1:2 Redundant LNA/LNB Systems Operation and Maintenance Manual

Document Number 11314, Revision C, May 24, 2000

This manual applies to the following VertexRSI
1:2 Redundant LNA/LNB Systems:
LRC-1200, LRK-1200, LRL-1200, LRX-1200,
BRC-1200, BRK-1200, and similar products
using the RSC-1200 1:2 Redundancy Controller.

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Section 1 General Information

1.1 How to Use This Manual

This manual contains information on how to install, operate and maintain the VertexRSI 1:2 Redundant Low Noise Amplifier (LNA) or Low Noise Block Converter (LNB) System. Information is organized according to section, with index tabs for convenience. Within each section the pages, Figures and Tables are numbered by section and by order of appearance within the section.

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

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

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

1.2 Safety Information

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

Before applying power, verify that the equipment has been set to match the available line voltage and that the correct fuse is installed.

An uninterruptable safety earth ground must be provided from the main power source to the input wiring terminals through the power cord set. The equipment is supplied with a three conductor AC power cable, which must be connected to a grounded outlet or be used with a three-wire to two-wire adapter with the green grounding wire firmly connected to an electrical ground at the power outlet.

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

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so. Do not replace components with the power cable connected. Capacitors within the equipment may still be charged even if the power cable has been disconnected. Discharge before touching.

WARNING Adjustments described in this manual are performed with power applied while protective covers are removed. Always be careful not to come into contact with dangerous voltages while performing these procedures and never work alone.

For continued protection against fire hazard, replace the line fuse(s) only with fuse(s) of the same current rating and type (normal or slo-blo).

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

1.3 General Introduction

This technical manual provides installation, operation and service instructions for the VertexRSI 1:2 Redundant LNA/LNB System.

The system has one standby amplifier/block converter and two main amplifiers/block converters (1:2). A variety of LNAs/LNBs are available, depending on the frequency band and the noise temperature options desired. This manual

shows the standard system without any options. For a description of the options ordered with your system, see Section 8, System Configuration.

1.4 Purpose of Equipment

Down time must be minimized in today's complex systems. The failure of a single LNA/LNB unit can put a system off the air. Designed to minimize down time, the VertexRSI 1:2 Redundant LNA/LNB System monitors the status of its LNA or LNB units and switches the standby unit on-line when a failure of either primary unit is detected.

1.5 Equipment and Accessories Supplied

The typical VertexRSI 1:2 Redundant LNA/LNB System, illustrated in Figure 1-1, consists of the items in Table 1-1.

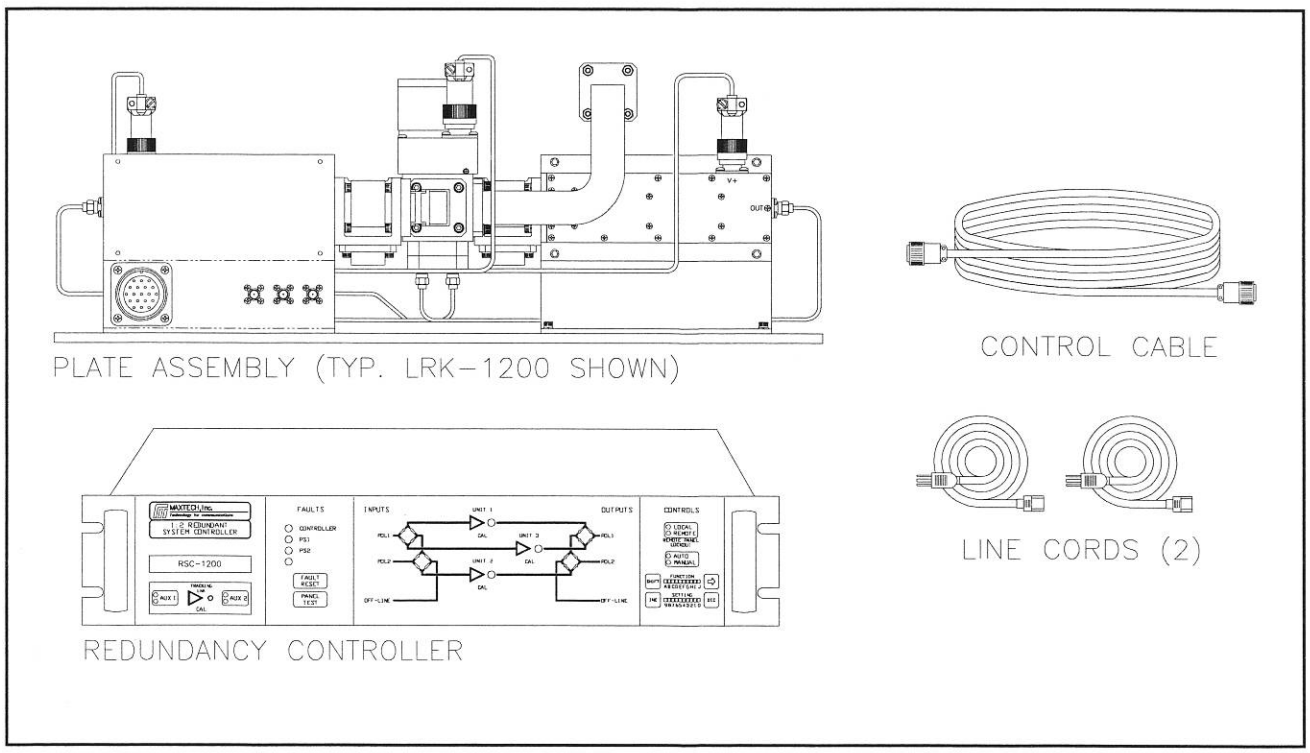


Figure 1-1. Typical 1:2 Redundant LNA/LNB System with Accessories Supplied

Table 1-1 List of Equipment and Accessories Normally Supplied

Quantity	Description
1	Indoor Redundancy Controller
2	Line Cord, USA
1	Operation and Maintenance Manual
1	Outdoor Plate Assembly
100 ft (30 m)	Interconnect Cable, Standard Service, with connectors

1.6 Options Available

The following options are available for the redundant system. Some are only available at time of order; others can be field installed. Contact the factory for more information.

- Chassis slides
- Control cable—up to 300 m (1000 ft) length, Ku-band systems; or up to 150 m (500 ft), L-, C- and X-band systems
- Control cable for direct burial service; lengths as above
- Transmit reject filters
- Offline amplifier input and/or output test ports
- Input and/or output directional couplers
- Remote control panel
- Upgrade to Dual 1:1 configuration
- Noise source (one or two)
- Tracking LNA support

Refer to Section 8, System Configuration, for the exact configuration of your system and the options installed.

1.7 Specifications

Refer to the specification sheet included in Section 8, System Configuration, for performance specifications of the VertexRSI 1:2 Redundant LNA/LNB System.

Section 2 Installation

2.1 General Introduction

To install the VertexRSI 1:2 Redundant LNA/LNB System, use the information contained in this section.

- Inspect the equipment before installation. See **Inspection**, Section 2.2.
- To install the equipment, see **Mechanical Installation** procedures in Section 2.3.
- For electromagnetic compatibility requirements, see **CE Compliance**, Section 2.4.
- To connect to the controller, see **Controller Interfaces**, Section 2.5.
- To connect to the plate assembly, see **Plate Assembly Interfaces**, Section 2.6.
- To configure various features and options prior to operation, see **Configuration**, Section 2.7.

2.2 Inspection

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

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

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

E2.3 Mechanical Installation

Install the system in three parts:

- Indoor controller
- Outdoor plate assembly
- Interconnecting control cable

2.3.1 Indoor Controller

The indoor controller for the 1:2 Redundant LNA/LNB System is designed to be mounted into a standard 19-inch EIA equipment rack. The controller requires 2U (3.5 inches) of vertical rack space, and is 17.5 inches (445 mm) deep. Choose a location in the rack that will provide adequate ventilation and allow cooling air to circulate through the perforated top and bottom covers at the rear of the chassis.

The equipment should be mounted on rack slides or support rails should be used at the rear of the chassis to support the weight of the controller.

CAUTION Do not try to support the controller by its front panel. Always use rack slides or support rails. The front panel is not designed to support the weight of the chassis.

After choosing an appropriate location in the rack, mount the movable section of the rack slides or the fixed support rails to the rack.

Attach the controller to the slides and slide it into the rack as far as it will go. If using support rails, slide the controller onto the rails and push it fully into the rack.

Attach the front panel to the rack using pan head 10-32 screws and flatwashers.

2.3.2 Outdoor Plate Assembly

Install the outdoor plate assembly in a convenient spot near the feed of the dish. Refer to the outline drawing in Section 8, System Configuration, for mounting details of the plate assembly. Loosen the mounting screws for the waveguide

switch support brackets and adjust the parts for alignment with the waveguide input ports.

Do not expose the outdoor plate assembly to direct rainfall or snowfall. The assembly is moisture resistant but not water-proof.

For longest life of the motorized waveguide switches, the waveguide systems should be pressurized and filled with dry air or gas. Long term exposure to moisture can cause rust and eventual degradation of the mechanism.

2.3.3 Interconnecting Control Cable

Interconnect the indoor controller and the outdoor plate assembly with a control cable assembly, which comes from the factory with connectors installed. If necessary, remove the connector from one end of the cable in order to feed the cable through conduit. In that case, refer to cable assembly drawing 10899 in Section 6, Drawings, for wiring information.

NOTE The end that connects to the indoor controller has a short pigtail with a plastic 3-pin connector attached. Use this connector to supply emergency power to the LNAs/LNBs. See Section 5.6.2 for information about emergency LNA/LNB power.

There are two grades of cable: standard service (standard) and direct burial (optional).

- Standard service cable has an outer PVC jacket that is UV stabilized and can be installed outdoors. However, it should not lie in water, and should not be buried underground.
- For more severe environments, order "direct burial" grade cable. This type can be laid directly on the ground or even buried underground.

Only one cable is needed between the redundancy controller and the plate assembly. The factory supplied control cable assembly both powers the LNAs or LNBs and motorized waveguide switches, and carries control and status

information between indoor and outdoor units. Separate AC connections to the outdoor plate assembly are not required.

2.4 CE Compliance

The system has been tested for compliance with CE regulations for electromagnetic susceptibility and emissions. In order to achieve proper emissions and susceptibility performance of the system, certain installation conditions must be met.

NOTE All cables connected to the controller should be kept as short as possible, and located and oriented to avoid pickup or radiation of electrical interference.

2.4.1 Use of Shielded Cables

With the exception of AC (mains) power cords, and the plate assembly interface cable, all cables connected to the redundant system controller (RSC) and optional remote control panel (RCP) must be of fully shielded construction.

- **Cable Shield Termination at Controller.** The shield of each cable must be connected to a metal connector housing at the controller (RSC or RCP) end. The connector housing must be securely screwed to the standoffs on the rear of the controller chassis.
- **Cable Shield Termination at End Opposite Controller.** The opposite end of the cable should terminate inside a shielded connector housing or enclosure, and the shield should be securely connected to Protective Earth at that end of the cable.

2.4.2 Grounding the Controller

The controller must be securely connected to the building's power system ground or earth. The Protective Earth stud on the rear panel of the controller must be connected to the equipment mounting rack using a low-impedance copper braid, kept as short as possible. The equipment mounting rack containing the controller must be connected to the

building or facility's Protective Earth using a low-impedance copper braid, kept as short as possible. When the controller is in normal use (i.e. not being serviced) the front panel must be securely clamped to the equipment mounting rack using four screws.

2.5 Controller Interfaces

Major I/O groups for the indoor redundancy controller are:

- Line inputs, J1 and J2
- Control cable interface to outdoor plate assembly, J3
- External alarm inputs, J4
- Remote control panel (RCP) link, J5
- Serial I/O loop connector, J6
- RS-232/-422/-485 Serial I/O, J7
- Parallel I/O, J8

Details of each group are discussed below. See Figure 2-1 for the locations of these I/O connections.

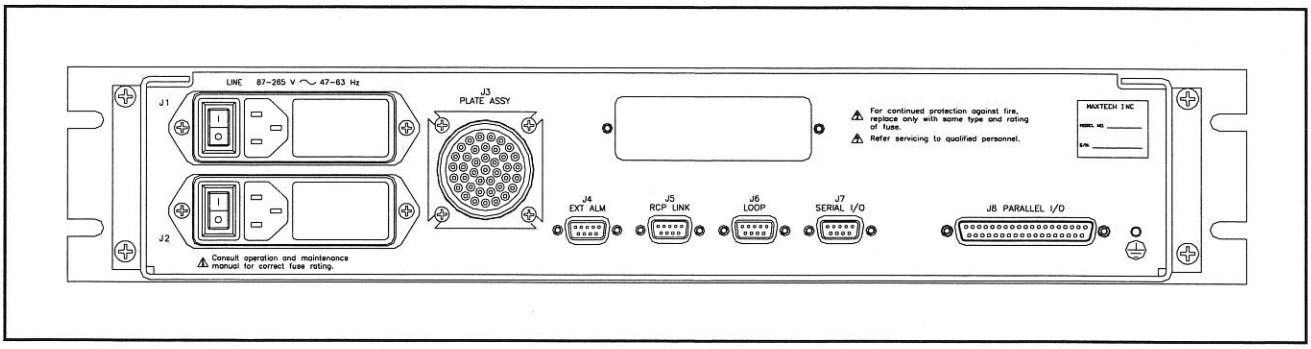


Figure 2-1. Redundancy Controller Rear Panel Interfaces

2.5.1 J1, J2 Line Inputs

The AC line inputs and the internal switching power supplies are fully redundant. Either input is capable of powering the entire system. **For maximum system reliability, connect each line input to a separate AC power source.** The second best option is to connect each input to a different phase of a three-phase AC line. The third option is to connect both inputs to the same AC line.

2.5.1.1 Power Requirements

CAUTION Before plugging the controller into the AC line, verify that the correct fuse(s) have been selected.

The 1:2 Redundant System Controller has worldwide AC input capability. It can operate from a power source of 90 to 264 Vac, 47 to 63 Hz, single phase. The power supplies are autoranging; no jumper or switch settings are required to operate at different voltages.

Line input is through an internationally standardized IEC connector. Select a cordset to match the power connectors in use in the local area. The controller is supplied with a pair of North American cordsets.

Fuses should be selected to match the voltage in use according to Table 2-1. For North America, use one fuse in the hot side of the line. For Europe, use two fuses. The controller is shipped from the factory set up for North American fusing.

Table 2-1 Fuse Ratings

Line Voltage	Rating	Size	Type
100–120 V	2.0 A	0.25" x 1.25"	MDL slo-blo
220–240 V	1.0 A	5 x 20 mm	GDC slo-blo

To change from North American to European fusing, open the cover and remove the fuseholder. The North American side of the fuseholder has one fuse and a jumper bar. Remove the fuse; loosen the Phillips screw and turn the fuseholder upside down. Install two fuses and replace the cover.

2.5.2 J3 Control Cable Interface

Interconnect the indoor redundancy controller and the outdoor plate assembly using the factory supplied control cable assembly. For details on cable installation, refer to Section 2.3.3.

2.5.3 J4 External Alarm Inputs

The system can be configured to receive unit failure information from an external circuit instead of the internal bias current monitors. (See Section 2.7, Configuration.) A typical use is for phase-locked LNBs where the alarm signal is generated by a phase lock alarm or loss-of-reference alarm in the receiving equipment.

The external alarm inputs are optoisolator coupled for noise and common mode ground loop rejection. A high or a floating, "open" input is interpreted as a fault and activates the alarm. To indicate normal (non-faulted) status, pull the line to ground with a switch, a relay, a gate or a transistor. Active devices must be capable of withstanding 5 V and sinking 5 mA. Standard CMOS (74Cxxx or MC14xxx families), HCMOS (74HCxxxx), open-collector TTL, or open drain CMOS are all suitable. The input will tolerate positive voltages up to 30 V. For pinouts, see Table 2-2.

Table 2-2 J4, External Alarm Inputs

Pin	Function	Notes
1	Ext alarm 1 in	Unit 1
2	Ext alarm 2 in	Unit 2
3	Ext alarm 3 in	Unit 3 (Spare, in 1:1 systems)
4	Ext alarm 4 in	Unit 4 (Spare, in 1:1 and 1:2 systems)
5	Ext alarm 5 in	Tracking Unit, or Spare (if no Tracking Unit)
6	Ext alarm 6 in	Spare
7	Ext alarm 7 in	Spare
8	Ext alarm 8 in	Spare
9	Ground	

2.5.4 J5 RCP Link

Use J5 to interconnect the redundant system controller and the optional remote control panel, if one is included in your system. The interface cable is supplied with the Remote Control Panel.

2.5.5 J6 Loop

The Loop connector, J6, duplicates the connections of the Serial I/O connector, J7 (see Section 2.5.6). This allows multiple devices to be daisy-chained on an RS-485 multi-drop serial I/O bus without the need for "Y" cable adapters at each controller; see Figure 2-2.

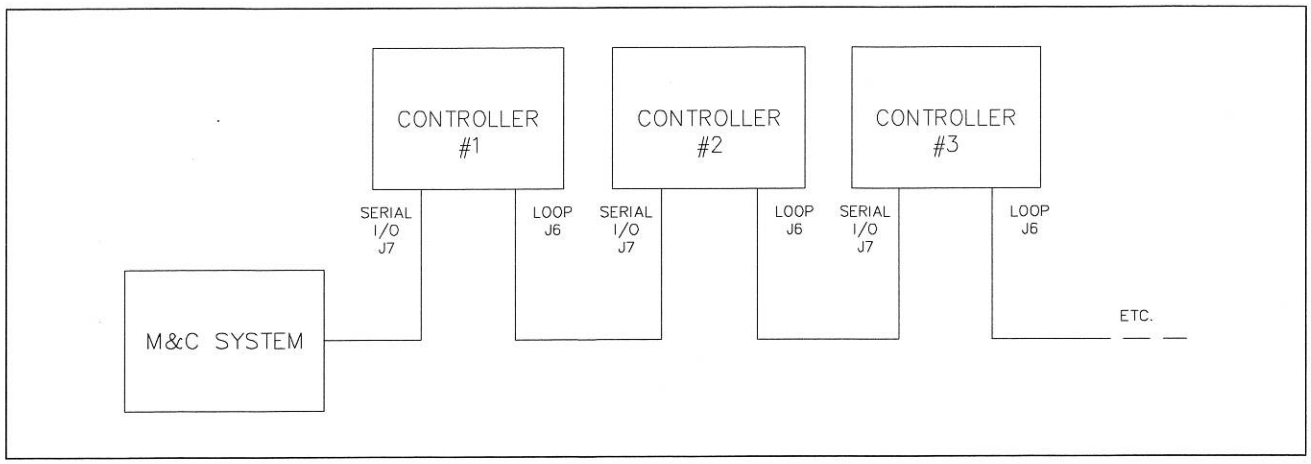


Figure 2-2. Daisy-Chained Controllers Using RS-485 Serial I/O

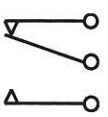
2.5.6 J7 Serial I/O

The serial I/O interface for remote monitoring and control supports RS-232, RS-422, or RS-485 (2-wire and 4-wire) connections. The various interface selections share some lines, so it is important to make sure the appropriate interface is selected on the equipment. Any pins not used in the desired interface should be left unconnected. Only one of these interfaces may be used at a time.

All data is transmitted and received with 8 data bits, 1 stop bit, 1 start bit, no parity, and no software handshaking. The baud rate is selectable using a setting on the front panel. (See Section 2.7, Configuration.)

Selection of an interface is done using both the connector wiring and a front panel setting on the controller. The pinout for the interfaces is shown in Table 2-3.

Table 2-3 J7, Serial I/O Connector

Pin	Function	Notes
RS-232 (EIA/TIA-574) — Full duplex, one unit on a bus.		
5	Signal Ground	Connect to DTE signal SG.
3	Data In	Connect to DTE signal TD.
2	Data Out	Connect to DTE signal RD.
RS-422 — Full duplex, one unit on a bus.		
4	+ Data In	
3	– Data In	
1	+ Data Out	Transmit driver on continuously.
2	– Data Out	
5	Ground	
9	Termination	Connect to pin 4 to terminate receiver. Terminate units on ends of bus.
RS-485 (4-wire) — Full duplex, multiple units.		
4	+ Data In	
3	– Data In	
1	+ Data Out	High impedance when not transmitting data, to allow multiple units on a bus.
2	– Data Out	
5	Ground	
9	Termination	Connect to pin 4 to terminate receiver. Terminate units on ends of bus.
RS-485 (2-wire) — Half duplex, bidirectional bus, multiple units.		
4 & 1	+ Data I/O	Connect indicated pins together for RS-485 interface.
3 & 2	– Data I/O	
5	Ground	
9	Termination	Connect to pin 4 to terminate RS-485 bus. Terminate units on ends of bus.
Service Request		
6	CLOSED Svc Req	 Form 'C' contacts, rated for 100 Vdc, 0.5 A, 3 W max. (resistive load).
7	Common	
8	OPEN Svc Req	

2.5.6.1 RS-232

The RS-232 pinout conforms to the DCE end of that specified in EIA/TIA-574, which is used on "IBM-compatible" computers for 9-pin COM ports. Since this uses the DCE end, it may be connected either to a computer's 9-pin COM port via a straight through 9-pin cable, or to a 25-pin COM port using a 9-pin-to-25-pin adapter. Only three of the RS-232 lines are used: Signal Ground, Transmit Data, and Receive Data. No handshaking lines are used.

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

2.5.6.2 RS-422

The RS-422 specification allows for full duplex communications over two differential pairs of wires: one pair for transmit data, the other for receive. See Figure 2-3. Cables may be up to 4000 feet in length using an RS-422 interface. RS-422 drivers are on all the time, so only one of them is allowed on either pair of lines. This avoids the problems of fail-safe biasing involved with RS-485 (see below), but limits communication to only one device and the host computer.

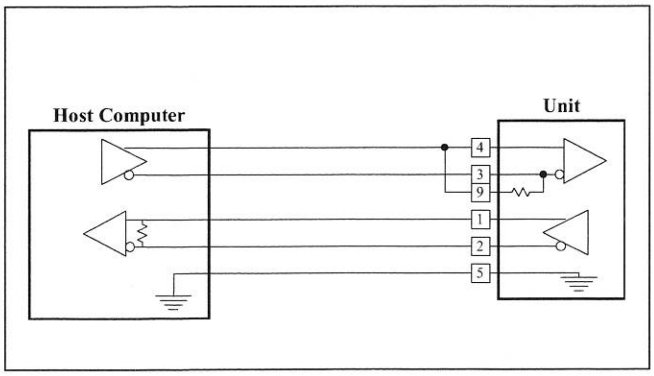


Figure 2-3. A Typical RS-422 Bus

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

VertexRSI's RS-422 pinout complements that on *some* popular PC plug-in RS-422 interface cards, and can connect to them using a straight through cable.

Terminations

In Figure 2-3, note the terminations on the receivers for the Host Computer and the Unit on the bus.

VertexRSI equipment uses an AC style termination, consisting of a 120-ohm resistor and a 0.01 µF capacitor in series. The termination is enabled by connecting the TERMINATION pin (pin 9) to the "RX+" input (pin 4).

For short cable runs, terminations may not be necessary.

2.5.6.3 RS-485 (4-wire)

The RS-485 specification is very similar to RS-422. It allows for full duplex communications over two differential pairs of wires, one pair for transmit data, the other for receive. Cable lengths up to 4000 feet are allowed using an RS-485 interface. The difference between RS-422 and RS-485 (4-wire) is that in RS-485, the transmit drivers may be switched on and off, allowing more than one driver on a bus.

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

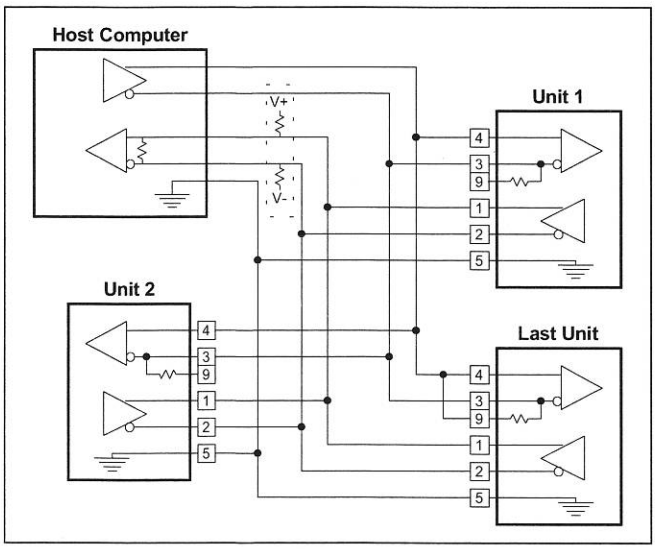


Figure 2-4. A Typical RS-485 (4-Wire) Bus

VertexRSI's RS-485 pinout complements that on *some* popular PC plug-in RS-485 interface cards, and can connect to them using a straight through cable.

Terminations

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

VertexRSI equipment uses an AC style termination, consisting of a 120-ohm resistor, and a 0.01 µF capacitor in

series. The termination is enabled by connecting the TERMINATION pin (pin 9) to the "+ Data I/O" input (pin 4).

For short cable runs, terminations may not be necessary.

Fail-safe Biasing

Since the RS-485 transmitter is turned off when no data is being sent (to support multiple units on the bus), the bus is left floating between messages and may register as either a "MARK" or a "SPACE" to the host computer. Some software cannot handle the "SPACE" condition, so fail-safe biasing may be necessary. The level of biasing depends on a number of factors, including the number of units on the bus and the impedance of the termination. Typical fail-safe biasing circuits are shown in Figure 2-4, enclosed in dashed lines.

It is not necessary for the transmit driver in the host computer to switch on and off, since it is the only driver on that pair of wires. If this is the case, no fail-safe biasing is necessary on the transmit output from the host computer.

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

2.5.6.4 RS-485 (2-wire)

With an RS-485 interface, you can connect the transmit and receive pairs together, and communicate in half duplex over only one pair of wires. This mode of operation is called RS-485 (2-wire), and is also supported by VertexRSI equipment.

To use RS-485 (2-wire) with this connector pinout, connect pins 1 and 4 together to form the positive (+) side of the bus, and pins 2 and 3 together to form the negative (–) side. Cable lengths up to 4000 feet are allowed using an RS-485 interface.

The host computer must switch its driver on to talk, and off to listen for a response. The timing for turning the transmitter off depends on the protocol that is being used. The

transmitter must be turned off by the earliest time that the unit may generate a response.

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

VertexRSI's RS-485 pinout complements that on *some* popular PC plug-in RS-485 interface cards, and can connect to them using a straight through cable.

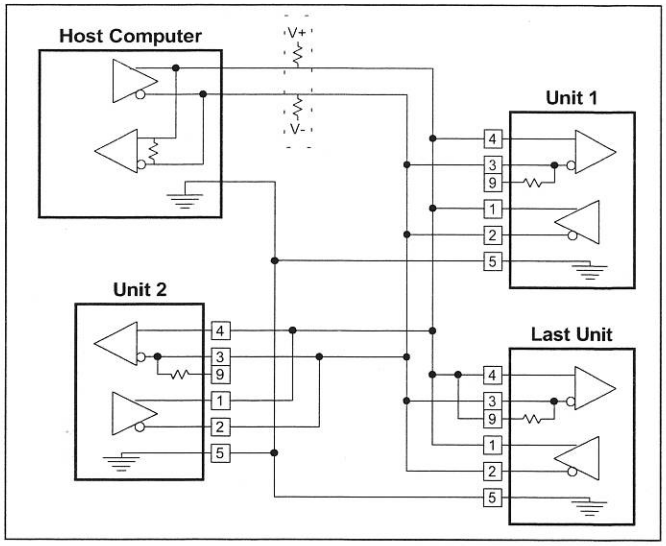


Figure 2-5. A Typical RS-485 (2-Wire) Bus

Terminations

In Figure 2-5, note the terminations on the receivers for the Host Computer (First Unit) and the Last Unit on the bus. No other unit (in this example, Unit 1 or Unit 2) should be terminated.

VertexRSI equipment uses an AC style termination, consisting of a 120-ohm resistor, and a 0.01 µF capacitor in series. The termination is enabled by connecting the TERMINATION pin (pin 9) to the "+ Data I/O" input (pin 4).

For short cable runs, terminations may not be necessary.

Fail-safe Biasing

Since nothing is driving the bus between messages, the bus is left floating and may register as either a "MARK" or a "SPACE" to any unit on the bus. This ambiguity may cause problems with equipment of software that is not designed to receive a long "SPACE" character, so fail-safe biasing may be necessary. The level of biasing depends on a number of factors, including the number of units on the bus and the impedance of the termination. Typical fail-safe biasing circuits are shown in Figure 2-5, enclosed in dashed lines.

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

2.5.6.5 Service Request

The service request is a Form 'C' relay contact that indicates whether a fault, or any other condition needing attention, has occurred on the unit.

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

2.5.7 J8 Parallel I/O

Use this connector for external control and monitoring of the system. Typical uses are for sending status information to a centralized customer status monitoring system or for remotely controlling the system from a nearby building.

Outputs are Form 'C' dry relay contacts suitable for switching up to 100 Vdc maximum, 0.5 A continuous (0.25 A during switching) maximum current, or up to a 3 W resistive load. Suitable loads are LEDs, incandescent lamps, relays or logic gates (with appropriate pull-up or pull-down resistors).

Inputs are optoisolator coupled for noise and common mode ground loop rejection. To activate an input, pull the line to ground with a switch, a relay, a gate or a transistor. Active devices must be capable of withstanding 5 V and sinking 5 mA. Standard CMOS (74Cxxx or MC14xxx families), HCMOS (74HCxxxx), open-collector TTL, or open drain CMOS are all suitable. The input will tolerate positive voltages up to 30 V.

To locate the correct pin on J8, see Table 2-4. For further details of the interface, refer to Section 3.6.2.

Table 2-4 J8, Parallel I/O Pinout

Group	Type	Function	Pin	Comments
Unit 1 Status	Output	Closed on Fault Common Open on Fault	25 6 26	See Note 1.
Unit 2 Status	Output	Closed on Fault Common Open on Fault	7 27 8	See Note 1.
Unit 3 Status	Output	Closed on Fault Common Open on Fault	16 36 17	See Note 1.
PS1 Status	Output	Closed on Fault Common Open on Fault	28 9 29	See Note 1.
PS2 Status	Output	Closed on Fault Common Open on Fault	10 30 11	See Note 1.
S1 Position	Output	Position 1 Common Position 2	31 12 32	Unit 1 on-line, POL1 Unit 3 on-line, POL1
S2 Position	Output	Position 1 Common Position 2	37 18 19	Unit 2 on-line, POL2 Unit 3 on-line, POL2
Auto/Manual	Output	MANUAL Common AUTOMATIC	13 33 14	Common connected to MANUAL when power is off or when in Manual mode.
Local/Remote	Output	LOCAL Common REMOTE	34 15 35	Common connected to LOCAL when power is off or when in Local mode.
Remote Control Inputs	Input	Ground Auto/Man Toggle Unit 1 POL1 Select Unit 3 POL1 Select Unit 2 POL2 Select Unit 3 POL2 Select Fault Reset	24 5 4 3 2 1 23	Falling-edge-sensitive inputs. Ground to activate. See Note 2.

Note 1: Relays are shown in Faulted (power-off) state.
Contact rating: 100 Vdc / 0.5 A / 3 W maximum (resistive load).

Note 2: Open-circuit voltage at inputs is 5 V. Short-circuit current is 5 mA maximum.
Minimum pulse width is 10 ms.

2.6 Plate Assembly Interfaces

Major I/O groups on the outdoor plate assembly are:

- RF Inputs
- RF Outputs
- Offline I/O (Optional)
- Test In (Optional)
- Control Cable

See the outline drawing in Section 8, System Configuration, for the locations of these I/O connections.

