



**INSTALLATION & SERVICE**  
**MANUAL**

**MODEL MCR4109-1**  
**MULTICARRIER CELLULAR**  
**AMPLIFIER SYSTEM SUBRACK**

**869-894 MHz**  
**100 WATTS AVERAGE POWER**  
**-65 dBc INTERMODULATION DISTORTION**

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## **GENERAL DESCRIPTION**

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### **1-1. INTRODUCTION**

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's model MCR4109-1 multicarrier cellular amplifier system subrack. The manual is organized into five sections as follows:

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

### **1-2. GENERAL DESCRIPTION**

The MCR4109-1 24-inch center-mount subrack (figure 1-1) contains an RF power splitter/combiner and a summary logic module that monitors the functional status of all plug-in amplifiers. The rear panel of the subrack interfaces with the host system via the system RF I/O connectors, an RF output sample connector, and a form C remote status connector to monitor the system. The system offers up to 360 watts output when four 100-watt amplifiers are employed. Primary power for the amplifier system is +27 Vdc, approximately 180 amps.

### **1-3. FUNCTIONAL AND PHYSICAL SPECIFICATIONS**

Functional and physical specifications for the amplifier system subrack 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. To that end, we ask that you, our customer, share with us any information acquired in field situations that would enhance this manual.

### **1-5. ORDERING INFORMATION**

Subracks may be ordered from Powerwave by specifying Model MCR4109-1, 4-way 24-inch center-mount configuration subrack.

Table 1-1. Model MCR4109-1 Subrack Functional Specifications

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Total Maximum Input Power	-3.0 dBm
Total Output Power (Minimum)	90 W (47 dBm) typical (1 Module) 180 W (50 dBm) typical (2 Modules) 270 W (51.8 dBm) typical (3 Modules) 360 W (53 dBm) typical (4 Modules)
Duty Cycle:	Continuous
DC Input Power:	+27 Vdc $\pm$ 1 Vdc, 45 Amps Max per module @ 100 Watts Operational +21 Vdc to 30 Vdc
Operating Temperature:	0 °C. to +50 °C.
Storage Temperature:	-40 °C. to +85 °C.
Operating Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
Storage Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
DC Input Connectors:	Terminal Block
Summary Alarm Connector:	15-Pin Female D-Subminiature
RS-485 Connector	9-Pin Female D-Subminiature
RF Input Connector:	SMA Female
RF Output Connector:	Type N Female
RF Output Sample Connector:	SMA Female
Subrack Dimensions:	15.72" (9U) High, 24.00" Wide, 17.13" Deep (with amplifiers)

