

# Section 1 General Description

## 1-1 Introduction

This manual contains information and procedures for installation, operation, and maintenance of Powerwave's ~~MCA9129-90~~MCA9129-90-A 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 ~~MCA9129-90~~MCA9129-90-A (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 -65 dBc third order intermodulation distortion (IMD) at 100 watts output, or -60 dBc IMD at 120 watts output. It is designed for use in an amplifier system that is modular in design, and is ideally suited for use in AMPS/TDMA/CDMA base stations. When used in a subrack employing four ~~MCA9129-90~~MCA9129-90-A amplifiers, the system offers up to 360 watts output at -65dBc IMD performance level (430 watts output at -60dBc IMD). The plug-in Model ~~MCA9129-90~~MCA9129-90-A amplifier modules can each provide 120 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.

Each 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 three fans, two mounted on the front and one 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 tables 1-2 and 1-3.

## 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

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
<del>MCA9129-90</del> <del>MCA9129-90-A</del>	100 W 869-894 MHz MCPA Module.
<del>800-01024-001</del> <del>800-01779-001</del>	Front fan assembly, <del>large</del> .
<del>800-01025-002</del> <del>800-01779-002</del>	<del>Front</del> <u>Rear</u> fan assembly, <del>small</del>
<del>800-00781-002</del>	<del>Rear fan assembly.</del>

### NOTE

A quality transmit filter or duplexer must be installed after this amplifier to ensure FCC Type Acceptance of the amplifier. The filter/duplexer should be rated for at least 500 Watts average power and 5000 Watts instantaneous power (minimum) when four amplifiers per subrack are installed.

**Table 1-2 ~~MCA9129-90~~MCA9129-90-A Multicarrier Cellular Amplifier Functional Specifications, 100 Watts**

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Total Maximum Input Power	-12 dBm
Total Output Power	100 W typical (1 Module)
BTUs @ 100 W	<b>3813</b>
Intermodulation Distortion and In-Band Spurious:	-65 dBc (Min) @ <del>+24</del> <u>+26</u> to +28 Vdc @ 100 Watts ( <del>-55 dBc (Min) @ +23 to +24 Vdc</del> )
RF Gain at 880 MHz	62 dB
Gain Flatness:	± 0.7 dB @ 27 Vdc ± 1 Vdc
Gain Variation Over Temperature:	± 0.3 dB from 23 to 30 Vdc
Output Protection:	Mismatch Protected
Input Port Return Loss:	-14 dB (Min)
Harmonics:	Better than -50 dBc
Out of Band Spurious:	Better than -60 dBc
Duty Cycle:	Continuous
DC Input Power:	+27 Vdc ± 1 Vdc, <del>45-36</del> Amps Max @ 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, Summary Alarm, and RF Input / Output Connectors:	21-Pin D-Subminiature Combo Connector plus single-pin D-Sub connector for additional DC capability.
Weight	45 pounds
Dimensions:	15.72" (9U) High, 5.50" Wide, <del>47.44</del> <u>16.75</u> " Deep

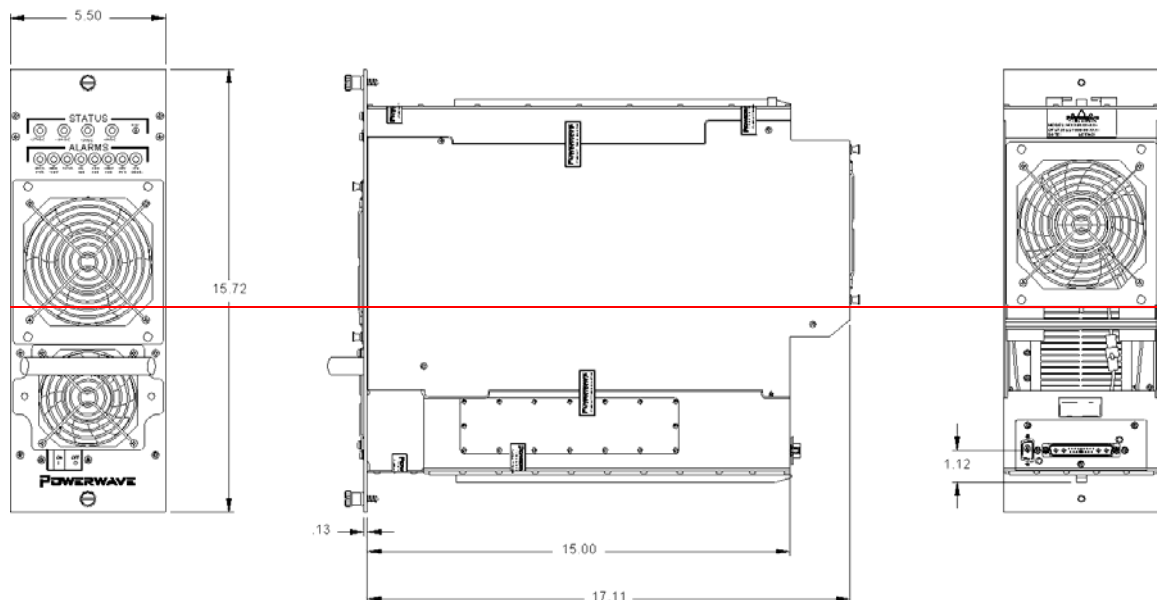


### NOTE

A quality transmit filter or duplexer must be installed after this amplifier to ensure FCC Type Acceptance of the amplifier. The filter/duplexer should be rated for at least 500 Watts average power and 5000 Watts instantaneous power (minimum) when four amplifiers per subrack are installed.

**Table 1-3 MCA9129-90 MCA9129-90-A Multicarrier Cellular Amplifier (FCC Tested @ 120 Watts)**

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Total Maximum Input Power	<del>-11</del> -11.2dBm
Total Output Power	120 W typical (1 Module)
BTUs @ 120 W	4384
Intermodulation Distortion and In-Band Spurious:	-60 dBc (MinMax) @ +24+26 to +28 Vdc @ 120 Watts (-55 dBc (Min) @ +23 to +24 Vdc)
RF Gain at 880 MHz	62 dB
Gain Flatness:	± 0.7 dB @ 27 Vdc ±1 Vdc
Gain Variation Over Temperature:	±0.3 dB from 23 to 30 Vdc
Output Protection:	Mismatch Protected
Input Port Return Loss:	-14 dB (Min)
Harmonics:	Better than -50 dBc
Out of Band Spurious:	Better than -60 dBc
Duty Cycle:	Continuous
DC Input Power:	+27 Vdc ± 1 Vdc, <del>52</del> 40 Amps Max @ 120 Watts Operational +21 Vdc to 30 Vdc
Operating Temperature:	<del>5</del> 0°C. to +40 °C.
Storage Temperature:	-40 °C. to +85 °C.
Operating Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
Storage Humidity:	5 % - 95 % Relative Humidity (Noncondensing)
DC Input, Summary Alarm, and RF Input / Output Connectors:	21-Pin D-Subminiature Combo Connector plus single-pin D-Sub connector for additional DC capability.
Weight	45 pounds
Dimensions:	15.72" (9U) High, 5.50" Wide, <del>17.11</del> 16.75" Deep



