Agilent 75000 Series B

Agilent E1361A
4 X 4 Relay Matrix

Service Manual

Enclosed is the Service Manual for the Agilent E1361A 4 X 4 Relay Matrix. Insert this manual, along with any other VXIbus manuals that you have, into the binder that came with your Agilent Technologies mainframe.

Agilent Technologies

Manual Part Number: E1361-90011
Printed in Malaysia E0406

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Agilent E1361A 4X4 Relay Matrix Module Service Manual
Edition 2 Rev 2

Printing History

The Printing History shown below lists all Editions and Updates of this manual and the printing date(s). The first printing 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 the current Edition of the manual. Updates are numbered sequentially starting with Update 1. When a new Edition is created, it contains all the Update information for the previous Edition. Each new Edition or Update also includes a revised copy of this printing history page. Many product updates or revisions do not require manual changes and, conversely, manual corrections may be done without accompanying product changes. Therefore, do not expect a one-to-one correspondence between product updates and manual updates.

Edition 1 (Part Number E1361-90010). . . . . November 1991

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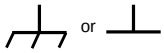
Safety Symbols

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

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



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

Alternating current (AC).

Direct current (DC).

Indicates hazardous voltages.

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

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

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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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Manufacturer's Name: Agilent Technologies, Incorporated
Manufacturer's Address: 815 – 14th St. SW
Loveland, Colorado 80537
USA

Declares, that the product

Product Name: 2 Wire 4x4 Relay Matrix
Model Number: E1361A
Product Options: *This declaration covers all options of the above product(s).*

Conforms with the following European Directives:

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

Conforms with the following product standards:

EMC	**Standard**	**Limit**
	CISPR 11:1990 / EN 55011:1991	*Group 1 Class A*
	EN50082-1 :1992	
	IEC 1000-4-2 :1995	*4kV CD, 8kV AD*
	IEC 1000-4-3 :1995	*3 V/m*
	IEC 1000-4-4 :1995	*0.5kV signal lines, 1kV power lines*
	The produt was tested in a typical configuration with Agilent Technologies or Hewlett-Packard Company test systems	
Safety	*IEC 1010-1:1990+A2:1996 / EN 61010-1:1993*	
	Canada: CSA C22.2 No. 1010.1:1992	
	UL 3111-1 : 1994	

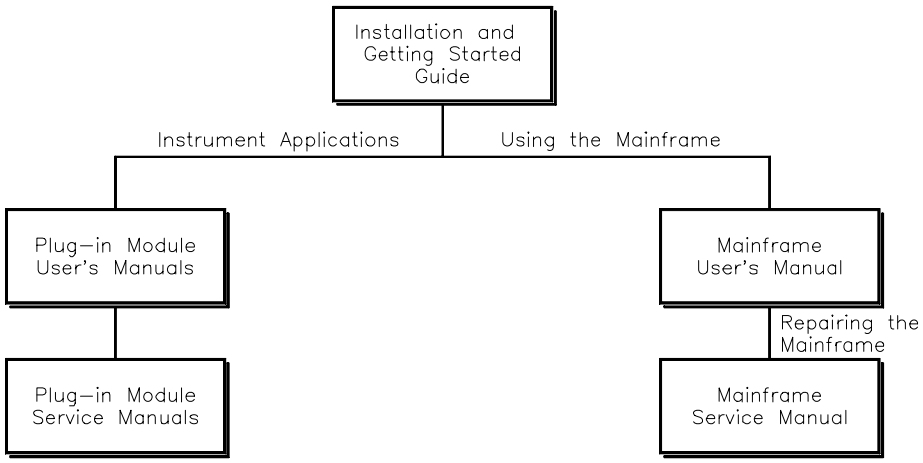
3 May 2001
Date

Ray Corson
Product Regulations Program Manager

For further information, please contact your local Agilent Technologies sales office, agent or distributor.
Authorized EU-representative: Agilent Technologies Deutschland GmbH, Herrenberger Strabe 130, D 71034 Böblingen, Germany

Agilent 75000 Series B Service Documentation

Suggested Sequence to Use Manuals



Manual Descriptions

Installation and Getting Started Guide. This manual contains step-by-step instructions for all aspects of plug-in module and mainframe installation. Introductory programming information and examples are also included.

Agilent E1300B/E1301B or E1302B Mainframe User's Manual. This manual contains programming information for the mainframe, front panel operation information (for the Agilent E1301B mainframe), and general programming information for instruments installed in the mainframe.

Plug-In Module User's Manuals. These manuals contain plug-in module programming and configuration information. Each manual contains examples for the most-used module functions, and a complete SCPI command reference for the plug-in module.

Agilent E1300B/E1301B or E1302B Mainframe Service Manual. This manual contains service information for the mainframe. It contains information for ordering replaceable parts and exchanging assemblies. Information and procedures for performance verification, adjustment, preventive maintenance, troubleshooting, and repair are also included.

Plug-In Module Service Manuals. These manuals contain plug-in module service information. Each manual contains information for exchanging the module and/or ordering replaceable parts. Depending on the module, information and procedures for functional verification, operation verification, performance verification, adjustment, preventive maintenance, troubleshooting, and repair are also provided.

What's in this Manual

Manual Overview

This manual shows how to service the Agilent E1361A 4 X 4 Relay Matrix. Consult the *Agilent E1361A User's Manual* for additional information on installing, configuring, and operating the Agilent E1361A. 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 the matrix.
4	Service	Procedures to aid in fault isolation and repair of the matrix.

Table of Contents

Chapter 3 — Replaceable Parts

Chapter 4 — Service

Appendix A — Verification Tests - C Programs

Chapter 1
General Information

Introduction

This manual contains information required to test, troubleshoot, and repair the Agilent E1361A 4 X 4 Relay Matrix Module. See the *Agilent E1361A User's Manual* for additional information on the Agilent E1361A .

Figure 1-1 shows the Agilent E1361A 4 X 4 Relay Matrix Module. Each matrix module consists of a component assembly and a terminal block.

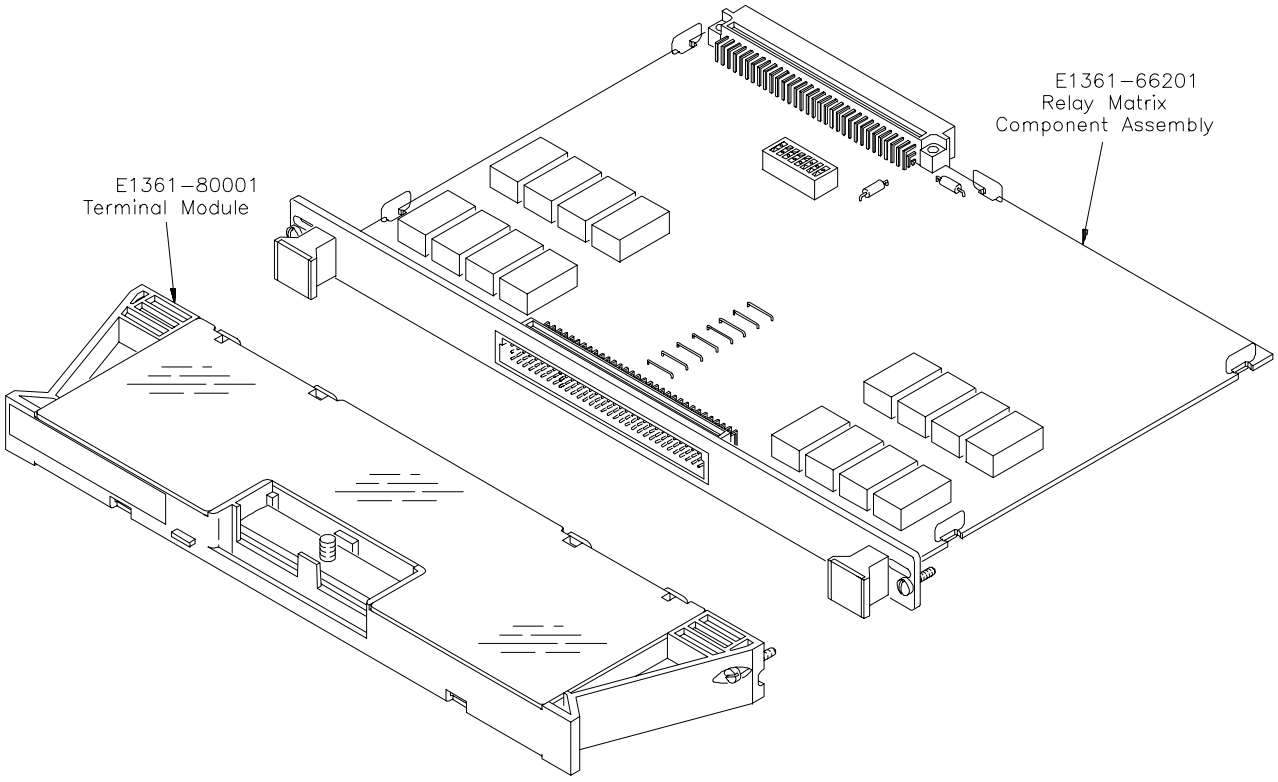


Figure 1-1. Agilent E1361A 4 X 4 Relay Matrix Modules

Safety Considerations

This product is a Safety Class I instrument that is provided with a protective earth terminal when installed in the mainframe. Check the mainframe, matrix, and all related documentation for safety markings and instructions before operation or service.

Refer to the WARNINGS page (page ii) 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.

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.)

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 250 V rms (354 Vac 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) and Low (L) terminals is 250 V dc or 250 Vac rms (354 Vac peak). The maximum current is 1 A (non-inductive) per channel. The maximum power per channel is 40 VA.

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

Relay Life

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

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 for the Agilent E1361A Matrix Module should be replaced when the contact resistance exceeds
3.5 Ω

Check Stability of Contact Resistance. The stability of relay contact resistance decreases with age. Using this method, the contact resistance is measured several times (5-10), 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 Agilent E1361A 4 X 4 Relay Matrix Module, maximum relay life is specified to be 10^6 operations at no load or 10^5 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, the entire circuit board can be replaced when the end of life approaches. The sensitivity of the application should be weighed against the cost of replacing relays with some useful life remaining.

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.

Matrix Module Description

The Agilent E1361A 4 X 4 Relay Matrix Module is an "instrument" in a VXIbus mainframe. As such, the matrix module is assigned an error queue, input and output buffers, and a status register.

