*Agilent 75000 Series B*

# Agilent E1343A, E1344A, E1345A, E1347A, E1355A and E1356A Relay Multiplexers

## Service Manual

Agilent Technologies



Printed in Malaysia

# Contents

E1343A/44A/45A/47A/55A/56A Service Manual

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E1343A, E1344A, E1345A, E1347A, E1355A and E1356A Relay Multiplexers Service Manual
Edition 4

## 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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Edition 2 (Part Number E1345-90012). . . . . June 1996

Edition 3 (Part Number E1345-90013). . . . . June 1997

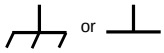
Edition 4 (Part Number E1345-90013) . . . . . September 2005

Edition 4 (Part Number E1345-90013) . . . . . September 2012

## 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.

## WARNINGS

**The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Agilent Technologies, Inc. assumes no liability for the customer's failure to comply with these requirements.**

**Ground the equipment**: For Safety Class 1 equipment (equipment having a protective earth terminal), an uninterruptible safety earth ground must be provided from the mains power source to the product input wiring terminals or supplied power cable.

**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.

**Keep away from live circuits:** Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers or shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

**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.

**DO NOT service or adjust alone:** Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

**DO NOT substitute parts or modify equipment:** Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the product. 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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- Go to **http://regulations.corporate.agilent.com/DoC/search.htm** . You can then search by product number to find the latest Declaration of Conformity.
- Alternately, you can go to the product web page **(e.g., www.agilent.com/find/E1343A),** click on the Document Library tab then scroll down until you find the Declaration of Conformity link.

# What's in This Manual

## Manual Overview

This manual shows how to service the E1343A, E1344A, E1345A, E1347A, E1355A, and E1356A Relay Multiplexers. Consult the *E1343A/E1344A/E1345A/E1347A User's Manual* for additional information on installing, configuring, and operating the E1343A, E1344A, E1345A and E1347A. Consult the *E1355A/E1356A Strain Gage Multiplexer User's Manual* for additional information on installing, configuring, and operating the E1355A and E1356A. Consult the appropriate mainframe user's manual for information on configuring and operating the mainframe.

## Manual Content

| Chap | Title | Content |
|---|---|---|
| 1 | General Information | Provides a basic description and lists the test equipment required for service. |
| 2 | Verification Tests | Functional verification, operation verification, and performance verification tests. |
| 3 | Replaceable Parts | Lists replaceable parts for multiplexers as follows:<br>E1343A w/Serial Number 3131A00852 and higher<br>E1344A w/Serial Number 3131A00512 and higher<br>E1345A w/Serial Number 2934A07622 and higher<br>E1347A w/Serial Number 2934A03663 and higher<br>E1355A w/Serial Number 3035A00331 and higher<br>E1356A w/Serial Number 3035A00457 and higher. |
| 4 | Service | Procedures to aid in fault isolation and repair of the multiplexers. |
| Appx A | Verification Tests - C Programs | Provides C Program Examples to do the Verification Tests in Chapter 2. |
| Appx B | Backdating Information | Lists replaceable parts for multiplexers as follows:<br>E1343A w/Serial Number 2934A00001 through 3131A00851<br>E1344A w/Serial Number 2934A00001 through 3131A00511<br>E1345A w/Serial Number 2934A00001 through 2934A07621<br>E1347A w/Serial Number 2934A00001 through 2934A03662<br>E1355A w/Serial Number 2934A00001 through 3035A00330<br>E1356A w/Serial Number 2934A00001 through 3035A00456 . |

# Chapter 1
# General Information

## Introduction

This manual contains information required to test, troubleshoot, and repair the following Agilent relay multiplexers:

- E1343A 16-Channel High Voltage Relay Multiplexer
- E1344A 16-Channel High Voltage & Thermocouple Compensated Relay Multiplexer
- E1345A 16-Channel Relay Multiplexer
- E1347A 16-Channel Thermocouple Compensated Relay Multiplexer
- E1355A 8-Channel 120-Ohm Relay Multiplexer
- E1356A 8-Channel 350-Ohm Relay Multiplexer.

Refer to the respective module's User's Manual for information on programming and configuring these modules.

Figure 1-1 shows a typical layout for each of the relay multiplexers. Each multiplexer consists of a component assembly and a terminal module. The Agilent E1345A, E1347A, E1355A, and E1356A multiplexers use the same component assembly, but each multiplexer uses a unique terminal module. The Agilent E1343 and E1344 multiplexers use a different component assembly.

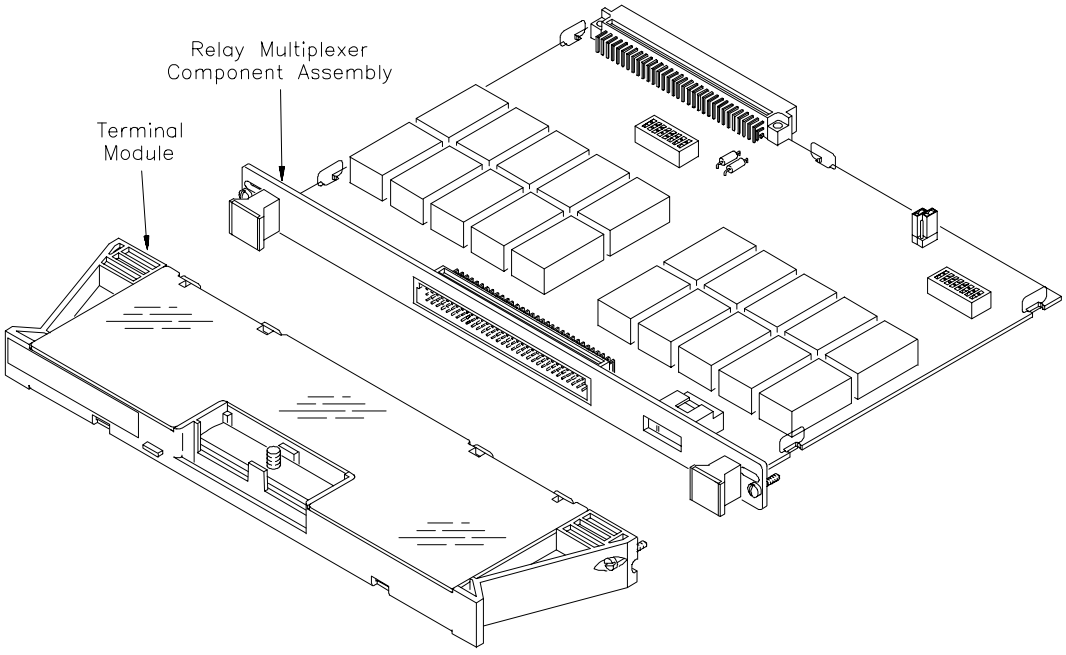


**Figure 1-1. Relay Multiplexer Assemblies**

# Safety Considerations

These products are Safety Class I instruments provided with a protective earth terminal when installed in the mainframe. Check the mainframe, multiplexer, and all related documentation for safety markings and instructions before operation or service.

Refer to the WARNINGS on page 4 in this manual for a summary of safety information. Safety information for preventive maintenance, testing, and service follows and is also found throughout this manual.

## WARNINGS

This section contains WARNINGS which must be followed for your protection when performing equipment maintenance or repair.

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**WARNING** **SERVICE-TRAINED PERSONNEL ONLY. The information in this manual is for service-trained personnel who are familiar with electronic circuitry and are aware of the hazards involved. To avoid personal injury or damage to the instrument, do not perform procedures in this manual or do any servicing unless you are qualified to do so.**

**CHECK MAINFRAME POWER SETTINGS. Before applying power, verify that the mainframe setting matches the line voltage and that the correct fuse is installed. An uninterruptible safety earth ground must be provided from the main power source to the supplied power cord set.**

**GROUNDING REQUIREMENTS. Interruption of the protective (grounding) conductor (inside or outside the mainframe) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury. (Grounding one conductor of a two-conductor outlet is not sufficient protection.)**

**IMPAIRED PROTECTION. Whenever it is likely that instrument protection has been impaired, the mainframe must be made inoperative and be secured against any unintended operation.**

**REMOVE POWER IF POSSIBLE. Some procedures in this manual may be performed with power supplied to the mainframe while protective covers are removed. Energy available at many points may, if contacted, result in personal injury. (If maintenance can be performed without power applied, the power should be removed.)**

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**WARNING**

**USING AUTOTRANSFORMERS. If the mainframe is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to neutral (that is, the grounded side of the main's supply).**

**CAPACITOR VOLTAGES. Capacitors inside the mainframe may remain charged even when the mainframe has been disconnected from its source of supply.**

**USE PROPER FUSES. For continued protection against fire hazard, replace the line fuses only with fuses of the same current rating and type (such as normal blow, time delay, etc.). Do not use repaired fuses or short-circuited fuseholders.**

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

## CAUTIONS

This section contains CAUTIONS which must be followed to avoid damage to the equipment when performing instrument maintenance or repair.

**CAUTION**

**MAXIMUM VOLTAGE/CURRENT. The maximum voltage that may be applied between High (H), Low (L), and Guard (G) terminals is 170VDC or 120Vrms (170Vpeak) for the E1345A, E1347A, E1355A, and E1356A modules. The maximum voltage that may be applied between High (H), Low (L), and Guard (G) terminals is 250VDC or ACrms (354Vpeak) for the E1343A or E1344A. The maximum current is 50 mA (non-conductive) per channel. The maximum power per channel is 1 VA.**

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

# Relay Life

Electromagnetic relays are subject to normal wear-out. Relay life depends on several factors. Two factors are loading and switching frequency effects.

## Loading and Switching Frequency Effects

**Relay Load**. In general, higher power switching reduces relay life. In addition, capacitive/inductive loads and high inrush currents (e.g., when turning on a lamp or motor) reduce relay life. *Exceeding the specified maximum inputs can cause catastrophic failure.*

**Switching Frequency**. Relay contacts heat up when switched. As the switching frequency increases, the contacts have less time to dissipate heat. The resulting increase in contact temperature reduces relay life.

## End-of-Life Detection

A preventive maintenance routine can prevent problems caused by unexpected relay failure. The end-of-the life of a relay can be determined using one or more of the following methods. The best method (or combination of methods), as well as the failure criteria, depends on the application in which the relay is used.

**Check Contact Resistance**. As a relay begins to wear out, its contact resistance will increase. When the resistance exceeds a pre-determined value, the relay should be replaced. Typically, a relay should be replaced when the contact resistance exceeds 2.0Ω.

**Check Stability of Contact Resistance**. The stability of relay contact resistance decreases with age. Using this method, the contact resistance is measured several (5-10) times, and the variance of the measurements is determined. An increase in the variance indicates deteriorating performance.

**Replace Relays after Defined Number of Operations**. Relays can be replaced after a predetermined number of contact closures. However, this method requires knowledge of the applied load and life specifications for the applied load. For the multiplexers, maximum relay life is specified to be $10^8$ operations at no load or $10^7$ operations at rated load.

### Replacement Strategy

The replacement strategy also depends on the application. If some relays are used more often, or at higher load, than the others, the relays can be individually replaced as needed. If all of the relays see similar loads and switching frequencies, then replace the entire circuit board when the relay end-of-life approaches. The sensitivity of the application should be weighed against the cost of replacing relays with some useful life remaining.

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**NOTE** Relays that wear out normally or fail due to misuse should not be considered defective and are not covered by the product's warranty.

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## Multiplexer Descriptions

The relay multiplexers are "instruments" in the slots of a VXIbus mainframe. As such, a multiplexer is assigned an error queue, input and output buffers, and a status register.

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**NOTE** Instruments are based on the logical addresses of the plug-in modules. Refer to the configuration guide provided with your system for information on setting the addresses to create an instrument.

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### E1343A/44A Descriptions

Both modules provide sixteen 3-wire or eight 4-wire multiplexer channels and can switch voltages up to 250VDC or VACrms. The E1344A provides a thermistor reference junction on the terminal card for thermocouple measurements. Both modules use the E1343A relay component module but they have different terminal card assemblies.

### E1345A/47A Descriptions

The E1345A and E1347A multiplexers provide multiplexing for up to 16 channels (channels 00 through 15). Each channel has HIGH (H), LOW (L), and GUARD (G) connections. The two multiplexers are identical, except that the E1347A terminal card assembly adds a thermistor for temperature measurement applications.

### E1355A/56A Descriptions

The E1355A and E1356A strain gage multiplexers (when used with a multimeter) provide static and dynamic strain measurement capabilities. Each multiplexer provides switching (multiplexing) for up to 8 channels (channels 00 through 07). Each channel has HIGH (H), LOW (L), GUARD (G), +E, -E1, and -E2 connections. The two multiplexers are identical, except that the E1355A uses 120Ω bridge resistors, and the E1356A uses 350Ω bridge resistors.

## Multiplexer Specifications

Refer to the individual module's User's Manual for specifications. These specifications are the performance standards or limits against which the instrument may be tested.

## Multiplexer Environment

The recommended operating environment for the relay multiplexers is:

| Environment | Temperature | Humidity |
|---|---|---|
| Operating | $0^{o}$C to $+55^{o}$C | <65% relative ($0^{o}$C to $+40^{o}$C) |
| Storage and Shipment | $-40^{o}$C to $+75^{o}$C | <65% relative ($0^{o}$C to $+40^{o}$C) |

## Multiplexer Serial Numbers

Multiplexers covered by this manual are identified by a serial number prefix listed on the title page. The serial number plate is located on the backplane connector. If the serial number prefix of your instrument is greater than the one listed on the title page, a Manual Update (as required) will explain how to adapt this manual to your instrument.

## Multiplexer Options

There are no electrical or mechanical options available for the E1343A, E1344A, E1345A, E1347A, E1355A, E1356A Relay Multiplexers.

## Schematics and Component Locators

Component locators and schematics for the multiplexers are packaged with this manual. Most of them are located in the back of this manual in plastic sleeves for convenient storage. Refer to the tables at the end of Chapter 4 for a listing of what is included and where to find it.

# Recommended Test Equipment

Table 1-1 lists the test equipment recommended for testing, adjusting, and servicing the relay multiplexers. Essential requirements for each piece of test equipment are described in the Requirements column.

**Table 1-1. Recommended Test Equipment**

| Instrument | Requirements | Recommended Model | Use* |
|---|---|---|---|
| Controller, HP-IB | HP-IB compatibility as defined by IEEE Standard 488-1987 and the identical ANSI Standard MC1.1: SH1, AH1, T2, TE0, L2, LE0, SR0, RL0, PP0, DC0, DT0, and C1, 2, 3, 4, 5. | HP 9000 Series 300 or IBM compatible PC with BASIC | F,O, P,T |
| Mainframe | Compatible with multiplexer | E1300A, E1301A, E1302A or E1401B/T, E1421B (requires E1406A) | F,O, P,T |
| Digital Multimeter | 2-wire ohms (up to 1 GΩ)<br>4-wire ohms | 3458A or 34401A | O,P,T |

* F = Functional Verification, O = Operation Verification Tests, P = Performance Verification Tests, T = Troubleshooting

# Inspection/Shipping

This section contains initial (incoming) inspection and shipping guidelines for the multiplexers.

## Initial Inspection

Use the steps in Figure 1-2 as guidelines to perform initial inspection of a relay multiplexer. Performance Verification tests are optional.

**WARNING** **To avoid possible hazardous electrical shock, do not perform electrical tests if there are signs of shipping damage to the shipping container or to the instrument.**

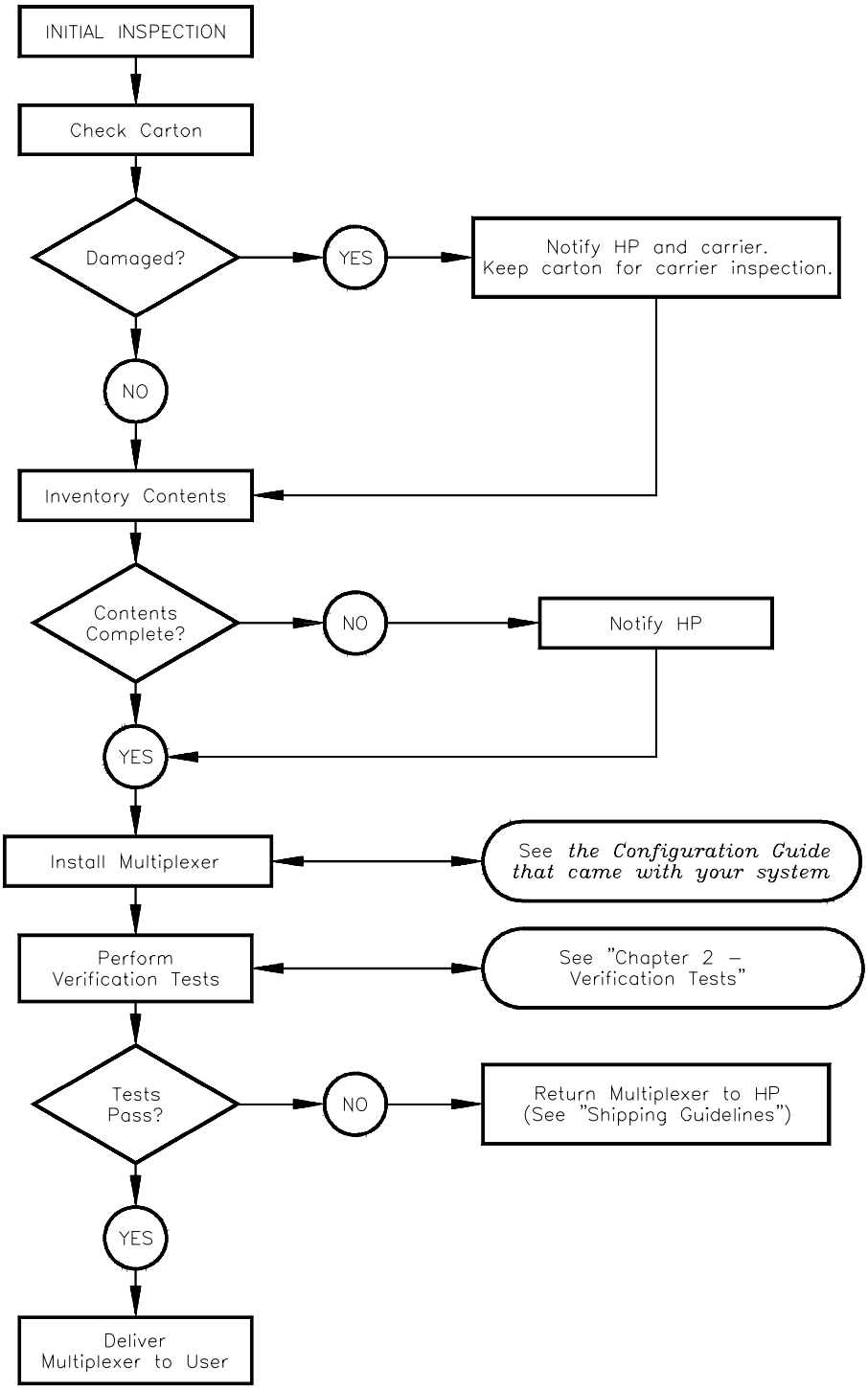
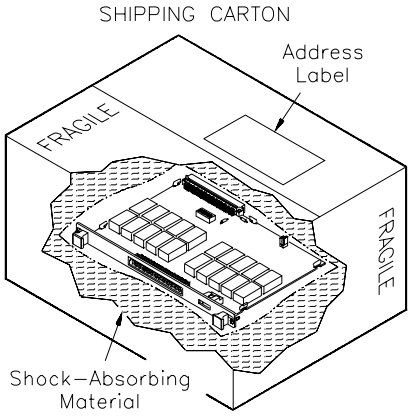



**Figure 1-2. Initial (Incoming) Inspection Guidelines**

## Shipping Guidelines

Follow the steps in Figure 1-3 to return a relay multiplexer to an Agilent Technologies Sales and Service Office.




* We recommend that you use the same shipping materials as those used in factory packaging (available from Agilent Technologies). For other (commercially-available) shipping materials, use a double-wall carton with minimum 2.4 MPa (350 psi) test.

