

# 1987 **MUSTANG**



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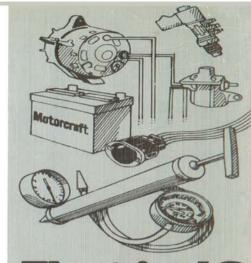
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# Electrical & Vacuum Trouble-Shooting Manual



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# 1987 Mustang Electrical & Vacuum Trouble-Shooting Manual (EVTM) EAN: 978-1-60371-398-6 ISBN: 1-60371-398-0

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1987 MUSTANG

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#### IMPORTANT SAFETY NOTICE

Appropriate service methods and proper repair procedures are essential for the safe, reliable operation of all motor vehicles, as well as the personal safety of the individual doing the work. This Manual provides general directions for accomplishing service and repair work with tested, effective techniques. Following them will help assure reliability.

There are numerous variations in procedures, techniques, tools, and parts for servicing vehicles, as well as in the skill of the individual doing the work. This Manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this Manual must first establish that he compromises neither his personal safety nor the vehicle integrity by his choice of methods, tools or parts.

The purpose of this manual is to show electrical and vacuum circuits of these vehicles in a clear and simple fashion to make troubleshooting easier. With each circuit is a description of *How the Circuit Works* and some *Troubleshooting Hints*. A *Component Location* chart lists components, connectors, and references to pictures in the manual.

Wiring Diagrams give a schematic picture of when and how the circuit is powered, what the current path is to circuit components, and how the circuit is grounded. Each circuit component is named (underlined titles). Wire and connector colors are listed (standard Ford color abbreviations are used):

#### **COLOR ABBREVIATIONS**

BL	Blue	N	Natural
BK	Black	0	Orange
BR	Brown	PK	Pink
DB	Dark Blue	P	Purple
DG	Dark Green	R	Red
GR	Green	T	Tan
GY	Gray	W	White
LB	Light Blue	Y	Yellow
LG	Light Green		

Where two colors are shown for a wire, the first color is the basic color of the wire. The second color is the stripe marking. It should be noted that the use of dots and hashes for circuit identification has been eliminated. Dots may still be encountered as an additional identification where the wire harness manufacturer has encountered multiple wires with the same identification colors (solid or stripe) in a connector, and requested a deviation.

Connector end views of switches and other components are shown to help with bench testing. The views show the harness wire colors that connect to the mating terminals. Connector colors and locations are shown in the *Component Location* chart. Two-color listings indicate separate colors for each connector half.

Components which work together are shown together. For example, all electrical components used in nay circuit are shown on one diagram. The circuit breaker or fuse is shown at the top of the page. All wires, connectors, splices, switches, and motors are shown in the flow of current to ground at the bottom of the page. Notes are included which describe how switches and other components work. If a component is used in several different circuits, it is shown in several different schematics. For example, the Light Switch is an electrical part of many circuits and is repeated on many pages. In some cases, however, a component may seem by its name to belong on a page where it has no electrical connection. For example, Radio Illumination is electrically part of Instrument Illumination. Since it has no electrical connection at all with the actual Radio circuit, it is not shown on the Radio page.

Troubleshooting Hints point the technician in a general direction, but are not intended as a step-by-step procedure. Ignition trouble-shooting is an exception to this. It includes a step-by-step procedure of basic quick checks to locate some of the more common **Ignition** System problems. Read the Shop Manual for more detailed repair procedures.

The **Grounds** pages show detailed views of multiple component ground points. This is useful for checking interconnections among the ground circuits of different diagrams.

Notes, Cautions, and Warnings appear in boxes on text pages and contain important car and mechanic safety information.

Notes give added information to help complete a particular procedure. Cautions are included to prevent making an error that could damage the vehicle. Warnings highlight areas where carelessness can cause personal injury. The following list contains some general Warnings that should be followed when working on a vehicle.

- Always wear safety glasses for eye protection.
- Use safety stands whenever a procedure requires being under a vehicle.
- Be sure that the **Ignition Switch** is always in the OFF position, unless otherwise required by the procedure.
- Set the parking brake when working on any vehicle. An automatic transmission should be in PARK. A manual transmission should be in NEUTRAL.
- Operate the engine only in a well-ventilated area to avoid the danger of carbon monoxide.
- Keep away from moving parts when the engine is running, especially the fan and belts.
- To prevent serious burns, avoid contact with hot metal parts such as the radiator, exhaust manifold, tail pipe, catalytic converter, and muffler.
- Do not allow flame or sparks near the battery. Gases are always present in and around the battery cell. An explosion could occur.
- Do not smoke.
- To avoid injury, always remove rings, watches, loose hanging jewelry, and loose clothing.

# TROUBLESHOOTING STEPS

These six steps present an orderly method of troubleshooting:

#### Step 1. Verify the problem.

- Operate the complete system and see all symptoms for yourself in order to:
  - —check the accuracy and completeness of the customer's complaint.
  - —learn more that might give a clue to the nature and location of the problem.

#### Step 2. Narrow the problem.

- Using the EVTM, narrow down the possible causes and locations of the problem in order to more quickly find the exact cause.
- Read the description of How the Circuit Works and study the wiring diagram. You should then know enough about the circuit operation to figure out where to check for this trouble.

#### Step 3. Test the cause.

- Use electrical test procedures to find the specific cause of the symptoms.
- Troubleshooting Hints will give some helpful ideas.
- The Component Location charts and the pictures will help you find components, grounds, and connectors.

# Step 4. Verify the cause.

 Confirm the fact that you have found the correct cause through operating the parts of the circuit you think are good.

# Step 5. Make the repair.

Repair or replace the faulty component.

# Step 6. Verify the repair.

 Operate the system as in Step 1 and check that your repair has removed all symptoms, and also has not caused any new symptoms.

Some engine circuits may need special test equipment and special procedures. See the *Shop Manual* and other service books for

details. You will find the circuits in this manual to be helpful with these special tests.

