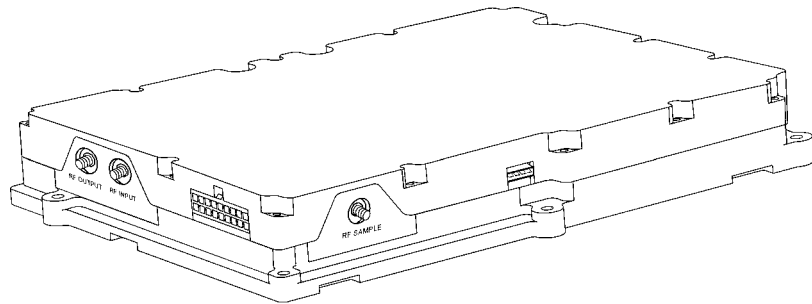


Installation & Service Manual

Powerwave®
technologies

THE POWER IN WIRELESS™



***Model NTGS86AB
Single-Channel Power Amplifier***



© 2002 Powerwave Technologies Incorporated. All rights reserved.

Powerwave Technologies, and the Powerwave logo are registered trademarks

Powerwave Technologies, Inc. reserves the right to make changes to the documentation and equipment, including but not limited to component substitution and circuitry changes. Changes that impact this manual may subsequently be incorporated in a later revision of this manual.

October 2002

***Powerwave Technologies, Inc.
1801 East St. Andrew Place
Santa Ana, CA 92705***

***Tel: (714) 466-1000
(888) 797-9283
Fax: (714) 466-5800
Web Site: www.powerwave.com***

Table Of Contents

Paragraph No.	Section 1 General Description	Page No.
1-1	<i>Introduction</i>	1-1
1-2	<i>General Description.....</i>	1-1
1-3	<i>Functional and Physical Specifications</i>	1-1
1-4	<i>Equipment Changes</i>	1-1
 Section 2 Installation 		
2-1	<i>Introduction</i>	2-1
2-2	<i>Electrical Service Recommendations.....</i>	2-1
2-3	<i>Unpacking and Inspection.....</i>	2-1
2-4	<i>Installation Instructions</i>	2-2
2-8	<i>Molex 18-Pin Power, Alarms, & Controls Connector</i>	2-3
 Section 3 Operating Instructions 		
3-1	<i>Introduction</i>	3-1
3-2	<i>Initial Start-Up and Operating Procedures</i>	3-1
 Section 4 Principles of Operation 		
4-1	<i>Introduction</i>	4-1
4-2	<i>RF Input Signal</i>	4-1
4-3	<i>RF Output Load</i>	4-1
4-4	<i>Amplifier Functional Description.....</i>	4-1
4-4.1	<i>Input Amplifier and Pre-Distortion Amplifier.....</i>	4-1
4-4.2	<i>Driver Amplifier</i>	4-1
4-4.2	<i>Main Amplifier</i>	4-2
4-5	<i>Amplifier Module Cooling</i>	4-2
4-6	<i>Power Distribution</i>	4-3
 Section 5 Maintenance 		
5-1	<i>Introduction</i>	5-1
5-2	<i>Periodic Maintenance.....</i>	5-1
5-3	<i>Amplifier Module Field Replacement</i>	5-1
 Section 6 Troubleshooting 		
6-1	<i>Introduction</i>	6-1
6-2	<i>Troubleshooting.....</i>	6-1
6-3	<i>Return for Service Procedures</i>	6-1
6-3.1	<i>Obtaining an RMA</i>	6-1

6-3.2	<i>Repackaging for Shipment.....</i>	<i>6-1</i>
--------------	---	-------------------

List Of Illustrations

<i>Figure No.</i>		<i>Page No.</i>
<i>1-1</i>	<i>NTGS86AB Amplifier Isometric View.....</i>	<i>1-3</i>
<i>1-2</i>	<i>NTGS86AB Amplifier Top and Side Views.....</i>	<i>1-3</i>
<i>2-1</i>	<i>NTGS86AB Amplifier Front and Side Connectors.....</i>	<i>2-2</i>
<i>2-2</i>	<i>Molex 18-Pin Power, Alarms, and Controls Connector.....</i>	<i>2-3</i>
<i>4-1</i>	<i>NTGS86AB Single-Channel Power Amplifier Block Diagram.....</i>	<i>4-2</i>

