



**1998-1999
ELECTRICAL WIRING
MANUAL**

MVP-EF

1998-1999 MVP-EF ELECTRICAL WIRING MANUAL

This manual should be kept in a convenient place for ready reference.

All information, illustrations, and specifications contained in this manual are based on the latest product information available at the time of publication approval. The right is reserved to make changes at any time without notice.

No part of this publication may be reproduced, stored in any retrieval system, or transmitted in any form or by any means, including but not limited to electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of Thomas Built Buses Incorporated.

1998-1999 MVP-EF BODY TABLE of CONTENTS

BODY SCHEMATICS	Page #
General Recommendations - Maintenance and Repair .....	.1
System Protection from Short Circuits .....	.1
Testing for Voltage Drop .....	.2
Testing for Short to Ground .....	.2
Checking Current Draw .....	.2
Troubleshooting Tools .....	.2
Troubleshooting Tests .....	.2
PANELS .....	.3
Elect. Components (Body) .....	.4
Elect. Components Front Elect. Panel CAT 3126 (Chassis) .....	.5
Elect. Diagram Front Elect. Panel (Chassis) .....	.6
Elect. Diagram Front Elect. Panel CAT 3126 Engine w/200/250 AMP Alternator (Chassis) .....	.7
Elect. Diagram Front Elect. Panel, Cummins 6B (Chassis) .....	.8
Elect. Diagram Front Elect. Panel, 98 Cummins ISB (Chassis) .....	.9
Elect. Diagram Front Elect. Panel, Cummins ISB Engine w/200/250 AMP Alternator (Chassis) .....	.10
Elect. Diagram Side Elect. Panel, 98 CAT 3126 (Chassis) (1 of 2) .....	.11
Elect. Diagram Side Elect. Panel, 98 CAT 3126 (Chassis) (2 of 2) .....	.12
Elect. Diagram Side Elect. Panel, Cummins 6B (Chassis) .....	.13
Elect. Diagram Side Elect. Panel, Cummins ISB (Chassis) (1 of 2) .....	.14
Elect. Diagram Side Elect. Panel, Cummins ISB (Chassis) (2 of 2) .....	.15
Chart - Circuits, Electrical (Body) (1 of 5) .....	.16
Chart - Circuits, Electrical (Body) (2 of 5) .....	.17
Chart - Circuits, Electrical (Body) (3 of 5) .....	.18
Chart - Circuits, Electrical (Body) (4 of 5) .....	.19
Chart - Circuits, Electrical (Body) (5 of 5) .....	.20
Chart - Electrical Circuits w/Color Codes, 1990 (Chassis) (1 of 3) .....	.21
Chart - Electrical Circuits w/Color Codes, 1990 (Chassis) (2 of 3) .....	.22
Chart - Electrical Circuits w/Color Codes, 1990 (Chassis) (3 of 3) .....	.23
MAIN BODY .....	.25
Main Body - Wiring .....	.26
LIGHTS .....	.28
Driver's Dome .....	.28
Separate Switch for Marker Lights (Option: B3670-01-000) .....	.29
Fog Light, Wiring .....	.30
Back-Up Lamps w/Emergency Door (New Jersey) .....	.31

BODY SCHEMATICS	Page #
LIGHTS (Continued) .....	.32
Strobe Light .....	.32
Strobe Light, Roof Mounted, Specialty Model #205-202 .....	.33
Strobe Light Roof Mounted, Specialty Model #205-212 .....	.34
Strobe Warning System, Whelen School .....	.35
Strobe Light (South Carolina) .....	.36
Strobe Light Operation w/Door Switch .....	.36
Red Warning Light Override Switch .....	.37
EIGHT LIGHT WARNING SYSTEM .....	.39
Four Light Warning System (Wisconsin) .....	.40
Eight Light Warning System .....	.41
Eight Light Warning System .....	.42
Eight Light Warning System .....	.43
Eight Light Warning System .....	.44
Eight Light Warning System .....	.45
Four Light Warning System .....	.46
Eight Light Warning System .....	.47
Eight Light Warning System w/Red Override Switch .....	.48
Eight Light Warning System (South Carolina) .....	.49
Eight Light Warning System .....	.50
Eight Light Warning System .....	.51
Eight Light Warning System .....	.52
Eight Light Warning System (Maryland) .....	.53
Eight Light Warning System (Virginia) .....	.54
Eight Light Warning System (Florida) .....	.55
Eight Light Warning System (Florida) .....	.56
Eight Light Warning System (California) .....	.57
Strobe Eight Light Warning System .....	.58
Eight Light Warning System w/Door Control (Kentucky) .....	.59
STOP SIGNS & CROSSING GATES .....	.61
Electric Stop Sign, Specialty 5000 Series .....	.62
Electric Crossing Arm 5000 Series .....	.63
Air Operated Crossing Control Arm .....	.64
Air Stop Sign & Air Crossing Control Arm .....	.65
Stop Arm Strobe Light, Single and H/L Operation, Electric, Air & Vacuum .....	.66