#### TROUBLESHOOTING TOOLS

#### JUMPER WIRE

This is a test lead used to connect two points of a circuit. A **Jumper Wire** can complete a circuit by bypassing an open.

Uses: Bypassing Switches or Open Circuits

#### WARNING

Never use a jumper wire across high resistance loads (motors, etc.) connected between hot and ground. This direct battery short may cause injury or fire.

#### **VOLTMETER**

A DC **Voltmeter** measures circuit voltage. Connect negative (- or black) lead to ground, and positive (+ or red) lead to voltage measuring point.

#### OHMMETER

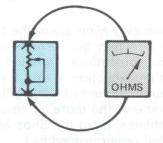


Figure 1 — Resistance Check

An **Ohmmeter** shows the resistance between two connected points (Figure 1).

#### **TEST LAMP**

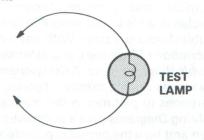


Figure 2—Test Lamp

A **Test Lamp** is a 12-volt bulb with two test leads (Figure 2).

Uses: Voltage Check. Short Check

#### SELF-POWERED TEST LAMP

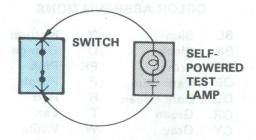


Figure 3-Continuity Check

The **Self-Powered Test Lamp** is a bulb, battery and set of test leads wired in series (Figure 3). When connected to two points of a continuous circuit, the bulb glows.

Uses: Continuity Check. Ground Check

#### CAUTION

......

When using a self-powered test lamp or ohmmeter, be sure power is off in circuit during testing. Hot circuits can cause equipment damage and false readings.

# TROUBLESHOOTING CHECKS

SWITCH CIRCUIT CHECK

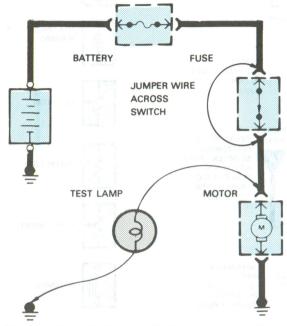


Figure 4-Switch Circuit Check and Voltage Check

In a bad circuit with a switch in series with the load, jumper the terminals of the switch to power the load. If jumping the terminals powers the circuit, the switch is bad (Figure 4).

# CONTINUITY CHECK (Locating open circuits)

Connect one lead of **Self-Powered Test Lamp** or **Ohmmeter** to each end of circuit (Figure 3). Light will glow if circuit is closed. Switches and fuses can be checked in the same way.

#### **VOLTAGE CHECK**

Connect one lead of **Test Lamp** to a known good ground, or the negative (-) battery terminal. Test for voltage by touching the other lead to the test point. Bulb goes on when the test point has voltage (Figure 4).

SHORT CHECK (short to ground)

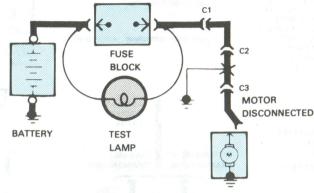


Figure 5-Short Check

A fuse that repeatedly blows is usually caused by a short to ground. It's important to be able to locate such a short quickly (Figure 5).

- 1) Turn off everything powered through the fuse
- 2) Disconnect other loads powered through the fuse:
  - Motors: disconnect motor connector.
  - Lamps: remove bulbs.
- 3) Turn **Ignition Switch** to RUN (if necessary) to power fuse.
- 4) Connect one **Test Lamp** lead to hot end of blown fuse. Connect other lead to ground. Bulb should glow showing power to fuse. (*This step is just a check to be sure you have power to the circuit.*)
- 5) Disconnect the **Test Lamp** lead from ground and reconnect it to the load side of the fuse.
  - If the Test Lamp is off, the short is in the disconnected equipment.
  - If the Test Lamp goes on, the short is in the wiring. You must find the short by disconnecting the circuit connectors one at a time until the Test Lamp goes out. For example: with a ground at X, the bulb goes out when C1 or C2 is disconnected, but stays on after disconnecting C3. This

means the ground is between C2 and C3.

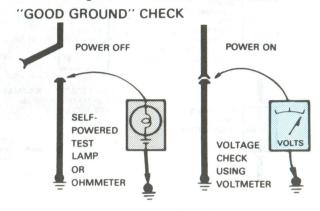


Figure 6-Grounds Checks

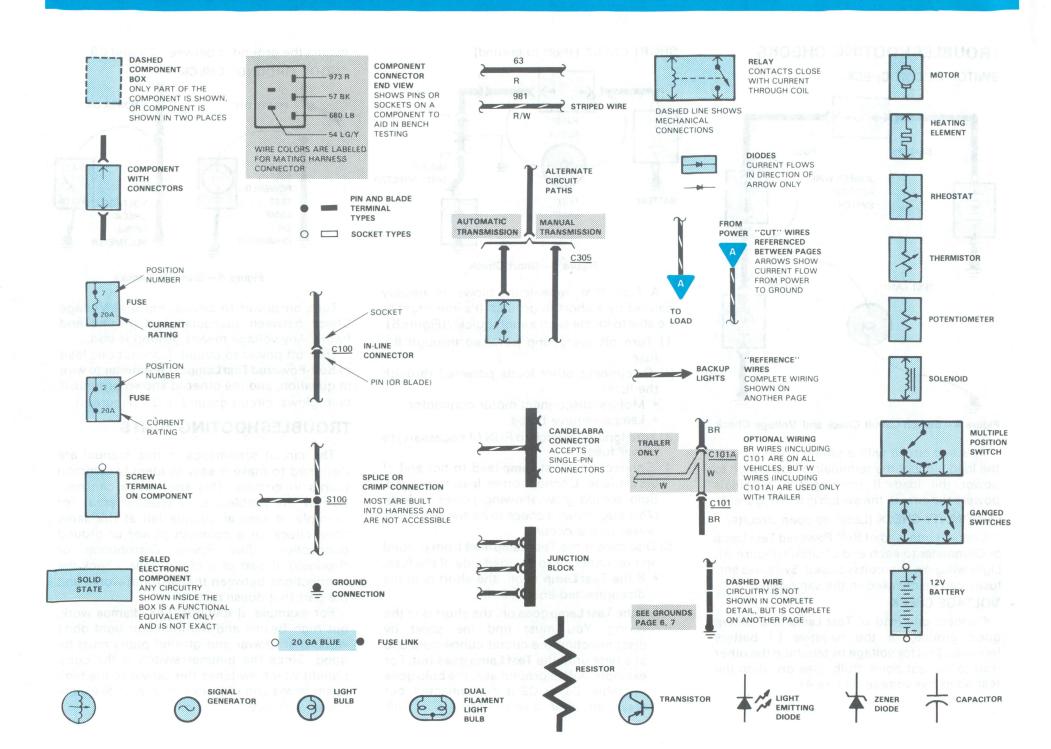
Turn on power to circuit. Perform Voltage Check between suspected bad ground and frame. Any voltage means ground is bad.

