



MCPS2000 Operations Manual

1 Introduction

This chapter introduces the MCPS2000 Series of Multi Carrier Power Amplifier (MCPA) Systems. It describes structure of this manual and introduces the different MCPS2000 Series amplifiers.

1.1 About this Manual

This Manual describes how to install, operate, and maintain the MCPS2000 series of amplifiers. It is arranged in chapters.

Chapter 1, *Introduction*, introduces the systems in the MCPS2000 family and their main features and describes how the system documentation is organized.

Chapter 2, *Installation and Operation*, describes how to install the MCPS2000 amplifier and place the amplifier in service.

Chapter 3, *Troubleshooting*, describes how to diagnose faults using the indicator LEDs and status/alarm messages.

Chapter 4, *Field Service Procedures*, describes how to perform routine maintenance and install new field-replaceable modules in the MCPS2000 amplifier.

The *Specifications Appendix* details the electrical, mechanical, and environmental specifications met by this MCPS2000 amplifier, including the Connector Pinouts and Interface Protocols used in the front panel diagnostic port and the optional base station alarm and control interfaces.

1.2 Introduction to the MCPS2000 Family

The MCPS2000 is a modular, ultra-linear cellular-frequency amplifier system providing up to 350 Watts (total) of output power. Designed for maximum flexibility and reliability, the MCPS2000 can increase the range or capacity of both new and existing base stations.

Modulations

The MCPS2000 can amplify any number of signal carriers using AMPS, CDPD, IS-136 TDMA, or IS-95 CDMA modulation up to the maximum rated system output power.

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Modularity

The MCPS2000 family is designed for operation with 1 to 4 amplifier modules, each providing 100 Watts of RF output power (up to 90 Watts effective output after combining losses).

Installation

The MCPS2000 housing is an 8RU shelf. Mounting kits are available for installation in 23-inch, 600mm, 24-inch, or 25-inch equipment racks.

RF Interfaces

It has a single RF input for the combined input signals, and a single RF output to the transmit filter.

Alarms and Control

The MCPS2000 provides status information through front-panel LED indicators and an RS-232 status port. Status information can be viewed through a front-panel RS-232 port using either a VT-100 terminal emulation program or Spectrian's Graphical User Interface program.

The MCPS2000 can also be optionally equipped with additional alarm and control interfaces, including dry-contact or TTL alarm connections and RS-485 or RS-422 interfaces to network operations and administration systems.

Reliability

The MCPS2000 is designed to enable system maintenance without removing the amplifier from service. The amplifier and system control modules can be hot-swapped during operation without affecting calls in process. The amplifier modules are designed so the cooling fans can be refit in the field by qualified service technicians, greatly reducing service shipping costs and turn-around time.

1.2.1 MCPS2000 Systems Modules

A fully-equipped MCPS2000 consists of a rack-mounted shelf containing up to four RF modules, an Alarm Management Module, and an internal divider/ combiner.

RF modules

The RF modules are ultra-linear amplifiers optimized for high power amplification of cellular signals. After combining losses, each RF module provides up to 90 Watts of RF output power.

Amplifier Management Module

The Amplifier Management Module contains the system control and alarm management logic and the interface to external operations and control systems.

Divider/Combiner

The divider/combiner allows the four RF modules to function as a single system. The divider/combiner has an active architecture, which automatically reconfigures to minimize combining losses if a RF module should fail.

Major Equipment Specifications for the MCPS2000

Electrical Specifications	Specification @ 25°C
Frequency Range	869 - 894 MHz
Average Power ¹ into 50 Ohms	100W (50 dBm) to 350W (55.4 dBm)
Intermodulation Distortion (IMD)	-65 dBc with AMPS and/or TDMA IS-136, or IS-97 CDMA dual mode input sources under nominal conditions
CDMA Adjacent Channel Power ³ @ 881 MHz, 100W Output	< -45 dBc, 750 KHz offset, 30 KHz res bandwidth < -60 dBc, 1.98 MHz offset, 30 KHz res bandwidth
Receive Band Noise	-30 dBm/30 kHz bandwidth
Carrier Spacing (AMPS/TDMA)	60 KHz min., 25 MHz max.
Power Output Stability for Single Frequency	± 0.5 dB under nominal conditions
Operating Bandwidth	up to 25 MHz
Gain	Factory set, 30 to 60 dB, 85 dB with optional preamp
Gain Flatness vs. Frequency	± 0.5 dB (over all temps)
Gain Variation over Temp @ Any Inband Frequency	± 1 dB
Forward Power Sample Port Gain	-50 dB typ.
Input/Output Port Return Loss	-15 dB min.
Second/Third and Greater Harmonic Output	-13 dBm/-20 dBm max.
DC Input Voltage Range	26 to 28VDC ²
DC Input Current @ 27VDC (max)	100W single RF module – 42A 175W two RF modules – 87A 260W three RF modules – 130A 350W four RF modules – 170A

¹Power levels at the output of the system combiner will vary depending on the configuration.

²Reduced power performance over 21-26V. Full spec performance (22-30V) available with optional DC/DC converter.

