INSTALLATION & SERVICE MANUAL

SINGLE CHANNEL POWER AMPLIFIER NTGS86AA

869-894 MHz 25 WATTS AVERAGE POWER

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GENERAL DESCRIPTION

1-1. INTRODUCTION

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's model NTGS86AA single channel power amplifier (SCPA). The manual is organized into six sections as follows:

Section 1. General Description
Section 2. Installation
Section 3. Operating Instructions
Section 4. Principles of Operation
Section 5. Maintenance
Section 6: Troubleshooting

1-2. GENERAL DESCRIPTION

The NTGS86AA is a linear, single-channel power amplifier that operates in the 25 MHz frequency band from 869 MHz to 894 MHz. It is designed as a self-contained module with EMI containment for use in both an indoor and outdoor North American Cellular Base Stations. Its flat base plate allows for mounting on a flat thermal-absorbing surface to provide adequate heat dissipation, thereby avoiding the use of any built-in fans.

Each amplifier module has a power, alarm, and control connector that allows the host system to monitor the amplifier module performance. Primary power for the amplifier is +26 Vdc.

1-3. FUNCTIONAL AND PHYSICAL SPECIFICATIONS

Functional and physical specifications for the amplifier are listed in table 1-1.

Table 1-1. NTGS86AA Single Channel Power Amplifier Functional Specifications

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Maximum Average Input Power	13 dBm
Continuous Average Output Power	25 Watts
Spurious Emissions @ Maximum Rated Output Power (44 dBm)	Frequency / Requirement / Meas. Bandwidth 750 kHz offset / -46 dBc / 30 kHz 1.23 MHz offset / -61 dBc / 30 kHz 1.5 MHz offset / -61 dBc / 30 kHz 1.98 MHz offset / -61 dBc / 30 kHz
RF Gain	43 ±2 dB
Gain Flatness:	± 0.15 dB for any 2-MHz band within frequency range.
Output Protection:	Mismatch Protected
Input Port Return Loss:	VSWR 2:1 Max.
Out of Band Spurious:	Less than -14 dBm
DC Input Power:	+26 ± 0.5 Vdc, 260 mV p-p max. ripple, ≤350 watts
Operating Temperature:	-15 ºC. to +85 ºC. (heatsink temperature)
Storage Temperature:	-40 ºC. to +70 ºC.
Operating Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
Storage Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
DC Input, Alarm, and Control Connector:	18-Pin Molex
RF Input Connector:	SMA Female
RF Output Connector:	SMA Female
RF Sample Connector:	SMA Female (27±1 dB below RF Output)
Dimensions (inches):	Width: 12.515; depth: 9.900; height: 1.670