RF Inputs. The RF inputs are waveguide flanges. Use an appropriate gasket and mating flange for a weatherproof seal.

RF Outputs. The RF outputs are coaxial connectors, one for each polarization.

Offline I/O (Optional). Input and output ports for the off-line Unit (LNA/LNB) are coaxial connectors. Terminate the off-line output when not in use.

Test In (Optional). Signals applied to the test inputs are injected into the on-line Units (LNAs/LNBs) via crossguide couplers. Inputs are coaxial connectors.

Control Cable. Interconnect the outdoor plate assembly and the indoor redundancy controller using the factory supplied control cable assembly. The cable connects to the plate assembly at multipin MS connector J1. For details on cable installation, see Section 2.3.3.

2.7 Controller Configuration

All options of the controller are configured by software settings, without using hardware jumpers. The configuration may be viewed and changed from the front panel, or in most cases by using Serial IO commands. Either way, the configuration may be viewed and modified without opening the controller or removing it from its rack.

When an RSC-1200 is purchased in a complete system, it will be factory configured to an appropriate state, which may differ slightly from factory defaults listed in the following sections. The configuration should be reviewed to verify settings are correct desired settings of Serial IO, priority channel, latched faults, and other features.

When as RSC-1200 is purchased as a stand-alone unit, it will be configured with the factory defaults listed in the following sections. It will be necessary to review all configuration settings to verify the controller is properly prepared for use.

2.7.1 From the Front Panel

The controller configuration can be quickly viewed and modified from the front panel, using no tools and without a PC or software.

To enter configuration mode using the front panel controls, press the SHIFT button twice. Portions of the FUNCTION and SETTING windows will illuminate to show you are in configuration mode.

In configuration mode, one or two segments of the FUNCTION window light to indicate the configuration function being accessed. One or more segments of the SETTING window light to indicate the setting of the function. For example, when indicator A is lit, the Serial I/O Interface type is being accessed. In that case, SETTING indicator 0, 1, 2, or 3 will light to indicate which of the four Serial I/O Interfaces is selected.

The INC and DEC buttons are used to change the value of a configuration setting. In some cases, the buttons will increment and decrement the value displayed as a binary number, so multiple segments of the SETTING window will light. In other cases, increment and decrement will change which single segment of the SETTING window is lit.

The > key is used to proceed to the next configuration function. Pressing SHIFT will exit configuration mode and save any changes which have been made.

2.7.2 Using Serial I/O

Serial I/O commands can be used to view and change most configuration options of the controller. This is particularly useful in systems where a Monitor & Control (M&C) system is interfaced to the controller.

Refer to Appendix A for descriptions of the Serial I/O commands to view and control the configuration settings. Remember that the controller must be in Remote mode for all Serial I/O configuration commands to have effect.

2.7.3 Detailed Descriptions

The configuration settings of the controller are described in the following sections.

2.7.3.1 FUNCTION A: Serial I/O Interface

This configuration function controls the hardware interface for the Serial I/O connector, which can be set for RS-232, RS-485 (4-wire), RS-485 (2-wire), or RS-422.

Function A:	Serial Port Interface	(Factory Default is **RS-232**)
Setting:	**0 = RS-232** 1 = RS-485, 4-wire 2 = RS-485, 2-wire 3 = RS-422	

The interface selected is transferred to the RCP-1200 remote control panel (if present) and used for its Serial I/O port as well.

2.7.3.2 FUNCTION B: Serial I/O Address

This configuration function selects a Serial I/O address for the controller.

If you are using a serial bus that is communicating with several pieces of VertexRSI equipment simultaneously, each must be assigned a unique address. The address is a number between 0 and 255.

Function B: Serial I/O Address (Factory Default is **0** i.e., no Setting LEDs lit.)

Setting:

0 = 2^0 = 1
1 = 2^1 = 2
2 = 2^2 = 4
3 = 2^3 = 8
4 = 2^4 = 16
5 = 2^5 = 32
6 = 2^6 = 64
7 = 2^7 = 128

Example:

64 + 16 + 8 + 1 = 89

In this function, SETTING lights 0 through 7 each represent one bit in a binary number. The Serial I/O address is determined by adding up the value of all lights which are on. In the above example, the address is 89.

NOTE

In a system with many devices on the same serial bus, do not use address 0. Address 0 is a global address. **Messages sent using an address of 0 are obeyed by all units that receive the message.**

Pressing the INC key will increase the address by one. Pressing the DEC key will decrease it by one. As a shortcut, pressing the INC and DEC simultaneously will change the setting to zero.

The address selected is transferred to the RCP-1200 remote control panel (if present) and used for its Serial I/O port also.

2.7.3.3 FUNCTION C: Serial I/O Baud Rate

This configuration function selects the baud rate for the Serial I/O port.

Function C: Baud Rate (Factory Default is **19200** baud)

Setting:

0 = 300 baud
1 = 1200
2 = 2400
3 = 4800
4 = 9600
5 = 14400
6 = 19200
7 = 28800

The baud rate selected is transferred to the RCP-1200 remote control panel (if present) and used for its Serial I/O port as well.

2.7.3.4 FUNCTION D: Auto/Remote Options

This function controls configuration of the Auto-Disables-Manual and Remote-Disables-Local options.

Function D: Auto/Remote Options (Factory Default is **both disabled**)

Feature:		Auto Disables Manual	Remote Disables Local
Setting:	**0**	**no**	**no**
	1	no	yes
	2	yes	no
	3	yes	yes

When **Auto-Disables-Manual** is enabled ("yes"), the unit buttons, the position control parallel I/O inputs, and the serial I/O switch command will be ignored if the unit is in AUTO mode.

When Auto-Disables-Manual is disabled ("no"), the unit buttons, the position control parallel I/O inputs, and the serial I/O switch command will be obeyed, as long as the command selects a valid position in that mode, as determined by any faults that might exist on the units.

When **Remote-Disables-Local** is enabled ("yes"), all front panel pushbuttons except PANEL TEST and LOCAL/REMOTE will be ignored if the unit is in REMOTE mode.

When Remote-Disables-Local is disabled ("no"), front panel buttons will operate normally, even when the unit is in REMOTE mode. In REMOTE mode parallel I/O inputs, serial I/O commands, and front panel controls will all be obeyed.

2.7.3.5 FUNCTION E: Current Window Width

This configuration function selects the window within which a unit's current can vary before a Unit alarm is triggered.

Function E:	Alarm Window Width	(Factory Default is **±10%**)
Setting:	0 = ±5%	
	1 = ±10%	
	2 = ±15%	
	3 = ±20%	
	4 = ±25%	

The current window is set for an appropriate level at the factory if the controller is shipped with a system, and should not be adjusted unless you are experiencing problems, or are moving the controller to another system which has a different current width setting.

The window width can be set for ±5%, ±10%, ±15%, ±20%, or ±25% of nominal current. These values mean that the measured current can vary by this much above or below the nominal current drawn by the unit at calibration, without an alarm occurring.

2.7.3.6 FUNCTION F: Auto Revert and Priority Channel

In the RSC-1200, this function does two things: it determines whether the Auto Revert feature is enabled, and sets the Priority Channel.

Function F: Auto Revert and Priority (RSC-1200 1:2 controller only)
(Factory Default is **neither set**)

Feature:	Auto Revert	Priority
Setting:	**0** **no**	**none**
	1 no	POL1
	2 no	POL2
	3 yes	none
	4 yes	POL1
	5 yes	POL2

When **Auto Revert** is enabled ("yes"), the controller will always switch the primary unit back on-line after it has been faulted and subsequently restored to proper operation. This feature is most useful in 1:2 systems, where the standby unit may not have as good noise performance on a particular Pol, and you want to be sure the best unit is always on-line. In a 1:2 system, the primary unit for Pol 1 is Unit 1, and for Pol 2 is Unit 2.

Auto Revert only works if the controller is in AUTO mode (see Section 3.5.6).

Note that if Latched faults are enabled (see Function AB, Section 2.7.3.11), a faulted unit remains faulted until reset by the operator. In this case, Auto Revert will *not* automatically switch the primary unit back on-line until faults are reset.

In a 1:2 system, Unit 3 is used as the standby unit for both polarizations. If failures occur on both of the main units, the **Priority** setting determines which POL gets the standby unit if failures are simultaneously detected on both on-line units. The choices are None, Pol 1, or Pol 2.

- When NONE is selected, if a failure occurs on both primary units the standby unit will be switched to the channel where the first fault was detected.
- When POL 1 is selected, if failures occur on both primary units the standby unit will be switched to POL 1.
- When POL 2 is selected, if failures occur on both primary units the standby unit will be switched to POL 2.

2.7.3.7 FUNCTION G: Channel Preference

In the RSC-1200, this function has no meaning. This function is only used in the RSC-1100 (1:1) and RSC-1111 (Dual 1:1) controllers.

2.7.3.8 FUNCTION H: Audible Alarm

This configuration function selects whether the controller's audible alarm is enabled.

Function H:	Audible Alarm	(Factory Default is **Off**)
Setting:	**0 = Off** 1 = On	

When the audible alarm is enabled ("on"), any controller fault will cause the audible alarm to beep until silenced, or until

the controller determines the fault went away. The alarm can be silenced by pressing any front panel key on the controller (or the remote control panel, if present). The audible alarm will also beep briefly during a panel test if it is enabled.

The Audible Alarm configuration is transferred to the RCP-1200 remote control panel, if present.

2.7.3.9 FUNCTION I: Controller Type (Read Only)

This configuration function displays the controller type. This configuration function is "display only." The setting cannot be changed by the user.

Function I:	Controller Type (display only) (Factory Default is **RSC-1200**)
Setting:	0 = RSC1100 (1:1 redundant) **1 = RSC1200 (1:2 redundant)** 2 = RSC1111 (Dual 1:1 redundant) 3 = UNKNOWN (Cannot determine type)

If the controller type is unknown, or does not match the front panel type, it is probably because the controller type jumper on the front panel has been mis-positioned. That jumper should not normally be changed by a customer.

2.7.3.10 FUNCTION J: Hardware Options

This configuration function does two things: it indicates whether optional hardware is configured in the controller; and it displays the status of optional hardware, indicating whether it is properly detected by the controller.

Function J:	Hardware Option Status
Setting:	0 = RSC Parallel I/O Board is configured 1 = Tracking Unit is configured 2 = Noise Diode 1 is configured 3 = Noise Diode 2 is configured 4 = spare (future use) 5 = Parallel I/O is detected 6 = Remote Control Panel (RCP) is detected 7 = RCP with Parallel I/O is detected 8 = spare (future use) 9 = spare (future use)

SETTING indicators 0 through 3 indicate the configuration status of hardware for Parallel I/O, the Tracking Unit, and Noise Diodes. If an indicator is lit, the corresponding hardware is configured and will be controlled by the controller. The INC and DEC buttons can be used to change these settings.

When a **Parallel I/O** board is detected by the controller at power up, its configuration is automatically turned on. If the Parallel I/O board is removed later, its configuration setting must be manually turned off here, or the controller will generate a fault because of the missing Parallel I/O board.

When the **Tracking Unit** configuration is on, the controller will power and monitor current to a Tracking Unit. The Tracking Unit light on the front panel will be on. Serial IO commands will report status of the Tracking Unit. The Tracking Unit should not be configured if it is not used. See Section 3.10 for more information.

When the **Noise Diode** configurations are on, the controller will power and monitor voltage to Noise Diode outputs. The AUX1 and AUX2 buttons will turn on and off the Noise Diode outputs. Serial IO commands will report status of the Noise Diodes and control them. Noise Diodes should not be configured if not used. See Section 3.9 for more information.

SETTING indicators 5, 6, and 7 display the detected status of optional hardware. The states of these indicators may not be changed.

Indicator 5 lights when Parallel I/O is configured and properly detected by the controller.

Indicator 6 lights when an (optional) RCP-1200 remote control panel is detected by the controller and is communicating properly.

Indicator 7 lights when a Parallel I/O board is detected in an RCP-1200 remote control panel connected to the controller.

SETTING indicators 4, 8 and 9 are reserved for future use.

Auto Configuration of Parallel I/O Board

When a controller containing a functioning Parallel I/O board is powered-on, the controller detects the Parallel I/O board and automatically sets its configuration to include parallel I/O. No user changes to the configuration are needed. Configuration choice FUNCTION J will light indicators Parallel IO Configured (SETTING 0) and Parallel IO Detected (SETTING 5).

Once an RSC has detected and autoconfigured a Parallel I/O board, it will generate a controller fault if the Parallel I/O board is removed or cannot be detected due to a fault or failure. If the board cannot be detected, configuration choice FUNCTION J will not light the Parallel IO Detected indicator.

Removing the Parallel I/O board from a controller which has already detected and autoconfigured it requires manual reconfiguration:

a) With the RSC on, enter configuration mode.
b) Use the > key to go to the options selection, FUNCTION J.
c) Change Parallel IO Configure (SETTING 0) to off (using INC / DEC).
d) Turn off power.
e) Remove the Parallel IO board.

Now when the RSC is powered on, the Parallel I/O board will not be detected or autoconfigured. Configuration choice FUNCTION J will not light either indicator Parallel IO Configured or Parallel IO Detected.

Auto Configuration of Remote Control Panel (Option)

When an RSC controller detects that a Remote Control Panel (RCP) is connected and correctly communicating, Configuration choice FUNCTION J will light indicator RCP Detected (SETTING 6).

If the RCP is disconnected or powered off during RSC operation, Configuration choice FUNCTION J will turn off indicator RCP Detected. No controller fault will be generated, as RCP presence is not considered necessary for RSC operation.

Auto Configuration of Remote Control Panel PIO

When an RSC controller detects that an RCP is connected, correctly communicating, and equipped with a Parallel IO board, Configuration choice FUNCTION J will light indicator RCP Parallel IO Detected (SETTING 7).

If the RCP is not equipped with a Parallel IO board, or the RCP is disconnected or powered off during RSC operation, Configuration choice J-OPTIONS will turn off indicator RCP Parallel IO Detected. No controller fault will be generated, as presence of the RCP or its Parallel I/O board is not considered necessary for RSC operation.

2.7.3.11 FUNCTION AB: Latched Faults

This configuration function selects whether Latched Faults are enabled or disabled.

Function AB:	Latched Faults (Factory Default is **enabled**)
Setting:	0 = disabled **1 = enabled**

When Latched Faults is enabled, ALL faults are latched. This means that a fault will continue to be reported, even after the condition that caused it goes away. This applies to both controller faults and unit faults. Faults will only cease to be reported if they are reset by pressing the FAULT RESET button, pulling the parallel I/O fault reset input low, or issuing a fault reset serial I/O command AFTER the fault condition has been corrected.

When Latched Faults is disabled, faults will stop being reported when the condition that caused them goes away.

Note that regardless of the setting of this jumper, both latched faults and existing faults are reported via the serial I/O port.

2.7.3.12 FUNCTION BC: External Alarm Inputs 5-8

This function determines which of External Alarm Inputs 5 through 8 are enabled. See Section 2.5.3 for more information on the External Alarm Inputs.

Function BC:	External Alarm Inputs 5-8	(Factory Default is all **off**)
Setting:	0 = External Alarm Input 5 1 = External Alarm Input 6 2 = External Alarm Input 7 3 = External Alarm Input 8	

Each indicator which is lit indicates that the corresponding alarm is enabled. Even when an alarm is disabled, its status may still be read using Serial I/O commands, which allows it to be used as a general-purpose input.

If the Tracking Unit is configured (see Function J, Section 2.7.3.10), it should have either an internal or an external alarm (or both) enabled. If not, a Tracking Unit fault will never be reported. If the Tracking Unit is not configured, the external Tracking alarm input (input 5) will never cause a Tracking Unit alarm, even if it is enabled here.

2.7.3.13 FUNCTION CD: External Alarm Inputs 1-4

This function determines which of External Alarm Inputs 1 through 4 are enabled. See Section 2.5.3 for more information on the External Alarm Inputs.

Function CD:	External Alarm Inputs 1-4	(Factory Default is all **off**)
Setting:	0 = External Alarm Input 1 1 = External Alarm Input 2 2 = External Alarm Input 3 3 = External Alarm Input 4	

Each indicator which is lit indicates that the corresponding alarm is enabled. Even when an alarm is disabled, it may still be read using Serial IO commands, which allows it to be used as a general-purpose input. In general, either an internal or external alarm (or both) should be enabled for each Unit in use. If not, that Unit cannot be automatically switched off-line by the controller.

In the RSC-1200, the external alarm input for Unit 4 will never cause a Unit 4 alarm, even if it is enabled here.

2.7.3.14 FUNCTION DE: Internal Alarm 1-4 and Tracking

This function determines which internal Unit alarms are enabled.

Function DE: Internal Alarms 1-4 and Tracking Unit Alarm
(Factory Default is **1-3, on; 4 & Tracking, off** *)

Setting:
0 = Internal Alarm, Unit 1
1 = Internal Alarm, Unit 2
2 = Internal Alarm, Unit 3
3 = Internal Alarm, Unit 4 (not used in RSC-1200)
4 = Tracking Unit Alarm

(* unless factory equipped with a Tracking Unit)

Each indicator which is lit indicates that the corresponding internal Unit alarm is enabled. In general, either an internal or external alarm (or both) should be enabled for each Unit in use. If not, that Unit cannot be automatically switched off-line by the controller.

In the RSC-1200, the internal alarm for Unit 4 will never generate a fault, even if it is enabled here. If the Tracking Unit is disabled in configuration function J, the internal Tracking alarm will likewise never cause a fault, even if enabled here.

2.7.3.15 FUNCTION EF: External Alarm Input Status (Read Only)

This function displays the states of the External Alarm inputs. See Section 2.5.3 for more information on the External Alarm Inputs.

Function EF: External Alarm Inputs 1-8 (no factory default)

Setting:
0 = External Alarm Input 1
1 = External Alarm Input 2
2 = External Alarm Input 3
3 = External Alarm Input 4
4 = External Alarm Input 5
5 = External Alarm Input 6
6 = External Alarm Input 7
7 = External Alarm Input 8

Each indicator which is lit represents an input which is active (not grounded). The indicators will always light if an input is active, even if that input is disabled by configuration Function BC or CD.

This configuration setting cannot be changed.

2.7.3.16 FUNCTION FG: Parallel I/O Input Status (Read Only)

This function displays the states of the Parallel I/O Inputs, if the Parallel I/O board is installed. See Section 3.6.2 for more information on the Parallel I/O.

Each indicator which is lit represents an input which is active (not grounded).

This configuration setting cannot be changed.

2.7.3.17 FUNCTION GH: Parallel I/O Output Status (Read Only)

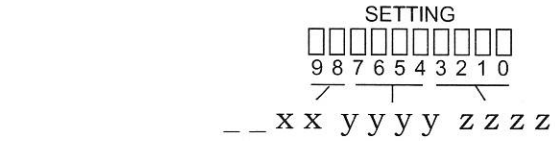
This function displays the states of the Parallel I/O Output relays, if the Parallel I/O board is installed. See Section 3.6.2 for more information on the Parallel I/O.

Each indicator which is lit represents a relay which is energized.

This configuration setting cannot be changed.

2.7.3.18 FUNCTION HI: Controller Software Version (Read Only)

This configuration function displays a code representing the version of software currently running on the controller. The code is the low 10 bits of 3 binary-coded-decimal (BCD) digits. (See Figure 2-6.)



This configuration setting cannot be changed.

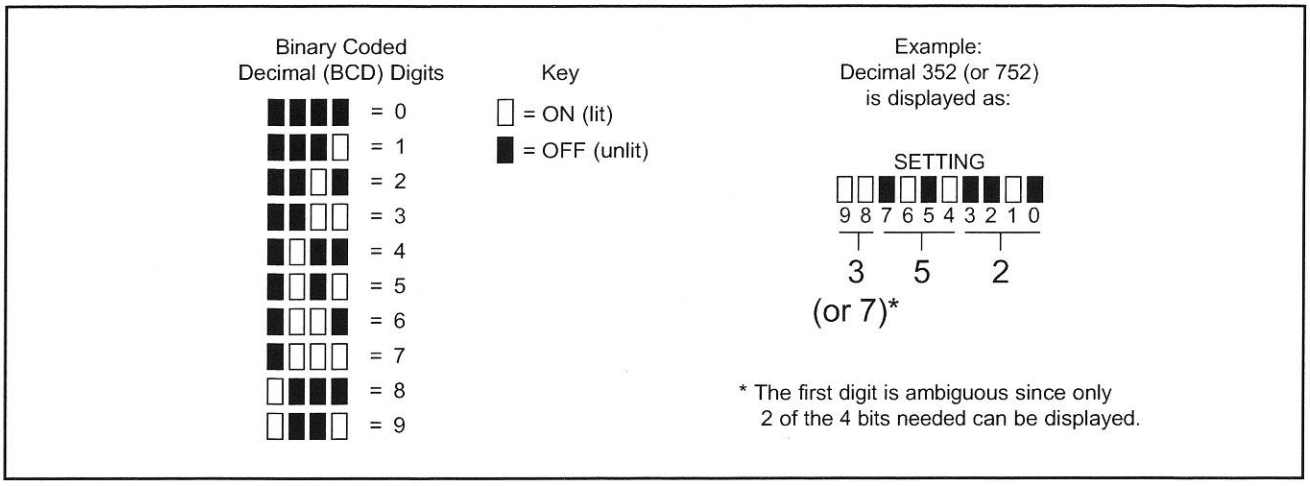
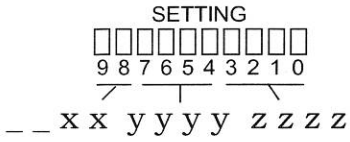


Figure 2-6. Binary Coded Decimal (BCD) Digit Code Chart

2.7.3.19 FUNCTION IJ: RCP Software Version (Read Only)

This configuration function displays a code representing the version of software currently running on the optional remote control panel, if present. The RCP must be connected and properly communicating with the controller for this code to be available. The code is the low 10 bits of 3 BCD digits.



This configuration setting cannot be changed.

Section 3 Operation

3.1 General Introduction

To operate the VertexRSI 1:2 Redundant LNA/LNB System, use the information contained in this section.

- To determine the function of a particular control or indicator, see **Description of Controls and Indicators**, Section 3.2.
- To read an overall description of how to operate the unit, see Sections 3.3 through 3.10.

3.2 Description of Controls and Indicators

3.2.1 Rear Panel

Turn power on and off using the two rear panel power switches. There is one switch per AC line input. Normally both power supplies operate simultaneously. If one fails, the other will continue to power the system.

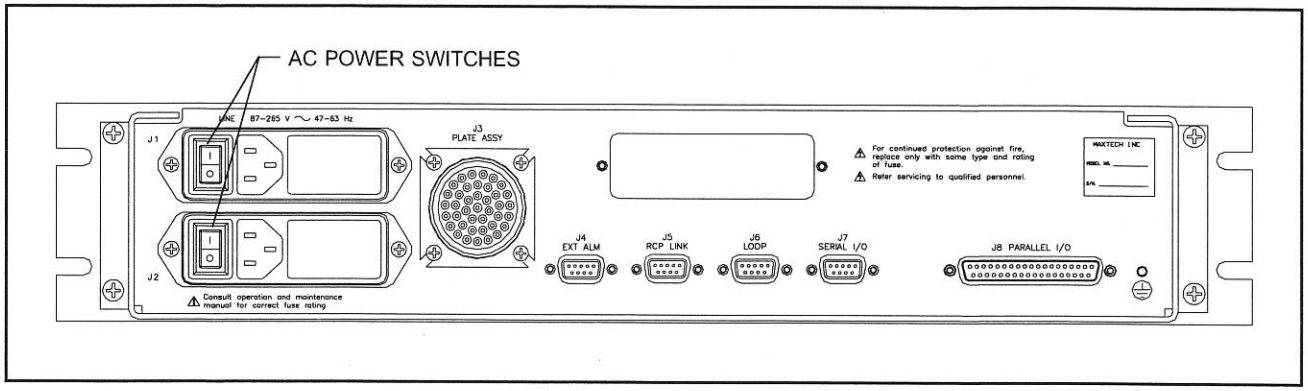
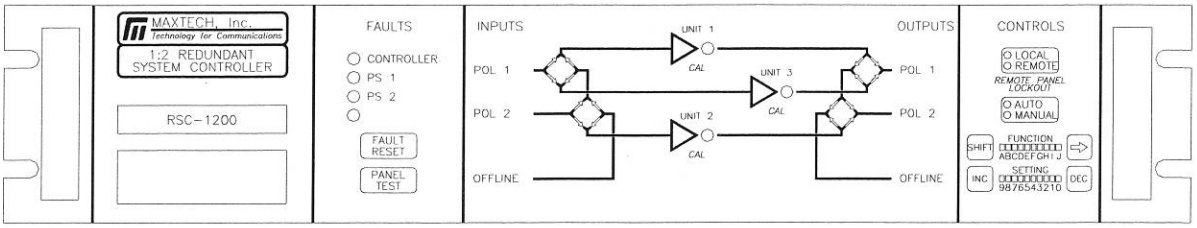


Figure 3-1. 1:2 Redundant LNA/LNB Controller Rear Panel

3.2.2 Front Panel

Operation of the front panel controls is briefly described in Figure 3-2.



FAULTS

○ CONTROLLER
○ PS 1
○ PS 2

Controller - Glows red when a controller fault is detected.

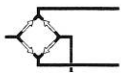
PS 1 and PS 2 - Glow red when corresponding power supply voltage is out of tolerance.

FAULT RESET

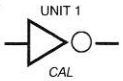
Fault Reset - After taking corrective action, press to clear latched faults. From Configuration mode (selected with the Shift button), press to enter Fault Display mode.

PANEL TEST

Panel Test - Press to cycle through test of all front panel indicators and audible alarm (if enabled).



Path indicator arrows show primary (green) and secondary (yellow) signal routing through switches for each polarization.



Unit - In Manual mode, press to select an on-line Unit*. Corresponding indicator glows green when Unit is operating normally (not faulted), and red when a fault has been detected.

CAL - In Calibration mode (selected with the Shift button), press a Unit button to set the nominal current limit for that Unit. **Units do not switch in CAL mode.**

This should be done after changing a Unit, or whenever the controller is first connected to a new plate assembly. Upon successful calibration of the nominal current the Unit indicator will flash green three times.

* Unit = LNA or LNB, or other controlled device.

CONTROLS

LOCAL
REMOTE
REMOTE PANEL LOCKOUT

Local/Remote - In Local mode, control is from the front panel. In Remote mode, control is through the serial I/O or parallel I/O interfaces.

Remote Panel Lockout - In Configuration mode (selected with the Shift button) press Local/Remote to enter or exit Remote Panel Lockout mode (blinking REMOTE LED). This mode disables control from the optional Remote Control Panel.

AUTO
MANUAL

Auto/Manual - In Auto mode, internal control logic causes automatic switchover to the standby unit if a fault is detected in the on-line unit. In Manual mode, the on-line unit is selected from the controller front panel.

Shift - From normal display mode, press once to enter Calibration mode; from Calibration mode, press a second time to enter Configuration mode. From Configuration mode press once to return to normal display mode.

Function A–J - In Configuration mode, these indicate which function is displayed. In Fault Display mode these indicate which fault code group is displayed.

Arrow - Press to advance through function or fault code group selections.

INC/DEC - In Configuration mode, press to increase or decrease the setting value. (INC/DEC have no effect in other display modes.)

Setting 9–0 - In Configuration mode, these indicate the set value of the function. In Fault Display mode, these show the fault code values for the group.

Figure 3-2. RSC-1200 Controller Front Panel

3.2.2.1 Front Panel Display Modes and Operation

There are four display modes — Normal, Calibration, Configuration, and Fault Display; each is described below:

In the **Normal** display mode, the signal path graphics, Unit LEDs, and switch LEDs indicate the path of the signal(s) though the system.

In Normal display mode,
- Unit select buttons are active and can cause a switch.
- The LOCAL/REMOTE and AUTO/MANUAL LEDs indicate the selected operating mode status, and these switches are active; pressing a switch toggles the operating mode state.
- The FUNCTION and SETTING displays are blank.

For the switch LEDs,
- Single green LEDs indicate the primary signal path.
- Single yellow LEDs indicate the secondary or alternate path.
- All yellow LEDs indicate that a switch is in progress.
- All red LEDs indicate that the controller cannot detect the switch position.

For the Unit LEDs:
- Green indicates normal operation, current within limits
- Red indicates a current or other fault
- Unlit means that the Controller is not configured for that Unit; or that a controller fault exists that prevents the Unit from receiving power.

If a Tracking Unit is configured and operating, its LED will operate the same as the Unit LEDs.

Pressing SHIFT from Normal mode will enter Calibration mode.

In the **Calibration** display mode, Unit LEDs flash on and off to indicate that the Calibration mode is active and nominal Unit currents may be set. Except as described below, other portions of the display are the same as in Normal mode.

For the Unit LEDs,

- Flashing green means that the current is within limits and new current may be set.
- Flashing red means that the current is outside the limits and a new current may be set.

In the Calibration display mode, pressing a Unit button calibrates the current for that Unit, and does *not* cause a switch. See Section 3.4, Calibrating Nominal Currents.

Pressing SHIFT from Calibration mode will enter the Configuration mode; pressing FAULT RESET from the Calibration mode will enter the Fault Display mode.

In the **Configuration** display mode, one or two segments of the FUNCTION display bar will be lit, and segments of the SETTING display bar light to indicate configuration settings and status. Refer to Section 2.7, Configuration, for further details of the configuration function choices and settings. You enter the Configuration display mode from the Normal display mode by pressing SHIFT twice in succession.

In the Configuration display mode,

- Switch indicator LEDs and Unit LEDs continue to indicate system status the same as in Normal mode, but pressing Unit buttons will *not* cause a switch.
- Pressing the > button steps through configuration and diagnostic function choices.
- The INC and DEC buttons can be used to increment or decrement configuration choices.
- Pressing LOCAL/REMOTE alternately enables or disables the Remote Panel Lockout feature and returns the panel to Normal display mode.
- The AUTO/MANUAL button has no effect.
- Pressing SHIFT returns the panel to Normal display mode.

In the **Fault Display** mode, all but one segment of the FUNCTION bar will be lit; the unlit segment indicates which fault group state is being displayed by the SETTINGS bar. Segments of the SETTINGS bar may light to indicate active faults. You enter the Fault Display mode from the Normal mode by pressing SHIFT, then FAULT RESET.

In the Fault Display mode,

- Switch indicator LEDs and Unit LEDs continue to indicate system status the same as in Normal mode, but the Unit buttons and the LOCAL/REMOTE and AUTO/MANUAL buttons have no effect.
- Pressing the > button steps through fault group choices. Refer to the Fault Group Descriptions chart in Appendix C to interpret the display.
- Pressing SHIFT or FAULT RESET will return the panel to Normal display mode.

3.3 Power Up

Power is applied by switching both power supplies on, using the switches on the rear panel (Figure 3-1).

When the unit is powered up, several internal tests are performed. These tests include various memory tests of the microprocessor and a test of the motor drive circuitry. If all is well after these tests are completed, the controller will commence operation.

If you power the unit up one supply at a time, and faults are latched, a controller fault may be reported. Although one supply is sufficient to power the controller, when it detects that the other supply is off, it reports a fault. To clear this fault, simply press the FAULT RESET button.

Note It is normal for each switching power supply in the controller to emit a single high-pitched "chirp" or "squeak" a second or so after input power is applied. If this sound continues or occurs repeatedly, it indicates a power supply overload. Turn off power and inspect for incorrect wiring, foreign objects which have entered the controller chassis, or other problems which could cause excessive current draw.

3.4 Calibrating Nominal Currents

The first time the controller is powered up when attached to a new plate assembly, or after replacing a Unit (i.e., LNA or LNB), it will be necessary to calibrate the nominal currents

for the Units. This can be done individually for each Unit, including a Tracking Unit if installed, using the front panel.