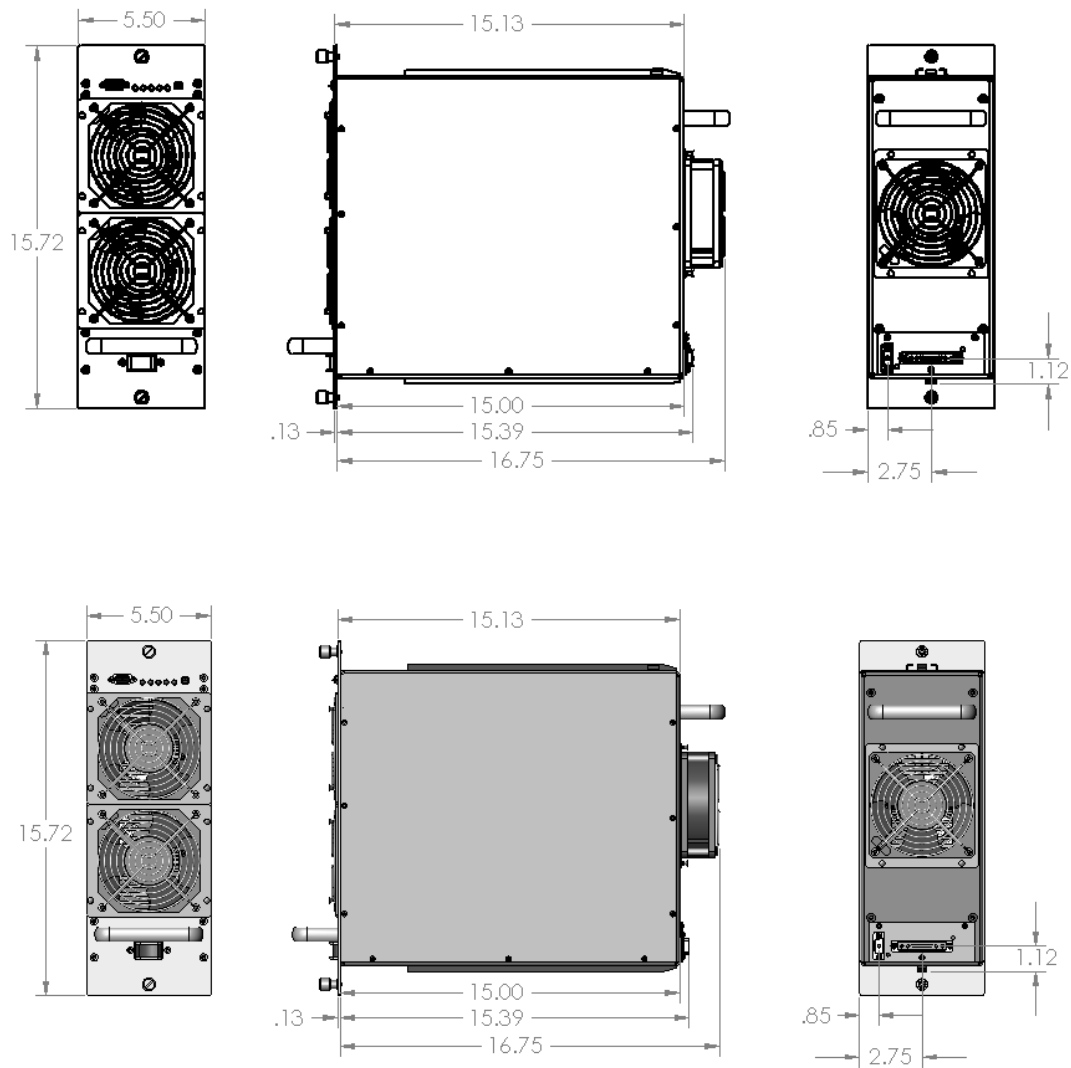


Figure 1-1 ~~MCA9129-90~~MCA9129-90-A Amplifier

## Section 2 Installation

### 2-1 Introduction

This section contains unpacking, inspection, and installation instructions / recommendations for the model ~~MCA9129-90~~MCA9129-90-A multicarrier cellular amplifier. It is important that the licensee perform the following tasks correctly and in good faith:

1. Carefully read all material in this section prior to equipment unpacking or installation.
2. Also, read and review the operating procedures in Section 3 prior to installing the equipment.
3. 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 Site Survey

Powerwave Technologies recommends that site surveys be performed by qualified individuals or firms prior to equipment ordering or installation. Performing a detailed site survey will reduce or eliminate installation and turn-up delays caused by oversights. A general site survey form is provided in Appendix A. This form is commonly used by Powerwave Field Engineers and may be used as a guide. Pay particular attention to power plant capacity, air conditioning needs, floor space, and RF/DC cabling/breaker requirements.

### 2-3 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 (70-amp minimum), 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. See table 2-1.

A typical three-sector site will utilize three MCR4109-1 amplifier subracks, each housing up to four ~~MCA9129-90~~MCA9129-90-A amplifiers. The power plant should be able to support the 540 amps 432 amps of current required by this equipment, plus the remaining base station equipment. A power plant of less than 800 amps is probably not sufficient. Since all the amplifiers are not running at full capacity at the same time in normal operation, table 2-1 describes the current load for a 3 sector (70%), 2 sector (80%) and omni (90%) site. Based on this table, an 800 amp power plant may suffice.

Battery backup or UPS systems should be installed in remote sites or in sites which experience brownout conditions or generator switchovers. Adding this equipment should eliminate the need for site visits by technicians after brownouts or power outages. Battery backup systems also provide excellent DC filtering as a side benefit.

**Table 2-1 Averaged DC Current Load**

Amplifier Power	No. Of Amplifiers	3 Sector Averaged Current	2 Sector Averaged Current	1 Sector Averaged Current
100	12	378		
100	8	252	288	
100	4	126	144	162
100	1	31.5	36	40.5

## 2-4 Air Conditioning

Each MCA9129-90MCA9129-90-A amplifier generates 3804 BTUs of heat at full power. A fully populated MCR4109-1 operating at full power will generate 15,217 BTUs of heat. A full three-sector site employing three fully populated MCR4109-1 subracks will generate 45,652 BTUs of heat at full power (360W per subrack). A five-ton air conditioner is needed to cool this Powerwave equipment. A full three-sector site probably needs at least a five-ton air conditioner to cool all of the site's equipment, based on heat load averaging as described in table 2-2. Since all the amplifiers are not running at full capacity at the same time in normal operation, table 2-2 describes the heat load for a 3 sector (70%), 2 sector (80%) and omni (90%) site. Perform a site survey to determine actual air conditioning needs.

**Table 2-2 Averaged Heat Loading**

Amplifier Power	No. Of Amplifiers	3 Sector Averaged BTU's	2 Sector Averaged BTU's	1 Sector Averaged BTU's
100	12	31,956.8		
100	8	21,304.5	24,348.0	
100	4	10,652.3	12,174.0	13,695.8
100	1	2,663.1	3,043.5	3,423.9

## 2-5 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 unpack each piece of equipment after it has reached the installation site and is approximately in place. Carefully open the several amplifier system containers and remove the subracks, amplifier modules, input combiners, and miscellaneous interconnect cables and hardware. 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 cabinet and all modules 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 connectors or fans. Inspect male connectors on modules and harnesses 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.

## 2-6 Installation Instructions (Refer to figures 1-1 and 2-1)

The ~~MCA9129-90~~MCA9129-90-A 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 the amplifier subrack in the equipment rack and secure in place based the subrack installation manual instructions.
2. Connect the antenna cable to the output of the subrack.
3. Connect the transceiver output(s) to the input of the subrack. Refer to tables 1-1 and 1-2 for proper RF input levels.
4. Connect the alarm cable(s) to the subrack.

### WARNING

Verify that all circuit breaker switches supplying power to 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.

### WARNING

Do not slam amplifiers into the subracks. Forcing the amplifier into the subrack at too fast a rate may cause the pins on the 21-pin D-sub connector of the amplifier to become recessed or broken. The use of too much force while installing the amplifier may also cause the splitter / combiner module of the MCR4109-1 to become poorly aligned resulting in the inoperation of an amplifier installed in one of the two outer slots.

6. Inspect the 21-pin D-sub connector on the rear of each amplifier before inserting it into the subrack. Verify that all pins are straight, no pins are recessed, and the alignment shield is not bent. At the front of the subrack, install the plug-in amplifier modules.
7. After verifying that the front panel power ON / OFF switch is in the OFF position, gently install the plug-in amplifier modules in the subrack. Tighten top and bottom thumbscrews until they are finger tight. Use a slotted screwdriver to tighten the thumbscrews an 1/8<sup>th</sup> to a 1/4 turn past finger tight.
8. Check your work before applying DC voltage to the system. Make certain all connections are tight and correct.
9. Measure primary DC input voltage. DC input voltage should be +27 Vdc  $\pm$ 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.
10. Refer to section 3 for initial turn-on and checkout procedures.



## 2-7 Multifunction Connector

The status, alarm, control, and power connections on the amplifier connectors are made through a 21-pin D-Sub male combo connector and supplemental single-pin male D-Sub connector (figure 2-1) and are listed and described in table 2-3.

