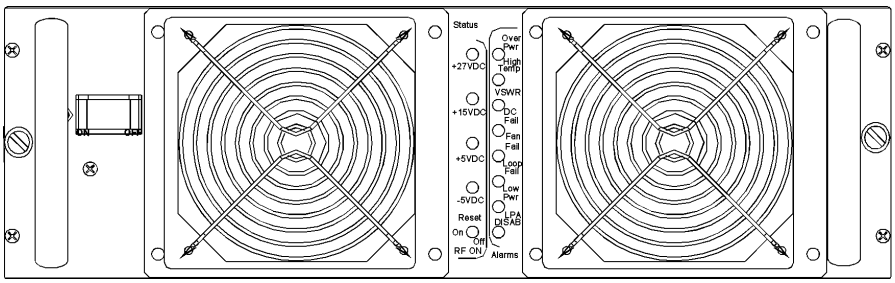
Installation & Service Manual

Powerwave® technologies

THE POWER IN WIRELESS™



G3S-800-140
Multi-Carrier Amplifier System
869 – 894 MHz

February 2001

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

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

Table Of Contents

Section 5
Maintenance

Section 6
Troubleshooting

List of Illustrations

Figure No.

List Of Tables

Table No.

Section 1 General Description

1-1 Introduction

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's G3S-800-140 multicarrier cellular amplifier. 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 G3S-800-140 (see figure 1-1) is a linear, feed-forward power amplifier that operates in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier can simultaneously transmit multiple frequencies, with better than -60 dBc third order intermodulation distortion (IMD). It is designed for use in an amplifier system that is modular in design, and is ideally suited for use in AMPS/TDMA/CDMA/CDPD/W-CDMA base stations. The plug-in Model G3S-800-140 amplifier modules can each provide 140 watts of power and function completely independently of each other. The amplifier modules are designed for parallel operation to produce high peak power output and backup redundancy for remote applications. All solid-state, the system is designed to provide trouble-free operation with minimum maintenance. The system's modular construction and unique and highly effective LED-based operational status and fault indicators help minimize downtime. The turn-on and turn-off sequences of voltages are fully automatic, as is overload protection and recycling. Inadvertent operator damage from front panel manipulation is virtually impossible.

The amplifier module has a status connector that allows the host system to monitor the amplifier module performance. The front panel of each amplifier module has unit level status/fault indicators and an RF on/off/reset switch. Primary power for the amplifier is +27 Vdc. Cooling for each plug-in amplifier module is provided by four fans, two mounted on the front and two on the rear of the module. The fans draw outside air through the front of the module and exhaust hot air out through the rear of the module.

1-3 Functional And Physical Specifications

Functional and physical specifications for the amplifier are listed in table 1-2.

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.

1-5 Ordering Information

Table 1-1 following gives the part numbers and descriptions to be used when ordering either an entire amplifier or replacement fans.

Table 1-1 Major Amplifier Components

Model number	Description
G3S-800-140	140 W 869-894 MHz MCPA Module.
800-01075-003	Front fan assembly
800-00972-002	Rear fan assembly.

Table 1-2 G3S-800-140 Multicarrier Cellular Amplifier Functional Specifications

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Total Maximum Input Power	-6.0 dBm
Total Output Power	140 W typical (1 Module)
Intermodulation Distortion and In-Band Spurious:	-60 dBc (Max) @ +26 to +28 Vdc @ 140 Watts -60 dBc (Max) @ +24 to +26 Vdc @ 143 Watts -60 dBc (Max) @ +21.7 to +24 Vdc @ 100 Watts
RF Gain at 880 MHz	58 dB
Gain Flatness:	± 0.5 dB @ 27 Vdc ±1 Vdc
Gain Variation Over Voltage:	±0.5 dB from 26 to 28 Vdc
Output Protection:	Mismatch Protected
Input Port Return Loss:	-16 dB (Min)
Second Harmonics:	+5 dBm (Max)
Out of Band Spurious:	Better than -60 dBc, +26 to +28 Vdc
Duty Cycle:	Continuous
DC Input Power:	+27 Vdc ± 1 Vdc, 70 Amps Max @ 140 Watts Operational +21.7 to 30 Vdc
Operating Temperature:	– 5°C to +50°C
Storage Temperature:	-40 ºC. to +85 ºC.
Operating Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
Storage Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
RF Input / Output Connector	BMA Coaxial Female, Radiall
Status / Alarm / Control / DC Input Connectors:	21-Pin D-Subminiature Combo Connector
Dimensions:	5.22” High, 17.00” Wide, 20.44” Deep (Including handles, rear fans)

