



Agilent E1343A/E1344A/E1345A/E1347A 16-Channel Relay Multiplexer Module

User's Manual and SCPI Programming Guide

Where to Find it - Online and Printed Information:

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Module configuration and wiring This Manual

SCPI Programming This Manual

SCPI Example Programs This Manual

SCPI command reference This Manual

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Agilent E1343A/44A/45A/47A User's Manual
Edition 5

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Documentation History

All Editions and Updates of this manual and their creation date are listed below. The first Edition of the manual is Edition 1. The Edition number increments by 1 whenever the manual is revised. Updates, which are issued between Editions, contain replacement pages to correct or add additional information to the current Edition of the manual. Whenever a new Edition is created, it will contain all of the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this documentation history page.

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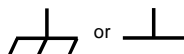
Safety Symbols



Instruction manual symbol affixed to product. Indicates that the user must refer to the manual for specific **WARNING** or **CAUTION** information to avoid personal injury or damage to the product.



Indicates the field wiring terminal that must be connected to earth ground before operating the equipment — protects against electrical shock in case of fault.



Frame or chassis ground terminal—typically connects to the equipment's metal frame.



Alternating current (AC)



Direct current (DC).



Indicates hazardous voltages.

WARNING

Calls attention to a procedure, practice, or condition that could cause bodily injury or death.

CAUTION

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

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DO NOT operate the product in an explosive atmosphere or in the presence of flammable gases or fumes.

For continued protection against fire, replace the line fuse(s) only with fuse(s) of the same voltage and current rating and type. **DO NOT** use repaired fuses or short-circuited fuse holders.

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DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, **REMOVE POWER** and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Agilent Technologies Sales and Service Office for service and repair to ensure that safety features are maintained.

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Model Number: E1343A
Product Options: *This declaration covers all options of the above product(s).*

Conforms with the following European Directives:

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC (including 93/68/EEC) and carries the CE Marking accordingly.

Conforms with the following product standards:

EMC	Standard	Limit
	CISPR 11:1990 / EN 55011:1991	Group 1 Class A
	EN50082-1 :1992	
	IEC 1000-4-2 :1995	4kV CD, 8kV AD
	IEC 1000-4-3 :1995	3 V/m
	IEC 1000-4-4 :1995	0.5kV signal lines, 1kV power lines

The product was tested in a typical configuration with Agilent Technologies or Hewlett-Packard Company test systems

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	EN50082-1 :1992	
	IEC 1000-4-2 :1995	4kV CD, 8kV AD
	IEC 1000-4-3 :1995	3 V/m
	IEC 1000-4-4 :1995	0.5kV signal lines, 1kV power lines

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	EN50082-1 :1992	
	IEC 801-2 :1991	4kV CD, 8kV AD
	IEC 801-3 :1984	3 V/m
	IEC 801-4 :1988	0.5kV signal lines, 1kV power lines

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Safety
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Conforms with the following product standards:

EMC	Standard	Limit
	CISPR 11:1990 / EN 55011:1991	Group 1 Class A
	EN50082-1 :1992	
	IEC 1000-4-2 :1995	4kV CD, 8kV AD
	IEC 1000-4-3 :1995	3 V/m
	IEC 1000-4-4 :1995	0.5kV signal lines, 1kV power lines

Safety

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Using This Chapter

This chapter describes the E1343A 16-Channel High Voltage Relay, E1344A 16-Channel General Purpose Thermocouple High Voltage Relay, E1345A 16-Channel Relay, and E1347A 16-Channel Thermocouple Relay Multiplexer Modules, and shows how to program the modules using SCPI commands (Standard Commands for Programmable Instruments). This chapter contains the following sections:

- Multiplexer Module Description Page 11
- Programming the Multiplexer Module Page 14
- Initial Operation Page 17

Multiplexer Module Description

Refer to Figure 1-1 for the following explanations of all four 16-Channel Relay Multiplexer Modules.

General Description

The multiplexer module switches (multiplexes) up to 16 channels. Each channel provides High (H), Low (L), and Guard (G) connections.

The multiplexer module consists of a component assembly and a terminal module. The channel relay switches are on the component assembly. The field wiring from user sources (e.g., thermocouples) connects to the terminal module. The terminal module also provides connections for multimeters, voltmeters, counters, and other measuring devices.

Multiplexer Channel Descriptions and Connections

The channel relay switches are separated into two banks, Bank 0 and Bank 1. Channels 00 to 07 are in Bank 0 and channels 08 to 15 are in Bank 1. Each bank has its own H, L, and G Common terminals to which the channel switches connect.

The channel switches also connect, through the AT and BT Tree Switches, to the AT and BT Tree Switch Terminals, respectively. The Bank 0 channels connect to the AT Tree Switch Terminals and the Bank 1 channels connect to the BT Tree Switch Terminals. An additional tree switch, the AT2 Tree Switch, provides connection of the Bank 1 channels to AT Tree Switch Terminals. Use channel numbers 90, 91, and 92 to select the AT, BT, and AT2 Tree Switches, respectively.

Connecting to the Tree Switch Terminals is the preferred method to connect measuring devices, like multimeters, to measure the multiplexer channels. This allows you to connect the measuring device to either the Bank 0 or Bank 1 channels at any given time, or to the channels of both banks.

The AT Tree Switch Terminals also connect to the H, L, and G connections on the Analog Bus Connector. The BT Tree Switch Terminals also connect to the I+, I-, and IG connections on the Analog Bus Connector. The Analog Bus Connector provides direct channel connections between multiple multiplexer modules, and connections between a multiplexer module and the E1326/E1411 Multimeters. Cables make the necessary connections without the need to externally wire the multimeter/multiplexer modules via the terminal modules.

The 16-Channel Thermocouple Relay Multiplexer Modules (E1344A and E1347A) uses the RT Tree Switch (Channel 93) to connect the thermistor on the terminal module to the Bank 1 channel common. The thermistor can be measured to determine the temperature inside of the terminal module to compensate for temperature measurements made with thermocouples (see Chapter 3).

Each channel High (H) line has a jumper on the terminal module that may be removed to add filter components (see Chapter 2 under the “Adding Signal Conditioning Components/Current Shunts” heading). Each Bank 0 and Bank 1 common line, the AT and BT Tree Switch, and the Analog Bus lines all have 100 ohm resistors in series with each line. The resistors provide relay protection and are located on the component module.