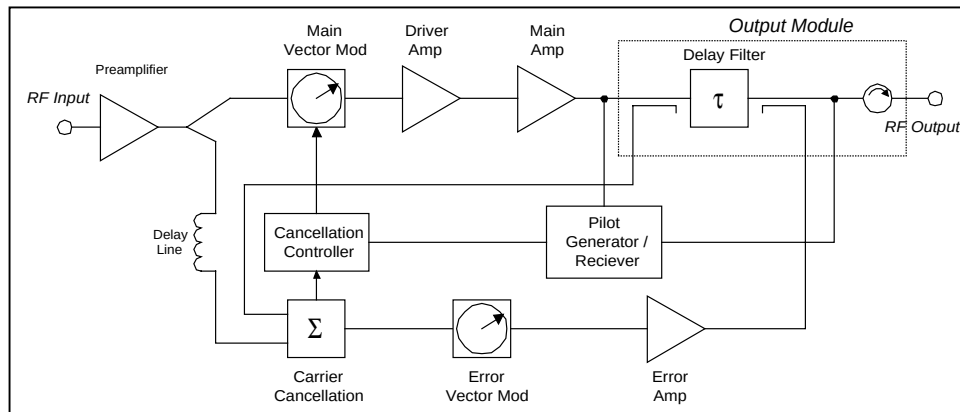
³Measured at the RF module output connector and in accordance with IS-97.

Mechanical Specifications

Operating/Storage Temperatures	0°C to 50°C/-40°C to 85°C
Size, 4 module system, mounting ears excluded	(D x W x H) 17.72 x 21.56 x 13.97 in. max (450 x 547,62 x 354,84 mm max.)
Weight, 4 module system	Installed: approx. 230 lbs (105 kg) Shipping: approx. 270 lbs max. (125 kg) Heaviest Module: <45 lbs max. (20 kg)
Connectors	RF Input(s): SMA (F) RF Output(s): N (F) Maintenance Port: RS232 Alarms Port: RS422 DC Inputs: 10-32 and ¼-20 threaded lugs DC Ground: ¼-20 threaded lugs RF Output Sample Port: SMA (F)
Indicators	AMM: DC On, Alarm LEDs MCPA Modules: DC On, Enable, Alarm, Fan LEDs

1.2.2 MCPS2000 Functional Description

To achieve the high level of linearity required to support multiple cellular carriers at the minimum cost, the RF modules in the MCPS2000 use a single loop feed-forward correction architecture with two amplification loops – the *main loop*, containing the main amplifier, and the *error loop*, containing the error amplifier. The combination of the two loops results in a signal in which the distortion products have been cancelled, enabling highly linear operation of the amplifier.



RF Module Functional Block Diagram

1.2.2.1 Main Loop

The output of the main amplifier contains both the desired signal and Inter-modulation Distortion (IMD) products. This signal is coupled off and combined with the desired signal coupled off the preamplifier. The relative delay and phases of these signals are adjusted so they combine to cancel out the desired signal, creating an error signal composed of only the main amplifier IMD products.

1.2.2.2 Error Loop

The error signal is amplified in the error loop and then combined with the output of the main amplifier containing both the desired signal and distortion products such that the distortion products cancel. The error loop provides the adjustments necessary so that the amplitude, phase and delay of both signals result in the desired cancellation.

2 Installation and Operation

2.1 Introduction

This chapter describes how to install, set up, and operate an MCPS2000 series amplifier in a base station. The described installation verification checks should be performed following installation of the MCPS2000 and after major maintenance or repairs have been completed.

The main installation steps detailed in this procedure are as follows.

- Installation Planning
- Installation Preparation
- Rack Installation
- Cable and Wire Installation
- Verify Installation
- Power-Up the MCPS2000
- Determine Required RF Input Power
- Set RF Input Power for each Channel

2.1.1 Safety Information

Please read and understand the instructions and warnings in this section and at the beginning of this manual before handling or unpacking the MCPS2000 modules.

The MCPS2000 is designed to be installed by trained and qualified technicians.

Each MCPS2000 amplifier module and the shelf subassembly weigh 20 kgs (44 lbs); when crated for shipping an MCPS2000 system can weigh in excess of 100 kgs (220 lbs) and be unbalanced. To avoid injuries or damage, use care and obtain assistance when lifting a crate containing MCPS2000 components.

2.2 Installation Planning

It is important to ensure all planning and site preparation is complete prior to beginning to install the MCPS2000. This section describes some installation considerations and the information required before beginning the installation procedure.

2.2.1 Site Planning Guide

For each MCPS2000 cell site installation, there must be a Site Planning or Site Engineering guide giving the detailed information on the site considerations, rack installation, cable connections, and Radio Parameters.

2.2.1.1 Site Considerations

Intended Installations

The MCPS2000 is intended for installation only in restricted access areas (dedicated equipment rooms, equipment closets, or the like) in accordance with Articles 110-16, -17, and -18 of the National Electrical Code, ANSI/NFPA No. 70.

Weight

The MCPS2000 shelf and each RF module weigh approximately 20 kg (44 pounds); the fully equipped system weighs 100 kg (220 pounds). The system must be installed, using the appropriate mounting kit, into a rack capable of supporting the unit, and located on a floor or surface capable of supporting the combined weight of the rack, the MCPS2000, and the installer or technician.

Floor Covering

If you intend to use a floor covering under the MCPS2000, avoid combustible materials, industrial carpeting, or materials that will permit generation of electrostatic charges.

