Agilent 75000 SERIES C

Agilent E1463A
32-Channel, 5-Amp, Form C Switch

Service Manual

Agilent Technologies

E1463-90011
E0606

Manual Part Number: E1463-90011

Printed: June 2006 Edition 2 Rev 2
Printed in Malaysia E0606

Contents

Agilent E1463A Form C Switch Service Manual

Certification

Agilent Technologies certifies that this product met its published specifications at the time of shipment from the factory. Agilent Technologies further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology (formerly National Bureau of Standards), to the extent allowed by that organization's calibration facility, and to the calibration facilities of other International Standards Organization members.

Warranty

This Agilent Technologies product is warranted against defects in materials and workmanship for a period of one (1) year from date of shipment. Duration and conditions of warranty for this product may be superseded when the product is integrated into (becomes a part of) other Agilent products. During the warranty period, Agilent Technologies will, at its option, either repair or replace products which prove to be defective.

For warranty service or repair, this product must be returned to a service facility designated by Agilent Technologies. Buyer shall prepay shipping charges to Agilent and Agilent shall pay shipping charges to return the product to Buyer. However, Buyer shall pay all shipping charges, duties, and taxes for products returned to Agilent from another country.

Agilent warrants that its software and firmware designated by Agilent for use with a product will execute its programming instructions when properly installed on that product. Agilent does not warrant that the operation of the product, or software, or firmware will be uninterrupted or error free.

Limitation Of Warranty

The foregoing warranty shall not apply to defects resulting from improper or inadequate maintenance by Buyer, Buyer-supplied products or interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

The design and implementation of any circuit on this product is the sole responsibility of the Buyer. Agilent does not warrant the Buyer's circuitry or malfunctions of Agilent products that result from the Buyer's circuitry. In addition, Agilent does not warrant any damage that occurs as a result of the Buyer's circuit or any defects that result from Buyer-supplied products.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. Agilent SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

Exclusive Remedies

THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES. Agilent SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, WHETHER BASED ON CONTRACT, TORT, OR ANY OTHER LEGAL THEORY.

Notice

The information contained in this document is subject to change without notice. Agilent Technologies MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THIS MATERIAL, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Agilent shall not be liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material. This document contains proprietary information which is protected by copyright. All rights are reserved. No part of this document may be photocopied, reproduced, or translated to another language without the prior written consent of Agilent Technologies, Inc. Agilent assumes no responsibility for the use or reliability of its software on equipment that is not furnished by Agilent.

U.S. Government Restricted Rights

The Software and Documentation have been developed entirely at private expense. They are delivered and licensed as "commercial computer software" as defined in DFARS 252.227- 7013 (Oct 1988), DFARS 252.211-7015 (May 1991) or DFARS 252.227-7014 (Jun 1995), as a "commercial item" as defined in FAR 2.101(a), or as "Restricted computer software" as defined in FAR 52.227-19 (Jun 1987)(or any equivalent agency regulation or contract clause), whichever is applicable. You have only those rights provided for such Software and Documentation by the applicable FAR or DFARS clause or the Agilent standard software agreement for the product involved.

Agilent E1463A 32-Channel, 5-Amp, Form C Switch 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 E1463-90010). . . . . October 1992

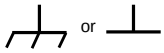
Edition 2 (Part Number E1463-90011). . . . . January 1997

Edition 2 Rev 2 (Part Number E1463-90011) . . . . . June 2006

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 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.

DECLARATION OF CONFORMITY

According to ISO/IEC Guide 22 and CEN/CENELEC EN 45014

Manufacturer's Name: Agilent Technologies, Incorporated
Manufacturer's Address: *Measurement Product Generation Unit*
815 14th ST. S.W.
Loveland, CO 80537 USA

Declares, that the product

Product Name: 32 Channel Form C VXI Switch
Model Number: E1463A
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 and carries the CE Marking accordingly

Conforms with the following product standards:

EMC	Standard	Limit
	IEC 61326-1:1997+A1:1998 / EN 61326-1:1997+A1:1998	
	CISPR 11:1997 +A1:1997 / EN 55011:1998	*Group 1 Class A [1]*
	IEC 61000-4-2:1995+A1:1998 / EN 61000-4-2:1995	*4kV CD, 8kV AD*
	IEC 61000-4-3:1995 / EN 61000-4-3:1995	*3 V/m, 80-1000 MHz*
	IEC 61000-4-4:1995 / EN 61000-4-4:1995	*0.5kV signal lines, 1kV power lines*
	IEC 61000-4-5:1995 / EN 61000-4-5:1995	*0.5 kV line-line, 1 kV line-ground*
	IEC 61000-4-6:1996 / EN 61000-4-6:1996	*3V, 0.15-80 MHz*
	IEC 61000-4-11:1994 / EN 61000-4-11:1994	*I cycle, 100%*
	Canada: ICES-001:1998	
	Australia/New Zealand: AS/NZS 2064.1	
Safety	*IEC 61010-1:1990+A1:1992+A2:1995 / EN 61010-1:1993+A2:1995*	
	Canada: CSA C22.2 No. 1010.1:1992	
	UL 3111-1:1994	

Supplemental Information:

[1] The product was tested in a typical configuration with Agilent Technologies test systems.

September 5, 2000
Date

Jim White
Name

Quality Manager
Title

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

Notes

Notes

Notes

Chapter 1
General Information

Introduction

This manual contains information required to test, troubleshoot, and repair the Agilent E1463A 32-Channel Form C Switch Module (see Figure 1-1).

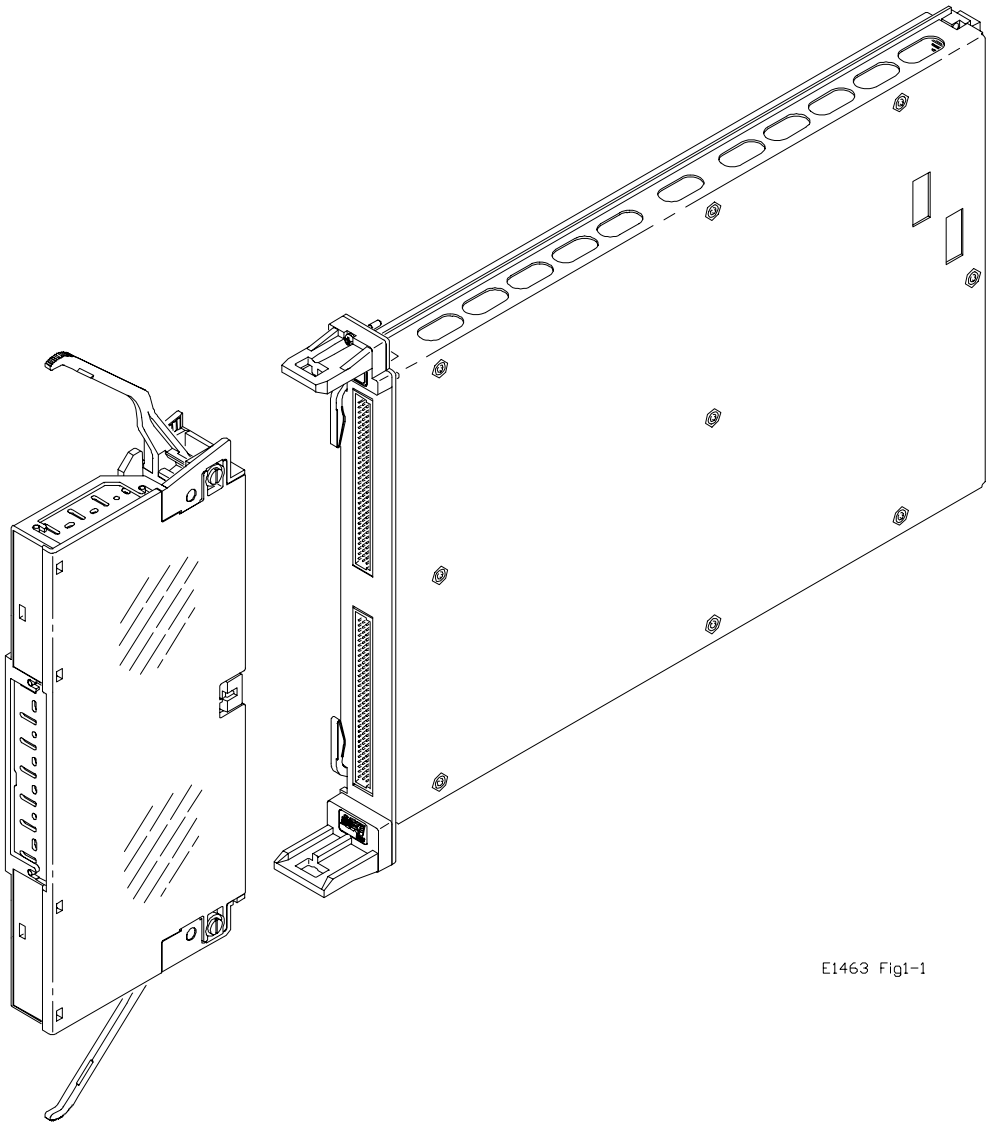


Figure 1-1. Agilent E1463A Form C Switch

Relay Life

Electromechanical relays are subject to normal wear-out. Relay life depends on several factors. The effects of loading and switching frequency are briefly discussed below:

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 three methods described below. The best method (or combination of methods), as well as the failure criteria, depends on the application in which the relay is used.

Contact Resistance. As the 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 2.0 Ohm.

Stability of Contact Resistance. The stability of the 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.

Number of Operations. Alternatively, 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 E1463A, maximum relay life is specified at 5×10^7 operations with no load and 3.5×10^4 operations at the worst-case 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.

Safety Considerations

This product is a Safety Class I instrument that is provided with a protective earth terminal when installed in the mainframe. The instrument, mainframe, and all related documentation should be reviewed for familiarization with 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 testing and service follows and is also found throughout this manual.

WARNINGS and CAUTIONS

This section contains WARNINGS which must be followed for your protection and CAUTIONS which must be followed to avoid damage to the equipment when performing instrument 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.

WARNING

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.)

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.

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the Agilent E1463A 32-Channel Form C Switch Module . Before you remove any installed module, disconnect AC power from the mainframe and from other modules that may be connected to the Switch Module.

CHANNEL WIRING INSULATION. All channels that have a common connection must be insulated so that the user is protected from electrical shock. This means wiring for all channels must be insulated as though each channel carries the voltage of the highest voltage channel.