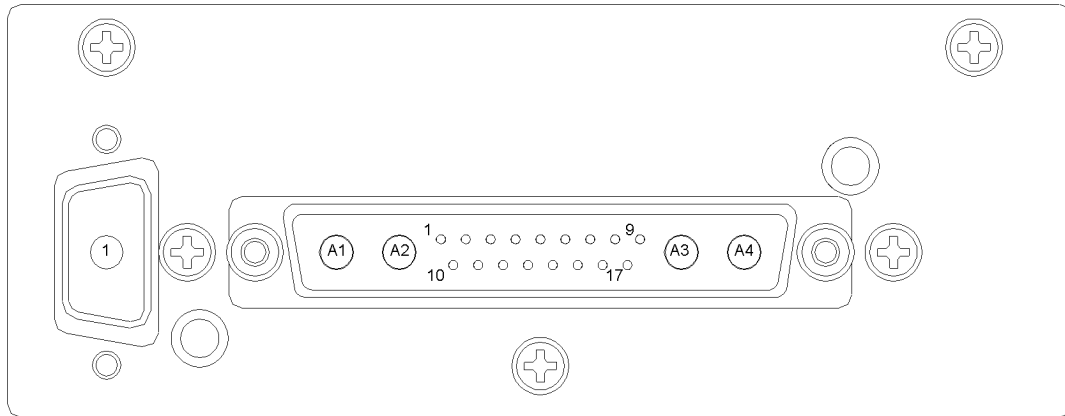


Figure 2-1 Amplifier Connectors (on Rear of ~~MCA9129-90~~MCA9129-90-A Module)

Table 2-3 Amplifier Module Status, Alarm, Control, and Power Connections

Pin	Function	Description
<b>21-Pin D-Sub Male Combo</b>		
A1	RF Input	Coaxial Contact
A2	Power Input	+27 Vdc (Power Contact)
A3	Ground	Ground (Power Contact)
A4	RF Output	Coaxial Contact
1	Ground	Ground
2	RS 485 +RxD	Serial Communication Data In
3	RS 485 –RxD	Serial Communication Data In
4	RS 485 +TxD	Serial Communication Data Out
5	RS 485 –TxD	Serial Communication Data Out
6	NA	
7	NA	
8	Fan Fail	TTL signal normally low. A high indicates one <del>or both of the</del> fans have failed
9	Forward Power Monitor	An analog DC signal representing the RF output power of the MCA. The voltage is 4 volts $\pm$ 100 mV at the maximum rated output power.
10	NA	
11	Average Power Input	An analog DC voltage representing the average detected power of all the MCAs in a subrack. This voltage is derived from dividing the sum of all the forward power voltages in a subrack by the number of enabled MCAs. This voltage is used by the MCA to determine a low power fault.
12	Address A0	Amp Address A0; Ground for high, float for low
13	Summary Fault	TTL signal normally low. A high level indicates that the MCA has been disabled by a recurring alarm fault.
14	Address A1	Amp Address A1; Ground for high, float for low
15	Module Detect	Ground potential. Informs the subrack that an MCA is plugged in.
16	<del>Bias Input</del> NA	<del>TTL signal normally low for an enabled MCPA. A high level will disable the MCPA.</del>
17	FP Disable Output	TTL signal, low if the front panel switch is in the ON position. A high level indicates the front panel switch in the OFF position.
<b>Single-Pin D-Sub Male</b>		
1	Power Input	+27 Vdc (Power Contact)

## Section 3 Operating Instructions

### 3-1 Introduction

This section contains operating instructions for the Multicarrier Cellular Amplifier.

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

The location and function of the plug-in amplifier module controls and indicators is shown in figure 3-1 and is described in detail in paragraphs 3-3 through 3-3.14.

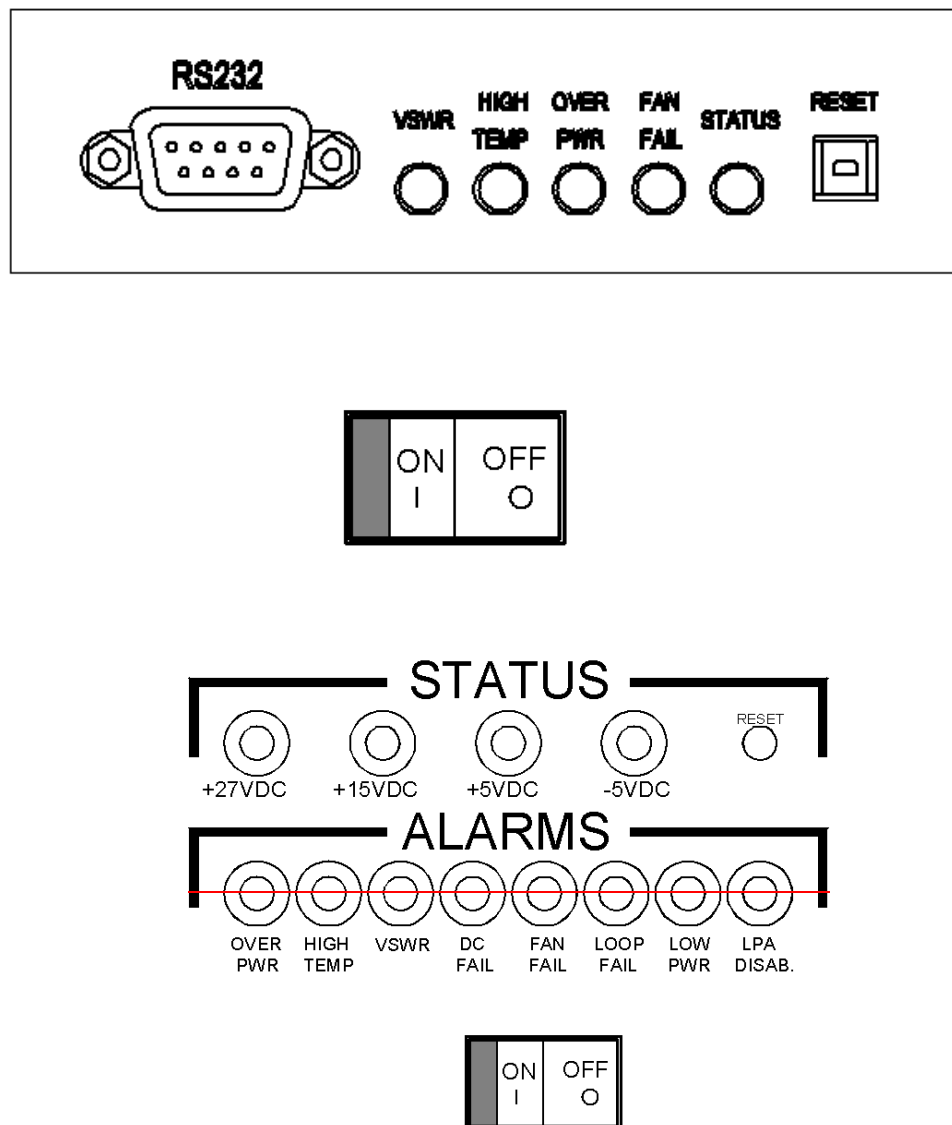


Figure 3-1. MCA9129-90 Amplifier Module Controls and Indicators

### 3-3 Controls And Indicators

### ~~3-3.1~~ 27V Indicator (+27VDC)

~~Green LED. When lit, indicates that the +27Vdc supply is greater than +21Vdc and less than +30Vdc. The indicator will blink if the voltage is 28Vdc to 30Vdc. If the voltage source drops below +21V a timer is started and the DC fail counter is incremented. After five seconds the voltage is analyzed, if still faulted the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The +27V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero. If the DC input voltage exceeds +30 volts, the MCA will be disabled instantaneously, as indicated by the illumination of the LPA DISAB indicator. The +27V and DC FAIL indicators will alternatively blink at a 1Hz rate. A timer is started and the DC fail counter is incremented. After five seconds the voltage is measured. If the fault exists the counter is incremented. If the count equals five before the timer reaches 15 minutes, the MCPA will enter fault mode. The +27V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches five, the counter and timer will reset to zero.~~

