

Table 7-1. Battery Specifications

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

Table 7-2. Spark Plug Specifications

SPARK PLUGS		
Size	12 mm	
Type	10R12A	
Gap	0.035 in.	0.9mm
Torque	11-18 ft-lbs	15-24 Nm
Cable Resistance (front and rear)	1,430-3,360 ohms	

Table 7-3. Alternator Specifications

ALTERNATOR	
AC Voltage Output	16-20 VAC per 1000 engine RPM
Stator Coil Resistance	0.1-0.3 Ohms

Table 7-4. Regulator Specifications

REGULATOR	
Voltage Output @ 3600 RPM	14.4-14.6 VDC @ 75° F (24° C)
Amperes @ 3600 RPM	34-38 Amps

Table 7-5. Ignition Coil Specifications

IGNITION COIL RESISTANCE	
Primary Winding	0.5-0.7 ohms
Secondary Winding	5500-7500 ohms

Table 7-6. Electrical System Specifications

ELECTRICAL SYSTEM	AMPERES
Battery fuse	30
Ignition fuse	15
Light fuse	15
Accessory fuse	7.5
Brake/Horn fuse	15
ECM fuse	7.5
Key switch fuse	15
Cooling fan fuse	7.5

Table 7-7. Specifications

BULB CHART		BULBS REQUIRED	WATTS	AMPS	PART NUMBER
Headlights	Bulb (H7)	2	55	4.58	Y0148.1AD
	Position Lamp (European models only)	1	5	0.37	53436-97
Marker Lamps	Tail/Stop Lamp	1	25/8	1.85/0.59	68169-90A
	Turn Signal Lamp (front and rear (1 bulb each)	4	2.0	0.17	68968-99Y
	License plate illumination lamp	1	5	0.37	Y0514B.C
	License plate illumination lamp (European models only)	1	5	0.37	53436-97
Indicator Lamps, Speedometer and Tachometer Illumination	Indicator, Speedometer and Tachometer LED's are part of the instrument module and are not replaceable. Entire assembly must be replaced if LED fails.				

TORQUE VALUES

ITEM	TORQUE		NOTES
Battery (+) to starter fastener	60-85 in-lbs	7-10 Nm	page 7-32
Battery terminal fasteners	72-96 in-lbs	8-11 Nm	page, 7-38, 7-69
Handlebar control housing screws (right side)	25-33 in-lbs	3-4 Nm	longer screw on bottom, page 7-49
Horn fastener	72-96 in-lbs	8.1-10.8 Nm	page 7-59
Ignition switch body fastener	12-36 in-lbs	1.4-4.0 Nm	page 7-8
Ignition switch fastener	12-14 ft-lbs	16.3-19 Nm	LOCTITE 272 (Red), page 7-9
Instrument module fastener	12-36 in-lbs	1.4-4.0 Nm	page 7-51
Main battery ground	48-72 in-lbs	5.4-8.1 Nm	page 7-32
Neutral indicator switch	36-60 in-lbs	4-6.8 Nm	LOCTITE 243 (Blue), page 7-61
Rotor mounting fasteners	90-110 in-lbs	10-12 Nm	LOCTITE 243 (Blue), page 7-29
Spark plugs	11-18 ft-lbs	15-24 Nm	page 7-1
Stator TORX mounting screws	30-40 in-lbs	3-4 Nm	T-27 TORX with retaining compound, replace with new after each removal, page 7-29
Turn signal fastener (rear)	25-28 in-lbs	2.8-3.2 Nm	page 7-46
Turn signal fasteners (front)	25-28 in-lbs	2.8-3.2 Nm	page 7-46
Turn signal flasher fastener	30-40 in-lbs	3.4-4.5 Nm	page 7-47
Voltage regulator mounting screws	48-60 in-lbs	5.4-6.8 Nm	use new fasteners, page 7-30

GENERAL

The vehicle uses a breakerless inductive-discharge ignition system. The system has both a primary and secondary circuit. The primary circuit consists of the battery, main fuse, ignition switch, primary coil windings, computerized ignition timer and associated wiring. The secondary circuit consists of the secondary coil, spark plugs and associated wiring. See Figure 7-1.

DIGITAL TECHNICIAN (Part No. HD-44750) can access the information received by and stored in the electronic control module.

The electronic control module (ECM) is located under the seat. The module has three primary functions. First, it computes the spark advance for proper ignition timing based on sensor input. Second, it controls the independent, primary windings of the spark coil and is thus able to provide sequential and independent firing of the spark plugs (non waste spark). Third, it calculates the correct air/fuel ratio based on input from the sensors.

The electronic control module contains all the solid-state components used in the ignition system. The dwell time for the ignition coil is also calculated by the ECM microprocessor and is dependent upon battery voltage. The programmed dwell is an added feature to keep battery drain to a minimum and to adequately charge the coil 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 and oil. The module is not repairable. Replace the unit if it fails.

The ECM uses six different sensors to monitor rider demands and changing engine conditions. These sensors are:

- Throttle Position (TP) Sensor
- Cam Position (CMP) Sensor
- Intake Air Temperature (IAT) Sensor
- Engine Temperature (ET) Sensor
- Oxygen (O2) Sensor
- Bank Angle Sensor (BAS)

The ECM uses the information provided by the throttle position and cam position sensors to calculate how much air is entering the engine. The throttle position sensor monitors the amount of air entering the engine by how far the throttle is open, whether it is opening or closing and how fast it is opening or closing. The IAT sensor measures the temperature of the air entering the engine, providing the rest of the information necessary to determine the density of the air entering the engine. The ECM also monitors the cam position sensor to determine the exact position of both cylinders in the combustion cycle and the engine speed.

The ET sensor provides the ECM the current engine temperature. Proper fuel and spark delivery are dependent on the temperature of the engine. The ECM will provide a richer fuel mixture on start up and a higher degree of spark advance. As the vehicle warms up to operating temperature the fuel mixture will lean and the spark advance will decrease.

Cooling fan actuation is controlled by the ECM. With key ON, fan turns on when engine cylinder head temperature reaches 220° C (428° F) and shuts off when temperature reaches 180° C (356° F). With key OFF, fan turns on when engine temperature reaches 170° C (338° F) and shuts off when temperature reaches 150° C (302° F).

The information provided by the O2 sensor allows the ECM to ensure a proper air/fuel mixture by monitoring the final combustion efficiency in the exhaust system. This ensures optimum engine performance at any altitude or barometric pressure. The O2 sensor input to the ECM is required to ensure a stoichiometric (14.7:1) air/fuel ratio during closed loop operation.

The Bank Angle Sensor (BAS) provides input to the ECM on whether the vehicle lean is greater than predetermined bank angle limit. As long as lean angle does not exceed limit, fuel supply and ignition operation are unaffected. If the vehicle exceeds the predetermined bank angle limit, the BAS will interrupt the operation of the ignition system and fuel supply. To reset system, return vehicle to the upright position and switch key OFF.

The ECM-controlled ignition coil fires each spark plug independently on the compression stroke of each cylinder (no waste spark). The spark plug in the front cylinder fires at the end of that cylinder's compression stroke, thereby igniting the air/fuel mixture. The same sequence occurs at the end of the rear cylinder's compression stroke (thereby igniting the air/fuel mixture in the rear cylinder).

The rotor and cam position sensor are located in the gear-case cover on the right side of the motorcycle. The Cam position sensor consists of a Hall-effect device, magnet and plate. The plate is mounted over a rotating cup ("rotor cup"). The rotor cup is mounted on the camshaft and operates at one-half crankshaft speed. As the rotor cup turns inside the gear-case, six asymmetrical teeth on the rotor cup sequentially break the magnetic field between the magnet and the Hall-effect device. The edges of these teeth are cut to correspond to specific positions of the camshaft during the engine cycle such as TDC for the front cylinder. The output of the cam position sensor is used by the ECM to not only determine engine position, but also to calculate engine speed. This method of measuring camshaft position provides accurate information on engine position down to zero engine speed.

