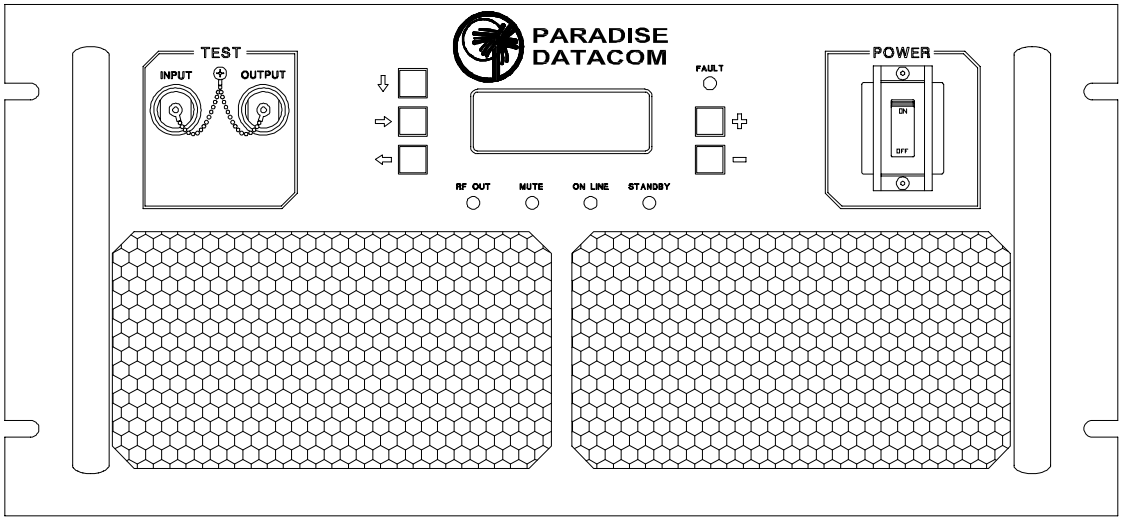
PARADISE
DATACOM

HPAC-100/125/150/200/250-RM
Solid State Power Amplifier
Operations Manual



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Introduction

This section provides the general information for the Paradise Datacom HPAC-100/125/150/200/250-RM Solid State Power Amplifier (SSPA). This includes a description of the unit and safety precautions.

Description

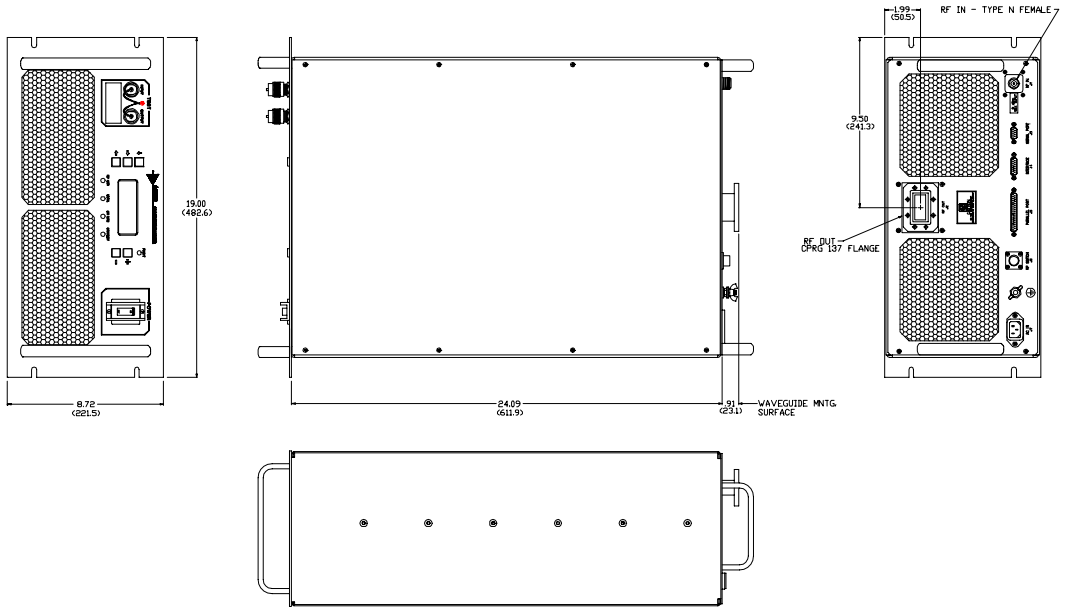
Please refer to Appendix A for the appropriate product data sheet and specifications. The indoor rack mounted unit contains an internal microprocessor which allows full monitoring and control from the front panel's 4x20 LCD display and pushbuttons or via a remote serial (RS-232 or RS-485) or parallel controller. The microprocessor monitors various voltages, currents, and temperatures within the unit for a full fault analysis. The user also has the ability to select additional faults related to the RF output level, reflected RF power level, and operating temperature.

An internal attenuator allows up to 20 dB of attenuation to be applied to the RF signal. Temperature compensation limits the amplifier's output response from varying significantly over the operating temperature. Also, the system contains input and output sample ports.

The HPAC-100/125/150/200/250-RM can be paired with another unit in a one-for-one redundant configuration. The interface port allows the two amplifiers to communicate with each other while being controlled from either the front panel or serial interface. An additional controller is not required.

The unit is 8.75 X 24 X 19 inches (222,3 X 609,6 X 482,6 mm). An outline drawing of the chassis is shown in Figure 1-1.

Figure 1-1: Outline drawing of an HPAC-100/125/150/200/250-RM.



Specifications

Refer to the Specification sheet in appendix A for the HPAC-100/125/150/200/250-RM Solid State Power Amplifier for complete specifications.

Equipment Supplied

The following equipment is supplied with each unit:
HPAC-100/125/150/200/250-RM
Power Cord
Rack Slides
Rack Extensions
Operations Manual HPAC-100/125/150/200/250-RM Solid State Power Amplifier

Safety Considerations

Potential safety hazards exist unless proper precautions are observed when working with this unit. To ensure safe operation, the user must follow the information, cautions, and warnings provided in this manual as well as the warning labels placed on and in the unit itself.

High Voltage Hazards

High voltage for the purpose of this paragraph, is any voltage in excess of 30 volts. Voltages above this value can be hazardous and even lethal under certain circumstances. Care should be taken when working with devices that operate at high voltage.

1. All probes and tools that contact the equipment should be properly insulated to prevent the operator from coming in contact with the voltage.
2. The work area should be secure and free of non-essential items.
3. Operators should never work alone on high voltage devices. There should always be another person present in the same work area to assist in the event of an emergency.
4. Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR.

An AC powered unit will have 115 VAC or 230 VAC entering through the AC power connector. Caution is required when working near this connector, the AC circuit breaker, or the internal power supply.

High Current Hazards

Many high power devices are capable of producing large surges of current. This is true at all voltages but needs to be emphasized for low voltage devices. Low voltage devices provide security from high voltage hazards, but they also require higher current to provide the same power. High current can cause severe injury from burns and explosion. The following precautions should be taken on devices capable of discharging high current:

1. Remove all conductive personal items, i.e., rings, watches, and medals.
2. The work area should be secure and free of non-essential items.
3. Wear safety glasses and protective clothing.
4. Operators should never work alone on high risk devices. There should always be another person present in the same work area to assist in the event of an emergency.
5. Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR.

Large DC currents are generated to operate the RF Module inside of the enclosure. ***EXTREME CAUTION IS REQUIRED WHEN THE ENCLOSURE IS OPEN AND THE AMPLIFIER IS OPERATING. DO NOT TOUCH ANY OF THE CONNECTIONS ON THE RF MODULES WHEN THE AMPLIFIER IS OPERATING. CURRENTS IN EXCESS OF 60 AMPERES MAY EXIST ON ANY ONE CONNECTOR.***

RF Transmission Hazards

RF transmissions at high power levels may cause eyesight damage and skin burns. Prolonged exposure to high levels of RF signals has been linked to cataracts. The following precautions should be followed with high levels of RF transmission:

1. Always terminate the RF input and output connector prior to energizing the unit.
2. Never look directly into the RF output connector.
3. A suitable distance should be maintained from the source of the transmission such that the power density is below recommended guidelines in ANSI/IEEE C95.1. The power density specified in ANSI/IEEE C95.1-1992 is 10 mW/cm^2. These requirements adhere to OSHA Standard 1910.97
4. When the distance required in item 3 is not practical, RF shielding should be employed to achieve the same result.

DO NOT OPERATE THE AMPLIFIER WITHOUT A CONNECTION ON THE RF OUTPUT. HIGH RF POWER CAN CAUSE BURNS TO HUMANS, ESPECIALLY SENSITIVE TISSUE SUCH AS THE EYES. DO NOT PLACE HANDS OR FACE NEAR THE OUTPUT WHEN THE AMPLIFIER IS IN OPERATION!

Electrical Discharge Hazards

An electric spark can not only create ESD reliability problems, it can also cause serious safety hazards. The following precautions should be followed when there is a risk of electrical discharge.

1. Follow all ESD guidelines.
2. Remove all flammable material and solvents from the area.
3. All probes and tools that contact the equipment should be properly insulated to prevent electrical discharge
4. The work area should be secure and free of non-essential items.
5. Operators should never work alone on hazardous equipment. There should always be another person present in the same work area to assist in the event of an emergency.
6. Operators should be familiar with procedures to employ in the event of an emergency, i.e., remove all power, CPR.

Introduction

This section provides information for the initial inspection, installation, external connections, and shipment of the unit.

Inspection

When the unit is received, an initial inspection should be completed. First ensure that the shipping container is not damaged. If it is, have a representative from the shipping company present when the container is opened. After opening, perform a visual inspection of the HPAC-100/125/150/200/250-RM to make sure that all items on the packing list are enclosed. If any damage has occurred or if items are missing, contact:

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Rack Mounting

The HPAC-100/125/150/200/250-RM is designed to fit in a standard 19” wide EIA rack. The unit is 9 rack units high, 8.75 inches (222,3 mm).

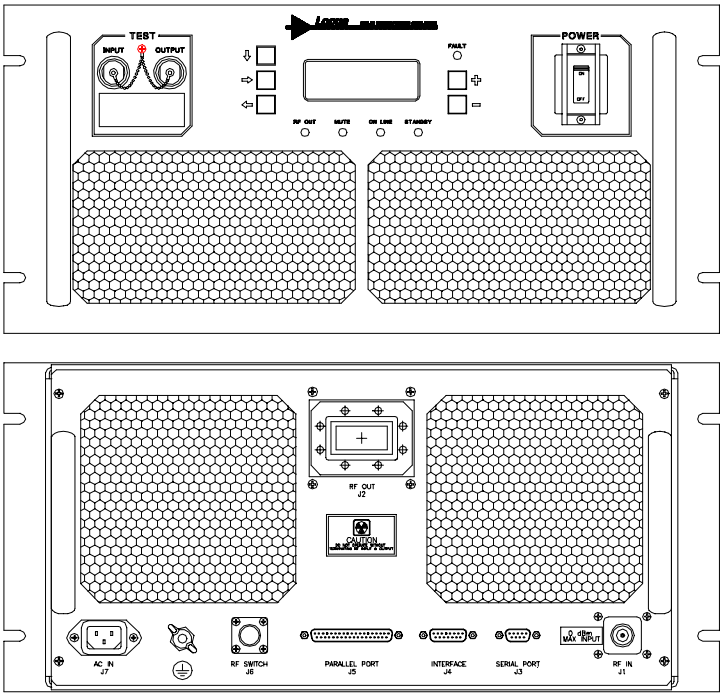
Prime Power Connection

The prime power connector is a filtered IEC connector. The unit can be ordered with an internal AC supply or an optional DC power converter. The configuration is marked upon the unit. HPAC-100-RM or an HPAC-125-RM unit can operate from 110 VAC or 220 VAC, but the HPAC-150-RM, HPAC-200-RM and HPAC-250-RM should only be operated from 220 VAC. ***Warning: The internal power supplies are autoranging, therefore no changes in configuration are necessary when changing prime power from 110 to 220 VAC.***

Cable Connections

Figure 2-1 shows a front and rear panel view of the unit. The connector locations can be found in this figure.

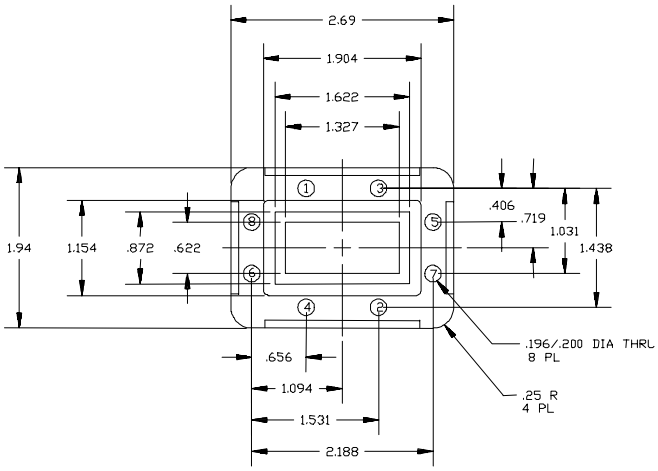
Figure 2-1: Front and rear panel view of the HPAC-100/125/150/200/250-RM.



RF Connectors

The RF Input (J1) connector, a type N female, is located in the lower right corner of the rear panel. The RF Output (J2) connector, a CPR137G waveguide flange, is located in the center of the rear panel. The following directions should be followed while referring to Figure 2-2.

Figure 2-2: CPR137G waveguide flange.



1. Insert dowel pins in mounting holes 7 & 8 to align waveguide with the mounting surface.
2. Insert #10 screws into mounting holes 1 and 6. Hand tighten.
3. Tighten screws 1 through 6 to three inch-pounds of torque.
4. Remove dowel pins and insert #10 screws into holes 7 & 8. Tighten to three inch-pounds of torque.
5. Tighten screws 1 through 8, in sequence, to 32 inch-pounds of torque for #10-32 screws and 23 inch-pounds for #10-24 screws.

Input Sample Port

The Input Sample Port connector is located on the far left of the front panel. It is a type N female connector.

Output Sample Port

The Output Sample Port connector is located next to the Input Sample Port connector on the front panel. It is a type N female connector.

Monitor and Control Connections

Serial Connector (J3)

The serial connector is the female 9 pin D connector located on the rear panel. A description of the socket functions is given in Section 3.

Interface Connector (J4)

The interface connector is the female 15 pin D connector located on the rear panel. It is used for redundant configurations to connect the two amplifiers together. Only factory supplied cables should be attached to this port.

Parallel Connector (J5)

The parallel connector is the female 37 pin D connector located on the rear panel. A description of the pin functions is given in Section 3.

Switch Connector (J6)

The switch connector is the 6 pin circular connector located on the rear panel. When properly configured, it allows the HPAC-100/125/150/200/250-RM to control an external switch for auxiliary switching or redundancy.

Shipment

To protect the HPAC-100/125/150/200/250-RM during shipment, use high quality commercial packing methods. When possible, use the original shipping container and its materials. Reliable commercial packing and shipping companies have the facilities and materials to adequately repack the instrument.