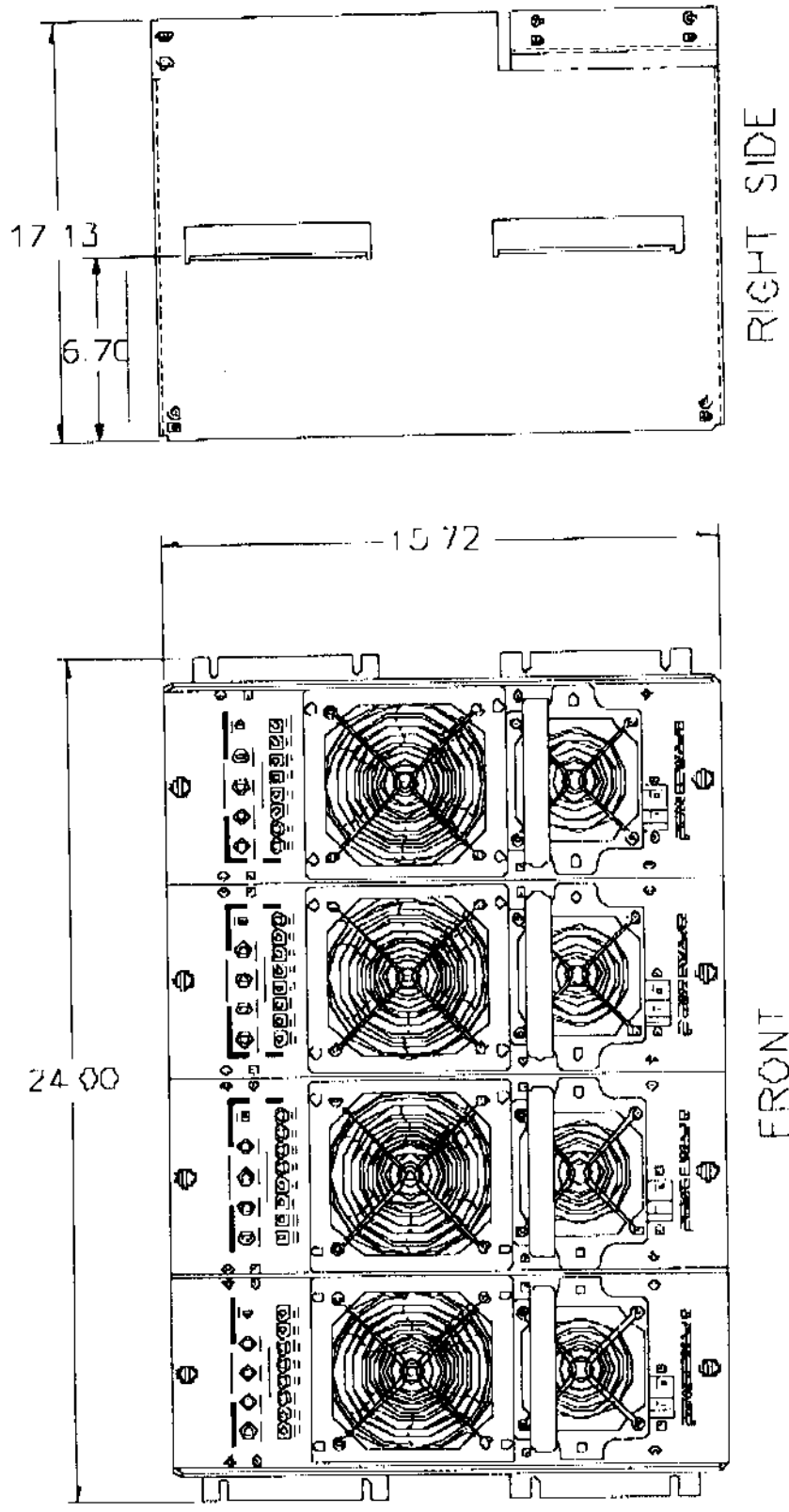


Figure 1-1. MCR4109-1 Subrack with Four Amplifier Modules.



## **INSTALLATION**

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### **2-1. INTRODUCTION**

This section contains installation recommendations, unpacking, inspection, and installation instructions for the Multicarrier Cellular Amplifier System subrack. 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 (minimum of 45 amps), 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. Check the outside of each shipping container for instructions regarding unpacking. Carefully open the containers and remove the subrack and amplifier modules. 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 subrack 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 connectors. 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 2-1 and table 2-1)

The MCR4109-1 24-inch subrack is designed for installation in a rack or cabinet that permits access to the rear of the subrack for connection of DC power, RF, and monitor cables.

The location and function of the system interface connectors is shown in figure 2-1 and is described in table 2-1.

Table 2-1. MCR4109-1 Subrack Input/Output Connectors

NO.	NAME	FUNCTION
1	J6 OUTPUT Connector	Type N female coax connector, RF output to antenna. Refer to table 1-2 for power output level of one to four amplifier module systems.
2	J7 - RF IN Connector	SMA female coax connector. Refer to table 1-2 for power input level.
3	RF SAMPLE -40 dB Connector	SMA female coax connector. -40 dB sample of the subrack RF output (J6).
4	ALARMS Connector	15-pin female D-Sub connector which permits remote monitoring of amplifier alarms. Refer to figure 2-2 and table 2-2 for details.
5	RS-485 Connector	9-pin female D-Sub connector which permits remote monitoring of RS-485 signals. Refer to figure 2-3 and table 2-3 for details.

