Installation, Operation, and Preventive Maintenance Manual

Ku-Band Antenna-Mount SSPA

DMAN-17221 Rev G

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Communications & Power Industries

Proprietary Information

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About this Manual

This manual is intended for use by personnel trained and qualified to install and operate satellite communications equipment, including high power radio frequency amplifiers.

Warning: Read the entire safety section and all operational warnings before attempting to install, operate, maintain, or service the equipment provided.

Disclaimer

This document is intended solely as a guideline and its content is subject to change without notice. CPI is not responsible for any system design containing CPI equipment, unless otherwise specified in a mutually agreed upon contract.

Safety

Safety considerations are noted in the applicable locations in the manual.

Section 1 General Information

1.1 How to Use This Manual

This manual contains information on how to install, operate and maintain the Ku-Band Antenna-Mount Solid-State Power Amplifier (SSPA). Information is organized according to section, with index tabs for convenience. Within each section the pages, Figures and Tables are numbered by section and by order of appearance within the section.

To locate information quickly, refer to the table of contents. To locate a figure or table, refer to the lists of figures and tables, which immediately follow the table of contents. To find a definition of an unfamiliar word or acronym, refer to the glossary of acronyms and terms at the end of the manual.

Safety information is summarized in the following section. Warnings, cautions or notes appear prior to dangerous procedures throughout the manual.

Section 7 contains warranty information and return procedures to be followed in the event that a factory repair is required. Please refer to this section for information on how to contact the factory for service.

1.2 Safety Information

This equipment has been designed to minimize exposure of personnel to hazards, and is a safety class I device (provided with a protective earth terminal).

An uninterruptable safety earth ground must be provided from the main power source to the input wiring terminals through the power cord set.

WARNING	Failure to ground the equipment as described will cause a potential shock hazard that could result in personal injury.

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so. Do not replace components with the power cable connected.

Capacitors within the equipment may still be charged even if the power cable has been disconnected. Discharge before touching.

Do not operate this equipment in the presence of flammable gases or fumes. Operation of any electrical equipment in such an environment is dangerous and can cause explosions and/or fires.

1.3 General Introduction

This technical manual provides operation and service instructions for the Ku-Band Antenna-Mount SSPA.

The SSPA consists of a solid-state power amplifier module, complete with power supply, cooling system and alarm circuitry. It is designed to be installed outdoors and is furnished in a weatherproof enclosure.

1.4 Purpose of Equipment

This solid-state power amplifier is designed to provide linear amplification at Ku-Band frequencies for uplink applications in satellite communication systems.

1.5 Equipment and Accessories Supplied

The Ku-Band Antenna-Mount SSPA, illustrated in Figure 1-1, consists of the items in Table 1-1. The amplifier setup program, provided with the SSPA, is also available from CPI.

1.6 Specifications

Refer to the specification sheet included in Section 8, System Configuration, for performance specifications of the Ku-Band Antenna-Mount SSPA.

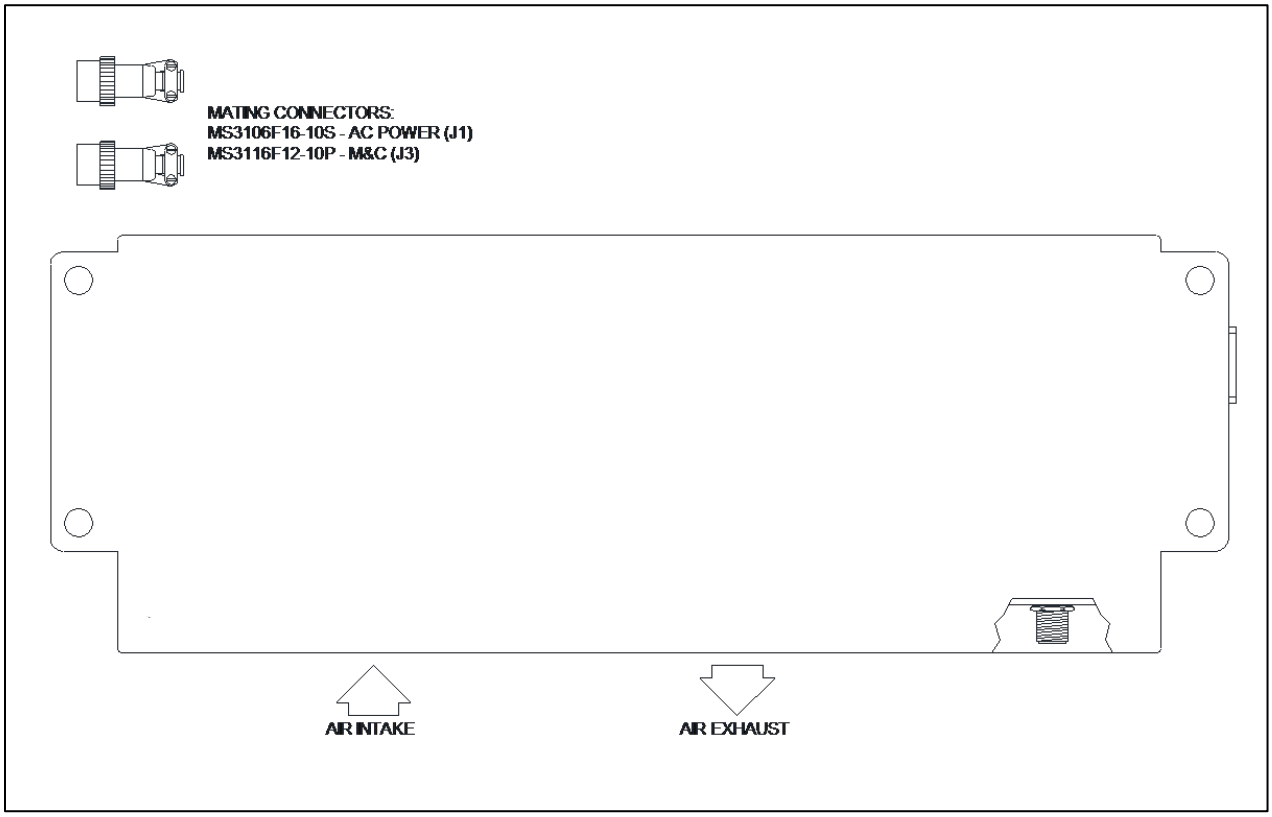


Figure 1-1 Ku-Band Antenna-Mount SSPA

Table 1-1 List of Equipment and Accessories Normally Supplied

Quantity	Description
1	Amplifier assembly
1	Power input mating connector, MS3106F16-10S
1	Serial I/O M&C mating connector, MS3116F12-10P
1	Operation and Maintenance Manual
1	Amplifier Setup Program
1	PC-to-SSPA RS-232 Cable (for setup program)
1	25-pin/9-pin “D” adapter

1.7 Optional Accessories

An optional **RCP-2001 Remote Control Panel** may be added to the antenna-mount SSPA. This rack-mount panel provides a user interface with a liquid crystal text display, colored indicator lights, and pushbuttons to monitor, control, and configure the amplifier. The RCP-2001 communicates with the SSPA using the J3 (Serial I/O) connector and may be located up to 4000 feet (1300 m) from the SSPA. A Serial I/O connector on the RCP-2001 provides the user M&C system interface when using the Remote Control Panel.

The RCP-2001 Remote Control Panel can be supplied with a **Parallel I/O** option. This option provides eight opto-isolated digital inputs and eight relay-isolated digital outputs. These inputs and outputs can be used to monitor and control the amplifier, and each can be configured for any available function.

An optional **L-Band to Ku-Band Block Upconverter (BUC)** is also available. The BUC is installed internal to the SSPA enclosure. An external 10 MHz reference is required for phase locking the BUC’s local oscillator. In units with this option, J2 is typically used for both the L-Band input signal and the multiplexed reference signal. An optional separate reference input port can be installed at the factory.

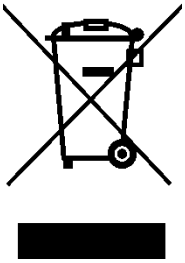
MAXCON™ Monitor and Control software allows you to monitor, control, and configure the SSPA via its serial I/O port. The Microsoft® Windows®-compatible program is available from CPI.

For now, MAXCON (versions 1.5x through 1.6x) can monitor and control the Antenna Mount amplifier, subject to the following limitations:

- In 1:1 systems, you can set the redundancy mode for AUTO or MANUAL only; you cannot set SPARE mode.
- Some new faults are reported as a FAULT CODE only; the text fault message is not shown.
- If the RCP-2001 has parallel I/O installed, the PARALLEL IO tab in MAXCON will not work properly, and may crash MAXCON.

An optional **Antenna/Dummy Load switch** may be added. The Antenna/Dummy Load switch option requires that the Redundancy Controller board be installed.

1.8 RoHs/WEEE Compliance



Waste electrical products should not be disposed of as unsorted municipal waste. Please recycle where facilities exist. Check with your local authority or Communications & Power Industries LLC for recycling or disposal advice.

Section 2 Installation

2.1 General Introduction

To install the Ku-Band Antenna-Mount SSPA, use the information contained in this section.

- Inspect the equipment before installation. See **Inspection**, Section 2.2.
- To install the equipment outdoors, see **Mechanical Installation,** Section 2.3.
- Before applying power, see **Power Requirements**, Section 2.4.
- To connect to the equipment, see **Electrical Interface,** Section 2.5.

2.2 Inspection

Inspect the shipping container for damage. If it or its cushioning material is damaged, keep it until the contents of the shipment have been checked for completeness and the unit has been checked electrically and mechanically.

Check that all items in the list of Equipment and Accessories, Table 1-1, were received with the shipment. Also check the packing list in the shipping container for a list of additional items that may have been ordered.

If the SSPA has been damaged in shipment, file a claim with the carrier. Keep all packaging materials for the carrier's inspection. If the contents are incomplete or there is evidence of improper packaging, notify CPI immediately.

2.3 Mechanical Installation

Install the outdoor enclosure in a convenient spot on the antenna oriented in such a way that the air intake and exhaust ports are on the bottom. Refer to Figure 2-1 for mounting details.

NOTE	If you are installing a 1:1 system, see also Section 2.6 for further setup instructions.

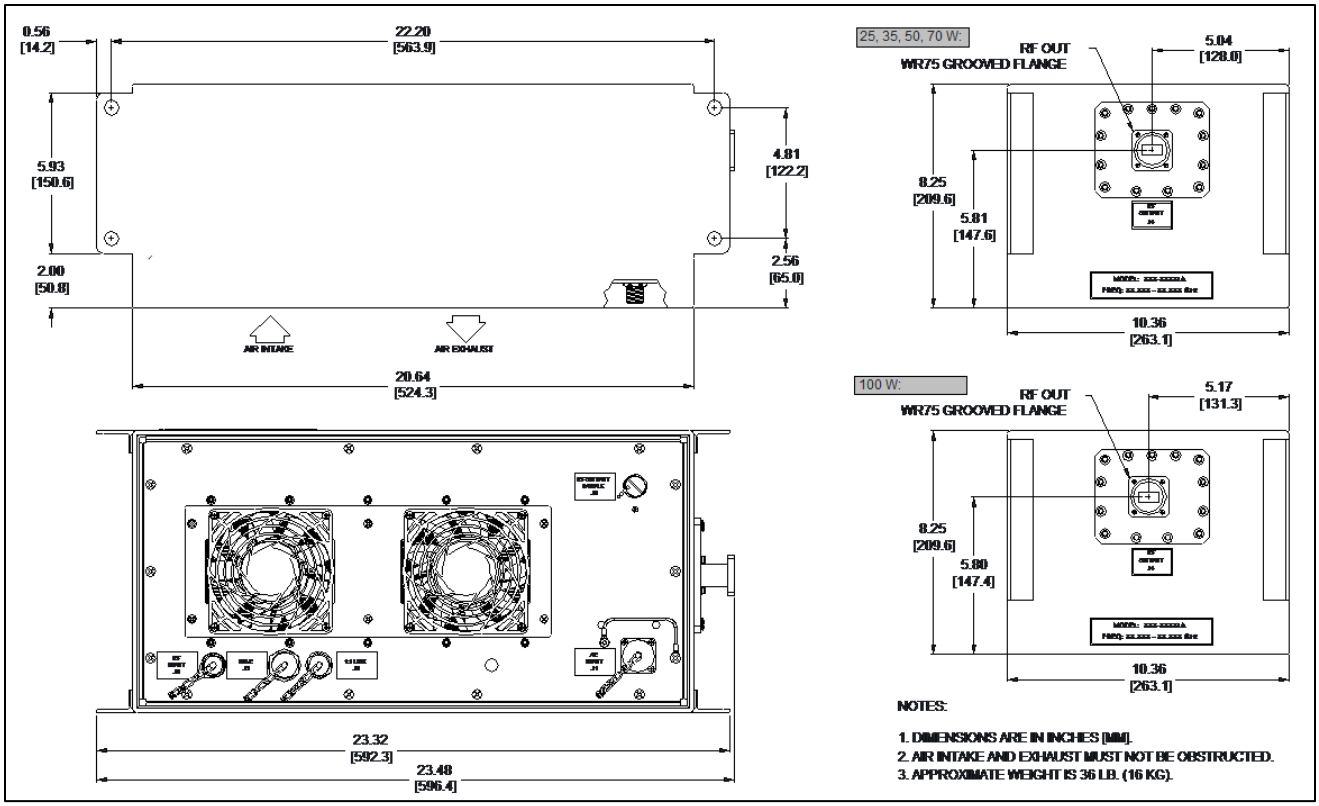


Figure 2-1 Ku-Band Antenna-Mount SSPA Outline

CAUTION	Heat is the enemy of any power amplifier. The Ku-Band Antenna-Mount SSPA has a forced air cooling system designed to minimize heat buildup inside the enclosure. This system relies on an ample supply of cooling air. Locate the unit so that the fan intake and outlet on the bottom panel are unobstructed. Keep the vents clean at all times.

The outdoor enclosure is weatherproof and may be exposed to direct rain and snowfall, as long as the air intake and exhausts remain clear and unobstructed.

2.4 Power Requirements

The standard Ku-Band Antenna-Mount SSPA has worldwide AC input capability. 48 Vdc input is available as an option.

2.4.1 AC Power (Standard)

The standard Ku-Band Antenna-Mount SSPA can operate from a power source of 100-242 Vac, 47 to 63 Hz, single phase. The input voltage range is autoselected.

Line input is through a 3-pin circular connector, J1. The mating connector for J1 is supplied with the unit. Connect ac power in accordance with Table 2-1.

Table 2-1 AC Input Connections

J1 Pin #	Function
A	Line 1
B	Line 2/Neutral
C	Ground/Frame ground

The end user is responsible for providing an approved 15/20 A fuse or circuit breaker as branch circuit protection.

2.4.2 DC Power (Option)

If the Ku-Band Antenna-Mount SSPA was ordered with the optional 48 Vdc input, it can operate from a power source of 36 to 72 Vdc.

DC input is through a 3-pin circular connector, J1. The mating connector for J1 is an MS3106F16-10S and is supplied with the unit. Connect dc power in accordance with Table 2-2. If desired, either the 48V + or 48V – pins can be connected to frame ground at either end of the power cable.

Table 2-2 DC Input Connections

J1 Pin #	Function
A	48V +
B	48V –
C	Ground/Frame ground

2.5 Electrical Interface

Interfaces to the Ku-Band Antenna-Mount SSPA consist of RF In, RF Out, Serial I/O Monitor & Control (M&C), and an optional output SAMPLE port. See Figure 2-1 for the location of these I/O connections.

2.5.1 RF Input – J2

RF input is through a Type N Female connector, 50-ohm impedance. Input level is -29 dBm nominal.

If your unit has the optional integrated L-band Block Upconverter (BUC) installed, it is a Solid-State Converter Amplifier (SSCA) and J2 is the IF Input. SSCAs require a 10 MHz externally supplied reference. Table 2-3 below describes the requirements of the external reference. Figure 2-2 shows how the reference is typically applied.

Table 2-3 10 MHz Reference Requirements

For proper operation, the SSCA requires an externally applied reference with the following characteristics:

Reference Frequency	10.00 MHz
Reference Input Level	-5 to +10 dBm (+3 dBm nominal)
Reference Input Impedance	50 ohms
Reference Phase Noise (maximum), at Offset Freq. (f_m):	
10 Hz	-105 dBc/Hz
100 Hz	-135 dBc/Hz
1 kHz	-145 dBc/Hz
10 kHz	-150 dBc/Hz
Reference Spurious Signals (maximum), at Offset Freq. (f_m):	
≤10 kHz	-120 dBm
100 kHz	-100 dBm
1 MHz	-75 dBm
4 MHz	-10 dBm

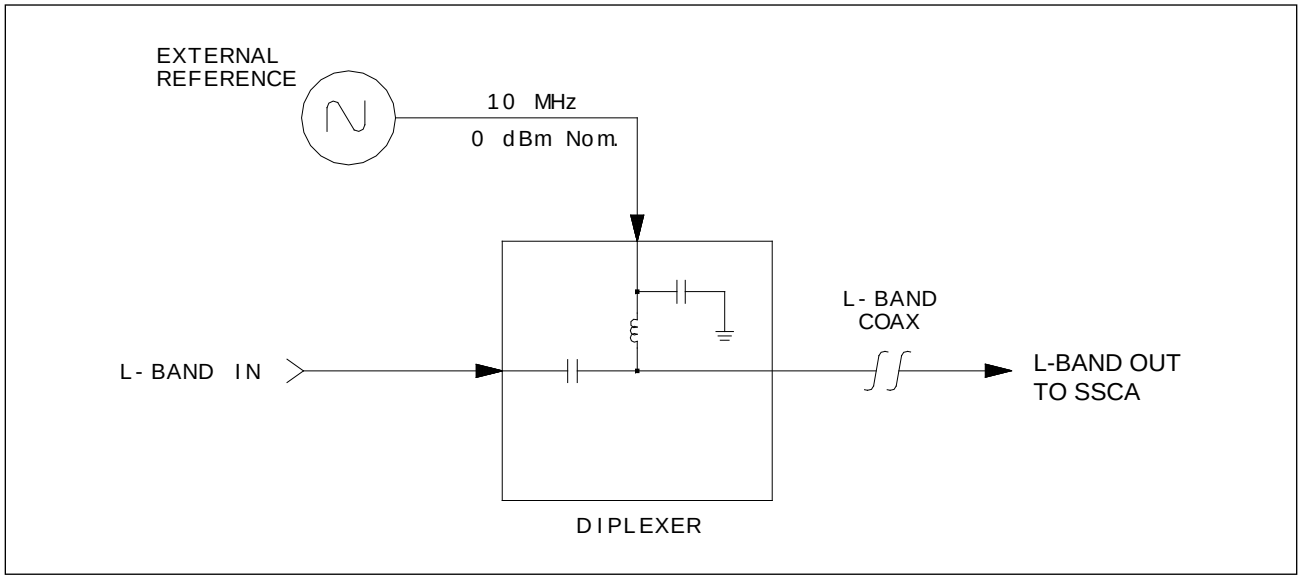


Figure 2-2 Applying the External 10 MHz Reference

CAUTION	Never exceed the maximum safe RF/IF input level, or permanent damage to the SSPA may result. The maximum safe level is printed on the unit next to the RF/IF Input connector.