**Figure 1-3. Packaging/Shipping Guidelines**

# Chapter 2
# Verification Tests

## Introduction

This chapter describes the verification tests for the E1343A, E1344A, E1345A, E1347A, E1355A, E1356A Relay Multiplexers. The three levels of test procedures described in this chapter are used to verify that the modules:

- are functional (Functional Verification Test)
- meet selected testable specifications (Operation Verification)
- meet all testable specifications (Performance Verification)

### Test Conditions & Procedures

See Table 1-1 for test equipment requirements. You should complete the Performance Verification tests at least once a year. For heavy use or severe operating environments, perform the tests more often. The verification tests assume that the person performing the tests understands how to operate the mainframe, the multiplexers, and the specified test equipment. The test procedures do not specify equipment settings for test equipment except in general terms. It is assumed that a qualified, service-trained technician will select and connect the cables, adapters, and probes required for the test.

### Performance Test Record

The results of each Performance Verification test may be recorded in Table 2-2, "Performance Test Record," at the end of this chapter. You may photocopy this form, if desired.

### Verification Test Examples

Each verification test procedure includes an example program that performs the test. All example programs assume the following configuration:

- HP 9000 Series 200/300 computer
- HP BASIC programming language
- Multiplexer address 70914
- Multiplexer card number 1
- 3458A Digital Multimeter (DMM)

# Functional Verification Test

The Functional Verification Test for the multiplexer modules consists of sending the *IDN? command and checking the response. This test can be used to verify that the multiplexer is connected properly and is responding to a basic command.

## Procedure

1. Verify that the multiplexer is properly installed in mainframe
2. Verify that the mainframe has passed its power-on test.
3. Send *IDN? to the multiplexer (see example following)
4. The return should be as follows (revision number may vary):

   ```
   HEWLETT-PACKARD,SWITCHBOX,0,A.06.00
   ```

---

**NOTE** If the primary address setting, secondary address setting, or the interface select code is set incorrectly, the multiplexer will not respond. Verify proper address selection before troubleshooting.

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## Example

An example follows which uses an HP 9000 Series 300 computer with HP BASIC and a multiplexer address of 70914.

```
10  DIM A$[100]
20  OUTPUT 70914;"*IDN?"          !Send the ID query command
30  ENTER 70914;A$                !Get response
40  PRINT A$                      !Print response
50  END
```

# Operation Verification Test

The procedures in this section are used to provide a high level of confidence that the multiplexer is meeting published specifications. The Operation Verification Test is a subset of the Performance Verification Tests and is suitable for checkout after performing repairs.

The Operation Verification Test is performed by completing the Closed Channel Resistance Test (Test 2-1) as described in the Performance Verification Test procedures. This test is usually sufficient to verify that the multiplexer is meeting its specifications.

# Performance Verification Tests

The procedures in this section are used to test the multiplexer's electrical performance using the specifications as the performance standards.

There are two performance verification tests for the relay multiplexers: Test 2-1: Closed-Channel Resistance Test, and Test 2-2: DC Isolation Test. These tests are suitable for incoming inspection, troubleshooting, and preventive maintenance.

## Wiring the Test Fixture

A test fixture is required for the Performance Verification Tests. Figure 2-1 shows typical connections using a terminal module (aka "terminal block") for the test fixture. You may want to order an extra terminal module to use as a test fixture so that you don't have to re-wire each time the tests are performed. The E1345A terminal module may be used to test the E1343A/45A/55A and 56A. The terminal module part number is E1345-80001. The E1347A terminal module may be used to test the E1344A and 47A. The terminal module part number is E1347-80001.

However, in most cases the E1345-80001 is adequate for testing any or all of the relay multiplexer component modules.

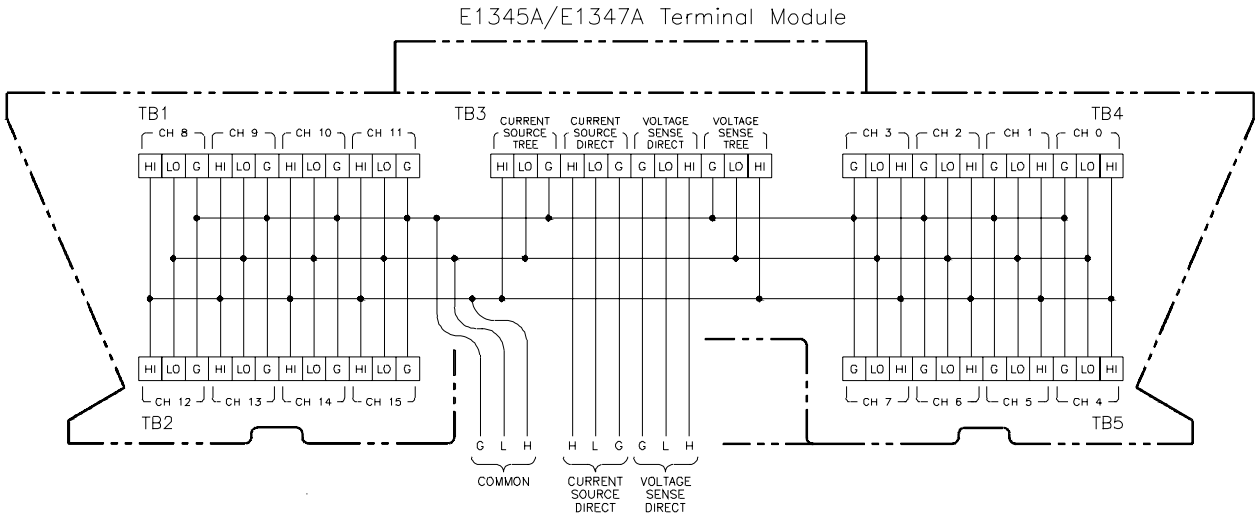


**Figure 2-1. Typical Test Fixture Connections**

# Test 2-1: Closed Channel Resistance Test

This test verifies that all relay contacts meet the closed-channel resistance specification for the multiplexer. If the closed-channel resistance of any relay contact is greater than 2Ω, the relay should be replaced. This test uses the test fixture (see Figure 2-1).

## Measuring Protection Resistors

Since there are 100Ω protection resistors (R20 through R31) in the relay paths, measure the protection resistor values to begin this test. The values of the protection resistors are then subtracted from the measured path resistance to determine the relay contact resistance. To measure the protection resistor values, set the 3458A DMM to 4-wire ohms, autorange and measure each resistor value with the DMM (see Figure 2-2). Record the measured values in Table 2-1.

**NOTE** On the E1343A and E1344A, Resistors R22, R25, R28, and R31 are 1.0kΩ resistors.

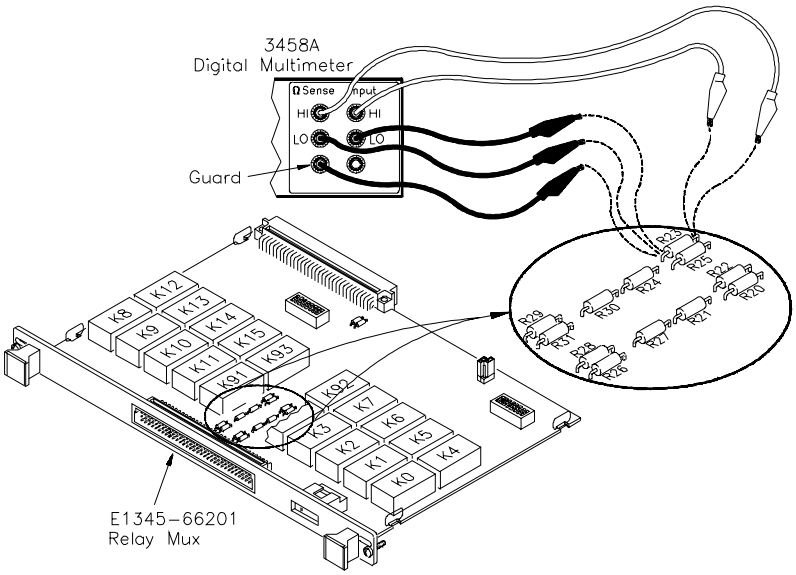


**Figure 2-2. Typical Resistance Measurement Connections**

**Table 2-1. Measured Protection Resistor Values**

| Resistor | Measured Value (Ω) | Resistor | Measured Value (Ω) |
|---|---|---|---|
| R20 | _____ | R26 | _____ |
| R21 | _____ | R27 | _____ |
| R22 | _____ | R28 | _____ |
| R23 | _____ | R29 | _____ |
| R24 | _____ | R30 | _____ |
| R25 | _____ | R31 | _____ |

## Chs 00 - 07 and 90 HI Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-3
   - Turn mainframe power ON

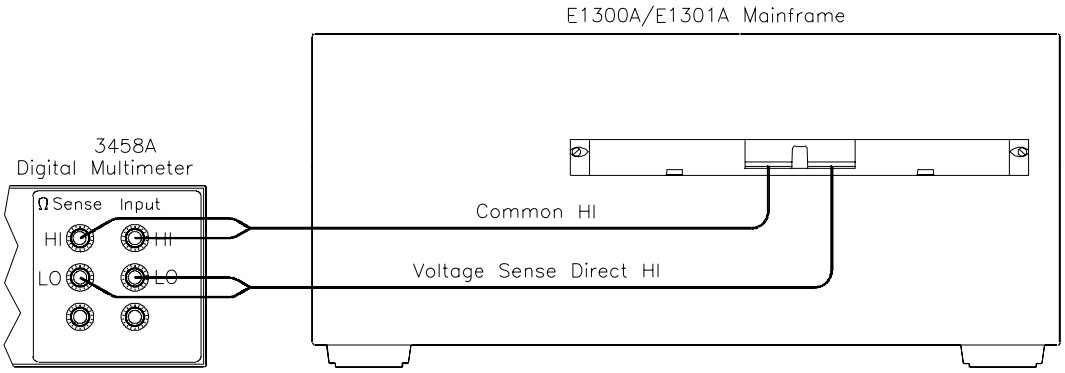


**Figure 2-3. Ch 0-7 and 90 HI Measurements Connections**

2. **Measure Channel 00 HI Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn00) to close chan 00, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn00) to open channel 00
   - Subtract measured value of R20 from DMM reading
   - Enter the result in Table 2-2 for Channel 00 HI
3. **Repeat for Channels 01 - 07 HI and Channel 90 HI**
   - Repeat steps 1 and 2 for channels 01 - 07 HI and 90 HI
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)
   - For Channel 90 HI, subtract combined value of R20 + R26

## Ch 00 - 07 and 90 LO Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-4
   - Turn mainframe power ON
2. **Measure Channel 00 LO Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn00) to close chan 00, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn00) to open channel 00
   - Subtract measured value of R21 from DMM reading
   - Enter the result in Table 2-2 for Channel 00 LO

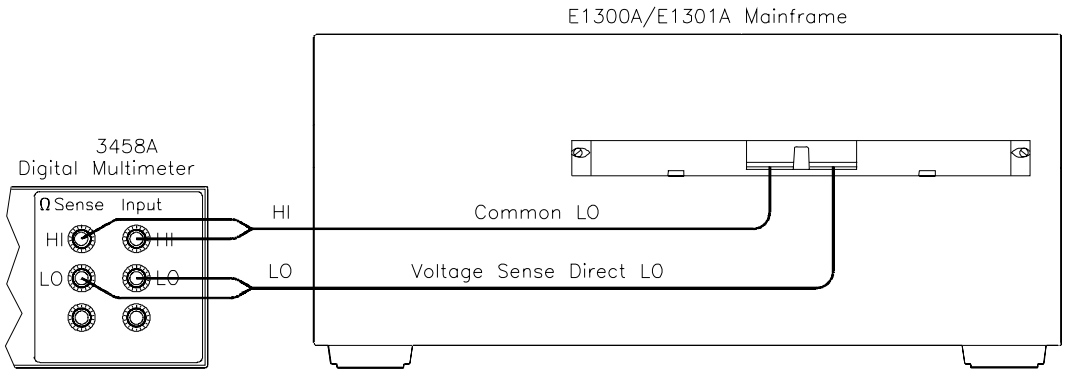


**Figure 2-4. Ch 0-7 and 90 LO Measurement Connections**

3. **Repeat for Channels 01 - 07 LO and Channel 90 LO**
   - Repeat steps 1 and 2 for channels 01 - 07 LO and 90 LO
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)
   - For Channel 90 LO, subtract combined value of R21 + R27

## Ch 00 - 07 and 90 GU Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-5
   - Turn mainframe power ON

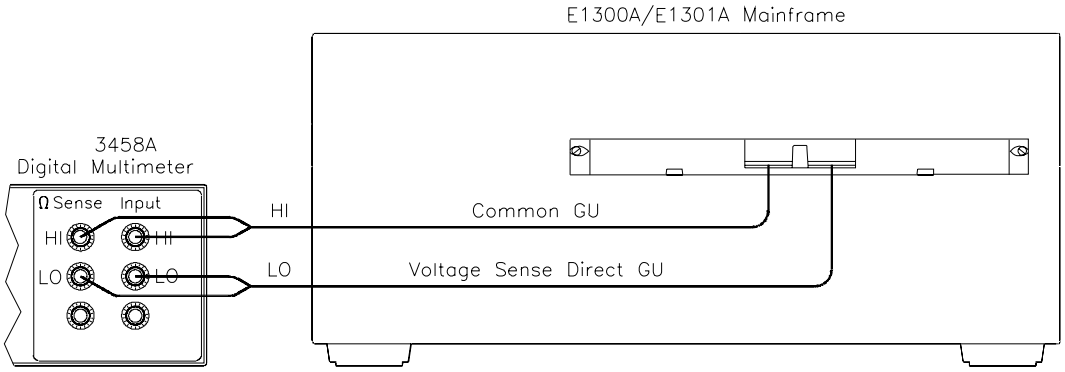


**Figure 2-5. Ch 00-07 and 90 GU Measurements Connections**

2. **Measure Channel 00 GU Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn00) to close chan 00, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn00) to open channel 00
   - Subtract measured value of R22 from DMM reading
   - Enter the result in Table 2-2 for Channel 00 GU

3. **Repeat for Channels 01 - 07 GU and Channel 90 GU**
   - Repeat steps 1 and 2 for channels 01 - 07 GU and 90 GU
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)
   - For Channel 90 GU, subtract combined value of R22 + R28

## Ch 08 - 15 and 91 - 92 HI Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-6
   - Turn mainframe power ON

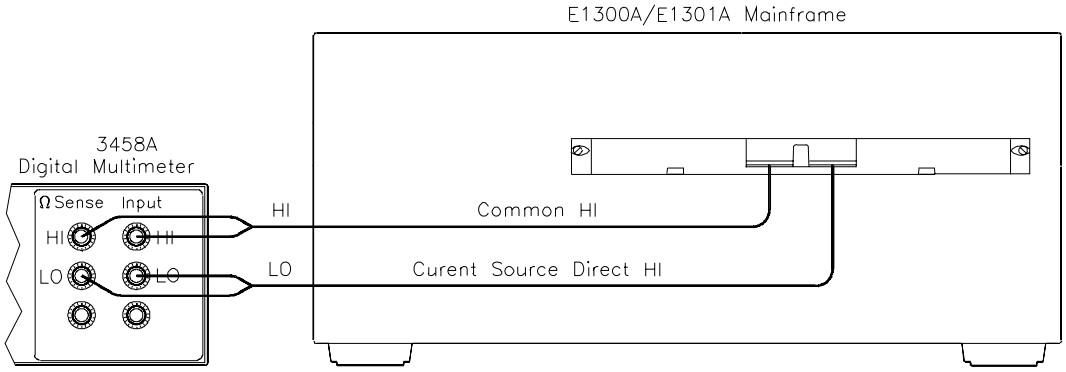


**Figure 2-6. Ch 08-15 and 91-92 HI Measurements Connections**

2. **Measure Channel 08 HI Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn08) to close chan 08, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn08) to open channel 08
   - Subtract measured value of R23 from DMM reading
   - Enter the result in Table 2-2 for Channel 08 HI
3. **Repeat for Channels 09 - 15 HI and Channels 91-92 HI**
   - Repeat steps 1 and 2 for channels 09 - 15 HI and 91 - 92 HI
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and **cc** = channel # (omit leading zeroes in nn)
   - For Channel 91 HI, subtract combined value of R23 + R29
   - For Channel 92 HI, subtract combined value of R23 + R26

## Ch 08 - 15 and 91 - 92 LO Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-7
   - Turn mainframe power ON

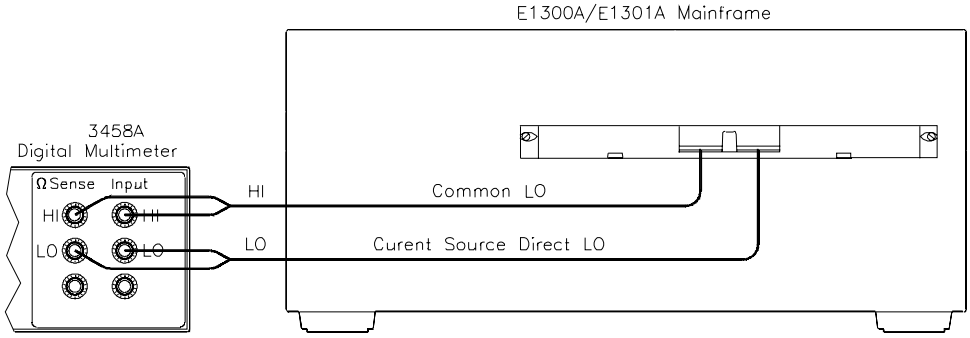


**Figure 2-7. Chs 08-15 and 91-92 LO Measurements Connections**

2. **Measure Channel 08 LO Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn08) to close chan 08, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn08) to open channel 08
   - Subtract measured value of R24 from DMM reading
   - Enter the result in Table 2-2 for Channel 08 LO
3. **Repeat for Channels 09 - 15 LO and Channels 91 - 92 LO**
   - Repeat steps 1 and 2 for channels 09 - 15 LO and 91 - 92 LO
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and **cc** = channel # (omit leading zeroes in nn)
   - For Channel 91 LO, subtract combined value of R24 + R30
   - For Channel 92 LO, subtract combined value of R24 + R27

## Ch 08 - 15 and 91 - 92 GU Measurements

1. **Make Hardware Connections**
   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-8
   - Turn mainframe power ON

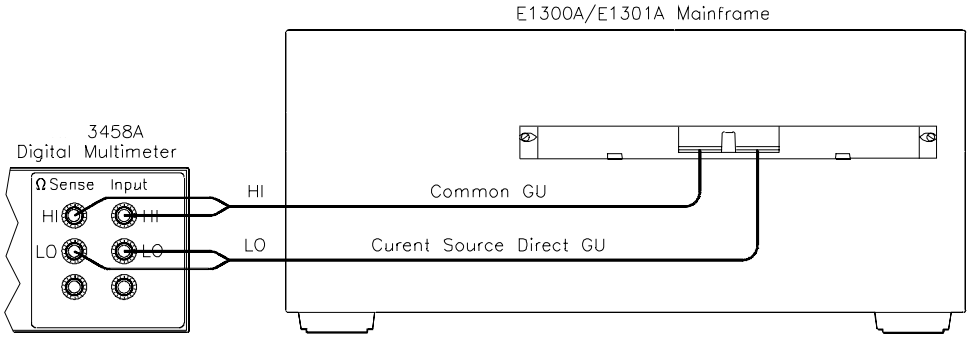


**Figure 2-8. Chs 08-15 and 91-92 GU Measurements Connections**

2. **Measure Channel 08 GU Resistance**
   - Send *RST to multiplexer
   - Send CLOS (@nn08) to close chan 08, where nn = card #
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@nn08) to open channel 08
   - Subtract measured value of R25 from DMM reading
   - Enter the result in Table 2-2 for Channel 08 GU
3. **Repeat for Channels 09 - 15 GU and Channels 91 - 92 GU**
   - Repeat steps 1 and 2 for channels 09 - 15 GU and 91- 92 GU
   - Use CLOS (@nncc) and OPEN (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)
   - For Channel 91 GU, subtract combined value of R25 + R31
   - For Channel 92 GU, subtract combined value of R25 + R28

## Example: Closed Channel Resistance Test

The following program performs a Closed Channel Resistance Test on Channels 00 - 15 and 90 - 92 HI, LO, and GU. If the contact resistance for a channel is >2.0 Ω, the program displays the message "Resistance for Channel *chan* Relay is >2.0 Ohms" and stops.