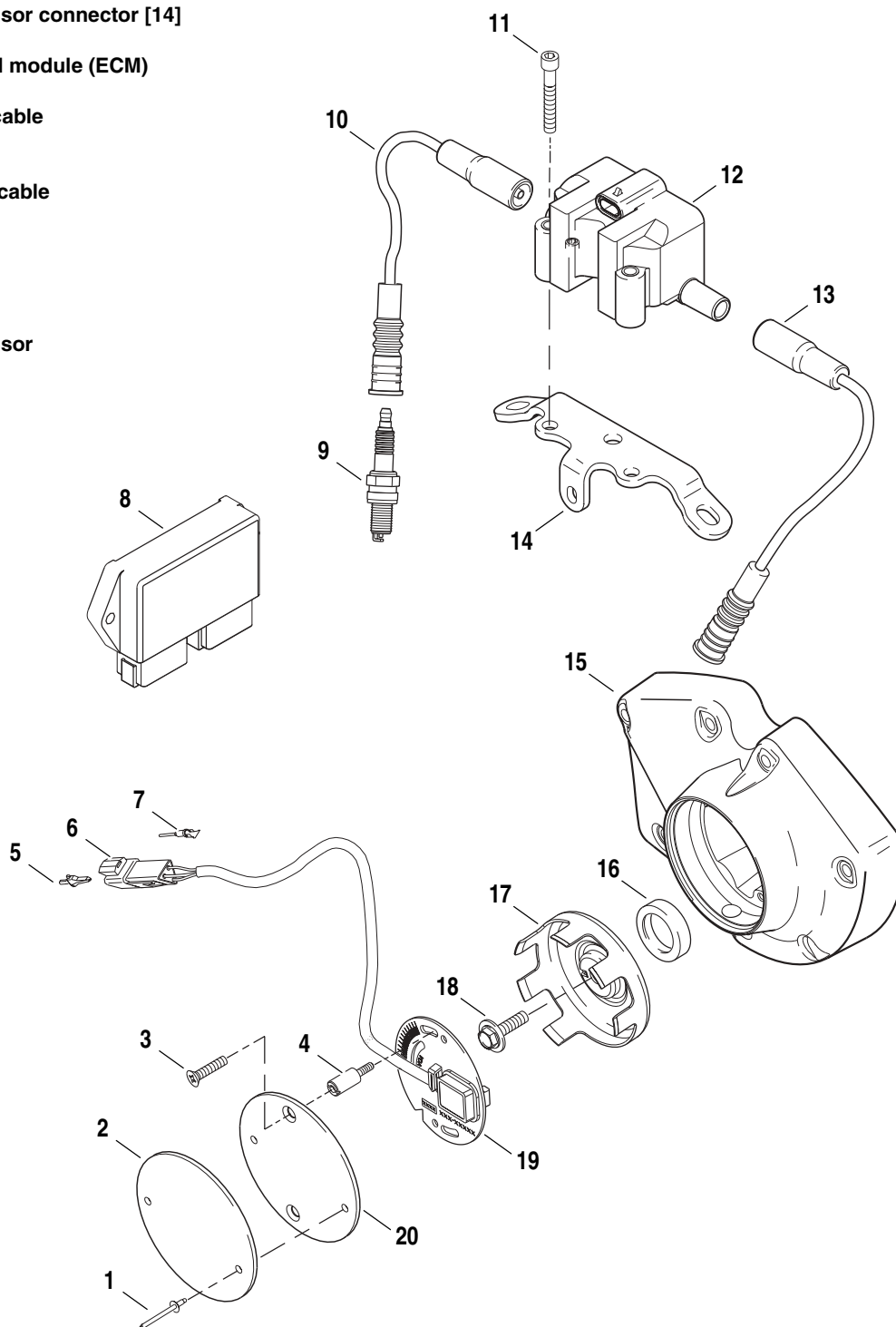
For more information on the sensors used in conjunction with the ECM see Section 4 Fuel System.

See the wiring diagrams in the Appendix for additional information on ignition system circuits.

TROUBLESHOOTING

See Section 4 Fuel System for troubleshooting information.

1. Pop rivet (2)
2. Timer cover
3. Screw (2)
4. Timer plate stud (2)
5. Secondary lock
6. Cam position sensor connector [14]
7. Terminal pin
8. Electronic control module (ECM)
9. Spark plug (2)
10. Rear spark plug cable
11. Fastener (2)
12. Ignition coil
13. Front spark plug cable
14. Engine mount
15. Gearcase cover
16. Seal
17. Trigger rotor
18. Trigger rotor bolt
19. Cam position sensor
20. Inner cover



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Figure 7-1. Ignition System Components

GENERAL

⚠ WARNING

DO NOT modify the ignition/headlight switch wiring to circumvent the automatic-on headlight feature. Visibility is a major concern for motorcyclists. Failure to have proper headlight operation could result in death or serious injury.

Switch positions are explained in [Table 7-8](#).

CAUTION

When turning off the ignition, verify that the key is removed in the OFF position and that the lights are not left on. If the rider stops the engine and inadvertently removes the key in the P position, the battery will be drained of its charge if the vehicle is left standing too long.

NOTE

The key locks the ignition system and is removable in both the LOCK and P positions. The P position is located counter-clockwise from the LOCK position and allows the rider to remove the key while leaving the lights on. When the key is placed in the P position, several indicator markers are or can be activated. Refer to [Table 7-9](#).

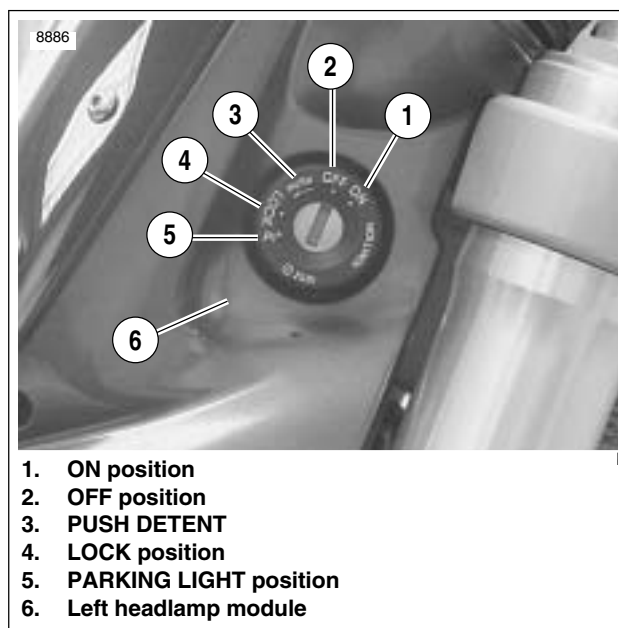


Figure 7-2. Ignition/Headlight Key Switch

Table 7-8. Ignition Key Switch Positions

LABEL	IGN.	LAMPS	REMOVE KEY
OFF	off	off	yes
P	off	See note & Table 7-9 .	yes
ON	on		no
LOCK	off	off	yes

Table 7-9. Indicator Markers

ITEM	P	ON
Headlight position marker (European models only)	on	on
Headlight high beam	off	can be activated
Headlight low beam	off	on
Instrument module illumination lamps	on	on
Stop lamp	on	can be activated
Front and rear turn signals	can be activated	
Horn	cannot be activated	can be activated

REMOVAL

1. Remove seat. See [2.41 SEAT](#).

WARNING

To protect against accidental start-up of vehicle, disconnect the negative battery cable before proceeding. Inadequate safety precautions could result in death or serious injury.

2. Disconnect negative battery cable.

3. Remove windscreen.
4. See [Figure 7-3](#). Disconnect:
 - Turn signal flasher [30]
 - Turn signals [31]
 - Left [24] and right [22] handlebar wiring harnesses
 - Instrument cluster [39]
 - Horn [122]
5. Remove horn (12) from horn mount (10).
6. Cut cable strap (7) that loosely holds main wiring harness (8) to the ignition switch (6) and disconnect ignition switch connector [33].