2.5.2 Serial I/O or Optional Remote Control Panel Interface – J3

The serial I/O interface, J3, is primarily used for remote monitoring and control of the SSPA by a user-supplied M&C system. This interface also includes one Form C status output.

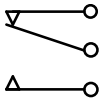
NOTE	SSPA connector J3 is used as the communication interface to the optional Remote Control Panel, if one is used. **When J3 is used as the Remote Control Panel interface, user M&C serial I/O is made available via a 9-pin D connector on the rear panel of the Remote Control Panel.** See the RCP-2001 Operation and Maintenance Manual for information. The remainder of this section applies to use of J3 for user M&C, without the Remote Control Panel.

J3 supports RS-232, RS-422, or RS-485 (2-wire and 4-wire) connections. The user must select one of these interfaces in the amplifier setup program. Refer to Appendix A, Amplifier Setup Program, for more information.

The pinout for the interfaces is shown in Table 2-4. J3 is a 10-pin MS connector; a mating 10-pin MS connector is supplied.

Selection of an interface is done using both the connector wiring *and* the selection in the setup program. The various interface selections share some lines, so it is important to make sure the appropriate interface is selected on the equipment. Any pins not used in the desired interface should be left unconnected. Only one of these interfaces may be used at a time.

Table 2-4 **J3, Serial I/O Connector**

Pin	Function	Notes
RS-232 (EIA/TIA-574) - Full duplex, one unit on a bus. (See Section 2.5.2.1.)		
E C B	Signal Ground Data In Data Out	Connect to DTE signal SG. Connect to DTE signal TD. Connect to DTE signal RD.
RS-485 (4-wire) - Full duplex, multiple units. (See Section 2.5.2.2.)		
D C A B E J	+ Data In – Data In + Data Out – Data Out Ground Termination	 High impedance when not transmitting Connect to pin D to terminate receiver. Terminate units on ends of bus.
RS-485 (2-wire) - Half duplex, bidirectional bus, multiple units. (See Section 2.5.2.3.)		
D & A C & B E J	+ Data I/O - Data I/O Ground Termination	Connect D and A together. Connect C and B together. Connect to pin D to terminate RS-485 bus. Terminate units on ends of bus.
RS-422 - Full duplex, one unit on a bus. (See Section 2.5.2.4.)		
D C A B E J	+ Data In – Data In + Data Out – Data Out Ground Termination	 Transmit driver on continuously. Connect to pin D to terminate receiver. Terminate units on ends of bus.
Programmable Relay (“Service Request” Function; see Section 2.5.2.5)		
F G H	CLOSED Svc Req Common OPEN Svc Req	 Form ‘C’ contacts, rated for 100 Vdc, 0.5 A, 3 W max. (resistive load). Relay shown in relaxed (Svc Req/Fault) state.

No hardware handshaking signals are needed for serial I/O. Units only transmit if they are first polled with an appropriate message. All data is transmitted and received with 8 data bits, 1 stop bit, 1 start bit, no parity, and

no software handshaking. The baud rate can be set for 300, 1200, 2400, 4800, 9600, 14400, 19200, or 28800 baud, using the setup program.

Since the units do not transmit until polled, you must interrogate the units to determine if there are any faults. Or, you may use the provided summary alarm contacts to alert your system, then poll for status. The alarm can be configured as either “Service Request” or “Latched Fault” through the setup program. In either case, the summary alarm will activate when a fault occurs. The Service Request can be cleared by serial I/O; a Fault has to be cleared by removing the condition that caused the fault.

For RS-422 and –485 interfaces, an AC termination is used in the SSPA that reduces the amount of current drawn when nothing is being transmitted or received.

NOTE In order to maintain CE compliance, shielded cables must be used on all data lines. For MS type connectors, a mate with a backshell is supplied. A lead from the cable shield must be connected to one of the screws on the backshell.

2.5.2.1 RS-232

The RS-232 electrical specification allows for a full-duplex communications path over up to 50 feet (15 m) of cable. One line is used for transmit data, the other for receive. The distance can normally be extended by using lower baud rates, or low capacitance cable. Only one driver is allowed on either the transmit data line or the receive data line, so communication is possible between only two devices (i.e., the host computer and the SSPA) on an RS-232 bus.

Only three lines are used for RS-232: Signal Ground, Receive Data (Data In) and Transmit Data (Data Out). No hardware handshaking lines are used.

2.5.2.2 RS-485 (4-wire)

The RS-485 specification allows for full duplex communication over two differential pairs of wires (one pair for transmit data, the other for receive), or for half duplex communication over a single pair of wires. The full duplex mode of operation is referred to as “RS-485 4-wire.” In RS-485, the transmit drivers may be switched on and off, allowing more than one driver on a bus. See Figure 2-3.

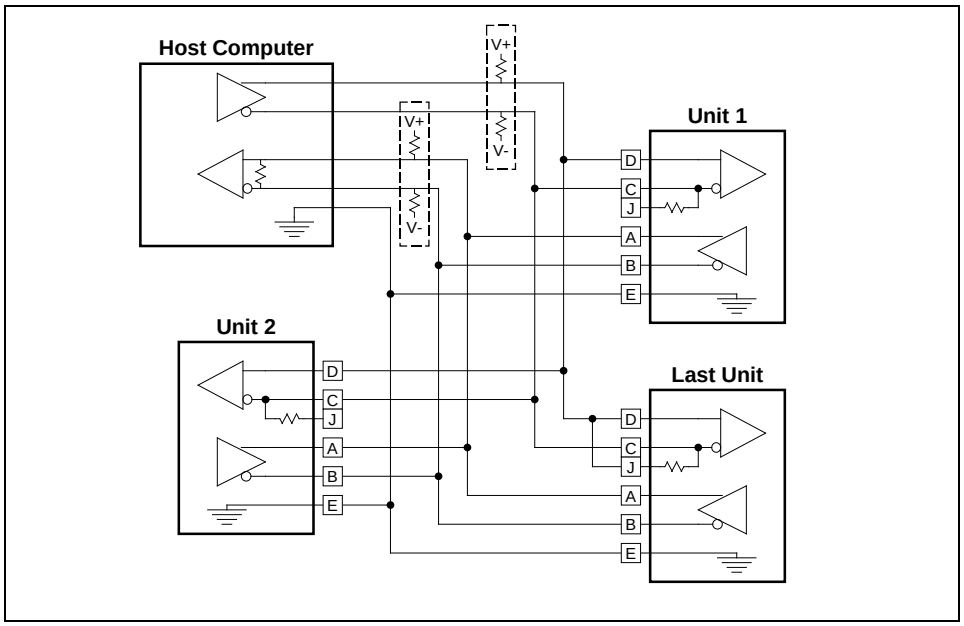


Figure 2-3 A Typical RS-485 4-Wire Bus

Cable lengths up to 4000 feet are allowed using an RS-485 interface.

There is a common mode voltage specification for RS-485, so it is normally necessary to run a common ground line to all devices on the bus.

2.5.2.2.1 Terminations

In Figure 2-3, note the terminations on the receivers for the Host Computer (First Unit) and the Last Unit on the bus. No other unit (in this example, Unit 1 or Unit 2) should be terminated.

This equipment uses an AC style termination, consisting of a 120-ohm resistor, and a 0.01 µF capacitor in series. The termination is enabled by connecting the TERMINATION pin (pin J) to the "+ Data I/O" input (pin D).

For short cable runs, terminations may not be necessary.

2.5.2.2.2 Fail-safe Biasing

Since the RS-485 transmitter is turned off when no data is being sent (to support multiple units on the bus), the bus is left floating (i.e., un-driven, in a high impedance state) between messages. During these times, the line is particularly sensitive to electromagnetic interference and may register as either a "1" or a "0". In other words, receiving UARTs on the line may see either random data or errors between legitimate messages. This can cause problems with certain equipment or software, so fail-safe biasing may be necessary.

A fail-safe biasing network is basically just a pull-up resistor on the "+" line and a pull-down resistor on the "–" line. This forces the bus into a "1" (or "MARK") state when nothing else is driving it. Typical fail-safe biasing circuits are shown in Figure 2-3, enclosed in dashed lines.

A voltage source (power supply) is needed to provide the pull-up voltage for the "+" line. As a general rule, the supply should be a dc supply of 5 to 12 volts, and the value of each resistor (in ohms) should be approximately

$$R = 2.5 \times V_S \times R_Z$$

where

R = The resistance of the pull-up and pull-down resistors

V_S = The voltage of the power supply

R_Z = The resistance of the terminations (60 ohms for 2-wire, 120 ohms for 4-wire)

In an RS-485 (4-wire) system, it is usually not necessary for the transmit driver in the host computer to switch on and off, since it is the only driver on that pair of wires. In this case, no fail-safe biasing is necessary on the transmit output from the host computer.

This equipment has an internal biasing network on its receiver inputs that guarantees a “MARK” state when the input is not connected.

2.5.2.3 RS-485 (2-wire)

With an RS-485 interface, you can connect the transmit and receive pairs together, and communicate in half duplex over only one pair of wires. This mode of operation is called RS-485 (2-wire). To use RS-485 (2-wire) with this connector pinout, connect pins A and D together to form the positive (+) side of the bus, and pins B and C together to form the negative (–) side. See Figure 2-4.

Cable lengths up to 4000 feet are allowed using an RS-485 interface.

There is a common mode voltage specification for RS-485, so it is normally necessary to run a common ground line to all devices on the bus.

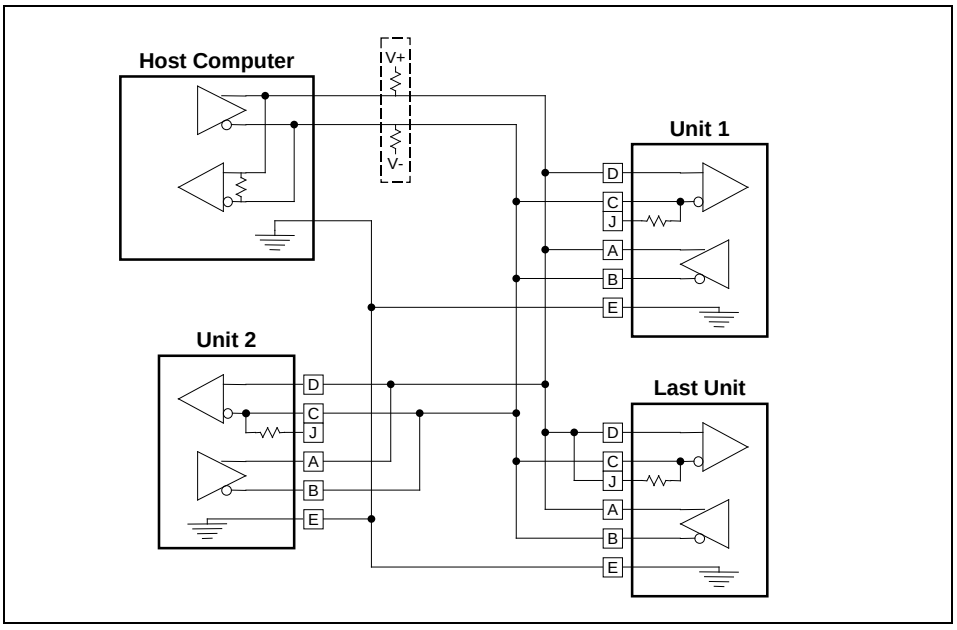


Figure 2-4 A Typical RS-485 2-Wire Bus

The host computer must switch its driver on to talk, and off to listen for a response. The timing for turning the transmitter off depends on the protocol that is being used. The transmitter must be turned off by the earliest time that the unit may generate a response.

2.5.2.3.1 Terminations

In Figure 2-4, note the terminations on the receivers for the Host Computer (First Unit) and the Last Unit on the bus. No other unit (in this example, Unit 1 or Unit 2) should be terminated.

This equipment uses an AC style termination, consisting of a 120-ohm resistor, and a 0.01 µF capacitor in series. The termination is enabled by connecting the TERMINATION pin (pin J) to the "+ Data I/O" input (pin D).

For short cable runs, terminations may not be necessary.

2.5.2.3.2 Fail-safe Biasing

Since nothing is driving the bus between messages, the bus is left floating in an un-driven, high impedance state, and may register as either a "1" or a "0" to any unit on the bus. This ambiguity may cause problems with equipment or software, so fail-safe biasing may be necessary.

A fail-safe biasing network is basically just a pull-up resistor on the "+" line and a pull-down resistor on the "–" line. This forces the bus into a "1" (or "MARK") state when nothing else is driving it. Typical fail-safe biasing circuits are shown in Figure 2-4, enclosed in dashed lines.

A voltage source (power supply) is needed to provide the pull-up voltage for the "+" line. As a general rule, the supply should be a dc supply of 5 to 12 volts, and the value of each resistor (in ohms) should be approximately

$$R = 2.5 \times V_S \times R_Z$$

where

- R = The resistance of the pull-up and pull-down resistors
- V_S = The voltage of the power supply
- R_Z = The resistance of the terminations (60 ohms for 2-wire, 120 ohms for 4-wire)

This equipment has an internal biasing network on its receiver inputs that guarantees a "MARK" state when the input is not connected.

2.5.2.4 RS-422

The RS-422 specification is similar to RS-485 (4-wire) in that it allows for full duplex communications over two differential pairs of wires: one pair for transmit data, the other for receive. See Figure 2-5. Unlike RS-485, however, RS-422 drivers are on all the time, so only one of them is allowed on either pair of lines. This avoids the problems of fail-safe biasing involved with RS-485, but limits communication to only one device and the host computer.

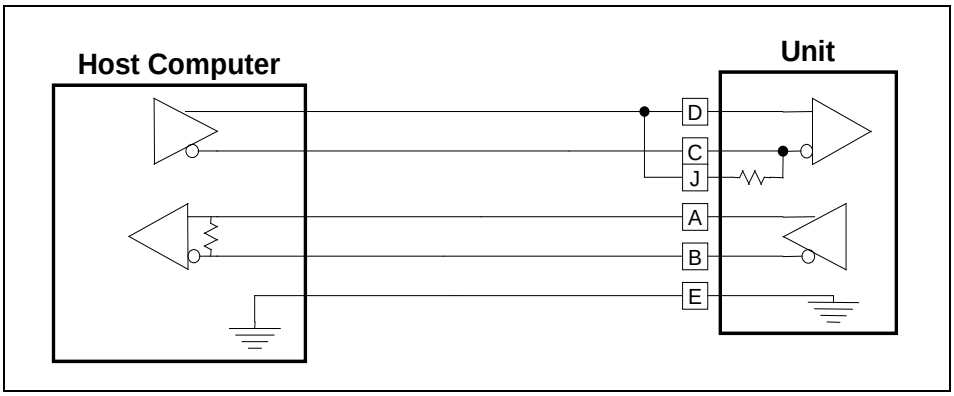


Figure 2-5 A Typical RS-422 Bus

Cables may be up to 4000 feet in length using an RS-422 interface.

There is a common mode voltage specification for RS-422, so it is normally necessary to run a common ground line to both devices on the bus.

2.5.2.4.1 Terminations

In Figure 2-5, note the terminations on the receivers for the Host Computer and the Unit on the bus.

This equipment uses an AC style termination, consisting of a 120-ohm resistor and a 0.01 µF capacitor in series. The termination is enabled by connecting the TERMINATION pin (pin J) to the "RX+" input (pin D).

For short cable runs, terminations may not be necessary.

2.5.2.5 Service Request Function

The Serial I/O interface includes a programmable relay output that can be utilized as a "Service Request" interrupt to alert the host status monitoring system. The service request is a Form 'C' relay contact that indicates whether a fault, or any other condition needing attention, has occurred on the unit. The status monitoring system can poll the unit to determine what the condition is and can reset the Service Request relay contact until another condition occurs. The pinout for the Serial I/O Port relay is identified in Table 2-4.

The Service Request is indicated as soon as a fault occurs, and clears either when acknowledged by serial I/O message, or when all faults are successfully reset.

The function of the programmable relay may be selected using the AMSETUP program (see Appendix A), or from the setup menus of an optional RCP-2001 Remote Control Panel (see Section 3.4.1.4).

2.5.3 RF Output – J4

RF output is through a WR75G waveguide flange. Use a gasket on the waveguide flange for a weatherproof, pressure tight seal.

WARNING	**A radiation hazard may exist if the SSPA is operated unterminated. Do not operate the SSPA without a suitable load or termination attached to the RF output.**

2.5.4 Output Sample Port – J5

A Type N RF output sample port, J5, provides a nominal -40 dBc sample of the RF output signal, and is isolated to reduce load mismatch effects. It is fitted with a weatherproof dust cap.

2.5.5 1:1 Link – J6 (Optional)

This option adds built-in 1:1 redundancy switchover logic to the SSPA, and is not installed in all units.

To install a unit with the 1:1 option, connect the supplied 1:1 link cable from each SSPA to the switch assembly. The switch assembly contains all the necessary hardware and switches for a 1:1 redundant system.

2.5.6 Reference Input – J7 (Optional)

On units that include the optional external reference input, connect a 10 MHz reference signal, -5 to +5 dBm, to the Reference Input, J7.

NOTE	If no reference signal is present, the SSCA will be muted.

2.6 1:1 System Installation Notes

NOTE	When connecting the amplifiers in the 1:1 system, it is important that the end of the 1:1 bus cable that is labeled “1” be connected to the amplifier whose waveguide connects to port 1 of the switch. This amplifier is designated UNIT 1; the other is UNIT 2.

