



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

**MCS6503-4 SUBRACK**  
**MCA 9503-60 AMPLIFIER**

**MULTICARRIER CELLULAR**  
**AMPLIFIER SYSTEM**

**869-894 MHz**  
**50 TO 200 WATTS AVERAGE POWER**  
**-65 dBc INTERMODULATION DISTORTION**

08 January 1998

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16 March 98

Federal Communications Commission  
Authorization and Evaluation Division  
Laboratory Division  
7435 Oakland Mills Road  
Columbia, MD 21046

Dear Sir or Madam,

In reference to the application under FCC ID: E675JS0026, we request that the following material submitted with the application be withheld from public disclosure:

Parts Lists, Assemblies and Block diagrams Supplement, 044-05026 Multicarrier Cellular Amplifier System, MCA9503-60, MCS6503-4 Amplifier and Subracks. ?

The requested material contains schematics, parts lists and block diagrams that are confidential and would not normally be considered public knowledge or be made available to the public.

A handwritten signature in black ink, appearing to read "Bruce C. Johnson". The signature is fluid and cursive, written over the typed name below.

Bruce C. Johnson  
Sr. Quality Engineer

File:fcc.lr2

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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 multicarrier cellular amplifier systems. 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 MCA9503-60 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). The amplifier system is modular in design, and is ideally suited for use in AMPS/TDMA/CDMA base stations. The plug-in Model MCA9503-60 amplifier modules can each provide 60 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. The system is housed in the MCS6503-4 subrack which holds up to four MCA9503-60 amplifiers to produce up to 200 watts output (figure 1-1). 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 down-time. The turn-on and turn-off sequences of voltages are fully automatic, as is overload protection and recycling. Inadvertent operator damage from front panel manipulation is virtually impossible.

The MCS6503-4 subrack 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 has the system RF I/O connectors, an RF output sample connector, and DC power input terminals. The front panel of each amplifier module has unit level status/fault indicators and a power on/off circuit breaker. Primary power for the amplifier system is +27 Vdc. Cooling for each plug-in amplifier module is provided by two fans 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 system are listed in table 1-2.

### **1-4. EQUIPMENT CHANGES**

Powerwave Technologies, Inc. reserves the right to make minor changes to the equipment without notice, including but not necessarily limited to component substitution and circuitry changes. Such changes may or may not be incorporated in this manual, although it is our intention to keep each manual as up-to-date as possible. To that end, we ask that you, our customer, share with us information acquired in field situations which might be of assistance to another user. If you share it with us, we'll pass it around.

**1-5. ORDERING INFORMATION**

Table 1-1 following gives the part numbers and descriptions to be used when ordering either an entire system or individual major components that comprise the system.

Table 1-1. Major System Components

<b>SYSTEM ORDER NUMBER</b>	<b>DESCRIPTION OF SYSTEM NUMBER</b>	<b>SUB-COMPONENT MODEL NUMBER</b>	<b>QTY PER SYSTEM</b>	<b>DESCRIPTION OF SUB-COMPONENT MODEL NUMBER</b>
MCS6503-4	200 W 869-894 MHz MCPA System for Base Station Equipment.	MCA9503-60	4	60 W 869-894 MHz MCPA Module.
		MCS6503-4	1	4-Way 26" Subrack.