**NOTE** Since small measurement variations occur when measuring the protection resistors, the program returns "0.00" if the calculated resistance is <0 Ω.

```
10    ! RE-SAVE "CLOS_TEST"
20    ASSIGN @Dmm TO 722
30    ASSIGN @Mux TO 70914
40    DISP CHR$(129)
50    DIM R(20:31),Value0(8,2),Value1(9,2),Result0(8,2), Result1(9,2),
Path$(2)[2]
60    DATA HI,LO,GU
70    READ Path$(*)
80    !
90                                        !Measure protection resistors
100   !
110   PRINT "Measure Protection Resistors R20 - R31 "
120   PRINT TABXY(1,3),"   1. Turn mainframe power OFF"
130   PRINT TABXY(1,4),"   2. Remove E1345A Component Assembly
from mainframe"
140   PRINT TABXY(1,5),"   3. Set DMM for 4-wire ohms (OHMF) function
"
150   DISP " Press Continue when ready to measure protection resistors "
160   PAUSE
170   CLEAR SCREEN
180   FOR I=20 TO 31
190     PRINT TABXY(1,4),"Connect DMM leads (4-wire) to resistor R";I
```

*Continued on Next Page*

```
200    PRINT TABXY(1,5),"Measure resistor R";I;"value (in Ohms)"
210    INPUT " Enter resistor value (in Ohms), then press Continue ",R(I)
220  NEXT I
230  CLEAR SCREEN
240  PRINT "Install Component Assembly and Test Fixture "
250  PRINT
260  PRINT "   1. Turn Mainframe power OFF"
270  PRINT "   2. Install E1345A Component Assembly into Mainframe "
280  PRINT "   3. Attach Test Fixture to Component Assembly"
290  PRINT "   4. Turn Mainframe power ON "
300  PRINT "   5. Press Continue when ready to begin testing "
310  PAUSE
320  CLEAR SCREEN
330  !
340              ! Measure Channels 00-07 and Channel 90 (HI, LO, and GU)
350  !
360  OUTPUT @Dmm;"PRESET NORM;FUNC OHMF"
370  OUTPUT @Mux;"*RST"
380  FOR K=0 TO 2
390    PRINT TABXY(1,1),"Channel 00-07 and Channel 90 ";Path$(K);"
Measurements                    "
400    PRINT TABXY(1,3),"Connect DMM Sense and Input HI leads to
COMMON ";Path$(K)
410    PRINT TABXY(1,4),"Connect DMM Sense and Input LO leads to
VOLTAGE SENSE ";Path$(K)
420    DISP " Press Continue when connections are complete "
430    PAUSE
440    CLEAR SCREEN
450    FOR I=0 TO 8
460      IF I<8 THEN J=I+100
470      IF I=8 THEN J=190
480      OUTPUT @Mux;"CLOS (@"&VAL$(J)&")"
490      OUTPUT @Dmm;"TRIG SGL"
500      ENTER @Dmm;Value0(I,K)
510      OUTPUT @Mux;"OPEN (@"&VAL$(J)&")"
520      IF I<8 AND K=0 THEN Result0(I,K)=Value0(I,K)-R(20)
530      IF I<8 AND K=1 THEN Result0(I,K)=Value0(I,K)-R(21)
540      IF I<8 AND K=2 THEN Result0(I,K)=Value0(I,K)-R(22)
550      IF I=8 AND K=0 THEN Result0(I,K)=Value0(I,K)-(R(20)+R(26))
560      IF I=8 AND K=1 THEN Result0(I,K)=Value0(I,K)-(R(21)+R(27))
570      IF I=8 AND K=2 THEN Result0(I,K)=Value0(I,K)-(R(22)+R(28))
580      IF Result0(I,K)<0. THEN Result0(I,K)=0.
590      IF Result0(I,K)>2.0 THEN
```

*Continued on Next Page*

```
600       PRINT "Resistance for Channel";I;"Relay is >2.0 Ohms"
610       PAUSE
620      END IF
630    NEXT I
640    IF K<2 THEN
650      PRINT "Measurements complete for Channels 00 - 07 and 90
";Path$(K)
660      DISP " Press Continue for Channels 00 - 07 and 90 ";Path$(K+1);"
measurements "
670      PAUSE
680    ELSE
690      PRINT " Measurements complete for Channels 00 - 07 and 90
";Path$(K)
700      DISP " Press Continue for Channels 08 - 15 and 91-92 tests "
710      PAUSE
720    END IF
730  NEXT K
740  !
750       !Measure Channels 08-15 and Channels 91-92 (HI, LO, and GU)
760  !
770  OUTPUT @Mux;"*RST"
780  CLEAR SCREEN
790  FOR K=0 TO 2
800    PRINT TABXY(1,1),"Channels 08-15 and Channels 91-92
";Path$(K);" Measurements                    "
810    PRINT TABXY(1,3),"Connect DMM Sense and Input HI leads to
COMMON ";Path$(K)
820    PRINT TABXY(1,4),"Connect DMM Sense and Input LO leads to
CURRENT SOURCE ";Path$(K)
830    DISP " Press Continue when connections are complete "
840    PAUSE
850    CLEAR SCREEN
860    FOR I=0 TO 9
870      IF I<8 THEN J=I+108
880      IF I=8 THEN J=191
890      IF I=9 THEN J=192
900      OUTPUT @Mux;"CLOS (@"&VAL$(J)&")"
910      OUTPUT @Dmm;"TRIG SGL"
920      ENTER @Dmm;Value1(I,K)
930      OUTPUT @Mux;"OPEN (@"&VAL$(J)&")"
940      IF I<8 AND K=0 THEN Result1(I,K)=Value1(I,K)-R(23)
950      IF I<8 AND K=1 THEN Result1(I,K)=Value1(I,K)-R(24)
960      IF I<8 AND K=2 THEN Result1(I,K)=Value1(I,K)-R(25)
970      IF I=8 AND K=0 THEN Result1(I,K)=Value1(I,K)-(R(23)+R(29))
980      IF I=8 AND K=1 THEN Result1(I,K)=Value1(I,K)-(R(24)+R(30))
```

*Continued on Next Page*

```
990       IF I=8 AND K=2 THEN Result1(I,K)=Value1(I,K)-(R(25)+R(31))
1000      IF I=9 AND K=0 THEN Result1(I,K)=Value1(I,K)-(R(23)+R(26))
1010      IF I=9 AND K=1 THEN Result1(I,K)=Value1(I,K)-(R(24)+R(27))
1020      IF I=9 AND K=2 THEN Result1(I,K)=Value1(I,K)-(R(25)+R(28))
1030      IF Result1(I,K)<0. THEN Result1(I,K)=0.
1040      IF Result1(I,K)>2.0 THEN
1050        PRINT "Resistance for Channel";I;"Relay is >2.0 Ohms"
1060        PAUSE
1070      END IF
1080    NEXT I
1090    IF K<2 THEN
1100      PRINT "Measurements complete for Channels 08 - 15 and 91 -
92 ";Path$(K)
1110      DISP " Press Continue for Channels 08 - 15 and 91  - 92
";Path$(K+1);" measurements "
1120      PAUSE
1130    ELSE
1140      PRINT "Measurements complete for Channels 08 - 15 and 91 -
92 ";Path$(K)
1150      DISP " Press Continue to display measurement results "
1160      PAUSE
1170      CLEAR SCREEN
1180    END IF
1190  NEXT K
1200  !
1210                                        ! Display Relay Contact Resistances
1220  !
1230 Format:IMAGE 3(12X,D.2D,12X,D.2D,12X,D.2D,/)
1240  PRINT TABXY(1,1),"Channels 00-15 and 90-92 Relay Contact
Resistances "
1250  PRINT TABXY(1,3),"Channel     HI (OHMS)     LO (OHMS)     GU
(OHMS)"
1260  PRINT
1270  PRINT USING Format;Result0(*)
1280  FOR I=0 TO 8
1290    IF I<8 THEN PRINT TABXY(2,5+I),I
1300    IF I=8 THEN PRINT TABXY(3,13),"90"
1310  NEXT I
1320  PRINT USING Format;Result1(*)
1330  FOR J=8 TO 17
1340    IF J<16 THEN PRINT TABXY(2,J+1),J
1350    IF J=16 THEN PRINT TABXY(3,J+1),"91"
1360    IF J=17 THEN PRINT TABXY(3,J+1),"92"
1370  NEXT J
1380  END
```

### Typical Results

| Channel | HI (OHMS) | LO (OHMS) | GU (OHMS) |
|---|---|---|---|
| 0 | 0.51 | 0.35 | 0.61 |
| 1 | 0.49 | 0.31 | 0.59 |
| 2 | 0.48 | 0.41 | 0.57 |
| 3 | 0.42 | 0.39 | 0.61 |
| 4 | 0.52 | 0.41 | 0.55 |
| 5 | 0.52 | 0.35 | 0.59 |
| 6 | 0.49 | 0.40 | 0.60 |
| 7 | 0.46 | 0.36 | 0.54 |
| 90 | 0.49 | 0.40 | 0.55 |
| 8 | 0.47 | 0.35 | 0.60 |
| 9 | 0.51 | 0.36 | 0.61 |
| 10 | 0.43 | 0.33 | 0.55 |
| 11 | 0.45 | 0.39 | 0.58 |
| 12 | 0.50 | 0.41 | 0.60 |
| 13 | 0.48 | 0.41 | 0.55 |
| 14 | 0.52 | 0.36 | 0.54 |
| 15 | 0.43 | 0.41 | 0.51 |
| 91 | 0.44 | 0.38 | 0.55 |
| 92 | 0.50 | 0.40 | 0.61 |

## Test 2-2: DC Isolation Test

This test verifies that sufficient DC isolation exists at various points on the multiplexer. DC Isolation is checked from HI to Chassis, HI to LO, and HI to GU (GUARD). This test uses the test fixture (see Figure 2-1).

**NOTE** The DMM used should be capable of measuring at least 1 GΩ. If the DMM indicates an overload, record the reading as >Rmax, where Rmax is the highest resistance that the DMM can measure. For example, if the DMM is an 3458A, a typical return for an overload is 1.E+38 and the entry in Table 2-2 should be >1.2 GΩ.

### HI to Chassis Isolation

1. Make hardware connections as shown in Figure 2-9
2. Set DMM to 2-wire ohms, 1 GΩ range
3. Send CLOS (@nn00:nn15, nn90:nn93) to close all relays
4. Trigger the DMM with TRIG SGL
5. Record the DMM reading on Table 2-2 (HI to Chassis)

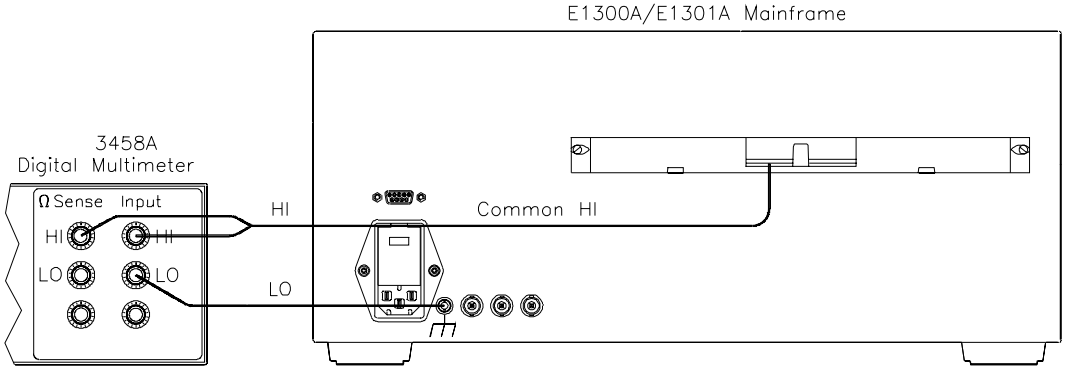


**Figure 2-9. HI to Chassis Isolation Connections**

### HI to LO Isolation

1. Make hardware connections as shown in Figure 2-10
2. Trigger the DMM with TRIG SGL
3. Record the DMM reading on Table 2-2 (HI to LO)

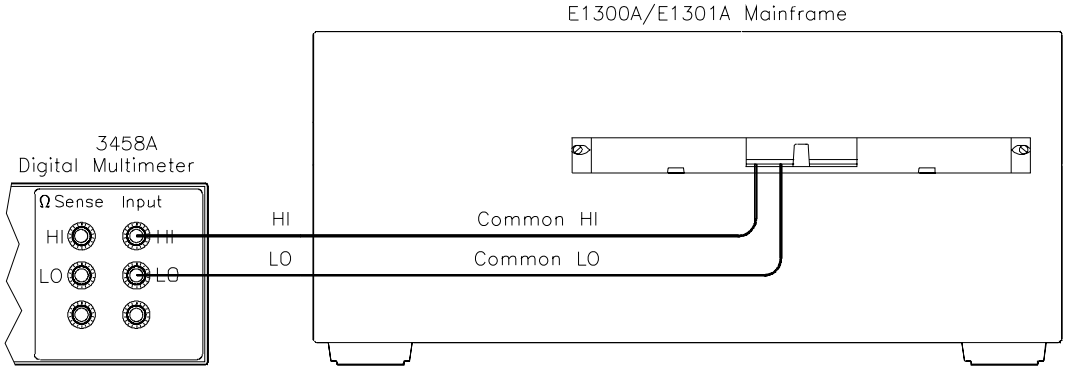


**Figure 2-10. HI to LO Isolation Connections**

### HI to GU Isolation

1. Make hardware connections as shown in Figure 2-11
2. Trigger the DMM with TRIG SGL
3. Record the DMM reading on Table 2-2 (HI to GU)

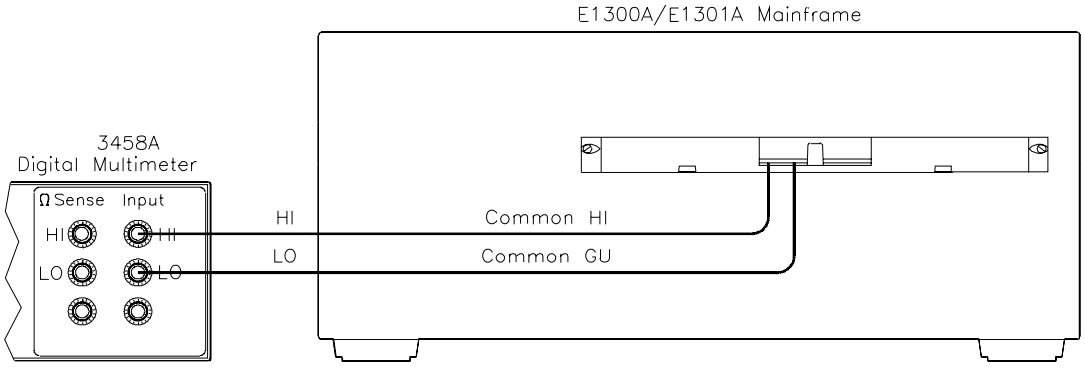


**Figure 2-11. HI to GU Isolation Connections**

### Example: DC Isolation Test

This example performs DC Isolation Tests for HI to Chassis, HI to LO, and HI to GU (GUARD).

```
10   !RE-SAVE "DC_ISOL"
20    ASSIGN @Dmm TO 722
30    ASSIGN @Mux TO 70914
40    DISP CHR$(129)
50    DIM Conn$(5)[10]
60    DATA CHASSIS, LO, GU, CHASSIS, COMMON LO, COMMON GU
70    READ Conn$(*)
80    OUTPUT @Dmm;"OHM 1E9"
90    PRINT "Equipment Connections "
100   PRINT
110   PRINT "   1. Turn Mainframe power OFF"
120   PRINT "   2. Install E1345A Component Assembly into Mainframe "
130   PRINT "   3. Attach Test Fixture to Component Assembly"
140   PRINT "   4. Turn Mainframe power ON"
150   PRINT "   5. Press Continue when ready to begin testing "
```

*Continued on Next Page*

```
160   PAUSE
170   CLEAR SCREEN
180   !
190             ! Measure DC Isolation (HI to Chassis, HI to LO, HI to GU)
200   !
210   OUTPUT @Mux;"*RST"
220   FOR I=0 TO 2
230     PRINT TABXY(1,1),"DC Isolation HI to ";Conn$(I);" Measurements
"
240     PRINT TABXY(1,3),"1. Connect DMM INPUT HI lead to COMMON
HI"
250     PRINT TABXY(1,4),"2. Connect DMM INPUT LO to ";Conn$(I+3)
260     DISP " Press Continue when connections are complete "
270     PAUSE
280     CLEAR SCREEN
290     OUTPUT @Mux;"CLOS (@100:115,190:193)"
300     OUTPUT @Dmm;"TRIG SGL"
310     ENTER @Dmm;Value(I)
320   NEXT I
330   DISP " Press Continue to display measurement results "
340   PAUSE
350   CLEAR SCREEN
360   PRINT TABXY(1,1),"DC Isolation Tests "
370  PRINT TABXY(1,3),"HI to CHASSIS (Ohms)";Value(0)
380   PRINT TABXY(1,4),"HI to LO (Ohms)     ";Value(1)
390   PRINT TABXY(1,5),"HI to GUARD (Ohms)  ";Value(2)
400   END
```

**Typical Result** A typical result for an overload on all three measurements is :

```
DC Isolation Tests

HI to Chassis(Ohms)      1.E+38
HI to LO (Ohms)          1.E+38
HI to GUARD (Ohms)       1.E+38
```

# Performance Test Record

Table 2-2, "Performance Test Record," is a form you may copy and use to record performance verification test results for the multiplexers. Table 2-2 shows multiplexer test limits, DMM measurement uncertainty, and test accuracy ratio (TAR) values.

## Test Limits

Test limits are defined for relay closed channel resistance and DC isolation using the specifications in the individual module's User's Manual. The relay contact resistance and DC isolation specifications are single-ended, meaning that there is an upper limit OR a lower limit, but not both. In Table 2-2, the Minimum or Maximum column is blank for a single-sided test.

## Measurement Uncertainty

For the performance verification tests in this manual, measurement uncertainties are calculated based on the 3458A Digital Multimeter. The measurement uncertainty shown in Table 2-2 is the accuracy of the 3458A using 90-day specifications. The calculations follow.

### Closed Channel Resistance Test

Conditions:

- 4-wire ohms function, 10 Ω range
- 90-day specifications
- Worst-case reading = 2.0 Ω

M.U. = (15 *ppm of Reading* + 5 *ppm of Range*)

$= (15\times10^{-6} \cdot 2.0 + 5\times10^{-6} \cdot 10)\ (\Omega)$

$= \underline{8.0\times10^{-5}\ \Omega}$

### DC Isolation Test

Conditions:

- 2-wire ohms function, 1 GΩ range
- 90-day specifications
- Worst-case reading = 1.2 GΩ (highest resistance that can be measured with the 3458A)

M.U. = (0.5% *of Reading* + 10*ppm of Range*)

$= (0.005 \cdot 1.2\times10^{9} + 10\times10^{-6} \cdot 1\times10^{9})\ (\Omega)$

$= \underline{6.0\times10^{6}\ \Omega}$

## Test Accuracy Ratio (TAR)

Test Accuracy Ratios (TAR) are not defined for single-sided measurements, so all closed-channel resistance and DC isolation measurements show NA (Not Applicable) in the TAR column.

