Agilent 75000 SERIES C

E1472A 50 Ohm RF Multiplexer
E1473A 50 Ohm RF Multiplexer Expander
E1474A 75 Ohm RF Multiplexer
E1475A 75 Ohm RF Multiplexer Expander

Service Manual

Agilent Technologies

E1472-90011

Manual Part Number: E1472-90011

Printed: August 2006 Edition 2 Rev 2
Printed in Malaysia E0806

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 Duration and conditions of warranty for this product may be superseded when the product is integrated into (becomes a part of) other Agilent products.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 E1472A/73A/74A/75A 50W/75W RF Multiplexers/Expanders 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 E1472-90010). . . . . August 1992

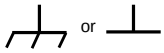
Edition 2 (Part Number E1472-90011). . . . . May 1996

Edition 2 Rev 2 (Part Number E1472-90011) . . . . . August 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: 50 Ohm RF Multiplexer and Expander
Model Number: E1472A/E1473A
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

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: 75 Ohm RF Multiplexer and Expander
Model Number: E1474A/E1475A
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

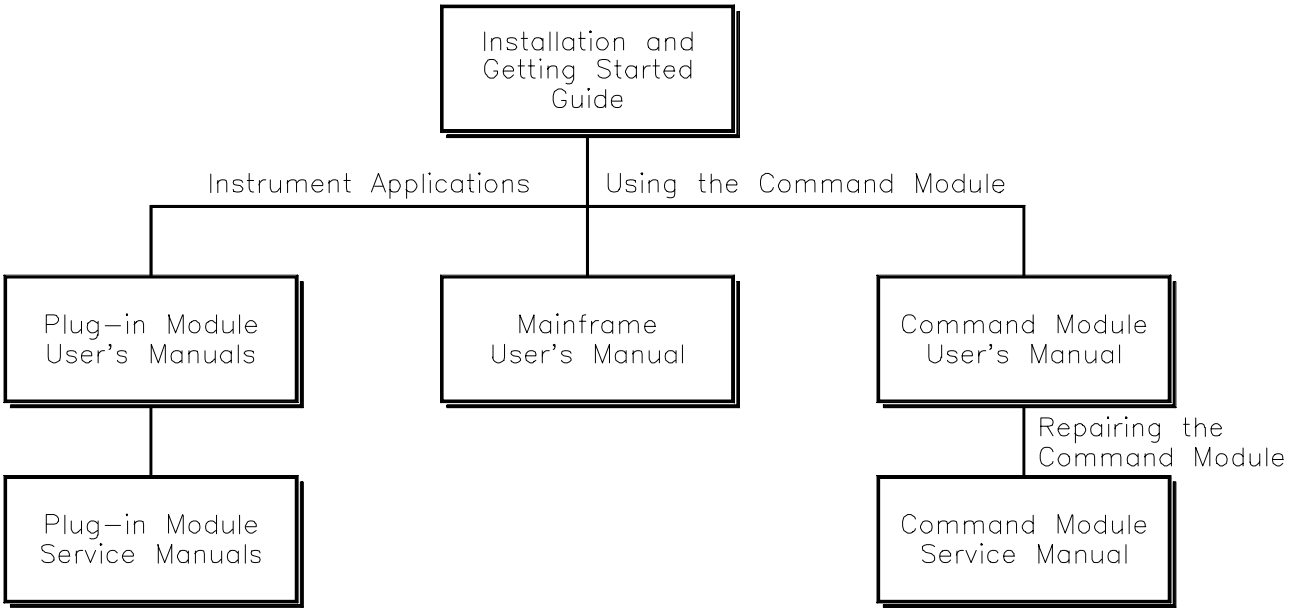
Jim White
Name

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

Agilent 75000 Series C Service Documentation

Suggested Sequence to Use Manuals



Manual Descriptions

Series C Installation and Getting Started Guide. This manual contains step-by-step instructions for all aspects of plug-in module, mainframe, and command module installation. This guide also contains introductory programming information and examples.

Command Module User's Manual. This manual contains programming information for the Command Module, and general programming information for instruments installed in the mainframe.

Mainframe User's Manual. This manual contains installation information to prepare the mainframe for use and shows how to install plug-in modules.

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

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, troubleshooting, and repair are also provided.

What's in this Manual

Manual Overview

This manual shows how to service the Agilent E1472A/E1474A RF Multiplexers and the Agilent E1473A/E1475A RF Multiplexer Expanders. Consult the *Agilent E1472A/73A User's Manual* or the *Agilent E1474A/75A User's Manual* for additional information on installing, configuring, and operating the modules. Consult the appropriate mainframe or command module 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	Replaceable parts lists and illustrations.
4	Service	Procedures to aid in fault isolation and repair.

Notes

Notes

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 E1472A 50 Ohm RF Multiplexer, the Agilent 1473A 50 Ohm RF Multiplexer Expander, the Agilent E1474A 75 Ohm RF Multiplexer, and the Agilent E1475A 75 Ohm RF Multiplexer Expander (see Figures 1-1 and 1-2).

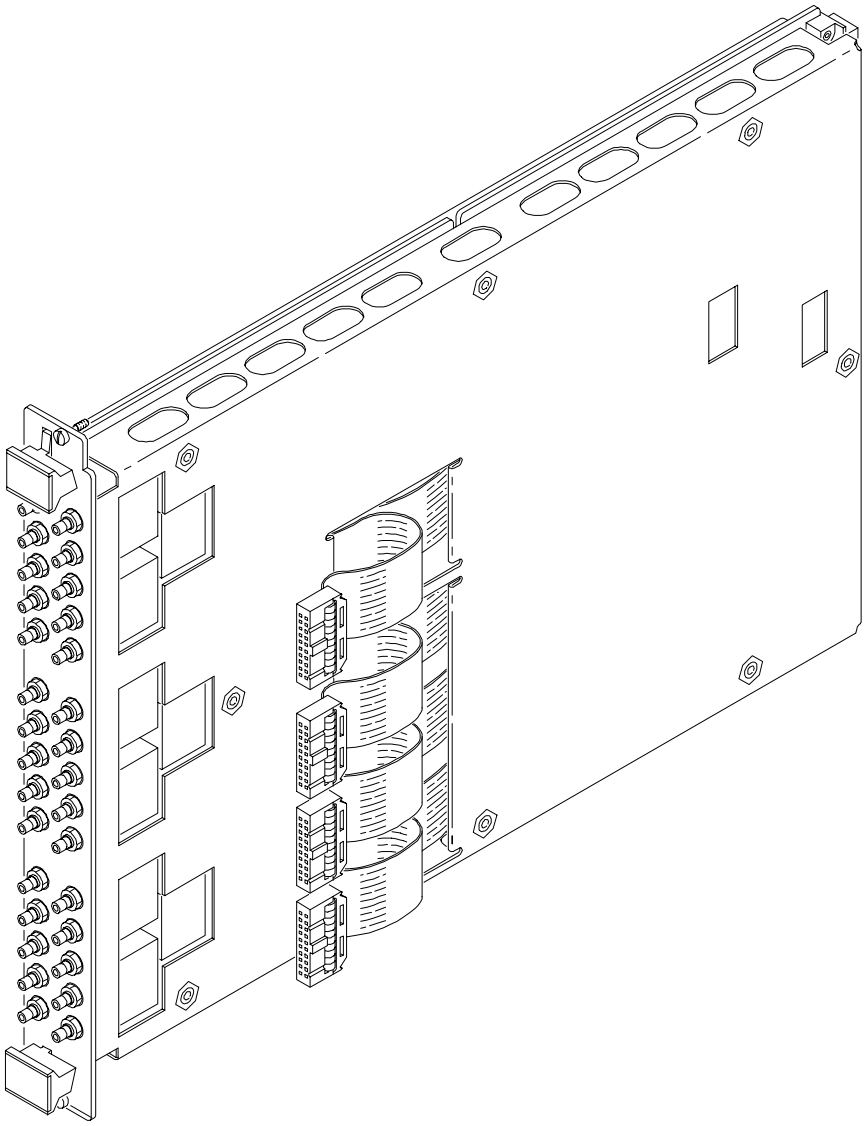


Figure 1-1. Agilent E1472A/E1474A RF Multiplexers

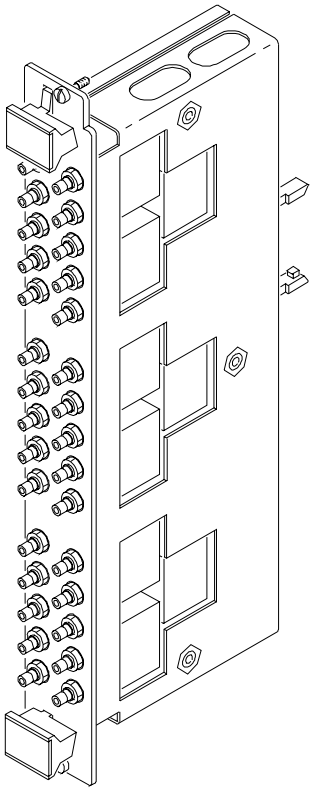


Figure 1-2. Agilent E1473A/E1475A RF Multiplexer Expanders

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 1.0 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 E1472A/73A/74A/75A, maximum relay life is specified at 5×10^6 operations with no load and 10^5 operations at the maximum rated load.

Replacement Strategy

The replacement strategy also depends on the application. 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. In general, individual relay replacement is not recommended for the Agilent E1472A or Agilent E1474A RF Multiplexers.

CAUTION

The RF relays in these multiplexers are high-mass, high-pin-count devices. A solder pot is recommended for removal or replacement. If a solder pot is not available, a RF surface mount soldering iron should be used. Use of standard soldering equipment will damage the relay and PC board. Damage to the PC board or relays caused by improper soldering techniques is not covered by the product's warranty.

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 page (page 2) 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.

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.

SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should install, remove, or configure the multiplexer or expander. Before you remove any installed module, disconnect AC power from the mainframe and from other modules that may be connected to the multiplexer or expander.

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 42 V Peak (any center or chassis to any other center of chassis). The maximum current per channel or common is 1 A DC or AC RMS. The maximum power that can be applied to any channel or common is 24 W or 24 VA.

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

RELAY REMOVAL. The RF relays used in these multiplexers are high-mass, high-pin-count devices. Individual relay removal is not recommended. A solder pot is required for removal or replacement. Use of standard soldering equipment will cause damage to the relay and PC board.

Inspection/ Shipping

This section contains initial (incoming) inspection and shipping guidelines for the multiplexer/expander modules.

Initial Inspection

Use the steps in Figure 1-3 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.