CAUTION

MAXIMUM INPUTS. The maximum voltage that can be applied to any terminal is 125 V dc (250 Vac rms). The maximum current per channel or common is 5 A DC or ac rms. The maximum power that can be applied to any channel or common is 150 W or 1250 VA.

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

Inspection/Shipping

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

Initial Inspection

Use the steps in Figure 1-2 as guidelines to perform initial inspection of one of the modules. 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.

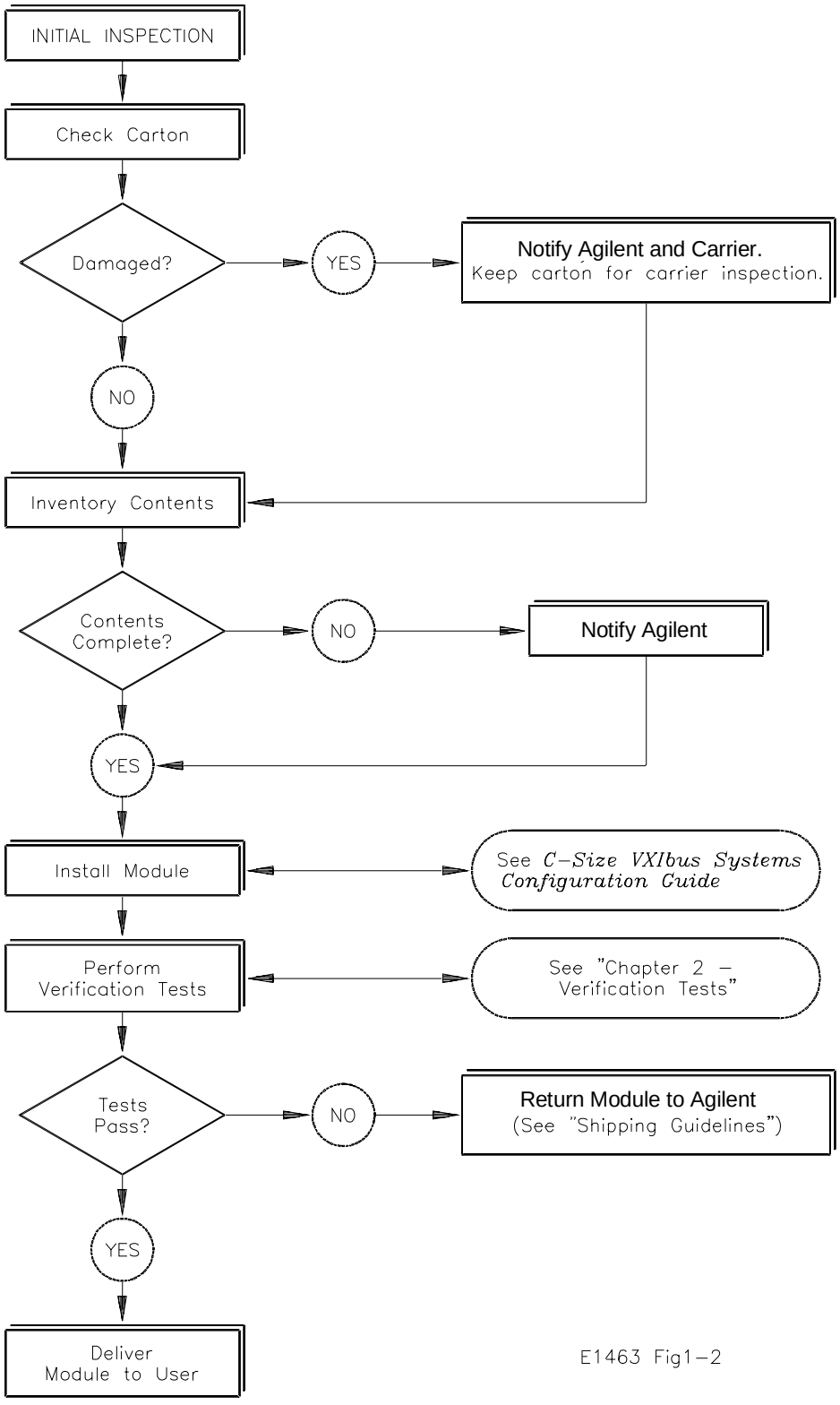
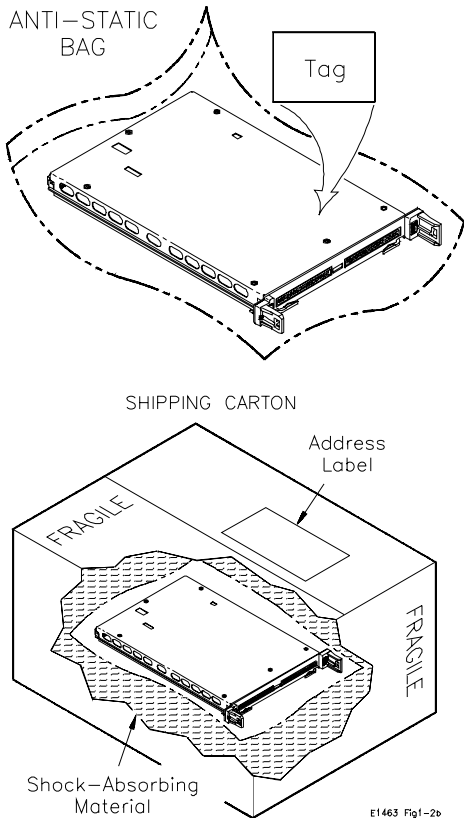


Figure 1-2. Initial (Incoming) Inspection Guidelines

Shipping Guidelines

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



1 Prepare the Module

- Remove user wiring from terminal module
- 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 Module in shipping carton*
- Place 75 to 100 mm (3 to 4 inches) of shock-absorbing material around the Module
- 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 minimum 2.4 MPa (350 psi) test.

Environment

The recommended operating environment for the Agilent E1463A 32-Channel Form C Switch 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)

Switch Module Description

The Agilent E1463A 32-Channel Form C Switch Module is an "instrument" in the slots of a VXIbus mainframe. Each 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 C-Size VXIbus Systems Configuration Guide *to set the addresses to create an instrument.*

Agilent E1463A Description

The Agilent E1463A 32-Channel Form C Switch Module is a VXI-bus C-Size register based product. The Form C Switch Module provides 32 channels of Form C relay switching. Each channel includes a Common (C), a Normally Open (NO) and a Normally Closed (NC) terminal. Each relay can switch up to 5 amps.

The channels can be individually controlled or can be scanned. Each channel uses a non-latching relay and all channel Commons (C) are connected to the Normally Closed (NC) terminals following a power ON or a reset command.

Pads are provided on the component assembly for the installation of user provided protection circuitry. The terminal module contains screw terminals for user wiring connections.

Switch Module Specifications

Specifications are listed in Appendix A of the *Agilent E1463A 32-Channel Form C Switch Module User's Manual*. These specifications are the performance standards or limits against which the modules may be tested.

Switch Module Serial Numbers

Devices 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 right-hand shield near the backplane connectors.

Switch Module Options

The Agilent E1463A comes standard with a terminal module consisting of screw terminals. In addition, a terminal module with solder eye terminals is available (Option A3G).

Schematics and Component Locators

Component locators and schematics for the modules 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 and servicing the module. 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 488-1988 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 switch module	Agilent E1401B/T or Agilent E1421B	F,O, P,T
Command Module	Compatible with switch module	Agilent E1405A/B or Agilent E1406A	F,O, P,T
Digital Multimeter	4-wire ohms 2-wire ohms (up to 1 GΩ)	Agilent 3458A or Agilent 34401A	O,P, T

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

Notes

Chapter 2
Verification Tests

Introduction

The three levels of test procedures described in this chapter are used to verify that the Agilent E1463A 32-Channel Form C Switch Module:

- is fully functional (Functional Verification)
- meets selected testable specifications (Operation Verification)
- meets all testable specifications (Performance Verification)

Test Conditions and 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 switch module, and 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.

It is assumed that the temperature is no greater than 25^{o}C and the relative humidity is no greater than 40%.

Performance Test Record

The results of each Performance Verification test may be recorded in the Performance Test Record (Table 2-1).

Verification Test Examples

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

- Controller is an HP 9000 Series 200/300 computer
- Programming language is BASIC
- Switch address is 70915
- Switch card number is 1

Switch Module Functional Verification

The Functional Verification Test for the Agilent E1463A 32-Channel Form C Switch Module consists of sending the *TST? command and checking the response. This test can be used at any time to verify that the device is connected properly and is responding to basic commands.

Procedure

1. Verify that the Switch Module is installed in the mainframe and that the mainframe has passed its power-on test.
2. Send the *TST? command to the device (see example following).
3. The device will return an error code. Any non-zero error code indicates a self-test failure. See Table 4-4 for a description of self-test error codes.

Example

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

```
10  OUTPUT 70915;"*TST?"        Send the self-test command
20  ENTER 70915;A               Get response
30  PRINT A
40  END
```

Operation Verification

The procedures in this section are used to provide a high degree of confidence that the Switch Module is meeting published specifications. The Operation Verification tests are usually a subset of the Performance Verification tests and are suitable for checkout after performing repairs.

For the Agilent E1463A Switch Module, Operation Verification is performed by completing the Closed Channel Resistance Test as described in the Performance Verification test procedures (Test 2-1). This test is usually sufficient to verify that the instrument is meeting its specifications.

Performance Verification

The procedures in this section are used to test the module's electrical performance using the specifications in Appendix A of the *Agilent E1463A 32-Channel Form C Switch Module User's Manual* as the performance standards.

The performance verification tests have two parts: a closed channel resistance test of all relay contacts (Test 2-1) and a DC isolation test (Test 2-2). These tests are sufficient to determine that the module is operating within specifications. 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 E1463A terminal module for the test fixture. You may want to order an extra terminal module to use as a test fixture, so you don't have to re-wire each time the tests are performed. The Agilent E1463A terminal module part number is E1463-80011 (for modules with serial numbers prior to 3126A01817, the terminal module part number is E1463-80001).