**Table 2-2. Performance Test Record (Page 1 of 3)**

**General Information**

**Test Facility:**

Name_____ Report No._____

Address_____ Date_____

City/State_____ Customer_____

Phone_____ Tested by_____

**Special Notes:**

_____

_____

_____

_____

_____

_____

**Test Equipment Record**

Model _____ Report No. _____ Date _____

| Test Equipment Used: Description | Model No. | Trace No. | Cal Due Date |
|---|---|---|---|
| 1._____ | _____ | _____ | _____ |
| 2. _____ | _____ | _____ | _____ |
| 3. _____ | _____ | _____ | _____ |
| 4. _____ | _____ | _____ | _____ |
| 5. _____ | _____ | _____ | _____ |
| 6. _____ | _____ | _____ | _____ |
| 7. _____ | _____ | _____ | _____ |

**Table 2-2. Performance Test Record (Page 2 of 3)**

| Test No/Description | Minimum* Value | Measured Value (V) | Maximum Value | Measurement Uncert | Test Acc Ratio (TAR) |
|---|---|---|---|---|---|
| **2-1. Closed Channel Resistance (Values in Ohms)** | | | | | |
| **HI Path Resistance** | | | | | |
| Channel 00 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 01 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 02 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 03 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 04 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 05 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 06 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 07 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 08 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 09 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 10 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 11 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 12 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 13 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 14 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 15 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 90 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 91 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 92 | | _____ | 2.0 | 8.00E-5 | NA |
| **LO Path Resistance** | | | | | |
| Channel 00 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 01 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 02 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 03 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 04 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 05 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 06 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 07 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 08 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 09 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 10 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 11 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 12 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 13 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 14 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 15 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 90 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 91 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 92 | | _____ | 2.0 | 8.00E-5 | NA |

*Single-sided specification - Minimum value does not apply

**Table 2-2. Performance Test Record (Page 3 of 3)**

| Test No/Description | Minimum* Value | Measured Value (V) | Maximum** Value | Meas Uncert | Test Acc Ratio (TAR) |
|---|---|---|---|---|---|
| **2-1. Closed Channel Resistance (Values in Ohms) (cont'd)** | | | | | |
| **GU Path Resistance** | | | | | |
| Channel 00 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 01 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 02 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 03 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 04 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 05 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 06 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 07 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 08 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 09 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 10 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 11 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 12 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 13 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 14 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 15 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 90 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 91 | | _____ | 2.0 | 8.00E-5 | NA |
| Channel 92 | | _____ | 2.0 | 8.00E-5 | NA |
| **2-2. DC Isolation (Values in Ohms)** | | | | | |
| **HI to CHASSIS** | 1E9 | _____ | | 6.0E6 | NA |
| HI to LO | 1E9 | _____ | | 6.0E6 | NA |
| HI to GU | 1E9 | _____ | | 6.0E6 | NA |

*Single-sided specification - Minimum value does not apply

**Single-sided specification - Maximum value does not apply

# Chapter 3
# Replaceable Parts

## Introduction

This chapter contains information on ordering replaceable parts for the E1343A/44A/45A/47A/55A/56A Relay Multiplexers with specific serial number ranges. The tables provide the following information:

- Table 3-1 lists assembly and terminal module part numbers for the relay multiplexers.
- Table 3-2 lists replaceable parts for the following multiplexers:

  E1345A with serial number 2934A07622 or higher
  E1347A with serial number 2934A03663 or higher
  E1355A with serial number 3035A00331 or higher
  E1356A with serial number 3035A00457 or higher.

- Table 3-3 lists replaceable parts for the following high-voltage multiplexers:

  E1343A with serial number 3131A00852 or higher
  E1344A with serial number 3131A00512 or higher.

- Table 3-4 shows reference designators for parts in Tables 3-2 and 3-3.

To order a part listed in Tables 3-2 and 3-3, specify the Agilent part number and the quantity required. Send the order to your nearest Agilent Technologies Sales and Service Office.

**NOTE** If your multiplexer has a serial number lower than what is listed above, see Appendix B, "Backdating Information," for replaceable parts ordering information.

## Replaceable Parts List

See the Parts Locator diagram (Figure 3-1) for locations of replaceable parts. See Table 3-1 for replacement part numbers for the Component Assemblies and Terminal Modules. A relay multiplexer consists of a Component Assembly and a Terminal Module.

A Terminal Module consists of a Terminal Card and a Terminal Case Assembly. For example, to order an E1345A Terminal Module, use E1345-80001. To order only the Terminal Card, use E1345-66510. To order only the Terminal Case Assembly, use E1300-84401.

**Table 3-1. Relay Multiplexer Assembly/Terminal Module Part Numbers**

| Multiplexer | Component Assembly | Terminal Module | Terminal Card | Terminal Case Assy |
|---|---|---|---|---|
| E1343A 16-Channel High-Voltage Relay Mux | E1343-66201 | E1343-80001 | E1345-66510 | E1300-84401 |
| E1344A 16-Channel High-Voltage Relay Mux with TC | E1343-66201 | E1344-80001 | E1347-66510 | E1300-84401 |
| E1345A 16-Channel Mux | E1345-66201 | E1345-80001 | E1345-66510 | E1300-84401 |
| E1347A 16-Channel Mux w/TC | E1345-66201 | E1347-80001 | E1347-66510 | E1300-84401 |
| E1355A 120-Ohm Strain Relay Mux | E1345-66201 | E1355-80001 | E1355-66510 | E1300-84401 |
| E1356A 350-Ohm Strain Relay Mux | E1345-66201 | E1356-80001 | E1356-66510 | E1300-84401 |

**Table 3-2. E1345A/47A/55A/56A Replaceable Parts**

(see applicable serial number ranges on first page of this chapter)

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **ASSEMBLIES/TERMINAL MODULES/CABLES** |
| | | | **ASSEMBLIES/TERMINAL MODULES** |
| | E1345-66201 | 1 | COMPONENT ASSEMBLY |
| | E1345-80001 | 1 | E1345A TERMINAL MODULE |
| | E1347-80001 | 1 | E1347A TERMINAL MODULE |
| | E1355-80001 | 1 | E1355A TERMINAL MODULE |
| | E1356-80001 | 1 | E1356A TERMINAL MODULE |
| | | | **CABLES** |
| | E1326-61601 | 1 | RIBBON CABLE 6-PIN 3-IN E1326B TO RLY MUXS |
| | E1326-61604 | 1 | RBN CBL 6-PIN 21-IN E1326A (INT) TO RLY MUXS |
| | E1326-61611 | 1 | RBN CBL 6-PIN 20-IN E1326B (INT) TO RLY MUXS |
| | E1300-61605 | 1 | RBN CABLE 6-PIN 2-IN RLY MUXS TO RLY MUXS |
| | E1400-61605 | 1 | RBN CABLE 6-PIN 2.5-IN RLY MUXS TO RLY MUXS |
| | | | **COMPONENT ASSY (E1345-66201) (Common to E1345/47/55/56 Relay Muxs) See Figure 3-1** |
| BRK1-BRK2 | 0050-2183 | 2 | CASTING-ZN P.C. BOARD HOLDER |
| LBL1 | E1300-84308 | 1 | LBL LOGO B SIZE |
| LBL2 | E1300-84312 | 1 | ID PLATE VXI (P & P) |
| F1-F2 | 2110-0936 | 2 | FUSE-SUBMINIATURE 4A 125V SMT |
| J1 | 1252-1596 | 2 | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| J2 | 1252-3712 | 1 | CONN-POST TYPE .100-PIN-SPCG 12-CONTACT |
| K100-K115 K90-K93 | 0490-1707 | 20 | RELAY-REED 3A 500MA 110VAC 5VDC-COIL 5VA |
| MP1-MP2 | 1400-1546 | 2 | BRACKET PC BOARD HOLDER; BLACK; EXTR |
| P1 | 1252-1596 | | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| PNL1 | E1345-00202 | 1 | PNL-RR RLY MUXR |
| SCR1-SCR2 | 0515-0444 | 2 | SCREW-MACH PHD M2.5 X 0.45 8MM-LG HD |
| SCR3-SCR4 | 0515-1968 | 2 | SCREW PHM 2.5 X 11 PAN - HD |
| SHD1 | E1300-80601 | 1 | SHIELD SAFETY - PLASTIC |
| SW1 | 3101-3142 | 1 | SWITCH-DIP 8-1A SMTV 0.25A 24 VDC |
| SW2 | 3101-3148 | 1 | SWITCH-DIP 4-1A SMT 0.05A 6 VDC |

**Table 3-2. E1345A/47A/55A/56A Replaceable Parts (cont'd)**

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **TERMINAL MODULES** |
| | **E1345-80001** | **1** | **E1345A TERMINAL MODULE (See Figure 3-2)** |
| A1 | E1345-66510 | 1 | TERMINAL CARD - 16 CH RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSY |
| | **E1347-80001** | **1** | **E1347A TERMINAL MODULE (See Figure 3-2)** |
| A1 | E1347-66510 | 1 | TERMINAL CARD - 16 CH T/C MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSY |
| | **E1355-80001** | | **E1355A TERMINAL MODULE (See Figure 3-3)** |
| A1 | E1355-66510 | 1 | TERMINAL CARD - 120 OHM STRAIN RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSEMBLY |
| | **E1356-80001** | **1** | **E1356A TERMINAL MODULE (See Figure 3-3)** |
| A1 | E1356-66510 | 1 | TERMINAL CARD - 350 OHM STRAIN RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSY |

**Table 3-3. E1343A/44A Replaceable Parts**

(see applicable serial number ranges on first page of this chapter)

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **ASSEMBLIES/TERMINAL MODULES/CABLES** |
| | | | **ASSEMBLIES/TERMINAL MODULES** |
| | E1343-66201 | 1 | COMPONENT ASSEMBLY |
| | E1343-80001 | 1 | E1343A TERMINAL MODULE |
| | E1344-80001 | 1 | E1344A TERMINAL MODULE |
| | | | **CABLES** |
| | E1326-61601 | 1 | RIBBON CABLE 6-PIN 3-IN E1326B TO RLY MUXS |
| | E1326-61604 | 1 | RBN CBL 6-PIN 21-IN E1326A (INT) TO RLY MUXS |
| | E1326-61611 | 1 | RBN CBL 6-PIN 20-IN E1326B (INT) TO RLY MUXS |
| | E1300-61605 | 1 | RBN CABLE 6-PIN 2-IN RLY MUXS TO RLY MUXS |
| | E1400-61605 | 1 | RBN CABLE 6-PIN 2.5-IN RLY MUXS TO RLY MUXS |
| | | | COMPONENT ASSY (E1343-66201)<br>(common to both E1343A/44A Relay Muxs)<br>See Figure 3-1 |
| BRK1-BRK2 | 0050-2183 | 2 | CASTING-ZN P.C. BOARD HOLDER |
| LBL1 | E1300-84308 | 1 | LBL LOGO B SIZE |
| LBL2 | E1300-84312 | 1 | ID PLATE VXI (P & P) |
| F1 - F2 | 2110-0936 | 2 | FUSE-SUBMINIATURE 4A 125V SMT |
| J1 | 1252-1596 | 2 | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| J2 | 1252-3712 | 1 | CONN-POST TYPE .100-PIN-SPCG 12-CONTACT |
| K100-K115<br>K90-K93 | 0490-1584 | 20 | RELAY-REED 3A 2A 350VAC 5VDC-COIL 5VA |
| MP1-MP2 | 1400-1546 | 2 | BRACKET PC BOARD HOLDER; BLACK; EXTR |
| P1 | 1252-1596 | | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| PNL1 | E1343-00202 | 1 | PNL-RR MUXR 16CH |
| SCR1-SCR2 | 0515-0444 | 2 | SCREW-MACH PHD M2.5 X 0.45 8MM-LG - HD |
| SCR3-SCR4 | 0515-1968 | 2 | SCREW PHM 2.5 X 11 PAN - HD |
| SHD1 | E1300-80601 | 1 | SHIELD SAFETY - PLASTIC |
| SW1 | 3101-3142 | 1 | SWITCH-DIP 8-1A SMTV 0.25A 24 VDC |
| SW2 | 3101-3148 | 1 | SWITCH-DIP 4-1A SMT 0.05A 6 VDC |
| | | | **TERMINAL MODULES** |
| | **E1343-80001** | **1** | **E1343A TERMINAL MODULE (See Figure 3-2)** |
| A1 | E1345-66510 | 1 | TERMINAL CARD - 16 CH RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSY |
| | **E1344-80001** | **1** | **E1344A TERMINAL MODULE (See Figure 3-2)** |
| A1 | E1347-66510 | 1 | TERMINAL CARD - 16 CH T/C MUX |
| CS | E1300-84401 | 1 | CASE - TERMINAL MODULE ASSY |

**Table 3-4. Reference Designators**

| Reference Designators | | | | |
|---|---|---|---|---|
| A | assembly | | PCB | printed circuit board |
| BRK | bracket | | PNL | panel |
| C | capacitor | | Q | transistor |
| CR | diode | | R | resistor |
| CS | case | | RP | resistor pack |
| F | fuse | | RT | thermistor probe |
| J | electrical connector (jack) | | SCR | screw |
| JM | jumper | | SHD | shield |
| K | relay | | SW | switch |
| LBL | label | | TB | terminal module (block) |
| MP | mechanical part | | U | integrated circuit |
| P | electrical connector (plug) | | | |

# Parts Locators

Figures 3-1 through 3-3 show locations of replaceable parts for the E1343A, E1344A, E1345A, E1347A, E1355A, and E1356A Relay Multiplexers with serial numbers that fall within a specific range. *(See applicable serial number ranges on the first page of this chapter.)* See Table 3-4 for Reference Designators. Schematic diagrams are provided at the back of this manual.