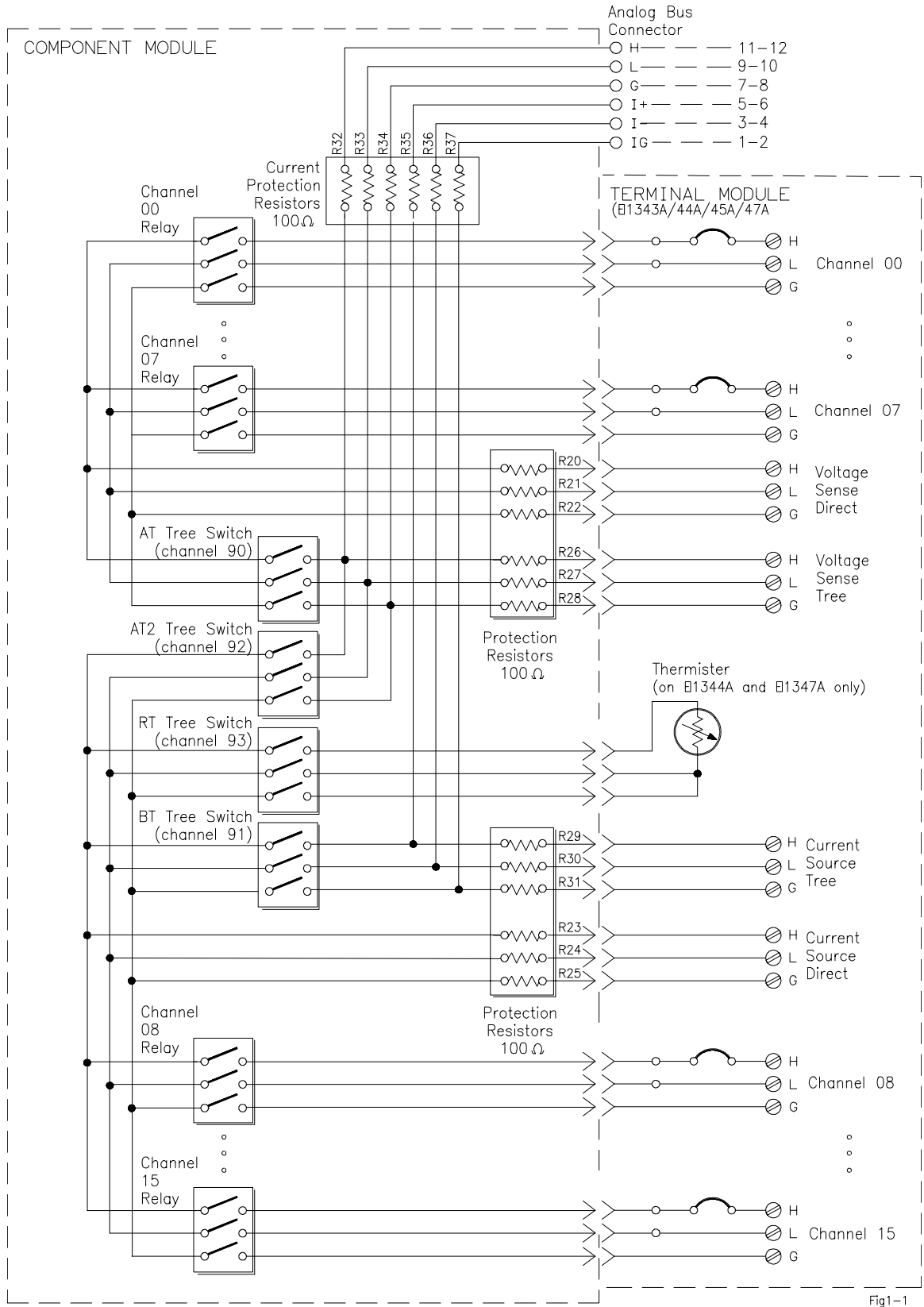


Fig1-1

Figure 1-1. Multiplexer Module Block Diagram

Programming the Multiplexer Module

The multiplexer modules are programmed either in a switchbox or scanning voltmeter configuration. To program the multiplexer modules using the Standard Commands for Programmable Instruments (SCPI), you must select the controller language, interface address, and SCPI commands to be used. See the *75000 Series B Installation and Getting Started Guide* or the *E1406 Command Module Manual* for interface addressing and controller language information of multiplexer modules in a switchbox or scanning voltmeter configuration. **If using the E1300 Mainframe or E1405 Command Module, you MUST have version 06.00 (or greater) firmware for the Multiplexer Modules to properly identify.**

Note This discussion applies to SCPI programming. See Appendix B (“16-Channel Relay Multiplexer Registers”) for details on multiplexer modules registers.

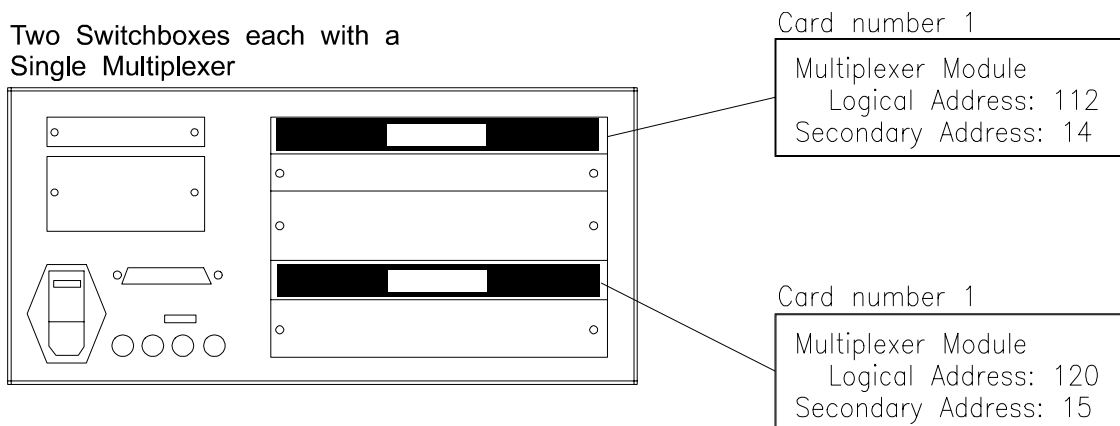
Selecting Channels

To address specific channels within a multiplexer module in a switchbox or scanning voltmeter configuration, you must:

- send the appropriate SCPI command string to the switchbox or scanning voltmeter (e.g., CLOSe, OPEN, etc.)
- specify the card number
- specify the channel number

Multiplexer Card Numbers

The card number identifies the module within a switchbox or scanning voltmeter configuration. The switch module with the lowest logical address is always card number 01. The card number with the next successive logical address is 02, and so on. Figure 1-2 illustrates the card number and logical address of a typical single module switchbox.



E1345 Fig1-2

Figure 1-2. Card Numbers for a Single Module Switchbox

Figure 1-3 illustrates the card numbers and logical addresses of a typical multiple module switchbox. Figure 1-4 illustrates the card numbers of a typical multiple module scanning voltmeter.

