
   a. **Yes.** **Go to Test 6.**
   b. **No.** See **Neutral Lamp Inoperative**.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and BCM [242A]. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between BOB terminal L2 and [128B].
5. Is resistance less than 0.5 ohm?
   a. **Yes.** **Go to Test 7.**
   b. **No.** Repair open in (R/BK) wire.

1. Turn IGN OFF.

2. Remove main fuse [5].
3. Disconnect BCM and replace with known good BCM.
4. Install main fuse.
5. Turn IGN ON.
6. Attempt to start vehicle.
7. Does engine crank?
    a. **Yes.** Replace BCM.
    b. **No.** Replace RHCM.

Table 1. Starter Solenoid Clicks Diagnostic Faults

Low battery
Starter malfunction
Starter solenoid malfunction
Poor battery cable connections
Mechanical binding

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Perform voltage drop test from battery (+) terminal to starter solenoid terminal 2 (BK) wire.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 4.**

1. Perform voltage drop test from battery (+) terminal to starter solenoid terminal 1 (BK) wire.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** Repair or replace (BK) wire from starter solenoid terminal 1 to battery (+) terminal.
    b. **No.** Replace starter assembly.

1. Perform voltage drop test from battery (-) terminal to chassis ground.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** Inspect (BK) wire for damage from battery (-) terminal to chassis ground, repair or replace if necessary. **Go to Test 5.**
    b. **No.** **Go to Test 6.**

1. Remove starter attaching bolts.
2. Clean bolts and starter base, install starter bolts.
3. Does engine crank?
    a. **Yes, engine cranks at normal speed.** Repair complete.
    b. **Yes, engine cranks, but at a slower speed.** See **Starter Current Draw Test**.
    c. **No.** Replace starter.

1. Perform Starter Current Draw Test on motorcycle. See **Starter Current Draw Test**.
2. Perform Starter Motor Free Running Current Draw Test on bench. See **Free Running Current Draw Test**.
3. Are test results within range?
    a. **Yes. Go to Test 7.**
    b. **No.** Replace starter.

1. Remove spark plugs and place transmission in sixth gear.
2. Raise vehicle.
3. Rotate rear wheel.
4. Check for engine binding in the primary and/or crankshaft.
5. Is engine binding?
    a. **Yes.** Repair as needed.
    b. **No.** Replace starter assembly.

Table 1. Starter Spins But Does Not Engage Diagnostic Faults

Starter clutch assembly
Clutch shell and/or starter pinion damage

1. Remove primary cover.
2. Inspect for damage to starter pinion gear and clutch shell and sprocket.

NOTE

Inspect ACR operation before installation of **new** starter clutch assembly.

3. Is damage present?
    a. **Yes.** Replace starter assembly or clutch shell and sprocket.
    b. **No.** Replace starter assembly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. Starter Stalls or Spins Too Slowly Diagnostic Faults

Low battery
Starter malfunction
Starter solenoid malfunction
Poor connections at starter ground
Poor battery cable connections

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Perform voltage drop test from battery (+) terminal to starter solenoid terminal 2. See **Voltage Drop**.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** **Go to Test 7.**
    b. **No.** **Go to Test 3.**

1. Perform voltage drop test between battery (-) terminal and starter attaching bolts.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** **Go to Test 4.**
    b. **No.** **Go to Test 5.**

1. Perform voltage drop test from battery (-) terminal to chassis ground.
2. Is voltage drop greater than 1.0V?
    a. **Yes.** Inspect (BK) wire for damage from battery (-) terminal to chassis ground, repair or replace if necessary.
    b. **No.** Clean bolts and starter base, install starter bolts.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wire harness [78B-1], [78B-2], [78B-3] and [78A-1], [78A-2], [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, jumper between BOB [78-2] terminals 4 and 10.
6. Do ACRs click?
    a. **Yes. Go to Test 6.**
    b. **No.** Replace front and rear ACR solenoids.

1. Perform Starter Current Draw Test on motorcycle. See **Starter Current Draw Test**.
2. Perform Starter Motor Free Running Current Draw Test (on bench). See **Free Running Current Draw Test**.
3. Are test results within range?
    a. **Yes.** With the spark plugs removed and transmission in 6th gear, rotate rear wheel. Check for engine, primary and/or crankshaft bind.
    b. **No.** Replace starter.

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

The starter solenoid circuit is controlled and monitored by the BCM. The BCM receives a CAN message from the start switch in the RHCM to engage the starter. Voltage is sent from the BCM to the starter solenoid [128] (R/BK) wire. The BCM disables the starter solenoid if the start switch is pressed for more than 10 seconds.

Table 1. Code Description

B2121	Starter output open
B2122	Starter output shorted high
B2123	Starter output shorted low
B2124	Starter output overloaded

- DTC B2121 will set if the starter solenoid circuit draws less than 600 milliamps.
- DTC B2124 will set if the starter solenoid circuit draws more than 12 amps.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

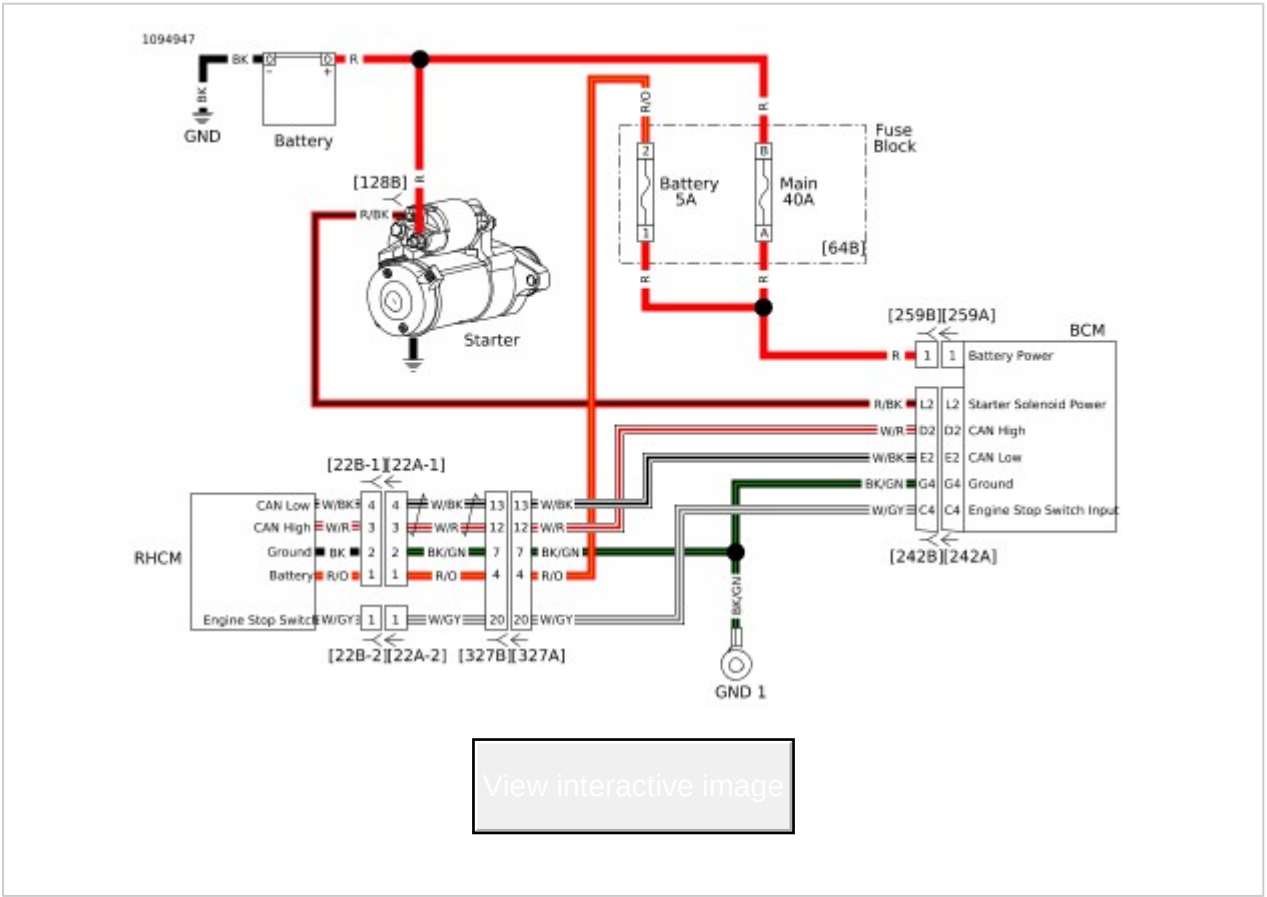


Figure 1. Starter

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2121 Diagnostic Faults

Open in starter circuit
Open in starter solenoid

1. Turn IGN OFF.
2. Disconnect starter solenoid [128].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, during first 4-5 seconds, while start button is pressed, test battery voltage between [128B] (R/BK) and ground.
5. Is battery voltage present?
    a. **Yes.** Replace starter assembly.
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. During first 4-5 seconds, while start button is pressed, test voltage between BOB terminal L2 and ground.
5. Is voltage present?
    a. **Yes.** Repair open in (R/BK) wire between [242B] terminal L2 and [128B].
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2122 Diagnostic Faults

Short in starter circuit
Short in starter solenoid

1. Turn IGN OFF.
2. Disconnect starter solenoid [128].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [128B] (R/BK) and ground.
5. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace starter assembly.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Turn IGN ON.
5. Without pressing start button, test voltage between BOB terminal L2 and ground.
6. Is voltage present?
    a. **Yes.** Repair short to voltage in (R/BK) wire between [242B] terminal L2 and [128B].
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2123 Diagnostic Faults

Short in starter circuit
Short in starter solenoid

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal L2 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (R/BK) wire between [242B] terminal L2 and [128B].
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2124 Diagnostic Faults

Short in starter circuit
Starter solenoid malfunction
Corrosion at connector

1. Turn IGN OFF.
2. Disconnect starter solenoid [128].
3. Inspect [128] and (R/BK) wire for damage or corrosion.
4. Is any present?
    a. **Yes.** Repair or replace [128] and (R/BK) wire.
    b. **No.** **Go to Test 2.**

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [128B] (R/BK) wire and ground.
2. Is continuity present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace starter assembly.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Test continuity between BOB terminal L2 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in (R/BK) wire between [242B] terminal L2 and [128B].

b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
FLUKE AC/DC CURRENT PROBE	HD-39617	1

NOTE

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

Check starter current draw with **FLUKE AC/DC CURRENT PROBE (Part Number:HD-39617)**. See **How To Use Diagnostic Tools**.

1. Verify that transmission is in neutral.
2. Disconnect CKP sensor [79].
3. Clamp **FLUKE AC/DC CURRENT PROBE (Part Number:HD-39617)** around positive battery cable to starter solenoid.

NOTE

After the start button has been pressed for 10 seconds, the BCM will stop voltage to the starter solenoid automatically.

4. With IGN ON, press start button and read ammeter. Disregard initial high current reading. This is normal when engine is first turned over.
5. Did starter current draw exceed 250A?
    a. **Yes.** Perform a bench test. See **Free Running Current Draw Test**.
    b. **No.** Starter current is within specification.

Special Tools

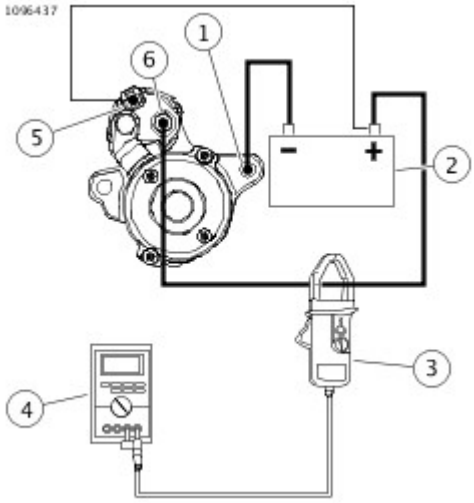
Description	Part Number	Qty.
FLUKE AC/DC CURRENT PROBE	HD-39617	1

1. Place starter in vise. Use a clean shop towel to prevent scratches or other damage.
2. See **Figure 1**. Attach one heavy jumper cable (6 gauge minimum).
   a. Connect one end to starter mounting flange.
   b. Connect the other end to battery (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
   a. Connect one end to battery (+) terminal of battery.
   b. Connect other end to battery terminal on starter. Clamp **FLUKE AC/DC CURRENT PROBE (Part Number:HD-39617)** around cable.

CAUTION

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

4. Connect a smaller jumper cable (14 gauge minimum).
   a. Connect one end to positive (+) terminal of battery.
   b. Connect other end to solenoid relay terminal [128].
5. Check ammeter reading.
   a. Ammeter should show 90A maximum.
   b. If reading is higher, replace starter.
   c. If starter current draw on vehicle was over 250A and this test was within specification, possible causes may be ACR malfunction, engine modifications, or powertrain binding.



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1	Mounting flange
2	Battery
3	Current probe
4	Multimeter
5	Relay terminal
6	Batter terminal

Figure 1. Free Running Current Draw Test

The charging system is the source of electric current that supplies power to run the ignition, lights, accessories and charges the battery.

- AC voltage is generated by an alternator assembly driven by the crankshaft.
- A rotor supplied with a magnetic field spins around a stator.
- A rectifier (located in the regulator) converts the voltage from AC to DC.
- A regulator matches the output voltage to the battery voltage as engine speed varies.

Even though the alternator provides additional voltage at all engine speeds, avoid idling the engine for extended periods of time.

The alternator consists of two main components:

- The rotor which mounts to the primary side of the crankshaft.
- The stator which is attached to the crankcase half.

See **Charging System Circuit**. The voltage regulator is a series regulator. The circuit combines the functions of rectifying and regulating.

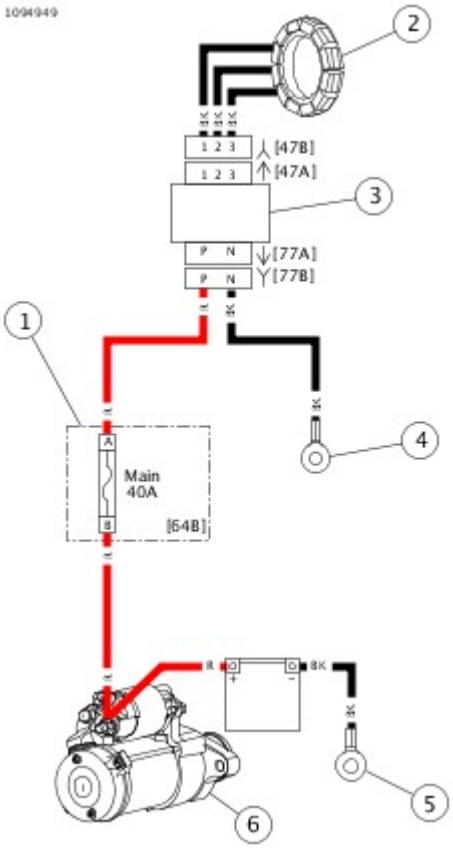
Test for a weak or dead battery. Battery must be fully charged in order to perform a battery diagnostic test, load test or starting or charging tests. See **General**.

The stator connections must be clean and tight.

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

The voltage regulator must be clean and tight. Verify both AC and DC connectors are fully inserted and locked with the regulator latch.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



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1	Fuse block

2	Stator
3	Voltage regulator
4	GND2
5	Engine GND
6	Starter

Figure 1. Charging System Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. Low or No Charging Diagnostic Faults

Battery
Stator malfunction
Rotor malfunction
Voltage regulator malfunction
Open voltage regulator circuit
Stator shorted to ground
AC wire shorted to ground

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Start engine and run at 3000 rpm for 30 seconds.
2. With the engine still running at 3000 RPM, test battery voltage.
3. Is voltage above 14V?
    a. **Yes.** Charging system working properly.
    b. **No.** **Go to Test 3.**

1. Perform AC output test. See **Battery Charging Tests**.
2. Did output test pass?
    a. **Yes.** **Go to Test 6.**
    b. **No.** **Go to Test 4.**

1. Perform stator test. See **Battery Charging Tests**.
2. Is the stator good?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Replace stator.

1. Turn IGN OFF.
2. Inspect rotor magnets for damage.
3. Remove compensator assembly and inspect rotor and shaft splines for excessive wear.
4. Verify stator bolts have not backed out and contacted rotor.
5. Is rotor in good condition?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace rotor.

1. Disconnect voltage regulator [77].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [77B] terminal (+) and battery.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open wire between voltage regulator [77B] terminal (+) and battery.

NOTE

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

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

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. Overcharging Diagnostic Faults

Voltage regulator malfunction
Open in ground circuit

1. Start engine and run at 3000 rpm, test battery voltage.
2. Is voltage above 15.5V?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charging system working properly.

NOTE

Voltage regulator ground must have a clean and tight connection for proper grounding.

1. Turn IGN OFF.
2. Disconnect voltage regulator [77].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [77B] terminal (-) and ground 2.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace voltage regulator.
    b. **No.** Repair open wire between [77B] terminal (-) and ground 2 (BK) wire.

Table 1. Low Battery After Extended IGN OFF Diagnostic Faults

Battery
Accessories improperly wired to stay on at all times
Excessive draw from electrical component with IGN OFF
Battery discharged because motorcycle was not operated for a long period

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Perform milliampere draw test. See **Battery Charging Tests**.
2. Did test exceed maximum draw?
    a. **Yes.** Repair excessive draw and run test again.
    b. **No.** System is working properly.

Table 1. Battery Runs Down During Use Diagnostic Faults

Battery
Excessive accessory draw
Accessories on when idling or low rpm riding for extended period

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace battery.

1. Perform total current draw and output test. See **Battery Charging Tests**.
2. Does charging system exceed current draw by 3.5A?
    a. **Yes.** System is working properly.
    b. **No.** System accessory power requirements exceed charging system capability.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

NOTE

Be sure accessories are not wired so they stay on at all times. This condition could drain battery completely if vehicle is parked for a long time.

1. **Security system:** Enable service mode before performing test. See **General**.
2. Turn IGN OFF.
3. Verify all lights and accessories are OFF.
4. Disconnect the security siren (if equipped).
5. Remove main fuse.

NOTE

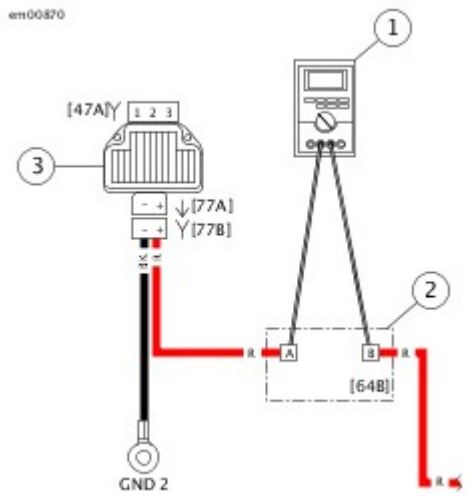
With IGN OFF, an initial current draw will occur directly after connecting meter. This should drop to the values shown in **Table 1** in less than 30 seconds.

6. See **Figure 1**. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect ammeter to main fuse socket terminals. With this arrangement, you will also pick up any regulator drain.
7. Observe current reading.
    a. Add the maximum draw values found in table for the components equipped on the vehicle being tested. If the reading observed on the ammeter is less than the sum of the maximum draw for the components, the draw is within specification. Refer to **Table 1**.
    b. A higher ammeter reading indicates excessive current draw. Locate the component or accessory with high draw by unplugging one at a time while observing the meter reading.

Table 1. Milliampere Draw Test

LHCM	0.5
RHCM	0.5
IM	0.5
Tachometer (if equipped)	0.5
Regulator	1.0
ABS (if equipped)	1.0
BCM	1.0

ECM	1.0
Security siren (if equipped)	20.0*
* Siren will draw for 2-24 hours from time motorcycle battery is connected and 0.05 mA once siren battery is charged. Disconnect siren during milliampere draw test.	



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1	Ammeter
2	Fuse block [64B]
3	Voltage regulator

Figure 1. Milliampere Draw Test (Ignition Turned to OFF)

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

NOTE

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

WARNING

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

1. See **Figure 2**. Connect load tester.
    a. Remove battery.

b. Install battery terminal adapters HD-50977 to the battery.
c. Using two foot long, 4-gauge jumper cables with terminal lugs, connect the battery to the vehicle.

NOTE

Use a 15 cm (6 in) piece of wiring sleeve to cover the positive cable connection to prevent shorting to the frame.

d. Connect negative and positive load tester leads to battery terminals.
e. Place load tester induction pickup over battery negative cable.

2. With IGN OFF, disconnect voltage regulator [77].
3. Start engine.
4. Turn all continuously running lights and accessories ON (headlamp on high beam).
5. Run engine at 3000 rpm and make note of the current draw.
6. Turn IGN OFF.
7. Connect voltage regulator [77].
8. Remove the induction pickup from the battery negative cable.
9. Place induction pickup over positive regulator cable.
10. Start engine and run at 3000 rpm.

NOTE

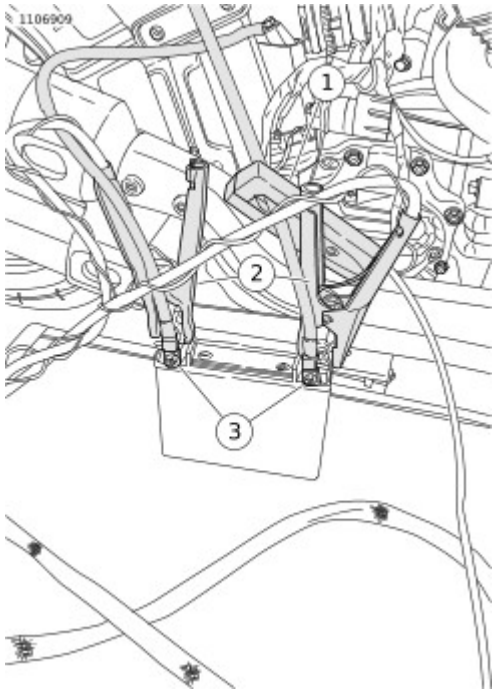
Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

11. Increase the load as required to obtain a constant 13.0V.
12. Current output should be 35-44A. Make note of current output.

NOTE

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

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



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1	Induction pickup
2	Load tester leads
3	Jump cables from battery to vehicle

Figure 2. Check Current Draw (Ignition On)

1. Turn IGN OFF.
2. See **Figure 3**. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect an ohmmeter.
    a. Disconnect voltage regulator [47] 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 continuity.
    a. A good stator will show no continuity (open circuit) between all stator sockets and ground.
    b. Any other reading indicates a grounded stator which must be replaced.
4. See **Figure 4**. Remove ground lead. Test resistance across stator [47B] terminals 1-2, 2-3 and 3-1.
    a. Resistance across all stator terminals should be 0.1-0.3 ohm.
    b. If resistance is out of range, replace stator.

NOTE

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

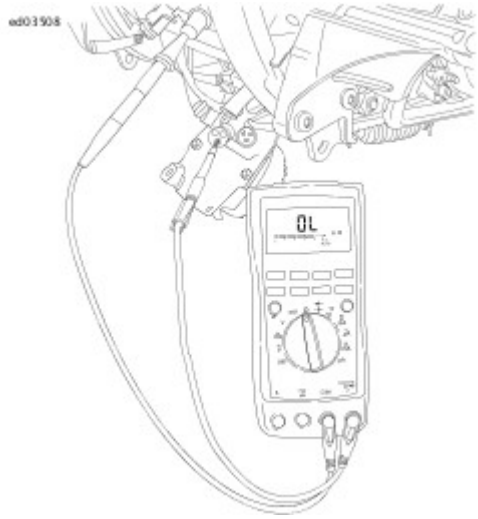

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Figure 3. Test for Grounded Stator (Typical)

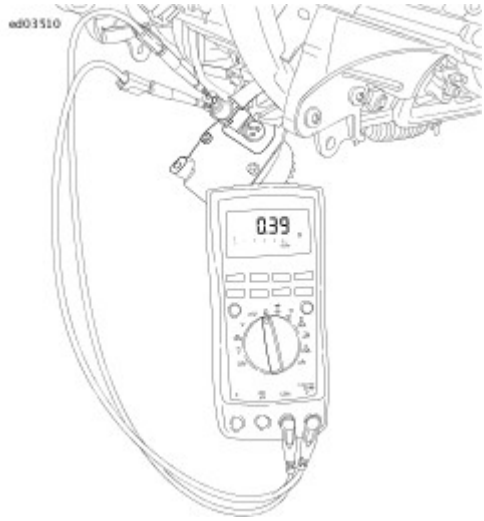

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Figure 4. Check for Stator Resistance (Typical)

1. See **Figure 5**. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test AC output.
    a. Disconnect voltage regulator [47] from alternator stator wiring.
    b. Test for VAC across stator [47B] terminals 1 to 2.
    c. Run the engine at 2000 rpm. The VAC output should be 32-56 VAC (approximately 16-28 per 1000 rpm).
    d. Repeat test using terminals 2 to 3 and 1 to 3.
2. Compare test results to specifications.
    a. If the output is below specifications, charging problem could be a faulty rotor or stator.
    b. If output is within specifications, charging problem might be faulty voltage regulator. Replace as required.

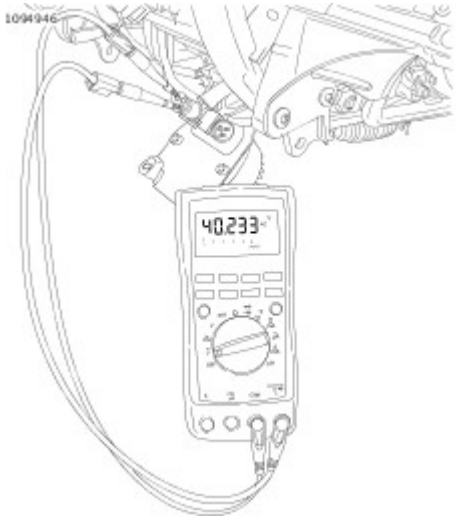

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Figure 5. Check Stator AC Voltage Output (Typical)

Battery voltage is monitored by the ABS module.

- If the battery voltage fails to meet normal operating parameters, the ABS indicator is illuminated.
- If the voltage remains out of normal operating parameters and the vehicle speed is above 6 km/h (4 mph), a DTC is set.

Battery voltage is monitored by the ABS module on both terminals 9 and 18.

- DTC C0562 is displayed when the ABS ECU falls below 9.4V during a non-ABS event or the ABS ECU falls below 9.2V during an ABS event.
- DTC C0563 is displayed when the ABS ECU exceeds 16.8V during a non-ABS event.

Table 1. Code Description

C0562	ABS voltage low
C0563	ABS voltage high

Any of the following conditions could cause these DTCs to set:

- The charging system is malfunctioning.
- There is excessive battery draw.
- Extended idling in heavy traffic.
- A faulty system ground is present.
- Shorted ABS actuator circuit.

Low voltage generally indicates a loose wire, corroded connections, battery or a charging system problem.

High voltage DTC may set when the vehicle is placed on an unapproved constant current battery charger for a long period of time.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

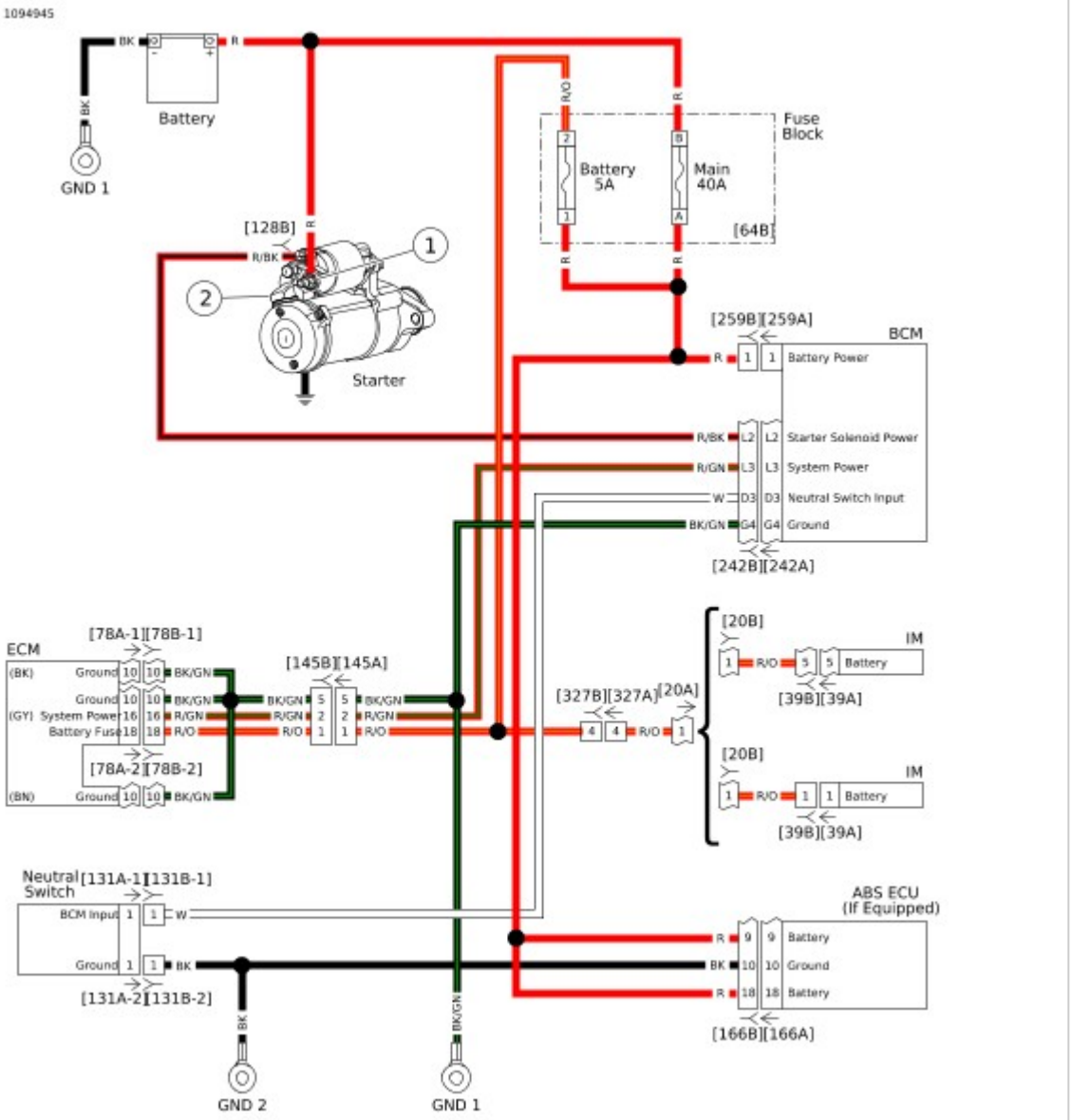

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Figure 1. High and Low Voltage Modules

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. DTC C0562 Diagnostic Faults

Low battery
Open ABS ECU ground circuit
Open ABS ECU battery circuit

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes. Go to Test 2.**
    b. **No.** Replace battery.

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** between wire harness [166A] and [166B]. See **How To Use Diagnostic Tools**.
3. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
4. With transmission in neutral, turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminals 9 and 10.
6. Test voltage between BOB terminals 18 and 10.
7. Is battery voltage present on both?
    a. **Yes. Go to Test 9.**

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

1. Perform a voltage drop test between battery (+) terminal and BOB terminal 9. See **Voltage Drop**.
2. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** **Go to Test 5.**

1. Perform a voltage drop test between BOB terminal 10 and battery (-) terminal.
2. Is voltage drop greater than 0.5V?
    a. **Yes.** Repair wiring between [166B] terminal 10 and battery negative.
    b. **No.** Problem may be intermittent. Locate and repair bad connection. Perform **Wiggle Test**. If no problem is found, then continue with tests. **Go to Test 9.**

1. Perform a voltage drop test between fuse block [64B] socket terminal A and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair or replace (R) wire between [64B] socket terminal A and BCM power [259B].

1. Perform a voltage drop test between [64B] socket terminal B and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Repair or replace [64B] socket terminals A and B.

1. Perform a voltage drop test between starter terminal 1 and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** Repair or replace (R) wire between starter terminal 1 and battery (+).
    b. **No.** Repair or replace (R) wire between starter terminal 1 and [64B] socket terminal B.

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Does DTC set?

a. **Yes.** Replace ABS module.
b. **No.** System working properly.

Table 1. DTC C0563 Diagnostic Faults

Charging system malfunction

1. Perform charging system tests. See **Description and Operation**.
2. Is charging system good?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair charging system.

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Did DTC reset?
    a. **Yes.** Replace ABS ECU.
    b. **No.** System working properly.

Battery voltage is monitored by the ECM on the system power terminal 16 of [78-2]. The system power is supplied to the ECM from the BCM system power terminal L3.

DTC P0562 is displayed when system power is less than 12.2V at idle and voltage does not increase when engine speed is greater than 2000 rpm.

Table 1. Code Description

P0562	ECM voltage low

Any of the following conditions could cause these DTCs to set:

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

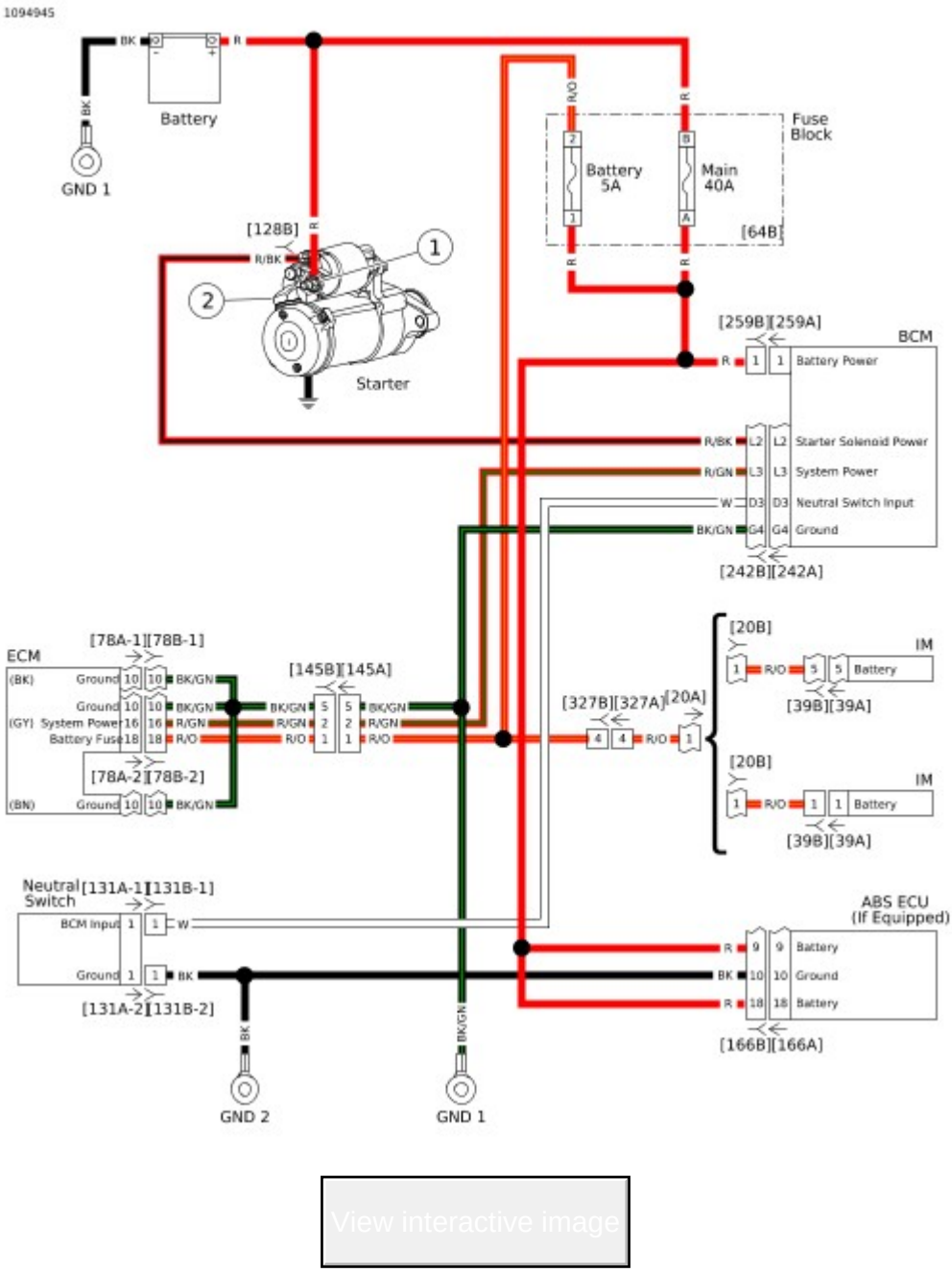


Figure 1. High and Low Voltage Modules

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0562 Diagnostic Faults

Low battery
Open ECM ground circuit
Open ECM system power circuit

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes. Go to Test 2.**
    b. **No.** Replace battery.

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3] and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.

4. Start vehicle.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminals 16 and 10.
6. Is voltage greater than 12.2V?
    a. **Yes.** System is working properly.
    b. **No.** **Go to Test 4.**

1. Test voltage between BOB [78-2] terminal 16 and ground.
2. Is voltage greater than 12.2V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** **Go to Test 8.**

1. Turn IGN OFF.
2. Test resistance between BOB [78-1] terminal 10 and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair wiring between ECM [78B-1] terminal 10 and ground.

1. Test resistance between BOB [78-2] terminal 10 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair wiring between ECM [78B-2] terminal 10 and ground.

1. Test resistance between BOB [78-3] terminal 10 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Problem may be intermittent. Locate and repair bad connection. Perform **Voltage Drop**. If no problem is found, then continue with tests. **Go to Test 13.**
    b. **No.** Repair wiring between ECM [78B-3] terminal 10 and ground.

1. Turn IGN OFF.
2. Remove BOB.
3. Connect [78A] to [78B].
4. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
5. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
6. Start vehicle.

7. Test voltage between BOB terminal L3 and ground.
8. Is voltage greater than 12.2V?
    a. **Yes.** Repair (R/GN) wire between [242B] terminal L3 and [78B-2] terminal 16.
    b. **No.** **Go to Test 9.**

1. Turn IGN OFF.
2. Disconnect BCM power [259].
3. Test voltage at [259B].
4. Is battery voltage present?
    a. **Yes.** Replace BCM.
    b. **No.** **Go to Test 10.**

1. Connect [259].
2. Turn IGN ON.
3. Leaving main fuse in place, perform a voltage drop test between fuse block [64B] socket terminal A and battery (+).
4. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 11.**
    b. **No.** Repair or replace (R) wire between fuse block [64B] socket terminal A and [259B].

1. Leaving main fuse in place, perform a voltage drop test between fuse block [64B] socket terminal B and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 12.**
    b. **No.** Repair or replace [64B] socket terminals A and B.

1. Perform a voltage drop test between starter terminal 1 and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** Repair or replace (R) wire between starter terminal 1 and battery (+).
    b. **No.** Repair or replace (R) wire between starter terminal 1 and fuse block [64B] socket terminal B.

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Did DTC reset?
    a. **Yes.** Replace ECM.

b. **No.** System working properly.

The RHCM is monitored by the BCM. Any communication failures between both modules sets a DTC.

These DTCs only refer to the redundant engine stop switch (W/GY) wire from the RHCM.

- DTC B2206 is set when the BCM indicates an open between [242B] terminal C4 and the engine stop switch.
- DTC B2208 is set when the BCM indicates a short to ground between [242B] terminal C4 and the engine stop switch.

Table 1. Code Description

B2206	Run/stop switch input open/shorted high
B2208	Run/stop switch input shorted low

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

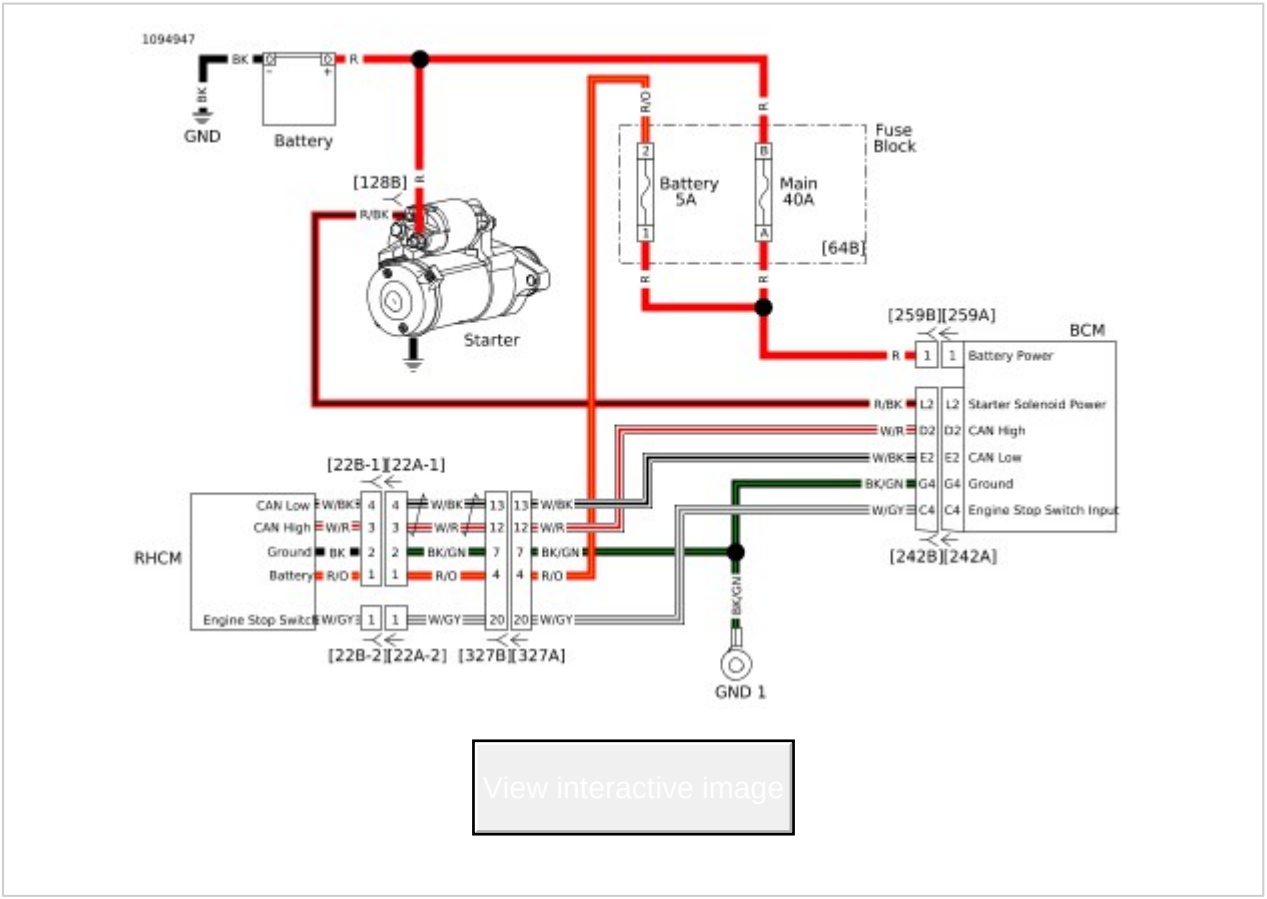


Figure 1. Starter

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2206 Diagnostic Faults

Open in engine stop circuit

1. Turn IGN OFF.
2. Disconnect RHCM [22-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [22A-2] terminal 1 (W/GY) wire and ground during the first 4-5 seconds after IGN ON.
4. Turn IGN ON.
5. Is voltage present?
    a. **Yes.** Replace RHCM.
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. During the first 4-5 seconds after IGN ON, test voltage between BOB terminal C4 and ground.
5. Is voltage present?
    a. **Yes.** Repair open in (W/GY) wire between [242B] terminal C4 and [22A-2].
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2208 Diagnostic Faults

Short to ground in engine stop circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test continuity between BOB terminal C4 and ground.
5. Is continuity present?
    a. **Yes. Go to Test 2.**
    b. **No.** Replace BCM.

1. Disconnect RHCM [22A-2].
2. Test continuity between BOB terminal C4 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground between [242B] terminal C4 and [22A-2] (W/GY) wire.
    b. **No.** Replace RHCM.

See **Figure 1**. Battery voltage is constantly monitored by the BCM and IM. Any voltage readings outside of normal parameters set a DTC.

The BCM monitors [259] terminal 1 for battery power.

DTC B2271 is displayed when battery voltage is less than 9.0V.

The BCM monitors [259] terminal 1 and the speedometer monitors terminal 5 for battery power.

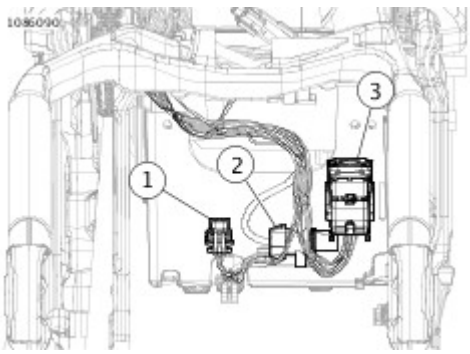
- DTC B2272 (BCM) is displayed when battery voltage is greater than 16.1V for longer than 5 seconds.
- DTC B2272 (Speedometer) is displayed when battery voltage is greater than 16.0V for longer than 5 seconds.

NOTE

ECM, ABS, and/or BCM may also set a battery voltage DTC.

Table 1. Code Description

B2271	BCM voltage low
B2272	BCM/speedometer voltage high



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1	Security siren [142]
2	BCM power [259]
3	BCM [242]

Figure 1. Front of Rear Tire

High voltage DTC may set when the vehicle is placed on an unapproved constant current battery charger, on fast charge, for a long period of time.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

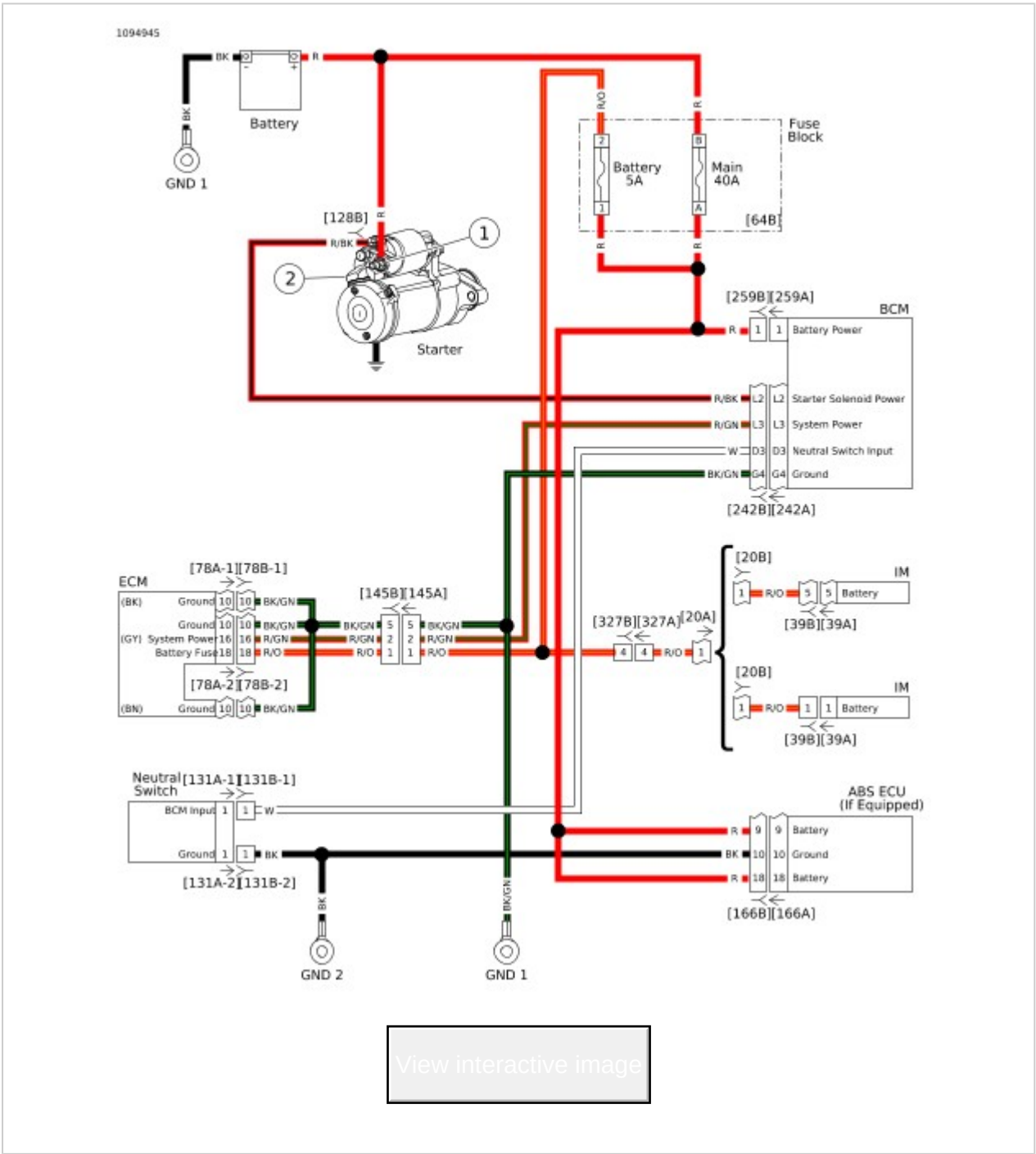


Figure 2. High and Low Voltage Modules

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC B2271 Diagnostic Faults

Charging system malfunction
BCM power circuit
Open in battery power circuit

1. Perform battery test. See **General**.
2. Did battery pass test?
    a. **Yes. Go to Test 2.**
    b. **No.** Charge or replace battery as needed. Verify repair.

1. Perform charging system test. See **Low or No Charging**.
2. Is charging system working properly?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair charging system. **Go to Test 7.**

1. Turn IGN OFF.
2. Disconnect BCM power [259].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [259B] to ground.
4. Is battery voltage present?
    a. **Yes. Go to Test 7.**
    b. **No. Go to Test 4.**

1. Perform a voltage drop test between fuse block [64B] socket terminal A and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes. Go to Test 5.**
    b. **No.** Repair or replace (R) wire between fuse block [64B] socket terminal A and [259B].

1. Perform a voltage drop test between fuse block [64B] socket terminal B and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair or replace fuse block [64B] socket terminals A and B.

1. Perform a voltage drop test between starter terminal 1 and battery (+).
2. Is voltage drop greater than 0.5V?
    a. **Yes.** Repair or replace (R) wire between starter terminal 1 and battery (+).
    b. **No.** Repair or replace (R) wire between starter terminal 1 and fuse block [64B] socket terminal B.

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** System working properly.

Table 1. DTC B2272 Diagnostic Faults

Charging system malfunction

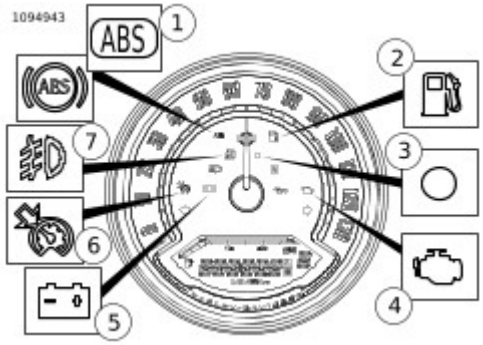
1. Perform charging system tests. See **Overcharging**.
2. Is charging system good?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair charging system.

1. Clear DTCs.
2. Start vehicle.
3. Run at 3000 rpm for 5 seconds.
4. Did DTC reset?
    a. **Yes, DTC set by speedometer.** Replace speedometer.
    b. **Yes, DTC set by BCM.** Replace BCM.
    c. **No.** System working properly.

See **Figure 1**. The IM contains several indicators. These indicators include the check engine, security, low battery, low fuel lamps and ABS and cruise control (if equipped).

Pressing the trip odometer reset switch, located on the left hand controls, provides the following functions:

- Change the odometer display between total mileage, trip odometer A and trip B, fuel remaining, 12/24 hour clock and tachometer.
- Reset the trip odometer (press and hold 2-3 seconds).
- Gain access to self-diagnostic mode and clear diagnostic codes. See **Odometer Self-Diagnostics**.
- Holding the trip switch for 2 seconds will put the vehicle in accessory mode.



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1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine
5	Battery
6	Cruise enabled
7	Aux lighting

Figure 1. Indicator Lamps (Except FXBB, FXBR)

The odometer mileage is permanently stored and will not be lost when electrical power is turned off or disconnected. The trip odometer reset switch allows switching between the odometer, trip odometer and fuel range displays.

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

The vehicle speed sensor is mounted at the back of the transmission case. The VSS is a Hall-Effect sensor that is triggered by the gear teeth of fifth gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by ECM, converted into CAN bus data then sent to the IM. The IM uses the data to control the position of the IM needle. The data message is also used by the BCM for turn signal cancellation.

The IM monitors direct inputs from sensors and switches, along with receiving information from the other modules over the CAN bus lines. It sets codes when the parameters for the inputs are out of range.

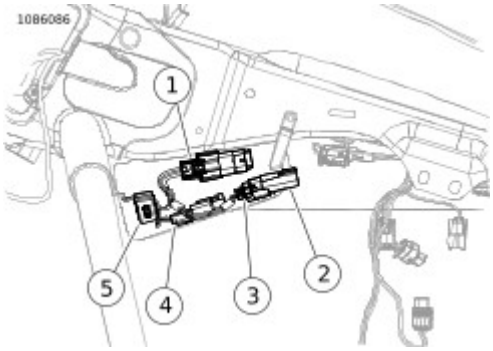
The fuel level is monitored by the ECM [78-1] at terminal 12 (Y/W) wire. The low fuel warning lamp serves two functions. It is used to indicate a low fuel condition and to communicate a circuit problem with the fuel sender circuit. The IM will flash the low fuel warning lamp on and off at a steady rate when a current fuel level sender DTC is set.

- If the voltage on terminal 12 exceeds the lower limit for greater than or equal to 15 seconds, a DTC P0462 will be set.
- If the voltage on terminal 12 exceeds the upper limit (or is open) for greater than or equal to 15 seconds, a DTC P0463 will set.

Table 1. Code Description

P0462	Fuel sender shorted low
P0463	Fuel sender shorted high/open

As the fuel level changes, the resistance of the sender changes. As the resistance of the sender changes, the voltage on the (Y/W) wire changes.



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1	USB caddy interconnect [329]
2	USB [264]
3	Fuel pump [141]
4	ET sensor [90]

Figure 1. Under Fuel Tank Left Side

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

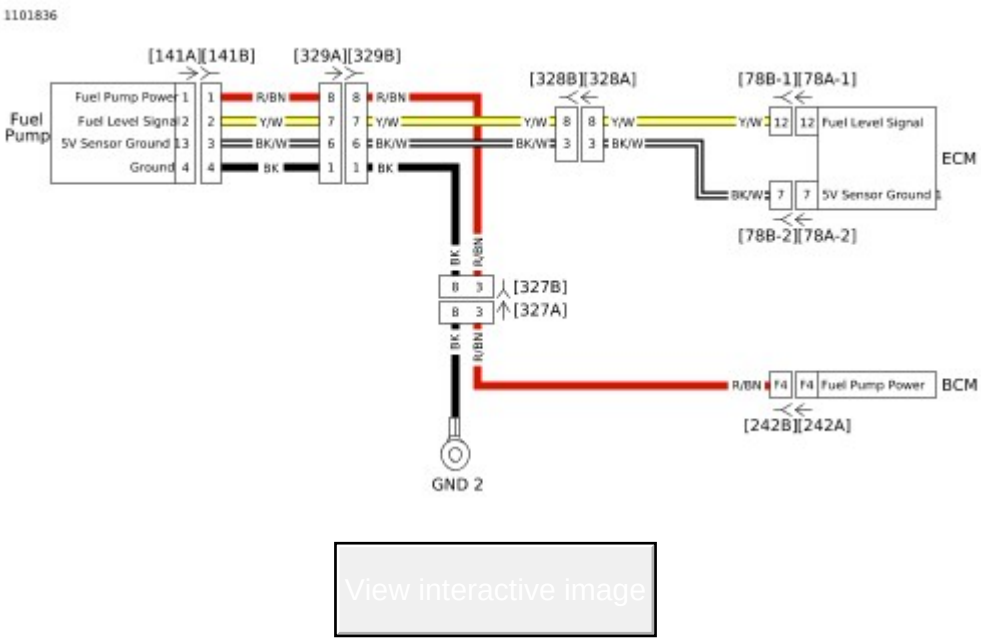


Figure 2. Fuel Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P0462 Diagnostic Faults

Short to ground in fuel level sender circuit
Fuel level sender assembly malfunction

1. Turn IGN OFF.
2. Disconnect the fuel pump [141] and ECM [78-1].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test for continuity between [141A] terminal 2 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in the (Y/W) wire.
    b. **No.** **Go to Test 2.**

1. Measure the resistance of fuel level sender between [141B] terminals 2 and 3.
2. Is the resistance between 50-260 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace the fuel pump assembly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1

Table 1. DTC P0463 Diagnostic Faults

Short to voltage in fuel level sensor circuit
Fuel level sender malfunction
Open fuel level sensor circuit

1. Disconnect ECM [78-1].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test for voltage between [141A] terminal 2 and ground.
3. Turn IGN ON.
4. Is voltage present?
    a. **Yes.** Repair short to voltage in (Y\W) wire.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected.
3. Measure resistance between [78B-1] terminal 12 and [141A] terminal 2.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (Y\W) wire.

1. Measure the resistance of the fuel level sender between [141B] terminals 2 and 3.
2. Is the resistance between 50-260 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace fuel pump assembly.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

DTC B2255 will be set if trip odometer reset switch is closed for more than 2 minutes. This code can be set by the IM or the BCM. It will normally be set by both if there is a concern with the trip odometer reset switch.

Odometer self-diagnostics will not function if the switch is stuck. It will not be possible to toggle the switch to navigate through the different diagnostic steps in the odometer.

- A stuck trip odometer reset switch disables odometer self-diagnostics.
- If **DIGITAL TECHNICIAN II (Part Number:HD-48650)** is connected to the DLC [91] and communicating with the vehicle then the odometer self-diagnostics will not function properly.
- Disconnect **DIGITAL TECHNICIAN II (Part Number:HD-48650)** before entering odometer self-diagnostics.

Table 1. Code Description

B2255	Trip switch stuck

Table 1. Trip Odometer Functions Inoperative Diagnostic Faults: DTC B2255

Trip odometer reset switch malfunction

1. Check trip switch for damage or obstruction.
2. Is switch moving freely?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Remove obstruction. If switch will not move freely replace LHCM.

1. Turn IGN ON.
2. Press and release trip odometer reset switch.
3. Does odometer cycle through different odometer counters?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Turn IGN ON while pressing trip odometer reset switch.
3. Does IM needle sweep its full range of motion?
    a. **Yes.** System functioning properly. Test for intermittent condition. See **Wiggle Test**.
    b. **No.** Replace IM.

1. Operate other switches on LHCM.
2. Do any switches operate?
    a. **Yes.** Replace LHCM.
    b. **No.** See **Left Hand Controls Inoperative: DTC U0141**.

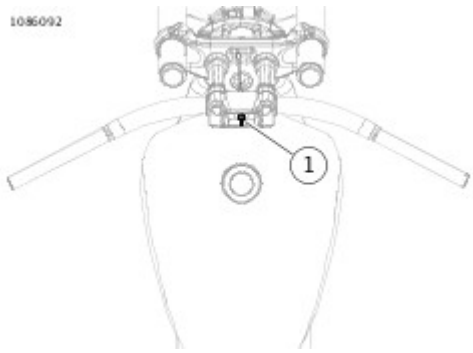
See **Figure 1** and **Figure 2** (all other models similar). The IM receives battery power at terminal 1 or 5. This is supplied through the battery fuse located in fuse block [64]. When the ACC power is on, the IM illuminates the backlighting and the odometer.

When IGN power is on, the IM illuminates the check engine, low fuel level, security and ABS lamp (if equipped). The backlighting, odometer, neutral lamp and low oil lamp also illuminate with the IGN ON.

The IM sets a DTC B1200 if it detects an internal malfunction.

Table 1. Code Description

B1200	Internal fault
B1201	Internal fault - default cal



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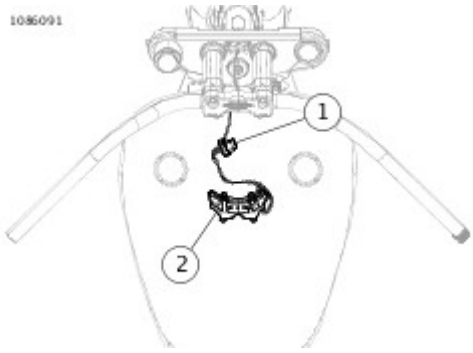
1	IM [39]

Figure 1. IM: FXBB, FXBR



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1	IM [39]

2	Indicator lamps

Figure 2. IM: FLDE, FLHC/S, FLSL

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

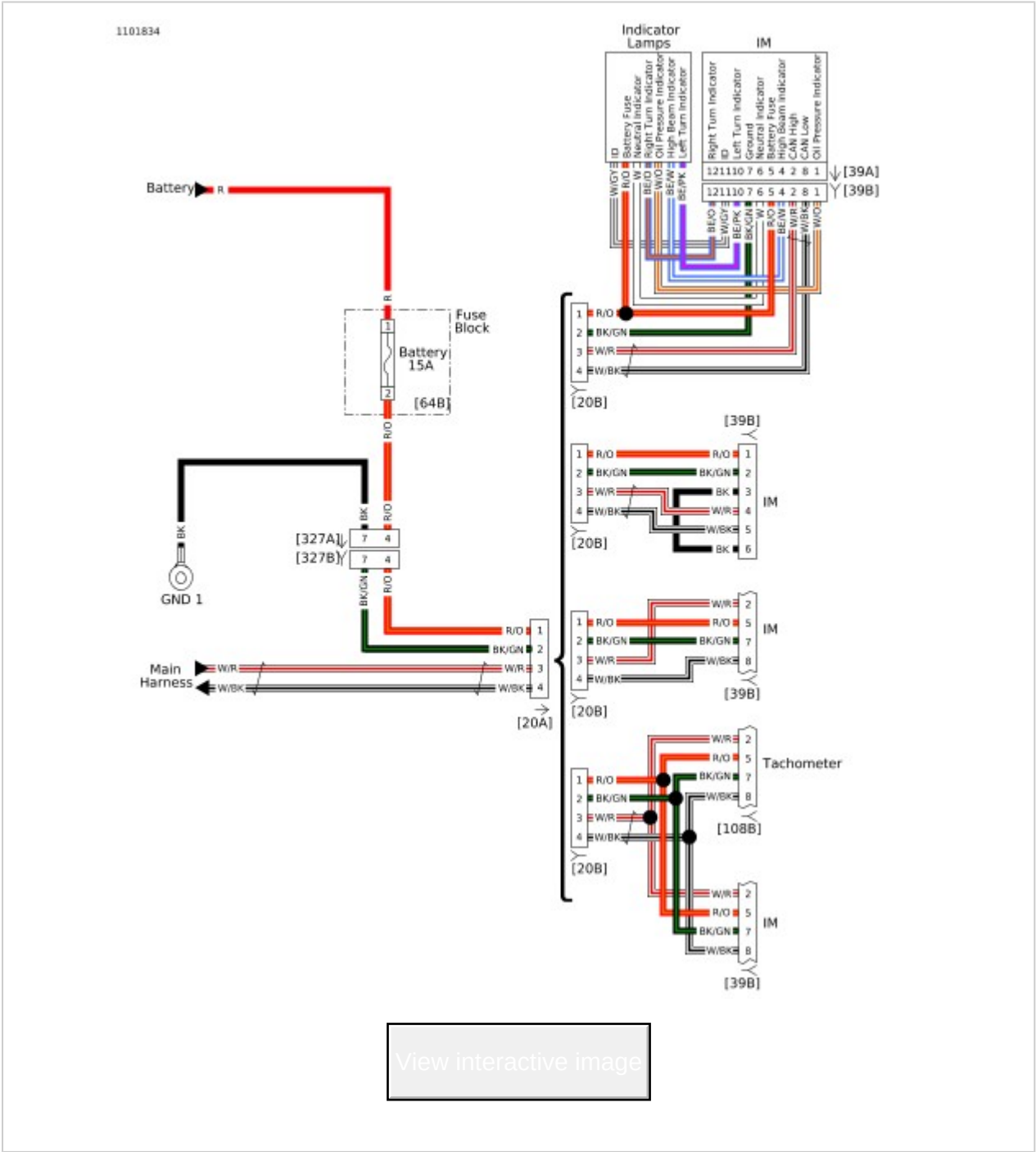


Figure 3. IM Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. No Instrument Power Diagnostic Faults

Open battery circuit
Open ground circuit
Open in CAN bus circuit to IM

1. Turn IGN ON.
2. Observe headlamp.
3. Does headlamp or tail lamp illuminate?
    a. **Yes. Go to Test 2.**
    b. **No.** See **No Vehicle Power: DTC U0140**.

1. Attempt to start vehicle.
2. Does engine crank?
    a. **Yes. Go to Test 3.**
    b. **No.** See **Description and Operation**.

1. Disconnect IM [39].
2. Inspect [39].
3. Is [39] a 12 place connector?
    a. **Yes. Go to Test 4.**
    b. **No. Go to Test 5.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39]. Attach connectors from **BREAKOUT BOX (Part Number:HD-42682)** to harness adapters leaving [39A] disconnected. See **How To Use Diagnostic Tools**.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal 5 and ground.
4. Is battery voltage present?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (R/O) wire.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [39B] terminal 1 and ground.
2. Is battery voltage present?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open in (R/O) wire.

1. Test resistance between BOB terminal 7 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace IM.
    b. **No.** Repair open in (BK/GN) wire.

1. Test resistance between [39B] terminal 2 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace IM.
    b. **No.** Repair open in (BK/GN) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. DTC B1200 Diagnostic Faults

Open in IM battery power circuit
Open in IM ground circuit

1. 1. Disconnect IM [39].
2. Inspect [39].
3. Is [39] a 12 place connector?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-42682)** and **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to wiring harness [39B], leaving [39A] disconnected. See **How To Use Diagnostic Tools**.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal 5 and ground.
4. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between BOB terminals 5 and 7.
2. Is battery voltage present?
    a. **Yes.** Replace IM.
    b. **No.** Repair open in ground circuit.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [39B] terminal 1 and ground.
2. Is battery voltage present?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (R/O) wire.

1. Test voltage between [39B] terminals 1 and 2.
2. Is battery voltage present?
    a. **Yes.** Replace IM.
    b. **No.** Repair open in ground circuit.

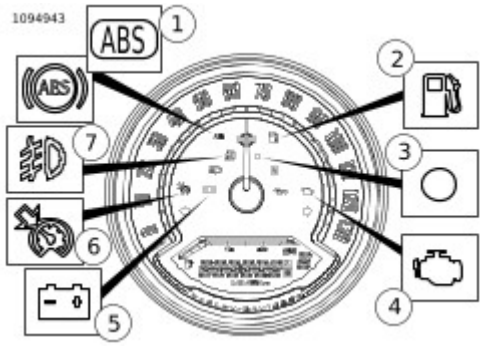
Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

See **Figure 1**. The battery, check engine, security, cruise control, ABS and low fuel indicators are located in the IM. The other indicators are located in the indicator bar (if equipped) separate from the IM.

Table 1. Code Description

B1214	External indicator bar short to battery
B1215	External indicator bar open load
B1216	External indicator bar short to ground
P0522	Engine oil pressure sensor/switch shorted low
P0523	Engine oil pressure sensor/switch shorted high/open



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1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine
5	Battery
6	Cruise enabled
7	Aux lighting

Figure 1. Indicator Lamps (Except FXBB, FXBR)

The IM illuminates the ABS indicator when the following occurs:

- The EHCU detects an ABS disabling malfunction. The EHCU sends a serial data message to the instrument requesting illumination.
- The IM performs a bulb check.
- The IM detects a loss of communication with the EHCU.
- See **Figure 2**. The ABS light may flash when the IGN is turned on. This will continue until the vehicle is driven to verify WSS operation.

The EHCU sends a message to the instrument when a malfunction that disables ABS operation is detected. Depending on the fault, the ABS indicator may stay on even after the malfunction is corrected. The indicator will not go off until the vehicle is operated at speeds greater than 16 km/h (10 mph). It is important to verify that this is not the cause of an ABS indicator, which is illuminated when no DTCs are set, before attempting to diagnose other possible causes.

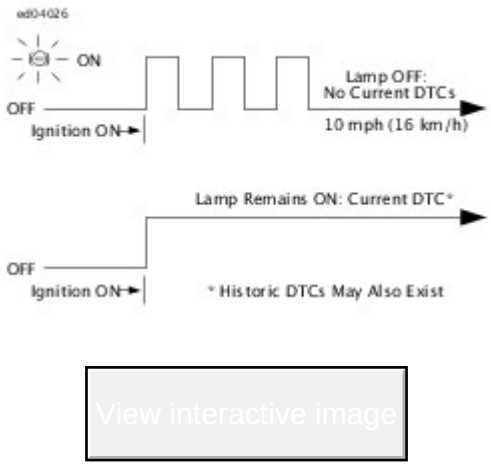

Figure 2. ABS Lamp Operation

See **Figure 3**. When the IGN is turned ON, the security lamp will illuminate for approximately four seconds and then turn off. The BCM and ECM controls the security lamp by sending a CAN message to the IM. The ECM uses the security lamp for non-emissions related DTCs. After the security lamp turns off following the first four second illumination period, one of two events may occur.

- The lamp remains off. This indicates there are no current or historic DTCs currently detected by the BCM or ECM.
- If the lamp illuminates again and remains lit, a current or historic DTC exists.

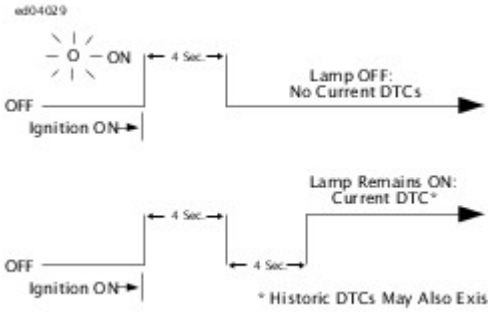

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Figure 3. Security Lamp Operation

When the IGN is ON, the check engine lamp will illuminate and stay illuminated until the engine is started. After engine startup, one of two events may occur.

- See **Figure 4**. The lamp turns off. This indicates there are no current or historic stored DTCs currently detected by the ECM.
- If the lamp remains illuminated, a current or historic DTC exists.

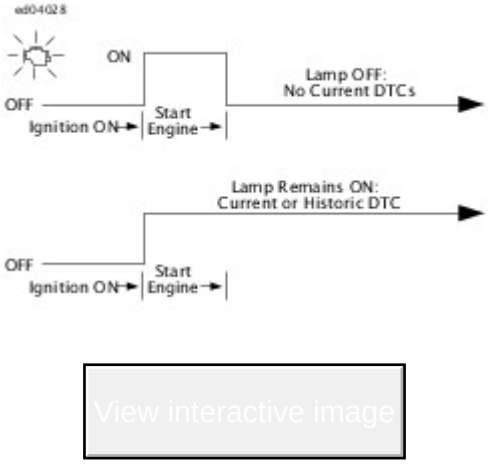

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Figure 4. Check Engine Lamp

The BCM sends a message to the IM to control the low battery lamp. The IM will turn the lamp on if the BCM identifies a low voltage condition on [259] terminal 1.

The low fuel indicator is controlled at terminal 12 (Y/W) of the ECM. When the fuel drops below 3.79 L (1.0 USgal), it signals the IM to activate the low fuel lamp. The low fuel lamp will also flash on and off at a steady rate if there is a problem with the circuit. The low fuel indicator can be enabled on and off using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**. Verify the vehicle is properly configured when diagnosing the low fuel indicator.

The low fuel lamp will not turn off until there is sufficient fuel in the tank, the ignition switch has been turned off and back on, and the vehicle has begun forward speed.

The neutral indicator is controlled through the (W) wire connected to the IM. When the transmission is in neutral, the neutral switch closes and supplies a ground to the BCM on terminal D3. The BCM then sends a message to the IM over the CAN bus indicating the transmission is in neutral. The IM supplies ground to the neutral indicator causing it to illuminate.

The oil pressure indicator is connected to the ECM at terminal 12. The switch opens when oil pressure is low. The ECM then sends a message to the IM over the CAN bus indicating the oil pressure is low. The IM supplies ground to the oil pressure indicator causing it to illuminate.

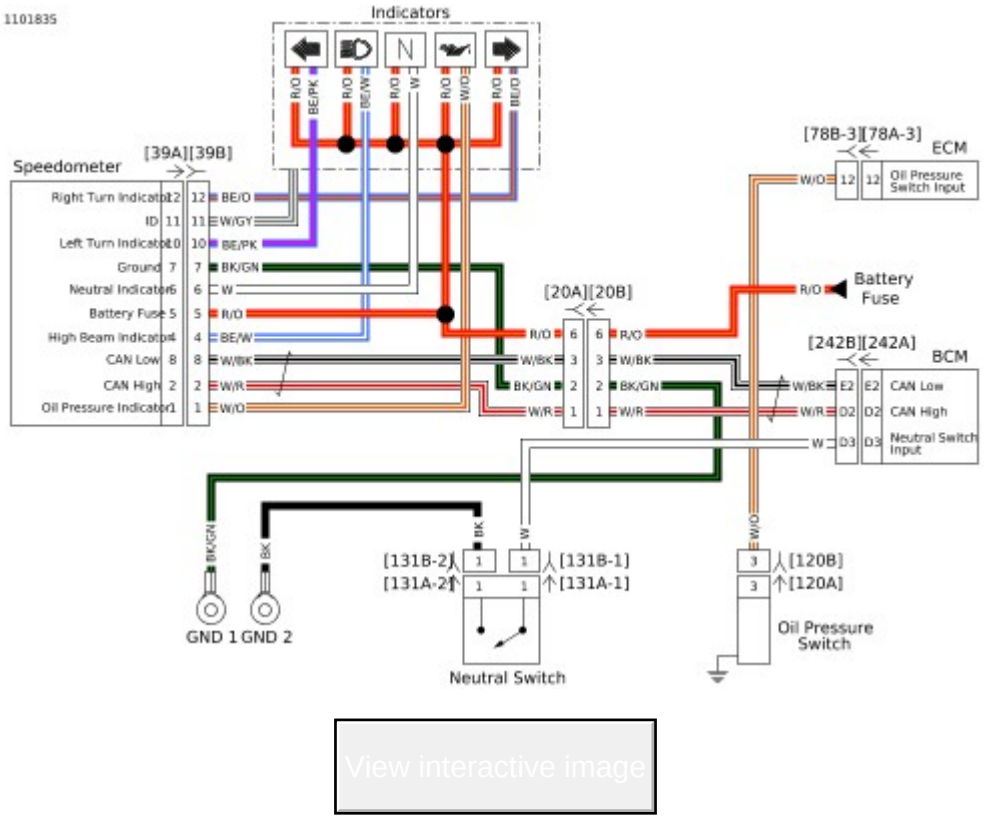
The turn signal indicators are controlled by the IM. When the BCM receives a CAN bus message from the left or right turn signal switch it flashes the correct turn signals. At the same time the BCM sends a message to the IM over the CAN bus indicating which turn signal to operate. The IM supplies ground to the corresponding turn signal indicator causing it to illuminate.

This circuit is grounded by the IM when the headlamp switch is placed in the high beam position. In the high position, a message is sent over the CAN bus to the IM and the BCM. The IM controls the indicator and the BCM controls the headlamp.

After replacing a component in the fuel circuit, verify the tank is full of fuel. Remove the main fuse for 2 minutes and install to turn low fuel lamp off.

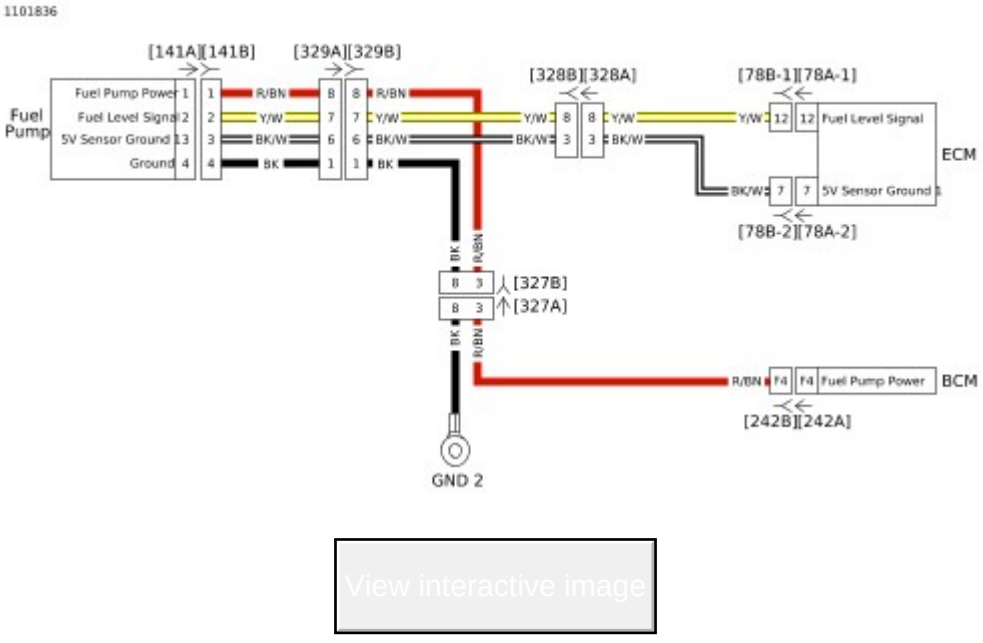
Some aftermarket fuel gauges not made by Harley-Davidson may cause the fuel circuit to report inaccurate readings.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



View interactive image

Figure 5. Indicator Circuit



View interactive image

Figure 6. Fuel Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1

Table 1. DTC B1214, B1215, B1216 Diagnostic Faults

Short to battery in indicator ID circuit
Open in indicator ID circuit
Short to ground in indicator ID circuit
Indicator malfunction
IM malfunction

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wiring harness [39B], leaving [39A] disconnected. See **How To Use Diagnostic Tools**.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal 11 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (W/GY) wire.
    b. **No. Go to Test 2.**

1. Turn IGN ON.
2. Test voltage between BOB terminal 11 and ground.
3. Is battery voltage present?
    a. **Yes.** Repair short to voltage in (W/GY) wire.
    b. **No. Go to Test 3.**

1. Test voltage between BOB terminal 11 and ground.
2. Is voltage present?
    a. **Yes. Go to Test 4.**

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

1. Replace indicator harness.
2. Clear DTC.
3. Did DTC return?
    a. **Yes.** Replace IM.
    b. **No.** Repair complete.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
OIL PRESSURE TEST GAUGE KIT	HD-96921-52D	1

Table 1. Oil Pressure Lamp Always On Diagnostic Faults

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

1. Start engine.
2. Does oil pressure lamp turn OFF and stay off?
    a. **Yes.** Oil pressure lamp is operating properly. Test for intermittent. See **Wiggle Test**.
    b. **No.** **Go to Test 2.**

1. Disconnect oil pressure switch [120].
2. Does oil pressure lamp turn OFF when the engine is running?
    a. **Yes.** **Go to Test 4.**
    b. **No.** **Go to Test 3.**

1. Disconnect [78-3].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [120B] terminal 3 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (W/O) wire.
    b. **No.** Replace indicator harness.

1. Inspect engine for any issues that impact oil pressure.
2. Using **OIL PRESSURE TEST GAUGE KIT (Part Number:HD-96921-52D)**, verify engine oil pressure.
3. Is oil pressure within specification?
    a. **Yes.** Replace oil pressure switch.
    b. **No.** Repair as needed.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P0523 Diagnostic Faults

Open oil pressure circuit
Indicator malfunction
Open ground circuit
Short to voltage in oil pressure circuit

1. Disconnect oil pressure switch [120].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [120B] terminals 1 and 3.
3. Is voltage greater than 6V?
    a. **Yes.** Repair short to voltage in (W/O) wire.
    b. **No. Less than 4V.** **Go to Test 2.**
    c. **No. Between 4V and 6V.** Replace oil pressure switch.

1. Test voltage between [120B] terminal 3 and ground.
2. Is voltage less than 4V?
    a. **Yes.** Repair open in (W/O) wire.
    b. **No.** Repair open in (BK/W) wire.

Table 1. Neutral Lamp Always On Diagnostic Faults

Short to ground in neutral switch circuit
Short to ground in neutral indicator circuit

1. Observe neutral lamp.
2. Does neutral lamp illuminate?
    a. **Yes.** **Go to Test 2.**
    b. **No.** See **Neutral Lamp Inoperative**.

1. Disconnect IM [39].
2. Did neutral lamp turn OFF?
    a. **Yes.** Replace IM.
    b. **No.** Repair short to ground in (W) wire between neutral indicator and IM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Neutral Lamp Inoperative Diagnostic Faults

Neutral switch malfunction
Open ground circuit
Open neutral switch circuit
Indicator malfunction

1. Verify vehicle is in neutral.
2. Does neutral lamp illuminate?
    a. **Yes.** Test for intermittent. See **Wiggle Test**.
    b. **No.** **Go to Test 2.**

1. Verify vehicle is in neutral.
2. With clutch lever released, start engine.
3. Does engine start?
    a. **Yes.** **Go to Test 6.**
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect neutral switch [131].

3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, jumper [131B-1] terminal 1 and [131B-2] terminal 1.
4. Does neutral lamp turn ON?
    a. **Yes.** Replace neutral switch.
    b. **No.** **Go to Test 4.**

1. Jumper between [131B-1] terminal 1 and ground.
2. Does neutral lamp turn on?
    a. **Yes.** Repair open in (BK) ground wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Connect the **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Test resistance between BOB terminal D3 and [131B-1] terminal 1 (W) wire.
6. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (W) wire between indicators and neutral switch.

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39]. Attach connectors from **BREAKOUT BOX (Part Number:HD-42682)** to harness adapters, leaving [39A] disconnected.
4. Turn IGN ON.
5. Jumper BOB terminal 6 to ground.
6. Does neutral lamp illuminate?
    a. **Yes.** Replace IM.
    b. **No.** Replace indicator harness.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. High Beam Indicator Inoperative Diagnostic Faults

Indicator malfunction
Open high beam indicator circuit

1. Operate headlamp switch.
2. Do high and low beam headlamps function correctly?
    a. **Yes.** **Go to Test 2.**
    b. **No.** See **Description and Operation**.

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Turn IGN ON.
4. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39]. Attach connectors from **BREAKOUT BOX (Part Number:HD-42682)** to harness adapters, leaving [39A] disconnected.
5. Jumper BOB terminal 4 to ground.
6. Does high beam indicator illuminate?
    a. **Yes.** Replace IM.
    b. **No.** Replace indicator harness.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. High Beam Indicator Inoperative Diagnostic Faults

Indicator malfunction
Open high beam indicator circuit

1. Operate headlamp switch.
2. Do high and low beam headlamps function correctly?
    a. **Yes.** **Go to Test 2.**
    b. **No.** See **Description and Operation**.

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Turn IGN ON.
4. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39]. Attach connectors from **BREAKOUT BOX (Part Number:HD-42682)** to harness adapters, leaving [39A] disconnected.
5. Jumper BOB terminal 4 to ground.
6. Does high beam indicator illuminate?
    a. **Yes.** Replace IM.
    b. **No.** Replace indicator harness.

Table 1. Low Fuel Lamp Inoperative Diagnostic Faults

Fuel level sensor malfunction
Fuel gauge malfunction

NOTE

Test must be performed with fuel level in tank less than 3.79 L (1.0 USgal).

1. Turn IGN OFF.
2. Remove main fuse for 1 minute and install main fuse.
3. Turn IGN ON.
4. View fuel gauge.
5. Does the fuel gauge read low?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace fuel level sensor.

1. Perform a "WOW" test.
2. Did the fuel indicator illuminate?
    a. **Yes.** Calibrate IM to enable indicator.
    b. **No.** Replace IM.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-42682	1
BREAKOUT BOX ADAPTERS	HD-46601	1

Table 1. Turn Signal Indicator Inoperative Diagnostic Faults

Indicator malfunction
Open turn signal circuit

1. Operate turn signals.
2. Do turn signals operate?
    a. **Yes. Go to Test 2.**
    b. **No.** See **Description and Operation**.

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Connect **BREAKOUT BOX ADAPTERS (Part Number:HD-46601)** to [39]. Attach connectors from **BREAKOUT BOX (Part Number:HD-42682)** to harness adapters, leaving [39A] disconnected.
4. Turn IGN ON.
5. Jumper BOB terminal 10 (left) or terminal 12 (right) to ground.
6. Does turn signal indicator illuminate?
    a. **Yes.** Replace IM.
    b. **No.** Replace indicator harness.

Table 1. Turn Signal Indicator Always On Diagnostic Faults

Indicator malfunction
Short to ground turn signal circuit

1. Operate turn signals.
2. Do turn signals operate?
    a. **Yes.** **Go to Test 2.**
    b. **No.** See **Description and Operation**.

1. Turn IGN OFF.
2. Disconnect IM [39].
3. Turn IGN ON.
4. Does turn signal indicator illuminate?
    a. **Yes.** Replace indicator harness.
    b. **No.** Replace IM.

The accessory circuit is powered from the BCM terminal M2 that powers the DLC, P&A, headlamp position lamp and the USB connectors. This circuit is energized by the BCM when the IGN is in the ACC or ON position.

Table 1. Code Description

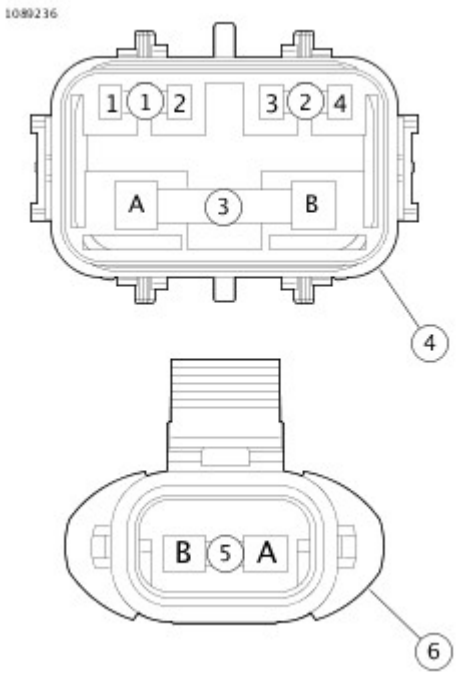
B2112	ACC output shorted high
B2113	ACC output shorted low
B2114	ACC output overloaded

The accessory circuit normally has power when the IGN is ON or in the ACC positions. If the accessory circuit has power when the IGN is OFF, then DTC B2112 will set.

DTC B2114 will set if the accessory circuit draws more than 15 Amps.

The other accessory circuit DTCs will set if the BCM identifies them with the IGN ON or in the ACC position.

This circuit may be used for aftermarket accessories or systems. If a code is set and cannot be duplicated, verify that an aftermarket device did not cause the concern.