NOTE If the Local Lockout mode (see 3.5.4) is in effect, you will not be able to calibrate the Unit currents from the front panel.

First, you should verify that the Units are operating properly. Power the system up and ignore any Unit faults that may be reported.

Once operation of the Units has been verified, press the SHIFT button once to enter Calibration mode. All Unit indicator LEDs will begin flashing. Press the button representing the Unit whose nominal current you wish to set. Repeat this process for each Unit on the plate assembly. (Note that, when in Calibration mode, pressing a Unit button will NOT cause the system to switch.)

The nominal LNA/LNB current will be determined and automatically set. If this is done successfully, the Unit indicator LED will flash green three times. If the Unit is drawing less than 50 mA, or greater than 550 mA, the nominal value will NOT be set, the indicator will light steady red, and a Unit fault will be reported.

If you have selected the latched fault option, press and release the FAULT RESET button to clear any faults.

Note The controller will automatically return to normal display mode after approximately 15 seconds if no key is pressed.

3.5 Modes of Operation

The controller is capable of operation in a variety of modes.

- Local and Remote modes affect whether or not the controller will respond to commands received by either the parallel I/O or serial I/O ports.
- Local Lockout mode (blinking REMOTE indicator), which disables control from the front panel, can be initiated only by a serial I/O command.

- Remote Panel Lockout mode (blinking LOCAL indicator) can be set from the front panel to disable control from the optional Remote Control Panel.
- Auto and Manual modes affect whether or not the controller will automatically switch to the standby unit (LNA/LNB) to replace a faulted unit.

3.5.1 Local Operation

Local mode is in effect when the LOCAL indicator is lit. In Local mode, commands received via the parallel I/O port, and, with certain exceptions, the serial I/O port, will be ignored. The status of the controller will still be indicated via the Form 'C' parallel outputs, and messages addressed to the serial port will still be able to fetch status information.

Local mode is controlled *only* by the LOCAL/REMOTE button on the front panel. There is no way to switch this mode either by serial or by parallel I/O, although both provide the status of LOCAL/REMOTE mode.

NOTE If the Local Lockout serial I/O command is issued while the system is in Remote mode, you will not be able to select Local mode from the front panel until Local Lockout is disabled by serial I/O command. See Section 3.5.4.

The Local/Remote mode setting is remembered, even if power to the controller is lost.

3.5.2 Remote Operation

Remote mode is in effect when the REMOTE indicator is lit. In Remote mode, commands received via the parallel I/O or serial I/O ports will be obeyed. If the "Remote Disables Local" option is enabled (see 3.5.3), all buttons on the front panel—except LOCAL/REMOTE and PANEL TEST—will be ignored.

Serial I/O and Parallel I/O are both equal in priority, and commands received from them will be processed in the order they are received. For example, if the controller is in Manual

mode, and the AUTO/MANUAL parallel I/O input is pulled low at the same instant as a switch to AUTO mode is received via serial I/O, the result will simply depend on which is processed first. See Section 3.6 for more information on the serial and parallel I/O interfaces.

Remote mode can be set only by using the LOCAL/REMOTE pushbutton on the front panel.

The Local/Remote mode setting is remembered, even if power to the controller is lost.

3.5.3 Remote Disables Local Option

When the "Remote Disables Local" option is enabled, front panel controls—other than LOCAL/REMOTE and PANEL TEST—will not function if the system is in Remote mode.

This option can be enabled or disabled by Serial I/O command (see Appendix A) or by manually selecting or clearing this option when the system is configured (see Section 2.7).

The Remote-Disables-Local setting is remembered, even if power to the controller is lost.

3.5.4 Local Lockout

A serial I/O command can be issued, while the controller is in Remote mode, that "locks out" the front panel. In this mode, PANEL TEST is the only active button on the front panel. You will not be able to reset faults, control the switch positions, set nominal currents, switch Auto/Manual modes, enable Remote Panel Lockout, or switch to Local mode if Local Lockout is in effect.

Local Lockout is indicated by a flashing REMOTE indicator on the front panel. If you have the optional Remote Control Panel, it will also be locked out.

NOTE The Local Lockout command can only be issued by a serial I/O command while the unit is in Remote mode, and can only be cancelled by serial I/O command. See **Appendix A, Serial I/O Protocol**, for more information.

The Local Lockout setting is remembered, even if power to the controller is lost.

3.5.5 Remote Panel Lockout

If you are using the optional Remote Control Panel, you can temporarily lock out commands from the Remote Panel by enabling the Remote Panel Lockout feature. To do so, press Shift once, and then press LOCAL/REMOTE. Remote Panel Lockout is indicated by a flashing LOCAL indicator on the front panel. (The LOCAL indicator on the Remote panel will be flashing as well.)

While Remote Panel Lockout is enabled, the indicators on the Remote Control Panel will continue to show correct status information, but none of the controls (other than PANEL TEST) will function at the Remote panel.

To disable Remote Panel Lockout and enter Local mode, press Shift once, and then press LOCAL/REMOTE. To disable Remote Panel Lockout and enter Remote mode, simply press LOCAL/REMOTE.

If Local Lockout mode (see 3.5.4) is in effect, you will not be able to activate Remote Panel Lockout.

The Remote Panel Lockout setting is remembered, even if power to the controller is lost.

3.5.6 Auto Mode

Auto mode is active when the AUTO indicator is lit. In AUTO mode, a fault occurring on an on-line unit will cause the controller to automatically switch the standby unit on line to replace the faulted one.

If the "Auto Disables Manual" option (see 3.5.7) is enabled, unit switch commands from the front panel, parallel I/O or serial I/O will be ignored in Auto mode. If this option is NOT enabled, any switch command received from any source will only be obeyed if it results in a valid position based on the current fault status of the units. In other words, the controller cannot select a faulted unit to be on-line in Auto mode.

The controller can be placed in Auto mode using the AUTO/MANUAL button on the front panel, the AUTO/MANUAL parallel input, or a serial I/O command.

NOTE If the "Remote Disables Local" option (see 3.5.3) is enabled, it will be necessary to place the controller in Local mode before using the front panel button. It will also be necessary to place the controller in Remote mode before using parallel or serial I/O to switch Auto/Manual mode.

If Local Lockout mode (see 3.5.4) is in effect, you will not be able to select Auto mode from the front panel.

The Auto Mode setting is remembered, even if power to the controller is lost.

3.5.7 Auto Disables Manual Option

When the "Auto Disables Manual" option is enabled, unit switch commands from the front panel, parallel I/O, or serial I/O will be ignored in Auto mode. Switching will occur ONLY if an on-line unit develops a fault *and* the standby unit is not faulted.

This option can be enabled or disabled by Serial I/O command (see Appendix A) or by manually selecting or clearing this option when the system is configured (see Section 2.7).

The Auto-Disables-Manual setting is remembered, even if power to the controller is lost.

3.5.8 Manual Mode

Manual mode is active when the MANUAL indicator is lit. In this mode the controller never switches without receiving a command from the front panel, parallel I/O, or serial I/O. If an on-line unit is faulted, either you, or your status monitoring system, must switch to the standby unit.

The controller can be placed in Manual mode using the AUTO/MANUAL button on the front panel, the AUTO/MANUAL parallel input, or a serial I/O command.

NOTE If the "Remote Disables Local" option (see 3.5.3) is enabled, it will be necessary to place the controller in Local mode before using the front panel button. It also will be necessary to place the controller in Remote mode before using parallel or serial I/O to switch Auto/Manual mode.

If Local Lockout mode (see 3.5.4) is in effect, you will not be able to select Manual mode from the front panel.

The Auto/Manual mode setting is remembered, even if power to the controller is lost.

In Manual mode, Unit buttons operate as follows.

Main Unit 1:
Online:
- Press its button to take it offline and replace it with Standby Unit 3. *If Standby Unit 3 was in use by Pol 2, it will be removed from Pol 2.*

Offline:
- Press its button to put it online for Pol 1.

Main Unit 2:
Online:
- Press its button to take it offline and replace it with Standby Unit 3. *If Standby Unit 3 was in use by Pol 1, it will be removed from Pol 1.*

Offline:
- Press its button to put it online for Pol 2.

Standby Unit 3:
Online:
- Press its button to take it offline. The Pol which was using it will return to its Main unit.

Offline:
- Its button has *no effect.*

In Auto mode, operation will be similar to that described above, but a particular switch may be prevented if:

- One or more units are faulted.
- A priority channel is configured.
- Auto Disables Manual is enabled.
- Auto Revert is enabled.

3.5.9 Manually Moving Switches in Manual or Auto Modes

The switches on the plate assembly may be manually rotated to select a desired position. While being switched, the front panel indicators for the switch will all light yellow.

If the controller is in Manual mode, the switches will remain where they are manually positioned, regardless of the fault status of the units, and no switch fault will occur.

If the controller is in Auto mode, the switches may immediately be switched back into their original state, depending on the fault status of the units.

A side effect of turning the switches while the controller is in Auto mode may be that a controller fault occurs. One condition that causes a controller fault is that an attempt to switch fails, so if Auto mode tries to switch while someone is physically holding or turning the motor, a fault will occur.

If faults are not latched, a fault caused by holding or turning the switch will automatically clear the next time a switch is successfully completed by the controller. Otherwise, it will be necessary to clear the fault by pressing and releasing the PANEL TEST button on the front panel.

3.6 Remote I/O Interfaces

3.6.1 Serial I/O

A serial port is provided on the rear panel that allows the unit to be controlled and monitored remotely, using an RS-232, RS-485, or RS-422 bus. (J7; see Table 2-3.)

Most command messages, except those directly related to serial I/O functions and configuration, are ignored if the controller is in Local mode. However, any status information or measurements are always available, regardless of the mode settings.

See **Appendix A, Serial I/O Protocol,** for complete information on the serial I/O interface. The system responds only to correctly formatted messages, as described in Appendix A, and never sends out data unless polled.

3.6.2 Parallel I/O

The parallel I/O port consists of several Form 'C' relay contacts that provide status information, and opto-isolated inputs to control the system.

All parallel I/O inputs are completely disabled if the controller is in Local mode; however, the status outputs still function normally.

The parallel I/O output drivers have a time-out function. If not regularly updated by the microprocessor, all contacts will go to their power-off or fault state. This provides an indication that something is wrong if the microprocessor fails. Without this time-out function, there would be no indication on the parallel I/O port that something was wrong.

The following sections describe the status and control lines available on the parallel I/O connector. (J8; see Table 2-4.)

3.6.2.1 Parallel I/O Outputs

Unit Status

One Form 'C' relay contact is available for each unit (LNA or LNB) in the system. The contacts are used to indicate faults on the unit they represent. These contacts follow the state of the unit status LEDs on the front panel; i.e., when the unit status LED is red, the relay contacts will indicate a fault.

Four sets of contacts are present regardless of whether this is a 1:1, 1:2, or Dual 1:1 controller. Only the first two are used for 1:1, the first three for 1:2, and all four for Dual 1:1 systems.

These contacts will indicate faults when power is removed.

Power Supply Status

One set of Form 'C' contacts is available for PS1, and one for PS2. These contacts are used to indicate that the voltage from a particular supply is outside the 13.5 to 16.5 V range.

These contacts follow the state of the PS1 and PS2 indicators on the front panel. When a PS status indicator is lit, the corresponding relay contacts will indicate a fault.

These contacts will indicate faults when power is removed.

Unit Switch Position

Two sets of Form 'C' contacts are present. One is unused in 1:1 systems. The first set indicates whether the standby or main unit is on-line for POL 1; the second set is for POL 2.

These contacts will both go to the MAIN position (Position 1) when power is removed.

In a 1:2 system, when the switches are positioned so that Unit 1 is connected to POL2, both sets of contacts will indicate STANDBY (Position 2).

AUTO/MANUAL Status

One set of Form 'C' contacts represents whether the system is in Auto or Manual mode.

When power is removed, this contact is in the MANUAL position.

LOCAL/REMOTE Status

One set of Form 'C' contacts represents whether the system is in Local or Remote mode.

When power is removed, this contact is in the LOCAL position.

3.6.2.2 Parallel I/O Inputs

All parallel I/O inputs are completely disabled if the controller is in Local mode; however, the status outputs still function normally.

AUTO/MANUAL Toggle Input

This input will toggle between Auto mode and Manual mode on falling edges, provided that the controller is in Remote mode.

Position Control Inputs

Two inputs for each POL, which operate on falling edges only, control whether the MAIN or STANDBY unit is switched to the POL. In 1:1 controllers, only the inputs for POL 1 are used.

These inputs only function in Remote mode. They will also only function in Manual mode if the Auto Disables Manual option is enabled.

Fault Reset Input

A falling edge on this line resets all faults as described under Section 3.7. This input only functions in Remote mode.

3.7 Handling Faults

A unit LED on the front panel which lights red indicates a fault. One indicator exists for each unit (LNA or LNB), and

lights red when the unit's current is too low or too high (if internal alarms are enabled), or when the corresponding external fault input is open (if external alarms are enabled).

There are also fault indicators labeled CONTROLLER, PS 1, and PS 2. These indicators light when any of a number of internal conditions occur that indicate a problem with the controller or either of its power supplies.

All of these fault indicators may be either latched or not, determined by configuration setting (see Section 2.7.3.11). If latched, the indicators will continue to show a fault until reset, even after the condition that caused the fault goes away. Latched faults must be reset by command from the front panel, parallel I/O, or serial I/O. Note that the fault reset command will not clear the fault indicator if the fault condition still exists.

If faults are not latched, the fault indicator will light when the condition occurs, and turn off when the condition goes away. Some controller faults, however, will not clear themselves, since they indicate one time events, and there is no way of detecting that the problem has gone away.

To reset faults from the front panel, in Local mode, simply press the FAULT RESET button. However, if the system is in Remote mode and the "Remote Disables Local" option is enabled, the RESET command must be issued via serial I/O or parallel I/O.

3.7.1 Unit Faults

If a unit fault indicator is red, you should first know whether the controller is configured to use internal alarms, external alarms, or both. Serial I/O can be a great help in determining the source of a unit fault, since this is the only means of obtaining the unit bias current measurements and other information.

If the controller is in AUTO mode when a fault occurs in an on-line unit, and an unfaulted standby unit is available to replace it, the failed unit will be automatically switched off-line and the standby unit switched in. You may remove the failed unit from the plate assembly, and repair or replace it.

NOTE With latched faults, the fault indication will continue to be reported even after the failed unit is repaired or replaced, until faults are RESET.

3.7.2 Power Supply Faults

A power supply fault is indicated when the voltage level is below 13.5 V or above 16.5 V. It is important to note that the system will continue to operate properly with only one power supply functioning. A power supply fault may occur if you power the unit up one supply at a time. A power supply fault will also result in a Controller fault; see 3.7.3.9.

This fault can only be cleared if the power supply voltage is corrected. First check that both rear-panel power switches are on. Check the AC line fuses and power cords. If the fault still cannot be reset, check the power supplies and adjust them if needed (see Section 5.4.1).

3.7.3 Controller Faults

Several problems with the controller itself will cause a controller fault. When a controller fault occurs, the specific fault code can be viewed from the front panel, by pressing SHIFT, then FAULT RESET, or by using Serial I/O. See Section 3.7.4 for more information.

Once you have determined the specific fault, look for obvious problems in the area indicated. For example, if the specific fault is a power supply 1 failure, check the power switch, wiring, and fuses for power supply 1. To clear the fault after trying to correct a problem, make sure the unit is in LOCAL mode, and press the FAULT RESET button to reset the fault.

If pressing FAULT RESET does not work, or the controller fault occurs frequently or repeatedly, a serious problem probably exists that needs further troubleshooting.

The following sections describe the various conditions that can cause a controller fault.

3.7.3.1 Microprocessor Failure

Hardware on the front panel board will illuminate the CONTROLLER fault LED if no update is received from the microprocessor for a few seconds. The PANEL TEST button lights all LEDs, but this function is actually performed by the microprocessor, so if pressing the PANEL TEST button has no effect, then either the microprocessor has stopped functioning, or something is wrong with the front panel board.

Another indication that the microprocessor is not functioning is that all the parallel I/O relay contacts will go to their power-off state. A similar hardware time-out circuit exists on the relay drivers.

Since the microprocessor handles serial I/O, no responses will be received to serial I/O messages if the microprocessor fails.

3.7.3.2 Microprocessor Memory Test(s) Failed

A self-test is performed on ROM and RAM at power-up. These tests can also be run from a serial I/O command. If any of these memory tests fail, a controller fault is reported.

ROM is memory that contains the program that runs the controller. RAM memory contains data such as measurements that occur during normal operation.

This fault can be cleared only by a successful test of whichever area of memory failed.

3.7.3.3 EEPROM Write Failed

Whenever you reset the nominal unit currents, or change one of the mode settings, this information must be written to EEPROM. EEPROM is memory that retains the data even when power is removed. Data is verified as it is written, and if a failure occurs, this fault is reported.

If this happens, it is an indication that the EEPROM memory may be wearing out. This is not likely to happen during normal operation.

This fault can be cleared by a successful write to EEPROM, or by a fault reset command.

3.7.3.4 Invalid or Spurious Interrupt

This fault indicates a hardware or firmware problem with the microprocessor. If this fault occurs repeatedly, the unit should be returned for repair.

This fault is cleared by a fault reset command.

3.7.3.5 Spurious Reset

This fault indicates a hardware or firmware problem with the microprocessor.

A likely cause of this fault is a failure of the crystal oscillator circuit for the microprocessor.

This fault is cleared by a fault reset command.

3.7.3.6 Stack Overflow

This fault would most likely be caused by a "bug" in the firmware. Contact the factory if this fault occurs.

This fault is cleared by a fault reset command.

3.7.3.7 Controller Type Unknown

This fault indicates that the front panel connected to the controller is not configured for a valid controller type (1:1, 1:2, or Dual 1:1). The controller type is normally read from a jumper setting on the front panel PCB. This fault could occur if the jumper is moved, or if the front panel board is damaged or defective. The jumper is installed at the factory, and should never be moved.

If the controller type is unknown, NONE of the position indicators will be lit, nor will any unit status indicators light.

This fault is cleared only by attaching a good front panel with the "type" jumper properly installed.

3.7.3.8 Low Power Supply Voltage

This fault indicates that one of the two power supplies has dropped outside the 13.5-to-16.5-volt range. If the condition continues to exist, you will observe that one of the indicators (PS1 or PS2) is lit. This fault may occur if you power the unit up one supply at a time.

First check that the power supply is turned on. Check the AC line fuses and power cord. If the fault still cannot be reset, check the power supplies, and adjust them if needed (see Section 5.4.1).

This fault can only be cleared if the power supply voltage is corrected.

3.7.3.9 Switch Attempt Failed

If the controller tries to switch to another unit, either because of a command or because a unit has faulted in AUTO mode, and the switch does not move, this fault is reported. If the switch was initiated by a command, the attempt is only made once. If the controller is switching because of AUTO mode, it will continue to attempt to switch.

If this fault was generated because a command failed, it should be obvious, as you will observe that the system did not switch as you requested. If this fault was generated because an AUTO mode switch failed, you may observe that a faulted unit is not being switched off-line from the front panel indicators.

3.7.3.10 Drive Circuitry Test Failed

The circuitry to generate and control the drive voltage for the motorized switch is tested at power-up, at intervals during operation, and during any switch cycle. This test is also performed when the self-test serial I/O command is issued. If this test fails, this controller fault occurs.

A likely cause is the power capacitors (C1, C2) being disconnected. This fault can be cleared if the drive circuitry passes its self-tests.

3.7.4 Fault Display Mode

Fault codes can be viewed from the front panel. To enter Fault Display mode: from normal operation mode, press SHIFT, then FAULT RESET. In Fault Display mode, all but one segment of the FUNCTION display will be lit; the unlit segment indicates which group of faults is being displayed.

Press the blue arrow button to step through the fault display groups (A-G). The LEDs in the SETTING display show the fault code(s) for that group.

Refer to Appendix C for information on how to interpret the Fault Codes.

To return to normal operation from Fault Display mode, press SHIFT or FAULT RESET.

3.8 Emergency Power

Repairs can be made to the controller without interruption of service if the emergency LNA/LNB power provision is used. Before switching the controller off, apply +15 Vdc to connector P3, which is attached to the controller end of the plate assembly cable. With +15 Vdc applied, the controller can be powered down and removed for repair without interruption of service.

NOTE Some repairs, such as replacement of the controller's front panel, can be performed without removing power from the controller. See Section 5.6.1 for more information on making on-line repairs.

3.9 Noise Diode (OPTION)

The controller provides two current-limited outputs which can be used to power noise diodes. One or both outputs can be enabled in the controller's configuration (see Section 2.7). Each output can nominally provide up to 25 mA of current at +15 V.

NOTE If only one noise diode is configured, it should be noise diode 1.

When a noise diode is configured, its output is not turned on automatically. During operation, a noise diode output may be turned on or off by pressing the appropriate AUX 1 or AUX 2 button in the lower left corner of the controller front panel.

Pressing AUX 1 will toggle Noise Diode 1 power, and AUX 2 will toggle Noise Diode 2. The top AUX 1 LED will light to indicate the Noise Diode 1 output is active. The top AUX 2 LED will light to indicate the Noise Diode 2 output is active.

NOTE In some versions of the controller, the AUX 1 and AUX 2 buttons and LEDs may be programmed for other functions and may not act as described here.

3.10 Tracking Unit (OPTION)

If the tracking unit option is configured, the controller provides a +15 V output to power a tracking LNA, LNB, or other unit. The current drawn by the tracking unit is compared to limits set by calibration, just like the other units. The same current window is used for all units.

The tracking unit is calibrated by pressing SHIFT and then the tracking unit button while its indicator LED is flashing.

If calibration is successful, the tracking unit LED flashes three times; if it fails, the LED lights steady red. If the LED is not lit, the tracking unit is not configured.

Faults for the tracking unit may be configured as internal, external, both or none. If external is used, the input is External Alarm #5 (see Table 2-2). Tracking unit faults are latched or un-latched depending on the configuration setting, just as other faults. Behavior of the tracking unit is virtually the same as other units, except that failure of the tracking unit will not cause a switch.

Section 4 Theory of Operation

4.1 General Introduction

To understand how the VertexRSI 1:2 Redundant LNA/LNB System works, use the information contained in this section. The description is organized by major subassemblies, with the first section describing the overall system and the interconnection between units.

- To understand the theory from the system level, see **System Level Description**, Section 4.2.
- To understand the operation of the outdoor plate assembly, see **Plate Assembly Description**, Section 4.3.
- To understand the operation of the interconnecting control cable, see **Control Cable Description**, Section 4.4.
- To understand the operation of the indoor controller, see **LNA/LNB Controller Description**, Section 4.5.

4.2 System Level Description

The 1:2 Redundant LNA/LNB System consists of three major subassemblies: an outdoor plate assembly which contains the Low Noise Amplifiers (LNAs) or Low Noise Block Converters (LNBs) and a pair of motorized switches; an indoor controller which contains controls and indicators; and a control cable assembly to interconnect the controller and the plate assembly. An optional remote panel is also available but is not described here.

Power for the 1:2 system originates in the controller and is supplied to the outdoor plate assembly via the interconnecting control cable. For redundancy, two supplies are used and may be wired to independent AC power sources if available. Supply outputs are arranged so that either supply is capable of powering the entire system, so the failure of one supply will not put the system off the air.

All parts of the system run from +15 V, including the LNA/LNB power, the displays and indicators and the control logic. +30 V for the motorized waveguide switch is generated on the logic board by the switch driver circuitry.

For details of the individual subsystems, see the following subsystem descriptions.

4.3 Plate Assembly Description

For help in understanding the following description, refer to the plate assembly schematic in Section 8, System Configuration.

The plate assembly contains the three LNAs/LNBs and the motorized waveguide/coaxial switches used to switch between them. Depending upon system configuration, it may also contain optional transmit reject filters, directional couplers and test ports.

The main signal path is through an input waveguide switch, through an LNA/LNB, and through the output coaxial switch to an output isolator. (A bias tee and matching transformer are used in LNB systems.) Two such paths are present, one for POL1 and the other for POL2.

Motorized dual waveguide/coaxial switches are used to insert and remove LNAs/LNBs from the signal paths. The 30-volt pulsed power required to operate the switches is supplied by the controller. To activate a switch, +30 V is applied to the common lead of the motor (pin B) and then one of the two position select leads is grounded (pin A or C). The motor switches to the other position and then shuts itself off. The pulsed power source applies power to the switch for 300 ms; normal switching time is 100 ms.

The latching feature of the motorized switches is used by the controller to sense switch position; the indicator contacts are not used.

+15 V power for the LNAs/LNBs is supplied by the controller and fed over the interconnecting control cable. Separate lines

are used for each LNA/LNB so that the controller can monitor the current drawn by each.

+15 V power for optional noise diodes, which can be connected to the off-line input port for noise temperature verification of the standby LNA/LNB, can also be fed over the interconnecting cable.

4.4 Control Cable Description

The interconnection between the outdoor plate assembly and the indoor controller is via a single control cable assembly. This multiconductor cable carries power to the LNAs/LNBs, optional noise diode, and motorized waveguide switches, and returns switch and LNA/LNB status information to the controller.

Refer to drawing 10899, Control Cable Assembly, in Section 6, Drawings, for details. A variety of cable types are used, depending upon cable length and type of service. Primary requirements on the cable are that it have the correct type of outer jacket for the intended use and that its dc resistance is low enough.

For a discussion of the types of outer jackets and their recommended uses, see Interconnecting Control Cable Installation, Section 2.3.3.

Ku-band switches draw 1 ampere while switching; C- and X-band switches, which are larger, draw 2 amperes while switching. The motorized waveguide/coaxial switches can tolerate a voltage drop in the cable of up to 4 volts; therefore, the total dc resistance of the interconnecting cable circuit must be less than 4 ohms for Ku-band switches or 2 ohms for C- and X-band switches. Since the circuit consists of a supply line and a return line, each can contribute half of this resistance. To further reduce resistance, each line to the switch consists of two conductors in parallel. Thus, the total circuit resistance is the same as the resistance of one conductor.

For example, the resistance of 18 AWG stranded wire is 6.48 ohms per 1000 feet. Thus, one 616 ft. long wire has 4 ohms resistance. Two in parallel give 2 ohms. One pair out and one pair back results in a total circuit resistance of 4 ohms. Thus, up to 616 ft. of #18 AWG cable is acceptable for Ku-band switches; or, up to 308 ft. for C- and X-band switches.

Suggested part numbers for Belden and Alpha cables are listed in the table on drawing 10899. For Ku-band switches, the drawing recommends #18 AWG for lengths up to 500 ft (150 m) and #16 for lengths of 500-1000 ft (150-300 m). For C- and X-band switches, use #18 AWG for lengths up to 250 ft (75 m), and #16 for 250-500 ft (75-150 m).

4.5 Controller Description

For help in understanding the following description, refer to the controller schematic diagram, drawing 11074, in Section 6, Drawings.

The controller provides the "intelligence" in the system. It has the ability to measure current drawn by the units, determine whether the current drawn is acceptable and, if not, report the unit fault, and switch a good unit on-line to replace the bad one.

The controller consists of the front panel board, the main logic board, two power supplies, and two capacitors that are charged up to drive the motorized switch.

4.5.1 Power Supplies

Two power supplies in a fully redundant configuration supply all of the power required by the system. Each supply produces +15 V at 3 A and is fully capable of powering the entire system if the other supply fails. Each is a commercial switching supply with foldback current limiting. The line power is supplied via an international power entry module. Line voltages of 90 to 264 Vac can be used.

4.5.2 Front Panel Board

The front panel board supports the pushbuttons and lamps accessible from the front of the unit. The same board is used for 1:1, 1:2, and Dual 1:1 controllers, but is populated with different lamps and switch logic. A jumper on this board identifies which type of front panel is installed. This is the only board which changes for the different types of controllers.

A clocked serial link exists between the front panel board and the main logic board.

4.5.3 Firmware

All of the logic that determines how the units will be switched in Auto mode, the switch circuitry timing, serial I/O, parallel I/O, and front panel interfacing is implemented in the firmware of the microprocessor. Much of this information is discussed in other sections of the manual.

The logic for Auto mode switching in a 1:2 system is somewhat complex. Refer to Table 4-1 for more information. In the table, each possible case of Unit Fault, Priority Channel setting, and Auto Revert setting is listed as a separate line; "Prior Position" describes the system state prior to a switch command; and "Switch Command" lists what each POL will switch to in that case. Even in those cases where the prior position is not known, the controller will still attempt to switch into the desired result state, just in case the hardware that detects the switch position has failed.

If switch commands are received in AUTO mode, they will be obeyed only if the Auto Disables Manual option is not enabled. However, a switch command will still be ignored if it results in a state that would immediately cause Auto mode to switch again. For example, in a 1:2 system, if Unit 3 were faulted, any command that would switch Unit 3 on-line on either POL 1 or POL 2 will be ignored, since the controller would immediately switch it off-line again.

Table 4-1 AUTO Mode Truth Table

Faults			Priority	Auto	Prior Position		Switch Command	
Unit 1	Unit 2	Unit 3	Channel	Revert	POL 1	POL 2	POL 1	POL 2
NO	NO	NO	X	NO	X	X	NONE	NONE
"	"	"	"	YES	Unit 1	Unit 2	NONE	NONE
"	"	"	"	"	Unit 3	X	Unit 1	Unit 2
"	"	"	"	"	X	Unit 3	Unit 1	Unit 2
YES	NO	NO	X	X	Unit 1	X	Unit 3	Unit 2
"	"	"	"	"	Unit 3	Unit 1	Unit 3	Unit 2
"	"	"	"	"	Unit 3	Unit 2	NONE	NONE
NO	YES	NO	X	X	X	Unit 2	Unit 1	Unit 3
"	"	"	"	"	Unit 1	Unit 3	NONE	NONE
"	"	"	"	NO	Unit 3	Unit 1	NONE	NONE
"	"	"	"	YES	Unit 3	Unit 1	Unit 1	Unit 3
NO	NO	YES	X	X	Unit 3	X	Unit 1	Unit 2
"	"	"	"	"	Unit 1	Unit 3	Unit 1	Unit 2
"	"	"	"	"	Unit 1	Unit 2	NONE	NONE
YES	YES	NO	1	X	Unit 1	X	Unit 3	Unit 2
"	"	"	"	"	Unit 3	X	NONE	NONE
"	"	"	2	X	Unit 3	X	Unit 1	Unit 3
"	"	"	"	"	Unit 1	Unit 2	Unit 1	Unit 3
"	"	"	"	"	Unit 1	Unit 3	NONE	NONE
"	"	"	NONE	X	Unit 1	Unit 2	Unit 3	Unit 2
"	"	"	"	"	Unit 3	X	NONE	NONE
"	"	"	"	"	Unit 1	Unit 3	NONE	NONE
YES	NO	YES	X	X	Unit 1	Unit 3	NONE	Unit 2
"	"	"	"	"	Unit 3	Unit 1	NONE	Unit 2
"	"	"	"	"	X	Unit 2	NONE	NONE
NO	YES	YES	X	X	Unit 3	Unit 2	Unit 1	NONE
"	"	"	"	"	Unit 1	X	NONE	NONE
"	"	"	1	X	Unit 3	Unit 1	Unit 1	NONE
"	"	"	2	X	Unit 3	Unit 1	NONE	NONE
"	"	"	NONE	NO	Unit 3	Unit 1	NONE	NONE
"	"	"	"	YES	Unit 3	Unit 1	Unit 1	NONE
YES	YES	YES	X	X	X	X	NONE	NONE

X = Don't care

Unit = LNA or LNB

Section 5 Maintenance

5.1 General Introduction

To maintain, repair or verify performance of the VertexRSI 1:2 Redundant LNA/LNB System, use the information contained in this section.