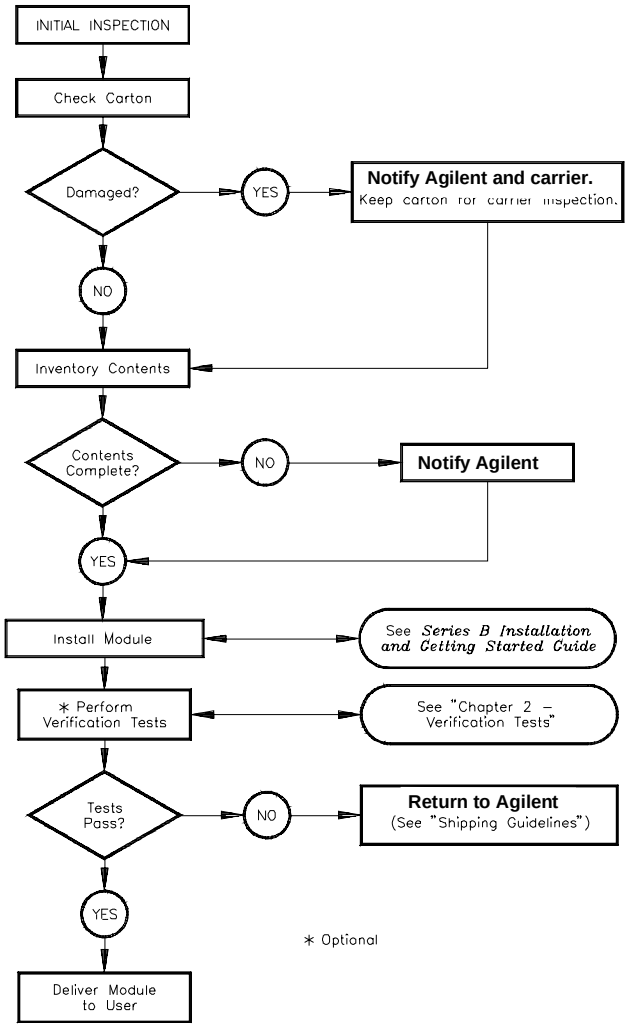
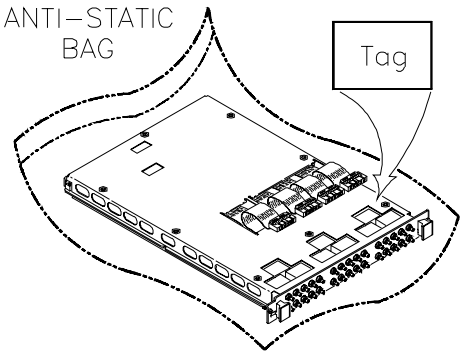


Figure 1-3. Initial (Incoming) Inspection Guidelines

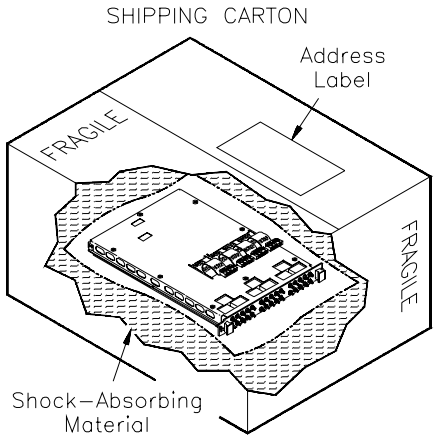
Shipping Guidelines

Follow the steps in Figure 1-4 to return one of the multiplexer/expander modules to a Agilent Technologies Sales and Support Office or Service Center.



1 Prepare the Multiplexer

- 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 Multiplexer

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

3 Ship the Multiplexer to Agilent Technologies

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

Figure 1-4. 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 multiplexers/ expanders is:

Environment	Temperature	Humidity
Operating	0^{o}C to +55^{o}C	<95% relative (0^{o}C to +40^{o}C)
Storage and Shipment	-40^{o}C to +75^{o}C	<95% relative (0^{o}C to +40^{o}C)

RF Multiplexer/ Expander Description

The Agilent E1472A and E1474A RF Multiplexer modules are "instruments" 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 Agilent 75000 Series C Installation and Getting Started Guide to set the addresses to create an instrument.

Agilent E1472A/E1473A Description

The Agilent E1472A 50 Ohm RF Multiplexer and the Agilent E1473A 50 Ohm RF Multiplexer Expander are VXI bus C-Size register-based products. The Agilent E1472A RF Multiplexer and the Agilent E1473A RF Multiplexer Expander each provide six banks of 4:1 switching. Inputs and outputs for either module use 50 Ohm SMB connectors.

The multiplexer and each multiplexer expander consists of six banks of channels (bank 0 through bank 5) to form six 4:1 multiplexers. Each channel in a bank is connected to COM when the channel is CLOSed. Following power-on, power off, or a card reset, the first channel in each bank is connected to COM.

Channel numbering is in the form *bc*, where *b* is the bank number (from 0 to 5) and *c* is the channel number (from 0 to 3). For example, following a card reset, channel 20 is closed (that is, channel 0 in bank 2 is connected to COM 20).

The Agilent E1472A RF Multiplexer can control up to two additional expander modules for up to eighteen banks of 4:1 switching. The expander modules can be either the Agilent E1473A 50 Ohm RF Multiplexer Expander module or the Agilent E1475A 75 Ohm RF Multiplexer Expander module.

The Agilent E1473A RF Multiplexer Expander Module can be inserted in a C-Size VXI bus mainframe next to the multiplexer, or can be located up to eight meters away from the multiplexer using remote expander cables. Locating the expander module close to the external device keeps connecting cable lengths to a minimum, thereby reducing the possibility of cross-talk and insertion loss of high frequency signals.

Agilent E1474A/E1475A Description

The Agilent E1474A 75 Ohm RF Multiplexer and the Agilent E1475A 75 Ohm RF Multiplexer Expander are identical in operation to the Agilent E1472A/E1473A described earlier in this chapter with the exception of the characteristic impedance of the RF channels.

Inputs and outputs for either module use special 75 Ohm SMB connectors. The special connectors and their mating connectors are listed in the *Agilent E1474A/E1475A RF Multiplexer/Expander User's Manual*.

Multiplexer/ Expander Specifications

Specifications are listed in Appendix A of the *Agilent E1472A/E1473A RF Multiplexer/RF Multiplexer Expander User's Manual* and the *Agilent E1474A/E1475A RF Multiplexer/RF Multiplexer Expander User's Manual*. These specifications are the performance standards or limits against which the modules may be tested.

Multiplexer/ Expander 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.

Multiplexer/ Expander Options

The following cables are available from Agilent Technologies for use with the multiplexer/expander. For other cable lengths and configurations, contact your Agilent Technologies sales office.

Agilent PN	Cable
E1473-80002	Remote Expander Cable Kit to remote mount either the Agilent E1473A or Agilent E1475A next to the DUT. Cables are 0.8 Meters long and can be daisy chained up to 8 Meters
E1472-61601	RMD Cable (3-to-1 Cable). Two cables are required to operate one or more expander modules.
50 Ω Cables	
8120-5629	Right-angle to right-angle female SMB connector (125 mm)
8120-5091	Straight to straight female SMB connector (125 mm)
8120-5609	Right-angle female to bulkhead mount male SMB connector (175 mm)
8120-5614	Right-angle female SMB to BNC female connector (175 mm)
75 Ω Cables	
8120-5591	Right-angle to right-angle female SMB connector (125 mm)
8120-5584	Straight to straight female SMB connector (125 mm)
8120-5580	Right-angle female to bulkhead mount male SMB connector (175 mm)
8120-5619	Right-angle female SMB to BNC connector (175 mm)

Test Kit

A test kit is available from Agilent Technologies for use in the Performance Verification tests of the Agilent E1474A/E1475A 75 Ω RF Multiplexer/Expander. Order Agilent part number E1474-80000. See Table 1-1 for kit parts.

CLIP

A CLIP (Component Level Information Packet) is available for the Agilent E1472A/E1473A/E1474A/E1475A RF Multiplexers/Expanders (order Agilent part number E1472-90033). This CLIP contains component locators, schematic diagrams, and detailed parts lists.

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. Other equipment may be substituted as long as it meets the requirements shown 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 multiplexer/expander	E1401B/T or E1421B (requires E1405A/B or E1406A)	F,O, P,T
Command Module	Compatible with multiplexer/expander	E1405A/B or E1406A	F,O, P,T
Network Analyzer	VSWR from 10 MHZ to 3 GHz.	Agilent 8753C	O, P,T
S-Parameter Test Set	Compatible with Agilent 8753C , single port 50 Ω for Agilent E1472A/E1473A 75 Ω for Agilent E1474A/E1475A	Agilent 85046A for Agilent E1472A/E1473A or Agilent 85046B for Agilent E1474A/1475A	O, P,T
Adapters and Cables	**E1472A/E1473A 50 Ω** APC-7-to-SMA (female) SMA-to-SMA cable (male-male) SMA -to- SMB (female-female) SMB LOAD(female) SMB SHORT (male) SMB Feedthrough (male-male) **E1474A/E1475A 75 Ω** Test Kit (contains the following parts)** N-to-SMB cable (male-female) SMB OPEN (male) SMB LOAD (female) SMB SHORT (male) SMB Feedthrough (male-male)	**50 Ω impedance** Agilent PN 11534A ———— ———— Agilent PN 1250-0676 ———— ———— **75 Ω impedance** Agilent PN E1474-80000** Agilent PN 8120-4482 Agilent PN 1250-2354 Agilent PN 1250-2343 Agilent PN 1250-2358 Agilent PN 1250-2337	O, P,T
Digital Multimeter	4-wire ohms 2-wire ohms (up to 1 GΩ)	Agilent 3458A or Agilent 34401A	T

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

** Test Kit must be ordered as a separate part from Agilent Technologies

Chapter 2
Verification Tests

Introduction

The three levels of test procedures described in this chapter are used to verify that the multiplexer or multiplexer expander:

- is fully functional (Functional Verification)
- 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 multiplexer/expander, 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 2-3).

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

Multiplexer Functional Verification

The Functional Verification Test for the Agilent E1472A/E1474A multiplexers consists of sending the *TST? command and checking the response. This test can be used to verify that the device is connected properly and is responding to basic commands.

Procedure

1. Verify that the multiplexer 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 4-3 for a description of self-test error codes.

Example

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

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

Expander Functional Verification

The Functional Verification Test for the Agilent E1473A/E1475A RF Multiplexer Expanders consists of sending the :COPTion? query command and checking the response. This test can be used to verify that the device is connected properly and is responding to basic commands.

Procedure

1. Verify that the multiplexer is installed in the mainframe and that both the mainframe and multiplexer have passed the power-on test. This test assumes the conditions listed in *Test Conditions/Procedures* in this chapter.
2. Send the SYSTem:COPTion? query command to the device (see example following).
3. The multiplexer will return a string indicating if any expander modules are connected. The string is in the form: *E1474A,E1475A,0* if only a single expander module (in this case an Agilent E1475A) is connected to the multiplexer.

   The first parameter of the returned string indicates the type of multiplexer installed in the mainframe (Agilent E1472A or E1474A). The second parameter in the string is the model number of the first installed expander module, and the last parameter in the string is the model number of a second installed expander module. If no expander modules are installed, the string returned will be *E1474A,0,0* and indicates a failure.

Example

An example follows which uses an HP 9000 Series 300 computer with BASIC and an multiplexer address of 70915. The multiplexer is assumed to be switch card 1.

```
10  DIM  A$[50]
20  OUTPUT  70915;"SYST:COPT? 1"      Send identify options command
30  ENTER  70915;A$                   Get response
40  PRINT  A$
50  END
```

Operation Verification

The procedures in this section are used to provide a high degree of confidence that the multiplexer/expander 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 E1472A/E1474A RF Multiplexer modules, Operation Verification is performed by completing the VSWR 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 multiplexer's electrical performance using the specifications in Appendix A of the *Agilent E1472A /E1473A User's Manual* or *Agilent E1474A /E1475A User's Manual* as the performance standards.

The performance verification test is a test of the VSWR for each channel of the multiplexer. This test is sufficient to determine that the multiplexer is operating within specifications. This test is suitable for incoming inspection, troubleshooting, and preventive maintenance.

Making Test Connections

Figure 2-1 shows typical test connections, cables, and adapters required to test the Agilent E1472A/E1473A 50 Ohm RF Multiplexer/Expander.

Figure 2-2 shows typical test connections, cables, and adapters required to test the Agilent E1474A/E1475A 75 Ohm RF Multiplexer/Expander.

Figure 2-3 shows the RMD cable connections needed to test either the Agilent E1473A or Agilent E1475A RF Multiplexer Expander. Refer to the list of multiplexer/expander options in Chapter 1 for RMD cable part numbers.

