Operating Instructions

Introduction

This section contains a functional description of the Powerwave Technologies, Inc.'s RFFE Multi-Carrier Power Amplifier System. Refer to Figure 1 for the system's functional block diagram.

RF INPUT Signal

The maximum input power for all carrier frequencies should not exceed the limits specified in section 1, table 1-2 of this manual. For proper amplifier loop balance, the out of band components of the input signals should not exceed -60 dBc. The input VSWR should be 2:1 maximum (or better).

RF OUTPUT Load

The load impedance should be as good as possible (1.5:1 or better) in the working band for good power transfer to the load. If the amplifier is operated into a filter, it will maintain its distortion characteristics outside the signal band even if the VSWR is infinite, provided the reflected power does not exceed one watt. A parasitic signal of less than one Watt incident on the output will not cause distortion at a higher level than the normal forward distortion (i.e. -60 dBc).

System Functional Description

A two piece design, the RF Front End (RFFE) Multi-Carrier Power Amplifier system is comprised of a Mast Head Unit (MHU) which is installed on the antenna tower and a Mast Head Unit Interface (MHUI) that is installed in the host base station.

The MHU is comprised of two transmit modules for redundancy and a common box assembly. Each transmit module houses one MPA8503-55 power amplifier and one 27 Vdc, 1200 Watt power supply. Powered by 220 Vac from the host base station, each module is equipped with a 220 Vac variable speed fan to maintain the system's operating temperature. The common box mates the two amplifiers via blind mate connectors. Mounted in a support frame to withstand heavy wind loads, the common box houses a redundant LNA path, I/P O/P duplexers, receiver filter, a two-way power splitter, an active combiner and a control module. The RF IN, RF OUT, +27 Vdc and the ALARM summary connector, interface with the host system via the rear panel of the MHUI.

The MHUI is the interface between the RFFE system and the host base station. The MHUI reports alarms via the RS-485 bus or form-C interface and displays alarms using an LED display. The MHUI houses a low power duplexer, control board, the system control panel, a preamp, and the cell size variable attenuators (both transmit and receive).

A composite RF signal from the base station radios is applied to J2 (TX/RX) at the rear of the control panel. From there the signal passes through a voltage variable attenuator (VVA), then a two-way splitter. Each leg of the splitter passes through an isolator, then the blind-mate connector to interface with the MCPA. The signal then returns to the MHUI via the blind-mate connector after being amplified by the MCPA modules. The two high-power signals are combined by the active power combiner. The active power combiner has the capability of switching MCPA channels off-line by the use of RF switches. If an MCPA is not present, turned off, or faulted, the switch will open in that channel and physically disconnect that MCPA. The combiner maintains its low insertion characteristics when used in the single path configuration. Note that the splitter is not switched, therefore the power is automatically reduced by 3 dB, thus eliminating an output overdrive condition. The output of the combiner is fed through a coupler, then a receive-band filter. The amplified RF signal is available for use at the output of the receive-band filter (J2). The coupler is used to sample the output power to the true RMS detector. The true RMS detector will supply the microcontroller with an accurate average power regardless of the signal modulation type. The dynamic range is 25 dB. The power reading is used during the gain initialization phase when deploying the system or monitoring to detect excessive output power. In both cases the VVA will be adjusted accordingly. Two non-RF features of the RFFE system are inrush current limiting and alarm status/serial interface ports. The inrush current limiting circuitry is used to minimize the instantaneous current demand when the MCPA is first DC powered-up. This is due to the high capacitance on the MCPA's DC input. The circuit is placed in series on the DC source before the MCPA. Voltage for the MHU is derived prior to the in-rush current limit circuitry. The circuitry is in a high impedance state upon DC power-up. When an MCPA is enabled the impedance is slowly brought down to nearly 0 ohms. This will allow the capacitors to charge over a longer period of time, thus reducing the high current drain on the power supply. The three ports on the rear of the subrack are for Form-C alarms (J1), RS-485/Addressing serial communication (J7) and RS-485 and RS-232 serial communication (J8). The J1, J7, and J8 connectors are detailed in chapter 2 (see figures 2-2, 2-3, and 2-4, and tables 2-2, 2-3, and 2-4). The serial interface allows the user to acquire MCPA internal voltages and status, exercise MCPA and VVA control, upgrade MCPA or subrack firmware, and obtain true RMS power readings.