1. Power the amplifiers on a bench, and connect them to a computer using the included serial port cable. Run AMSETUP, and adjust the gains of the amplifiers to match. You must also tweak the gains so the output power readings match, after they are installed in the system.
2. Set the 1:1 Redundancy Mode. You have 3 choices:

   MANUAL mode
   The system will NOT automatically switch when a fault is detected on an amplifier. You must control the switch via serial control, or from an RCP-2001.

   AUTO mode
   The system WILL automatically switch when a fault (or other condition) is detected on the on-line amplifier. MANUAL switch commands are accepted only so long as you don't command a switch from a "good" amplifier to a faulted one.

   SPARE mode
   The amplifier will automatically switch to either AUTO or MANUAL when it is installed in a system, based on the setting of the other amplifier in that system. If BOTH are set to spare, they will assume AUTO mode.
3. After the amplifiers are installed in a system, you must adjust the gains and detector offsets so that the output power readings are the same. You can use AMSETUP or MAXCON, along with an external power meter to accomplish this.

a) Temporarily place the amplifiers in MANUAL mode, to avoid accidental switches while you adjust the gain.
b) Connect a power meter to the output of the entire system.
c) Switch the switch between Unit 1 and Unit 2, and note the power meter reading in each position.
d) Adjust the gain of the unit with the higher power reading downward by the difference between the two units.
e) Switch between Units 1 and 2 again, to check that the two units now read the same on the power meter.
f) Now, view the output power reading reported by the two units on MAXCON. Ideally, they should both read approximately 0.5 dB higher than the power meter.
g) Use the detector offset (MAXCON Calibration Tab) to adjust the amplifier's own power readings to be about 0.5 dB higher than the power meter.
h) After the two amplifiers are adjusted to match, return the system to AUTO mode.

If the procedure is correctly followed, the amplifiers should automatically switch if the output power of the on-line amplifier drops 4 dB below that of the off-line amplifier.

Startup Link Failures (Units Switching Back And Forth)

If, upon powering up your system, the two amplifiers begin switching the 1:1 switch back and forth every 5 seconds, it is probably because of one of the following conditions:

- *Both amplifiers have the same serial number.*
  The serial number is programmed at the factory, so this problem should not occur.
- *Amplifiers with two different rated powers have been installed in the system.*
  Check the output power rating (model numbers) of both amplifiers. If they are not the same, this is the reason for the problem.
- *Unit 1 cannot be identified.*
  This could be a problem in the 1:1 bus cable. Disconnect all ends of the 1:1 bus cable, and, on the UNIT 1 end, check between pins A and D with an ohmmeter. You should read approximately 6.2K between these two pins. On the UNIT 2 end, there should be infinite resistance between the same two pins.

If you cannot determine the cause, please contact the factory.

Section 3 Operation

3.1 General Introduction

This section describes RF operation and control of the Ku-Band Antenna-Mount SSPA. RF considerations including gain adjustment, output level, and distortion are outlined. The Ku-Band Antenna-Mount SSPA system can be controlled remotely through the serial I/O interface.

- For a discussion of RF operation considerations, see **RF Operation**, Section 3.2.
- To find out how to operate the amplifier, see **How to Operate**, Section 3.3.
- To control and monitor operation of the unit remotely using serial I/O, see **Using Serial I/O**, Section 3.4.
- For details on controls and settings that affect RF performance, see **Function Reference**, Section 3.6.
- To control and monitor operation of the unit remotely using optional Parallel I/O in an attached RCP-2001, see **Using Parallel I/O**, Section 3.5.

3.2 RF Operation

This section explains the relation between the RF operating parameters of gain, input and output level, and intermodulation distortion.

3.2.1 Adjusting Gain

The RF input level and SSPA gain together determine the output level. Since input level is often fixed in a particular installation, the Ku-Band Antenna-Mount SSPA includes a gain adjustment feature that can be used to set a desired output level. The gain adjustment is accessible over the serial I/O port, using the amplifier setup program; see Appendix A.

Gain is adjustable from 0 to -20.0 dB in 0.1 dB steps, and is relative to the maximum gain value. Gain in dB is computed by adding the (negative) gain reading to the unit's maximum gain from the test data sheet; for example, a unit with 75.0 dB maximum gain will have 65.0 dB gain when the gain adjust is set to -10.0 dB. At this setting, the unit would produce a +45.0 dBm output level if a -20.0 dBm signal is applied to the input.

3.2.2 Selecting Output Level

The Ku-Band Antenna-Mount SSPA can safely be operated up to and slightly above its rated output. Gain will start to compress as output level approaches rated power. The SSPA will saturate, or reach maximum output level, at 0.5 to 1.0 dB above its 1 dB compression point. If input level or gain is further increased once the SSPA saturates, the current drawn by one or more of the RF devices may change, generating current alarms. You may safely operate the SSPA in saturation; however, do not drive the input more than 3 dB beyond the level needed to produce 1 dB gain compression for an extended period.

CAUTION	Never exceed the maximum safe RF input level (+20 dBm), or permanent damage to the SSPA may result.

3.2.3 Intermodulation Distortion

For linear operation, minimization of intermodulation distortion (IMD) levels is an important consideration. Figure 3-1 shows IMD versus backoff from rated $P_{1\,dB}$ using two-tone CW, single-, and dual-QPSK signals.

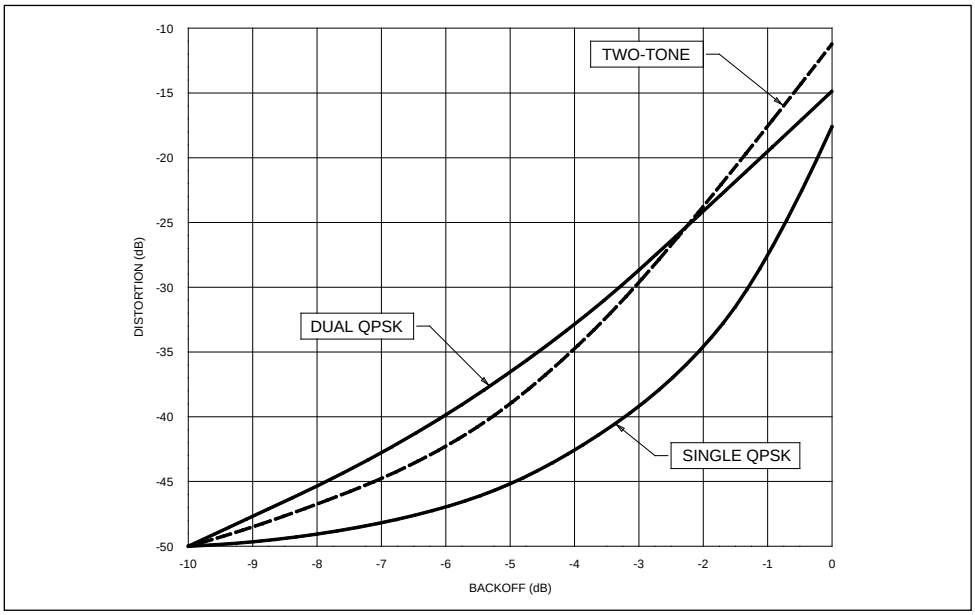


Figure 3-1 IMD vs. Backoff

In Figure 3-1, backoff is the reduction in total output power below the SSPA's 1 dB gain compression point. The plot is based on measured data from typical SSPAs, and can be used to determine required backoff from $P_{1\,dB}$ to achieve a given IMD suppression. After choosing an appropriate operating point from Figure 3-1, adjust input level and gain to set the output to the required backoff.

3.3 How to Operate

Before operating the Ku-Band Antenna-Mount SSPA, ensure that the installation procedures of Section 2 have been completed and that all interconnecting cabling is in place. Make sure that the RF output is connected to a suitable load.

Turn on power and adjust the input drive level for the desired power output. Nominal input level is -29 dBm at the maximum gain setting.

To monitor the output signal, use the optional sample port, J5. The signal at the sample port is a -40 dBc nominal sample of the output signal, obtained from a directional coupler at the amplifier output. The port includes a directional coupler and attenuators so that amplifier operation is not affected by any load attached to the port.

To protect against catastrophic failure, the amplifier shuts down if the heatsink temperature reaches 80 °C. Normal operation is restored automatically when the temperature drops below 80 °C. Overtemperature

faults usually are the result of inadequate cooling ventilation. Keep the heatsink fins of the amplifier assembly clear at all times.

3.3.1 "Local" Operation

NOTE	There are no local operator controls on the SSPA itself. When the optional Remote Control Panel is not installed, the SSPA can only be controlled and monitored "remotely" by a user-supplied M&C system; see Section 3.3.2 below.

You may add virtual local controls with an optional Remote Control Panel. Front panel controls of the Remote Control Panel are treated as if they are local controls for SSPA operation. Refer to the RCP-2001 manual supplement (in Section 8, System Configuration, if present) for more information.

Table 3-1 shows the entire menu structure available from the front panel of an attached RCP-2001. Some choices, marked with circled numbers, appear only under certain conditions as follows.

① The 1:1 redundancy status and menu choices appear only 1:1 redundancy has been enabled.

② The Unlock screen (Unlk) appears only if a screen password is enabled, or if a Local Lockout serial command is in effect.

③ The Ant/DL menu choice and related screens appear only if the Antenna/Dummy Load switch option is enabled.

④ The regulated voltage internal to the amplifier module is displayed only if the module is capable of making the measurement.

⑤ The BUC status screen appears only in amplifiers equipped with an optional Block Upconverter (BUC).

⑥ Parallel I/O related screens appear only if the RCP-2001 has the Parallel I/O option installed.

Selection of a particular menu is described in this manual in the form "... Menu | Submenu | … " (For example, "... select Set | Faults | Limits …." means select the Set menu, then the Faults menu, then the Limits menu.

Table 3-1 Menu Listing

Default Status Screen

Top Line (one of the following):
Highest priority Fault message (if any Fault is present; Section 3.6.4.1); or
Output Status (if RF is off; Section 3.6.2.1); or
Output Power (Section 3.6.2.2)

Bottom Line:
Control Mode and ① Redundancy Mode (if 1:1 support is enabled; Section 3.6.7)

Main Menu

② [Unlk] (Unlock; appears if screen password is enabled, or local lockout command is issued)
Enter Password (Section 3.6.6.6)

[Flt] (Fault status information)
Fault Menu
[List]
Fault List (Section 3.6.4.1)
[Reset]
Fault Reset (Section 3.6.4.2.3)

[Oper] (Operate)
Operate Menu
[Mute]
SSPA: (followed by mute status and source if muted)
[Mute] or [Operate] (choose one; Section 3.6.1.1)

[Gain]
Pout: (output power, in currently selected units, i.e., dBm, dBW or Watts)
Gain setting and gain range (gain is settable from –20 to 0 dB, in 0.1 dB steps; Section 3.6.1.4)

[Ctl] (Control)
Ctl Mode: (control mode)
[Remote] or [Local] or [Maint] (choose one; Section 3.6.6.1)

③ [AntDL] (Antenna/Dummy Load)
AntDL: (antenna/dummy load switch status)
[Antenna] or [DummyLd] (choose one; Section 3.6.1.5)

① [1:1] (1:1 Redundancy Menu; appears only if 1:1 support is enabled)
1:1 Menu
[Mode] (Redundancy Mode)
1:1 Mode: (redundancy mode, one of: Manual, Auto, or Spare)
[Manual] or [Auto] or [Spare] (choose one; Section 3.6.7.1.)

[OnLine] (1:1 Switch Control)
This (unit number): (on-line status; Section 3.6.7.2)
[OnLine] or [Standby] (choose one)

[Status] (1:1 Status Information)
I am unit (unit number)
Other: (other unit status; Section 3.6.7.3)

Table 3-1 **Menu Listing**

[Srvc] (Service)
Service Menu
[Pout]
Pout = (Output Power; Section 3.6.2.2)
[dBm] or [dBW] or [Watts] (power units, choose one; Section 3.6.2.3)

[Temp] (Temperature)
SSPA Module Temperature (Section 3.6.2.4)

[Volt] (Voltages)
Vin = (Input Voltage; Section 3.6.2.5)
Vg = (Gate Voltage); ④ Vr = (regulated voltage)
(Regulated voltage is displayed only if the module is capable of making that measurement)

[Curr] (Current)
Current:
Total = (Total Current; Section 3.6.2.6)

⑤[BUC] (Block Upconverter; appears only if optional BUC is installed)
BUC (Status; Section 3.6.2.7)

⑥[Inp] (Parallel I/O Inputs, appears only if optional Parallel I/O is installed)
Inp (R1-R8): Input Function
PIO Input Status (Section 3.5.2)

[Test] (Self Test)
Test Results (Section 3.6.5.1)

[Reset]
Press SELECT to Reset Microprocessor (Section 3.6.5.2)

[Ver] (Version)
ANTMNT v (Firmware Version; Section 3.6.5.3)
(C) 2000 VertexRSI

[Set] (Setup)
Setup Menu
[Faults]
Setup Faults
[PoutLim] (Output Power limits; Section 3.6.4.2.1)
Pout: (Output Power; Section 3.6.2.2)
(low Pout limit) to (high Pout limit)

[LocWarn] (Local Warning; Section 3.6.4.2.2)
LocWarn: (Local Mode Warning setting)
[Disable] or [Enable] (choose one)

[AudAlarm] (Audible Alarm; Section 3.6.4.2.6)
AudAlarm: (Audible Alarm setting)
[Off] or [Fault] or [All] or [Test] (choose one)

[PwrCal] (Output Power Calibration)
Pout = (Output Power; Section 3.6.2.2)
Offset = (Output Power Detector Offset, -6.0 - +6.0 dB; Section 3.6.3)

Table 3-1 Menu Listing

[Ser] (Serial I/O)
Setup Serial IO
[Intfc] (Interface)
SIO Intfc: (Serial I/O Interface type; Section 3.4.1.1)
[RS232] or [RS485:4] or [RS485:2] or [RS422] (choose one)

[Baud] (Baud Rate)
SIO Baud Rate: (baud rate, 300 to 28800; Section 3.4.1.2)
[300] [1200] [2400] [4800] [9600] [14400] [19200] [28800] (choose one)

[Adr] (Address)
SIO Address (Serial Address, 0-255; (Section 3.4.1.3)

[Alarm]
SIO Alarm: (Serial I/O Relay setting; Section 3.4.1.4)
[Svc Req] (Service Request) or [Flt] (Fault) (choose one)

⑤ [Par] (Parallel I/O, appears only if Parallel I/O is installed)
Setup Parallel IO
[Inp] (Inputs)
Inp (R1-R8): (Input function)
(input function selection list; Section 3.5.1 and Table 3-2)

[Outp] (Outputs)
Out (R1-R8): (Output function)
(output function selection list; Section 3.5.3 and Table 3-3)

[AnAdj] (Analog Adjust)
Adjust for 5 V on analog output (Section 3.5.5)

[R/L] (Remote/Local; Section 3.6.6.8)
Rem Disables Loc (Remote Disables Local Setting)
[No] or [Yes] (choose one)

[PwrUp] (Power-Up State; Section 3.6.1.3)
Power Up: (Power Up Setting)
[Mute] or [Oper] or [Prev] (choose one)

[Passw] (Passwords)
Passwords: (Password Enable Setting; Section 3.6.6.5)
[Disbl] or [Enbl] or [Set] (choose one)

[Set]
Set Password (Section 3.6.6.5)

(end)

3.3.2 "Remote" Operation

The SSPA can be controlled and monitored remotely using serial I/O connected directly to SSPA J3. See Section 2.5.2 and Table 2-4 in this manual for information on the serial I/O interface. Refer to Appendix B, Serial I/O Protocol, for information on the serial I/O message format and commands. See Section 3.4 below for information about using Serial I/O to control your amplifier.

When the optional RCP-2001 Remote Control Panel is installed, the SSPA can be controlled and monitored remotely using the serial I/O port on the RCP-2001. The user M&C system commands, messages and protocol are

the same, but the connector is physically different. Refer to the RCP-2001 manual supplement for information on using serial I/O with the Remote Control Panel.

The SSPA can also be controlled and monitored remotely using parallel I/O if that option is installed in the optional Remote Control Panel. See Section 3.5 for information on using the parallel I/O option.

3.4 Using Serial I/O

The amplifier is equipped with a serial port that allows remote monitoring and control of virtually all functions of the amplifier. All fault and warning information for the amplifier may be obtained by a remote M&C system using Serial I/O messages.

Refer to Appendix B, Serial I/O Protocol, for information on the serial I/O message format and commands. See Section 2.5.2 and Table 2-1 in this manual for information on the serial I/O interface.

Use of the serial port requires knowledge of electrical interface standards (RS-232, RS-422, or RS-485) and of how serial communication operates.

This equipment uses a polled binary protocol. You must either write or obtain software that will communicate with this equipment in order to make use of the serial features.

NOTE You cannot monitor or control this equipment with *HyperTerminal* or any other "terminal emulation" program.

3.4.1 Interface

The interface supports RS-232, RS-422, or RS-485 (4-wire or 2-wire) connections. Only one of these interfaces may be enabled at any time. Pin-outs for all three interfaces are shown in Table 2-4. Further details of these interfaces are given in Section 2.5.2. The various interface selections share some lines, so it is important to make sure the appropriate interface is selected on the equipment.

All data is transmitted and received with 8 data bits, 1 stop bit, 1 start bit, no parity, and no software handshaking.

The interface type (RS-232, RS-485 2-wire, or RS-485 4-wire), baud rate (300 to 28800), and unit address (0 to 255) are selected using the Serial I/O Setup menus accessed from an attached RCP-2001 Remote Control Panel as described in the following paragraphs, or by means of an Amplifier SETUP program provided by CPI.

The interface type, baud rate, and unit address selections cannot be set or changed by user Serial I/O commands.

3.4.1.1 Interface Selection (RCP-2001)

To set the serial port interface from the RCP-2001's front panel, select Set | Ser | Intfc. The top line of the screen will show you the current serial interface setting. The bottom line allows selection of the four interface types:

- RS-232 (See Section 2.5.2.1)
- RS-485 (4-wire) (See Section 2.5.2.2)
- RS-485 (2-wire) (See Section 2.5.2.3)

- RS-422 (See Section 2.5.2.4)

Pressing MODIFY ⌂ or ▽ will cycle through the four settings.

3.4.1.2 Baud Rate Selection (RCP-2001)

The serial baud rate can be selected from the front panel of an attached RCP-2001. It should be set to match the baud rate of your M&C computer.