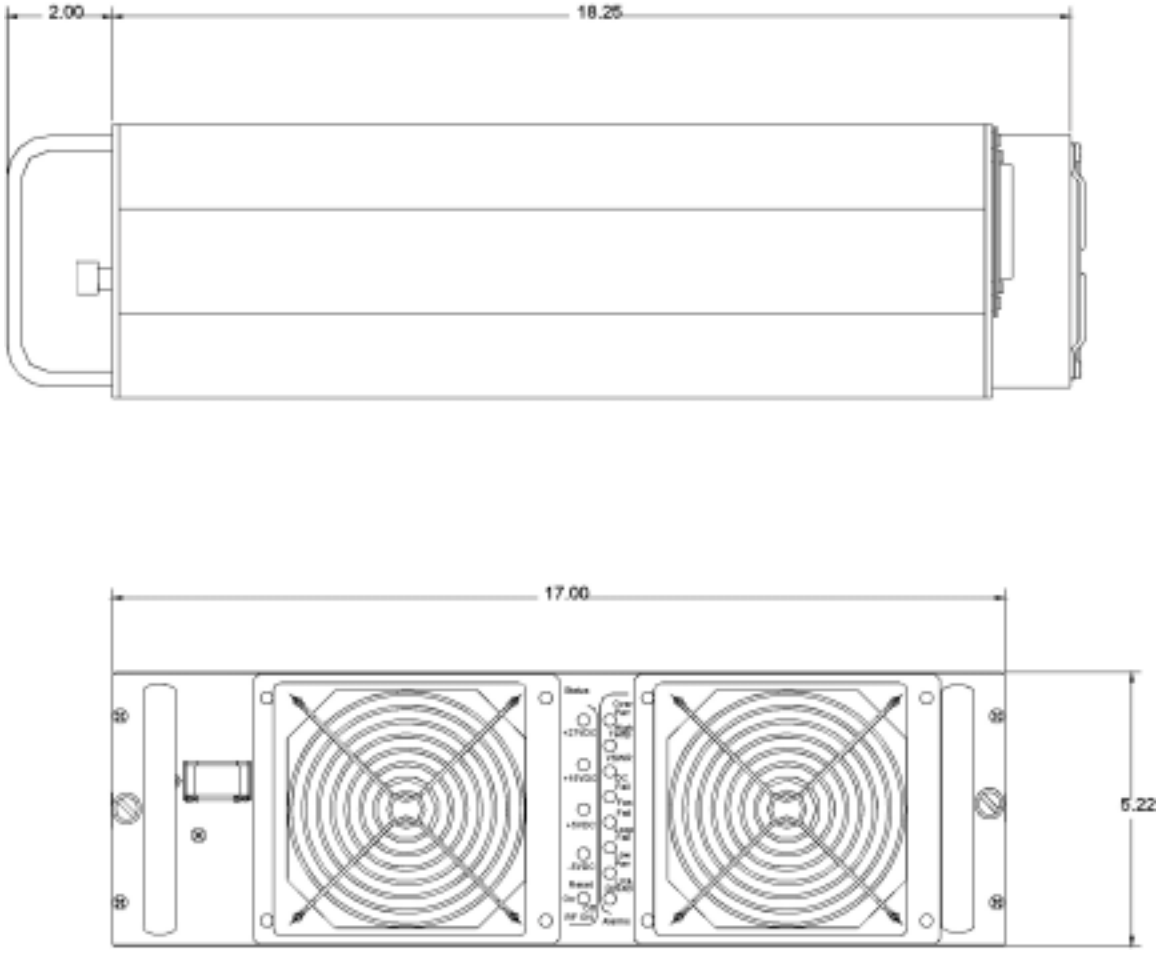


Figure 1-1 G3S-800-140

Section 2 Installation

2-1 Introduction

This section contains installation recommendations, unpacking, inspection, and installation instructions for the Multicarrier Cellular 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 review the Federal Communications Commission (FCC) rules as 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 +27 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 capable of handling the 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. Only in the event of severe shocks or other mistreatment should any substantial readjustment be required. 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 or fans. Inspect the rear panel connector for bent connector pins. 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 figures 1-1 and 2-1)

The G3S-800-140 amplifier module is designed for installation in a subrack that permits access to the rear of the subrack for connection of DC power, RF, and monitor cables.

To install the amplifier proceed as follows:

1. Install subrack in equipment rack and secure in place.
2. Connect antenna cable to rear of subrack.
3. Connect the transceiver output(s) to rear of subrack.
4. Connect alarms cable(s).

WARNING

Verify that all circuit breaker switches on the rear panel of the subrack are in the OFF position. Turn off external primary DC power before connecting DC power cables.

5. Connect positive primary power and negative primary power to the subrack. Tighten the subrack power connections.
6. Install the plug-in amplifier module(s) in the subrack. Tighten left and right thumbscrews.
7. Check your work before applying DC voltage to the system. Make certain all connections are tight and correct.
8. Measure primary DC input voltage. DC input voltage should be +27 Vdc ±1.0 Vdc. If the DC input voltage is above or below the limits, call and consult Powerwave before you turn on your amplifier system.
9. Refer to section 3 for initial turn-on and checkout procedures.