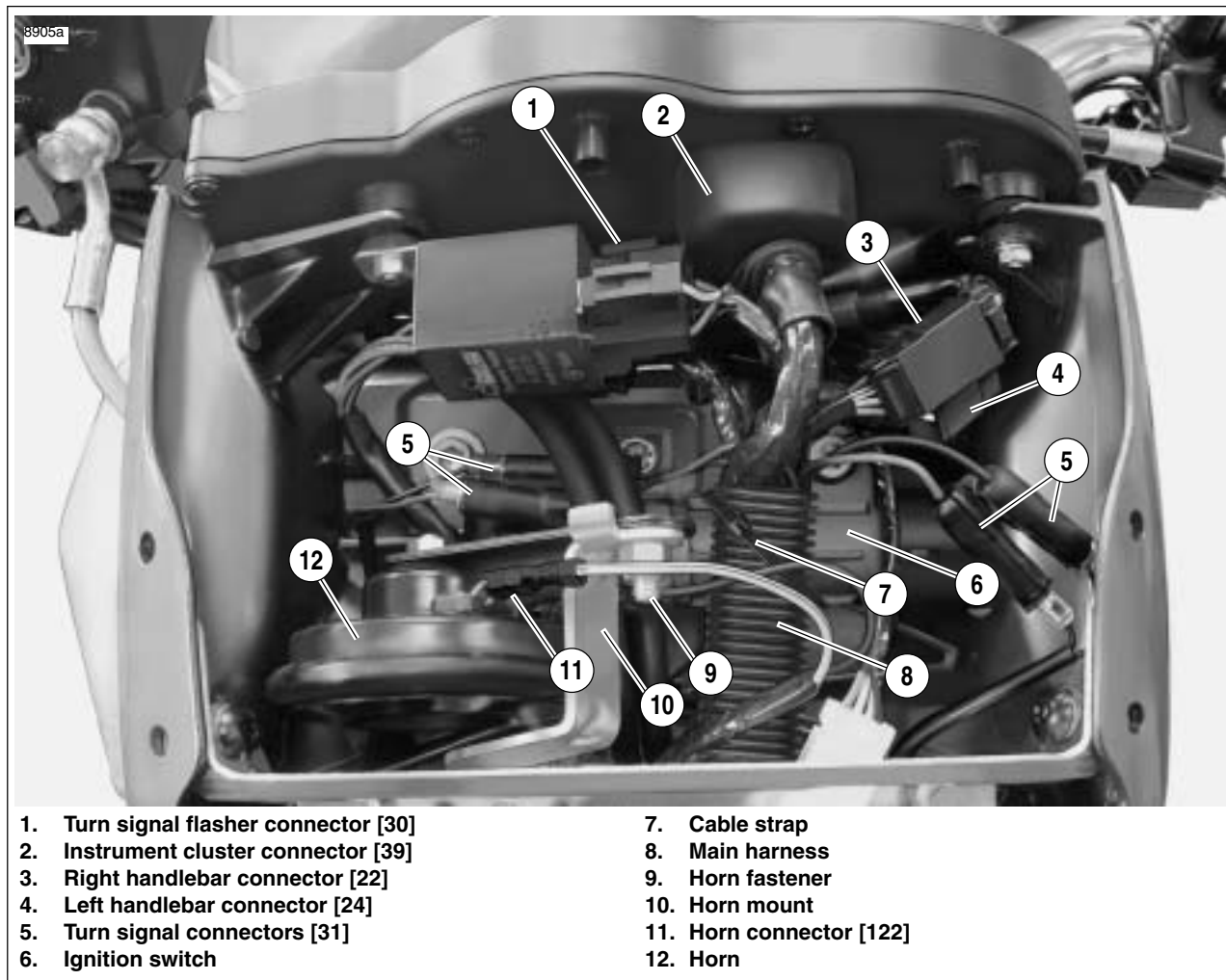


Figure 7-3. Electrical Connectors Behind Windscreen

7. See [Figure 7-4](#). Use Snap-on Tamper-Resistant T45 Torx driver (Part No. FTXR45E) to remove the two tamper-resistant Torx fasteners (2) securing ignition switch to upper fork clamp.
8. Remove the final ignition switch fastener (1) along with spacer located behind the ignition switch.
9. While holding the throttle cables (3) to your left (the right side of the vehicle), pull the ignition switch (4) toward you and roll the assembly away from you until the fork stop pin (5) is pointing down.
10. Slide the ignition switch assembly out to your left (the right side of the vehicle).

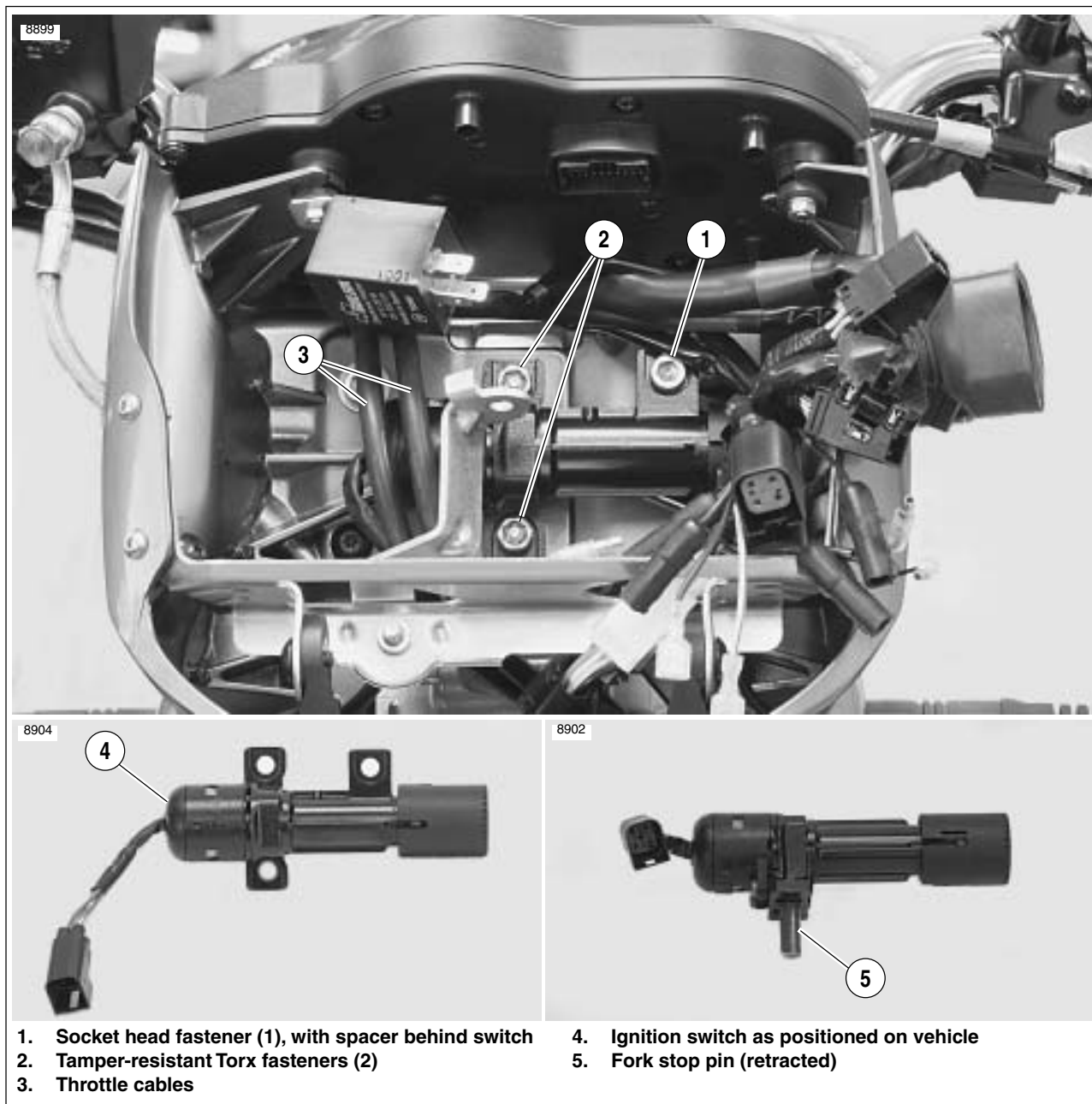


Figure 7-4. Ignition Switch

DISASSEMBLY

1. See [Figure 7-5](#). Remove ignition switch housing (4) from ignition switch (5) by prying tabs on side of housing
2. Remove ignition switch body fasteners (1). Separate ignition switch body (2) from ignition switch (5).

ASSEMBLY

NOTE

See [Figure 7-5](#). In next step, be sure wide slot in ignition switch housing (4) is installed over wide boss on ignition switch (5).

1. Push ignition switch housing (5) on to ignition switch (4).

NOTE

In next step, do not force ignition switch (4) into ignition switch body (2). If ignition switch does not easily slide into ignition switch body, rotate slot in ignition switch body with screwdriver until proper installation can be achieved.

2. Mate ignition switch to ignition switch body.
3. Install ignition switch body fasteners (1). Tighten to 12-36 in-lbs (1.4-4.0 Nm).