1998-1999 MVP-EF BODY TABLE of CONTENTS

BODY SCHEMATICS	Page #
STOP SIGNS & CROSSING GATES (Continued) .....	.61
Crossing Arm Deactivating Switch .....	.67
Electric Stop Sign, BMR 6000 Series .....	.68
Electric Crossing Control Arm, BMR 6000 Series .....	.69
Electrical Stop Arm Transpec w/LED's, 4 Wire Harness .....	.70
Electrical Stop Arm Transpec w/LED's, 3 Wire Harness .....	.71
Stop and Crossing Arm Schematic .....	.72
HEATERS .....	.73
Front Heater .....	.74
Stepwell Heater .....	.75
Underseat Heaters .....	.76
Heater (Webasto) Model 2010 12-Volt .....	.77
7 Day digital Timer Heater Model 2010 (Webasto) .....	.78
AIR CONDITIONING .....	.79
Air Conditioning DC-1052, 1053 .....	.80
Air Conditioning AC-7532 .....	.81
LIFTS .....	.83
Lift Schematic (Braun Lift) .....	.84
Lift Schematic (Ricon Lift) .....	.84
Wiring, Thomas Elevator Lift .....	.85
DOORS .....	.87
Lift Door .....	.88
Lift Door with Brake Interlock .....	.89
Loading Door Buzzer Shut Off Switch (Option B3110-01-000) .....	.90
Emergency Door Activated Door Lights, w/and without Vandalock .....	.91
Bode Rear Exterior and Thomas Front Air Door w/5 Position Door Control & Brake .....	.92
Door Control, 2 Position, with Interlock (Option B5016-21-000) .....	.93
Door Control, 2 Position, No Interlock (Option B5016-22-000) .....	.94
Door Control, 5 Position, with Interlock (Option B5016-16-000) .....	.95
Door Terminal Block Wiring (Bode) .....	.96
Wheelchair, Rear Exit, 2 Position Door Control, w/Brake Interlock (Bode) .....	.97
Wheelchair Rear Exit, 2 Position Door Control, w/Brake Interlock (Bode) .....	.98
Wheelchair Driver Controlled Exit Door, Brake Interlock (Bode) .....	.99
Wheelchair Exit w/Touch Bar, Driver Close, w/Brake Interlock (Bode) .....	.100
Wheelchair Driver Controlled Exit Door, Front Door, Brake Interlock (Bode) .....	.101
Wheelchair Exit w/Touch Bar and Time Delay, and Brake Interlock (Bode) .....	.102