NOTE

Instruments are based on the logical addresses of the plug-in modules. See the Agilent 75000 Series B Installation and Getting Started Guide to set the addresses to create an instrument.

E1361A Description

The Agilent E1361A 4 X 4 Relay Matrix Module provides four row by four column two-wire switching and scanning. This switching is accomplished using 16 latching relays. The relays are connected as cross-point relays so that closing a channel connects both High and Low leads from a row to a column. The latching relays retain their last programmed state during power-up or power-down. Following a reset, all relays are open.

The Agilent E1361A 4 X 4 Relay Matrix has two main parts; the component assembly (containing all control circuitry and relays), and a terminal block (containing user connections). The Agilent E1361A is shown in Figure 1-1. Optionally, the module can be configured as two 4 X 2 matrices using jumpers contained on the component assembly.

Matrix Specifications

See *Appendix A* of the *Agilent E1361A User's Manual* for Agilent E1361A specifications. These specifications are the performance standards or limits against which the instrument may be tested.

Matrix Environment

The recommended operating environment for the Agilent E1361A 4 X 4 Matrix Module 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)

Matrix Serial Numbers

Modules covered by this manual are identified by a serial number prefix listed on the title page. Agilent Technologies uses a two-part serial number in the form XXXXAYYYYY, where XXXX is the serial prefix, A is the country of origin (A=USA), and YYYYY is the serial suffix. The serial number prefix identifies a series of identical instruments. The serial number suffix is assigned sequentially to each instrument.

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.

Matrix Options

There are no electrical or mechanical options available for the Agilent E1361A 4 X 4 Relay Matrix Module.

Schematics/ Component Locators

Component locators and schematics for the matrix are packaged with this manual. Clear plastic sleeves are included for storage.

Recommended Test Equipment

Table 1-1 lists the test equipment recommended for testing, adjusting, and servicing the matrix. 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, GPIB	GPIB 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 Matrix	Agilent E1300A, E1301A, E1302A or E1401B/T, E1421A (requires E1405A/B)	F,O, P,T
Digital Multimeter	2-wire ohms (up to 1 GΩ) 4-wire ohms	Agilent 3458A or Agilent 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 matrix.

Initial Inspection

Use the steps in Figure 1-2 as guidelines to perform initial inspection of a matrix module. 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.

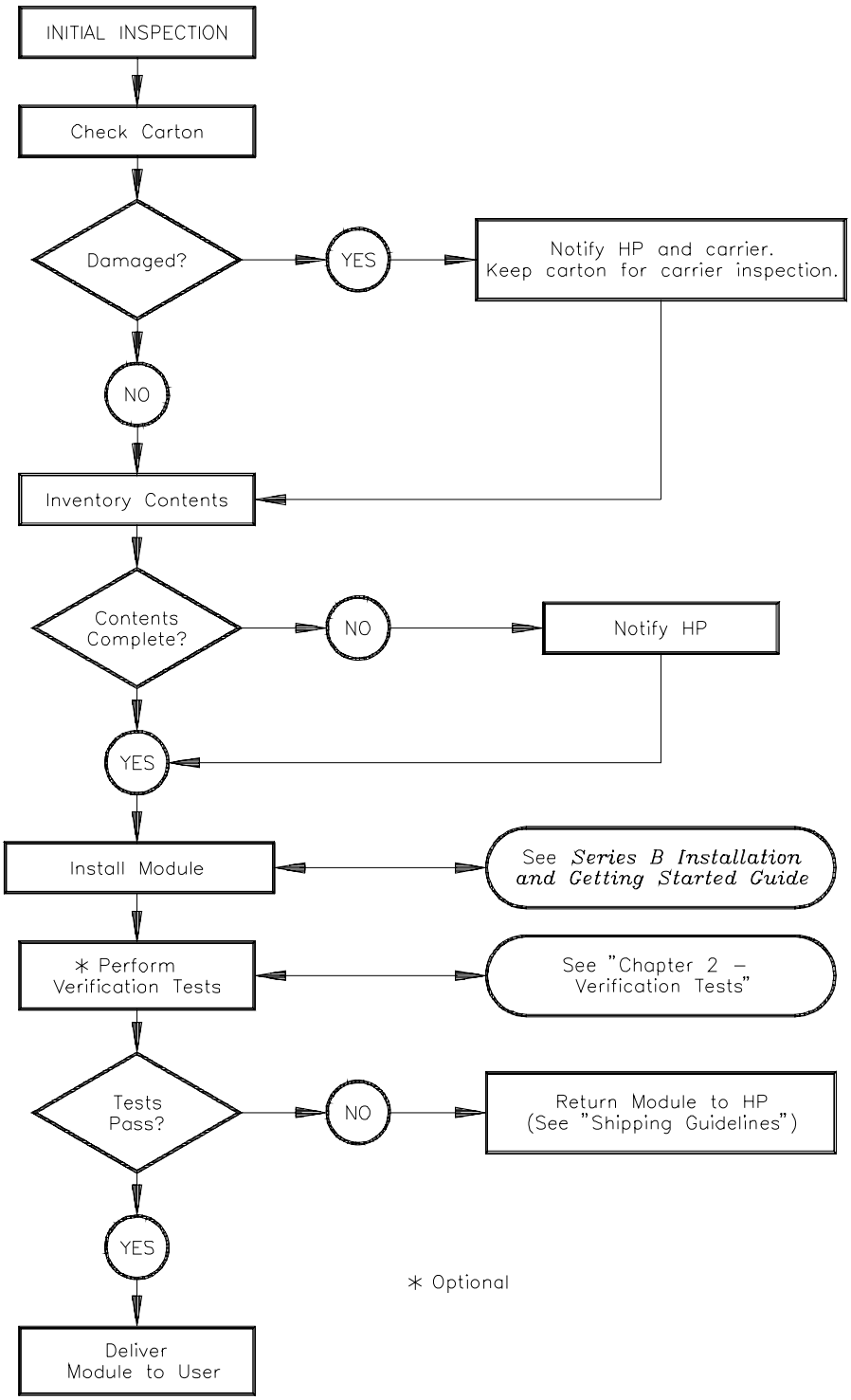
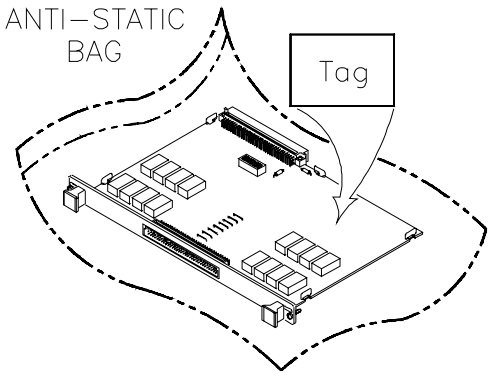
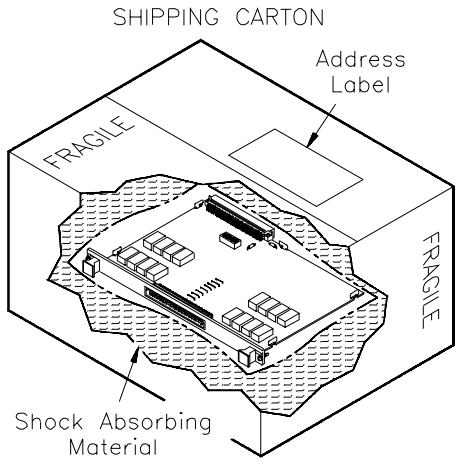


Figure 1-2. Initial (Incoming) Inspection Guidelines

Shipping Guidelines

Follow the steps in Figure 1-3 to return a matrix module to an Agilent Technologies Sales and Support Office or Service Center.





1 Prepare the module

- Remove user wiring from terminal block
- Attach tag to module/pod that identifies
  - Owner
  - Model Number/Serial Number
  - Service Required
- Place tagged device in approved anti-static bag

2 Package the module

- Place packaged matrix module in shipping carton*
- Place 75 to 100 mm (3 to 4 inches) of shock-absorbing material around the Matrix.
- Seal the shipping carton securely.
- Mark the shipping carton FRAGILE.

3 Ship the module to Agilent Technologies

- Place address label on shipping carton
- Send carton to Agilent Technologies

Figure 1-3. Packaging/Shipping Guidelines

*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 a minimum 2.4 MPa (350 psi) test.

Chapter 2
Verification Tests

Introduction

This chapter describes the verification tests for the E1361A 4 X 4 Relay Matrix. The three levels of test procedures described in this chapter are used to verify that the Agilent E1361A:

- is functional (Functional Verification Test)
- meets selected testable specifications (Operation Verification)
- meets 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 matrix, 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 2-1, *Performance Test Record*, at the end of this chapter. You can make a copy of 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
- BASIC programming language
- Matrix address 70915
- Matrix card number 1
- Agilent 3458A Digital Multimeter (DMM)

Functional Verification Test

The Functional Verification Test for the Agilent E1361A 4 X 4 Relay Matrix consists of sending the *IDN? command and checking the response. This test can be used to verify that the matrix is connected properly and is responding to a basic command.

Procedure

1. Verify that the matrix component assembly is properly installed in mainframe
2. Verify that the mainframe has passed its power-on test
3. Send *IDN? to the matrix (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 matrix will not respond. Verify proper address selection before troubleshooting.

Example

An example follows which uses an HP 9000 Series 300 computer with BASIC and a matrix address of 70915.

```
10 DIM A$[100]
20 OUTPUT 70915;"*IDN?"          !Send the ID command
30 ENTER 70915;A$                !Get response
40 PRINT A$
50 END
```

Operation Verification Test

The procedures in this section are used to provide a high level of confidence that the matrix 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 matrix is meeting its specifications.

Performance Verification Tests

The procedures in this section are used to test the matrix's electrical performance using the specifications in *Appendix A - Specifications* of the *E1361A 4 X 4 Relay Matrix User's Manual* as the performance standard.