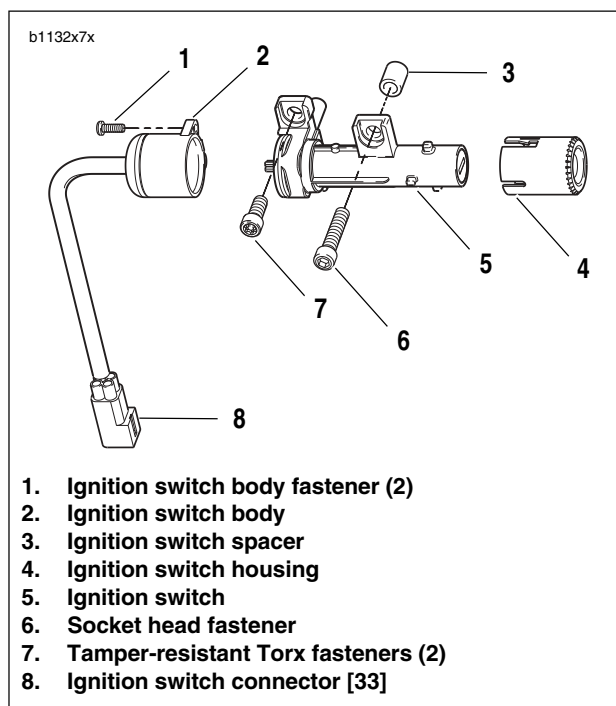


Figure 7-5. Ignition Switch Assembly

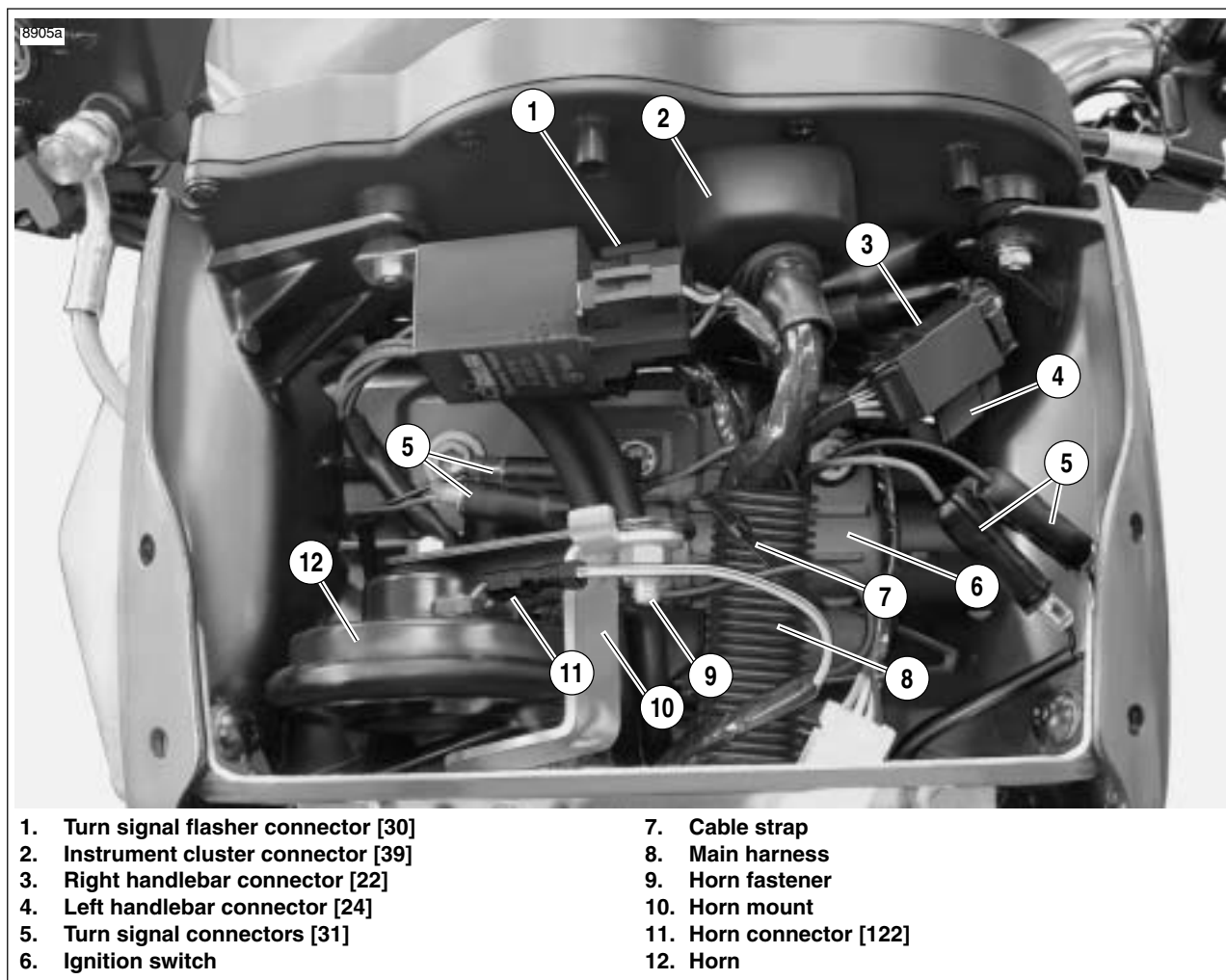


Figure 7-6. Electrical Connectors Under Windscreen

INSTALLATION

NOTE

When installing the ignition switch it is important to have the fork lock pin pointing down while sliding the switch into place.

1. See [Figure 7-4](#). While holding the throttle cables (3) to your left (the right side of the vehicle), slide the ignition switch assembly in to your right (the left side of the vehicle).
2. Install the ignition switch (4) with the fork stop pin (5) pointing down and, once in place, roll the assembly toward you and insert the fork stop pin into the upper triple clamp.
3. Attach ignition switch assembly to upper triple clamp using ignition switch fasteners (1, 2). Use LOCTITE 272 (Red) on fasteners. Tighten to 12-14 ft-lbs (16.3-19 Nm).
4. See [Figure 7-7](#). Connect ignition switch connector [33] to wiring harness.
5. Install horn connectors [122] and install horn assembly tightening fastener to 72-96 **in-lbs** (8.1-10.8 Nm).
6. See [Figure 7-6](#). Connect:
 - Instrument cluster [39]
 - Left [24] and right [22] handlebar wiring harnesses
 - Turn signals [31]
 - Turn signal flasher [30]
7. Loosely install cable strap around the main wiring harness and the ignition switch.

⚠ WARNING

Always connect positive battery cable first. If the positive cable should contact ground with the negative cable installed, the resulting sparks may cause a battery explosion resulting in personal injury.

8. Install negative battery cable to battery terminal. Tighten fastener to 60-96 **in-lbs** (6.8-10.8 Nm).
9. Check ignition switch for proper operation. If operation fails, reread procedure and verify that all steps were performed.

⚠ WARNING

After installing seat, pull upward on front of seat to be sure it is locked in position. If seat is loose, it could shift during vehicle operation and startle the rider, causing loss of control which could result in death or serious injury.

10. Install seat. See [2.41 SEAT](#).
11. Install windscreen and tighten fasteners to 10-12 **in-lbs** (1.1-1.4 Nm).

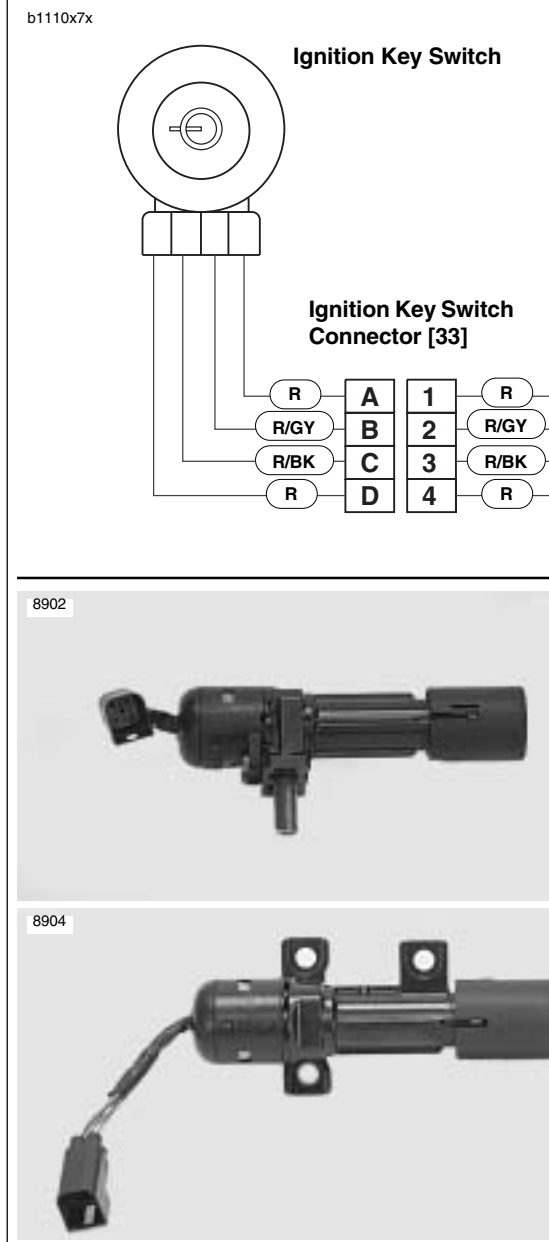


Figure 7-7. Ignition Key Switch Wiring

GENERAL

Resistor-type high-tension spark plug cables have a carbon-impregnated fabric core, instead of solid wire, for radio noise suppression and improved reliability of electronic components. Use the exact replacement cable for best results.