BODY SCHEMATICS	Page #
DOORS (Continued) .....	.....
Rear Door w/Front Door, 5 Position Door Control, w/Brake Interlock (Bode) .....	.103
Rear Exit, 2 Position Door Control, w/Brake Interlock (Bode) .....	.104
Rear Door w/Front Door, 5 Position Door Control, w/Brake Interlock (Bode) .....	.105
Rear Exit, 2 Position Door Control, w/Brake Interlock (Bode) .....	.106
Rear Door w/Front Door, 5 Position Door Control, w/Brake Interlock (Bode) .....	.107
Rear Exit, 2 Position Door Control, w/Brake Interlock (Bode) .....	.108
Speedswitch .....	.109
VANDALOCK .....	.111
Electro Thermo Operated Door (Vandalock) .....	.112
Wiring Schematic (Vandalock) .....	.113
RADIO & SPEAKERS .....	.115
PA Radio, Mito SP Series .....	.116
Speaker Hook-Up .....	.117
Speaker Hook-Up .....	.118
PA Radio w/Two Speakers w/Volume Control at Each Speaker .....	.119
Radio w/Speaker Chick Bus .....	.120
Radio Speakers .....	.121
Six Radio Speakers .....	.122
Rheostat Controlled Driver's Speaker .....	.123
Rheostat - 10 Watt Single Line Audio .....	.123
MISCELLANEOUS .....	.125
Doran Monitor All Models .....	.126
Fan Overhead Fan on Chick Bus .....	.127
Fan Wiring .....	.128
Heated Mirrors .....	.129
Video Camera Supply and Ground Circuit (South Carolina) .....	.130
Backing Alarm .....	.131
Roll Back Alarm .....	.131
Cellular Phone Power Outlet and Location .....	.132
Roof Escape Hatch w/Power Vent (Transpec, Model 1600) .....	.133
Onspot Chains .....	.134
Touch Tape Chime System, for ADA Stop Request .....	.135

1998-1999 MVP-EF CHASSIS TABLE of CONTENTS

CHASSIS SCHEMATICS	Page #
MAIN CHASSIS .....	.137
FC Unit Main Chassis (1 of 2) .....	.138
FC Unit Main Chassis (2 of 2) .....	.139
Main Chassis, Cat 3126 Engine (1 of 2) .....	.140
Main Chassis, Cat 3126 Engine (2 of 2) .....	.141
Main Chassis, Cummins ISB (1 of 2) .....	.142
Main Chassis, Cummins ISB (2 of 2) .....	.143
Main Chassis, 98 Elect. Cat 3126 Engine (1 of 2) .....	.144
Main Chassis, 98 Elect. Cat 3126 Engine (2 of 2) .....	.145
Main Chassis, Cummins ISB w/200/250 Amp Alternator (1 of 2) .....	.146
Main Chassis, Cummins ISB w/200/250 Amp Alternator (2 of 2) .....	.147
Main Chassis, Cummins ISB w/200/250 Amp Alternator (1 of 2) .....	.148
Main Chassis, Cummins ISB w/200/250 Amp Alternator (2 of 2) .....	.149
ENGINE .....	.151
Elect. Cat 3126 (1 of 2) .....	.152
Elect. Cat 3126 (2 of 2) .....	.153
Elect. 98 Cummins ISB Engine, FC OEM Interface Conn. B .....	.154
Ether Start Cummins 6B Engine .....	.155
TRANSMISSION .....	.157
Elect. Allison WTEC III Transmission .....	.158
WTEC III, Bussman VIM .....	.159
Elect. Allison MD Elect. Transmission .....	.160
Manual Transmission .....	.161
2 Speed Axle Manual Transmission .....	.162
BRAKES .....	.163
Anti-Lock Brake System (97 Models) (1 of 2) .....	.164
Anti-Lock Brake System (97 Models) (2 of 2) .....	.165
Anti-Lock Brake System w/Traction (98 Models) (1 of 2) .....	.166
Anti-Lock Brake System w/Traction (98 Models) (2 of 2) .....	.167
ABS External Relay Functions .....	.168
Hydraulic Anti-Lock Brake System (98 Models) .....	.169