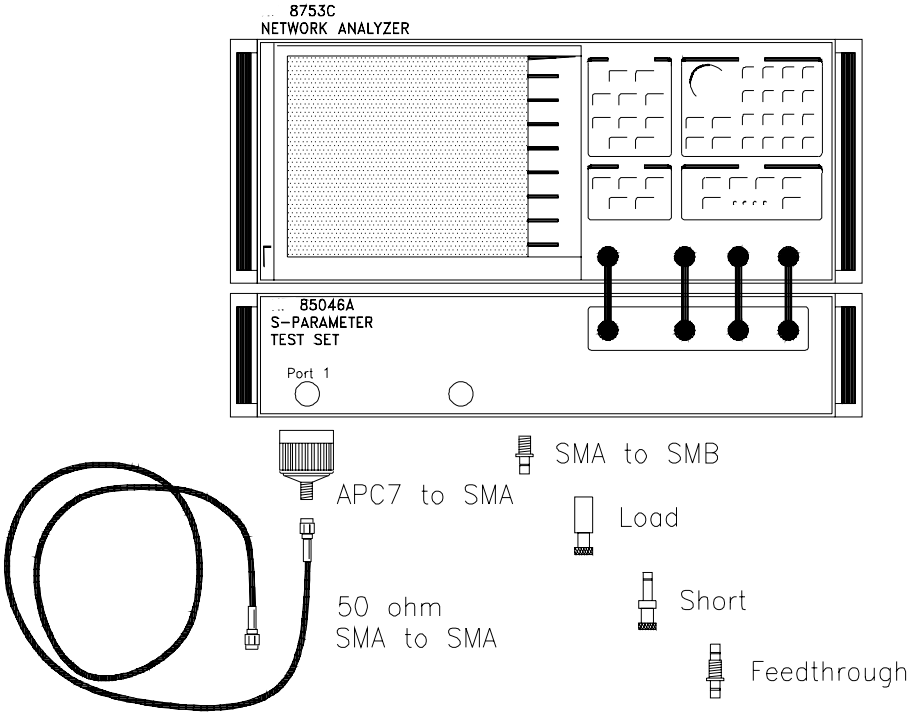


Figure 2-1. 50 Ohm Test Cables and Adapters

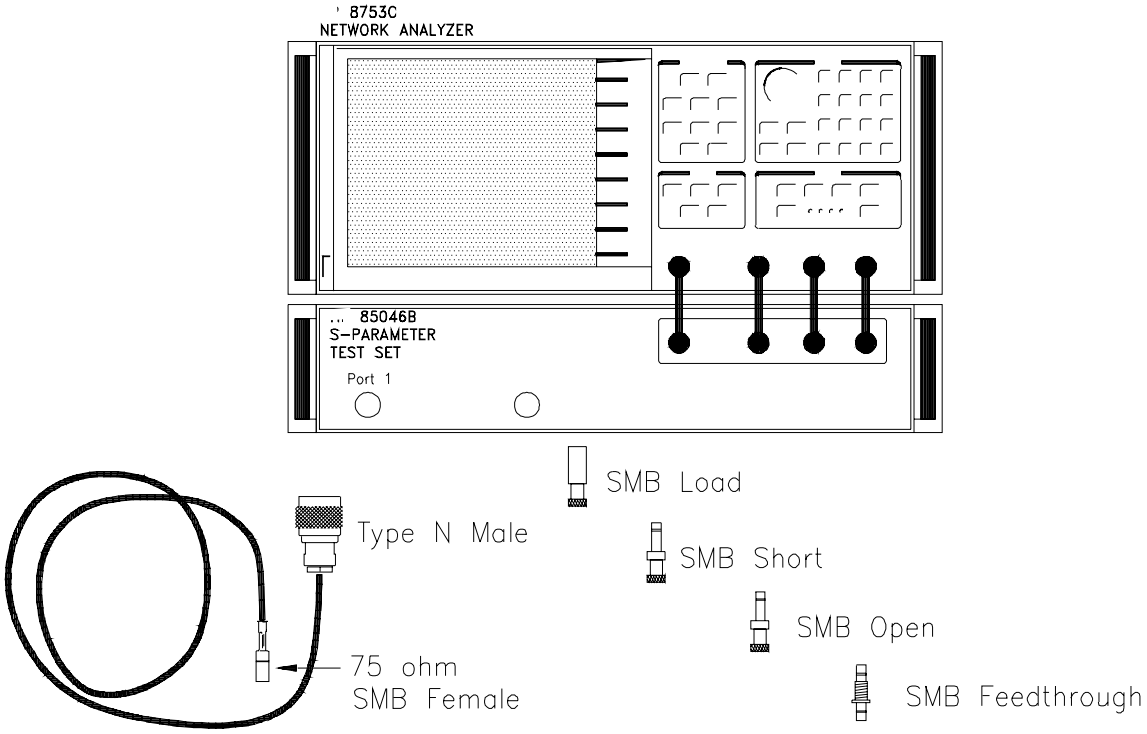


Figure 2-2. 75 Ohm Test Cables and Adapters

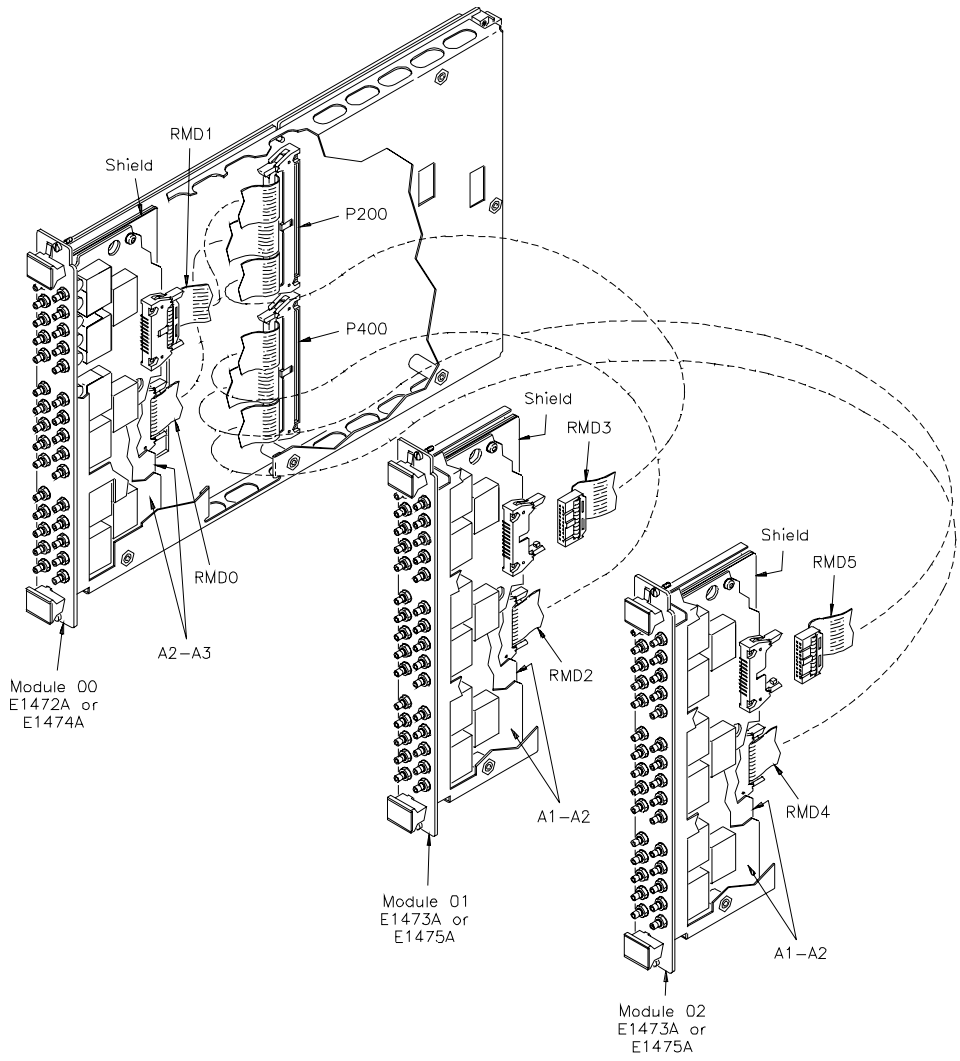


Figure 2-3. RF Multiplexer Expander Connections

Test 2-1: VSWR Test

This test checks to see if all channels meet the VSWR specification for the multiplexer.

100 MHz to 500 MHz Measurements

1. **Setup and Calibrate the Network Analyzer**

   - Turn on the test set and allow at least a one-hour warm up period.
   - Press the PRESET button.
   - Select the SWR measurement type from the FORMAT menu.
   - Set the START frequency to 100 MHz and the STOP frequency to 500 MHz.
   - Select the CAL menu. Select the 3.5 mm cal kit.

- From the CAL menu, select a single port measurement (typically port S11).
- Calibrate the port for OPEN, SHORT, and LOAD using the appropriate test connectors on the cable that will be used for the test (refer to Table 1-1). Press DONE when the Network Analyzer indicates it is calibrated and ready for a measurement.
- Set an appropriate scale per division to measure the VSWR (typically 100 mV/DIV).

NOTE

The connectors, cables, adapters, loads, and shorts used to calibrate the Network Analyzer must be the same connectors, cables, adapters, and loads used in the VSWR tests.

---

2. **Measure Bank 0 VSWR**

   - Turn mainframe power ON
   - Send *RST to multiplexer
   - Connect the Port 1 test cable to the COM 00 port on the multiplexer/expander as shown in Figure 2-4.
   - Install the appropriate load on Channel 00 as shown in Figure 2-4.
   - Send CLOS (@*ccmm*00) to close chan 00, where *cc* = card number and *mm* = module number.
   - Observe the Network Analyzer response. Select marker search for MAX (or, manually locate the maximum value indicated) and record the measurement VSWR in Table 2-3 for Channel 00.
   - Send OPEN (@*ccmm*00) to open chan 00, where *cc* = card number and *mm* = module number.

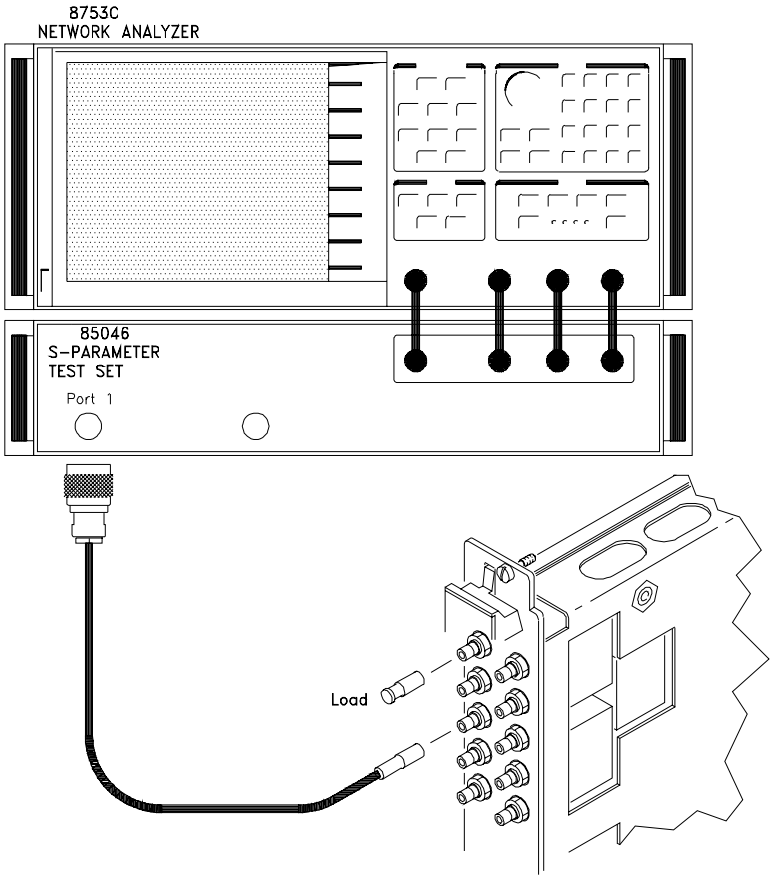


Figure 2-4. Channel 00 VSWR Test Connections

3. **Repeat for Channels 01, 02, and 03**

   - Repeat step 2 for channels 01, 02 and 03.
   - Move the load to the channel under test.
   - Use CLOS (*@ccmmnn*) and OPEN (*@ccmmnn*), where *cc* = card number, *mm* = module number, and *nn* = channel number.

4. **Repeat for Banks 1, 2, 3, 4, and 5**

   - Repeat steps 2 and 3 for the remaining banks and channels.
   - Connect the Port 1 test cable to the COM port on the Bank being tested.
   - Install the appropriate load on each channel as shown in Figure 2-4.

