# INSTALLATION & SERVICE MANUAL

## MULTICHANNEL POWER AMPLIFIER G3L-800-25-001

## 869-894 MHz 25 WATTS AVERAGE POWER

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Section

1

# GENERAL DESCRIPTION

## 1-1. INTRODUCTION

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's model G3L-800-25-001 multichannel power 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 G3L-800-25-001 (see figures 1-1 and 1-2) is a linear, multichannel 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 indoor and outdoor North American cellular base stations. The G3L-800-25-001 accepts single channel and transmit voice RF signals. The G3L-800-25-001 uses an internally generated tone to optimize its performance. The system operating band (A or B) is externally provided to the G3L-800-25-001 so that it knows where the tone frequency is going to be. If the operating band is A, then a tone at B band is generated; if the operating band is B, then a tone at A band is generated.

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 +27 Vdc.

## 1-3. FUNCTIONAL AND PHYSICAL SPECIFICATIONS

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

Table 1-1. G3L-800-25-001 Multichannel 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 | -60 dBc maximum (820 MHz – 900 MHz)<br>-50 dBc maximum (all other frequencies) |
| RF Gain | 57±0.5 dB |
| Gain Flatness: | ±0.5 dB (869 MHz – 894 MHz) |
| Gain Variation<br>(Temperature and Voltage) | ±0.7dB (From 25 ºC, across specified temperature range.)<br>±0.7dB (From 27 V, across specified voltage range.) |
| Output Protection: | Mismatch Protected |
| Input Port Return Loss: | -12 dB at any given power level |
| Operating Temperature: | 0 ºC. to +50 ºC. (room ambient) |
| Storage Temperature: | -40 ºC. to +65 ºC. (room ambient) |
| Operating Humidity: | 5% - 95% Relative Humidity (noncondensing) not to exceed 0.024 grams of water per gram of dry air. |
| Storage Humidity: | 5% - 95% Relative Humidity (noncondensing) |
| DC Input, Alarm, and Control Connector: | 21WA4 (male, D-sub) |
| RF Input Connector: | 21WA4 (male, D-sub) |
| RF Output Connector: | 21WA4 (male, D-sub) |
| Phase | 180±5 degrees (measured at 880 MHz, 25 ºC, any power level) |
| Phase Tracking | ±10 degrees (from 25 ºC, across specified temperature range) |
| IMD | -60 dBc (8 carriers, continuous phase random, equal carrier spacing of 1.25 MHz. Any power up to maximum average output power.) |
| Output Return Loss | -18 dB (at any power level) |
| Harmonic Output | -45 dBc (at any number of carriers, any power level.) |
| Communications | RS-485 interface for control and status |
| Status Indicators: POWER ON:<br>MINOR:<br>MAJOR: | Green LED = Power applied<br>Yellow LED = Minor alarm (loop failure)<br>Red LED = Major alarm (module failure and shut down) |
| Internally Generated Alarms | Over temp., DC over voltage, Overpower, VSWR, Loop fail. |
| Externally Generated Alarms | Fan failure: Open collector pulled low = amp functioning<br>Open collector floating high = amp failure |
| Hot Swap Capable | Unit is capable of being replaced without shutting down power. |
| DC Input Power: | +27±0.1 Vdc, 260 mV p-p max. ripple, ≤350 watts |
| Power Supply Current | 15 amps max. (at max. RF power out) |
| Overload Protection | 20 A (circuit breaker / on-off switch) |
| Dimensions (inches): | Height: 13.82; width: 2.64; depth: 15.57 |