### ~~3-3.2~~ +15V Indicator (+15VDC)

~~Green LED. When lit, indicates that the +15Vdc supply is greater than +14Vdc and less than +16Vdc. If the voltage source varies out of its operating window, a timer is started and the DC fail counter is incremented. After five seconds the voltage is analyzed, if still faulted the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The +15V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.~~

### ~~3-3.3~~ +5V Indicator (+5VDC)

~~Green LED. When lit, indicates that the +5Vdc supply is greater than +4.5Vdc and less than +5.5Vdc. If the voltage source varies out of its operating window, a timer is started and the DC fail counter is incremented. After five seconds the voltage is analyzed, if still faulted the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The +5V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.~~

### ~~3-3.4~~ -5V Indicator (-5VDC)

~~Green LED. When lit, indicates that the -5Vdc supply is greater than -5.5Vdc and less than -4.5Vdc. If the voltage source varies out of its operating window, a timer is started and the DC fail counter is incremented. After five seconds the voltage is analyzed, if still faulted the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The -5V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.~~

### ~~3-3.5~~ ~~3-3.1~~ RESET Switch

Three position switch:

Down Position – ~~Has no effect~~ Disabled.

Center Position - Normal amplifier on position.

RESET (up position) - When toggled to reset position, all the ~~green~~ LED indicators will turn off and ~~all~~ the ~~red-Status~~ LED indicators will illuminate momentarily (LED test); this will also reset the fault latches. ~~Then a series of fault LEDs will illuminate for 2 seconds to illustrate configuration type.~~ 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 MCA is disabled, the alarms can be cleared and the MCA enabled by this reset position. The functions of the switch are disabled for five seconds after a power-up condition.

### ~~3-3.6~~ ~~3-3.2~~ Over Power Indicator (OVER PWR)

Red LED. When ~~blinking, illuminated~~, indicates the output power from the amplifier ~~has exceeded 120-52dBmwatts.~~ ~~When lit, indicates the output power from the amplifier exceeded~~

~~260 watts.~~ If an over power condition occurs the MCA is immediately disabled. ~~The and the~~ LPA DISAB indicator will illuminate ~~and the OVER PWR indicator will blink at a 1Hz rate.~~ A timer is started and the over power fault counter is incremented. After five seconds the MCA is enabled and the fault is analyzed. If the fault exists, the MCA is again disabled and the counter is incremented. If the count equals five before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The OVER PWR and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches five, the counter and timer will reset to zero.

### ~~3-3.7~~ 3-3.3 High Temperature Indicator (HIGH TEMP)

Red LED. When lit, indicates that the main amplifier heat sink base plate temperature has exceeded 75.0 °C. If a high temperature condition occurs a timer is started and the high temperature fault counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes or if the base temperature exceeds 85 °C, the MCPA will enter fault mode. ~~Fault mode will disable the MCPA. The HIGH TEMP and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. If the temperature drops below 65 °C, the amplifier will recover to the original enabled state and the alarm condition will be cleared. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators.~~ If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.

### ~~3-3.8~~ 3-3.4 VSWR Indicator (VSWR)

Red LED. When lit, indicates that the reflected power detected at the amplifier output exceeds 70 46.5 dBm watts. If a VSWR condition occurs a timer is started and the VSWR fault counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes or if the reflected power level exceeds 150W, the MCPA will enter fault mode. Fault mode will disable the MCPA. The VSWR and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.

### ~~3-3.9~~ DC Fail Indicator (DC FAIL)

~~Red LED. When lit, indicates that one of the internal DC voltages dropped below or exceeded the safe threshold level (+21 V<+27 V<+30 V, +14 V<+15 V<+16 V, +4.5 V<+5 V<+5.5 V, or -5.5 V<-5 V<-4.5 V). If a DC fail condition occurs a timer is started and the DC fail counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The green indicator representing the invalid voltage will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero. If the DC input voltage exceeds +30 volts, the MCA will be disabled instantaneously, as indicated by the illumination of the LPA DISAB indicator. The +27V and DC FAIL indicators will alternatively blink at a 1Hz rate. A timer is started and the DC fail counter is incremented. After five seconds the voltage is measured. If the fault exists the counter is incremented. If the count equals five before the timer reaches 15 minutes, the MCPA will enter fault mode. The +27V indicator will turn off, the DC FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. Toggling the reset switch will enable the MCPA and clear the~~

summary alarm and latched indicators. If 15 minutes elapse before the counter reaches five, the counter and timer will reset to zero.

### ~~3-3.10~~ 3-3.5 Fan Fail Indicator (FAN FAIL)

Red LED. When lit, indicates that ~~either the upper front or rear one or more fans have~~ failed. ~~The lower front fan is not monitored for failure. If one fan fails, the FAN FAIL indicator will light. If the fan speed is below the threshold read at IOC2, 3, 6 or 7, the fan fail alarm LED will be illuminated and a TTL high signal (+5Vdc) will be reported at pin 8 on the back plane connector. Fan failure will not trigger a summary fault condition.~~

~~— If both fans fail, the FAN FAIL indicator will light, a timer is started, and the fan fail counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The FAN FAIL and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero. Indicator is applicable to the large front and rear fans, not to the small front fan.~~

### ~~Loop Indicator (LOOP FAIL)~~

~~Red LED. When lit, indicates that one of the loop control voltages has transitioned above or below safe operating limits. If a loop fail condition occurs a timer is started and the loop fail counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The LOOP and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.~~

### ~~3-3.12~~ Low Power Indicator (LOW PWR)

~~Red LED. When lit, indicates that the RF power output from the amplifier dropped -2dB (-1, +0dB) below the average power output of all amplifier modules in the rack. If a low power condition occurs a timer is started and the low power fault counter is incremented. After five seconds the fault is analyzed. If the fault exists, the counter is incremented. If the count equals 25 before the timer reaches 15 minutes, the MCPA will enter fault mode. Fault mode will disable the MCPA. The LOW PWR and LPA DISAB indicators will illuminate and a summary fault will occur signaling the shelf that the MCPA is disabled. In fault mode the LED indications are latched. Toggling the reset switch will enable the MCPA and clear the summary alarm and latched indicators. If 15 minutes elapse before the counter reaches 25, the counter and timer will reset to zero.~~

### ~~3-3.13~~ 3-3.6 LPA Disable Indicator (LPA DISAB-) STATUS Indicator

Green/Red LED. When lit, indicates that the MCPA was disabled due to an internal fault or by positioning the disable switch in the down position, or by the shelf performing the sleep mode function. If a fault indicator does not accompany the LA DISAB indicator, the sleep mode function is active. The status LED is green under normal operating conditions.

### 3.3.7 Power Circuit Breaker (OFF / ON)

Rocker style circuit breaker, which controls DC power to amplifier. The circuit breaker is rated for 100 amps, with amplifier thermal impact considered.

### 3-4 Initial Start-Up And Operating Procedures

The only operating controls on each amplifier module are the rocker-style power switch and the RESET switch.

#### WARNING

Always turn the amplifier off when disconnecting and reconnecting RF interface cables. Failure to do so may cause damage to the amplifier and/or personal injury.

To perform the initial start-up, proceed as follows:

1. Verify 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 tables 1-1 and 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's front panel power rocker switch is in the OFF position.
3. Turn on the power supply that provides +27 Vdc to the amplifier system. Do not apply an RF signal to the amplifier system.
4. Set the amplifier's front panel power rocker switch to the ON position.
5. Visually check the indicators on each amplifier module, and verify that the following indicators are as follows:
  - A. ~~LPA-DISAB. Indicator (red) should turn off after 2.5 seconds. Status indicator should illuminate green immediately upon startup.~~
  - B. ~~The +27VDC, +15VDC, +5VDC and -5VDC indicators (green) on all amplifier modules should be on. The VSWR, Over Power, High Temp and Fan Fail LEDs should be off.~~
6. Follow the power setting procedure set forth in the amplifier subrack or system integration manual. 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. -65 dBc).