- For a list of test equipment and accessories required for maintenance, see **Equipment Required**, Section 5.2.
- **Preventive Maintenance Procedures** are in Section 5.3. Follow these regularly to keep the equipment in peak operating condition.
- Instructions for periodic checks are in **Performance Checks**, Section 5.4.
- To verify that the equipment is operating properly, see **Performance Verification**, Section 5.5.
- For service and repair information, see **Troubleshooting**, Section 5.6.

5.2 Equipment Required

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

Table 5-1 Recommended Test Equipment

Model Number	Item
Tek 2235	Oscilloscope, dual trace
Fluke 77	Digital Multimeter (DMM)
	120 ohms, 2 W, ±5% resistor
	1000 ohms, 0.25 W, ±5% resistor
	Insulated Alignment Tool, flat blade, 1/8 in (3 mm)
	Brush, small (for general cleaning)

5.3 Preventive Maintenance Procedures

The following procedures keep the equipment in top working order and should be performed at least once yearly. It is recommended that a log be kept.

First, gain access to the interior of the unit. Remove the unit from the rack or, if it is mounted on slides, slide it out. Remove the top cover by loosening the captive screws at both sides of the cover. Lift the cover off.

WARNING Disconnect both line cords before working on the interior of the unit. Capacitors within the unit may still be charged after power cables have been disconnected. Discharge with 1000 ohms resistor before touching.

Do the following:

- **Periodic cleaning** - keep the interior free of dust and dirt. A vacuum cleaner and a small, soft brush are helpful.
- **Check power supply voltages** - Check and adjust the power supply voltages using the procedure in Section 5.4.1.
- **Check Unit Current settings** - Check the Unit Nominal Currents using the procedure in Section 5.4.2.

5.4 Performance Checks

The following procedures are contained in this section:

- Check Power Supply Voltages 5.4.1
- Check Unit Nominal Currents 5.4.2

Periodically, you should check the power supplies, adjust them if the voltage has drifted, and reset the Unit nominal currents. If you are using the serial I/O port, you can measure the power supply voltages, Unit currents, and read Unit nominal currents settings without opening the chassis. If the power supplies measure 15.0 ± 0.1 volts, and the Unit currents are within ±4 mA of the nominal value, no adjustments are needed.

If you are not using serial I/O, it will be necessary to open the chassis. First, remove the unit from the rack or, if it is mounted on slides, slide it out. Remove the top cover by loosening the captive screws along the sides. Lift the cover off.

WARNING Adjustments described in this section are performed with power applied and protective covers removed. Always be careful not to come into contact with dangerous voltages while performing these procedures and never work alone.

The adjustment procedures described can be performed while the unit is operating without interruption of service.

5.4.1 Check Power Supply Voltages

Do this every 12 months. Set the power supply output voltages as follows:

a) Turn PS2 off.

NOTE This will result in a controller fault and a PS2 fault. If the audible alarm is enabled, it will sound. To silence the audible alarm, press any button on the front panel.

b) Connect the positive lead of a DMM to TP1 on the logic board, and the negative lead to the chassis.
c) Carefully insert an *insulated* adjustment tool through the cover of PS1 to reach its Vadj pot.
d) Adjust the Vadj pot on PS1 for +15.0 ± 0.1 Vdc at TP1.
e) Turn PS2 back on, and turn PS1 off.

NOTE This will result in a controller fault and a PS1 fault. If the audible alarm is enabled, it will sound. To silence the audible alarm, press any button on the front panel.

f) Use the adjustment tool to adjust the Vadj pot on PS2 for +15.0 ± 0.1 Vdc at TP1.
g) Turn PS1 back on.
h) If faults are latched, put the unit in Local mode, and reset faults by pressing the FAULT RESET button. If desired, put the unit back in Remote mode.

5.4.2 Checking Unit Nominal Currents

If you are using serial I/O, you can send a message to view the measured Unit currents, and the Unit nominal current settings. If the measured currents are close to the nominal settings, it is not necessary to reset these nominal currents.

You may wish to calibrate Unit Currents by following the procedure in Section 3.4.

If you are not using serial I/O, you must calibrate Unit Currents by following the procedure in Section 3.4.

5.5 Performance Verification

Use the procedures in this section to verify that controller hardware is operating as expected.

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

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

The procedures used are:

- Power Supply Tests 5.5.1
- Unit Current Limiter Tests 5.5.2
- Unit Current Monitor Tests 5.5.3
- External Alarm Input Tests 5.5.4
- Capacitor Charge Current Limiter Test 5.5.5
- Front Panel Tests 5.5.6
- Plate Assembly Tests 5.5.7
- Parallel I/O Output Tests 5.5.8
- Parallel I/O Input Tests 5.5.9
- Serial I/O Tests 5.5.10
- RCP Link Port Tests 5.5.11
- RF Tests 5.5.12

NOTE These tests cannot be performed with the system on-line. Certain procedures will interrupt service to one or more Units (LNAs or LNBs). Remove the system from service before doing performance verification tests.

Some tests require access to the outdoor plate assembly. Place the assembly on the bench next to the control panel.

WARNING Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so. Do not replace components with the power cable connected. Discharge capacitors with 1000 ohms resistor before touching.

Gain access to the interior of the control panel by loosening the captive screws on the cover and lifting the cover off. Refer to drawing 9683 in Section 6, Drawings.

NOTE Do the tests in the order presented. Some later tests depend on the results and settings done in previous tests.

5.5.1 Power Supply Tests

a) Connect line cords from J1 and J2 to a source of AC power.
b) Turn on PS1, but not PS2.

NOTE This will result in a controller fault and a PS2 fault. If the audible alarm is enabled, it will sound. To silence the audible alarm, press any button on the front panel.

c) Connect the positive lead of a DMM to TP1 on the logic board, and the negative lead to the chassis.
d) Carefully insert an *insulated* adjustment tool through the cover of PS1 to reach its Vadj pot.
e) Adjust the Vadj pot on PS1 for +15.0 ± 0.1 Vdc at TP1.
f) Turn off PS1 and turn on PS2.

NOTE This will result in a controller fault and a PS1 fault. If the audible alarm is enabled, it will sound. To silence the audible alarm, press any button on the front panel.

g) Use the adjustment tool to adjust the Vadj pot on PS2 for +15.0 ± 0.1 Vdc at TP1.
h) Turn PS1 back on so that both supplies are operating. Press FAULT RESET to clear the controller fault.

If the supplies fail to adjust, and especially if the voltage is close to 0 Vdc, they are probably in current limiting. Refer to Troubleshooting, Section 5.6 and eliminate the source of the problem before continuing.

5.5.2 Unit Over-current Protection Tests

Electronic shutdown circuitry protects Unit power circuitry in case a Unit or the interconnecting cable shorts. Without this protection, a short at one Unit would disable the power supply and cause failure of the entire system. Circuitry will interrupt power to a Unit if a maximum current of approximately 600 mA is exceeded. This procedure tests for correct functioning of the shutdown circuitry.

a) Connect the plate cable to J3 of the controller.
b) Ensure that all Unit currents are set properly.
c) Clear any Unit alarms which are present. Verify that all Unit indicators are green.
d) Configure Latched Faults to disabled.
e) Set the DMM to measure current on a 3 A or greater range.
f) Connect the positive lead of the DMM to TP5 and the negative lead to the chassis.
g) Verify that < 10 mA current is flowing and that the Unit indicator turns red. If the front panel indicators go out during this test, or the controller resets, there is a problem with the logic board.
h) Disconnect the positive lead from TP5. Verify that the Unit indicator turns green.
i) Repeat steps f) through h) using TP7 and TP9.
j) If a Tracking Unit is configured and connected, repeat steps f) through h) for the Tracking Unit, connecting to TP2.

5.5.3 Unit Current Monitor Tests

The microprocessor monitors the current drawn by each Unit by measuring the voltage across a sense resistor in the supply lead to each Unit. A circuit scales the sensed voltage across the resistor to an appropriate value for the A/D converter.

Each circuit should be tested, using the following test points.

Unit 1: Load on TP5, measure TP4
Unit 2: Load on TP7, measure TP6
Unit 3: Load on TP9, measure TP8

If a Tracking Unit is configured, test it as well:

Tracking Unit: Load on TP2, measure across C44 (near TP10)

CAUTION When connecting to test points, be careful not to short to surrounding circuitry. Doing so can cause permanent damage to the circuitry.

a) Disconnect the plate cable from J3 of the controller.
b) Measure the 120 ohms, 2 W resistor, record the resistance.
c) Connect the 120 ohms resistor between TP_{LOAD} and ground (chassis). This represents a Unit load, and draws approximately 120 mA.
d) Measure the voltage at TP_{LOAD} with respect to ground. Divide by the resistance of the 120 ohms resistor to get the actual current drawn by the load.
e) Measure the voltage at $TP_{MEASURE}$ with respect to ground. Multiply by 200 to get the current (in mA) that this voltage represents. This current should be within 5% of the actual current measured in step d)
f) Repeat steps c-e for each pair of test points listed above.

Before returning the unit to service, refer to Section 5.4.2 to set the nominal Unit currents, if necessary.

5.5.4 External Alarm Input Tests

External alarm inputs are used by some systems as an alternate method of indicating unit failure. A typical example is a phase-locked LNB, where an alarm must be generated if the LNB loses phase lock. The following procedure checks the function of the external alarm circuitry.

External alarm inputs can be tested via the front panel.

a) Refer to Section 2.7 and note the current configuration settings for internal and external alarms, and latched faults. Then configure the controller as follows:
   ENABLE all of External Alarms 1-4,
   ENABLE all of External Alarms 5-8,
b) Go to configuration function EF, which displays External Alarm Input status.
c) Individually connect pins of J4 to ground as shown below. As you do this, watch the SETTINGS bargraph indicators. An indicator should go out as each pin is shorted to ground, and light again as the pin is opened.
   J4 pin 1 controls SETTINGS indicator 0
   J4 pin 2 controls SETTINGS indicator 1
   J4 pin 3 controls SETTINGS indicator 2
   J4 pin 4 controls SETTINGS indicator 3
   J4 pin 5 controls SETTINGS indicator 4
   J4 pin 6 controls SETTINGS indicator 5
   J4 pin 7 controls SETTINGS indicator 6
   J4 pin 8 controls SETTINGS indicator 7
d) If all indicators function as described, all External Alarm Inputs are functioning correctly.
e) Restore the controller configuration noted in step a).

5.5.5 Capacitor Charge Current Limiter Tests

The power capacitors used to drive the switch motors are charged in two stages. The first stage is an initial slow charge, which brings the capacitors to approximately 7 V. The second stage roughly doubles the charging current, to quickly bring C1 and C2 to full voltage.

The following procedure checks the current limiter for the fast charging stage.

a) Turn off the controller and wait one minute for the capacitors to discharge.
b) Set the DMM to measure dc current and to a range of 3 A or greater.
c) Connect the negative lead to the chassis and the positive lead to TP3.
d) Turn on the controller and observe the current through the DMM.
e) After approximately 5 seconds, the meter should read about 450-550 mA. After approximately 5 more seconds, the reading should increase to 900-1100 mA and remain at that level.
f) Disconnect the DMM and reconfigure the leads to measure dc voltage.

CAUTION Leaving the DMM set for current measurement may cause damage to circuitry.

If the front panel indicators go out or the controller resets during this test, there is a malfunction in the fast charging current limiter, and the logic board should be swapped or replaced.

The next few steps check the remainder of the circuitry associated with C1 and C2.

g) Connect the DMM leads to the two terminals of one of the power capacitors. Turn both power supplies on and verify that the capacitor voltage rises to greater than 14 V within 10 seconds. This verifies that the capacitors charge properly.
h) Turn off both power supplies, and verify the capacitor voltage discharges to < 3 V within 10 seconds. This checks the discharge circuit for the capacitor.
i) Repeat the above two steps with the DMM leads connected to the other power capacitor. Similar results should be observed.

5.5.6 Front Panel Tests

This procedure tests all front panel lights, the audible alarm beeper, and all front panel buttons.

a) Using front panel configuration, enable and disable audible alarms several times (this verifies operation of the SHIFT, [>], INC and DEC buttons). Leave the audible alarm enabled.
b) Exit configuration mode, and press the PANEL TEST button.
c) Observe that all LEDs light. Multicolor LEDs will first light green, then light red, then light amber (yellow). Single color LEDs will remain lit the same color during the entire test.
d) Observe that the audible alarm beeper sounds briefly at the end of the test.
e) Press the LOCAL/REMOTE button several times, verifying the LOCAL and REMOTE LEDs toggle state.
f) Verify there are no Unit alarms which would cause and undesired switch, then press the AUTO/MANUAL button several times, verifying the AUTO and MANUAL LEDs toggle state.
g) With the controller in LOCAL mode and MANUAL mode, press each Unit button, verifying that it causes the expected switch.
h) Press the SHIFT button, and then the FAULT RESET button, to enter Fault Display mode. All but the FUNCTION 'A' bargraph indicators should light. Press FAULT RESET again to exit Fault Display mode.
i) If a Tracking Unit is present, configured, and operating properly, press the SHIFT button to enter calibration mode. Press the Tracking Unit button within 5 seconds. If calibration mode is exited (Unit indicators stop flashing), the Tracking Unit button is operating properly.
j) If Noise Diodes are configured, press the AUX1 and AUX2 buttons several times, making sure they toggle the top LED in the AUX1 and AUX2 buttons.
k) If a Remote Control Panel is present, repeat the above tests from that front panel.
l) Disable the audible alarm, if it is no longer desired.

5.5.7 Plate Assembly Tests

This series of tests checks the wiring of the control cable, the operation of the waveguide switch and the Unit dc power circuitry and current monitors. Refer to the plate assembly drawing in Section 8, System Configuration, for help in identifying components.

a) Turn power off and connect the control cable assembly between the control panel (J3) and the plate assembly (J1).
b) Turn power back on. Turn the control knobs on the waveguide/coaxial switches so that Unit 1 is on-line on POL 1, and Unit 2 is on-line on POL 2. Verify that the front panel indicators show Unit 1 and Unit 2 are on-line.
c) Rotate the knob on switch S1 to the other position, selecting Unit 3 on POL 1. Verify that the front panel indicators show Unit 3 is on-line on POL 1. Rotate the knob back to the first position to put Unit 1 on-line again. Verify that all arrow indicators for POL1 turn amber (yellow) while the switch is being rotated.
d) Rotate the knob on switch S2 to the other position, selecting Unit 3 on POL 2. Verify that the front panel indicators show Unit 3 is on-line on POL 2. Rotate the knob back to the first position to put Unit 2 on-line again. Verify that all arrow indicators for POL2 turn amber (yellow) while the switch is being rotated.
e) Disconnect the cable to switch S1 and verify that all arrow indicators for POL1 turn red. Some arrow indicators for POL2 may change between amber and green, but none should turn red. Reconnect the cable and verify the indicators return to normal.
f) Disconnect the cable to switch S2 and verify that all arrow indicators for POL2 turn red. Some arrow indicators for POL1 may change between amber and green, but none should turn red. Reconnect the cable and verify the indicators return to normal.
g) Press each of the front panel Unit buttons in turn and verify that the controller switches to the correct Unit.
h) Calibrate the nominal currents for each Unit as described in Section 3.4.
i) Disconnect the power connector from Unit 1 and verify that the front panel Unit 1 indicator lights red.

j) Reconnect Unit 1 power. If Faults are Latched, press FAULT RESET to clear the Unit fault.
k) Repeat steps i) and j) for Unit 2 and then for Unit 3.

5.5.8 Parallel I/O Output Tests

This procedure checks out the parallel I/O form 'C' relays and interconnections to rear panel connector J8. Refer to Table 2-4 for pinouts and to Section 3.6.2 for a functional description of each status output.

a) Using an ohmmeter, check continuity from J8-6 to J8-26. Simulate a Unit 1 failure by disconnecting the dc power connector from Unit 1. Verify no continuity between pins 6 and 26 and continuity between pins 6 and 25. Restore power to Unit 1.
b) Similarly, for each Unit status output listed in Table 2-4, repeat the procedure described in step a).
c) Using an ohmmeter, check continuity from J8-9 to J8-29. Turn off PS1. Verify no continuity between pins 9 and 29 and continuity between pins 9 and 28. Turn PS1 back on.
d) Check PS2 status as in step c), using J8 pins 30, 11, and 10.
e) In a similar manner, check the S1 and S2 position, Auto/Manual, and Local/Remote outputs as listed in Table 2-4.
f) Check the Service Request output on the serial I/O and LOOP connectors, J6 and J7. With no controller fault present, there should be continuity between pins 6 and 7 of both J6 and J7. There should be no continuity between pins 7 and 8 of both J6 and J7.
g) Create a controller fault by turning off one power supply. With the fault present, there should be continuity between pins 7 and 8 of both J6 and J7. There should be no continuity between pins 6 and 7 of both J6 and J7.
h) If you are using an Remote Control Panel with Parallel I/O, repeat the above tests on its J8, J6, and J7 as well.

5.5.9 Parallel I/O Input Tests

Inputs on connector J8 allow the system to be controlled by external circuitry. All inputs are actuated by a closure to ground.

The operation of the Parallel I/O inputs can be verified from the front panel.

a) Go to the configuration function for Display Parallel I/O Input status.
b) One at a time, successively ground each input pin of J8 as listed in the table below.
c) When an input is grounded, its corresponding indicator on the SETTINGS bargraph should go off. When the input is opened, its corresponding indicator should go on.

Parallel I/O Input	J8 Pin #	SETTINGS Indicator
AUTO/MANUAL Toggle	5	2
POL 1 Main Unit Select	4	3
POL 1 Standby Unit Select	3	4
POL 2 Main Unit Select	2	5
POL 2 Standby Unit Select	1	6
FAULT RESET	23	7

5.5.10 Serial I/O Tests

To test the serial I/O port, you need a computer running a program capable of sending messages to the controller and receiving the response.

a) Use configuration functions to set the controller Serial I/O for RS-232, 19200 baud, and address 01.
b) Connect the computer's RS-232 port to J7. See Table 2-3 for the pinout.
c) Send a message to the controller that will have a response. Make sure all bytes are received. For example (assuming the controller is on address 01), send:

02 06 01 07 08 03

The response should start with an 02, end with an 03, and contain a 32, which indicates the device type, which is a controller. See Appendix A for more information on serial I/O messages.

To test other Serial I/O interface modes, you will need an RS-232 to RS-422/RS-485 converter or a PC card with an RS-422/RS-485 interface. The program running on the PC

must be capable of switching the converter's output driver on or off to test the controller in RS-485 2-wire mode.

If it is desired to test Serial I/O in another interface mode:
1) Disconnect the Serial I/O cable
2) Use configuration functions to set the controller for the new interface (RS-422, RS-485 2 wire, or RS-485 4 wire)
3) Connect the correct interface cable from the PC serial port to the controller port. See Table 2-3 for pinout.
4) Send a serial I/O message as described in step c) above.

5.5.11 RCP Link Port Tests

The Remote Control Panel (RCP) link is continuously tested for proper operation whenever a remote unit is connected.

There are no additional tests of the RCP Link port.

5.5.12 RF Tests

Use a copy of the first two pages of the Measured Test Data form in Section 8, System Configuration, to record RF test data. It is assumed that the reader is familiar with standard microwave test techniques such as gain, VSWR, intermodulation and noise figure, and has access to the proper test equipment. No details of these tests are given here. Refer to the manuals of your microwave test equipment for measurement details, if necessary.

The following RF parameters are measured:
- Gain, gain flatness
- VSWR
- Noise temperature
- Power output at 1 dB compression
- Third order intercept point

Using the test data form, pages 1 and 2, plot the swept gain response. Record two traces on each of two plots. Make one set of plots for POL1 and another set for POL2. In each set, plot the gain for both the main and standby units. Draw arrows from the traces to the identifying labels next to the plots.

Likewise, plot input and output return loss for both LNAs/LNBs in each of two polarizations. Then plot noise temperature for each input. Again, plot traces for both the main and standby units on the same plot and identify each with arrows.

This completes the Performance Verification. If all of the procedures from Section 5.5.1 through 5.5.12 are completed satisfactorily, then the 1:2 Redundant System complies with factory specifications.

5.6 Troubleshooting

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

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

Before starting, look first for the following common problems.

- Are you certain that the problem has been isolated to this piece of equipment? Perform tests to verify that the problems being experienced are not caused by some other part of the system.
- Are you certain the controller is configured correctly?
- Is power applied and are fuses ok?
- Are power supply voltages correct?

If evidence points to a problem with the controller, several service options are available. If you wish to return the unit to the factory for service, refer to Section 7 for Warranty Information and Return Procedures.

If you can isolate a controller problem to one board, for example, the front panel or Parallel I/O board, you can simply replace the suspected board. Contact VertexRSI for replacement boards for the controller.

If you have spare boards available, you may be able to isolate a problem to one board by replacing boards one at a time, and noting when the problem is corrected. Contact VertexRSI for spare boards for the controller.

Refer to the appropriate parts lists and assembly drawings in Section 6, Drawings, or Section 8, System Configuration, to help find the appropriate board to swap or replace.

Following repairs, the Performance Verification tests of Section 5.5 may be used to verify that the equipment is fully operational.

NOTE Troubleshooting controller circuit boards is beyond the scope of this manual. Problems within boards should be resolved by swapping or replacing boards, or returning them for factory test and repair. Customers are advised **not** to attempt board-level servicing of the controller.

5.6.1 On-Line Repairs

The following kinds of repairs can be made to the system without interruption of service:

- **Unit Replacement**. A defective Unit can be replaced. First, switch the defective unit off-line. With the system switched to the good unit, unplug the power connector, disconnect the RF output cable, disconnect the mounting screws and the input connector, and remove the defective unit.

- **Power Supply Replacement**. Either of the two power supplies can be disconnected and replaced. Turn off the supply and disconnect the line cord from the power entry module for the supply being replaced. Slightly loosen the screws holding the small metal cover over the AC input terminals of the supply and slide it to the side. Carefully unplug the AC power input connector. Carefully noting its position, unplug the DC power output connector. Remove the two power supply mounting screws and lift the supply from the chassis. Install the new supply, making sure to install the AC input power and DC output power connectors properly.

- **Front Panel Repairs**. The front panel board can be removed without interrupting service, although removing it will cause a controller fault. Carefully disconnect the flat cable at front panel connector J1. Front panel indicators will go out, but the system will remain operational in the LOCAL and AUTO modes. Disconnect the power cable at front panel connector J3. Remove the chassis handles and lift the front panel from the chassis.

  NOTE: It is possible that reconnecting the front panel with power on will cause the controller to reset. Do not reconnect the front panel with power on if a controller reset is undesirable.

  First reconnect the power cable to front panel connector J3. Then very carefully align the flat ribbon cable connector to front panel connector J1 and plug it in place. Front panel indicators should light. Reset the controller fault due to the missing front panel.

- **Other Repairs**. To make other repairs to the control panel, use the emergency Unit power connector to supply power to the Units and then disconnect and remove the control panel. The procedure is given below.

5.6.2 Emergency Unit Power

To make repairs without interrupting service, use the emergency power provision:

1) Locate Emergency Power connector P3 on the plate cable connected to J3 of the controller. Refer to Figure 5-1 and to cable drawing 10899 for details.
2) Connect a dc power supply to P3. For convenience, a mating connector is supplied with the cable assembly.
3) Adjust the dc supply to 12 V and plug the mating connector into P3.
4) Put the system in MANUAL mode to prevent automatic switching and then slowly turn up the voltage on the dc supply until the Unit alarm indicators come on. At this voltage, the external dc supply is powering the amplifiers.
5) Disconnect P1 from J3 on the rear of the control panel and remove the controller for service.

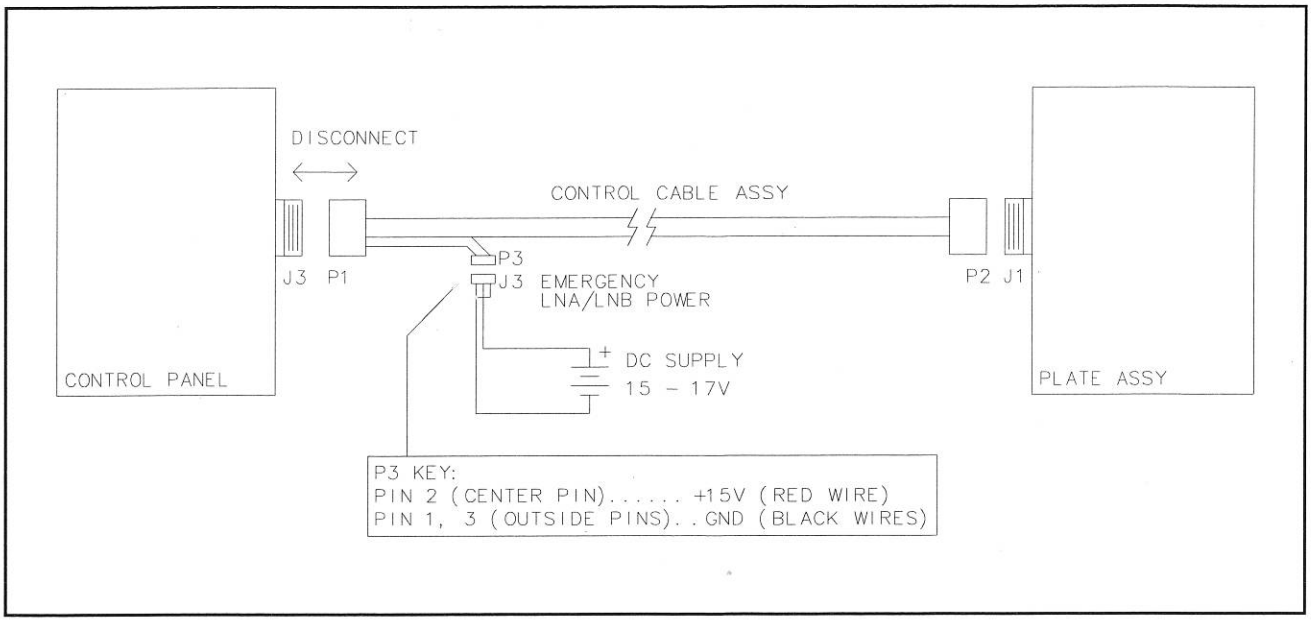


Figure 5-1. Emergency Unit Power

NOTE Internal power from the control panel and external emergency power inputs are diode isolated from each other. When the external supply is less than 15 V, the internal supplies will power the Units (LNAs/LNBs). When it is greater than 15 V, the external supply will take over.

Note that you may leave the emergency power connected to P3 continuously. It will provide a third level of redundancy to the two internal power supplies.

5.6.3 Board Removal

Front Panel: The front panel is intended to be replaced as a unit consisting of the keypad, metal panel, and circuit board.

To remove the front panel assembly, unplug the flat cable at front panel connector J1. Release the latch on the power cable at front panel connector J3, and unplug that connector. Remove the four screws holding the chassis handles in place, and lift the front panel from the chassis.

Logic Board: To remove the logic board, first disconnect all cables from J4, 5, 6, and 7. Unplug all cables, making sure to fully release the catches used on some of the cables. Remove the screws holding the board to the standoffs, and lift the board from the chassis.

Parallel I/O Board: First disconnect any cable from J8. Unplug the cable at connector J1. Remove the screws holding the board to the standoffs, and lift the board from the chassis.

Section 6 Drawings

6.1 General Introduction

This section contains all of the drawings needed to maintain and service the 1:2 Redundant LNA/LNB System Controller. Refer to Section 8, System Configuration, for plate assembly drawings.

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

Table 6-1 Drawing Types

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

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

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

6.2 Drawing Index

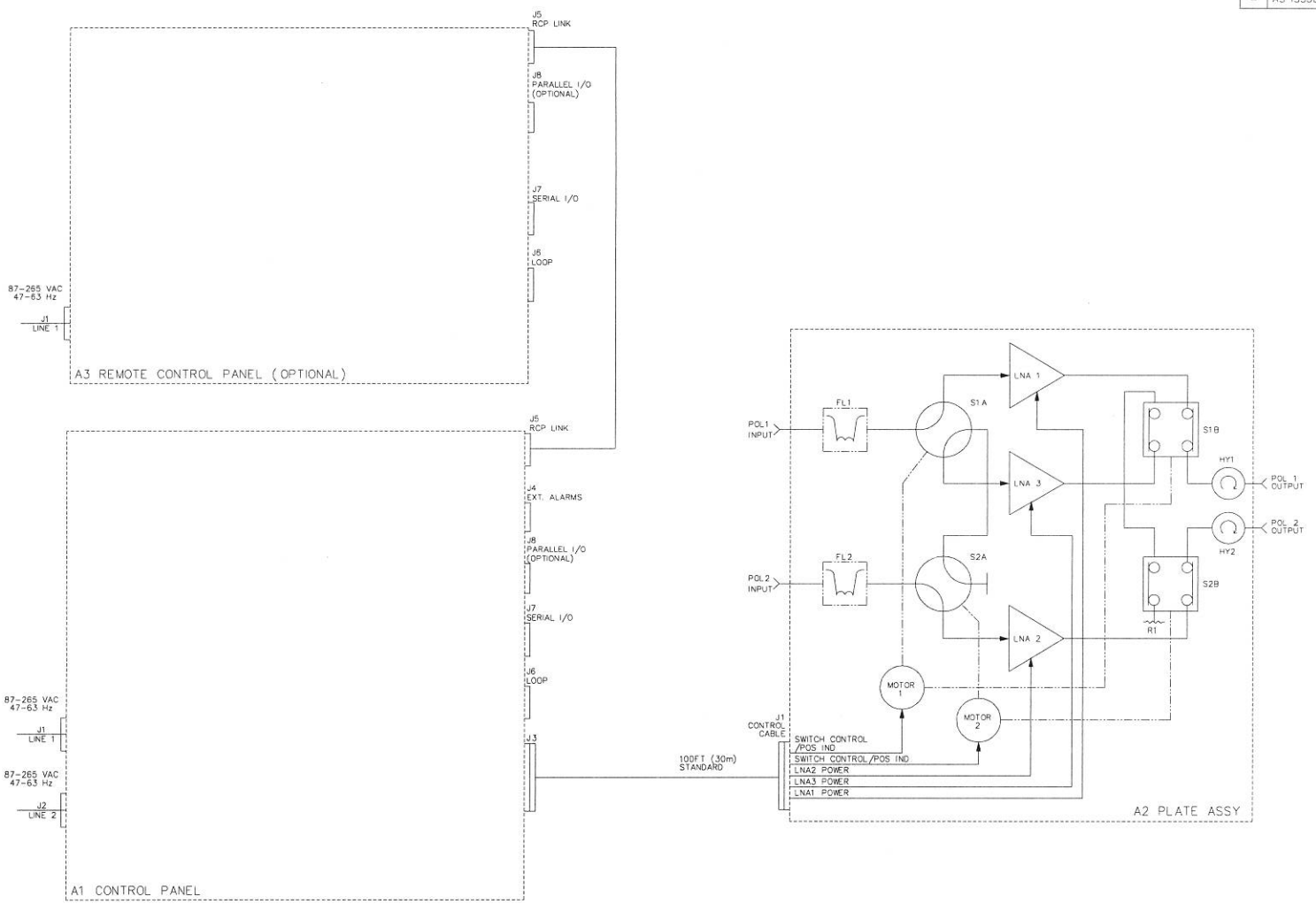
Refer to Table 6-2 to locate a drawing. Drawings are inserted in the order in which they appear in the Table.

