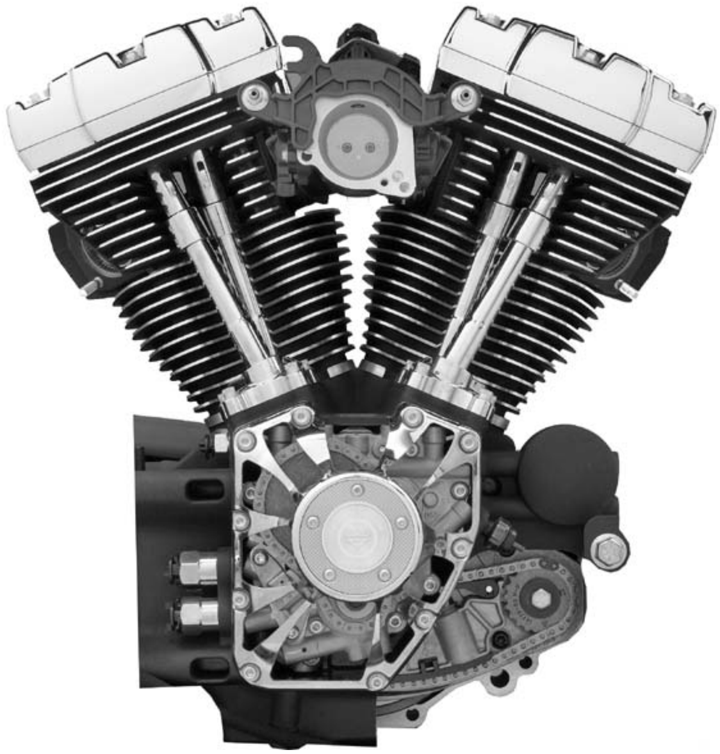
SkillsUSA
2012 Contest Projects

Motorcycle Service Technology

Click the “Print this Section” button above to automatically print the specifications for this contest. Make sure your printer is turned on before pressing the button.

1	**350**	Air Cooled Engine Assembly
2	**150**	Steering Head Bearing Adjustment
3	**150**	Meter Usage/Measuring
4	**50**	HD PHD Testing
5	**100**	Wheel Bearing R&R
6	**50**	MMI - Theory Test
7	**100**	Oral Proficiency
8	**40**	MMI - Manual Test
9	**10**	MMI - Industry Essay

2012 SkillsUSA Championships
Motorcycle Service Technology Contest



Harley-Davidson Twin Cam
Oil Pump, Camshafts and Valve Train Assembly Station
350 points

Sponsored by Harley-Davidson University®

Participant Work Sheet

Time Limit 2 Hours

2012 Skills USA Harley-Davidson Oil Pump, Camshaft and Valve Train Installation Station

Participant # ____________________

Judge__________________________

Items below to be filled out by the participant: (5 points per question)

1) What is done to the motor while initially "snugging" the (4) oil pump fastener screws?

2) Initial oil pump torque specification (not including initial "snug"): ____________________

3) Final oil pump fastener torque specification:________________________

4) Order of tightening oil pump fasteners: #_____ #_____ #_____ #_____

5) Initial rear camshaft fastener torque:____________________

6) Final rear camshaft fastener torque:_____________________

7) Initial crankshaft sprocket fastener Torque:_______________

8) Final crankshaft fastener torque:________________________

2012 Skills USA Harley-Davidson Oil Pump, Camshaft and Valve Train Installation Station

JUDGE GRADING SHEET AND ANSWER KEY TOTAL POINTS_________

Participant # ______________

Judge ____________________

CIRCLE ZERO IN FIRST COLUMN IF INCORRECT / ERROR
CIRCLE VALUE IN SECOND COLUMN IF CORRECT

0	20	Properly phased camshafts when installing into cam support plate (dots faced each other)
0	20	Installed proper spacer onto front camshaft
0	10	Properly installed circlip onto front camshaft (Sharp Side out - MUST be seated all the way and MUST have worn safety glasses)
0	15	Properly assembled and installed hydraulic tensioners
0	10	Properly installed oil pump o-ring into crankcase
0	10	Properly installed oil filter screen and o-rings into crankcase
0	10	Properly installed oil pump body into crankcase
0	20	Properly installed oil pump internal components
0	20	Properly tightened oil pump fasteners while rotating engine (it is acceptable if they tightened all 4 while rotating engine)
0	20	Properly selected spacer for rear cam shaft and installed chain and sprocket assemblies. Demonstrated that they pushed the crank and cam components into case prior to taking sprocket measurements.
0	20	Properly installed valve lifters
0	15	Properly installed lifter anti-rotation pin, gasket and lifter cover
0	20	Properly installed pushrod tubes
0	20	Properly installed pushrods (silver intake, black exhaust)
0	25	Properly installed rocker arm assembly
0	15	Properly installed breather assembly
0	10	Properly installed rocker cover
0	10	Properly installed camcover
0	5	Properly torqued all components till end of timed session
0	15	Motor completely assembled and fasteners torqued properly

0 40 or________ Answered all questions correctly - 5 points/question

_________ TOTAL POINTS

1. What is done to the motor while initially "snugging" two of the oil pump fastener screws?
   Rotate the motor using the crankshaft wrench
2. Initial oil pump torque specification (after "snug"): **40-45 in-lb**
3. Final oil pump fastener torque: **90 in-lb**
4. Order of tightening oil pump fasteners: **1 - 2 - 3 - 4**
5. Initial rear camshaft fastener torque: **15 ft-lb**
6. Final rear camshaft fastener torque: **34 ft-lb**
7. Initial crankshaft sprocket fastener Torque: **15 ft-lb**
8. Final crankshaft fastener torque: **24 ft-lb**

2012 SkillsUSA Championships
Motorcycle Service Technology Contest

Harley-Davidson Twin Cam
Oil Pump, Camshafts and Valve Train Assembly Station
350 points

Sponsored by Harley-Davidson University®

Workstation Information

Time Limit 2 Hours

OBJECTIVE:

Given the tools, various engine components and workstation reference materials, participants will need to correctly assemble and install the oil pump, camshafts, and valve train of a Harley-Davidson Twin Cam engine.

Specific Skills:

Participants will perform the following:

1. Assemble and install the oil pump assembly
2. Assemble the two camshafts in the cam support plate with proper timing using the special tool
3. Install the appropriate O-Rings and oil screen in their respective locations
4. Install the cam support plate and properly time the rear cam with the crankshaft
5. Correctly measure the height alignment of rear cam to crankshaft sprocket
6. Choose the appropriate shim to align the cam sprocket
7. Install the remaining valve train
8. Demonstrate the proper use of torque wrenches and tool usage
9. Clean and organize the work area for the next student

Important: This document includes the service literature that is essential to your success at this station.

The tasks you must perform at this station are to properly install an oil pump, camshafts, cam support plate, o-rings, oil filter screen, hydraulic tensioners, cam timing chains, valve lifters and remaining valve train in a Harley-Davidson Twin Cam engine. You will be graded on following proper service and safety procedures. This includes wearing safety glasses.

It is highly advisable that you familiarize yourself with the provided literature before attempting this station.

All small ¼" fasteners will be torqued to a final torque of 90 in/lb. This includes the oil pump.

The fasteners for the oil pump, the rear cam shaft and the crank sprocket all have specific instructions on initial and final torque procedures.

Assembly lubricant and Loctite will not be used due to time constraints. However, it is essential that you understand that when assembling an engine that will be run, it is critical that assembly lubricant and Loctite be used wherever the service literature instructs you to do so.

The rear of the engine is attached to the engine stand.

The hydraulic tensioners must be assembled as shown in figure 3-99 on page 3.

Page 1, Step #7. Prior to installing the cam support plate, (2) O-rings and a filter screen must be installed. Using figure 3-117 on page 1 as a reference, first install the metal filter screen into hole #2 and then install an O-ring into hole #1 and hole #2.

Very specific instructions are given regarding how the engine should be oriented on the engine stand in order to align the rear cam sprocket (large) and crankshaft sprocket (small).

It is acceptable to either have the cam compartment facing completely upward or a 45 degree angle upward. If you need physical assistance with this, please ask your judge, and he or she will assist you with re-orienting the engine on the stand.

Be certain to demonstrate to your judge that you followed Step "d" on page 5.

Page 4, when performing the procedure to tighten the oil pump screws, it is acceptable to ask your judge for physical assistance if you are finding the procedure to be awkward.

OIL PUMP

1. See Figure 3-118 part identifications of the oil pump.

2. Install O-ring (6) on scavenge port stub of oil pump housing.

3. Slide oil pump housing (5) onto crankshaft while fitting O-ring on scavenge port stub into crankcase bore.
   Firmly push on scavenge port stub with thumb to verify that it is snug in bore.
   Inspect O-ring to verify that it is not pinched or distorted.

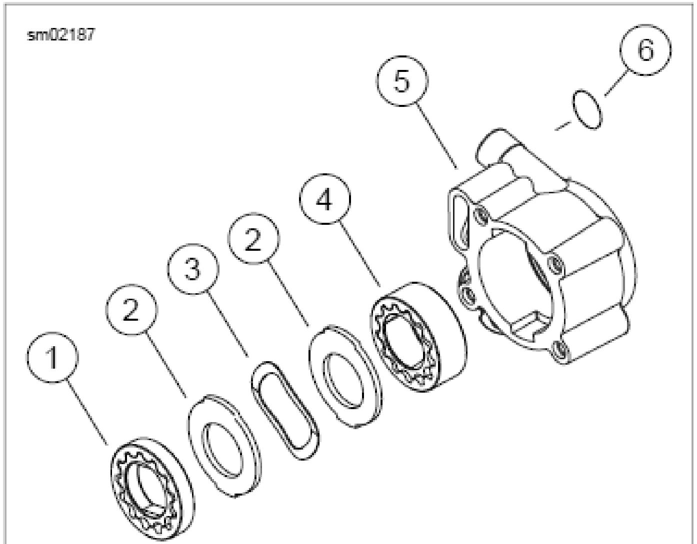
4. Assemble the wide gerotor set (4). Install on the crankshaft until it bottoms in the oil pump housing.

5. Install inside separator plate (2) on the crankshaft until it contacts the wide gerotor set (4). Install wave washer (3) and outside separator plate (2).

6. Assemble the narrow gerotor set (1). Install on the crankshaft until it contacts the outside separator plate (2).

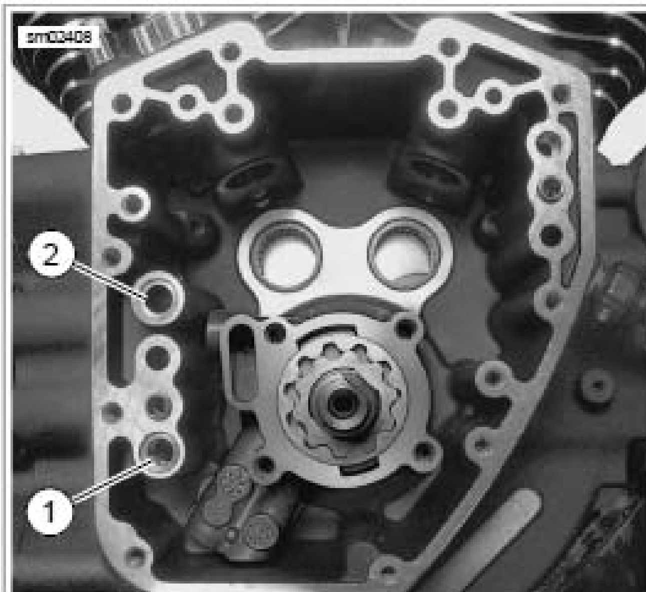
7. See Figure 3-117. Install filter screen in port (2) followed by O-rings (1, 2) for crankcase post.

8. Complete engine assembly. See CAM COMPARTMENT AND COMPONENTS and TOP END OVERHAUL



1. Narrow gerotor set (feed)
2. Separator plate
3. Wave washer
4. Wide gerotor set (scavenge)
5. Oil pump housing
6. Scavenge port O-ring

Figure 3-118. Assembling Oil Pump



1. Oil feed hole O-ring
2. O-ring on crankcase post

Figure 3-117. Oil Pump O-rings

Installation

1. See Figure 3-96. Align timing marks on teeth of secondary cam sprockets.

NOTE
Do not mix camshafts during installation. The rear camshaft, identified by the splined shaft, must go into the hole at the rear of the cam support plate.

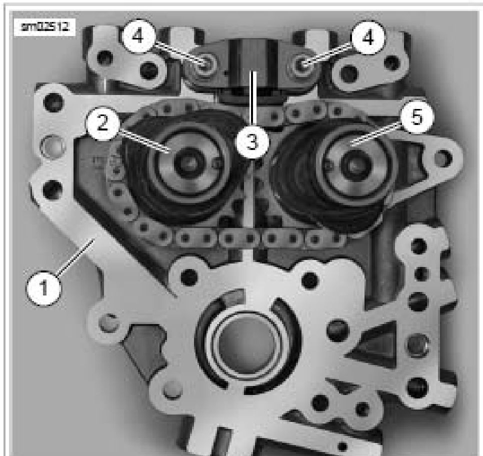
2. Place secondary cam chain around sprockets of both front and rear camshafts while keeping timing marks (3) in alignment.

3. See Figure 3-97. Obtain CAMSHAFT ASSEMBLY TOOL(Part No. HD-47956). Place crankcase side of camshaft/cam chain assembly into assembly tool base (7) while maintaining cam timing mark (6) alignment.

4. Place small guide (2) on rear camshaft (1). Place large guide (4) on front camshaft (3).

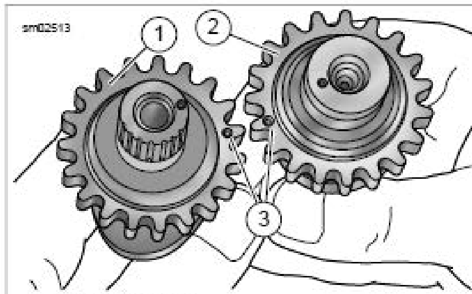
5. Install cam support plate over guides.

6. Remove guides and base.



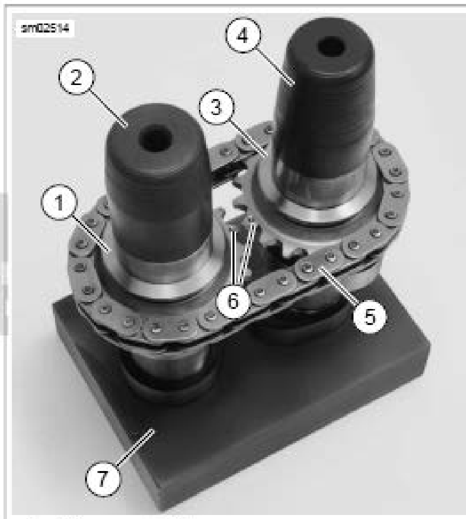
1. Cam support plate
2. Front cam
3. Secondary cam chain tensioner
4. Secondary cam chain tensioner fasteners
5. Rear cam

Figure 3-95. Camshafts



1. Rear camshaft
2. Front camshaft
3. Timing marks

Figure 3-96. Camshaft Timing Marks

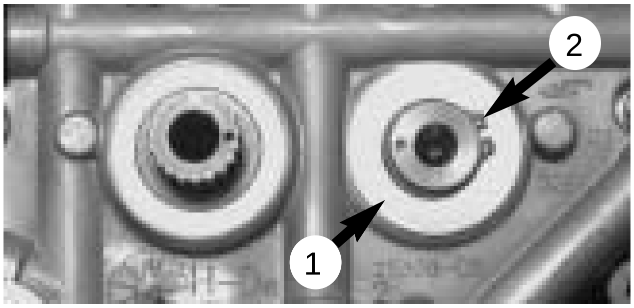


1. Rear camshaft
2. Small guide
3. Front camshaft
4. Large guide
5. Cam chain
6. Timing marks
7. Assembly tool base

Figure 3-97. Camshaft Assembly Tool

7. See Figure 3-98. Using a straightedge, verify that the timing marks are in alignment. If they are not, then the camshafts must be removed, realigned and reinstalled.

8. See Below. Install 0.100 in. thick front camshaft spacer (1) over end of front camshaft.



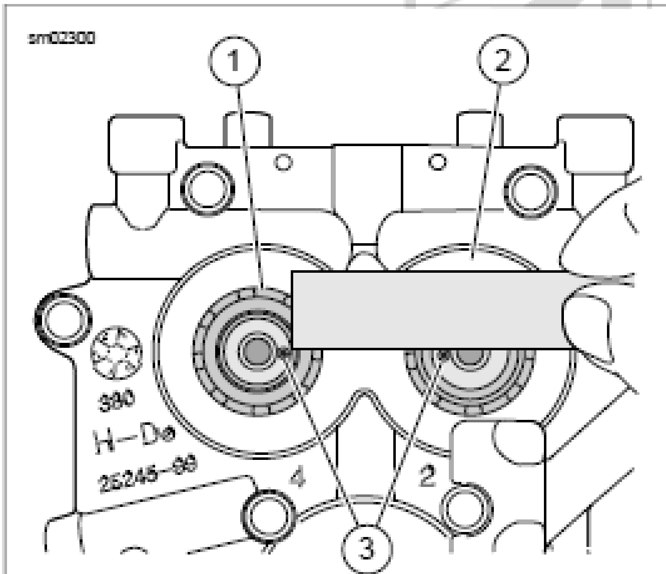
9. See above. With the sharp edge out, install new retaining ring (2) in groove at end of front camshaft.

10. Inspect primary and secondary cam chain tensioners.

    a. Inspect tensioners for wear. Replace tensioners if damaged or if chain contact portion of shoe material is less than 0.060 in. thick.

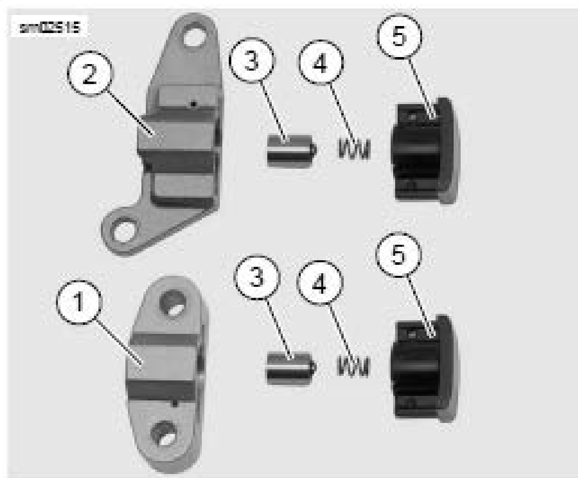
    b. See Figure 3-99. Be sure primary and secondary cam chain tensioners are assembled as shown. If assembled incorrectly, tensioners will not function properly.

11. See figure 3-95. Install secondary cam chain tensioner and fastenters. Tighten to 90 in-lbs.



1. Rear camshaft
2. Front camshaft
3. Timing marks

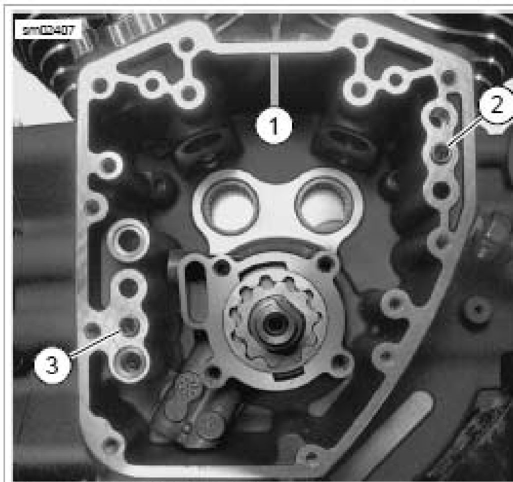
Figure 3-98. Verify Alignment of Timing Marks



1. Secondary cam chain tensioner
2. Primary cam chain tensioner
3. Piston
4. Spring
5. Shoe

Figure 3-99. Cam Chain Tensioner Assemblies

12. See figure 3-94. Slide cam support plate over crank shaft and onto two ring dowels in crankcase flange. Use a rubber mallet to fully seat cam support plate on ring dowels.



1. Right crankcase half
2. Forward ring dowel
3. Rear ring dowel

Figure 3-94. Ring Dowels

NOTE

The cam support plate and cam cover uses two different screw sizes. The support plate screws are shorter. Verify screws are installed in the proper locations.

13. See Figure 3-111. Install cam support plate screws. Tighten to 90 in-lbs in the sequence shown.

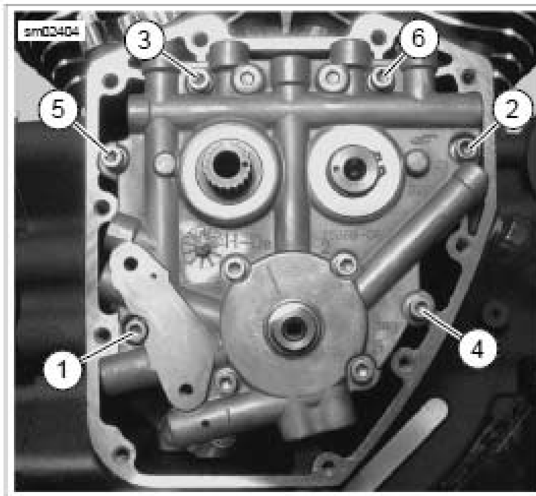


Figure 3-111. Cam Support Plate Torque Sequence

14. See Figure 3-112. Secure oil pump.

a. Start four screws to secure oil pump.

NOTE

Rotating the crankshaft while tightening screws will allow the oil pump to find its natural center. With engine mounted in engine stand: Install CRANK SHAFT ROTATING WRENCH on sprocket shaft and rotate counterclockwise.

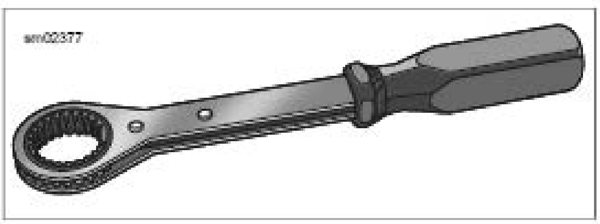


Figure 3-19. Crankshaft Rotating Wrench

b. While rotating the crankshaft, install screws (1 and 2) until snug.

c. Install screws (3 and 4) until snug.

NOTE

Numbers cast adjacent to the bolt holes indicate the oil pump torque sequence.

d. Tighten all four screws to 40-45 in-lbs in the sequence shown.

e. Final tighten all four screws to 90 in-lbs in the sequence shown.

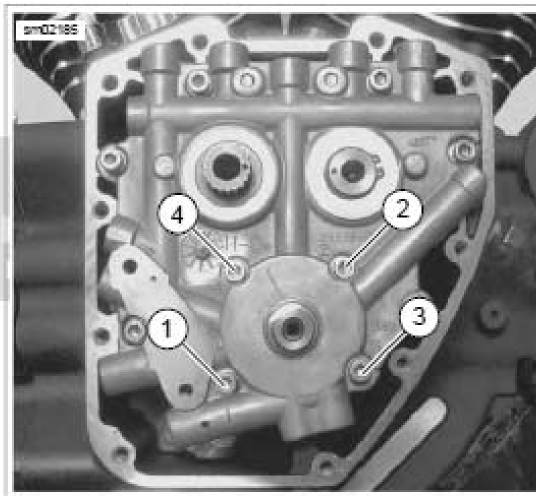


Figure 3-112. Oil Pump Torque Sequence

15. With the lettering facing inboard, install rear cam sprocket spacer onto the rear camshaft.

16. Sprocket alignment. See figure 3-91

a. Install primary cam sprocket without chain using the long flange bolt with thicker flat washer.

b. Install crankshaft sprocket without chain using the short flange bolt and a flat washer.

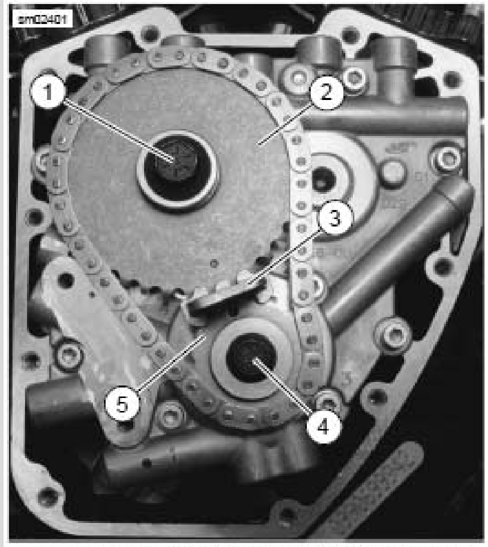
c. Position the CRANKSHAFT SPROCKET LOCKING TOOL (Part No. HD-47941) between the crankshaft and primary cam sprockets. Tighten both sprocket flange bolts to 15 ft-lbs. Remove the sprocket locking tool.

d. Rotate engine stand so cam compartment is pointing upward. Push on crankshaft and rear camshaft to eliminate endplay.

e. See Figure 3-113. Place a straightedge across the sprocket faces. Attempt to insert a 0.010 in. feeler gauge between the straightedge and the each sprocket face. If the feeler gauge will not fit at either location, sprocket offset is within specification. Remove both sprockets.

f. If measurement is not within specification, replace the rear cam sprocket spacer using Table 3-41 as a guide.

g. Repeat alignment inspection with the new spacer installed.
Remove both sprockets when measurement is within specification.



1. Rear cam sprocket bolt (large) and flat washer
2. Rear cam sprocket
3. Camshaft locking tool
4. Crank sprocket bolt (small) and flat washer
5. Crank sprocket

Figure 3-91. Cam Support Plate Assembly

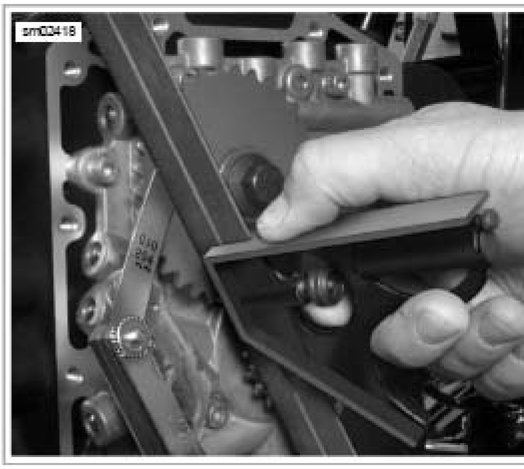


Figure 3-113. Check Alignment of Crank and Rear Cam Sprocket Faces

Table 3-41. Rear Cam Sprocket Spacers

PART NO.	IN.	MM.
25729-06	0.100	2.54
25731-06	0.110	2.79
25734-06	0.120	3.05
25736-06	0.130	3.30
25737-06	0.140	3.56
25738-06	0.150	3.81

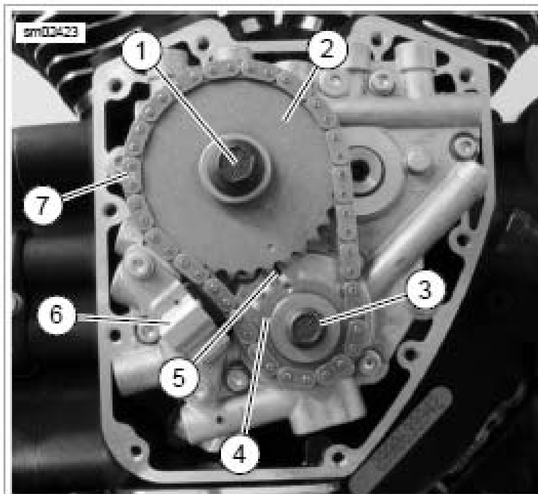
17. See Figure 3-114. Install the primary cam chain and sprocket assembly.

    a. Place both cam sprockets (2, 4) in the primary chain with the timing marks (5) aligned.

    b. With the timing marks (5) in alignment, start the rear cam sprocket onto the end of the rear camshaft. Note that the sprocket has an integral key that must be aligned with the keyway in the camshaft.

    c. Maintaining the position of the crankshaft sprocket on the chain, rotate the rear cam sprocket clockwise until the flat on the crankshaft sprocket is aligned with the flat on the crankshaft.
    Install the crankshaft sprocket.

18. Rotate the crankshaft clockwise until the timing marks on the sprockets are aligned and also aligned with alignment mark (5) on cam support plate.



1. Rear cam sprocket bolt (large) and flat washer
2. Rear cam sprocket
3. Crank sprocket bolt (small) and flat washer
4. Crank sprocket
5. Alignment mark on support plate
6. Primary chain tensioner
7. Marked link

Figure 3-114. Primary Chain and Sprockets

NOTE

The crankshaft and rear cam sprocket flange bolts and flat washers are not interchangeable.

19. Apply a film of oil to bottom of both sprocket bolt heads and washers. Loosely install to secure sprockets

.

20. See figure 3-91. Position the CRANKSHAFT SPROCKET LOCKING TOOL (3) between the crankshaft and rear cam sprockets to prevent rotation. The handle of the tool is stamped "Crank" and "Cam" to verify proper orientation.

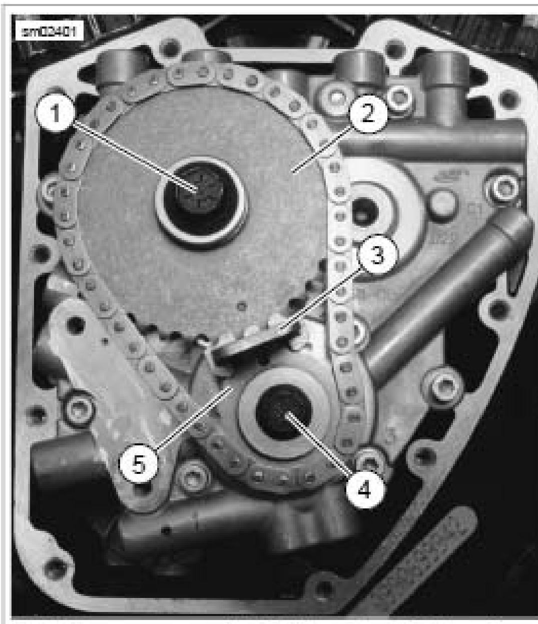
    a. Tighten both sprocket bolts (1, 4) to 15 ft-lbs.

    b. Loosen both bolts one revolution (360 degrees).

    c. Final tighten the rear cam sprocket bolt (1) to 34 ft-lbs

    d. Final tighten the crankshaft sprocket bolt (4) to 24 ft-lbs.

    e. Remove the sprocket locking tool.



1. Rear cam sprocket bolt (large) and flat washer
2. Rear cam sprocket
3. Camshaft locking tool
4. Crank sprocket bolt (small) and flat washer
5. Crank sprocket

Figure 3-91. Cam Support Plate Assembly

21. See Figure 3-116. Secure cover with socket head screws.
Following the sequence shown, tighten the screws to 90 in-lbs.

22. Complete motorcycle assembly see TOP END OVERHAUL: ASSEMBLY.

Figure 3-116. Cam Cover Screws

PUSH RODS, LIFTERS AND COVERS

1. Install lifters in the crankcase bores with the oil hole on the inboard side and the flats on the lifters facing forward and rearward. To avoid damage, do not drop lifters onto cam lobes.

2. See Figure 3-83. Place the anti-rotational pin (4) on the machined flat between the blocks cast into the crankcase.

NOTE

During cover installation, verify that the anti-rotational pin (4) is held in place by the ribs (3) cast into the inboard side of the lifter cover. Movement or loss of the pin can result in lifter rotation causing engine damage.

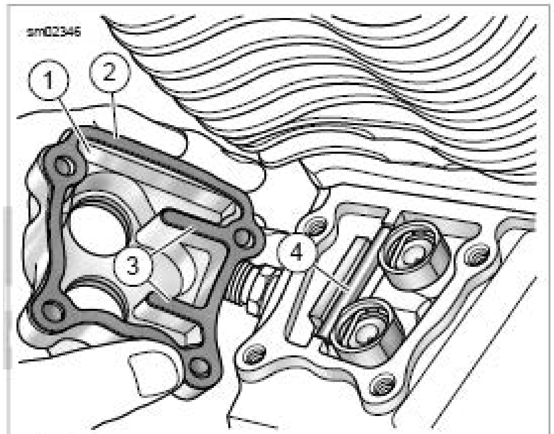
3. Install the lifter cover (1) and new gasket (2). Install four socket head screws. Tighten the lifter cover screws to 90 in-lbs in a crosswise pattern.

4. See figure 3-40

5. Slide the spring cap (4), spring (5), flat washer (6) and intermediate size O-ring (7) onto the body of the upper push rod cover. Move parts up body until spring cap (4) contacts upper O-ring seat.

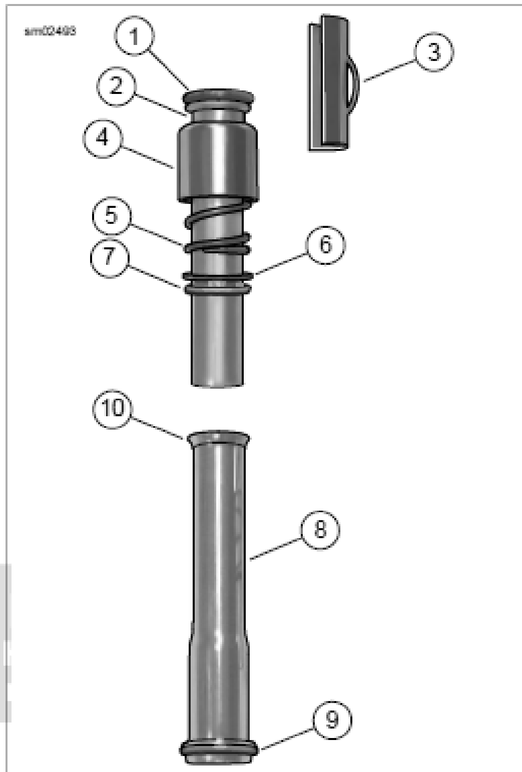
6. Fit the straight end of the upper push rod cover into the flared end of the lower push rod cover (8).

7. Install new large O-ring (9) on seat at bottom of lower push rod cover.



1. Cover
2. Gasket
3. Ribs on cover
4. Anti-rotational pin

Figure 3-83. Installing Lifters



1. Upper O-ring (small)
2. Upper push rod cover
3. Spring cap retainer
4. Spring cap
5. Spring
6. Flat washer
7. Middle O-ring (intermediate)
8. Lower push rod cover
9. Lower O-ring (large)
10. Flared end of lower push rod cover

Figure 3-40. Assembled Push Rod Cover

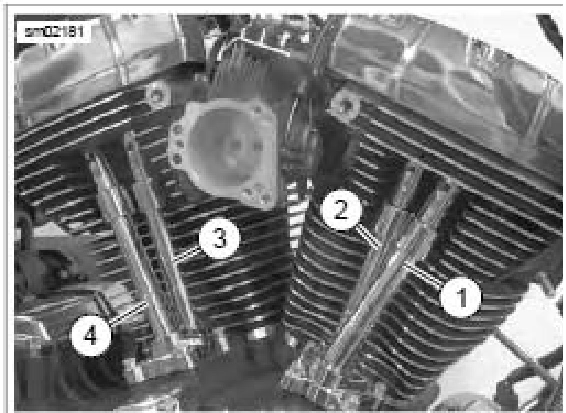
8. Install push rod covers.

   a. Assemble push rod covers with O-rings.

   b. Hand compress the push rod cover assembly and fit the push rod cover into the lifter cover bore.

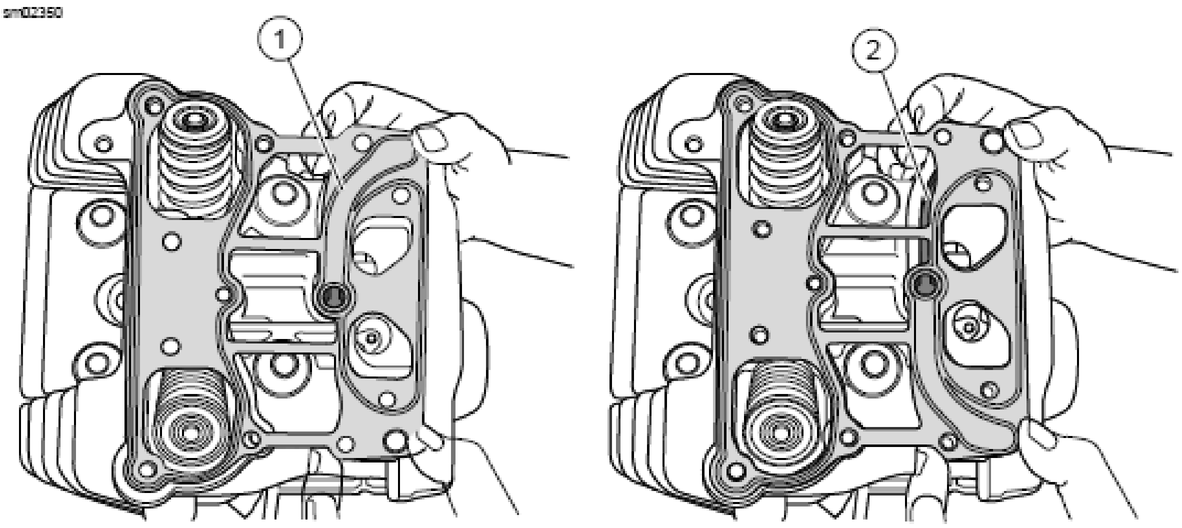
   c. Extending the assembly, fit the push rod cover into the cylinder head bore.

   d. Do not install the spring cap retainers at this time.



1. Front cylinder exhaust pushrod
2. Front cylinder intake pushrod
3. Rear cylinder intake pushrod
4. Rear cylinder exhaust pushrod

Figure 3-84. Pushrod Locations



1. CORRECT: Breather channel covered
2. INCORRECT: Breather channel exposed

Figure 3-80. Install Rocker Housing Gasket (Rear Cylinder Shown)

9. See Figure 3-80. Install a new rocker housing gasket on the cylinder head. Verify that the rocker housing gasket covers the breather channel.

10. See Figure 3-82. With the indent (1) facing forward, place the rocker housing into position aligning the holes in the housing with those in the gasket.

1. Indent
2. Breather baffle hole O-ring

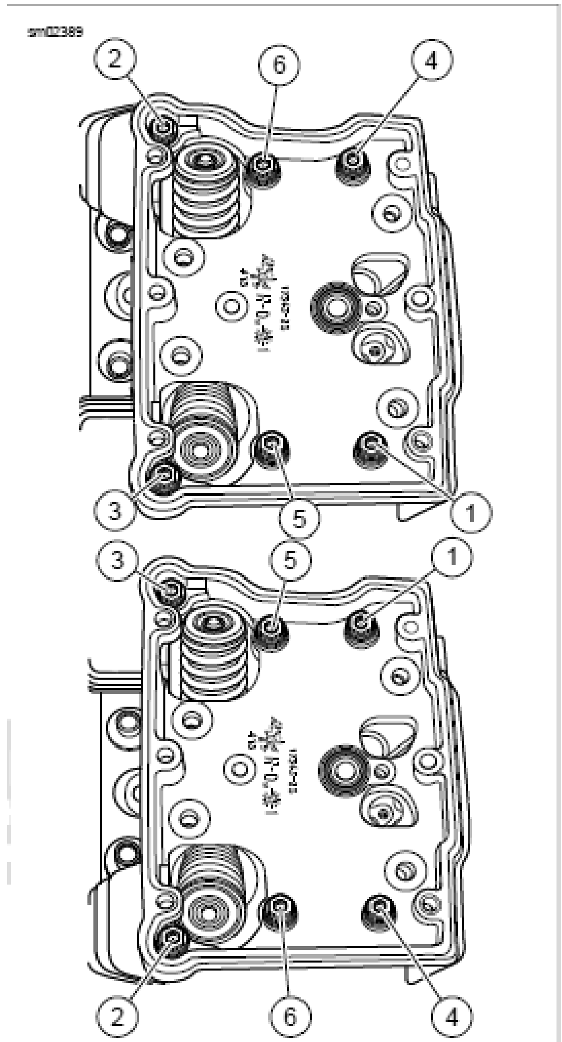
Figure 3-82. Rocker Housing Alignment

11. See Figure 3-81. Loosely install the rocker housing bolts. Place two long bolts on the left side. Tighten the bolts in the sequence shown to 90 in-lbs.

12. See Figure 3-82 previous page, install a O-ring in groove around breather baffle hole in rocker housing.

NOTE

Do not confuse breather baffle hole O-ring with the top push rod O-ring, small inner diameter.



1. Short bolt, 1.25 in. (31.8 mm)
2. Long bolt, 1.75 in. (44.5 mm)
3. Long bolt, 1.75 in. (44.5 mm)
4. Short bolt, 1.25 in. (31.8 mm)
5. Short bolt, 1.25 in. (31.8 mm)
6. Short bolt, 1.25 in. (31.8 mm)

Figure 3-81. Rocker Housing Torque Sequence and Bolt Size

13. Install the push rods. They are different lengths. The black push rod is for the exhaust valve and the silver is for the intake.

14. Rotate the crankshaft and observe the ends of the push rods to position both lifters of the cylinder being serviced on the base circle (or lowest position) of the cam lobe.

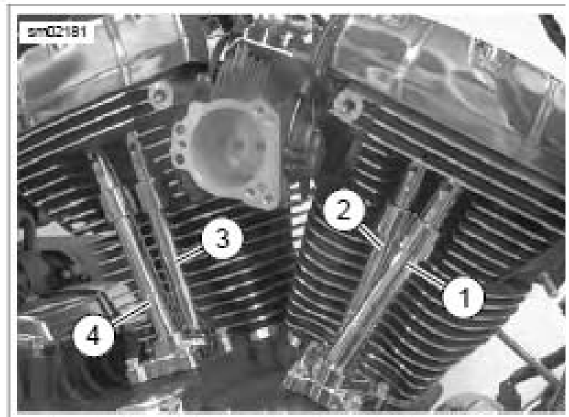
15. See Figure 3-85. Place the rocker arm support plate assembly into the rocker housing and loosely install four rocker arm support plate bolts with flat washers.

16. Tighten rocker arm support plate bolts.

    a. Following the sequence shown, alternately tighten each of the four rocker arm support plate bolts 1/4 turn at a time until snug.

    b. Following the same sequence, tighten the bolts to 18-ft-lbs

17. See Figure 3-29. Install breather assembly and rocker cover baffle assembly, tighten two screws to 90 in-lbs



1. Front cylinder exhaust pushrod
2. Front cylinder intake pushrod
3. Rear cylinder intake pushrod
4. Rear cylinder exhaust pushrod

Figure 3-84. Pushrod Locations

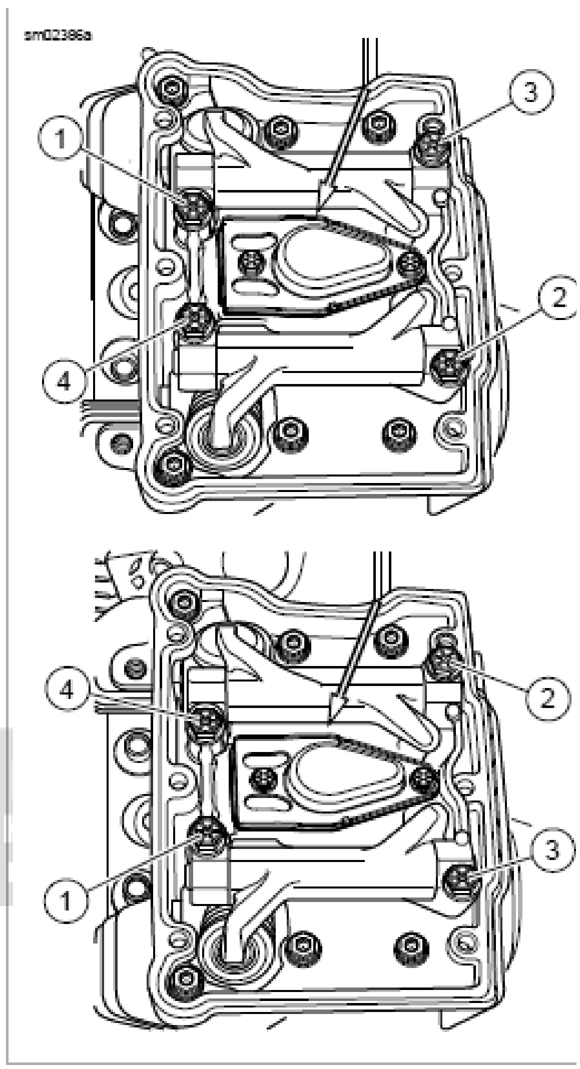
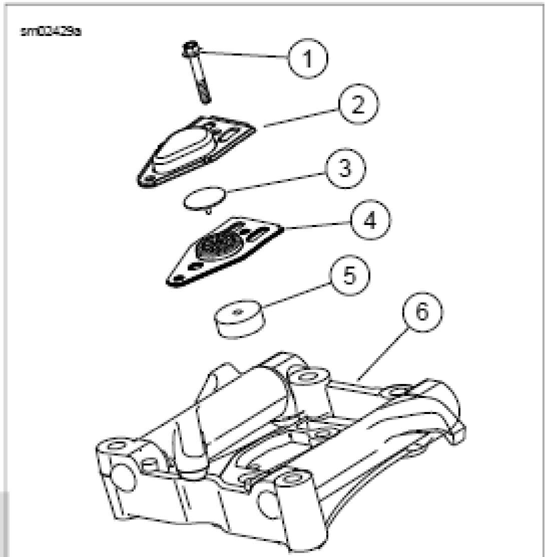


Figure 3-85. Rocker Arm Support Screw Sequence



1. Fasteners (2)
2. Breather cover
3. Umbrella valve
4. Breather baffle
5. Filter element
6. Rocker arm support plate

Figure 3-29. Breather Assembly

18. Complete installation of the pushrod covers.

    a. Verify that the O-ring ends of the upper and lower pushrod covers fit snugly into the cylinder head and lifter cover bores.

    b. Insert the upper edge of spring cap retainer into the cylinder head bore leaving the bottom edge free.

    c. Insert blade of small screwdriver between bottom edge of spring cap retainer and top of spring cap.

NOTE

For best results, verify that screwdriver, spring cap and spring cap retainer are free of grease and oil.

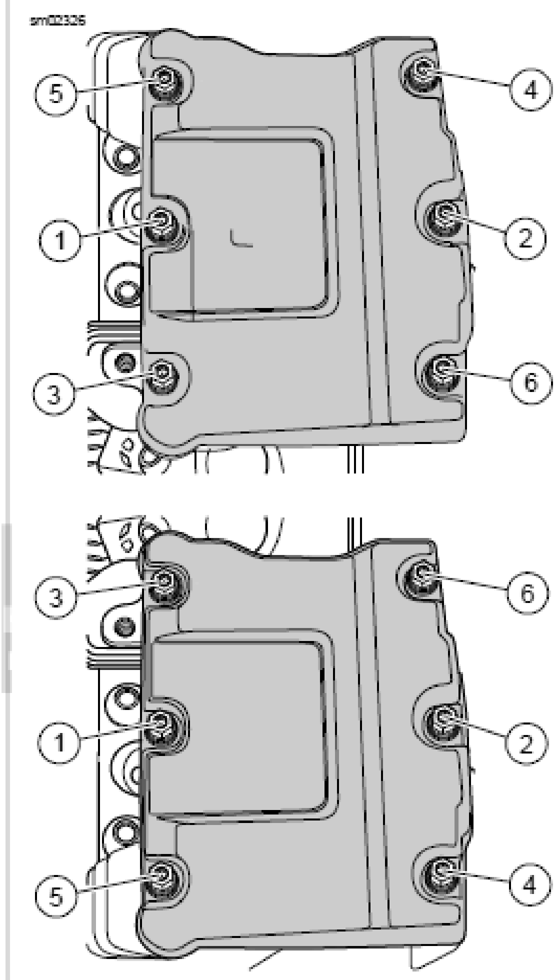
    d. See Figure 3-86. Press spring cap down with tip of screwdriver and slide bottom edge of retainer towards tip of screwdriver.

    e. Verify that spring cap retainer seats tightly against upper pushrod cover.

19. See Figure 3-87. Install rocker cover and a rocker cover gasket. Tighten screws following the sequence shown to 15 ft-lbs.

CLEAN UP WORK AREA AND RETURN TOOLS TO THE LOCATIONS SHOWN IN THE PHOTO OF THE TOOLS AT THE WORK STATION.

Figure 3-86. Install Spring Cap Retainers



1. Short bolt, 1.0 in. (25.4 mm)
2. Long bolt, 1.75 in. (44.5 mm)
3. Short bolt, 1.0 in. (25.4 mm)
4. Long bolt, 1.75 in. (44.5 mm)
5. Short bolt, 1.0 in. (25.4 mm)
6. Long bolt, 1.75 in. (44.5 mm)

Figure 3-87. Rocker Cover Bolts Torque Sequence

SkillsUSA - 2012 Motorcycle Service Technology

XL Steering Head Bearing Adjustment

Workstation Set-up Instructions

Set-Up:

1. Each motorcycle should be staged with the front wheel raised as shown below by placing a FatJack under the frame in front of the side stand and securing it with a ratchet strap. The bike should be put into 1st gear and a block of wood placed / wedged behind the rear tire securely to prevent any rearward movement.

2. Remove the rear handlebar riser cover on the 1200C models.
3. The following workstation materials and tools should be organized at each station.

Inventory per Workstation (five workstations):

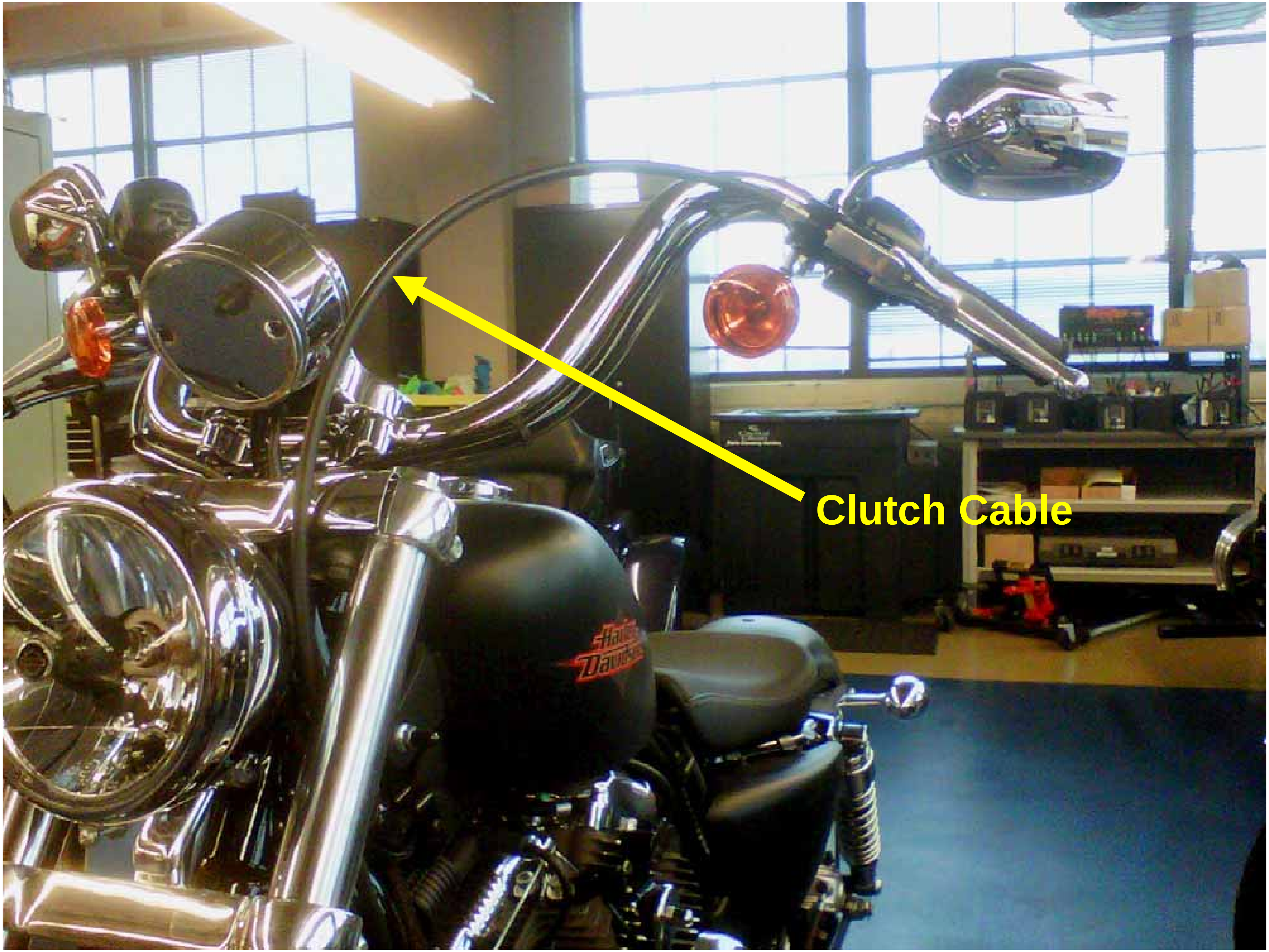
Qty.	Description	Part Number	Furnished by
1	Station Reference booklet		H-D
1	Fall-away pointer		H-D
1	Clutch lever pivot pin circlip	11379	H-D
1	T55 Torx socket		H-D
1	T45 Torx Socket		H-D
1	3/8" Ratchet		H-D
1	3/8" Breaker bar		H-D
1	3/8" dr. Extention		H-D
1	9/16" Wrench		H-D
1	½" Wrench		H-D
1	Snap Ring Pliers		H-D
1	0 – 6" Machinist rule		H-D
1	3/8" dr. 20 – 100# Torque wrench		H-D
1	Ink marker		H-D
1	Roll masking tape		H-D
1	Tank protector		H-D

Harley-Davidson
XL Steering Head Bearing Adjustment

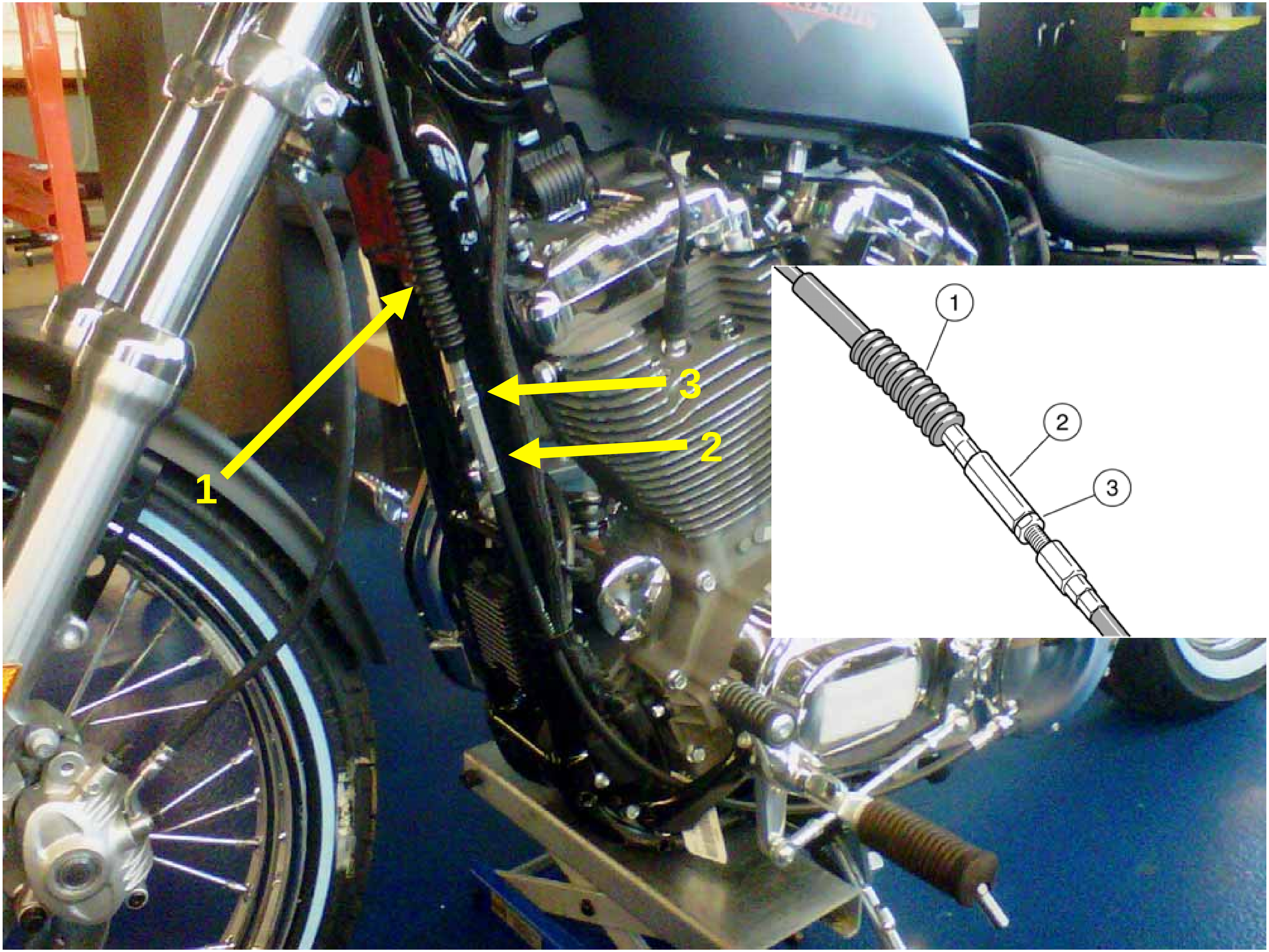
WELCOME!

READ AND FOLLOW THESE PROCEDURAL INSTRUCTIONS CAREFULLY

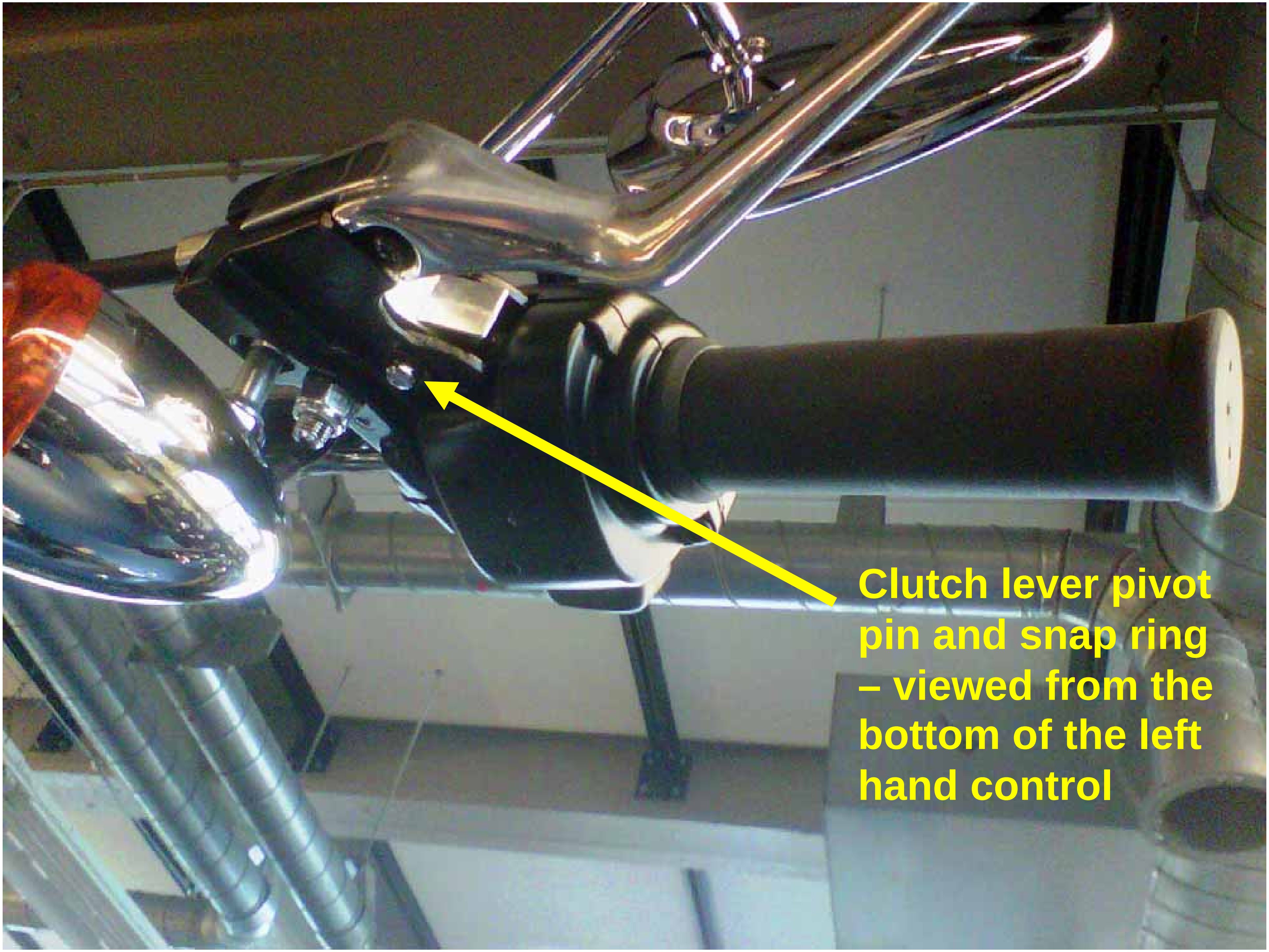
Good Luck!

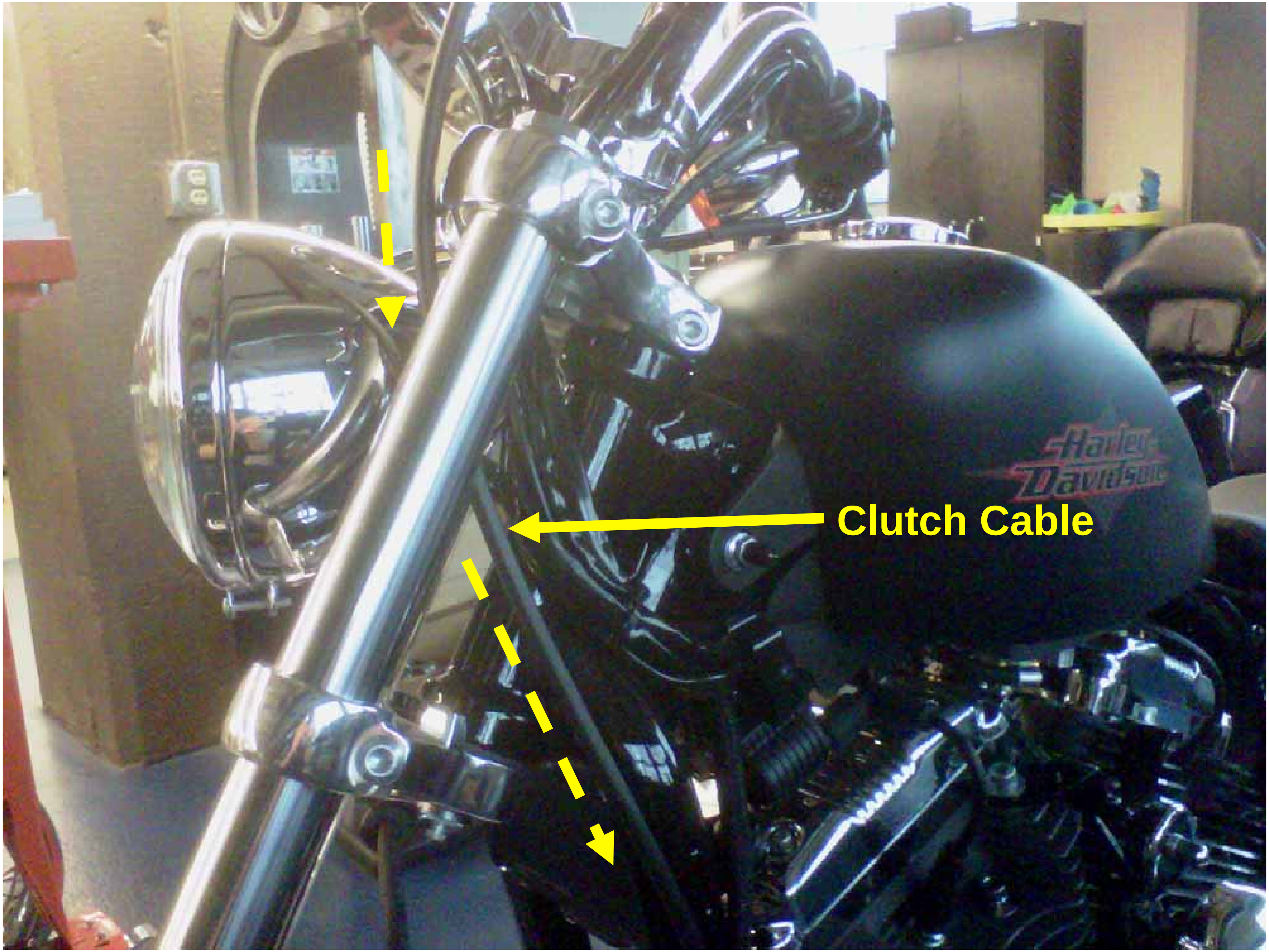

Clutch Cable


Clutch cable guide
retaining clamp

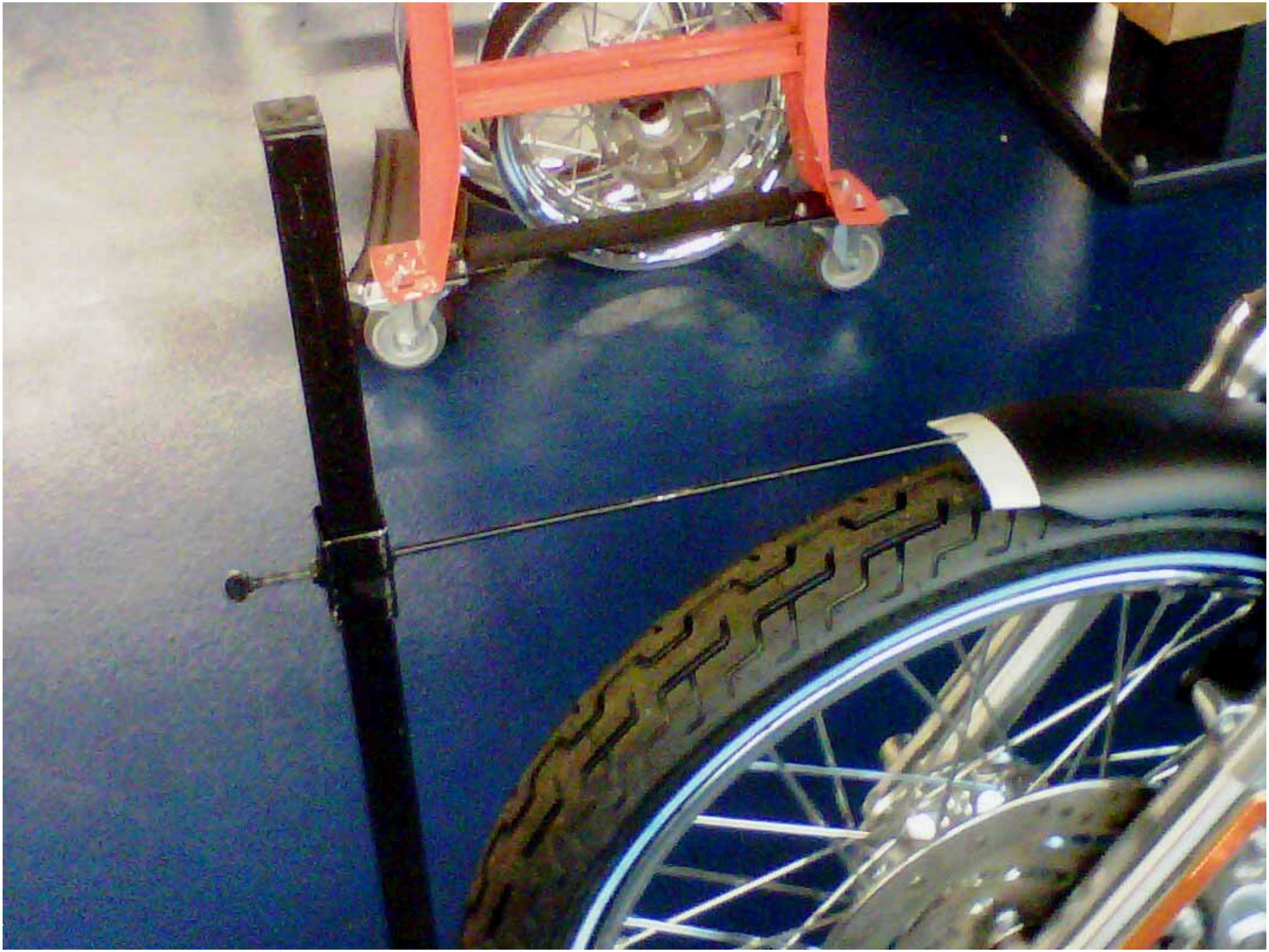


1
2
3
1
2
3


Clutch lever pivot pin and snap ring – viewed from the bottom of the left hand control


Harley-Davidson
Clutch Cable


Place masking tape on tip of fender

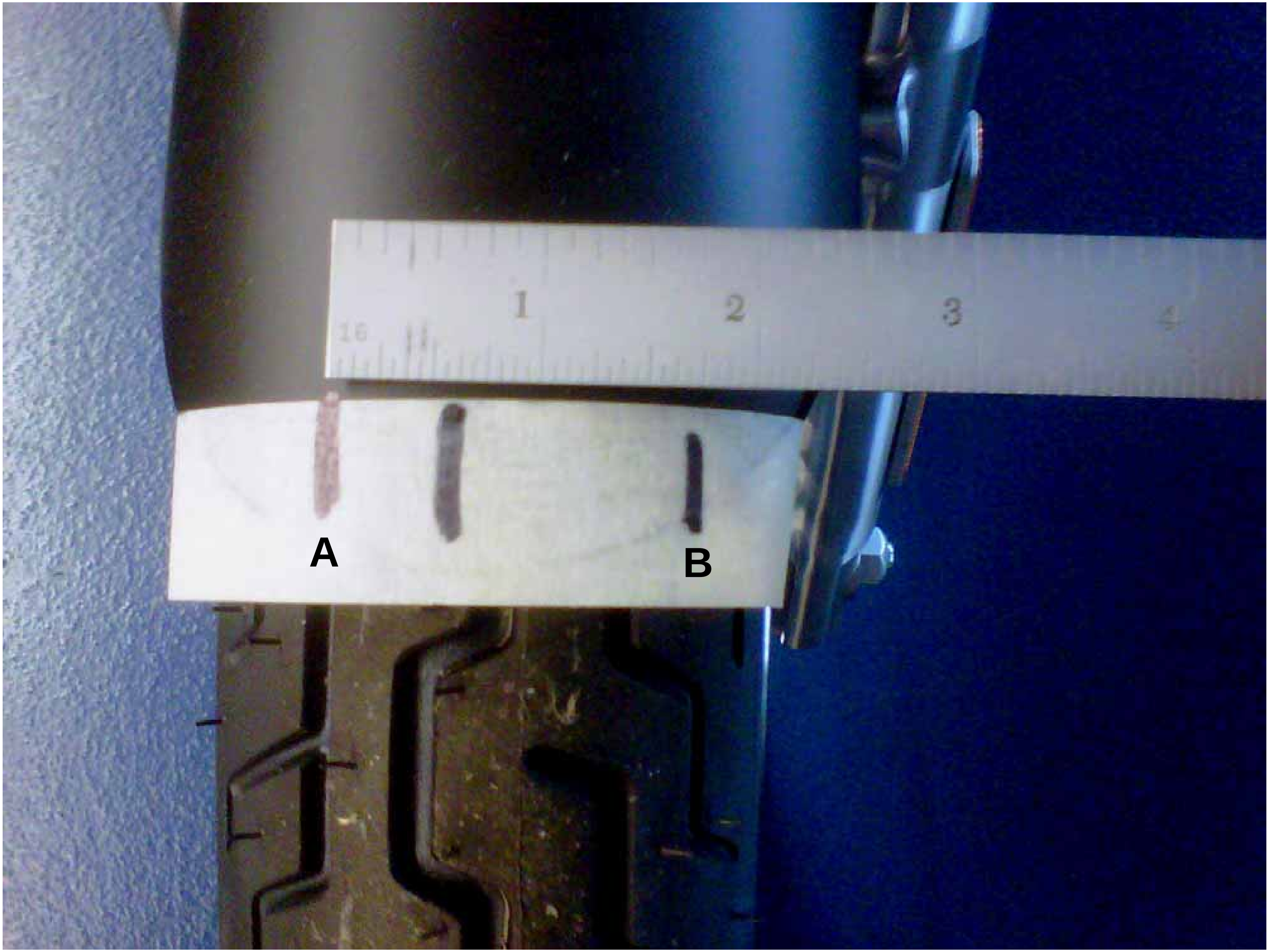



A


Direction of tapping

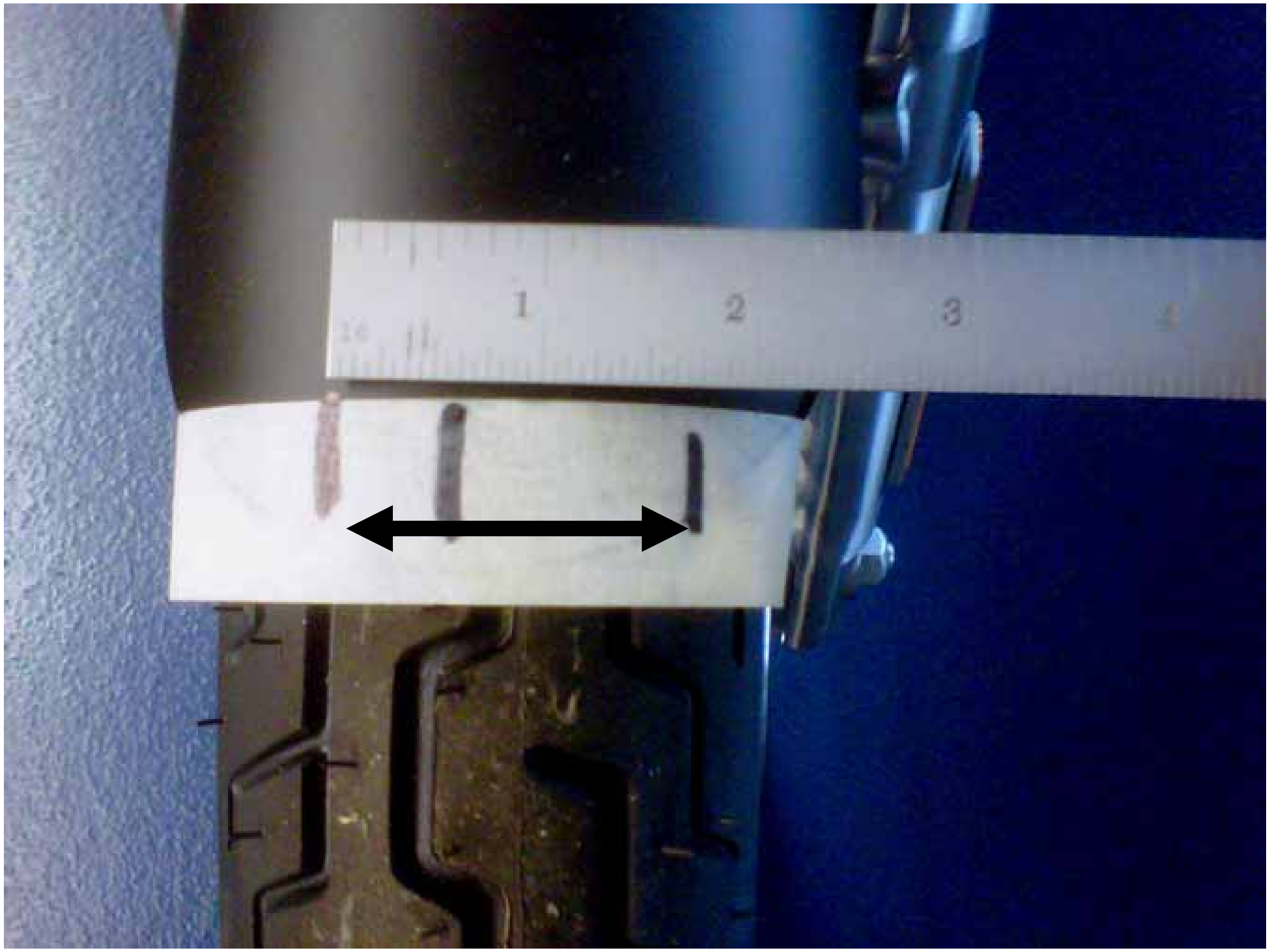

Point where front-end falls away freely

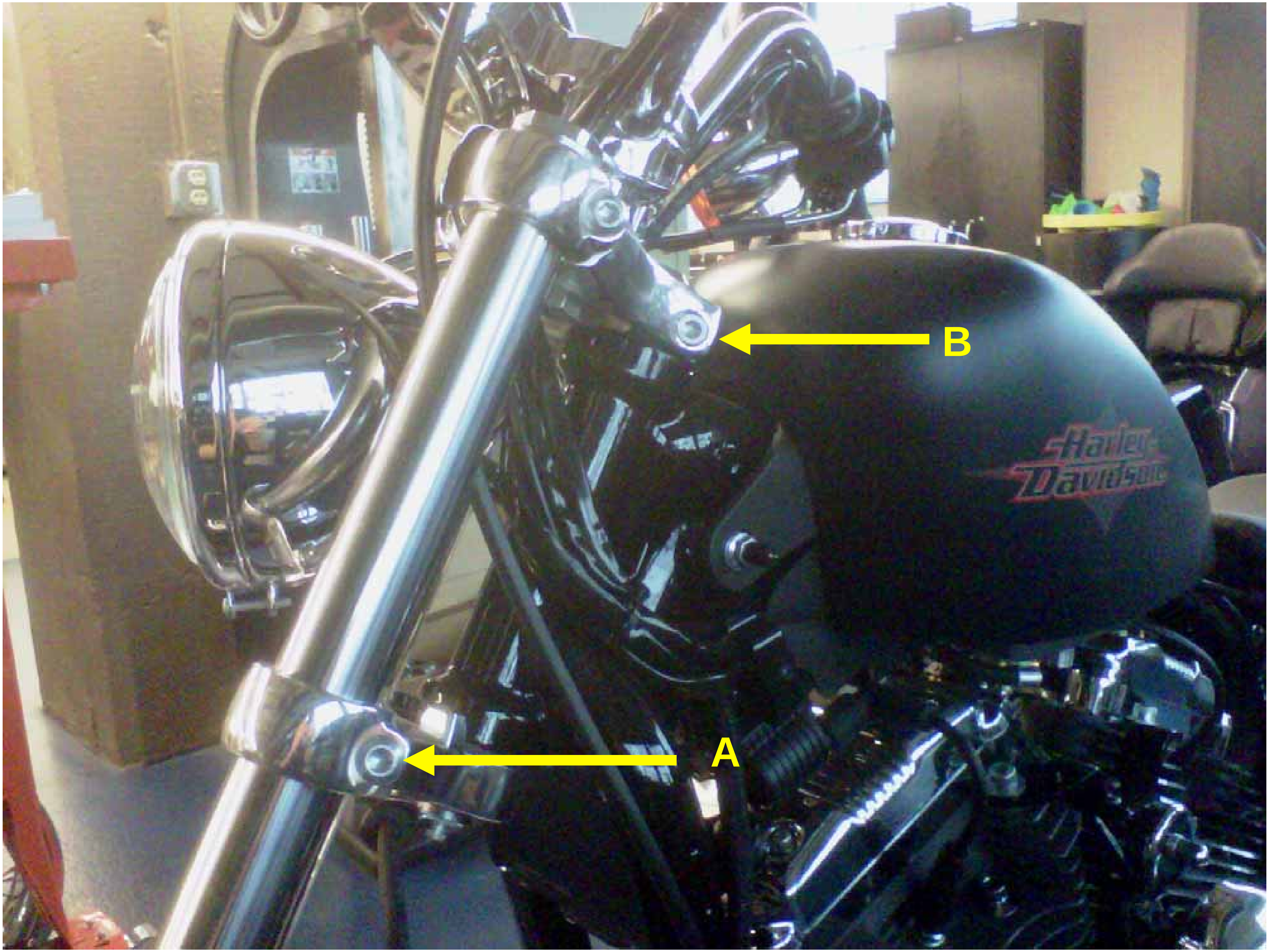

Direction of tapping

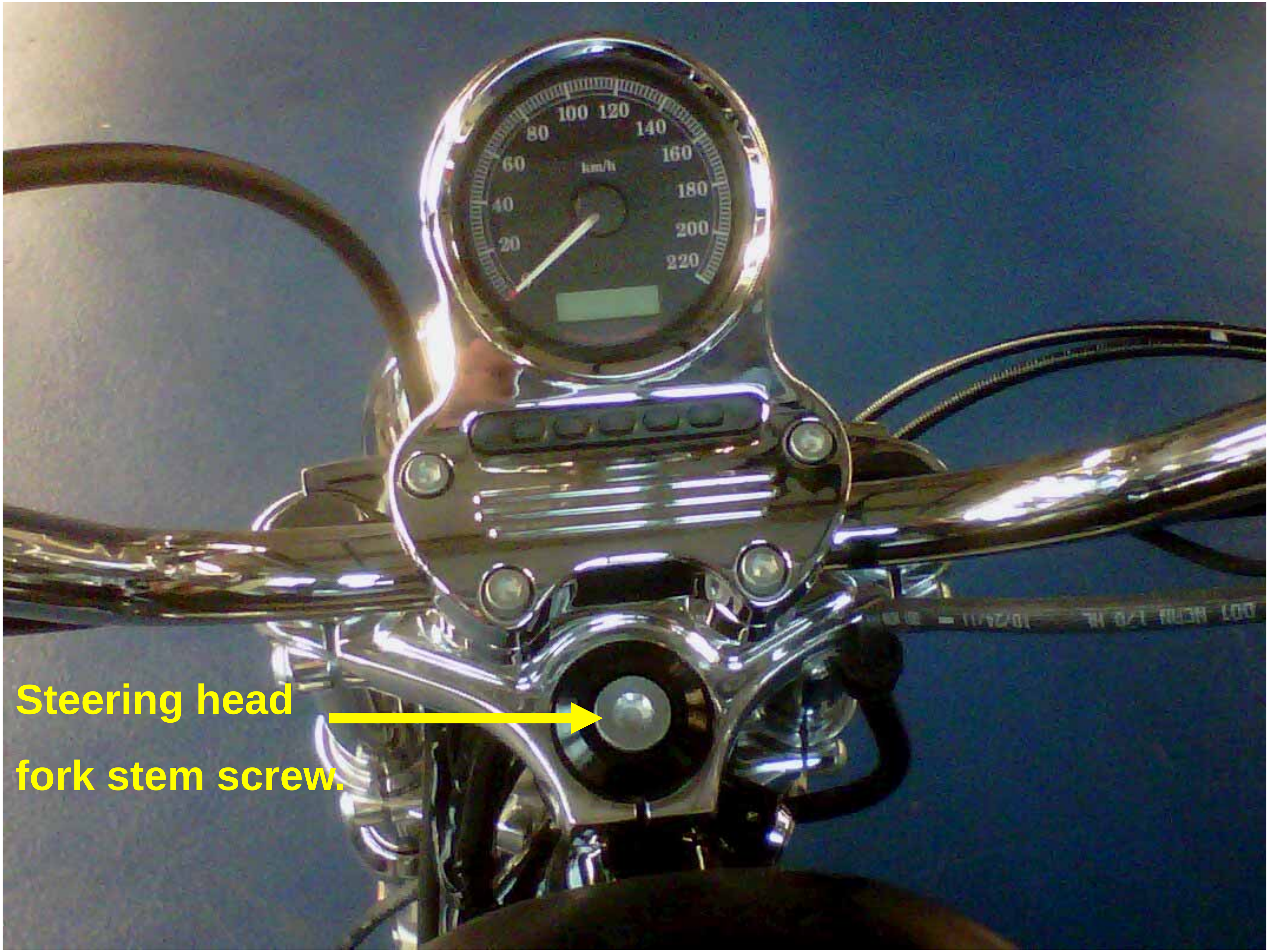

1
2
3
4
A
B

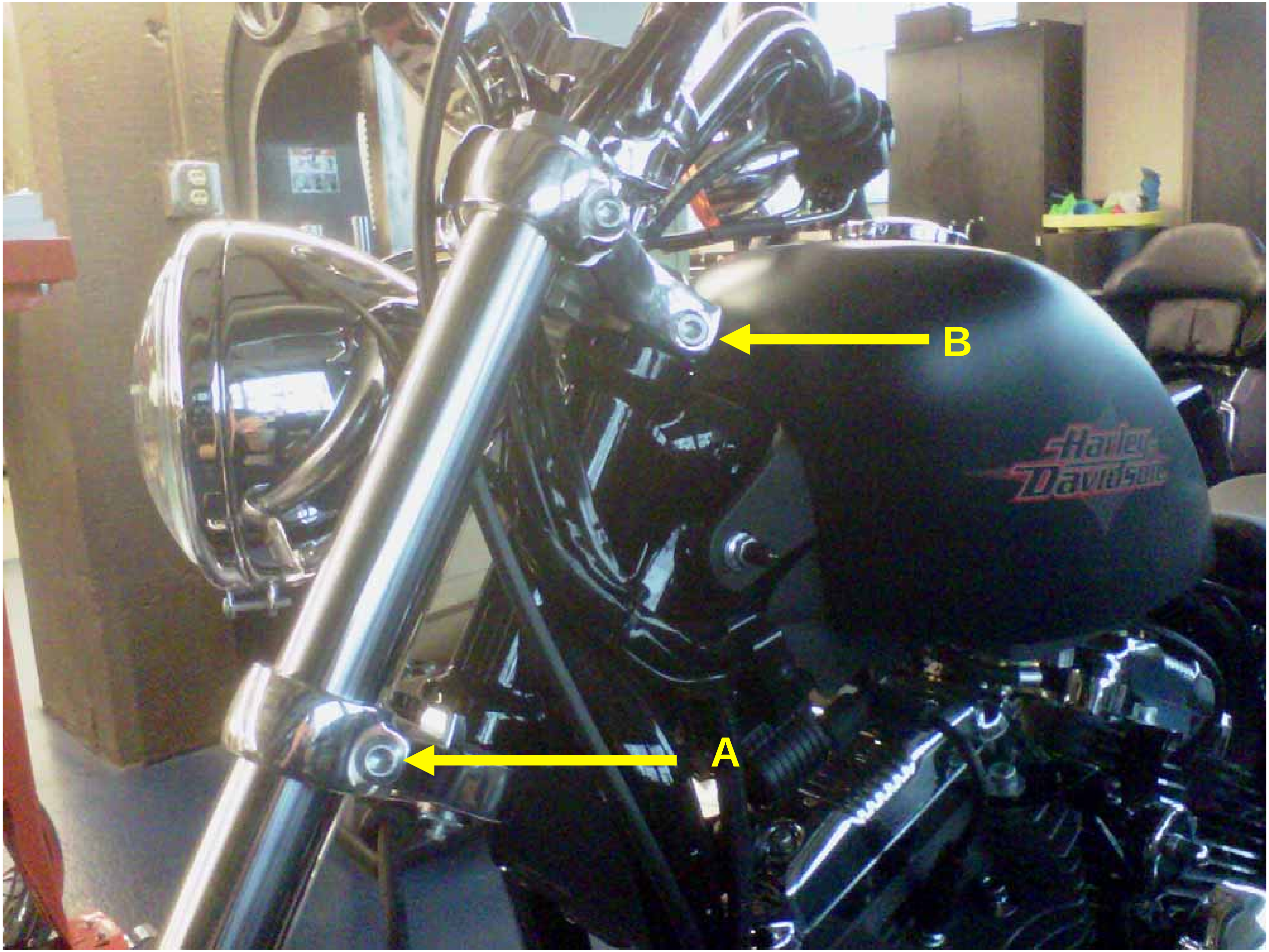
Fall-Away Specification

The fall-away measurement should be between 1” to 2” as shown below




B
Harley-Davidson
A

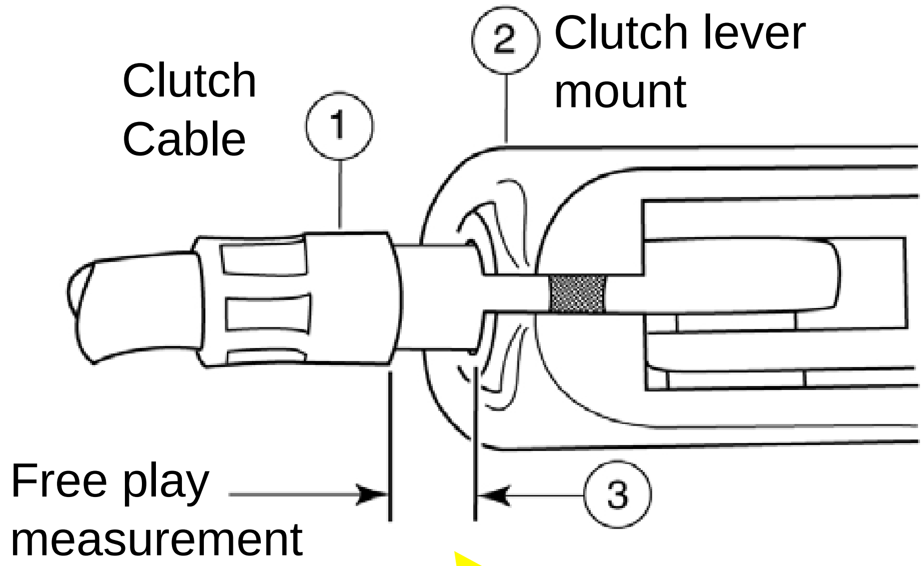

Steering head
fork stem screw.

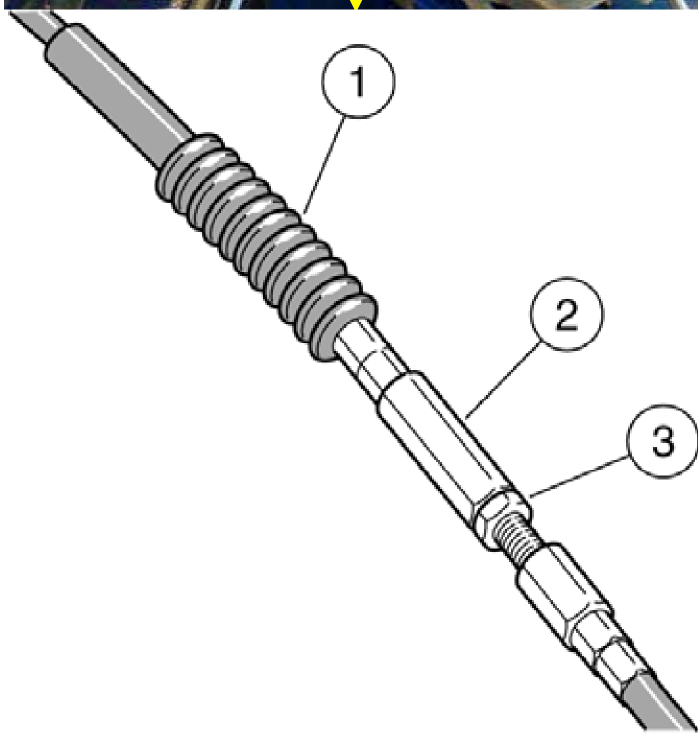

B
Harley-Davidson
A

STOP

- Call the workstation judge over to check your adjustment and work.


Clutch Cable Routing


2
Clutch lever
mount
Clutch
Cable
1
Free play
measurement
3


1
2
3

CONGRATULATIONS !!!

SkillsUSA
2012 Motorcycle Service Technology
XL Steering head bearing adjustment

Objective Information Sheet

Time Limit 30 Minutes

OBJECTIVE:

Given the tools, motorcycle, and Procedural Instruction Sheet, participants will correctly adjust the steering head bearings on a Harley-Davidson XL model motorcycle.

SPECIFIC SKILLS:

The contestant will:

1. Follow the instructions outlined in the station test materials to correctly adjust the steering head bearings on an XL model.
2. Use the tools and equipment properly and safely.
3. Clean and organize the work area.

The judge must completely re-set-up the station for the next participant by verifying that the steering head bearings are out of adjustment.

SkillsUSA

2012 Motorcycle Service Technology

XL Steering head bearing adjustment

Judge's Score sheet

Time Limit 30 Minutes

Contestant #____________ Start Time:___________

Judge's Initials:__________ Stop Time:____________

Scoring Directions: The performance of each task should be either "0" or full points, i.e "25"or "100".

Use the following criteria listed below: **"0"** indicates the contestant ***could not or did not*** correctly perform this task. **"25"** or **"100"** indicates the contestant **did perform or demonstrate** the skill correctly.

The judge should monitor the participant's progress to ensure safe use of the equipment.

- **PERFORMANCE:** Grade the student's performance and record the score below.

1) Correctly measured the initial steering head fall-away prior to adjsutment. **(0,25)** __________
2) Correctly adjusted the steering head bearings to the required fall-away specification of 1" – 2". **(0,100)** __________
3) Completed all task requirements for this workstation.
   a. Correctly torque all critical fasteners. I.e. upper & lower fork pinch bolts.
   b. Clutch cable reinstalled and freeplay adjusted. **(0,25)** __________

Total Possible Score 150 **Total Points _____________**

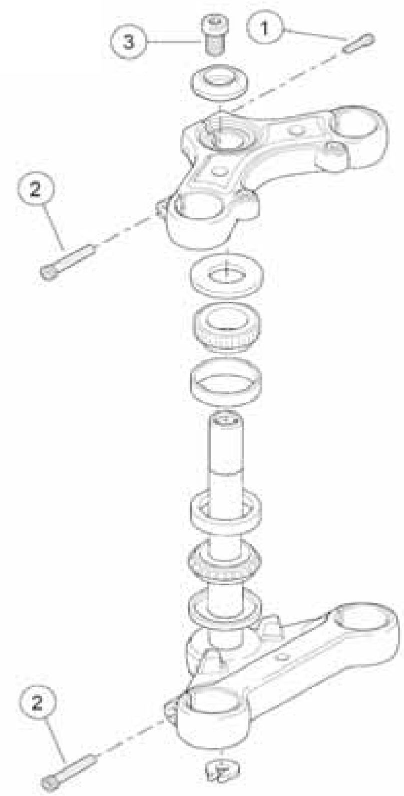
XL Steering Head Bearing Adjustment Workstation Overview

Sponsored by

Harley-Davidson University

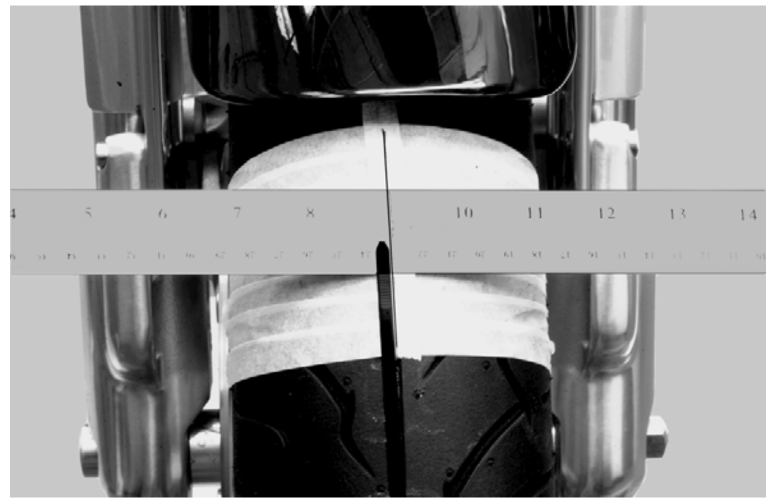
Typical Harley-Davidson Steering Head Bearing Design & Application

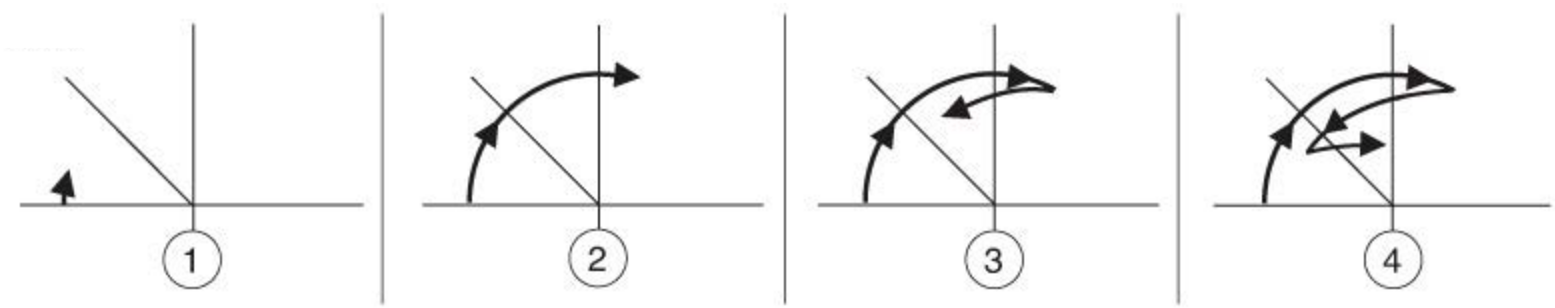
- Tapered roller bearing design.
- The amount of bearing pre-load (specification) for each model is determined by rigorous HDMC testing.
- Bearing pre-load is established by tightening or loosening the fork stem screw or adjuster nut.



Service Methods for Harley-Davidson Steering Head Bearing Adjustment

- Fall-away method
- Swing method

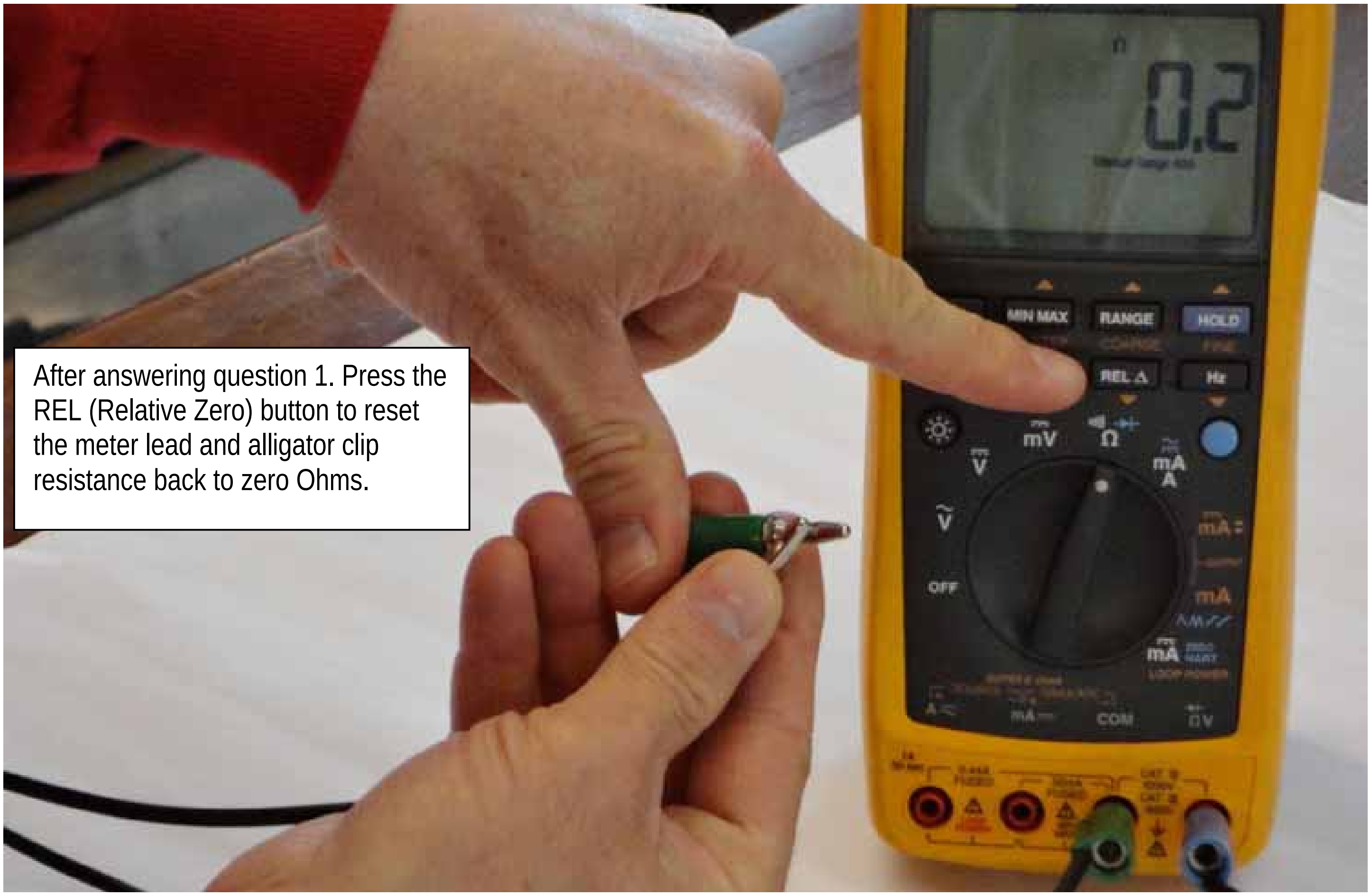




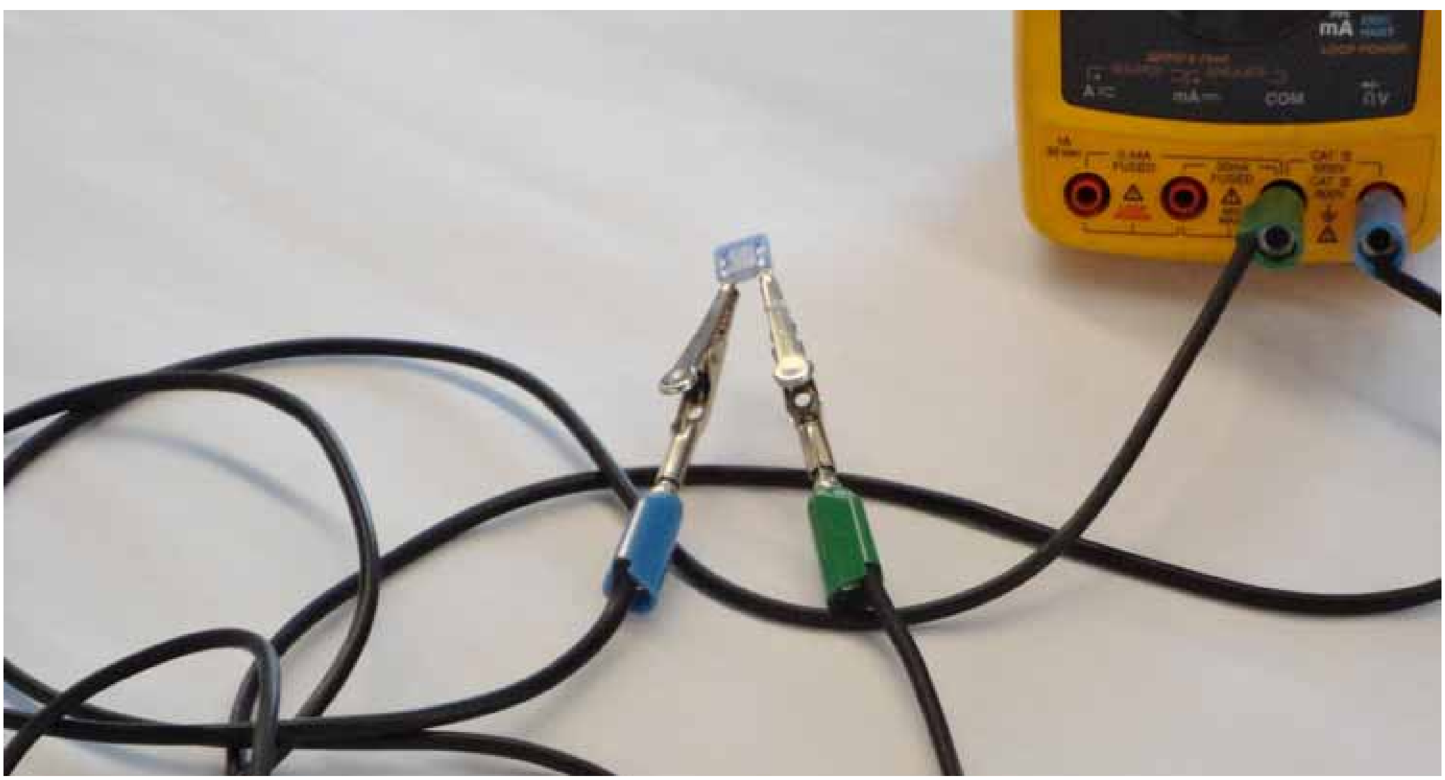
Questions?

- Good Luck Tomorrow!

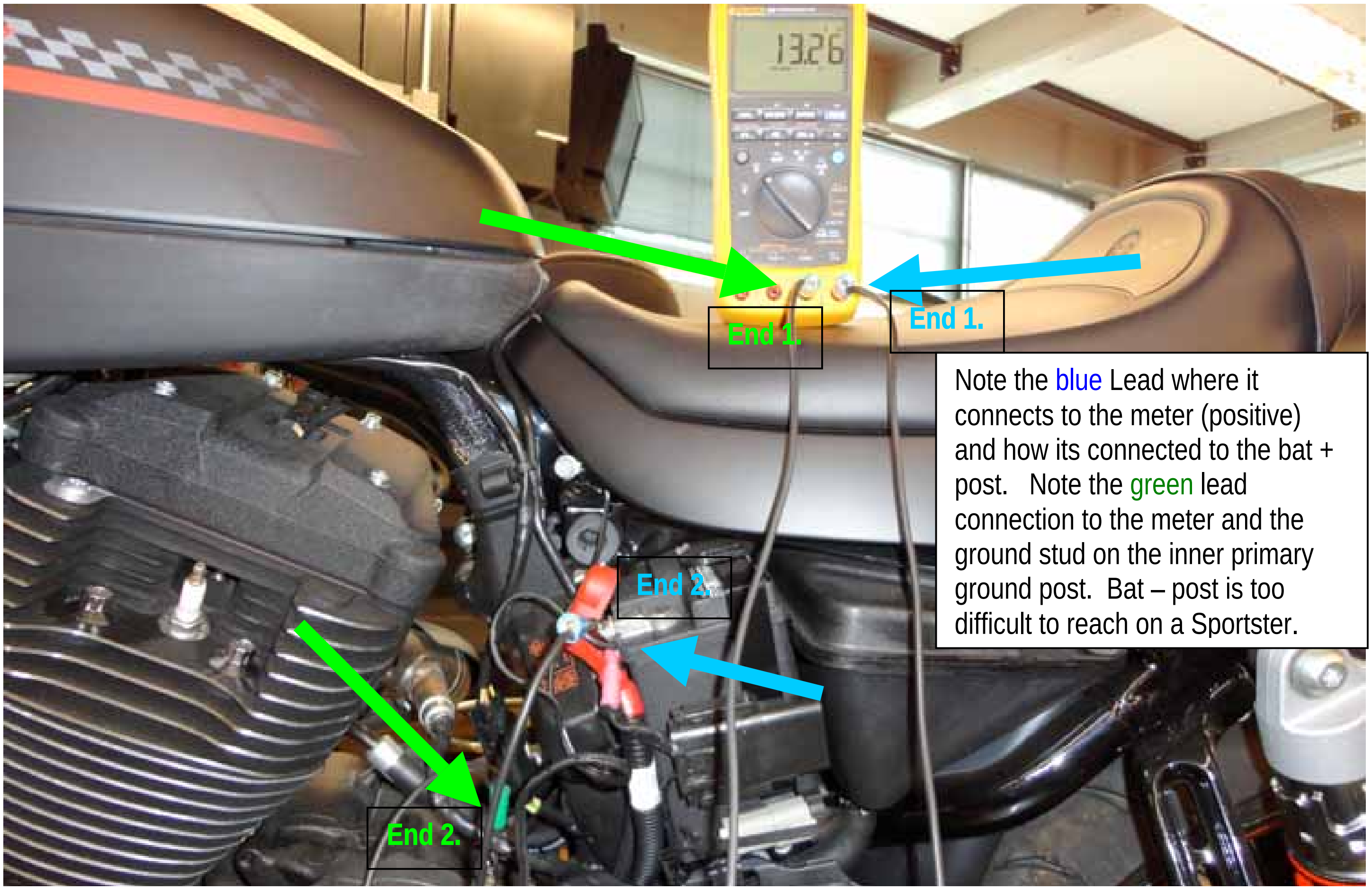
Question 1. (connections for all questions are as shown)



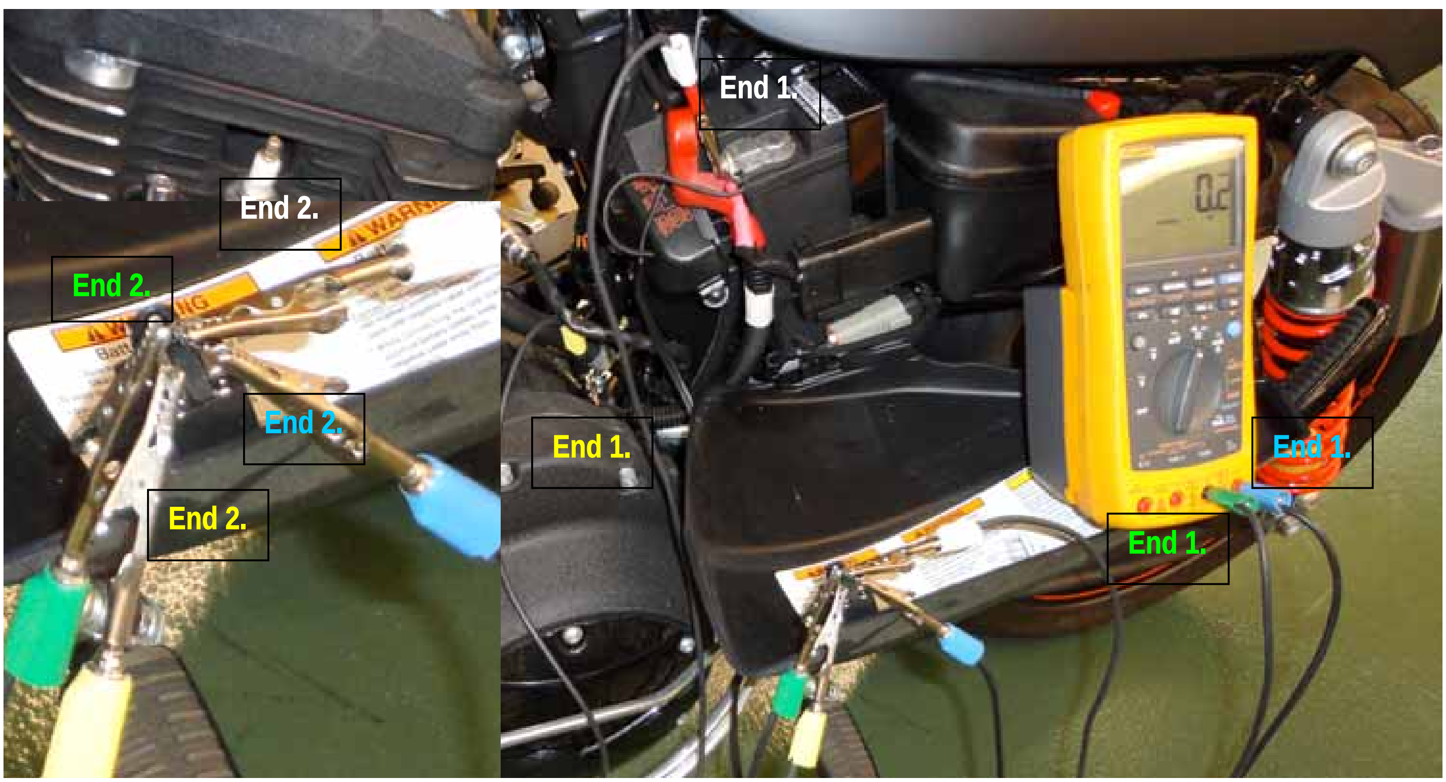
Questions 2.-3.



Questions 4.-5.



Questions 6.-10. (follow Relay Test instructions on the next page)



Questions 6.-10. Continued

Relay Test

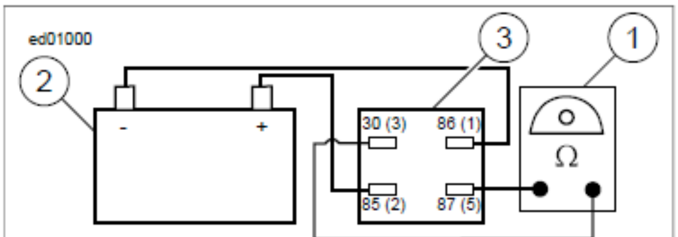
A relay can be tested using the motorcycle's 12V battery and a multimeter.

1. Unplug the relay from relay block.
2. See Figure 1-33 and Figure 1-34 to energize the relay. Connect relay terminal 85 to the negative battery terminal and relay terminal 86 to the positive battery terminal.

NOTE

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

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



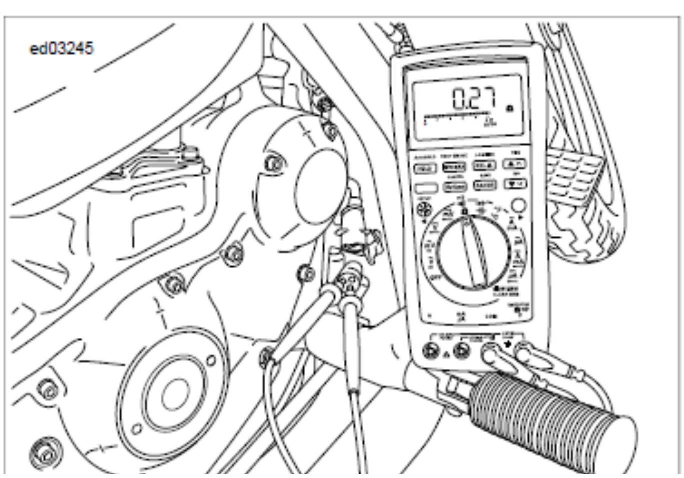
1. **Ohmmeter**
2. **Battery**
3. **Start relay**

Figure 1-33. Four Terminal Relay Test

Questions 11.-15.

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.



Questions 11.-15.

Stator Test

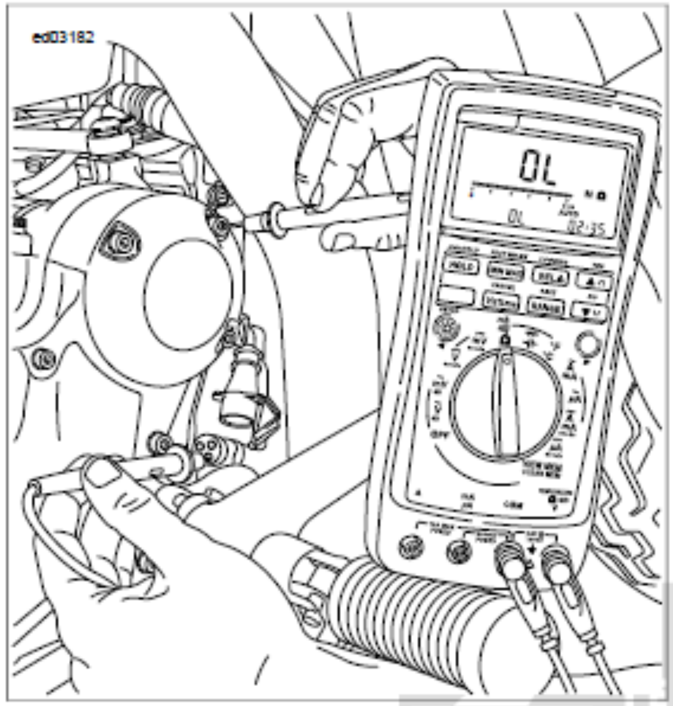
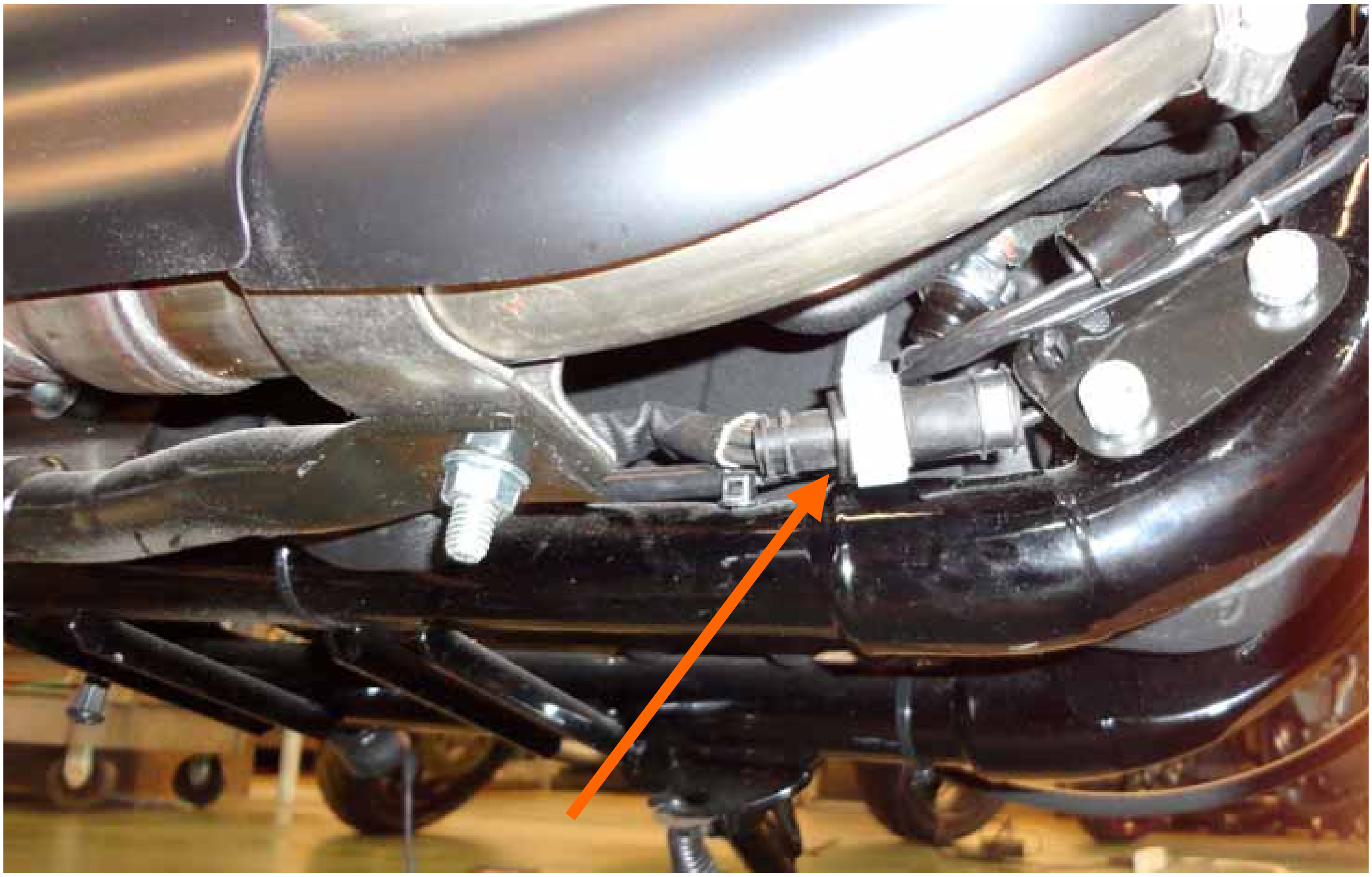


Figure 3-12. Test for Grounded Stator (Typical)

1. Turn IGN OFF.
2. See Figure 3-12. Connect an ohmmeter.
   a. Disconnect voltage regulator [47] from stator wiring.
   b. Insert one ohmmeter lead into a stator connector socket.
   c. Attach the other lead to a suitable ground.
3. Test for continuity.
   a. A good stator will show no continuity (open circuit) between all stator sockets and ground.
   b. Any other reading indicates a grounded stator which must be replaced.
4. See Figure 3-13. Remove ground lead. Measure resistance across stator [47B] terminals 1-2.
   a. Resistance across all the stator terminals should be 0.1-0.3 Ohm.
   b. If the resistance is higher, the stator is damaged and must be replaced.
   c. If resistance is lower, the stator may have a turn-to-turn short and should be replaced.