To control the baud rate from the RCP-2001's front panel, select Set | Ser | Baud. The top line of the screen will show the current baud rate setting. The bottom line allows selection from the following commonly used baud rates:

- 300
- 1200
- 2400
- 4800
- 9600
- 14400
- 19200
- 28800

Pressing MODIFY ⌂ or ▽ will cycle through the settings.

3.4.1.3 Address Selection (RCP-2001)

In a serial bus structure where more than one unit can "hear" messages sent to other units, each unit must be assigned a unique, non-zero address. The Serial I/O protocol contains an address in the message header that determines which unit should obey the message. Address 0 is reserved for messages you wish to send to ALL units at once. However, address 0 is safe to use where there is only one unit on the bus.

To assign an address to the SSPA from the RCP-2001's front panel, select Set | Ser | Adr. Press MODIFY ⌂ or ▽ to change the address of the amplifier.

3.4.1.4 Serial I/O Relay Setting (RCP-2001)

The Serial I/O interface includes a programmable relay that can be utilized to alert the host status monitoring system of faults or warnings in the SSPA. The Form 'C' contact set can be programmed for one of the following functions:

- **Latched Fault –** If any fault has been detected by the amplifier since faults were last reset, the contact set will indicate a fault. Note that a latched fault can only be reset if the fault condition has been cleared and a Fault Reset serial I/O command (**0A**) is issued.
- **Service Request –** The contact set indicates a fault as soon as any condition is detected by the amplifier that requires attention, including any warning or fault. The contacts will be cleared when either all faults are successfully cleared by a Fault Reset command, or a Clear Service Request serial I/O command (**09**) is issued (and no faults or warnings are currently active).

To choose a setting from the RCP-2001's front panel, select Set | Ser | Alarm. The top line of the screen will show the current alarm setting. The bottom line allows selection of the setting.

NOTE	This output is available on J3 of the SSPA as well as J2 of the RCP-2001. It is possible with a user-supplied interface cable to break out the Service Request signals directly from the SSPA for local use while passing the serial I/O communication signals to the RCP-2001. However, this is not necessary, because the Service Request contact set on the RCP-2001 provides the same status information.

A third choice, **Active Fault,** is available only through the AMSETUP program. If set for Active Fault, the contact set indicates a fault only for as long as a fault condition is detected by the amplifier. When the condition clears, the contact set reverts to its non-fault state. This is the recommended setting if the amplifier is used in a 1:1 or 1:2 system with an external redundancy controller. The Active Fault setting is not supported by the contact set in the RCP-2001 and is thus not allowed when using an RCP-2001. The relay on the serial port of an attached RCP-2001 will always act as the Service Request function.

3.4.2 Accessing Fault Information Using Serial I/O

All fault and warning information for the amplifier may be obtained using Serial I/O messages.

A brief summary of faults and warnings is reported by the Get Faults message, **08**. This short message should be used when repeatedly polling for system faults.

When a fault is detected using the Get Faults message, detailed fault or warning information can be obtained using Serial I/O message **16 59**. That message returns a list of fault codes, which are described in Appendix B.

Refer to Appendix B, the Serial I/O Protocol document, for detailed information on messages, commands, controls, and replies.

3.5 Using Parallel I/O

Parallel I/O is available only as an optional accessory to an optional RCP-2001 Remote Control Panel. It consists of 8 inputs, 8 outputs, and an analog voltage output that is proportional to amplifier output power.

3.5.1 Input Functions

The operator may program the functions of the 8 inputs on the Parallel I/O module. These settings may be changed from the front panel, or via Serial I/O. Table 3-2 lists the functions available.

Table 3-2 Parallel I/O Input Functions

Screen Title	Serial I/O Code	Function	Active On	See Section
None	**30**	No function	H	3.5.2
Mute	**33**	Mute	⌐	3.6.1.1
Un-Mute	**34**	Un-mute	⌐	3.6.1.1
Mute/UnMut Tog	**35**	Mute/Un-mute toggle	⌐	3.6.1.1
Mute.L/UnMut.H	**46**	Mute Un-mute	⌐ ⌐	3.6.1.1
Fault.L	**44**	User Fault (active LOW)	L	—
Fault.H	**32**	User Fault (active HIGH)	H	—
RF Inhibit.L	**36**	RF Inhibit (active LOW)	L	3.6.1.2
RF Inhibit.H	**37**	RF Inhibit (active HIGH)	H	3.6.1.2
Fault Reset	**38**	Resets Faults	⌐	3.6.4.2.3

In Table 3-2, “Screen Title” shows how the function will be shown on the input function selection screen. The “Serial I/O Code” is the hexadecimal value of the byte that must be sent in the message to select a particular input function. “Function” is a description of the operation that the input will perform. “Active On” shows the edge (falling, ⌐ ; or rising, ⌐) or level (L, H) which will cause the function to be executed. “See Section” refers to the section of this manual where the input function is described.

NOTE In Local Mode or Maintenance Mode, Parallel I/O inputs that are programmed to generate a Fault still function normally.

To set the input functions from the front panel, select Set | Par | Inp. Press the ◁ or ▷ MENU buttons until the desired input is shown.

The top line shows the input number, and the current function setting for that input. The bottom line allows the function to be changed. Press MODIFY △ or ▽ to step through the list of available input functions, which are presented in alphabetical order. When the function you want is shown, press SEL ▽. Note that you MUST press SEL ▽ to change the input function to the one you want, otherwise it will be left unchanged.

Using Serial I/O, the input functions for Parallel I/O inputs can be read and controlled using message **17 56**.

3.5.2 Input Active State

The current state of all 8 Parallel I/O inputs can be determined at any time via the front panel, or by Serial I/O.

From the front panel, select Srvc | Inp. The top line shows the input number, and the function for which that input is programmed. The bottom line shows the current state of the input. This will be:

- **HIGH:** The input is high or open.
- **LOW:** The input is pulled to ground.
- **?INP:** There is a problem with the Parallel I/O board.

Use the ◁ or ▷ MENU buttons to scroll through the list of inputs.

Inputs that are not assigned any function may be *latched*. An input is considered *latched* if it has been high since the last time its state was checked via Serial I/O.

Inputs that are assigned any function are not latched.

Using Serial I/O, both the latched and active state of Parallel I/O inputs can be obtained using message **16 5C**.

3.5.3 Output Functions

The operator may control the functions of the 8 outputs on the Parallel I/O module. These settings may be changed from the front panel or by Serial I/O. Table 3-3 lists the functions available.

In Table 3-3, "Screen Title" shows how the selected function will appear on the output function selection screen. "Serial I/O Code" is the hexadecimal value of the byte that must be sent in the Serial I/O message to select the function. "Function" describes the overall meaning of the Parallel I/O output. "Contacts" shows the meaning of the two positions of the Form 'C' contact set; the relays are shown in their de-energized position. "See Section" refers to the section where the function is described.

To set the output functions from the front panel, select Set | Par | Outp. Press the ◁ or ▷ MENU buttons until the desired output number is shown.

The top line shows the output number, and the current function setting for that output. The bottom line allows the function to be changed. Press MODIFY △ or ▽ to step through the list of available output functions, which are presented in alphabetical order. When the function you want is shown, press SEL ▽. Note that you MUST press SEL ▽ to change the output function to the one you want, otherwise it will be left unchanged.

Using Serial I/O, the output functions for Parallel I/O outputs can be read and controlled using message **17 59**.

3.5.3.1 Output Power Fault

The Output Power Fault indicates that the measured output power of the SSPA is either too high (above the PoutHi limit) or too low (below the PoutLo limit).

Table 3-3 Parallel I/O Output Functions

Screen Title	Serial I/O Code	Function	Contacts	See Section
None	**30**	No function assigned (relay may be controlled via SIO)	N.C. N.O. 	3.5.4
Pout Fault	**31**	Output Power Fault (either high or low)	FAULT NO FAULT 	3.5.3.1

Table 3-3 **Parallel I/O Output Functions**

Screen Title	Serial I/O Code	Function	Contacts	See Section
Volt Fault	**38**	Voltage Fault	FAULT NO FAULT 	3.5.3.2
Curr Fault	**3C**	Current Fault	FAULT NO FAULT 	3.5.3.3
Temp Fault	**40**	Temperature Fault	FAULT NO FAULT 	3.5.3.4
BUC Fault	**43**	Block Upconverter	FAULT NO FAULT 	3.5.3.5
Any Fault	**35**	Any Fault	FAULT NO FAULT 	3.5.3.6
Any Warning	**36**	Any Warning	WARNING NO WARN 	3.5.6.7
Any Flt/Wrn	**44**	Any Fault or Warning	FAULT NO FAULT 	3.5.6.8
Remote/Local	**39**	Remote/Local Control Mode	LOCAL REMOTE 	3.6.6.1
Maint Mode	**3A**	Maintenance Mode	MAINT NORMAL 	3.6.6.1
RF Inhibit	**3D**	RF Inhibit	INHIBIT NOT INH 	3.6.1.2
RF On/Off	**3E**	RF On/Off	RF OFF RF ON 	3.6.6.1
Mute/Operate	**42**	Mute or Operate	MUTE OPERATE 	3.6.1.1

3.5.3.2 Voltage Fault

The Voltage Fault indicates that the power supply voltage internal to the SSPA is out of tolerance, either high or low.

3.5.3.3 Current Fault

The Current Fault indicates that the current drawn by the SSPA is out of tolerance, either too high or too low.

3.5.3.4 Temperature Fault

The Temperature Fault indicates that the measured internal temperature of the SSPA is above the factory-preset limit.

3.5.3.5 BUC Fault

The BUC Fault indicates that a problem has been detected in the Block Upconverter. If an output is set for this choice when no BUC is installed, the relay will be de-energized (Fault state).

3.5.3.6 Any Fault

"Any Fault" is the summary of all of the fault conditions, but does not include warnings. It illuminates the RCP-2001's red front panel indicator labeled "FAULT". It is also available as a Parallel I/O output.

3.5.3.7 Any Warning

"Any Warning" is the summary of all of the warning conditions. It illuminates the RCP-2001's amber front panel indicator labeled "WARNING". It is also available as a Parallel I/O output.

3.5.3.8 Any Fault or Warning

"Any Fault or Warning" is a summary of *all* fault and warning conditions. It is available only as a Parallel I/O output.

3.5.4 Unused Output Control

Parallel I/O outputs that are not assigned any function may be independently controlled remotely via Serial I/O. You may switch the contact to either its normally-open or its normally-closed position.

These controls only affect outputs that are not assigned to any function. These outputs will default to their normally-open state upon power-up if no control message is issued.

Unused output controls are not stored in non-volatile memory.

Using Serial I/O, the functions for unused Parallel I/O outputs can be read and controlled using message **18 53**.

3.5.5 Analog Output Adjustment

The Parallel I/O interface includes a voltage output that is proportional to the output power in dBm. This voltage is adjusted at the factory to be exactly 0.1 volts/dBm, so a +50 dBm output power would be represented by 5 volts.

This output might need to be adjusted if:

- It drifts with aging.

- A Parallel I/O module is replaced or installed in the field.

The gain of the differential amplifier on the board varies from part to part, so you will definitely need to adjust the analog output if you replace or install the module in the field. This adjustment is handled by the microprocessor, and is stored in non-volatile memory after it is complete.

This adjustment can only be carried out from the RCP-2001 front panel.

To adjust the analog output:

1. Connect a DVM across the analog output terminals on the Parallel I/O module. Position it where you can see it from the front panel.
2. On the front panel, select Set | Par | AnAdj. This will take you to the Analog Adjust screen for the SSPA Parallel I/O module. At this time, the analog output is controlled by this screen, and *does not* represent the output power.
3. Press MODIFY ⌂ or ▽ to raise or lower (as necessary) the voltage on the analog output, until the DVM reads 5.00 volts.
4. Press the PREV ⌂ button. You will exit the Analog Adjust screen and be back in the Setup Parallel IO menu. At this time, the analog output will again represent output power.

3.6 Function Reference

3.6.1 RF Path Functions

This section describes controls, measurements, and settings that affect the amplifier RF path.

3.6.1.1 Mute Control

There are several functions that can shut off the amplifier. One of these is the Mute Control. The Mute Control can be set to one of two states: Mute or Operate.

- **Mute:** When the Mute Control is set for Mute, the entire amplifier is shut down.
- **Operate:** When the Mute Control is set for Operate, the amplifier is turned on, unless it is supposed to be off for another reason.

The Mute Control can be operated via Serial I/O; or, if an optional RCP-2001 Remote Control Panel is attached, from the RCP-2001 front panel, or via Serial I/O, or via Parallel I/O (if that option is installed in the RCP-2001). Other conditions may automatically mute the amplifier. The following is a complete list of conditions that may mute the amplifier. The bold text shows how each condition will be indicated on the RCP-2001's display.

- **Muted:Local:** The amplifier has been muted from an attached RCP-2001 control panel, or upon power-up with Power Up State set to Mute or Prev (see Section 3.6.1.3).
- **Muted:SerIO:** The amplifier has been muted by a Serial I/O command.
- **Muted:ParIO:** The amplifier has been muted by a Parallel I/O input, or when RF Inhibit inputs are turned off in Maintenance mode (available only with RCP-2001 Parallel I/O option).

The Mute Control may be changed from any source. For example, it may be set to Mute by a Parallel I/O input, and then returned to Operate from the RCP-2001 front panel, or by Serial I/O command. The Mute Control may be set to Mute even if the output is already off due to another condition (such as RF Inhibit), in which case the amplifier will remain off even if the other condition goes away.

The Mute Control can be controlled from the RCP-2001's front panel RF ON or MUTE buttons. Pressing MUTE will set the control to Mute. Pressing RF ON will set the control to Operate. The current screen shown in the display window is not changed in response to presses of these buttons.

The Mute Control is also available by selecting Oper | Mute in the menu structure displayed on the RCP-2001. The top line shows the reason the amplifier is muted (from the above list). If the amplifier is not muted, the top line will show one of the following:

- **Operating:** The amplifier is on.
- **RF Inhibit:** The amplifier is off because one or more Parallel I/O RF Inhibit inputs is in its active state.
- **BUC UnlkInh:** (If BUC installed). The amplifier is off because the Block Up Converter has become unlocked.
- **ThermShtdwn:** The amplifier has been shut down because its temperature became hot enough to damage the GaAs FET devices.
- **Ext Inh:** An internal amplifier connection has been broken, which caused the amplifier to be shut off.
- **FastMute:** An internal amplifier signal has been shorted to ground, causing the amplifier to shut off.
- **GateVSht:** The amplifier has been shut down to protect the GaAs FET devices because the internal Gate Voltage generator has failed.
- **HiCurr Shtdn:** The amplifier has been shut down because it has been detected that the amplifier was drawing too much current.
- **Off:** The amplifier is off, but no reason can be detected.

The bottom line allows the Mute Control to be changed locally. Pressing MODIFY ⌂ or ▽ will toggle the Mute Control between Mute and Operate.

The MUTE indicator on the RCP-2001's front panel illuminates if the Mute Control has been set to Mute by any source.

The Mute Control may be changed by the Serial I/O **18 50** message.

Parallel I/O inputs (see Section 3.5.1 and Table 3-2) may also be configured to change the Mute Control. Any input may be programmed to:

- **Mute:** Change Mute Control to Mute on a falling edge.
- **Un-Mute:** Change Mute Control to Operate on a falling edge.
- **Mute/UnMut Tog:** Mute Control toggles on a falling edge.
- **Mute.L/UnMut.H:** Change Mute Control to Mute on a falling edge, and to Operate on a rising edge.

Note that all Parallel I/O input choices for the Mute Control are *edge sensitive*. Even if they are held in a certain state, they will *not* lock out other control sources.

Any Parallel I/O output may be configured to monitor the Mute Control (see Section 3.5.3 and Table 3-3). The Form 'C' output indicates Mute in its de-energized state and Operate in its energized state.

3.6.1.2 RF Inhibit (via RCP-2001, with Parallel I/O Option Only)

RF Inhibit is a Parallel I/O feature that allows implementation of interlock switches, or a level-sensitive RF on/off control. Any Parallel I/O input may be programmed for the RF Inhibit function. The active level may be set for HIGH or LOW.

WARNING

Since RF Inhibit inputs are located on the Parallel I/O board, this feature depends on a reliable communications link between the Parallel I/O board, Logic Board, and amplifier. **Use caution if using this function for safety related interlocks. It may not work if there is a failure in communications between Parallel I/O Board and Logic Board, or Logic Board and amplifier.**

If any RF Inhibit input is in its active state, the amplifier will be held off, regardless of any other controls. Setting the Control Mode for LOCAL or MAINTENANCE does not prevent RF Inhibit inputs from functioning. When all active RF Inhibit inputs are returned to their inactive state, the amplifier will be turned on unless another function (e.g., Mute Control or Maintenance Mode [see below]) dictates that it be left off.

If all active RF Inhibit inputs return to their inactive state while in Maintenance Mode, the output will not be turned on. Instead, the Mute Control will be set to MUTE, and can then be set to OPERATE from the local control panel (which will turn the amplifier on). This behavior is to guarantee the integrity of Maintenance Mode, in which nothing changes unless commanded by the local control panel of the amplifier (i.e., the RCP-2001).

Any Parallel I/O output may also be programmed to indicate when RF Inhibit is active (see Section 3.5.3 and Table 3-3). This Form 'C' output is de-energized to indicate Inhibit, and energized when the output is not inhibited.

3.6.1.3 Power-Up State

The amplifier system may be programmed to start up muted (Mute), not muted (Oper), or to remember the previous state in which it was powered down (Prev).

This setting might not be effective if it is overridden by another control (e.g., RF Inhibit).

The current Mute Control setting must be stored in EEPROM when the Power-Up State is set to Prev. Since EEPROM memory can wear out if it incurs too many write cycles, Prev is not recommended in systems where the amplifier will frequently be turned on and off using the Mute Control (e.g., where the amplifier is used to turn the carrier on and off).

With an attached RCP-2001, you may change this setting by selecting Set | PwrUp. The top line shows the current setting, and the bottom line allows the setting to be changed. Also, pressing MODIFY ⌂ or ▽ toggles through the three available settings.

Via Serial I/O, the Power-Up State setting is controlled using the **17 58** message.