View interactive image

1	Battery

2	Battery tender
3	Main
4	Fuse block [64]
5	System power
6	Fuse block [332]

Figure 1. Fuse Blocks and Socket Terminals

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

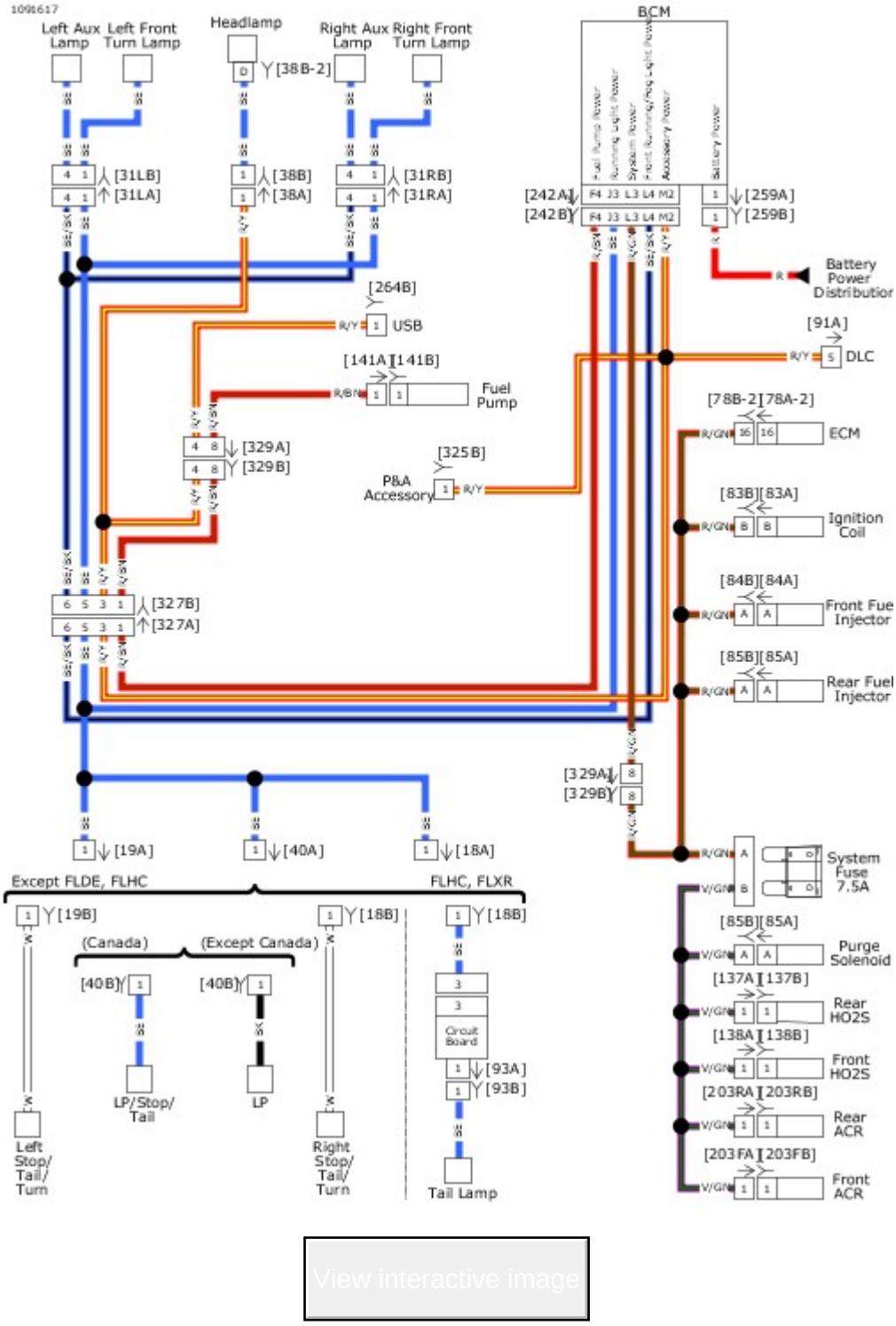


Figure 2. Ignition and Accessory Power Distribution

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC B2112 Diagnostic Faults

Short to battery in the accessory power circuit

1. Turn IGN OFF.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between DLC [91A] terminal 5 and ground.
3. Is battery voltage present?
    a. **Yes.** Repair short to voltage on (R/Y) wire.
    b. **No.** **Go to Test 2.**

1. Clear DTC.
2. Turn IGN ON, then OFF.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. Accessory devices may have caused DTC to set. Inspect and repair as needed.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2113, B2114 Diagnostic Faults

Excessive current draw in accessory power circuit
Short to ground in the accessory power circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B] leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal M2 and ground.
5. Is continuity present?
    a. **Yes. Go to Test 2.**
    b. **No.** Concern is intermittent. See **Wiggle Test**.

1. Inspect for any accessories connected to the accessory circuit.
2. Disconnect any accessories on the circuit.
3. Test continuity between BOB terminal M2 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in (R/Y) wire.
    b. **No. Go to Test 3.**

1. Leave all aftermarket accessories disconnected.
2. Connect BCM [242A].
3. Clear DTC.
4. Turn IGN ON.

5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Accessory devices may have caused DTC to set. Inspect and repair as needed.

The horn is powered by the BCM from terminal E4 and grounded through GND 2. When the horn switch is pressed, a CAN signal is sent to the BCM. The BCM then supplies power to the horn over the (R/V) wire.

The horn switch is a push button switch on the left handlebar controls. The LHCM sends a signal to the BCM over the CAN bus when the horn switch is pressed. The horn switch is diagnosed with the other switches in the hand controls. See **Description and Operation**.

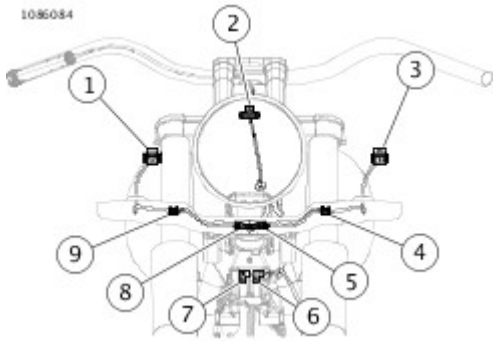
NOTE

If the horn button is pressed for more than 10 seconds, the BCM deactivates the horn to protect it from damage. Checking horn output from the BCM has to be done within 10 seconds of pressing the horn button.

See **Figure 1**. The horn is located between the front frame tubes.

Table 1. Code Description

B2127	E4 output shorted high
B2128	E4 output shorted low
B2129	E4 output overloaded



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1	Right AUX/fog lamp [73R-2]
2	Headlamp [38-2]
3	Left AUX/fog lamp [73L-2]
4	Front left turn [31L-2]
5	Left AUX/fog lamp [73L]
6	Horn [122-1]
7	Horn [122-2]

8	Right AUX/fog lamp [73R]
9	Front right turn [31R-2]

Figure 1. Headlamp: FLSTC, FLSTN

Press the horn switch to activate the horn in order to set these DTCs.

DTC B2129 will set if the horn circuit draws more than 5 Amps.

There will not be a code set if the horn switch is always open. If the horn will not function when the switch is pressed but the other switches on the LHCM work normally, see **Description and Operation**.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

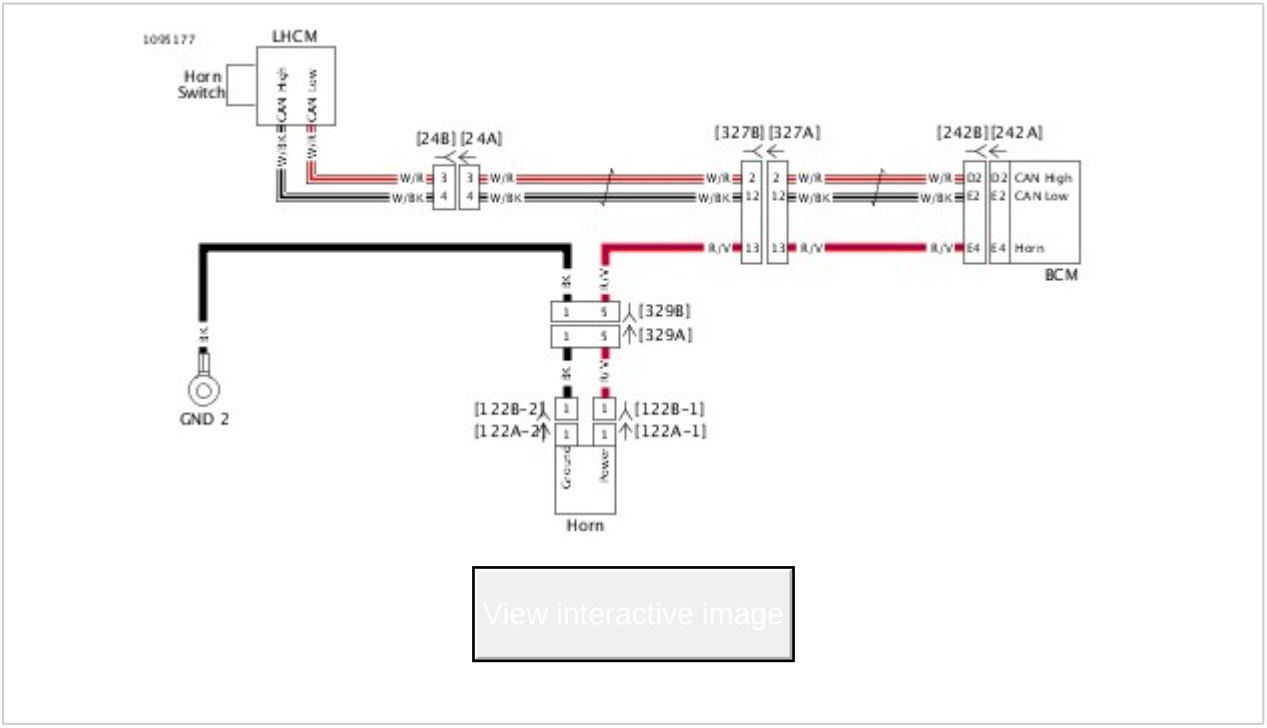


Figure 2. Horn

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
0.6 MM TERMINAL EXTACTOR TOOL	HD-50423	1

Table 1. DTC B2127 Diagnostic Faults

Short to voltage in horn power circuit

1. Turn IGN OFF.
2. Using **0.6 MM TERMINAL EXTACTOR TOOL (Part Number:HD-50423)**, remove terminal E4 (R/V) wire from BCM harness connector [242B].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Turn IGN ON.
6. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between extracted terminal E4 and ground.
7. Is voltage present?
    a. **Yes.** Repair short to voltage in horn power circuit (R/V) wire.
    b. **No. Go to Test 2.**

1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC B2128, B2129 Diagnostic Faults

Accessory horn overloading circuit
Short to ground in horn power circuit
Horn malfunction

1. Turn IGN OFF.
2. Disconnect horn [122].
3. Disconnect BCM [242].
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [122B-1] terminal 1 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (R/V) wire.
    b. **No.** **Go to Test 2.**

1. Connect [242].
2. Clear DTC.
3. Turn IGN ON.
4. Press horn switch.
5. Check DTCs.
6. Did DTC reset?
    a. **Yes.** Replace horn.
    b. **No.** Concern is intermittent.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Horn Inoperative Diagnostic Faults

Open in horn ground circuit
Open in horn power circuit
Horn malfunction

1. Turn IGN OFF.
2. Disconnect horn [122].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [122B-1] and [122B-2] while pressing horn switch.
5. Is battery voltage present?
    a. **Yes.** Replace horn.
    b. **No. Go to Test 2.**

1. While pressing horn switch, test voltage between [122B-1] terminal 1 and ground.

NOTE

If the horn button is pressed for more than 10 seconds, the BCM deactivates the horn to protect it from damage. Checking horn output from the BCM has to be done within 10 seconds of pressing the horn button.

2. Is battery voltage present?
    a. **Yes.** Repair open in (BK) ground circuit.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. While pressing horn switch, test voltage between BOB terminal E4 and ground.
5. Is battery voltage present?
    a. **Yes.** Repair open in (R/V) wire.
    b. **No.** Replace BCM.

The ECM controls and monitors the operation of the vehicle cruise control. The cruise switch allows the control circuit to be enabled or disabled and, when enabled, the lamp illuminates.

The CRUISE/SET/RESUME switch automatically regulates the speed of the vehicle. It is located on the LHCM and is a three position momentary switch, spring loaded to the center position.

- **CRUISE:** Press the CRUISE switch to enable cruise control. The cruise control indicator lights orange. Pressing the CRUISE switch again turns off cruise control.
- **SET/-:** With cruise control enabled, press SET/- to set cruise to current vehicle speed. The cruise control indicator lights green. While at cruising speed, press SET/- to reduce speed.
- **RESUME/+:** While at cruising speed, press RESUME/+ to increase speed. If cruise control is disengaged (such as a braking event), press RESUME/+ to resume the previous cruising speed.

Table 1. Code Description

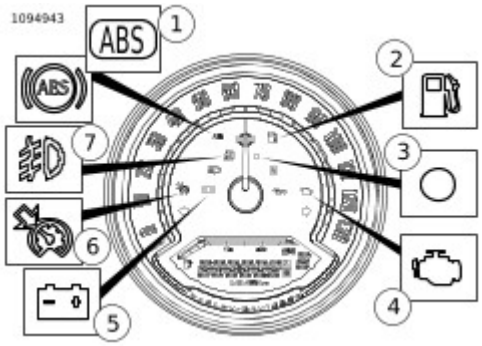
P0577	Cruise control input error

To engage and disengage the cruise control system, proceed as follows:

1. While riding in second gear and above, press straight in on the CRUISE/SET/RESUME switch to turn the cruise ON. The cruise enabled/engaged lamp in the instrument turns orange to indicate the system is activated.
2. With the motorcycle traveling at the desired cruise speed, 40.2–144.8 km/h (25–90 mph) and cruise control enabled, press SET/- to set the cruising speed.
3. The ECM monitors the VSS to establish the desired vehicle speed. The ECM then modulates the throttle control actuator to maintain vehicle speed. The cruise enabled/engaged lamp in the instrument turns from orange to green to indicate the cruising speed is locked in.
4. The ECM monitors both the engine rpm and the VSS output speed signal. The ECM signals the throttle control actuator to open or close the throttle to keep the speedometer output speed signal constant. The engine rpm is monitored to detect engine overspeed, a condition which automatically causes cruise disengagement.
5. The ECM automatically disengages cruise mode whenever the ECM receives one of the following inputs:
    a. Front or rear brake is applied.
    b. Throttle is "rolled forward" past closed, thereby actuating throttle roll off (disengage) command.
    c. Motorcycle clutch is disengaged or wheel slip detected. (ECM senses too great an increase in rpm).
    d. Pressing the CRUISE switch again turns off cruise control. The cruise enabled/engaged lamp in the instrument turns off to indicate the system is not activated.
    e. Handlebar-mounted engine stop switch placed in the off position.
    f. The SET/- switch is pressed and held in that position until vehicle speed drops below 40.2 km/h (25 mph) or press the RESUME/+ switch until vehicle speed exceeds 149.7 km/h (93 mph).

NOTE

If the vehicle speed is above 40.2 km/h (25 mph) when the cruise RESUME/+ switch is released, then the cruise system automatically re-engages.

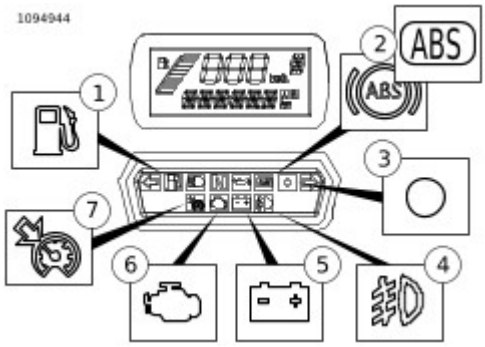


View interactive image

1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine
5	Battery
6	Cruise enabled

7	Aux lighting

Figure 1. Indicator Lamps (Except FXBB, FXBR)



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1	Low fuel
2	ABS (km/h ABS icon lamp also shown)
3	Security
4	Aux lighting
5	Battery
6	Check engine
7	Cruise enabled

Figure 2. Indicator Lamps (FXBB, FXBR)

Cruise control switch interactive diagnostics are provided to allow testing of the cruise control inputs without the use of a service tool. Note that the diagnostic mode is only available if cruise control has been selected. The cruise engaged lamp is used to verify that each switch is activating properly.

To enter diagnostic mode:

1. Turn IGN ON.
2. Press cruise enable to turn on the orange cruise enable lamp.
3. Turn IGN OFF.
4. Hold the cruise SET switch ON while switching IGN ON.

In the diagnostic test mode, the green cruise engaged lamp is illuminated whenever any of these inputs are actuated:

- SET switch.
- RES switch.
- Front brake.
- Rear brake.
- Twist grip in "Cruise Rolloff" position.
- Clutch lever is pulled in.

NOTE

The cruise enable switch is automatically tested with the cruise power indicator light. No special test mode is needed.

The diagnostic mode is exited for any of these conditions:

- Turn IGN OFF.
- The cruise enable switch is turned off.
- The engine is turning.

- An intermittent may be caused by poor connection, rubbed through wire insulation or an inoperative wire inside the insulation.
- **Poor connection:** Inspect component and harness connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses.

The cruise control will become inoperative under the following conditions:

- Engine stop switch is off.
- Loss of ignition voltage.
- Throttle position faults P0120 and P0220.
- VSS faults P0501 and P0502.
- Cruise control switch or brake switch failure P0577.
- TPS correlation error P2135.
- Flash memory error P0605.
- Brake switch fault.
- ETC limited performance mode P1510.
- Cruise control set speed is too low.
- Cruise control set speed is too high.
- Vehicle cannot increase to cruise control set speed (uphill).
- Vehicle cannot decrease to cruise control set speed (downhill).
- Brake is applied.
- Twist grip roll-off.
- Engine has not been running long enough.
- Clutch lever is pulled in.
- Vehicle acceleration rate is too high.
- Vehicle deceleration rate is too high.
- Vehicle speed is too high.
- Vehicle speed is too low.
- Engine rpm is too high.
- Engine rpm is too low.
- Engine rpm acceleration is too high.
- Transmission is first gear or in neutral.

The cruise control system is monitored and controlled through the ECM. The CRUISE/SET/RESUME switch send signals from the LHCM to the ECM. If the ECM sees the same signal with no interruptions for more than two minutes, DTC P0577 will set.

If the switch is held or stuck for over 2 minutes with the engine stop switch ON, the stuck switch code will set for that switch.

Pressing the switch for an extended period of time can set the stuck switch DTCs. These codes should be cleared and operate the vehicle to see if they return. Stuck switch codes will take over two minutes to set.

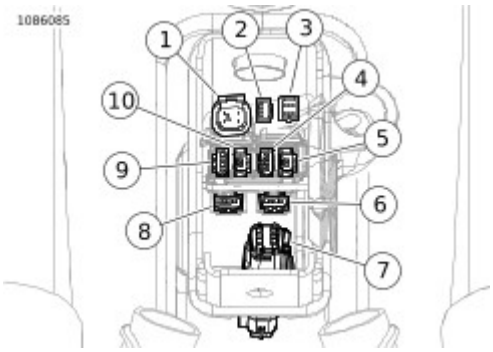
Table 1. DTC P0577 Diagnostic Faults

LHCM malfunction

1. Clear DTC.
2. Turn engine stop switch ON, wait three minutes.
3. Operate vehicle to meet conditions for setting DTC.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace LHCM.
    b. **No.** Concern is intermittent. Switch may have been pressed for an extended period of time.

The BCM controls the turn signal functions, including the hazard lamps and turn signal cancellation feature. The BCM has separate controls for each of the turn signals. This allows the BCM to set DTCs for each turn signal individually.

See **Figure 1**. The BCM sends power to the turn signals directly over the specific wire for each signal. The BCM has different turn signal DTCs depending on vehicle configuration.



View interactive image

1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 1. USB Caddy

The LHCM and RHCM send messages to the BCM over the CAN bus when either of the turn signal switches or hazard warning switch are pressed. The BCM will also set codes if it determines a switch is stuck in the pressed position for longer than two minutes. The switch DTCs are diagnosed with the other hand control module switches. See **Description and Operation**.

To stop the turn signals from flashing, briefly press the turn signal switch a second time.

If signaling to turn in one direction, pressing the switch for the opposite turn signal will cause the first signal to cancel and the opposite side to begin.

Press the left or right turn switch to activate automatic turn signal cancellation. There is no need to hold the turn switch in when approaching the turn. The BCM will not cancel the signal before the turn is actually completed.

- When the turn signal switch is released, the system starts a 20 count. As long as the vehicle is traveling above 13 km/h (8 mph), the directional will always cancel after 20 flashes if the system does not recognize any other input.
- If the vehicle speed drops to 13 km/h (8 mph) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle speed reaches 13 km/h (8 mph) and will automatically cancel when the count total equals 20 as stated above.
- The turn signals may cancel within two seconds upon turn completion depending on vehicle lean angle during turn. The BCM monitors an internal accelerometer and cancels the signal after the vehicle has been returned to an upright position.

NOTE

The bank angle cancellation function has an automatic calibration feature. Ride the vehicle for 0.4 km (0.25 mi) at steady speeds (upright) to calibrate the system. This calibration process optimizes the performance of the bank angle function. This automatic calibration is performed every time the vehicle is started.

Use the following method to activate the four-way flashers:

1. With the ignition switch ON or in ACC, press the hazard warning switch.

NOTE

To activate or deactivate hazards on vehicle equipped with security system, the fob must be within range of the vehicle.

2. Turn the ignition switch OFF (the security system will arm if equipped). The four-way flashers will continue for two hours.
3. To cancel four-way flashing, disarm the security system if equipped, turn the ignition switch ON or to ACC and press the hazard warning switch.

NOTE

To activate or deactivate hazards on vehicle equipped with security system, the fob must be within range of the vehicle.

This system allows a stranded vehicle to be left in the four-way flashing mode and secured until help is found.

If the security system is disarmed while the four-way flashers are active, the lights will flash as follows:

1. BCM stops four-way flashing mode. Vehicle sits for one second with turn signals off.
2. BCM performs disarming confirmation (one flash).
3. Vehicle sits for one second with turn signals off.
4. Vehicle restarts four-way flashing mode.

The BCM uses an internal accelerometer to monitor vehicle position. Under normal driving conditions, the BCM uses the accelerometer along with speed input provided from the ECM to know when to automatically cancel the turn signals after a turn. The BCM will disable accessory power and starter activation and will shut down the ignition and the fuel pump if the vehicle is tipped over. The odometer will display "TIP" and the hazard lamps will activate when a tip-over condition is present. The hazard lamps will activate with or without the IGN ON.

1. Cycle IGN OFF.
2. Return the vehicle to an upright position.
3. Cycle IGN ON.
4. Turn hazard lamps OFF.
5. Start engine.

Table 1. Will Not Cancel Upon Turn Completion, No DTCs Diagnostic Faults

Conditions to self-cancel not met
Improper configuration

1. Verify BCM is mounted correctly.
2. Is BCM mounted correctly?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Mount correctly.

1. Check if BCM is configured correctly. See **General**.
2. Is BCM configured correctly?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Select proper vehicle configuration.

1. Operate vehicle at a speed greater than 13 km/h (8 mph) in a straight line.
2. Activate either turn signal.
3. Turn signals should cancel after 20 flashes.
4. Do turn signals cancel?
    a. **Yes.** System operating properly.
    b. **No.** **Go to Test 4.**

1. Does speedometer register vehicle speed?
    a. **Yes.** Replace BCM.
    b. **No.** See **Description and Operation**.

See **Figure 1**. The turn signals are controlled by the BCM. The BCM supplies power to the turn signals and controls the flash rate of the turn signals through the turn signals individual power circuit.

When the turn signal or hazard warning lamp switch is pressed, the hand control module sends a message over the CAN bus to the BCM. The BCM then controls the power to the turn signal. The turn signals have a constant ground.

Before troubleshooting errors after relocating front turn signals, perform following steps:

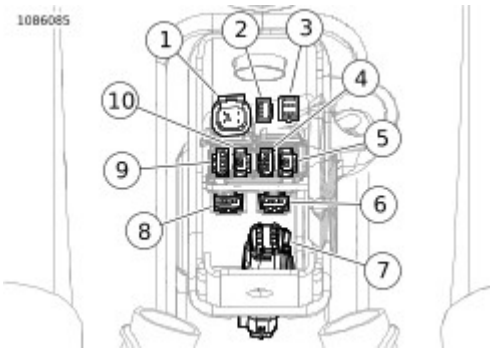
1. Turn IGN ON.
2. Activate hazard lights for ten flashes.
3. Deactivate hazards.
4. Activate hazard lights for ten flashes.
5. Deactivate hazards.
6. Clear DTCs.
7. Turn IGN OFF, ON, activate hazard lights.
8. Verify DTCs.

NOTE

This is necessary for the BCM to validate the proper front lighting configuration and which module is actually controlling them.

Table 1. Code Description

B2141	Left front turn signal output open
B2143	Left front turn signal output shorted low
B2144	Left front turn signal output overloaded
B2146	Right front turn signal output open
B2148	Right front turn signal output shorted low
B2149	Right front turn signal output overloaded



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1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 1. USB Caddy

After clearing DTCs, test inoperative turn signal. Verify DTC does not return.

- DTC B2141 or B2146 will set if the corresponding front turn signal circuit draws less than 120 milliamps.
- DTC B2144 or B2149 will set if the corresponding front turn signal circuit draws more than 3 Amps.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

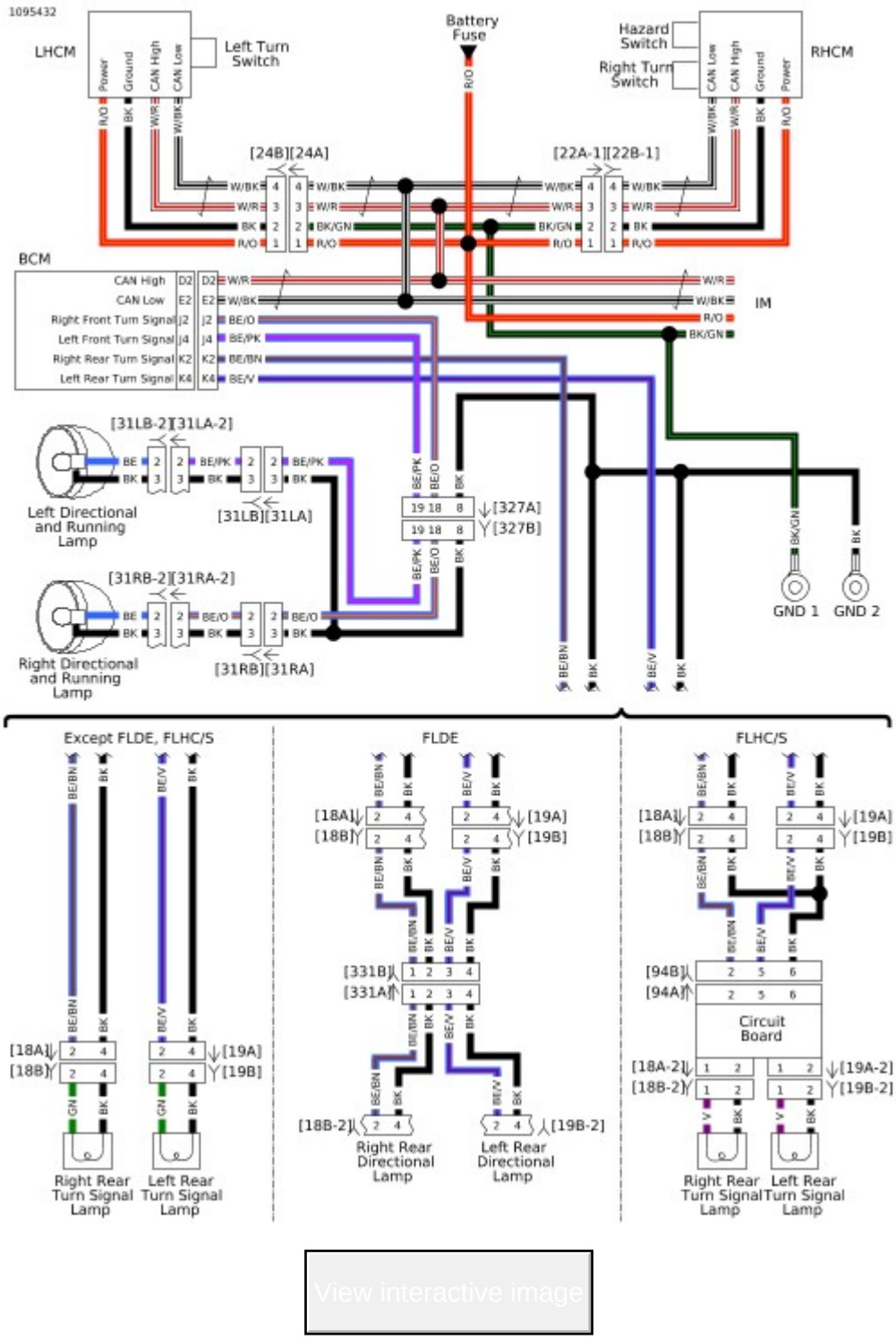


Figure 2. Turn Signal Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2141 Diagnostic Faults

Open in left front turn signal ground circuit
Open in left front turn signal power circuit
Short to voltage in left front turn signal power circuit
Bulb malfunction

1. Turn IGN OFF.
2. Inspect left front turn signal.
3. Is lamp good?
    a. **Yes. Go to Test 2.**
    b. **No. Lamp is LED. Go to Test 3.**
    c. **No. Bulb does not work.** Replace bulb.

1. Disconnect left front turn signal [31LA-2].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [31LA-2] terminals 2 and 3.
3. Turn IGN ON.
4. Press left turn signal switch.
5. Does test light flash?
    a. **Yes.** Replace left front turn signal.
    b. **No. Go to Test 4.**

1. Disconnect left front turn signal [31RA-2].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, check for voltage [31LA-2] terminals 2 and 3.

3. Turn IGN ON.
4. Press left turn signal switch.
5. Does battery voltage turn on and off?
    a. **Yes.** Replace left front turn signal.
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal J4 and [31LA-2] terminal 2.
5. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (BE/PK) wire.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [31LA-2] terminal 3 and ground.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (BK) wire.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal J4 and ground.
5. Is voltage present?
    a. **Yes.** Repair short to voltage in BE/PK) wire.
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2143, B2144 Diagnostic Faults

Left front turn signal bulb current exceeds 3.0A
Accessory lighting overloading circuit
Short to ground in left front turn signal power circuit

1. Turn IGN OFF.
2. Inspect left front turn signal.
3. Is bulb good or LED?
    a. **Yes. Go to Test 2.**
    b. **No.** Replace bulb.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, with [31LB-2] disconnected, test continuity between BOB terminal J4 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in left front turn signal power circuit (BE/PK).
    b. **No. Go to Test 3.**

1. Connect [242].
2. Clear DTC.
3. Turn IGN ON.
4. Turn on left turn signal.

5. With [31LB-2] disconnected, check DTCs.
6. Did DTC B2143 or B2144 reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace turn signal assembly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2146 Diagnostic Faults

Open in right front turn signal ground circuit
Open in right front turn signal power circuit
Short to voltage in right front turn signal power circuit
Bulb malfunction

1. Turn IGN OFF.
2. Inspect right front turn signal.
3. Is lamp good?
    a. **Yes. Go to Test 2.**
    b. **No. Lamp is LED. Go to Test 3.**
    c. **No. Bulb does not work.** Replace bulb.

1. Disconnect right front turn signal [31RA-2].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [31RA-2] terminals 2 and 3.
3. Turn IGN ON.
4. Press right turn signal switch.
5. Does test light flash?
    a. **Yes.** Replace right front turn signal.
    b. **No. Go to Test 4.**

1. Disconnect right front turn signal [31RA-2].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, check for voltage [31RA-2] terminals 2 and 3.

3. Turn IGN ON.
4. Press right turn signal switch.
5. Does battery voltage turn on and off?
    a. **Yes.** Replace right front turn signal.
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal J2 and [31RA-2] terminal 2.
5. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (BE/O) wire.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [31RA-2] terminal 3 and ground.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (BK) wire.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal J2 and ground.
5. Is voltage present?
    a. **Yes.** Repair short to voltage in BE/O) wire.
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2148, B2149 Diagnostic Faults

Right front turn signal bulb current exceeds 3.0A
Accessory lighting overloading circuit
Short to ground in right front turn signal power circuit

1. Turn IGN OFF.
2. Inspect right front turn signal.
3. Is bulb good or LED?
    a. **Yes. Go to Test 2.**
    b. **No.** Bulb does not work. Replace bulb.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, with [31RB-2] disconnected, test continuity between BOB terminal J2 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in right front turn signal power circuit (BE/O) wire.
    b. **No. Go to Test 3.**

1. Connect [242].
2. Clear DTC.
3. Turn IGN ON.
4. Turn on right turn signal.

5. With [31RB-2] disconnected, check DTCs.
6. Did DTC B2148 or B2149 reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace turn signal assembly.

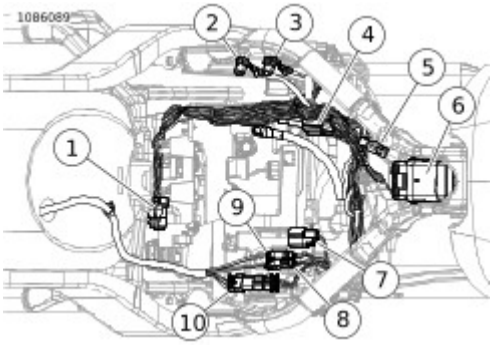
See **Figure 1**. The rear turn signals are controlled by the BCM. The BCM supplies power to the rear turn signals and controls the flash rate of the turn signals through the power circuit.

Table 1. Code Description

B2151	Left rear turn signal output open
B2153	Left rear turn signal output shorted low
B2154	Left rear turn signal output overloaded
B2156	Right rear turn signal output open
B2158	Right rear turn signal output shorted low
B2159	Right rear turn signal output overloaded

After clearing the DTCs, operate the inoperative turn signal to verify if the DTC has returned.

- DTC B2151 or B2156 will set if the corresponding rear turn signal circuit draws less than 120 milliamps.
- DTC B2154 or B2159 will set if the corresponding rear turn signal circuit draws more than 3 Amps.



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1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]

8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

Figure 1. Under Seat

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

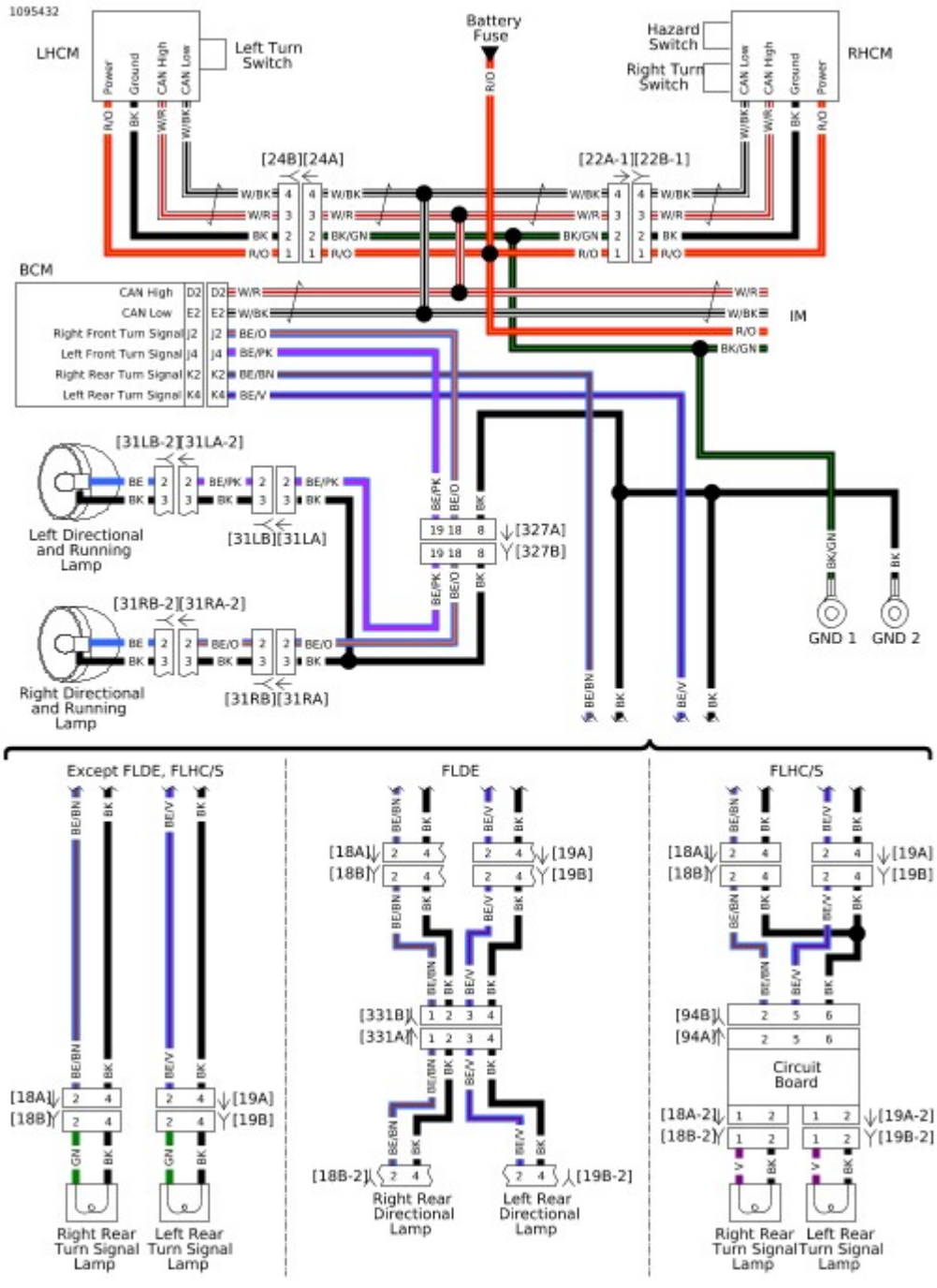

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Figure 2. Turn Signal Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2151 Diagnostic Faults

Open in left rear turn signal ground circuit
Open in left rear turn signal power circuit
Short to voltage in left rear turn signal power circuit
Bulb malfunction

1. With IGN ON, inspect left rear turn signal.
2. Is the turn signal always on?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 3.**

1. Disconnect left rear turn signal [19] at main harness.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [19A] terminals 2 and 4.
3. Turn IGN ON.
4. Does test light illuminate?
    a. **Yes.** Repair short to voltage in (BE/V) wire.
    b. **No.** Repair short to voltage in rear lighting harness.

1. Turn IGN OFF.
2. Inspect left rear turn signal.
3. Is bulb good or LED?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace bulb.

1. Disconnect left rear turn signal [19] at main harness.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [19A] terminals 2 and 4.
3. Turn IGN ON.
4. Press left turn signal switch.
5. Does test light flash?
    a. **Yes. Except FLDE, FLHC/S.** Replace left rear turn signal.
    b. **Yes. FLDE. Go to Test 7.**
    c. **Yes. FLHC/S. Go to Test 10.**
    d. **No. Go to Test 5.**

1. Connect test light to [19A] terminal 2 and ground.
2. Press left turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in (BK) wire.
    b. **No. Go to Test 6.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K4 and [19A] terminal 2.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/V) wire.

1. Connect [19].
2. Disconnect left rear turn signal [19-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [19B-2] terminals 2 and 4.
4. Turn IGN ON.
5. Press left turn signal switch.
6. Does test light flash?
    a. **Yes.**Replace left rear turn signal.
    b. **No. Go to Test 8.**

1. Connect test light to [19B-2] terminals 2 and ground.
2. Press left turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in left rear turn signal ground circuit.
    b. **No.** **Go to Test 9.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K4 and [19B-2] terminal 2.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/V) wire.

1. Connect [19].
2. Disconnect left rear turn signal [19-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [19A-2] terminals 1 and 2.
4. Turn IGN ON.
5. Press left turn signal switch.
6. Does test light flash?
    a. **Yes.** Replace left rear turn signal.
    b. **No.** **Go to Test 11.**

1. Connect test light to [19A-2] terminals 1 and ground.
2. Press left turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in left rear turn signal ground circuit.
    b. **No.** **Go to Test 12.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K4 and [19A-2] terminal 1.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** **Go to Test 13.**

1. Disconnect circuit board [94].
2. Test resistance between BOB terminal K4 and [94B] terminal 5.
3. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace circuit board.
    b. **No.** Repair open in (BE/V) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2153, B2154 Diagnostic Faults

Left rear turn signal bulb current too high
Accessory lighting overloading circuit
Short to ground in left rear turn signal power circuit

1. Disconnect left rear turn signal [19] at main harness.
2. Check DTCs.
3. Did DTC change to historic code?
    a. **Yes. Except FLDE, FLHC/S.** Replace left rear turn signal.
    b. **Yes. FLDE.** **Go to Test 3.**
    c. **Yes. FLHC/S.** **Go to Test 4.**
    d. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal K4 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/V) wire.
    b. **No.** Replace BCM.

1. Disconnect left rear turn signal.

2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [19B] terminal 2 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in left rear turn signal power circuit.
    b. **No.** Replace left rear turn signal assembly.

1. Disconnect left rear turn signal.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [19A] terminal 1 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in left rear turn signal power circuit.
    b. **No.** Replace left rear turn signal assembly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2156 Diagnostic Faults

Open in right rear turn signal ground circuit
Open in right rear turn signal power circuit
Short to voltage in right rear turn signal power circuit
Bulb malfunction

1. With IGN ON, inspect right rear turn signal.
2. Is the turn signal always on?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 3.**

1. Disconnect right rear turn signal [18] at main harness.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [18A] terminals 2 and 4.
3. Turn IGN ON.
4. Does test light illuminate?
    a. **Yes.** Repair short to voltage in (BE/BN) wire.
    b. **No.** Repair short to voltage in rear lighting harness.

1. Turn IGN OFF.
2. Inspect right rear turn signal.
3. Is bulb good or LED?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace bulb.

1. Disconnect right rear turn signal [18] at main harness.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [18A] terminals 2 and 4.
3. Turn IGN ON.
4. Press right turn signal switch.
5. Does test light flash?
    a. **Yes. Except FLDE, FLHC/S.** Replace right rear turn signal.
    b. **Yes. FLDE. Go to Test 7.**
    c. **Yes. FLHC/S. Go to Test 10.**
    d. **No. Go to Test 5.**

1. Connect test light to [18A] terminal 2 and ground.
2. Press right turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in (BK) wire.
    b. **No. Go to Test 6.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K2 and [18A] terminal 2.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/BN) wire.

1. Connect [19].
2. Disconnect right rear turn signal [18-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [18B-2] terminals 2 and 4.
4. Turn IGN ON.
5. Press right turn signal switch.
6. Does test light flash?
    a. **Yes.** Replace right rear turn signal.
    b. **No. Go to Test 8.**

1. Connect test light to [18B-2] terminals 2 and ground.
2. Press right turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in right rear turn signal ground circuit.
    b. **No.** **Go to Test 9.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K2 and [18B-2] terminal 2.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/BN) wire.

1. Connect [18].
2. Disconnect right rear turn signal [18-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, connect test light to [18A-2] terminals 1 and 2
4. Turn IGN ON.
5. Press right turn signal switch.
6. Does test light flash?
    a. **Yes.** Replace right rear turn signal.
    b. **No.** **Go to Test 11.**

1. Connect test light to [18A-2] terminals 1 and ground.
2. Press right turn signal switch.
3. Does test light flash?
    a. **Yes.** Repair open in right rear turn signal ground circuit.
    b. **No.** **Go to Test 12.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal K2 and [18A-2] terminal 1.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** **Go to Test 13.**

1. Disconnect circuit board [94].
2. Test resistance between BOB terminal K2 and [94B] terminal 2.
3. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace circuit board.
    b. **No.** Repair open in (BE/BN) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2158, B2159 Diagnostic Faults

Right rear turn signal bulb current too high
Accessory lighting overloading circuit
Short to ground in right rear turn signal power circuit

1. Disconnect right rear turn signal [18] at main harness.
2. Check DTCs.
3. Did DTC change to historic code?
    a. **Yes. Except FLDE, FLHC/S.** Replace right rear turn signal.
    b. **Yes. FLDE.** **Go to Test 3.**
    c. **Yes. FLHC/S.** **Go to Test 4.**
    d. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal K2 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/BN) wire.
    b. **No.** Replace BCM.

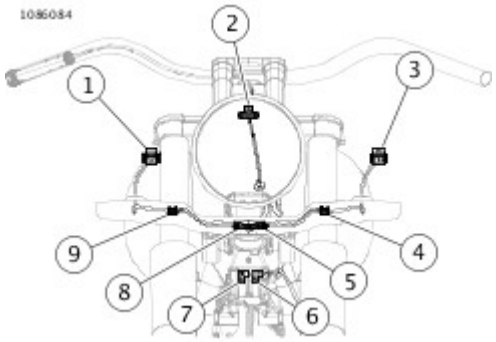
1. Disconnect right rear turn signal.

2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [18B] terminal 2 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in right rear turn signal power circuit.
    b. **No.** Replace right rear turn signal assembly.

1. Disconnect right rear turn signal.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [18A] terminal 1 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in right rear turn signal power circuit.
    b. **No.** Replace right rear turn signal assembly.

The headlamp switch activates either the high beam or the low beam headlamps. When the ignition is turned ON, the BCM defaults to the low beam position. Pressing the upper part of the switch toggles to the high beam headlamp and the lower part of the switch toggles to the low beam headlamp.

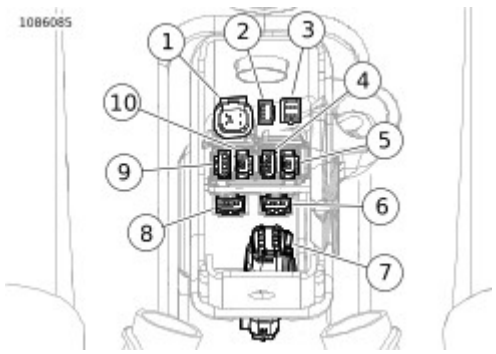
- In the low position, the BCM supplies power to illuminate the low beam headlamp.
- Push the low position again, the BCM supplies power to the high beam headlamp to provide a flash to pass feature.
- In the high position, BCM supplies power to the high beam headlamp and sends a message to the speedometer over the CAN bus to illuminate the high beam indicator.



View interactive image

1	Right AUX/fog lamp [73R-2]
2	Headlamp [38-2]
3	Left AUX/fog lamp [73L-2]
4	Front left turn [31L-2]
5	Left AUX/fog lamp [73L]
6	Horn [122-1]
7	Horn [122-2]
8	Right AUX/fog lamp [73R]
9	Front right turn [31R-2]

Figure 1. Headlamp: FLSTC, FLSTN



View interactive image

1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 2. USB Caddy

Table 1. Code Description

B2106	L4 output open
B2107	L4 output shorted high
B2108	L4 output shorted low
B2109	L4 output overloaded
B2131	High beam output open
B2132	High beam output shorted high
B2133	High beam output shorted low
B2134	High beam output overloaded
B2136	Low beam output open
B2137	Low beam output shorted high
B2138	Low beam output shorted low
B2139	Low beam output overloaded

The headlamp DTCs may require either the high or low beam headlamp be requested on in order to set the DTC. Toggle back and forth between the high and low beam headlamp positions to check DTCs on both circuits.

- DTC B2106 will set if the running lights circuit is below 120 milliamps. This will happen if all lights on the circuit are open.
- DTC B2109 will set if the switched power output circuit is above 10 Amps.
- DTC B2131 or B2136 will set if the corresponding headlamp circuit draws less than 1.2 Amps.
- DTC B2134 or B2139 will set if the corresponding headlamp circuit draws more than 12 Amps.

If the headlamp cannot be switched from one position to the other with no codes it could be an open switch causing the problem. See **Description and Operation**.

Turn IGN to ACC. If low beam illuminates, this circuit is shorted to voltage. If the high beam illuminates, this circuit is shorted to voltage.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

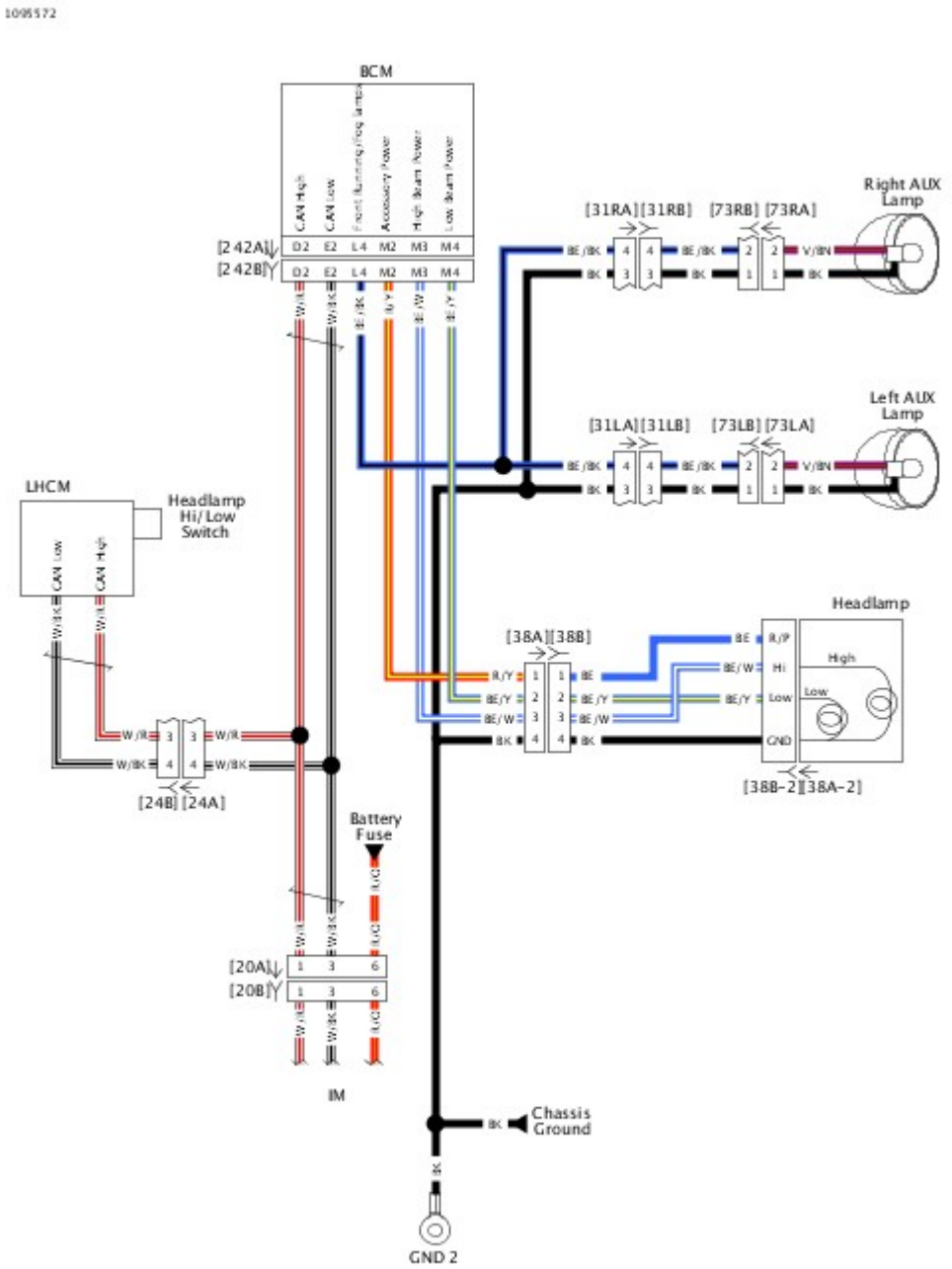


Figure 3. Headlamp and Auxiliary Lamps

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Auxiliary Lamps Inoperative Diagnostic Faults

Auxiliary lamp malfunction
LHCM auxiliary switch malfunction
Open in auxiliary power circuit
Open in auxiliary ground circuit

1. Turn IGN ON.
2. Activate aux lamp switch on LHCM.
3. Do auxiliary lamps illuminate?
    a. **Yes.** System operating properly. Intermittent perform wiggle test. See **Wiggle Test**.
    b. **No. Auxiliary lamps inoperative.** Verify DTC B2259 is not present. Refer to **Diagnostics**.
    c. **No. One or both auxiliary lamp is operative. Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect left and right auxiliary lamps [73L] and [73R].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between inoperative circuit at [73B] terminal 1 or 2 of inoperative aux lamp.
5. Is battery voltage present?
    a. **Yes.** Replace inoperative auxiliary lamp.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Test resistance between [73LB] or [73RB] terminal 1 and ground.
3. Is resistance less than 0.5 ohm?

a. **Yes.** **Go to Test 4.**
b. **No.** Repair open in ground circuit.

1. Connect **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A].
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Test resistance between BOB terminal L4 and [73B] terminal 2 of both left and right aux lamps.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in power circuit.

1. Plug in a good known LHCM.
2. Turn IGN ON.
3. Do aux lamps function?
    a. **Yes.** Replace LHCM.
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
1.5 MM TERMINAL EXTRACTOR TOOL	HD-50424	1

Table 1. DTC B2106, B2107 Diagnostic Faults

Short to power in aux lamp circuit

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Using **1.5 MM TERMINAL EXTRACTOR TOOL (Part Number:HD-50424)**, remove terminal L4 from [242B].
4. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.
5. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
6. Turn IGN ON.
7. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between extracted terminal L4 and ground.
8. Is voltage present?
    a. **Yes.** Repair short to voltage in the aux lamp circuit.
    b. **No. Go to Test 2.**

1. Connect [242].
2. Clear DTC.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Condition not currently present.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Auxiliary Lamps Inoperative Diagnostic Faults: Japan

Auxiliary lamp malfunction
Open in auxiliary power circuit
Open in auxiliary ground circuit

1. Turn IGN ON.
2. Do auxiliary lamps illuminate?
    a. **Yes.** System operating properly. Intermittent perform wiggle test. See **Wiggle Test**.
    b. **No. Auxiliary lamps inoperative.** Verify DTC code B2259 is not present. Refer to **Diagnostics**.
    c. **No. One or both auxiliary lamp is operative. Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect both [73LB] and [73RB] auxiliary lamps.
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between inoperative circuit at [73B] terminal 1 or 2 of inoperative aux lamp.
5. Is battery voltage present?
    a. **Yes.** Replace inoperative auxiliary lamp.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Test resistance between [73LB] and [73RB] terminal 1 and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 4.**
    b. **No.** Repair open in ground circuit.

1. Connect **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A].
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Test resistance between BOB terminal L4 and [73B] terminal 2 of both left or right aux lamps.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in power circuit.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2108, B2109 Diagnostic Faults

Short to ground in aux lamp circuit
High current in aux lamp circuit
Accessory lighting overloading circuit

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Disconnect aux lamp [73RB] and [73LB].
4. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
5. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
6. Test continuity between BOB terminal L4 and ground.
7. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/BK) wire.
    b. **No. Go to Test 2.**

1. Cycle IGN ON-OFF-ON.
2. Check DTCs.
3. Is the code current?
    a. **Yes. Go to Test 3.**
    b. **No.** Replace aux lamp that was causing issue.

1. Turn IGN OFF.
2. Connect [242].
3. Clear DTC.
4. Turn IGN ON.

5. Check DTCs.
6. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Condition not currently present.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
1.5 MM TERMINAL EXTRACTOR TOOL	HD-50424	1

Table 1. DTC B2132 Diagnostic Faults

Short to voltage in headlamp high beam circuit

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Using **1.5 MM TERMINAL EXTRACTOR TOOL (Part Number:HD-50424)**, remove terminal M3 from [242B].
4. Connect [242].
5. Turn IGN ON.
6. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between extracted terminal M3 and ground.
7. Is voltage present?
    a. **Yes.** Repair short to voltage in (BE/W) wire.
    b. **No.** **Go to Test 2.**

1. Install terminal M3 from [242B].
2. Connect [242].
3. Clear DTCs.
4. Turn IGN ON.
5. Observe headlamp in high and low beam positions.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Condition is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2133, B2134 Diagnostic Faults

Short to ground in high beam headlamp circuit
Accessory lighting overloading circuit
Headlamp malfunction

1. Turn IGN OFF.
2. Disconnect headlamp [38-2].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal M3 and ground.
6. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/W) wire.
    b. **No. Go to Test 2.**

1. Connect [242].
2. Clear DTCs.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace headlamp.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. High Beam Headlamp Inoperative, DTC B2131 Diagnostic Faults

Open in high beam ground circuit
Open in high beam power circuit
Headlamp malfunction

1. Turn IGN OFF.
2. Disconnect headlamp [38-2].
3. Turn IGN ON.
4. Switch headlamp to HI beam.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [38B-2] terminal HI (BE/W) and ground.
6. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Test resistance between [38B-2] terminal GND (BK) and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace headlamp.
    b. **No.** Repair open in (BK) ground wire.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A].

3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between BOB terminal M3 and [38-2] terminal HI (BE/W).
5. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/W) wire between BCM and headlamp.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
1.5 MM TERMINAL EXTRACTOR TOOL	HD-50424	1

Table 1. DTC B2137 Diagnostic Faults

Short to voltage in headlamp low beam circuit

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Using **1.5 MM TERMINAL EXTRACTOR TOOL (Part Number:HD-50424)**, remove terminal (M4) from [242B].
4. Connect BCM [242].
5. Turn IGN ON.
6. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between removed terminal (M4) and ground.
7. Is voltage present?
    a. **Yes.** Repair short to voltage in (BE/Y) wire.
    b. **No.** **Go to Test 2.**

1. Install terminal M4 from [242B].
2. Connect [242].
3. Clear DTCs.
4. Turn IGN ON.
5. Observe headlamp in high and low beam positions.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Condition is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2138, B2139 Diagnostic Faults

Short to ground in low beam headlamp circuit
Accessory lighting overloading circuit
Headlamp malfunction

1. Turn IGN OFF.
2. Disconnect headlamp [38-2].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal (M4) and ground.
6. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/Y) wire.
    b. **No. Go to Test 2.**

1. Connect [242].
2. Clear DTCs.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace headlamp.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Low Beam Headlamp Inoperative, DTC B2136 Diagnostic Faults

Open in low beam ground circuit
Open in low beam power circuit
Headlamp malfunction

1. Turn IGN OFF.
2. Disconnect headlamp [38-2].
3. Turn IGN ON.
4. Switch headlamp to low beam.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [38B-2] terminal low (BE/Y) and ground.
6. Is battery voltage present?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Test resistance between [38B-2] terminal GND (BK) and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace headlamp.
    b. **No.** Repair open in (BK) ground wire.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A].

3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between BOB terminal M4 and [38-2] terminal low (BE/Y).
5. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/Y) wire between BCM and headlamp.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

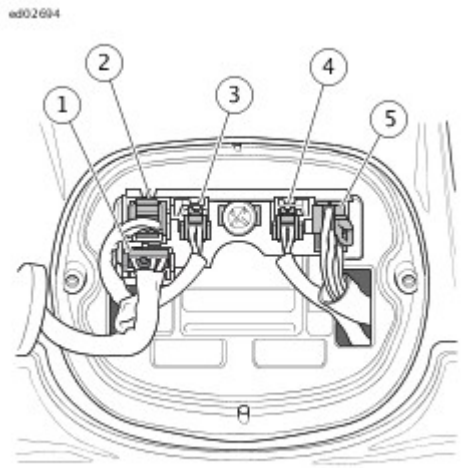
See **Figure 1** and **Figure 6**. The BCM controls the stop lamp based off inputs from the front and rear stop lamp switches. The front stop lamp switch is a mechanical switch. When the front brake lever is applied, the lever presses a mechanical switch and closes the contacts on the switch. The front stop lamp switch is part of the RHCM. When the switch is pressed, the RHCM sends a message to the BCM over the CAN bus and the BCM supplies power to the stop lamp.

The rear stop lamp switch is a pressure switch. When the rear brake is applied, it generates pressure in the brake fluid. This pressure in the fluid closes the contacts for the rear stop lamp switch. The BCM supplies power to the rear stop lamp switch. When the rear stop lamp switch is closed, it grounds the circuit from the BCM. This signals the BCM to supply power to the stop lamp.

Some models have no center stop lamp. Instead the turn signals are used for stop, turn and tail lamp functions. If DTC B2161 is set and all stop lamps are functional, it means the vehicle is improperly configured. Use **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to configure properly.

Table 1. Code Description

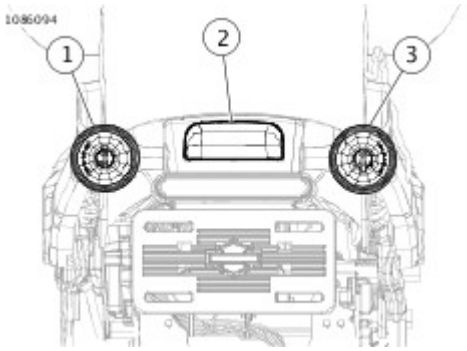
B2161	Brake lamp output open
B2163	Brake lamp output shorted low
B2164	Brake lamp output overloaded
B2223	Rear brake switch shorted low (light on)



View interactive image

1	Tail lamp [93]
2	Rear fender tip lamp [45]
3	Left rear turn signal [19-2]
4	Right rear turn signal [18-2]
5	Rear fender lights harness in circuit board [94]

Figure 1. Rear Fender Lights



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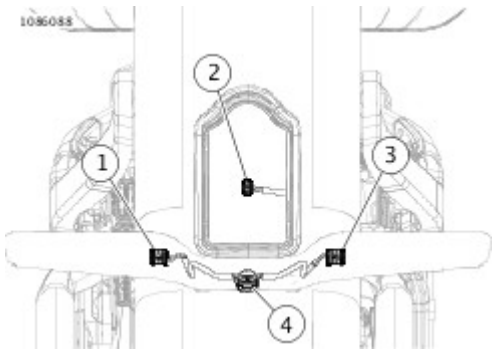
1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

Figure 2. Rear Lighting: FLSL, FLSB



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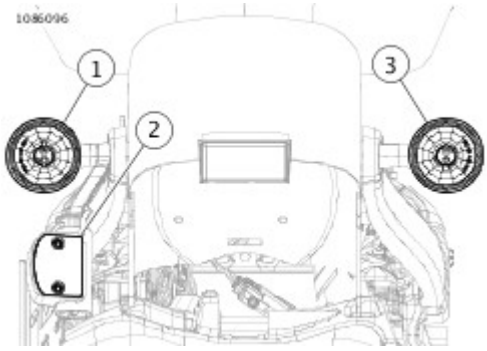
1	Left rear turn [18-2]
2	Stop/tail lamp [40]

3	Right rear turn [19-2]
4	Light bar interconnect [331]

Figure 3. Rear Lighting: FLDE



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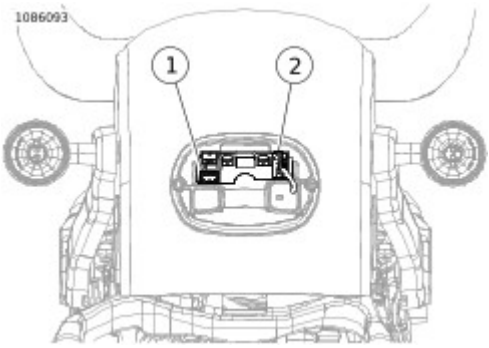
1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

Figure 4. Rear Lighting: FLFB/S, FXBB, FXBR/S, FXFB



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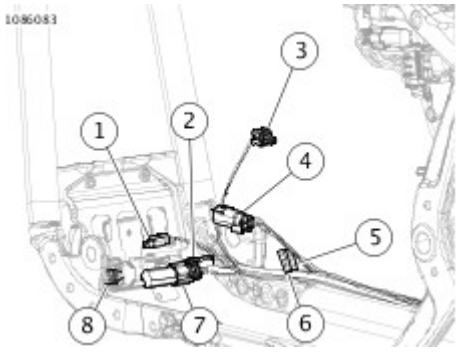
1	Left turn lamp
2	Tail lamp [93]
3	Stop lamp [94]
4	Right turn lamp

Figure 5. Rear Lighting: FLHC, FXLR



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1	CKP [79]
2	Voltage regulator [77]
3	Oil pressure sensor [120]
4	Front HO2S [138]
5	Rear brake switch [121-1]
6	Rear brake switch [121-2]
7	JSS [133]
8	Stator [47]

Figure 6. Front of Engine: Typical

The stop lamp circuit needs to see activation to set DTCs. Apply the front and rear brakes to verify stop lamp DTCs do not return.

- DTC B2161 is set when the stop lamp circuit current draw is less than 120 milliamps.
- DTC B2164 is set when the stop lamp circuit current draw is above 4 Amps.
- DTC B2223 is set when the brake switch input circuit is grounded for 120 seconds and the vehicle speed is above 72.4 km/h (45 mph).

The brake switch is normally open and supplies a path to ground when closed. In order to set a shorted brake switch code, the vehicle needs to be operated over 72.4 km/h (45 mph) for at least two minutes. DTC B2161 will only set when all loads on the circuit are inoperable.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

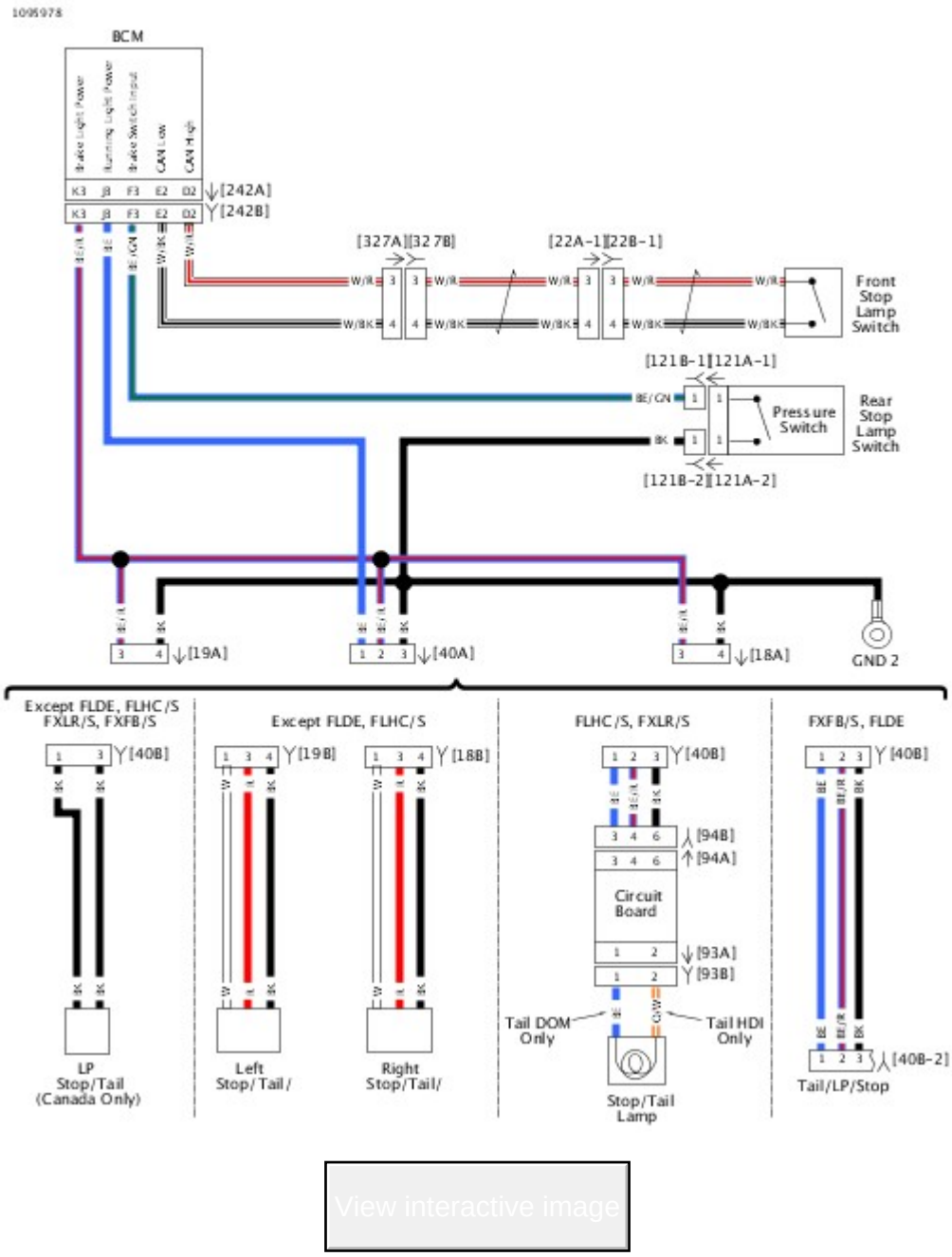


Figure 7. Stop/Tail Lamps

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
0.6 MM TERMINAL EXTACTOR TOOL	HD-50423	1

Table 1. Stop Lamp Always On, DTC B2223 Diagnostic Faults

Brake switch malfunction
Short to voltage on stop lamp output circuit

1. Turn IGN OFF.
2. Disconnect rear brake switch [121-1] (BE/GN) wire.
3. Turn IGN ON.
4. Does stop lamp go out?
    a. **Yes.** Replace rear brake switch.
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal F3 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground between [242B] and [121B-1] (BE/GN) wire.
    b. **No. Go to Test 3.**

1. Using **0.6 MM TERMINAL EXTACTOR TOOL (Part Number:HD-50423)**, remove terminal K3 from [242B]

(BE/R) wire.
2. Connect [242A].
3. Turn IGN ON.
4. Is stop lamp on?
    a. **Yes.** Repair short to voltage on stop lamp power circuit.
    b. **No.** **Go to Test 4.**

1. Remove BOB.
2. Insert terminal K3 into [242B] (BE/R) wire.
3. Connect [242].
4. Clear DTCs.
5. Operate system in the conditions for setting DTCs.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2161 Diagnostic Faults

Open in brake lamp ground circuit
Open in brake lamp power circuit
Bulb malfunction

1. Turn IGN OFF.
2. Inspect brake lamp.
3. Is lamp good?
    a. **Yes.** **Go to Test 2.**
    b. **No. Lamp is LED.** **Go to Test 6.**
    c. **No. Bulb does not work.**Replace bulb.

1. Disconnect tail lamp [93].
2. Turn IGN ON.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, with brake applied, test voltage between [93A] terminals 3 and 4.
4. Is battery voltage present?
    a. **Yes.** Replace stop lamp assembly.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect rear fender lights [94].
3. Turn IGN ON.
4. With brake applied, test voltage between [94B] terminals 4 and 6.

5. Is battery voltage present?
    a. **Yes.** Replace circuit board.
    b. **No.** **Go to Test 4.**

1. With brake applied, test voltage between [94B] terminal 4 and ground.
2. Is battery voltage present?
    a. **Yes.** Repair open in (BK) wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B] and [242A].
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Connect [93] and [94].
5. Install stop lamp bulb.
6. Jumper BOB terminals M2 and K3.
7. Turn IGN ON.
8. Does stop lamp illuminate?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/R) wire.

1. Disconnect rear lighting [40].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, with brake applied, test voltage between [40A] terminals 3 and 4.
3. Is battery voltage present?
    a. **Yes.** Replace rear stop light assembly.
    b. **No.** **Go to Test 7.**

1. With brake applied, test voltage between [40A] terminal 3 and ground.
2. Is battery voltage present?
    a. **Yes.** Repair open in (BK) wire.
    b. **No.** **Go to Test 8.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.

3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between BOB K3 and [40A] terminal 3.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.**Repair open in (BE/R) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2163, B2164 Diagnostic Faults

Accessory tail lamp overloading circuit
Short to ground in stop lamp power circuit
Bulb malfunction

1. Turn IGN OFF.
2. Inspect right rear turn signal.
3. Is lamp good?
    a. **Yes.** **Go to Test 2.**
    b. **No. Lamp is LED.** **Go to Test 3.**
    c. **No. Bulb does not work.** Replace bulb.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal K3 and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground in (BE/R) wire.
    b. **No.** Replace BCM.

1. Turn IGN OFF.
2. Clear DTCs.
3. Disconnect [40].

4. Turn IGN ON.
5. With brake applied, verify DTC did not reset.
6. Did DTC B2163 or B2164 reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace rear brake light assembly.

These DTCs pertain to stuck switches or an internal fault in the LHCM, RHCM or BCM. If the switches are open they will not set DTCs. In most cases, there will be symptoms depending on which switch is malfunctioning.

Table 1. Switch Symptoms

High beam	Headlamp will not toggle to high beam
Low beam	Headlamp will not toggle to low beam
Left turn signal	Left turn signals will not function, PIN cannot be entered
Right turn signal	Right turn signals will not function, PIN cannot be entered
Trip	Odometer will not cycle through different settings
Aux lamps	Auxiliary lamps will not function
Front brake	Stop lamp will not function with brake lever pulled in
Clutch	Vehicle will not start unless in neutral
Horn	Horn will not sound
Hazard	Hazard lamps will not function
Start switch	Vehicle will not start (nothing clicks)
Engine stop switch	Vehicle will not start (nothing clicks)

Table 2. Code Description

B1103	LHCM internal error
B1153	RHCM internal error
B2210	Engine stop switch inputs both open
B2212	Engine stop switch inputs both closed
B2250	Clutch switch stuck
B2251	Horn switch stuck
B2253	FTP switch stuck
B2254	Left turn switch stuck
B2259	Aux lamp switch stuck

B2260	Start switch stuck
B2261	Right turn switch stuck
B2262	Front brake switch stuck
B2263	Hazard switch stuck
B2270	BCM internal error

If the switches are held or stuck for over 2 minutes with the IGN ON, a DTC will set for that switch. The engine stop is either in the run or the stop position. If the RHCM does not see either input or both inputs at the same time, DTC B2210 or B2212 will set.

For DTC B2262 or B2250 to be set, the vehicle has to be in operation for more than 2 minutes at speed above 48 km/h (30 mph). Historic codes may indicate the rider continually applies the brake or clutch. For example, coasting downhill with the clutch lever pulled in for more than 2 minutes will set codes.

Clear the DTCs and operate the vehicle to verify the DTCs are current. Stuck switch codes will take over two minutes to set. If vehicle will only start in neutral, verify proper alignment of the left hand control housing to the clutch perch. Misalignment or a gap between the two parts may affect clutch switch operation.

Table 1. DTC B1103, B1153 Diagnostic Faults

Open in hand control module ground circuit
Open in hand control module power circuit

1. Clear DTC.
2. Turn IGN ON and wait 3 minutes.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace LHCM or RHCM.
    b. **No.** Condition not currently present.

Table 1. DTC B2210, B2212, B2250, B2251, B2253, B2254, B2260, B2261, B2262, B2263 Diagnostic Faults

Clutch switch malfunction
Front brake switch malfunction

1. Clear DTC.
2. Turn IGN ON and wait 3 minutes.
3. Operate vehicle to meet conditions for setting DTC.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes, DTC B2210 or B2212.** Replace run/stop key cap.
    b. **Yes, DTC B2250 or B2262.** Replace clutch or brake switch.
    c. **Yes, except DTC B2250 or B2262.** Replace LHCM or RHCM.
    d. **No.** Concern is intermittent. Switch may have been pressed for an extended period of time.

Table 1. DTC B2259 Diagnostic Faults

Auxiliary lamp switch stuck

1. Clear DTC.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace LHCM.
    b. **No.** Condition not currently present.

Table 1. DTC B2270 Diagnostic Faults

Open in BCM battery circuit
Open in BCM ground circuit

1. Clear DTC.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Condition not currently present.

Table 1. Any Hand Control Switch Inoperative Diagnostic Faults

Clutch switch malfunction
Brake switch malfunction

1. Operate inoperative switch.
2. Does switch operate correctly?
    a. **Yes.** Condition not currently present.
    b. **No.** Replace LHCM or RHCM.

There are two stop lamp switches.

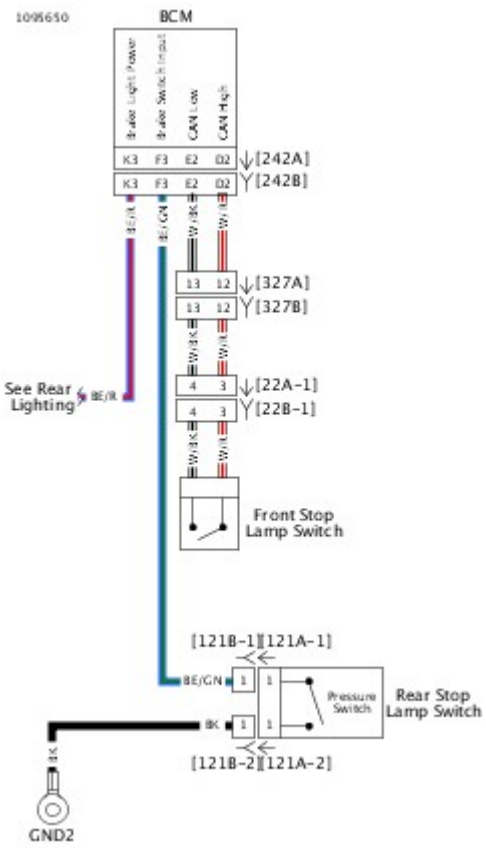
- The front stop lamp switch is a mechanical switch located on the right hand controls.
- The rear stop lamp switch is a pressure switch located in the brake line under the exhaust pipes.

During an ignition cycle, the ECM must receive a valid brake switch input. During the same ignition cycle the vehicle has to reach 31 mph (50 km/h) in third gear or higher and return to a stop three times without any brake switch signals in order to set DTC P0572.

Table 1. Code Description

P0572	Brake switch low

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



View interactive image

Figure 1. Brake Switch Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC P0572 Diagnostic Faults

RHCM malfunction
Rear brake switch malfunction
Short to ground in rear brake circuit

1. Verify stop lamp is illuminated.
2. Is stop lamp illuminated?
    a. **Yes. Go to Test 4.**
    b. **No. Go to Test 2.**

1. Activate rear brake.
2. Does stop lamp illuminate?
    a. **Yes.** Replace RHCM.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Disconnect rear stop lamp switch [121B-1].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal F3 and [121B-1] (BE/GN) wire.
6. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace rear brake switch.

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

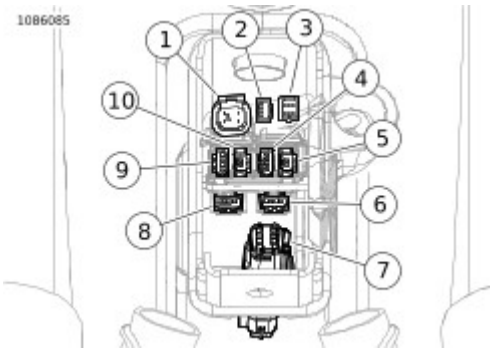
1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal F3 and ground.
5. Is continuity present?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Replace RHCM.

1. Disconnect rear stop lamp switch [121B-1].
2. Test continuity between BOB terminal F3 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in [242B] terminal F3 (BE/GN) wire.
    b. **No.** Replace rear brake switch.

The running lamps consist of the front position lamp (HDI), located in the headlamp housing, the front running lamps, the license plate lamp and the tail lamp. The running lamps are powered by the BCM through terminal J3 and M2 (if equipped).

Table 1. Code Description

B2168	Running lights output shorted low
B2169	Running lights output overloaded



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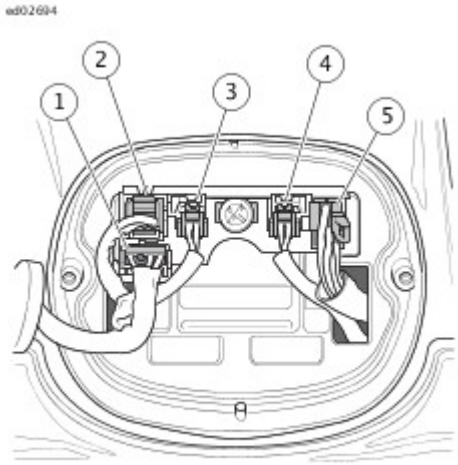
1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 1. USB Caddy



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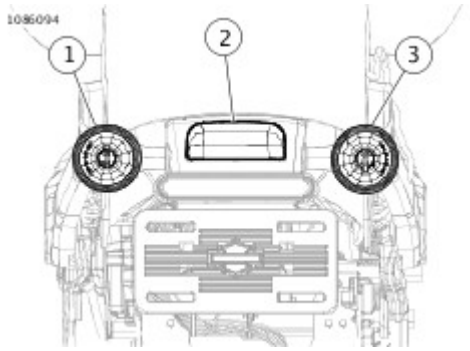
1	Tail lamp [93]
2	Rear fender tip lamp [45]
3	Left rear turn signal [19]
4	Right rear turn signal [18]
5	Rear fender lights harness in circuit board [94]

Figure 2. Rear Fender Lights



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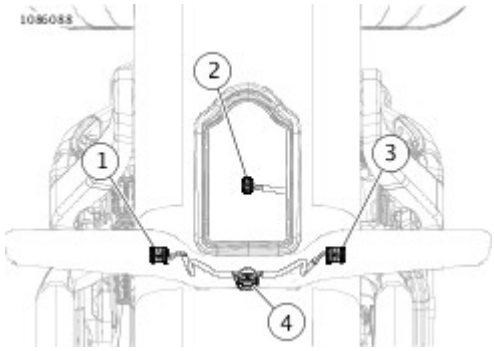
1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

Figure 3. Rear Lighting: FLSL, FLSB



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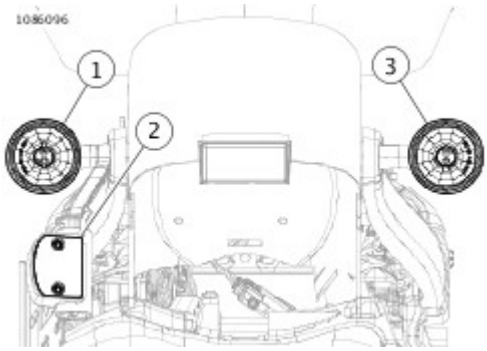
1	Left rear turn [18-2]
2	Stop/tail lamp [40]
3	Right rear turn [19-2]
4	Light bar interconnect [331]

Figure 4. Rear Lighting: FLDE



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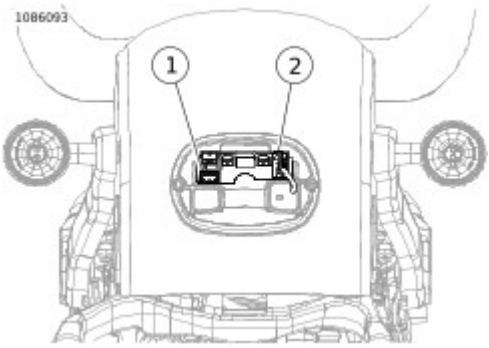
1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

Figure 5. Rear Lighting: FLFB/S, FXBB, FXBR/S, FXFB



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1	Left turn lamp
2	Tail lamp [93]
3	Stop lamp [94]
4	Right turn lamp

Figure 6. Rear Lighting: FLHC, FXLR

The running lamps circuit powers up when the ignition is turned on. On HDI models, the running lamp circuit is also powered in the ACC position. Any running lamp related DTCs will set shortly after the ignition is turned on. DTC B2169 will set if the running lights circuit is above 3 Amps.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

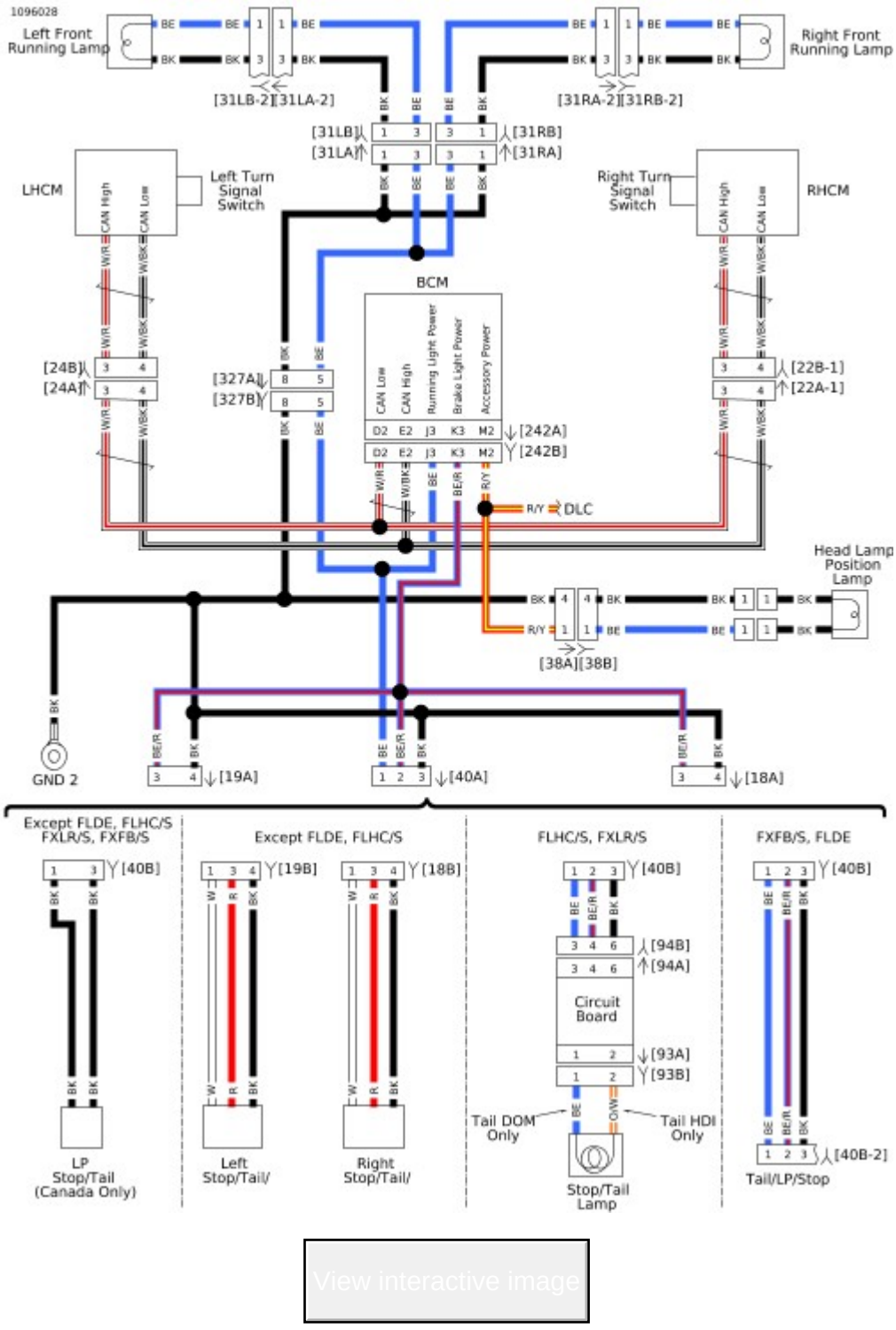


Figure 7. Running Lamps

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. Front Running Lamps Inoperative Diagnostic Faults

Open running lights circuit
Lamp malfunction
Open ground circuit

NOTE

This test refers to US running lamps integrated with the front turn signals.

1. Inspect front running lamp.
2. Is the running lamp LED?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 2.**

1. Inspect inoperative bulb.
2. Is bulb good?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace bulb.

1. Turn IGN OFF.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between running lamp bulb socket ground and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** Repair open in running lamp power circuit (BE) wire.
    b. **No.** Repair open in (BK) ground circuit.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. Rear Running Lamps Inoperative Diagnostic Faults

Open running lights circuit
Lamp malfunction
Open ground circuit

1. Inspect running lamp.
2. Is the running lamp LED?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 2.**

1. Inspect inoperative bulb and socket.
2. Is bulb and socket good?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace bulb.

1. Turn IGN OFF.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between tail lamp bulb socket terminal ground and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in ground circuit (BK) wire.

1. Disconnect rear lighting harness [40], [18] and [19].
2. Turn IGN ON.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [40A] terminal 1 and ground.
4. Is voltage present?

a. **Yes.** Replace running lamp assembly.
b. **No.** Repair open in (BE) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. License Plate Lamp Inoperative Diagnostic Faults

Open running lights circuit
Lamp malfunction
Open ground circuit

1. Turn IGN OFF.
2. Inspect license plate lamp.
3. Is lamp good?
    a. **Yes.** **Go to Test 2.**
    b. **No. Lamp is LED.** **Go to Test 2.**
    c. **No. Bulb does not work.** Replace bulb.

1. Disconnect rear lighting [40].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage [40A] terminal 1 and 3.
3. Is voltage present?
    a. **Yes.** Replace LP light assembly.
    b. **No.** **Go to Test 3.**

1. Test voltage between [40A] terminal 1 and ground.
2. Is voltage present?
    a. **Yes.** Repair open in (BK) wire.
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between BOB J3 and [40A] terminal 1.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (BE/R) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2168, B2169 Diagnostic Faults

Running lights circuit resistance too low
Short to ground in running lights power circuit
Accessory lighting overloading circuit

1. Turn IGN OFF.
2. Disconnect right rear turn lamp [18].
3. Clear DTC.
4. Cycle IGN OFF-ON.
5. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair short to ground or high current draw in right rear turn signal harness in the running lamp power circuits.