List Of Tables

<i>Table No.</i>		<i>Page No.</i>
<i>1-1</i>	<i>NTGS86AB Single-Channel Power Amplifier Functional Specifications.....</i>	<i>1-2</i>
<i>2-1</i>	<i>Molex 18-Pin Power, Alarms, and Controls Connector Signal Descriptions.....</i>	<i>2-3</i>
<i>5-1</i>	<i>Periodic Maintenance.....</i>	<i>5-1</i>
<i>6-1</i>	<i>Troubleshooting.....</i>	<i>6-1</i>

Section 1 General Description

1-1 Introduction

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's model NTGS86AB Single-Channel Power Amplifier (SCPA) module. 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 NTGS86AB amplifier module is a CDMA signal source, linear, single-channel power amplifier (SCPA) module that operates in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier output is typically 25 watts with a gain range between 41 and 45 dB. The amplifier is designed to be mounted in an enclosure with EMI containment. Its flat base plate allows for mounting on a flat thermal-absorbing surface to provide adequate heat dissipation.

As shown in figure 1-1, each amplifier module has an RF input, RF output, and RF sample connectors, as well as an 18-pin power, alarm, and control interface connector that allows the host system to provide power and monitor the amplifier module performance. Primary power for the amplifier is +26 Vdc.

Physical dimensions of the amplifier module are shown in figure 1-2.

1-3 Functional & Physical Specifications

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

1-4 Equipment Changes

Powerwave Technologies, Inc. reserves the right to make minor changes to the equipment, including but not necessarily limited to component substitution and circuitry changes. Changes that impact this manual may subsequently be incorporated in a later revision of this manual.

Table 1-1 NTGS86AB Single Channel Power Amplifier Functional Specifications

Frequency Range	869 - 894 MHz (25 MHz Bandwidth)		
Maximum Average Input Power	13 dBm without damage; 0 dBm typical @ rated Pout		
Continuous Average Output Power	25 Watts (44 dBm)		
Spurious Emissions @ Maximum Rated Output Power (25 W/44 dBm)	<u>Frequency Offset</u>	<u>Requirement</u>	<u>Meas. Bandwidth</u>
	750 kHz	-46 dBc	30 kHz
	1.5 MHz	-14dBm	37.5 kHz
	1.98 MHz	-61 dBc	30 kHz
	4 MHz	-14 dBm	100 kHz
	Outside Tx Band	-14 dBm	30 kHz
Maximum RF Gain	45 dB		
Gain Flatness	± 0.15 dB for any 2-MHz band within operating ranges.		
Output Protection	Mismatch Protected		
Input Port Return Loss	VSWR 2:1 Maximum		
Out of Band Spurious	Less than -13 dBm/30 kHz (see above)		
DC Input Power	+26 $\pm$ 0.5 Vdc, 260 mV p-p maximum ripple, $\leq$ 350 watts 6 Amps typical, 13 Amps maximum		
Operating Temperature Range	-40 °C to +50 °C, Ambient		
Operating Humidity	5% - 95% Relative Humidity (Non-condensing)		
Storage Humidity	5% - 95% Relative Humidity (Non-condensing)		
Interface Connectors:			
RF Input	SMA Female		
RF Output	SMA Female		
RF Sample	SMA Female		
Power Supply, alarm, and Control Interface	18-Pin, Molex, Female		
Test	4-Pin		
Weight	8 lbs		
Dimensions (inches)	7.865 (W) x 10.275 (D) x 1.55 (H)		

*The base station reports the center frequency of the desired operating band to the amplifier and the amplifier adjusts the bandwidth window accordingly, between the upper and lower limits of the frequency range.