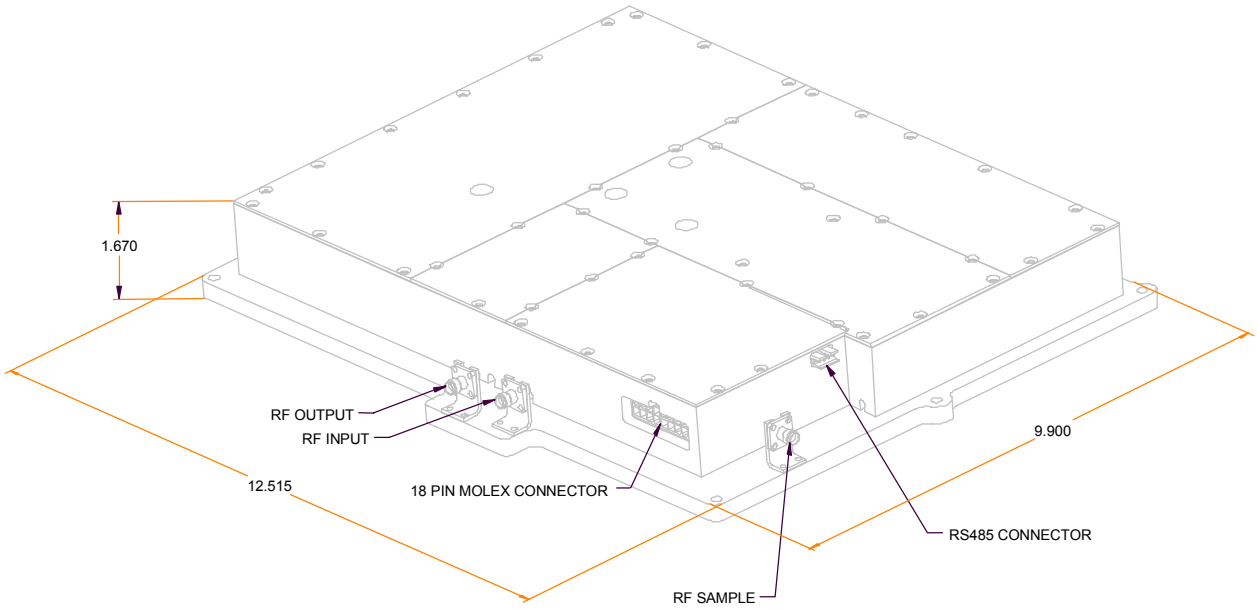

Figure 1-1. NTGS86AA Single Channel Power Amplifier

Section

2

INSTALLATION

2-1. INTRODUCTION

This section contains unpacking, inspection, and installation instructions and recommendations for the Model NTGS86AA Single Channel Power Amplifier. Carefully read all material in this section prior to equipment unpacking or installation. Also read and review the operating procedures in Section 3 prior to installing the equipment. It is important that the licensee perform these tasks correctly and in good faith. If applicable, carefully read Parts 73 and 74 of the Federal Communications Commission (FCC) rules to determine how they apply to your installation. DON'T TAKE CHANCES WITH YOUR LICENSE.

2-2. ELECTRICAL SERVICE RECOMMENDATIONS

Powerwave Technologies recommends that proper AC line conditioning and surge suppression be provided on the primary AC input to the +26 Vdc power source. All electrical service should be installed in accordance with the National Electrical Code, any applicable state or local codes, and good engineering practice. Special consideration should be given to lightning protection of all systems in view of the vulnerability of most transmitter sites to lightning. Lightning arrestors are recommended in the service entrance. Straight, short ground runs are recommended. The electrical service must be well grounded.

Each amplifier system should have its own circuit breaker, so a failure in one does not shut off the whole installation. Circuit breakers should be thermal type, capable of handling the maximum anticipated inrush current, in a load center with a master switch.

2-3. UNPACKING AND INSPECTION

This equipment has been operated, tested and calibrated at the factory. Carefully open the container(s) and remove the amplifier module(s). Retain all packing material that can be reassembled in the event that the unit must be returned to the factory.

CAUTION

Exercise care in handling equipment during inspection to prevent damage caused by rough or careless handling.

Visually inspect the amplifier module for damage that may have occurred during shipment. Check for evidence of water damage, bent or warped chassis, loose screws or nuts, or extraneous packing material in the connector. If the equipment is damaged, a claim should be filed with the carrier once the extent of any damage is assessed. We cannot stress too strongly the importance of IMMEDIATE careful inspection of the equipment and the subsequent IMMEDIATE filing of the necessary claims against the carrier if necessary. If possible, inspect the equipment in the presence of the delivery person. If the equipment is damaged, the carrier is your first area of recourse. If the equipment is damaged and must be returned to the factory, write or phone for a return authorization. Powerwave may not accept returns without a return authorization. Claims for loss or damage may not be withheld from any payment to Powerwave, nor may any payment due be withheld pending the outcome thereof. WE CANNOT GUARANTEE THE FREIGHT CARRIER'S PERFORMANCE

2-4. INSTALLATION INSTRUCTIONS (Refer to figure 1-1)
The NTGS86AA amplifier module is designed for installation on a heatsink that permits access to the module for connection of RF cables and the power, alarm, and control connector.