To install the amplifier system proceed as follows:

1. Install subrack in equipment rack or cabinet and secure in place with eight screws.
2. Refer to figure 2-1 and table 2-1 for the location and definition of all subrack input/output connectors.
3. Connect antenna cable to J6 OUTPUT connector on rear of subrack.
4. Connect the transceiver or combiner output to J7 RF IN connector on rear of subrack.
5. Connect the dry-contact alarms cable (if RS-485 is not used) to the ALARMS 15-pin D-sub connector on rear of subrack. Refer to figure 2-2 and table 2-2 for definition of the 15-pin D-sub ALARMS connector.
6. Connect the RS-485 cable to the RS-485 9-pin D-sub connector on rear of subrack. Refer to figure 2-3 and table 2-3 for definition of the 9-pin D-sub RS-485 connector.
7. Using the RACK ADDRESS switches, set R0 (LSB) through R4 (MSB) to correspond to the desired RS-485 bus address (see figure 2-4).

### **WARNING**

**Turn off external primary DC power before connecting DC power cables.**

8. Using a ¼" nut driver, remove protective covers on power terminal blocks; do not discard. All power connections are to be made with power cables approaching from the lower side of the terminal block. Connect positive primary power for amplifier module 1 to MOD 1 27 V terminal and corresponding negative primary power to MOD 1 GND terminal on rear of subrack. Tighten the subrack power connections until snug; **do not overtighten**. Powerwave recommends using 6 AWG wire rated for 120 °C for most applications. Each installation should be evaluated separately.