Questions 11.-15. (lower right side of XR1200 stator plug shown)

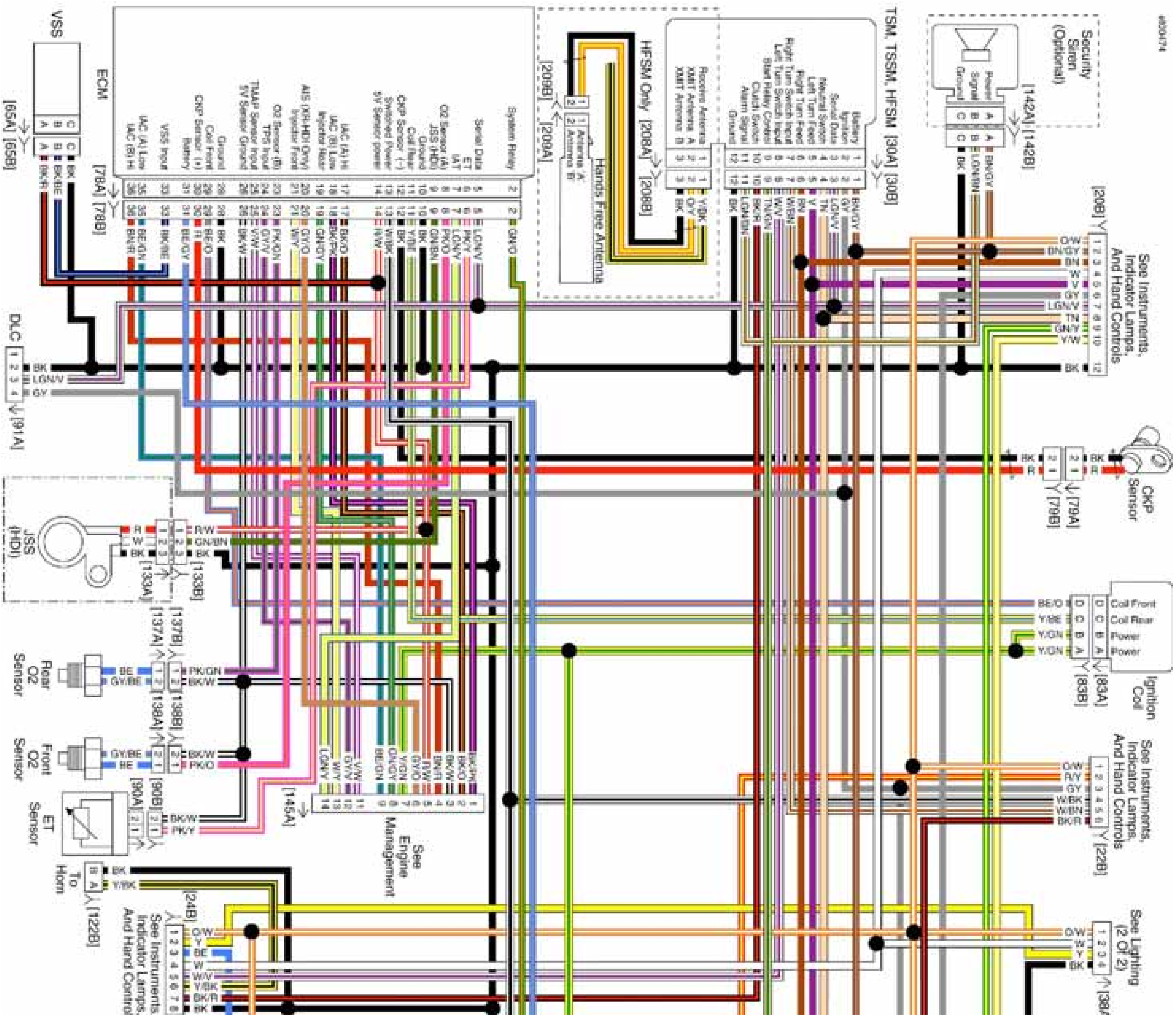


Questions 16.-17.

Remember for every ECM pin there is a corresponding socket in the break out box (B.O.B.). The design of Harley-Davidson B.O.B. requires the use of two pink pin terminals. Place the blade of the pin terminal in the slot of the socket within the B.O.B. If this is not done, the sockets in the B.O.B. will be expanded and damaged.

Questions 16. – 17. (wiring diagram showing all ECM pins and CKP sensor)

The CKP sensor, located on the left front of the lower crankcase half, is a variable reluctance device 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.



2012 SKILLS USA MULTIMETER USAGE *JUDGES ANSWER SHEET*

Contestant Number __________ Total Score __________ Judges Initials __________

FAILURE TO LIST UNITS OF MEASURE = ZERO POINTS FOR THAT QUESTION

	PTS	METER READING?
1. Meter Lead Resistance	*(0,2)*	**0.1 Ω - 0.6 Ω (watch contestant zero meter after)**
2. Fuse A Resistance	*(0,2)*	**0.1 Ω -.3 Ω or OL (judges must know station)**
3. Fuse B Resistance	*(0,2)*	**0.1 Ω -.3 Ω or OL**
4. Battery Voltage *(Key Off)*	*(0,2)*	**13.2 VDC-13.8 VDC (*watch student's meter*)**
5. Battery Voltage *(Key On)*	*(0,2)*	**12.8 VDC-13.4 VDC - less VDC than key off**

RELAY BENCH TEST — **LEAD CONNECTIONS PER SERVICE MANUAL**

		End1	End 2
6. Blue Lead	*(0,5)*	**V / Ω**	**Relay Pin 3**
7. Green Lead	*(0,5)*	**COM**	**Relay Pin 5**
8. White Lead	*(0,5)*	**BAT +**	**Relay Pin 2**
9. Yellow Lead	*(0,5)*	**BAT -**	**Relay Pin 1**

		RELAY DETERMINATION?	METER READING?
10. Relay Bench Check *(circle best answer)*	*(0,20)*	**GOOD/BAD**	**0.1Ω - 0.3 Ω**

		PIN TO PIN (1:2)	PIN TO GROUND (1:⏚)
11. Stator Specifications	*(0,5)*	**0.1Ω - 0.3 Ω**	**OL**

		METER READING?
12. Stator 1:2	*(0,10)*	**0.1Ω - 0.3 Ω**
13. Stator 1: ⏚	*(0,10)*	**OL**
14. Stator 2: ⏚	*(0,10)*	**OL**

		STATOR DETERMINATION?
15. Stator Analysis *(circle best answer)*	*(0,25)*	**GOOD/BAD**

CKP CRANKING OUTPUT TEST

		BLUE LEAD WHAT PIN IN B.O.B.?	GREEN LEAD WHAT PIN IN B.O.B.?
16. ECM Break Out Box (B.O.B.)	*(0,15)*	**Pin 30**	**Pin 12**

		CKP DETERMINATION?	METER READING?
17. CKP ANALYSIS *(circle best answer)*	*(0,25)*	**GOOD/BAD**	**3 ACV – 6 ACV**

DO NOT WRITE BELOW THIS LINE (For judges only)

(150 points possible) **TOTAL ______________**

2012 SKILLSUSA MULTIMETER USAGE (150 points)

- **First, read the task procedure on the laminated sheet.**

- **Perform tasks recording answers on the provided answer sheets.**

- **IMPORTANT:** **Before recording a reading on the answer sheet be sure meter leads are in the appropriate multimeter inputs and that the meter selector is set to the proper unit of measure.**

Make sure the contestant number is entered on the answer sheet.

30 minutes will be given to complete this station.

2012 SKILLSUSA MULTIMETER USAGE ANSWER SHEET

Contestant Number __________ **Total Score** __________ **Judges Initials** __________

FAILURE TO LIST UNITS OF MEASURE = ZERO POINTS FOR THAT QUESTION

METER READING?

1. Meter Lead Resistance __________
2. Fuse A Resistance __________
3. Fuse B Resistance __________

4. Battery Voltage *(Key Off)* __________
5. Battery Voltage *(Key On)* __________

RELAY BENCH TEST — **LEAD CONNECTIONS PER SERVICE MANUAL**

	End1	End 2
6. Blue Lead	__________	__________
7. Green Lead	__________	__________
8. White Lead	__________	__________
9. Yellow Lead	__________	__________

10. Relay Bench Check *(circle best answer)* — **RELAY DETERMINATION?** **GOOD/BAD** — **METER READING?** __________

	PIN TO PIN (1:2)	PIN TO GROUND (1:⏚)
11. Stator Specifications	__________	__________

METER READING?

12. Stator 1:2 __________
13. Stator 1: ⏚ __________
14. Stator 2: ⏚ __________

STATOR DETERMINATION?

15. Stator Analysis *(circle best answer)* — **GOOD/BAD**

CKP CRANKING OUTPUT TEST

	BLUE LEAD WHAT PIN IN B.O.B.?	GREEN LEAD WHAT PIN IN B.O.B.?
16. ECM Break Out Box (B.O.B.)	__________	__________

17. CKP ANALYSIS *(circle best answer)* — **CKP DETERMINATION?** **GOOD/BAD** — **METER READING?** __________

DO NOT WRITE BELOW THIS LINE (For judges only)

(150 points possible) **TOTAL** __________

SkillsUSA®

Contestant Number: _________ Total Score: __________ Judge's Initials: _________

Test questions for PHD 175.08, ABS Service Procedures, Video

Highlight the letter of the correct answer for each question. Each worth 2 points.

1. The video emphasizes that the Harley-Davidson ABS system is designed to help the rider "maintain control when braking in…"
   a) any emergency situation.
   b) a straight line emergency.
   c) slippery conditions only.
   d) all of the above.

2. The Harley-Davidson ABS system is:
   a) A linked system integrating both the front to rear calipers.
   b) Power assisted by the ABS hydraulic unit
   c) A manual, two channel system.
   d) easily installed on non-ABS models.

3. When the Harley-Davidson ABS system activates, the rider should:
   a) Pump the lever/pedal
   b) Maintain pressure on the lever/pedal and let the ABS system do its job
   c) Let off the brakes, downshift then re-apply the brakes.
   d) None of the above

4. How many times per second can the Harley-Davidson ABS system "pump" the brakes?
   a) Two
   b) Five
   c) Seven
   c) Nine
   d) None of the above

5. ABS brake calipers incorporate a special check valve; calipers cannot be interchanged between ABS and non ABS equipped motorcycles.
   a) True
   b) False

6. A customer has a concern that when he starts his ABS equipped motorcycle and lets it idle, the ABS light slowly blinks.

Technician A says that the system has stored a “historic” trouble code.
Technician B says that the system has a “current” code
Technician C says that the system is functioning normally.
Who is correct?

a) Technician A
b) Technician B
c) Technician C
d) No one is correct; the light is blinking because the customer has a brake bulb burned out.

7. “WSS” stands for:

a) Wheel Side Spacer
b) Wheel Speed Sensor
c) Wheel Speed Spacer
d) None of the above

8. Why does the system need a “tone ring”?

a) Reduce the vibration induced sounds of the brake disc during braking.
b) It works with the WSS to generate a signal that is used by the ECU to determine wheel speed.
c) To provide an audible feedback to the rider when the system is functioning.
d) None of the above

9. Why can’t a wheel bearing from an ABS equipped motorcycle be placed in a magnetic tray?

a) The magnetic tray may damage the tone ring.
b) The magnetic tray will magnetize the bearing surfaces.
c) There is no problem with placing the ABS equipped bearing in a magnetic tray.
d) None of the above

10. During a non-abs event, the brake lever pressure applied by the rider is directly applied to the caliper. During an ABS event, the brake pressure applied by the rider is:

a) amplified by the ABS pump.
b) irrelevant because the ABS system completely takes over control of braking.
c) modulated by the ABS system.
d) amplified if the rider squeezed the brake lever harder.
e) none of the above.

11. The accumulator pumps fluid back to the inlet circuit of the brake system.

a) True
b) False

12. The accumulator is responsible for bleeding off a large amount of fluid during an ABS event.
   a) True
   b) False

13. The ABS increases the hydraulic pressure during an ABS event to make up for the fluid bled off by Hydraulic Control Unit.
   a) True
   b) False

14. Every time the ignition switch is turned on, the ABS system:
   a) checks Module and WSS electrical circuits.
   b) internally bleeds air bubbles from the ABS pump
   c) communicates with the ECM to ensure the proper password exists between the modules
   d) goes to sleep until the vehicle is traveling 3-5 miles per hour.
   e) None of the above.

15. ABS always offers additional protection when braking on a motorcycle.
   a) True
   b) False

16. Together, the ECU and HCU are called the ABS Module.
   a) True
   b) False

17. Harley-Davidson ABS is called a “two channel system” because:
   a) It has the ability to control both the front and rear brakes
   b) The front and rear brake systems are not linked together; they are independent systems.
   c) The ABS module is actually made up of two components.
   d) All of the above
   e) None of the above

18. What will happen if an ABS equipped wheel bearing is installed backward?
   a) The ABS will report a trouble code
   b) The ABS will become inactive
   c) The ABS light will remain illuminated
   d) All of the above
   e) None of the above

19. During a non-ABS braking event, the brake fluid simply passes through the ABS module.
   a) True
   b) False

20. When the ABS light is blinking slowly, it indicates the _______.
   a) ABS is in the process of performing a self-test
   b) vehicle has not traveled at least 3-5 miles per hour
   c) ABS is reporting a current trouble code
   d) A & B only
   e) All of the above

21. When replacing a brake caliper, Digital Technician II is required to bleed the ABS.
   a) True
   b) False

22. When replacing an ABS Module, Digital Technician II is required to bleed the ABS.
   a) True
   b) False

23. DTII is required to bleed the ABS Module when replacing a component between the master cylinder and the ABS Module.
   a) True
   b) False

24. When bleeding the ABS Module with DTII, the following occur:
   a) The ABS pump motor and solenoid valves are energized
   b) Proper brake line connections are verified
   c) Any air trapped in the ABS module is purged
   d) All of the above
   e) A & C only

25. Wheel bearings that are pressed into the wheel must always be replaced once they have been removed from the wheel.
   a) True
   b) False

SkillsUSA®

Answer Key

Test questions for PHD 175.08, ABS Service Procedures

Correct answers are **bolded.** Each question is worth 2 points.

1. The video emphasizes that the Harley-Davidson ABS system is designed to help the rider "maintain control when braking in…"
   a) any emergency situation.
   b) a straight line emergency.
   c) slippery conditions only.
   d) all of the above.

2. The Harley-Davidson ABS system is:
   a) A linked system integrating both the front to rear calipers.
   b) Power assisted by the ABS hydraulic unit
   c) A manual, two channel system.
   d) easily installed on non-ABS models.

3. When the Harley-Davidson ABS system activates, the rider should:
   a) Pump the lever/pedal
   b) Maintain pressure on the lever/pedal and let the ABS system do its job
   c) Let off the brakes, downshift then re-apply the brakes.
   d) None of the above

4. How many times per second can the Harley-Davidson ABS system "pump" the brakes?
   a) Two
   b) Five
   c) Seven
   c) Nine
   d) None of the above

5. ABS brake calipers incorporate a special check valve; calipers cannot be interchanged between ABS and non ABS equipped motorcycles.
   a) True
   b) False

6. A customer has a concern that when he starts his ABS equipped motorcycle and lets it idle, the ABS light slowly blinks.

Technician A says that the system has stored a “historic” trouble code.
Technician B says that the system has a “current” code
Technician C says that the system is functioning normally.
Who is correct?

a) Technician A
b) Technician B
c) Technician C
d) No one is correct; the light is blinking because the customer has a brake bulb burned out.

7. “WSS” stands for:

a) Wheel Side Spacer
b) Wheel Speed Sensor
c) Wheel Speed Spacer
d) None of the above

8. Why does the system need a “tone ring”?

a) Reduce the vibration induced sounds of the brake disc during braking.
b) It works with the WSS to generate a signal that is used by the ECU to determine wheel speed.
c) To provide an audible feedback to the rider when the system is functioning.
d) None of the above

9. Why can’t a wheel bearing from an ABS equipped motorcycle be placed in a magnetic tray?

a) The magnetic tray may damage the tone ring.
b) The magnetic tray will magnetize the bearing surfaces.
c) There is no problem with placing the ABS equipped bearing in a magnetic tray.
d) None of the above

10. During a non-abs event, the brake lever pressure applied by the rider is directly applied to the caliper. During an ABS event, the brake pressure applied by the rider is:

a) amplified by the ABS pump.
b) irrelevant because the ABS system completely takes over control of braking.
c) modulated by the ABS system.
d) amplified if the rider squeezed the brake lever harder.
e) none of the above.

11. The accumulator pumps fluid back to the inlet circuit of the brake system.

a) True
b) False

12. The accumulator is responsible for bleeding off a large amount of fluid during an ABS event.
   a) True
   b) False

13. The ABS increases the hydraulic pressure during an ABS event to make up for the fluid bled off by Hydraulic Control Unit.
   a) True
   b) False

14. Every time the ignition switch is turned on, the ABS system:
   a) checks Module and WSS electrical circuits.
   b) internally bleeds air bubbles from the ABS pump
   c) communicates with the ECM to ensure the proper password exists between the modules
   d) goes to sleep until the vehicle is traveling 3-5 miles per hour.
   e) None of the above.

15. ABS always offers additional protection when braking on a motorcycle.
   a) True
   b) False

16. Together, the ECU and HCU are called the ABS Module.
   a) True
   b) False

17. Harley-Davidson ABS is called a “two channel system” because:
   a) It has the ability to control both the front and rear brakes
   b) The front and rear brake systems are not linked together; they are independent systems.
   c) The ABS module is actually made up of two components.
   d) All of the above
   e) None of the above

18. What will happen if an ABS equipped wheel bearing is installed backward?
   a) The ABS will report a trouble code
   b) The ABS will become inactive
   c) The ABS light will remain illuminated
   d) All of the above
   e) None of the above

19. During a non-ABS braking event, the brake fluid simply passes through the ABS module.
   a) True
   b) False

20. When the ABS light is blinking slowly, it indicates the _______.
   a) ABS is in the process of performing a self-test
   b) vehicle has not traveled at least 3-5 miles per hour
   c) ABS is reporting a current trouble code
   d) A & B only
   e) All of the above

21. When replacing a brake caliper, Digital Technician II is required to bleed the ABS.
   a) True
   b) False

22. When replacing an ABS Module, Digital Technician II is required to bleed the ABS.
   a) True
   b) False

23. DTII is required to bleed the ABS Module when replacing a component between the master cylinder and the ABS Module.
   a) True
   b) False

24. When bleeding the ABS Module with DTII, the following occur:
   a) The ABS pump motor and solenoid valves are energized
   b) Proper brake line connections are verified
   c) Any air trapped in the ABS module is purged
   d) All of the above
   e) A & C only

25. Wheel bearings that are pressed into the wheel must always be replaced once they have been removed from the wheel.
   a) True
   b) False

2012 SKILLSUSA WHEEL BEARING REMOVAL AND INSTALLATION (100 points)

- **First, read the procedure from the laminated Service Manual sheets.**
- **Answer all 10 questions**
- **Remove and replace the wheel bearings on the supplied wheel.**
- **One bearing is a conventional wheel bearing and the other is an ABS (Anti-lock Brake System) wheel bearing.**

IMPORTANT: Before removing and replacing the wheel bearings, read the procedure provided from the laminated Harley-Davidson service manual before performing the task.

- **Multiple choice questions = 2 points (20 points total)**
- **ABS wheel bearing removal and replacement = 45 points**
- **Non-ABS wheel bearing removal and replacement = 35 points**

Points will be deducted for damaged or improper use of tools, damage to the wheel, incorrect procedures, or leaving the work station in disorder upon completion.

Enter answers (A,B,C or D) on answer sheet

Mark the contestant number on the answer sheet.

30 minutes will be given to complete this station.

2012 SKILLSUSA WHEEL BEARING REMOVAL AND INSTALLATION

ANSWER SHEET

Contestant Number __________ Total Score __________ Judges Initials __________

1. ___________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________

DO NOT WRITE BELOW THIS LINE (For judges only)

---

10 questions Total (20 points possible - 2 pts each) __________

Non ABS/ABS Bearing removal and replacement Procedure (80 points possible) __________

2012 SKILLSUSA Wheel Bearing Procedure Questions

Choose the best answer and write on answer **sheet** **20 POINTS-questions, 80 POINTS-procedure**

1. What color surface faces out on a non-ABS wheel bearing?
   - A. Light orange
   - B. Green/tan
   - C. Red
   - D. Black

2. What color faces surface faces out on a ABS wheel bearing?
   - A. Light orange
   - B. Green/tan
   - C. Red
   - D. Black

3. The collets used to remove wheel bearings are different for non-ABS vs. ABS bearings. Which part number is used for an ABS bearing? *(The "A" after the number means a newer version of the tool).*
   - A. HD-44060-10
   - B. HD-44060-11
   - C. HD-44060-12
   - D. HD-44060-13

4. The primary side of a wheel is the brake disc side (single disc wheels). When installing a new set of bearings, on what side of the wheel should the first bearing be installed? What side of the bearing faces outward?
   - A. Primary side (black side)
   - B. Primary side (green/tan side)
   - C. Non-primary side (red side)
   - D. Non-primary side (black side)

5. What is the result if the HD-44060-11 wheel bearing collet is used to remove both bearings?
   - A. One bearing needs more force to be removed
   - B. Collet will be damaged if used on both bearings as its longer than one bearing requires and will fit loose
   - C. Collet is too short to extract one of the bearings
   - D. No significant difference when used with either bearing

6. What is the advantage when installing the first and second bearing with the wheel flat on the bench top?
   - A. It's easier to see the bearing going in
   - B. It's more ergonomic
   - C. There is no advantage
   - D. Ensures bearings and sleeve installation are straight and proper

7. List a verification technique the technician can perform to verify correct installation of the second bearing?
   - A. Primary bearing 0.30" below hub edge
   - B. Count 2 turns of wrench after bearing touches the shoulder in the bearing bore
   - C. Forcing screw torque is at least 9 foot lbs. after green/tan side of bearing contacts the shoulder in bearing bore
   - D. Sleeve is square and in-line with the bearing bore and may or may not be free to rotate and bearing is square to bearing bore

8. Why would the wheel bearing collet fail to extract the wheel bearing from the hub?
   - A. Incorrect collet was used
   - B. Ball bearing was not used
   - C. Collet was 'flared' prior to being installed properly
   - D. All of the above

9. For a front wheel, what is a visual cue to determine the primary side?
   - A. Valve stem side of wheel
   - B. Primary side is stamped 'P' on hub
   - C. Primary side has 'PRIMARY' stamped on the hub
   - D. Brake disc side or side opposite valve stem for most front wheels

10. Magnetic trays are helpful in the shop to prevent loss of parts during service. What is important to remember?
    - A. Bearing will rotate faster when magnetized.
    - B. Magnetic trays damage sensors/ABS bearings
    - C. Nothing, magnetic trays help organization
    - D. Magnetic bearings could pick up metal chips

REMOVAL

PART NUMBER	TOOL NAME
HD-44060C	WHEEL BEARING REMOVER/INSTALLER

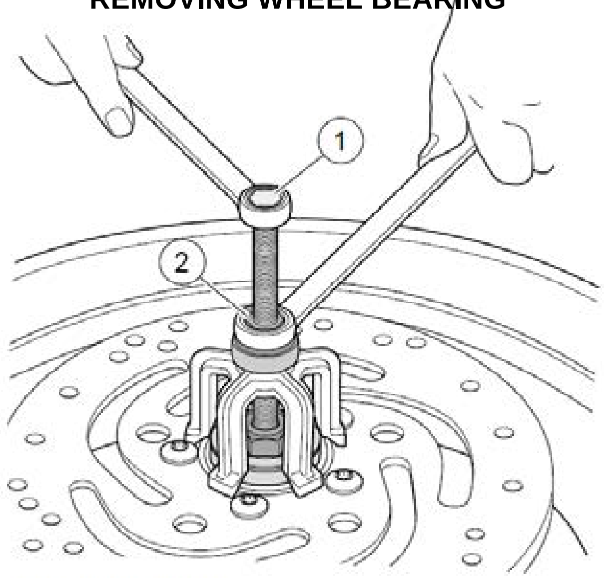
1. Remove wheel. See 2.4 FRONT WHEEL or 2.5 REAR WHEEL.
2. If servicing rear wheel, remove the sprocket.

NOTES

- *On front wheel, remove the primary brake disc side (left) bearing first.*
- *ABS equipped motorcycles use both a special encoder bearing (greenish tan in color) on the primary brake disc side and a standard bearing (black) on the opposite side. Select (Part No. HD-44060-11) if the motorcycle is ABS equipped, or (Part No. HD-44060-10) for non-ABS equipped motorcycles.*

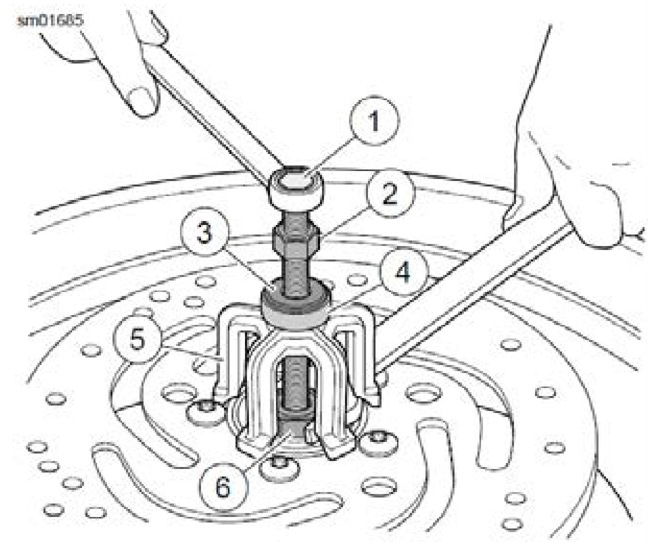
3. See Figure 2-32. Sparingly apply graphite lubricant to threads of forcing screw (1) of WHEEL BEARING REMOVER/INSTALLER (Part No. HD-44060C).
4. Install nut (2), washer (3) and bearing (4) on forcing screw. Insert assembly through hole in bridge (5).
5. Place steel ball inside collet and install collet at end of forcing screw.
6. Insert collet into bearing. Hold forcing screw (1) and turn hex on collet (6) until lip makes firm contact with inside edge of bearing.
7. See Figure 2-33. Turn hex nut (2) until bearing is free. Discard bearing.
8. See Figure 2-34. Remove spacer sleeve (6) from hub.
9. Repeat steps to remove remaining bearing from opposite side of wheel.

REMOVING WHEEL BEARING

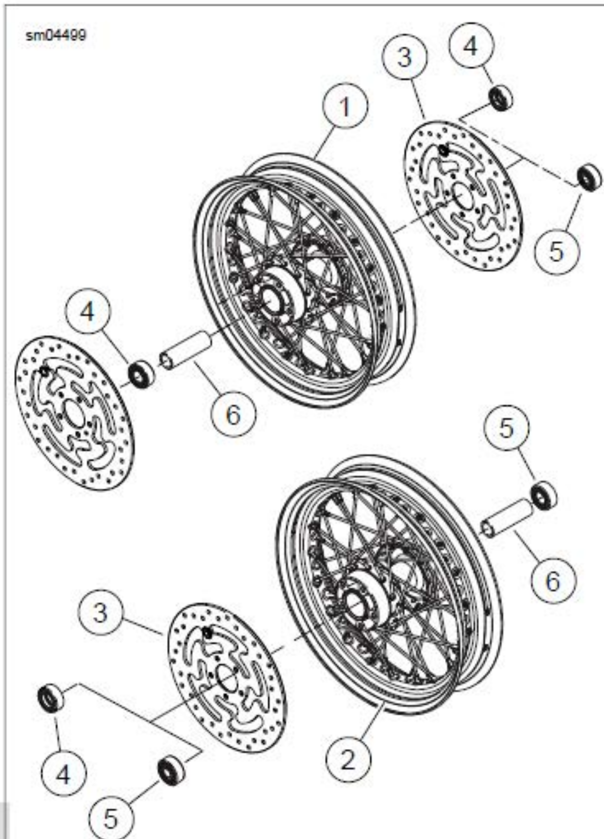


1. Forcing screw
2. Nut

INSTALLING WHEEL BEARING REMOVAL TOOL



1. Forcing screw
2. Nut
3. Washer
4. Bearing
5. Bridge
6. Collet with ball bearing inside



1. Front wheel
2. Rear wheel
3. Brake disc (primary)
4. ABS encoder bearing
5. Standard bearing
6. Spacer sleeve

Figure 2-34. Wheel Bearing Assemblies

INSTALLATION

PART NUMBER	TOOL NAME
HD-44060C	WHEEL BEARING REMOVER/INSTALLER

NOTES

- *Keep ABS encoder bearings away from magnetic fields (such as magnetic parts trays, magnetic base dial indicators, alternator rotors, etc.) or damage will occur.*
- *Always replace both bearings as a complete set.*

1. See Figure 2-35. Sparingly apply graphite lubricant to threads of threaded rod (1) of WHEEL BEARING REMOVER/INSTALLER (Part No. HD-44060C).

NOTE

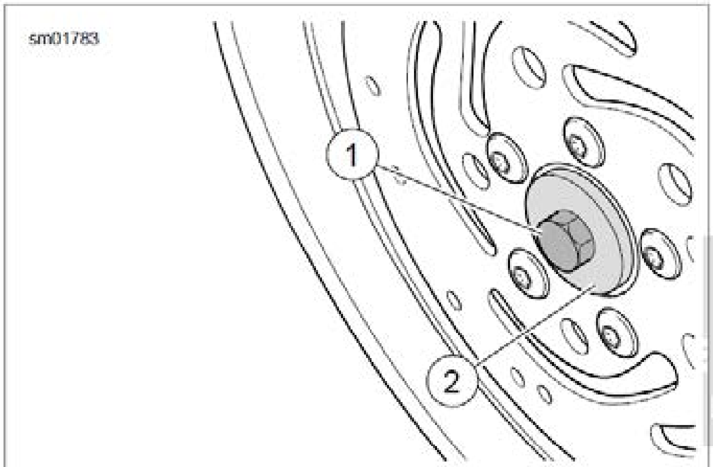
Install the primary brake disc side bearing first. ABS equipped motorcycles use a special encoder bearing (greenish tan in color) on the primary brake disc side and a standard bearing (black) on the opposite side.

2. Install support plate (2) onto rod (1) and slide rod through hub from the side opposite the primary brake side.

NOTE

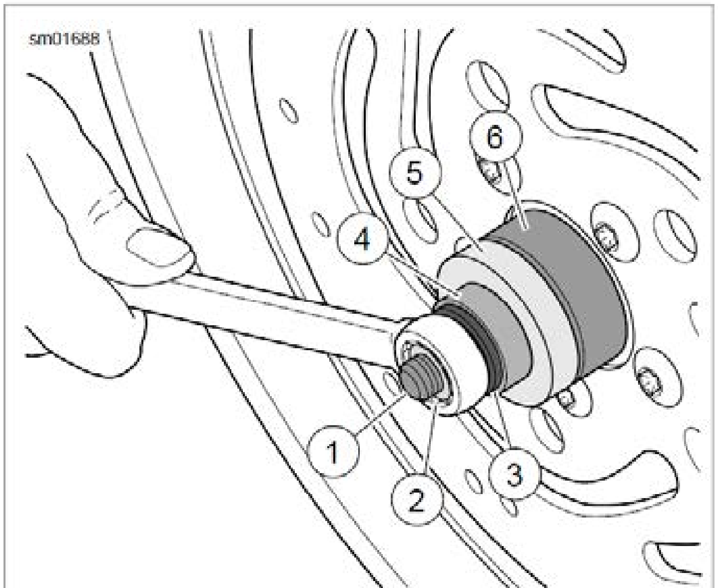
Bearing orientation is important.

3. See Figure 2-36. Place the bearing on the rod.
   a. Standard bearing with the lettered side against installer (5).
   b. ABS bearing with greenish tan side against installer (5).
4. Install 1 inch installer (Part No. HD-44060-8) (5), bearing (4), flat washer (3) and nut (2) onto rod.
5. Hold hex on rod and turn nut (2) until bearing is fully seated.
6. Install spacer sleeve in hub.
7. Reverse tool and install opposite side bearing until bearing contacts spacer sleeve.
8. Install wheel. See 2.4 FRONT WHEEL or 2.5 REAR WHEEL.



1. **Threaded rod**
2. **Support plate**

Figure 2-35. Assembling Installation Tool



1. **Threaded rod**
2. **Nut**
3. **Washer**
4. **Bearing**
5. **Installer**
6. **Wheel bearing**

Figure 2-36. Installing Bearing

JUDGES ANSWER SHEET

2012 SKILLSUSA WHEEL BEARING REMOVAL AND INSTALLATION

Contestant Number __________ **Total Score** __________ **Judges Initials** __________

1. ____D_______(2,0) ___
2. ____B_______(2,0) ___
3. ____B_______(2,0) ___
4. ____B_______(2,0) ___
5. ____B_______(2,0) ___
6. ____D_______(2,0) ___
7. ____D_______(2,0) ___
8. ____D_______(2,0) ___
9. ____D_______(2,0) ___
10. ____B_______(2,0) ___

total points from multiple choice questions ___

11. **Assembled removal collet tools properly per instructions** (5,0) ___
12. **Removed ABS Bearing 1st using special collet tool HD-44060-11A.** (10,0) ___
13. **Removed non ABS Bearing 2nd using special collet tool HD-44060-10A.** (5,0) ___
14. **Used special collet removal tools without damage.** (5,0) ___
15. **Assembled installer tools HD-44060C properly per instructions** (5,0) ___
16. **Installed ABS Bearing 1st-squarely and fully seated** (20,0) ___
17. **Installed ABS Bearing with greenish/brown side out – not RED side out** (5,0) ___
18. **Assembled wheel sleeve properly** (5,0) ___
19. **Installed non ABS Bearing 2nd, snug to sleeve-all square** (15,0) ___
20. **Did not damage tools and did not leave work station messy** (5,0) ___

Score = 100 points possible ______

SkillsUSA
2012 Motorcycle Service Technology Contest

Written Test

Motorcycle Technology Theory

Sponsored by

MOTORCYCLE MECHANICS INSTITUTE

A DIVISION OF UNIVERSAL TECHNICAL INSTITUTE

SkillsUSA
2012 Motorcycle Service Technology Contest
Motorcycle Technology Theory

Objective: This written test allows the participant to demonstrate knowledge of Motorcycle Technology Theory.

Directions: Select the best answer(s) for each question, and then fill in the appropriate letter's box on the answer sheet provided.

1. Pre-ignition is:

   A. spontaneous ignition after normal ignition
   B. auto-ignition before normal ignition
   C. compression
   D. auto-ignition after normal ignition

2. The intake valve opens in which quadrant?

   A. BTDC
   B. ATDC
   C. BBDC
   D. ABDC

3. The exhaust valve opens in which quadrant?

   A. BTDC
   B. ATDC
   C. BBDC
   D. ABDC

4. Valve overlap occurs at the:

   A. end of the combustion stroke and the beginning of the exhaust stroke
   B. end of the compression stroke and the beginning of the combustion stroke
   C. end of the exhaust stroke and the beginning of the intake stroke
   D. end of the intake stroke and the beginning of the compression stroke

5. Intake valve area is commonly __________ that of the exhaust valve.

   A. greater than

B. the same as
C. less than
D. hotter than

6. Which of these components changes reciprocation motion into rotary motion?

A. rocker arm
B. camshaft
C. crankshaft
D. piston

7. The intake port of a piston –port two-stroke engine typically:

A. opens at BTDC and closes at ATDC
B. opens at BTDC and closes at ABDC
C. opens at BBDC and closes at ABDC
D. opens at BBDC and closes at ATDC

8. A two-stroke engine with a leaking wet (clutch) side seal will exhibit which symptom?

A. run lean
B. smoke excessively
C. none of the above
D. all of the above

9. Changing a 32:1 pre-mix ration to 50:1 will:

A. put more oil in the fuel/oil mixture
B. put less oil in the fuel/oil mixture
C. lubricate the engine better
D. have no effect

10. Overdrive is a gear that is numerically:

A. less than 1:1
B. more than 1:1
C. 1:1
D. none of the above

11. Clutch drag is:

A. the clutch does not transfer 100% of the engine's powerflow
B. clutch friction plates contaminated with oil
C. the clutch will not fully disengage

D. a clutch with worn out clutch springs

12. The four purposes of motor oil are:

A. clean, cool, seal, quiet
B. clean, cool, seal, lubricate
C. clean, cool, seal, motivate
D. clean, cool, seal, calcify

13. The __________ is a lubricating system that stores oil in a remote tank.

A. wet sump
B. centrifugal
C. splash
D. dry sump

14. a 20W-50 multi-viscosity motor oil is one which:

A. is both 20 weight and 50 weight oil combined
B. acts like a 20 weight when cold and acts like a 50 weight when hot
C. is a 20 weight mixed with 30 weight
D. thins less when cold than a 20 weight and thickens less when hot than a 50 weight

15. The bearing which is the best for radial loads, but not at all good for axial loads is the:

A. thrust bearing
B. tapered roller bearing
C. ball bearing
D. roller bearing

16. Which one of these is one of the four purposes of bearings?

A. support radial and/or axial loads
B. lubricate
C. impressibility
D. permeability

17. In a liquid cooling system, the __________ determines the cooling system's operating pressure.

A. thermostat
B. water pump
C. radiator
D. radiator cap

18. The main purpose of oxygenated fuels is to:

    A. improve fuel mileage of the engine
    B. reduce CO2 emissions
    C. reduce CO emissions
    D. reduce HC emissions

19. Air density:

    A. refers to the amount of oxygen in a given space
    B. decreases as altitude decreases
    C. affects the pressure differences
    D. increases and altitude increases

20. The force that results from an electrical pressure difference is called:

    A. watts
    B. ohms
    C. amps
    D. EMF

21. Which of the following formulas is correct?

    A. Volts = Amps X Ohms
    B. Volts X Ohms = Amps
    C Ohms ÷ Amps = Volts
    D. Amps ÷ Volts = Watts

22. The two major types of charging systems are:

    A. rising field, collapsing field
    B. excited field, normally open
    C. permanent magnet, full wave
    D. permanent magnet, electromagnet

23. The three types of permanent magnet charging system outputs are:

    A. half-wave, full-wave, permanent magnet
    B. half-wave, full-wave, sine-wave
    C. half-wave, full-wave, 3-phase
    D. permanent magnet, electromagnet, rising field

24. The ignition coil's __________ windings has more wire turns than it's __________ winding.

A. solenoid; starter
B. field; stator
C. secondary; primary
D. primary; secondary

25. An ignition coil operates on the principle of:

A. polarity
B. grounding
C. residual magnetism
D. mutual induction

Motorcycle Service Technology WORKSTATION 7 Professional Oral Assessment

CONTESTANT __________ START__________ END__________

"Without using your name, home town or state, tell me why you should be hired for the position of technician in two (2) minutes to four (4) minutes"

Audible pauses (umm, ahh, uhh, OK, alright, etc) -5 POINTS EACH

Eye contact – must make eye contact during the presentation. -20 FOR NO EYE CONTACT

Hand gestures and facial expressions must be used to demonstrate persuasion or exchange of information. -20 FOR NO HAND GESTURES <u>AND</u> NO FACIAL EXPRESSIONS

-10 FOR NO HAND GESTURES <u>OR</u> NO FACIAL EXPRESSIONS

Time Limits -20 FOR FALLING OUTSIDE OF THE TIME LIMITS – HIGH OR LOW

SCORING 100

Audible Pauses	-__________
Eye Contact	-__________
Facial/Hand Gestures	-__________
Time	-__________

Judge Initials __________ TOTAL __________

2010 Harley-Davidson Dyna Models Electrical Diagnostic Manual

99496-10

IMPORTANT NOTICE

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

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

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

Harley-Davidson Motor Company

2010 Harley-Davidson Dyna Models Electrical Diagnostic Manual

99496-10

Printed in the U.S.A.

VISIT THE HARLEY-DAVIDSON WEB SITE
http://www.harley-davidson.com

READER COMMENTS

The Harley-Davidson Service Communications Department maintains a continuous effort to improve the quality and usefulness of its publications. To do this effectively, we need user feedback - your critical evaluation of this manual.

Please comment on the completeness, accuracy, organization, usability, and readability of this manual.

Please list the page, item, and part number(s) of any errors you find in this manual.

Please tell us how we can improve this manual.

Occupation:

Name: Dealership:

Street: Department:

City: State: Zip:

Cut Here

Cut Here

2010 Harley-Davidson Dyna Models Electrical Diagnostic Manual (99496-10)

Please clip out and mail to:
Service Communications Department
Harley-Davidson Motor Company
P.O. Box 653
Milwaukee, WI USA 53201

NOTES

ABOUT THIS MANUAL

GENERAL

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

HOW TO USE YOUR SERVICE MANUAL

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

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

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

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

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

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

PREPARATION FOR SERVICE

⚠WARNING

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

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

NOTES

- *To avoid unnecessary disassembly, carefully read all relative service information before repair work is started.*
- *In figure legends, the number which follows the name of a part indicates the quantity necessary for one complete assembly.*
- *When servicing a vehicle equipped with the Harley-Davidson Smart Security System (H-DSSS), you must first disarm the security system. Either keep the fob in close proximity to the vehicle, or use Digital Technician II to disable the security system while the vehicle is being serviced and re-enable the system after service is completed.*

SERVICE BULLETINS

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

USE GENUINE REPLACEMENT PARTS

⚠WARNING

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

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

WARNINGS AND CAUTIONS

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

⚠WARNING

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

⚠CAUTION

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

CAUTION

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

NOTE

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

Proper service and repair is important for the safe, reliable operation of all mechanical products. The service procedures recommended and described in this service 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 service manual. However, please remember that these warnings are not all-inclusive. Inadequate safety precautions could result in death or serious injury.

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

PRODUCT REFERENCES

WARNING

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

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

Kent-Moore Products

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

Loctite Sealing and Threadlocking Products

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

PRODUCT REGISTERED MARKS

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

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

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

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NOTES

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SPECIFICATIONS

Table 1-1. Fuel System Specifications

FUEL SYSTEM	TYPE
Intake	Side draft
Recommended fuel	91 Octane

Table 1-2. Idle Speed Specifications

ADJUSTMENT	RPM
Normal idle speed	950-1050 Nominal, non-adjustable

Table 1-3. Battery Specifications

BATTERY	SPECIFICATIONS
Size	12V/19 AH/270CCA
Type	Sealed, AGM

Table 1-4. Spark Plug Specifications

SPARK PLUG	SPECIFICATIONS	
Gap	0.038-0.043 in.	0.97-1.09 mm
Torque with anti-seize applied to threads	12-18 ft-lbs	16.3-24.4 Nm
Type	Harley-Davidson No. 6R12	

Table 1-5. Spark Plug Cables

SPECIFICATION	FRONT	REAR
Length in.	21.9-22.4	7.25-7.50
Length mm	555.8-568.5	184.2-190.5
Resistance-ohms	4750-14920	1812-4375

Table 1-6. Ignition Coil Specifications

WINDING	RESISTANCE
Ignition coil primary resistance at room temperature	0.5-0.7 Ohm
Ignition coil secondary resistance at room temperature	5500-7500 Ohms

Table 1-7. Starter Specifications

STARTER	SPECIFICATIONS
Cranking current	200A
Free speed	3000 RPM (min)
Free current	90A
Stall torque	8.0 ft-lbs (10.8 Nm)

Table 1-8. Fuel Pump Pressure Specifications

RANGE	VALUE
Normal	55-62 psi (380-425 kPA)

Table 1-9. Relay Specifications

RELAY	PART NO.
Start	31586-07
System	31586-07

Table 1-10. Alternator Specifications

MEASUREMENT	VALUE
AC voltage output	16-23 VAC per 1000 RPM
Stator coil resistance	0.1-0.2 Ohm

Table 1-11. Regulator Specifications

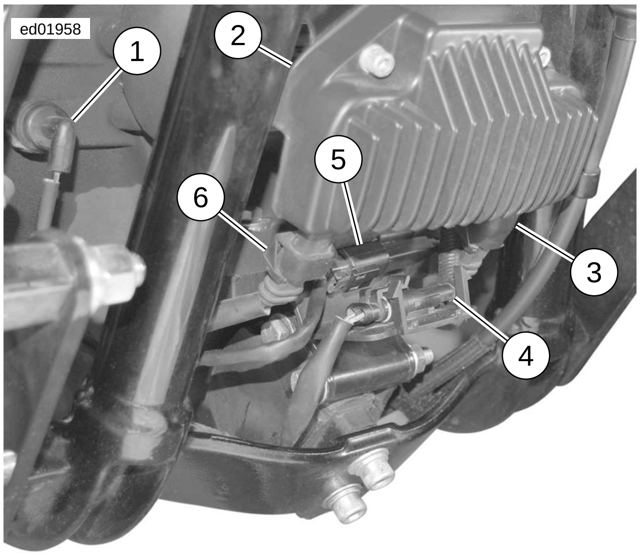
MEASUREMENT	VALUE
Amperes @ 3600 RPM	35-50A
Voltage @ 3600 RPM	14.3-14.7V @ 75 °F (24 °C)

Table 1-12. Fuse Specifications

ITEM	RATING (AMPERES)
Instruments fuse	15
ACCY fuse	15
Battery fuse	15
ECM fuse	15
Fuel pump fuse	15
Ignition fuse	15
Lights fuse	15
Main fuse	40
Customer ACCY	15
Engine control fuse	15

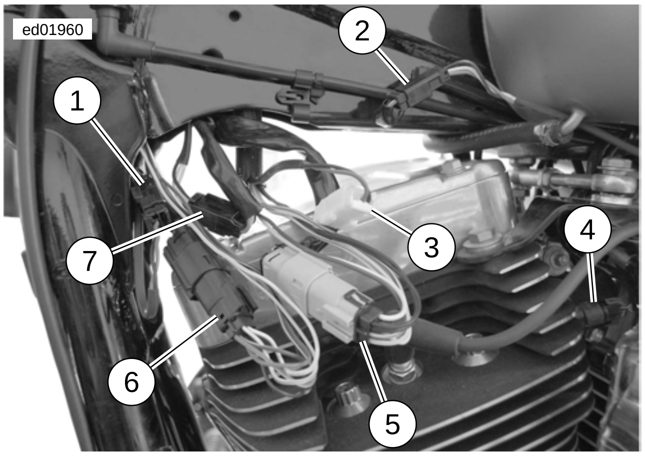
COMPONENT LOCATIONS

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



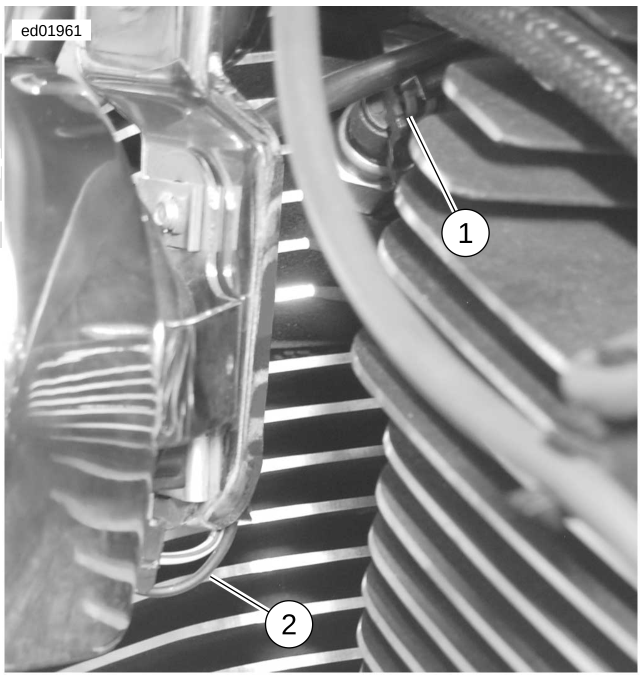
1. Oil pressure switch [120]
2. Voltage regulator
3. Voltage regulator to stator [47]
4. Front O2 sensor (Domestic Only) [138]
5. CKP sensor [79]
6. Voltage regulator [77]

Figure 1-1. Lower Front



1. Front turn signals (right) [31R]
2. Fuel gauge [117]
3. Front turn signals (left) [31L]
4. ET sensor [90]
5. Left hand controls and horn [24]
6. Right hand controls [22]
7. Headlamp [38]

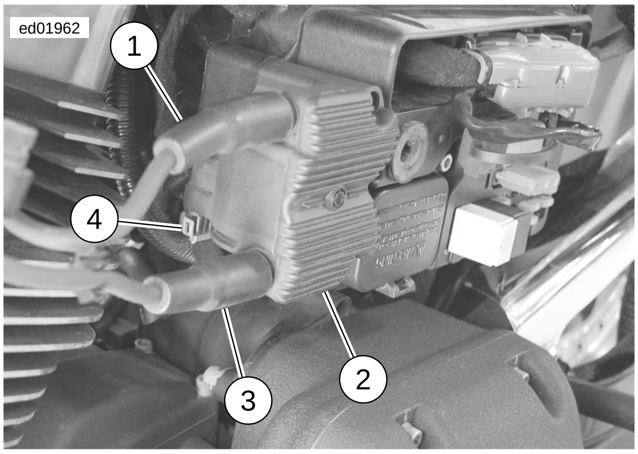
Figure 1-2. Under Fuel Tank Left Side



1. ET sensor [90]
2. Horn [122]

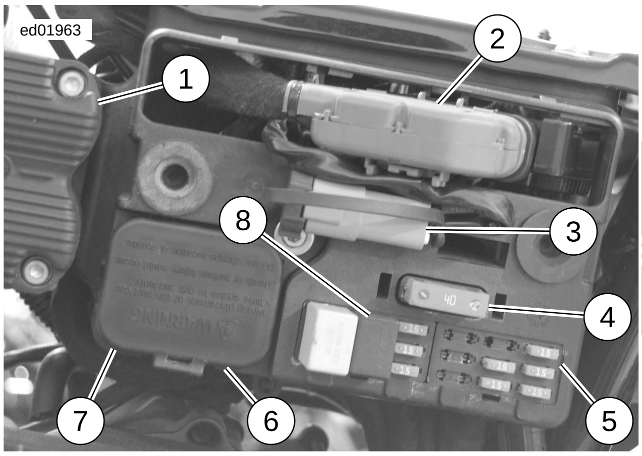
Figure 1-3. Horn: Except FXCWC

HOME



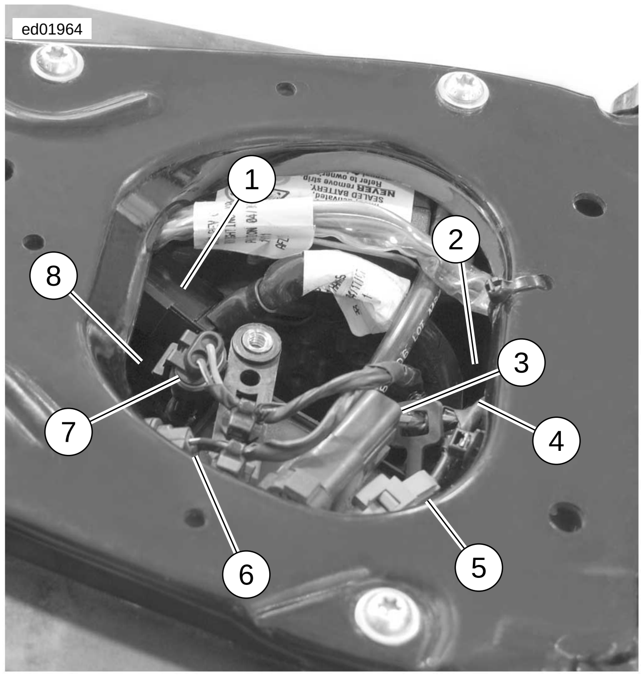
1. Rear spark plug wire
2. Coil
3. Front spark plug wire
4. Ignition coil [83]

Figure 1-4. Ignition Coil



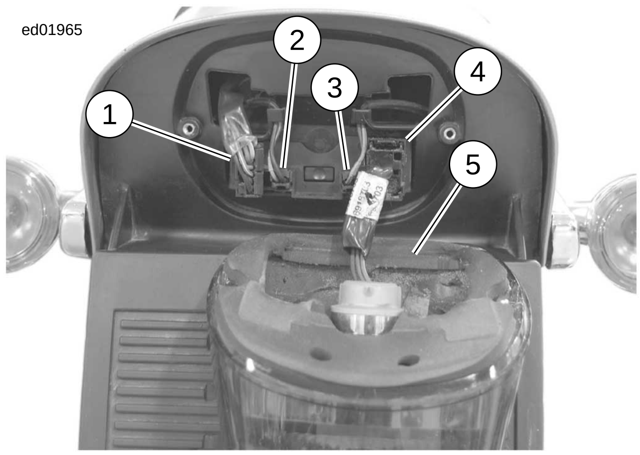
1. Ignition coil
2. ECM [78]
3. DLC [91]
4. Main fuse [5]
5. Fuse block [64]
6. TSM/TSSM/HFSM
7. HFSM antenna harness [208]
8. Fuse/relay block [62]

Figure 1-5. Under Left Side Cover



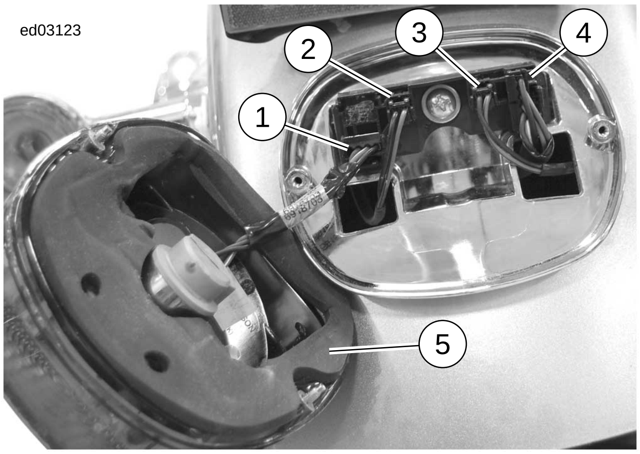
1. Tail lamp harness to main harness [7]
2. Grounds [GND1] & [GND2]
3. Accessory [4]
4. Security siren [142]
5. B+ [160]
6. IAT sensor [89]
7. Rear O2 sensor [137]
8. JSS (HDI only) [133]

Figure 1-6. Under Seat



1. Tail lamp power in [94]
2. Right rear turn signal [18]
3. Left rear turn signal [19]
4. Tail lamp [93]
5. Tail lamp

Figure 1-7. Tail Lamp: FXDF



1. Tail lamp [93]
2. Left rear turn signal [19]
3. Right rear turn signal [18]
4. Tail lamp power in [94]
5. Tail lamp

Figure 1-8. Tail Lamp: Except FXDF

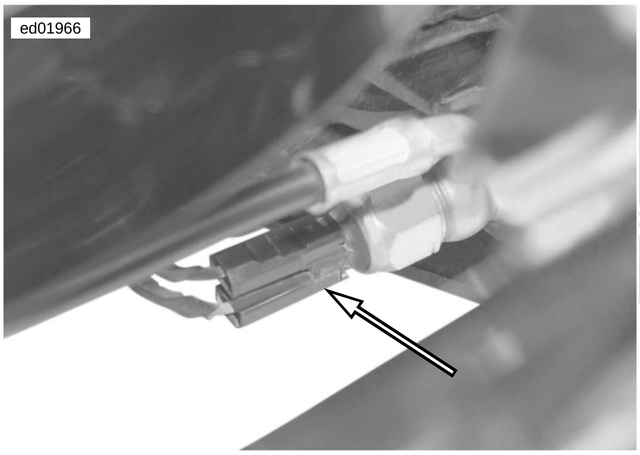
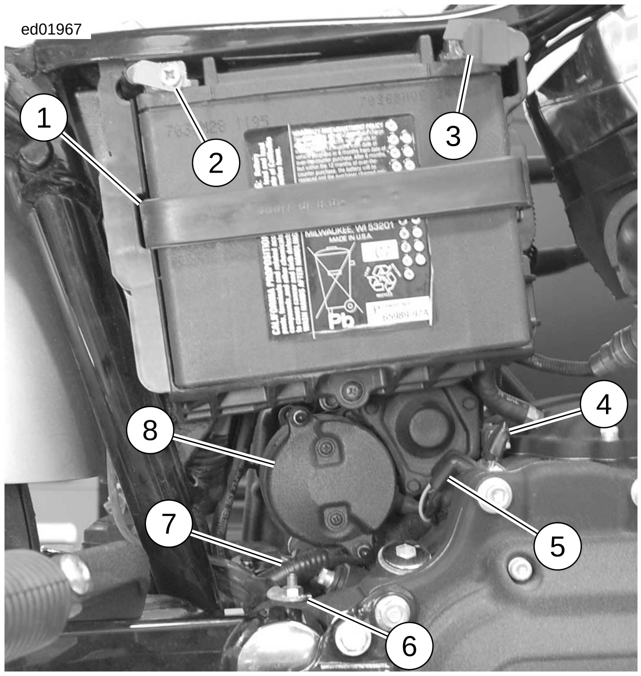
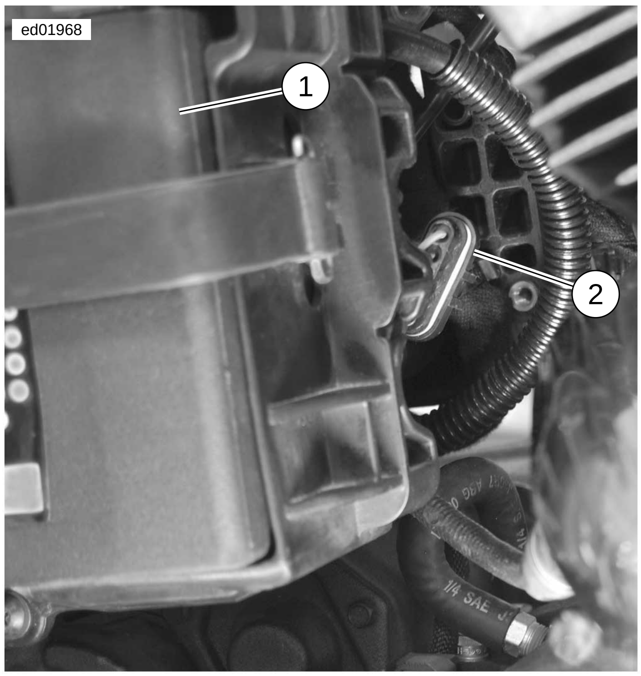


Figure 1-9. Rear Stop Lamp Switch [121]



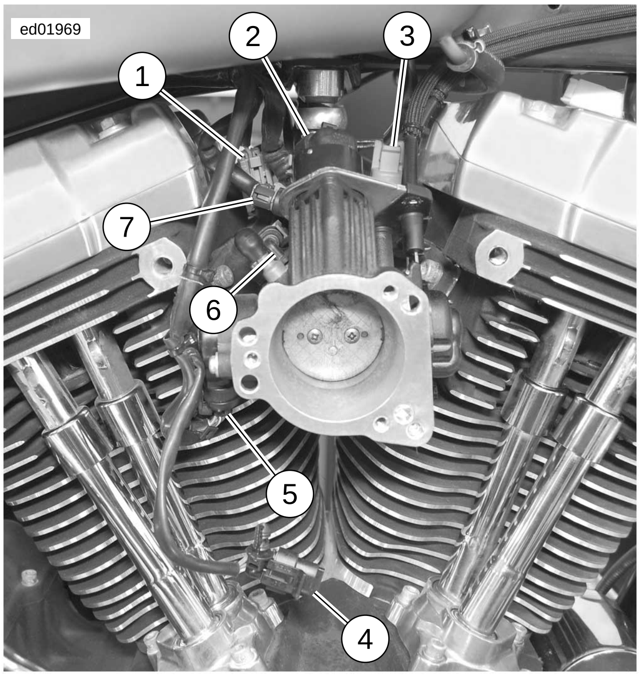
1. Battery
2. Battery negative
3. Battery positive
4. Starter solenoid [128]
5. Neutral switch [131]
6. Battery ground cable
7. VSS [65]
8. Starter

Figure 1-10. Under Right Side Cover



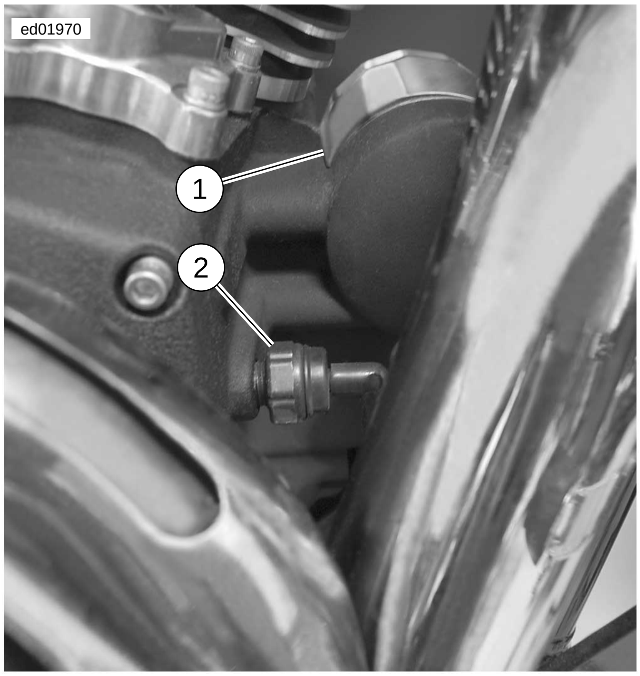
1. Battery
2. Active exhaust (HDI) [179]

Figure 1-11. Active Exhaust



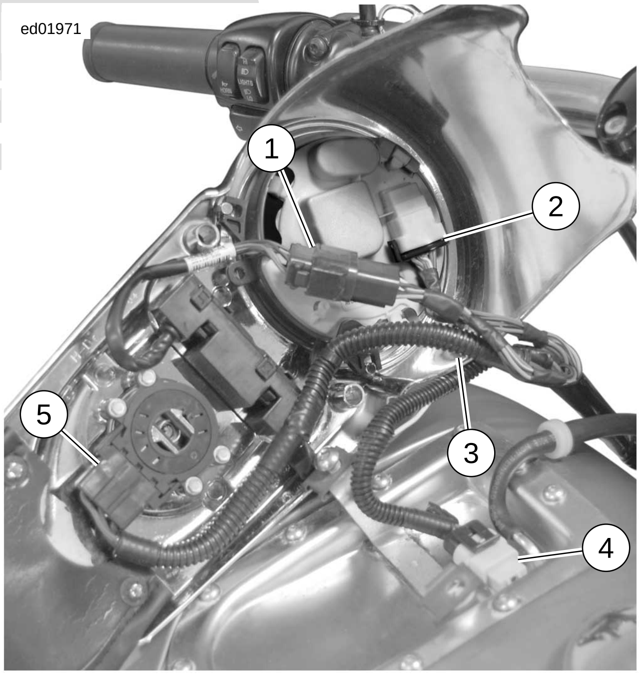
1. Rear fuel injector [85]
2. IAC [87]
3. Front fuel injector [84]
4. Active intake solenoid (HDI) [178]
5. TPS [88]
6. IAT sensor [89]
7. MAP sensor [80]

Figure 1-12. Between Cylinders Right Side



1. Oil filter
2. Oil pressure switch [120]

Figure 1-13. Oil Pressure Switch



1. Indicator lamps [21]
2. Speedometer [39]
3. Trip odometer reset switch
4. Fuel pump and sender [141]
5. Ignition switch [31]

Figure 1-14. Under Console (Typical)

DIAGNOSTIC TOOLS 1.2

HOW TO USE DIAGNOSTIC TOOLS

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-41199-3	IAC TEST LIGHT
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER
HD-46601	BREAKOUT BOX ADAPTERS
HD-48053	ADVANCED BATTERY CONDUCT-ANCE AND ELECTRICAL SYSTEM ANALYZER
HD-48650	DIGITAL TECHNICIAN II

HD-26792 Spark Tester

See Figure 1-15. The SPARK TESTER (Part No. HD-26792) is used to verify adequate spark at the spark plug. Attach the tester to the coil top plug and to ground, while cranking the engine a spark should jump across the gap on the tester leads.

NOTE

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

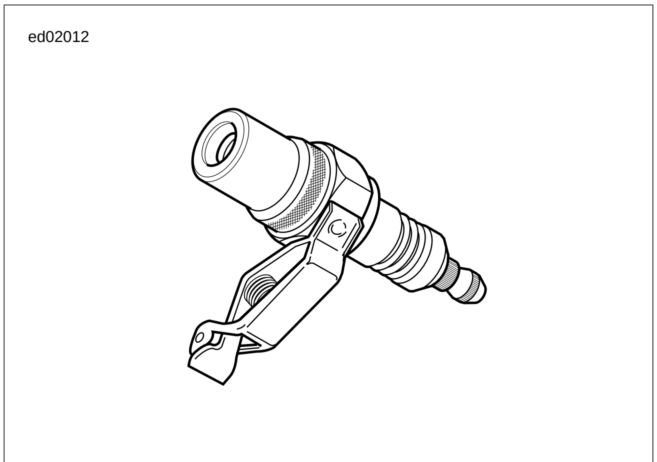
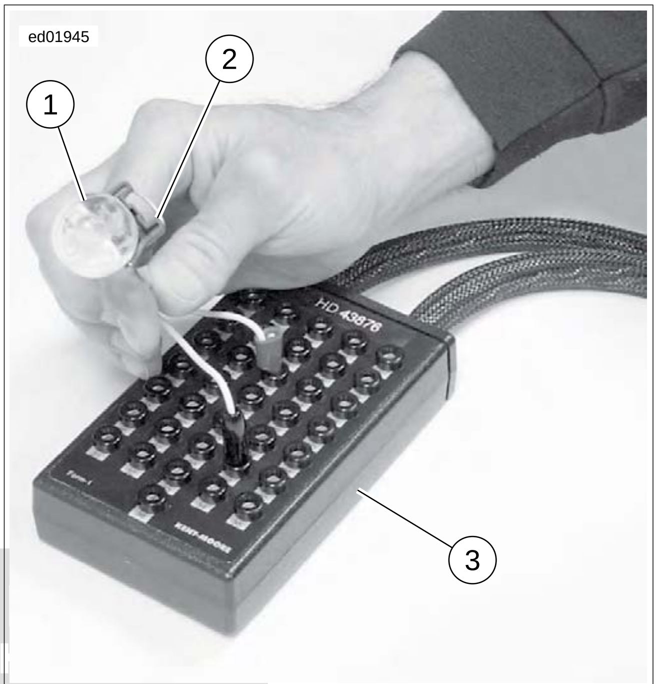


Figure 1-15. Spark Tester

HD-34730-2D Fuel Injector Test Light

The FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) and IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) are used to test the fuel injector drivers as well as the ignition coil drivers in the ECM.

1. Connect the BREAKOUT BOX (Part No. HD-43876).
2. Disconnect the fuel injector connectors.
3. See Figure 1-16 for typical setup. Connect one side of the fuel injector test light to power and the other to the terminal on the ECM for the circuit you are testing.
4. Crank the engine.
5. If the test light flashes, the circuit is working properly.



1. **HD-34730-2D Fuel Injector Test Light**
2. **HD-44687 Ignition Coil Circuit Test Adapter**
3. **HD-43876 Breakout Box**

Figure 1-16. Fuel Injector Test Light

HD-39978 Digital Multimeter (Fluke 78)

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

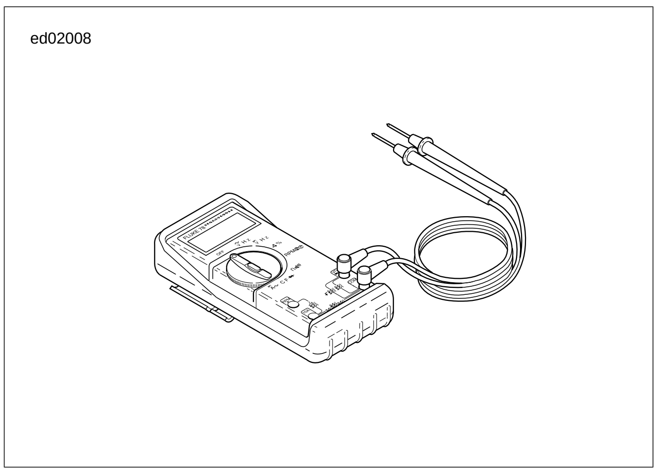


Figure 1-17. Digital Multimeter (Fluke 78) (Part No. HD-39978)

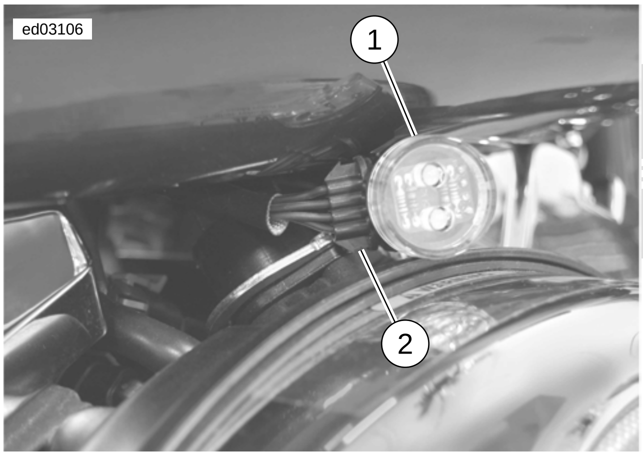
HD-41199-3 IAC Test Light

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

1. Disconnect IAC [87B] and connect test light.
2. See Figure 1-18.
3. Turn IGN ON for 2 seconds, then turn IGN OFF for 10 seconds. Test light behavior may follow two patterns. The color of the lights ins not relevant to IAC operation.
   a. **Normal behavior:** At IGN ON, test lights will alternately flash and then remain on to confirm ECM signals. At IGN OFF lights alternately flash and go out after 10 second reset procedure.
   b. **Problem indicated:** One or more lights fail to illuminate during IGN ON/IGN OFF cycle.

   NOTE

   There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn ignition ON. probe terminals to check for this condition.
4. Disconnect test light and connect IAC [87B].



1. **HD-41199-3 IAC Test Light**
2. **IAC [87]**

Figure 1-18. HD-41199-3 IAC Test Light

HD-41404-B Harness Connector Test Kit

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

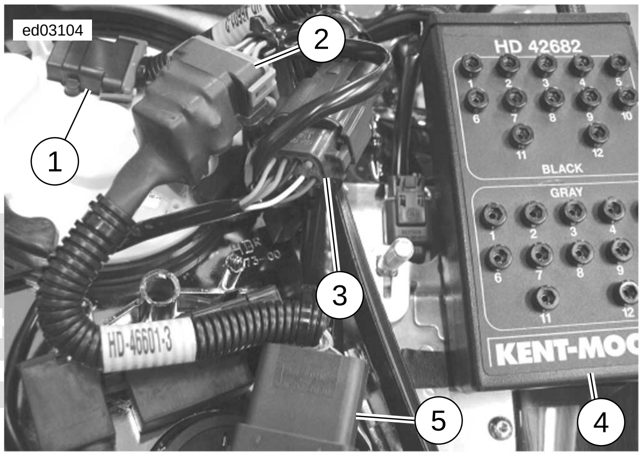
NOTE

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

HD-42682 Breakout Box

The BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. 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]. See the service manual.
2. See Figure 1-19. Press latch and disconnect [39B].
3. Connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39A] and [39B].
4. Attach black connectors from BREAKOUT BOX (Part No. HD-42682) to BREAKOUT BOX ADAPTERS (Part No. 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, restore connections.



1. **Speedometer [39]**
2. **Breakout box adapter HD-46601 to speedometer [39]**
3. **Breakout box adapter to harness connector**
4. **Breakout box HD-42682**
5. **Breakout box harness connector**

Figure 1-19. Breakout Box Connection

HD-42682 Breakout Box (TSM/TSSM/HFSM)

The BREAKOUT BOX (Part No. HD-42682) splices 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

For HFSM: Disarm security system, then remove main fuse while the system remains disarmed.

1. Access TSM/TSSM/HFSM. See the service manual.
2. Disconnect [208B] and [30B] from TSM/TSSM/HFSM:
   a. **For HFSM:** Press latches and disconnect [208B].
   b. Press latches and disconnect [30B].

HOME

3. See Figure 1-20. Connect BREAKOUT BOX (Part No. HD-42682) to connectors.
4. **For HFSM:** Mate antenna [208B] to HFSM.
5. When testing is completed remove the breakout box and restore connections.

NOTE

Vehicle will not start with TSM/TSSM/HFSM disconnected or incorrectly mounted.

Figure 1-20. Breakout Box: TSM/HFSM

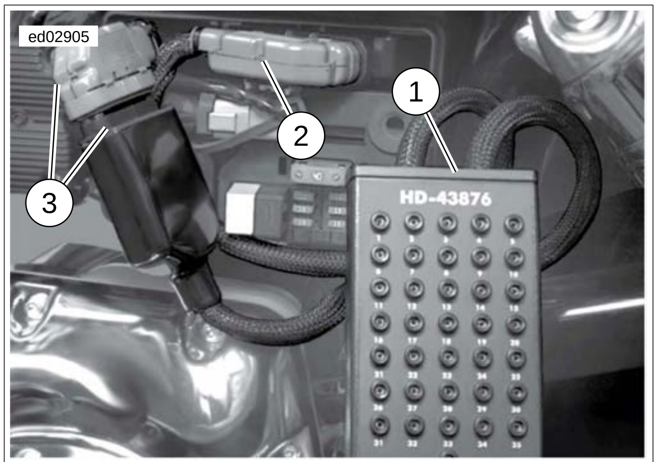
HD-43876 Breakout Box (ECM)

The BREAKOUT BOX (Part No. HD-43876) splices 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 passenger seat.

1. Access the ECM. See the service manual.
2. Press latch and disconnect [78B].
3. See Figure 1-21. Connect BREAKOUT BOX (Part No. HD-43876) to connectors.
4. When testing is completed, remove the breakout box and restore connections.



1. **Breakout Box**
2. **ECM connection**
3. **Wiring harness connection**

Figure 1-21. Installed Breakout Box

HD-44687 Ignition Coil Circuit Test Adapter

The IGNITION COIL CIRCUIT TEST ADAPTER (Part No. HD-44687) and FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) are used to test the fuel injector drivers as well as the ignition coil drivers in the ECM.

1. Connect the BREAKOUT BOX (Part No. HD-43876).
2. Disconnect the fuel injector connectors.
3. See Figure 1-16 for typical setup. Connect one side of the fuel injector test light to power and the other to the terminal on the ECM for the circuit you are testing.
4. Crank the engine.
5. If the test light flashes, the circuit is working properly.

HD-48053 Advanced Battery Conductance and Electrical System Analyzer

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

Figure 1-22. HD-48053 Advanced Battery Conductance and Electrical System Analyzer Kit

HD-48650 Digital Technician II

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

Diagnostics in this manual are developed under the assumption that DTII is not available.

DIGITAL
TECHNICIAN II
HARLEY-DAVIDSON

VOLTAGE DROP

Voltage Drop Test

The voltage drop test:

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

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.

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

The benefits of doing it this way are:

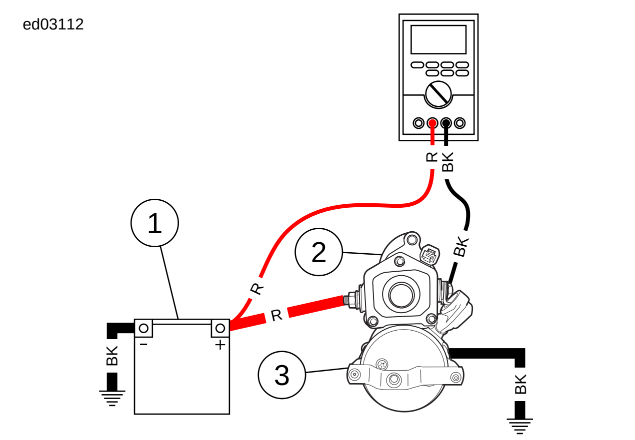
- Readings are not as sensitive to real battery voltage.
- Readings show the actual voltage dropped not just the presence of voltage.
- The system is tested as it is actually being used.
- Testing is more accurate and displays hard-to-find poor connections.
- Starting circuits, lighting circuits or ignition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

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

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

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

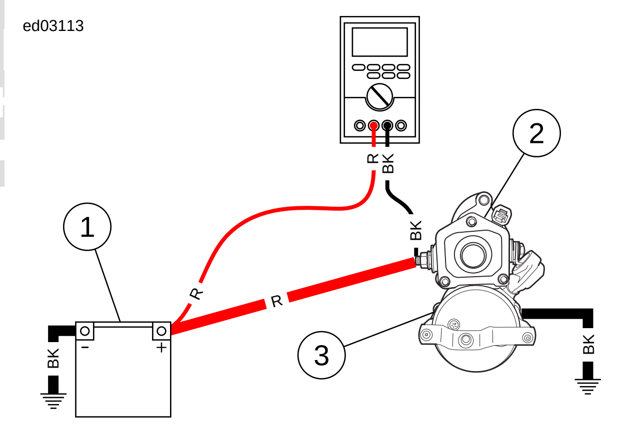
1. Disconnect the fuel pump connector [86] to prevent the engine from starting.
2. See Figure 1-23. Connect the red meter lead to the positive battery post. Connect the black meter lead to the starter side post of the starter solenoid and observe the meter reading. Crank the starter and observe the meter reading. The difference in the voltage is the voltage drop.



1. **Battery**
2. **Starter solenoid**
3. **Starter motor**

Figure 1-23. To Starter Solenoid Starter Terminal

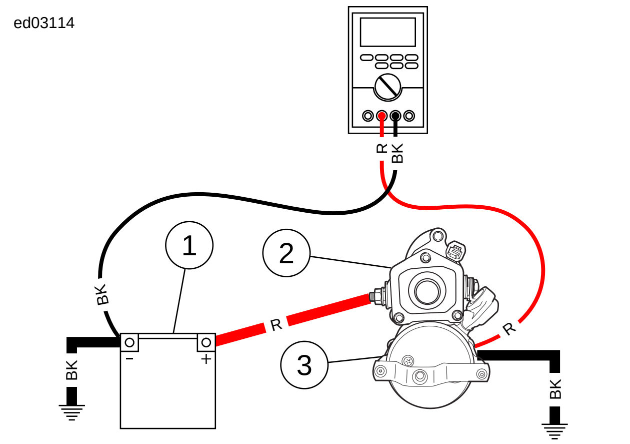
3. See Figure 1-24. Move the black meter lead to the battery side post on the starter solenoid. Crank the starter.



1. **Battery**
2. **Starter solenoid**
3. **Starter motor**

Figure 1-24. To Starter Solenoid Battery Terminal

4. See Figure 1-25. Finally move the black meter lead to the negative battery post and the red meter lead to the starter case. Crank the starter.



1. **Battery**
2. **Starter solenoid**
3. **Starter motor**

Figure 1-25. Starter Ground Circuit

WIGGLE TEST

PART NUMBER	TOOL NAME
HD-39978	DIGITAL MULTIMETER (FLUKE 78)
HD-43876	BREAKOUT BOX
HD-48650	DIGITAL TECHNICIAN II

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

1. See Figure 1-26. Connect DIGITAL MULTIMETER (FLUKE 78) (Part No. HD-39978) to wiring harness between the suspect connections. When diagnosing ECM connections, use BREAKOUT BOX (Part No. HD-43876) to simplify the procedure. See 1.2 DIAGNOSTIC TOOLS.
2. Set the multimeter to read voltage changes.
3. Start the motorcycle engine and run at idle.
4. Shake or wiggle the harness to detect intermittents. If intermittents are present, radical voltage changes register on the multimeter.

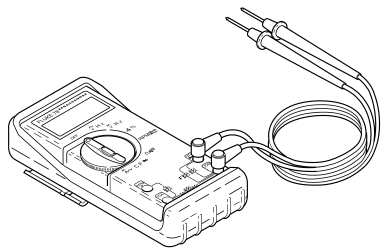
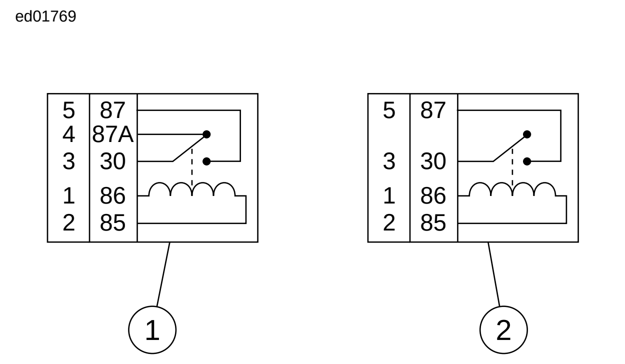


Figure 1-26. Digital Multimeter (Fluke 78) (Part No. HD-39978)

RELAY DIAGNOSTICS

Relay Variation

See Figure 1-27. Relays normally have four or five terminals. The circuitry inside the relays are very similar with the exception of the normally closed contact being eliminated in the four terminal relay. Some relays have five terminals at the base, even though internally 4 or 87A are not connected. See this topic whenever a relay terminal is referenced in this manual to make sure the proper terminal is being accessed.



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

Figure 1-27. Standard Relays

Relay Test

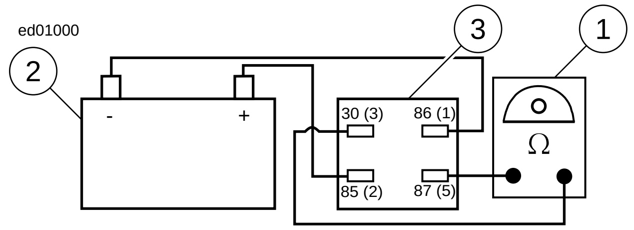
A relay can be tested using the motorcycle's 12V battery and a multimeter.

1. Unplug the relay from relay block.
2. See Figure 1-28 and Figure 1-29 to energize the relay. Connect relay terminal 85 to the negative battery terminal and relay terminal 86 to the positive battery terminal.

NOTE

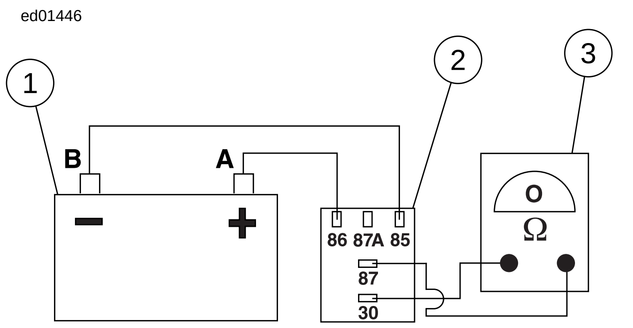
Some relays contain internal diodes. If the applied voltage is not the correct polarity, the diode could be damaged.

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



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

Figure 1-28. Four Terminal Relay Test



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

Figure 1-29. Five Terminal Relay Test

JOB/TIME CODES VALUES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

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

TABLE OF CONTENTS

NOTES

INITIAL DIAGNOSTICS 2.1

DESCRIPTION AND OPERATION

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

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

RETRIEVING TROUBLE CODES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

There are two levels of diagnostics.

- The most sophisticated mode uses a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650).
- The second mode requires using the odometer self-diagnostics. Speedometer, tachometer, TSM/TSSM/HFSM, ECM, and ABS (if equipped) codes can be accessed and cleared.

ODOMETER SELF-DIAGNOSTICS

Diagnostic Mode

1. To enter diagnostic mode press and hold the trip odometer reset switch while turning the IGN ON.
2. Release the trip odometer reset switch. "diag" should appear on the odometer display.
3. Press and release the trip odometer reset switch. "PSSPtb" will appear on the odometer display.
4. PSSPtb indicates the different modules that could display codes if equipped.

- P - ECM codes
- S - TSM/TSSM/HFSM codes
- SP - Speedometer codes
- t - Tachometer codes
- b - ABS codes

5. Quickly press and release the trip odometer reset switch to cycle through the letters. The letters will flash as they are selected.
6. Once the corresponding letter is flashing to the desired module press and hold the trip odometer reset switch.
7. If no DTCs are present the odometer will display "none".
8. If any DTCs are stored in the module either current or historic the odometer will display the DTC. Quickly pressing and releasing the trip odometer reset switch will cycle through the stored DTCs.
9. If odometer displays "no rsp" then the motorcycle may not be equipped with the module. If the motorcycle is equipped with the selected module then go to other modules and look for applicable communication codes.
10. When all the DTCs have been cycled the odometer will display "end".
11. To clear all the DTCs in that module press and hold the trip odometer reset switch. 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.
12. Press and release the trip odometer reset switch again to continue to the next module.
13. Turn the IGN OFF to exit diagnostic mode.

DIAGNOSTICS

Diagnostic Tips

- For a quick check of instrument function, a "WOW" test can be performed by entering odometer self-diagnostics. Background lighting should illuminate, gauge needles should sweep their full range of motion, and indicator lamps controlled by the serial data circuit (battery, security, and check engine) should illuminate.
- If the instrument fails "WOW" test, check for battery, ground and ignition voltage to the instrument. If any feature in the speedometer or tachometer is non-functional, see 4.1 INSTRUMENTS.

Table 2-1. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
B0563	72	Battery voltage high	3.6 DTC B0563, P0562, P0563
B1004	76	Fuel sender low	4.2 DTC B1004, B1005
B1005	77	Fuel sender open/high	4.2 DTC B1004, B1005

Table 2-1. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
B1006	78	Accessory line overvoltage	3.7 DTC B1006, B1007
B1007	79	Ignition line overvoltage	3.7 DTC B1006, B1007
B1008	80	Trip odometer rest switch closed	4.3 DTC B1008
B1121	63	Left turn output fault	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1122	64	Right turn output fault	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1123	65	Left turn signal short-to-ground	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1124	66	Right turn signal short-to-ground	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1125	67	Left turn signal short-to-voltage	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1126	68	Right turn signal short-to-voltage	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126
B1131	73	Alarm output low	5.15 DTC B1131, B1132
B1132	74	Alarm output high	5.15 DTC B1131, B1132
B1134	62	Start relay output high	5.16 DTC B1134
B1135	18	Accelerometer fault	5.9 DTC B1135, B1136, B1141, B1142
B1136	19	Accelerometer tip-over self-test fault	5.9 DTC B1135, B1136, B1141, B1142
B1141	75	Ignition switch open/low	5.9 DTC B1135, B1136, B1141, B1142
B1142	17	Internal fault	5.9 DTC B1135, B1136, B1141, B1142
B1143	69	Security antenna short-to-ground	5.17 DTC B1143, B1144, B1145
B1144	70	Security antenna short-to-battery	5.17 DTC B1143, B1144, B1145
B1145	71	Security antenna open	5.17 DTC B1143, B1144, B1145
B1154	20	Clutch swith short-to-ground	5.18 DTC B1154, B1155
B1155	21	Neutral switch short-to-ground	5.18 DTC B1154, B1155
P0107	36	MAP sensor open/low	6.4 DTC P0107, P0108
P0108	37	MAP sensor high	6.4 DTC P0107, P0108
P0112	40	IAT sensor voltage low	6.5 DTC P0112, P0113
P0113	41	IAT sensor open/high	6.5 DTC P0112, P0113
P0117	38	ET sensor voltage low	6.6 DTC P0117, P0118
P0118	39	ET sensor open/high	6.6 DTC P0117, P0118
P0122	22	TP sensor open/low	6.7 DTC P0122, P0123
P0123	23	TP sensor high	6.7 DTC P0122, P0123
P0131	56	Front O2 sensor low (lean)	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0132	58	Front O2 sensor high (rich)	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0134	60	Front O2 sensor open/not responding	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0151	57	Rear O2 sensor low (lean)	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0152	59	Rear O2 sensor high (rich)	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0154	61	Rear O2 sensor open/not responding	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154
P0261	32	Front injector open/low	6.9 DTC P0261, P0262, P0263, P0264

Table 2-1. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
P0262	34	Front injector high	6.9 DTC P0261, P0262, P0263, P0264
P0263	33	Rear injector open/low	6.9 DTC P0261, P0262, P0263, P0264
P0264	35	Rear injector high	6.9 DTC P0261, P0262, P0263, P0264
P0373	16	CKP sensor intermittent	6.10 DTC P0373, P0374
P0374	15	CKP sensor synch error	6.10 DTC P0373, P0374
P0501	44	VSS low	6.11 DTC P0501, P0502
P0502	45	VSS high	6.11 DTC P0501, P0502
P0505	50	Loss of idle speed control	6.12 DTC P0505
P0562	42	Battery voltage low	3.6 DTC B0563, P0562, P0563
P0563	43	Battery voltage high	3.6 DTC B0563, P0562, P0563
P0603	2	ECM EEPROM error	6.13 DTC P0603, P0605
P0605	1	ECM flash error	6.13 DTC P0603, P0605
P0661	54	Intake solenoid low/open	6.14 DTC P0661, P0662
P0662	55	Intake solenoid high/shorted	6.14 DTC P0661, P0662
P1001	11	System relay coil open/low	6.16 DTC P1001, P1002, P1003, P1004
P1002	10	System relay coil high/shorted	6.16 DTC P1001, P1002, P1003, P1004
P1003	9	System relay contacts open	6.16 DTC P1001, P1002, P1003, P1004
P1004	12	System relay contacts closed	6.16 DTC P1001, P1002, P1003, P1004
P1009	13	Incorrect password	6.15 DTC P1009, P1010
P1010	14	Missing password	6.15 DTC P1009, P1010
P1351	26	Front ignition coil open/low	6.17 DTC P1351, P1352, P1354, P1355
P1352	28	Front ignition coil high/shorted	6.17 DTC P1351, P1352, P1354, P1355
P1353	49	Front cylinder no combustion detected	6.18 DTC P1353, P1356, P1357, P1358
P1354	27	Rear ignition coil open/low	6.17 DTC P1351, P1352, P1354, P1355
P1355	29	Rear ignition coil high/shorted	6.17 DTC P1351, P1352, P1354, P1355
P1356	48	Rear cylinder no combustion detected	6.18 DTC P1353, P1356, P1357, P1358
P1357	30	Front ignition coil intermittent secondary detected	6.18 DTC P1353, P1356, P1357, P1358
P1358	31	Rear ignition coil intermittent secondary detected	6.18 DTC P1353, P1356, P1357, P1358
P1475	51	Exhaust position actuator error	6.19 DTC P1475, P1477, P1478
P1477	52	Exhaust actuator low/open	6.19 DTC P1475, P1477, P1478
P1478	53	Exhaust actuator high/shorted	6.19 DTC P1475, P1477, P1478
P1501	24	JSS low	6.20 DTC P1501, P1502
P1502	25	JSS high	6.20 DTC P1501, P1502
P1653	46	Tachometer low	6.21 DTC P1653, P1654
P1654	47	Tachometer high	6.21 DTC P1653, P1654
U1016	6	Loss of ECM serial data	2.3 DTC U1016, U1064, U1097, U1255
U1064	5	Loss of TSM/TSSM/HFSM serial data	2.3 DTC U1016, U1064, U1097, U1255
U1097	7	Loss of speedometer serial data	2.3 DTC U1016, U1064, U1097, U1255

Table 2-1. Diagnostic Trouble Codes (DTCs) and Fault Conditions

DTC	PRIORITY ORDER	FAULT CONDITION	SOLUTION
U1255	8	Missing response at module	2.3 DTC U1016, U1064, U1097, U1255
U1300	3	Serial data low	2.4 DTC U1300, U1301 OR BUS ER
U1301	4	Serial data open/high	2.4 DTC U1300, U1301 OR BUS ER

CODE TYPES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

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

NOTES

- *Odometer self-diagnostics will display both current and historic DTCs. To differentiate between current and historic DTCs, a computer-based diagnostic package called DIGITAL TECHNICIAN II (Part No. HD-48650) must be employed.*
- *Current DTCs reside in the memory of the ECM, TSM/TSSM/ HFSM, speedometer, or tachometer until the DTC is resolved.*
- *A historic DTC can be cleared by use of the odometer self-diagnostics or after a total of 50 ignition cycles (start and run cycle) have elapsed. After the 50 ignition cycle retention period, the DTC is automatically erased from memory providing that no subsequent faults of the same type are detected in that period.*

Current

Current DTCs are those which presently disrupt motorcycle operation and are set during the current ignition cycle. See the appropriate diagnostic procedures for solutions.

Historic

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

Historic DTCs are stored for 50 ignition cycles after any DTC was last set as current to assist in the diagnosis of intermittent faults. On the 50th cycle, the DTC will clear itself. The security lamp will only indicate the existence of historic DTCs for two ignition cycles.

It is important to note that historic DTCs will exist whenever the system indicates the existence of a current fault. See 2.1 INITIAL DIAGNOSTICS, Multiple Trouble Codes if multiple DTCs are found.

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

MULTIPLE TROUBLE CODES

While it is possible for more than one fault to occur and set more than one trouble code, there are several conditions which may result in **one** fault setting **multiple** trouble codes:.

Serial data codes (DTC U1300, U1301, U1016, U1064, U1097, and U1255) may be accompanied by other codes. **Always** correct the serial data codes before resolving the other codes.

In the event multiple DTCs are present, DTCs are assigned priority order numbers to determine the order in which they should be diagnosed. The lowest priority number DTC should be diagnosed first and then continue with the next lowest DTC. DTCs should be cleared after each repair to verify they are still current. Refer to Table 2-1.

CLEARING DTCS

DTCs should be cleared after any diagnostic or repair procedure is performed. The odometer is capable of displaying and clearing ECM, TSM/TSSM/HFSM, speedometer, 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.

SECURITY LAMP

The security lamp functions in the same manner as the check engine lamp, except that it is controlled by the TSSM/HFSM. The security lamp will be turned on when codes are present in the TSSM/HFSM. When B1004 or B1005 codes are present in the TSSM/HFSM, the low fuel lamp on the speedometer will also be illuminated.

CHECK ENGINE LAMP

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

NOTES

- *"IGN ON" means that the ignition switch is turned to IGN and the engine stop switch is set to RUN (although the engine is **not** running).*
- *When the IGN is turned ON, the check engine lamp will illuminate for approximately four seconds and then turn off.*
- *If the check engine lamp is not illuminated at IGN ON or if it fails to turn off after the initial four-second period, then see 6.23 NO ECM POWER.*

1. See Figure 2-1. After the check engine lamp turns off following the first four second illumination period, one of three events may occur.
   a. The lamp remains off. This indicates there are no current fault conditions or stored DTCs currently detected by the ECM.
   b. The lamp stays off for only four seconds and then comes back on for an eight second period. This indicates a DTC is stored, but no current DTC exists.
   c. If the lamp remains on beyond the eight-second period, a current DTC exists.
2. See 2.1 INITIAL DIAGNOSTICS, Code Types for a complete description of DTC formats.

NOTE

Some DTCs can only be fully diagnosed during actuation. For example, a problem with the ignition coil will be considered a current fault even after the problem is corrected, since 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.

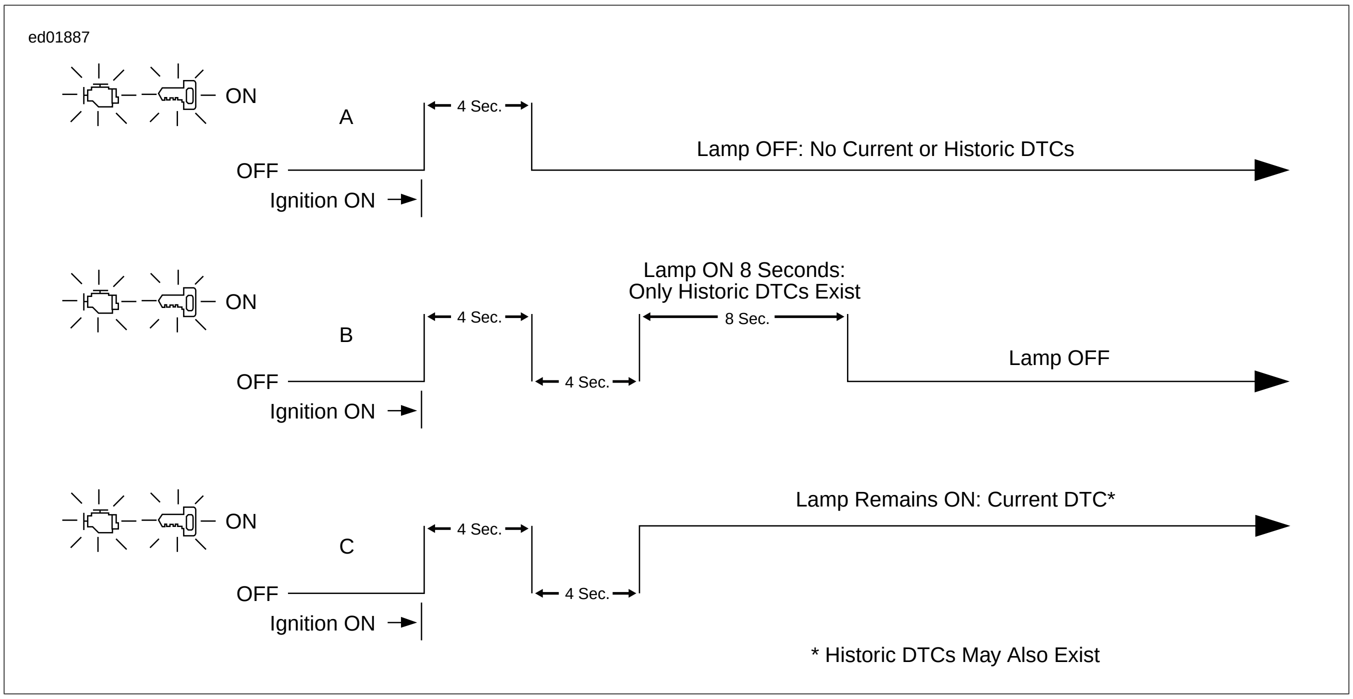


Figure 2-1. Check Engine Lamp and Security Lamp Operation

SYMPTOMS

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

Table 2-2. Symptom Table

SYMPTOM	DIAGNOSTIC PROCEDURE
Battery runs down during use	3.5 CHARGING SYSTEM
Bus Er displayed	2.2 SERIAL DATA COMMUNICATION
Charging system inoperative	3.5 CHARGING SYSTEM
Check engine lamp inoperative	6.23 NO ECM POWER
Engine cranks, but will not start	6.22 ENGINE CRANKS, BUT WILL NOT START
Headlamp inoperative	5.3 LIGHTS
High beam indicator inoperative	4.5 INDICATOR LAMPS
Horn always on	5.2 HORN
Horn inoperative	5.2 HORN
Low battery after extended IGN OFF	3.5 CHARGING SYSTEM
Low fuel lamp always on	4.5 INDICATOR LAMPS

Table 2-2. Symptom Table

SYMPTOM	DIAGNOSTIC PROCEDURE
Low fuel lamp inoperative	4.5 INDICATOR LAMPS
Low or no charging	3.5 CHARGING SYSTEM
Neutral lamp always on	4.5 INDICATOR LAMPS
Neutral lamp inoperative	4.5 INDICATOR LAMPS
No ECM power	6.23 NO ECM POWER
Misfire at idle or under load	6.26 MISFIRE AT IDLE OR UNDER LOAD
Oil pressure lamp always on	4.5 INDICATOR LAMPS
Oil pressure lamp inoperative	4.5 INDICATOR LAMPS
Overcharging	3.5 CHARGING SYSTEM
P&A battery power inoperative	5.1 ACCESSORIES
Running lamps inoperative	5.3 LIGHTS
Security lamp inoperative	5.10 SECURITY SYSTEM
Speedometer inoperative	4.1 INSTRUMENTS
Starter does not spin	3.2 STARTING SYSTEM
Starter inoperative	3.2 STARTING SYSTEM
Starter solenoid clicks	3.2 STARTING SYSTEM
Starter spins, but does not engage	3.2 STARTING SYSTEM
Starter stalls or spins too slowly	3.2 STARTING SYSTEM
Starts, then stalls	6.24 STARTS, THEN STALLS
Stop lamp inoperative	5.3 LIGHTS
Tachometer inoperative	4.1 INSTRUMENTS
Tail lamp inoperative	5.3 LIGHTS
Turn signal indicator inoperative	4.5 INDICATOR LAMPS
Turn signal inoperative	5.3 LIGHTS

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

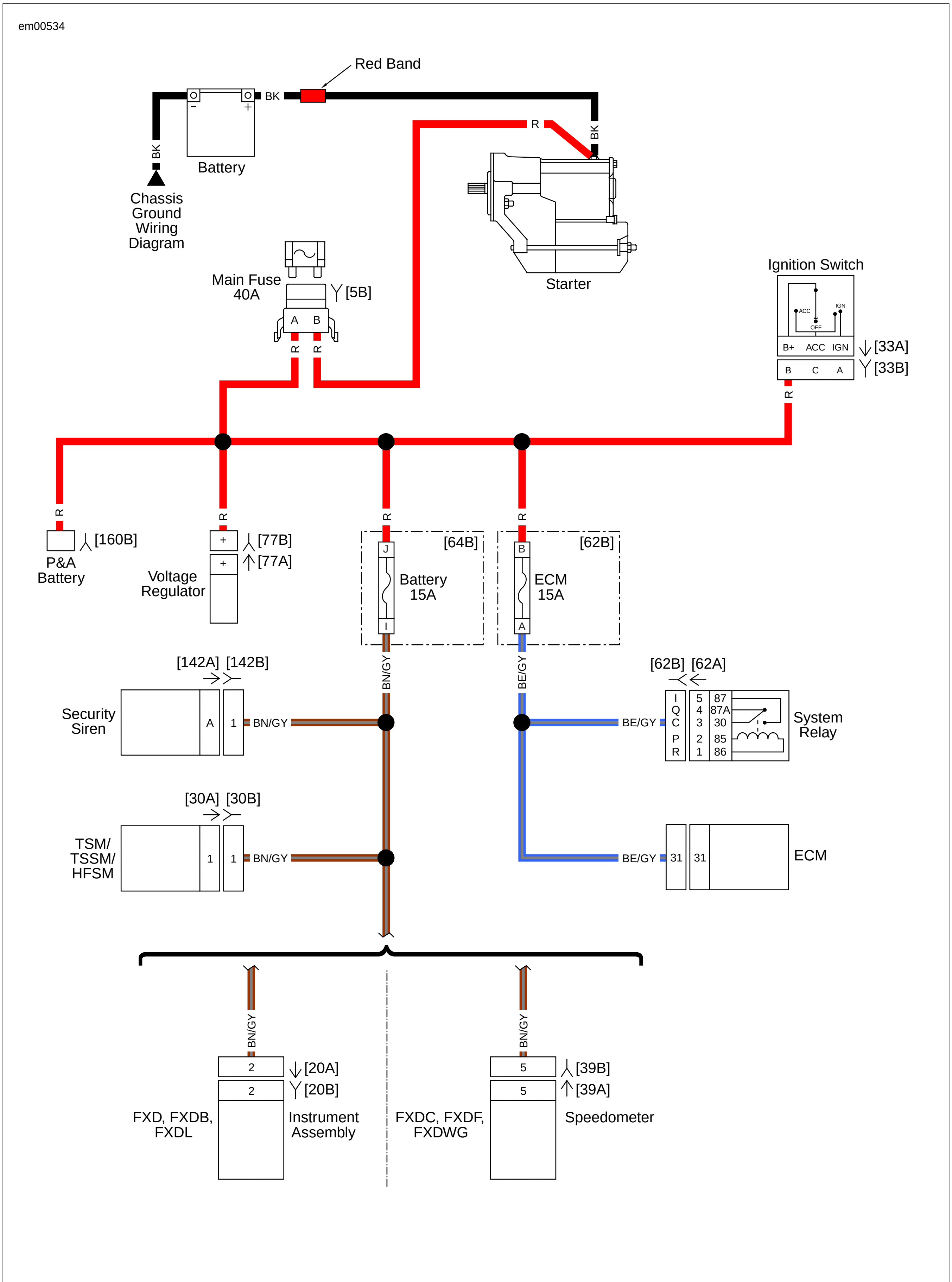


Figure 2-2. Battery Power

HOME

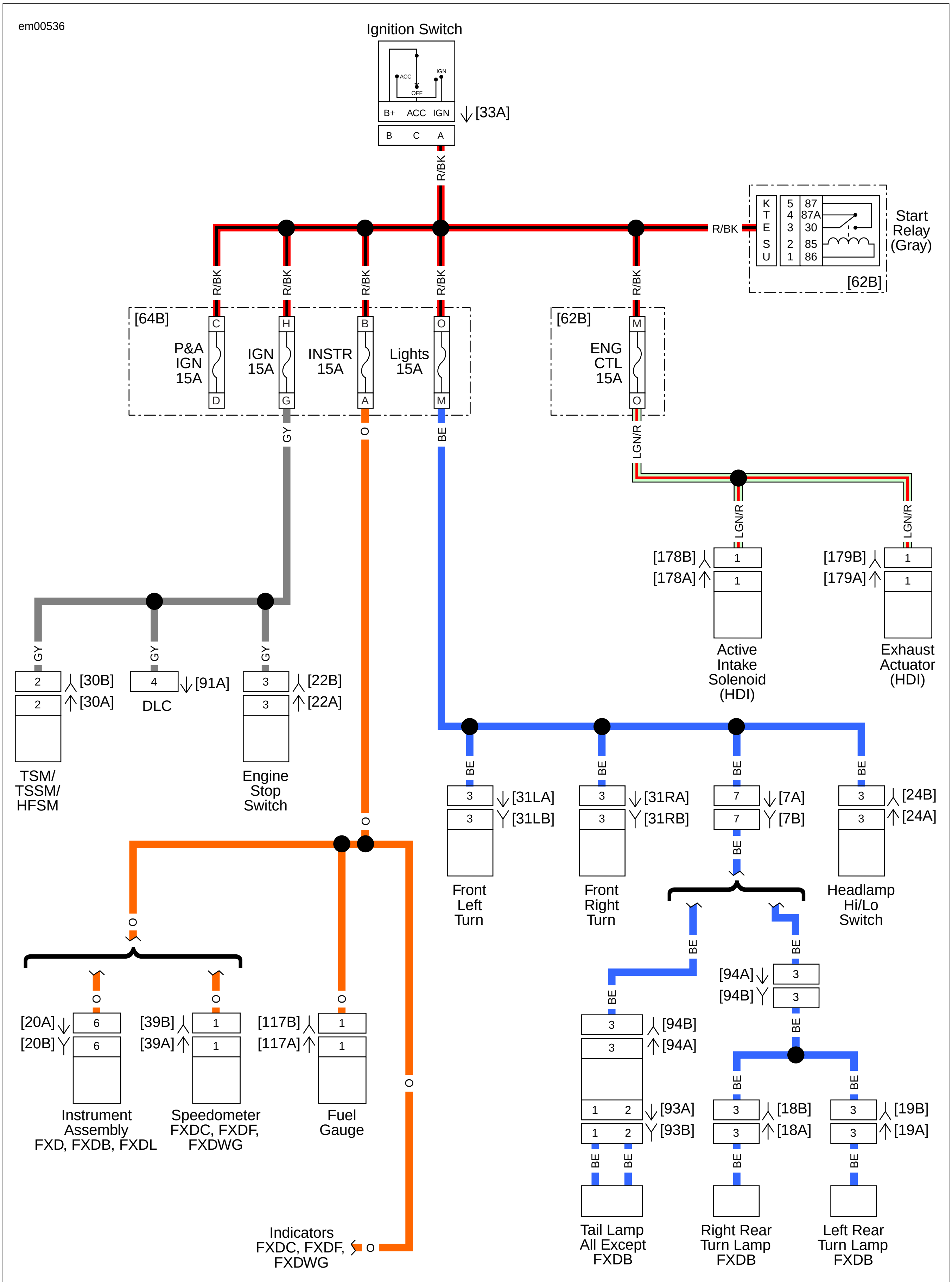


Figure 2-3. Ignition Power

HOME

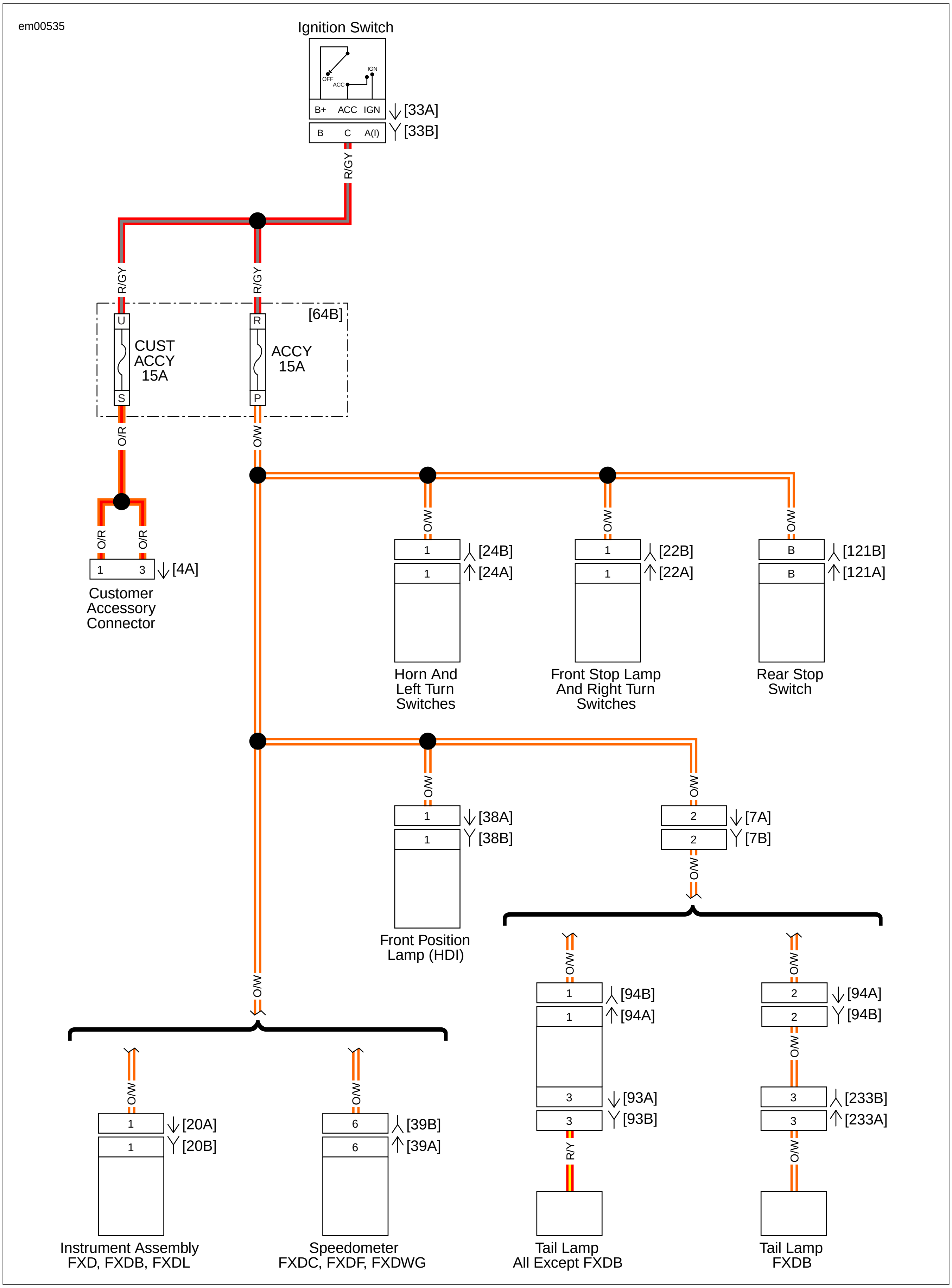


Figure 2-4. Accessory Power

HOME

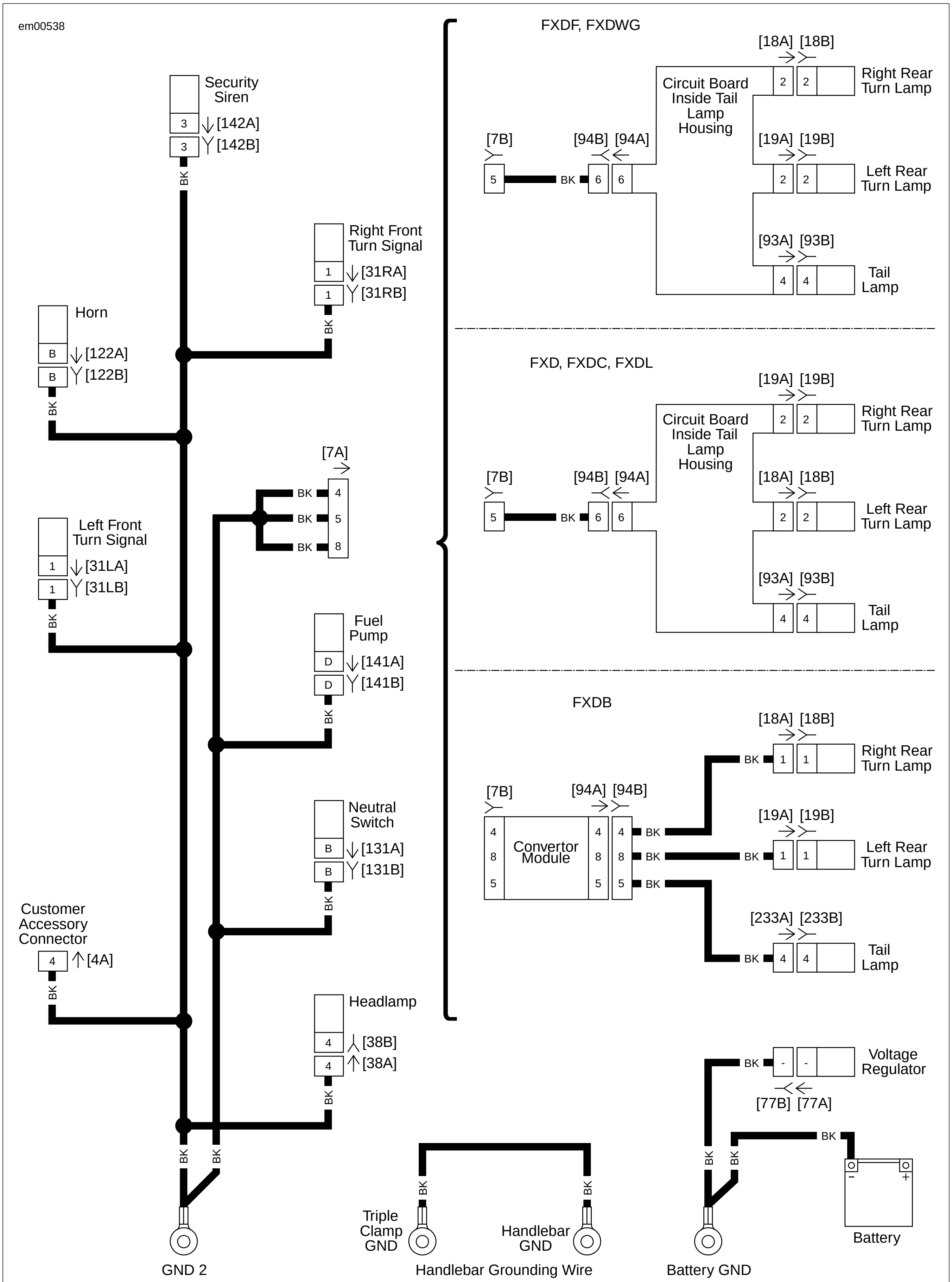


Figure 2-5. Chassis Grounds

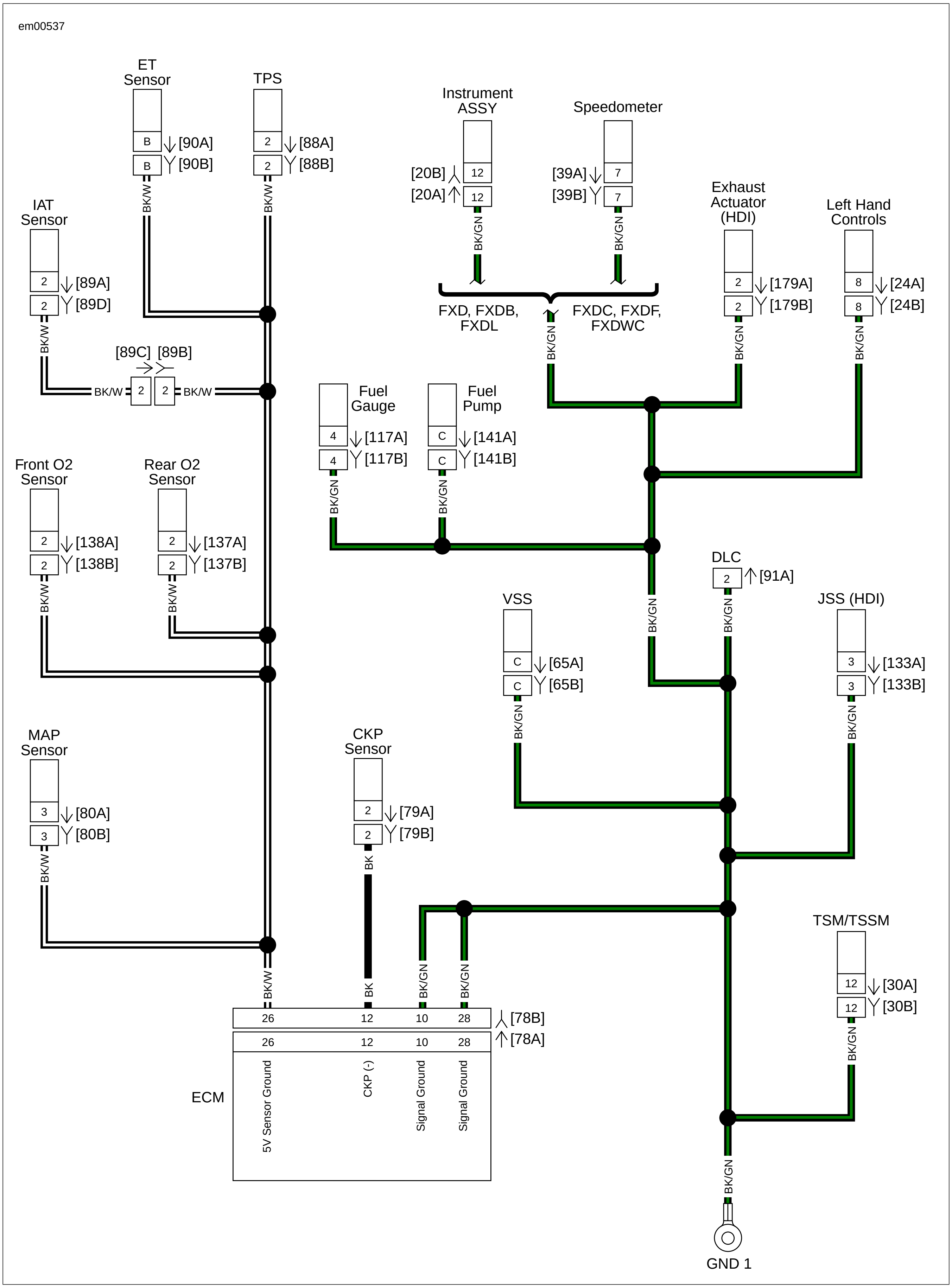


Figure 2-6. Sensor Grounds

INITIAL DIAGNOSTICS

1. Verifying Current DTC Test

1. Check for DTCs. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Are any DTCs present?
   a. **Yes.** Go to DTC diagnostics. Refer to Table 2-1.
   b. **No.** Go to Test 2.