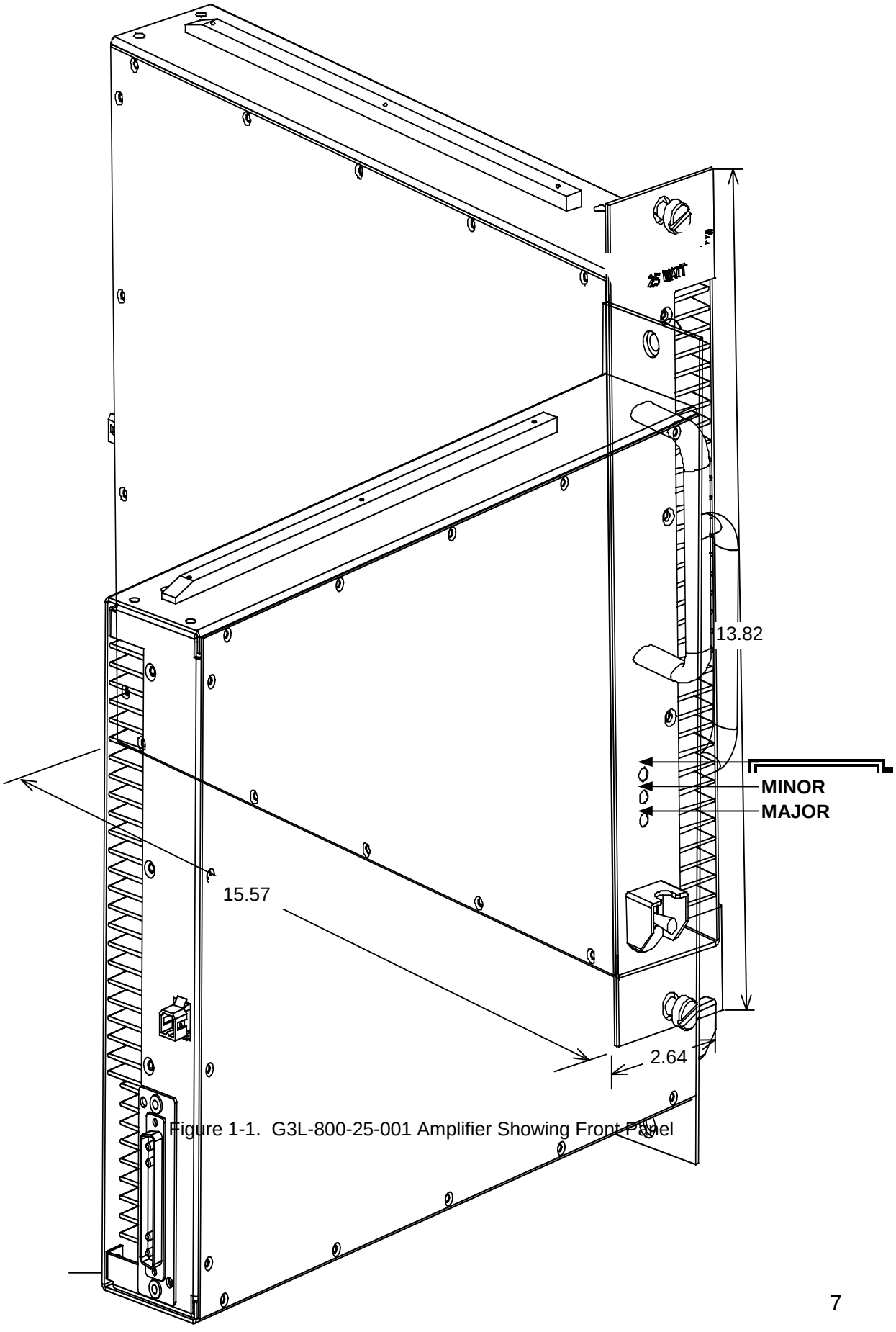
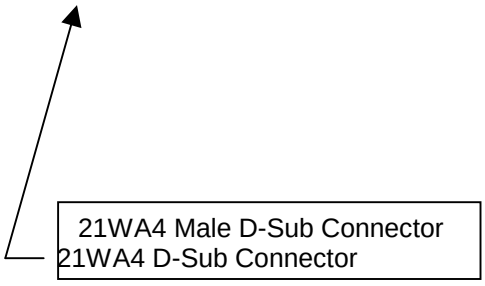



Figure 1-1. G3L-800-25-001 Amplifier Showing Front Panel

Figure 1-2. G3L-800-25-001 Amplifier Showing Rear Panel



Section

2

# INSTALLATION

## 2-1. INTRODUCTION

This section contains unpacking, inspection, and installation instructions and recommendations for the Model G3L-800-25-001 Multichannel 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 +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 thermal type, 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. 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

The G3L-800-25-001 amplifier module is designed for installation in a subrack that permits access to the subrack for connection of DC power, RF, and monitor cables.

To install the amplifier proceed as follows:

1. Install subrack in equipment rack or cabinet and secure in place.
2. Connect antenna cable to subrack.
3. Connect the transceiver output(s) to subrack.
4. Connect RS-232 cable to subrack.
5. Connect alarm and control cables to subrack.

**WARNING**

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

7. Connect positive primary power and negative primary power to the subrack. Tighten the subrack power connections.
8. Place power on/off switch on the amplifier front panel in the “off” (down) position. Insert the plug-in amplifier module(s) in the subrack. Tighten top and bottom thumbscrews.
9. Check your work before applying DC voltage to the system. Make certain all connections are tight and correct.
10. 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.
11. Refer to section 3 for initial turn-on and checkout procedures.