1. Turn IGN OFF.
2. Disconnect left rear turn lamp [19].
3. Clear DTC.
4. Cycle IGN OFF-ON.
5. Did DTC reset?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair short to ground or high current draw in left rear turn signal harness in the running lamp power circuits.

1. Turn IGN OFF.

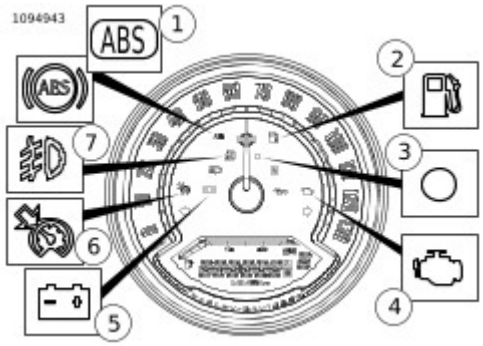
2. Disconnect tail lamp [40].
3. Clear DTC.
4. Cycle IGN OFF-ON.
5. Did DTC reset?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair short to ground or high current draw in tail lamp harness in the running lamp power circuits.

1. Turn IGN OFF.
2. Disconnect front turn signal [31R].
3. Clear DTC.
4. Cycle IGN OFF-ON.
5. Did DTC reset?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair short to ground in right front running lamps harness.

1. Turn IGN OFF.
2. Disconnect front turn signal [31L].
3. Clear DTC.
4. Cycle IGN OFF-ON.
5. Did DTC reset?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair short to ground in front running lamps harness.

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal J3 and ground.
6. Is continuity present?
    a. **Yes.** Repair short to ground in (BE) wire.
    b. **No.** Replace BCM.

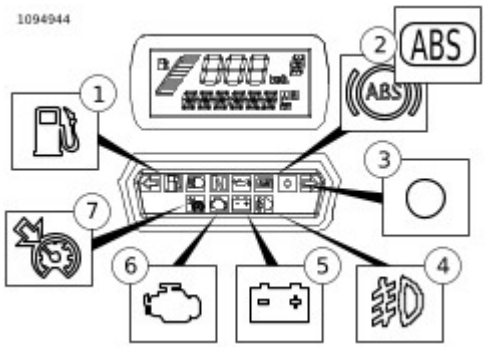
See **Figure 1** and **Figure 2**. The security lamp indicates system status. Refer to **Table 1**.



View interactive image

1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine
5	Battery
6	Cruise enabled
7	Aux lighting

Figure 1. Indicator Lamps (Except FXBB, FXBR)



View interactive image

1	Low fuel
2	ABS (km/h ABS icon lamp also shown)
3	Security

4	Aux lighting
5	Battery
6	Check engine
7	Cruise enabled

Figure 2. Indicator Lamps (FXBB, FXBR)

Table 1. Security Lamp Status

Does not flash.	Security system not armed.
Flashes every second.	Two minute timeout after failed PIN entry attempt or a battery reconnect has occurred while armed.
Flashes every 2.5 seconds.	Security system armed.
Flashes four times a second.	PIN entry mode.
Stays on solid with IGN OFF.	Arming is starting up. You have five seconds before system is armed.
Stays on solid with IGN ON.	If solid for more than four seconds after IGN ON, a current DTC is present.

NOTE

Always disarm the vehicle by turning the IGN ON with the fob present before removing or disconnecting the battery. This prevents the siren (if installed) from activating.

If the vehicle is equipped with the security system, the functionality is provided by a security BCM. The BCM will disable the starter and ignition system. Additional functions include the ability to alternately flash the left and right turn signals and sound a siren (if equipped) if a theft attempt is detected.

NOTE

The siren must be in the chirp mode for the siren to chirp on arming or disarming. See **Siren Chirp Mode Confirmation**.

Conditions that trigger a security event when system is armed include:

- **Detecting tampering of the ignition circuit:** Turn signals flash three times, optional siren chirps once and then turns off. If the tampering continues, a second warning will activate after four seconds. Continued tampering will cause the alarm to activate for 30 seconds and then turn off. The two warnings/alarm cycle is repeated for each tampering incident. The system will remain armed and the vehicle will be immobilized.
- **Detecting vehicle movement:** Turn signals flash three times, optional siren chirps once and then turns off. If the vehicle is not returned to its original position, a second warning will activate after four seconds. If the vehicle is not returned to its original position, the alarm activates for 30 seconds then turns off. The two warnings/alarm cycle may repeat a maximum of 10 times with a 10 second pause between cycles.
- **Detecting that a battery or ground disconnect has occurred while armed:** The optional siren activates its self-alarm mode. Turn signals will not flash.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

The following information applies only to vehicles equipped with the security.

- **Personal code disarming:** If the fob is not available or inoperative, the BCM allows the rider to disable the security alarm and immobilization functions with a five-digit personal code.
- **Arming confirmation:** When the security system is armed, the system provides visual feedback (confirmation) to the rider by flashing the turn signals and an audible "chirp" if equipped with the optional smart siren and chirp mode is enabled.
- **Disarming confirmation:** When the security system is disarmed, the system provides an audible "chirp" (confirmation) if equipped with the optional smart siren and chirp mode is enabled.
- **Transport mode:** It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be moved in an immobilized state.
- **Starter/ignition disable:** When armed the starter and ignition system are disabled.
- **Security system alarm:** See **Description and Operation**. The system will alternately flash the left and right turn signals and sound an optional Smart Siren if a vehicle security condition is detected while the system is armed.
- **Dealer service mode:** This mode allows the dealer to disable security system via **DIGITAL TECHNICIAN II (Part Number:HD-48650)**. Dealer service mode is exited when the IGN is turned ON with the assigned fob in range.

A warning consists of three alternate flashes of the turn signals and chirp from the optional smart siren. Warnings are issued from an armed security system in the following order:

1. **First warning:** A warning is issued whenever a person without a fob present or with the system armed attempts to move the vehicle or turns the ignition switch to **IGN.**
2. **Second warning:** If the motion continues or the ignition switch is not turned back to **OFF**, a second warning is issued within four seconds of the first.
3. **Alarm:** If the motion continues or the ignition switch is not turned to **OFF** past the second warning, the smart security system will go into full alarm.

The H-DSSS automatically arms within 5 seconds when the vehicle is parked and the ignition switch is turned to **OFF** or **ACC** and motion is not detected.

On arming, the turn signals flash twice and the smart siren will chirp twice if chirp function is activated. While armed, the security lamp will flash once every 2.5 seconds. Refer to **Security Lamp Status**.

There are two ways to disarm the H-DSSS:

- Automatic disarming.
- Using the PIN.

Always have the fob present when riding, loading, fueling, moving, parking or servicing the vehicle. The vehicle can be moved in an armed state with the fob present without triggering the alarm. The H-DSSS disarms automatically when the ignition switch is turned to ON.

On disarming, the smart siren will chirp once (if chirp function is activated) and the security lamp will turn ON solid for 4 seconds then go out. Refer to **Security Lamp Status**.

See **General** to enter an initial PIN to enable the system.

If you make an error while disarming the security system using the PIN, the alarm will activate for 30 seconds after the last digit is entered. Refer to **Table 1**.

Table 1. Entering a PIN to Disarm Harley-Davidson Smart Security System

1	If necessary, verify the current 5-digit PIN.		Should be recorded on wallet card.
2	Turn ignition to **IGN**.	If armed, the odometer window display will read: ENTER PIN and the security lamp will be flashing at a fast rate. The headlight will not be on.	
3	Press and release the left turn signal switch.	In the odometer window, a flashing 1 will appear.	
4	Increment the digit by tapping the left turn signal until the odometer window displays the first digit of the PIN.	The first digit in the odometer will be the first digit in the PIN.	
5	Press **right** turn switch **one time.**	The first digit is stored and the next digit will flash.	Serves as enter key.
6	Increment the second digit using the left turn switch until the digit reaches the second digit of the PIN.	The second digit in the odometer will be the second digit in the PIN.	
7	Press right turn switch 1 time.	The second digit is stored and the next dash will flash.	Serves as enter key.
8	Increment the third digit using the left turn switch until it reaches the third	The third digit in the odometer will be the third digit in the PIN.	

	digit of the PIN.		
9	Press **right** turn switch **one time**.	The third digit is stored and the next dash will flash.	Serves as enter key.
10	Increment the fourth digit using the left turn switch until it reaches the fourth digit of the PIN.	The fourth digit in the odometer will be the fourth digit in the PIN.	
11	Press **right** turn switch **one time.**	The fourth digit is stored and the next dash will flash.	Serves as enter key.
12	Increment the fifth digit using the left turn switch until it reaches the fifth digit of the PIN.	The fifth digit in the odometer will be the fifth digit in the PIN.	
13	Press **right** turn switch **one time**.	The fifth digit is stored. The security system indicator lamp stops blinking.	Smart Security System is disarmed.

When the alarm system is activated:

- Turn signals alternately flash.
- Smart siren, if equipped, sounds.

After 30 seconds of alarm, if no further vehicle motion is detected, the alarm will stop.

NOTE

Vehicle must be returned to original parked position with ignition **OFF**.

If vehicle motion continues, the alarm will start again and continue for another 30 seconds.

The security system will repeat the alarm cycles 10 times for a total of 5 minutes, with a 10-second pause between alarm cycles.

During warnings and alarms, the starter motor and the ignition remain disabled.

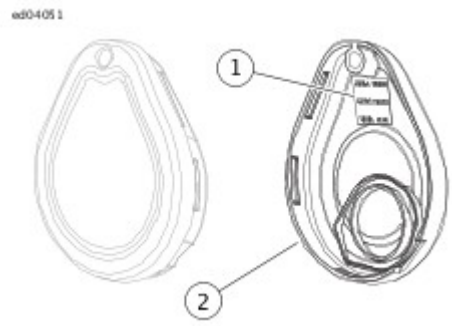
Stop the alarm at any time by moving an assigned fob to the vehicle. The presence of the fob will terminate the alarm.

See **Figure 1**. The fob's reception range for the signal depends on a specific receiver pattern. The typical range will be an arm's length.

See **Figure 2**. Replace the fob battery every year.

NOTE

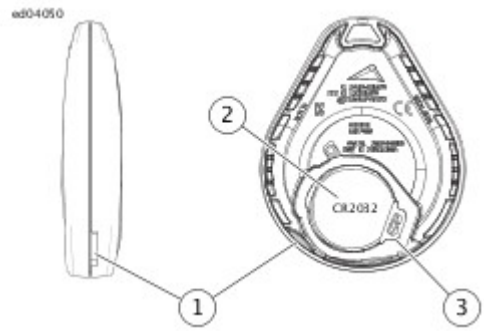
- Environmental and geographic conditions impact signal range.
- Always have the fob present whenever the vehicle is operated.
- Do not place fob in metal enclosure. Do not place it closer than 8 cm (3.0 in) to cellular phones, the hands-free antenna, displays and other electronic devices while operating the vehicle. That may prevent the fob from disarming the security system.



View interactive image

1	Fob serial number
2	Fob cover

Figure 1. Fob Serial Number



View interactive image

1	Thumbnail slot
2	Battery (CR2032)

3	Latch

Figure 2. Replace Fob Battery

Special Tools

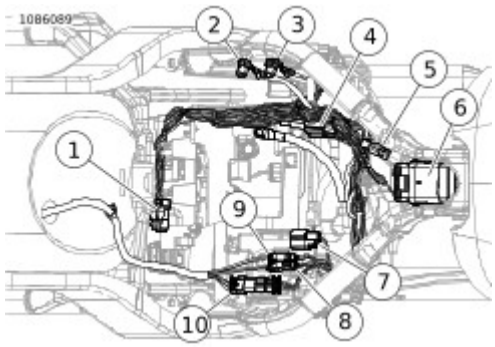
Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Use **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to assign both fobs to the H-DSSS. Follow the menu prompts in the **DIGITAL TECHNICIAN II (Part Number:HD-48650)** display and scan the fob serial number with the bar code reader, or key-in the number from the keyboard.

NOTE

Each fob has a unique serial number. Attach fob label to a blank NOTES page in the owner's manual for reference.

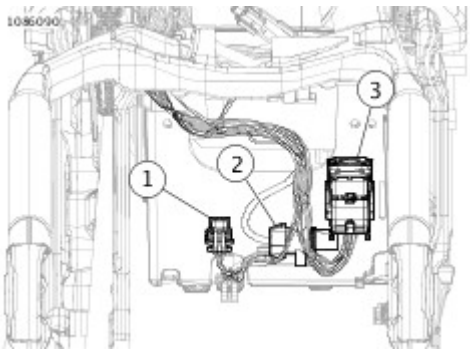
See **Figure 1** and **Figure 2**. If equipped, the siren is attached at [142]. Through this connector it shares the battery circuit, the ground circuit and the alarm signal circuit with the BCM. The siren adds an audible warning to the visual warnings that are a standard function of the security system.



View interactive image

1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

Figure 1. Under Seat



View interactive image

1	Security siren [142]
2	BCM power [259]
3	BCM [242]

Figure 2. Front of Rear Tire

In the chirpless mode, the siren does not chirp on arming or disarming.

NOTE

When armed in the chirpless mode, the siren still chirps warnings on movement and will activate the alarm through the normal cycles.

On arming in the chirp mode, the siren responds with two chirps. When disarming, the siren responds with a single chirp.

Cycling quickly through three armings and disarmings will switch chirp mode.

1. With the fob present, the IGN ON and the system disarmed, turn the IGN OFF.
2. When the security lamp turns off, immediately turn the IGN ON. If the turn signals flash twice before the IGN is turned ON, the system will drop out of the switching mode sequence and will have to be started over from the beginning.
3. Wait until the security lamp goes out, then immediately turn the IGN OFF.
4. When the security lamp turns off, immediately turn the IGN ON. If the turn signals flash twice before the IGN is turned ON, the system will drop out of the switching mode sequence and will have to be started over from the beginning.
5. Wait until the security lamp goes out, then immediately turn the IGN OFF.
6. When the security lamp turns off, immediately turn the IGN ON. If the turn signals flash twice before the IGN is turned ON, the system will drop out of the switching mode sequence and will have to be started over from the beginning.

Setting up a vehicle's security requires a BCM that is security equipped.

Actuation consists of assigning two fobs to the system and entering an initial PIN. The PIN can be changed by the owner at any time.

1. Configure vehicles by assigning **both** fobs to the vehicle.
2. Configure vehicles by entering a PIN picked by the owner. The personal code allows the owner to operate the system if the fob is lost or inoperable. Record the PIN in the owner's manual wallet card. Instruct the customer to always carry this card when riding the motorcycle.

Once the system has been activated, it will always arm within 5 seconds of turning the ignition switch to **OFF** or **ACC** and no vehicle motion.

The PIN consists of five digits. Each digit can be any number from 1-9. There can be no zeros (0) in the PIN. The PIN **must** be used to disarm the security system in case the fob becomes unavailable.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

The initial PIN entry should be performed using **DIGITAL TECHNICIAN II (Part Number:HD-48650)** in conjunction with fob assignment.

To change a PIN, refer to **Table 1**.

If a PIN was previously entered, the odometer will display the equivalent digit. To increment the digits, press the left turn signal switch. The first press selects the same value and then each additional press of the left turn signal switch will increment the digit by one.

Examples:

- To advance from 5 to 6, press and release the left turn switch twice.
- To advance from 8 to 2, press and release the left turn switch four times.

Table 1. Changing the PIN

1	Select a 5-digit (1 thru 9) PIN and record on the wallet card from owner's manual.		
2	With an assigned fob present, turn the engine stop switch to **OFF**.		
3	Cycle the OFF/RUN switch twice: **RUN - OFF - RUN - OFF - RUN**.		
4	Press **left** turn signal switch **two times**.	ENTER PIN will scroll through the odometer window.	
5	Press **right** turn signal switch **one time** and release.	Turn signals will flash three times. Current PIN will appear in odometer. The first digit will be flashing.	
6	Enter first digit of new PIN by pressing and releasing the **left** turn signal switch until the selected digit appears.		
7	Press **right** turn signal switch **one time** and release.	The new digit will replace the current in odometer window.	
8	Enter second digit of selected PIN by pressing and releasing the **left** turn signal switch until the selected digit is present.		
9	Press **right** turn signal switch **one time** and release.	The new digit will replace the current in odometer window.	
10	Enter third digit of the selected PIN by pressing and releasing the **left** turn signal switch until the selected digit is present.		
11	Press **right** turn switch **one time** and release.	The new digit will replace the current in odometer window.	
12	Enter fourth digit of new PIN by pressing		

	and releasing the **left** turn signal switch until the selected digit is present.		
13	Press **right** turn switch **one time** and release.	The new digit will replace the current in odometer window.	
14	Enter fifth digit of the new PIN by pressing and releasing the **left** turn signal switch until the selected digit is present.		
15	Press **right** turn switch **one time** and release.	The new digit will replace the current in odometer window.	
16	Turn the engine stop switch **OFF**.		Pushing the engine stop switch to **OFF** stores the new PIN in the module.

Put the system in transport mode to transport the motorcycle. Otherwise, the alarm activated by motion detection can discharge the battery.

In the transport mode, the security system is armed without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state. Any attempt to start the engine when the fob is not within range will trigger the alarm.

1. With an assigned fob within range, turn the ignition ON.
2. Before the security system lamp goes out, turn the ignition OFF.
3. Within 3 seconds, simultaneously press both the left and the right turn signal switches.
4. After the turn signals flash once, the system enters the transport mode. With the fob removed, the motorcycle can be moved without setting off the alarm.

With the fob present, turn the ignition ON to disarm the system.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

With a fob present, the security system can be configured for service by disabling the security system with **DIGITAL TECHNICIAN II (Part Number:HD-48650)**.

Once disabled, the vehicle can be operated without an assigned fob present. To maintain the service mode, the assigned fobs must be kept out of range. If the fob appears in range, the service mode is cancelled.

If it is necessary to leave a vehicle parked on the side the road, the hazard warning four-way flashers can be turned ON with the smart security system armed.

1. Turn IGN ON or ACC.
2. Press the hazard warning switch. The four-way flashers will continue for two hours.
3. Turn IGN OFF to arm the smart security system.

1. With a fob present, turn IGN to ON or ACC.
2. Press the hazard warning switch.

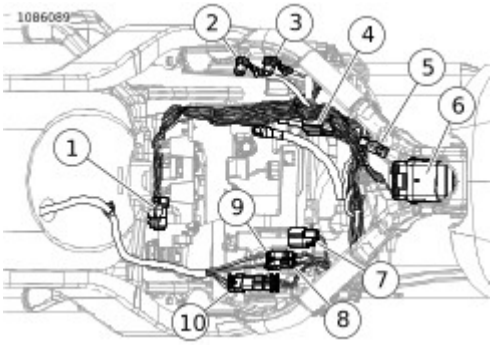
NOTE

This section applies only to those vehicles equipped with the optional security system.

See **Figure 1** and **Figure 2**. An alarm cycle is activated when the BCM is connected, the siren has been armed by the BCM and a security event occurs. See **Security Lamp**. Under normal armed operation, the siren input (terminal 2) is driven low by the BCM to trigger the audible alarm. When the siren input is driven high by the BCM the audible alarm stops.

Table 1. Code Description

B2172	H2 output shorted high
B2173	H2 output shorted low

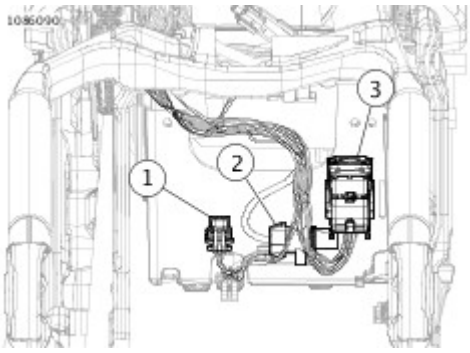


View interactive image

1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]

11	Tail lamp [40]

Figure 1. Under Seat



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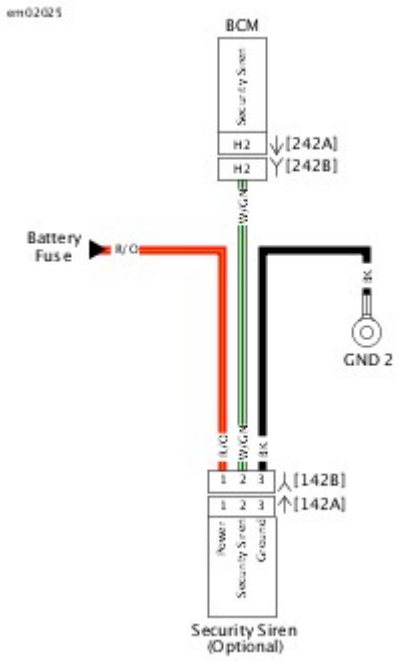
1	Security siren [142]
2	BCM power [259]
3	BCM [242]

Figure 2. Front of Rear Tire

- If the siren is armed and the internal siren battery is dead, shorted, disconnected or has been charging for a period longer than 24 hours, the siren will respond with three chirps on arming instead of two.
- The internal siren battery may not charge if the vehicle's battery is less than 12.5V.
- If the siren does not chirp two or three times on a valid arming command from the BCM, the chirp function has been disabled, the siren is either not connected, not working or the siren wiring was opened or shorted while the siren was disarmed.
- If the siren enters the self-driven mode where it is powered from the siren internal 9V battery, the turn-signal lamps will not alternately flash. If the BCM activates the siren, the turn-signal lamps will flash. If the siren has been armed and a security event occurs, and the siren is in self-driven mode, the siren will alarm for 20-30 seconds and then turn off for 5-10 seconds. This alarm cycle will be repeated ten times if the siren is in the self-driven mode.
- If the siren does not stop alarming after it has been armed, then either the BCM output or siren input may be shorted to ground, the siren vehicle battery connection is open or the siren vehicle ground connection is open or a security event has occurred. See **Security Lamp** for a description of alarm functions.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



View interactive image

Figure 3. Smart Siren Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC B2172 Diagnostic Faults

Short to voltage in alarm signal
Siren malfunction

1. Disconnect siren [142] (if equipped).
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [142B] terminal 2 and ground.
3. Is battery voltage present?
    a. **Yes.** Repair short to voltage in (W/GN) wire.
    b. **No.** **Go to Test 2.**

1. Clear DTCs.
2. Turn IGN OFF. Verify security activates.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace siren.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2173 Diagnostic Faults

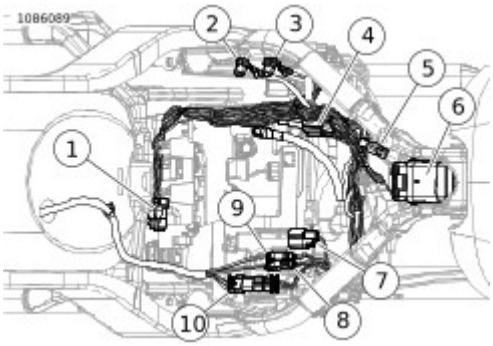
Short to ground in alarm signal
Open ground circuit
Open alarm signal
Siren malfunction

1. Disconnect security siren [142] (if equipped).
2. Turn IGN OFF.
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal H2 and ground.
6. Is continuity present?
    a. **Yes.** Repair short to ground in (W/GN) wire between [142B] and [242B].
    b. **No.** **Go to Test 2.**

1. Connect [242].
2. Clear DTCs.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Replace security siren.

See **Figure 1** (all other models similar). DTC B2176, B2177 or B2178 will set when a fault occurs to the security antenna circuit used to transmit to the fob. Refer to **Table 1**.

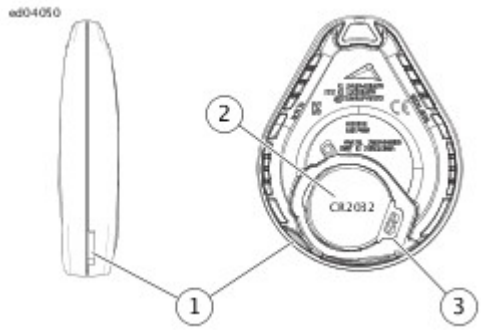
If the security system does not respond, responds with limited range or will not consistently disarm with fob within normal range, follow the fails to disarm diagnostic procedure.



View interactive image

1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

Figure 1. Under Seat



View interactive image

1	Thumbnail slot
2	Battery (CR2032)
3	Latch

Figure 2. Replace Fob Battery

Table 1. Code Description

B2176	Security antenna output open
B2177	Security antenna output shorted high
B2178	Security antenna output shorted low

The BCM will recognize the faults with IGN ON.

- Verify that cell phone is not within 80 mm (3.0 in) of key fob.
- Interference from physical surroundings impacts RF transmission. Place fob next to vehicle or move vehicle to a new location and retest.
- See **Figure 1**. Verify that antenna is in OE location. Make sure that seat has not been replaced with a metal base seat.
- Check for damage to antenna wire.
- See **Figure 2**. Verify fob battery voltage is at least 2.9V.
- Fob serial number is located inside fob. Twist thin blade in thumbnail slot to open.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

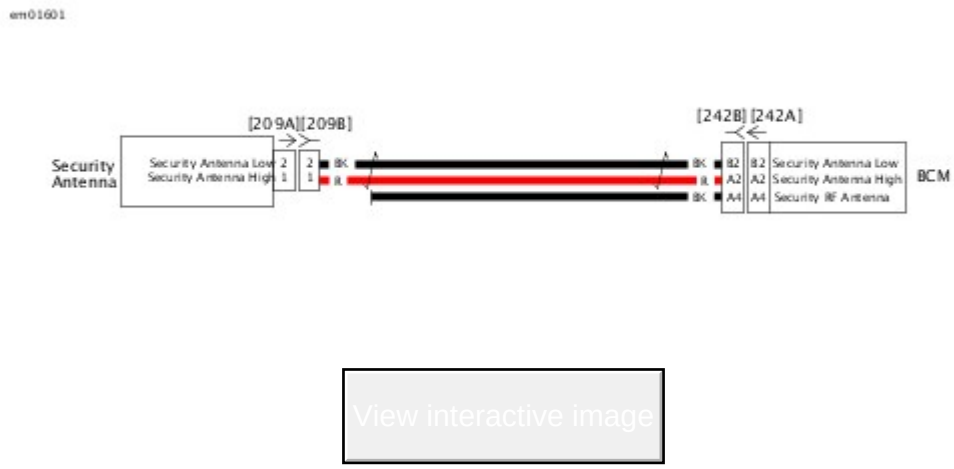


Figure 3. Antenna Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2176 Diagnostic Faults

Security antenna malfunction
Open antenna circuit

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. With fob present, turn IGN ON.
3. Does odometer read ENTER PIN?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 6.**

1. Inspect security antenna for damage.
2. Is security antenna damaged?
    a. **Yes.** Repair or replace security antenna as needed.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect antenna [209].
3. Inspect for water or contamination.

4. Is water or contamination present?
    a. **Yes.** Replace antenna.
    b. **No.** **Go to Test 4.**

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [209A] terminals 1 and 2.
2. Is resistance greater than 5700 ohms?
    a. **Yes.** Replace security antenna.
    b. **No.** **Go to Test 5.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Test resistance between BOB terminal B2 and [209B] terminal 2.
4. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (BK) wire.

1. Test resistance between BOB terminal A2 and [209B] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open in (R) wire.

1. Connect [242] and [209] (if needed).
2. Clear DTCs.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2177 Diagnostic Faults

Security antenna malfunction
Short to voltage in antenna circuit

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Inspect security antenna for damage.
2. Is security antenna damaged?
    a. **Yes.** Repair or replace security antenna as needed.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect antenna [209].
3. Inspect for water or contamination.
4. Is water or contamination present?
    a. **Yes.** Replace antenna.
    b. **No.** Connect [209]. **Go to Test 3.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B] and [242A]. See **How To Use Diagnostic Tools**.

2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal A2 and ground.
5. Is voltage greater than 0.6V?
    a. **Yes.** Repair short to voltage in (R) wire.
    b. **No.** **Go to Test 4.**

1. Test voltage between BOB terminal B2 and ground.
2. Is voltage greater than 0.6V?
    a. **Yes.** Repair short to voltage on (BK) wire.
    b. **No.** **Go to Test 5.**

1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC B2178 Diagnostic Faults

Security antenna malfunction
Open antenna circuit

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Inspect security antenna for damage.
2. Is security antenna damaged?
    a. **Yes.** Repair or replace security antenna as needed.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect antenna [209].
3. Inspect for water or contamination.
4. Is water or contamination present?
    a. **Yes.** Replace antenna.
    b. **No.** **Go to Test 3.**

1. Disconnect BCM [242].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [209B] terminal 1 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (R) wire.
    b. **No.** **Go to Test 4.**

1. Test continuity between [209B] terminal 2 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (BK) wire.
    b. **No.** **Go to Test 5.**

1. Connect BCM [242] and [209].
2. Clear DTC.
3. Turn IGN ON.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
DIGITAL TECHNICIAN II	HD-48650	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. Fails to Disarm Diagnostic Faults

Open antenna circuit
Short to ground in antenna circuit
RF interference
Antenna malfunction
Fob malfunction or dead battery

1. Check battery on non-functional fob.
2. Is battery voltage greater than 2.9V?
    a. **Yes.**
    b. **No.** Replace battery.

1. Move vehicle away from any possible interference sources.
2. Place fob on seat.
3. Will security system disarm?
    a. **Yes.** Inspect for electrical accessories or an aftermarket seat that may be causing interference.
    b. **No.**

1. Inspect antenna location and connection.

2. Is antenna properly located and connected?
    a. **Yes.**
    b. **No.** Repair connection.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving BCM [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal A4 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground.
    b. **No.**

1. Disconnect security antenna [209].
2. Test continuity between BOB terminals A2 and B2.
3. Is continuity present?
    a. **Yes.** Repair short between antenna circuits.
    b. **No.**

1. Test resistance between BOB terminal A4 and end of (BK) wire. Pull back conduit to expose unterminated end of wire.
2. Is resistance less than 0.5 ohm?
    a. **Yes.**
    b. **No.** Repair open on (BK) wire.

1. Replace security antenna with a known good security antenna.
2. Does security system now disarm?
    a. **Yes.** Replace security antenna.
    b. **No.**

1. Replace non-functional fob with a known good fob.
2. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**, program known good fob to BCM.
3. Turn IGN ON.
4. Push TEST button on DT unit.
5. Did DT unit see fob?

a. **Yes.** Replace original fob.
b. **No.** Verify fob serial number is correct. If so, replace BCM.

These outputs are intended for future applications and are not used for this model.

Table 1. Code Description

B2183	ABS wake shorted low
B2188	G3 output shorted low
B2193	H4 output shorted low
B2198	H3 output shorted low

This output is shorted to ground in one of three areas:

- Wire harness.
- Device the output is connected to.
- BCM.

This circuit may be used for aftermarket accessories or systems. If a code is set and cannot be duplicated, check for aftermarket devices.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

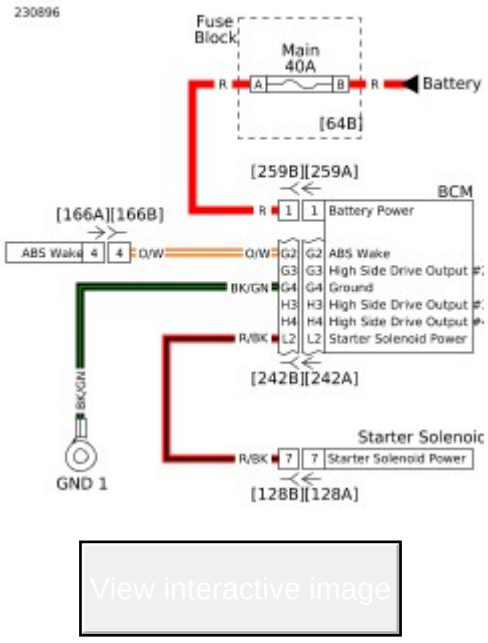


Figure 1. Spare Outputs

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2183 Diagnostic Faults

Short to ground in ABS wake circuit

1. Disconnect ABS [166].
2. Check DTCs.
3. Did DTC change to historic code?
    a. **Yes.** Replace ABS module.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB terminal G2 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (O/W) wire.
    b. **No.** Replace BCM.

Table 1. DTC B2183, B2188, B2193, B2198 Diagnostic Faults

Short to ground in spare output circuit

1. Visually inspect BCM [242].
2. Are there wires plugged into any of the spare output terminals?
    a. **Yes.** Problem may be caused by aftermarket devices. See aftermarket manufacturer for repair.
    b. **No.** **Go to Test 2.**

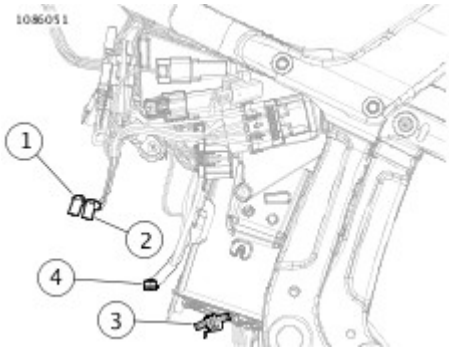
1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent.

See **Figure 1**. The BCM monitors the clutch and neutral switch circuits to determine whether or not to let the vehicle start. No power will be supplied to the starter solenoid unless either:

- Clutch switch is closed (lever pulled in).
- Neutral switch is closed (shifted to neutral).

Table 1. Code Description

B2218	Neutral switch shorted low



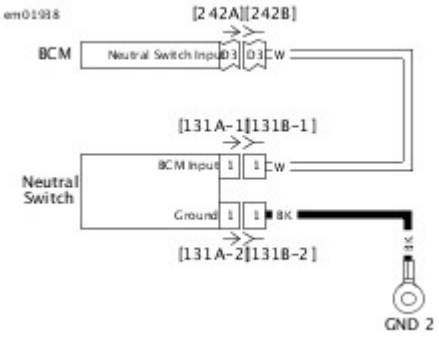
View interactive image

1	Neutral [131-1]
2	Neutral [131-2]
3	VSS [65]
4	Transmission GND

Figure 1. Top of Transmission

DTC B2218 will set when the neutral switch circuit is shorted low at speeds greater than 8 km/h (5 mph) for more than 60 seconds.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.



View interactive image

Figure 2. Neutral Switch Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2218 Diagnostic Faults

Short to ground in neutral circuit
Neutral switch malfunction

NOTE

This DTC may occur if the vehicle is ridden in neutral at speeds greater than 8 km/h (5 mph) for more than 60 seconds. For example, if coasting down a long mountain road with the transmission in neutral.

1. Shift transmission into 1st or 2nd gear.
2. Turn IGN ON.
3. Is neutral indicator illuminated?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Verify neutral switch torque.

1. Disconnect neutral switch [131-1].
2. Is neutral lamp illuminated?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace neutral switch.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.

3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal D3 and ground.
5. Is resistance less than 10 ohms?
    a. **Yes.** Repair short to ground on (W) wire.
    b. **No.** **Go to Test 4.**

1. Connect BCM [242] and neutral switch.
2. Clear DTC.
3. Turn IGN ON.
4. Operate vehicle above 8 km/h (5 mph) for at least two minutes.
5. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

The engine management system consists of the following components:

- ECM
- CKP sensor
- TMAP sensor
- ET sensor
- TGS
- TCA
- VSS
- Knock sensors
- HO2S
- Ignition coil
- Fuel pump
- Fuel injector
- Purge solenoid (if equipped)

The ECM is a solid state device mounted under the seat and sealed to prevent contamination from dust/dirt, water and oil. The ECM controls engine performance based upon input supplied to the ECM from the ET, CKP, TMAP, TGS, HO2S and the VSS sensors and other additional low-voltage circuits and components between the battery and ignition coil.

- The ECM controls the dwell time for the ignition coil, providing optimum ignition circuit performance for all engine speeds/load conditions. Optimizing the ignition system allows the ECM to control/vary engine timing (as needed) from 0-50 degrees BTDC.
- The ECM is a non-repairable item and must be replaced when it fails.

The CKP sensor is located in the front left side of the crankcase. The CKP generates an AC signal that is sent to the ECM where it is used to reference engine position (TDC) and speed. It functions by taking readings off the 30 teeth on the left side flywheel (two teeth are missing to establish a reference point).

The TMAP sensor is a dual-purpose sensor, mounted in the top of the intake manifold. One portion is used to measure temperature and the other portion is used to measure the air pressure inside the intake manifold. The temperature part of the TMAP contains a thermistor element, used to measure the temperature of the air entering the intake manifold. The MAP portion of this sensor is used to measure the difference between atmospheric pressure and vacuum pressure, within the intake manifold. The ECM processes information from the TMAP (and other sensors) to adjust ignition timing and fuel to achieve optimum engine performance.

The ET sensor contains a thermistor element that varies the sensor's internal electrical resistance. As the engine temperature changes the resistance in the ET sensor changes. The ECM monitors this resistance to compensate for various operating conditions.

The TGS, mounted on the right hand side of the handlebar, houses two internal (opposing) Hall-effect sensors for operator control of the engine's throttle. The opposing operation of the sensors ensures that repositioning of the throttle twist grip, forward and/or back, is accurately reported to the ECM. As the throttle is operated, position changes are reported to the ECM which controls the corresponding movement of the throttle plate by the TCA.

The TCA, mounted to the intake manifold, operates the throttle plate internal to the induction module on the engine. Two corresponding TP sensors receive input from the ECM, corresponding to the position of the TGS, to adjust the position of the throttle plate, accordingly. The ECM incorporates an H-Bridge and WatchDog microprocessor, used to control inadvertent or unexpected operations/conditions of the TCA and TGS.

The VSS is mounted in the transmission, beneath the starter motor. The VSS is a Hall-effect sensor, used to monitor and report vehicle speed based upon a reference point on the 5th gear of the transmission. A 5V reference signal and common ground circuitry are provided to the VSS, from the ECM. The VSS communicates electrical pulses to the ECM, where vehicle speed is calculated and sent to the speedometer as a serial data message.

The knock sensor creates a voltage signal based on the vibrations caused by detonation. The ECM uses this signal to alter the ignition timing and prevent detonation.

There are two HO2S, one mounted in each of the two exhaust pipes, to monitor the exhaust gas air/fuel mixture ratio. Each HO2S samples the exhaust oxygen content and provides specific voltage to the ECM. The ECM continuously adjusts the air/fuel mixture to maintain an optimal air/fuel mixture. When properly mixed, the HO2S voltage(s) will measure approximately 0.45V, each when measuring across the sensor.

The ignition coils provide high voltage output to the spark plugs. Each ignition coil is made up of a primary winding where low voltage input creates a high voltage spike in the collapsible field of the secondary winding. The front and rear coils are fired independently (one cylinder at a time).

The fuel pump, mounted inside the fuel tank, is a submersible pump used to provide fuel to the fuel injectors. The fuel pump is powered by the BCM.

- When the IGN is ON, the BCM supplies voltage to the fuel pump.
- The fuel pump also runs when the start button is pressed for up to 10 seconds, as long as the ECM is receiving input from the CKP sensor. If no CKP pulses are received, the ECM sends a message to the BCM to turn off the fuel pump within 2 seconds after the ignition is turned on, the engine has stalled or immediately after the engine is shut off.
- The fuel pump contains a pressure regulator which maintains consistent fuel pressure to each of the fuel injectors. Excess fuel flow is bypassed into the fuel tank by the pressure regulator.

There are two fuel injectors mounted to the intake manifold. The ECM controls the injectors by actuating the injector solenoid enabling fuel to be metered through the injector and atomized into the intake manifold.

The injectors are timed to the combustion cycle and are triggered sequentially. When the ECM determines that fuel is required, the ECM supplies a short duration ground to the fuel injector, which opens and releases fuel into the air intake manifold.

The purge solenoid (working with the charcoal canister only used in certain destinations) allows the vapors to escape back into the throttle body. The purge solenoid is timed to the throttle position but is disabled at startup, low engine temperature, low engine speed or low vehicle speed. The power for the purge solenoid comes from the BCM. The ECM provides the path to ground to trigger the purge solenoid.

To improve rider comfort, an optional heat management system (EITMS) may be enabled. After being enabled, the heat management system improves rider comfort by turning off the rear cylinder fuel injector when all of the following conditions exist:

- High engine temperature.
- Engine at idle speed.
- Low or no vehicle speed.
- Clutch lever pulled in or transmission in neutral.

There is a four minute delay after startup before EITMS will engage. As the engine maintains idle speed, the rear cylinder functions as an "air pump," helping to cool the engine. This continues until one of the above listed conditions is no longer met, then the rear cylinder fires normally again.

NOTE

When the engine is in heat management mode, a noticeable difference in idle may be accompanied by a unique exhaust odor. While these conditions are normal, a rider or technician unaware of the heat management system may incorrectly assume an idle problem is present.

1. Turn the ignition ON. Push the engine OFF/RUN switch on the right handlebar to the RUN position (the

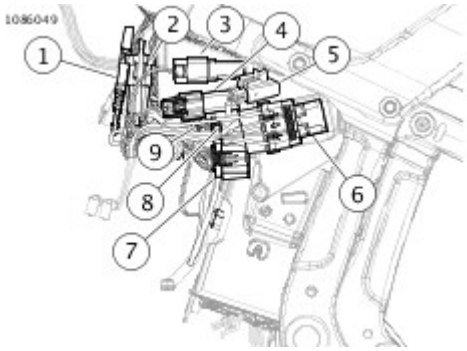
motorcycle may be running or not running).

2. Verify cruise control is OFF.
3. Push the throttle to roll-off position and hold.
4. After approximately 3 seconds, the cruise indicator will flash either amber (disabled) or green (enabled).
5. Repeat the procedure as necessary to enable or disable.

NOTE

On platforms/models equipped with a radio, the status of the EITMS can be viewed on the information display.

See **Figure 1**. The ECM receives and processes signals from the sensors and applies output signals to the drivers to start, idle and run the engine. This section describes the configuration of the ECM.



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1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover

The ECM is mounted under the seat. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from ET, CKP, TMAP, TGS, HO2S and VSS sensors) and controls the low-voltage circuits for the ignition coils and injectors.

The ECM contains all of the components used in the ignition system. The dwell time for the ignition coil is also calculated in the microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to give adequate spark at all speeds. The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced.

The left flywheel has positions for 32 teeth evenly spaced around its circumference with 30 teeth present and 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.

In the 32-2 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.

Phasing is accomplished by the ECM identifying a widening in the CKP signal caused by the deceleration of the crankshaft, as a piston approaches TDC on its compression stroke. Since the rear cylinder approaches TDC earlier than the front cylinder, engine phase can be readily discriminated. Phasing is normally accomplished on the first TDC cycle after engine synchronization. Once phased, the ECM can begin normal ignition events. If the ECM experiences a system reset or loss of synchronization while the engine is running it also loses phase.

When phase is lost one of the following occurs:

- If an engine-not-running (Crank Mode) rpm is detected, the ECM executes the normal start-up phasing process.
- If Engine Run Mode is detected, the ECM executes a running re-phase sequence.

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

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

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 **Description and Operation**.

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 EFI system.

The CKP sensor, located on the left front of the lower crankcase half, is a variable reluctance sensor that generates AC voltage as the teeth on the flywheel 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.

The TGS, mounted on the right hand side of the handlebar, houses two internal (opposing) Hall-effect sensors for operator control of the engine's throttle. The opposing operation of the sensors ensures that repositioning of the throttle twist grip, forward and/or back, is accurately reported to the ECM. As the throttle is operated, position changes are reported to the ECM that controls the corresponding movement of the throttle plate by the TCA.

The TCA, mounted to the intake manifold, operates the throttle plate internal to the induction module on the engine. Two corresponding TP sensors provide input to the ECM, so the ECM may verify that plate position corresponds to TGS input (rider desired position of the plate) and to adjust the position of the throttle plate, accordingly.

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

The accelerometer is within the BCM. The BCM will shut the engine down if the vehicle is tipped over and the odometer will display tip. Once the sensor is tripped, the motorcycle must be righted, the ignition turned off and then on again before the engine can be restarted. This is communicated across the CAN communication.

The clutch switch is part of the LHCM. There are two types of clutch switches, one type for mechanical (cable) operated clutches and one for hydraulic operated clutches. The switches function differently and are not interchangeable. The LHCM communicates the position of the clutch switch to the ECM and BCM over the CAN communication circuits.

NOTE

The clutch switches are not interchangeable. If swapped, it could cause DTCs or improper vehicle operation.

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

The ET 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 [78-2] terminal 8.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V.

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

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

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 [78-2] terminal 6.

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

The knock sensor is a piezoelectric sensor that contains a seismic mass, brass carrier, contact ring and a ceramic piezo element. The knock sensor creates a voltage signal based on the vibrations caused by detonation. The ECM uses this signal to alter the ignition timing and prevent detonation.

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 to the

ECM.

- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V. The ECM monitors this voltage to determine when to start the cooling fans.

The VSS is a Hall-effect device mounted close to the teeth of the 5th gear in the transmission. The output signal frequency varies with vehicle speed. The ECM processes the vehicle speed signal and transmits it via the serial data circuit to the speedometer to indicate vehicle speed.

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

- The normal output is 0.5V which represents a balance between a lean (not enough fuel) and rich (too much fuel) air/fuel mixture.
- An output less than 0.5V represents a lean mixture; greater than 0.5V represents a rich mixture.
- The change in output level signals the ECM to modify the air/fuel ratio. The HO2S does not operate efficiently until the engine is at operating temperature. Always warm-up the vehicle prior to troubleshooting the HO2S. The heater elements on the HO2S helps bring the HO2S up to operating temperature quicker. Leaks in the exhaust system, leaky exhaust valves, misfires or any engine problem allowing unburned oxygen into the exhaust stream could create a DTC indicating a bad sensor. Look for problems related to an improper air/fuel mixture before replacing the sensor.

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

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

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

The BCM powers a separate ignition coil for each cylinder.

The BCM 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.

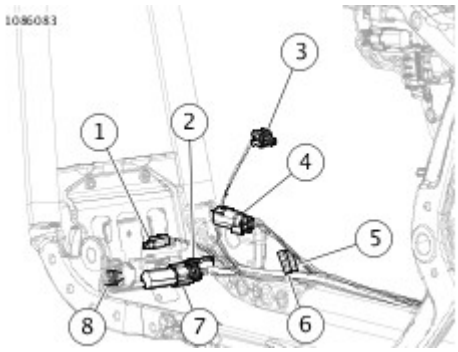
See **Figure 1** , **Figure 2** , **Figure 3** , **Figure 4** and **Figure 5**. The BCM supplies and monitors the 12V system power circuit from terminal L3 of the BCM to the following components:

- Ignition coil
- Front fuel injector
- Rear fuel injector
- Purge solenoid
- ECM
- Front HO2S
- Rear HO2S
- Front ACR
- Rear ACR

The system power circuit is energized when the ignition is turned on.

Table 1. Code Description

B2102	System power output shorted high
B2103	System power output shorted low
B2104	System power output overloaded



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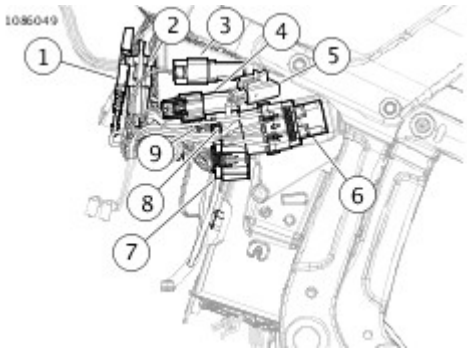
1	CKP [79]
2	Voltage regulator [77]
3	Oil pressure sensor [120]
4	Front HO2S [138]
5	Rear brake switch [121-1]
6	Rear brake switch [121-2]
7	JSS [133]

8	Stator [47]

Figure 1. Front of Engine: Typical



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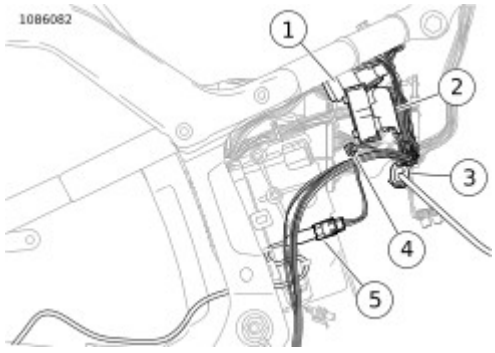
1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 2. Behind Left Side Cover



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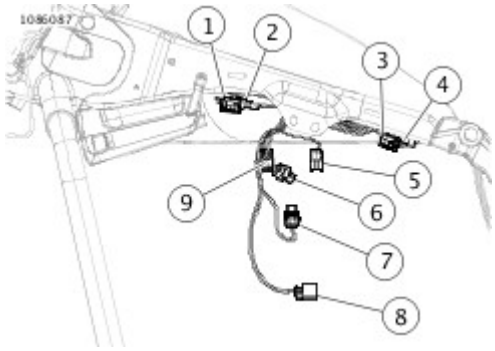
1	Engine harness [145]

2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]
5	Rear WSS [168]

Figure 3. Behind Right Side Cover



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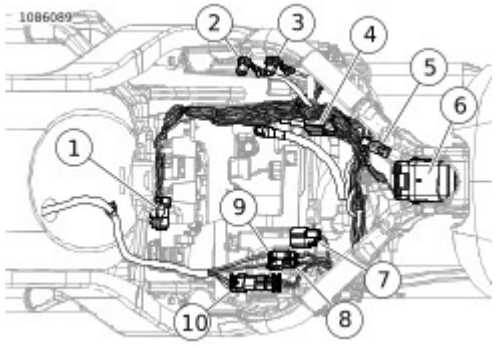
1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 4. Engine



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1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

Figure 5. Under Seat

DTC B2104 will set if the system power circuit draws more than 10 Amps.

Since the system power circuit normally has ignition voltage with IGN ON, the short to voltage will have to be present with the vehicle turned off in order to set DTC B2102.

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

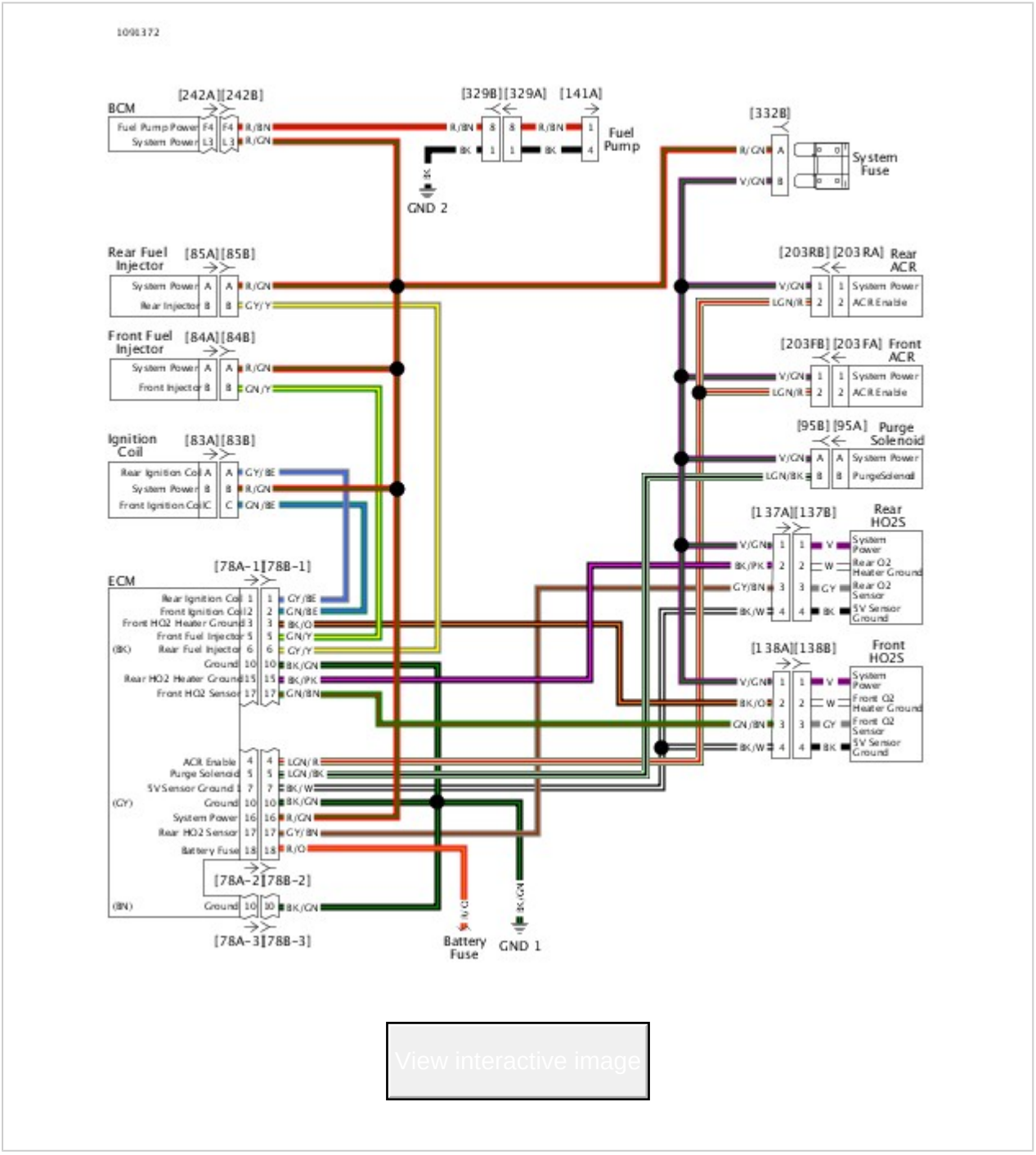


Figure 6. System Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC B2102 Diagnostic Faults

Short to battery in the system power circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to [78B-1], 78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 16 and ground.
5. Is battery voltage present?
    a. **Yes.** Repair short to voltage in (R/GN) wire.
    b. **No.** Replace BCM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2103, B2104 Diagnostic Faults

Short to ground in the system power circuit
Ignition coil resistance too low
Front coil shorted low
Rear coil shorted low
Front HO2S resistance too low
Rear HO2S resistance too low
Front fuel injector resistance too low
Rear fuel injector resistance too low
ACR resistance too low
Purge solenoid resistance too low

1. Inspect the system fuse.
2. Is the fuse good?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 14.**

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Clear DTCs.
4. Turn IGN ON.

5. Check DTCs.
6. Did DTC reset?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace ignition coil.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [83B] terminal A and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (GY/BE) wire.
    b. **No.** **Go to Test 4.**

1. Test continuity between [83B] terminal C and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (GN/BE) wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Connect [83].
3. Disconnect rear fuel injector [85].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace rear fuel injector.

1. Turn IGN OFF.
2. Connect [85].
3. Disconnect front fuel injector [84].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Replace front fuel injector.

1. Turn IGN OFF.
2. Disconnect purge solenoid [95].
3. Clear DTCs.
4. Turn IGN ON.
5. Check DTCs.
6. Did DTC reset?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Replace purge solenoid.

1. Turn IGN OFF.
2. Connect [95].
3. Disconnect front HO2S [138].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace front HO2S.

1. Turn IGN OFF.
2. Connect [138].
3. Disconnect rear HO2S [137].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 10.**
    b. **No.** Replace rear HO2S.

1. Turn IGN OFF.
2. Connect [137].
3. Disconnect front ACR [203F].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 11.**
    b. **No.** Replace front ACR.

1. Turn IGN OFF.

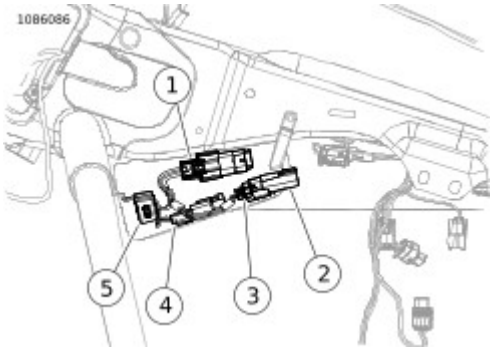
2. Connect [203F].
3. Disconnect rear ACR [203R].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 12.**
    b. **No.** Replace rear ACR.

1. Turn IGN OFF.
2. Connect [85].
3. Disconnect ECM [78-2].
4. Clear DTCs.
5. Turn IGN ON.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 13.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Connect [78].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B] leaving BCM [242A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
5. Test continuity between BOB terminal L3 and ground.
6. Is continuity present?
    a. **Yes.** Repair short to ground in (R/GN) wire.
    b. **No.** Replace BCM.

1. Test continuity between fuse block [64B] socket terminal 3 and ground.
2. Disconnect front and rear HO2S, front and rear ACRs, purge solenoid and active exhaust (if equipped).
3. Was continuity lost as components were removed?
    a. **Yes.** Replace last component removed when continuity was lost.
    b. **No.** Repair short to ground in (V/GN) wire.

See **Figure 1**. The BCM supplies and monitors the 12V system power circuit from terminal F4 of the BCM to the fuel pump. The fuel pump is constantly grounded. The BCM controls the fuel pump by turning on and off the power to the pump on the (R/BN) wire.



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1	USB caddy interconnect [329]
2	USB [264]
3	Fuel pump [141]
4	ET sensor [90]

Figure 1. Under Fuel Tank Left Side

Table 1. Code Description

B2116	Fuel pump output open
B2117	Fuel pump output shorted high
B2118	Fuel pump output shorted low
B2119	Fuel pump output overloaded

DTC B2116 will set if the fuel pump circuit draws less than 600 milliamps.

DTC B2119 will set if the fuel pump circuit draws more than 6 Amps.

DTC B2119 can set if the BCM sees an excessive load on the fuel pump circuit. This could be caused by a fuel pump being run dry. If the fuel pump was replaced or the vehicle was run out of gas, prime the pump and clear the code. Start the vehicle and check DTCs to see if the code returns.

Any circuit that is powered up continually with IGN ON could cause DTC B2117 or B2119 to set if shorted to the fuel pump circuit. If a short to voltage or overload conditon is found, test continuity between fuel pump circuit and the other power circuits from the BCM.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

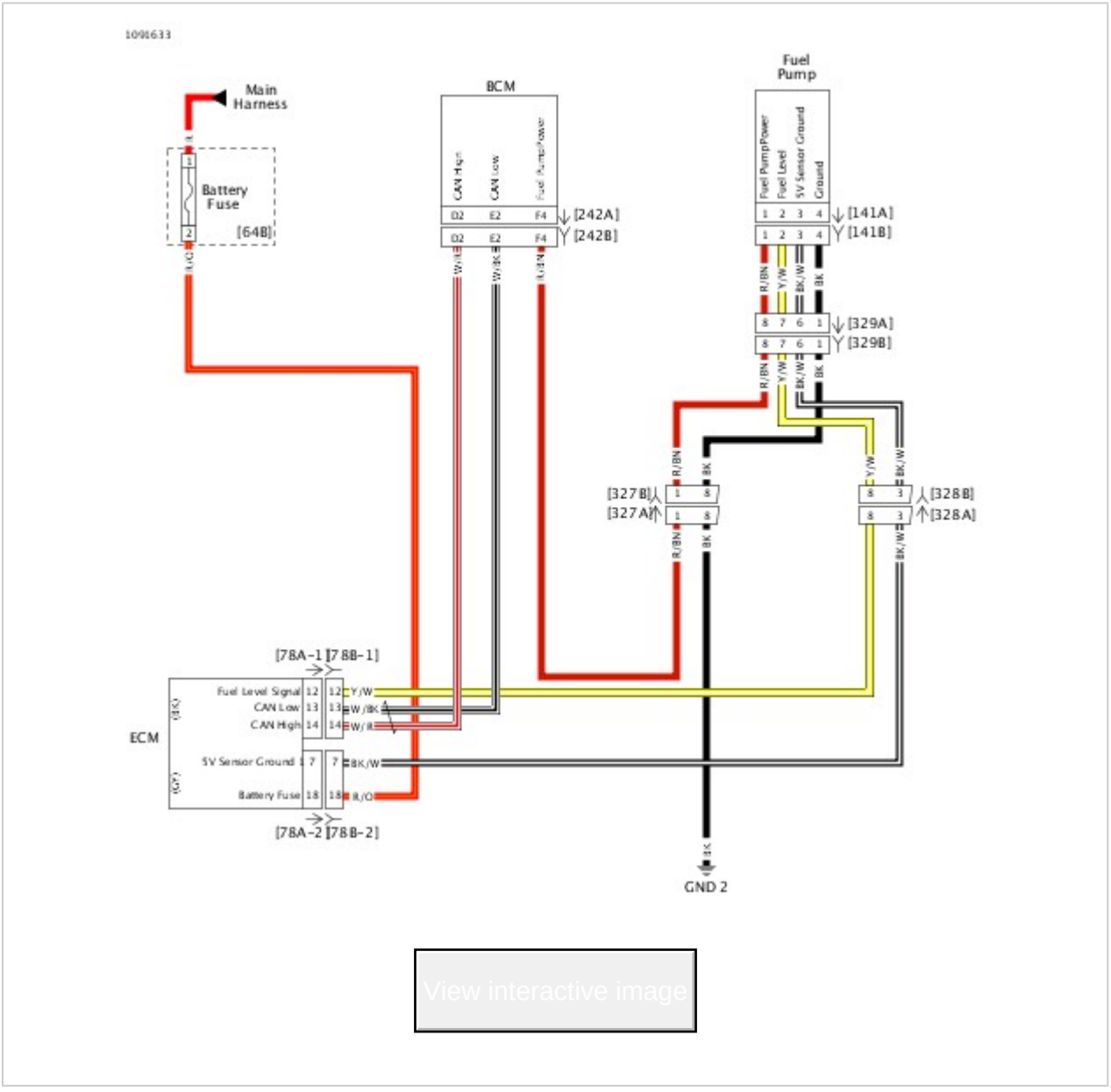


Figure 2. Fuel Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1

Table 1. DTC B2116 Diagnostic Faults

Open in the fuel pump power circuit
Fuel pump fault or malfunction

1. Turn IGN OFF.
2. Disconnect fuel pump [141].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [141B] terminals 1 and 4.
4. Turn IGN ON.
5. Was battery voltage displayed for a short time?
    a. **Yes.** Replace fuel pump.
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Test resistance between [141B] terminal 4 and ground.
3. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK) ground wire.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** to wire harness [242B], leaving BCM [242A] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
3. Test resistance between BOB terminal F4 and [141B] terminal 1.
4. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace BCM.
    b. **No.** Repair open in (R/BN) wire.

Table 1. DTC B2117 Diagnostic Faults

Short to voltage in the fuel pump power circuit

1. Turn IGN ON.
2. Does fuel pump continue to run after the initial 2 second start up?
    a. **Yes.** Repair short to voltage in (R/BN) wire. See diagnostic tips. If no source of short is found, replace BCM.
    b. **No.** **Go to Test 2.**

1. Clear DTC.
2. Start engine.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace BCM.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

Table 1. DTC B2118, B2119 Diagnostic Faults

Short to ground in the fuel pump power circuit
Fuel pump malfunction

1. Verify there is fuel in fuel tank.
2. Is fuel present in tank?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Fill tank with fuel and clear DTCs. If the DTC returned, then continue with tests. **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect fuel pump [141].
3. Clear DTC.
4. Turn IGN ON.
5. Check DTCs.
6. Did DTC reset?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace fuel pump.

1. Turn IGN OFF.
2. Disconnect BCM [242].
3. Test continuity between [141B] terminal 1 (R/BN) wire and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground on (R/BN) wire.
    b. **No.** See diagnostic tips. If problem not found, replace BCM.

Special Tools

Description	Part Number	Qty.
VACUUM PUMP	HD-23738	1

See **Figure 1**. The TMAP sensor provides the functions of both an IAT sensor and a MAP sensor in one unit. The TMAP sensor is supplied 5V from ECM [78-3] terminal 18. It sends MAP and IAT signals back to ECM [78-1] terminal 7 and [78-2] terminal 6, respectively. Refer to **Table 1**.

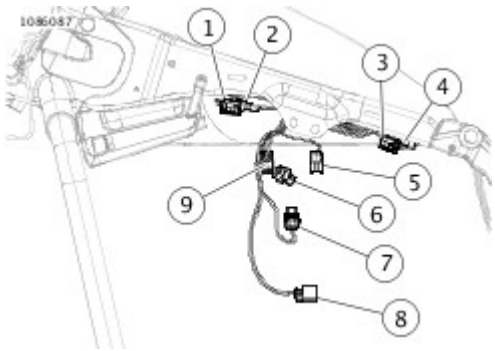
Table 1. Code Description

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

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

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

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



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1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 1. Engine

- DTCs P0107 or P0108 will set if the MAP sensor signal is out of range. DTC P0108 can only be detected with the engine running.
- Using the **VACUUM PUMP (Part Number:HD-23738)**, apply a vacuum to the pressure port of the TMAP sensor. The MAP signal voltage should lower as the vacuum is applied.
- The TMAP and TGS are connected to the same reference line (+5V Vref). If the reference line goes to ground or open, multiple codes will be set (DTCs P0107, P0108, P0122, P0123, P1501 and P1502).

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

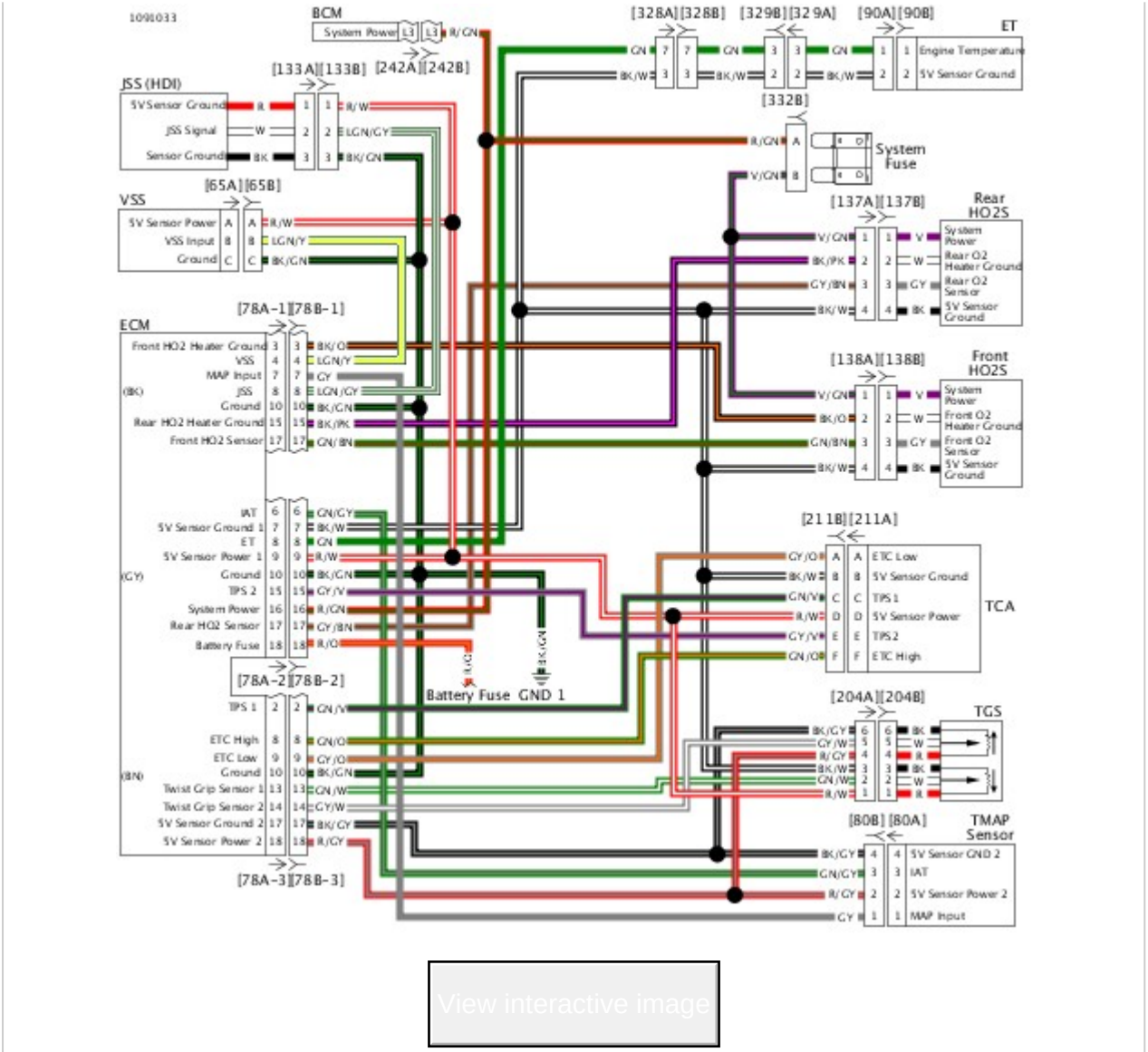

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Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0107 Diagnostic Faults

MAP sensor malfunction
Open or shorted to ground signal wire
Open or shorted to ground 5V reference circuit

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, jumper between [80B] terminals 1 (GY) wire and 3 (R/GY) wire.
4. Clear DTCs.
5. Start engine.
6. Turn IGN ON.
7. Check DTCs.
8. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace TMAP sensor.

1. Turn IGN OFF.
2. Remove jumper.
3. Turn IGN ON.
4. Test voltage between [80B] terminal 2 (R/GY) wire and ground.
5. Is voltage approximately 5V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 6.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between [80B] terminal 1 (GY) wire and BOB [78-1] terminal 7.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 4.**
    b. **No.** Repair open in (GY) wire.

1. Test continuity between BOB [78-1] terminal 7 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (GY) wire.
    b. **No. Go to Test 5.**

1. Test continuity between BOB [78-1] terminal 7 and [78-3] terminal 17.
2. Is continuity present?
    a. **Yes.** Repair short between (GY) and (BK/GY) wires.
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between [80B] terminal 2 (R/GY) wire and BOB [78-3] terminal 18.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 7.**
    b. **No.** Repair open in (R/GY) wire.

1. Test continuity between BOB [78-3] terminals 17 and 18.
2. Is continuity present?
    a. **Yes.** Repair short between the (R/GY) and (BK/GY) wires.
    b. **No.** See diagnostic tips before replacement. Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0108 Diagnostic Faults

MAP sensor malfunction
Short to voltage

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].
3. Clear DTC.
4. Start engine.
5. Turn IGN OFF.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace MAP sensor.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wire harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB [78-1] terminal 7 and [78-3] terminal 18.
5. Is continuity present?
    a. **Yes.** Repair short between (R/GY) and (GY) wires.
    b. **No.** **Go to Test 3.**

1. Turn IGN ON.
2. Test voltage between BOB [78-1] terminal 7 and ground.
3. Is voltage present?
    a. **Yes.** Repair short to voltage in (GY) wire.
    b. **No.** **Go to Test 4.**

1. Test voltage between BOB [78-3] terminal 18 and ground.
2. Is voltage greater than 5.25V?
    a. **Yes.** Repair short to voltage in (R/GY) wire.
    b. **No.** **Go to Test 5.**

1. Test resistance between [80B] terminal 4 and BOB [78-3] terminal 17.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace TMAP sensor.
    b. **No.** Repair open in (BK/GY) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0112 Diagnostic Faults

Short to ground in 5V reference circuit

NOTE

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

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

1. Test resistance between [80B] terminal 3 (GN/GY) and ground.
2. Is resistance reading less than 1 ohm?
    a. **Yes.** Repair short to ground on (GN/GY) wire.
    b. **No.** **Go to Test 3.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wire harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Test continuity between BOB [78-2] terminals 6 and 10.

4. Is continuity present?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair short to ground on (GN/GY) wire.

1. Test continuity between BOB [78-2] terminal 6 and [78-3] terminal 17.
2. Is continuity present?
    a. **Yes.** Repair short between [80B] terminals 4 and 3 (GN/GY and BK/GY) wires.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0113 Diagnostic Faults

Open or short to voltage in 5V reference circuit

NOTE

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

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

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to

wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.

3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between [80B] terminal 3 (GN/GY) and BOB [78-2] terminal 6.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open circuit in (GN/GY) wire.

1. Test resistance between BOB [78-3] terminal 17 and [80B] terminal 4 (BK/GY).
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (BK/GY) wire.

1. Test continuity between BOB [78-2] terminal 6 and [78-3] terminal 18.
2. Is continuity present?
    a. **Yes.** Repair short between (GN/GY) and (R/GY) wires.
    b. **No.** Replace ECM.

See **Figure 1**. A dual TPS is integrated into the TCA, mounted to the induction module.

Within the TCA, a set of potentiometers are designated as TPS (TPS1 and TPS2). The ECM drives the motor in the TCA to open and close the throttle plate based on the signals from the twist grip sensor. The TPS (TPS1 and TPS2) send signals back to the ECM based on throttle plate position to verify the throttle plate movement.

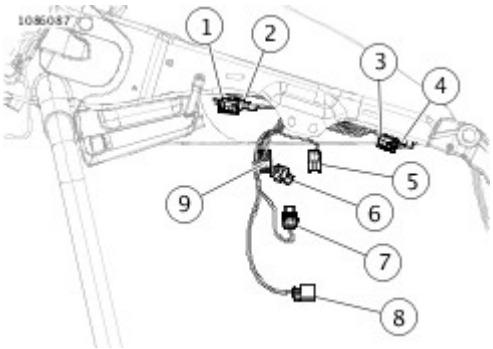
The ECM supplies a 5.0V signal from terminal [78-2] terminal 9 to TPS1 and [78-3] terminal 18 to TPS2. The signals from TPS1 and TPS2 are sent back to the ECM [78-3] terminals 13 and 14 and vary in voltage according to actual throttle plate position.

The two TP sensors work opposite each other. When one sensor reads high, the other reads low. The sum of TPS1 and TPS2 signals should measure around 5.0V.

See **Figure 2** for TCA (TPS1 and TPS2) circuitry diagram. Refer to **Table 1** for DTCs associated with TPS1 and TPS2 of the TCA.

Table 1. Code Description

P0120	TPS1 range error
P0122	TPS1 low/open
P0123	TPS1 high
P0220	TPS2 range error
P0222	TPS2 low/open
P0223	TPS2 high



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1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]

5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 1. Engine

NOTE

The TGS, JSS, TCA and VSS sensors are connected to the same reference line (5V reference). If the reference line goes to ground or open, multiple codes will be set (DTC P0122, P0123, P0502, P0503, P1501, P1502, P2101, P2102, P2103, 2122, 2123, P2127, P2128). Start with the trouble code having the highest priority DTC. Refer to **Diagnostics**.

Check for the following conditions:

- **Poor connection:** Inspect ECM harness connector [78B-1], [78B-2] and [78-B-3] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform Wiggle Test to locate intermittents:** If connections and harness check out OK, monitor TPS voltage using a multimeter while moving related connectors and wiring harness. If the failure is induced, the TPS voltage will change.
- An intermittent may be caused by poor connection, rubbed through wire insulation or an inoperative wire within the wire insulation.

A faulty sensor can negatively affect the signal voltage of the other sensors sharing the same 5V reference. If the wiring passes the following tests, disconnect one sensor at a time on the 5V reference and verify the DTC is still present. Additional DTCs will be set as each sensor is disconnected, clear DTCs after this test. Be sure to perform this test before replacing a component.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

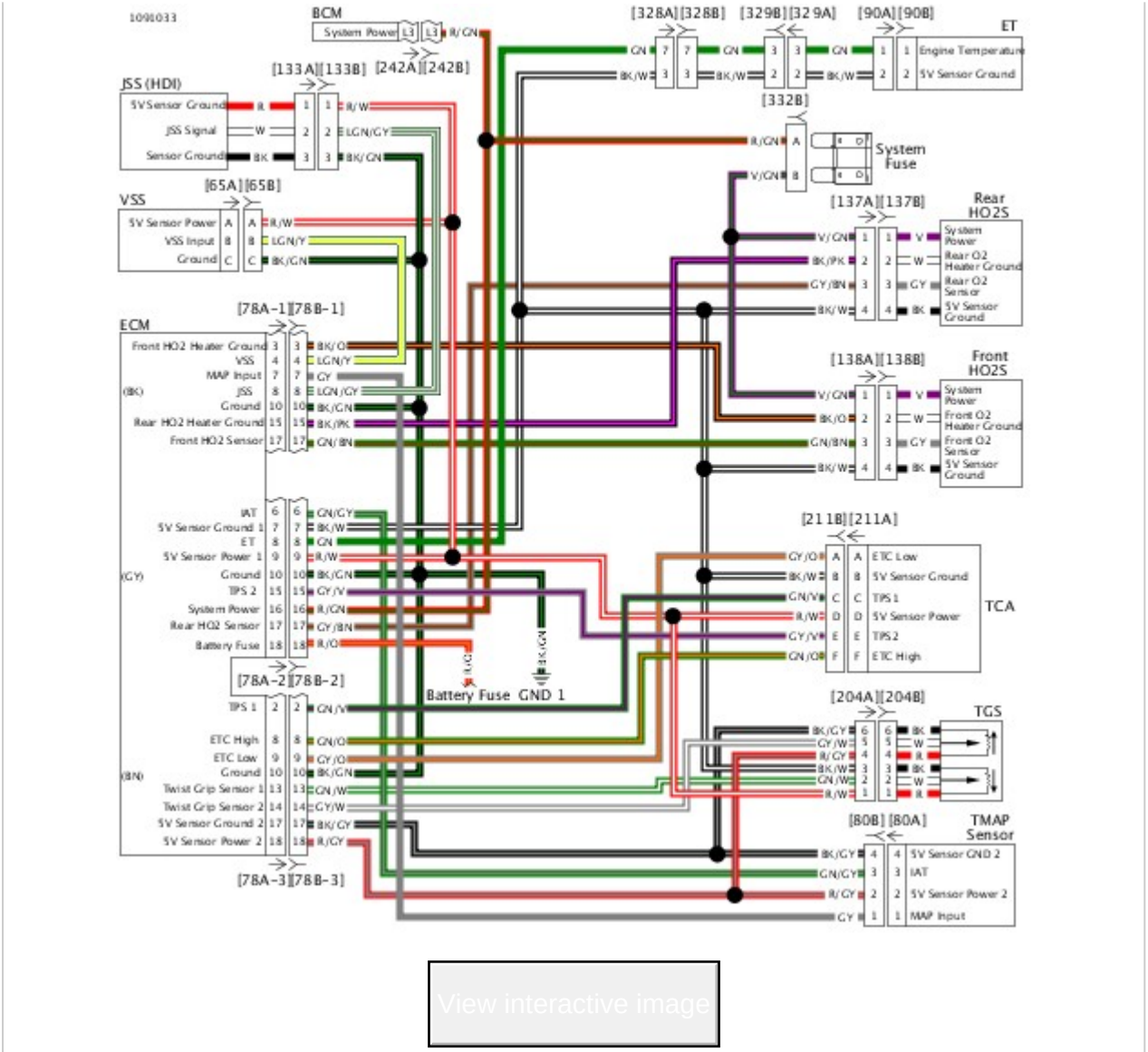

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Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0120 Diagnostic Faults

Open in sensor power circuit
Short to voltage in TPS-1 circuit
Open in TPS-1 circuit
Short to ground in TPS-1 circuit
Open sensor ground circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TCA [211].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 9 and [211B] terminal D.
6. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (R/W) wire.

1. Test continuity between BOB [78-2] terminal 9 and [78-3] terminal 2.
2. Is continuity present?
    a. **Yes.** Repair short between (GN/V) and (R/W) wires.
    b. **No. Go to Test 3.**

1. Test resistance between BOB [78-3] terminal 2 and [211B] terminal C.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (GN/V) wire.

1. Test continuity between BOB [78-3] terminal 2 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (GN/V) wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN ON.
2. Test voltage between BOB [78-3] terminal 2 and ground.
3. Is voltage present?
    a. **Yes.** Repair short to voltage on (GN/V) wire.
    b. **No.** **Go to Test 6.**

1. Test resistance between BOB [78-2] terminal 7 and [211B] terminal B.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open in (BK/W) wire.

1. Turn IGN OFF.
2. Connect [78A-1], [78A-2] and [78A-3] to BOB.
3. Connect [211].
4. Turn IGN ON.
5. Test voltage between BOB [78-2] terminal 7 and [78-3] terminal 2.
6. Is voltage between 0.4-4.8V?
    a. **Yes.** Replace ECM.
    b. **No.** Replace TCA.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0122 Diagnostic Faults

Short to ground in TPS-1 Circuit
Open in sensor power circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3] and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-3] terminal 2 and [78-2] terminal 7.
6. Is voltage greater than 0.2V?
    a. **Yes. Go to Test 2.**
    b. **No. Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect ECM [78A-1], [78A-2] and [78A-3] from BOB.
3. Disconnect TCA [211].
4. Test continuity between BOB [78-3] terminal 2 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (GN/V) wire.
    b. **No. Go to Test 3.**

1. Test resistance between BOB [78-2] terminal 9 and [211] terminal 5.

2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace TCA.
    b. **No.** Repair open in (R/W) wire.

1. Turn IGN OFF.
2. Disconnect TCA [211].
3. Test voltage between BOB [78-2] terminal 9 and ground.
4. Is voltage greater than 4V?
    a. **Yes.** Replace TCA.
    b. **No.** **Go to Test 5.**

1. Disconnect ECM [78A-1], [78A-2] and [78A-3] from BOB.
2. Test continuity between BOB [78-3] terminal 2 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (GN/V) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0123 Diagnostic Faults

Open in TPS-1 circuit
Short to voltage in TPS-1 circuit
Short to voltage in sensor power circuit
Open in sensor ground circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-3] terminal 2 and [78-2] terminal 7.
6. Is voltage less than 4.8V?
    a. **Yes. Go to Test 8.**
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect TCA [211].
3. Turn IGN ON.
4. Test voltage between [211B] terminal C and ground.
5. Is voltage between 4-5.25V?
    a. **Yes. Go to Test 3.**
    b. **No, less than 4V.** Repair open in (GN/V) wire.
    c. **No, greater than 5.25V.** Repair short to voltage in (GN/V) wire.

1. Test voltage between [211B] terminal D and ground.
2. Is voltage less than 5.25V?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair short to voltage in (R/W) wire.

1. Jumper [211B] terminals C and B.
2. Test voltage between BOB [78-3] terminal 2 and [78-2] terminal 7.
3. Is voltage greater than 1.0V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Replace TCA.

1. Turn IGN OFF.
2. Test resistance between [211B] terminal B and ground.
3. Is resistance less than 2 ohms?
    a. **Yes.** **Go to Test 6.**
    b. **No.** **Go to Test 7.**

1. Test continuity between [211B] terminals D and C.
2. Is continuity present?
    a. **Yes.** Repair short between (GN/V) and (R/W) wires.
    b. **No.** Replace ECM.

1. Disconnect ECM [78A-1], [78A-2] and [78A-3].
2. Test resistance between [211B] terminal B and BOB [78-2] terminal 7.
3. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (BK/W) wire.

1. Disconnect TCA [211].
2. Test voltage between [211B] terminal C and ground.
3. Is voltage between 2-5.25V?
    a. **Yes.** **Go to Test 9.**

b. **No. Less than 2V.** Repair open in (GN/V) wire.
c. **No. Greater than 5.25V.** Repair short to voltage on (GN/V) wire.

1. Test voltage between [211B] terminal D and ground.
2. Is voltage less than 5.25V?
    a. **Yes.** **Go to Test 10.**
    b. **No.** Repair short to voltage on (R/W) wire.

1. Turn IGN OFF.
2. Disconnect ECM [78A-1], [78A-2] and [78A-3].
3. Test resistance between [211B] terminal B and BOB [78-2] terminal 7.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 11.**
    b. **No.** Repair open in (BK/W) wire.

1. Test resistance between [211B] terminal C and BOB [78-3] terminal 2.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace TCA.
    b. **No.** Repair open in (GN/V) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0220 Diagnostic Faults

Open in sensor power circuit
Short to voltage in sensor power circuit
Open in TPS-2 circuit
Short to voltage in TPS-2 circuit
Short to ground in TPS-2 circuit
Open in sensor ground circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TCA [211].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 9 and [211] terminal 5.
6. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (R/W) wire.

1. Turn IGN ON.
2. Test voltage between BOB [78-2] terminal 9 and ground.
3. Is battery voltage present?
    a. **Yes.** Repair short to voltage (R/W) wire.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Test continuity between BOB [78-2] terminals 9 and 15.
3. Is continuity present?
    a. **Yes.** Repair short between (R/W) and (GY/V) wires.
    b. **No.** **Go to Test 4.**

1. Test resistance between BOB [78-2] terminal 15 and [211B] terminal E.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (GY/V) wire.

1. Test continuity between BOB [78-2] terminal 15 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (GY/V) wire.
    b. **No.** **Go to Test 6.**

1. Turn IGN ON.
2. Test voltage between BOB [78-2] terminal 15 and ground.
3. Is voltage present?
    a. **Yes.** Repair short to voltage on (GY/V) wire.
    b. **No.** **Go to Test 7.**

1. Turn IGN OFF.
2. Test resistance between BOB [78-2] terminal 7 and [211B] terminal B.
3. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Repair open in (BK/W) wire.

1. Connect [78A-1], [78A-2] and [78A-3] to BOB.
2. Connect [211].
3. Turn IGN ON.

4. Test voltage between BOB [78-2] terminals 15 and 7.
5. Is voltage between 0.4-4.8V?
    a. **Yes.** Replace ECM.
    b. **No.** Replace TCA.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0222 Diagnostic Faults

Open in sensor power circuit
Short to ground in TPS-2 circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminals 15 and 7.
6. Is voltage greater than 0.2V?
    a. **Yes. Go to Test 2.**
    b. **No. Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect [78A-1], [78A-2] and [78A-3] from BOB.
3. Disconnect TCA [211].
4. Test continuity between BOB [78-2] terminal 15 and ground.
5. Is continuity present?
    a. **Yes.** Repair short to ground in (GY/V) wire.
    b. **No. Go to Test 3.**

1. Test resistance between BOB [78-2] terminal 9 and [211] terminal 5.

2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace TCA.
    b. **No.** Repair open in (R/W) wire.

1. Turn IGN OFF.
2. Disconnect [211].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminal 9 and ground.
5. Is voltage greater than 4V?
    a. **Yes.** Replace TCA.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Disconnect [78A] from BOB.
3. Test resistance between BOB [78-2] terminal 15 and ground.
4. Is resistance greater than 0.5 ohms?
    a. **Yes.** Repair short to ground in (GY/V) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0223 Diagnostic Faults

Open in sensor power circuit
Short to voltage in sensor power circuit
Open in TPS-2 circuit
Short to voltage in TPS-2 circuit
Short to ground in TPS-2 circuit
Open in sensor ground circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminals 15 and 7.
6. Is voltage less than 4.8V?
    a. **Yes. Go to Test 7.**
    b. **No. Go to Test 2.**

1. Disconnect TCA [211].
2. Test voltage between [211B] terminal E and ground.
3. Is voltage less than 0.2V?
    a. **Yes. Go to Test 3.**
    b. **No. Go to Test 5.**

1. Test voltage between [211B] terminal D and ground.
2. Is voltage less than 5.25V?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair short to voltage in (R/W) wire.

1. Turn IGN OFF.
2. Test resistance between [211B] terminal B and ground.
3. Is resistance less than 2 ohms?
    a. **Yes.** Replace TCA.
    b. **No.** **Go to Test 6.**

1. Disconnect [78A-1], [78A-2] and [78A-3].
2. Test continuity between [211B] terminals E and D.
3. Is continuity present?
    a. **Yes.** Repair short between (GY/V) and (R/W) wires.
    b. **No.** Replace ECM.

1. Test resistance between [211B] terminal B and BOB [78-2] terminal 7.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (BK/W) wire.

1. Disconnect [78A-1], [78A-2] and [78A-3].
2. Disconnect TCA [211].
3. Turn IGN ON.
4. Test voltage between [211B] terminal E and ground.
5. Is voltage less than 1.0V?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Repair short to voltage on (GY/V) wire.

1. Test voltage between [211B] terminal D and ground.

2. Is voltage less than 5.25V?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Repair short to voltage on (R/W) wire.

