Chapter 1
General Information

1-1 SCOPE OF MANUAL

This manual provides general service and preventive maintenance information for the ANRITSU MS4782A and MS4782D Test Set for the ME7840A Power Amplifier Test System. It contains procedures for:

- Testing the instrument for proper operation.
- Verifying measurement accuracy and traceability to National Institute of Standards and Technology (NIST).
- Troubleshooting a failed instrument to the exchange subassembly level or the subsystem requiring adjustment.
- Locating and replacing failed parts.

Throughout this manual, the terms "MS4782X" and "Test Set" will be used interchangeably to refer to both Models of MS4782X Test Set, unless otherwise noted.

1-2 INTRODUCTION

This chapter provides a general description of Power Amplifier Test System serial numbers, frequency ranges, and related manuals. It also includes service strategy, available service facilities, and static-sensitive component handling precautions, and a list of recommended test equipment.

1-3 IDENTIFICATION NUMBER

All ANRITSU instruments are assigned a six-digit ID number, such as "401001". This number appears on a decal affixed to the rear panel. Please use this identification number during any correspondence with ANRITSU Customer Service about this instrument.

1-4 ONLINE MANUAL

This manual is available on CD ROM as an Adobe Acrobat™ (*.pdf) file. The file can be viewed using Acrobat Reader™, a free program that is also available on the CD ROM. This file is "linked" such that the viewer can choose a topic to view from the displayed "bookmark" list and "jump" to the manual page on which the topic resides. The text can also be word-searched. A copy of this CD ROM, part number 10920-00035, is provided free of charge with this manual.

1-5 PATS SYSTEM OVERVIEW

The ANRITSU ME7840A Power Amplifier Test System (PATS) is intended for the measurement and real-time graphical display of the following parameters of a power amplifier in the frequency range of 800 MHz to 2.4 GHz:

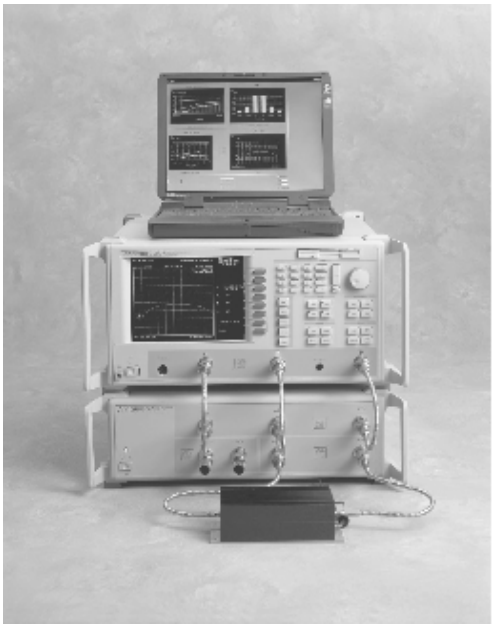
- S-Parameters including Hot S_{22}
- K Factor
- Gain Compression and Phase Distortion
- Intermodulation Distortion
- Harmonics
- Drain Current and Power Added Efficiency (PAE)

PATS is designed to facilitate alignment, tuning and pass/fail testing of the components, modules and subassemblies of a power amplifier as well as the completed amplifier.

1-6 HARDWARE DESCRIPTION

The ME7840A hardware (below) consists of a MS462XC, Direct Receiver Access (DRA) Scorpion, a MS4782X Test Set, a customer supplied Personal Computer (PC), and an optional current probe. The MS462XC is available in two frequency ranges: 10 MHz to 3 GHz or 10 MHz to 6 GHz.

The Test Set is available in two configurations, as described in Table 1-1 The MS4782D is standard, and the MS4782A is Option 2. A block diagram of the PATS is shown in Figure 1-2 and the Option 2 system in Figure 1-1.