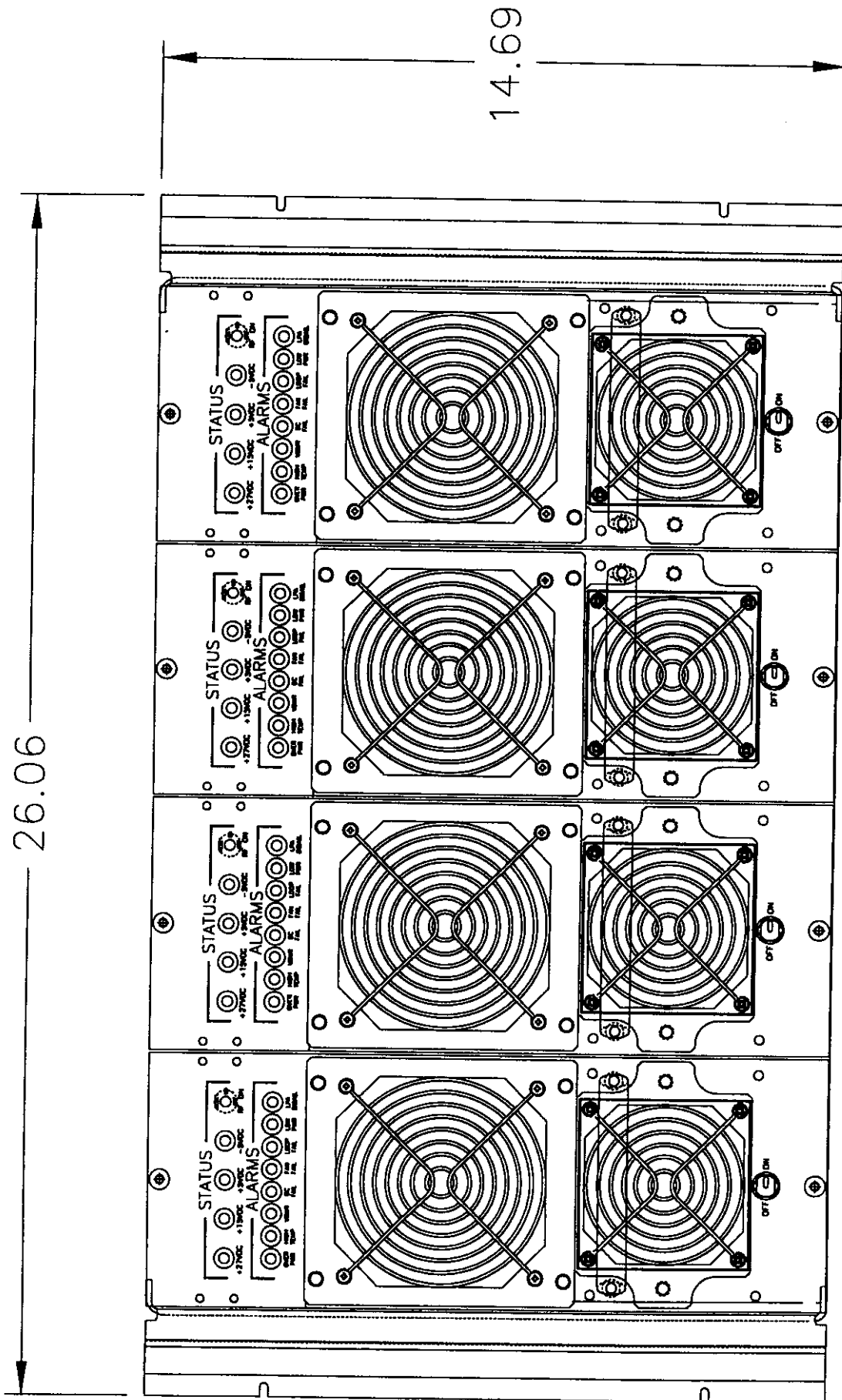


Figure 1-1. MCS6503-4 Subrack with Four Amplifier Modules

Table 1-2. Multicarrier Cellular Amplifier System Functional Specifications

Frequency Range	869-894 MHz (25 MHz Bandwidth)
Total Maximum Input Power	0 dBm
Total Output Power (Minimum) in MCS6503-4 System	50 W typical (1 Module) 100 W typical (2 Modules) 150 W typical (3 Modules) 200 W typical (4 Modules)
Intermodulation Distortion and In-Band Spurious:	1 Module : -65 dBc (Min) @ +24 to +28 Vdc @ 40 Watts 2 Modules: -65 dBc (Min) @ +24 to +28 Vdc @ 90 Watts 3 Modules: -65 dBc (Min) @ +24 to +28 Vdc @ 135 Watts 4 Modules: -65 dBc (Min) @ +24 to +28 Vdc @ 175 Watts (-55 dBc(Min) @ +23 to +24 Vdc)
RF Gain at 880 MHz	47.5 dB (1 Module) 51.3 dB (2 Modules) 53.0 dB (3 Modules) 54.0 dB (4 Modules)
Gain Flatness:	± 0.7 dB @ 27 Vdc ±1 Vdc
Gain Variation Over Temperature:	± 1.0 dB @ 27 Vdc ±1 Vdc ± 1.5 dB @ 24 to 26 Vdc
Output Protection:	Mismatch Protected
Input Port Return Loss:	-18 dB (Min)
Harmonics:	Better than -45 dBc
Out of Band Spurious:	Better than -60 dBc
Duty Cycle:	Continuous
DC Input Power:	+27 Vdc ± 1 Vdc, 28 Amps Max per module @ 50 Watts Operational +23 Vdc to 30 Vdc
Operating Temperature:	0 °C. to +50 °C.
Storage Temperature:	-40 °C. to +85 °C.
Operating Humidity:	5% - 95% Relative Humidity (Non-Condensing)
Storage Humidity:	5% - 95 % Relative Humidity (Non-Condensing)
DC Input Connectors:	Threaded Studs, 5/16 - 18 thread.
Fan/Summary Alarm Connector:	Six position terminal block
RF Input Connector:	SMA Female
RF Output Connector:	Type 7/16 DIN Female*
RF Output Sample Connector:	SMA Female
Dimensions:	
MCA 9503-60 Amplifier:	14.66" High, 5.50" Wide, 16.74" Deep
MCS6503-4 Subrack:	14.69" High, 26.06" Wide, 18.52" Deep (with input filter)

\* Powerwave recommends mating with a 7/16 DIN Male on RG 214/U cable.



## **SECTION 2 INSTALLATION**

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

This section contains installation recommendations, unpacking, inspection, and installation instructions for the Multicarrier Cellular Amplifier System. 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. Section 3 contains applicable standards imposed by the Federal Communications Commission. It is important that the licensee perform these tasks correctly and in good faith. Carefully read Parts 73 and 74 of the 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 an inrush current of 125 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. The amplifier system is shipped in two containers. Check the outside of each for instructions regarding unpacking. Carefully open the containers and remove the rack and amplifier modules. Retain all packing material that can be reassembled