Table 6-2 Drawing Index

Drawing Number	Description
6441-4	Block Diagram, 1:2 Redundant System
10899-1, -2	Control Cable Assembly
11074-1	Schematic Diagram, RSC/RCP
9683-1, -2, -3	Assembly, RSC/RCP Controller
ARLC-9683-2001	BOM, Controller, 1:2
AMAX-9683-101	BOM, Base Assembly, Controller
9860-1	Assembly, Front Panel, 1:2

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

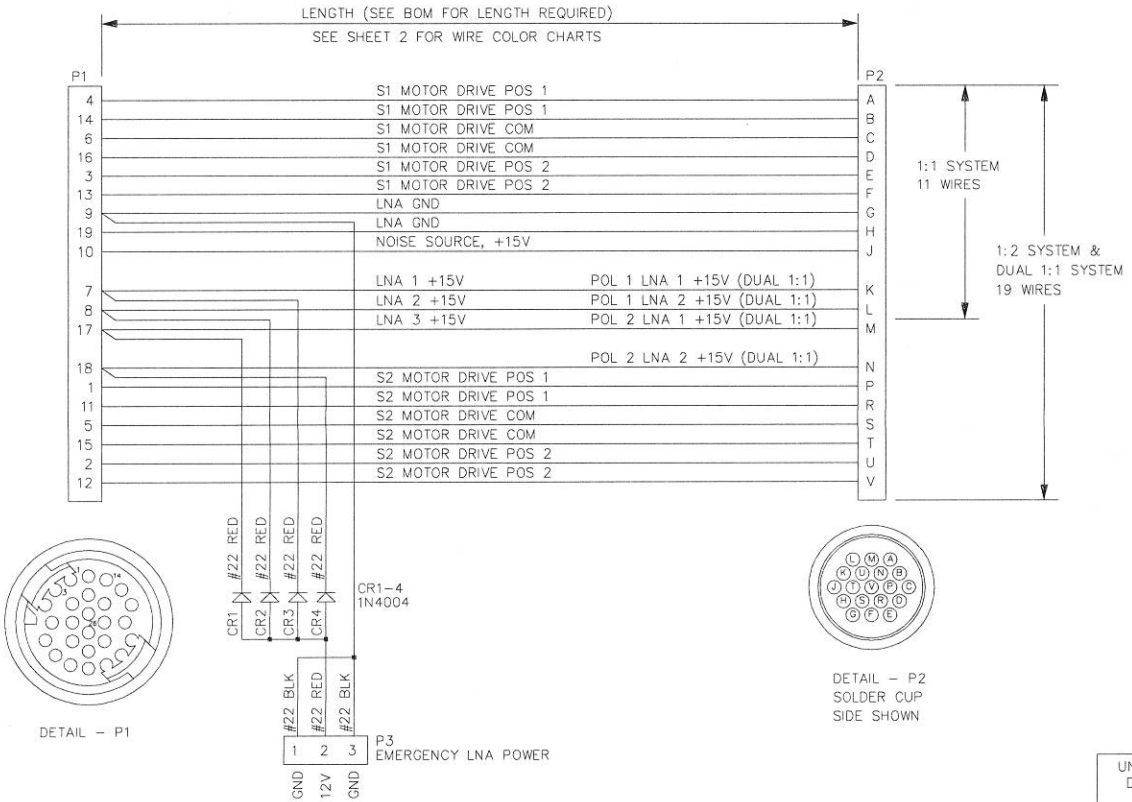
REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	5/19/99	PEG



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: DECIMALS .XXX ±.005, .XX ±.01; FRACTIONS X/X ±1/32", ANGULAR ±1/2°	VERTEX ELECTRONIC PRODUCTS, INC. 2120 OLD GATESBURG RD STATE COLLEGE, PA 16803	
DRAWN CNM 5/18/99	TITLE: BLOCK DIAGRAM 1:2 REDUNDANT SYSTEM	
CHECKED PEG 5/19/99	SIZE D	FSCM NO. OHF70
ISSUED PEG		DWG NO. 6441
DO NOT SCALE DRAWING	SCALE	SHEET 4 OF

TYPE	USAGE (SEE NOTES)	LENGTH, FT (m)			# WIRES	AWG	BELDEN P/N	ALPHA P/N	BUSHING P/N MS3420-_
		C-BAND	Ku-BAND	L-BAND					
-A	1:1, STANDARD	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	12	18 (16 X 30)	8466	--	8
-B	1:1, BURIAL	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	12	18 (16 X 30)	--	35036	10
-C	1:1, STANDARD	250-500 (75-150)	500-1000 (150-300)	750-1200 (225-350)	12	16 (19 X 29)	8622	--	12
-D	1:1, BURIAL	250-500 (75-150)	500-1000 (150-300)	750-1200 (225-350)	12	16 (19 X 29)	--	7511	10
-E	1:2, STD & DUAL 1:1, STD	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	19	18 (16 X 30)	8619	--	10
-F	1:2, BURIAL & DUAL 1:1, BURIAL	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	20	18 (16 X 30)	--	35070/20	10
-G	1:2, STD & DUAL 1:1, STD	250-500 (75-150)	500-1000 (150-300)	750-1200 (225-350)	19	16 (19 X 29)	8624	--	--
-H	1:2, BURIAL & DUAL 1:1, BURIAL	250-500 (75-150)	500-1000 (150-300)	750-1200 (225-350)	20	16 (19 X 29)	--	35080/20	--
-I	1:1, STD, LO TEMP	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	15	18 (16 X 30)	--	45070/15	8
-J	1:2, STD, LO TEMP	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	19	16	83716	45080/20	--
-K	1:2, CUSTOM	0-250 (0-75)	0-500 (0-150)	0-750 (0-225)	19	18 (16 X 30)	8619	--	10

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
-	AS ISSUED	12/1/98	PEG
A	PER ECR 2289 JAM	2/15/99	PEG
B	PER ECR 2543 CNM	5/5/99	PEG
C	UPDATED PER J5113 MCB	2/16/00	MSI
D	PER ECR 3258 JAM	4/19/00	PEG



NOTES:

1. REFER TO BOM: AMAX-10899-X CONNECTOR KIT
   ACAB-10899-XXXX CABLE ASSY
   CABLE TYPE — CABLE LENGTH
2. STD SERVICE CABLE CAN BE INSTALLED OUTDOORS, BUT SHOULD NOT LIE IN WATER OR BE BURIED UNDERGROUND.
3. BURIAL SERVICE CABLE CAN BE LAID DIRECTLY ON THE GROUND OR BURIED UNDERGROUND.
4. FOR -G, H & J ASSEMBLIES:
   NO BUSHING REQUIRED.
   APPLY HEATSHRINK TUBING AT P2 END.
5. FOR DETAILED ASSEMBLIES REFER TO SHEET 3.
6. FOR -K: P1 CONNECTOR INSTALLED BY CUSTOMER.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
DECIMALS .XXX ±.005
.XX ±.01
FRACTIONS X/X ±1/32"
ANGULAR ±1/2°

DRAWN	MCB	12/1/98
CHECKED	PEG	12/1/98
ISSUED	PEG	12/1/98

DO NOT SCALE DRAWING

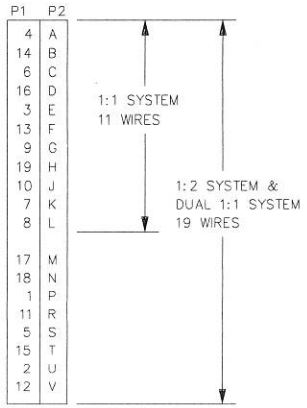
VERTEX ELECTRONIC PRODUCTS, INC.
2120 OLD GATESBURG RD
STATE COLLEGE, PA 16803

TITLE
CONTROL CABLE ASSY

SIZE	FSCM NO.	DWG NO.
C	0HF70	10899

SCALE NONE SHEET 1 OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	2/15/99	PEG



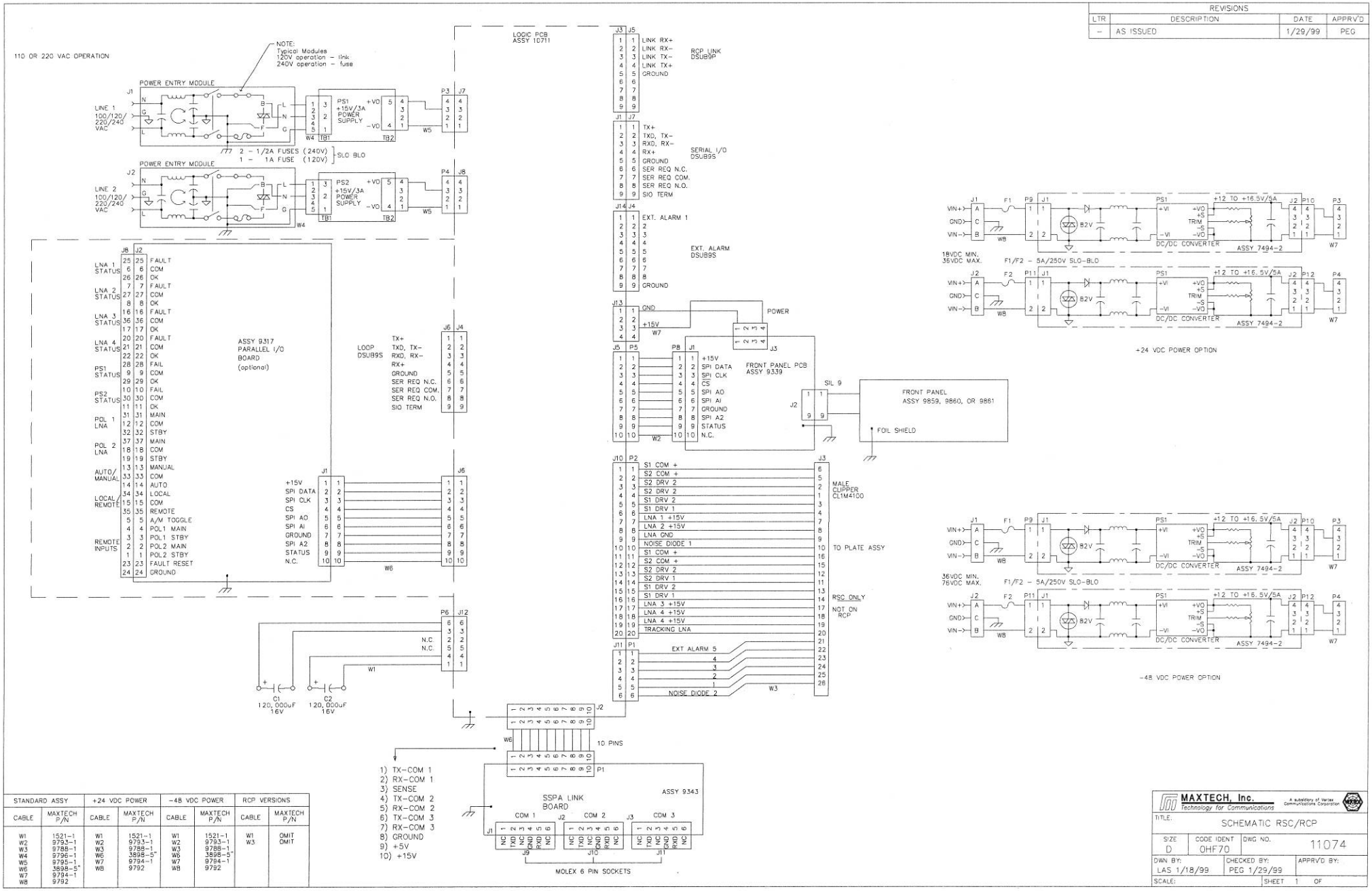
1:1 SYSTEM COLOR CHART

P1	P2	BELDEN 8466 BELDEN 8622	ALPHA 35036	ALPHA 7511	ALPHA 45070/15 (LOW TEMP)
3	E	ORANGE/BLACK	TBD	TBD	TBD
4	A	WHITE			
6	C	RED/BLACK			
7	K	WHITE/BLACK			
8	L	BLACK			
9	G	BLACK/WHITE			
10	J	ORANGE			
13	F	BLUE/BLACK			
14	B	RED			
16	D	GREEN/BLACK			
19	H	GREEN			

1:2 SYSTEM COLOR CHART

P1	P2	BELDEN 8619 BELDEN 8624	ALPHA 35070/20 ALPHA 35080/20 ALPHA 45080/20
1	P	BLUE	BROWN
2	U	WHITE	BLUE
3	E	BLACK/WHITE	RED/YELLOW
4	A	BLACK/RED	VIOLET
5	S	GREEN	WHITE
6	C	GREEN/WHITE	TAN
7	K	BLUE/RED	WHITE/YELLOW
8	L	ORANGE/RED	WHITE/BLUE
9	G	ORANGE/BLACK	WHITE/BLACK
10	J	RED/BLACK	WHITE/GREEN
11	R	ORANGE	RED
12	V	WHITE/BLACK	BLACK
13	F	BLUE/BLACK	RED/BLACK
14	B	BLUE/WHITE	GRAY
15	T	RED	GREEN
16	D	RED/WHITE	RED/GREEN
17	M	WHITE/RED	YELLOW
18	N	BLACK	ORANGE
19	H	GREEN/BLACK	WHITE/RED

		UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLRANCES ARE:	MAXTECH, Inc. *Technology for Communications* — A subsidiary/division of Vertex Communications Corporation		
		FRACTIONS +/- .020 DECIMALS .XX +/- .010 .XXX +/- .003 ANGLES +/-1/2°	TITLE: CONTROL CABLE ASSY		
		MATERIAL: SEE NOTES	SIZE C	CODE IDENT 0HF70	DWG NO. 10899
		FINISH: SEE NOTES	DWN BY: JAM 2/12/99	CHECKED BY: PEG 2/15/99	APPRV'D BY: PEG 2/15/99
NEXT ASSY	USED ON				
APPLICATION		DO NOT SCALE DRAWING	SCALE: NONE	SHEET 2 OF 2	



STANDARD ASSY		+24 VDC POWER		–48 VDC POWER		RCP VERSIONS	
CABLE	MAXTECH P/N	CABLE	MAXTECH P/N	CABLE	MAXTECH P/N	CABLE	MAXTECH P/N
W1	1521–1	W1	1521–1	W1	1521–1	W1	OMIT
W2	9793–1	W2	9793–1	W2	9793–1	W3	OMIT
W3	9788–1	W3	9788–1	W3	9788–1		
W4	9796–1	W6	3898–5"	W6	3898–5"		
W5	9795–1	W7	9794–1	W7	9794–1		
W6	3898–5"	W8	9792	W8	9792		
W7	9794–1						
W8	9792						

MAXTECH, Inc. Technology for Communications
A subsidiary of Vertex Communications Corporation

TITLE: SCHEMATIC RSC/RCP

SIZE	CODE IDENT	DWG NO.
D	0HF70	11074

DWN BY:	CHECKED BY:	APPRV'D BY:
LAS 1/18/99	PEG 1/29/99	

SCALE: SHEET 1 OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
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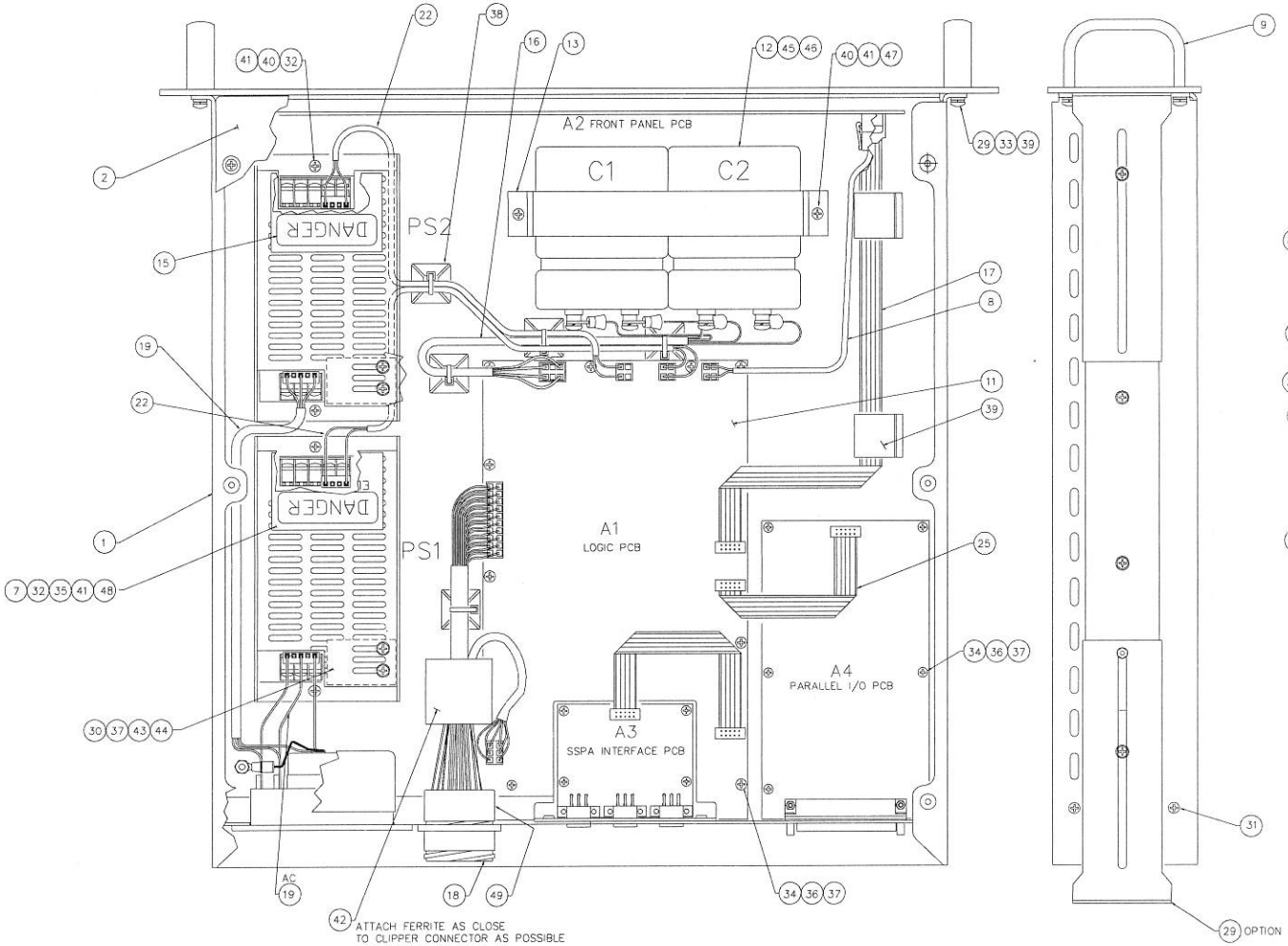
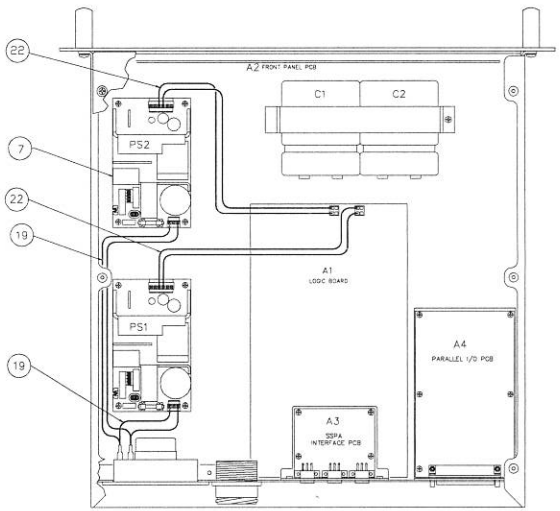
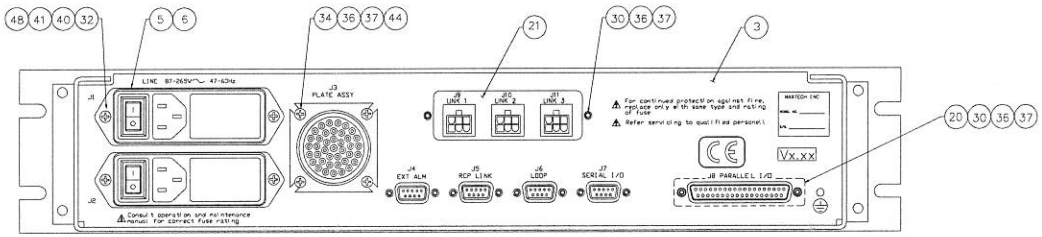
A	PER ECR 2088	11/6/98	PEG
B	PER ECR 2232	2/5/99	PEG
C	PER ECR 2304 LAS	3/1/99	PEG
D	PER ECR 2444 JPL	4/8/99	PEG
E	PER ECR 2677 & 2759 LAS	11/1/99	MSI
F	PER ECR 3088 JAM	1/17/00	RJS





ALTERNATIVE AC POWER SUPPLY



NOTES:
1. REFER TO BOM AMAX-9683-101, BASE ASSY, AC
   ARLC-9683-100X, 1:1 RSC
   ARLC-9683-200X, 1:2 RSC
   ARLC-9683-300X, DUAL 1:1 RSC
   ARLC-9683-400X, 1:1 RCP
   ARLC-9683-500X, 1:2 RCP
   ARLC-9683-600X, DUAL 1:1 RCP
   BLOCK DIAGRAM 9787
   SCHEMATIC 11074
2. SEE SHEET 2 FOR FRONT PANEL DETAILS.
3. SEE SHEET 3 FOR DC INPUT.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES:
DECIMALS .XXX ±.005 .XX ±.01
FRACTIONS X/X ±1/32" ANGULAR ±1/2°

VERTEX ELECTRONIC PRODUCTS, INC.
2120 OLD GATESBURG RD
STATE COLLEGE, PA 16803

TITLE: ASSY,RSC/RCP CONTROLLER

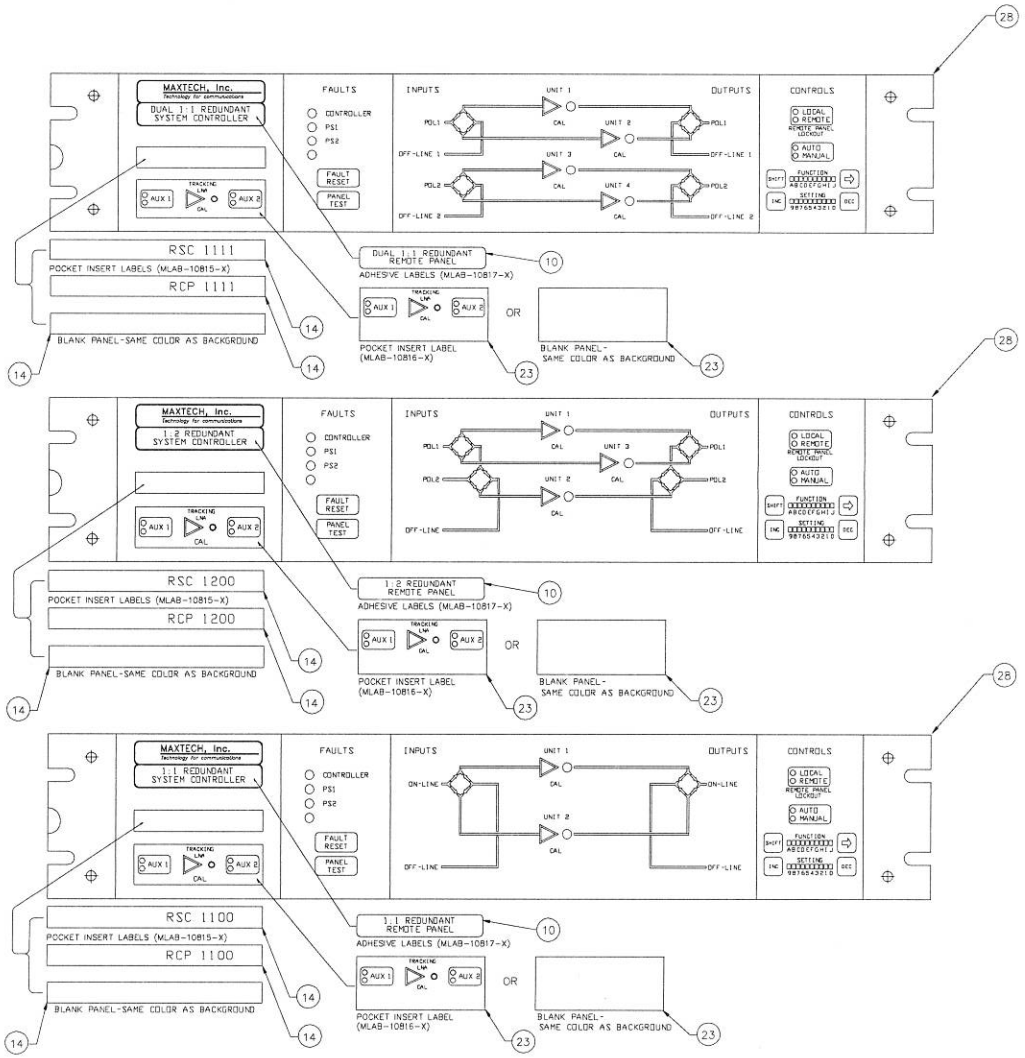
DRAWN	JPL	12/8/97
CHECKED	GFS	1/24/98
ISSUED		

DO NOT SCALE DRAWING

SIZE	FSCM NO.	DWG NO.
D	0HF70	9683

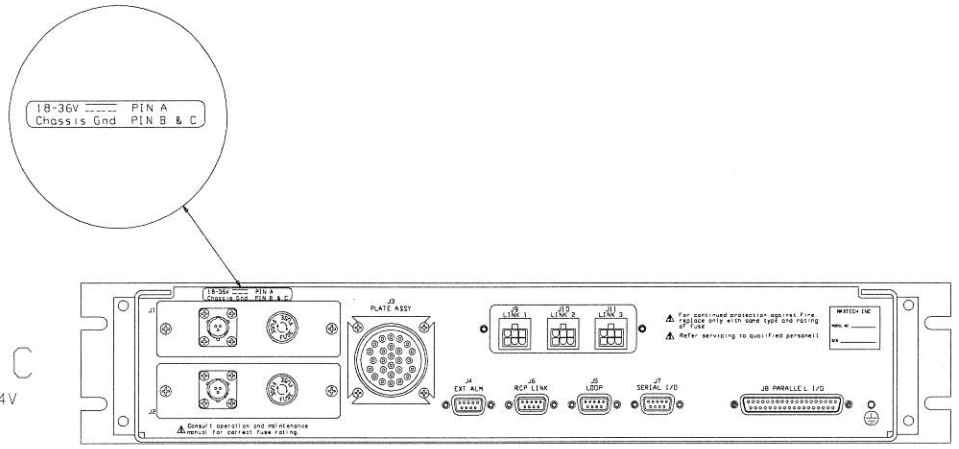
SCALE 3/4 x SIZE SHEET 1 OF

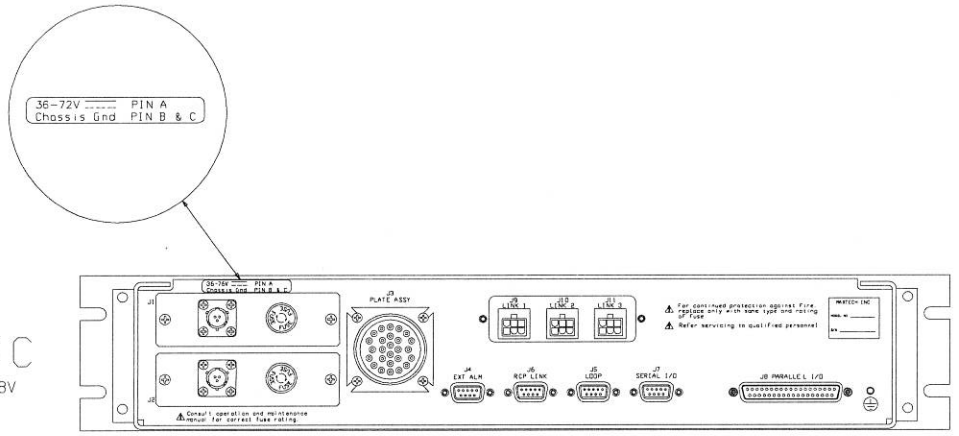
REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	2/5/99	PEG
A	PER ECR 2677 & 2759	11/1/99	MSI



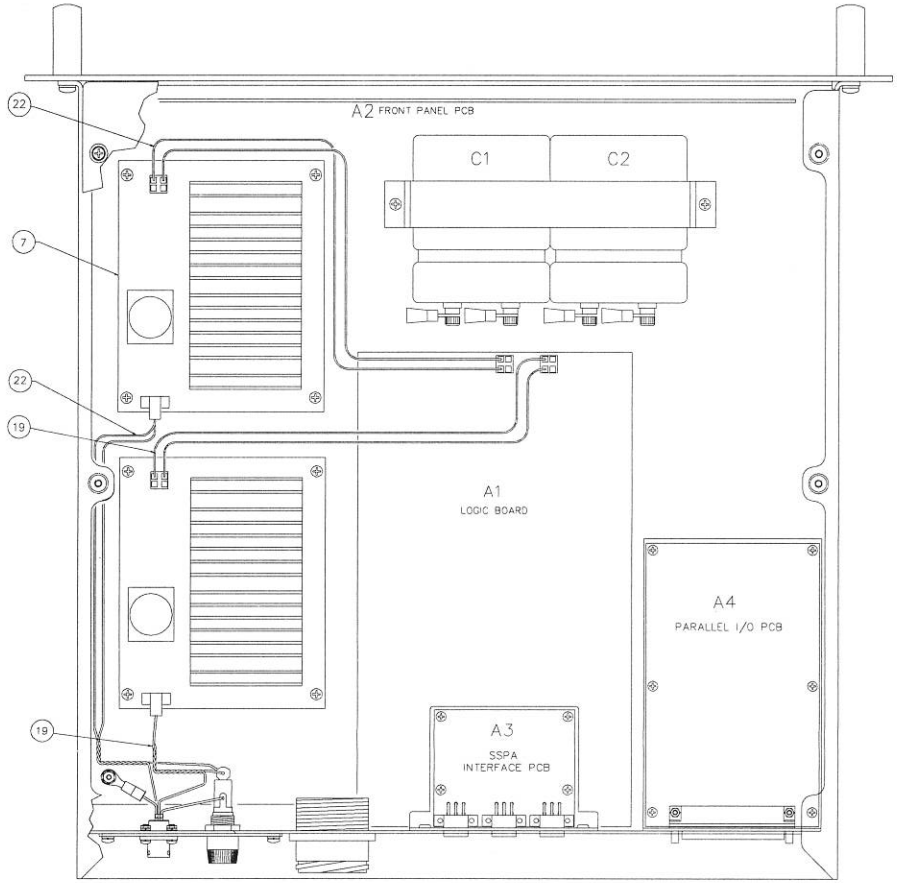
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: DECIMALS .XXX ±.005 .XX ±.01 FRACTIONS X/X ±1/32" ANGULAR ±1/2°	VERTEX ELECTRONIC PRODUCTS, INC. 2120 OLD GATESBURG RD STATE COLLEGE, PA 16803	
DRAWN JPL DATE 12/8/97	TITLE ASSY. RSC/RCP CONTROLLER	
CHECKED PEG 2/5/99	SIZE D	FSCM NO. OHF70
ISSUED	DWG NO. 9683	
DO NOT SCALE DRAWING	SCALE 3/4 x SIZE	SHEET 2 OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	2/5/99	PEG





DC ARRANGEMENTS



MAXTECH, Inc.
Technology for Communications
A subsidiary of Vertex Communications Corporation

TITLE: ASSY, RSC/RCP CONTROLLER			
SIZE: D	CODE IDENT: 0HF70	DWG NO.: 9683	
DWN BY: JPL 1/26/99	CHECKED BY:	APPRV'D BY:	
SCALE: 3/4	SHEET 3 OF		