500 MHz to 1.3 GHz Measurements

Repeat Test 2-1, 100 MHz to 500 MHz Test with the following changes:

- In Step 1, set the START frequency to 500 MHz and the stop frequency to 1.3 GHz.

Example This example performs the VSWR Test for the Agilent E1472A/E1474A and Agilent E1473A/E1475A. If a channel fails the VSWR test, a message indicating the failing channel number is printed and the program pauses.

```
10 ! RE-SAVE "VSWR_72"
20    DIM Result1(3,5),Result2(3,5)
30    Cc$="01"        ! Card Number
40    Mm$ = "00"      ! Module Number
50    ASSIGN @Mux TO 70915
60    DISP CHR$(129)
70    CLEAR SCREEN
80    PRINT "Select the test to run"
90    PRINT "Test 1. RF Multiplexer (Agilent E1472A or E1474A)"
100   PRINT "Test 2. RF Multiplexer Expander (Agilent E1473A or E1475A)"
110   INPUT "Enter the test number (1 or 2)",Tst
120   IF Tst = 2 THEN
130     Mm$ = "01"
140   END IF
150   CLEAR SCREEN
160   PRINT "Equipment Setup"
170   PRINT
180   PRINT " 1. Turn Network Analyzer ON, allow a 1 hour warm-up"
190   PRINT "  2. Install Agilent E1472A or E1474A RF Multiplexer in
mainframe"
200   IF Tst = 2 THEN
210     PRINT " 2a. Install Agilent E1473A or E1475A Expander"
220   END IF
230   PRINT " 3. Turn mainframe power ON"
240   DISP "Press Continue when ready to begin testing"
250   PAUSE
260   CLEAR SCREEN
270   PRINT "Calibrate the Network Analyzer"
280   PRINT
290   PRINT " 1. Press PRESET"
300   PRINT " 2. Select SWR measurement type from the FORMAT menu"
310   PRINT " 3. Set the START frequency to 100 MHz"
320   PRINT " 4. Set the STOP frequency to 500 MHz"
330   PRINT " 5. Select the 3.5 mm CAL kit"
340   PRINT " 6. Calibrate the test port and cable for OPEN, SHORT, and
LOAD"
350   PRINT " 7. Set the scale to 100 mV/DIV"
360   DISP "Press Continue when ready to begin testing"
370   PAUSE
380   CLEAR SCREEN
```

```
390   OUTPUT @Mux;"*RST"
400   FOR K = 0 TO 5
410    PRINT TABXY(1,1),"VSWR from 100 MHz to 500 MHz"
420    FOR I = 0 TO 3
430     CLEAR SCREEN
440     PRINT TABXY(1,3),"1. Connect test port cable to COM ";VAL$(K);"0"
450     PRINT TABXY(1,4),"2. Connect LOAD to Channel ";VAL$(K);VAL$(I)
460     DISP "Press Continue when test connections are complete"
470     PAUSE
480     OUTPUT @Mux;"CLOS (@"&Cc$&Mm$&VAL$(K)&VAL$(I)&")"
490     PRINT
500     PRINT "Observe the Network Analyzer display"
510     PRINT "Note the highest measured VSWR reading"
520     INPUT "Enter measured value",Result1(I,K)
530     IF Result1(I,K)>1.25 THEN
540       PRINT
550       PRINT "Channel "&VAL$(K)&VAL$(I)&" FAILED -- VSWR > 1.25"
560       PRINT "Press Continue to test the next channel"
570       PAUSE
580       CLEAR SCREEN
590     END IF
600    NEXT I
610   NEXT K
620   OUTPUT @Mux;"*RST"
630   CLEAR SCREEN
640   PRINT "100 MHz to 500 MHz VSWR test complete"
650   DISP "Press Continue for 500 MHz to 1.3 GHz VSWR Test"
660   PAUSE
670   CLEAR SCREEN
680   PRINT "Equipment Setup"
690   PRINT
700   PRINT " 1. Turn network Analyzer ON, allow a 1 hour warm-up"
710   PRINT "  2. Install Agilent E1472A or E1474A RF Multiplexer in
mainframe"
720   IF Tst = 2 THEN
730     PRINT " 2a. Install Agilent E1473A or E1475A Expander"
740   END IF
750   PRINT " 3. Turn mainframe power ON"
760   DISP "Press Continue when ready to begin testing"
770   PAUSE
780   CLEAR SCREEN
790   PRINT "Calibrate the Network Analyzer"
```

```
800   PRINT
810   PRINT " 1. Press PRESET"
820   PRINT " 2. Select SWR measurement type from the FORMAT menu"
830   PRINT " 3. Set the START frequency to 500 MHz"
840   PRINT " 4. Set the STOP frequency to 1.3 GHz"
850   PRINT " 5. Select the 3.5 mm CAL kit"
860   PRINT " 6. Calibrate the test port and cable for OPEN, SHORT, and
LOAD"
870   PRINT " 7. Set the scale to 100 mV/DIV"
880   DISP "Press Continue when ready to begin testing"
890   PAUSE
900   CLEAR SCREEN
910   OUTPUT @Mux;"*RST"
920   FOR K = 0 TO 5
930     PRINT TABXY(1,1),"VSWR from 500 MHz to 1.3 GHz"
940     FOR I = 0 TO 3
950       CLEAR SCREEN
960       PRINT TABXY(1,3),"1. Connect test port cable to COM
";VAL$(K);"0"
970       PRINT TABXY(1,4),"2. Connect LOAD to Channel
";VAL$(K);VAL$(I)
980       DISP "Press Continue when test connections are complete"
990       PAUSE
1000      OUTPUT @Mux;"CLOS (@"&Cc$&Mm$&VAL$(K)&VAL$(I)&")"
1010      PRINT
1020      PRINT "Observe the Network Analyzer display"
1030      PRINT "Note the highest measured VSWR reading"
1040      INPUT "Enter measured value",Result1(I,K)
1050      IF Result1(I,K)>1.35 THEN
1060        PRINT
1070        PRINT "Channel "&VAL$(K)&VAL$(I)&" FAILED -- VSWR >1.35"
1080        PRINT "Press Continue to test the next channel"
1090        PAUSE
1100        CLEAR SCREEN
1110      END IF
1120      NEXT I
1130    NEXT K
1140    OUTPUT @Mux;"*RST"
1150    CLEAR SCREEN
1160    PRINT "500 MHz to 1.3 GHz VSWR test complete"
1170    DISP "Press Continue to display measurement results"
1180    PAUSE
1190    CLEAR SCREEN
```

```
1200  !
1210  ! Print Measurement Results
1220  !
1230  PRINT "  100 MHz to 500 MHz       "
1240  PRINT
1250  Format: IMAGE 2("Channel ",D,D," VSWR = ",D.DDD,5X)
1260  FOR K = 0 TO 2
1270    FOR I = 0 TO 3
1280      PRINT USING Format;K,I,Result1(I,K),K+3,I,Result1(I,K+3)
1290    NEXT I
1300  NEXT K
1310  PRINT
1320  PRINT "  500 MHz to 1.3 GHz  "
1330  PRINT
1340  FOR K = 0 TO 2
1350    FOR I = 0 TO 3
1360      PRINT USING Format;K,I,Result2(I,K),K+3,I,Result2(I,K+3)
1370    NEXT I
1380  NEXT K
1390  END
```

Performance Test Record

Table 2-3 is a form you can copy and use to record performance verification test results for the multiplexer/expander. Information concerning test limits, measurement uncertainty, and test accuracy ratio (TAR) is provided below.

Test Limits

Test limits are defined for VSWR using the specifications in Appendix A of the *Agilent E1472A User's Manual* or the *Agilent E1474A User's Manual*. The VSWR specifications are single-sided, (i.e., there is an upper limit but no lower limit). In the Performance Test Record, the Minimum column is blank.

Measurement Uncertainty

For the performance verification tests in this manual, measurement uncertainties are calculated based on an Agilent 8753C Network Analyzer used with an Agilent 85046A 50 Ohm S-Parameter Test Set for the Agilent E1472A/E1473A VSWR Test and an Agilent 85046B 75 Ohm S-Parameter Test Set for the Agilent E1474A/E1475A VSWR Test. The measurement uncertainty shown in Table 2-3 is computed using the 50 and 75 Ohm 3.5 mm connectors and the 3.5 mm CAL kit. The calculations follow.

VSWR Test

Assumptions:

- no change of temperature during the measurements
- all calculations are for a one-port test, all parameters related to port-2 are set to 0.00
- calculations use typical parameters for the 3.5 mm CAL kit as provided in the Agilent 85046C System Performance Manual and shown in Table 2-2

Table 2-2. Parameters used in Measurement Uncertainty Equations

Symbol	Error Term	Linear Value @ 500 MHz	Linear Value @ 1.3 GHz
D	Directivity	0.010	0.010
T_r	Reflection Tracking	0.016	0.016
M_s	Source Match	0.015	0.015
A_M	Dynamic Accuracy (Magnitude)*	0.035	0.035
S11	S11**	1.250	1.350
N_l	Noise Floor	0.000	0.000
N_h	High Level Noise	0.00046	0.00046
R_r	Connector Reflection Repeatability	0.00032	0.00032
R_t	Connector Transmission Repeatability	0.00032	0.00032
T_{rd}	Magnitude drift due to temperature	0.000	0.000
S_{r1}	Cable Reflection Stability	0.00032	0.00032

* Worst case Reference Power Level = 0 dbm

** S11 is a measured value, not an error term. The measurement uncertainty is calculated using the maximum VSWR specification as the S11 term.

Measurement Uncertainty Equations Used

$$Y_r = random\ port\ 1\ repeatability = R_{r1} + 2 * R_{t1} * S11 + R_{r1} * S11^2$$

$$X_r = random\ high\text{–}level\ noise = 3 * N_h * S11$$

$$W_r = random\ low\text{–}level\ noise = 3 * N_l$$

$$S_r = systematic\ error = D + S_{r1} + T_r * S11 + (M_s + S_{r1}) * S11^2 + A_m * S11$$

$$V_r = S_r + \sqrt{W_r^2 + X_r^2 + Y_r^2}$$

$$E_r\ (linear) = reflection\ uncertainty\ magnitude = V_r + S11 * T_{rd}\ (magnitude)$$

Measurement Uncertainty @ 500 MHz

Measurement Uncertainty is calculated using the values in Table 2-2 as follows:

$$Y_r = 0.00032 + 2 * 0.00032 * 1.250 + 0.00032 * 1.250^2 = 0.0016$$

$$X_r = 3 * 0.00046 * 1.250 = 0.0017$$

$$W_r = 3 * 0.000 = 0.000$$

$$S_r = 0.010 + 0.00032 + 0.016 * 1.250 + (0.015 + 0.00032) * 1.250^2 + 0.035 * 1.250 = 0.0980$$

$$V_r = 0.0980 + \sqrt{0.0016^2 + 0.0017^2} = 0.1003$$

$$M.U. = E_r\,(linear) = 0.1003 + 1.250 * 0.000 = 0.1003$$

Measurement Uncertainty @ 1.3 GHz

Measurement Uncertainty is calculated using the values in Table 2-2 as follows:

$$Y_r = 0.00032 + 2 * 0.00032 * 1.350 + 0.00032 * 1.350^2 = 0.0018$$

$$X_r = 3 * 0.00046 * 1.350 = 0.0019$$

$$W_r = 3 * 0.000 = 0.000$$

$$S_r = 0.010 + 0.00032 + 0.016 * 1.350 + (0.015 + 0.00032) * 1.350^2 + 0.035 * 1.350 = 0.1071$$

$$V_r = 0.1071 + \sqrt{0.0019^2 + 0.0018^2} = 0.1097$$

$$M.U. = E_r\,(linear) = 0.1097 + 1.350 * 0.000 = 0.1097$$

Test Accuracy Ratio (TAR)

Test Accuracy Ratios are not defined for single-sided measurements, so all VSWR measurements have 'NA' (Not Applicable) in the TAR column.