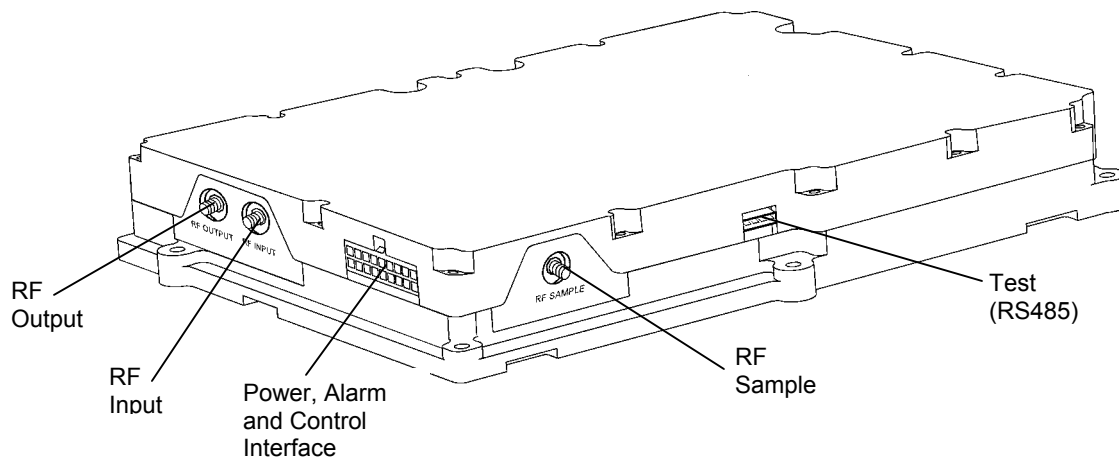


Figure 1-1. NTGS86AB Amplifier Isometric View

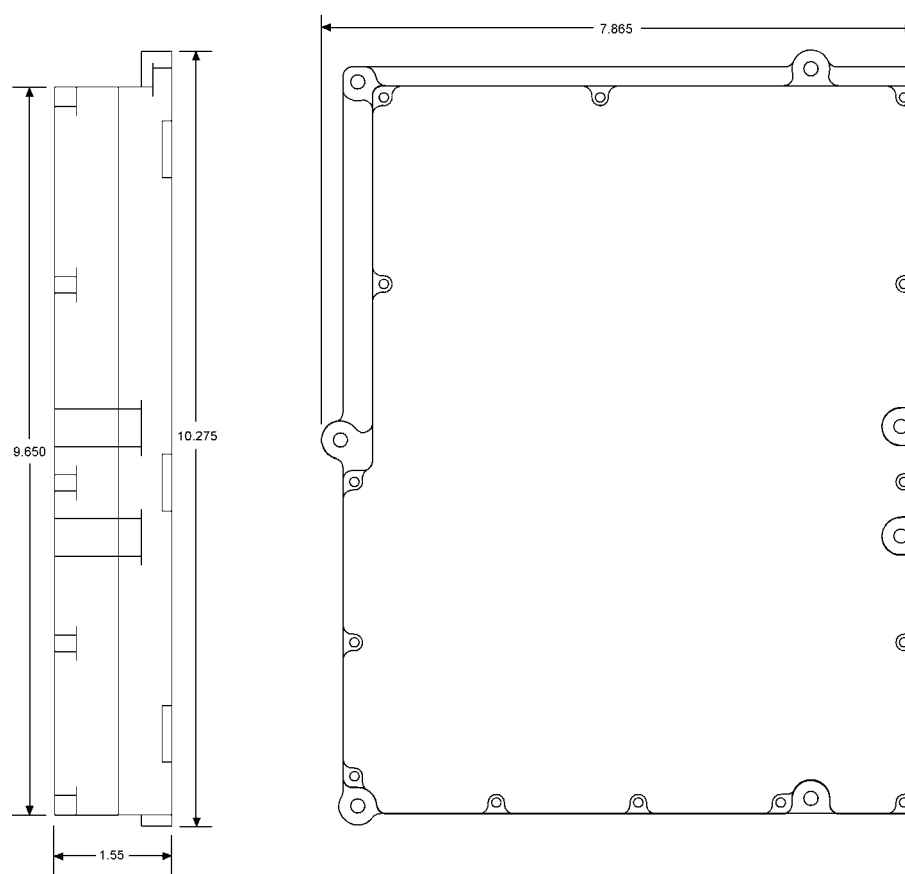


Figure 1-2. NTGS86AB Amplifier Top and Side Views with Dimensions

Section 2 Installation

2-1 Introduction

This section contains unpacking, inspection, and installation instructions and recommendations for the Model NTGA86AB Single-Channel Power Amplifier module. 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 the appropriate parts 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 & 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 NTGS86AB amplifier module is designed for installation on a heatsink that permits access to the module for connection of the RF cables and to the 18-pin power, alarms, and control connector.