in the event the 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 rack and 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 connectors or fans. Inspect all connectors for bent connector pins. If the equipment is damaged, a claim should be filed with the carrier once the extent of any damage is assessed. We cannot stress too strongly the importance of IMMEDIATE careful inspection of the equipment and the subsequent IMMEDIATE filing of the necessary claims against the carrier if necessary. If possible, inspect the equipment in the presence of the delivery person. If the equipment is damaged, the carrier is your first area of recourse. If the equipment is damaged and must be returned to the factory, write or phone for a return authorization. Powerwave may not accept returns without a return authorization. Claims for loss or damage may not be withheld from any payment to Powerwave, nor may any payment due be withheld pending the outcome thereof. **WE CANNOT GUARANTEE THE FREIGHT CARRIER'S PERFORMANCE**

### **2-4. INSTALLATION INSTRUCTIONS** (Refer to figures 1-1, 3-1, and 3-2)

The MCS6503-4 26-inch subrack, which holds up to four amplifier modules, is designed for installation in a rack or cabinet that permits access to the rear of the amplifier system for connection of DC power, RF, and control cables

To install the amplifier system proceed as follows:

1. Install subrack in equipment rack or cabinet and secure in place with four screws
2. Refer to figure 3-1 for the location of all subrack input/output connectors.
3. Connect alarm, status, and control cable to J5 CONTROL.
4. Connect antenna cable to J6 RF OUT connector on rear of subrack.
5. Connect transceiver or exciter input to the input terminal of the filter on the rear of the subrack.
6. Connect the RF sampling cable to J8 RF SAMPLE.

**WARNING**

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

7. Remove protective cover on power terminal block; do not discard. All power connections are to be made from the lower side of the terminal block. Connect positive primary power to either +27V terminal and negative primary power to either GND terminal.

**WARNING**

**Replace protective cover on DC terminal block 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.**

**CAUTION**

**Verify that all circuit breaker switches on the front panels of the amplifiers are in the left (OFF) position.**

8. Install the plug-in amplifier modules in the slots of the subrack.
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  $\pm$ 1.0 Vdc. If the DC input voltage is above or below the limits, call and consult Powerwave before you turn on your amplifier.
11. Refer to section 3 for initial turn-on and check-out procedures.