2. Battery Power Test

1. Verify battery is charged. See 3.1 BATTERY TESTING.
2. Does vehicle have battery power?
   a. **Yes.** Go to Test 4.
   b. **No.** Go to Test 3.

3. Ignition Power Test

1. With the engine stop switch in the off position, turn IGN ON.
2. Does the headlamp and instruments illuminate?
   a. **Yes.** Go to Test 4.
   b. **No.** Go to appropriate system. Refer to Table 2-2.

4. Engine Stop Switch Circuit Test

1. Turn the engine stop switch to the RUN position.
2. Does the check engine lamp illuminate for a few seconds, then turn off?
   a. **Yes.** Go to Test 5.
   b. **No.** See 6.23 NO ECM POWER.

5. Security System Test

1. Turn the IGN OFF-ON.
2. Observe the security lamp.
3. Does the security lamp illuminate for a few seconds and then turn off?
   a. **Yes.** Go to Test 6.
   b. **No.** See 5.10 SECURITY SYSTEM.

6. Starter System Test

1. Press the start button.
2. Does the starter spin and crank the engine?
   a. **Yes.** Go to Test 7.
   b. **No.** See 3.2 STARTING SYSTEM.

7. Engine Running Test

1. Start the engine.
2. Does the engine start and run correctly?
   a. **Yes.** Go to Test 8.
   b. **No.** See 6.1 EFI SYSTEM.

8. Verification Test

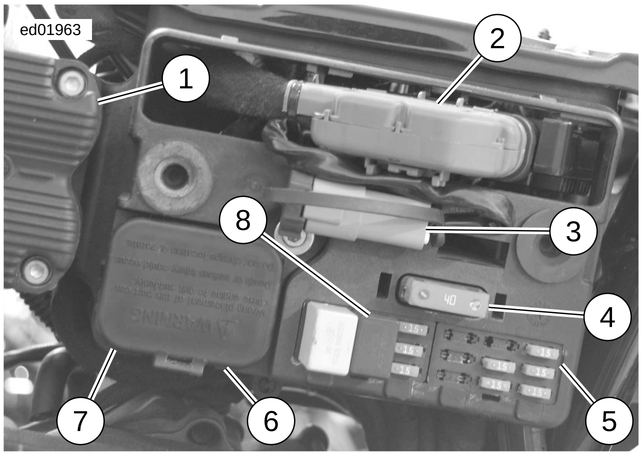
1. Operate the systems of the vehicle to verify the concern.
2. Was the concern duplicated?
   a. **Yes.** Go to appropriate diagnostic. Refer to Table 2-2.
   b. **No.** Concern is intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.

SERIAL DATA COMMUNICATION 2.2

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

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



1. Ignition coil
2. ECM [78]
3. DLC [91]
4. Main fuse [5]
5. Fuse block [64]
6. TSM/TSSM/HFSM
7. HFSM antenna harness [208]
8. Fuse/relay block [62]

Figure 2-7. Under Left Side Cover

The speedometer, ECM, TSM/TSSM/HFSM and tachometer (if equipped) all communicate on the serial data line. The serial data line is a (LGN/V) wire that runs to all the modules and is used to transfer data from one module to the other. This line also runs to the DLC [91] and is used to communicate with the modules using DIGITAL TECHNICIAN II (Part No. HD-48650).

COMPONENTS

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Electronic Control Module (ECM)

See Figure 2-7. The ECM is located under the left side cover. The ECM monitors the sensors from the engine and fuel system in order to manage the fuel and spark delivery to the motorcycle which enhances performance and driveability.

Speedometer and Tachometer

The speedometer and tachometer contain part of the indicator and warning lamps for the motorcycle. They use the serial data line to receive information from the other modules to know which lamps to illuminate at any given time.

TSM/TSSM/HFSM

See Figure 2-7. The TSM/TSSM/HFSM is located under the left side cover. It monitors the turn signal switches and controls the turn signals. The clutch and neutral switches are also inputs to the TSM/TSSM/HFSM. It uses these inputs to determine when it is safe to allow the motorcycle to start. It allows starter engagement and sends the information to the ECM over the serial data line letting the ECM know to activate the fuel injectors. The TSSM/HFSM also controls the security functions on the motorcycle if equipped with the factory security system.

Data Link Connector (DLC)

See Figure 2-7. The DLC is located under the left side cover. The DLC is used to connect the DIGITAL TECHNICIAN II (Part No. HD-48650) to the motorcycle.

COMMUNICATION DTCS AND "BUS ER"

There are several DTCs that may set due to and issue with the serial data line. Different DTCs are set by different modules. If a module loses communication it is not able to generate a DTC. Therefore the other modules will set DTCs for that module indicating they are not able to communicate with it.

Diagnostic Tips

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. In some cases "Bus Er" will show on the odometer.

DTC U1016, U1064, U1097, U1255 2.3

DESCRIPTION AND OPERATION

The serial data circuit provides a means for the ECM, speedometer, tachometer, and TSM/TSSM/HFSM to communicate their current status. When all operating parameters on the serial data link are within specifications, a state of health message is sent between the components.

- DTC U1016 indicates that the ECM is not capable of sending this state of health message. It also indicates that there was communication on the data bus since power up, but communication was lost or interrupted during that key cycle.
- DTC U1064 indicates that the TSM/TSSM/HSFM is not capable of sending this state of health message. It also indicates that there was communication on the data bus since power up, but was lost or interrupted during that key cycle.
- DTC U1097 indicates the speedometer is not capable of sending its state of health message.
- DTC U1255 indicates that no messages were present during power up of the current key cycle.

NOTE

It is important to always start from 2.1 INITIAL DIAGNOSTICS before proceeding with this test.

Table 2-3. Code Description

DTC	SYMPTOM
U1016	Loss of all ECM serial data (state of health)
U1064	Loss of TSM/TSSM/HFSM serial data (state of health)
U1097	Loss of speedometer serial data (state of health)
U1255	Serial data error/missing message

Diagnostic Tips

The TSM/TSSM/HFSM controls the turn signals and supplies voltage for the turn signals to operate. A short on the turn signal circuits can cause the battery fuse to open. If no short to ground is found in the battery fuse circuit check the turn signal circuits between the TSM/TSSM/HFSM and the turn signals for a short to ground.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

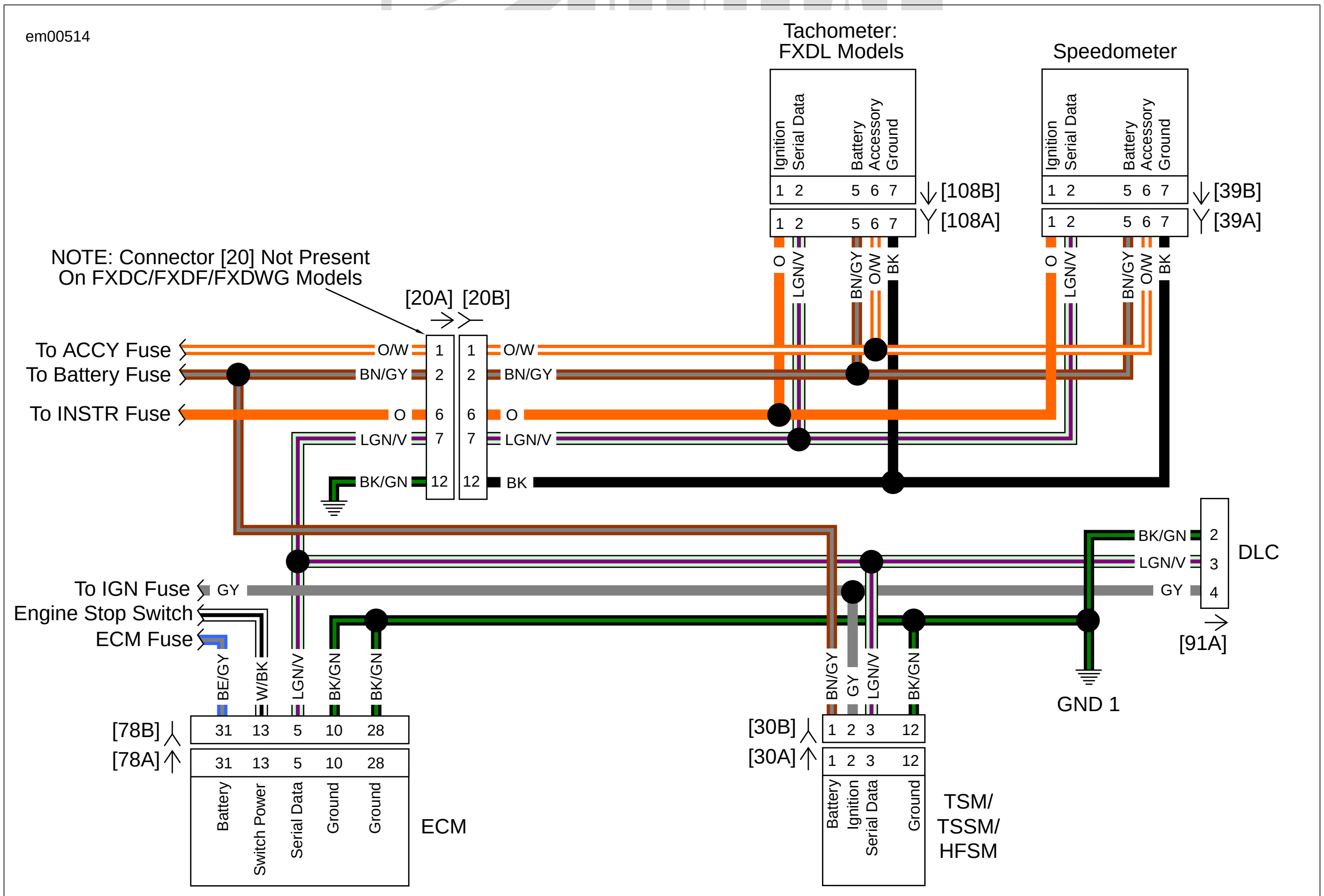


Figure 2-8. Serial Data Circuit

DTC U1016

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 2-4. DTC U1016 Diagnostic Faults

POSSIBLE CAUSES
Open ground
Open switched power
ECM malfunction
Open serial data circuit

1. Open Ground Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity from breakout box terminals 10 and 28 to ground.
3. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair open in ground circuit.

2. Switched Power Circuit Open Test

1. With IGN ON and engine stop switch in the RUN position, test for voltage at breakout box terminal 13.
2. Is battery voltage present?
   a. **Yes.** The TSM/TSSM/HFSM is reporting the DTC. Go to Test 3.
   b. **Yes.** The speedometer is reporting the DTC. Go to Test 4.
   c. **Yes.** The tachometer is reporting the DTC. Go to Test 5.
   d. **No.** Repair open in (W/BK) wire.

3. TSM/TSSM/HFSM Serial Data Circuit Continuity Test

1. With the IGN OFF, install BREAKOUT BOX (Part No. HD-42682) at the TSM/TSSM/HFSM. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between TSM/TSSM/HFSM breakout box terminal 3 and ECM breakout box terminal 5.
3. Is continuity present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

4. Speedometer Serial Data Circuit Continuity Test

1. Connect harness BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39A] and [39B]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters, leaving [39A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between speedometer breakout box terminal 2 and ECM breakout box terminal 5.
3. Is continuity present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

5. Tachometer Serial Data Circuit Continuity Test

1. Connect harness BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [108A] and [108B]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters, leaving [108A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between tachometer breakout box terminal 2 and ECM breakout box terminal 5.
3. Is continuity present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

DTC U1064, U1255

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 2-5. DTC U1064, U1255 Diagnostic Faults

POSSIBLE CAUSES
Open battery fuse
Open battery circuit
Open ground circuit
Open serial data circuit
TSM/TSSM/HFSM malfunction
Short to ground in power circuit

1. Fuse Test

1. Inspect battery fuse.
2. Is battery fuse good?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 6.

2. Loss of Battery Power Test

1. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness [30B] and TSM/TSSM/HFSM [30A] and connect BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. HD-46601) to the speedometer [39]. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON and engine stop switch in the RUN position, use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter to test for voltage at TSM/TSSM/HFSM breakout box terminal 1.
3. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open in (BN/GY) wire.

3. Loss of Ignition Power Test

1. Test for voltage at terminal 2 of the TSM/TSSM/HFSM breakout box.
2. Is battery voltage present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (GY) wire.

4. Loss of Ground Test

1. Turn IGN OFF.
2. Test for continuity to ground from TSM/TSSM/HFSM breakout box terminal 12.
3. Is continuity present?
   a. **Yes.** The speedometer is reporting the DTC. Go to Test 5.
   b. **Yes.** The ECM is reporting the DTC. Go to Test 7.
   c. **Yes.** The tachometer is reporting the DTC. Go to Test 8.
   d. **No.** Repair open in ground circuit.

5. Speedometer Serial Data Circuit Continuity Test

1. Test for continuity between speedometer breakout box terminal 2 and TSM/TSSM/HFSM breakout box terminal 3.
2. Is continuity present?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

6. Power Circuit Short to Ground Test

1. Disconnect the siren (if equipped).
2. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness [30B] and TSM/TSSM/HFSM [30A] and connect BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. HD-46601) to the speedometer [39]. See 1.2 DIAGNOSTIC TOOLS.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between speedometer breakout box terminal 5 to ground.
4. Is continuity present?
   a. **Yes.** Repair short to ground in (BN/GY) wire and replace battery fuse.
   b. **No.** See diagnostic tips. Replace battery fuse and test for intermittent short to ground. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.

7. ECM Serial Data Circuit Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between TSM/TSSM/HFSM breakout box terminal 3 and ECM breakout box terminal 5.
3. Is continuity present?
   a. **Yes.** Replace TSM/TSSM/HFSM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

8. Tachometer Serial Data Circuit Continuity Test

1. Test for continuity between tachometer breakout box terminal 2 and TSM/TSSM/HFSM breakout box terminal 3.
2. Is continuity present?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

DTC U1097, U1255

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-43876	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 2-6. DTC U1097, U1255 Diagnostic Faults

POSSIBLE CAUSES
Open battery fuse
Open ignition circuit
Open ground circuit
Speedometer malfunction
Open serial data circuit
Short to ground in power circuit

1. Fuse Test

1. Inspect battery fuse.

2. Is battery fuse good?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 5.

2. Loss of Power Test

1. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness [30B] and TSM/TSSM/HFSM [30A] and connect BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. HD-46601) to the speedometer [39]. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON and engine stop switch in the RUN position, use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter to test for voltage at speedometer breakout box terminal 5.
3. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open in (BN/GY) wire.

3. Loss of Ground Test

1. Turn IGN OFF.
2. Test for continuity to ground from speedometer breakout box terminal 7.
3. Is continuity present?
   a. **Yes.** The TSM/TSSM/HFSM is reporting the DTC. Go to Test 4.
   b. **Yes.** The ECM is reporting the DTC. Go to Test 6.
   c. **No.** Repair open in ground circuit.

4. Speedometer Serial Data Circuit Continuity Test

1. Test for continuity between speedometer breakout box terminal 2 and TSM/TSSM/HFSM breakout box terminal 3.
2. Is continuity present?
   a. **Yes.** Replace the speedometer. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

5. Power Circuit Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-42682), using BREAKOUT BOX ADAPTERS (Part No. HD-46601) between wire harness [39B] and speedometer [39A]. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for short to ground breakout box terminal 5.
3. Is a short to ground present?
   a. **Yes.** Repair short to ground in (BN/GY) wire and replace battery fuse.
   b. **No.** Replace battery fuse and test for intermittent short to ground. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.

6. ECM Serial Data Circuit Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter test for continuity between speedometer breakout box terminal 2 and ECM breakout box terminal 5.
3. Is continuity present?
   a. **Yes.** Replace speedometer. See the service manual.
   b. **No.** Repair open on (LGN/V) wire.

HOME

DTC U1300, U1301 OR BUS ER 2.4

DESCRIPTION AND OPERATION

The typical serial data voltage range is 0V (inactive) to 7V (active). Due to the high speed voltage fluctuations of the signal, voltages will be much lower on a multimeter. In analog mode, a multimeter reading serial data will show continuous voltage when active, typically 0.6-0.8V. The range for acceptable operations is 0-7.0V.

Table 2-7. Code Description

DTC	DESCRIPTION
U1300	Serial data open/low
U1301	Serial data high

Diagnostic Tips

- If serial data is shorted, these DTCs will automatically cause the check engine lamp to illuminate. The odometer will read "BUS Er" in this condition.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

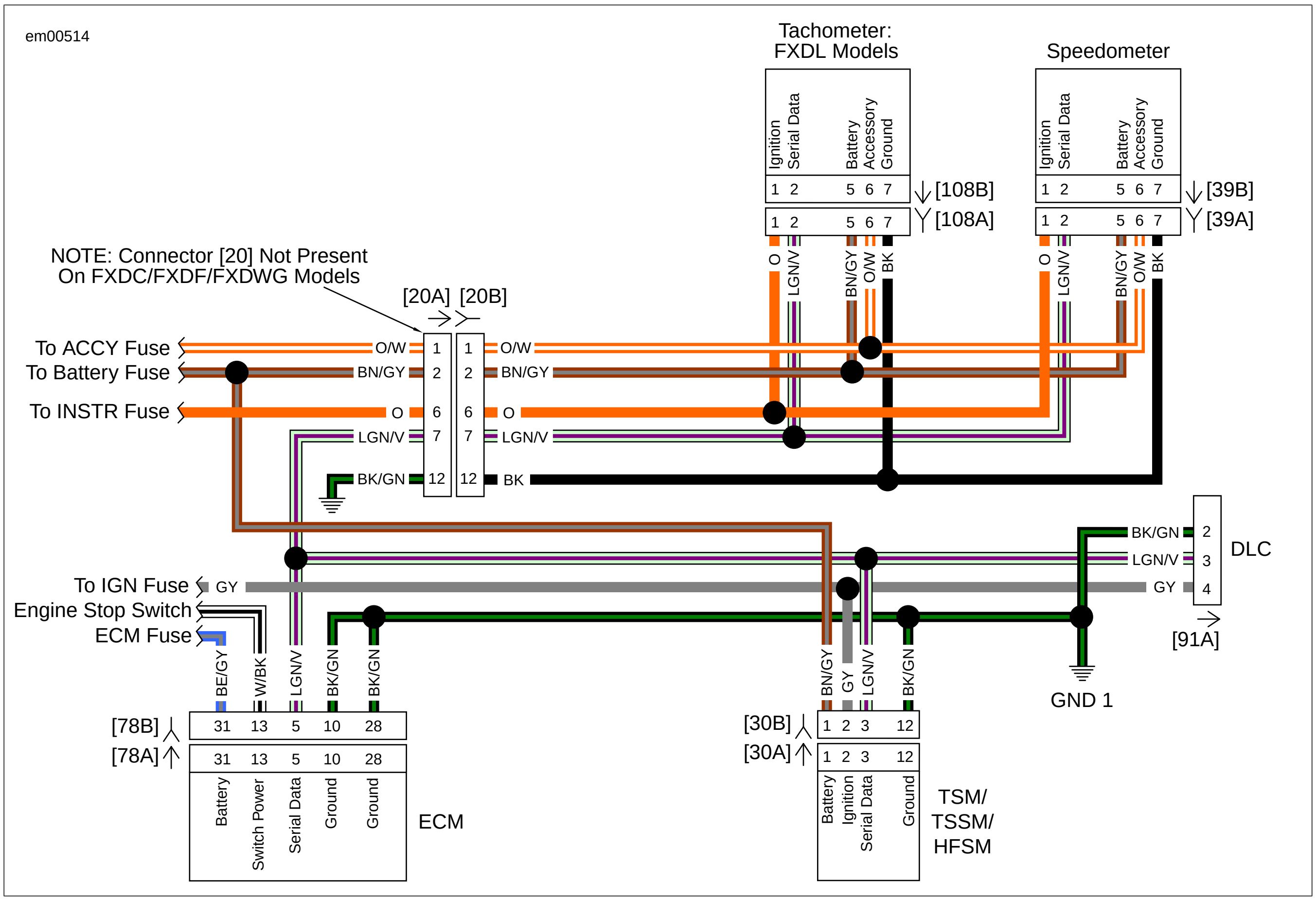


Figure 2-9. Serial Data Circuit

DTC U1300

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 2-8. DTC U1300 Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
TSM/TSSM/HFSM malfunction
Tachometer malfunction
Short to ground in serial data wire
Speedometer malfunction
Open in Serial data circuit

1. Serial Data Short to Ground Test

1. Turn IGN ON.
2. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 7.

2. ECM Test

1. Turn IGN OFF.
2. Disconnect the ECM [78B].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace ECM. See the service manual.

3. TSM/TSSM/HFSM Test

1. Turn IGN OFF.
2. Disconnect the TSM/TSSM/HFSM [30A].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual.

4. Tachometer Test (If Vehicle is not Equipped with Tachometer, Go to Test 5.)

1. Turn IGN OFF.
2. Disconnect tachometer [108].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 5.
   b. **No.** Replace tachometer. See the service manual.

5. Serial Data Short to Ground Test

1. Turn IGN OFF.
2. Disconnect speedometer [39].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for continuity from DLC [91A] terminal 3 to ground.
4. Is continuity present?
   a. **Yes.** Repair short to ground in (LGN/V) wire.
   b. **No.** Go to Test 6.

6. Serial Data Circuit Open Test

1. Connect BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. HD-46601) to the wiring harness [39B], leaving the speedometer disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity from terminal 2 of breakout box to DLC [91A] terminal 3.
3. Is continuity present?
   a. **Yes.** Replace speedometer. See the service manual.
   b. **No.** Repair open in (LGN/V) wire.

7. Intermittent Test

1. Turn IGN OFF.
2. Disconnect the ECM [78B], speedometer [39B], TSM/TSSM/HFSM [30B], and tachometer [108B] (if equipped).
3. Test for continuity between DLC [91A] terminal 3 and ground while performing a wiggle test. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
4. Is continuity present?
   a. **Yes.** Repair short to ground in (LGN/V) wire.
   b. **No.** Verify that current DTC U1300 is set.

DTC U1301

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 2-9. DTC U1301 Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
TSM/TSSM/HFSM malfunction
Tachometer malfunction
Short to voltage in serial data circuit
Speedometer malfunction

1. Serial Data Short to Voltage Test

1. Turn IGN ON.

2. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 7.

2. ECM Test

1. Turn IGN OFF.
2. Disconnect the ECM [78B].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace ECM. See the service manual.

3. TSM/TSSM/HFSM Test

1. Turn IGN OFF.
2. Disconnect the TSM/TSSM/HFSM [30B].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual.

4. Tachometer Test (If Vehicle is not Equipped with Tachometer, Go to Test 5.)

1. Turn IGN OFF.
2. Disconnect the tachometer [108B].
3. Turn IGN ON.
4. Does BUS Er appear on odometer display?
   a. **Yes.** Go to Test 5.
   b. **No.** Replace tachometer. See the service manual.

5. Serial Data Short to Voltage Test

1. Turn the IGN OFF.
2. Disconnect the speedometer [39B].
3. Turn IGN ON.
4. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for voltage from DLC [91A] terminal 3 to ground.
5. Is battery voltage present?
   a. **Yes.** Repair short to voltage in (LGN/V) wire.
   b. **No.** Go to Test 6.

6. Serial Data Circuit Open Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) and BREAKOUT BOX ADAPTERS (Part No. HD-46601) to the wiring harness [39B], leaving the speedometer disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity from breakout box terminal 2 to DLC [91A] terminal 3.
4. Is continuity present?
   a. **Yes.** Replace speedometer. See the service manual.
   b. **No.** Repair open in (LGN/V) wire.

7. Intermittent Test

1. Turn IGN OFF.
2. Disconnect the ECM [78B], speedometer [39B], TSM/TSSM/HFSM [30B], and tachometer [108B] (if equipped).
3. Turn IGN ON.
4. Test for voltage between DLC [91A] terminal 3 and ground while performing a wiggle test. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
5. Is voltage present?
   a. **Yes.** Repair short to voltage in (LGN/V) wire.
   b. **No.** Verify that current DTC U1301 is set.

TABLE OF CONTENTS

NOTES

BATTERY TESTING 3.1

GENERAL

Three different procedures may be performed to provide a good indication of battery condition: a voltage test, a conductance test or a load test.

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

VOLTMETER TEST

The voltmeter test provides a general indication of battery state of charge or condition. Check the voltage of the battery to verify that it is in a 100% fully charged condition. Refer to Table 3-1.

If the open circuit (disconnected) voltage reading is below 12.6V, charge the battery and then recheck the voltage after the battery has set for one to two hours. If the voltage reading is 12.7V or above, perform a load test. See 3.1 BATTERY TESTING, Load Test.

Table 3-1. Voltmeter Test For Battery Charge Conditions

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

CONDUCTANCE TEST

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

Test the battery using the ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER (Part No. HD-48053). Perform a battery test as follows:

1. Connect the analyzer leads to the vehicle battery terminal, not to the bolt or wire terminal.

NOTE

Connecting the analyzer to the bolt or wire terminal may not give an accurate reading of battery condition.

2. Follow the instructions in the analyzer instruction manual to perform a battery test.

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

See Figure 3-1. The analyzer printer will provide a printout including the possible test results:

NOTE

A REPLACE BATTERY test result may also mean a poor connection between the battery cables and the vehicle. After disconnecting the battery cables from the battery, retest the battery using the out-of-vehicle test before replacing.

- GOOD BATTERY - Return the battery to service.
- GOOD-RECHARGE - Fully charge the battery and return to service.
- CHARGE & RETEST - Fully charge the battery and then check the voltage after the battery has set for one to two hours, and retest. If battery fails retest, replace battery.
- REPLACE BATTERY - Replace the battery.
- BAD CELL-REPLACE - Replace the battery.
- BATTERY NOISE - Remove surface charge from battery and retest.

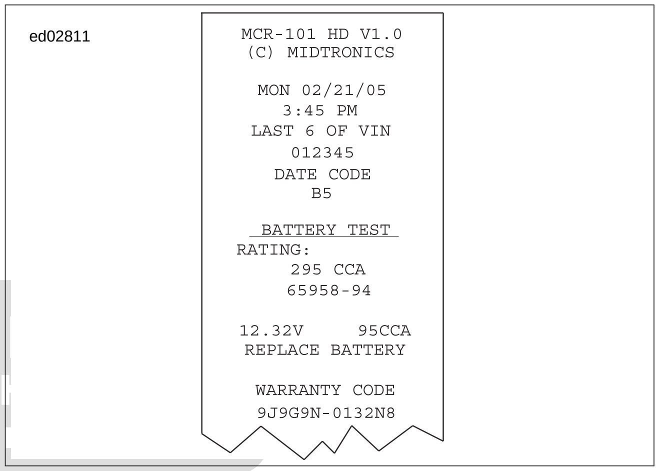


Figure 3-1. Battery Test Results Printout

LOAD TEST

⚠WARNING

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

1. With vehicle battery on a bench, charge the battery.

NOTE

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

⚠WARNING

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

2. See Figure 3-2. Connect tester leads to battery posts and place induction pickup over negative (black) cable.

NOTE

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

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

WARNING

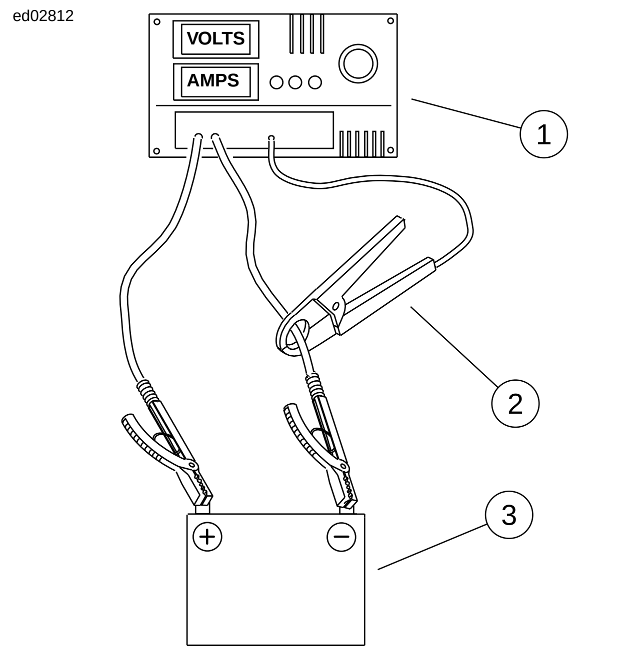
Turn battery load tester OFF before disconnecting tester cables to battery terminals. Disconnecting tester cables with load tester ON can cause a spark and battery explosion, which could result in death or serious injury. (00253a)

WARNING

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

CAUTION

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



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

Figure 3-2. Load Test Battery

Table 3-2. Battery Load Test

COLD CRANKING AMPERAGE (CCA)	100%	50%
Dyna models	270	135

STARTING SYSTEM 3.2

DESCRIPTION AND OPERATION

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

With engine stop switch to RUN, battery voltage is supplied to the start switch and the ECM. The TSM/TSSM/HFSM monitors the clutch switch, neutral switch, and the state of the security system. If the security system is not armed and either the clutch lever is pulled in or the motorcycle is in neutral, the TSM/TSSM/HFSM provides ground to the start relay coil.

When the start switch is pressed, power flows to the coil side of the start relay. The TSM/TSSM/HFSM supplies the ground to the start relay, energizing the start relay. This allows battery voltage from the ignition switch to flow through the start relay to the starter solenoid. This energizes the solenoid and full battery power is sent to the starter.

COMPONENTS

Starter

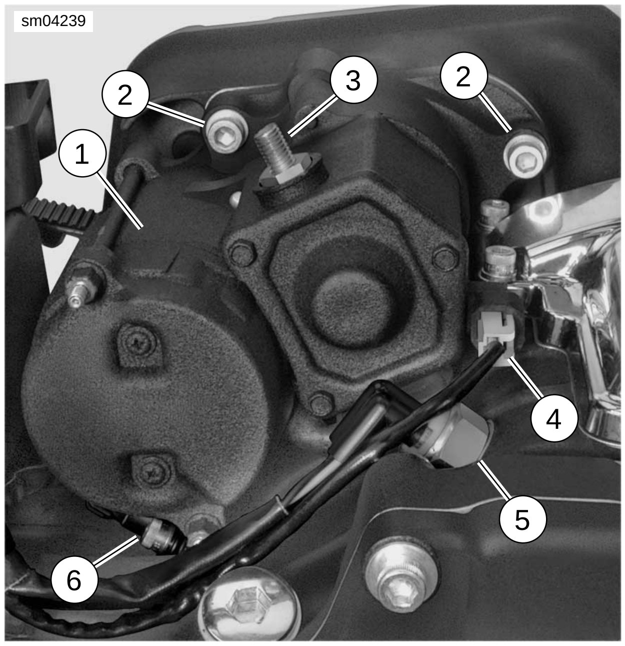
The starter receives power from the battery through the starter solenoid and is grounded through the starter case. When the starter solenoid is energized, two actions happen:

- 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 to the following:

- 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 is equipped with one way clutch so 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.



1. **Starter**
2. **Starter mounting fasteners**
3. **Positive battery cable post**
4. **Solenoid wire**
5. **Neutral switch**
6. **Vehicle speed sensor**

Figure 3-3. Starter

Starter Solenoid

See Figure 3-3. The starter solenoid provides power to the starter. The solenoid is a means of controlling a high amperage device with a low amperage switch. The low amperage switch in this circuit is the start relay. When the start relay is activated it sends voltage to the starter solenoid making a magnetic field that pulls a larger circuit closed, allowing voltage to the starter.

Engine Stop Switch (Right Hand Controls)

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

Start Switch (Right Hand Controls)

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

Start Relay

The fuse block located under the left side cover contains the start relay. With the IGN ON, battery voltage is supplied to the start relay and ignition fuse. The ignition fuse supplies battery voltage to the engine stop switch and TSM/TSSM/HFSM. With the engine stop switch in the RUN position, battery voltage is supplied to the start switch and the ECM. When the start switch is pressed, power flows to the coil side of the start relay. The TSM/TSSM/HFSM supplies the ground to the start relay, energizing the start relay. This allows battery voltage from the ignition switch to flow through the start relay to the starter solenoid.

Ignition Switch

The ignition switch turns the electrical power to the vehicle on and/or off. The ignition switch has three positions. In the OFF position, the ignition switch turns off all power to the vehicle except for the components powered directly by the battery. When the ignition switch is in the ACC position it allows power to flow through the ACCY fuse and supplies power to only certain parts of the vehicle such as the lights. In the ON or IGN position the ignition switch supplies power for all the systems on the vehicle.

Battery

WARNING

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

WARNING

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

WARNING

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

WARNING

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

WARNING

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

CAUTION

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

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 over-charging by the regulator during use.

Battery condition can be determined by a voltage test, a conductance test, or a load test. See 3.1 BATTERY TESTING.

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

Job/Time Code Values

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

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

HOME

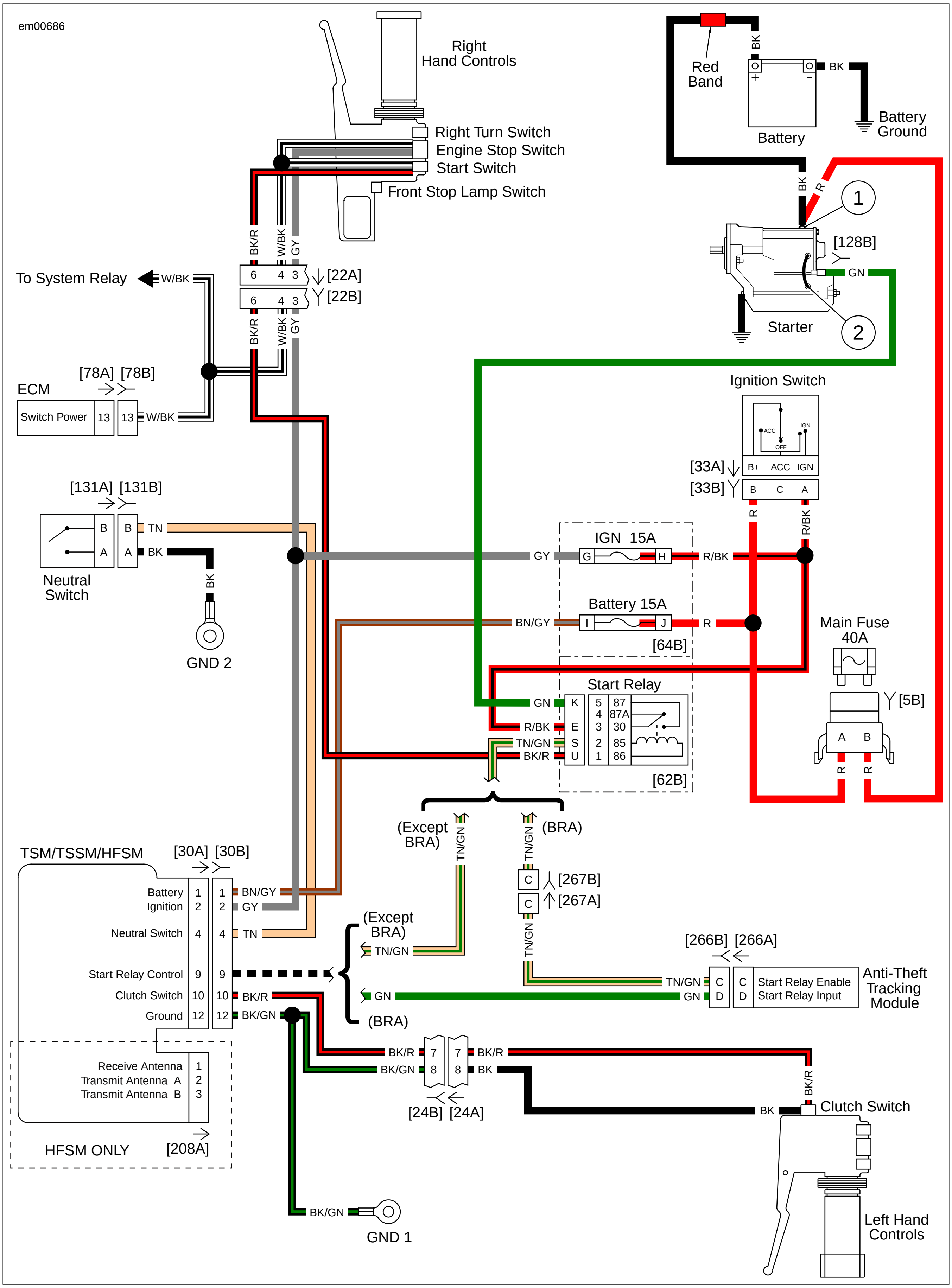


Figure 3-4. Starting Circuit

STARTER TROUBLESHOOTING

The troubleshooting tables contain detailed procedures to solve and correct problems. Follow 3.2 STARTING SYSTEM to diagnose starting system problems. The 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop procedure will help you to locate poor connections or components with excessive voltage drops.

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

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuit or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Wiring	Poor or no connection at either end of the battery positive or negative cable.	Repair or replace cable(s).
	Cracked or corroded battery cable ends.	Clean, tighten or replace cable(s) as needed.
	Open wire(s) or poor connection at handlebar switch or start relay, especially relay ground wire (grounds through TSM/TSSM/HFSM).	Tighten connections or repair or replace wire(s).
Start switch, clutch switch, engine stop switch or neutral switch	Poor switch contacts or open switch.	Replace switch.
Start relay	Open coil winding.	Replace relay.
	Poor or no continuity at relay points.	Replace relay.
	TSM/TSSM/HFSM has disabled start relay.	Disarm security system inspect for neutral or clutch circuit issue.
Starter solenoid	Poor contact condition caused by burned contacts.	Replace solenoid assembly.
	Windings open or short-circuited.	Replace solenoid assembly.
Starter motor	Brushes worn below specification.	Replace brush holder and brush springs.
	Commutator burnt.	Re-face commutator or replace armature and bearing.
	Commutator high mica.	Correct by undercutting or replace armature and bearing.
	Field winding grounded.	Replace field coil and armature and bearing.
	Armature winding grounded or short-circuited.	Replace armature and bearing.
	Free running current draw out of range.	Rebuild starter.
	Insufficient brush spring tension.	Replace brush springs.
Starter clutch	Starter clutch failure.	Replace starter clutch.

Table 3-4. Starter Spins But Does Not Engage

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Battery	Voltage drop due to discharged battery.	Charge battery.
	Short-circuit or open between electrodes.	Replace battery.
	Poor contact condition of battery terminal(s).	Clean and retighten.
Starter motor	Pinion gear teeth worn out.	Replace clutch sub-assembly

Table 3-4. Starter Spins But Does Not Engage

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Gear teeth on clutch shell and sprocket.	Excessively worn teeth.	Replace clutch shell and sprocket.
Starter clutch	Starter clutch failure.	Replace clutch sub-assembly

Table 3-5. Starter Does Not Stop Running

SOURCE OF PROBLEM	POSSIBLE CAUSE	SOLUTION
Start switch or start relay	Unopened contacts.	Replace start switch or start relay.
	Poor return caused by sticky switch or relay contacts.	Replace start switch or start relay.
Starter solenoid	Coil shorted.	Replace starter solenoid.
	Contact plate melted and stuck.	Replace starter solenoid.

STARTER TESTING

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

Table 3-6. Starter Testing Diagnostic Faults

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

1. Starting System Operational Test

1. With IGN ON, transmission in neutral, and the engine stop switch in the RUN position, press the start switch.
2. Does the starter spin?
   a. **Yes, starter spins but does not engage.** See 3.2 STARTING SYSTEM, Starter Spins But Does Not Engage.
   b. **Yes, starter stalls or spins too slowly.** See 3.2 STARTING SYSTEM, Starter Stalls or Spins Too Slowly.
   c. **Yes, starter runs on.** Go to Test 3.
   d. **No.** Go to Test 2.

2. Audible Noise Test

1. While listening for audible clicking noises from the start relay and starter solenoid, press the start switch.
2. Is there a click?
   a. **Yes, starter solenoid clicks.** See 3.2 STARTING SYSTEM, Starter Solenoid Clicks.
   b. **Yes, relay clicks.** See 3.2 STARTING SYSTEM, Start Relay Clicks.
   c. **No.** See 3.2 STARTING SYSTEM, Nothing Clicks.

3. Starter Solenoid Test

1. Disconnect [128].
2. Does starter stop?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace starter solenoid. **(5845)**

4. Start Switch Circuit Test

1. Turn IGN OFF, remove start relay.
2. Turn IGN ON. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) test for voltage at [62B] socket terminal U (BK/R) wire.
3. Is battery voltage present?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 7.

5. Start Switch Circuit Short to Voltage Test

1. Turn IGN OFF, disconnect [22].
2. Turn IGN ON, test for voltage at [22B] terminal 6.
3. Is voltage present?
   a. **Yes.** Repair short to voltage between [22B] terminal 6 and [62B] socket terminal U (BK/R) wire. **(5041)**
   b. **No.** Go to Test 6.

6. Start Switch Test

1. Test for continuity between [22A] terminal 4 (W/BK) wire and terminal 6 (BK/R) wire.
2. Is continuity present?
   a. **Yes.** Replace start switch. See the service manual. **(5818)**
   b. **No.** Repair short to voltage on [22A] terminal 6 (BK/R) wire. **(5041)**

7. Start Relay Test

1. Perform relay test. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
2. Is the start relay good?
   a. **Yes.** Perform wiggle test to locate short to voltage between [62B] socket terminals K (GN) wire or E (R/BK) wire. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test. **(5041)**
   b. **No.** Replace start relay. **(5832)**

NOTHING CLICKS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 3-7. Nothing Clicks Diagnostic Faults

POSSIBLE CAUSES
Low battery
Open fuse
Open ignition switch feed circuit
Start switch malfunction
Start relay malfunction
TSM/TSSM/HFSM malfunction
Ignition switch malfunction
Open ignition circuit
Open start switch circuit
Neutral switch malfunction
Open neutral circuit
Clutch switch malfunction
Open clutch switch circuit
Engine stop switch malfunction
Open ignition circuit
Open security circuit

NOTE

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

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed, attempt to start engine, if nothing clicks continues. Go to Test 2.

2. Fuse Test

1. Verify that all fuses, including main fuse are good.
2. Are all fuses good?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace fuse and repair circuit accordingly. If problem is still present, then continue with tests. Go to Test 3.

3. Ignition Circuit Test

1. With IGN ON, verify that ignition circuit is working properly.
2. Do lights illuminate?
   a. **Yes.** Go to Test 6.
   b. **No.** Go to Test 4.

4. Ignition Switch Supply Voltage Test

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

5. Ignition Switch Test

1. With IGN ON, test for continuity between ignition switch [33A] terminals B+ and IGN.
2. Is continuity present?
   a. **Yes.** Repair open in (R/BK) wire from [33B] terminal A. **(5041)**
   b. **No.** Replace ignition switch. See the service manual. **(7287)**

6. Start Switch Circuit Voltage Test

1. With IGN OFF, remove start relay.
2. Turn IGN ON.
3. While pressing the start switch, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for battery voltage at [62B] socket terminal U (BK/R) wire.
4. Is battery voltage present?
   a. **Yes.** Go to Test 9.
   b. **No.** Go to Test 7.

7. Start Switch Test

1. Turn IGN OFF and disconnect [22].

2. With the start switch pressed, test for continuity between [22A] terminals 6 (BK/R) wire and 4 (W/B) wire.
3. Is continuity present?
   a. **Yes.** Go to Test 8.
   b. **No.** Replace the start switch. See the service manual. **(5818)**

8. Start Switch Circuit Continuity Test

1. Test for continuity between [22B] terminal 6 and [62B] socket terminal U (BK/R) wire.
2. Is continuity present?
   a. **Yes.** Go to Test 15.
   b. **No.** Repair open between [22B] terminal 6 and [62B] socket terminal U (BK/R) wire. **(5041)**

9. Start Relay Control Circuit Test

1. Test for continuity between [62B] socket terminal S (TN/GN) wire and ground.
2. Is continuity present?
   a. **Yes.** Replace start relay. See the service manual. If problem is still present, go to 3.2 STARTING SYSTEM, Start Relay Clicks. **(5832)**
   b. **No.** Go to Test 10.

10. Start Relay Control Circuit Open Test

1. Connect BREAKOUT BOX (Part No. HD-42682) between wire harness [30B] and TSM/TSSM/HFSM [30A]. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between [62B] socket terminal S and breakout box terminal 9 (TN/GN) wire.
3. Is continuity present?
   a. **Yes.** Go to Test 11.
   b. **No.** Repair open between [62B] socket terminal S and TSM/TSSM/HFSM [30B] terminal 9 (TN/GN) wire. **(5041)**

11. TSM/TSSM/HFSM Ground Test

1. Test for continuity between breakout box terminal 12 (BK) wire and ground.
2. Is continuity present?
   a. **Yes.** Go to Test 12.
   b. **No.** Repair open between TSM/TSSM/HFSM [30B] terminal 12 and GND 1 (BK/GN) wire. **(5041)**

12. Continuity at Neutral Switch Test

1. Verify that transmission is in neutral.
2. Measure for resistance between breakout box terminal 4 (TN) wire and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 14.
   b. **No.** Go to Test 13.

13. Neutral Switch Ground Circuit Test

1. Test for continuity between neutral switch [131] (BK) wire and ground.
2. Is continuity present?
   a. **Yes.** Replace neutral switch. See the service manual. **(5157)**
   b. **No.** Repair open between neutral switch [131] and GND 2 (BK) wire. **(5041)**

14. Start Relay Coil Control Circuit Short to Voltage Test

1. Turn IGN ON.
2. Test for battery voltage on breakout box terminal 9.
3. Is battery voltage present?
   a. **Yes.** Repair short to voltage between TSM/TSSM/HFSM [30B] terminal 9 and [62B] socket terminal S on (TN/GN) wire. **(5041)**
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual. **(5838)**

15. Engine Stop Switch Voltage Test

1. Test for voltage between [22B] terminal 3 and ground.
2. Is battery voltage present?
   a. **Yes.** Replace engine stop switch. See the service manual.
   b. **No.** Repair open between ignition fuse and [22B] (GY) wire.

START RELAY CLICKS

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

Table 3-8. Start Relay Clicks Diagnostic Faults

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

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed, attempt to start engine, if start relay continues to click and starter does not engage. Go to Test 2.

2. Starter Solenoid Control Coil Voltage Test

1. With IGN OFF, disconnect [128].
2. Turn IGN ON.

3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for battery voltage on [128B] terminal 1 (GN) wire.
4. Is battery voltage present when start switch is pressed?
   a. **Yes.** Replace starter solenoid. See the service manual. **(5845)**
   b. **No.** Go to Test 3.

3. Starter Solenoid Control Coil Continuity Test

1. Turn IGN OFF and remove start relay.
2. Test for continuity between [128B] terminal 1 and [62B] socket terminal K (GN) wire.
3. Is continuity present?
   a. **Yes.** See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics. If relay tests good, then continue tests. Go to Test 4.
   b. **No.** Repair open between [128B] terminal 1 and [62B] socket terminal K (GN) wire. **(5041)**

4. Start Solenoid Wiring Inspection Test

1. Inspect for corrosion or damage to the wiring from [128A] to starter solenoid.
2. Are there any problems?
   a. **Yes.** Repair damage or replace starter solenoid. See the service manual. If problem is still present, then continue with test. Go to Test 5. **(5845)**
   b. **No.** Go to Test 5.

5. Starter Solenoid Test

1. With IGN ON, press the start switch.
2. Does starter solenoid click?
   a. **Yes.** Go to 3.2 STARTING SYSTEM, Starter Solenoid Clicks.
   b. **No.** Repair open in [62B] socket terminal E (R/BK) wire.

STARTER SOLENOID CLICKS

Table 3-9. Starter Solenoid Clicks Diagnostic Faults

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

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed, attempt to start engine, if starter solenoid continues to click and starter does not engage. Go to Test 2.

2. Starter Voltage Test

1. With IGN ON, test for battery voltage at starter solenoid terminal 2 (BK) wire.
2. Is battery voltage present when start switch is pressed?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 4.

3. Starter Ground Test

1. Remove starter attaching bolts.
2. Clean bolts and starter base, install starter bolts. See the service manual.
3. Does engine crank?
   a. **Yes.** Engine cranks at normal speed.
   b. **Yes.** Engine cranks, but at a slower speed. See 3.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
   c. **No.** Replace starter. See the service manual. **(5817)**

4. Starter Stud Voltage Drop Test

1. Perform voltage drop tests from battery (+) to starter stud on starter (BK) wire. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.
2. Is voltage drop greater than 1.0V?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 7.

5. Starter Solenoid Voltage Drop Starter Side Test

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 6.
   b. **No.** Replace starter solenoid. **(5845)**

6. Starter Solenoid Battery Side Voltage Drop Test

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. **(5041)**
   b. **No.** Replace starter solenoid. See the service manual. **(5845)**

7. Starter Ground Circuit Voltage Drop Test

1. Perform voltage drop test from battery (-) terminal to GND 2.
2. Is voltage drop greater than 1.0V?
   a. **Yes.** Repair or replace (BK) wire from battery (-) terminal. **(5041)**
   b. **No.** Go to Test 8.

8. Starter Draw Test

1. Perform Starter Current Draw Test on motorcycle. See 3.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
2. Perform Starter Motor Free Running Current Draw Test (on bench). See 3.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.
3. Are test results within range?
   a. **Yes.** Go to Test 9.
   b. **No.** Replace starter. See the service manual. **(5817)**

9. Mechanical Binding Test

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

STARTER SPINS BUT DOES NOT ENGAGE

Table 3-10. Starter Spins But Does Not Engage Diagnostic Faults

POSSIBLE CAUSES
Clutch sub-assembly
Clutch shell and sprocket
Idler gear

1. Pinion Gear and Clutch Shell Test

1. Remove primary cover.
2. Inspect for damage to starter pinion gear and clutch shell and sprocket.
3. Is damage present?
   a. **Yes.** Replace the clutch sub-assembly or clutch shell and sprocket. See the service manual. **(5825)**
   b. **No.** Replace the clutch sub-assembly and idler gear. See the service manual. **(5837)**

STARTER STALLS OR SPINS TOO SLOWLY

Table 3-11. Starter Stalls or Spins Too Slowly Diagnostic Faults

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

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed. If symptom is still present, then continue with tests. Go to Test 2.

2. Starter Stud Voltage Drop Test

1. Perform voltage drop test from battery (+) terminal to starter stud on starter (BK) wire. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.
2. Is voltage drop greater than 1.0V?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 3.

3. Starter Ground Circuit Voltage Drop Test

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

4. Starter Draw Test

1. Perform Starter Current Draw Test on motorcycle. See 3.3 TESTING STARTER ON MOTORCYCLE, Starter Current Draw Test.
2. Perform Starter Motor Free Running Current Draw Test (on bench). See 3.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.
3. Are test results within range?
   a. **Yes.** With the spark plugs removed and the transmission in 5th gear, rotate rear wheel. Check for engine, primary and/or crankshaft bind. (Use appropriate code)
   b. **No.** Replace starter. See the service manual. **(5817)**

5. Starter Solenoid Voltage Drop Starter Side Test

1. Perform voltage drop test between battery (+) terminal to starter solenoid terminal 2.
2. Is voltage drop greater than 1.0V?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair connection or (BK) wire between starter solenoid and starter. **(5041)**

6. Starter Solenoid Battery Side Voltage Drop Test

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

TESTING STARTER ON MOTORCYCLE 3.3

STARTER CURRENT DRAW TEST

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

NOTES

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

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

1. Verify that transmission is in neutral and engine stop switch is in OFF position.
2. Remove start relay.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect patch cord to [62B] socket terminals K and E.
4. Clamp induction ammeter over positive starter cable to starter solenoid.

NOTE

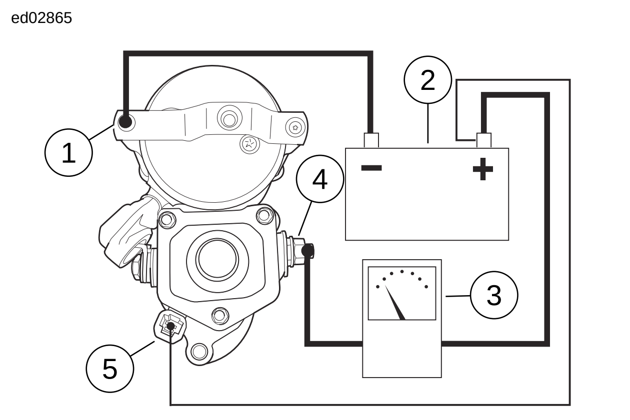
In next step with engine stop switch in OFF position and purple male probes connected to the [62B] terminals K and E in place of the start relay, starter will turn but engine will not start. This configuration also prevents diagnostic trouble codes from being set.

5. With IGN ON, read the ammeter. Disregard initial high current reading which is normal when engine is first turned over.
   a. Typical starter current draw will range between 160-200A.
   b. If starter current draw exceeds 250A, then the problem may be in the starter or starter drive. See 3.4 TESTING STARTER ON BENCH, Free Running Current Draw Test.

TESTING STARTER ON BENCH 3.4

FREE RUNNING CURRENT DRAW TEST

1. Place starter in vise, using a clean shop towel to prevent scratches or other damage.
2. See Figure 3-5. Attach one heavy jumper cable (6 gauge minimum).
   a. Connect one end to the starter mounting flange.
   b. Connect the other end to the battery (-) terminal of a fully charged battery.
3. Connect a second heavy jumper cable (6 gauge minimum).
   a. Connect one end to the battery (+) terminal of the battery.
   b. Connect the other end to the battery terminal on the starter. Place an induction ammeter over cable.
4. Connect a smaller jumper cable (14 gauge minimum).
   a. Connect one end to the positive (+) terminal of the battery.
   b. Connect the other end to the solenoid relay terminal.
5. Check ammeter reading.
   a. Ammeter should show 90A max.
   b. If reading is higher, repair or replace starter motor. See the service manual.
   c. If starter current draw on vehicle was over 120A and this test was within specification, there may be a problem with engine or primary drive.



1. Mounting flange
2. Battery
3. Induction ammeter
4. Battery terminal
5. Relay terminal

Figure 3-5. Free Running Current Draw Test

STARTER SOLENOID

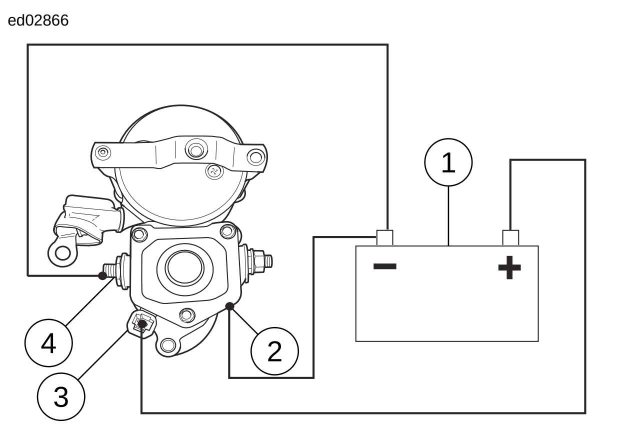
Do not disassemble solenoid. Before testing, disconnect field wire from motor terminal as shown in Figure 3-6.

Each test should be performed for only 3-5 seconds to prevent damage to solenoid.

The solenoid Pull-in, Hold-in, and Return tests must be performed together in one continuous operation. Conduct all three tests one after the other in the sequence given without interruption.

SOLENOID PULL-IN TEST

1. See Figure 3-6. Using a 12 volt battery, connect three separate test leads as follows:
   a. Solenoid housing to negative battery post.
   b. Solenoid motor terminal to negative battery post.
   c. Solenoid relay terminal to positive battery post.
2. Observe starter shaft.
   a. If starter shaft extends strongly, solenoid is working properly.
   b. If starter shaft does not extend strongly, replace the solenoid.

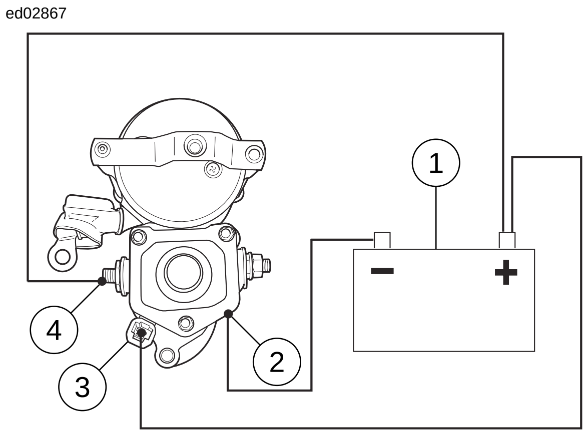


1. Battery
2. Solenoid housing
3. Solenoid relay terminal
4. Solenoid motor terminal

Figure 3-6. Pull-In Test

SOLENOID HOLD-IN TEST

1. See Figure 3-7. With test leads still connected in the manner specified in the previous 3.4 TESTING STARTER ON BENCH, Solenoid Pull-In Test, disconnect solenoid motor terminal/battery negative test lead at negative battery post only; reconnect loose end of this test lead to positive battery post instead.
2. Observe starter shaft.
   a. If starter shaft remains extended, solenoid is working properly.
   b. If starter shaft retracts, replace the solenoid.

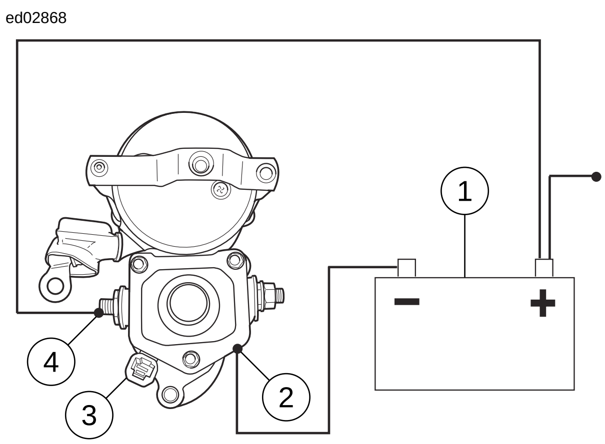


1. **Battery**
2. **Solenoid housing**
3. **Solenoid relay terminal**
4. **Solenoid motor terminal**

Figure 3-7. Hold-In Test

SOLENOID RETURN TEST

1. See Figure 3-8. With test leads still connected in the manner specified at the end of 3.4 TESTING STARTER ON BENCH, Solenoid Hold-In Test, disconnect solenoid relay terminal/positive battery post test lead at either end.
2. Observe starter pinion.
   a. If starter shaft retracts, solenoid is working properly.
   b. If starter shaft does not retract, replace the solenoid.



1. **Battery**
2. **Solenoid housing**
3. **Solenoid relay terminal**
4. **Solenoid motor terminal**

Figure 3-8. Return Test

ARMATURE TEST

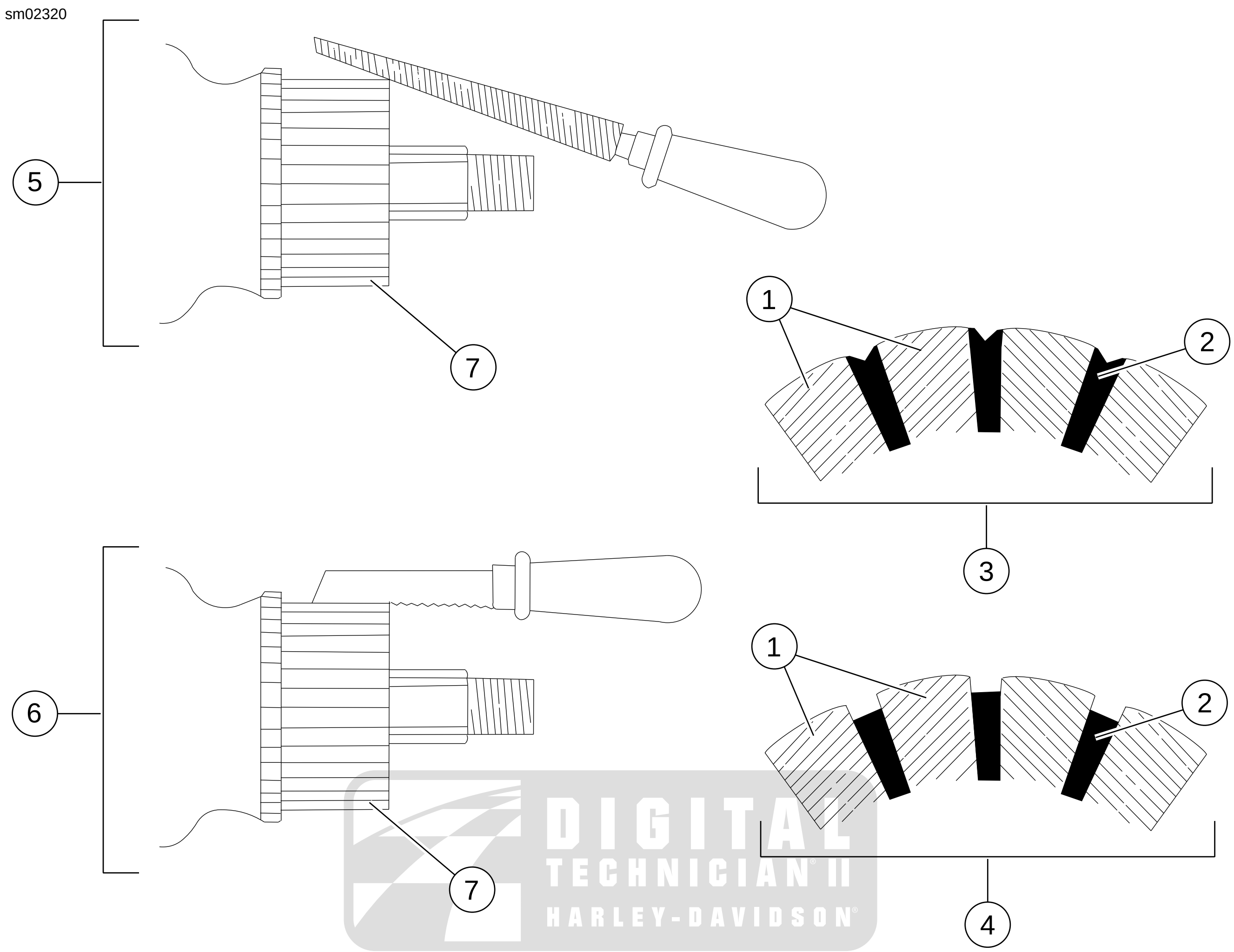
Armature

1. Remove armature and brush holder from field coil. See the service manual.
2. Place armature in lathe or truing stand and check runout of commutator. Commutators with more than 0.015 in. (0.38 mm) of runout should be replaced or machined on a lathe. Commutators should be replaced when diameter is less than 1.141 in. (29.98 mm).
3. Check depth of mica on commutator. If undercut is less than 0.008 in. (0.20 mm), use an undercutting machine to undercut the mica to 1/32 in. (0.79 mm) deep. The slots should then be cleaned to remove any dirt or copper dust.

NOTES

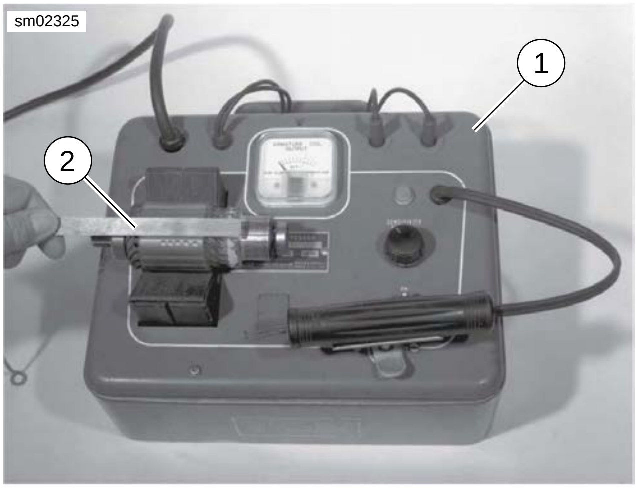
- *See Figure 3-9. If an undercutting machine is not available, undercutting can be done satisfactorily using a thin hacksaw blade. After undercutting, lightly sand the armature with crocus cloth to remove any burrs.*
- *Do not use sandpaper or emery cloth on commutator. The abrasive grit may remain on commutator segments and could cause excessive brush wear.*

4. See Figure 3-10. Check for a SHORTED ARMATURE.
   a. Place armature on growler.
   b. Hold a thin steel strip (hacksaw blade), against the armature core and slowly turn armature.
   c. A shorted armature will cause the steel strip to vibrate and be attracted to the core. Replace the armature if shorted.
5. See Figure 3-11. Check for a GROUNDED ARMATURE with an ohmmeter or continuity tester.
   a. Touch one probe to any commutator segment.
   b. Touch the other probe to the armature core.
   c. There should be no continuity (infinite ohms). If there is continuity, the armature is grounded. Replace a grounded armature.
6. See Figure 3-12. Check for an OPEN ARMATURE with an ohmmeter or continuity tester.
   a. Check for continuity between all commutator segments.
   b. There should be continuity (0 ohms) at all test points. If there is no continuity at any test point, then the armature is open. Replace an open armature.



1. **Segments**
2. **Mica**
3. **Incorrect (Mica must not be left with a thin edge next to segments)**
4. **Correct (Mica must be cut away clean between segments)**
5. **Starting groove in mica with 3 cornered file**
6. **Undercutting mica with piece of hacksaw blade**
7. **Commutator**

Figure 3-9. Undercutting Mica Separators



1. **Growler**
2. **Thin steel strip (hacksaw blade)**

Figure 3-10. Shorted Armature Test Using Growler

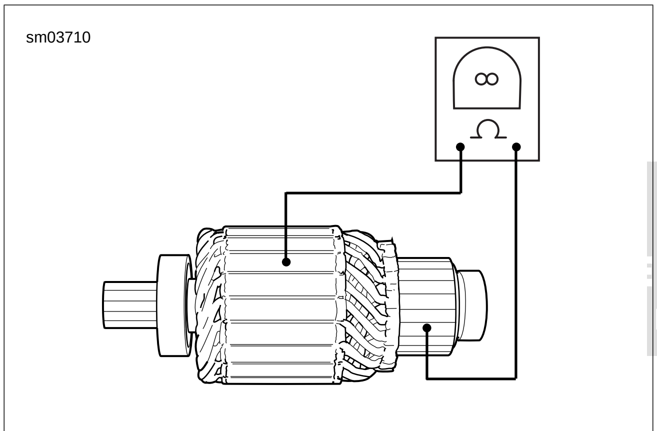


Figure 3-11. Grounded Armature Test

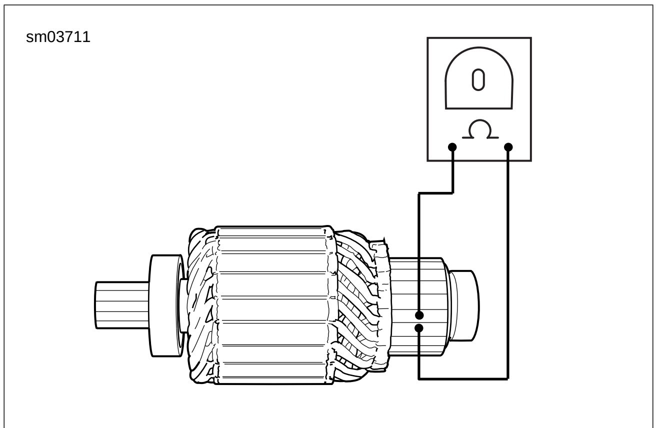


Figure 3-12. Armature Open Test

Brushes and Brush Holder

1. Remove armature and brush holder from field coil. See the service manual.
2. Measure the brush length. If any one of four brushes is less than 0.433 in. (11 mm), replace the field coil and brush holder assembly. No further testing is necessary.
3. See Figure 3-13. Check for a GROUNDED FIELD COIL WINDING with an ohmmeter or continuity tester.
   a. Touch one probe to the field coil housing (frame).
   b. Touch the other probe to each of two brushes attached to the field coil winding.
   c. There should be no continuity (infinite ohms). If there is continuity at either brush, then the field coil winding is grounded. Replace the field coil/brush holder assembly if grounded.
4. See Figure 3-14. Check for an OPEN FIELD COIL WINDING with an ohmmeter or continuity tester.
   a. Touch one probe to the field wire.
   b. Touch the other probe to each of the two brushes attached to the field coil winding(s).
   c. There should be continuity (0 ohms). If there is no continuity at either brush, then the field coil winding(s) are open. Replace the field coil/brush holder assembly if open.
5. See Figure 3-15. Test the BRUSH HOLDER INSULATION with an ohmmeter or continuity tester.
   a. Touch one probe to the holder plate.
   b. Touch the other probe to each of the positive (insulated) brush holders.
   c. There should be no continuity (infinite ohms). If there is continuity at either brush holder, replace the field coil/brush holder assembly.
   d. Touch one probe to the non-insulated brush holders and the other probe to the holder plate. If any resistance is measured, replace the field coil/brush holder assembly.

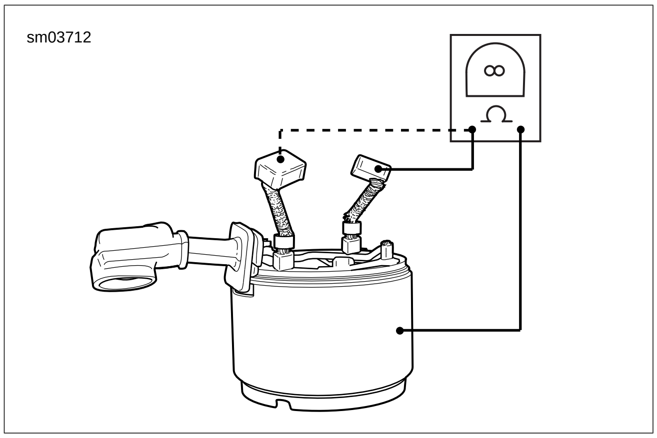


Figure 3-13. Grounded Field Test

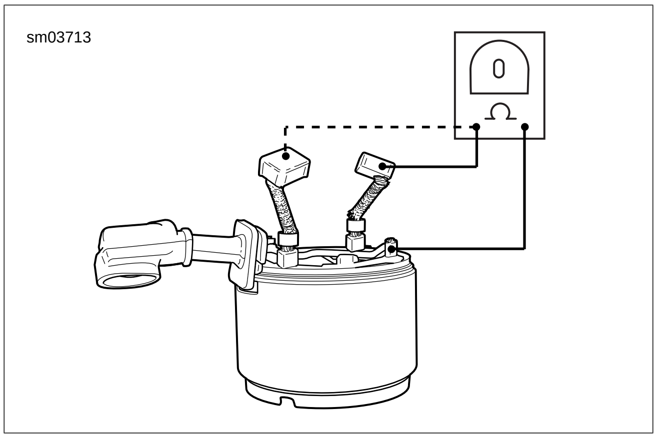


Figure 3-14. Open Field Test

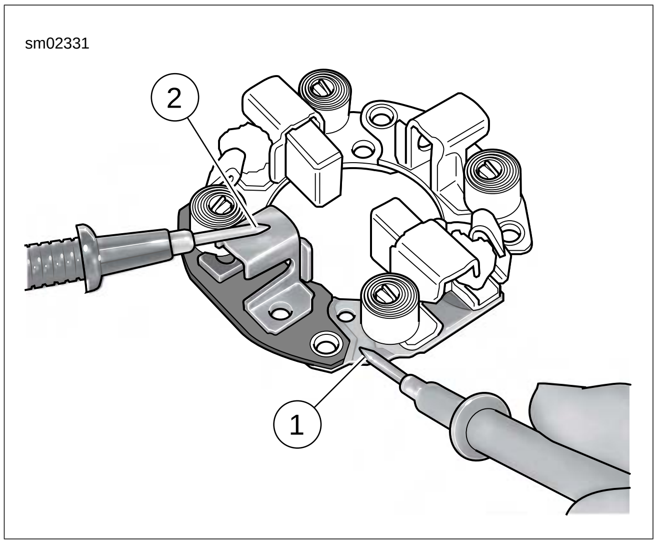


Figure 3-15. Brush Holder Insulation Test

CHARGING SYSTEM 3.5

DESCRIPTION AND OPERATION

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

Alternator

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.

Voltage Regulator

See Figure 3-16. The voltage regulator is a series regulator. The circuit combines the functions of rectifying and regulating.

TROUBLESHOOTING

When the charging system fails to charge or does not charge at a satisfactory rate, make the following recommended checks.

Battery

Test for a weak or dead battery. See 3.1 BATTERY TESTING for battery testing procedures. Battery must be fully charged in order to perform a load test, or starting or charging tests.

Wiring

The stator connections must be clean and tight.

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

Voltage Regulator Inspection

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

Job/Time Code Values

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

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

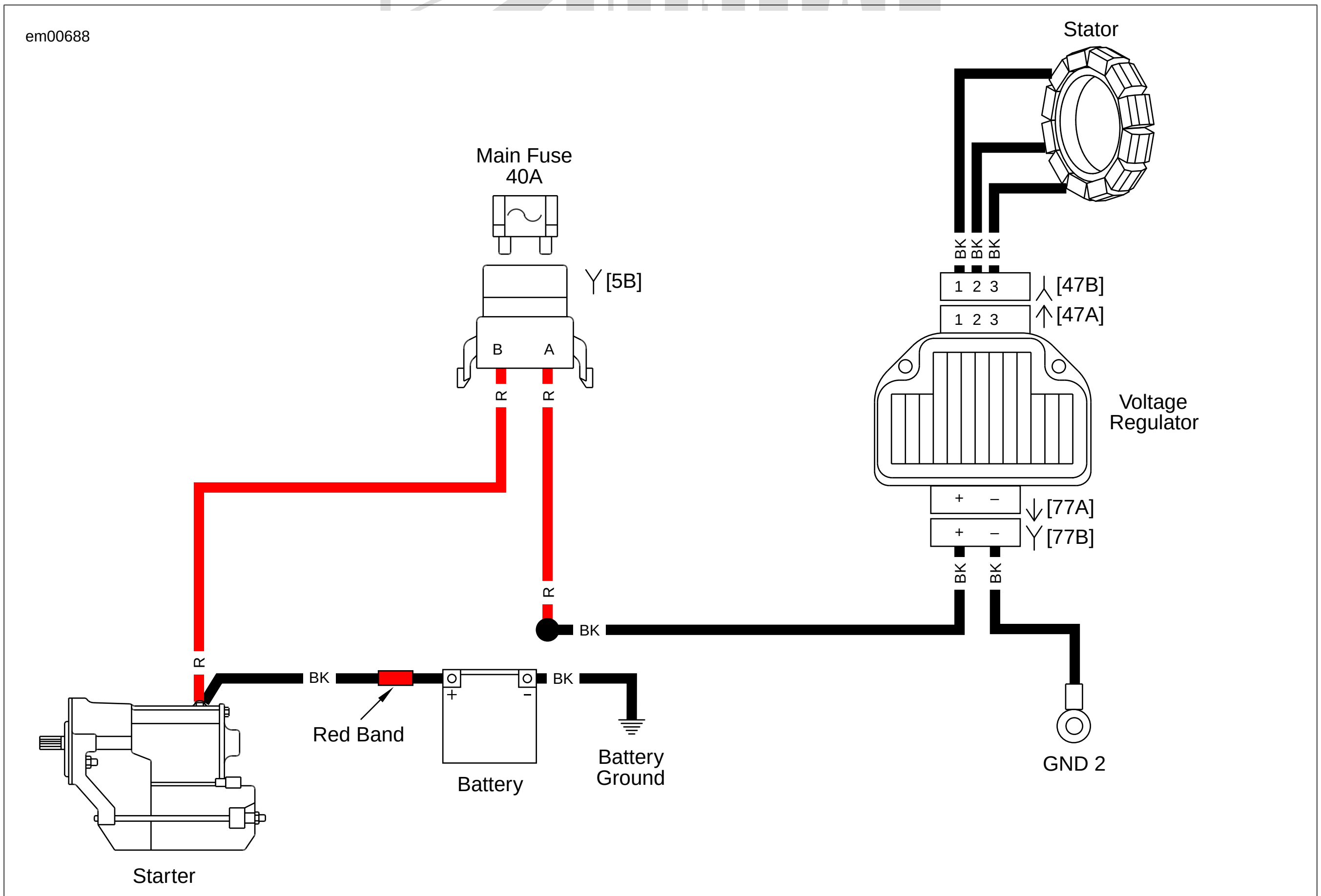


Figure 3-16. Charging System Circuit

LOW OR NO CHARGING

Table 3-12. Low or No Charging Diagnostic Faults

POSSIBLE CAUSES
Low battery
Stator malfunction
Rotor malfunction
Voltage regulator malfunction
Open voltage regulator circuit

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed. Verify repair.

NOTE

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

2. Off Idle Voltage Test

1. With the vehicle is neutral, start engine and run at 3000 RPM.
2. Test battery voltage.
3. Is voltage above 13V?
   a. **Yes.** Charging system working properly.
   b. **No.** Go to Test 3.

3. AC Output Test

1. Perform an AC output test. See 3.5 CHARGING SYSTEM, Battery Charging Tests.
2. Did the output test pass?
   a. **Yes.** Go to Test 6.
   b. **No.** Go to Test 4.

4. Stator Test

1. Perform a stator test. See 3.5 CHARGING SYSTEM, Battery Charging Tests.
2. Is the stator good?
   a. **Yes.** Go to Test 5.
   b. **No.** Replace stator. See the service manual. **(5309)**

5. Rotor Inspection Test

1. Inspect the rotor for damage.
2. Remove center bolt and inspect for signs of the center hole becoming oval. See the service manual.
3. Verify that stator bolts have not backed out and contacted the rotor.
4. Is rotor in good condition?
   a. **Yes.** Go to Test 6.
   b. **No.** Replace rotor. See the service manual. **(5319)**

6. Voltage Regulator Ground Circuit Test

NOTE

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

1. With IGN OFF, disconnect voltage regulator [77].
2. Test for continuity between voltage regulator [77B] terminal - and ground.
3. Is continuity present?
   a. **Yes.** Replace voltage regulator. See the service manual. **(5316)**
   b. **No.** Repair or replace wire between voltage regulator [77B] terminal - and GND 2 (BK) wire. **(5041)**

OVERCHARGING

Table 3-13. Overcharging Diagnostic Faults

POSSIBLE CAUSES
Voltage regulator malfunction
Open voltage regulator circuit

1. Battery Voltage Test

1. With the vehicle in neutral, 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.

2. Voltage Regulator Ground Circuit Test

NOTE

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

1. With IGN OFF, disconnect voltage regulator [77].
2. Test for continuity between voltage regulator [77B] terminal - and ground.
3. Is continuity present?
   a. **Yes.** Replace voltage regulator. See the service manual. **(5316)**
   b. **No.** Repair or replace wire between voltage regulator [77B] terminal - and GND 2 (BK) wire. **(5041)**

LOW BATTERY AFTER EXTENDED IGN OFF

Table 3-14. Low Battery After Extended IGN OFF Diagnostic Faults

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

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed. Verify repair.

2. Amp Draw Test

1. Perform a milliampere draw test. See 3.5 CHARGING SYSTEM, Battery Charging Tests.
2. Did the test exceed maximum draw?
   a. **Yes.** Repair excessive draw, and run test again. **(5308)**
   b. **No.** System is working properly.

BATTERY RUNS DOWN DURING USE

Table 3-15. Battery Runs Down During Use Diagnostic Faults

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

1. Total Current Draw Test

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

2. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** System is working properly.
   b. **No.** Charge or replace battery as needed.

BATTERY CHARGING TESTS

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

Milliampere Draw Test

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. Test for this by connecting ammeter between negative battery terminal and battery.

1. If vehicle is equipped with HFSM, enable service mode before performing test.
2. Disconnect the security siren (if equipped).
3. Remove main fuse.

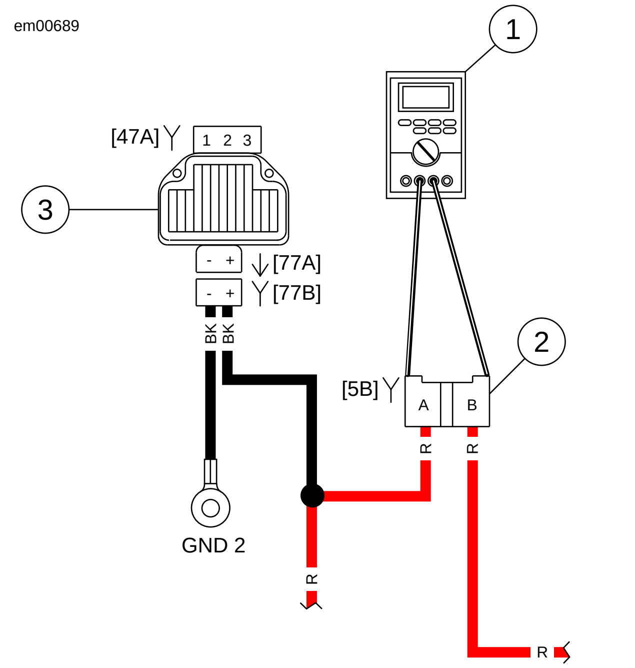
NOTE

With IGN OFF, an initial current draw of up to 200 mA will occur directly after connecting meter. This should drop to the values shown in table in less than one minute.

4. See Figure 3-17. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect ammeter to main fuse socket terminals. With this arrangement, you will also pick up any regulator drain.
5. With IGN OFF and all lights and accessories off, observe current reading.
   a. Refer to Table 3-16. Add voltage regulator draw to appropriate value for TSM/TSSM/HFSM and ECM. If observed ammeter reading is less than listed in table, draw is within limits.
   b. A higher reading indicates excessive current draw. Any accessories must be considered and checked for excessive drain.

Table 3-16. Milliampere Draw Test

ITEM	MAXIMUM DRAW IN MILLI-AMPERES
Speedometer	1.0
Tachometer (if equipped)	1.0
Regulator	1.0
TSM (non security models)	1.0
TSSM (disarmed)	3.0
TSSM (armed)	3.0
TSSM/HFSM-Storage mode (armed or disarmed)	1.0
HFSM	1.0
ECM	1.0
Security siren (optional)	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.	



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

Figure 3-17. Milliampere Draw Test (Ignition Turned to OFF)

Total Current Draw and Output Test

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, an ammeter with current probe may be used.

⚠WARNING

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

1. See Figure 3-18. Connect load tester.
   a. Connect negative and positive leads to battery terminals.
   b. Place load tester induction pickup over battery negative cable.
2. With IGN OFF, disconnect voltage regulator [77].
3. Start engine.
4. Turn all continuously running lights and accessories turned ON (headlamp on high beam).
5. Run engine at 3000 RPM, and make note of the current draw.
6. Turn engine OFF.
7. With IGN OFF, connect voltage regulator [77].
8. Remove the induction pickup from the battery negative cable.
9. Place induction pickup over positive regulator cable.
10. Start engine and run at 3000 RPM.

NOTE

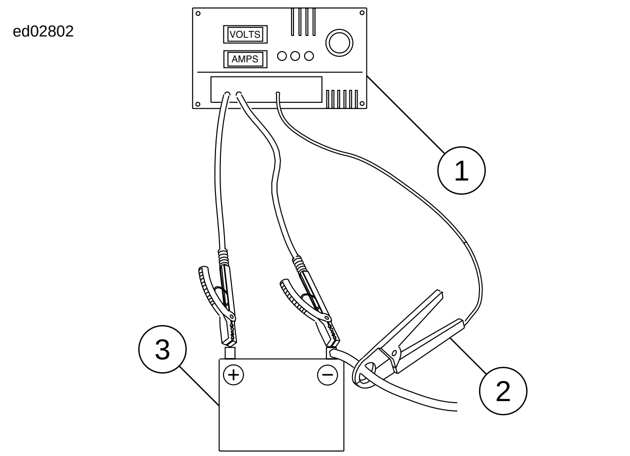
Do not leave any load switch turned on for more than 20 seconds or overheating and tester damage are possible.

11. Increase the load as required to obtain a constant 13.0V.
12. Current output should be 30-50A. 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.



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

Figure 3-18. Check Current Draw (Ignition Switch On)

Stator Test

1. Turn IGN OFF.
2. See Figure 3-19. Connect an ohmmeter.
   a. Disconnect voltage regulator connector from alternator stator wiring.
   b. Insert one ohmmeter lead into a stator connector socket.
   c. Attach the other lead to a suitable ground.
3. Test for continuity.
   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 3-20. Remove ground lead. Measure resistance across stator [47B] terminals 1-2, 2-3 and 3-1.
   a. Resistance across all the stator terminals should be 0.1-0.3 Ohm.
   b. If the resistance is higher, the stator is damaged and must be replaced.
   c. If resistance is lower, the stator may have a turn-to-turn short and should be replaced.

NOTE

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

Figure 3-19. Test for Grounded Stator (Typical)

Figure 3-20. Check for Stator Resistance (Typical)

AC Output Test

1. See Figure 3-21. 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 32-46 VAC (approximately 16-22 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. See the service manual.
3. Check the output again as previously described under Current and Voltage Output Test.

Figure 3-21. Check Stator AC Voltage Output (Typical)

DTC B0563, P0562, P0563 3.6

DESCRIPTION AND OPERATION

Battery voltage is monitored by several modules. If the battery voltage fails to meet normal operating parameters, a DTC is set.

DTC B0563

Battery voltage is monitored by the TSM/TSSM/HFSM on terminal 1. DTC B0563 is displayed when the TSM/TSSM/HFSM exceeds 16.0V for more than 5.0 ±0.5 seconds.

DTC P0562 and P0563

Battery voltage is monitored by the ECM on terminal 13.

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

Table 3-17. Code Description

DTC	DESCRIPTION
B0563	Voltage high
P0562	Voltage low
P0563	Voltage high

DIAGNOSTICS

Diagnostic Tips

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

- The vehicle is placed on a battery charger, on fast charge, for a long period of time.
- 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.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

HOME

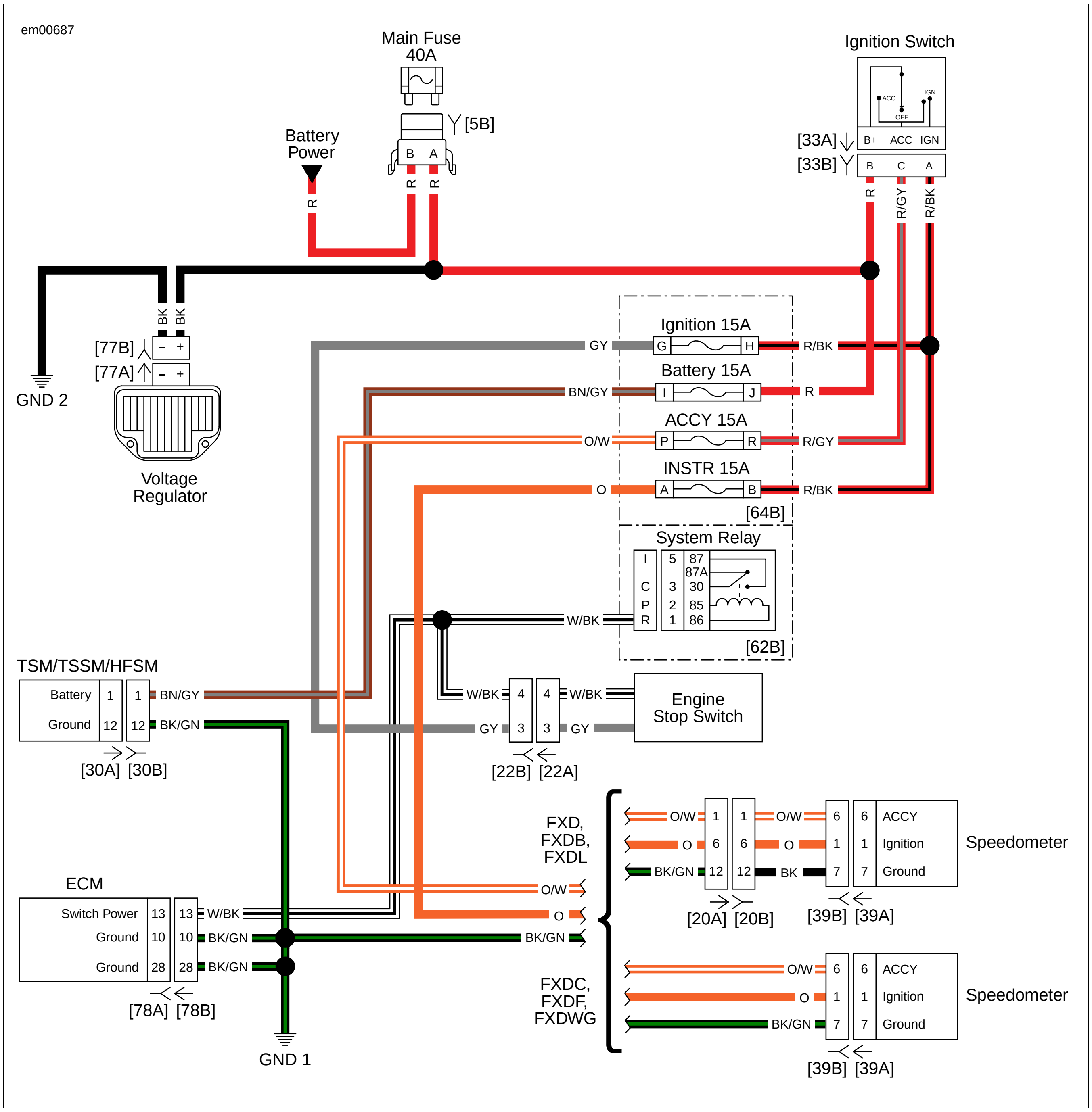


Figure 3-22. High and Low Voltage Sensors

DTC P0562

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 3-18. DTC P0562 Diagnostic Faults

POSSIBLE CAUSES
Low battery
Ignition switch malfunction
Engine stop switch malfunction
ECM malfunction
Open ECM ground circuit
Open ECM switched power circuit
Open ignition circuit

1. Battery Test

1. Verify battery condition. See 3.1 BATTERY TESTING.
2. Is battery condition good?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery as needed. Verify repair.

2. Charging System Test

1. Perform charging system test. See 3.5 CHARGING SYSTEM, Low or No Charging.
2. Is charging system working properly?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair charging system. Go to Test 15.

3. ECM Switched Voltage Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78A] and ECM [78B]. See 1.2 DIAGNOSTIC TOOLS.
2. With the engine stop switch in the RUN position and the transmission in neutral, turn the IGN ON.
3. Test for voltage on breakout box between terminals 13 and 28.
4. Is battery voltage present?
   a. **Yes.** System is working properly. Go to Test 15.
   b. **No.** Go to Test 4.

4. ECM Switched Voltage Drop Test

1. Perform a voltage drop test between battery (+) terminal and breakout box terminal 13. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.
2. Is voltage drop greater than 0.5V?
   a. **Yes.** Go to Test 6.
   b. **No.** Go to Test 5.

5. ECM Ground Circuit Voltage Drop Test

1. Test for voltage drop test between breakout box terminals 10 and 28 and battery (-) terminal.
2. Is voltage drop greater than 0.5V?
   a. **Yes.** Repair wiring between ECM [78B] terminals 10 and 28 and battery negative.
   b. **No.** Problem may be intermittent. Locate and repair bad connection. Perform 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test. If no problem is found, then continue with tests. Go to Test 15.

6. ECM Switched Power Circuit Resistance Test

1. With IGN OFF, remove system relay.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between breakout box terminal 13 and [62B] socket terminal R (W/BK) wire.
3. Is resistance greater than 1 Ohm?
   a. **Yes.** Repair (W/BK) wire between ECM [78B] terminal 13 and [62B] socket terminal R.
   b. **No.** Go to Test 7.

7. Switched Power Circuit Resistance Test

1. Disconnect [22].
2. Measure resistance between [22B] terminal 4 and [62B] socket terminal R (W/BK) wire.
3. Is resistance greater than 1 Ohm?
   a. **Yes.** Repair (W/BK) wire between [22B] terminal 4 and [62B] socket terminal 2.
   b. **No.** Go to Test 8.

8. Ignition Circuit Resistance Test

1. Measure resistance between ignition fuse [62B] socket terminal G and [22B] terminal 3 (GY) wire.
2. Is resistance greater than 1 Ohm?
   a. **Yes.** Repair (GY) wire between [64B] socket terminal G and [22B] terminal 3.
   b. **No.** Go to Test 9.

9. Engine Stop Switch Test

1. Measure resistance between [22A] terminals 4 (GY) wire and 3 (W/BK) wire.
2. Is resistance greater than 1 Ohm?
   a. **Yes.** Replace the engine stop switch assembly. See the service manual.
   b. **No.** Go to Test 10.

10. Ignition Circuit Voltage Drop Test

1. With IGN ON, perform a voltage drop test between battery (+) terminal and [64B] socket terminal H. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.

2. Is voltage drop greater than 0.5V?
   a. **Yes.** Go to Test 11.
   b. **No.** Go to Test 13.

11. Ignition Circuit Resistance Test

1. With IGN OFF, disconnect ignition switch [33].
2. Measure resistance between ignition switch [33B] terminal A (R/BK) wire and [64B] socket terminal H.
3. Is resistance greater than 1 Ohm?
   a. **Yes.** Repair wire between ignition switch [33B] terminal A (R/BK) wire and [64B] socket terminal H.
   b. **No.** Go to Test 12.

12. Ignition Switch Battery Circuit Voltage Drop Test

1. Perform a voltage drop test between battery (+) terminal and ignition switch [33B] terminal B (R) wire.
2. Is voltage drop greater than 0.5V?
   a. **Yes.** Go to Test 13.
   b. **No.** Replace ignition switch. See the service manual.

13. Battery Voltage to Main Fuse Voltage Drop Test

1. With IGN OFF, remove main fuse.
2. Perform a voltage drop test between battery (+) terminal and main fuse [5B] terminal B (R) wire.
3. Is voltage drop greater than 0.5V?
   a. **Yes.** Repair wire between battery (+) terminal and main fuse [5B] terminal A (R) wire.
   b. **No.** Go to Test 14.

14. Main Fuse to Ignition Switch Resistance Test

1. Measure resistance between main fuse [5B] terminal A and ignition switch [33B] terminal B (R) wire.
2. Is resistance greater than 1 Ohm?
   a. **Yes.** Inspect main fuse for corrosion. If main fuse is good, repair wire between main fuse [5B] terminal A and ignition switch [33B] terminal B (R) wire.
   b. **No.** Go to Test 15.

15. Repair Validation Test

1. Clear DTCs using odometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Start vehicle.
3. Run at 3000 RPM for 5 seconds.
4. Does code set?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** System working properly.

DTC B0563, P0563

Table 3-19. DTC B0563, P0563 Diagnostic Faults

POSSIBLE CAUSES
Charging system malfunction
TSM/TSSM/HFSM malfunction
ECM malfunction

1. Charging System Test

1. Perform charging system tests. See 3.5 CHARGING SYSTEM.
2. Is charging system good?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair charging system. Go to Test 2.

2. Repair Validation Test

1. Clear DTCs using odometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Start vehicle.
3. Run at 3000 RPM for 5 seconds.
4. Does code set?
   a. **Yes.DTC B0563.** Replace TSM/TSSM/HFSM. See the service manual.
   b. **Yes.DTC P0563.** Replace ECM. See the service manual.
   c. **No.** System working properly.

DTC B1006, B1007 3.7

DTC B1006, B1007

Description and Operation

Battery voltage is constantly monitored by the speedometer. If the battery voltage fails to meet normal operating parameters, a DTC is set.

DTC B1006 and B1007

The speedometer monitors terminal 1 for ignition power, and terminal 6 for accessory power.

- DTC B1006 is displayed when accessory line voltage is greater than 16.0V for longer than 5 seconds.
- DTC B1007 is displayed when ignition line voltage is greater than 16.0V for longer than 5 seconds.

NOTE

ECM, ECU, and/or TSM/TSSM/HFSM may also set a battery voltage DTC.

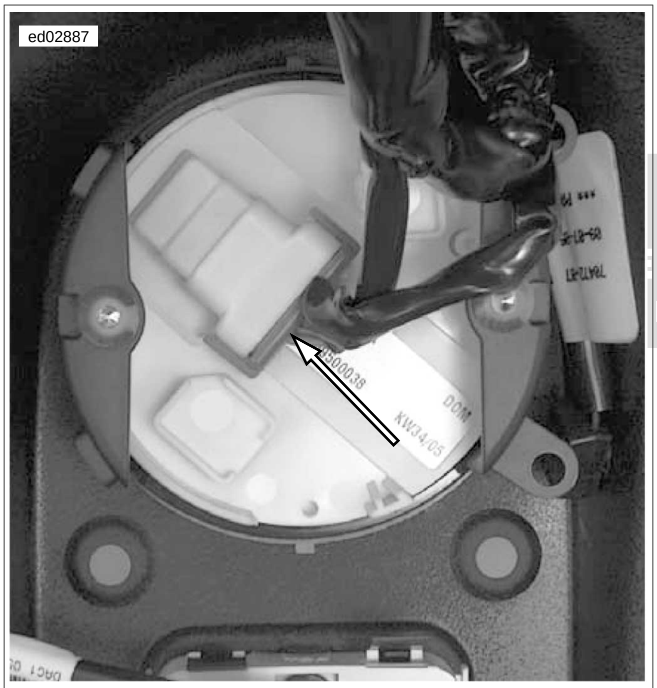


Figure 3-23. Speedometer Connector [39]

Table 3-20. Code Description

DTC	DESCRIPTION
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage

Diagnostic Tips

This DTC may set when the vehicle is placed on a battery charger, on fast charge, for a long period of time.

DTCS B1006 AND B1007

Table 3-21. DTCs B1006 and B1007 Diagnostic Faults

POSSIBLE CAUSES
Charging system malfunction
Speedometer malfunction

1. Charging System Test

1. Perform charging system tests. See 3.5 CHARGING SYSTEM.
2. Is charging system good?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair charging system.

2. Repair Validation Test

1. Clear DTCs using odometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Start vehicle.
3. Run at 3000 RPM for 5 seconds.
4. Does code reset?
   a. **Yes.** Replace speedometer. See the service manual.
   b. **No.** System working properly.

TABLE OF CONTENTS

NOTES

INSTRUMENTS 4.1

DESCRIPTION AND OPERATION

See Figure 4-1 and Figure 4-2. The speedometer contains several indicators. These indicators include the check engine, security, low battery, and low fuel lamps. The sixth gear and cruise control indicators my also be shown depending on the model of vehicle.

Trip Odometer Reset Switch Operation

Pressing the trip odometer reset switch provides the following capabilities:

- Change the odometer display between mileage, trip and fuel range values (press and immediately release).
- Reset the trip odometer (press and hold 2-3 seconds).
- Gain access to self-diagnostic mode and clear diagnostic codes. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.

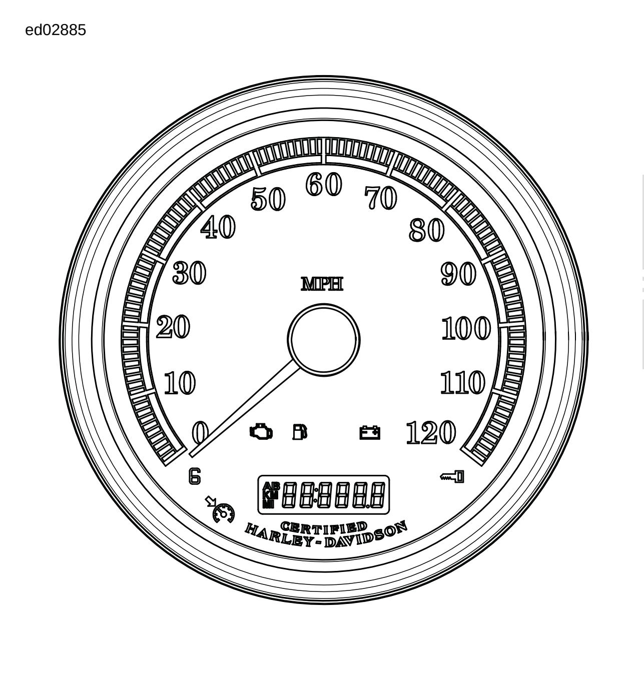


Figure 4-1. Speedometer: FXDC, FXDF

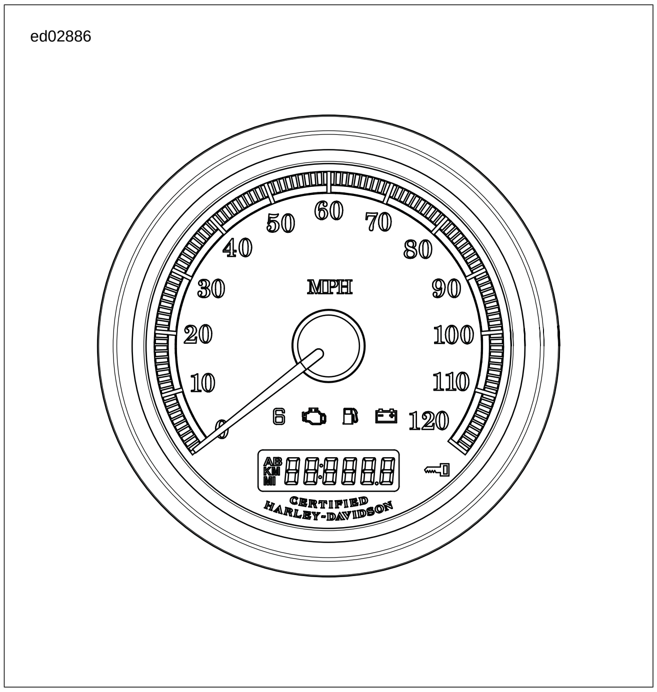


Figure 4-2. Speedometer: FXD, FXDB, FXDL

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 miles.

The odometer can display six numbers to indicate a maximum of 999999 miles (999999 kilometers). The trip odometer can display six numbers with a tenth of a mile accuracy for a maximum of 999999.9 miles (999999.9 kilometers).

SPEEDOMETER THEORY OF OPERATION

The speed sensor is mounted at the back of the transmission case. The sensor circuitry is a Hall-Effect sensor that is triggered by the gear teeth of 5th gear on the transmission mainshaft.

The output from the sensor is a series of pulses that are interpreted by ECM circuitry, converted into serial data then sent to the speedometer. The speedometer converts the data to control the position of the speedometer needle. It also provides input to the TSM/TSSM/HFSM for turn signal cancellation.

TACHOMETER THEORY OF OPERATION

The tachometer receives serial data from the ECM. The ECM converts the signal from the CKP to serial data and sends it to the tachometer. The tachometer interprets the serial data and converts it into tachometer needle movement.

INSTRUMENT DIAGNOSTICS

The speedometer and tachometer monitor direct inputs from sensors and switches, along with receiving information from the ECM over the serial data line. They set codes when the parameters for the inputs are out of range. These codes begin with a B prefix to separate them from other types of codes.

Table 4-1. Code Description

CODE	DESCRIPTION
B1004	Fuel level sensor low
B1005	Fuel level sensor high/open
B1006	Accessory line overvoltage
B1007	Ignition line overvoltage
B1008	Trip switch closed

Some sensors and switches send direct inputs to the instruments and do not have DTCs associated with them. Therefore, symptoms may occur indicating a fault without any DTCs present.

DTC B1004, B1005 4.2

DESCRIPTION AND OPERATION

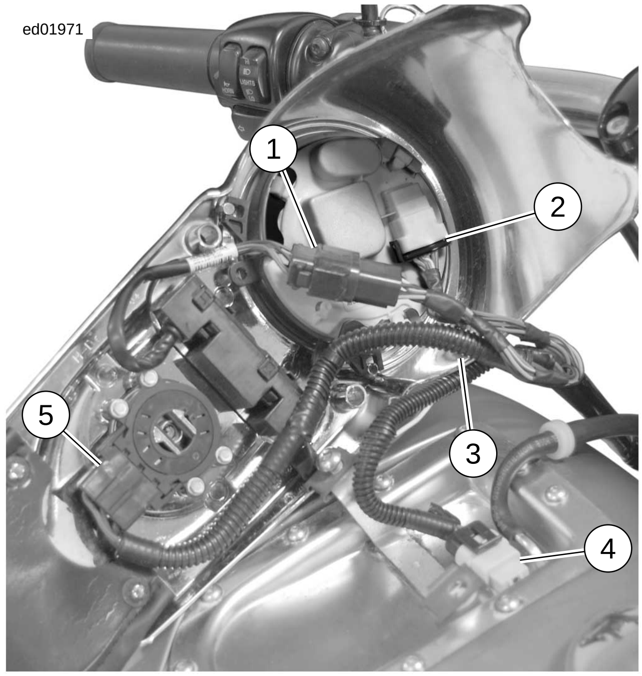
The fuel level is monitored by the speedometer [39] at terminal 9 (Y/W) wire.

- If the voltage on terminal 9 exceeds the lower limit for greater than or equal to 15 seconds a DTC B1004 will be set and the low fuel warning lamp will illuminate.
- If the voltage on terminal 9 exceeds the upper limit (or is open) for greater than or equal to 15 seconds a DTC B1005 will set and the low fuel warning lamp will illuminate.

Table 4-2. Code Description

DTC	DESCRIPTION
B1004	Fuel level sensor or wiring shorted low
B1005	Fuel level sensor or wiring high/open

Voltage is supplied to the fuel pump and sender from the fuel pump fuse through the (O/GY) wire. Voltage is also supplied to the fuel level sender on the (Y/W) wire from the fuel gauge. As the fuel level changes the resistance of the sender changes. The fuel gauge and the low fuel lamp are controlled through the (Y/W) wire based off the change in the resistance of the fuel level sender.



1. **Indicator lamps [21]**
2. **Speedometer [39]**
3. **Trip odometer reset switch**
4. **Fuel pump and sender [141]**
5. **Ignition switch [31]**

Figure 4-3. Under Console (Typical)

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

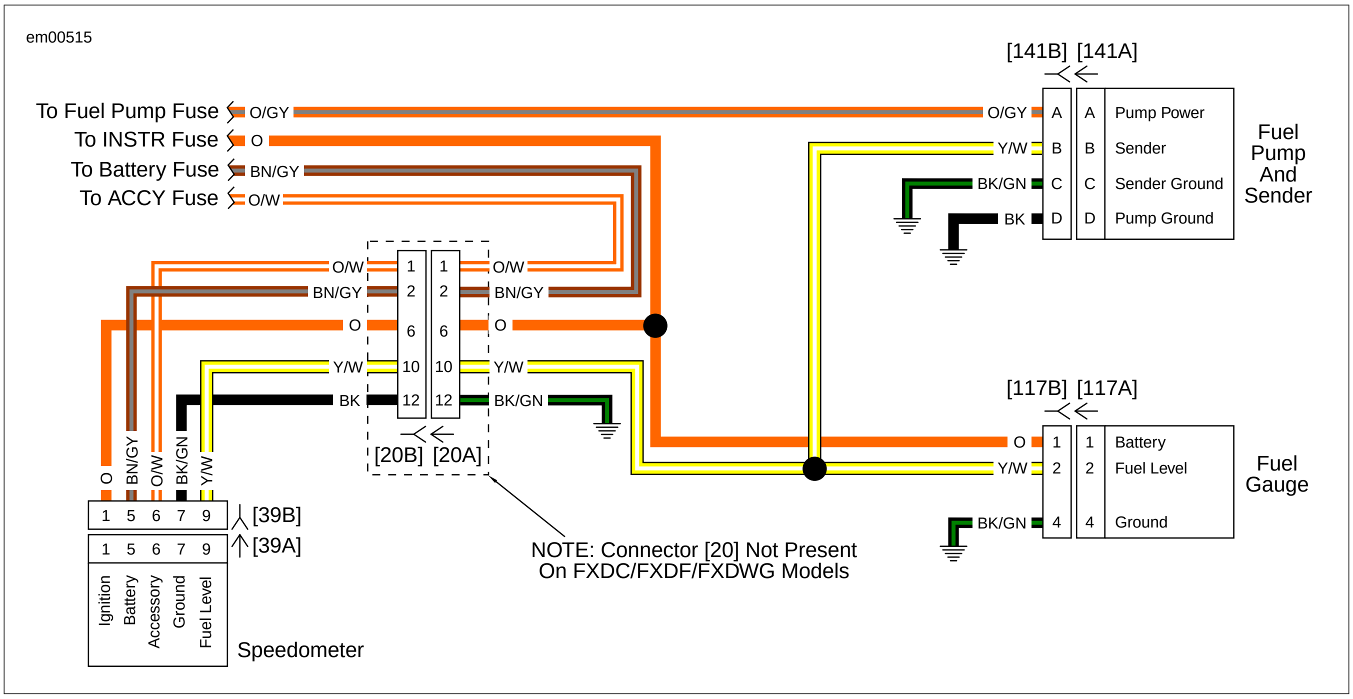


Figure 4-4. Fuel Sensor Circuit

DTC B1004

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 4-3. DTC B1004 Diagnostic Faults

POSSIBLE CAUSES
Instrument malfunction
Short to ground in fuel level sensor circuit
Fuel pump and sender assembly malfunction
Open fuel level sender circuit
Short to ground in accessory power circuit
Ignition switch malfunction
Open ignition accessory circuit

1. Fuel Level Sender Voltage Test

1. Disconnect the speedometer [39].
2. Connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected.
3. Turn IGN ON.
4. Measure voltage between terminal 9 and ground of breakout box.
5. Is voltage greater than 5.0V?
   a. **Yes.** Replace the speedometer. See the service manual.
   b. **No.** Go to Test 2.

2. Fuel Pump and Sender Test

1. Disconnect the fuel pump and sender assembly.
2. Measure voltage between breakout box terminal 9 and ground.
3. Is voltage greater than 5.0V?
   a. **Yes.** Replace the fuel pump and sender assembly. See the service manual.
   b. **No.** Go to Test 3.

3. Fuel Gauge Voltage Test

1. Disconnect the fuel gauge.
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between fuel gauge [117B] terminal 1 and ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (O) wire between fuel gauge terminal 1 and instrument fuse.

4. Fuel Level Sender Circuit Test

1. Test for continuity between [117B] terminal 2 and breakout box terminal 9.

2. Is continuity present?
   a. **Yes.** Go to Test 5.
   b. **No.** Repair open in (Y/W) wire between fuel gauge and speedometer.

5. Fuel Level Sender Circuit Test

1. Test for continuity between [117B] terminals 2 and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground in (Y/W) wire.
   b. **No.** Replace the fuel gauge. See the service manual.

DTC B1005

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 4-4. DTC B1005 Diagnostic Faults

POSSIBLE CAUSES
Open ground circuit
Short to voltage in fuel level sensor circuit
Fuel gauge malfunction
Instrument malfunction
Fuel pump and sender malfunction
Open fuel level sensor circuit

1. Fuel Level Sender Voltage Test

1. Disconnect the speedometer [39].
2. Connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected.
3. Turn IGN ON.
4. Measure voltage between breakout box terminal 9 and ground.
5. Is voltage greater than 7.0V?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the speedometer. See the service manual.

2. Fuel Pump and Sender Test

1. Disconnect the fuel gauge [117].
2. Measure voltage between breakout box terminal 9 and ground.
3. Is voltage greater than 7.0V?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 4.

3. Fuel Level Sender Circuit Test

1. Disconnect fuel level sender [141].
2. Measure voltage between breakout box terminal 9 and ground.
3. Is voltage greater than 7.0V?
   a. **Yes.** Repair short to voltage on (Y/W) wire.
   b. **No.** Replace the fuel pump and sender assembly. See the service manual.

4. Fuel Level Sender Circuit Test

1. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [117B] terminal 2 and breakout box terminal 9.
2. Is continuity present?
   a. **Yes.** Go to Test 5.
   b. **No.** Repair open in (Y/W) wire between fuel gauge and speedometer.

5. Fuel Gauge Ground Circuit Test

1. Test for continuity between [117B] terminal 4 and ground.
2. Is continuity present?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair open between [117] terminal 4 (BK/GN) wire and ground.

6. Fuel Sender Resistance Test

1. Disconnect fuel level sender [141].
2. Measure resistance between [141A] terminal B and ground.
3. Is resistance greater than 350 Ohms?
   a. **Yes.** Replace the fuel level sender. See the service manual.
   b. **No.** Replace the fuel gauge. See the service manual.

DTC B1008 4.3

DESCRIPTION AND OPERATION

Trip Odometer Reset Switch Closed

Code B1008 will be set if trip odometer reset switch terminals are closed for more than 2 minutes.

Table 4-5. Code Description

DTC	DESCRIPTION
B1008	Trip odometer reset switch closed

DTC B1008

Table 4-6. DTC B1008 Diagnostic Faults

POSSIBLE CAUSES
Trip odometer reset switch boot malfunction
Instrument malfunction
Trip odometer reset switch malfunction

1. Rubber Boot Test

1. Remove the speedometer.
2. Remove rubber boot.
3. With the speedometer connected, clear DTCs using odometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
4. Did DTC B1008 set? This code may take up to 2 minutes to set.
   a. **Yes.** Go to Test 2.
   b. **No.** Replace boot. See the service manual.

2. Trip Odometer Reset Switch Test

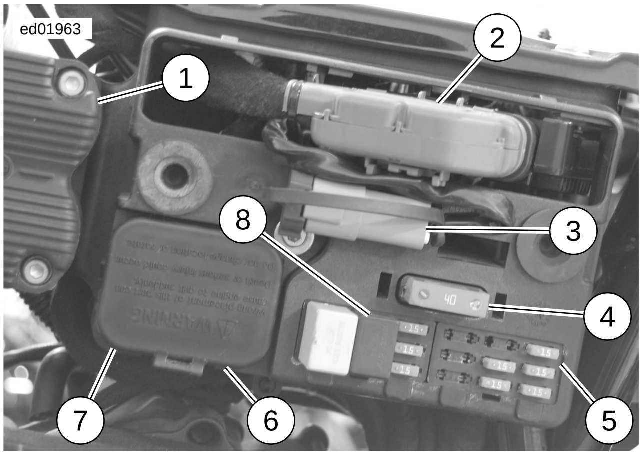
1. Disconnect [39]. Using terminal remover HD-45928, remove terminal 11 from [39B]. Reconnect [39].
2. Turn IGN ON and observe the check engine lamp.
3. Is the DTC current? See 2.1 INITIAL DIAGNOSTICS, Check Engine Lamp.
   a. **Yes.** Replace speedometer. See the service manual.
   b. **No.** Replace the trip odometer reset switch. See the service manual.

NO INSTRUMENT POWER 4.4

DESCRIPTION AND OPERATION

See Figure 4-5. The speedometer and tachometer (if equipped) receive battery power at terminal 5 and ignition power at terminal 1. This is supplied through the battery fuse and the instrument fuse located in fuse block [64]. Accessory power is supplied through the ACCY fuse at terminal 6. The speedometer and tachometer (if equipped) go through an initialization sequence every time power is removed and re-applied to terminal 1. The visible part of this sequence is the illumination of check engine lamp, security lamp, backlighting, odometer and fuel level. With IGN ON, the check engine lamp and security lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

Loss of power on any of the inputs will change the instruments behavior. Refer to Table 4-7.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 4-5. Under Left Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

Table 4-7. Function Chart - Loss of Input

TERMINAL 5 (BATTERY)	TERMINAL 1 (IGN)	TERMINAL 6 (ACC)	TERMINAL 7 (GND)
Speedometer is non-functional	Will not "WOW"	Will not "WOW"	Instrument completely non-functional
	Needles freeze	Speedometer non-functional in ACC position.	Other features non-functional or erratic
	Check engine lamp, low fuel, and battery lamp are non-functional. Diagnostics absent.	Diagnostics absent	Diagnostics absent

HOME

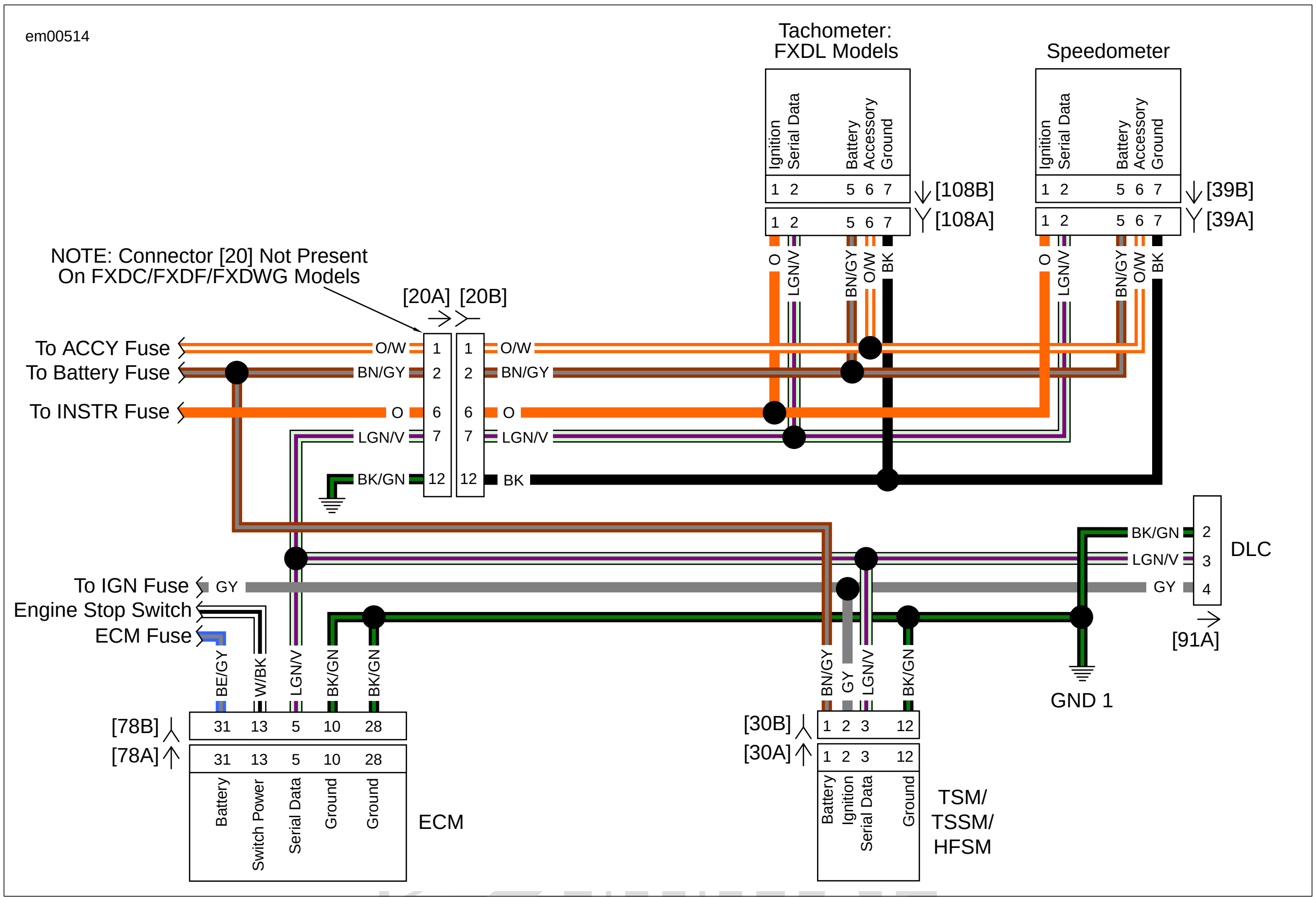


Figure 4-6. Instruments Power Circuit Diagram

SPEEDOMETER INOPERATIVE

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX
HD-46601	BREAKOUT BOX ADAPTERS

Table 4-8. Speedometer Inoperative Diagnostic Faults

POSSIBLE CAUSES
Instrument malfunction
Open accessory circuit
Open battery circuit
Open ignition circuit
Short to ground in cooling fan circuit
Ignition switch malfunction
Short to ground in ignition circuit
Open ground circuit
Short in accessory circuit

1. Battery and Ignition Function Test

1. Turn IGN ON.
2. Does the speedometer have full function?
   a. **Yes.** Go to Test 2.
   b. **No.** Check engine lamp, battery lamp, and security lamp are inoperative but backlighting is functional. Go to Test 8.
   c. **No.** Speedometer does not operate at all. Go to Test 4.