### 4-4 System Functional Description

The ~~MCA9129-90~~MCA9129-90-A amplifier is a linear, feed-forward power amplifier that operates in the 25 MHz frequency band from 869 MHz to 894 MHz. A typical four-module system is shown in figure 4-1. The power output specification is listed in table 1-2. Each amplifier is a self-contained plug-in module and is functionally independent of the other amplifier modules. The amplifier modules are designed for parallel operation to achieve high peak power output, and for redundancy in unmanned remote locations. Each amplifier in the 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). Each amplifier in the system has been FCC tested to simultaneously transmit multiple carrier frequencies, at an average total power output of 108 watts (1 amplifier module in a subrack unit) to 430 watts (4 amplifier modules), with -60 dBc third order intermodulation distortion (IMD). Refer to the MCR4109-1 subrack installation and service manual (044-05061) for complete system level power and IMD specifications.

The output from each amplifier is an amplified composite signal of approximately 100 watts at -65dBc IMD (120 watts at -60dBc IMD) before combiner losses. All phase and gain corrections are performed on the signal(s) in the individual amplifier modules. In a four -module system, the amplifier outputs are fed to a power combiner and combined to form a composite RF output of up to 360 watts at -65dBc IMD (430 watts at -60dBc IMD). 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.

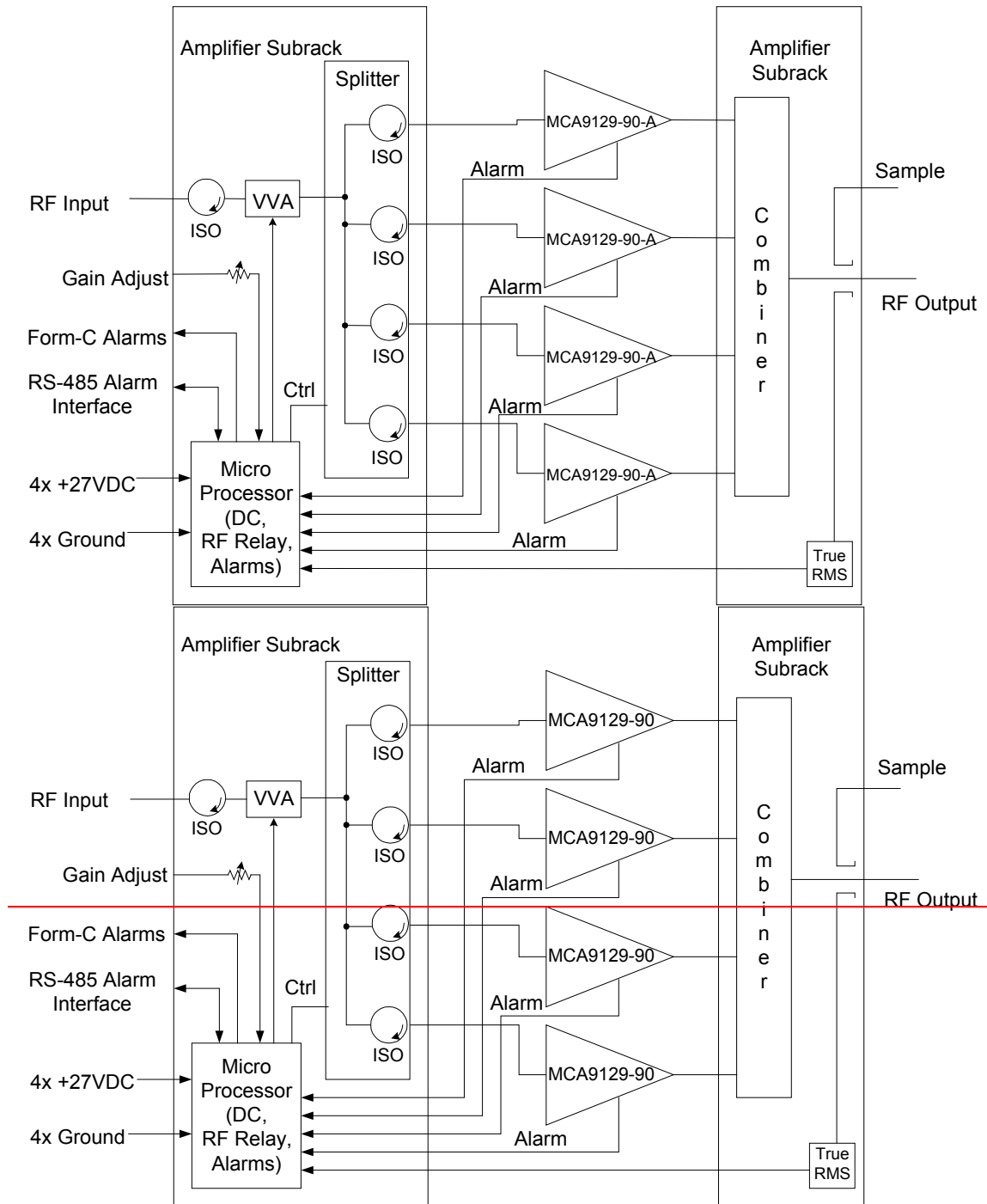


Figure 4-1 ~~MCA9129-90~~MCA9129-90-A Four Module Amplifier System

#### 4-5 ~~MCA9129-90~~MCA9129-90-A Amplifier Module

The amplifier module, figure 4-2, has an ~~average output of 120 watts power (1200 watts peak power) with~~ intermodulation products suppressed to better than -65 dBc below carrier levels at 100 watts output, -60 dBc at 120 watts output. 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

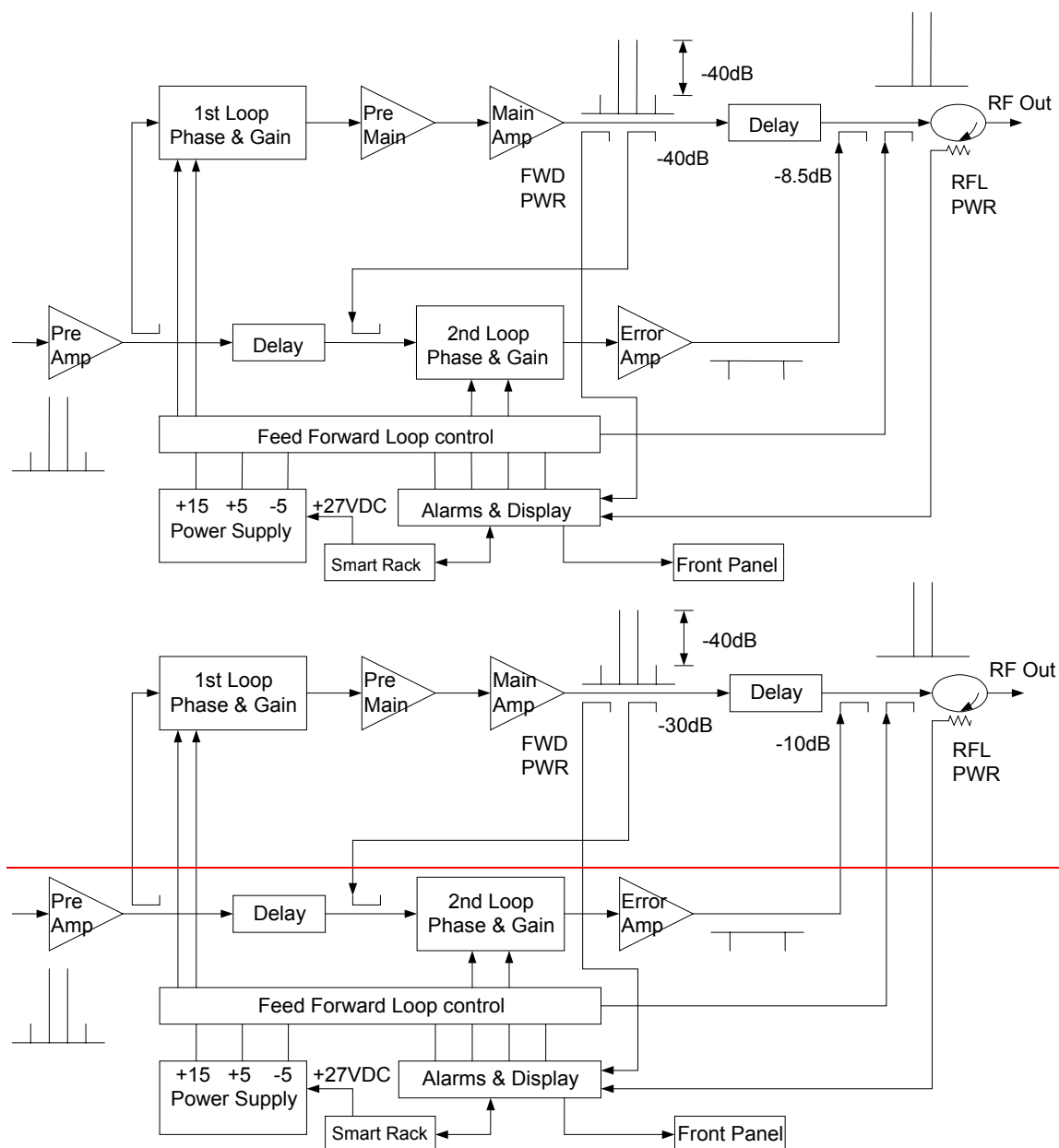
and phase variations, for example those due to temperature, are reduced to the passive reference variations. The amplifier module is comprised of:

- Preamplifiers
- 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 ~~120-140~~ watts. The signal is output to several couplers and a delay ~~line~~ filter.

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.

The primary function of the first loop is to provide an error signal for the second loop. The primary function of the second loop is to amplify the error signal to cancel out spurious products developed in the main amplifier. The input signal is amplified by a preamplifier and fed to a coupler and delay line. The signal from the coupler is fed to the attenuator and phase shifter in the 1st loop. The first loop control section phase shifts the main input signals by 180 degrees and constantly monitors the output for correct phase and gain.



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.

### 4-5.1 Main Amplifier

The input and output of the amplifier employ three-stage, class AB amplifiers which provide approximately 30-15 dB of gain in the 25 MHz frequency band from 869 MHz to 894 MHz. The amplifier operates on +27 Vdc, and a bias voltage of +5-+12 Vdc, and is mounted directly on a heat sink which is temperature monitored by a digital thermostat IC. If the heat sink temperature exceeds 92-85 °C, the thermostat opens and a high temperature fault occurs. The alarm logic controls the +5-12 Vdc bias voltage that shuts down the amplifier.

#### 4-5.2 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 class ~~A~~B amplifier, has ~~50-15~~ dB of gain. The amplifier operates on +27 Vdc and a bias voltage of ~~+15-+12~~ Vdc and is mounted directly on a heat sink.

### 4-5.3 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 in 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.

### 4-5.4 Amplifier Module Cooling

Although each amplifier module contains its own heat sink, it is cooled with forced air. Three fans are used for forced air cooling and redundancy. The fans are located on the front and rear of the amplifier module, draw air in through the rear of the amplifier, and exhaust hot air out the front of the module. ~~The lower front fan is not monitored for failure as are the other two.~~ The fans are field replaceable (refer to paragraph 5-6.2).

## 4-6 Power Distribution

Primary DC power for the system is provided by the host system to the subrack. The subrack supplies each amplifier module with +27 Vdc directly and via the RF power splitter/combiner. The amplifier module has ~~linear and switching regulators that generates required DC voltages such as a DC/DC converter that converts the +27 Vdc to +15 Vdc, +5 Vdc, +9V and -5 Vdc from +27Vdc.~~

## 4-7 Intermodulation

The ~~MCA9129-90~~MCA9129-90-A amplifier is designed to deliver a 120-watt composite average analog power, multicarrier signal, occupying a bandwidth less than or equal to 25 MHz, in the bandwidth from 869-894 MHz. The maximum average power for linear operation, and thus the amplifier efficiency, will depend on the type of signal amplified.

### 4-7.1 Two-Tone Intermodulation

When measured with two equal CW tones spaced anywhere from 30 kHz to 25 MHz apart, and at any power level up to the peak power, the third order intermodulation products will be below -65 dBc at 100 watts output, below -60 dBc at 120 watts output.

### 4-7.2 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 -65 dBc @ 100 W output, -60 dBc @ 120 W output, or better, with a maximum of one MHz channel spacing.

## 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 tests in accordance with individual manuals for amplifiers.

### 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 <del>(4 each)</del>	<del>H.P.</del> RDL	<del>8656B</del> IMD-801D-03A
20 dB Attenuator, <del>250-500</del> Watt	<del>Tenuline</del> Weinschel	<del>WA53-20-34</del>
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
<del>Variable Attenuator</del>		
<del>Four Tone Combiner</del>		
Network Analyzer	H.P.	<del>8753C</del> 8753ES
Current Probe	Agilent	1146A

## 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 cleaning 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 Performance Test

This test is applicable to a subrack equipped with one to four plug-in ~~MCA9129-90~~MCA9129-90-A amplifier modules. Perform the tests applicable to your system. To perform the test, proceed as follows:

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

### NOTE

Do not apply any RF signals at this time.

2. Turn on all four signal generators and set frequency ~~F1 to 880, 881, 882, 883, 884, 885, 886 and 887 MHz, F2 to 881 MHz, F3 to 882 MHz, and F4 to 883 MHz.~~ Adjust each signal generator output so that the ~~composite power equals -12dBm, sum power output from all four signal generators equals -4 dBm at the output of the 4-way combiner.~~

#### 5-5.1.1 Single Amplifier IMD Test

3. Adjust attenuator for an input signal at ~~-12, -12~~dBm. Reset channel 1 amplifier with the front panel ON/OFF/RESET switch, and set switch to ON. Set amplifiers 2, 3, and 4 to OFF. Ad-



just variable attenuator to set amplifier power output on power meter to 90 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc max. Record test data in table 5-3. Switch tested amplifier to OFF.

4. Repeat step 3 for amplifiers 2, 3, and 4, as applicable, for each plug-in amplifier module.

#### 5-5.1.2 Two Amplifier IMD Test

5. Reset and turn on channel 1 and 2 amplifier modules, and turn off channel 3 and 4 amplifiers. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
6. Reset and turn on channel 1 and 3 amplifiers, and turn off channel 2. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
7. Reset and turn on channel 1 and 4 amplifiers and turn off channel 3. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
8. Reset and turn on channel 2 and 3 amplifiers, and turn off channel 1. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
9. Reset and turn on channel 2 and 4 amplifiers, and turn off channel 3. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
10. Reset and turn on channel 3 and 4 amplifiers, and turn off channel 2. Adjust the variable attenuator to set power output on power meter to 180 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.

#### 5-5.1.3 Three Amplifier IMD Test

11. Reset and turn on channel 1, 2 and 3 amplifiers, and turn off channel 4. Adjust the variable attenuator to set power output on power meter to 270 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
12. Reset and turn on channel 1, 2 and 4 amplifiers, and turn off channel 3. Adjust the variable attenuator to set power output on power meter to 270 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
13. Reset and turn on channel 1, 3 and 4 amplifiers, and turn off channel 2. Adjust the variable attenuator to set power output on power meter to 270 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
14. Reset and turn on channel 2, 3 and 4 amplifiers, and turn off channel 1. Adjust the variable attenuator to set power output on power meter to 270 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.

#### 5-5.1.4 Four Amplifier IMD And Current Test

15. Reset and turn on channel 1, 2, 3, and 4 amplifiers. Adjust the variable attenuator to set power output on power meter to 360 watts. Measure IMD on spectrum analyzer. IMD should be -65 dBc maximum. Record test data in table 5-3.
16. With the power amplifier set at 360 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 ~~180-144~~ 180-144 amps maximum. Record test data in table 5-3.

#### 5-5.1.5 Harmonics Test

17. With the power amplifier set at 360 watts power output, use the spectrum analyzer and check the frequency band from 869 MHz to 894 MHz for harmonics. Harmonics should be -50 dBc maximum. Record test data in table 5-3.

#### 5-5.1.6 Spurious Test

18. With the power amplifier set at 360 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 -65 dBc maximum. Record test data in table 5-3.