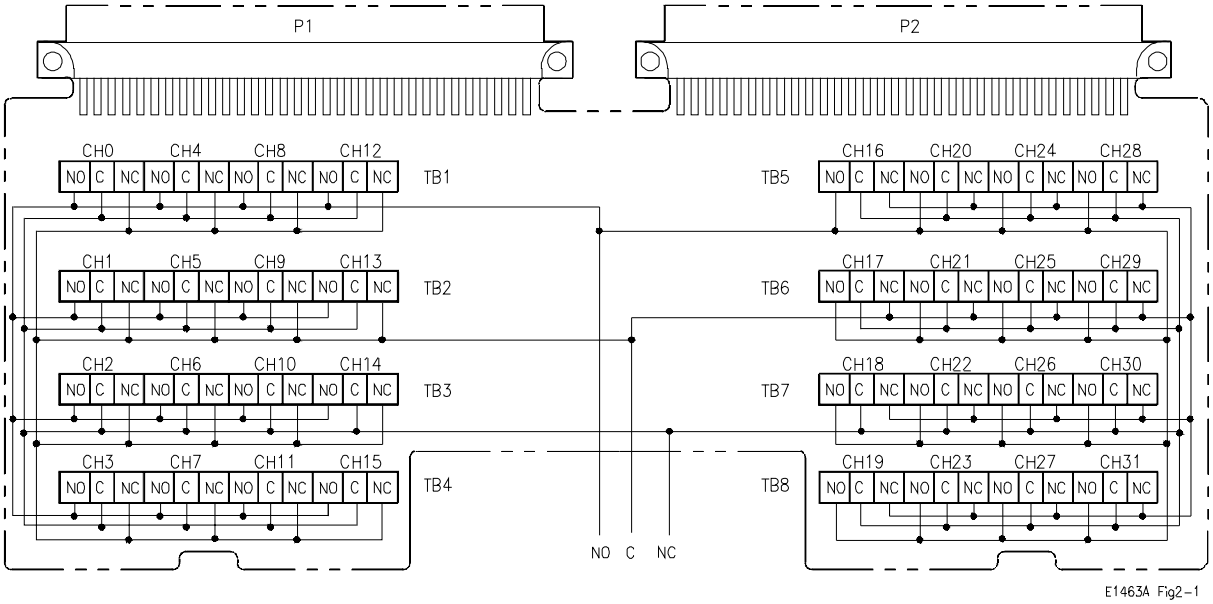


Figure 2-1. Agilent E1463A Test Fixture

Test 2-1: Closed Channel Resistance Test

This test verifies that all relay contacts meet the closed-channel resistance speci- fication for the module. When making the Closed Channel Resistance Test, the NO and NC paths relay contacts are tested independently. This test uses the test fixture (see Figure 2-1).

The Closed Channel resistance specification for each relay contact is 2.0 W.

Common to NO 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 Channel 0 C to NO Resistance**

- Send *RST to Module
- Send CLOS (@nn00) to close channel 0, where nn = card # (typically 01)
- Trigger the DMM with TRIG SGL and note reading
- Send OPEN (@nn00) to open channel 0, where nn = card # (typically 01)
- Enter the result in Table 2-1 for channel 0 C to NO

3. **Repeat for Channels 1 through 31 C to NO**

- Repeat step 2 for channels 1 through 31
- Use OPEN (@nncc) and CLOS (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)

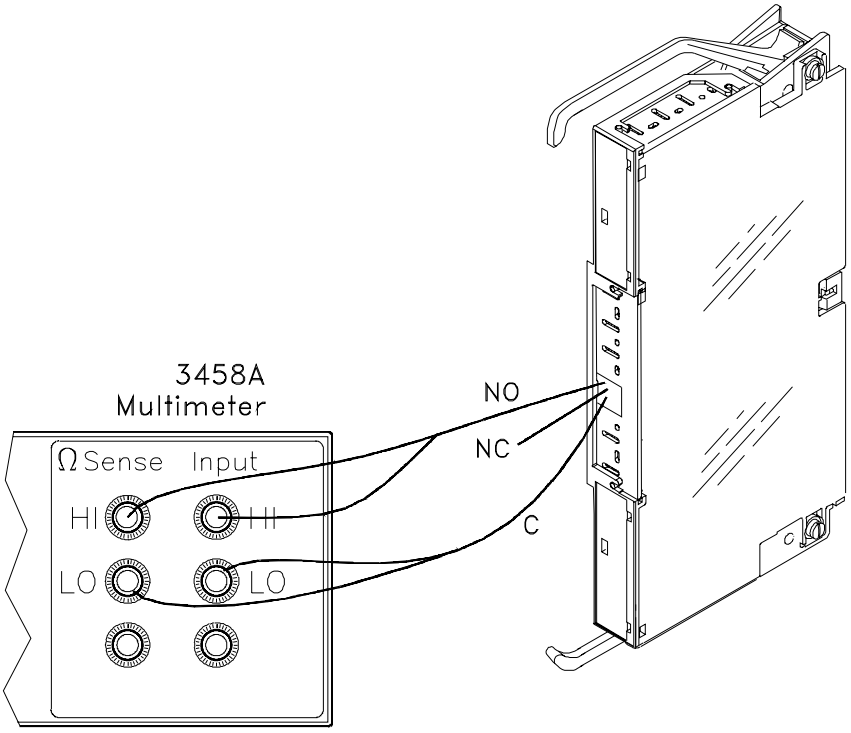


Figure 2-2. Common to NO Test Connections

Channel 0 C to NC 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 Channel 0 C to NC Resistance**

- Send *RST to Module
- Send CLOS (@nn00:nn31) to close all channels, where nn = card # (typically 01)
- Send OPEN (@nn00) to open channel 0, where nn = card # (typically 01)
- Trigger the DMM with TRIG SGL and note reading
- Enter the result in Table 2-1 for Channel 0 C to NC
- Send CLOS (@nn00) to close channel 0, where nn = card # (typically 01)

3. **Repeat for Channels 1 through 31**

- Repeat step 2 for channel 1 through 31 C to NC
- Use OPEN (@nncc) and CLOS (@nncc), where nn = card # and cc = channel # (omit leading zeroes in nn)

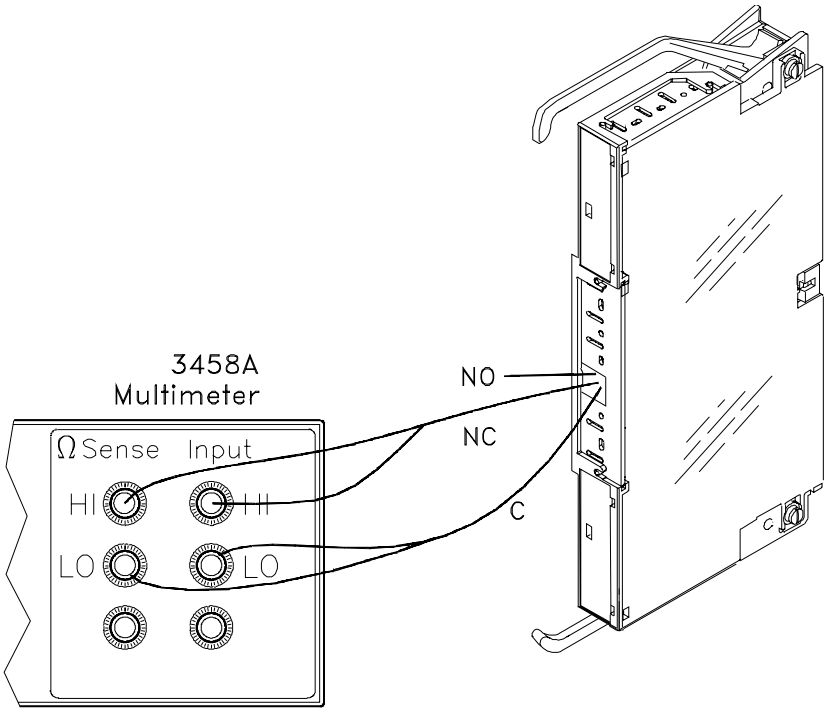


Figure 2-3. Common to NC Test Connections

Example: Closed Channel Resistance Test

This example performs a Closed Channel Resistance Test to measure Channels 0 through 31 relay contact resistances. If the relay contact resistance for a channel is >2.0 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 module is configured without protection varistors, fuses, or resistors and that jumpers JM1 through JM8 are installed on the Agilent E1463A Component Assembly (factory setting). Refer to the Agilent E1463A User's Manual *for details and locations of user installed protection circuits*

```
10!   RE-SAVE "CLOS_TEST"
20    ASSIGN @Dmm TO 722
30    ASSIGN @Sw TO 70915
40    DISP CHR$(129)
50    DIM Result(1,31),Path$(1)[2]
60    DATA NO,NC
70    READ Path$(*)
80     Cc$="01"              ! Card number
90     Ph$="0"               ! Place holder
100   !
110   !Start test
120   !
130   CLEAR SCREEN
140   PRINT "Install Component Assembly and Test Fixture "
150   PRINT
160   PRINT "  1. Turn Mainframe and Agilent 3458A DMM power OFF"
170   PRINT "  2.  Connect GPIB Cable between mainframe and DMM"
180   PRINT "  3.  Install E1463A Component Assembly into Mainframe"
190   PRINT "  4. Attach Test Fixture to Component Assembly"
200   PRINT "  5. Turn Mainframe and DMM power ON "
210   PRINT "  5. Press Continue when ready to begin testing "
220   PAUSE
230   CLEAR SCREEN
240   !
250   !  Start the measurements
260   !
270   FOR J = 0 TO 1
280       OUTPUT @Dmm;"PRESET NORM;FUNC OHMF"
```

(Continued on Next Page)

```
290         OUTPUT @Sw;"*RST"
300         OUTPUT @Sw;"*OPC?"
310         ENTER @Sw;Opc
320         IF Opc<>1 THEN GOTO 300
330         IF J=1 THEN
340             OUTPUT @Sw;"CLOS (@"&Cc$&"00:"&Cc$&"31)"
350         END IF
360         PRINT TABXY(1,1),"Channels 00-31  "&Path$(J)&
"  measurements"
370         PRINT TABXY(1,3),"1.  Connect DMM Sense and Input HI leads
to test fixture "&Path$(J)
380         PRINT TABXY(1,4),"2.  Connect DMM Sense and Input LO leads
to test fixture C"
390         DISP "Press Continue when connections are complete"
400         PAUSE
410         CLEAR SCREEN
420         OUTPUT @Dmm;"TRIG SGL"       ! Check for stuck relays
430         ENTER @Dmm;Meas
440         IF Meas <1.E+6 THEN
450             PRINT "Stuck relay found"
460             PRINT "Repair problem and re-run test"
470             STOP
480         END IF
490         FOR I=0 TO 31
500             IF J<1 THEN
510                 IF I <10 THEN
520                     OUTPUT @Sw;"CLOS (@"&Cc$&Ph$&VAL$(I)&")"
530                 ELSE
540                     OUTPUT @Sw;"CLOS (@"&Cc$&VAL$(I)&")"
550                 END IF
560             ELSE
570                 IF I <10 THEN
580                     OUTPUT @Sw;"OPEN (@"&Cc$&Ph$&VAL$(I)&")"
590                 ELSE
600                     OUTPUT @Sw;"OPEN (@"&Cc$&VAL$(I)&")"
610                 END IF
620             END IF
630             OUTPUT @Sw;"*OPC?"
640             ENTER @Sw;Opc
650             IF Opc<>1 THEN GOTO 630
660             OUTPUT @Dmm;"TRIG SGL"
670             ENTER @Dmm;Result(J,I)
```