There are two performance verification tests for the matrix: *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 an Agilent E1361A terminal block for the test fixture. You may want to order an extra terminal block to use as a test

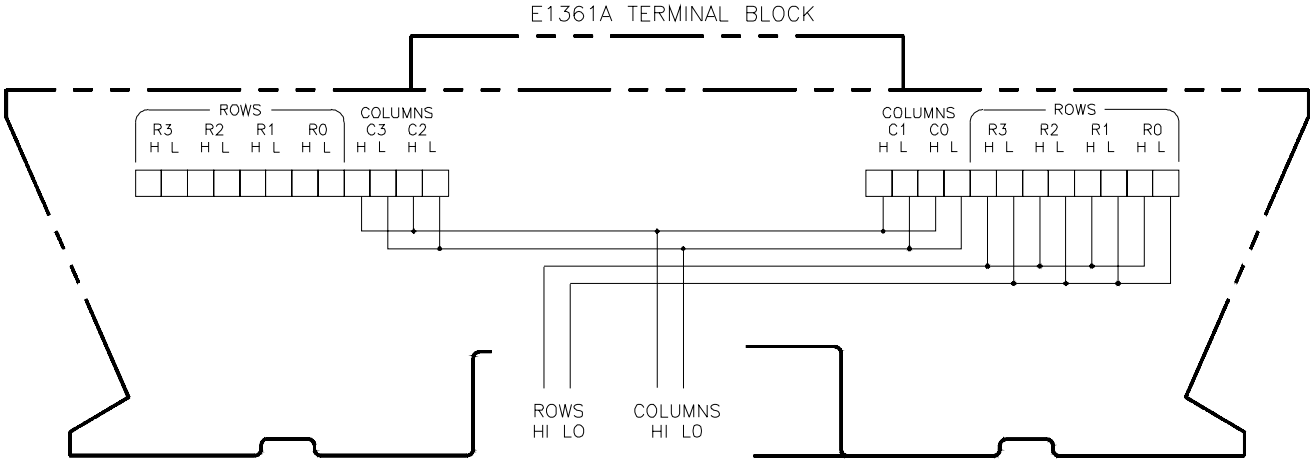


Figure 2-1. Agilent E1361A Test Fixture

fixture, so that you don't have to re-wire each time the tests are performed. The Agilent E1361A terminal block part number is E1361-80001.

Test 2-1: Closed Channel Resistance Test

This test verifies that all relay contacts meet the closed-channel resistance specification for the matrix. When making the Closed Channel Resistance Test, the High path and the Low path relay contacts are tested independently. To minimize test lead movements, the High contacts are all tested first, followed by all the Low contacts. This test uses the test fixture (see Figure 2-1). The Closed Channel resistance specification for each relay contact is 3.5 Ω

Row 0, Col 0 HI Measurements

1. **Make Hardware Connections**

   - Turn mainframe power OFF
   - Connect DMM leads as shown in Figure 2-2
   - Set DMM to measure 4-wire Ohms
   - Turn mainframe power ON

2. **Measure Row 0, Col 0 HI Resistance**

   - Send *RST to matrix
   - Send CLOS (@*nn*00) to close row 0, column 0, where *nn* = card # (typically 01)
   - Trigger the DMM with TRIG SGL and note reading
   - Send OPEN (@*nn*00) to open row 0, column 0, where *nn* = card # (typically 01)
   - Enter the result in Table 2-1 for Row 0, Column 0 HI

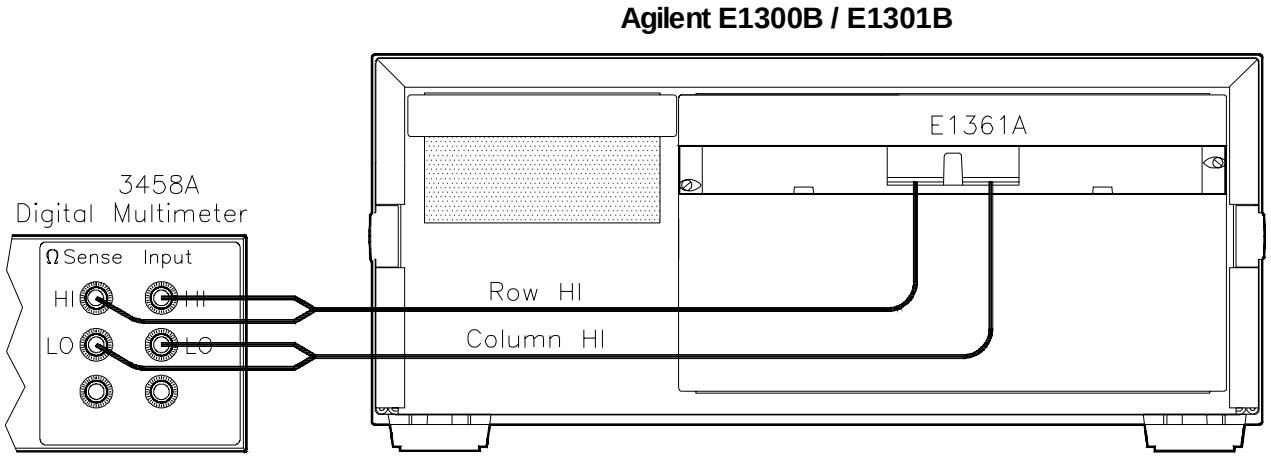


Figure 2-2. HI Resistance Measurement Connections

3. **Repeat for Columns 1 through 3 HI**

- Repeat step 2 for row 0, columns 1 - 3 HI
- Use CLOS (*@nn0c*) and OPEN (*@nn0c*), where *nn* = card #, *0* = row #, and *c* = column # (omit leading zeroes in *nn*)

4. **Repeat for Rows 1 through 3 HI**

- Repeat steps 2 and 3 for Rows 1-3 HI
- Use CLOS (*@nnrc*) and OPEN (*@nnrc*), where *nn* = card #, *r* = row #, and *c* = column # (omit leading zeroes in *nn*)

Row 0, Col 0 LO Measurements

1. **Make Hardware Connections**

- Turn mainframe power OFF
- Set DMM to measure 4-wire Ohms
- Connect DMM leads as shown in Figure 2-3
- Turn mainframe power ON

2. **Measure Row 0, Col 0 LO Resistance**

- Send *RST to matrix
- Send CLOS (*@nn*00) to close row 0, column 0, where *nn* = card # (typically 01)
- Trigger the DMM with TRIG SGL and note reading
- Send OPEN (*@nn*00) to open row 0, column 0, *where nn* = card # (typically 01)
- Enter the result in Table 2-1 for Row 0, Column 0 LO

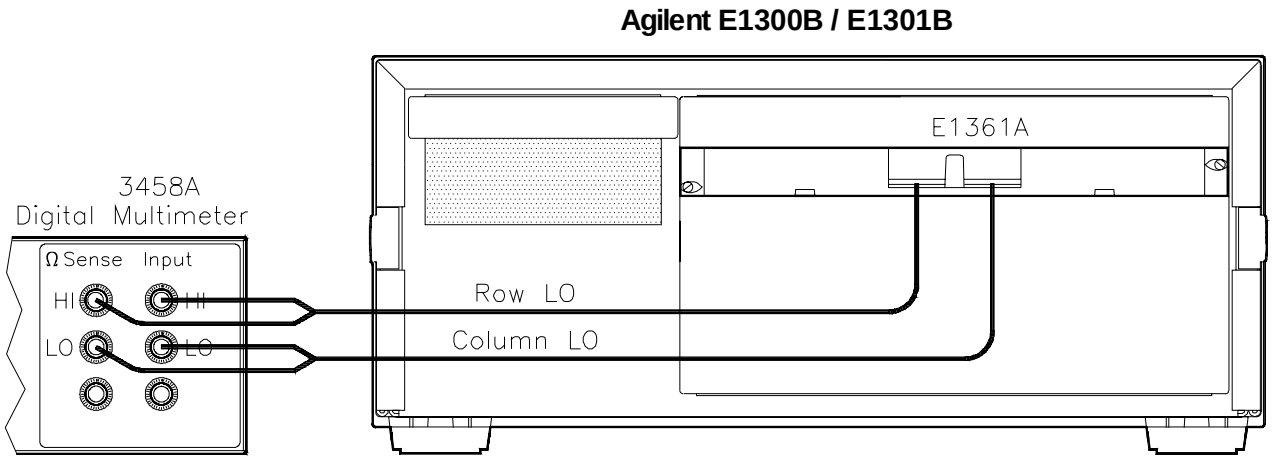


Figure 2-3. LO Resistance Measurement Connections

3. **Repeat for Columns 1 through 3 LO**

   - Repeat step 2 for row 0, columns 1 - 3 LO
   - Use CLOS (*@nn0c*) and OPEN (*@nn0c*), where *nn* = card #, *0* = row #, and *c* = column # (omit leading zeroes in *nn*)

4. **Repeat for Rows 1 through 3 LO**

   - Repeat steps 2 and 3 for rows 1-3 LO
   - Use CLOS (*@nnrc*) and OPEN (*@nnrc*), where *nn* = card #, *r* = row #, and *c* = column # (omit leading zeroes in *nn*)

Example: Closed Channel Resistance Test

This example performs a Closed Channel Resistance Test to measure Rows 0-3 to Columns 0-3 relay contact resistances. If the relay contact resistance for a channel is >3.5 Ω the program prints a message indicating which channel has failed the test. Use this list in Chapter 4 when troubleshooting a failing relay.