CHASSIS SCHEMATICS	Page #
BRAKES (Continued) .....	.170
Hydro - Max Hydraulic Brakes 10 Pin Control Module .....	.170
Hydro - Max Hydraulic Brakes Electronic Engine, Cat 3126 .....	.171
Hydraulic Brakes Module, 98 Cat 3126 .....	.172
Hydro - Max Hydraulic Brakes Elect. Engine, 98 Cummins 6B .....	.173
Elect. Pacebrake Exhaust Brake .....	.174
Exhaust Brake w/WTEC III Transmission .....	.175
FUEL .....	.177
Fuel Relay and Fuel Solenoid w/Kysor Protection System .....	.178
SPEEDOMETER .....	.179
Speedo at Trans., Pulse Distrib. Mod. 98 Cummins 6B .....	.180
Speedo MD Trans., WTEC III, 98 Cummins 6B .....	.181
COOLANT .....	.183
Elect. Fan Operation .....	.184
Elect. Fan/Shutter Operation (97 Models) .....	.185
Elect. Fan/Shutter Operation Cat 3126 Engine (97 Models) .....	.186
Shutter Operation 98 Cummins 6B .....	.187
LIGHTS .....	.189
Alarm Head Lights .....	.190
Daytime Running Lights, Standard Headlight Switch .....	.191
Daytime Running Lights, Standard Headlight Switch .....	.192
Daytime Running Lights w/Std. Headlight Switch & Starter Interrupt (1 of 3) .....	.193
Daytime Running Lights w/Std. Headlight Switch & Starter Interrupt (2 of 3) .....	.194
Daytime Running Lights w/Std. Headlight Switch & Starter Interrupt (3 of 3) .....	.195
Pilot "Stop Engine" Lamp 98 Engine, FC Instrument Panel .....	.196
Master Control Switch .....	.197
Hazard Lamps Solid State Flasher .....	.198
MISCELLANEOUS .....	.199
Roll-Back Alarm .....	.200
Alternator Low Output Charge Indicator Relay/Light (Delco Alternator) .....	.201

General Recommendations - Maintenance and Repair

The following comments may be helpful in avoiding some of the most common problems experienced over the life of the bus.

1. Shorts in Cables and Harnesses:

Cables that chafe or dangle will eventually wear through the insulation and result in a short. This can also cause terminals to loosen at their terminal point. Many times a mounting clip is removed to permit access to another component or to service that particular harness/cable. ALWAYS reinstall the mounting clips to their original position.

2. Corrosion in Sockets and Terminals:

This can be a serious problem on units operating on streets and highways using salt and sodium chloride products.

The use of an anti-corrosive sealant, such as Graffo 116 to coat exposed connectors, switches, and ground terminals, is very helpful in deterring corrosion in such areas.

The use of a dielectric grease to coat the base and sockets of bulbs will deter the formation of corrosion in lamps exposed to road contaminants. It, also, reduces road shock in the bulb filaments.

3. Circuit Resistance:

Circuit resistance is usually caused by loose terminals at the point of termination, improper crimping of replacement terminals onto the wire, and unprofessional splicing of two wires together.

Practically all replacement terminals require a special tool to insure a complete, secure bond of the terminal and the wire. If the proper crimping tool is not available, the terminal should be soldered to the wire, using a rosin flux solder. Always cover the end of the terminal with a one inch piece of heat shrink tubing to prevent the entrance of water, salt, etc.

Twisting the wires together is acceptable only if the union is then soldered with rosin flux solder, and covered with a heat shrink tubing extending one inch on each side of the union. Butt splices are also common in such a repair. Again, cover the splice with heat shrink tubing.

Wiring left improperly sealed will corrode, and the corrosion can wick up the entire length of the wire. **Figure 1** is an example of the proper way to splice two wires together.