2. Accessory Function Test

1. Turn IGN to ACC.
2. Does the instrument have full ACC function?
   a. **Yes.** Concern is intermittent, perform a wiggle test to test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** Go to Test 3.

3. Accessory Fuse Test

1. With IGN OFF, connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Turn IGN ON.

3. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage at breakout box terminal 6.
4. Is battery voltage present?
   a. **Yes.** Replace the speedometer. See the service manual. **(7311)**
   b. **No.** Repair open in (O/W) wire. **(5043)**

4. Battery Fuse Test

1. Inspect the battery fuse.
2. Is the fuse good?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 7.

5. Battery Circuit to Battery Fuse Test

1. Test for voltage at [64B] socket terminal J.
2. Is battery voltage present?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair open between battery fuse and main fuse (R) wire. **(5041)**

6. Battery Circuit to Speedometer Test

1. With IGN OFF, connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Install battery fuse in fuse block.
3. Test for voltage at breakout box terminal 5.
4. Is battery voltage present?
   a. **Yes.** Go to Test 13.
   b. **No.** Repair open between [39B] terminal 5 and [64B] socket terminal I (BN/GY) wire. **(5041)**

7. Battery Circuit Short to Ground Test

1. With IGN OFF, connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between breakout box terminal 5 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground in (BN/GY) wire. **(5041)**
   b. **No.** Concern is intermittent, perform a wiggle test to test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test. Replace the battery fuse.

8. Ignition Circuit Test

1. Turn IGN OFF for at least 15 seconds.
2. Turn IGN ON.
3. Does the fuel pump run and then shut off?
   a. **Yes.** Go to Test 9.
   b. **No.** Go to Test 10.

9. Instrument Power Circuit Test

1. With IGN OFF, disconnect [39].
2. Connect BREAKOUT BOX ADAPTERS (Part No. HD-46601) to [39]. Attach connectors from BREAKOUT BOX (Part No. HD-42682) to harness adapters leaving [39A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. With IGN ON, test for voltage between breakout box terminal 1 and ground.
4. Is battery voltage present?
   a. **Yes.** Replace speedometer. See the service manual. **(7311)**
   b. **No.** Repair open in (O) ignition wire. **(5041)**

10. Ignition Fuse Test

1. Inspect the ignition fuse.
2. Is the fuse good?
   a. **Yes.** Go to Test 11.
   b. **No.** Go to Test 12.

11. Ignition Power to Ignition Fuse Test

1. With IGN ON, test for battery voltage between [64B] socket terminal B and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (O) wire. **(5041)**
   b. **No.** Inspect wiring from ignition fuse to ignition switch for an open or damaged condition. If the wiring is good replace the ignition switch. See the service manual.

12. Ignition Power Short to Ground Test

1. Test for continuity between [64B] socket terminal A and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground in (O) wire. Replace ignition fuse. **(5041)**
   b. **No.** Replace the ignition fuse and verify operation.

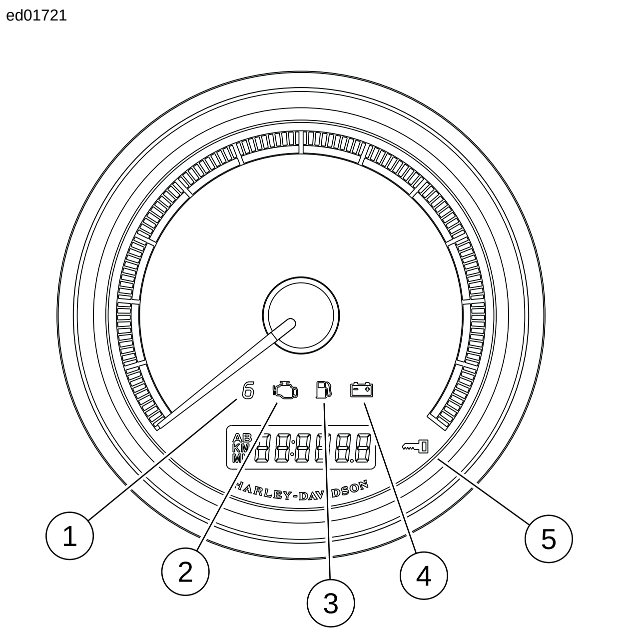
13. Ground Circuit Test

1. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between breakout box terminal 7 and ground.
2. Is continuity present?
   a. **Yes.** Replace the speedometer. See the service manual. **(7311)**
   b. **No.** Repair open in (BK) wire. **(5041)**

INDICATOR LAMPS

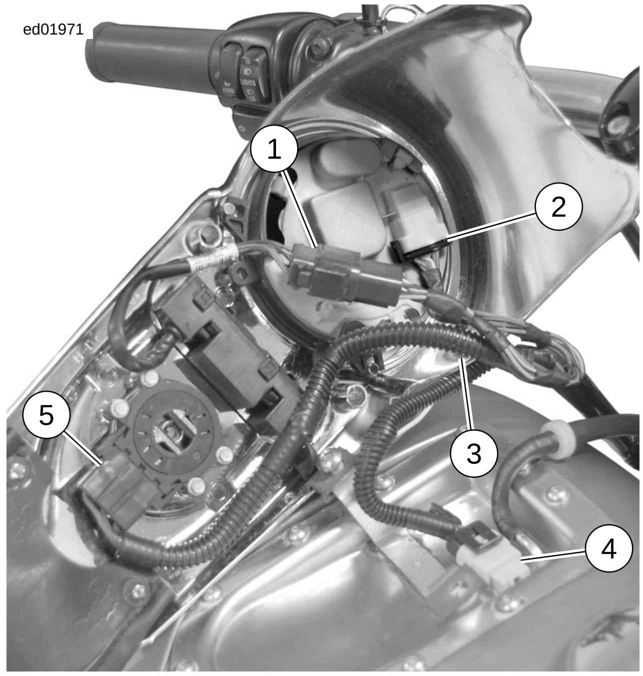
DESCRIPTION AND OPERATION

See Figure 4-7. The battery, check engine, security, and low fuel indicators are located in the speedometer. The other indicators are located separately from the speedometer.



1. **Sixth gear indicator**
2. **Check engine lamp**
3. **Low fuel lamp**
4. **Battery lamp**
5. **Security lamp (key icon)**

Figure 4-7. Indicator Lamps (Typical)



1. **Indicator lamps [21]**
2. **Speedometer [39]**
3. **Trip odometer reset switch**
4. **Fuel pump and sender [141]**
5. **Ignition switch [31]**

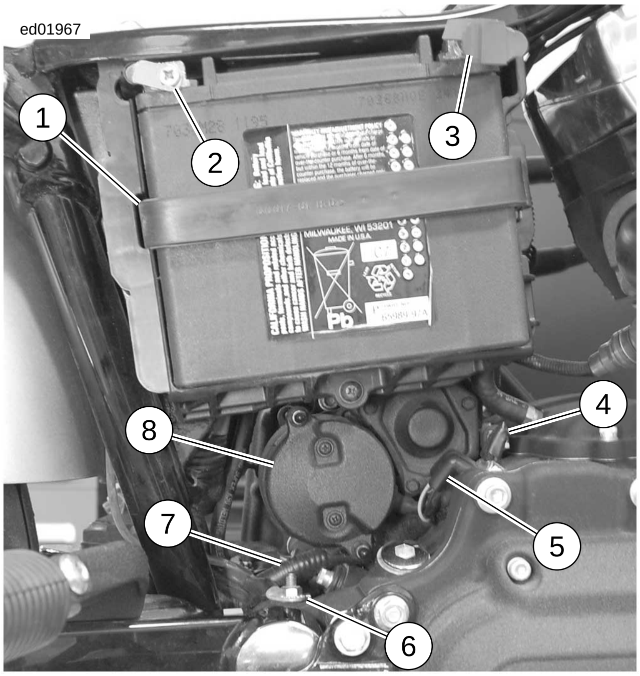
Figure 4-8. Under Console (Typical)

Table 4-9. Indicator Lamp Wiring

INDICATOR LAMP	CONNECTION
Check engine	Serial data
Security	Serial data
Battery	Serial data
Oil pressure	Ground through switch
Neutral	Ground through switch
High beam	12V when active
Right/left turn	12V when active
Low fuel	1.0 gal (3.8 L)

Low Fuel Indicator

See Figure 4-8. The low fuel indicator is controlled at terminal 9 (Y/W) of the speedometer. The fuel gauge sends voltage on the (Y/W) wire to the low fuel lamp and fuel level sender. When the fuel drops below 1.0 gal (3.8 L), the resistance in the fuel level sender reaches a point that causes enough of a change in the voltage on the (Y/W) wire it signals the speedometer to activate the low fuel lamp.

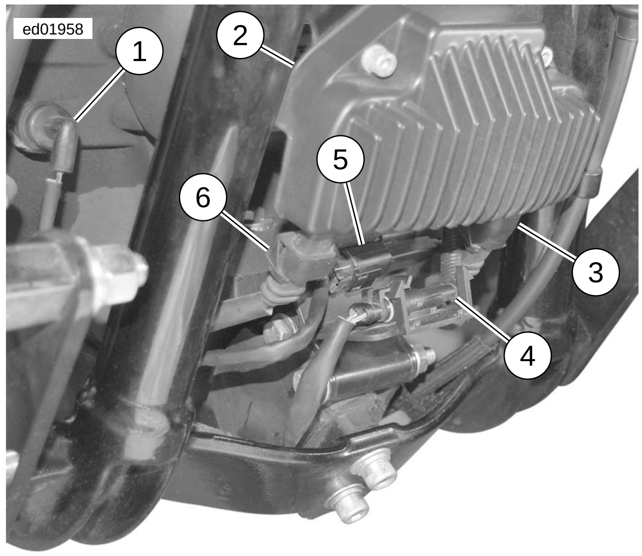


1. **Battery**
2. **Battery negative**
3. **Battery positive**
4. **Starter solenoid [128]**
5. **Neutral switch [131]**
6. **Battery ground cable**
7. **VSS [65]**
8. **Starter**

Figure 4-9. Under Right Side Cover

Neutral Indicator

See Figure 4-9. The neutral indicator is controlled through the (TN) wire connected to the TSM/TSSM/HFSM and the neutral switch. When the transmission is in neutral, the neutral switch closes and illuminates the neutral indicator.



1. **Oil pressure switch [120]**
2. **Voltage regulator**
3. **Voltage regulator to stator [47]**
4. **Front O2 sensor (Domestic Only) [138]**
5. **CKP sensor [79]**
6. **Voltage regulator [77]**

Figure 4-10. Lower Front

Oil Pressure Indicator

See Figure 4-10. The oil pressure indicator is connected to the oil pressure switch. The switch closes when oil pressure is low and illuminates the oil pressure indicator. This is why the oil pressure indicator is illuminated with the IGN ON and the engine OFF.

Turn Signal Indicators

The turn signal indicators are controlled by the TSM/TSSM/HFSM. When the TSM/TSSM/HFSM receives an input from the left or right turn signal switch it flashes the correct turn signals including the turn signal indicators. When the left turn signal switch is pressed voltage is supplied on the (V) wire to the left turn signals including the turn signal indicator. When the right turn signal switch is pressed, voltage is supplied on the (BN) wire to the right turn signals including the indicator.

High Beam

This circuit is powered when the headlamp switch is placed in the high beam position. In the high position, voltage is supplied to the (W) wire and the high beam headlamps. This wire also supplies power to the high beam indicator, causing it to illuminate.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

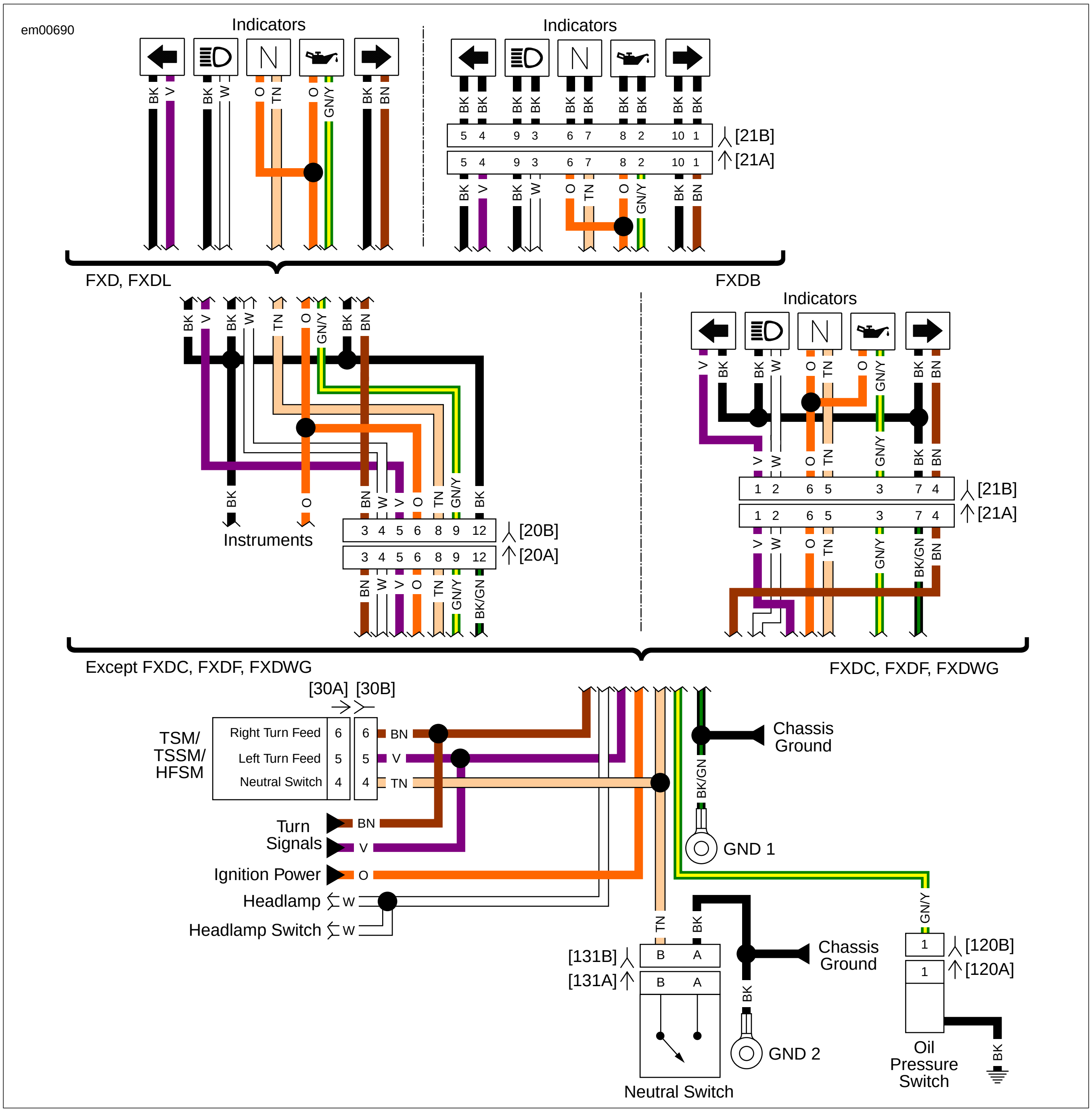


Figure 4-11. Indicator Lamps

OIL PRESSURE LAMP ALWAYS ON

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

Table 4-10. Oil Pressure Lamp Always On Diagnostic Faults

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

1. Oil Pressure Lamp Function Test

1. Turn IGN ON with the engine OFF.
2. Does the oil pressure lamp illuminate?
   a. **Yes.** Go to Test 2.
   b. **No.** See 4.5 INDICATOR LAMPS, Oil Pressure Lamp Inoperative.

2. Engine Running Test

1. Start the engine.
2. Does the oil pressure lamp turn OFF and stay off?
   a. **Yes.** Oil pressure lamp is operating properly. Test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** Go to Test 3.

3. Oil Pressure Sensor Test

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

4. Oil Pressure Circuit Test

1. With IGN OFF, disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDB).
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity on the (GN/Y) wire between [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB) and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (GN/Y) wire. **(5041)**
   b. **No.** Repair or replace the indicator harness. See the service manual. (Except FXDB) **(5191)**
   c. **No.** Go to Test 6. (FXDB).

5. Mechanical Test

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

6. Indicator Harness Test: FXDB

1. Disconnect indicator lamp harness [21].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [21A] terminal 2 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground between [21] and [20] (GN/Y) wire.
   b. **No.** Repair or replace indicator lamp harness. See the service manual. **(5191)**

OIL PRESSURE LAMP INOPERATIVE

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

Table 4-11. Oil Pressure Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Oil pressure switch malfunction
Open oil pressure circuit
Indicator malfunction

1. Oil Pressure Lamp Function Test

1. Turn IGN ON with the engine OFF.
2. Does the oil pressure lamp illuminate?
   a. **Yes.** Test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** Go to Test 2.

2. Oil Pressure Switch Test

1. Disconnect the oil pressure sensor [120].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect [120B] terminal 1 to ground.
3. Does the oil pressure lamp turn ON?
   a. **Yes.** Replace oil pressure switch. See the service manual. **(5161)**
   b. **No.** Go to Test 3.

3. Oil Pressure Circuit Test

1. With IGN OFF, disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDWG, FXDB).
2. Test for continuity on (GN/Y) wire between [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB) and [120B] terminal 1.

3. Is continuity present?
   a. **Yes.** Repair or replace the indicator harness. See the service manual. **(5191)**
   b. **No.** Repair open between indicators and [120] (GN/Y) wire. **(5041)**

NEUTRAL LAMP ALWAYS ON

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

Table 4-12. Neutral Lamp Always On Diagnostic Faults

POSSIBLE CAUSES
Neutral switch malfunction
Short to ground in neutral circuit
Indicator malfunction
TSM/TSSM/HFSM malfunction

1. Neutral Lamp Function Test

1. With the vehicle in neutral, turn IGN ON with the engine OFF.
2. Does the neutral lamp illuminate?
   a. **Yes.** Go to Test 2.
   b. **No.** See 4.5 INDICATOR LAMPS, Neutral Lamp Inoperative.

2. Transmission Operation Test

1. Shift the transmission out of neutral.
2. Does the neutral lamp turn OFF and stay off?
   a. **Yes.** Neutral lamp is operating properly. Test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** Go to Test 3.

3. Neutral Switch Test

1. Disconnect the neutral switch [131].
2. Does the neutral lamp turn OFF?
   a. **Yes.** Replace the neutral switch. See the service manual. **(5157)**
   b. **No.** Go to Test 4.

4. TSM/TSSM/HFSM Test

1. Disconnect the TSM/TSSM/HFSM [30].
2. Does the neutral lamp turn OFF?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual. **(6845)**
   b. **No.** Go to Test 5.

5. Neutral Switch Circuit Test

1. Disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDWG, FXDB).
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity on the (TN) wire between [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB) and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground in (TN) wire. **(5041)**
   b. **No.** Repair or replace the indicator harness. See the service manual. **(5191)**

NEUTRAL LAMP INOPERATIVE

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

Table 4-13. Neutral Lamp Inoperative Diagnostic Faults

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

1. Neutral Lamp Function Test

1. With the vehicle in neutral, turn IGN ON with the engine OFF.
2. Does the neutral lamp illuminate?
   a. **Yes.** Test for intermittent. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** Go to Test 2.

2. Neutral Switch Test

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

3. Neutral Switch Power Circuit Open Test

1. With IGN OFF, disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDWG, FXDB).
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity on the (TN) wire between [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB) and [131B].
3. Is continuity present?
   a. **Yes.** Repair or replace the indicator harness. See the service manual. **(5191)**
   b. **No.** Repair open in (TN) wire between indicators and neutral switch. **(5041)**

HIGH BEAM INDICATOR LAMP INOPERATIVE

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

Table 4-14. High Beam Indicator Lamp Inoperative Diagnostic Faults

POSSIBLE CAUSES
Indicator malfunction
Open High beam indicator circuit

1. High Beam Indicator Function Test

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

2. High Beam Indicator Circuit Test

1. With IGN OFF, disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDWG, FXDB).
2. With the headlamp switch in the high position and using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage on (W) wire at [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB).
3. Is voltage present?
   a. **Yes.** Repair or replace the indicator harness. See the service manual. **(5191)**
   b. **No.** Repair open in (W) wire between headlamp switch and indicators. **(5041)**

TURN SIGNAL INDICATOR INOPERATIVE

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

Table 4-15. Turn Signal Indicator Inoperative Diagnostic Faults

POSSIBLE CAUSES
Indicator malfunction
Open turn signal circuit

1. Turn Signal Function Test

1. With ignition ON, operate the turn signals.
2. Do the turn signals operate?
   a. **Yes.** Go to Test 2.
   b. **No.** See 5.3 LIGHTS.

2. Turn Signal Indicator Circuit Test

1. With IGN OFF, disconnect [20] (FXD, FXDL) or [21] (FXDC, FXDF, FXDWG, FXDB).
2. With the turn signals activated and using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage on (BN) (right) or (V) (left) wires at [20A] (FXD, FXDL) or [21A] (FXDC, FXDF, FXDWG, FXDB).
3. Is voltage cycling on and off?
   a. **Yes.** Repair or replace the indicator harness. See the service manual. **(5191)**
   b. **No.** Repair open between indicators and TSM/TSSM/HFSM (BN) wire (right) or (V) wire (left). **(5041)**

NOTES

TABLE OF CONTENTS

NOTES

DESCRIPTION AND OPERATION

The P&A battery circuit is connected to battery power after the 40 Amp main fuse. This circuit can be used to supply power to additional systems on the motorcycle.

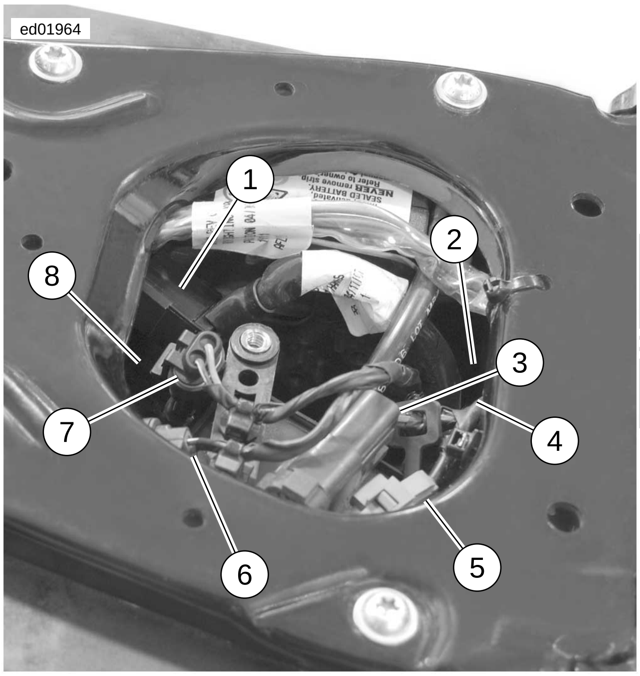
COMPONENTS

P&A Connector

See Figure 5-1. The P&A [160] is located under the seat with a cover plugged into it to keep it from being accidentally grounded.

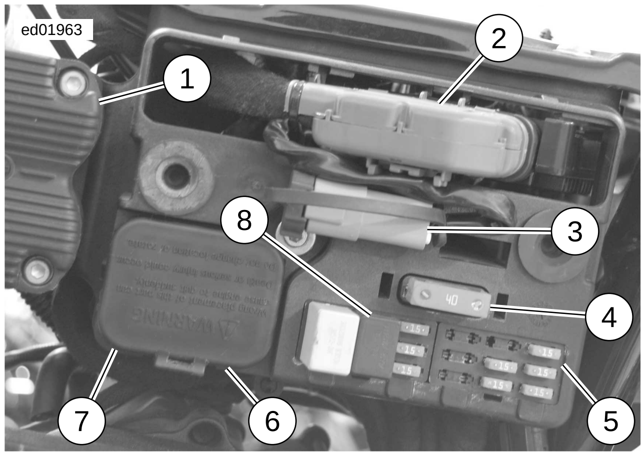
P&A Fuse

See Figure 5-2. The P&A IGN fuse is located in the fuse block under the left side cover. This is a 15A fuse that has voltage to it only when the ignition switch is turned ON.



1. **Tail lamp harness to main harness [7]**
2. **Grounds [GND1] & [GND2]**
3. **Accessory [4]**
4. **Security siren [142]**
5. **B+ [160]**
6. **IAT sensor [89]**
7. **Rear O2 sensor [137]**
8. **JSS (HDI only) [133]**

Figure 5-1. Under Seat



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 5-2. Under Left Side Cover

HORN 5.2

DESCRIPTION AND OPERATION

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

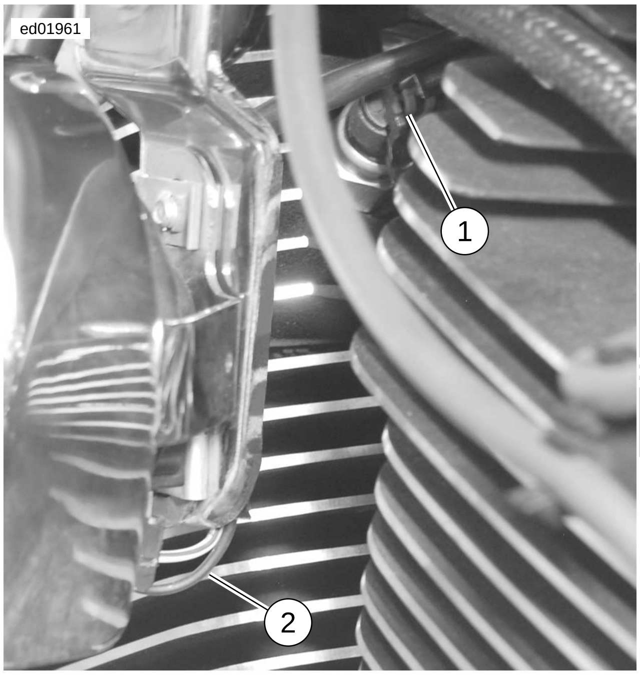
COMPONENTS

Horn Switch

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

Horn

See Figure 5-3. The horn is located on the left side of the vehicle between the cylinders.



1. **ET sensor [90]**
2. **Horn [122]**

Figure 5-3. Horn: Except FXCWC

SYMPTOMS

The horn circuit does not set DTCs when there is a malfunction. Instead, one of the symptoms shown in Table 5-1 exists to indicate a concern with the system.

Table 5-1. Horn Symptom Table

SYMPTOM	COMMON CAUSE
Horn Always On	Short to voltage or a stuck switch
Horn Inoperative	Open circuit, faulty horn or horn switch

Diagnostic Tips

If the fuse is open, check the circuit between the horn switch and the horn for a short to ground. This would cause the fuse to open only when the horn switch is pressed. A short between the brake lamp switches and the tail/stop lamp causes this fuse to open when the brakes are applied.

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

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

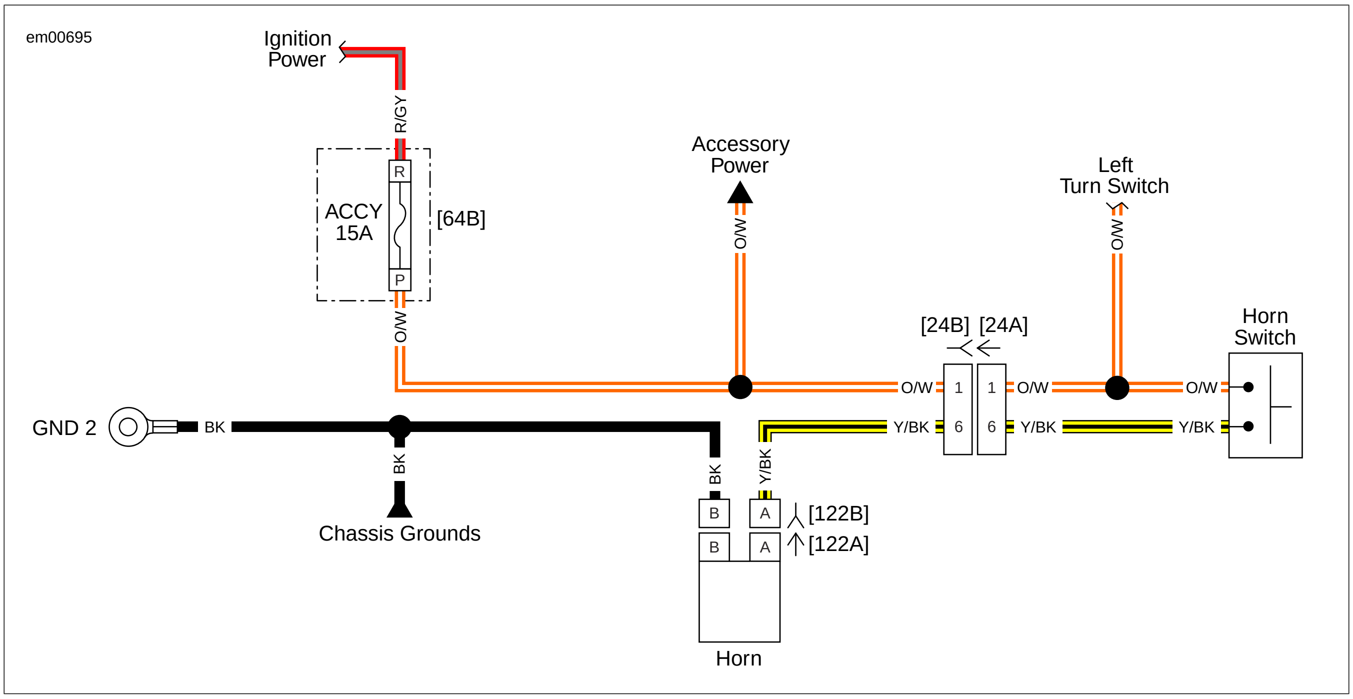


Figure 5-4. Horn

HORN ALWAYS ON

Table 5-2. Horn Always On Diagnostic Faults

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

1. Horn Switch Test

1. Disconnect [24].
2. Does the horn turn off?
   a. **Yes.** Replace the horn switch. See the service manual. **(5171)**
   b. **No.** Repair short to voltage in the (Y/BK) wire between horn and left hand controls. **(5041)**

HORN INOPERATIVE

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

Table 5-3. Horn Inoperative Diagnostic Faults

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

1. Accessory Circuit Open or Shorted Test

1. With the IGN ON, activate the front and rear brakes.
2. Does the tail/stop lamp illuminate?
   a. **Yes.** Go to Test 2.
   b. **No.** Inspect the fuse. If fuse is good locate and repair open in (O/W) wire. If fuse is open repair short to ground in circuits that may affect the fuse. Refer to Diagnostic Tips. **(5043)**

2. Horn Test

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

3. Ground Circuit Open Test

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

4. Horn Switch Malfunction Test

1. Connect the horn [122].

2. Disconnect [24].
3. With IGN ON, using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) jumper [24B] terminals 1 and 6.
4. Does the horn sound?
   a. **Yes.** Replace the horn switch. See the service manual. **(5171)**
   b. **No.** Go to Test 5.

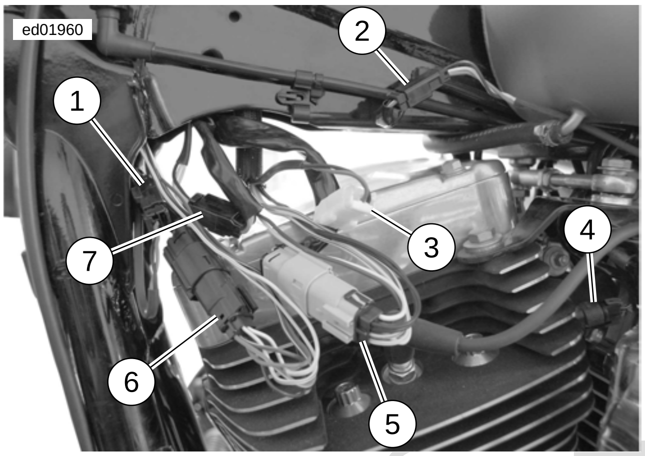
5. Horn Power Circuit Open Test

1. Test for voltage from [24B] terminal 1 (O/W) to ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (Y/BK) wire between [24B] and horn. **(5041)**
   b. **No.** Repair open (O/W) wire between [24B] and fuse block. **(5043)**

LIGHTS 5.3

DESCRIPTION AND OPERATION

See Figure 5-5. The lighting system includes the headlamps, turn signals, running lamps, license plate lamps, tail, and brake lamps. The lights are powered by the accessory fuse and lights fuse. The accessory fuse circuit supplies power for the front running lamps, the turn signal switches, the license plate lamps, the tail lamp, the stop lamp switches, and the front position lamp (HDI only). The accessory circuit receives power when the ignition switch is in the IGN or the ACC position.



1. **Front turn signals (right) [31R]**
2. **Fuel gauge [117]**
3. **Front turn signals (left) [31L]**
4. **ET sensor [90]**
5. **Left hand controls and horn [24]**
6. **Right hand controls [22]**
7. **Headlamp [38]**

Figure 5-5. Under Fuel Tank Left Side

COMPONENTS

TSM

The TSM has three major functions:

- Controls the turn signals
- Serves as the BAS
- Monitors the clutch and neutral switches to prevent starter engagement

See Figure 5-6. The TSM is located under the left side cover. It receives battery power through terminal 1 and ignition power through terminal 2. The ground for the TSM is through terminal 12. The TSM communicates with the other modules on the vehicle through the serial data line from terminal 3.

The turn signal switches are inputs to the TSM. When the TSM receives voltage from either of the turn signal switches it supplies voltage to the corresponding turn signal lamps and the correct turn signal indicator.

The TSM also monitors the position of the clutch and neutral switches to determine if it is safe to start the vehicle. The BAS is internal to the TSM and allows the TSM to determine if the vehicle is tipped over. If a tip over event occurs, the TSM sends a signal to the ECM to turn off the engine.

Headlamp Switch

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

BAS Operation

See Figure 5-6. The TSM/TSSM/HFSM uses an internal BAS to monitor vehicle position. Under normal driving conditions the TSM/TSSM/HFSM uses the BAS along with speed input provided from the ECM to know when to automatically cancel the turn signals after a turn.

The TSM/TSSM/HFSM will disable turn signal lamps and starter activation and will send a message to the ECM to shut down the ignition and the fuel pump if the vehicle is tipped over. The odometer will display "tIP" when a tip-over condition is present.

BAS Restart

To restart the vehicle after shutdown has occurred:

1. Return the vehicle to an upright position.
2. Cycle the IGN OFF-ON before restarting the vehicle.

Low Beam Headlamp

The low beam headlamp receives power on the (Y) wire from the headlamp HI/LO switch. The low beam headlamp is only illuminated when the switch is in the low beam position.

High Beam Headlamp

The high beam headlamp receives power on the (W) wire from the headlamp HI/LO switch. When the switch is in the high position the low beam headlamp turns off and the high beam headlamp illuminates along with the high beam indicator.

Left Turn Signal Switch

The left turn signal switch is located on the left handlebar controls. The switch supplies an input to the TSM/TSSM/HFSM at terminal 8 on the (W/V) wire.

Right Turn Signal Switch

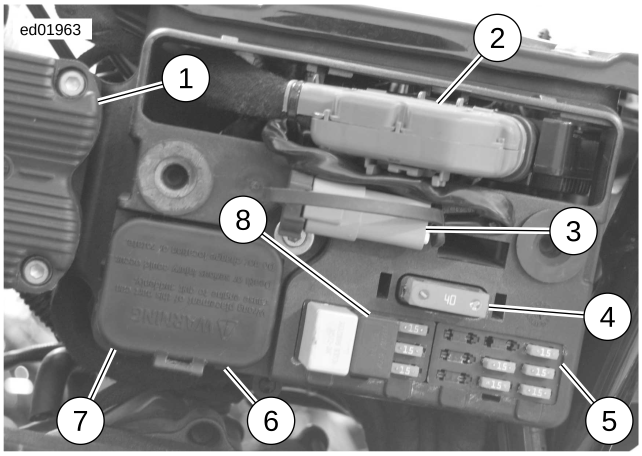
The right turn signal switch is located on the right handlebar controls. The switch supplies an input to the TSM/TSSM/HFSM at terminal 7 on the (W/BN) wire.

Turn Signals

The front turn signals are located below the handlebars. The rear turn signals are located at the sides of the rear fender. The TSM/TSSM/HFSM controls the turn signals. When the turn signal switch is pressed, voltage is sent to the TSM/TSSM/HFSM. The TSM/TSSM/HFSM then drives the turn signals for the appropriate side.

Tail/Stop Lamp

See Figure 5-6. The tail/stop lamp illuminates with the ignition switch in the ON or ACC position. When either the front or rear stop lamp switches are applied, the second filament in the bulb illuminates to light the brake lamp. The tail lamp portion of the lamp is powered by the accessory fuse through the (O/W) wire. The stop lamp portion of the lamp receives power through the (R/Y) wire when either one of the stop lamp switches are applied.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 5-6. Under Left Side Cover

License Plate Lamp

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

Stop Lamp Switches

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

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

SYMPTOMS

The lighting circuit may not set DTCs when there is a malfunction. Instead symptoms will appear. Symptoms and the corresponding diagnostics are described in Table 5-4.

Table 5-4. Lighting Symptoms

SYMPTOM	START WITH DIAGNOSTIC PROCEDURE
Both turn signals on one side inoperative, no DTCs	5.4 TURN SIGNALS, Both Turn Signal Lamps on One Side Inoperative, No DTCs
Headlamps inoperative	5.5 HEADLAMPS, Headlamp Inoperative
Running lamps inoperative	5.7 MARKER LAMPS, Running Lamps Inoperative
One turn signal lamp inoperative, no DTCs	5.4 TURN SIGNALS, One Turn Signal Lamp Inoperative, No DTCs
Position lamp inoperative: HDI Only	5.7 MARKER LAMPS, Position Lamp Inoperative: HDI Only
Stop lamps inoperative	5.6 STOP LAMPS, Stop Lamp Inoperative
Turn signals flash at double normal rate	5.4 TURN SIGNALS, Flash at Double Normal Rate
Turn signals will not cancel on turn completion	5.4 TURN SIGNALS, Will Not Cancel Upon Turn Completion

TURN SIGNAL FUNCTION

Operation

The basic turn signal operation functions the same way whether you have a TSM, a TSSM, or a HFSM. The accessory fuse supplies power to the left and right turn signal switches. When the turn signal switch is pressed the switch closes and power flows to terminal 8 (left) or terminal 7 (right) of the TSM/TSSM/HFSM. This signals the TSM/TSSM/HFSM to supply voltage and control the flash rate to the turn signals and the turn signal indicator. The turn signals receive power from terminals 5 (left) and 6 (right). If the turn signal switches are pressed at the same time and held down the TSM/TSSM/HFSM initiates the four-way flashers.

Manual Cancellation

If you want to stop the turn signals from flashing, briefly press the turn signal switch a second time.

If you are signalling to turn in one direction and you press the switch for the opposite turn signal, the first signal is cancelled and the opposite side begins flashing.

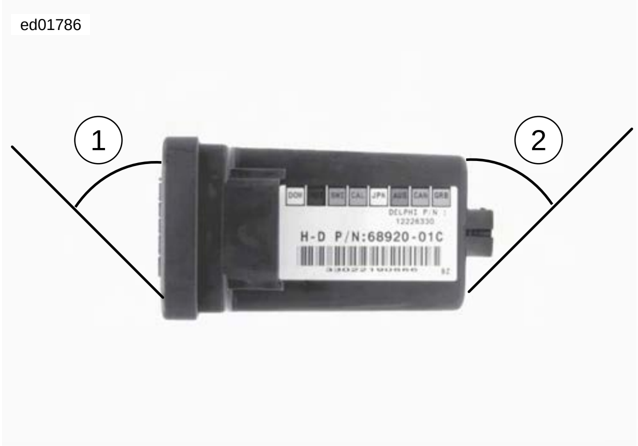
Automatic Cancellation

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 TSM/TSSM/HFSM will not cancel the signal before the turn is actually completed.

- When the directional switch is released, the system starts a 20 count. As long as the vehicle is traveling above 7 mph (11 km/h), the directional will always cancel after 20 flashes if the system does not recognize any other input.
- If the vehicle speed drops to 7 mph (11 km/h) or less, including stopped, the directionals will continue to flash. Counting will resume when vehicle speed reaches 8 mph (12.9 km/h) and will automatically cancel when the count total equals 20 as stated above.
- See Figure 5-7. The turn signals will cancel within two seconds upon turn completion. A sensor inside the TSM/TSSM/HFSM 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 0.25 mile (0.4 km) at steady speeds (upright) to calibrate the system. Performance of bank angle function may not be optimal until this calibration is performed. This self-calibration is performed automatically every time the vehicle is started and ridden.



1. **45 degrees left**
2. **45 degrees right**

Figure 5-7. Tilting TSM/TSSM/HFSM

Four-Way Flashing

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

1. With the ignition switch ON and the security system disarmed (models with security only), press the left and right turn signal switches at the same time.
2. Turn the ignition switch OFF and arm the security system if present and desired. The four-way flashers will continue for two hours.
3. To cancel four-way flashing, disarm the security system if necessary, turn the ignition switch ON and press the left and right turn signal switches at the same time.

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

HOME

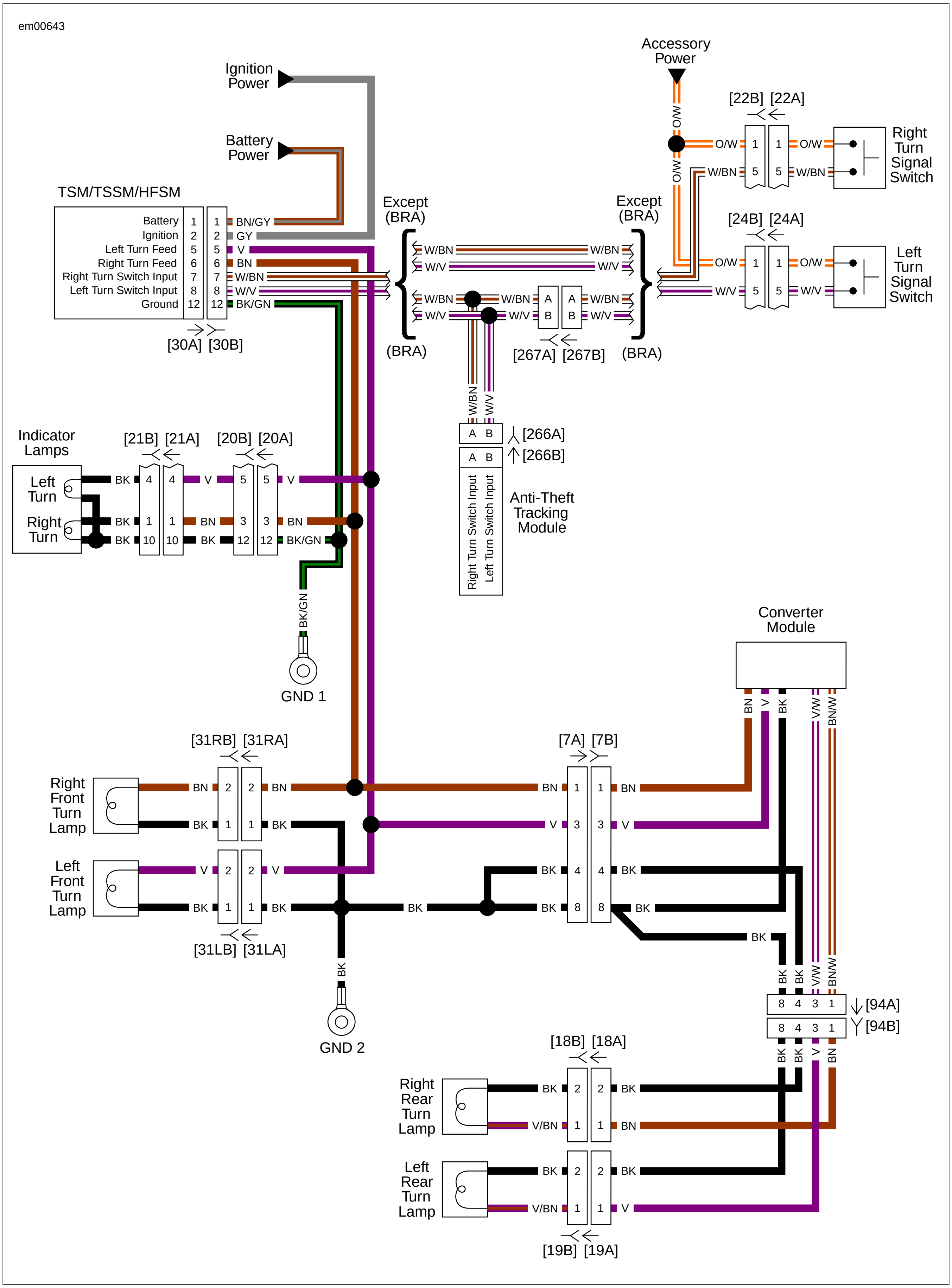


Figure 5-8. Turn Signal Circuit (FXDB)

HOME

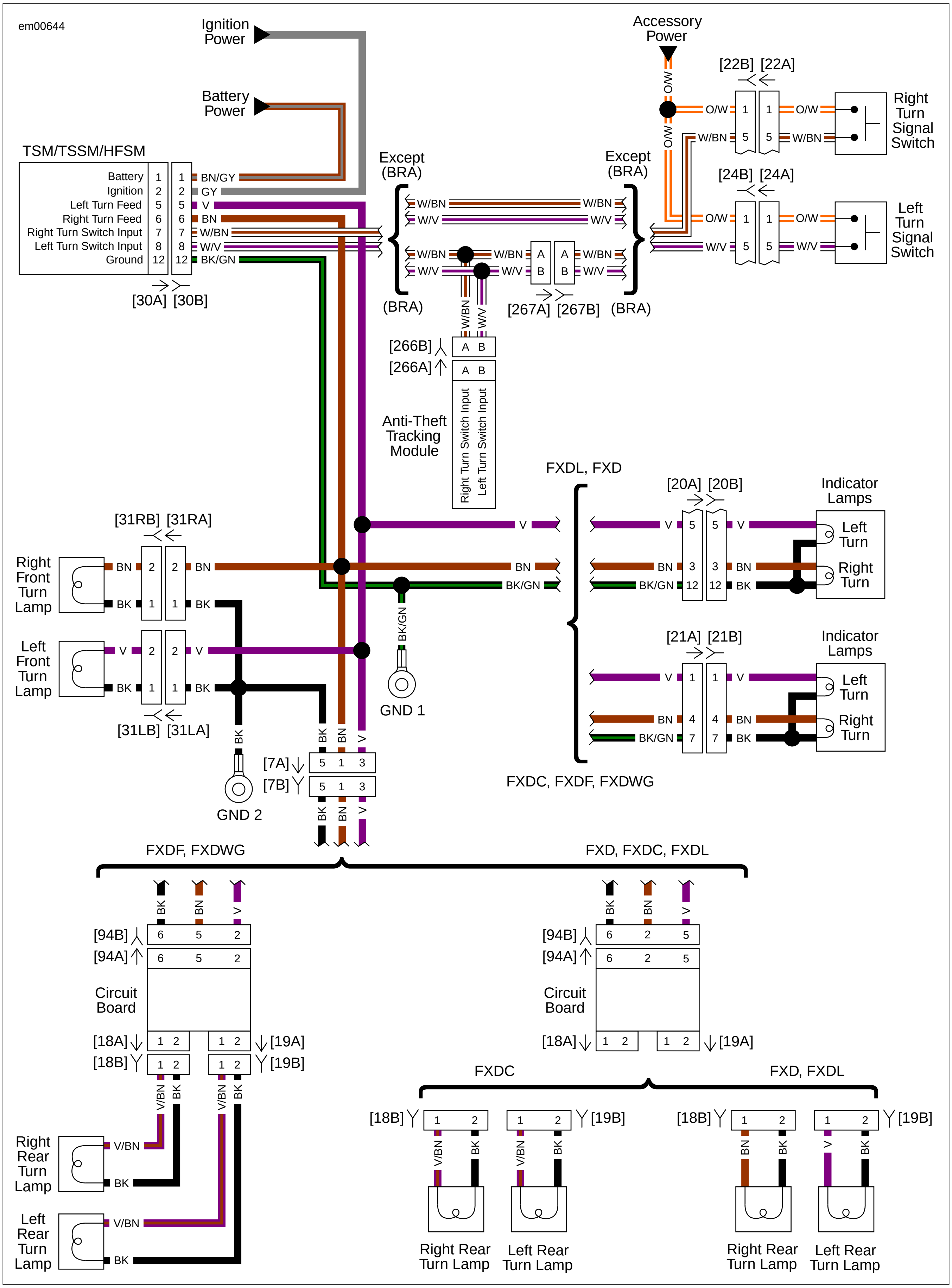


Figure 5-9. Turn Signal Circuit (Except FXDB)

HOME

WILL NOT CANCEL UPON TURN COMPLETION

Table 5-5. Will Not Cancel Upon Turn Completion No DTCs Diagnostic Faults

POSSIBLE CAUSES
Improper configuration
TSM/TSSM/HFSM malfunction

1. TSM/TSSM/HFSM Mounting Test

1. Verify TSM/TSSM/HFSM is mounted correctly.
2. Is TSM/TSSM/HFSM mounted properly?
   a. **Yes.** Go to Test 2.
   b. **No.** Mount correctly.

2. Correct Configuration Test

1. Check if TSM/TSSM/HFSM is configured correctly. See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS.
2. Proper configuration?
   a. **Yes.** Go to Test 3.
   b. **No.** Select proper vehicle configuration.

3. 4-Way Cancellation Test

1. Gain access to the vehicle's TSM/TSSM/HFSM.
2. See Figure 5-7. Position TSM/TSSM/HFSM in the same orientation it is mounted on the vehicle.
3. With IGN ON, turn on 4-way flashers by depressing both left and right turn signal switches at the same time.
4. Turn IGN OFF. The 4-way flashers should continue to flash.
5. Tilt the module greater than 45 degrees to the left.
6. Repeat steps 2-4 then tilt the module greater than 45 degrees to the right.
7. Do 4-way flashers cancel in both directions?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual. **(6773)**

4. Turn Signals Cancel Test

1. Operate vehicle at a speed greater than 7 mph (11.2 km/h) 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 5.

5. Speedometer Test

1. Does speedometer register vehicle speed?
   a. **Yes.** Replace TSM/TSSM/HFSM. See the service manual. **(6773)**
   b. **No.** See 2.1 INITIAL DIAGNOSTICS.

FLASH AT DOUBLE NORMAL RATE

Table 5-6. Flash at Double Normal Rate, All Bulbs Work No DTCs Diagnostic Faults

POSSIBLE CAUSES
Incorrect lamps
TSM/TSSM/HFSM malfunction
Lamp malfunction

NOTE

Before troubleshooting this issue you should verify that the lamp loads have been learned by:

- *Disconnect the negative battery cable for 1 minute. Reconnect negative battery cable.*
- *Turn IGN OFF-ON.*
- *Activate left turn lamps for 4 or more flashes.*
- *Activate right turn lamps for 4 or more flashes.*

1. Lamp Verification Test

1. Determine correct part number for all installed turn signal bulbs.
2. Verify correct parts are installed on vehicle.
3. Are the correct parts installed?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace with correct bulbs. See the service manual. **(6820)**

2. Bulb Corrosion Test

1. Check for corrosion on bulbs and/or sockets.
2. Is corrosion present?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 3.

3. Lamp Connection Terminal Corrosion Test

1. Check for corrosion on all lamp connection terminals.
2. Is corrosion present?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual. **(6791)**

4. Verification Test

1. Clean corrosion from wires and terminals.

2. Do lamps flash at normal rate?
   a. **Yes.** System OK. **(6822)**
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual. **(6791)**

5. Lamp Operation Test

1. Remove corrosion with a wire brush.
2. Install ELECTRICAL CONTACT LUBRICANT (Part No. 99861-02) in bulb sockets.
3. Do lamps flash at normal rate?
   a. **Yes.** System OK. **(6822)**
   b. **No.** Go to Test 6.

6. Lamp Assembly Test

1. Clean or replace bulb.
2. Do lamps flash at normal rate?
   a. **Yes.** System OK. **(6822)**
   b. **No.** Replace lamp assembly. See the service manual. **(6823)**

BOTH TURN SIGNAL LAMPS ON ONE SIDE INOPERATIVE, NO DTCS

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-7. Both Turn Signal Lamps on One Side Inoperative, No DTCs Diagnostic Faults

POSSIBLE CAUSES
Open on turn signal inputs
Open accessory circuit
Left turn signal switch malfunction
Right turn signal switch malfunction
TSM/TSSM/HFSM malfunction

1. Left or Right Turn Signal Malfunction Test

1. With IGN ON, operate the left and right turn signals.
2. Are the right turn signals inoperative?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 5.

2. Right Turn Signal Circuit Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) between wire harness connector [30B] and TSM/TSSM/HFSM [30A]. See 1.2 DIAGNOSTIC TOOLS.
2. Turn IGN ON.
3. While pressing the right turn signal switch, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage on breakout box (gray) terminal 7.
4. Is battery voltage present when switch is pressed?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual.
   b. **No.** Go to Test 3.

3. Right Turn Signal Switch Test

1. Disconnect [22].
2. Test for voltage between [22B] terminal 1 and ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (O/W) wire. **(5043)**

4. Right Turn Signal Circuit Continuity Test

1. Turn IGN OFF.
2. Test for continuity between [22B] terminal 5 and breakout box (gray) terminal 7.
3. Is continuity present?
   a. **Yes.** Replace the right turn signal switch. See the service manual. **(6811)**
   b. **No.** Repair open in (W/BN) wire. **(5041)**

5. Left Turn Signal Circuit Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) between wire harness connector [30B] and TSM/TSSM/HFSM [30A]. See 1.2 DIAGNOSTIC TOOLS.
2. Turn IGN ON.
3. While pressing the left turn signal switch, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage on breakout box (gray) terminal 8.
4. Is battery voltage present when switch is pressed?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual. **(6791)**
   b. **No.** Go to Test 6.

6. Left Turn Signal Switch Test

1. Disconnect [24].
2. Test for voltage between [24B] terminal 1 and ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 7.
   b. **No.** Repair open in (O/W) wire. **(5043)**

7. Left Turn Signal Circuit Continuity Test

1. Turn IGN OFF.
2. Test for continuity between [24B] terminal 5 and breakout box (gray) terminal 8.
3. Is continuity present?
   a. **Yes.** Replace the right turn signal switch. See the service manual. **(6811)**
   b. **No.** Repair open in (W/V) wire. **(5041)**

ONE TURN SIGNAL LAMP INOPERATIVE, NO DTCS

PART NUMBER	TOOL NAME
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-41404-B	HARNESS CONNECTOR TEST KIT

Table 5-8. One Turn Signal Lamp Inoperative, No DTCs Diagnostic Faults

POSSIBLE CAUSES
Open turn signal circuit
Open turn signal ground circuit
Inoperative turn signal
TSM/TSSM/HFSM malfunction

1. Inoperative Signal Location Test

1. With IGN ON, operate the left and right turn signals.
2. Do all the turn signals operate on both sides?
   a. **Yes.** System operating properly.
   b. **No.** Right front turn signal inoperative. Go to Test 2.
   c. **No.** Left front turn signal inoperative. Go to Test 5.
   d. **No.** Right rear turn signal inoperative. Go to Test 8.
   e. **No.** Left rear turn signal inoperative. Go to Test 11.

2. Right Front Turn Signal Bulb Test

1. Remove the right front turn signal bulb.
2. Inspect the bulb.
3. Is the bulb good?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace the bulb. See the service manual. **(6820)**

3. Right Front Turn Signal Circuit Test

1. Disconnect [31R].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect the FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) to [31RA] between terminals 1 and 2.
3. Press the right turn signal switch.
4. Does the test light flash?
   a. **Yes.** Replace the right front turn signal. See the service manual. **(6823)**
   b. **No.** Go to Test 4.

4. Right Front Turn Signal Ground Circuit Test

1. Test for voltage between [31RA] terminal 2 and ground.
2. Does the test light flash?
   a. **Yes.** Repair open in (BK) wire between [31RA] terminal 1 and ground. **(5041)**
   b. **No.** Repair open in (BN) wire between [31RA] terminal 2 and TSM/TSSM/HFSM. **(5041)**

5. Left Front Turn Signal Bulb Test

1. Remove the left front turn signal bulb.
2. Inspect the bulb.
3. Is the bulb good?
   a. **Yes.** Go to Test 6.
   b. **No.** Replace the bulb. See the service manual. **(6820)**

6. Left Front Turn Signal Circuit Test

1. Disconnect [31].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect a test light to [31LA] between terminals 1 and 2.
3. Press the left turn signal switch.
4. Does the test light flash?
   a. **Yes.** Replace the left front turn signal. See the service manual. **(6823)**
   b. **No.** Go to Test 7.

7. Left Front Turn Signal Ground Circuit Test

1. Test for voltage between [31LA] terminal 2 and ground.
2. Does the test light flash?
   a. **Yes.** Repair open in (BK) wire between [31LA] terminal 1 and ground. **(5041)**
   b. **No.** Repair open in (V) wire between [31LA] terminal 1 and TSM/TSSM/HFSM. **(5041)**

8. Right Rear Turn Signal Bulb Test

1. Remove the right rear turn signal bulb.
2. Inspect the bulb.
3. Is the bulb good?
   a. **Yes.** Go to Test 9.
   b. **No.** Replace the bulb. See the service manual. **(6820)**

9. Right Rear Turn Signal Circuit Test

1. Disconnect [18].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect a test light to [18A] between terminals 1 and 2.
3. Press the right turn signal switch.
4. Does the test light flash?
   a. **Yes.** Replace the right rear turn signal. See the service manual. **(6823)**
   b. **No.** Go to Test 10.

10. Right Rear Turn Signal Ground Circuit Test

1. Disconnect [94].
2. Connect a test light between [94A] terminals 1 and 4 (FXDB) or [94B] terminals 2 and 6 (except FXDB).
3. Does the test light flash?
   a. **Yes.** Repair open in (BK) or (BN) wire between [94] and [18] (FXDB). **(5041)**
   b. **Yes.** Replace circuit board (Except FXDB). See the service manual. **(5215)**
   c. **No.** Go to Test 14.

11. Left Rear Turn Signal Bulb Test

1. Remove the left rear turn signal bulb.
2. Inspect the bulb.
3. Is the bulb good?
   a. **Yes.** Go to Test 12.
   b. **No.** Replace the bulb. See the service manual. **(6820)**

12. Left Rear Turn Signal Circuit Test

1. Disconnect [19].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect a test light to [19A] between terminals 1 and 2.
3. Press the left turn signal switch.
4. Does the test light flash?
   a. **Yes.** Replace the left rear turn signal. See the service manual. **(6823)**
   b. **No.** Go to Test 13.

13. Left Rear Turn Signal Ground Circuit Test

1. Disconnect [94].
2. Connect a test light between [94A] terminals 3 and 8 (FXDB) or [94B] terminals 5 and 6 (Except FXDB).
3. Does the test light flash?
   a. **Yes.** Repair open in (BK) or (V) wire between [94A] and [19]. **(5041)**
   b. **Yes.** Replace circuit board (Except FXDB). See the service manual. **(5215)**
   c. **No.** Go to Test 16.

14. Right Turn Signal Wiring Test

1. Disconnect [7].
2. Connect a test light between [7A] terminals 1 and 4 (FXDB) or 1 and 5 (Except FXDB).
3. Does the test light flash?
   a. **Yes.** Replace the converter module (FXDB). See the service manual. **(6809)**
   b. **Yes.** Repair open in (BN) wire between [7] and [94] (except FXDB). **(5041)**
   c. **No.** Go to Test 15.

15. Right Turn Signal Ground Test

1. Connect a test light between [7A] terminals 1 and ground.
2. Does the test light flash?
   a. **Yes.** Repair open in (BK) wire between [7A] and the turn signal switch. **(5041)**
   b. **No.** Repair open in (BN) wire between [7A] and the turn signal switch. **(5041)**

16. Left Turn Signal Wiring Test

1. Disconnect [7].
2. Connect a test light between [7A] terminals 3 and 4 (FXDB) or 3 and 5 (Except FXDB).
3. Does the test light flash?
   a. **Yes.** Replace the converter module (FXDB). See the service manual. **(6809)**
   b. **Yes.** Repair open in (V) wire between [7] and [94] (except FXDB). **(5041)**
   c. **No.** Go to Test 17.

17. Left Turn Signal Ground Test

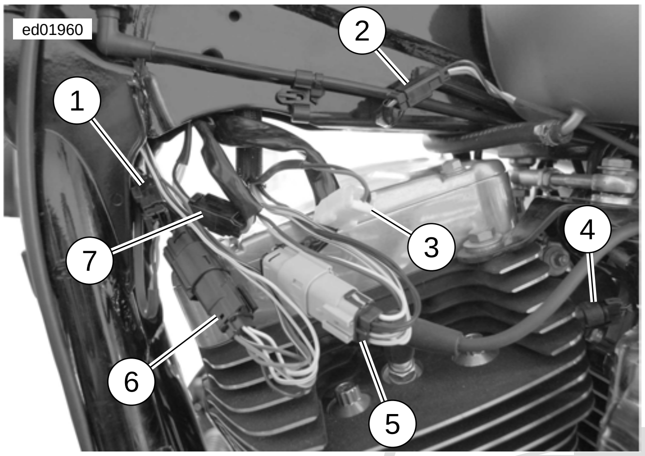
1. Connect a test light between [7A] terminals 3 and ground.
2. Does the test light flash?
   a. **Yes.** Repair open in (BK) wire between [7A] and the turn signal switch. **(5041)**
   b. **No.** Repair open in (V) wire between [7A] and the turn signal switch. **(5041)**

HEADLAMPS 5.5

DESCRIPTION AND OPERATION

When the ignition is turned ON the headlamp switch receives power through the lights fuse.

- In the low position, the headlamp switch directs voltage through the (Y) wire to illuminate the low beam headlamp.
- In the high position, voltage is directed through the (W) wire to the high beam headlamp and the high beam indicator.



1. **Front turn signals (right) [31R]**
2. **Fuel gauge [117]**
3. **Front turn signals (left) [31L]**
4. **ET sensor [90]**
5. **Left hand controls and horn [24]**
6. **Right hand controls [22]**
7. **Headlamp [38]**

Figure 5-10. Under Fuel Tank Left Side

Diagnostic Tips

If the lights fuse is open, test for short to ground on (BE) wire from the fuse to the headlamp switch. Also, check for a short to ground on the (W) wire from the headlamp switch. If this circuit is grounded, it will open the fuse when the headlamp switch is in the high position.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

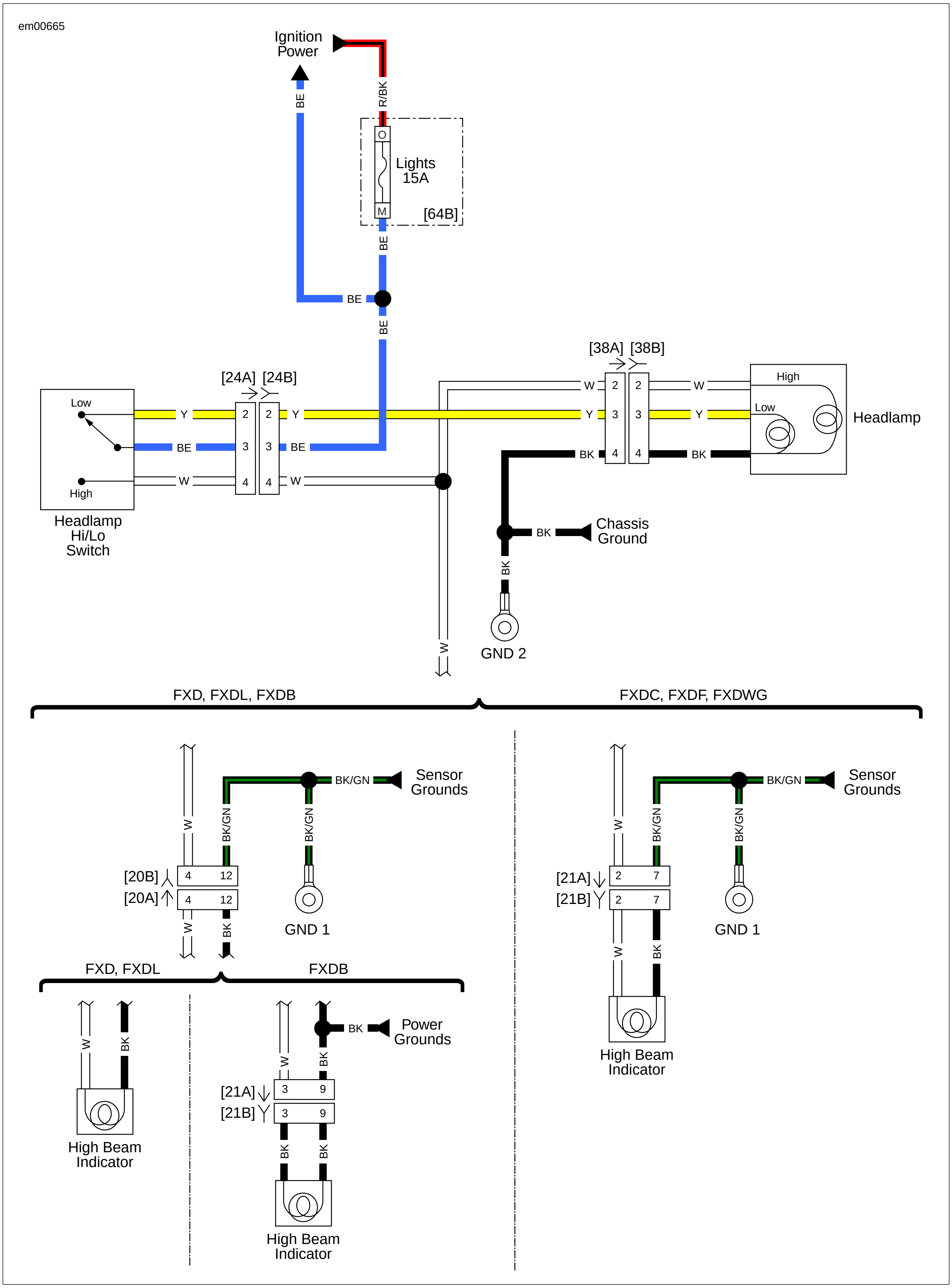


Figure 5-11. Headlamp and Running Lamps

HEADLAMP INOPERATIVE

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

Table 5-9. Headlamp Inoperative No DTCs Diagnostic Faults

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

1. Operational Test

1. Turn IGN ON.
2. Move the headlamp switch to the high and low positions.
3. Do the headlamps work in both positions?
   a. **Yes.** Concern is intermittent perform wiggle test. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test.
   b. **No.** High beam headlamp inoperative. Go to Test 2.
   c. **No.** Low beam headlamp inoperative. Go to Test 5.
   d. **No.** Both headlamps inoperative. Go to Test 7.

2. High Beam Indicator Test

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

3. Headlamp Hi/Lo Switch Test

1. With IGN OFF, disconnect [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jumper [24B] terminals 3 and 4 together.
3. Turn IGN ON.
4. Does the high beam headlamp operate?
   a. **Yes.** Replace the left switch assembly. See the service manual. **(5171)**
   b. **No.** Repair open in (W) wire between [24B] and indicator. **(5041)**

4. High Beam Headlamp Test

1. Disconnect the headlamp.
2. With the IGN ON, and the headlamp Hi/Lo switch in the high position using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between [38A] terminals 2 and 4.
3. Is battery voltage present?
   a. **Yes.** Replace the headlamp. See the service manual. **(5185)**
   b. **No.** Repair open in (W) wire to headlamp. **(5041)**

5. Headlamp Hi/Lo Switch Test

1. With the IGN OFF, disconnect [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jumper [24B] terminals 2 and 3 together.
3. Turn IGN ON.
4. Does the low beam headlamp operate?
   a. **Yes.** Replace the left switch assembly. See the service manual. **(5171)**
   b. **No.** Go to Test 6.

6. Low Beam Headlamp Test

1. Connect [24].
2. Disconnect the headlamp.
3. With the headlamp Hi/Lo switch in the low position using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between terminals 3 and 4 of [38A].
4. Is battery voltage present?
   a. **Yes.** Replace the headlamp. See the service manual. **(5185)**
   b. **No.** Repair open in (Y) wire to headlamp. **(5041)**

7. High Beam Indicator Test

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

8. Headlamp Test

1. Disconnect the headlamp.
2. With the IGN ON, and the headlamp Hi/Lo switch in the high position test for voltage between [38A] terminals 2 and 4.
3. Is battery voltage present?
   a. **Yes.** Replace the headlamp. See the service manual. **(5185)**
   b. **No.** Repair open in (BK) wire between headlamp and ground. **(5041)**

9. Ignition Power Circuit Test

1. With IGN ON, observe the tail lamp.

2. Is the tail lamp illuminated?
   a. **Yes.** Go to Test 10.
   b. **No.** Go to Test 11.

10. Headlamp Hi/Lo Switch Test

1. With the IGN OFF, disconnect [24].
2. Using a HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jumper [24B] terminals 2 and 3 together.
3. Turn IGN ON.
4. Does the low beam headlamp operate?
   a. **Yes.** Replace the left switch assembly. See the service manual. **(5171)**
   b. **No.** Repair open in (BE) wire to [24B]. **(5039)**

11. Lights Fuse Test

1. Inspect the lights fuse.
2. Is the fuse good?
   a. **Yes.** Go to Test 12.
   b. **No.** Go to Test 13.

12. Power Circuit Test

1. Test for voltage on [61B] socket terminal G of the lights fuse.
2. Is battery voltage present?
   a. **Yes.** Repair open in (BE) wire between fuse block and headlamp Hi/Lo switch. **(5039)**
   b. **No.** Repair open in (R/BK) wire. **(5041)**

13. Power Circuit Short to Ground Test

1. With IGN OFF, remove the lights fuse.
2. Disconnect [24].
3. Measure resistance between [24B] terminal 3 and ground.
4. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 14.
   b. **No.** Go to Test 17.

14. Tail Lamp Test

1. Disconnect [94] or [7].
2. Measure resistance between [24B] terminal 3 and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 15.
   b. **No.** Go to Test 16.

15. Front Turn Signal Test

1. Disconnect [31].
2. Measure resistance between [24B] terminal 3 and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Repair short to ground in (BE) wire between [24B] and fuse block. **(5039)**
   b. **No.** Repair short to ground in front turn signal. **(5041)**

16. Rear Turn Signal Test

1. Connect [94] or [7].
2. Disconnect [93] (single tail lamp) or [18] and [19] dual tail lamp.
3. Measure resistance between [93A] terminal 1 and ground (single tail lamp) or [18A] and [19A] terminal 3 (dual tail lamp).
4. Is resistance less than 10 Ohms?
   a. **Yes.** Replace the circuit board (single stop lamp). See the service manual. **(5215)**
   b. **Yes.** Replace the converter module (dual tail lamps DOM). **(6809)**
   c. **Yes.** Repair short to ground in (O/W) wire between [7B] and tail lamps (dual tail lamps HDI). **(5039)**
   d. **No.** Replace tail/stop lamp assembly. See the service manual. **(5215)**

17. Low Beam Circuit Short to Ground Test

1. Measure resistance between [24B] terminal 2 and ground.
2. Is resistance less than 10 Ohms?
   a. **Yes.** Repair short to ground in (Y) low beam circuit. **(5041)**
   b. **No.** Go to Test 18.

18. High Beam Circuit Short to Ground Test

1. Measure resistance between [24B] terminal 4 and ground.
2. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 19.
   b. **No.** Intermittent short perform wiggle test. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test. Replace lights fuse and verify repair.

19. Indicator Short to Ground Test

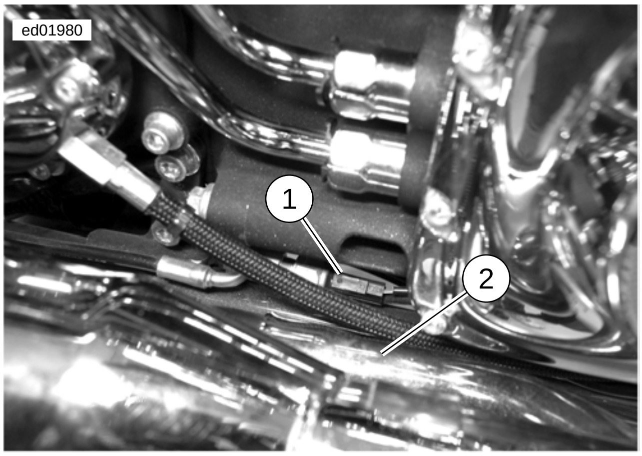
1. Disconnect the [20].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between [24B] terminal 4 and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Repair short to ground in (W) high beam circuit. **(5041)**
   b. **No.** Repair or replace the indicator harness. See the service manual. **(5191)**

STOP LAMPS 5.6

DESCRIPTION AND OPERATION

The front stop lamp switch is a mechanical switch located under the fluid reservoir on the right handlebar. See Figure 5-12. The rear stop lamp switch is a pressure switch located under the left side cover.

The stop lamp switches receive power through the accessories fuse. When the front or rear stop lamp switch is applied, voltage travels through the switch to the tail/stop lamp.



1. **Rear stop lamp switch [121]**
2. **Exhaust pipe**

Figure 5-12. Rear Stop Lamp Switch [121]

Diagnostic Tips

When testing for a short to ground due to an open fuse, check the (R/Y) wire between the brake switches and the stop lamp. A short to ground on these wires causes the fuse to open only when the brake switches are closed. A short to ground in the (Y/BK) wire between the horn switch and the horn causes this fuse to open when the horn switch is pressed and needs to be checked for a short to ground as well.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

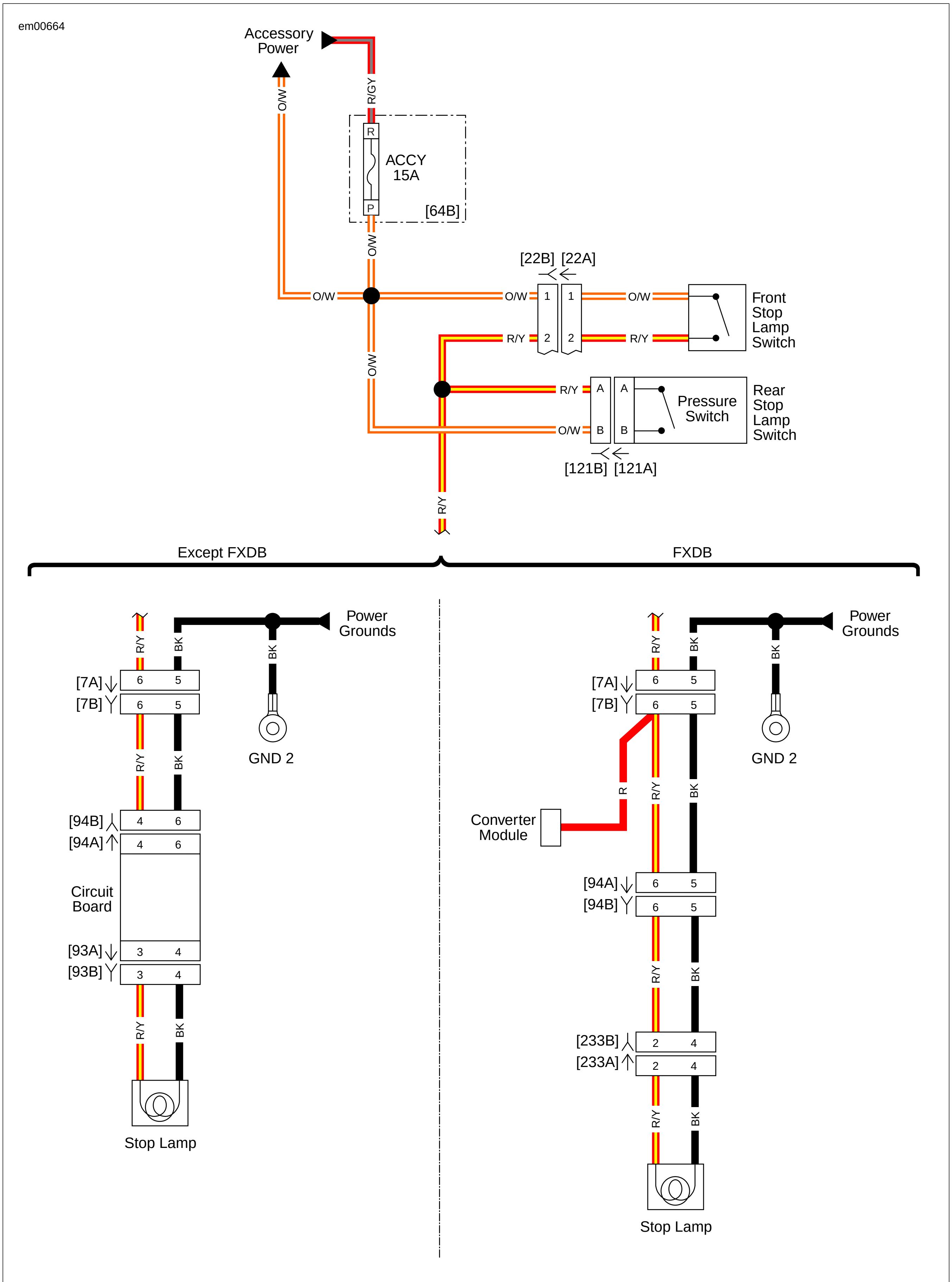


Figure 5-13. Tail/Stop and Turn Signal Lamps

STOP LAMP INOPERATIVE

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

Table 5-10. Stop Lamp Inoperative Diagnostic Faults

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

1. Accessory Circuit Test

1. Turn IGN to ACC.
2. Do the instruments illuminate?
   a. **Yes.** Go to Test 8.
   b. **No.** Go to Test 2.

2. Accessories Fuse Test

1. Inspect the ACCY fuse.
2. Is the fuse good?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 5.

3. Accessory Circuit from Ignition Switch Test

1. With IGN in ACC, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between [64B] socket terminal P and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (O/W) wire from ACCY fuse. **(5043)**
   b. **No.** Go to Test 4.

4. Ignition Switch Test

1. Inspect for open or damaged wires between the ignition switch and the accessory fuse.
2. Was any damage to the wiring found?
   a. **Yes.** Repair open between [64B] socket terminal R and ignition switch. **(5041)**
   b. **No.** Replace the ignition switch. See the service manual. **(7287)**

5. Accessory Circuit Resistance Test

1. With the accessories fuse removed, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between [64B] socket terminal P and ground.
2. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 6.
   b. **No.** See diagnostic tips. Replace accessories fuse and verify repair.

6. Speedometer Test

1. Disconnect the speedometer [39].
2. Measure resistance between [64B] socket terminal P and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Without tachometer. Repair short to ground in accessory circuit (O/W) wire. **(5043)**
   b. **Yes.** With tachometer. Go to Test 7.
   c. **No.** Replace the speedometer. See the service manual. **(6765)**

7. Tachometer Test

1. Disconnect the tachometer [108].
2. Measure resistance between [64B] socket terminal P and ground.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Repair short to ground in accessory circuit (O/W) wire. **(5043)**
   b. **No.** Replace the tachometer. See the service manual. **(6772)**

8. Stop Lamp Switch Test

1. Apply the front stop lamp switch while observing the stop lamp.
2. Apply the rear stop lamp switch while observing the stop lamp.
3. Does the stop lamp illuminate?
   a. **Yes.** Stop lamp illuminates only with front stop lamp switch applied. Go to Test 11.
   b. **Yes.** Stop lamp illuminates only with rear stop lamp switch applied. Go to Test 13.
   c. **No.** Go to Test 9.

9. Tail Stop Lamp Test

1. Disconnect [94] (single stop lamp) or [7] (dual stop lamps).
2. With one of the stop lamp switches applied test for voltage between [94B] (single stop lamp) or [7A] (dual stop lamps) terminals 4 and 6.
3. Is battery voltage present?
   a. **Yes.** Single stop lamp. Go to Test 15.
   b. **Yes.** Dual stop lamps. Go to Test 17.
   c. **No.** Go to Test 10.

10. Stop Lamp Ground Test

1. With one of the stop lamp switches applied test for voltage between [94B] (single stop lamp) or [7B] (dual stop lamps) terminal 4 and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in the (BK) ground wire between stop lamp and GND 1. **(5041)**
   b. **No.** Repair open in (R/Y) wire between stop lamp switches and stop lamp. **(5041)**

11. Rear Stop Lamp Switch Test

1. Disconnect [121].
2. Jumper [121B] terminals A and B together.
3. Turn IGN ON.
4. Does the brake lamp illuminate?
   a. **Yes.** Replace the rear stop lamp switch. See the service manual. **(5141)**
   b. **No.** Go to Test 14.

12. Rear Stop Lamp Switch ACCY Circuit Test

1. Test for voltage between [121B] terminal B and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (R/Y) wire between rear stop lamp switch and stop lamp. **(5041)**
   b. **No.** Repair open in (O/W) wire. **(5043)**

13. Front Stop Lamp Switch Test

1. With IGN OFF, disconnect [22].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) jumper [22B] terminals 1 and 2 together.
3. Turn IGN ON.
4. Does the brake lamp illuminate?
   a. **Yes.** Replace front stop lamp switch. See the service manual. **(5176)**
   b. **No.** Go to Test 14.

14. Front Stop Lamp Switch ACCY Circuit Test

1. Test for voltage between [22B] terminal 1 and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (R/Y) wire between front stop lamp switch and stop lamp. **(5041)**
   b. **No.** Repair open in (O/W) wire. **(5043)**

15. Stop Lamp Bulb Test

1. Inspect the stop lamp bulb.
2. Is the bulb good?
   a. **Yes.** Go to Test 16.
   b. **No.** Replace the stop lamp bulb. See the service manual. **(5197)**

16. Circuit Board Test

1. Connect [94].
2. Disconnect [93].
3. With one of the stop lamp switches applied test for voltage at [93A] between terminals 3 and 4.
4. Is battery voltage present?
   a. **Yes.** Replace the tail lamp socket assembly. See the service manual. **(5215)**
   b. **No.** Replace the circuit board. See the service manual. **(5215)**

17. Stop Lamp Verification Test

1. Connect [7].
2. Apply either stop lamp switch while observing the stop lamps.
3. Are both stop lamps inoperative?
   a. **Yes.** Replace the tail lamp converter module. **(6809)**
   b. **No.** Go to Test 18.

18. Stop Lamp Circuit Test

NOTE

Depending on the model the stop lamps may be LEDs or conventional bulbs. If conventional bulbs are present inspect the bulbs and replace as needed.

1. Disconnect inoperative stop lamp [18] right or [19] left.
2. With the stop lamp switch applied test for voltage at [18] right or [19] left between terminals 1 and 2 (DOM) or terminals 1 and 4 (except DOM).
3. Is voltage present?
   a. **Yes.** Replace turn signal. See the service manual. **(6823)**
   b. **No.** (FXDB). Replace the tail lamp converter module. See the service manual. **(6809)**
   c. **No.** (Except DOM). Go to Test 19.

19. Stop Lamp Circuit Ground Test

1. With the stop lamp switch applied test for voltage at [18] right or [19] left between terminal 4 and ground.
2. Is voltage present?
   a. **Yes.** Repair open in (BK) wire between [7] and [18] right or [19] left. **(5041)**
   b. **No.** Repair open in (R/Y) wire between [7] and [18] right or [19] left. **(5041)**

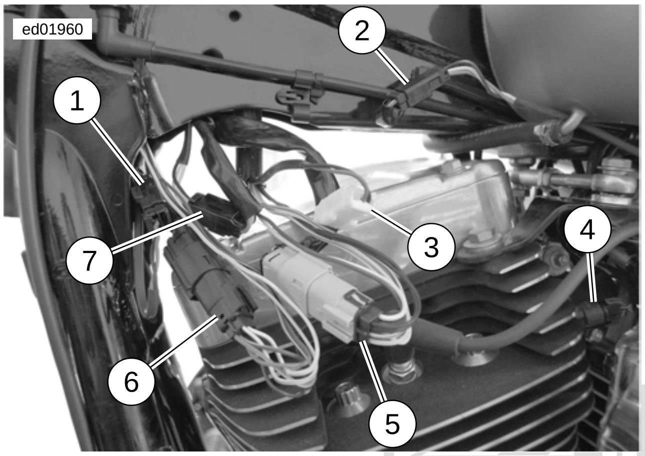
MARKER LAMPS 5.7

DESCRIPTION AND OPERATION

See Figure 5-14. The headlamp connector is located under the left side of the fuel tank.

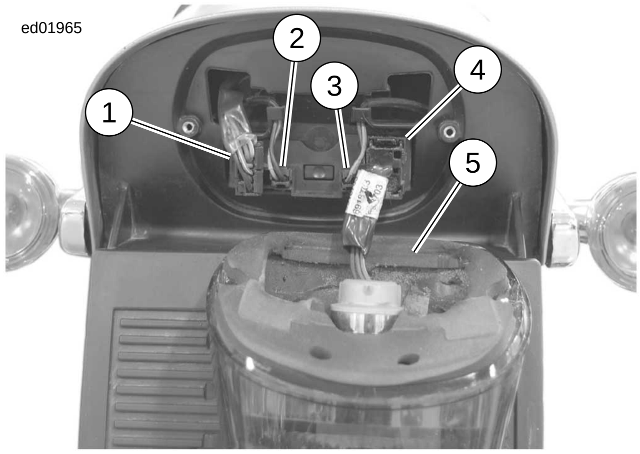
See Figure 5-15. The rear tail/stop lamp and license plate lamp connectors are located behind the tail lamp in the circuit board.

The running lamps consist of the front position lamp (HDI), located in the headlamp housing, the license plate lamp, and the tail lamp. The running lamps are powered through the accessory fuse when the ignition switch is in the ON or ACCY position.



1. **Front turn signals (right) [31R]**
2. **Fuel gauge [117]**
3. **Front turn signals (left) [31L]**
4. **ET sensor [90]**
5. **Left hand controls and horn [24]**
6. **Right hand controls [22]**
7. **Headlamp [38]**

Figure 5-14. Under Fuel Tank Left Side



1. **Tail lamp power in [94]**
2. **Right rear turn signal [18]**
3. **Left rear turn signal [19]**
4. **Tail lamp [93]**
5. **Tail lamp**

Figure 5-15. Tail Lamp: FXDF

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

HOME

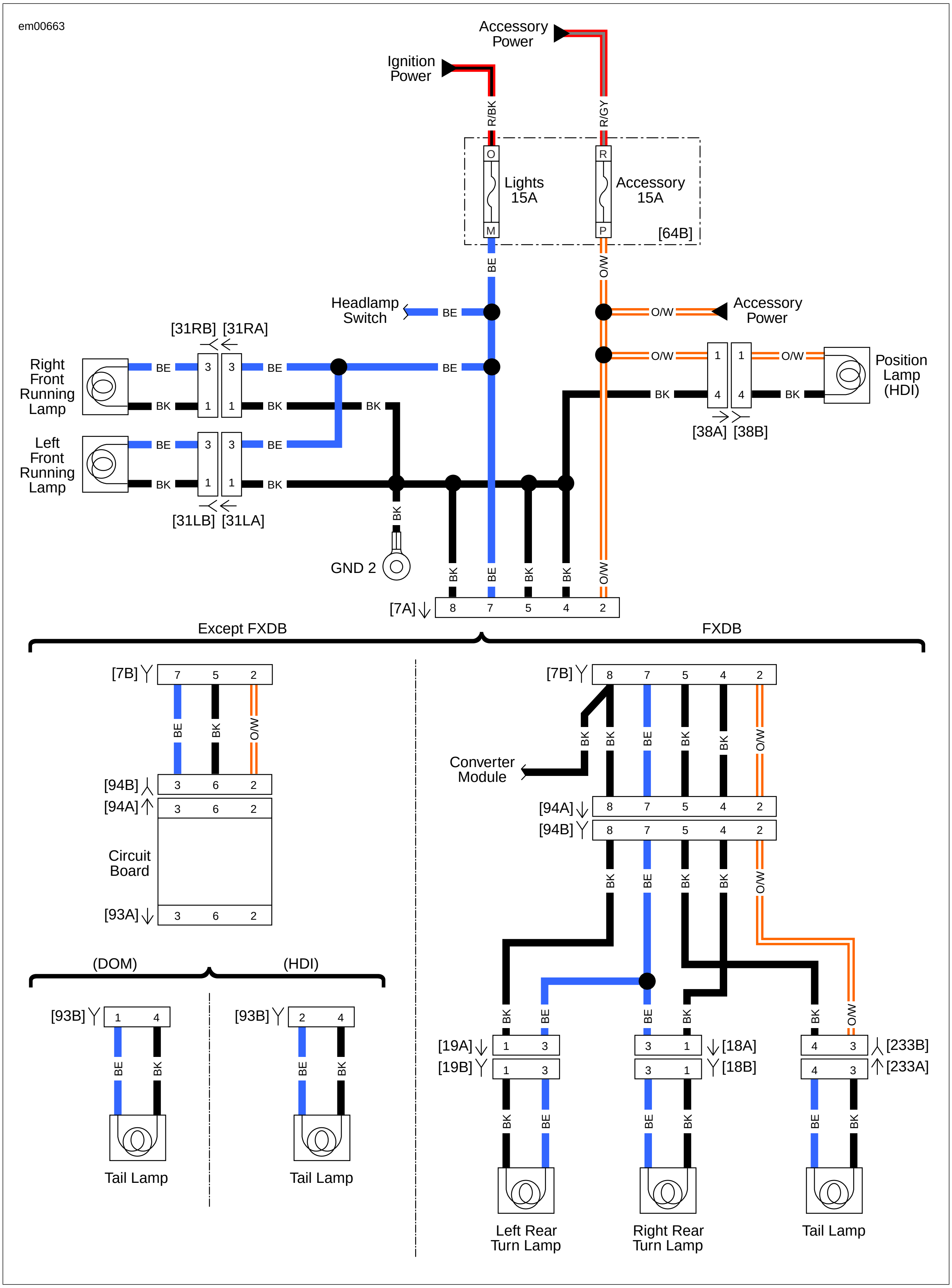


Figure 5-16. Running Lamps

POSITION LAMP INOPERATIVE: HDI ONLY

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

Table 5-11. Position Lamp Inoperative (HDI) Diagnostic Faults

POSSIBLE CAUSES
Open accessory circuit
Lamp malfunction
Open ground

1. Accessory Circuit Test

1. Turn the IGN to ACC.
2. Apply either the front or rear stop lamp switch.
3. Does the stop lamp illuminate?
   a. **Yes.** Go to Test 2.
   b. **No.** See 5.6 STOP LAMPS, Stop Lamp Inoperative.

2. Position Lamp Test

1. Disconnect [38].
2. With the IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between [38A] terminals 1 and 4.
3. Is battery voltage present?
   a. **Yes.** Replace position lamp. See the service manual. **(5143)**
   b. **No.** Go to Test 3.

3. Ground Circuit Test

1. Test for voltage between [38] terminal 1 and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (BK) ground wire. **(5041)**
   b. **No.** Repair open in (O/W) wire. **(5043)**

RUNNING LAMPS INOPERATIVE

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

Table 5-12. Running Lamps Inoperative Diagnostic Faults

POSSIBLE CAUSES
Open lights circuit
Lamp malfunction
Open ground

1. Lights Circuit Test

1. Turn the IGN ON.
2. Does the headlamp illuminate?
   a. **Yes.** Go to Test 2.
   b. **No.** See 5.5 HEADLAMPS, Headlamp Inoperative.

2. Stop Lamp Test

1. Apply either stop lamp switch.
2. Does the stop lamp illuminate?
   a. **Yes.** Go to Test 3.
   b. **No.** See 5.6 STOP LAMPS, Stop Lamp Inoperative.

3. Tail Lamp Inspection Test

1. Inspect the tail lamp.
2. Is the bulb good?
   a. **Yes.** Go to Test 4.
   b. **No.** Replace the bulb. **(5197)**

4. Running Lamps Circuit Test

1. Disconnect [94].
2. With the IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between [94A] terminals 2 and 5 (FXDB) or 3 and 6 (Except FXDB).
3. Is battery voltage present?
   a. **Yes.** Go to Test 5. (Except FXDB)
   b. **Yes.** Go to Test 6. (FXDB only)
   c. **No.** Repair open in (BE) or (O/W) wire [94A] terminal 2 (FXDB) or 3 (Except FXDB). **(5039)**

5. Tail Lamp Test: Except FXDB

1. Connect [94].
2. Disconnect [93].
3. Connect a test light between [93] terminals 1 and 4 (DOM) or 2 and 4 (HDI).
4. With the running lamps on does the test light illuminate?
   a. **Yes.** Repair or replace the tail lamp assembly. See the service manual.
   b. **No.** Replace the circuit board. See the service manual.

6. Tail Lamp Test: FXDB

1. Connect [94].
2. Disconnect [233].
3. Connect a test light between [233] terminals 3 and 4.
4. With the running lamps on does the test light illuminate?
   a. **Yes.** Repair or replace the tail lamp assembly. See the service manual. **(5215)**
   b. **No.** Repair open in (O/W) or (BK) wire between [94] and [233]. **(5043)**

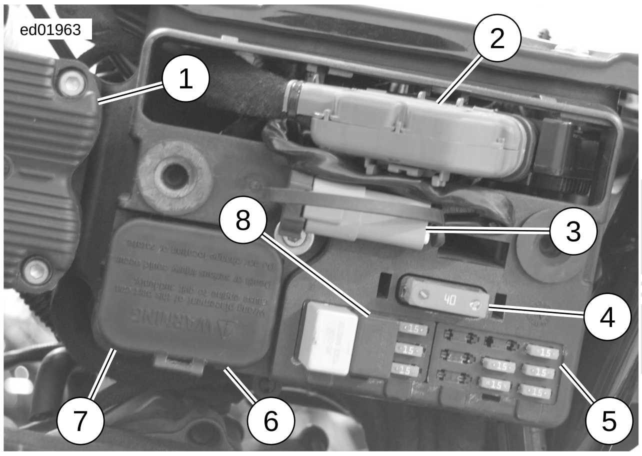
DTC B1121, B1122, B1123, B1124, B1125, B1126 5.8

GENERAL

See Figure 5-17. The TSM/TSSM/HFSM is located under the left side cover. It receives battery power through terminal 1 and ignition power through terminal 2. The ground for the TSM/TSSM/HFSM is through terminal 12. The TSM/TSSM/HFSM communicates with the other modules on the vehicle through the serial data circuit from terminal 3.

The turn signal switches are inputs to the TSM/TSSM/HFSM. When the TSM/TSSM/HFSM receives voltage from either of the turn signal switches it supplies voltage to the corresponding turn signal lamps and the correct turn signal indicator.

The TSM/TSSM/HFSM also monitors the position of the clutch and neutral switches to determine if it is safe to start the vehicle. The BAS is internal to the TSM/TSSM/HFSM and allows the TSM/TSSM/HFSM to determine if the vehicle is tipped over. If a tip over event occurs, the TSM/TSSM/HFSM shuts off the engine.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 5-17. Under Left Side Cover

The TSM/TSSM/HFSM monitors the output circuits and sets DTCs if faults are detected.

Table 5-13. Turn Signal DTCs

DTC	DESCRIPTION
B1121	Left turn output fault
B1122	Right turn output fault
B1123	Left turn signal short-to-ground (HFSM only)
B1124	Right turn signal short-to-ground (HFSM only)
B1125	Left turn signal short-to-voltage (HFSM only)
B1126	Right turn signal short-to-voltage (HFSM only)

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

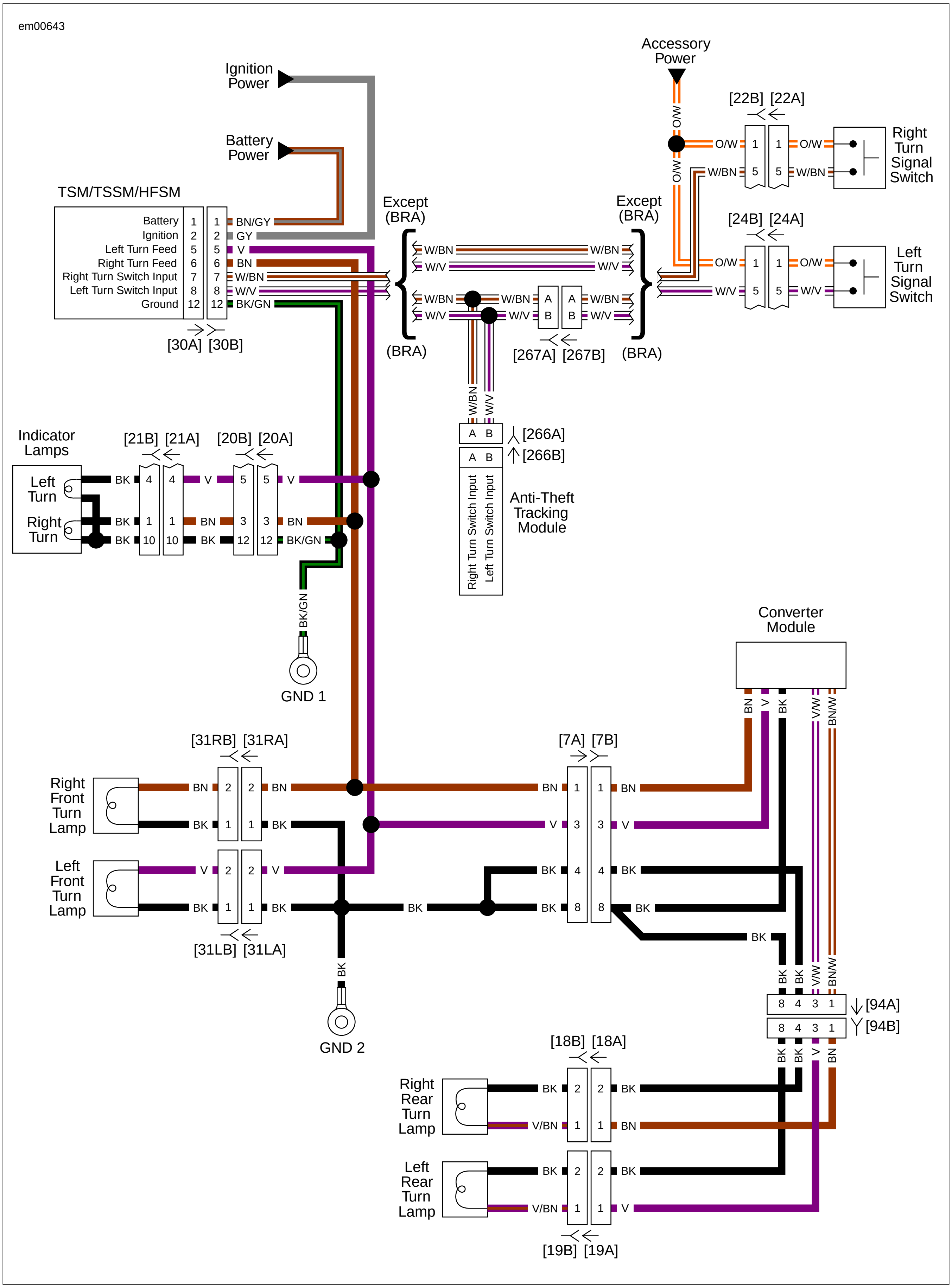


Figure 5-18. Turn Signal Circuit (FXDB)

HOME

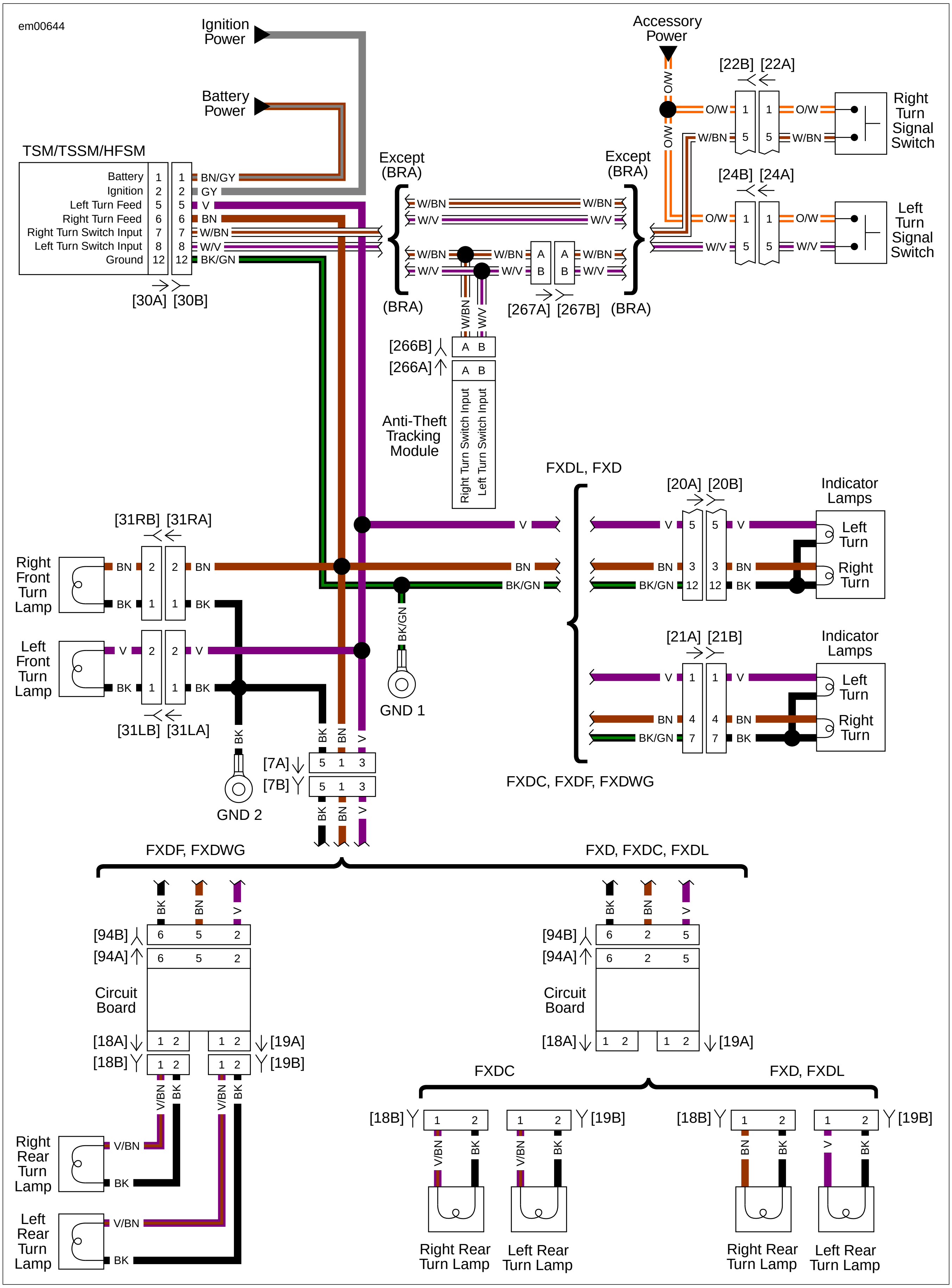


Figure 5-19. Turn Signal Circuit (Except FXDB)

DTC B1121: HFSM

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Table 5-14. DTC B1121 (HFSM) Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp malfunction
HFSM malfunction
Open left turn signal circuit

1. Turn Signal Lamp Inspection Test

1. Remove and inspect left side turn signal bulbs.
2. Confirm the turn signal bulbs are the correct part numbers and the sockets are not corroded or damaged.
3. Were any issues found with the lamps?
   a. **Yes.** Repair as needed.
   b. **No.** Go to Test 2.

2. Turn Signal Circuit Open Test

1. With IGN OFF, disconnect HFSM [30].
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness connector [30B] leaving HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Disconnect [31].
4. Test for continuity between breakout box terminal 5 and [31A] terminal 5.
5. Is continuity present?
   a. **Yes.** Replace the HFSM. See the service manual.
   b. **No.** Repair open in (V) wire.

DTC B1121: TSM/TSSM

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-15. DTC B1121 (TSM/TSSM) Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
Short to voltage on left turn signal circuit
TSM/TSSM malfunction
Short to ground on left turn signal circuit
Open left turn signal circuit

1. Operational Test

1. Turn IGN ON.
2. Are the turn signal lamps on continuously?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 4.

2. Indicator Short to Voltage Test

1. Turn IGN OFF.
2. Disconnect [20].
3. Turn IGN ON.
4. Are the turn signal lamps on continuously?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace indicator lamp assembly. See the service manual.

3. TSM/TSSM Short to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness connector [30B], leaving the TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between breakout box terminal 5 and ground.
4. Is voltage present?
   a. **Yes.** Repair short to voltage on the (V) wire.
   b. **No.** Replace the TSM/TSSM. See the service manual.

4. Indicator Shorted Test

1. With IGN OFF, disconnect [20].
2. Turn IGN ON.
3. Operate the left turn signals.
4. Do the turn signals flash?
   a. **Yes.** Replace indicator lamp assembly. See the service manual.
   b. **No.** Go to Test 5.

5. Shorted Turn Signal Circuit Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness connector [30B] leaving TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between breakout box terminal 5 and ground.
4. Is continuity present?
   a. **Yes.** Repair short to ground in (V) wire from terminal 5.
   b. **No.** Go to Test 6.

6. Turn Signal Circuit Open Test

1. Disconnect [31].
2. Test for continuity between breakout box terminal 5 and [31A] terminal 5.

3. Is continuity present?
   a. **Yes.** Replace the TSM/TSSM. See the service manual.
   b. **No.** Repair open in (V) wire.

DTC B1122: HFSM

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

Table 5-16. DTC B1122 (HFSM) Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
HFSM malfunction
Open right turn signal circuit

1. Turn Signal Lamp Inspection Test

1. Remove and inspect the right side turn signal bulbs.
2. Confirm the turn signal bulbs are the correct part numbers and the sockets are not corroded or damaged.
3. Were any issues found with the lamps?
   a. **Yes.** Repair as needed.
   b. **No.** Go to Test 2.

2. Turn Signal Circuit Open Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness connector [30B], leaving HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Disconnect [31].
4. Test for continuity between breakout box terminal 6 and [31A] terminal 2.
5. Is continuity present?
   a. **Yes.** Replace the HFSM. See the service manual.
   b. **No.** Repair open in (BN) wire.

DTC B1122: TSM/TSSM

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-17. DTC B1122 (TSM/TSSM) Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
Short to voltage on right turn signal circuit
TSM/TSSM malfunction
Short to ground on right turn signal circuit
Open right turn signal circuit

1. Operational Test

1. Turn IGN ON.
2. Are the turn signal lamps on continuously?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 4.

2. Indicator Short to Voltage Test

1. Turn IGN OFF.
2. Disconnect [20].
3. Turn IGN ON.
4. Are the turn signal lamps on continuously?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace indicator lamp assembly. See the service manual.

3. TSM/TSSM/HFSM Short to Voltage Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between breakout box terminal 6 and ground.
4. Is voltage present?
   a. **Yes.** Repair short to voltage on the (BN) wire.
   b. **No.** Replace the TSM/TSSM. See the service manual.

4. Indicator Shorted Test

1. With IGN OFF, disconnect [20].
2. Turn IGN ON.
3. Operate the left turn signals.
4. Do the turn signals flash?
   a. **Yes.** Replace indicator lamp assembly. See the service manual.
   b. **No.** Go to Test 5.

5. Turn Signal Circuit Shorted Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B] leaving TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between breakout box terminal 6 and ground.
4. Is continuity present?
   a. **Yes.** Repair short to ground in (BN) wire.
   b. **No.** Go to Test 6.

6. Turn Signal Circuit Open Test

1. Disconnect [31].

2. Test for continuity between breakout box terminal 6 and [31A] terminal 2.
3. Is continuity present?
   a. **Yes.** Replace the TSM/TSSM. See the service manual.
   b. **No.** Repair open in (BN) wire.

DTC B1123

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-18. DTC B1123 Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
HFSM malfunction
Short to ground on left turn signal circuit

1. Turn Signal Lamp Inspection Test

1. Remove and inspect left side turn signal bulbs.
2. Confirm the turn signal bulbs are the correct part numbers and the sockets are not corroded or damaged.
3. Were any issues found with the lamps?
   a. **Yes.** Repair as needed.
   b. **No.** Go to Test 2.

2. Turn Signal Circuit Short to Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving the HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Disconnect speedometer [20].
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between breakout box terminals 5 and 12.
5. Is continuity present?
   a. **Yes.** Repair short to ground in left turn signal circuit (V) wire.
   b. **No.** Go to Test 3.

3. Indicator Test

1. Install turn signal bulbs.
2. Remove breakout box and connect HFSM [30].
3. With [20] disconnected, operate the left turn signals.
4. Do the turn signals function and flash correctly?
   a. **Yes.** Replace the indicator lamp assembly. See the service manual.
   b. **No.** Replace the HFSM. See the service manual.

DTC B1124

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-19. DTC B1124 Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
HFSM malfunction
Short to ground on right turn signal circuit

1. Turn Signal Lamp Inspection Test

1. Remove and inspect right side turn signal lamps.
2. Confirm the turn signal bulbs are the correct part numbers and the sockets are not corroded or damaged.
3. Were any issues found with the lamps?
   a. **Yes.** Repair as needed.
   b. **No.** Go to Test 2.

2. Turn Signal Circuit Short to Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Disconnect speedometer [20].
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between breakout box terminals 6 and 12.
5. Is continuity present?
   a. **Yes.** Repair short to ground in right turn signal circuit (BN) wire.
   b. **No.** Go to Test 3.

3. Indicator Test

1. Install turn signal bulbs.
2. Remove breakout box and connect HFSM [30].
3. With speedometer [20] disconnected, operate the right turn signals.
4. Do the turn signals function and flash correctly?
   a. **Yes.** Replace the indicator lamp assembly. See the service manual.
   b. **No.** Replace the HFSM. See the service manual.

DTC B1125

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-20. DTC B1125 Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
HFSM malfunction
Short to voltage on left turn signal circuit

1. Turn Signal Circuit Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving the TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between breakout box terminals 5 and 12.
3. Is voltage present?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace HFSM. See the service manual.

2. Indicator Test

1. With IGN OFF, disconnect [20].
2. Turn IGN ON.
3. Test for voltage between breakout box terminals 5 and 12.
4. Is voltage present?
   a. **Yes.** Repair short to voltage in left turn signal circuit (V) wire.
   b. **No.** Replace the indicator lamp assembly. See the service manual.

DTC B1126

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-21. DTC B1126 Diagnostic Faults

POSSIBLE CAUSES
Indicator lamp assembly malfunction
HFSM malfunction
Short to voltage on right turn signal circuit

1. Turn Signal Circuit Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSM/TSSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and multimeter, test for voltage between breakout box terminals 6 and 12.
3. Is voltage present?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace HFSM. See the service manual.

2. Indicator Test

1. With IGN OFF, disconnect [20].
2. Turn IGN ON.
3. Test for voltage between breakout box terminals 6 and 12.
4. Is voltage present?
   a. **Yes.** Repair short to voltage in right turn signal circuit (V) wire.
   b. **No.** Replace the indicator lamp assembly. See the service manual.

DTC B1135, B1136, B1141, B1142 5.9

DIAGNOSTICS

DTC B1135 Accelerometer Fault

DTC B1135 indicates a failure which requires replacement of the TSM/TSSM/HFSM.

NOTE

When DTC B1135 is set, the tip-over engine shutdown, HFSM tamper alarm, and bank angle sensors are disabled. The security lamp will also illuminate when this code is set.

DTC B1136 Accelerometer Tip-Over Self-Test Fault

DTC B1136 indicates a failure which requires replacement of the HFSM.

DTC B1141

DTC B1141 indicates the TSM/TSSM/HFSM is recognizing an open or low condition on the ignition circuit.

DTC B1142 Internal Fault

DTC B1142 indicates a failure which requires replacement of the HFSM.

DTC B1141

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-22. DTC B1141 Diagnostic Faults

POSSIBLE CAUSES
TSM/TSSM/HFSM malfunction
Open ignition circuit

1. Ignition Circuit Open Test

1. With IGN OFF, connect TSM/TSSM/HFSM BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSM/TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. With the IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between breakout box terminal 2 and ground.
3. Is voltage present?
   a. **Yes.** Replace the TSM/TSSM/HFSM. See the service manual.
   b. **No.** Repair open in (GY) ignition wire.

HOME

SECURITY SYSTEM 5.10

SECURITY LAMP

The security lamp (key icon) in the speedometer face provides feedback to the rider confirming armed or disarmed status. Refer to Table 5-23.

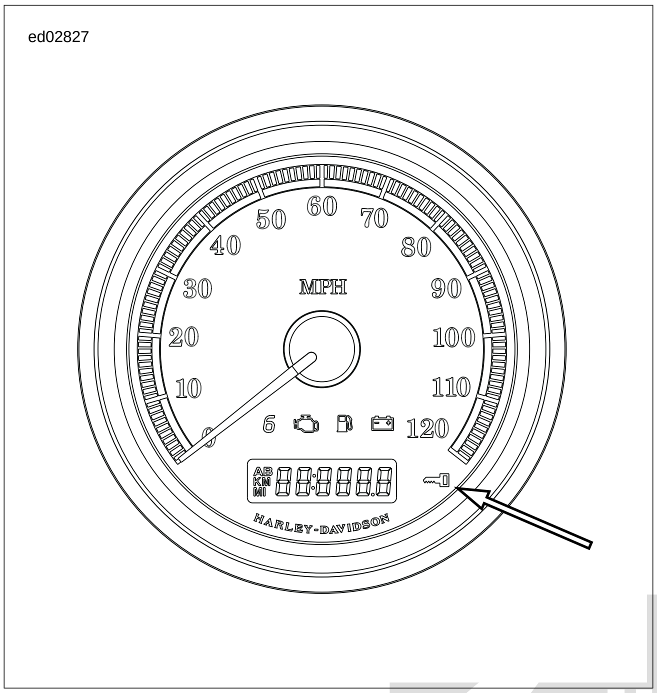


Figure 5-20. Security Lamp (key icon): Dyna Models

Table 5-23. Security Lamp Status

LAMP	MODE
Does not flash.	No security system (TSM only), security system not armed.
Flashes every second.	2 minute (HFSM) or ten minute (TSSM) timeout after failed PIN entry attempt or a battery reconnect has occurred while armed.
Flashes every 2.5 seconds.	Security system armed.
Flashes 4 times a second.	PIN entry mode.
Stays on solid with IGN OFF.	Arming is starting up. You have 5 seconds (HFSM) or 30 seconds (TSSM) before system is armed.
Stays on solid with IGN ON.	If solid for more than 4 seconds after IGN ON, a current DTC is present.

SECURITY IMMOBILIZATION

The TSSM/HFSM provides security and immobilization functions not found on the TSM. The TSSM/HFSM 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 5.12 SIREN, Siren Chirp Mode Confirmation: HFSM Only.

Conditions that activate the security system 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.
- **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.

NOTE

Always disarm the TSSM/HFSM before removing or disconnecting the battery to prevent the siren (if installed) from activating. If the TSSM is in auto-arming mode, you must disarm the system and disconnect the battery or remove the battery fuse before the 30 second arming period expires.

TSSM/HFSM FEATURES

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The following information applies only to vehicles equipped with the TSSM/HFSM.

- **Security lamp:** See Figure 5-20. The security lamp (key icon) tells the rider if the system is armed or disarmed.
- **Personal code disarming:** If the fob is not available, the TSSM/HFSM allows the rider to disable the security alarm and immobilization functions with a five-digit personal code.
- **Arming confirmation:** When the TSSM/HFSM 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.
- **Remote arming/disarming (TSSM only):** See 5.11 KEY FOB. Owners may enable and disable security alarm and immobilization functions with a personally carried transmitter. This transmitter is referred to as a **key fob**. Remote

arming/disarming is a function of the TSSM (Japan/Korea) only.

- **Auto-arming (TSSM only):** Automatically enables the security alarm and immobilization functions within 30 seconds after the ignition switch is switched OFF.
- **Disarming confirmation:** When the TSSM/HFSM 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 5.12 SIREN. 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 (HFSM only):** This mode allows the dealer to disable security system via DIGITAL TECHNICIAN II (Part No. HD-48650). Dealer service mode is exited when module detects an assigned fob in range.

Security System Options: TSSM

The following options are only available on the TSSM unit: alarm sensitivity, auto-arming feature, and storage mode.

Default settings for the TSSM include:

- Solo vehicle configuration.
- Medium motion sensitivity on alarm sensitivity.
- All vehicles are shipped with auto-arming disabled.
- Storage mode set to 10 days.

WARNINGS

A warning consists of three alternate flashes of the turn signals and chirp from the optional smart siren. Warnings are issued from an armed TSSM/HFSM 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.

ARMING: HFSM

The H-DSSS automatically arms within five seconds when the vehicle is parked and the ignition switch is turned to **OFF** 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 (key icon) will flash once every 2.5 seconds. Refer to Table 5-23.

ARMING: TSSM

There are two methods to arm the security system:

- Using the key fob.
- Using auto-arming.

NOTE

The vehicle cannot be armed with the IGN ON.

Auto-Arming Function: TSSM

Auto-arming causes the system to automatically arm itself (no key fob needed) within 30 seconds after the ignition switch is turned OFF. During this period, the security lamp stays illuminated to indicate auto-arming is starting up.

The vehicle may be moved during these 30 seconds without triggering the alarm. However, any motion after that period will trigger the security alarm. Upon expiration of the auto-arming period, the turn signals flash twice, the security lamp begins to flash and the siren (if equipped) chirps twice.

The TSSM allows remote arming via the key fob at any time. However, if the system is remotely disarmed (with the key fob) but the ignition switch is not turned ON within 30 seconds, the system will re-arm itself when auto-arming is enabled.

Japan and Korea vehicles have auto-arming disabled by default. However, the feature may be enabled if the customer desires.

When auto-arming is disabled, the key fob must be used to arm the security system. To set the auto-arming function, refer to Table 5-24.

Table 5-24. Selecting TSSM Auto-Arming Function

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to **OFF**		Verify the security lamp is not flashing (vehicle is disarmed)
2	Turn IGN **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	Two flashes turn signals and indicators (See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: TSSM regarding battery disconnects.)	Two flashes - Japan/Korea configuration TSSM

Table 5-24. Selecting TSSM Auto-Arming Function

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
4	Press and hold **key fob** button until confirmation is received	One flash turn signals and indicators	
5	Press and hold **key fob** button until confirmation is received	Two flashes turn signals and indicators	
6	Press **left** turn switch **1 time** and release	Turn signals and indicators flash to indicate option selected	One flash - auto-arming disabled Two flashes - auto-arming enabled
7	Press and release **left** turn switch to advance through options	Turn signals and indicators flash to indicate option selected	
8	Turn IGN OFF		

DISARMING: HFSM

There are two ways to disarm the H-DSSS:

- Automatic Disarming.
- Using the PIN.