1. Turn IGN OFF.
2. Disconnect [78A-1], [78A-2] and [78A-3].
3. Test resistance between [211B] terminal B and BOB [78-2] terminal 7.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace TCA.
    b. **No.** Repair open in (BK/W) wire.

See **Figure 1**. The ECM supplies and monitors a voltage signal from [78-2] terminal 8 to one side of the ET sensor. The other side of the ET sensor is connected to a common sensor ground. The ground is also connected to the ECM [78-2] terminal 7.

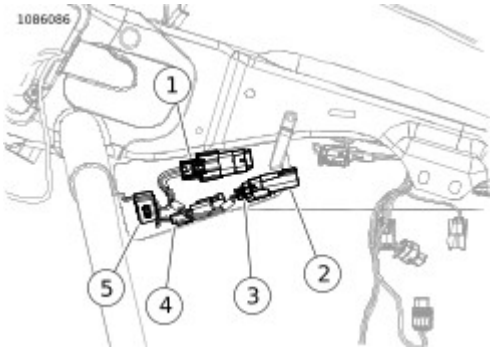
The ET sensor is a thermistor device. At a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on ECM [78-2] terminal 8.

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

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

Table 1. Code Description

P0117	ET sensor shorted low
P0118	ET sensor high/open



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1	USB caddy interconnect [329]
2	USB [264]
3	Fuel pump [141]
4	ET sensor [90]

Figure 1. Under Fuel Tank Left Side

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

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

Check the following conditions:

- **Poor connection:** Inspect ECM harness connector [78-1], [78-2] and [78-3] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform Wiggle Test to locate intermittents:** If connections and harness check out OK, use a multimeter to check the engine temperature reading while moving related connectors and wiring harness. If the failure is induced, the engine temperature display will change.
- **Shifted sensor resistance value:** Measure ET and IAT sensor temperatures with a cool engine. The sensor temperatures should be within 5.6 °C (10 °F) of each other. If the two sensors are not within the specified range replace the inaccurate sensor.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

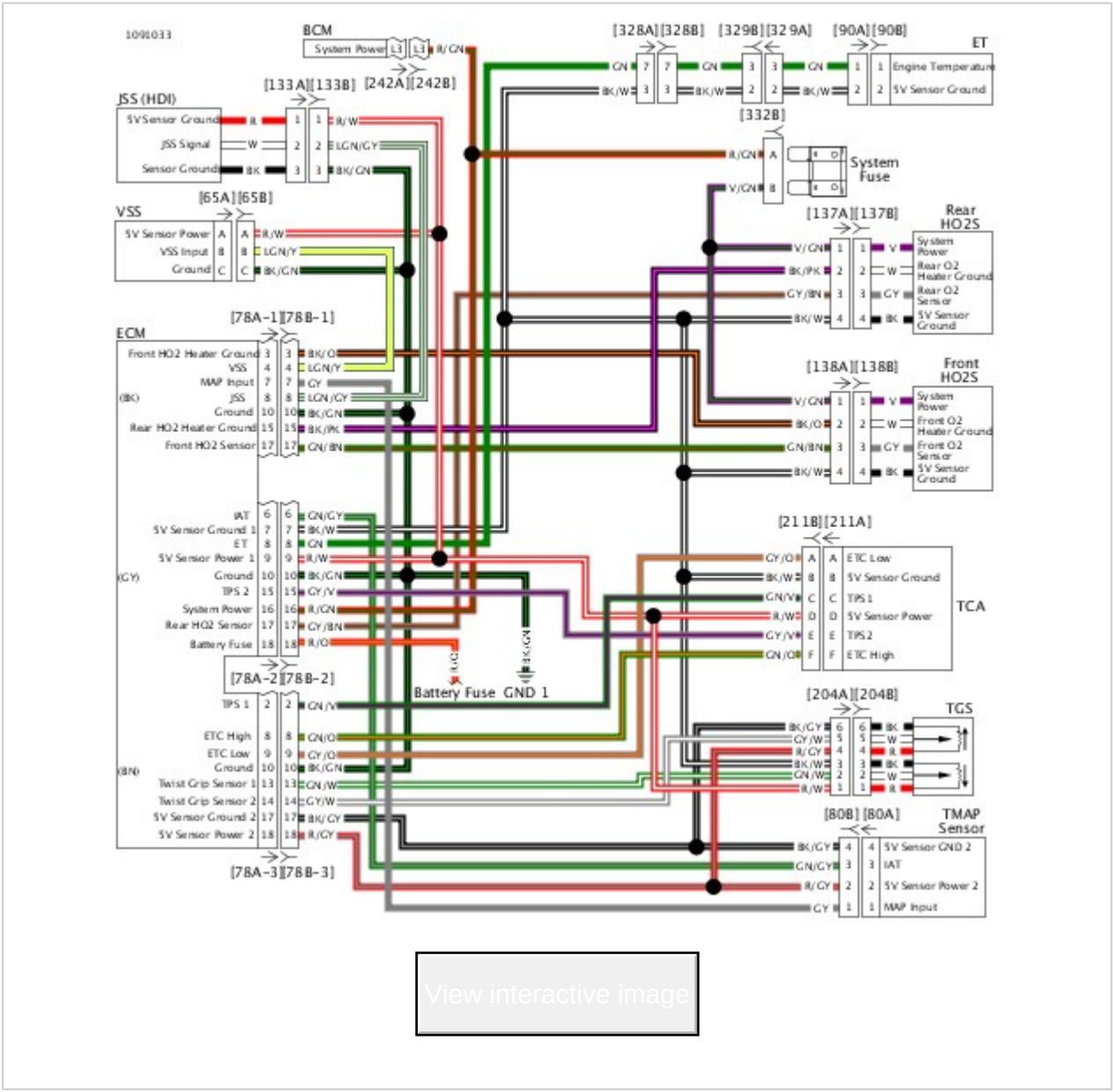

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Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0117 Diagnostic Faults

ET sensor malfunction
Short to ground in 5V reference circuit

NOTE

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

1. Turn IGN OFF.
2. Disconnect ET sensor [90].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [90B] terminals 1 and 2.
4. Is resistance between 900-10,000 ohms?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace ET sensor.

1. Test resistance between [90A] terminal 1 (GN) wire and ground.
2. Is resistance less than 1 ohm?
    a. **Yes.** Repair short to ground in (GN) wire.
    b. **No.** **Go to Test 3.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.

3. Test continuity between BOB [78-2] terminals 8 and 7.
4. Is continuity present?
    a. **Yes.** Repair short between [90A] terminals 1 (GN) wire and 2 (BK/W) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0118 Diagnostic Faults

ET sensor malfunction
Open or short to voltage in 5V reference circuit

1. Turn IGN OFF.
2. Disconnect ET sensor [90].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [90A] terminal 1 (GN) wire and ground.
4. Turn IGN ON.
5. Is voltage greater than 6V?
    a. **Yes.** Repair short to voltage on (GN) wire.
    b. **No.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between [90A] terminal 1 (GN) wire and BOB [78-2] terminal 8.
5. Is resistance less than 0.5 ohms?
    a. **Yes.**
    b. **No.** Repair open in (GN) wire.

1. Test resistance between [90A] terminal 2 (BK/W) wire and BOB [78-2] terminal 7.
2. Is resistance less than 0.5 ohms?

a. **Yes.**
b. **No.** Repair open in (BK/W) wire.

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

1. Connect [90].
2. Test continuity between BOB [78-2] terminals 8 and 7.
3. Is continuity present?
    a. **Yes.** Replace ECM.
    b. **No.** Replace ET sensor.

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

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

Table 1. Code Description

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

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

The ECM requires a HO2S fault be present for three drive cycles before it sets a code. After clearing codes, operate the vehicle for three drive cycles before checking for codes.

The heater circuits in the HO2S are powered from the system power circuit. This circuit voltage is supplied by the BCM through the system power fuse. Any short causing the fuse to open will cause the ECM to set DTC P0031 and P0051. If these codes are present with an open fuse, the fault is a short to ground somewhere in the circuit or the components.

The multimeter displays the signal from the HO2S in Volts. This voltage will have an average value tending towards lean, rich or ideal value depending on operating temperature of the engine, engine speed and throttle position. An open/short to voltage or short to ground in the (GN/BN) wire (front) and (GY/BN) wire (rear) will cause the engine to run rich (short to ground) or lean (short to voltage) until the fault is detected. Once fault is detected, vehicle will run in open loop.

Check for the following conditions:

- **Poor connection:** Inspect the ECM [78-1], [78-2] and [78-3], fuel injector [84, 85] and HO2S [137, 138] connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses.
- **Dirty/stuck open injectors:** The vehicle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there are injector problems. This could also cause poor fuel economy and performance.
- **Leaking injectors:** This causes fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air box and air filter. Then, with the throttle wide open, turn IGN ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors in the service manual.
- **Loose HO2S:** If an HO2S is loose, engine performance may be affected. This could also show up as a slow changing HO2S voltage.
- **Loose/leaking exhaust:** This can cause a poor ground connection for the sensor or allow fresh air into the exhaust system. If fresh air enters exhaust system, the HO2S will read a lean condition, causing the system to go rich.
- **Engine misfire:** See **Description and Operation**.
- **Intake leaks:** See the service manual.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

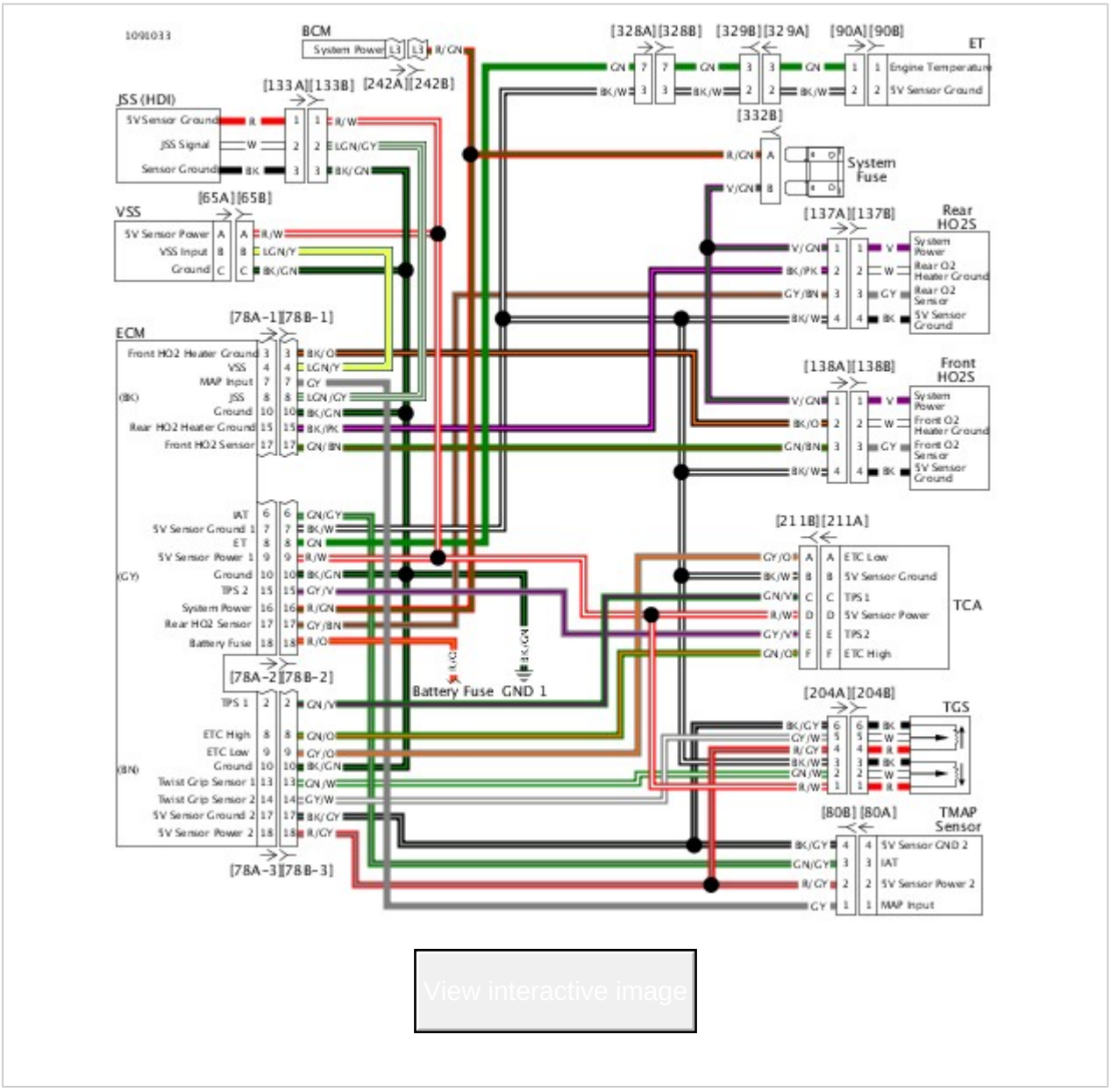


Figure 1. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0031 Diagnostic Faults

Open or short to ground on front HO2S circuit
Open in sensor power circuit

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between BOB [78-1] terminal 3 and [138A] terminal 2 (BK/O) wire.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK/O) wire.

1. Test continuity between BOB [78-1] terminal 3 and ground.
2. Is continuity present?

a. **Yes.** Repair short to ground in (BK/O) wire.
b. **No.** **Go to Test 4.**

1. Test resistance between [138B] terminals 1 (V) wire and 2 (W) wire.
2. Is resistance between 13.5-35 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace front HO2S.

Special Tools

Description	Part Number	Qty.
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0032 Diagnostic Faults

Front HO2S circuit shorted to 12V

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Test voltage between BOB [78-1] terminal 3 and ground.
6. Is voltage present?
    a. **Yes.** Repair short to voltage on (BK/O) wire.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect front HO2S [138].
3. Test resistance between [138B] terminals 1 (V) wire and 2 (W) wire.
4. Is resistance between 13.5-35 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace front HO2S.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0051 Diagnostic Faults

Open or short to ground on rear HO2S circuit
Open in sensor power circuit

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between BOB [78-1] terminal 15 and [137A] terminal 2 (BK/PK) wire.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (BK/PK) wire.

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

a. **Yes.** Repair short to ground in (BK/PK) wire.
b. **No.** **Go to Test 4.**

1. Test resistance between [137B] terminals 1 (V) wire and 2 (W) wire.
2. Is resistance between 13.5-35 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace rear HO2S.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0052 Diagnostic Faults

Rear HO2S circuit shorted to voltage

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

1. Turn IGN OFF.
2. Test resistance between [137B] terminals 1 (V) wire and 2 (W) wire.
3. Is resistance between 13.5-35 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace front HO2S.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0131 Diagnostic Faults

Short to ground in signal circuit
Fuel system malfunction

NOTE

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

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

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

1. Turn IGN OFF.

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

1. Test continuity between [138A] terminal 3 (GN/BN) wire and ground.
2. Is continuity present?
    a. **Yes.** Repair short between (GN/BN) wire and ground.
    b. **No.** Replace ECM.

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

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0132 Diagnostic Faults

Fuel system malfunction

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Start engine and allow it to reach operating temperature.
5. With engine speed at a steady rpm, using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-1] terminal 17 and [78-2] terminal 7.
6. Is voltage approximately 0.45V?
    a. **Yes.** Replace ECM.
    b. **No.** (0.6-1.0V) Perform fuel pressure test. Look for incorrect ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace HO2S.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0134 Diagnostic Faults

Open or short to voltage in signal circuit
Open sensor ground

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

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between [138A] terminal 4 (BK/W) wire and BOB [78-2] terminal 7.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace front O2 sensor.
    b. **No.** Repair open on (BK/W) wire.

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

2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (GN/BN) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0151 Diagnostic Faults

Short to ground in signal circuit
Fuel system malfunction

NOTE

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

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

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

1. Turn IGN OFF.

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

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

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

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0152 Diagnostic Faults

Fuel system malfunction

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Start engine and allow it to reach operating temperature.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, with engine speed at a steady rpm, test voltage between BOB [78-2] terminal 17 and [78-2] terminal 7.
6. Is voltage approximately 0.45V?
    a. **Yes.** Replace ECM.
    b. **No.** (0.6-1.0V). Perform fuel pressure test. Look for incorrect ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace HO2S.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0154 Diagnostic Faults

Open or short voltage in signal circuit
Open sensor ground

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

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

1. Test resistance between [137A] terminal 3 (GY/BN) wire and BOB [78-2] terminal 17.

2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (GY/BN) wire.

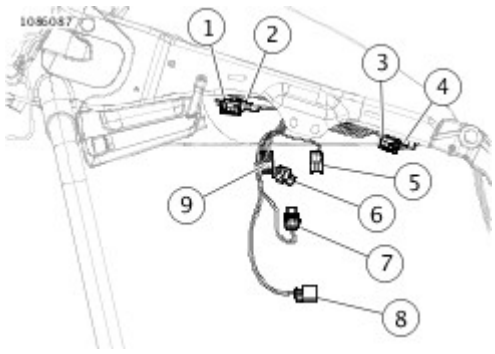
See **Figure 1**. The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the BCM. The ECM provides the path to ground to trigger the injectors.

NOTE

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

Table 1. Code Description

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



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1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]

9	Front injector [84]

Figure 1. Engine

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

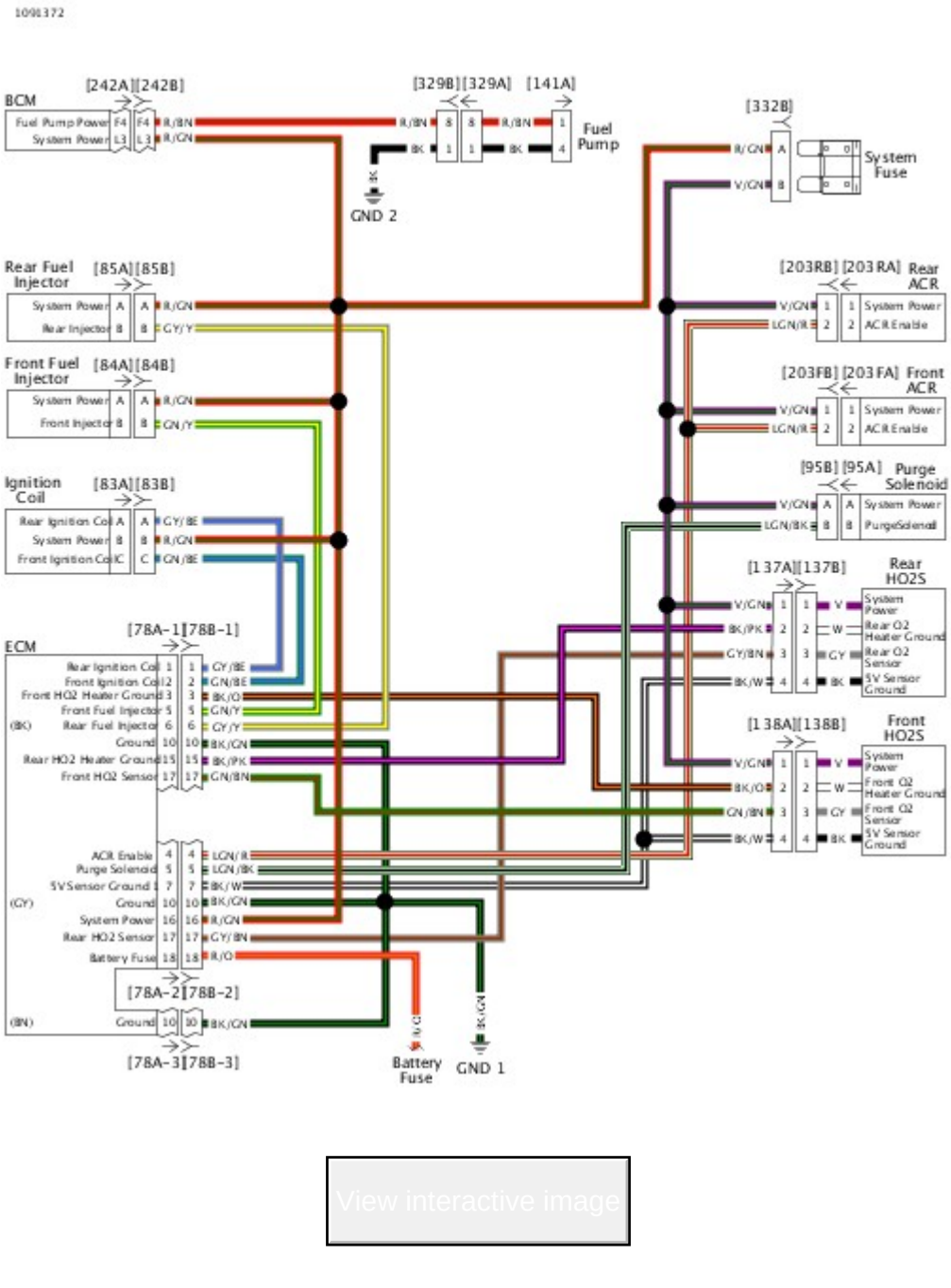

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Figure 2. System Power Circuit

Special Tools

Description	Part Number	Qty.
FUEL INJECTOR TEST LIGHT	HD-34730-2E	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0261 Diagnostic Faults

Front fuel injector malfunction
Open signal circuit
Open power circuit

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

1. Turn IGN OFF.
2. Remove fuel injector test light.
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 16 and [84B] terminal A (R/GN) wire.
6. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (R/GN) wire.

1. Test resistance between BOB [78-1] terminal 5 and [84B] terminal B (GN/Y) wire.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (GN/Y) wire.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [84A] terminals A and B.
2. Is resistance between 10-20 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace front injector.

1. Remove fuel injector test light.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [84A] terminal B and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground on (GN/Y) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P0262 Diagnostic Faults

Short to ground in signal circuit

1. Turn IGN OFF.
2. Disconnect front injector [84].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [84B] terminal B (GN/Y) wire and ground.
5. Is voltage less than 5.0V?
    a. **Yes. Go to Test 3.**
    b. **No. Go to Test 2.**

1. Turn IGN OFF.
2. Test continuity between [84B] terminals A and B.
3. Is continuity present?
    a. **Yes.** Repair short between (R/GN) and (GN/Y) wires.
    b. **No.** Repair short to voltage on (GN/Y) wire.

1. Test resistance between [84A] terminals A and B of injector [84A].
2. Is resistance between 10-20 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace front injector.

Special Tools

Description	Part Number	Qty.
FUEL INJECTOR TEST LIGHT	HD-34730-2E	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0264 Diagnostic Faults

Open signal circuit
Open power circuit

1. Turn IGN OFF.
2. Disconnect rear fuel injector [85].
3. Connect **FUEL INJECTOR TEST LIGHT (Part Number:HD-34730-2E)** to [85B].
4. Crank engine.
5. Does lamp flash when engine is cranking (or running)?
    a. **Yes.** **Go to Test 4.**
    b. **No, lamp does not illuminate.** **Go to Test 2.**
    c. **No, lamp is on steady.** **Go to Test 5.**

1. Turn IGN OFF.
2. Remove fuel injector test light.
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 16 and [85B] terminal A (R/GN) wire.
6. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (R/GN) wire.

1. Test resistance between BOB [78-1] terminal 6 and [85B] terminal B (GY/Y) wire.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (GY/Y) wire.

1. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [85A] terminal A and B of injector [85A].
2. Is resistance between 10-20 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace rear injector.

1. Remove fuel injector test light.
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [85B] terminal B and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground on (GY/Y) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P0265 Diagnostic Faults

Short to ground in signal circuit

1. Turn IGN OFF.
2. Disconnect rear injector [85].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [85B] terminal B (GY/Y) wire and ground.
5. Is voltage less than 5.0V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Test continuity between [85B] terminals A (R/GN) wire and B (GY/Y) wire.
3. Is continuity present?
    a. **Yes.** Repair short between (R/GN) and (GY/Y) wires.
    b. **No.** Repair short to voltage on (GY/Y) wire.

1. Test resistance between [85A] terminals A and B of injector [85A].
2. Is resistance between 10-20 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace rear injector.

See **Figure 1**. If the CKP sensor signal is weak or absent, DTC P0371 or P0374 sets. DTC P0371 usually sets when several attempts to crank the engine have failed.

NOTE

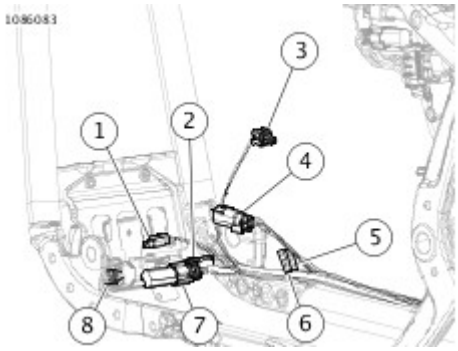
If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

Table 1. Code Description

P0371	CKP sensor wrong number of pulses
P0374	CKP sensor no pulses

Engine must be cranked for more than five seconds without CKP signal to set P0374 code. Intermittent TMAP wiring or sensor issues may cause these codes to set prior to setting TMAP codes. Verify TMAP wiring and sensor prior to replacing the ECM.

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



View interactive image

1	CKP [79]
2	Voltage regulator [77]
3	Oil pressure sensor [120]
4	Front HO2S [138]
5	Rear brake switch [121-1]
6	Rear brake switch [121-2]
7	JSS [133]

8	Stator [47]

Figure 1. Front of Engine: Typical

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

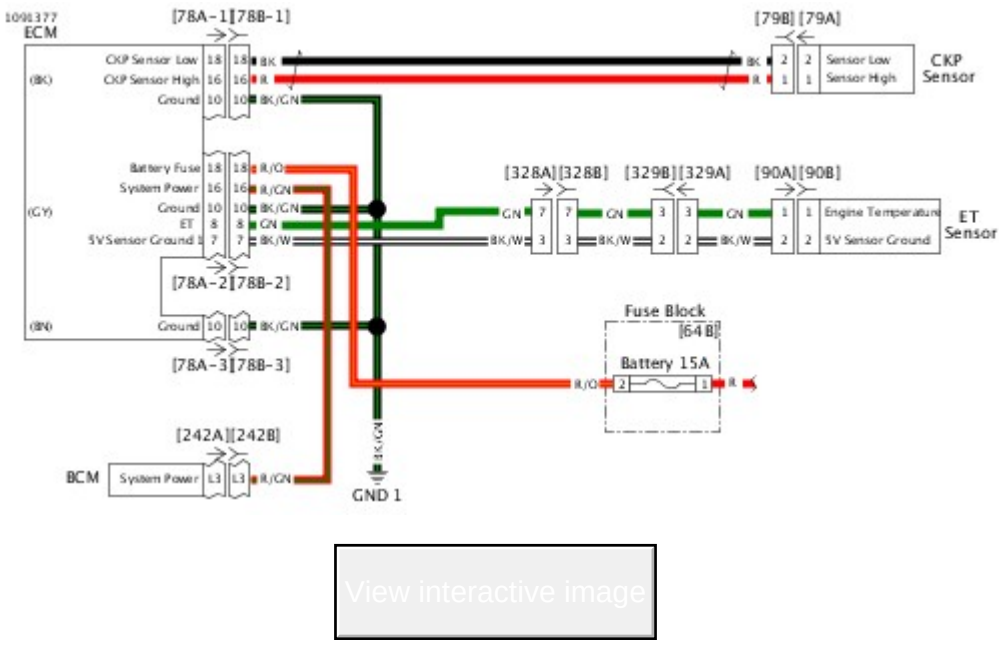


Figure 2. ET Sensor and CKP Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0371, P0374 Diagnostic Faults

CKP sensor malfunction
Open or short to ground in signal circuit
May be set if there are incorrect fluctuations from TMAP that does not set TMAP codes (examples - intermittent sensor or wiring issue)

1. Turn IGN OFF.
2. Disconnect ECM [78-1], [78-2] and [78-3].
3. Inspect connection for corrosion or backed out terminals.
4. Are terminal problems present?
    a. **Yes.** Repair terminals as required.
    b. **No. Go to Test 2.**

1. Disconnect CKP sensor [79].
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-1] terminal 16 to [79B] terminal 1 (R) wire.
5. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open on (R) wire.

1. Test resistance between BOB [78-1] terminal 18 to [79B] terminal 2 (BK) wire.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open on (BK) wire.

1. Test continuity between BOB [78-1] terminals 16 and 18.
2. Is continuity present?
    a. **Yes.** Repair short between [79B] terminals 1 (R) and 2 (BK).
    b. **No.** **Go to Test 5.**

1. Connect CKP sensor [79].
2. Test AC voltage between BOB [78-1] terminals 16 and 18.
3. Crank engine for 5 seconds while observing multimeter.
4. Is AC voltage greater than 2V?
    a. **Yes.** See diagnostic tips. If TMAP sensor is good, replace ECM.
    b. **No.** Replace CKP sensor.

The knock sensor is a piezoelectric sensor that contains a seismic mass, brass carrier, contact ring and a ceramic piezo element. The knock sensor creates a voltage signal based on the vibrations caused by detonation. The ECM uses this signal to alter the ignition timing and prevent detonation.

Table 1. Code Description

P0325	Knock sensor front open circuit
P0327	Knock sensor front circuit low
P0328	Knock sensor front circuit high
P0330	Knock sensor rear open circuit
P0332	Knock sensor rear circuit low
P0333	Knock sensor rear circuit high

The symptoms of a bad knock sensor show up at highway speeds or under load. A fault in the knock sensor circuit may impact acceleration and fuel mileage due to incorrect ignition timing.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

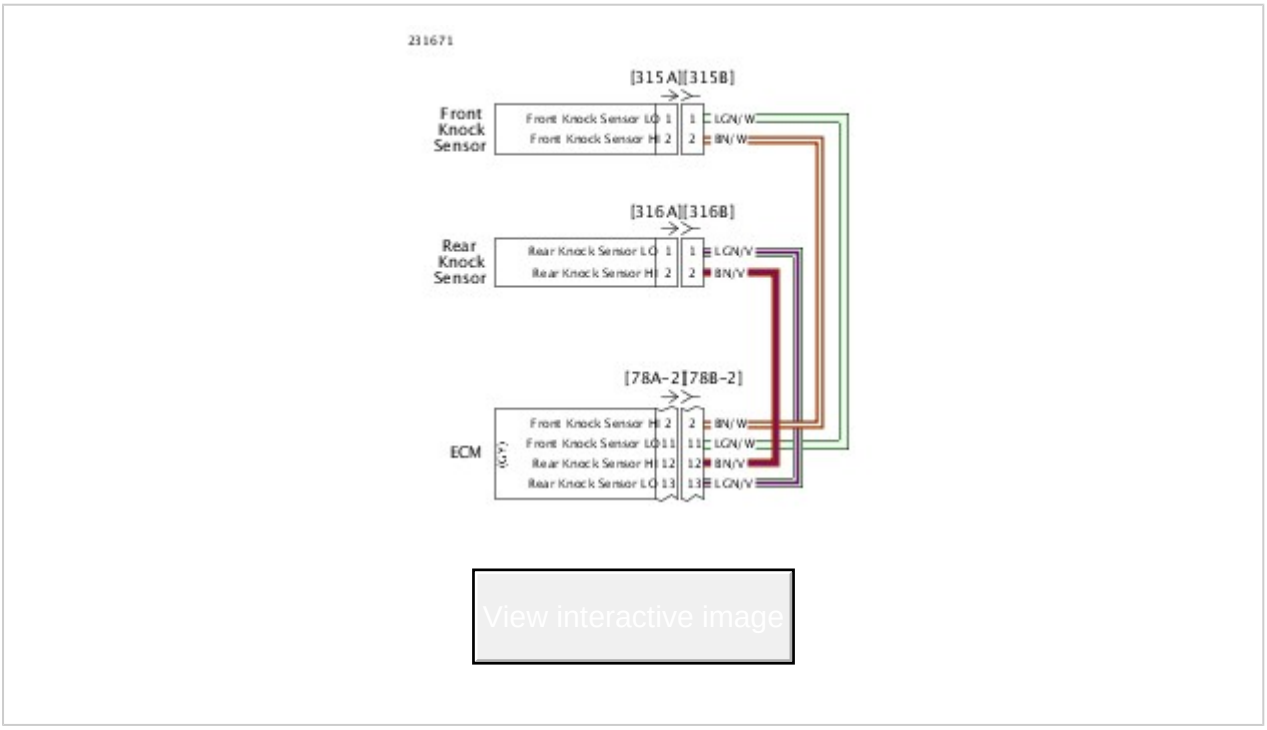


Figure 1. Knock Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0325 Diagnostic Faults

Loose front knock sensor
Open in front knock sensor circuit

1. Verify knock sensor is secured to front cylinder.
2. Is sensor secured?
    a. **Yes. Go to Test 2.**
    b. **No.** Secure sensor.

1. Disconnect front knock sensor [315].
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [315B] terminal 1 (LGN/W) and BOB [78-2] terminal 11.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (LGN/W).

1. Test resistance between [315B] terminal 2 (BN/W) and BOB [78-2] terminal 2.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace front knock sensor.
    b. **No.** Repair open in (BN/W).

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0327, P0328 Diagnostic Faults

Short to ground in front knock sensor circuit
Short to voltage in front knock sensor circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3].
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 11 and ground.
6. Is voltage between 2-3V?
    a. **Yes. Go to Test 2.**
    b. **No. Greater than 3V.** Repair short to voltage on (LGN/W).
    c. **No. Less than 2V.** Repair short to ground on (LGN/W).

1. Test voltage between BOB [78-2] terminal 2 and ground.
2. Is voltage between 2-3V?
    a. **Yes. Go to Test 3.**
    b. **No. Greater than 3V.** Repair short to voltage on (BN/W).
    c. **No. Less than 2V.** Repair short to ground on (BN/W).

1. Turn IGN OFF.
2. Disconnect BOB, connect ECM to main harness.
3. Clear DTCs.

4. Turn IGN OFF for 1 minute.
5. Start and run engine for 1 minute.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System operating properly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0330 Diagnostic Faults

Loose rear knock sensor
Open in rear knock sensor circuit

1. Verify knock sensor is secured to rear cylinder.
2. Is sensor secured?
    a. **Yes. Go to Test 2.**
    b. **No.** Secure sensor.

1. Disconnect rear knock sensor [316].
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [316B] terminal 1 (LGN/V) and BOB [78-2] terminal 13.
5. Is resistance less than 0.5 ohms?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (LGN/V).

1. Test resistance between [316B] terminal 2 (BN/V) and BOB [78-2] terminal 12.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace rear knock sensor.
    b. **No.** Repair open in (BN/V).

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0332, P0333 Diagnostic Faults

Short to ground in rear knock sensor circuit
Short to voltage in rear knock sensor circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3].
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 13 and ground.
6. Is voltage between 2-3V?
    a. **Yes. Go to Test 2.**
    b. **No. Greater than 3V.** Repair short to voltage on (LGN/V).
    c. **No. Less than 2V.** Repair short to ground on (LGN/V).

1. Test voltage between BOB [78-2] terminal 12 and ground.
2. Is voltage between 2-3V?
    a. **Yes. Go to Test 3.**
    b. **No. Greater than 3V.** Repair short to voltage on (BN/V).
    c. **No. Less than 2V.** Repair short to ground on (BN/V).

1. Turn IGN OFF.
2. Disconnect BOB, connect ECM to main harness.
3. Clear DTCs.

4. Turn IGN OFF for 1 minute.
5. Start and run engine for 1 minute.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System operating properly.

See **Figure 1**. The solenoid connects to a fuel tank vent line and a vent canister.

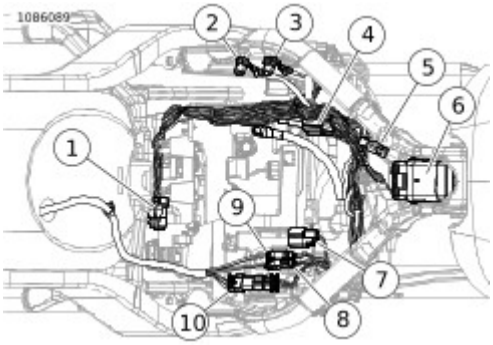
A return line from the canister reconnects to the air intake manifold allowing vented fumes to be recirculated, for emission efficiency. The purge solenoid is timed to the throttle position and is disabled during startup, low engine temperature, low engine speed or low vehicle speed.

Power for the purge solenoid is supplied by the BCM. The BCM also provides power for the VSS, fuel injectors, active exhaust, active intake, ECM and the ignition coil.

The ECM provides a path to ground to trigger the purge solenoid.

NOTE

- BCM or wiring harness problems will cause 12V power to be lost to the VSS, fuel injectors, active exhaust, active intake, ECM, ignition coil and purge solenoid.
- Purge solenoid is not installed on non-emission vehicles and DTCs P0444 and P0445 are not available. If these DTCs appear, the ECM should be reprogrammed.



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1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]

11	Tail lamp [40]

Figure 1. Under Seat

Table 1. Code Description

P0444	Purge solenoid low/open
P0445	Purge solenoid shorted high

The purge solenoid is powered from the system power circuit. This circuit voltage is supplied by the BCM through the system power fuse. Any short causing the fuse to open will cause the ECM to set DTC P0444. If this code is present with an open fuse, the fault is a short to ground somewhere in the circuit or the components.

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

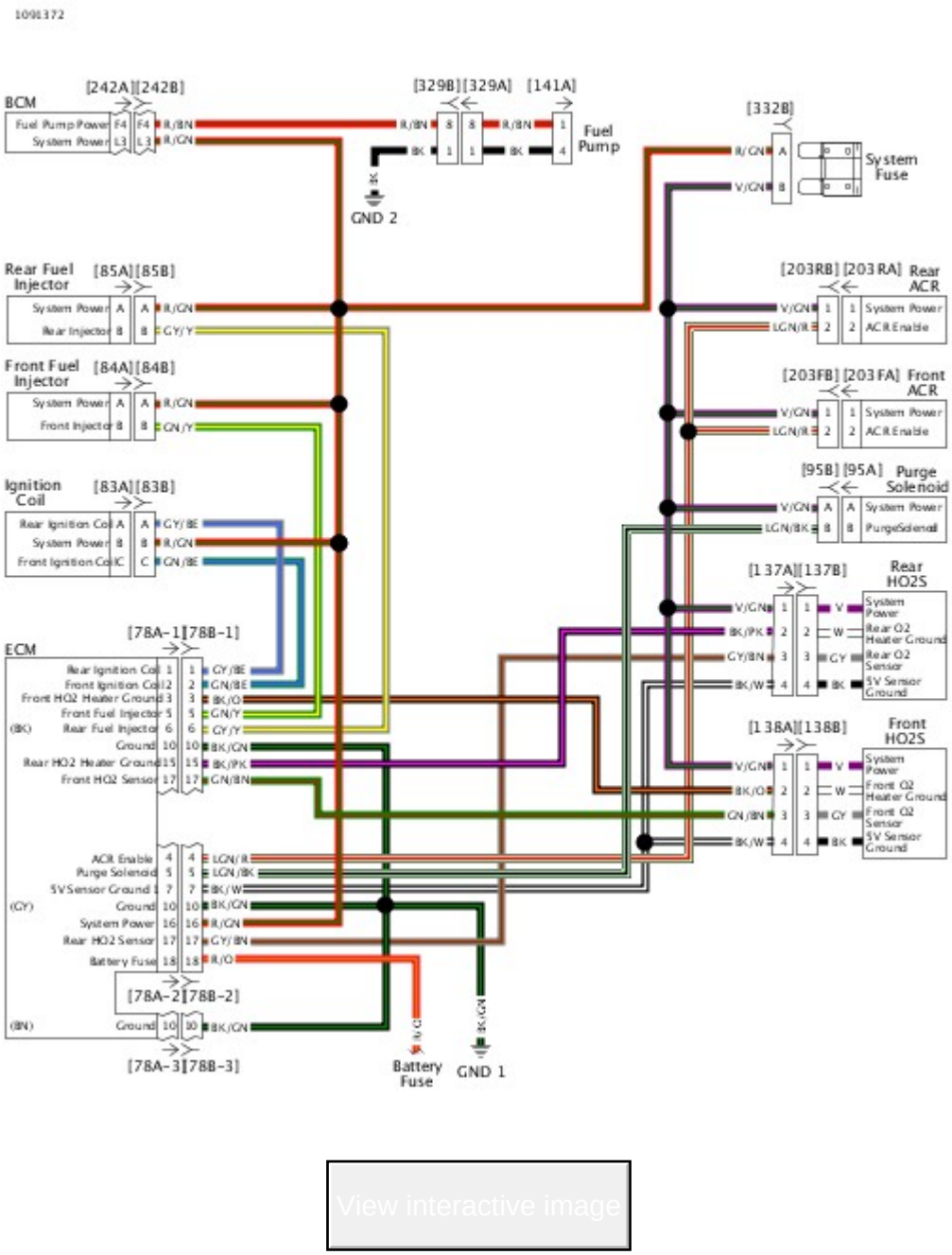


Figure 2. System Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0444 Diagnostic Faults

Purge solenoid malfunction
Short to ground in signal circuit

1. Turn IGN OFF.
2. Disconnect purge solenoid [95].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [95A] terminals A and B of the purge solenoid.
4. Is resistance between 4-21 ohms?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace purge solenoid.

1. Test voltage between [95B] terminal A (V/GN) wire and ground.
2. Turn IGN ON.
3. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Disconnect ECM [78-1], [78-2] and [78-3].
3. Test continuity between [95B] terminal B (LGN/BK) wire and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground on (LGN/BK) wire.
    b. **No.** **Go to Test 4.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Test resistance between [95B] terminal B (LGN/BK) wire and BOB [78-2] terminal 5.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (LGN/BK) wire.

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Test resistance between [95B] terminal A (V/GN) wire and BOB [78-2] terminal 16.
4. Is resistance less than 0.5 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (V/GN) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P0445 Diagnostic Faults

Short to voltage in signal circuit

1. Turn IGN OFF.
2. Disconnect purge solenoid [95].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [95A] terminals A and B of purge solenoid.
4. Is resistance between 4-21 ohms?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace purge solenoid.

1. Turn IGN ON.
2. Test voltage between [95B] terminal B (LGN/BK) wire and ground.
3. Is voltage greater than 5.0V?
    a. **Yes.** Repair short to voltage on (LGN/BK) wire.
    b. **No.** Replace ECM.

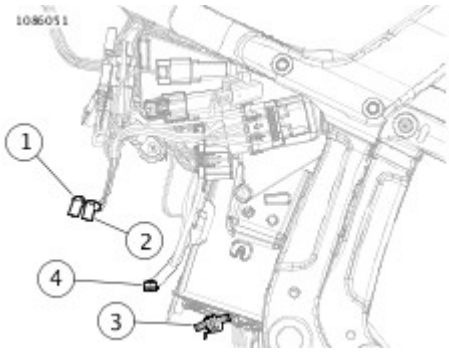
See **Figure 1**. The VSS is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the BCM and the speedometer/IM through the CAN bus circuit.

NOTE

- The ECM uses VSS input to calculate idle air control position. Therefore problems with the vehicle speed signal can lead to improper operation of the idle air control.
- The TGS, JSS, TCA and VSS sensors are connected to the same reference line (5V reference). If the reference line goes to ground or open, multiple codes will be set (DTC P0122, P0123, P0502, P0503, P1501, P1502, P2101, P2102, P2103, P2122, P2123, P2127, P2128). Start with the trouble code having the lowest ranking value.
- A faulty sensor can negatively affect the signal voltage of the other sensors sharing the same 5V reference. If the wiring passes the following tests, disconnect one sensor at a time on the 5V reference and verify the DTC is still present. Additional DTCs will be set as each sensor is disconnected, clear DTCs after this test. Be sure to perform this test before replacing a component.

Table 1. Code Description

P0502	VSS failed low
P0503	VSS failed high



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1	Neutral [131-1]
2	Neutral [131-2]
3	VSS [65]
4	Transmission GND

Figure 1. Top of Transmission

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

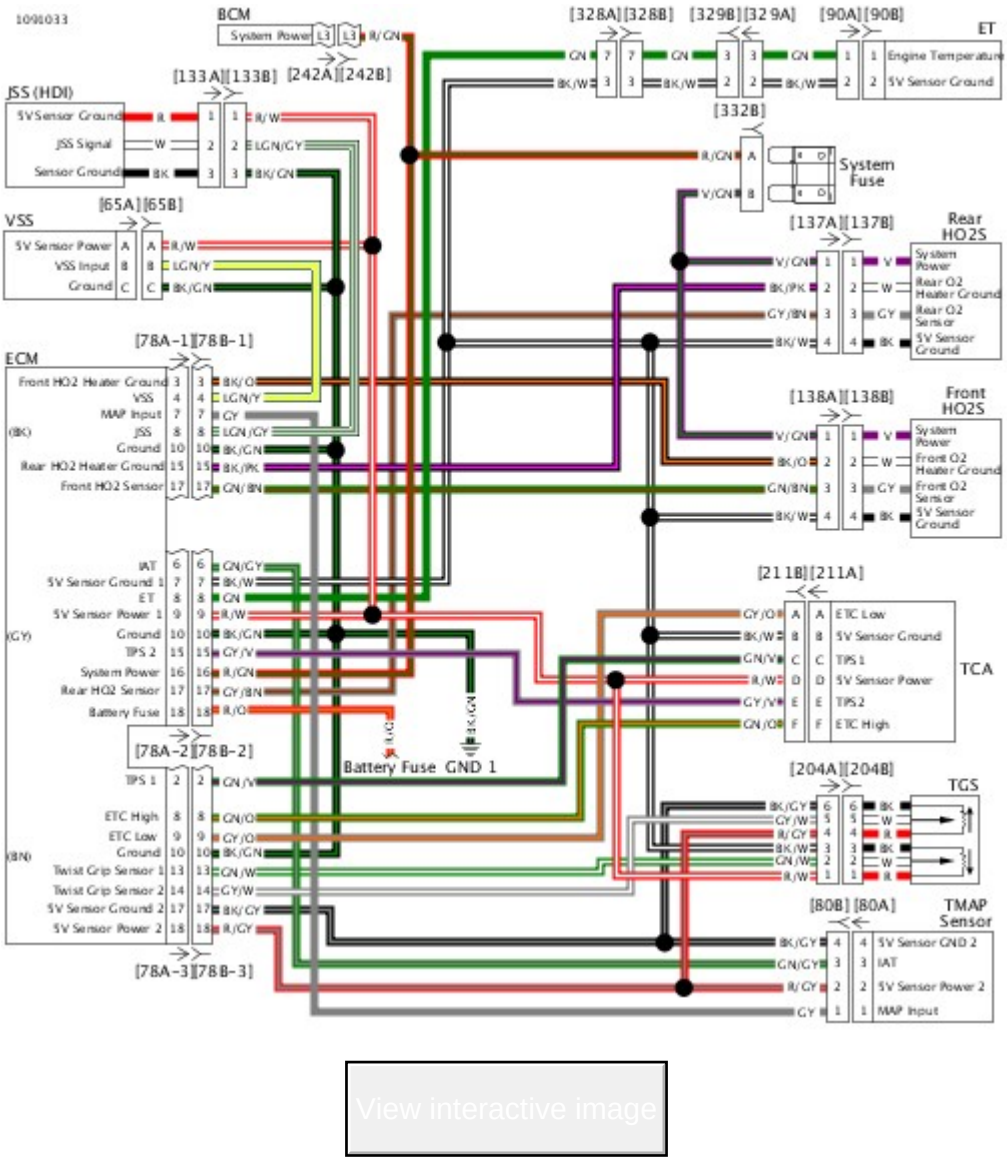


Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0502 Diagnostic Faults

VSS malfunction
Open or short to ground in signal circuit
Open or short to ground in 5V reference circuit

1. Turn IGN OFF.
2. Disconnect VSS [65].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [65B] terminal A (R/W) wire and ground.
5. Is voltage approximately 5.0V?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open on (R/W) wire.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test continuity between BOB [78-1] terminals 4 and 10.
5. Is continuity present?
    a. **Yes.** Repair short to ground on (LGN/Y) wire.
    b. **No.** **Go to Test 3.**

1. Test resistance between BOB [78-1] terminal 4 and [65B] terminal B (LGN/Y) wire.
2. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open on (LGN/Y) wire.

1. Remove VSS.
2. Check for debris on sensor tip.
3. Is debris present?
    a. **Yes.** Clean debris from VSS and install.
    b. **No.** Replace VSS.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0503 Diagnostic Faults

Short to voltage in signal circuit
Open ground
5V reference shorted to battery voltage

1. Turn IGN OFF.
2. Disconnect VSS [65].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [65B] terminals A (R/W) wire and C (BK/GN) wire.
5. Is voltage greater than 6.0V?
    a. **Yes.** Repair short to voltage on (R/W) wire.
    b. **No.** **Go to Test 2.**

1. Test voltage between [65B] terminal B (LGN/Y) wire and ground.
2. Is voltage above 6.0V?
    a. **Yes.** Repair short to voltage on (LGN/Y) wire.
    b. **No.** **Go to Test 3.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Test resistance between BOB [78-1] terminal 10 and [65B] terminal C (BK/GN) wire.

4. Is resistance less than 0.5 ohms?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open on (BK/GN) wire.

1. Test continuity between BOB [78-1] terminal 4 and [78-2] terminal 9.
2. Is continuity present?
    a. **Yes.** Repair short between (LGN/Y) and (R/W) wires.
    b. **No.** **Go to Test 5.**

1. Connect [78A-1], [78A-2] and [78A-3] to BOB.
2. Clear DTC.
3. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** Replace VSS.

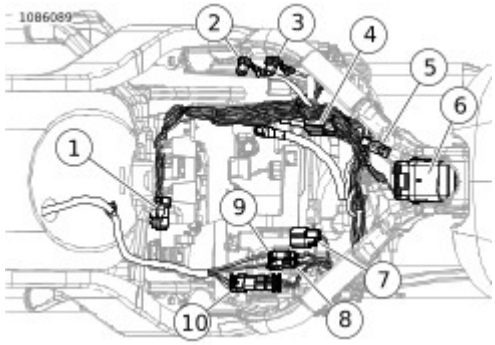
See **Figure 1**. The TCA uses a two wire DC motor to move the throttle plate from the spring loaded off-idle detent. The ECM supplies a pulse width modulated voltage signal through [78-3] terminals 8 and 9. The ECM monitors throttle position through the dual position sensors (TPS1 and TPS2). This code will set if the idle speed becomes unstable. This can be caused by a fuel or ignition related issue, throttle actuator friction or an intermittent air leak.

NOTE

Although the ECM monitors [78-3] terminals 8 and 9, faults on these terminals will not cause this DTC. Faults on these terminals will be higher priority DTCs, address them first.

Table 1. Code Description

P0505	Idle speed control - unstable



View interactive image

1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

Figure 1. Under Seat

Before replacing the TCA, cycle the ignition four times when idle is high.

1. Start engine.
2. Increase rpm to 2500 rpm and bring engine back to idle.
3. Turn IGN OFF.
4. Repeat previous steps a total of four times.

This process will help the controller learn throttle plate position.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

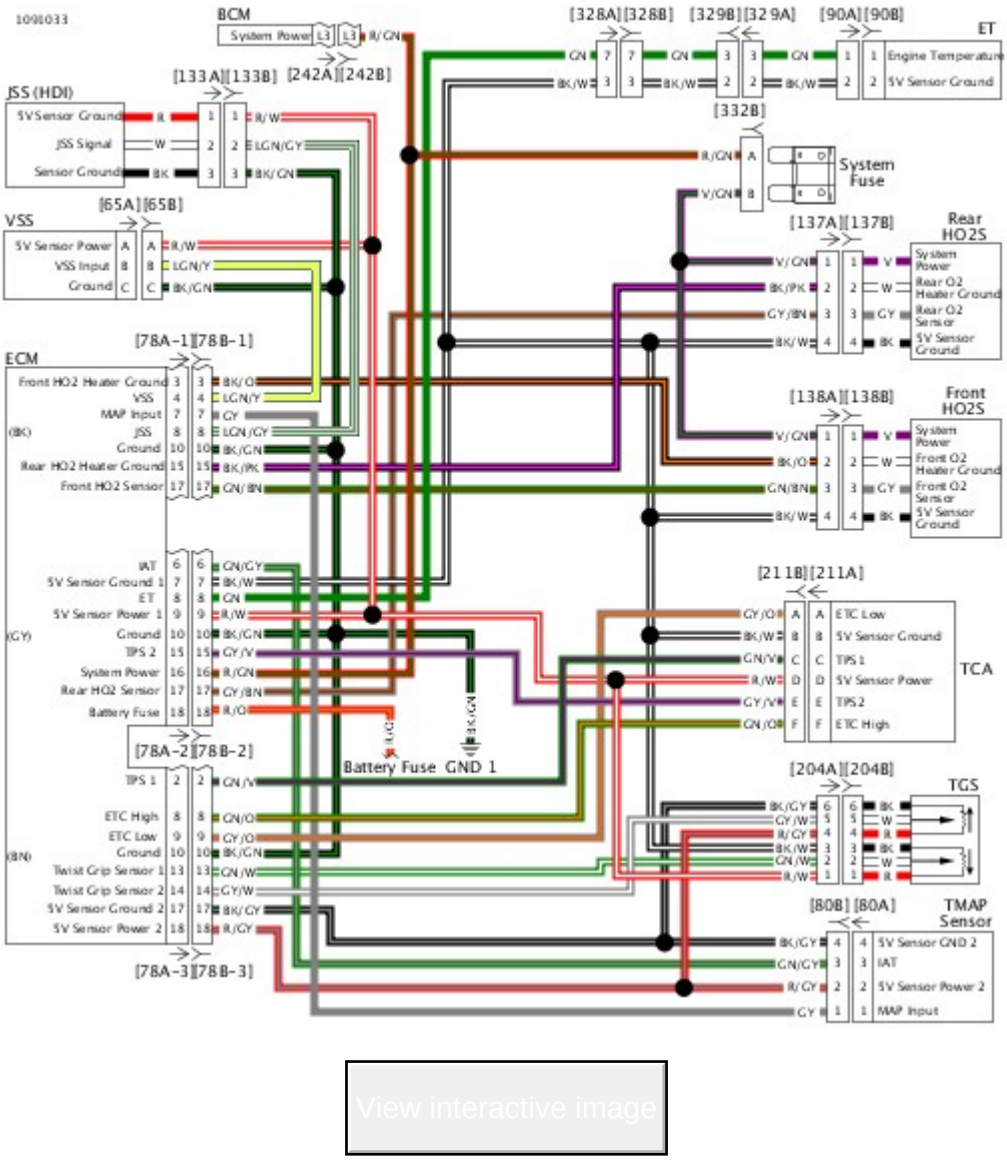


Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
SPARK PLUG TESTER	HD-26792	1

Table 1. DTC P0505 Diagnostic Faults

Vacuum/air leaks
Fuel system problems
Ignition system problems
Loss of engine compression

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected to the coil and plugs.
4. Verify fuel injectors are not clogged.
5. Verify battery condition. See **General**.
6. Does battery pass tests?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charge or replace battery.

1. Start the motorcycle and check for vacuum leaks.
2. Were any leaks found?
    a. **Yes.** Repair the vacuum leak.
    b. **No.** **Go to Test 3.**

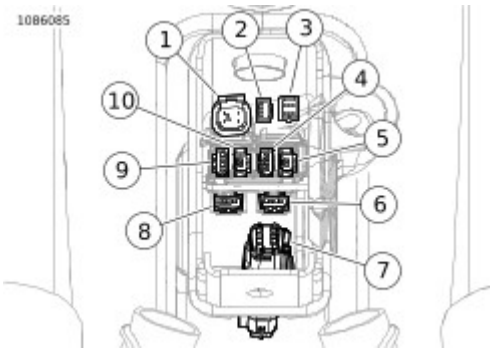
1. Check spark plug condition. Replace if fouled.
2. Using **SPARK PLUG TESTER (Part Number:HD-26792)**, check spark at both plugs while cranking engine.
3. Is spark present?
    a. **Yes.** **Go to Test 4.**
    b. **No.** The spark plugs will not spark if there is low or no compression. If spark is not present, test compression before troubleshooting ignition circuit. Once good compression is confirmed, check condition of ignition coils, coil primary wiring and spark plug boots. See **Description and Operation**.

1. Perform compression test.
2. Does engine pass compression test?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair engine loss of compression.

1. Check fuel system and perform fuel pressure test.
2. Does fuel pressure meet specification?
    a. **Yes.** Replace TCA.
    b. **No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

See **Figure 1** , **Figure 2** , **Figure 3** and **Figure 4**. The ECM supplies 5V to the TGS, JSS, TCA and VSS from [78-2] terminal 9. These sensors may have individual codes along with this code since they all share the 5V reference circuit.

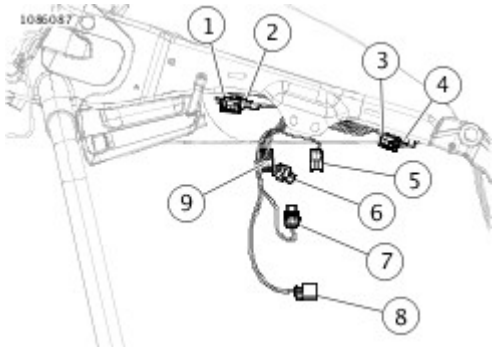
- DTC P0641 is displayed when sensor power-1 is out of range. The 5V sensor power-1 circuit supplies the TCA, VSS, JSS and sensor 2 of the TGS with a 5V reference signal.
- DTC P0651 is displayed when sensor power-2 is out of range. The 5V sensor power-2 circuit supplies the TMAP sensor and sensor 1 of the TGS with a 5V reference signal.



View interactive image

1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

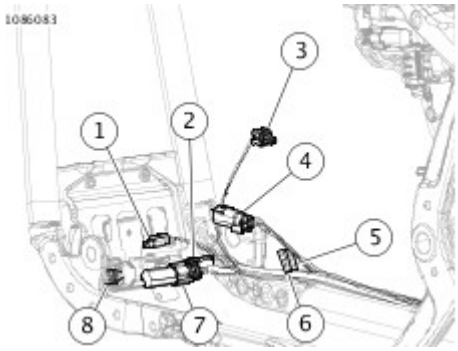
Figure 1. USB Caddy



View interactive image

1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 2. Engine



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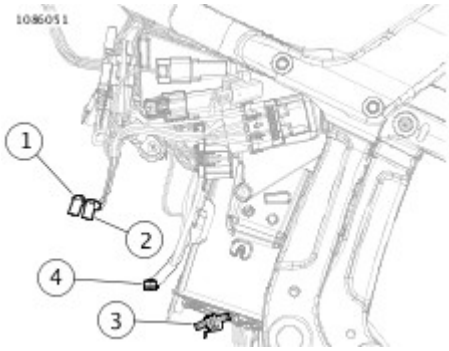
1	CKP [79]
2	Voltage regulator [77]
3	Oil pressure sensor [120]

4	Front HO2S [138]
5	Rear brake switch [121-1]
6	Rear brake switch [121-2]
7	JSS [133]
8	Stator [47]

Figure 3. Front of Engine: Typical



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1	Neutral [131-1]
2	Neutral [131-2]
3	VSS [65]
4	Transmission GND

Figure 4. Top of Transmission

Table 1. Code Description

P0641	5V reference out of range
P0651	5V reference 2 out of range

Any of these conditions will set these DTCs:

- Short to ground on the 5V sensor power circuit.
- Short to voltage on the 5V sensor power circuit.
- VSS fault or malfunction.
- TMAP sensor fault or malfunction.
- TCA fault or malfunction.
- JSS (HDI) fault or malfunction.
- TGS fault or malfunction.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

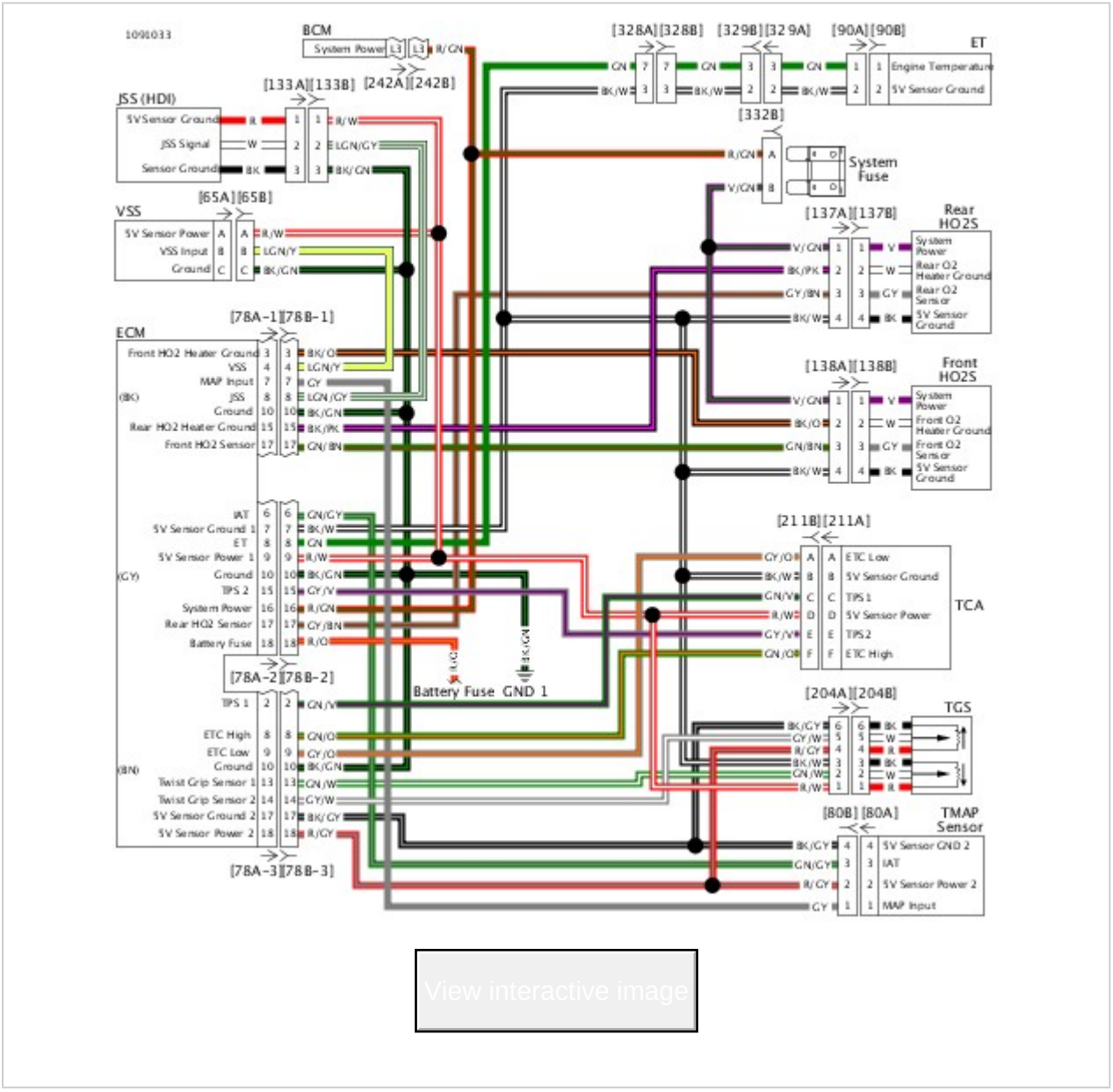

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Figure 5. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0641 Diagnostic Faults

Short to ground on the 5V sensor power circuit
Short to voltage on the 5V sensor power circuit
VSS fault or malfunction
TGS fault or malfunction
TCA fault or malfunction
JSS (HDI) fault or malfunction

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 9 and ground.
6. Is voltage between 4-6V?
    a. **Yes.** Concern is intermittent. See **Wiggle Test**.
    b. **No, greater than 6V.** Repair short to voltage on (R/W) wire.
    c. **No, less than 4V.** **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect TCA [211].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminal 9 and terminal 7.

5. Is voltage less than 4V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace TCA.

1. Turn IGN OFF.
2. Disconnect TGS [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace TGS.

1. Turn IGN OFF.
2. Disconnect VSS [65].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
    a. **Yes, with JSS.** **Go to Test 5.**
    b. **Yes, without JSS.** **Go to Test 6.**
    c. **No.** Replace VSS.

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminals 9 and 10.
5. Is voltage less than 4V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace JSS.

1. Disconnect ECM from BOB.
2. Test continuity between BOB [78-2] terminal 9 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (R/W) wire.
    b. **No.** **Go to Test 7.**

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

2. Is continuity present?
    a. **Yes.** Repair short between (R/W) and (BK/W) wires.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P0651 Diagnostic Faults

Short to ground on the 5V sensor power circuit
Short to voltage on the 5V sensor power circuit
TMAP sensor fault or malfunction
TGS fault or malfunction

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1] and [78B-2] and ECM [78A-1] and [78A-2]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-3] terminal 18 and ground.
6. Is voltage between 4-6V?
    a. **Yes.** Concern is intermittent. See **Wiggle Test**.
    b. **No, greater than 6V.** Repair short to voltage on (R/GY) wire.
    c. **No, less than 4V.** **Go to Test 2.**

1. Turn IGN OFF.
2. Disconnect TGS [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-3] terminals 18 and 10.
5. Is voltage less than 4V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace TGS.

1. Turn IGN OFF.
2. Disconnect TMAP sensor [80].
3. Turn IGN ON.
4. Test voltage between BOB [78-3] terminals 18 and 10.
5. Is voltage less than 4V?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace TMAP sensor.

1. Disconnect ECM from BOB.
2. Test continuity between BOB [78-3] terminal 18 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (R/GY) wire.
    b. **No.** **Go to Test 5.**

1. Test continuity between BOB [78-3] terminals 17 and 18.
2. Is continuity present?
    a. **Yes.** Repair short between (R/GY) and (BK/GY) wires.
    b. **No.** Replace ECM.

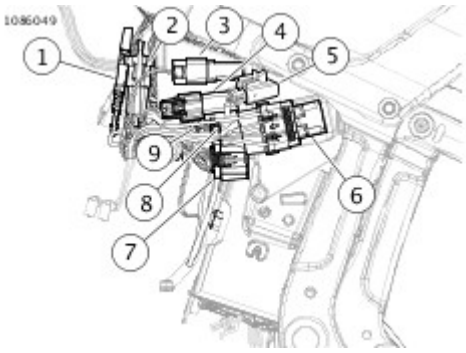
See **Figure 1**. The DTCs listed indicate a failure which requires replacement of the ECM. Refer to **Table 1**.

NOTE

After replacing ECM, perform password learning procedure and clear DTCs using odometer self-diagnostics. See **Odometer Self-Diagnostics**.

Table 1. Code Description

P0603	ECM EEPROM memory error
P0605	ECM flash memory error
U0300	Internal control module software incompatibility



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1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover

1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System operating properly.

1. Clear DTCs.
2. Attempt to program ECM using correct calibration.
3. Start engine.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System operating properly.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Within the ECM, there are two independent Analog/Digital (A/D) converter modules used to validate the input of Twist Grip Sensor 2 (TGS2). TGS2 inputs are sent into both converter modules and if the output of the two readings are not within the designated value of each other for a specified time, then DTC P1270 fault is initiated.

Unless the ECM has a poor or intermittent connection, DTC P1270 indicates the ECM is defective and requires replacement.

NOTE

After replacing the ECM, perform password learning procedure using **DIGITAL TECHNICIAN II (Part Number:HD-48650)** and clear codes.

Table 1. Code Description

P1270	TGS 2 A/D validation error

Table 1. DTC P1270 Diagnostic Faults

ECM internal fault

1. Clear DTCs.
2. Turn IGN ON.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** Replace ECM.
    b. **No.** System operating properly.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

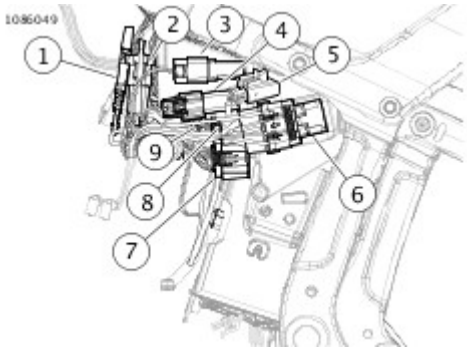
See **Figure 1**. The ECM and BCM exchange passwords during operation. An incorrect password sets a DTC. If any U-codes exist, troubleshoot the higher priority codes prior to performing the tests in this section. Refer to **Diagnostics**.

NOTE

Vehicle will not start if BCM is disconnected.

Table 1. Code Description

P1009	VTD disabled fuel due to bad password



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1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]

9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover

This code will usually appear after replacing the ECM or BCM. **New** modules must be programmed using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**. After parts are programmed and matched correctly for specific vehicle, clear codes.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Table 1. DTC P1009 Diagnostic Faults

ECM malfunction
BCM malfunction

1. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**, attempt to calibrate the ECM using the module replace feature found in vehicle set up.
2. Clear DTCs.
3. Turn IGN OFF.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** System operating properly.

1. Turn IGN OFF.
2. Replace BCM.
3. Attempt to calibrate the BCM using the module replace feature found in vehicle set-up.
4. Clear DTCs.
5. Turn IGN OFF.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Install original BCM and replace ECM.
    b. **No.** System operating properly.

See **Figure 1**. The jiffy stand sensor (JSS) uses a Hall-effect sensor to monitor jiffy stand position.

- When the jiffy stand is fully retracted the sensor picks up the presence of the metal tab mounted to the jiffy stand. The metal tab is moved away from the sensor as the jiffy stand is extended.
- When the jiffy stand is extended the engine will only start and run if the BCM determines the transmission is in neutral. This is done by monitoring the neutral switch input to the BCM and communicating that input over the CAN bus circuit to the ECM.

The JSS is powered and monitored by the ECM. The ECM supplies the 5V reference to the JSS. The JSS sends a signal back to the ECM. This signal is used by the ECM to determine when the jiffy stand is retracted or extended. The JSS is grounded through the ECM.

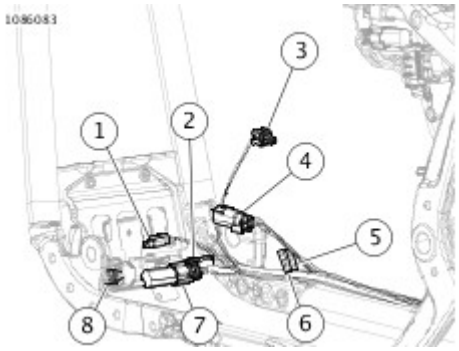
The JSS also has a Fail Enable Mode. This mode allows the engine to start and run if the system recognizes a problem with the JSS circuit. When a problem exists or if the transmission is put in gear with the jiffy stand extended the odometer will display "SIdE Stand." DTC P1501 or P1502 will set if the JSS circuits are out of range.

NOTE

The ECM supplies 5V reference voltage to the VSS, TCA and TGS in addition to the JSS. Problems on the 5V reference will cause other DTCs.

Table 1. Code Description

P1501	JSS low
P1502	JSS high/open



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1	CKP [79]
2	Voltage regulator [77]
3	Oil pressure sensor [120]
4	Front HO2S [138]
5	Rear brake switch [121-1]

6	Rear brake switch [121-2]
7	JSS [133]
8	Stator [47]

Figure 1. Front of Engine: Typical

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

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

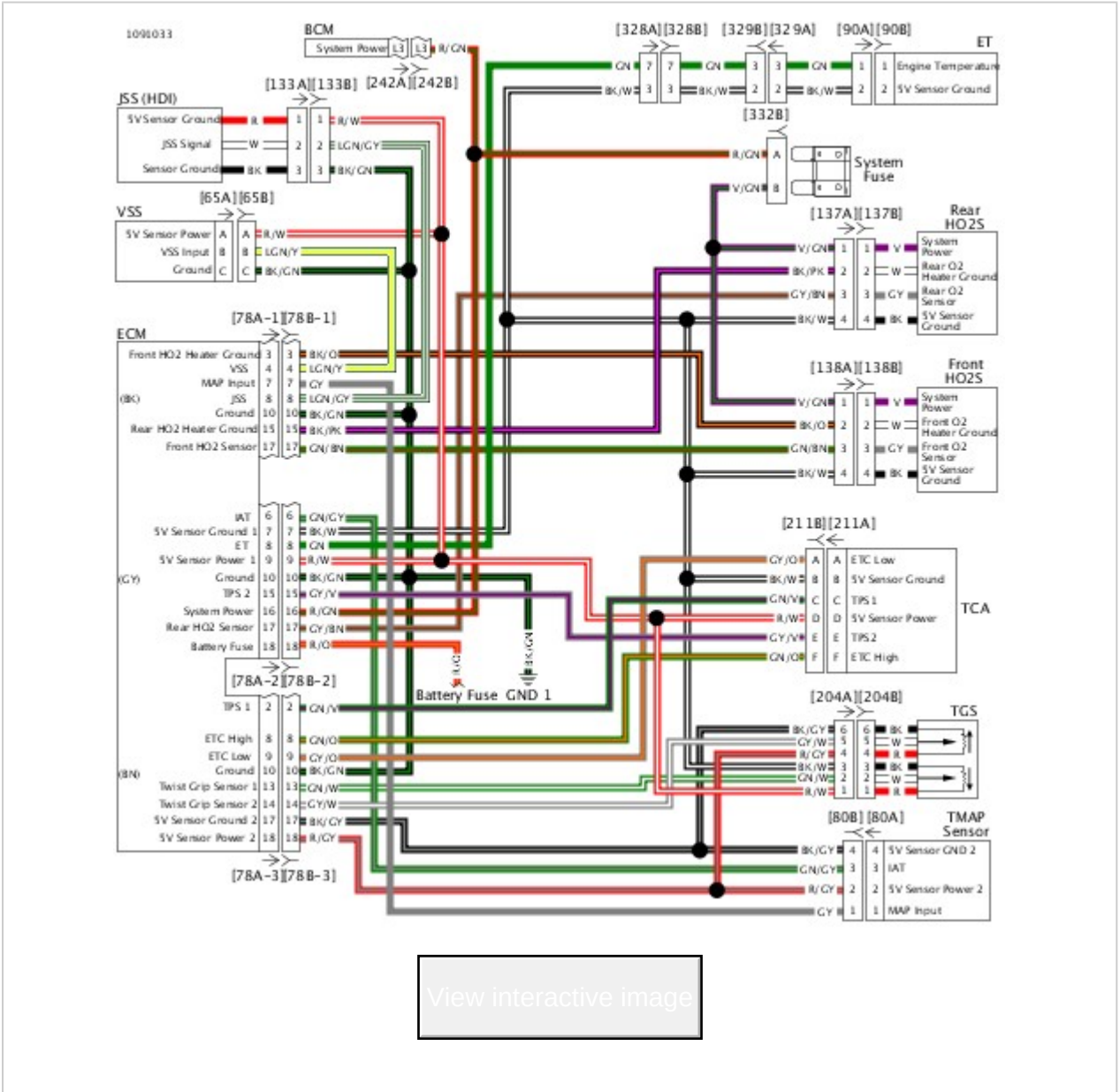

Figure 2. Sensor Circuit

Table 1. DTC P1501 Diagnostic Faults

Short to ground in signal circuit

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Test continuity between [133B] terminal 2 (LGN/GY) wire and ground.
4. Is continuity present?
    a. **Yes.** Repair short to ground on (LGN/GY) wire.
    b. **No.** Replace JSS.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P1502 Diagnostic Faults

Short to voltage in signal circuit
Open ground
Short between 5V reference circuit and signal circuit
Open in signal circuit

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [133B] terminal 3 and ground.
4. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (BK/GN) wire.

1. Turn IGN ON.
2. Test voltage between [133B] terminal 2 (LGN/GY) wire and ground.
3. Is voltage greater than 5V?
    a. **Yes.** Repair short to voltage on (LGN/GY) wire.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect ECM [78-1], [78-2] and [78-3].
3. Test continuity between [133B] terminals 1 (R/W) wire and 2 (LGN/GY) wire.

4. Is continuity present?
    a. **Yes.** Repair short between (R/W) and (LGN/GY) wires.
    b. **No.** **Go to Test 4.**

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Test resistance between BOB [78-1] terminal 8 and [133B] terminal 2 (LGN/GY) wire.
4. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace JSS.
    b. **No.** Repair open on (LGN/GY) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. Side Stand Displayed on Speedometer Diagnostic Faults

Jiffy stand is down
Jiffy stand out of adjustment
Open 5V sensor power wire

1. Start engine.
2. Does engine start and stall?
    a. **Yes.** See **Description and Operation**.
    b. **No.** **Go to Test 2.**

1. Verify transmission is in neutral.
2. Is neutral indicator illuminated?
    a. **Yes.** **Go to Test 3.**
    b. **No.** See **Description and Operation**.

1. Inspect JSS and jiffy stand for correct mounting and clearance to jiffy stand tab.
2. Is clearance less than 4.5 mm (0.18 in)?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Install JSS and jiffy stand correctly.

1. Turn IGN OFF.
2. Disconnect JSS [133].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 9 and [133B] terminal 1 (R/W) wire.
6. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace JSS.
    b. **No.** Repair open on (R/W) wire.

The ECM constantly monitors throttle actuation and throttle plate positioning. Several features are programmed into the ECM to limit performance when an error or fault in throttle actuation is detected. These DTCs always accompany another code. Refer to **Table 1**.

Table 1. Code Description

P1510	ETC limited performance mode
P1511	ETC power management mode
P1512	ETC forced idle mode

Performance limitations are identified by code, as follows:

- **P1510 Limited Performance:** Enables near normal operation of the vehicle, guarding against inadvertent wide open throttle conditions. Typically this code is the result if one of the TGS or TP sensors, or one of each, has failed.
- **P1511 Power Management:** Provides more limitation on driveability, due to failure of the TCA, without a TGS, TMAP or airflow faults. The TCA is de-energized and the throttle plate returns to its idle detent position. The ECM monitors the operation of the TGS and adjusts the spark advance and cylinder shutoff/rev limiting, allowing the vehicle to reach traffic speeds (limp-home).
- **P1512 Forced Idle Mode:** Provides extreme limitation of driveability, due to a failure of both TGS, TGS validation error or failure of one TGS and the brake switch. The TCA is de-energized and the throttle plate is forced to a fast idle position providing enough torque to operate at a high idle speed.

Table 1. DTC P1510, P1511, P1512 Diagnostic Faults

Other DTCs set

1. Clear DTCs.
2. Start and run engine for a few seconds.
3. Cycle the engine on and off, for a few seconds each time a total of three times.
4. Did DTC P1510, P1511 or P1512 set with no other DTCs?
    a. **Yes.** Replace ECM.
    b. **No, other DTCs set.** Refer to **Diagnostics**.
    c. **No, no DTCs set.** DTC was properly cleared.

The ECM uses the TMAP sensor to monitor air flow past the throttle plate. This ensures proper throttle plate positioning when the throttle is released and allowed to return to the unpowered position. The unpowered position is typically 7% of throttle plate range.

In order to avoid inconsistent readings at low rpm (or at idle), testing air flow is only performed at engine speeds above normal idle (10% of throttle plate range or approximately 1300 rpm).

The ECM compares the intake manifold pressure value from the TMAP to the throttle plate position value from the TPS. DTC P1514 sets if the manifold pressure is higher than it should be for that given throttle plate position. If a TMAP sensor error is present, then the ECM does not check P1514 parameters and instead P2105 (forced shutdown mode) is initiated, shutting down the fuel pump and fuel injectors. See **Description and Operation**. The ECM only checks for DTC P1514 if power management mode (DTC P1511) is present.

The ECM uses a main microprocessor and a monitoring microcontroller to communicate with the throttle actuation control system.

The microcontroller monitors the main microprocessor of the ECM. When a communication failure is identified, the microcontroller shuts down the TCA and fuel injectors.

An internal ignition delay timer monitors when the ignition circuit is energized. The microcontroller issues DTC P1600 if no communication is established between the main microprocessor or if a monitoring failure occurs within three consecutive ignition cycles.

Table 1. Code Description

P1514	TCA airflow error
P1600	TCA internal error

Table 1. DTC P1514 Diagnostic Faults

Other DTCs set

1. Clear DTCs.
2. Start and run the engine for a few seconds.
3. Cycle engine on and off, for a few seconds each time a total of three times.
4. Did DTC P1514 set with no other DTCs?
    a. **Yes.** Replace ECM.
    b. **No, other DTCs set.** Refer to **Diagnostics**.
    c. **No, no DTCs set.** DTC was properly cleared.

Table 1. DTC P1600 Diagnostic Faults

Other DTCs set

1. Clear DTCs.
2. Start and run the engine for a few seconds.
3. Cycle engine on and off, for a few seconds each time a total of three times.
4. Did DTC P1600 set with no other DTCs?
    a. **Yes.** Replace ECM.
    b. **No, other DTCs set.** Refer to **Diagnostics**.
    c. **No, no DTCs set.** DTC was properly cleared.

See **Figure 1**. When open, compressed gases are released through the exhaust port.

See **Figure 2**. The automatic compression release (ACR) is opened and closed by the ECM to assist starting.

Table 1. Code Description

P1655	ACR solenoid low/open
P1656	ACR solenoid shorted high

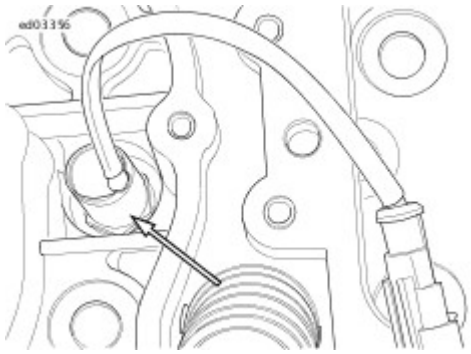

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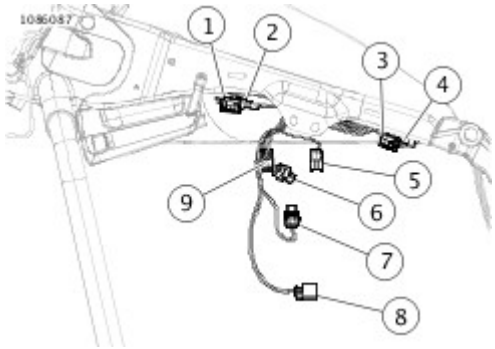
Figure 1. ACR in Head



View interactive image

1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]

6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 2. Engine

The ACR circuits are powered from the system power circuit. This circuit voltage is supplied by the BCM through the system power fuse. Any short causing the fuse to open will cause the ECM to set DTC P1655. If this code is present with an open fuse the fault is a short to ground somewhere in the circuit or the components.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

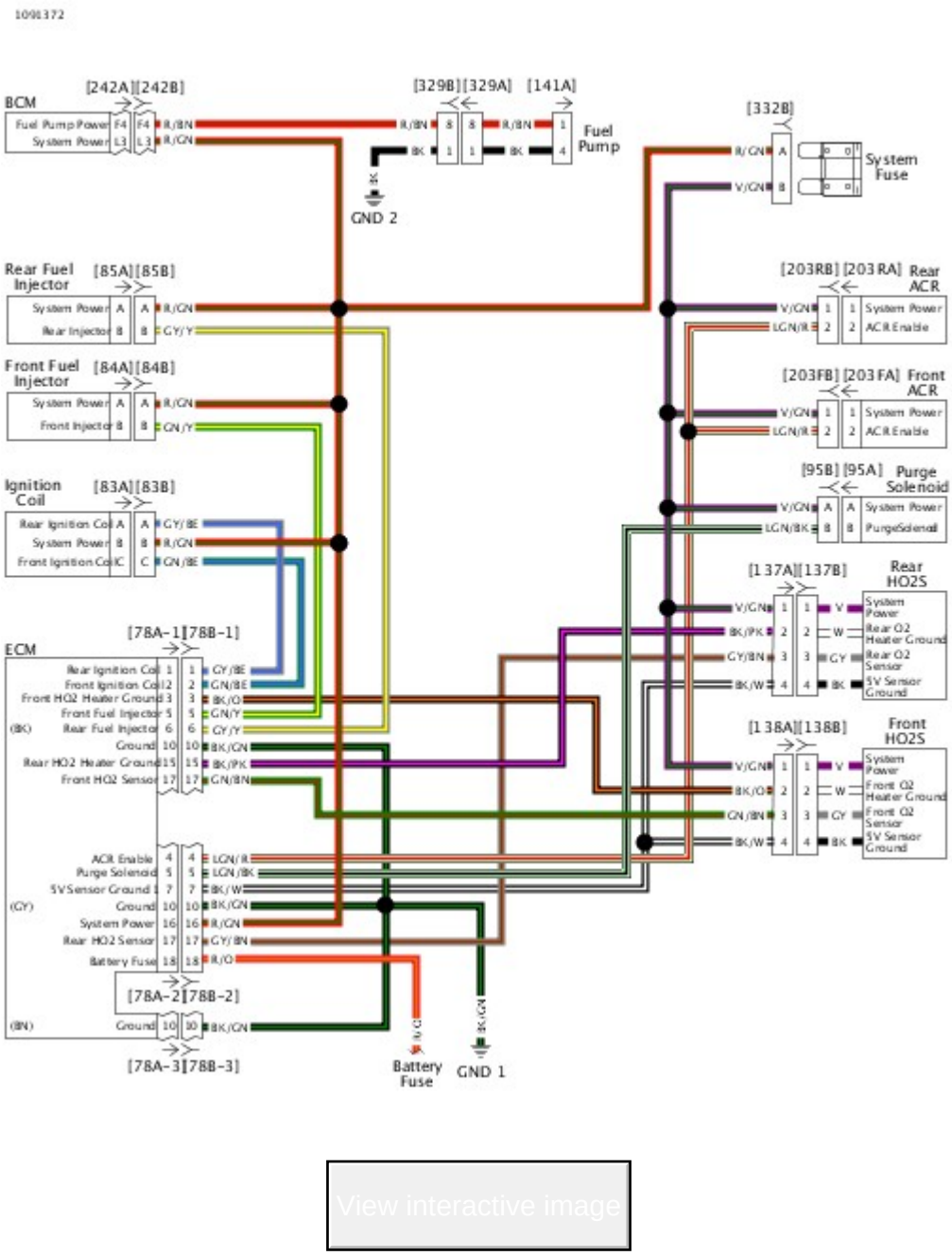


Figure 3. System Power Circuit

Special Tools

Description	Part Number	Qty.
FUEL INJECTOR TEST LIGHT	HD-34730-2E	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P1655 Diagnostic Faults

ACR solenoid malfunction
Open in ACR control circuit
Open in system power circuit
Short to ground in ACR control circuit

1. Turn IGN OFF.
2. Disconnect front ACR [203F].
3. Connect **FUEL INJECTOR TEST LIGHT (Part Number:HD-34730-2E)**.
4. Crank engine for 5 seconds.
5. Does the test light flash on and off?
    a. **Yes. Go to Test 2.**
    b. **No, test light stays on steady. Go to Test 4.**
    c. **No, did not stay on steady. Go to Test 6.**

1. Turn IGN OFF.
2. Disconnect rear ACR [203R].
3. Connect **FUEL INJECTOR TEST LIGHT (Part Number:HD-34730-2E)**.
4. Crank engine for 5 seconds.
5. Does the test light flash on and off?
    a. **Yes.** Replace front and rear ACR solenoids.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect test light.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [203FB] terminal 1 (V/GN) wire and [203RB] terminal 1 (V/GN) wire.
4. Is continuity present?
    a. **Yes.** Repair open in (LGN/R)wire.
    b. **No.** Repair open in (V/GN) wire.

1. Turn IGN OFF.
2. Disconnect ECM [78-2].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between [203FB] terminal 2 (LGN/R) wire and ground.
4. Is continuity present?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Replace ECM.

1. Disconnect rear ACR [203RB].
2. Test continuity between [203FB] terminal 2 (LGN/R) wire and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (LGN/R) wire.
    b. **No.** Replace front and rear ACR solenoids.

1. Turn IGN OFF.
2. Disconnect rear ACR [203RB].
3. Crank engine for 5 seconds.
4. Does the test light flash on and off?
    a. **Yes.** Replace front and rear ACR solenoids.
    b. **No.** **Go to Test 7.**

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 4 and [203FB] terminal 2 (LGN/R) wire.
5. Is resistance less than 0.5 ohm?

a. **Yes.** **Go to Test 8.**
b. **No.** Repair open in (LGN/R) wire.