Illumination

The MCPS2000 is designed to be installed and serviced under normal workroom lighting. During installation, room lighting must be bright enough to allow reading instructions and inspection of modules, but not so bright as to interfere with viewing the status LED indicators on the front panel. The MCPS2000 should be oriented or shielded so that direct sunlight does not fall upon the front panel.

Fire Protection

Spectrian recommends that the MCPS2000 installation site be equipped with smoke detectors and an automatic fire-extinguishing system. In addition, for personnel safety, the site should be equipped with a portable halogen or CO₂ fire extinguisher.

Altitude

When installing the MCPS2000 above 5000 ft (1542 m), derate the maximum operating temperature by 2° C per 1000 ft (304 m) above 5000 ft.

Ventilation

The MCPS2000 requires unrestricted airflow around the MCPS2000. The site must be ventilated or air-conditioned so that ventilation air does not exceed 50° Celsius.

Ambient air quality

The MCPS2000 should be installed in a location that is free of airborne dust and toxic or corrosive fumes.

Vibration and Noise

The MCPS2000 tolerates moderate levels of vibration and ambient noise. The MCPS2000 should not be installed in a location subject to mechanical shocks or vibrations conducted from nearby mechanical equipment. The MCPS2000 generates fan noise below 85 dBA during operation and no additional acoustic treatment of the site is needed.

Lightning Protection

Spectrian recommends that when used in locations subject to lightning discharge, all power, RF, and signal lines that connect to the MCPS2000 be protected by approved lightning arrestors. Your local fire or safety codes will determine the type of lightning protection required.

2.2.1.2 Rack Installation Considerations***Rack Space***

The MCPS2000 requires 8RU of rack space in a 24" rack (four-slot shelves) or a 19" rack (three-slot shelves). Optional mounting hardware for other rack sizes is also available. When used, the optional preamplifier requires an additional 2RU above the shelf.

Clearance

When operating, the MCPS2000 requires front cabinet clearance for unrestricted cooling air input, plus a minimum of 8 inches behind the MCPS2000 to exhaust hot air. Some additional rear clearance is desirable to accommodate routing the RF input and output cables and the DC power cables to their connections on the rear of the unit.

2.2.1.3 Cable Connections***DC Power Supply***

The MCPS2000 requires customer-supplied connections to the site +27 VDC power supply. The MCPS2000 is normally connected to the power supply with a separate connection for each RF module; a single connection to each shelf is also possible using the optional shelf power bus. The following tables show the required current and recommended power service for MCPS2000 systems with the indicated number of active amplifier modules installed in a system shelf.

Individual Power Connections to each RF Module

# RF Modules	RF Output Power	$I_{(Max)}$, 27 VDC	Recommended Service
1	100W	42 Amps	2 wires (2/module), #6AWG, #10 lugs 1 ea 50A Circuit Breaker
2	175W	87 Amps	4 wires (2/module), #6AWG, #10 lugs 2 ea 50A Circuit Breaker
3	260W	130 Amps	6 wires (2/module), #6AWG, #10 lugs 3 ea 50A Circuit Breaker
4	350W	170 Amps	8 wires (2/module), #6AWG, #10 lugs 4 ea 50A Circuit Breaker

Single Bussed Connection

When using the bussed connection option, the service should be sized for a fully equipped shelf even if the shelf is not initially fully populated to enable future expansion.

Recommended Service: 2 Wires, #2AWG, ¼" narrow tongue lug (T&B 55116 or equivalent); 1 ea 200A Circuit Breaker.

Chassis Ground Wire

The MCPS2000 shelf requires a customer-supplied chassis ground connection using #8AWG with a ¼" ring lug.

RF Input and Output Cables

The MCPS2000 requires a single customer-supplied SMA male RF input cable and a single customer-supplied male type-N RF output cable. The female connectors are on the rear of the MCPS2000 shelf.

Alarm Interface Cables

The MCPS2000 requires customer-supplied interface cables to the system alarm interfaces. The standard system has screw terminal connections for form C relay alarm contacts; optional RS 422 or 485 serial connections are also available. The alarm connection options for this MCPS2000 are listed in the Appendix.

Radio Parameters

To set up the MCPS2000, the installer must know the radio parameters for the MCPS2000 installation.

- Total Planned Output Power
- Number of CDMA Frequency Assignments and power of each
- Number of AMPS/TDMA/CDPD Channels
- Planned System Gain

Installation Equipment

Refer to the Tools and Materials listing in the following sections for the required MCPS2000 installation and test supplies.

2.3 Prepare for Installation

Before beginning the installation, verify that all the necessary site and radio information, installation materials, tools, and MCPS2000 equipment are on hand. Correct any problems or omissions before continuing. If necessary, refer to the following *Receiving and Unpacking Procedure* to prepare the MCPS2000 equipment.

Receiving and Unpacking Procedure

A Inventory Received Equipment

1. Upon receipt of the MC2004 remove the packing lists, installation kit, and other documents attached to the shipping container.
2. Examine shipping documents to make certain that they agree with your copy of the order. If there is a discrepancy between the order and the items or quantity shipped, contact your Spectrian representative listed in the front of this manual.
3. Check the packing list and verify that all necessary equipment has been delivered, and that the parts are undamaged. If any evidence of shipping damage is noted, notify the delivery agency before continuing.