To install the amplifier proceed as follows:

1. Install amplifier on heatsink with thermally conductive material inserted between amplifier module and heatsink, and secure in place with four mounting screws.

2. Connect the antenna cable to **RF OUT** SMA connector.

3. Connect the transceiver output cable to **RF IN** SMA connector.

4. Connect coupled RF output monitor cable to **RF SAMPLE** SMA connector.

WARNING
Turn off external primary DC power before connecting cable to 18-pin Molex connector.

5. Connect power, alarm, and control cable to 18-pin Molex connector.

6. Check your work before applying DC voltage to the system. Make certain all connections are tight and correct.

7. Measure primary DC input voltage. DC input voltage should be +26 ±0.5 Vdc. If the DC input voltage is above or below the limits, call and consult Powerwave before you turn on your amplifier system.

8. Refer to section 3 for initial turn-on and checkout procedures.

2-5. AMPLIFIER MODULE POWER, ALARM, AND CONTROL CONNECTOR
The power, alarm, and control connections on the amplifier are made through an 18-pin Molex connector (figure 2-1) and are listed and described in table 2-1.

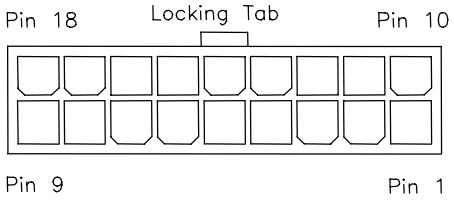

Figure 2-1. Power, Alarm, and Control Connector (18-Pin Molex)

Table 2-1. 18-Pin Molex Alarm, Control, and Power Connections

PIN	SIGNAL DESCRIPTION	SIGNAL NAME
1	Temperature Output (0-4.7 volts)	TEMP_OUT
2	Reverse Power Detection (0-4.7 volts)	REV_PWR
3	Forward Power Detection (0-4.7 volts)	FWR_PWR
4	Ground	GND
5	NC	NA
6	– Anxiety output (RS 422 level)	ANX (-)
7	Ground	GND
8	Ground	GND
9	Ground	GND
10	+ Anxiety output (RS 422 level)	ANX (+)
11	+ Enable input (RS 422 level)	ENABLE (+)
12	– Enable input (RS 422 level)	ENABLE (–)
13	+ Alarm output (RS 422 level)	ALARM (+)
14	– Alarm output (RS 422 level)	ALARM (–)
15	+26 Vdc	VDD
16	+26 Vdc	VDD
17	+26 Vdc	VDD
18	+26 Vdc	VDD

2-6. RS485 CONNECTOR

The RS485 connector (figure 2-2) allows the user to monitor the status of the amplifier, download new firmware, and revise the amplifier attributes. The pin connections are defined in table 2-2.

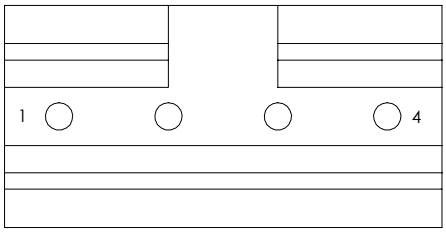

Figure 2-2. RS485 Connector

Table 2-2. RS485 Pin Definition

PIN	FUNCTION
1	Rxd+
2	Rxd–
3	Txd–
4	Txd+

Section

3

OPERATING INSTRUCTIONS

3-1. INTRODUCTION
This section contains operating instructions for the Multicarrier Cellular Amplifier.

3-2. INITIAL START-UP AND OPERATING PROCEDURES

There are no operating controls or indicators on the NTGS86AA amplifier module. To perform the initial start-up, proceed as follows:

1. Double check to ensure that all input and output cables are properly connected.

CAUTION

Before applying power, make sure that the input and output of the amplifier are properly terminated at 50 ohms. Do not operate the amplifier without a load attached. Refer to table 1-1 for input power requirements. Excessive input power may damage the amplifier

NOTE

The output coaxial cable between the amplifier and the antenna must be 50 ohm coaxial cable. Use of any other cable will distort the output.