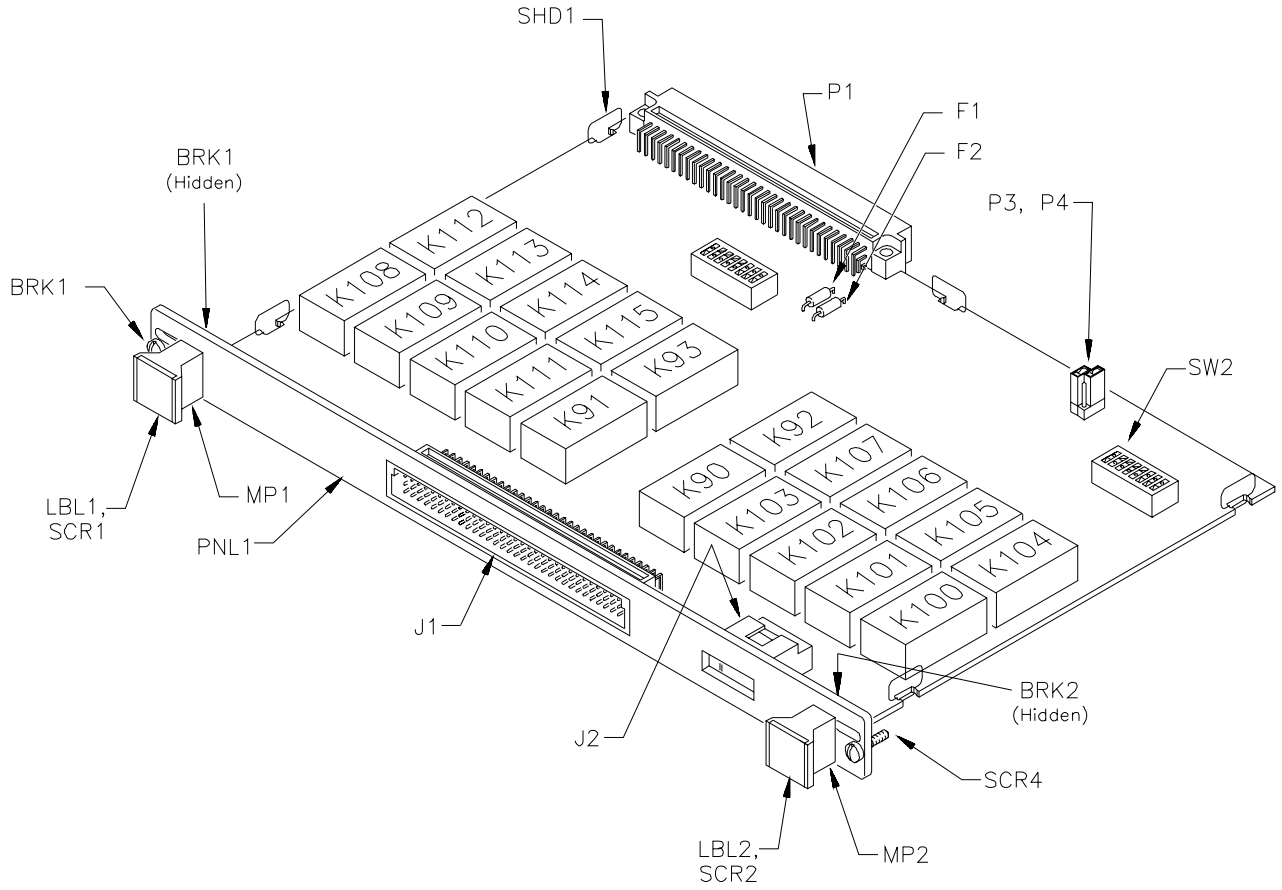


**Figure 3-1. Component Assembly Parts**

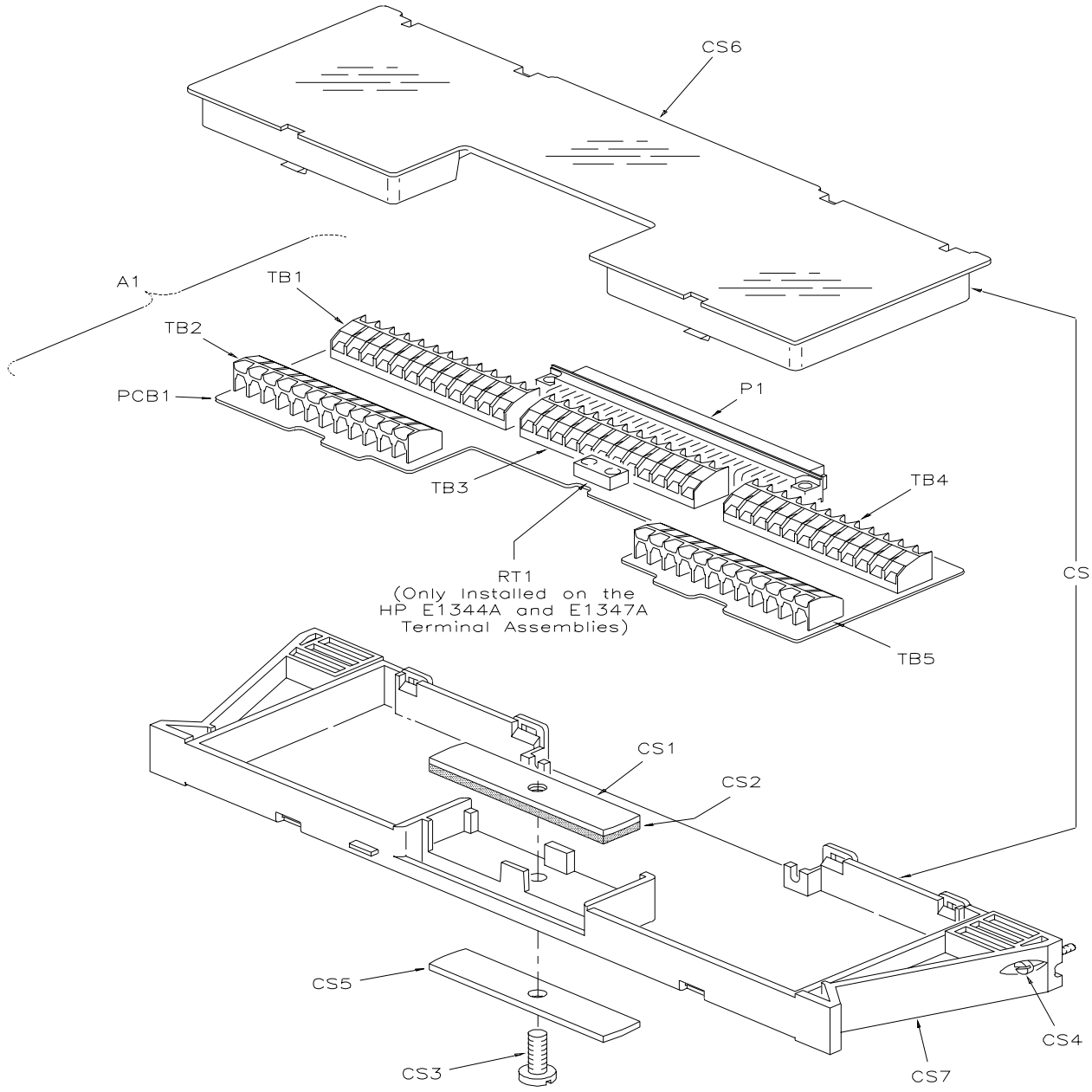


**Figure 3-2. E1343A, E1344A, E1345A, E1347A Terminal Module Mechanical Parts**

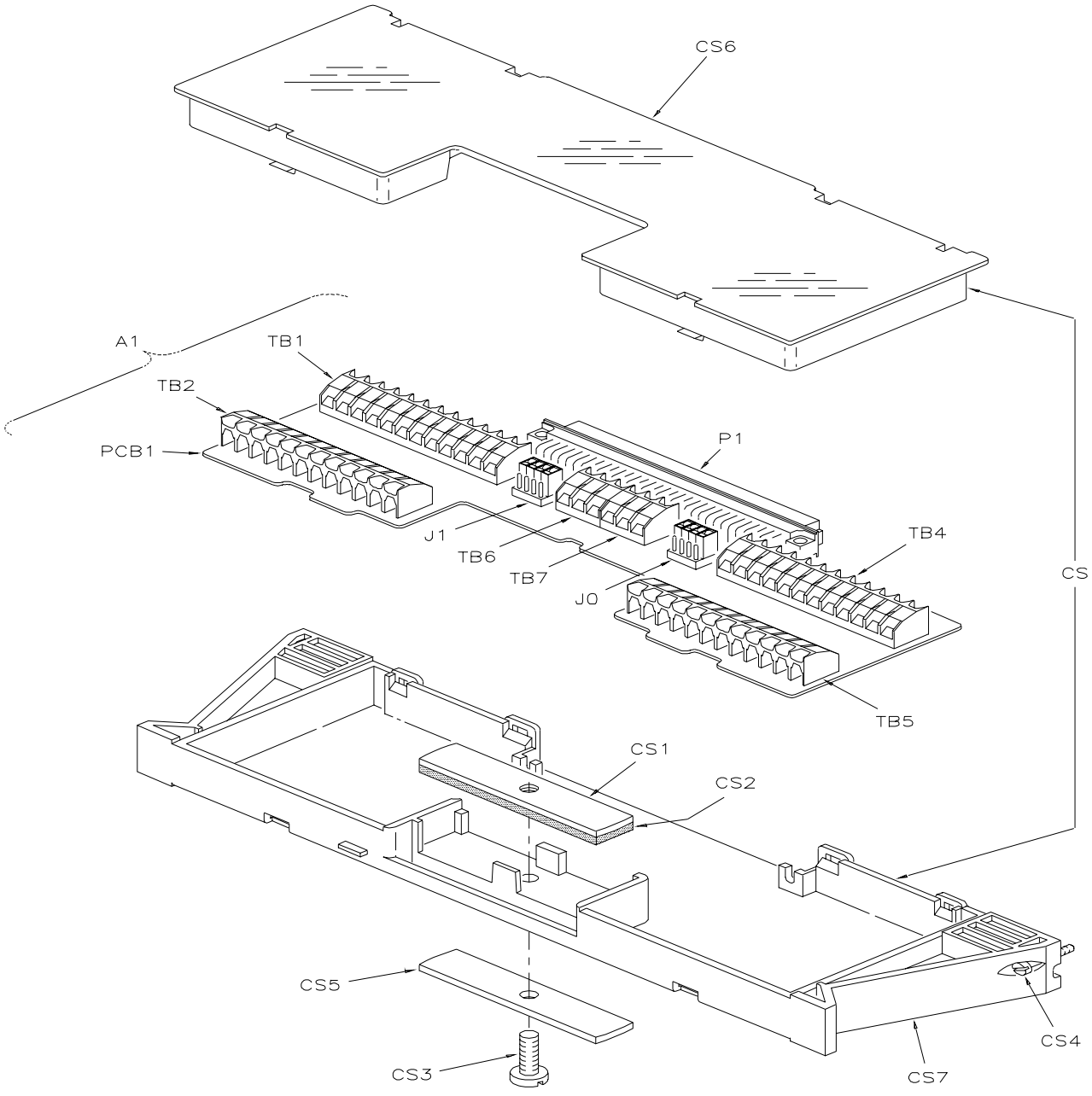


**Figure 3-3. E1355A/E1356A Terminal Module Mechanical Parts**

# Chapter 4
# Service

## Introduction

This chapter contains generic service information for the multiplexers. Also included are troubleshooting, repair, and maintenance guidelines. Refer to the tables at the end of this chapter for information on the Parts Locator, Component Locator and Schematic Diagram drawings included with this manual.

**WARNING** **Do not perform any of the service procedures shown unless you are a qualified, service-trained technician and have read the WARNINGS and CAUTIONS in Chapter 1.**

### Equipment Required

Equipment required for multiplexer troubleshooting and repair is listed in Table 1-1, "Recommended Test Equipment." Any equipment that satisfies the requirements given in the table may be substituted. To avoid damage to the screw head slots, use a T8 Torx driver to remove the front panel handles.

### Service Aids

See Chapter 3, "Replaceable Parts," *or* Appendix B, "Backdating Information," for descriptions and locations of the replaceable parts, depending on the serial number of your multiplexer. Service notes, manual updates, and service literature for the multiplexers may be available through Agilent Technologies. For information, contact your nearest Agilent Technologies Sales and Service Office.

## E1343A/44A Multiplexer Descriptions

The E1343A 16-Channel High Voltage Relay Multiplexer and the E1344A 16-Channel High Voltage Relay Multiplexer (with thermocouple compensation) modules consist of an E1343A component assembly (part number E1343-66201) and a terminal module. Each multiplexer provides switching (multiplexing) of up to 16 channels (channels 00 to 15). Each channel has HIGH (H), LOW (L), and GUARD (G) connections. See Figure 4-1 for a block diagram of these modules.

The component assembly is the same for the E1343A and E1344A. The only difference between the two component assemblies is their module ID jumper settings. The E1343A uses an E1343-80001 terminal assembly and the E1344A uses an E1344-80001 terminal assembly.

### Component Assembly Description

The E1343A Component Assembly consists of 16 channel relays and four tree switch relays. The channel relay switches are separated into two banks, Bank 0 (channels 00 through 07) and Bank 1 (channels 08 to 15). Each bank has its own common H, L, and G terminals that connect to the channel switches.

The Bank 0 channel switches also connect to the AT Tree Switch Terminals (on the terminal module) via the AT Tree Switch (Channel 90) and three protection resistors (R26, R27, and R28). The Bank 1 channel switches connect to the BT Tree Switch terminals (on the terminal module) via the BT Tree Switch (Channel 91) and three protection resistors (R29, R30, and R31).

The AT2 Tree Switch (Channel 92) connects Bank 1 channels to the AT Tree Switch. For the E1347A only, the RT Tree Switch (Channel 93) connects the thermistor (on the terminal module) to the Bank 1 channel common. This allows measurement of the thermistor to compensate for temperature measurements made with thermocouples.

The AT Tree Switch connects to the H, L, and G connections on the Analog Bus Connector and the BT Tree Switch connects 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 E1326/E1411 multimeters.

Each Bank 0 and Bank 1 Common line and AT and BT Tree Switch line has a 100Ω resistor in series to provide relay contact protection. The Analog Bus Connector also has six 100Ω resistor in series to provide current protection.

### Terminal Module Description

The terminal module provides connections from user devices to the multiplexer. The terminal module also provides connections for multimeters, voltmeters, counters, and other measuring devices. For the E1344A only, a thermistor is mounted on the terminal module.

Terminal module connections include H, L, and G terminals for Channels 00 - 15, Bank 0 and Bank 1 Commons, and the AT and BT Tree Switches. In addition, each channel H line has a jumper on the terminal module that can be removed to add filter components, attenuators, or current shunts.

## E1345A/47A Multiplexer Descriptions

The E1345A 16-Channel Relay Multiplexer and the E1347A 16-Channel Thermocouple Relay Multiplexer modules consist of an E1345A component assembly ( E1345-66201) and a terminal module. Each multiplexer provides switching (multiplexing) of up to 16 channels (channels 00 to 15). Each channel has HIGH (H), LOW (L), and GUARD (G) connections. See Figure 4-1 for a block diagram of these modules.

The component assembly is the same for the E1345A and E1347A. The only difference between the two component assemblies is their jumper settings. The E1345A has an E1345-80001 terminal module and the E1347A has an E1347-80001 terminal module.

### Component Assembly Description

The E1345A Component Assembly consists of 16 channel relays and four tree switch relays. The channel relay switches are separated into two banks, Bank 0 (channels 00 through 07) and Bank 1 (channels 08 to 15). Each bank has its own common H, L, and G terminals that connect to the channel switches.

The Bank 0 channel switches also connect to the AT Tree Switch Terminals (on the terminal module) via the AT Tree Switch (Channel 90) and three protection resistors (R26, R27, and R28). The Bank 1 channel switches connect to the BT Tree Switch terminals (on the terminal module) via the BT Tree Switch (Channel 91) and three protection resistors (R29, R30, and R31).

The AT2 Tree Switch (Channel 92) connects Bank 1 channels to the AT Tree Switch. For the E1347A only, the RT Tree Switch (Channel 93) connects the thermistor (on the terminal module) to the Bank 1 channel common. This allows measurement of the thermistor to compensate for temperature measurements made with thermocouples.

The AT Tree Switch connects to the H, L, and G connections on the Analog Bus Connector and the BT Tree Switch connects 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 E1326/E1411 multimeters.

Each Bank 0 and Bank 1 Common line and AT and BT Tree Switch line has a 100Ω resistor in series to provide relay contact protection. The Analog Bus Connector also has six 100Ω resistor in series to provide current protection.

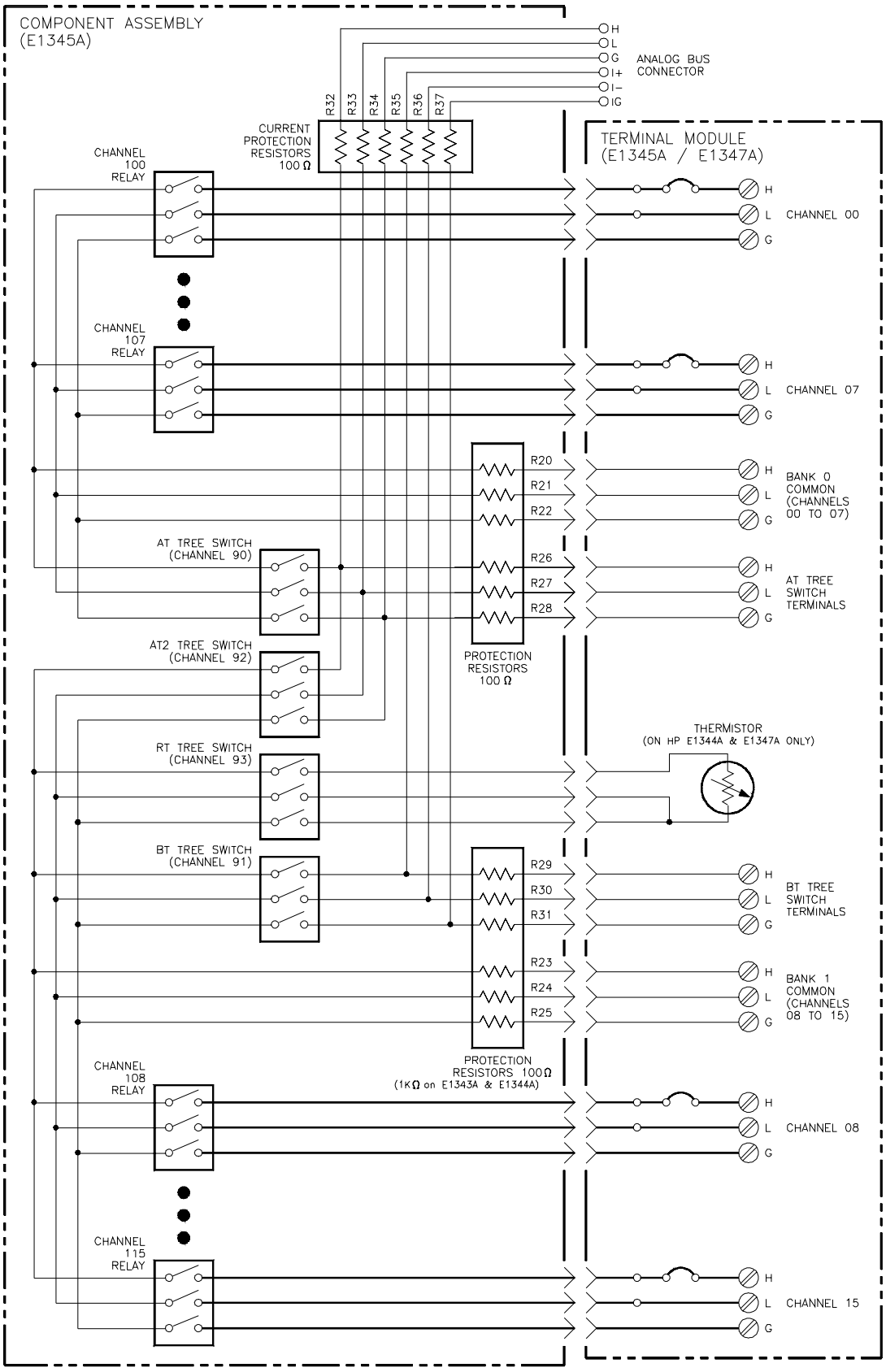


**Figure 4-1. E1343A, E1344A, E1345A, E1347A Multiplexer Block Diagram**

## Terminal Module Description

The terminal module provides connections from user devices to the multiplexer. The terminal module also provides connections for multimeters, voltmeters, counters, and other measuring devices. For the E1347A only, a thermistor is mounted on the terminal module.

Terminal module connections include H, L, and G terminals for Channels 00 - 15, Bank 0 and Bank 1 Commons, and the AT and BT Tree Switches. In addition, each channel H line has a jumper on the terminal module that can be removed to add filter components, attenuators, or current shunts.

## E1355A/56A Strain Gage Multiplexer Descriptions

The E1355A and E1356A multiplexers, together with an E1326B or E1411B multimeter, provide static and dynamic strain measurement capabilities for an Agilent 75000 Series B or 75000 Series C VXIbus system.

The E1355A and E1356A multiplexer are B-Size, 8-Channel, 120Ω and 350Ω relay strain gage multiplexers respectively. See Figure 4-2 for a block diagram of the E1355A 120 Ohm Relay Strain Gage Multiplexer. The block diagram shows a 1/4 bridge arrangement.

Each strain gage multiplexer provides switching (multiplexing) of up to eight channels. Each channel has HIGH (H), LOW (L), GUARD (G), +E, -E1, and -E2 connections to provide 1/4, 1/2, or full bridge arrangements. See the *E1355A - E1358A Strain Gage Multiplexers User's Manual* for a complete description of strain gage bridge arrangements.

The strain gage multiplexer module consists of a component assembly and a terminal module. The component assembly is the same for the E1355A and E1356A multiplexer modules. The only difference between the two component assemblies is their jumper settings. The E1355A has an E1355-80001 terminal module and the E1356A has an E1356-80001 terminal module.

## Component Assembly Description

Relay switches and relay control logic are located on the E1345A Component Assembly. The component assembly can be configured to provide the strain gage excitation voltage, or this voltage can be supplied by the user. Refer to the *E1355A - E1358A Strain Gage Multiplexers User's Manual* for information on bridge excitation voltage configurations. Table 4-1 summarizes the functions of each relay on the component assembly.

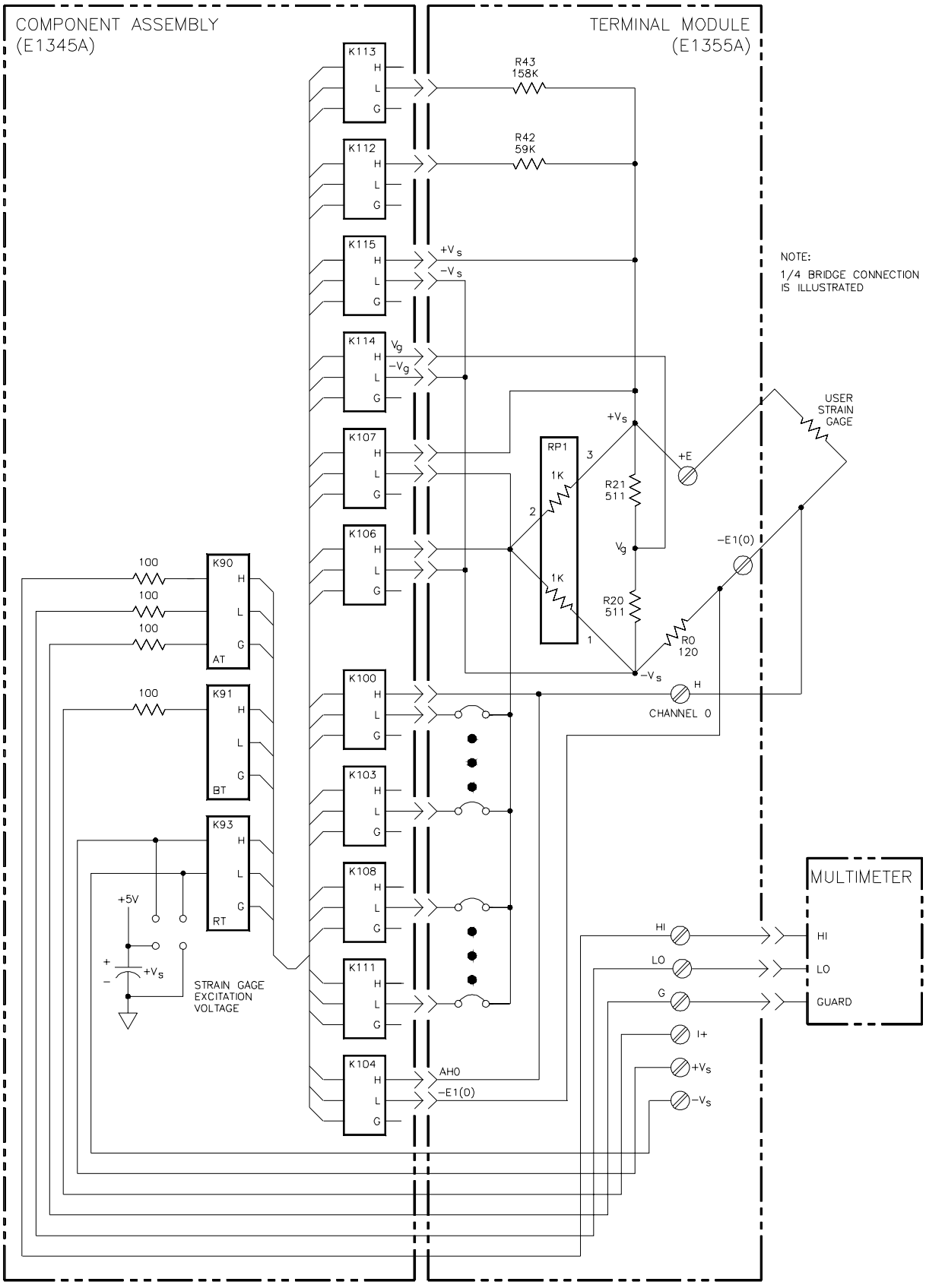


**Figure 4-2. E1355A/56A Multiplexers Block Diagram**

**Table 4-1. E1355A/E1356A Relay Functions**

| Relay | Function | Notes |
|---|---|---|
| K100<br>K101<br>K102<br>K103 | Measure strain (channel 00)<br>Measure strain (channel 01)<br>Measure strain (channel 02)<br>Measure strain (channel 03) | All strain gage measurements are made via the K90 relay connected to a multimeter |
| K108<br>K109<br>K110<br>K111 | Measure strain (channel 04)<br>Measure strain (channel 05)<br>Measure strain (channel 06)<br>Measure strain (channel 07) | All strain gage measurements are made via the K90 relay when connected to a multimeter |
| K104<br>K105 | Measure lead wire resistance (channel 08)<br>Measure lead wire resistance (channel 09) | This measurement increases accuracy of strain gage measurements by canceling effects of lead wire resistance. |
| K106<br>K107 | Measure voltage across 1KΩ bridge (channel 10)<br>Measure voltage across 1KΩ bridge (channel 11) | These measurements check stability and condition of the resistor pack RP1. |
| K112<br>k113<br>K114<br>K115 | Shunt verification test (channel 12)<br>Shunt verification test (channel 13)<br>Measure guard voltage (Vg) (channel 14)<br>Measure bridge excitation voltage (+Vs) (chan 15) | Simulates known value of compression<br>Simulates known value of tension<br>Made with respect to the excitation voltage (-Vs) |
| K90<br>K91<br>K93 | Strain gage measurements<br>I+ source<br>+Vs, -Vs excitation voltage | |

## Terminal Module Description

The terminal module contains the set of bridge resistors used in strain gage measurements. The two 1kΩ bridge resistors contained in the resistor pack (RP1) make up one half of the bridge arrangement. The other half of the bridge arrangement for channel 0 consists of a user-supplied 120Ω strain gage and the 120Ω resistor R0.