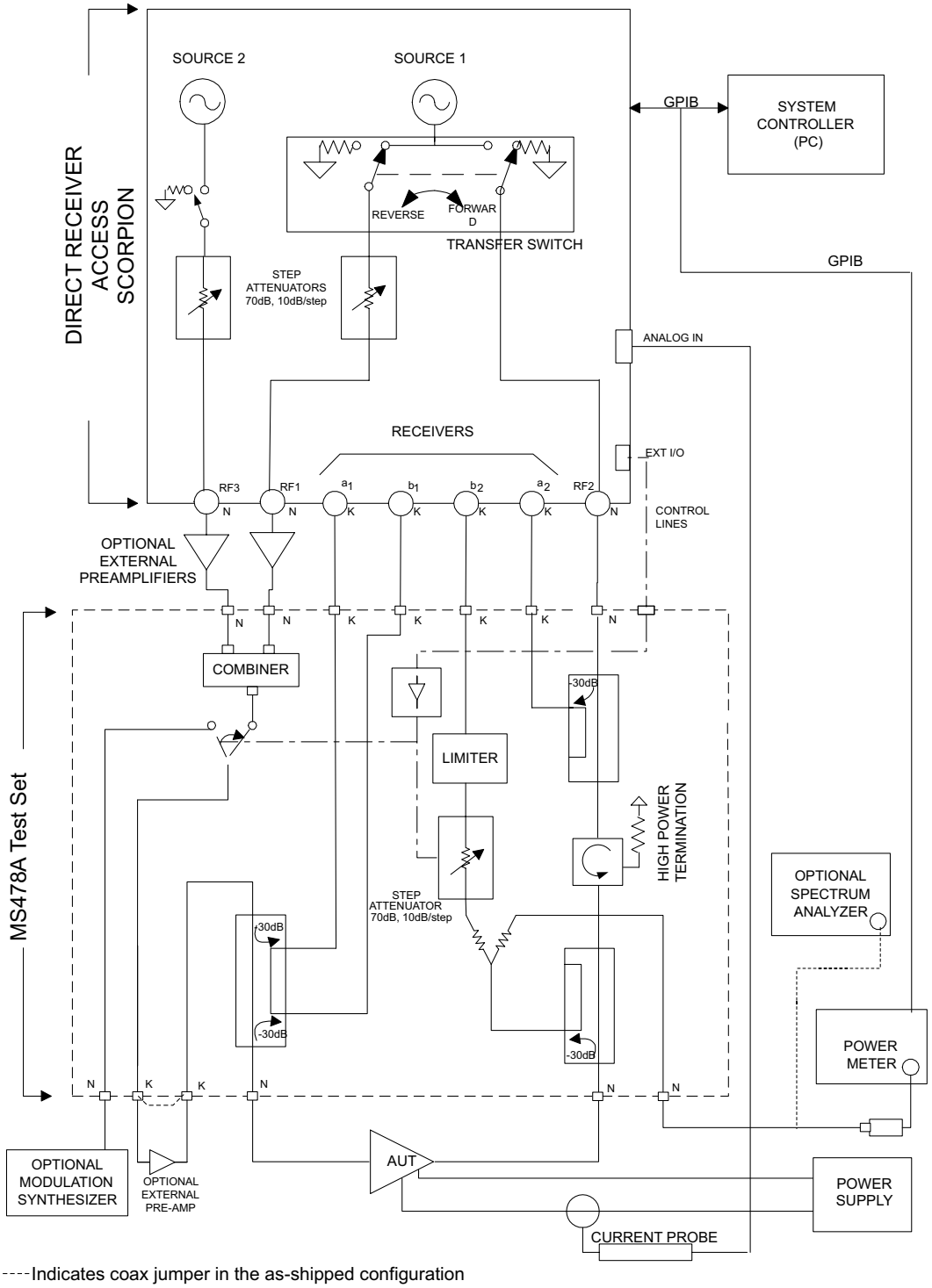


Figure 1-1. *Overall Functional Block Diagram of the Option 2 Power Amplifier Test System (PATS) with MS4782A Test Set*