2. Turn on supply that provides +26 Vdc to the amplifier system.

3. Turn on external exciter/transceiver and apply RF input signals.

Section

4

PRINCIPLES OF OPERATION

4-1. INTRODUCTION
This section contains a functional description of the Single Channel Power Amplifier (SCPA).

4-2. RF INPUT SIGNAL
The maximum input power should not exceed the limits specified in table 1-1.

4-3. 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.

4-4. AMPLIFIER FUNCTIONAL DESCRIPTION

The NTGS86AA amplifier (figures 1-1 and 4-1) is a linear, single-channel power amplifier that operates in the 25 MHz frequency band from 869 MHz to 894 MHz at an output power of 25 watts. Each amplifier is a self-contained module and is functionally independent of any other amplifier modules in the system. Each amplifier module has an alarm board that monitors the amplifier performance. If a failure or fault occurs in an amplifier module, it is transmitted to the host system via an 18-pin Molex connector.

The amplifier is compliant to the requirements of FCC Part 22 and TIA/EIA IS97A with respect to spurious emissions (see table 1-1). Constant gain is maintained by continuously comparing active paths with passive references, and correcting for small variations through the RF feedback controls. All gain variations, for example those due to temperature, are reduced to the passive reference variations. The amplifier module is comprised of:

A three-stage driver amplifier
A main amplifier
Alarm monitoring and control
A spurious emission detection DSP circuit

4-4.1. THREE-STAGE DRIVER AMPLIFIER

The input of the amplifier employs three stages of class AB amplification which provide approximately 33 dB of gain in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +26 Vdc, and a bias voltage of +5 Vdc, and is mounted directly on a heat sink. The alarm logic controls the +5 Vdc bias voltage that shuts down the amplifier.

4-4.2. MAIN AMPLIFIER

The main amplifier employs class AB amplification for maximum efficiency. The signal provides approximately 10 dB of gain in the 25 MHz frequency band. The output from the main amplifier is typically 30 watts. The amplifier operates on +26 Vdc, and a bias voltage of +5 Vdc, and is mounted directly on a heat sink. The alarm logic controls the +5 Vdc bias voltage that shuts down the amplifier.