3.6.1.4 Gain Adjustment

The gain of the amplifier is controlled over a range of -20.0 to 0.0 dB, in 0.1 dB increments, relative to its nominal gain. A gain setting of 0.0 dB represents maximum gain of the amplifier.

Via Serial I/O, gain can be controlled using the **18 52** message.

With an attached RCP-2001, the gain can be controlled most conveniently from the front panel using the GAIN ⌂ or ▽ buttons. Pressing either of these buttons once will take you immediately to the gain control screen. Further presses of these buttons will either increment or decrement the gain. If you press any other button, or wait about 5 seconds, you will be returned to the screen you were in before pressing the GAIN button.

The gain control screen is also accessible from the menus, by selecting Oper | Gain. When viewing this screen, pressing either the MODIFY ⌂ and ▽ *or* GAIN ⌂ and ▽ buttons will adjust the gain.

The gain screen (whether accessed from the menu, or by pressing one of the GAIN buttons) shows the amplifier's RF output power (Section 3.6.2.2) on the top line. If the amplifier is operating in saturation, decreasing the gain may appear to have no effect on the Output Power, until the amplifier is no longer saturated. If the gain setting is 0.0 dB, pressing the MODIFY ⌂ or GAIN ⌂ buttons will have no effect, since 0.0 dB is the maximum setting.

3.6.1.5 Antenna/Dummy Load Switch (Option)

An optional antenna/dummy load switch may be installed at the amplifier's RF output port to allow test or maintenance of the system while the amplifier is powered and generating RF output. This option requires that the redundancy controller board be installed.

From the Oper menu, select AntDL. The top line of the screen shows the current status of the switch, which may be one of the following:

- **Antenna** — RF output is directed to the antenna.
- **DummyLoad** — RF output is directed to the dummy load.
- **Switching** — The Ant/DL switch is changing positions.
- **SwPwrFail** — The power supply to the switch has failed.
- **Disc** — The switch has become disconnected.
- **?ADL** — A hardware error prevents reading the switch status.

To control the switch position, select either Antenna or DummyLd on the second line of the AntDL menu.

The Ant/DL switch can also be controlled via serial I/O message **19 54**. To request the switch status, use either message **08** or **20**. The AntDL Fail fault condition will be reported in message **16 59**.

At this time, the switch cannot be controlled via the RCP-2001's parallel I/O port.

3.6.2 Measurements

The following settings and controls affect measurements and status reports in the amplifier system.

3.6.2.1 RF Status

RF status refers to the RF output state of the amplifier:

- Whether the RF is ON (capable of emitting RF) or OFF (the amplifier is shut down).
- The reason that the RF is OFF.

There are many functions that can control the state of the amplifier. If one or more of these functions result in the amplifier being turned off, the RF Status will be OFF; otherwise, the RF Status will be ON.

If an RCP-2001 is attached, when the RF status is ON the display shows the following:

- **Operating:** The amplifier is ON.

When the RF status is OFF, it may be in one of these states:

- **RF Inhibit:** The amplifier is off because one or more Parallel I/O RF Inhibit inputs is in its active state.
- **BUC UnlkInh:** (If BUC installed). The amplifier is off because the Block Upconverter has become unlocked.
- **ThermShtdwn:** The amplifier has been shut down because its temperature became hot enough to damage the GaAs FET devices.
- **Ext Inh:** An internal amplifier connection has been broken, which caused the amplifier to be shut off.
- **FastMute:** An internal amplifier signal has been shorted to ground, causing the amplifier to shut off.
- **GateVSht:** The amplifier has been shut down to protect the GaAs FET devices because the internal Gate Voltage generator has failed.
- **HiCurr Shtdn:** The amplifier has been shut down because it was drawing too much current.
- **Muted:Local:** The amplifier has been muted from an attached RCP-2001 control panel, or upon power-up with Power Up State set to Mute or Prev (see Section 3.6.1.3).
- **Muted:SerIO:** The amplifier has been muted by a Serial I/O command.
- **Muted:ParIO:** The amplifier has been muted by a Parallel I/O input, or when RF Inhibit inputs are turned off in Maintenance mode (available only with RCP-2001 Parallel I/O option).
- **Off:** The amplifier is off, but no reason can be detected.

With an attached RCP-2001, you can quickly determine the state of the amplifier RF Output: simply glance at the RF ON indicator on the front panel. If it is lit, then the amplifier is ON. If it is unlit, then the amplifier is OFF.

In the RCP-2001's menus, the RF output status information is also available from two display screens.

- On the default screen, the top line shows the Output Power if there are no faults, and the amplifier is on. If the amplifier is off, the RF Output Status is shown as one of the above states.
- RF status is also indicated in the Mute Control screen under Oper | Mute (see Section 3.6.1.1).

RF Status can also be indicated by optional Parallel I/O outputs on an attached RCP-2001. Refer to Section 3.5.3.

3.6.2.2 Output Power

Output Power is a measurement of the power out of the amplifier. This measurement can be requested via Serial I/O in any of the following power units:

- dBm
- dBW
- Watts

With an attached RCP-2001, the measurement can be displayed on the front panel, and with optional Parallel I/O, is also available as a scaled voltage output on the Parallel I/O connector.

A fault may be programmed to occur if the output power exceeds or drops below a user programmable threshold.

The range of this measurement depends upon two factors:

- The nominal output power of the amplifier.
- The Output Power Calibration offset.

The top end of the measurement range is equal to the nominal output power of the amplifier system (in dBm) plus the calibration offset plus 2 dB. The bottom end is equal to the nominal output power of the amplifier system (in dBm) plus the calibration offset minus 30 dB. The total measurement range is 32 dB.

To view the output power reading from an RCP-2001, select Srvc | Pout. The top line of the screen will show the power reading in the currently selected measurement units. It may display one of the following:

- A decimal number for a normal in-range power reading.
- A decimal number preceded by a greater than (>) or less than (<) symbol for an out-of-range high or low reading, respectively.
- A question mark (?) for an error, such as a failure of the detector circuitry.
- A non-decimal number if the calibration data for the detector has been lost.

The bottom line allows the power units to be changed.

Output power is also reported in several other display screens. The default status screen shows the output power level if RF is ON and no faults are being reported. The Gain control screen (3.6.1.4), Output Power Limits screen (3.6.4.2.1) and Output Power Calibration Offset screen (3.6.3) also display the output power reading.

To request the output power reading via Serial I/O, send the **16 50** message with no parameters.

The output power reading is also presented on the RCP-2001's optional Parallel I/O in the form of a differential analog voltage. This voltage is scaled to be 0.1 volts for every 1 dBm of output power. Thus, an output power of +50 dBm would produce 5.0 volts on the analog output. Out-of-range LOW values are represented by a 0-volt output, and out-of-range HIGH values by a 6.8-volt output.

3.6.2.3 Power Level Units

All power measurements may be reported in units of dBm, dBW, or Watts. The Power Level Units setting applies to all Output Power measurements, whether viewed from the front panel of an attached RCP-2001 or returned via Serial I/O.

The power units may be set for:

- **dBm:** A decibel scale referenced to 1 milliwatt (mW) of power.
- **dBW:** A decibel scale referenced to 1 watt of power.
- **Watts:** The raw power measurement in watts.

To view or change the power units from an attached RCP-2001, select Srvc | Pout. The screen will show the amplifier output power on the top line, and allow you to select the units on the bottom line. Pressing MODIFY ⌂ or ⛉ will cycle between the three settings.

Via Serial I/O, power units can be controlled using message **18 54**.

3.6.2.4 Amplifier Temperature

The internal temperature of the amplifier module is measured, and is available for display on an attached RCP-2001 or by Serial I/O. This reading can range from –55 to +125 °C.

From the RCP-2001, select Srvc | Temp.

To request the temperature via Serial I/O, send the **16 51** message, either with no parameters or with **31** as the module number.

A Temperature Fault is reported if the internal temperature exceeds a factory-set threshold. The amplifier will be shut down (Thermal Shutdown) if the temperature exceeds a higher threshold. The shutdown threshold has hysteresis; that is, the amplifier will not resume operation until the temperature drops 5 ºC below the shutdown threshold (assuming no other condition prevents it from operating).

3.6.2.5 Amplifier Voltages

For most amplifier modules, two internal module voltage measurements are available:

- **Input Voltage:** The supply voltage entering the module. A fault will be reported if the Input Voltage supplied to the amplifier module moves out of a factory-set window.
- **Gate Voltage:** A negative voltage applied to the gate of each amplifier stage. If the Gate Voltage fails, the amplifier will be automatically shut down.

Later-design modules can display a third voltage measurement:

- **Regulated Voltage:** Regulated voltage distributed internally within the amplifier module. If the Regulated Voltage deviates from its nominal value by more than a factory-set difference, a Vreg Adj Fault occurs.

These voltage measurements can be displayed on an attached RCP-2001, and are available via Serial I/O.

From the RCP-2001, select Srvc | Volt. The screen will show the Gate Voltage (Vg), and Input Voltage (Vi) for the amplifier; later modules also display the regulated voltage (Vr).

To request the internal voltage measurements from the amplifier via Serial I/O, send the **16 60** message, either with no parameters or with **31** as the module number.

3.6.2.6 Amplifier Current

The current drawn by the amplifier is available for display on an attached RCP-2001 and by Serial I/O command.

From the RCP-2001, select Srvc | Curr. The display screen will show the total current drawn by the amplifier on the top line.

Via Serial I/O, the current can be returned using the Total Amplifier Current message, **16 58**.

If the current rises above a factory-set threshold, the amplifier will be shut down and a HiCur Shdn fault will be reported. When shut down for his reason, the amplifier will try to restart once every 10 seconds. If the current drops below a factory-set threshold, a Curr Lo fault will be reported.

3.6.2.7 BUC Status

If the amplifier is equipped with the factory-installed optional Block Upconverter (BUC), its status can be obtained from the front panel of an attached RCP-2001, via Serial I/O, or from an optional RCP-2001 Parallel I/O output.

To view the BUC status from an attached RCP-2001, select Srvc | BUC. The top line will display “BUC” and the bottom line will report the status, as one of the following:

- **OK, Locked** — BUC is connected, operating, and locked.
- **Disconnected** — BUC has been disconnected (failure).
- **Unlocked** — BUC has lost the 10 MHz reference, or is unlocked due to a failure.
- **ERR** — A hardware error prevents reading BUC status.

To request the BUC status via Serial I/O, send the Get Faults (**08**) message. A bit flag ($b_{AFLT\text{-}BUC\_FAIL}$) in the reply reports the BUC status.

BUC status can also be indicated by optional RCP-2001 Parallel I/O outputs. Refer to Section 3.5.3.

The BUC Status screen in the Service menu will not be available if a Block Upconverter is not installed.

3.6.3 Output Power Calibration Offset

Power readings within the amplifier use a detector that is calibrated with a single frequency, CW signal. The detectors are very accurate at the

calibration frequency, with a CW signal, but frequency, modulation, and signal bandwidth all affect the absolute accuracy of the power reading.

You can adjust the power readings to agree with a power meter using the calibration offset. You can also use the offset to compensate for losses due to couplers, waveguide, etc. in your system to get a better reading of the power level being delivered to the antenna. The offset has a range of -6.0 dB to +6.0 dB, and a resolution of 0.1 dB. The offset is always represented as a dB value.

The output power measurement range is related to the calibration offset by the following formulas:

Maximum output power measurement	=	Nominal amplifier power rating [in dBm]	+	Calibration offset	+	2 dB
Minimum output power measurement	=	Nominal amplifier power rating [in dBm]	+	Calibration offset	–	30 dB

Thus the calibration offset effectively shifts the range window up or down.

Fault limits are not changed when this offset is adjusted, but if the fault limit falls outside the detector range after this offset is changed, that limit will be disabled. If you are using the Output Power High or Low fault, you may wish to re-check your fault limits after adjusting this offset.

To calibrate the output power readings from an attached RCP-2001, select Set | PwrCal | Pout.

The top line of the display will show you the current power reading. Pressing MODIFY ⌂ or ▽ will change the offset shown on the bottom line, and you can watch the power reading change on the top line.

Via Serial I/O, output power offset can be controlled using message **17 5A**.

3.6.4 Faults and Warnings

The primary purpose of the amplifier's digital hardware is to detect and report problems as quickly as possible. There are several important terms relating to faults and warnings:

- **Faults** are problems detected within the amplifier that could potentially affect RF output. Faults can occur in the primary RF path and in digital circuitry monitoring the RF path. Failures of digital circuitry are reported as faults because they may hide problems in the RF path.
- **Warnings** are intended to indicate a condition exists that should be corrected to insure normal operation of the amplifier. Some warnings automatically clear when the condition causing them is resolved; some are latched like faults and will need to be cleared (Reset). Some warnings, such as Local Mode Warning, can be disabled.

While a condition exists that causes a fault, that fault is considered Active. When the condition that causes a fault goes away, that fault is no longer

active, *but it continues to be reported until faults are reset.* This is how faults are "latched." A fault that is Active is also considered to be "latched."

Warnings behave the same way; however some warning conditions (such as the Local Mode Warning), which are intended to remind the operator of something, will automatically stop being reported when the condition clears.

Some conditions (for example, a Spurious Reset), are based on an event, not a measurement. Faults or Warnings generated from such events are considered Active until a Fault Reset command is issued.

If any Faults are detected, the red FAULT lamp on an attached RCP-2001 will be lit. If any Warning conditions occur, the amber WARNING lamp will be lit. To see a list of Faults and Warnings that are currently detected on your amplifier, access the Fault List (Section 3.6.4.1).

3.6.4.1 Fault List

The Fault List reports all faults and warnings that have been detected by the amplifier logic. It is available from the front panel of an attached RCP-2001 by selecting Flt | List. If there are currently no faults or warnings, the bottom line will read “None”. Otherwise, the bottom line will show the fault list. If there is more than one fault, a right arrowhead (►) will appear on the right hand side of the display. Use the ◁ or ▷ MENU buttons to scroll through the faults. Each fault or warning in the list will be preceded by a check symbol (✓) if it is currently active.

Table 3-4 is a complete list of all fault conditions detected by the Antenna Mount SSPA firmware.

Fault and warning code details (SIO message **16 59** response bytes) are described in Appendix B, Serial I/O Protocol.

Table 3-4 Fault Conditions

SIO Code (16 59)	Screen Text (RCP-2001)	Description
10	Vinp Lo	Power supply voltage is low.
11	Vinp Hi	Power supply voltage is high.
13	Pout Hi	Output power is above high limit.
14	Pout Lo	Output power is below low limit
15	Ext Inh	An internal signal that inhibits RF output is shorted or disconnected.
17	TempShdn	Amplifier shutdown due to high temperature.
18	TempHi	Amplifier temperature is too high.
29	GateV Shdn	Amplifier shutdown due to failure of gate supply voltage.
2D	BUC Fail	The Block Up-Converter has failed, or has unlocked.
2E	Curr Tbl	Current measurement calibration table has been lost.
2F	Curr Sig	Current measurement signal has been lost (older amplifiers).
31	Det AD	Output power detector A/D converter has failed.
33	Det Cal	Output power detector calibration table has been lost.
34	Temp Err	Temperature sensor has failed.

Table 3-4 **Fault Conditions**

SIO Code (16 59)	Screen Text (RCP-2001)	Description
36	Gain Cal	Gain calibration table has been lost.
38	ROM	ROM checksum test has failed.
39	RAM	RAM test has failed.
3A	AD	General purpose A/D converter has failed.
3B	Inv Int	CPU interrupt hardware failure.
3C	StkOvFl	CPU program error (bug).
3D	IllglOp	CPU executed an illegal instruction.
40	Curr Lo	Amplifier's current is too low.
41	HiCur Shdn	Amplifier shutdown due to excessive current.
42	Local Warn	Warning that you have set Local mode (which prevents remote control).
43	Maint Warn	Warning that you have set Maintenance mode.
44	Manl Warn	Reserved (not used at this time)
45	InpR1	Parallel I/O input 1 fault.
46	InpR2	Parallel I/O input 2 fault.
47	InpR3	Parallel I/O input 3 fault.
48	InpR4	Parallel I/O input 4 fault.
49	InpR5	Parallel I/O input 5 fault.
4A	InpR6	Parallel I/O input 6 fault.
4B	InpR7	Parallel I/O input 7 fault.
4C	InpR8	Parallel I/O input 8 fault.
4D	Vreg Adj	Power supply voltage to RF section is out of range.
4E	RelPwr	This amplifier's output level is significantly lower than the other in a 1:1 system.
50	RefDet Wrn	Reflected Power Detector has failed (set for Warning).
51	PreflHiWrn	Reflected power is too high (set for Warning).
57	AntDL Fail	The Antenna-Dummy Load switch is disconnected or the power supply to the switch has failed.
77	SpurRst	CPU has been unexpectedly reset.
78	EE Data	Control settings have been lost.
79	EE Write	CPU detected an error writing settings to non-volatile memory.
7A	Test Firmw	The wrong firmware has been loaded into your amplifier.
7B	Fan1 Wrn	Fan 1 speed is too slow.
7C	Fan2 Wrn	Fan 2 speed is too slow.
7D	RefDet Flt	Reflected Power Detector has failed (set for Fault).
7E	PreflHiFlt	Reflected power is too high (set for Fault).

3.6.4.2 Fault Settings and Controls

The following settings and controls affect the reporting of faults in the amplifier system.

3.6.4.2.1 Output Power Limits

You may set both a HIGH and a LOW output power fault limit. Separate faults are reported for the output power being too high or too low, because each of these conditions implies a different kind of failure.

The high limit should be set slightly above the maximum power that you expect your system to put out. If this power level is exceeded, it may indicate that the amplifier is oscillating, or that a failure in the equipment supplying the signal to the amplifier has caused the input level to be too high.

The low limit should be set about 1 dB lower than the minimum output power you expect from the system. If you are switching your carrier on and off, or if your modulation scheme causes extreme dips in the measured signal level, you probably will not be able to use the low limit, so you should disable it. If set properly, this fault will be able to detect module failures that are not detected by the other measurements in the amplifier system.

The output power low limit is not checked (and no Pout Lo fault is reported) when RF is turned OFF by a mute or inhibit command. The firmware delays 1 second after RF has been restored before checking this limit.

To control the output power fault limits from an attached RCP-2001, select Set | Faults | PoutLim. The top line will show the current power units setting (i.e., dBm, dBW, or Watts).