## 2-5. AMPLIFIER MODULE POWER, ALARM, CONTROL, AND RF CONNECTOR

The power, alarm, control, and RF connections on the amplifier are made through a 21WA4 male connector (figure 2-1) and are listed and described in table 2-1.

Table 2-1. Amplifier Module Power, Alarm, Control, and RF Connector Definition

| PIN | SIGNAL | I/O | SIGNAL NAME |
|---|---|---|---|
| 1 | GROUND | - | - |
| 2 | RxD+ | DATA IN | SERIAL-RS485 |
| 3 | RxD- | DATA IN | SERIAL-RS485 |
| 4 | TxD+ | DATA OUT | SERIAL-RS485 |
| 5 | TxD- | DATA OUT | SERIAL-RS485 |
| 6 | RACK A2 | ADDRESS IN (MSB) | GROUND PIN FOR A HIGH,FLOAT FOR A LOW |
| 7 | RACK A1 | ADDRESS IN (MiddleSB) | GROUND PIN FOR A HIGH,FLOAT FOR A LOW |
| 8 | RACK A0 | ADDRESS IN (LSB) | GROUND PIN FOR A HIGH,FLOAT FOR A LOW |
| 9 | | | NOT USED |
| 10 | AMP A2 | ADDRESS IN (MSB) | GROUND PIN FOR A LOW,FLOAT FOR A HIGH |
| 11 | FAN FAIL | INPUT | GROUND PIN FOR A LOW,FLOAT FOR A HIGH |
| 12 | AMP A1 | ADDRESS IN (MiddleSB) | GROUND PIN FOR A LOW(PASS),FLOAT FOR A HIGH(FAIL) |
| 13 | | | NOT USED |
| 14 | AMP A0 | ADDRESS IN (LSB) | GROUND PIN FOR A LOW,FLOAT FOR A HIGH |
| 15 | | | NOT USED |
| 16 | | | NOT USED |
| 17 | | | NOT USED |
| A1 | RF INPUT | | PDM 24 SERIES COAX |
| A2 | Vin | SOURCE | TYPICALLY 27 VOLTS DC |
| A3 | GROUND | - | POWER SUPPLY RETURN |
| A4 | RF OUTPUT | | PKZ 26 SERIES COAXIAL CONNECTOR (50 OHM, .050” CENTER CONTACT) |

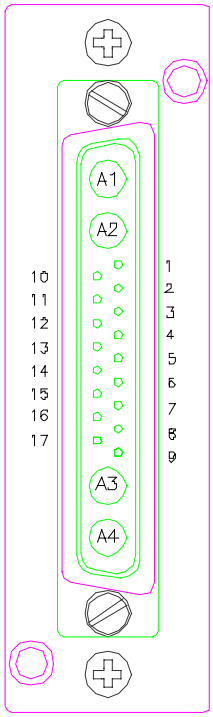



Figure 2-1. Power, Alarm, Control, and RF Connector (D-SubMiniature 21WA4, Male Connector)

**2-6. AMPLIFIER MODULE RS-232 CONNECTOR**
The RS-232 connection on the amplifier is made through a 4-pin male Molex connector (figure 2-2). The connector is defined in table 2-2.

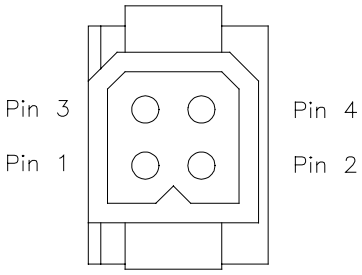



Figure 2-2. RS-232 Connector (on Rear of G3L-800-25-001 Module)

Table 2-2. Amplifier Module RS-232 Connector Definition

| PIN NUMBER | DESCRIPTION |
|---|---|
| 1 | RS-232 Rx |
| 2 | RS-232 Tx |
| 3 | Summary Alarm |
| 4 | Ground |

Section 3

# OPERATING INSTRUCTIONS

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

**3-2. INITIAL START-UP AND OPERATING PROCEDURES**

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 +27 Vdc to the amplifier system.

3. Place power on/off switch on the amplifier front panel in the “on” (up) position.

4. 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 G3L-800-25-100 Multichannel Power Amplifier.

## 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 G3L-800-25-001 amplifier (figures 1-1, 1-2, and 4-1) is a linear, multichannel 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 the D-subminiature 21Wa4 connector at the rear of the module.