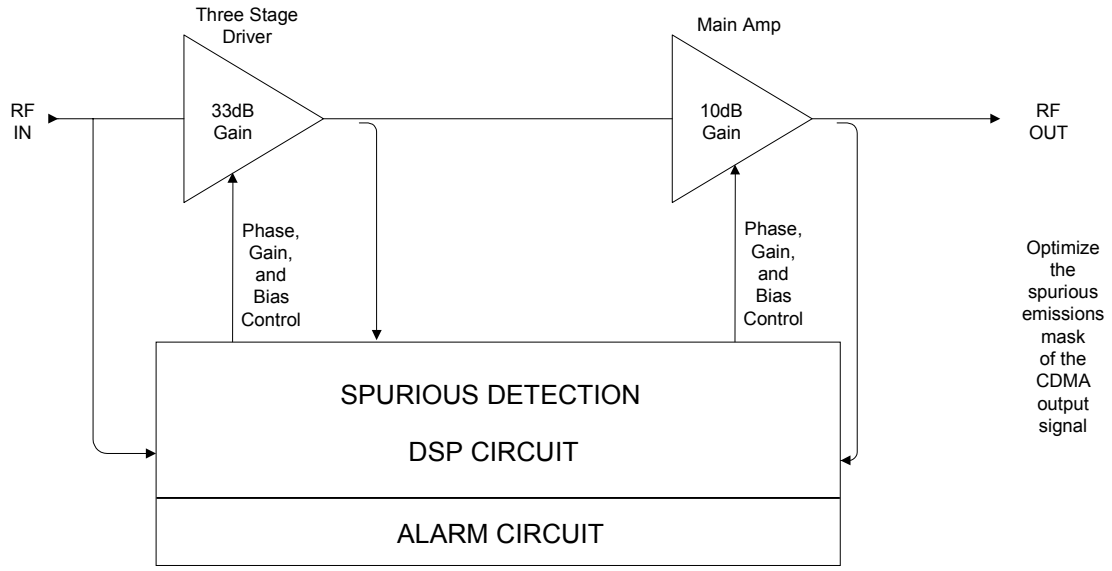

Figure 4-1. NTGS86AA Single Channel Power Amplifier Functional Block Diagram

4-4.3. ALARM MONITORING AND CONTROL

In the amplifier, all normal variations are automatically compensated for by the spurious detector control. However, when large variations occur beyond the adjustment range of the loop control, a loop fault will occur. The alarms are output via an 18-pin Molex connector on the module for subsequent remote monitoring.

4-4.4. SPURIOUS EMISSION DETECTION DSP CIRCUIT

The primary function of the spurious detection circuit is to monitor the spurious emissions mask of the RF signal at all amplifier stages. DSP circuitry is used to control the phase, gain, and bias of all amplifier stages, thereby optimizing the spurious emissions mask of the CDMA output signal.

4-5. AMPLIFIER MODULE COOLING

Each amplifier module is contained within a thermally conductive chassis which, when properly mounted on an adequate thermal surface, will provide sufficient cooling to maintain the amplifier within the specified operating temperature range.

4-6. POWER DISTRIBUTION

Primary DC power for the amplifier is provided by the host system. The amplifier module has a DC/DC converter that converts the +26 Vdc to +15 Vdc, +5 Vdc and +8 Vdc.

Section

5

MAINTENANCE

5-1. INTRODUCTION

This section contains periodic maintenance and performance test procedures for the Single Channel Power Amplifier. It also contains a list of test equipment required to perform the identified tasks.

NOTE

Check your sales order and equipment warranty before attempting to service or repair the unit. Do not break the seals on equipment under warranty or the warranty will be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory.

5-2. PERIODIC MAINTENANCE

Periodic maintenance requirements are listed in Table 5-1. Table 5-1 also lists the intervals at which the tasks should be performed.

Table 5-1. Periodic Maintenance

TASK	INTERVAL	ACTION
Inspection Cables and Connectors	12 Months	Inspect signal and power cables for frayed insulation. Check RF connectors to be sure that they are tight.
Performance Tests	12 Months	Perform annual test per paragraph 5-5.

5-3. TEST EQUIPMENT REQUIRED FOR TEST

Test equipment required to test the amplifier is listed in Table 5-2. Equivalent test equipment may be substituted for any item, keeping in mind that a thermistor type power meter is required.

NOTE

All RF test equipment must be calibrated to 0.05 dB resolution. Any deviation from the nominal attenuation must be accounted for and factored into all output readings.

Table 5-2. Test Equipment Required

MENCLATURE	MANUFACTURER	MODEL
Signal Generator	H.P.	8656B
20 dB Attenuator, 250 Watt	Tenuline	
20 dB Attenuator, 20 Watt (2 each)	Tenuline	
Spectrum Analyzer	H.P.	8560E
Coax Directional Coupler	H.P.	778D
Power Meter / Sensor	H.P.	437B / 8481A
Arbitrary Waveform Generator	Sony	AWG2021
Network Analyzer	H.P.	8753C
Current Probe		
Source Diskette	Powerwave	
CDMA Generator	Noise Com	800-1

5-4. PERFORMANCE TEST

Performance testing should be conducted every 12 months to ensure that the amplifier system meets the operational specifications listed in table 5-3. Also verify system performance after any amplifier module is replaced in the field. The test equipment required to perform the testing is listed in table 5-2, and the test setup is shown in figure 5-1.

NOTE

The frequencies used in this test are typical for an amplifier with a 25 MHz band from 869 MHz to 894 MHz. Select evenly spaced F1, F2, F3, and F4 frequencies that cover the instantaneous bandwidth of your system.