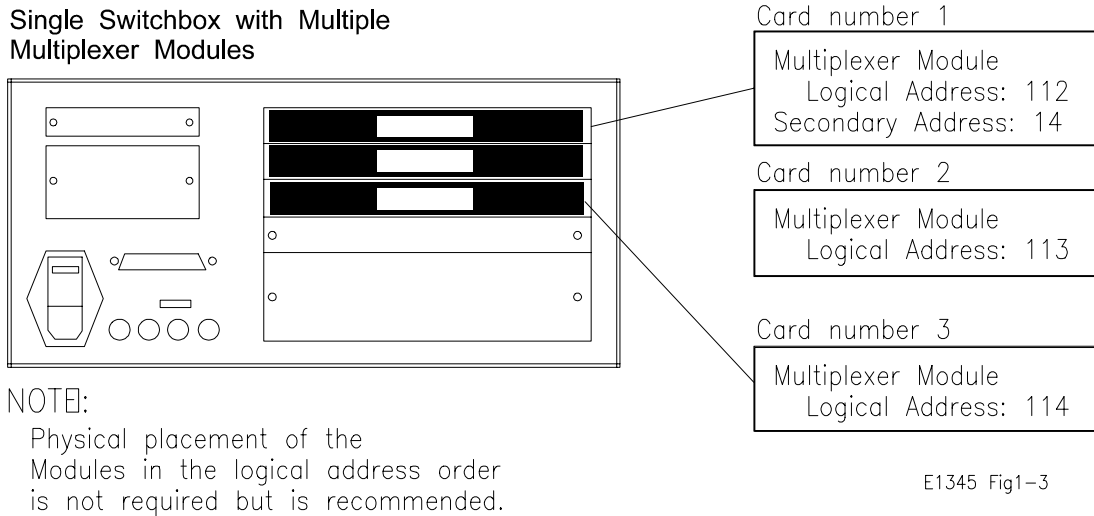


Figure 1-3. Card Numbers for a Multiple Module Switchbox

The logical addresses noted in Figures 1-2, 1-3, and 1-4 apply to modules installed in an 75000 Series B Mainframe (Model Number E1300/E1301) or in a mainframe with an E1405/E1406 Command Module. See the *75000 Series B Installation and Getting Started Guide* or the *E1406 Command Module Manual* for more information on switchboxes and scanning voltmeter configurations, and logical addressing. **If using the E1300 Mainframe or E1405 Command Module, you MUST have version 06.00 (or greater) firmware for the 16-Channel Multiplexer Modules to properly identify.** For uses in other systems or mainframes, see the appropriate manuals.

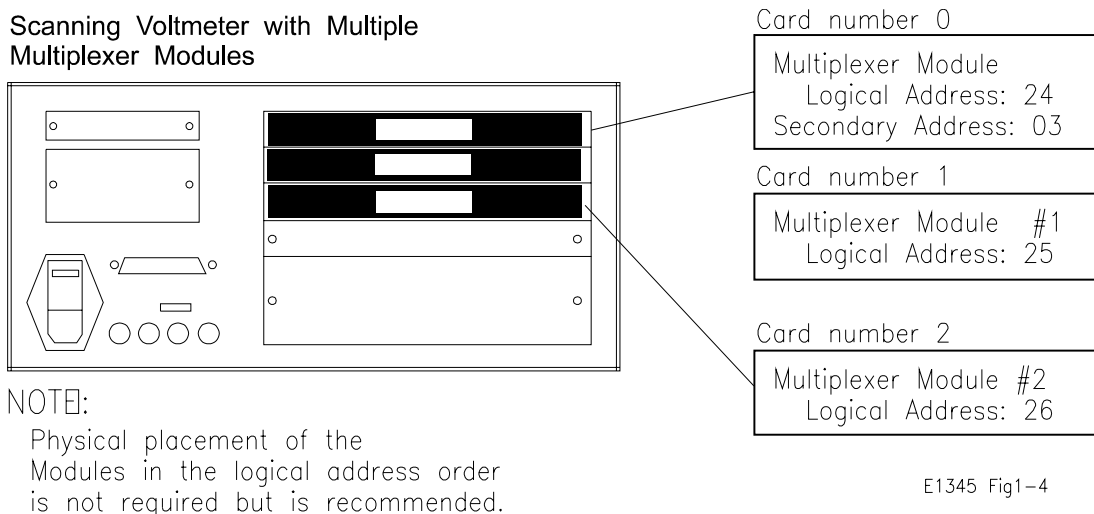


Figure 1-4. Card Numbers for a Multiple Module Scanning Voltmeter

Multiplexer Channel Address

For the 16-Channel Multiplexers, the channel address (*channel_list*) is in the form:

- (@ccnn) for a single channel;
- (@ccnn,ccnn) for multiple channels;
- (@ccnn:ccnn) for sequential channels;
- (@ccnn:ccnn,ccnn:ccnn) for groups of sequential channels;
- or any combination of the above.

where "cc" is the card number and "nn" is the channel number.

For example, the command string to close channel 02 of card number 1 is:

```
CLOSe (@0102)
```

Since "cc" (the card number) must be sent, it becomes part of the channel number. Also, you can ignore leading zeros in the card numbers. Thus, to close channel 02, send "102" instead of "0102". To close the above channel, execute:

```
CLOSe (@102)
```

SCPI Command Format Used in This Manual

You can send SCPI commands in either a short or long form. A long form example is:

```
CLOSe (@102)
```

The same command shown without the lower case letters is the short form. The command then becomes:

```
CLOS (@102)
```

Some commands in this manual are shown with brackets ([]). These are implied or optional commands that you do not have to execute. For example, the ROUT command is an implied command and is shown in this manual as:

```
[ROUT:]CLOS (@102)
```

Thus, to execute these commands, simply enter:

```
CLOS (@102)
```

See Chapter 5 for more explanation about SCPI commands and how to send them.

Initial Operation

Use the following program example to verify initial multiplexer operation by closing a channel and querying channel closure. The example first resets the switchbox and then closes channel 02 of a single multiplexer module (card number 1) in the switchbox. The program next queries the channel closure state. A returned "1" shows that the command to close the channel has been sent to the switchbox. A returned "0" shows that the command to close the channel has not been sent to the switchbox.

The computer used in the example is an Series 200/300 computer with BASIC as the program language. The computer interfaces to the mainframe using the General Purpose Interface Bus (GPIB)¹. The GPIB interface select code is 7, the primary address is 09, and the secondary address is 14. Refer to the *75000 Series B Installation and Getting Started Guide* for addressing information.