2-5 Amplifier Module Connectors

The amplifier has three connectors on the right rear of the module. The larger is a 21-pin male D-Sub combo which provides the status, alarm, control, and power connections. The smaller BMA coaxial female connectors provide the RF connections. Refer to figure 2-1.

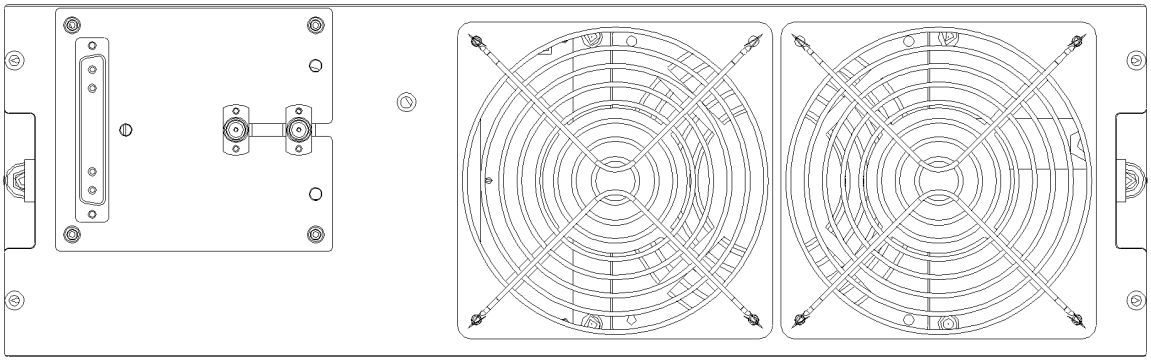


Figure 2-1 G3S-800-140 Amplifier, Rear View

2-5.1 Amplifier Module Status, Alarm, Control, And Power Connector

The amplifier has a separate remote alarm and control connector which may be used by the host system to monitor and control the individual amplifier modules. The status, alarm, control, and power connections on the amplifier connector are made through a 21-pin male D-Sub combo connector (figure 2-2) and are listed and described in table 2-1.

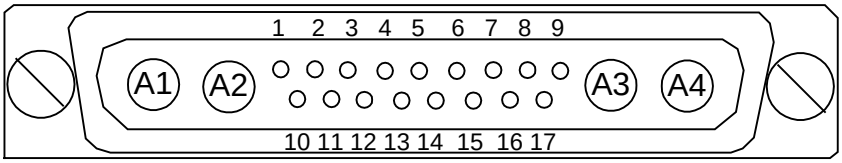


Figure 2-2 DC and Logic Connector (on Rear of G3S-800-140 Amplifier Module)

Table 2-1 Amplifier Module DC and Logic Connector Definition

Pin	Function	Description
A1	Power Input	+27 Vdc (Power Contact)
A2	Power Input	+27 Vdc (Power Contact)
A3	Ground	Ground (Power Contact)
A4	Ground	Ground (Power Contact)
1	RS485 +TxD	Serial Communication Data Out
2	RS485 +RxD	Serial Communication Data In
3	Service Loop	TTL input to Amp. Gnd. for special test mode (Note 1)
4	MCPA Disabled (Summary Fault)	TTL signal normally low indicates MCPA enabled. A high level indicates that the MCPA has been disabled. Over Power, Over Voltage takes one second to activate the signal.
5	Mod Addr 0	TTL input to Amp. Gnd. supplied by shelf to identify slot.
6	Mod Addr 1	TTL input to Amp. Gnd. supplied by shelf to identify slot.
7	TP1	TTL output. Future test point.
8	Manual Download	GND to download manually
9	DC on stat	TTL output. High indicates Amp is powered on.
10	RS485 –TxD	Serial Communication Data Out
11	RS485 –RxD	Serial Communication Data In
12	SCL7	No connection
13	SDA7	No connection
14	FP Disable Output	Output, GND if the front panel switch is in the OFF position; +5 volts indicates the front panel switch is in the ON position.
15	FP RST	Output, GND if the front panel switch is in the RESET position; +5 volts otherwise.
16	GND	Ground
17	Module Detect	Ground potential. Informs the subrack that an MCPA is plugged in.

Note 1: Service loop grounded allows the MCPA to be enabled or disabled by the front panel switch when not mounted in the shelf.

2-5.2 Amplifier Module RF Connector

The amplifier has a separate RF connector which is used for the RF signal input and output. The RF connections on the amplifier connector are made through two BMA female coaxial connectors (figure 2-3) and are listed and described in table 2-2.