Turn off power to circuit. Connect one lead of **Self-Powered Test Lamp**or **Ohmmeter** to wire in question, and the other to known ground. If bulb glows, circuit ground is OK (Figure 6).

# TROUBLESHOOTING HINTS

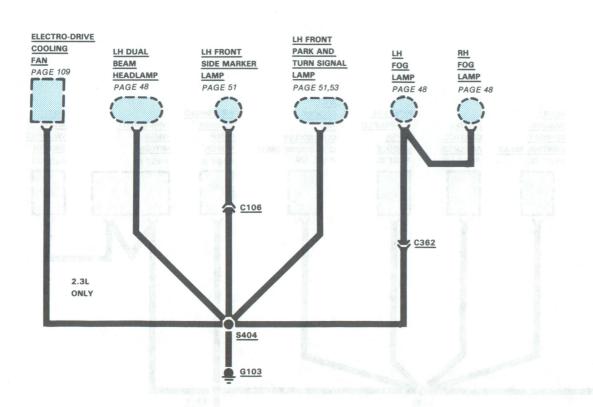
The circuit schematics in this manual are designed to make it easy to identify common points in circuits. This knowledge can help narrow the problem to a specific area. For example, if several circuits fail at the same time, check for a common power or ground connection. (See *Power Distribution* or *Grounds*). If part of a circuit fails, check the connections between the part that works and the part that doesn't work.

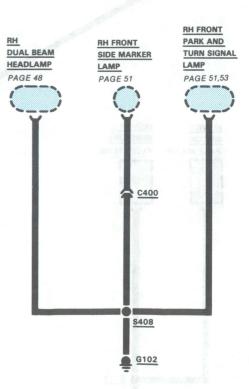
For example, if low beam headlamps work, but high beams and the indicator light don't work, then power and ground paths must be good. Since the dimmer switch is the component which switches this power to the high beam lamps and indicator, it is most likely the cause of failure.