(Continued on Next Page)

```
680                 IF J<1 THEN
690                     IF I <10 THEN
700                         OUTPUT @Sw;"OPEN (@"&Cc$&Ph$&VAL$(I)&")"
710                     ELSE
720                         OUTPUT @Sw;"OPEN (@"&Cc$&VAL$(I)&")"
730                     END IF
740                 ELSE
750                     IF I <10 THEN
760                         OUTPUT @Sw;"CLOS (@"&Cc$&Ph$&VAL$(I)&")"
770                     ELSE
780                         OUTPUT @Sw;"CLOS (@"&Cc$&VAL$(I)&")"
790                     END IF
800                 END IF
810                 OUTPUT @Sw;"*OPC?"
820                 ENTER @Sw;Opc
830                 IF Opc<>1 THEN GOTO 810
840                 IF Result(J,I)<0 THEN Result(J,I)=0
850                 IF Result(J,I)>2.0 THEN
860                     PRINT "Resistance for Channel ";I;" "&Path$(J)&" contacts
 is >2.0 Ohms"
870                 END IF
880             NEXT I
890             PRINT "Measurements complete for Channel 00-31 "&Path$(J)&" contacts"
900             IF J<1 THEN
910                 DISP "Press Continue for channels 00-31 Normally Closed
measurements"
920                 PAUSE
930             END IF
940         NEXT J
950         PRINT "Closed Contact Resistance measurements complete"
960         DISP "Press continue to print measurement results"
970         PAUSE
980         CLEAR SCREEN
990         !
1000        !  Print measurement results
1010        !
1020    Format:IMAGE "CH ",DD,3X,DD.DDDD," Ohms",3X,DD.DDDD," Ohms"
1030    PRINT TABXY(1,3),"        NO Contacts            NC Contacts"
1040    PRINT
1050    FOR I=0 TO 31
1060        PRINT USING Format;I,Result(0,I),Result(1,I)
1070    NEXT I
1080    END
```

Typical Result

	NO Contacts	NC Contacts
CH 0	.1453 Ohms	.1453 Ohms
CH 1	.1616 Ohms	.1661 Ohms
CH 2	.1914 Ohms	.1948 Ohms
CH 3	.3491 Ohms	.2657 Ohms
CH 4	.4644 Ohms	.2628 Ohms
CH 5	.1226 Ohms	.1389 Ohms
CH 6	.1499 Ohms	.1678 Ohms
CH 7	.1547 Ohms	.1817 Ohms
CH 8	.3347 Ohms	.2257 Ohms
CH 9	.4932 Ohms	.3096 Ohms
CH 10	.1572 Ohms	.1849 Ohms
CH 11	.1836 Ohms	.2106 Ohms
CH 12	.1543 Ohms	.1317 Ohms
CH 13	.2861 Ohms	.2144 Ohms
CH 14	.4500 Ohms	.2722 Ohms
CH 15	.1366 Ohms	.1771 Ohms
CH 16	.1694 Ohms	.1639 Ohms
CH 17	.1848 Ohms	.1569 Ohms
CH 18	.3753 Ohms	.2373 Ohms
CH 19	.5508 Ohms	.2952 Ohms
CH 20	.1295 Ohms	.1257 Ohms
CH 21	.1648 Ohms	.1328 Ohms
CH 22	.1839 Ohms	.1438 Ohms
CH 23	.3609 Ohms	.2349 Ohms
CH 24	.4500 Ohms	.2808 Ohms
CH 25	.1733 Ohms	.1507 Ohms
CH 26	.2115 Ohms	.1723 Ohms
CH 27	.2362 Ohms	.1876 Ohms
CH 28	.2808 Ohms	.1874 Ohms
CH 29	.4140 Ohms	.2340 Ohms
CH 30	.1692 Ohms	.1412 Ohms
CH 31	.1822 Ohms	.1833 Ohms

Test 2-2: DC Isolation Test

This test verifies that sufficient DC isolation exists at various points on the Module. DC Isolation is checked from NO to NC, NO to Chassis, and NC 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.

NC (&C) to NO Isolation

1. Make hardware connections as shown in Figure 2-4
2. Set DMM to 2-wire ohms, 1 G Ω range
3. Send *RST to Module
4. Trigger the DMM with TRIG SGL
5. Record the DMM reading in Table 2-1 (NC to NO)

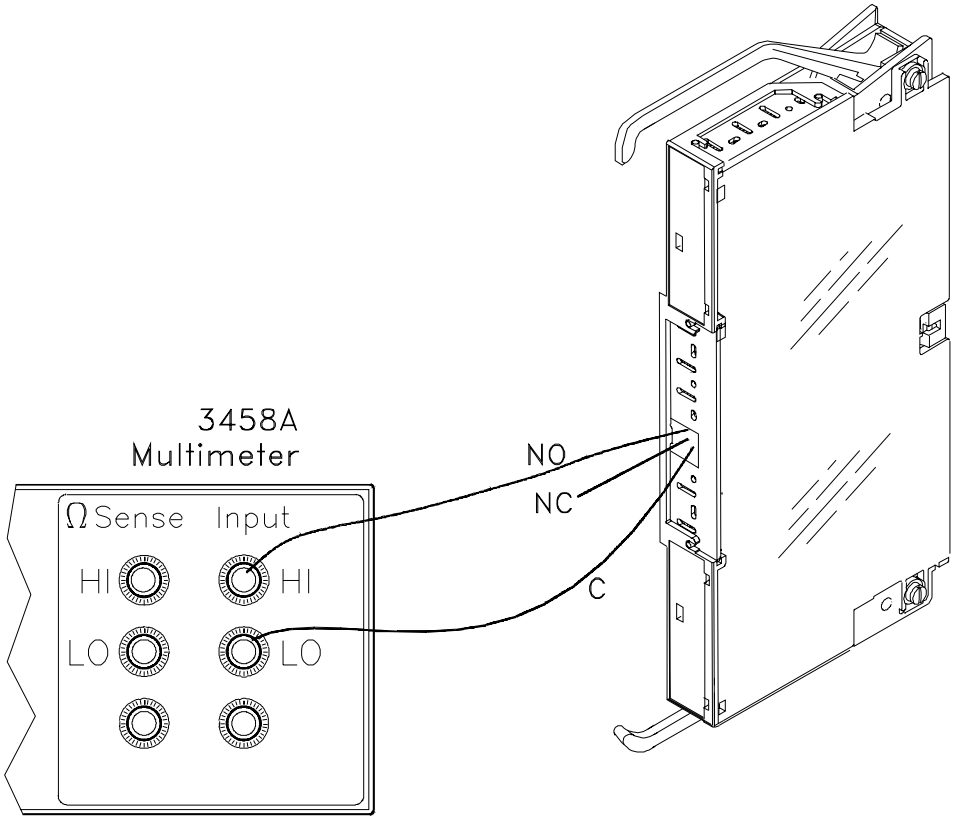


Figure 2-4. NC to NO Isolation

NC (&C) to Chassis Isolation

1. Make hardware connections as shown in Figure 2-5
2. Set DMM to 2-wire ohms, 1 G Ω range
3. Send *RST to Module
4. Trigger the DMM with TRIG SGL
5. Record the DMM reading in Table 2-1 (NC to Chassis)

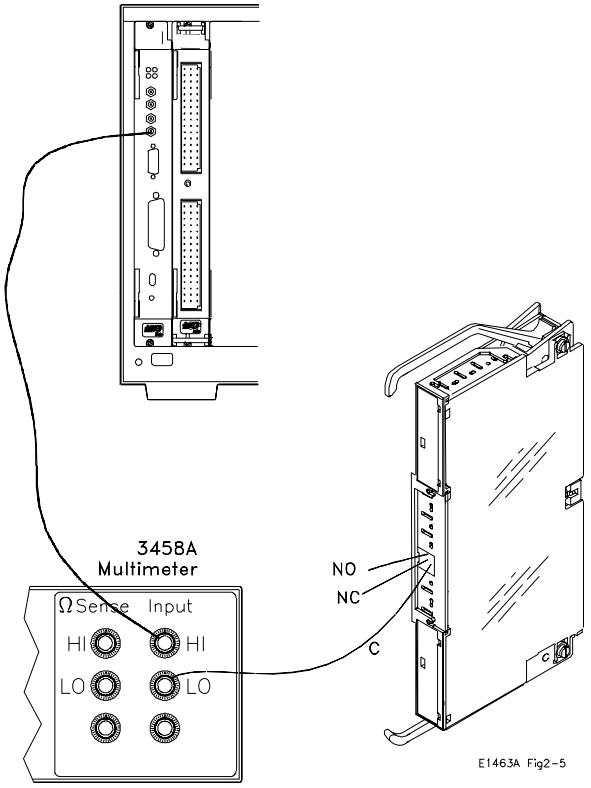


Figure 2-5. NO and NC to Chassis Isolation

NO (&C) to Chassis Isolation

1. Make hardware connections as shown in Figure 2-5
2. Set DMM to 2-wire ohms, 1 G Ω range
3. Send *RST to Module
4. Send CLOS (@100:131) to Module to close all channels
5. Trigger the DMM with TRIG SGL
6. Record the DMM reading in Table 2-1 (NO to Chassis)