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

Each amplifier in the subrack has a separate remote alarm and control connector which may be used by the host system to monitor and control the individual amplifier modules. The status, alarm, control, and power connections on the amplifier connector are made through a 17-pin D-Sub male combo connector (figure 2-1) and are listed and described in table 2-1.

## **2-6. SUBRACK MODULE STATUS AND FAN ALARM CONNECTOR**

Each amplifier in the subrack has a set of alarm connections that are connected to subrack relays, the output of which is used by the host system to monitor whether any amplifier module in the system has a fault. The relay output contacts are rated at two amps @ 150 volts. Connections are made to connector J5 CONTROL in accordance with figure 3-2 and table 3-2.

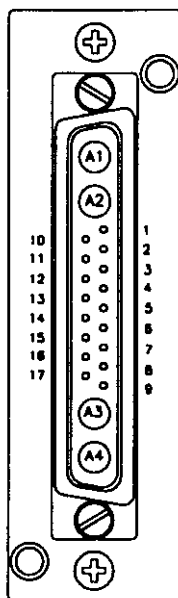


Figure 2-1. Amplifier Connector (on Rear of MCA 9503-60 Module)

Table 2-1. Amplifier Module Status, Alarm, Control, and Power Connections

PIN NUMBER	FUNCTION	DESCRIPTION
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	NC (No Connection)	
3	NC (No Connection)	
4	NC (No Connection)	
5	NC (No Connection)	
6	NC (No Connection)	
7	NC (No Connection)	
8	Fan Fail	TTL signal normally low. A high level indicates that one or both of the 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	NC (No Connection)	
11	Average Power Input	An analog DC voltage representing the average detected power of all the MCAs in a rack. This voltage is derived from dividing the sum of all the forward power voltages in a rack by the number of enabled MCAs. This voltage is used by the MCA to determine a low power fault.
12	NC (No Connection)	
13	Summary Fault	TTL signal normally low. A high level indicates that the MCA has been disabled by a recurring alarm fault.
14	NC (No Connection)	
15	Module Detect	Ground potential. Informs the rack that an MCA is plugged in.
16	Bias Input	TTL signal normally low for an enabled MCA. A high level will disable the MCA.
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.

### SECTION 3 OPERATING INSTRUCTIONS

#### 3-1. INTRODUCTION

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

#### 3-2. LOCATION AND FUNCTION OF SUBRACK AND AMPLIFIER MODULE CIRCUIT PROTECTORS, CONTROLS, AND INDICATORS

The amplifier system subracks are rack mountable chassis. The location and function of the system interface connectors and fuse are shown in figures 3-1 and 3-2, and are described in tables 3-1 and 3-2. The plug-in amplifier module controls and indicators, are shown in figure 3-3 and are described in detail in table 3-3.

Table 3-1. MCS6503-4 Subrack Fuse, Alarms, and Input/Output Connectors

NO.	NAME	FUNCTION
1	F1 - 5A	Subrack mounted 5-amp fuse used to protect the splitter/combiner from overload.
2	+27V and GND Terminals	Input terminals for primary +27 Vdc source voltage and its return.
3	J5 - CONTROL Connector	25-pin, female type D-SUB connector. (Refer to table 3-2 for individual pin signals.)
4	J6 - RF OUT Connector	Extended TYPE N female coax connector. Output to antenna. Refer to table 1-2 for power output level of one to four amplifier module systems.
5	J7 - RF IN Connector	SMA female coax connector attached via RF cable to filter. Filter input connector: SMA female. Refer to table 1-1 for power input level to amplifier module system.
6	J8 - RF SAMPLE - -40±1.0 dB connector	SMA female coax connector. RF output signal is at -40 dB of signal output to antenna.