Introduction

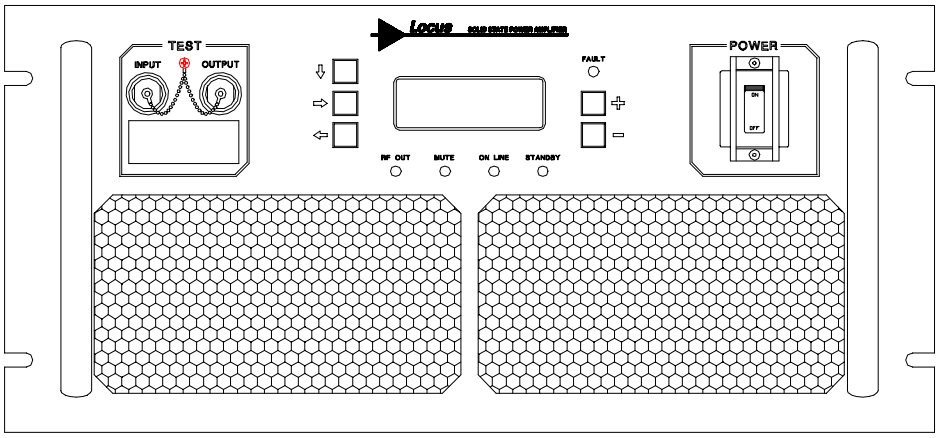
This section contains operating information including a description of the front panel indicators and controls, and I/O connectors and their functions.

Description of Controls, Indicators, and Connectors

Front Panel Features

The front panel LCD, pushbuttons, and LEDs permit the user to operate the SSPA locally. Figure 3-1 illustrates the front panel.

Figure 3-1: Front panel of the HPAC-100/125/150/200/250-RM.



LCD

A 4 line by 20 character LCD display allows the monitoring of unit temperature, output power, voltages, currents, and faults. In addition, it is used for locally setting summary fault options, thresholds, attenuation values, and the RF mute state. The active line is indicated by the cursor on the leftmost position of the display.

Pushbuttons

The menus on the LCD display are manipulated with 5 front panel keys: ↓ , ← , → , + , - . The down arrow key moves the cursor between the four lines, selecting the active line. The left and right arrows scroll within a line to view various options. The plus and minus keys are used to toggle or increment/decrement the active value for functions which require inputs.

LEDs

As seen in Figure 3-1, five LEDs are located on the front panel: RF Out, Mute, On-line, Standby, and Fault. The first four are located below the LCD display while the Fault LED is above the upper right corner of the LCD. Table 3-1 indicates the meaning of their on-state.

Table 3-1: Front panel LED colors and functions.

LED Label	LED Color	LED On-State Function
Fault	Red	Amplifier has a summary fault
RF Out	Green	RF output level is above the Low RF Power set threshold
Mute	Yellow	Amplifier is muted
On-line	Green	Stand-Alone Unit: Amplifier is not muted 1:1 Redundant System: Amplifier is the on-line unit
Standby	Yellow	Stand-Alone Unit: Not used 1:1 Redundant system: Amplifier is the standby unit

Input Sample Port

The type N female connector on the far left of the front panel is used to sample the RF input level to the amplifier. A label with the coupler calibration data is located below the connector.

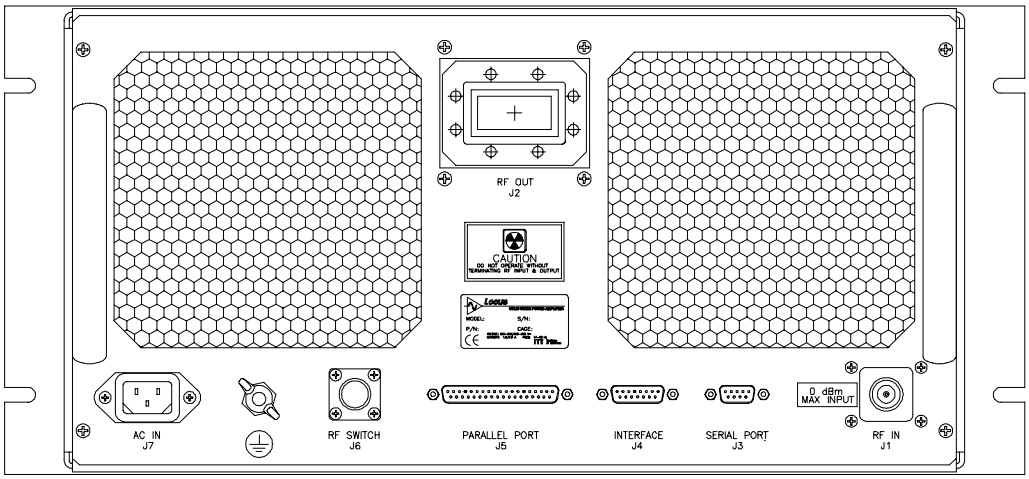
Output Sample Port

The type N female connector to the right of the Input Sample Port connector is used to sample the RF output level of the amplifier. The actual sampling value is indicated on the calibration label below the connector.

Rear Panel Features

Figure 3-2 shows an illustration of the rear panel view of the HPAC-100/125/150/200/250-RM.

Figure 3-2: Rear panel view of the HPAC-100/125/150/200/250-RM.



RF Input Port (J1)

The type N female connector on the right side of the rear panel is used as the RF input.

RF Output Port (J2)

The WR137 waveguide connector in the middle of the rear panel is used as the RF output. **Do not operate the amplifier without having a termination or mating connection on the RF Output Port. RF Hazard warnings apply.**

Serial Connector (J3)

The 9 socket D connector on the rear panel is used for the serial interface. Table 3-2 shows the socket designations. The RS-485 wires should be twisted pair for maximum transmission distance.

Table 3-2: Serial connector (9 socket D connector).

Socket	Function
1	NC
2	Transmit (RS-232)
3	Receive (RS-232)
4	NC
5	Ground
6	Transmit - (RS-485)
7	Transmit + (RS-485)
8	Receive + (RS-485)
9	Receive - (RS-485)

Interface Connector (J4)

The 15 socket D connector is used to interface two SSPAs together when in a one for one (1:1) redundant configuration. Only a factory supplied cable should be attached to this connector.

Parallel Connector (J5)

The 37 socket D connector is used for the parallel port. Table 3-3 shows the socket designations.

Table 3-3: Parallel connector (37 socket D connector).

Group	Signal	Socket
Summary Alarm 1	Closed on Fault Common Open on Fault	34 15 33
Summary Alarm 2	Closed on Fault Common Open on Fault	14 32 13
Summary Alarm 3	Closed on Fault Common Open on Fault	31 12 30
RF Output Alarm	Closed on Fault Common Open on Fault	28 9 27
Mute Status	Closed when Muted Common Open when Muted	10 29 11
RF Switch 1 Position	Closed in Pos. 1 Common Closed in Pos. 2	8 26 7
RF Switch 2 Position	Closed in Pos. 1 Common Closed in Pos. 2	25 6 24
Power Monitor	Voltage + Voltage -	3 22
Temperature Monitor	Temperature GND	21 20
Attenuation Control	Attenuation GND	4 1
Control Inputs	Mute/Unmute Fault Reset GND	5 23 20
Auxiliary Inputs	Fault Input (Flt = open) GND	2 1

RF Switch Connector (J6)

The 6 pin circular connector is used to interface an SSPA to an external switch. Only a factory supplied cable should be attached to this connector.

Prime Power Connector (J7)

The prime power connector is a filtered IEC connector. Figure 3-3 and Table 3-4 contain the pin functions of this connector.

Figure 3-3: Prime Power connector (IEC).

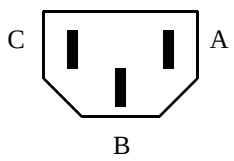


Table 3-4: Prime Power connector (IEC).

Pin	AC Supply
A	100-120/200-240 VAC
B	Ground
C	100-120/200-240 VAC Return

*HPAC-150/200/250: 220-240 VAC only.

Front Panel Operation

The HPAC-100/125/150/200/250-RM can be controlled locally via the front panel LCD and pushbuttons. The unit must be in LOCAL mode for front panel operations as explained in the Operations Menu section. The following paragraphs explain how to operate the front panel.

Cursor Control

The cursor, which indicates the active line, is designated by the greater than sign, ">", in the left column of the display.

Down Arrow Key (↓)

This key moves the cursor between the four display lines: line 1 to line 2, line 2 to line 3, line 3 to line 4, and line 4 to line 1. When the cursor is on a specific line, it becomes active. The remaining keys will only function upon this active line.

Left and Right Arrow Keys (← and →)

These keys scroll the cursor within a line to view the different options. For example, when in the Operations Menu, line 3 can display the attenuation level, mute status, or remote/local control of the amplifier. The left and right arrow keys are used to scroll through these choices to place a particular item on the display.

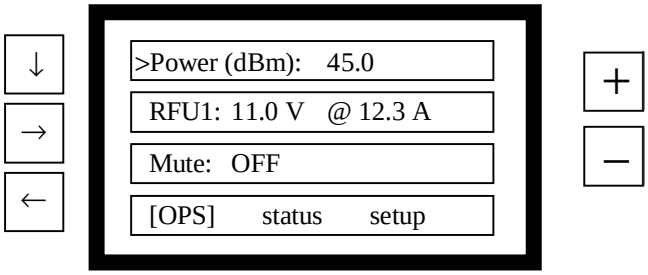
Plus and Minus Keys (+ and -)

These keys are used to toggle an option or increment/decrement the displayed value. For example, if line 3 is the active line and is displaying the mute status of the amplifier, pressing the "+" or "-" key will change the state. If the unit was muted, pressing the key will unmute it. If the unit was unmuted, pressing the key will mute it. Either key can be pressed when acting as a toggle. If line 3 is active and displaying the attenuation level, pressing the "+" key increases the attenuation level by 1 dB while pressing the "-" key decreases the attenuation level by 1 dB.

Menus

Three different menus are available: Operations Menu ("OPS"), Status Menu ("STATUS"), and Setup Menu ("SETUP"). The active menu is designated on line 4 by all capital letters enclosed in brackets. The left and right arrow keys are used to select the current menu mode when line 4 is the active line. The three remaining lines have different functions depending upon the menu selection.

Operations Menu



The OPS menu is used for the basic operation of the amplifier. It provides mechanisms for local monitoring and control.

Line 1 displays the output power in dBm or watts; unit temperatures in degrees Celsius; and a detailed list of the amplifier faults, if any exist. In addition, if the reflected power monitor was purchased, the reflected power in dBm will be displayed.

Line 2 displays the voltages and currents of the RF units. In addition, if the auxiliary switch or 1:1 redundant option is selected, the voltage of the +28V power supply is also displayed.

Line 3 displays the unit ID and permits the user to select the mute state, the attenuation level, and the remote/local control of the amplifier.

Unit ID: For serial communications, each SSPA is identified by a unit ID in addition to the system address. The unit ID is displayed.

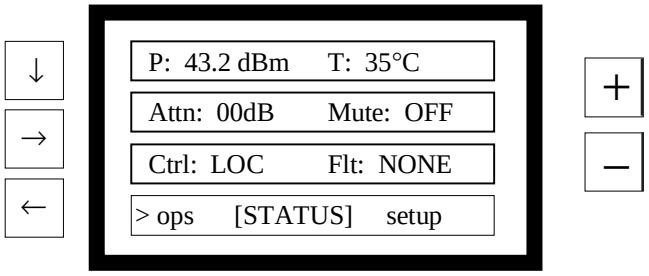
Mute State: The mute state determines whether the amplifier radiates any RF signal. Amplifier muting can be toggled “ON” or “OFF”. The operating state is when the mute is toggled “OFF”. The present state is displayed along with being indicated by the Mute LED.

Attenuation Level: An attenuator within the chassis can be set in 1 dB increments from 0 to 20 dB. The output gain level is appropriately changed. The present level is displayed.

Control Location: The control location must be set to operate the unit locally or from a remote location. To have the amplifier respond to front panel inputs, the unit must be set to “LOC”. To access the unit via the serial or parallel ports, the unit must be set to “REM”.

Additional functions are included on this line if the amplifier contains system options such as an auxiliary switch or 1:1 redundancy.

Status Menu



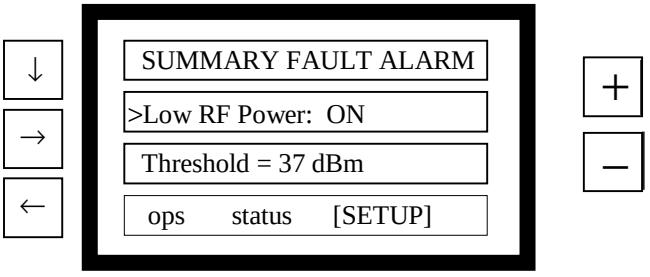
The Status menu displays the current settings of the amplifier. It is a monitoring tool only and values cannot be set from it.

Line 1 displays the output power in dBm and the temperature of the hottest unit in degrees Celsius.

Line 2 displays the attenuation level and the mute state of the amplifier.

Line 3 shows whether the control is LOC/REM and any amplifier faults. Normal operation should display “FLT: NONE”, whereas if a fault occurs then “NONE” will be replaced by “FAULT”. A detailed description of the fault is available on line 1 of the OPS menu.

Setup Menu



The Setup menu is used to select which user selectable faults should be included in the summary fault and also the appropriate threshold values. The summary fault of the unit automatically includes voltage, current, and an over temperature shutdown fault. In addition, the user can select to include Low RF Power, High RF Power, High Temperature, Auxiliary Input and High Reflected Power (optional) faults. Each of the user configurable faults contains an ON/OFF toggle on line 2 as well as a threshold value on line 3.

Also shown on the setup menu is the revision level of the unit software.

Low RF Power

The Low RF Power fault alerts the user when the output power falls below the threshold value. Due to the sensitivity of the power monitor diode, do not set the threshold value more than 15 dB below the rated output power. Also, the Low RF Power threshold must be less than the High RF Power threshold. Regardless of whether this fault is included in the summary alarm, the threshold value must be set to control the RF Output LED on the front panel.

High RF Power

The High RF Power fault alerts the user when the output power is above the specified level. The threshold cannot be greater than 1 dB higher than the rated output of the amplifier and must be greater than the Low RF Power threshold.

High Temperature

The High Temperature fault alerts the user when the unit temperature is above the specified level. It does not cause RF muting. In addition to the user selectable fault, a factory set Over Temperature Shutdown fault exists. The Over Temperature Shutdown fault occurs when the temperature of an RF unit exceeds a factory set temperature in order to prevent component damage due to excessive heating. When an Over Temperature Shutdown occurs the unit is automatically muted and a fault is indicated until the temperature falls below the High Temperature Threshold value set by the user. The user must manually unmute the amplifier when the fault is no longer registered. If the fault continues to occur, a problem may exist with the system fans or the unit may be operating in too high of an ambient temperature.

Auxiliary Input

The Auxiliary Input fault is intended for use with external transmit equipment such as converters or modems. This feature is used when input switching is not employed and it is desirable to switch the entire converter/amplifier chain when either an amplifier or converter faults. The proper converter summary fault can be brought into the SSPA through the Auxiliary Input connection located on the parallel port connector. The logic required at the Auxiliary Input connector is open on fault or ground for no fault.

High Reflected Power (optional)

The High Reflected Power fault alerts the user when the reverse power is above a specified level. The threshold cannot be greater than 1 dB above the rated output of the amplifier or lower than 15 dB below the rated output power.

Default Menu Settings

The HPAC-100/125/150/200/250-RM has default menu settings when delivered. These initial settings are shown in Table 3-5.

Table 3-5: Initial factory menu settings.