The amplifier is compliant to the requirements of FCC Part 22 and TIA/EIA IS97A with respect to spurious emissions. 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 preamp
A driver amplifier
A main amplifier
An error and preerror amplifier

Alarm monitoring and control

### 4-4.1. PREDRIVER AMPLIFIER

The input of the amplifier employs two stages of class AB amplification which provide approximately 13.5 dB of gain in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +27 Vdc.

### 4-4.2. THREE STAGE DRIVER AMPLIFIER

The input of the amplifier employs three stages of class AB amplification which provide approximately 32 dB of gain in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +27 Vdc.

### 4-4.3. MAIN AMPLIFIER

The main amplifier employs class AB amplification for maximum efficiency. The signal provides approximately 11 dB of gain in the 25 MHz frequency band. The output from the main amplifier is typically 30 watts. The amplifier operates on +27 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.

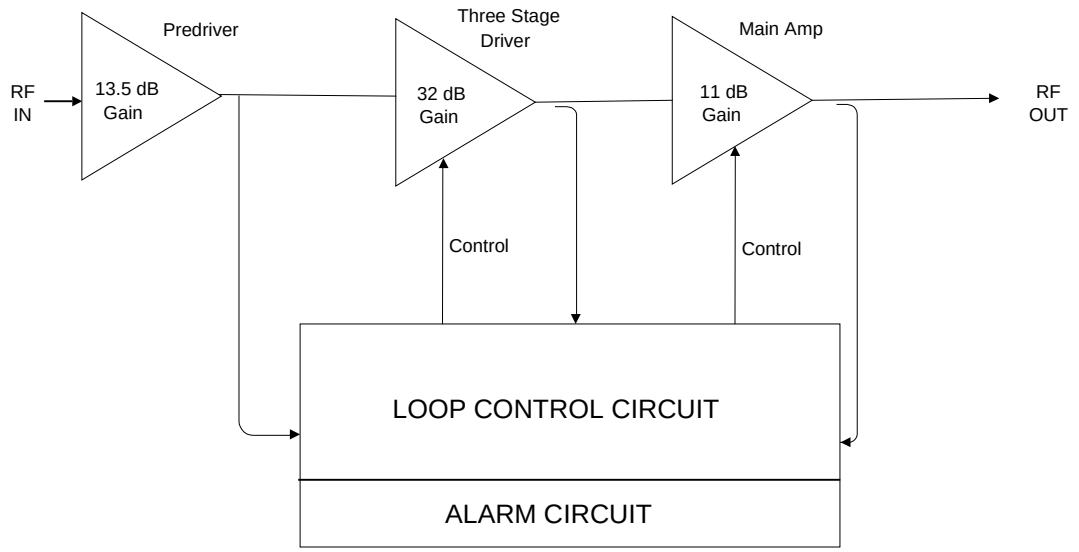



Figure 4-1. G3L-800-25-001 Multichannel Power Amplifier Functional Block Diagram

### 4-4.4. ALARM MONITORING AND CONTROL

In the amplifier, all normal variations are automatically compensated for by the loop control circuit. However, when large variations occur beyond the adjustment range of the loop control, a loop fault will occur. The alarms are output via a 21WA4 D-sub connector on the module for subsequent remote monitoring.

### 4-4.5. LOOP CONTROL CIRCUIT

The primary function of the loop control circuit is to reduce the spurious emissions of the RF signal at all amplifier stages. The loop control circuit controls internal amplifier parameters of all amplifier stages, thereby optimizing spurious emissions.

## 4-5. AMPLIFIER MODULE COOLING

Each amplifier module is contained within a thermally conductive finned chassis which, when properly cooled with external fans, 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 +27 Vdc to +15 Vdc, +5 Vdc, and +8 Vdc for internal use.

Section 5

# MAINTENANCE

## 5-1. INTRODUCTION

This section contains periodic maintenance and performance test procedures for the Multichannel 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**<br>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 -13 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. 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.