Table 2-3. 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 Used

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

Table 2-3. 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. VSWR Test					
VSWR 100 MHz to 500 MHz					
Channel 00		_____	1.25	1.003E-1	NA
Channel 01		_____	1.25	1.003E-1	NA
Channel 02		_____	1.25	1.003E-1	NA
Channel 03		_____	1.25	1.003E-1	NA
Channel 10		_____	1.25	1.003E-1	NA
Channel 11		_____	1.25	1.003E-1	NA
Channel 12		_____	1.25	1.003E-1	NA
Channel 13		_____	1.25	1.003E-1	NA
Channel 20		_____	1.25	1.003E-1	NA
Channel 21		_____	1.25	1.003E-1	NA
Channel 22		_____	1.25	1.003E-1	NA
Channel 23		_____	1.25	1.003E-1	NA
Channel 30		_____	1.25	1.003E-1	NA
Channel 31		_____	1.25	1.003E-1	NA
Channel 32		_____	1.25	1.003E-1	NA
Channel 33		_____	1.25	1.003E-1	NA
Channel 40		_____	1.25	1.003E-1	NA
Channel 41		_____	1.25	1.003E-1	NA
Channel 42		_____	1.25	1.003E-1	NA
Channel 43		_____	1.25	1.003E-1	NA
Channel 50		_____	1.25	1.003E-1	NA
Channel 51		_____	1.25	1.003E-1	NA
Channel 52		_____	1.25	1.003E-1	NA
Channel 53		_____	1.25	1.003E-1	NA

*Single-sided specification - Minimum value does not apply

Table 2-3. 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. VSWR Test					
VSWR 500 MHz to 1.3 GHz					
Channel 00		_____	1.35	1.097E-1	NA
Channel 01		_____	1.35	1.097E-1	NA
Channel 02		_____	1.35	1.097E-1	NA
Channel 03		_____	1.35	1.097E-1	NA
Channel 10		_____	1.35	1.097E-1	NA
Channel 11		_____	1.35	1.097E-1	NA
Channel 12		_____	1.35	1.097E-1	NA
Channel 13		_____	1.35	1.097E-1	NA
Channel 20		_____	1.35	1.097E-1	NA
Channel 21		_____	1.35	1.097E-1	NA
Channel 22		_____	1.35	1.097E-1	NA
Channel 23		_____	1.35	1.097E-1	NA
Channel 30		_____	1.35	1.097E-1	NA
Channel 31		_____	1.35	1.097E-1	NA
Channel 32		_____	1.35	1.097E-1	NA
Channel 33		_____	1.35	1.097E-1	NA
Channel 40		_____	1.35	1.097E-1	NA
Channel 41		_____	1.35	1.097E-1	NA
Channel 42		_____	1.35	1.097E-1	NA
Channel 43		_____	1.35	1.097E-1	NA
Channel 50		_____	1.35	1.097E-1	NA
Channel 51		_____	1.35	1.097E-1	NA
Channel 52		_____	1.35	1.097E-1	NA
Channel 53		_____	1.35	1.097E-1	NA

*Single-sided specification - Minimum value does not apply

Chapter 3
Replaceable Parts

Introduction

This chapter contains information for ordering replaceable parts for the Agilent E1472A/74A RF Multiplexers and Agilent E1473A/75A RF Multiplexer Expander modules.

Replaceable Parts List

Table 3-2 through 3-5 list replaceable parts for the multiplexers and expanders. Table 3-6 shows reference designators for these parts, and Table 3-7 shows the manufacturer code list for these parts.

Exchange Assemblies

Table 3-1 lists assemblies that may be replaced on an exchange basis. Exchange assemblies are available only on a trade-in basis. Defective assemblies must be returned for credit. Order assemblies for spare parts stock by the new assembly part number.

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.

Table 3-1. Exchange/Replaceable Assemblies

Model	Assembly	Exchange PN	Replaceable PN
Agilent E1472A	A1	E1472-69501	E1472-66501
	A2-A3	————————	E1472-66502
Agilent E1473A	A1-A2	————————	E1472-66502
Agilent E1474A	A1	E1472-69501	E1472-66501
	A2-A3	————————	E1474-66502
Agilent E1475A	A1-A2	————————	E1474-66502
RMD Cable	3-to-1 Cable		E1472-61601

Table 3-2. Agilent E1472A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
			50 OHM RF MULTIPLEXER ASSEMBLY (See Figure 3-1)		
A1	E1472-66501	1	**PC ASSEMBLY RF COAX MUX**	28480	E1472-66501
F500-F503	2110-0712	4	FUSE-SUBMINIATURE 4A 125V NTD AX	75915	R251004T1
A2-A3	E1472-66502	2	**RELAY PRINTED CIRCUIT ASSEMBLY**	28480	E1472-66502
CBL1	E1472-61601	1	CABLE-INTERCONNECT	28480	E1472-61601
	1251-7584	3	CONNECTOR-POST TYPE .100-PIN-SPCG 20-CONTACT	18873	66900-220
	1252-1371	1	CONNECTOR-POST TYPE .100-PIN-SPCG 60-CONTACT	18873	66900-260
	8120-2981	1	CABLE-FLAT-RIBBON 28AWG 60-CNDCT GRA-JKT	76381	3365-60
HDW1-HDW30	2950-0078	30	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	74163	500220
MNL1	E1472-90001	1	E1472A/E1473A USER'S MANUAL	28480	E1472-90001
MP1	E1300-45102	1	HANDLE KIT-BOTTOM, VXI	28480	E1300-45102
MP2	E1300-45101	1	HANDLE KIT-TOP, Agilent	28480	E1300-45101
MP3	8160-0686	1	RFI STRIP-FINGERS BE-CU TIN-PLATED	30817	00786-185
MP4	1400-0482	1	CABLE TIE .062-3-DIA .14-WD NYLON	59730	TY-26M-8
PNL1	E1472-00201	1	FRONT PANEL	28480	E1472-00201
SCR1-SCR2	0515-0368	2	SCREW-MACHINE M2.5 X 0.45 12MM-LG PAN-HD	28480	0515-0368
SCR3-SCR5	0515-0664	3	SCREW-MACHINE M3 X 0.5 12MM-LG PAN-HD	28480	0515-0664
SCR6-SCR13	0515-1135	8	SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD	28480	0515-1135
SCR14-SCR17	0515-1375	4	SCREW-MACHINE M2.5 X 0.45 6MM-LG FLAT-HD	83486	343-300-02506
SCR18-SCR19	0515-1968	2	SCREW PH M2.5 X 11 TX	28480	0515-1968

Table 3-2. Agilent E1472A Replaceable Parts (Continued)

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
SHD1	E1472-00601	1	SHIELD-TOP	28480	E1472-00601
	0590-1893	8	THREADED INSERT-C'SINK-SPCR-NO THD	28480	0590-1893
SHD2	E1472-00602	1	SHIELD	28480	E1472-00602
SHD3	E1472-00603	1	SHIELD-BOTTOM	28480	E1472-00603
	0590-1459	8	THREADED INSERT-STDF M3 X 0.5 6-MM-LG	46384	SOS-3.5M3-6
WSH1-WSH30	2190-0124	30	WASHER-LOCK INTL T NO. 10 .195-IN-ID	98291	3002-26

Table 3-3. Agilent E1473A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
			50 OHM RF MULTIPLEXER EXPANDER ASSEMBLY (See Figure 3-2)		
A1-A2	E1472-66502	2	**RELAY PRINTED CIRCUIT ASSEMBLY**	28480	E1472-66502
CBL1	E1472-61601	1	CABLE-INTERCONNECT	28480	E1472-61601
	1251-7584	3	CONNECTOR-POST TYPE .100-PIN-SPCG 20-CONTACT	18873	66900-220
	1252-1371	1	CONNECTOR-POST TYPE .100-PIN-SPCG 60-CONTACT	18873	66900-260
	8120-2981	1	CABLE-FLAT-RIBBON 28AWG 60-CNDCT GRA-JKT	76381	3365-60
HDW1-HDW30	2950-0078	30	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	74163	500220
MP1	E1300-45102	1	HANDLE KIT-BOTTOM, VXI	28480	E1300-45102
MP2	E1300-45101	1	HANDLE KIT-TOP, Agilent	28480	E1300-45101
MP3	8160-0686	1	RFI STRIP-FINGERS BE-CU TIN-PLATED	30817	00786-185
PNL1	E1473-00201	1	FRONT PANEL	28480	E1473-00201
SCR1-SCR2	0515-0368	2	SCREW-MACHINE M2.5 X 0.45 12MM-LG PAN-HD	28480	0515-0368
SCR3-SCR7	0515-0375	5	SCREW-MACHINE M3 X 0.5 16MM-LG PAN-HD	28480	0515-0375
SCR8-SCR10	0515-1135	3	SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD	28480	0515-1135
SCR11-SCR12	0515-1375	2	SCREW-MACHINE M2.5 X 0.45 6MM-LG FLAT-HD	83486	343-300-02506
SCR13-SCR14	0515-1968	2	SCREW PH M2.5 X 11 TX	28480	0515-1968
SHD1	E1472-00602	1	SHIELD	28480	E1472-00602
SHD2	E1472-00601	1	SHIELD-TOP	28480	E1472-00601
	0590-1893	8	THREADED INSERT-C'SINK-SPCR-NO THD	28480	0590-1893
SHD3	E1472-00603	1	SHIELD-BOTTOM	28480	E1472-00603
	0590-1459	8	THREADED INSERT-STDF M3 X 0.5 6-MM-LG	46384	SOS-3.5M3-6
WSH1-WSH30	2190-0124	30	WASHER-LOCK INTL T NO. 10 .195-IN-ID	98291	3002-26

Table 3-4. Agilent E1474A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
			75 OHM RF MULTIPLEXER ASSEMBLY (See Figure 3-1)		
A1	E1472-66501	1	**PC ASSEMBLY RF COAX MUX**	28480	E1472-66501
F500-F503	2110-0712	4	FUSE-SUBMINIATURE 4A 125V NTD AX	75915	R251004T1
A2-A3	E1474-66502	2	**PC ASSEMBLY 75 OHM MULTIPLEXER**	28480	E1474-66502
CBL1	E1472-61601	1	CABLE-INTERCONNECT	28480	E1472-61601
	1251-7584	3	CONNECTOR-POST TYPE .100-PIN-SPCG 20-CONTACT	18873	66900-220
	1252-1371	1	CONNECTOR-POST TYPE .100-PIN-SPCG 60-CONTACT	18873	66900-260
	8120-2981	1	CABLE-FLAT-RIBBON 28AWG 60-CNDCT GRA-JKT	76381	3365-60
HDW1-HDW30	2950-0078	30	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	74163	500220
MNL1	E1474-90001	1	E1474A/E1475A USER'S MANUAL	28480	E1474-90001
MP1	E1300-45102	1	HANDLE KIT-BOTTOM, VXI	28480	E1300-45102
MP2	E1300-45101	1	HANDLE KIT-TOP, Agilent	28480	E1300-45101
MP3	8160-0686	1	RFI STRIP-FINGERS BE-CU TIN-PLATED	30817	00786-185
MP4	1400-0482	1	CABLE TIE .062-3-DIA .14-WD NYLON	59730	TY-26M-8
PNL1	E1474-00201	1	FRONT PANEL	28480	E1474-00201
SCR1-SCR2	0515-0368	2	SCREW-MACHINE M2.5 X 0.45 12MM-LG PAN-HD	28480	0515-0368
SCR3-SCR5	0515-0664	3	SCREW-MACHINE M3 X 0.5 12MM-LG PAN-HD	28480	0515-0664
SCR6-SCR13	0515-1135	8	SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD	28480	0515-1135
SCR14-SCR17	0515-1375	4	SCREW-MACHINE M2.5 X 0.45 6MM-LG FLAT-HD	83486	343-300-02506
SCR18-SCR19	0515-1968	2	SCREW PH M2.5 X 11 TX	28480	0515-1968
SHD1	E1474-00601	1	SHIELD-TOP	28480	E1474-00601
	0590-1893	8	THREADED INSERT-C'SINK-SPCR-NO THD	28480	0590-1893
SHD2	E1472-00602	1	SHIELD	28480	E1472-00602
SHD3	E1472-00603	1	SHIELD-BOTTOM	28480	E1472-00603
	0590-1459	8	THREADED INSERT-STDF M3 X 0.5 6-MM-LG	46384	SOS-3.5M3-6
WSH1-WSH30	2190-0124	30	WASHER-LOCK INTL T NO. 10 .195-IN-ID	98291	3002-26