1. Test resistance between BOB [78-2] terminal 16 and [203B] terminal 1 (V/GN) wire.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (V/GN) wire.

Special Tools

Description	Part Number	Qty.
FUEL INJECTOR TEST LIGHT	HD-34730-2E	1
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P1656 Diagnostic Faults

Short to voltage in ACR control circuit
ACR solenoid malfunction

1. Turn IGN OFF.
2. Disconnect front ACR [203F].
3. Connect **FUEL INJECTOR TEST LIGHT (Part Number:HD-34730-2E)**.
4. Crank engine for 5 seconds.
5. Does test light flash on and off?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect rear ACR [203R].
3. Disconnect test light from [203F].
4. Connect test light to [203R].
5. Crank engine for 5 seconds.
6. Does test light flash on and off?
    a. **Yes.** Replace front and rear ACR.
    b. **No.** **Go to Test 3.**

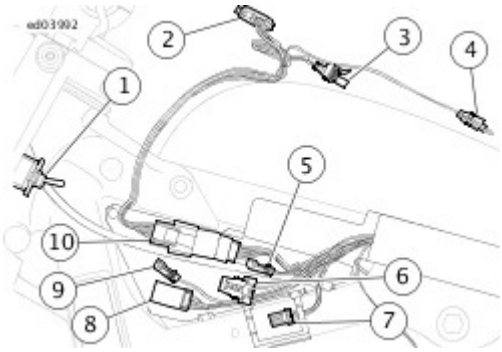
1. Disconnect test light.
2. While cranking engine, using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [203RB] terminal 2 (LGN/R) wire and ground.
3. Is voltage greater than 5.0V?
    a. **Yes.** Repair short to voltage on (LGN/R) wire.
    b. **No.** Replace ECM.

1. Disconnect rear ACR [203R].
2. While cranking engine, using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [203FB] terminal 2 (LGN/R) wire and ground.
3. Is voltage greater than 5.0V?
    a. **Yes.** Repair short to voltage on (LGN/R) wire.
    b. **No.** Replace front and rear ACR.

See **Figure 1** and **Figure 2**. Improper fuel system pressure may contribute to hesitation or loss of power.

Table 1. Code Description

P1505	Power limit violation



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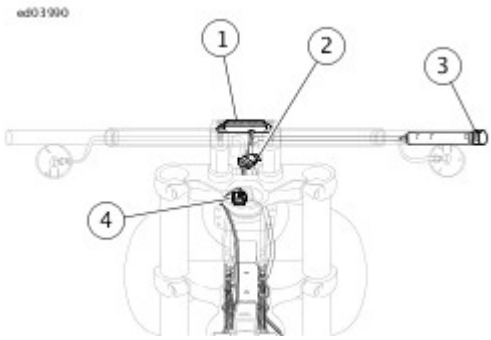
1	Auxiliary lamp switch (FLSTC, FLSTN)
2	Speedometer [39] (except FXSB)
3	Fuel pump [141]
4	Ignition switch [33] (except FXSB)
5	LHCM [24]
6	Front WSS [167]
7	Fuel gauge [117]
8	Headlamp [38]
9	Left front turn/auxiliary [31L] (except FLSTC, FLSTN) and fender tip [32] (FLSTC)
10	Console [20]

Figure 1. Under Fuel Tank Left Side



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1	Indicators
2	Speedometer [39]
3	TGS
4	Fuel pump [141]

Figure 2. Handlebar: FXSB

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Table 1. DTC P1505 Diagnostic Faults

Intake leak
Throttle plate damage

1. Verify no other engine sensor DTCs are present.
2. Are other DTCs present?
    a. **Yes.** Diagnose other DTCs first.
    b. **No.** **Go to Test 2.**

1. Start engine.
2. Check for vacuum leaks.
3. Are any leaks found?
    a. **Yes.** Repair vacuum leak.
    b. **No.** **Go to Test 3.**

1. Inspect throttle plate.
2. Has throttle plate been modified or damaged?
    a. **Yes.** Repair or replace throttle plate.
    b. **No.** **Go to Test 4.**

1. Clear DTCs.
2. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**, attempt to calibrate ECM using module replace feature found in vehicle set up.
3. Did DTC return?
    a. **Yes.** Replace ECM.
    b. **No.** Repair complete.

Special Tools

Description	Part Number	Qty.
INLINE SPARK TESTER KIT	HD-51724	1

Table 1. Hesitation or Loss of Power Test Diagnostic Faults

Loss of engine compression
Fuel system issues
Battery condition and connections
Spark plug condition
Air filter condition
Poor chassis ground connections
Performance modifications
Electrical modifications
Throttle valve malfunction

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected the coil and plugs.
4. Verify fuel injectors are not clogged.
5. Verify battery condition. See **General**.
6. Does battery pass tests?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charge or replace battery.

1. Start engine. Check for vacuum leaks.
2. Were any leaks found?
    a. **Yes.** Repair vacuum leak.
    b. **No.** **Go to Test 3.**

1. Check spark plug condition and replace if fouled.
2. Using **INLINE SPARK TESTER KIT (Part Number:HD-51724)**, check spark at both plugs while cranking engine.
3. Is spark present?
    a. **Yes.** **Go to Test 4.**
    b. **No.** The spark plugs will not spark if there is low or no compression. If spark is not present, test compression before troubleshooting ignition circuit. Once good compression is confirmed, check condition of ignition coils, coil primary wiring and spark plug boots. See **Description and Operation**.

1. Perform compression test.
2. Does engine pass compression test?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair engine loss of compression.

1. Perform fuel pressure test.
2. Does fuel pressure meet specification?
    a. **Yes.** Inspect and clean throttle body and repair as needed.
    b. **No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

Table 1. Starts Hard or Emits Black Smoke Diagnostic Faults

Clogged air filter
Poor compression
Leaking injectors
Manifold leak

1. Inspect air filter.
2. Is air filter clean and in good condition?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace air filter.

1. Perform compression test.
2. Is compression within normal specifications?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair as needed.

1. Perform intake leak test.
2. Did leak test pass?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair as needed.

1. Inspect fuel injectors for mechanical failure.
2. Were any issues found?
    a. **Yes.** Repair as needed.
    b. **No.** **Go to Test 5.**

1. Inspect throttle cable for correct adjustment.
2. Is throttle cable properly adjusted?
    a. **Yes. California models.** **Go to Test 6.**

b. **Yes. Except California models.** Perform misfire diagnostics.
c. **No.** Repair as needed.

1. Inspect EVAP hose for leak.
2. Is EVAP hose in good condition?
    a. **Yes.** Perform misfire diagnostics.
    b. **No.** Repair as needed.

The TCA contains two potentiometers (designated as TPS1 and TPS2) and an electric DC motor for controlling the actuation of the throttle. TPS1 and TPS2 are mounted in the TCA. They are connected to the keyed shaft for the throttle plate and used to communicate the position of the throttle plate.

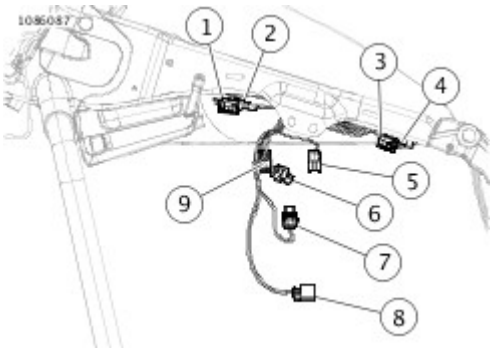
Each TPS supplies input to the ECM in response to the positioning of the throttle plate. The ECM activates the motor in the TCA to move the throttle plate, based on signals from the TGS.

See **Figure 2**. The TCA motor receives input (position data) from the ECM connector [78-3] terminal 8 for electronic throttle control - HI and terminal 9 for electronic throttle control - LOW. The TCA motor drives a series of gears to rotate the position of the throttle plate. Refer to **Table 1** for DTCs associated with TCA drive motor.

Table 1. Code Description

P2100	ETC driver open circuit
P2101	ETC actuation error
P2102	ETC driver shorted low
P2103	ETC driver shorted high

- **P2100 TCA Motor Circuit Open:** Indicates the ECM identified an open load fault for the TCA motor driver.
- **P2101 TCA Motor Circuit Range/Performance:** Indicates the actual position of the throttle plate is out of range from the commanded throttle plate position.
- **P2102 TCA Motor Control Circuit Shorted Low:** Indicates the ECM identified that the drive motor is shorted to ground within the TCA drive motor circuit.
- **P2103 TCA Motor Control Circuit Shorted High:** Indicates the drive motor is shorted high within the TCA drive motor circuit.



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1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]

5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 1. Engine

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

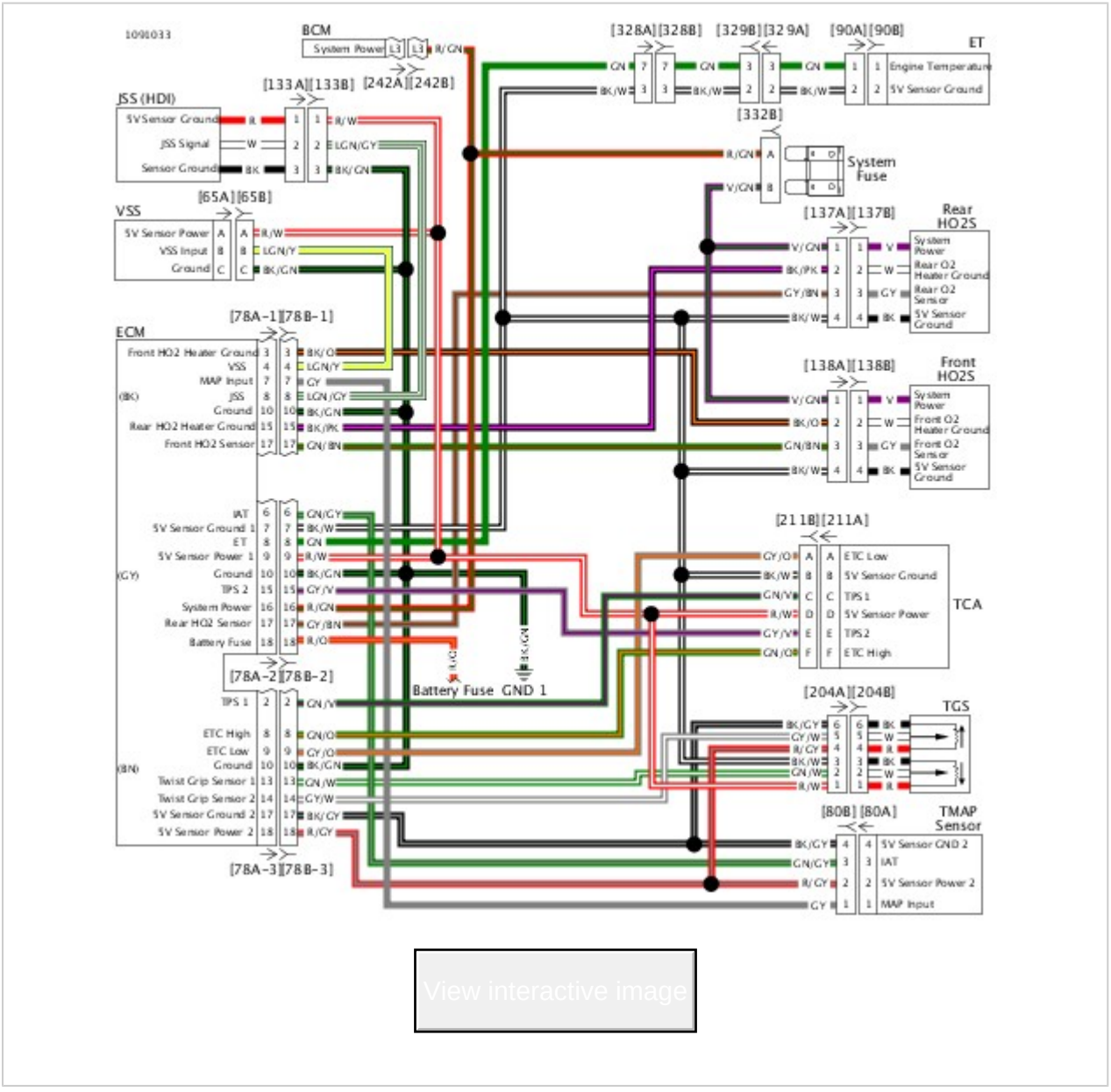

Figure 2. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2100 Diagnostic Faults

Open in throttle actuator control circuit high
Open in throttle actuator control circuit low

1. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
2. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminals 8 and 9.
4. Is resistance greater than 10 ohms?
    a. **Yes. Go to Test 2.**
    b. **No.** Perform wiggle test. See **Wiggle Test**. If resistance is below 10 ohms, replace ECM.

1. Disconnect TCA [211].
2. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminal 8 and TCA [211B] terminal F.
3. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair open in (GN/O) wire.

1. Test resistance between BOB [78-3] terminal 9 and TCA [211B] terminal A.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace TCA.
    b. **No.** Repair open in (GY/O) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2101 Diagnostic Faults

Short between throttle actuator control circuits
Open in throttle actuator control circuit high
Open in throttle actuator control circuit low

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminals 8 and 9.
5. Is resistance less than 2 ohms?
    a. **Yes.**
    b. **No.**

1. Disconnect TCA [211].
2. Test resistance between BOB [78-3] terminal 8 and terminal 9.
3. Is resistance less than 2 ohms?
    a. **Yes.** Repair short between the (GN/O) and (GY/O) wires.
    b. **No.** Replace TCA.

1. Test resistance between BOB [78-3] terminal 8 and [211B] terminal F.
2. Is resistance less than 0.5 ohm?

a. **Yes.**
b. **No.** Repair open in (GN/O) wire.

1. Test resistance between BOB [78-3] terminal 9 and [211B] terminal A.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** Replace ECM.
    b. **No.** Repair open in (GY/O) wire.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P2102 Diagnostic Faults

Short to ground in throttle actuator control circuit low
Short to ground in throttle actuator control circuit high

1. Turn IGN OFF.
2. Disconnect TCA [211].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [211B] terminal F and ground.
4. Is resistance greater than 1000 ohms?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair short to ground in (GN/O) wire.

1. Test resistance between [211B] terminal A and ground.
2. Is resistance less than 2 ohms?
    a. **Yes.** Repair short to ground in (GY/O) wire.
    b. **No.** Replace TCA.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2103 Diagnostic Faults

Short to ground in throttle actuator control circuit low
Short to ground in throttle actuator control circuit high

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TCA [211].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test continuity between BOB [78-2] terminal 16 and [78-3] terminal 8.
6. Is continuity present?
    a. **Yes.** Repair short between (GN/O) and (R/GN) wires.
    b. **No. Go to Test 2.**

1. Test continuity between BOB [78-2] terminal 16 and [78-3] terminal 9.
2. Is continuity present?
    a. **Yes.** Repair short between (GY/O) and (R/GN) wires.
    b. **No.** Replace ECM.

The ECM sets DTC P2105 and provides a forced shut down of the engine when the performance of the TCA cannot be verified.

Initially, the ECM commands the fuel pump and fuel injectors to be disabled until the actual fault is cleared.

The ECM sets DTC P2107 to identify an internal over-temperature shutdown or a power supply failure. Refer to **Table 1**.

Table 1. Code Description

P2105	ETC forced shutdown mode
P2107	ETC driver internal error

Table 1. DTC P2105, P2107 Diagnostic Faults

Internal ECM fault

1. Clear DTCs.
2. Start and run the engine for 30 seconds.
3. Check DTCs.
4. Did DTC P2105 set with no other DTCs?
    a. **Yes.** Replace ECM.
    b. **No, other DTCs set.** Refer to **Diagnostics**.
    c. **No, no DTCs set.** DTC was properly cleared.

The starts, then stalls condition may be created by the fuel system, the idle air control system or an ECM failure.

There may be DTCs set causing this condition. Solve the problems with the DTCs before performing the tests in this section. The DTCs that may be involved with starts, then stalls are:

- **Fuel injectors:** DTCs P0261, P0262 and P0264
- **Password problem:** DTC P1009
- **TPS1:** DTCs P0122 and P0123
- **ECM errors:** DTCs P0603 and P0605

- The vehicle will stall if the jiffy stand is extended when the transmission is in gear.
- If this condition is fuel related, perform fuel pressure test.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

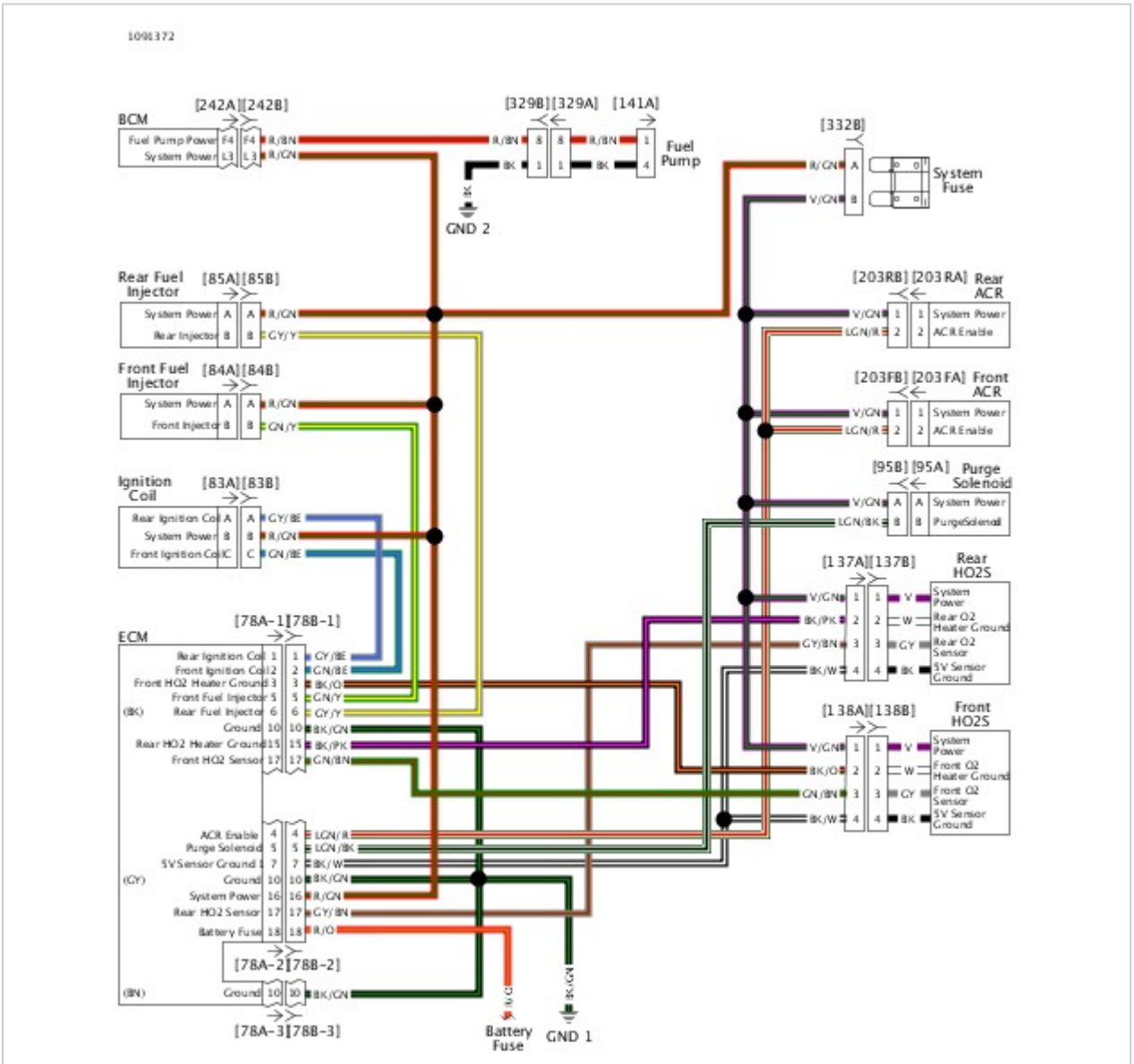

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Figure 1. System Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. Starts, Then Stalls Diagnostic Faults

Fuel system malfunction
Idle air control system malfunction

1. Will engine start with throttle partially opened and then stall when closed?
    a. **Yes.** See **Loss of Idle Speed Control**.
    b. **No.** **Go to Test 2.**

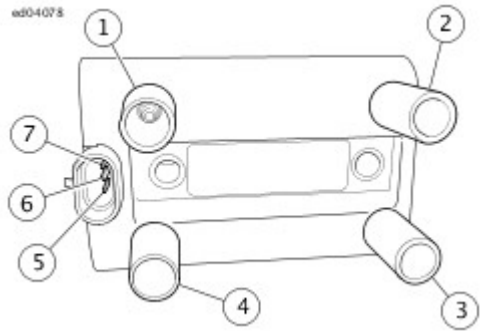
1. Perform fuel pressure test.
2. Is fuel pressure normal?
    a. **Yes.** If fuel injectors are okay, then continue with tests. **Go to Test 3.**
    b. **No.** Repair fuel pressure problem.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 16 and ground.
6. Is voltage present?
    a. **Yes.** Inspect connections at ECM. See **Wiggle Test**. If connections are good and wiggle test does not find intermittent, replace ECM.
    b. **No.** Repair open in (R/GN) wire.

See **Figure 1**. Ignition coil DTCs sets if the ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to the coil. If front and rear DTCs are set simultaneously, it is likely a coil power failure or a coil failure. The coil receives power from the BCM at the same time the purge solenoid, active exhaust actuator, active intake solenoid, ECM and injectors are activated.

Table 1. Code Description

P2300	Ignition coil driver low/open (front)
P2301	Ignition coil driver shorted high (front)
P2303	Ignition coil driver low/open (rear)
P2304	Ignition coil driver shorted high (rear)



View interactive image

1	Secondary #2: right front cylinder
2	Secondary #3: left front cylinder
3	Secondary #4: left rear cylinder
4	Secondary #1: right rear cylinder
5	Coil [83A] terminal A: rear ignition coil
6	Coil [83A] terminal B: system power
7	Coil [83A] terminal C: front ignition coil

Figure 1. Ignition Coil

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

required.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

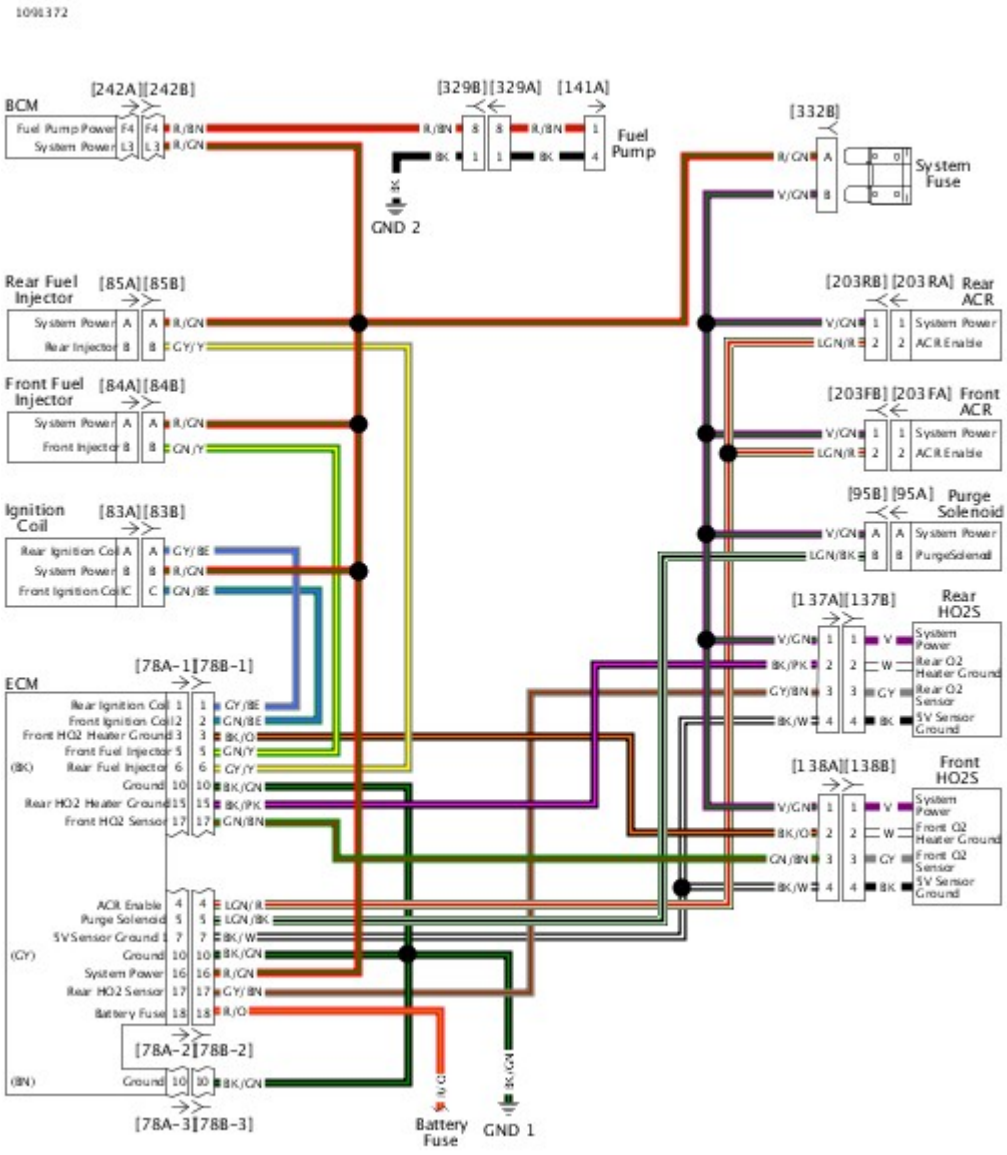


Figure 2. System Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2300 Diagnostic Faults

Ignition coil malfunction
Open or short to ground in signal circuit
Open power circuit

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [83A] terminals B and C.
4. Is resistance greater than 2 ohms?
    a. **Yes.** Replace ignition coil.
    b. **No.** **Go to Test 2.**

1. Turn IGN ON.
2. Test voltage between [83B] terminal B (R/GN) wire and ground.
3. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open on (R/GN) wire.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between BOB [78-1] terminal 2 and [83B] terminal C (GN/BE) wire.

5. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (GN/BE) wire.

1. Disconnect [78-1], [78-2] and [78-3].
2. Test continuity between BOB [78-1] terminal 2 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (GN/BE) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P2301 Diagnostic Faults

Short to voltage in signal circuit

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [83B] terminal C (GN/BE) wire and ground.
5. Is voltage greater than 5.0V?
    a. **Yes.** Repair short to voltage in (GN/BE) wire.
    b. **No. Go to Test 2.**

1. Test resistance between [83A] terminals B and C.
2. Is resistance greater than 0.4 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace ignition coil.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2303 Diagnostic Faults

Open or short to ground in signal circuit
Open power circuit

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between [83A] terminals B and A.
4. Is resistance greater than 2 ohms?
    a. **Yes.** Replace ignition coil.
    b. **No.** **Go to Test 2.**

1. Turn IGN ON.
2. Test voltage between [83B] terminal B (R/GN) wire and ground.
3. Is battery voltage present?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (R/GN) wire.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Test resistance between BOB [78-1] terminal 1 and [83B] terminal A (GY/BE) wire.
5. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**

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

1. Disconnect [78-1], [78-2] and [78-3].
2. Test continuity between BOB [78-1] terminal 1 and ground.
3. Is continuity present?
    a. **Yes.** Repair short to ground in (GY/BE) wire.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1

Table 1. DTC P2304 Diagnostic Faults

Short to voltage in signal circuit

1. Turn IGN OFF.
2. Disconnect ignition coil [83].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [83B] terminal A (GY/BE) wire and ground.
5. Is voltage more than 5.0V?
    a. **Yes.** Repair short to voltage in (GY/BE) wire.
    b. **No. Go to Test 2.**

1. Test resistance between [83A] terminals B and A.
2. Is resistance greater than 2 ohms?
    a. **Yes.** Replace ECM.
    b. **No.** Replace ignition coil.

The ECM sets DTC P2119 when it determines the throttle plate does not return to the correct de-energized position. This error primarily indicates there may be non-electrical conditions which affect the throttle body range/performance. Refer to **Table 1**.

Table 1. Code Description

P2119	ETC actuator return error

This DTC may have the following conditions:

- Something may be physically interfering with the throttle plate operation such as foreign material, debris, physical obstruction or loosely/improperly mounted throttle plate.
- Damaged or inoperative throttle plate return spring.
- Defective mechanical component(s) internal to the TCA.

Table 1. DTC P2119 Diagnostic Faults

Mechanical interference

1. Inspect air inlet. Check for foreign debris and/or mechanical interference to the throttle plate.
2. Were any issues found?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Replace induction module.

1. Clear inlet. Check throttle plate movement.
2. Clear DTCs.
3. Start the engine and operate the throttle.
4. Check DTCs.
5. Did DTC P2119 set?
    a. **Yes.** Replace induction module.
    b. **No.** Repair complete.

If the starter will not crank the engine, the problem is not EFI related. See **Description and Operation** or **Security Lamp**.

There may be DTCs associated with this problem. Check for DTCs and clear them before proceeding with this test.

NOTE

To set a CKP DTC, a start attempt must last at least five seconds.

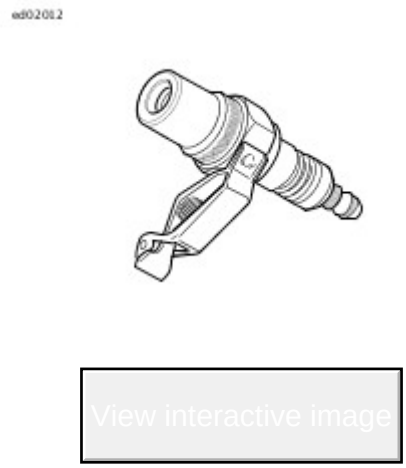


Figure 1. Spark Tester

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

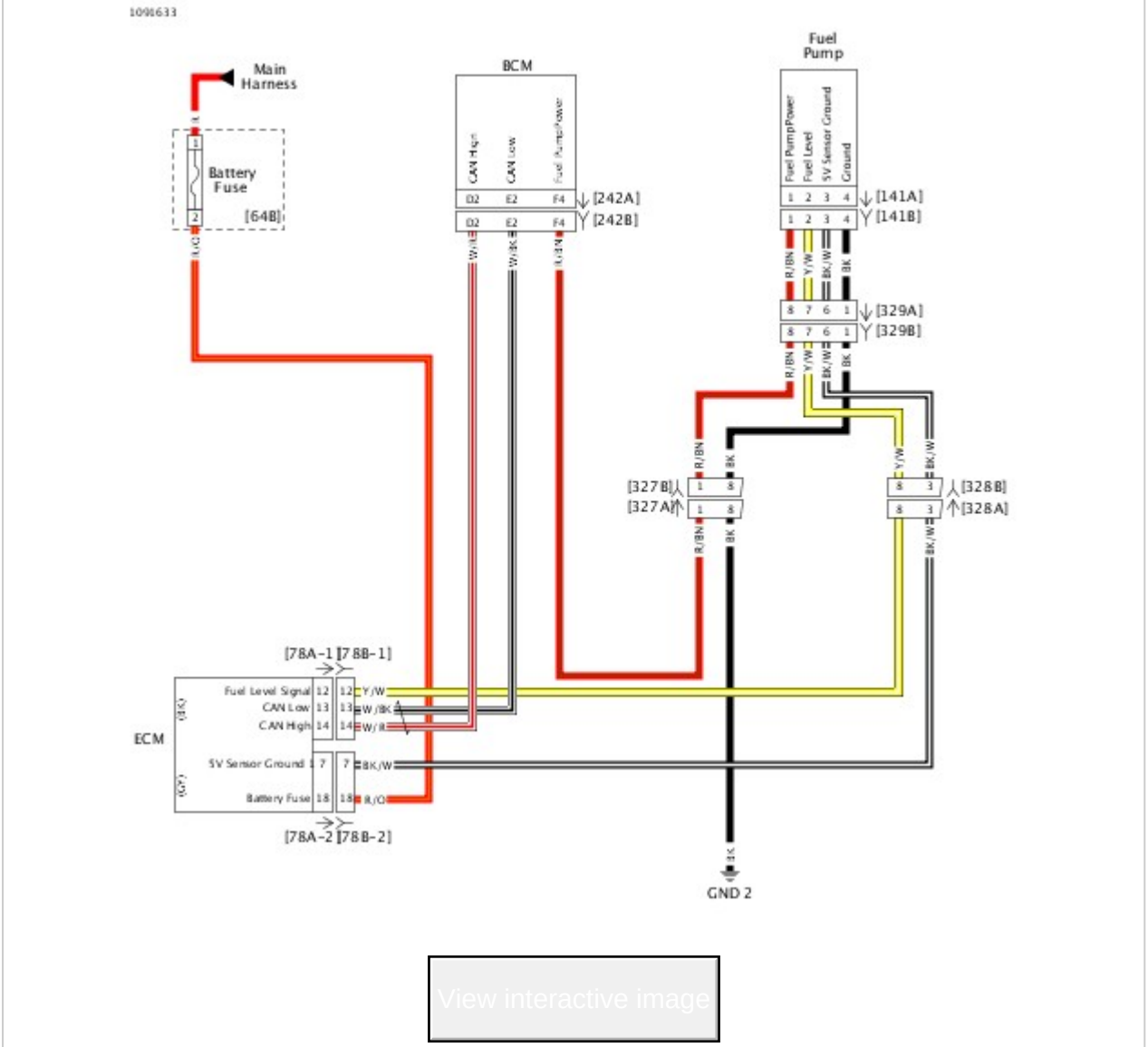


Figure 2. Fuel Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
BCM CABLE	HD-50390-2	1
BCM OVERLAY	HD-50390-2-P	1
INLINE SPARK TESTER KIT	HD-51724	1

Table 1. Engine Cranks but Will Not Start Diagnostic Faults

Battery voltage too low
Ignition system issues
Fuel system issues
Electrical system issues
No or low compression
Open ground circuit

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected to the coil and plugs.
4. Verify fuel injectors are not clogged.
5. Verify battery condition. See **General**.
6. Does battery pass tests?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charge or replace battery.

1. Turn IGN OFF.
2. Wait 30 seconds, then turn IGN ON.
3. Does check engine lamp illuminate for 4 seconds immediately after IGN ON?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Verify all fuses are good. See **Initial Diagnostics**.

1. Check spark plug condition. Replace if fouled.
2. Using **INLINE SPARK TESTER KIT (Part Number:HD-51724)**, check spark at both plugs while cranking engine.
3. Is spark present?
    a. **Yes.** **Go to Test 4.**
    b. **No.** The spark plugs will not spark if there is low or no compression. If spark is not present, test compression before troubleshooting ignition circuit. Once good compression is confirmed, check condition of ignition coils, coil primary wiring and spark plug boots. See **Description and Operation**.

1. Perform compression test.
2. Does engine pass compression test?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair engine loss of compression.

1. Turn IGN OFF.
2. Disconnect fuel pump [141].
3. Turn IGN ON.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between [141B] terminals A and D during the first 2-3 seconds after IGN ON.
5. Is battery voltage present?
    a. **Yes.** **Go to Test 6.**
    b. **No.** **Go to Test 7.**

1. Check fuel system and perform fuel pressure test.
2. Does fuel pressure meet specification?
    a. **Yes.** Inspect and clean throttle body and repair as needed.
    b. **No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **BCM CABLE (Part Number:HD-50390-2)** between wire harness [242B], leaving [242A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **BCM OVERLAY (Part Number:HD-50390-2-P)** is in position on BOB.
4. Test resistance between [141B] terminal A and BOB terminal F4.
5. Is resistance less than 0.5 ohms?
    a. **Yes.** Repair open on (BK) wire to ground.

b. **No.** Repair open (R/BN) wire.

Misfire conditions may be caused by:

- Battery condition and connections.
- Fuel system problems. See **Description and Operation**.
- Ignition system faults.

WARNING

Wipe up spilled fuel and dispose of rags in a suitable manner. An open spark around gasoline could cause a fire or explosion, resulting in death or serious injury. (00518b)

- When performing the steps in the diagnostic tests, use a known good part to verify whether a suspected part is faulty.
- The ignition coil does not require full installation to be functional.
- Verify faulty ignition coil by performing resistance test.

Special Tools

Description	Part Number	Qty.
INLINE SPARK TESTER KIT	HD-51724	1

See **Figure 1**. Using a **INLINE SPARK TESTER KIT (Part Number:HD-51724)** can help determine whether a problem exists in the ignition or fuel systems.

- If the test light flashes without interruption on both cylinders during the misfire event, verify spark plug condition and gap and inspect the fuel system for proper operation.
- If the test light does not flash or the flash is interrupted during the misfire event, the problem is ignition related.

1. Turn IGN OFF.
2. Remove front spark plug wire.
3. Install inline spark tester between spark plug wire and spark plug.
4. Start engine and inspect tester light. The light will flash on each spark event if power is transmitted to the plug.
5. Install and repeat procedure on rear cylinder.

NOTE

Use an inline spark tester and a load applying dynamometer to diagnose misfire under load.

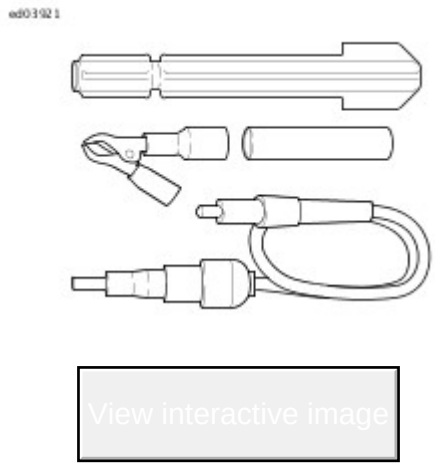


Figure 1. Inline Spark Tester Kit

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

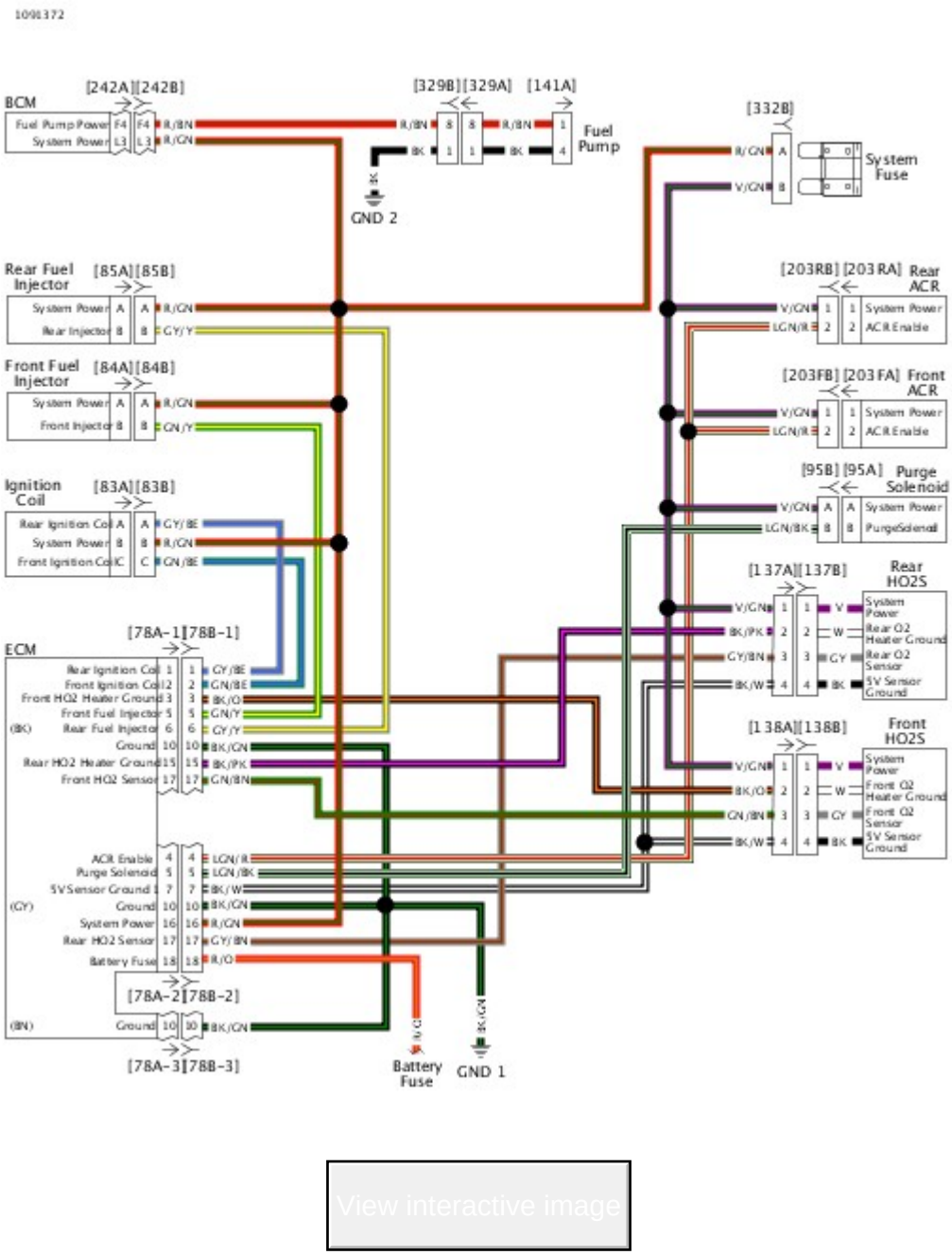


Figure 2. System Power Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1
INLINE SPARK TESTER KIT	HD-51724	1

Table 1. Misfire At Idle or Under Load Diagnostic Faults

Ignition system malfunction
Fuel system malfunction
Electrical system malfunction

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** between wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3]. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-1] terminal 10, [78-2] terminal 10 and then [78-3] terminal 10 to ground.
5. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open on (BK/GN) wire.

1. Connect **INLINE SPARK TESTER KIT (Part Number:HD-51724)** between front spark plug cable and ground. See **How To Use Diagnostic Tools**.
2. Crank engine for a few seconds.
3. Remove tester from front spark plug cable. Connect rear spark plug cable and ground.
4. Crank engine for a few seconds.
5. Did spark jump gap on both cables?
    a. **Yes.** Check for faulty, worn or cracked spark plugs, plug fouling due to mechanical problems or faulty connection at plug or coils. Repair as required.
    b. **No. Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect spark plug cables.
3. Test resistance of both spark plug cables.
4. Is resistance within specifications? Refer to **Spark Plug Cables**.
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace out of range spark plug cable.

1. Inspect top of ignition coils for carbon tracking.
2. Is carbon tracking present?
    a. **Yes.** Replace ignition coil.
    b. **No.** Switch ignition coil with known good unit and perform previous test. If spark jumps gap, replace ignition coil. If not, then continue with tests. **Go to Test 5.**

1. Disconnect ignition coil [83].
2. Disconnect BCM [242].
3. Test resistance between [242B] terminal L3 and [83B] terminal B (R/GN) wire. Wiggle connectors while measuring.
4. Is resistance continuously less than 0.5 ohms?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair intermittent on (R/GN) wire.

1. Start engine.
2. Perform voltage drop test between battery (+) and main fuse [64B] terminal A (R) wire.
3. Is voltage drop more than 1.0V?
    a. **Yes.** Repair (R) wire between terminal A of [64B] and connection at battery including connections at starter.
    b. **No.** Check for corrosion or damage at BCM [259].

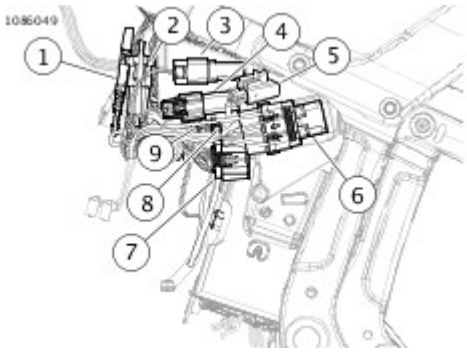
See **Figure 1** and **Figure 2**. The TGS is an electronic assembly that replaces the conventional cable operated throttle. Two opposing Hall-effect sensors transmit signals to the ECM. The ECM uses these signals to determine the desired throttle plate position. The ECM controls the motor in the TCA to move the throttle plate to the desired position.

The TGS receives a 5V reference signal from the ECM. As the throttle plate is opened the TGS1 signal voltage increases and TGS2 signal voltage decreases. By design, the sum of the voltages when measured for both TGS1 and TGS2 should equal approximately 5.0V. If the sum of these voltages is not 5.0V, then DTCs are set for TGS1 and/or TGS2.

The ECM monitors and controls the TCA system and generates DTCs when errors are reported by the ECM. Refer to **Table 1**.

Table 1. Code Description

P2122	TGS1 low/open
P2123	TGS1 high
P2127	TGS2 low/open
P2128	TGS2 high



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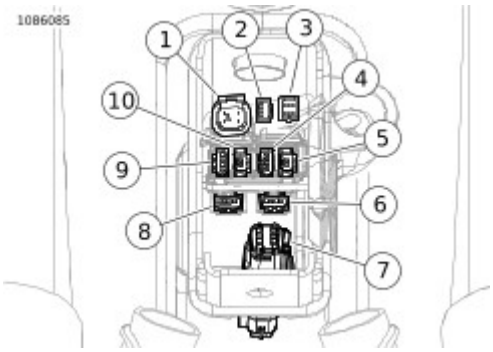
1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]

9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover



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1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 2. USB Caddy

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

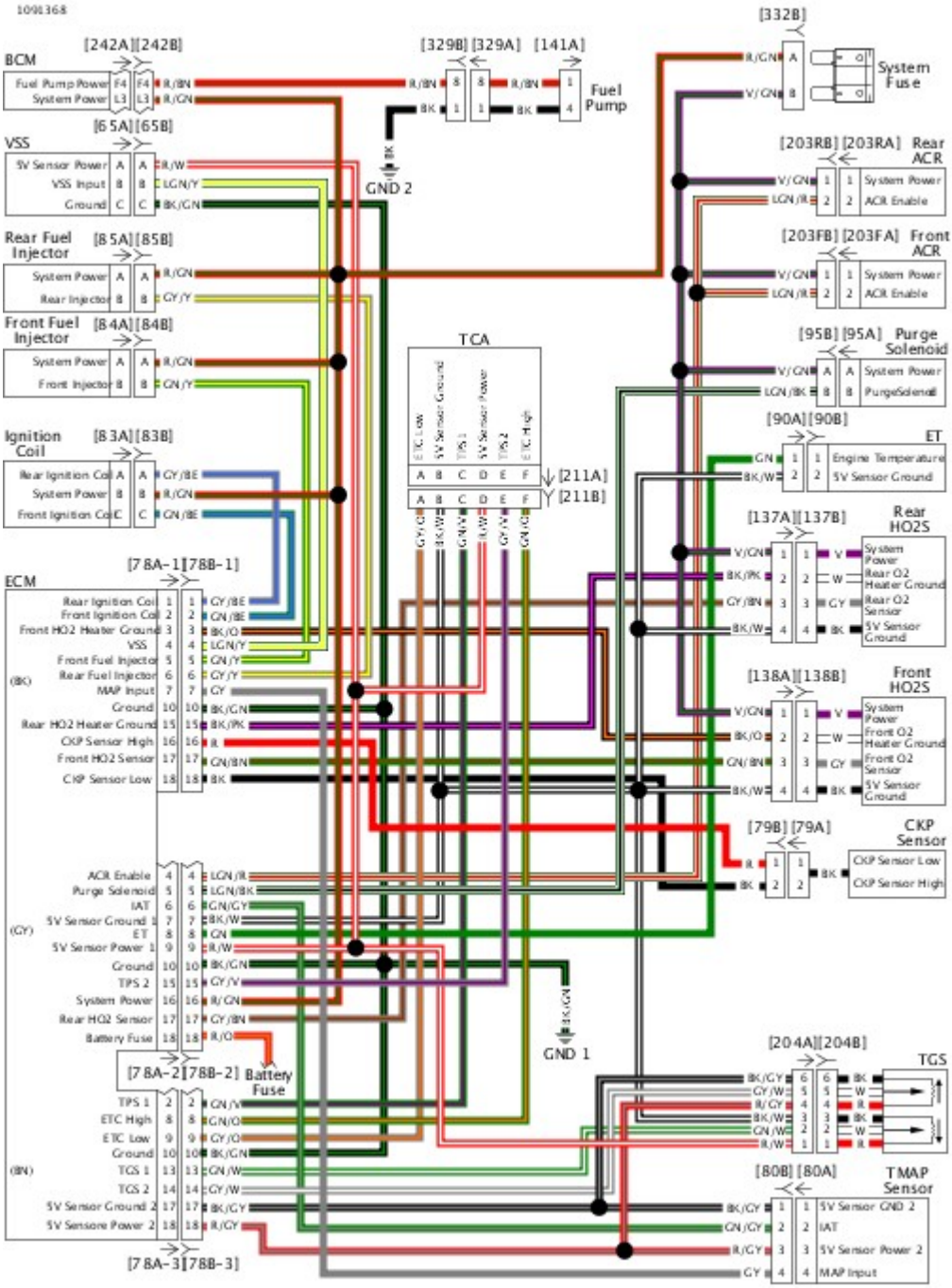

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Figure 3. EFI Simplified Schematic

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2122 Diagnostic Faults

Open in TGS-1 circuit
Short to ground in TGS-1 circuit

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TGS [204].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-2] terminal 9 and [204A] terminal 1 (R/W).
6. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (R/W).

1. Test resistance between BOB [78-3] terminal 13 and [204A] terminal 2 (GN/W).
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (GN/W).

1. Test continuity between BOB [78-3] terminal 13 and [78-1] terminal 10.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (GN/W).
    b. **No.** **Go to Test 4.**

1. Connect [78A-1], [78A-2] and [78A-3] to BOB.
2. Connect [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminal 7 and [78-1] terminal 10.
5. Is voltage greater than 1.0V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** **Go to Test 7.**

1. Turn IGN OFF.
2. Disconnect [78B-2].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 7 (BK/W) wire from ECM harness connector [78B-2].
4. Connect [78B-2].
5. Turn IGN ON.
6. Test voltage between extracted terminal 7 and BOB [78-1] terminal 10.
7. Is voltage greater than 1.0V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect TGS [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-2] terminal 7 and [78-1] terminal 10.
5. Is voltage greater than 1.0V?
    a. **Yes.** Repair short to voltage on (BK/W).
    b. **No.** Replace TGS.

1. Turn IGN OFF.
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 8.**

b. **No.** **Go to Test 14.**

1. Disconnect TGS [204].
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace TGS.

1. Disconnect TCA [211].
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes, with JSS.** **Go to Test 10.**
    b. **Yes without JSS.** **Go to Test 11.**
    c. **No.** Replace TCA.

1. Disconnect JSS [131].
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 11.**
    b. **No.** Replace JSS.

1. Disconnect VSS [65].
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 12.**
    b. **No.** Replace VSS.

1. Disconnect oil pressure [139].
2. Test continuity between BOB [78-2] terminal 9 and ground.
3. Is continuity present?
    a. **Yes.** **Go to Test 13.**
    b. **No.** Replace oil pressure sensor.

1. Disconnect [78A-1], [78A-2] and [78A-3].
2. Test resistance between BOB [78-2] terminal 9 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** Repair short to ground in (R/W) wire.
    b. **No.** Replace ECM.

1. Clear DTCs.
2. Turn IGN OFF, wait 1 minute.
3. Start vehicle and operate throttle.
4. Check DTCs.
5. Did DTC return?
    a. **Yes.** **Go to Test 15.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Test voltage between BOB [78-2] terminal 9 and [78-1] terminal 10.
2. Is voltage greater than 4.6V?
    a. **Yes.** **Go to Test 16.**
    b. **No.** Replace ECM.

1. Test voltage between BOB [78-3] terminal 13 and [78-1] terminal 10.
2. Slowly turn throttle to wide open position and observe voltage.
3. Does voltage steadily increase to greater than 4.5V?
    a. **Yes.** **Go to Test 17.**
    b. **No.** Replace TGS.

1. Turn IGN OFF, wait 1 minute.
2. Test resistance between BOB [78-2] terminal 7 and [78-1] terminal 10.
3. Is resistance less than 1.0 ohm?
    a. **Yes.** Replace TGS.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2123 Diagnostic Faults

Short to voltage in sensor signal
Short to voltage in sensor power

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3].
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminals 9 and 10.
6. Is voltage greater than 6.0V?
    a. **Yes.** **Go to Test 2.**
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect [78B-2].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 9 (R/W) wire from ECM harness connector [78B-2].
4. Connect [78B-2].

5. Turn IGN ON.
6. Test voltage between extracted terminal 9 and BOB [78-2] terminal 10.
7. Is voltage greater than 5.0V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect [78B-2].
3. Insert extracted terminal 9 back into [78B-2].
4. Connect [78B-2].
5. Disconnect TGS [204].
6. Turn IGN ON.
7. Test voltage between BOB [78-2] terminal 9 and ground.
8. Is voltage greater than 6.0V?
    a. **Yes.** Repair short to voltage in (R/W).
    b. **No.** **Go to Test 7.**

1. Test voltage between BOB [78-3] terminal 13 and [78-2] terminal 10.
2. Is voltage greater than 6.0V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 13 (GN/W) wire from ECM harness connector [78B-3].
4. Connect [78B-2].
5. Turn IGN ON.
6. Test voltage between extracted terminal 13 and BOB [78-2] terminal 10.
7. Is voltage greater than 6.0V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Insert extracted terminal 13 back into [78B-3].
4. Connect [78B-3].
5. Disconnect TGS [204].
6. Turn IGN ON.
7. Test voltage between BOB [78-3] terminal 13 and [78-1] terminal 10.

8. Is voltage greater than 6.0V?
    a. **Yes.** Repair short to voltage in (GN/W).
    b. **No.** **Go to Test 7.**

1. Clear DTCs.
2. Turn IGN OFF, wait 1 minute.
3. Start vehicle and operate throttle.
4. Check DTCs.
5. Did DTC return?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Test voltage between BOB [78-2] terminal 9 and [78-1] terminal 10.
2. Is voltage greater than 4.6V?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace ECM.

1. Test voltage between BOB [78-3] terminal 13 and [78-1] terminal 10.
2. Slowly turn throttle to wide open position and observe voltage.
3. Does voltage steadily increase to greater than 4.5V?
    a. **Yes.** **Go to Test 10.**
    b. **No.** Replace TGS.

1. Turn IGN OFF, wait 1 minute.
2. Test resistance between BOB [78-2] terminal 7 and [78-1] terminal 10.
3. Is resistance less than 1.0 ohm?
    a. **Yes.** Replace TGS.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2127 Diagnostic Faults

Open in TGS-2 circuit
Short to ground in TGS-2 circuit

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TGS [204].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminal 18 and [204A] terminal 4 (R/GY).
6. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (R/GY).

1. Test resistance between BOB [78-3] terminal 14 and [204A] terminal 5 (GY/W).
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Repair open in (GY/W).

1. Test continuity between BOB [78-3] terminal 14 and [78-1] terminal 10.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (GY/W).
    b. **No.** **Go to Test 4.**

1. Connect [78A-1], [78A-2] and [78A-3] to BOB.
2. Connect [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-3] terminal 27 and [78-1] terminal 10.
5. Is voltage greater than 1.0V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** **Go to Test 7.**

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 17 (BK/GY) wire from ECM harness connector [78B-3].
4. Connect [78B-3].
5. Turn IGN ON.
6. Test voltage between extracted terminal 17 and BOB [78-1] terminal 10.
7. Is voltage greater than 1.0V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect TGS [204].
3. Turn IGN ON.
4. Test voltage between BOB [78-3] terminal 17 and [78-1] terminal 10.
5. Is voltage greater than 1.0V?
    a. **Yes.** Repair short to voltage on (BK/GY).
    b. **No.** Replace TGS.

1. Turn IGN OFF.
2. Test resistance between BOB [78-3] terminal 18 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 8.**

b. **No.** **Go to Test 11.**

1. Disconnect TGS [204].
2. Test resistance between BOB [78-3] terminal 18 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace TGS.

1. Disconnect TMAP [80].
2. Test resistance between BOB [78-3] terminal 18 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** **Go to Test 10.**
    b. **No.** Replace TMAP.

1. Disconnect [78A-1], [78A-2] and [78A-3].
2. Test resistance between BOB [78-3] terminal 18 and [78-1] terminal 10.
3. Is resistance less than 200 ohms?
    a. **Yes.** Repair short to ground in (R/GY) wire.
    b. **No.** Replace ECM.

1. Clear DTCs.
2. Turn IGN OFF, wait 1 minute.
3. Start vehicle and operate throttle.
4. Check DTCs.
5. Did DTC return?
    a. **Yes.** **Go to Test 12.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Test voltage between BOB [78-3] terminal 18 and [78-1] terminal 10.
2. Is voltage greater than 4.6V?
    a. **Yes.** **Go to Test 13.**
    b. **No.** Replace ECM.

1. Test voltage between BOB [78-3] terminal 14 and [78-1] terminal 10.
2. Slowly turn throttle to wide open position and observe voltage.
3. Does voltage steadily decrease to less than 0.5V?
    a. **Yes.** **Go to Test 14.**
    b. **No.** Replace TGS.

1. Turn IGN OFF, wait 1 minute.
2. Test resistance between BOB [78-3] terminal 17 and [78-1] terminal 10.
3. Is resistance less than 1.0 ohm?
    a. **Yes.** Replace TGS.
    b. **No.** Replace ECM.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2128 Diagnostic Faults

Short to voltage in sensor signal
Short to voltage in sensor power

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3].
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-3] terminal 18 and [78-1] terminal 10.
6. Is voltage greater than 6.0V?
    a. **Yes. Go to Test 2.**
    b. **No. Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 18 (R/GY) wire from ECM harness connector [78B-3].
4. Connect [78B-3].

5. Turn IGN ON.
6. Test voltage between extracted terminal 18 and BOB [78-1] terminal 10.
7. Is voltage greater than 5.0V?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Insert extracted terminal 18 back into [78B-3].
4. Connect [78B-3].
5. Disconnect TGS [204].
6. Turn IGN ON.
7. Test voltage between BOB [78-3] terminal 18 and ground.
8. Is voltage greater than 6.0V?
    a. **Yes.** Repair short to voltage in (R/GY).
    b. **No.** **Go to Test 7.**

1. Test voltage between BOB [78-3] terminal 14 and [78-1] terminal 10.
2. Is voltage greater than 6.0V?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, remove terminal 14 (GY/W) wire from ECM harness connector [78B-3].
4. Connect [78B-3].
5. Turn IGN ON.
6. Test voltage between extracted terminal 14 and BOB [78-1] terminal 10.
7. Is voltage greater than 6.0V?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Replace ECM.

1. Turn IGN OFF.
2. Disconnect [78B-3].
3. Insert extracted terminal 14 back into [78B-3].
4. Connect [78B-3].
5. Disconnect TGS [204].
6. Turn IGN ON.
7. Test voltage between BOB [78-3] terminal 14 and ground.

8. Is voltage greater than 6.0V?
    a. **Yes.** Repair short to voltage in (GY/W).
    b. **No.** **Go to Test 7.**

1. Clear DTCs.
2. Turn IGN OFF, wait 1 minute.
3. Start vehicle and operate throttle.
4. Check DTCs.
5. Did DTC return?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Issue could be intermittent. Perform wiggle test.

1. Test voltage between BOB [78-3] terminal 18 and [78-1] terminal 10.
2. Is voltage greater than 4.6V?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace ECM.

1. Test voltage between BOB [78-3] terminal 14 and [78-1] terminal 10.
2. Slowly turn throttle to wide open position and observe voltage.
3. Does voltage steadily decrease to less than 0.5V?
    a. **Yes.** **Go to Test 10.**
    b. **No.** Replace TGS.

1. Turn IGN OFF, wait 1 minute.
2. Test resistance between BOB [78-3] terminal 17 and [78-1] terminal 10.
3. Is resistance less than 1.0 ohm?
    a. **Yes.** Replace TGS.
    b. **No.** Replace ECM.

The ECM sets DTC P2176 when it determines the zero position of the throttle plate has not been successfully learned.

At power up, the ECM adjusts the throttle plate to the limp-home position, then begins to move the throttle plate closed. The ECM monitors and verifies the amount of movement that occurred. The throttle plate minimum position is held briefly then verified against the expected minimum and maximum range of throttle. If the zero position is found within range, then the position is stored.

If the ECM is not able to learn the minimum position or if the learning fails four consecutive ignition cycles, the ECM sets DTC P2176. Refer to **Table 1**.

Table 1. Code Description

P2176	ETC zero position learning error

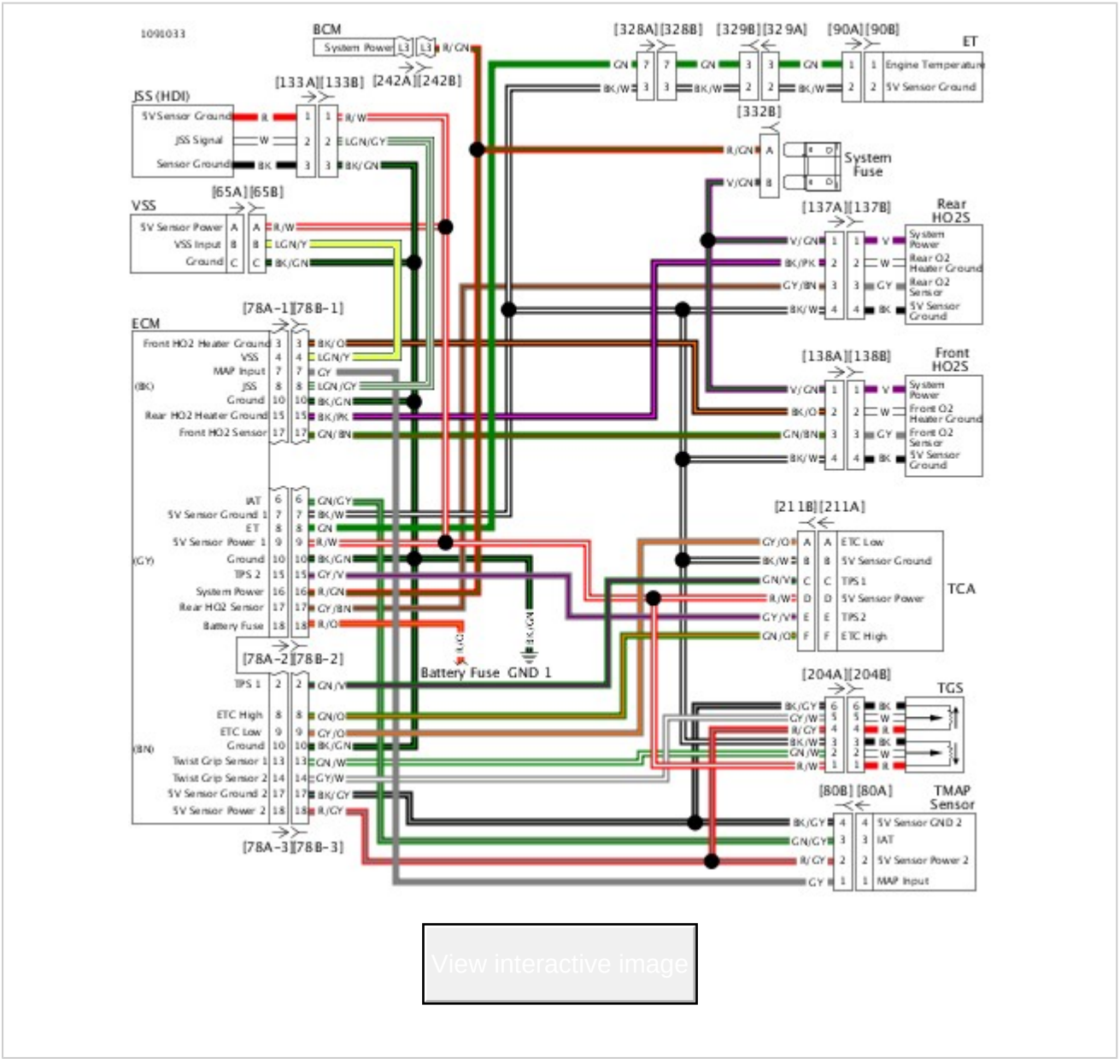


Figure 1. Sensor Circuit

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2176 Diagnostic Faults

Induction module malfunction
Mechanical interference

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], and ECM [78A-1], [78A-2] and [78A-3].
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Turn IGN ON.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB [78-2] terminal 16 and ground.
6. Is battery voltage present?
    a. **Yes. Go to Test 2.**
    b. **No.** See **Description and Operation**.

1. Test voltage between BOB [78-3] terminal 8 and ground and terminal 9 and ground.
2. Is battery voltage present?
    a. **Yes. Go to Test 3.**
    b. **No.** Replace ECM.

1. Inspect air inlet. Check for foreign debris and/or mechanical interference to throttle plate.
2. Were any issues found?
    a. **Yes. Go to Test 4.**
    b. **No.** Replace induction module.

1. Clear inlet. Check throttle plate movement.
2. Clear DTCs.
3. Start engine and operate throttle.
4. Check DTCs.
5. Did DTC P2176 set?
    a. **Yes.** Replace induction module.
    b. **No.** Repair complete.

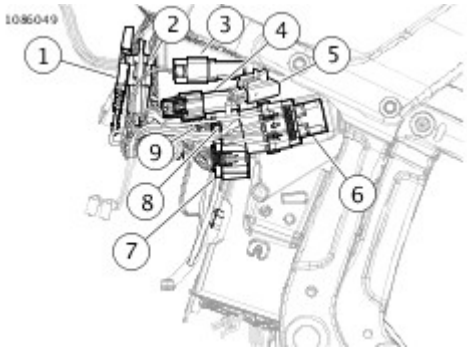
See **Figure 1** and **Figure 2**. The ECM sets DTCs when it determines that a correlation error exists for either the TP sensor or the TGS.

The two TP sensors work opposite of each other. As the throttle plate opens, TPS1 voltage ranges from 0.0-5.0V, while TPS2 voltage ranges from 5.0-0.0V. The sum of the two TPS voltages should always measure approximately 5.0V.

The two TGSs work the same way. As the TGS is opened, TGS1 voltage increases and TGS2 voltage decreases. The sum of these two voltages should always measure approximately 5.0V. If either component fails to correlate the proper voltage or has out-of-range voltage conditions, the ECM will set a DTC. Refer to **Table 1**.

Table 1. Code Description

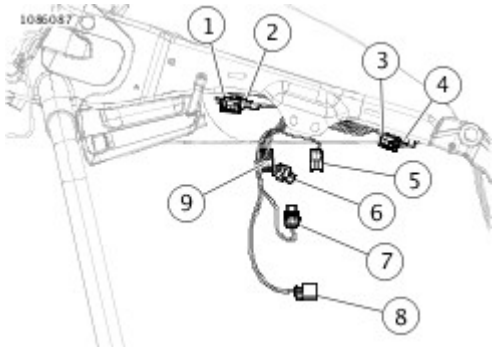
P2135	TPS correlation error
P2138	TGS correlation error



View interactive image

1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 1. Behind Left Side Cover



View interactive image

1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]
9	Front injector [84]

Figure 2. Engine

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **General**.

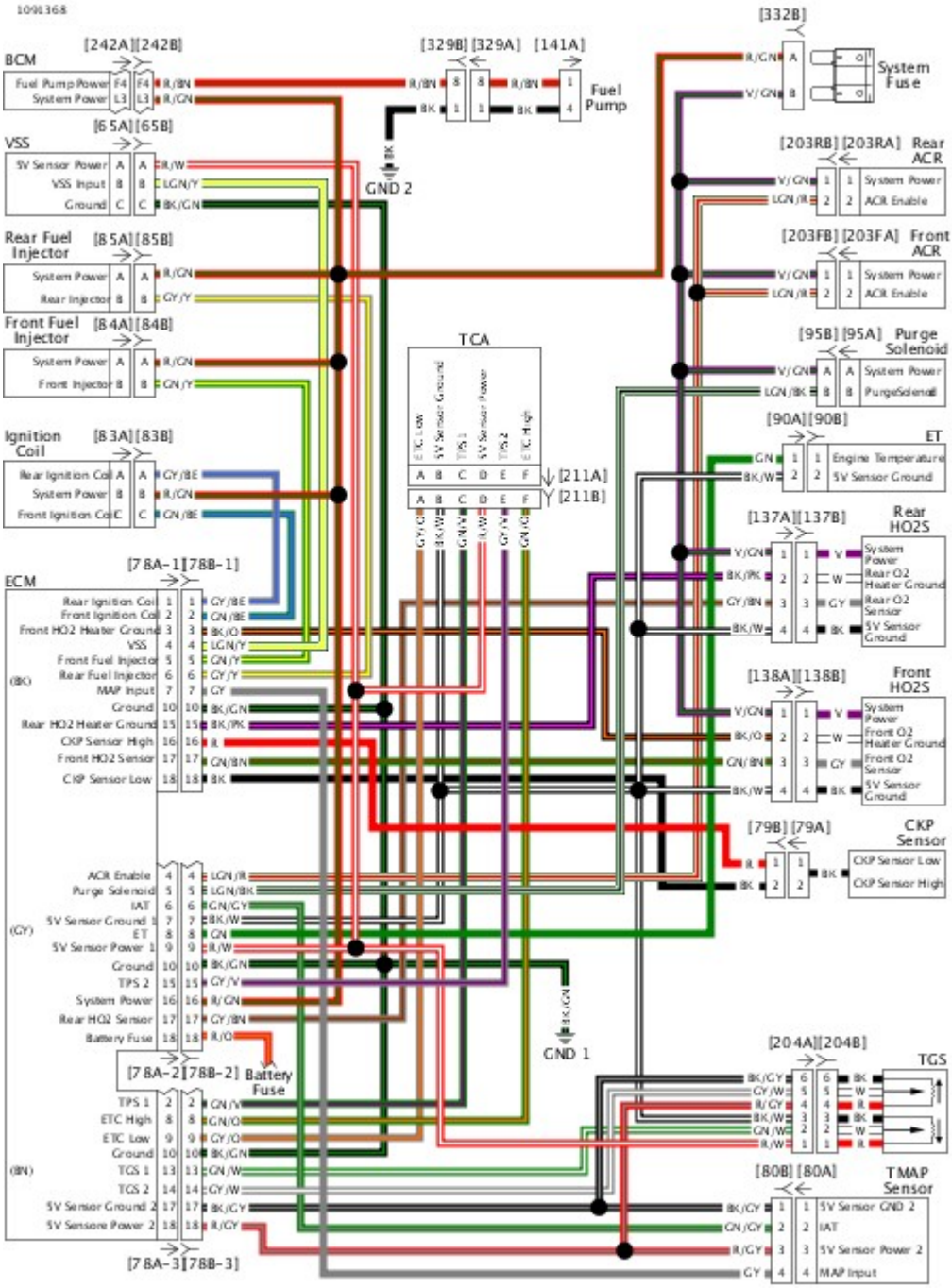


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Figure 3. EFI Simplified Schematic

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2135 Diagnostic Faults

Open in TPS-1 circuit
Short to ground in TPS-1 circuit
Short to voltage in TPS-1 circuit
Open in TPS-2 circuit
Short to ground in TPS-2 circuit
Short to voltage in TPS-2 circuit
Short to voltage in sensor power circuit

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TCA [211].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminal 2 and [211B] terminal C.
6. Is resistance less than 0.5 ohm?
    a. **Yes. Go to Test 2.**
    b. **No.** Repair open in (GN/V) wire.

1. Test continuity between BOB [78-3] terminal 2 and [78-2] terminal 7.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (GN/V) wire.

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

1. Test continuity between BOB [78-3] terminal 2 and [78-2] terminal 9.
2. Is continuity present?
    a. **Yes.** Repair short between (GN/V) and (R/W) wires.
    b. **No.** **Go to Test 4.**

1. Test resistance between BOB [78-2] terminal 15 and [211B] terminal E.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (GY/V) wire.

1. Test continuity between BOB [78-2] terminals 15 and 7.
2. Is continuity present?
    a. **Yes.** Repair short to ground in (GY/V) wire.
    b. **No.** **Go to Test 6.**

1. Test continuity between BOB [78-2] terminals 15 and 9.
2. Is continuity present?
    a. **Yes.** Repair short between (GY/V) and (R/W) wires.
    b. **No.** **Go to Test 7.**

1. Connect [78A-1], [78A-2] and [78A-3].
2. Turn IGN ON.
3. Test voltage between BOB [78-2] terminals 15 and 7.
4. Is voltage greater than 5.25V?
    a. **Yes.** Repair short to voltage on (GY/V) wire.
    b. **No.** **Go to Test 8.**

1. Test voltage between BOB [78-3] terminals 2 and [78-2] terminal 7.
2. Is voltage greater than 5.25V?
    a. **Yes.** Repair short to voltage on (R/W) wire.

b. **No.** **Go to Test 9.**

1. Connect [211].
2. Clear DTCs.
3. Start vehicle. Operate throttle.
4. Did DTC return?
    a. **Yes.** Replace TCA.
    b. **No.** Operation normal.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ECM CABLE	HD-50390-4	1
ECM OVERLAY	HD-50390-4-P	1

Table 1. DTC P2138 Diagnostic Faults

Open or high resistance in TGS-1 circuit
Open or high resistance in TGS-2 circuit
Open or high resistance in sensor ground 1
Open or high resistance in sensor ground 2

NOTE

Always inspect connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses when disconnecting any connector.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ECM CABLE (Part Number:HD-50390-4)** to wiring harness [78B-1], [78B-2] and [78B-3], leaving ECM [78A-1], [78A-2] and [78A-3] disconnected.
3. Verify **ECM OVERLAY (Part Number:HD-50390-4-P)** is in position on BOB.
4. Disconnect TGS [204].
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB [78-3] terminal 13 and [204A] terminal 2.
6. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Repair open in (GN/W).

1. Test resistance between BOB [78-2] terminal 9 and [204A] terminal 1.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 3.**

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

1. Test resistance between BOB [78-2] terminal 7 and [204A] terminal 3.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (BK/W).

1. Test resistance between BOB [78-3] terminal 14 and [204A] terminal 5.
2. Is resistance less than 0.5 Ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (GY/W).

1. Test resistance between BOB [78-3] terminal 18 and [204A] terminal 4.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (R/GY).

1. Test resistance between BOB [78-3] terminal 17 and [204A] terminal 6.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open in (BK/GY).

1. Connect [78A-1], [78A-2] and [78A-3] to BOB.
2. Test resistance between BOB [78-2] terminal 7 and ground.
3. Is resistance less than 1 ohm?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Replace ECM.

1. Test resistance between BOB [78-3] terminal 17 and ground.
2. Is resistance less than 1 ohm?
    a. **Yes.** **Go to Test 9.**
    b. **No.** Replace ECM.

1. Connect [204].
2. Clear DTCs.
3. Turn IGN OFF, wait 1 minute.
4. Start vehicle and operate throttle.
5. Check DTCs.
6. Did DTC return?
    a. **Yes.** Replace TGS.
    b. **No.** Operation normal.

Erratic idle conditions may be caused by:

- Fouled spark plugs.
- Damaged spark plug cables.
- Fuel system problems.
- Ignition system faults.

WARNING

Wipe up spilled fuel and dispose of rags in a suitable manner. An open spark around gasoline could cause a fire or explosion, resulting in death or serious injury. (00518b)

When performing the steps in the diagnostic tests, use a known good part to verify whether a suspected part is faulty.

Special Tools

Description	Part Number	Qty.
INLINE SPARK TESTER KIT	HD-51724	1

Table 1. Erratic Idle Diagnostic Faults

Bad fuel
Faulty spark plug cables
Malfunctioning fuel system
Fouled spark plugs

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected to the coil and plugs.
4. Verify heat management system is not operating.
5. Verify fuel injectors are not clogged.
6. Verify battery condition. See **General**.
7. Does battery pass tests?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charge or replace battery.

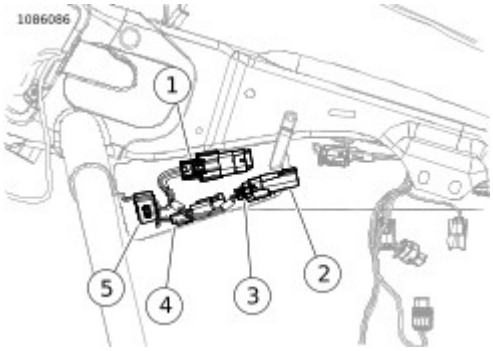
1. Connect **INLINE SPARK TESTER KIT (Part Number:HD-51724)** between front spark plug cable and ground. See **How To Use Diagnostic Tools**.
2. Crank engine for a few seconds.
3. Remove tester from front spark plug cable. Connect rear spark plug cable and ground.
4. Did spark jump gap on both cables?
    a. **Yes.** Check for faulty, worn or cracked spark plugs, plug fouling due to mechanical problems or faulty connection at plug or coils. Repair as required.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect spark plug cables.
3. Test resistance of both spark plug cables.
4. Is resistance within specifications? Refer to **Spark Plug Cables**.

a. **Yes.** **Go to Test 4.**
b. **No.** Replace out of range spark plug cable.

1. Perform fuel pressure test.
2. Is fuel pressure normal?
    a. **Yes.** If fuel injectors are okay, replace the fuel.
    b. **No.** Repair fuel pressure problem.

See **Figure 1**. Improper fuel system pressure may contribute to hesitation or loss of power.



View interactive image

1	USB caddy interconnect [329]
2	USB [264]
3	Fuel pump [141]
4	ET sensor [90]

Figure 1. Under Fuel Tank Left Side

Table 1. Code Description

P1505	Power limit violation

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Table 1. DTC P1505 Diagnostic Faults

Intake leak
Throttle plate damage

1. Verify no other engine sensor DTCs are present.
2. Are any other DTCs present?
    a. **Yes.** Diagnose other DTCs first.
    b. **No. Go to Test 2.**

1. Start engine.
2. Check for vacuum leaks.
3. Were any leaks found?
    a. **Yes.** Repair vacuum leak.
    b. **No. Go to Test 3.**

1. Inspect throttle plate.
2. Has the throttle plate been modified or damaged?
    a. **Yes.** Repair or replace throttle plate.
    b. **No. Go to Test 4.**

1. Clear DTCs.
2. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**, attempt to calibrate the ECM using the module replace feature found in vehicle set up.
3. Did DTC return?
    a. **Yes.** Replace ECM.
    b. **No.** Repair complete.

Special Tools

Description	Part Number	Qty.
INLINE SPARK TESTER KIT	HD-51724	1

Table 1. Hesitation or Loss of Power Test Diagnostic Faults

Loss of engine compression
Fuel system issues
Battery condition and connections
Spark plug condition
Air filter condition
Poor chassis ground connections
Performance modifications
Electrical modifications
Throttle valve malfunction

1. Verify battery connections are in good condition.
2. Verify fuel in the tank is fresh and not contaminated.
3. Verify spark plug wires are firmly connected the coil and plugs.
4. Verify fuel injectors are not clogged.
5. Verify battery condition. See **General**.
6. Does battery pass tests?
    a. **Yes.** **Go to Test 2.**
    b. **No.** Charge or replace battery.

1. Start engine. Check for vacuum leaks.
2. Were any leaks found?
    a. **Yes.** Repair vacuum leak.
    b. **No.** **Go to Test 3.**

1. Check spark plug condition and replace if fouled.
2. Using **INLINE SPARK TESTER KIT (Part Number:HD-51724)**, check spark at both plugs while cranking engine.
3. Is spark present?
    a. **Yes.** **Go to Test 4.**
    b. **No.** The spark plugs will not spark if there is low or no compression. If spark is not present, test compression before troubleshooting ignition circuit. Once good compression is confirmed, check condition of ignition coils, coil primary wiring and spark plug boots. See **Description and Operation**.

1. Perform compression test.
2. Does engine pass compression test?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair engine loss of compression.

1. Perform fuel pressure test.
2. Does fuel pressure meet specification?
    a. **Yes.** Inspect and clean throttle body and repair as needed.
    b. **No.** Inspect fuel inlet sock and fuel filter for obstruction. Inspect internal fuel hose for leaks. If no issues are found, replace fuel pump assembly.

Special Tools

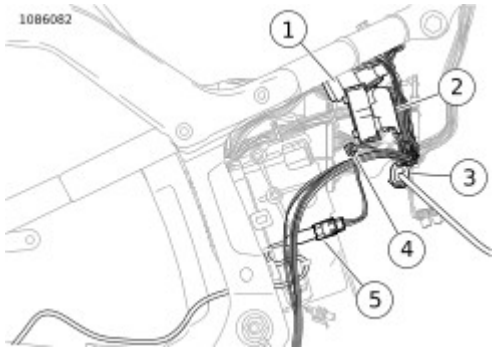
Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

The ABS module consists of an electro-hydraulic control unit (EHCU) which controls brake application under extreme stopping conditions. The ABS only activates when wheel slip is detected.

The ABS includes the:

- See **Figure 1**. The EHCU.
- See **Figure 2**. Front WSS.
- See **Figure 1**. Rear WSS.

The EHCU responds to WSS inputs. When the EHCU is activated, the solenoid valves decrease, hold or increase hydraulic fluid pressure to control the individual calipers of each wheel to prevent wheel slipping. However, the EHCU cannot increase hydraulic pressure beyond the pressure or force being applied to the brake pedal or lever by the rider.



View interactive image

1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]
5	Rear WSS [168]

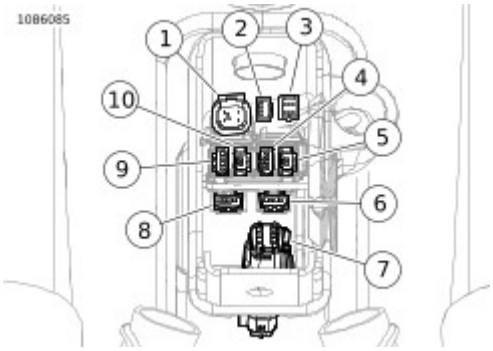
Figure 1. Behind Right Side Cover

The RHCM has a front brake switch that supplies a signal on the CAN bus. This CAN communication signal is sent to the EHCU to indicate that the front brake is applied. The rear brake switch supplies a ground input to the BCM. The BCM sends a rear brake applied CAN communication signal to the EHCU.

During normal ABS operation:

- A series of rapid solenoid valve pulsations may be felt in either the front brake lever or rear brake pedal but only during initialization and anti-lock braking.
- A ticking or popping noise may be heard as the solenoid valves cycle rapidly.
- During anti-lock braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping.

When the EHCU is replaced, use **DIGITAL TECHNICIAN II (Part Number:HD-48650)** to program and bleed the EHCU.



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1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 2. USB Caddy

The EHCU controls the release and apply valves. This holds the same constant pressure on the appropriate caliper. The EHCU will release the pressure hold in the event of wheel slip.

Sometimes the pressure being applied to the caliper is high enough for the EHCU to detect wheel slip. To control the

wheel slip, the EHCU closes the apply valve and opens the release valve. This releases pressure on the appropriate caliper until wheel slip is no longer detected. The excess fluid is stored in the accumulator until the pump can return the fluid to the master cylinder or fluid reservoir.

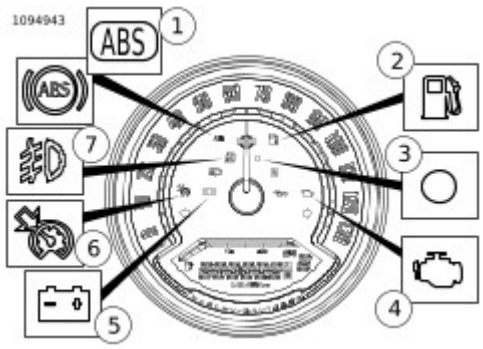
After the wheel slip is corrected during an ABS event, a pressure increase occurs. The EHCU closes the release valve and opens the apply valve. This increases the pressure applied to the caliper during deceleration in order to reduce the speed of the wheel. The increased pressure will not exceed the pressure being applied to the master cylinder by the rider.

The ABS module performs one initialization test each ignition cycle. As part of the initialization self-test, the ABS module energizes the actuators and commands the motor and solenoids on and off. The ABS ECU will run this test the first time the vehicle speed exceeds 4.8 km/h (3 mph) in an ignition cycle.

See **Figure 3** and **Figure 4**. The IM illuminates the ABS indicator if:

- The EHCU detects an ABS disabling malfunction. The EHCU sends a message to the IM requesting illumination.
- The IM performs a lamp check.
- The IM detects a loss of communication with the EHCU.
- The ABS indicator may flash when the IGN is turned on. This will continue until the vehicle is driven to verify WSS operation.

The EHCU sends a message to the instrument when a malfunction that disables ABS operation is detected. Depending on the fault, the ABS indicator may stay on even after the malfunction is corrected. The indicator will not go off until the vehicle is operated at speeds greater than 4.8 km/h (3 mph). It is important to verify that this is not the cause of an ABS indicator illumination when no DTCs are set, before attempting to diagnose other possible causes.

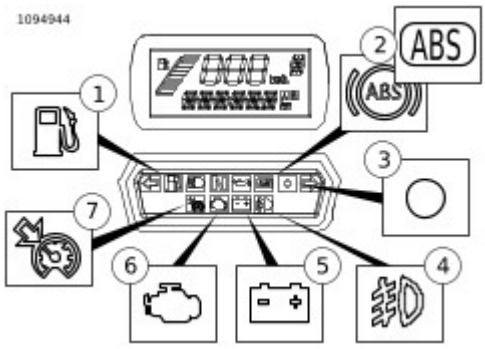


View interactive image

1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine

5	Battery
6	Cruise enabled
7	Aux lighting

Figure 3. Indicator Lamps (Except FXBB, FXBR)



View interactive image

1	Low fuel
2	ABS (km/h ABS icon lamp also shown)
3	Security
4	Aux lighting
5	Battery
6	Check engine
7	Cruise enabled

Figure 4. Indicator Lamps (FXBB, FXBR)

See **Figure 1**. The EHCU is replaced as a unit. It contains the pump, valves and solenoids along with all the controlling circuitry.

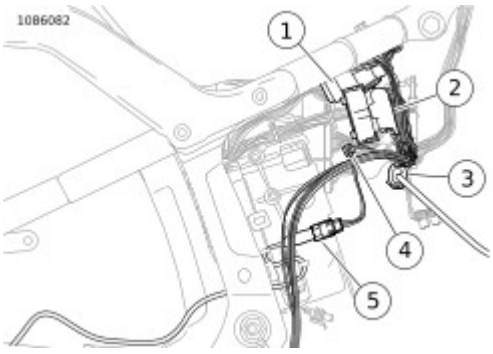
The ABS module monitors the voltage level available for system operation. A low voltage condition prevents the system from operating properly. The ABS module also performs several self-tests for internal problems.

Table 1. Code Description

C1014	ABS ECU relay error
C1040	ABS pump/motor error
C1055	ABS ECU internal error
C1061	ABS front apply solenoid circuit open/high resistance
C1062	ABS front release solenoid circuit open/high resistance
C1065	ABS rear apply solenoid circuit open/high resistance
C1066	ABS rear release solenoid circuit open/high resistance

These DTCs will set if one of the following conditions exists in the EHCU:

- Low battery voltage.
- High resistance in the ABS power or ground circuits.
- EHCU malfunction.



View interactive image

1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]

5	Rear WSS [168]

Figure 1. Behind Right Side Cover

- ABS is disabled.
- The ABS indicator is illuminated.

If improper voltage is supplied to the EHCU, these codes may set. Using an improper or high voltage charger may cause these codes to inadvertently set when there is nothing wrong with the ABS system.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **Connector Locations**.