To install the amplifier proceed as follows:

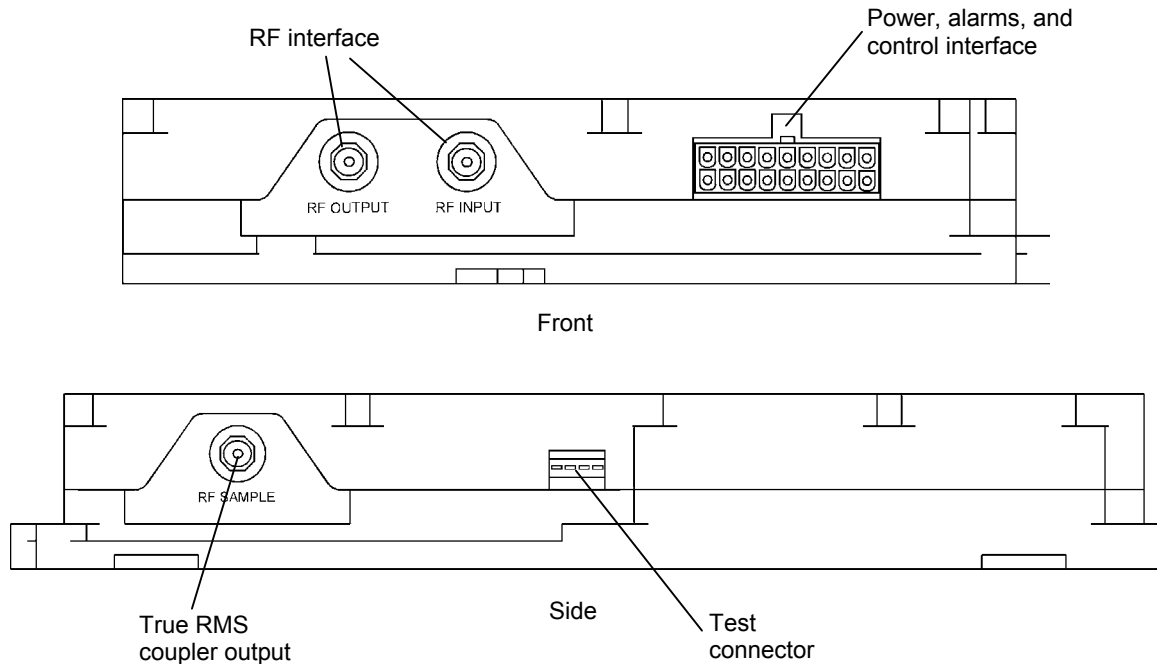


Figure 2-1 NTGS86AB Amplifier Front and Side Connectors

1. Install amplifier on heatsink with thermally conductive material inserted between amplifier module and heatsink, and secure in place with appropriate mounting screws. See figure 1-2.
2. Connect the antenna cable to **RF OUTPUT** female SMA connector.
3. Connect the transceiver output cable to **RF INPUT** female SMA connector.

WARNING

Turn external primary DC power off before connecting any cables.

4. Connect power, alarm, and control cable to matching 18-pin Molex connector located on the front of the amplifier as shown in figure 2-1. Refer to figure 2-2 and table 2-1 for the 18-pin Molex connector pin orientation and a list of related signal definitions.
5. Connect to the **RF SAMPLE** output.
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 for $+26 \pm 0.5$ 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 Molex 18-Pin Power, Alarms, and Controls Connector

The power, alarms, and controls connections for the amplifier are made through the 18-pin Molex connector shown in figure 2-2. The signals for each connector pin are listed and described in table 2-1.