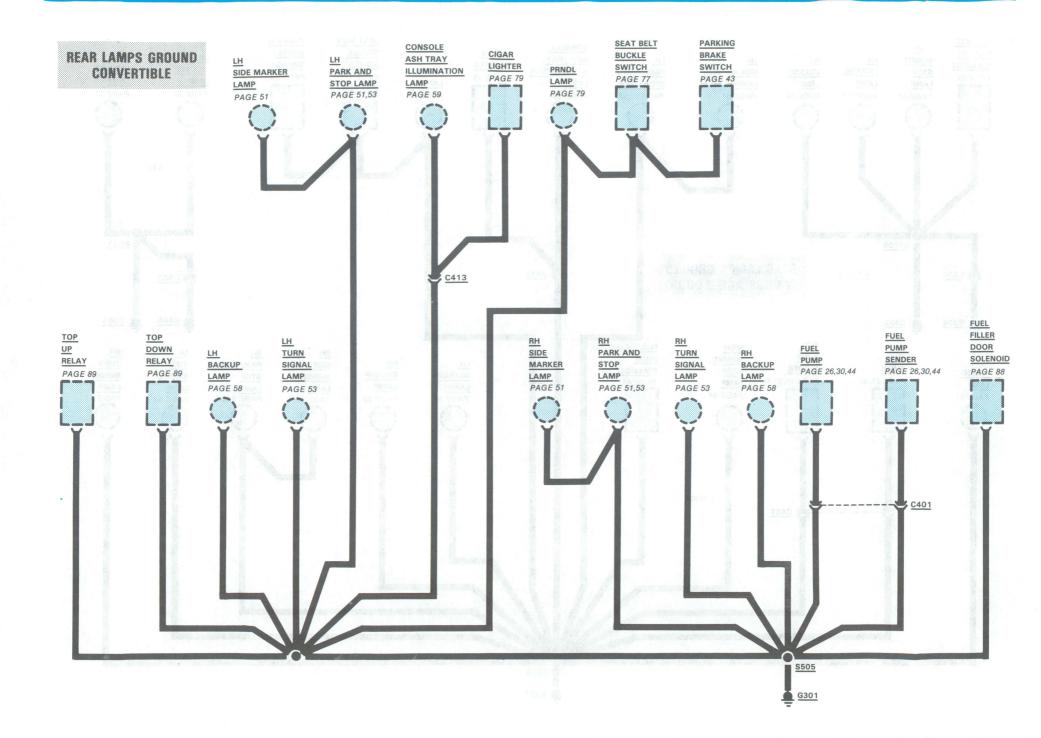


#### **INSTRUMENT PANEL GROUND GLÓVE** MAIN DUAL DAY/NIGHT HAZARD LOW INSTRUMENT LIGHT WARNING ILLUMINATION FLUID COMPARTMENT INSTRUMENT WARNING HORN CLUSTER LAMP SWITCH SWITCH CLUSTER SWITCH CHIME RELAY SWITCH MODULE LH INSTRUMENT A/C CONTROL PAGE 43 PAGE 16 PAGE 43 PAGE 59 PAGE 53 PAGE 45 PANEL COURTESY PAGE 79 PAGE 77 ILLUMINATION LAMP PAGE 61 PAGE 59 LOW OIL WARNING 2 12 RH INSTRUMENT RELAY PANEL COURTESY PAGE 45 LAMP PAGE 61 A/C INTERVAL DUAL REAR COOLING WINDSHIELD WINDSHIELD BRAKE WINDOW SPEED FAN WASHER WINDSHIELD DEFROST CONTROL WIPER CONTROLLER PUMP WARNING **WIPER** BLOWER **BLOWER** RESISTORS **CONTROL RELAY AMPLIFIER** MODULE (2.3L ENGINE ONLY) MOTOR MOTOR SWITCH SWITCH PAGE 101 PAGE 83 PAGE 80 **PAGE 109** PAGE 80 PAGE 80 PAGE 43 PAGE 104,106 PAGE 104.106 S512 **S303** S302 <u>G100</u> G201

# **HEADLAMP GROUNDS**





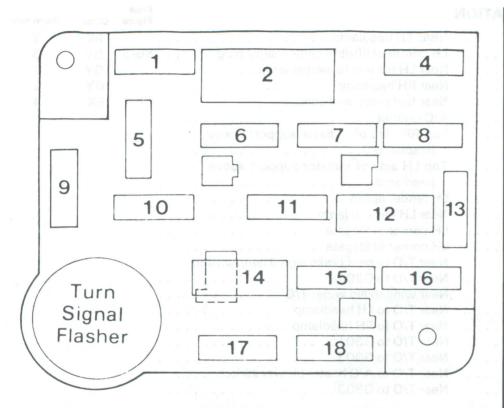


The ground circuits shown here are complete, and connect several components together to screw terminal ground points. On other pages only parts of these circuits may be shown. Partial ground circuits are shown dashed on those pages.

All simple or component ground circuits are shown on the individual circuit pages, and are complete on those pages.

All wires are 57 BK unless otherwise noted.

COMPONENTIOLATION	Page- Figure	Color	Terminals
Connector C106 Near LH headlamp		BK	2
Connector C302 LH corner of liftgate behind sight plug	86-3	GY	3
Connector C362 Near LH front side marker lamp		GY	2
Connector C400 Near RH headlamp		GY	2
Connector C401 Near fuel pump and sender	42-7	BK	4
Ground G100 A/C ground			
Ground G102 Top RH side of radiator support above			
headlamp			
Ground G103 Top LH side of radiator support above			
headlamp			
Ground G201 LH fender apron			
Ground G301 Near LH backup lamp			
Ground G303 LH corner of liftgate			
Ground G304 LH corner of liftgate			
Ground G500 Near T/O to park brake signal lamp switch			
Splice S302 Near T/O to G201			
Splice S303 Near windshield wiper T/O			
Splice S404 Near T/O to LH headlamp			
Splice S408 Near T/O to RH headlamp			
Splice S505 Near T/O to G301			
Splice S511 Near T/O to G303			
Splice S512 Near T/O to A/C heater blower switch			
Splice S1004 Near T/O to G303			



Fuse Position Amps		Circuits Protected		
0401	15	Stop/Hazard Lamps; Speed Control		
2	8.25 c.b.	Interval Wiper		
4 001	10	Exterior Lamps; Instrument Illumination		
5	15	Turn Lamps; Backup Lamps		
6 0	20	Speed Control, Day/Night Illumination Relay; A/C; Decklid Release		
7	Smuma C	(Not Used)		
8 08	0 15 on 0	Courtesy Lamps; Dimmer Switch;		
	@ briugna	Power Mirrors; Radio; Fuel Filler		
908	Ground	Door Release		
9 003	30 o.5	Heater Blower; A/C Blower		
10	20	Headlamps; Low Oil Level Warning		
11	15	Radio; Premium Sound; Graphic Equalizer		
12	Ale collas	(Not Used)		
13	5	Instrument Illumination		
14	20 c.b.	Power Windows		
15	15	Fog Lamps		
16	20	Horn; Cigar Lighter		
17	_	(Not Used)		
18	15	Seatbelt Buzzer; Warning Indicators; Low Coolant Switch; Low Fluid Monitor; Instrument Cluster		

Fuse Value Amps	Color Code
4	Pink
5	Tan
10	Red
15	Light Blue
20	Yellow
25	Natural
30	Light Green

#### **Power Distribution**

The **Alternator** and **Battery** are connected together at the **Starter Relay** hot terminal. Other circuits originate at the **Starter Relay** hot terminal and are protected by fuse links. Low power circuits are also protected by fuses.

The Ignition Switch and Main Light Switch are powered at all times, as are Fuses 1, 4, 8, 10 and 16. The other fuses are powered through the Ignition Switch or the Main Light Switch.

Position 3 is not used, and is covered by Circuit Breaker 2.

# REPLACEMENT OF FUSES/ CIRCUIT BREAKERS



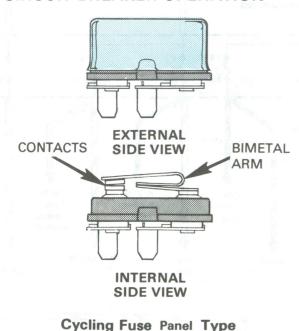


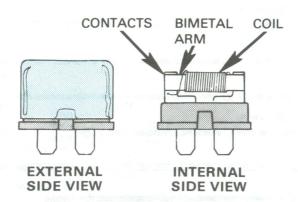
**GOOD FUSE** 

**BLOWN FUSE** 

Fuses are mounted either in the **Fuse Panel** or in-line. They are identified by the numbered value in amperes, and by a color code. Some positions may have either a fuse with adapter or a circuit breaker. Be sure to replace a fuse or circuit breaker with the same kind of unit and with the same ampere rating. Remove fuses in order to check them.