Example: DC Isolation Test

This example performs DC Isolation Tests for C to chassis and NO to NC.

```
10!   RE-SAVE "DC_ISOL"
20    ASSIGN @Dmm TO 722
30    ASSIGN @Sw TO 70915
40    DISP CHR$(129)
50    Cc$="01"                          ! Card number
60    DIM Result(2)
70    PRINT "Equipment Connections "
80    PRINT
90    PRINT " 1.  Turn Mainframe and Agilent 3458A DMM power OFF"
100   PRINT " 2.  Connect GPIB Cable between mainframe and DMM"
110   PRINT " 3.   Install E1463A Component Assembly into Mainframe "
120   PRINT " 4.  Attach Test Fixture to Component Assembly"
130   PRINT " 5.  Turn Mainframe and Agilent 3458A power ON"
140   DISP  "Press Continue when ready to begin testing "
150   PAUSE
160   OUTPUT @Dmm;"OHM 1E9"
170   CLEAR SCREEN
180   !
190   ! Measure DC isolation (NC to NO)
200   !
210   OUTPUT @Sw;"*RST"
220   OUTPUT @Sw;"*OPC?"
230   ENTER @Sw;Opc
240   IF Opc<>1 THEN GOTO 220
250   PRINT TABXY(1,1),"NC (&C) to NO DC Isolation "
260   PRINT TABXY(1,3),"1. Connect DMM Input HI lead to test fixture NO"
270   PRINT TABXY(1,4),"2. Connect DMM Input LO lead to test fixture C"
280   DISP " Press Continue when connections are complete"
290   PAUSE
300   OUTPUT @Dmm:"TRIG SGL"
310   ENTER @Dmm;Result(0)
320   CLEAR SCREEN
330   PRINT TABXY(1,1),"NC (&C) to Chassis DC Isolation"
340   PRINT TABXY(1,3),"1. Connect DMM Input HI lead to Chassis"
350   PRINT TABXY(1,4),"2. Connect DMM Input LO lead to test fixture C"
360   DISP " Press Continue when connections are complete"
370   PAUSE
380   OUTPUT @Dmm;"TRIG SGL"
390   ENTER @Dmm;Result(1)
```

(Continued on Next Page)

```
400   CLEAR SCREEN
410   PRINT TABXY(1,1),"NO (&C) to Chassis DC Isolation"
420   DISP " Press Continue to make measurement"
430   PAUSE
440   OUTPUT @Sw;"CLOS (@"&Cc$&"00:"&Cc$&"31)"  !Close all channels
450   OUTPUT @Sw;"*OPC?"
460   ENTER @Sw;Opc
470   IF Opc<>1 THEN GOTO 450
480   OUTPUT @Dmm;"TRIG SGL"
490   ENTER @Dmm;Result(2)
500   OUTPUT @Sw;"*RST"
510   PRINT "DC Isolation tests complete"
520   DISP "Press Continue to print measurement results"
530   PAUSE
540   CLEAR SCREEN
550   PRINT TABXY(1,1),"DC Isolation Tests"
560   PRINT TABXY(1,3),"NC to NO (Ohms)          ";Result(0)
570   PRINT TABXY(1,4),"NC to Chassis (Ohms)     ";Result(1)
580   PRINT TABXY(1,5),"NO to Chassis (Ohms)     ";Result(2)
590   END
```

Typical Result

```
DC Isolation Tests


NC to NO (Ohms)                    1E+38
NC to Chassis (Ohms)               1E+38
NO to Chassis (Ohms)               1E+38
```

Performance Test Record

Table 2-1 is a form you can copy and use to record performance verification test results for the Switch Module. Information concerning test limits, measurement uncertainty, and test accuracy ratio (TAR) is provided below.

Test Limits

Test limits are defined for Closed Channel Resistance Test and DC Isolation Test using the specifications in Appendix A of the *Agilent E1463A 32-Channel Form C Switch Module User's Manual*. The specifications are single-sided, (i.e., there is an upper limit or a lower limit, but not both). In the Performance Test Record, the Minimum or Maximum column will be blank.

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 2-1 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*)
$= (15 \times 10^{-6} * 2.0) + (5 \times 10^{-6} * 10)\ \Omega$
$= 8.0 \times 10^{-5}\ \Omega$

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 Agilent 3458A)

M.U. = (0.5% *of Reading* + 10*ppm of Range*)
$= (0.005 * 1.2 \times 10^{9}) + (10 \times 10^{-6} * 1 \times 10^{9})\ \Omega$
$= 6.1 \times 10^{6}\ \Omega$

Test Accuracy Ratio (TAR)

Test Accuracy Ratios are not defined for single-sided measurements, so all measurements have "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 _____

Address _____

City/State _____

Phone _____

Report No. _____

Date _____

Customer _____

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	Maximum Value	Meas Uncert	Test Acc Ratio (TAR)
2-1. Contact Resistance Test (values in Ohms)					
NO to C Resistance					
Channel 00		_____	2.0	8.000E-5	NA
Channel 01		_____	2.0	8.000E-5	NA
Channel 02		_____	2.0	8.000E-5	NA
Channel 03		_____	2.0	8.000E-5	NA
Channel 04		_____	2.0	8.000E-5	NA
Channel 05		_____	2.0	8.000E-5	NA
Channel 06		_____	2.0	8.000E-5	NA
Channel 07		_____	2.0	8.000E-5	NA
Channel 08		_____	2.0	8.000E-5	NA
Channel 09		_____	2.0	8.000E-5	NA
Channel 10		_____	2.0	8.000E-5	NA
Channel 11		_____	2.0	8.000E-5	NA
Channel 12		_____	2.0	8.000E-5	NA
Channel 13		_____	2.0	8.000E-5	NA
Channel 14		_____	2.0	8.000E-5	NA
Channel 15		_____	2.0	8.000E-5	NA
Channel 16		_____	2.0	8.000E-5	NA
Channel 17		_____	2.0	8.000E-5	NA
Channel 18		_____	2.0	8.000E-5	NA
Channel 19		_____	2.0	8.000E-5	NA
Channel 20		_____	2.0	8.000E-5	NA
Channel 21		_____	2.0	8.000E-5	NA
Channel 22		_____	2.0	8.000E-5	NA
Channel 23		_____	2.0	8.000E-5	NA
Channel 24		_____	2.0	8.000E-5	NA
Channel 25		_____	2.0	8.000E-5	NA
Channel 26		_____	2.0	8.000E-5	NA
Channel 27		_____	2.0	8.000E-5	NA
Channel 28		_____	2.0	8.000E-5	NA
Channel 29		_____	2.0	8.000E-5	NA
Channel 30		_____	2.0	8.000E-5	NA
Channel 31		_____	2.0	8.000E-5	NA

*Single-sided specification - Minimum value does not apply

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

Model _____ **Report No.** _____ **Date** _____

Test No/Description	Minimum* Value	Measured Value	Maximum Value	Meas Uncert	Test Acc Ratio (TAR)
2-1. Contact Resistance Test (values in Ohms)					
NC to C Resistance					
Channel 00		_____	2.0	8.000E-5	NA
Channel 01		_____	2.0	8.000E-5	NA
Channel 02		_____	2.0	8.000E-5	NA
Channel 03		_____	2.0	8.000E-5	NA
Channel 04		_____	2.0	8.000E-5	NA
Channel 05		_____	2.0	8.000E-5	NA
Channel 06		_____	2.0	8.000E-5	NA
Channel 07		_____	2.0	8.000E-5	NA
Channel 08		_____	2.0	8.000E-5	NA
Channel 09		_____	2.0	8.000E-5	NA
Channel 10		_____	2.0	8.000E-5	NA
Channel 11		_____	2.0	8.000E-5	NA
Channel 12		_____	2.0	8.000E-5	NA
Channel 13		_____	2.0	8.000E-5	NA
Channel 14		_____	2.0	8.000E-5	NA
Channel 15		_____	2.0	8.000E-5	NA
Channel 16		_____	2.0	8.000E-5	NA
Channel 17		_____	2.0	8.000E-5	NA
Channel 18		_____	2.0	8.000E-5	NA
Channel 19		_____	2.0	8.000E-5	NA
Channel 20		_____	2.0	8.000E-5	NA
Channel 21		_____	2.0	8.000E-5	NA
Channel 22		_____	2.0	8.000E-5	NA
Channel 23		_____	2.0	8.000E-5	NA
Channel 24		_____	2.0	8.000E-5	NA
Channel 25		_____	2.0	8.000E-5	NA
Channel 26		_____	2.0	8.000E-5	NA
Channel 27		_____	2.0	8.000E-5	NA
Channel 28		_____	2.0	8.000E-5	NA
Channel 29		_____	2.0	8.000E-5	NA
Channel 30		_____	2.0	8.000E-5	NA
Channel 31		_____	2.0	8.000E-5	NA
Test 2-2 DC Isolation (values in Ohms)					
NO to NC	1.2E9	_____	*	6.1E6	NA
NC to Chassis	1.2E9	_____		6.1E6	NA
NO to Chassis	1.2E9	_____		6.1E6	NA

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

Notes

Chapter 3
Replaceable Parts

Introduction

This chapter contains information for ordering replaceable parts for the Agilent E1463A 32-Channel Form C Switch Module.

Ordering Information

To order a part listed in this chapter, specify the Agilent Technologies part number and the quantity required. Send the order to your nearest Agilent Technologies Sales and Support Office.