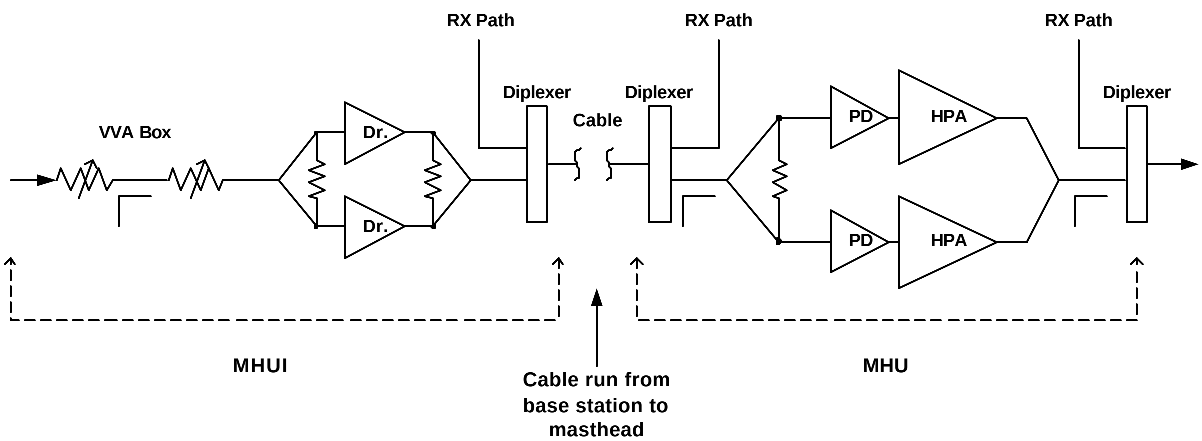

Figure 1RF Front End System Functional Block Diagram

Transmit Modules

Power output specifications for a one or two module system are listed in section 1, table1-1. Each amplifier is a self-contained plug-in module and is functionally independent of other amplifier modules. The amplifier modules are designed for parallel operation to achieve high peak power output, and for redundancy in unmanned remote locations.

The MPA8503-55 amplifier is a linear, feed-forward power amplifier that operates in the 25 MHz frequency band from 1930 to 1945 MHz.

	DOCUMENT NUMBER: ATP 500-01084	Page 1 of 9
Powerwave technologies	TITLE: Tower Top Pre-Distorter Tuning Procedure	

REVISION HISTORY

AUTHORITY	REV.	DESCRIPTION OF CHANGE	CHANGE DATE	RELEASE DATE
	A	Initial Release		
	B	Revised whole body of procedure	01/23/01	

Required Approval Signatures:

Title	Name (Print)	Signature	Date
Originator	John Lacanlale		
Quality Assurance	Chang-Kuo Tai		
Test Engineering	Howard Sheinman		
Mfg. Supervisor	Robert Rutkowski		
Mfg. Engineering	Steve Durand		

REVISION HISTORY (Continued)

AUTHORITY	REV.	DESCRIPTION OF CHANGE	CHANGE DATE	RELEASE DATE

Table of Contents

1.0 Purpose

The purpose of this procedure is to detail the tuning and testing requirements for the Pre-Distorter (500-01188) used on the MPA 8503-55.