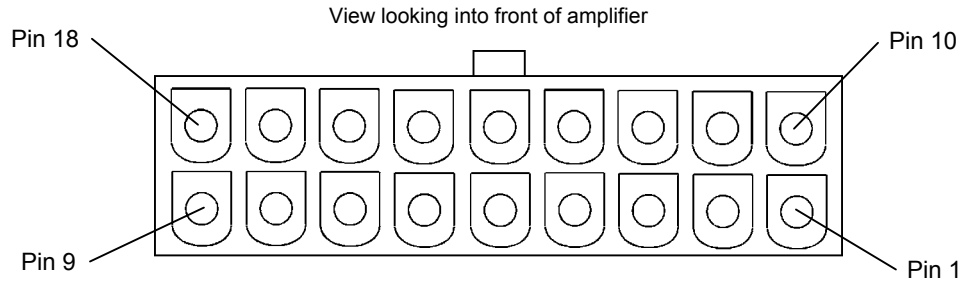


Figure 2-2 Molex 18-Pin Power, Alarms, and Controls Connector

Table 2-1 Molex 18-Pin Power, Alarms, and Controls Connector Signal Descriptions

Pin	Signal	Description
1	TEMP_OUT	0-4.7 V temperature output
2	REV_PWR	0-4.7 V Reverse power detection
3	FWR_PWR	0-4.7 V forward power detection
4	GND	GND
5	N/C	N/C
6	ANX(-)	- Anxiety output (RS-422 level)
7	GND	GND
8	GND	GND
9	GND	GND
10	ANX(+)	+ Anxiety output (RS-422 level)
11	ENABLE(+)	+ Enable input (RS-422 level)
12	ENABLE(-)	- Enable input (RS-422 level)
13	ALARM(+)	+ Alarm output (RS-422 level)
14	ALARM(-)	- Alarm output (RS-422 level)
15	VDD	+26 VDC
16	VDD	+26 VDC
17	VDD	+26 VDC
18	VDD	+26 VDC

Section 3 Operating Instructions

3-1 Introduction

This section contains operating instructions for the NTGS86AB Single-Carrier Cellular Power Amplifier module.

3-2 Initial Start-Up & Operating Procedures

There are no operating controls or indicators on the NTGS86AB amplifier module. To perform the initial start-up, proceed as follows:

1. Verify that all input and output cables are properly connected per section 2.

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 NTGS86AB Single-Carrier Cellular Power Amplifier module.

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 NTGS86AB 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. The amplifier produces a typical output power of 25 watts (44 dBm). Each amplifier in a system is a self-contained module and is functionally independent of any other amplifier modules. Each amplifier module has alarms that monitor the amplifiers performance. If a failure or fault occurs in an amplifier module, it is transmitted to the host system via an RS-422 interface.

The amplifier is compliant to the requirements of FCC Part 24 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:

- Input amplifier
- Pre-distortion amplifier
- Driver amplifier
- Main amplifier
- Isolator

4-4.1 Input Amplifier and Predistortion Amplifier

RF is fed to the input amplifier then to the predistortion amplifier where the input signal is distorted such that it linearizes the output of the main amplifier. All the predistortion voltages and loop voltages are controlled by a microprocessor.

4-4.2 Driver Amplifier

The driver amplifier is a class AB amplifier. The amplifier operates on +26 Vdc with bias voltage controlled by the microprocessor.

4-4.3 Main Amplifier

The main amplifier is a class AB amplification stage for maximum efficiency. The RF output signal from the main amplifier is then applied to an isolator. The amplifier power performance is monitored by the microprocessor via the forward and reverse detectors. The final output power is typically 44 dBm. The amplifier operates on +26 Vdc with gate bias voltages controlled by the microprocessor.