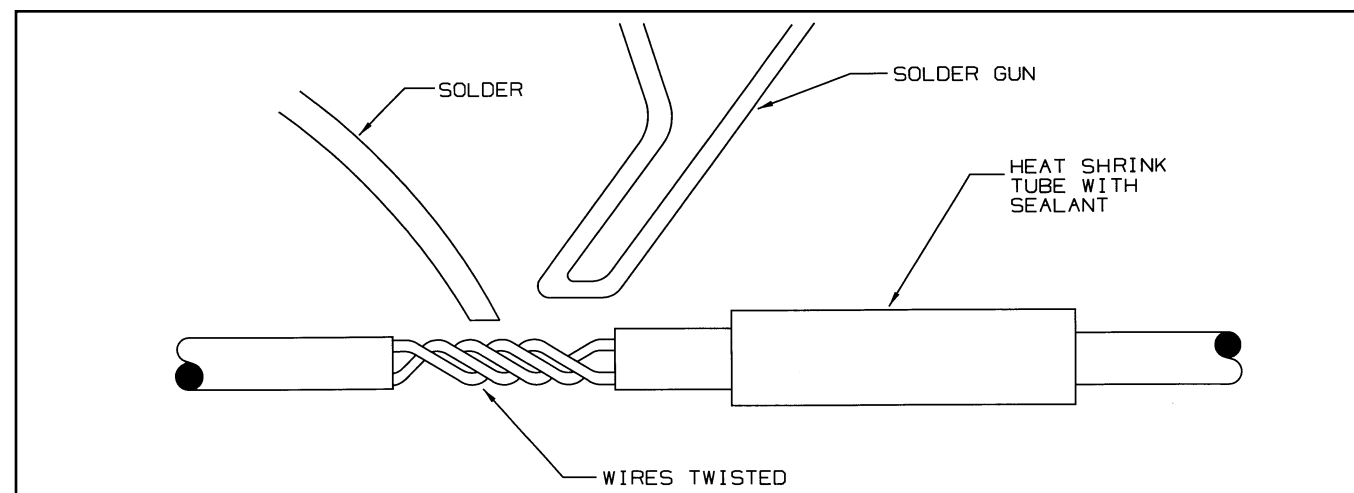


Figure 1

4. Overloaded Circuits:

Additional electrical components should not be added to existing circuits. There is room for additional circuit breakers on the side electrical panel, if additional options are added in the field.

5. Proper Diagnosis:

Thorough diagnosis is a must to eliminate repeat failures in the electrical system. Determining the cause of a particular failure not only solves the problem on the unit involved, but it may be helpful in preventing failures on other similar units in the fleet.

In the event a particular circuit breaker continues to trip, even though no short is found, it would be wise to check the circuit flow on that circuit and compare it to the rating of the circuit breaker. The circuit breaker may be tripping below its rating, or the current draw may be in excess of the breaking rating.

To check current draw on any given circuit, connect an ammeter in series between the circuit and a battery terminal. Energize the circuit and read the amps registered on the ammeter.

System Protection from Short Circuits

The electrical system has three means of protection from damage due to a short circuit in the total system:

1. Each circuit is protected by an automatic resetting circuit breaker. In some instances a circuit breaker may accommodate more than one circuit; however, in no case would the combined load be in excess of the rating of the circuit breaker if all the circuits were energized at the same time. In the event such a circuit breaker is tripping all the time it will be necessary to check out each circuit using that circuit breaker.
2. A 150 amp manual-reset Master circuit breaker is located on the front electrical panel of the MVP-EF, and on the rear electrical panel of the MVP-ER, ER-Transit, CL960 and TL960. This will protect the electrical system from damage that may occur from a major short in any area not protected by a fuse or automatic circuit breaker. This circuit breaker must be manually reset in the event it trips. When the breaker trips, the small RED button will depress. To reset it, move the small black lever located on the left side of the breaker back against the body of the breaker. When the electrical system has to be taken out of service to make other repairs, the master breaker can be tripped by depressing the small RED button in the center of the breaker.

In the event the Master breaker should trip more than once, the cause **MUST** be determined before placing the bus back in service.

3. In the unlikely event a battery cable should short out against a chassis component, the 2 AWG engine-to-chassis ground cable will fail. This cable is attached to the engine block on the right side and is connected to the right frame rail.

In addition to the above precautions to minimize damage from an electrical fire, the insulation on all wiring is of a crosslink polyethylene composition which will not maintain combustion once the copper core of the wire cools. The same applies to convoluted tubing used to protect harnesses and tubing from chafing and the elements.