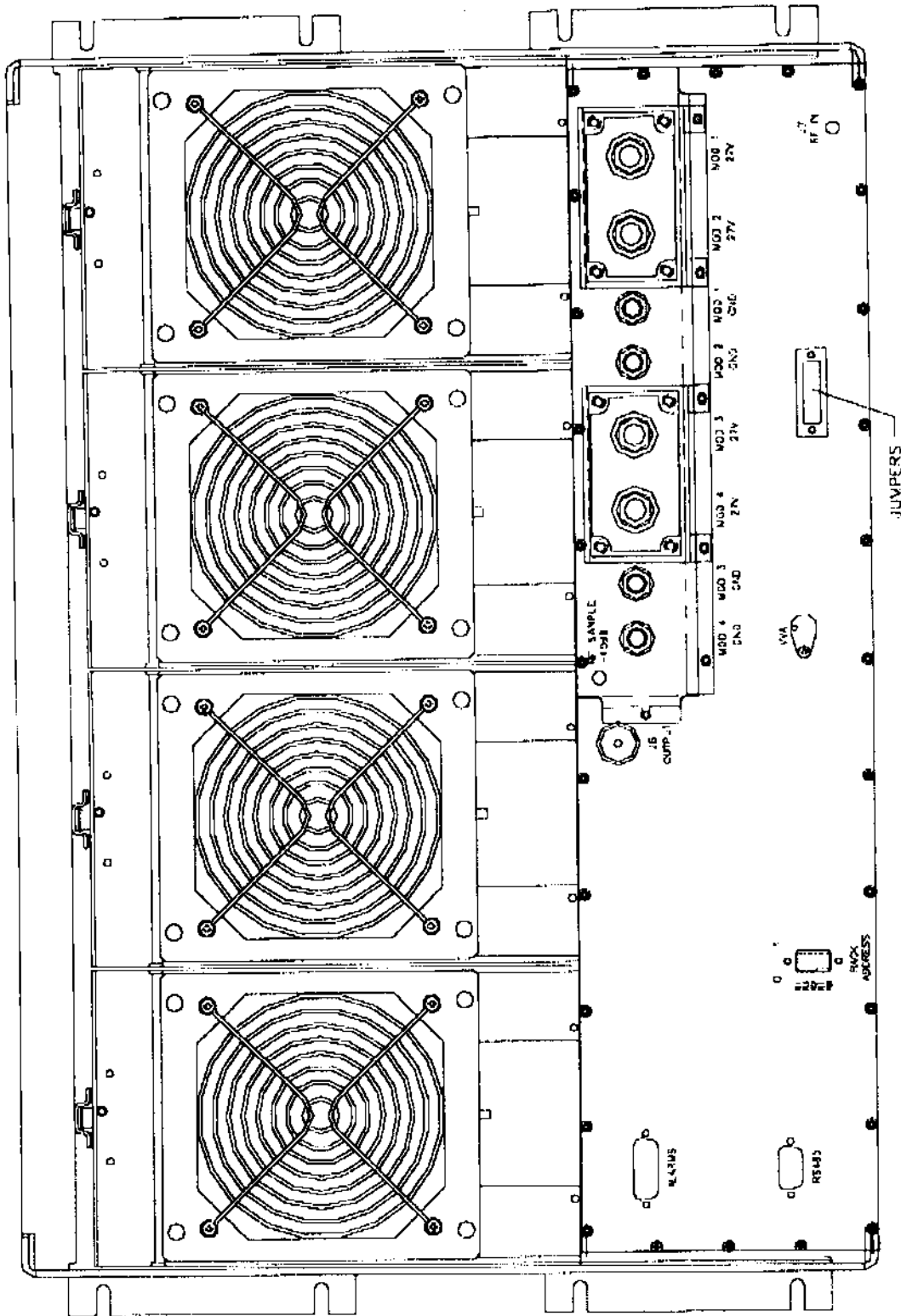


Figure 2-1. MCR4109-1 Rear View

9. Repeat connection procedure of step 8 for amplifier modules 2, 3, and 4.

**WARNING**

**Replace protective covers on DC terminal blocks such that the terminals are covered on the top. If any of the power leads or cables have been installed from the top, the cover will not go on properly. Reinstall such improperly installed leads or cables from the bottom. Failure to replace cover properly could result in personal injury and damage to equipment in the event of a short circuit.**

10. Check your work before applying DC voltage to the system. Make certain all connections are tight and correct.
11. Measure primary DC input voltage. DC input voltage should be  $+27 \text{ Vdc} \pm 1.0 \text{ Vdc}$ . If the DC input voltage is above or below the limits, call and consult Powerwave before proceeding and before you turn on your amplifier system.
12. At the front of the subrack, install the plug-in amplifier modules.
13. Refer to the amplifier module manual for power setting procedure and section 3 (following) for initial turn-on and checkout procedures of the rack assembly.

## 2-5. ALARMS CONNECTOR

Amplifier alarms may be monitored through the dry contact ALARMS 15-pin female D-sub connector on the rear of the subrack. Refer to table 2-2 and figure 2-2 for pin definition of the ALARMS connector. See also table 2-4 for alarm attributes and figure 2-4 for RS-485 alarm conditions.

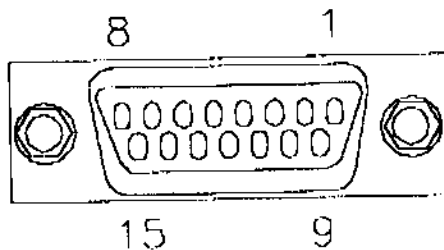


Figure 2-2. ALARMS Connector

Table 2-2. ALARMS Connector Definition

PIN	FUNCTION	DESCRIPTION
1	Continuity with common if no fan fault	Minor - Normally open
2	Common	Minor - Common
3	Continuity with common if one or more fan faults on any MCPA	Minor - Normally closed
4	Continuity with common if all installed MCPAs are active	Major - Normally open
5	Common	Major - Common
6	Continuity with common if one or more MCPAs are disabled	Major - Normally closed
7	Continuity with common if one or more MCPAs are active	Critical - Normally open
8	Common	Critical - Common
9	Continuity with common if all installed MCPAs are disabled	Critical - Normally closed
10	Continuity with common if external preamp is functioning correctly	PA Major - Normally open
11	Common	PA Major - Common
12	Continuity with common if external preamp first channel faults, or if pins 8 and 9 of the RS-485 connector are left open	PA Major - Normally closed
13	Continuity with common if external preamp channel 1 or 2 is functioning correctly	PA Critical - Normally open
14	Common	PA Critical - Common
15	Continuity with common if external preamp channels 1 and 2 are faulted, or if pins 2 and 3 of the RS-485 connector are left open	PA Critical - Normally closed

**2-6. RS-485 CONNECTOR**

RS-485 signals may be monitored through the RS-485 9-pin female D-sub connector on the rear of the subrack. Refer to table 2-3 and figure 2-3 for pin definition of the RS-485 connector and table 2-4 for alarm attributes.