REMOVAL

⚠ WARNING

Never disconnect a spark plug cable with the engine running. If you disconnect a spark plug cable with the engine running, you may receive a potentially fatal electric shock from the ignition system which could result in death or serious injury.

CAUTION

When disconnecting each spark plug cable from its spark plug terminal, always grasp and pull on the rubber boot at the end of the cable assembly (as close as possible to the spark plug terminal). Do not pull on the cable portion itself. Pulling on the cable will damage the cable's carbon core.

1. Remove airbox assembly. See [4.43 AIRBOX](#).
2. See [Figure 7-8](#). Disconnect spark plug cables from ignition coil and spark plug terminals. Inspect cables for damage.

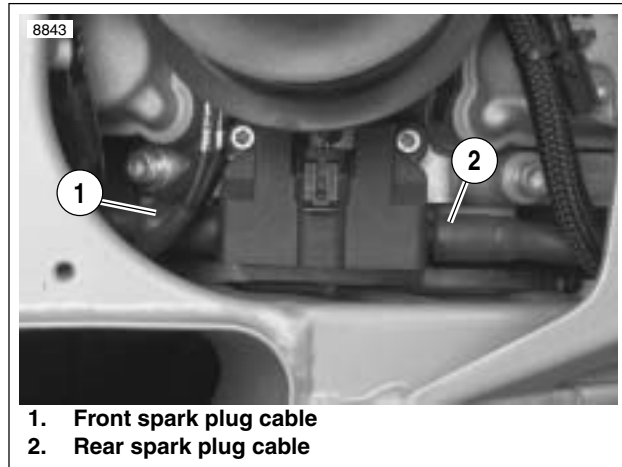


Figure 7-8. Spark Plug Cable Location

INSPECTION

1. Inspect spark plug cables. Replace cables that are worn or damaged.
 - a. Check for cracks or loose terminals.
 - b. Check for loose fit on ignition coil and spark plugs.
2. Check cable boots/caps for cracks or tears. Replace boots/caps that are worn or damaged.

NOTE

Both cables are the same length.

3. See [Figure 7-9](#). Check spark plug cable resistance with an ohmmeter. Replace cables not meeting resistance specifications.

Table 7-10. Spark Plug Cables

SPECIFICATION	FRONT & REAR
Length-in. (mm)	5.75 (146)
Resistance - ohms	1,430-3,360

INSTALLATION

NOTES

- *To ease installation, install spark plug cables to ignition coil first.*
 - *See [1.14 SPARK PLUGS](#) for spark plug information.*
1. Connect spark plug cables to ignition coil and spark plugs. Fasten boots/caps securely. Tight connections provide the necessary moisture-proof environment for the ignition coil and spark plug terminals.
 2. Install airbox assembly. See [4.43 AIRBOX](#).

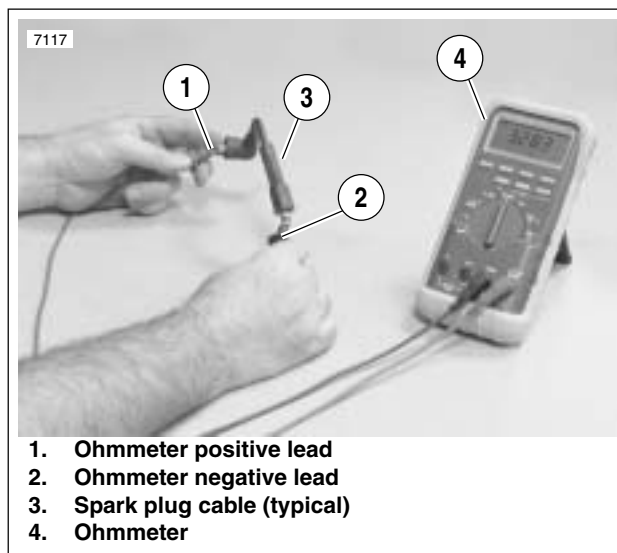


Figure 7-9. Testing Resistance

GENERAL

The starter interlock system is designed to prevent unintended start-up and/or forward motion of the motorcycle with the vehicle’s sidestand not retracted.

Two circuits make up the starter interlock system.

Starter Circuit

The starter circuit prevents the motorcycle from being started unless a ground has been established at the starter relay. This ground may come from one of two sources.

- By placing the motorcycle in neutral and grounding through the neutral switch.
- By disengaging the clutch and grounding through the clutch lever switch.

Once the starter circuit is grounded and the starter button pushed, the starter relay can be energized. The energized relay then permits the starter motor to crank the engine.

Ignition Circuit

The ignition circuit prevents the motorcycle from operating unless a ground is established at the ignition relay. If this ground is not established, the ignition system will be not turned on and the motorcycle will not run. Grounds may be established three ways.

- By retracting the sidestand and grounding through the sidestand switch.
- By placing the motorcycle in neutral and grounding through the neutral switch.
- By disengaging the clutch and grounding through the clutch lever switch.

Note that the ignition circuit allows operation in gear with the sidestand extended if the clutch is disengaged. However, if the motorcycle is in gear with the sidestand extended, and the clutch is released, the ignition ground is lost and the ignition system is turned off. This system will prevent vehicle operation if forward motion is attempted with the sidestand down.

Table 7-11. Starter Interlock Troubleshooting

PROBLEM	CHECK FOR	CORRECTION
Electric starter will not crank.	Battery problems.	See 7.10 BATTERY.
	Inappropriate gear selected.	Place vehicle in neutral.
	Clutch lever not disengaged.	Pull in clutch lever.
	Starter relay problems.	Listen for starter relay “click”. If click is not heard, perform starter relay tests.
		Follow starter troubleshooting in Section 5.
Electric starter cranks, but vehicle will not start.	Sidestand not retracted.	Retract sidestand.
Motorcycle will not start with side-stand retracted.	Clutch lever not disengaged.	Pull in clutch lever.
Motorcycle will not start with side-stand retracted or clutch disengaged.	Ignition relay problems.	Listen for relay “click”. If click is not heard, perform ignition system tests.
Motorcycle will not start after starter relay tests.	No spark at spark plug.	Check for 12 VDC at coil W/BK wire.
		Follow ignition system troubleshooting.

DIAGNOSTICS

The reference numbers below correlate with the circled numbers in the 7.5 STARTER INTERLOCK flow charts.