Table 3-2. Connector J5 Definition

CONNECTOR	PIN	SIGNAL
J5 CONTROL	1	RS485 RxD+
	2	RS485 RxD-
	3	RS485 TxD+
	4	RS485 TxD-
	5	Ground
	6	DC On/Off
	7-23	Not Used
	24	Mode Select A
	25	Mode Select B

I/O | NOTES

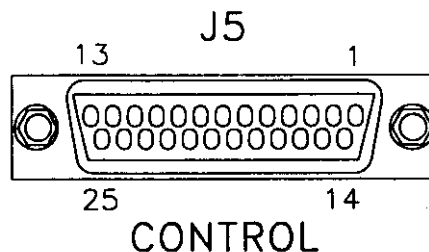


Figure 3-2. Connector J5

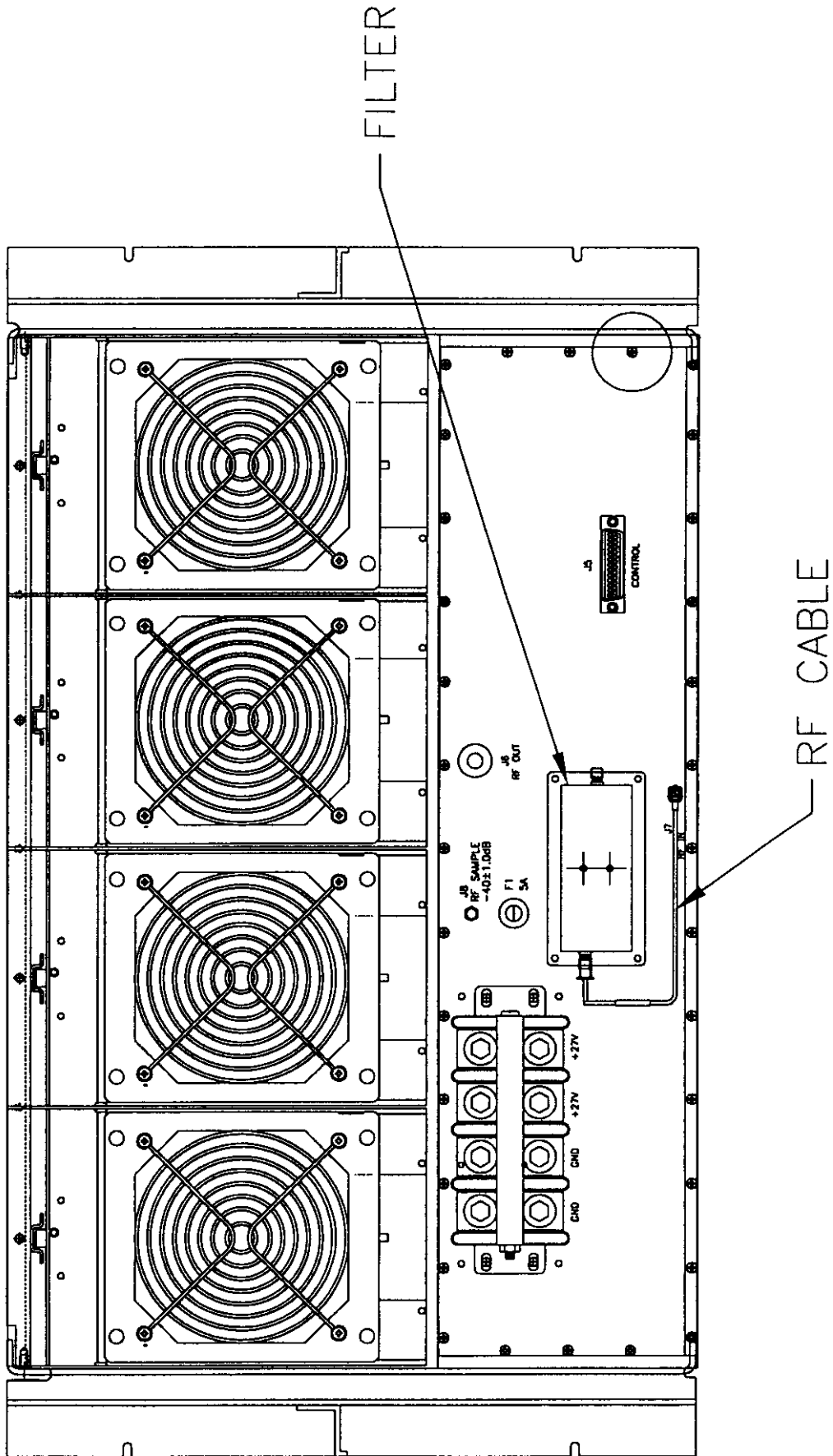


Figure 3-1. MCS6503-4 Subrack with Four Amplifier Modules, Rear View