Example: Reset the switchbox and close channel 02

10 OUTPUT 70914;"*RST"	<i>Opens all channels.</i>
20 OUTPUT 70914;"CLOS (@102)"	<i>Close channel 02.</i>
30 OUTPUT 70914;"CLOS? (@102)"	<i>Query channel 02 state.</i>
40 ENTER 70914;Value	<i>Enter results into Value.</i>
50 PRINT Value	<i>Display result.</i>
60 END	

1. GPIB is Agilent Technologies' implementation of IEEE-488.2

Notes:

Configuring the Relay Multiplexer Modules

This chapter shows how to connect external wiring to the 16-Channel Relay Multiplexer Modules, and how to configure them:

- Warnings and Cautions Page 19
- Connecting Field Wiring. Page 20
- Wiring a Terminal Module Page 21
- Connecting the Analog Bus Page 22
- Setting the Card ID Page 23
- Setting the Logical Address Switch Page 23
- Using the Multiplexer Module with an Agilent Mainframe or Command Module. Page 24
- Selecting the Interrupt Priority Page 26
- 5 Volt Excitation for Strain Gages Page 27
- Adding Signal Conditioning Components/Current Shunts. . . Page 27
- Connecting User Inputs. Page 29

Warnings and Cautions

WARNING SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the modules. Before installing any module, disconnect AC power from the mainframe and from user wiring.

To prevent electrical shock, all wires to the channel connections must be insulated to at least 120 Vrms (170 V peak).

Caution MAXIMUM VOLTAGE/CURRENT. Maximum voltage that may be applied between High (H), Low (L), and Guard (G) terminals is 170 V dc or 120 V rms (170 V peak) for the E1345A/47A or 250 V dc or AC RMS (354 V peak) for the E1343A/44A. Maximum current is 50mA (non-conductive) per channel.

STATIC ELECTRICITY. Static electricity is a major cause of component failure. To prevent damage to the electrical components in the multiplexer module, observe anti-static techniques whenever removing a module from the mainframe or whenever working on a module.

Connecting Field Wiring

Figure 2-1 shows the terminal module for the 16-Channel High Voltage Relay (E1343A), 16-Channel Relay (E1345A), 16-Channel General Purpose Thermocouple High Voltage Relay (E1344A), and 16-Channel Thermocouple Relay Multiplexer Modules (E1347A). Use the following guidelines for wire connections.

Wiring Guidelines

- If possible, use shielded cables with the shields connected to the Guard (G) terminals and to the low connection near the measurement point.
- Be sure the wires make good connections on the screw terminals.
- For thermocouples, connect the Guard terminal to the thermocouple's shield lead and the low connection near the measurement point.