Replaceable Parts List

Table 3-1. Agilent E1463A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description
A2	E1463A†	1	**GP RELAY ASSEMBLY** (See Figure 3-1)
MP1	E1400-45101†	1	HANDLE - TOP METAL INJECTION
MP2	E1400-45102†	1	HANDLE - BOTTOM METAL INJECTION
MP3	8160-0686	1	RFI STRIP-FINGERS BE-CU TIN-PLATED
PNL1	E1463-00202†	1	FRONT PANEL
SCR1-SCR2	E1400-00610†	2	SHOULDER SCREW ASSEMBLY
SCR3-SCR8	0515-1135	9	SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD
SCR13	0515-1375		SCREW MACHINE M2.5X0.45 6MM-LG FLAT-HD
SCR14-SCR16	0515-1135		SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD
SHD1	E1463-00601	1	SHIELD-TOP
SHD2	E1463-00602	1	SHIELD-BOTTOM
A2A1	E1463-66501	1	PC ASSEMBLY-GP RLY BOARD
C201	0160-4835	18	CAPACITOR-FXD 0.1uF +-10% 50 V
C202	0160-4801	5	CAPACITOR-FXD 100pF +-5% 100 V
C203-C215	0160-4835		CAPACITOR-FXD 0.1uF +-10% 50 V
C301	0160-4822	4	CAPACITOR-FXD 1000pF +-5% 100 V
C302	0160-4801		CAPACITOR-FXD 100pF +-5% 100 V
C303	0160-4822		CAPACITOR-FXD 1000pF +-5% 100 V
C304	0160-4801		CAPACITOR-FXD 100pF +-5% 100 V
C305-C306	0160-4835		CAPACITOR-FXD 0.1uF +-10% 50 V
C307-C308	0160-4844	4	CAPACITOR-FXD 1uF +80% -20% 50 V

Table 3-1. Agilent E1463A Replaceable Parts (Continued)

Reference Designator	Agilent Part Number	Qty	Part Description
C401	0160-4822		CAPACITOR-FXD 1000pF +-5% 100 V
C402	0160-4801		CAPACITOR-FXD 100pF +-5% 100 V
C403	0160-4822		CAPACITOR-FXD 1000pF +-5% 100 V
C404	0160-4801		CAPACITOR-FXD 100pF +-5% 100 V
C405-C406	0160-4835		CAPACITOR-FXD 0.1uF +-10% 50 V
C407-C408	0160-4844		CAPACITOR-FXD 1uF +80% -20% 50 V
C601-C604	0180-1746	4	CAPACITOR-FXD 15uF +-10% 20 V
CR300-CR316	1902-0964	36	DIODE-ZENER 18V 5% PD=.4W TC=+.09% IR=5UA
CR318-CR320	1902-0964		DIODE-ZENER 18V 5% PD=.4W TC=+.09% IR=5UA
CR416-CR431	1902-0964		DIODE-ZENER 18V 5% PD=.4W TC=+.09% IR=5UA
F601-F602	2110-0712	2	FUSE-SUBMINIATURE 4A 125V NTD AX
J1-J2	1252-1575	2	CONNECTOR-POST TYPE 5.08-PIN-SPCG 48-CONTACT
J101	1251-4927	2	CONNECTOR-POST TYPE .100-PIN-SPCG 16-CONTACT
J201	1251-4927		CONNECTOR-POST TYPE .100-PIN-SPCG 16-CONTACT
JM0-JM23	8159-0005		RESISTOR 0 MFS
JM25-JM31	8159-0005	33	RESISTOR 0 MFS
JM424	8159-0005		RESISTOR 0 MFS
K0-K31	0490-1773	32	RELAY 1AB 12VDC-COIL 5A 380VAC
L601-L602	9140-1354	2	INDUCTOR-FIXED 47UH +-15% .453D-INX.9LG-IN
L603	9100-1623	1	INDUCTOR-FIXED RF-CHOKE-MOLDED 27UH +-5%
MP1	0050-2183	1	CASTING-ZINC P.C. BOARD HOLDER
P1	1252-1596	1	CONNECTOR-POST TYPE 2.54-PIN-SPCG 96-CONTACT
P2	1252-4743	1	CONNECTOR-POST TYPE 2.54-PIN-SPCG 64-CONTACT
P101	1258-0247	1	JUMPER-4 POSITIONS HOUSING MATERIAL
R101	0757-0421	1	RESISTOR 825 +-1% .125W TF TC=0+-100
R201	0757-0469	1	RESISTOR 150K +-1% .125W TF TC=0+-100
R203	0757-0453	1	RESISTOR 30.1K +-1% .125W TF TC=0+-100
R204	0757-0417	1	RESISTOR 562 +-1% .125W TF TC=0+-100
R301-R302	0757-0442	4	RESISTOR 10K +-1% .125W TF TC=0+-100
R303-R304	0757-0407	4	RESISTOR 200 +-1% .125W TF TC=0+-100
R305-R306	0757-0346	4	RESISTOR 10 +-1% .125W TF TC=0+-100
R401-R402	0757-0407		RESISTOR 200 +-1% .125W TF TC=0+-100
R403-R404	0757-0442		RESISTOR 10K +-1% .125W TF TC=0+-100

Table 3-1. Agilent E1463A Replaceable Parts (Continued)

Reference Designator	Agilent Part Number	Qty	Part Description
R405-R406	0757-0346		RESISTOR 10 +-1% .125W TF TC=0+-100
RP101-RP103	1810-0279	3	NETWORK-RES 10-SIP 4.7K OHM X 9
RP301-RP302	1810-0265	4	NETWORK-RES 16-DIP 680.0 OHM X 8
RP401-RP402	1810-0265		NETWORK-RES 16-DIP 680.0 OHM X 8
SP101	3101-2094	1	SWITCH-DIP ROCKER 8-1A 0.15A 30VDC
U101	1820-3631	2	IC COMPARATOR CMOS/HCT MAGNITUDE 8-BIT
U102	1820-3975	3	IC DRIVER CMOS/HC LINE OCTL
U103	1820-4586	1	IC DRIVER/RECEIVER CMOS/HCT BUS OCTL
U104-U105	1820-3975		IC DRIVER CMOS/HC LINE OCTL
U106	1820-3631		IC COMPARATOR CMOS/HCT MAGNITUDE 8-BIT
U107	1820-4147	1	IC LATCH CMOS/HCT TRANSPARENT OCTL
U108-U109	1820-3714	2	IC TRANSCEIVER TTL/ALS BUS OCTL
U110-U111	1820-3079	2	IC DECODER CMOS/HC BIN 3-TO-8-LINE
U112	1820-4643	2	IC GATE CMOS/HCT NOR QUAD 2-INP
U201	1820-4643		IC GATE CMOS/HCT NOR QUAD 2-INP
U203	1820-4242	1	IC SCHMITT-TRIG CMOS/HCT INV HEX
U204	1820-3081	2	IC FF CMOS/HC D-TYPE POS-EDGE-TRIG
U205	1820-4590	1	IC MV CMOS/HC MONOSTBL RETRIG DUAL
U206	1820-6731	1	IC-ASIC GATE-ARRAY CMOS
U207	1820-4057	1	IC BUFFER TTL/F NAND QUAD 2-INP
U208	1820-3097	1	IC GATE CMOS/HC AND QUAD 2-INP
U209	1820-3081		IC FF CMOS/HC D-TYPE POS-EDGE-TRIG
U301-U302	1820-4086	4	IC FF CMOS/HCT D-TYPE POS-EDGE-TRIG
U303-U304	1858-0069	4	TRANSISTOR ARRAY 18-PIN PLASTIC DIP
U401-U402	1820-4086		IC FF CMOS/HCT D-TYPE POS-EDGE-TRIG
U403-U404	1858-0069		TRANSISTOR ARRAY 18-PIN PLASTIC DIP
†NOTE: For modules with serial numbers prior to 3126A01817, the following parts must be used for replacement (see inset in figure 3-1).			
*A1	E1463-66201	1	GP RELAY ASSEMBLY
*MP1	E1400-84105	1	EXT HANDLE KIT-BOTTOM
*MP2	E1400-84106	1	EXT HANDLE KIT-TOP
*PNL1	E1463-00201	1	FRONT PANEL
*SCR1-*SCR2	0515-0368	2	SCREW-MACHINE ASSY M2.5 X 12MM-LG PAN-HD
*SCR9-*SCR10	0515-1375	3	SCREW-MACHINE M2.5 X 0.45 6MM-LG FLAT-HD
*SCR11-*SCR12	0515-1968	2	SCREW PH M2.5 X 11TX

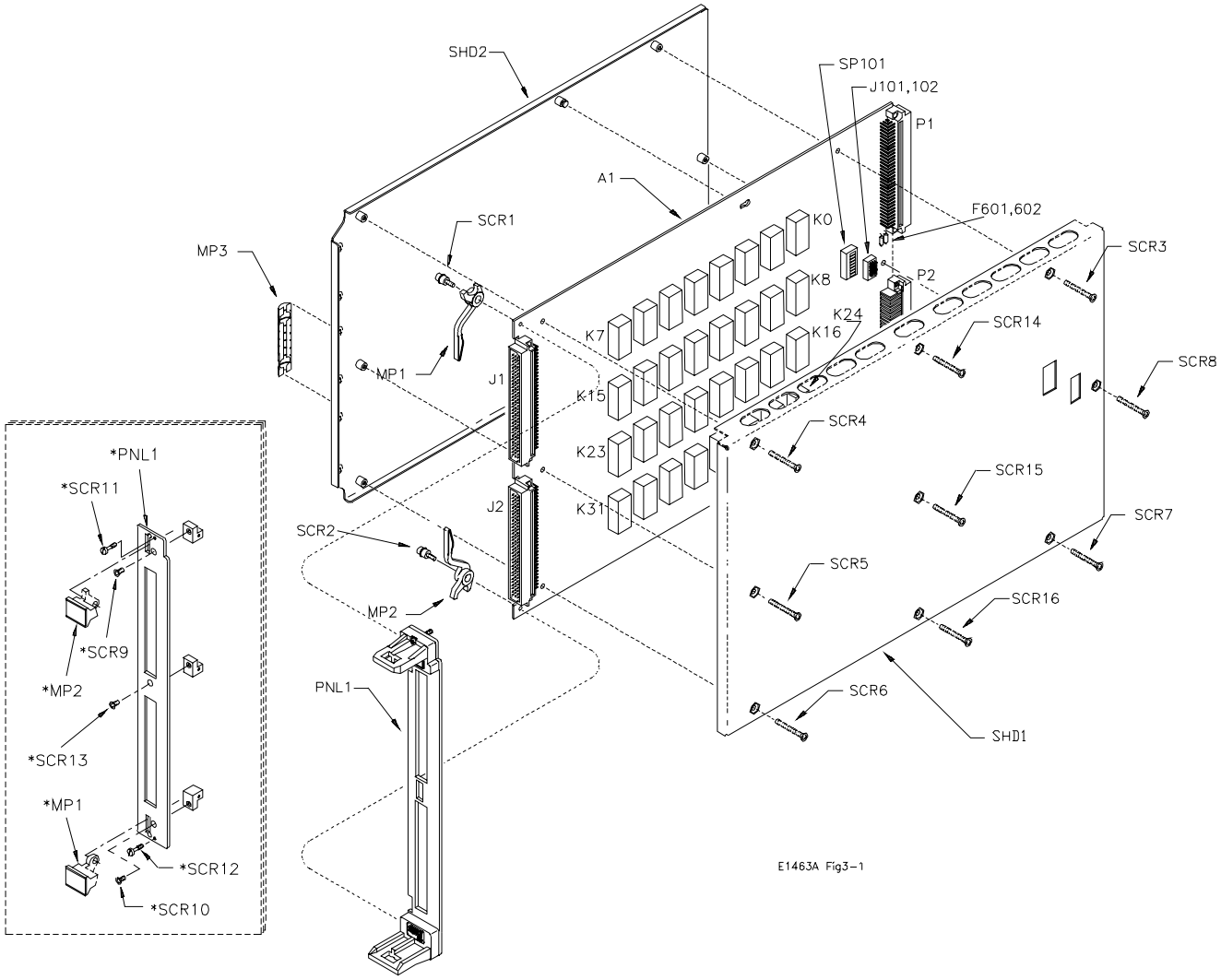


Figure 3-1. E1463A Mechanical Replaceable Parts

Table 3-2. Agilent E1463A Terminal Case Replaceable Parts (for modules with serial numbers after 3126A01818)