NOTE: *If the container or contents appear to be damaged, you must contact the carrier without delay and file a damage claim. If shipping damage occurred, the carrier may wish to have a claims agent present when the MCPS2000 is unpacked and inspected. To protect your warranty rights, you must also notify your Spectrian representative and advise that the MCPS2000 was damaged during shipment.*

B Unpack Received Equipment

Uncrating, inspecting, and preparing the MCPS2000 for site installation will require some tools and materials not included in the shipment. Use of the following materials is suggested to perform these tasks.



Assemble all tools, materials, and safety equipment before beginning work.

Safety Equipment

- Safety glasses
- Work gloves
- Steel-toe shoes
- Back-support belt

Tools

- Box knife
- Pair of large scissors
- Inspection flashlight or lamp
- Pen or pencil
- Strap cutter
- Straight-blade screwdriver

Other Materials

- Purchase Order (copy)
- Packing List (copy)

1. Open the shipping container(s) and inspect the contents. Using the required safety equipment and tools, carefully cut the metal and/or nylon straps that surround the shipping containers. When using a box knife or scissors, take care not to damage the contents of the box. Take care to avoid scratching the cabinet finish.
2. Do not remove the ESD protective wrapping that surrounds the cabinet, unless wearing an ESD protective wrist strap. If possible remove this material by unwrapping the MCPS2000 by hand, rather than cutting this material with

scissors or knives. Spectrian recommends not removing the protective wrapping until installation.

3. Remove spacers, packing inserts, protective coverings, plastic bags, and other shipping materials from the outside of the MCPS2000. Avoid using knives or scissors to perform this task.
4. Carefully collect and dispose of the packing materials. Many of the packing materials used by Spectrian are suitable for recycling and need not contribute to landfills.
5. While inspecting the unpacked MCPS2000 compare the quantity and labeling of each module with shipping documents and the purchase order. If there is an unresolved discrepancy between the order and the items received, contact your Spectrian representative.
6. Inspect the MCPS2000 exterior for evidence of shipping damage. Metal surfaces should not be dented or scratched. Panels, handles, screws, and indicators should appear undamaged and properly aligned. Connectors should be tightly affixed to the cabinet, with no visible dents or distortion.



Note: If you discover damage during inspection, contact the shipper and Spectrian at once. The shipper will furnish instructions on how to document the discovered damage. Spectrian will arrange to promptly ship replacement parts.

C Repackaging for Return Shipment

Detailed repackaging instructions are beyond the scope of this document. If it becomes necessary to repackage parts of the MCPS2000 for return shipment to the factory, contact Spectrian Customer Service for detailed instructions..

2.4 Installation

This chapter provides instructions for site preparation and hardware installation.

Each MCPS2000 features rear-access RF input and output connectors, a DC voltage input receptacle, and a front-access RS-232 status interface connector. Additional optional features include a rear-access RS-422 or RS-485 serial interface connector and a remote alarms interface connector. Specific connector pinout information for your MCPS2000 configuration is provided in the Appendix.



Local building and fire codes govern the manner in which some site preparation and installation tasks are performed. If there are any questions concerning how the site installation conforms to local building codes, Spectrian recommends that you consult your local building inspector or a licensed engineer.

2.4.1 Task safety equipment, tools and materials

The following safety equipment, tools, and materials are recommended to perform the installation tasks in this section.

Safety Equipment

- Safety glasses
- Work gloves
- Back-support belt

Tools

- Flat and Phillips screwdrivers
- Adjustable wrench
- Inspection lamp or flashlight
- Volt-Ohmmeter (VOM)
- ESD protective wrist strap or continuity tester

Materials

- Pressurized can of spray-on contact cleaner
- Rack-mounting hardware and fasteners
- DC Power, RF, and signal cables
- Crimp-on circular lugs
- 10 AWG solid copper ground wire

2.4.2 Rack Installation

The MCPS2000 mounts in the equipment rack using rack-mounted side support rails.

The MCPS2000 shelf subassemblies are labeled with the part and serial numbers, using standard EIA part identification, date code, and serializing methods. It is also labeled with the appropriate FCC approvals.

The MCPS2000 shelf subassembly contains all internal wiring for DC power and RF signal distribution to the RF modules and the interfaces to the cell site. Brushless DC cooling fans are mounted on each RF module; cooling air is drawn through grille openings in the front of each module and discharged through the rear.



Warning: The MCPS2000 shelf sub-assembly is heavy. Use caution when lifting.

2.4.2.1 Install Shelf Subassembly

1. Make certain that adequate vertical space (8RU) within the rack enclosure is available. Verify that there will be at least 20cm (8 inches) of space behind the unit when installed for cooling air flow.
2. Put on an ESD protective wrist strap.
3. Unpack the MCPS2000 side mounting rails and attachment hardware and install them in the rack as shown on the accompanying job sheet.
4. Unpack the MCPS2000 shelf and record its serial number. Ensure the shelf is in the proper upright vertical orientation and slide it onto the mounting rails.
5. Use the supplied mounting screws to attach the shelf to the rack.