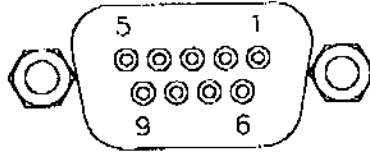


Figure 2-3. RS-485 Connector

Table 2-3. RS-485 Connector Definition

PIN	FUNCTION	DESCRIPTION
1	+ Data Input	RS-485 +RxD
2	Preamp Critical Fault Input +	Preamp Critical Fault Input +
3	Preamp Critical Fault Input -	Preamp Critical Fault Input -
4	- Data Input	RS-485 -RxD
5	NC	No Connection
6	- Data Output	RS-485 -TxD
7	+ Data Output	RS-485 +TxD
8	Preamp Major Fault Input +	Preamp Major Fault Input +
9	Preamp Major Fault Input -	Preamp Major Fault input -

**2-7. SUBRACK ADDRESSING**

Subrack addressing may be set in accordance with figure 2-4.

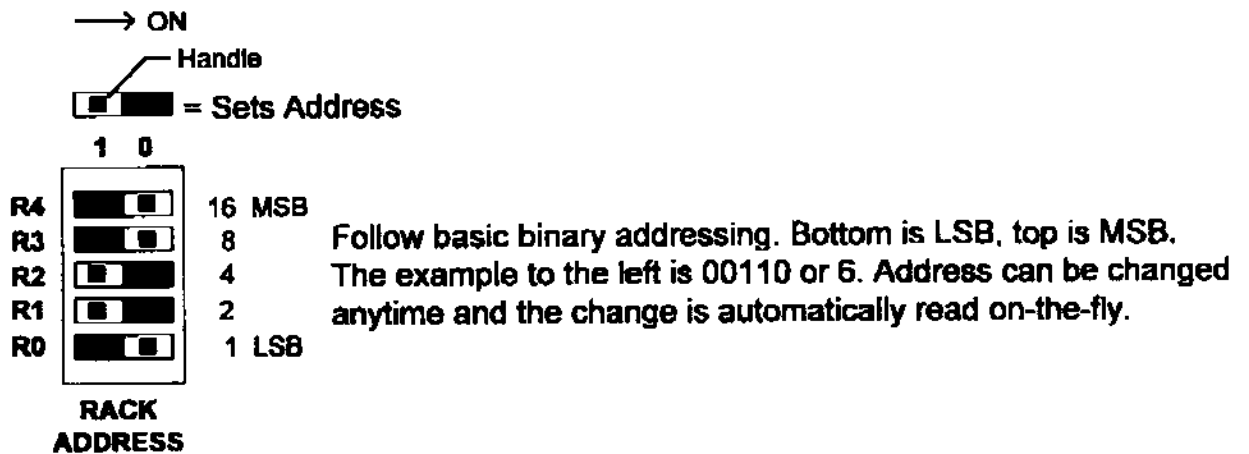


Figure 2-4. RS-485 Subrack Addressing

Table 2-4. Alarm Attributes

		Form-C					RS-485		
		Minor	Major	Critical	Major	Critical	Minor	Major	Critical
MCA's Installed	MCA's Enabled				Pre- amp	Pre- amp			
4	4		0	0				0	0
4	3		1	0				1	0
4	2		1	0				1	0
4	1		1	0				1	0
4	0		1	1				0	1
3	3		0	0				0	0
3	2		1	0				1	0
3	1		1	0				1	0
3	0		1	1				0	1
2	2		0	0				0	0
2	1		1	0				1	0
2	0		1	1				0	1
1	1		0	0				0	0
1	0		1	1				0	1
One Fan Fault		1						1	
No Fan Fault		0						0	
No Preamp Fault					0	0		0	0
One Side Preamp Fault					1	0		1	0
Both Sides Preamp Fault					1	1		0	1