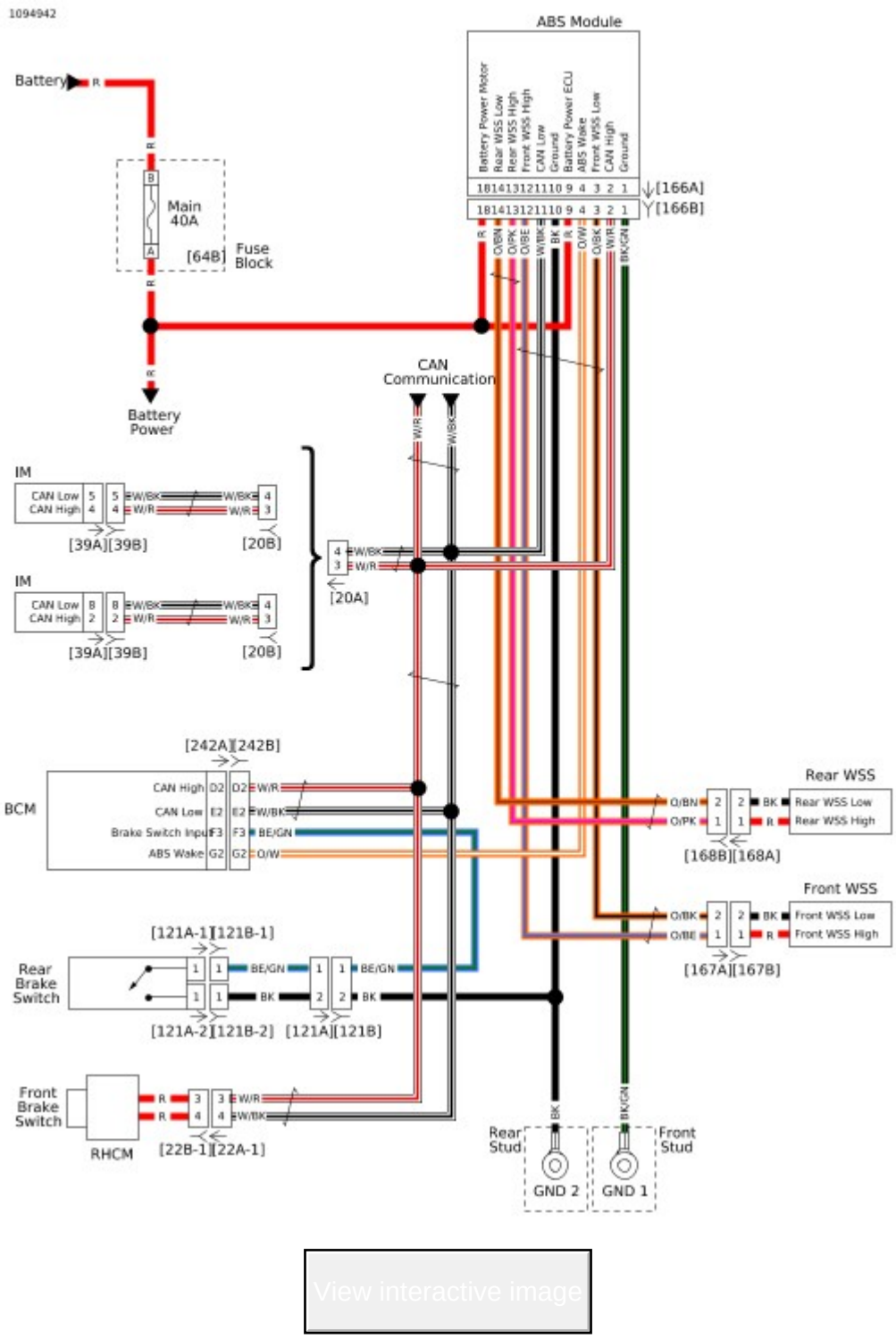


Figure 2. ABS Schematic

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. DTC C1014, C1040, C1055, C1061, C1062, C1065, C1066 Diagnostic Faults

High resistance in the ABS power or ground circuits
Low battery voltage

1. Turn IGN OFF.
2. Verify battery terminals are properly connected, tightened and clean.
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** to wiring harness [166B], leaving EHCU [166A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
5. Turn IGN ON.
6. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal 9 and ground.
7. Test voltage between BOB terminal 18 and ground.
8. Is voltage between 10.5-16.0V on both circuits?
    a. **Yes. Go to Test 2.**
    b. **No. Go to Test 4.**

1. Turn IGN OFF.
2. Test resistance between BOB terminal 1 and ground.
3. Test resistance between BOB terminal 10 and ground.
4. Is resistance less than 0.5 ohms on both circuits?
    a. **Yes. Go to Test 3.**
    b. **No.** Repair high resistance or open condition on ground circuit.

1. Clear DTCs.
2. Turn IGN ON.

3. Check DTCs.
4. Do any of the following DTCs reset: C1014, C1040, C1055, C1061, C1062, C1065, C1066?
    a. **Yes.** Replace EHCU.
    b. **No.** System working properly.

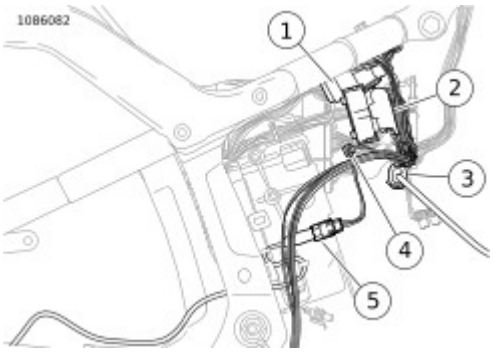
1. Turn IGN OFF.
2. Remove main fuse [64].
3. Test resistance between BOB terminal 9 and [64B] socket terminal A (R) wire.
4. Test resistance between BOB terminal 18 and [64B] socket terminal A (R) wire.
5. Is resistance less than 0.5 ohms on both circuits?
    a. **Yes.** Inspect battery and charging system. See **Description and Operation**.
    b. **No.** Repair open in (R) wire.

See **Figure 1** and **Figure 2**. The active WSS is supplied system voltage from the EHCU. The sensor returns a 7mA or 14mA signal back to the EHCU.

- **Front WSS high circuit:** The EHCU monitors ignition voltage from terminal 12 of the EHCU through terminal 1 of the front WSS.
- **Front WSS low circuit:** The EHCU monitors the signal from terminal 2 of the front WSS through terminal 3 of the ABS ECU.
- **Rear WSS high circuit:** The EHCU monitors ignition voltage from terminal 13 of the EHCU through terminal 1 of the rear WSS.
- **Rear WSS low circuit:** The EHCU monitors the frequency signal from terminal 2 of the rear WSS through terminal 14 of the EHCU.

Table 1. Code Description

C1021	ABS front WSS always zero
C1023	ABS rear WSS always zero
C1025	ABS front wheel speed intermittent
C1027	ABS rear wheel speed intermittent
C1029	ABS wheel speed difference too high
C1032	ABS front wheel speed circuit open/shorted
C1034	ABS rear wheel speed circuit open/shorted



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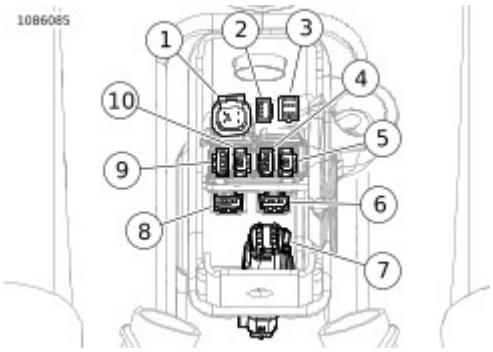
1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]

5	Rear WSS [168]

Figure 1. Behind Right Side Cover



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1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 2. USB Caddy

DTC C1021, C1023, C1025, C1027 or C1029 can set if the following conditions exist in the WSS circuit:

- Interference on the WSS circuit.
- Dynamometer testing.
- WSS malfunction.
- ABS ECU malfunction.
- Incorrect or worn bearing assembly.
- Mismatched or improperly sized tires.
- Worn suspension components.
- Riding over rough terrain.
- External or internal wheel speed circuit intermittent open.

- Electrical noise on the WSS wires.

DTC C1032 can set if one of the following conditions exist in the front high or low WSS circuit:

- Short to ground, short to battery, open or high resistance in the front high or low WSS circuits.
- WSS malfunction.
- ABS ECU malfunction.

DTC C1034 can set if one of the following conditions exist in the rear high or low WSS circuit:

- Short to ground, short to battery, open or high resistance in the rear high or low WSS circuits.
- WSS malfunction.
- ABS ECU malfunction.

- ABS is disabled.
- The ABS indicator is illuminated.

All the DTCs that set in this diagnostic are related to terminals 1 and 2 of the WSS, either internally in the EHCU or WSS, or externally in the wire or connectors. If a DTC is intermittent, it may be a connection problem from terminal 1 or 2 of the WSS to the harness wiring.

Check for these issues prior to part replacement:

- A correctly installed ABS wheel bearing will have a gray seal facing outward.
- If the red seal is showing, the bearing is installed backward.
- If the wheel bearing has a metallic shield, it is a non-ABS bearing and should be replaced with the correct bearing.
- Open in WSS circuit.
- WSS circuit short to voltage.
- Short to ground in WSS circuit.
- Short between WSS circuits.
- External or internal wheel speed circuit intermittent open.
- ABS module malfunction.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **Connector Locations**.

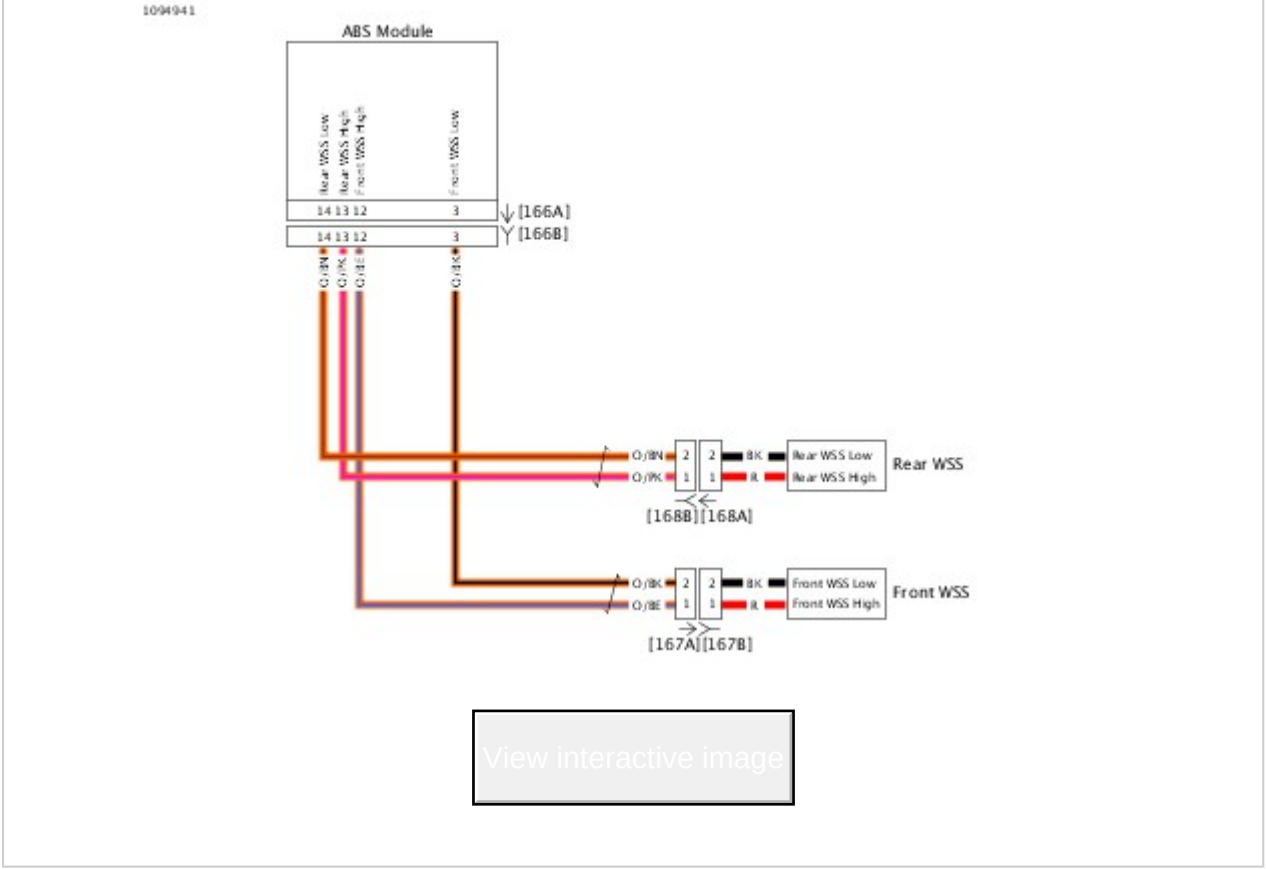


Figure 3. Wheel Speed Sensor Circuits

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. DTC C1021, C1023, C1025, C1027, C1029 Diagnostic Faults

Electrical interference
Poor connections
WSS malfunction
Worn bearing assembly

1. Inspect vehicle for accessories that may cause electrical interference with the wheel speed sensors.
2. Electrical interference present?
    a. **Yes.** Remove or relocate interference.
    b. **No.** **Go to Test 2.**

1. Clear DTC.
2. Operate vehicle above 5 km/h (3 mph) for at least 90 seconds.
3. Check DTCs.
4. Did DTC reset?
    a. **Yes.** **Go to Test 3.**
    b. **No.** See diagnostic tips.

1. Inspect for worn, damaged or incorrect bearing assembly.

NOTE

A correctly installed ABS wheel bearing will have a gray seal facing outward.

- If the seal is red, the bearing is installed backward.
- If the wheel bearing has a metallic shield, it is a non-ABS bearing and should be replaced with the correct bearing.

2. Were worn, damaged or incorrect components found?
    a. **Yes.** Repair as needed.
    b. **No.** **Go to Test 4.**

1. Turn IGN OFF.
2. Disconnect front WSS [167].
3. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** to wiring harness [166B], leaving EHCU [166A] disconnected. See **How To Use Diagnostic Tools**.
4. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
5. Turn IGN ON.
6. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test voltage between BOB terminal 12 and ground.
7. Is voltage greater than 1.0V?
    a. **Yes.** Repair short to voltage on (O/BE) wire.
    b. **No.** **Go to Test 5.**

1. Turn IGN OFF.
2. Disconnect rear WSS [168].
3. Turn IGN ON.
4. Test voltage between BOB terminal 13 and ground.
5. Is voltage greater than 1.0V?
    a. **Yes.** Repair short to voltage on (O/PK) wire.
    b. **No.** **Go to Test 6.**

1. Inspect WSS connector for proper fit and damage.
2. Is WSS connector secure and in good condition?
    a. **Yes.** Replace with appropriate bearing assembly and WSS and retest. If code comes back during retest replace ABS module.
    b. **No.** Repair or replace WSS connector.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
WHEEL SPEED SENSOR TEST LEAD	HD-50341	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. DTC C1032 Diagnostic Faults

WSS malfunction
Intermittent open in the front high or low WSS circuits
Short to ground, short to battery, open or high resistance in the front WSS circuits

1. Inspect vehicle for accessories that may cause electrical interference with the WSS.
2. Inspect front wheel bearing.
3. Is electrical interference or wheel bearing malfunction present?
    a. **Yes.** Remove or relocate interference or correct wheel bearing issues.
    b. **No.** **Go to Test 2.**

1. Turn IGN OFF.
2. Inspect for loose or damaged connections on front WSS circuits.
3. Were poor connections found?
    a. **Yes.** Repair connections and circuits.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect front WSS [167].
3. Connect **WHEEL SPEED SENSOR TEST LEAD (Part Number:HD-50341)** between [167A] terminals 1 and 2. See **How To Use Diagnostic Tools**.

4. Clear DTCs.
5. Cycle IGN OFF, ON, wait 10 seconds for ABS to complete initialization test.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Replace front WSS.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** between wire harness [166B], leaving ABS module [166A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
4. Remove sensor test lead.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal 3 and [167A] terminal 2 (O/BK) wire.
6. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (O/BK) wire.

1. Test resistance between BOB terminal 12 and [167A] terminal 1 (O/BE) wire.
2. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in (O/BE) wire.

1. Test continuity between BOB terminals 3 and 12.
2. Is continuity present?
    a. **Yes.** Repair short between (O/BE) and (O/BK) wires.
    b. **No.** **Go to Test 7.**

1. Test continuity between BOB terminal 3 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (O/BK) wire.
    b. **No.** **Go to Test 8.**

1. Test continuity between BOB terminal 12 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (O/BE) wire.

b. **No.** **Go to Test 9.**

1. Turn IGN ON.
2. Test voltage between BOB terminal 3 and ground.
3. Is voltage present?
    a. **Yes.** Repair short to voltage on (O/BK) wire.
    b. **No.** Replace ABS module.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
WHEEL SPEED SENSOR TEST LEAD	HD-50341	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. DTC C1034 Diagnostic Faults

WSS malfunction
Intermittent open in the rear high or low WSS circuits
Short to ground, short to battery, open or high resistance in the rear WSS circuits

1. Inspect vehicle for accessories that may cause electrical interference with the WSS.
2. Inspect rear wheel bearing.
3. Is electrical interference or wheel bearing malfunction present?
    a. **Yes.** Remove or relocate interference or correct wheel bearing issues.
    b. **No.** **Go to Test 2.**

1. Inspect for loose or damaged connections on rear WSS circuits.
2. Were poor connections found?
    a. **Yes.** Repair connections and circuits.
    b. **No.** **Go to Test 3.**

1. Turn IGN OFF.
2. Disconnect rear WSS [168].
3. Connect **WHEEL SPEED SENSOR TEST LEAD (Part Number:HD-50341)** between [168B] terminals 1 and 2. See **How To Use Diagnostic Tools**.
4. Clear DTCs.

5. Cycle IGN OFF, ON, wait 10 seconds for ABS to complete initialization test.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes. Go to Test 4.**
    b. **No.** Replace rear WSS.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** between wire harness [166B], leaving ABS module [166A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
4. Remove sensor test lead.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between BOB terminal 14 and [168B] terminal 2 (O/BN) wire.
6. Is resistance less than .5 ohm?
    a. **Yes. Go to Test 5.**
    b. **No.** Repair open in (O/BN) wire.

1. Test resistance between BOB terminal 13 and [168B] terminal 1 (O/PK) wire.
2. Is resistance less than .5 ohm?
    a. **Yes. Go to Test 6.**
    b. **No.** Repair open in (O/PK) wire.

1. Test continuity between BOB terminals 14 and 13.
2. Is continuity present?
    a. **Yes.** Repair short between (O/BN) and (O/PK) wires.
    b. **No. Go to Test 7.**

1. Test continuity between BOB terminal 14 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (O/BN) wire.
    b. **No. Go to Test 8.**

1. Test continuity between BOB terminal 13 and ground.
2. Is continuity present?
    a. **Yes.** Repair short to ground on (O/PK) wire.
    b. **No. Go to Test 9.**

1. Turn IGN ON.
2. Test voltage between BOB terminal 14 and ground.
3. Is voltage present?
    a. **Yes.** Repair short to voltage on (O/BN) wire.
    b. **No.** Replace ABS module.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

The EHCU is calibrated to maximize ABS performance. If the correct calibration is not in the module the ABS may not perform correctly. The ECM and ABS modules also compare VINs to verify the correct ABS module is installed. These VINs must match before the ABS will operate properly.

Table 1. Code Description

C1159	ABS invalid stored VIN
C1178	ABS no VIN received from ECM
C1184	ABS invalid VIN from ECM

The ABS module determines final calibration is not completed or that the VIN does not match calibration.

- ABS is disabled.
- The ABS indicator is illuminated.

These codes will usually appear after replacing the ECM or the EHCU. The **new** modules must be programmed using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**. After the parts are programmed and matched correctly for the specific vehicle, clear the codes.

Special Tools

Description	Part Number	Qty.
DIGITAL TECHNICIAN II	HD-48650	1

Table 1. DTC C1159, C1178, C1184 Diagnostic Faults

An EHCU that is not calibrated correctly or has an internal fault
ECM VIN does not match ABS

1. Clear DTC.
2. Start engine, wait 10 seconds for ABS to complete initialization test.
3. Turn engine off.

NOTE

If more than one DTC resets, make sure to diagnose the DTC with the higher priority first. Refer to **Diagnostics**.

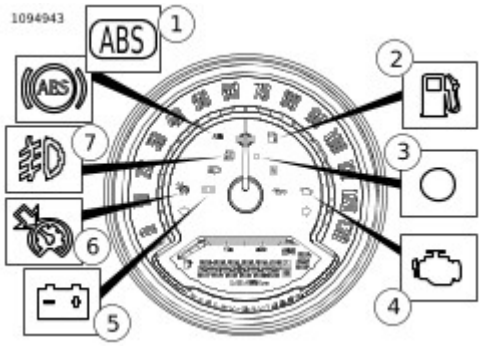
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** **Go to Test 2.**
    b. **No.** See diagnostic tips.

1. Using **DIGITAL TECHNICIAN II (Part Number:HD-48650)**, attempt to calibrate the EHCU using the reflash icon and selecting ABS.
2. Clear DTCs.
3. Turn IGN ON.
4. Check DTCs.
5. Did DTC reset?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Calibration complete.

1. Cycle IGN OFF and ON.
2. Does IM display "VINERR"?
    a. **Yes.** Replace ECM.
    b. **No.** Replace EHCU.

See **Figure 1** and **Figure 2**. The IM illuminates the ABS indicator by supplying ground to the lamp. The ABS module sends a message on the CAN bus to the IM in order to command the indicator ON or OFF.

The ABS indicator will normally come on and then begin to flash when the vehicle is turned ON. It will continue to flash until the EHCU sees at least 4.8 km/h (3 mph) from both WSS to verify proper operation.



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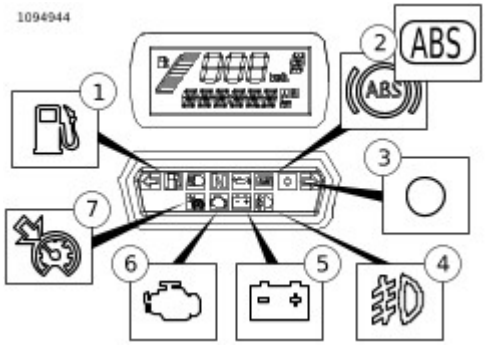
1	ABS (km/h ABS icon lamp also shown)
2	Low fuel
3	Security
4	Check engine
5	Battery
6	Cruise enabled
7	Aux lighting

Figure 1. Indicator Lamps (Except FXBB, FXBR)



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1	Low fuel

2	ABS (km/h ABS icon lamp also shown)
3	Security
4	Aux lighting
5	Battery
6	Check engine
7	Cruise enabled

Figure 2. Indicator Lamps (FXBB, FXBR)

The malfunction must be present during diagnosis in order to prevent unnecessary parts replacement.

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), see **Connector Locations**.

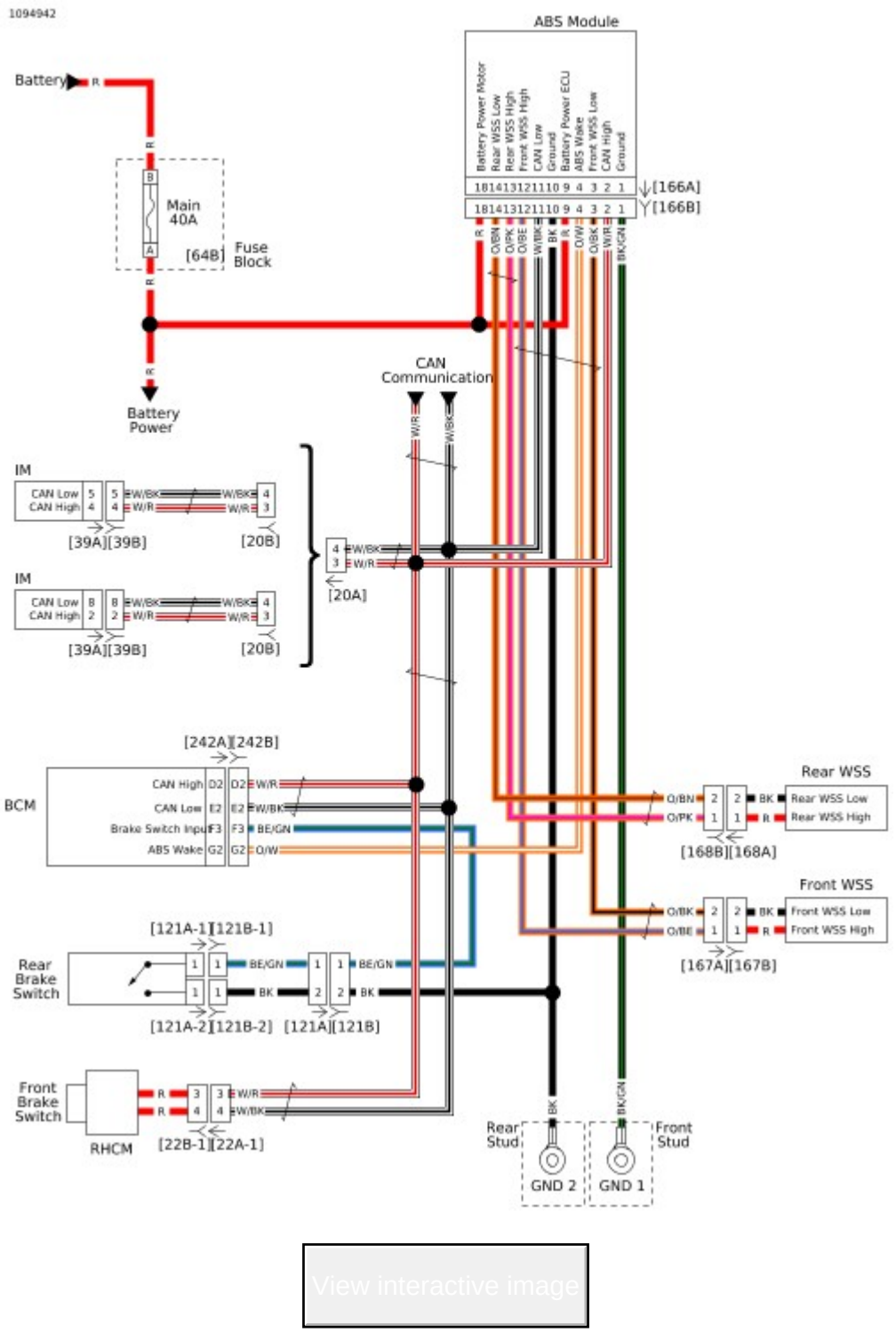


Figure 3. ABS Schematic

Table 1. ABS Indicator Continuously Flashing, No DTCs Diagnostic Faults

Incorrect wheel bearing
Bearing not properly installed
Damaged wheel bearing

1. Verify vehicle is equipped with ABS and has appropriate IM.
2. Clear DTCs.
3. Turn IGN OFF.
4. Check DTCs.
5. Did DTCs set?
    a. **Yes.** See appropriate diagnostic procedure.
    b. **No.** **Go to Test 2.**

1. Inspect for worn, damaged or incorrect bearing assembly on the front wheel.

NOTE

A correctly installed ABS wheel bearing will have a gray seal facing outward.

- If the seal is red, the bearing is installed backward.
- If the wheel bearing has a metallic shield, it is a non-ABS bearing and should be replaced with the correct bearing.

2. Inspect for worn, damaged or incorrect bearing assembly on both wheels.
3. Were worn, damaged or incorrect components found on either wheel?
    a. **Yes.** Repair wheel bearing as needed.
    b. **No.** System working properly.

Special Tools

Description	Part Number	Qty.
TEST CONNECTOR KIT	HD-41404	1
BREAKOUT BOX	HD-42682	1
JUMPER HARNESS	HD-45325	1
BREAKOUT BOX	HD-50390-1	1
ABS OVERLAY	HD-50390-1-P1	1
ABS CABLE	HD-50390-6	1

Table 1. ABS Indicator Always On or Inoperative Diagnostic Faults

Open battery circuit
Open ground circuit
Short to ground in battery circuit

1. Verify vehicle is equipped with ABS and has appropriate IM.
2. Clear DTCs.
3. Turn IGN OFF.
4. Check DTCs.
5. Did DTCs set?
    a. **Yes.** See appropriate diagnostic procedure.
    b. **No.** **Go to Test 2.**

1. Perform a "WOW" test. See **Description and Operation**.
2. Does ABS lamp function properly during the "WOW" test?
    a. **Yes.** **Go to Test 3.**
    b. **No.** Replace IM.

1. Turn IGN OFF.
2. Connect **BREAKOUT BOX (Part Number:HD-50390-1)** and **ABS CABLE (Part Number:HD-50390-6)** to

wiring harness [166B], leaving ABS module [166A] disconnected. See **How To Use Diagnostic Tools**.
3. Verify **ABS OVERLAY (Part Number:HD-50390-1-P1)** is in position on BOB.
4. Connect **BREAKOUT BOX (Part Number:HD-42682)** and **JUMPER HARNESS (Part Number:HD-45325)** between wire harness [39B] and IM [39A]. See **How To Use Diagnostic Tools**.
5. Using **TEST CONNECTOR KIT (Part Number:HD-41404)**, test resistance between ABS BOB terminal 2 and IM BOB terminal 2.
6. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 4.**
    b. **No.** Repair open in (W/R) wire.

1. Turn IGN OFF.
2. Test resistance between ABS BOB terminal 11 and IM BOB terminal 8.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 5.**
    b. **No.** Repair open in (W/BK) wire.

1. Turn IGN ON.
2. Test voltage between ABS BOB terminal 9 and ground.
3. Test voltage between ABS BOB terminal 18 and ground.
4. Is battery voltage present on both circuits?
    a. **Yes.** **Go to Test 6.**
    b. **No.** Repair open in ABS module battery circuit.

1. Turn IGN OFF.
2. Test resistance between ABS BOB terminal 1 and ground.
3. Is resistance less than 0.5 ohm?
    a. **Yes.** **Go to Test 7.**
    b. **No.** Repair open in (BK/GN) wire.

1. Turn IGN ON.
2. Test voltage between ABS BOB terminal 4 to ground.
3. Is battery voltage present?
    a. **Yes.** **Go to Test 8.**
    b. **No.** Repair open in (O/W) wire.

1. Remove ABS BOB and connect [166].

2. Remove IM BOB and connect [39].
3. Clear DTCs.
4. Start vehicle. Operate in the parameters for initialization self-test.
5. Turn IGN OFF.
6. Check DTCs.
7. Did DTC reset?
    a. **Yes.** Replace EHCU.
    b. **No.** Concern is intermittent. See **Wiggle Test**.

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

For Solid Color Wires: See **Figure 1**. The alpha code identifies wire color.

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

See **Figure 1**. On wiring diagrams and in service/repair instructions, connectors are identified by a number in brackets [ ]. The letter inside the brackets identifies whether the housing is a socket or pin housing.

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

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

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

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

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

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

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

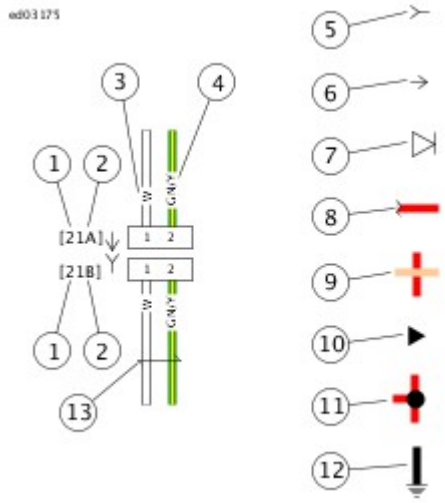
Ground: Grounds can be classified as either clean or dirty grounds. Clean grounds are identified by a (BK/GN) wire and are normally used for sensors or modules.

NOTE

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

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

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



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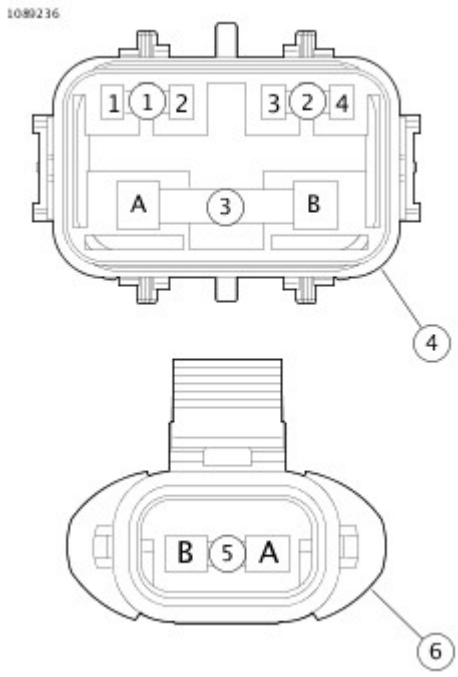
1	Connector number
2	Terminal code (A=pin, B=socket)
3	Solid wire color
4	Striped wire color
5	Socket symbol
6	Pin symbol
7	Diode
8	Wire break
9	No connection
10	Circuit to/from
11	Splice
12	Ground
13	Twisted pair

Figure 1. Connector/Wiring Diagram Symbols



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1	Battery
2	Battery tender
3	Main
4	Fuse block [64]
5	System power
6	Fuse block [332]

Figure 2. Fuse Blocks and Socket Terminals

Table 1. Wire Color Codes

BE	Blue
BK	Black
BN	Brown
GN	Green
GY	Gray
LBE	Light Blue
LGN	Light Green

O	Orange
PK	Pink
R	Red
TN	Tan
V	Violet
W	White
Y	Yellow

Refer to the table below for wiring diagram information.

WIRING DIAGRAM LIST

FIGURE	NUMBER
Battery Power Distribution	Figure 1.
Ignition and Accessory Power Distribution	Figure 2.
Sensor Grounds	Figure 3.
Ground Circuit	Figure 4.
Front Lighting and Hand Controls: 2018 Softail	Figure 5.
Backbone Harness 1 of 3: 2018 Softail	Figure 6.
Engine Harness 2 of 3: 2018 Softail	Figure 7.
Main Harness 3 of 3: 2018 Softail	Figure 8.
Rear Lighting: 2018 Softail	Figure 9.

Figure 1. Battery Power Distribution

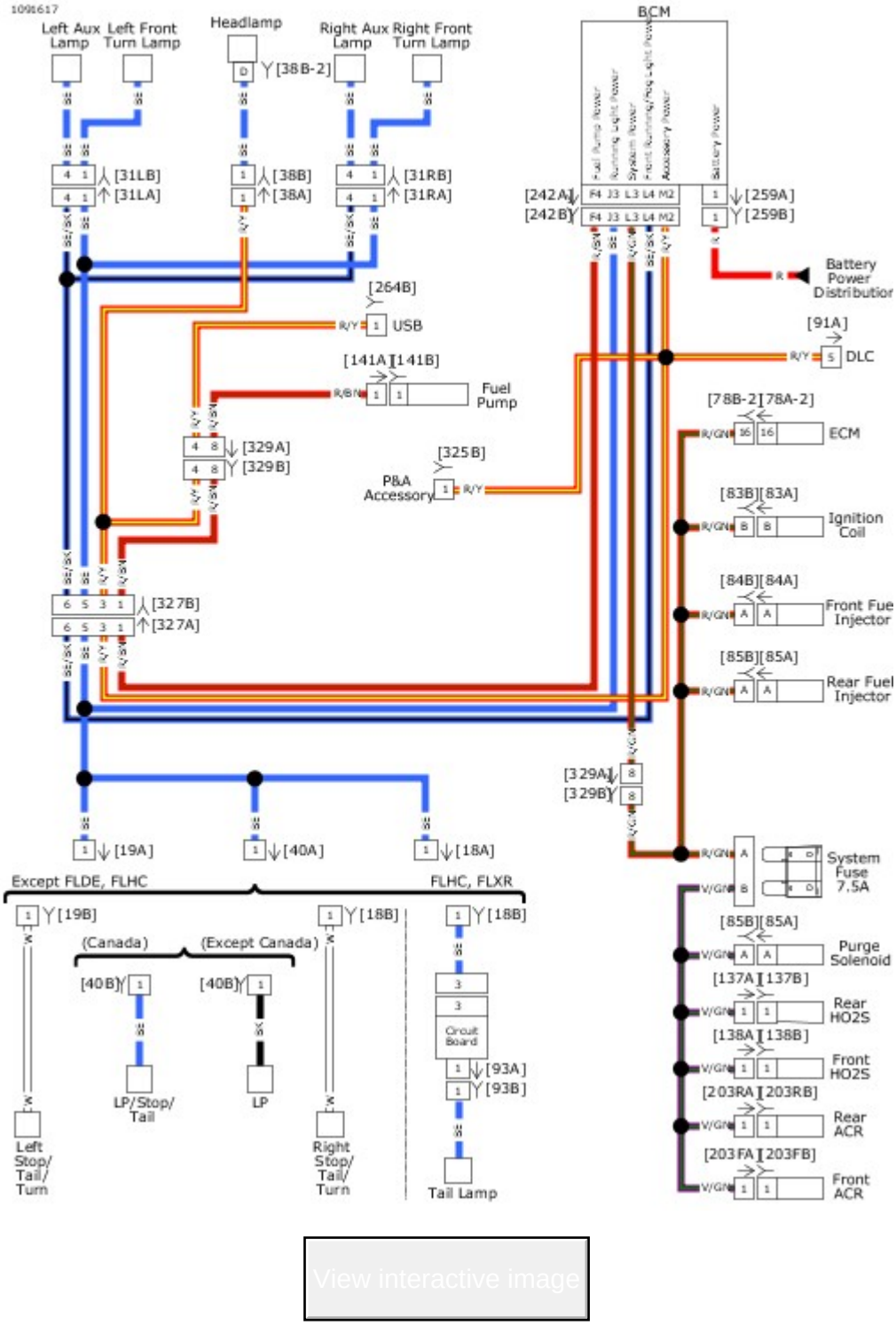

Figure 2. Ignition and Accessory Power Distribution

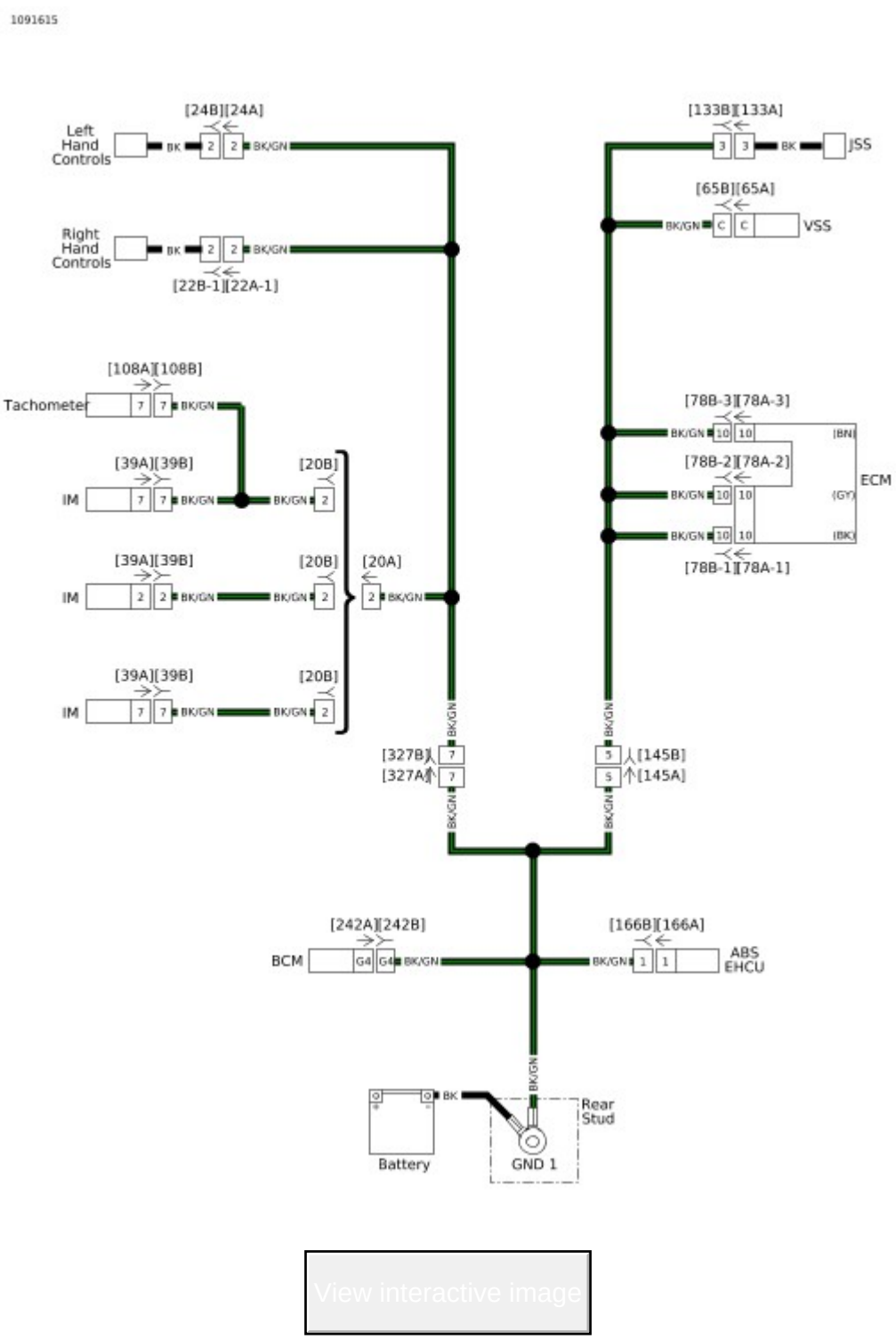

Figure 3. Sensor Grounds

Figure 4. Ground Circuit

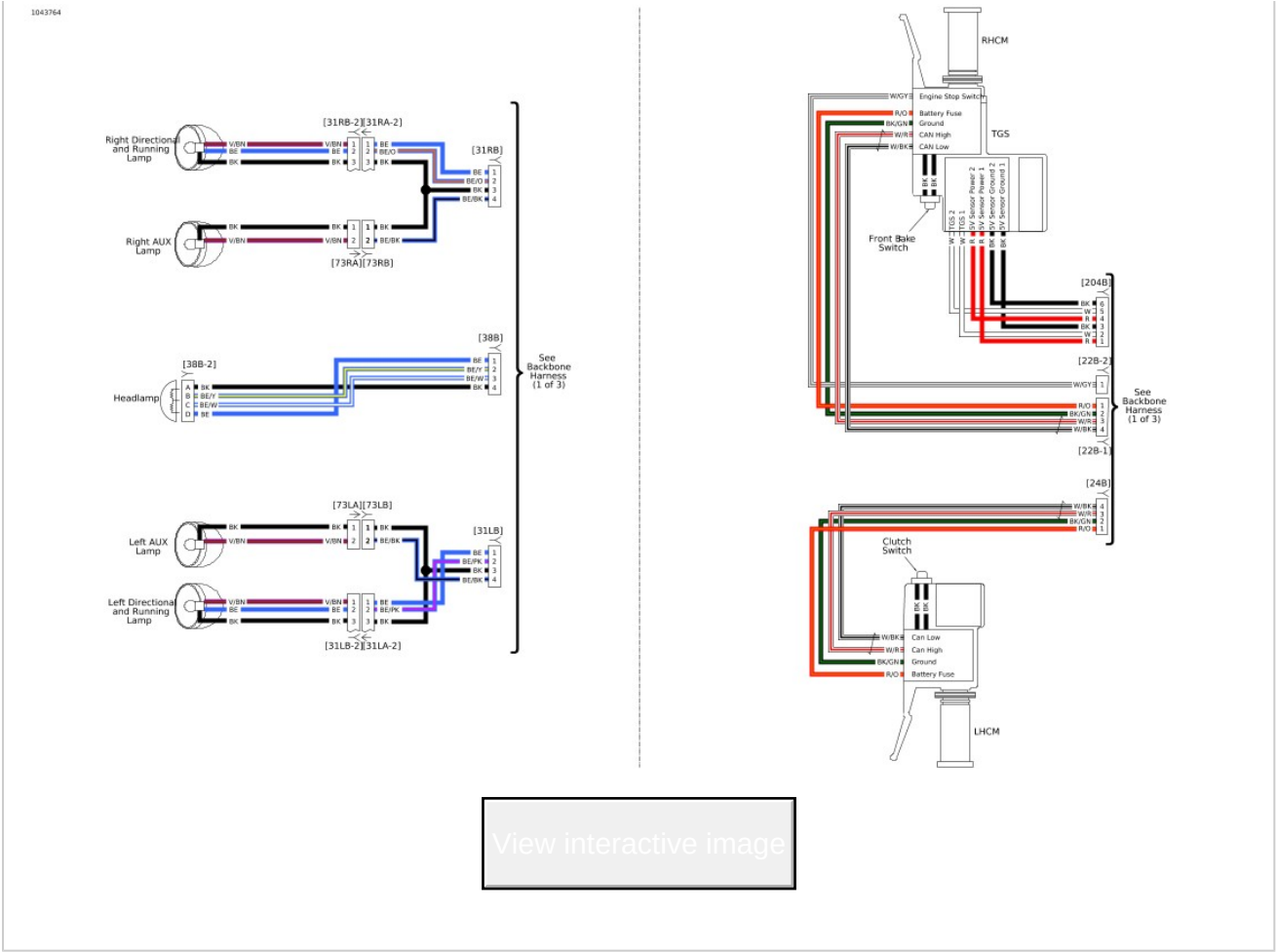

Figure 5. Front Lighting and Hand Controls: 2018 Softail

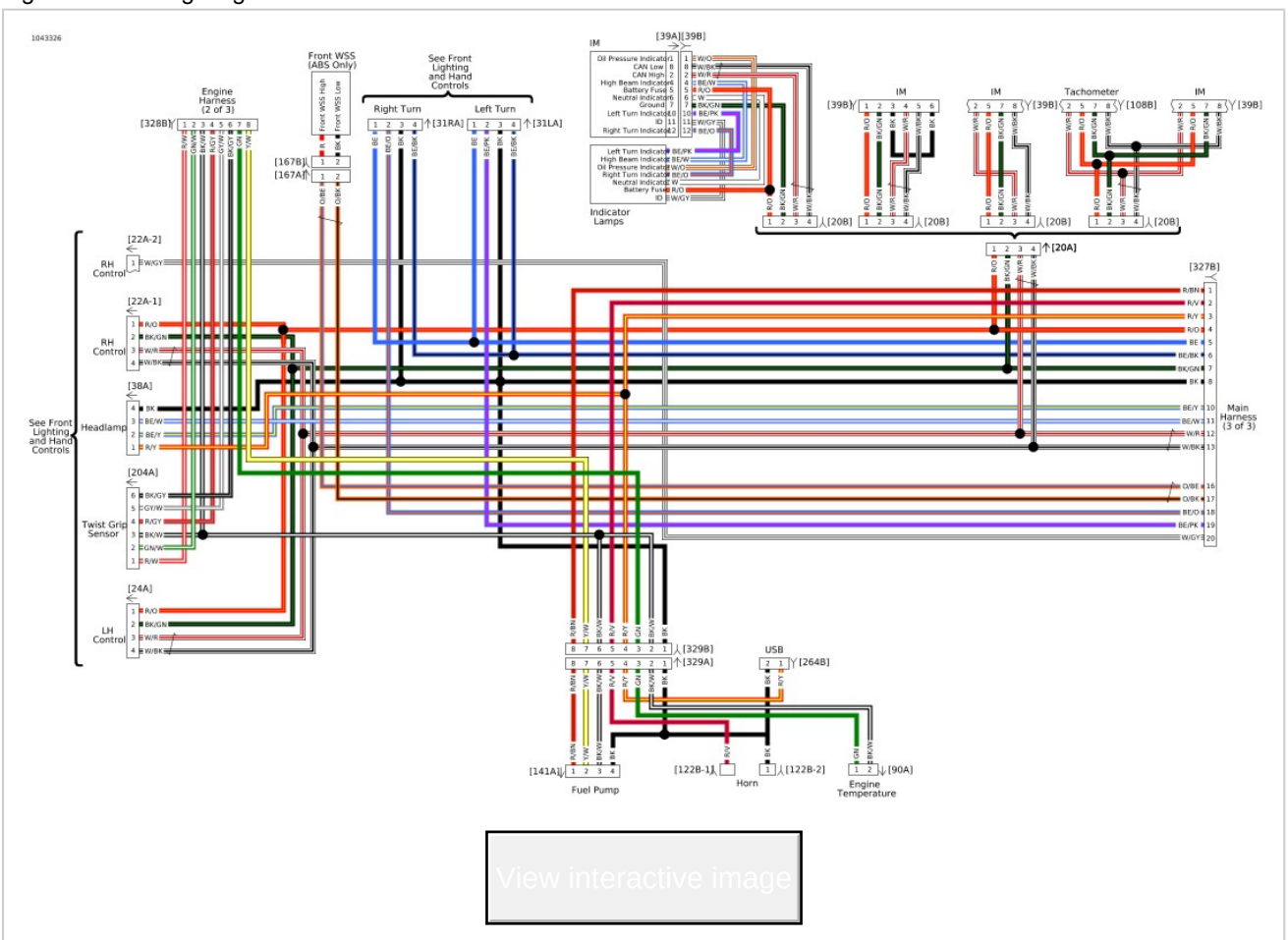

Figure 6. Backbone Harness 1 of 3: 2018 Softail

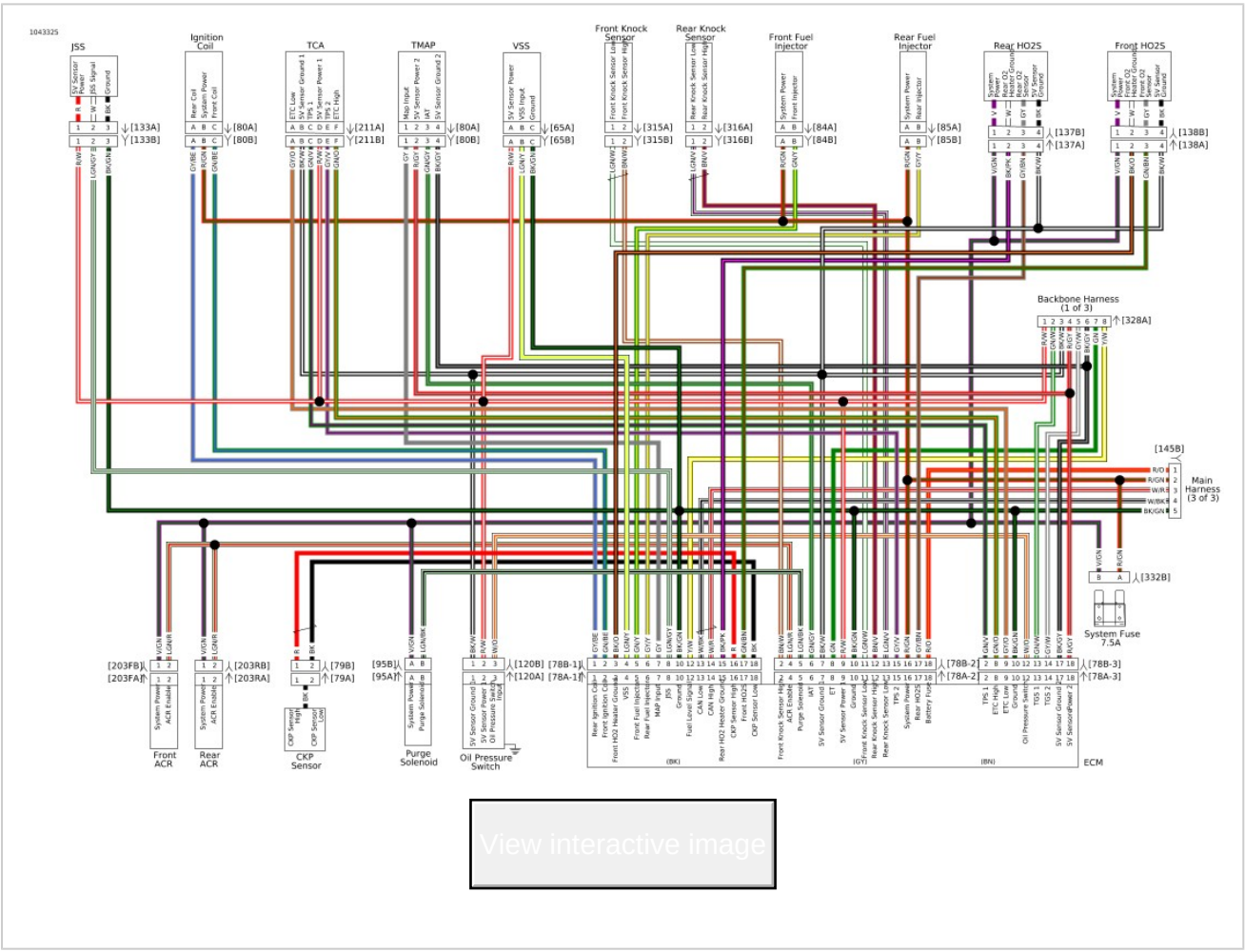

Figure 7. Engine Harness 2 of 3: 2018 Softail

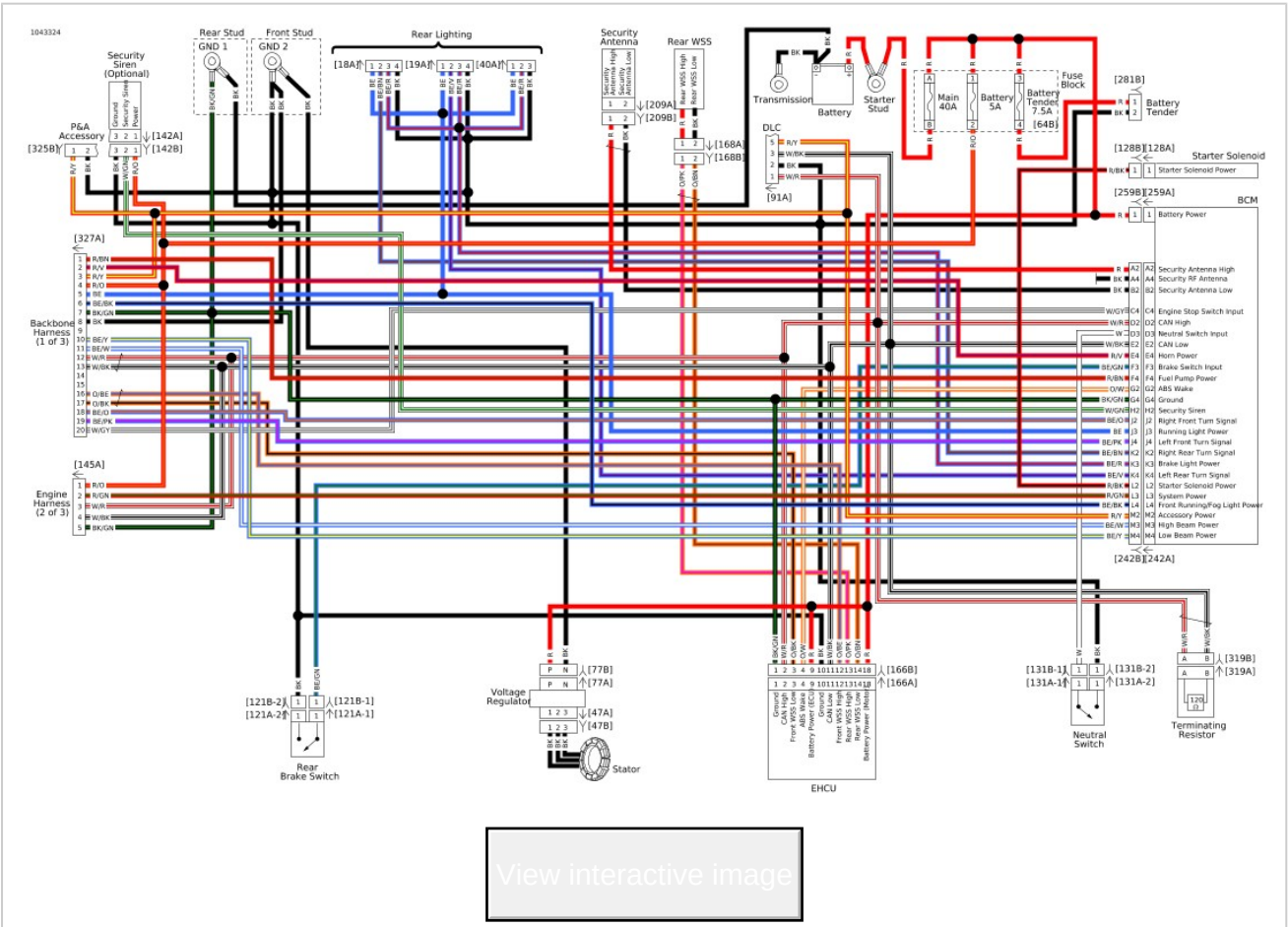

Figure 8. Main Harness 3 of 3: 2018 Softail

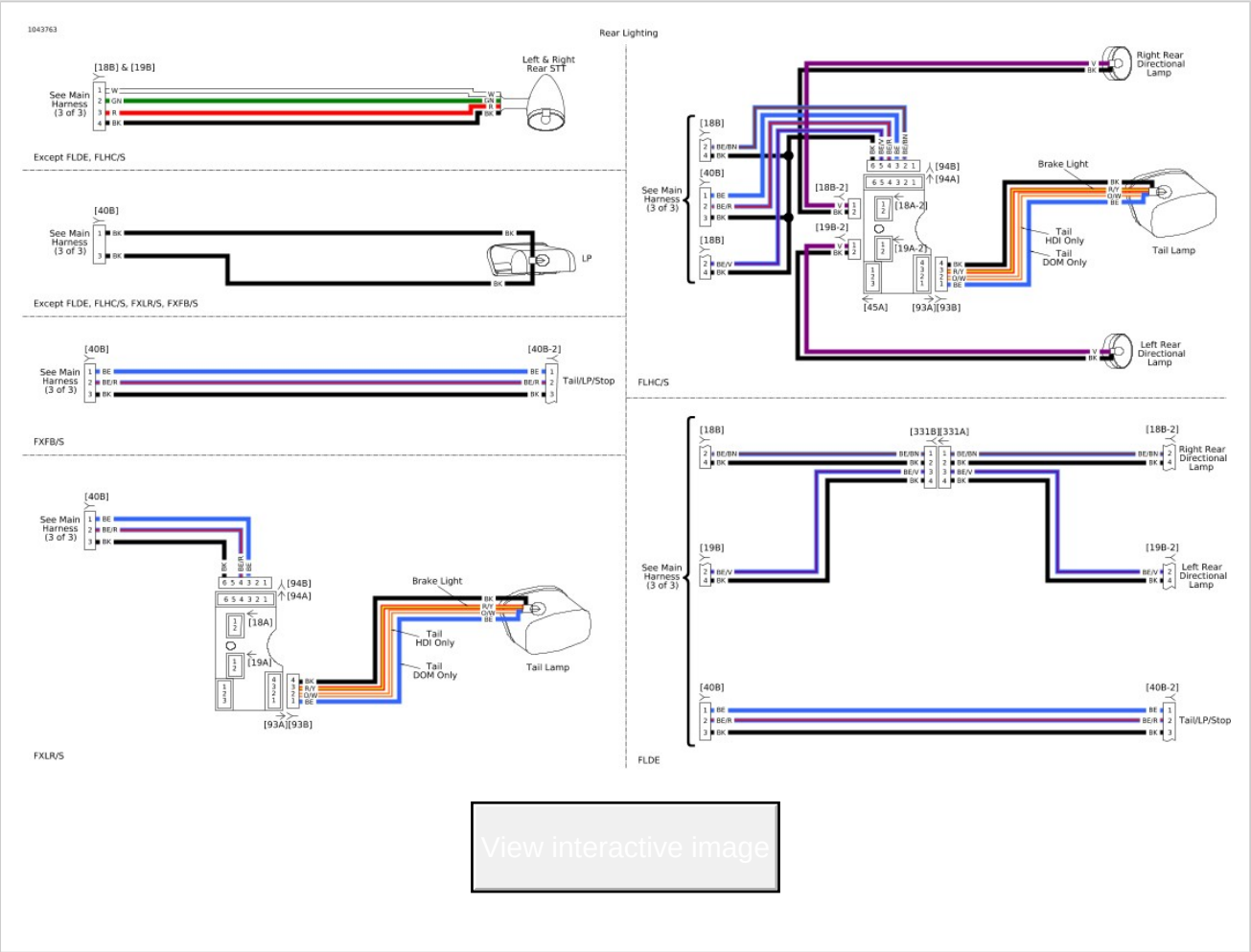

Figure 9. Rear Lighting: 2018 Softail

All vehicle connectors are identified by their function and location. Refer to **Table 1**.

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

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

The repair instructions in Appendix B of the electrical diagnostic manual (EDM) are by connector type. Refer to **Table 1**.

Table 1. Softail Connector Locations

[18]	Right rear stop, tail and turn assembly	4-place JAE MX19 Sealed (BK)	Yellow	Under seat
[18-2]	Right rear turn	4-place JAE MX19 Sealed (BK)	Yellow	Inside light bar (FLDE) Inside stop lamp (FLHC/S)
[19]	Left rear stop, tail and turn assembly	4-place JAE MX19 Sealed (BK)	Yellow	Under seat
[19-2]	Left rear turn	4-place JAE MX19 Sealed (BK)	Yellow	Inside light bar (FLDE) Inside stop lamp (FLHC/S)
[20]	Console harness	4-way JST JWPF Sealed (BK)	Yellow	Inside USB compartment
[22-1]	Right hand controls	4-place JAE MX19 Sealed (BK)	Yellow	Under frame in front of front cylinder
[22-2]	Right hand controls	2-place JAE MX19 Sealed (BK)	Yellow	Under frame in front of front cylinder
[24]	Left hand controls	4-place JAE MX19 Sealed (BK)	Yellow	Under frame in front of front cylinder
[31L]	Left front turn signal/auxiliary lamp	4-way JAE MX19 Sealed (BK) (with fairing)	Yellow	Under frame in front of front cylinder
[31R]	Right front turn	4-way JAE MX19 Sealed (BK)	Yellow	Under frame in front of

	signal/auxiliary lamp	(with fairing)		front cylinder
[31R-2]	Right front turn	4-way JAE MX19 Sealed (BK) (with fairing)	Yellow	Inside light bar (FLDE)
[31L-2]	Left front turn	4-way JAE MX19 Sealed (BK) (with fairing)	Yellow	Inside light bar (FLDE)
[38]	Headlamp	4-place Deutsch DTM Sealed (BK) (FXBR/S, FXFR/S)	Brown	Under frame in front of front cylinder
[38-2]	Headlamp	4-way Delphi 150 Metri-Pack (BK)	Gray	Inside headlamp nacelle
[39]	IM	12-place Delphi Micro 64 Sealed (GY) (except FXBR/S, FXBB) 6-place JST JWPF Sealed (BK) (FXBR/S, FXBB)	BOB Yellow	IM
[40]	Center rear lighting	3-place Tyco MCON 1.2 Sealed (BK)	Gray	Under seat
[40-2]	Tail lamp	4-place JAE MX19 Sealed (BK)	Yellow	Inside light bar
[47]	Voltage regulator to stator	3-place Dekko (BK)	Green	Back of voltage regulator
[64]	Fuse block	Delphi 280 Metri-pack Sealed Delphi 800 Metri-pack Sealed (main fuse)	Purple/Red	Behind left side cover
[65]	VSS	3-place Delphi GT 150 3.5 Sealed (BK)	Gray	Top of transmission case
[73L]	Left auxiliary lamps	2-place JAE MX19 Unsealed (BK)	Yellow	Behind front fork panel
[73L-2]	Left auxiliary lamps	2-way Delphi 280 Metri-Pack	Purple	Inside auxiliary/fog lamps sealed (BK)
[73R]	Right auxiliary lamps	2-place JAE MX19 (BK)	Yellow	Behind front fork panel
[73R-2]	Right auxiliary lamps	2-way Delphi 280 Metri-Pack	Purple	Inside auxiliary/fog lamps sealed (BK)
[77]	Voltage regulator	2-place Dekko (BK)	Green	Back of voltage regulator
[78-1]	ECM	18-place Tyco GET 64 Sealed (BK)	BOB	Behind left side cover under fuse block caddy
[78-2]	ECM	18-place Tyco GET 64 Sealed (GY)	BOB	Behind left side cover under fuse block caddy

[78-3]	ECM	18-place Tyco GET 64 Sealed (GY)	BOB	Behind left side cover under fuse block caddy
[79]	CKP sensor	2-place Deutsch DTM Sealed (BK)	Brown	Back of voltage regulator bracket
[80]	TMAP	4-place Tyco MCON 1.2 Sealed (BK)	Gray	Top of induction module
[83]	Ignition coil	3-place Delphi GT 150 Sealed (BK)	Gray	Rear of coil
[84]	Front fuel injector	2-place Delphi GT 150 3.5 Sealed (GY)	Gray	Beneath fuel tank
[85]	Rear fuel injector	2-place Delphi GT 150 3.5 Sealed (GY)	Gray	Beneath fuel tank
[90]	ET sensor	2-place Tyco MCON 1.2 Sealed (GY)	Gray	Rear of front cylinder, left side
[91]	DLC	6-place Deutsch DT Sealed (GY)	Black	Behind left side cover
[94]	Rear fender lights harness in circuit board	6-place Tyco 070 Multilock Unsealed (BK)	Gray	Circuit board under tail lamp assembly (FLHC, FXLR)
[95]	Purge solenoid	2-place Delphi 150 Metri-pack Sealed (BK)	Gray	Under seat in front of rear fender
[108]	Tachometer	12-place Delphi Micro 64 Sealed (GY)	BOB	Behind tachometer
[120]	Oil pressure switch	3-place Delphi GT 150 3.5 (BK)	Gray	Front right crankcase
[121]	Rear stop lamp switch	Tyco Insulated Spade terminal (BK)	Red	Right side of transmission
[122]	Horn	Flag terminals (BK)	Red	Front of frame above voltage regulator
[128]	Starter solenoid	Tyco Insulated Spade terminal (W)	Red	Top of starter
[131]	Neutral switch	Right Angle Push On Molded (BK)		Top of transmission
[133]	JSS	3-place Molex MX 150 Sealed (BK)	Gray	Back of voltage regulator bracket
[137]	HO2 sensor (rear)	4-place Molex MX 150 Sealed (BK)	Gray	Under seat in front of battery
[138]	HO2 sensor (front)	4-place Molex MX 150 Sealed (BK)	Gray	Behind voltage regulator

[141]	Fuel pump and sender	4-place Molex MX150 Sealed (BK)	Gray	Under frame in front of front cylinder
[142]	Security siren (optional)	3-place Delphi GT 150 3.5 Sealed (BK)	Gray	Electrical panel behind fender extension
[145]	Engine harness	5-way Tyco MCON 1.2	Gray	Under seat
[166]	ABS EHCU	18-place Tyco MCON 1.2 Sealed (BK)	BOB	Behind right side cover
[167]	Front WSS	2-place JAEMX19 Sealed (GY)	Yellow	Under frame in front of front cylinder
[168]	Rear WSS	2-place Deutsch DTM Sealed (BK)	Brown	Behind right side cover
[203F]	ACR (front)	2-place Tyco Superseal 1.5 Sealed	Gray	Bracket attached to the throttle body
[203R]	ACR (rear)	2-place Tyco Superseal 1.5 Sealed	Gray	Bracket attached to the throttle body
[204]	TGS	6-place JST JWPF Sealed	Yellow	Under frame in front of front cylinder
[209]	Security antenna	2-place Molex MX 64 Unsealed (BK)	Light Blue	Under seat
[211]	TCA	6-way Delphi GT 150 Sealed (BK)	Gray	Right side of engine (induction module)
[242]	BCM	48-place Molex CMC Sealed (BK)	BOB	Electrical panel behind fender extension
[259]	BCM battery power	1-place Delphi 800 Metri-pack Sealed (BK)	Red	Electrical panel behind fender extension
[264]	USB	2-way Deutsch DT (GY)	Black	Under frame in front of front cylinder
[281]	Battery tender	2-way over mold (BK)		Behind left side cover
[315]	Front knock sensor	2-way Kostal MLK 1.2	Light blue	Under fuel tank
[316]	Rear knock sensor	2-way Kostal MLK 1.2	Light blue	Under fuel tank
[319]	Terminating resistor	2-way Delphi GT 150 (BK)	Gray	Behind left side cover
[325]	P&A accessory	3-way Molex MX150 (BK)	Gray	Behind left side cover
[327]	Backbone harness interconnect	20-way Molex MX150 (BK)	Gray	Under seat
[328]	Engine harness interconnect	8-way JST JWPF Sealed (BK)	Yellow	Under fuel tank behind rear cylinder

[329]	USB caddy interconnect	8-way Molex MX150	Gray	Under frame in front of front cylinder
[331]	Rear light bar interconnect	4-place JAE MX19 Sealed (BK)	Yellow	Inside light bar (FLDE)
[332]	Fuse holder	2-way Delphi Metri-Pack 280	Gray	Under seat
[GND1] [GND2] [GND2A]	Left side ground stud Right side ground stud (Regulator) Right side ground stud	Ring terminals		Under seat

Table 1. Right Rear Turn Signal [18A]

1	-	N/C
2	BE/BN	Right rear turn signal
3	-	N/C
4	BK	Ground

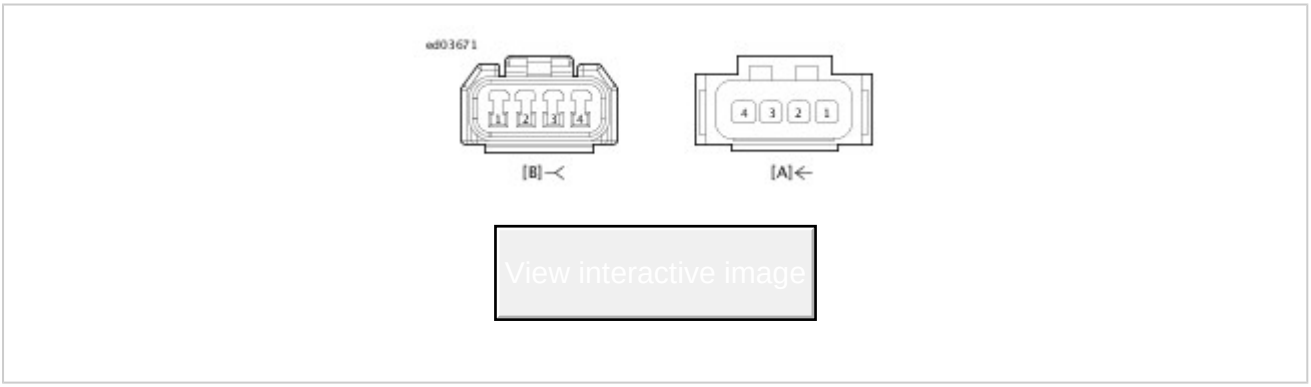

Figure 1. Right Rear Turn Signal [18A]

Table 2. Right Rear Turn Signal [18-2]

1	-	N/C
2	BE/BN	Right rear turn signal
3	BK	Ground
4	-	N/C

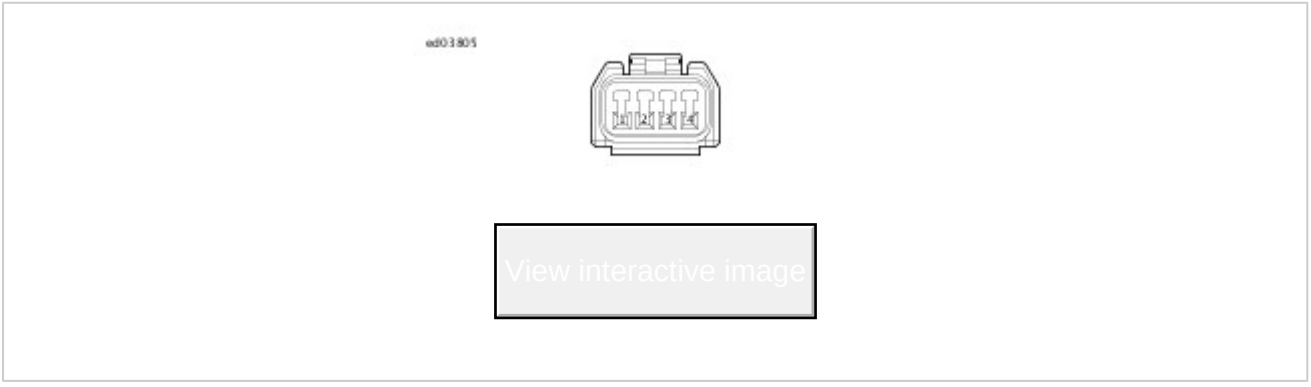

Figure 2. Right Rear Turn Signal [18-2]

Table 3. Left Rear Turn Signal [19A]

1	-	N/C

2	BE/BN	Left rear turn signal
3	-	N/C
4	BK	Ground

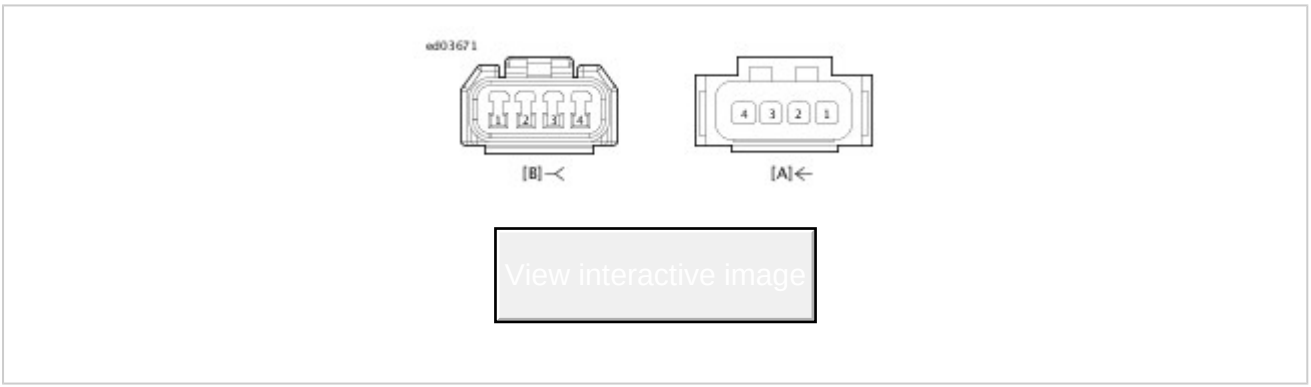

Figure 3. Left Rear Turn Signal [19A]

Table 4. Left Rear Turn Signal [19-2]

1	-	N/C
2	BE/V	Left rear turn signal
3	BK	Ground
4	-	N/C

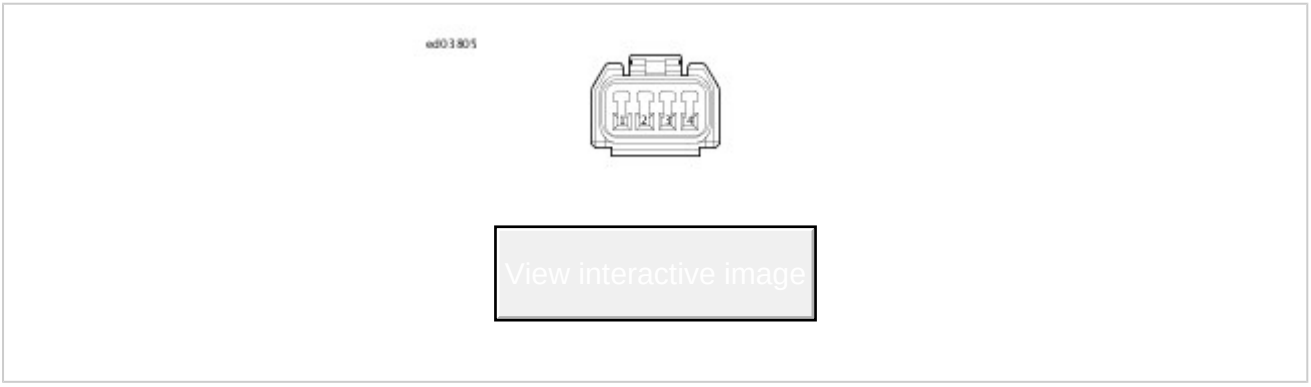

Figure 4. Left Rear Turn Signal [19-2]

Table 5. Console Harness [20]

1	R/O	Battery fuse
2	BK/GN	Ground
3	W/R	CAN high
4	W/BK	CAN low

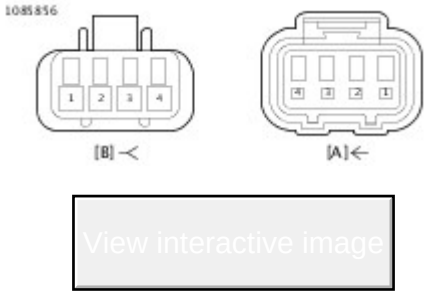

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Figure 5. Console Harness [20]

Table 6. RHCM [22-1]

1	R/O	Battery fuse
2	BK	Ground
3	W/R	CAN high
4	W/BK	CAN low

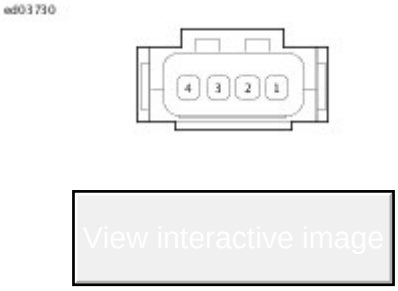

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Figure 6. RHCM [22-1]

Table 7. RHCM [22-2]

1	W/GY	Engine stop switch
2	-	N/C

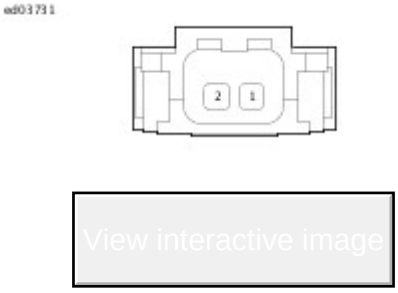

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Figure 7. RHCM [22-2]

Table 8. LHCM [24]

1	R/O	Battery fuse
2	BK	Ground
3	W/R	CAN high
4	W/BK	CAN low

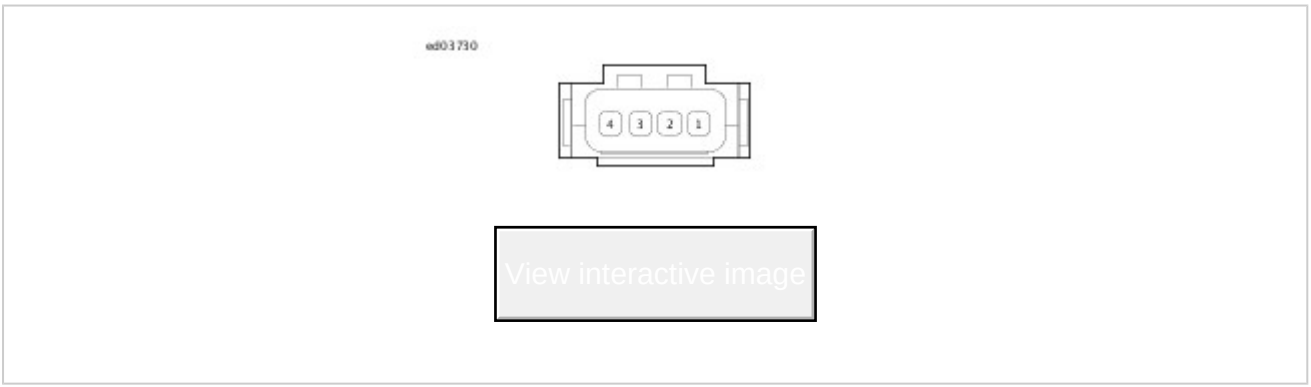

Figure 8. LHCM [24]

Table 9. Front Left Turn Signal [31L]

1	BE	Position
2	BE/PK	Left front turn signal
3	BK	Ground
4	BE/BK	AUX/fog

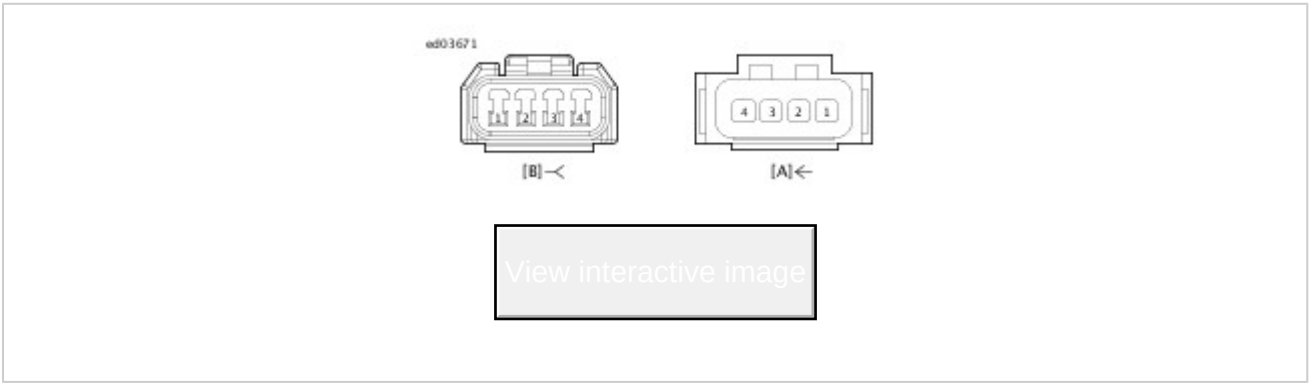

Figure 9. Front Left Turn Signal [31L]

Table 10. Front Left Turn [31L-2]

1	BE	Position
2	BE/PK	Left front turn signal
3	BK	Ground
4	-	N/C

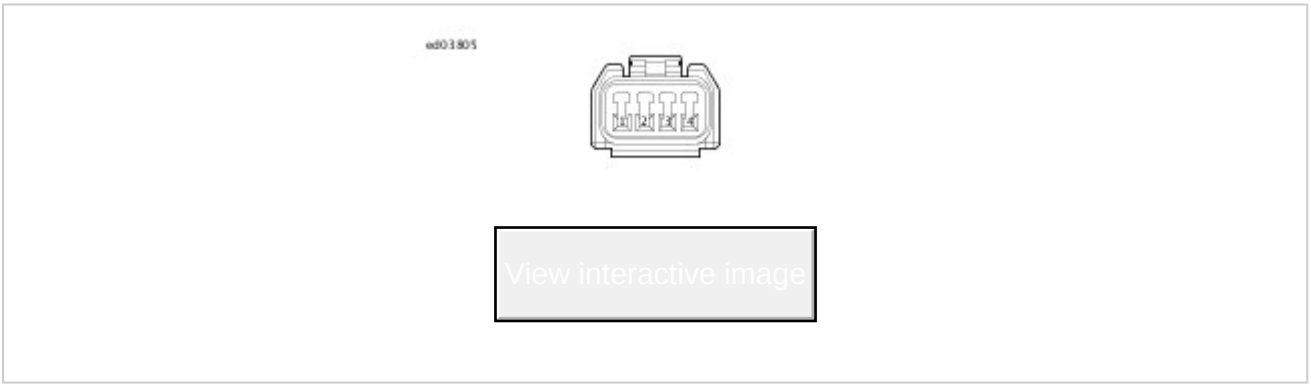

Figure 10. Front Left Turn [31L-2]

Table 11. Front Right Turn Signal [31R]

1	BE	Position
2	BE/O	Left front turn signal
3	BK	Ground
4	BE/BK	AUX/fog

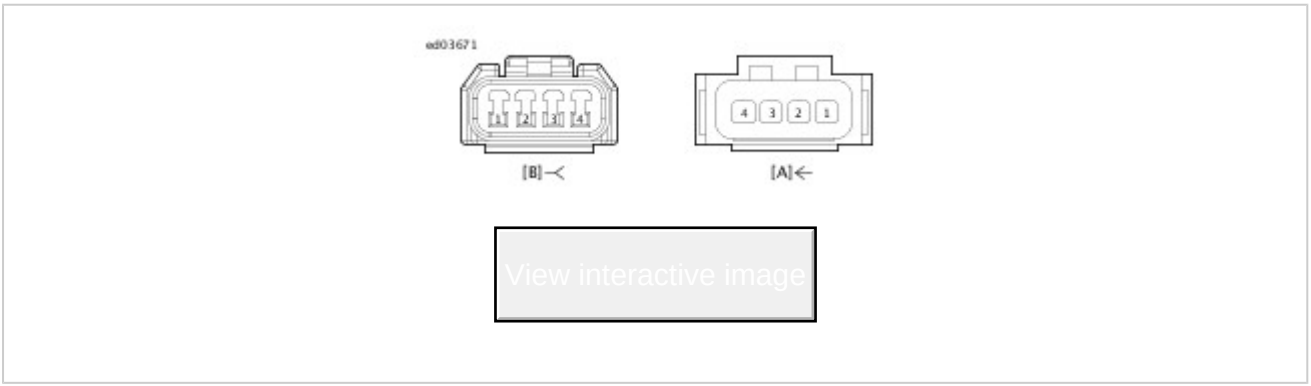

Figure 11. Front Right Turn Signal [31R]

Table 12. Front Right Turn Signal [31R-2]

1	BE	Position
2	BE/O	Right front turn signal
3	BK	Ground

4	-	N/C

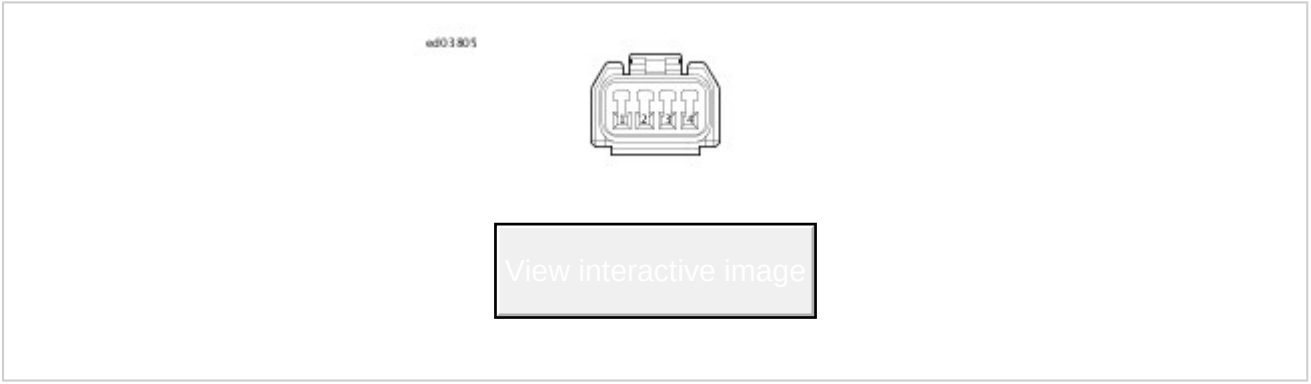

Figure 12. Front Right Turn Signal [31R-2]

Table 13. Headlamp [38]

1	BE	Running/position lamp
2	BE/Y	Low beam
3	BE/W	High beam
4	BK	Ground

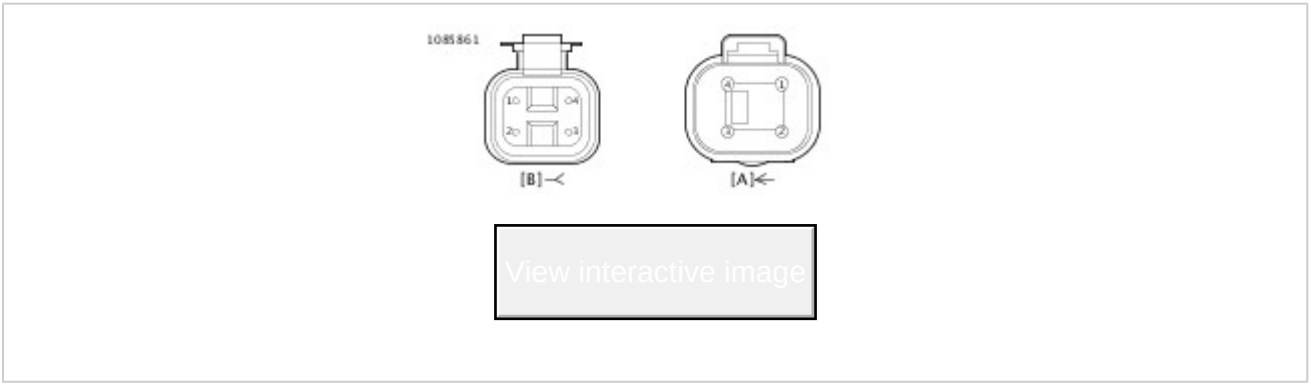

Figure 13. Headlamp [38]