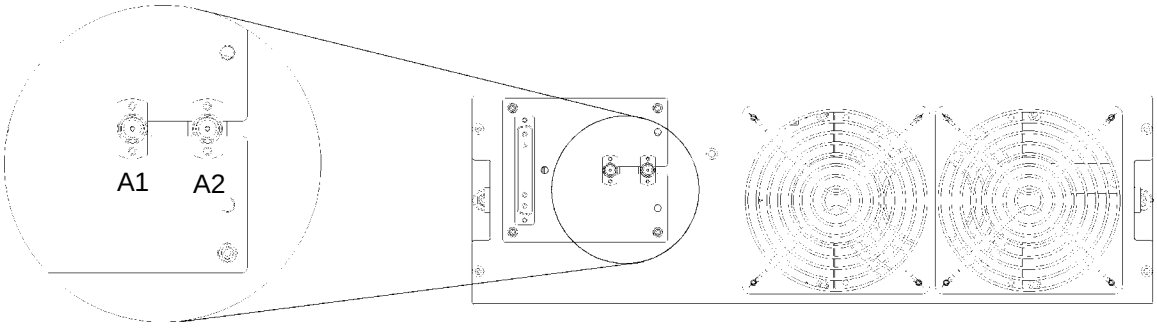


Figure 2-3 Amplifier RF Connector

Table 2-2 Amplifier RF Connector Definition

Pin	Function	Description
A1	RF Input	BMA Coaxial Female, Radiall
A2	RF Output	BMA Coaxial Female, Radiall

Section 3 Operating Instructions

3-1 Introduction

This section contains operating instructions for the Multicarrier Cellular Amplifier System.

3-2 Location And Function Of Amplifier Module Controls And Indicators

Primary +27 Vdc power is applied to the amplifier via a 100-amp circuit breaker (ON-OFF) located on the left side of the amplifier front panel.

The plug-in amplifier module RF control and indicators, located in the center of the amplifier front panel between the cooling fans, are shown in figure 3-1. The status and RF control functions are described in detail in table 3-1. The alarms are described in detail in table 3-2.

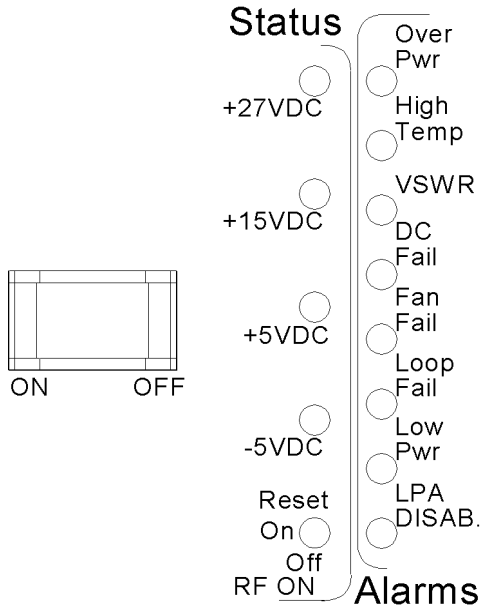


Figure 3-1 G3S-800-140 Amplifier Module RF Control and Indicators

Table 3-1 Amplifier Module RF Control and Indicators Definition

Name	**Function** (Note: MCPA = Multicarrier Power Amplifier)
+27VDC Indicator	Green LED. When lit, indicates that the +27 Vdc supply is greater than +21 Vdc and less than +31 Vdc. If the +27 Vdc indicator goes out, the DC FAIL indicator will illuminate. This indicates that the +27 Vdc voltage dropped below +21 Vdc.
+15VDC Indicator	Green LED. When lit, indicates that the +15 Vdc supply is greater than +12 Vdc and less than +17 Vdc. If the +15 Vdc indicator goes out, the DC FAIL indicator will illuminate. This indicates that the +15 Vdc voltage dropped below +12 Vdc or increased above +17 Vdc.
+5VDC Indicator	Green LED. When lit, indicates that the +5 Vdc supply is greater than +2 Vdc and less than +7 Vdc. If the +5 Vdc indicator goes out, the DC FAIL indicator will illuminate. This indicates that the +5 Vdc voltage dropped below +2 Vdc or increased above +7 Vdc.
-5VDC Indicator	Green LED. When lit, indicates that the -5 Vdc supply is greater than -7 Vdc and less than -2 Vdc. If the -5 Vdc indicator goes out, the DC FAIL indicator will illuminate. This indicates that the -5 Vdc voltage dropped below -7 Vdc or increased above -2 Vdc.
RF ON Switch	Three position switch: Off (down position) - Turns off amplifier module. On (center position) - Normal amplifier on position. Reset (up position) - When toggled to reset position, all the red LED indicators will turn on one at a time in sequence followed by all the green indicators one at a time in sequence; this will also reset the fault latches. If the switch is held in the reset position, a microcontroller reset will occur. This will be verified by the LEDs toggling state again. The switch is spring loaded to return to the normal ON position when released. If a fault occurs and the MCPA is disabled, the alarms can be cleared and the MCPA enabled by this reset position. The functions of the switch are disabled for five seconds after a power-up condition.