Menu Item	Initial Setting
Mute	ON
Attenuation	0 dB
Low RF Power Fault	OFF
Low RF Power Threshold	10 dB below rated power
High RF Power Fault	OFF
High RF Power Threshold	Rated power
High Temperature Fault	OFF
High Temperature Threshold	70°C
Auxiliary Input Fault	OFF

When the unit is turned off, all menu settings are stored in nonvolatile memory. This permits the unit to return to the same state when power is restored. **Warning: If the unit was powered down while in the unmuted state, it will be unmuted when powered up. For safety concerns, it is advisable to mute the amplifier before removing power.**

Remote Operation

The HPAC-100/125/150/200/250-RM has two means for remote operation: a parallel port and a serial port.

Parallel Port Monitors and Controls

The parallel port contains a series of Form C contact closures for monitoring summary faults, low RF output power, and the mute status; opto-isolated inputs for controlling the mute status and clearing faults; voltage outputs for monitoring the output power and unit temperature; and a voltage input for controlling the attenuation level. Line 3 of the OPS menu must be set to “REM” and pin 4 of DIP switch 7 must be set to *ON* to allow inputs from the parallel port. The pin out of the parallel connector is given in Table 3-3.

Contact Closures: A Form C contact closure contains three pins: a common, a normally open contact, and a normally closed contact. Three individual sets of contacts are provided for monitoring a summary fault. Each set reports the same fault. A set of contacts is provided for monitoring whether the output power level drops below the Low RF Power Threshold. The last set of contacts reports the mute state of the amplifier. The contacts have the following resistive load ratings: 30VDC @ 1A, 110 VDC @ 0.3A, or 125 VAC @ 0.5A. The contacts can be monitored at any time, even when the unit is in local mode.

Opto-Isolated Inputs: Two opto-isolated inputs are provided on the parallel connector: mute configuration and fault reset. The mute pin can have two different modes of operation depending on the internal DIP switch configuration, refer to Table 3-19 and associated text. In one configuration, pulsing the mute pin low for 100 milliseconds toggles the mute state. In the other configuration, the rear panel mute input must be continuously grounded for unmute and left open for mute. The changing of the mute status can be monitored using the contact closure as described above. The second input is used as a fault reset. Holding the pin to ground disables the reporting of faults. When the pin is released from ground, faults will be newly detected and reported.

Voltage Outputs: The output power of the SSPA can be determined by the differential voltage between the two power output pins on the parallel port. Nominally, 5 volts corresponds to the rated output power with a scale of 0.1 V/dBm. The output has an accuracy to 15 dB below the rated output power of the unit.

The temperature pin has a voltage proportional to the highest unit temperature. 3.03 VDC corresponds to 303K (30°C) with a slope of 0.01V/K (0.01V/°C).

Voltage Inputs: The attenuation level of the unit can be controlled by varying the voltage to the attenuation control pin on the parallel port. This is accomplished by varying the resistance from this pin to ground. Internally this pin is pulled up to 5V through a 10K ohm resistor. When calculating the external resistor value use the voltage division equation of $V_{pin\ a} = ((R_{external}/(R_{external} + 10K))(5V)$. Every 0.1 V increment corresponds to 1 dB of attenuation with 2 V corresponding to the maximum attenuation, 20 dB. This voltage must be continuously held.

Serial Port Monitors and Controls

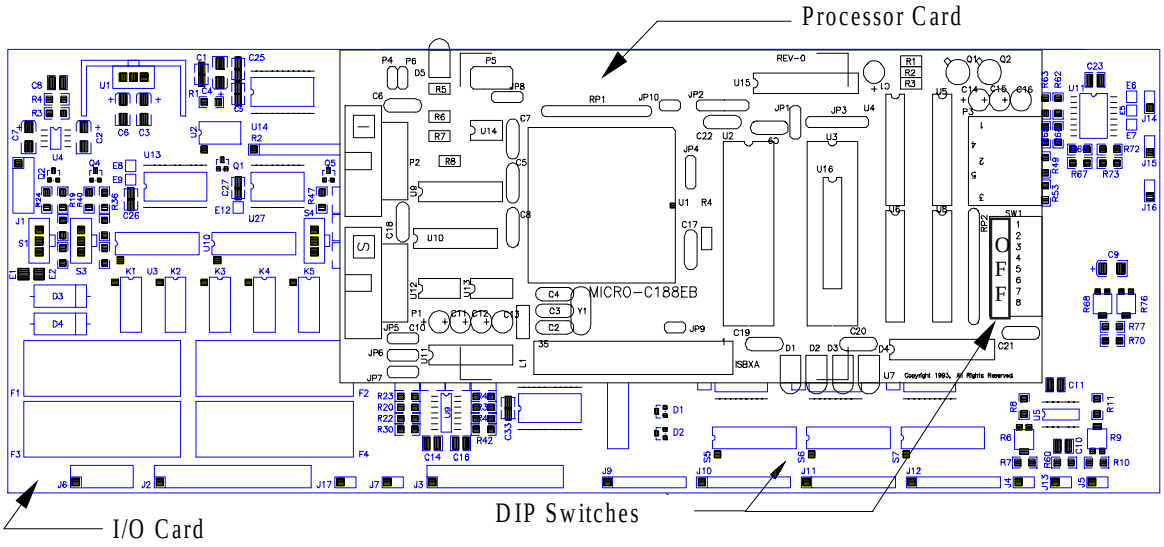
The HPAC-100/125/150/200/250-RM can be entirely controlled via the serial port. All functions available on the front panel are also available through the serial interface. Before communication can occur, the serial port must be configured properly by setting internal DIP switches for the proper system address and baud rate along with changing an internal connector on the processor board for the correct protocol, RS-232 or RS-485. Also, the mode of control on line 3 of the OPS menu must be set to “REM” or the serial command, set control mode to remote, must be sent.
Pin 4 of DIP switch 7 must be set to *OFF* to control the attenuator through the serial port. If it is not, the attenuation level is set through the parallel port. A separate user-furnished System Controller is assumed to be the source of the M&C capability when operating the HPA.

The HPA will not transmit any information over the bus unless queried to do so from the M&C system. The unit requires no handshaking on the interface, employing only Data In, Data Out, and Ground signals. The serial communication utilizes 8 data bits, 1 stop bit, and no parity.

System Configuration

The system configuration is set using three banks of DIP switches located on the I/O card, one bank of DIP switches located on the processor card, and a connector which plugs into the processor card. Access to both cards is obtained by removing the bottom panel of the chassis. The processor card is plugged into the I/O card. The location of the DIP switches can be seen in Figure 3-4. Specific descriptions of the DIP switches are in the following sections.

Figure 3-4: HPA I/O card with attached microprocessor card.



DIP Switches

The three banks of DIP switches located on the lower portion of the I/O board and one bank of DIP switches located on the processor board are used for setting the system configuration. Figure 3-5 shows an expanded picture of the DIP switches. Their position can be *OFF* or *ON*. Table 3-6 lists the switches and their functions. Some of the switches are user configurable while others are reserved for factory use only.

Figure 3-5: Example of I/O card and processor card DIP switches.

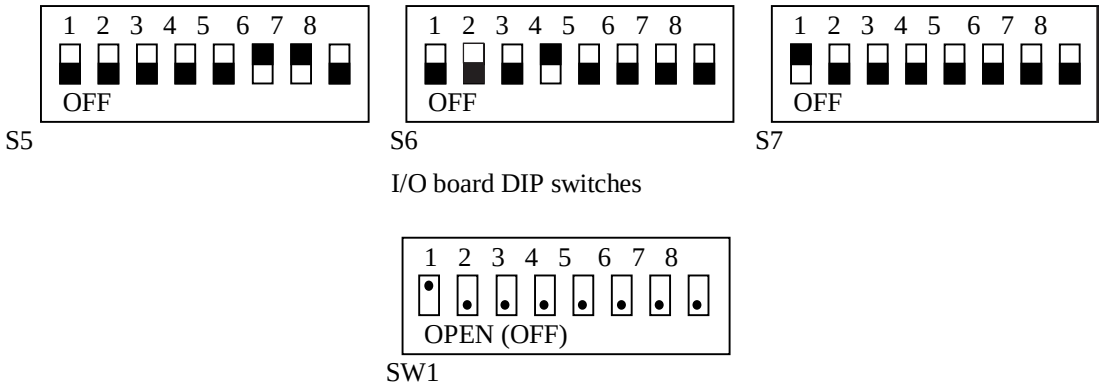


Table 3-6: DIP switch functions.

Switch	Pins	Function	Access
S5	1-5	System Address	User
S5	6-8	System Baud Rate	User
S6	1-2	Frequency Band	Factory
S6	3-4	RF Module Count	Factory
S6	5-6	Power Rating	Factory
S6	7-8	Redundancy	Factory
S7	1-2	Unit Address	Factory
S7	3	Hot Standby	Factory
S7	4	Parallel Port Enable	User
S7	5	Calibration Enable	Factory
S7	6-7	System Options	Factory
S7	8	Spare	Factory
SW1	1	Reserved	Factory
SW1	2	Parallel Port Mute Configuration	User
SW1	3-5	Spare	Factory
SW1	6-8	Auxiliary Power Rating	Factory

User Configurable DIP Switches

The user must access only a portion of the DIP switches for setting the system address, the baud rate, and enabling / configuring the parallel port. Table 3-7 shows the default positions of the user configurable DIP switches. Table 3-8 illustrates the system address selections, Table 3-9 illustrates the system baud rate selections, Table 3-16 illustrates the parallel port enable selections, Table 3-19 illustrates the parallel port configuration and Tables 3-10 to 3-15, 3-17, 3-18, and 3-20 illustrate factory selections.

Table 3-7: Default user configurable DIP switch settings.

Switch	Pins	Setting	Description
S5	1-5	OFF,OFF,OFF,OFF,OFF	System Address = 0
S5	6,7,8	ON,ON,OFF	Baud rate = 9600
S7	4	OFF	Parallel Port Disabled
SW1	2	OFF	Parallel Port Pulse/Toggle Mode

Table 3-8: System address configuration.

System Address	S5 Pin 1	S5 Pin 2	S5 Pin 3	S5 Pin 4	S5 Pin 5
0	OFF	OFF	OFF	OFF	OFF
1	ON	OFF	OFF	OFF	OFF
2	OFF	ON	OFF	OFF	OFF
3	ON	ON	OFF	OFF	OFF
4	OFF	OFF	ON	OFF	OFF
5	ON	OFF	ON	OFF	OFF
6	OFF	ON	ON	OFF	OFF
7	ON	ON	ON	OFF	OFF
8	OFF	OFF	OFF	ON	OFF
9	ON	OFF	OFF	ON	OFF
10	OFF	ON	OFF	ON	OFF
11	ON	ON	OFF	ON	OFF
12	OFF	OFF	ON	ON	OFF
13	ON	OFF	ON	ON	OFF
14	OFF	ON	ON	ON	OFF
15	ON	ON	ON	ON	OFF
16	OFF	OFF	OFF	OFF	ON
17	ON	OFF	OFF	OFF	ON
18	OFF	ON	OFF	OFF	ON
19	ON	ON	OFF	OFF	ON
20	OFF	OFF	ON	OFF	ON
21	ON	OFF	ON	OFF	ON
22	OFF	ON	ON	OFF	ON
23	ON	ON	ON	OFF	ON
24	OFF	OFF	OFF	ON	ON
25	ON	OFF	OFF	ON	ON
26	OFF	ON	OFF	ON	ON
27	ON	ON	OFF	ON	ON
28	OFF	OFF	ON	ON	ON
29	ON	OFF	ON	ON	ON
30	OFF	ON	ON	ON	ON
31	ON	ON	ON	ON	ON

Table 3-9: System baud rate configuration.

Baud rate	S5 pin 6	S5 Pin 7	S5 Pin 8
1200	OFF	OFF	OFF
2400	ON	OFF	OFF
4800	OFF	ON	OFF
9600	ON	ON	OFF
19200	OFF	OFF	ON
38400	ON	OFF	ON
38400	OFF	ON	ON
38400	ON	ON	ON

Table 3-10: Frequency band configuration.

Frequency Band	S6 Pin 1	S6 Pin 2
C/X/Ku (50W/100W)	OFF	OFF
L/S	ON	OFF
Ku (40W/80W)	OFF	ON
reserved	ON	ON

Table 3-11: RF module count configuration.

Module Count	S6 Pin 3	S6 pin 4
1	ON	OFF
2	OFF	ON
3	ON	ON

Table 3-12: Power rating configuration.

C/X/Ku(100W)-Band Power Rating	S6 Pin 5	S6 Pin 6
100W	OFF	OFF
150W	ON	OFF
200W	OFF	ON
125W	ON	ON

L/S-Band Power Rating	S6 Pin 5	S6 Pin 6
50W	OFF	OFF
100W	ON	OFF

Ku-Band Power Rating (40W/80W)	S6 Pin 5	S6 Pin 6
40W	OFF	OFF
80W	ON	OFF

DIP switch pins 5 and 6 may be invalidated by DIP SW1 pins 6-8, see Table 3-20.

Table 3-13: Redundancy configuration.

Redundancy	S6 Pin 7	S6 Pin 8
Stand Alone	OFF	OFF
1:1	ON	OFF
1:2	OFF	ON
Reserved	ON	ON

Table 3-14: Unit address configuration.

Unit Address	S7 Pin 1	S7 Pin 2
Invalid	OFF	OFF
1	ON	OFF
2	OFF	ON

Table 3-15: Hot standby configuration.

Hot Standby	S7 Pin 4
Muted in Standby	OFF
Not Muted in Standby	ON

Table 3-16: Parallel port enable configuration.

Parallel Port Enable	S7 Pin 4
Parallel Port Disabled	OFF
Parallel Port Enabled	ON

Table 3-17: Calibration mode configuration.

Calibration Mode	S7 Pin 5
Cal Mode Disable	OFF
Cal Mode Enabled	ON

Table 3-18: System options configuration.

System Options	S7 Pin 6	S7 Pin 7
None	OFF	OFF
Aux Switch	ON	OFF
Return Power Monitor	OFF	ON
Aux Switch & Return Power Monitor	ON	ON

Table 3-19: Parallel port configuration.

Parallel Port Configuation	SW1 Pin 2
Pulse/Toggle Mode	OFF
Continuous Mode	ON

When the parallel port is configured for pulse mode, pulsing the parallel mute pin low for 100 milliseconds toggles the mute state. In continuous mode this pin must be held low to unmute the amplifier and if left open will mute the amplifier. The continuous mode is intended for users that have open collector logic driving the parallel mute pin.

Table 3-20: Auxiliary power rating configuration.

Auxiliary Power Rating	SW1 Pin 6	SW1 Pin 7	SW1 Pin 8
Use S6 for power rating input	OFF	OFF	OFF
10W	ON	OFF	OFF
20W	OFF	ON	OFF
30W	ON	ON	OFF
50W	OFF	OFF	ON
400W	ON	OFF	ON

Factory Configured DIP Switches

Some of the DIP switches are set at the factory for the configuration of the amplifier. ***They should not be changed by the user***. **Changing these switches will result in improper operation of the amplifier.** Reference the final test data sheet supplied with the unit for the correct factory settings in the event the factory configured DIP switches are inadvertently changed.

Communications Protocol

The serial port protocol of the HPAC-100/125/150/200/250-RM can be configured for RS-232 or RS-485. The microprocessor card only accepts RS-232, but by using a converter internal to the unit, the user can communicate with RS-485. To accomplish this, one of two marked connectors must be installed into the mating connector on the processor card which is marked with an "S". All connectors are labeled appropriately.