Table 14. Headlamp [38-2]

A	BK	Ground
B	BE/Y	Low beam
C	BE/W	High beam
D	BE	Running/position lamp

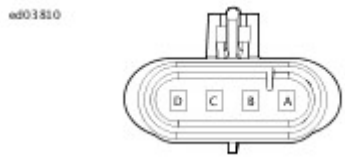

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Figure 14. Headlamp [38-2]

Table 15. IM [39] (12 place connector)

1	W/O	Oil pressure indicator
2	W/R	CAN high
3	-	N/C
4	BE/W	High beam indicator
5	R/O	Battery fuse
6	W	Neutral indicator
7	BK/GN	Ground
8	W/BK	CAN low
9	-	N/C
10	BE/PK	Left turn indicator
11	W	Indicator type ID
12	BE/O	Right turn indicator

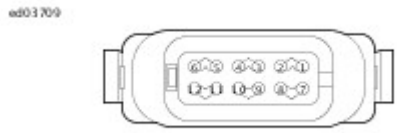

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Figure 15. IM [39] (12 place connector)

Table 16. IM [39] (6 place connector)

1	R/O	Battery fuse
2	BK/GN	Ground
3	BK	Spare
4	W/R	CAN +
5	W/BK	CAN low
6	BK	H-D link

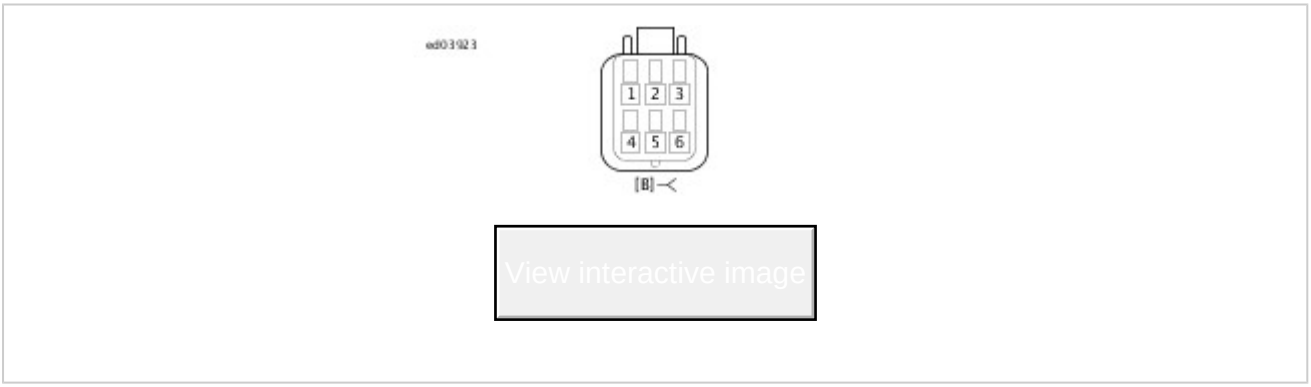

Figure 16. IM [39] (6 place connector)

Table 17. Center Lighting [40]

1	BE	Running/position lamps
2	BE/R	Brake lamp power
3	BK	Ground

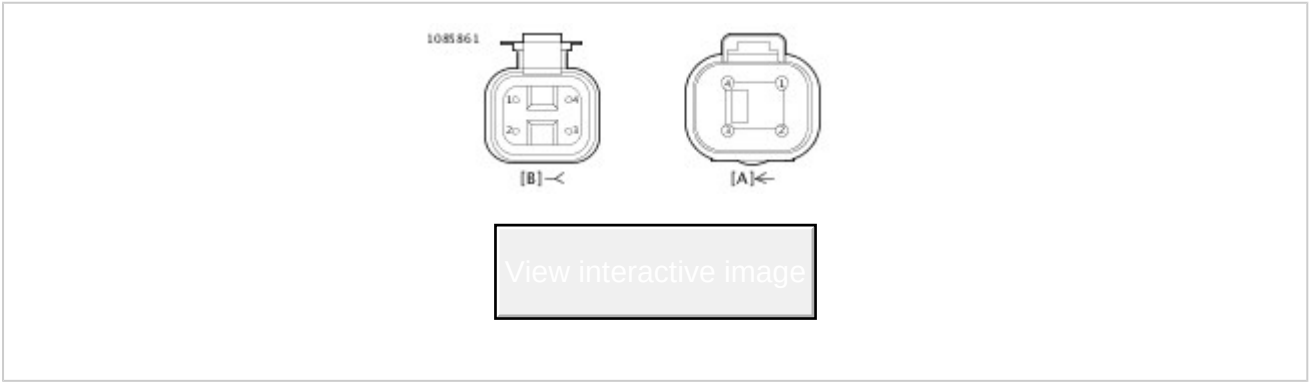

Figure 17. Center Lighting [40]

Table 18. Stop Tail Lamp [40-2]

1	BE	Position
2	BE/R	Brake lamp power

3	BK	Ground
4	-	N/C

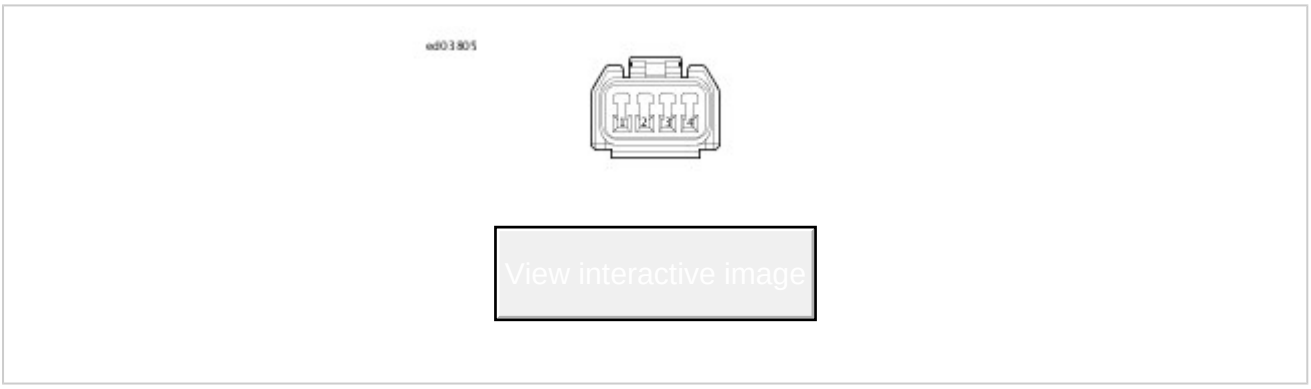

Figure 18. Stop Tail Lamp [40-2]

Table 19. Stator [47]

1	BK	Stator
2	BK	Stator
3	BK	Stator

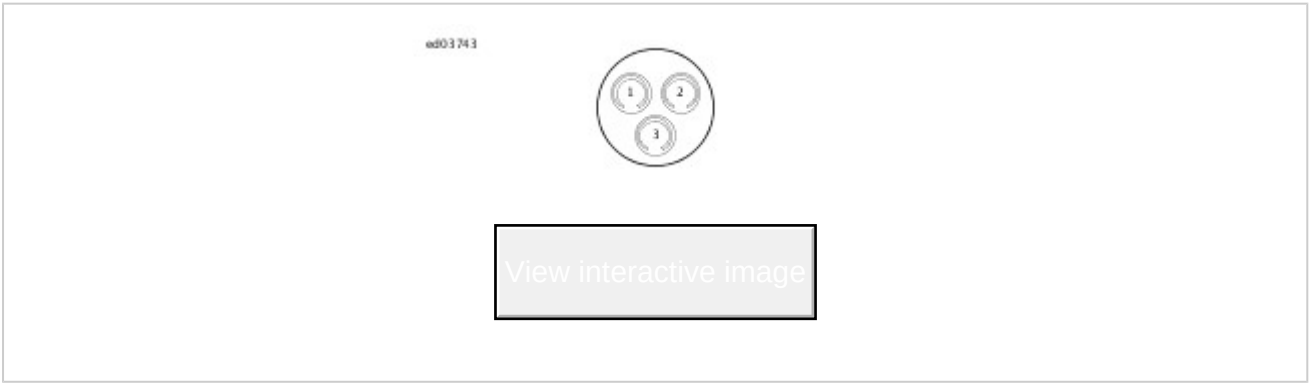

Figure 19. Stator [47]

Table 20. Fuse Block [64]

1	R	Battery
2	R/O	Battery fuse
3	R	Battery
4	R	Tender fuse
A	R	Battery/main fuse
B	R	Battery/main fuse

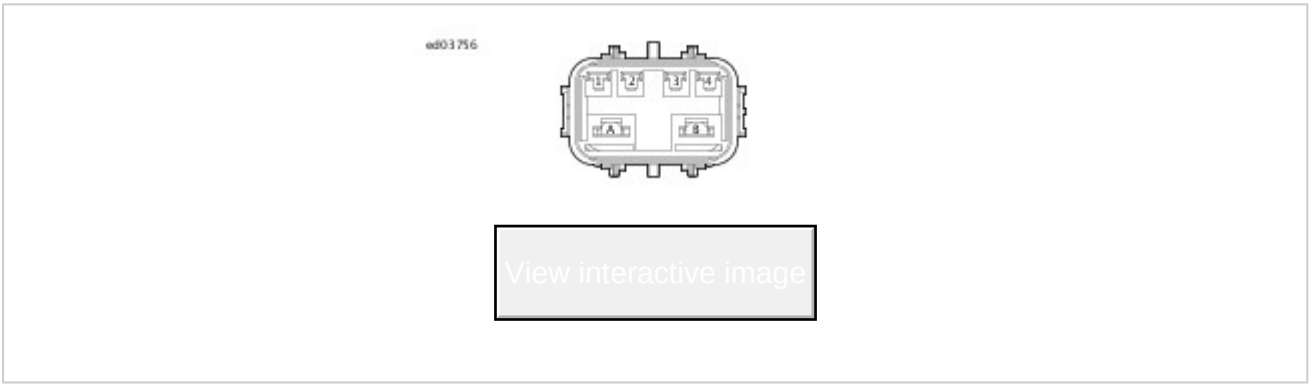

Figure 20. Fuse Block [64]

Table 21. VSS [65]

A	R/W	5 Volt sensor power
B	LGN/Y	VSS input
C	BK/GN	Sensor ground

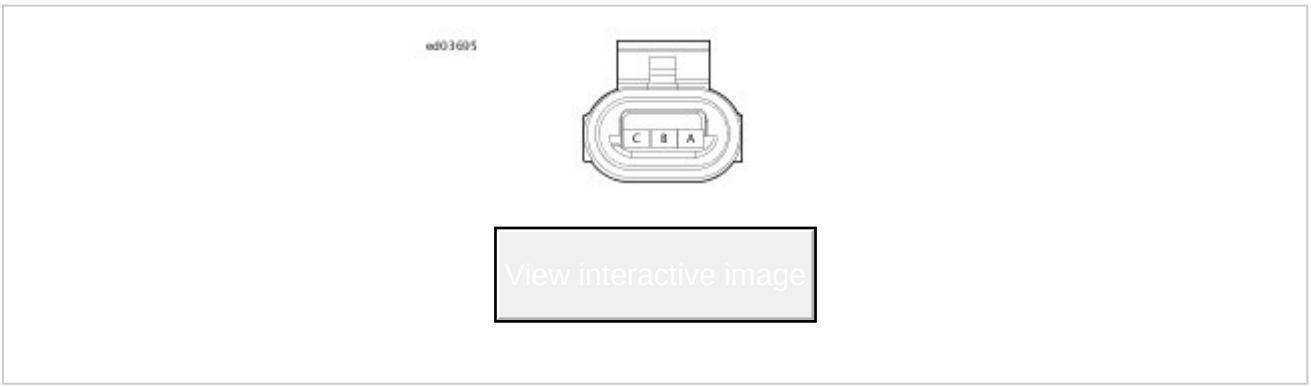

Figure 21. VSS [65]

Table 22. Auxiliary/Fog Lamps [73L]

1	BK	Ground
2	BE/BK	Front running/fog light power

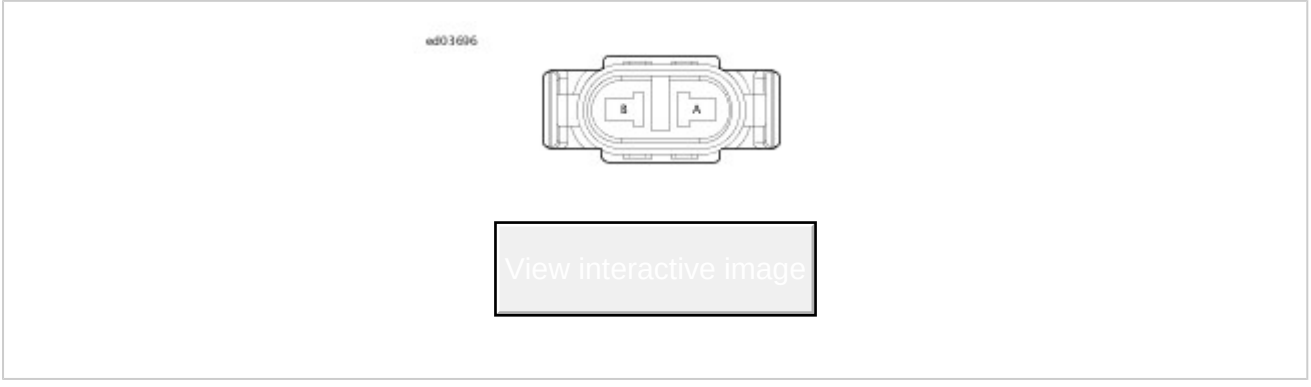

Figure 22. Auxiliary/Fog Lamps [73L]

Table 23. Left Auxiliary/Fog Lamps [73L-2]

A	BE/BK	Front running/fog light power
B	BK	Ground

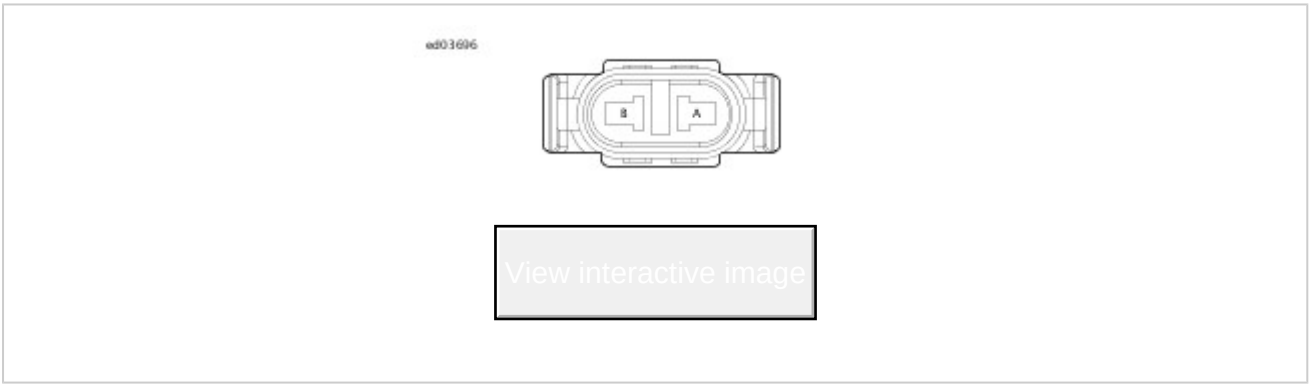

Figure 23. Left Auxiliary/Fog Lamps [73L-2]

Table 24. Auxiliary/Fog Lamps [73R]

1	BK	Ground
2	BE/BK	Front running/fog light power

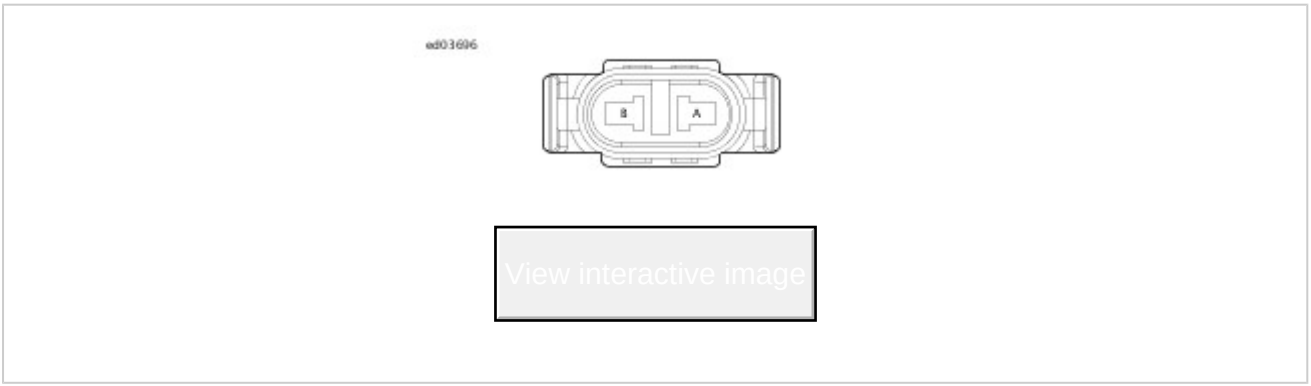

Figure 24. Auxiliary/Fog Lamps [73R]

Table 25. Right Auxiliary/Fog Lamp [73R-2]

A	BE/BK	Front running/fog light power
B	BK	Ground

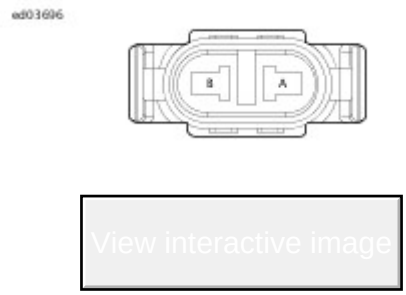

Figure 25. Right Auxiliary/Fog Lamp [73R-2]

Table 26. Voltage Regulator [77]

P	R	Battery
N	BK	Ground

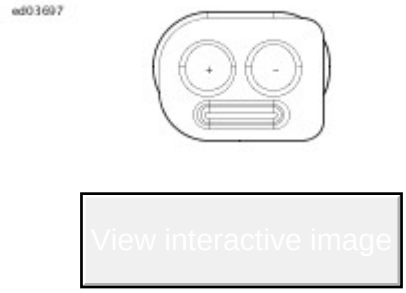

Figure 26. Voltage Regulator [77]

Table 27. ECM [78-1]

1	GY/BE	Rear ignition coil
2	GN/BE	Front ignition coil
3	BK/O	Front HO2S heater ground
4	LGN/Y	VSS input
5	GN/Y	Front fuel injector
6	GY/Y	Rear fuel injector
7	GY	MAP input
8	LGN/GY	JSS signal
9	-	N/C
10	BK/GN	Ground

11	-	N/C
12	Y/W	Fuel level
13	W/BK	CAN low
14	W/R	CAN high
15	BK/PK	Rear HO2S heater ground
16	R	CKP sensor high
17	GN/BN	Front HO2S
18	BK	CKP sensor low

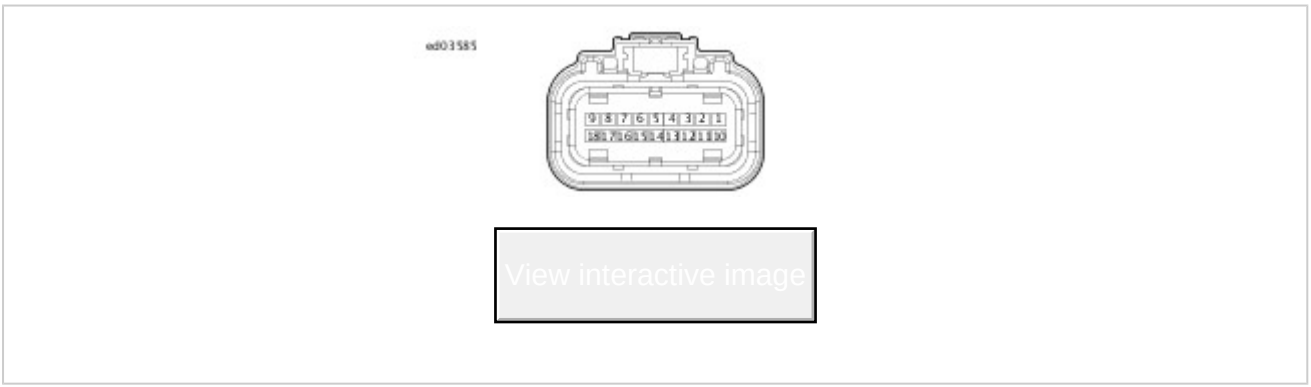

Figure 27. ECM [78-1]

Table 28. ECM [78-2]

1	-	N/C
2	BN/W	Front knock sensor +
3	-	N/C
4	LGN/R	ACR enable
5	LGN/BK	Purge solenoid
6	GN/GY	IAT
7	BK/W	5 Volt sensor ground
8	GN	ET sensor
9	R/W	5 Volt sensor power
10	BK/GN	Ground
11	LGN/W	Front knock sensor -
12	BN/V	Rear knock sensor +

13	LGN/V	Rear knock sensor -
14	-	N/C
15	GN/V	TPS 2
16	R/GN	System power
17	GY/BN	Rear HO2S
18	R/O	Battery fuse

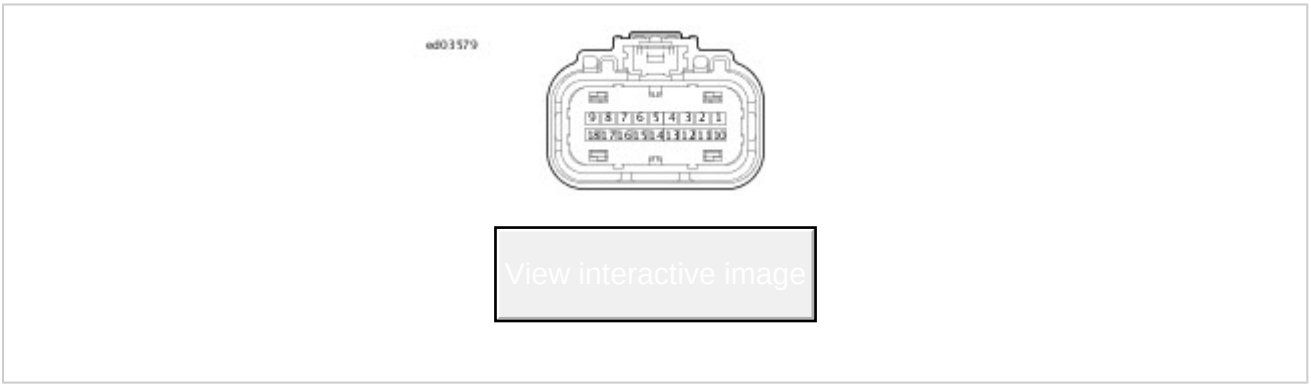

Figure 28. ECM [78-2]

Table 29. ECM [78-3] (BN)

1	-	N/C
2	GN/V	TPS1
3	-	N/C
4	-	N/C
5	-	N/C
6	-	N/C
7	-	N/C
8	GN/O	TCA high
9	GY/O	TCA low
10	BK/GN	Ground
11	-	N/C
12	W/O	Oil pressure
13	GN/W	TGS 1
14	GY/W	TGS 2

15	-	N/C
16	-	N/C
17	BK/GY	5V sensor ground 2
18	R/GY	5V sensor power 2

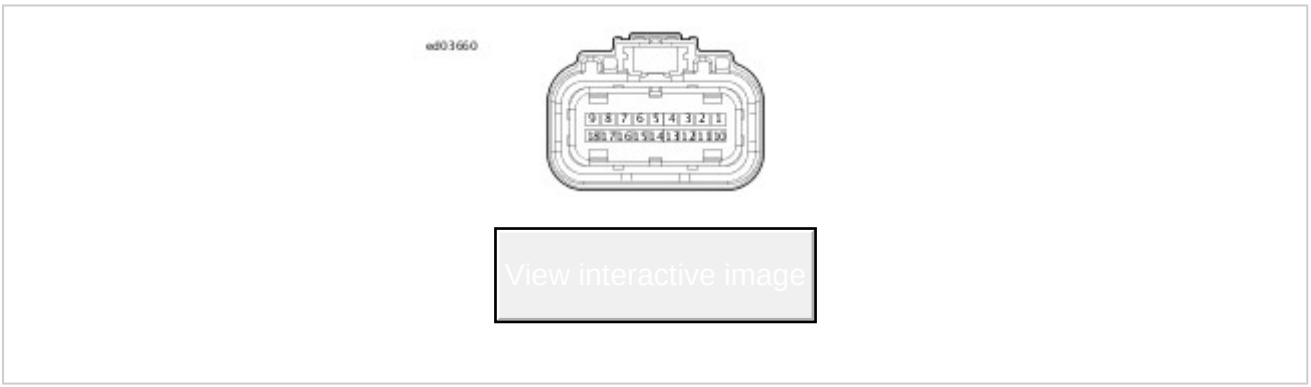

Figure 29. ECM [78-3]

Table 30. CKP Sensor [79]

1	R	CKP sensor high
2	BK	CKP sensor low

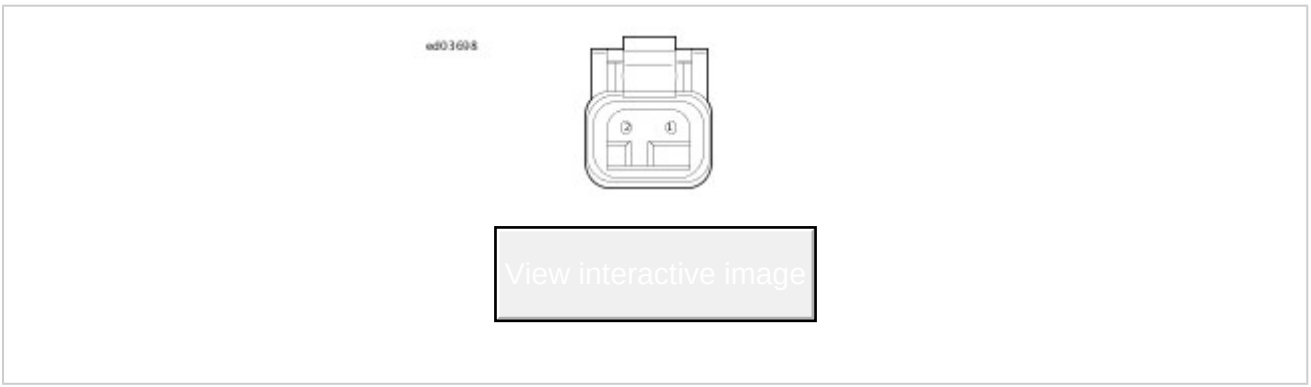

Figure 30. CKP Sensor [79]

Table 31. TMAP [80]

1	GY	MAP input
2	R/GY	5V sensor power 2
3	GN/GY	IAT
4	BK/GY	5V sensor ground 2

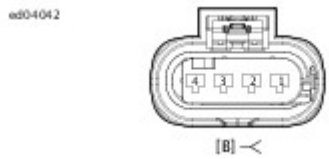

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Figure 31. TMAP [80]

Table 32. Ignition Coil [83]

A	GY/BE	Rear ignition coil
B	R/GN	System power
C	GN/BE	Front ignition coil

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Figure 32. Ignition Coil [83]

Table 33. Front Fuel Injector [84]

A	R/GN	System power
B	GN/Y	Rear fuel injector

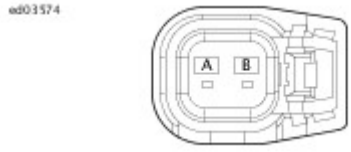

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Figure 33. Front Fuel Injector [84]

Table 34. Rear Fuel Injector [85]

A	R/GN	System power
B	GY/Y	Front fuel injector

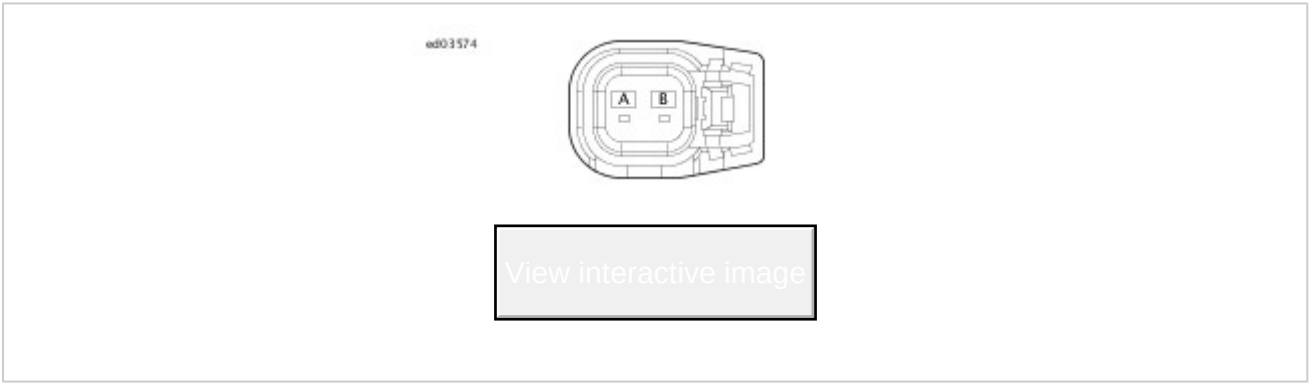

Figure 34. Rear Fuel Injector [85]

Table 35. ET Sensor [90]

1	GN	ET sensor
2	BK/W	5V sensor ground

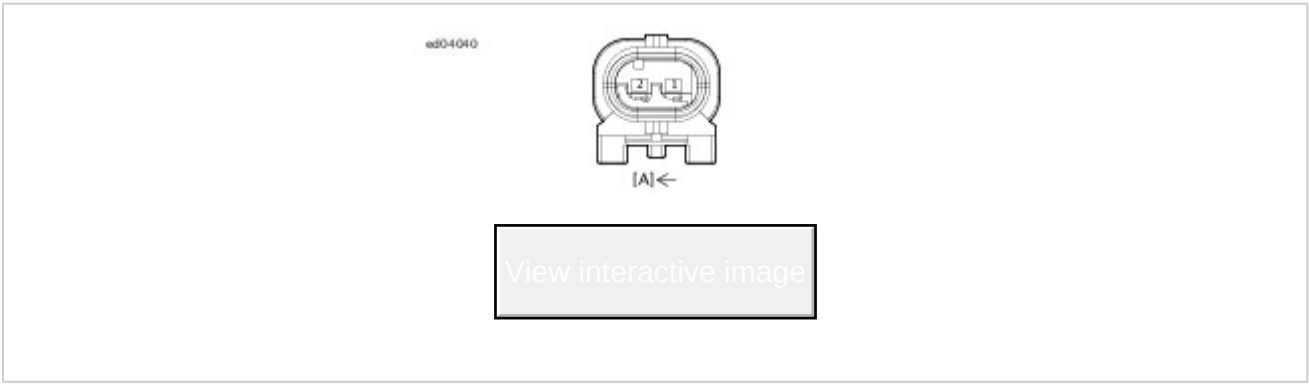

Figure 35. ET Sensor [90]

Table 36. DLC [91]

1	W/R	CAN high
2	BK	Ground
3	W/BK	CAN low
4	-	N/C
5	R/Y	Accessory power
6	-	N/C

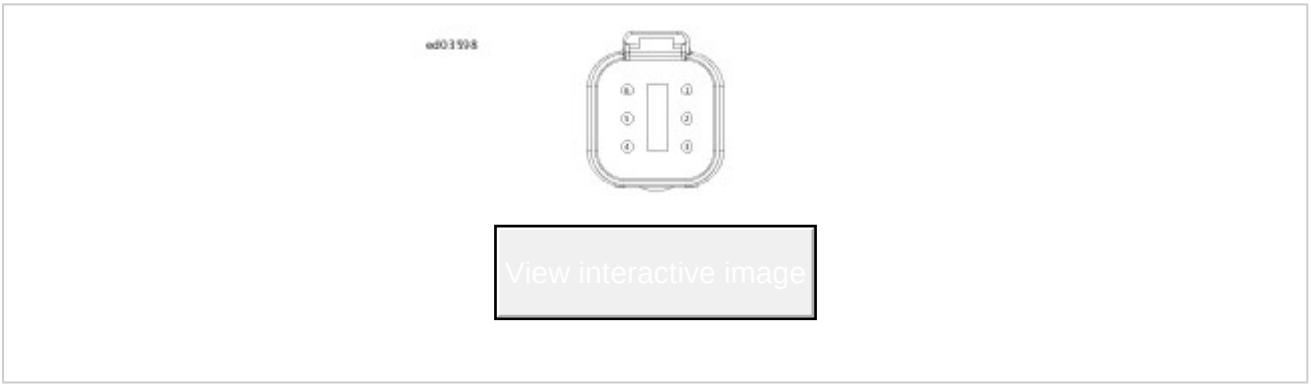

Figure 36. DLC [91]

Table 37. Stop Tail Lamp [94]

1	-	N/C
2	BE/BN	Right rear turn signal
3	BE	Running lights power
4	BE/R	Brake lamp power
5	BE/V	Left rear turn signal
6	BK	Ground

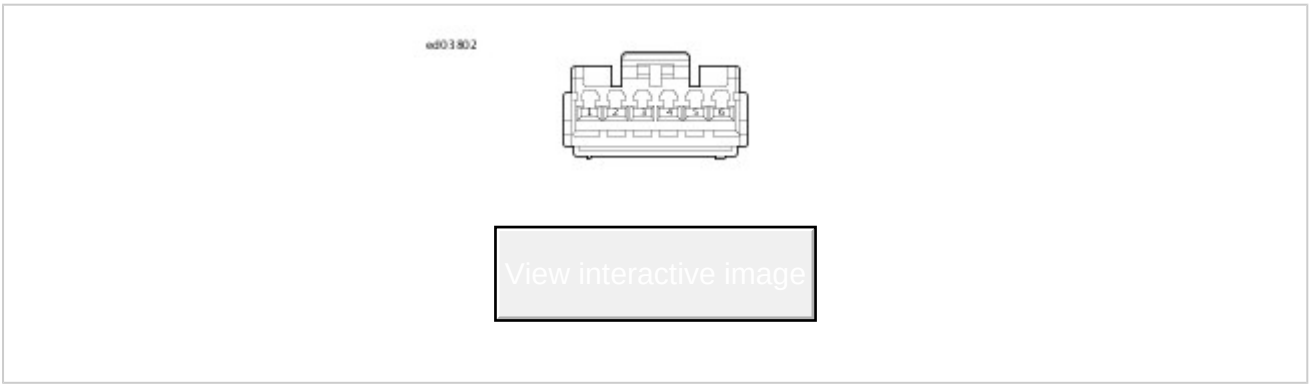

Figure 37. Stop Tail Lamp [94]

Table 38. Purge Solenoid [95]

A	R/GN	System power
B	LGN/BK	Purge solenoid

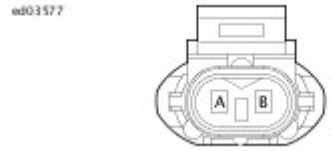

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Figure 38. Purge Solenoid [95]

Table 39. Tachometer [108]

1	-	N/C
2	W/R	CAN +
3	-	N/C
4	-	N/C
5	R/O	Battery power
6	-	N/C
7	BK/GN	Ground
8	W/BK	CAN -
9	-	N/C
10	-	N/C
11	-	N/C
12	-	N/C

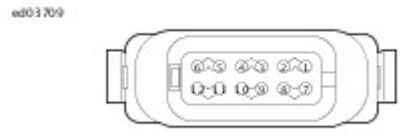

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Figure 39. Tachometer [108]

Table 40. Oil Pressure Switch [120]

1	BK/W	5V sensor ground
2	R/W	5V sensor power
3	W/O	Oil pressure

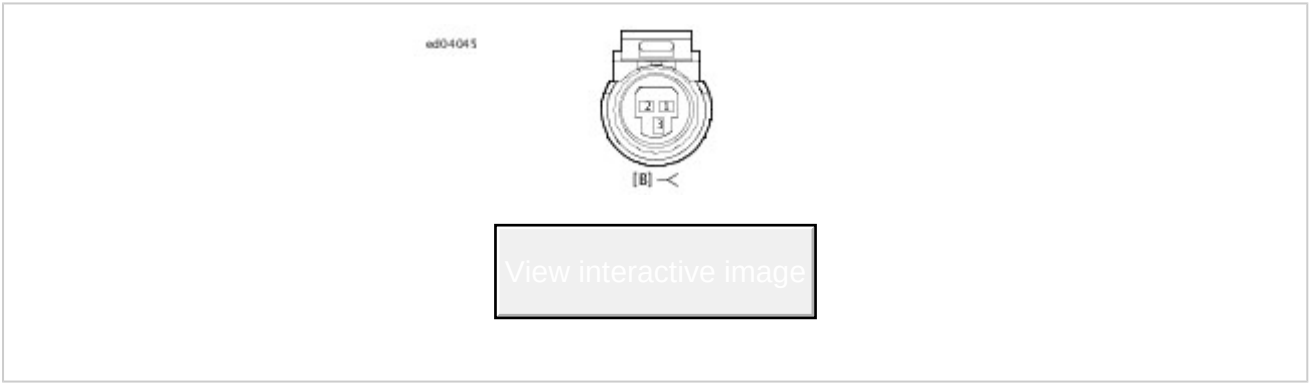


Figure 40. Oil Pressure Switch [120]

Table 41. Rear Brake Switch [121-1] [121-2]

1	BE/GN	Rear brake switch
1	BK	Ground

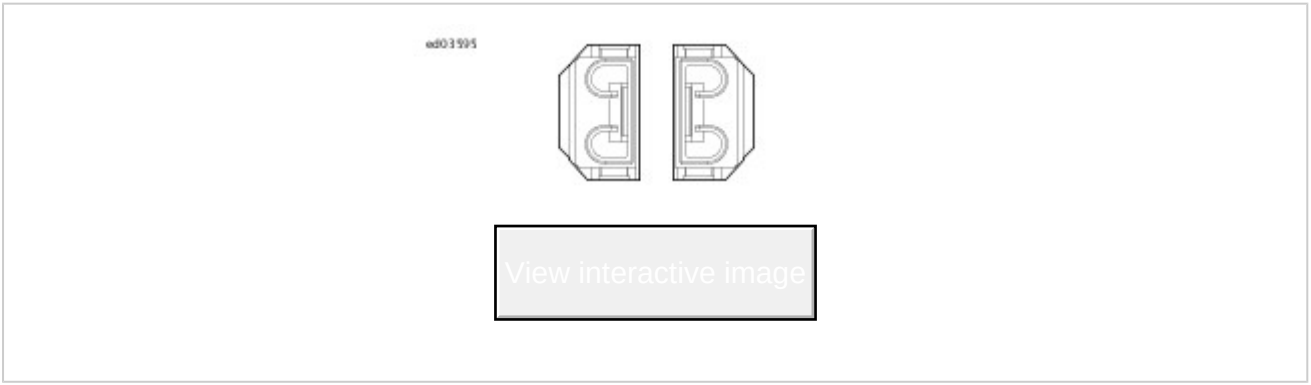
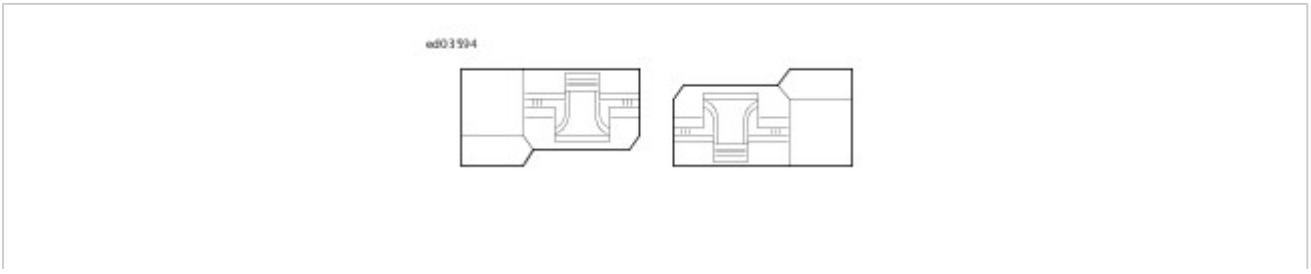


Figure 41. Rear Brake Switch [121-1] [121-2]

Table 42. Horn [122-1] [122-2]

1	R/V	Horn power
1	BK	Ground



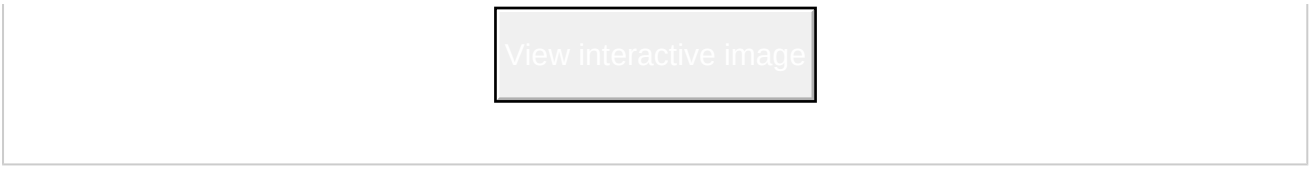


Figure 42. Horn [122-1] [122-2]

Table 43. Starter Solenoid [128]

1	R/BK	Starter solenoid power

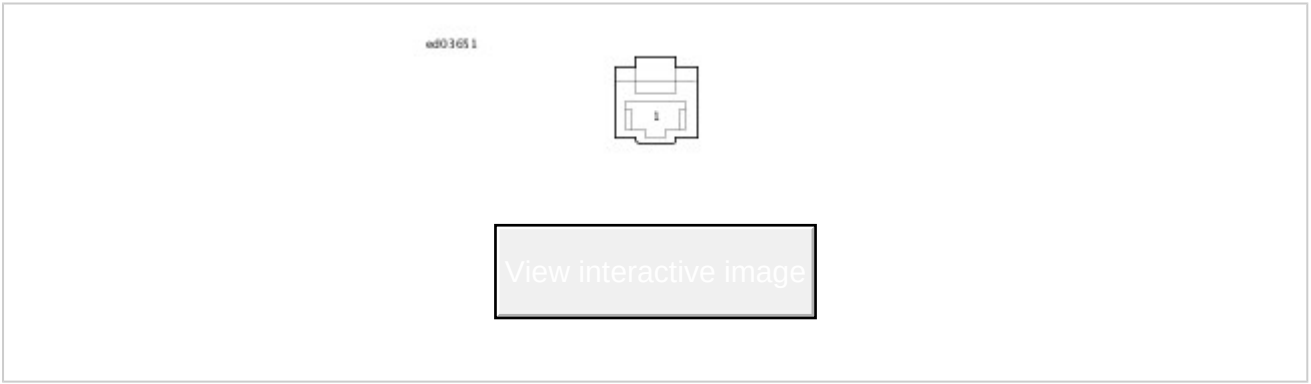


Figure 43. Starter Solenoid [128]

Table 44. Neutral Switch [131-1] [131-2]

1	W	Neutral switch input
1	BK	Ground

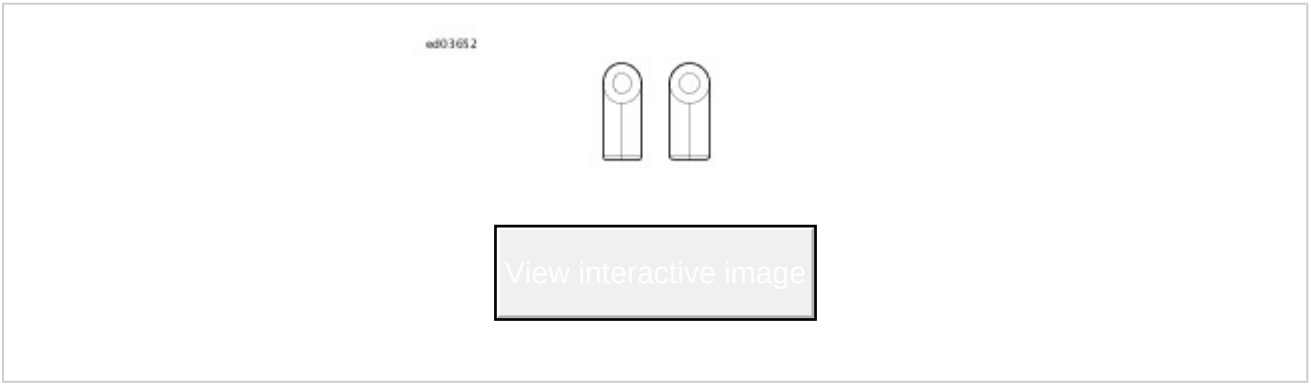
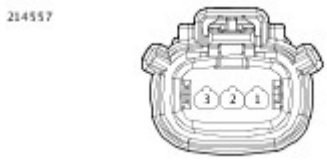


Figure 44. Neutral Switch [131-1] [131-2]

Table 45. Jiffy Stand [133]

1	R/W	5 Volt sensor power
2	LGN/GY	JSS signal
3	BK/GN	Sensor ground



View interactive image

Figure 45. Jiffy Stand [133]

Table 46. HO2S Rear [137]

1	V/GN	Fuse system power
2	BK/PK	Rear HO2S heater ground
3	GY/BN	Rear HO2S
4	BK/W	5 Volt sensor ground

View interactive image

Figure 46. HO2S Rear [137]

Table 47. HO2S Front [138]

1	V/GN	Fuse system power
2	BK/O	Front HO2S heater ground
3	GN/BN	Front HO2S
4	BK/W	5 Volt sensor ground

Figure 47. HO2S Front [138]

Table 48. Fuel Pump [141]

1	R/BN	Fuel pump power
2	W/Y	Fuel level sender
3	BK/W	5V sensor ground
4	BK	Ground

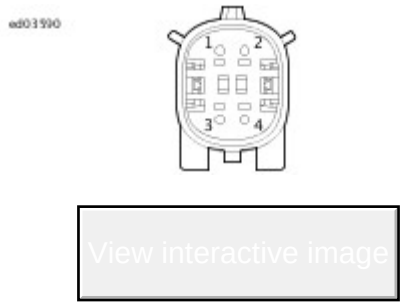


Figure 48. Fuel Pump [141]

Table 49. Security Siren (Optional) [142]

1	R/O	Power
2	W/GN	Security siren
3	BK	Ground

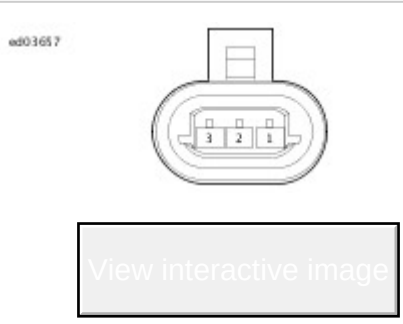


Figure 49. Security Siren (Optional) [142]

Table 50. Engine Harness [145]

1	R/O	Battery power
2	R/GN	System power
3	W/R	CAN +
4	W/BK	CAN -
5	BK/GN	Ground

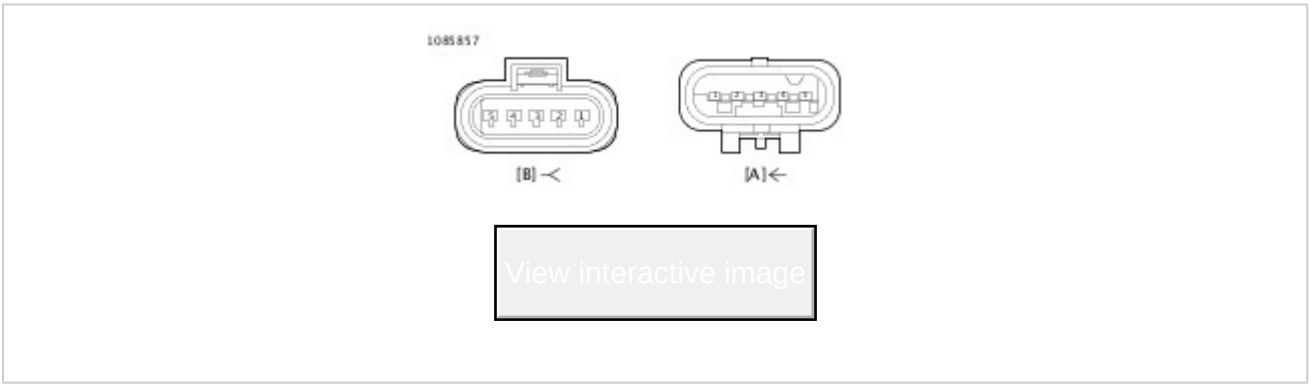


Figure 50. Engine Harness [145]

Table 51. ABS [166]

1	BK/GN	Ground
2	W/R	CAN high
3	O/BK	Front WSS low
4	BE/BK	Switched aux lamp PWR
5	-	N/C
6	-	N/C
7	-	N/C
8	-	N/C
9	R	Battery power
10	BK	Ground
11	W/BK	CAN low
12	O/BE	Front WSS high
13	O/PK	Rear WSS high
14	O/BN	Rear WSS low

15	-	N/C
16	-	N/C
17	-	N/C
18	R	Battery power

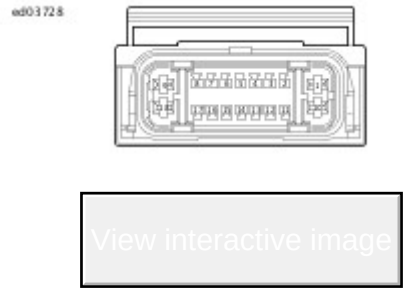


Figure 51. ABS [166]

Table 52. Front WSS [167]

1	O/BE	Front WSS high
2	O/BK	Front WSS low

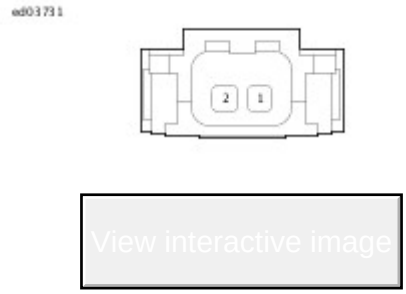


Figure 52. Front WSS [167]

Table 53. Rear WSS [168]

1	O/PK	Rear WSS high
2	O/BN	Rear WSS low

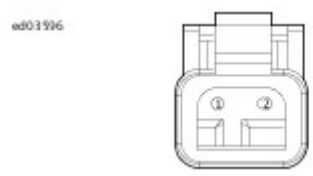


Figure 53. Rear WSS [168]

Table 54. ACR [203]

1	R/GN	System power
2	LGN/R	ACR enable

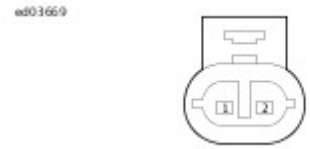


Figure 54. ACR [203]

Table 55. TGS [204A]

1	R/W	5V sensor power 1
2	GN/W	TGS 1
3	BK/W	5V sensor ground 1
4	R/GY	5V sensor power 2
5	GY/W	TGS 2
6	BK/GY	5V sensor ground 2

Figure 55. TGS [204]

Table 56. TGS [204B]

1	R	5V sensor power 1
2	W	TGS 1
3	BK	5V sensor ground 1
4	R	5V sensor power 2
5	W	TGS 2
6	BK	5V sensor ground 2

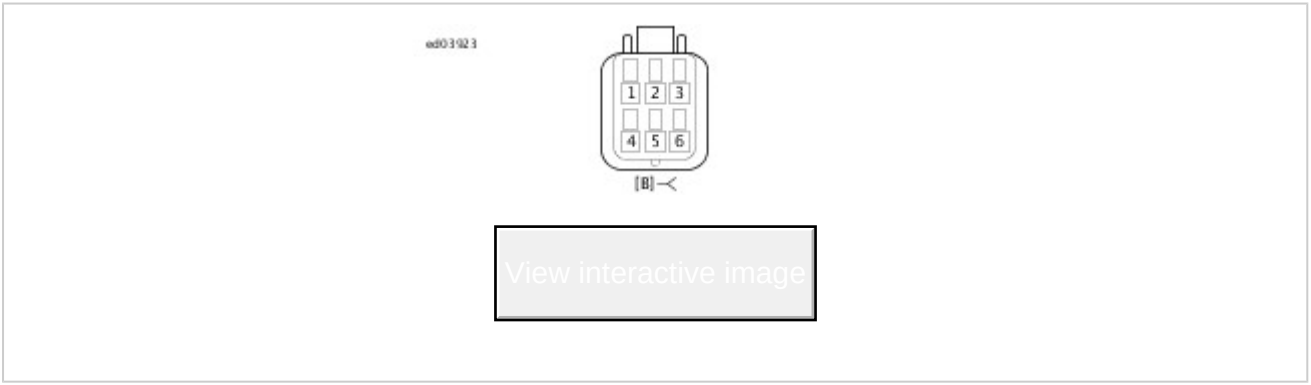


Figure 56. TGS [204B]

Table 57. Security Antenna [209]

1	R	Security antenna high
2	BK	Security antenna low

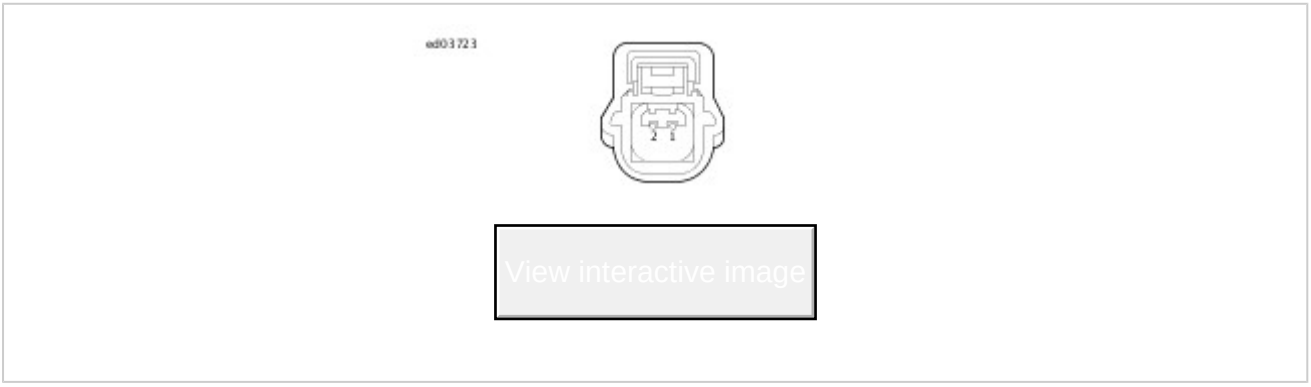


Figure 57. Security Antenna [209]

Table 58. TCA [211]

A	GY/O	ETC low

B	BK/W	5V sensor ground 1
C	GN/V	TPS 1
D	R/W	5V sensor power 1
E	GY/V	TPS 2
F	GN/O	ETC high

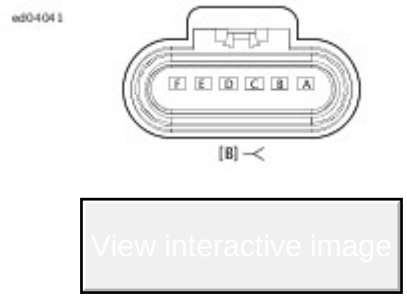


Figure 58. TCA [211]

Table 59. BCM [242]

A1	-	N/C
A2	R	Security antenna high
A3	-	N/C
A4	BK	Security RF antenna
B1	-	N/C
B2	BK	Security antenna low
B3	-	N/C
B4	-	N/C
C1	-	N/C
C2	-	N/C
C3	-	N/C
C4	W/GY	Engine stop switch input
D1	-	N/C
D2	W/R	CAN high
D3	W	Neutral switch input

D4	-	N/C
E1	-	N/C
E2	W/BK	CAN low
E3	W/O	Oil pressure switch input
E4	R/V	Horn power
F1	-	N/C
F2	-	N/C
F3	BE/GN	Brake switch input
F4	R/BN	Fuel pump power
G1	-	N/C
G2	O/W	ABS wake
G3	-	N/C
G4	BK/GN	Sensor ground
H1	-	N/C
H2	W/GN	Security siren
H3	-	N/C
H4	-	N/C
J1	-	N/C
J2	BE/O	Right front turn signal
J3	BE	Running lights
J4	BE/PK	Left front turn signal
K1	-	N/C
K2	BE/BN	Right rear turn signal
K3	BE/R	Brake lamp power
K4	BE/V	Left rear turn signal
L1	-	N/C
L2	R/BK	Starter solenoid power
L3	R/GN	System power
L4	BE/BK	Front running/Fog light power

M1	-	N/C
M2	R/Y	Accessory power
M3	BE/W	High beam power
M4	BE/Y	Low beam power

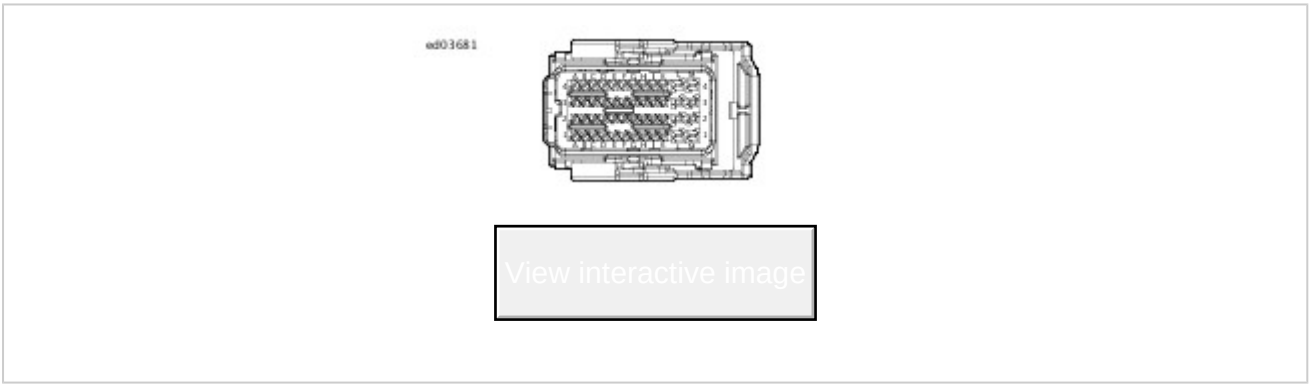


Figure 59. BCM [242]

Table 60. BCM Power [259]

1	R	Battery power

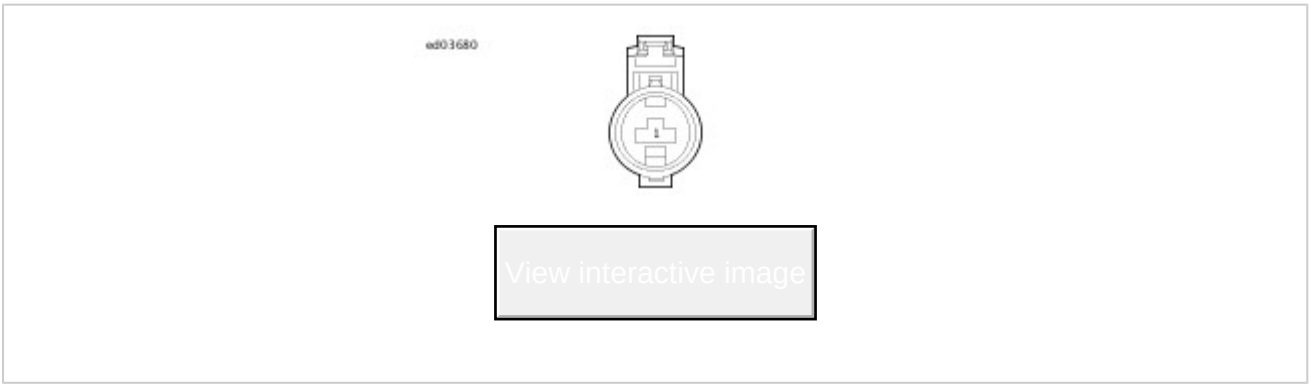


Figure 60. BCM Power [259]

Table 61. USB Interconnect [264]

1	R/Y	Accessory power
2	BK	Ground

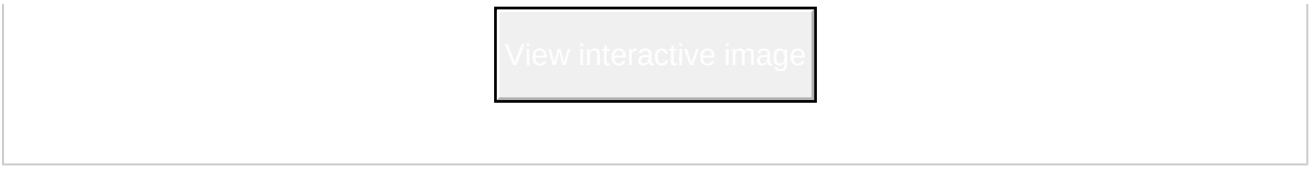


Figure 61. USB Interconnect [264]

Table 62. Battery Tender [281]

1	R	Battery power
2	BK	Ground

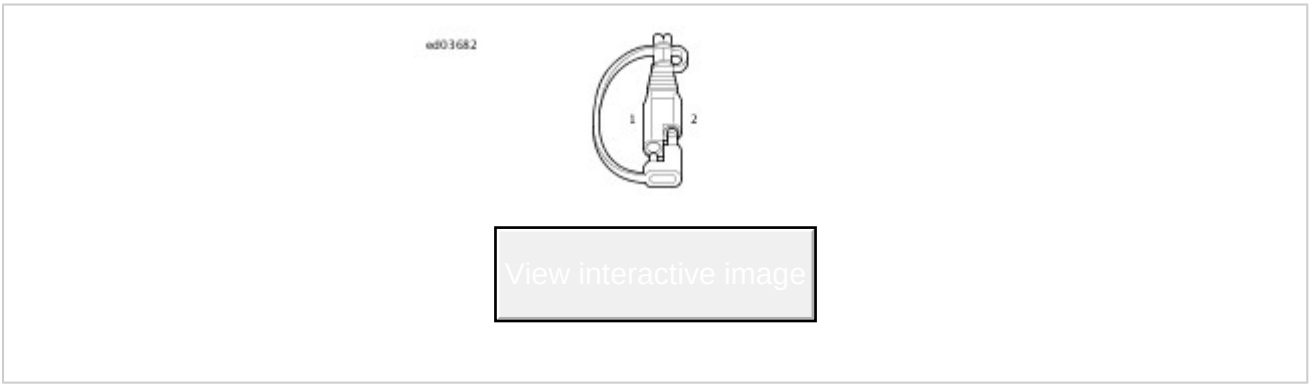


Figure 62. Battery Tender [281]

Table 63. Front Knock Sensor [315]

1	LGN/W	Front knock sensor LO
2	BN/W	Front knock sensor HI

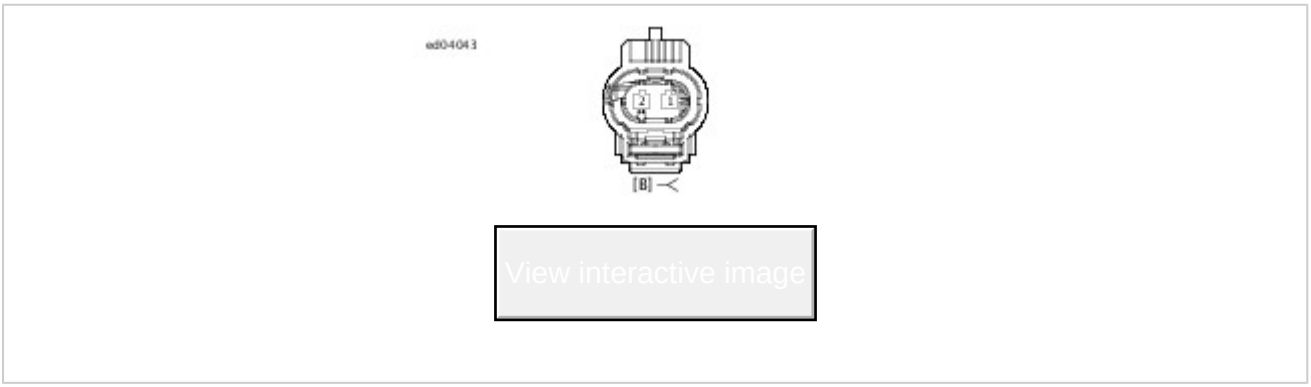


Figure 63. Knock Sensor

Table 64. Rear Knock Sensor [316]

1	LGN/V	Rear knock sensor LO
2	BN/V	Rear knock sensor HI

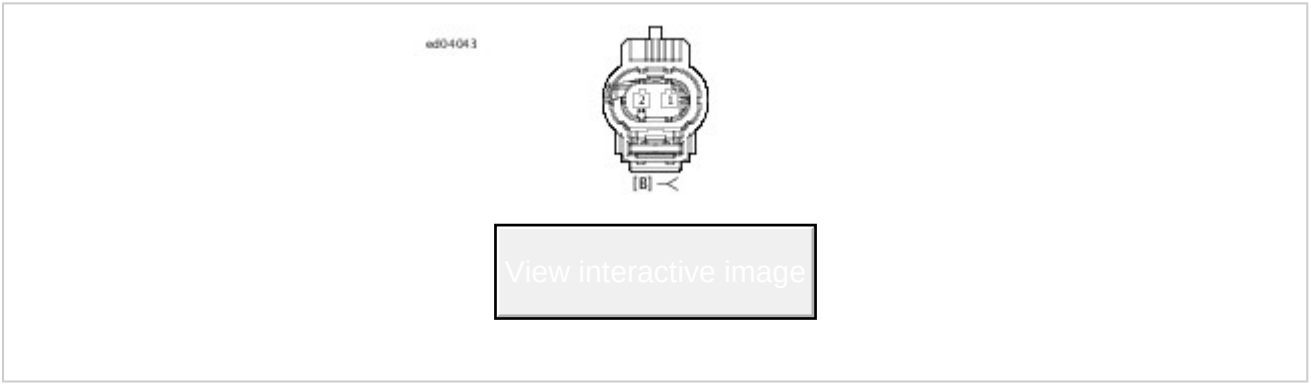


Figure 64. Knock Sensor

Table 65. Termination Resister [319]

A	W/R	CAN High
B	W/BK	CAN Low

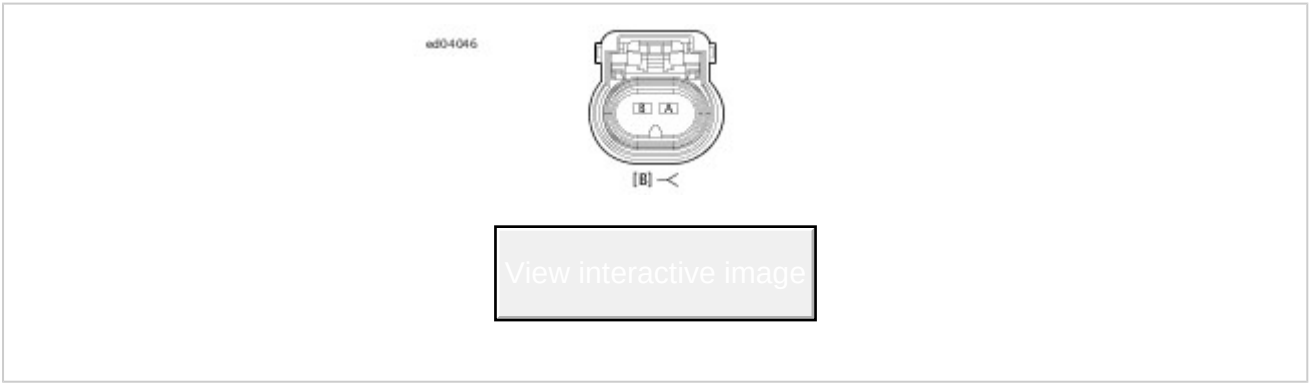


Figure 65. Termination Resister [319]

Table 66. P&A Accessory [325]

1	R/Y	Accessory power
2	BK	Ground
3	-	N/C

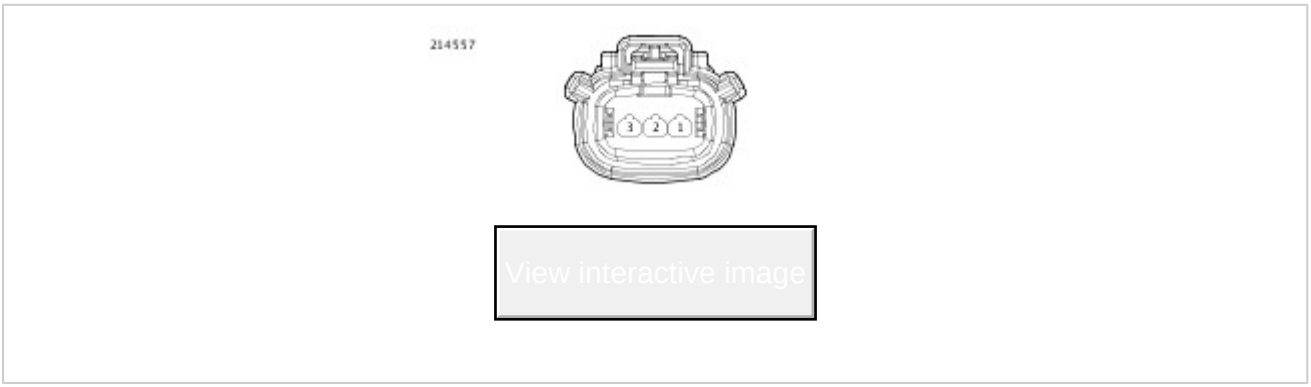


Figure 66. P&A Accessory [325]

Table 67. Backbone Harness Interconnect [327A]

1	R/BN	Fuel pump power
2	R/V	Horn power
3	R/Y	Accessory power
4	R/O	Battery fuse
5	BE	Position lamp
6	BE/BK	AUX/fog lamps
7	BK/GN	Ground
8	BK	Ground
9	-	N/C
10	BE/Y	Low beam
11	BE/W	High beam
12	W/R	CAN +
13	W/BK	CAN -
14	-	N/C
15	-	N/C
16	O/BE	Front WSS +
17	O/BK	Front WSS -
18	BE/O	Front right turn
19	BE/PK	Front left turn
20	W/GY	Run/stop switch

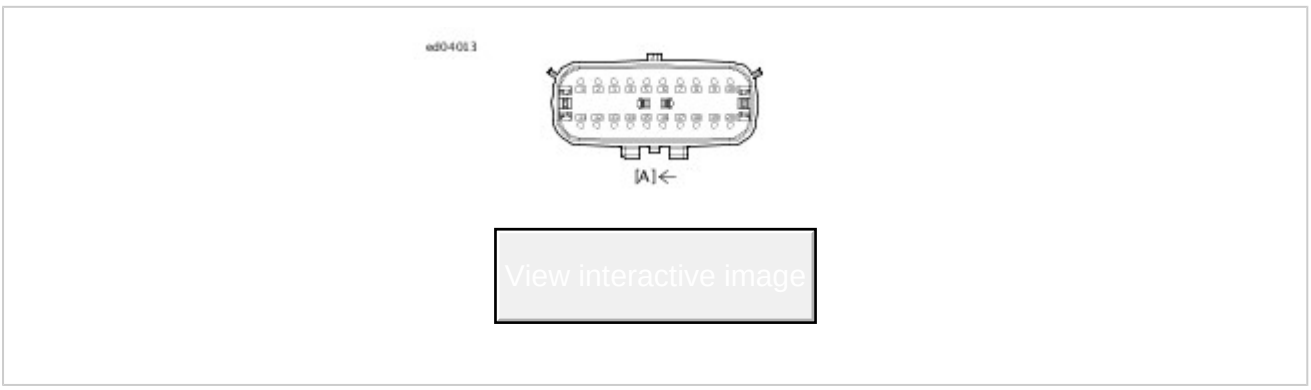


Figure 67. Backbone Harness Interconnect [327A]

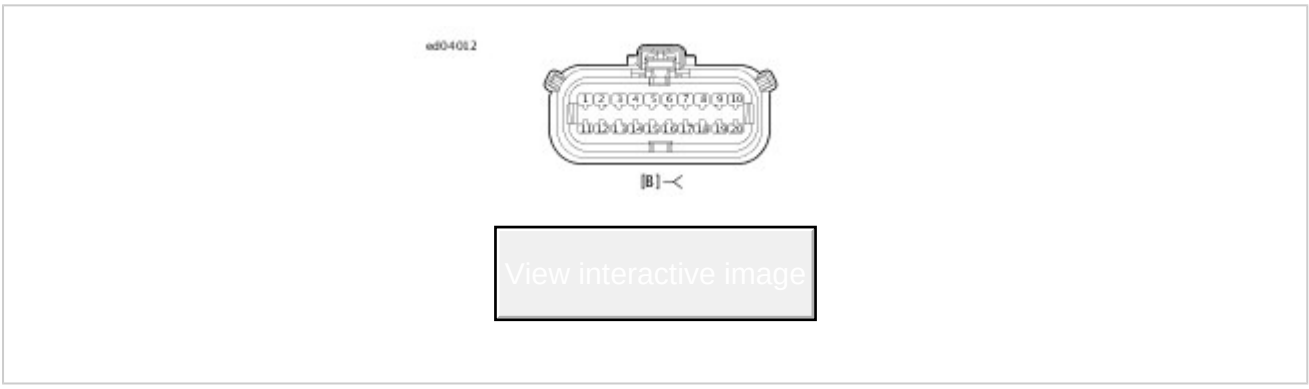


Figure 68. Backbone Harness Interconnect [327B]

Table 68. Engine Harness Interconnect [328]

1	R/W	5V sensor power 1
2	GN/W	TGS 1
3	BK/W	5V sensor ground 1
4	R/GY	5V sensor power 2
5	GY/W	TGS 2
6	BK/GY	5V sensor ground 2
7	GN	Engine temperature
8	Y/W	Fuel level

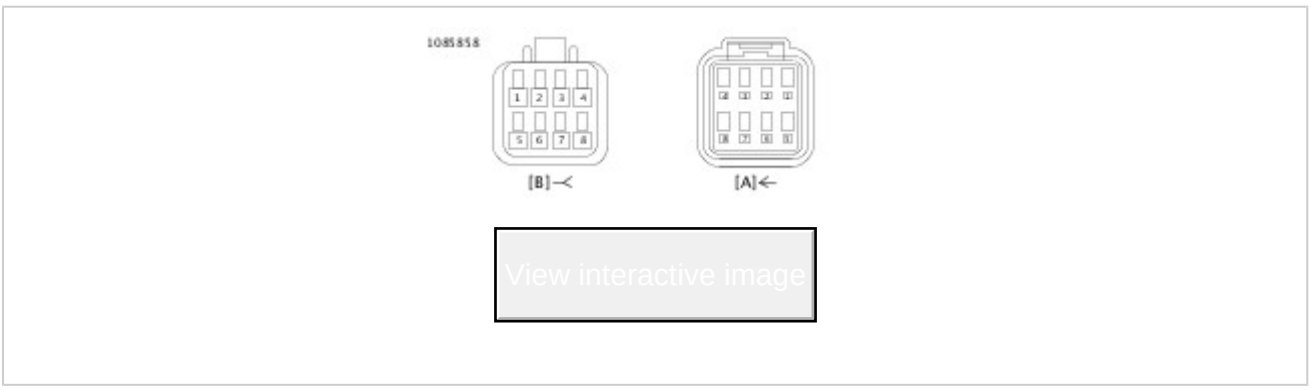


Figure 69. Engine Harness Interconnect [328]

Table 69. USB Caddy Interconnect [329]

1	BK	Ground
2	BK/W	5V sensor ground 1
3	GN	Engine temperature
4	R/Y	Accessory power

5	R/V	Horn power
6	BK/W	5V sensor ground 1
7	Y/W	Fuel level
8	R/BN	Fuel pump power

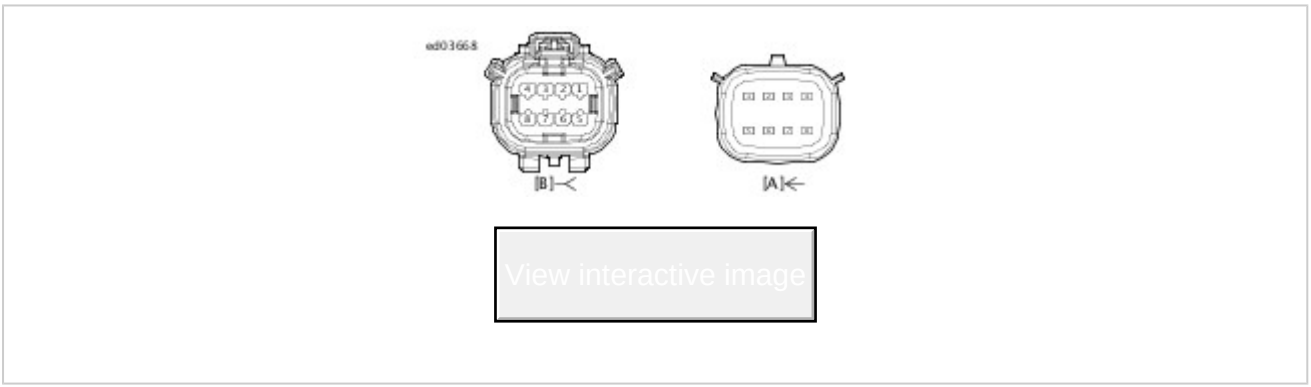


Figure 70. USB Caddy Interconnect [329]

Table 70. Light Bar Interconnect [331]

1	BE/BN	Right rear turn signal
2	BK	Ground
3	BE/V	Left rear turn signal
4	BK	Ground

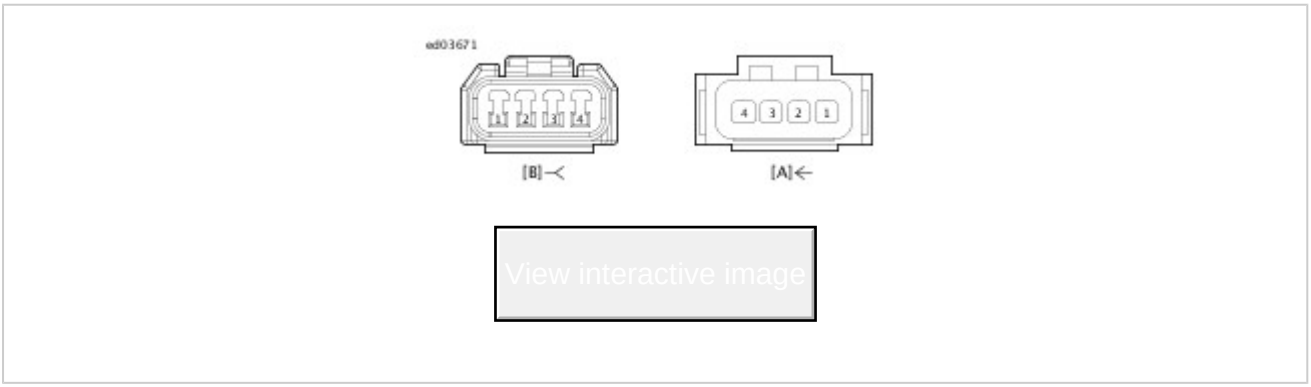


Figure 71. Light Bar Interconnect [331]

Table 71. Fuse Block [332]

A	R/GN	System power
B	V/GN	Fused system power

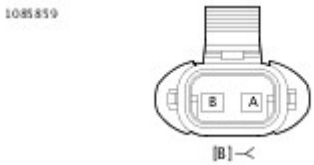


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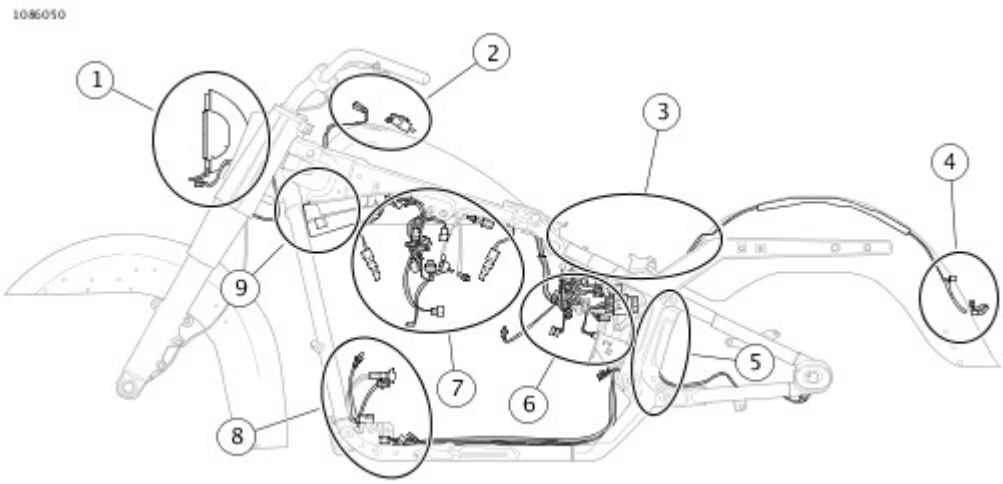
Figure 72. Fuse Block [332]

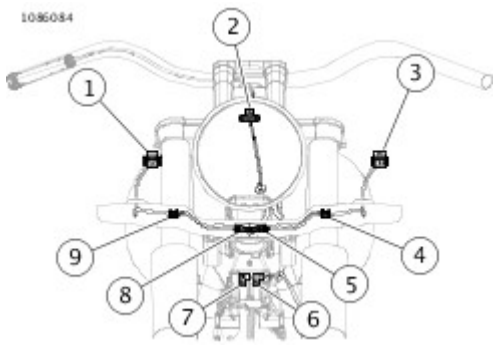
Some components and connectors are not easily located on the motorcycle. The following figures show locations for these components and connectors. The figures are generally ordered from front to back around the motorcycle.