2.4.2.2 Install Modules in Shelf

6. Unpack each RF module. Align each module with the guides in an amplifier slot and slide the module as far as possible into the shelf, making sure the module is fully seated. Note that each module weighs approximately 20 kgs (44 lbs); get a helper to assist if necessary. Tighten the fasteners at the bottom of each faceplate to lock the modules in place.
7. Unpack and install the Amplifier Management Module (AMM) module in the rightmost slot of the shelf. Tighten the fastener at the bottom of the faceplate to lock the module in place.
8. Inspect the alignment of the finished installation, and adjust if needed. If no problems are found, rack installation is complete.

2.4.3 Cable and Wire Connections

2.4.3.1 Connect Chassis Ground Wire

9. Locate the chassis ground stud on the rear of the MCPS2000 for ground wire attachment.
10. Measure the distance and routing between the MCPS2000 ground stud and an attachment point to earth ground. Cut a length of #8 AWG insulated (green) solid copper wire sufficient for the connection.
11. Crimp a ¼" circular lug to one end of the ground wire.
12. Remove the nut and lock washer on the MCPS2000 ground stud. Attach the DC ground wire lug to the grounding stud on the MCPS2000, and replace the lock washer and nut. Tighten the nut securely.
13. Connect the other end of the ground wire to the appropriate earth ground.
14. Use a VOM to verify that the resistance between the chassis ground and true earth ground is less than 100 Ohms.
15. Inspect the finished connection. If no problems are discovered, ground wire installation is complete.

2.4.3.2 Connect DC Input Power Cables

The MCPS2000 power connection can be made using a pair of wires for each RF module, or via a single bussed connection. The DC input voltage cabling must be terminated by crimped lugs and sized to the correct wire gauge to accommodate the wire length and the DC current requirements of the MCPS2000 in accordance with local building codes and industry practice. Refer to paragraph 2.1.2.3 for the recommended power supply circuit and wire sizing for each option.



WARNING: Do not perform DC lead installation with energized leads. Ensure that the DC power supply is OFF for all installation activities!

16. Locate the positive and negative terminals on the customer-provided DC power source, and verify polarity with a VOM.
17. Locate the power supply lugs at the top of the rear of the shelf subassembly. The four #10 lugs for the per-RF-Module connection option, the single pair of ¼” lugs are for the bussed power option. Determine which set of lugs will be used for this installation.
18. Measure the distance and routing between the power source and the MCPS2000 DC lugs.
19. For each power connection being made, cut equal lengths of wire for power and return. Strip and connect each wire to the appropriate power connection.



Verify the polarity of each supply wire prior to connecting them to the shelf subassembly. A reversed-polarity connection will severely damage the MCPS2000 and will void the product warranty.

20. Crimp the appropriate terminal lugs onto each power supply wire.
21. Attach one positive supply wire and one return wire to each of the four sets the power supply lugs at the top of the rear of the shelf subassembly. Tighten the attachment nuts firmly.

2.4.3.3 Connect RF Output and Input Cables

The MCPS2000 has one female type-N amplified RF output for connection to a customer-supplied coaxial cable terminated with a male connector, and one female SMA RF input for connection to an operator-supplied input cable terminated with a male SMA connector.



Important: The integrity of RF cabling is critical to the electrical performance of the MCPS2000. Ensure connectors are properly built, free of debris, and clean.



WARNING: Do not perform RF cable installation with DC power supplied to the MCPS2000. Ensure that the input DC power supply is OFF before handling RF cables.



Important: The Output cable must be connected before connecting the Input cable.

22. Locate the male N-type RF output connector on the end of the coaxial cable attached to the output load. Inspect the connector and clean if necessary; fix any problems with the cable or connector before proceeding.
23. Locate the female connector labeled “RF OUTPUT” on the MCPS2000.

24. Screw the male cable connector firmly into the female RF output connector of the MCPS2000.
25. Locate the male input RF connector on the end of the coaxial cable from the RF signal source. Inspect the connector for damage or irregularity, and fix any problems with the cable or connector before proceeding.
26. Locate the female SMA connector labeled “RF INPUT” on the rear of the MCPS2000.
27. Screw the male cable connector firmly onto the MCPS2000 female connector.

2.4.3.4 Connect Alarm Interface Cables

28. The MCPS2000 provides optional factory-configured connections for dry contact, TTL, RS-422, or RS-485 communications and alarm output to the customer system. Refer to the connector pinout and descriptions in the Appendix for the connections applicable to your MCPS2000.
29. Locate the interface connectors located on the rear of the shelf subassembly behind the Amplifier Management Module (AMM). Inspect the connector and clean if necessary; fix any problems with the cable or connector before proceeding.
30. Connect the male connector or input wires to the connector mounted on the MCPS2000. Tighten the two screws on the cable connector (if any) firmly.

2.4.4 Finish Installation

2.4.4.1 Set the MCPS2000 unit address

Each MCPS2000 may be configured with a unique address (0 – 7) for commands and status reports sent through the RS-422 or RS-485 port.

31. If this option is included in the MCPS2000, locate the rotary switch on the rear of the MCPS2000 Amplifier Management Module.
32. Set the switch to the desired address.

2.4.4.2 Verify Installation

33. Recheck all physical and electrical connections to the MCPS2000 and remedy any problems discovered.

Once the installation is verified, the MCPS2000 is ready to be set up to be placed in service, as described in the next section of this chapter.