NOTE

This test assumes that the matrix is configured as a 4 X 4 matrix (factory setting) by having jumpers JM1 through JM8 installed on the Agilent E1361A Component Assembly.

```
10!   RE-SAVE "CLOS_TEST"
20    ASSIGN @Dmm TO 722
30    ASSIGN @Mux TO 70915
40    DISP CHR$(129)
50    DIM Result0(3,3),Result1(3,3),Path$(1)[2]
60    DATA HI,LO
70    READ Path$(*)
80    !
90    !Start test
100   !
110   CLEAR SCREEN
120   PRINT "Install Component Assembly and Test Fixture "
130   PRINT
140   PRINT " 1. Turn Mainframe and Agilent 3458A DMM power OFF"
150   PRINT " 2. Connect GPIB Cable between mainframe and DMM"
160   PRINT " 3. Install Agilent E1361A Component Assembly into
Mainframe "
170   PRINT " 4. Attach Test Fixture to Component Assembly"
180   PRINT " 5. Turn Mainframe power ON "
190   PRINT " 6. Press Continue when ready to begin testing "
200   PAUSE
```

```
210   CLEAR SCREEN
220   !
230   ! Measure Row HI to Column HI and Row LO to Column LO
240   !
250   OUTPUT @Dmm;"PRESET NORM;FUNC OHMF"
260   OUTPUT @Mux;"*RST"
270   FOR I = 0 TO 1
280     PRINT TABXY(1,1),"Row to Column ";Path$(I);" Measurements"
290     PRINT TABXY(1,3),"Connect DMM Sense and Input HI leads to
ROW ";Path$(I)
300     PRINT TABXY(1,4),"Connect DMM Sense and Input LO leads to
COLUMN ";Path$(I)
310     DISP " Press Continue when connections are complete "
320     PAUSE
330     CLEAR SCREEN
340      FOR R=0 TO 3
350       FOR C=0 TO 3
360         OUTPUT @Mux;"CLOS (@1"&VAL$(R)&VAL$(C)&")"
370         OUTPUT @Dmm;"TRIG SGL"
380         ENTER @Dmm;Value
390         OUTPUT @Mux;"OPEN (@1"&VAL$(R)&VAL$(C)&")"
400        IF I=0  THEN
410          Result0(R,C)=Value
420          IF Result0(R,C)>3.5 THEN
430            PRINT "Resistance for Row ";R;" to Column ";C;" ";Path$(I);"
Path is > 3.5 Ohms"
440          END IF
450        ELSE
460          Result1(R,C)=Value
470          IF Result1(R,C)>3.5 THEN
480            PRINT "Resistance for Row ";R;" to Column ";C;" ";Path$(I);"
Path is > 3.5 Ohms"
490          END IF
500       END IF
510     NEXT C
520   NEXT R
530    PRINT "Measurements complete for Row to Column ";Path$(I)
540    IF I=0 THEN
550         DISP "Press Continue for ";Path$(I+1);" measurements"
560         PAUSE
570    END IF
580   NEXT I
590    PRINT "Contact Resistance measurements complete"
```

```
600     DISP "Press Continue to print measurement results"
610     PAUSE
620     CLEAR SCREEN
630     !
640     !    Print Measurement Results
650     !
660  Format: IMAGE 3X,"Row ",D," to Column ",D,3X,DD.DDDD," Ohms",5X,DD.DDDD," Ohms"
670     PRINT TABXY(1,1),"                              HI Path                LO Path"
680     PRINT
690     FOR R=0 TO 3
700        FOR C=0 TO 3
710           PRINT USING Format;R,C,Result0(R,C),Result1(R,C)
720        NEXT C
730     NEXT R
740     END
```

Typical Result

	HI Path	LO Path
Row 0 to Column 0	.2264 Ohms	.2315 Ohms
Row 0 to Column 1	.2747 Ohms	.2524 Ohms
Row 0 to Column 2	.2303 Ohms	.2437 Ohms
Row 0 to Column 3	.4254 Ohms	.3577 Ohms
Row 1 to Column 0	.5688 Ohms	.4392 Ohms
Row 1 to Column 1	.2331 Ohms	.2147 Ohms
Row 1 to Column 2	.2350 Ohms	.2195 Ohms
Row 1 to Column 3	.2405 Ohms	.2253 Ohms
Row 2 to Column 0	.3829 Ohms	.2943 Ohms
Row 2 to Column 1	.5364 Ohms	.4104 Ohms
Row 2 to Column 2	.1991 Ohms	.1884 Ohms
Row 2 to Column 3	.2238 Ohms	.2068 Ohms
Row 3 to Column 0	.1926 Ohms	.1645 Ohms
Row 3 to Column 1	.3512 Ohms	.2763 Ohms
Row 3 to Column 2	.4968 Ohms	.3528 Ohms
Row 3 to Column 3	.1872 Ohms	.1765 Ohms

Test 2-2: DC Isolation Test

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

NOTE

The DMM used should be capable of measuring at least 1 G Ω 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 Agilent 3458A, a typical return for an overload is 1.E+38 and the entry in Table 2-1 should be >1.2 G Ω

HI to LO Isolation

1. Make hardware connections as shown in Figure 2-4
2. Set DMM to 2-wire ohms, 1 G Ω range
3. Send CLOS (@*nn*00:*nn*33) to close all relays
4. Trigger the DMM with TRIG SGL
5. Record the DMM reading in Table 2-1 (HI to LO)

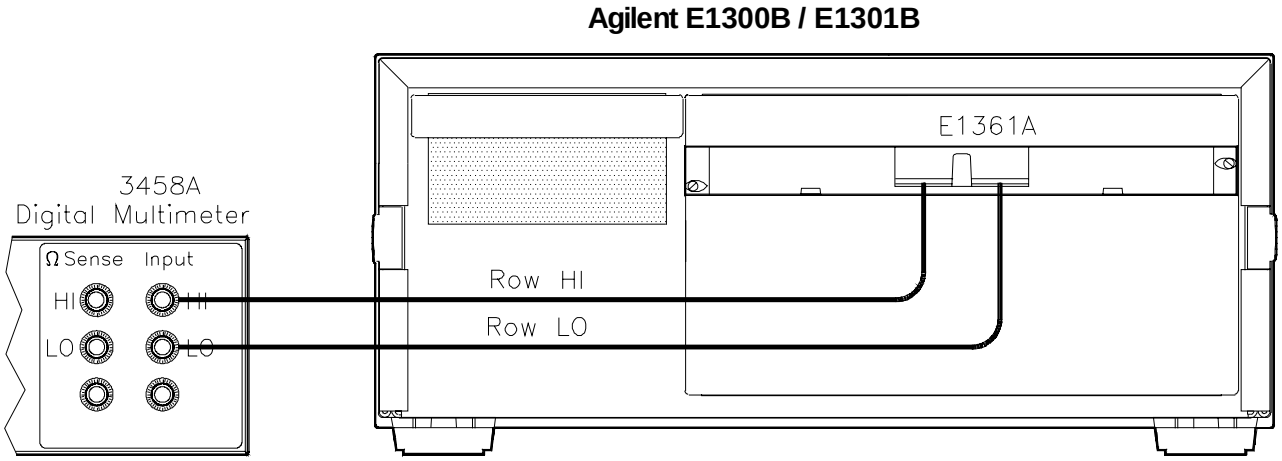


Figure 2-4. HI to LO DC Isolation Connections

HI to Chassis Isolation

1. Make hardware connections as shown in Figure 2-5
2. Trigger the DMM with TRIG SGL
3. Record the DMM reading in Table 2-1 (HI to Chassis)

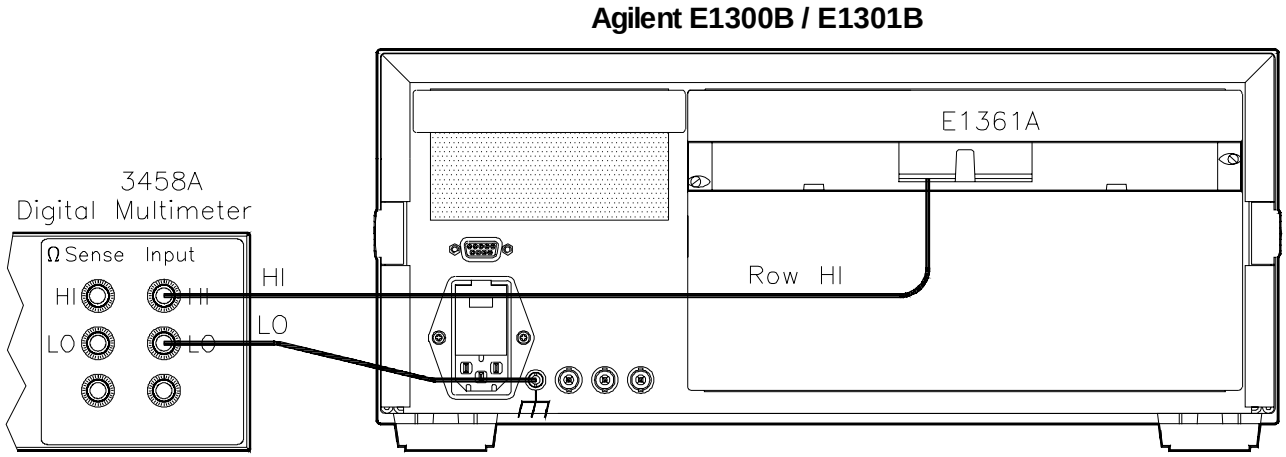


Figure 2-5. HI to Chassis DC Isolation Connections

LO to Chassis Isolation

1. Make hardware connections as shown in Figure 2-6
2. Trigger the DMM with TRIG SGL
3. Record the DMM reading in Table 2-1 (LO to Chassis)