# CIRCUIT BREAKER OPERATION





# Non-Cycling Fuse Panel Type

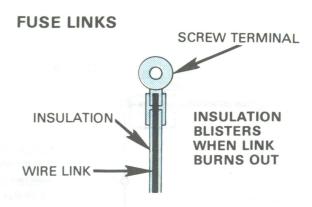


# **Cycling In-Line Type**

Some circuits are protected by circuit breakers. (Abbreviated "c.b." in fuse chart.) They can be **Fuse Panel** mounted or in-line. Like fuses, they are rated in amperes.

Each circuit breaker conducts current through an arm made of two types of metal fastened together (bimetal arm). If the arm starts to carry too much current, it heats up. As one metal expands faster than the other the arm bends, opening the contacts. Current flow is broken. In the cycling type, the arm cools and straightens out. This closes the circuit again. This cycle repeats as long as the overcurrent exists, with power applied.

In the non-cycling type, there is also a coil wrapped around the bimetal arm. When an overcurrent exists and the contacts open, a small current passes through the coil. This current through the coil is not large enough to operate a load, but it does heat up both the coil and bimetal arm. This keeps the arm in the open position until power is removed.



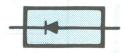
The fuse link is a short length of wire smaller in gage than the wire in the protected circuit. The wire is covered with a thick non-flammable insulation. An overload causes the link to heat and the insulation to blister. If the overload remains, the link will melt, causing an open circuit. The links are color coded for wire size as follows:

#### **COLOR CODE**

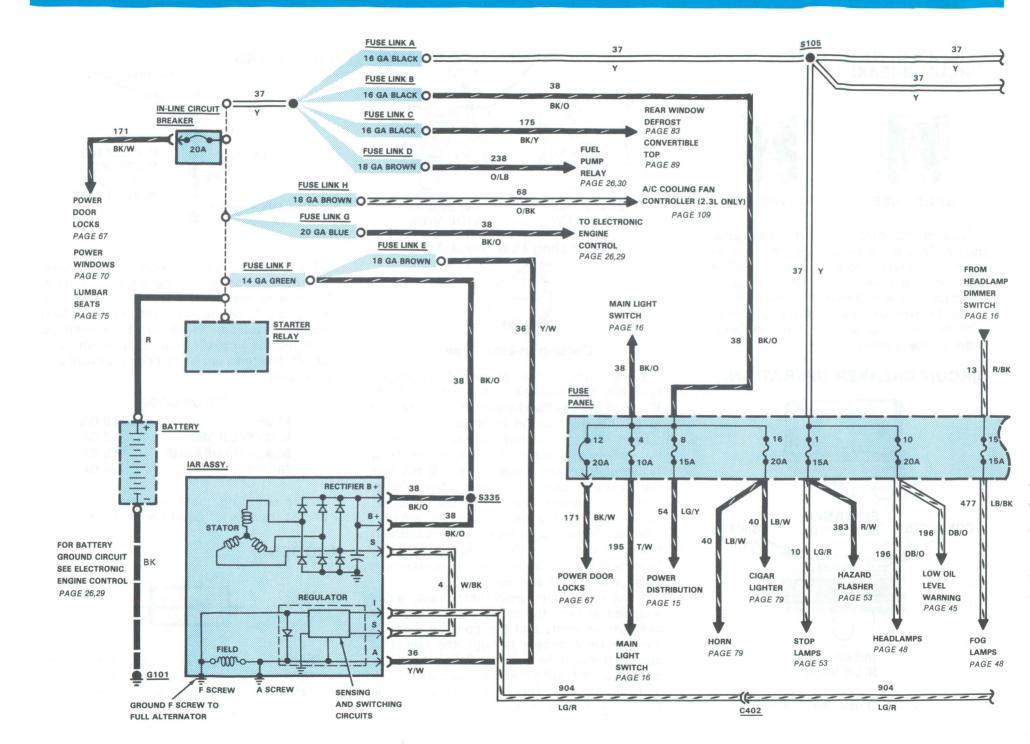
BLUE	20 GA
BROWN OR RED	18 GA
<b>BLACK OR ORANGE</b>	16 GA
GREEN	14 GA

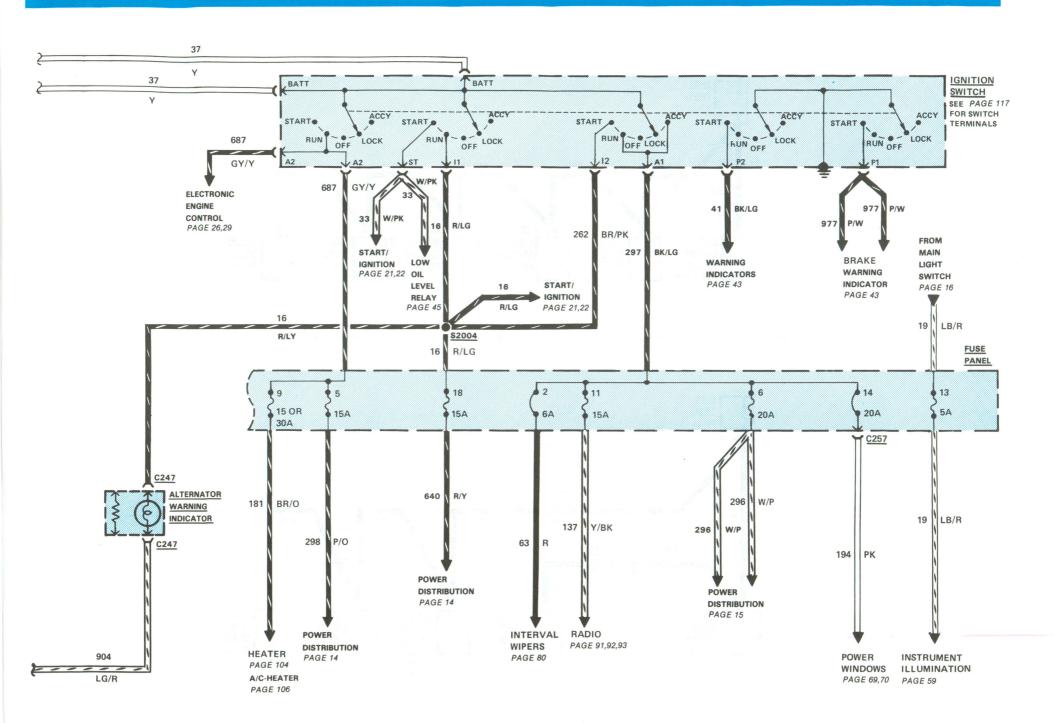
When replacing, make tight crimp joints or hot solder joints for good connections.