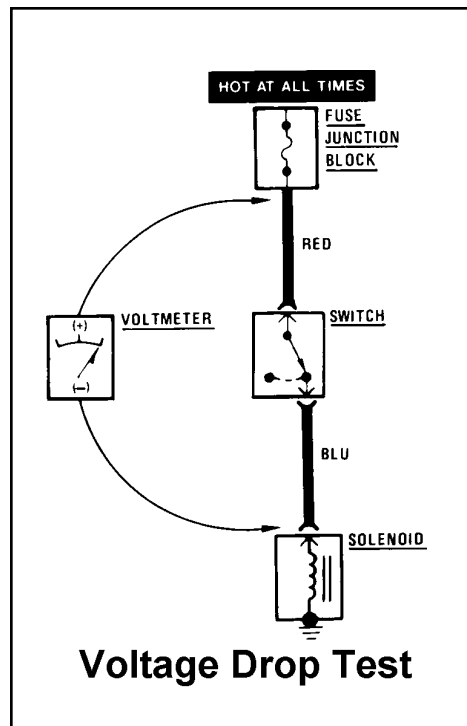


Figure 2

Testing for Voltage Drop

This test checks for voltage being lost along a wire, or through a connection or switch. See **Figure 2**.

1. Connect the positive lead of a voltmeter to the end of the wire (or to the side of the connection or switch) which is closest to the battery.
2. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
3. Operate the circuit.
4. The voltmeter will show the difference in voltage between the two points. A difference (or drop) of more than one volt indicates a problem.

Testing for Short to Ground

1. Remove the blown fuse, leaving the battery connected.
2. Connect the short finder across the fuse terminals.
3. Close all switches in series with the circuit you are troubleshooting.

4. Operate the short finder. The short finder will pulse current to the short. This creates a pulsing magnetic field surrounding the circuit wiring between the fuse junction block and the short.
5. Beginning at the fuse junction block, slowly move the short finder meter along the circuit wiring. The meter will show current pulses through sheet metal and body trim.

As long as the meter is between the fuse junction block and the short, the needle will move with each current pulse. When you have moved the meter past the point of the short, the needle will stop moving. Examine the wiring in that area for the short to ground. See **Figure 3**.

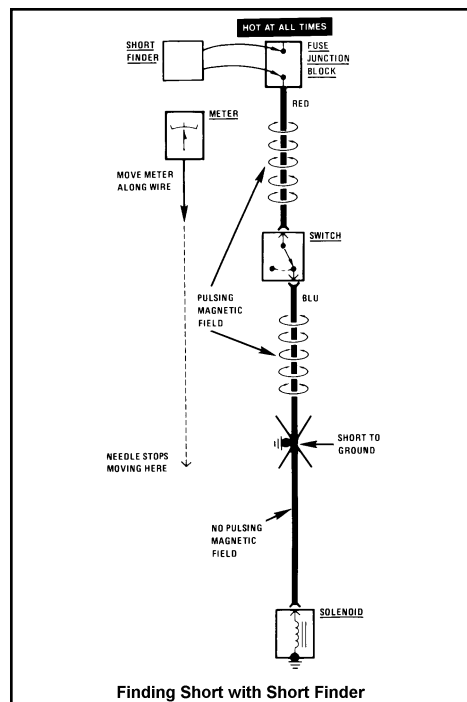


Figure 3

Checking Current Draw

1. Connected in series IN a circuit according to polarity.
2. Measures current flow.
3. Used in a closed circuit. See **Figure 4**.

Troubleshooting Tools

Electrical troubleshooting requires the use of common electrical test equipment.

Test Light/Voltmeter:

Use a test light to check for voltage. A Test Light is made up of a 12-volt light bulb with a repair of leads attached. After grounding one lead, touch the other lead to various points along the circuit where voltage should be present. When the bulb goes on, there is voltage at the point being tested.