The junction (Vg) between the resistors R21 and R20 is known as a Wagner Ground. The purpose of the Wagner Ground is to reduce stray leakage currents when the Guard lead (G) is connected to the specimen being measured.

# Troubleshooting Techniques

To troubleshoot a relay multiplexer problem, you must first identify the problem and then isolate the cause of the problem to a replaceable part. See Chapter 3, "Replaceable Parts," *or* Appendix B, "Backdating Information," for descriptions and locations of replaceable parts, depending on the serial number of your multiplexer.

---

**NOTE** If the problem cannot be isolated to a user-replaceable part, we suggest you return the multiplexer to Hewlett-Packard for repair, or order a replacement assembly. See Chapter 1, "General Information," for procedures to return multiplexers to Hewlett-Packard. See Chapter 3, "Replaceable Parts," for information on ordering replaceable parts.

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## Identifying the Problem

Table 4-2 lists some common problems for the relay multiplexers, along with symptoms and possible solutions. If the problem cannot be identified using these steps, perform component-level troubleshooting using the parts locator diagram in Chapter 3 (Figure 3-1) and the schematic diagrams located at the back of this manual.

**Table 4-2. E1343A/44A/45A/47A/55A/56A Typical Problems**

| Problem Type | Symptom | Possible Solutions |
|---|---|---|
| Operator Errors | Non-zero error code in response to SYST:ERR? | For E1343A/44A/45A/47A, see Appendix C of the *E1343A/E1344A/E1345A/E1347A Relay Multiplexers User's Manual*<br><br>For E1355A/56A, see Appendix E of the *E1355A - E1358A Strain Gage Multiplexers User's Manual* |
| Catastrophic Failure | Multiplexer not responding to commands. | See "Making Visual Checks" in this chapter |
| Performance Out of Specification | Multiplexer fails Closed Channel Resistance Test (Test 2-1)<br><br>Multiplexer fails DC Isolation Test (Test 2-2) | See "Testing the Multiplexer" in this chapter<br><br>Check user wiring and test fixture connections. |

## Making Visual Checks

Visual checks for the multiplexer assemblies include the following. See Table 4-3 for typical symptoms/actions.

- Check switches/jumpers
- Check for heat damage
- Check terminal module connections

---

**NOTE** Refer to the appropriate user's manual for information on logical address and IRQ settings. If there are no apparent problems following the visual checks, run the Performance Verification Tests in Chapter 2 to see if a relay or other component is defective.

---

**Table 4-3. E1343A/44A/45A/47A/55A/56A Visual Tests/Checks**

| Test/Check | Reference Designator | Check | Action/Notes |
|---|---|---|---|
| Heat Damage | - - - - -<br>- - - - -<br>- - - - - | Discolored PC boards<br>Damaged insulation<br>Evidence of arcing | If there is damage, do not operate the multiplexer until you have corrected the problem. |
| Switch/Jumper Settings | - - - - -<br>SW1<br>SW2 | IRQ Level setting<br>Logical address setting<br>Card ID setting | Factory set at 1<br>Factory set at 112<br>Set to 45A,47A,55A, or 56A as appropriate for multiplexer |
| Component Assembly | F1, F2<br>J1<br>P1 | Fuse continuity<br>Dirty or bent connector pins<br>Dirty or bent connector pins | Check fuses with ohmmeter<br>Straighten/clean pins<br>Straighten/clean pins |
| Terminal Module | P1<br>TB1 - TB5<br>J0, J1 (E1355A/56A) | Dirty or bent connector pins<br>Loose screw connections<br>Bridge connections | Straighten/clean pins<br>Check/tighten connections<br>Set for 1/4, 1/2, or full as required |

## Testing the Multiplexer

You can use the tests and checks in Chapter 2, "Verification Tests," and the information in Table 4-4 to isolate the problem to a relay, to a component, or both. For example, if Test 2-1: Closed Channel Resistance Test failed for channel 0, replace relay K100, etc. See Chapter 3, "Replaceable Parts," *or* Appendix B, "Backdating Information," for replaceable parts lists and locator diagrams, depending on the serial number of your multiplexer.

**Table 4-4. Checks for Relay/Component Failures***

| If Test 2-1 failed for this Channel: | Check/Replace these Relays/ICs: |
|---|---|
| Channel 00 | K100 |
| Channel 01 | K101 |
| Channel 02 | K102 |
| Channel 03 | K103 |
| Channel 04 | K104 |
| Channel 05 | K105 |
| Channel 06 | K106 |
| Channel 07 | K107 |
| Channel 08 | K108 |
| Channel 09 | K109 |
| Channel 10 | K110 |
| Channel 11 | K111 |
| Channel 12 | K112 |
| Channel 13 | K113 |
| Channel 14 | K114 |
| Channel 15 | K115 |
| Channels 00 - 07 | U1, U21, U38 |
| Channels 08 - 15 | U2, U21, U30 |
| Channel 90 | K90 |
| Channel 91 | K91 |
| Channel 92 | K92 |
| Channels 90 - 92 | U3, U21, U25 |
| Channels 00 - 15 and 90 - 92 | CR2, Q1, U3, U6, U8, U12, U15, U20, U21, U22 |
| **If these items failed:** | **Replace:** |
| Channel 93 | K93 |
| Device Type ID | U10 |
| CRESET failed | U9, U21 |

* See Test 2-1: Closed Channel Resistance Test for information.

# Repair and Maintenance Guidelines

This section provides guidelines for handling the relay multiplexers including:

- ESD precautions
- Soldering printed circuit boards
- Post-repair safety checks

## ESD Precautions

Electrostatic discharge (ESD) may damage static sensitive devices in the multiplexers. This damage can range from slight parameter degradation to catastrophic failure. When handling multiplexer assemblies, observe the following guidelines to avoid damaging multiplexer components:

- Always use a static-free work station with a pad of conductive rubber or similar material when handling multiplexer components.
- If a device requires soldering, be sure the assembly is placed on a pad of conductive material. Also, be sure that you, the pad, and the soldering iron tip are grounded to the assembly.

## Soldering Printed Circuit Boards

Some of the components on the etched circuit boards of the multiplexer modules have plated through-holes that provide a solder path to both sides of the insulating material. Soldering can be done from either side of the board with equally good results. When soldering to any circuit board, keep in mind the following guidelines:

- Avoid unnecessary component unsoldering and soldering. Excessive replacement can result in damage to the circuit board, adjacent components, or both.
- Do not use a high power soldering iron on etched circuit boards, as excessive heat may lift a conductor or damage the board.
- Use a suction device or wooden toothpick to remove solder from component mounting holes. When using a suction device, be sure that the equipment is properly grounded.

## Post-Repair Safety Checks

After making repairs to the multiplexer, inspect the multiplexer for any signs of abnormal internally generated heat, such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and correct the cause of the condition. Then perform the functional tests as described in Chapter 2, "Verification Tests," to verify that the multiplexer is functional.

# Component Locators and Schematic Diagrams

The following tables list Component Locator Diagrams and Schematic Diagrams provided with this manual. Refer to Table 4-5 *or* Table 4-6, depending on the serial number of your E1343/44/45/47/55/56A multiplexer. Table 4-7 lists the terminal module diagrams. The terminal module diagram table applies to all E1343A/44A/45A/47A/56A/57A multiplexers, regardless of their serial number.

**Table 4-5. Relay Multiplexers Component Locator and Schematic Diagram Drawings for relay multiplexers with the following serial number ranges:**

E1343A with serial number 3131A00852 and higher
E1344A with serial number 3131A00512 and higher
E1345A with serial number 2934A07622 and higher
E1347A with serial number 2934A03663 and higher
E1355A with serial number 3035A00331 and higher
E1356A with serial number 3035A00457 and higher

| | Part Number | Drawing Number | Drawing Title |
|---|---|---|---|
| Parts Locator | E1345-66511 | | See Figure 3-1 (Chapter 3) |
| Schematic Diagrams | E1345-66511<br>E1345-66511<br>E1345-66511<br>E1345-66511<br>E1345-66511 | S-E1345-66511 (pg 1)<br>S-E1345-66511 (pg 2)<br>S-E1345-66511 (pg 3)<br>S-E1345-66511 (pg 4)<br>S-E1345-66511 (pg 5) | E1343A/E1344A/E1345A/E1347A/E1355A/E1356A - VXI Interface #1<br>E1343A/E1344A/E1345A/E1347A/E1355A/E1356A - VXI Interface #2<br>E1343A/E1344A/E1345A/E1347A/E1355A/E1356A - Relay Drivers<br>E1343A/E1344A/E1345A/E1347A/E1355A/E1356A - Relays<br>E1343A/E1344A/E1345A/E1347A/E1355A/E1356A - Part Location |

**Table 4-6. Relay Multiplexers Component Locator and Schematic Diagram Drawings for relay multiplexers with the following serial number ranges:**

E1343A with serial number 2934A00001 through 3131A00851
E1344A with serial number 2934A00001 through 3131A00511
E1345A with serial number 2934A00001 through 2934A07621
E1347A with serial number 2934A00001 through 2934A03662
E1355A with serial number 2934A00001 through 3035A00330
E1356A with serial number 2934A00001 through 3035A00456

| | Part Number | Drawing Number | Drawing Title |
|---|---|---|---|
| Component Locator | E1345-66501 | L-E1345-66501 | Relay Multiplexers Component Assembly (all modules) |
| Schematic Diagrams | E1345-66501<br>E1345-66501<br>E1345-66501<br>E1343-66501<br>E1345-66501 | S-E1345-66501 (pg 1)<br>S-E1345-66501 (pg 2)<br>S-E1345-66501 (pg 3)<br>S-E1343-66501 (pg 4)<br>S-E1345-66501 (pg 5) | Relay Multiplexers Component Assembly - VXI Interface #1<br>Relay Multiplexers Component Assembly - VXI Interface #2<br>Relay Multiplexers Component Assembly - Relay Drivers<br>Relay Multiplexers Component Assembly - Relays (E1343A/44A)<br>Relay Multiplexers Component Assembly - Relays ( E1345A/47A/55A/56A) |

**Table 4-7. Terminal Module Component Locator and Schematic Diagram Drawings**
**(for all E1343A/44A/45A/47A/55A/56A Relay Multiplexers, regardless of serial number)**

| | Part Number | Drawing Number | Drawing Title |
|---|---|---|---|
| Component Locators | E1345-66510<br>E1347-66510<br><br>E1355-66510<br>E1356-66510 | L-E1345-66510<br>L-E1347-66510<br><br>L-E1355-66510<br>L-E1356-66510 | E1343A/E1345A 16-Ch. Relay Multiplexer Terminal Card<br>E1344A/E1347A 16-Ch. Thermocouple Relay Multiplexer Terminal Card<br>E1355A 8-Ch. 120 Ohm Strain Relay Multiplexer Terminal Card<br>E1356A 8-Ch. 350 Ohm Strain Relay Multiplexer Terminal Card |
| Schematic Diagrams | E1345-66510<br>E1347-66510<br><br>E1355-66510<br>E1356-66510 | S-E1345-66510<br>S-E1347-66510<br><br>S-E1355-66510<br>S-E1356-66510 | E1343A/E1345A 16-Ch. Relay Multiplexer Terminal Card<br>E1344A/E1347A 16-Ch. Thermocouple Relay Multiplexer Terminal Card<br>E1355A 8-Ch. 120 Ohm Strain Relay Multiplexer Terminal Card<br>E1356A 8-Ch. 350 Ohm Strain Relay Multiplexer Terminal Card |

# Appendix A
# Verification Tests - C Programs

## Functional Verification Test

These programs are designed to do the Functional Verification Tests found in Chapter 2, "Verification Tests."

### Example: Self-Test

The Functional Verification Test for the multiplexer modules consists of sending the *IDN? command and checking the response. This test can be used to verify that the multiplexer is connected properly and is responding to a basic command.

```
#include <stdio.h>
#include <sicl.h>

#define ADDR "hpib7,9,14"                    /* Address of device */

void main (void)
{
   INST id;                                  /* Define id as an instrument */
   char a[256] = {0};                        /* Result variable */
   int i;

   ionerror (I_ERROR_EXIT);
   id = iopen (ADDR);                        /* Open instrument session */

   iprintf(id, "*IDN?\n");                   /* Send *IDN? command */
   iscanf (id, "%t", a);                     /* Get response */

   printf("\n %s", a);                       /* Print result */
   getchar();                                /* Pause */

   iclose (id);                              /* Close instrument session */

}
```

# Performance Verification Tests

These programs are designed to do the Performance Verification Tests found in Chapter 2, "Verification Tests."

## Example: Closed Channel Resistance Test

The following program performs a Closed Channel Resistance Test on Channels 00 - 15 and 90 - 92 HI, LO, and GU. If the conntact resistance for a channel is > 2.0 Ω, the program displays the message `Resistance for Channel chan Relay is > 2.0 Ohms.`

```
/*  Closed-channel Resistance Test          E1346A  */

#include <stdio.h>
#include <sicl.h>

#define ADDR "hpib7,9,14"                    /* Address of device */
#define DMM "hpib7,22"                       /* Address of multimeter */

void main (void)
{
   INST id, dm;                              /* Define id and dm as instruments */
   int channel, i, j;
   double ohm, R[6], result[48], value[48], result1[3][3], value1[3][3];
   char cr[256] = {0};

  #if defined(__BORLANDC__) && !defined(__WIN32__)
    _InitEasyWin();
  #endif

   ionerror(I_ERROR_EXIT);

/* Open instrument session */
   dm = iopen (DMM);
   itimeout (dm, 10000);

   iprintf (dm, "PRESET NORM\n");
   iprintf (dm, "END ALWAYS\n");
   iprintf (dm, "TRIG HOLD\n");
   iprintf (dm, "FUNC OHMF\n");

/* .....Measure Protection Resistors.....*/

   printf ("\n\nMeasure Protection Resistors R38 - R43");
   printf ("\n\n 1. Turn mainframe power OFF.");
   printf ("\n 2. Remove E1346A component assembly from mainframe.");
   printf ("\n\nPress ENTER when ready to measure protection resistors.");

   getchar ();
   printf ("\n\n");

   for (i = 0;i <= 5; i++)
   {
     printf ("\nConnect DMM leads (4-wire) to resistor R%u", i+38);
     printf ("\nPress ENTER when ready to measure resistance");
     getchar ();
```

```
      iprintf (dm, "TRIG SGL\n");
      iscanf (dm, "%lf", &R[i]);
      iscanf (dm, "%t", cr);
      printf ("\nResistance of R%u = %lf", i+38, R[i]);
    }

    printf ("\n\n\nInstall Component Assembly and Test Fixture");
    printf ("\n\n 1. Turn Mainframe AND 3458a DMM power OFF.");
    printf ("\n 2. Connect HP-IB Cable between mainframe and DMM.");
    printf ("\n 3. Install E1364A Component Assembly into Mainframe.");
    printf ("\n 4. Attach Test Fixture to Component Assembly.");
    printf ("\n 5. Turn Mainframe and DMM power ON");
    printf ("\n 6. Press ENTER when ready to begin testing.");
    getchar ();

/*.............Measure Channels 00-47 and 90-92 (HI, Lo, and G).....*/

    id = iopen(ADDR);
    iprintf (id, "*RST\n");
    iprintf (dm, "PRESET NORM;TRIG HOLD\n");
    iprintf (dm, "END ALWAYS\n");
    iprintf (dm, "FUNC OHMF\n");

    j = 100;
    printf ("\n\nChannel 00-47 and 90-92 HI measurements");
    printf ("\n\n 1. Connect DMM Sense and Input HI leads to COMMON HI.");
    printf ("\n 2. Connect DMM Sense and Input LO leads to VOLTAGE SENSE HI.");
    printf ("\n 3. Press ENTER when connections are complete.");
    getchar ();

    for (i = 0;i <= 47; i++)
    {
      iprintf (id, "CLOS (@%u)\n", j+i);
      iprintf (dm, "TRIG SGL\n");
      iscanf (dm, "%lf", &value[i]);
      iscanf (dm, "%t", cr);
      iprintf (id, "OPEN (@%u)\n", j+i);
      result[i] = value[i] - R[5];

      if (result[i] < 0)  result[i] = 0;
      if (result[i] > 2.0)  printf ("\n*** Resistance for Channel %u HI path is  2.0 Ohms
***  %lf", i, result[i]);
    }

    printf ("\n\nMeasurements complete for Channels 00-47 and 90-92 HI");
    printf ("\nPress ENTER for Channels 90-92 LO measurements");
    getchar ();

/*.........................Measure Channels 90-92 LO.....................*/

    iprintf (id, "*RST\n");

    printf ("\n\n\nChannels 90-92 LO measurements");

    printf ("\n\n 1. Connect DMM Sense and Input HI leads to COMMON LO.");
    printf ("\n 2. Connect DMM Sense and Input LO leads to VOLTAGE SENSE
LO.");
    printf ("\n 3. Press ENTER when connections are complete.");
    getchar ();
```

```
    j = 100;
    for (i = 0;i <= 2; i++)
    {
      iprintf (id, "CLOS (@%u)\n", j);
      iprintf (dm, "TRIG SGL\n");
      iscanf  (dm, "%lf", &value1[i][1]);
      iscanf  (dm, "%t", cr);
      iprintf (id, "OPEN (@%u)\n", i*8);
      result1[i][1] = value1[i][1] - R[42];

      if (result1[i][1] < 0)  result1[i][1] = 0;
      if (result1[i][1] > 2.0)  printf ("\n*** Resistance for Channel %u LO Relay is  2.0
Ohms", i+90);

      j = j + 8;
    }

    printf ("\n\nMeasurements complete for Channels 90-92 LO.");
    printf ("\nPress ENTER for Channel 90-92 G measurements.");
    getchar ();

/*.............................Measure Channels 90-92 G.....................................*/

    printf ("\n\n\nChannels 90-92 G measurements");
    printf ("\n\n 1. Connect DMM Sense and Input HI leads to COMMON G.");
    printf ("\n 2. Connect DMM Sense and Input LO leads to VOLTAGE SENSE G.");
    printf ("\n 3. Press ENTER when connections are complete.");
    getchar ();

    j = 100;
    for (i = 0;i <= 2; i++)
    {
      iprintf (id, "CLOS (@%u)\n", j);
      iprintf (dm, "TRIG SGL\n");
      iscanf  (dm, "%lf", &value1[i][2]);
      iscanf  (dm, "%t", cr);
      iprintf (id, "OPEN (@%u)\n", i*8);
      result1[i][2] = value1[i][2] - R[42];

      if (result1[i][2] < 0)  result1[i][2] = 0;
      if (result1[i][2] > 2.0)  printf ("\n*** Resistance for Channel %u G Relay is  2.0
Ohms", i+90);

      j = j + 8;
    }

    printf ("\n\nMeasurements complete for Channels 90-92 G.");
    printf ("\nPress ENTER for Channel 93 HI, LO, and G measurements.");
    getchar ();

/*.............................Measure Channel 93 HI, LO, and G.............................*/

    j = 193;
    printf ("\n\n\nChannel 93 HI, LO, and G measurements");
    printf ("\n\n 1. Connect DMM Sense and Input HI leads to VOLTAGE SENSE
HI.");

    printf ("\n 2. Connect DMM Sense and Input LO leads to CURRENT SOURCE
HI.");
    printf ("\n 3. Press ENTER when connections are complete.");
```

```
    getchar ();

    iprintf (id, "CLOS (@%u)\n", j);
    iprintf (dm, "TRIG SGL\n");
    iscanf  (dm, "%lf", &value1[0][3]);
    iscanf  (dm, "%t", cr);
    result1[0][3] = value1[0][3] - R[38] - R[43];
    iprintf (id, "open (@%u)\n", j);

    if (result1[0][3] < 0)  result1[0][3] = 0;
    if (result1[0][3] > 2.0) printf ("\n*** Resistance for Channel 93 HI Relay is  2.0
Ohms");

    printf ("\n\n 1. Connect DMM Sense and Input HI leads to VOLTAGE SENSE
LO.");
    printf ("\n 2. Connect DMM Sense and Input LO leads to CURRENT SOURCE
LO.");
    printf ("\n 3. Press ENTER when connections are complete.");
    getchar ();

    iprintf (id, "CLOS (@%u)\n", j);
    iprintf (dm, "TRIG SGL\n");
    iscanf  (dm, "%lf", &value1[1][3]);
    iscanf  (dm, "%t", cr);
    result1[1][3] = value1[1][3] - R[39] - R[42];
    iprintf (id, "open (@%u)\n", j);

    if (result1[1][3] < 0)  result1[1][3] = 0;
    if (result1[1][3] > 2.0)  printf ("\n*** Resistance for Channel 93 LO Relay is  2.0
Ohms");

    printf ("\n\n 1. Connect DMM Sense and Input HI leads to VOLTAGE SENSE
G.");
    printf ("\n 2. Connect DMM Sense and Input LO leads to CURRENT SOURCE
G.");
    printf ("\n 3. Press ENTER when connections are complete.");
    getchar ();

    iprintf (id, "CLOS (@%u)\n", j);
    iprintf (dm, "TRIG SGL\n");
    iscanf  (dm, "%lf", &value1[2][3]);
    iscanf  (dm, "%t", cr);
    result1[2][3] = value1[2][3] - R[40] - R[41];
    iprintf (id, "open (@%u)\n", j);

    if (result1[2][3] < 0)  result1[2][3] = 0;
    if (result1[2][3] > 2.0)  printf ("\n*** Resistance for Channel 93 G Relay is  2.0
Ohms");

    printf ("\n\nMeasurements complete for Channel 93 HI, LO, and G.");
    printf ("\nPress ENTER to display measurement results.");
    getchar ();

/*.........................Display Measurement Results.....................*/

    printf ("\n\n\nChannels 00-47 & 90-92 HI Contact Resistance\n");
    for (i = 0;i <= 23; i++)
    {
      printf ("\n   CH %u & %u    %6.4lf Ohms    CH %u & %u    %6.4lf
Ohms",i,90+(i/8),result[i],i+24,90+(i/8),result[i+24]);
    }
```

```
    printf ("\n\nChannels 90-92 LO and G Contact Resistance\n");
    printf ("\n   CH 90 LO %6.4lf Ohms   CH 91 LO %6.4lf Ohms   CH 92 LO %6.4lf
Ohms", result1[0][1],result1[1][1],result1[2][1]);
    printf ("\n   CH 90  G %6.4lf Ohms   CH 91  G %6.4lf Ohms   CH 92  G %6.4lf
Ohms", result1[0][2],result1[1][2],result1[2][2]);

    printf ("\n\nChannel 93 HI, LO, and G Contact Resistance\n");

    printf ("\n   CH 93 HI %6.4lf Ohms\n   CH 93 LO %6.4lf Ohms\n   CH 93  G
%6.4lf Ohms\n",result1[0][3],result1[1][3],result1[2][3]);

    iclose (id);
    iclose (dm);                                    /* Close instrument session */
}
```