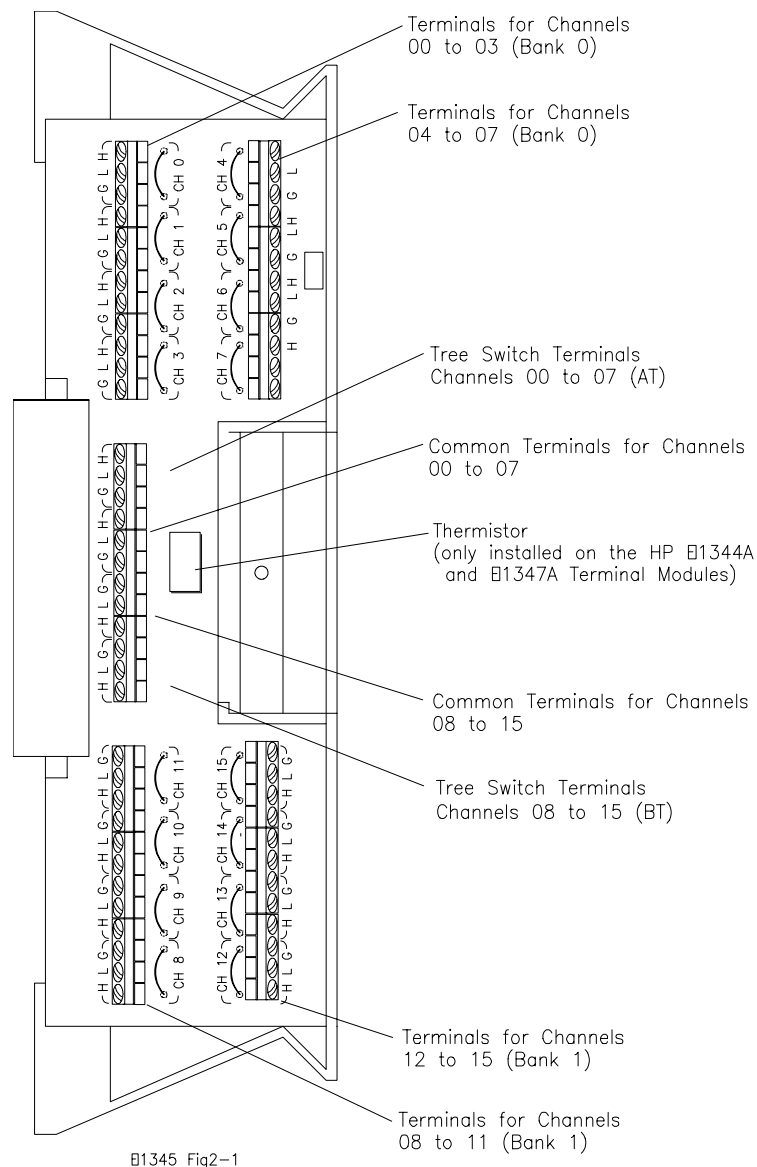
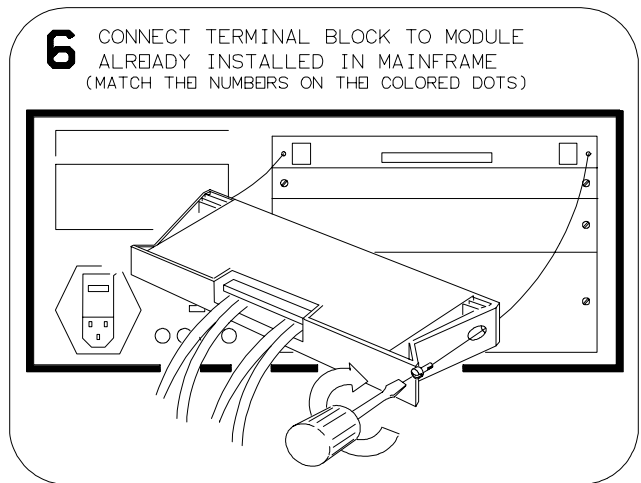
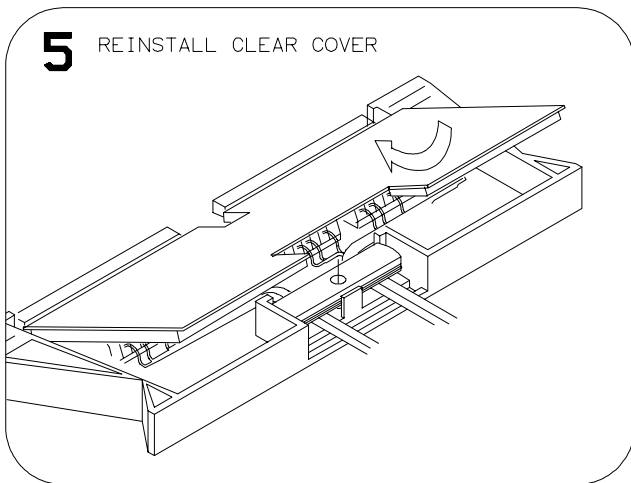
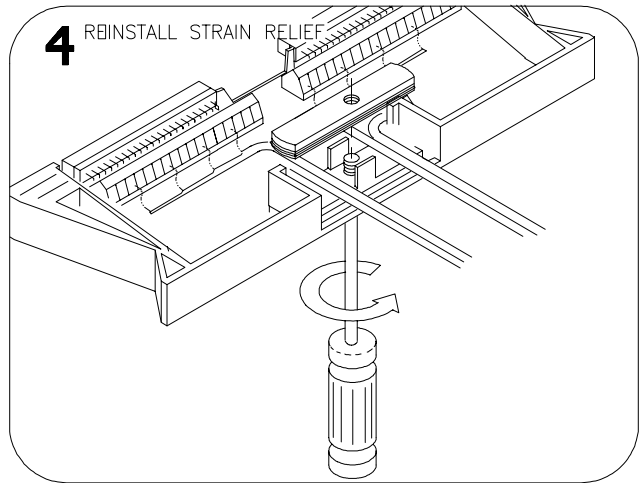
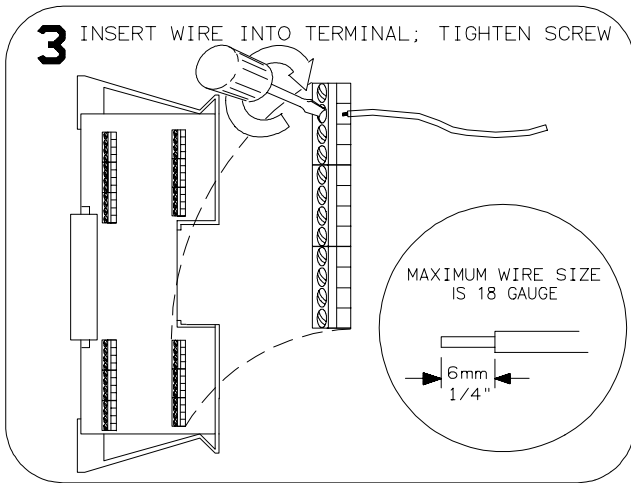
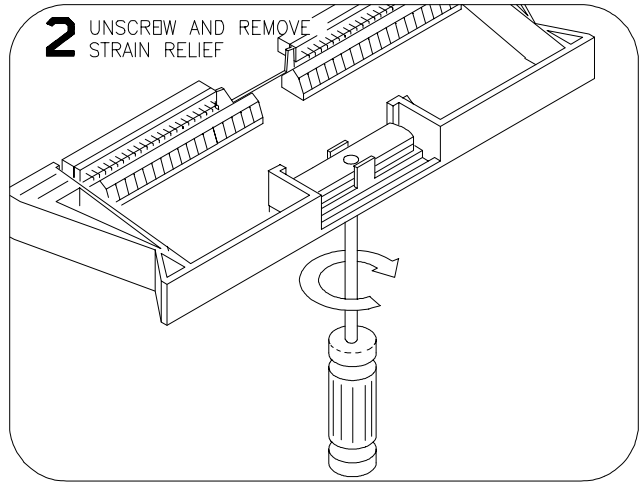
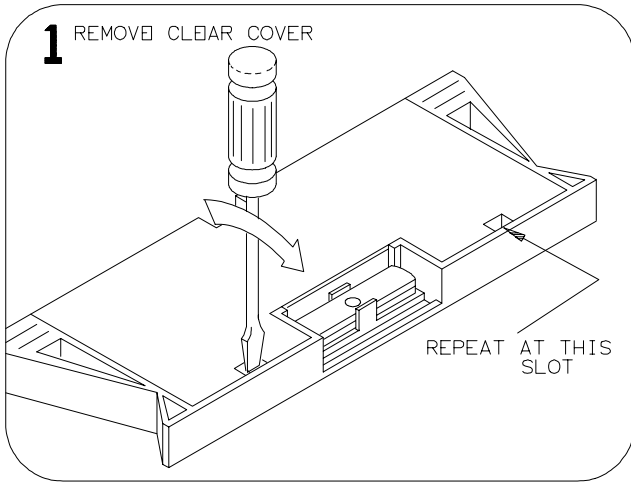