2.0 Applicable Documents:

DS 500-01084-003	Data Sheet
090-03114	Process Analysis Check Sheet (PAC)

3.0 General Requirements

3.1 Test Conditions

The Acceptance tests shall be conducted under the following environmental conditions:

Temperature	25 °C to 35 °C (ambient)
Relative Humidity	<80% Noncondensing
Elevation/Altitude	Between 0 and 10,000 Feet
Load and impedance:	50 Ω VSWR <1.2:1
Supply Voltage:	15.0 V ±0.1V

3.2 Measurement Accuracy

Unless otherwise specified, measurement accuracy shall be within the accuracy of the specified test equipment. The following tolerances represent a reasonable limit on how many digits to record or how much interpolation to make of an analog meter:

DC Voltage	± 5%
DC Current	± 5%
RF Power	± 0.03 Watts except for 0.0 Watts
RF Frequency	±0.1 MHz

3.3 Calibration of Instruments

Instruments used in testing will be checked to verify that they are current within their calibration cycle.

3.4 Failure Reporting

Failures will be reported on the PAC sheet document number 090-03114.

4.0 Applicable Specifications

The Pre-Distorter shall be tested to the requirements stated in this test procedure.

5.0 Equipment and Materials

The following items are required in the performance of this procedure.
Substitutions may be made if they meet or exceed the minimum requirements.

ITEM NO.	DESCRIPTION	Minimum Requirements
1.	HP 8753D Network Analyzer	
2.	HP E3616A Power Supply (2)	0-35V, 0-1.7A
3.	HP 441A Power Meter	
4.	HP 8481A Power Sensor	
5.	HP 33401A Digital Multimeter	
6.	10 dB fixed attenuator	
7.	Test Fixture	

6.0 Station Calibration

NOTE: Station Calibration and Set-up should be done at the beginning of each shift.

The quality and the properties of the cables and the connectors will deteriorate with use. The person performing the tests must verify the quality of the test set-up such as cables, adapters, etc. during daily calibration.

Keys will be described using the text that appears on the key.
A hard-key designation will be indicated by straight brackets: [ ]
A soft-key designation will be indicated by parentheses: ( )
Sometimes several key-presses are needed to accomplish one function in which case the key-presses will all be on the same line (if there is room).

6.1 Calibration and Set-Up of the Network Analyzer

6.1.1 [MENU]

- a. (CW FREQ) [1.865] [G/n]
- b. (SWEEP TYPE MENU) (POWER SWEEP)

6.1.2 [START]

a. [-15] [x1]

6.1.3 [STOP]

a. [-3] [x1]

6.1.4 [CHAN 1]

6.1.5 [MEAS]

a. (TRANS: FWD; S21 (B/R))

6.1.6 [FORMAT]

a. (PHASE)

6.1.7 [SCALE REF]

a. (SCALE/ DIV) [3] [x1]

6.1.8 [CHAN 2]

6.1.9 [MEAS]

a. (TRANS: FWD; S21 (B/R))

6.1.10 [FORMAT]

a. (LOG MAG)

6.1.11 [SCALE REF]

a. (SCALE/ DIV) [1] [x1]
b. (REFERENCE VALUE) [20] [x1]

6.1.12 [DISPLAY]

a. (DUAL CHAN **"ON"**)
b. (MORE)
c. (SPLIT DISP **"OFF"**)
d. [MARKER]
a. (1) [-15] [x1]
b. (2) [-9] [x1]
c. (3) [-3] [x1]

6.1.13 Verify that there is a 10dB inline attenuator on PORT-2 of the Network Analyzer.

6.1.14 Connect the Port-1 RF test cable to the PORT-2 RF test cable.

6.1.15 [CAL]

a. (CALIBRATE MENU)
b. (RESPONSE)
c. (THRU)

6.1.16 [CHAN 1]

6.1.17 [CAL]

a. (CALIBRATE MENU)
b. (RESPONSE)
c. (THRU)

6.1.18 [MENU]

a. (POWER)
b. (SOURCE PWR **"OFF"**)