0 = Low (no alarm)

1 = High (alarm)

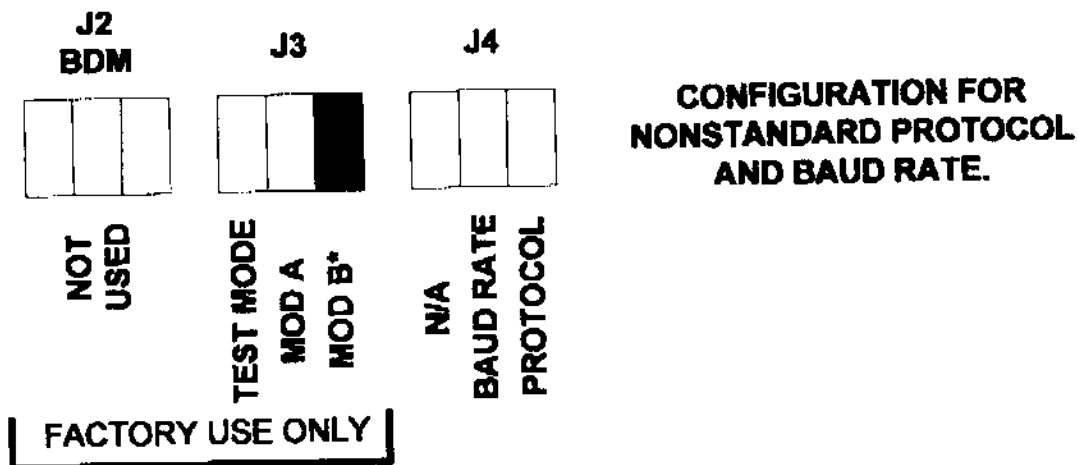
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**2-8. JUMPER SETTINGS**

Beneath the MOD 2 GND and MOD 3 27V power terminals on the rear of the MCR4109 subrack is a small cover plate held in place by two screws. Beneath the cover plate lie several pin terminals which may be jumpered (shunted) to set the baud rate and protocol.

NOTE

Terminal sets J2 BDM and J3 are for factory use only.

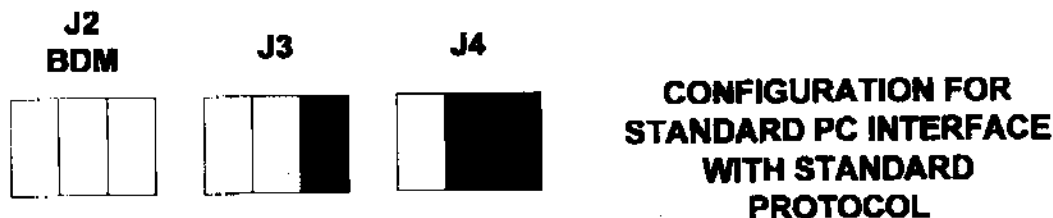
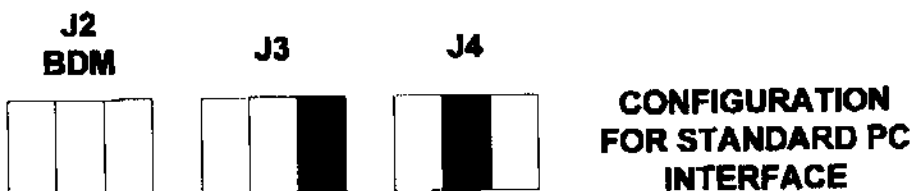


**\* DENOTES ALWAYS SHORTED**

**BAUD RATE: OPEN = 15.6 Kbaud; SHUNT = 9600 baud.**

**OPEN FOR BAM EQUIPMENT, SHUNT FOR EXERCISING SHELF WITH A PC.**

**PROTOCOL: OPEN = NONSTANDARD PROTOCOL; SHUNT = STANDARD PROTOCOL.**



**Figure 2-5. Jumper Settings**

## OPERATING INSTRUCTIONS

### 3-1. INTRODUCTION

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

### 3-2. LOCATION AND FUNCTION OF SUBRACK CONNECTORS

The amplifier system subrack is a rack mountable chassis.