Figure 2-1. Multiplexer Modules Connector Blocks

Wiring a Terminal Module



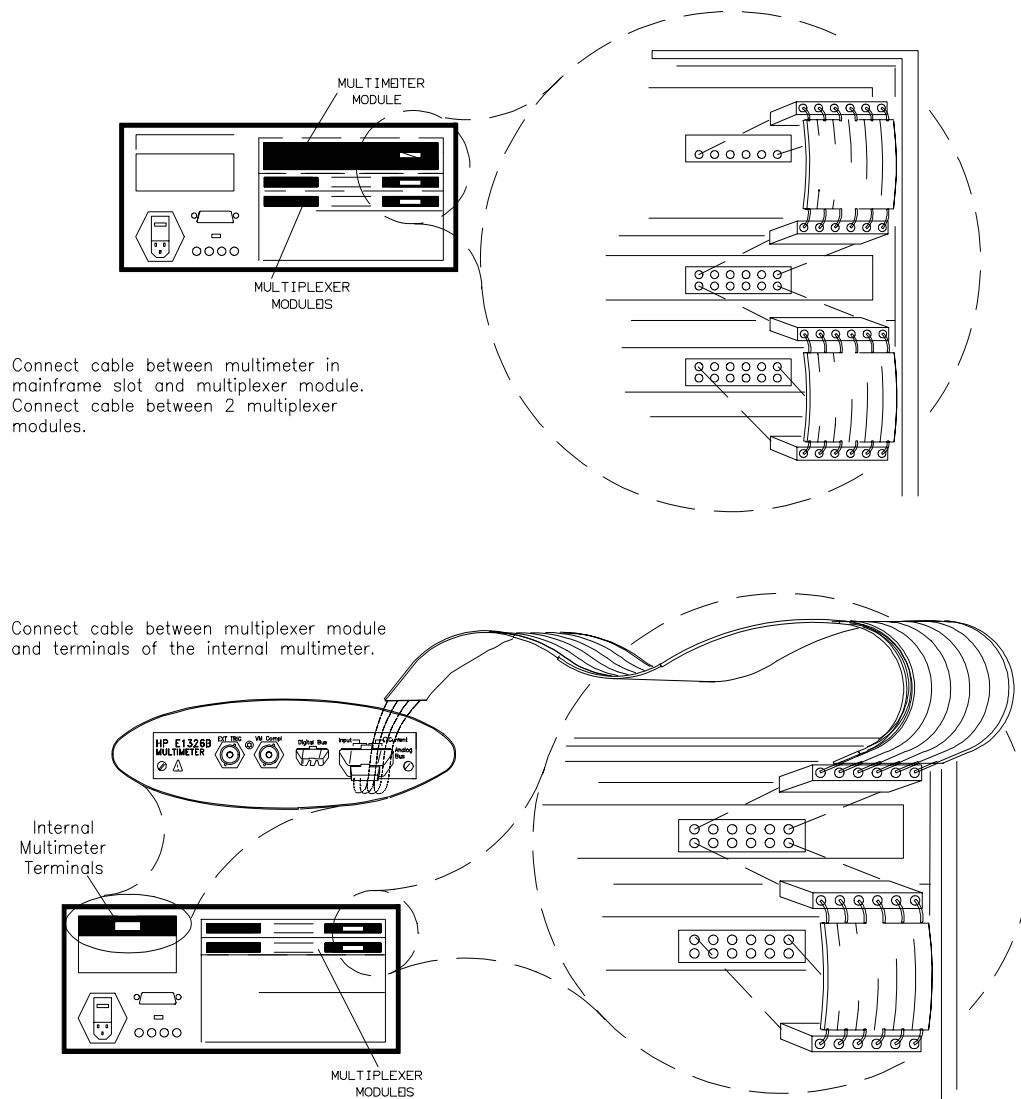
E1345 Fig2x

Connecting the Analog Bus

Figure 2-2 shows how to connect the analog bus between multiple multiplexer modules and to the E1326 Multimeter. Use the cables shipped with the multiplexer modules to connect the analog bus of the multiplexer modules. Use the cable shipped with the E1326 Multimeter to connect the analog bus of the multiplexer module to the Multimeter input.

These cables are needed to connect the MUX when mounted in the E1403 Module Carrier to the E1411A/B DMM in a C-size cardcage. They must be ordered separately.

1. Connecting E1411 to RELAY MUXs: use E1326-61611 (long analog bus cable).
2. Connecting RELAY to RELAY or RELAY to FET MUX: use E1400-61605.



E1345A FIG2-2

Figure 2-2. Analog Bus Connections Between Multiplexer/Multimeter Modules

Setting the Card ID

The Card ID Jumpers indicate which terminal assembly is used. Since the E1343-66201 and E1345-66201 assembly is used with a variety of terminal modules, the ID jumpers may be changed. To reduce setup time and avoid configuration errors, check the jumpers to make sure they match the terminal module used.

When the relay multiplexers are shipped from the factory, the Card ID Jumpers are set according to the terminal module (E1343/44/45/47/55/56) shipped with them. The system is able to identify the multiplexer with or without the terminal module attached.

Note If the jumper setting does not match the terminal module attached, the system will identify the card based on the jumper setting.

Setting the Logical Address Switch

The address switch (LADDR) factory setting is 112. You may have changed the setting during module installation. Valid address values are from 0 to 255. Refer to the *75000 Series B System Installation and Getting Started Guide* or the *E1406 Command Module Manual* for addressing information. Otherwise, to change the setting, refer to the Figure 2-3.

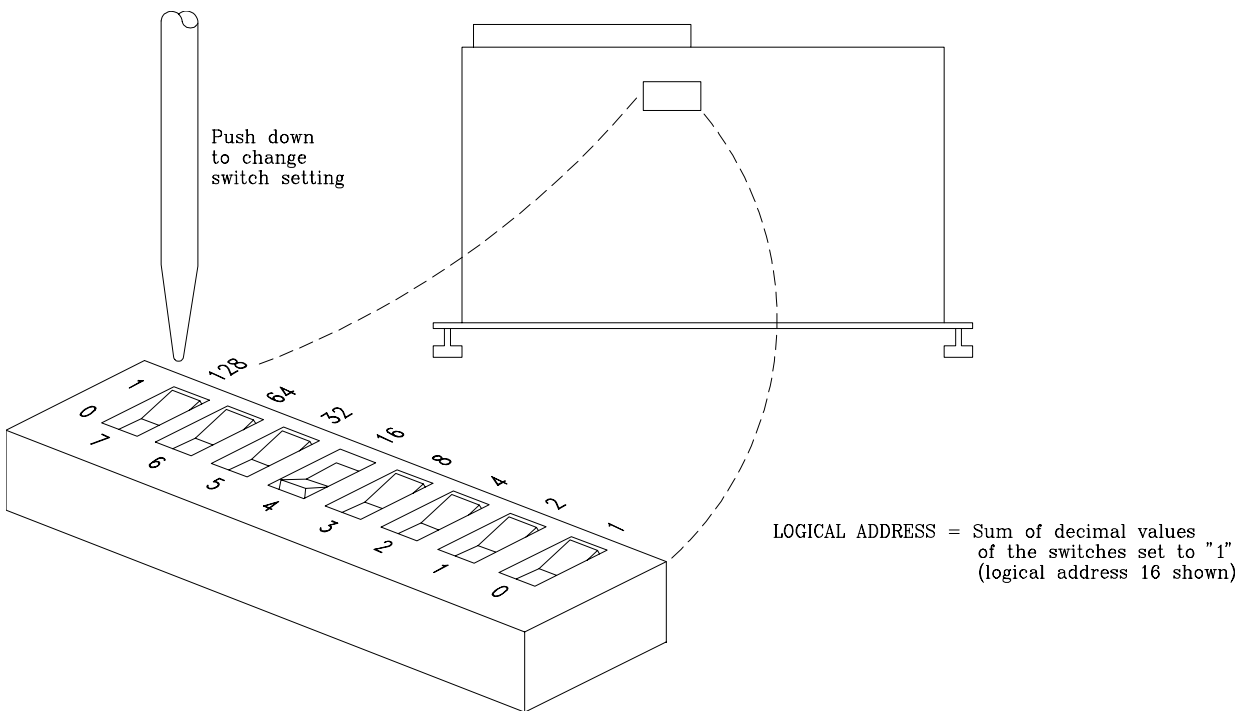


Figure 2-3. Locate and Set the Logical Address Switch

Using the Multiplexer Module with an Agilent Mainframe or Command Module

To program the multiplexer modules with an E1300A/01A Mainframe or an 1405B/E1406A Command Module, the modules must be configured as an instrument. **If using the E1300 Mainframe or E1405 Command Module, you MUST have version 06.00 (or greater) firmware for the 16-Channel Multiplexer Modules to properly identify.** An instrument configuration for the multiplexer modules must be a:

- Scanning Voltmeter - Used with an E1326B/E1411A Multimeter.
- Switchbox - Used with other switch type modules, like other multiplexer modules, etc.