Automatic Disarming

Always have the fob present when riding, loading, fueling, moving, parking or servicing the vehicle. Carry the fob in a convenient pocket. 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 (key icon) will turn ON solid for four seconds then go out. Refer to Table 5-23.

Disarming with a PIN

See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS to enter an initial PIN to enable the system.

If you make an error while disarming the HFSM using the PIN, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 2 minutes (HFSM) or ten minutes (TSSM). **During this time, the vehicle will not accept any attempt to enter a PIN.** Refer to Table 5-23.

DISARMING: TSSM

There are two ways to disarm the system:

- Using the key fob. This method works in all situations **except** before turning ignition switch ON when TSSM storage mode is activated.
- Using a PIN.

If you make an error while disarming the TSSM using a PIN, the alarm will activate for 30 seconds after the last digit is entered. After a failed attempt, the security lamp will flash once every second for 10 minutes. **During this time, the vehicle will not accept any attempt to enter a PIN.** Refer to Table 5-25.

Table 5-25. Disarming TSSM with the PIN (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to **OFF**		
2	Turn IGN to **ACC**		
3	Hold **both** turn switches in until confirmation	Security lamp flashes at fast rate	System is ready for PIN entry
4	Enter first digit of code (3) by pressing **left** turn switch **3 times**		
5	Press **right** turn switch **1 time**		Serves as "enter" key for first digit
6	Enter second digit of code (1) by pressing **left** turn switch **1 time**		
7	Press **right** turn switch **1 time**		Serves as "enter" key for second digit
8	Enter third digit of code (3) by pressing **left** turn switch **3 times**		
9	Press **right** turn switch **1 time**		Serves as "enter" key for third digit
10	Enter fourth digit of code (1) by pressing **left** turn switch **1 time**		Serves as "enter" key for fourth digit
11	Press **right** turn switch **1 time**		

Table 5-25. Disarming TSSM with the PIN (Example: 3-1-3-1-3)

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
12	Enter fifth digit of code (3) by pressing **left** turn switch **3 times**		System is disarmed. You may use the vehicle or program another key fob
13	Press **right** turn switch **1 time**	Security lamps stop flashing	

ALARM

Activation

In the full alarm state, the turn signals flash alternately, and if equipped with the smart siren, the siren will sound.

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 switch turned to **OFF**.*

If vehicle motion continues, the alarm will start again continue for another 30 seconds.

The TSSM/HFSM will repeat the alarm cycles 10 times for a total of five minutes, with a 10-second pause between alarm cycles.

During warnings and alarms, the starter motor and the ignition remain disabled.

Deactivation

The alarm cycles can be discontinued at any time by moving an assigned fob to the vehicle. The presence of the fob will terminate the alarm.

ALARM SENSITIVITY: TSSM

Sensitivity

The TSSM has four sensitivity settings: extremely low, low, medium or high. The selection chosen controls the sensitivity of the security system regarding motion detection.

To set alarm sensitivity, refer to Table 5-26.

Table 5-26. TSSM Alarm Sensitivity

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to **OFF**		Verify the security lamp is not flashing (vehicle is disarmed)
2	Turn IGN **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	Two flashes turn signals and indicators depending on vehicle configuration. (See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: TSSM regarding battery disconnects.)	Two flashes - Japan/Korea configuration TSSM
4	Press and hold **key fob** button until confirmation is received	One flash turn signals and indicators	
5	Press **left** turn switch **1 time** and release	Turn signals and indicators flash to indicate option selected	One flash - extremely low Two flashes - low sensitivity Three flashes - medium sensitivity Four flashes - high sensitivity
6	Press and release **left** turn switch to advance through options	Turn signals and indicators flash to indicate option selected	One flash - extremely low Two flashes - low sensitivity Three flashes - medium sensitivity Four flashes - high sensitivity
7	Turn IGN OFF		

KEY FOB 5.11

HFSM FOB

See Figure 5-21. The HFSM's reception range for the hands-free fob signal depends on a specific receiver pattern. The typical range will be an arm's length.

NOTES

- *Environmental and geographic conditions may affect signal range.*
- *Always have the fob present whenever the vehicle is operated.*
- *Do not place fob in metal enclosure, and do not place it closer than 3.0 in. (80.0 mm) to cellular phones, the handsfree antenna, PDAs, displays and other electronic devices while operating the vehicle. That may prevent the fob from disarming the security system.*
- *Fob battery should be replaced every year. See the service manual.*

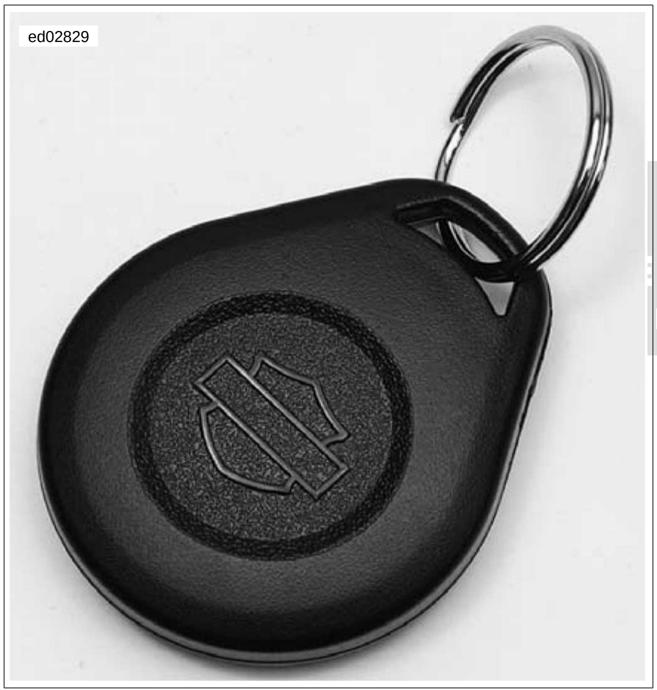


Figure 5-21. Hands-Free Fob

TSSM FOB

The TSSM reception range for the key fob signal depends on a specific receiver pattern.

NOTE

Environmental and geographic conditions may affect signal range.

Arming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Hold down the key fob button until the system responds with two turn signal flashes.

Disarming the System

1. Hold key fob horizontal at waist level.
2. Point key fob at the front of the vehicle.
3. Quickly press the key fob button twice. The system will respond with one turn signal flash.

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

Troubleshooting

If the key fob button has been pressed numerous times while away from the vehicle, the fob may fall out of synchronization with the TSSM. If this happens, the TSSM might fail to recognize the key fob's commands.

To solve this problem, press and hold the key fob button for 10-15 seconds until the security system responds with two turn signal flashes. After confirmation, you may resume normal fob operation.

FOB ASSIGNMENT: HFSM

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

Use DIGITAL TECHNICIAN II (Part No. HD-48650) to assign both fobs to the H-DSSS. Follow the menu prompts in the DIGITAL TECHNICIAN II (Part No. HD-48650) display and scan the fob serial number with the bar code reader, or key-in the number from the keyboard. See a Harley-Davidson dealer.

NOTE

Each fob has a unique serial number. The label should be removed from the fob and attached to a blank NOTES page in the Owner's Manual for reference.

FOB ASSIGNMENT: TSSM

Refer to Table 5-27 to assign a key fob to a vehicle equipped with a TSSM.

The key fob on TSSM vehicles must be set so it will operate the alarm system on the vehicle. This assignment **must** be completed with no pauses between steps greater than 10 seconds. Turn the ignition OFF after all key fobs have been assigned. The programming mode will also exit after 60 seconds has elapsed without detecting any fob sign-up messages or turn signal switch activity.

Two key fobs may be assigned to the TSSM. The first successful attempt to program a fob will disable all previously assigned fobs. If a second fob is to be programmed, it must be done in the same programming sequence as the initial fob.

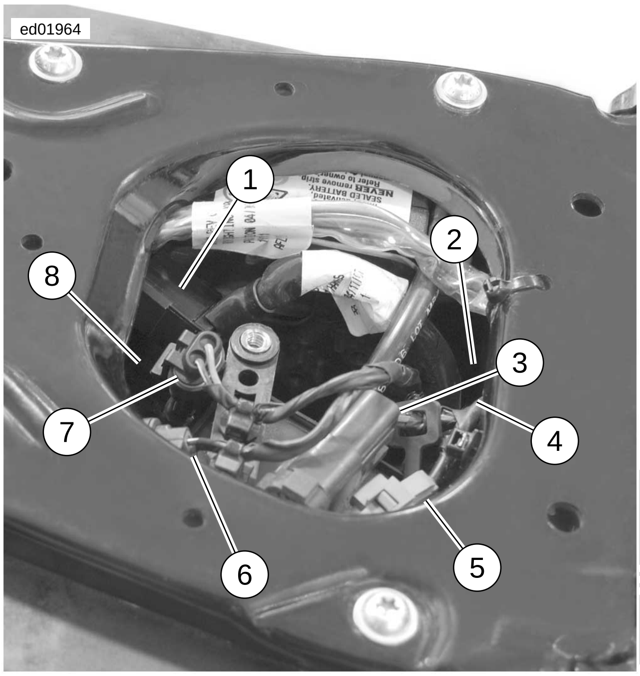
Table 5-27. Key FOB Assignment: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop to **OFF**		Verify the security lamp is not flashing (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn ignition/headlamp switch **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	One to four flashes turn signals and indicators depending on vehicle configuration (See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: TSSM regarding battery disconnects.)	One flash - Worldwide TSM, no security Two flashes - Japan/Korea configuration TSSM
4	Press **right** turn switch **1 time** and release	One flash turn signals and indicators	
5	Press **left** turn switch **1 time** and release	Two flashes turn signals and indicators	
6	Press and hold **key fob** button until confirmation is received	Two flashes turn signals and indicators	This may take 10-25 seconds.
7	If you have two key fobs, press and hold button on second **key fob** until confirmation is received	Two flashes turn signals and indicators	Optional step
8	Turn ignition/headlamp switch OFF		

SIREN 5.12

DESCRIPTION AND OPERATION

See Figure 5-22. The Smart Siren is not a standard part of the security system but can be added to the system. The siren is attached at [142] off the TSSM/HFSM. Through this connector it shares the battery circuit, the ground circuit, and the alarm signal circuit with the TSSM/HFSM. The siren is used to add an audible warning to the visual warnings that are a standard function of the security system.



1. **Tail lamp harness to main harness [7]**
2. **Grounds [GND1] & [GND2]**
3. **Accessory [4]**
4. **Security siren [142]**
5. **B+ [160]**
6. **IAT sensor [89]**
7. **Rear O2 sensor [137]**
8. **JSS (HDI only) [133]**

Figure 5-22. Under Seat

SIREN CHIRP MODE CONFIRMATION: HFSM ONLY

Chirpless Mode

In the chirpless mode, the siren does not chirp on arming or disarming.

NOTE

Even when armed in the chirpless mode, the siren still chirps warnings on movement and will activate the alarm through the normal cycles.

Chirp Mode

On arming in the chirp mode, the siren responds with two chirps. When disarming, the siren responds with a single chirp.

Switching Modes

Cycling quickly through three armings and disarmings will switch the system from either the chirpless mode or the chirp mode to its opposite.

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.

SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS 5.13

GENERAL

Setting up a vehicle's TSM/TSSM/HFSM depends on whether the vehicle has a TSM or the optional TSSM or HFSM security system installed.

ACTUATION: HFSM

Actuation consists of assigning two fobs to the system, and entering an initial PIN. The PIN can be changed by the rider at any time.

1. Configure HFSM vehicles by assigning **both** fobs to the vehicle.
2. Configure HFSM 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 and instruct the customer to carry a copy (use the wallet card found in the owner's manual).

Once the system has been activated, it will always "arm" within 5 seconds of turning the ignition switch to **OFF** and no vehicle motion.

CONFIGURING A TSSM

NOTE

Do not forget to enter a PIN for TSSM vehicles. If a PIN is not assigned and both key fobs are lost or damaged while the vehicle is armed, the TSSM must be replaced.

Changes to TSSM settings are made by a series of programming operations involving the ignition key, left/right turn signal switches and key fob (security systems).

At certain steps in the programming sequence, the vehicle may provide confirmation of settings by flashing the turn signals, turn signal indicators and/or security lamp. In addition, when programming a PIN into a TSSM system, the odometer displays the PIN to the user and dynamically updates it as the code is entered or changed.

All programming operations are listed in table format. Follow the numbered steps to configure the system. If a confirmation response is listed, wait for the confirmation before continuing to the next step. Important information pertaining to certain actions will be found in the NOTES column.

SELECTING A PIN

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.

INITIAL PIN ENTRY: HFSM

To enter a PIN on a vehicle with no PIN previously installed during HFSM actuation, refer to Table 5-28.

Table 5-28. Entering an Initial PIN: HFSM

NO.	ACTION	WAIT FOR CONFIRMATION
1	Select a 5-digit (1 through 9) initial PIN and record in the owner's manual and on the wallet card.	
2	With an assigned fob present, set engine stop switch to **OFF.**	
3	Cycle **IGN ON-OFF-ON-OFF-ON**	
4	Press **left** turn signal button **2** times.	Turn signals will flash 3 times.
5	Press **right** turn signal button **1** time.	Five dashes will appear in the odometer window. The first dash will flash.
6	Enter first digit (a) of initial PIN by pressing **left** turn signal button **a** times.	
7	Press **right** turn signal button **1** time.	The digit (a) will replace the dash in the odometer. The second dash will flash.
8	Enter second digit (b) of initial PIN by pressing **left** turn signal button until desired digit is displayed in odometer.	
9	Press **right** turn signal button **1** time.	The digit (b) will replace the dash in the odometer. The third dash will flash.
10	Enter third digit (c) of initial PIN by pressing **left** turn signal button **c** times.	
11	Press **right** turn signal button **1** time.	The digit (c) will replace the dash in the odometer. The fourth dash will flash.
12	Enter fourth digit (d) of initial PIN by pressing **left** turn signal button **d** times.	

Table 5-28. Entering an Initial PIN: HFSM

NO.	ACTION	WAIT FOR CONFIRMATION
13	Press **right** turn signal button **1** time.	The digit (d) will replace the dash in the odometer. The fifth dash will flash.
14	Enter fifth digit (e) of initial PIN by pressing **left** turn signal button **e** times.	
15	Press **right** turn signal button **1** time.	The digit (e) will replace the dash in the odometer. The first digit will flash.
16	Turn **IGN OFF.**	

INITIAL PIN ENTRY: TSSM

NOTE

Do not forget to enter a PIN for TSSM vehicles. If a PIN is not assigned and the key fob is lost or damaged while the vehicle is armed, the TSSM must be replaced.

The TSSM 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 key fob becomes unavailable.

Refer to Table 5-29 to enter an initial PIN with no PIN previously installed. The procedure listed uses 3-1-3-1-3 as the desired PIN.

NOTE

For better security, do not use 3-1-3-1-3 as a PIN. It is shown as an example only.

Decide what five-digit PIN the owner would like to use. The code will be programmed using the turn signal switches and key fob. Keep a record of the PIN in a secure place such as your wallet or the Owner's Manual.

- When programming the PIN, the security lamp flashes to provide feedback when entering each digit. The odometer also displays the PIN and the change dynamically.
- The number of security lamp flashes corresponds to the number currently selected for a given digit. Therefore, the lamp may flash 1-9 times depending on the number entered. The five-digit PIN will change in the odometer window and the active digit will blink.
- Press the left turn switch one time to increment each digit.
- Quickly press the key fob button twice to advance to the next digit.

NOTE

The programming mode exits upon turning the ignition switch to OFF, or if no turn signal switch/key fob button activity occurs for 60 seconds. No data is saved for partial configuration attempts if entering a PIN for the first time. If a PIN has previously been entered, the user can change any digit or group of digits.

Table 5-29. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to **OFF**		Verify the security lamp is not flashing (vehicle is disarmed) This assignment procedure **must** be completed with no pauses between steps greater than 10 seconds
2	Turn IGN **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2** times and release	One to four flashes turn signals and indicators depending on vehicle configuration (See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: TSSM regarding battery disconnects)	One flash - Worldwide TSM, no security Two flashes - Japan/Korea configuration TSSM
4	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators Odometer displays current five-digit PIN (five dashes if no code entered), first digit flashes	Vehicle is in PIN entry mode ready to enter or modify first digit

Table 5-29. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
5	Press **left** turn switch **1 time** and release	Security lamp flashes 1-9 times if code was previously entered	A lack of confirmation flashes indicates no digit entered
6	Press and release **left** turn switch to advance through the digits In this example, you will press and release three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You have selected 3 as a number for the first digit
7	Quickly press **key fob** button **2 times** and release	Two flashes turn signals and indicators second digit in odometer display blinks	You have confirmed 3 as a number for the first digit and have advanced to entering the second digit
8	Press **left** turn switch **1 time** and release	None	A lack of confirmation flashes indicates no digit entered
9	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You have selected 1 as a number for the second digit
10	Quickly press **key fob** button **2** times and release	Three flashes turn signals and indicators third digit in odometer display blinks	You have confirmed 1 as a number for the second digit and have advanced to entering the third digit
11	Press **left** turn switch **1** time and release	None	A lack of confirmation flashes indicates no digit entered
12	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You have selected 3 as a number for the third digit
13	Quickly press **key fob** button **2 times** and release	Four flashes turn signals and indicators fourth digit in odometer display blinks	You have confirmed 3 as a number for the third digit and have advanced to entering the fourth digit
14	Press **left** turn switch **1** time and release	None	A lack of confirmation flashes indicates no digit entered
15	Press and release **left** turn switch to advance through the digits In this example, you will perform this step one time	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 1 and the security lamp will flash one time	You have selected 1 as a number for the fourth digit
16	Quickly press **key fob** button **2 times** and release	Five flashes turn signals and indicators fifth digit in odometer display blinks	You have confirmed 1 as a number for the fourth digit and have advanced to entering the fifth digit
17	Press **left** turn switch **1 time** and release	None	A lack of confirmation flashes indicates no digit entered
18	Press and release **left** turn switch to advance through the digits In this example, you will repeat this step three times	Blinking digit in odometer display increments, security lamp flashes to indicate each digit selected In this example, the blinking digit displayed is 3 and the security lamp will flash three times	You have selected 3 as a number for the fifth digit
19	Quickly press **key fob** button **2 times** and release	One flash turn signals and indicators first digit in odometer display blinks	You have confirmed 3 as a number for the fifth digit and have gone back to the first digit

Table 5-29. Entering an Initial TSSM PIN (Example: 3-1-3-1-3) with No PIN Previously Entered

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
20	Turn IGN OFF		
21	Write down code in Owner's Manual		
22	Arm the security system and attempt to disarm using PIN entry. Refer to Table 5-25.		

CHANGING THE PIN

To change a PIN, refer to Table 5-30.

If a PIN was previously entered, the odometer will display the equivalent digit. Each additional press of the left turn switch will increment the digit.

Examples:

- To advance from 5 to 6, press and release the left turn switch 1 time.
- To advance from 8 to 2, press and release the left turn switch 3 times (9-1-2).

Table 5-30. Changing the PIN: HFSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Select a 5-digit (1 through 9) personal code and record in the owner's manual and on the wallet card.		
2	With fobs present, cycle **IGN ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn signal button **2** times.	Turn signals will flash 3 times.	
4	Press **right** turn signal button **1** time.	Current PIN will appear in odometer. The first digit will flash.	
5	Enter first digit (a) of new PIN by pressing **left** turn signal button until desired digit is displayed in odometer.		
6	Press **right** turn signal button **1** time.	The new digit will replace the current in the odometer. The second digit will flash.	
7	Enter second digit (b) of new PIN by pressing **left** turn signal button until the desired digit is displayed in the odometer.		
8	Press **right** turn signal button **1** time.	The new digit will replace the current in the odometer. The third digit will flash.	
9	Enter third digit (c) of new PIN by pressing **left** turn signal button until desired digit is displayed in the odometer.		
10	Press **right** turn signal button **1** time.	The new digit will replace the dash in the odometer. The fourth digit will flash.	
11	Enter fourth digit (d) of new PIN by pressing **left** turn signal button until desired digit is displayed in the odometer.		
12	Press **right** turn signal button **1** time.	The new digit will replace the current in the odometer. The fifth digit will flash.	

Table 5-30. Changing the PIN: HFSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
13	Enter fifth digit (e) of new PIN by pressing **left** turn signal button until desired digit is displayed in the odometer.		
14	Press **right** turn signal button **1** time.	The new digit will replace the current in the odometer. The first digit will flash.	
15	Turn the IGN OFF.		Turning the ignition switch to OFF stores the PIN.

TRANSPORT MODE

Transport mode is especially useful when working on the vehicle. If it is not used, the alarm will activate under many typical service activities.

To Enter Transport Mode: HFSM

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state, however, any attempt to start the engine will trigger the alarm.

1. Turn the ignition switch to IGN.
2. Set the engine stop switch to the OFF position.
3. With an assigned fob within range, turn the ignition switch from OFF to ACC.
4. Simultaneously, press both the left and the right turn signal switches. This must be done within five seconds of turning the ignition switch to ACC.
5. After the turn signals flash once, turn the ignition switch to OFF and the module is armed.
6. The turn signals flash three times to confirm module arming in transfer mode for one ignition cycle.

To Exit Transport Mode: HFSM

Return the system to normal operation:

1. With the fob present, turn the ignition switch to IGN to disarm the HFSM.
2. To cancel the transport mode, set the engine stop switch to RUN.

To Enter Transport Mode: TSSM

It is possible to arm the security system without enabling the motion detector for one ignition cycle. This allows the vehicle to be picked up and moved in an armed state. In this mode, any attempt to bypass the ignition system will trigger the security system.

1. Turn the engine stop switch to the OFF position. Verify the security lamp is not flashing.
2. Turn IGN ON.
3. Press and hold key fob button until the turn signals and indicators flash three times.
4. Turn IGN OFF.
5. Press and hold key fob button until the turn signals and indicators flash three times.

To Exit Transport Mode: TSSM

To exit from transport mode and return the system to normal operation/functions, disarm the system using either the key fob or PIN.

SERVICE MODE

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

With a fob present, the HFSM can be configured for service by disabling the security system with DIGITAL TECHNICIAN II (Part No. 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 will be exited.

FOUR-WAY FLASHING

To Arm the HFSM with the Hazard Warning Flashers ON

If it is necessary to leave a vehicle parked along side the road, the hazard warning four-way flashers can be turned ON with the smart security system armed.

1. Turn IGN ON.
2. Simultaneously press both left and right turn signal switches to turn the four-way flashers ON. The four-way flashers will continue for two hours.
3. Turn IGN OFF to arm the smart security system.

To Disarm the HFSM and Turn the Hazard Warning Flashers OFF

1. With a fob present, turn the ignition switch to IGN.
2. Simultaneously press the left and right turn signal switches.

STORAGE MODE: TSSM

The TSSM has a special mode for long term storage. This mode prevents the security system from draining the battery after a period of days (10, 20, 60 or infinite) without any ignition switch activity.

- If the TSSM is set to infinite, the system will not go into storage mode.
- Vehicles will enter storage mode whether the security system is armed or disarmed.
- If set to 20 days or greater, the customer must use an approved trickle charger to keep the battery from discharging.

In storage mode, all alarm functions remain active but the receiver is shut down and will not respond to the key fob. The vehicle is immobilized because the starter motor and ECM are disabled. When the storage mode is entered, the security lamp stops flashing to conserve power.

To wake up the TSSM from storage mode, the ignition switch must be turned ON. This will trigger a warning/alarm if the system was previously armed. You must use the key fob or PIN to disarm the system and stop the alarm.

To set the storage mode preferences, refer to Table 5-31.

Table 5-31. Storage Mode Preferences: TSSM

NO.	ACTION	WAIT FOR CONFIRMATION	NOTES
1	Set engine stop switch to **OFF**		Verify the security lamp is not flashing (vehicle is disarmed)
2	Turn IGN **ON**-OFF-**ON**-OFF-**ON**		
3	Press **left** turn switch **2 times** and release	Two flashes turn signals and indicators depending on vehicle configuration (See 5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: TSSM regarding battery disconnects.)	Two flashes - Japan/Korea configuration TSSM
4	Press and hold **key fob** button until confirmation is received	One flash turn signals and indicators	
5	Release and then hold **key fob** button until confirmation is received	Two flashes turn signals and indicators	
6	Release and then hold **key fob** button until confirmation is received	Three flashes turn signals and indicators	
7	Press **left** turn switch **1 time** and release	Turn signals and indicators flash to indicate option selected	One flash - 10 days Two flashes - 20 days Three flashes - 60 days Four flashes - Infinite
8	Press **left** turn switch to advance through options	Turn signals and indicators flash to indicate option selected	One flash - 10 days Two flashes - 20 days Three flashes - 60 days Four flashes - Infinite
9	Turn IGN OFF.		

POWER DISRUPTION AND CONFIGURING: HFSM

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

The HFSM will not enter PIN entry mode on the first attempt after battery voltage has been removed from terminal 1. This will occur after any of the following:

- Battery disconnect or power drain.
- Main fuse removal.
- Connecting BREAKOUT BOX (Part No. HD-42682) to HFSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows:

1. Set engine stop switch to the OFF position, cycle ignition switch IGN to **ON**-OFF-**ON**-OFF-**ON** and press left turn signal switch twice.
2. Repeat steps listed above.
3. Continue with PIN entry sequence listed.

POWER DISRUPTION AND CONFIGURING: TSSM

PART NUMBER	TOOL NAME
HD-42682	BREAKOUT BOX

The TSM/TSSM will not enter configuration mode on the first attempt after battery voltage has been removed from terminal 1. This will occur after any of the following:

- Battery disconnect or power drain.
- Main fuse removal.
- Connecting BREAKOUT BOX (Part No. HD-42682) to TSSM connector.

Therefore, after all battery reconnects, the configuration sequence must be modified as follows.

1. Set engine stop switch to OFF, cycle ignition/headlamp switch **ON**-OFF-**ON**-OFF-**ON** and press left turn signal switch twice.
2. Repeat step listed above.
3. Continue with configuration sequence listed.

FAILS TO DISARM 5.14

DESCRIPTION AND OPERATION

HFSM

If the HFSM does not respond, responds with limited range, or will not consistently disarm with fob within normal range, follow the diagnostic procedure.

TSSM

This section applies only to those vehicles equipped with the optional security system (TSSM).

NOTE

*Disarming function may require practice. The key fob button **must** be pressed twice within 1.5 seconds to send the disarm command. The action is very similar to double-clicking a computer mouse. Light quick taps work best; very hard or very slow taps are less likely to work.*

The key fob sends a RF signal to activate all remote TSSM functions. The left front turn signal switch wire serves as the vehicle's antenna. If the TSSM does not respond (no confirmation at arming/disarming system) or responds weakly (limited range, won't consistently arm/disarm or synchronize), follow the diagnostic procedure.

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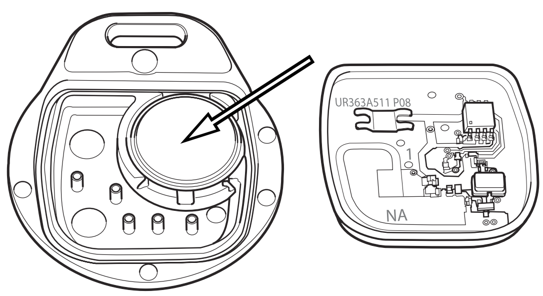

Figure 5-23. Key Fob Battery: TSSM

Diagnostic Tips

- Verify that cell phone is not within 3.0 in. (80.0 mm) of key fob.
- Interference from physical surroundings may affect RF transmission. Place fob next to vehicle or move vehicle to a new location and retest.
- See Figure 5-23. Verify that antenna is in OE location and that seat has not been replaced with a metal base seat.
- Check for damage to antenna wire.
- See Figure 5-24. Verify fob battery voltage is at least 2.9V.
- Fob serial number is located inside fob. Open fob by twisting a thin blade in the thumbnail slot between fob halves.

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1. **Battery**
2. **Fob serial number**

Figure 5-24. Open Fob: HFSM

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

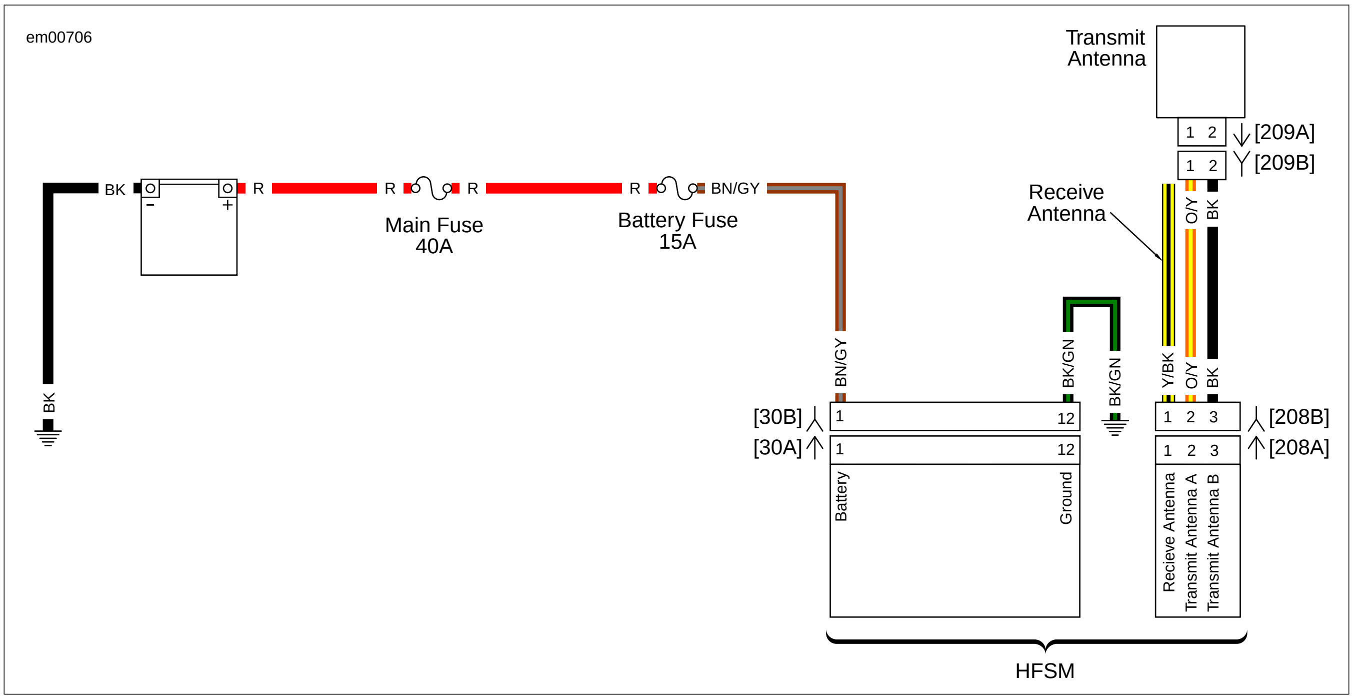


Figure 5-25. Antenna Circuit: HFSM

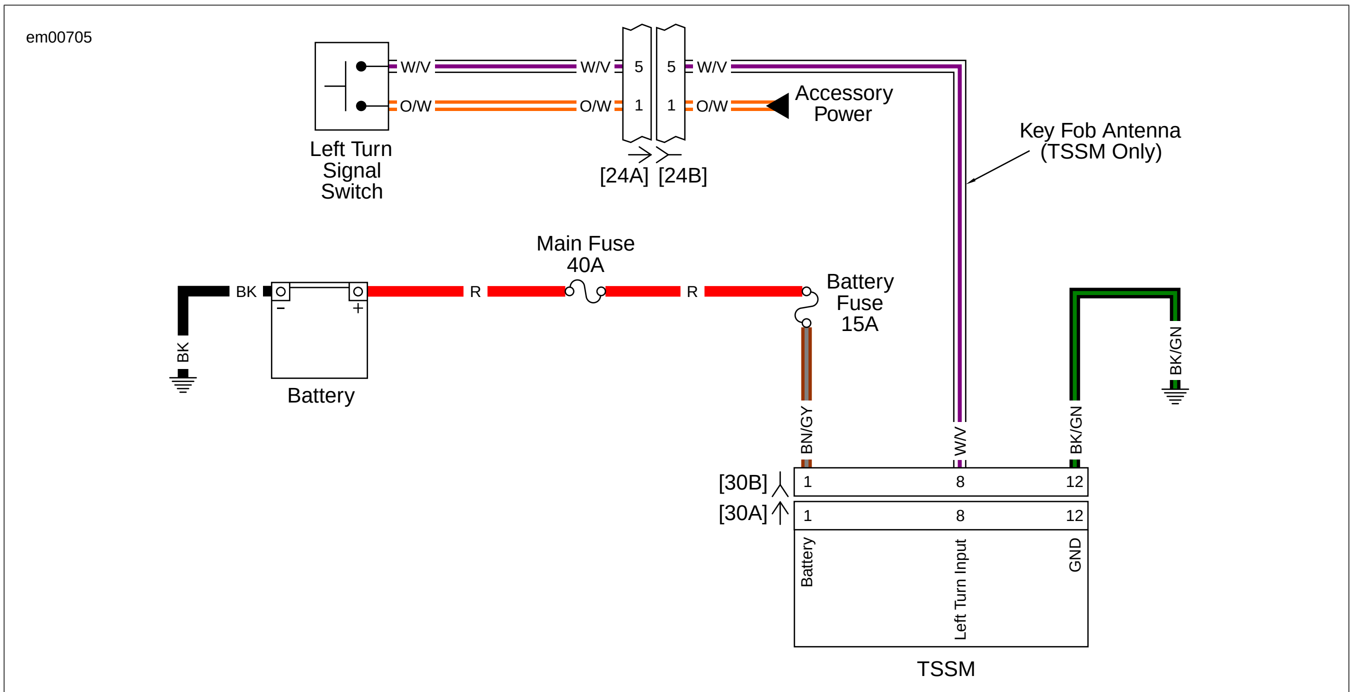


Figure 5-26. Antenna Circuit: TSSM

FAILS TO DISARM: HFSM

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

Table 5-32. Fails to Disarm Diagnostic Faults: HFSM

POSSIBLE CAUSES
Open antenna circuit
Short to ground in antenna circuit
Antenna malfunction
Fob malfunction
HFSM malfunction

1. Fob Test

1. Test all assigned fobs.
2. Does any assigned fob work?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 2.

2. Antenna Circuit Short to Ground Test

1. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [208B] terminal 1 and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground. **(5041)**
   b. **No.** Go to Test 3.

3. Antenna Circuit Open Test

1. Check for continuity between [208B] terminal 1 and end of (Y/BK) wire (pull back conduit to expose unterminated end of wire).
2. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open on (Y/BK) wire. **(5041)**

4. Security System Antenna Test

1. Replace the security antenna with a known good security antenna. See the service manual.
2. Does the security system now disarm?
   a. **Yes.** Replace the security antenna. See the service manual. **(6878)**
   b. **No.** Replace HFSM. See the service manual. **(6757)**

5. Non-Functional Fob Test

1. Check battery on non-functional fob.
2. Is battery voltage greater than 2.9V?
   a. **Yes.** Replace fob. See the service manual. **(6756)**
   b. **No.** Replace battery. See the service manual. **(6755)**

FAILS TO DISARM: TSSM

Table 5-33. Fails to Disarm Diagnostic Faults: TSSM

POSSIBLE CAUSES
Fob malfunction
Fob battery discharged
TSSM malfunction

1. Key Fob Test

1. Verify the key fob is correct for the vehicle.
2. Is the key fob correct for the vehicle?
   a. **Yes.** Go to Test 2.
   b. **No.** Obtain correct fob or replace fob. See the service manual. Verify fob is synchronized to vehicle's TSSM.

2. Left Turn Signal Test

1. Operate the left turn signal.
2. Does left turn signal function?
   a. **Yes.** Go to Test 3.
   b. **No.** See 5.4 TURN SIGNALS.

3. Fob Battery Test

1. Replace fob battery and retest. See the service manual.
2. Does fob work?
   a. **Yes.** System OK. **(6755)**
   b. **No.** Go to Test 4.

4. TSSM Test

1. Attempt to assign new fob to TSSM and retest.
2. Does fob work?
   a. **Yes.** System OK. **(6756)**
   b. **No.** Replace TSSM. See the service manual. **(6757)**

DTC B1131, B1132 5.15

DESCRIPTION AND OPERATION

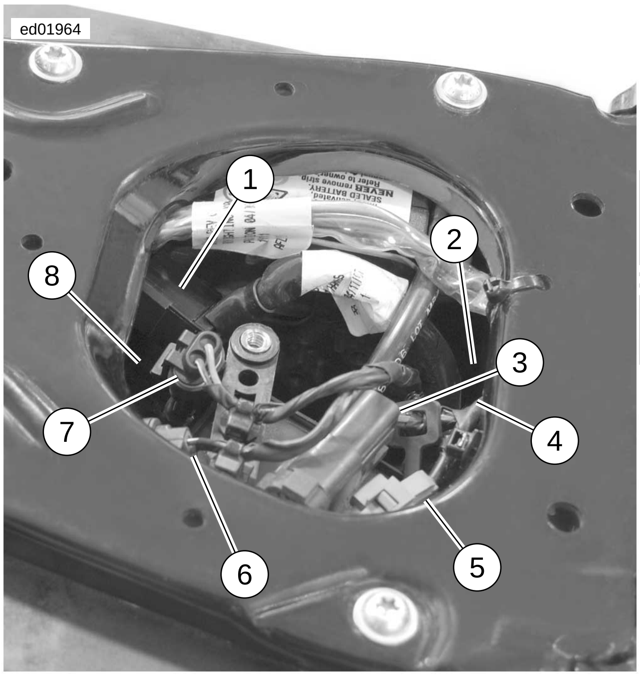
NOTE

This section applies only to those vehicles equipped with the optional security system.

See Figure 5-27. An alarm cycle is activated when the HFSM is connected, the siren has been armed by the HFSM and a security event occurs. See 5.10 SECURITY SYSTEM. Under normal armed operation, the siren input (terminal 2) is driven low by the HFSM to trigger the audible alarm. When the siren input is driven high by the HFSM the audible alarm stops.

Table 5-34. Siren Alarm Output DTCs

DTC	SYMPTOM
B1131	Alarm output low
B1132	Alarm output high



1. **Tail lamp harness to main harness [7]**
2. **Grounds [GND1] & [GND2]**
3. **Accessory [4]**
4. **Security siren [142]**
5. **B+ [160]**
6. **IAT sensor [89]**
7. **Rear O2 sensor [137]**
8. **JSS (HDI only) [133]**

Figure 5-27. Under Seat

Diagnostic Tips

- 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 HFSM, 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 HFSM 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 HFSM output or siren input may be shorted to ground, or the siren vehicle battery connection is open or shorted to ground, or the siren vehicle ground connection is open, or a security event has occurred. See 5.10 SECURITY SYSTEM for a description of alarm functions.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

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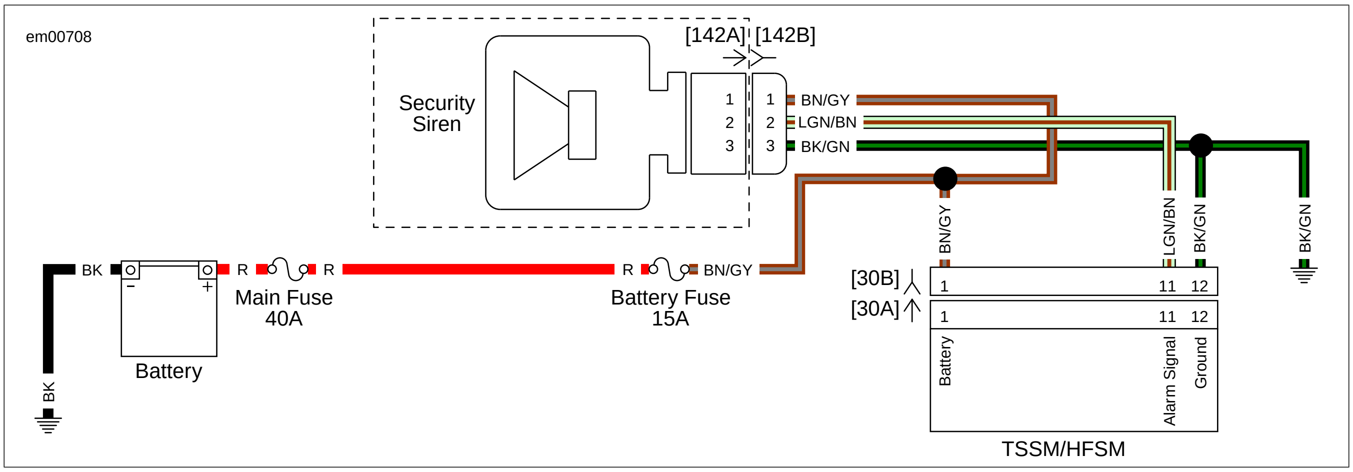


Figure 5-28. Smart Siren Circuit

DTC B1131

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-35. DTC B1131 Diagnostic Faults

POSSIBLE CAUSES
Short to ground in alarm signal
Open ground circuit
Open power circuit
TSSM/HFSM malfunction
Open alarm signal
Siren malfunction

1. Siren Verification Test

1. Disarm the security system.
2. Inspect the vehicle for a security siren.
3. Is a security siren present?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 2.

2. Alarm Signal Short to Ground Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between breakout box terminals 11 and 12.
3. Is continuity present?
   a. **Yes.** Repair short to ground in (LGN/BN) wire between [142B] terminal B and [30B] terminal 11.
   b. **No.** Replace the TSSM/HFSM. See the service manual.

3. Battery Circuit Test

1. Remove the security siren.
2. With IGN ON, and the engine stop switch in the RUN position, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for battery voltage at [142B] between terminals A and C.
3. Is battery voltage present?
   a. **Yes.** Go to Test 5.
   b. **No.** Go to Test 4.

4. Power Supply and Ground Test

1. Test for battery voltage between [142B] terminal A and ground.
2. Is battery voltage present?
   a. **Yes.** Repair open in (BK) ground wire between [142B] terminal C and ground.
   b. **No.** Repair open in (BN/GY) wire.

5. Alarm Signal Circuit Open Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [142B] terminal B and breakout box terminal 11.
3. Is continuity present?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair open in (LGN/BN) wire between [142B] and [30B].

6. Alarm Signal Short to Ground Test

1. Test for continuity between breakout box terminals 11 and 12.

2. Is continuity present?
   a. **Yes.** Repair short to ground in (LGN/BN) wire.
   b. **No.** Go to Test 7.

7. Security Siren Resistance Test

1. Measure resistance at [142A] between terminals B and C.
2. Is the security siren resistance between 40,000-160,000 Ohms?
   a. **Yes.** Go to Test 8.
   b. **No.** Replace the security siren. See the service manual.

8. Security Siren Validation Test

1. Connect and operate the security siren on a known good vehicle.
2. Does the siren function properly with no DTCs set?
   a. **Yes.** Replace the TSSM/HFSM. See the service manual.
   b. **No.** Replace the security siren. See the service manual.

DTC B1132

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-36. DTC B1132 Diagnostic Faults

POSSIBLE CAUSES
Short to ground in alarm signal
Open ground circuit
Open power circuit
TSM/TSSM/HFSM malfunction
Open alarm signal
Siren malfunction

1. Siren Verification Test

1. Disarm the security system.
2. Inspect the vehicle for a security siren.
3. Is a security siren present?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 2.

2. Alarm Signal Circuit Short to Voltage Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between breakout box terminal 11 and ground.
3. Is battery voltage present?
   a. **Yes.** Repair short to voltage in (LGN/BN) wire.
   b. **No.** Replace the TSSM/HFSM. See the service manual.

3. Alarm Signal Short to Voltage Test

1. Disconnect the security siren.
2. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. With IGN ON, test for voltage between breakout box terminal 11 and ground.
4. Is battery voltage present?
   a. **Yes.** Repair short to voltage on LGN/BN wire.
   b. **No.** Replace the TSSM/HFSM. See the service manual.

[HOME](#)

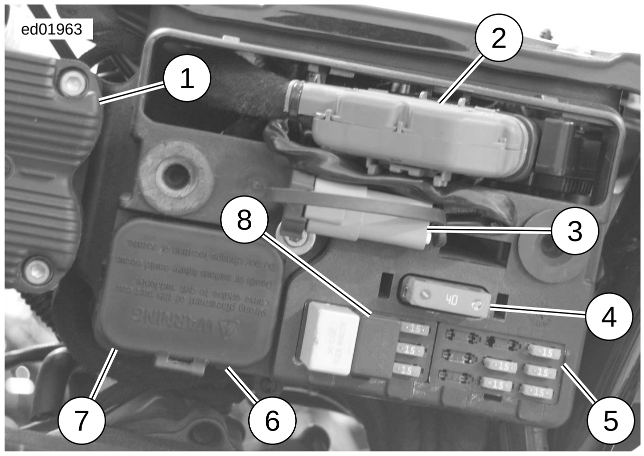
DTC B1134 5.16

DESCRIPTION AND OPERATION

See [Figure 5-29](#). With the TSSM/HFSM (if equipped) disarmed, IGN ON, engine stop switch in the RUN position, and the transmission in neutral or clutch lever pulled in, the start relay is grounded. Battery voltage is applied to the start relay coil which is grounded through the TSM/TSSM/HFSM. DTC B1134 is set when that ground is not established through the TSM/TSSM/HFSM.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see [B.1 CONNECTORS](#).



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 5-29. Under Left Side Cover

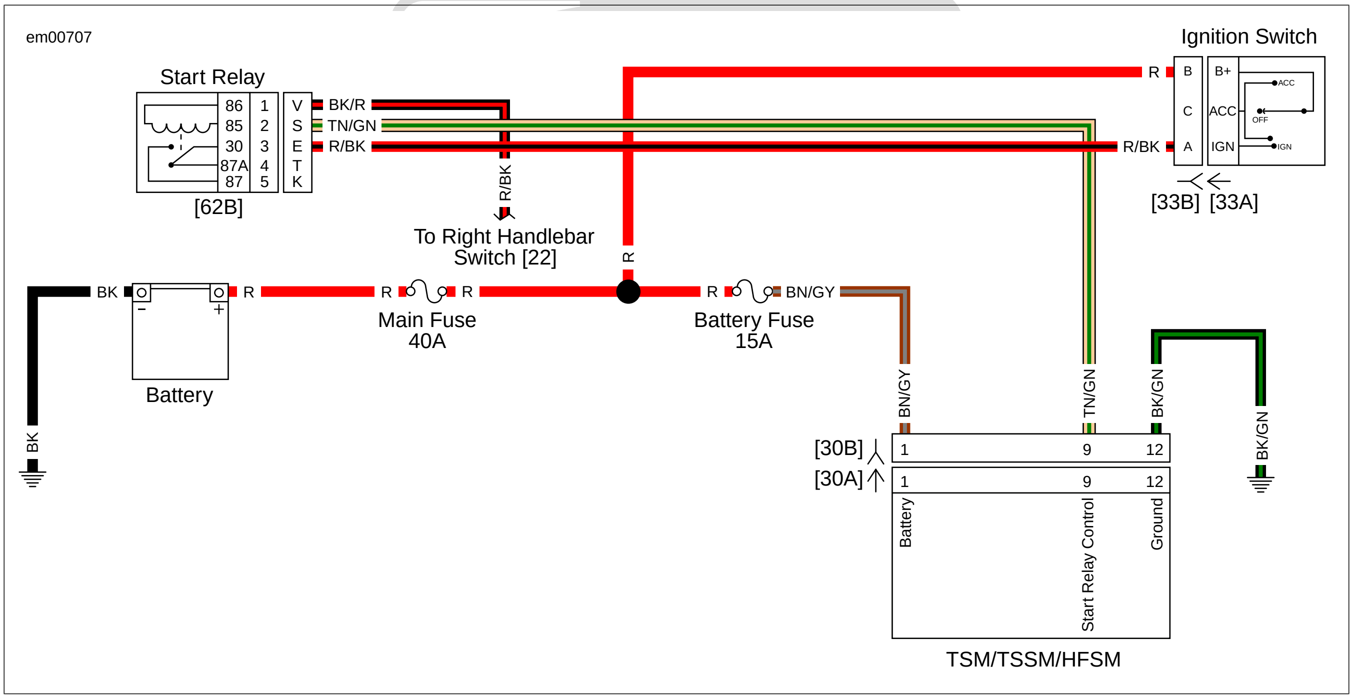


Figure 5-30. Starter TSM/TSSM/HFSM Circuit

DTC B1134

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-37. DTC B1134 Diagnostic Faults

POSSIBLE CAUSES
TSM/TSSM/HFSM malfunction
Start relay malfunction
Short to voltage in start relay control circuit

1. Relay Control Circuit Short to Voltage Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) between wire harness [30B] and TSM/TSSM/HFSM [30A]. See 1.2 DIAGNOSTIC TOOLS.
2. Remove start relay.
3. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage on breakout box (Gray) terminal 9.
4. Is battery voltage present?
   a. **Yes.** Repair short to voltage on (TN/GN) wire.
   b. **No.** Go to Test 2.

2. Start Relay Test

1. Test start relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
2. Does relay pass test?
   a. **Yes.** Replace TSM/TSSM/HFSM. See the service manual.
   b. **No.** Replace start relay. See the service manual.

HOME

DTC B1143, B1144, B1145 5.17

DESCRIPTION AND OPERATION

DTC B1143, B1144, or B1145 will set when a fault occurs to the security antenna circuit used to transmit to the fob. Refer to Table 5-38.

Table 5-38. Security Antenna DTCs

DTC	CONDITION
B1143	Security antenna short-to-ground
B1144	Security antenna short-to-voltage
B1145	Security antenna open

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

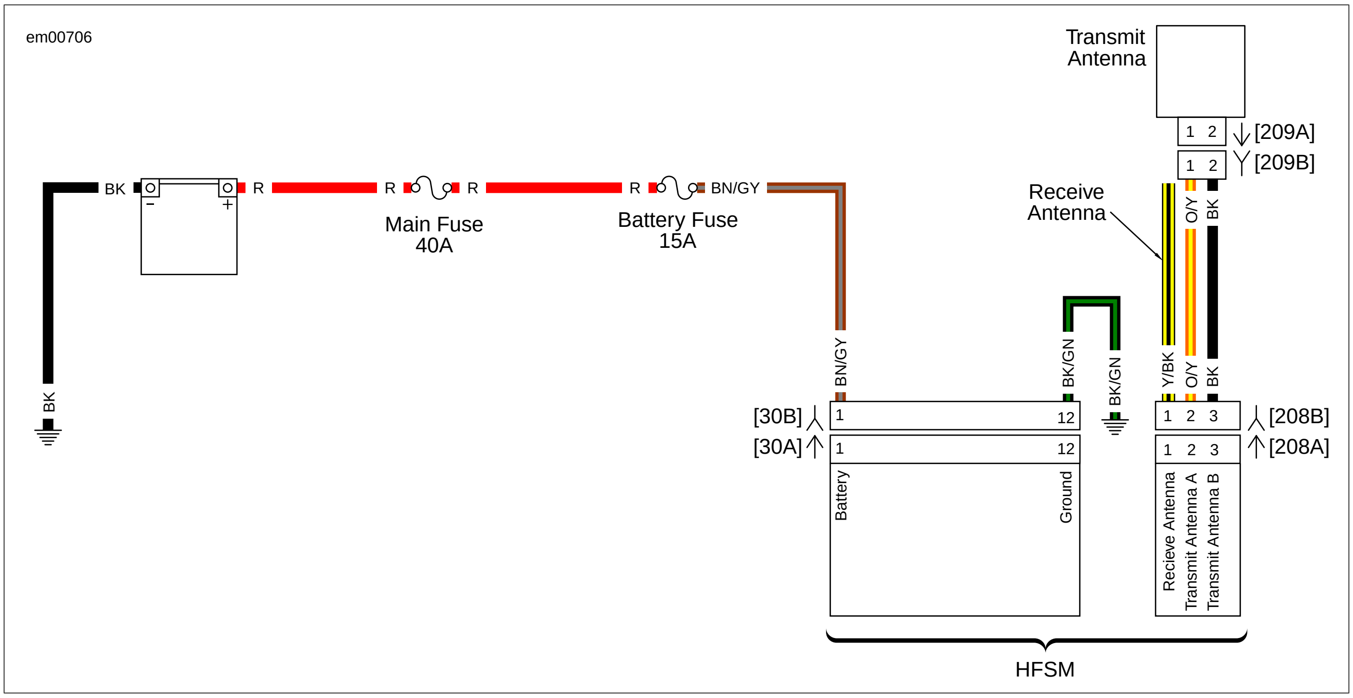


Figure 5-31. Antenna Circuit: HFSM

DTC B1143

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

Table 5-39. DTC B1143 Diagnostic Faults

POSSIBLE CAUSES
Security antenna malfunction
HFSM malfunction
Open antenna circuit

1. Security Antenna Visual Test

1. Inspect the security antenna for damage.
2. Is damage to the security antenna present?
   a. **Yes.** Repair or replace security antenna as needed. See the service manual.
   b. **No.** Go to Test 2.

2. Security Antenna Short to Ground Test

1. Disconnect [208].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between terminal 2 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground in (O/Y) wire.
   b. **No.** Replace the HFSM. See the service manual.

DTC B1144

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

Table 5-40. DTC B1144 Diagnostic Faults

POSSIBLE CAUSES
Security antenna malfunction
HFSM malfunction
Short to voltage in antenna circuit

1. Security Antenna Visual Test

1. Inspect the security antenna for damage.
2. Is damage to the security antenna present?
   a. **Yes.** Repair or replace security antenna as needed. See the service manual.
   b. **No.** Go to Test 2.

2. Security Antenna Short to Voltage Test

1. Disconnect [208].
2. With IGN ON, using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between terminal 2 and ground.
3. Is voltage present?
   a. **Yes.** Repair short to voltage in (O/Y) wire.
   b. **No.** Replace the HFSM. See the service manual.

DTC B1145

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

Table 5-41. DTC B1145 Diagnostic Faults

POSSIBLE CAUSES
Security antenna malfunction
HFSM malfunction
Open antenna circuit

1. Security Antenna Resistance Test

1. Disconnect [209].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance at [209A] between terminals 1 and 2.
3. Is resistance greater than 5700 Ohms?
   a. **Yes.** Replace the security antenna. See the service manual.
   b. **No.** Go to Test 2.

2. Antenna B Circuit Open Test

1. Disconnect [208].
2. Test for continuity between [208B] terminal 3 and [209B] terminal 2.
3. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open in (BK) wire.

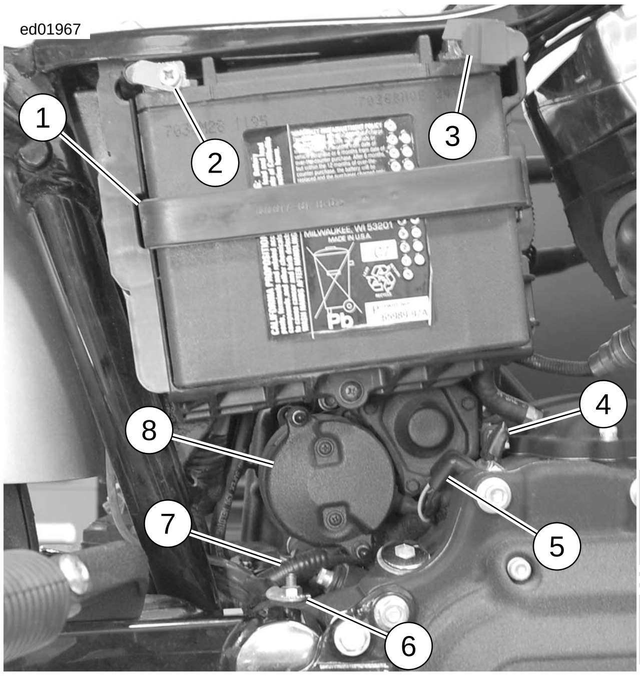
3. Antenna A Circuit Open Test

1. Test for continuity between [208B] terminal 2 and [209B] terminal 1.
2. Is continuity present?
   a. **Yes.** Replace the HFSM. See the service manual.
   b. **No.** Repair open in (O/Y) wire.

DTC B1154, B1155 5.18

DESCRIPTION AND OPERATION

The TSM/TSSM/HFSM monitors the clutch and neutral switch circuits to determine if it is safe to let the vehicle start. If the TSM/TSSM/HFSM does not see that the clutch switch is closed (lever pulled in) or the neutral switch is closed (transmission in neutral) it will not activate the start relay. The TSM/TSSM/HFSM controls the start relay by supplying the ground circuit to the coil of the start relay.



1. **Battery**
2. **Battery negative**
3. **Battery positive**
4. **Starter solenoid [128]**
5. **Neutral switch [131]**
6. **Battery ground cable**
7. **VSS [65]**
8. **Starter**

Figure 5-32. Under Right Side Cover

Diagnostic Tips

DTCs B1154 and B1155 will set when either the clutch switch circuit or neutral switch circuit is shorted to ground at speeds greater than 10 mph (16 km/h) for more than 60 seconds. Refer to Table 5-42.

Table 5-42. Clutch/Neutral Switch DTCs

DTC	SYMPTOM
B1154	Clutch switch short-to-ground
B1155	Neutral switch short-to-ground

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

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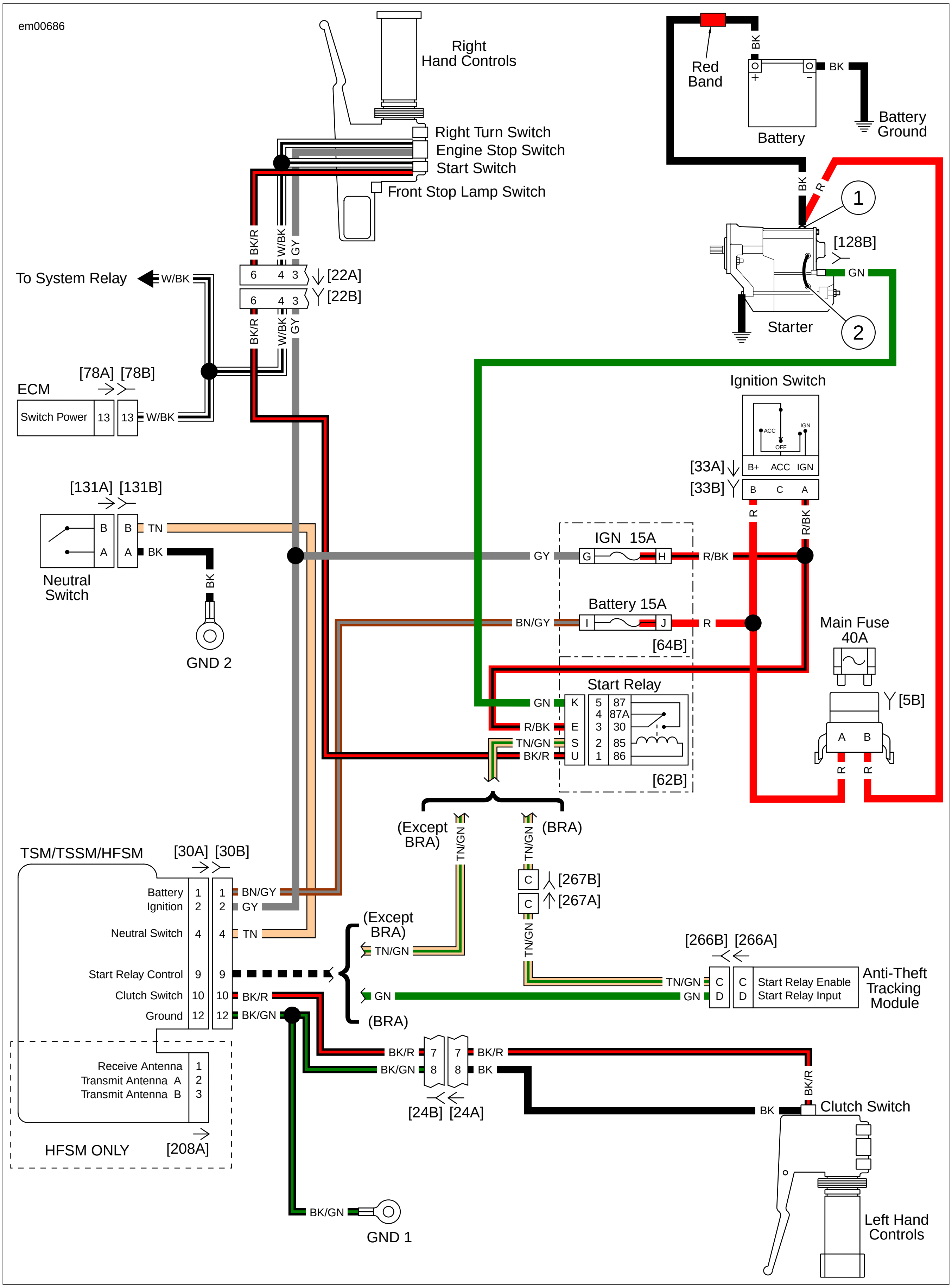

Figure 5-33. Starting Circuit

DTC B1154

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-43. DTC B1154 Diagnostic Faults

POSSIBLE CAUSES
TSM/TSSM/HFSM malfunction
Switch malfunction
Short to ground in clutch switch circuit

NOTE

This DTC may occur if the vehicle is ridden with clutch disengaged (pulled in) at speeds greater than 10 mph (16 km/h) for more than 60 seconds (coasting down a long mountain road).

1. Clutch Circuit Short to Ground Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSM/TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between breakout box (Gray) terminal 10 and terminal 12.
3. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual.

2. Clutch Switch Circuit Test

1. Disconnect [24].
2. Test for continuity between breakout box (Gray) terminal 10 and terminal 12.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (BK/R) wire in main wiring harness between [30B] and [24B].
   b. **No.** Go to Test 3.

3. Clutch Switch Test

1. Inspect left handlebar switch wiring for a short to ground.
2. Was a short to ground present?
   a. **Yes.** Repair short to ground in left handlebar switch wiring.
   b. **No.** Replace clutch switch. See the service manual.

DTC B1155

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-42682	BREAKOUT BOX

Table 5-44. DTC B1155 Diagnostic Faults

POSSIBLE CAUSES
TSM/TSSM/HFSM malfunction
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 10 mph (16 km/h) for more than 60 seconds (coasting down a long mountain road).

1. Neutral Circuit Short to Ground Test

1. Shift the transmission into 1st or 2nd gear.
2. With IGN OFF, connect BREAKOUT BOX (Part No. HD-42682) to wire harness [30B], leaving TSM/TSSM/HFSM [30A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between breakout box (Gray) terminal 4 and terminal 12.
4. Is resistance less than 10 Ohms?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace TSM/TSSM/HFSM. See the service manual.

2. Neutral Switch Short to Ground Test

1. Disconnect [131].
2. Measure resistance between breakout box (Gray) terminal 4 and terminal 12.
3. Is resistance less than 10 Ohms?
   a. **Yes.** Repair short to ground on (TN) wire.
   b. **No.** Replace neutral switch. See the service manual.

NOTES

TABLE OF CONTENTS

NOTES

EFI SYSTEM 6.1

GENERAL

This chapter describes the operation of the Harley-Davidson EFI System. It is essential to have a working knowledge of the many components surrounding the engine to accurately troubleshoot and correct problems that may occur. 6.2 ELECTRONIC CONTROL MODULE and 6.3 SENSORS AND DRIVERS briefly explain the operation of the ECM and function of the various sensors and drivers. See 1.2 DIAGNOSTIC TOOLS for instructions on using the test equipment called out in the diagnostic test procedures in this chapter.

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

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

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

- Crank Position (CKP) sensor
- Throttle Position Sensor (TPS)
- Jiffy Stand Sensor (JSS) (HDI only)
- Turn Signal Module (TSM) or optional, factory-installed Turn Signal Security Module (TSSM Japan/Korea only) or Hands-Free Security Module (HFSM). This includes an integrated Bank Angle Sensor (BAS).
- Clutch switch
- Neutral switch
- Engine Temperature (ET) sensor
- Vehicle Speed Sensor (VSS)
- Oxygen (O2) Sensor
- Manifold Absolute Pressure (MAP)
- Intake Air Temperature (IAT) sensor

EFI Operation

The EFI system operates as an open or closed loop system, allowing it to adjust for all possible operating conditions. During open loop operation, the system uses programmed fuel and spark maps in the ECM providing easy cold starting and maximum power at Wide Open Throttle (WOT). The adaptive fuel value, learned during closed loop operation, is applied to open loop operation to adjust fuel and spark maps for optimal performance.

During closed loop operation, the O2 sensors provide input for an optimal air/fuel mixture resulting in reduced emissions, good fuel economy, and smooth power. O2 sensors must be at the normal operating temperature of the engine.

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

Symptom Diagnostics

Sections 6-4 through 6-21 contain diagnostic test procedures for DTCs listed in 2.1 INITIAL DIAGNOSTICS. For symptoms of engine malfunctions not specifically covered by DTCs, refer to tables 6-1 through 6-3 and sections 6-22 through 6-26.

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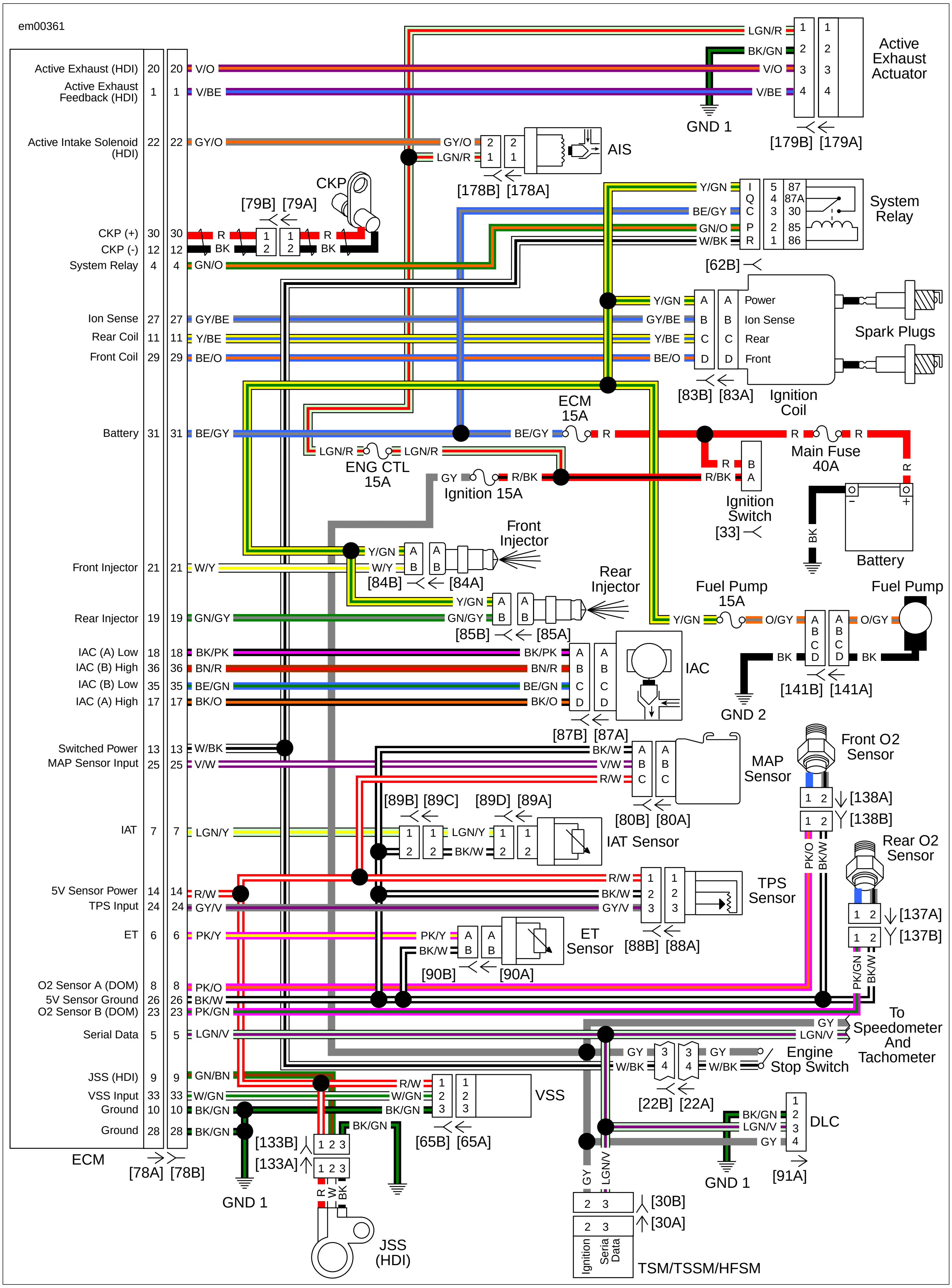
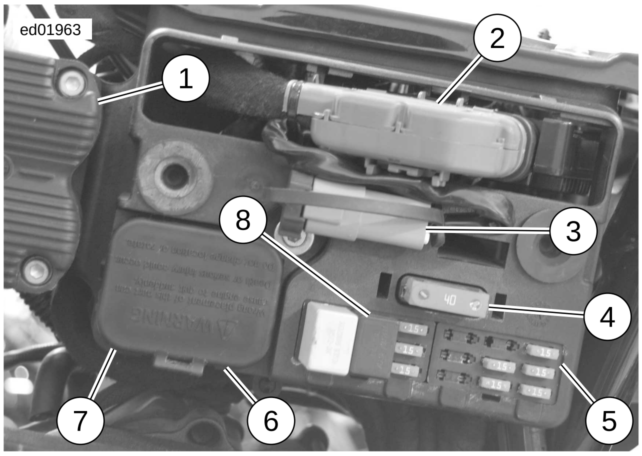


Figure 6-1. EFI Simplified Schematic

ELECTRONIC CONTROL MODULE 6.2

GENERAL

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



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 6-2. Under Left Side Cover

ECM

The ECM is mounted under the left side cover. It computes the spark advance for proper ignition timing and fuel control based on sensor inputs (from CKP, MAP, and TPS 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 has added protection against transient voltages, continuous reverse voltage protection, and damage due to jump starts.) The ECM is fully enclosed to protect it from vibration, dust, water or oil. This unit is a non-repairable item. If it fails, it must be replaced. When the ECM is replaced, see the service manual.

32-2 Crankshaft

The crankshaft has 32 teeth evenly spaced around its circumference with two consecutive teeth missing (sync gap). In this configuration, the ECM determines engine position, engine phase, and engine speed from the CKP sensor input. Phase (TDC compression) is determined by the ECM during startup and, when necessary, while running. No engine ignition events can occur until the ECM determines the relationship of piston position to crankshaft position. The following paragraphs in this section describe synchronization and phasing by the ECM to provide smooth operation of the engine at all speeds.

Crank Position Signal Synchronization

In the 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.

Engine Phase

Phasing is accomplished by the ECM identifying a widening in the CKP signal caused by the deceleration of the crankshaft, as a piston approaches TDC on its compression stroke. Since the rear cylinder approaches TDC earlier than the front cylinder, engine phase can be readily discriminated. Phasing is normally accomplished on the first TDC cycle after engine synchronization. Once phased, the ECM can begin normal ignition events. If the ECM experiences a system reset or loss of synchronization while the engine is running it also loses phase.

When phase is lost one of the following occurs:

- If an engine-not-running (Crank Mode) RPM is detected, the ECM executes the normal start-up phasing process.
- If Engine Run Mode is detected, the ECM executes a running re-phase sequence.

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

Engine Run Mode

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

SENSORS AND DRIVERS 6.3

DESCRIPTION AND OPERATION

Sensors and drivers play an important part in the ECM's ability to provide the proper operational parameters for engine efficiency, emissions control, and fuel economy. When a failure occurs, a DTC is generated by, and stored in, the ECM. These codes help the technician diagnose engine trouble to the proper sensor or driver. See 2.1 INITIAL DIAGNOSTICS.

SENSORS

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

Crank Position (CKP) Sensor

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

Throttle Position Sensor (TPS)

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

Jiffy Stand Sensor (JSS): HDI Only

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 is engaged. Otherwise, the engine stalls as the clutch is released with the transmission in gear.

Bank Angle Sensor (BAS)

The BAS is within the TSM/TSSM/HFSM. The TSM/TSSM/HFSM will shut the engine down if the vehicle is tipped over. 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 serial data circuit.

Clutch Switch

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

Neutral Switch

The indicators provide 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 TSM/TSSM/HFSM will not allow the engine to start unless the transmission is in neutral or the clutch is engaged.

Engine Temperature (ET) Sensor

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] 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 ECM also uses the sensor input as a reference for determining Idle Air Control (IAC) pintle position.

Manifold Absolute Pressure (MAP) Sensor

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 CKP sensor is present.

Intake Air Temperature (IAT) Sensor

The IAT sensor is a thermistor device. As such, it will have a specific resistance across its terminals at a specific temperature. As the temperature varies, the thermistor resistance varies, and so does the voltage on ECM [78] terminal 7.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on ECM [78] terminal 7.
- At low temperatures, the resistance is very high, allowing the voltage to rise close to 5V. The ECM monitors this voltage to compensate for various operating conditions.

Vehicle Speed Sensor (VSS)

The VSS is a Hall-effect device mounted close to the teeth of the 5th gear in the transmission. The output signal frequency varies with vehicle speed. The ECM processes the vehicle speed signal and transmits it via the serial data circuit to the speedometer to indicate vehicle speed.

O2 Sensor (Front and Rear)

The O2 sensor detects unburned oxygen in the engine exhaust. The output of the sensor is a voltage having a range of about 0-1.0V. 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.

It is important to note the O2 sensor does not operate efficiently until it is at vehicle operating temperature. Therefore, before any troubleshooting takes place, bring the sensor to operating temperature. Leaks in the exhaust system, leaky exhaust valves, misfires, or any engine problem allowing unburned oxygen into the exhaust stream could create a DTC indicating a bad sensor. Look for problems related to an improper air/fuel mixture before replacing the sensor.

DRIVERS

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

Fuel Pump

The fuel pump, located inside the fuel tank, is provided battery voltage when the system relay is activated.

Ignition Coils and Spark Plugs

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

See Figure 6-1. Each cylinder has its own ignition coil which is provided power by the system relay. Each coil is controlled independently by the ECM.

Fuel Injectors

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

Idle Air Control (IAC)

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

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

Start Relay

Pressing the start switch activates the start relay, sending battery voltage to the starter solenoid. The TSM/TSSM/HFSM controls the ground to the start relay, disabling it during security and tip over conditions.

Active Intake Solenoid (AIS): HDI Only

The AIS regulates the amount of air entering the air cleaner. The AIS opens when vehicle speed exceeds 45 mph (70 km/h) with 50% or greater throttle opening. Once open, active intake will close when vehicle speed falls below 40 mph (65 km/h).

Active Exhaust Actuator: HDI Only

The active exhaust system utilizes an actuator valve located in the rear exhaust pipe which is connected to a servo motor via a cable. The valve position automatically adjusts to enhance engine performance.

Table 6-1. Engine Starts Hard

CAUSE	SOLUTION
Engine temperature circuit	Repair the circuit. If DTC P0117 or P0118 is present, diagnose and correct DTCs.
Fuel or Ignition system fault	Perform misfire diagnostics.
Battery discharged	Charge and test the battery. Perform charging system diagnosis if problem continues.
Crank position sensor circuit	Repair the circuit. If DTC P0373 or P0374 is present, diagnose and correct DTC.
Manifold leak	Perform intake leak test. See the service manual.
Ignition coil circuit/spark plugs	Repair the circuit. If DTC P1351, P1352, P1354, or P1355 is present, diagnose and correct DTCs.
Leaky injectors	Check for mechanical failures of the fuel injectors. If DTC P0261, P0262, P0263, or P0264 is present, diagnose and correct them.
Valve sticking	Perform compression test. See the service manual.

Table 6-2. Engine Performance Problems

CAUSE	SOLUTION
Engine temperature circuit	Repair the circuit. If DTC P0117 or P0118 are present, diagnose and correct DTCs.
Crank position sensor circuit	Repair the circuit. If DTC P0373 and P0374 are present, diagnose and correct DTC.
Fuel or Ignition system fault	Perform misfire diagnostics.
Manifold Leak **Note:** If manifold leak is large enough, the IAC closes and DTC P0505 sets.	Perform intake leak test. See the service manual.
Clogged fuel injectors	Clean or replace fuel injectors. See the service manual.
Throttle plates not opening fully	Perform Throttle Cable Adjustment. See the service manual.
Fuel system contaminated	Drain and refill with fresh fuel.

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

CAUSE	SOLUTION
Engine temperature circuit	Repair the circuit. If DTC P0117 or P0118 are present, diagnose and correct DTCs.
Clogged air filter	Replace air filter.
Leaky injectors	Repair the circuit. If DTC P0261, P0262, P0263, or P0264 are present, diagnose and correct DTCs.
IAT sensor circuit	Repair the circuit. If DTC P0112 or P0113 are present, diagnose and correct DTCs.

DTC P0107, P0108 6.4

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-23738	VACUUM PUMP

See Figure 6-3. The MAP sensor is supplied 5V from the ECM terminal 14 and sends a signal back to the ECM terminal 25. This signal varies in accordance with engine vacuum and atmospheric barometric pressure. Changes in barometric pressure are influenced by weather and altitude.

Table 6-4. Code Description

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

Diagnostic Tips

These codes will set if the MAP sensor signal is out of range. Code P0108 can only be detected with the engine running.

NOTE

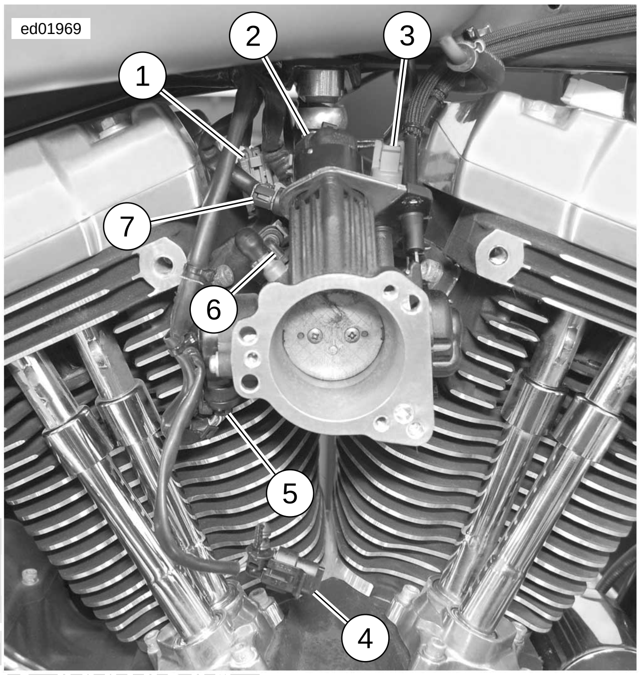
Do not over-pump vacuum pump during MAP sensor output check as sensor damage may result.

- MAP sensor output check. Using the VACUUM PUMP (Part No. HD-23738), apply a vacuum to the pressure port of the MAP sensor. The signal voltage should lower as the vacuum is applied.
- The MAP, JSS, TPS, and VSS are connected to the same 5V reference line. If the reference line shorts to ground or opens, multiple codes will be set (DTC P0107, P0108, P0122, P0123, P1501, P1502).
- 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 DTC's will be set as each sensor is disconnected, clear DTC's after this test. Be sure to perform this test before replacing a component.
- MAP sensor codes may be set in cases of an intermittent TPS which has not yet set TPS codes.

See Figure 6-4 for common 5V sensor power and ground interconnections.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.



1. **Rear fuel injector [85]**
2. **IAC [87]**
3. **Front fuel injector [84]**
4. **Active intake solenoid (HDI) [178]**
5. **TPS [88]**
6. **IAT sensor [89]**
7. **MAP sensor [80]**

Figure 6-3. Between Cylinders Right Side

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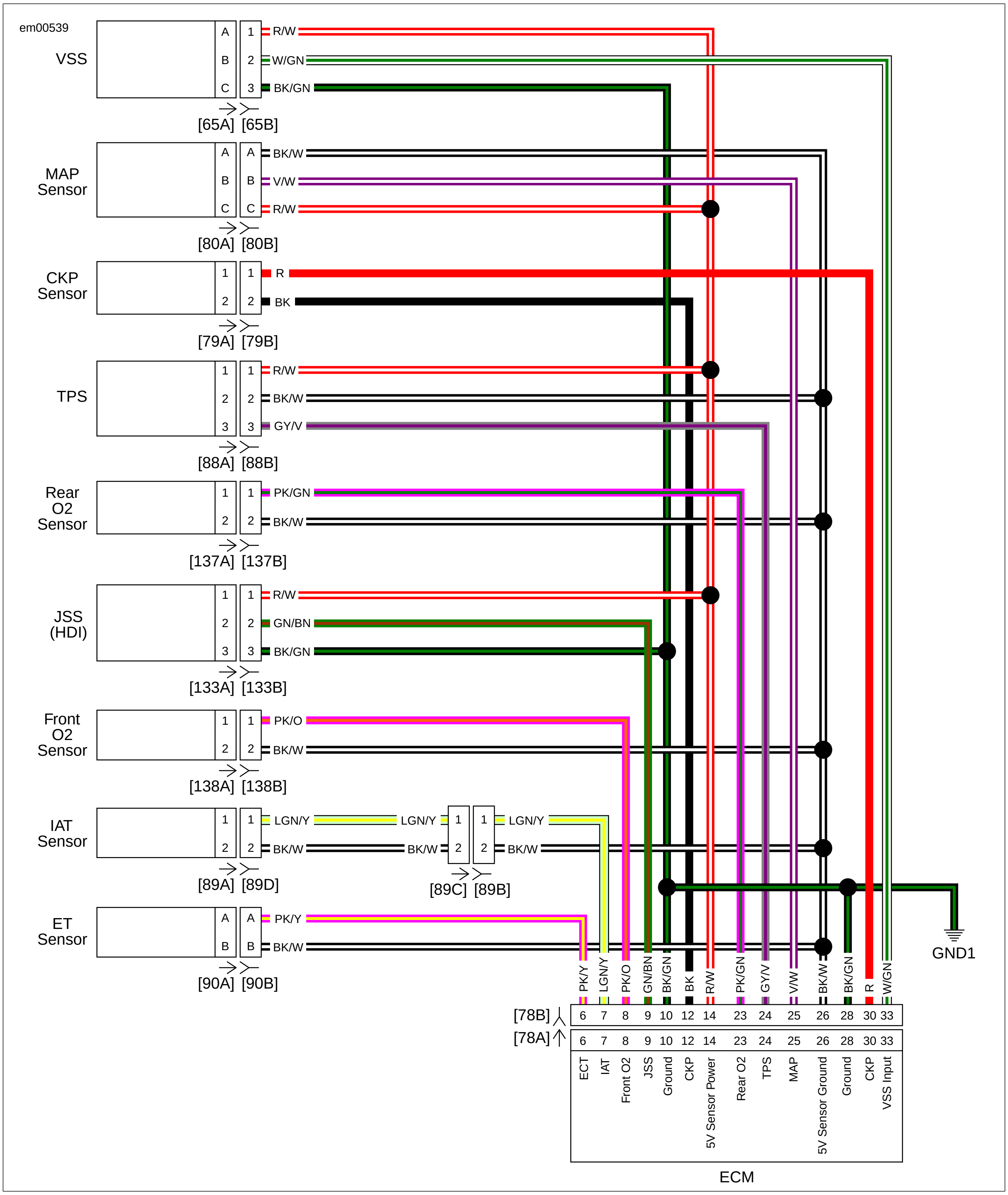


Figure 6-4. Sensor Circuit

DTC P0107

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-5. DTC P0107 Diagnostic Faults

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

1. MAP Sensor Test

1. Disconnect the MAP sensor [80].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect a test wire between [80B] terminals B and C.
3. Clear DTC P0107. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
4. Turn IGN OFF and ON.
5. Does the DTC P0107 reset?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the MAP sensor. See the service manual.

2. MAP Sensor Signal Voltage Test

1. Remove the test wire
2. With IGN ON, test for voltage from [80B] terminal C to ground.
3. Is voltage approximately 5V?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 6.

3. MAP Sensor Signal Wire Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between [80B] terminal B and breakout box terminal 25.
3. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (V/W) wire.

4. MAP Sensor Signal Wire Shorted to Ground Test

1. Test for continuity between breakout box terminal 25 and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground in (V/W) wire.
   b. **No.** Go to Test 5.

5. MAP Sensor Signal Wire Shorted to Sensor Ground Test

1. Turn IGN OFF.
2. Test for continuity between breakout box terminals 25 and 26.
3. Is continuity present?
   a. **Yes.** Repair short between (V/W) and (BK/W) wires.
   b. **No.** Replace the ECM. See the service manual.

6. MAP Sensor 5V Reference Wire Open Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between [80B] terminal C and breakout box terminal 14.
3. Is continuity present?
   a. **Yes.** Go to Test 7.
   b. **No.** Repair open in (R/W) wire.

7. MAP Sensor 5V Reference Shorted to Signal Ground Test

1. Test for continuity between breakout box terminals 14 and 26.
2. Is continuity present?
   a. **Yes.** Repair short between the (R/W) and (BK/W) wires.
   b. **No.** Replace the ECM. See the service manual.

DTC P0108

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-6. DTC P0108 Diagnostic Faults

POSSIBLE CAUSES
MAP sensor malfunction
ECM malfunction
Short to voltage

1. MAP Sensor Test

1. Disconnect the MAP sensor [80].
2. Clear DTC P0108. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
3. Start engine.

4. Does the DTC P0108 reset?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 4.

2. MAP Sensor Signal Wire Short to 5V Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B]. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between breakout box terminals 14 and 25.
3. Is continuity present?
   a. **Yes.** Repair short between (R/W) and (V/W) wires.
   b. **No.** Go to Test 3.

3. MAP Sensor Signal Wire Short to Voltage Test

1. With IGN ON, test for voltage on breakout box terminal 25.
2. Is voltage present?
   a. **Yes.** Repair short to voltage in (V/W) wire.
   b. **No.** Go to Test 4.

4. MAP Sensor 5V Reference Shorted to Battery Voltage Test

1. With IGN ON, test for voltage between breakout box terminal 14 and ground.
2. Is voltage greater than 5.25V?
   a. **Yes.** Repair short to voltage in (R/W) wire.
   b. **No.** Go to Test 5.

5. MAP Sensor Ground Wire Open Test

1. Test for continuity between [80B] terminal A and breakout box terminal 26.
2. Is continuity present?
   a. **Yes.** Replace the MAP sensor. See the service manual.
   b. **No.** Repair open in (BK/W) wire.

DTC P0112, P0113 6.5

DESCRIPTION

The ECM supplies and monitors a voltage signal on terminal 7 to one side of the IAT sensor. The other side of the IAT sensor is connected to a common sensor ground, which is also connected to the ECM terminal 26.

The IAT sensor is a thermistor device, meaning that at a specific temperature, it will have a specific resistance across its terminals. As this resistance varies, so does the voltage at terminal 7.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on terminal 7.
- 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.

Table 6-7. Code Description

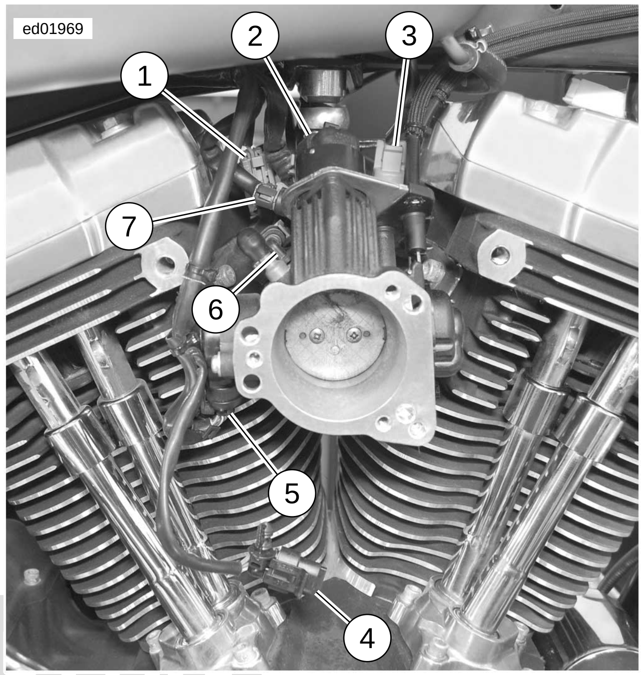
DTC	DESCRIPTION
P0112	IAT sensor voltage low
P0113	IAT sensor open/high

Diagnostic Tips

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

Check the following conditions:

- **Poor connection:** Inspect ECM and harness connector [78] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal- to-wire connection and damaged harness.
- **Perform** 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test **to locate intermittents:** If connections and harness check out OK, use a multimeter to check the IAT sensor voltage while moving related connectors and wiring harness. If the failure is induced, the IAT voltage will change.
- **Shifted sensor resistance value:** Compare the temperatures of the ET and IAT sensors with the engine at ambient temperature in order to evaluate the possibility of a shifted (out of calibration) sensor which may result in driveability problems. The sensor temperatures should be within 10 degrees of each other.



1. **Rear fuel injector [85]**
2. **IAC [87]**
3. **Front fuel injector [84]**
4. **Active intake solenoid (HDI) [178]**
5. **TPS [88]**
6. **IAT sensor [89]**
7. **MAP sensor [80]**

Figure 6-5. Between Cylinders Right Side

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

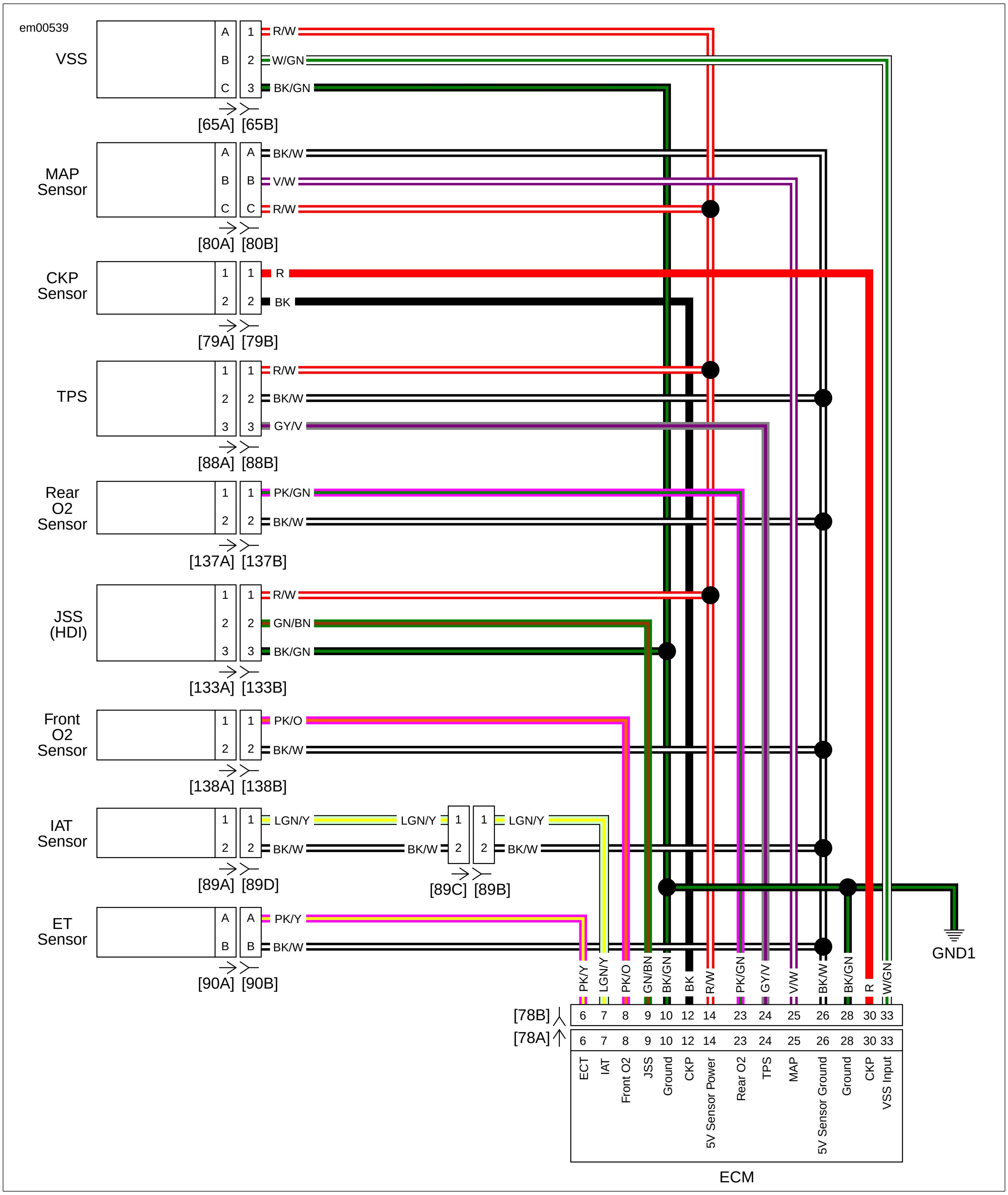


Figure 6-6. Sensor Circuit

DTC P0112

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-8. DTC P0112 Diagnostic Faults

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

1. IAT Sensor Test

1. Disconnect IAT sensor [89].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between terminals 1 and 2 of [89A].
3. Is the resistance reading between 500-5K Ohms with the vehicle and sensor at ambient room temperature?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace IAT sensor. See the service manual.

2. IAT Sensor Signal Wire Shorted to Ground Test

1. Measure resistance between [89B] terminal 1 (LGN/Y), and ground.
2. Is resistance reading less than 1 Ohm?
   a. **Yes.** Repair short to ground.
   b. **No.** Go to Test 3.

3. IAT Sensor Signal Voltage High Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test continuity between breakout box terminals 7 and 10.
3. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair short to ground on (LGN/Y) wire.

4. IAT Sensor Signal Wire Shorted to Sensor Ground Test

1. Test continuity between to breakout box terminals 7 and 26.
2. Is continuity present?
   a. **Yes.** Repair short between terminals 1 and 2 of [89B] (LGN/Y and BK/W) wires.
   b. **No.** Replace ECM. See the service manual.

DTC P0113

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-9. DTC P0113 Diagnostic Faults

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

1. IAT Sensor Test

1. Disconnect IAT sensor [89].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between [89B] terminal 1 (LGN/Y), and ground.
3. Is the voltage reading greater than 6V?
   a. **Yes.** Repair short to voltage on (LGN/Y) wire.
   b. **No.** Voltage is less than 4V. Go to Test 2.

2. IAT Sensor Signal Wire Open Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) to wiring harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between [89B] terminal 1 (LGN/Y) and breakout box terminal 7.
4. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open circuit.

3. IAT Sensor Open Ground Wire Test

1. Test for continuity between breakout box terminal 26 and [89B] terminal 2 (BK/W).
2. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (BK/W) wire.

4. IAT Sensor Signal Wire Shorted to Sensor Power Test

1. Test for continuity between breakout box terminals 7 and 14.
2. Is continuity present?
   a. **Yes.** Repair short between (LGN/Y) and (R/W) wires. Verify IAT sensor resistance value and if incorrect replace IAT sensor. See the service manual.
   b. **No.** Replace ECM. See the service manual.

DTC P0117, P0118 6.6

DESCRIPTION AND OPERATION

The ECM supplies and monitors a voltage signal terminal 6 to one side of the ET sensor. The other side of the ET sensor is connected to a common sensor ground, which is also connected to the ECM terminal 26.

The ET sensor is a thermistor device, which means that at a specific temperature it will have a specific resistance across its terminals. As this resistance varies, so does the voltage on terminal 6.

- At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage on 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 ECM also uses the sensor input as a reference for determining IAC pintle position.

Table 6-10. Code Description

DTC	DESCRIPTION
P0117	ET sensor voltage low
P0118	ET sensor open/high

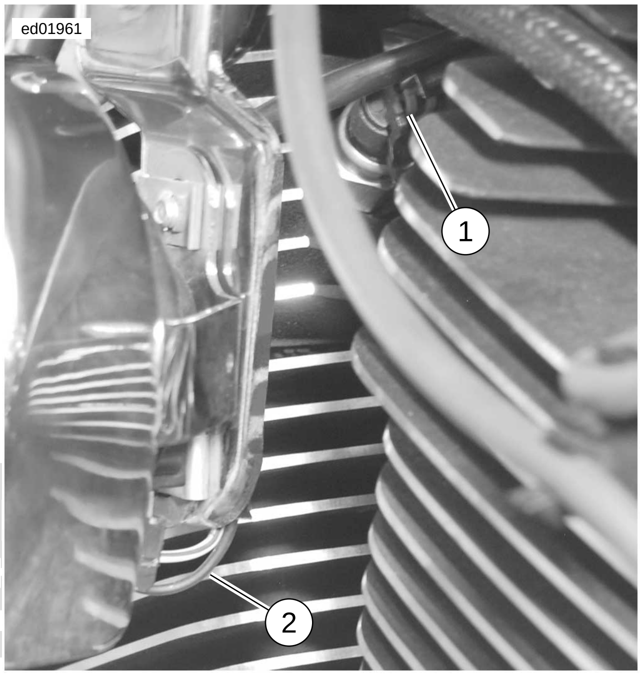
Diagnostic Tips

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

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] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test to locate intermittents:** If connections and harness check out OK, use a multimeter to check the engine temperature reading while moving related connectors and wiring harness. If the failure is induced, the engine temperature display will change.
- **Shifted sensor resistance value:** Compare the temperatures of the ET and IAT sensors with the engine at ambient temperature in order to evaluate the possibility of a shifted (out of calibration) sensor which may result in driveability problems. The sensor temperatures should be within 10 degrees of each other.



1. **ET sensor [90]**
2. **Horn [122]**

Figure 6-7. Horn: Except FXCWC

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

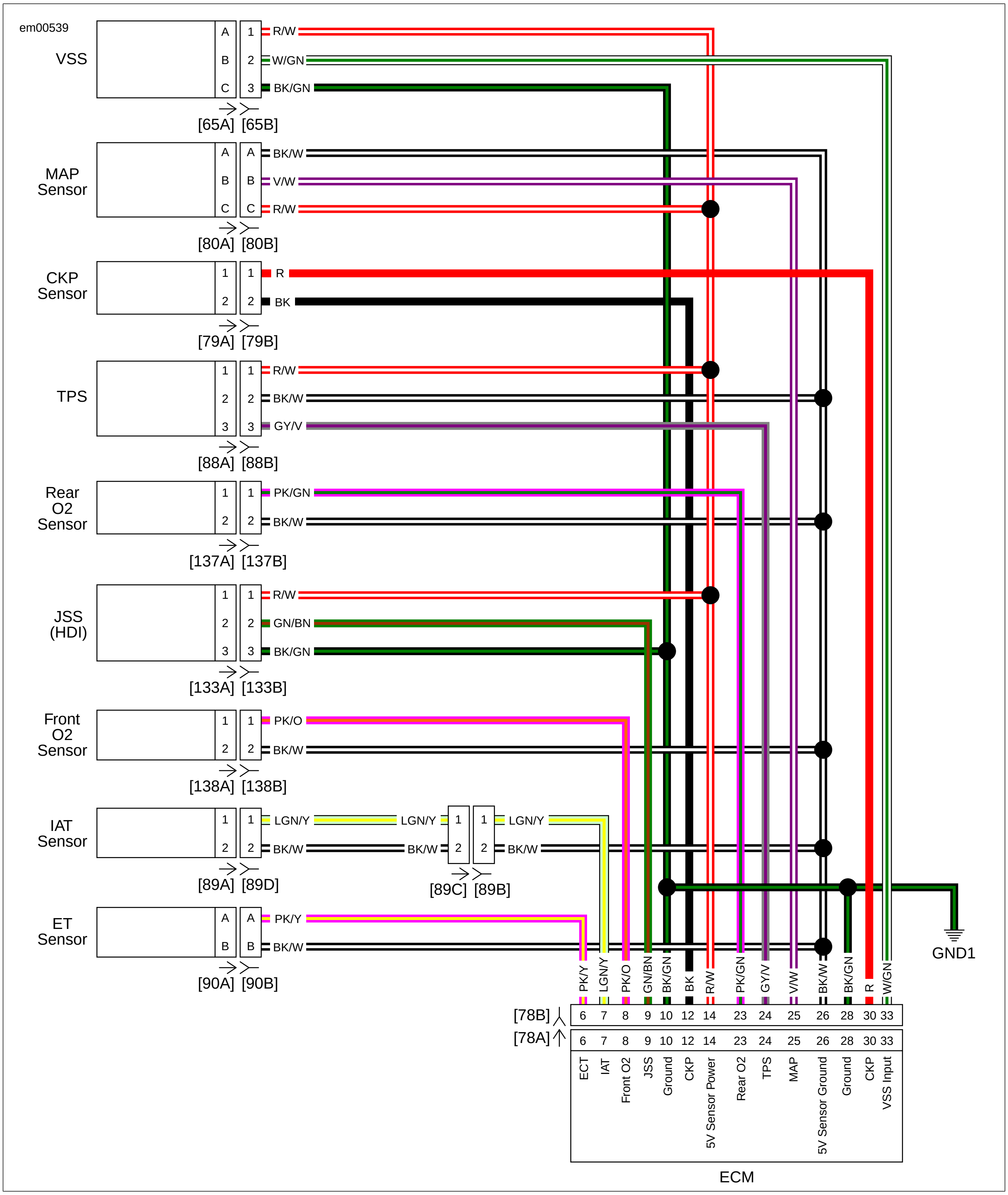


Figure 6-8. Sensor Circuit

DTC P0117

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-11. DTC P0117 Diagnostic Faults

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

1. ET Sensor Test

1. Disconnect ET sensor [90].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure the resistance between [90A] terminals A and B.
3. Is the resistance reading between 900-10K Ohms with the vehicle and sensor at ambient room temperature?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace ET sensor. See the service manual.

2. ET Sensor Signal Wire Shorted to Ground Test

1. Measure resistance between ET sensor [90B] terminal A (PK/Y) and ground.
2. Is resistance reading less than 1 Ohm?
   a. **Yes.** Repair short to ground in (PK/Y) wire.
   b. **No.** Go to Test 3.

3. ET Sensor Signal Wire Shorted to Sensor Ground Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test continuity between to breakout box terminals 6 and 26.
3. Is continuity present?
   a. **Yes.** Repair short between terminal A (PK/Y) and B (BK/W) of [90B] wires.
   b. **No.** Replace ECM. See the service manual.

DTC P0118

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-12. DTC P0118 Diagnostic Faults

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

1. ET Sensor Test

1. Disconnect ET sensor [90].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure the voltage between to ET sensor [90B] terminal A (PK/Y) and ground.
3. Is the voltage reading greater than 6V?
   a. **Yes.** Repair short to voltage on (PK/Y) wire.
   b. **No.** Voltage is less than 4V. Go to Test 2.

2. ET Sensor Signal Wire Open Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) to wiring harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between ET sensor [90B] terminal A (PK/Y) and breakout box terminal 6.
4. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open circuit.

3. ET Sensor Open Ground Wire Test

1. Test for continuity between ET sensor [90B] terminal B (BK/W) and breakout box terminal 26.
2. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (BK/W) wire.

4. ET Sensor Signal Wire Shorted to Sensor Power Test

1. Test for continuity between breakout box terminals 6 and 14.
2. Is continuity present?
   a. **Yes.** Repair short between (PK/Y) and (R/W) wires. Verify ET sensor resistance value and if incorrect replace ET sensor. See the service manual.
   b. **No.** Replace ECM. See the service manual.

DTC P0122, P0123 6.7

DESCRIPTION AND OPERATION

The ECM supplies a 5V signal on terminal 14 to terminal B of the TPS. The TPS sends a signal back to the ECM on terminal 24. The returned signal varies in voltage according to throttle position.

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

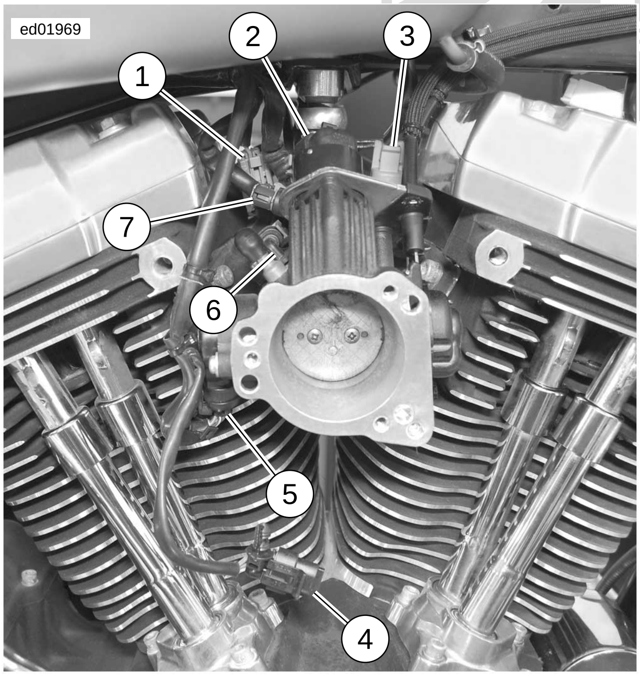
DTC P0122 or P0123 will set if the TPS voltage signal does not fall within the acceptable range.

Table 6-13. Code Description

DTC	DESCRIPTION
P0122	TPS open/low
P0123	TPS high

Diagnostic Tips

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



1. **Rear fuel injector [85]**
2. **IAC [87]**
3. **Front fuel injector [84]**
4. **Active intake solenoid (HDI) [178]**
5. **TPS [88]**
6. **IAT sensor [89]**
7. **MAP sensor [80]**

Figure 6-9. Between Cylinders Right Side

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 DTC's will be set as each sensor is disconnected, clear DTC's after this test. Be sure to perform this test before replacing a component.

NOTE

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

Check for the following conditions:

- **Poor connection:** Inspect ECM harness connector [78B] for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harness.
- **Perform** 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test **to locate intermittents:** If connections and harness check out OK, monitor TPS voltage using a multimeter while moving related connectors and wiring harness. If the failure is induced, the TPS voltage will change.
- **TPS scaling:** Observe the TPS voltage display while opening the throttle with engine stopped and ignition switch ON. Display should vary from closed throttle TPS voltage (when throttle is closed) to greater than 4.0V (when throttle is held wide open). As the throttle is **slowly** moved, the voltage should change gradually without spikes or low voltages being observed.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

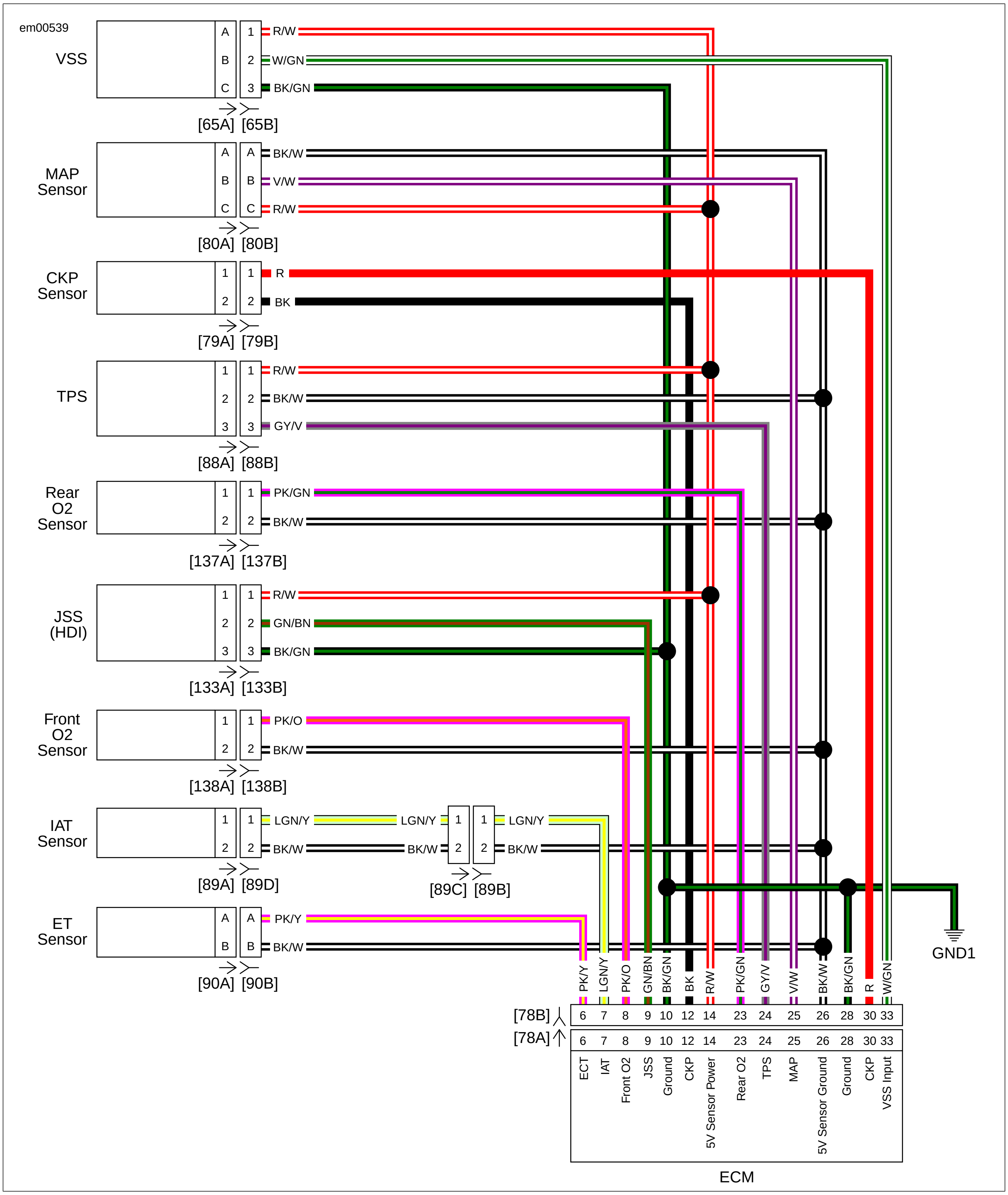


Figure 6-10. Sensor Circuit

DTC P0122

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-14. DTC P0122 Diagnostic Faults

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

1. TPS Test

1. Disconnect the TPS [88].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), connect a test wire across [88B] terminals 1 and 3.
3. Clear DTCs using speedometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
4. Turn IGN OFF and ON.
5. Does the DTC P0122 reset?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the TPS. See the service manual.

2. TPS Signal Voltage Test

1. Remove the test wire.
2. With IGN ON, test for voltage between [88B] terminal 1 and ground.
3. Is voltage approximately 5V?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 6.

3. TPS Signal Wire Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity in (GY/V) wire between [88B] terminal 3 and breakout box terminal 24.
3. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in (GY/V) wire.

4. TPS Signal Wire Shorted to Ground Test

1. Test for continuity in (GY/V) wire between breakout box terminal 24 and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground in (GY/V) wire.
   b. **No.** Go to Test 5.

5. TPS Signal Wire Shorted to Sensor Ground Test

1. Test for continuity between breakout box terminals 24 and 26.
2. Is continuity present?
   a. **Yes.** Repair short between (GY/V) and (BK/W) wires.
   b. **No.** Replace the ECM. See the service manual.

6. TPS 5V Sensor Power Open Wire Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity in (R/W) wire between [88B] terminal 1 and breakout box terminal 14.
3. Is continuity present?
   a. **Yes.** Replace the ECM. See the service manual.
   b. **No.** Repair open in (R/W) wire.

DTC P0123

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-15. DTC P0123 Diagnostic Faults

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

1. TPS Test

1. Disconnect the TPS [88].
2. Clear DTCs using speedometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
3. Turn IGN OFF and ON.
4. Does the DTC P0123 reset?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to Test 4.

2. TPS Signal Wire Short to 5V Test

1. Disconnect the ECM [78].
2. Test for continuity between [88B] terminals 1 and 3.
3. Is continuity present?
   a. **Yes.** Repair short between (R/W) and (GY/V) wires.
   b. **No.** Go to Test 3.

3. TPS Signal Wire Short to Voltage Test

1. With IGN ON, test for voltage on [88B] terminal 3.

2. Is voltage present?
   a. **Yes.** Repair short to voltage in (GY/V) wire.
   b. **No.** Replace the ECM. See the service manual.

4. TPS 5V Shorted to Battery Voltage Test

1. With IGN ON, test for voltage on [88B] terminal 1 and ground.
2. Is voltage greater than 5.25V?
   a. **Yes.** Repair short to voltage in (R/W) wire.
   b. **No.** Go to Test 5.

5. TPS Ground Wire Open Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between [88B] terminal 2 and breakout box terminal 26.
3. Is continuity present?
   a. **Yes.** Replace the TPS. See the service manual.
   b. **No.** Repair open in (BK/W) wire.

DTC P0131, P0132, P0134, P0151, P0152, P0154 6.8

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

See Figure 6-11. The O2 sensor 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 O2 sensor fails.
- A P0132 (front) or P0152 (rear) is set when the ECM detects an excessively rich condition for a specified length of time. DTCs may also set if O2 sensor fails. This condition may also occur with oil contamination.
- A P0134 is set when the front O2 sensor circuit is open or sensor is too cold to respond. A P0154 is set when the rear O2 sensor circuit is open or sensor is too cold to respond. May also occur in cases of extreme oil contamination.

When the air/fuel mixture is ideal, approximately 14.6 parts air to 1 part fuel, the voltage will be approximately 0.45V.

Table 6-16. Code Description

DTC	DESCRIPTION
P0131	Front O2 sensor low or engine running lean
P0132	Engine running rich
P0134	Front O2 sensor open/not responding/high
P0151	Rear O2 sensor low or engine running lean
P0152	Engine running rich
P0154	Rear O2 sensor open/not responding/high

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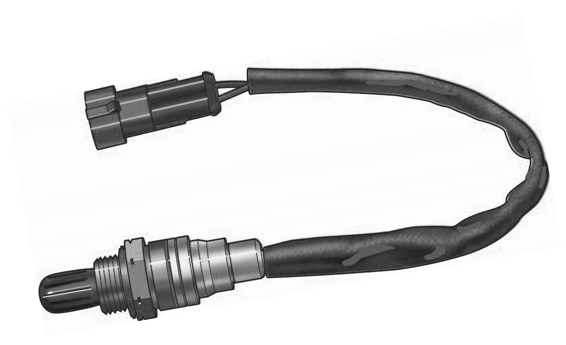


Figure 6-11. O2 Sensor

Diagnostic Tips

O2 sensor diagnostic codes may be seen during the vehicle break-in period. The O2 sensor DTCs will not illuminate the check engine lamp for current or historic codes and will only be indicated by DIGITAL TECHNICIAN II (Part No. HD-48650) or speedometer self-diagnostics. If the DTCs are reported during the break-in period, clear or ignore the codes until the break-in period is completed. All historic O2 sensor DTCs are to be ignored and cleared.

The multimeter displays the signal from the O2 sensor 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 (PK/O) wire (front) and (PK/GN) wire (rear) will cause the engine to run rich (short to ground) or lean (short to voltage) until fault is detected. Once fault is detected, vehicle will run in open loop.

Check for the following conditions:

- **Poor connection:** Inspect the ECM [78], fuel injector [84, 85] and O2 sensor connectors for backed out terminals, improper mating, inoperative locks, improperly formed or damaged terminals, poor terminal-to-wire connection and damaged harnesses.
- **Dirty/stuck open injectors:** The vehicle may run lean (dirty/clogged injectors) or rich (stuck open injectors) if there are injector problems. This could also cause poor fuel economy and performance.
- **Loose O2 sensor:** If an O2 sensor is loose, engine performance may be affected. This could also show up as a slow changing O2 sensor 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 O2 sensor will read a lean condition, causing the system to go rich.
- **Engine misfire:** See 6.26 MISFIRE AT IDLE OR UNDER LOAD.
- **Leaking injectors:** This causes fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air box and air filter. See the service manual. Then, with the throttle wide open, turn IGN ON for 2 seconds and then OFF for 2 seconds five consecutive times. Replace the fuel injector if there is any evidence of raw fuel in the bores. See Fuel Injectors in the service manual.
- **Intake leaks:** See the service manual.
- **High oil usage:** (all O2 sensor codes).

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

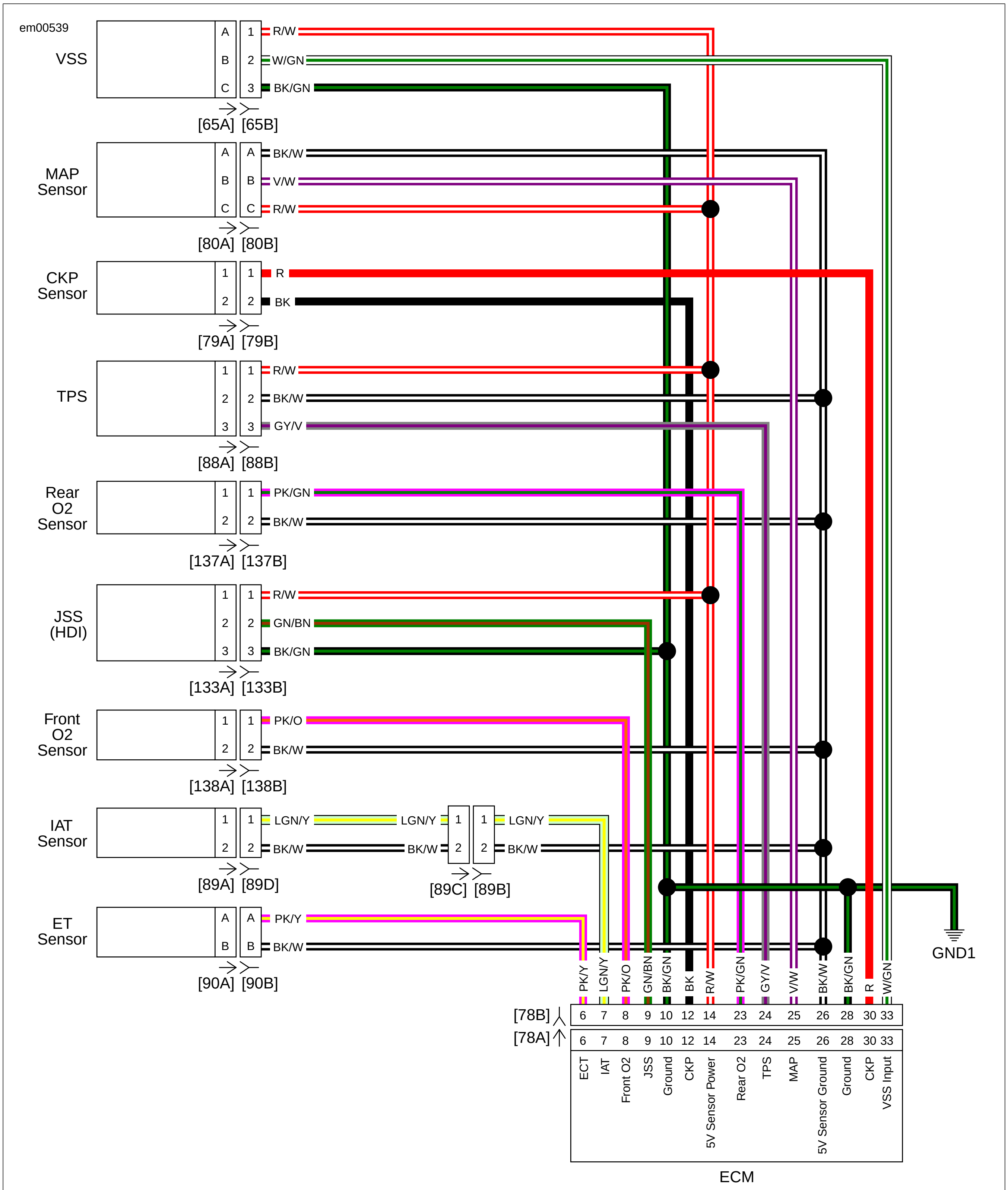


Figure 6-12. Sensor Circuit

DTC P0131

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-17. DTC P0131 Diagnostic Faults

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

1. Front O2 Sensor Test

1. Disconnect front O2 sensor [138].
2. Turn IGN ON.
3. Measure voltage between front O2 sensor [138B] terminal 1 (PK/O), to chassis ground.
4. Is voltage approximately 5V?
   a. **Yes.** Go to Test 4.
   b. **No.** Go to Test 2.