<u>Subrack</u>	<u>Amplifiers</u>	<u>Alarms</u>	<u>RS-485</u>	<u>Figure</u>	<u>Table</u>
MCR4109-1	4	15-Pin Female D-Sub	9-Pin Female D-Sub	2-1	2-1

Refer to section 2 of this manual for installation procedures.

### 3-3. 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 subrack are properly terminated at 50 ohms. Do not operate the system without a load attached. Refer to table 1-2 for input power requirements. Excessive input power may damage the amplifier(s).

#### NOTE

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

2. Verify that all 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. Visually check the indicators on the amplifier modules, and verify that they are operating properly.
5. Turn on all amplifier front panel switches in accordance with the amplifier instruction manual.
6. Refer to the amplifier manual for power setting procedures before applying external exciter/transceiver RF input signals.



## PRINCIPLES OF OPERATION

### 4-1. INTRODUCTION

This section contains a functional description of the Multicarrier Cellular Amplifier System subrack.

### 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

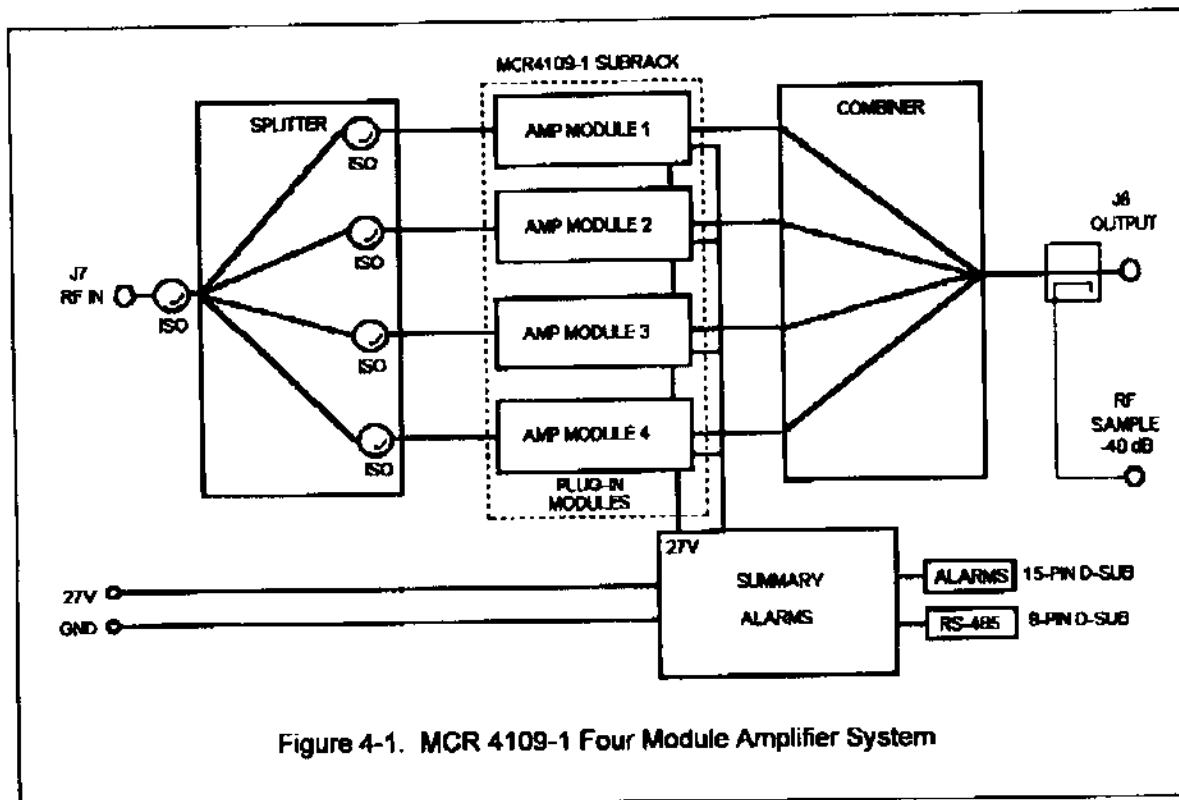
The load impedance should be as good as possible (1.5:1 or better) in the working band for good power transfer to the load. If the amplifier is operated into a filter, it will maintain its distortion characteristics outside the signal band even if the VSWR is infinite, provided the reflected power does 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. -65 dBc).