A 'Minor Alarm' will flag a potential fatal problem by the LEDs and the MCPA fault will be in evaluation. A 'Critical Alarm' is indicative of a fatal problem. The fault indicator will latch on and the MCPA module will be disabled. A 'Major Alarm' indicates a major problem but the MCPA module will not be disabled. Both 'Major Alarm' and 'Critical Alarm' will be sent to the host system via the MCPA subrack.

Table 3-2 Amplifier Module Alarm Indicators Definition

Alarm	Mode	LED	MCPA Module	MCPA Disable signal (pin 4 inTable 2-1)	Condition
Over Pwr	Critical	Red	Disable	High	MCPA module output power >200 watts (Note 4)
Over Pwr	Critical	Red	Disable	High	Input power >-2 dBm
High Temp	Minor	Red	Enable	Low	High temperature detected
High Temp	Critical	Red	Disable	High	High temperature detected for longer than two minutes
VSWR	Minor	Red	Enable	Low	14.5 W < Reflected Power < 38W
VSWR	Critical	Red	Disable	High	60W < Reflected power detected at output longer than approx. two min.
DC Fail	Minor	Red	Enable	Low	One of the internal DC voltages dropped below or exceeded the safe threshold level
DC Fail	Critical	Red	Disable	High	Voltage out of range for longer than approx. two minutes (Note 2)
DC Fail (Over voltage)	Critical	Red	Disable	High	+27 Vdc input >30 V for longer than one sec. after initial detection of DC input >31 V (Note 3)
Fan Fail (one)	Major	Red	Enable	Low	Any fan failure
Loop Fail	Minor	Red	Enable	Low	Loop failure detected
Loop Fail	Critical	Red	Disable	High	Loop failure detected longer than 2 minutes
Low Pwr	Minor	Red	Enable	Low	Rack controller detected MCPA output is 3 dB below that of the other MCPA in the system.
Low Pwr	Critical	Red	Disable	High	Rack controller detected low power condition for more than approx. two minutes
LPA DISAB.	Critical	Red	Disable	High	Unit is manually switched off using the front panel RF ON switch, or disabled by a serial command or auto shutdown by an alarm condition.

NOTES:

1. RS-485 serial alarm will follow LED status.
2. The appropriate status LED shall turn off indicating which voltage is out of its range.
3. When overvoltage is detected:
   a) MCPA shall shut down (disable)
   b) Turn on red DC Fail LED
   c) Set flag for DC Fail alarm
4. When overpower is detected:
   a) MCPA shall shut down (disable)
   b) Turn on Over Pwr LED
   c) Set flag for Over Pwr alarm
   d) The MCPA module shall use a peak power detector to determine the overpower fault.

3-3 Initial Start-Up And Operating Procedures

The amplifier module has two operating controls, both located on the front face of the module: the power ON - OFF switch and the RF ON - ON/OFF/RESET switch. 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 1-2 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. Verify that the amplifier front panel switches are in the OFF position.
3. Turn on supply that provides +27 Vdc to the amplifier system. Do not apply an RF signal to the amplifier system
4. Place the ON - OFF circuit breaker on the amplifier in the ON position. Visually check the indicators on the amplifier module, and verify that the following indicators are on:
   A. LPA DISAB. indicator (red) should be on.
   B. The +27VDC, +15VDC, +5VDC and -5VDC indicators (green) on the amplifier module should be on.
5. Set the RF ON switch to the ON (center) position. All red LEDs should turn off after six seconds.
6. 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 Multicarrier Cellular Amplifier.

4-2 RF Input Signal

The maximum input power for all carrier frequencies should not exceed the limits specified in table 1-2. For proper amplifier loop balance, the out of band components of the input signals should not exceed -40 dBc. The input VSWR should be 2:1 maximum (or better).

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. 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).

4-4 G3S-800-140 Amplifier Module

The G3S-800-140 amplifier is a linear, feed-forward power amplifier that operates in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier modules are designed for parallel operation to achieve high peak power output, and for redundancy in unmanned remote locations. The amplifier module, figure 4-1, has an average output of 140 watts power (1400 watts peak power) with intermodulation products suppressed to better than -60 dBc below carrier levels. The amplifier provides an amplified output signal with constant gain and phase by adding approximately 30 dB of distortion cancellation on the output signal. Constant gain and phase is maintained by continuously comparing active paths with passive references, and correcting for small variations through the RF feedback controls. All gain and phase variations, for example those due to temperature, are reduced to the passive reference variations. Each amplifier module has an alarm and display board that monitors the amplifier performance. If a failure or fault occurs in an amplifier module, it is displayed on the individual amplifier front panel.