2. Front O2 Sensor Signal Wire Shorted to Sensor Ground Test

1. Turn IGN OFF.
2. Disconnect ECM [78].
3. Test for continuity between front O2 sensor [138B] terminals 1 (PK/O) and 2 (BK/W).
4. Is continuity present?
   a. **Yes.** Repair short between (PK/O) and (BK/W) wires.
   b. **No.** Go to Test 3.

3. Front O2 Sensor Signal Wire Shorted to Ground Test

1. Test for continuity between front O2 sensor [138B] terminal 1 (PK/O) and vehicle ground.
2. Is continuity present?
   a. **Yes.** Repair short between (PK/O) wire and ground.
   b. **No.** If ECM [78] connections are good, replace ECM. See the service manual.

4. Front O2 Sensor Operation Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Connect O2 sensor.
3. Place transmission in neutral, engine stop switch to RUN, and IGN ON. Start engine and allow to reach operating temperature.
4. With engine speed at a steady RPM, measure voltage between breakout box terminals 8 and 26.
5. Is voltage above 0.6V?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** (0.0-0.6V). Perform fuel pressure test. See the service manual. Look for correct ECM calibration, low fuel pressure, air leaks, and dirty injectors. If no issues are found, replace O2 sensor.

DTC P0132

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-18. DTC P0132 Diagnostic Faults

POSSIBLE CAUSES
Front O2 sensor malfunction
ECM malfunction
Fuel system malfunction

1. Front O2 Sensor Operation Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
3. Start the engine and allow it to reach operating temperature.
4. With engine speed at a steady RPM, measure voltage between breakout box terminals 8 and 26.
5. Is voltage less than 0.4V?
   a. **Yes.** Replace the ECM. See the service manual.
   b. **No.** (0.4-1.0V) Perform fuel pressure test. See the service manual. Look for correct ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace the O2 sensor.

DTC P0134

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-19. DTC P0134 Diagnostic Faults

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

1. Front O2 Sensor Signal Wire Short Circuit Voltage Test

1. Disconnect front O2 Sensor [138].
2. Turn IGN ON.

3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between front O2 sensor [138B] terminal 1 to ground.
4. Is voltage greater than 5.5V?
   a. **Yes.** Repair short to voltage on (PK/O) wire.
   b. **No.** (Greater than 4V.) Go to Test 2.
   c. **No.** (Less than 4V.) Go to Test 3.

2. Front O2 Sensor Open Sensor Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between front O2 sensor [138B] terminal 2 (BK/W), and breakout box terminal 26.
4. Is continuity present?
   a. **Yes.** Replace the front O2 sensor. See the service manual.
   b. **No.** Repair open on (BK/W) wire.

3. Front O2 Sensor Signal Wire Open Test

1. Test for continuity between front O2 sensor [138B] terminal 1 (PK/O) and breakout box terminal 8.
2. Is continuity present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open (PK/O) wire.

DTC P0151

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-20. DTC P0151 Diagnostic Faults

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

1. Rear O2 Sensor Test

1. Disconnect rear O2 sensor [137].
2. Turn IGN ON.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between rear O2 sensor [137B] terminal 1 (PK/GN) to ground.
4. Is voltage approximately 5V?
   a. **Yes.** Go to Test 4.
   b. **No.** Go to Test 2.

2. Rear O2 Sensor Signal Wire Shorted to Sensor Ground Test

1. Turn IGN OFF.
2. Disconnect ECM [78].
3. Test for continuity between rear O2 sensor [137B] terminals 1 (PK/GN) and 2 (BK/W).
4. Is continuity present?
   a. **Yes.** Repair short between (PK/GN) and (BK/W) wires.
   b. **No.** Go to Test 3.

3. Rear O2 Sensor Signal Wire Shorted to Ground Test

1. Test for continuity between rear O2 sensor [137B] terminal 1 (PK/GN) and ground.
2. Is continuity present?
   a. **Yes.** Repair short between (PK/GN) wire and ground.
   b. **No.** If ECM [78] connections are good, replace ECM. See the service manual.

4. Rear O2 Sensor Operation Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Place transmission in neutral, engine stop switch to RUN, and IGN ON. Start engine and allow to reach operating temperature.
3. With engine speed at a steady RPM, measure voltage between ECM breakout box terminals 23 and 26.
4. Is voltage above 0.6V?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** (0.0-0.4V). Perform fuel pressure test. See the service manual. Look for correct ECM calibration, low fuel pressure, air leaks, and dirty injectors. If no issues are found, replace O2 sensor.

DTC P0152

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-21. DTC P0152 Diagnostic Faults

POSSIBLE CAUSES
Rear O2 sensor malfunction
ECM malfunction
Fuel system malfunction

1. Rear O2 Sensor Operation Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.

3. Start the engine and allow it to reach operating temperature.
4. With engine speed at a steady RPM, measure voltage between breakout box terminals 23 and 26.
5. Is voltage less than 0.4V?
   a. **Yes.** Replace the ECM. See the service manual.
   b. **No.** (0.6-1.0V). Perform fuel pressure test. See the service manual. Look for correct ECM calibration, high fuel pressure, stuck open or leaking injectors. If no issues are found, replace the O2 sensor.

DTC P0154

PART NUMBER	TOOL NAME
HD-43876	HARNESS CONNECTOR TEST KIT

Table 6-22. DTC P0154 Diagnostic Faults

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

1. Rear O2 Sensor Signal Wire Short Circuit Voltage Test

1. Disconnect rear O2 Sensor [137].
2. Turn IGN ON.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-43876) and a multimeter, measure voltage between rear O2 sensor [137B] terminal 1 to ground.
4. Is voltage greater than 5.5V?
   a. **Yes.** Repair short to voltage on (PK/GN) wire.
   b. **No.** (Greater than 4V.) Go to Test 2.
   c. **No.** (Less than 4V.) Go to Test 3.

2. Rear O2 Sensor Open Sensor Ground Test

1. Turn IGN OFF.
2. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between rear O2 sensor [137B] terminal 2 (BK/W) and breakout box terminal 26.
4. Is continuity present?
   a. **Yes.** Replace the rear O2 sensor. See the service manual.
   b. **No.** Repair open on (BK/W) wire.

3. Rear O2 Sensor Signal Wire Open Test

1. Test for continuity between rear O2 sensor [137B] terminal 1 (PK/GN) and breakout box terminal 23.
2. Is continuity present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open in (PK/GN) wire.

DTC P0261, P0262, P0263, P0264 6.9

DESCRIPTION AND OPERATION

The fuel injectors are solenoids that allow pressurized fuel into the intake tract. The injectors are timed to the engine cycle and triggered sequentially. The power for the injectors comes from the system relay. The system relay also provides power for the fuel pump and the ignition coil. The ECM provides the path to ground to trigger the injectors.

NOTE

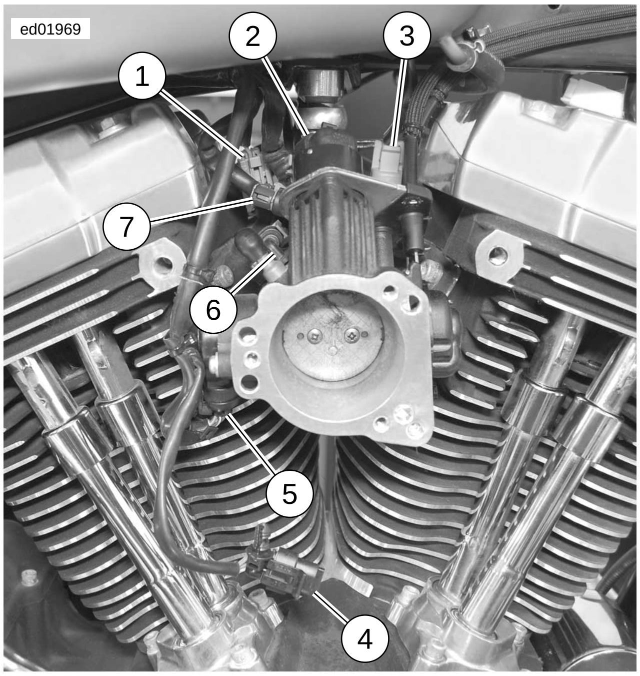
ECM fuse and system relay failures or wiring harness problems will cause 12V power to be lost to both injectors, ignition coils and fuel pump.

Table 6-23. Code Description

DTC	DESCRIPTION
P0261	Front injector open/low
P0262	Front injector high
P0263	Rear injector open/low
P0264	Rear injector high

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.



1. **Rear fuel injector [85]**
2. **IAC [87]**
3. **Front fuel injector [84]**
4. **Active intake solenoid (HDI) [178]**
5. **TPS [88]**
6. **IAT sensor [89]**
7. **MAP sensor [80]**

Figure 6-13. Between Cylinders Right Side

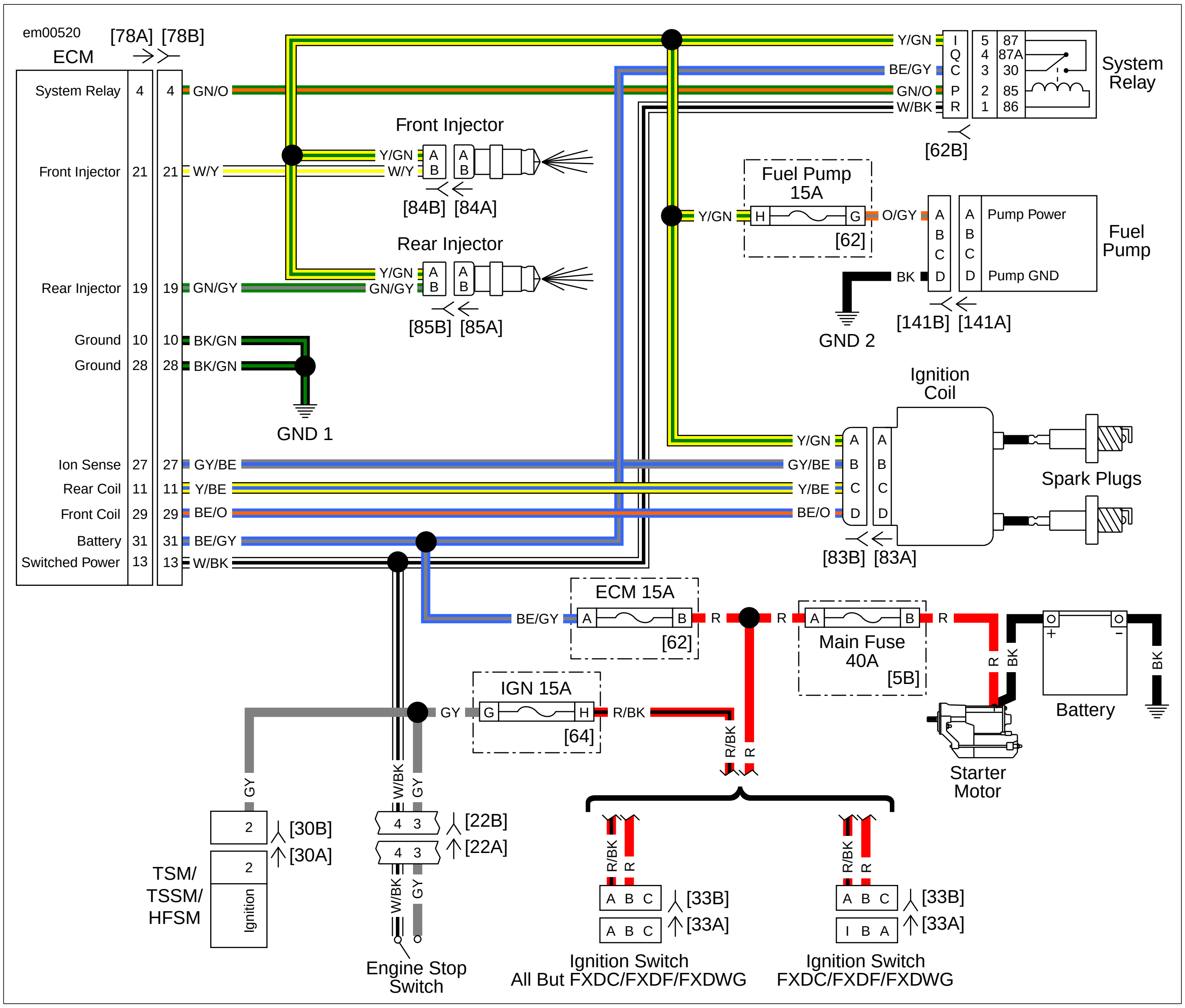


Figure 6-14. Ignition Circuit

DTC P0261

PART NUMBER	TOOL NAME
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-43876	BREAKOUT BOX

Table 6-24. DTC P0261 Diagnostic Faults

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

1. Front Fuel Injector Test

1. Disconnect front fuel injector [84].
2. Connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) to [84B].
3. Crank engine.
4. Does light flash when engine is cranking (or running)?
   a. **Yes.** Go to Test 5.
   b. **No, lamp does not illuminate.** Go to Test 2.
   c. **No, lamp is on steady.** Go to Test 6.

2. Front Fuel Injector Power Wire Open Circuit Test

1. Turn IGN OFF and engine stop switch to RUN.
2. Remove fuel injector test light.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.

4. Test for continuity between breakout box terminal 21 and fuel injector [84B] terminal B (W/Y).
5. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open on (W/Y) wire.

3. Front Fuel Injector Power Wire Shorted to Ground Test

1. Test for continuity between breakout box terminal 21 and ground.
2. Is continuity present?
   a. **Yes.** Repair short in (W/Y) to ground.
   b. **No.** Go to Test 4.

4. Fuel Injector/System Relay Test

1. Remove system relay.
2. Test for continuity between system relay socket terminal I (Y/GN) wire and front injector [84B] terminal A (Y/GN).
3. Is continuity present?
   a. **Yes.** If connections are good, replace ECM. See the service manual.
   b. **No.** Repair open (Y/GN) wire.

5. Injector Resistance Test

1. Test resistance between terminal A and B of injector [84A].
2. Is resistance value between 10-20 Ohms?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Replace injector. See the service manual.

6. Driver Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between breakout box terminal 21 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (W/Y) wire.
   b. **No.** Replace ECM. See the service manual.

DTC P0262

Table 6-25. DTC P0262 Diagnostic Faults

POSSIBLE CAUSES
Front fuel injector malfunction
ECM malfunction
Short to ground in signal circuit

1. Front Fuel Injector Control Wire Shorted to Voltage Test

1. Disconnect front injector [84].
2. Measure the voltage between front injector [84B] terminal B (W/Y) and ground.
3. Is voltage less than 1.0V?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair short to voltage on (W/Y) wire.

2. Injector Resistance Test

1. Test resistance between terminal A and B of injector [84A].
2. Is resistance value between 10-20 Ohms?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Replace front injector. See the service manual.

DTC P0263

PART NUMBER	TOOL NAME
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-43876	BREAKOUT BOX

Table 6-26. DTC P0263 Diagnostic Faults

POSSIBLE CAUSES
Rear fuel injector malfunction
ECM malfunction
Open signal circuit
Open power circuit

1. Rear Fuel Injector Test

1. Disconnect rear fuel injector [85].
2. Connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) to [85B].
3. Crank engine.
4. Does lamp flash when engine is cranking (or running)?
   a. **Yes.** Go to Test 5.
   b. **No, lamp does not illuminate.** Go to Test 2.
   c. **No, lamp is on steady.** Go to Test 6.

2. Rear Fuel Injector Power Wire Open Circuit Test

1. Turn IGN OFF and engine stop switch to RUN.
2. Remove fuel injector test light.
3. Connect BREAKOUT BOX (Part No. HD-43876) to ECM harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
4. Test for continuity between breakout box terminal 19 and fuel injector [85B] terminal B (GN/GY).
5. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open on (GN/GY) wire.

3. Rear Fuel Injector Power Wire Shorted to Ground Test

1. Test for continuity between breakout box terminal 19 and ground.
2. Is continuity present?
   a. **Yes.** Repair short in (GN/GY) to ground.
   b. **No.** Go to Test 4.

4. Fuel Injector/System Relay Test

1. Remove system relay.
2. Test for continuity between system relay socket terminal I (Y/GN) wire and rear injector [85B] terminal A (Y/GN).
3. Is continuity present?
   a. **Yes.** If connections are good, replace ECM. See the service manual.
   b. **No.** Repair open (Y/GN) wire.

5. Injector Resistance Test

1. Test resistance between terminal A and B of injector [85A].
2. Is resistance value between 10-20 Ohms?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Replace front injector. See the service manual.

6. Driver Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between breakout box terminal 19 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (GN/GY) wire.
   b. **No.** Replace ECM. See the service manual.

DTC P0264

Table 6-27. DTC P0264 Diagnostic Faults

POSSIBLE CAUSES
Rear fuel injector malfunction
ECM malfunction
Short to ground in signal circuit

1. Rear Fuel Injector Control Wire Shorted to Voltage Test

1. Disconnect rear injector [85].
2. Measure the voltage between rear injector [85B] terminal B (GN/GY) and ground.
3. Is voltage less than 1.0V?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair short to voltage on (GN/GY) wire.

2. Injector Resistance Test

1. Test resistance between terminal A and B of injector [85A].
2. Is resistance value between 10-20 Ohms?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Replace rear injector. See the service manual.

DTC P0373, P0374 6.10

DESCRIPTION AND OPERATION

If the CKP sensor signal is weak or absent, DTCs P0373 or P0374 will be set. DTC P0373 is usually set when several attempts to crank the engine have failed.

NOTE

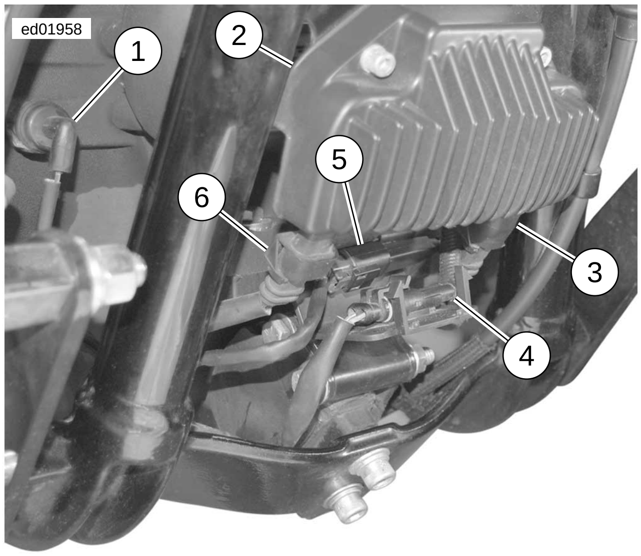
If signal is not detected or cannot synchronize (DTC P0374), engine will not start.

Table 6-28. Code Description

DTC	DESCRIPTION
P0373	CKP sensor intermittent
P0374	CKP sensor synch error

Diagnostic Tips

Engine must be cranked for more than five seconds without CKP signal to set P0374 code. Intermittent MAP or IAT wiring or sensor issues may cause these codes to set prior to setting MAP or IAT codes. Verify MAP or IAT wiring and sensor prior to replacing the ECM.



1. **Oil pressure switch [120]**
2. **Voltage regulator**
3. **Voltage regulator to stator [47]**
4. **Front O2 sensor (Domestic Only) [138]**
5. **CKP sensor [79]**
6. **Voltage regulator [77]**

Figure 6-15. Lower Front

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

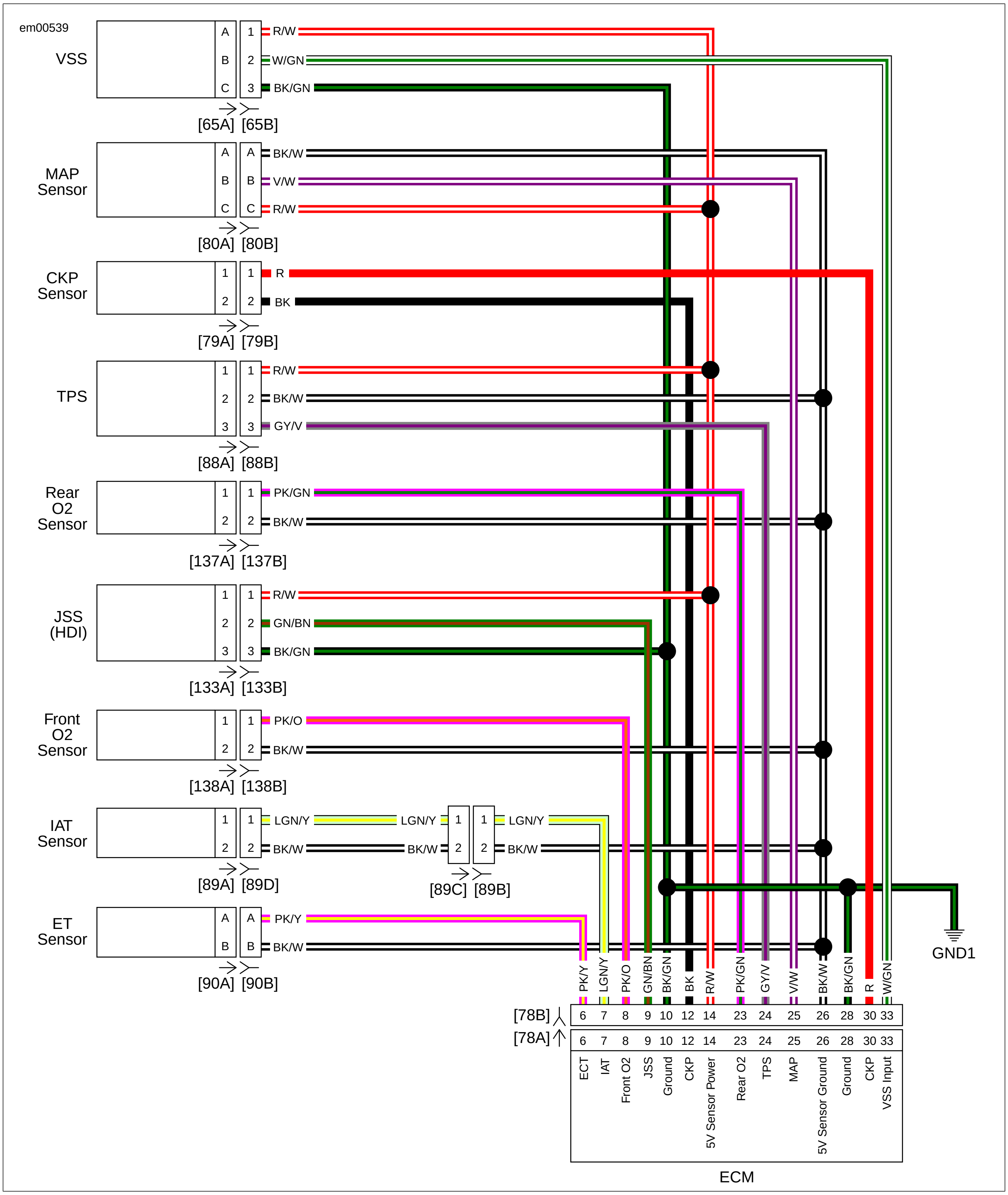


Figure 6-16. Sensor Circuit

DTC P0373

Table 6-29. DTC P0373 Diagnostic Faults

POSSIBLE CAUSES
CKP sensor malfunction
ECM malfunction
Open or short to ground in signal circuit

1. CKP Sensor Test

1. Clear the DTC. 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Start the vehicle.
3. Did DTC P0373 reset?
   a. **Yes.** Inspect and verify battery and starting system. See 3.2 STARTING SYSTEM.
   b. **No.** System functioning properly.

DTC P0374

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-30. DTC P0374 Diagnostic Faults

POSSIBLE CAUSES
CKP sensor malfunction
ECM malfunction
Open or short to ground in signal circuit
May be set if there are incorrect fluctuations from MAP that does not set MAP codes (examples - intermittent sensor or wiring issue)

1. CKP Sensor Connections Test

1. With IGN OFF, disconnect ECM [78].
2. Inspect the connection for corrosion or backed out terminals.
3. Are terminal problems present?
   a. **Yes.** Repair terminals as required.
   b. **No.** Go to Test 2.

2. CKP Sensor Signal Wire Continuity Test

1. Disconnect CKP sensor [79].
2. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between breakout box terminal 30 to CKP sensor [79B] terminal 1 (R).
4. Is resistance less than 1.0 Ohm?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open wire (R).

3. CKP Sensor Ground Wire Continuity Test

1. Test continuity from breakout box terminal 12 to CKP sensor [79B] terminal 2 (BK).
2. Is resistance less than 1.0 Ohm?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open on (BK) wire.

4. CKP Sensor Signal Wire Shorted to CKP Ground Wire Test

1. Test for continuity between breakout box terminals 30 and 12.
2. Is continuity present?
   a. **Yes.** Repair short between CKP [79B] terminals 1 (R) and 2 (BK).
   b. **No.** Go to Test 5.

5. CKP Sensor Low Shorted to Ground Test

1. Test for continuity between breakout box terminals 12 and 28.
2. Is continuity present?
   a. **Yes.** Repair short to sensor ground on (BK) wire.
   b. **No.** Go to Test 6.

6. CKP Sensor Output Test

1. Connect CKP sensor [79].
2. Test for AC voltage at breakout box terminals 30 and 12.
3. Place transmission in neutral, turn IGN ON, and engine stop switch to RUN.
4. Crank engine for 5 seconds while observing multimeter.
5. Is AC voltage present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Go to Test 7.

7. CKP Sensor Signal Wire Shorted to Ground Test

1. Disconnect CKP sensor [79].
2. Test for continuity between breakout box terminals 30 and 28.
3. Is continuity present?
   a. **Yes.** Repair shorted (R) wire to ground.
   b. **No.** Replace the CKP sensor. See the service manual.

DTC P0501, P0502 6.11

DESCRIPTION AND OPERATION

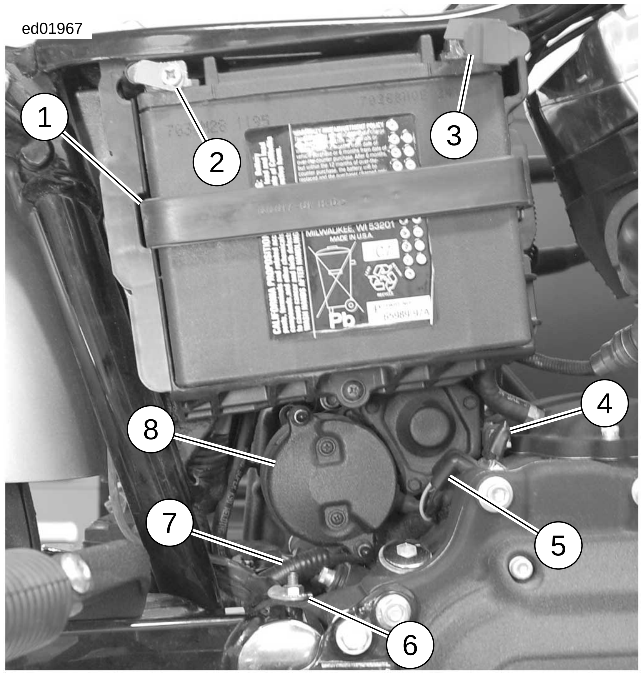
See Figure 6-17. The VSS is powered and monitored by the ECM. The ECM processes the vehicle speed signal and transmits this signal to the TSM/TSSM/HFSM, and speedometer through serial data.

NOTES

- *The ECM uses VSS input to calculate idle air control position. Therefore problems with the vehicle speed signal can lead to improper operation of the idle air control.*
- *The MAP, JSS, TPS, and VSS sensors are connected to the same reference line (+5V REF). If the reference line goes to ground or open, multiple codes will be set (DTC P0107, P0108, P0122, P0123, P0501, P0502, P1501, P1502). 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 DTC's will be set as each sensor is disconnected, clear DTC's after this test. Be sure to perform this test before replacing a component.*

Table 6-31. Code Description

DTC	DESCRIPTION
P0501	VSS low
P0502	VSS high



1. **Battery**
2. **Battery negative**
3. **Battery positive**
4. **Starter solenoid [128]**
5. **Neutral switch [131]**
6. **Battery ground cable**
7. **VSS [65]**
8. **Starter**

Figure 6-17. Under Right Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

HOME

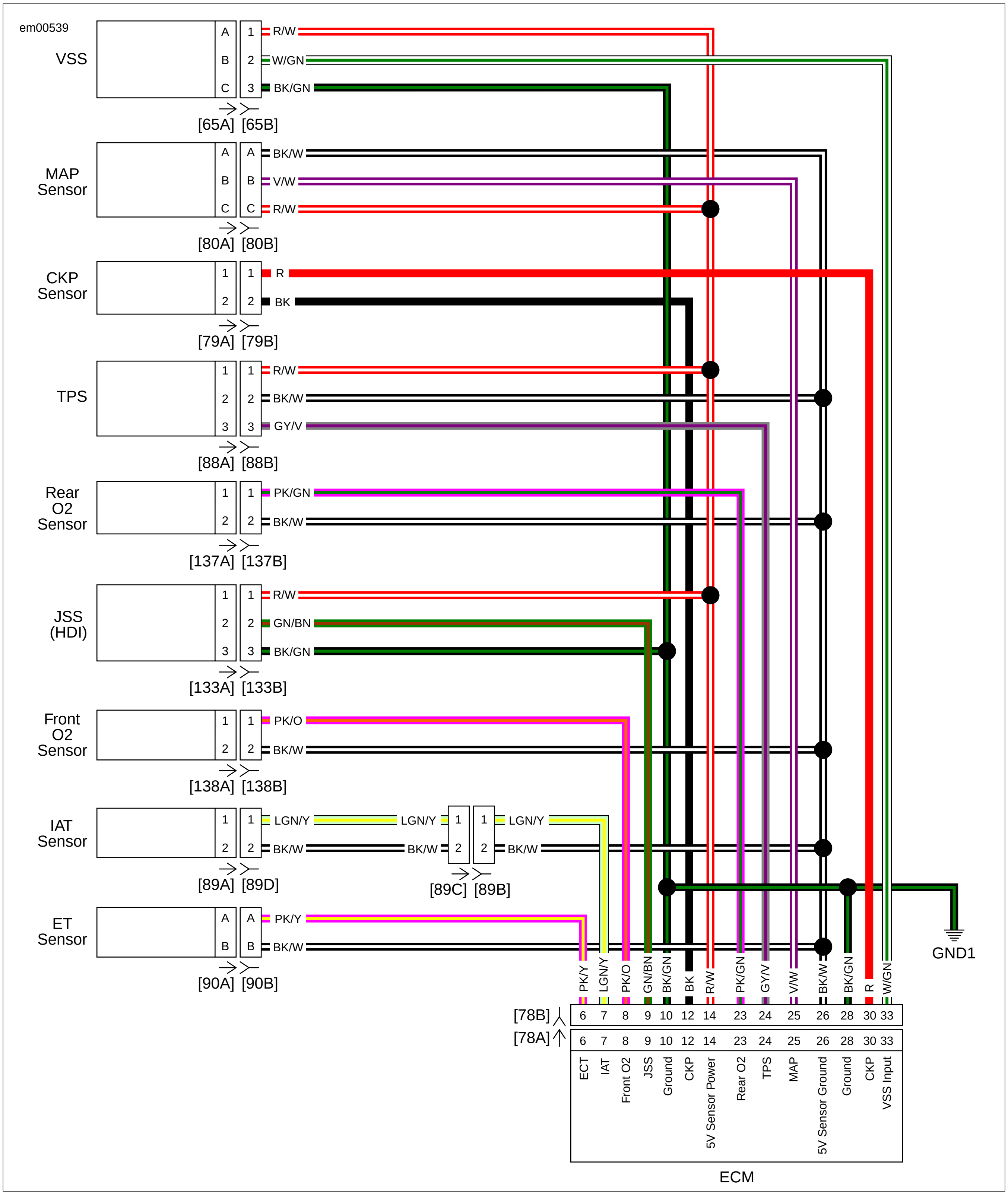


Figure 6-18. Sensor Circuit

DTC P0501

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-32. DTC P0501 Diagnostic Faults

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

1. VSS Connections Test

1. With IGN OFF, disconnect VSS [65].
2. Inspect [65] for damaged terminals, backed out or bent terminals. Repair as necessary.
3. Place transmission in neutral, turn IGN ON, and engine stop switch to RUN.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between VSS [65B] terminal A and ground.
5. Is voltage reading approximately 5.0V?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 2.

2. VSS Sensor Power Short to Ground Test

1. Turn IGN OFF.
2. Disconnect ECM.
3. Test continuity between [65B] terminal A and ground.
4. Is continuity present?
   a. **Yes.** Repair short to ground on (R/W) wire.
   b. **No.** Repair open on (R/W) wire.

3. VSS Signal Wire Short to Ground Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B, leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between breakout box terminals 33 and 28.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (W/GN) wire.
   b. **No.** Go to Test 4.

4. VSS Signal Wire Open Test

1. Test for continuity between breakout box terminals 33 and [65B] terminal B.
2. Is continuity present?
   a. **Yes.** Go to Test 5.
   b. **No.** Repair open on (W/GN) wire.

5. VSS Dirty or Damaged Test

1. Remove VSS.
2. Check for debris on the sensor tip.
3. Is debris present?
   a. **Yes.** Clean debris from VSS and install.
   b. **No.** If VSS connections are good, replace VSS. See the service manual.

DTC P0502

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-33. DTC P0502 Diagnostic Faults

POSSIBLE CAUSES
VSS malfunction
ECM malfunction
Short to voltage in signal circuit
Open ground
5V reference shorted to battery voltage

1. VSS Sensor Power Shorted to Voltage Test

1. With IGN OFF, disconnect VSS [65].
2. Inspect [65] for damaged, terminals backed out or bent terminals. Repair as necessary.
3. Place transmission in neutral, turn IGN ON, and engine stop switch to RUN.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between VSS [65B] terminals A (BK/R) and C.
5. Is voltage greater than 6.0V?
   a. **Yes.** Repair short to voltage on (R/W) wire.
   b. **No.** Go to Test 2.

2. VSS Signal Wire Short to Voltage Test

1. Measure voltage between VSS [65B] terminal B (W/GN) and ground.
2. Is voltage above 6.0V?
   a. **Yes.** Repair short to voltage on (W/GN) wire.
   b. **No.** Go to Test 3.

3. VSS Signal Wire Shorted to Sensor Power Test

1. With IGN OFF, connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test continuity between breakout box terminals 33 and 14.

3. Is continuity present?
   a. **Yes.** Repair short between (W/GN) and (R/W) wires.
   b. **No.** If ECM connections are good, replace ECM. See the service manual. Go to Test 4.

4. VSS Ground Wire Open Test

1. Test continuity between breakout box terminal 28 and VSS [65B] terminal C (BK/GN).
2. Is continuity present?
   a. **Yes.** Replace VSS. See the service manual.
   b. **No.** Repair open on (BK/GN) wire.

DTC P0505 6.12

DESCRIPTION AND OPERATION

PART NUMBER	TOOL NAME
HD-48650	DIGITAL TECHNICIAN II

The ECM controls engine idle speed by moving the IAC to open or close a passage around the throttle plates. It does this by sending voltage pulses to the proper motor winding of the IAC. This causes the pintle to move in or out of the IAC a given distance for each pulse received.

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

The IAC position can be measured in steps. This can only be done by using DIGITAL TECHNICIAN II (Part No. HD-48650).

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

Each time the ignition is turned OFF, the ECM resets the IAC by sending enough pulses to extend the pintle and effectively close the throttle body. The fully extended value is the ECM reference point. A given number of steps are then calculated by the ECM for use in setting the proper idle speed and IAC position for the next start event.

NOTE

Idle speed is controlled by the ECM and cannot be adjusted.

Diagnostic Trouble Code P0505: Loss of Idle Speed Control

Loss of idle speed control will result if the idle RPM is ±200 from preset idle speed and IAC motor is at zero or maximum for greater than 5 seconds. This DTC may occur with others for a multiple code situation. Resolve the other codes first to correct.

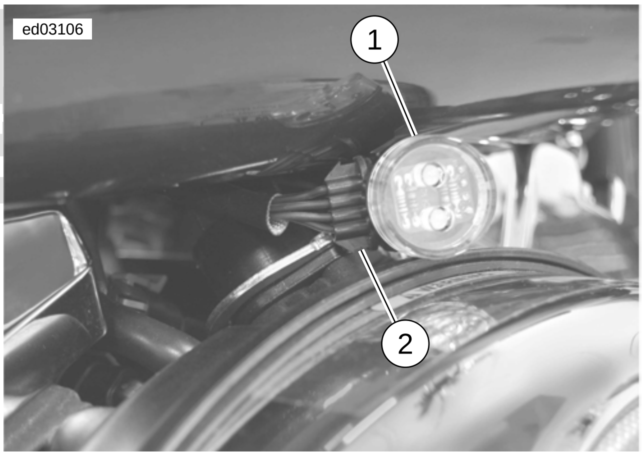
Table 6-34. Code Description

DTC	DESCRIPTION
P0505	Loss of idle speed control

Diagnostic Tips

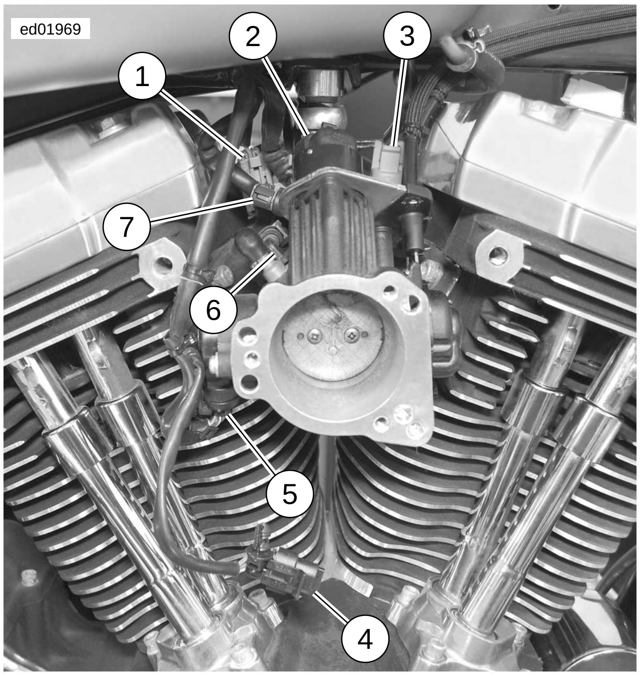
Engine idle speed can be adversely affected by the following:

- A loss of idle speed control does not necessarily imply the IAC actuator or wiring has failed. It can be caused by a number of conditions such as an intake air leak, improperly adjusted throttle stop or a misfiring cylinder.
- A non-O.E engine configuration can lead to idle instability and the generation of the P0505 code.
- Leaking injectors will cause fuel imbalance and poor idle quality due to different air/fuel ratios in each cylinder. To check for leaky injectors, first remove the air box and air filter. See the service manual. 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 the service manual.
- Intake leaks. See the service manual.
- Contaminated fuel.
- TPS reading of greater than 1% (possible throttle cable misadjustment) or battery voltage reading of less than 9V or a VSS greater than 0 will disable idle speed control.
- If there is a loss of battery power at ECM terminal 31, vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.



1. **HD-41199-3 IAC Test Light**
2. **IAC [87]**

Figure 6-19. IAC Test Light (Part No. HD-41199-3)



1. **Rear fuel injector [85]**
2. **IAC [87]**
3. **Front fuel injector [84]**
4. **Active intake solenoid (HDI) [178]**
5. **TPS [88]**
6. **IAT sensor [89]**
7. **MAP sensor [80]**

Figure 6-20. Between Cylinders Right Side

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

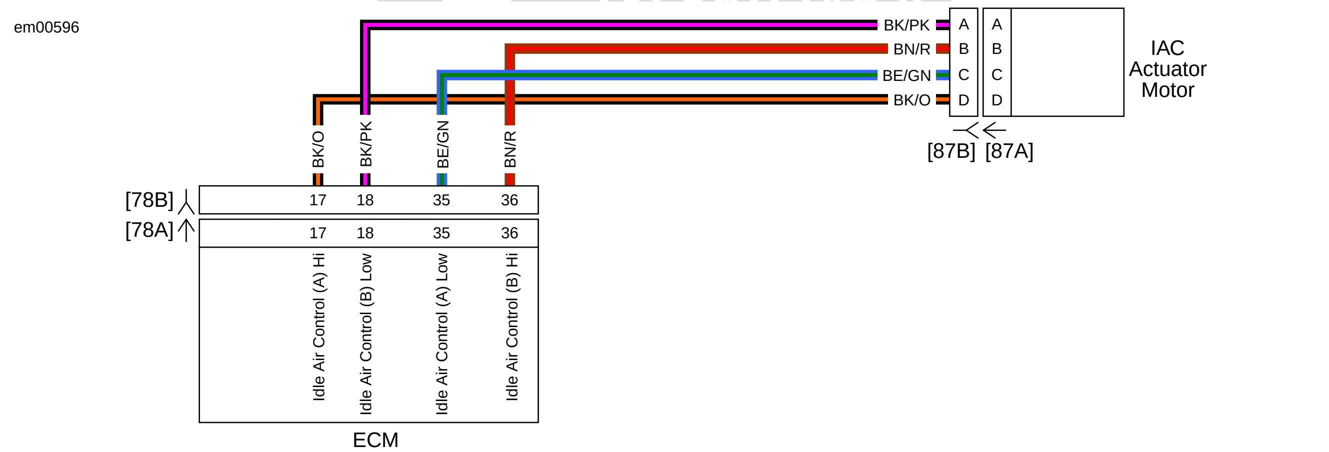


Figure 6-21. IAC Circuit

DTC P0505

PART NUMBER	TOOL NAME
HD-41199-3	IAC TEST LIGHT
HD-43876	BREAKOUT BOX

Table 6-35. DTC P0505 Diagnostic Faults

POSSIBLE CAUSES
IAC malfunction
ECM malfunction
Short to voltage in circuits
Short to ground in circuits
Open circuits
Vacuum/air leaks
Fuel system problems

1. IAC Operational Test

1. Remove air cleaner cover and element.
2. Turn IGN ON, then OFF, while watching the IAC pintle for movement.
3. Does the pintle move?
   a. **Yes.** IAC system okay. Check for improperly adjusted throttle stop, vacuum leaks, cylinder misfire, contaminated fuel, leaking injectors, and engine mechanical failure.
   b. **No.** Go to Test 2.

2. IAC Connector Test

1. Remove air cleaner base.
2. Disconnect IAC motor harness [87].
3. Connect IAC TEST LIGHT (Part No. HD-41199-3) to [87B].
4. Place IGN ON and engine stop switch to RUN.
5. While observing test light, turn IGN OFF.
6. Did both IAC test lights flash alternately?
   a. **Yes.** If connections are good, replace IAC motor. See the service manual.
   b. **No.** Go to Test 3.

Table 6-36. IAC, Wire Color, ECM

IAC [87B]	WIRE COLOR	ECM [78B]
A	BE/GN	35
B	BN/R	36
C	BK/PK	18
D	BK/O	17

3. IAC Circuits Open Test

1. Remove test light.
2. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity on each IAC wire between breakout box and [87B]. Refer to Table 6-36.
4. Is continuity present on all circuits?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open in appropriate circuit.

4. IAC Circuits Shorted to Ground Test

1. Test for continuity on each IAC wire between breakout box and ground. Refer to Table 6-36.
2. Is continuity present on any circuits?
   a. **Yes.** Repair short to ground on appropriate circuit.
   b. **No.** Go to Test 5.

5. IAC Circuits Short to Voltage Test

1. Turn IGN ON.
2. Test for voltage between breakout box and ground on each IAC wire. Refer to Table 6-36.
3. Is voltage present on any circuit?
   a. **Yes.** Repair short to voltage in appropriate circuit.
   b. **No.** Inspect ECM connections. If connections are good, replace the ECM. See the service manual.

HOME

DTC P0603, P0605 6.13

DESCRIPTION AND OPERATION

See Figure 6-22. The DTCs listed indicate a failure which requires replacement of the ECM. See the service manual for replacement information. Refer to Table 6-37.

NOTE

After replacing ECM, perform password learning procedure and clear DTCs using odometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.

Table 6-37. Code Description

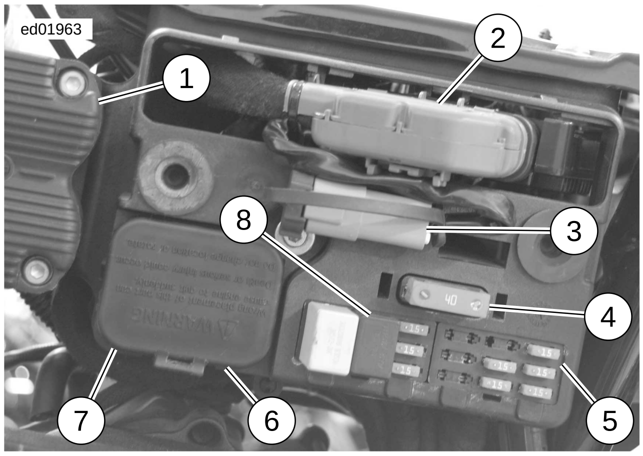
DTC	DESCRIPTION
P0603	ECM EEPROM error
P0605	ECM flash error

DTC P0603 Test

1. Clear DTCs using speedometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Replace ECM if DTCs reappear. See the service manual.

DTC P0605 Test

1. Clear DTCs using speedometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics.
2. Attempt to program ECM using correct calibration.
3. Restart vehicle. If DTC reappears, replace ECM. See the service manual.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 6-22. Under Left Side Cover

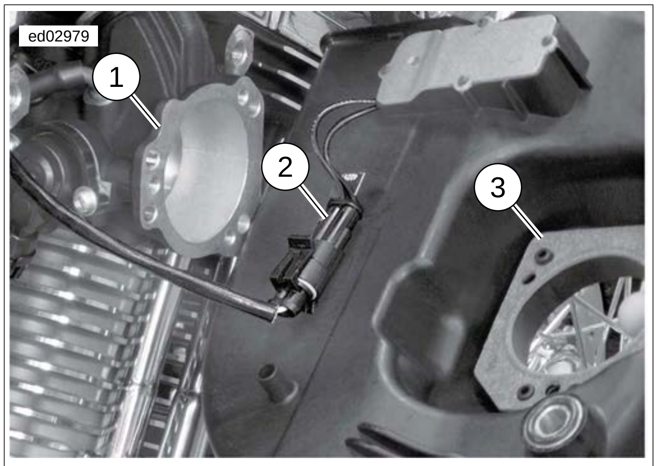
DTC P0661, P0662 6.14

DESCRIPTION AND OPERATION

The active intake solenoid (AIS) regulates the amount of air entering the air cleaner. The AIS opens when vehicle speed exceeds 45 mph (70 km/h) with 50% or greater throttle opening. Once open, active intake will close when vehicle speed falls below 40 mph (65 km/h). See Figure 6-24. The power for the AIS comes from the engine control fuse. The ECM provides the path to ground to trigger the AIS. AIS is included on HDI vehicles only.

Table 6-38. Code Description

DTC	DESCRIPTION
P0661	AIS open/low
P0662	AIS high/shorted



1. **Intake module**
2. **Intake solenoid connector [178]**
3. **Air cleaner backing plate**

Figure 6-23. Intake Solenoid Connector Location

NOTE

The AIS and active exhaust actuator share the same power source and function simultaneously.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

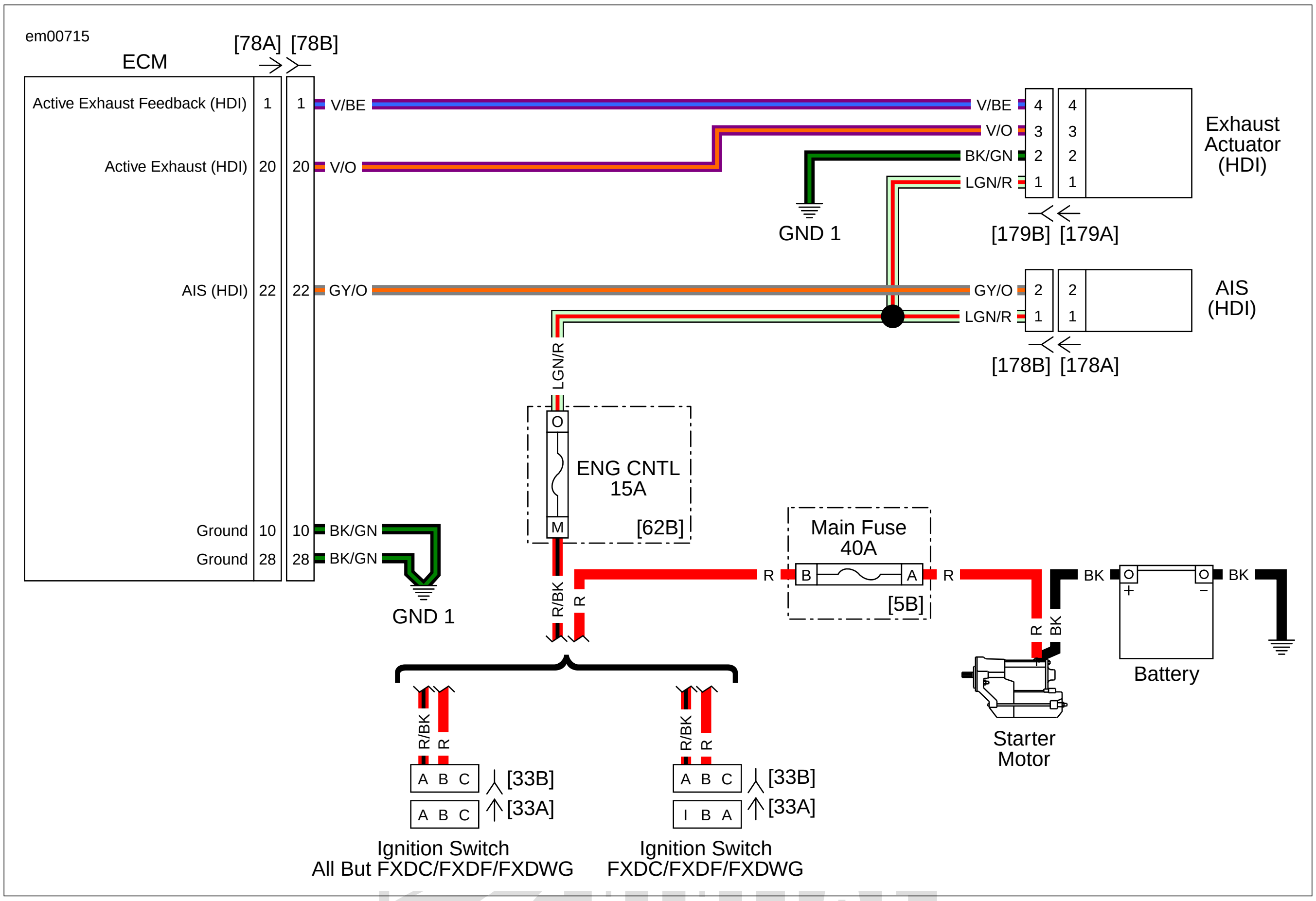


Figure 6-24. Active Exhaust Actuator and AIS Circuit

DTC P0661, P0662

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-39. DTC P0661, P0662 Diagnostic Faults

POSSIBLE CAUSES
AIS malfunction
ECM malfunction
Shorted high to ground
Open low to ground

1. AIS Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to [78B], leaving ECM [78A] disconnected.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jump breakout box terminal 22 to terminal 10 or 28.
3. Turn IGN ON.
4. Does AIS activate immediately?
   a. **Yes.** AIS okay. Replace ECM. See service manual.
   b. **No.** Go to Test 2.

2. AIS Resistance Test

1. Turn IGN OFF and disconnect AIS [178].
2. Measure resistance between [178A] terminals 1 and 2.
3. Is resistance between 16 and 20 Ohms?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace AIS. See service manual.

3. AIS Open Ground Wire Test

1. Test for continuity from breakout box terminal 22 to AIS [178B] terminal 2 (GY/O).
2. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open wire (GY/O).

4. AIS Low Short to Ground Test

1. Test for continuity from breakout box terminal 22 to ground.

2. Is continuity present?
   a. **Yes.** Repair short to ground on (GY/O) wire.
   b. **No.** Go to Test 5.

5. AIS High Short to Ground Test

1. Remove engine control fuse.
2. Test for continuity between [62B] terminal O and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (LGN/Y) wire.
   b. **No.** Go to Test 6.

6. AIS Open Supply Wire Test

1. Test for continuity between engine control fuse [62B] terminal O and AIS [178B] terminal 1 (LGN/Y).
2. Is continuity present?
   a. **Yes.** Replace AIS. See the service manual.
   b. **No.** Repair open wire (LGN/Y).

DTC P1009, P1010

GENERAL

Password Problem

The ECM and TSM/TSSM/HFSM exchange passwords during operation. An incorrect password or missing password will set a DTC. If any U-codes exist, troubleshoot the higher priority codes prior to performing the tests in this section.

NOTE

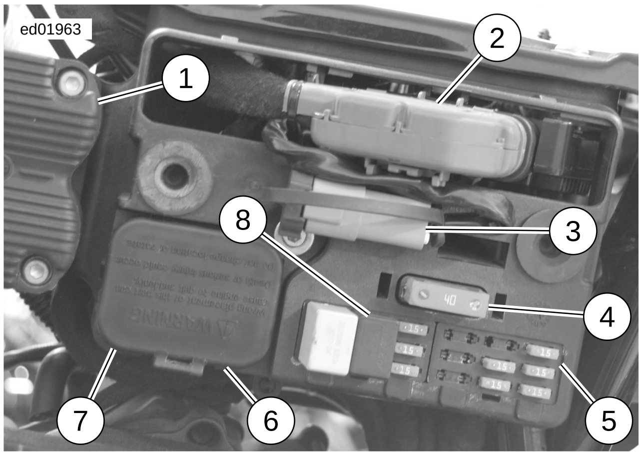
If the TSM/TSSM/HFSM is not connected to the wiring harness, the vehicle will not start.

Table 6-40. Code Description

DTC	DESCRIPTION
P1009	Incorrect password
P1010	Missing password

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 6-25. Under Left Side Cover

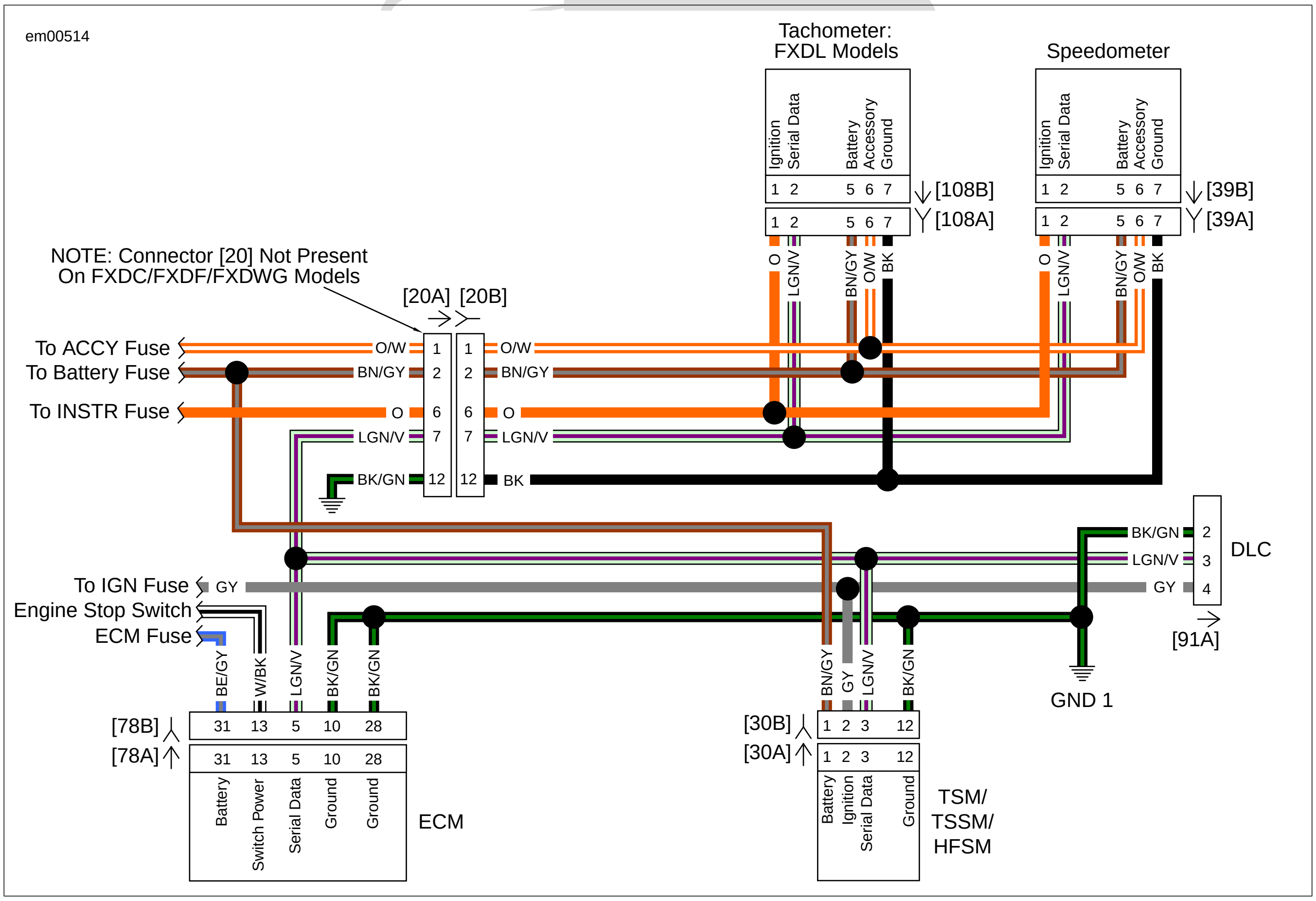


Figure 6-26. ECM and TSM/TSSM/HFSM Circuit

DTC P1009 OR P1010

Table 6-41. DTC P1009 and P1010 Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
TSM/TSSM/HFSM malfunction

1. Incorrect Password Test

1. Reprogram password. See the service manual.
2. Does DTC P1009 or P1010 set?
   a. **Yes.** Go to Test 2.
   b. **No.** System okay.

2. TSM/TSSM/HFSM Replacement Test

1. Replace TSM/TSSM/HFSM. See the service manual.
2. Program password. See the service manual.
3. Does DTC P1009 or P1010 set?
   a. **Yes.** Install original TSM/TSSM/HFSM and replace ECM. See the service manual.
   b. **No.** System okay.

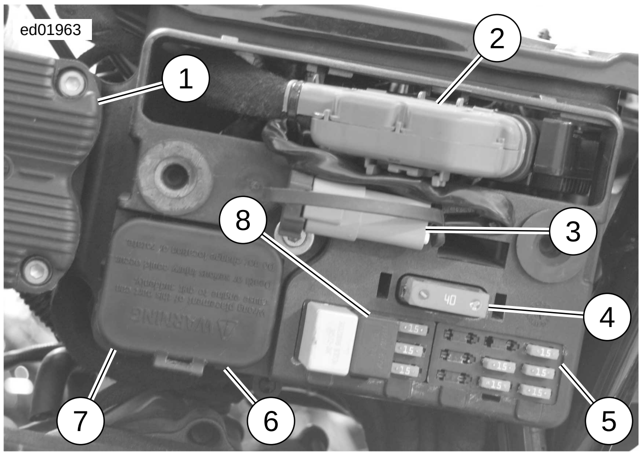
DTC P1001, P1002, P1003, P1004 6.16

DESCRIPTION AND OPERATION

See Figure 6-27. With IGN ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the fuel pump, ignition coils, and fuel injectors. They will remain powered as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP sensor. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is ON or engine has stalled, or immediately after the ignition is shut OFF.

Table 6-42. Code Description

DTC	DESCRIPTION
P1001	System relay coil open/low
P1002	System relay coil high/shorted
P1003	System relay contacts open
P1004	System relay contacts closed



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 6-27. Under Left Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

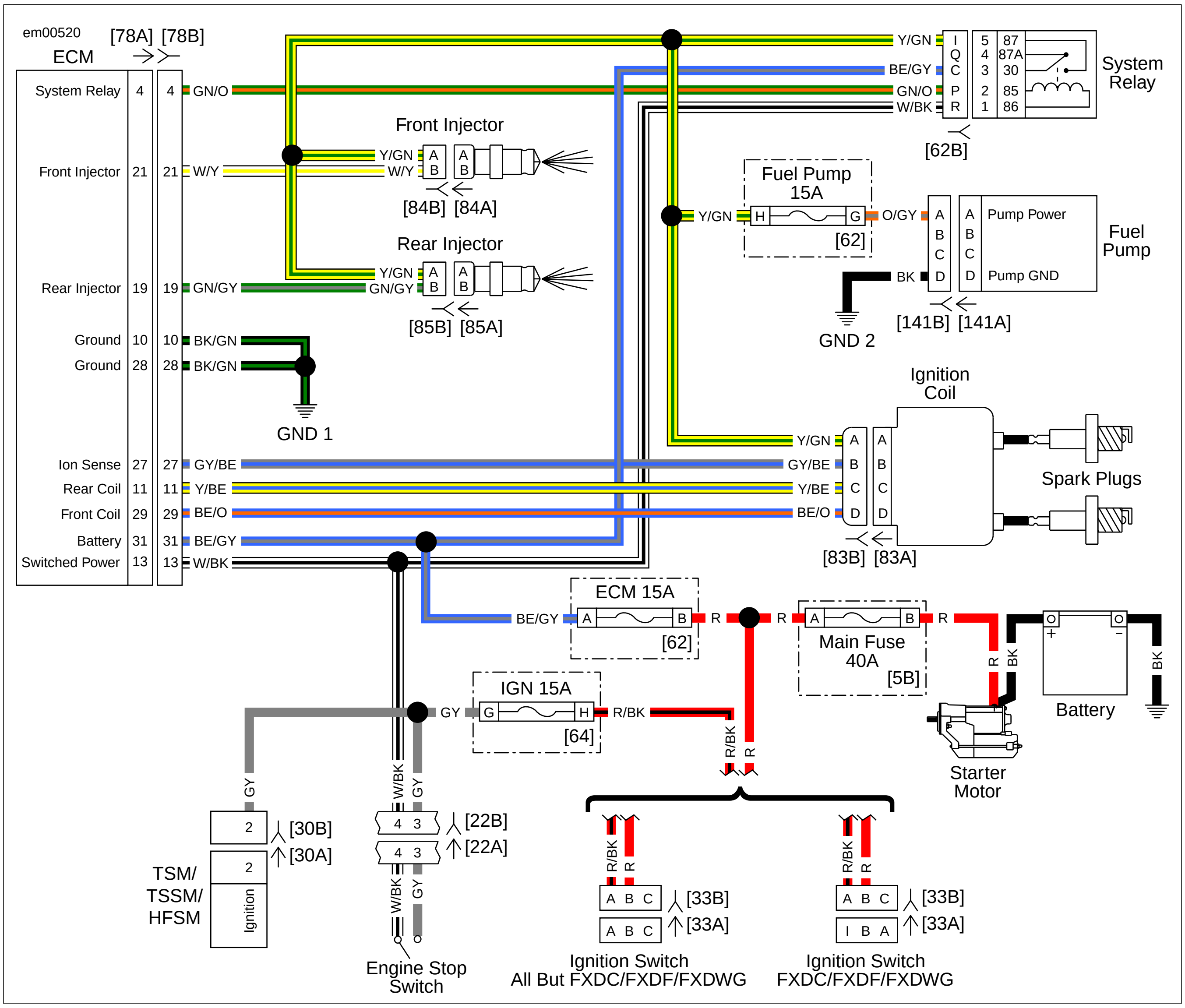


Figure 6-28. Ignition Circuit

DTC P1001

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-43. DTC P1001 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Open in coil supply circuit
Short to ground in coil control circuit
ECM malfunction
Open in coil control circuit

1. System Relay Test

1. Remove the system relay.
2. Test the system relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
3. Is the system relay OK?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the system relay. See the service manual.

2. System Relay Coil Power Circuit Test

1. With IGN ON and the engine stop switch in RUN, test for voltage at [62B] socket terminal R.
2. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open in (W/BK) wire.

3. System Relay Coil Control Short to Ground Test

1. With IGN OFF, disconnect the ECM [78].
2. Test for continuity from [62B] socket terminal P to ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground in (GN/O) wire.
   b. **No.** Go to Test 4.

4. System Relay Coil Control Circuit Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Test for continuity between [62B] socket terminal P and breakout box terminal 4.
3. Is continuity present?
   a. **Yes.** Replace the ECM. See the service manual.
   b. **No.** Repair open in (GN/O) wire.

DTC P1002

Table 6-44. DTC P1002 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Short to voltage in coil control circuit
ECM malfunction

1. System Relay Test

1. Remove the system relay.
2. Test the system relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
3. Is the system relay OK?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the system relay. See the service manual.

2. System Relay Coil Short to Voltage Test

1. Test for voltage between [62B] socket terminal P and ground.
2. Is voltage present?
   a. **Yes.** Repair short to voltage in (GN/O) wire.
   b. **No.** Replace the ECM. See the service manual.

DTC P1003

Table 6-45. DTC P1003 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
ECM malfunction
Open in switch output circuit
Short to ground in the switch supply circuit
Open in switch supply circuit

1. System Relay Test

1. Remove the system relay.
2. Test the system relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
3. Is the system relay OK?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the system relay. See the service manual.

2. System Relay Power Supply Test

1. Test for voltage between [62B] socket terminal C and ground.
2. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to Test 4.

3. System Relay Switch Side Circuit Test

1. Disconnect the rear injector [85].
2. Test for continuity between [62B] socket terminal I and [85B] terminal A.
3. Is continuity present?
   a. **Yes.** Replace the ECM. See the service manual.
   b. **No.** Repair open in (Y/GN) wire.

4. System Relay Power Supply Circuit Test

1. Test for continuity between [62B] socket terminal C and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground in (BE/GY) wire and replace ECM fuse.
   b. **No.** Repair open in power supply to system relay. This includes the (BE/GY) wire, ECM fuse, and the (R) wire between the ECM and 40A main fuse.

DTC P1004

PART NUMBER	TOOL NAME
HD-43876	BREAKOUT BOX

Table 6-46. DTC P1004 Diagnostic Faults

POSSIBLE CAUSES
Relay malfunction
Short to voltage in the switch circuit
Short to ground in coil control circuit
Short to voltage rear coil control circuit
Short to voltage front coil control circuit

1. System Relay Test

1. Remove the system relay.
2. Test the system relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.
3. Is the system relay OK?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace the system relay. See the service manual.

2. System Relay Switch Side Short to Voltage Test

1. Test for voltage on [62B] socket terminal I.
2. Is voltage present?
   a. **Yes.** Repair short to voltage in (Y/GN) wire.
   b. **No.** Go to Test 3.

3. System Relay Coil Short to Ground Test

1. Disconnect the ECM.
2. Test for continuity between [62B] socket terminal P and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (GN/O) wire.
   b. **No.** Go to Test 4.

4. Rear Coil Short to Voltage Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON, test for voltage on breakout box terminal 11 to ground.
3. Is voltage present?
   a. **Yes.** Repair short to voltage on (Y/BE) wire.
   b. **No.** Go to Test 5.

5. Front Coil Short to Voltage Test

1. With IGN ON, test for voltage on breakout box terminal 29 to ground.
2. Is voltage present?
   a. **Yes.** Repair short to voltage on (BE/O) wire.
   b. **No.** Replace the ECM. See the service manual.

DTC P1351, P1352, P1354, P1355 6.17

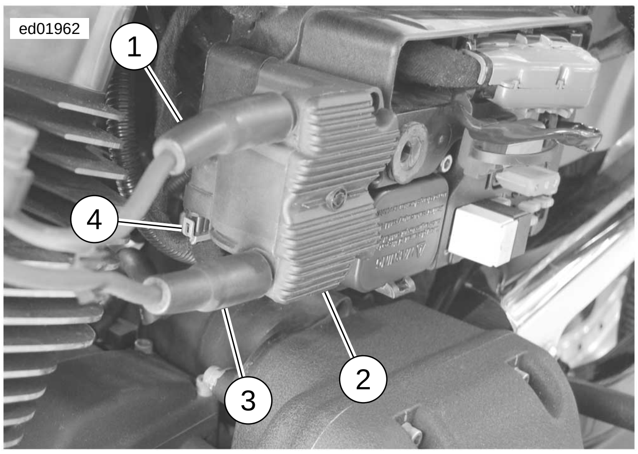
DESCRIPTION AND OPERATION

Ignition coil DTCs will set if the ignition coil primary voltage is out of range. This could occur if there is an open coil or loss of power to the coil. If front and rear DTCs are set simultaneously, it is likely a coil power failure or a coil failure.

The coil receives power from the system relay at the same time that the fuel pump and injectors are activated. The system relay is active for the first 2 seconds after the ignition switch is turned ON and then shuts off until RPM is detected from the CKP sensor, at which time system relay is reactivated. The ECM is responsible for turning on the system relay by providing the ground to activate the relay, which in turn powers the coil.

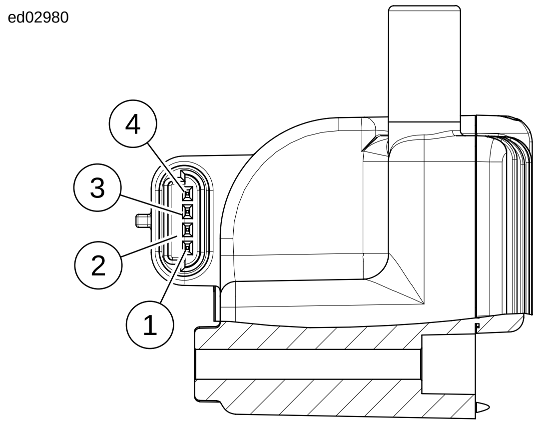
Table 6-47. Code Description

DTC	DESCRIPTION
P1351	Front ignition coil open/low
P1352	Front ignition coil high/shorted
P1354	Rear ignition coil open/low
P1355	Rear ignition coil high/shorted



1. **Rear spark plug wire**
2. **Coil**
3. **Front spark plug wire**
4. **Ignition coil [83]**

Figure 6-29. Ignition Coil



1. **Pin A: power**
2. **Pin B: ion sense**
3. **Pin C: rear coil**
4. **Pin D: front coil**

Figure 6-30. Ignition Coil

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

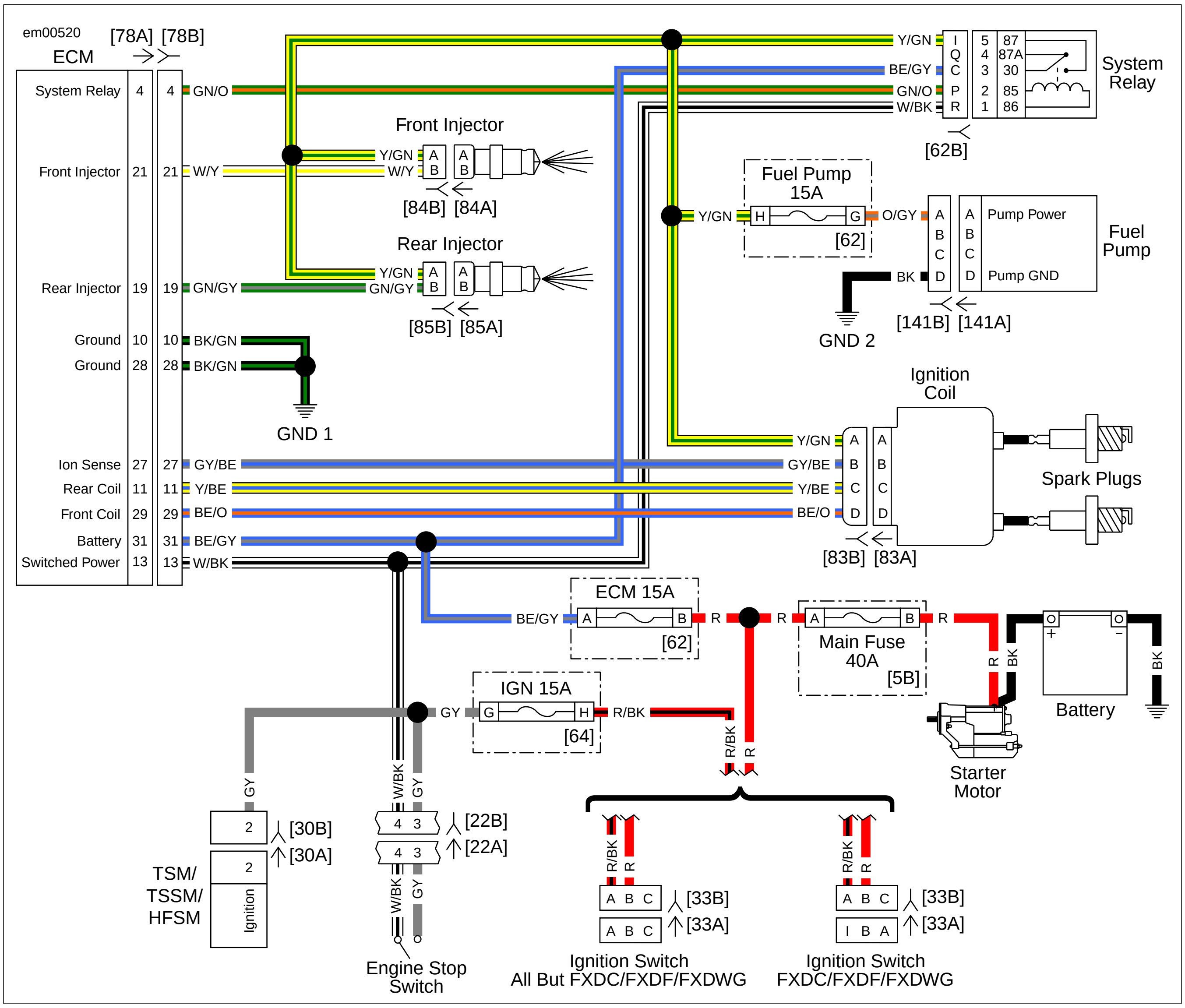


Figure 6-31. Ignition Circuit

DTC P1351

PART NUMBER	TOOL NAME
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-48. DTC P1351 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Open or short to ground in signal circuit
Open power circuit

1. Ignition Coil Test

1. Disconnect ignition coil [83]. Inspect for damaged or backed out terminals and corrosion. Repair as required.
2. See Figure 6-30. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) to [83B] terminals A and D.
3. Turn IGN ON and engine stop switch to RUN.
4. Does lamp flash when engine is cranked?
   a. **Yes.** Replace ignition coil. See the service manual.
   b. **No.** Go to Test 2.

2. Ignition Coil Input Voltage Test

1. Turn IGN ON. Voltage will only be present for 2 seconds after ignition is turned on.

2. Test for battery voltage at ignition coil [83B] terminal A to ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open (Y/GN) wire between [83B] and system relay [62B] terminal I.

3. Ignition Coil Control Wire Continuity Test

1. Turn IGN OFF and engine stop switch to RUN.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between breakout box terminal 29 and ignition coil [83B] terminal D (BE/O).
4. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open (BE/O) wire.

4. Ignition Coil Control Wire Shorted to Ground Test

1. Disconnect EDM [78A] from breakout box.
2. Test for continuity between breakout box terminals 29 and 28.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (BE/O) wire.
   b. **No.** Replace ECM. See the service manual.

DTC P1352

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

Table 6-49. DTC P1352 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Short to voltage in signal circuit

1. Ignition Coil Shorted to Voltage Test

1. Disconnect ignition coil harness [83].
2. Turn IGN ON.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), measure voltage between terminal D of ignition coil [83B] and ground.
4. Is voltage more than 1.0V?
   a. **Yes.** Repair short to voltage on (BE/O) wire.
   b. **No.** Go to Test 2.

2. Ignition Coil Open Test

1. Test resistance between ignition coil [83A] terminals A and D.
2. Is resistance greater than 4.0 Ohms?
   a. **Yes.** If ECM connections are good, replace ECM. See the service manual.
   b. **No.** Replace ignition coil. See the service manual.

DTC P1354

PART NUMBER	TOOL NAME
HD-34730-2D	FUEL INJECTOR TEST LIGHT
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-50. DTC P1354 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Open or short to ground in signal circuit
Open power circuit

1. Ignition Coil Test

1. Disconnect ignition coil [83]. Inspect for damaged or backed out terminals and corrosion. Repair as required.
2. See Figure 6-30. Use HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) to connect FUEL INJECTOR TEST LIGHT (Part No. HD-34730-2D) [83B] terminals A and C.
3. Turn IGN ON and engine stop switch to RUN.
4. Does lamp flash when engine is cranked?
   a. **Yes.** Replace ignition coil. See the service manual.
   b. **No.** Go to Test 2.

2. Ignition Coil Input Voltage Test

1. Turn IGN ON. Voltage will only be present for 2 seconds after ignition is turned on.
2. Test for battery voltage at ignition coil [83B] terminal A to ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair open (Y/GN) wire between [83B] and system relay [62B] terminal I.

3. Ignition Coil Control Wire Continuity Test

1. Turn IGN OFF and engine stop switch to RUN.
2. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
3. Test for continuity between breakout box terminal 11 and ignition coil [83B] terminal C (Y/BE).
4. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open (Y/BE) wire.

4. Ignition Coil Control Wire Shorted to Ground Test

1. Disconnect ECM [78A] from breakout box.
2. Test for continuity between breakout box terminals 11 and 28.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (Y/BE) wire.
   b. **No.** Replace ECM. See the service manual.

DTC P1355

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

Table 6-51. DTC P1355 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Short to voltage in signal circuit

1. Ignition Coil Shorted to Voltage Test

1. Disconnect ignition coil harness [83].
2. Turn IGN ON.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), measure voltage between terminal C of ignition coil [83B] and ground.
4. Is voltage more than 1.0V?
   a. **Yes.** Repair short to voltage on (Y/BE) wire.
   b. **No.** Go to Test 2.

2. Ignition Coil Open Test

1. Measure resistance between ignition coil [83A] terminals A and C.
2. Is resistance greater than 4.0 Ohms?
   a. **Yes.** If ECM connections are good, replace ECM. See the service manual.
   b. **No.** Replace ignition coil. See the service manual.

HOME

DTC P1353, P1356, P1357, P1358 6.18

DESCRIPTION AND OPERATION

See Figure 6-32. A feedback voltage signal in the secondary ignition circuit (terminal B) detects the presence of combustion each time a cylinder fires on ECM terminal 27. For diagnostic purposes, this signal is only analyzed at high speed and load conditions where it may be easily measured. Failure to detect combustion at high speed and load means one of following conditions is true:

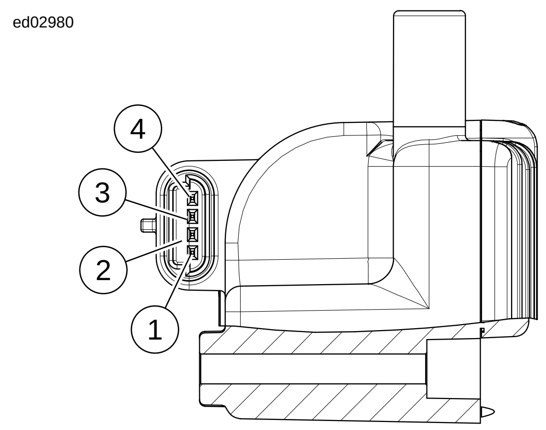
- Cylinder is truly misfiring.
- There is a lack of continuity in the ignition coil secondary circuit.

NOTE

Make sure vehicle is running properly before performing the tests in this section. Perform fuel pressure tests if required. See the service manual. If fuel pressure is not within the proper range, see 6.25 FUEL SYSTEM ELECTRICAL TEST.

Table 6-52. Code Description

DTC	DESCRIPTION
P1353	Front cylinder no combustion
P1356	Rear cylinder no combustion
P1357	Front cylinder combustion intermittent
P1358	Rear cylinder combustion intermittent



1. **Pin A: power**
2. **Pin B: ion sense**
3. **Pin C: rear coil**
4. **Pin D: front coil**

Figure 6-32. Ignition Coil

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

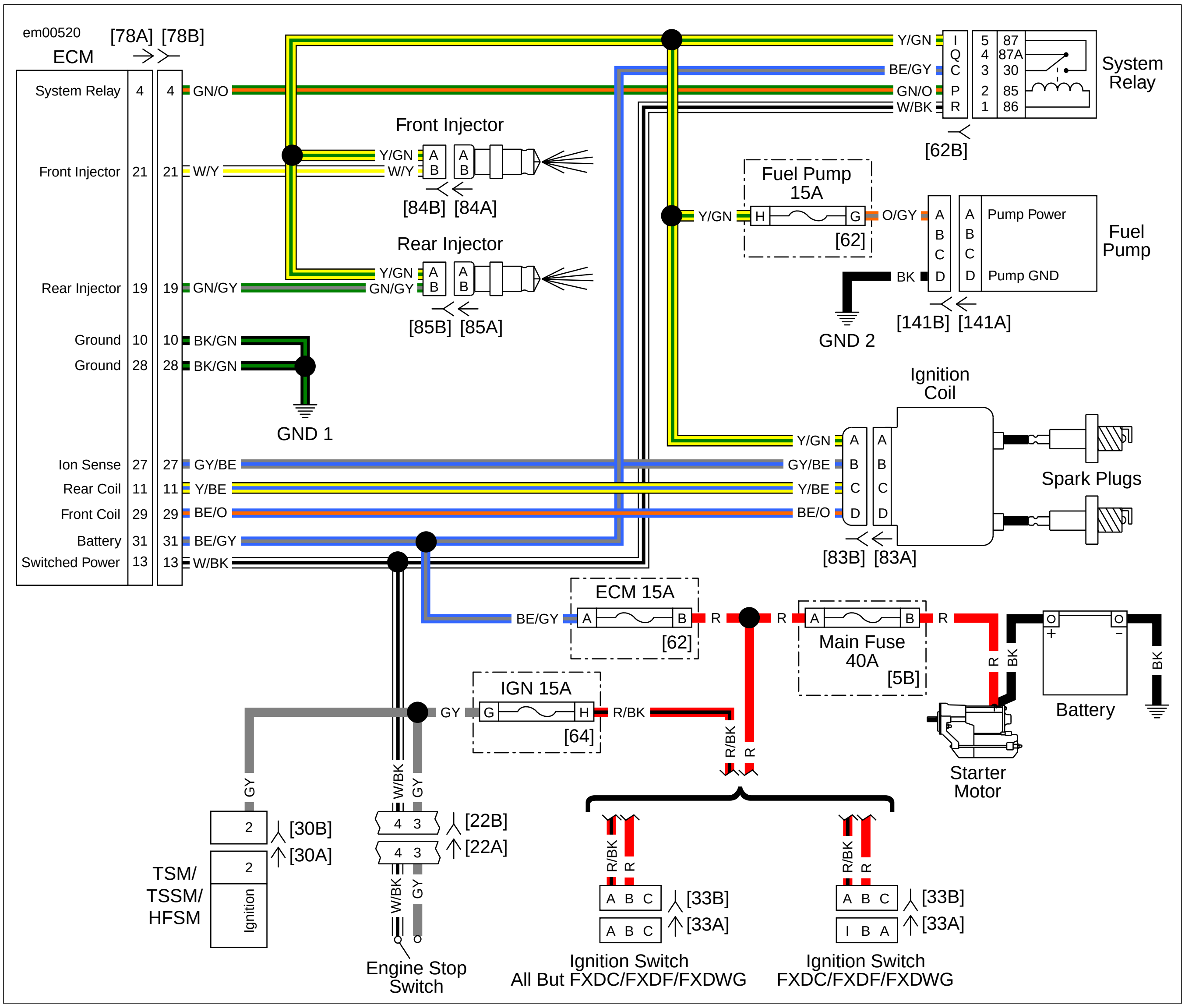


Figure 6-33. Ignition Circuit

DTC P1353 AND P1356

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

Table 6-53. DTC P1353 and P1356 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Fuel system problems
Open or short to voltage in signal circuit
Spark plug wire connections faulty

1. Absence of Fuel Test

1. Verify vehicle has fuel.
2. Has vehicle run out of fuel recently?
   a. **Yes.** Clear DTCs using speedometer self-diagnostics. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics. Fill with fresh fuel and restart. If code returns, then continue with tests. Go to Test 2.
   b. **No.** Go to Test 2.

2. Ignition Coil Primary Resistance Test

1. Disconnect ignition coil [83].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure resistance between ignition coil [83] terminals A and C, and then from terminals A and D.
3. Is resistance 0.3-0.5 Ohms?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace the ignition coil. See the service manual.

3. Spark Plug Wire Test

1. Disconnect the spark plug wires.
2. Measure the resistance of the spark plug wires.
3. Is the front and rear spark plug wire resistance within the specified range? See Table 1-5.
   a. **Yes.** Go to Test 4.
   b. **No.** Replace the out of range spark plug wire. See the service manual.

4. Ignition Coil Secondary Resistance Test

1. Measure resistance between ignition coil [83A] terminal A to the front spark plug boot. Repeat measurement for the rear boot.
2. Is resistance 3500-4500 Ohms?
   a. **Yes.** Replace spark plug.
   b. **No.** Replace the ignition coil. See the service manual.

DTC P1357 AND P1358

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-54. DTC P1357 and P1358 Diagnostic Faults

POSSIBLE CAUSES
Ignition coil malfunction
ECM malfunction
Fuel system problems
Open or short to voltage in signal circuit
Spark plug wire connections faulty

1. Ion Sense Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between the ignition coil [83B] terminal B and breakout box terminal 27.
3. Is continuity present?
   a. **Yes.** Replace spark plug. See the service manual. If condition persists, then continue with tests. Go to Test 2.
   b. **No.** Repair open in (GY/BE) wire.

2. Ion Sense Resistance Test

1. Measure resistance between ignition coil [83A] terminals A and B.
2. Is resistance greater than 100K Ohms?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Go to Test 3.

3. Ion Sense Short to Voltage Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. With IGN ON, use the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for voltage between ignition coil [83B] terminal B and breakout box terminals 10 or 28.
3. Is voltage present?
   a. **Yes.** Repair short to voltage on (GY/BE) wire.
   b. **No.** Replace ignition coil. See the service manual.

DTC P1475, P1477, P1478 6.19

DESCRIPTION AND OPERATION

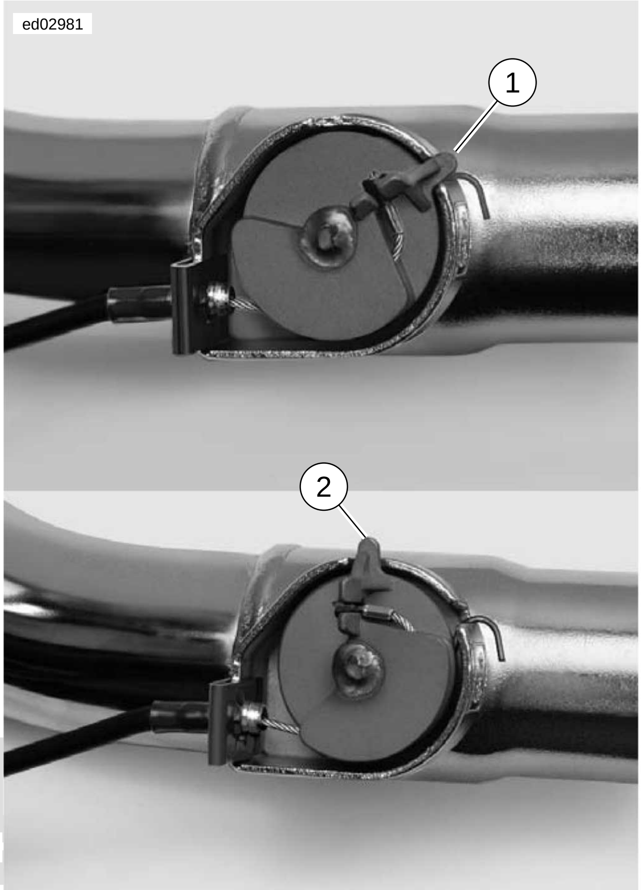
The active exhaust actuator system utilizes an actuator valve located in the rear exhaust pipe which is connected to a servo motor via a cable. The valve position automatically adjusts to enhance engine performance. Active exhaust actuator is included on HDI vehicles only.

Table 6-55. Code Description

DTC	DESCRIPTION
P1475	Exhaust actuator position failure
P1477	Exhaust actuator open/low
P1478	Exhaust actuator high

NOTE

The AIS and active exhaust actuator share the same power source and function simultaneously.



1. **Open position**
2. **Closed position**

Figure 6-34. Bellcrank

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

[HOME](#)

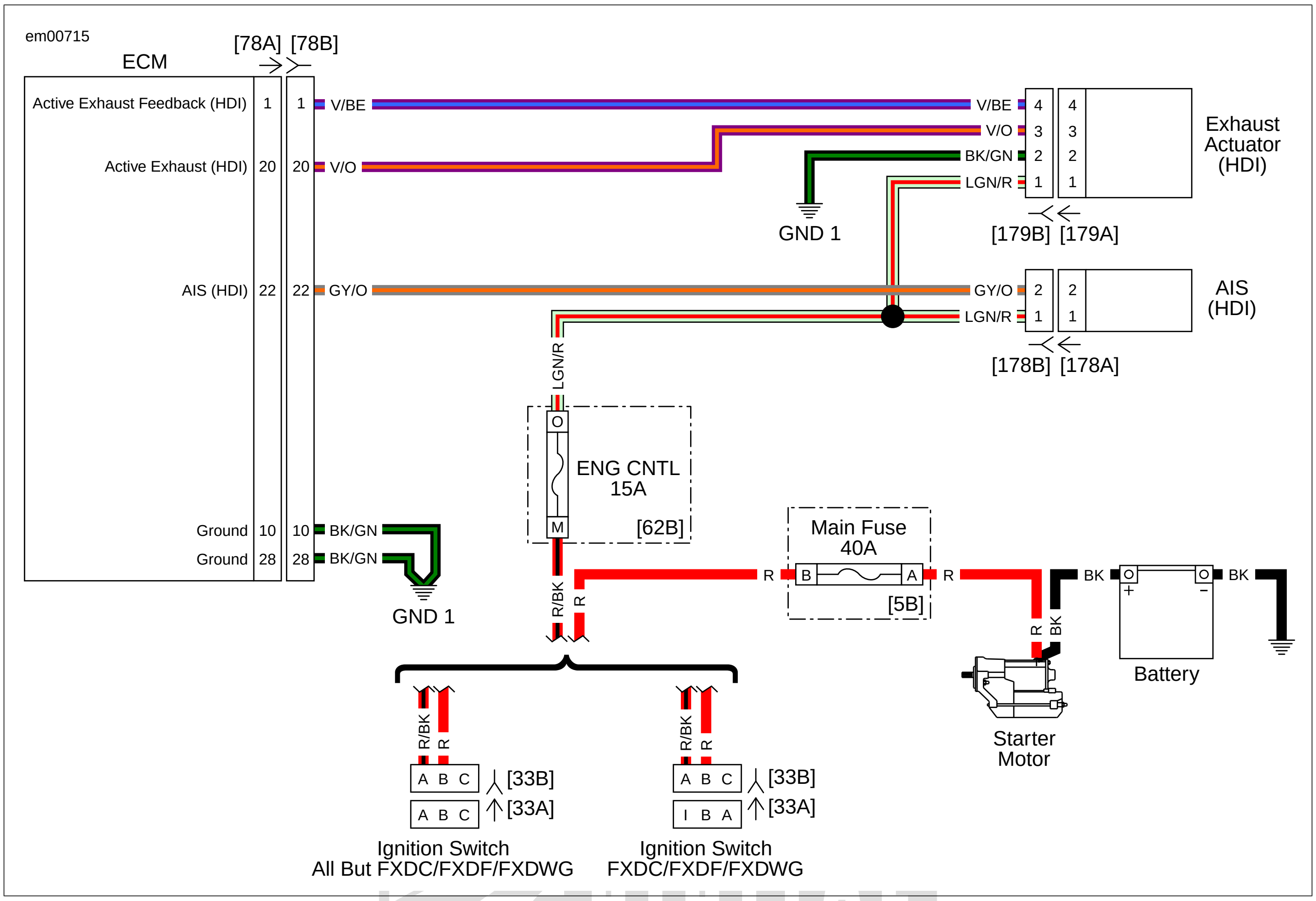


Figure 6-35. Active Exhaust Actuator and AIS Circuit

DTC P1475

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-56. DTC P1475 Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
Cable and bellcrank malfunction
Open in ground circuit
Open in power circuit
Open in active exhaust feedback circuit
Exhaust actuator malfunction
Short to voltage in active exhaust feedback circuit
Short to ground in active exhaust feedback circuit

1. Exhaust Actuator Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to [78B], leaving ECM [78A] disconnected.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jump breakout box terminal 20 to terminal 10 or 28.
3. Turn IGN ON.
4. Does actuator activate immediately?
   a. **Yes.** Replace ECM. See service manual.
   b. **No.** Check engine control fuse. If fuse is okay, then continue with tests. [Go to Test 2.](#)

2. Exhaust Actuator Voltage Test

1. Disconnect exhaust actuator [179].
2. With IGN ON, measure the voltage between [179B] terminals 1 and 2.
3. Is battery voltage present?
   a. **Yes.** Check the cable and bellcrank assembly from exhaust actuator to exhaust valve for proper operation. See the service manual.
   b. **No.** [Go to Test 3.](#)

3. Exhaust Actuator Motor Ground Wire Continuity Test

1. Turn IGN OFF.

2. Test for continuity between [179B] terminal 2 and ground.
3. Is continuity present?
   a. **Yes.** Go to Test 4.
   b. **No.** Repair open on (BK/GN) wire.

4. Exhaust Actuator Motor Power Wire Continuity Test

1. With IGN OFF, test for continuity between [179B] terminal 1 and engine control fuse [62B] terminal O.
2. Is continuity present?
   a. **Yes.** Go to Test 5.
   b. **No.** Repair open on (LGN/R) wire.

5. Exhaust Actuator Feedback Voltage Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between ECM [78A] and harness [78B].
2. Turn IGN ON.
3. Measure the voltage between breakout box terminals 1 and 10 or 28.
4. Is voltage 4.5-5.5V?
   a. **Yes.** Go to Test 6.
   b. **No.** Battery voltage. Go to Test 9.
   c. **No.** 0V. Go to Test 10.

6. Exhaust Actuator Feedback Continuity Test

1. Disconnect exhaust actuator [179].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and multimeter, test for continuity between [179B] terminal 4 and breakout box terminal 1.
3. Is continuity present?
   a. **Yes.** Go to Test 7.
   b. **No.** Repair open wire (V/BE).

7. Exhaust Actuator Feedback Control Test

1. Connect the exhaust actuator [179].
2. Turn IGN ON and engine stop switch to RUN.
3. Measure the voltage between breakout box terminals 1 and 10 or 28.
4. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), jump between breakout box terminals 20 and 28 several times.
5. Does the voltage change to less than 1 Volt and the exhaust actuator valve open each time?
   a. **Yes.** Go to Test 8.
   b. **No.** Replace exhaust actuator. See the service manual.

8. Exhaust Actuator Feedback Run Test

1. Clear codes and start the engine.
2. Run the engine in neutral between 1500-2500 RPM.
3. Does the exhaust valve open at 1600 RPM or less and close at 1800 or more?
   a. **Yes.** System okay.
   b. **No.** Check connectors for damaged, pushed out, or corroded pins. If no problems are found, replace ECM. See the service manual.

9. Exhaust Actuator Feedback Short to Voltage Test

1. Disconnect ECM from breakout box.
2. With IGN ON and engine not running, test for voltage between breakout box terminal 1 and ground.
3. Is voltage present?
   a. **Yes.** Repair short to voltage on (V/BE) wire.
   b. **No.** Replace ECM. See the service manual.

10. Exhaust Actuator Feedback Short to Ground Test

1. Disconnect ECM from breakout box.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and multimeter, test for continuity between [179B] terminal 4 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (V/BE) wire.
   b. **No.** Replace ECM. See the service manual.

DTC P1477

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-57. DTC P1477 Diagnostic Faults

POSSIBLE CAUSES
Open in active exhaust circuit
ECM malfunction
Short to ground in active exhaust circuit
Exhaust actuator malfunction

1. Exhaust Actuator Motor Open Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to harness [78B], leaving ECM [78A] disconnected.
2. Disconnect exhaust actuator [179].
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for continuity between breakout box terminal 20 to [179B] terminal 3.
4. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair open (V/O) wire.

2. Exhaust Actuator Motor Shorted to Ground Test

1. Connect ECM to breakout box.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for continuity between breakout box terminal 20 and ground.
3. Is continuity present?
   a. **Yes.** Go to Test 3.
   b. **No.** Replace ECM. See the service manual.

3. Exhaust Actuator Feedback Shorted to Ground Test

1. Disconnect exhaust actuator [179] and disconnect ECM from breakout box.
2. Test for continuity between breakout box terminal 20 and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground on (V/O) wire.
   b. **No.** Replace active exhaust actuator. See the service manual.

DTC P1478

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-58. DTC P1478 Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
Short to voltage in active exhaust circuit
Exhaust actuator malfunction

1. Exhaust Actuator Motor High Test

1. Connect BREAKOUT BOX (Part No. HD-43876) to harness [78B], leaving ECM [78A] disconnected.
2. Turn IGN ON and engine stop switch to RUN.
3. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for voltage between breakout box terminal 20 and ground.
4. Is voltage present?
   a. **Yes.** Go to Test 2.
   b. **No.** Replace ECM. See the service manual.

2. Exhaust Actuator Motor Shorted to Voltage Test

1. Disconnect exhaust actuator [179].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for voltage between breakout box terminal 20 and ground.
3. Is voltage present?
   a. **Yes.** Repair short to voltage on (V/O) wire.
   b. **No.** Replace active exhaust control actuator.

DTC P1501, P1502 6.20

DESCRIPTION AND OPERATION

The 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 TSM/TSSM/HFSM determines the transmission is in neutral. Otherwise the engine will start and stall. This is done by monitoring the neutral switch input to the TSM/TSSM/HFSM and communicating that input over the serial data circuit to the ECM.

See Figure 6-37. The JSS is powered and monitored by the ECM. The ECM terminal 14 supplies the 5V reference to the JSS connector [133] terminal 1. The JSS terminal 2 sends a signal back to the ECM terminal 9. This signal is used by the ECM to determine when the jiffy stand is retracted or extended. The JSS terminal 3 is grounded through the ECM terminal 28.

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 speedometer will display "SIdE Stand." DTC P1501 or P1502 will set if the JSS circuits are out of range.

Table 6-59. Code Description

DTC	DESCRIPTION
P1501	JSS low
P1502	JSS high

NOTE

The ECM supplies 5V reference voltage from [78] terminal 14 to the VSS, TPS, and MAP sensors in addition to the JSS. Problems on the 5V reference will cause other DTCs.

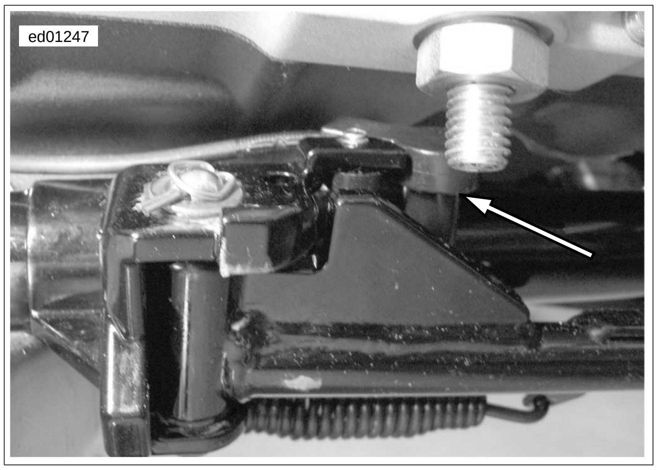


Figure 6-36. JSS (HDI)

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

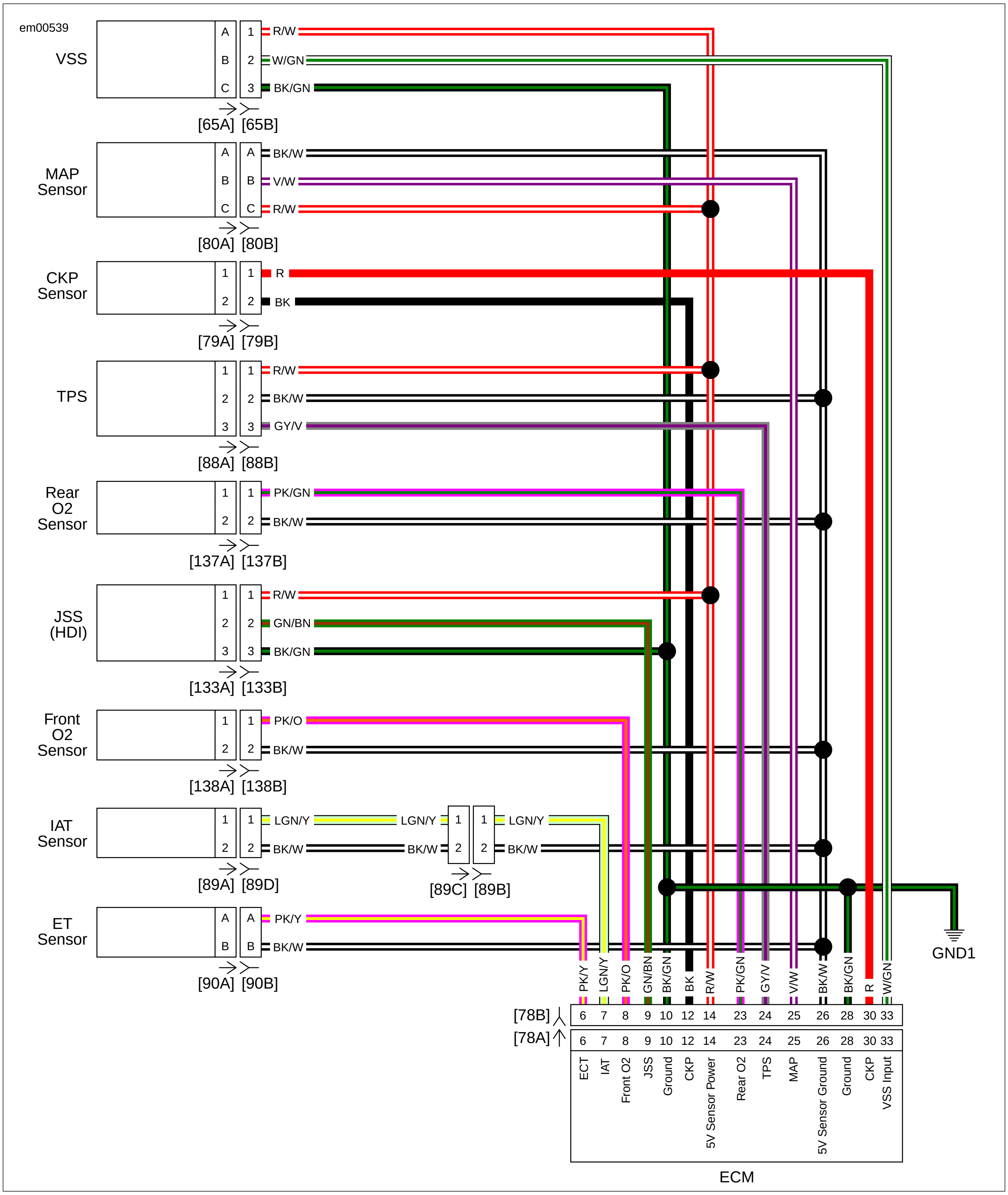


Figure 6-37. Sensor Circuit

DTC P1501

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-60. DTC P1501 Diagnostic Faults

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

1. JSS 5V Reference Open Circuit Test

1. Disconnect the JSS [133].
2. Inspect the connection for corrosion or backed out terminals. Repair as required.
3. Connect BREAKOUT BOX (Part No. HD-43876) to wire harness [78B], leaving ECM [78A] disconnected. See 1.2 DIAGNOSTIC TOOLS.
4. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for continuity between breakout box terminal 14 and JSS [133B] terminal 1 (R/W).
5. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair open on (R/W) wire.

2. JSS 5V Reference Shorted to Ground Test

1. Test for continuity between JSS [133B] terminal 1 (R/W) to ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground on (R/W) wire.
   b. **No.** Go to Test 3.

3. JSS Signal Wire Shorted to Ground Test

1. Test for continuity between breakout box terminal 9 and ground.
2. Is continuity present?
   a. **Yes.** Repair short to ground on (GN/BN) wire.
   b. **No.** Go to Test 4.

4. JSS Signal Wire Open Circuit Test

1. Test for continuity between breakout box terminal 9 and JSS [133B] terminal 2 (GN/BN).
2. Is continuity present?
   a. **Yes.** Replace JSS. See the service manual.
   b. **No.** Repair open on (GN/BN) wire.

DTC P1502

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

Table 6-61. DTC P1502 Diagnostic Faults

POSSIBLE CAUSES
JSS malfunction
ECM malfunction
Short to voltage in signal circuit
Open ground
Short to voltage in 5V reference circuit

1. JSS Ground Wire Test

1. Disconnect the JSS [133].
2. Using the HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B), test for continuity between terminal 3 of [133B] and ground.
3. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair open in (BK/GN) wire.

2. JSS 5V Reference Wire Short to Voltage Test

1. Test for voltage at [133B] terminal 1 (R/W) wire.
2. Is voltage greater than 6V?
   a. **Yes.** Repair short to battery voltage on (R/W).
   b. **No.** Go to Test 3.

3. JSS Signal Wire Short to Voltage Test

1. Test for voltage on [133B] terminal 2.
2. Is voltage greater than 5.5V?
   a. **Yes.** Repair short to battery voltage in (GN/BN) wire.
   b. **No.** Go to Test 4.

4. JSS 5V Reference and Signal Shorted Together Test

1. With IGN OFF, disconnect the ECM [78].
2. Test for continuity between terminals 1 and 2 of [133B].
3. Is continuity present?
   a. **Yes.** Repair short between (R/W) and (GN/BN) wires.
   b. **No.** Replace JSS. See the service manual.

SIDE STAND DISPLAYED ON SPEEDOMETER

Table 6-62. Side Stand Displayed on Speedometer Diagnostic Faults

POSSIBLE CAUSES
Jiffy stand is down
Jiffy stand out of adjustment

1. Starts then Stalls Test

1. Check for DTCs and diagnose them first.
2. Does the engine start and stall?
   a. **Yes.** See 6.24 STARTS, THEN STALLS.
   b. **No.** Go to Test 2.

2. Neutral Test

1. Verify the transmission is in neutral.
2. Is the neutral indicator on?
   a. **Yes.** Go to Test 3.
   b. **No.** See 4.5 INDICATOR LAMPS.

3. JSS Clearance Test

1. Inspect the JSS and the jiffy stand for correct mounting and clearance to the jiffy stand tab.
2. Is the clearance less than 0.18 in (4.5mm)?
   a. **Yes.** Replace the JSS. See the service manual.
   b. **No.** Install the JSS and jiffy stand correctly. See the service manual.

DTC P1653, P1654 6.21

DESCRIPTION AND OPERATION

DTCs P1653 and P1654 are associated with terminal 3 from the ECM. This terminal supports a tachometer output that is not used from the factory. If either of these codes appear when checking for DTCs, inspect for any aftermarket components or systems wired into terminal 3 of the ECM.

Table 6-63. Code Description

DTC	DESCRIPTION
P1653	Tachometer low
P1654	Tachometer high

An issue with the wiring or component using this terminal could cause the codes to set. If no wiring is present in this terminal, clear the codes and perform a road test. If the codes return, replace the ECM.

ENGINE CRANKS, BUT WILL NOT START 6.22

DESCRIPTION AND OPERATION

If the starter will not crank the engine, the problem is not EFI related. Refer to 3.2 STARTING SYSTEM or 5.10 SECURITY SYSTEM.

There may be DTC's associated with this problem. check for DTC's and clear them before proceeding with this test.

NOTE

To set a CKP DTC, a start attempt must last at least 5 seconds.

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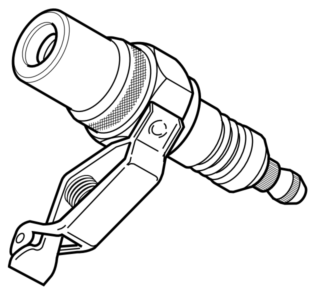

Figure 6-38. Spark Tester

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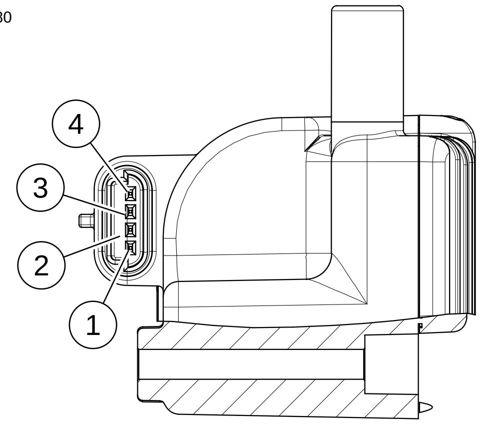


1. **Pin A: power**
2. **Pin B: ion sense**
3. **Pin C: rear coil**
4. **Pin D: front coil**

Figure 6-39. Ignition Coil

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

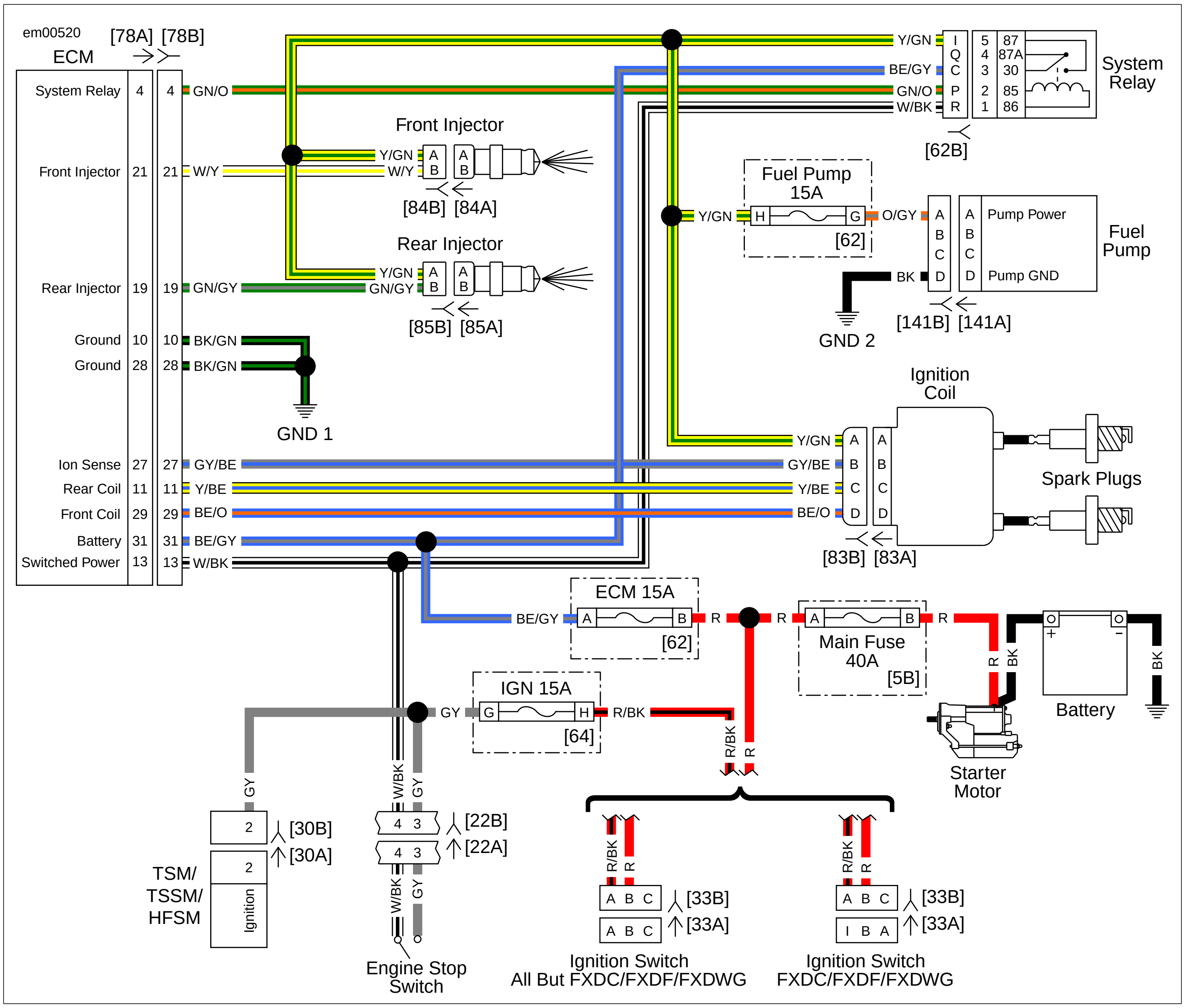


Figure 6-40. Ignition Circuit

ENGINE CRANKS BUT WILL NOT START

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER

Table 6-64. Engine Cranks But Will Not Start Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
Battery voltage too low
Ignition system malfunction
Fuel system malfunction
IAC malfunction
No or low compression

1. Preliminary Engine Tests

1. Make sure there is fresh fuel in tank, spark plug wires firmly connected to coil terminals, and battery connections in good condition.
2. Check for DTCs. See 2.1 INITIAL DIAGNOSTICS, Odometer Self-Diagnostics. If DTCs are present, go to the appropriate DTC procedure.
3. Verify battery condition. See 3.1 BATTERY TESTING.
4. Does battery pass tests?
   a. **Yes.** Go to Test 2.
   b. **No.** Charge or replace battery.

2. Check Engine Lamp Test

1. Turn IGN ON and engine stop switch to RUN.

2. Does check engine lamp illuminate for 4 seconds immediately after key ON?
   a. **Yes.** Go to Test 3.
   b. **No.** Go to 6.23 NO ECM POWER.

3. IAC Operation Test

1. Remove the air cleaner.
2. Turn IGN ON.
3. Does IAC function (pintle moving in and out of idle air passage)?
   a. **Yes.** Go to Test 4.
   b. **No.** Refer to 6.12 DTC P0505.

4. Spark Present Test

1. Check spark plug condition and replace if fouled.
2. Using SPARK TESTER (Part No. HD-26792), check spark at both plugs while cranking engine.
3. Is spark present?
   a. **Yes.** Perform compression test, check fuel system, and perform fuel pressure test. See the service manual.
   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. Refer to 6.17 DTC P1351, P1352, P1354, P1355 or 6.10 DTC P0373, P0374.

NO ECM POWER 6.23

DESCRIPTION AND OPERATION

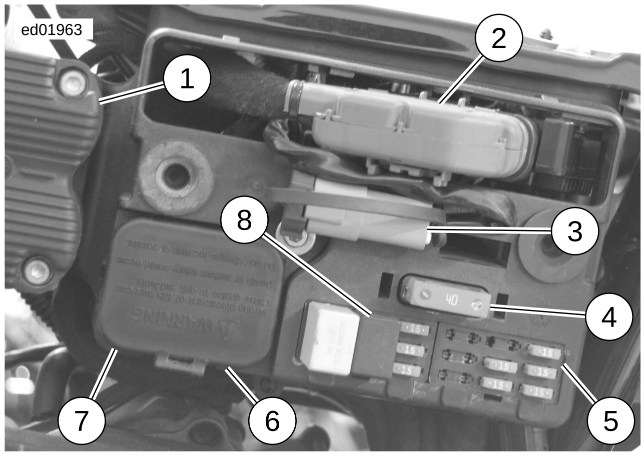
Constant power is supplied to the ECM through terminal 31. The ECM turns on when power is applied to terminal 13 of connector [78]. The ECM goes through an initialization sequence every time power is removed and re-applied to terminal 13. The only visible part of this sequence is the check engine lamp. Upon starting, the check engine lamp will illuminate for 4 seconds and then (if parameters are normal) go out.

If battery power is absent at ECM terminal 31:

- DTCs cannot be cleared. Tool will show them as cleared but will be present next time ignition key is cycled.
- ECM cannot be re-flashed.
- Vehicle will start but IAC pintle will not reset at key OFF. Eventually pintle will be out of position causing performance problems.

NOTE

The IGN ON sequence also activates the idle air control motor. If power from terminal 31 is disrupted (open fuse, etc.) always turn IGN OFF wait 10 seconds then turn IGN ON to reset the motor to the default position.



1. **Ignition coil**
2. **ECM [78]**
3. **DLC [91]**
4. **Main fuse [5]**
5. **Fuse block [64]**
6. **TSM/TSSM/HFSM**
7. **HFSM antenna harness [208]**
8. **Fuse/relay block [62]**

Figure 6-41. Under Left Side Cover

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

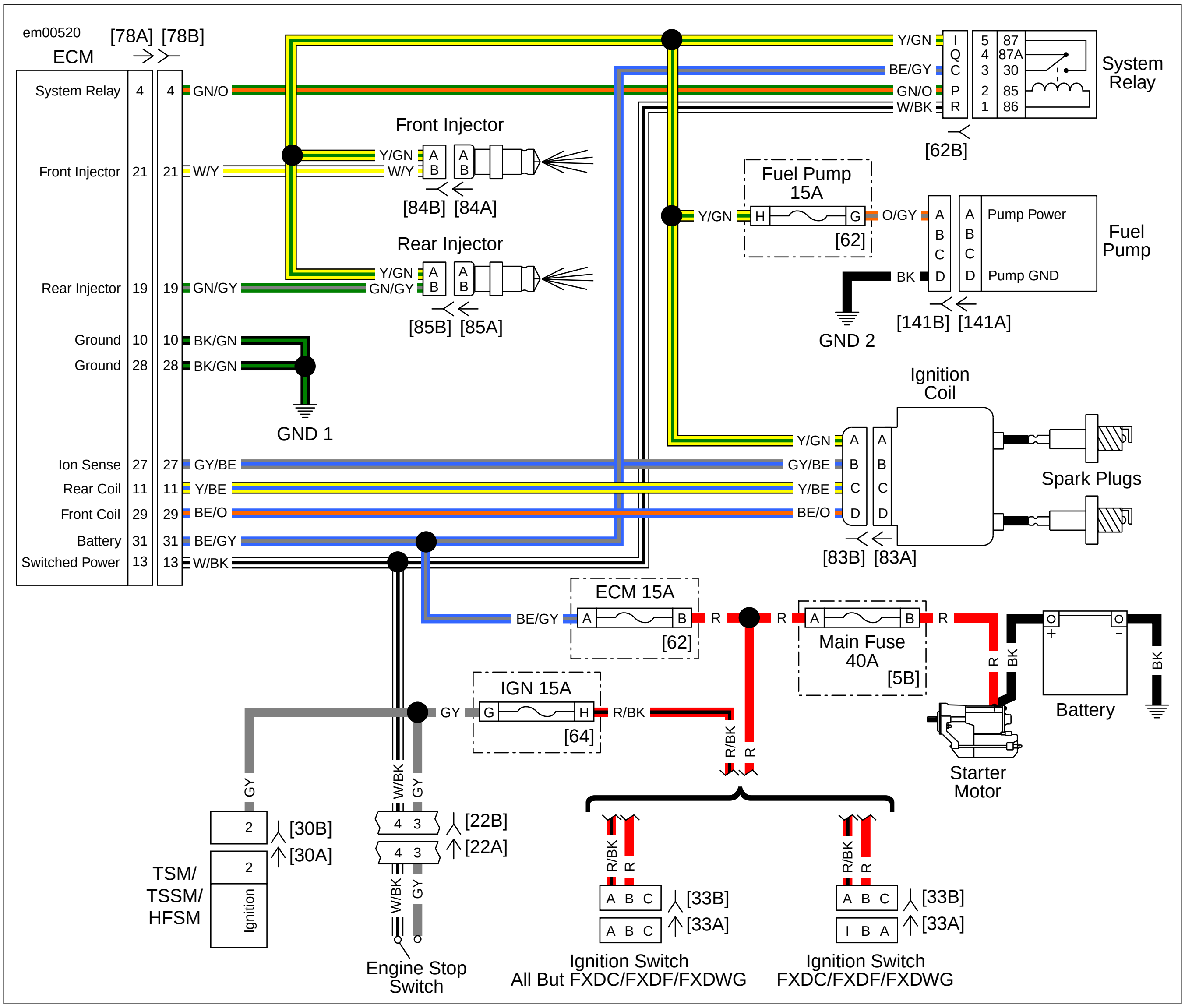


Figure 6-42. Ignition Circuit

NO ECM POWER

PART NUMBER	TOOL NAME
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-65. No ECM Power Diagnostic Faults

POSSIBLE CAUSES
Short to ground in ECM power circuit
Open in ECM switched power circuit
Open ECM ground circuit
ECM malfunction
Engine stop switch malfunction

1. ECM Fuse Test

1. Check ECM fuse.
2. Is fuse good?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair short to ground on (BE/GY) wire and replace fuse.