5-4.1. AMPLIFIER PERFORMANCE TEST.

To perform the test, proceed as follows:

1. Connect test equipment as shown in figure 5-1.

NOTE

Do not apply any RF signals at this time.

AMPLIFIER SPURIOUS EMISSIONS TEST:

2. With the RF input signal to the amplifier set to be as shown in figure 5-2, use the spectrum analyzer to measure the spurious emissions performance. Record test data in table 5-3. Verify that it is within the specifications shown in table 1-1. Switch tested amplifier to OFF.

GAIN TEST:

3. Disconnect spectrum analyzer from test setup, and connect the network analyzer.

4. Set network analyzer as follows:
   a. Power output to 11 dBm.
   b. Frequency start to 869 MHz.
   c. Frequency stop to 894 MHz.
   d. Normalize the network analyzer for gain and return loss.

5. Check the amplifier gain across the band from 869 MHz to 894 MHz. Gain should be as specified in table 1-1 ±1 dB. Record test data in table 5-3.

INPUT RETURN LOSS TEST:

6. Read and record the S_{11} return loss measurement on network analyzer. Record test data in table 5-3.

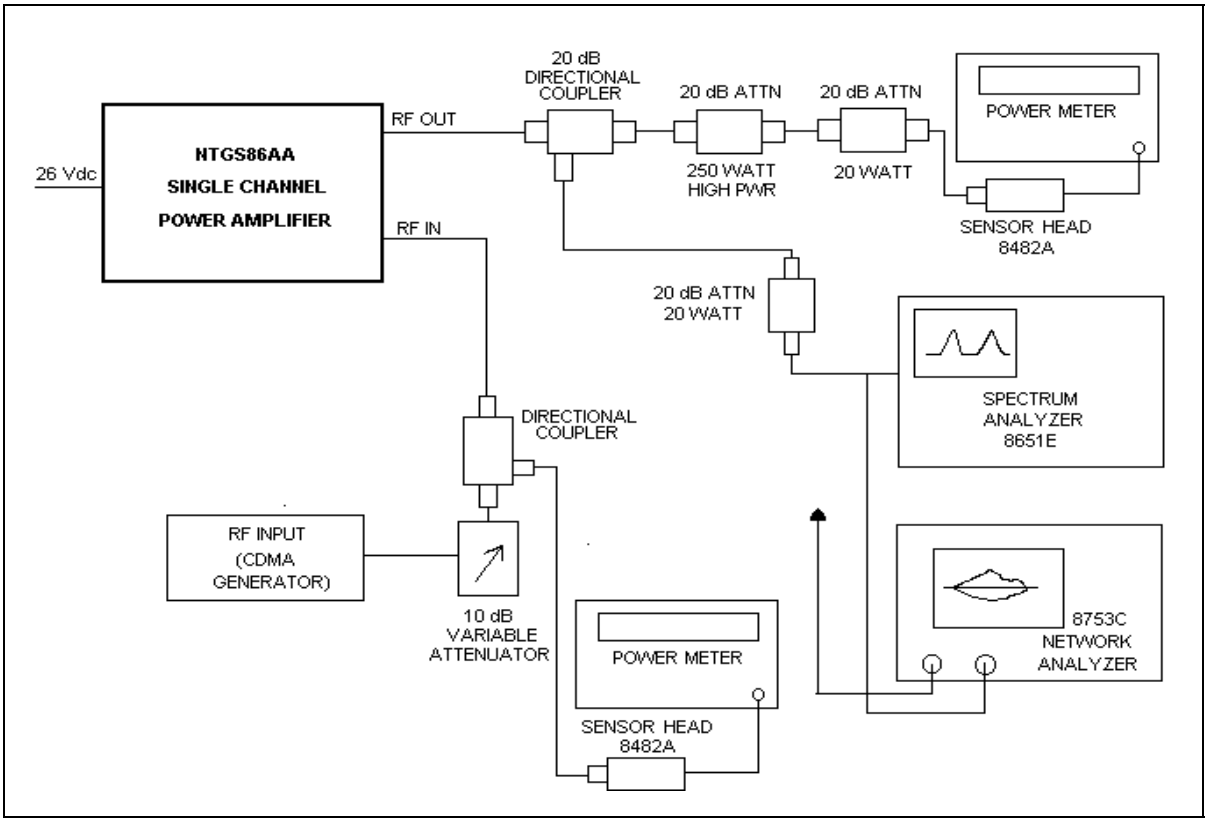

Figure 5-1. NTGS86AA Amplifier Test Setup Diagram

Table 5-3. Single Channel Power Amplifier Test Data Sheet

DATE_____

MODULE S/N _____

TEST CONDITIONS:
Load and Source Impedance: 50 Ohms
VSWR: < 1.2:1
Supply Voltage: +26 Vdc ±0.1 Vdc

TEST	SPECIFICATION	MIN	MAX	DATA
RF Gain	Vcc = 26 Vdc PO = 25 W Freq. = 880 MHz	Table 1-1 -1 dB	Table 1-1 +1 dB	
Spurious Emissions	Vcc = 26 Vdc PO =25 W 869 - 894 MHz Band		-65 dBc	
Gain Flatness	Vcc = 26 Vdc PO =25 W 869 - 894 MHz Band		±0.7 dB	
Input Return Loss	Vcc = 26 Vdc PO = 25 W 869-894 MHz Band	-18 dB		

PASS _____ FAIL _____

Tested by _____

5-5. FIELD REPLACEMENT OF THE MODULE

The NTGS86AA single channel power amplifier module can be replaced in the field on site by a qualified technician with experience maintaining RF power amplifiers and similar equipment:

To replace a power amplifier module, proceed as follows:

1. Turn off 26 Vdc power to that specific module.
2. Disconnect the three RF cables, 18-pin Molex cable, and RS485 cable.