The amplifier module is comprised of:

Pre-amplifiers

Main amplifier

Error amplifier

Two feed-forward loops with phase-shift and gain controls

DC/DC power regulator

Alarm monitoring, control and display panel

The main amplifier employs class AB amplification for maximum efficiency. The error amplifier and feed forward loops are employed to correct signal nonlinearities introduced by the class AB main amplifier. The error amplifier operates in class AB mode. The RF input signals are amplified by a preamp and coupled to an attenuator and phase shifter in the first feed-forward loop. The main signal is phase shifted by 180 degrees and amplified in the premain amplifier. The output from the premain amplifier is fed to the class AB main amplifier. The output from the main amplifier is typically 220 watts. The signal is output to several couplers and a delay line.

The signal output from the main amplifier is sampled using a coupler, and the sample signal is combined with the main input signal and input to the second feed-forward loop. The error signal is

attenuated, phase shifted 180 degrees, then fed to the error amplifier where it is amplified to a level identical to the sampled output from the main amplifier. The output from the error amplifier is then coupled back and added to the output from the main amplifier. The control loops continuously make adjustments to cancel out any distortion in the final output signals.

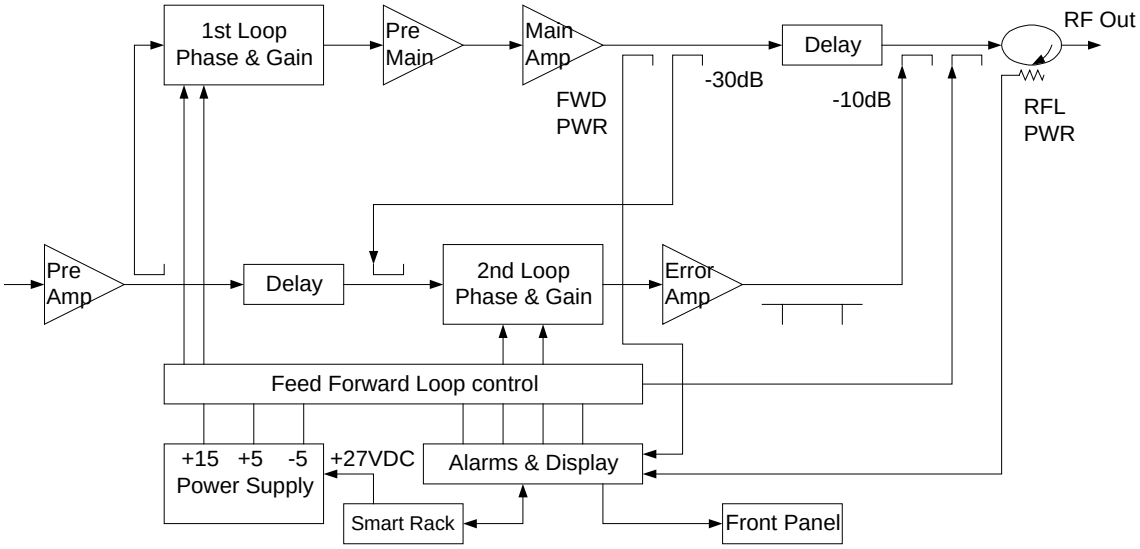


Figure 4-1 G3S-800-140 Power Amplifier Module Functional Block Diagram

The 2nd loop control section obtains a sample of the distortion added to the output signals by the main amplifiers, phase shifts the signals by 180 degrees, then feeds it to the error amplifier. There it is amplified to the same power level as the input sample and coupled on to the main output signal. The final output is monitored by the 2nd loop and adjusted to ensure that the signal distortion and IMD on the final output is canceled out.

4-4.1 Main Amplifier

The input and output of the amplifier employ two-stage, class AB amplifiers which provide approximately 32 dB of gain in the 25 MHz frequency band from 869 to 894 MHz. The amplifier operates on +27 Vdc, and a bias voltage of +5 Vdc, and is mounted directly on a heat sink which is temperature monitored by a thermostat. If the heat sink temperature exceeds 85 °C, the thermostat opens and a high temperature fault occurs. The alarm logic controls the +5 Vdc bias voltage which shuts down the amplifier.

4-4.2 Error Amplifier

The main function of the error amplifier is to sample and amplify the signal distortion level generated by the main amplifier, to a level that cancels out the distortion and IMD when the error signal is coupled onto the main signal at the amplifier output. The error amplifier is a balanced multistage, class AB amplifier, has 51 dB of gain, and produces up to an 80-watt output. The amplifier operates on 27 Vdc and a bias voltage of +5 Vdc, and is mounted directly on a heat sink.

4-4.3 Amplifier Monitoring

In the main and error amplifier modules, all normal variations are automatically compensated for by the feedforward loop control. However, when large variations occur beyond the adjustment range of the loop control, a loop fault will occur. The alarms are displayed on the front panel indicators and output via a 21-pin connector on the rear of the module to the subrack summary board for subsequent remote monitoring via the ALARMS connector. Refer to paragraph 2-5 as well as figure 2-2 and table 2-2 for a description of the ALARMS connector.