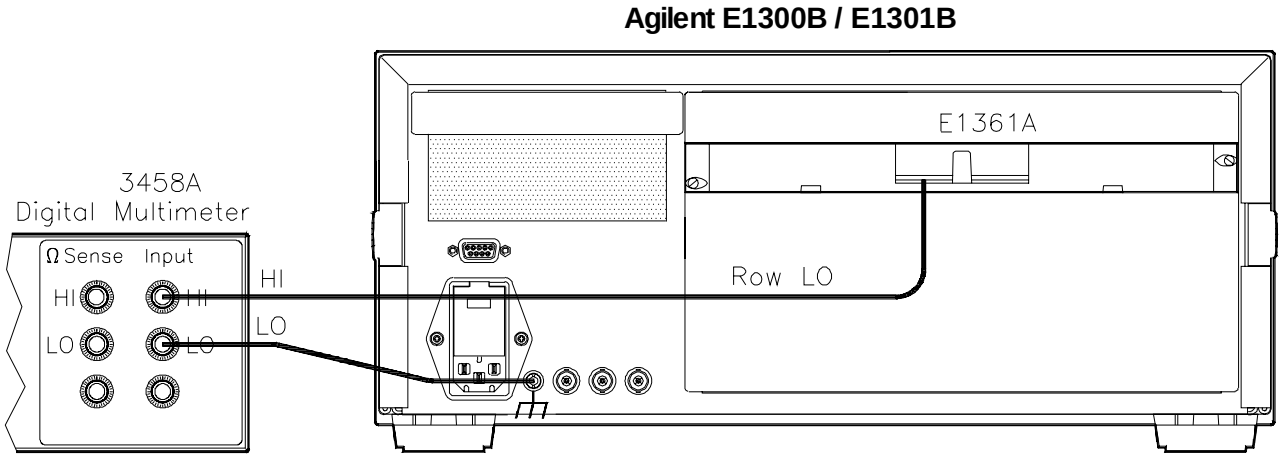


Figure 2-6. LO to Chassis DC Isolation Connections

Example: DC Isolation Test

This example performs DC Isolation Tests for HI to LO, HI to Chassis, and LO to Chassis.

```
10!  RE-SAVE "DC_ISOL"
20   ASSIGN @Dmm TO 722
30   ASSIGN @Mux TO 70915
40   DISP CHR$(129)
50   DIM Value(2)
60   PRINT "Equipment Connections "
70   PRINT
80   PRINT " 1.  Turn Mainframe and Agilent 3458A DMM power OFF"
90   PRINT " 2.  Connect GPIB Cable between mainframe and DMM"
100  PRINT " 3.   Install Agilent E1361A Component Assembly into
Mainframe "
110  PRINT " 4.  Attach Test Fixture to Component Assembly"
120  PRINT " 5.  Turn Mainframe power ON"
130  DISP  "Press Continue when ready to begin testing "
140  PAUSE
150  OUTPUT @Dmm;"OHM 1E9"
160  CLEAR SCREEN
170  !
180  ! Measure DC isolation (HI to LO, HI to Chassis, and LO to Chassis)
190  !
200  OUTPUT @Mux;"*RST"
210  OUTPUT @Mux;"CLOS (@100:133)"
220  PRINT TABXY(1,1),"DC Isolation HI to LO"
230  PRINT TABXY(1,3),"1. Connect DMM INPUT HI lead to ROW HI"
240  PRINT TABXY(1,4),"2. Connect DMM INPUT LO lead to ROW LO"
250  DISP " Press Continue when connections are complete"
260  PAUSE
270  CLEAR SCREEN
280  OUTPUT @Dmm;"TRIG SGL"
290  ENTER @Dmm;Value(0)
300  PRINT TABXY(1,1),"DC Isolation HI to Chassis"
310  PRINT TABXY(1,3),"1. Connect DMM INPUT HI lead to ROW HI"
320  PRINT TABXY(1,4),"2. Connect DMM INPUT LO lead to Chassis"
330  DISP " Press Continue when connections are complete"
340  PAUSE
350  CLEAR SCREEN
360  OUTPUT @Dmm;"TRIG SGL"
370  ENTER @Dmm;Value(1)
380  PRINT TABXY(1,1),"DC Isolation LO to Chassis"
390  PRINT TABXY(1,3),"1. Connect DMM INPUT HI lead to ROW LO"
```

```
400  PRINT TABXY(1,4),"2. Connect DMM INPUT LO lead to Chassis"
410  DISP " Press Continue when connections are complete"
420  PAUSE
430  CLEAR SCREEN
440  OUTPUT @Dmm;"TRIG SGL"
450  ENTER @Dmm;Value(2)
460  OUTPUT @Mux;"*RST"
470  PRINT "Measurements complete"
480  DISP "Press Continue to print measurement results"
490  PAUSE
500  CLEAR SCREEN
510  PRINT TABXY(1,1),"DC Isolation Tests"
520  PRINT TABXY(1,3),"HI to LO (Ohms)          ";Value(0)
530  PRINT TABXY(1,4),"HI to Chassis (Ohms)     ";Value(1)
540  PRINT TABXY(1,5),"LO to Chassis (Ohms)     ";Value(2)
550  END
```

Typical Result

DC Isolation Tests	
HI to LO (Ohms)	1E+38
HI to Chassis (Ohms)	1E+38
LO to Chassis (Ohms)	1E+38

Performance Test Record

Table 2-1, *Performance Test Record*, is a form you can copy and use to record performance verification test results for the matrix. Table 2-2 shows matrix 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 *Appendix A - Specifications* of the *E1361A 4 X 4 Relay Matrix 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 2-1, 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 Agilent 3458A Digital Multimeter. The measurement uncertainty shown in Table 2-2 is the accuracy of the Agilent 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*)
= $(15x10^{-6} * 3.5) + (5x10^{-6} * 10)$ Ω
= 1.025×10^{-4} Ω

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 Agilent 3458A)

M.U. = (0.5% *of Reading* + 10*ppm of Range*)
= $(0.005 * 1.2x10^{9}) + (10x10^{-6} * 1x10^{9})$ Ω
= $6.0x10^{6}$ Ω

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

Model _____ Report No. _____ Date _____

General Information

Test Facility:

Name _____ Report No. _____

Address _____ Date _____

City/State _____ Customer _____

Phone _____ Tested by _____

Special Notes:

_____

_____

_____

_____

_____

_____

Test Equipment Record

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

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

Model _____ Report No. _____ Date _____

Test No/Description	Minimum* Value	Measured Value (V)	Maximum Value	Meas Uncert	Test Acc Ratio (TAR)
2-1. Closed Channel Resistance (Values in Ohms)					
HI Path Resistance					
ROW COL					
0 0		_____	3.5	1.025E-4	NA
0 1		_____	3.5	1.025E-4	NA
0 2		_____	3.5	1.025E-4	NA
0 3		_____	3.5	1.025E-4	NA
1 0		_____	3.5	1.025E-4	NA
1 1		_____	3.5	1.025E-4	NA
1 2		_____	3.5	1.025E-4	NA
1 3		_____	3.5	1.025E-4	NA
2 0		_____	3.5	1.025E-4	NA
2 1		_____	3.5	1.025E-4	NA
2 2		_____	3.5	1.025E-4	NA
2 3		_____	3.5	1.025E-4	NA
3 0		_____	3.5	1.025E-4	NA
3 1		_____	3.5	1.025E-4	NA
3 2		_____	3.5	1.025E-4	NA
3 3		_____	3.5	1.025E-4	NA
LO Path Resistance					
ROW COL					
0 0		_____	3.5	1.025E-4	NA
0 1		_____	3.5	1.025E-4	NA
0 2		_____	3.5	1.025E-4	NA
0 3		_____	3.5	1.025E-4	NA
1 0		_____	3.5	1.025E-4	NA
1 1		_____	3.5	1.025E-4	NA
1 2		_____	3.5	1.025E-4	NA
1 3		_____	3.5	1.025E-4	NA
2 0		_____	3.5	1.025E-4	NA
2 1		_____	3.5	1.025E-4	NA
2 2		_____	3.5	1.025E-4	NA
2 3		_____	3.5	1.025E-4	NA
3 0		_____	3.5	1.025E-4	NA
3 1		_____	3.5	1.025E-4	NA
3 2		_____	3.5	1.025E-4	NA
3 3		_____	3.5	1.025E-4	NA

*Single-sided specification - Minimum value does not apply

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

Model _____ Report No. _____ Date _____

Test No/Description	Minimum Value	Measured Value (V)	Maximum Value *	Meas Uncert	Test Acc Ratio (TAR)
2-2. DC Isolation (Values in Ohms)					
HI to LO	1E9	_____		6.0E6	NA
HI to Chassis	1E9	_____		6.0E6	NA
LO to Chassis	1E9	_____		6.0E6	NA

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

Chapter 3
Replaceable Parts

Introduction

This chapter contains information to order replaceable parts for the Agilent E1361A 4 x 4 Relay Matrix. Table 3-1 lists replaceable parts for the Agilent E1361A 4 X 4 Relay Matrix. Table 3-2 shows reference designators for parts in Table 3-1, and Table 3-3 shows the manufacturer code list for these parts.

To order a part listed in Table 3-1, specify the Agilent part number and the quantity required. Send the order to your nearest Agilent Technologies Sales and Support Office.

Replaceable Parts List

Table 3-1 lists replaceable parts for the Agilent E1361A 4 X 4 Relay Matrix. See Figures 3-1 and 3-2 for locations of selected mechanical parts.

See the Component Locator diagrams at the end of *Chapter 4 - Service* for locations of electrical components.

Table 3-1. Agilent E1361A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
A1 & A3	E1361-80001	1	**TERMINAL BLOCK ASSEMBLY** (See Figure 3-2)	28480	E1361-80001
A1	E1361-66510	1	**TERMINAL BLOCK 4X4 MATRIX SWITCH** (See Figure 3-2)	28480	E1361-66510
P1	1252-1592	1	CONNECTOR-POST TYPE 5.08-PIN-SPCG 48-CONTACT	06776	DIN-96RSC-SR48-TR
TB1	0360-2391	2	TERMINAL BLOCK 12 P. POLYAMIDE	28480	0360-2391
TB4	0360-2391		TERMINAL BLOCK 12 P. POLYAMIDE	28480	0360-2391
A2	E1361-66201	1	**MOD-4X4 MATRIX SWITCH** (See Figure 3-1)	28480	E1361-66201
BRK1-BRK2	0050-2183	2	CASTING-ZINC P.C. BOARD HOLDER	28480	0050-2183
LBL1	E1300-84308	1	LBL LOGO Agilent B SIZE	28480	E1300-84308
LBL2	E1300-84309	1	LBL LOGO VXI B SIZE	28480	E1300-84309
MNL1	E1361-90002	1	USER'S MANUAL	28480	E1361-90002
MP1-MP2	1400-1546	2	HANDLE-BLACK 3Agilent	28480	1400-1546
PNL1	E1361-00202	1	PNL-RR MATRIX SW	28480	E1361-00202
SCR1-SCR2	0515-0444	2	SCREW-MACHINE M2.5 X 0.45 8MM-LG PAN-HD	28480	0515-0444
SCR3-SCR4	0515-1968	2	SCREW PH M2.5 X 11	28480	0515-1968
SHD1	E1300-80601	1	SAFETY SHIELD-PLASTIC E1326A	28480	E1300-80601
A2A1	E1361-66501	1	**PC ASSY-4X4 MATRIX SW 2 LAYER VME DBL**	28480	E1361-66501
	3050-0082	2	WASHER-FL NM NO. 4 .116-IN-ID .188-IN-OD	76854	8942-3
C1	0180-3899	1	CAPACITOR-FXD 220uF +-20% 50 V	28480	0180-3899
C2	0160-3334	2	CAPACITOR-FXD 0.01uF +-10% 50 V	04222	SA105C103KAAH
C9	0160-4801	1	CAPACITOR-FXD 100pF +-5% 100 V	04222	SA102A101JAAH
C11	0160-3334		CAPACITOR-FXD 0.01uF +-10% 50 V	04222	SA105C103KAAH
C17	0160-4835	10	CAPACITOR-FXD 0.1uF +-10% 50 V	04222	SA105C104KAAH
C38-C42	0160-4835		CAPACITOR-FXD 0.1uF +-10% 50 V	04222	SA105C104KAAH
C44	0180-1746	1	CAPACITOR-FXD 15uF +-10% 20 V	56289	150D156X9020B2-DYS
C45-C48	0160-4835		CAPACITOR-FXD 0.1uF +-10% 50 V	04222	SA105C104KAAH
CR1	1902-0557	1	DIODE-ZENER 24V 5% PD=1W IR=5UA	04713	1N4749ARL
CR2	1901-1098	1	DIODE-SWITCHING 50V 200MA 4NS	27014	1N4150
F1	2110-0712	1	FUSE-SUBMINIATURE 4A 125V NTD AX	75915	R251004T1
F2	2110-0665	1	FUSE-SUBMINIATURE 1A 125V NTD AX UL CSA	75915	R251001T1
J1	1252-1591	1	CONNECTOR-POST TYPE 5.08-PIN-SPCG 48-CONTACT	00779	534893-5
JM1-JM8	7175-0057	10	RESISTOR 0 MFS	28480	7175-0057
JM15-JM16	7175-0057		RESISTOR 0 MFS	28480	7175-0057