Serial Communications Format

Communications between an M&C station and a system of SSPA units is achieved through a packet based, messaging protocol. The communication packet utilizes 8 data bits, 1 stop bit, and no parity.

Packet Format

A packet is the basic unit of information that is used to communicate between nodes on an SSPA network. It can be thought of as a block of bytes formatted into three major components: the header, data, and trailer. Each major component is subdivided into fields that contain information specific to that packet. The packet format will serve for both commands and responses. Figure 3-6 demonstrates the packet format.

Figure 3-6: Packet format and associated byte size for serial communications.

HEADER				DATA		TRAILER
Frame Sync	Packet Length	Dest Addr	Source Addr	Command	Data	Checksum
2	1	1	1	1	1 - 182	1

The header is divided into four fields: Frame Sync Word, Packet Length, Destination Address, and Source Address.

Frame Sync Word: The frame sync word is a two byte field that marks the beginning of a packet. The value placed in this field is a constant: **0xAA55**. This field provides a means for a node to synchronize to a known point in a transmission.

Packet Length: This field indicates the number of bytes contained in the packet. The leading frame sync bytes are not included in the count.

Destination Address: The destination address field specifies the system for which the packet is intended. This field consists of one byte containing an integer address (0 to 31). Each unit or node in an SSPA system must determine if the packet currently on the bus is meant for it. This is done by comparing the destination address on the bus to the SSPA's System Address.

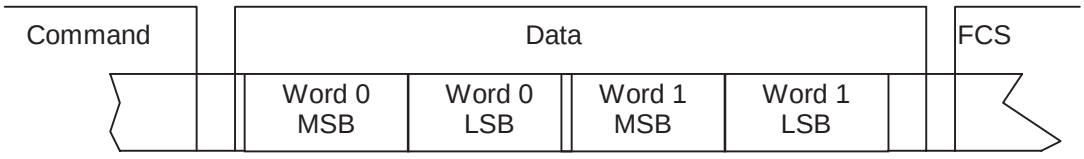
Source Address: The source address field specifies the address of the node that sent the packet. This field consists of one byte containing an integer address (0 to 31).

The data portion of a packet consists of two fields: Command and Data.

Command Field: The command field is a one byte field that either instructs the destination node how to use the data that the source node is sending or requests that specific information from the destination node be returned.

Data Field: The data field is variable in length depending upon the associated command. The first byte of the data field contains the unit ID of the amplifier with which the controller is communicating. This byte acts as a modifier for the destination address which is especially important when communicating with a redundant SSPA system. The unit ID designates which unit should receive the command packet and also designates which unit a packet came from. The range of valid values are 0 to 3. The value 0 indicates the System Controller of a redundant system and the values 1, 2, and 3 correspond to a particular SSPA within the system. The unit ID of a specific amplifier is displayed on line 3 of the OPS menu and is determined from a factory set DIP switch. ***The unit ID of all stand-alone SSPAs is 1.*** The remaining bytes in this field are for the data associated with a command or response. Some commands require no additional data while others require several bytes. If the logical data size of the information is 16 bits, then each data word will be placed in the frame with its most significant byte first. This is demonstrated in Figure 3-7.

Figure 3-7: Example of data field information in the packet.



The trailer component only contains one field: Frame Check Sequence.

Frame Check Sequence: The checksum field is a 1 byte field that provides a parity check during packet transmission. This value is computed as a function of the contents of the packet length, destination address, source address, command field, and data field. In general, the sender formats a message frame, calculates the checksum, appends it to the frame, and then transmits the packet. Upon receipt, the destination node re-calculates the check sequence and compares it to the check sequence embedded in the frame. If the check sequences are the same then the data was transferred without errors, otherwise, an error has occurred and some form of recovery must take place.

Checksums are generated by summing the value of each byte in the packet while ignoring any carry bits. A simple algorithm follows:

```
chksum = 0
FOR (byte_index = 0) TO (byte_index = ( packet_length - 1 ))
chksum = ( chksum + BYTE [ byte_index ] ) MOD 256
NEXT byte_index
```

Commands

Packets are categorized by the function they serve, commands, queries, or responses. All essentially have the same format. The M&C system sends commands and queries to the SSPA system while the SSPA system sends response messages to the M&C. Only one command can be sent at a time and the M&C system should wait until a valid response is returned from the SSPA system before sending another. Commands and queries can be directed to the SSPA system controller or to an individual SSPA unit. Steering a command in this way is accomplished by selecting the appropriate unit ID. Table 3-22 contains a list of the valid commands the M&C can issue. The SSPA responds with an ACK to indicate that the command was received and implemented or a NAK to indicate that the command was not implemented.

Table 3-21: Valid M&C commands.

Command
Set Configuration Mode
Set RF Muting
Set Attenuation
Set High Temp Threshold
Enable High Temp Fault
Set Low RF Power Threshold
Enable Low RF Power Fault
Set High RF Power Threshold
Enable High RF Power Fault
Set Reflected RF Power Threshold
Enable Reflected RF Power Fault
Enable Auxilliary Fault 1 Input
Set Control Mode

The following paragraphs give detailed descriptions of each command.

The item labeled length indicates the total number of bytes in the packet which includes the two frame sync bytes.

Set Configuration Mode

Determines which control and status messages are recognized by the unit.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x21	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Mode:	(1 byte, integer)
	0 = OPS	Operations mode.
	1 = SETUP	Setup Mode.
Length:	9 bytes	

Set RF Muting

Sets the mute state of the unit.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x22	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Mute State:	(1 byte, integer)
	0 = OFF	RF muting is turned off.
	1 = ON	RF muting is turned on.
Length:	9 bytes	

Set Attenuation

Sets the amount of RF signal attenuation for a unit. The Parallel Port Enable DIP switch (S7, pin-4) must be set to “OFF”.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x23	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Attenuation Level:	(1 byte, integer)
	[0..20]	Attenuation level in dB.
Length:	9 bytes	

Set High Temperature Threshold

Sets the threshold beyond which the unit is considered to be in a state of elevated temperature. This threshold is used to determine when the unit has recoverd from an over temperature shutdown condition. This command is only recognized in setup mode.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x24	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Temperature:	(1 byte, integer)
	[40..80]	°C
Length:	9 bytes	

Enable High Temperature Fault

Selects whether a detected high temperature condition is considered a fault and thus contributes to a summary fault condition. This command is only recognized in setup mode.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x25	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Fault Monitor State:	(1 byte, integer)
	0 = DISABLE (OFF)	High temperature fault is deselected.
	1 = ENABLE	High temperature fault is selected.
Length:	9 bytes	

Set Low RF Power Threshold

Sets the threshold below which the unit is considered to be transmitting low RF output power. Also, this threshold is used to determine whether the front panel RF Out LED is illuminated. This command is only recognized in setup mode.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x26	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Power Threshold:	(1 byte, integer)
	[16 . . 56]	dBm
Length:	9 bytes	

Enable Low RF Power Fault

Sets whether a detected low RF output power condition is considered a fault and thus contributes to a summary fault condition. This command is only recognized in setup mode.

Type: COMMAND
Pkt Length; 7
Destination: SSPA System Address
Source: M&C Address
Command: 0x27
Data:
Unit ID: (1 byte, integer)
[1 | 2 | 3]
Fault Monitor State: (1 byte, integer)
0 = DISABLE (OFF) Low RF power fault is deselected.
1 = ENABLE Low RF power fault is selected.
Length: 9 bytes

Set High RF Power Threshold

Sets the threshold above which the unit is considered to be transmitting excessive RF output power. This command is only recognized in setup mode.

Type: COMMAND
Pkt Length: 7
Destination: SSPA System Address
Source: M&C Address
Command: 0x28
Data:
Unit ID: (1 byte, integer)
[1 | 2 | 3]
Power Threshold: (1 byte, integer)
[16 . . 56] dBm
Length: 9 bytes

Enable High RF Power Fault

Sets whether a detected high RF output power condition is considered a fault and thus contributes to a summary fault condition. This command is only recognized in setup mode.

Type: COMMAND
Pkt Length: 7
Destination: SSPA System Address
Source: M&C Address
Command: 0x29
Data:
Unit ID: (1 byte, integer)
[1 | 2 | 3]
Fault Monitor State: (1 byte, integer)
0 = DISABLE (OFF) High RF power fault is deselected.
1 = ENABLE High RF power fault is selected.
Length: 9 bytes

Set Reflected RF Power Threshold (Reflected power monitor option only)

Sets the threshold above which the reflected RF power is considered to be too high. This command is only recognized in setup mode.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x2A	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Power Threshold:	(1 byte, integer)
	[16 . . 56]	dBm
Length:	9 bytes	

Enable Reflected RF Power Fault (Reflected power monitor option only)

Sets whether the reflected RF output power condition is considered a fault and thus contributes to a summary fault condition. This command is only recognized in setup mode.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x2B	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Fault Monitor State:	(1 byte, integer)
	0 = DISABLE (OFF)	High reflected power fault is deselected.
	1 = ENABLE	High reflected power fault is selected.
Length:	9 bytes	

Enable Auxiliary Fault 1 Input

Enable or disable fault monitoring of Aux 1 input. The signal is active high (or open contacts) meaning a high level or open form C contacts will trigger the fault. In redundant configurations, when enabled this fault will cause external switching to occur.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x3E	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Fault Monitor State:	(1 byte, integer)
	0 = DISABLE (OFF)	Auxilliary fault disabled.
	1 = ENABLE (ON)	Auxiliary fault enabled.
Length:	9 bytes	

Set Control Mode

Establishes the location from which the unit is controlled; local or remote. This command is only recognized in operations mode.

Type: COMMAND
Pkt Length: 7
Destination: SSPA System Address
Source: M&C Address
Command: 0x3D
Data:
Unit ID: (1 byte, integer)
[1 | 2 | 3]
Control Mode: (1 byte, integer)
0 =Local Mode - control from front panel.
1 = Remote Mode - control from parallel or serial ports
Length: 9 bytes

Queries

Queries request specific information from an SSPA. They can be directed to the SSPA system controller or an individual SSPA unit by selecting the appropriate unit ID. Table 3-22 contains a list of the valid queries the M&C can issue and the corresponding response. Only one query can be sent at a time and the M&C system should wait until a valid response is returned from the SSPA system before sending another query.

Table 3-22: Valid M&C queries and associated responses.

Query	Response
Report System Summary	System Summary
Report Unit Faults	Unit Faults
Report Unit Status	Unit Status
Report Unit Diagnostics	Unit Diagnostics
Report Unit Setups	Unit Setups
Report Rev Level	Rev Level

The following paragraphs give detailed descriptions of each query.

Report System Summary

Requests the system or unit summary fault status. The system or unit responds with a terse message that provides a Go/No-Go status.

Type:	QUERY	
Pkt Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x32	
Data:		
	Unit ID:	(1 byte, integer)
	[0 | 1 | 2 | 3]	
Length:	8 bytes	

Report Unit Faults

Requests a detailed fault status from a particular unit.

Type:	QUERY	
Pkt Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x33	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
Length:	8 bytes	

Report Unit Status

Requests a report of the operating parameters of a particular unit.

Type:	QUERY	
Pkt Length;	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x34	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
Length:	8 bytes	

Report Unit Diagnostics

Requests a detailed listing of a particular unit's operating diagnostics, such as voltage monitor readings.

Type:	QUERY	
Pkt Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x35	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
Length:	8 bytes	

Report Unit Setups

Requests a complete listing of a particular unit's setup information.

Type:	QUERY	
Pkt Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x36	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
Length:	8 bytes	

Report Unit Software Revision Level

Requests the software revision level of a particular unit.

Type:	QUERY	
Packet Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x3C	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
Length:	8 bytes	

Responses

When the M&C unit sends a query command, the SSPA responds with the requested information. Some of the response packets contain data in 2's complement form or binary coded decimal (BCD) format. The following sections contain some programming hints on how to interpret such data.

Interpreting 2's complement data

The temperature data sent from the SSPA are 2's complement integers. This permits negative as well as positive temperatures to be transmitted. A discussion of 2's complement integers will not be given here, but a simple routine for interpreting such data is given. The 2's complement data byte can be decoded by sign extending the packet byte to the length of the integer data type in the M&C's machine. The following example shows this technique for expanding the temperature data.

```
unsigned character buf;                 /* one byte of packet data */
int CTemp;                              /* temperature in Celsius */

buf = temperature byte from packet
if ( ( buf & 0x80 ) = = 0x80 )                  /* if MSB is set */
    CTemp = (int) (0xFF00 | buf);       /* set all upper bits, 2-byte integer
else
   CTemp = (int) buf;                   /* temperature is a positive integer
```

Interpreting Binary Coded Decimal (BCD) values

The voltages and currents within the SSPA are interpreted as floating point values. However, to transmit these values, they are encoded in BCD format. Each value is encoded into 2 bytes where each four bits will have a value in the range of [0..9]. Figure 3-8 shows how the data is transmitted and Table 3-23 is used to interpret the data.

Figure 3-8: BCD format.

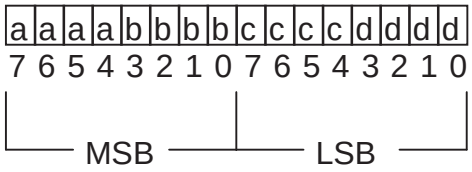
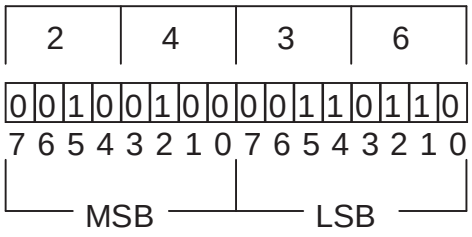


Table 3-23: Interpreting BCD format.

Byte	Bits	Digit	Figure 5 Code
MSB	7-4	tens	aaaa
MSB	3-0	ones	bbbb
LSB	7-4	tenths	cccc
LSB	3-0	hundredths	dddd

As an example, the representation of 24.36 in BCD format is shown in Figure 3-9.

Figure 3-9: Representation of 24.36 in BCD format.



System Summary

Response to a Report System Summary command. The Data field value indicates the general “health” of a particular unit or the entire system.

Type:	RESPONSE	
Pkt Length:	7	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x90	
Data:		
	Unit ID:	(1 byte, integer)
	[0 | 1 | 2 | 3]	
	Summary Fault Status	(1 byte, integer)
	0 = No Go	Unit or system has a summary fault.
	1 = Go	Unit or system does not have a summary fault.
Length:	9 bytes	

When this response is coming from the system controller, Unit ID = 0, the “Go” status indicates that at least one amplifier in the redundant configuration is operational. The “No Go” status indicates that all amplifiers are faulted.

For a standalone unit, Unit ID = 1, 2, or 3, the “Go” status indicates that the amplifier is not faulted. The “No Go” status indicates that the amplifier is faulted. This is the same value as Unit Summary Fault in the Unit Status Response.

Unit Faults

Response to a Report Unit Faults command. The Data field contains a detailed list of fault information for a particular SSPA unit.