4-4.4 Amplifier Module Cooling

Although each amplifier module contains its own heat sink, it is cooled with forced air. Four fans are used for forced air cooling and redundancy. The fans, located on the front and rear of the amplifier module, draw air in through the front of the amplifier and exhaust hot air out the back of the module. The fans are field replaceable.

4-5 Power Distribution

Primary DC power for the system is provided by the host system to the MCR30830-1-3 Series subrack. The subrack supplies each amplifier module with +27 Vdc directly and via the RF power splitter/combiner. The amplifier module has a DC/DC converter that converts the +27 Vdc to +15 Vdc, +5 Vdc and -5 Vdc.

4-6 Intermodulation

The G3S-800-140 amplifier is designed to deliver a 140-watt composite average power, multicarrier signal, occupying a bandwidth less than or equal to 25 MHz, in the bandwidth from 869 to 894 MHz. The maximum average power for linear operation, and thus the amplifier efficiency, will depend on the type of signal amplified.

4-6.1 Two Tone Intermodulation

When measured with two equal CW tones spaced anywhere from 30 kHz to 20 MHz apart, and at any power level up to the average power, the third order intermodulation products will be below -60 dBc

4-6.2 Multitone Intermodulation

Adding more tones to the signal will lower individual intermodulation products. If the frequencies are not equally spaced, the level of intermodulation products gets very low. When the frequencies are equally spaced, those products fall on top of each other on the same frequency grid. The average power of all intermodulation beats falling on the same frequency is called the composite intermodulation; it is -60 dBc or better.

4-7 Alarms

The presence of several plug-in amplifier alarms can be detected at the DC and logic connector on the amplifier rear panel. Refer to table 2-1 and figure 2-2 for a description of the connector.

Section 5 Maintenance

5-1 Introduction

This section contains periodic maintenance and performance test procedures for the Multicarrier Cellular 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.

WARNING

Wear proper eye protection to avoid eye injury when using compressed air.

Table 5-1 Periodic Maintenance

Task	Interval	Action
Cleaning Air Vents	30 Days	Inspect and clean per paragraph 5-4
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 system 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

Nomenclature	Manufacturer	Model
Signal Generator	RDL	IMD-801D-03A
30 dB Attenuator, 500 Watt	Weinschel Corp.	53-30-34
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
Network Analyzer	H.P.	8753C
Current Probe		

5-4 Cleaning Air Inlets/Outlets

The air inlets and outlets should be cleaned every 30 days. If the equipment is operated in a severe dust environment, they should be cleaned more often as necessary. Turn off DC power source before removing fans. If dust and dirt are allowed to accumulate, the cooling efficiency may be diminished. Using either compressed air or a brush with soft bristles, loosen and remove accumulated dust and dirt from the air inlet panels.

5-5 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.

5-5.1 Amplifier System Performance Test

This test is applicable to the G3S-800-140 amplifier modules. To perform the test, proceed as follows:

1. Connect test equipment to the amplifier as shown in figure 5-1.

NOTE

Do not apply any RF signals at this time.

Turn on signal generator and set frequency F1 to 880 MHz, F2 to 883 MHz, F3 to 886 MHz, and F4 to 889 MHz. Adjust each signal generator output so that the sum power output from all four signal generators equals -6 dBm at the input.

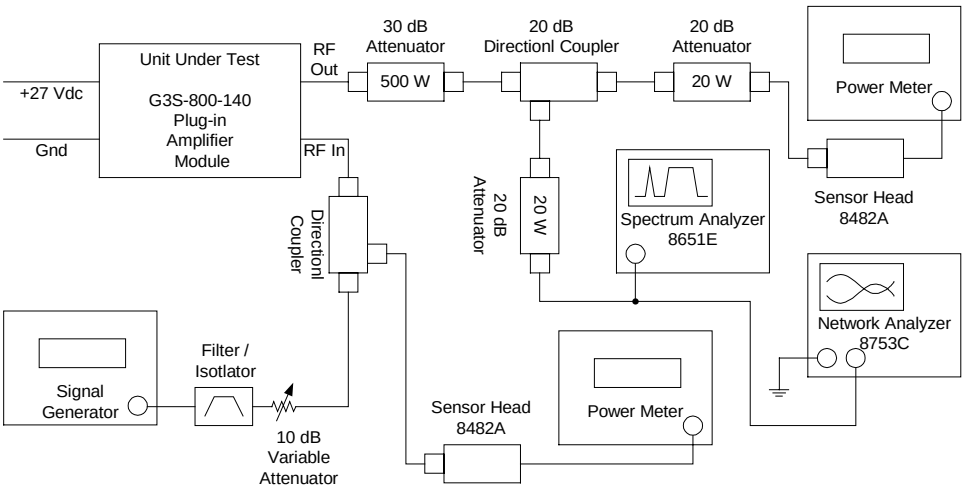


Figure 5-1 Amplifier System Test Setup Diagram

5-5.2 Amplifier IMD Test And Current Test

2. Adjust attenuator for an input signal at -10 dBm. Turn on the amplifier by setting RF ON switch of amplifier. Adjust variable attenuator to set amplifier power output on power meter to 140 watts. Measure IMD on spectrum analyzer. IMD should be -60 dBc max. Record test data in table 5-3. Set RF ON switch to OFF.
3. With the amplifier module set at 140 watts power output, use the current probe (magnetic field type) and measure the dc current flow from the +27 Vdc power source. Current should be 70 amps maximum. Record test data in table 5-3.