6.1.19 Disconnect the Port-1 RF test cable from the Port-2 RF test cable.

7.0 DC Power Supply Set-Up

7.1 Set the Following DC power supplies as follows:

V1, Supply Voltage = 15 Vdc
V2, Bias Voltage = 5 Vdc

8.0 Connections and Set-Up

8.1 Get a DUT from the designated area.
8.2 Verify that the J1 solder Pins on the reverse side of the board are trimmed.
8.3 Verify that there are no DC or RF shorts to ground.
8.4 Visually check and verify that all components are installed correctly.
 a. Pay close attention to the couplers at CP1, CP2, CP3, CP4, CP5, and CP6 of the DUT.
8.5 Record the visual check on section 1.0 of the data sheet.
8.6 Mount the DUT to the test fixture.
8.7 Solder the “pigtails” from the test fixture to E1 (input) and E2 (output) of the DUT.
8.8 Connect the RF test cable from **Port-1** of the Network Analyzer to the “pigtail” at **E1**.
8.9 Connect the RF test cable from **Port-2** of the Network Analyzer to the “pigtail” at **E2**.
8.10 Verify the 5-pin DC connector from the DC power supplies have the following designated voltages:

 a. Pin-1 = +15 Vdc
 b. Pin-2 = +5 Vdc
 c. Pin-3 = +15 Vdc
 d. Pin-4 = N/A
 e. Pin-5 =+15 Vdc

8.11 Connect the 5-pin DC connector to **J1** on the DUT.
8.12 Connect the DC ground lines to the test fixture chassis.
8.13 Turn **R2** fully clockwise.

9.0 Voltage Measurements

9.1 Turn **“ON”** V1.
9.2 Turn **“ON”** V2.
9.3 Verify a +15 Vdc measurement on the positive side of **C30**.
9.4 Record this voltage check on section **2.0** of the data sheet.
9.5 Verify a +12 Vdc measurement on the positive side of **C29**.
9.6 Record this voltage check on section **2.1** of the data sheet.

9.7 Verify a +4.8 ± 0.3 Vdc measurement on the outputs of **U1** and **U2**.
9.8 Record this voltage check on section **3.0** of the data sheet.
9.9 Verify a +6.0 ± 1.0 Vdc measurement on the output of **U3**.
9.10 Record this voltage check on section **3.1** of the data sheet.

10.0 Biasing

Note: While adjusting R2 monitor the common trace of R7, R8, and C31.

10.1 Turn **R2 counter-clockwise** until a voltage measurement of +4.5 Vdc is achieved.
10.2 Verify that the current draw on the V1 current display meter is approximately 350 ± 30 mA.

11.0 Gain and Phase Measurements

11.1 Turn **"ON"** RF source power from the network analyzer.
11.2 Verify that the gain at **MARKER 1** (–15 dBm input power) is within 16 to 22 dBm.
11.3 Record this gain data on section **4.0** of the data sheet.
11.4 Verify that the gain expansion from **MARKER 1, MARKER 2, and MARKER 3** (-15 dBm, -9 dBm, and –3 dBm) is greater than **2 dB**.
11.5 Record the gain expansion data on section **4.1** of the data sheet.
11.6 Verify that the phase expansion from **MARKER 1, MARKER 2, and MARKER 3** (-15 dBm, -9 dBm, and –3 dBm) is greater than **6 degrees**.
11.7 Record the phase expansion data on section **5.0** of the data sheet.
11.8 Turn **"OFF"** RF source power from the network analyzer.
11.9 Turn **"OFF"** V2.
11.10 Turn **"OFF"** V1.

12.0 Test Complete

12.1 Remove the 5-pin DC connector from **J1** on the DUT.
12.2 Disconnect the RF test cable from **Port-2** of the Network Analyzer from the "pigtail" at **E2**.
12.3 Disconnect the RF test cable from **Port-1** of the Network Analyzer from the "pigtail" at **E1**.
12.4 Remove the solder from the "pigtails" of the test fixture from E1 (input) and E2 (output) of the DUT.
12.5 Remove the DUT from the test fixture.
12.6 Clear the DUT of all debris.
12.7 Place the DUT in the designated area.

TITLE: Pre-Distorter Tower Top Tuning Procedure	DOCUMENT NUMBER: ATP 500-01084	Page 9 of 9
	REV. B	RELEASE DATE:

13.0 Test Equipment Configuration