2. IGN Fuse Test

1. Check IGN fuse.
2. Is fuse good?
   a. **Yes.** Go to Test 3.
   b. **No.** Repair short to ground on (GY) or (W/BK) wire and replace IGN fuse.

3. ECM Connector Test

1. With IGN OFF, disconnect ECM [78].
2. Inspect the connection for corrosion or backed out terminals. Repair as required.

3. Connect ECM [78].
4. Turn IGN ON.
5. Does ECM have power?
   a. **Yes.** Problem solved.
   b. **No.** Go to Test 4.

4. ECM Battery Wire Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for battery voltage between breakout box terminal 31 and ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 5.
   b. **No.** Repair open in (BE/GY) wire.

5. ECM Switched Voltage Test

1. Turn IGN ON and engine stop switch in RUN.
2. Measure voltage between breakout box terminal 13 and ground.
3. Is battery voltage present?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair open (W/BK) wire. If wire is okay, then continue with tests. Go to Test 7.

6. ECM Ground Wires Test

1. Measure voltage between positive battery terminal and breakout box terminals 10 and 28.
2. Is battery voltage present?
   a. **Yes.** Replace ECM. See the service manual.
   b. **No.** Repair open in (BK/GN) wire.

7. Engine Stop Switch Battery Voltage Test

1. Disconnect [22].
2. Turn IGN ON.
3. Measure voltage on [22B] terminal 3 (GY) and ground.
4. Is battery voltage present?
   a. **Yes.** Go to Test 8.
   b. **No.** Repair open wire (GY).

8. Engine Stop Switch Test

1. Turn IGN OFF and engine stop switch in RUN.
2. Measure the resistance between [22A] terminals 3 and 4.
3. Is resistance less than 1.0 Ohm?
   a. **Yes.** Repair open in (W/BK) wire from terminal 4 of [22B] and ECM (78B).
   b. **No.** Repair or replace engine stop switch. See the service manual.

STARTS, THEN STALLS 6.24

DESCRIPTION AND OPERATION

The starts, then stalls condition may be created by the fuel system, the idle air control system or an ECM failure. When this condition exists, refer to 2.4 DTC U1300, U1301 OR BUS ER.

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, P0263, and P0264
- Ignition coils: DTCs P1351, P1352, P1354, and P1355
- IAC actuator: DTC P0505
- Password problem: DTCs P1009 and P1010
- TPS: DTCs P0122 and P0123
- JSS: DTCs P1501, P1502, and P1503
- Neutral switch: DTC P1155
- All modes: DTCs P0603 and P0605

Diagnostic Tips

- The vehicle will stall on HDI models, if the jiffy stand is extended when the transmission is in gear and the clutch is released.
- If serial data is shorted, U1300 and U1301 will automatically set the check engine light.
- DTCs P1009 and P1010 may accompany DTCs U1300 and U1301.
- If this condition is fuel related, perform Fuel Pressure Test. See the service manual.
- If the fuel system passes the pressure test, perform the Fuel System Electrical Test. See 6.25 FUEL SYSTEM ELECTRICAL TEST.

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

STARTS, THEN STALLS

Table 6-66. Starts, Then Stalls Diagnostic Faults

POSSIBLE CAUSES
Fuel system malfunction
Idle air control system malfunction
Speedometer malfunction
Open serial data circuit
Neutral switch malfunction
TSM/TSSM/HFSM malfunction

1. Throttle Test

1. Will engine start with the throttle partially opened and then stall when closed?
   a. **Yes.** Check IAC for proper operation. If necessary, perform IAC test, DTC P0505.
   b. **No.** Go to Test 2.

2. Jiffy Stand Test

1. Turn IGN OFF.
2. Raise jiffy stand.
3. Turn IGN ON and engine stop switch to RUN.
4. Does speedometer display SidE StAnd?
   a. **Yes.** Inspect JSS for correct mounting and clearance to jiffy stand tab 0.18 in (4.5mm). If sensor is mounted correctly, replace sensor. See the service manual.
   b. **No.** Go to Test 3.

3. Neutral Switch Test

1. Verify neutral switch circuit operation.
2. Is neutral switch circuit operating normally?
   a. **Yes.** Replace TSM/TSSM/HFSM. See the service manual.
   b. **No.** Replace neutral switch. See the service manual.

4. Fuel System Test

1. Perform Fuel Pressure test. See the service manual.
2. Is fuel pressure normal?
   a. **Yes.** If fuel injectors are okay, replace ECM. See the service manual.
   b. **No.** Repair fuel pressure problem. See the service manual.

FUEL SYSTEM ELECTRICAL TEST 6.25

DESCRIPTION AND OPERATION

With the IGN ON and the engine stop switch at RUN, the ECM will energize the system relay to complete the circuit to the in-tank fuel pump. It will remain on as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses from the CKP sensor. If there are no reference pulses, the ECM will de-energize the system relay within 2 seconds after ignition is turned on or the engine has stalled, or immediately after the ignition is shut off.

The fuel pump delivers fuel to the injectors. The pressure regulator controls system pressure.

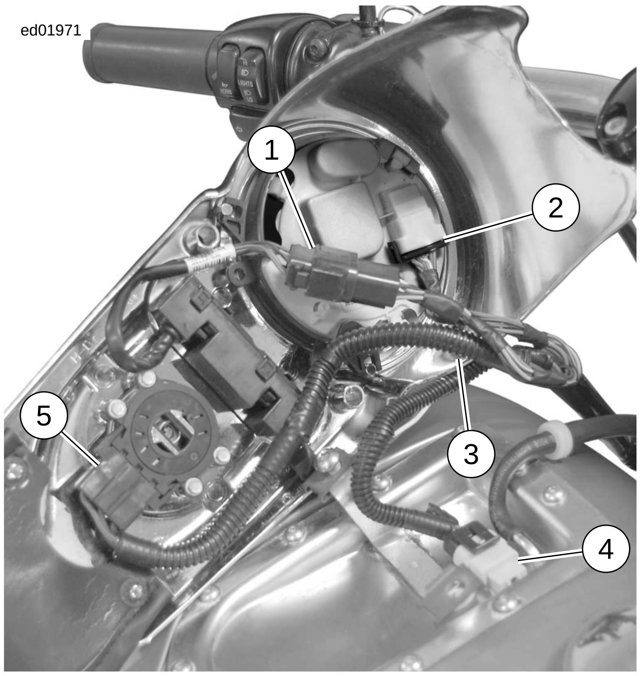
See Figure 6-43. When the engine is stopped, the pump can be turned on by applying battery voltage to terminal 1 and ground to terminal 4 of the fuel pump connector [141B].

Improper fuel system pressure may contribute to the following symptoms:

- Engine cranks, but will not run.
- Engine cuts out (may feel like ignition problems).
- Hesitation, loss of power and poor fuel economy.

NOTE

After turning ignition off, you must wait 10 seconds before turning the ignition back on to get the fuel pump to reprime. This time-out period is necessary for the fuel pump and IAC to reset.



1. **Indicator lamps [21]**
2. **Speedometer [39]**
3. **Trip odometer reset switch**
4. **Fuel pump and sender [141]**
5. **Ignition switch [31]**

Figure 6-43. Under Console (Typical)

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

HOME

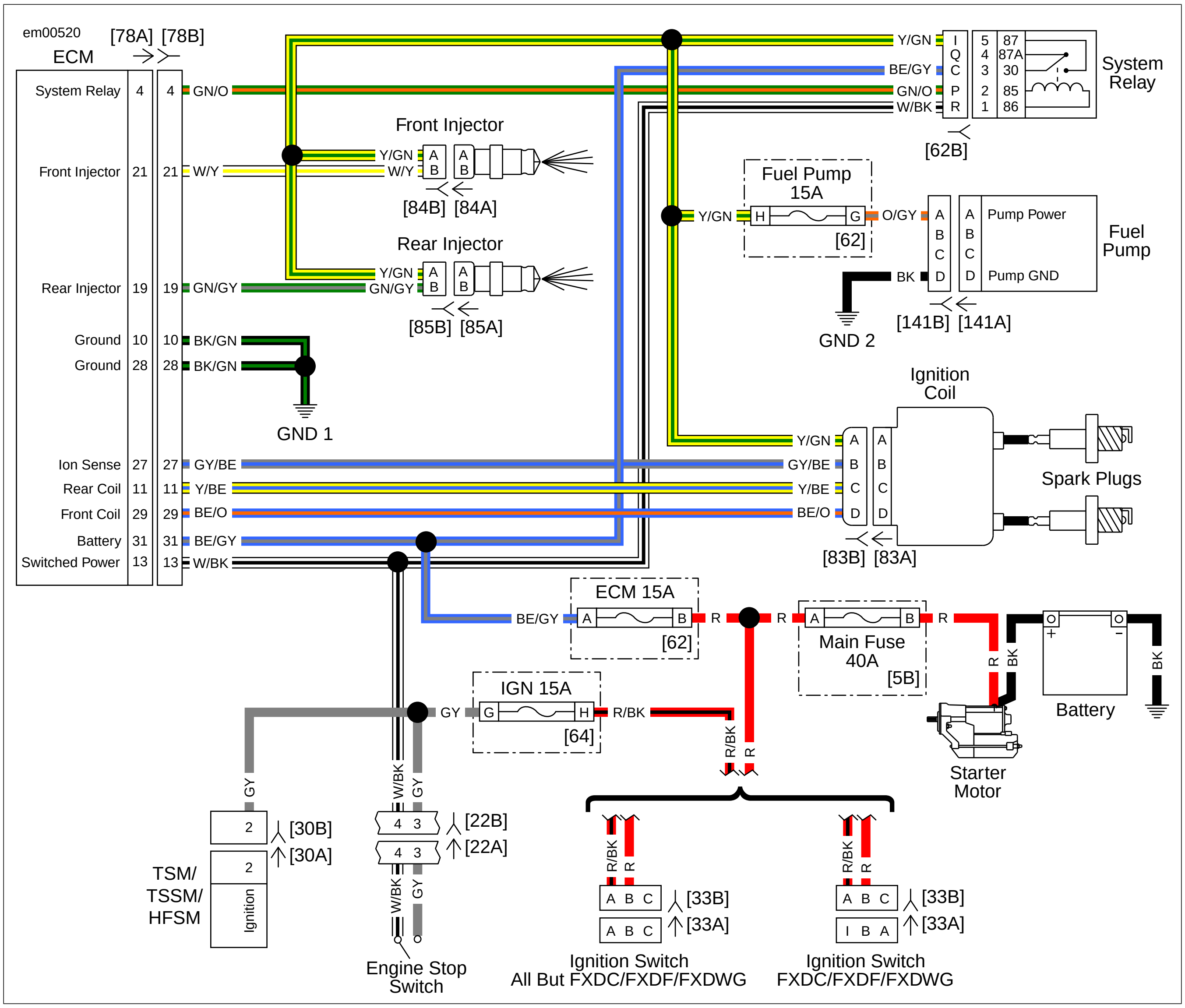


Figure 6-44. Ignition Circuit

FUEL SYSTEM ELECTRICAL TEST

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

Table 6-67. Fuel System Electrical Test Diagnostic Faults

POSSIBLE CAUSES
Fuel pump malfunction
Fuel pump electrical system
ECM malfunction
Electrical system malfunction
System relay malfunction
Open ground circuit

1. ECM and Fuel Pump Fuse Test

1. Check ECM and fuel pump fuses.
2. Are fuses good?
   a. **Yes.** Go to Test 2.
   b. **No.** Go to 6.23 NO ECM POWER.

2. Fuel Pump Voltage Test

1. Disconnect fuel pump connector [141].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, measure voltage between fuel pump [141B] terminals A and D during the first 2-3 seconds after IGN ON.
3. Is battery voltage present?
   a. **Yes.** Replace fuel pump. See service manual.
   b. **No.** Go to Test 3.

3. Fuel Pump Open Circuit Test

1. Turn IGN OFF.

2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [141A] terminal A and system relay [62B] terminal I.
3. Is continuity present?
   a. **Yes.** Repair open on (BK) wire to ground.
   b. **No.** Repair open (Y/GN) wire.

4. Fuel Pump Voltage Short to Ground Test

1. Disconnect fuel pump [141].
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, test for continuity between [141B] terminal A and ground.
3. Is continuity present?
   a. **Yes.** Repair short to ground (Y/GN) and replace fuel pump fuse.
   b. **No.** Test system relay. See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Relay Diagnostics.

MISFIRE AT IDLE OR UNDER LOAD 6.26

DESCRIPTION AND OPERATION

Misfire conditions may be caused by:

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

Diagnostic Tips

⚠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, a known good part can be used to verify whether a suspected part is faulty. The ignition coil does not require full installation to be functional. Verify faulty ignition coil by performing resistance test. See 6.17 DTC P1351, P1352, P1354, P1355.

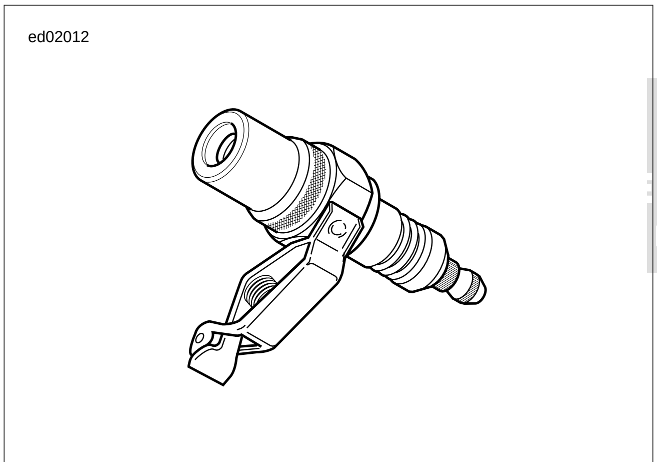


Figure 6-45. Spark Tester

IN-LINE SPARK TESTER

PART NUMBER	TOOL NAME
YA840	SNAP-ON IN-LINE SPARK TESTER

See Figure 6-46. The use of a SNAP-ON IN-LINE SPARK TESTER (Part No. YA840) or equivalent, can help determine whether a problem exists in the ignition or fuel systems. If the test light flashes without interruption on both cylinders during the misfire event, verify spark plug condition and gap, and inspect the fuel system for proper operation. If the test light does not flash, or the flash is interrupted during the misfire event, the problem is ignition related.

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

NOTE

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

Figure 6-46. Inline Spark Tester

Connector Information

For additional information about the connectors in the following diagram(s) and diagnostic procedure(s), including the color of the harness test kit terminal probes, see B.1 CONNECTORS.

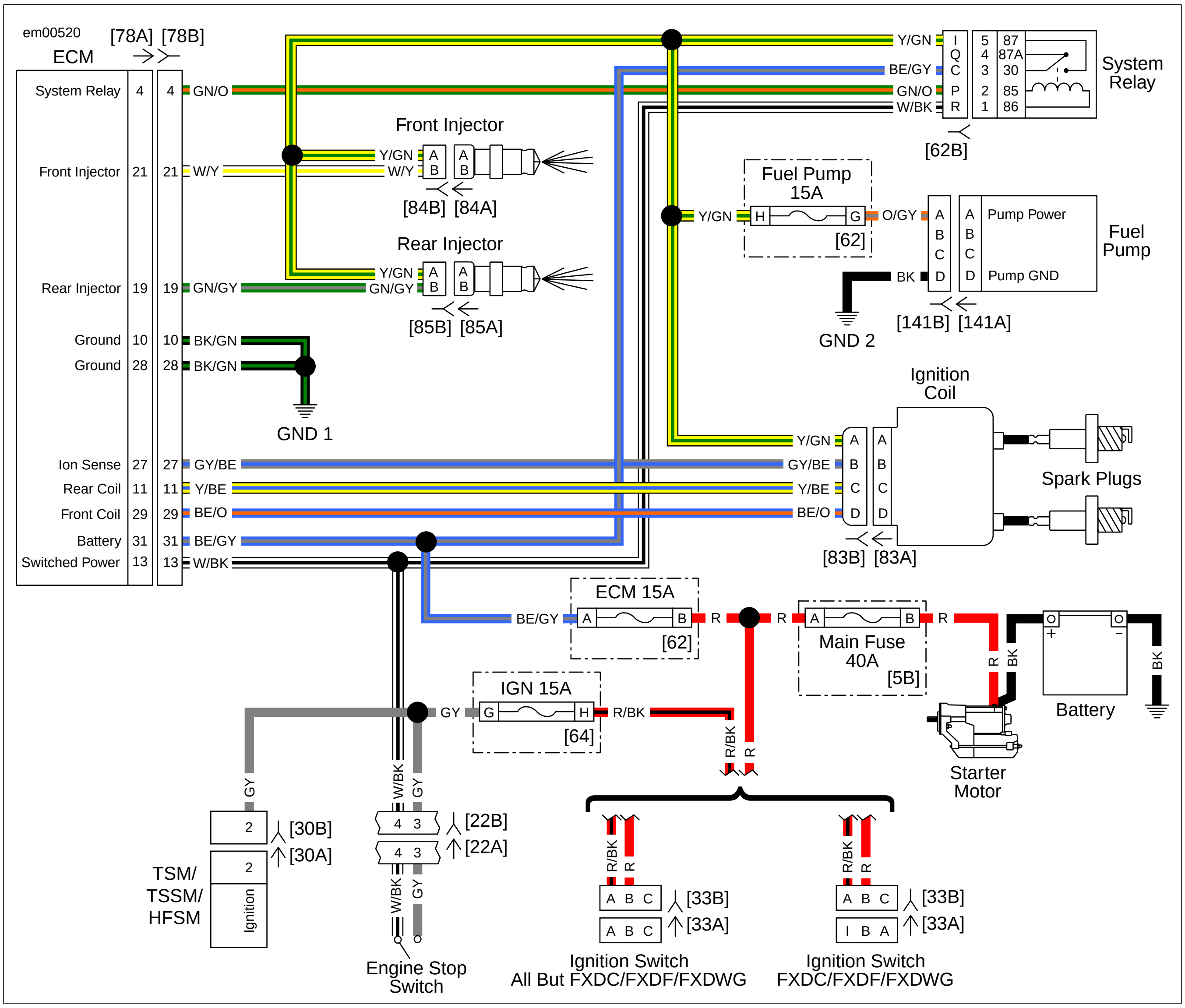


Figure 6-47. Ignition Circuit

MISFIRE AT IDLE OR UNDER LOAD

PART NUMBER	TOOL NAME
HD-26792	SPARK TESTER
HD-41404-B	HARNESS CONNECTOR TEST KIT
HD-43876	BREAKOUT BOX

Table 6-68. Misfire At Idle or Under Load Diagnostic Faults

POSSIBLE CAUSES
ECM malfunction
Ignition system malfunction
Fuel system malfunction
IAC malfunction
Electrical system malfunction

1. Power Ground Continuity Test

1. Connect BREAKOUT BOX (Part No. HD-43876) between wire harness [78B] and ECM [78A]. See 1.2 DIAGNOSTIC TOOLS.
2. Using HARNESS CONNECTOR TEST KIT (Part No. HD-41404-B) and a multimeter, check for continuity between breakout box terminals 10 and then 28, to ground.
3. Is continuity present?
   a. **Yes.** Go to Test 2.
   b. **No.** Repair poor ground on (BK/GN) wire.

2. Spark Test

1. Connect SPARK TESTER (Part No. HD-26792) between front spark plug cable and ground. See 1.2 DIAGNOSTIC TOOLS.
2. Crank engine for a few seconds.

3. Remove tester from front spark plug cable and 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. See the service manual and repair as required.
   b. **No.** Go to Test 3.

3. Spark Plug Wire Test

1. Disconnect the spark plug wires.
2. Measure the resistance of the spark plug wires.
3. Is the front and rear spark plug wire resistance within the specified range? See Table 1-5.
   a. **Yes.** Go to Test 4.
   b. **No.** Replace the out of range spark plug wire. See the service manual.

4. Carbon Tracking Inspection Test

1. Inspect top of ignition coils for carbon tracking.
2. Is carbon tracking present?
   a. **Yes.** Replace ignition coil. See the service manual.
   b. **No.** Switch ignition coil with known good unit and perform Test 2. If spark jumps gap, replace ignition coil. See the service manual. If not, then continue with tests. Go to Test 5.

5. Ignition Coil Primary Wire Continuity Test

1. Turn IGN OFF.
2. Remove system relay and disconnect [83].
3. Measure resistance between [62B] socket terminal I and [83B] terminal A. Wiggle connectors while measuring.
4. Is resistance continuously less than 0.5 Ohms?
   a. **Yes.** Go to Test 6.
   b. **No.** Repair intermittent on (Y/GN) wire.

6. Battery to System Relay Voltage Drop Test

1. Reconnect ignition coil and install system relay.
2. Turn IGN ON, start engine.
3. With engine running, measure voltage drop between battery (+) and system relay [62B] socket terminal I (underside of fuse/relay block). See 1.3 DIAGNOSTICS AND TROUBLESHOOTING, Voltage Drop.
4. Is voltage drop less than 1.0V?
   a. **Yes.** Problem is fuel related. Recheck symptoms.
   b. **No.** Go to Test 7.

7. Battery to System Relay Contact Voltage Drop Test

1. With engine running, measure voltage drop between battery (+) and system relay [62B] socket terminal C (underside of fuse/relay block).
2. Is voltage drop less than 1.0V?
   a. **Yes.** Replace system relay. See the service manual.
   b. **No.** Go to Test 8.

8. Battery to ECM Fuse Voltage Drop Test

1. With engine running, measure voltage drop between battery (+) and [64B] socket terminal A.
2. Is voltage drop less than 1.0V?
   a. **Yes.** Repair (BE/GY) wire or connections.
   b. **No.** Go to Test 9.

9. Battery to Fuse Block Voltage Drop Test

1. With engine running, measure voltage drop between battery (+) and [64B] socket terminal B.
2. Is voltage drop less than 1.0V?
   a. **Yes.** Repair ECM fuse connections or replace ECM fuse.
   b. **No.** Go to Test 10.

10. Battery to Main Fuse Block Voltage Drop Test

1. With engine running, measure voltage drop between battery (+) and main fuse [5B] terminal B.
2. Is voltage drop less than 1.0V?
   a. **Yes.** Repair (R) wire.
   b. **No.** Go to Test 11.

11. Battery to Main Fuse Block Voltage Drop Test

1. With engine running, measure voltage drop between battery (+) and main fuse [5B] terminal A.
2. Is voltage drop less than 1.0V?
   a. **Yes.** Repair main fuse connections or replace main fuse.
   b. **No.** Repair (R) wire between battery and main fuse [5B] terminal A.

TABLE OF CONTENTS

NOTES

AMP MULTILOCK CONNECTORS A.1

AMP MULTILOCK CONNECTOR REPAIR

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

General

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

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

Obtain the necessary tools to repair the connector and terminals.

NOTE

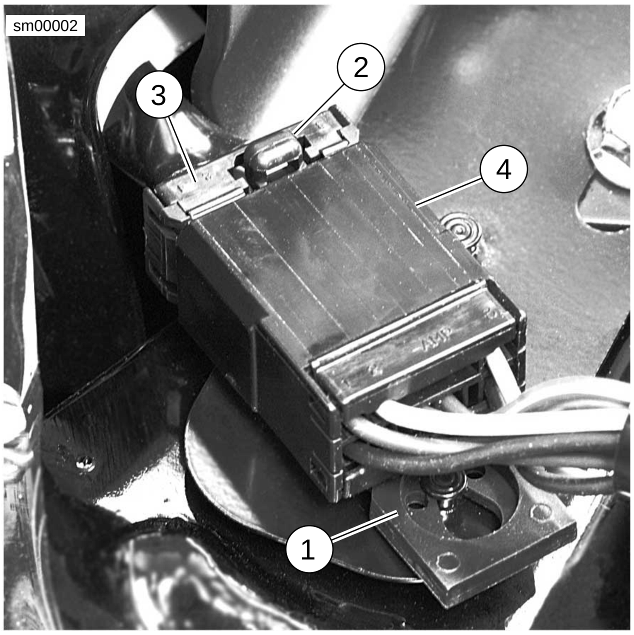
For terminal crimping use the AMP MULTILOCK CRIMPER (Part No. HD-41609).

Separating Pin and Socket Housings

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

Mating Pin and Socket Housings

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



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

Figure A-1. AMP Multilock Connector

Removing Terminals from Housing

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

NOTE

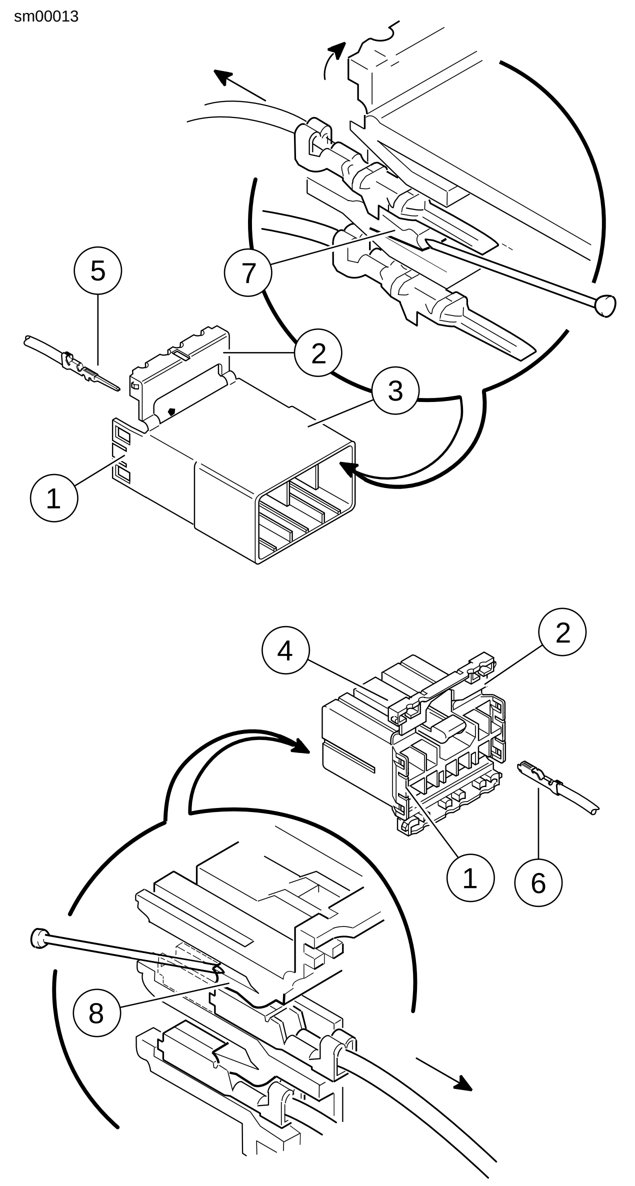
If socket/pin terminal tool is not available, a push pin/safety pin or a SNAP-ON PICK (Part No. SNAP-ON TT600-3) may be used.

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

NOTE

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

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



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

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

Inserting Terminals into Housing

NOTE

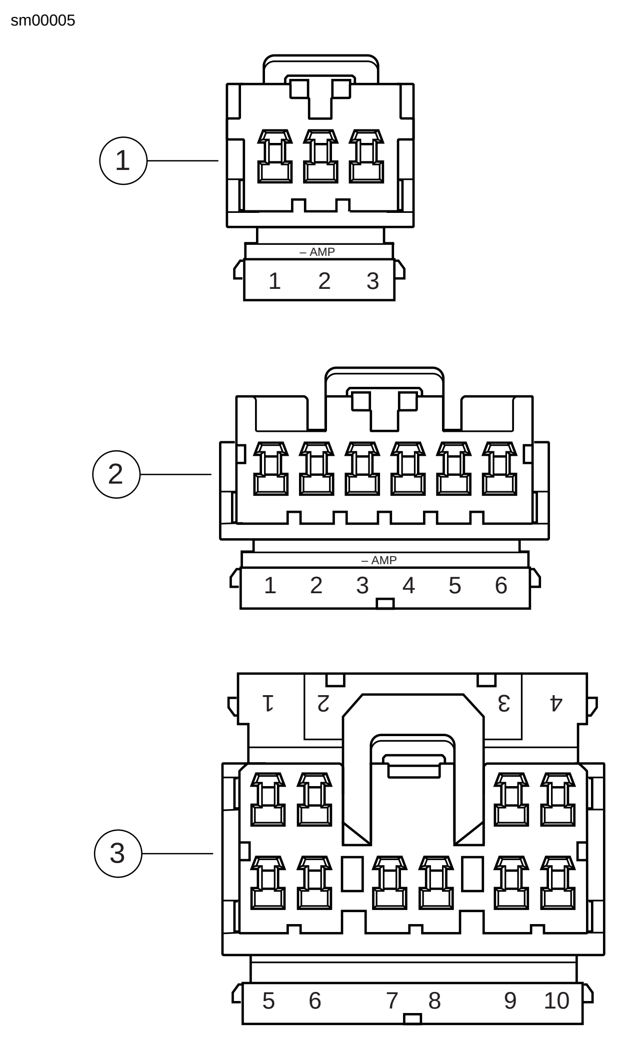
See Figure A-3. Cavity numbers are stamped into the secondary locks of both the socket and pin housings. Match the wire color to the cavity number found on the wiring diagram.

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

NOTES

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

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



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

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

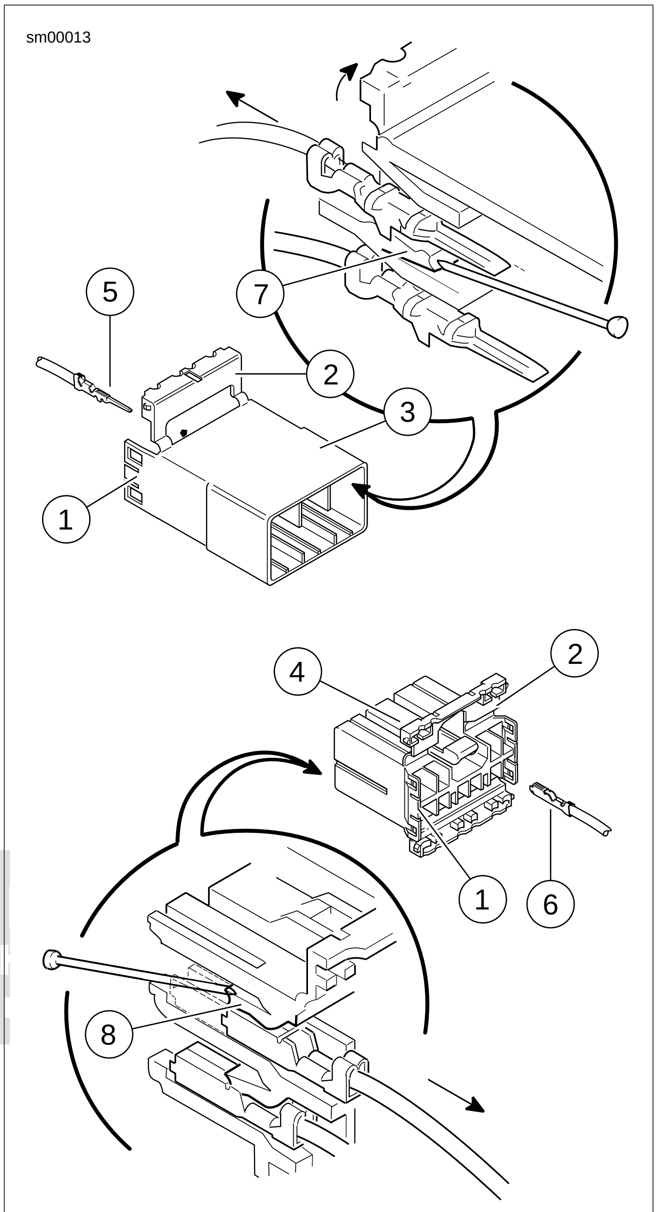
Preparing Wire Leads for Crimping

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

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

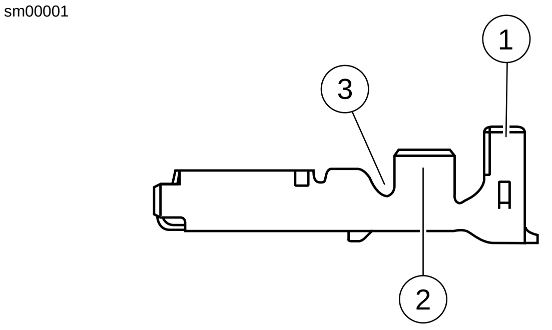
Table A-1. AMP Multilock Connector: Crimp Tool Wire Gauge/Nest

WIRE GAUGE	NEST
20	Front
16	Middle
18	Rear



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

Figure A-4. AMP Multilock Connector: Socket and Pin Housings



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

Figure A-5. AMP Multilock Connector: Socket Terminal

Crimping Terminals to Leads

NOTE

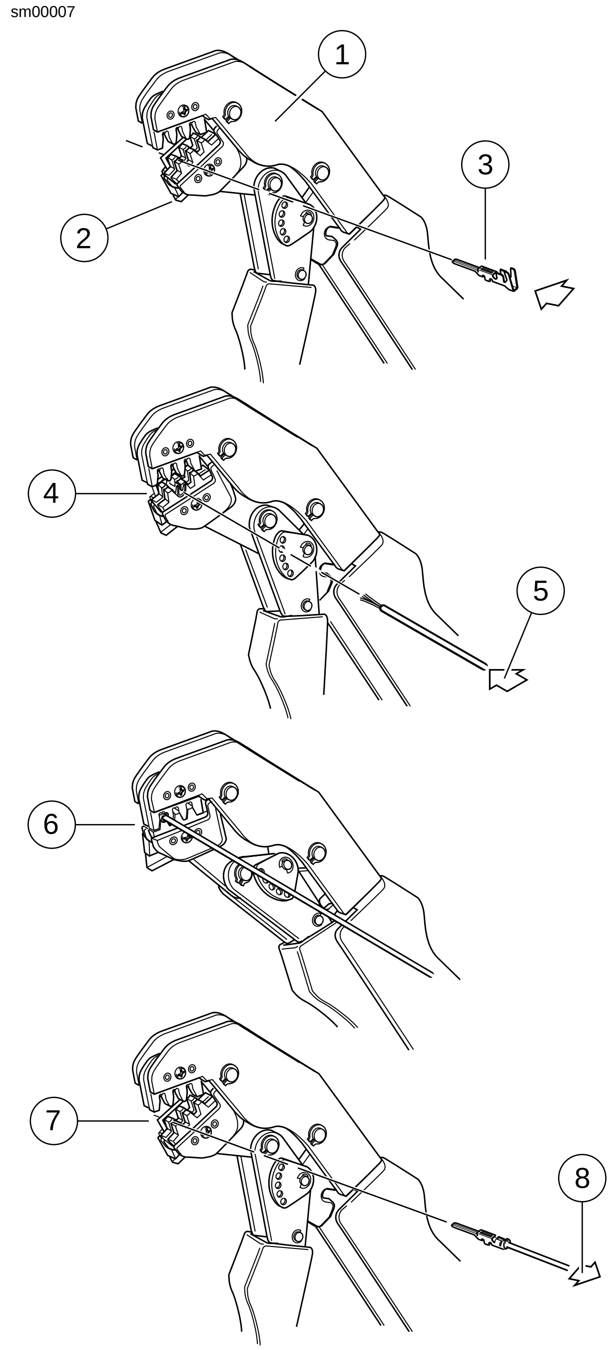
Crimping with an Amp Multilock tool is a one step operation. One squeeze crimps both the wire core and the insulation tails.

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

NOTE

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

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

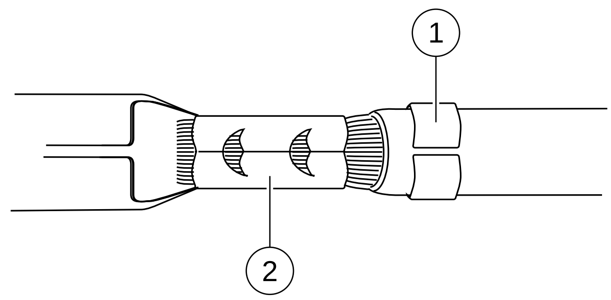


1. **Open position**
2. **Locking bar flange**
3. **Insert contact**
4. **Release locking bar**
5. **Insert lead**
6. **Squeeze**
7. **Raise locking bar**
8. **Remove crimped terminal**

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

Inspecting Crimped Terminals

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



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

Figure A-7. AMP Multilock Connector: Terminal Crimp

DELPHI CONNECTOR REPAIR

General

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

Separating Pin and Socket Housings

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

Mating Pin and Socket Housings

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

Removing Socket Terminals

NOTE

Although the parts of the different Delphi connectors vary in appearance, the instructions which follow will work for all.

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

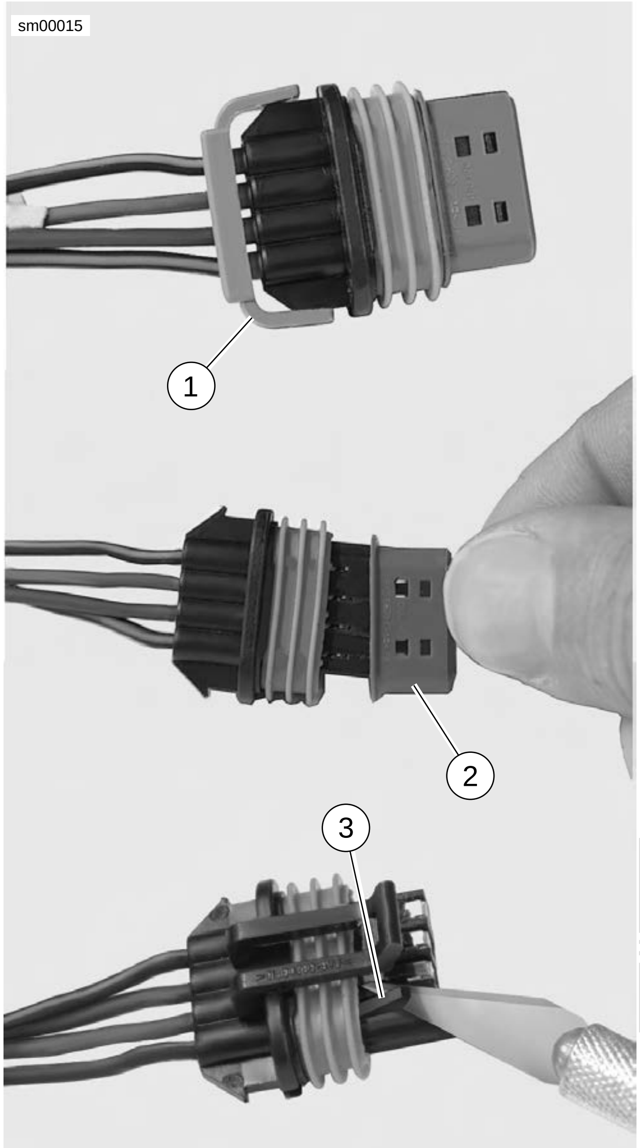
Installing Socket Terminals

NOTE

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

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

Figure A-8. Delphi Connector: Socket Housing Latch



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

Figure A-9. Delphi Connector: Removing Socket Terminals

DEUTSCH 1-PLACE ELECTRICAL CONNECTORS A.3

DEUTSCH 1-PLACE CONNECTOR REPAIR

Separating Pin and Socket Housings

Depress external latch and separate the pin and socket housings of the Deutsch one place connector found on voltage regulators.

Mating Pin and Socket Housings

Orient the housings so the latch faces the catch and push the housings together until it clicks.

Removing Socket Terminals

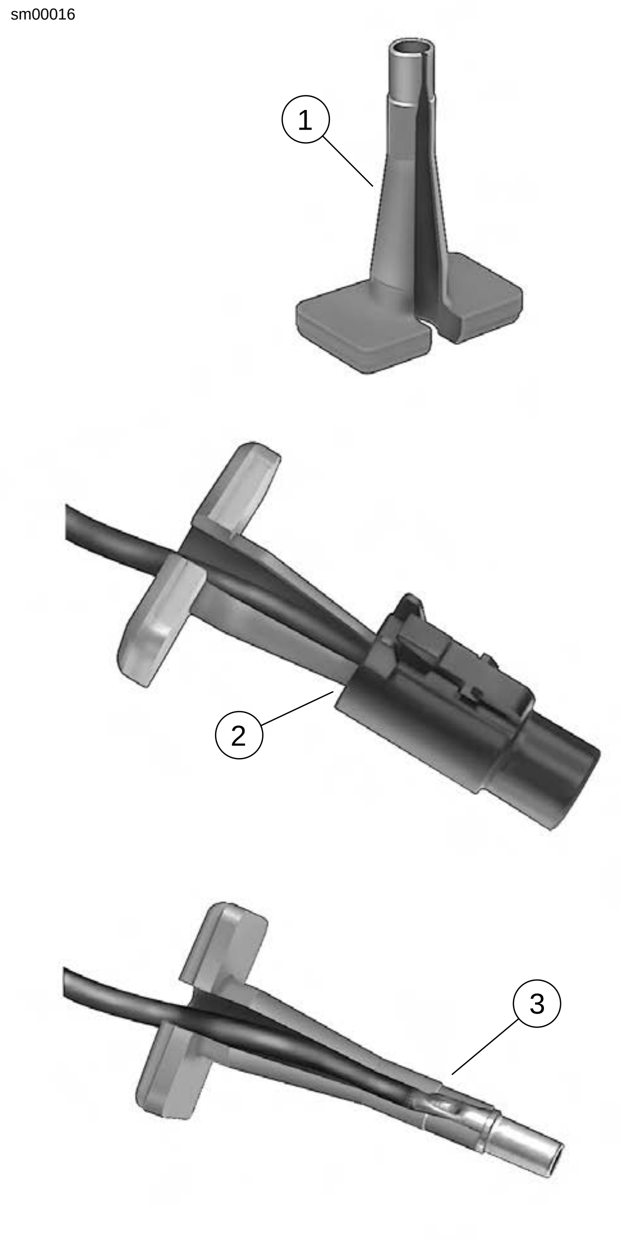
NOTE

Rough handling or careless storage can result in tool damage. Exercise care to avoid cracking or breaking the thin plastic construction.

1. Pull rear wire seal from back of housing and slide down voltage regulator cable to move out of the way.
2. See Figure A-10. Using terminal pick tool (Deutsch® 114008) (1), install tool onto voltage regulator cable so that the tapered end is in the wire end of the housing (2).
3. Push tool into wire end of housing until it bottoms. Gently tug on housing to pull from terminal (3).
4. Remove tool from voltage regulator cable.

Installing Socket Terminals

1. Insert terminal into wire end of housing until it "clicks" in place. Verify that terminal will not back out of housing. A slight tug on the voltage regulator cable will confirm that it is properly locked in place.
2. Fit rear wire seal into back of housing.



1. **Deutsch terminal pick tool (114008)**
2. **Tool installed in housing**
3. **Terminal removed from housing**

Figure A-10. Deutsch 1-Place Connector: Remove Socket/Pin Housing

DEUSCH ELECTRICAL CONNECTORS A.4

DEUTSCH CONNECTOR REPAIR

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

General

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

NOTE

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

Separating Pin and Socket Housings

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

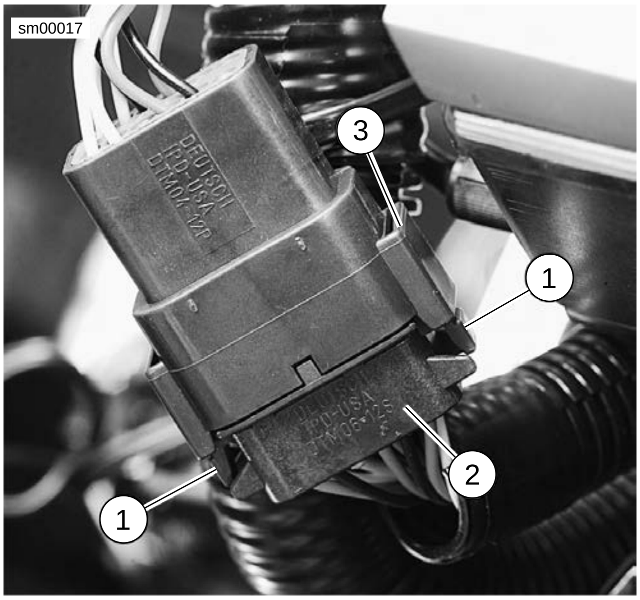
NOTES

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

Mating Pin and Socket Housings

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

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



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

Figure A-11. Deutsch Connector

Removing Socket Terminals

1. See Figure A-12. Insert a small screwdriver between the socket housing and locking wedge in-line with the groove (in-line with the pin holes if the groove is absent). Turn the screwdriver 90 degrees to pop the wedge up and remove the secondary locking wedge.
2. See Figure A-15. Use a pick or small screwdriver to depress terminal latches inside socket housing and back out sockets through holes in rear wire seal.

NOTE

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

Installing Socket Terminals

1. Match wire lead color to connector cavity.
2. See Figure A-14. Fit rear wire seal (1) into back of socket housing (2), if removed.
3. Grasp wire lead (3) approximately 1.0 in. (25.4 mm) behind the socket terminal. Gently push socket through hole in wire seal into its chambers until it "clicks" in place.
4. A tug on the wire will confirm that it is properly locked in place.

NOTE

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

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

NOTES

- *See Figure A-13. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (1) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the socket housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*

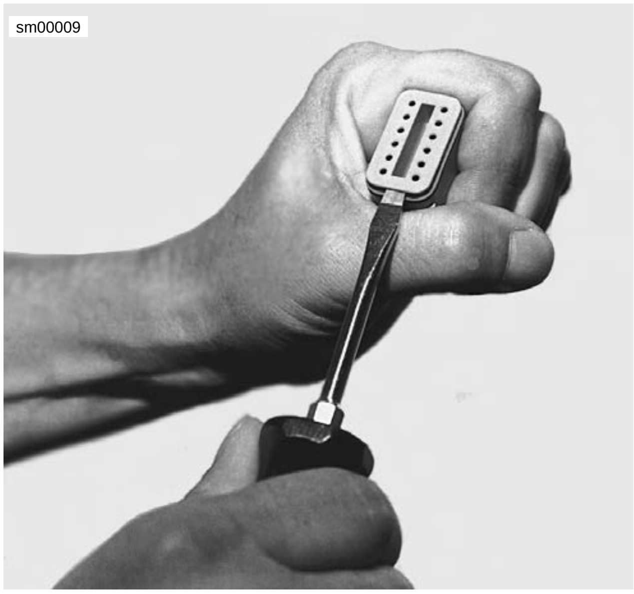
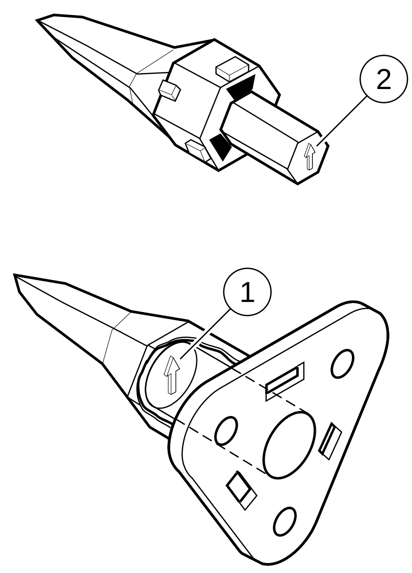


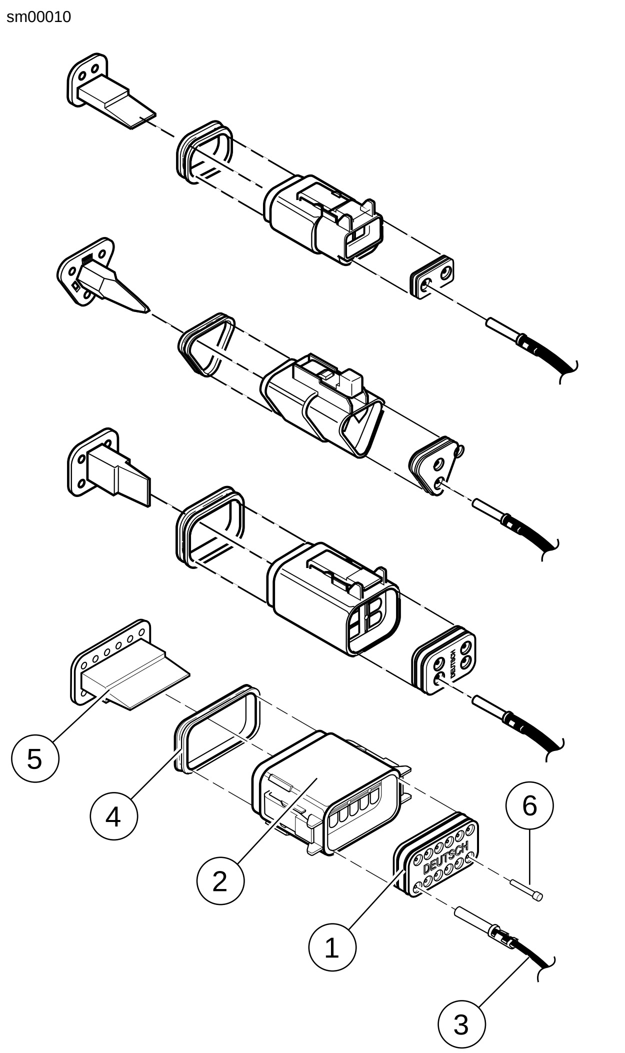
Figure A-12. Deutsch Connector: Remove Secondary Locking Wedge



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

Figure A-13. Deutsch Connector: 3-Place Locking Wedges

HOME



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

Figure A-14. Deutsch Connector: 2, 3, 4 and 12-Place Socket Housings

Removing Pin Terminals

1. Use the hooked end of a stiff piece of mechanics wire, a needle nose pliers or the FLAT BLADE L-HOOK (Part No. HD-41475-100) to remove the secondary locking wedge.
2. Gently depress terminal latches inside pin housing and back out pins through holes in wire seal.

NOTES

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

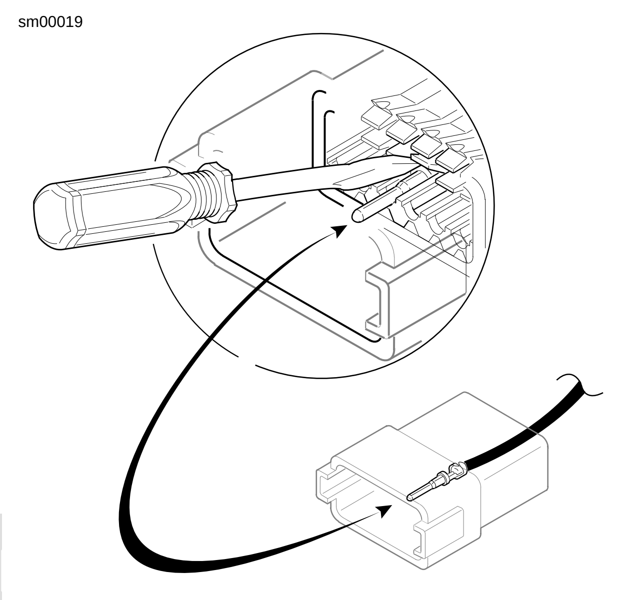


Figure A-15. Deutsch Connector: Depress Terminal Latch and Back Out Pin

Installing Pin Terminals

1. See Figure A-16. Fit wire seal (1) into back of pin housing (2).
2. Grasp wire lead approximately 1.0 in. (25.4 mm) behind the pin terminal (3). Gently push pin through holes in wire seal into its respective numbered chamber until it "clicks" in place.

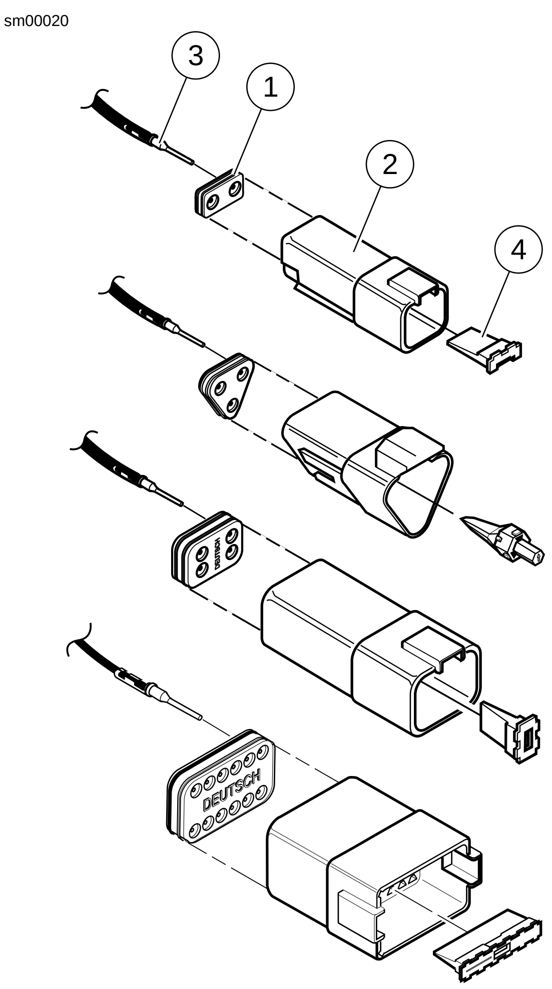
NOTE

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

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

NOTES

- *The wedge fits in the center groove of the pin housing and holds the terminal latches tightly closed.*
- *See Figure A-13. While rectangular wedges do not require a special orientation, the conical secondary locking wedge of the 3-place connector must be installed with the arrow (2) pointing toward the external latch.*
- *If the secondary locking wedge does not slide into the installed position easily, verify that all terminals are fully installed in the pin housing. The lock indicates when terminals are not properly installed by not entering its fully installed position.*



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

Figure A-16. Deutsch Connector: 2, 3, 4 and 12-Place Pin Housings

Crimping Terminals

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

Table A-2. Deutsch Connector: Terminal Crimping Instructions

TYPE	CRIMPING INSTRUCTIONS
Standard (with crimp tails)	A.5 DEUTSCH STANDARD TERMINALS
Mini Terminal (solid barrel)	A.7 DEUTSCH SOLID BARREL TERMINALS
Mini Terminal (with crimp tails)	A.6 DEUTSCH MINI-TERMINAL CRIMPS

DEUTSCH STANDARD TERMINALS A.5

DEUTSCH STANDARD TERMINAL CRIMPS

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

Preparing Wire Leads for Crimping

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

Crimping Terminal to Lead

1. See Figure A-17. Squeeze the handles of the DEUTSCH TERMINAL CRIMP TOOL (Part No. HD-39965-A) to open the jaws. Push the locking bar (1) up.
2. Insert (2) terminal (socket/pin) through hole of the locking bar, so that the rounded side of the contact barrel rests in the nest (concave split level area) with the crimp tails facing upward. To match the wire gauge to the crimp tool die, refer to Table A-3.
3. Release locking bar to lock terminal in die.

NOTE

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

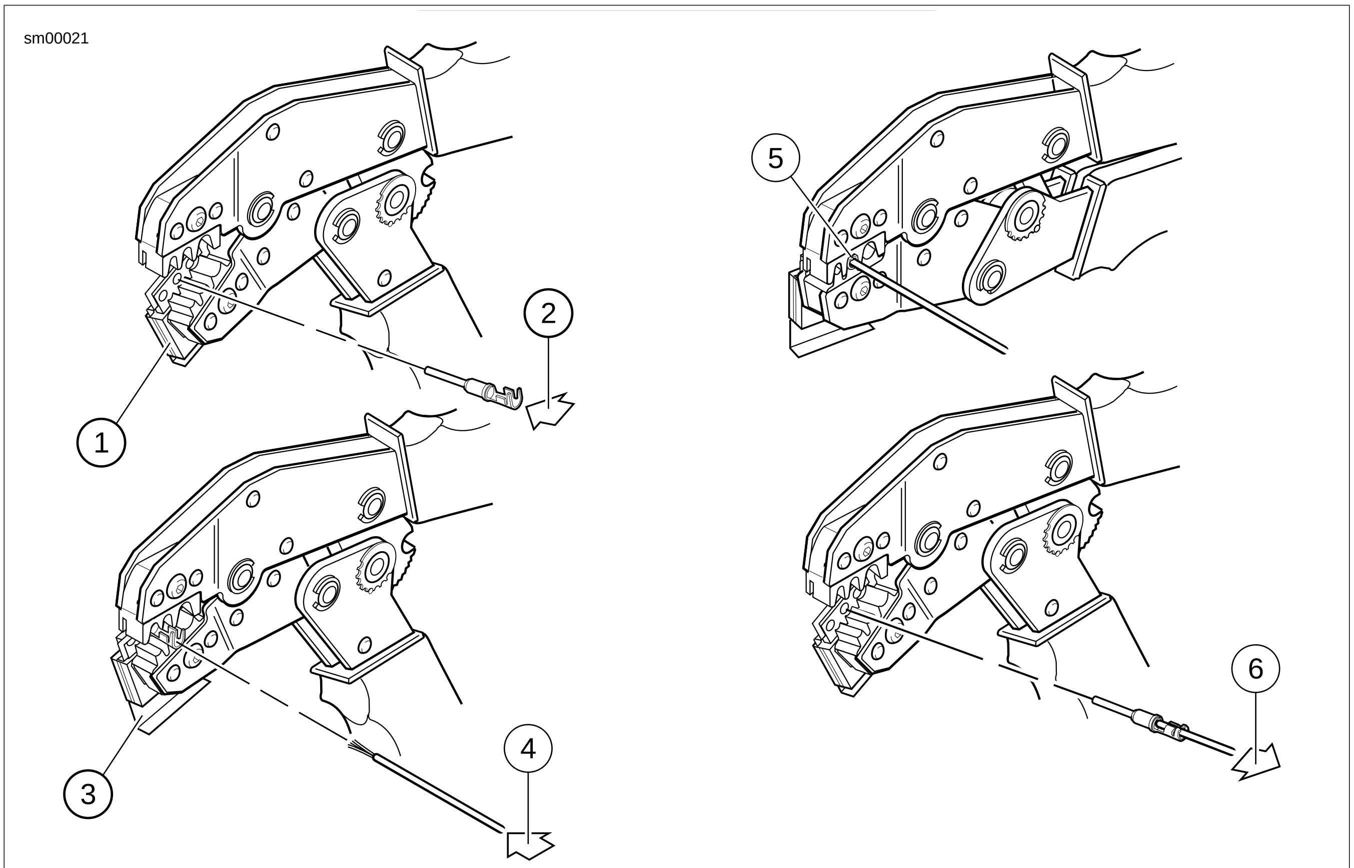
4. Insert stripped wire core between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that short pair of crimp tails squeeze bare wire strands, while long pair folds over the insulation.
5. Squeeze handle of crimp tool until tightly closed. Tool automatically opens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

Inspecting Crimps

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

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

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



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

Figure A-17. Crimping a Deutsch Standard Terminal

DEUTSCH MINI-TERMINAL CRIMPS A.6

DEUTSCH MINI TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-38125-7	PACKARD TERMINAL CRIMPER

Preparing Wire Leads for Crimping

Strip wire lead removing 5/32 in. (4.0 mm) of insulation.

Crimping a Mini Terminal to Wire Lead

1. See Figure A-18. Compress the handles of PACKARD TERMINAL CRIMPER (Part No. HD-38125-7) until the ratchet (2) automatically opens.

NOTE

Always perform core crimp before insulation crimp.

2. Position the core crimp on die E (1) of the crimper. Be sure the core crimp tails are facing the forming jaws.
3. Gently apply pressure to handles of tool until crimpers just secure the core crimp tails.
4. Insert stripped wire core stands between crimp tails. Position wire so that short pair of crimp tails squeeze bare wire strands, while long pair squeeze over the insulation.
5. Squeeze handle of crimper until tightly closed. Tool automatically opens when the crimping sequence is complete.

NOTE

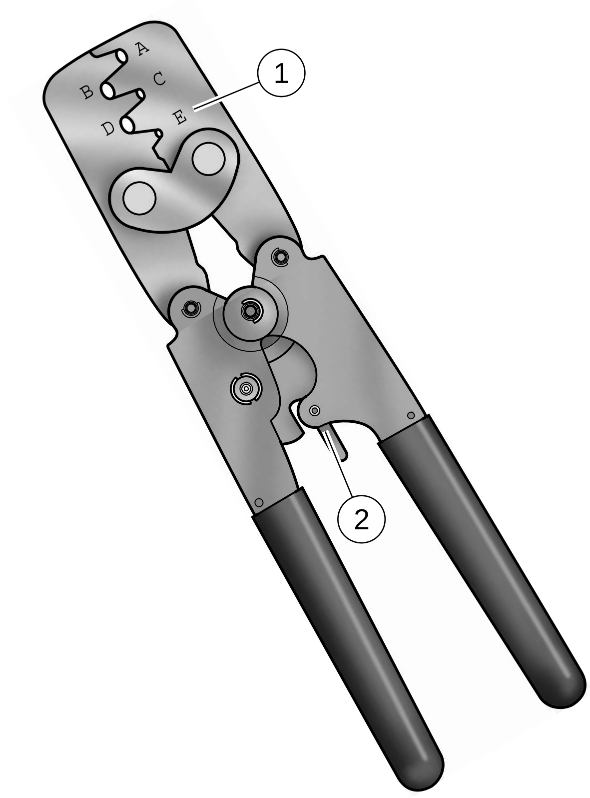
If the crimper does not open, it can be opened by squeezing the ratchet trigger (2).

6. Position the insulation crimp on nest C of the crimper. Be sure the insulation crimp tails are facing the forming jaws.
7. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.

Inspecting Crimps

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

sm00022



1. **E die**
2. **Crimper ratchet trigger**

Figure A-18. Packard Terminal Crimper (HD-38125-7)

DEUTSCH SOLID BARREL TERMINALS A.7

DEUTSCH SOLID BARREL TERMINAL CRIMPS

PART NUMBER	TOOL NAME
HD-42879	ELECTRICAL CRIMPER TOOL

Preparing Wire Leads For Crimping

For size 20, 16 and 12 contacts, wire ranges 26-12 AWG.

Strip wire lead removing 1/4 in. (6.4 mm) of insulation.

Adjusting Crimper Tool

1. See Figure A-19. Squeeze the ELECTRICAL CRIMPER TOOL (Part No. HD-42879) handles to cycle the crimp tool to open.
2. Remove locking pin (1) from selector knob (2).
3. Raise selector knob and rotate until selected wire size stamped on wheel is aligned with "SEL. NO." arrow (3).
4. Loosen knurled locknut (4) and turn adjusting screw (5) clockwise (in) until it stops.

Crimping a Barrel Contact To Wire Lead

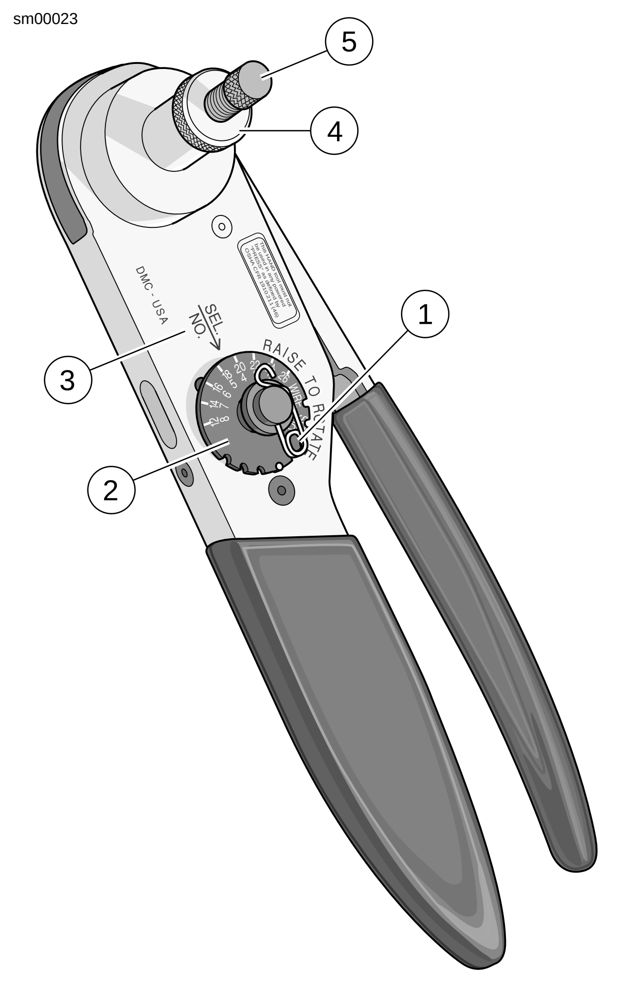
1. See Figure A-20. Turn tool over and drop contact barrel (1) into indentor cover (2) hole with the wire end out.
2. Turn adjusting screw counterclockwise (out) until contact is flush with bottom of depression in indentor cover. Tighten knurled locknut.
3. Slowly squeeze handles of crimp tool until contact is centered between the four indentor points (3).
4. Insert bare wire core strands of stripped wire lead (4) into contact barrel. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimping sequence is complete.
5. Remove wire lead with crimped contact from indentor.

NOTE
Tool must be readjusted when changing contact size/type.

6. Install pin to lock selector knob.

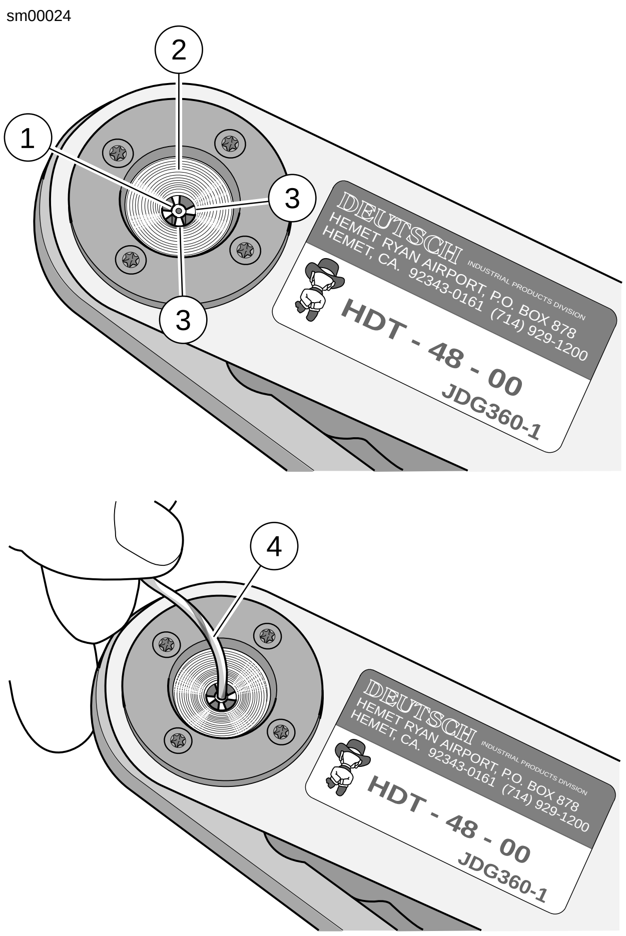
Inspecting Crimps

Inspect the crimp. All core wire strands are to be crimped in the barrel.



1. **Locking pin**
2. **Selector knob**
3. **SEL. NO. arrow**
4. **Knurled locknut**
5. **Adjusting screw**

Figure A-19. Electrical Crimper Tool (HD-42879)



1. **Contact barrel**
2. **Indentor cover**
3. **Indentor point**
4. **Stripped wire lead**

Figure A-20. Deutsch Solid Barrel

FUSE BLOCK REPAIR

Removing Socket Terminals

1. See Figure A-21. To remove secondary locks, insert end of small flat blade screwdriver (1) under lip of locking wedge (2) and gently pry up secondary lock.

NOTE

For best results, start with locking wedge on outboard side of secondary lock.

2. Looking into chamber at top of fuse block, note the tang next to each socket terminal.
3. Using a thin flat blade, like that on a hobby knife, gently push tang away from terminal, and then tug on wire to back terminal out.

Installing Socket Terminals

1. Match the wire lead color to the fuse block terminal cavity.

NOTES

- *Refer to the main harness wiring diagram for wire lead color codes.*
- *See Figure A-22. The main fuse block terminal cavity is identified as alpha (1) and numeric (2) coordinates. Refer to the main harness wiring diagram for fuse block terminal cavity coordinates.*

2. With the open side of the socket terminal facing the tang, push lead into chamber at the wire end of the fuse block. A click is heard when the terminal is properly engaged.
3. Gently tug on the wire to verify that the terminal is locked in place and will not back out of the chamber.
4. Install the secondary locks. With the locking wedges positioned above the tangs in each chamber, slide flat side of secondary lock into slot (between rows), and push down until it bottoms.

Crimping Terminals

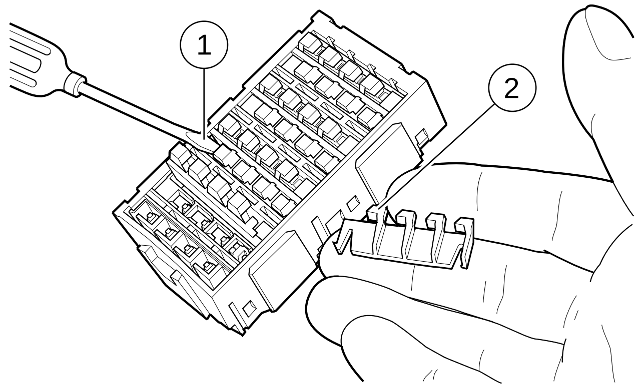
Terminals are crimped twice; once over the wire core and a second time over the insulation/seal.

A correctly crimped terminal may require different crimping dies found on separate crimpers.

NOTE

The wiring diagram indicates when one socket terminal is be crimped to two wire leads.

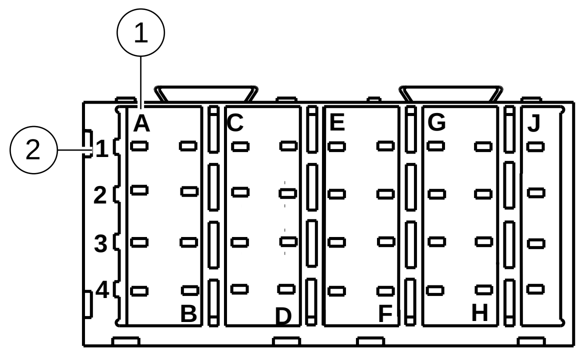
sm00025



1. **Pry up secondary lock**
2. **Lip of locking wedge**

Figure A-21. Fuse Block: Remove Secondary Locks

sm00026



1. **Alpha**
2. **Numeric**

Figure A-22. Fuse Block: Coordinates (typical)

150 METRI-PACK CONNECTORS A.9

150 METRI-PACK CONNECTOR REPAIR

General

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

There are two types of connectors in this series:

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

Separating Pin and Socket Housings

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

Mating Pin and Socket Housings

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

Removing Socket Terminal

1. See Figure A-23 for pull-to-seat connector or Figure A-24 for push to seat connector. Remove wire lock (1) from wire end of socket housing on push-to-seat type connectors.

NOTE

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

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

NOTE

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

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

NOTE

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

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

NOTE

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

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

Inserting Socket Terminal

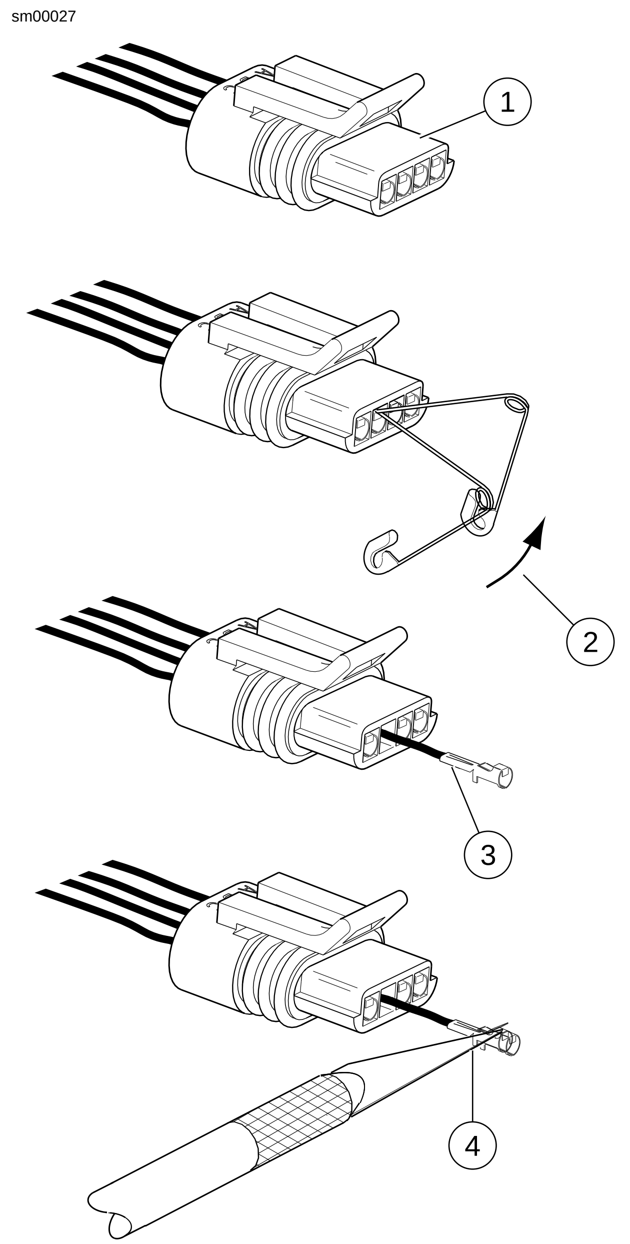
NOTE

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

1. See Figure A-23 for pull-to-seat connector or Figure A-24 for push to seat connector. Using a thin flat blade, like that on a hobby knife, carefully bend the tang outward away from the terminal body.
2. Gently pull or push on the lead to install the terminal back into the chamber. A click is heard when the terminal is properly seated.
3. Gently pull or push on the lead to verify that the terminal is locked in place.

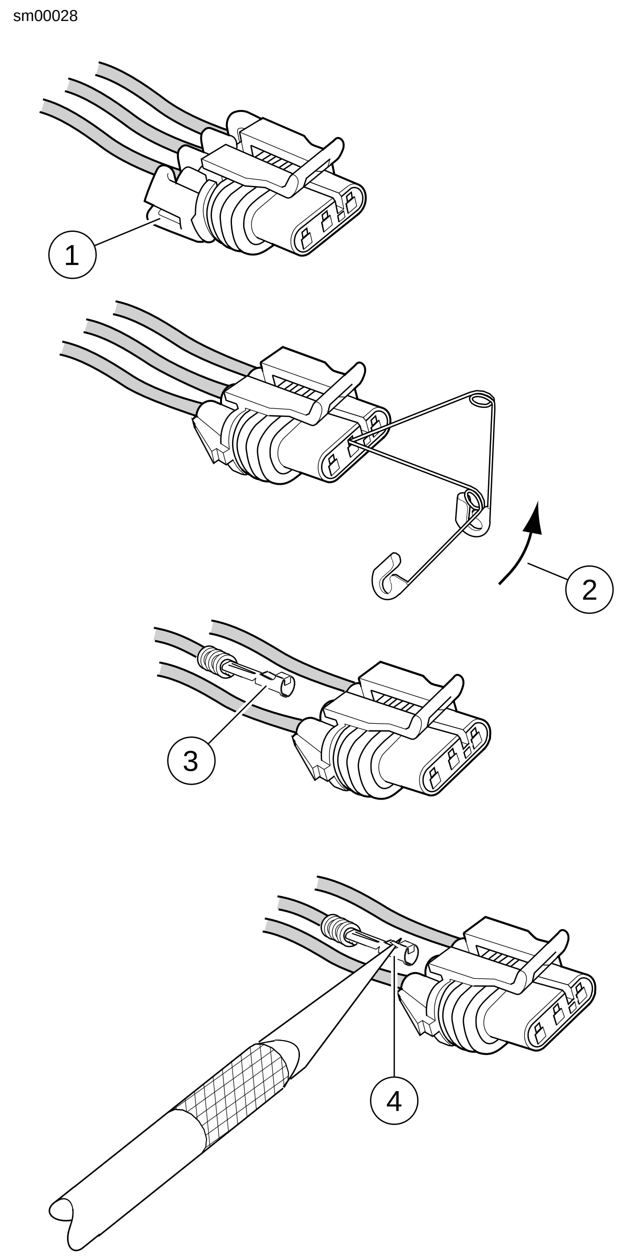
   For push-to-seat: See Figure A-24. Seat wires in separate channels of wire lock and then push channels **inside** chambers at wire end of socket housing. Fully installed, slot on each side of wire lock engages ear on socket housing.

[HOME]



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

Figure A-23. 150 Metri-Pack Connector: Pull-to-Seat



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

Figure A-24. 150 Metri-Pack Connector: Push-to-Seat

280 METRI-PACK CONNECTORS A.10

280 METRI-PACK CONNECTOR REPAIR

General

See Figure A-25. Called Packard connectors, Metri-Pack series connectors are embossed with the initials (P.E.D.)

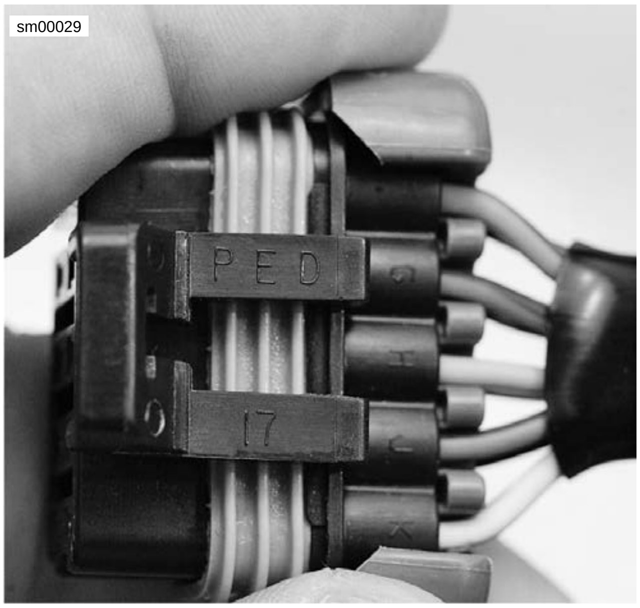


Figure A-25. 280 Metri-Pack Connector (P.E.D.)

Separating Pin and Socket Housings

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

Mating Pin and Socket Housings

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

Removing Socket Terminals

1. See Figure A-26. Pry rubber seal from wire end of connector and move seal down wires (1) toward conduit. Hold the connector so that the wireform is facing down.
2. Looking into the wire end of the connector, insert the point of a safety pin (2) between the top of the terminal and the inside chamber wall.
3. Push safety pin completely into chamber while watching terminal on mating end of connector. When terminal is observed moving forward slightly, tang is depressed. Remove safety pin.

NOTE

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

4. Push on wire end of the lead to extract the terminal from the mating end of the connector.
5. If necessary, crimp new terminals on wires. See A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps.

Installing Socket Terminals

NOTE

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

1. See Figure A-26. Using a thin flat blade, like a hobby knife (4), carefully bend the tang outward away from the terminal body.
2. Gently pull on the wire lead (5) to draw the terminal back into the chamber. The tang faces opposite the wireform as it enters the chamber.

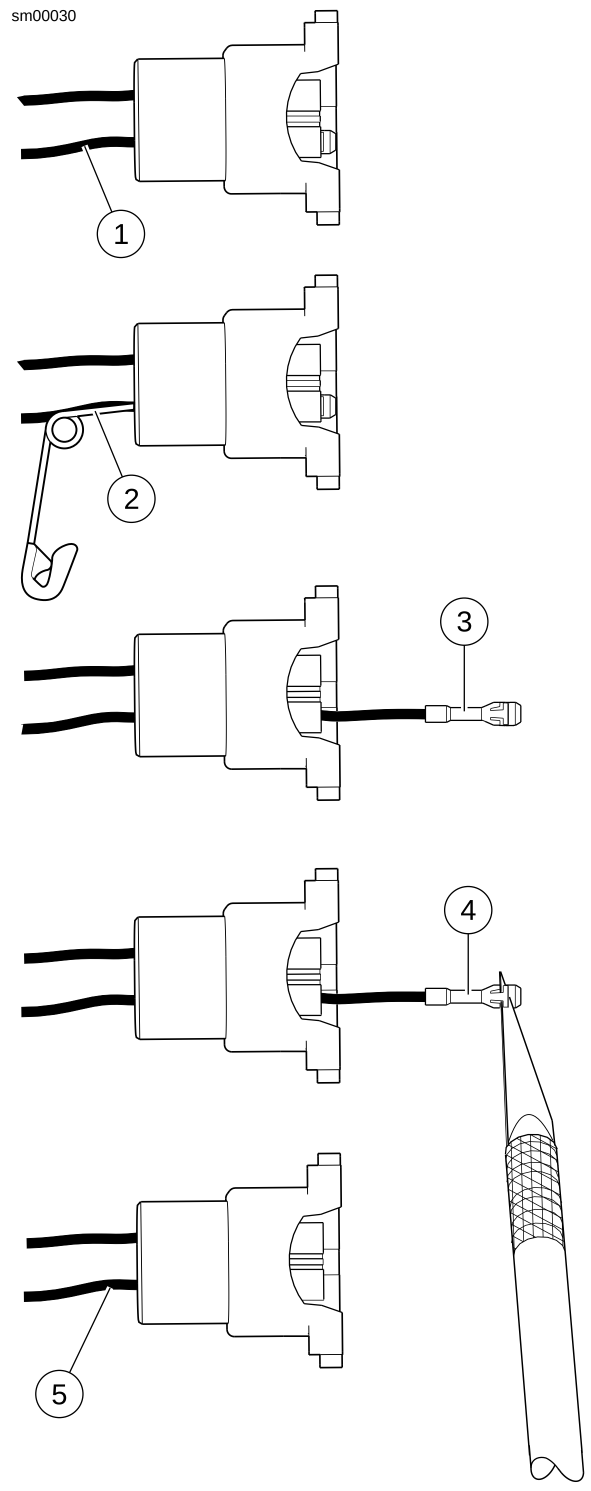
NOTE

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

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

Crimping Terminals

If necessary, crimp new terminals on the wire leads. Refer to A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps.



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

Figure A-26. 280 Metri-Pack Connector: Remove/Install Socket Terminal

480 METRI-PACK CONNECTOR REPAIR

General

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

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

See Figure A-27. An AFL housing (5) is used on many ignition/light switches. The secondary lock (4) must be opened before removing the terminal from the housing.

Separating Pin and Socket Housings

NOTE

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

See Figure A-27. Using small flat blade screwdriver, press button (1) on pin housing (red wire) side of the connector and pull apart the pin and socket housings.

Mating Pin and Socket Housings

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

Removing Socket Terminals

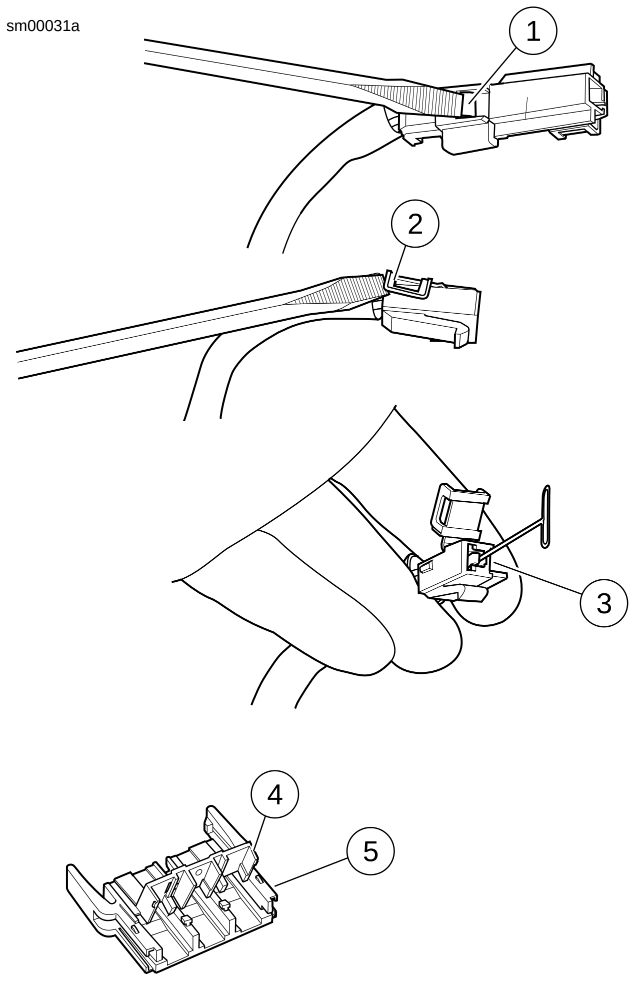
1. See Figure A-27. Bend back the latch (2) slightly and free one side of secondary lock, then repeat to release the opposite side. Rotate the secondary lock outward on hinge to access terminal in chamber of connector housing.
2. On the mating end of the connector, note the tang in the square shaped opening centered next to the terminal. Gently insert the point of a stick pin or large safety pin into the opening (3) between the tang and the chamber wall until it stops.
3. Pivot the end of the pin toward the terminal body to press the tang.
4. Remove the pin and then pull terminal out of the wire end of connector housing.
5. If necessary, crimp **new** terminals on wires. See A.14 METRI-PACK TERMINALS.

Installing Socket Terminals

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

NOTE

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



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

Figure A-27. 480 Metri-Pack Connector: Remove Socket Terminal

630 METRI-PACK CONNECTORS A.12

630 METRI-PACK CONNECTOR REPAIR

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

General

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

Separating Pin and Socket Housings

NOTE

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

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

Mating Pin and Socket Housings

Orient the latch to the catch and push the pin and socket halves of the connector together until the latch "clicks".

NOTE

If removed, install connector on barbed anchor or other OE retaining device.

Removing Socket Terminal

1. Bend back the latch slightly and free one side of the secondary lock. Repeat the step to unlatch the other side.
2. Rotate the secondary lock outward on hinge to view the terminals in the chambers of the connector housing. The locking tang is on the side opposite the crimp tails and engages a rib in the chamber wall to lock the terminal in place.
3. Moving to the mating end of the connector, take note of the small opening on the chamber wall side of each terminal.
4. Insert SNAP-ON PICK (Part No. SNAP-ON TT600-3) into opening until it stops. Pivot the end of the pick toward the terminal to depress the locking tang.
5. Remove the pick and gently tug on the wire to pull the terminal from the wire end of the connector. Repeat steps if the terminal is still locked in place.
6. If necessary, crimp **new** terminals on wires. Refer to A.14 METRI-PACK TERMINALS.

Installing Socket Terminal

NOTE

Refer to the wiring diagrams to match wire lead colors to alpha characters molded into the secondary locks of each connector housing.

1. Using a thin flat blade, like that of a hobby knife, carefully bend the tang outward away from the terminal body.
2. With the tang facing the chamber wall, push the lead into the chamber at the wire end of the connector. A click is heard when the terminal is properly seated.
3. Gently tug on the wire end to verify that the terminal is locked in place and will not back out of the chamber.
4. Rotate the hinged secondary lock inward until tabs fully engage latches on both sides of connector.

800 METRI-PACK CONNECTORS A.13

DELPHI MAIN FUSE HOUSING REPAIR

General

A Delphi Main fuse connector completes the circuit through the main fuse.

Removing Main Fuse

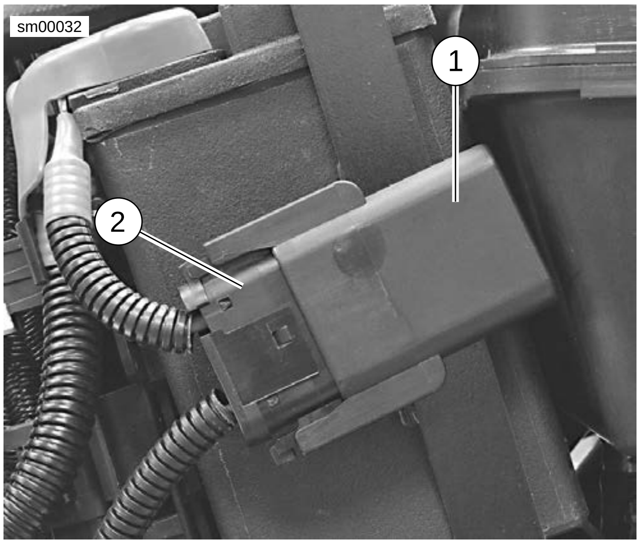
1. See Figure A-28. Depress latches on main fuse cover (1) and then slide cover off of connector (2).
2. Holding the connector (fuse holder), pull the main fuse out of the connector.

Installing Main Fuse

1. Insert the blade terminals of the main fuse into the sockets of the connector and press the main fuse into the connector.
2. Slide the cover over the fuse until the cover clicks into place.

NOTE

If removed from an OE attachment such as a grooved fuse block cover, engage cover and slide into place.



1. **Main fuse cover**
2. **Delphi main fuse housing**

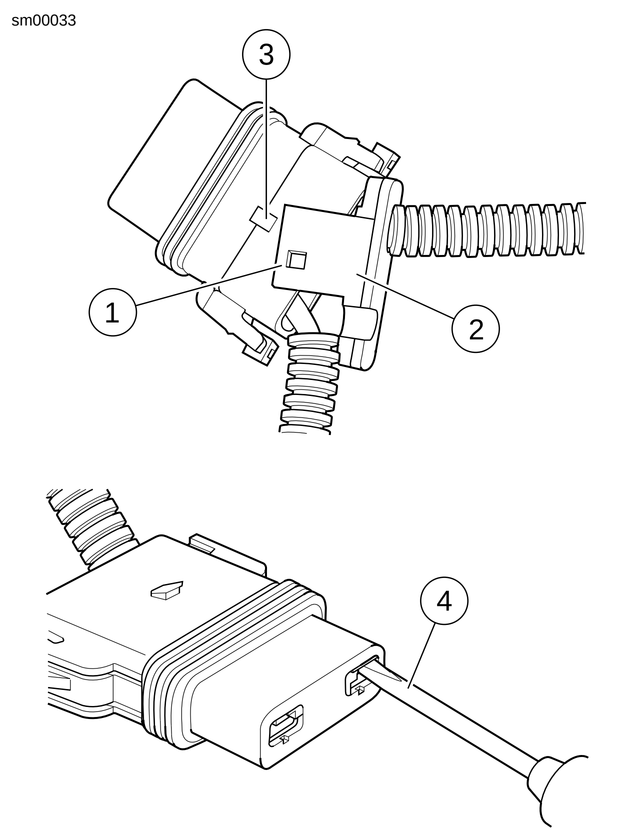
Figure A-28. Delphi Connector Housing: Main Fuse

Removing Socket Terminals

1. See Figure A-29. Gently pull socket housing to disengage slots (1) on secondary lock (2) from tabs (3) on socket housing. Free secondary lock from cables and set aside.
2. Take note of the opening on one side of the socket terminal. Gently insert flat blade of pick (Snap-On TT600-5) or small screwdriver into opening (4) until it stops. Pivot the pick toward the terminal body and hold in position.
3. Tug on cable to pull socket from wire end of socket housing. A firm tug is necessary to overcome the resistance of the rubber seal.
4. Repeat to remove remaining socket terminal.

Installing Socket Terminals

1. See Figure A-30. Carefully bend tang outward away from the terminal body.
2. Feed socket into wire end of socket housing until it clicks in place. Verify that socket will not back out of chamber. A slight tug on the cable will confirm that it is locked.
3. Push rubber seal into wire end of socket housing.
4. Repeat to install remaining socket terminal.
5. Install secondary lock onto cables and then push onto wire end of socket housing until slots engage tabs on sides of socket housing.



1. Secondary lock slot
2. Secondary lock
3. Tab
4. Insert flat blade into opening

Figure A-29. Delphi Main Fuse Housing: Remove Socket Terminals

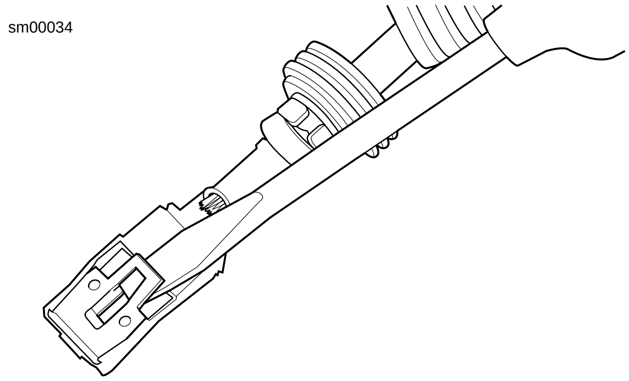


Figure A-30. Delphi Main Fuse Housing: Bend Tang

METRI-PACK TERMINALS A.14

METRI-PACK TERMINAL CRIMPS

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

Matching Terminal To Crimper

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

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

See Figure A-31. A completed crimp may require two different crimping dies found on PACKARD TERMINAL CRIMP TOOL (Part No. HD-38125-6) and/or PACKARD TERMINAL CRIMPER (Part No. HD-38125-7). The terminal (pin or socket) and the wire lead gauge will determine the core crimp die and the insulator/seal die.

NOTE

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

Preparing Wire Lead

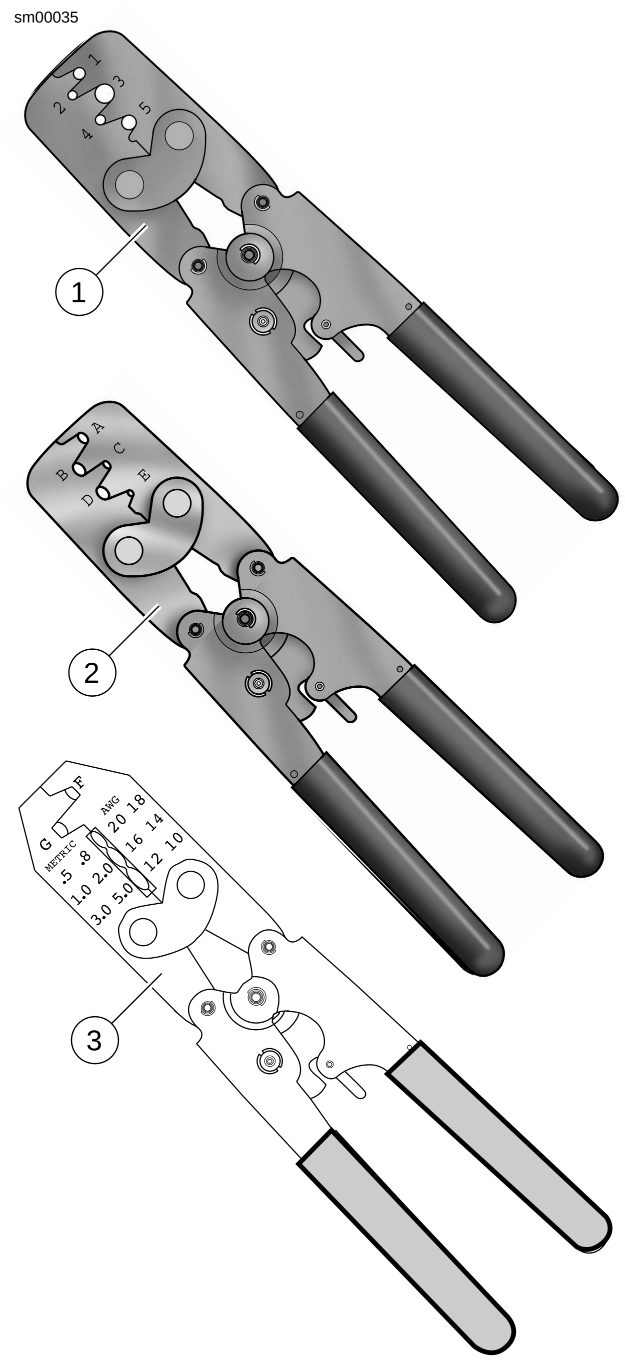
Use a wire striper to strip off the insulation and expose 5/32 in. (4.0 mm) of wire core.

Crimping Wire Core

NOTE

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

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



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

Figure A-31. Metri-Pack Terminal Crimp Tools

Crimping Insulation/Seal

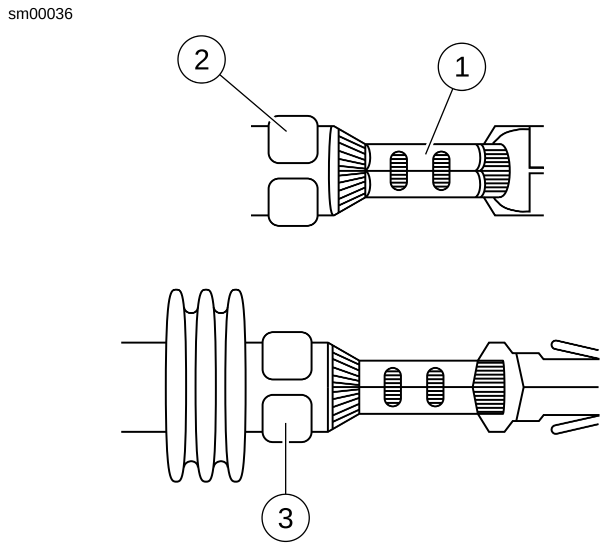
NOTE

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

1. See Figure A-32. Identify the correct die for the insulation/seal crimp (2).
2. Position the insulation/seal crimp in the nest. Be sure the insulation/seal crimp tails are facing the forming jaws.
3. Squeeze handle of crimp tool until tightly closed. Tool automatically opens when the crimp is complete.

Inspecting Crimps

1. See Figure A-32. Inspect the wire core crimp (1). The tails should be folded in on the wire core without any distortion or excess wire strands.
2. Inspect the insulation (2) or seal (3) crimp. The tails of the terminal should be wrapped around the insulation without distortion.



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

Figure A-32. Metri-Pack Connector: Inspect Core and Insulation/Seal Crimps

MOLEX CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER

Separating Pin and Socket Housings

See Figure A-33. Depress the latch while pulling the pin and socket housings apart.

Mating Pin and Socket Housings

1. Orient the latch on the pin housing to the latch pocket on the socket housing so the rails on the outside of the pin housings lines up with the tunnels on the socket housing.
2. Press the housings together until the latch clicks.

Removing Terminals

1. Pull the secondary lock up, approximately 3/16 in. (4.8 mm), until it stops.
    a. **Socket Housing:** See Figure A-34. Use a small screwdriver in the pry slot. The slot next to the external latch provides a pivot point.
    b. **Pin Housing:** See Figure A-35. Use needle nose pliers to engage the D-holes in the center of the secondary lock.

NOTE
Do not remove the secondary lock from the connector housing.

2. See Figure A-36. Insert MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER (Part No. HD-48114) into the pin hole next to the terminal until the tool bottoms.
    a. **Socket Housing:** The pin holes are inside the terminal openings.
    b. **Pin Housing:** The pin holes are outside the pins.
3. Pressing the terminal remover to the bottom of the pin hole, gently pull on the wire to remove wire terminal from its cavity.

Installing Terminals

1. See Figure A-37. From the wiring diagram, match the wire color to its numbered terminal cavity.

NOTE
Cavity numbers (1) are stamped on the housing at the ends of the cavity rows. The cavity number can be determined by counting the cavities up or down along the row from each stamped number.

2. Orient the terminal so that the tang (2) opposite the open crimp engages the slot (3) in the cavity.
3. Push the terminal into the cavity.
4. Gently tug on wire to verify that the terminal is captured by the secondary lock.
5. With all terminals installed, push the secondary lock into the socket housing to lock the wire terminals into the housing.

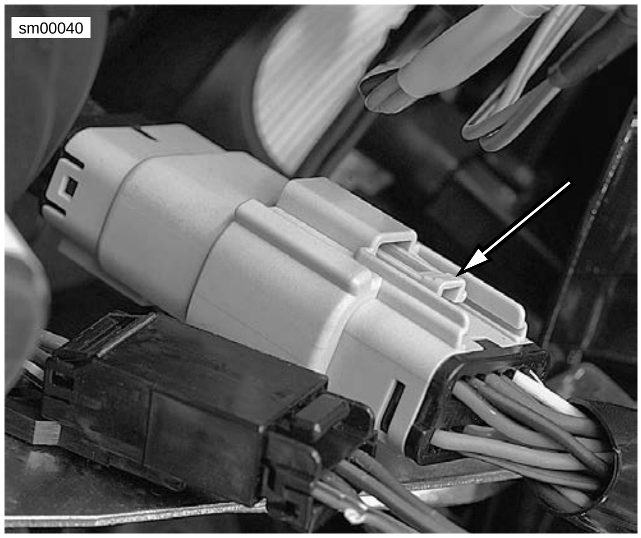


Figure A-33. Molex Connector: Latch

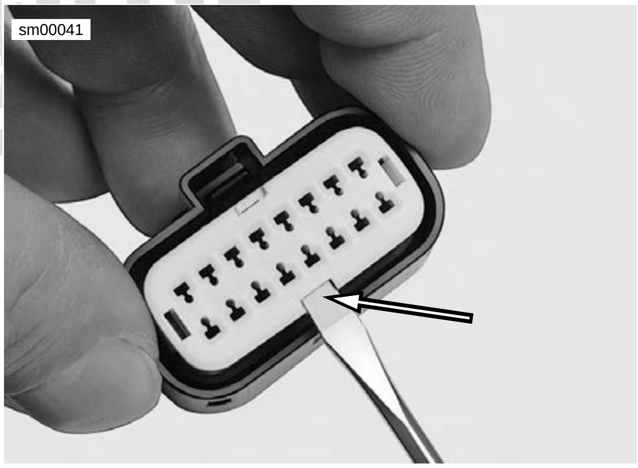


Figure A-34. Molex Connector: Secondary Lock Pry Slot (Socket Housing)

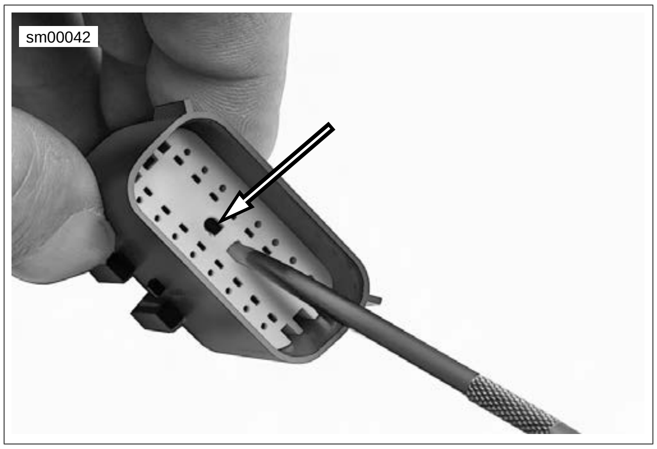


Figure A-35. Molex Connector: Secondary Lock D-Holes (Pin Housing)

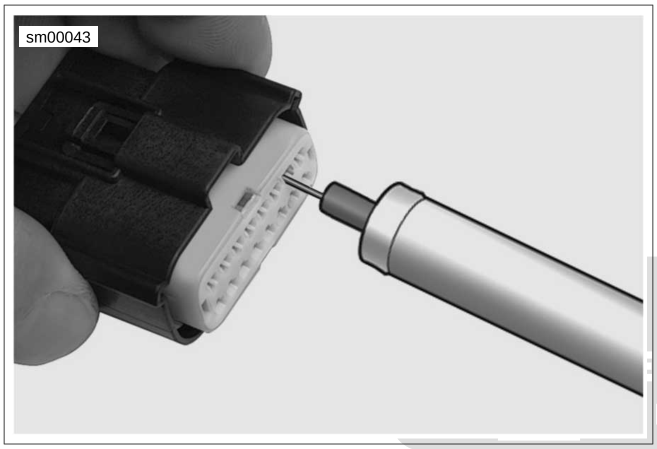
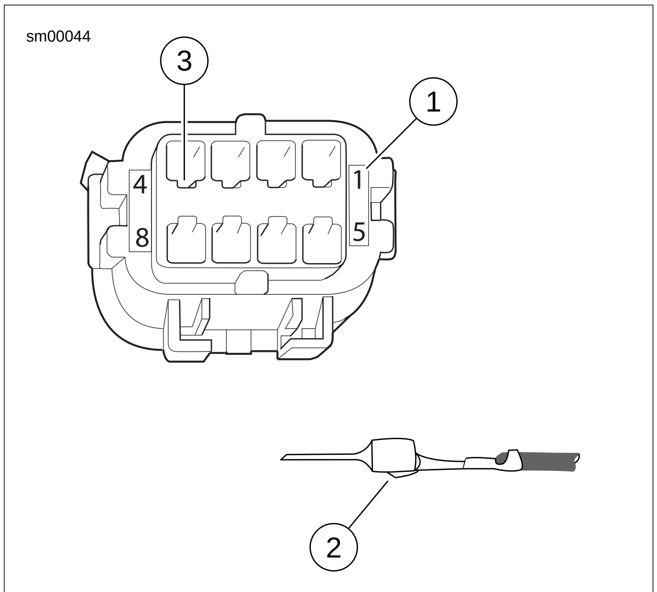


Figure A-36. Molex Connector: Terminal Remover (HD-48114)



1. Cavity number
2. Tang
3. Cavity slot

Figure A-37. Molex Connector: Pin Cavities and Wire Terminal

PACKARD ECM CONNECTOR A.16

PACKARD 100W CONNECTOR REPAIR

General

A Packard 100W connector connects the electronic control module (ECM) to the main harness.

NOTE

For vehicles with 73-pin connectors, see A.17 PACKARD MICRO-64 CONNECTORS and A.14 METRI-PACK TERMINALS.

Separating Socket Housing From ECM

See Figure A-38. While pressing the connector into the ECM, press the thumb lever (1) against the connector until the latch (2) pops out of the catch (3) on the ECM.

Mating Socket Housing To ECM

Push the connector into the ECM until the latch is captured by the catch on the ECM.

Removing Socket Terminal

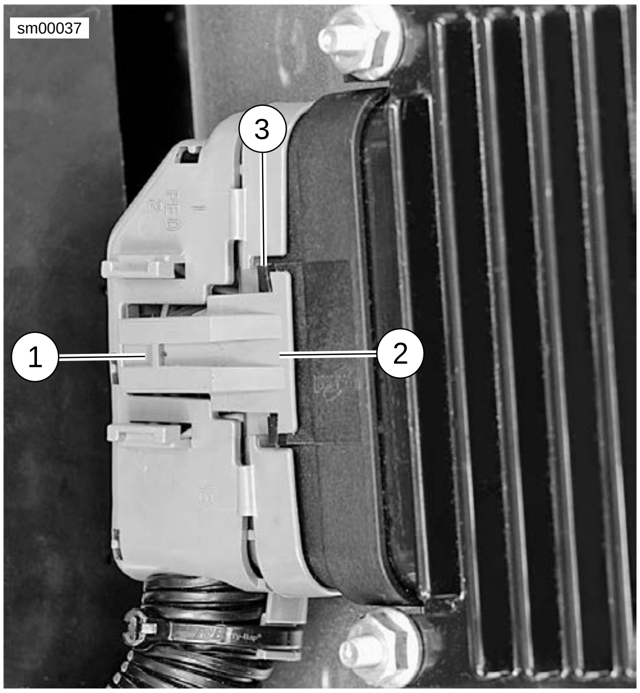
1. See Figure A-39. Gently press latch (1) on each side of the clear plastic secondary lock (2) and remove. For best results, release one side at a time.
2. Carefully cut cable strap (3) to free strain relief collar (4) from conduit (5).
3. See Figure A-40. Using a thin blade, gently pry at seam at back of socket housing to release three plastic pins (1) from slots in housing. Separate and spread halves of socket housing.
4. Push on wire lead to free terminal from chamber.

Installing Socket Terminal

1. From inside socket housing, gently pull on wire to draw terminal into chamber.
2. Exercising caution to avoid pinching wires, press halves of socket housing together until three plastic pins fully engage slots in housing.
3. Install **new** cable strap in groove of strain relief collar capturing cable conduit.
4. With the two ribs on the secondary lock on the same side as the external latch, install over terminals until latches lock in place.

Crimping Terminals

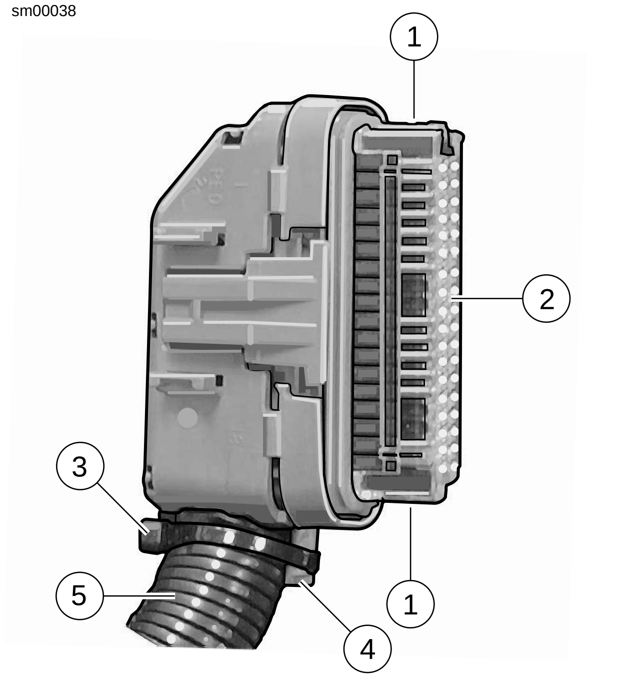
If necessary, crimp new terminals on wire leads. See A.14 METRI-PACK TERMINALS.



1. Thumb lever
2. Latch
3. Catch (ECM)

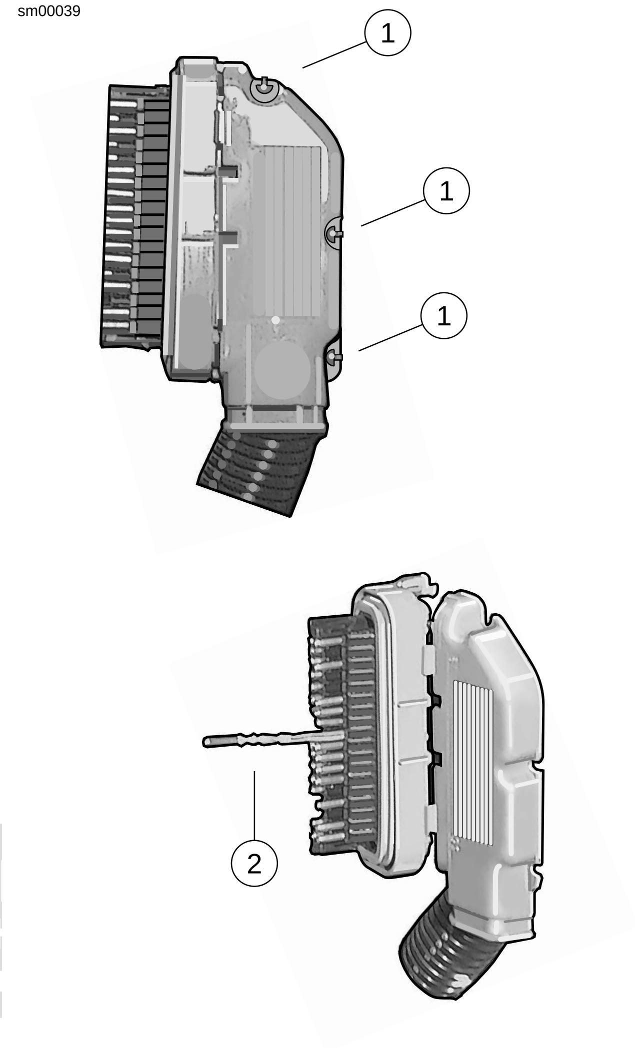
Figure A-38. Packard 100W to ECM (Typical)

HOME



1. **Latch**
2. **Secondary lock**
3. **Cable strap**
4. **Strain relief collar**
5. **Conduit**

Figure A-39. Packard 100W Connector



1. **Pins**
2. **Socket terminal**

Figure A-40. Packard 100W Connector: Separate Halves of Socket Housing

PACKARD MICRO-64 CONNECTORS A.17

PACKARD MICRO-64 CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER

General

Packard Micro-64 connectors are frequently found on speedometers, tachometers and the ECM of Touring Models. For pin 73 of these ECMs, see A.9 150 METRI-PACK CONNECTORS.

Separating Pin and Socket Housings

Bend back the external latches slightly and separate the pin and socket housings.

Mating Pin and Socket Housings

Orient the wire lead colors and push the pin and socket housings of the connector together until the latches click.

Removing Terminal

1. See Figure A-43. Locate the head of the secondary lock (1) 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 (2) between terminals on mating end of connector.
4. See Figure A-44. Obtain the PACKARD MICRO-64 TERMINAL REMOVER (Part No. HD-45928).
5. See Figure A-42. 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.

sm00046

Figure A-41. Packard Micro 64 Terminal Remover (HD-45928)

sm00048

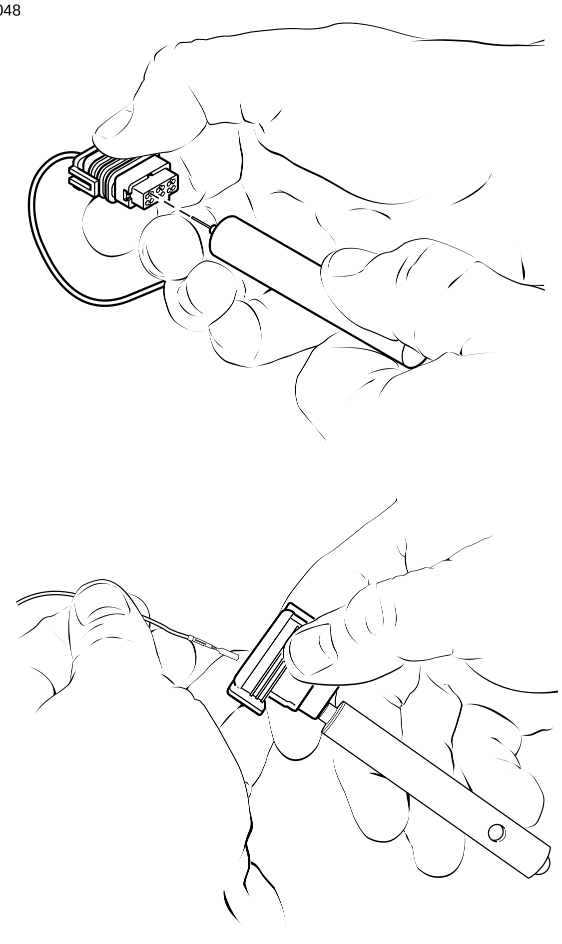


Figure A-42. Packard Micro 64 Connector: Insert Tool and Remove Terminal

Installing Terminal

1. Insert terminal into its respective numbered chamber on wire end of connector. No special orientation of the terminal is necessary.

NOTE

See Figure A-43. For wire location purposes, the corners of the socket housing are stamped (3) 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 chamber and then gently tug on the wire to verify that it is locked in place.

NOTE

Once the terminal is removed it 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 lockpin facing the mating end of the connector, push secondary lock in until head is flush with the connector housing.

Preparing Wire Leads for Crimping

Strip lead removing 1/8 in. (3.0 mm) of insulation.

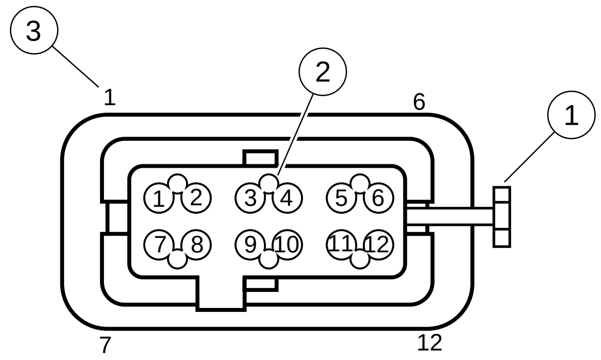
Crimping Terminals

1. Inspect **new** socket terminal for bent or deformed contact and crimp tails. Replace as necessary.
2. See Figure A-45. Squeeze the handles of the PACKARD MICRO-64 TERMINAL CRIMPER (Part No. HD-45929) to cycle the tool to the fully open position (1).
3. Raise locking bar and barrel holder by pushing up on bottom tab with index finger (2).
4. With the crimp tails facing upward, insert terminal through locking bar into front hole in barrel holder (20-22 gauge wire) (3).
5. Release locking bar to lock position of contact. When correctly positioned, the locking bar fits snugly in the space at the front of the core crimp tails and the closed side of the terminal rests on the outer nest of the crimp tool.
6. Insert wires between crimp tails until ends make contact with locking bar. Verify that wire is positioned so that wide pair of crimp tails squeeze bare wire strands, while the narrow pair folds over the insulation material.
7. Squeeze handle of crimp tool until tightly closed (4). Tool automatically opens when the crimping sequence is complete.
8. Raise locking bar and barrel holder to remove contact.