Table 3-1. Agilent E1361A Replaceable Parts (continued)

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
K0-K15	0490-1912	16	RELAY 2C 12VDC-COIL 2A 250VAC	28480	0490-1912
P1	1252-1596	1	CONNECTOR-POST TYPE 2.54-PIN-SPCG 96-CONTACT	06776	DIN-96CPC-SRI-TR
R1	0757-04651	1	RESISTOR 100 K +- 1% .125W TF TC=0+-100	24546	CT4-1/8-T0-1003-F
R2	0757-0453	1	RESISTOR 30.1K +-1% .125W TF TC=0+-100	24546	CT4-1/8-T0-3012-F
R9	0757-0417	1	RESISTOR 562 +-1% .125W TF TC=0+-100	24546	CT4-1/8-T0-562R-F
R10	0698-3451	1	RESISTOR 133K +-1% .125W TF TC=0+-100	24546	CT4-1/8-T0-1333-F
RP1-RP4	1810-0265	4	NETWORK-RES 16-DIP 680.0 OHM X 8	11236	761-3-R680
RP25-RP26	1810-0279	3	NETWORK-RES 10-SIP 4.7K OHM X 9	91637	MSP10A01-472G
RP32	1810-0279		NETWORK-RES 10-SIP 4.7K OHM X 9	91637	MSP10A01-472G
SW1	3101-3066	1	SWITCH-DIP ROCKER 8-1A 0.15A 30VDC	81073	76YY22968S
U1-U4	1858-0069	4	TRANSISTOR ARRAY 18-PIN PLASTIC DIP	56289	ULN-2803A
U5	1820-4057	1	IC BUFFER TTL/F NAND QUAD 2-INP	18324	74F38N
U6	1820-6731	1	IC ASIC GATE-ARRAY CMOS PLASTIC DIP	27014	SCX6B04ACE/N9
U7-U8	1820-3079	2	IC DECODER CMOS/HC BIN 3-TO-8-LINE	04713	MC74HC138AN
U9	1820-3081	1	IC FF CMOS/HC D-TYPE POS-EDGE-TRIG	04713	MC74HC74N
U10-U11	1820-3975	2	IC DRIVER CMOS/HC LINE OCTL	01295	SN74HC541N
U12	1820-4590	1	IC MV CMOS/HC MONOSTBL RETRIG DUAL	27014	MM74HC423AN
U15	1820-4147	1	IC LATCH CMOS/HCT TRANSPARENT OCTL	27014	MM74HCT573N
U16	1820-3714	2	IC TRANSCEIVER TTL/ALS BUS OCTL	01295	SN74ALS245A-1N
U17-U18	1820-3631	2	IC COMPARATOR CMOS/HCT MAGTD 8-BIT	27014	MM74HCT688N
U19	1820-3664	1	IC GATE CMOS/HCT NAND QUAD 2-INP	27014	MM74HCT00N
U20	1820-4242	1	IC SCHMITT-TRIG CMOS/HCT INV HEX	18324	74HCT14N
U21-U22	1820-4643	2	IC GATE CMOS/HCT NOR QUAD 2-INP	18324	74HCT02N
U25-U26	1820-5424	2	IC DRIVER CMOS/HCT LINE OCTL	18324	74HCT540N
U30	1820-4152	2	IC FF CMOS/HCT D-TYPE POS-EDGE-TRIG	01295	SN74HCT574N
U35	1820-3714		IC TRANSCEIVER TTL/ALS BUS OCTL	01295	SN74ALS245A-1N
U38	1820-4152		IC FF CMOS/HCT D-TYPE POS-EDGE-TRIG	01295	SN74HCT574N

Table 3-1. Agilent E1361A Replaceable Parts (continued)

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
A3	E1300-84401	1	**TERMINAL BLOCK CASE ASSY** (See figure 3-2)	28480	E1300-84401
CS1	03852-01201	1	CLAMP-STRAIN RELIEF	28480	03852-01201
CS2	03852-86701	1	PAD-STRAIN RELIEF CLAMP	28480	03852-86701
CS3	0515-2109	1	SCREW-MACHINE 10-24 .625-IN-LG PAN-HD-SLT	28480	0515-2109
CS4	1390-0846	2	FASTENER-CAPTIVE SCREW M2.5 X 0.45	28480	1390-0846
CS5	E1300-01202	1	CLAMP STRAIN RELIEF	28480	E1300-01202
CS6	E1300-44101	1	COVER-TOP, TERMINAL MOLDED HOUSING	28480	E1300-44101
CS7	E1300-44102	1	COVER-BOTTOM, TERMINAL HOUSING	28480	E1300-44102

Table 3-2. Agilent E1361A Reference Designators

Agilent E1361A Reference Designators	
A ..... assembly	P ..... electrical connector (plug)
BRK ..... bracket	PCB ..... printed circuit board
C ..... capacitor	PNL ..... panel
CR ..... diode	Q .....transistor
CS..... case	R .....resistor
LBL ..... label	RP ..... resistor pack
F ..... fuse	RT ..... thermistor probe
J ..... electrical connector (jack)	SCR..... screw
JM ..... jumper	SH ..... shield
K .....relay	SW ..... switch
MNL ..... manual	TB ..... terminal block
MP .....mechanical part	U ..... integrated circuit

Table 3-3. Agilent E1361A Code List of Manufacturers

Mfr. Code	Manufacturer's Name	Manufacturer's Address	Zip Code
00779	AMP INC	HARRISBURG PA US	17111
01295	TEXAS INSTRUMENTS INC	DALLAS TX US	75265
04222	AVX CORP	GREAT NECK NY US	11021
04713	MOTOROLA INC	ROSELLE IL US	60195
06776	ROBINSON NUGENT INC	NEW ALBANY IN US	47150
11236	CTS CORP	ELKHART IN US	46514
12014	CHICAGO RIVET & MACHINE CO	NAPERVILLE IL US	60540
12038	THE SIMCO CO INC	LANSDALE PA US	19446
18324	SIGNETICS CORP	SUNNYVALE CA US	94086
24546	CORNING GLASS WORKS	CORNING NY US	14830
27014	NATIONAL SEMICONDUCTOR CORP	SANTA CLARA CA US	95052
28480	AGILENT TECH - CORPORATE	PALO ALTO CA US	94304
56289	SPRAGUE ELECTRIC CO	LEXINGTON MA US	02173
75915	LITTELFUSE INC	DES PLAINES IL US	60016
76854	OAK INDUSTRIES INC CO	WALTHAM MA US	02154
81073	GRAYHILL INC	LA GRANGE IL US	60525
91637	DALE ELECTRONICS INC	COLUMBUS NE US	68601

Mechanical Parts Locators

Figures 3-1 and 3-2 shows the location of selected mechanical parts for the Agilent E1361A 4 X 4 Relay Matrix. See the Component Locators at the end of *Chapter 4 - Service* for locations of electrical components.