APPROVED BY: MA
RUN DATE: 1/17/00

PARENT ITEM: ARLC-9683-2001
DESCRIPTION: ASSY, RSC-1200 CONTROLLER, AC
REV: F

MAXTECH, INC.
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
TMAX-9683-101	MAXTECH	TMAX-9683-101	1	-	BASE ASSY, RSC/RCP CONTROLLER, AC INPUT (TESTED)	
MCOV-4058	MAXTECH	4058	1	E	COVER, REDUNDANT CONTROLLER	FIND # 2
EPOW-17250	BELDEN	17250	2		POWER CORD, 18AWG, LENGTH 7'6"	FIND # 5; MATE - J1, 2
HMIS-FV44510	VEMALINE/ AMATOM	FV445-20/ 10935-A-1032-36	2		HANDLE, 2.5", BLACK EPOXY 10-32 THREAD, 1.5" H x 2.5" L	FIND # 9
MLAB-INSERTKIT	MAXTECH	10815/10816/10817	1		SET MADE OF 10815,10816,10817 13 INDIVIDUAL INSERTS/LABELS	FIND # 14, INSTALL 10815-4 (RSC-1200); FIND # 23, INSTALL 10816-1 (BLANK)
MCOV-9799	MAXTECH	9799	1		COVER PLATE, REAR PANEL SSPA INTERFACE OPTION	FIND # 21, (REPLACES J9-11)
TPAN-9860-1	MAXTECH	TPAN-9860-1	1	-	ASSY, FRONT PANEL, 1:2 RSC/RCP MEMBRANE DESIGN (TESTED)	FIND # 28
HWLS-10			4		WASHER,SPLIT LOCK,#10 MED.,SS 316 STAINLESS	FIND # 29, (FRONT PANEL)
HSPS-4-40X5/16			2		SCREW,PAN HD,PHIL,4-40X5/16,SS	FIND # 30, (COVER PLATE)
HSPS-10-32X5/8			4		SCREW,PAN HD,PHIL,10-32X5/8,SS 316 STAINLESS	FIND # 33, (FRONT PANEL)
HWFS-4-SM	VARIOUS	NAS620C4	2		WASHER,FLAT,#4 SM. PATTERN, SS	FIND # 36, (COVER PLATE)
HWLS-4			2		WASHER,SPLIT LOCK,#4 MED.,S.S. 18-8 STAINLESS	FIND # 37, (COVER PLATE)
HWFS-10-SM	VARIOUS	NAS620C10	4		WASHER,FLAT,#10 SM. PATTERN,SS 316 STAINLESS	FIND # 39, (FRONT PANEL)
IFLS-11617V20			1		FIRMWARE, REDUNDANT RSC CONTROLLER	
MLFW-11617V20	MAXTECH	MLFW-11617V20	1		LABEL, FIRMWARE, REDUNDANT RSC CONTROLLER, VERSION 2.06	

APPROVED BY: MA
RUN DATE: 4/3/00

PARENT ITEM: AMAX-9683-101
DESCRIPTION: BASE ASSY, RSC/RCP CONTROLLER, AC INPUT
REV: L

VertexRSI™
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
DSCH-11074-1	VERTEXRSI	11074-1	1		SCHEMATIC, REDUNDANT CONTROL PANEL (RSC/RCP-1000 SERIES)	
MENC-9684	VERTEXRSI	9684	1	F	CHASSIS, RSC/RCP CONTROLLER	FIND # 1
MPAN-9685/9688	VERTEXRSI	9685/9688	1	E	REAR PANEL & SS, CONTROLLER (RSC-RCP)	FIND # 3
EFUS-313002	LITTELFUSE	313002	2		FUSE, SLO-BLO, 2A/250V	FIND # 6; F1, 2 (120V OPERATION)
EFUS-218001	LITTELFUSE	218001	4		FUSE, SLO-BLO, 1A/250V	FIND # 6; F1-4 (240V OPERATION)
EPOW-MAP551012C	POWER ONE	MAP55-1012C	2		POWER SUPPLY, 12-15V, ADJ, W/ COVER ,U-CHANNEL CHASSIS	FIND # 7; PS1, 2
ACAB-9794-1	VERTEXRSI	ACAB-9794-1	1	A	CABLE ASSY, 4 PIN MOLEX (2)	FIND # 8; A1J13 (LOGIC PCB) to A2J3 (FRONT PANEL PCB)
APCB-10711-1	VERTEXRSI	APCB-10711-1	1	D	ASSY, LOGIC PCB, CONTROLLER	FIND # 11, A1
PCEL-3186GD124U	MALLORY; MEPCO	3186GD124U015AMA1;...124U016AM	2		CAP, 15 VDC, 120,000uF,3X3-5/8	FIND # 12; C1, 2
MMIS-4190	VERTEXRSI	4190	1		CAPACITOR CLAMP	FIND # 13; (C1, 2)
MLAB-327CT	SETON	327CT	2		LABEL, "DANGER - ELECTRICAL HAZARD", 2-1/2" x1-3/4"	FIND # 15; (PS1, 2)
ACAB-1521-1	VERTEXRSI	ACAB-1521-1	1	B	CABLE ASSY, P6-C1 & 2	FIND # 16; A1J12 (LOGIC PCB) to C1, 2
ACAB-3898-17"	VERTEXRSI	ACAB-3898-17"	1	-	CABLE ASSY, 10 CONDUCTOR FLAT, LENGTH 17"	FIND # 17, A1J5 (LOGIC PCB) to A2J1 (FRONT PANEL PCB)
ACAB-9788-1	VERTEXRSI	ACAB-9788-1	1	B	CABLE ASSY, P1 & 2 to J10, J11 & P3 to J3	FIND # 18; J3 (PLATE ASSY) to A1J10, A1J11 (LOGIC PCB)
ACAB-9796-1	VERTEXRSI	ACAB-9796-1	2	B	CABLE ASSY, POWER ENTRY to POWER SUPPLY	FIND # 19; J1 (AC INPUT) to PS1, J2 (AC INPUT) to PS2
APCB-9317-1	VERTEXRSI	APCB-9317-1	1	-	ASSY, PARALLEL I/O PCB, CONTROLLER	FIND # 20, A4/J8
ACAB-9795-1	VERTEXRSI	ACAB-9795-1	2	A	CABLE ASSY, LOGIC PCB to POWER SUPPLY	FIND # 22; PS1 to A1J7 (LOGIC PCB), PS2 to A1J8 (LOGIC PCB)
ACAB-3898-5"	VERTEXRSI	ACAB-3898-5"	1	-	CABLE ASSY, 10 CONDUCTOR FLAT, LENGTH 5"	FIND # 25, A4J1 (PARALLEL I/O PCB) to A1J6 (LOGIC PCB)

PARENT ITEM: AMAX-9683-101
DESCRIPTION: BASE ASSY, RSC/RCP CONTROLLER, AC INPUT
REV: L

RUN DATE: 4/3/00

VertexRSI™
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
HSPS-4-40X5/16			6		SCREW,PAN HD,PHIL,4-40X5/16,SS	FIND # 30; (J8, HIGH VOLTAGE GUARD)
HSFS-6-32X5/16			9		SCREW,FLAT HD,PHL,6-32X5/16,SS 18-8 STAINLESS	FIND # 31, (REAR PANEL)
HSPS-6-32X3/8	VARIOUS	N/A	8		SCREW,PAN HD,PHIL,6-32X3/8,SS 316 STAINLESS	FIND # 32; (PS1 & 2, J1 & 2)
HSPS-4-40X3/8			24		SCREW,PAN HD,PHIL,4-40X3/8,SS	FIND # 34; (LOGIC PCB, PARALLEL I/O PCB, J3)
HSTD-2237	RAF	2237-632-B-5	4		STANDOFF,HEX,6-32,7/16",BRASS 3/8" HEX	FIND # 35; (PS1, 2)
HWFS-4-SM	VARIOUS	NAS620C4	22		WASHER,FLAT,#4 SM. PATTERN, SS	FIND # 36; (LOGIC PCB, PARALLEL I/O PCB)
HWLS-4			30		WASHER,SPLIT LOCK,#4 MED.,S.S. 18-8 STAINLESS	FIND # 37; (LOGIC PCB, PARALLEL I/O PCB, J3, HI VOLTAGE GUARD)
CNSM-08461	DENNISON	08461	6		CABLE TIE MOUNT, ACRYLIC ADHESIVE, 100/PK (DENNISON)	FIND # 38
HCLM-FCCAD8	Panduit	FCC-A-D8	2		WIRE CLAMP,RIBBON CAB,PVC GRAY	FIND # 39
HWFS-6-SM	VARIOUS	NAS620C6	2		WASHER,FLAT,#6 SM. PATTERN, SS 316 STAINLESS	FIND # 40, (CAPACITOR CLAMP)
HWLS-6	VARIOUS	N/A	10		WASHER,SPLIT LOCK,#6 MED.,S.S. 316 STAINLESS	FIND # 41; (PS1 & 2, J1 & 2, CAPACITOR CLAMP)
FMIS-28B20240A0	STEWARD	28A2024-0A0	1		FERRITE,SPLIT FOR ROUND CABLE, PLASTIC SNAP-ON CASE, WHITE	FIND # 42
MMIS-5417	VERTEXRSI	5417	2	B	HI VOLTAGE GUARD, MAP55/80 PS	FIND # 43; (PS1, 2)
HWFS-4-LG		AN960C4	8		WASHER,FLAT,#4 LG. PATTERN, SS	FIND # 44; (J3, HIGH VOLTAGE GUARD)
HSSS-10-32X5/16			4		SCREW,SOCKET HD,10-32X5/16,SS 316 STAINLESS	FIND # 45; (C1, 2)
HWLS-10			4		WASHER,SPLIT LOCK,#10 MED.,SS 316 STAINLESS	FIND # 46; (C1, 2)

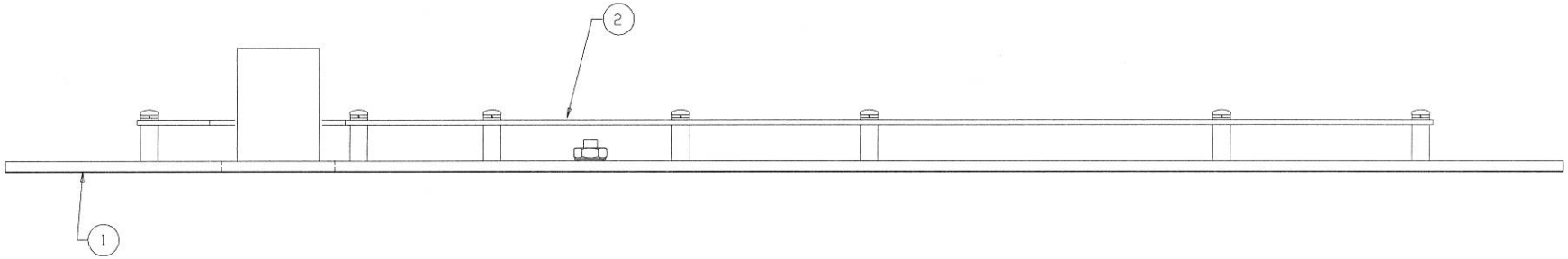
PARENT ITEM: AMAX-9683-101
DESCRIPTION: BASE ASSY, RSC/RCP CONTROLLER, AC INPUT
REV: L

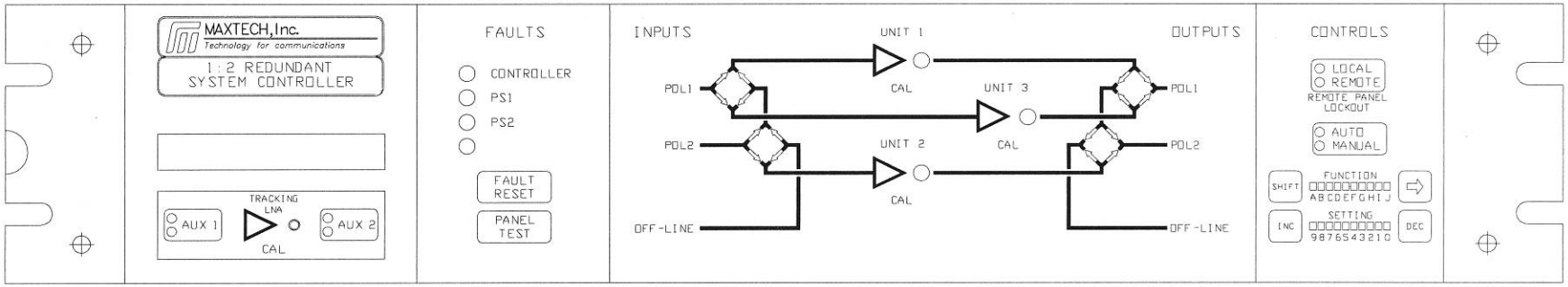
RUN DATE: 4/3/00

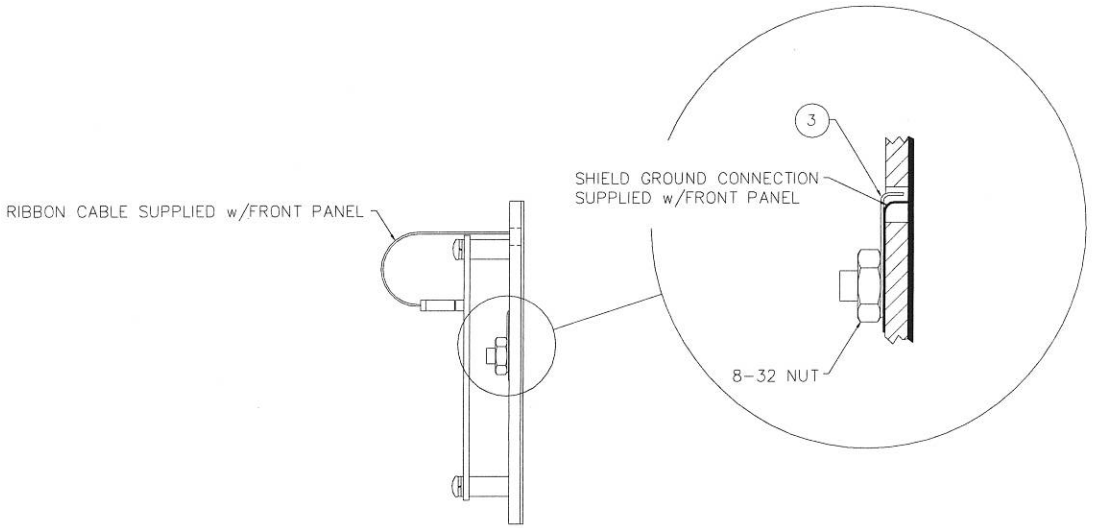
VertexRSI™
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
HSPS-6-32X7/16			2		SCREW,PAN HD,PHIL,6-32X7/16,SS 316 STAINLESS	FIND # 47, (CAPACITOR CLAMP)
HWFS-6-LG		AN960C6	8		WASHER,FLAT,#6 LG. PATTERN, SS 18-8 STAINLESS	FIND # 48; (PS1 & 2, J1 & 2)
KCIR-CL114000	FRAMATOME (FCI) @ Arrow PEMCo	CL114000	1		CONN,UNSEALED BACKNUT,26CTS, FOR MALE & FEMALE CONTACTS	FIND # 49, (INSTALL ON J3)

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	1/19/99	PEG
A	PER ECR 2530 JPL	4/30/99	PEG







NOTES:

1. REFER TO BOM APAN-9860-1

MAXTECH, Inc. Technology for Communications — A subsidiary of Vertex Communications Corporation			
TITLE: FRONT PANEL ASSY 1:2 REDUNDANCY			
SIZE: C	CODE IDENT: 0HF70	DWG NO.: 9860	
DWN BY: JPL 1/15/99	CHECKED BY: PEG 1/19/99	APPRV'D BY:	
SCALE: FULL	SHEET 1 OF		

Section 7 Warranty

7.1 General Introduction

VertexRSI warrants all equipment to be free of defects. Specific warranty policies along with technical support, repair and return procedures are listed in this section.

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

7.2 Technical Support

Technical support is available by calling VertexRSI directly at (814) 238-2700 between 8 a.m. and 5 p.m. USA Eastern time. Before calling, please have your technical manual in front of you and the model and serial number of the relevant equipment.

Our experienced technicians stand ready to help with installation, operation or maintenance problems.

7.3 Warranty

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

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

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

7.4 Return Procedures

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

- Contact either VertexRSI directly or the appropriate VertexRSI sales representative for issuance of a Return Materials Authorization (RMA) number. If the sales representative is contacted, they will in turn contact VertexRSI for approval to return materials.
- Supply sufficient information regarding the reason(s) for return.
- Supply the date and purchase order number through which the materials in question were purchased.
- Supply the location to which the materials are to be returned.
- Include a name and phone number of an individual to contact in case of questions regarding the return materials.

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

NOTE **Unauthorized returned materials will not be accepted by VertexRSI and will be shipped back to the buyer at the buyer's expense.**

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

Contact VertexRSI at

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

Shipping Address:
2120 Old Gatesburg Road
State College, PA 16803 USA

1:2 Redundant LNA/LNB Systems

Section 8 System Configuration

8.1 General Introduction

This section contains configuration information for your system as it was shipped from the factory. Such information typically includes a drawing section which contains drawings peculiar to your plate assembly, and may include manual supplements for any optional equipment ordered, or information on ancillary equipment.

1:2 Redundant LNA/LNB Systems

8.2 Drawing Index

This section contains drawings peculiar to your system plate assembly as it was shipped from the factory.

Table 8-1 Drawing Index

Drawing Number	Description
LRC1200.1012	LRC-1200 W/Serial I/O, 1:2 C-Band LNA System
1431-1	Outline, C-Band 1:2 Redundant Plate Assembly
6442-1	Schematic, Plate Assy, 1:2 Redundant System
6438-1	Plate Assembly, 1:2 Redundant System
ARLP-6438-1009	BOM, Plate Assy, LRC-1200 w/Serial I/O
TD11578	Test Data Sheet, LRC-1200
11842	Specification, C-Band Redundant LNA Systems
2077	Specification, LC-4000 Series C-Band LNAs

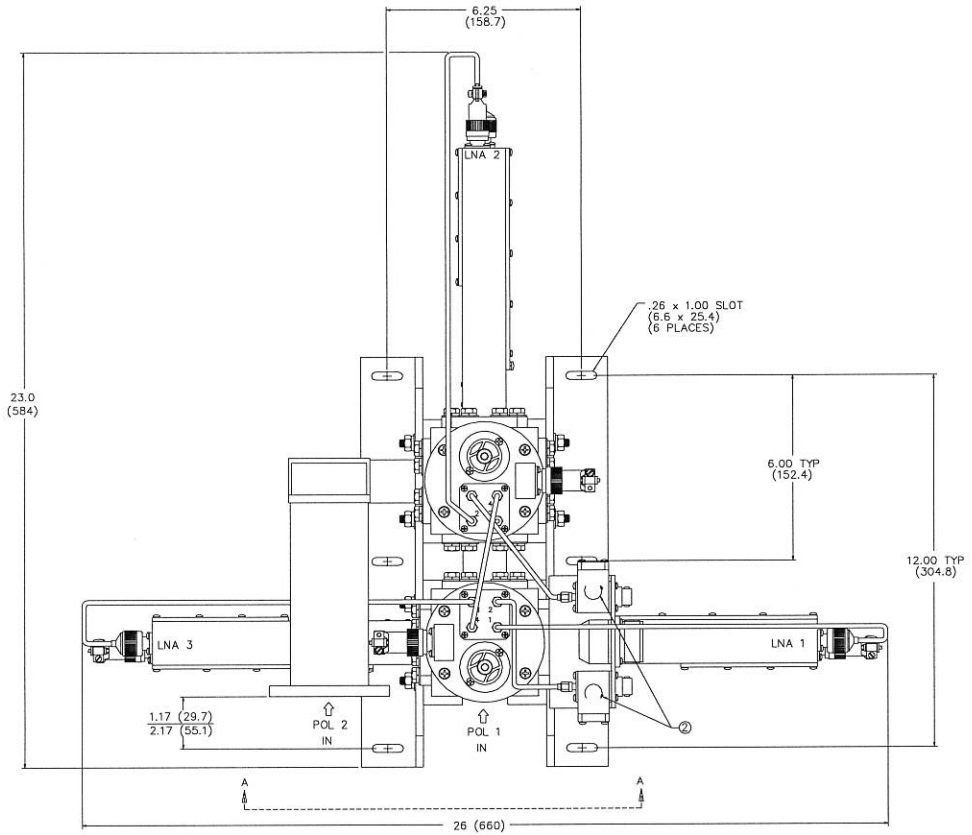
APPROVED BY: EF
RUN DATE: 3/28/00

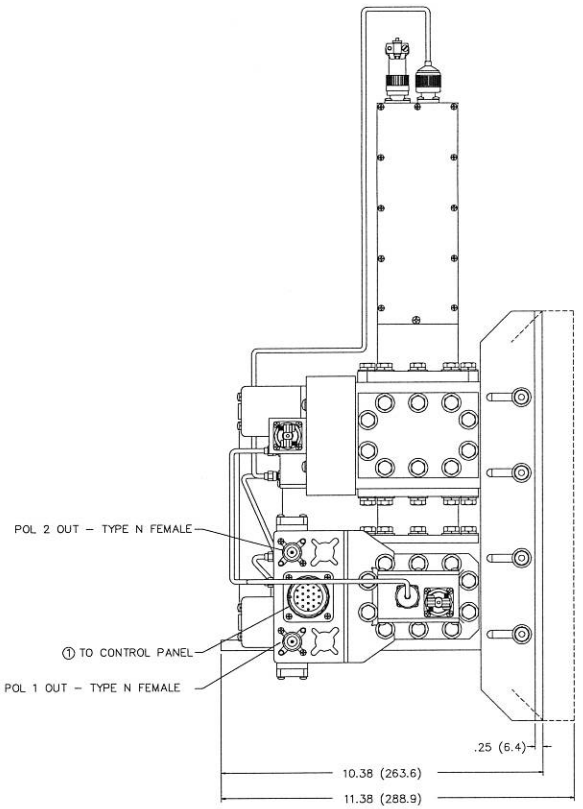
PARENT ITEM: LRC1200.1012
DESCRIPTION: LRC-1200 W/ SERIAL I/O 1:2 C-Band LNA System
REV: -

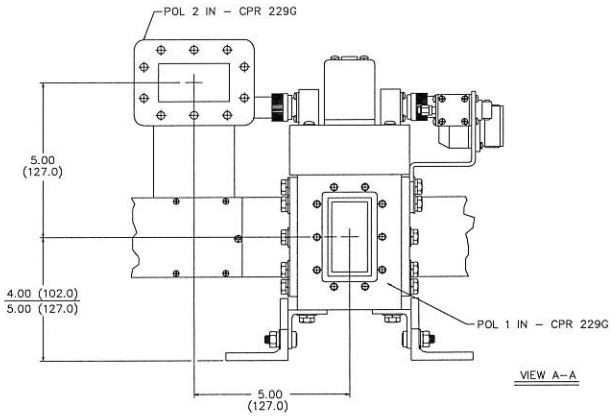
MAXTECH, INC.
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
DSPC-11842	MAXTECH	11842	1		SPECIFICATION, LRC-1000 SERIES	
DMAN-11314	MAXTECH	DMAN-11314	1		O&M MANUAL, 1:2 LNA/LNB SYSTEM W/ SERIAL I/O	
DMTD-11578	MAXTECH	DMTD-11578	1		TEST DATA, LRC-1200 W/ SERIAL I/O	
DBLK-6441-4	MAXTECH	6441-4	1		BLOCK DIAGRAM, LR-1200 W/ SERIAL I/O	
ARLC-9683-2001	MAXTECH	ARLC-9683-2001	1	F	ASSY, RSC-1200 CONTROLLER, AC	
ARLP-6438-1009	MAXTECH	ARLP-6438-1009	1	B	PLATE ASSY, LRC-1200 W/ SERIAL I/O, NO OPT. (OUTLINE 1431-1)	
LCB4035.0001	MAXTECH	LCB4035.0001	3		LCB-4035 35K C-Band LNA 3.625-4.2 GHz	LNA1-3
ACAB-10899-E100	MAXTECH	ACAB-10899-E100	1	-	CONTROL CABLE, 1:2 & DUAL 1:1 STANDARD, 100 FT.	

REVISIONS			
LTR	DESCRIPTION	DATE	APPR'D
–	AS ISSUED	12/21/89	MJW







VIEW A–A

NOTES:

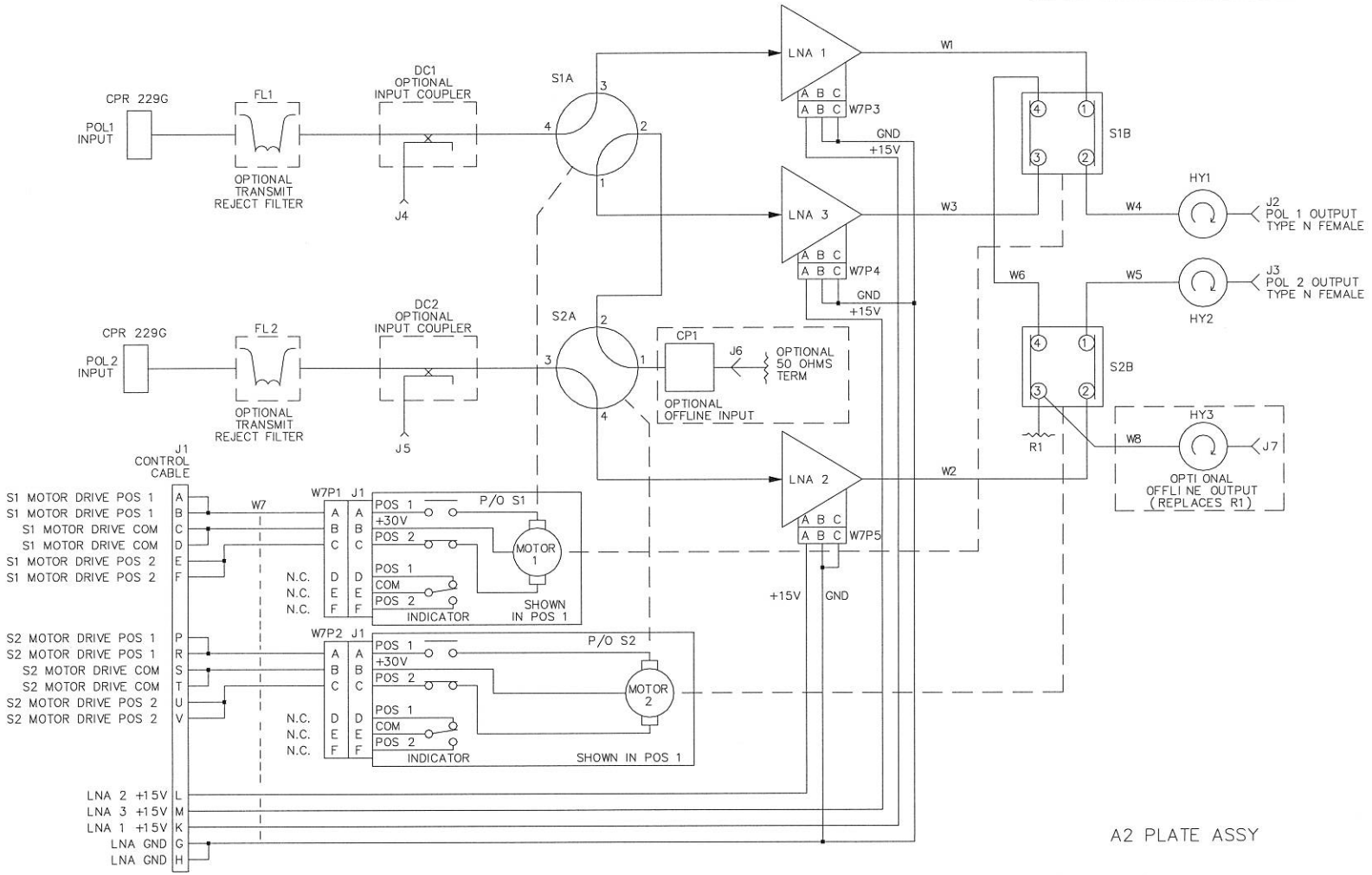
1) INTERCONNECTING CABLE AND MATING CONNECTOR INCLUDED BUT NOT SHOWN.

2) OUTPUT ISOLATORS INCLUDED WITH STANDARD SYSTEM.

3) DIMENSIONS ARE IN INCHES AND (MILLIMETERS).