Type:	RESPONSE	
Pkt Length:	9	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x91	
Data:		
	Unit ID:	(1 byte, integer)
	[0 | 1 | 2 | 3]	
	RFU1 and RFU2	(1 byte, aggregate)
	Bit 0 = RFU1 Over Temp	0 = OK, 1 = FAULT
	Bit 1 = RFU1 Voltage	0 = OK, 1 = FAULT
	Bit 2 = RFU1 Current	0 = OK, 1 = FAULT
	Bit 3 = RFU2 Over Temp	0 = OK, 1 = FAULT
	Bit 4 = RFU2 Voltage	0 = OK, 1 = FAULT
	Bit 5 = RFU2 Current	0 = OK, 1 = FAULT
	Bit 6 = unused	
	Bit 7 = unused	
	RFU3	(1 byte, aggregate)
	Bit 0 = RFU3 Over Temp	0 = OK, 1 = FAULT
	Bit 1 = RFU3 Voltage	0 = OK, 1 = FAULT
	Bit 2 = RFU3 Current	0 = OK, 1 = FAULT
	Bit 3 = unused	0
	Bit 4 = unused	0
	Bit 5 = +28V Supply Voltage	0 = OK, 1 = FAULT
	Bit 6 = RF Switch 1	0 = OK, 1 = FAULT
	Bit 7 = RF Switch 2	0 = OK, 1 = FAULT
	User Faults	(1 byte, aggregate)
	Bit 0 = Low RF Power	0 = OK, 1 = FAULT
	Bit 1 = High RF Power	0 = OK, 1 = FAULT
	Bit 2 = High Temperature	0 = OK, 1 = FAULT
	Bit 3 = Reflected Power	0 = OK, 1 = FAULT
	Bit 4 = Aux 1	0 = OK, 1 = FAULT
	Bit 5 = unused	0
	Bit 6 = unused	0
	Bit 7 = unused	0
Length:	11 bytes	

Unit Status

Response to a Report Unit Status command. The Data field contains the status of essential operating parameters for a particular unit.

Type:	RESPONSE	
Pkt Length:	15	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x92	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	Control Location	(1 byte, integer)
	0 = Local	
	1 = Remote	
	Configuration Mode	(1 byte, integer)
	0 = Operation	
	1 = Setup	
	RF Muting	(1 byte, integer)
	0 = OFF	
	1 = ON	
	Attenuation	(1 byte, integer)
	[0 .. 20]	dB
	Power	(2 byte, binary coded decimal)
	[0.0 .. 55.0]	+dBm
	Temperature	(1 byte, 2's complement integer)
	[- 99 .. + 99]	°C
	Aux Switch Position	(1 byte, integer)
	0 = NONE	No auxiliary switch
	1 = POS 1	Auxiliary switch in position 1
	2 = POS 2	Auxiliary switch in position 2
	3 = BOTH	Auxiliary switch is stuck between positions
	Unit Summary Fault	(1 byte, integer)
	0 = OK	No summary fault.
	1 = FAULT	Summary fault exists.
Length:	17 bytes	

Unit Diagnostics

Response to a Report Unit Diagnostics command. The Data field contains a detailed list of the voltages and currents for the specified SSPA unit.

Type:	RESPONSE	
Pkt Length:	24	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x93	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	RFU1 Voltage	(2 bytes, binary coded decimal)
	RFU1 Current	(2 bytes, binary coded decimal)
	RFU2 Voltage	(2 bytes, binary coded decimal)
	RFU2 Current	(2 bytes, binary coded decimal)
	RFU3 Voltage	(2 bytes, binary coded decimal)
	RFU3 Current	(2 bytes, binary coded decimal)
	+28V Supply Voltage	(2 bytes, binary coded decimal)
	Ambient Temperature	(1 byte, 2's complement)
	RFU1 Temperature	(1 byte, 2's complement)
	RFU2 Temperature	(1 byte, 2's complement)
	RFU3 Temperature	(1 byte, 2's complement)
Length:	26 bytes	

Unit Setups

Response to a Report Unit Setups command. The Data field contains a list of the setup data for a particular unit.

Type:	RESPONSE	
Pkt Length:	15	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x94	
Data:		
	Unit ID:	(1 byte, integer)
	[1 | 2 | 3]	
	High Temp Threshold	(1 byte, integer)
	[40 .. 80]	°C
	High Temp Fault	(1 byte, integer)
	0 = DISABLED (OFF)	
	1 = ENABLE	
	Low RF Power Threshold	(1 byte, integer)
	[0 .. 55]	dBm
	Low RF Power Fault	(1 byte, integer)
	0 = DISABLED (OFF)	
	1 = ENABLE	
	High RF Power Threshold	(1 byte, integer)
	[0 .. 55]	dBm
	High RF Power Fault	(1 byte, integer)
	0 = DISABLED (OFF)	
	1 = ENABLE	
	Reflected Power Threshold	(1 byte, integer)
	[0 .. 55]	dBm
	Reflected Power Fault	(1 byte, integer)
	0 = DISABLED (OFF)	
	1 = ENABLE	
	Aux 1 Fault	(1 byte, integer)
	0 = DISABLED (OFF)	
	1 = ENABLE	
Length:	17 bytes	

Software Revision Level

Response to a Report Unit Software Revision Level command. The Data field contains an ASCII character that corresponds to the revision level for a particular unit.

Type:	RESPONSE
Packet Length:	7
Destination:	M&C Address
Source:	SSPA System Address
Command:	0x9C
Data:	
	Unit ID (1 byte, integer)
	[0 | 1 | 2 | 3]
	Rev Level: (1 byte, integer)
	(ASCII code for revision character A, B, … Z)
Length:	9 bytes

Command Acknowledged (ACK)

Response to those commands which do not request responses. This packet is issued when the command was accepted by the destination address as being valid.

Type:	RESPONSE
Pkt Length:	7
Destination:	M&C Address
Source:	SSPA System Address
Command:	0x99
Data:	
	Unit ID: (1 byte, integer)
	[0 | 1 | 2 | 3]
	Command being acknowledged (1 byte, integer)
Length:	9 bytes

Command Not Acknowledged (NAK)

Response to those commands which do not request responses. This packet is issued when the command was rejected by the destination address as being invalid.

Type:	RESPONSE
Pkt Length:	7
Destination:	M&C Address
Source:	SSPA System Address
Command:	0x9A
Data:	
	Unit ID: (1 byte, integer)
	[0 | 1 | 2 | 3]
	Command being rejected (1 byte, integer)
Length:	9 bytes

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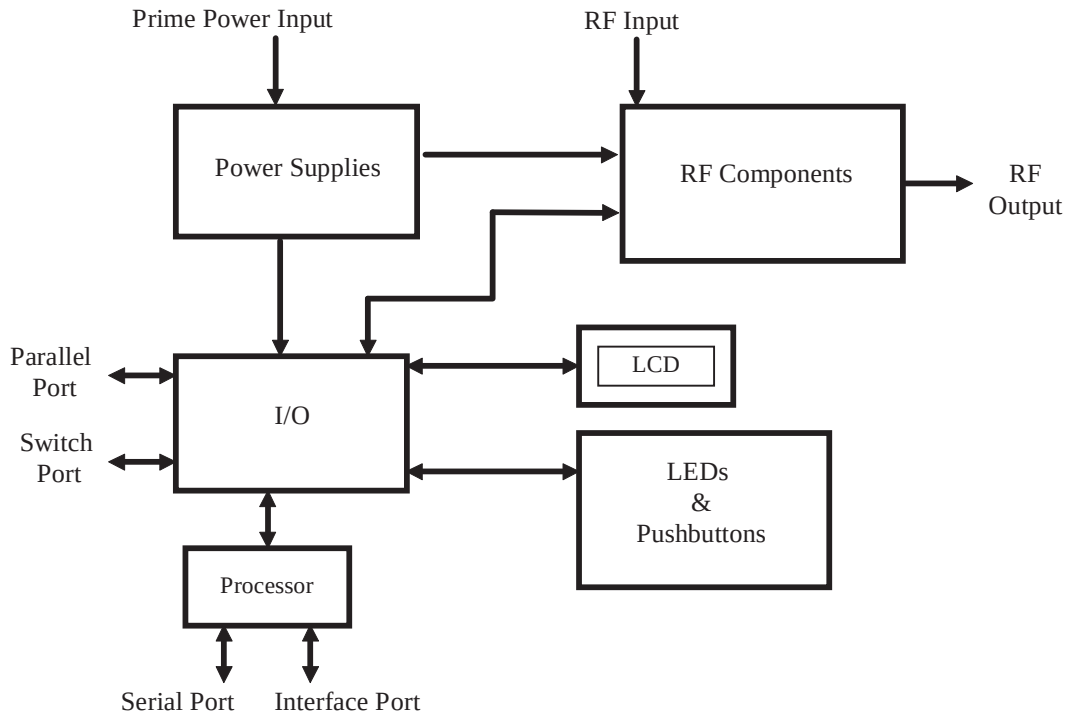
Introduction

This section contains information on the theory of operation of the HPAC-100/125/150/200/250-RM. This includes: simple block diagrams of the system, an explanation of some of the active components, and the fault determination.

Functional Block Diagram

The HPAC unit is comprised of four essential areas: RF components, I/O card with Processor, Power Supplies, and the Interface Mechanisms. Figure 4-1 shows how these elements are linked together.

Figure 4-1: System block diagram.



Figures 4-2 and 4-3 show the basic RF block diagrams for a 2 RF module and 3 RF module unit.

Figure 4-2: 2 RF module block diagram.

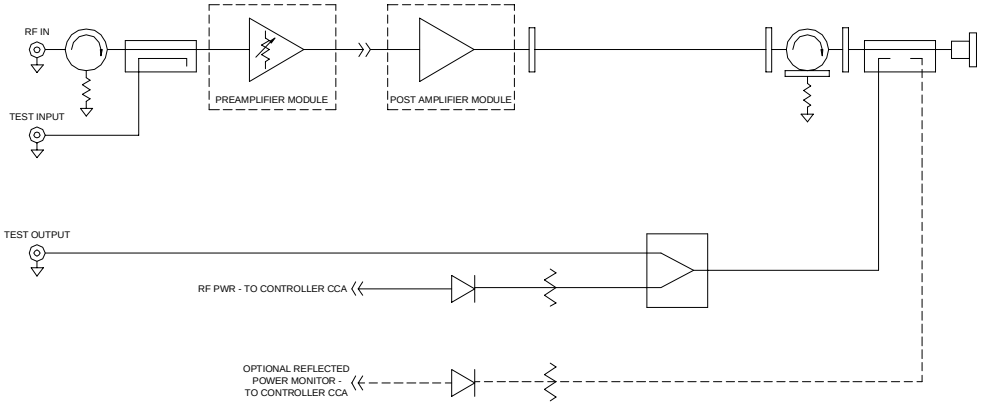
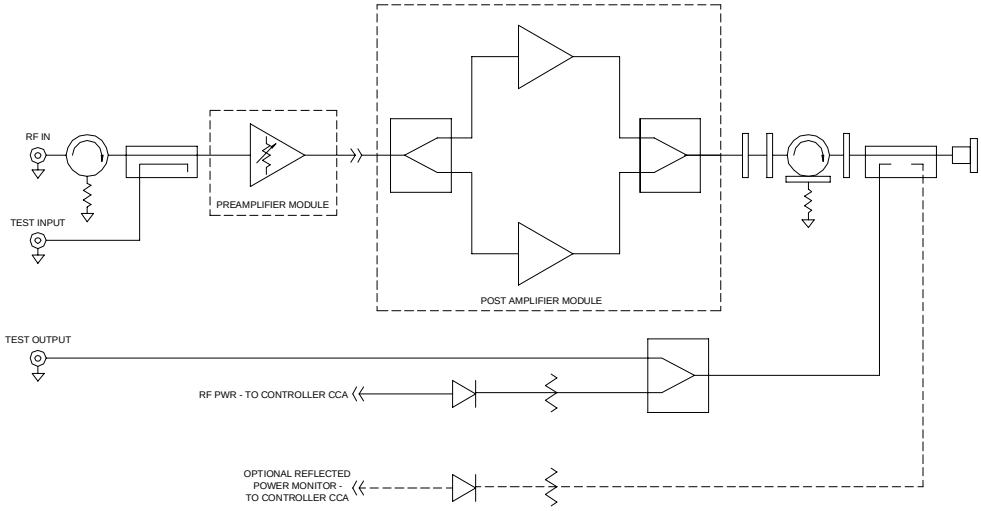


Figure 4-3: 3 RF module block diagram.



As seen in the figure 4-1, the I/O card with the processor has control of all aspects of the unit. All information traveling between the on board components and the user must pass through the processor which permits the processor to have total control.

The amplifier modules, attenuator, power monitor diode, and couplers comprise the RF components. Depending upon the amplifier configuration, the number of these components can differ.

Fault Analysis

The fault analysis in the HPAC is extensive. Figures 4-4 and 4-5 illustrate the monitored faults for the 2 RF module and 3 RF module unit, respectively.

Figure 4-4: Fault monitor points for the 2 RF module unit.

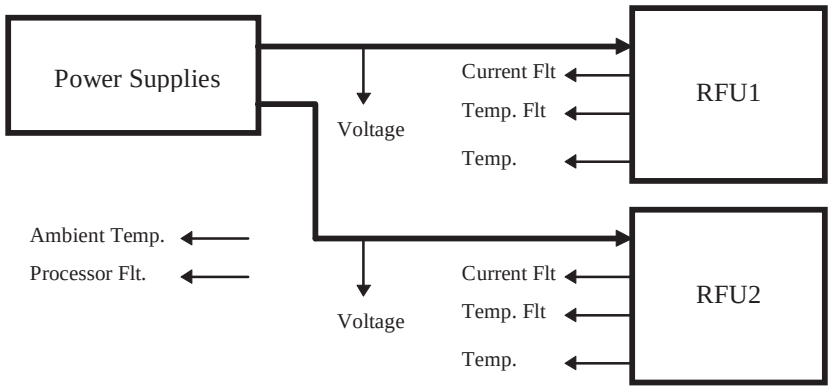
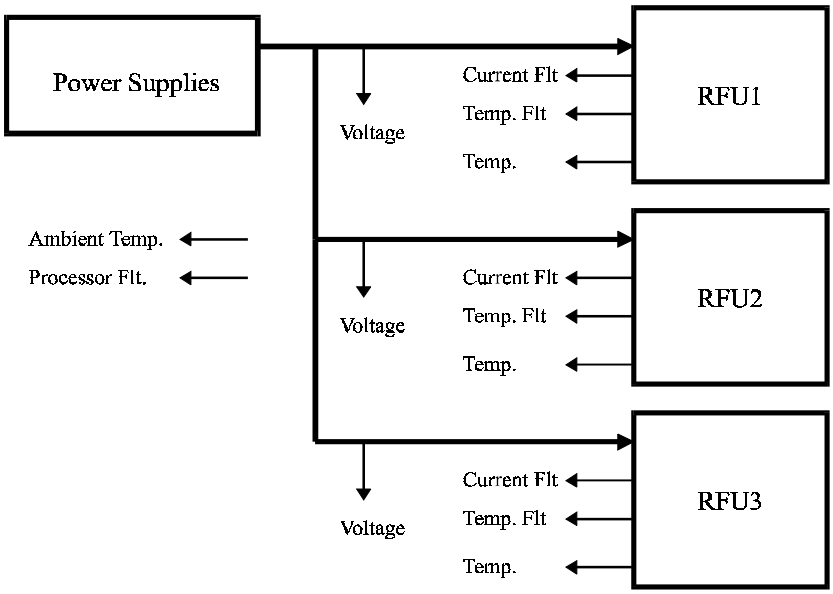


Figure 4-5: Fault monitor points for the 3 RF module.