Two numbers will be shown on the bottom line. These will be the LOW (left) and HIGH (right) limits for the output power, in the currently selected power units. A greater than (>) or less than (<) symbol indicates that the limit is disabled.

Use the ◁ or ▷ MENU buttons to select either limit, and the MODIFY ⌂ (increase) and ▽ (decrease) buttons to change them. Set the LOW limit for the minimum acceptable power level (a fault will occur only if the measured power is less than this number). Set the HIGH limit for the maximum acceptable power level (a fault will occur only if the measured power is greater than this number).

If you adjust the Output Power Calibration Offset, remember to re-check these fault limit settings. If a fault limit falls outside the measurement range after the offset is adjusted, that limit will be disabled.

You can read and control the Output Power Limit via Serial I/O, using message **17 51**.

3.6.4.2.2 Local Mode Warning Enable/Disable

Most systems will be run in Remote Mode, which allows Serial I/O control of the amplifier (and optional Parallel I/O control with an attached RCP-2001). Local Mode is available only with an optional RCP-2001 attached to the unit. The Local Mode Warning exists to remind the operator to return the amplifier to Remote Mode if they change it to Local while working on the amplifier.

If you have an RCP-2001 and do *not* wish to remotely control your amplifier, you may wish to leave it in Local Mode. In that case you probably would want

to disable this warning. To do so, select Set | Faults | LocWarn. The top line of the screen will show the current setting, Enabled or Disabled. Select the desired setting from the choices on the bottom line, or press MODIFY ⌂ or ▽ to change the setting.

This warning may be enabled or disabled using Serial I/O message **17 5F**.

3.6.4.2.3 Fault Reset

Faults and warnings that are latched (where the condition that caused them has cleared); faults and warnings that are based on discrete events; and faults that are caused by test failures will be reported until they are reset by the operator.

In order to stop reporting these latched faults and warnings, use the Fault Reset command. This command is available by Serial I/O, or from the front panel of an attached RCP-2001. If the RCP-2001 has an optional parallel I/O board installed, one of its inputs can be programmed to issue a Fault Reset command as well.

Faults or warnings based on conditions that are still active will not be cleared by this command.

If there are faults that are caused by internal test failures, those tests will be re-run when a Fault Reset command is issued. Some tests take significant processor time, so avoid repeatedly issuing a Fault Reset command if there is a fault condition that will not clear.

If no faults or warnings are reported after a Fault Reset command is executed (serial I/O or otherwise), the Service Request will also be cleared. See Section 3.6.4.2.4 for more information about the Service Request feature.

To reset faults from an attached RCP-2001, press the Fault Reset button. This function is also available from the menu (Flt | Reset).

Faults can also be reset using optional Parallel I/O if one of the inputs has been programmed as a Fault Reset input. Any high-to-low transition on such a line will issue a Fault Reset command.

To reset faults via Serial I/O, simply send the **0A** message with no parameters.

3.6.4.2.4 Service Request Feature

The Service Request is a programmable function available for the Form 'C' relay contact on the Serial I/O interface connector. Its purpose is to alert the monitoring system that the amplifier has detected a condition that needs attention. The monitoring system would send a Get Faults message, **08**, to find out what is wrong, and then acknowledge the service request by issuing a Clear Service Request command (see Section 3.6.4.2.5, below).

The Service Request contact will change to its fault state any time a new Fault or Warning is detected. It will remain in its fault state until one of the following occurs:

- A Fault Reset command (serial I/O or otherwise) is issued that causes all latched Faults and Warnings to stop being reported.
- A Serial I/O Clear Service Request command (Section 3.6.4.2.5) is issued.

3.6.4.2.5 Clear Service Request

When a Service Request occurs (see Section 3.6.4.2.4, above) the monitoring system can acknowledge it, and cause it to stop being reported by issuing the Serial I/O Clear Service Request message, **09**. To reset the Service Request contact, simply send the message with no parameters.

This command will be obeyed regardless of the setting of the Control Mode. The Service Request will be cleared even if there are still active faults. If any new faults are detected, the Service Request will occur again.

3.6.4.2.6 Audible Alarm

The RCP-2001 is equipped with an Audible Alarm. The alarm can be configured to sound if any Fault is detected in the amplifier, or if either a Fault or Warning is detected. The alarm may also be disabled entirely.

To stop the audible alarm from sounding, simply press any button on the RCP-2001's front panel. The alarm will also stop sounding if a Serial I/O command (or Parallel I/O command, if that option is included) results in all faults being reset.

The audible alarm can be configured to sound on Faults, Faults and Warnings, or not sound at all. This setting is only available through the RCP-2001's front panel.

To configure the audible alarm, select Set | Faults | AudAlarm. The top line will show the current state of this setting: Off, Fault, or All. Use the menu choices on the second line to alter this setting. Pressing MODIFY ⌂ or ▽ will also cycle the setting. The last menu choice allows the audible alarm to be tested (see below).

To test the audible alarm, select Set | Faults | AudAlarm. Press the right arrow to change to the last menu choice, Test, then press SEL ▽. The audible alarm will sound immediately. Once you are satisfied that it is working, press any button to stop it.

3.6.4.2.7 Relative Power Fault (1:1 Systems Only)

This is a new fault condition detected by the amplifier in a 1:1 system. If the output power of one unit is 4 dB or more below that of the other, then the unit with low output power will report a Relative Power Fault. If that is the on-line unit, and the 1:1 Mode is set for AUTO, a switch will occur to the unit with higher output power.

The relative power fault is reported in both the Get Faults (**08**) message and Get Fault Code (**16 59**) message.

3.6.5 Hardware and Firmware Functions

Several functions exist to test the amplifier, get information about the amplifier, or to install and remove optional hardware (such as Parallel I/O). You will probably not use these functions very often.

3.6.5.1 Self Test Command

A built-in self-test allows you to check operation of much of the digital hardware and microprocessor circuitry in the amplifier. Running the self test should not disturb the RF path of your amplifier.

To run the Self Test from an attached RCP-2001, select Srvc | Test. The screen will then read “Testing…” for several seconds and then display either “Test Passed!” or “Test Failed”.

If any test fails, a fault will be generated. You should go to the Faults List menu to determine what failed.

To run the Self Test via Serial I/O, simply send the **0B** message with no parameters.

If any test fails, a fault will be generated. About 5 seconds after sending this command, send a Get Faults (**08**) or Get Fault Code (**16 59**) message to see whether any test failed.

3.6.5.2 Microprocessor Reset Command

Issuing a microprocessor reset command will clear any faults being reported, clear all memory, and reload all settings and calibration information from non-volatile memory. It will not disturb the RF path of the amplifier.

Issuing this command will not result in a Spurious Reset fault.

Normally, it is not necessary to use the reset function. If you observe unusual behavior of the amplifier’s controls, you can try this to see if the problem goes away.

To reset the processor from an attached RCP-2001, select Srvc | Reset. The screen will read “Press SELECT to reset Processor”. Press SEL ▽, and the microprocessors will be reset. Press the PREV ⌂ button if you decide not to do so.

To reset the microprocessor via serial I/O, simply send the **04** message with no parameters.

3.6.5.3 Firmware Versions and Mask Number

If you call the factory for technical support, they may need to know both the firmware version and mask number to help you. The firmware version identifies what level of firmware is in your amplifier. The mask number identifies any special hardware support, or custom features that may have been installed in your amplifier.

To obtain the firmware version and mask information from an attached RCP-2001, select Srvc | Ver. The screen will show the firmware name, mask number and version number on the bottom line.

Using Serial I/O, the firmware version can be obtained using message **16 57**. To request the firmware version information via Serial I/O, send the **16 57** message with no other parameters.

3.6.5.4 Unit Type

The unit type is a one-byte code available via Serial I/O that identifies the type of unit you are communicating with.

To request the unit type, simply send message **07** with no parameters.

The return message will contain the unit type code. Unit type code **34** is assigned to the Antenna-Mount Solid State Power Amplifier family.

3.6.5.5 Optional Hardware

"Optional" hardware (such as a Parallel I/O board) is hardware that provides additional operating features. For the Antenna-Mount product line, these features are available only as factory installed options.

You can determine whether optional hardware is installed in your system from an attached RCP-2001 as follows:

To Check For:	Do This:
Parallel I/O	Go into the Service Menu. Use the MENU button to scroll through the choices in the menu. If the choice "Inp" (Inputs) appears, then you have Parallel I/O (i.e., a parallel board installed in your RCP-2001).
BUC (Block Upconverter)	Go into the Service Menu. Use the MENU button to scroll through the choices. If the choice "BUC" appears, then you have a Block Upconverter installed.
1:1	Go into the Main Menu. Use the MENU button to scroll through the choices. If the choice "1:1" appears, then you have 1:1 installed.
Antenna-Dummy Load switch (or Maintenance switch)	Go into the Operate menu. Use the MENU button to scroll through the choices. If the choice "AntDL" appears, then you have the Antenna-Dummy Load switch installed.

You can retrieve the status of optional hardware via Serial I/O using message **16 5A**. Simply send the message with no other parameters.

3.6.5.6 Reloading Firmware

Firmware may be reloaded via the SSPA Serial I/O port. To do so, obtain the loader software from the factory for the new version you wish to load. The loader software requires Windows 3.0 or higher to run. Connect the RS-232 serial port from your computer to the SSPA serial port, and follow the instructions provided with the loader to start the reload process.

3.6.6 Security Functions

The menu structure and Serial I/O protocol allow several mechanisms to restrict access to the system controls. If your amplifier site is unmanned, you may wish to lockout control so that someone cannot wander in and change anything. If you are an operator working at the site and controlling the system through an attached RCP-2001, you may wish to disable remote control of the system (i.e., via Serial I/O or optional Parallel I/O) while you are working on it.

The security mechanisms are:

- **Control Mode:** The control mode determines whether Local controls (i.e., the front panel of an attached RCP-2001), Remote controls (Serial I/O, and Parallel I/O if the RCP-2001 is so equipped), or both are able to control the amplifier.
- **Local Lockout:** A Serial I/O command can lockout the optional RCP-2001 front panel from being used to change anything. At your discretion, an operator can bypass Local Lockout with a password, or not.

- **Screen Passwords:** You can program a password that the operator MUST enter if he intends to change anything from the front panel of an attached RCP-2001.

These controls and settings can be used individually, or combined to produce whatever level of security you wish on changes to the controls and settings of the amplifier.

3.6.6.1 Control Mode

The control mode can only be changed from the optional RCP-2001 front panel, if present. It controls whether or not remote control of the amplifier is possible. The RCP-2001 front panel is considered “local” control, and Serial and optional Parallel I/O are both considered “remote” control.

The control mode can be set for one of three states:

- **Remote mode:** This is the normal operating mode. Serial I/O and optional Parallel I/O (via an attached RCP-2001, if so equipped) can control the amplifier. Local control (via an RCP-2001, if present) is also possible, unless either Remote Disables Local is set to YES, or Serial I/O issues a Local Lockout command. ***Remote mode is the only operating mode if there is no RCP-2001 attached.***
- **Local mode:** This mode is available *only* when an optional RCP-2001 is attached, and can only be selected from the RCP-2001 front panel. In Local mode, Serial and optional Parallel I/O cannot control the amplifier; except that, in Local mode, any optional Parallel I/O inputs that are programmed to generate a fault will do so if asserted. Serial I/O can still request information, and the optional Parallel I/O outputs (Form ‘C’ and analog output) still function to report status. Also, the optional Parallel I/O RF Inhibit inputs, if enabled, *can* shut the amplifier off. Local controls on the RCP-2001 function normally.
- **Maintenance mode:** This mode is also available *only* when an RCP-2001 is attached. In Maintenance mode, nothing changes on the amplifier unless directly commanded from the RCP-2001 front panel. However, if a fault condition such as Thermal Shutdown or Overcurrent Shutdown occurs, or an RF Inhibit (optional PIO input) occurs, the amplifier will be muted. If the amplifier is off due to RF Inhibit, it will not turn on again if RF Inhibit goes inactive. In Maintenance mode, faults are *not* reported on optional Parallel I/O; but Serial I/O Service Request will function normally. Serial I/O can still request information, and the non-fault optional Parallel I/O outputs will still function.

To change the control mode, select Oper | Ctrl. The top line shows the current control mode setting, and the bottom line allows the mode to be changed. Pressing MODIFY ⌂ and ▽ will toggle between Remote and Local, but the only way to enter Maintenance Mode is to move the selection to Maint with the MENU ▷ button, and then press SEL ▽.

Although Control Mode can only be changed from the RCP-2001 front panel, you can obtain the Control Mode setting using Serial I/O message **20**. Also, Any Parallel I/O output on the RCP-2001 (if the Parallel I/O option is installed) can be set to indicate Local or Remote control mode status, or Maintenance mode status (see Section 3.5.3 and Table 3-3).

3.6.6.2 Maintenance Mode Warning

In many installations, the amplifier is normally operated in Remote Mode so it can be monitored and controlled by an M&C system. In this situation, it is undesirable to leave the amplifier in either Maintenance Mode or Local Mode, as it will prevent remote control. This could happen, for example, if service personnel change the control mode from the front panel of the RCP-2001 and then do not restore it to Remote Mode.

For this reason, the amplifier will generate a Maintenance Mode warning as long as it is in Maintenance Mode. The front panel Warning indicator on the RCP-2001 will therefore be lit, reminding the operator to return the amplifier to Remote Mode.

3.6.6.3 Local Mode Warning

In a similar way, the Local Mode warning can help prevent leaving the amplifier in Local Mode. When Local Mode warning is enabled, a warning will be generated when the amplifier is in Local Mode. The front panel Warning indicator on the RCP-2001 will therefore be lit, reminding the operator to return the amplifier to Remote Mode.

3.6.6.4 Screen "Flash" Messages

There are three messages which will appear on the display of an attached RCP-2001 for a few seconds if you try to execute a function that is currently not allowed. These are referred to as "flash" messages:

PASSWORD

LOCAL LOCKOUT

REMOTE

- The ***PASSWORD*** flash message will appear if you try to change a setting or control from the RCP-2001's front panel while the menus are locked using a screen password. You will not be able to change any controls or settings from the front panel while this is the case, until you enter the correct password in the Unlock screen. See Sections 3.6.6.5 and 3.6.6.6 for more information.
- The **LOCAL LOCKOUT** flash message will appear if you try to change a setting or control from the RCP-2001 while Serial I/O Local Lockout message is in effect. You will not be able to change any controls or settings from the front panel while this is the case (unless a screen password has been enabled and set to something other than 0 0 0 0 0 0). Local Lockout can only be removed (or established) by Serial I/O command. See Section 3.6.6.7 for more information.
- The ***REMOTE*** flash message will appear if you try to change a setting or control from the RCP-2001's front panel while the SSPA is in Remote Mode *and* Remote Disables Local is set to Yes. You will not be able to change most controls or settings from the front panel while this is the case. The one exception is the Control Mode itself. You can change the Control Mode from Remote to Local (using Oper | Ctl | Local). This will re-enable all front panel functions. See Section 3.6.6.8 for more information.

3.6.6.5 Screen Passwords

You can set a screen password for more complete protection from changes through the front panel menus of an attached RCP-2001. In order to enable a password, you must set the password to something other than 0 0 0 0 0 0.

To enable or disable a password, select Set | Pass. The top line will show whether the password is Enabled or Disabled. The bottom line allows control of the setting. The bottom line also gives access to the Set Menu, where you can choose your screen password. You may set a password that allows you to gain access to the menus in two situations:

- The Serial I/O Local Lockout command has been issued.
- Screen Passwords are Enabled

To set a screen password, select Set | Pass | Set. The current password will be shown as a six-digit number. The ◁ or ▷ MENU buttons allow you to select any of the six digits, and the MODIFY △ and ▽ buttons allow you to change the selected digit.

NOTE If you enter this screen while the screens are locked (either due to Local Lockout, or the Screen Password being Enabled) the password will appear as X X X X X X, and will not be editable. In this case, you need to enter the current password in the Unlock screen before you can disable it or change it.

Set the six digits to your desired password, and then decide how you want to use the password:

- If you just wish to have a way to temporarily override Local Lockout, press PREV △ and make sure that the Screen Password setting is DISABLED.
- If you wish to have the operator enter the password any time he is going to change anything, press PREV △, and make sure that the Screen Password setting is ENABLED.

Note that you have to *set* a screen password, but you do not have to *enable* it, in order to use the password to temporarily override Local Lockout.

If you attempt to Enable a screen password set to the factory default value 0 0 0 0 0 0, or if you later change the password to 0 0 0 0 0 0 after enabling it, the screen password setting will revert to Disabled. In this case, however, there will be no local control method to bypass Local Lockout.

Once a screen password is enabled, the RCP-2001's front panel controls will be locked, until someone enters the correct password in the Unlock screen. While locked, an operator can view any setting or measurement. However, attempts to change any setting are blocked, and result in the message ***PASSWORD*** being shown on the screen.

When the screen password is enabled, you will have to enter the correct password in the Unlock screen every time you go to use the menus to change anything.

The screen password cannot be enabled, disabled, or set via Serial I/O.

See Section 3.6.6.6 for information on what to do if you lose your password.

3.6.6.6 Unlock

The Unlock choice appears in the first position of the Main Menu on an attached RCP-2001 if one of the following occurs:

- A screen password is enabled.
- A Serial I/O Local Lockout command is in effect.

The Unlock screen allows an operator at the front panel to regain control of the amplifier if he knows the password. The password is a six-digit number.

NOTE If you lose your password, write down the six-digit number that is shown when you first enter the Unlock screen, and contact the factory for assistance.

To unlock the front panel, select Unlock from the Main Menu. The screen will show a random six-digit number on the bottom line. The ◁ or ▷ MENU buttons allow each of the six digits to be selected separately. Pressing MODIFY △ or ▽ will change the selected digit.

Change all six numbers to match the currently enabled password. Once the entire password is entered, press PREV △ ***once*** to get back to the Main Menu. ***Do not press PREV △ from the Main Menu, as it will cancel the password you entered, and you must start over again.*** If the Unlock choice is now gone from the Main Menu, then you have entered the correct password, and may navigate from the Main Menu to whatever settings you need to change.

Once you are finished, simply press PREV △ enough times to get back to the default screen, and the front panel will be re-locked. (If you do not use any front panel control for about 5 minutes, the timeout function will also return you to the default screen, and re-lock the menus.)