Reference Designator	Agilent Part Number	Qty	Part Description
1	E1400-84405	1	Case Assembly - Terminal
2	E1400-45103	1	Top Lever
3	E1400-45104	1	Bottom Lever
4	1460-2552	1	Torsion Spring - Left Hand Wound
5	1460-2553	1	Torsion Spring - Right Hand Wound
6	1390-1027	2	Receptical Quick Fastener
PCA			**PC Assembly:**
	E1463-66510	1	Screw Terminal (Standard)
	1252-1574	2	Connector - Rcpt, 48 Pin (Option A3G)
	0515-0905	4	Screw Pan Head 2.5 x 06 (Option A3G)
	E1400-21204	4	Crimp & Insert Connector Support (Option A3G)

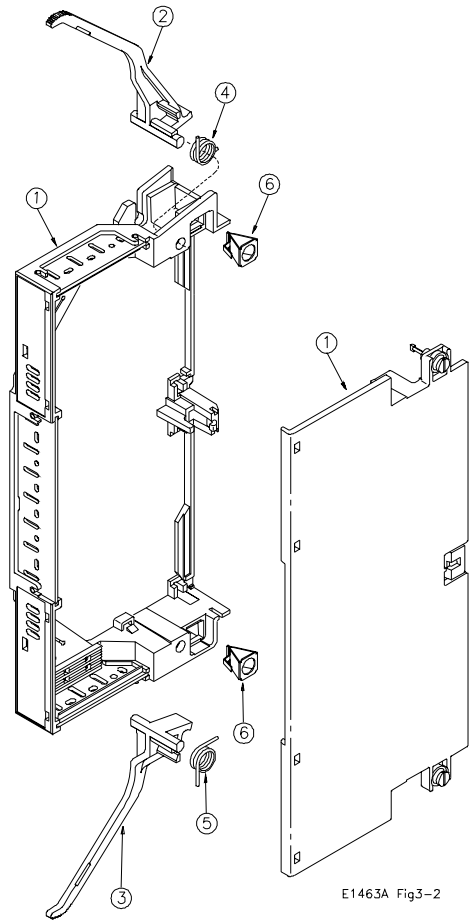


Figure 3-2. E1463A Terminal Case Replaceable Parts

Table 3-3. Agilent E1463A Terminal Case Replaceable Parts (for modules with serial numbers prior to 3126A01817)

Reference Designator	Agilent Part Number	Qty	Part Description
A1	E1400-84401	1	**TERMINAL MODULE CASE ASSY** (See Figure 3-1)
MP1	03852-01201	1	CLAMP
MP2	03852-86701	1	PAD-CLAMP
MP3	0515-2109	1	SCREW-MACHINE 10-24 .625-IN-LG PAN-HD-SLT
MP4	1390-0846	2	FASTENER-CAPTIVE SCREW M2.5 X 0.45
MP5	E1300-01202	1	CLAMP STRAIN RELIEF
MP6	E1400-44104	1	TERMINAL HOUSING-BOTTOM
MP7	E1400-44105	1	TERMINAL HOUSING-TOP

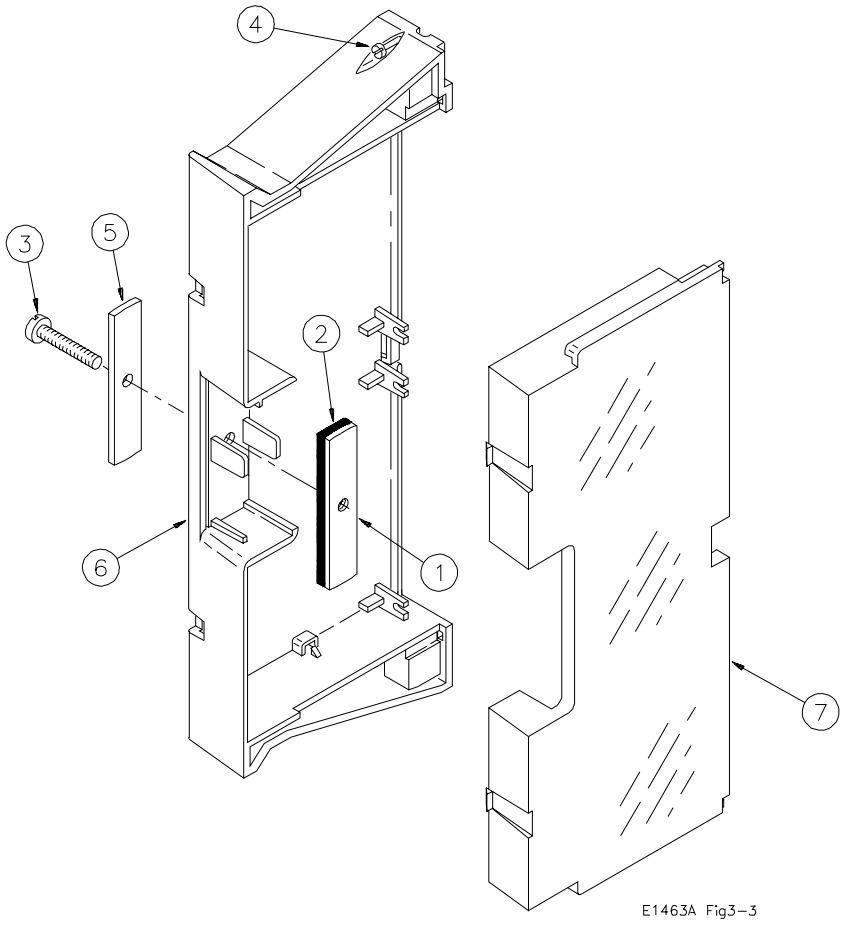


Figure 3-3. E1463A Terminal Case Replaceable Parts

Table 3-4. Agilent E1463A Terminal Module PCA Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description
A3	E1463-66510	1	**TERMINAL MODULE PC ASSEMBLY** (See Figure 3-3)
P1-P2	1252-1577	2	CONNECTOR-POST TYPE 5.08-PIN-SPCG 48-CONTACT
TB1-TB8	0360-2391	8	TERMINAL MODULE 12 P. POLYAMIDE

NOTE: For option A3G replaceable parts, see Table 3-2.

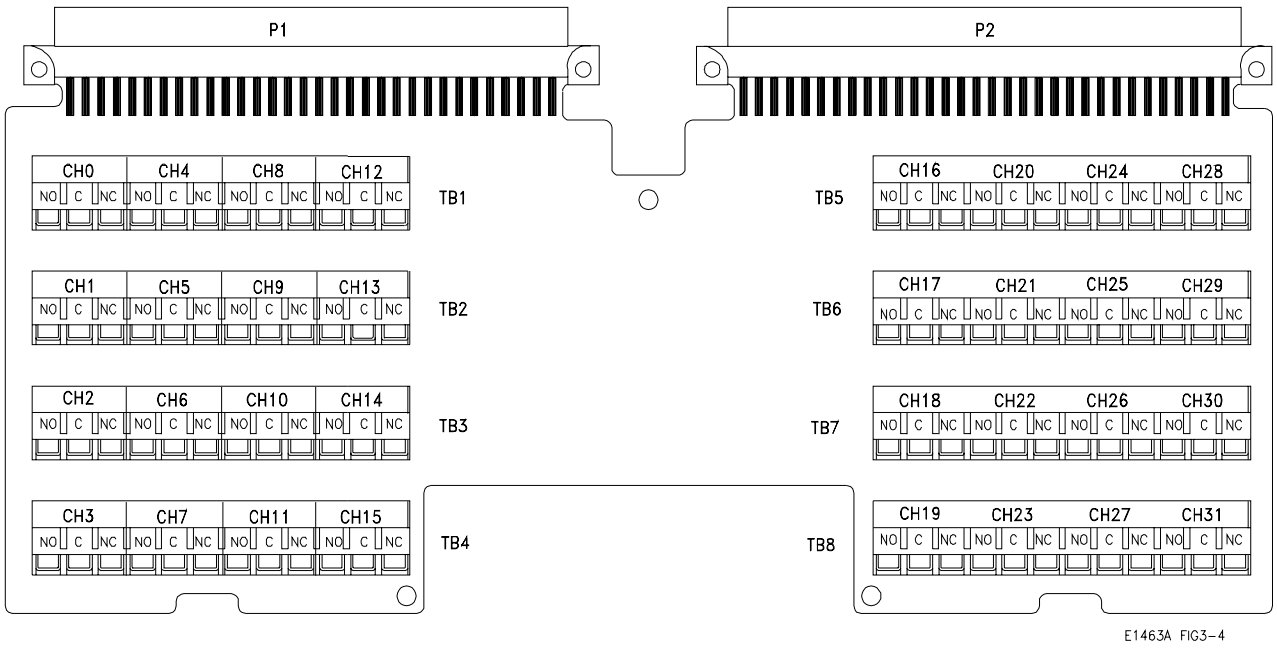


Figure 3-4. E1463A Terminal Board

Table 3-5. Agilent E1463A Reference Designators

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
CVR ..... cover	RP ..... resistor pack
F..... fuse	RT .....thermistor probe
J ..... electrical connector (jack)	SCR.....screw
JM..... jumper	SHD ..... shield
K .....relay	SW ..... switch
MNL .....manual	TB ..... terminal block (module)
MP .....mechanical part	U ..... integrated circuit

Chapter 4
Service

Introduction

This chapter contains service information for the Agilent E1463A Form C Switch Module, including troubleshooting techniques and repair and maintenance guidelines.

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.

Repair Strategy

Agilent Technologies recommends component replacement for the Agilent E1463A. 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." See Chapter 1, "General Information," for a description of relay life factors.

Equipment Required

Equipment required for the Agilent E1463A Form C Switch Module 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 and a T10 Torx driver to remove the shields.

Service Aids

See Chapter 3, "Replaceable Parts," for descriptions and locations of Agilent E1463A replaceable parts. Service notes, manual updates, and service literature for the switch module may be available through Agilent Technologies. For information, contact your nearest Agilent Technologies Sales and Support Office.