Each amplifier module contains circuitry to monitor the operating current of the internal FETs as well as the unit temperature. If the currents drop below threshold limits or the module temperature exceeds a threshold limit, a fault signal is transmitted. In addition, the input voltage of each module is monitored to ensure that it stays within specified operating conditions. The user controlled faults for low and high RF power depend upon the voltage of a calibrated detector diode. This voltage is compared via the processor with the user set thresholds to determine fault conditions. The user specified temperature fault is calculated by comparing the maximum temperature of all of the temperature monitors within the rack enclosure to the threshold. Finally, for the reflected power fault option, an additional detector diode is installed to measure the amount of power reflected back into the output of the unit. This voltage again is compared to the user set threshold via the processor.

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Introduction

This section describes some of the standard RF tests performed on the unit before shipment.

RF Specification Tests

Gain and Gain Flatness

The unit gain is swept over the operating frequency range under small signal conditions to confirm the minimum gain and flatness specifications. The RF module is also taken to the temperature extremes and again measurements are taken to verify that the specifications are met.

1 dB Gain Compression Point

The 1 dB gain compression point is measured at discrete frequencies across the band to characterize the output power over the operating frequency range. It indicates the point at which the nonlinearities of the transistors cause a 1 dB decrease in the expected output signal. These measurements are taken at room temperature to meet specification, but they are also measured at the temperature extremes to ensure proper operation.

Input and Output Return Loss

The input and output return losses indicate how closely the amplifier is matched to a 50 Ohm system. The return loss is easily translated into input and output VSWR by the following equation:

$$VSWR = \frac{1+10^{-\frac{RL}{20}}}{1-10^{-\frac{RL}{20}}}$$

A return loss of infinity or a VSWR of 1 indicates a perfect match to a 50 Ohm system. Having mismatches in a system increases the system losses which translates into lower output power and in severe cases, damage to equipment. Frequency swept plots of the return losses are taken.

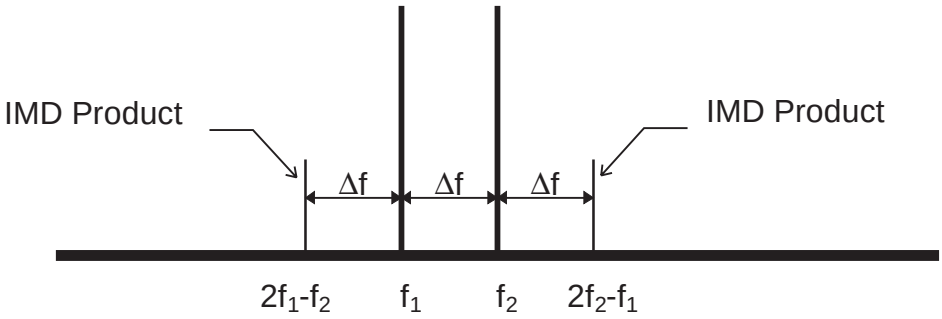
Spurious

Spurious signals are undesirable byproducts of amplifiers caused by nonlinearities within the amplifier and other system level components such as switching power supplies. The unwanted signals cause signal management problems in system applications; constructively or destructively adding with desired signals. When out of band, they can cause interference to other pieces of equipment.

Intermodulation Distortion

The third order intermodulation distortion products are caused by nonlinearities in the system when more than one desired signal is present. Figure 5-1 depicts the two-tone third order IMD products along with the desired signals.

Figure 5-1: Depiction of two tone third order IMD products.



Although $3f_1$ and $3f_2$ are also third order products, the two pictured products are usually considered because they have the possibility of being in the frequency band of interest. The products reduce the total output power of the amplifier and cause interference with other signals and equipment. Because their existence is inevitable, system applications require these unwanted signals be a specified level below the desired tones. The levels of the IMD products vary with the output power of the amplifier. As the unit approaches the 1 dB gain compression point, nonlinearities are higher than when operating at lower power levels. Two tone tests are performed on the RF module at different power levels and at different locations throughout the operating frequency band.

RF Sample Port

Sample port data is measured at discrete frequencies across the band to characterize the internal couplers. The data for the input sample port is measured with respect to the amplifier's input while the data for the output sample port is measured with respect to the amplifier's output.

Front Panel Monitors and Controls

To verify that all front panel controls are functioning, the HPAC-100/125/150/200/250-RM is operated in Local mode. All menu data and controls are verified along with the setting of the user faults and thresholds. The contrast of the front panel LCD is set.

Parallel Port Monitors and Controls

All parallel port monitors and controls are verified. Due to resistor and the digital to analog converter tolerances, the value of the differential power monitor at the amplifier's rated 1dB gain compression point differs slightly between units. This value is measured and recorded on the test data sheet.

Serial Port Monitors and Controls

The HPAC-100/125/150/200/250-RM is operated in Remote mode and a sampling of the serial commands and queries is tested to ensure that the proper responses are received. These tests are performed using RS-232 and RS-485 protocols.

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Introduction

This section contains information on standard maintenance practices and contacting the factory.

Maintenance

Although no regularly scheduled maintenance is required, certain items should be routinely checked. Ensure that the amplifier is operated within the specified temperature range and that the fans and fan screens are free from obstructions. It is imperative that the amplifier receives proper cooling. It is also recommended that all cables and connections be routinely checked for mechanical as well as electrical integrity.

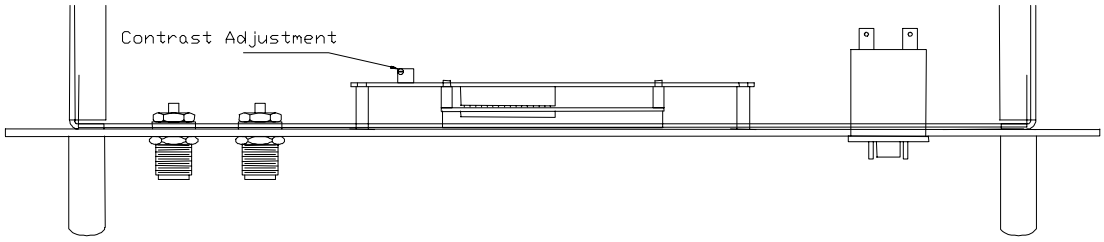
Cover Removal

To access the interior of the HPAC-100/125/150/200/250-RM for user adjustments, the top or bottom covers will have to be removed. Each cover is held in place by eight 1/4 turn Phillips head screws. Turning the screws counter-clockwise loosens them. ***Caution: when tightening, the screw requires only a 1/4 turn before it locks into place. Do not force the screw any further or damage will occur.***

LCD Contrast

The contrast of the LCD can be changed by adjusting a potentiometer located on the front panel board. When the top cover of the HPAC-100/125/150/200/250-RM is removed, this board can be found mounted to the backside of the front panel. Figure 6-1 shows a top view of this board.

Figure 6-1: View of the front panel circuit card.



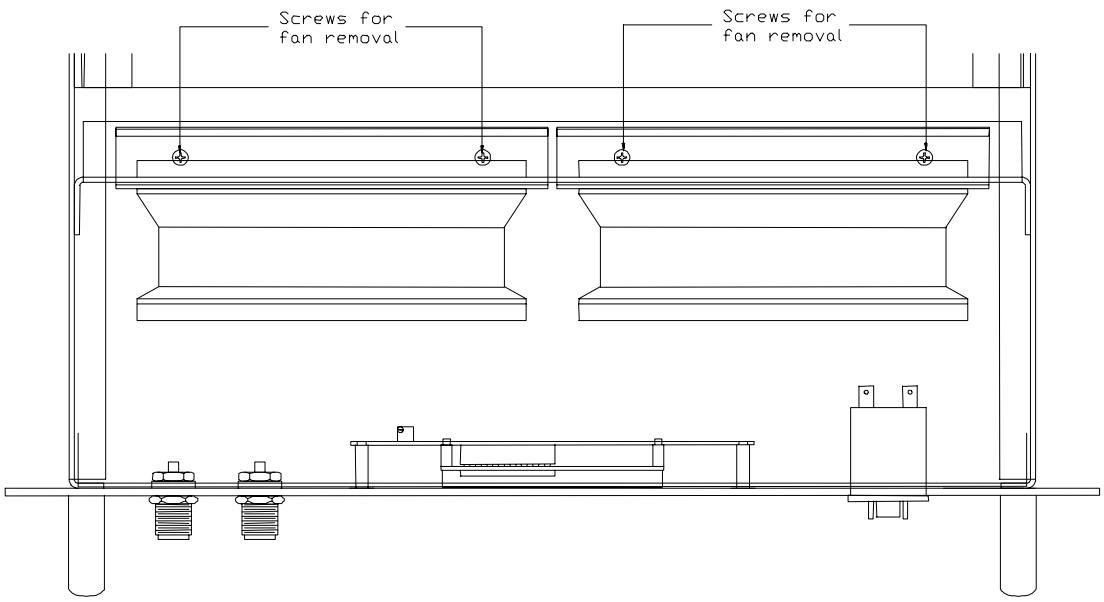
I/O Card Fuses

The fuses on the I/O card, 3AG 3A 250V, are only used when the HPAC-100/125/150/200/250-RM controls an external switch. They are not needed otherwise. Refer to the specific appendix if the external switch or redundant option is ordered.

Fan Removal

Although all fans contained within the enclosure operate on 12 VDC, it is recommended that the unit be powered down to perform this operation! Removing the fans is a simple process once the top cover is removed. As seen in Figure 6-2, each fan bracket is held to the rack by two screws.

Figure 6-2: Removal of HPAC-100/125/150/200/250-RM fans.



To remove a fan, first remove the associated power cord from any holding clamps. Next, remove the power connector from the top of the fan. Finally, remove the two screws holding the fan bracket in place and lift the fan bracket from the unit.

To reinstall a fan, follow the above directions in the reverse order.

Ordering Information

If questions arise over the operation or maintenance of the HPAC-100/125/150/200/250-RM unit and associated parts, contact Paradise Datacom at the below address, phone number, fax number, or e-mail address.

Paradise Datacom LLC
1012 East Boal Avenue
Boalsburg, PA 16827 USA
Phone: (814) 466-6275
Fax: (814) 466-3341
E-mail: sales@paradisedata.com

Paradise Datacom Ltd
1 Wheaton Road
Witham, Essex, CM8 3TD England
Phone: +44(0)1376 515636
Fax: +44(0)1376 533764
E-mail: sales@pardise.co.uk

If replacement parts are necessary, identify all parts by their Paradise Datacom part number or the manufacturer's part number. When contacting Paradise Datacom, include:

a. Instrument model number
b. Instrument serial number
c. Description of the part
d. Location or function of the part

Warranty Information

Refer to the WARRANTY AND MATERIAL RETURN INFORMATION sheet that was shipped with the unit.

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HPAC-100/125/150/200/250-RM Product Literature

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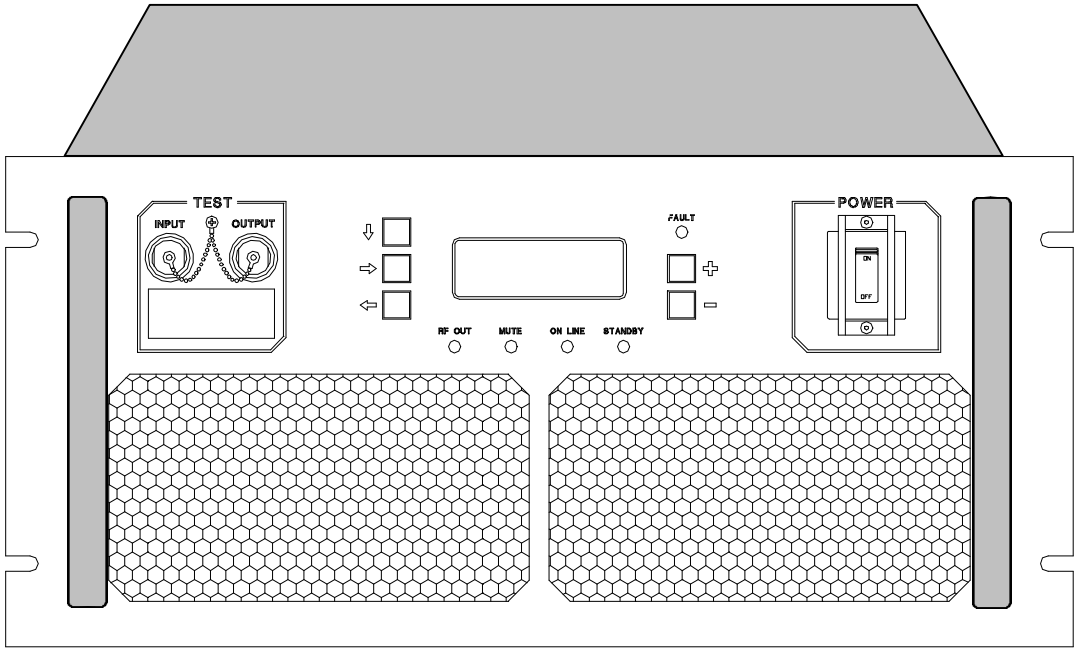
C-Band SSPA; Rack Mount

Model:

HPAC-100, 125, 150, 200 & 250-RM

PARADISE DATACOM
AN INTELEK GROUP COMPANY



Description:

Solid state power amplifiers in the HPAC series offer premium performance and reliability for satellite uplink applications. These C-Band high power amplifiers (100 through 250 watts) provide the linearity and gain stability required for earth station performance in a package that offers the system designer an easy path to integration. A full range of monitor and control features are included in the standard configuration, eliminating the need for detailed option selection with each installation. The long-term reliability of the system is ensured by a thorough approach to thermal management to keep key components in a safe operating range in all rated conditions. With reliable power at guaranteed levels, solid state linearity, reliable thermal management, and a full complement of front panel, serial, and parallel interfaces, the HPAC series offers the most flexible solution available for satellite earth station uplink.