Table 3-5. Agilent E1475A Replaceable Parts

Reference Designator	Agilent Part Number	Qty	Part Description	Mfr. Code	Mfr. Part Number
			75 OHM RF MULTIPLEXER EXPANDER ASSEMBLY (See Figure 3-2)		
A1-A2	E1474-66502	2	P**C ASSEMBLY 75 OHM MULTIPLEXER**	28480	E1474-66502
CBL1	E1472-61601	1	CABLE-INTERCONNECT	28480	E1472-61601
	1251-7584	3	CONNECTOR-POST TYPE .100-PIN-SPCG 20-CONTACT	18873	66900-220
	1252-1371	1	CONNECTOR-POST TYPE .100-PIN-SPCG 60-CONTACT	18873	66900-260
	8120-2981	1	CABLE-FLAT-RIBBON 28AWG 60-CNDCT GRA-JKT	76381	3365-60
HDW1-HDW30	2950-0078	30	NUT-HEX-DBL-CHAM 10-32-THD .067-IN-THK	74163	500220
MP1	E1300-45102	1	HANDLE KIT-BOTTOM, VXI	28480	E1300-45102
MP2	E1300-45101	1	HANDLE KIT-TOP, Agilent	28480	E1300-45101
MP3	8160-0686	1	RFI STRIP-FINGERS BE-CU TIN-PLATED	30817	00786-185
PNL1	E1475-00201	1	FRONT PANEL	28480	E1475-00201
SCR1-SCR2	0515-0368	2	SCREW-MACHINE M2.5 X 0.45 12MM-LG PAN-HD	28480	0515-0368
SCR3-SCR7	0515-0375	5	SCREW-MACHINE M3 X 0.5 16MM-LG PAN-HD	28480	0515-0375
SCR8-SCR10	0515-1135	3	SCREW-MACHINE M3 X 0.5 25MM-LG FLAT-HD	28480	0515-1135
SCR11-SCR12	0515-1375	2	SCREW-MACHINE M2.5 X 0.45 6MM-LG FLAT-HD	83486	343-300-02506
SCR13-SCR14	0515-1968	2	SCREW PH M2.5 X 11 TX	28480	0515-1968
SHD1	E1472-00602	1	SHIELD	28480	E1472-00602
SHD2	E1475-00601	1	SHIELD-TOP	28480	E1475-00601
	0590-1893	3	THREADED INSERT-C'SINK-SPCR-NO THD	28480	0590-1893
SHD3	E1473-00603	1	SHIELD-BOTTOM	28480	E1473-00603
	0590-1367	5	THREADED INSERT-STDF M3 X 0.5 10-MM-LG	46384	SOS-3.5M3-10
	0590-1459	3	THREADED INSERT-STDF M3 X 0.5 6-MM-LG	46384	SOS-3.5M3-6
WSH1-WSH30	2190-0124	30	WASHER-LOCK INTL T NO. 10 .195-IN-ID	98291	3002-26

Table 3-6. Agilent E1472A/73A/74A/75A Reference Designators

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

Table 3-7. Agilent E1372A/73A/74A/75A Code List of Manufacturers

Mfr. Code	Manufacturer's Name	Manufacturer's Address	Zip Code
18873	DUPONT E I DE NEMOURS & CO	WILMINGTON DE US	19801
28480	AGILENT TECHNOLOGIES - CORPORATE	PALO ALTO CA US	94304
30817	INSTRUMENT SPECIALTIES CO INC	DEL WATER GAP PA US	18327
46384	PENN ENGINEERING & MFG CORP	DOYLESTOWN PA US	18901
59730	THOMAS & BETTS CORP	RARITAN NJ US	08869
74163	PHELPS DODGE CORP	NEW YORK NY US	10022
75915	LITTELFUSE INC	DES PLAINES IL US	60016
76381	3M CO	ST PAUL MN US	55144
83486	ELCO INDUSTRIES INC	ROCKFORD IL US	61125
98291	ITT SEALECTRO CORP	TRUMBULL CT US	06611

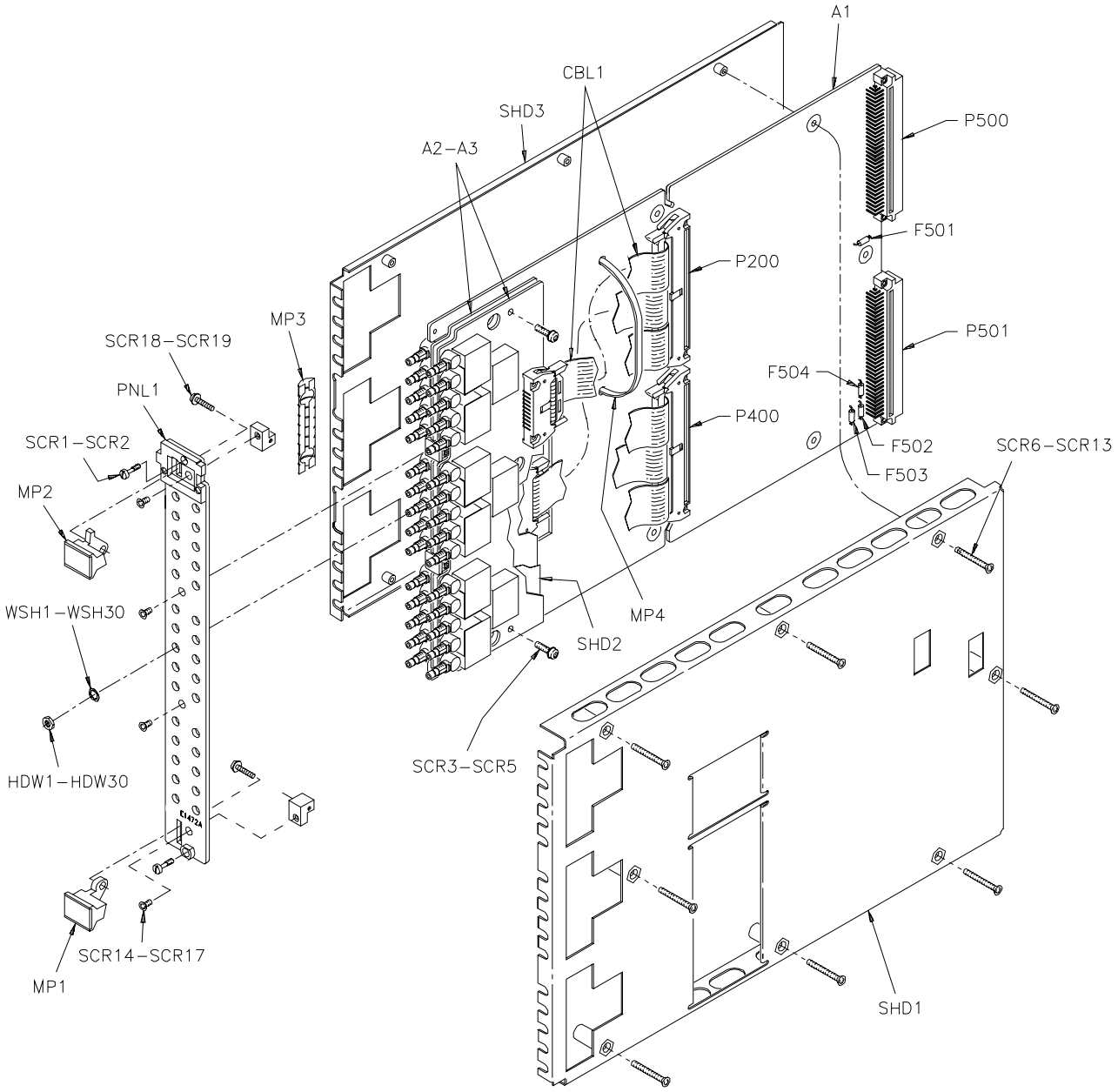


Figure 3-1. Agilent E1472A & E1474A Replaceable Parts

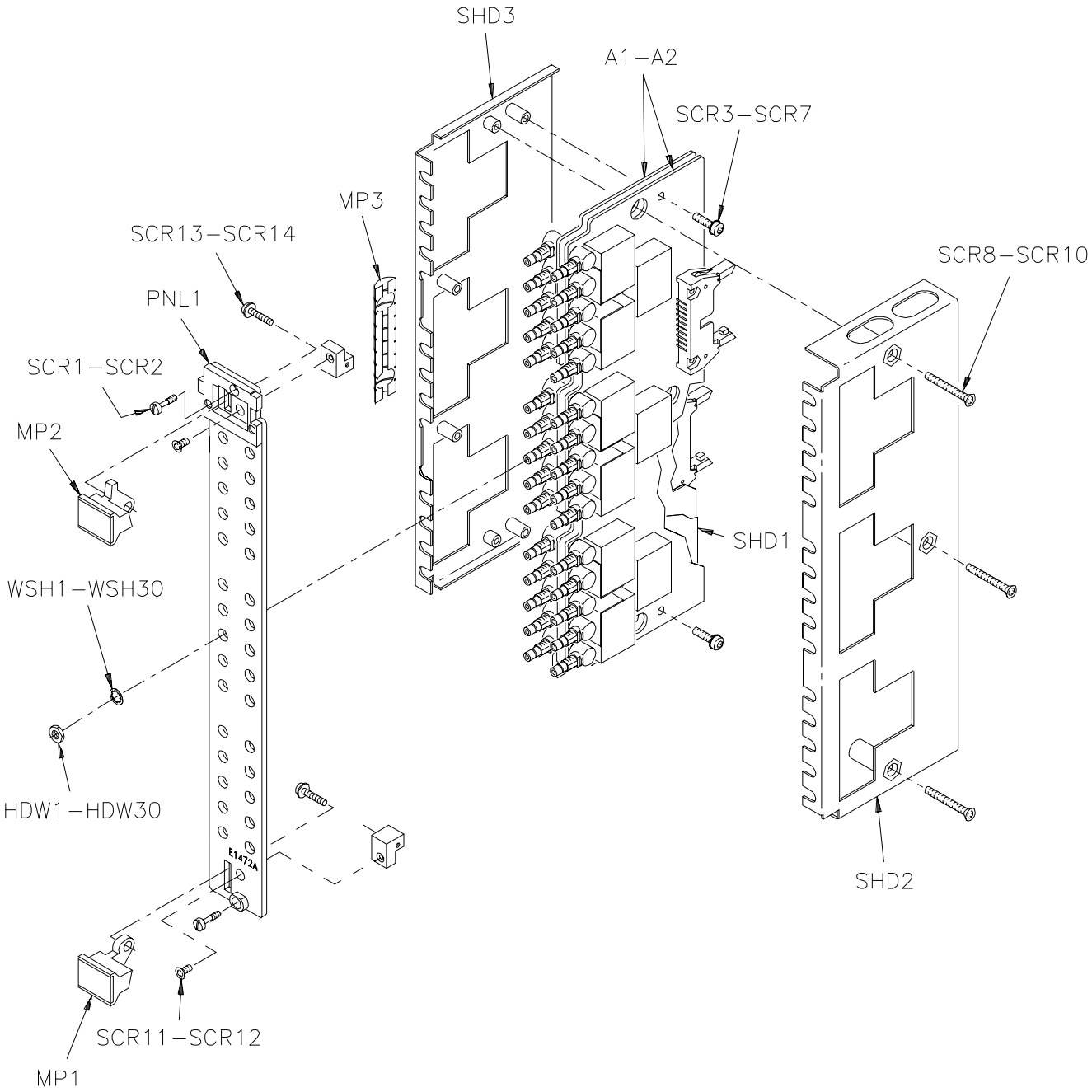


Figure 3-2. Agilent E1473A & E1475A Replaceable Parts

Chapter 4
Service

Introduction

This chapter contains service information for the Agilent E1472A/73A/74A/75A RF Multiplexer/Expander modules, including repair strategy, troubleshooting techniques and repair/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

Procedures in this chapter describe troubleshooting techniques for the Agilent E1472A/E1474A RF Multiplexers and Agilent E1473A/E1475A RF Multiplexer Expanders. The VXI interface, relay decoders and relay drivers are all contained on a single PC board in the Agilent E1472A or Agilent E1474A RF Multiplexer. This PC board should be replaced as an exchange assembly. Exchange assembly part numbers are contained in *Chapter 3 - Replaceable Parts.*

The multiplexer relays, tree relays, and their associated RF connectors are contained on separate PC boards. The Relay Assembly PC board (Agilent PN E1472-66502 or E1474-66502) is available only as a replaceable part (not an exchange assembly). Each Relay Assembly PC Board contains three banks of channels. Two complete Relay Assembly PC Boards are contained in each Agilent E1472A/E1473A/E1474A/E1475A module.

Equipment Required

Equipment required for multiplexer/expander 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 for descriptions and locations of Agilent E1472A/73A/74A/75A mechanical replaceable parts. Service notes, manual updates, and service literature for the modules may be available through Agilent Technologies. For information, contact your nearest Agilent Technologies Sales and Support Office.

Troubleshooting

The troubleshooting information and procedures in this section will help isolate a problem to an assembly.

Identifying the Problem

Table 4-1 lists some common problems, along with symptoms and possible solutions.

Table 4-1. Agilent E1472A/73A/74A/75A Common Problems

Problem Type	Symptom	Possible Solutions
Self-test Errors	Non-zero error code in response to the *TST? command.	See Table 4-3 for information on self-test errors.
	Incorrect response to SYST:COPT? command.	See "Isolating to an Assembly" in this chapter.
Operator Errors	Non-zero error code in response to the SYST:ERR? command.	See Appendix C of the the *Agilent E1472A/E1473A User's Manual* or *Agilent E1474A/E1475A User's Manual* for RF multiplexer 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.
	Failing Functional Verification Test (Chapter 2)	Check RMD cables and connectors.
Performance Out of Specification	Failing VSWR Test (see Test 2-1 in Chapter 2).	Check user wiring and test connections. If channels are near or above the test limit, replace the printed circuit board (Agilent PN E1472-66502 or E1474-66502).

Testing the Assembly

You can use the tests and checks in Table 4-2 to isolate the problem. See Figures 3-1 and 3-2 in Chapter 3 for locations of mechanical parts.

Table 4-2. Agilent E1472A/73A/74A/75A Tests/Checks

Test/Check	Reference Designator	Check:
Heat Damage	- - - - - - - - - -	Discolored PC boards Damaged insulation Evidence of arcing
Switch/Jumper Settings	J100, J101 SP1 J200	IRQ Level setting LADDR setting Relay Drive Level
RF Multiplexer PCA	F501, F502, F503, F504 P200, P400, P500, P501	Fuse continuity Connector contacts
Relay Assembly PCA	P1 A2 - A3	Connector Contacts Test 2-1, VSWR 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). Verify the Relay Drive Level is set correctly (factory set at +12 Vdc). Refer to the *Agilent E1472A/E1473A User's Manual* or *Agilent E1474A/E1475A User's Manual* for procedures to set or check these switches/jumpers.

Checking the RF Multiplexer PCA

Check the following:

- Verify that fuses F501, F502, F503, and F504 are good.
- Check connectors P200, P400, P500, and P501 for damage.
- Perform Test 2-1 in Chapter 2. Replace Relay Assembly PC for failing channels.

Checking the Relay Assembly PCA

Check the following:

- Check connector contacts P1.
- Perform Test 2-1 in Chapter 2. Replace Relay Assembly PC for failing channels.

Isolating to an Assembly

Figure 4-1 is a simplified diagram of the multiplexer and two multiplexer expanders. For this configuration, up to six relay assemblies can be driven by a single control assembly. The relay assemblies must be driven in pairs and both RMD cables must be connected to the relay assemblies for the assembly to be recognized using the SYST:COPT? command (See *Expander Functional Verification - Chapter 2*).

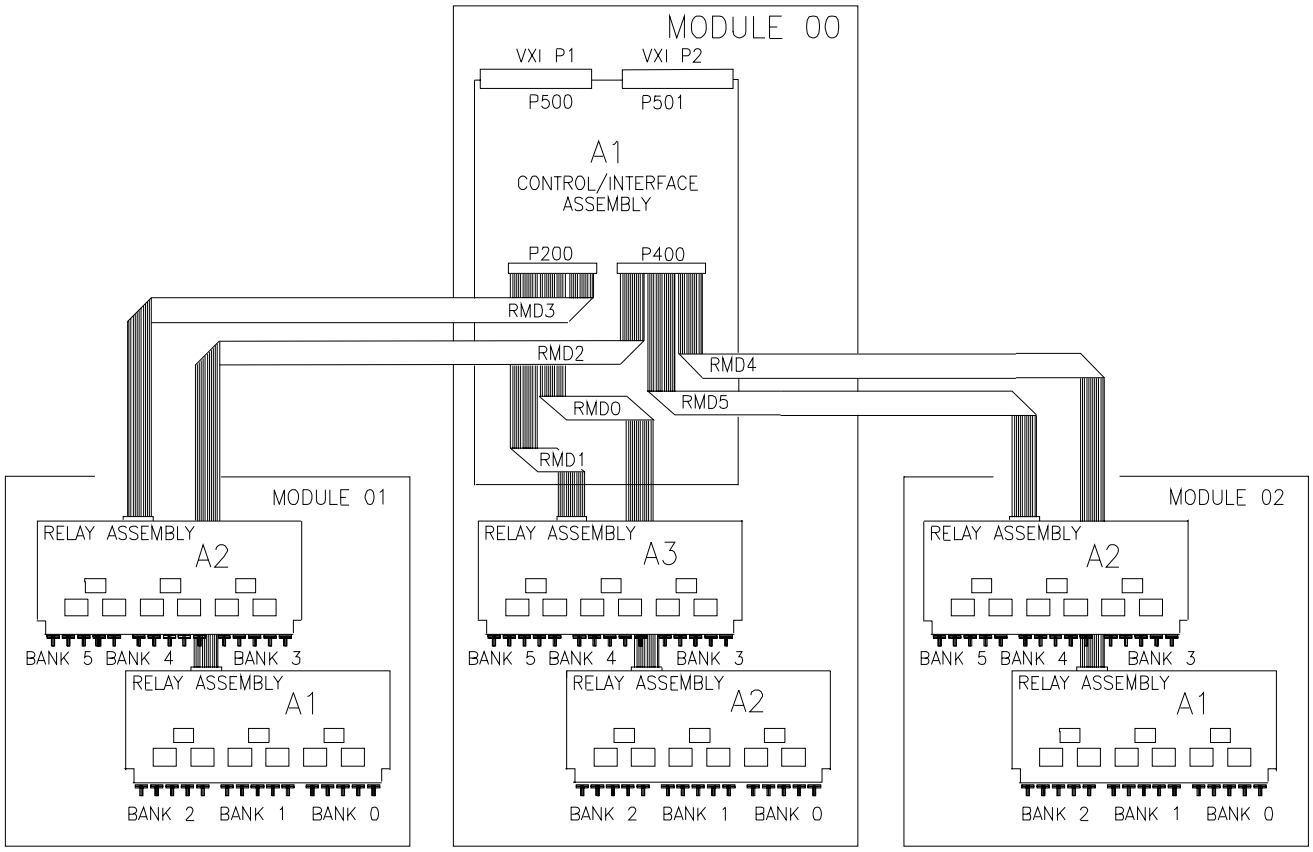


Figure 4-1. Multiplexer/Expander Simplified Diagram

Self-test Error Codes

Table 4-3 shows the self-test error codes for the multiplexer modules. 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 4-3. 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)

Procedure

1. Verify that the multiplexer 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 4-3 for a description of self-test error codes.

Example

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

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

Disassembly

Use the following procedures to disassemble the Agilent E1472A/E1474A RF Multiplexer or Agilent E1473A/E1475A RF Multiplexer Expander module. For disassembly refer to Figures 4-2 and 4-3.

RF Multiplexer Disassembly

1. To remove the covers:

   - Remove all 30 nuts and washers from the RF connectors as shown.
   - Remove the eight T10 Torx screws from the top cover as shown.
   - Lift the top cover off the module. The cover may be a tight fit around the RF Connectors.
   - Turn the assembly over and lift off the bottom cover. The cover may be a tight fit around the RF Connectors.

2. To remove the A2 and A3 Assemblies:

   - Remove the 3-to-1 cable from the A1, A2, and A3 assemblies.
   - Remove the three T10 Torx screws from the relay assembly PC board as shown.
   - Lift the top Relay Assembly out.
   - Lift the shield out as shown.
   - Lift the bottom Relay Assembly out.

3. To remove the front panel:

   - Remove the two T8 Torx screws from handles MP1 and MP2 as shown.
   - Remove the two T8 Torx screws holding the panel to the A1 PC Assembly as shown.
   - Lift the front panel from the A1 assembly.

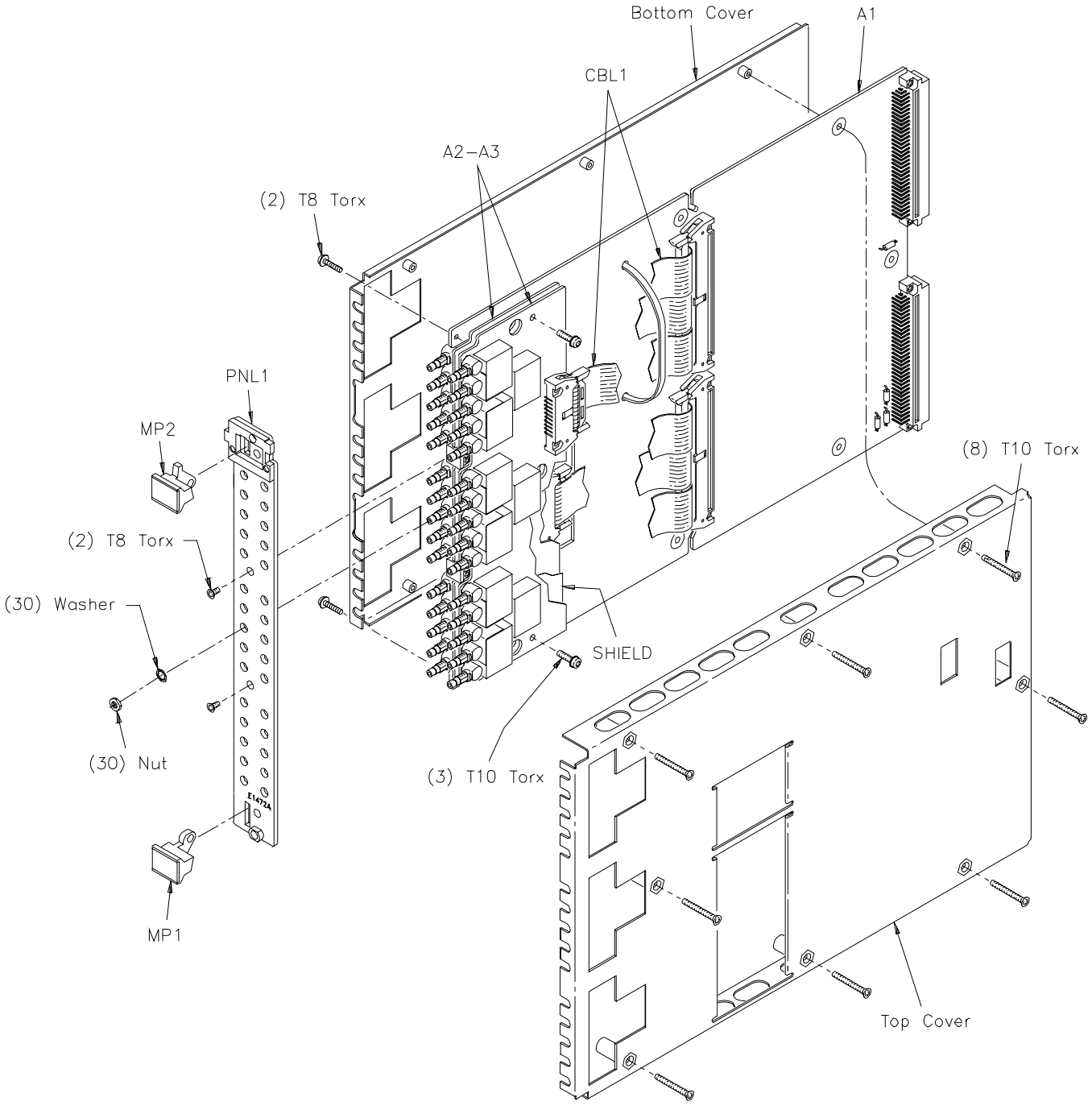


Figure 4-2. Agilent E1472A/E1474A Disassembly

RF Multiplexer Expander Disassembly

1. To remove the covers:

   - Remove all 30 nuts and washers from the RF connectors as shown.
   - Remove the three T10 Torx screws from the top cover as shown.
   - Lift the top cover off of the module. The cover may be a tight fit around the RF Connectors.
   - Turn the assembly over and lift off the bottom cover. The cover may be a tight fit around the RF Connectors.

2. To remove the A1 and A2 Assemblies:

   - Remove the three T10 Torx screws from the relay assembly PC board as shown.
   - Lift the top Relay Assembly out.
   - Lift the shield out as shown.
   - Lift the bottom Relay Assembly out.

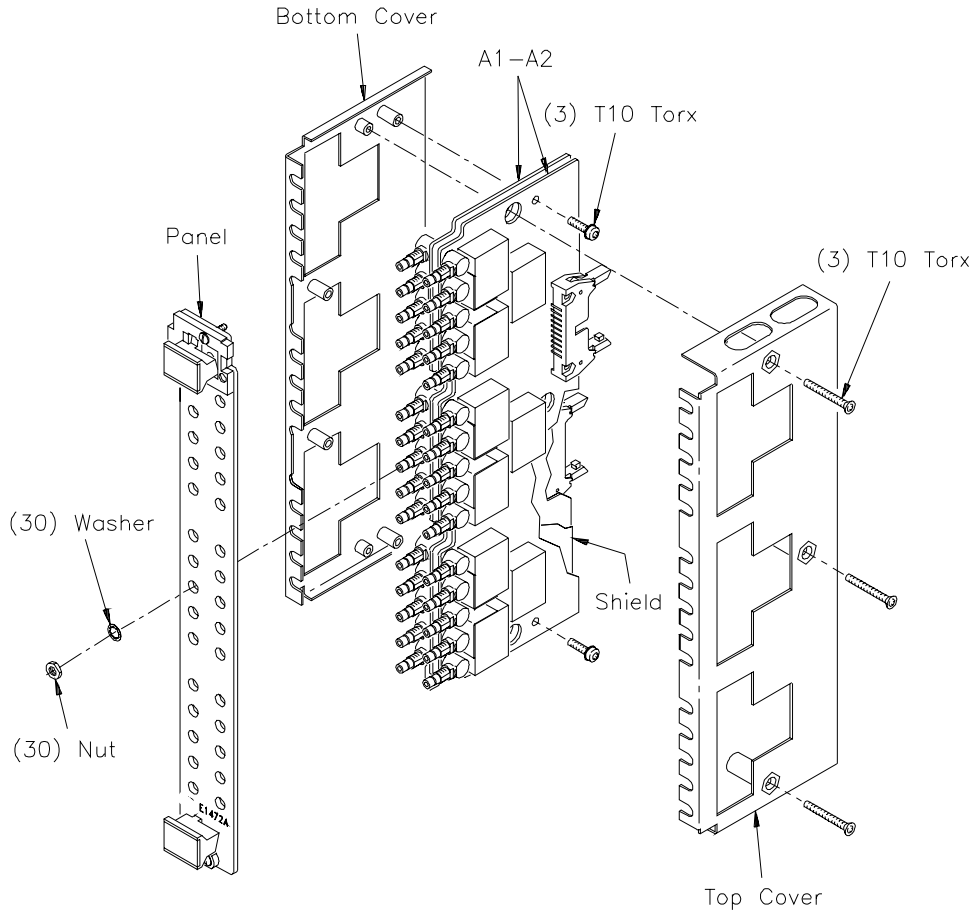


Figure 4-3. Agilent E1473A/E1475A Disassembly

Repair/ Maintenance Guidelines

This section provides guidelines for repairing and maintaining the Agilent E1472A/73A/74A/75A RF Multiplexer/Expander modules, including:

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

ESD Precautions

Electrostatic discharge (ESD) may damage static-sensitive devices in the multiplexer/expander modules. This damage can range from slight parameter degradation to catastrophic failure. When handling multiplexer/expander 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 multiplexer/expander modules 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 that 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.

Chapter A
Verification Tests - C Programs

Functional Verification Tests

These programs are designed to do the Functional Verification Tests found in *Chapter 2 - Verification Tests*.

Example: Multiplexer Self Test

The Functional Verification Test for the Agilent E1472A and E1474A RF Multiplexers consists of sending the *TST? command and checking the response. This test can be used to verify that the multiplexer is connected properly and is responding to a basic command.

NOTE

This program assumes a primary address of 09 and a secondary address of 15. If your Multiplexer address does not match this, you must either change the Multiplexers address setting or change the program line #define ADDR "hpib7,9,15" *to match your Multiplexers 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, "*TST?\n", "%t", a);          /* Self test command */
  printf("\n %s", a);                        /* Print result */
  getchar();                                 /* Pause */

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

Example: Expander Self Test

The Functional Verification Test for the Agilent E1473A and E1475A RF Multiplexer Expanders consists of sending the :COPTion? query command and checking the response. This test can be used to verify that the device is connected properly and is responding to basic commands.

```
#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, "SYST:COPT? 1\n", "%t", a);   /* Self test command */
  printf("\n %s", a);                        /* Print result */
  getchar();                                 /* Pause */

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

Performance Verification Test

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

NOTE

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

Example: VSWR Test

This example performs a VSWR Test on all channels in the RF Multiplexer. If a channel is out of specification, the program prints a message and pauses.

```
/*  VSWR Test                          E1366A  */

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

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

void main (void)
{
  INST id, dm;                    /* Define id and dm as an instrument */
  double result[4][12];
  int i, k, Mm, tst;

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

  ionerror(I_ERROR_EXIT);

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

RETRY:
  printf ("\n\nSelect the test to run");
  printf ("\n\n Test 1. RF Multiplexer (Agilent E1472A or E1474A)");
  printf ("\n Test 2. RF Multiplexer Expander (Agilent E1473A or E1475A)");
  printf ("\nEnter the test number (1 or 2) ");
  scanf ("%u", tst);

  if (tst == 1) Mm = 0;
  if (tst == 2) Mm = 1;
  if (!(tst==1) && !(tst==2)) goto RETRY;

  printf ("\n\nEquipment Setup");
```

```
  printf ("\n\n 1. Turn Network Analyzer power ON, allow a one hour warm-up");
  printf ("\n 2. Install Agilent E1472A or E1474A Component Assembly into
Mainframe.");
  if (tst == 2)
    printf ("\n 2a. Install Agilent E1473A or E1475A Expander");
  printf ("\n 3. Turn Mainframe power ON");
  printf ("\n 4. Press ENTER when ready to begin testing.");
  getchar ();

  printf ("\n\nCalibrate the Network Analyzer");        printf ("\n\n 1. Press PRESET");
  printf ("\n 2. Select SWR measurement type from FORMAT menu");
  printf ("\n 3. Set the START frequency to 100 MHz");
  printf ("\n 4. Set the STOP frequency to 500 MHz");

  printf ("\n 5. Select the 3.5 mm CAL kit");
  printf ("\n 6. Calibrate the test port and cable for OPEN, SHORT, and LOAD");
  printf ("\n 7. Set the scale to 100 mV/DIV");
  printf ("\n 8. Press ENTER when ready to begin testing");
  getchar ();

  /*--------------------100 - 500 MHz Test----------------------------*/

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

  for (k = 0; k <= 5; k++)
   {
     printf ("\n\nVSWR from 100 MHz to 500 MHz");
     for (i = 0; i <= 3; i++)
     {
       printf ("\n\n 1. Connect test port cable to COM %u0", k);
       printf ("\n 2. Connect LOAD to channel %u%u", k, i);
       printf ("\n 3. Press ENTER when connections are complete");
       getchar ();

       iprintf (id, "CLOS (@10%u%u%u)\n", Mm, k, i);
       printf ("\n\nObserve the Network Analyzer display");
       printf ("\n Enter the highest measured VSWR reading: ");
       scanf ("%lf", &result[i][k]);
       iprintf (id, "OPEN (@10%u%u%u)\n", Mm, k, i);

       if (result[i][k] > 1.25)
       {
         printf ("\n\n*** Channel %u%u FAILED - VSWR  1.25", k, i);
         printf ("\n Press ENTER to test next channel");
         getchar ();
       }
     }
   }

  printf ("\n\n100 MHz to 500 MHz VSWR Test complete");
  printf ("\n Press ENTER for 500 MHz to 1.3 GHz test");
  getchar ();
```

```
  /*--------------------500 MHz - 1.3 GHz Test-------------------------*/

  printf ("\n\nEquipment Setup");
  printf ("\n\n 1. Turn Network Analyzer power ON, allow a one hour warm-up");
  printf ("\n 2. Install Agilent E1472A or E1474A Component Assembly into
Mainframe.");
  if (tst == 2)
    printf ("\n 2a. Install Agilent E1473A or E1475A Expander");
  printf ("\n 3. Turn Mainframe power ON");
  printf ("\n 4. Press ENTER when ready to begin testing.");
  getchar ();

  printf ("\n\nCalibrate the Network Analyzer");
  printf ("\n\n 1. Press PRESET");
  printf ("\n 2. Select SWR measurement type from FORMAT menu");

  printf ("\n 3. Set the START frequency to 500 MHz");
  printf ("\n 4. Set the STOP frequency to 1.3 GHz");
  printf ("\n 5. Select the 3.5 mm CAL kit");
  printf ("\n 6. Calibrate the test port and cable for OPEN, SHORT, and LOAD");
  printf ("\n 7. Set the scale to 100 mV/DIV");
  printf ("\n 8. Press ENTER when ready to begin testing");
  getchar ();

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

  for (k = 0; k <= 5; k++)
  {
    printf ("\n\nVSWR from 500 MHz to 1.3 GHz");

    for (i = 0; i <= 3; i++)
    {
      printf ("\n\n 1. Connect test port cable to COM %u0", k);
      printf ("\n 2. Connect LOAD to channel %u%u", k, i);
      printf ("\n 3. Press ENTER when connections are complete");
      getchar ();

      iprintf (id, "CLOS (@10%u%u%u)\n", Mm, k, i);
      printf ("\n\nObserve the Network Analyzer display");
      printf ("\n Enter the highest measured VSWR reading: ");
      scanf ("%lf", &result[i][k+6]);
      iprintf (id, "OPEN (@10%u%u%u)\n", Mm, k, i);

      if (result[i][k+2] > 1.35)
      {
        printf ("\n\n*** Channel %u%u FAILED - VSWR  1.35", k, i);
        printf ("\n Press ENTER to test next channel");
        getchar ();
      }
    }
  }
```

```
  printf ("\n\n500 MHz to 1.3 GHz VSWR Test complete");
  printf ("\n Press ENTER to display measurement results");
  getchar ();

  /*--------------------Display Measurement Results--------------------*/

  printf ("\n\n------------------------------------------------------------");
  printf ("\n                  100 MHz to 500 MHz    500 MHz to 1.3 GHz\n");

  for (k = 0; k <= 5; k++)
    for (i = 0; i <= 3; i++)
      printf ("\nChannel %u%u  VSWR = %18lf    %18lf", k, i, result[i][k], result[i][k+6]);

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