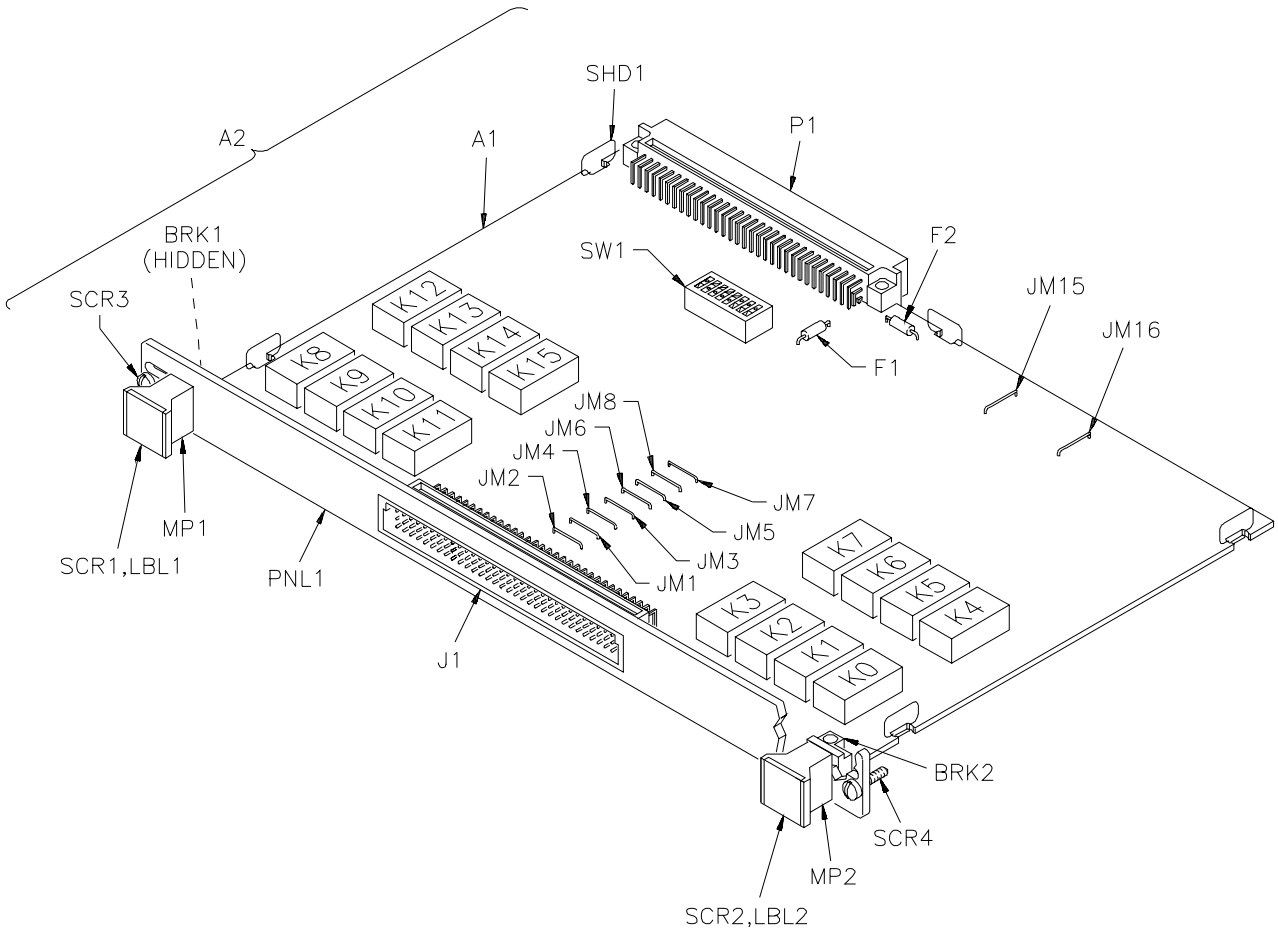


Figure 3-1. Component Assembly Replaceable Parts

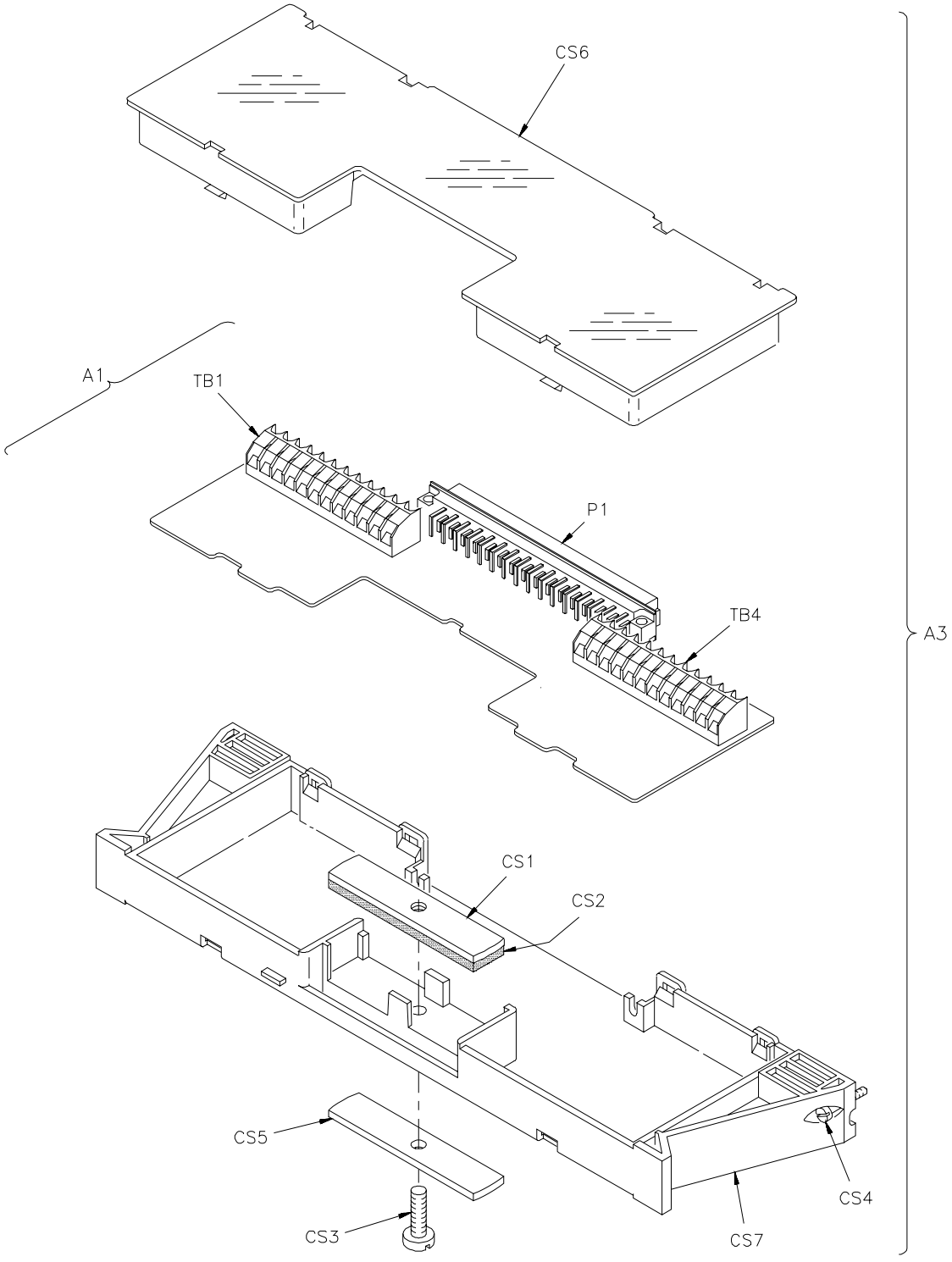


Figure 3-2. Terminal Block Replaceable Parts

Chapter 4
Service

Introduction

This chapter contains service information for the Agilent E1361A 4 X 4 Relay Matrix. Also included are troubleshooting, repair, and maintenance guidelines. Component locators and schematic diagrams for the matrix are located at the end of this chapter.

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 matrix 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* for descriptions and locations of Agilent E1361A replaceable parts. Service notes, manual updates, and service literature for the matrix may be available through Agilent Technologies. For information, contact your nearest Agilent Technologies Sales and Support Office.

E1361A 4 X 4 Matrix Description

The Agilent E1361A 4 X 4 Relay Matrix provides switching of HI and LO leads from any of four rows to any of four columns. Each relay is a latching relay and will remain in the state last programmed during power down. Following a card reset, all relays are set to the open state. More than one relay can be closed at a time.

Figure 4-1 shows a simplified diagram of the matrix switching.

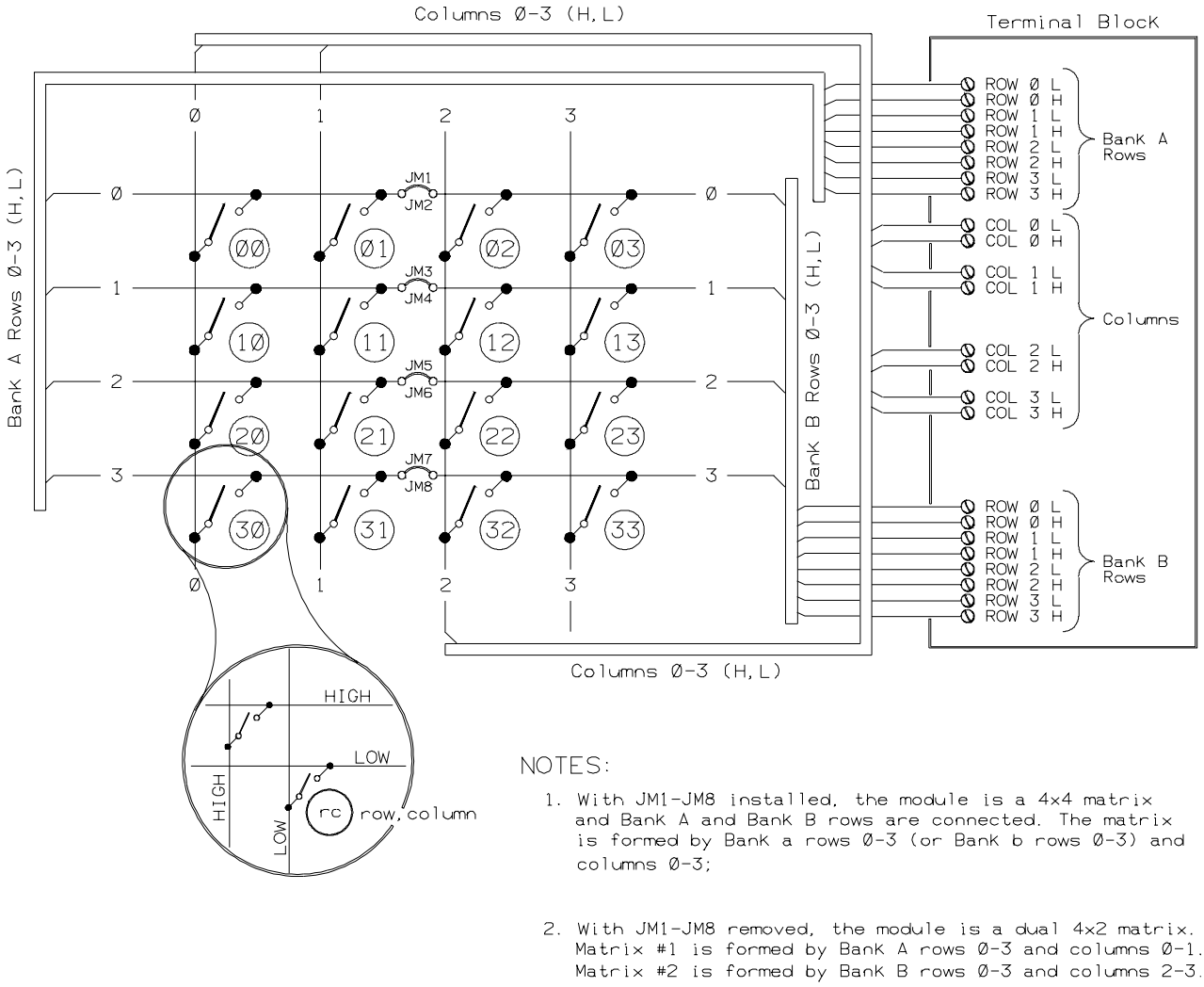


Figure 4-1. E1361A Simplified Switching Diagram

Repair Strategy

Agilent recommends component replacement for the Agilent E1361A. Procedures in this chapter describe troubleshooting techniques. Schematics and Component Locators are located at the back of this manual. Component level replaceable parts lists are contained in *Chapter 3 - Replaceable Parts*.

The mechanical relays have a high probability of failure. See *Chapter 1 - General Information* for a description of relay life factors. The section *Repair and Maintenance Guidelines* in this chapter describes soldering techniques and ESD precautions that must be followed when troubleshooting or repairing the matrix module.

Troubleshooting Techniques

To troubleshoot a matrix problem you must first identify the problem and then isolate the cause of the problem to a replaceable part. See *Chapter 3 - Replaceable Parts* and the component locators at the back of this manual for descriptions and locations of Agilent E1361A replaceable parts.