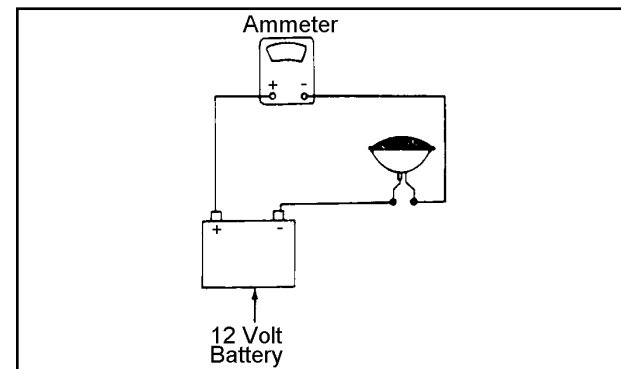


Figure 4

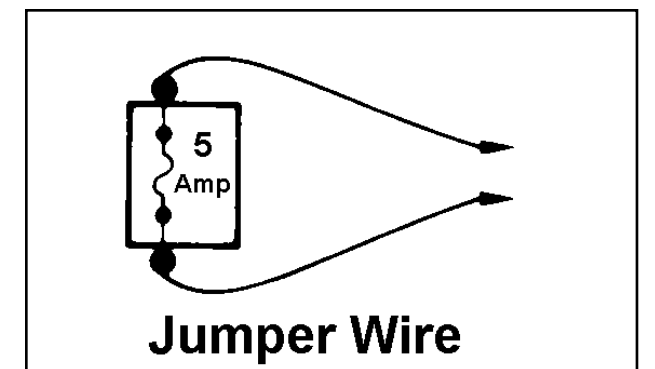


Figure 5

A voltmeter can be used instead of a test light. While a test light shows whether or not voltage is present, a voltmeter indicates how much voltage is present.

Never use a test light on circuits that contain solid state components, since damage to these components may result.

Jumper Wire:

A jumper wire is made up of an in-line fuse holder connected to a set of test leads. It should have a five ampere fuse. Use it for bypassing open circuits. Never use a jumper wire across any load (motors, etc.). This direct battery short will blow the fuse. See **Figure 5**.

Short Finder:

Short Finders are available to locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows you the location of the short through body trim or sheet metal.

Troubleshooting Tests

Test for Voltage:

1. Connect one lead of a test light to a known good ground. If you are using a voltmeter, be sure it is the voltmeter's negative lead that you have connected to ground.
2. Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).
3. If the test light glows, there is voltage present. If you are using a voltmeter, note the voltage reading. It should be within one of measured battery voltage. A loss of more than one volt indicates a problem. See **Figure 6**.

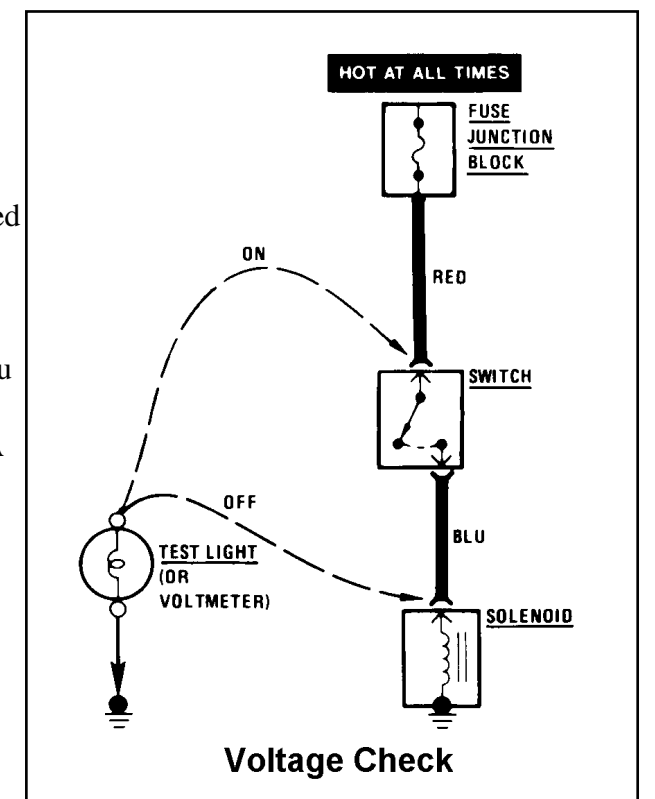


Figure 6

1998-1999 Electrical Wiring Manual

1408 Courtesy Road
Post Office Box 2450
High Point, NC 27261
(336) 889-4871

Thomas Built Buses of Canada
275 Tecumseh Street
Woodstock, Ontario, Canada N4S-7Z5

Thomas Built Buses de Mexico, S.A. de C.V.
Av. "A" No. 100 Frac. Industrial Almacentro
Apodaca, N.L. C.P. 66600 Mexico



A Subsidiary of **FREIGHTLINER**
CORPORATION

Freightliner Corporation is a DaimlerChrysler Company