1. Check diode polarity as shown in Figure 7-10.
2. Check diode with an ohmmeter as shown in Figure 7-11.

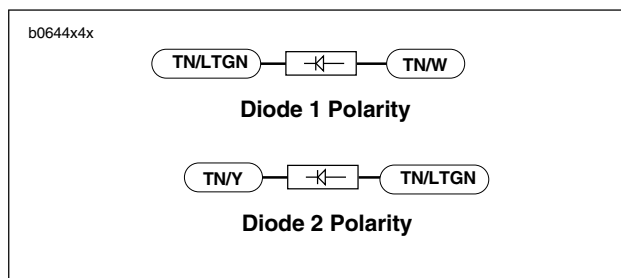


Figure 7-10. Diode Polarity

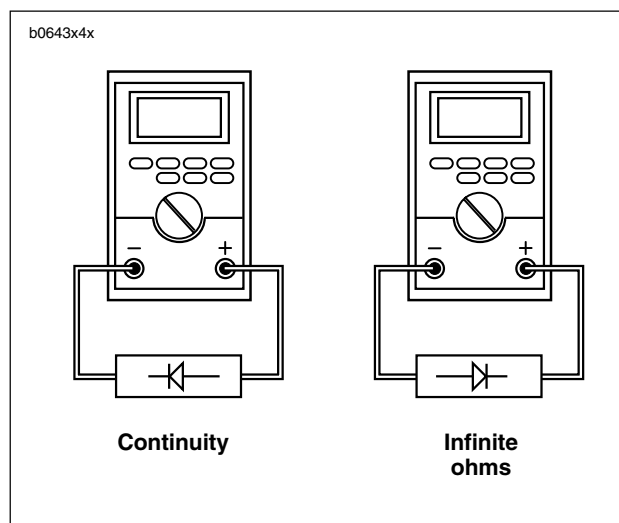


Figure 7-11. Ohmmeter Diode Test

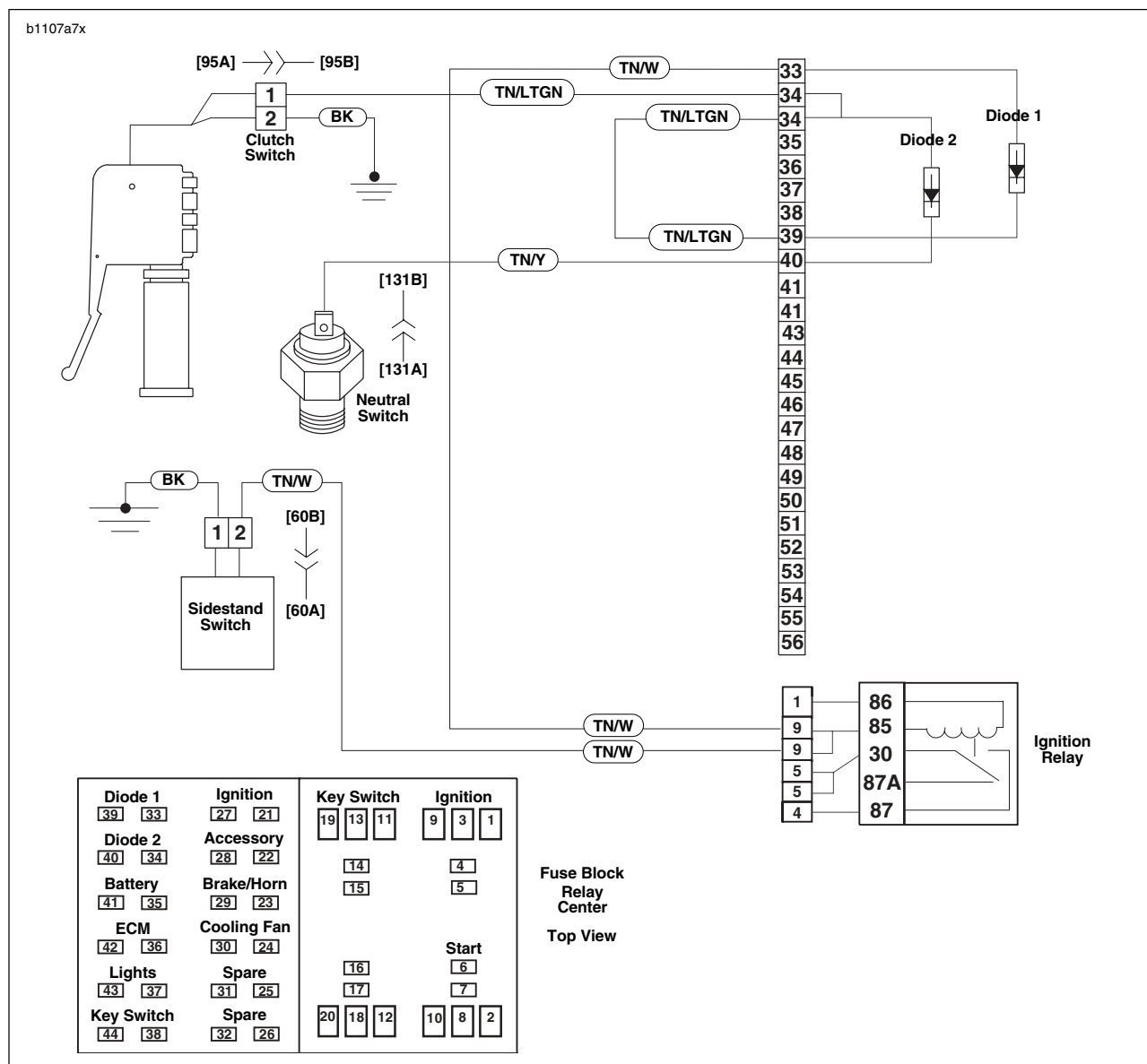
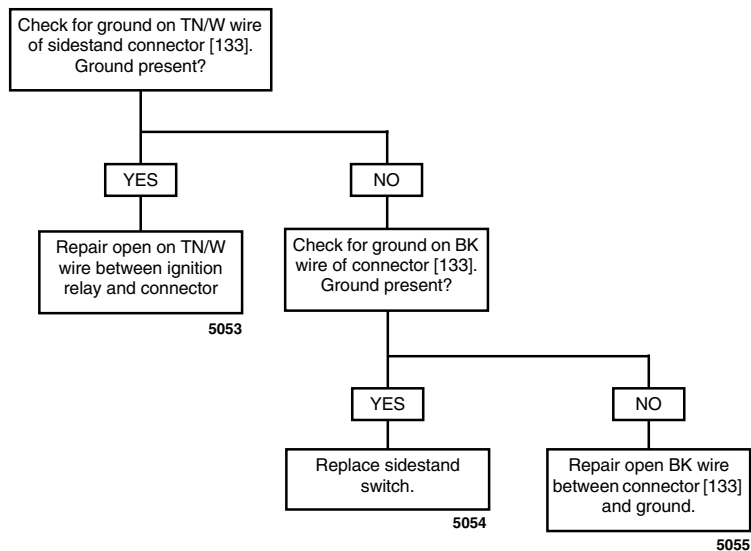