View interactive image

1	Headlamp
2	IM
3	Under seat
4	Tail lamp
5	Front of rear tire
6	Side covers
7	Engine
8	Front of engine
9	USB caddy

Figure 1. Left Side: Typical



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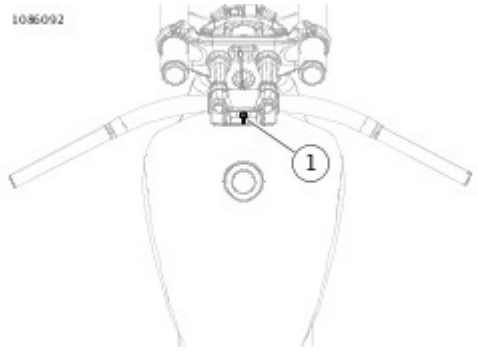
1	Right AUX/fog lamp [73R-2]
2	Headlamp [38-2]
3	Left AUX/fog lamp [73L-2]
4	Front left turn [31L-2]
5	Left AUX/fog lamp [73L]
6	Horn [122-1]
7	Horn [122-2]
8	Right AUX/fog lamp [73R]
9	Front right turn [31R-2]

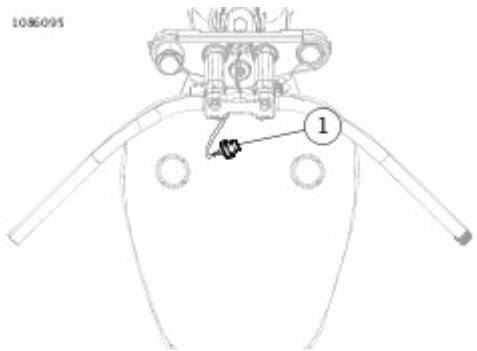
Figure 2. Headlamp: FLSTC, FLSTN



View interactive image

1	IM [39]

Figure 3. IM: FXBB, FXBR



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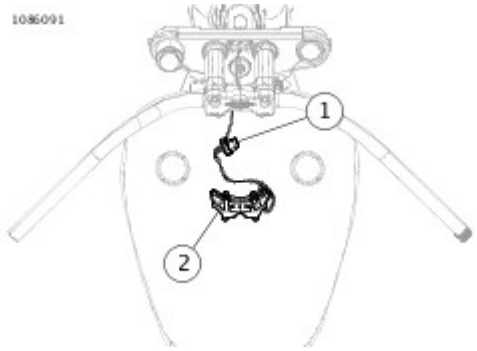
1	IM [39]

Figure 4. IM: FLFB, FLSB, FXFB



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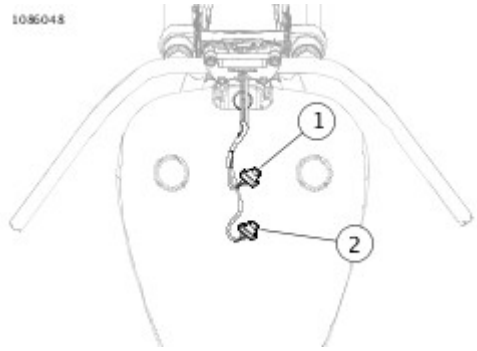
1	IM [39]
2	Indicator lamps

Figure 5. IM: FLDE, FLHC/S, FLSL



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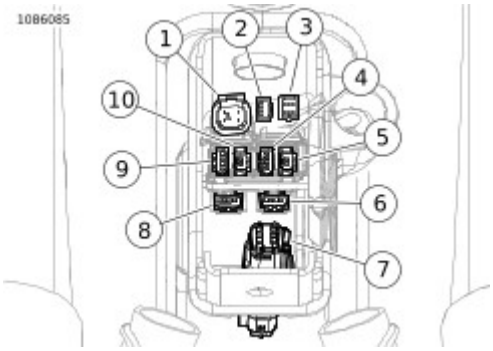
1	IM [39]
2	Tachometer [108]

Figure 6. IM: FXLR



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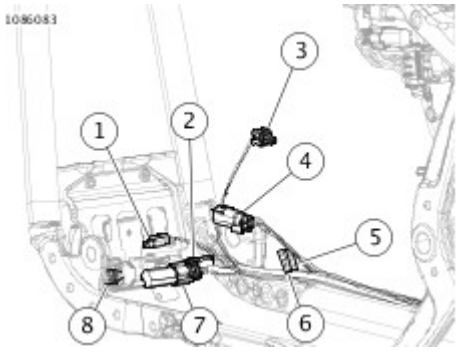
1	Headlamp security siren [38]
2	Console [20]
3	TGS [204]
4	Right front lighting [31R]
5	Front WSS [167]
6	Left front lighting [31L]
7	USB caddy interconnect [329]
8	LHCM [24]
9	RHCM [22-1]
10	RHCM [22-2]

Figure 7. USB Caddy



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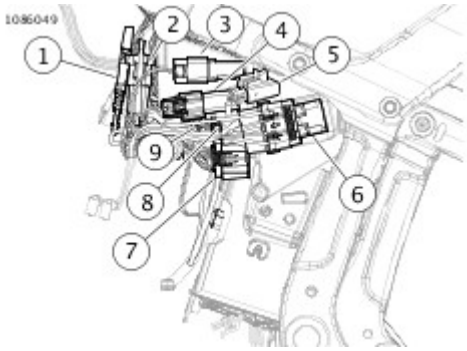
1	CKP [79]
2	Voltage regulator [77]

3	Oil pressure sensor [120]
4	Front HO2S [138]
5	Rear brake switch [121-1]
6	Rear brake switch [121-2]
7	JSS [133]
8	Stator [47]

Figure 8. Front of Engine: Typical



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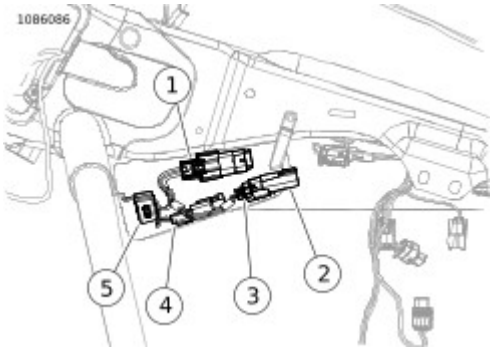
1	Battery tender [281]
2	DLC [91]
3	Termination resistor [319]
4	P&A accessory [325]
5	Fuse holder [332]
6	Fuse block [64]
7	ECM [78-3]
8	ECM [78-2]
9	ECM [78-1] (behind sub caddy)

Figure 9. Behind Left Side Cover



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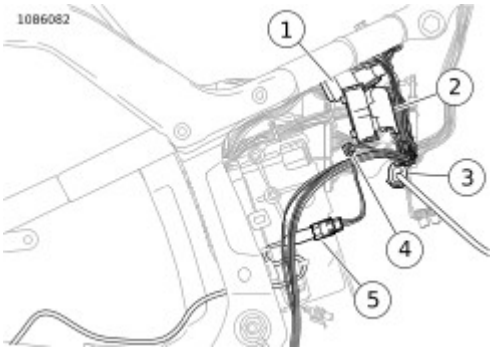
1	USB caddy interconnect [329]
2	USB [264]
3	Fuel pump [141]
4	ET sensor [90]

Figure 10. Under Fuel Tank Left Side



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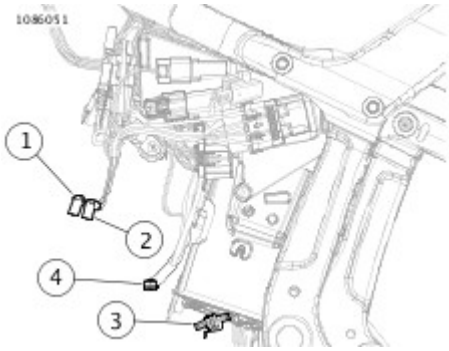
1	Engine harness [145]
2	ABS EHCU [166]
3	Rear HO2S [137]
4	Starter solenoid [128]
5	Rear WSS [168]

Figure 11. Behind Right Side Cover



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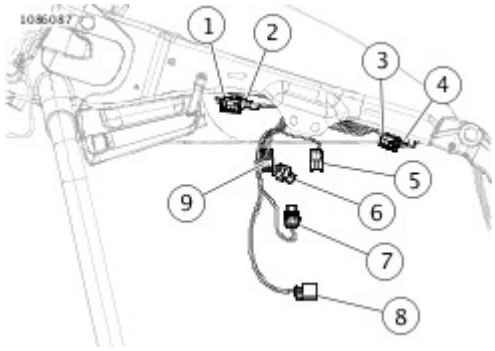
1	Neutral [131-1]
2	Neutral [131-2]
3	VSS [65]
4	Transmission GND

Figure 12. Top of Transmission

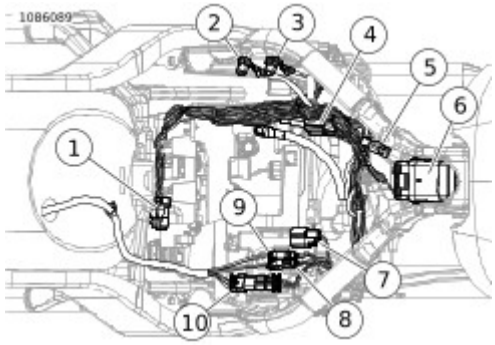


View interactive image

1	Front knock sensor [315]
2	Front ACR [203F]
3	Rear knock sensor [316]
4	Rear ACR [203R]
5	Rear injector [85]
6	TMAP [80]
7	Ignition coil [83]
8	Throttle control [211]

9	Front injector [84]

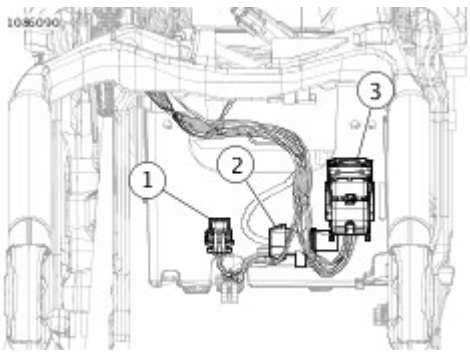
Figure 13. Engine



View interactive image

1	Purge solenoid [95]
2	GND 2A
3	GND 1
4	GND 2
5	Backbone harness interconnect [327]
6	Engine harness interconnect [328]
7	Engine harness [145]
8	Security antenna [209]
9	Left rear lighting [19]
10	Right rear lighting [18]
11	Tail lamp [40]

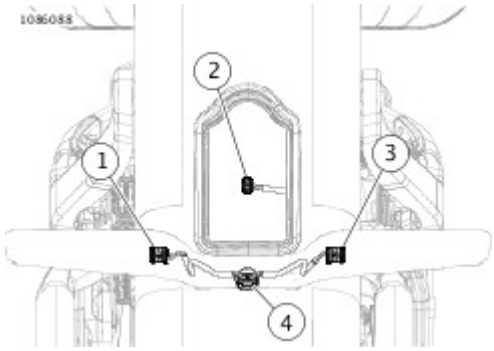
Figure 14. Under Seat



View interactive image

1	Security siren [142]
2	BCM power [259]
3	BCM [242]

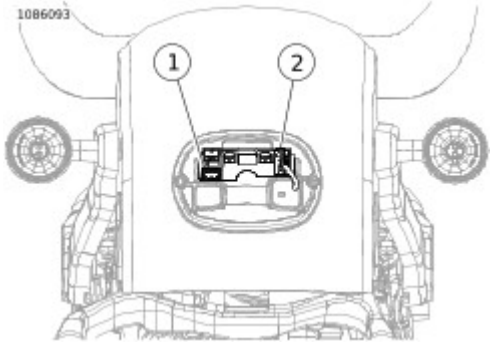
Figure 15. Front of Rear Tire



View interactive image

1	Left rear turn [18-2]
2	Stop/tail lamp [40]
3	Right rear turn [19-2]
4	Light bar interconnect [331]

Figure 16. Rear Lighting: FLDE

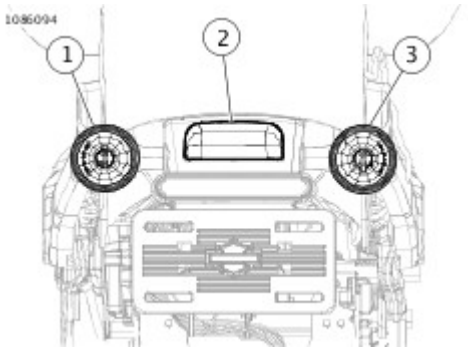


View interactive image

1	Left turn lamp

2	Tail lamp [93]
3	Stop lamp [94]
4	Right turn lamp

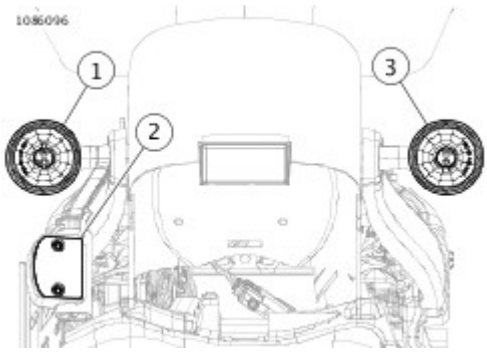
Figure 17. Rear Lighting: FLHC, FXLR



View interactive image

1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

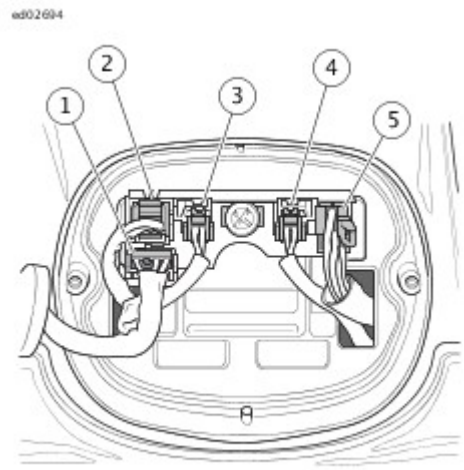
Figure 18. Rear Lighting: FLSL, FLSB



View interactive image

1	Left stop/turn lamp
2	LP lamp
3	Right stop/turn lamp

Figure 19. Rear Lighting: FLFB/S, FXBB, FXBR/S, FXFB



View interactive image

1	Tail lamp [93]
2	Rear fender tip lamp [45]
3	Left rear turn signal [19]
4	Right rear turn signal [18]
5	Rear fender lights harness in circuit board [94]

Figure 20. Rear Fender Lights

Special Tools

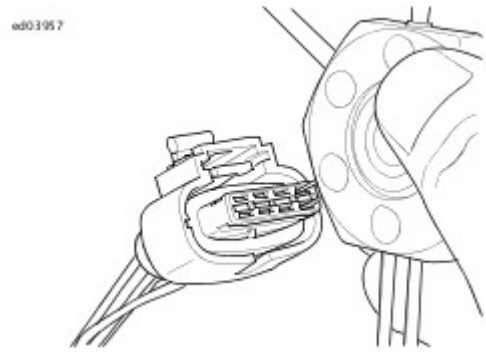
Description	Part Number	Qty.
SNAP-ON TERMINAL PICK	GA500A	1

The Bosch Compact 1.1M style connector is typically found on ACR, MAP or TMAP sensors.

Snap back the secondary lock. Press on the latch while pulling the connector from the sensor.

1. Align the connector housings.
2. Press the housings together until the locking tab snaps into place.

1. See **Figure 1**. Slide the locking bar off the terminal housing.
2. Insert the smallest pins of the **SNAP-ON TERMINAL PICK (Part Number:GA500A)** into the gaps on each side of the terminal to compress the tangs on each side of the terminal.
3. Gently pull on the wire to remove the terminal.



View interactive image

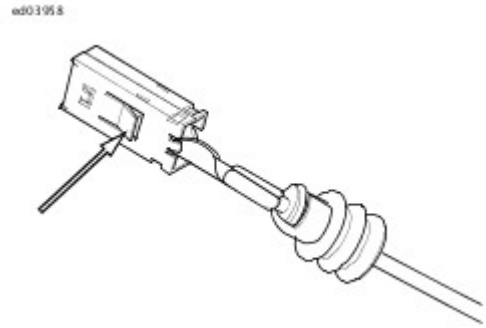
Figure 1. Terminal Removal: Bosch Compact 1.1M Connector

1. See **Figure 2**. Use a hobby knife to bend the tangs on each side of the terminal outward.
2. Align terminal to connector. Press terminal into connector until it snaps.

NOTE

The teeth on the locking bar face down.

3. Slide the locking bar onto the connector.



View interactive image

Figure 2. Tangs: Bosch Compact 1.1M Terminal

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. DO NOT re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
PACKARD TERMINAL CRIMP TOOL	HD-38125-6	1

Delphi GT 150 connectors are typically used on fuel injectors, ignition coil and VSS. The GT 280 sealed connectors are used to connect to the fuel pump and sender.

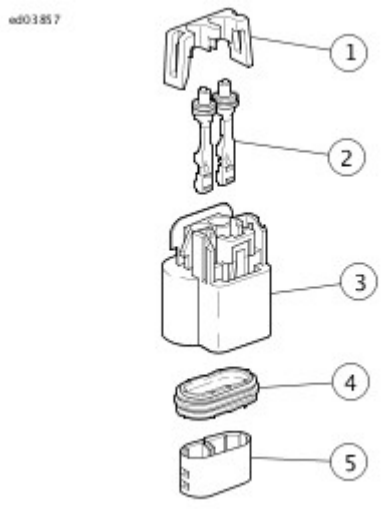
See **Figure 1**. The plug assembly consists of housing with connector cavities, terminals, secondary lock, wire seals, safety lock, mating seal and primary lock.

NOTE

Use **PACKARD TERMINAL CRIMP TOOL (Part Number:HD-38125-6)** for Delphi GT sealed terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 2**. Press connector release (A), separate the two halves (B).

Push the halves of connector together until external latch(es) engage.

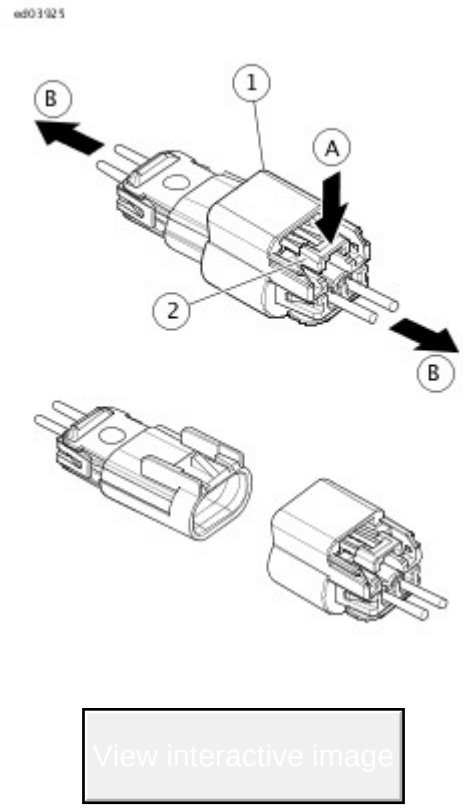


View interactive image

1	Secondary lock
2	GT 280 female terminals

3	Connector housing 2-way
4	Seal
5	Primary lock

Figure 1. Exploded View

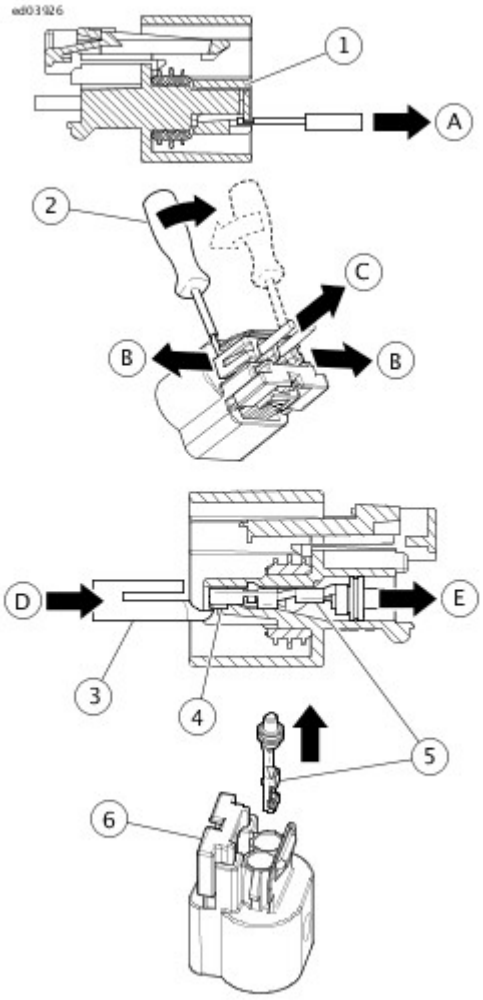


View interactive image

1	Connector housing
2	Connector release

Figure 2. Disconnect

1. See **Figure 3**. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, completely remove the primary lock.
2. Release the two locks and remove the secondary lock.
3. From the front of the cavity, locate the terminal lock. Insert the removal tool straight into the cavity, deflect the terminal lock and release the terminal. Gently pull on the wire to remove terminal from the connector.



View interactive image

1	Primary lock
2	Removing secondary lock
3	Removal tool
4	Terminal lock
5	Terminal
6	Connector housing

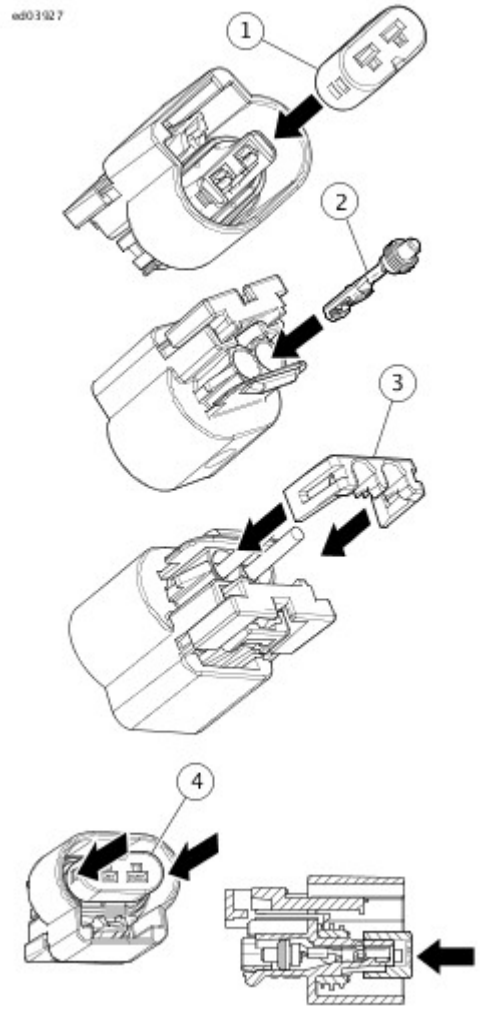
Figure 3. Terminal Removal

1. See **Figure 4**. Insert the primary lock into the outer most position on the connector.

NOTE

Proper orientation of terminal required.

2. Insert terminals into connector housing.
3. Insert secondary lock onto cavity until locked.
4. Install primary lock until it is locked in position.



View interactive image

1	Primary lock
2	Terminal
3	Secondary lock
4	Primary lock

Figure 4. Terminal Installation

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals

or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
PACKARD TERMINAL CRIMP TOOL	HD-38125-6	1
PACKARD TERMINAL CRIMPER	HD-38125-7	1

There are two types of connectors in this series:

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

NOTE

- Use **PACKARD TERMINAL CRIMP TOOL (Part Number:HD-38125-6)** for push-to-seat Delphi Metri-Pack terminal crimping.
- Use **PACKARD TERMINAL CRIMPER (Part Number:HD-38125-7)** for pull-to-seat Delphi Metri-Pack terminal crimping.

Refer to Bosch tool instruction sheet for crimping instructions.

Pry up on the external latch slightly and separate the connector.

Push the halves of the connector together.

NOTE

- The same process is followed for both the male and female ends of the push to seat connectors.
- For best results, free one side of the secondary lock first and then release the other side.

1. See **Figure 1**. Remove secondary lock from wire end of connector.
2. Find the locking tang in the mating end of the connector.

NOTE

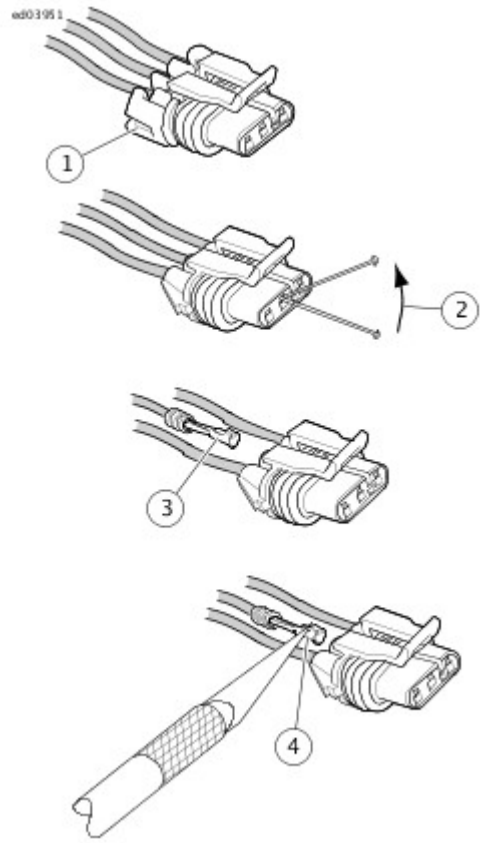
- The tangs are always positioned in the middle of the cavity on the same side as the external latch.
- There is a small opening for the pin.

3. Gently insert a small diameter straight pin into the cavity about 3.2 mm (⅛ in).

NOTE

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

4. Pick at the tang until the clicking stops and the pin seems to slide in deeper. This indicates the tang is pressed in.
5. Pull on the lead to draw the terminal out the wire end.



View interactive image

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

Figure 1. Removing Delphi Metri-Pack Sealed Connector: Push-to-Seat

NOTE

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

1. See **Figure 2**. Find the locking tang in the mating end of the connector.

NOTE

Stay between the terminal and the cavity wall and pivot the end of the pin toward the terminal body.

2. Gently insert a small diameter straight pin into the cavity about 3.2 mm (⅛ in).

NOTE

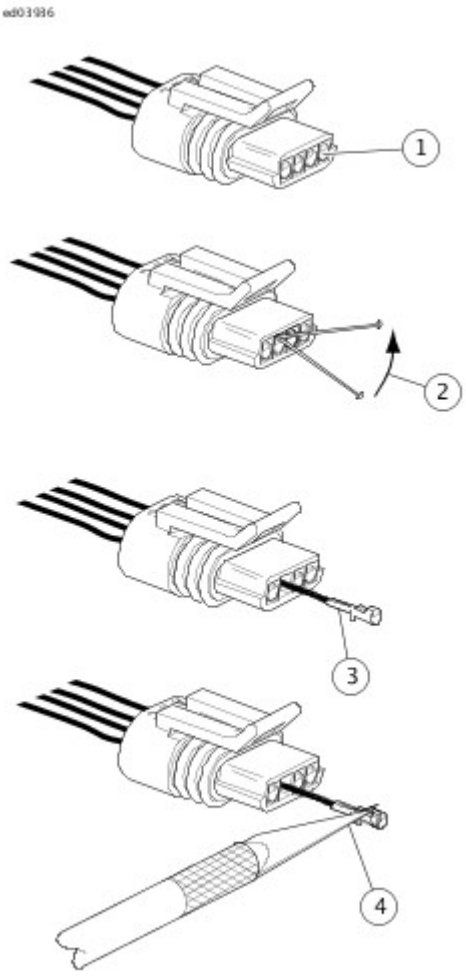
The click is the sound of the tang returning to the locked position as it slips from the point of the pin.

3. When a click is heard, remove the pin and repeat the procedure.

NOTE

After repeated terminal extractions, the click may not be heard, but pivot the pin as if the click was heard at least three times.

4. Pick at the tang until the clicking stops and the pin seems to slide in deeper. This indicates the tang is pressed in.
5. Push on the lead to extract the terminal from the mating end of the connector.

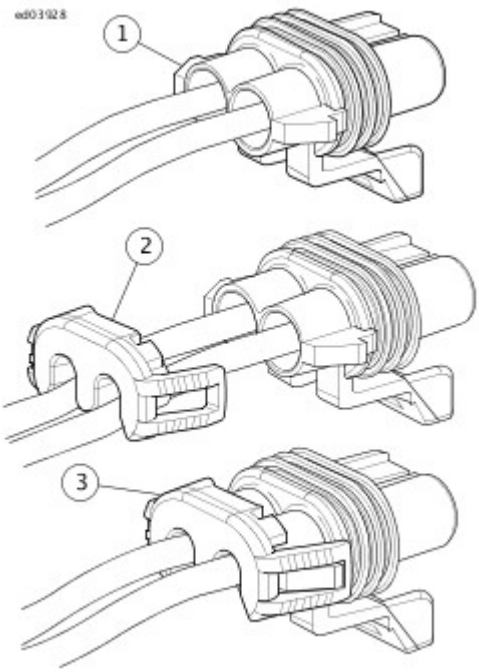


View interactive image

1	Locate tang in cavity
2	Pivot pin to release tang
3	Push to remove
4	Raise tang to install

Figure 2. Delphi 150.2 Metri-Pack Sealed Connector: Pull-to-Seat

1. See **Figure 3**. Plug terminals into connector assembly.
2. After all leads are plugged, install secondary lock to connector.
    a. Hold connector as shown and install secondary lock.
    b. Position secondary locks with corresponding grooves and verify one lead per cavity. Apply pressure with fingers until secondary lock snaps into place.



View interactive image

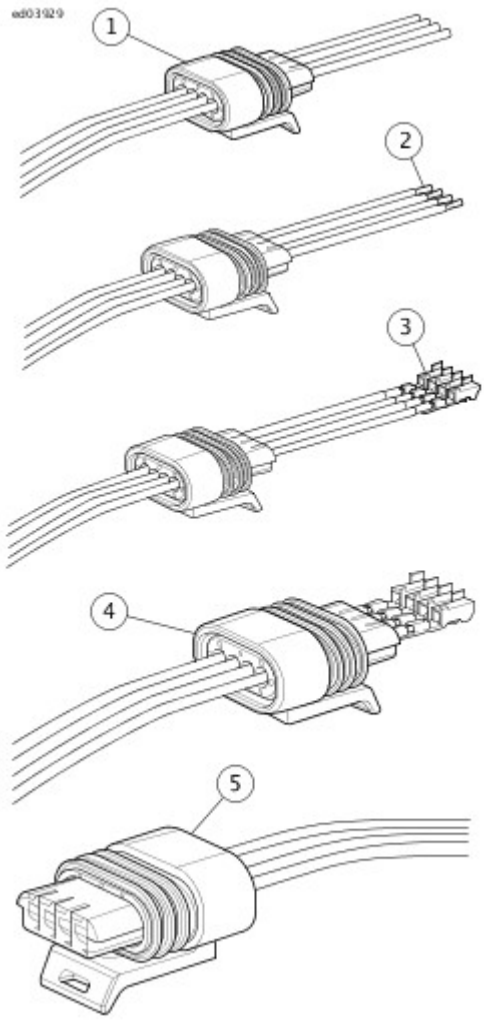
1	Insert terminals into connector
2	Install secondary lock
3	Locked

Figure 3. Insert Terminals Push-to-Seat

NOTE

Leads must be blunt cut for this operation.

1. See **Figure 4**. Push wire leads through cable seal at least 203 mm (8 in).
2. Strip each wire lead to the required length for the terminal being applied.
3. Crimp terminals on wire ends
4. Align the terminals with the locating tabs in the cavity and pull wires back through connector to install the terminal.
5. Verify terminal is fully seated in the terminal cavity.



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1	Push wire leads through cable seal
2	Strip each wire lead

3	Crimp terminals on wire ends
4	Pull wires back through connector
5	Verify terminal is fully seated

Figure 4. Inserting Terminal Pull-to-Seat

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
PACKARD MICRO-64 TERMINAL REMOVER	HD-45928	1
PACKARD MICRO-64 TERMINAL CRIMPER	HD-45929	1

Delphi Micro 64 Sealed connectors are frequently found on speedometers and tachometers.

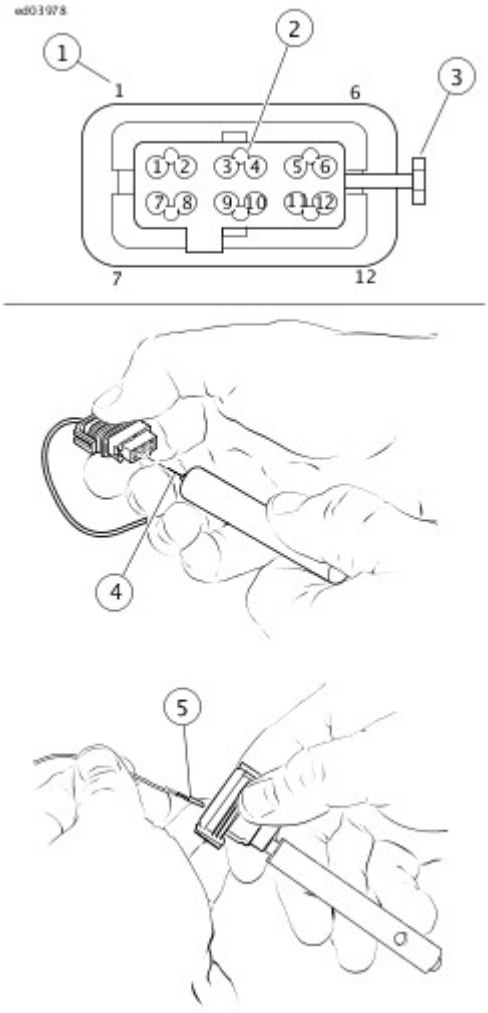
NOTE

Use **PACKARD MICRO-64 TERMINAL CRIMPER (Part Number:HD-45929)** for Delphi Micro 64 terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

Bend back the external latches slightly and separate the connector.

Align the terminals and press the connector together until the latch snaps.

1. See **Figure 1**. Locate the head of the secondary lock on one side of the connector housing.
2. Insert the blade of a small screwdriver between the center ear of the lock and the connector housing and gently pry out lock. When partially removed, pull lock from connector housing.
3. Locate pin hole between terminals on mating end of connector.



View interactive image

1	Stamped number
2	Pin hole
3	Secondary lock
4	Insert terminal remover
5	Remove terminal

Figure 1. Terminal Removal

4. Obtain the **PACKARD MICRO-64 TERMINAL REMOVER (Part Number:HD-45928)**.
5. Push the adjacent terminals all the way into the connector housing and then insert tool into hole until it bottoms.
6. Leaving the tool installed, gently tug on wires to pull either one or both terminals from wire end of connector. Remove tool.

1. Insert terminal into its respective numbered cavity on wire end of connector. No special orientation of the terminal is necessary.

NOTE

For wire location purposes, the corners of the connector are stamped with the numbers 1, 6, 7 and 12, representing terminals 1-6 on one side, and 7-12 on the other.

2. Bottom the terminal in the cavity and then gently tug on the wire to verify that it is locked in place.

NOTE

Once removed, the terminal may not lock in place when first installed. Until the lock engages, move the terminal back and forth slightly while wiggling the lead.

3. Since the terminal remover tool releases two terminals simultaneously, repeat step 2 on the adjacent terminal even if it was not pulled from the connector housing.
4. With the center ear on the head of the secondary lock facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
DEUTSCH CRIMPER	HD-39965-a	1
DEUTSCH CONNECTOR SERVICE KIT	HD-41475	1
FLAT BLADE L-HOOK	HD-41475-100	1
ELECTRICAL CRIMPER TOOL	HD-42879	1

A **DEUTSCH CONNECTOR SERVICE KIT (Part Number:HD-41475)** contains a selection of seals and seal plugs, locking wedges, attachment clips and terminals. Also included is a **FLAT BLADE L-HOOK (Part Number:HD-41475-100)** used to remove locking wedges, compartmented storage box and carrying case.

NOTE

- Use the **DEUTSCH CRIMPER (Part Number:HD-39965-a)** for non-solid barrel terminal crimping.
- Use the **ELECTRICAL CRIMPER TOOL (Part Number:HD-42879)** for solid barrel terminal crimping.

Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. To separate the connector halves, press the external latch(es) on the connector while rocking the connector halves, and pull.

NOTE

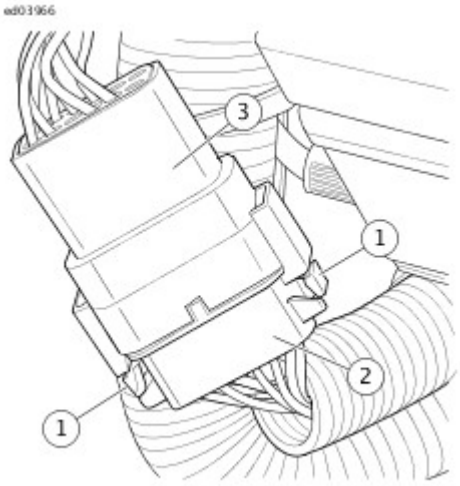
- Six-place and smaller Deutsch connectors have one latch on the connector.
- Eight- and twelve-place connectors have a latch on each side. Simultaneously press both latches to separate the connector.

1. Align the connectors to match the wire lead colors.
   a. **For One External Latch:** To join the halves, align the latch on the socket side with the latch cover on the pin side.
   b. **For Two External Latches:** Align the tabs on the connector halves.

NOTE

For Two External Latches: 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.

2. Insert the two halves together until it locks into place.

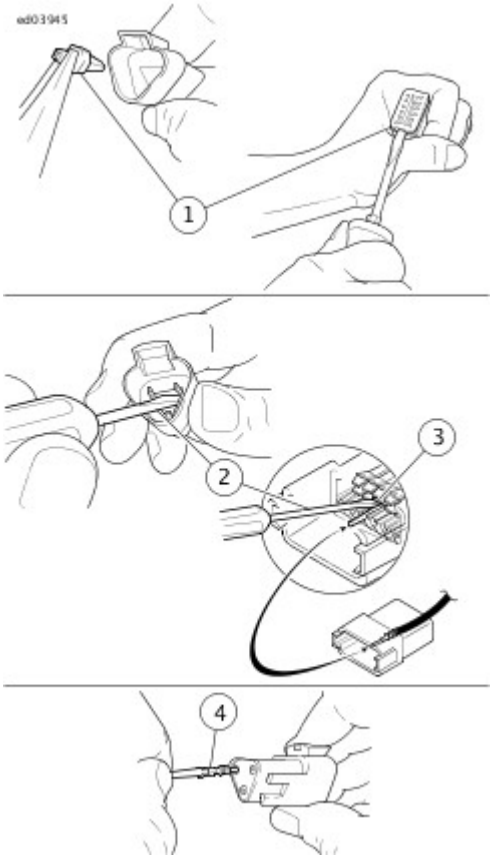


View interactive image

1	External latch
2	Socket housing
3	Pin housing

Figure 1. Deutsch DT Sealed Connector

1. See **Figure 2**. Remove wedgelock using needlenose pliers or removal tool.
2. To remove the terminals, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the terminal with a screwdriver.
3. Hold the rear seal in place when pulling terminal/wire out, as removing the terminal may displace the seal.



View interactive image

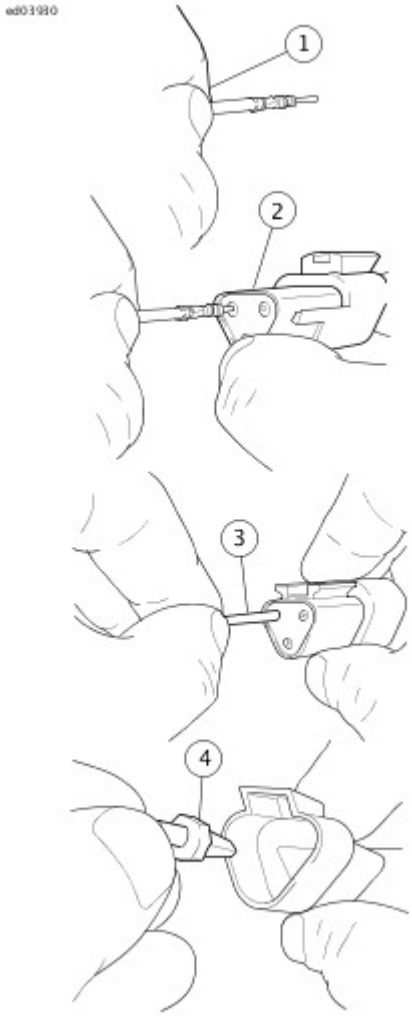
1	Remove wedgelock
2	Releasing locking finger
3	Locking finger
4	Remove terminal

Figure 2. Terminal Removal

NOTE

The receptacle is shown. Use the same procedure for plug.

1. See **Figure 3**. Grasp terminal approximately 25.4 mm (1 in) behind the terminal barrel.
2. Push terminal straight into connector grommet until a click is felt.
3. Gently pull on the wire to confirm that it is properly locked in place.
4. Once all terminals are in place, insert wedgelock. The wedgelock will snap into place.



View interactive image

1	Grasp terminal
2	Hold connector
3	Insert terminal
4	Insert wedgelock

Figure 3. Inserting Terminals

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

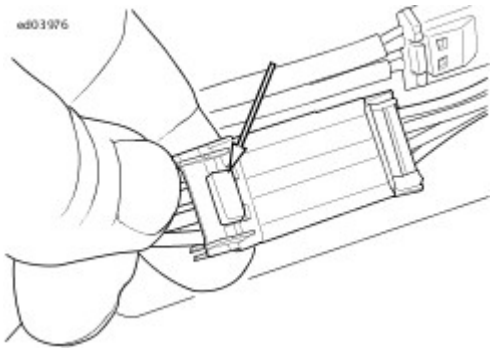
Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
HAND CRIMP FRAME	HD-50120-2	1
JAE DIE	HD-50120-6	1

The plug assembly consists of a wire seal (part of housing), housing and two terminals.

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **JAE DIE (Part Number:HD-50120-6)** for JAE MX19 series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Press the latch while pulling the connector halves apart.

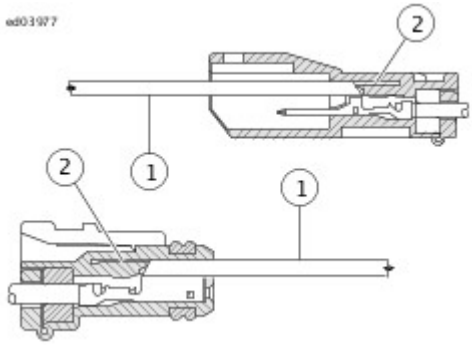


View interactive image

Figure 1. Release Button

Align the terminals and press the connectors together until the latch snaps.

1. Modify a **TERMINAL EXTRACTOR (Part Number:B-50085)** by filing the front edge to 45 degrees.
2. See **Figure 2**. Insert the extractor into the opening above the terminal and press the plastic molding up and out of the way.
3. Pull the wire lead and terminal out of the back of the connector.



View interactive image

1	Terminal extractor
2	Connector

Figure 2. Terminal Removal

1. Inspect the connector housing and replace if necessary.
2. Orient the terminal to the housing. Push terminal into housing until it clicks into place.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
DIE SET	HD-50120-11	1
HAND CRIMP FRAME	HD-50120-2	1

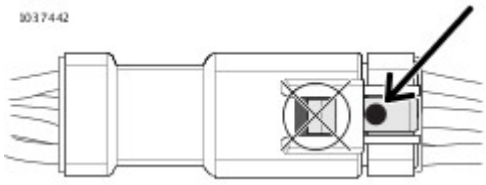
The plug assembly consists of a wire seal (part of housing), housing, yellow secondary, two terminals, and one red mating seal. The mating seal provides a tight closure for mated connectors.

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **DIE SET (Part Number:HD-50120-11)** for JST JWPF series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Press locking lever on female housing. Pull connector halves apart.

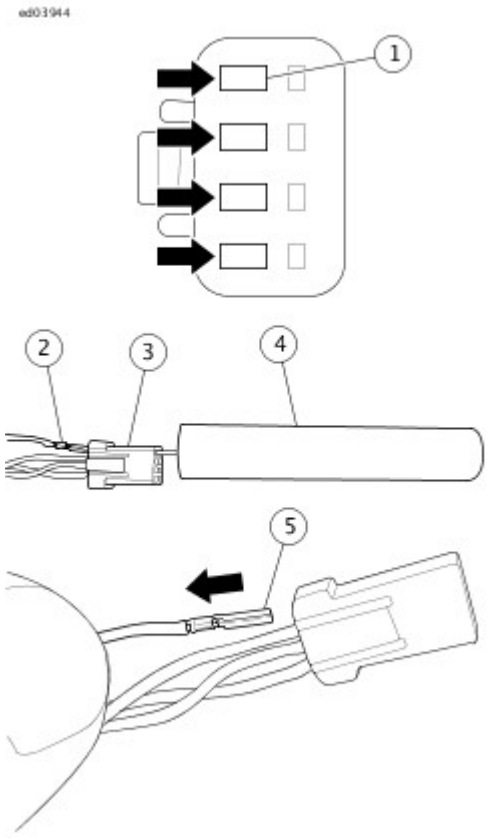
1. Align the connectors so the latches line up.
2. Press together until locked.



View interactive image

Figure 1. Locking Lever: JST JWPF Sealed Connector

1. See **Figure 2**. Locate large openings on the front of the connector housing.
2. Insert **TERMINAL EXTRACTOR (Part Number:B-50085)** into large openings and release retention finger that locks terminal in place.
3. Remove terminal.



View interactive image

1	Openings for removal tool
2	Terminal
3	Connector housing
4	Terminal extractor
5	Removing terminal

Figure 2. Terminal Removal

1. Inspect connector housing and replace if necessary.
2. Orient the terminal to the housing. Push terminal into housing until it clicks into place.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

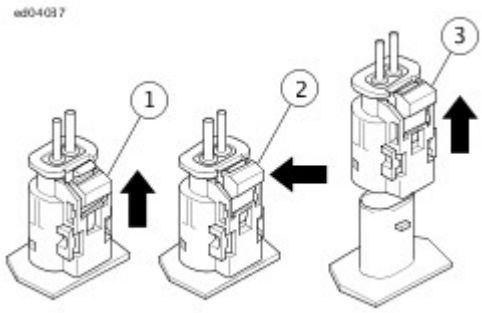
Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
HAND CRIMP FRAME	HD-50120-2	1

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with HD-50120-12 (DIE SET) for Kostal MLK 1.2 series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

1. See **Figure 1**. Lift the locking clip up in the unlocked position.
2. Press the locking clip in and release.
3. Pull and separate the two halves.

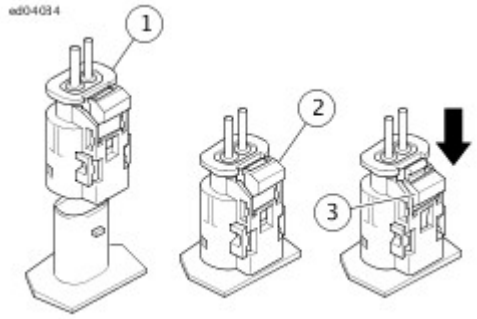


View interactive image

1	Locking clip in locked position
2	Lift locking clip to the unlocked position
3	Press locking clip and lift connector to separate

Figure 1. Separating Connector

1. See **Figure 2**. Push the halves of connector together until they click.
2. Push the locking clip down into locked position.



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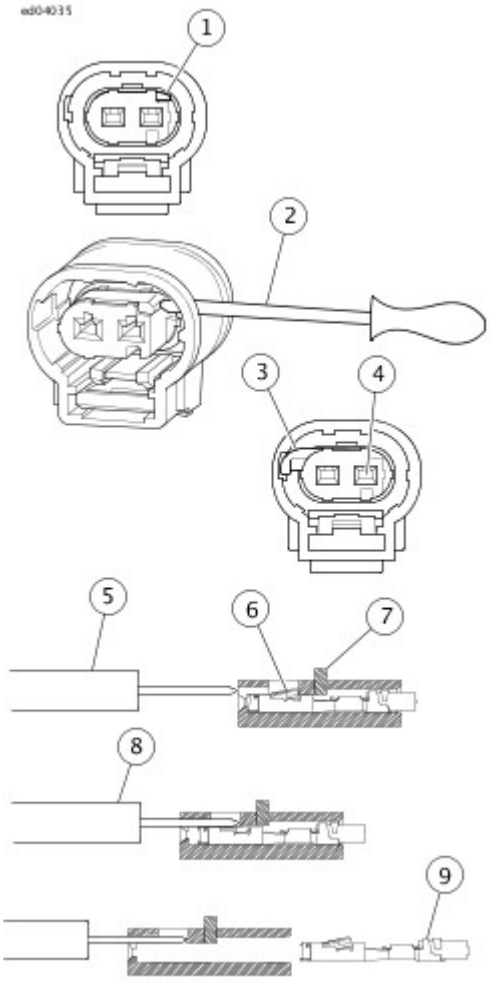
1	Push connectors together
2	Listen for click
3	Push safety lock down

Figure 2. Mating Connector

1. See **Figure 3**. Using a screwdriver, insert in hole in side of protective Housing and release the secondary lock.
2. Insert **TERMINAL EXTRACTOR (Part Number:B-50085)** into opening over terminal.
3. The terminal can be removed by pulling on the wire while simultaneously applying light pressure to disengage the primary lock.



View interactive image

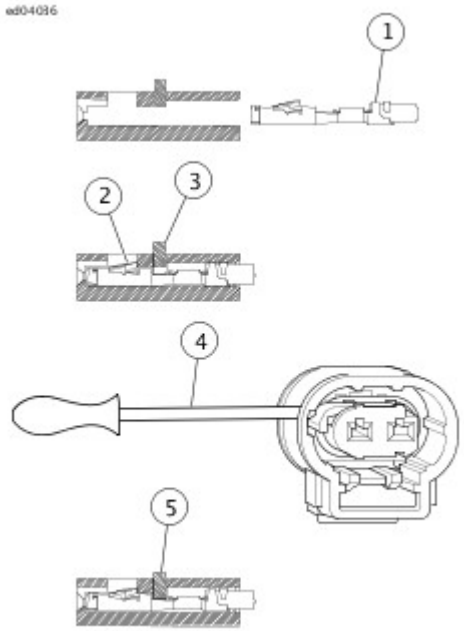
1	Secondary lock in locked position
2	Insert screwdriver and release secondary lock
3	Secondary lock in unlocked position
4	Opening over terminal
5	Terminal extractor
6	Primary lock
7	Secondary lock
8	Push terminal extractor into opening over terminal
9	Remove terminal

Figure 3. Terminal Removal

NOTE

Proper orientation of terminal required.

1. See **Figure 4**. Insert female terminals into receptacle connector until an audible click is heard or lock is felt
2. Using a screwdriver, insert in hole in side of protective Housing and using a slight force push secondary lock into locked position.



View interactive image

1	Terminal
2	Primary lock
3	Secondary lock in unlocked position
4	Insert screwdriver and push secondary lock into locked position
5	Secondary lock in locked position

Figure 4. Installing Terminal

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
HAND CRIMP FRAME	HD-50120-2	1
JAE DIE	HD-50120-3	1
JAE DIE	HD-50120-4	1
0.6 MM TERMINAL EXTACTOR TOOL	HD-50423	1
1.5 MM TERMINAL EXTRACTOR TOOL	HD-50424	1

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **JAE DIE (Part Number:HD-50120-3)** for 18-16 gauge or **JAE DIE (Part Number:HD-50120-4)** for 20-18 gauge Molex CMC series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Press the catch and rotate the lever arm down.

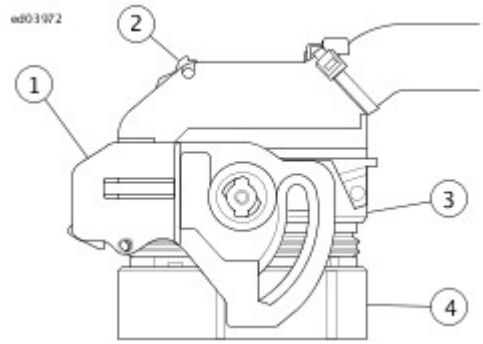


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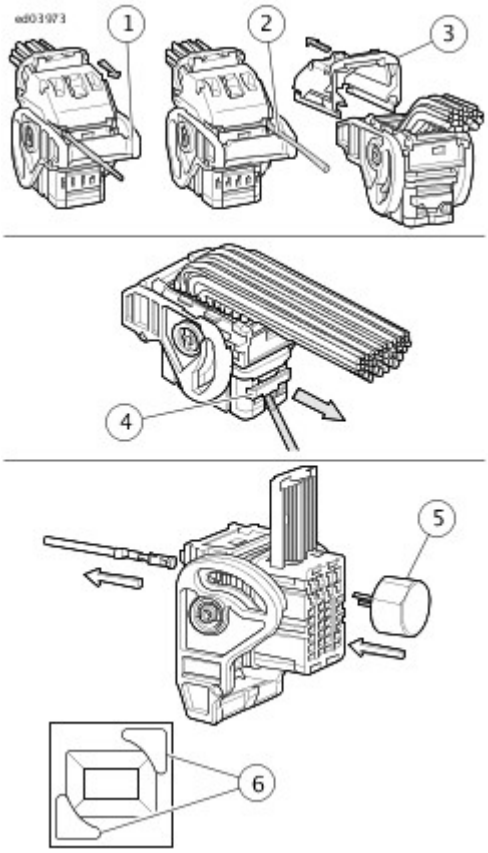
Figure 1. Release

1. Align the connector.
2. Rotate the lever arm up until the catch clicks in place.

1. With the lever arm open, cut the cable strap around the wire bundle.
2. See **Figure 2**. Open a wire cap latch with a small screwdriver.
3. Maintain pressure on the cap and open the opposite latch with the screwdriver.
4. Slide the cap off.
5. Use the screwdriver to open the secondary lock. Pull the locking bar all the way out.
6. Locate the wire lead cavity by the alpha-numeric coordinates.
7. Identify the size of the terminal and select either the CMC extractor **0.6 MM TERMINAL EXTACTOR TOOL (Part Number:HD-50423)** or the **1.5 MM TERMINAL EXTRACTOR TOOL (Part Number:HD-50424)**.
8. Insert the pins of the CMC extractor tool into the access slots of the terminal cavity and retract the lead and terminal.



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1	Press latch
2	Press cap and latch
3	Remove wire lead cap
4	Remove secondary lock
5	Extractor tool
6	Access slots

Figure 2. Terminal Removal

1. Orient the terminal to the housing cavity. Snap the terminal in place.
2. Slide the cap over the lead bundle. Snap the cap in place.
3. Install a cable strap through the guide and around the lead bundle.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER	HD-48114	1
ELECTRICAL CRIMP TOOL	HD-48119	1
DIE SET	HD-50120-11	1
HAND CRIMP FRAME	HD-50120-2	1

NOTE

- Use **ELECTRICAL CRIMP TOOL (Part Number:HD-48119)** for Molex MX150 terminal crimping.
- Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **DIE SET (Part Number:HD-50120-11)** for Molex MX64 series terminal crimping.

Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Press the latch while pulling the connector halves apart.

1. Align the connectors so the latches line up.
2. Press together until locked.

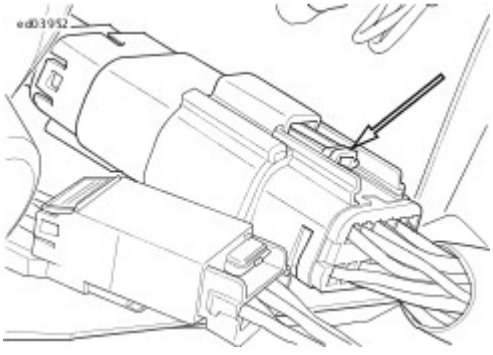

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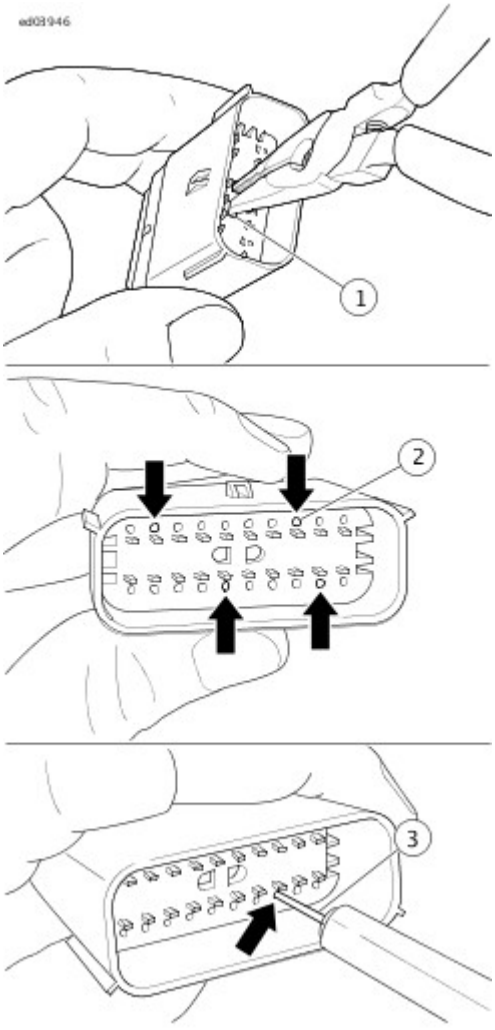
Figure 1. Molex MX 150 Sealed Connector Latch

NOTE

- The secondary lock should never be fully removed from the connector. Excessive force may damage the secondary lock.
- Do not apply any lateral force. This may damage the tool or the locking finger.
- Excessive force can damage the lock finger.
- Do not insert the service tool at an angle. This may cause damage to the terminal.
- Do not insert the removal tool into the terminal opening.

1. See **Figure 2**. Insert a small pair of needle nose pliers in the removal holes.
2. Pull back gently 5 mm (0 in) until the secondary lock is unlocked.
3. Using the **MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part Number:HD-48114)**, insert the tip into the terminal service ports adjacent to the terminal cavity to be removed.
4. Apply downward pressure to release the lock and remove the wire. If the terminal resists, the removal tool may not be fully engaged. Verify that it has fully disengaged the lock.



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1	Pull up secondary lock

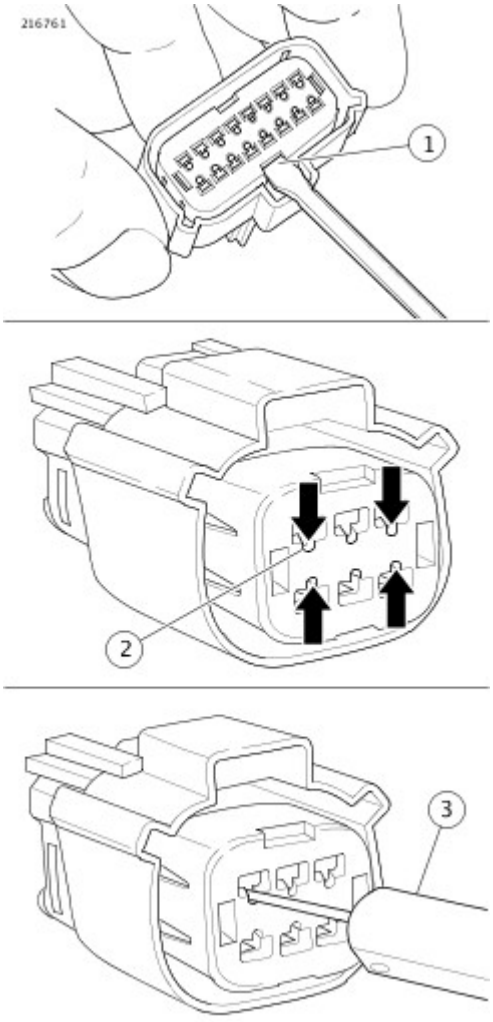
2	Service ports
3	Insert removal tool

Figure 2. Terminal Removal: Male

NOTE

- The secondary lock should never be fully removed from the connector housing. Excessive force may damage the secondary lock.
- Do not apply any lateral force. This may damage the tool or the locking finger.
- Excessive force can damage the lock finger.
- Do not insert the service tool at an angle. This may cause damage to the terminal.
- Do not insert the removal tool into the terminal opening.

1. See **Figure 3**. Insert a small screwdriver into the secondary lock release.
2. Using the housing as a pivot point gently pry out on the secondary lock to unlock.
3. Using the **MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part Number:HD-48114)**, insert the tip into the terminal service ports adjacent to the terminal cavity to be removed.
4. Apply downward pressure to release the lock and remove the wire. If the terminal resists, the removal tool may not be fully engaged. Verify that it has fully disengaged the lock.



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1	Pry up secondary lock
2	Service ports
3	Insert removal tool

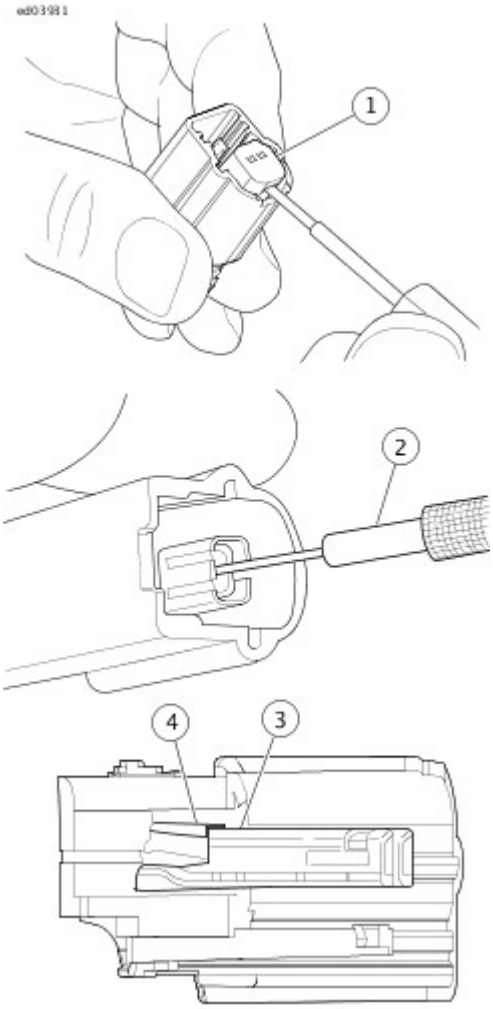
Figure 3. Terminal Removal: Female

1. See **Figure 4**. Using a small blade screwdriver pry up on the secondary lock and remove.

NOTE

Do not use excessive force. Excessive force can damage the lock finger.

2. Using a small blade screwdriver, release the terminal lock. Gently pull on the wire to remove the terminal.



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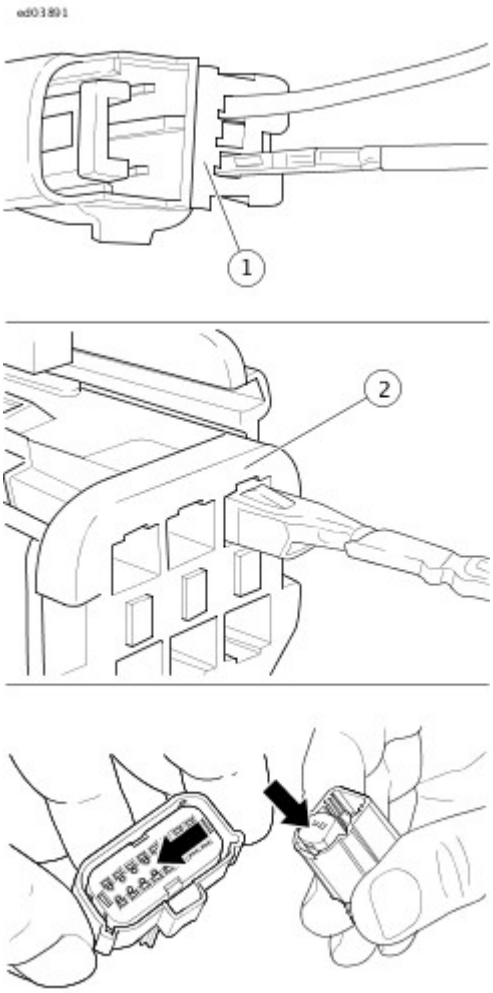
1	Remove secondary lock
2	1 mm pry tool
3	Pry point for terminal lock
4	Primary lock

Figure 4. Removing Terminals in MX64 Series Connector

1. See **Figure 5**. With secondary lock unlocked, align the terminal to rear of connector.
2. Insert the terminal until it stops and locks on the lock finger with an audible click.
3. See **Figure 5**.
    a. On the MX64, install and lock the secondary lock.
    b. On the MX150, push to lock the secondary lock.



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1	MX 64 series
2	MX 150 series

Figure 5. Terminal Installation

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
ROBINAIR HEAT GUN	HD-25070	1
PACKARD CRIMPING TOOL	HD-38125-8	1
ULTRA TORCH UT-100	HD-39969	1
HEAT SHIELD ATTACHMENT	HD-41183	1

NOTE

Refer to Bosch tool instruction sheet for crimping instructions.

Splice connectors and several OEM ring terminal connectors use heat shrink covering to seal the connection.

NOTE

When splicing adjacent wires, stagger the splices so the sealed splice connectors will not touch each other.

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 1**.
3. Strip insulation off the wire lead. Refer to **Table 1**.

Table 1. Sealed Splice Connectors

18-20 (0.5-0.8 mm)	Red	70585-93	3/8	9.5
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8	9.5
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8	9.5

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.

NOTE

The connector is crimped on one side and then the other.

1. See **Figure 1**. Open the **PACKARD CRIMPING TOOL (Part Number:HD-38125-8)** ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws. Insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See **Figure 2**. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert.
5. Squeeze the handles tightly closed to crimp the lead in the insert. 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 until it stops. Crimp the lead in the insert.

WARNING

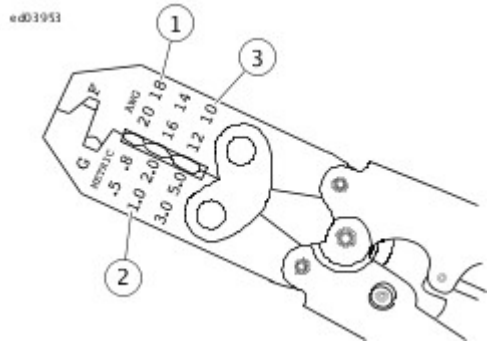
Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any electrical system component that is not being serviced.
- Always keep hands away from tool tip area and heat shrink attachment.

NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

7. Use an **ULTRA TORCH UT-100 (Part Number:HD-39969)**, or a **ROBINAIR HEAT GUN (Part Number:HD-25070)** with a **HEAT SHIELD ATTACHMENT (Part Number:HD-41183)**, to heat the connector from the center of the crimp out to each end.



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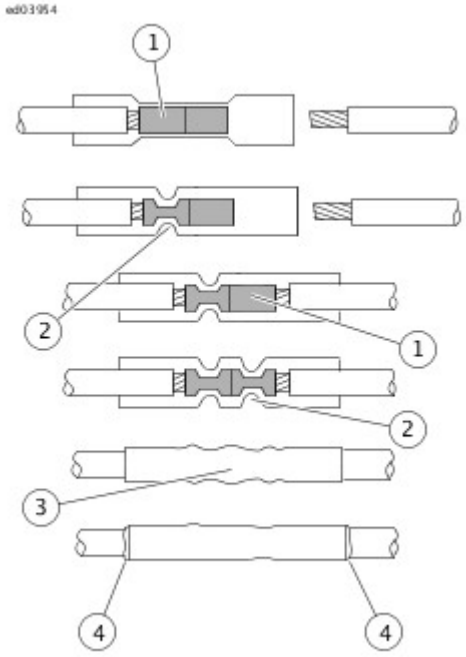
1	Red connector die
2	Blue connector die
3	Yellow connector die

Figure 1. Packard Crimping Tool (HD-38125-8)

See **Figure 2**. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends of the insulation.



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1	Wire lead in metal insert
2	Crimp metal insert
3	Center of crimp
4	Melted SEALANT

Figure 2. Sealed Splice Connector

Special Tools

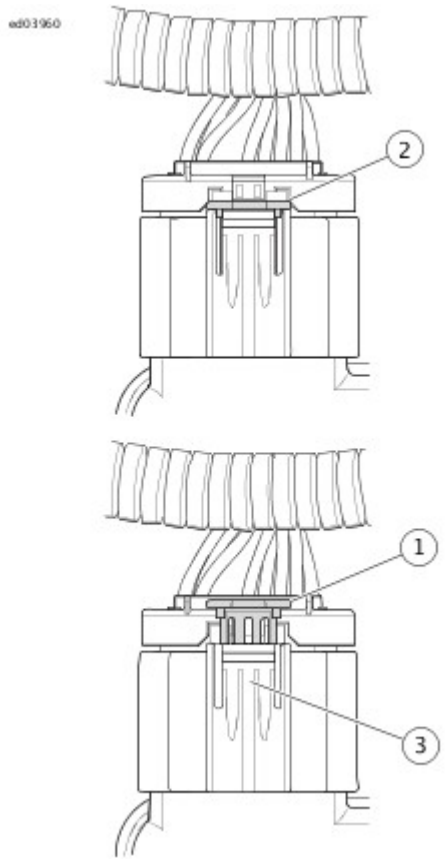
Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
HAND CRIMP FRAME	HD-50120-2	1
TYCO GET 64 DIE	HD-50120-7	1

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **TYCO GET 64 DIE (Part Number:HD-50120-7)** for Tyco GET 64 series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

1. See **Figure 1**. Pull the latch lock open.
2. While pressing the connector latch, pull the connector apart.

1. Align the connector housings.
2. Press the housings together.
3. Push the latch lock closed.



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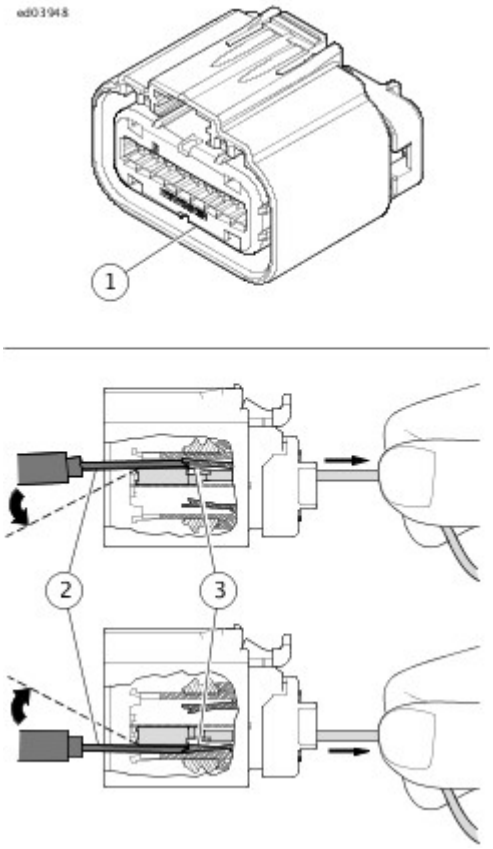
1	Latch lock (open)
2	Latch lock (closed)
3	Connector latch

Figure 1. Tyco GET 64 Sealed Connector Latch and Lock

1. See **Figure 2**. Remove secondary lock from the connector.
2. Insert **TERMINAL EXTRACTOR (Part Number:B-50085)** into the cavity next to the terminal.
3. Pry and hold the tang away from the terminal.
4. Pull on the wire lead to remove the terminal.



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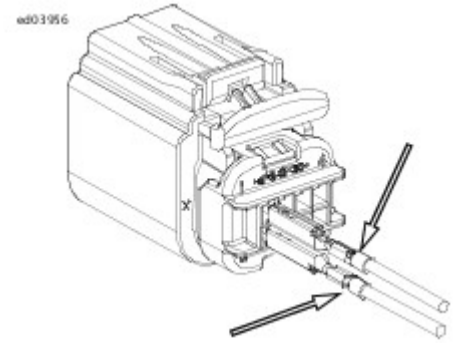
1	Secondary lock
2	Terminal extractor
3	Retention beam

Figure 2. Terminal Removal

1. See **Figure 3**. Align the open side of the crimp to the tang side of the connector cavity.
2. Install the terminal into the connector. Terminal will snap into place.
3. Install secondary lock into the connector.



View interactive image

Figure 3. Socket Terminal Orientation: Crimp Open Side

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

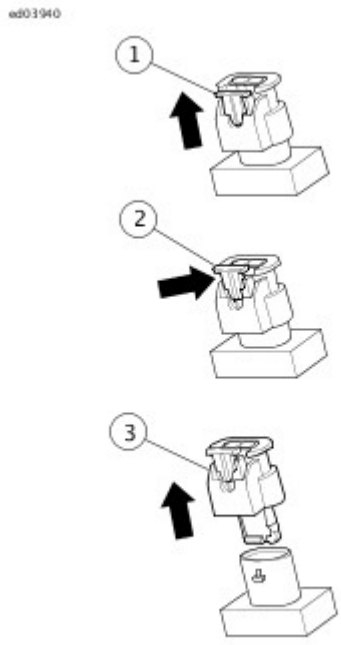
Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
DIE SET	HD-50120-11	1
HAND CRIMP FRAME	HD-50120-2	1

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **DIE SET (Part Number:HD-50120-11)** for Tyco MCON series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Pull the safety lock up, press the safety lock to the connector and release, pull and separate the two halves.



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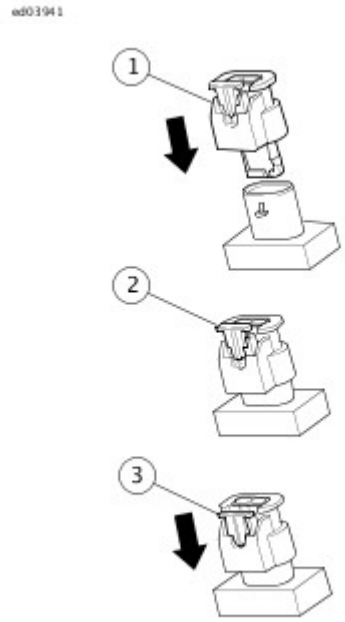
1	Pull safety lock
2	Press safety lock
3	Pull and separate connector

Figure 1. Separating Connector

See **Figure 2**. Push the halves of connector together, listen for click of the safety lock, then push the safety lock down.



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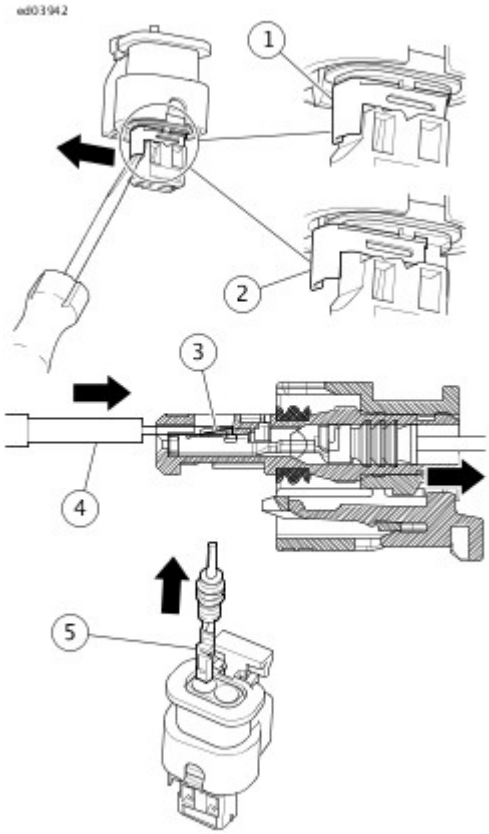
1	Push connectors together
2	Listen for click
3	Push safety lock down

Figure 2. Mating Connector

1. See **Figure 3**. Using a screwdriver, release the secondary lock.
2. Insert **TERMINAL EXTRACTOR (Part Number:B-50085)** into primary lock.
3. The terminal can be removed by pulling on the wire while simultaneously applying slight press to disengage the primary lock.



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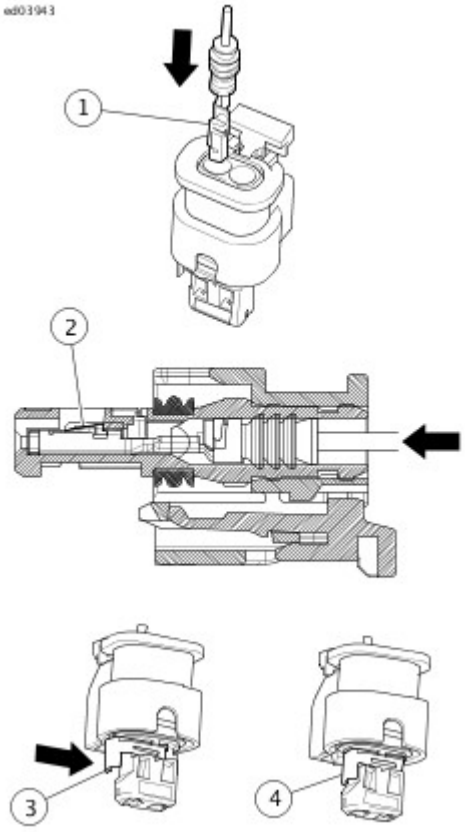
1	Secondary lock in locked position
2	Secondary lock in unlocked position
3	Primary lock
4	Removal tool
5	Remove terminal

Figure 3. Removing Terminal

NOTE

Proper orientation of terminal required.

1. See **Figure 4**. Insert terminals into connector until an audible click is heard or lock is felt.
2. Push secondary lock into locked position.



View interactive image

1	Terminal
2	Primary lock
3	Secondary lock in unlocked position
4	Secondary lock in locked position

Figure 4. Inserting Terminal

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

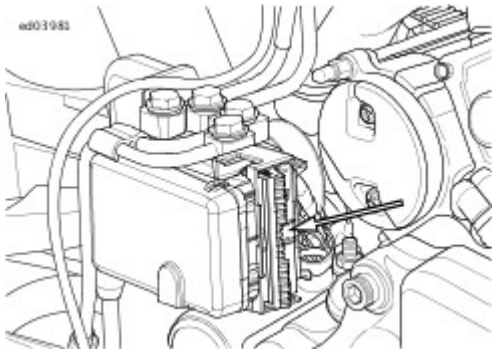
Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
SNAP-ON TERMINAL PICK	GA500A	1
HAND CRIMP FRAME	HD-50120-2	1
TYCO MCP DIE	HD-50120-8	1

The Tyco MCP sealed connector is used on certain ABS modules.

NOTE

Use **HAND CRIMP FRAME (Part Number:HD-50120-2)** with **TYCO MCP DIE (Part Number:HD-50120-8)** for Tyco MCP series terminal crimping. Refer to Bosch tool instruction sheet for crimping instructions.

See **Figure 1**. Press and hold the lock tab. Pulling on both ends of the lever, open the lever.



View interactive image

Figure 1. Tyco MCP Connector Release Bar

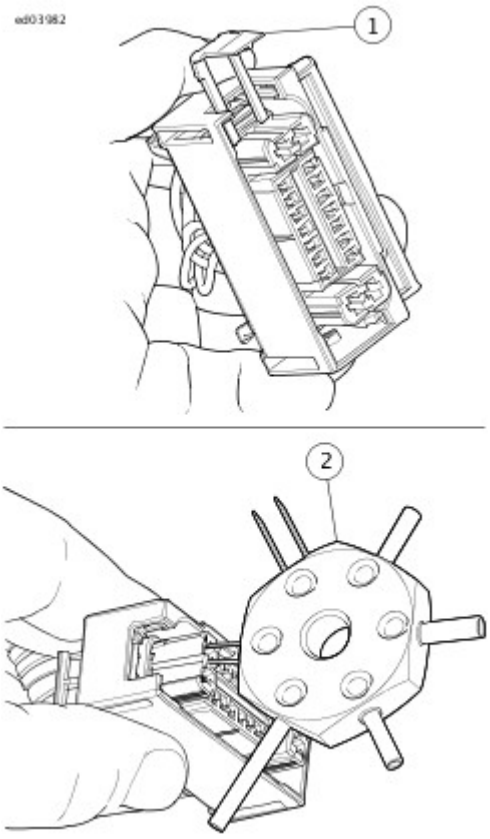
Gently mate the pins to the socket. Press and hold the lock tab. Pressing on both ends of the lever, close the lever.

1. Snap the wire harness cover off of the back of the connector

NOTE

Insert a thin flat bladed screwdriver all the way to the bottom behind the tab of the secondary lock.

2. See **Figure 2**. Gently slide the secondary lock out of the connector with a screwdriver.
3. Insert the smallest pins of the **SNAP-ON TERMINAL PICK (Part Number:GA500A)** into the gaps on each side of the terminal to compress the tangs on each side of the terminal.
4. Gently pull on the wire to remove the terminal.



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1	Secondary lock
2	Terminal pick

Figure 2. Removing Small Socket Terminals

1. Snap the wire harness cover off of the back of the connector

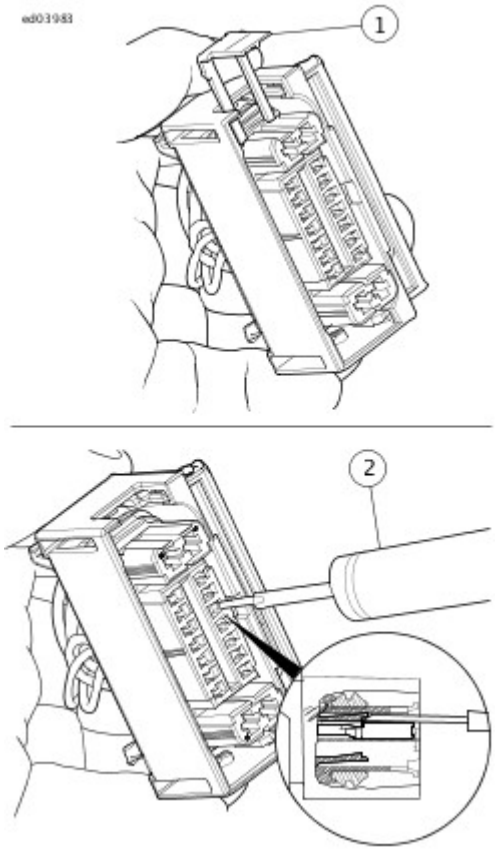
NOTE

Insert a thin flat bladed screwdriver all the way to the bottom behind the tab of the secondary lock.

2. Gently slide the secondary lock out of the connector with a screwdriver.
3. See **Figure 3**. Insert the **TERMINAL EXTRACTOR (Part Number:B-50085)** into the cavity on the outside of

the terminal.

4. Tilt extractor to lift the latch and release the terminal.
5. Gently pull on the wire to remove the terminal.



View interactive image

1	Secondary lock
2	Terminal extractor

Figure 3. Removing Small Socket Terminals

1. Locate the wire lead cavity by number.
2. Use a hobby knife to bend the tangs on each side of the terminal outward.
3. Align the terminal.
4. Push the terminal in until it clicks.
5. Press the secondary lock back into the connector.
6. Snap the wire cover in place.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals

or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1
AMP MULTILOCK CRIMPER	HD-41609	1
MULTI-LOCK CRIMPER	HD-44695-A	1

Tyco Multilock Unsealed connectors are found between wire harnesses and component wiring. They are either floating or anchored to the frame with attachment clips. To maintain serviceability, always return connectors to OEM locations after service.

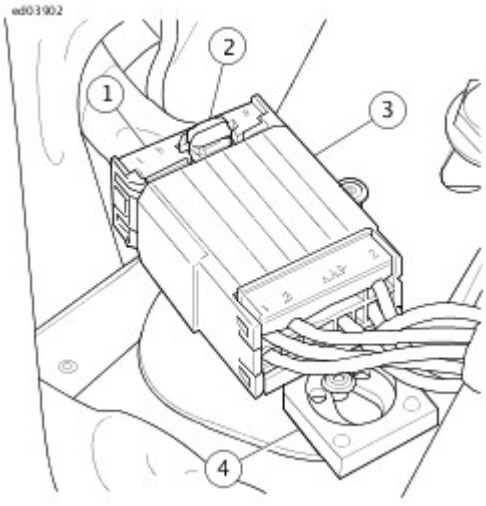
NOTE

- Use the **AMP MULTILOCK CRIMPER (Part Number:HD-41609)** for 070 Multilock terminal crimping.
- Use the **MULTI-LOCK CRIMPER (Part Number:HD-44695-A)** for 040 Multilock terminal crimping.

Refer to Bosch tool instruction sheet for crimping instructions.

1. If necessary, slide connector attachment clip so T-stud is in the large end of the clip opening. Remove connector from T-stud.
2. See **Figure 1**. Press the release button and pull the connector halves apart.

1. Hold the connectors to match wire color to wire color.
2. Align the terminals and press the connectors together until they click in place.
3. If OEM location is a T-stud, fit large opening end of attachment clip over T-stud. Slide connector to engage T-stud to small end of opening in clip.



View interactive image

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

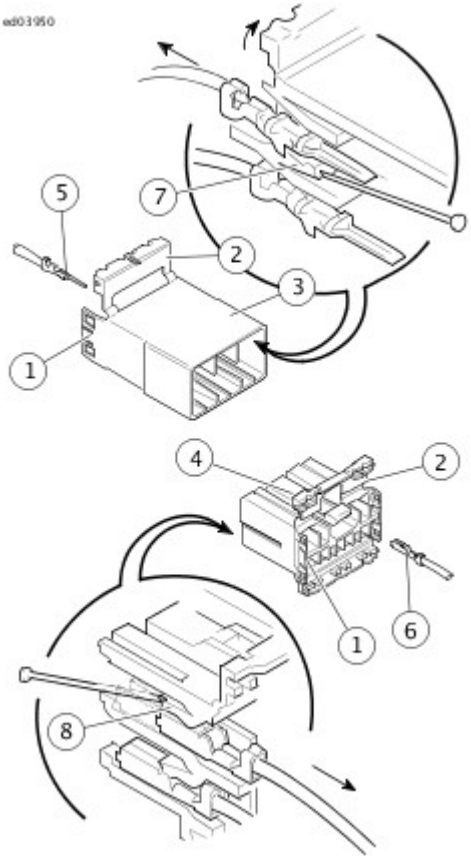
Figure 1. Tyco Multilock Unsealed Connector

1. See **Figure 2**. Bend back the latch to free one end of secondary lock 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. Using **TERMINAL EXTRACTOR (Part Number:B-50085)**, press the tang in the housing to release the terminal.
    a. **Socket:** Lift the socket tang up.
    b. **Pin:** Press the pin tang down.

NOTE

If the tang is released, a click is heard.

4. Gently pull on wire to remove terminal from cavity.



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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 2. Tyco 070 Multilock Unsealed Connector: Socket and Pin Housings

NOTE

- Match the wire color to the cavity number found on the wiring diagram.

The release button is always on the top of the connector.

- On the pin side of the connector, tangs are positioned at the bottom of each cavity. Therefore, 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. Therefore, the socket terminal slot (on the same side as the crimp tails) must face upward.

1. Hold the terminal so the catch faces the tang in the cavity. Insert the terminal into its numbered cavity until it snaps in place.
2. Gently tug on wire ends to verify that all terminals are locked.
3. Rotate the hinged secondary lock inward until tabs are fully engaged on both sides of connector.

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Special Tools

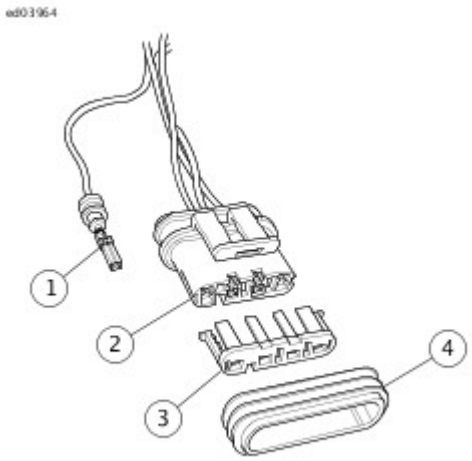
Description	Part Number	Qty.
TERMINAL EXTRACTOR	B-50085	1

1. Lift locking tab.
2. Pull the connector apart.

1. Align the connector housings.
2. Press the housings together until the locking tab snaps into place.

1. File the edge of a **TERMINAL EXTRACTOR (Part Number:B-50085)** to a 45 degree angle.
2. See **Figure 1**. Remove seal from connector.
3. Lift locking tab on either side of connector and remove secondary lock.
4. Insert the extractor into the cavity next to the terminal. Press the retainer away from the terminal.
5. Gently pull the wire to remove the terminal from the connector.

1. Align terminal to the connector.
2. Install the terminal into the connector until it snaps into place.
3. Gently pull wire to verify terminal is locked.
4. See **Figure 1**. Install secondary lock into connector.
5. Install seal.



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1	Terminal
2	Connector
3	Secondary lock
4	Seal

Figure 1. Tyco SuperSeal 1.5 Sealed Connector

The terminals and connector assemblies are not repairable. Discard and replace any defective or damaged terminals or connector assemblies. Do not re-use a terminal by removing the wire.

Refer to the table below for a list of common acronyms and abbreviations.

Table 1. Acronyms and Abbreviations

A	Amperes
AAT	Ambient air temperature
ABS	Anti-lock braking system
AC	Alternating current
ACC	Accessory position on ignition switch
ACR	Automatic compression release
AGM	Absorbed glass mat (battery)
Ah	Ampere-hour
AIS	Active intake solenoid
AWG	American wire gauge
B+	Battery voltage
bar	Bar
BAS	Bank angle sensor
BCM	Body control module
BOB	Breakout box
BTDC	Before top dead center
°C	Celsius (Centigrade)
CA	California
CAL	Calibration
CAN	Controller area network
CB Tx	CB send transmission
CB Rx	CB receive transmission
cc	Cubic centimeters
CCA	Cold cranking amps
CCW	Counterclockwise

CKP	Crankshaft position
cm	Centimeters
cm^3	Cubic centimeters
CW	Clockwise
DC	Direct current
DLC	Data link connector
DOM	Domestic
DOT	Department of Transportation
DTC	Diagnostic trouble code
DVOM	Digital volt ohm meter
ECM	Electronic control module
ECT	Engine coolant temperature
ECU	Electronic control unit
EEPROM	Electrically erasable programmable read only memory
EFI	Electronic fuel injection
EHCU	Electro hydraulic control unit
ET	Engine temperature
ETC	Electronic throttle control
EVAP	Evaporative emissions control system
°F	Fahrenheit
fl oz	Fluid ounce
FPS	Fuel pressure sensor
ft	Feet
ft-lbs	Foot pounds
FTP	Flash to pass
g	Gram
gal	Gallon
GAWR	Gross axle weight rating

GND	Ground (electrical)
GPS	Global positioning system
GVWR	Gross vehicle weight rating
HCU	Hydraulic control unit
HDI	Harley-Davidson International
HD-Link	Networking system
H-DSSS	Harley-Davidson smart security system
HFM	Hands-free mode
HFSM	Hands-free security module
Hg	Mercury
H02S	Heated oxygen sensor
hp	Horsepower
hr	Hour
IAC	Idle air control
IAT	Intake air temperature
IC	Instrument cluster
ID	Inside diameter
IGN	Ignition light/key switch position
IM	Instrument module
in	inch
in^3	Cubic inch
INJ PW	Injector pulse width
INTCM	Intercom
in-lbs	Inch pounds
JSS	Jiffy stand sensor
kg	Kilogram
km	Kilometer
km/h	Kilometers per hour
kPa	Kilopascal

kW	Kilowatt
KS	Knock sensor
L	Liter
lb	Pounds
LCD	Liquid crystal display
LED	Light emitting diode
LH	Left hand
LHCM	Left hand control module
LP	License plate
LT	Left
mA	Milliampere
MAP	Manifold absolute pressure
max	Maximum
mi	Mile
min	Minimum
mL	Milliliter
mm	Millimeter
mph	Miles per hour
ms	Millisecond
Nm	Newton-meter
NIM	Navigation interface module
NiMH	Nickel metal hydride
N/A	Not applicable
O2	Oxygen
OD	Outside diameter
OEM	Original equipment manufacturer
oz	Ounce
P&A	Parts and Accessories

Part No.	Part number
PIN	Personal identification number
PND	Personal navigation device
psi	Pounds per square inch
PWM signal	Pulse width modulated signal
qt	Quart
RAD	Radio
RCM	Reverse control module
RDS	Radio data system
RES	Reserve mark on fuel supply valve
RH	Right hand
RHCM	Right hand control module
rpm	Revolutions per minute
RT	Right
s	Seconds
SCFH	Cubic feet per hour at standard conditions
SDARS	Satellite digital audio radio service
SPDO	Speedometer
SPKR	Speaker
STT	Stop/tail/turn
TA	Traffic announcement
TCA	Throttle control actuator
TDC	Top dead center
TGS	Twist grip sensor
TPMS	Tire pressure monitoring system
TPS	Throttle position sensor
TSM	Turn signal module
TSSM	Turn signal/security module
TT	Telltale

USB	Universal serial bus
V	Volt
VAC	Volts of alternating current
VDC	Volts of direct current
VIN	Vehicle identification number
VR	Voice recognition
VSS	Vehicle speed sensor
W	Watt
WA	Weather alert
WHIM	Wireless headset interface module
WSS	Wheel speed sensor

Table 1. Metric Conversions

.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1-15/16	49.21	5
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3-
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2-1/16	52.39	3
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	7
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2-1/8	53.97	3-
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2-3/16	55.56	9
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2-1/4	57.15	3-
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	1
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2-5/16	58.74	3
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2-3/8	60.32	3-
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1-1/16	26.99	2.4	60.96	3
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2-7/16	61.91	13
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-
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
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	15
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1-1/4	31.75	2-5/8	66.67	
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2-11/16	68.26	1

10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1-5/16	33.34	2.7	68.58	4
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-
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	3
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
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-
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
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2-15/16	74.61	5
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1-5/8	41.27	3	76.20	4-
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
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	7
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-
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3-3/16	80.96	9
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
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-
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	1

Unless otherwise specified, all fluid volume measurements in this manual are expressed in United States (U.S.) units-of-measure. See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

Fluid volume measurements in this manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). To convert between U.S. units-of-measure and metric units-of-measure, refer to the following:

- fluid ounces (U.S.) 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.)

Fluid volume measurements in this manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. To convert between U.S. units and British Imperial units, refer to the following:

- fluid ounces (U.S.) 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.)

The U.S. units of torque, foot pounds and inch pounds, are used in this 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)

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)