Inspecting Crimps

Inspect the quality of the core and insulation crimps. Distortion should be minimal.

sm00047



1. **Secondary lock**
2. **Pin hole**
3. **Stamped number**

Figure A-43. Packard Micro 64 Connector: Housing

sm00045

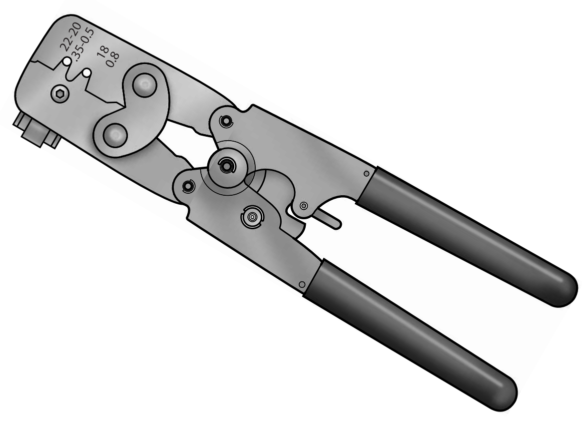
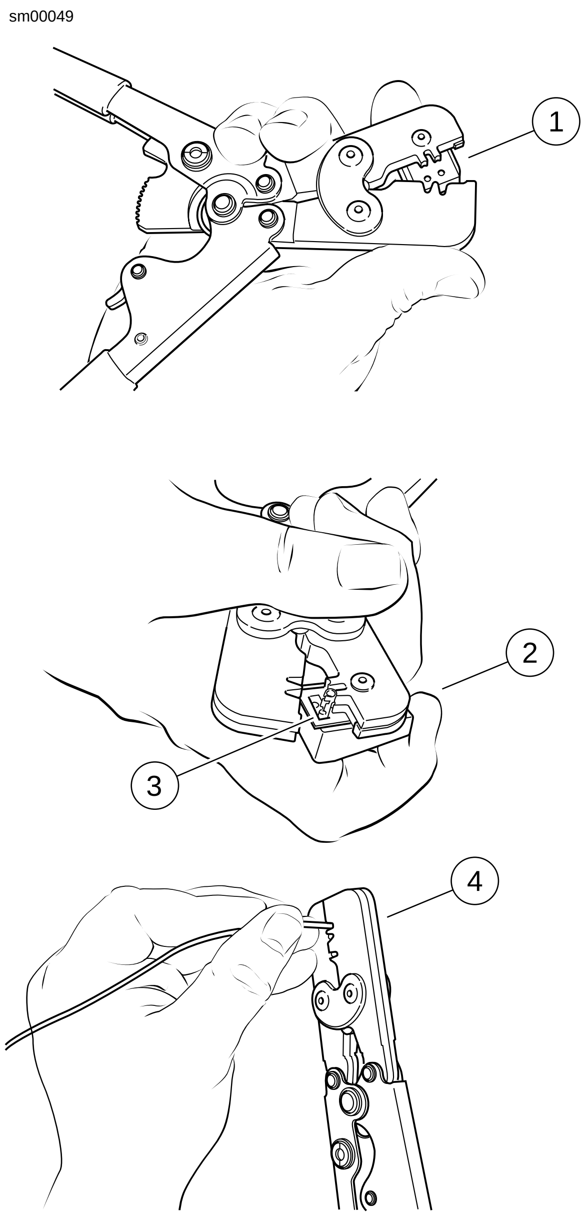


Figure A-44. Packard Micro 64 Terminal Crimper (HD-45929)



1. Open position
2. Raising locking bar
3. Insert terminal
4. Crimp terminal

Figure A-45. Packard Micro 64 Connector: Terminal in Crimper

SEALED SPLICE CONNECTORS A.18

SEALED SPLICE CONNECTOR REPAIR

PART NUMBER	TOOL NAME
HD-25070	ROBINAIR HEAT GUN
HD-38125-8	PACKARD CRIMPING TOOL
HD-39969	ULTRA TORCH UT-100
HD-41183	HEAT SHIELD ATTACHMENT

General

Splice connectors and several OE ring terminal connectors use heat shrink covering to seal the connection.

Preparing Wire Leads

NOTE

If adjacent wires are to be spliced, stagger the splices so that the sealed splice connectors will not touch each other but are located at different positions along the length of the wires.

1. Using a shop gauge, identify the gauge of the wire.
2. Match the wire gauge to a sealed splice connector by color and part number. Refer to Table A-4.
3. Using a wire stripper, cut and strip a length of insulation off the wire ends. Refer to Table A-4 for the strip length.

Table A-4. Sealed Splice Connectors

WIRE GAUGE	COLOR	PART NO.	STRIP LENGTH
18-20 (0.5-0.8 mm)	Red	70585-93	3/8 in. (9.5 mm)
14-16 (1.0-2.0 mm)	Blue	70586-93	3/8 in. (9.5 mm)
10-12 (3.0-5.0 mm)	Yellow	70587-93	3/8 in. (9.5 mm)

NOTE

If any copper wire strands are cut off of the wire core, trim the end and strip the wire again in a larger gauge stripper.

Splicing Wire Leads

NOTE

See Figure A-47. The connector is crimped twice - one side and then the other.

1. See Figure A-46. Open the PACKARD CRIMPING TOOL (Part No. HD-38125-8) ratchet by squeezing the handles closed.
2. Match the connector color to the wire gauge crimp die in the jaws and insert one end of the sealed connector.
3. Gently squeeze the handles until the connector is held in the jaws.
4. See Figure A-47. Feed the stripped end of a wire into the connector until the wire stops inside the metal insert (1).
5. Squeeze the handles tightly closed to crimp the lead in the insert (2). The tool automatically opens when the crimping is complete.
6. Slide the connector to the other half of the metal insert. Insert the stripped wire lead (1) until it stops, and crimp the lead in the insert (2).

WARNING

Be sure to follow manufacturer's instructions when using the UltraTorch UT-100 or any other radiant heating device. Failure to follow manufacturer's instructions can cause a fire, which could result in death or serious injury. (00335a)

- Avoid directing heat toward any fuel system component. Extreme heat can cause fuel ignition/explosion resulting in death or serious injury.
- Avoid directing heat toward any electrical system component other than the connectors on which heat shrink work is being performed.
- Always keep hands away from tool tip area and heat shrink attachment.

7. Use an ULTRA TORCH UT-100 (Part No. HD-39969), or a ROBINAIR HEAT GUN (Part No. HD-25070) with a HEAT SHIELD ATTACHMENT (Part No. HD-41183), to heat the connector from the center of the crimp (3) out to each end.

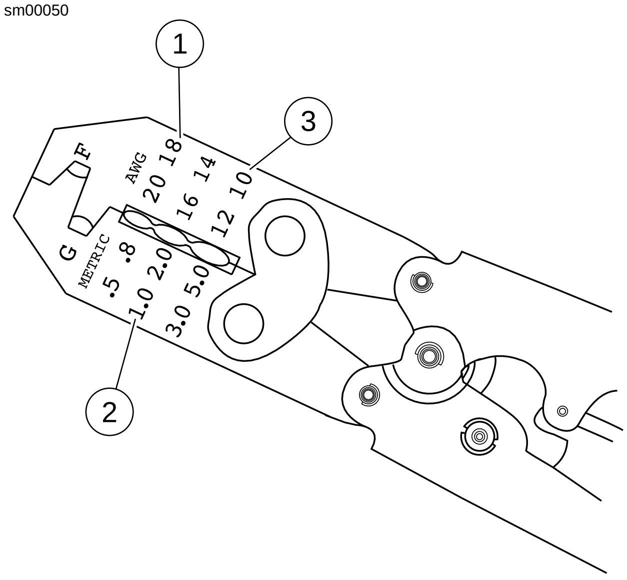
NOTE

It is acceptable for the splice to rest against the heat shrink tool attachment.

Inspecting Seals

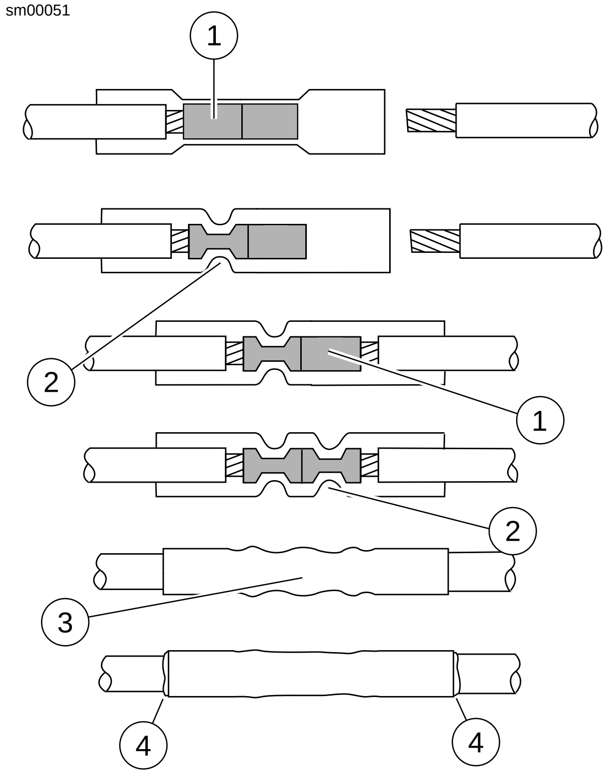
See Figure A-47. Allow the splice to cool and inspect the seal. The insulation should appear smooth and cylindrical. Melted sealant will have extruded out the ends (4) of the insulation.

HOME



1. Red connector die
2. Blue connector die
3. Yellow connector die

Figure A-46. Packard Crimping Tool (HD-38125-8)



1. Wire lead in metal insert
2. Crimp metal insert
3. Center of crimp
4. Melted sealant

Figure A-47. Sealed Splice Connector

TABLE OF CONTENTS

SUBJECT **PAGE NO.**

NOTES

CONNECTORS B.1

CONNECTOR LOCATIONS

Function/Location

On the vehicle, a connector can be identified by its function and location. Refer to Table B-1.

Place and Color

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

Connector Number

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

Repair Instructions

The repair instructions in Appendix A are by connector type. Refer to Table B-1.

Table B-1. Dyna Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[4]	Accessory connector	4-place Deutsch (BK)	Black	Under seat
[5]	Main fuse	Spade terminals (BK)	Red	Under electrical caddie cover
[7]	Tail lamp harness to main harness	8-place Multilock (BK)	Gray	Under seat
[18]	Right rear turn signal	2-place Multilock (BK)	Gray	Inside tail lamp lens
[19]	Left rear turn signal	2-place Multilock (BK)	Gray	Inside tail lamp lens
[20]	Console gauges/indicator lamps (all except FXDC, FXDF, and FXDWG	12-place Deutsch (BK)	Black	Inside top frame tube
[21]	Indicator lamps	8-place Mini-Deutsch (BK) (FXDC, FXDF, FXDWG) 10-place Mini-Deutsch (BK) (FXDB)	Brown	Under fuel tank console
[22]	Right hand controls	6-place Molex (BK)	Gray	Inside top frame tube
[24]	Left hand controls	8-place Molex (GY)	Gray	Inside top frame tube
[30]	TSM/TSSM/HFSM	12-place Deutsch (GY)	Breakout Box	Under electrical caddie cover
[31 L]	Front turn signals (left)	3-place Multilock (W)	Gray	Inside top frame tube
[31 R]	Front turn signals (right)	3-place Multilock (BK)	Gray	Inside top frame tube
[33]	Ignition switch	3-place Delphi (BK)	Red	Inside top frame tube (FXD, FXDL) Under fuel tank console (FXDC, FXDF, FXDWG)
[38]	Headlamp	4-place Multilock (BK)	Gray	Inside top frame tube
[39]	Speedometer	12-place Packard (GY)	Breakout Box	Back of speedometer
[47]	Voltage regulator to stator	3-place Dekko (BK)		Back of voltage regulator
[62]	Fuse/Relay block (starter relay, system relay)	Spade terminals (BK)	Gray	Under electrical caddie cover
[64]	Fuse block	Spade terminals (BK)	Gray	Under electrical caddie cover
[65]	VSS	3-place Delphi (BK)	Gray	Rear of transmission case
[77]	Voltage regulator	2-place Dekko (BK)		Back of voltage regulator
[78]	ECM	36-place Packard (GY)	Breakout Box	Under electrical caddie cover
[79]	CKP Sensor	2-place Mini-Deutsch (BK)	Brown	Inside front electrical caddie
[80]	MAP sensor	3-place Delphi (GY)	Gray	Top of induction module
[83]	Ignition coil	4-place Delphi (GY)	Gray	Back of coil
[84]	Front fuel injector	2-place Delphi (GY)	Purple	Beneath fuel tank
[85]	Rear fuel injector	2-place Delphi (GY)	Purple	Beneath fuel tank

Table B-1. Dyna Connector Locations

NO.	DESCRIPTION	TYPE	TERMINAL PROBE COLOR	LOCATION
[87]	IAC	4-place Delphi (BK)	Gray	Beneath fuel tank
[88]	TP sensor	3-place Delphi (BK)	Gray	Behind air cleaner backing plate
[89A]	IAT sensor	2-place Delphi (GY)	Gray	Behind air cleaner backing plate
[89B]	IAT sensor	2-place Deutsch (GY)	Brown	Under seat
[90]	ET sensor	2-place Delphi (BK)	Gray	Back of front cylinder, left side
[91]	DLC	4-place Deutsch (GY)	Black	Under electrical caddie cover
[93]	Tail lamp	4-place Multilock (BK)	Gray	Inside tail lamp lens
[94]	Tail lamp power in	6-place Multilock (BK)	Gray	Inside tail lamp lens
[108]	Tachometer	12-place Packard (GY)	Breakout Box	Back of tachometer
[117]	Fuel gauge	4-place Multilock (BK)	Gray	Under fuel tank
[120]	Oil pressure switch	Post terminal (BK)		Oil pressure switch, front of right crankcase
[121]	Rear stop lamp switch	Spade terminals (BK)	Red	Behind rear brake master cylinder
[122]	Horn	Spade terminals (BK)	Red	Between cylinders, left side
[128]	Starter solenoid	Spade terminal (W)	Red	Top of starter
[131]	Neutral switch	Post terminals (BK)		Top of transmission
[133]	JSS (HDI)	3-place Molex (BK)	Gray	Under seat
[137]	Rear O2 sensor (Domestic only)	2-place Amp (BK)	Gray	Under seat
[138]	Front O2 sensor (Domestic only)	2-place Amp (BK)	Gray	Inside front electrical caddie
[141]	Fuel pump and sender	4-place Delphi (BK)	Gray	Top of fuel tank
[142]	Security siren (optional)	3-place Delphi (BK)	Gray	Under seat
[154]	Trip odometer reset switch		Black	Back of speedometer (FXD) On console (FXDB, FXDL, FXDC, FXDF)
[160]	B+ connector	1-place Packard (GY)	Purple	Under seat
[178]	Active intake solenoid (HDI)	2-place Amp (BK)	Gray	Air cleaner backing plate
[179]	Active exhaust (HDI)	5-place Amp (BK)	Gray	Behind rear cylinder head
[208]	HFSM antenna harness	4-place Deutsch (GY)	Black	Under electrical caddie cover
[209]	HFSM antenna	2-place Molex (GY)	Gray	Under seat
[257]	Rear lighting	6-place Molex (BK)	Gray	Under seat
[266]	Anti-theft tracking module (BRA)	4-place Delphi (BK)	Gray	Under seat
[267]	Main harness	3-place Deutsch (BK)	Black	Under seat
[GND1] [GND2]	Harness grounds (3)	Ring terminals		Under electrical caddie

WIRING DIAGRAM INFORMATION

Wire Color Codes

Wire traces on wiring diagrams are labeled with alpha codes. Refer to Table B-2.

For Solid Color Wires: See Figure B-1. The alpha code identifies wire color.

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

Wiring Diagram Symbols

See Figure B-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.

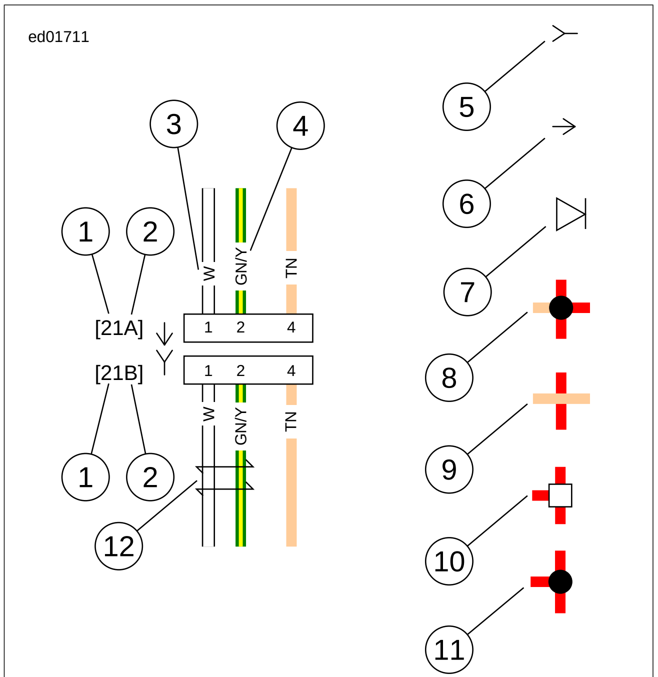
A=Pin: The letter A after a connector number and the pin symbol identifies a pin housing.

B=Socket: The letter B after a connector number and the socket symbol identifies a socket housing.

Other symbols found on the wiring diagrams include the symbol for a diode, a symbol for a wire-to-wire connection, a symbol verifying that no connection between two wire traces exists, symbols for actual and virtual splices, and a symbol identifying two wires that are twisted together.

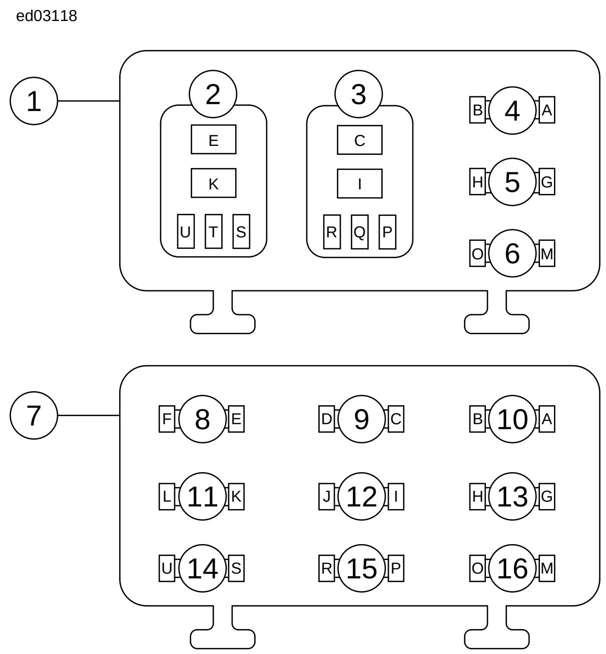
Actual splices are splices where two wires are connected together at a specific location along a wire. Virtual splices are splices shown connected anywhere along a wire, usually used in a wiring or schematic diagram for clarity.

Grounds are classified as either clean or dirty grounds. Clean grounds are normally used for sensors or modules. These grounds usually do not have electric motors or coils or anything that may cause electrical interference on the ground circuit. The dirty grounds are used for components that are not as sensitive to electrical interference.



1. **Connector number**
2. **Terminal code (A=pin, B=socket)**
3. **Solid wire color**
4. **Striped wire color**
5. **Socket symbol**
6. **Pin symbol**
7. **Diode**
8. **Connection**
9. **No connection**
10. **Actual splice**
11. **Virtual splice**
12. **Twisted pair**

Figure B-1. Connector/Wiring Diagram Symbols



1. Fuse and relay block [62] (under left side cover)
2. Start relay
3. System relay
4. ECM
5. Fuel pump
6. Eng CTL
7. Fuse block [64] (under left side cover)
8. Spare
9. P&A IGN
10. Instruments
11. Spare
12. Battery
13. Ignition
14. Cust ACCY
15. Accessories
16. Lights

Figure B-2. Fuse Block and Socket Terminals

Table B-2. Wire Color Codes

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

2010 DYNA WIRING DIAGRAMS

Refer to the table below for wiring diagram information.

Wiring Diagram List

DIAGRAM	LOCATION
Battery Power	Figure B-3
Accessory Power	Figure B-4
Ignition Power	Figure B-5
Sensor Grounds	Figure B-6
Chassis Grounds	Figure B-7
Sensor 5 Volt Reference Distribution	Figure B-8
Charging Circuit: 2010 Dyna	Figure B-9
Main Harness (1 of 2): 2010 Dyna (FXD, FXDB, and FXDL)	Figure B-10
Main Harness (1 of 2): 2010 Dyna (FXDC, FXDF, and FXDWG)	Figure B-11
Main Harness (2 of 2): 2010 Dyna	Figure B-12
Instruments and Indicators: 2010 Dyna	Figure B-13
Starting Circuit: 2010 Dyna	Figure B-14
Ignition Circuit: 2010 Dyna	Figure B-15
Lighting, Hand Controls, and Adapter Harnesses: 2010 Dyna	Figure B-16
Security Circuit: 2010 Dyna (FXD, FXDB, and FXDL)	Figure B-17
Security Circuit: 2010 Dyna (FXDC, FXDF, and FXDWG)	Figure B-18
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXD, FXDB, and FXDL)	Figure B-19
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXDC, FXDF, and FXDWG)	Figure B-20

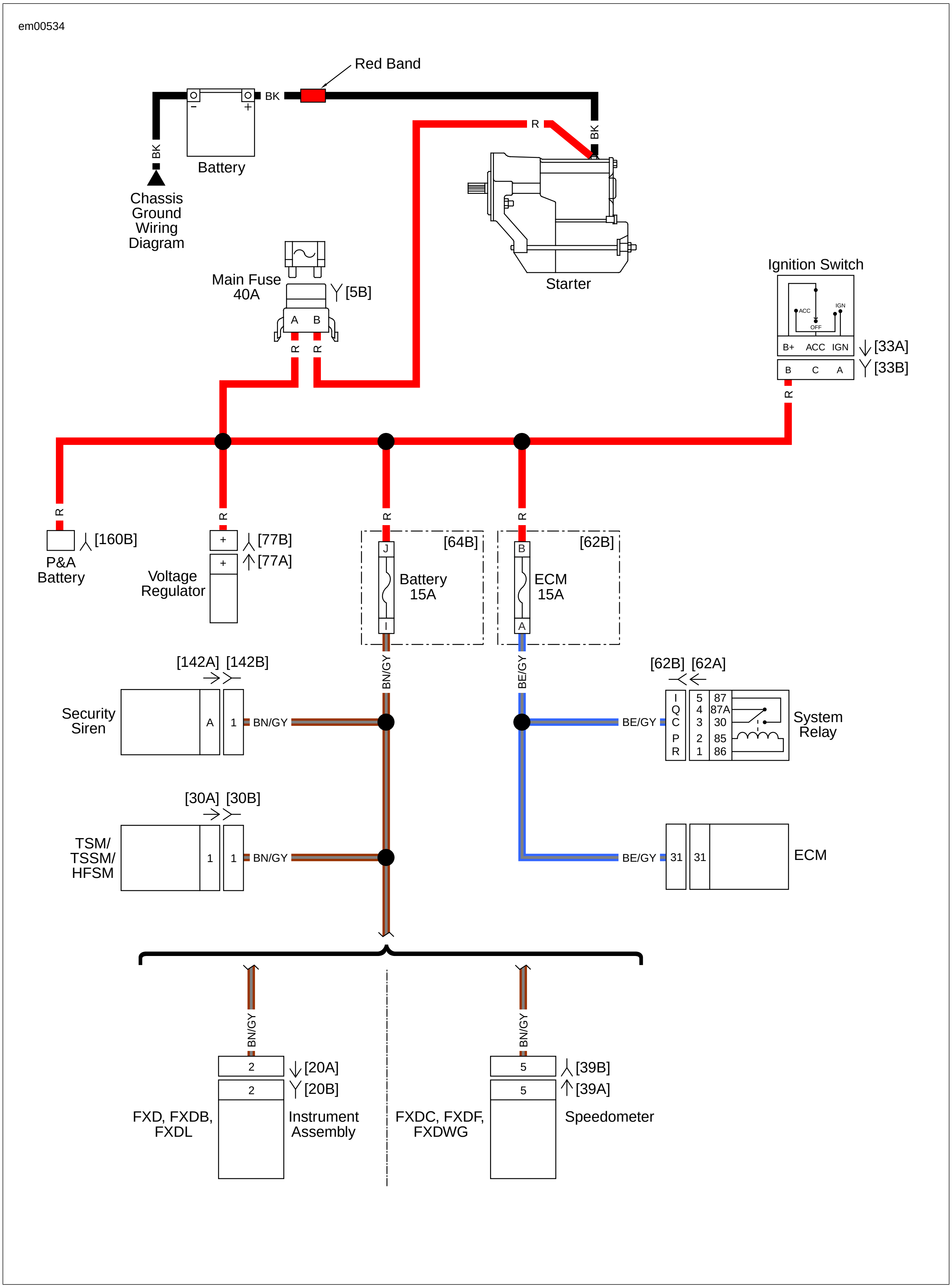


Figure B-3. Battery Power

HOME

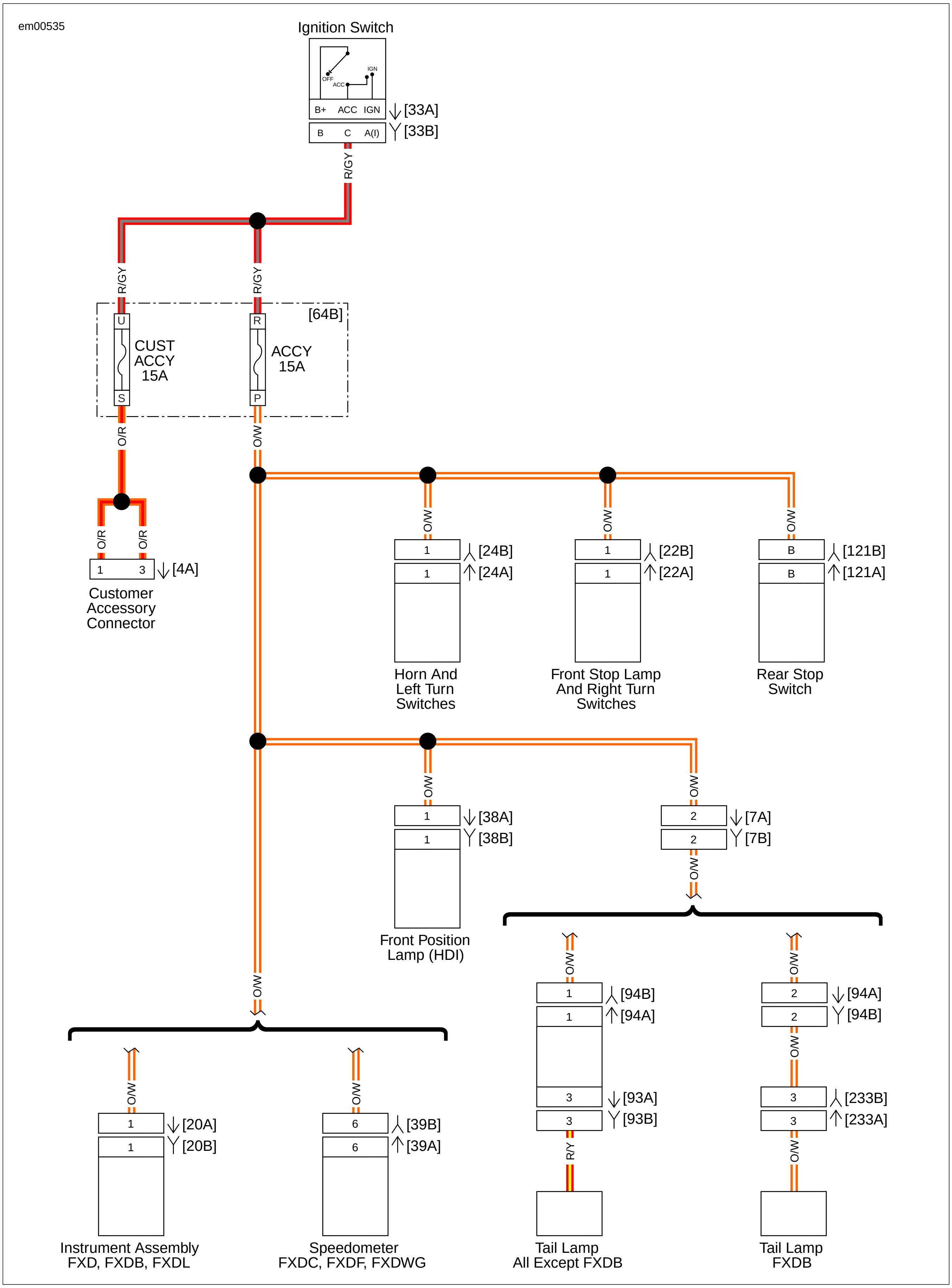


Figure B-4. Accessory Power

HOME

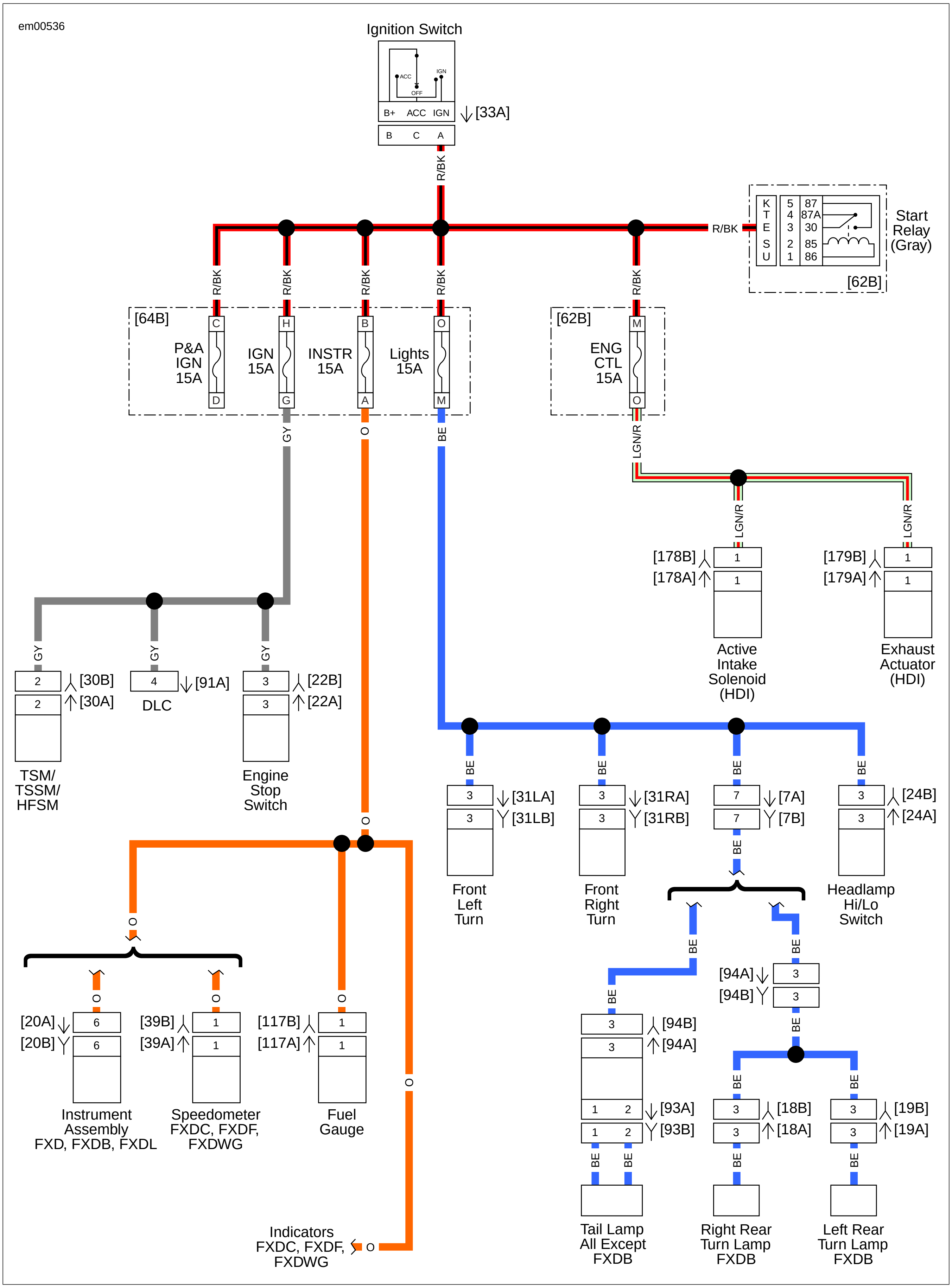


Figure B-5. Ignition Power

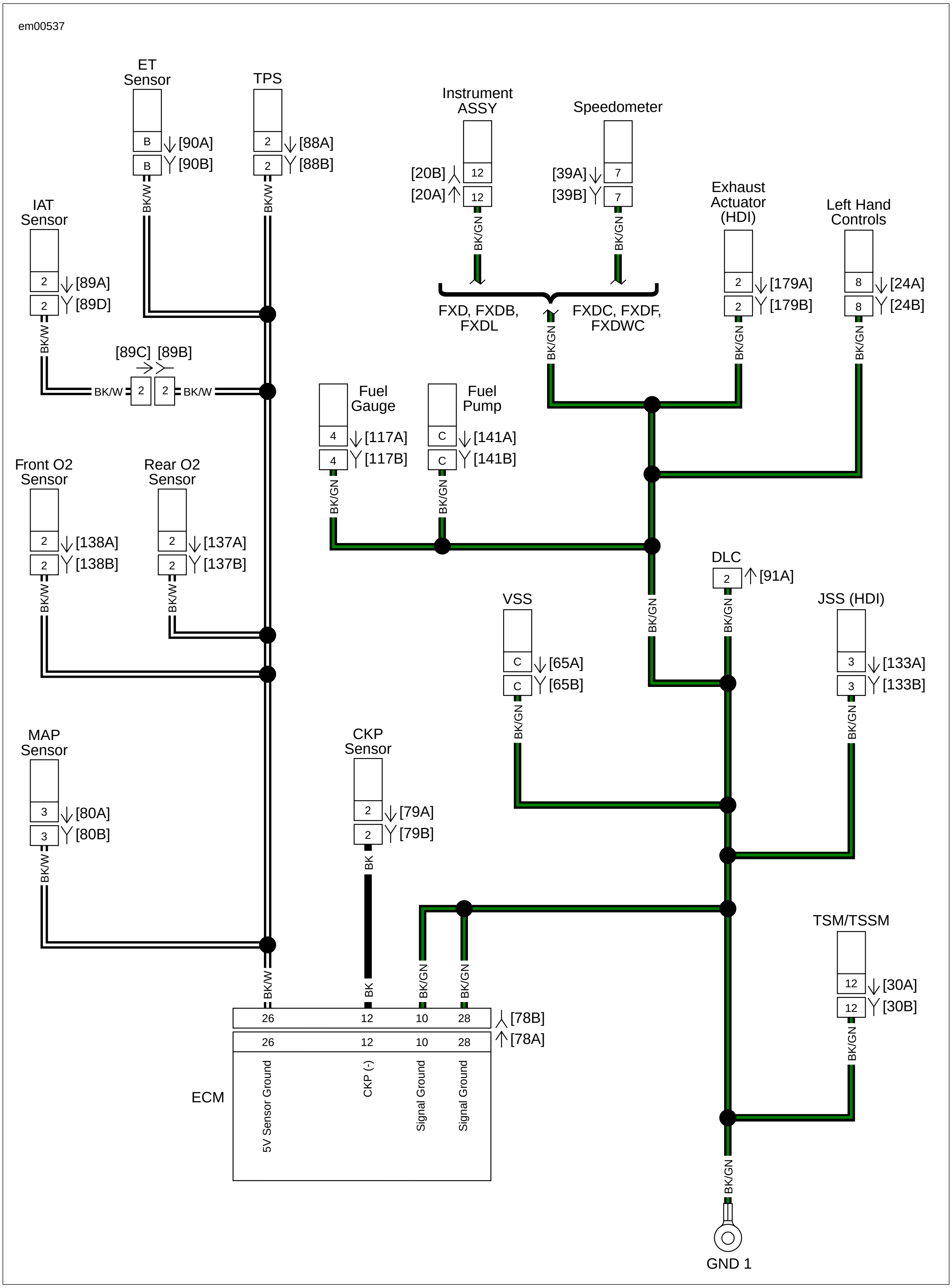


Figure B-6. Sensor Grounds

HOME

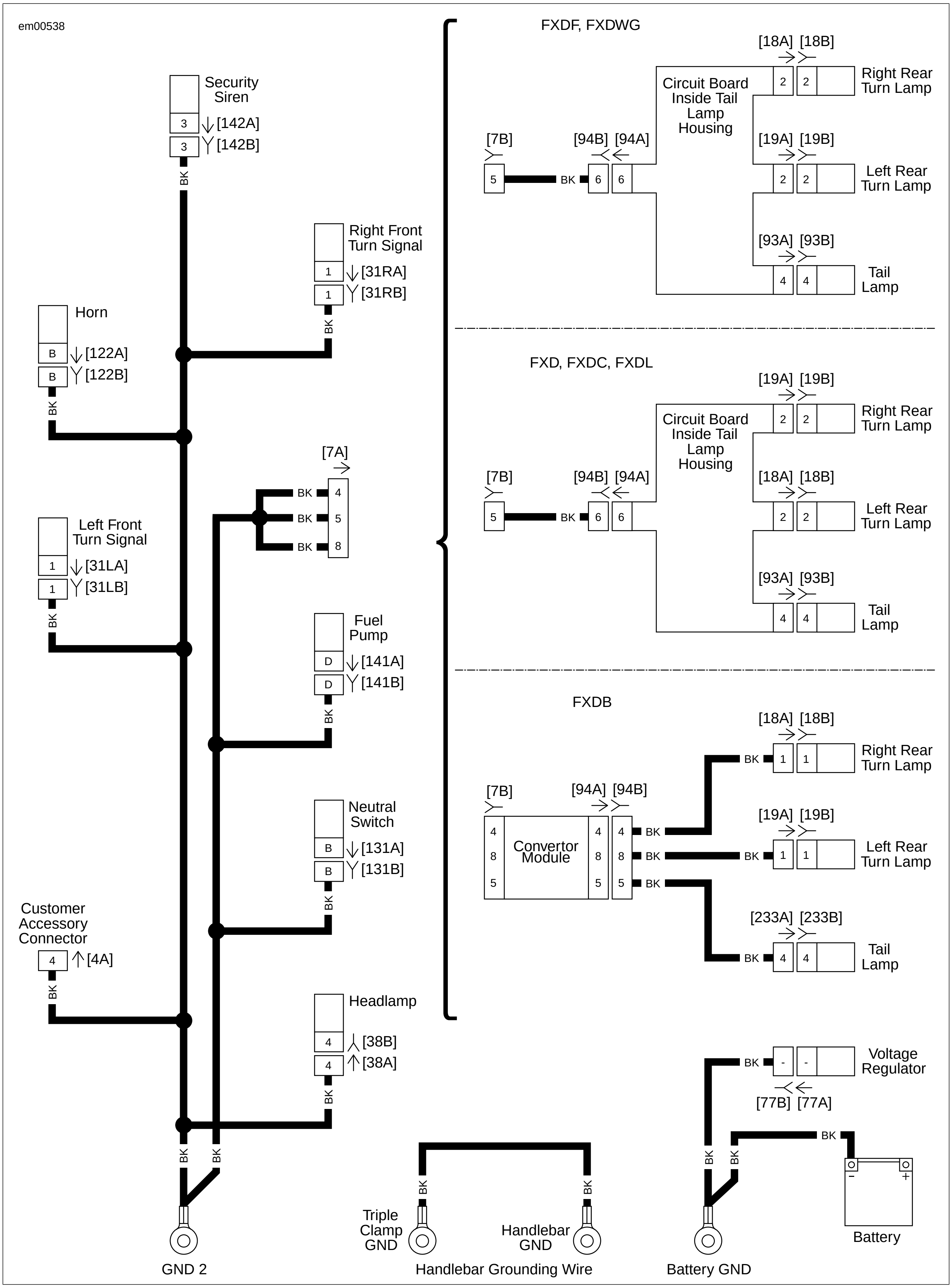


Figure B-7. Chassis Grounds

HOME

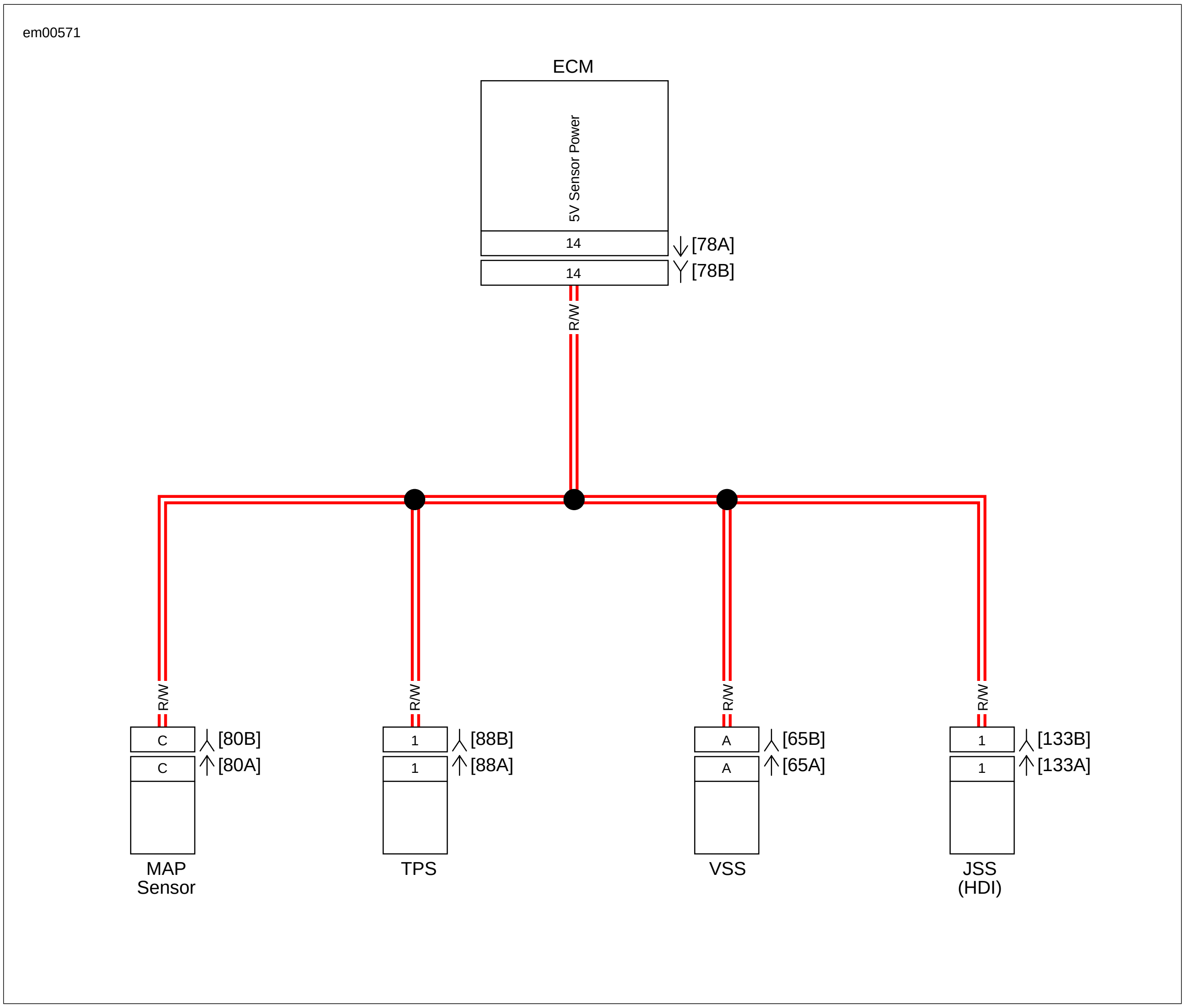


Figure B-8. Sensor 5 Volt Reference Distribution

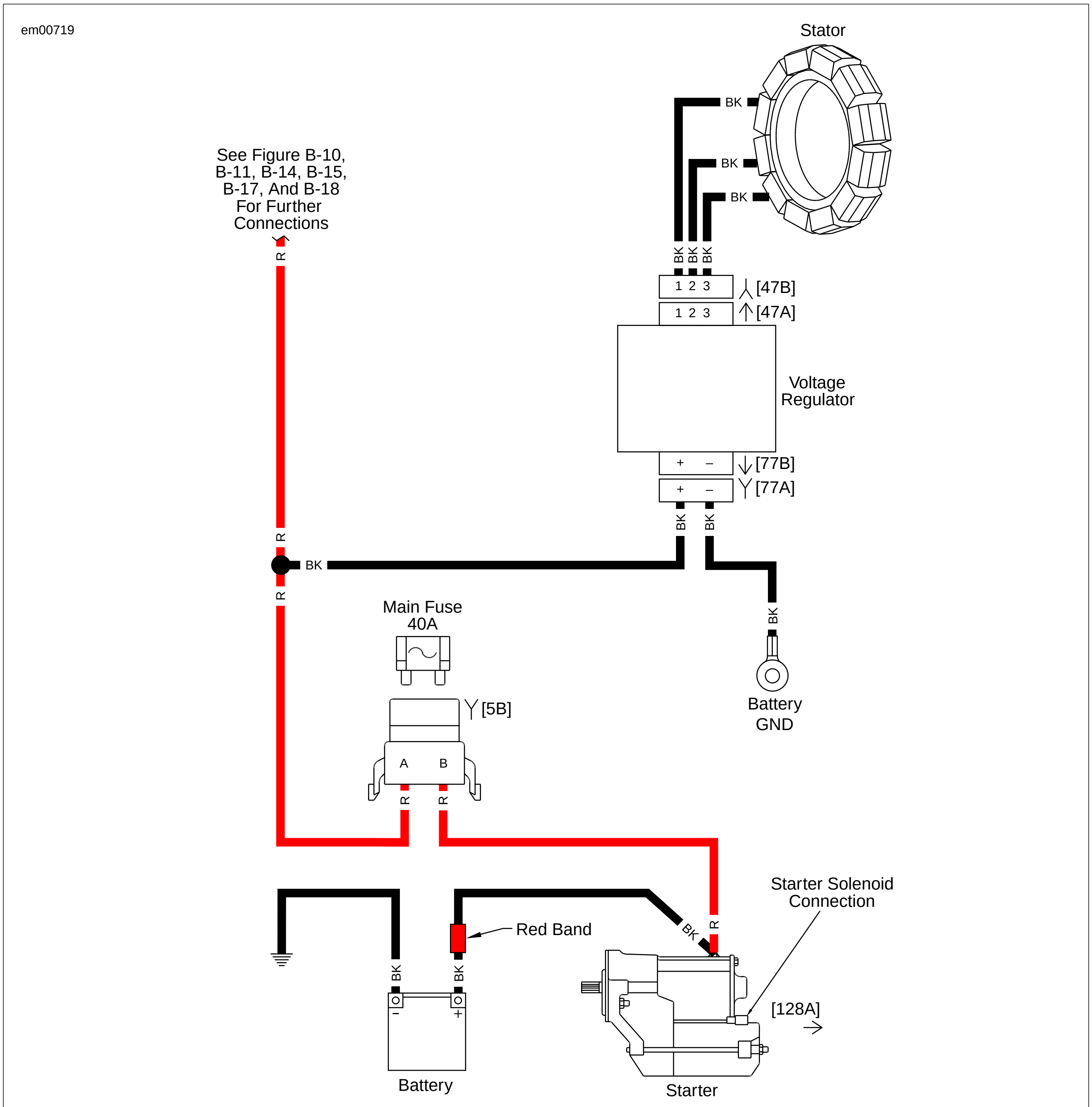


Figure B-9. Charging Circuit: 2010 Dyna

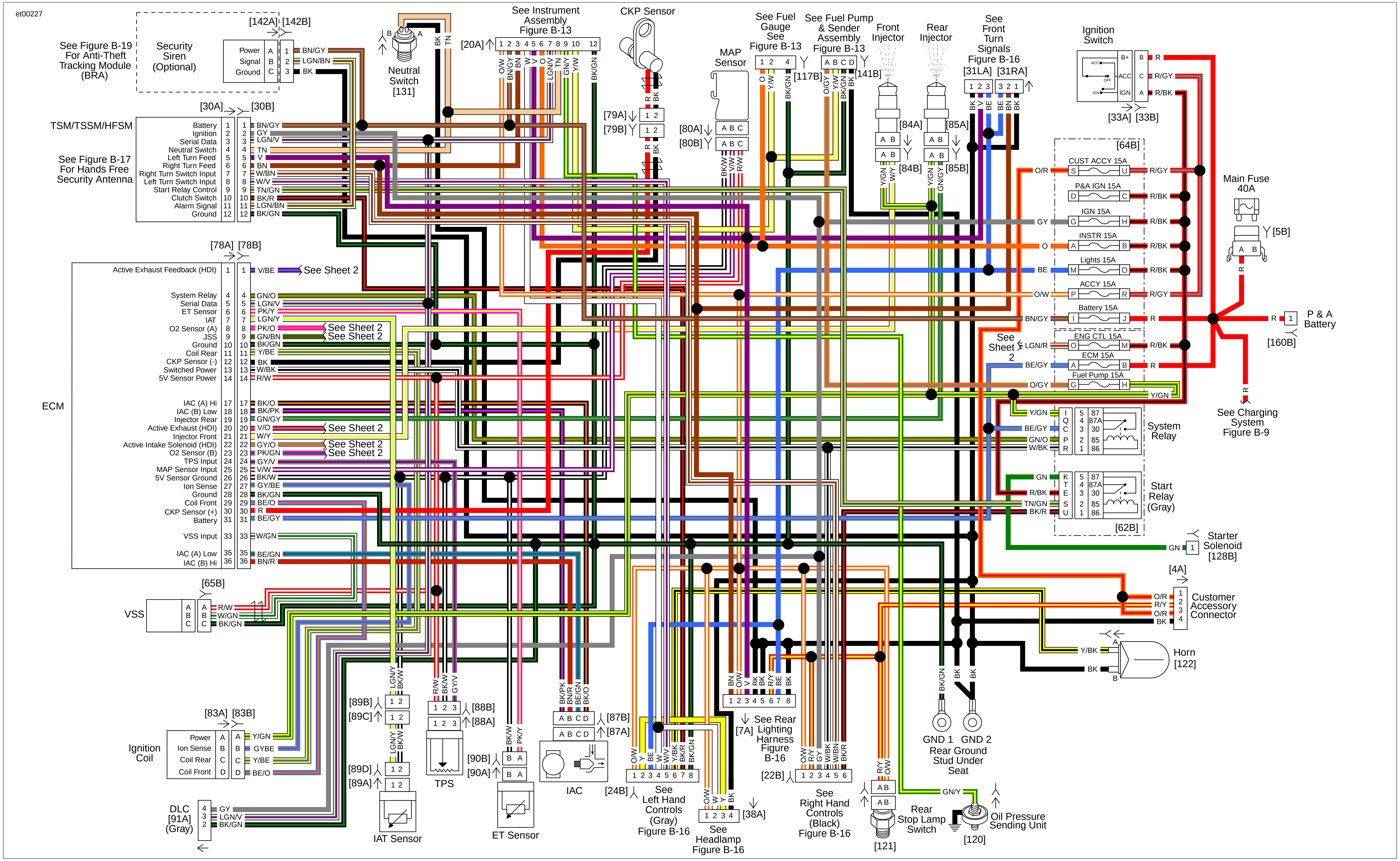


Figure B-10. Main Harness (1 of 2): 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-10.
Main Harness (1 of 2): 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-10.
Main Harness (1 of 2): 2010 Dyna (FXD, FXDB, and FXDL)

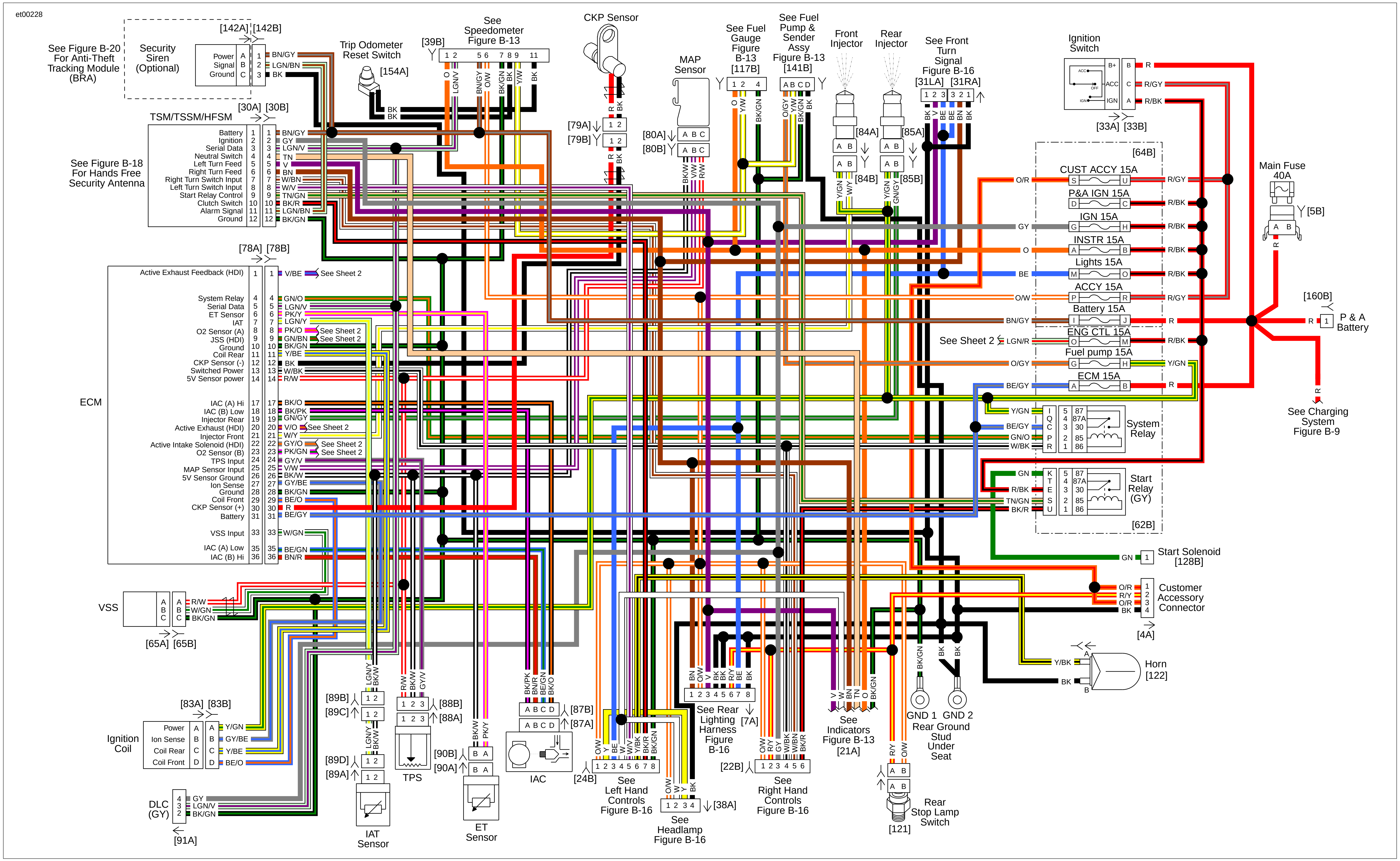


Figure B-11. Main Harness (1 of 2): 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-11.
Main Harness (1 of 2): 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-11.
Main Harness (1 of 2): 2010 Dyna (FXDC, FXDF, and FXDWG)

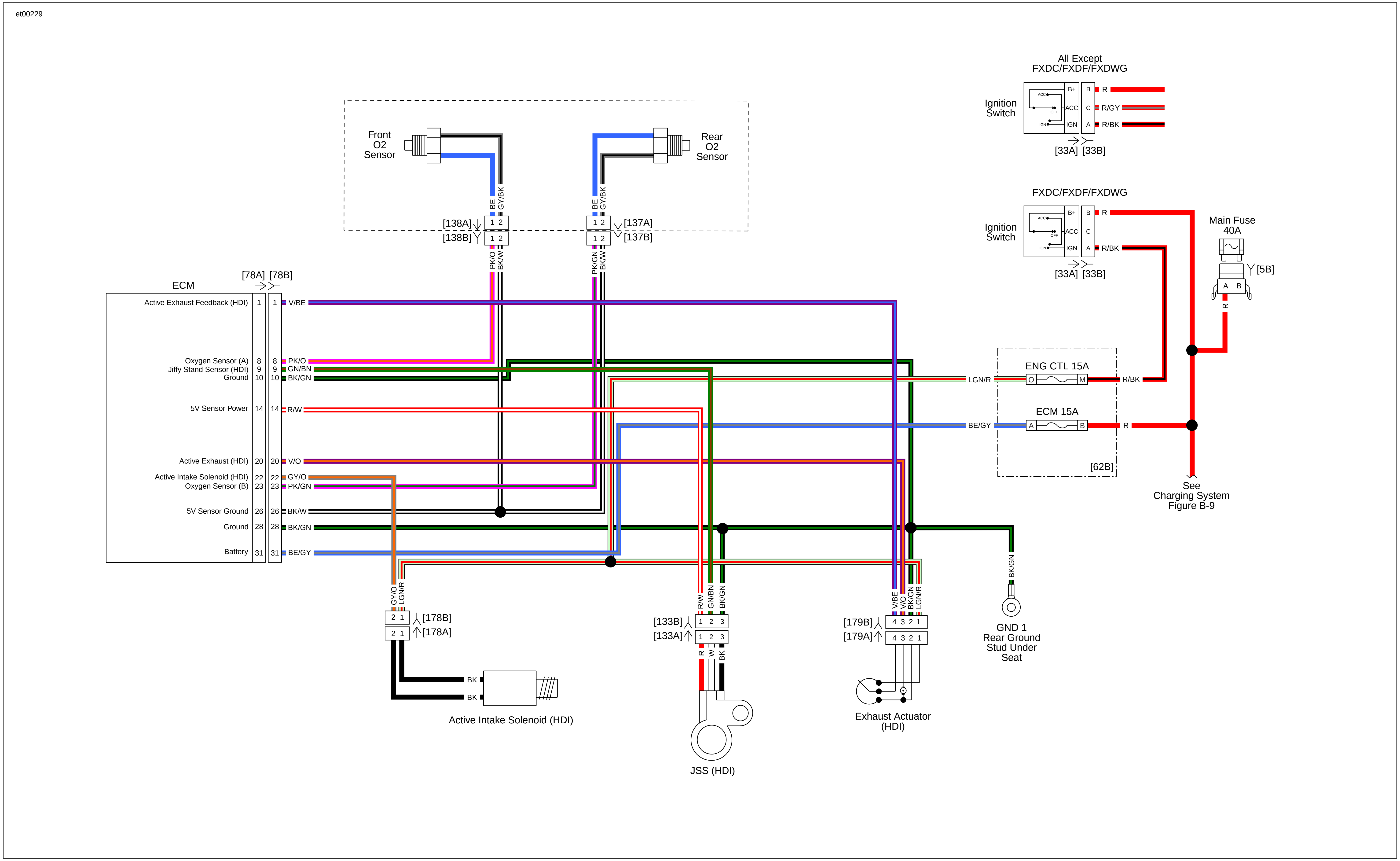


Figure B-12. Main Harness (2 of 2): 2010 Dyna

Figure B-12.
Main Harness (2 of 2): 2010 Dyna

Figure B-12.
Main Harness (2 of 2): 2010 Dyna

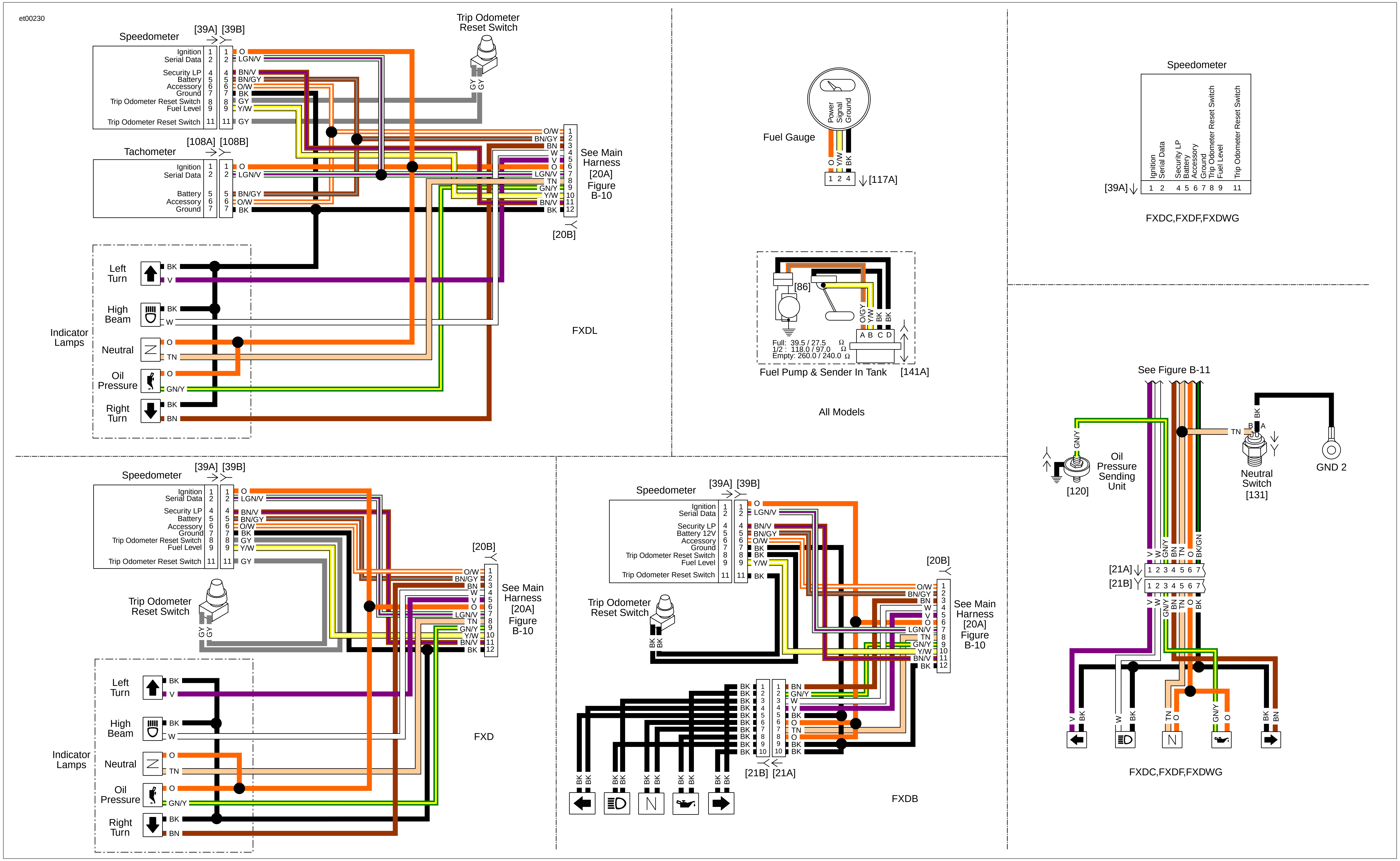


Figure B-13. Instruments and Indicators: 2010 Dyna

Figure B-13.
Instruments and Indicators: 2010 Dyna

Figure B-13.
Instruments and Indicators: 2010 Dyna

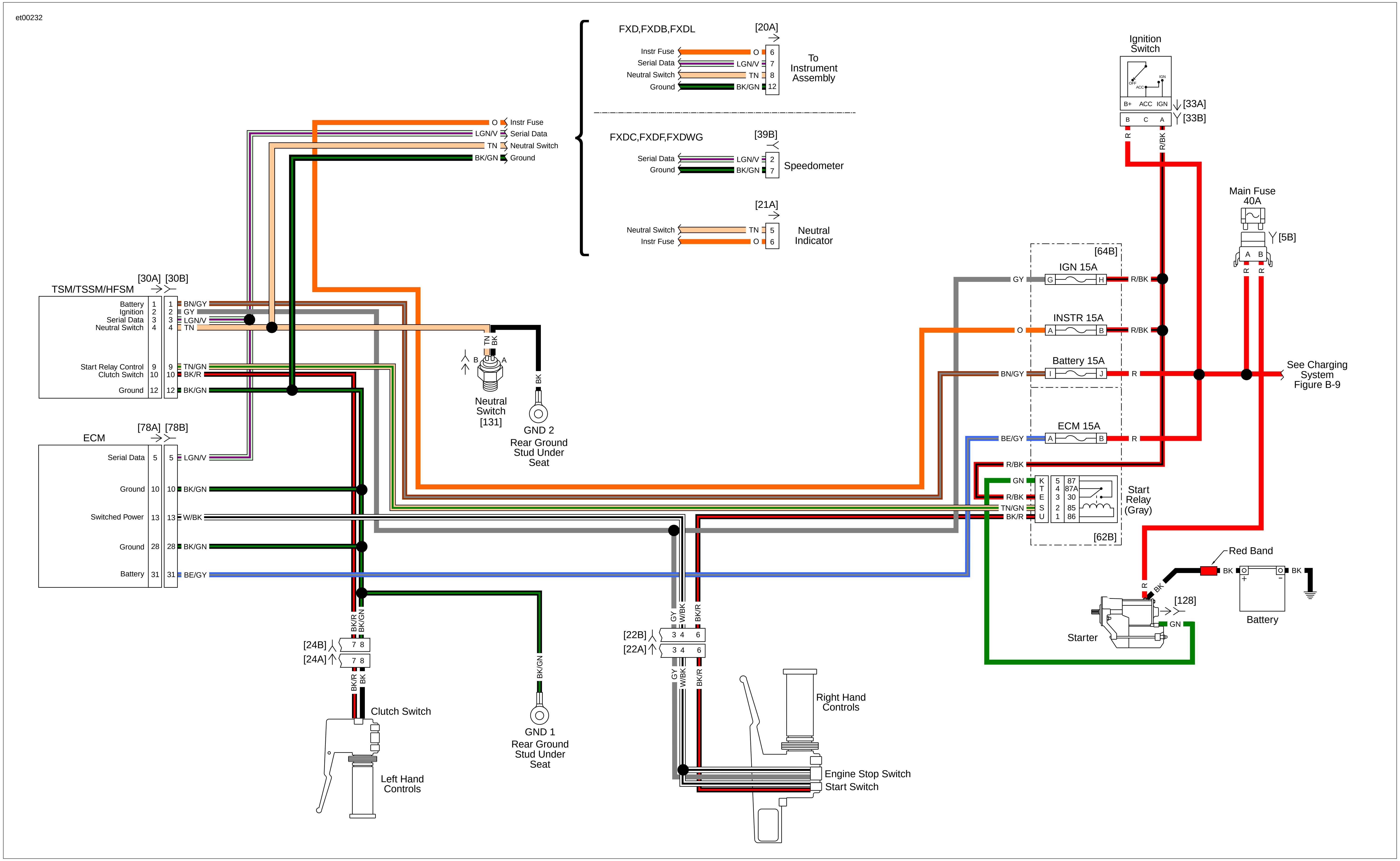


Figure B-14. Starting Circuit: 2010 Dyna

Figure B-14.
Starting Circuit: 2010 Dyna

Figure B-14.
Starting Circuit: 2010 Dyna

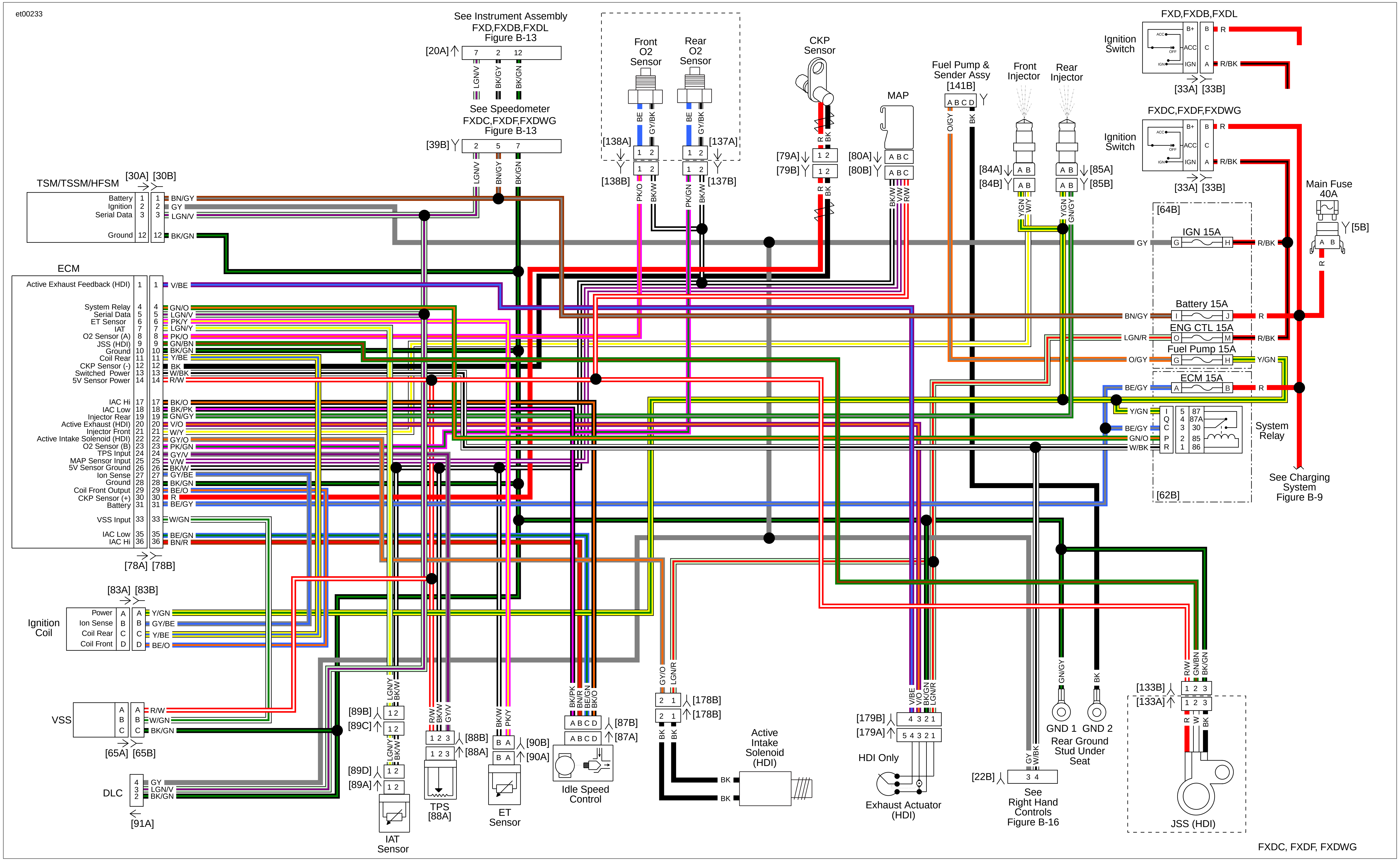


Figure B-15. Ignition Circuit: 2010 Dyna

Figure B-15.
Ignition Circuit: 2010 Dyna

Figure B-15.
Ignition Circuit: 2010 Dyna

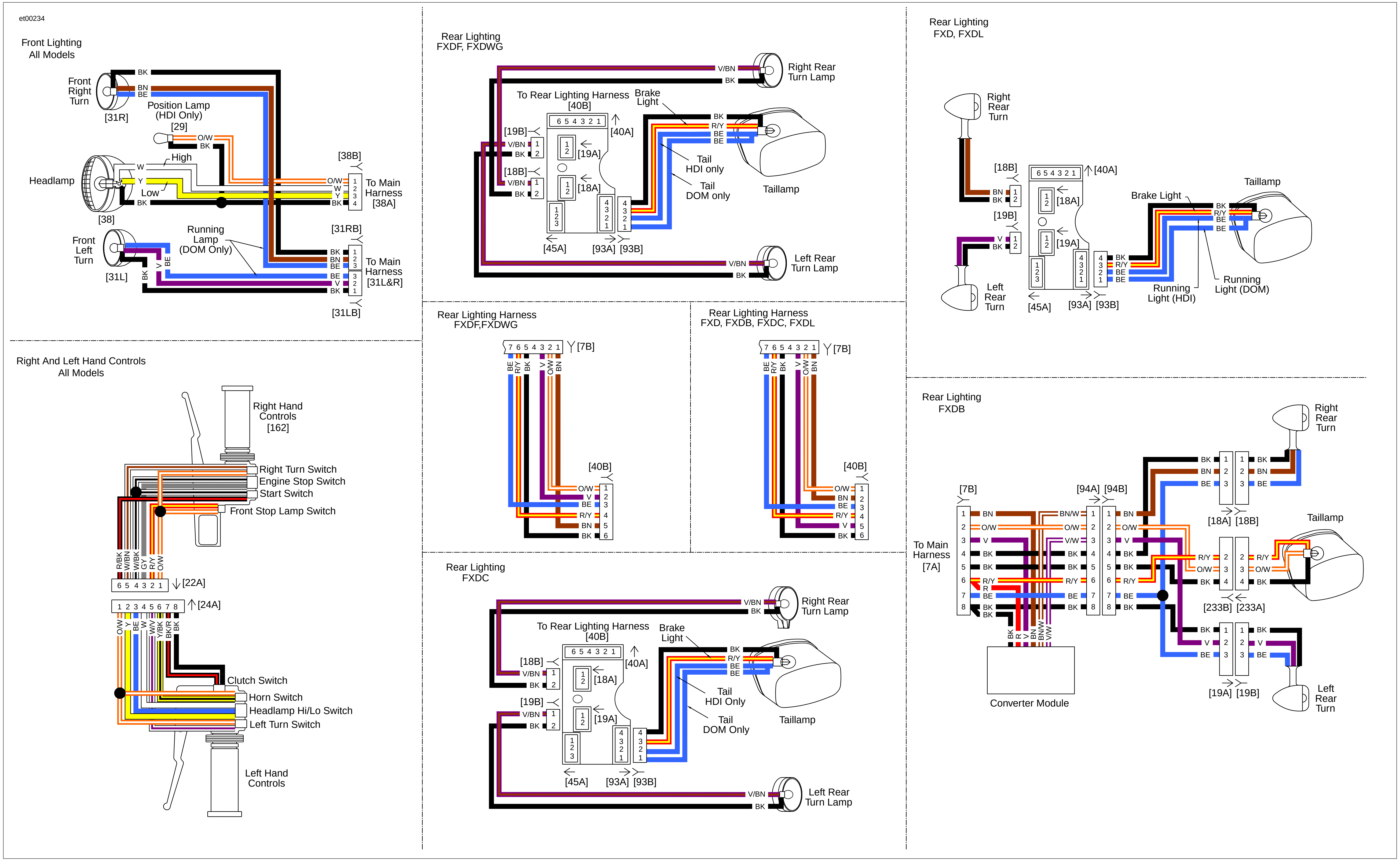


Figure B-16. Lighting, Hand Controls, and Adapter Harnesses: 2010 Dyna

Figure B-16.
Lighting, Hand Controls, and Adapter Harnesses: 2010 Dyna

Figure B-16.
Lighting, Hand Controls, and Adapter Harnesses: 2010 Dyna

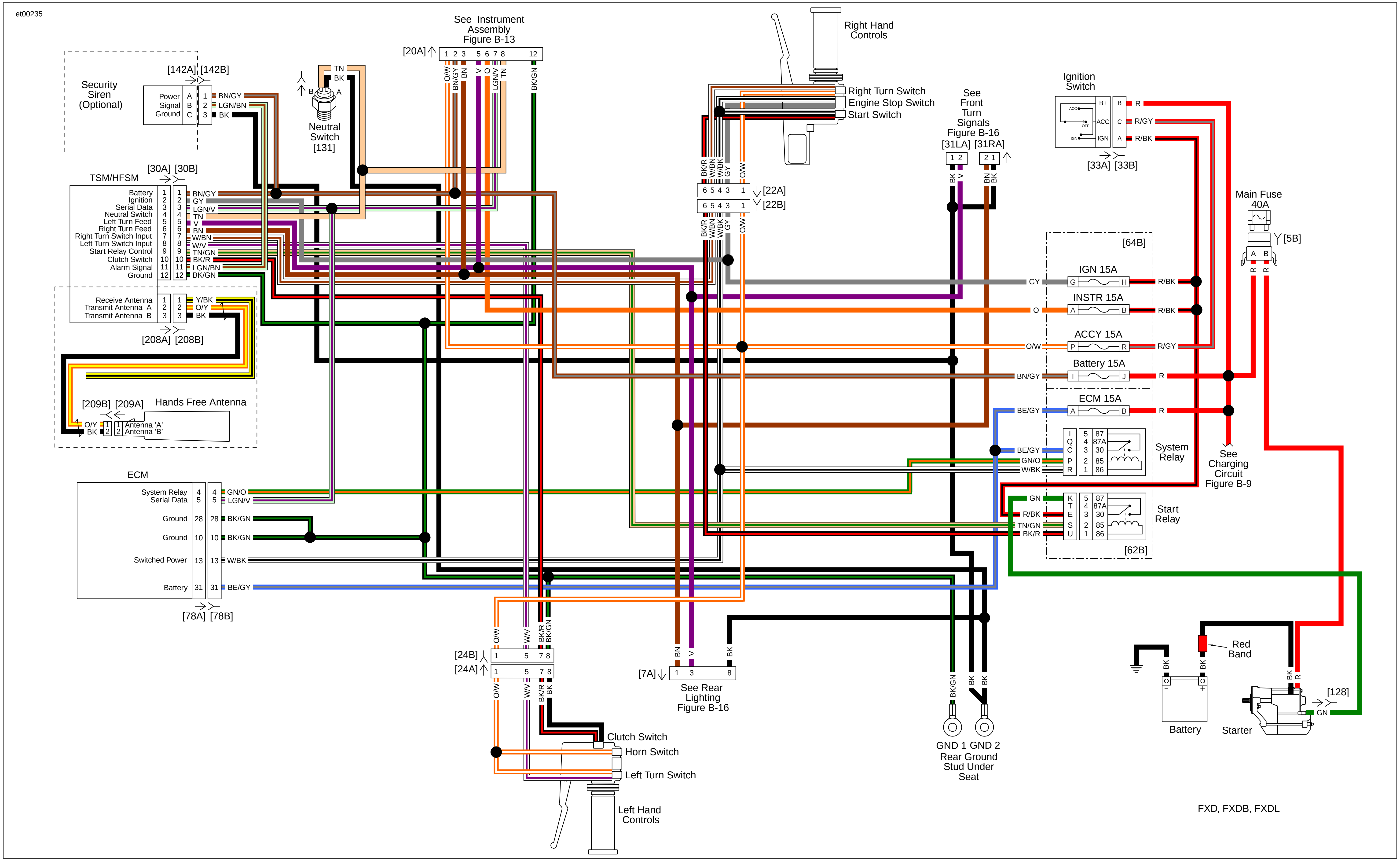


Figure B-17. Security Circuit: 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-17.
Security Circuit: 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-17.
Security Circuit: 2010 Dyna (FXD, FXDB, and FXDL)

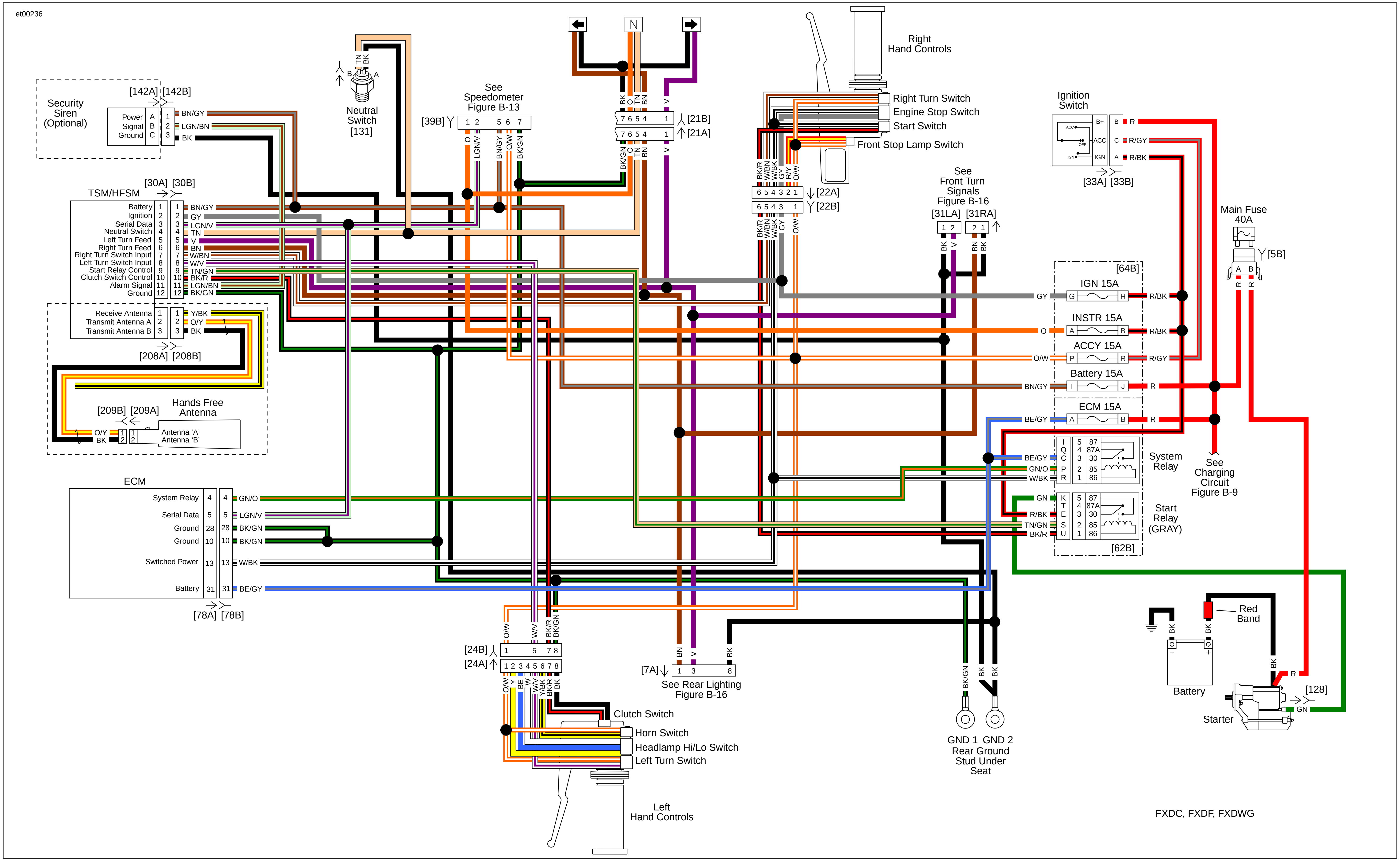


Figure B-18. Security Circuit: 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-18.
Security Circuit: 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-18.
Security Circuit: 2010 Dyna (FXDC, FXDF, and FXDWG)

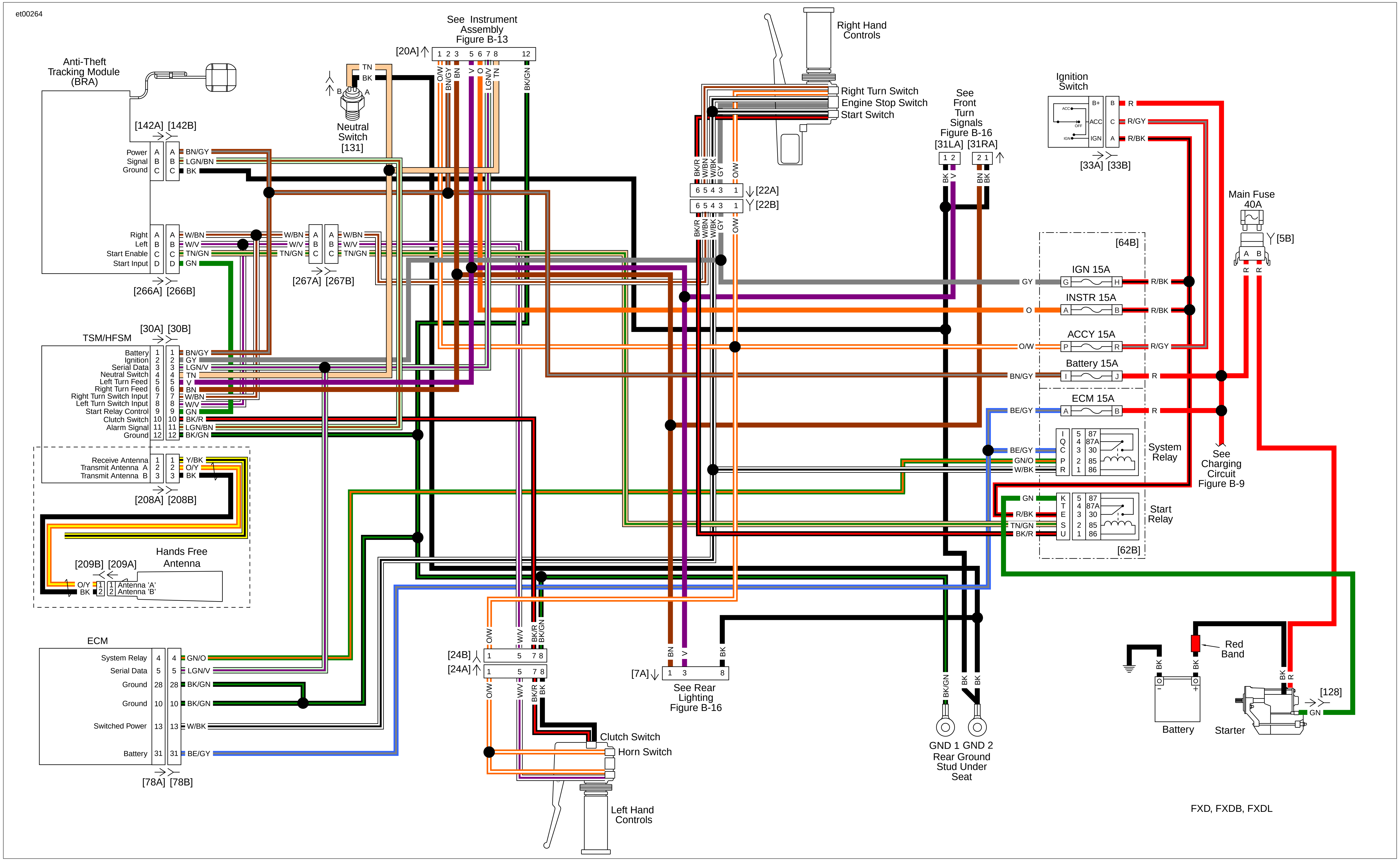


Figure B-19. Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-19.
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXD, FXDB, and FXDL)

Figure B-19.
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXD, FXDB, and FXDL)

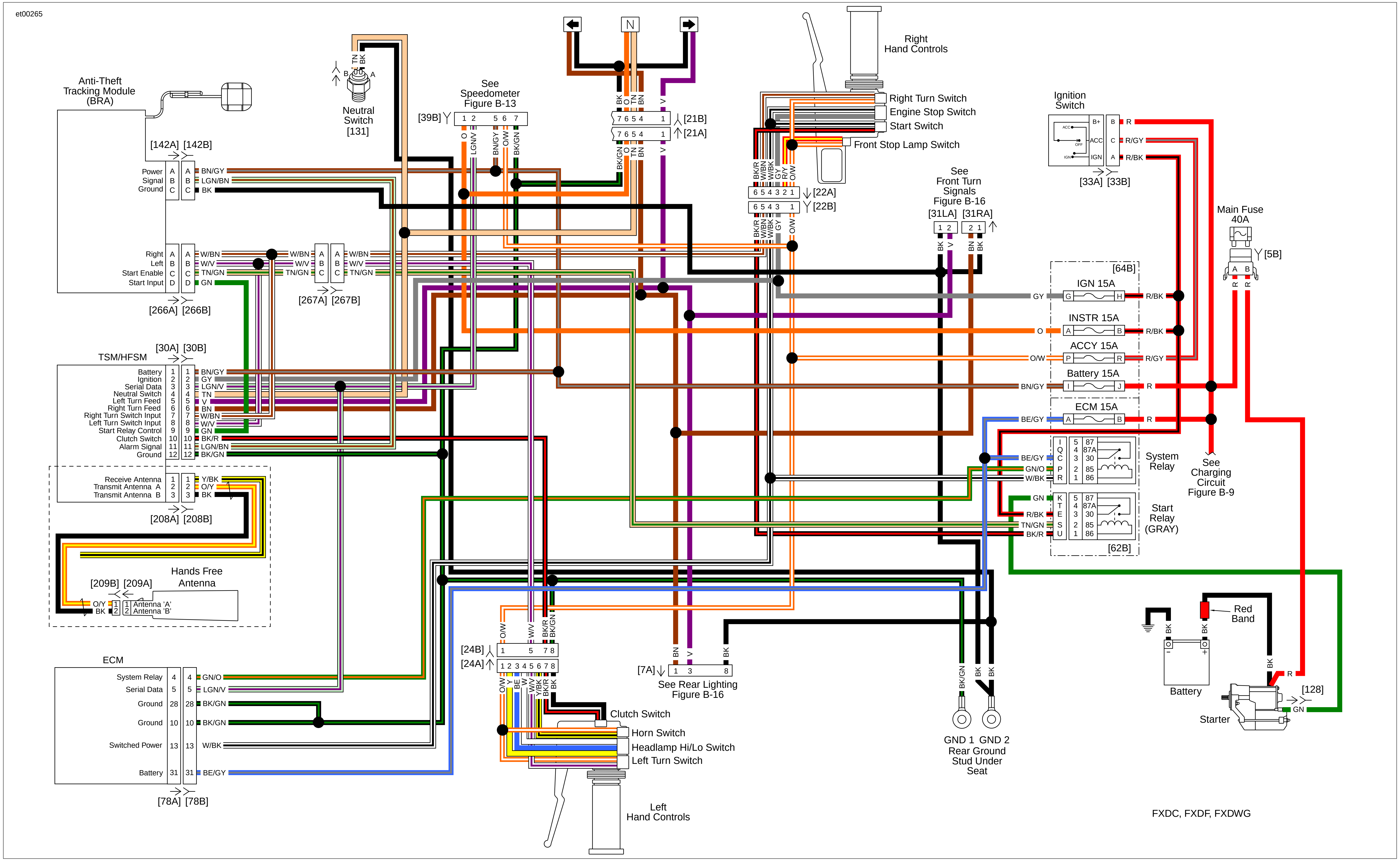


Figure B-20. Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-20.
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXDC, FXDF, and FXDWG)

Figure B-20.
Security Circuit, Anti-Theft Tracking Module (BRA): 2010 Dyna (FXDC, FXDF, and FXDWG)

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METRIC CONVERSION C.1

CONVERSION TABLE

Table C-1. Metric Conversions

MILLIMETERS to INCHES (MM x 0.03937 = IN)								INCHES to MILLIMETERS (IN x 25.40 = MM)							
mm	in	mm	in	mm	in	mm	in	in	mm	in	mm	in	mm	in	mm
.1	.0039	25	.9842	58	2.283	91	3.582	.001	.025	.6	15.240	1-15/16	49.21	3-5/16	84.14
.2	.0078	26	1.024	59	2.323	92	3.622	.002	.051	5/8	15.875	2	50.80	3-3/8	85.72
.3	.0118	27	1.063	60	2.362	93	3.661	.003	.076	11/16	17.462	2-1/16	52.39	3.4	86.36
.4	.0157	28	1.102	61	2.401	94	3.701	.004	.102	.7	17.780	2.1	53.34	3-7/16	87.31
.5	.0197	29	1.142	62	2.441	95	3.740	.005	.127	3/4	19.050	2-1/8	53.97	3-1/2	88.90
.6	.0236	30	1.181	63	2.480	96	3.779	.006	.152	.8	20.320	2-3/16	55.56	3-9/16	90.49
.7	.0275	31	1.220	64	2.519	97	3.819	.007	.178	13/16	20.638	2.2	55.88	3.6	91.44
.8	.0315	32	1.260	65	2.559	98	3.858	.008	.203	7/8	22.225	2-1/4	57.15	3-5/8	92.07
.9	.0354	33	1.299	66	2.598	99	3.897	.009	.229	.9	22.860	2.3	58.42	3-11/16	93.66
1	.0394	34	1.338	67	2.638	100	3.937	.010	.254	15/16	23.812	2-5/16	58.74	3.7	93.98
2	.0787	35	1.378	68	2.677	101	3.976	1/64	.397	1	25.40	2-3/8	60.32	3-3/4	95.25
3	.1181	36	1.417	69	2.716	102	4.016	.020	.508	1-1/16	26.99	2.4	60.96	3.8	96.52
4	.1575	37	1.456	70	2.756	103	4.055	.030	.762	1.1	27.94	2-7/16	61.91	3-13/16	96.84
5	.1968	38	1.496	71	2.795	104	4.094	1/32	.794	1-1/8	28.57	2-1/2	63.50	3-7/8	98.42
6	.2362	39	1.535	72	2.834	105	4.134	.040	1.016	1-3/16	30.16	2-9/16	65.09	3.9	99.06
7	.2756	40	1.575	73	2.874	106	4.173	.050	1.270	1.2	30.48	2.6	66.04	3-15/16	100.01
8	.3149	41	1.614	74	2.913	107	4.212	.060	1.524	1-1/4	31.75	2-5/8	66.67	4	101.6
9	.3543	42	1.653	75	2.953	108	4.252	1/16	1.588	1.3	33.02	2-11/16	68.26	4-1/16	102.19
10	.3937	43	1.693	76	2.992	109	4.291	.070	1.778	1-5/16	33.34	2.7	68.58	4.1	104.14
11	.4331	44	1.732	77	3.031	110	4.331	.080	2.032	1-3/8	34.92	2-3/4	69.85	4-1/8	104.77
12	.4724	45	1.772	78	3.071	111	4.370	.090	2.286	1.4	35.56	2.8	71.12	4-3/16	106.36
13	.5118	46	1.811	79	3.110	112	4.409	.1	2.540	1-7/16	36.51	2-13/16	71.44	4.2	106.68
14	.5512	47	1.850	80	3.149	113	4.449	1/8	3.175	1-1/2	38.10	2-7/8	73.02	4-1/4	107.95
15	.5905	48	1.890	81	3.189	114	4.488	3/16	4.762	1-9/16	39.69	2.9	73.66	4.3	109.22
16	.6299	49	1.929	82	3.228	115	4.527	.2	5.080	1.6	40.64	2-15/16	74.61	4-5/16	109.54
17	.6693	50	1.968	83	3.268	116	4.567	1/4	6.350	1-5/8	41.27	3	76.20	4-3/8	111.12
18	.7086	51	2.008	84	3.307	117	4.606	.3	7.620	1-11/16	42.86	3-1/16	77.79	4.4	111.76
19	.7480	52	2.047	85	3.346	118	4.645	5/16	7.938	1.7	43.18	3.1	78.74	4-7/16	112.71
20	.7874	53	2.086	86	3.386	119	4.685	3/8	9.525	1-3/4	44.45	3-1/8	79.37	4-1/2	114.30
21	.8268	54	2.126	87	3.425	120	4.724	.4	10.160	1.8	45.72	3-3/16	80.96	4-9/16	115.89
22	.8661	55	2.165	88	3.464	121	4.764	7/16	11.112	1-13/16	46.04	3.2	81.28	4.6	116.84
23	.9055	56	2.205	89	3.504	122	4.803	1/2	12.700	1-7/8	47.62	3-1/4	82.55	4-5/8	117.47
24	.9449	57	2.244	90	3.543	123	4.842	9/16	14.288	1.9	48.26	3.3	83.82	4-11/16	119.06

FLUID CONVERSIONS C.2

UNITED STATES SYSTEM

Unless otherwise specified, all fluid volume measurements in this Service Manual are expressed in United States (U.S.) units-of-measure. See below:

- 1 pint (U.S.) = 16 fluid ounces (U.S.)
- 1 quart (U.S.) = 2 pints (U.S.) = 32 fl. oz. (U.S.)
- 1 gallon (U.S.) = 4 quarts (U.S.) = 128 fl. oz. (U.S.)

METRIC SYSTEM

Fluid volume measurements in this Service Manual include the metric system equivalents. In the metric system, 1 liter (L) = 1,000 milliliters (mL). Should you need to convert from U.S. units-of-measure to metric units-of-measure (or vice versa), refer to the following:

- fluid ounces (U.S.) x 29.574 = milliliters
- pints (U.S.) x 0.473 = liters
- quarts (U.S.) x 0.946 = liters
- gallons (U.S.) x 3.785 = liters
- milliliters x 0.0338 = fluid ounces (U.S.)
- liters x 2.114 = pints (U.S.)
- liters x 1.057 = quarts (U.S.)
- liters x 0.264 = gallons (U.S.)

BRITISH IMPERIAL SYSTEM

Fluid volume measurements in this Service Manual do not include the British Imperial (Imp.) system equivalents. The following conversions exist in the British Imperial system:

- 1 pint (Imp.) = 20 fluid ounces (Imp.)
- 1 quart (Imp.) = 2 pints (Imp.)
- 1 gallon (Imp.) = 4 quarts (Imp.)

Although the same unit-of-measure terminology as the U.S. system is used in the British Imperial (Imp.) system, the actual volume of each British Imperial unit-of-measure differs from its U.S. counterpart. The U.S. fluid ounce is larger than the British Imperial fluid ounce. However, the U.S. pint, quart, and gallon are smaller than the British Imperial pint, quart, and gallon, respectively. Should you need to convert from U.S. units to British Imperial units (or vice versa), refer to the following:

- fluid ounces (U.S.) x 1.042 = fluid ounces (Imp.)
- pints (U.S.) x 0.833 = pints (Imp.)
- quarts (U.S.) x 0.833 = quarts (Imp.)
- gallons (U.S.) x 0.833 = gallons (Imp.)
- fluid ounces (Imp.) x 0.960 = fluid ounces (U.S.)
- pints (Imp.) x 1.201 = pints (U.S.)
- quarts (Imp.) x 1.201 = quarts (U.S.)
- gallons (Imp.) x 1.201 = gallons (U.S.)

TORQUE CONVERSIONS C.3

UNITED STATES SYSTEM

The U.S. units of torque, foot pounds and inch pounds, are used in this service manual. To convert units, use the following equations:

- foot pounds (ft-lbs) X 12.00000 = inch pounds (**in-lbs**).
- inch pounds (**in-lbs**) X 0.08333 = foot pounds (ft-lbs).

METRIC SYSTEM

All metric torque specifications are written in Newton-meters (Nm). To convert metric to United States units and United States to metric, use the following equations:

- Newton meters (Nm) X 0.737563 = foot pounds (ft-lbs).
- Newton meters (Nm) X 8.85085 = inch pounds (**in-lbs).**
- foot pounds (ft-lbs) X 1.35582 = Newton meters (Nm).
- inch pounds (**in-lbs**) X 0.112985 = Newton meters (Nm).

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GLOSSARY D.1

ACRONYMS AND ABBREVIATIONS

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
A	Amperes
ABS	Anti-lock Braking System
Ah	Ampere-hour
AC	Alternating Current
ACC	Accessory position on ignition switch
ACR	Automatic compression release
AIS	Active Intake Solenoid
AGM	Absorbed Glass Mat (battery)
AWG	American Wire Gauge
B+	Battery voltage
bar	Bar
BAS	Bank angle sensor
BTDC	Before top dead center
°C	Celsius (Centigrade)
CA	California
CAL	Calibration
CAN	Controller area network
cc	Cubic Centimeters
cm	Centimeters
cm^3	Cubic centimeters
CCA	Cold Cranking Amps
CKP	Crankshaft position
cm	Centimeter
CCW	Counterclockwise
CW	Clockwise
DC	Direct current
DLC	Data link connector
DOM	Domestic
DTC	Diagnostic Trouble Code
DOT	Department of Transportation
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
ET	Engine Temperature
EVAP	Evaporative Emissions Control System
°F	Fahrenheit
FPS	Fuel Pressure Sensor

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
ft	Foot
ft-lbs	Foot-Pounds
fl oz	Fluid Ounce
g	Gram
gal	Gallon
GAWR	Gross axle weight rating
GPS	Global Positioning System
GND	Ground (electrical)
GVWR	Gross vehicle weight rating
HCU	Hydraulic control unit
HDI	Harley-Davidson International
H-DSSS	Harley-Davidson Smart Security System
HFSM	Hands-Free Security Module
Hg	Mercury
H02S	Heated oxygen sensor
hp	Horsepower
hr	Hour
IAC	Idle Air Control
IAT	Intake Air Temperature
IC	Instrument Cluster
ID	Inside diameter
IGN	Ignition light/key switch position
in	Inch
in^3	Cubic inch
INJ PW	Injector pulse width
in-lbs	Inch-pounds
JSS	Jiffy stand sensor
kg	Kilogram
km	Kilometer
kPa	Kilopascal
km/h	Kilometers per hour
kW	Kilowatt
L	Liter
lb	Pounds
LCD	Liquid crystal display
LED	Light emitting diode
L	Liter
mA	Milliampere
MAP	Manifold absolute pressure
max	Maximum
mi	Mile
ml	Milliliter
min	Minimum

Table D-1. Acronyms and Abbreviations

ACRONYM OR ABBREVIATION	DESCRIPTION
mL	Milliliter
mm	Millimeter
mph	Miles per hour
ms	millisecond
Nm	Newton-meter
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
psi	Pounds per square inch
PWM signal	Pulse Width Modulated signal
qt	Quart
RCM	Reverse control module
RES	Reserve mark on fuel supply valve
RPM	Revolutions per minute
s	seconds
SCFH	Cubic feet per hour at standard conditions
TCA	Throttle control actuator
TDC	Top dead center
TGS	Twist grip sensor
TMAP	Intake Air Temperature/Manifold Absolute Pressure
TPS	Throttle Position Sensor
TSM	Turn Signal Module
TSSM	Turn Signal/Security Module
V	Volt
VAC	Volts of alternating current
VDC	Volts of direct current
VIN	Vehicle identification number
VSS	Vehicle speed sensor
W	Watt
WSS	Wheel speed sensor

NOTES

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-23738	VACUUM PUMP	6.4 DTC P0107, P0108, Description and Operation
HD-25070	ROBINAIR HEAT GUN	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-26792	SPARK TESTER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-26792	SPARK TESTER	6.22 ENGINE CRANKS, BUT WILL NOT START, Engine Cranks but Will Not Start
HD-26792	SPARK TESTER	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-34730-2D	FUEL INJECTOR TEST LIGHT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-34730-2D	FUEL INJECTOR TEST LIGHT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-34730-2D	FUEL INJECTOR TEST LIGHT	5.4 TURN SIGNALS, One Turn Signal Lamp Inoperative, No DTCs
HD-34730-2D	FUEL INJECTOR TEST LIGHT	6.9 DTC P0261, P0262, P0263, P0264, DTC P0261
HD-34730-2D	FUEL INJECTOR TEST LIGHT	6.9 DTC P0261, P0262, P0263, P0264, DTC P0263
HD-34730-2D	FUEL INJECTOR TEST LIGHT	6.17 DTC P1351, P1352, P1354, P1355, DTC P1351
HD-34730-2D	FUEL INJECTOR TEST LIGHT	6.17 DTC P1351, P1352, P1354, P1355, DTC P1354
HD-38125-6	PACKARD TERMINAL CRIMP TOOL	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.6 DEUTSCH MINI-TERMINAL CRIMPS, Deutsch Mini Terminal Crimps
HD-38125-7	PACKARD TERMINAL CRIMPER	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.14 METRI-PACK TERMINALS, Metri-Pack Terminal Crimps
HD-38125-8	PACKARD CRIMPING TOOL	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39965-A	DEUTSCH TERMINAL CRIMP TOOL	A.5 DEUTSCH STANDARD TERMINALS, Deutsch Standard Terminal Crimps
HD-39969	ULTRA TORCH UT-100	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-39978	DIGITAL MULTIMETER (FLUKE 78)	1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-41183	HEAT SHIELD ATTACHMENT	A.18 SEALED SPLICE CONNECTORS, Sealed Splice Connector Repair
HD-41199-3	IAC TEST LIGHT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41199-3	IAC TEST LIGHT	6.12 DTC P0505, DTC P0505
HD-41404-B	HARNESS CONNECTOR TEST KIT	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-41404-B	HARNESS CONNECTOR TEST KIT	2.4 DTC U1300, U1301 OR BUS ER, DTC U1301

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.2 STARTING SYSTEM, Starter Testing
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.2 STARTING SYSTEM, Start Relay Clicks
HD-41404-B	HARNESS CONNECTOR TEST KIT	3.6 DTC B0563, P0562, P0563, DTC P0562
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.2 DTC B1004, B1005, DTC B1004
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.2 DTC B1004, B1005, DTC B1005
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-41404-B	HARNESS CONNECTOR TEST KIT	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.4 TURN SIGNALS, Both Turn Signal Lamps on One Side Inoperative, No DTCs
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.4 TURN SIGNALS, Both Turn Signal Lamps on One Side Inoperative, No DTCs
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.4 TURN SIGNALS, One Turn Signal Lamp Inoperative, No DTCs
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1121: TSM/TSSM
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1122: TSM/TSSM
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1123
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1124
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1125
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1126
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.9 DTC B1135, B1136, B1141, B1142, DTC B1141
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.14 FAILS TO DISARM, Fails to Disarm: HFSM
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.15 DTC B1131, B1132, DTC B1131
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.15 DTC B1131, B1132, DTC B1131
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.15 DTC B1131, B1132, DTC B1132
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.16 DTC B1134, DTC B1134
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.18 DTC B1154, B1155, DTC B1154
HD-41404-B	HARNESS CONNECTOR TEST KIT	5.18 DTC B1154, B1155, DTC B1155
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.4 DTC P0107, P0108, DTC P0107
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.5 DTC P0112, P0113, DTC P0112
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.5 DTC P0112, P0113, DTC P0113
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.6 DTC P0117, P0118, DTC P0117
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.6 DTC P0117, P0118, DTC P0118
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.6 DTC P0117, P0118, DTC P0118
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, DTC P0134
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, DTC P0151
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.11 DTC P0501, P0502, DTC P0501

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.11 DTC P0501, P0502, DTC P0502
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.14 DTC P0661, P0662, DTC P0661, P0662
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.17 DTC P1351, P1352, P1354, P1355, DTC P1351
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.17 DTC P1351, P1352, P1354, P1355, DTC P1352
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.17 DTC P1351, P1352, P1354, P1355, DTC P1355
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.18 DTC P1353, P1356, P1357, P1358, DTC P1357 and P1358
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.18 DTC P1353, P1356, P1357, P1358, DTC P1357 and P1358
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.19 DTC P1475, P1477, P1478, DTC P1475
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.19 DTC P1475, P1477, P1478, DTC P1475
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.19 DTC P1475, P1477, P1478, DTC P1477
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.19 DTC P1475, P1477, P1478, DTC P1478
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.20 DTC P1501, P1502, DTC P1501
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.23 NO ECM POWER, No ECM Power
HD-41404-B	HARNESS CONNECTOR TEST KIT	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-41475	DEUTSCH CONNECTOR SERVICE KIT	A.4 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41475-100	FLAT BLADE L-HOOK	A.4 DEUSCH ELECTRICAL CONNECTORS, Deutsch Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-41609	AMP MULTILOCK CRIMPER	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
HD-42682	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-42682	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-42682	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-42682	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-42682	BREAKOUT BOX	2.4 DTC U1300, U1301 OR BUS ER, DTC U1300
HD-42682	BREAKOUT BOX	2.4 DTC U1300, U1301 OR BUS ER, DTC U1301
HD-42682	BREAKOUT BOX	3.2 STARTING SYSTEM, Nothing Clicks
HD-42682	BREAKOUT BOX	4.2 DTC B1004, B1005, DTC B1004
HD-42682	BREAKOUT BOX	4.2 DTC B1004, B1005, DTC B1005
HD-42682	BREAKOUT BOX	4.4 NO INSTRUMENT POWER, Speedometer Inoperative

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-42682	BREAKOUT BOX	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-42682	BREAKOUT BOX	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-42682	BREAKOUT BOX	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-42682	BREAKOUT BOX	5.4 TURN SIGNALS, Both Turn Signal Lamps on One Side Inoperative, No DTCs
HD-42682	BREAKOUT BOX	5.4 TURN SIGNALS, Both Turn Signal Lamps on One Side Inoperative, No DTCs
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1121: HFSM
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1121: TSM/TSSM
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1122: TSM/TSSM
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1124
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1125
HD-42682	BREAKOUT BOX	5.8 DTC B1121, B1122, B1123, B1124, B1125, B1126, DTC B1126
HD-42682	BREAKOUT BOX	5.9 DTC B1135, B1136, B1141, B1142, DTC B1141
HD-42682	BREAKOUT BOX	5.13 SERVICE AND EMERGENCY FUNCTIONS AND CONFIGURATIONS, Power Disruption and Configuring: HFSM
HD-42682	BREAKOUT BOX	5.15 DTC B1131, B1132, DTC B1131
HD-42682	BREAKOUT BOX	5.15 DTC B1131, B1132, DTC B1131
HD-42682	BREAKOUT BOX	5.15 DTC B1131, B1132, DTC B1132
HD-42682	BREAKOUT BOX	5.15 DTC B1131, B1132, DTC B1132
HD-42682	BREAKOUT BOX	5.18 DTC B1154, B1155, DTC B1154
HD-42682	BREAKOUT BOX	5.18 DTC B1154, B1155, DTC B1155
HD-42879	ELECTRICAL CRIMPER TOOL	A.7 DEUTSCH SOLID BARREL TERMINALS, Deutsch Solid Barrel Terminal Crimps
HD-43876	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-43876	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-43876	BREAKOUT BOX	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-43876	BREAKOUT BOX	1.3 DIAGNOSTICS AND TROUBLESHOOTING, Wiggle Test
HD-43876	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-43876	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255
HD-43876	BREAKOUT BOX	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-43876	BREAKOUT BOX	3.6 DTC B0563, P0562, P0563, DTC P0562
HD-43876	BREAKOUT BOX	6.4 DTC P0107, P0108, DTC P0107
HD-43876	BREAKOUT BOX	6.5 DTC P0112, P0113, DTC P0112

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-43876	BREAKOUT BOX	6.5 DTC P0112, P0113, DTC P0113
HD-43876	BREAKOUT BOX	6.6 DTC P0117, P0118, DTC P0117
HD-43876	BREAKOUT BOX	6.6 DTC P0117, P0118, DTC P0118
HD-43876	BREAKOUT BOX	6.7 DTC P0122, P0123, DTC P0122
HD-43876	BREAKOUT BOX	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, DTC P0131
HD-43876	BREAKOUT BOX	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, DTC P0134
HD-43876	BREAKOUT BOX	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, DTC P0151
HD-43876	BREAKOUT BOX	6.9 DTC P0261, P0262, P0263, P0264, DTC P0261
HD-43876	BREAKOUT BOX	6.9 DTC P0261, P0262, P0263, P0264, DTC P0263
HD-43876	BREAKOUT BOX	6.11 DTC P0501, P0502, DTC P0501
HD-43876	BREAKOUT BOX	6.11 DTC P0501, P0502, DTC P0502
HD-43876	BREAKOUT BOX	6.12 DTC P0505, DTC P0505
HD-43876	BREAKOUT BOX	6.16 DTC P1001, P1002, P1003, P1004, DTC P1001
HD-43876	BREAKOUT BOX	6.17 DTC P1351, P1352, P1354, P1355, DTC P1351
HD-43876	BREAKOUT BOX	6.17 DTC P1351, P1352, P1354, P1355, DTC P1354
HD-43876	BREAKOUT BOX	6.18 DTC P1353, P1356, P1357, P1358, DTC P1357 and P1358
HD-43876	BREAKOUT BOX	6.18 DTC P1353, P1356, P1357, P1358, DTC P1357 and P1358
HD-43876	BREAKOUT BOX	6.19 DTC P1475, P1477, P1478, DTC P1475
HD-43876	BREAKOUT BOX	6.19 DTC P1475, P1477, P1478, DTC P1475
HD-43876	BREAKOUT BOX	6.19 DTC P1475, P1477, P1478, DTC P1477
HD-43876	BREAKOUT BOX	6.19 DTC P1475, P1477, P1478, DTC P1478
HD-43876	BREAKOUT BOX	6.20 DTC P1501, P1502, DTC P1501
HD-43876	BREAKOUT BOX	6.23 NO ECM POWER, No ECM Power
HD-43876	BREAKOUT BOX	6.26 MISFIRE AT IDLE OR UNDER LOAD, Misfire At Idle or Under Load
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-44687	IGNITION COIL CIRCUIT TEST ADAPTER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-45928	PACKARD MICRO-64 TERMINAL REMOVER	A.17 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair
HD-45929	PACKARD MICRO-64 TERMINAL CRIMPER	A.17 PACKARD MICRO-64 CONNECTORS, Packard Micro-64 Connector Repair
HD-46601	BREAKOUT BOX ADAPTERS	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-46601	BREAKOUT BOX ADAPTERS	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1016
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1064, U1255

Tools Used in This Manual

PART NUMBER	TOOL NAME	NOTES
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-46601	BREAKOUT BOX ADAPTERS	2.3 DTC U1016, U1064, U1097, U1255, DTC U1097, U1255
HD-46601	BREAKOUT BOX ADAPTERS	2.4 DTC U1300, U1301 OR BUS ER, DTC U1300
HD-46601	BREAKOUT BOX ADAPTERS	2.4 DTC U1300, U1301 OR BUS ER, DTC U1301
HD-46601	BREAKOUT BOX ADAPTERS	4.2 DTC B1004, B1005, DTC B1004
HD-46601	BREAKOUT BOX ADAPTERS	4.2 DTC B1004, B1005, DTC B1005
HD-46601	BREAKOUT BOX ADAPTERS	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-46601	BREAKOUT BOX ADAPTERS	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-46601	BREAKOUT BOX ADAPTERS	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-46601	BREAKOUT BOX ADAPTERS	4.4 NO INSTRUMENT POWER, Speedometer Inoperative
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-48053	ADVANCED BATTERY CONDUCTANCE AND ELECTRICAL SYSTEM ANALYZER	3.1 BATTERY TESTING, Conductance Test
HD-48114	MOLEX ELECTRICAL CONNECTOR TERMINAL REMOVER	A.15 MOLEX CONNECTORS, Molex Connector Repair
HD-48650	DIGITAL TECHNICIAN II	1.2 DIAGNOSTIC TOOLS, How To Use Diagnostic Tools
HD-48650	DIGITAL TECHNICIAN II	1.3 DIAGNOSTICS AND TROUBLESHOOTING, Job/Time Codes Values
HD-48650	DIGITAL TECHNICIAN II	5.10 SECURITY SYSTEM, TSSM/HFSM Features
HD-48650	DIGITAL TECHNICIAN II	6.8 DTC P0131, P0132, P0134, P0151, P0152, P0154, Description and Operation
HD-48650	DIGITAL TECHNICIAN II	6.12 DTC P0505, Description and Operation
SNAP-ON TT600-3	SNAP-ON PICK	A.1 AMP MULTILOCK CONNECTORS, AMP Multilock Connector Repair
SNAP-ON TT600-3	SNAP-ON PICK	A.12 630 METRI-PACK CONNECTORS, 630 Metri-Pack Connector Repair
YA840	SNAP-ON IN-LINE SPARK TESTER	6.26 MISFIRE AT IDLE OR UNDER LOAD, In-line Spark Tester

2010 Harley-Davidson Dyna Models Electrical Diagnostic Manual

FASTENER	TORQUE VALUE	NOTES
No torque values were found in this manual.		

NOTES

P

R

S

T

V

W

SkillsUSA
2012 Motorcycle Service Technology Contest

Written Test

Harley-Davidson 2010 FXD Electrical Diagnostic Manual

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MOTORCYCLE MECHANICS INSTITUTE

SkillsUSA
2012 Motorcycle Service Technology Contest
Written Test
Electrical Diagnostic Manual

Objective: This written test allows the participant to demonstrate knowledge of motorcycle service manuals and the ability to locate specific information contained in the manual provided.

Directions: Reference the provided 2010 Harley-Davidson FXD Electrical Diagnostic Manual (PN 99496-10) for all test questions and answers. Select the best answer for each question, and then fill in the appropriate letter's box on the answer sheet provided.

Read page I, "HOW TO USE YOUR SERVICE MANUAL"

1. The acronym DTC stands for__________.

A. Darn Tootin' Cool
B. Diagnostic Transportation Code
C. Diagnostic Temperature Code
D. Diagnostic Trouble Code
E. None of the above

2. The EFI system operates in _______ or __________ loop modes allowing the system to adjust for all possible operating conditions.

A. open, shorted
B. closed, grounded
C. open, closed
D. shorted, grounded
E. none of the above

3. The DTC with the highest Priority Order (1) is __________.

A. B1006
B. P1001
C. U1016
D. P0605
E. none of the above

4. A DTC P0505 Loss of Idle Speed Control could be set if the idle speed fluctuates __________ RPM from the preset idle speed for a period longer than 5 seconds with the IAC motor at zero or maximum.

A. +/- 100
B. +/- 200
C. +100
D. +2000
E. none of the above

5. When testing a Spark Plug Cable that is 7.4" long, a resistance (ohms) reading of __________ would indicate that the Spark Plug Cable is good.

A. 1.9K
B. 190.5
C. 1812K
D. 4750
E. 14.9K

6. The ET (Engine Temperature) sensor is a/an __________ device, which means that at a specific temperature it has a specific resistance across its terminals. As this resistance varies, so does the voltage.

A. potentiometer
B. Hall-effect
C. accelerometer
D. thermistor
E. pulse-width

7. When performing a Battery Voltage Test, a voltage reading of __________ would indicate that the battery has 75% state of charge.

A. 9.6
B. 12.0
C. 12.3
D. 12.6
E. 13.0

8. Typical starter motor current draw while on the motorcycle will range __________.

A. 160-200A
B. 180-220A
C. 160-200V
D. 180-220V
E. all are within range

9. The alternator consists of two main components:
The __________ which mounts to the primary side of the crankshaft.
The __________ which is attached to the crankcase half.

choose two (2) answers in the correct order

A. regulator
B. stator
C. rotor
D. generator
E. rectifier

10. Reference Figure 3-16 Charging System Circuit.
The 2010 FXD has a __________ charging system.

A. single phase
B. full wave
C. three phase
D. none of the above
E. all of the above

11. Loss of power on terminal __________, can cause the speedometer to be nonfunctional and the speedometer needle to freeze.

A. 1
B. 3
C. 5
D. 7
E. 9

12. Reference Figure 4-11 on pg 4-12.
The wire color at connector 21, pin 4 is _________.

A. TN (tan)
B. W (white)
C. BN (brown)
D. V (violet)
E. BK (black)

13. The Crank Position (CKP) sensor generates _________ as the teeth on the crankshaft pass by the sensor.

A. DC voltage
B. AC voltage
C. DC amps
D. AC resistance
E. ohms

14. Normal engine idle speed is _________ RPM.

A. 750-850
B. 850-950
C. 950-1050
D. 1050-1150
E. 1200

15. The possible causes for the oil pressure lamp to stay on are _________.

A. indicator malfunction
B. oil pressure switch malfunction
C. mechanical issue
D. short to ground in oil pressure circuit
E. all of the above
F. none of the above

16. Which of the following statements is correct when describing how a thermistor device functions?

A. At high temperatures, the resistance of the sensor is very low, which effectively lowers the signal voltage
B. At high temperatures, the resistance of the sensor is very high, which effectively lowers the signal voltage
C. At low temperatures, the resistance is very high, allowing the voltage to lower
D. At low temperatures, the resistance is very low, allowing the voltage to rise

17. All diagnostics described in the 2010 Harley-Davidson FXD Electrical Diagnostic Manual require the use of the Digital Technician II.

A. true
B. false

18. Locate Figure 6-4 Sensor Circuit for reference.
The BK/W (black/white) wire is a 5V sensor ground for __________ sensors.

A. 2
B. 4
C. 6
D. 8
E. 10

19. Special tool HD-41404-B is described as __________.

A. DEUTSCH CONNECTOR SERVICE KIT
B. HARNESS CONNECTOR TEST KIT
C. BREAKOUT BOX
D. ELECTRICAL CRIMPER TOOL
E. FLAT BLADE L-HOOK

20. Any vehicle sensor can cause the engine to shut down if the sensor fails.

A. true
B. False

The contestant will create an essay based on a single motorcycle experience or why he/she is interested in the motorcycle industry.

They must be able to communicate their thoughts clearly and on topic.

The essay must be hand written and legible.

There will not be any point deductions for spelling or grammar mistakes.

10 points for completion.

-5 points for illegible handwriting.