Features:

- Solid State Performance for Multicarrier Applications
- Complete Monitor and Control Capabilities
- Front Panel Keys & LCD for Local M & C
- RS-232/422/485 Serial Interface for Remote M & C
- Parallel I/O; Form C Contact Closure Outputs & Opto-Isolated Inputs
- Temperature Compensation
- 20 dB Gain Adjustment
- RF Input/Output Sample Port

System Options:

- 1:1 Redundant System
- 1:2 Redundant System
- DC Operation

Paradise Datacom LLC
1012 East Boal Avenue
Boalsburg, PA 16827
USA
Telephone: +1 814 466 6275
Fax: +1 814 466 3341

www.paradise.co.uk

Paradise Datacom Ltd
1 Wheaton Road, Witham
Essex, CM8 3TD
United Kingdom
Telephone: +44(0) 1376 515636
Fax: +44(0) 1376 533764

C-Band SSPA; Rack Mount

Model:

HPAC-100, 125, 150, 200 & 250-RM

PARADISE DATACOM
AN INTELEK GROUP COMPANY

PARAMETER	NOTES	LIMITS	UNITS
Electrical			
Frequency Range		5.850 to 6.425	GHz
Output Power @ 1dB Gain Compression (P_{1dB})	HPAC-100A-RM HPAC-125A-RM HPAC-150A-RM HPAC-200A-RM HPAC-250A-RM	49.8 (min.) 50.6 (min.) 51.5 (min.) 52.5 (min.) 53.8 (min.)	dBm dBm dBm dBm dBm
Output Power @ Saturation	HPAC-100A-RM HPAC-125A-RM HPAC-150A-RM HPAC-200A-RM HPAC-250A-RM	50.3 (min.) 51.1 (min.) 52.0 (min.) 53.0 (min.) 54.3 (min.)	dBm dBm dBm dBm dBm
Gain Gain Flatness Gain Slope Gain vs. Temperature Gain Adjustment Range	@ 0 Attenuation Full band Over operating temperature 1 dB steps	80 (min.) ±1.00 0.5 ±1.0 20 (min.)	dB dB dB/40 MHz dB dB
Intermodulation Distortion (Third Order)	For two tones with composite power: 6dB below rated P_{1dB} 3dB below rated P_{1dB}	 -36 -26	 dBc dBc
AM/PM Conversion	@ rated P_{1dB}	2	^{o}/dB
Spurious Harmonics	@ rated P_{1dB} @ rated P_{1dB}	-60 -40	dBc dBc
Input/Output VSWR		1.3:1	
Noise Figure		10	dB
Group Delay (per 40 MHz segment)	Linear Parabolic Ripple	0.03 0.003 1.0	ns/MHz ns/MHz^2 ns p-p
Line Voltage Line Frequency Line Power	HPAC-100A/125A/150A-RM HPAC-200A/250A-RM HPAC-100A-RM HPAC-125A-RM HPAC-150A-RM HPAC-200A-RM HPAC-250A-RM	100-120 or 200-240 200-240 47-63 0.90 1.00 1.25 1.50 1.65	VAC VAC Hz kW kW kW kW kW
Monitor & Control User Interface:	 Local Remote	 Front panel LCD/keypad Serial port Parallel port	 Menu-driven RS-232, 422,485 (4-wire) Form-C outputs, opto-isolated inputs
Mechanical			
Size	width X height X depth	19.0 X 8.75 X 24.0 483 X 222 X 610	in. mm.
Weight		75 34	lbs. kg
Finish	Front Panel	Paint	Gray; enamel
Connectors	RF Input RF Output RF In/Out Sample Line Power Serial I/O Parallel I/O	Type N WR137 Waveguide Type N IEC 9-pin D 37-pin D	Female CPR137G flange Female Plug Socket Socket
Environmental			
Operating Temperature	Ambient	0 to +50	^{o}C
Relative Humidity	Non-condensing	95	%
Optional Features			
Reflected Power Monitor	(-1 P/N Suffix)		(Option 1)
DC Option	(-2 P/N Suffix)	36-76	VDC (Option 2)
SMA; RF Input	(-3 P/N Suffix)	SMA Type	Female (Option 3)

NOTE: *Specifications subject to change without notice*

C-Band SSPA; Rack Mount

Model:

HPAC-100, 125, 150, 200 & 250-RM

PARADISE DATACOM
AN INTELEK GROUP COMPANY

PARAMETER	NOTES	LIMITS	UNITS
Electrical			
Frequency Range		5.850 to 6.725	GHz
Output Power @ 1dB Gain Compression (P_{1dB})	HPAC-100AX-RM HPAC-125AX-RM HPAC-150AX-RM HPAC-200AX-RM	49.5 (min.) 50.3 (min.) 51.2 (min.) 52.2 (min.)	dBm dBm dBm dBm
Output Power @ Saturation	HPAC-100AX-RM HPAC-125AX-RM HPAC-150AX-RM HPAC-200AX-RM	50.0 (min.) 50.8 (min.) 51.7 (min.) 52.7 (min.)	dBm dBm dBm dBm
Gain Gain Flatness Gain Slope Gain vs. Temperature Gain Adjustment Range	@ 0 Attenuation Full band Over operating temperature 1 dB steps	80 (min.) ±1.00 0.5 ±1.0 20 (min.)	dB dB dB/40 MHz dB dB
Intermodulation Distortion (Third Order)	For two tones with composite power: 6dB below rated P_{1dB} 3dB below rated P_{1dB}	 -36 -26	 dBc dBc
AM/PM Conversion	@ rated P_{1dB}	2	°/dB
Spurious Harmonics	@ rated P_{1dB} @ rated P_{1dB}	-60 -40	dBc dBc
Input/Output VSWR		1.3:1	
Noise Figure		10	dB
Group Delay (per 40 MHz segment)	Linear Parabolic Ripple	0.03 0.003 1.0	ns/MHz ns/MHz^2 ns p-p
Line Voltage Line Frequency Line Power	HPAC-100AX/125AX-RM HPAC-150AX/200AX-RM HPAC-100AX-RM HPAC-125AX-RM HPAC-150AX-RM HPAC-200AX-RM	100-120 or 200-240 200-240 47-63 0.90 1.00 1.25 1.50	VAC VAC Hz kW kW kW kW
Monitor & Control User Interface:	 Local Remote	 Front panel LCD/keypad Serial port Parallel port	 Menu-driven RS-232, 422,485 (4-wire) Form-C outputs, opto-isolated inputs
Mechanical			
Size	width X height X depth	19.0 X 8.75 X 24.0 483 X 222 X 610	in. mm.
Weight		75 34	lbs. kg
Finish	Front Panel	Paint	Gray; enamel
Connectors	RF Input RF Output RF In/Out Sample Line Power Serial I/O Parallel I/O	Type N WR137 Waveguide Type N IEC 9-pin D 37-pin D	Female CPR137G flange Female Plug Socket Socket
Environmental			
Operating Temperature	Ambient	0 to +50	°C
Relative Humidity	Non-condensing	95	%
Optional Features			
Reflected Power Monitor	(-1 P/N Suffix)		(Option 1)
DC Option	(-2 P/N Suffix)	36-76	VDC (Option 2)
SMA; RF Input	(-3 P/N Suffix)	SMA Type	Female (Option 3)

NOTE: *Specifications subject to change without notice*

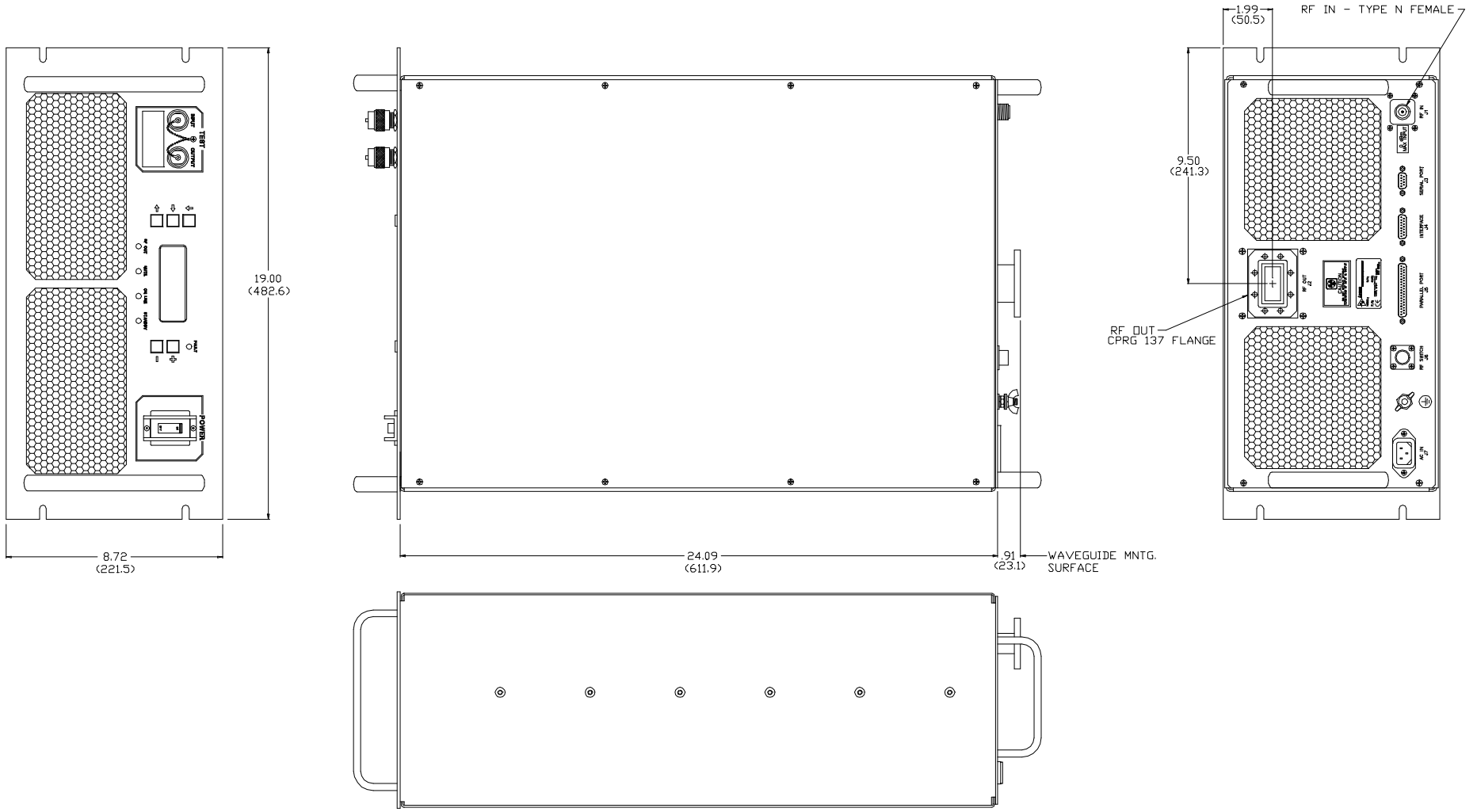
C-Band SSPA; Rack Mount

Model:

HPAC-100, 125, 150, 200 & 250-RM

PARADISE DATACOM

AN INTELEK GROUP COMPANY

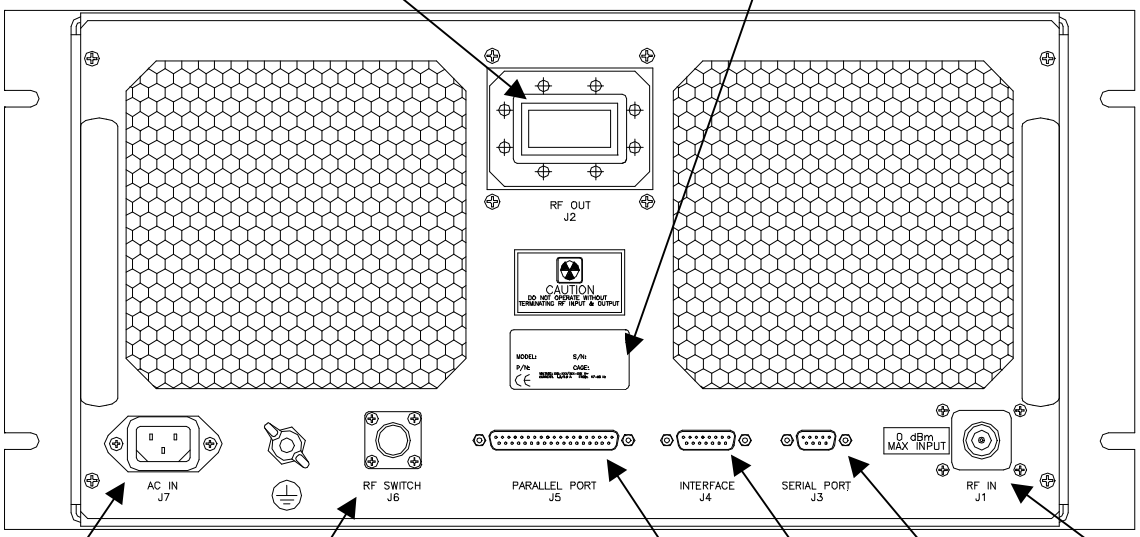


C-Band SSPA; Rack Mount
Model:
HPAC-100, 125, 150, 200 & 250-RM

PARADISE DATACOM
AN INTELEK GROUP COMPANY

J2: **RF Output**,
WR 137 Waveguide
With CPR137G Flange

Product Identification Label:
Contains Equipment Model Number,
Equipment Serial Number,
Manufacturer Information



J7: **AC Line Entrance**,
IEC Socket

J6: **RF Switch**, Provides power to waveguide/coaxial switches used in

J1: **RF Input**,
Type N female

J5: **Parallel Port,**
Provides dry contact closures for the following conditions:
- RF amplifier fault
- Over-temperature fault
- Power supply fault

} Summary Fault

- Microprocessor fault
- RF mute status
- Low RF output

Provides analog voltage outputs for monitoring:
- RF output power, balanced output (0-5 vdc)
  - +0.1 v/dB, 5.0 v @ rated output
- Amplifier case temperature (2.5-5.0 vdc)
  - +0.01v/deg. C, 2.73 v = 0 deg. C

Accommodates opto-isolated TTL level control inputs for:
- RF mute/un-mute
- Fault reset

Accommodates analog voltage inputs for:
- Attenuation control (0-2 vdc)

J3: **Serial Port**, Supports operation from a standard RS232, 422, or 4-wire 485 communications bus.

J4: **Local Interface**, Used as a local communications port when the amplifier is configured for use with other Locus Communications Products' equipment such as redundant system applications, phase combining applications, or when a remote control panel is required.

Operation of a 1:1 Redundant HPAC-100/125/150/200/250-RM

Introduction

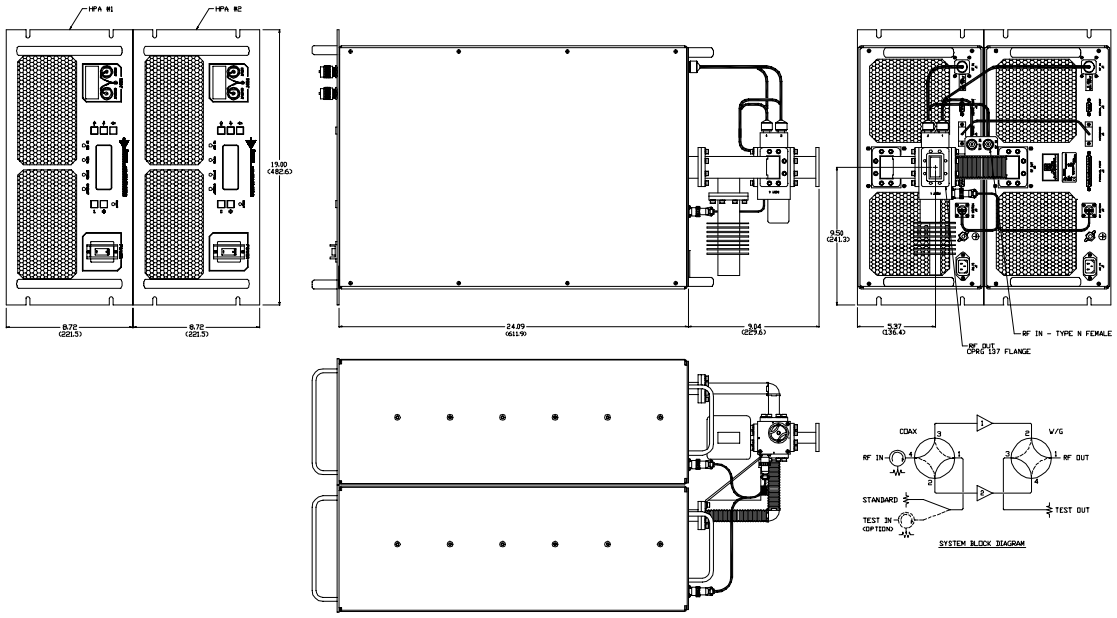
Two HPAC-100/125/150/200/250-RM units can be connected in a one for one (1:1) redundant configuration. This configuration automatically switches in an operating amplifier if the on-line amplifier develops a system fault. Because each amplifier contains a microprocessor, an additional controller is not required. Only one serial connection is necessary for remote operation of the system. The amplifiers communicate to each other using the Interface cable.