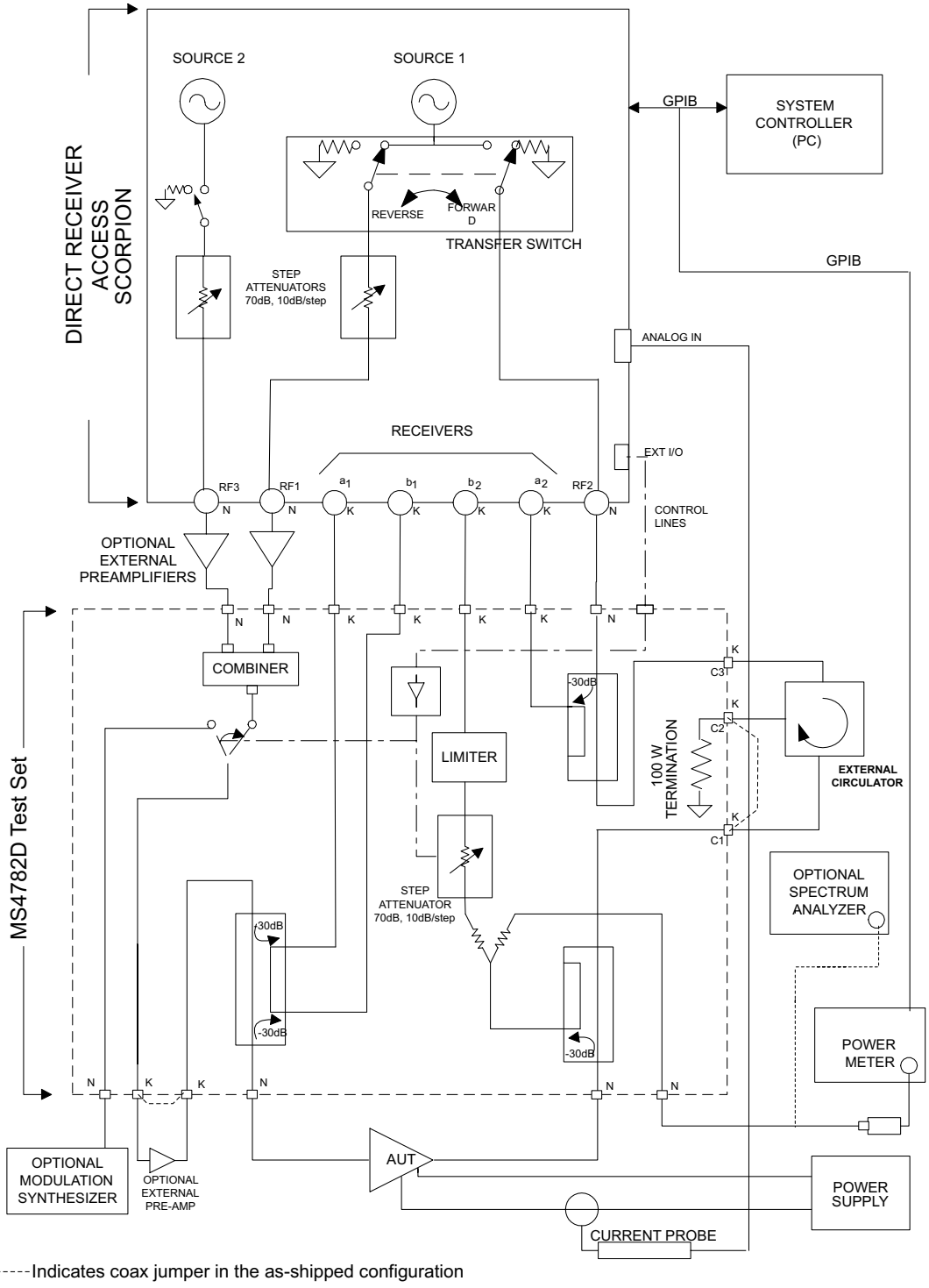


Figure 1-2. *Overall Functional Block Diagram of the Basic Power Amplifier Test System (PATS) with MS4782D Test Set*

Table 1-1. *Test Set Configurations*

Model	Frequency Range (MHz)	Max AUT Power Output (Watts)	Reverse Measurements (S_{22}, Hot S_{22}, S_{12} Possible)	Circulator (at AUT Output Path)
MS4782A	800 to 1000	50	Yes	Internal
MS4782D	800 to 2400 (Note 1)	100 (Note 2)	Yes	External

Notes:

1. This frequency range does not account for any restricting effects caused by use of external circulator.
2. This Max AUT power assumes a minimum isolation of 23 dB provided by external circulator(s). Two circulators may have to be used to provide the required isolation.

1-7 SYSTEM DESCRIPTION

Brief descriptions of the DRA Scorpion (MS462XC) and MS4782X Test Set are given below.

DRA Scorpion

The Scorpion Direct Receiver Access (DRA) version Vector Network Measurement System (VNMS) (Figure 1-2) 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 & 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 0dB to 70dB 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.