### 4-4. SYSTEM FUNCTIONAL DESCRIPTION

The amplifier system is comprised of an MCR4109-1 subrack and four 100-watt plug-in power amplifiers that operate in the 25 MHz frequency band from 868 MHz to 894 MHz. A typical four-module system is shown in figure 4-1. Power output specifications for one to four module systems are listed in table 1-2. The subrack houses a four-way power splitter/combiner, summary alarm logic, and a voltage regulator. The rear panel of the subrack has I/O connectors that interface with the host system, RF signal source, system antenna, and the system DC power source. The amplifier system can simultaneously transmit multiple carrier frequencies, at an average total power output of 90 watts (1 amplifier module in a subrack unit) to 360 watts (4 amplifier modules), with -65 dBc third order intermodulation distortion (IMD).

The RF input (carrier frequencies) to the power splitter will vary depending on the number of amplifier modules in the system. In a four-module system, the signal will be split into four signals of equal power and input to the plug-in amplifier modules. The output from each amplifier is an amplified composite signal of approximately 100 watts before combiner losses. The amplifier outputs are fed to a power combiner and combined to form a composite RF output of up to 360 watts. If a failure or fault occurs in an amplifier module, the summary form C contacts will activate and a fault message is placed on the RS-485 bus.

The summary alarm module in the subrack is the system fault monitor. When an amplifier is turned off, it is physically disconnected via relays from the combiner. The purpose of the summary alarm board is to control the turn-on and turn-off sequence of the amplifiers and splitter/combiner, and calculate the average power output from all amplifier modules in the system.



#### 4-5. MCR4109-1 SUBRACK

The MCR4109-1 subrack (see block diagram, figure 4-1) is not field repairable. The subrack contains a four-way RF power splitter/combiner, voltage regulator, and summary alarm board. The splitter/combiner has an input splitter and an output combiner, which provide good VSWR and ensure low insertion loss. The splitter/combiner has relays that are activated and deactivated by the summary alarm board when a plug-in amplifier is power sequenced on or is shut down. The voltage regulator provides +5 Vdc and +15 Vdc power to the summary alarm board. The primary function of the summary alarm board is to control the amplifier turn-on and turn-off sequence. Other functions include calculating the average power output from the amplifiers and controlling the relays in the combiner. Additionally, the summary board also controls the form C contacts whose output terminals are connected to the rear panel 15-pin female D-Sub ALARMS connector and the rear panel 9-pin female D-Sub RS-485 connector.

#### 4-6. POWER DISTRIBUTION

Primary DC power for the system is provided by the host system to the MCR4109-1 subrack. The subrack supplies each amplifier module with +27 Vdc directly and via the RF power splitter/combiner.

#### 4-7. ALARMS

The presence of several plug-in amplifier alarms can be detected at the ALARMS connector on the subrack rear panel. Refer to figure 2-2 and table 2-2 for a description of the ALARMS connector, and figure 2-3 and tables 2-3 and 2-4 for a description of the RS-485 connector.

## MAINTENANCE

### 5-1. INTRODUCTION

This section contains periodic maintenance procedures for the Multicarrier Cellular Amplifier System subrack. The subrack is not tested as a stand-alone unit. Rather, it is tested with up to four amplifiers inserted. Accordingly, when tested with Powerwave amplifiers, the test procedure presented in section five of the amplifier manual should be followed.

#### 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 amplifier manual.
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 amplifier manual.

### 5-3 RETURN FOR SERVICE PROCEDURES

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

#### 5-3.1 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 (949) 757-0530 to obtain this number. Failure to obtain this RMA number may result in delays in receiving repair service.

#### 5-3.2 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.