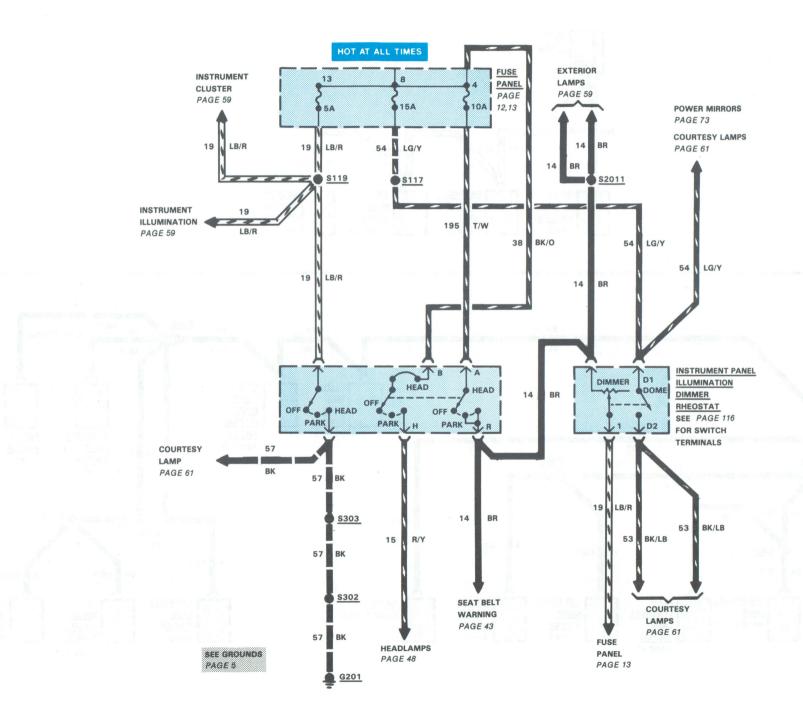
# **DIODES**



Diodes are electrical devices that permit current to flow in one direction only. The current flows in the direction indicated by the arrow.







#### **HOW THE CIRCUIT WORKS**

The **Battery**, **Alternator** and **Voltage Regulator** make up the **Charging System**.

#### With Alternator Warning Indicator

With the **Ignition Switch** in RUN, **Battery** current flows into the **Voltage Regulator** at terminal I and to ground through the solid-state regulator circuits. If the electronic control measures a low voltage at regulator terminal A it closes the field switch. This applies **Battery** voltage to the field.

With current in the field and the rotor turning, the **Alternator** stator produces an AC voltage. This is converted to DC by the rectifier assembly and is fed to terminal B (to **Battery**) and terminal S (stator). (Voltage at S is one-half voltage at B).

A pre-set voltage at terminal S operates the electronic control to open the indicator switch which removes ground from the **Alternator Warning Indicator** (through the heated windshield control modules, on models so equipped).

The Alternator output is controlled by the current in the field. The average voltage on the field depends on the percentage of time the field switch is closed. The electronic control closes the field switch when the voltage at A is low, and opens the switch when the voltage at A is high.

The **Voltage Regulator** holds the system voltage at about 14 volts. The average **Alternator** output is then any required value between zero and full current depending on conditions sensed by the **Voltage Regulator**.

# TROUBLESHOOTING HINTS

#### **IMPROPER CHARGING**

The most common charge system complaints are dead **Battery** and **Alternator Warning Indicator** on at normal speed.

- Check Fuse Link G at Starter Relay.
- · Check Alternator belt tension.

- Check Battery terminals and cable clamps.
- Check for clean and tight connection on Alternator, Regulator, and Starter Relay and alternator output control relay.
- Refer to Shop Manual Section 31-01, Charging System Diagnosis.

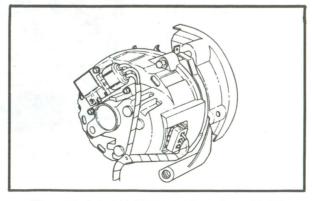


Figure 1- Integral Alternator/Regulator (5.0L)

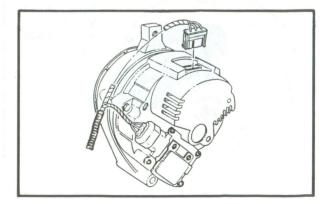


Figure 2- Alternator (2.3L)