3. Loosen four screws that secure amplifier module to heat sink.
4. Carefully remove amplifier module from heat sink.
5. Install replacement in reverse order of steps 1 through 4 above.

Section

6

TROUBLESHOOTING

6-1 INTRODUCTION

This section contains a list of problems which users have encountered and a few suggested actions that may correct the problem. If the suggested corrective action does not eliminate the problem, please contact your Powerwave field representative or the factory for further instructions.

NOTE

Check your sales order and equipment warranty before attempting to service or repair the unit. Do not break the seals on equipment under warranty or the warranty will be null and void. Do not return equipment for warranty or repair service until proper shipping instructions are received from the factory.

6-2 TROUBLESHOOTING

Refer to table 6-1 for troubleshooting suggestions.

Table 6-1. Troubleshooting.

SYMPTOM	SUGGESTED ACTION
SCPA Inoperative	1. Check for proper power supply voltage.
SCPA Not Enabled	1. Verify RS 422 + (ENABLE signal) is high.
Anxiety Output is RS 422 High	1. Verify DC supply is ≤28.5±0.25 Vdc 2. Verify TEMP_OUT <5 °C above maximum sensor temp. 3. Verify RF input <6 dBm ±0.5 dB; remove overdrive and toggle ENABLE input.

Alarm Output is RS 422 High	Verify input RF is within specified power and frequency limits

6-3 RETURN FOR SERVICE PROCEDURES

When returning products to Powerwave, the following procedures will ensure optimum response.

6-3.1 Obtaining an RMA

A Return Material Authorization (RMA) number must be obtained prior to returning equipment to the factory for service. Please contact our Customer Service Department at (949) 757-0530 to obtain this number. Failure to obtain this RMA number will result in considerable delays in receiving repair service.

6-3.2 Repackaging for Shipment

To ensure safe shipment of the amplifier, it is recommended that the package designed for the amplifier be used. The original packaging material is reusable. If it is not available, contact Powerwave's Customer Service Department for packing materials and information.