Troubleshooting

To troubleshoot a switch module 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 E1463A replaceable parts.

Identifying the Problem

Table 4-1 lists some common problems, along with symptoms and possible solutions. If the problem persists, perform component-level troubleshooting using the component locator and schematics.

Table 4-1. Agilent E1463A Common Problems

Problem Type	Symptom	Possible Solutions
Self-test Errors	Non-zero error code in response to the *TST? command.	See Table 4-4 for information on self-test errors.
Operator Errors	Non-zero error code in response to the SYST:ERR? command.	See Appendix C of the the *Agilent E1463A User's Manual* for Switch Module errors and causes. See Appendix B of the *Agilent E1405 User's Manual* for additional information on operator errors.
Catastrophic Failures	Not responding to commands.	Check logical address setting. Check GPIB cables and connections. See "Testing the Assembly" in this chapter.
Performance Out of Specification	Failing Closed Channel Resistance Test (see Test 2-1 in Chapter 2).	Check user wiring, test connections, and installed protection devices. Replace relays that correspond to the channels that are failing (see Table 4-3). If most of the channels are near or above the test limit (2.0 Ohms), replace entire printed circuit board (Agilent part number E1463-66501)
	Failing DC Isolation test (See Test 2-2 in Chapter 2)	Check user wiring, test connections, and installed protection devices. Remove dust from relay module and terminal module printed circuit board.

Testing the Assembly

You can use the tests and checks in Table 4-2 to isolate the problem. See Figures 3-1, 3-2, and 3-3 in Chapter 3 for locations of mechanical parts. See the component locator included with this manual for locations of electrical components.

Table 4-2. Agilent E1463A Tests/Checks

Test/Check	Reference Designator	Check:
Heat Damage	- - - - - - - - - -	Discolored PC boards Damaged insulation Evidence of arcing
Switch/Jumper Settings	J101, J201 SP101	IRQ Level setting LADDR setting
Switch Module PCA	F601, F602 P1, P2, J1, J2 K0-K31	Fuse continuity Connector contacts Test 2-1, Closed Channel Resistance Test

Checking for Heat Damage

Inspect the assembly for signs of abnormal internally generated heat such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing.

Checking Switches/Jumpers

Verify that the logical address switch is set correctly (factory set at 120). Verify that the interrupt priority jumpers are set correctly (factory set at level 1).

Checking the Switch Module PCA

Check the following:

- Verify that fuses F601 and F602 are good.
- Check connectors J1, J2, P1, and P2 for damage.
- Perform Test 2-1 in Chapter 2.

Matching Relays to Channels

Use Table 4-3 to help match channel numbers to relay and drive circuit reference designators.

Table 4-3. Channel Relays/Reference Designators

Channel	Relay	Driver	Driver Register
00	K00	U303	U301
01	K01		
02	K02		
03	K03		
04	K04		
05	K05		
06	K06		
07	K07		
08	K08	U304	U302
09	K09		
10	K10		
11	K11		
12	K12		
13	K13		
14	K14		
15	K15		
16	K16	U403	U401
17	K17		
18	K18		
19	K19		
20	K20		
21	K21		
22	K22		
23	K23		
24	K24	U404	U402
25	K25		
26	K26		
27	K27		
28	K28		
29	K29		
30	K30		
31	K31		

Self-Test Error Codes

Table 4-4 shows the self-test error codes for the Switch Module. The meaning of each code is given in the right-hand column. If a self-test failure occurs, cycle power and repeat the test. If the problem reoccurs, the device may need repair.

Table 4-4. Self-test Error Codes

Error*	Description
+0	Self-test passes
+ss01	Firmware error
+ss02	Bus error (communications problem with card)
+ss03	Bad ID information in ID register
+ss10	Interrupt expected but not received
+ss11	Busy bit was not held ≈10.5 to 18.5 msec

*ss = card number (with leading zero deleted)

Disassembly

Use the following procedures to disassemble the Agilent E1463A Switch Module. For disassembly refer to Figure 4-1.

Switch Module Disassembly

1. To remove the covers:

   - Remove the nine T10 Torx screws from the top cover as shown.
   - Lift the top cover off of the module.
   - Turn the assembly over and lift off the bottom cover.

2. To remove the front panel:

   - Remove the two T8 Torx screws from the front panel handles as shown.
   - Remove the T8 Torx screw holding the panel to the A1 PC Assembly as shown.
   - Lift the front panel from the A1 assembly.

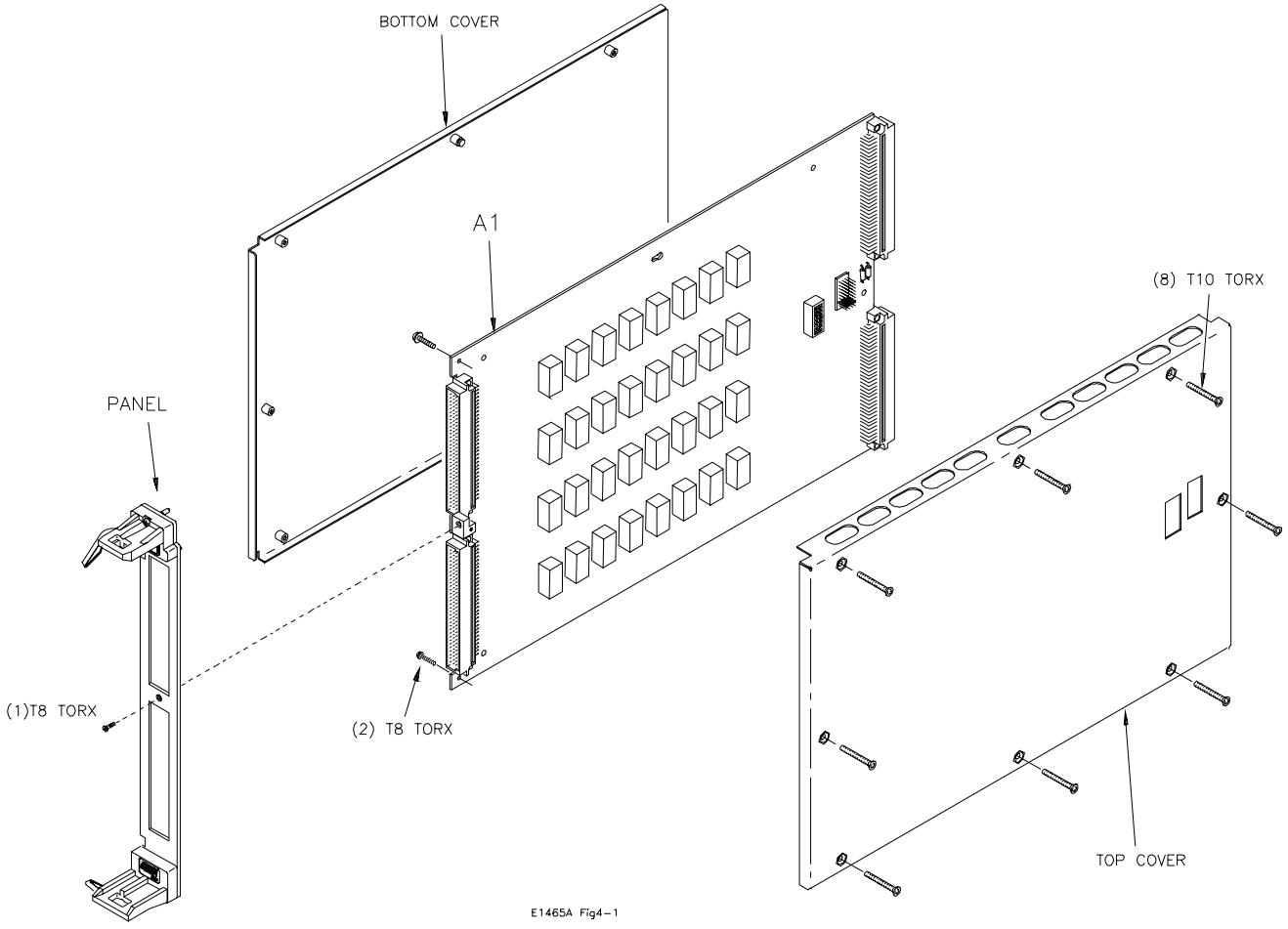


Figure 4-1. Agilent E1463A Disassembly

Repair/Maintenance Guidelines

This section provides guidelines for repairing and maintaining the Agilent E1463A Switch Module, including:

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

ESD Precautions

Electrostatic discharge (ESD) may damage static-sensitive devices in the switch modules. This damage can range from slight parameter degradation to catastrophic failure. When handling the switch module assemblies, follow these guidelines to avoid damaging components:

- Always use a static-free work station with a pad of conductive rubber or similar material when handling electronic components.
- Do not use pliers to remove a MOS or CMOS device from a high-grip socket. Instead, use a small screwdriver to pry the device up from one end. Slowly lift the device up, one pair of pins at a time.
- After you remove a MOS or CMOS device from a module, place the device onto a pad of conductive foam or other suitable holding material.
- 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 in the switch module have plated-through holes that allow 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:

- The relays used on these printed circuit boards require special soldering techniques and equipment. The use of a solder-pot is recommended for relay removal and replacement.
- 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 the equipment is properly grounded.

Post-Repair Safety Checks

After making repairs to the module, inspect the device 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 Verification Test described in Chapter 2 to verify that the device is functional.

Component Locators and Schematic Diagrams

Table 4-5 lists Component Locator Diagrams and Schematic Diagrams for the Agilent E1463A Switch Module.

Table 4-5. Component Locators and Schematics Diagrams

	Part Number	Drawing Number	Drawing Title
Component Locator Diagram	E1463-66501	L-E1463-66501	E1463A Form C Switch Component Assembly
Schematic Diagrams	E1463-66501 E1463-66501 E1463-66501 E1463-66501 E1463-66501	S-E1463-66501 (1 of 5) S-E1463-66501 (2 of 5) S-E1463-66501 (3 of 5) S-E1463-66501 (4 of 5) S-E1463-66501 (5 of 5)	E1463A Form C Switch - VXI Interface #1 E1463A Form C Switch - VXI Interface #2 E1463A Form C Switch - Relay Drivers/Relays 0-15 E1463A Form C Switch - Relay Drivers/Relays 16-31 E1463A Form C Switch - VXI P1 and P2 Conn