#### 5-5.1.7 Gain Test

19. Disconnect spectrum analyzer from test setup, and connect the network analyzer.
20. Set network analyzer as follows:
  - A. Power output to ~~-4~~ -12 dBm.
  - B. Frequency start to 869 MHz.
  - C. Frequency stop to 894 MHz.
  - D. Normalize the network analyzer for gain and return loss.
21. Reset and turn on the channel 1 amplifier, turn off channel 2, 3 and 4 amplifiers. Check the gain across the band from 869 MHz to 894 MHz. Gain should be as specified in table 1-2  $\pm 1$  dB. Record test data in table 5-3.
22. Turn off the channel 1 amplifier and reset and turn on the channel 2 amplifier. Check the gain across the band from 869 MHz to 894 MHz. Gain should be as specified in table 1-2  $\pm 1$  dB. Record test data in table 5-3.
23. Repeat steps 21 and 22 and individually check and record the gain of each amplifier module in the system. Record test data in table 5-3.
24. Refer to table 5-3. Collectively reset and turn on the amplifier modules in groups of two three and four, as shown in table 5-3, and check the gain of each group. The minimum/maximum gain of each group of amplifiers should be within the limits shown in table 5-3. Record test data in table 5-3.

#### 5-5.1.8 Input Return Loss Test

25. Reset and turn on all amplifier modules in the main frame. Read and record the  $S_{11}$  return loss measurement on network analyzer. Record test data in table 5-3.

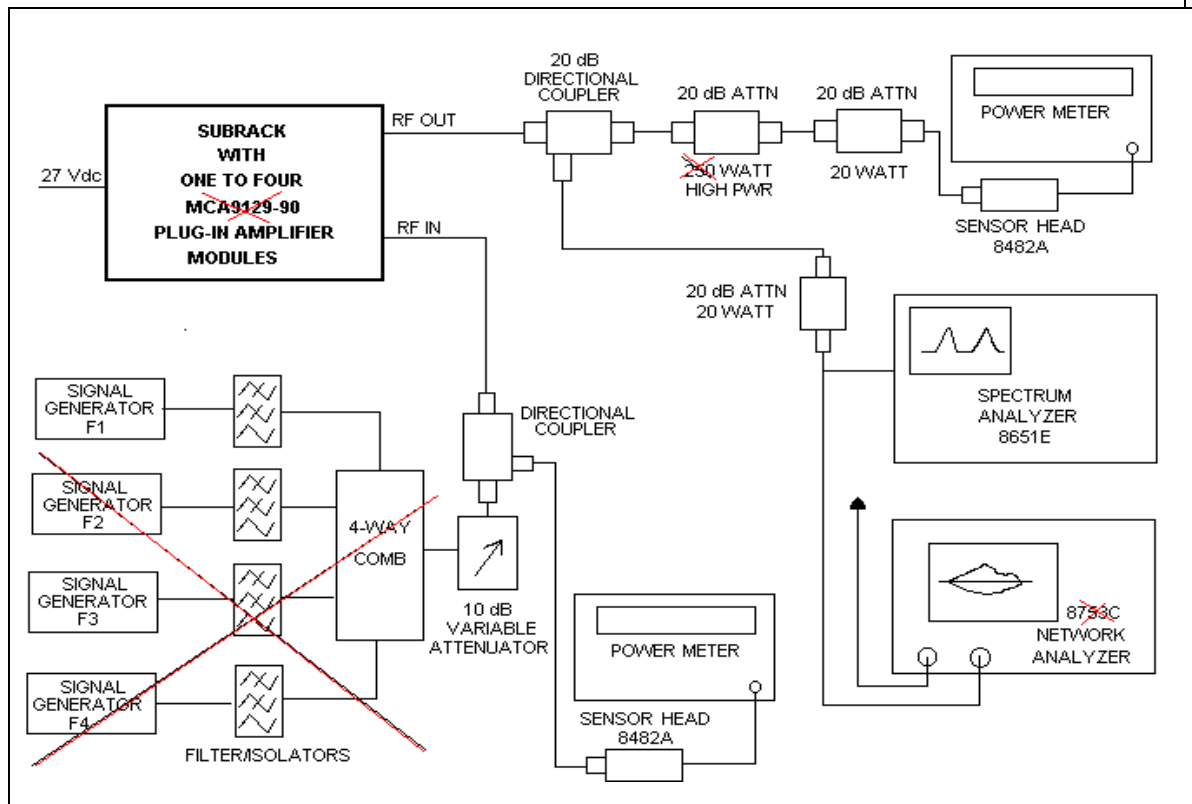


Figure 5-1 Amplifier System Test Setup Diagram

**Table 5-3 Multicarrier Cellular Amplifier Test Data Sheet**

DATE \_\_\_\_\_

MODULE #1 S/N \_\_\_\_\_ MODULE #2 S/N \_\_\_\_\_

MODULE #3 S/N \_\_\_\_\_ MODULE #4 S/N \_\_\_\_\_

**TEST CONDITIONS:**

Load and Source Impedance: 50 Ohms

VSWR: < 1.2:1

Supply Voltage: +27 Vdc  $\pm$ 0.1 Vdc

TEST	SPECIFICATION	MIN	MAX	DATA					
<del>4.8</del> -TONE IMD One Module	Vcc = 27 Vdc PO = 90 W Freq.: 880, <del>881, 882, 883 - 887</del> MHz		-65 dBc	1	2	3	4		
<del>4.8</del> -TONE IMD Two Modules	Vcc = 27 Vdc PO = 180 W Freq.: 880, <del>881, 882, 883 - 887</del> MHz		-65 dBc	1,2	1,3	1,4	2,3	2,4	3,4
<del>4.8</del> -TONE IMD Three Modules	Vcc = 27 Vdc PO = 270 W Freq.: 880, <del>881, 882, 883 - 887</del> MHz		-65 dBc	1,2,3	1,2,4	1,3,4	2,3,4		
<del>4.8</del> -TONE IMD Four Modules	Vcc = 27 Vdc PO = 360 W Freq.: 880, <del>881, 882, 883 - 887</del> MHz		-65 dBc	All					
RF Gain One Module	Vcc = 27 Vdc PO = 90 W Freq. = 880 MHz	Table 1-2 -1 dB	Table 1-2 +1 dB	1	2	3	4		
RF Gain Two Modules	Vcc = 27 Vdc PO = 180 W Freq. = 880 MHz	Table 1-2 -1 dB	Table 1-2 +1 dB	1,2	1,3	1,4	2,3	2,4	3,4
RF Gain Three Modules	Vcc = 27 Vdc PO = 270 W Freq. = 880 MHz	Table 1-2 -1 dB	Table 1-2 +1 dB	1,2,3	1,2,4	1,3,4	2,3,4		
RF Gain Four Modules	Vcc = 27 Vdc PO = 360 W Freq. = 880 MHz	Table 1-2 -1 dB	Table 1-2 +1 dB	All					
Harmonics	Vcc = 27 Vdc PO = 360 W <b>869 - 894 MHz Band</b>		-50 dBc	All					
Spurious	Vcc = 27 Vdc PO = 360 W 869 - 894 MHz Band		-65 dBc	All					
Gain Flatness	Vcc = 27 Vdc PO = 360 W 869 - 894 MHz Band		$\pm$ 0.7 dB	All					
Input Return Loss	Vcc = 27 Vdc PO = 360 W 869-894 MHz Band	-18 dB		All					
DC Power	Vcc = 27 Vdc PO = 360 W <del>4.8</del> Tones		<del>180-144</del> Amps	All					

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. ~~MCA9129-90~~MCA9129-90-A Power Amplifier Modules
2. Cooling Fans

### 5-6.1 ~~MCA9129-90~~MCA9129-90-A Power Amplifier Module

To replace a power amplifier module, proceed as follows:

1. Set ON/OFF/RESET switch on the front panel of the amplifier module to OFF.
2. Loosen two screws 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 multipin connector.