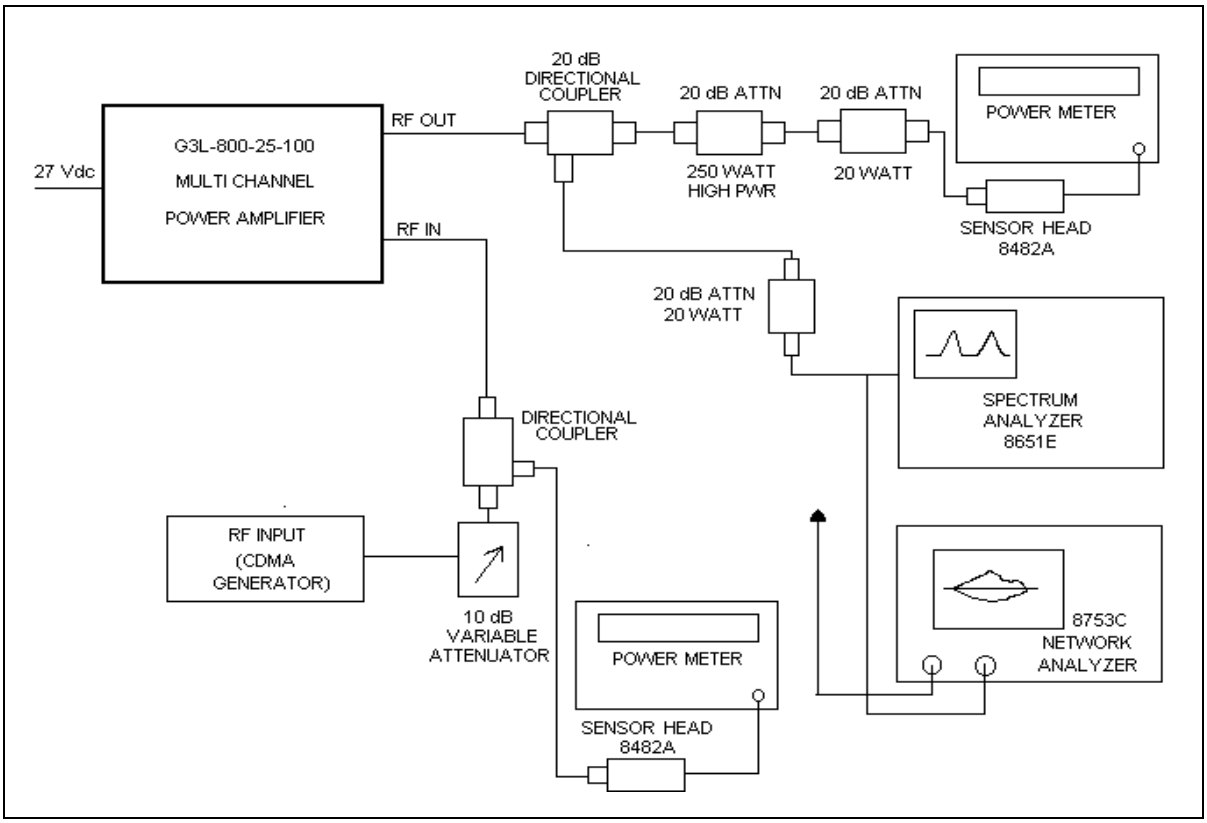



Figure 5-1. G3L-800-25-001 Amplifier Test Setup Diagram

Table 5-3. Multichannel Power Amplifier Test Data Sheet

DATE_____

MODULE S/N _____

TEST CONDITIONS:
Load and Source Impedance: 50 Ohms
VSWR: < 1.2:1
Supply Voltage: +27 Vdc ±0.1 Vdc

| TEST | SPECIFICATION | MIN | MAX | DATA |
|---|---|---|---|---|
| RF Gain | Vcc = 27 Vdc<br>PO = 25 W<br>Freq. = 880 MHz | Table 1-1<br>-0.5 dB | Table 1-1<br>+0.5 dB | |
| Spurious Emissions | Vcc = 27 Vdc<br>PO =25 W<br>869 - 894 MHz Band | | -60 dBc | |
| Gain Flatness | Vcc = 27 Vdc<br>PO =25 W<br>869 - 894 MHz Band | | ±0.5 dB | |
| Input Return Loss | Vcc = 27 Vdc<br>PO = 25 W<br>869-894 MHz Band | -12 dB | | |

PASS _____ FAIL _____

Tested by _____

### 5-5. FIELD REPLACEMENT OF THE MODULE

The G3L-800-25-001 multichannel 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. Set on/off switch on the front panel of the amplifier module to OFF (down).

2. Loosen two thumbscrews that secure amplifier module to 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 the guide rail disengages from the track. A drop such as this could damage the rear 21WA4 multipin connector.

3. With steady even pressure, use handle on front of amplifier to pull module out of subrack.

4. Install replacement in reverse order of steps 1 through 3 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 |
|---|---|
| G3L-800-25-001 Inoperative | 1. Check for proper power supply voltage.<br>2. Verify all RF connections. |

| | |
|---|---|
| | 3. Verify that unit does not have a major fault (red LED on front panel). Recycle power. |

## 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 may 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.