3.6.6.7 Local Lockout

The front panel of an attached RCP-2001 may be locked out remotely using the Local Lockout command. The Local Lockout Serial I/O command may be issued only if the amplifier is in Remote Mode. If there is no RCP-2001 attached, enabling Local Lockout has no practical effect.

When enabled, Local Lockout prevents an operator at the RCP-2001 from changing anything. They may still navigate through the menu screens and view settings and measurements. However, any attempt to edit or change anything with the front panel controls results in the message **LOCAL LOCKOUT** temporarily being displayed on the bottom line.

If you have set up a screen password, the operator may regain control of the system by entering the password in the Unlock screen. However, if the screen password is 0 0 0 0 0 0, no menu screen exists that will allow local control of the amplifier. In this case, a Serial I/O message must be issued to turn off Local Lockout.

Using the password only temporarily bypasses Local Lockout. As soon as you return to the default screen, Local Lockout will again be active.

Powering the amplifier off and on or resetting the CPU via Serial I/O will turn off Local Lockout.

To control Local Lockout via Serial I/O, use message **0E**. To request the current Local Lockout setting, send the message with no parameters. To turn ON Local Lockout, send message **0E** with a **31** data byte parameter. To turn OFF Local Lockout, send message **0E** with a **30** data byte parameter.

3.6.6.8 "Remote Disables Local" Setting

You can set the amplifier so that the local controls on an attached RCP-2001 do not function while the amplifier is in Remote Mode. This is called "Remote Disables Local". If this setting is ON (set to "YES"), the operator may not change anything from the front panel of an attached RCP-2001 without first setting the amplifier to Local Mode.

To turn this setting on or off, select Set | R/L. The top line shows whether the setting is ON or OFF ("YES" or "NO"). The bottom line allows the setting to be changed. Pressing MODIFY ⌂ or ▽ will toggle the setting.

If you turn on Remote Disables Local while the amplifier is in Remote Mode, you will immediately lose the ability to change anything. You must return to the Control Mode setting in the Operate Menu, and set Local Mode, before you can do anything else.

Attempts to edit anything from the RCP-2001 while this setting is ON and the amplifier is in Remote Mode will result in the message *** REMOTE *** being displayed for a few seconds.

You can read and control the setting of Remote Disables Local using Serial I/O message **17 5F**.

3.6.7 1:1 Redundancy Functions

The following settings and controls affect 1:1 operation and status reporting in the amplifier system.

3.6.7.1 Redundancy Mode

This screen allows you to view the current redundancy mode, and set it for Manual, Auto, or Spare.

- In **Manual** mode, the system will NOT automatically switch when a fault is detected on the on-line amplifier. You must control the switch via serial control or from an attached RCP-2001.
- In **Auto** mode, the system will automatically switch from the on-line amplifier to the standby unit (if the standby amplifier status is good) when a fault is detected in the on-line unit. Manual switch commands are also accepted, so long as you don't command a switch from a good amplifier to a faulted one.
- In **Spare** mode, the amplifier will automatically switch to either Manual or Auto mode when it is installed in a system, based on the setting of the other amplifier in that system. If BOTH are set to Spare, they will both assume Auto mode.

To choose a setting from the RCP-2001's front panel, select 1:1 | Mode. The top line of the screen will show the current redundancy mode. The bottom line allows selection of the setting.

To control the 1:1 redundancy mode via Serial I/O, send the **18 51** message.

3.6.7.2 1:1 Switch Control

The top line of the screen will show the amplifier's unit number (1 or 2) and the unit's 1:1 switch control status, as one of the following:

- **On-Line** — This unit is the on-line unit.
- **Standby** — This unit is the standby unit.
- **No Switch** — Switch is not connected to this unit.
- **?SW** — A hardware failure prevents switch position detection.
- **Pwr Fail** — Power to the motorized switch has failed.

Note that when the switch is being changed, the status field is blank.

The bottom line allows selection of either "OnLine" or "Standby" for this unit.

To control the 1:1 switch via Serial I/O, send the **19 52** message.

3.6.7.3 1:1 Status Information

To obtain the status of the other unit from the RCP-2001's front panel, select 1:1 | Status. The top line of the screen will show this amplifier's unit number (1 or 2) and the 1:1 operating status of the other unit, which can be one of the following:

- **OK** — The other unit is connected and operating properly.
- **Faulted** — The other unit is connected and reporting a fault.
- **No Comm** — There is no communication with the other unit, and its status cannot be determined; however, this in itself is a fault.

To request the 1:1 status via Serial I/O, send the **20** message. Bit flags in the reply report the status.

Section 4 Theory of Operation

4.1 General Introduction

To understand how the Ku-Band Antenna-Mount SSPA works, use the information contained in this section. The description is organized by major subassemblies, with the first section describing the overall unit and the interconnection between subassemblies.

- To understand the theory from the top level, see **Unit Level Description**, Section 4.2.
- To understand the operation of the SSPA module, see **SSPA Module Description**, Section 4.3.

4.2 Unit Level Description

For help in understanding the following description, refer to the system schematic diagram in Section 6, Drawings.

The unit consists of a solid-state power amplifier module, power supply, and fans in an outdoor mountable weatherproof enclosure. An optional block upconverter can also be integrated into the enclosure for L-band input capability.

Power for the system is supplied by an 11.0-volt, high-efficiency switching power supply that operates from the 115/230 Vac nominal input. The SSPA and cooling fans receive power from the dc supply. The unit's internal monitor and control circuitry and serial I/O is microprocessor controlled. The microprocessor is located inside the SSPA module.

The microprocessor oversees the monitoring of power supply voltages, overtemperature detectors, current fault detectors for microwave power devices, heatsink temperature, and an RF power level monitor. The microprocessor also controls the amplifier gain and maintains gain at a constant level over temperature.

Details of circuit operation follow.

4.2.1 Power Supply

In standard ac-powered Antenna-Mount SSPAs, ac power is applied to J1, then routed through an EMI filter to the power supply. There is no integral on/off switch in the amplifier. A 275 V MOV between the AC line and neutral provides additional protection.

A high-efficiency switching type supply provides +11.0 Vdc at 36, 54, or 72 A maximum, depending on the SSPA output power. The supply is power factor corrected and operates over an input voltage range of 100 to 242 Vac.

In Antenna-Mount SSPAs supplied with the dc input option, dc power is applied to J1, then routed through EMI filter and transient suppression modules. High-energy transient suppressors protect against many line transients, over-voltage, and reverse polarity.

A high-efficiency power supply based on switching converters provides +11.0 Vdc at 36, 54, or 72A maximum, depending on the SSPA output power. The supply operates over an input voltage range of 36 to 72 Vdc.

4.2.2 Cooling

An integral heatsink and fan combination provide the required cooling for the amplifier assembly. The fans are arranged in a push-pull configuration in that one fan provides air intake while the other provides exhaust. For optimum cooling it is recommended to have at least 12 inches (300 mm) of clearance between the fans and any external obstruction.

Both the SSPA module and power supply components are attached to the heatsink for cooling. Solid-state temperature sensors mounted to the SSPA baseplate monitor the heatsink temperature. This temperature can be monitored via the serial I/O interface or Remote Control Panel menus.

4.3 SSPA Module

The SSPA module is the heart of the Antenna-Mount amplifier and contains the following functions:

- 75 dB of small signal RF gain
- Output power of 25 to 70 W (depending on model)
- Microprocessor-based monitor & control circuitry
- Serial I/O or Remote Control Panel interface
- Gain control circuitry for 20 dB gain adjustment range
- Temperature compensation circuitry
- RF output coupled sample (-40 dBc)

4.3.1 RF Amplification

The RF input to the module goes through an isolator to provide good VSWR at the amplifier's input. There is approximately 60 dB of small signal gain that amplifies the signal up to one watt. A 30 dB range electronic attenuator provides gain adjustment and temperature-compensated gain for the amplifier.

The output section of the SSPA module contains several high power GaAs microwave transistors, which provide an additional 25 dB power gain. The output of these devices are combined using very low insertion loss stripline combiners to achieve the rated output power.

Output power is measured by a detector and can be monitored via the serial I/O interface or Remote Control Panel menus.

4.3.2 Microprocessor

The amplifier module contains microprocessor-based logic circuitry that provides the serial I/O interface; monitors internal power levels, temperature, currents and voltages; and controls the amplifier gain and maintains a constant gain over temperature.

Program memory consists of a FLASH ROM that can be loaded with a new program via the serial port. Thus, logic problems can be fixed, or new features added, by upgrading the internal FLASH memory.

The microprocessor contains an 8-channel, 8-bit analog-to-digital converter that is used to monitor several internal voltages and currents. Various fault conditions are reported when these voltages or currents are found to be out

of their normal operating ranges. The microprocessor can also measure total current drawn by the GaAs FET amplifier stages.

Output power is measured using a simple Schottky diode peak detector. Calibration data for the detector (which includes corrections for temperature) are stored in the FLASH memory.

Gain control and gain/temperature compensation are achieved using a digital-to-analog converter driving a PIN diode circuit in one of the input stages. The amplifier can measure its own temperature. A calibration table stored in FLASH memory allows the microprocessor to achieve a certain gain at a certain temperature with this circuit.

4.3.3 Serial I/O Interface

The 10-pin serial port includes RS-232, RS-422, RS-485 and summary alarm. The summary alarm can be programmed to activate the contacts upon any fault condition or warning condition, or only upon a fault.

The user can utilize the serial I/O with a user-supplied monitor and control system. For a full description of the serial communications protocol, see Appendix B.

The Serial I/O interface is also used to communicate with an optional Remote Control Panel, which provides a front panel display and controls for the amplifier. The Remote Control Panel includes a separate serial I/O port on its rear panel for connection to the user's M&C system.

Section 5 Maintenance

5.1 General Introduction

To maintain, repair or verify performance of the Ku-Band Antenna-Mount SSPA, use the information contained in this section.

- For a list of test equipment and accessories required for maintenance, see **Equipment Required**, Section 5.2.
- **Preventive Maintenance Procedures** are in Section 5.3. Follow these regularly to keep the equipment in peak operating condition.
- To verify that the equipment is operating properly, see **Performance Verification**, Section 5.4.
- For service and repair information, see **Troubleshooting**, Section 5.5.

5.2 Recommended Equipment

Equipment recommended for use during maintenance and alignment procedures is listed in Table 5-1, Recommended Test Equipment. Alternate items may be substituted if the listed item is unavailable.

Table 5-1 Recommended Test Equipment

Model Number	Item
Mitec M0907-8-35	35 dB Crossguide Coupler
Mitec M1233-8	High Power Termination
Fluke 77	Digital Multimeter (DMM)
Fluke 80TK	Temperature Probe for DMM
HP 8757A	Scalar Network Analyzer with appropriate detectors and bridge
HP 8350B	Sweep Oscillator with appropriate RF plug-in
HP 437B	Power Meter with appropriate power sensor
HP 7470A/002	Digital Plotter
HP 8592B	Spectrum Analyzer

5.3 SSPA Cooling System Preventive Maintenance

Ensuring proper operation of the cooling system is the only preventive maintenance action required. There are no electrical or mechanical adjustments required for normal operation. The following procedures help keep the equipment in top working order and should be performed at least every 12 months. It is recommended that a log be kept.

The amplifier module in the SSPA unit is forced-air cooled by means of a fan and heatsink/plenum assembly. The fans and heatsink are protected by steel grilles. To maintain low, efficient operating temperatures for the SSPA and

power supplies, it is important that the fan grilles be kept clear and free of obstruction.

Visually inspect the intake and exhaust grilles to ensure that leaves or other debris are not obstructing the air flow. If necessary, gently clean both grilles with a wire brush. If the grilles are found to be extremely dirty, the frequency of this maintenance action should be increased.

Repeated thermal alarms reported by the amplifier are a good indication that the fan grilles may be clogged with debris, or that a fan is failing or has failed.

If a fan failure has occurred, the fan may be easily replaced. The fan tray can be detached from the baseplate by removing the six (6) screws around the perimeter of the tray. Each fan has its own in-line electrical connector that can be disconnected, allowing the fan to be removed.

NOTE Although this procedure can be done with power applied, it is recommended, for safety reasons, that AC input power be removed from the amplifier.

5.4 Performance Verification

Use the procedures in this section to verify that the Ku-Band Antenna-Mount SSPA is operating within specifications.

The procedures should be used as a tool for incoming inspection before initial installation or whenever any problems are detected and the unit is suspected as a source of the problems.

Use a copy of the Measured Test Data form in Section 8, System Configuration, as a checklist and to record results of the measurements.

NOTE These tests cannot be performed with the SSPA on-line. Certain procedures will interrupt service to the SSPA. Disconnect from service before doing performance verification tests.

The RF performance tests require laboratory microwave test equipment such as sweepers and power meters. Do these tests only if the proper test equipment is available.

WARNING Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so. Do not replace components with the power cable connected.

In preparation for the tests, connect a termination to the RF output, J4. Suitable loads include high power waveguide terminations or a waveguide-to-coax adapter and coaxial terminations. A precision 35 dB coupler is convenient for making power meter or spectrum analyzer measurements. Loads must be capable of dissipating the SSPA's maximum rated output power; refer to the specifications in Section 8.

It is assumed that the reader is familiar with standard RF and microwave test techniques such as gain, return loss, power output and intermodulation. No details of these tests are given here other than conditions and test limits. Refer to the manuals of your microwave test equipment for measurement details, if necessary.

The following parameters of the Ku-Band Antenna-Mount SSPA are measured:

- Gain and gain flatness
- VSWR
- Power output at 1 dB compression
- Two-tone intermodulation (IM) suppression

Use a copy of the test data sheet in Section 8 to record measured test data.

CAUTION This amplifier system is capable of generating over +45 dBm of output power. Most test equipment can be damaged by levels in excess of +20 dBm. Use a 35 dB attenuator between the output and your test equipment to protect it against high power. Use caution at all times.

Measure gain from J2 (Input) to J4 (Output). Use an input level that is in the small signal region of the amplifier (less than +30 dBm out). Plot the swept response on the test data sheet. From the plot, determine gain and gain flatness. Record values on the test data sheet.

Measure VSWR (Return Loss) at the Type N input (J2) and at the waveguide output (J4). For input measurements, keep the test signal low enough to avoid saturation in the amplifier. Plot the swept return loss for both input and output on the same graph. Identify traces by drawing an arrow and labeling the appropriate trace. Record minimum return loss on the test data sheet.

For output power measurements, determine the output power when the amplifier is 1 dB compressed. Use frequencies specified on the test data sheet.

Measure two-tone intermodulation suppression using the tone combinations specified on the test data sheet. Adjust input levels to produce the level shown on the test data sheet per tone at the output.

This completes the Performance Verification. If all of the procedures from Section 5.4.1 through 5.4.3 are completed satisfactorily, then the Ku-Band Antenna-Mount SSPA is in compliance with factory specifications.

5.5 Troubleshooting

Use this section to help isolate faults in the equipment and to perform repairs.

Before starting, look first for the following common problems.

- Are you certain that the problem has been isolated to this piece of equipment? Perform tests to verify that the problems being experienced are not caused by some other part of the system.
- Is power applied?
- Is the line voltage correct?

If you need to return the unit to the factory for service, refer to Section 7 for Warranty Information and Return Procedures.

5.5.1 Troubleshooting Chart

Use the troubleshooting chart in Table 5-2 to quickly isolate the problem to a subassembly or a part of the circuitry. Then refer to the appropriate

schematics, parts lists and assembly drawings in Section 6 to help find the specific problem.

Table 5-2 Troubleshooting Guide

Symptom	Check
Completely inoperative	Not field serviceable; return to factory for repair.
Temperature Alarm	Clogged fan, debris in heatsink fins; clean thoroughly. Defective fan; replace.
No RF output	Possible Remote Mute input.
Fails RF tests	Return to factory for repair.

If necessary, read the Theory of Operation in Section 4 for a better understanding of circuit operation.

Following repairs, the Performance Verification tests of Section 5.4 may be used to verify that the equipment is fully operational.

CAUTION This amplifier system is capable of generating over +45 dBm of output power. Most test equipment can be damaged by levels in excess of +20 dBm. Use a 35 dB attenuator between the output and your test equipment to protect it against high power. Use caution at all times.

5.5.2 Replacing a Defective Fan

1. Disconnect ac power from the SSPA.
2. Remove the 6 screws holding the fan mounting plate to the SSPA enclosure using a Philips screwdriver. The fan cable assembly will prevent the fan mounting plate to come completely free of the SSPA.
3. Disconnect the MS connector from inside the baffle and remove the fan mounting plate with both fans attached.
4. Remove the 4 sets of hardware attaching the defective fan to the fan mounting plate and finger guard using a Philips screwdriver. As you remove the old fan, note its airflow direction so you can install the new fan the same way.
5. Using the hardware just removed, attach the new fan in the same orientation as the old fan.
6. Reconnect the MS connector from the repaired fan assembly.
7. Use the 6 screws removed earlier to re-attach the fan mounting plate to the SSPA enclosure.

Connect ac power to the SSPA and return to service.

Section 6 Drawings

6.1 General Introduction

This section contains drawings needed to maintain and service the Ku-Band Antenna-Mount SSPA.

- Drawing types are briefly described in Table 6-1 below.
- Refer to the Drawing Index, Table 6-2 to locate a particular drawing.

Table 6-1 Drawing Types

Drawing Type	Description
Block Diagram	Depicts overall signal flow through a subassembly with major circuit groups shown as blocks. Sometimes annotated with signal levels.
Schematic	Standard electronic schematics with appropriate reference designators on components.
Assembly Drawing	Pictorial view of a circuit board, subassembly or unit. Components on the assembly drawing are identified by schematic designator or by item number. Item numbers refer to the bill of materials.
Bill of Materials (BOM)	Shows quantities, manufacturer and manufacturer's part number of each item of an assembly; also lists reference designators that appear on schematics.

All original drawings which were C size or larger have been reduced for inclusion in this manual.

Revisions to drawings are identified in the revision block in the upper right corner of the drawing. The initial release of a drawing has no revision. The first revision is A, the second B, and so on.

6.2 Drawing Index

Refer to Table 6-2 to locate a drawing. Drawings are inserted in the order in which they appear in Table 6-2.

Table 6-2 Drawing Index

Drawing Number	Description
12205-1	Cable Assembly, Antenna-Mount SSPA to PC
ACAB-12205-10'	BOM, Cable Assembly, Antenna-Mount SSPA to PC

NOTE Also see Section 8, System Configuration, for information on specific options included with your SSPA system.