Figure 7-12. Diode Wiring

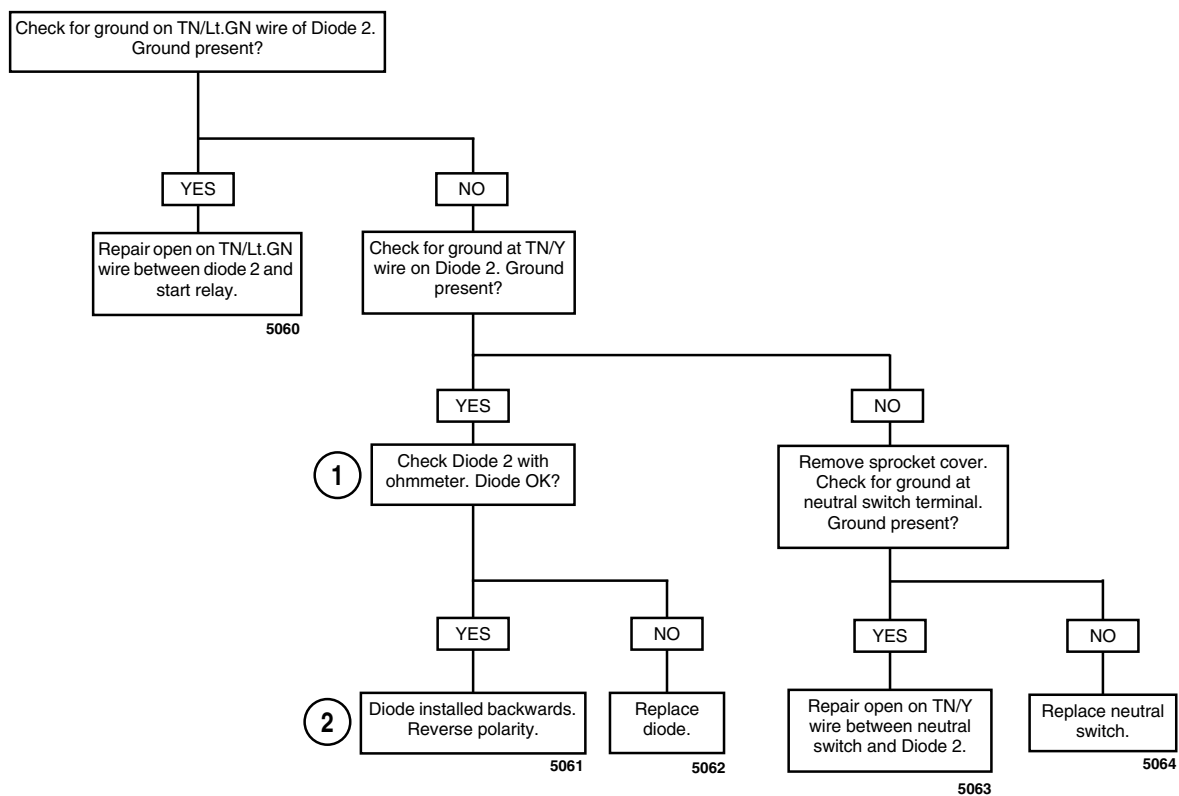
Ignition Test

CONDITION: Sidestand up and key ON, transmission in neutral and clutch engaged



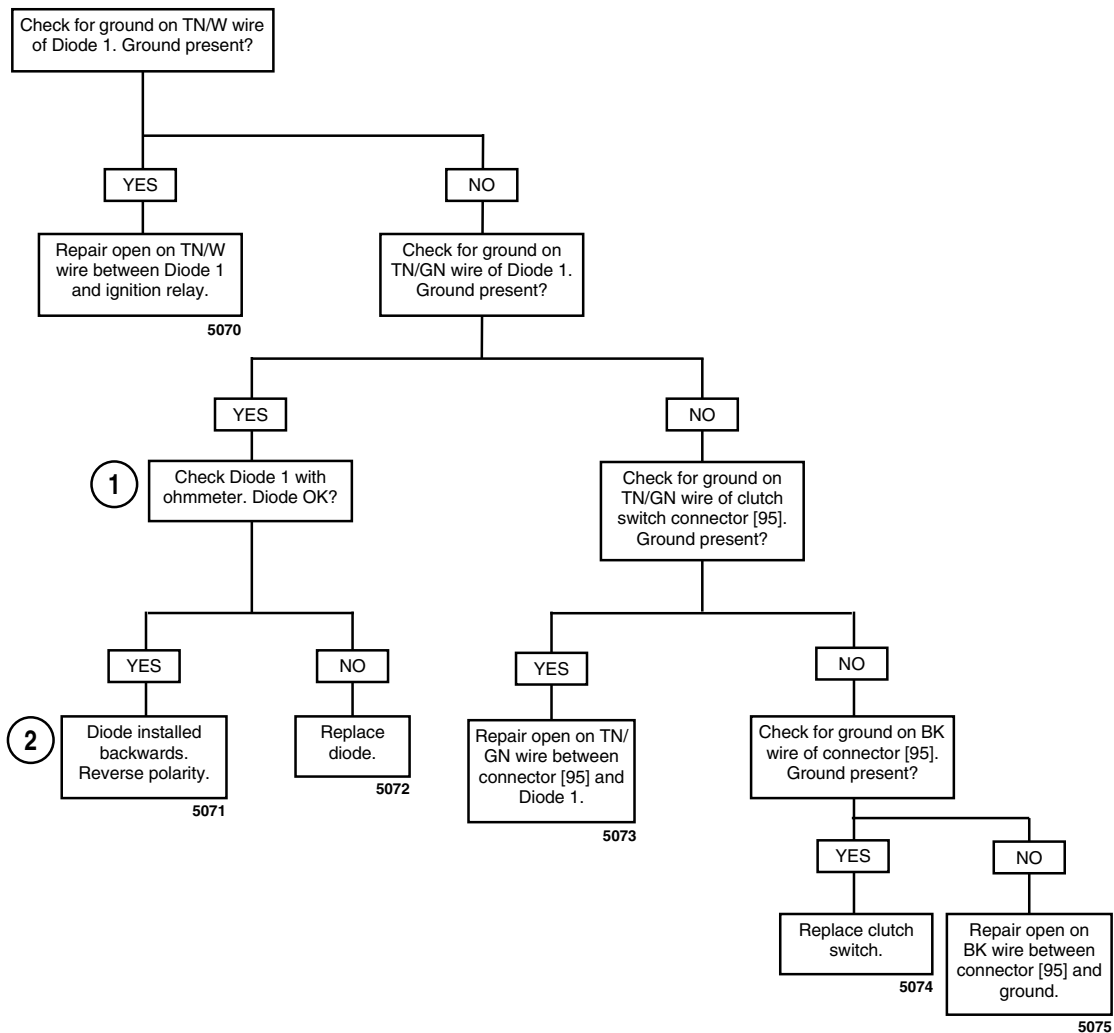
Starter Test (Part 1 of 2)

CONDITION: Sidestand down, key ON, transmission in neutral and clutch engaged

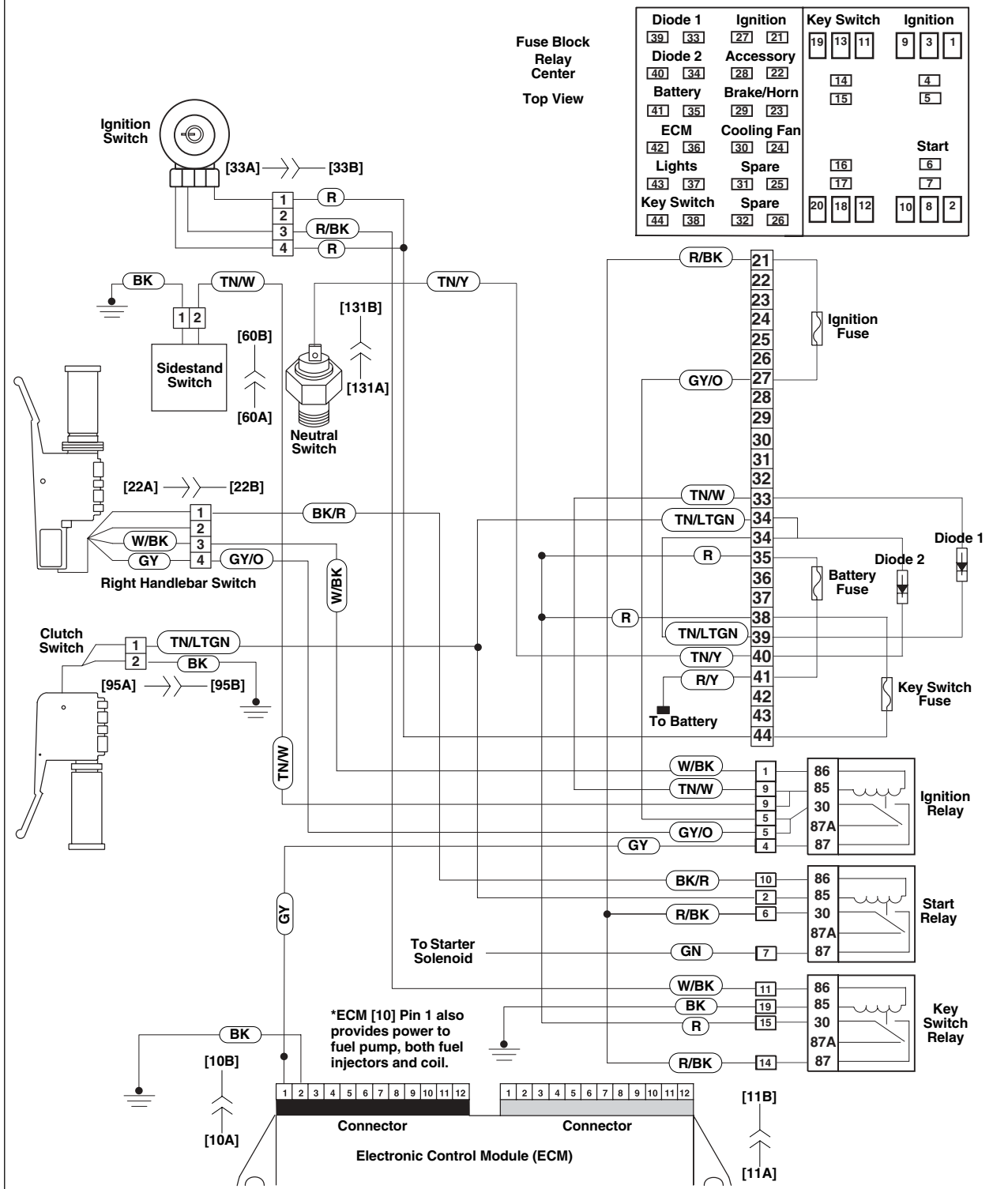


Starter Test (Part 2 of 2)

CONDITION: Sidestand down, key ON, transmission in gear and clutch disengaged



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TESTING/REPLACEMENT

Sidestand Switch

See [Figure 7-14](#). The sidestand switch is a rotary type switch. The switch completes a path to ground for the ignition relay when the sidestand is in the retracted position. Test the switch as follows:

1. Remove heat shrink tubing from sidestand switch connector [60].
2. Unplug the 2-place sidestand switch connector [60].
3. Test the switch using an ohmmeter.
 - a. With sidestand down (switch open), the switch should show ∞ ohms (infinite ohms).
 - b. With sidestand up (switch closed), the switch should show 0 ohms or little resistance.
4. Replace the assembly with a **new** switch if necessary. See [2.43 SIDESTAND ASSEMBLY](#).
5. Replace heat shrink tubing.