MS4782X Test Set

The Series MS4782X Test Set contains a Wilkinson type combiner that combines the two RF signals from Ports 1 and 3 (RF1 & RF3) of the Scorpion. External preamplifiers can optionally be provided at the

combiner input to boost the input RF power to the amplifier-under-test (AUT). The combiner has power input rating of 30-Watts maximum when terminated with a VSWR of 1.2:1. For an open or short at the combiner output, the combiner input power rating is 0.5 Watts maximum.

The output of the combiner is fed to a source selection switch that enables 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.

A provision for the insertion of an optional external pre-amplifier (after the combiner and source selection switch) is also provided. Refer to Chapter 7, “Preamplifier Operations,” for details.

The test set includes a bi-directional coupler at the input of the AUT that separates the incident signal from the reflected signal. The power rating of this bi-directional coupler is 100 watts average. The –30 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 high power coupler in the test set. The power rating of this coupler is also 100-watts average. The –30 dB coupled arm of this coupler is routed to the test port b_2 of the Scorpion through a 6 dB resistive divider and a 0-dB to 70-dB step attenuator (10dB/step). A limiter is also provided in this path provide added protection for the Scorpion reference channel .

The divider enables the connections of a power meter or Spectrum Analyzer, when desired, to measure the AUT b_2 output.

The through arm of the 100-W coupler is routed to a high power (100-Watt) termination through a circulator. In the MS4782A Test Set, the circulator is internal and has a rating of 100 watts average. This circulator has an isolation specification of 20-dB minimum. This means that the AUT output power is attenuated by 20 dB (plus other losses) before reaching the Scorpion port 2. Since the maximum (no-damage) power level for this port is 27 dBm (0.5 watt), this establishes the maximum AUT output power at 50 watts.

In the MS4782D Test Set, the circulator is external as shown in Figure 1-2. In selecting an external circulator, the following criteria should be used.

- *Power rating:* Should be no less than the power output of the amplifier-under-test (AUT). It should be noted that a 100 watt termination is provided in the Test Set for the termination port of the external circulator.
- *Bandwidth:* Should be sufficiently wide to cover the frequency band of the AUT.
- *Isolation:* Should be no less than (P_O -27 dB), where P_O is the power output in dBm of the AUT. Thus for Po = 47 dBm (50 watts), a 20 dB isolation is required. For a P_O greater than 47 dBm up to 50 dBm (100 watts), two circulators in series can be used.

Where S_{22} or Hot S_{22} measurements are not required, power amplifiers with up to 100 watts average output power can be tested with the MS4782D Test Set without any circulator by connecting the through arm of the output coupler directly to the 100 watt termination (Port C1 connected to Port C2 on the rear. The unit is shipped from the factory with this loop jumper.)

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 100-watt coupler in the test set applies the –30 dB portion of this incident signal to the Scorpion reference port a_2. The –30 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 coupler.

The PATS calibration is performed with the test set in place, at the connectors where 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 MS4622/3C DRA Scorpion three Type N (female) connectors are provided for Ports 1, 2 and 3.

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

On the rear of the unit, four SMA connectors (Figure 1-) 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 MS4782D Test Set, three additional SMA connectors provide for connecting an external circulator. If reverse measurements (S_{22} and Hot S_{22}) are not desired, then a circulator is not required. Instead, a through line should be connected between connectors C1 and C2 (Figure 1-). The MS4782A is shipped from the factory with this through line in place.

1-8 SERVICE CENTERS

ANRITSU Company offers a full range of repair and calibration services at fully staffed and equipped service centers throughout the world. Table 2-1, located on page 2-2, lists all ANRITSU services centers.

1-9 STATIC SENSITIVE COMPONENT HANDLING PROCEDURES

The Test Set contains components that can be damaged by static electricity. Figure 1-2 illustrates the precautions that should be followed when handling static-sensitive subassemblies and components. If followed, these precautions will minimize the possibilities of static-shock damage to these items.

1-10 RECOMMENDED TEST EQUIPMENT

Table 1-2 lists the recommended test equipment to be used for all maintenance activities for the MS4782X models. Note the “Use” codes listed in the right hand column of the table. These codes list the applicable maintenance activities for the equipment listed.