## Example: DC Isolation Test

This example performs DC Isolation Tests for HI to Chassis, HI to LO, and HI to GU (Guard).

```
/*  DC Isolation Test           E1346A  */

#include <stdio.h>
#include <sicl.h>

#define ADDR "hpib7,9,14"                       /* Address of device */
#define DMM "hpib7,22"                          /* Address of multimeter */

void main (void)
{
    INST id, dm;                                /* Define id and dm as instruments
*/
    char reading[256]= {0};                     /* Result variable */
    char cr[256]= {0};

    #if defined(__BORLANDC__) && !defined(__WIN32__)
      _InitEasyWin();
    #endif

    ionerror(I_ERROR_EXIT);

    id = iopen (ADDR);                          /* Open instrument session */
    dm = iopen (DMM);

    iprintf (dm, "PRESET NORM;TRIG HOLD\n");
    iprintf (dm, "FUNC OHM;RANGE 1E9\n");
    iprintf (dm, "END ALWAYS\n");

    iprintf (id, "*RST\n");
    iprintf (id, "CLOS (@193,100,108,116)\n");

/*.....HI to CHASSIS.....*/

    printf ("\n\nConnect DMM HI and LO to E1346A COMMON HI and CHASSIS");
    getchar ();
```

```
    iprintf (dm, "TRIG SGL\n");
    iscanf  (dm, "%t", reading);
    printf ("\nDC Isolation -- HI to CHASSIS ");
    printf (" R = %s Ohms", reading);

/*.....................HI to LO.....................*/

    printf ("\n\nConnect DMM HI and LO to E1346A COMMON HI and COMMON
LO");
    getchar ();
    iprintf (dm, "TRIG SGL\n");
    iscanf (dm, "%t", reading);

    printf ("\nDC Isolation -- HI to LO ");
    printf (" R = %s Ohms", reading);

/*.....................HI to GUARD.....................*/

    printf ("\n\nConnect DMM HI and LO to E1346A COMMON HI and COMMON G");
    getchar ();
    iprintf (dm, "TRIG SGL\n");
    iscanf  (dm, "%t", reading);
    printf ("\nDC Isolation -- HI to GUARD ");
    printf (" R = %s Ohms", reading);
/*.....................................................................*/

    iprintf (id, "OPEN (@193,100,108,116)\n");

    iclose (id);                                    /* Close instrument session */
    iclose (dm);
}
```

*Notes*

# Appendix B
# Backdating Information

## Introduction

This chapter contains information for ordering replaceable parts for the E1343A/44A/45A/47A/55A/56A Relay Multiplexers with specific serial number ranges not covered in Chapter 3. The tables provide the following:

- Table B-1 lists assembly and terminal module part numbers for the relay multiplexers.
- Table B-2 lists replaceable parts for the following relay multiplexers:

  E1345A w/serial number 2934A00001 through 2934A07621
  E1347A w/serial number 2934A00001 through 2934A03662
  E1355A w/serial number 2934A00001 through 3035A00330
  E1356A w/serial number 2934A00001 through 3035A00456

- Table B-3 lists replaceable parts for the following high-voltage multiplexers:

  E1343A w/serial number 2934A00001 through 3131A00851
  E1344A w/serial number 2934A00001 through 3035A00511

- Table B-4 shows reference designators for parts in Tables B-2 and B-3.

To order a part listed in Table B-2 or Table B-3, specify the Agilent part number and the quantity required. Send the order to your nearest Agilent Technologies Sales and Service Office

---

**NOTE** If your multiplexer has a higher serial number, see Chapter 3, "Replaceable Parts," for replaceable parts ordering information.

---

## Replaceable Parts List

See the Parts Locator diagram (Fig. B-1) or the Component Locator (in the back of this manual) for locations of replaceable parts. See Table B-1 for replacement part numbers for the Component Assemblies and Terminal Modules. A relay multiplexer consists of a Component Assembly and a Terminal Module.

A Terminal Module consists of a Terminal Card and a Terminal Case Assembly. For example, to order an E1345A Terminal Module, use

E1345-80001. To order only the Terminal Card, use E1345-66510. To order only the Terminal Case Assembly, use E1300-84401.

**Table B-1. Relay Multiplexer Assembly/Terminal Module Part Numbers**

| Multiplexer | Component Assembly | Terminal Module | Terminal Card | Terminal Case Assy |
|---|---|---|---|---|
| E1343A 16-Channel High Voltage Relay Mux | E1343-66201 | E1343-80001 | E1345-66510 | E1300-84401 |
| E1344A 16-Channel High Voltage Relay Mux with TC | E1343-66201 | E1344-80001 | E1347-66510 | E1300-84401 |
| E1345A 16-Channel Mux | E1345-66201 | E1345-80001 | E1345-66510 | E1300-84401 |
| E1347A 16-Channel Mux w/TC | E1345-66201 | E1347-80001 | E1347-66510 | E1300-84401 |
| E1355A 120 Ohm Strain Rly Mux | E1345-66201 | E1355-80001 | E1355-66510 | E1300-84401 |
| E1356A 350 Ohm Strain Rly Mux | E1345-66201 | E1356-80001 | E1356-66510 | E1300-84401 |

**Table B-2. E1345A/47A/55A/56A Replaceable Parts**

(See applicable Serial Number ranges listed on the first page of this chapter)

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **ASSEMBLIES/TERMINAL MODULES/CABLES** |
| | | | **ASSEMBLIES/TERMINAL MODULES** |
| | E1345-66201 | 1 | COMPONENT ASSEMBLY |
| | E1345-80001 | 1 | E1345A TERMINAL MODULE |
| | E1347-80001 | 1 | E1347A TERMINAL MODULE |
| | E1355-80001 | 1 | E1355A TERMINAL MODULE |
| | E1356-80001 | 1 | E1356A TERMINAL MODULE |
| | | | **CABLES** |
| | E1326-61601 | 1 | RIBBON CABLE 6-PIN 3-IN E1326B TO RLY MUXS |
| | E1326-61604 | 1 | RBN CBL 6-PIN 21-IN E1326A (INT) TO RLY MUXS |
| | E1326-61611 | 1 | RBN CBL 6-PIN 20-IN E1326B (INT) TO RLY MUXS |
| | E1300-61605 | 1 | RBN CABLE 6-PIN 2-IN RLY MUXS TO RLY MUXS |
| | E1400-61605 | 1 | RBN CABLE 6-PIN 2.5-IN RLY MUXS TO RLY MUXS |
| | | | **COMPONENT ASSEMBLY (HP E1345-66201)**<br>**(Common to HP E1345/47/55/56 Relay Muxs)**<br>**See Figure B-1 and Component Locator in back of manual.** |
| BRK1-BRK2 | 0050-2183 | 2 | CASTING-ZN P.C. BOARD HOLDER |
| LBL1 | E1300-84308 | 1 | LBL LOGO B SIZE |
| LBL2 | E1300-84312 | 1 | ID PLATE VXI (P & P) |
| F1 | 2110-0712 | 1 | FUSE-SUBMINIATURE 4A 125V NTD AX |
| F2 | 2110-0665 | 1 | FUSE-SUBMINIATURE 1A 125V NTD AX UL CSA |

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **COMPONENT ASSY (CONT'D...HP E1345-66201)** |
| J1 | 1252-1596 | 2 | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| J2 | 1252-3712 | 1 | CONN-POST TYPE .100-PIN-SPCG 12-CONTACT |
| J3 | 1251-6001 | 1 | CONN-POST TYPE .100-PIN-SPCG 6-CONTACT |
| K0-K15<br>K90-K93 | 0490-1707 | 20 | RELAY-REED 3A 500MA 110VAC 5VDC-COIL 5VA |
| MP1-MP2 | 1400-1546 | 2 | BRACKET PC BOARD HOLDER; BLACK; EXTR |
| P1 | 1252-1596 | | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| P3-P4 | 1258-0141 | 2 | JUMPER-REMOVABLE FOR .025 IN SQ PINS |
| PNL1 | E1345-00202 | 1 | PNL-RR RLY MUXR |
| SCR1-SCR2 | 0515-0444 | 2 | SCREW-MACH PHD M2.5 X 0.45 8MM-LG - HD |
| SCR3-SCR4 | 0515-1968 | 2 | SCREW PHM 2.5 X 11 PAN - HD |
| SHD1 | E1300-80601 | 1 | SHIELD SAFETY - PLASTIC |
| SW1 | 3101-3066 | 1 | SWITCH-DIP ROCKER 8-1A 0.15A 30 VDC |
| **A1** | | | PRINTED CIRCUIT ASSY, 16 CHAN MULTI |
| A1C1 | 0180-1746 | 2 | CAPACITOR-FXD 15uF +-0% 20 V TA |
| A1C2-C3 | 0160-4822 | 3 | CAPACITOR-FXD 1000pF +-5% 100 V CER C0G |
| A1C5 | 0160-4801 | 4 | CAPACITOR-FXD 100pF +-5% 100 V CER C0G |
| A1C6 | 0160-4822 | | CAPACITOR-FXD 1000pF +- 5% 100 V CER C0G |
| A1C7-C9 | 0160-4801 | | CAPACITOR-FXD 100pF +-5% 100 V CER C0G |
| A1C11 | 0160-3334 | 1 | CAPACITOR-FXD 0.01uF +-10% 50 V CER X7R |
| A1C17 | 0160-4835 | 9 | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C38-C42 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C44 | 0180-1746 | | CAPACITOR-FXD 15uF +-10% 20 V TA |
| A1C45-C46 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C48 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1CR1 | 1902-0554 | 1 | DIODE-ZENER 10V 5% PD=1W IR=10UA |
| A1CR2 | 1901-1065 | 1 | DIODE-POWER RECTIFIER 1N4936 400V 1A 200NS |
| A1JM15-JM16 | 7175-0057 | 2 | RESISTOR 0 MFS |
| A1Q1 | 1855-0518 | 1 | TRANSISTOR MOSFET N-CHAN E-MODE SI |
| A1R2 | 0757-0453 | 1 | RESISTOR 30.1K +-1% .125W TF TC=0+-100 |
| A1R3 | 0698-3615 | 1 | RESISTOR 47 +-5% 2W MO TC=0+-200 |
| A1R5 | 0698-8737 | 1 | RESISTOR 100K +-5% .25W CC TC=-400/+800 |
| A1R6-R7 | 0757-0465 | 2 | RESISTOR 100K +-1% .125W TF TC=0+-100 |
| A1R9 | 0757-0417 | 1 | RESISTOR 562 +-1% .125W TF TC=0+-100 |
| A1R10 | 0757-0442 | 1 | RESISTOR 10K +-1% .125W TF TC=0+-100 |
| A1R20-R37 | 0698-8768 | 18 | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1RP1-RP3 | 1810-0265 | 3 | NETWORK-RESISTOR 16-DIP 680.0 OHM X 8 |
| A1RP25-RP26 | 1810-0279 | 3 | NETWORK-RES 10-SIP 4.7K OHM X 9 |
| A1RP32 | 1810-0279 | | NETWORK-RES 10-SIP 4.7K OHM X 9 |

| Reference Designator | Part Number | Qty | Part Description |
|---|---|---|---|
| | | | **COMPONENT ASSY (CONT'D...HP E1345-66201)** |
| A1U1-U3 | 1858-0069 | 3 | TRANSISTOR ARRAY 18-PIN PLASTIC DIP |
| A1U5 | 1820-4057 | 1 | IC BUFFER TTL/F NAND QUAD 2-INP |
| A1U6 | 1820-6731 | 1 | IC GATE-ARRAY CMOS |
| A1U7-U8 | 1820-3079 | 2 | IC DCDR CMOS/74HC BIN 3-TO-8-LINE |
| A1U9 | 1820-3081 | 1 | IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG |
| A1U10-U11 | 1820-3975 | 2 | IC-DRIVER CMOS/74HC LINE OCTAL |
| A1U12 | 1820-4590 | 1 | IC MV CMOS/74HC MONOSTBL RETRIG DUAL |
| A1U15 | 1820-4147 | 1 | IC LCH CMOS/74HCT TRANSPARENT OCTL |
| A1U16 | 1820-3714 | 2 | IC TRANSCEIVER TTL/ALS BUS OCTL |
| A1U17-U18 | 1820-3631 | 2 | IC COMPARATOR CMOS/74HCT MAGTD 8-BIT |
| A1U19 | 1820-3664 | 1 | IC GATE CMOS/HCT NAND QUAD 2-INP |
| A1U20 | 1820-4242 | 1 | IC SCHMITT-TRIG CMOS/74HCT INV HEX |
| A1U21-U22 | 1820-4643 | 2 | IC GATE CMOS/74HCT NOR QUAD 2-INP |
| A1U25 | 1820-4086 | 3 | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| A1U30 | 1820-4086 | | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| A1U35 | 1820-3714 | | IC TRANSCEIVER TTL/ALS BUS OCTL |
| A1U38 | 1820-4086 | | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| | **E1345-80001** | **1** | **E1345A TERMINAL MODULE (See Figure B-2)** |
| A1 | E1345-66510 | 1 | TERM CARD - 16 CH RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |
| | **E1347-80001** | **1** | **E1347A TERMINAL MODULE (See Figure B-2)** |
| A1 | E1347-66510 | 1 | TERM CARD - 16 CH T/C MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |
| | **E1355-80001** | **1** | **E1355A TERMINAL MODULE (See Figure B-3)** |
| A1 | E1355-66510 | 1 | TERM CARD - 120 OHM STRAIN RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |
| | **E1356-80001** | **1** | **E1356A TERMINAL MODULE (See Figure B-3)** |
| A1 | E1356-66510 | 1 | TERM CARD - 350 OHM STRAIN RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |

**Table B-3. E1343A, E1344A Replaceable Parts**

(See applicable Serial Number ranges listed on the first page of this chapter))

| Reference Designator | Part Number | Qty. | Part Description |
|---|---|---|---|
| | | | **ASSEMBLIES/TERMINAL MODULES/CABLES** |
| | | | **ASSEMBLIES/TERMINAL MODULES** |
| | E1343-66201 | 1 | COMPONENT ASSEMBLY |
| | E1343-80001 | 1 | E1343A TERMINAL MODULE |
| | E1344-80001 | 1 | E1344A TERMINAL MODULE |
| | | | **CABLES** |
| | E1326-61601 | 1 | RIBBON CABLE 6-PIN 3-IN E1326B TO RLY MUXS |
| | E1326-61604 | 1 | RBN CBL 6-PIN 21-IN E1326A (INT) TO RLY MUXS |
| | E1326-61611 | 1 | RBN CBL 6-PIN 20-IN E1326B (INT) TO RLY MUXS |
| | E1300-61605 | 1 | RBN CABLE 6-PIN 2-IN RLY MUXS TO RLY MUXS |
| | E1400-61605 | 1 | RBN CABLE 6-PIN 2.5-IN RLY MUXS TO RLY MUXS |
| | | | **COMPONENT ASSY (E1343-66201)**<br>**(Common to both E1343A/44A Relay Muxs)**<br>**See Figure B-1 and Component Locator in back of manual.** |
| BRK1-BRK2 | 0050-2183 | 2 | CASTING-ZN P.C. BOARD HOLDER |
| LBL1 | E1300-84308 | 1 | LBL LOGO B SIZE |
| LBL2 | E1300-84312 | 1 | ID PLATE VXI (P & P) |
| F1 | 2110-0712 | 1 | FUSE-SUBMINIATURE 4A 125V NTD AX |
| F2 | 2110-0665 | 1 | FUSE-SUBMINIATURE 1A 125V NTD AX UL CSA |
| J1 | 1252-1596 | 2 | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| J2 | 1252-3712 | 1 | CONN-POST TYPE .100-PIN-SPCG 12-CONTACT |
| J3 | 1251-6001 | 1 | CONN-POST TYPE .100-PIN-SPCG 6-CONTACT |
| K0-K15<br>K90-K93 | 0490-1584 | 20 | RELAY-REED 3A 2A 350VAC 5VDC-COIL 5VA |
| MP1-MP2 | 1400-1546 | 2 | BRACKET PC BOARD HOLDER; BLACK; EXTR |
| P1 | 1252-1596 | | CONN-POST TYPE 2.54-PIN-SPCG 96-CONTACT |
| P3-P4 | 1258-0141 | 2 | JUMPER-REMOVABLE FOR .025 IN SQ PINS |
| PNL1 | E1343-00202 | 1 | PNL-RR MUXR 16CH |
| SCR1-SCR2 | 0515-0444 | 2 | SCREW-MACH PHD M2.5 X 0.45 8MM-LG - HD |
| SCR3-SCR4 | 0515-1968 | 2 | SCREW PHM 2.5 X 11 PAN - DH |
| SHD1 | E1300-80601 | 1 | SHIELD SAFETY - PLASTIC |
| SW1 | 3101-3066 | 1 | SWITCH-DIP ROCKER 8-1A 0.15A 30 VDC |

| Reference Designator | Part Number | Qty. | Part Description |
|---|---|---|---|
| | | | **COMPONENT ASSY (CONT'D...E1343-66201)** |
| **A1** | | | **PRINTED CIRCUIT ASSY, 16 CHAN MULTI** |
| A1C1 | 0180-1746 | 2 | CAPACITOR-FXD 15uF +-10% 20 V TA |
| A1C2-C3 | 0160-4822 | 3 | CAPACITOR-FXD 1000pF +-5% 100 V CER C0G |
| A1C5 | 0160-4801 | 4 | CAPACITOR-FXD 100pF +-5% 100 V CER C0G |
| A1C6 | 0160-4822 | | CAPACITOR-FXD 1000pF +-5% 100 V CER C0G |
| A1C7-C9 | 0160-4801 | | CAPACITOR-FXD 100pF +-5% 100 V CER C0G |
| A1C11 | 0160-3334 | 1 | CAPACITOR-FXD 0.01uF +-10% 50 V CER X7R |
| A1C17 | 0160-4835 | 9 | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C38-C42 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C44 | 0180-1746 | | CAPACITOR-FXD 15uF +-10% 20 V TA |
| A1C45-C46 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1C48 | 0160-4835 | | CAPACITOR-FXD 0.1uF +-10% 50V CER X7R |
| A1CR1 | 1902-0554 | 1 | DIODE-ZENER 10V 5% PD=1W IR=10UA |
| A1CR2 | 1901-1065 | 1 | DIODE-POWER RECTIFIER 1N4936 400V 1A 200NS |
| A1JM15-JM16 | 7175-0057 | 2 | RESISTOR 0 MFS |
| A1Q1 | 1855-0518 | 1 | TRANSISTOR MOSFET N-CHAN E-MODE SI |
| A1R2 | 0757-0453 | 1 | RESISTOR 30.1K +-1% .125W TF TC=0+-100 |
| A1R3 | 0698-3615 | 1 | RESISTOR 47 +-5% 2W MO TC=0+-200 |
| A1R5 | 0698-8737 | 1 | RESISTOR 100K +-5% .25W CC TC=-400/+800 |
| A1R6-R7 | 0757-0465 | 2 | RESISTOR 100K +-1% .125W TF TC=0+-100 |
| A1R9 | 0757-0417 | 1 | RESISTOR 562 +-1% .125W TF TC=0+-100 |
| A1R10 | 0757-0449 | 1 | RESISTOR 20K +-1% .125W TF TC=0+-100 |
| A1R20-R21 | 0698-8768 | 12 | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R22 | 0698-8777 | 6 | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1R23-R24 | 0698-8768 | | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R25 | 0698-8777 | | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1R26-R27 | 0698-8768 | | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R28 | 0698-8777 | | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1R29-R30 | 0698-8768 | | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R31 | 0698-8777 | | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1R32-R33 | 0698-8768 | | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R34 | 0698-8777 | | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1R35-R36 | 0698-8768 | | RESISTOR 100 +-5% .25W CC TC=-400/+500 |
| A1R37 | 0698-8777 | | RESISTOR 1k +-5% .25W CC TC=-400/+900 |
| A1RP1-RP3 | 1810-0265 | 3 | NETWORK-RESISTOR 16-DIP 680.0 OHM X 8 |
| A1RP25-RP26 | 1810-0279 | 3 | NETWORK-RES 10-SIP 4.7K OHM X 9 |
| A1RP32 | 1810-0279 | | NETWORK-RES 10-SIP 4.7K OHM X 9 |
| A1U1-U3 | 1858-0069 | 3 | TRANSISTOR ARRAY 18-PIN PLASTIC DIP |
| A1U5 | 1820-4057 | 1 | IC BUFFER TTL/F NAND QUAD 2-INP |

| Reference Designator | Part Number | Qty. | Part Description |
|---|---|---|---|
| | | | **COMPONENT ASSY (CONT'D...E1343-66201)** |
| A1U6 | 1820-6731 | 1 | IC GATE-ARRAY CMOS |
| A1U7-U8 | 1820-3079 | 2 | IC DCDR CMOS/74HC BIN 3-TO-8-LINE |
| A1U9 | 1820-3081 | 1 | IC FF CMOS/74HC D-TYPE POS-EDGE-TRIG |
| A1U10-U11 | 1820-3975 | 2 | IC-DRIVER CMOS/74HC LINE OCTAL |
| A1U12 | 1820-4590 | 1 | IC MV CMOS/74HC MONOSTBL RETRIG DUAL |
| A1U15 | 1820-4147 | 1 | IC LCH CMOS/74HCT TRANSPARENT OCTL |
| A1U16 | 1820-3714 | 2 | IC TRANSCEIVER TTL/ALS BUS OCTL |
| A1U17-U18 | 1820-3631 | 2 | IC COMPARATOR CMOS/74HCT MAGTD 8-BIT |
| A1U19 | 1820-3664 | 1 | IC GATE CMOS/HCT NAND QUAD 2-INP |
| A1U20 | 1820-4242 | 1 | IC SCHMITT-TRIG CMOS/74HCT INV HEX |
| A1U21-U22 | 1820-4643 | 2 | IC GATE CMOS/74HCT NOR QUAD 2-INP |
| A1U25 | 1820-4086 | 3 | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| A1U30 | 1820-4086 | | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| A1U35 | 1820-3714 | | IC TRANSCEIVER TTL/ALS BUS OCTL |
| A1U38 | 1820-4086 | | IC FF CMOS/74HCT D-TYPE POS-EDGE-TRIG |
| | | | **TERMINAL MODULES** |
| | **E1343-80001** | **1** | **E1343A TERMINAL MODULE (See Figure B-2)** |
| A1 | E1345-66510 | 1 | TERM CARD - 16 CH RLY MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |
| | **E1344-80001** | **1** | **E1344A TERMINAL MODULE (See Figure B-2)** |
| A1 | E1347-66510 | 1 | TERM CARD - 16 CH T/C MUX |
| CS | E1300-84401 | 1 | CASE - TERM MODULE ASSY |

**Table B-4. Reference Designators**

| Reference Designators | | | | |
|---|---|---|---|---|
| A | assembly | | PCB | printed circuit board |
| BRK | bracket | | PNL | panel |
| C | capacitor | | Q | transistor |
| CR | diode | | R | resistor |
| CS | case | | RP | resistor pack |
| F | fuse | | RT | thermistor probe |
| J | electrical connector (jack) | | SCR | screw |
| JM | jumper | | SHD | shield |
| K | relay | | SW | switch |
| LBL | label | | TB | terminal block (module) |
| MP | mechanical part | | U | integrated circuit |
| P | electrical connector (plug) | | | |

# Parts Locators

Figures B-1 through B-3 show locations of replaceable parts for the E1343A, E1344A, E1345A, E1347A, E1355A, and E1356A Relay Multiplexers with serial numbers that fall within a specific range. (See applicable serial number ranges on the first page of this chapter.) See Table B-4 for Reference Designators. A more detailed component locator and schematic diagrams are provided at the back of this manual.

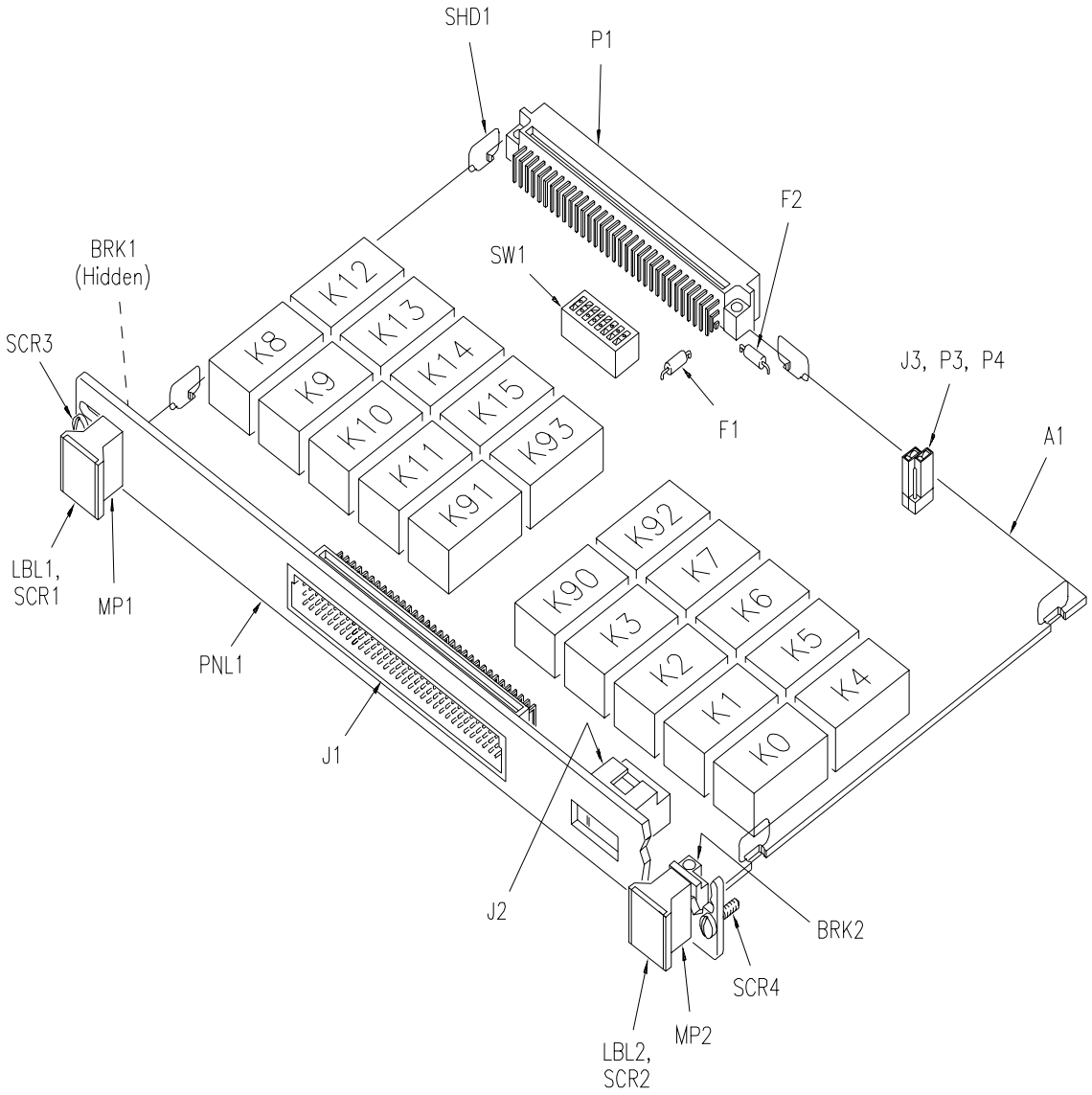


**Figure B-1. Component Assembly Parts**

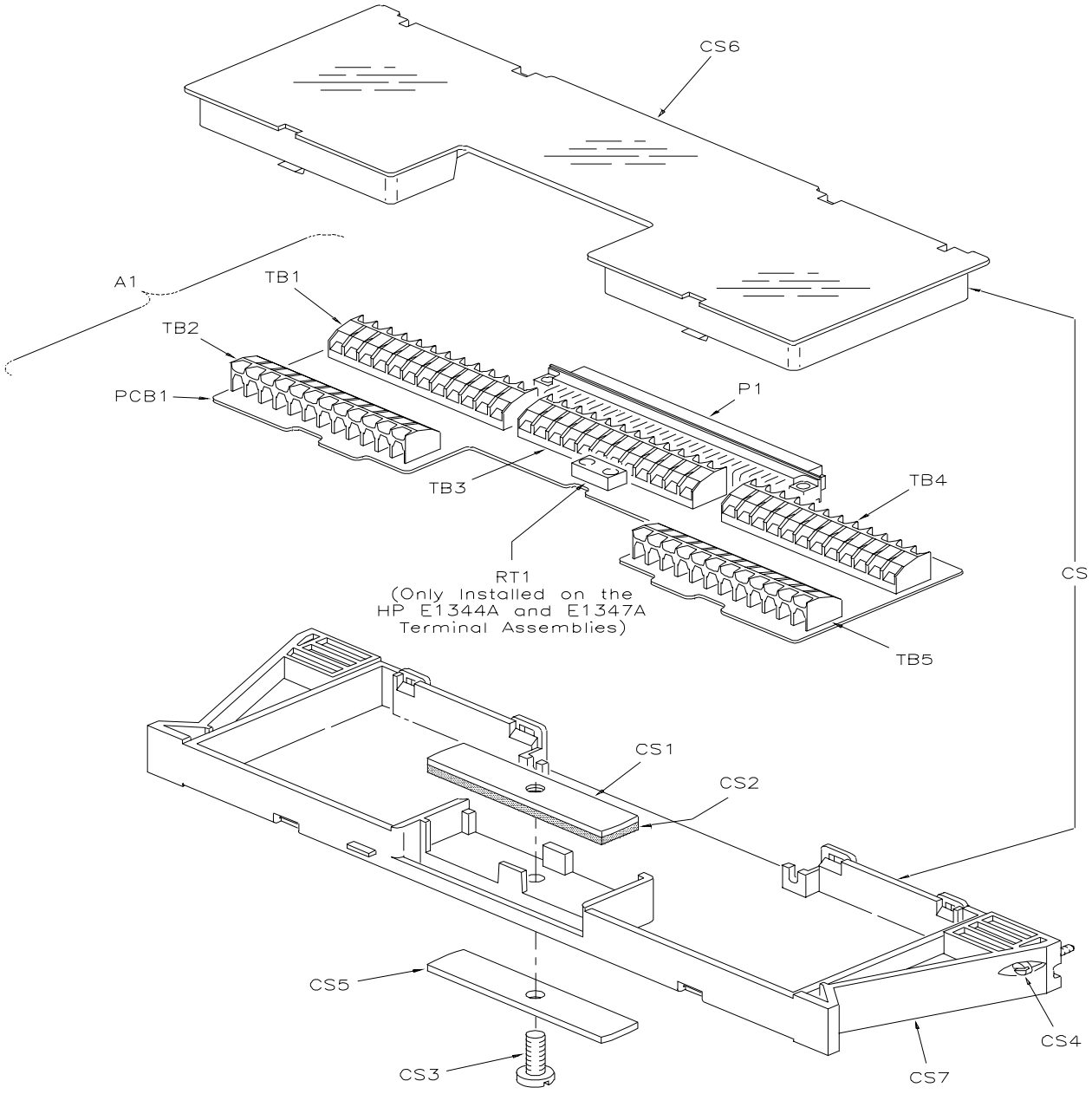


**Figure B-2. E1343A/44A/45A/47A Terminal Module Mechanical Parts**

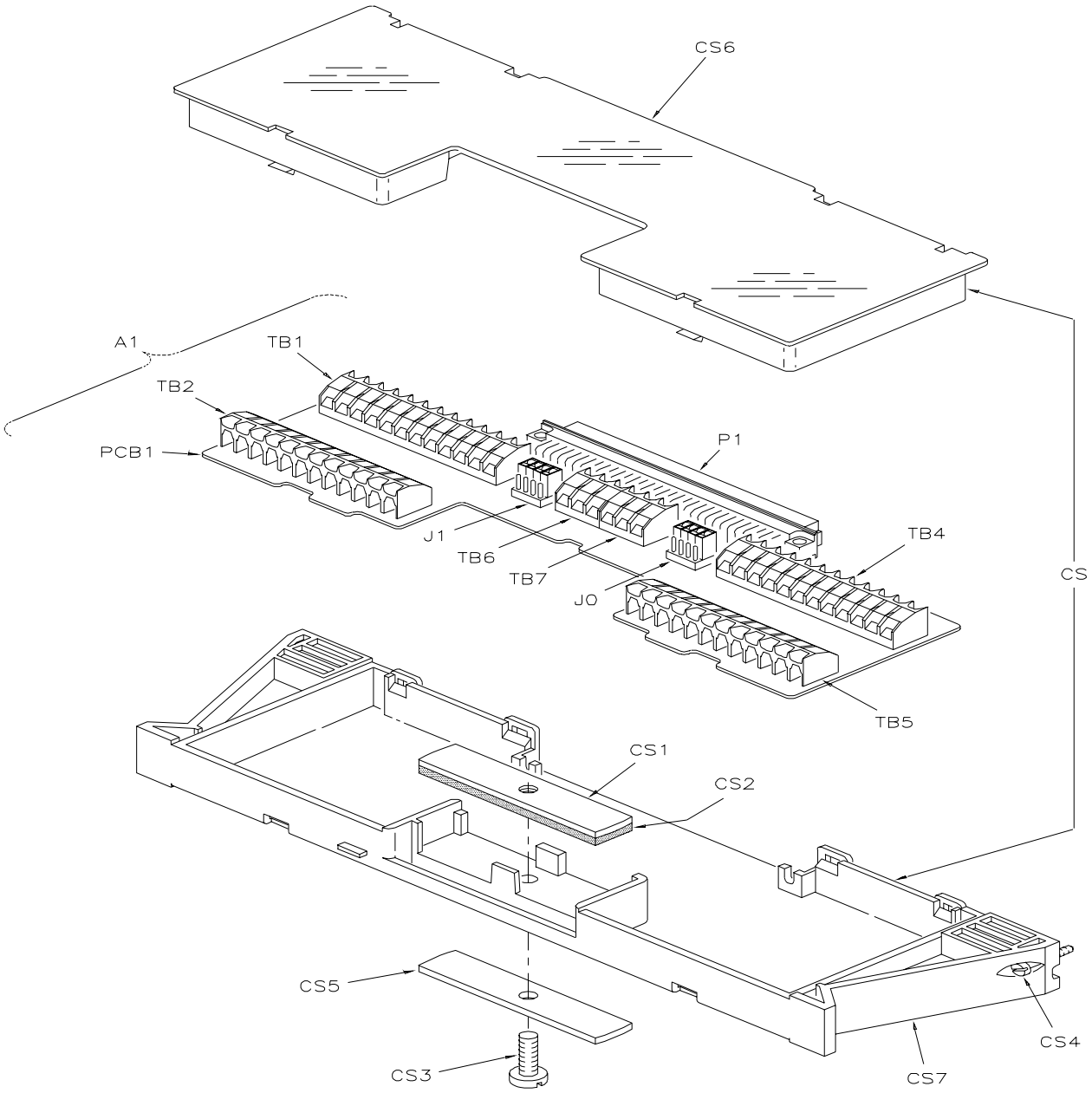


**Figure B-3. E1355A/56A Terminal Module Mechanical Parts**

Agilent Technologies



E1345-90013