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: DECIMALS .XXX ±.005 .XX ±.01 FRACTIONS X/X ±1/32" ANGULAR ±1/2"	VERTEX ELECTRONIC PRODUCTS, INC. 2120 OLD GATESBURG RD STATE COLLEGE, PA 16803
DRAWN CEM 12/21/89	TITLE: OUTLINE, C–BAND, 1:2 REDUNDANT PLATE ASSY
CHECKED MJW 12/21/89	SIZE D · FSCM NO. OHF70 · DWG NO. 1431
ISSUED	
DO NOT SCALE DRAWING	SCALE 1/2 x SIZE · SHEET 1 OF

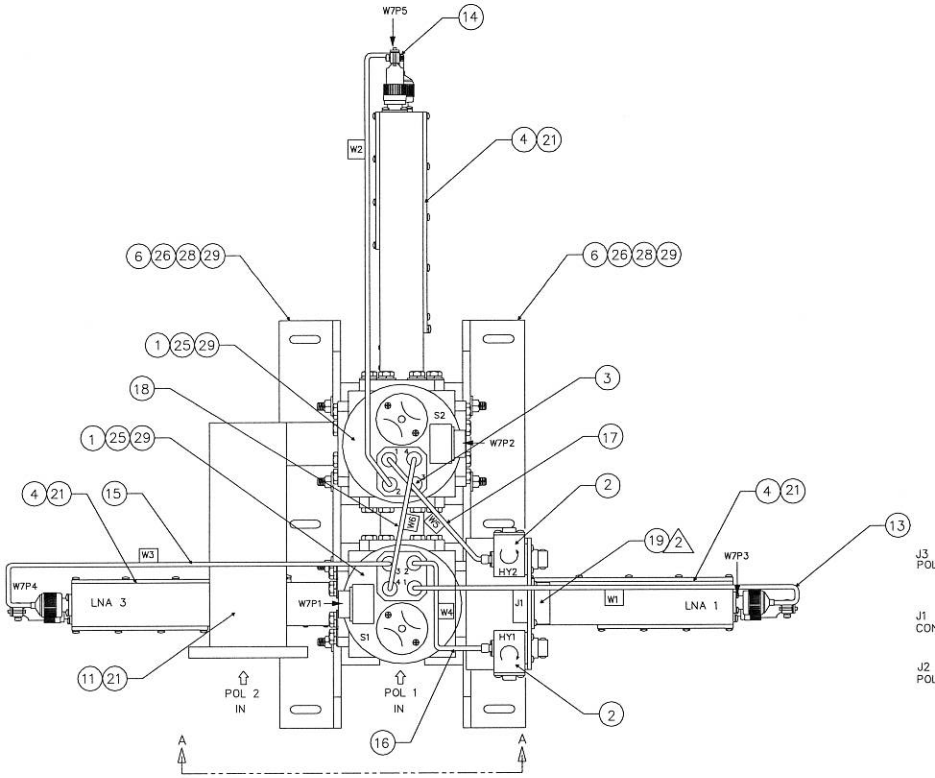
REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	7/27/94	GLK
A	ADDED OPTIONAL 50 OHMS TERMINATION MBV	4/24/97	GLK

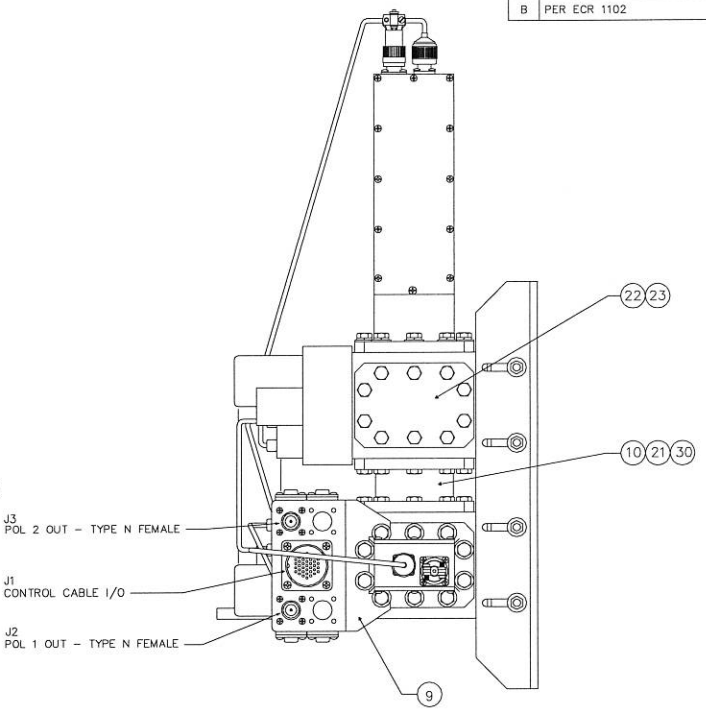


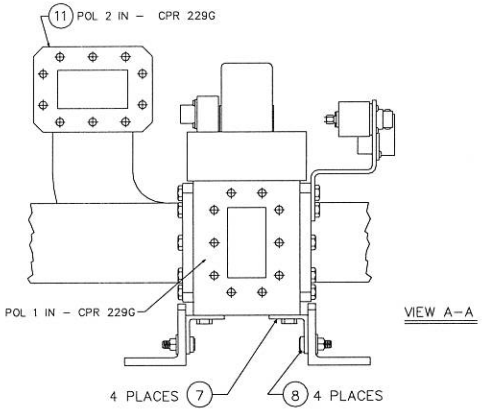
A2 PLATE ASSY

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: DECIMALS .XXX ±.005 .XX ±.01 FRACTIONS X/X ±1/32" ANGULAR ±1/2°	VERTEX ELECTRONIC PRODUCTS, INC. 2120 OLD GATESBURG RD STATE COLLEGE, PA 16803
DRAWN JAM 3/9/90	TITLE SCHEMATIC, PLATE ASSY, 1:2 REDUNDANT SYS w/ SERIAL INTERFACE
CHECKED GLK 7/27/94	SIZE C · FSCM NO. 0HF70 · DWG NO. 6442
ISSUED	
DO NOT SCALE DRAWING	SCALE NTS · SHEET 1 OF

REVISIONS			
LTR	DESCRIPTION	DATE	APPRV'D
–	AS ISSUED	7/27/94	GLK
A	PER ECR 1046	6/5/97	GLK
B	PER ECR 1102	9/4/97	GLK







VIEW A–A

NOTES:
1) REFER TO BOM ARLP–6438–1, SCHEMATIC 6442–1.
2 W7 CONTROL CABLE ASSEMBLY NOT SHOWN FOR CLARITY.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES: DECIMALS .XXX ±.005 .XX ±.01 FRACTIONS X/X ±1/32" ANGULAR ±1/2°	VERTEX ELECTRONIC PRODUCTS, INC. 2120 OLD GATESBURG RD STATE COLLEGE, PA 16803
DRAWN JAM 7/26/94	TITLE PLATE ASSEMBLY, 1:2 REDUNDANT SYSTEM
CHECKED GLK 7/27/94	SIZE D · FSCM NO. OHF70 · DWG NO. 6438
ISSUED	
DO NOT SCALE DRAWING	SCALE 1/2 x SIZE · SHEET 1 OF

APPROVED BY: MA
RUN DATE: 6/8/99

PARENT ITEM: ARLP-6438-1009
DESCRIPTION: PLATE ASSY, LRC-1200 W/ SERIAL I/O, NO OPT. (OUTLINE 1431-1)
REV: B

MAXTECH, INC.
SINGLE-LEVEL BILL OF MATERIALS

COMPONENT ITEM	MANUFACTURER	MFR PART #	QTY	REV	COMPONENT DESCRIPTION	REFERENCE
DSCH-6442-1	MAXTECH	6442-1	1		SCHEMATIC, LRC-1200 PLATE ASSY W/ SERIAL I/O	
ARLP-10409-101	MAXTECH	ARLP-10409-101	1	-	BASE ASSY, LRC-1200 PLATE, STANDARD SWITCH	
AMAX-10409-501	MAXTECH	AMAX-10409-501	1	-	SUB-ASSY, NO OFFLINE INPUT	
KTER-TS60M	INMET	TS-60M	1		TERMINATION, SMA (M)	INSTALL ON S2B PORT 3
ACAB-6067-3	MAXTECH	ACAB-6067-3	1	A	CABLE ASSY, CONTROL, W/ SERIAL I/O (LRC-1200)	
CNSM-SLM1000	WIELAND ELECTROCODE	SLM-1000	0		WIRE MARKERS,5/8" X 1",WHITE, 500/PK (WIELAND ELECTROCODE)	FIND # 32, QTY 7; (W1-7)
AMAX-10409-801	MAXTECH	AMAX-10409-801	1	-	HARDWARE KIT, LRC-1200 LNAs	

Gain vs Frequency

LNA1
LNA3

Return Loss vs Frequency

Input
LNA1
LNA3

Output
LNA1
LNA3

Markers: Low_____GHz High_____GHz

Polarization 1 Test Data

System Level Options - Functional Check		
Offline Input/Output	❑ NA	❑ Pass
Transmit Reject Filter(s)	❑ NA	❑ Pass
Input Crossguide Coupler(s)	❑ NA	❑ Pass_____dB
Output Coupler(s)	❑ NA	❑ Pass_____dB
Switch Position Indicator(s)	❑ NA	❑ Pass

Model Number	LRC-1200
Serial Number	
Customer P/N	
Revision	
Test Technician	
Date	
Approved By	

Measured Test Data

Gain vs Frequency

LNA2
LNA3

Return Loss vs Frequency

Input
LNA2
LNA3

Output
LNA2
LNA3

Markers: Low_____GHz High_____GHz

Polarization 2 Test Data

System Level Options - Functional Check		
Offline Input/Output	❑ NA	❑ Pass
Transmit Reject Filter(s)	❑ NA	❑ Pass
Input Crossguide Coupler(s)	❑ NA	❑ Pass_____dB
Output Coupler(s)	❑ NA	❑ Pass_____dB
Switch Position Indicator(s)	❑ NA	❑ Pass

Model Number	LRC-1200
Serial Number	
Customer P/N	
Revision	
Test Technician	
Date	
Approved By	

Measured Test Data

Model No. LRC-1200 S/N _____ Job No. _____ Test Technician _____ Date _____ Approved by _____

Parameter	Conditions		Specification	Data for Polarization 1	
				LNA1	LNA3
Frequency Range	For specified performance		GHz	--	--
Gain, Total System	See plot.		dB minimum	dB	dB
Gain Flatness	Full band. See plot.		dB maximum	dB	dB
	dB per 40 MHz. See plot.		dB maximum	dB/40 MHz	dB/40 MHz
VSWR (Return Loss)	Input. See plot.		:1 max. (dB min.)	dB	dB
	Output. See plot.		:1 max. (dB min.)	dB	dB
Noise Temperature	At +23 °C. See plot.		°K	°K	°K
Output Power	At 1 dB compression ($P_{1\ dB}$)	GHz	dBm minimum	dBm	dBm
		GHz		dBm	dBm
		GHz		dBm	dBm
Third Order Intercept	Output. OIP_3	and GHz	dBm minimum	dBm	dBm
		and GHz		dBm	dBm
		and GHz		dBm	dBm
Waveguide Pressure			5 psi	❑ Pass ❑ Fail	❑ Pass ❑ Fail

LNA Model #: _____ LNA 1 S/N: _____ LNA 2 S/N: _____ LNA 3 S/N: _____

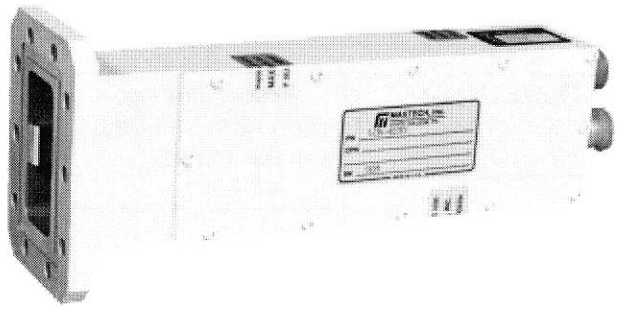
Parameter	Conditions		Specification	Data for Polarization 2	
				LNA2	LNA3
Frequency Range	For specified performance		GHz	--	--
Gain, Total System	See plot.		dB minimum	dB	dB
Gain Flatness	Full band. See plot.		dB maximum	dB	dB
	dB per 40 MHz. See plot.		dB maximum	dB/40 MHz	dB/40 MHz
VSWR (Return Loss)	Input. See plot.		:1 max. (dB min.)	dB	dB
	Output. See plot.		:1 max. (dB min.)	dB	dB
Noise Temperature	At +23 °C. See plot.		°K	°K	°K
Output Power	At 1 dB compression ($P_{1\ dB}$)	GHz	dBm minimum	dBm	dBm
		GHz		dBm	dBm
		GHz		dBm	dBm
Third Order Intercept	Output. OIP_3	and GHz	dBm minimum	dBm	dBm
		and GHz		dBm	dBm
		and GHz		dBm	dBm
Waveguide Pressure			5 psi	❑ Pass ❑ Fail	❑ Pass ❑ Fail

Para.*	Check/Adjust	Desired Results	Data
1.1	120V Line I_{RMS} @ J1	700 mA maximum	mA
1.2	120V Line I_{RMS} @ J2	700 mA maximum	mA
2.1	Configure fuse settings per	1 fuse, std. (North America)	❑
	customer requirement	2 fuses, opt. (Europe)	❑
3.1	PS1 verification	+15.0 ± 0.1 Vdc @ TP1	❑
3.2	PS2 verification	+15.0 ± 0.1 Vdc @ TP1	❑
4.1	LNA1 nom. current	Set	mA
4.2	LNA2 nom. current	Set	mA
4.3	LNA3 nom. current	Set	mA
5.1	Plate assembly S1	Function OK	❑
5.2	Plate assembly S2	Function OK	❑
6.1	LED and beeper test	All LEDs lit; beeper sounds	❑
6.2	LNA1 POL1 select	Function OK	❑
6.3	LNA3 POL1 select	Function OK	❑
6.4	LNA2 POL2 select	Function OK	❑
6.5	LNA3 POL2 select	Function OK	❑
7.1	Emergency Power	Function OK	❑
(Opt.)	RCP Link Tests	Function OK	❑

* Refer to Test Procedure DPRO-11577.

Model Number	LRC-1200
Serial Number	
Customer P/N	
Revision	
Test Technician	
Date	
Approved By	

C-Band Low Noise Amplifiers



Introduction

VertexRSI LC-4000 series C-Band Low Noise Amplifiers are specially designed for satellite earth station receiver front ends and other telecommunications applications. Utilizing state-of-the-art HEMT and GaAs FET technology, these amplifiers have been designed for both fixed and transportable applications. High performance models are available in several standard frequency ranges, with noise temperatures of 30, 35, 40 and 45 K. All noise temperature specifications are guaranteed over the full bandwidth of the LNA and are verified by cold load testing.

Features

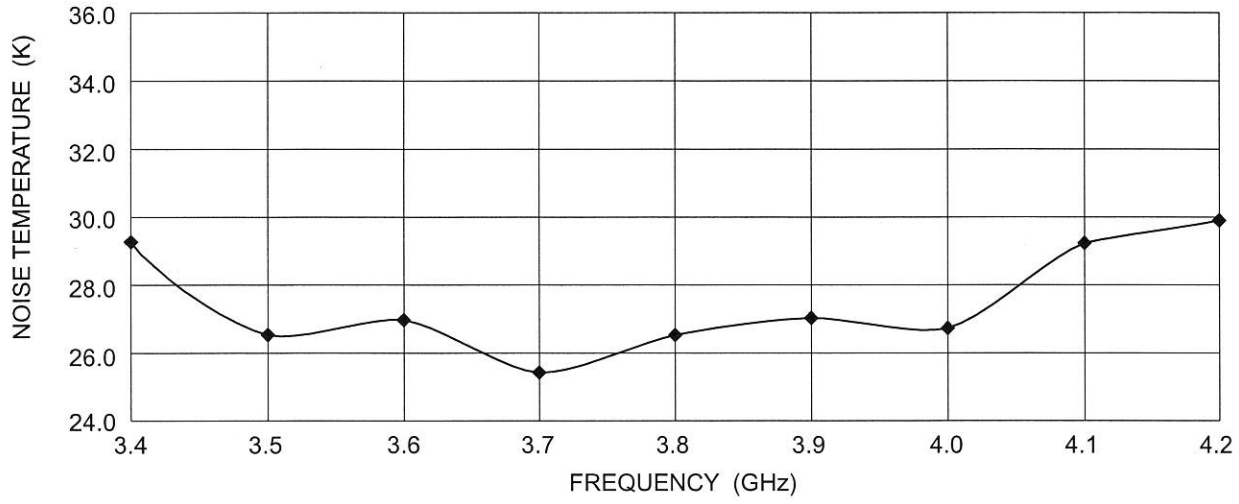
- State-of-the-art noise performance
- HEMT/GaAs FET design
- Weatherproof enclosure
- Internal low-loss input isolator
- Internal regulator
- Internal Form 'C' alarm
- Reverse polarity protection
- Surge and transient protection
- High reliability

Options

- High output power, +20 dBm
- Universal input ac power supply
- Redundant configurations (1:1, 1:2)

30 K C-Band LNA, Model LCD4S30-XX

(◆ = Actual Measured Cold-Load Data)



2120 Old Gatesburg Road, State College, PA 16803 USA • Telephone 814-238-2700 • FAX 814-238-6589
www.tripointglobal.com

Table 1 — Part Number/Ordering Information

LC□4S□-□□

Frequency Range	Noise Temperature	Output Power	Power Config.
C = 3.6-4.2 GHz D = 3.4-4.2 GHz	45 = 45 K ‖ 40 = 40 K 35 = 35 K ‖ 30 = 30 K	X = +10 dBm 2 = +20 dBm	X = +12 to +24 Vdc 4 = 90-265 Vac, 47-63 Hz

Consult factory for custom configurations.

Table 2 — Noise Temperature vs. Ambient Temperature

Noise temperature vs. ambient temperature can be found from the equation:

$$\frac{NT_2}{NT_1} = \left(\frac{T_2}{T_1}\right)^{1.5}$$

where NT_2 = Noise Temperature at T_2
NT_1 = Noise Temperature at T_1
T_2 = Temperature 2 in K
T_1 = Temperature 1 in K
(K = °C + 273)

For the case where T_1 = 296 K (+23 °C), the ratio NT_2/NT_1 is shown in the table:

Ambient Temperature T_2 (°C)	Ratio NT_2/NT_1
0	0.89
+23	1.00
+40	1.09
+50	1.14
+60	1.19

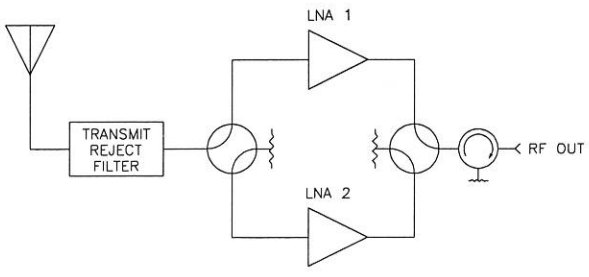
Example: For model LCC4S30-XX, NT_1 = 30 K at +23 °C; what is NT_2 at +50 °C?

From the table, NT_2/NT_1 at 50 °C = 1.14:

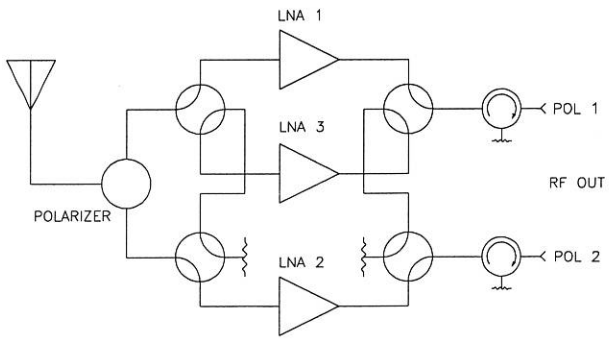
NT_2 = 1.14 x (30 K) = 34.2 K at 50 °C

Typical Applications

1:1 Redundant Systems



1:2 Redundant Systems



SPECIFICATIONS LC-4000 Series

Parameter	Notes	Min	Nom./Typ.[a]	Max	Units
Frequency Range	Band C Band D	3.6 3.4		4.2 4.2	GHz GHz
Gain		60	64	66	dB
Gain Flatness	Full band Per 40 MHz			±0.5 ±0.2	dB dB
VSWR	Input Output		1.20 1.20	1.25 1.50	:1 :1
Noise Temperature[b]	At +23 °C Versus temperature		See Table 2	See Table 1	
Power Output at 1 dB compression	Standard Option 2	+10 +20	+15 +22		dBm dBm
3rd Order Output Intercept Point	Standard Option 2	+20 +30	+26 +32		dBm dBm
Group Delay per 40 MHz	Linear Parabolic Ripple			0.01 0.001 0.1	ns/MHz ns/MHz^2 ns p-p
AM/PM Conversion	-5 dBm output power			0.05	°/dB
Gain Stability (Constant Temp)	Short term (10 min) Medium term (24 hrs) Long term (1 week)			±0.1 ±0.2 ±0.5	dB dB dB
Gain Stability	Versus temperature		-0.05		dB per °C
Maximum Input Power	Damage threshold Desens. threshold, 5.825-6.425 GHz			0 -10	dBm dBm
Connectors	Input Output Power		CPR 229G Flange Type N Female MS3112E10-6P (mate supplied)		
Power Requirements	Voltage Current, standard Current, with Option 2	12	15 140 200	24 180 240	V mA mA
Operating Temperature		-40		+70	°C
MTBF (MIL-HDBK-217F)	Ground fixed, +40 °C		296,000		hours

Notes:

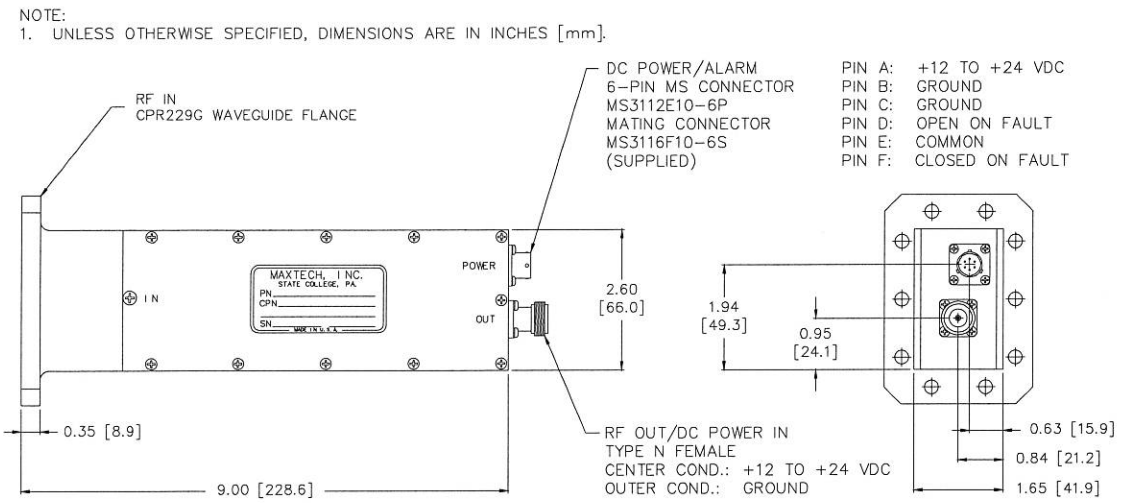
[a] When there is only one entry on a line, the Nom./Typ. column is a nominal value; otherwise it is a typical value. Typical values are intended to illustrate typical performance, but are not guaranteed.

[b] Maximum noise temperature at +23 °C at any frequency in the specified band.

Specifications are subject to change at VertexRSI's discretion.

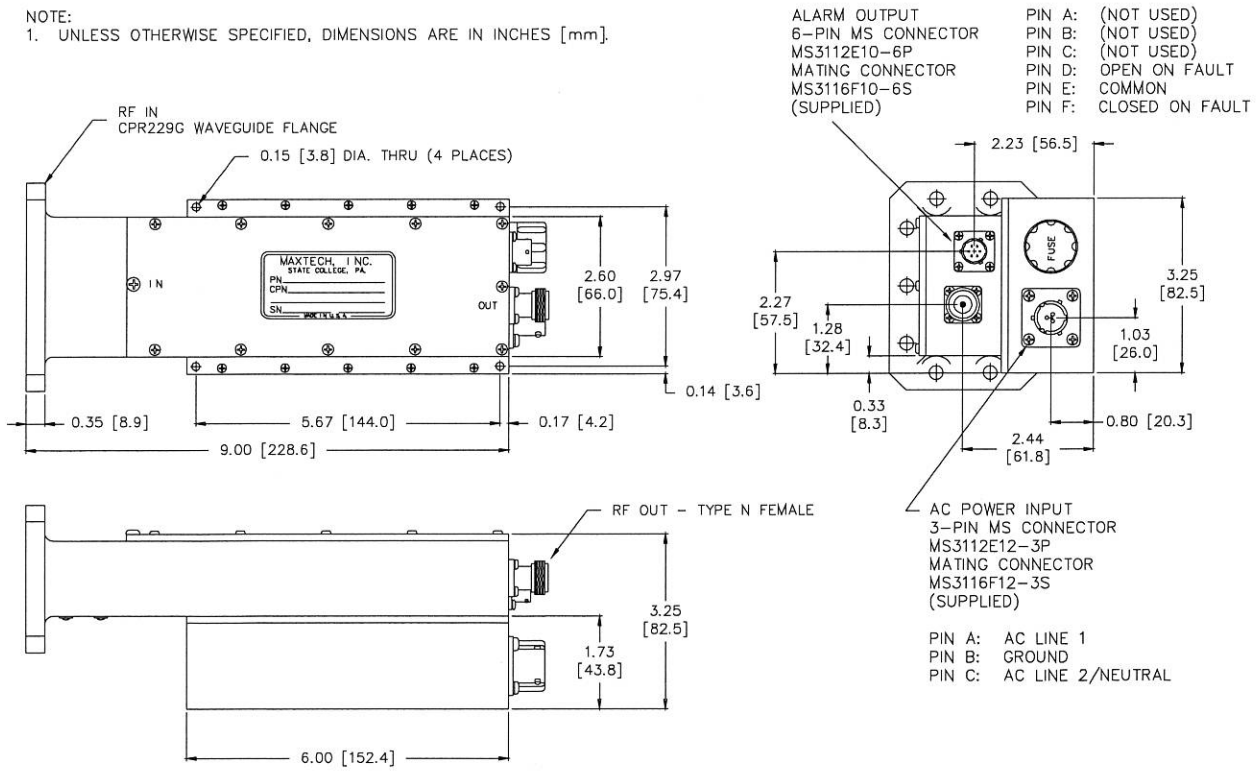
Outline Drawings

Standard LNA



Outline 1045

LNA with Power Supply



Outline 1620

C-Band Redundant LNA Systems

Introduction

Redundant LNA systems minimize system downtime due to LNA failure by providing a spare LNA and an automatic means of switching to the spare upon failure of a primary LNA. A 1:1 system provides one spare LNA for one primary LNA. A 1:2 system provides one spare LNA for either of two primary LNAs. The systems consist of an outdoor plate assembly which mounts at the antenna hub and an indoor control panel.

Plate Assembly Features

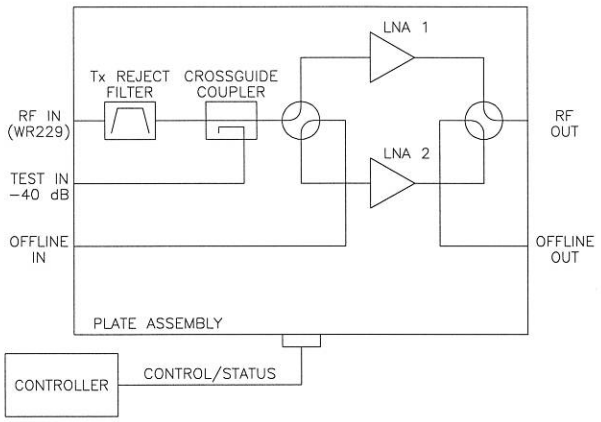
- VertexRSI Low Noise Amplifiers
- High quality dual waveguide/coaxial switches
- Manual override
- Waveguide input flanges
- Output coaxial isolators standard
- Tx reject filter, coupler, and offline I/O options available

Control Panel Features

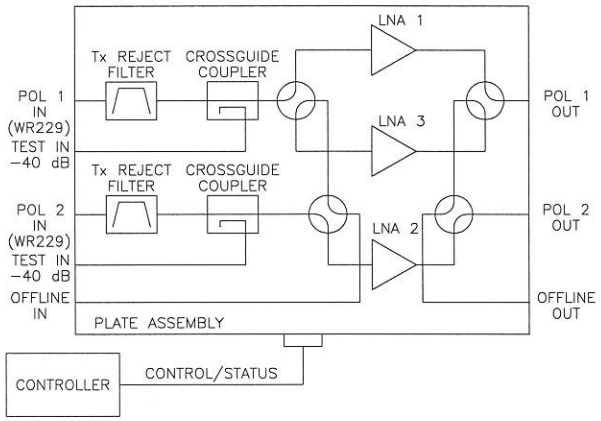
- Standard 19" rack panel, 3½" high
- Dual, redundant power supplies
- Worldwide universal AC input capability
- Manual or automatic operation
- Monitors LNA bias currents to detect faults
- Automatically switches to standby LNA when fault occurs
- RS-232/-422/-485 and parallel I/O M&C interfaces
- Audible alarm

System Block Diagrams

1:1 System



1:2 System



CE

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System Specifications*

LRC-1000 Systems

Parameter	Notes	Min	Nom/Typ†	Max	Units
Frequency Range	Band "C" Band "D"	3.6 3.4		4.2 4.2	GHz GHz
Noise Temperature, System	At +23 °C Versus temperature		See Table 1 See Table 2		
Gain	Standard LNA	60	63		dB
Gain Match	Between LNAs			1	dB
Gain Flatness	Full band Per 40 MHz			±0.5 ±0.2	dB dB
Gain Stability	Per day, constant temp Versus temperature		 -0.05	±0.2	dB dB/°C
VSWR	Input, standard Input, with System Option A or B, Tx filter Output		1.20 1.25 1.20	1.25 1.30 1.25	:1 :1 :1
Power Output at 1 dB Compression ($P_{1\ dB}$)	Standard LNA LNA with Option 2 LNA with Option 2 & System Option D, Output Couplers	+10 +18 +17	+13 +20 +19		dBm dBm dBm
Third Order Output Intercept Point (OIP_3)	Standard LNA LNA with Option 2 LNA with Option 2 & System Option D, Output Couplers	+20 +28 +27	+23 +30 +29		dBm dBm dBm
AM/PM Conversion	At -5 dBm out			0.05	°/dB
Group Delay per 40 MHz	Linear Parabolic Ripple			0.02 0.002 0.2	ns/MHz ns/MHz^2 ns p-p
Maximum Input Power	Without damage			0	dBm
Desensitization Threshold for 5.850–6.425 GHz in (Band C) 5.850–6.725 GHz in (Band D)	Standard system With System Option A or B, Tx filter			-10 +45	dBm dBm
Connectors	RF Input RF Output Offline In/Out Coupler In/Out		CPR229G Waveguide Flange Type N Female Type N Female Type N Female		
Temperature Range	Switch Plate Assy	-40		+60	°C

* System specifications depend on choice of LNA and various options. Specifications shown are for VertexRSI LC-4000 Series LNAs. Consult factory for custom configurations.

† When there is only one value on a line, this column is a nominal value. Otherwise it is a typical value. Typical values are intended to illustrate typical performance, but are not guaranteed.

Part Number/Ordering Information

C-Band LNA Systems* L R C [ ][ ][ ][ ] - [X][ ][ ][ ][ ][ ]

System Type:	1:1	1
	1:2	2
LNA Frequency:	3.6-4.2 GHz	C
	3.4-4.2 GHz	D
LNA Temperature:	30 K	3 0
	35 K	3 5
	40 K	4 0
	45 K	4 5
LNA Options:	+10 dBm output (std.)	X
	+20 dBm output	2
System Options:	No filter	X
	Tx reject filter, -60 dB (5.850-6.725 GHz reject band)	A
	Tx reject filter, -60 dB (5.850-6.425 GHz reject band)	B
	No input coupler(s)	X
	Input CG coupler(s), -40 dB	C
	No output coupler(s)	X
	Output coaxial coupler(s), -20 dB	D
	No offline I/O.	X
	Offline I/O, terminated, with isolator	E
Control Cable: (Standard service)	No cable.	X
	100 ft. (30 m).	1
	150 ft. (45 m).	2
	200 ft. (60 m).	3
	250 ft. (75 m).	4

Examples:

1:1 system with 3.6-4.2 GHz, 40 K LNAs, no LNA options, no system options, and 100 ft. cable:

Order Number L R C 1 C 4 0 - X X X X X X 1

1:1 system with 3.4-4.2 GHz, 35 K LNAs, no LNA options, Tx Reject filter, CG coupler, and 200 ft. cable:

Order Number L R C 1 D 3 5 - X X B C X X 3

1:2 system with 3.6-4.2 GHz, 45 K LNAs, no LNA options, input CG coupler, output coax coupler, Offline I/O, and 150 ft. cable:

Order Number L R C 2 C 4 5 - X X X C D E 2

1:2 system with 3.4-4.2 GHz, 30 K LNAs with high power output option, input and output couplers, and 150 ft. cable:

Order Number L R C 2 D 3 0 - X 2 X C D X 2

** Note: Consult factory for custom configurations.*

Table 1 — System Noise Temperature with Various Options (Add to T_{LNA})

	1:1	1:2		
System Configuration		Pol. 1	Pol. 2 Main	Pol. 2 Standby
Standard Configuration	1.5 K	1.5 K	3.0 K	4.5 K
40 dB Crossguide Coupler(s)	2.0 K	2.0 K	3.5 K	5.0 K
Transmit Reject Filter(s), Band C	4.5 K	4.5 K	6.0 K	7.5 K
Transmit Reject Filter(s), Band D	9.5 K	9.5 K	11.0 K	12.5 K
Tx Filter(s) and Coupler(s), Band C	5.0 K	5.0 K	6.5 K	8.0 K
Tx Filter(s) and Coupler(s), Band D	10.0 K	10.0 K	11.5 K	13.0 K

Table 2 — Noise Temperature vs. Ambient Temperature

Noise temperature vs. ambient temperature can be found from the equation

$$\frac{NT_2}{NT_1} = \left(\frac{T_2}{T_1}\right)^n$$

where NT_2 = Noise Temperature at T_2
NT_1 = Noise Temperature at T_1
T_2 = Temperature 2 in K
T_1 = Temperature 1 in K
n = 1.5 for LNA,
= 1.0 for passive losses

For the case where T_1 = 296 K (+23 °C), the ratio NT_2/NT_1 is shown in the table below for both LNAs (n = 1.5) and for passive losses (n = 1.0):

Ambient Temperature T_2 (°C)	n=1.5 NT_2/NT_1	n=1.0 NT_2/NT_1
0	0.89	0.92
+23	1.00	1.00
+40	1.09	1.06
+50	1.14	1.09
+60	1.19	1.13

Example:
1:1 system with Tx filter, CG coupler, and 30 K LNAs, LCC4S30-XX. T_{LNA} = 30 K at +23 °C, passive losses = 5 K at +23 °C; thus T_{SYS} = 35 K at +23 °C. What is T_{SYS} at +50 °C? From the table, NT_2/NT_1 at 50 °C = 1.14 for the LNA and 1.09 for the passive losses.