Two HPAC-100/125/150/200/250-RM amplifiers are connected to each other and to a waveguide/coaxial switch. One of the amplifiers is designated as being “on-line” while the other is “standby”. The on-line amplifier receives the input RF signal and amplifies it while the standby amplifier input and output are terminated into 50 ohm loads. When the system is in “AUTO” mode, if a summary fault develops within the on-line amp, the waveguide/coaxial switch changes position to put the non-faulted standby amp on-line. The entire process takes nominally 200ms. If a problem occurs during switching a system summary fault, switch fault, is issued.

This Appendix describes how to control the redundant system from the front panel of either amplifier or via the serial port.

An outline drawing of the system is shown in Figure B-1.

Figure B-1: Outline of the 1:1 redundant HPAC-100/125/150/200/250-RM rack mounted system.



Hardware

HPAC-100/125/150/200/250-RM units

Two HPAC-100/125/150/200/250-RM units are used for a 1:1 redundant configuration. They communicate with each other through the interface cable passing system controller information, serial information, and fault information. The units distinguish themselves by their factory set local addresses.

Power Supply

Each amplifier contains a +28V power supply to supply power to the waveguide/coaxial switch.

RF Switch

The HPAC-100/125/150/200/250-RM redundant system controls a -28V waveguide/coaxial switch using the 6-pin rear panel connector. The switches are controlled by applying +28V to the common of the switch and pulsing either position to ground. The system then verifies the position of each switch.

Switch Connector

The 6-pin circular connector (MS3112E10-6S) on the rear panel is used to interface with the switch. Table B-1 lists each pin function.

Table B-1: Switch connector pin out.

Pin	Function
A	Position 1 Drive
B	+28V Common
C	Position 2 Drive
D	NC
E	NC
F	NC

Interface Connector

The 15 socket D interface connector allows the two amplifiers to communicate with each other. ***This cable should not be removed during operation! The system will not operate properly.***

Fuses

When in a 1:1 redundant configuration, F1 and F2 on the processor board must be installed. F1 is the fuse associated with switch position 1 and F2 is associated with switch position 2. If either fuse is cleared, then the system will not be able to switch to the corresponding position. Each fuse should be of type 3AG with a value of 3 Amperes 250 Volts.

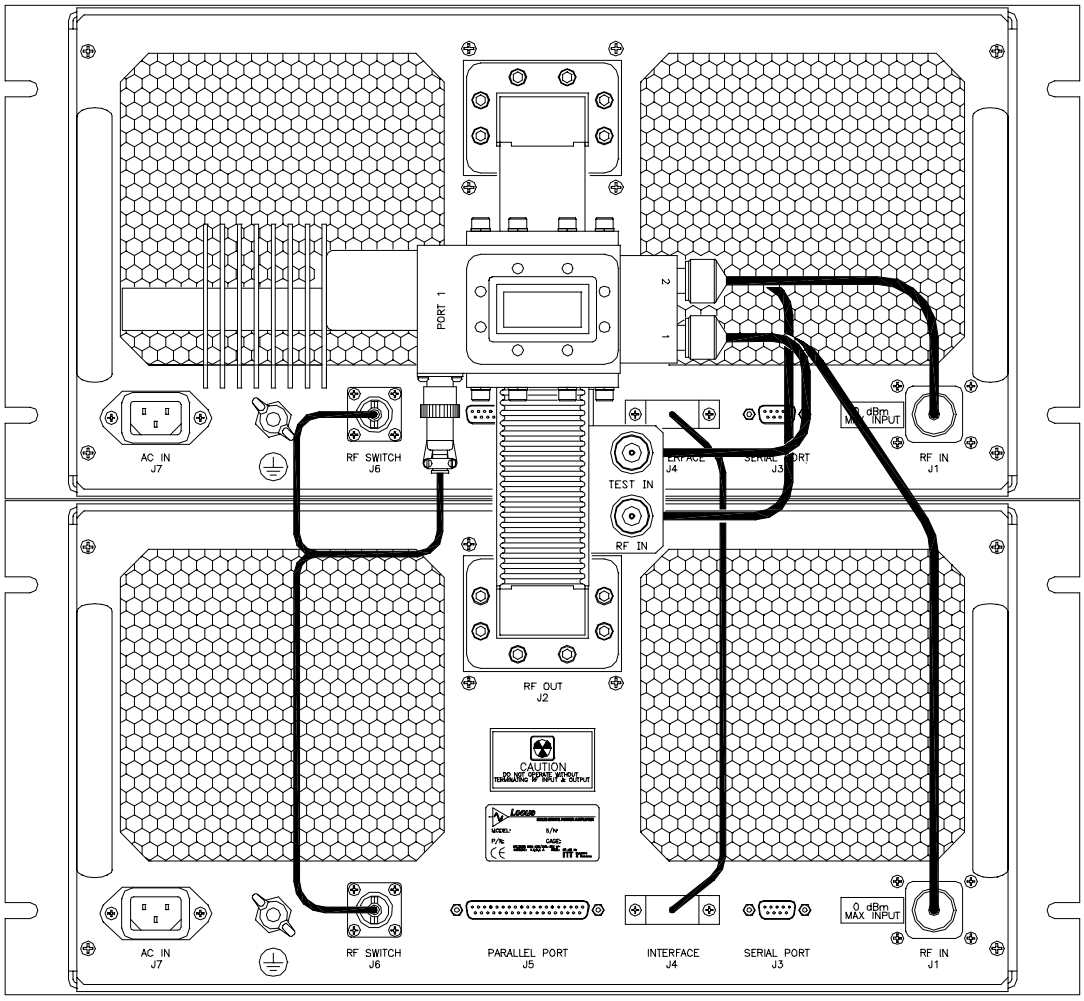
Installation

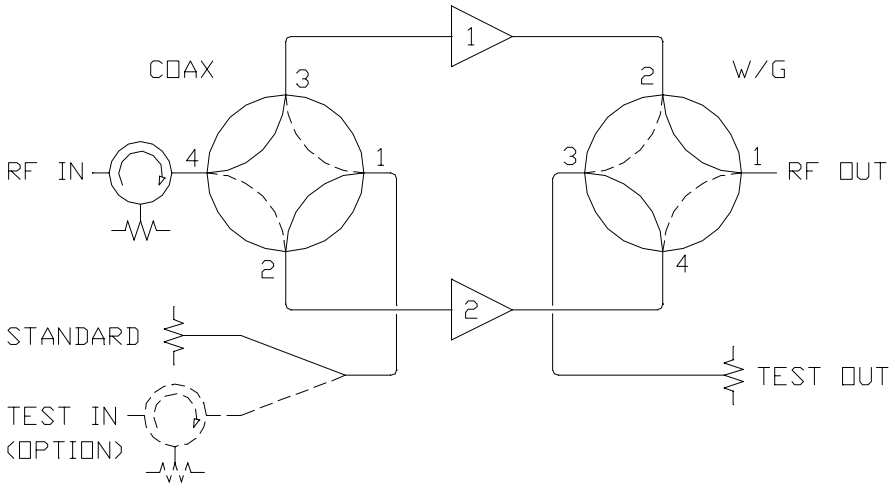
The two HPAC-100/125/150/200/250-RM units are designed to be installed in a standard EIA rack. ***Warning: Ensure that the rack is properly supported to prevent it from tipping forward when the amplifiers are extended on their slides.*** Amplifier 2 should be on top of amplifier 1. Waveguide pieces, semi-rigid cables (marked with the amplifier/switch connections), switch cable, and the interface cable connect the two units as shown in Figure B-2. Table B-2 lists the required coaxial connections. Ensure that all connections are tightened properly.

Table B-2: Switch connections.

Switch Port	Connection	Device
SW1, Port 1	Termination or Test In	50 Ohm Termination or Semi-rigid, W1
SW1, Port 2	Amp2 Input	Semi-rigid, W2
SW1, Port 3	Amp1 Input	Semi-rigid, W3
SW1, Port 4	RF In	Semi-rigid, W4

Figure B-2: Rear view of the 1:1 redundant HPAC-100/125/150/200/250-RM rack mounted system.





SYSTEM BLOCK DIAGRAM

Attach the 15 pin interface cable to the interface ports on each amplifier. Attach the switch control cable to the amplifiers and the switches. Ensure that the A1 labeled connector connects to amplifier 1, the A2 labeled connector connects to amplifier 2.

DIP Switch Selections

The user configurable DIP switches have the same functions as for a stand-alone unit. Several of the factory set DIP switches change.

System Architecture

To differentiate the amplifier as being part of a 1:1 redundant system, S6 pin-7 is set to “ON” and S6 pin 8 is “OFF”.

Local Address

To serially communicate with the individual amplifiers as well as the system, each amplifier is assigned a unit ID. This ID is set using pin-1 and pin-2 of S7. To designate an amplifier as unit 1, pin-1 is set to “ON”, pin-2 to “OFF”. To designate an amplifier as unit 2, pin-1 is set to “OFF”, pin-2 to “ON”.

Front Panel Operation

The system can be controlled from the front panel of either amplifier using the keypad and LCD display. The LEDs on the front panels indicate the state of the specific amplifier, refer to Table 3-1.

Operations Menu

The OPS menu has several additions for changing the system parameters.

Switch Voltage

A monitor is provided to ensure that the additional +28V supply is operating correctly. This voltage is viewed on line 2 of the OPS menu

Set Switching Mode

The Switching Mode selection is added to line three of the OPS menu. When active, the “+” or “-” keys will toggle the mode between Auto and Manual. When the system is in Auto mode, automatic amplifier switching occurs when the on-line amp registers a summary fault. When in Manual mode, automatic switching does not occur, however, a system summary fault is registered. The user must manually issue the command through the Set Standby Amp command from the front panel or the serial port.

Set Standby Amp

This entry is added to line three of the OPS menu. When active, the “+” or “-” keys will toggle the system standby amplifier. This command is only accepted when the Switching Mode is set to Manual. If an amplifier has faulted when the system is in

Manual mode, this control provides the means for switching the system configuration.

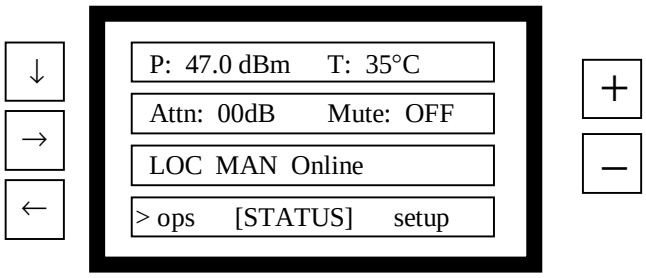
Mute Status

The front panel mute LED on each unit indicates the mute status of the individual amplifier. Line three of the OPS menu has two provisions for muting. System mute/unmute controls both amplifiers simultaneously. Unit mute/unmute controls the individual unit the command is issued to via front panel or remote.

Status Menu

Figure B-3 shows an example Status Menu screen for a redundant system. Line 1 shows the output power of the amplifier and its temperature. Line two shows the attenuation setting of the amplifier and the mute status of the system.

Figure B-3: Status Menu for a redundant system.



Line 3 is divided into four fields. The first field indicates the control location: LOC for local or REM for remote. The second field indicates the switching mode: MAN for manual or AUTO for auto. The third field indicates the amplifier status: Stdby for standby or On-line for on-line. The fourth field indicates the amplifier's fault status: FLT to indicate a fault (see line one of the OPS menu for the detailed fault description) or <blank> for no summary faults.

Remote Operation

Parallel Port

The only redundant function accessible from the parallel port is the capability to monitor the position of the RF switch. Table 3-3 shows the proper sockets to monitor on the parallel port. Switch 2 is not used in an HPAC 1:1 redundant system.

Serial Port

All functions available on the front panel are also available through the serial interface. The mode of control on line 3 of the OPS menu must be set to "REM" or the serial command, set control mode to remote, must be sent.

Communication Protocol

A user's M&C system can only communicate with a redundant system via an RS-485 interface.

Commands

The commands associated with a stand-alone unit are valid with the following additions. The response to each new command is ACK or NAK.

Set Switching Mode

Determines whether the RF switching occurs automatically or manually when a summary fault is registered.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x30	
Data:	Unit ID:	(1 byte, integer)
	[0]	system controller
	Switching Mode:	(1 byte, integer)
	0 = Manual	No switching on summary fault.
	1 = Auto	Switching occurs on summary fault.
Length:	9 bytes	

Select Standby Amp

Selects which SSPA unit is designated as the standby amplifier. This command is not acknowledged if the switching mode is set to Auto.

Type:	COMMAND	
Pkt Length:	7	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x31	
Data:	Unit ID:	(1 byte, integer)
	[0]	system controller
	Standby Amp:	(1 byte, integer)
	1 = Amp1	Set amp 1 as the standby amplifier.
	2 = Amp2	Set amp 2 as the standby amplifier.
Length:	9 bytes	

Queries

All queries associated with a stand-alone unit are valid, however, the queries *Report Unit Faults* and *Report Unit Diagnostics* contain additional information.

Report System Summary can be used as a system query or as a unit query. When this response is coming from the system controller, Unit ID = 0, the "Go" status indicates that at least one amplifier in the redundant configuration is operational. The "No Go" status indicates that all amplifiers are faulted.

For a standalone unit, Unit ID = 1 or 2, the “Go” status indicates that the amplifier is not faulted. The “No Go” status indicates that the amplifier is faulted. This is the same value as Unit Summary Fault in the Unit Status Response.

Report System Status

Requests a list of information pertaining to the system of SSPAs. A System Status response is returned.

Type:	QUERY	
Pkt Length:	6	
Destination:	SSPA System Address	
Source:	M&C Address	
Command:	0x37	
Data:	Unit ID:	(1 byte, integer)
	[0]	system controller
Length:	8 bytes	

Responses

The Unit Faults and Unit Diagnostics responses have been modified to contain additional information. Please refer to the appropriate Section 3 text. Also, a new response was added.

System Status

Response to the Report System Status command. Contains data pertaining to the redundant system status.

Type:	RESPONSE	
Pkt Length:	16	
Destination:	M&C Address	
Source:	SSPA System Address	
Command:	0x95	
Data:	Unit ID:	(1 byte, integer)
	[0]	
	Switching Mode	(1 byte, integer)
	0 = Manual	
	1 = Auto	
	Control Location	(1 byte, integer)
	0 = Local	
	1 = Remote	
	Switch 1 Position	(1 byte, integer)
	1 = Position 1	
	2 = Position 2	
	Switch 2 Position	(1 byte, integer)
	1 = Position 1	
	2 = Position 2	
	Standby Amp	(1 byte, integer)
	1 = Amp 1	
	2 = Amp 2	
	Amp 1 Summary Fault	(1 byte, integer)
	0 = OK	
	1 = Fault	
	Amp 2 Summary Fault	(1 byte, integer)
	0 = OK	
	1 = Fault	
	Amp 3 Summary Fault	(1 byte, integer)
	0 = OK	
	1 = Fault	
	RF Switch 1 Fault	(1 byte, integer)
	0 = OK	
	1 = Fault	
	RF Switch 2 Fault	(1 byte, integer)
	0 = OK	
	1 = Fault	
Length:	18 bytes	

Manual Switching

If necessary, the system can be switched manually by turning the red knob on top of each switch. A cover is installed over the manual override knob when sealed switches are provided. To access the knob, remove cover. The system must be in Manual Mode to perform this operation.

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