5-5.3 Gain Test

4. Disconnect spectrum analyzer from test setup, and connect the network analyzer.
5. Set network analyzer as follows:
   - Power output to -10 dBm.
   - Frequency start to 869 MHz.
   - Frequency stop to 894 MHz.
   - Normalize the network analyzer for gain and return loss.
6. Check the gain across the band from 869 MHz to 894 MHz. Gain should be between 58 dB. Record test data in table 5-3.

5-5.4 Harmonics Test

7. 10.With the power set at 140 watts power output, use the spectrum analyzer and check the frequency band from 869 MHz to 894 MHz for harmonics. Harmonics should be 5 dBm maximum. Record test data in table 5-3.

5-5.5 Spurious Test

8. With the power amplifier set at 140 watts power output, use the spectrum analyzer and check the frequency band from 869 MHz to 894 MHz for spurious signals. Spurious signals should be -60 dBc maximum. Record test data in table 5-3.

5-5.6 Input Return Loss Test

9. Reset and turn on amplifier module. Read and record the S_{11} return loss measurement on network analyzer. Input return loss should be –16 dB maximum. Record test data in table 5-3.

Table 5-3 Multicarrier Cellular Amplifier Test Data Sheet

DATE _____

AMPLIFIER S/N _____

TEST CONDITIONS:
Load and Source Impedance: 50 Ohms
VSWR: < 1.2:1
Supply Voltage: +27 Vdc ±1.0 Vdc

TEST	SPECIFICATION	MIN	MAX	DATA
4-TONE IMD	Vcc = 27 Vdc PO = 140 W Freq.: 880, 883, 886, and 889 MHz		-60 dBc	
RF Gain	Vcc = 27 Vdc PO = 140 W Freq. = 880 MHz	57.5 dB	58.5 dB	
Gain Flatness	Vcc = 27 Vdc ±1 Vdc PO =140 W 869-894 MHz Band	-0.5 dB	+0.5 dB	
Harmonics	Vcc = 27 Vdc PO = 140 W 869-894 MHz Band		5 dBm	
Spurious	Vcc = 27 Vdc PO =140 W 869-894 MHz Band		-60 dBc	
Input Return Loss	Vcc = 27 Vdc PO = 140 W 869-894 MHz Band		-16 dB	
DC Power	Vcc = 27 Vdc PO = 140 W 4 Tones		70 Amps	

PASS _____ FAIL _____

Tested by _____

5-6 Field Replaceable Parts And Modules

The following parts and modules can be replaced in the field on site by a qualified technician with experience maintaining RF power amplifiers and similar equipment:

1. G3S-800-140 power amplifier modules
2. Cooling fans

5-6.1 G3S-800-140 Power Amplifier Module

To replace a power amplifier module, proceed as follows:

1. Set both the RF ON On/Off/Reset switch and the power ON/OFF switch on the front panel of the amplifier module to OFF.
2. Loosen two screws that secure amplifier module to subrack.
3. Use handle on front of module, and with a steady even pressure, pull module out of subrack.

CAUTION

When removing the amplifier from the subrack, it is very important to support the amplifier such that the rear of the module does not suddenly drop when it disengages from the track. A drop such as this could damage the module.

5-6.2 Cooling Fans

To replace a cooling fan, proceed as follows:

1. Remove amplifier module from subrack; see paragraph 5-6.1 preceding.
2. Loosen four snap fasteners that secure fan to amplifier module. Disconnect fan power connector from amplifier module.

Install replacement in reverse order of steps 1 and 2 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
Any voltage indicators (green) are not lit or blinking	1. Check that subrack power connection is secure. 2. Check for proper power supply voltage. 3. Check fuses or circuit breakers on amplifier or subrack. 4. Verify that amplifier is fully inserted into subrack.
HIGH TEMP alarm (red) is lit	1. Verify fan(s) are operating properly. 2. Check ambient temperature (not to exceed spec – see table 1-2).
OVER PWR alarm (red) is lit	Verify RF input level does not exceed spec – see table 1-2.
VSWR alarm (red) is lit	Check output connections and cables for integrity and tightness.
LOW PWR alarm (red) is lit	Contact Powerwave field representative or factory.

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 (714) 466-1000 to obtain this number, or FAX your request to (714) 466-5800. 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 our Repair Department for packing materials and information.