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

### 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. Pull out snap fasteners that secure fan to amplifier module. Disconnect fan power connector from amplifier module.
3. Install replacement in reverse order of steps 1 and 2 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

The ON/RESET switch can clear many alarm faults. It is located on the front panel of the faulted amplifier module. An attempt to reset the fault should be your first course of action. 24 Hour technical support service is available at our main phone number 888-797-9283 or 714-466-1000; select the "System Operator Technical Support" option to receive assistance from Powerwave's Applications Support Group.

The following are general guidelines established to aid Field Engineers or Cell Site Technicians in the proper method of Powerwave equipment fault resolution by fault mode.

#### 6-2.1 ~~DC Voltage Indicators Not~~ Status Lamp not Illuminated

1. Check the front panel ON/OFF switch.
2. Check the power plant circuit breaker.
3. Check for  $+27 \pm 1.0$  VDC at the amplifier subrack input.
  - A. If the voltage is low, verify that all DC connections between the power plant and the amplifier subrack are tight.
  - B. If the voltage is correct,
    1. Remove the amplifier from the subrack slot and move the amplifier to another amplifier subrack slot.
    2. Check the voltage on the power pins of the mating amplifier and amplifier subrack connector.
    3. Verify that the amplifier DC connections are not damaged.
4. Return the amplifier to the factory for repair.

#### 6-2.2 OVER PWR Illuminated ~~or Blinking~~

1. If all the amplifiers in a given amplifier subrack are in Over Pwr and the ~~LPA Disable~~ Status LED is illuminate, then the input RF power level is too high and the amplifiers have been disabled. RF power may be incorrectly set during equipment commissioning. This may be due to a faulty jumper cable. Verify the amplifier subrack output cables, transmit filter, and directional coupler are in proper working order. The loss between the amplifier subrack and the hatch plate is typically less than 2.0 dB.

2. If all the amplifiers in a given amplifier subrack are in Over Pwr and the LPA Disable Status LED is not illuminated, then the input RF power level is too high. The amplifier subrack is attempting to maintain a safe power output level (smart subracks with True RMS power detectors and voltage variable attenuators only). This may be validated by checking the APC LED on the subrack for a blinking state. RF power may be incorrectly set during equipment commissioning. This may be due to a faulty jumper cable. Verify the amplifier subrack output cables, transmit filter, and directional coupler are in proper working order. The loss between the amplifier subrack and the hatch plate is typically less than 2.0 dB.
3. If only one or two amplifiers in a given amplifier subrack are in Over Pwr and the LPA Disable Status LED is blinking is illuminated after disabling or removing an amplifier, then the amplifier subrack is probably in Sleep Mode Constant Gain Mode. (smart subracks with True RMS power detectors and voltage variable attenuators only).
  - A. The input power level must be adjusted to compensate for the loss of any module when in constant gain mode. Pressing the On/Off/Reset switch momentarily in the Up position or cycling DC power on the amplifier should bring the amplifier back on-line.
  - B. Sleep Mode Constant gain firmware may be disabled in the field with a PC interface and software available from Powerwave.
4. Move the amplifier to another slot in a different subrack, if available. Mark the amplifier with a sticker or place a tie wrap on the handle to identify the amplifier. Monitor for future failure.
  - A. If the same amplifier fails again, return the amplifier to the factory for repair.
  - B. If the replacement amplifier in the original subrack fails, replace the amplifier subrack.

#### 6-2.3 HIGH TEMP Illuminated

1. If an amplifier is in HIGH TEMP and the LPA Disable Status LED is illuminate, then the amplifier heat sink main amp base plate temperature is too high. This may be due to:
  - A. High ambient temperature.
  - B. Fan failure.
  - C. Insufficient air-volume capacity. Most of Powerwave's amplifiers require a certain amount of free-space to allow proper airflow.
2. Correct the heat problem, then reset the amplifier by momentarily pressing the Reset button on the amplifier front panel up.

#### 6-2.4 VSWR Illuminated

1. If all the amplifiers in a given amplifier subrack are in VSWR and the LPA Disable Status LED is illuminate, then the output RF reflected power level is too high and the amplifiers have been disabled. This may be due to a faulty jumper cable or transmit filter. Verify the amplifier subrack output cables, transmit filter, and directional coupler are in proper working order. The loss between the amplifier subrack and the hatch plate is typically less than 2.0 dB. This fault normally occurs during site or just following site power setting and normally takes about 10 to 15 minutes to reveal itself. This fault may not occur at low power levels (i.e. when just one or two channels are up).
2. If one amplifier in a given amplifier subrack is in VSWR and the LPA Disable LED is illuminated, then the output RF reflected power level is too high for that amplifier. This may be due to
  - A. A damaged or recessed amplifier RF output connector. Return the amplifier to the factory for repair.

Mishandling of the amplifier normally causes recessed pins. Before installing an amplifier, look at the D-sub connector to ensure none of the pins are recessed, bent or that

the outer connector shield is not damaged. When installing the amplifier, do not force the amplifier into the slot. Gentle even pressure is all that is needed to properly seat the amplifier.

- B. Improper seating of the amplifier.
  - 1. Ensure the amplifier thumbscrews are properly tightened.
  - 2. Try seating the amplifier in another subrack slot.
  - 3. Try seating the amplifier in a subrack in another sector.

#### ~~6-2.5~~ DC FAIL Illuminated

If an amplifier is in DC FAIL and the LPA Disable LED is illuminate, then one of the four amplifier DC voltages is either out of tolerance or not present. Return the amplifier to the factory for repair.

#### ~~6-2.6~~~~6-2.5~~ FAN FAIL Illuminated

If an amplifier is in FAN FAIL, then ~~the~~ one or more of the amplifier's cooling fans has failed. Replace the fan.

Model ~~MCA9129-90~~MCA9129-90-A Amplifiers

A single A fan failure does not cause the amplifier to shut down.

~~Two failed large fans cause the amplifier to shut down. These amplifiers have a small fan on the front lower panel. The smaller front fan's performance is not monitored.~~

#### ~~6-2.7~~~~6-2.6~~ LOOP FAIL Illuminated

Loop Fail is always accompanied by LPA Disable LED illuminated. This may be due to

- 1. Inability of the amplifier to maintain a 180° phase shift between the first and second loops.
- 2. A damaged error amplifier. This can be caused by
  - A. Out of band spurious or intermods being applied at too high of a level at the amplifier input port. An input band-pass filter may be necessary to correct this problem.
  - B. Disconnecting amplifier RF output cables while the amplifier is still turned on. Always turn the amplifier off when moving output RF cables from the hatch plate to test equipment and back again.
- 3. Improper power balance between amplifiers in a given subrack.
  - A. Ensure the amplifier thumbscrews are properly tightened. Reset the amplifier by momentarily pressing the Reset button on the amplifier front panel up.
  - B. Try seating the amplifier in another subrack slot.
  - C. Try seating the amplifier in a subrack in another sector.

#### ~~6-2.8~~~~6-2.7~~ LOW PWR Illuminated

Low Power is always accompanied by the LPA Disable LED illuminated. This is due to the gain of either the internal preamplifier or main amplifier being 0.5 dB (typically) or more below the amplifier specification. The amplifier should be returned to the factory.

#### ~~6-2.9~~~~6-2.8~~ LPA DISABLEStatus LED Illuminated Only

- 1. LPA DisableStatus LED only illuminated indicates that the amplifier RF section is disabled. This may be due to the following:



A. An accompanied alarm indicating a critical amplifier fault ~~(i.e. Loop Fail fault).~~ Such as:

- Loop Fail
- DC Fail
- Input Overdrive
- Low Power
- Error Amp Over Current

For the alarm conditions above, the DB-9 connector on the front panel must be interfaced via RS-232 with a PC to determine exact cause for shutdown. This information is accessible with a Powerwave GUI interface program and the flight recorder provided in the amplifier software.

B. The front panel disable switch is in the down position.

~~B. A response to a subrack command, purposely inhibiting the amplifier (i.e. Sleep Mode activation)~~

~~C. Improper seating of the amplifier in the subrack.~~

2. Ensure the amplifier thumbscrews are properly tightened. Reset the amplifier by momentarily pressing the Reset button on the amplifier front panel up.
3. Try seating the amplifier in another subrack slot.
4. Try seating the amplifier in a subrack in another sector.

## 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 our Repair Department for packing materials and information.