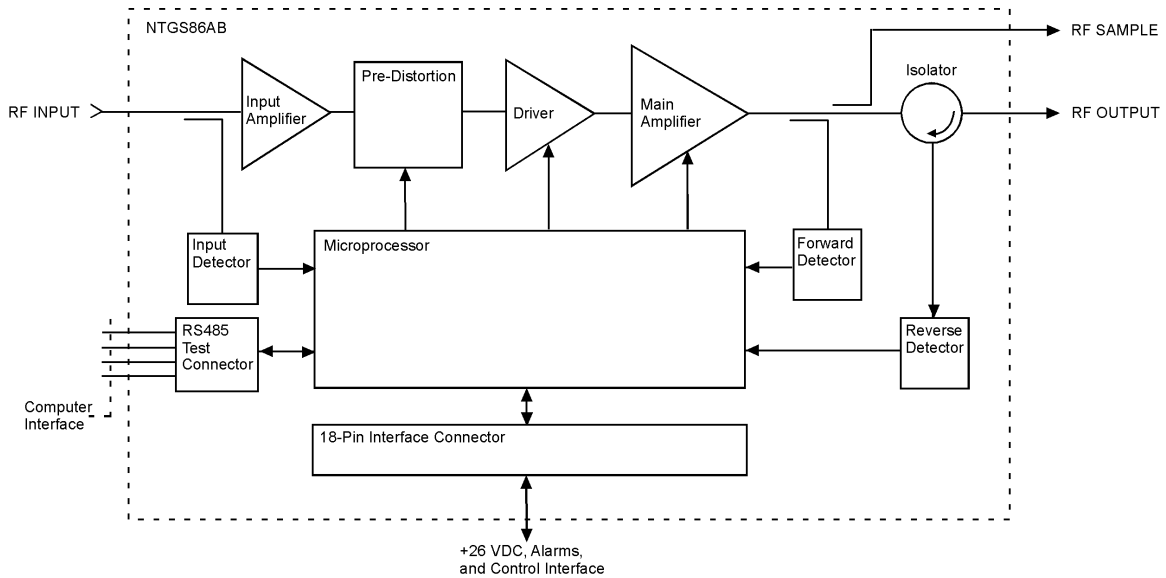


Figure 4-1 NTGS86AB Single-Channel Power Amplifier Functional Block Diagram

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 generates all the required voltages internally from the main source.

Section 5 Maintenance

5-1 Introduction

This section contains periodic maintenance and performance test procedures for NTGS86AB Single-Carrier Cellular Power Amplifier module.

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 ensure they are tight.
Performance Tests		No periodic maintenance is necessary beyond that recommended by the base station manufacturer.

5-3 Amplifier Module Field Replacement

The NTGS86AB power amplifier module can be replaced in the field on site by a qualified technician with adequate ESD protection and experience maintaining RF power amplifiers and similar equipment.

To replace a power amplifier module, proceed as follows:

1. Turn off the +26 Vdc power source to that specific amplifier module.
2. Disconnect the RF INPUT, RF OUTPUT, RF SAMPLE, and 18-pin Molex connectors.
3. Remove seven (7) screws that secure the amplifier module to the heat sink.
4. Carefully remove the amplifier module from the heat sink.
5. Remove any remaining Thermstrate from the heat sink. Use alcohol or other recommended cleaning agent to achieve a clean heat sink mounting surface.

NOTE

Failure to completely remove old thermal grease, or the introduction of too much thermal grease will dramatically alter the thermal transfer process between the amplifier module and the heatsink.

6. Add Thermstrate thermal interface pad to surface of replacement amplifier, that mates with heatsink. Use just enough Thermstrate to be evenly visible on the mounting surface.
7. Install replacement in reverse order of steps 1 through 4 above.

Section 6 Troubleshooting

6-1 Introduction

This section contains a list of problems 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

Table 6-1 lists general guidelines established to aid Field Engineers or Cell Site Technicians in the proper method of Powerwave equipment fault resolution by fault mode.

Table 6-1 Troubleshooting

Symptom	Suggested Action
SCPA Inoperative	Check for proper power supply voltage.
SCPA Not Enabled	Verify ENABLE(+) line is high.
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 Repair Department at (888) 797-9283 or (714) 466-1000 to obtain this number, or FAX your request to (714) 466-5816. Failure to obtain this RMA number may result in 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.