2.5 System Start-Up

2.5.1 Safety Information and Tools

To avoid injury, installers, technicians, and maintenance personnel must follow Spectrian's recommended procedures and observe safety precautions.



Important: *The MCPS2000 should be only operated by trained and qualified personnel. Always follow safety warnings.*



Note: *Before shipment, the MCPS2000 was inspected and found free of mechanical and electrical defects. The electrical performance of the MCPS2000 should be verified using these procedures. If there is any deficiency, or if electrical performance is not within specifications, notify your Spectrian representative immediately.*



Warning: *Persons with cardiac pacemakers should avoid exposure to RF radiating elements.*



Warning: *Exposing the human eye to high levels of radio-frequency radiation may result in the formation of cataracts. Do not operate exposed circuitry or radiating elements with personnel in close proximity to the radiating source. Always replace covers and shields during operation.*

Tools

The following tools are recommended to perform installation tasks.

- HP 436 Power meter
- Volt-Ohmmeter (VOM)

2.5.2 Verify system installation

Before operating the MCPS2000, verify proper installation as described in the previous section.

34. Verify that there are no obstructions to airflow in the front or rear of the MCPS2000.
35. Ensure that the DC power supply at the site is functioning normally. DO NOT turn on the DC supply to the MCPS2000 at this time.
36. Ensure that the MCPS2000 is physically connected to an input RF signal source and terminated in an output load. DO NOT turn on the RF signal source at this time.
37. If used, verify that the MCPS2000 address is set correctly.



WARNING: *The RF output of the MCPS2000 should be connected to a 50-ohm load before DC power is turned on. If a dummy load is used, it must be capable of dissipating at least 350 watt average power and 4500 watts of peak power.*

After mechanical and electrical installation tasks are complete, the MCPS2000 is ready for power-on check.

2.5.3 Power Up the MCPS2000



Important: Read and understand the following steps before taking any action.

38. Switch on the DC input power to the MCPS2000. Measure the input voltage at the bus bar connections at the rear of the unit and verify it is 27VDC. Adjust the power supply if necessary.

The MCPS2000 AMM POWER LED should be GREEN, indicating that the unit is functional and that input voltage is between 24 and 28 VDC. If the POWER LED is amber, red, or does not light, turn off the DC input power and correct the power supply fault.

The MCPS2000 RF modules will automatically be ENABLED. All four LEDs on each MCPA module should be GREEN.

To DISABLE an RF module, set the front panel ENABLE/DISABLE switch to DISABLE; the ENABLE LED will be RED.

39. Wait 5 minutes for the MCPS2000 to reach a stable operating temperature and to charge the real-time clock backup power. DO NOT apply commercial traffic signal power during this time.
40. If the MCPS2000 is connected to a remote operations center via one of the rear panel interface connections, verify no alarms have been reported.
41. Verify that all MCPS2000 LED indicators remain GREEN.
42. If any LED indicators are AMBER or RED, then RF modules are disabled or there is a problem which must be remedied before continuing.

If no problems are encountered, continue to the next step, determining the required RF input drive power as described below.

2.5.4 Determine the required RF input power



Note: The MCPS2000 should be powered on and enabled before the RF input power is applied.

43. Before applying the RF input power to the MCPS2000, determine the input drive level and output power needed for each channel being amplified by using the attached worksheet.
44. Before applying RF input power to the MCPS2000, verify that the applied RF input power for a single channel and the sum of all channels is below the calculated maximum rated RF input.

Once the required RF input power for each channel is determined, continue to the next step, setting the RF input drive power.

2.5.5 Set RF input drive power for each channel



Note: If RF Input Cable is connected to the MCPS2000, disconnect it from the MCPS2000 and connect it to the Power Meter for the following step.

45. Switch on the RF input drive power at the customer provided host system exciter following the instructions supplied with your RF source equipment.

46. Set and verify the RF input drive level for each individual channel
 - a. Key-on each RF input channel individually.
 - b. Monitor the RF input using a HP436A or equivalent power.
 - c. Verify that the maximum input power for that channel does not exceed the calculated levels on the RF Drive Power worksheet (line G).
 - d. Key off the channel and repeat for the remaining channels. Continue to verify the required channel input power is not exceeded.
47. After verifying the power of each individual channel individually, ensure that the total average input power remains less than or equal to the maximum rated composite power (-1.6 dBm).
 - a. Key-on all channels at one time, including any CDMA F.A.s, and continue to monitor input power.

If the average composite input power exceeds the calculated average composite input power (line H), readjust all channels as necessary to ensure average input power remains less than or equal to specifications.