Clutch Switch

See [Figure 7-15](#). The clutch switch attaches to the clutch control lever bracket. The switch completes a path to ground for the ignition relay and the starter relay when the clutch is disengaged. Test the switch as follows:

1. Unplug the 2-place clutch switch connector [95].
2. Test the switch using an ohmmeter.
 - a. With clutch engaged (1) (switch open), the switch should show ∞ ohms (infinite ohms).
 - b. With clutch disengaged (2) (switch closed), the switch should show 0 ohms or little resistance.
3. Replace the assembly with a **new** switch if necessary. See [2.24 CLUTCH HAND LEVER](#).

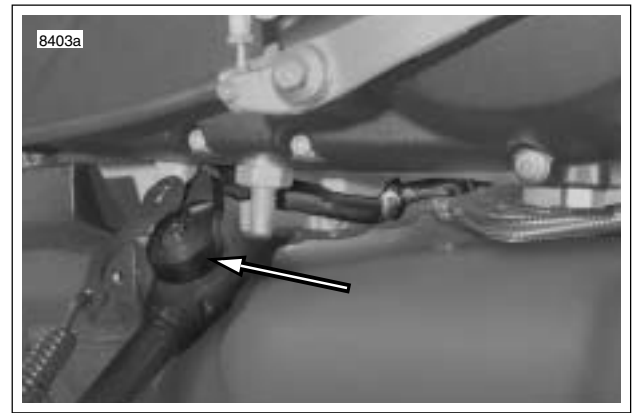
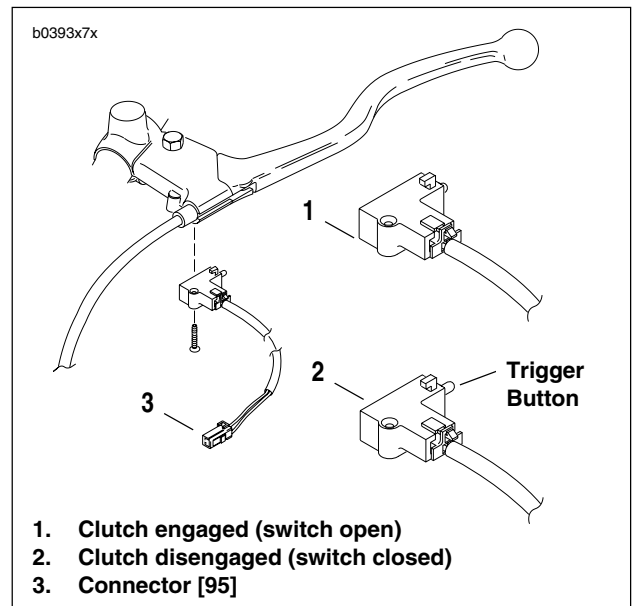


Figure 7-14. Sidestand Switch



1. Clutch engaged (switch open)
2. Clutch disengaged (switch closed)
3. Connector [95]

Figure 7-15. Clutch Switch

Ignition Relay

The ignition relay is located under the seat. Test the relay as follows:

1. See [Figure 7-16](#). Locate ignition relay (2) within relay block.
2. To test relay, proceed to Step 3. If installing a **new** starter relay, remove old relay. Install **new** relay into relay block.
3. See [Figure 7-17](#). Obtain a 12 volt battery and a continuity tester or ohmmeter.
 - a. Pull relay from relay block.
 - b. Connect positive battery lead to the 86 terminal.
 - c. Connect negative battery lead to the 85 terminal to energize relay.
 - d. Check for continuity between the 30 and 87 terminals. A good relay shows continuity (continuity tester lamp "on" or a zero ohm reading on the ohmmeter). A malfunctioning relay will not show continuity and must be replaced.
4. Replace the relay with a **new** relay if necessary.

Key Switch Relay

See [Figure 7-16](#). The key switch relay (1) is under the seat. See [Ignition Relay](#) under **7.5 STARTER INTERLOCK** for testing procedure.

Battery Fuse

A 30 Amp battery fuse links the ignition key switch and the battery. The 30A battery fuse is located under the rider's seat. See [7.23 BATTERY FUSE AND FUSES](#) for more information.

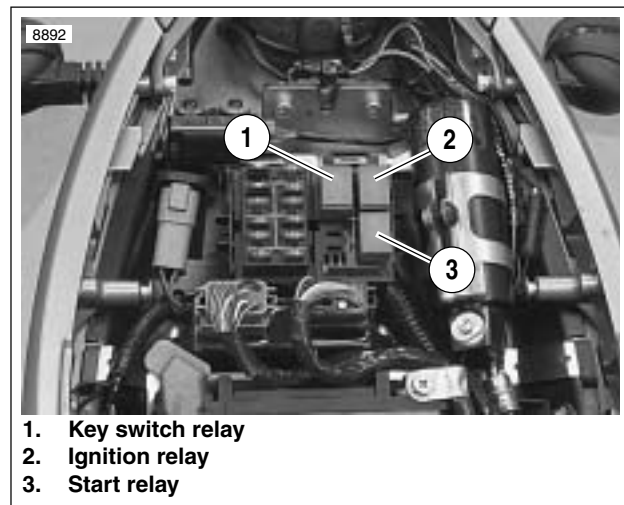


Figure 7-16. Relay Block

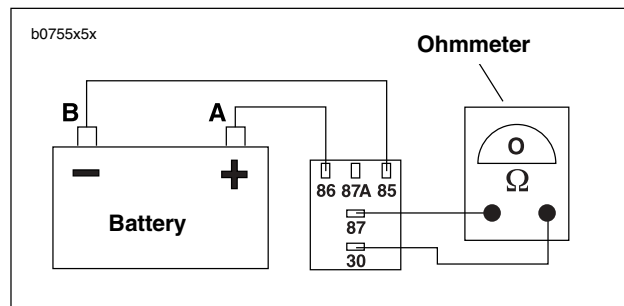


Figure 7-17. Starter Relay Test

Diodes

See [Figure 7-18](#). The diodes are located in the fuse block under the seat.

1. See [Figure 7-19](#). Locate diodes within fuse block.
2. Test diodes using Starter Test flow charts under [DIAGNOSTICS](#).
3. Identify the diode which must be replaced. Replace both diodes if necessary.
4. Replace the diodes by pulling them straight out. The spare diode may be used in either circuit as long as it is installed in the correct direction.

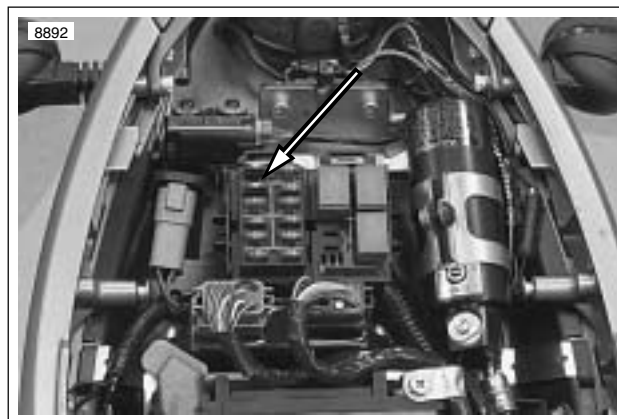


Figure 7-18. Fuse Block (contains diodes)

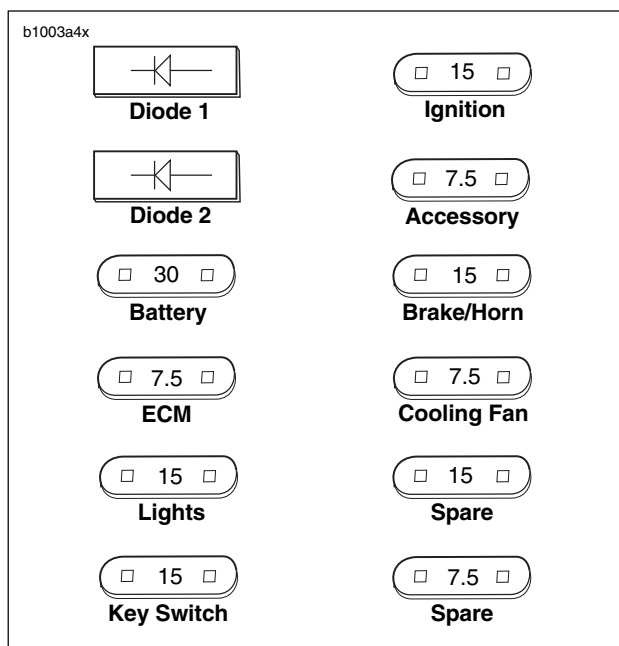


Figure 7-19. Fuses and Diodes

NOTES