Identifying the Problem

Table 4-1 lists some common problems for the matrix, along with symptoms and possible solutions. If the problem cannot be identified using these steps, perform component-level troubleshooting using the component locator diagram and schematics at the end of this chapter.

Table 4-1. Agilent E1361A Typical Problems

Symptom	Possible Solutions
Non-zero error code in response to SYST:ERR?	See Appendix C of the E1361A 4 X 4 Matrix User's Manual.
Matrix not responding to commands.	See "Making Visual Checks" in this chapter
Matrix fails Relay contact Resistance Test (Test 2-1)	See "Testing the Matrix" in this chapter

Making Visual Checks

Visual checks for the Agilent E1361A include the following. See Table 4-2 for typical checks.

- Check switches/jumpers
- Check for heat damage
- Check connector contacts

NOTE

See the Agilent E1361A 4 X 4 Matrix 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 - Verification Tests to see if a relay or other component is defective.

Table 4-2. Agilent E1361A Visual Tests/Checks

Test/Check	Reference Designator	Check	Action/Notes
Heat Damage	- - - - - - - - - - - - - - -	Discolored PC boards Damaged insulation Evidence of arcing	If there is damage, do not operate the matrix until you have corrected the problem.
Switch/Jumper Settings	JM15-JM16 JM1-JM8 SW1	IRQ Level setting Channel Jumpers Logical address setting	Factory set at 1 Factory Installed Factory set at 120
Component Assembly	F1, F2 J1 P1	Fuse continuity Dirty or bent connector pins Dirty or bent connector pins	Check fuses with ohmmeter Straighten/clean pins Straighten/clean pins

Testing the Matrix

You can use the tests and checks in *Chapter 2 - Verification Tests* and the information in Table 4-3 to isolate the problem to a relay, to a component, or to both. See *Chapter 3 - Replaceable Parts* for locations of mechanical parts. See the component locator diagrams at the end of this chapter for locations of electrical components.

Table 4-3 shows the relationship between the failing channel number and the associated channel relay and driver/decoder. Use Table 4-3 together with the results of *Test 2-1. Closed Channel Resistance Test* to help isolate a problem. For example, if the contact resistance is out of specification for Row 0 to Column 2 HI contacts, relay K8 should be suspected.

Table 4-3. Troubleshooting

ROW	COLUMN	RELAY	DRIVER/DECODER
0	0	K0	U1, U3/U25, U38
	1	K4	
	2	K8	U2, U4/U26, U30
	3	K12	
1	0	K1	U1, U3/U25, U38
	1	K5	
	2	K9	U2, U4/U26, U30
	3	K13	
2	0	K2	U1, U3/U25, U38
	1	K6	
	2	K10	U2, U4/U26, U30
	3	K14	
3	0	K3	U1, U3/U25, U38
	1	K7	
	2	K11	U2, U4/U26, U30
	3	K15	

Repair and Maintenance Guidelines

This section provides guidelines for repairing and maintaining the Agilent E1361A 4 X 4 Relay Matrix including:

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

ESD Precautions

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

- Always use a static-free work station with a pad of conductive rubber or similar material when handling matrix 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

The etched circuit boards of the matrix 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 matrix, inspect the matrix 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 Test 2-1 as described in *Chapter 2 - Verification Tests* to verify that the matrix is functional.

Component Locators and Schematic Diagrams

Table 4-4 lists Component Locator Diagrams and Schematic Diagrams for the Agilent E1361A 4 X 4 Relay Matrix.

Table 4-4. Agilent E1361A 4 X 4 Relay Matrix Component Locator and Schematic Diagram Drawings

	Part Number	Drawing Number	Drawing Title
Component Locator Diagrams	E1361-66501	L-E1361-66501	4 X 4 Matrix Component Assembly
Schematic Diagrams	E1361-66501 E1361-66501 E1361-66501 E1361-66501 E1361-66510	S-E1361-66501 (pg 1) S-E1361-66501 (pg 2) S-E1361-66501 (pg 3) S-E1361-66501 (pg 4) S-E1361-66510 (pg 5)	4 X 4 Matrix Component Assembly - VXI Interface #1 4 X 4 Matrix Component Assembly - VXI Interface #2 4 X 4 Matrix Component Assembly - Relay Drivers 4 X 4 Matrix Component Assembly - Relays Terminal Block

Appendix A
Verification Tests - C Programs

Functional Verification Test

This program is designed to do the Functional Verification Test found in *Chapter 2 - Verification Tests*.

Example: Self Test

The Functional Verification Test for the Agilent E1361A 4 X 4 Relay Matrix consists of sending the *IDN? command and checking the response. This test can be used to verify that the matrix is connected properly and is responding to a basic command.

NOTE

This program assumes a primary address of 09 and a secondary address of 15. If your Relay Matrix address does not match this, you must either change the Relay Matrix address setting or change the program line #define ADDR "hpib7,9,15" *to match your Relay Matrix address setting.*

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

#define ADDR "hpib7,9,15"              /* Address of device */

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

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

  ipromptf(id, "*IDN?\n", "%t", a);    /* Self test command */
  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*.

NOTE

These programs assume a primary address of 09 and a secondary address of 15. If your Relay Matrix address does not match this, you must either change the Relay Matrix address setting or change the program lines #define ADDR "hpib7,9,15" *to match your Relay Matrix address setting.*

Example: Closed Channel Resistance Test

This example performs a closed channel resistance test to measure Rows 0-3 and Columns 0-3 relay contact resistances. If a relay contact resistance is >3.5 Ω, the program prints a message indicating which channel has failed. Use this list in Chapter 4 when troubleshooting a failing relay.

```
/*  Closed-channel Resistance Test          E1361A  */

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

#define ADDR "hpib7,9,15"               /* Address of device */
#define DMM "hpib7,22"

void main (void)
{
  INST id, dm;                          /* Define id and dm as an instrument */
  double result0[4][4], result1[4][4], value;
  int i, r, c;
  char *path, cr[256];

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

  ionerror(I_ERROR_EXIT);

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

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

```
  printf ("\n\n\nInstall Component Assembly and Test Fixture");
  printf ("\n\n 1. Turn Mainframe AND Agilent 3458A DMM power OFF.");
  printf ("\n 2. Connect GPIB Cable between mainframe and DMM.");
  printf ("\n 3. Install Agilent E1361A 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 ();

  for (i = 0; i <= 1; i++)
  {
   if (i == 0)  path = "HI";
   else         path = "LO";

   printf ("\n\nRow to Column %s Meaurements", path);
   printf ("\n\n  Connect DMM Sense and Input HI leads to ROW %s", path);
   printf ("\n  Connect DMM Sense and Input LO leads to COLUMN %s", path);
   printf ("\n  Press ENTER to continue");
   getchar ();

   for (r=0; r <= 3; r++)
   {
    for (c=0; c <= 3; c++)
    {
     iprintf (id, "CLOS (@1%u%u)\n", r,c);
     iprintf (dm, "TRIG SGL\n");
     iscanf  (dm, "%lf", &value);
     iscanf  (dm, "%t", cr);
     iprintf (id, "OPEN (@1%u%u)\n", r,c);

     if (i==0)
     {
      result0[r][c] = value;
      if (result0[r][c] > 3.5)
       printf ("\n*** Resistance for row %u to column %u %s Path is  3.5
Ohms", r, c, path);
     }
     else
     {
      result1[r][c] = value;
      if (result1[r][c] > 3.5)
       printf ("\n*** Resistance for row %u to column %u %s Path is  3.5
Ohms", r, c, path);
     }
    }
   }

   if (i == 0)
   {
    printf ("\n\nMeasurements complete for Row to Column HI");
    printf ("\n Press ENTER for LO measurements");
```

```
      getchar ();
    }
    else
    {
      printf ("\n\nMeasurements complete for Row to Column LO");
    }
  }

  printf ("\n\nContact resistance measurements complete");
  printf ("\n Press ENTER to display measurement results");
   getchar ();

  printf ("\n\n-----------------------------------------------------");
  printf ("\n                    HI Path        LO Path\n");

  for (r = 0; r <= 3; r++)
  {
    for (c = 0; c <= 3; c++)
    {
      printf ("\nRow %u to Column %u     %6.4lf Ohms     %6.4lf
Ohms",r,c,result0[r][c],result1[r][c]);
    }
  }

  printf ("\n\n-----------------------------------------------------");

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

Example: DC Isolation Test

This example performs DC Isolation Tests for HI to LO, HI to Chassis, and LO to Chassis.

```
/*  DC Isolation Test          E1361A  */

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

#define ADDR "hpib7,9,15"                    /* Address of device */
#define DMM "hpib7,22"

void main (void)
{
 INST id, dm;                        /* Define id and dm as an instrument */
 char reading[3][256] = {0};         /* Result variable */

 #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");

 /*--------------------Measure DC Isolation-------------------------*/

 iprintf (id, "*RST\n");
 iprintf (id, "CLOS (@100:133)");
 printf ("\n\nDC Isolation HI to LO");
 printf ("\n 1. Connect DMM Input HI lead to ROW HI");
 printf ("\n 2. Connect DMM Input LO lead to ROW LO");
 printf ("\n 3. Press ENTER when connections are complete");
 getchar ();

 ipromptf (dm, "TRIG SGL\n", "%t", reading[0]);

 printf ("\n\nDC Isolation HI to Chassis");
 printf ("\n 1. Connect DMM Input HI lead to ROW HI");
 printf ("\n 2. Connect DMM Input LO lead to Chassis");
 printf ("\n 3. Press ENTER when connections are complete");
 getchar ();

 ipromptf (dm, "TRIG SGL\n", "%t", reading[1]);
```

```
  printf ("\n\nDC Isolation LO to Chassis");
  printf ("\n 1. Connect DMM Input HI lead to ROW LO");
  printf ("\n 2. Connect DMM Input LO lead to Chassis");
  printf ("\n 3. Press ENTER when connections are complete");
  getchar ();

  ipromptf (dm, "TRIG SGL\n", "%t", reading[2]);

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

  printf ("\n\nMeasurements complete");
  printf ("\nPress ENTER to display measurement results");
  getchar ();

  printf ("\n\n------------------------------");
  printf ("\n      DC Isolation Tests\n");
  printf ("\nHI to LO          %s Ohms", reading[0]);
  printf ("\nHI to Chassis  %s Ohms", reading[1]);
  printf ("\nLO to Chassis %s Ohms", reading[2]);
  printf ("\n------------------------------");

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