RF Drive Power Worksheet

A) Total output power (P_{OUT}) required =	W	dBm
B) Determine total output required for each fully loaded CDMA Frequency Assignment (FA):		
# of FA's =		
total power per FA =		
total CDMA power (P_{CDMA}) =		
Total available analog power (P_{AN}) = ($P_{AN} = P_{OUT} - P_{CDMA}$)	W	
D) Total # of analog channels, including setup (#ch) =		
E) Maximum per channel analog output power (P_{AN}/ch) = ($P_{AN}/ch = P_{AN}/\# \text{ of channels}$)	W	dBm
F) System Gain (Gain) =	dB	
G) Maximum per channel analog input power (P_{IN}/ch) = ($P_{IN}/ch \text{ in dBm} = P_{AN}/ch \text{ in dBm} - \text{Gain in dB}$)	dBm	
H) Maximum composite input power (P_{IN}) = ($P_{IN} = P_{OUT} \text{ in dBm} - \text{Gain in dB}$)	dBm	

2.6 Monitoring the MCPS2000 operation

The MCPS2000 Amplifier Management Module (AMM) has a front panel RS-232 status port. This port can be used to monitor the operation and status of the MCPS2000 using a laptop computer or VT-100 compatible ASCII terminal.

There are two monitoring options.

- A LabView-based GUI, which can run on Windows95, 98, or NT4.0-based laptop computers
- A VT-100 compatible status display, which can also be used with a laptop computer running a terminal emulation program such as the Windows Terminal accessory.

Documentation of these interfaces is included in the software distribution.

3 Troubleshooting

3.1 Introduction

This chapter provides basic information about diagnosis of problems with the MCPS2000. Please read the following safety information prior to beginning diagnosis and repair actions.



Important: *Troubleshooting and repairs should be performed only by trained and qualified personnel or at authorized Spectrian repair depots. Observe all safety warnings and use the required safety equipment when performing the tasks described in this chapter.*

3.1.1 Safety Information

To avoid injury, installers, technicians, and maintenance personnel must follow Spectrian's recommended procedures and observe all safety precautions.



The MCPS2000 transmits high power at radio frequencies. Severe radiation burns can occur if recommended safety precautions are not strictly observed.



Warning: *Persons with cardiac pacemakers should avoid exposure to RF radiating elements.*



Warning: *Exposing the human eye to high levels of radio-frequency radiation may result in the formation of cataracts. Do not operate exposed circuitry or radiating elements with personnel in close proximity to the radiating source. Always replace covers and shields during operation.*



Except where specifically indicated, always disconnect RF input power and DC input power to the MCPS2000 before performing procedures that do not require power. For those procedures that do require power, be extremely cautious in handling test leads, tools, and equipment near live circuits. Never reach into an enclosure for the purpose of servicing or adjusting except in the presence of a person who can render aid.

3.2 Alarm Definitions

Fault management may be accomplished by various means with the MCPS2000. The MCPS2000 includes alarm LEDs, an RS-232 diagnostics port, and an optional base station status/alarm interface. These LEDs may be used for visual diagnostics by on-site technicians.

3.2.1 Alarm classification

The MCPS2000 fault management subsystem classifies faults into three categories. In order of escalation, these are *minor* faults, *major* faults, and *critical* faults.

3.2.1.1 Minor Alarm

A minor problem exists, but the fault does not require a module to be taken out of service.

Routine service attention is recommended.

3.2.1.2 Major Alarm

A major problem exists such that the MCPS2000 is not meeting all performance specifications, but the unit is not automatically disabled.

Urgent service attention is required or the unit may take itself out of service.

3.2.1.3 Critical Alarm

A major failure or a condition exists that could result in damage. The MCPS2000 is automatically taken out of service.

Immediate service attention is required.

3.2.2 Alarm Responses

The fault management system automatically responds when a fault is detected. Responses vary in impact from alarm notification with no subsequent action (for minor faults) to alarm notification and shut-down (for out-of-service faults). The hierarchy of responses is designed to keep the MCPS2000 in operation unless continued operation would result in damage to the unit. Under some fault conditions, the MCPS2000 continues to operate in a degraded state. The operator may choose to continue to operate in a degraded state, shed channels, or shut down the MCPS2000 until repairs can be completed.

3.2.2.1 Automatic Alarm resets

Critical Alarm

When a critical alarm occurs, the MCPS2000 will automatically be DISABLED (i.e., taken out of service) until the operator ENABLES the unit.

Major Alarm

When a major fault is detected, the MCPS2000 attempts to clear the fault by performing a reset. In most cases, the MCPS2000 will attempt to reset three times. If the alarm condition fails to clear after three attempts, the MCPS2000 remains in operation with the fault alarm set.

In the case of an over-temperature major alarm, the fault manager will attempt to clear the alarm one time only by resetting. If the fault condition does not clear, the alarm classification will escalate to out-of-service, and the MCPS2000 will shut down and remain off-line until returned to service by the operator.

Alarm Transient Supression

To minimize false alarms from transient anomalies, the fault management system is designed with built-in hysteresis. If the fault condition persists past the hysteresis interval, the appropriate fault alarm is set.

3.2.2.2 Manual Alarm resets

When a major Alarm is detected the operator may choose from the following options:

- Take no action and allow the MCPS2000 to operate in a degraded state until service can be performed.
- Shed input channels to reduce the power to the MCPS2000.
- Disable the RF Module using the front panel switch, diagnostic port, or optional base station alarm and control interface
- Enable the faulting RF using the front panel amplifier switch, diagnostic port, or optional base station alarm and control interface, assuming that a false alarm has occurred, and wait to see if the fault alarm returns.



This action involves risk to the MCPS2000 and is not recommended by Spectrian. Re-enabling an off-line MCPS2000 without determining the cause of the fault could result in damage and void the product warranty.