(The above requirements are not necessary if using register-based programming to program the modules.)

Using the Scanning Voltmeter Configuration

Use this configuration for:

1. Easiest system programming.
2. Fastest execution speed.
3. Thermocouple measurements if using the E1326B/E1411B temperature function.

To use this configuration, set the multimeter's logical address to a multiple of 8. Also set the first multiplexer module's logical address to the next address value, the second module to the next address value, and so on. The following shows the logical address settings of a Scanning Voltmeter with the multimeter address set to 24.

Logical Address	Module	Channels
24	E1326B/E1411A	N/A
25	E1345A/E1347A	100-115
26	E1345A/E1347A	200-215

To program the scanning voltmeter, use the programming information in the appropriate multimeter manual.

Using the Switchbox Configuration

Use this configuration when:

1. Simultaneously closing multiple channels on multiple modules.
2. Other multimeters/modules cannot control the multiplexer modules.

To use this configuration, set the first multiplexer module's logical address to a multiple of 8. Set the next multiplexer module's logical address to the next address value, the third module to the next address value, and so on. The following shows the logical address settings of a switchbox with the first multiplexer module address set to 112.

Logical Address	Module	Channels
112	E1345A/E1347A	100-115
113	E1345A/E1347A	200-215
114	E1345A/E1347A	300-315

To program the switchbox, use the programming information in this manual.

Verifying Correct Logical Address Settings

To verify that the modules have the correct logical address setting, query the E1300A/E1301A Mainframe or E1405B/E1406A Command Module as follows:

E1301A Mainframe - From the “Select a Instrument” prompt of the front panel, select the following menus:

```
SYSTEM
CONFIG?
LADDS
```

E1300A Mainframe, E1405B, or E1406A Command Module with an RS-232 Terminal - From the “Select an Instrument” prompt, select the following menus:

```
SYSTEM
CONFIG?
LADDS
```

If no front panel or RS-232 terminal is available, send the following SCPI query command to the mainframe/command module:

```
VXI:CONF:DLAD?
```

The returning string contains all logical addresses in the system.

Selecting the Interrupt Priority

The multiplexer modules generate interrupts after a channel relay closing or opening completes. These interrupts set the selected line on the VXI peripheral interrupt bus true.

The VXI peripheral interrupt bus consists of 7 interrupt priority lines that carry the interrupt signal to the commander. Line 1 has the highest priority and line 7 the lowest. The multiplexer module's default setting is line 1, since it is the most commonly used interrupt line.

The E1300A/E1301A Mainframe default operation is to monitor all seven interrupt lines. The E1405B/E1406A Command Module's default operation is to manage only one line. The Command Module does, however, use an interrupt line allocation table that allows you to select which lines the command module is to monitor. For embedded controllers, refer to the appropriate controller documentation to determine which of the line(s) the controller monitors.

When using an E1300A/E1301A Mainframe or E1405B/E1406A Command Module for register-based programming (instead of the SCPI driver) and where the program generates an interrupt, be sure to use the multiplexer module's interrupt line that does not interfere with the program. Use the line that is not used by the SCPI driver to generate interrupts.

Refer to Figure 2-4 to change the interrupt priority. Unsolder and remove two jumpers from the old priority location. Install the jumpers in the new priority location (Figure 2-4 shows a priority change from 1 to 7).

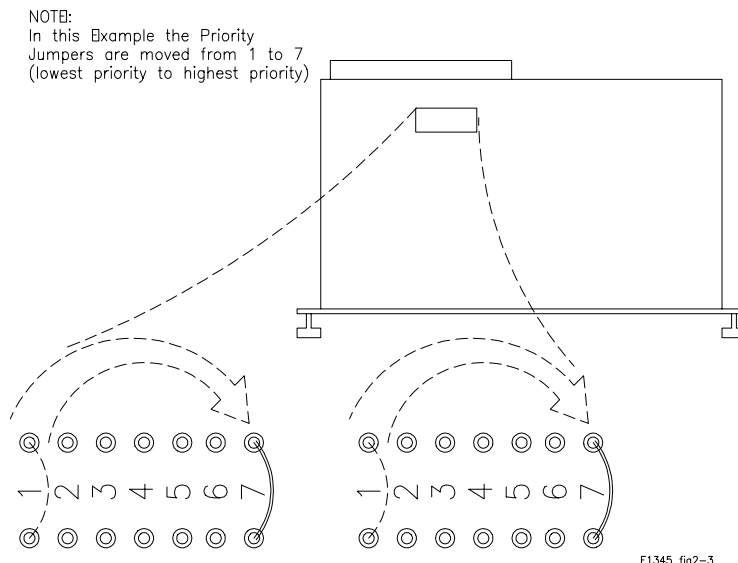


Figure 2-4. Changing the Priority Interrupt Level Jumpers

5 Volt Excitation for Strain Gages

The E1345-66201 is used with a variety of terminal modules including the E1355A and E1356A Strain Gage Multiplexers. When used with these strain gages, the jumpers JM1 and JM2 may be installed to provide 5 volt excitation to the strain gage bridge. This voltage is fused at 4A. Channel x93 is used to sense it.

Jumpers JM1 and JM2 must be removed when used with the E1347A Thermocouple terminal module. This must be done because the connector pins in this case are used to sense the 5k Ohm thermistor on the terminal module.