18

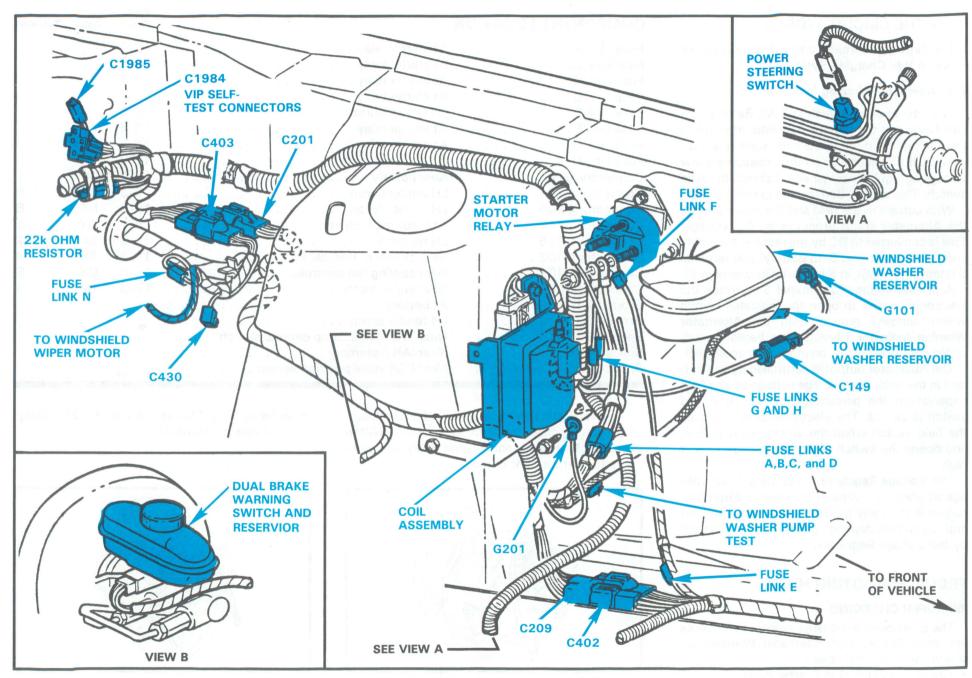


Figure 3- LH Fender Apron (2.3L)

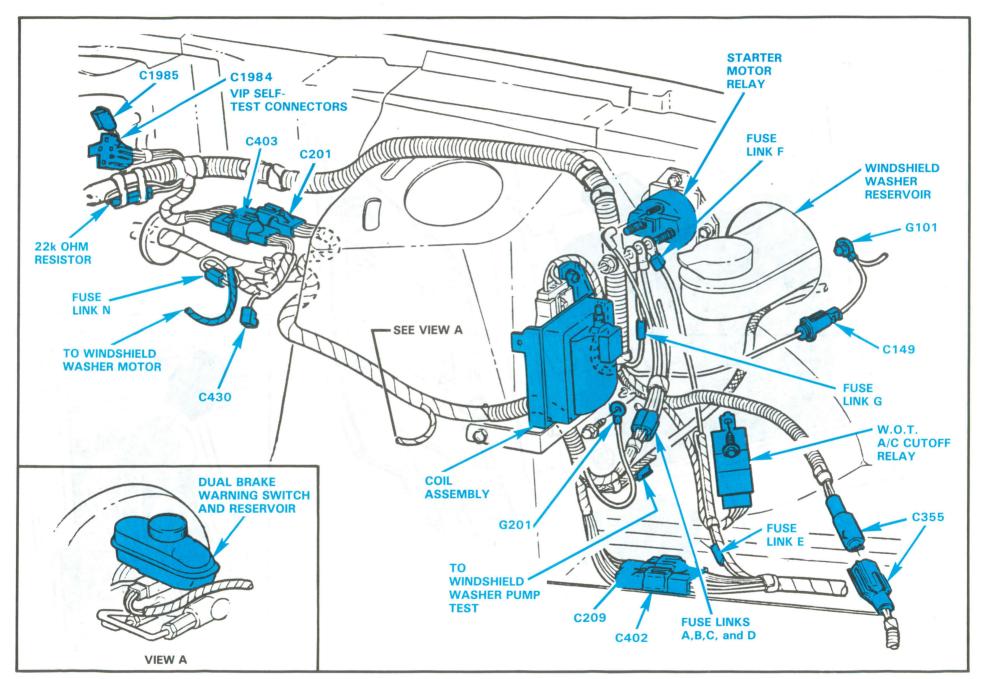


Figure 4- LH Fender Apron (5.0L)

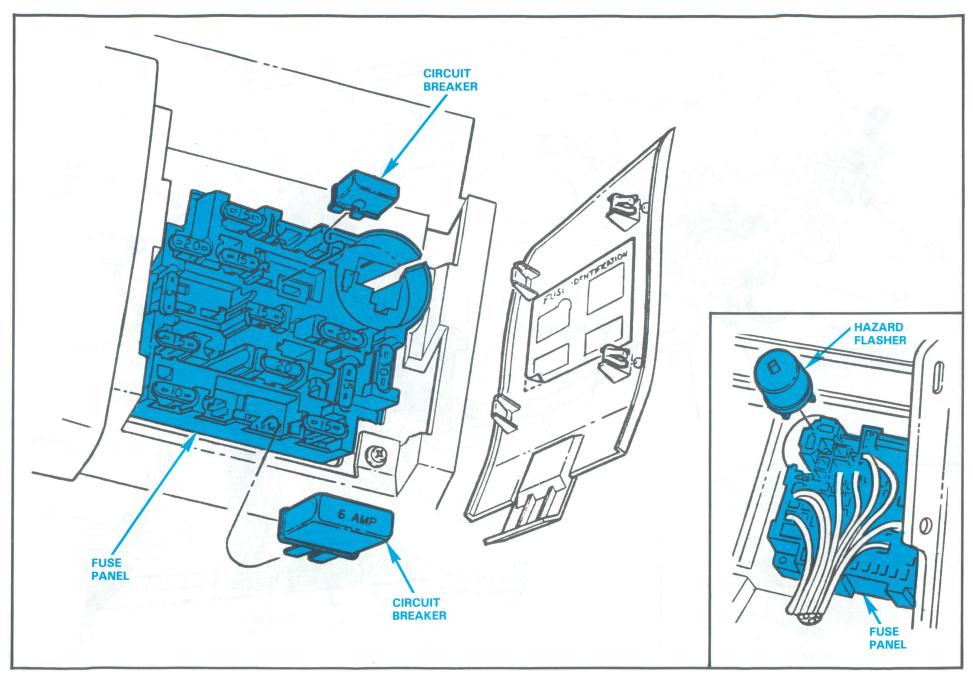
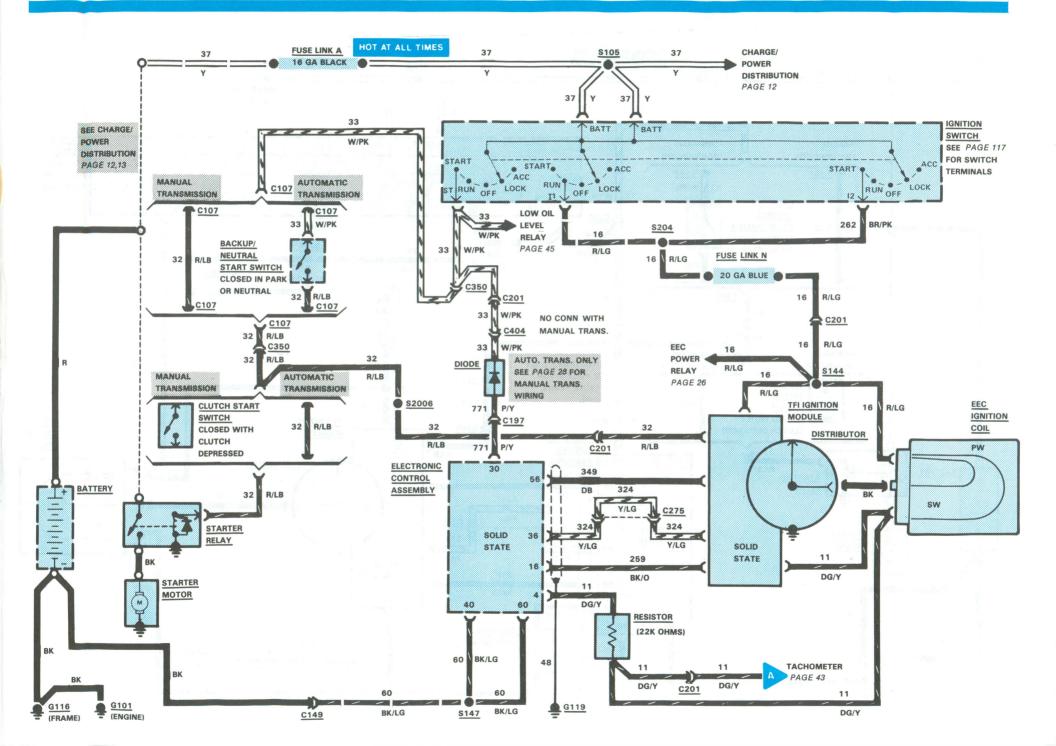


Figure 5- Circuit Breaker and Hazard Warning Flasher



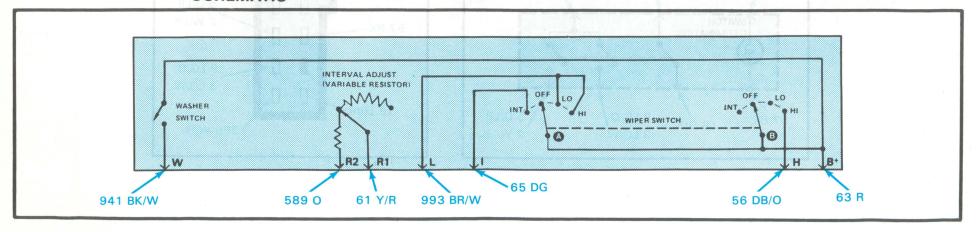
# **TERMINAL LOCATIONS**

# 993 BR/W 65 DG . 941 BK/W 61 Y/R 63 R 589 O 56 DB/O

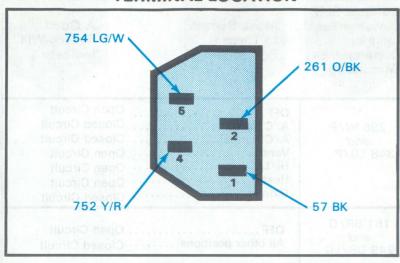
# INTERVAL WIPER/WASHER SWITCH COMPONENT TESTING PROCEDURE

TO TEST	Connect Self Powered Test Lampor Ohmmeter to Terminals	Move Switch to These Positions A Good Switch Will Indicate	
Washer Switch Circuit	941 BK/W (W) and 63 R (B+)	Pull Washer Knob	
ircuit	63 R (B+) and 65 DG (I)	Wiper Switch to INT position . Closed Circuit  All other positions Open Circuit	
Wiper Switch Circuit	63 R (B+) and 993 BR/W (L)	Wiper Switch to Lo position Closed Circuit Wiper Switch to Hi position Closed Circuit All other positions Open Circuit	
ircuit	63 R (B+) and 56 DB/O (H)	Wiper Switch to Hi position Closed Circuit  All other positions Open Circuit	
Interval Adjust	61 Y/R (R1) and 589 O (R2)	Rotate Control Clockwise Ohmmeter will indicate smoothly increasing resistance from 420/880 Ohms minimum to 7000/13,000 Ohms maximum.	

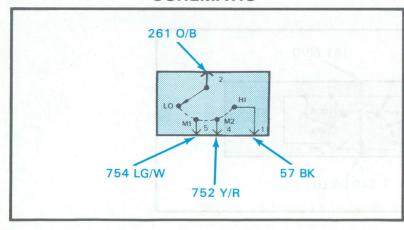
# SCHEMATIC



# TERMINAL LOCATION



# **SCHEMATIC**



# **COMPONENT TESTING PROCEDURE**

TO TEST	Connect Self Powered Test Lamp or Ohmmeter to Terminals	Move Control to These Positions	A Good Switch Will Indicate
Medium-Low Speed	261 O/BK (2) and 754 LG/W (5)	Lo	Closed Circuit Open Circuit
Medium-High Speed	261 O/BK (2) and 752 Y/R (4)	Lo	Open Circuit Closed Circuit
High Speed	261 O/BK (2) and 57 BK (1)	Lo Medium-1 Medium-2 Hi	Open Circuit Open Circuit

#### NOTE

Blower Switch is designed to make contacts with two terminals at one time, except when in LO.