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Section 7 Warranty

7.1 General Introduction

Specific warranty policies, along with technical support, repair and return procedures, are listed in this section.

- For help installing, maintaining or servicing the unit, see **Technical Support**, Section 7.2.
- For terms and conditions of the warranty, see **Warranty**, Section 7.3.
- Before returning any equipment for factory service, see **Return Procedures**, Section 7.4.

7.2 Technical Support

Technical support is available by calling Communications & Power Industries LLC directly at (814) 238-2700 between 8:00 a.m. and 5:00 p.m. USA Eastern time. Before calling, please have your technical manual at hand and the model and serial number of the relevant equipment.

7.3 Warranty

Communications & Power Industries LLC. warrants that its products will be in accordance with the written specifications, will be the kinds and quality described in the agreement, and will be free from defects in material and workmanship, under normal use and service, when correctly installed and maintained, for a period of three (3) years from the date of shipment.

Communications & Power Industries LLC liability is limited solely, at its discretion, to replacing, repairing or issuing credit for products which become defective during the warranty period. CPI must be notified by the buyer, in writing, of any discrepancy before any action may be taken. The buyer must provide CPI with the opportunity to inspect and test the product(s) alleged to be defective.

Under no circumstances shall CPI be held liable for any defective product(s) if examination of the product(s) shows that the defect was caused by misuse, abuse, improper installation or application, improper maintenance or repair, alteration, accident or negligence in use, storage, transportation or handling.

7.4 Return Procedures

Before returning any materials to CPI, the buyer must complete all of the following tasks:

- Contact either CPI directly or the appropriate CPI sales representative for issuance of a Return Materials Authorization (RMA) number. If the sales representative is contacted, they will in turn contact CPI for approval to return materials.
- Supply sufficient information regarding the reason(s) for return.

- Supply the date and purchase order number through which the materials in question were purchased.
- Supply the location to which the materials are to be returned.
- Include a name and phone number of an individual to contact in case of questions regarding the return materials.

Materials approved for return must be accompanied by the information requested above. **All materials must have an RMA number.**

NOTE	**Unauthorized returned materials will not be accepted by Communications & Power Industries LLC and will be shipped back to the buyer at the buyer's expense.**

All returned materials must arrive with postage, duties and all handling costs prepaid by the buyer. CPI will evaluate the returned materials to determine responsibility and will advise the buyer of any repair or replacement charges that apply.

Contact Communications & Power Industries LLC at

voice: (814) 238-2700
fax: (814) 238-6589

Shipping Address:
Communications & Power Industries LLC
60 Decibel Road, Suite 200
State College, PA 16801 USA

Section 8 System Configuration

8.1 General Introduction

This section contains configuration information for your system as it was shipped from the factory. Such information may include outline drawings for custom configurations, manual supplements for optional equipment ordered, and information on ancillary equipment.

See also Section 6 for drawings that are common to many system configurations.

Appendix A Serial I/O Protocol

A.1 Introduction

The Antenna-Mount Amplifier setup program, AMSETUP, provides the means to set up various operating parameters of the Antenna-Mount SSPA prior to installation, using its Serial I/O interface port. AMSETUP is able to connect to an Antenna-Mount amplifier, regardless of its current serial port settings, using the RS-232 cable provided with the amplifier.

Once connected, AMSETUP allows you to control the following settings:

- Gain
- Output Power Calibration Offset
- Output Power Fault Limits
- Output Power Measurement Units
- Power-Up Mute Control Setting
- Redundancy Mode
- Serial I/O Baud Rate
- Serial I/O Interface Type
- Serial I/O Address
- Serial I/O Port Indicator Relay Function

In addition, AMSETUP provides readings of the current Output Power, and displays the version of firmware in your amplifier.

You can run the program at any time after installation, if it becomes necessary to change any of these settings.

A factory settings screen is also provided that accesses a variety of configuration settings normally used only at the factory. We strongly suggest that you use those settings *only when advised by factory technical support*, as some of them can disable important features in your amplifier, or cause it to not function properly.

Please note that AMSETUP is not intended for use as a permanent means to monitor and control the amplifier. While communicating with AMSETUP, the amplifier is running exclusively in RS-232 mode, which is not sufficient for many situations. Also, AMSETUP does not display many important measurements and fault conditions that the amplifier is capable of reporting. If you require a more permanent means to monitor and control your amplifier, please see our MAXCON software, or purchase an RCP-2001 Remote Control Panel.

A.2 System Requirements

AMSETUP requires a computer running Microsoft Windows 3.1, 95, 98, ME, NT 3.5 (or higher), 2000, or XP. The computer must have at least one available RS-232 serial port.

AMSETUP will not operate through an RS-485 or RS-422 serial port or converter box, nor will it operate through a serial port that is shared from another computer over a network.

You will also need the Antenna Mount RS-232 cable supplied with your amplifier, and possibly the 9-pin to 25-pin adapter. If these items are unavailable, you can build your own cable, as described later.

A.3 Installation

A.3.1 Software Installation

To install the program, simply copy the AMSETUPW.EXE and AMSETUP.HLP files into the file directory or folder of your choice on your computer's hard drive. Alternatively, you may run them directly from the O & M manual.

A.3.2 Hardware Connection

Next, you must connect the Antenna-Mount SSPA M&C connector, J3 to your computer's RS-232 serial port. Choose any available serial port on your computer.

A computer's serial port is normally a male 25-pin or 9-pin D connector. The RS-232 cable supplied with the Antenna-Mount SSPA has a 9-pin D connector at the computer end. If your computer's serial port connector has 25 pins, then use the supplied 25-pin to 9-pin adapter. If you don't have the cable supplied with your amplifier, you can build one (see below), or contact the factory to order a replacement cable.

To build your own cable, you will need either a 9-pin or 25-pin female D connector (depending on your PC's connector type), a 10-pin male MS connector (MS3116F12-10P or equivalent), and a 3-wire shielded cable, not exceeding 50 feet in length.

Wire the cable as follows:

9-Pin COM Port Pin		25-Pin COM Port Pin	Signal Name	SSPA J3 Pin
2	or	3	RD	B
3		2	TD	C
5		7	SG	E

Note that the labels RD, TD, and SG in the table refer to the functions of the RS-232 lines at the computer end of the cable.

Connect the serial I/O interface cable between the computer's serial port and J3 on the SSPA, using the adapter if necessary. Make sure you know the device name assigned by Windows to the serial port you are using. For most PC's with two serial ports, the device names are usually COM1 and COM2.

A.4 Running the Program

You can use AMSETUP on an amplifier that is on the bench, or on an amplifier that is in service. AMSETUP will not affect the RF path, unless you adjust the gain of the amplifier, or use the Factory Settings view (which is not recommended without specific direction from factory technical support).

WARNING	**A radiation hazard exists if the amplifier is operated unterminated. Make sure that the amplifier's output is properly terminated before applying power. It is possible for an amplifier that is not connected to any RF source to self-oscillate, which could radiate hazardous microwave power if the output is left open. Do not operate the SSPA without a load or termination attached to the waveguide output.**

CAUTION	Never exceed the maximum safe RF input level, or permanent damage to the SSPA may result. The maximum safe level is printed on the unit next to the RF Input connector.

Apply power to the SSPA. The SSPA must be operating when you launch the setup program. (You may provide an RF input signal to the SSPA if desired, to calibrate output power levels, but this is not necessary to run the setup program.)

To run the program, open Windows 3.x File Manager or Windows 95/98 Explorer, locate and open the directory or folder where you copied the program, and either double-click its icon in the window, or right-click it and choose "**Open...**" Or, in Windows 95 and higher, you may click the **Start** button, choose **Run ...**, click the **Browse ...** button, locate the program file, click the **Open** button, and then click **OK**.

A.4.1 Opening Screen

When you launch the AMSETUP program (and any time you click on the Reconnect button), you will be presented with the Connect To Port dialog box, where you should enter the device name for the serial port you are connected to. The commonly used device names COM1 through COM4 are in the drop-down list for convenience. However, you may type in the device name if you wish. The device name you enter must be a valid RS-232 serial port on your computer. You probably will not be able to connect through an RS-485/RS-422 interface, or through a serial port on another computer that is shared through a network. When you press the Reconnect button, the device name you previously entered will be shown in the box.

You do not have to enter a baud rate, address, or any other parameters. AMSETUP can connect to an Antenna-Mount amplifier, regardless of its current serial settings.

After you enter a device name, either press ENTER or click on the OK button to accept your selection. There will be a short pause while the program opens the serial port, and establishes communications with the amplifier. The Connection Status area of the Main Amplifier Screen (the indicator and status box at the bottom of the window) will let you see whether AMSETUP has connected to the amplifier or not.

A.4.2 Main Amplifier Screen

The Main Amplifier Screen consists of four main parts. They are (from top to bottom): the Title Bar, the View Selection Tabs, the Settings Area, and the Connection Controls.

The Title Bar simply shows the title of the program (Antenna Mount Setup) and the current version. The System Menu button (the icon in the top left corner) and the miminize and close buttons are all standard Windows functions.

The settings you can control are divided into 3 categories by the View Selection Tabs: Amp Settings, Serial Settings, and Factory Settings. Clicking on any one of these tabs changes the view shown in the Settings Area (immediately below the tabs). The Amp Settings view is shown by default, when you first connect to an amplifier after launching the program.

The Connections Controls are the buttons (Reconnect, Disconnect, Exit, and Help) near the bottom of the screen, and the Connection Status, which is the simulated LED indicator and status box to the right of the Disconnect button at the bottom edge of the Main Amplifier Screen.

A.4.2.1 Amp Settings

The Amp Settings View shows settings and controls that you will use to monitor and control the RF path of the amplifier.

The following items are displayed in this View.

- Output Power (Measurement)
- Gain
- Output Power Cal Offset
- Low Power Limit
- High Power Limit
- Power Units
- Power-Up State
- 1:1 Mode (if 1:1 support is enabled)
- Firmware Version (Display Only)

Some values you may need to set only once, others you may want to change from time to time during operation. Most settings take effect immediately upon entry. Programmed settings are stored in memory within the SSPA and will be retained even if power to the SSPA is interrupted.

A.4.2.1.1 Gain Setting

The RF input level and SSPA gain together determine the output level. Since input level is often fixed in a particular installation, the SSPA includes a gain adjustment feature that can be used to set a desired output level. Gain is adjustable from 0 to -20.0 dB in 0.1 dB steps, and is relative to the SSPA's maximum specified gain value. Absolute gain in dB is computed by adding the (negative) gain setting to the unit's maximum specified gain. For example, a unit with 75.0 dB maximum gain will have 65.0 dB gain when the gain adjust is set to -10.0 dB. At this setting, the unit would produce a +45.0 dBm output level if a -20.0 dBm signal were applied to the input.

A.4.2.1.2 Output Power Calibration Offset

The current output power measurement is calibrated at a single frequency near the center of the detector's frequency response. If your carrier is elsewhere in the band, your readings may deviate from those at the calibration point.

You can enter an offset to fine-tune the output level calibration to agree with measurements made by a power meter or other instrument. You can adjust the offset in 0.1 dB increments from -6 dB to +6 dB.

To calibrate the output power display, attach a power meter to the SSPA output. Adjust the offset value so that the displayed “Current Output Power” level agrees with your measurement.

A.4.2.1.3 Output Power Fault Limits

An Output Power Fault is generated if the SSPA’s RF power output goes above the High limit or below the Low limit. The Output Power limits can be set according to your needs, and either or both limits can be disabled.

NOTE If you are running a switched carrier through the SSPA, you should disable the low limit to prevent a fault when the carrier switches off.

No Output Power Fault will be generated while the unit is muted. If an Output Power Fault occurs, and the unit is subsequently muted, the Output Power Fault will continue to be reported. This fault cannot be cleared by a RESET command while the amplifier is Muted.

NOTE The Amplifier Output Power Detector Offset value (see Section A.4.2.1.2, above) may affect the output power limits. For example, if the high output power limit is near its highest setting, decreasing the Offset can cause the highest possible setting to drop below the set value for the high limit, thus disabling the high limit. Once a limit is disabled, it will remain disabled regardless of changes to the Offset value, until the limit is re-enabled.

A.4.2.1.4 Amplifier Power-Up State

When power is first applied to the SSPA, the output is muted until the microprocessor is running and has completed all of its initial tests. You can configure the SSPA to then do one of three things:

- Leave the output muted until you or your M&C system unmutes it (“Power Up Muted”); or,
- Un-mute the output (“Power Up On”); or,
- Set the output as it was before the unit last powered down (“Power Up In Previous State”).

NOTE If you choose “Power Up In Previous State,” each time the SSPA is muted or unmuted its state is stored in permanent EEPROM memory, which has a limited number of write/ erase cycles. To save on EEPROM write cycles, “Power Up In Previous State” should not be used if the output will be frequently muted and un-muted as part of normal operation.

The output will not be affected if a RESET command is issued by a serial I/O message.

A.4.2.1.5 1:1 Mode

If 1:1 support has been enabled for your amplifier, you can view the current redundancy mode and set it for Manual, Auto, or Spare.

- In Manual mode, the system will NOT automatically switch when a fault is detected on the on-line amplifier. You must control the switch via serial control or from an attached RCP-2001.
- In Auto mode, the system will automatically switch from the on-line amplifier to the standby unit (if the standby amplifier status is good) when a fault is detected in the on-line unit. Manual switch commands are also accepted, so long as you don't command a switch from a good amplifier to a faulted one.
- In Spare mode, the amplifier will automatically switch to either Manual or Auto mode when it is installed in a system, based on the setting of the other amplifier in that system. If BOTH are set to Spare, they will both assume Auto mode.

A.4.2.2 Serial Settings

The Serial Settings View contains controls to set up the serial port on the Antenna Mount Amplifier. Changing these settings does not affect communications while the amplifier is connected to the AMSETUP software. The settings will take effect after you disconnect AMSETUP from the amplifier. At that time, the serial port address, baud rate, and interface type will change to the settings shown in this view.

The following serial settings are available:

- Baud Rate
- Interface
- Address
- Form-C Contact Function*

  * In very early versions of the Antenna Mount firmware, the setting of the Form-C Contact Function was not readable. If your amplifier is running one of these versions, a note will appear telling you this. In this case, you can still set the value by clicking on the appropriate radio button.

A.4.2.2.1 Baud Rate

The baud rate selection screen shows a list of possible choices for the serial I/O baud rate. The serial I/O port uses standard serial protocol, with 1 start bit, 1 stop bit, 8 data bits, and no parity. The baud rate can be set for 300, 1200, 2400, 4800, 9600, 14400, 19200, or 28800. Choose a value that is compatible with your M&C program and interface. Generally, choose the highest speed possible.

A.4.2.2.2 Interface Type

Before using serial I/O for remote operation, you must tell the SSPA logic which of the available types of serial I/O interfaces you will be using. The interface selection screen allows you to choose from RS-232, RS-485 (4-wire), RS-485 (2-wire), or RS-422 interfaces. (See Section 2.5.2 in the main manual for a detailed discussion of the various interfaces.)

A.4.2.2.3 Address

For remote operation through the serial I/O port when more than one unit shares a common communications circuit (such as RS-485), each unit must be assigned a unique address.

The address can be set for any value from 0 to 255. The factory default value is 1.

Note that you cannot use address 0 when multiple units share a common communications circuit. Refer to the Serial I/O Protocol, Appendix B, for more information on choosing the address.

A.4.2.2.4 Form C Contact Function

A Form C contact set, available on pins F, G, and H of the M&C connector (J3), can be programmed for one of three different functions:

- **Latched Fault –** If any fault has been detected by the amplifier since faults were last reset, the contact set will indicate a fault. Note that a latched fault can only be reset if the fault condition has been cleared and a FAULT RESET serial I/O command is issued.
- **Service Request –** The contact set indicates a fault as soon as any condition is detected by the amplifier that requires attention, including any fault. The contacts will be cleared if either all faults are reset, or a Clear Service Request serial command is issued.
- **Active Fault* –** The contact set indicates a fault only for as long as a fault condition is detected by the amplifier. When the condition clears, the contact set reverts to its non-fault state. This is the recommended setting if the amplifier is used in a 1:1 system with an external redundancy controller.

  * The Active Fault setting for the Form-C Contact Function was not available in early versions of the Antenna Mount firmware. In this case, that choice will be disabled (grayed out). If you need this setting, contact the factory for a firmware upgrade.

A.4.2.3 Factory Settings

The Factory Settings are meant to be used when you have a problem in which some internal configuration setting of the amplifier needs to be restored. Normally, these settings are made at the factory. However, if you have contacted factory technical support personnel, and they suspect that one or more of these settings may have been lost or changed, they may request that you run AMSETUP, and change one or more settings in this View.

When you first click on the Factory tab, you will be given a message warning you that these settings can cause features in your amplifier to stop working correctly. If you then click on OK, you will have access to the Factory Settings View. We strongly suggest that you use those settings *only when advised by factory technical support*. If you decide not to access the Factory Settings, click on either of the other two View tabs to leave

Appendix B Serial I/O Protocol

Document 12245,
Serial I/O Protocol for Antenna-Mount SSPAs

Appendix C Glossary

Term	Definition
A	Ampere
AC or ac	Alternating current
Ant	Antenna
BUC	Block upconverter
°C	Degrees Celsius
CMOS	Complementary metal-oxide semiconductor
CW	Clockwise
CCW	Counter-clockwise
dB	Decibel
dBc	Decibels with reference to carrier power
dBm	Decibels with reference to a power of 1 milliwatt
DC or dc	Direct current
DL	Dummy Load
DMM	Digital multimeter
DVM	Digital voltmeter
FET	Field-effect transistor
GaAs FET	Gallium arsenide field-effect transistor
GHz	Gigahertz
Hz	Hertz
IF	Intermediate frequency
I/O	Input/output
IC	Integrated circuit
Ku-Band	Frequencies in the range of 12 to 18 GHz
LED	Light emitting diode

Term	Definition
mA	Milliampere
ms	Millisecond
mV	Millivolt
ns	Nanosecond
NC	Normally closed
NO	Normally open
OIP_3	Third order output intercept point
p-p	Peak-to-peak
PCB	Printed circuit board
PS	Power supply
RF	Radio frequency
SSPA	Solid-state power amplifier
TEMP	Temperature
V	Volt
Vac	Volts alternating current
Vdc	Volts direct current
VSWR	Voltage standing wave ratio
W	Watt

Notes