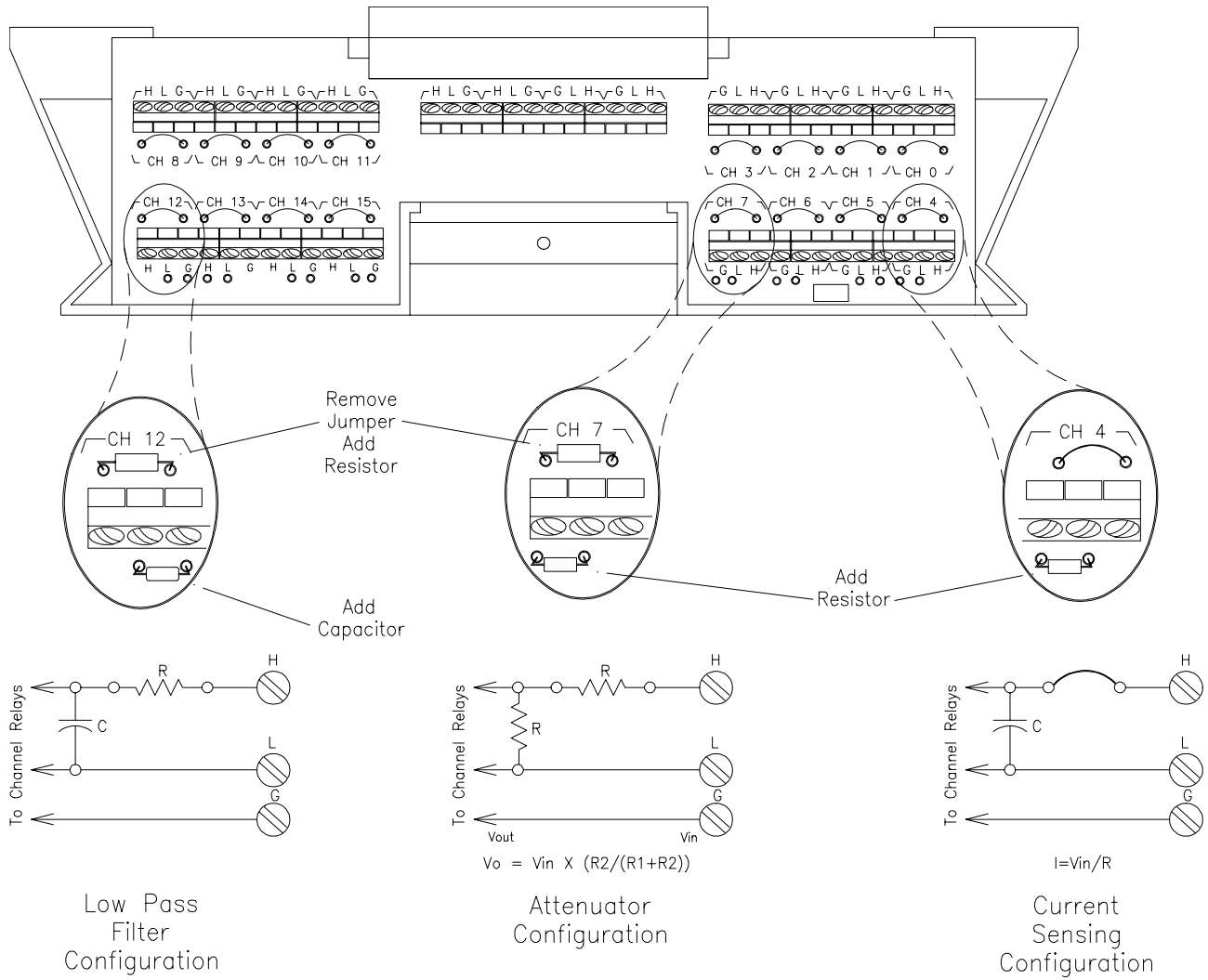
When the relay multiplexer is shipped from the factory, the jumpers are not installed.

Adding Signal Conditioning Components/Current Shunts

The multiplexer module's terminal module allows you to add components on each channel for:

- Low-Pass Filters
- Attenuators
- Current Shunts (for current measurements using a voltmeter)

Figure 2-5 shows how to install the appropriate components for the above configurations. In the figure, channel 12 shows a low pass filter configuration, channel 07 an attenuator configuration, and channel 04 a current shunt configuration.



E1345 Fig2-4

Figure 2-5. Signal Conditioning Components/Current Shunts

Connecting User Inputs

The relay switch modules consist of a relay component module and a connector (terminal) block. If you choose not to use the supplied connector block, Figure 2-6 shows the front panel for the modules and the connection diagram for wiring your own terminal connector.

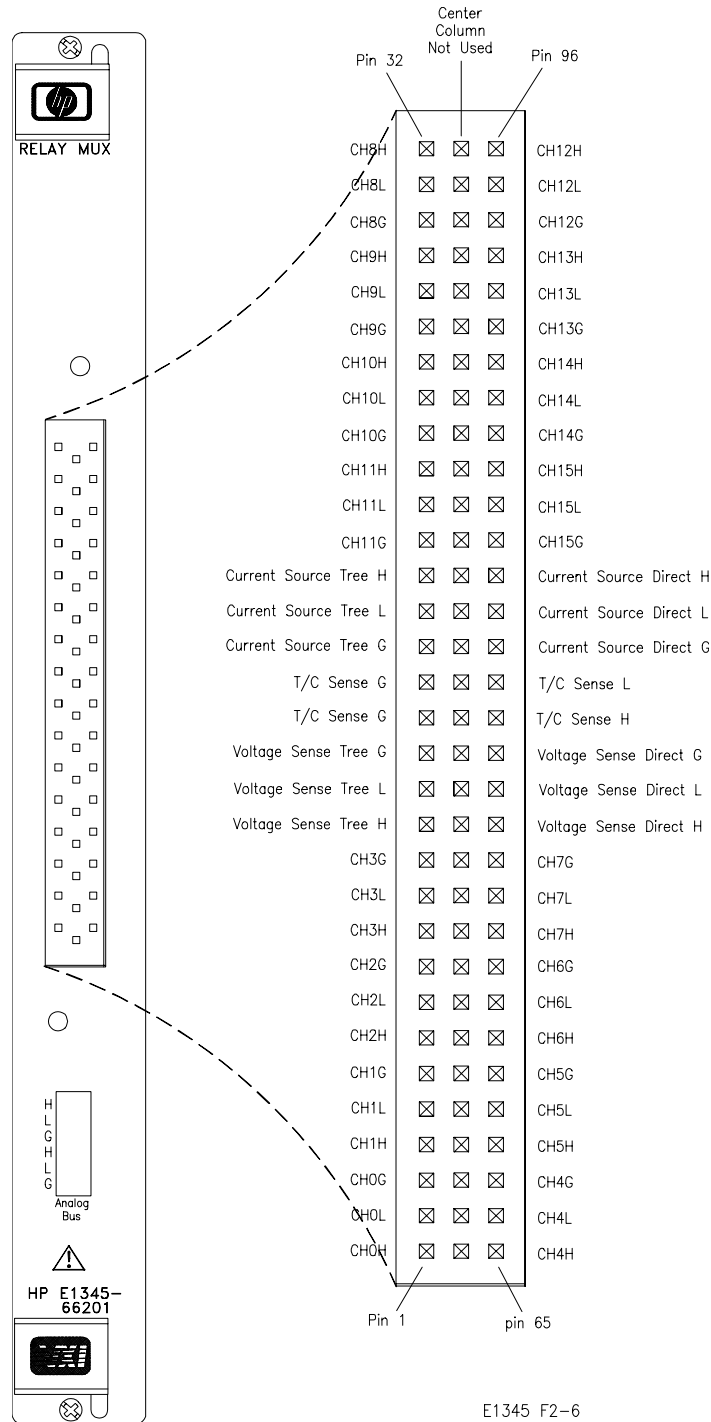


Figure 2-6. Relay Multiplexer Modules Front Panel and Connector Pinout

Notes:
