Model
ME7840A With Option 4
Power Amplifier Test System,
Handset Configuration (ME7840/4)

Operation Manual

Anritsu

490 JARVIS DRIVE - MORGAN HILL, CA 95037-2809

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DECLARATION OF CONFORMITY

Manufacturer's Name: ANRITSU COMPANY

Manufacturer's Address: Microwave Measurements Division
490 Jarvis Drive
Morgan Hill, CA 95037-2809
USA

declares that the product specified below:

Product Name: Handset Amplifier Test System

Model Number: MN4783A

conforms to the requirement of:

EMC Directive 89/336/EEC as amended by Council Directive 92/31/EEC & 93/68/EEC
Low Voltage Directive 73/23/EEC as amended by Council directive 93/68/EEC

Electromagnetic Interference:

Emissions:	CISPR 11:1990/EN55011: 1991 Group 1 Class A EN 61000-3-2:1995 Class A EN 61000-3-3:1995 Class A
Immunity:	EN 61000-4-2:1995/EN61326: 1998 - 4kV CD, 8kV AD EN 61000-4-3:1997/EN61326: 1998 - 3V/m EN 61000-4-4:1995/EN61326: 1998 - 0.5kV SL, 1kV PL EN 61000-4-5:1995/EN61326: 1998 - 1kV L-L, 2kV L-E EN 61000-4-6:1994/EN61326: 1998 – 3V EN 61000-4-11:1994/EN61326: 1998 – 1 cycle@100%

Electrical Safety Requirement:

Product Safety: IEC 1010-1:1990 + A1/EN61010-1: 1993

Corporate Quality Director

Morgan Hill, CA

22-NOV-02
Date

European Contact: For Anritsu product EMC & LVD information, contact Anritsu LTD, Rutherford Close, Stevenage Herts, SG1 2EF UK, (FAX 44-1438-740202)

Safety Symbols

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Symbols Used in Manuals

DANGER	This indicates a very dangerous procedure that could result in serious injury or death if not performed properly.
WARNING	This indicates a hazardous procedure that could result in serious injury or death if not performed properly.
CAUTION	This indicates a hazardous procedure or danger that could result in light-to-severe injury, or loss related to equipment malfunction, if proper precautions are not taken.

Safety Symbols Used on Equipment and in Manuals

The following safety symbols are used inside or on the equipment near operation locations to provide information about safety items and operation precautions. Ensure that you clearly understand the meanings of the symbols and take the necessary precautions BEFORE operating the equipment.

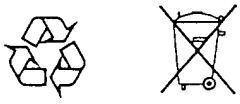
Some or all of the following five symbols may or may not be used on all Anritsu equipment. In addition, there may be other labels attached to products that are not shown in the diagrams in this manual.

This indicates a prohibited operation. The prohibited operation is indicated symbolically in or near the barred circle.

This indicates a compulsory safety precaution. The required operation is indicated symbolically in or near the circle.

This indicates warning or caution. The contents are indicated symbolically in or near the triangle.

This indicates a note. The contents are described in the box.

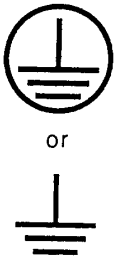


These indicate that the marked part should be recycled.

For Safety

WARNING

Always refer to the operation manual when working near locations at which the alert mark, shown on the left, is attached. If the operation, etc., is performed without heeding the advice in the operation manual, there is a risk of personal injury. In addition, the equipment performance may be reduced.
Moreover, this alert mark is sometimes used with other marks and descriptions indicating other dangers.



WARNING

When supplying power to this equipment, connect the accessory 3-pin power cord to a 3-pin grounded power outlet. If a grounded 3-pin outlet is not available, use a conversion adapter and ground the green wire, or connect the frame ground on the rear panel of the equipment to ground. If power is supplied without grounding the equipment, there is a risk of receiving a severe or fatal electric shock.

Repair

WARNING

This equipment can not be repaired by the operator. DO NOT attempt to remove the equipment covers or to disassemble internal components. Only qualified service technicians with a knowledge of electrical fire and shock hazards should service this equipment. There are high-voltage parts in this equipment presenting a risk of severe injury or fatal electric shock to untrained personnel. In addition, there is a risk of damage to precision components.

WARNING

Use two or more people to lift and move this equipment, or use an equipment cart. There is a risk of back injury, if this equipment is lifted by one person.

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Chapter 1
General Information

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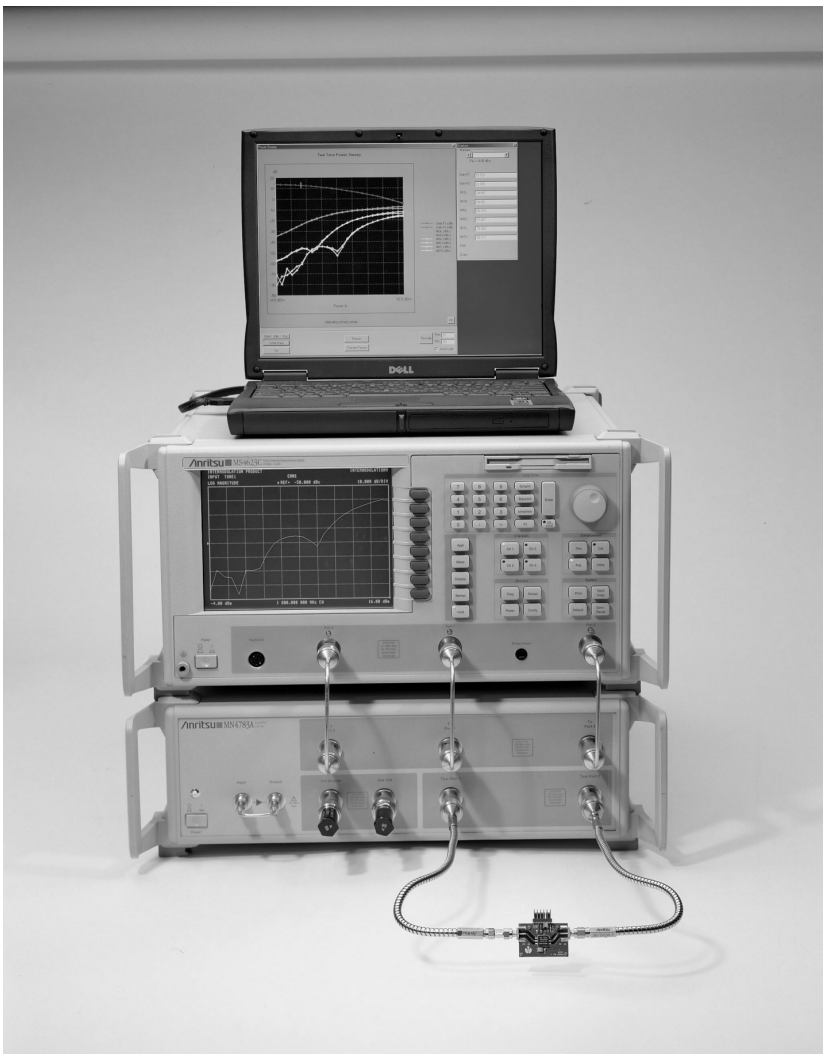

Figure 1-1. *Model ME7840/4 Power Amplifier Test System, Handset Configuration.*

Chapter 1
General Information

1-1 Scope of Manual

This manual provides general information, installation, operating, and maintenance information for the Anritsu Model ME7840/4 Power Amplifier Test System, Handset Configuration (Figure 1-1). Manual organization is shown in the table of contents. The following topics are discussed:

- Equipment Description
- Equipment Installation and Connection
- System Operation
- Test Procedures and Test Result Interpretation
- System Performance Verification
- Preamplifier Operations

The procedures described in this manual presume a working knowledge of vector network analyzers and RF power amplifier testing procedures. Refer to the other manuals supplied with the ME7840/4 (see below) for more detailed explanations of the system equipment and procedures.

1-2 Introduction

This chapter provides information to familiarize the user with the ME7840/4. It includes a general description of the test system, technical specifications, related manuals, and the available models and options.

1-3 Related Manuals

The ME7840/4 manual set consists of the following manuals:

Manual Description	Anritsu Part Number
ME7840/4 Operation Manual (OM)	10410-00247
MN4783A Maintenance Manual (MM)	10410-00248 (optional)
Scorpion Navigator User's Guide (SUG)	10410-00249
MS462XX Operating Manual (OM)	10410-00203
MS462XX Programming Manual (PM)	10410-00204
MS462XX Maintenance Manual (MM)	10410-00205 (optional)

The operating and programming manuals are supplied with the equipment; the maintenance manuals are optional items that may be purchased.

1-4 Related Literature

There are a number of marketing brochures and related application notes available for the ME7840/4 and the MS462XX VNMS. Refer to Table 1-1 for a listing and part numbers. Most of these items are available from our Internet site, *http://www.anritsu.com*.

Table 1-1. *Related Manuals, Literature, and Software for the MS462XX* and *ME7840/4*

Literature	Part Number	Literature	Part Number
Brochures and Data Sheets		Scorpion Frequency Translated Group Delay	11410-00236
Scorpion Data Sheet/Brochure	11410-00212	Scorpion Global Power Sweep	11410-00243
AutoCal Brochure	11410-00189	Scorpion Multiple Source Control	11410-00244
PATS Data Sheet	11410-00263	Reflectometer Measurements-Revisited	11410-00214
TMATS Data Sheet	11410-00292	Time Domain for VNAs	11410-00206
Application Notes		AutoCal	11410-00258
Adjacent Channel Power Ratio (ACPR)	11410-00264	***Software***	
Scorpion Noise Figure	11410-00210	Scorpion Command Encyclopedia	2300-364
Scorpion Noise Figure Accuracy	11410-00227	Power Tools	2300-218
Scorpion Intermodulation Distortion	11410-00213	Exact Uncertainty	2300-361
Scorpion Harmonics	11410-00222	***Demonstration Kits***	
Hot S_{22} and Hot K-factor Measurements	11410-00295	Scorpion Demo Kit	SC6287

1-5 Conventions

Throughout this manual, the ME7840/4 Power Amplifier Test System, Handset Configuration may be referenced as *ME7840/4*, or *test system*; the MS4623C Vector Network Measurement System may be referenced as *VNMS, Scorpion* or *MS4623C*; the MN4783A test set may be referenced as *test set* or *MN4783A*; the Amplfier Under Test, including the related components to their system, may be referenced as *AUT*.

1-6 Serial Number

All Anritsu instruments are assigned a unique six-digit serial number, such as “940101.” This number is affixed to a decal on the rear panel of each unit. In any correspondence with Anritsu Customer Service, please use this number.

1-7 Online Manuals

Updates to this manual, if any, may be downloaded from the Anritsu Internet site at: *http://www.anritsu.com*.

1-8 System Overview

The Anritsu ME7840/4 is intended for the measurement and real-time graphical display of the following parameters of a power amplifier in the frequency range of 10 MHz to 6 GHz:

- S-parameters including Hot S_{22} and K-factor
- Single-tone Power Sweep
- Two-tone Power Sweep
- Intermodulation Distortion
- Harmonics
- Noise Figure
- Adjacent Channel Power Ratio (ACPR)

The ME7840/4 test system is designed to facilitate alignment, tuning and pass/fail testing of the components, modules, and subassemblies of RF and microwave power amplifiers as well as the assembled amplifier systems.

1-9 Hardware Description

The ME7840/4 hardware (Figure 1-1) consists of a MS4623C Direct Receiver Access (DRA) Scorpion®, a MN4783A test set, a customer supplied Personal Computer (PC), and an optional current probe (refer to Chapter 2, Figure 2-4). A block diagram of the ME7840/4 test system is shown in Figure 1-2 on the following page. General test set specifications appear below.

Table 1-2. *Test Set Specifications*

Model	Frequency Range (MHz)	Maximum AUT Power Output (Watts)	Reverse Measurements (S_{22}, Hot S_{22}, S_{12} Possible)	Attenuator or Isolator (at AUT Output Path)
MN4783A	10 to 6000 (Note 1)	5.0 (Note 2)	Yes	External

Notes:

1. The frequency range does not account for any restricting effects caused by use of external isolators or circulators.
2. The maximum AUT power assumes a minimum isolation of 20 dB provided by external isolators or circulators. The provided external 20 dB attenuator ensures the proper isolation for reverse measurements up to the specified maximum AUT power output.

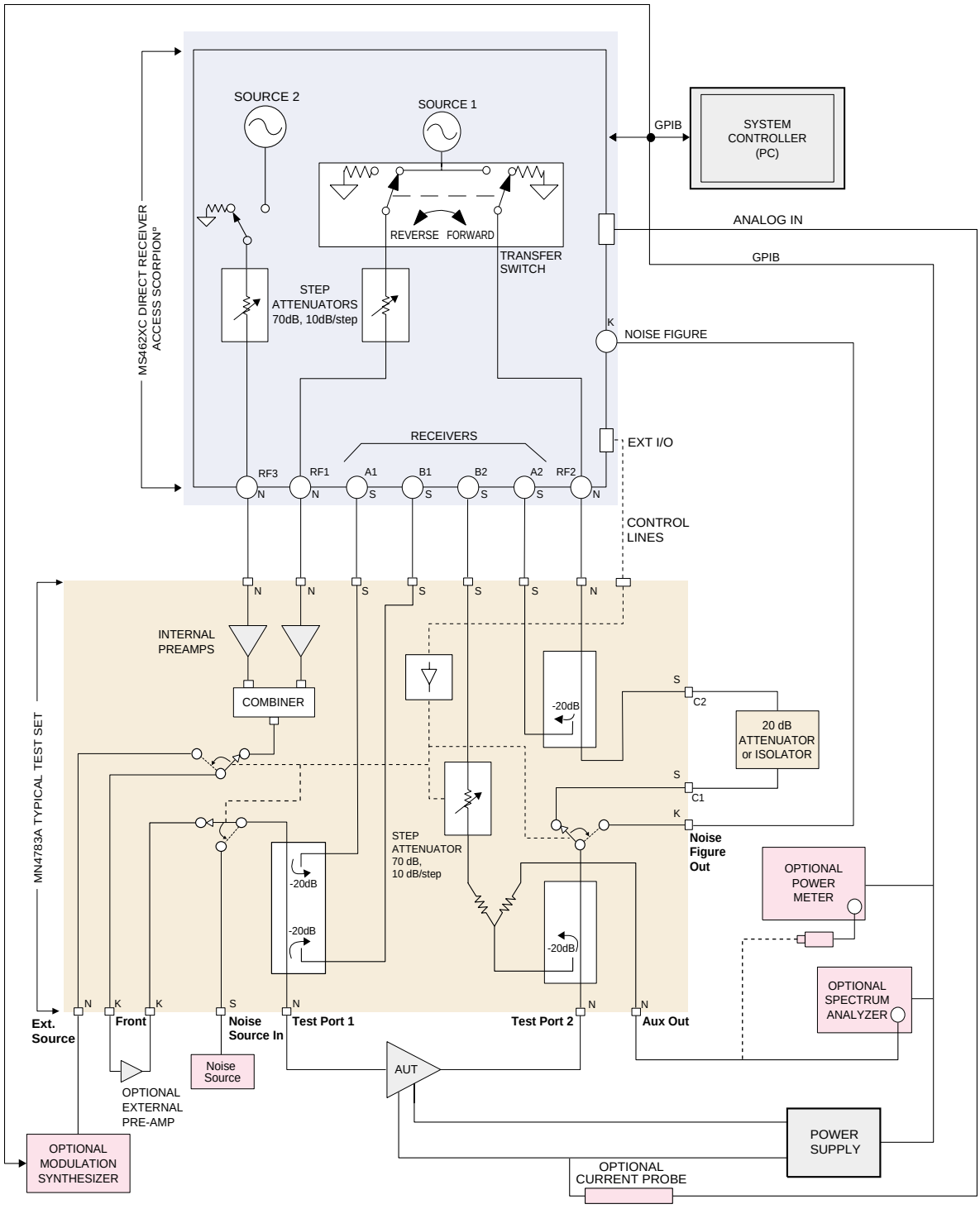

Figure 1-2. *Overall Functional Block Diagram of the ME7840/4 Power Amplifier Test System, Handset Configuration with the MN4783A Test Set.*

1-10 System Description

The ME7840/4 test system consists of the MS4623C Direct Receiver Access Scorpion (DRA), the MN4783A Handset Amplifier Test Set and a library of external measurement software. Scorpion Navigator® orchestrates the calibration and performs measurements on power amplifiers in the 10 MHz to 6 GHz range. Software modules exist for S-parameters, K-factor, IMD, One-Tone Power Sweep, Two-Tone Power Sweep, Harmonics, Hot S_{22}, and ACPR measurements. Scorpion Navigator software runs best on Windows® NT/2000/XP and requires a GPIB controller (preferably a National Instruments GPIB controller with NI-488.2 software version 1.7 or higher and NI VISA version 2.5 or higher) and Scorpion firmware version 1.11 or higher.

DRA Scorpion

The Scorpion Direct Receiver Access version of the Vector Network Measurement System functions under control of the software residing in the PC through GPIB commands. The software supports tuning and alignment operations by generating real time graphic displays of the measured data on the PC screen.

Under software control, 3rd, 5th and 7th order IMD products can be measured and displayed. Also, the Upper and Lower Side Band (USB and LSB) components of the IMD products are measured and displayed separately.

The DRA Scorpion includes the following capabilities:

- Two internal, independent RF sources. Each source has a range of –15 dBm to +10 dBm. A 0 dB to 70 dB step attenuator (10 dB / step) is provided for each source resulting in a power output range of –85 dBm to +10 dBm from each source.
- Complete built-in capability for IMD measurements. A combiner is provided in the test set.
- Internal Transfer Switch enabling S_{22} and Hot S_{22} measurements. The reflectometer set-up is provided in the test set.
- Direct access to each of the four receiver channels (two reference channels and two test channels) for maximum flexibility in measuring forward and reverse S-parameters over a wide range of AUT output power. The test set provides incident and reflected signal separation.

CAUTION

The combiner has a power input rating of 5 Watts maximum when terminated with a VSWR of 2:1. For an open or short at the combiner output, the combiner input power rating is 0.5 Watts maximum.

MN4783A Test Set

The MN4783A test set contains a Wilkinson type combiner that combines the two RF signals from Port 1 and Port 3 (RF1 and RF3) of the Scorpion. Two preamplifiers at the combiner input boost the input RF power to the AUT.

The output of the combiner is fed to source selection switches that enable one of the following to be applied to the AUT:

- The combined signal from the Scorpion sources
- A modulated signal from an optional external modulation synthesizer
- An innovative noise figure measurement capability based on Y-factor techniques that can be routed through the test set for use in characterizing amplifiers

A provision for the insertion of an optional external preamplifier (after the combiner and source selection switch) is also provided. Refer to Chapter 5, "Preamplifier Operations," for details.

The test set includes two VSWR bridges connected back-to-back at the input of the AUT that separates the incident signal from the reflected signal. The power rating of these VSWR bridges is 5 Watts average. The –20 dB portion of the incident and reflected signals are applied to the Scorpion reference-port a_1 and test-port b_1, respectively, for S_{11} measurement. The S_{11} measurement determined by the DRA Scorpion is simply the ratio of the reflected signal to the incident signal.

The amplified output of the AUT is fed to a VSWR bridge in the test set. The power rating of this bridge is also 5 Watts average. The –20 dB coupled arm of this bridge is routed to the test-port b_2 of the Scorpion through a Wilkinson type power divider and a 0 dB to 70 dB step attenuator (10 dB/step).

The divider enables the connections of a power meter or spectrum analyzer, when desired, to measure the AUT output. The through arm of the bridge is routed to the Scorpion Port 2 via a 20 dB 10 Watt attenuator (or optional isolator).

In the MN4783A test set, the attenuator (or isolator) is external as shown in Figure 1-2 (page 1-6). In selecting an external isolator (alternatively, a circulator with a termination on the unused port may be used), the following criteria should be followed:

- *Power rating:* Should be no less than the power output of the AUT
- *Bandwidth:* Should be sufficiently wide to cover the frequency band of the AUT
- *Isolation:* Should be no less than (P_o –17 dB), where P_o is the power output in dBm of the AUT

Where S_{22} or Hot S_{22} measurements are not required, power amplifiers with up to 5 Watts average output power can be tested with the MN4783A test set without any isolator by connecting the 20 dB 10 Watt attenuator to port C1 and port C2 on the rear panel. The unit is shipped from the factory with this attenuator in place.

For S_{22} measurements, the transfer switch located within the Scorpion routes the Source 1 output signal to the output port of the AUT via Port 2 (RF2) of the Scorpion. A separate VSWR bridge in the test set applies the –20 dB portion of this incident signal to the Scorpion reference-port a_2. The –20 dB portion of the signal reflected from the AUT output port is applied to the Scorpion test-port b_2 by means of the AUT output VSWR bridge.

The ME7840/4 calibration is performed with the test set in place and at the connectors where the AUT will be connected directly. Therefore, the test set components and cables are included in the calibration loop and their effects are calibrated out, resulting in correct and accurate measurements of the AUT.

The software supplied by Anritsu supports operator control of the source selection switch and step attenuator in the test set. This control is achieved through the parallel TTL control lines available at the Scorpion rear panel "External I/O" connector. The GPIB commands from the PC to the Scorpion set the TTL control lines to the desired states.

Connectors and Ports

On the front panel of the model MS4623C DRA Scorpion three type N (female) connectors are provided for Ports 1, 2 and 3.

CAUTION

Connecting the external circulator incorrectly or placing a direct connection between C1 and C2 on the MN4783A rear panel will cause permanent damage to the MS4623C.

The unused port of the circulator must be terminated with a high power termination.

Port 1 provides RF Source 1 when the transfer switch is in the forward position, and is terminated into 50 ohms to ground when the transfer switch is in the reverse position.

Port 2 provides RF Source 1 when the transfer switch is in the reverse position, and is terminated into 50 ohms to ground when the transfer switch is in the forward position.

Port 3 is allocated to RF Source 2. Under independent control, Port 3 provides RF Source 2 or is terminated into 50 ohms to ground.

On the rear panel of the Scorpion, four SMA connectors (Figure 1-3, page 1-10) are provided for reference-ports (a_1 and a_2) and test-ports (b_1 and b_2). The front of the unit, as well as all other mechanical specifications, is the same as the model MS4623B.

On the MN4783A test set, two additional SMA connectors provide for connecting an external isolator. If reverse measurements (S_{22} and Hot S_{22}) are not desired, then an isolator is not required. Instead, a 20 dB external attenuator should be connected between connectors C1 and C2 (Figure 1-4, page 1-10). The MN4783A is shipped from the factory with this attenuator in place.

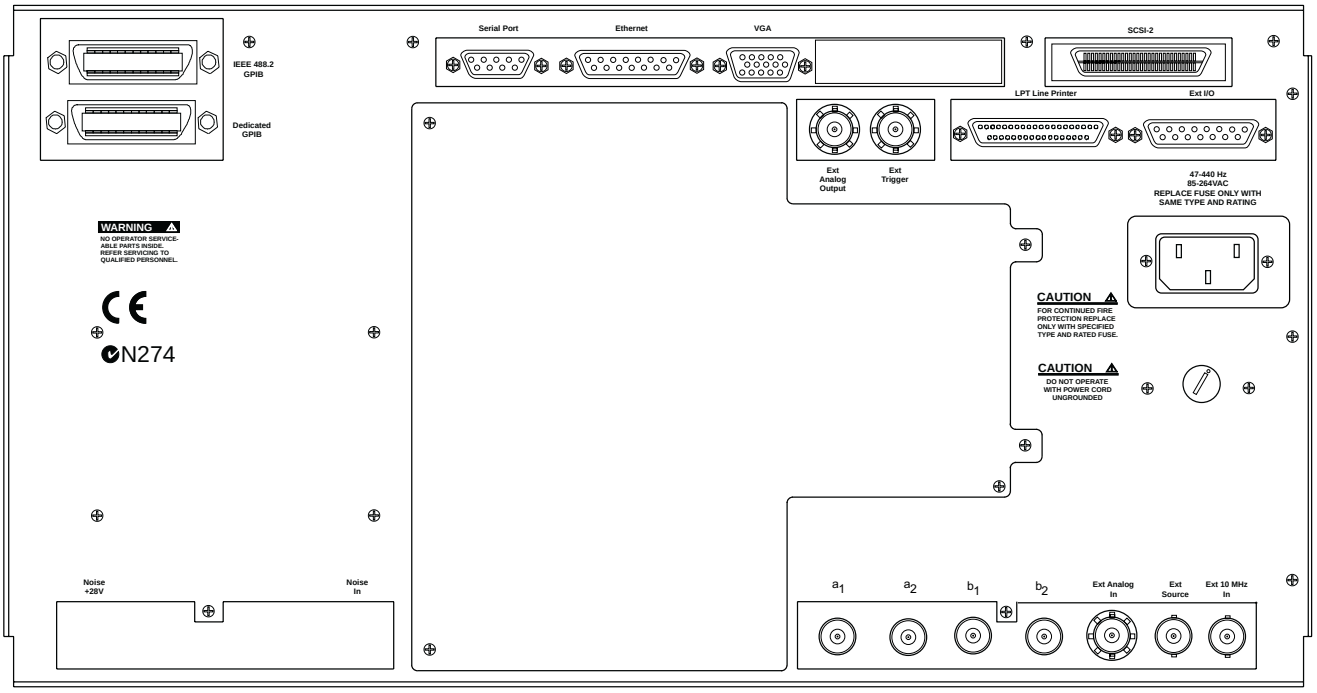

Figure 1-3. *MS4623C Rear Panel Drawing*

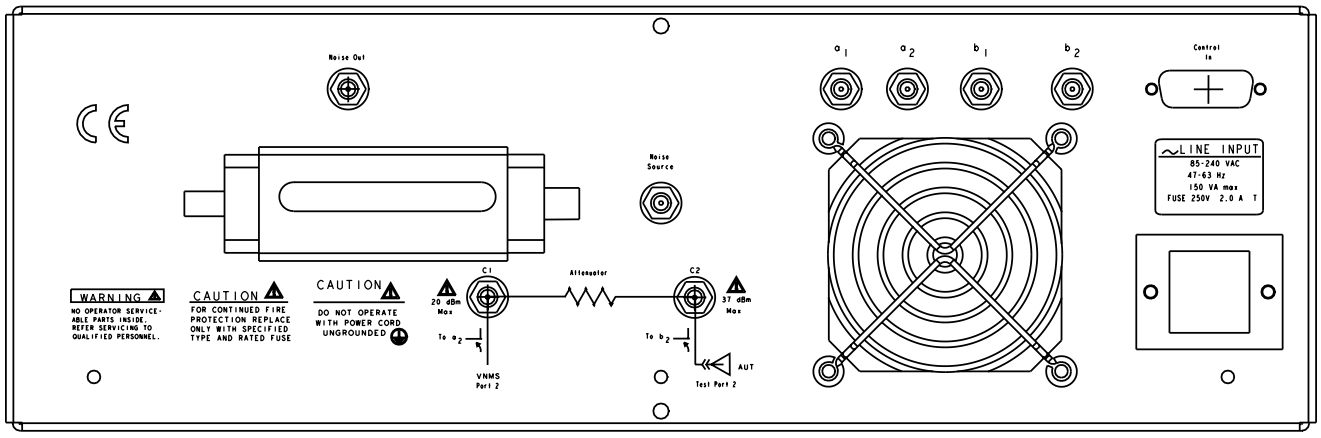

Figure 1-4. *MN4783A Rear Panel Drawing*

1-11 Optional Accessories

The accessories described below are available from Anritsu:

- Model ML2430A Power Meter
- Model MG3672A Digital Modulation Signal Generator with MG0314A W-CDMA Modulation Unit
- MG3681A Digital Modulation Signal Generator for use with ACPR measurements on W-CDMA devices
- Model MS2602A Spectrum Analyzer
- Model MS8607A Digital Mobile Radio Transmitter Tester
- AC/DC Current Probe for AUT drain current and power-added-efficiency (PAE) measurements (see Table 1-3, below)

Table 1-3. *Anritsu Current Probes*

Max Current	Accuracy (at lesser current range setting)	Anritsu Part Number
100 mV/A: 10A 10 mV/A: 100A	3% of reading ±50 mA	2000-1067
1 mV/mA: 1A 10 mV/A: 80A	2% of reading ±5 mA	2000-1085

- Circulators to be used externally with the MN4783A test set (see Table 1-4, below)

Table 1-4. *Anritsu Circulators*

Frequency Band	Isolation	Max AUT Power	Anritsu Part Number
800 to 1000 MHz	20 dB min	5 Watts	1000-50
1.8 to 2.5 GHz	20 dB min	5 Watts	1000-52
1.8 to 2.5 GHz	22 dB min	5 Watts	1000-53

Note: All circulators have 3 SMA female connectors. A 5 Watt (minimum) termination is required on the unused circulator port.

1-12 Preventative Maintenance

The ME7840/4 does not require any preventative maintenance.

1-13 User Supplied Items

The following items are required for the operation of the ME7840/4 and must be supplied by the user.

Table 1-5. *User Supplied Items*

Item	Critical Specification
Personal Computer (PC)	Pentium II or better, 200 MHz or faster, with Windows® 95/98/NT/2000 or XP operating system and National Instruments GPIB card installed.
GPIB Cable	IEEE 488, long enough to connect the PC controller to the test system.

1-14 Performance Specifications

Specifications for the ME7840/4 are provided in Table 1-6 on the following page.

Table 1-6. *Performance Specifications for ME7840/4 Handset Amplifier Test System*

Characteristic	Value	Notes
Amplifier Under Test Power Output	+37 dBm (5 Watts maximum)	With the MN4783A test set and with 20 dB isolation between the AUT power output and Port 2 of the MS4623C
Amplifier Under Test Input Power Range	–70 dBm to +13 dBm	At AUT input
Bandwidth through Test Set	10 MHz to 6 GHz	With MN4783A test set (Note)
Dynamic Range	80 dB typical	10 MHz to 3 GHz
	70 dB typical	3 GHz to 6 GHz
IMD 3rd Order Dynamic Range	70 dB minimum	500 MHz to 6 GHz and > 300 kHz offset with 10 Hz IF Bandwidth @ 300 kHz tone separation and –20 dBm tone levels
IMD Accuracy	±1 dB maximum @ > –60 dBc levels	500 MHz to 6 GHz and > 300 kHz offset
Port Power Accuracy	±0.1 dB typical	With flat power calibration
	±1 dB maximum	Without flat power calibration
Port Match (Test Ports 1 and 2)	40 dB minimum	Corrected value from 10 MHz to 3 GHz
	13 dB minimum	Uncorrected value from 10 MHz to 3 GHz
	37 dB minimum	Corrected value from 3 GHz to 6 GHz
	13 dB minimum	Uncorrected value from 3 GHz to 6 GHz
Directivity	40 dB minimum	Corrected value 10 MHz to 3 GHz
	38 dB minimum	Corrected value 3 GHz to 6 GHz
Noise Figure	50 MHz to 6 GHz	Option 4E
Environmental	Storage Temperature Range	40° C to +75° C
	Operating Temperature Range	0° C to +50° C
	Range Over Which Specifications Apply	23 ±3° C
	Relative Humidity	5% to 95% at +40° C
Physical, MN4783A Test Set	Height	152.5 mm (6 in.)
	Width	444 mm (17.4 in.)
	Depth	500 mm (19.7)
	Weight	10 kg (22 pounds) or less

Note: This frequency range does not take into account any restricting effects of the external isolator or circulator (if one is used for reverse measurements).

Chapter 2
Installation

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Chapter 2
Installation

2-1 Introduction

This chapter describes the installation, connection and set-up of the equipment that comprises the ME7840/4 Power Amplifier Test System, Handset Configuration.

2-2 Equipment Complement

The ME7840/4 is made up of the following pieces of equipment:

- Scorpion Vector Network Measurement System (VNMS) Direct Receiver Access (DRA) version: Model MS4623C (10 MHz to 6 GHz)
- Model MN4783A Handset Amplifier Test Set
- Scorpion Navigator® system measurement software
- Current probe(s) (optional item)
- One or more external isolators (optional item for use with the MN4783A test set)
- Accessory Kit: Includes interconnect cables and 50Ω terminations for Aux ports
- Optional for ACPR measurements: MG3681 Signal Generator for W-CDMA or Agilent ESG E4423B Signal Generator for CDMA

2-3 Unpacking and Inspection

The ME7840/4 equipment has been securely packaged. The packaging material and container should be retained in case the equipment must be re-shipped or placed into storage.

The MS4623C DRA Scorpion VNMS and the MN4783A test set are each packed within heavy cardboard boxes.

Step 1. Carefully cut the sealing tape on the top box surface with a packing knife.

Step 2. Open the box lids, and remove the upper layer of foam material.

Step 3. Lift the equipment from the boxes. Two persons should do this, as the equipment is heavy and bulky.

A listing of the non-optional-accessories always supplied with the ME7840/4 is listed below. The cables and terminators are shown in Figures 2-2 and 2-3 (page 2-5).

Item	Part No.	Quantity
Broadband Termination	28N50LF	2
Control Cable	803-49	1
RF Cables, Type N Connectors (front)	58361	3
RF Cables, SMA Connectors (rear)	58364-1 58365-2	4 1

2-4 Hardware Installation

System hardware set-up is a straight-forward process. Follow the steps below in sequence to ensure a trouble free installation.

Step 1. Place the MS4623C on top of the MN4783A test set. Figure 2-1 shows how the green colored feet on the case of each unit stack on each other.

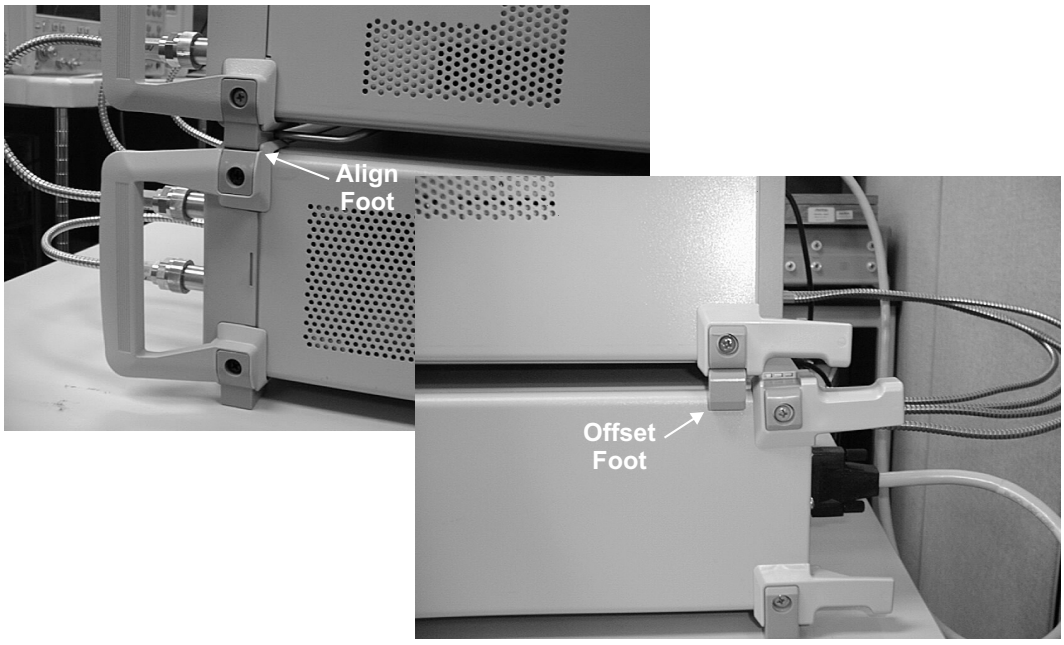

Figure 2-1. *ME7840/4 Component Assembly*

Step 2. Install the three front RF interconnect cables. Figure 2-2 on the following page shows the installation of the RF interconnect cables between the front panel of the MS4623C and the front panel of the test set. Table 2-1 (page 2-6), lists the applicable connectors by designation or function.

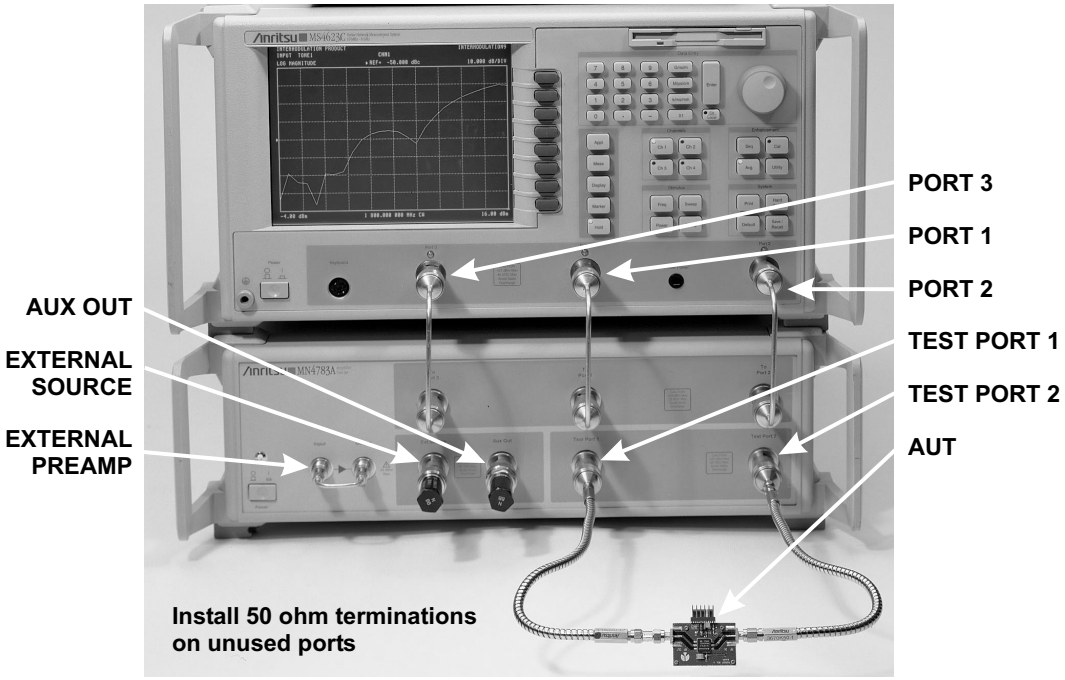

Figure 2-2. *ME7840/4 Front Panel RF Cable Connections*

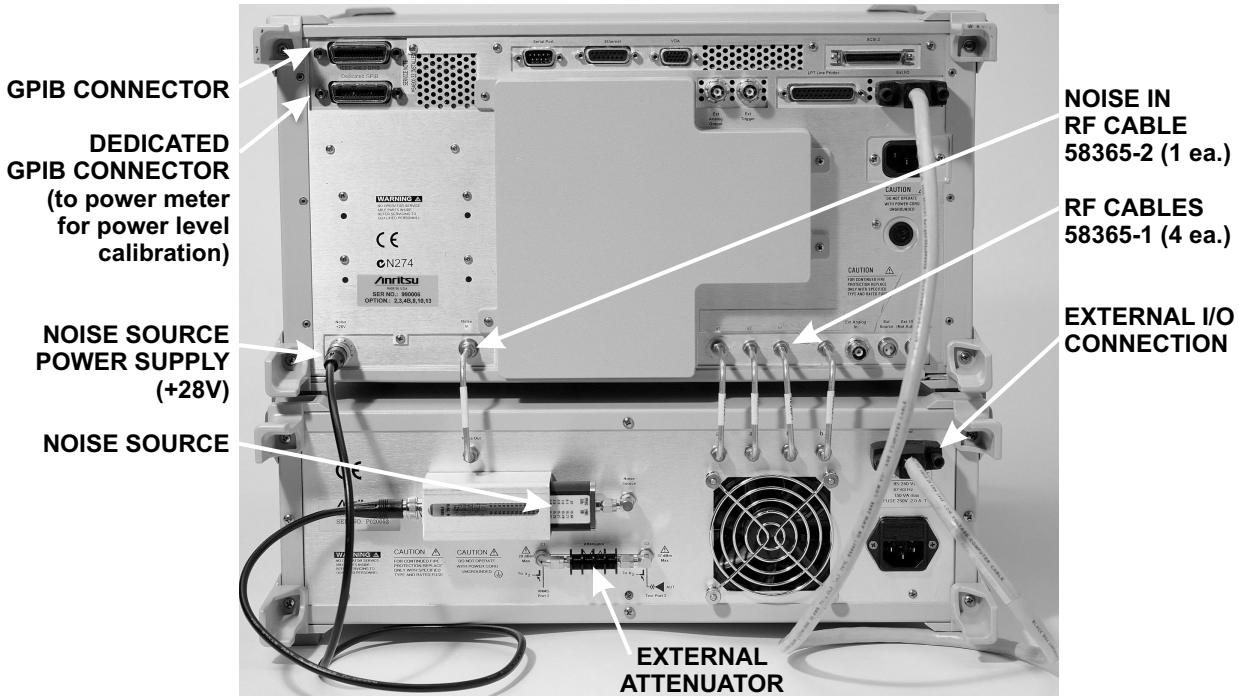

Figure 2-3. *ME7840/4 Rear Panel Cable Connections*

Step 3. Install the four RF cables between the rear of the MS4623C and the test set. Torque the cables to 8 inch-pounds (SMA connectors) or 12 inch-pounds (Type N connectors). Table 2-1 lists the applicable connectors by designation or function.

Table 2-1. *RF Cable Connection*

VNMS - FRONT	Connects To:	**TEST SET - FRONT**
PORT 1		"TO PORT 1"
PORT 2		"TO PORT 2"
PORT 3		"TO PORT 3"
TEST SET - FRONT	Connects To:	**DEVICE UNDER TEST**
TEST PORT 1		DUT INPUT
TEST PORT 2		DUT OUTPUT
VNMS - REAR	Connects To:	**MN4783A -REAR**
PORT a1		PORT a1
PORT a2		PORT a2
PORT b1		PORT b1
PORT b2		PORT b2
NOISE IN		NOISE OUT
MN4783A TEST SET - REAR	Connects To (See Figure 2-3 for a block diagram)	**ISOLATOR**
C1		20 dB Attenuator or Isolator In
C2		20 dB Attenuator or Isolator Out

Step 4. For Noise Figure measurements only (Noise Source and adapters are not included):

a. Slide the Noise Source into the rear panel bracket and connect the Noise Source RF connector to the rear panel Noise Source In connector via a right angle SMA adapter.

b. Connect a BNC cable between the Noise Source Bias Input connector and the rear panel Noise +28V connector of the MS4623C.

Step 5. Install the control cable between the External I/O connector on the rear panel of the MS4623C and the Control In connector on the rear panel of the test set.

Step 6. Connect the GPIB cable from the IEEE-488.2 connector on the rear panel of the MS4623C to the PC/System Controller. (Note: This cable is not supplied with the ME7840/4.)

Step 7. Connect an AC power cord to both of the three-prong connectors on the rear panel of the test set and the MS4623C.

Step 8. (Optional, for drain current PAE measurements.) Connect the current probe cable BNC connector to the Ext. Analog In connector on the rear panel of the MS4623C as shown in Figure 2-4, below.

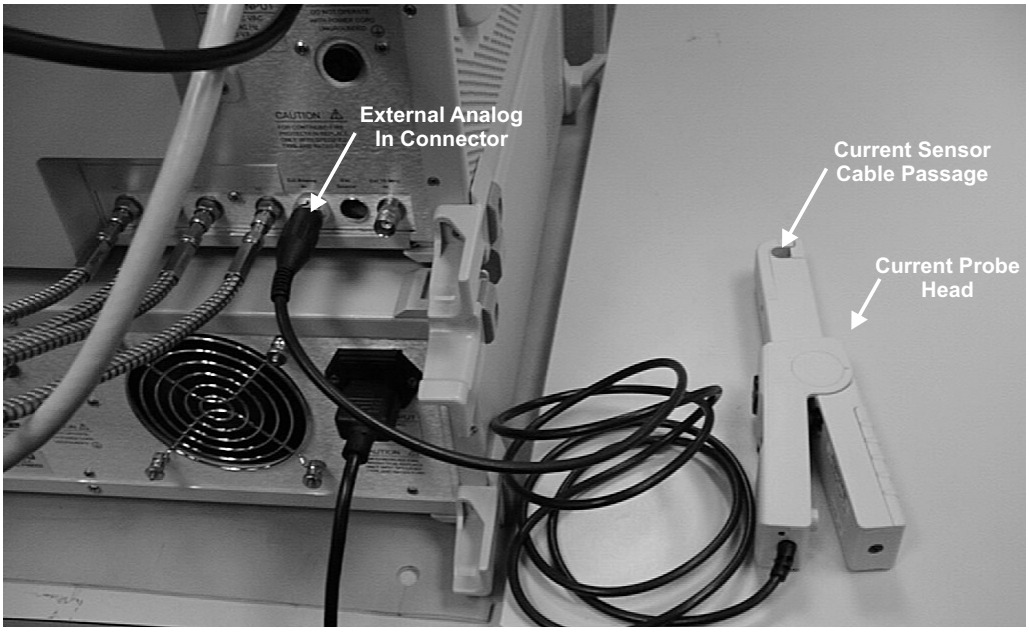

Figure 2-4. *Current Probe Connection*

2-5 Service Centers

Table 2-2. *Anritsu Service Centers*

UNITED STATES

ANRITSU COMPANY
490 Jarvis Drive
Morgan Hill, CA 95037-2809
Telephone: (408) 776-8300
1-800-ANRITSU
FAX: 408-776-1744

ANRITSU COMPANY
10 New Maple Ave., Unit 305
Pine Brook, NJ 07058
Telephone: (973) 227-8999
1-800-ANRITSU
FAX: 973-575-0092

ANRITSU COMPANY
1155 E. Collins Blvd
Richardson, TX 75081
Telephone: 1-800-ANRITSU
FAX: 972-671-1877

AUSTRALIA

ANRITSU PTY. LTD.
Unit 3, 170 Foster Road
Mt Waverley, VIC 3149
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Telephone: 03-9558-8177
FAX: 03-9558-8255

BRAZIL

ANRITSU ELECTRONICA LTDA.
Praia de Botafogo, 440, Sala 2401
CEP22250-040, Rio de Janeiro, RJ, Brasil
Telephone: 021-527-6922
FAX: 021-53-71-456

CANADA

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700 Silver Seven Road, Suite 120
Kanata, Ontario K2V 1C3
Telephone: (613) 591-2003
FAX: (613) 591-1006

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No. 516 Fu Te Rd (N)
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FAX: 21-58680588

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FAX: 016-44-61-065

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ANRITSU GmbH
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FAX: 0211-9685555

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FAX : 011-2-644250023

ISRAEL

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Tel-Aviv 69719
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FAX: (03) 64-78-334

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ANRITSU Sp.A
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00144 Roma EUR
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FAX: (06) 50-22-4252

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FAX: 02-553-6604

Service Center:
8F Hyunjuk Building
832-41, Yeoksam Dong
Kangnam-Gu
Seoul, South Korea 135-080
Telephone: 82-2-553-6603
FAX: 82-2-553-6605

JAPAN

ANRITSU CUSTOMER SERVICE LTD.
1800 Onna Atsugi-shi
Kanagawa-Prf. 243 Japan
Telephone: 0462-96-6688
FAX: 0462-25-8379

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#07-01/02 Keppel Towers
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FAX: 282-2533

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FAX: 011-27-11-787-0446

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FAX: (08) 534-707-30

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Chapter 3
General Operation

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Chapter 3
General Operation

3-1 Introduction

This chapter describes the general operation of the Model ME7840/4 (without the use of external preamplifiers). The following procedure provides information to set up and prepare the test system for making calibrated measurements. Refer to Chapter 5, Preamplifer Operations, for operating information when using external preamplifiers.

3-2 Preparing the System

Refer to Figure 3-1 (page 3-5) to identify the equipment named in the recommended power-up sequence for the ME7840/4.

Step 1. Turn on the MS4623C, then the MN4783A test set.

Step 2. Set the output of the MS4623C such that the source power plus the gain of the AUT does not exceed the maximum MN4783A Test Port 2 input level of 5 Watts. If the AUT output power exceeds 5 Watts, use external attenuation to bring the power level down to the maximum power level (below).

Test Set Model	External Circulator Used	Test Port 2 Maximum Power*
MN4783A	Supplied 20 dB 10 Watt Attenuator	5 Watts
MN4783A	None (port C1 directly connected to port C2)	0.1 Watts Forward 0.1 Watts Reverse
MN4783A	1000-50 or 1000-52 (20 dB isolation)	5 Watts
MN4783A	1000-53 (22 dB isolation)	5 Watts

***** Also limited by the power rating of the isolator or circulator, if used.

CAUTIONS

The maximum AUT RF power output level should be no more than the level shown in the tabulation at the right. Otherwise, damage to the equipment will occur.

Because of the high risk of damage to the equipment, it is not recommended to directly connect port C1 to port C2.

Use of circulators require a 5 Watt (or higher) termination on the unused port.

Step 3. Connect the output of the AUT to Test Port 2 of the MN4783A.

Step 4. Connect the input of the AUT to Test Port 1 of the MN4783A.

Step 5. Ensure that the power rating of the cables is suitable for the test and that the connections are tightened.

NOTE
The 20 dB attenuator is used to protect Scorpion's Port 2 from damage. When making reverse or probe tone power level measurements, it is important to consider the limitations imposed by the use of an attenuator, isolator, circulator, or throughline connected between port C1 and C2 of the test set.

These limitations affect measurement power levels and frequency coverage as indicated by the components used and the power handling capacity of the test ports.

Step 6. Check the following front and rear panel connections of the MN4783A test set:

- A coaxial "jumper" cable on the front panel between the Input and Output Preamplifier connectors
- A 20 dB attenuator, isolator, circulator, or a through line between ports C1 and C2 on the rear panel

Step 7. When ready for measurements, cautiously apply DC power to the AUT.

Step 8. If drain current and/or PAE measurements are desired, the optional current probe (Anritsu part number 2000-1067 or 2000-1085) can be used. Ensure the probe (Figure 3-1, following page) has a fresh battery, and set the zero offset using the MS4623C as follows:

a. Press the Appl key, then select the Domain soft-key to set **Transmission & Reflection**; using the Display soft-key, set for **Single Channel**; using the Graph Type soft-key, set for **Real**; using the Scale soft-key and Data Entry keys, set for 1 mU/Division. Use the Avg key and associated soft-keys to set **Averaging** for 10 and **IF Bandwidth** for 300 Hz. Use the Config key, **DATA POINTS** and associated soft-keys to set for 101 **Max Data Points**.

b. Use the Measure soft-key and select **Ext. Analog In**.

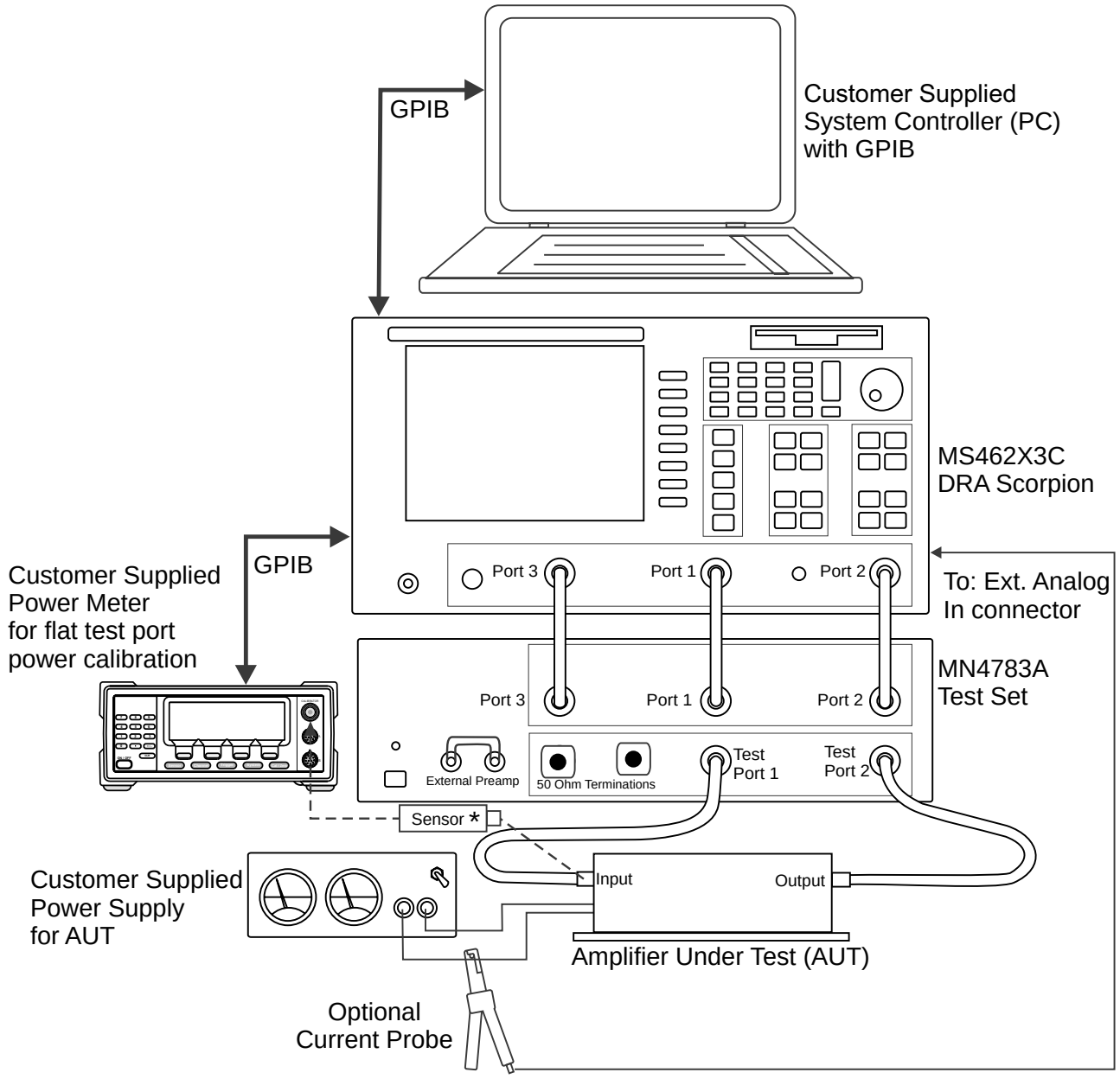
c. Turn on the current probe and set it for the desired range (ensure that there is no object through the jaws and that they are closed).

d. Adjust the "Zero Adjustment" thumb wheel until the reading is minimum (typically 0 ±100μU).

e. On the current probe:
Orient the probe such that the "Current Direction" arrow points in the direction of dc current flow (away from the power supply).

Place the jaws only over the positive dc wire (not both wires).

Unused Connections The EXT. SOURCE and AUX. OUT connectors must be terminated with 50Ω terminations when not in use.



*Connect when directed by the procedure for power calibrations

Figure 3-1. *ME7840/4 Measurement Setup*

3-3 Calibrations and Measurements

All calibration and measurement operations are covered in the Scorpion Navigator Software User's Guide. The Scorpion Navigator User's Guide describes the installation and use of Scorpion Navigator as well as documents the calibrations, measurements, and measurement results from the test system. Refer to this guide for calibration, measurement, and test procedures when using Scorpion Navigator with your Handset Amplifier Test System.

Chapter 4
Performance Verification Procedures

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Chapter 4
Performance Verification Procedures

4-1 Introduction

The following are the specific tests that should be used to verify the performance of the Handset Amplifier Test System:

- Source Output Level Accuracy Test
- Effectivity, Directivity, and Effective Test Port Match Test
- System Dynamic Range Test

4-2 Conventions

For the tests in this chapter, instructions direct the use of front panel hard-keys and soft-keys. The hard-keys and soft-keys will appear in a different typeface. For example:

Step 1. Press the Utility key and select:

DIAGNOSTICS
TROUBLESHOOTING
MORE
VERIFY ALC CALIBRATION

The Utility key is a front panel hard-key and DIAGNOSTICS, TROUBLESHOOTING, MORE, and VERIFY ALC CALIBRATION are all soft-keys.

4-3 Test Equipment

The following equipment is required to perform the verification procedures:

- Anritsu Model ML243XA Power Meter
- Anritsu Model MA247XA Power Sensor
- Anritsu Model 3753LF or 3753R N Connector Calibration Kit
- Anritsu Model 3670NN50-2 Cable
- Anritsu 2100-2 GPIB Cable
- Anritsu Model 18N50 Air Line
- Anritsu Model 29A50-20 Offset Termination
- Anritsu Model 22A50 Open/Short

4-4 Source Output Accuracy

This test verifies the source output accuracy of the MS4623C. The test procedure uses the Power ALC Verification built-in function of the MS4623C Basic Measurement Software (BMS).

Setup:

Turn on the MS4623C VNMS and the MN4783A test set and allow them to warm up for 30 minutes.

Step 1. Connect a GPIB cable between the power meter GPIB connector and the MS4623C dedicated GPIB connector, as shown in Figure 4-1.

Step 2. Turn on the MS4623C VNMS and allow it to warm-up at least one hour.

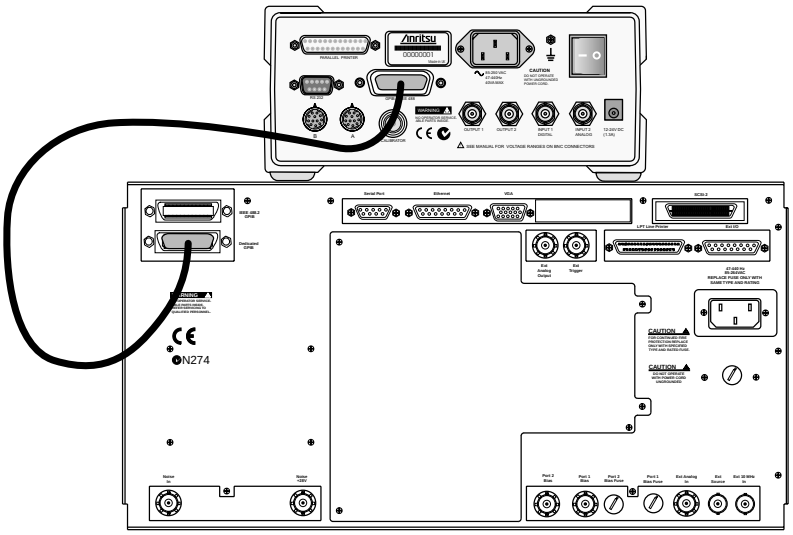

Figure 4-1. *ML2430A Series Power Meter GPIB Connection to the MS4623C Vector Network Measurement System*

Test Procedure:

Step 1. Disconnect the cables between Port 1 of the MS4623C and Port 1 of the MN4783A test set and between Port 3 of the MS4623C and Port 3 of the MN4783A test set.

Step 2. Press the Utility key and select:

DIAGNOSTICS
TROUBLESHOOTING
MORE
VERIFY ALC CALIBRATION

Step 3. Calibrate and zero the power sensor.

Step 4. Connect the power sensor to Port 1 of the MS4623C and select the START VERIFICATION soft-key.

NOTE
The worst case test result will be displayed on the screen only when the instrument fails this test. The failed test result is also recorded in the service log.

CAUTION
The troubleshooting function must be properly exited to restore normal operation.

Step 5. Verify that Source 1 passes this test.

Step 6. Press the SELECT SOURCE soft-key to select 2.

Step 7. Connect the power sensor to Port 3 of the MS4623C and select the START VERIFICATION soft-key.

Step 8. Verify that Source 2 passes this test.

Step 9. To exit the TROUBLESHOOTING mode, select the menu soft-keys as follows:

RETURN
RETURN
FINISHED, RECOVER FROM TROUBLESHOOTING

Step 10. Reconnect the cables between Port 1 of the MS4623C and Port 1 of the MN4783A test set and between Port 3 of the MS4623C and Port 3 of the MN4783A test set.

4-5 *Effective Directivity and Effective Test Port Match*

This test verifies that the effective directivity and effective test port match of the system meets specifications.

Setup:

Turn on the MS4623C VNMS and the MN4783A test set and allow them to warm up for 30 minutes.

Step 1. Press the Default key then the 0 key.

Step 2. Press the Seq key and select:

TTL I/O
PARALLEL OUT SETUP
SET PARALLEL OUT PORT (0-255)

Step 3. Change the value from 0 to 8.

Step 4. Select:

RETURN
RETURN

Step 5. Press the Display key and select:

DISPLAY MODE
SINGLE CHANNEL
RETURN

Step 6. Press the Ch 4 key and then the Display key.

Step 7. Select:

GRAPH TYPE
LOG MAGNITUDE

Step 8. Press the Ch 1 key and select LOG MAGNITUDE.

Test Procedure: Insert the Calibration Component Coefficients disk into the MS4623C floppy disk drive.

Step 1. Press the Cal key and select:

COMPONENT UTILITIES
INSTALL KIT INFO FROM FLOPPY DISK
RETURN

Step 2. Follow the prompts and select:

PERFORM CAL: 2 PORT
CAL METHOD: STANDARD
LINE TYPE: COAXIAL
SELECT CALIBRATION TYPE: REFLECTION ONLY – PORT 1 ONLY
FREQUENCY RANGE OF CALIBRATION: 10 MHz TO 6000 MHz
SELECT CALIBRATION DATA POINTS: NORMAL
DATA POINTS: 401 POINTS
PORT 1 CONNECTOR TYPE: N (F)
LOAD TYPE: BROADBAND LOAD

Step 3. Select the START CAL soft-key to begin the calibration.

Step 4. Install the calibration device per the instruction on the display. Select the appropriate soft-key to measure the calibration device.

Step 5. When the message, "CALIBRATION SEQUENCE COMPLETED" is displayed, press the Enter key to continue.

Step 6. Connect the N male connector end of the Air Line to Test Port 1 and terminate the GPC-7 end of the Air Line with a Short.

Step 7. Press the Display key and select AUTO SCALE.

Step 8. Press the Marker key and select READOUT MARKERS.

Step 9. Turn on Marker 1, Marker 2 and Marker 3. Find the biggest ripple between 10 MHz and 3 GHz.

Step 10. Using the rotary knob, position Marker 1 and Marker 2 to adjacent peaks of the ripple with the greatest negative trough (or adjacent troughs if the ripple has the greatest positive peak). Also, position Marker 3 to the bottom of the trough (or the top of the peak if the ripple has the greatest positive peak). Refer to Figure 4-2.

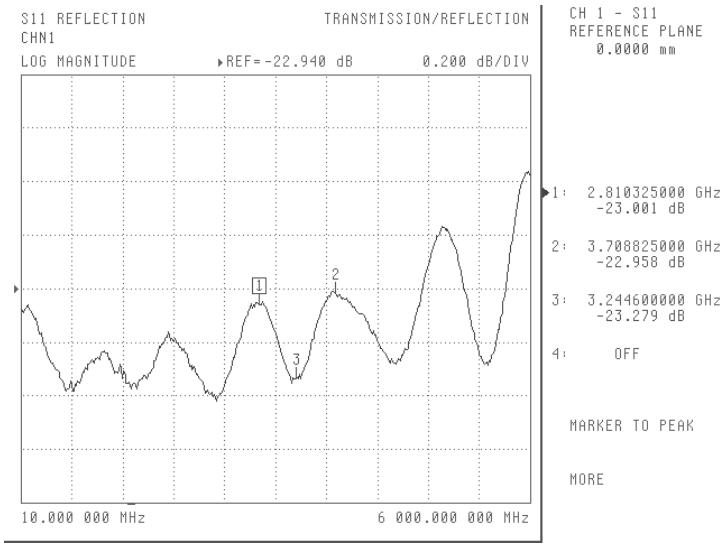

Figure 4-2. *Measuring Peak-to-Peak Ripple*

Step 11. Record the value of Marker 1 and Marker 2. Sum the two values and divide the result by two (see the formula below). This is the average value of the two peaks (or troughs). Record this average value.

$$\frac{M1 + M2}{2} = Average\ value$$

Step 12. Record the value of Marker 3.

Step 13. Find the absolute difference of the values recorded in Steps 11 and 12.

|Average value – M3| = Peak-to-Peak Ripple

This is the Peak-to-Peak Ripple value. Use an RF Measurement Chart to find the corresponding Return Loss value. This is the measured effective test port match. Verify that the test port match is better than 40 dB (Table 4-3, following page).

Step 14. Find the largest ripple between 3 GHz and 6 GHz.

Step 15. Repeat Steps 10 through 13 and verify that the test port match is better than 33 dB from 3 GHz to 6 GHz (Table 4-3).

Step 16. Remove the Short and connect the 29A50-20 Offset Termination to the GPC-7 end of the Air Line.

Step 17. Press the Display key and select AUTO SCALE.

Step 18. Find the largest ripple between 10 MHz and 3 GHz.

Step 19. Repeat Steps 10 through 12.

Step 20. Find the absolute difference of the values recorded in Steps 11 and 12. This is the Peak-to-Peak Ripple value. Use an RF Measurement Chart to find the corresponding Return Loss value.

Step 21. Find the corresponding 1 + X or 1 – X value from the RF Measurement Chart. Use the following formula to calculate the effective directivity value:

For ripple with a negative trough:

Effective Directivity =
Return Loss value + |(Marker 3 value)| – |(1 – X value)|

For ripple with a positive peak:

Effective Directivity =
Return Loss value + |(Marker 3 value)| + |(1 + X value)|

Step 22. Verify that the directivity is better than 44 dB from 10 MHz to 3 GHz (Table 4-3, following page).

Step 23. Find the largest ripple between 3 GHz and 6 GHz.

Step 24. Repeat Steps 25 through 27 and verify that the directivity is better than 38 dB from 3 GHz to 6 GHz (Table 4-3).

Step 25. Press the Ch 4 key and then the Display key.

Step 26. Select:

GRAPH TYPE
LOG MAGNITUDE
RETURN

Step 27. Press the Cal key.