3.3 Troubleshooting

3.3.1 Using LED Indicators

Each MCPS2000 RF Module is equipped with four LED indicators mounted on the front panel. The system Alarm Management Module has two LED indicators mounted on the front panel. These indicators provide useful status and diagnostic information to operators and technicians.

RF LED	Green	Amber	Red
Power	Voltage OK, 26 VDC	22-24 V or 28-29V; RF has degraded performance	<22 V or >29V; RF shuts down
Enabled	Enabled	N/a	Disabled
Status	OK	Minor Alarm	Major or Critical Alarm
Fan	OK	N/a	Fan Failure

AMM LED	Green	Amber	Red
DC Power	Voltage OK, 26 VDC	22-24 V or 28-29V; system has degraded performance	<22 V or >29V; system shuts down
Status	No Faults	N/a	System Fault Exists

3.3.2 Using Diagnostic Port output

Use of the Diagnostic Port is described in the release notes with the interface software distribution.

3.3.3 Using Remote Alarm Monitoring

The MCPS2000 can include an optional alarm or control interface to base station monitoring systems. These systems provide a serial interface to transmit status codes to a remote host computer and receive a limited set of commands from the host. For system with such an interface, the interface is described in detail in the specifications Appendix.



Note: *The MCPS2000 fault management system and its associated alarms and fault indicators operate independently of the serial interface.*

4 Field Service Procedures

4.1 Introduction



Important: *The MCPS2000 should be serviced only by trained and qualified personnel. Always follow safety warnings.*



Note: *Before shipment, the MCPS2000 was inspected and found free of mechanical and electrical defects. The electrical performance of the MCPS2000 should be verified using these procedures. If there is any deficiency, or if electrical performance is not within specifications, notify your Spectrian representative immediately.*

4.1.1 Safety Precautions and Tools

To avoid injury, installers, technicians, and maintenance personnel must follow Spectrian's recommended procedures and observe safety precautions.



Warning: *Persons with cardiac pacemakers should avoid exposure to RF radiating elements.*



Warning: *Exposing the human eye to high levels of radio-frequency radiation may result in the formation of cataracts. Do not operate exposed circuitry or radiating elements with personnel in close proximity to the radiating source. Always replace covers and shields during operation.*

Tools

The following tools are recommended to perform system service tasks.

- HP 436 Power meter
- Volt-Ohmmeter (VOM)

4.2 Periodic Maintenance

4.2.1 Dust Removal

Keep the air inputs and outputs of the MCPS2000 free of dust or other material that could block cooling airflow.

4.2.2 Visual Inspection

Periodically visually inspect the MCPS2000 to ensure that all indicators are functioning normally and that all system interfaces are properly connected.

4.3 Module Replacement

The RF and AMM modules of the MCPS2000 are hot-swappable Field Replaceable Units (FRUs) which can be removed and inserted while the system is online without affecting the operation of the other units in the system.

4.3.1 Replacing an RF Module



WARNING: *The RF Module is very heavy (20kgs / 44 lbs.) Get assistance if necessary.*

7. Disable the RF Module being replaced by switching the front panel switch to DISABLE. The ENABLE LED will be RED.
8. Undo the RF Module front panel fastener.
9. Slide the RF Module out of the shelf subassembly.
10. Place the RF module in a safe, static-free location.
11. Insert the replacement RF Module.
12. Fasten the RF Module front panel fastener.
13. The RF Module will automatically ENABLE; the ENABLE LED will be GREEN.

4.3.2 Replacing an AMM

1. Undo the AMM front panel fasteners.
2. Slide the AMM module out of the shelf subassembly.
3. Place the AMM in a safe, static-free location.
4. Slide the new AMM into the shelf sub-assembly.
5. Fasten the AMM front panel fastener.
6. The POWER LED will be GREEN.

4.3.3 Replacing shelf subassembly



Caution: Turn off the DC voltage and RF power prior to replacing a MCPS2000. Remove all DC and RF connectors prior to removing the MCPS2000 from the rack.

1. Remove the RF Modules' front panel retaining screws.
2. Remove the RF modules from the rack.



WARNING: The RF Module is very heavy (20kgs / 44 lbs.) Get assistance if necessary.

3. Set each RF Module aside in a clean, safe place, free of electrostatic charges.
4. Remove the rack retaining screws. Grasp the front panel with both hands and pull the MCPS2000 straight out from the rack.
5. Set the disconnected MCPS2000 aside in a clean, safe place, free of electrostatic charges.
6. Remove the replacement MCPS2000 from its static-protective packaging.



Note: You may wish to record the serial number on your repair record before installing the module.

7. Follow the installation and operation instructions in Chapter 2 to place the unit back in service.

4.4 Module Service

4.4.1 Replacing MCPS2000 Fan Modules

8. Remove the RF module with the failed fan from the rack. Note that these modules are heavy (20kgs / 44 lbs each).
9. Place the RF module on a clean, static-free work surface.
10. Remove the screws securing the fan module to the RF module.
11. Disconnect the wiring harness from the fan module.
12. Connect the harness to the new fan module.
13. Replace the fan module and replace the attachment screws.

Replace the RF module in the rack. The unit will automatically enable; the FAN indicator LED should be GREEN.