Step 28. Follow the prompts and select:

PERFORM CAL: 2 PORT
CAL METHOD: STANDARD
LINE TYPE: COAXIAL
SELECT CALIBRATION TYPE: REFLECTION ONLY – PORT 2 ONLY
FREQUENCY RANGE OF CALIBRATION: 10 MHz TO 6000 MHz
SELECT CALIBRATION DATA POINTS: NORMAL
DATA POINTS: 401 POINTS
PORT 2 CONNECTOR TYPE: N(F)
LOAD TYPE: BROADBAND LOAD

Step 29. Select the START CAL soft-key to begin the calibration.

Step 30. Install the calibration device per the instruction on the display. Select the appropriate soft-key to measure the calibration device.

Step 31. When the message, "CALIBRATION SEQUENCE COMPLETED" is displayed, press the Enter key to continue.

Step 32. Connect the N male connector end of the Air Line to Test Port 2 and terminate the GPC-7 end of the Air Line with a Short.

Step 33. Repeat Step 7 through Step 24 to verify the effective directivity and effective test port match of Test Port 2.

Table 4-3. *Test Port Specifications*

	Test Port 1	Test Port 2	Specifications
Directivity 10 MHz to 3 GHz 3 GHz to 6 GHz			 40 dB 40 dB
Test Port Match 10 MHz to 3 GHz 3 GHz to 6 GHz			 40 dB 37 dB

4-6 System Dynamic Range

This test verifies the ME7840/4 system dynamic range.

Setup: Turn on the MS4623C VNMS and the MN4783A test set and allow them to warm up for 30 minutes.

Step 1. Press the Default key then the 0 key of the MS4623C to reset the system.

Step 2. Press the Seq key.

Step 3. Select:

TTL I/O
PARALLEL OUT SETUP
SET PARALLEL OUT PORT (0-255)

Step 4. Change the value from 0 to 8.

Step 5. Select:

RETURN
RETURN

Step 6. Press the Ch 3 key.

Step 7. Press the Display key and select:

DISPLAY MODE
SINGLE CHANNEL
RETURN
GRAPH TYPE
LOG MAGNITUDE
RETURN

Test Procedure:

Step 1. Press the Cal key.

Step 2. Follow the prompts and select:

PERFORM CAL: 2 PORT
CAL METHOD: STANDARD
LINE TYPE: COAXIAL
SELECT CALIBRATION TYPE: TRANSMISSION FREQUENCY RESPONSE
PATH: FORWARD PATH (S_{21})
USE OF ISOLATION IN CALIBRATION: INCLUDE
FREQUENCY RANGE: 10 MHz TO 6000 MHz
SELECT CALIBRATION DATA POINTS: NORMAL
DATA POINTS: 401 POINTS
TEST SIGNAL/PORT 1 POWER: 10 dBm

Step 3. After the selections are complete, press the START CAL soft-key to begin the calibration.

Step 4. Install the calibration device per the instruction on the display. Select the appropriate soft-key to measure.

Step 5. When prompted to connect the isolation device, press the Avg key and select:

SELECT I.F. BANDWIDTH
I.F BW 10 Hz

Step 6. Select the MEASURE BOTH PORTS soft-key to continue.

Step 7. Connect a cable between Test Port 1 and Test Port 2 of the MN4783A test set when the software display prompts you for a throughline.

Step 8. When the message, "CALIBRATION SEQUENCE COMPLETED" is displayed, press the Enter key to continue.

Step 9. Press the Avg key and select:

SELECT I.F. BANDWIDTH
I.F. BW 10 Hz

Step 10. Remove the through cable between Test Port 1 and Test Port 2 of the MN4783A test set and connect terminations to both test ports.

Step 11. Press the Display key and then select SCALE.

Step 12. Set the REFERENCE VALUE to –80.

Step 13. Verify that the trace is less than –80 dB from 10 MHz to 3 GHz and is less that –70 dB from 3 GHz to 6 GHz..

Chapter 5
Preamplifier Operations

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Chapter 5
Preamplifier Operations

5-1 Introduction

This chapter describes the use of external preamplifiers to boost signal power at the input of a test amplifier.

5-2 Use of External Preamplifiers

External preamplifiers can be used to boost signal level at the input of the AUT. The maximum power per tone at the AUT input without any external preamplifier is +13 dBm. Block diagrams showing this feature are contained in Figure 5-1 (page 5-4).

As shown in Chapter 1, Figure 1-2, an optional external preamplifier may be added to the front panel preamplifier loop to boost power in excess of +13 dBm. However, the nonlinearity of this preamplifier may adversely affect the linearity measurements of the AUT, unless it is far below the AUT.

When using an external preamplifier in the front panel loop, two other issues must be addressed:

- Driving the DRA Scorpion channels a_1 and b_1 into compression
- Possibility of damage to the combiner

The first issue is avoided by using an attenuator at the input of channels a_1 and b_1. The value of this attenuator should be selected noting that the maximum operating signal level at a_1 and b_1 is –5 dBm, and that the coupling factor between AUT input and channel a_1/ b_1 input is –20 dB. Thus, if measurements with an AUT input power of 1 watt (30 dBm) is required, a 15 dB attenuator in each path is needed. In general, attenuators are needed if P_{in} (max power at AUT input) is greater than 25 dBm and the value of attenuator is given by A (dB) = P_{in} (dBm) –25. As an alternative to using the internal preamplifiers, additional flexibility is possible to use higher power external preamplifiers as shown in Figure 5-1.

Alternative Preamplifier Configuration

For greater preamplifier power levels, an external combiner should be used. Figure 5-1 is a suggested block diagram for this configuration. The ME7840/4 is designed to enable power calibrations in the presence of external preamplifiers. For the flat power calibration, the user can specify his target power (at the AUT input which is the calibration reference plane) and an approximate source power (at the Scorpion Port 1, Port 3, or both). For tests involving power sweep, the ME7840/4 enables a linear power calibration over the desired power range (and the frequency range). For this calibration, the user can specify his target power start and stop values and a nominal power offset between this reference plane and the Scorpion source (the net of preamplifier gain minus test setup losses).

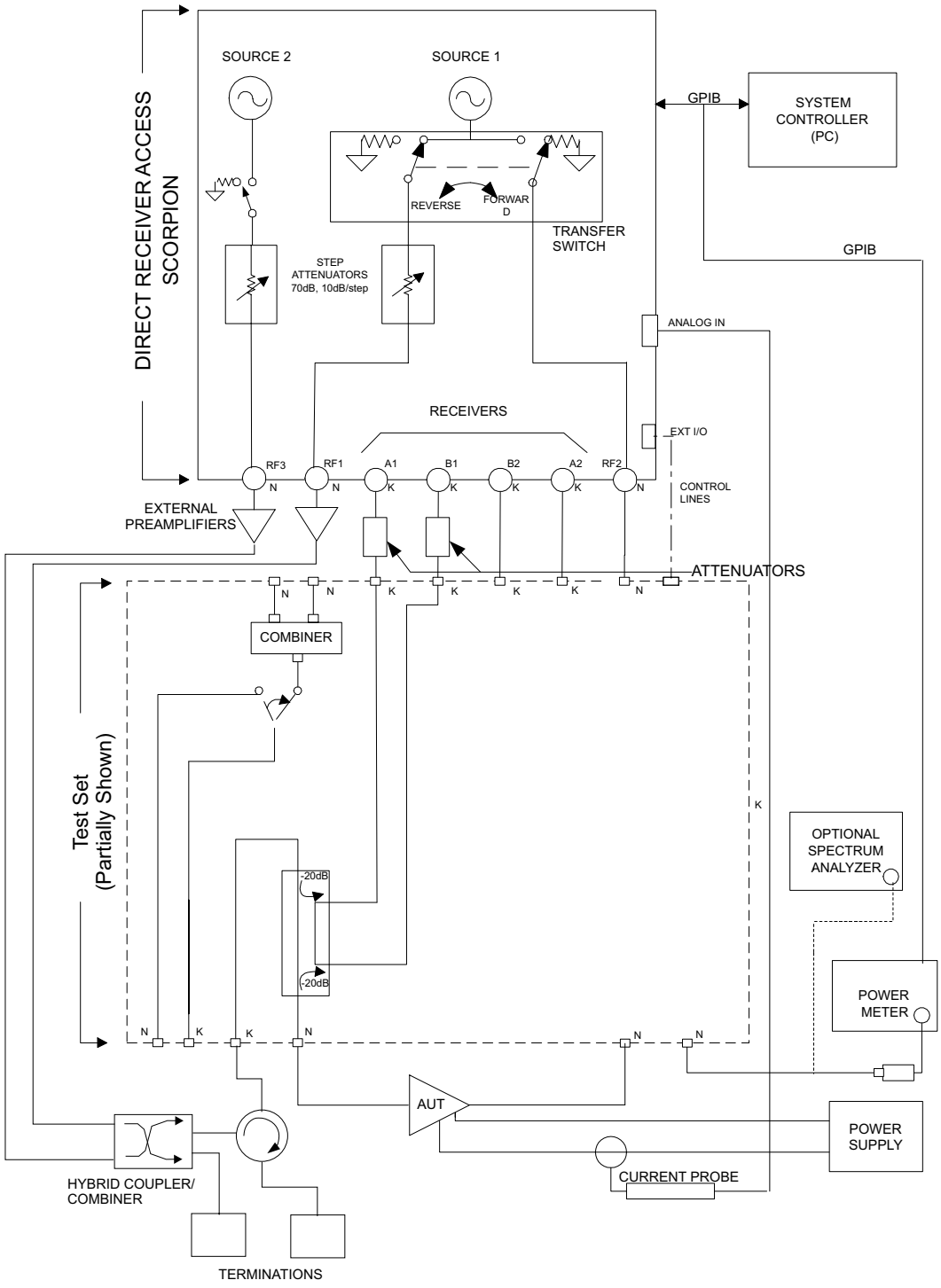

Figure 5-1. *MN4783A with External Combiner*

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NOTES


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