NT_2 = 1.14 x (30 K) + 1.09 x (5 K)
= 34.2 K + 5.45 K = 39.65 K at 50 °C.

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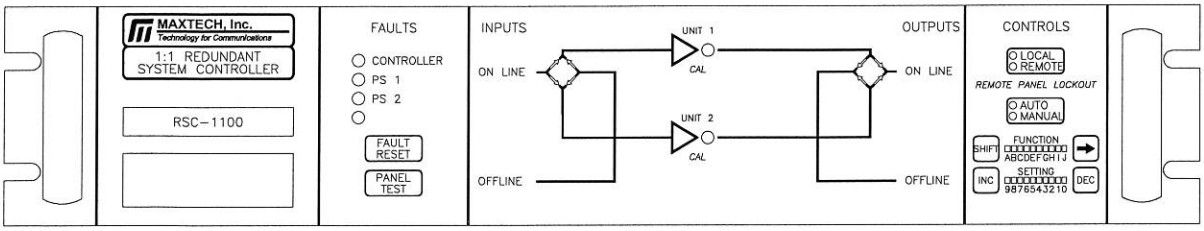
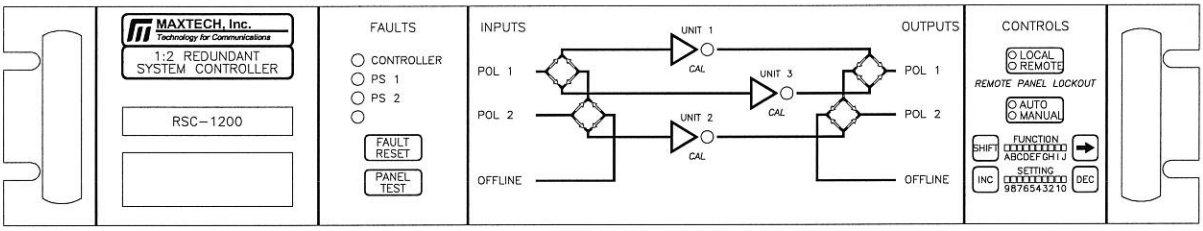
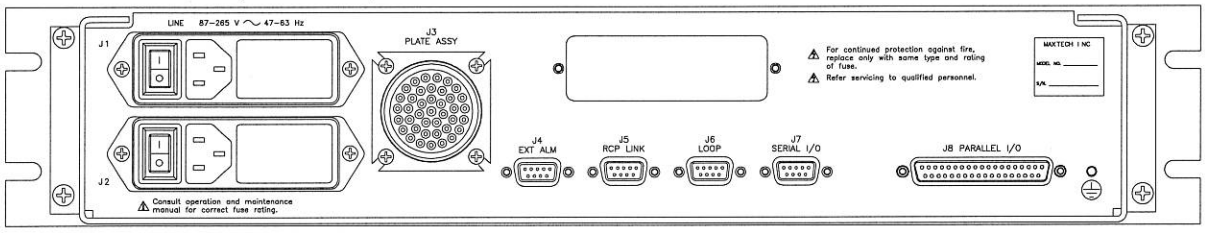
Controller Front Panel (1:1 System)



Controller Front Panel (1:2 System)



Controller Rear Panel (All models)



Specifications — Controller

LNA Status Monitor Method	Control panel monitors LNA bias current. Alarm is generated if current goes outside of allowed tolerance window.
Window Width	±5% to ±25% of nominal; software selectable in 5% steps
Switchover Time	100 ms
Serial I/O:	
Interface	RS-232/RS-422/RS-485 2- or 4-wire
Connector	9-Pin D, female
Parallel I/O:	
Status outputs	Form 'C' dry contacts; 100 Vdc, 0.5 A, 3 W max (resistive load)
Control inputs	Contact closures to ground; withstand 15 V, sink 20 mA
Connector	37-pin D, male
Controller Dimensions	19" (483 mm) W x 3.47" (88.1 mm) H x 17.5" (445 mm) D; 25 lb (11.4 kg)
Chassis Slides	Standard
Cable Length to Plate Assy	100 ft (30 m) to 250 ft (75 m) available
AC Input	87-265 Vac, 47–63 Hz, 100 W. Dual AC inputs and dual redundant power supplies.
Operating Temperature Range	0 to +50 °C

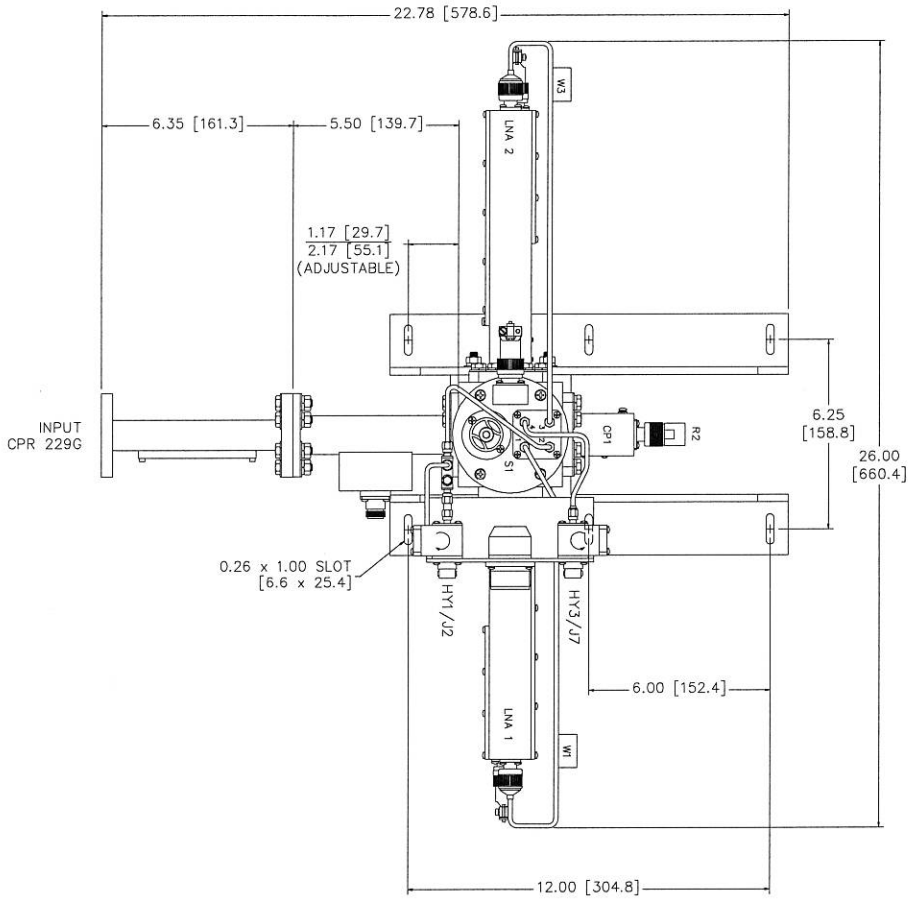
Front Panel Controls and Indicators

LNA Status Alarms	LED Indicators glow green when OK, red when an LNA fault is detected.
PS1, PS2 Indicators	Glow red to show fault with dual redundant power supplies.
Panel Test Pushbutton	Lights all indicators & test audible alarm.
Unit Pushbuttons and Indicators	Pushbuttons are used to manually switch the LNAs. Arrow indicators show which LNAs are switched on-line. Unit indicators light red to show faulted LNAs. In 1:1 systems, LNA1 is normally the primary LNA and LNA2 is on standby. In 1:2 systems, LNA1 and LNA2 are the primary LNAs for Polarization 1 and Polarization 2, respectively. LNA3 is the standby LNA and can be selected for either polarization.
Auto/Manual Switch and Indicators	In Auto mode, an LNA failure initiates automatic switchover to the standby LNA. In manual mode, the on-line LNA can be selected from the front panel.
Remote/Local Switch and Indicators	Selects local control or remote control from serial I/O or optional parallel I/O or remote panel.

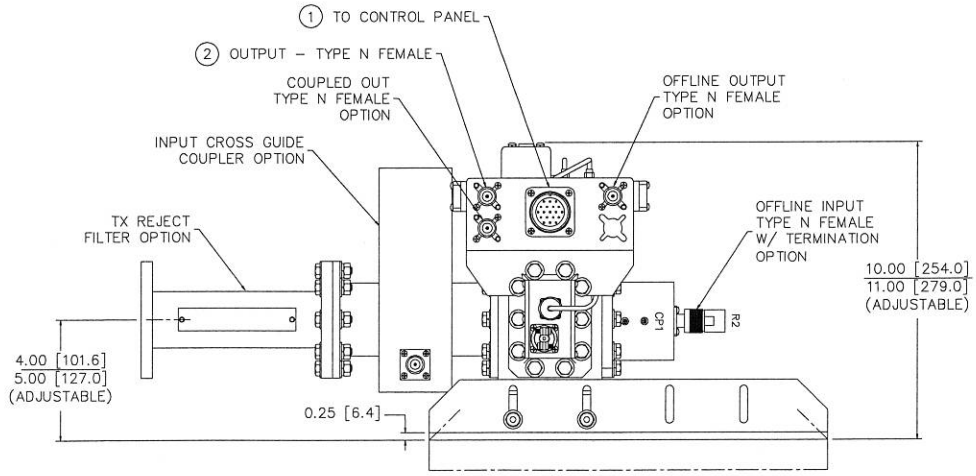
Rear Panel I/O Interface

LINE 1 - J1, LINE 2 - J2	Dual power entry modules contain the AC line input connector, fuses, and power switch. System can be powered from separate AC lines if desired. Either or both power supplies are capable of operating the system.
TO PLATE ASSEMBLY - J3	Cable to antenna plate assembly carries LNA power and switch drive signals. System normally supplied with 100 feet of control cable; other lengths are optional.
Parallel I/O - J8	Parallel I/O connection for customer control or monitoring. Capable of controlling all features of the system except remote/local switch. Form 'C' relay contact outputs (1:1 systems): • LNA1 status • PS1 status • Auto/Manual mode • LNA2 status • PS2 status • Local/Remote mode • Switch position Control inputs—contact closure to ground (1:1 systems): • LNA1 select • LNA2 select • Auto/Manual select Form 'C' relay contact outputs (1:2 systems): • LNA1 status • PS1 status • Auto/Manual mode • LNA2 status • PS2 status • Pol. 1: LNA1 or LNA3 • LNA3 status • Local/Remote mode • Pol. 2: LNA2 or LNA3 Control inputs—contact closure to ground (1:2 systems): • Pol. 1: LNA1 select • Pol. 2: LNA2 select • Auto/Manual select • Pol. 1: LNA3 select • Pol. 2: LNA3 select
Serial I/O and Loop - J6 & J7	RS-232/RS-422/RS-485 connectors for user M&C System. Commands provide monitoring, controlling, and configuration.
RCP Link - J5	For optional Remote Control panel, which duplicates all front panel functions.
External Alarm - J4	External Alarm inputs. Substitute for or combine with internal LNA current monitor alarms. Allows an external signal to indicate LNA failure. Unused inputs can be used as status inputs to M&C system.

1:1 Plate Assembly Outline Drawing, with Various Options Installed

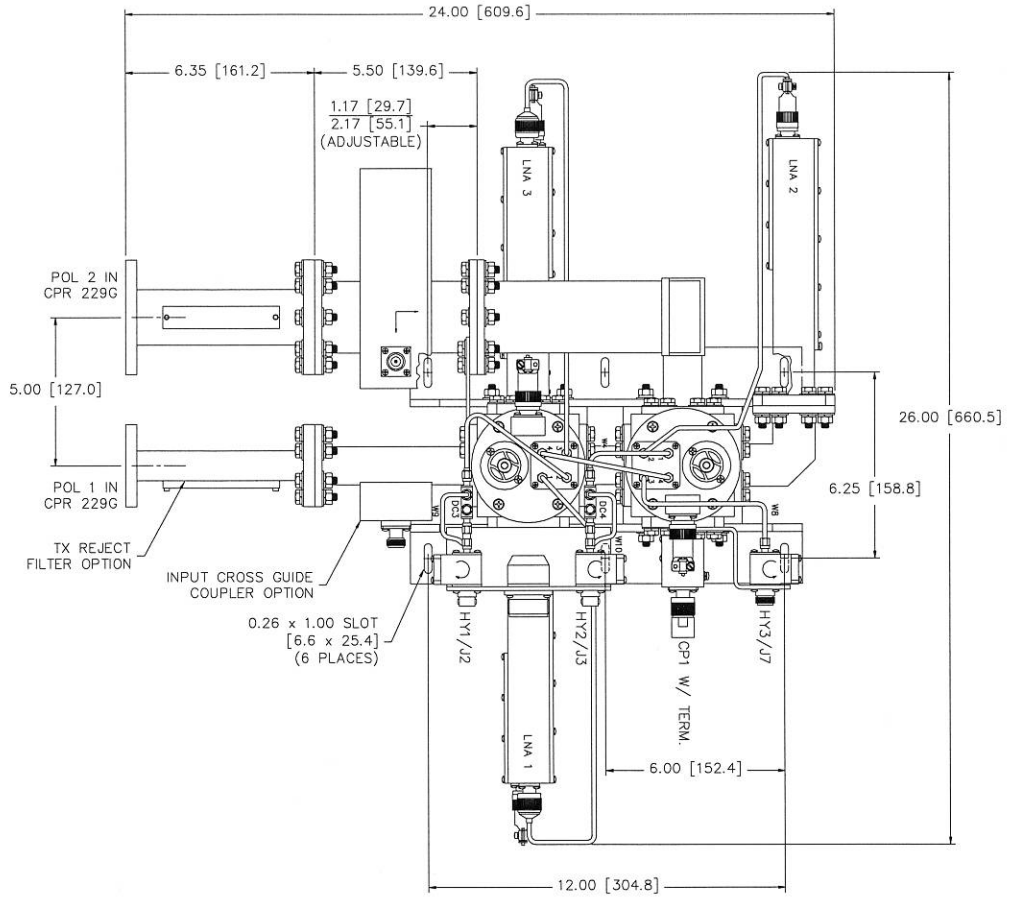


NOTES:
1) INTERCONNECTING CABLE AND MATING CONNECTOR INCLUDED BUT NOT SHOWN
2) OUTPUT ISOLATOR INCLUDED WITH STANDARD SYSTEM
3) DIMENSIONS ARE IN INCHES AND [MILLIMETERS].

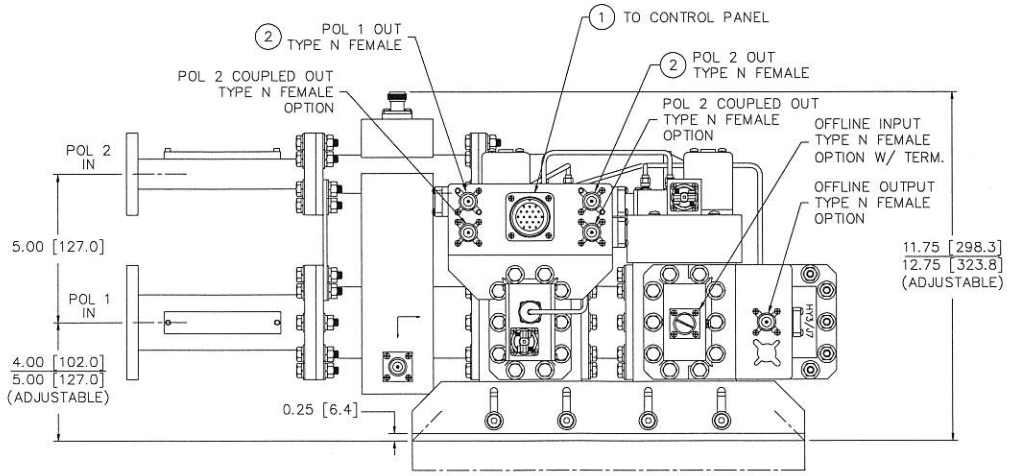


Outline 12668-2

1:2 Plate Assembly Outline Drawing, with Various Options Installed



NOTES:
1) INTERCONNECTING CABLE AND MATING CONNECTOR INCLUDED BUT NOT SHOWN
2) OUTPUT ISOLATORS INCLUDED WITH STANDARD SYSTEM
3) DIMENSIONS ARE IN INCHES AND [MILLIMETERS]



Outline 12667-2

OTHER VertexRSI PRODUCTS

- **Low Noise Amplifiers and LNA Systems**
- **Solid-State Power Amplifiers and SSPA Systems**
- **General Purpose Converters**
- **Satellite Communications Equipment**
- **Custom Subsystems**

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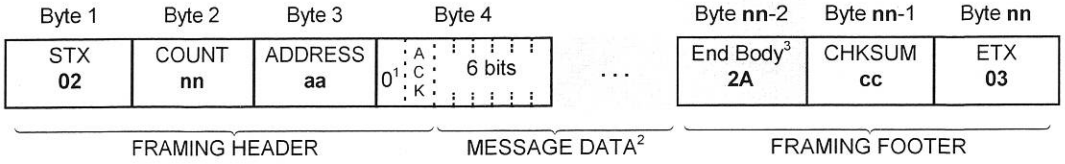
Appendix A Serial I/O Protocol

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
-	Initial Release for v2.00	06-16-99	

CONTRACT NO.		**MAXTECH, INC.** STATE COLLEGE, PA.	
DRAWN BY: PBT/PEG	DATE: 06-16-99	TITLE: Serial I/O Protocol for Redundant System Controller firmware rev 2.00	
CHECKED BY			
APPROVED BY			
		SIZE: A	FSCM NO.: OHF70
		DWG. NO.: 11667	
FILENAME: 11667.doc		SHEET 1 OF 34	

1. Message Framing Protocol

This framing protocol is used for communications between a *host* and a *unit*. This is a polling protocol, meaning that *units* answer ONLY when they receive a correctly formatted message from the *host*. The same framing protocol is used for all messages to and from a unit. A message from a unit in response to one from the host is referred to as a *reply*.



[1]The most significant bit of byte 4 is reserved, and should always be 0.
[2]The message data can be of any length from 1 byte (6 bits of byte 4) to 250 bytes (249 if End Body byte is used). Bytes **02** and **03** may not appear in the message data.
[3]End Body byte (**2A**) is optional, and is included for compatibility with version 1 of this protocol.

1.1 STX/ETX

All message frames start with the framing byte STX (**02**) and end with the framing byte ETX (**03**).

1.2 Count

The second byte of the message frame is the count of all bytes in the entire message, including the STX and ETX bytes.

The protocol's framing determines that the smallest message possible is 6 bytes.

1.3 Address

The third byte of the message frame is the address. Any unit whose address setting matches this byte will accept the message.

An address of **00** is used to send a command or control message to all units on the bus.

A reply, if any, will contain the unit's set address.

1.4 ACK Response Flag

Bit 6 (with bit 0 being the least significant bit, and bit 7 the most significant bit) of the fourth byte in a message frame is used to request and ACK response. This bit will never be set in a reply.

If an ACK response is returned by a unit, it will be sent quickly following receipt of the last byte of the host message, if possible. See section 1.8.3, ACK Responses, for specifications.

An ACK response will be returned ONLY if all of the following are true:

1. The address of the host message matches that of the unit. In other words a unit will send an ACK response to a message addressed to 0 ONLY if its own address is set to 0.
2. The message is not REJECTED for any of the reasons described under section 1.7.1, Rejected Messages.

An ACK response is a correctly framed message, with the least significant 6 bits of byte 4 equal to the value **3F**.

Example, ACK response from unit address 1: **02 06 01 3F 40 03**

1.5 Message Data

The actual content of the message starts with the least significant 6 bits of Byte 4, and can be of any length up to 250 bytes (including Byte 4). An optional End Body byte may be placed in the message footer (at the end of the Message Data), in which case the maximum length of the message data is 249 bytes.

The optional End Body byte is used for compatibility with version 1 of this protocol, in which the End Body byte was required if the message data contained more bytes than byte 4. Units determine whether or not to send this byte as follows:

1. If a message is received by the unit with more bytes in the message data than byte 4, but not containing an End Body byte, the setting will be changed to NOT use the End Body byte in replies.

2. If a message is received by the unit WITH an End Body byte, the setting will be changed to use the End Body byte in replies.

Messages will always be accepted by units, with or without the End Body byte.

The least significant six bits of byte 4 are not allowed to be equal to **02**, **03**, or **3F,** and no value in the message data can be equal to **02** or **03**.

The least significant six bits of byte 4 are normally an instruction code.

1.6 Checksum

The checksum is the arithmetic sum of all the bytes starting with the address, and ending with the byte preceding the checksum. The sum is truncated to the least significant byte.

The checksum is the second to last byte of a message frame.

1.7 Message Handling

1.7.1 Rejected Messages

Messages will be rejected if any of the following are true:

1. The message does not start with an STX (**02**).
2. A communications (framing) error occurs on any byte.
3. The message COUNT (**nn**) is less than 6.
4. The last byte of the message, as determined by the COUNT is not an ETX (**03**).
5. The message ADDRESS does not match the unit's address, and is not **00**.
6. The fourth byte of the message contains a 1 in the most significant bit.
7. The low six bits of the fourth byte are equal to **3F**.
8. A byte equal to **02** or **03** is received anywhere in the MESSAGE DATA.
9. The message checksum (CHKSUM) is not equal to the low byte of the arithmetic sum of bytes 3 (ADDRESS) through **nn**-2 (where **nn** is the COUNT).
10. The receive buffer has become full, causing the unit to miss bytes of the message.

If a message is rejected because of any of these conditions, no ACK response will be returned, if requested in Byte 4 of the message. (As mentioned previously, an ACK response will also not be sent if the global address

(**00**) is used, and the unit address is not set to **00**.) The unit will immediately begin watching the data stream for the next STX (**02**) byte AS SOON AS one of the listed problems is detected.

A message may also be rejected at a higher level, if something is wrong with the MESSAGE DATA itself (e.g. illegal instruction code), but in this case an ACK response will still be sent. See the protocol document for the equipment you are using to find out more about message data format.

1.7.2 Framing Synchronization

A unit not currently receiving a message is watching the message stream for an STX (**02**) byte. Upon receiving that byte, the unit begins looking for the rest of the message.

If a byte value of **02** or **03** is received for the message count, or anywhere in the message data, the unit assumes that it is the end of the message (if **03** is received), or the start of a new message (if **02** is received), and rejects the original message.

The STX byte value (**02**) can legally appear as either an address or a checksum in a message. This has the potential for causing mis-synchronization if a unit starts up in the middle of a message. This is unlikely for the following reasons:

- Should a unit detect a checksum of **02** as being the STX byte, it will immediately be followed by the ETX byte (**03**). Because a byte count of 3 is not valid (all messages must have at least 6 bytes), the unit will abort receiving the message, and start looking for the STX again.

- Should a unit detect an address of **02** as being the STX byte, it will detect the following byte (Byte 4) as being the message count, and attempt to receive the address from the bytes that follow. In this case, the ETX (**03**) from the actual message will terminate this false message, and the address, checksum, or actual message content will most likely be invalid, and will be rejected.

If you wish to guarantee that all listening units are synchronized, send a string of 3 ETX (**03**) bytes. This will terminate all units' receive sequences, after which they will start looking for the STX (**02**) byte again.

1.7.3 Address

A means is provided on every unit to set its address. In any interface bus in which messages are received by more than one unit, each unit should be assigned a unique address that is not equal to **00**.

1.8 Timing Issues

1.8.1 Inter-character spacing

There is no maximum specification on inter-character spacing in messages in either direction. Bytes in messages to units may be spaced as far apart as you wish. However, be aware that if you are using a half duplex interface and a unit is ready to send an ACK response or reply, it will be watching the receive data stream for an idle period to send its message.

Generally, there will be no spacing between characters in replies generated by units, but this is not guaranteed.

1.8.2 Inter-message spacing

There is no requirement to provide any space between messages. However the following points should be considered if message spacing becomes too short.

The receive data buffer of the unit may become full if too many messages are received at once. If this happens, subsequent messages will be rejected until the receive buffer has room. The receive buffer size is dependent upon the RAM available in a particular unit, so there is no global specification available on this.

When using a half duplex interface (such as RS-485), ACK responses or replies will be held until the line is idle for a specified time (see next section). Therefore, an idle time should be provided for any message that expects a response.

If an ACK response is requested on every message, the host will know if a message was rejected (for ANY reason) because it will not receive the quick ACK response.

1.8.3 ACK Responses

If requested, an ACK response will be generated as quickly as possible following receipt of the original message. With a full duplex interface, if the unit is already transmitting when it becomes time to send an ACK response, it will send the ACK as soon as it finishes transmitting the existing message. When using a half-duplex interface, a delay of 1 byte time is introduced to allow time for the host to switch from transmitting to receiving. The line must be idle during this time. Another delay of 1 byte time is always introduced when the transmitter is turned on.

The timing of the ACK response (after the end of the host message) is as follows:

FULL DUPLEX interface:

MINIMUM:	1 BYTE TIME
MAXIMUM:	(1 BYTE TIME + 1 milli-second), or as soon as the transmitter is done sending a message

HALF DUPLEX interface:

MINIMUM:	2 BYTE TIMES with idle line
MAXIMUM:	(2 BYTE TIMES + 1 milli-second) with idle line

NOTE: If the half duplex line is not idle, the unit simply waits for the line to be idle for 1 BYTE TIME, then generates the ACK response.

1.8.4 Replies

If a message generates a reply, that reply should start no more than 100 mS after the original host message. With a full duplex interface, if the unit is already transmitting when it becomes time to send a reply, it will send it as soon as the transmitter is finished. If a message generates a reply and an ACK response, the ACK response will always be first (according to ACK Response specifications), followed by the reply, within its specified time frame.

The MINIMUM time for a reply (with no ACK response) is the same as the MINIMUM specification for an ACK response above, depending on the interface.

2. Message Data Summary

2.1 Instruction Codes

The least significant six bits of the first byte of the MESSAGE DATA contain the *instruction code*. Some instruction codes require a *sub-instrcution*. If a *sub-instruction* is required, it is sent in the second byte of the MESSAGE DATA.

If the message contains an *instruction* or *sub-instruction* code that are not defined for the particular unit being addressed, the message will be ignored.

Instructions are represented here by a one or two byte value. If a one byte value is listed, it represents an *instruction code*. A two byte code represents an *instruction code* (first byte) followed by a *sub-instruction*.

2.2 Message Types

There are three types of messages, the type being determined by the instruction code.

Status messages request measured data from the unit. In general, no data is sent to the unit in the message requesting the data. A response message will be generated by the unit containing the requested data in the message body. The format of the returned data depends on the value being returned.

Control messages affect some operational control on the unit, whose value can be queried or set. Data may be sent to the unit in the message body. When a message is sent to the unit containing data in the message body, the control is set to that value, and no message is returned in response. If a control message is sent to the unit with no data, a response message is returned with data containing the current setting of that control. The format of the data is usually the same in both directions, and depends on the specific control whose data is being set or read.

Configuration messages are similar to control messages, except that data in them does not correspond to some operational control or button. Usually these are settings that are made once, when the system is set up.

Command messages cause the device to perform some action or function that can't necessarily be evaluated. Commands may (but don't have to) contain data in the message body. No message is returned from the unit is response to a command, unless an ACK response is requested.

Instr Code	Description	Type
04	Reset Unit	Command
07	Unit Type	Status
08	Get Faults	Status
09	Clear Service Request	Command
0A	Fault Reset	Command
0B	Self Tests	Command
0E	Local Lockout	Control
16*	Get Measured Data	Status
17*	Set/Read Configuration	Control
18*	Set/Read Controls	Control
19*	Unit Commands	Command
20	Unit Status	Status

*Sub-instruction required

2.3 Data Formats

The data in a message is sent to or from the unit as part of the message body. The format of the data depends on the specific message being sent, but the following general forms are used.

2.3.1 Analog Data

Analog data is numeric values representing a measurement such as currents or voltages. Analog data is returned as an ASCII string representing the value. Analog data can be a floating point value, or an integer value. The data can be signed or unsigned. Overrange and underrange values are preceded by a > or < symbol, respectively.

If the measurement is unavailable for some reason, a question mark ("?", ASCII code **3F**) will be returned. If more than one value needs to be sent, the values will be separated by commas (",", ASCII code **2C**).

In the message summary tables, the following symbols will be used to represent analog data being sent in the message body:

N_i	an unsigned floating point value
$\pm N_i$	a signed floating point value
I_i	an unsigned integer value
$\pm I_i$	a signed integer value

2.3.2 Enumerated Data

Enumerated Data is data that can be represented as one of two or more states. For example, an amplifier may be "ON" or "OFF". Enumerated data is represented by a single byte in the message body. Each possible state is represented by a different value byte. Usually the ASCII code for "0" (**30**) is used to represent NO, OFF, FALSE, etc. and the ASCII code for "1" (**31**) is used to represent YES, ON, TRUE, etc. Other codes may represent other conditions, such as "?" (**3F**) for "unknown".

In cases where more than one enumerated value is sent, each value is represented by a single byte, with no delimiter between them.

In the message summary tables, the following codes are used to represent enumerated data in the message body:

B_i	A single enumerated value

A brief description of the possible values for each byte will follow.

2.3.3 Bit Data

Groups of flags representing simple YES/NO or TRUE/FALSE data are sometimes passed as bits in a single byte. Because the protocol does not allow certain bytes in the message body (including **02**, which starts a message, **03** which ends a message, and **2A** which terminates the message body) bit data is sent in the least significant six bits of a byte, with the most significant two bits being 0 and 1 (bit 7 is 0).

In cases where more than six bits are needed, more bytes are sent, with no delimiters between them.

In the message summary tables, the following codes are used to represent bit data in the message body:

$01b_5b_4b_3b_2b_1b_0$ $0100b_9b_8b_7b_6$	Two bytes containing 10 flag bits

Brief descriptions of the meanings of each bit when it is SET will follow.

2.3.4 String Data

Text data, such as the version and mask number, will be returned as a string of ASCII characters. Note that the asterisk ("*", ASCII code **2A**) is not allowed as part of the text, as it would terminate the message body.

In the message summary tables, the following codes will be used to represent string data in the message body:

"*descriptive_text*"

Note that the quotation marks are NOT sent. The *descriptive_text* will identify the data returned in the string.

2.4 Message Summary Tables

All messages are represented here, and are divided into three types. *BASIC OPERATIONAL MESSAGES* (Table 2-1) are the messages required to perform the basic operations in the controller, and to read back basic information. *EXTENDED OPERATIONAL MESSAGES* (Table 2-2) are more advanced messages, to obtain more detailed information from the unit, or to send "housekeeping" commands that are not necessary to the basic functioning of the unit.

Table 2-1 BASIC OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
Status Messages			
20	Unit Status	No message body	01 $b_5 b_4 b_3 b_2 b_1 b_0$ 01 $b_{11} b_{10} b_9 b_8 b_7 b_6$ 01 $b_{17} b_{16} b_{15}$ 0 $b_{13} b_{12}$ 01 00 $b_{21} b_{20} b_{19} b_{18}$ b_0: UNIT 1 or UNIT 1, POL 1 fault b_1: UNIT 2 or UNIT 2, POL 1 fault b_2: UNIT 3 or UNIT 1, POL 2 fault b_3: UNIT 2, POL 2 fault b_4: Power supply 1 fault b_5: Power supply 2 fault b_6: Controller fault b_7: Remote Mode b_8: Auto Mode $b_{10} b_9$: POL2,POL1 Switch position (0=primary, 1=standby) b_{11}: Switch in progress (POL1 or POL2) b_{12}: RC Panel Lockout b_{13}: **FUTURE USE** Switch in progress (AUX1 or AUX2) $b_{16} b_{15}$: POL2,POL1 Switch position known b_{17}: Tracking unit fault $b_{19} b_{18}$: **FUTURE USE** AUX2,AUX1 Switch position known $b_{21} b_{2-}$: **FUTURE USE** AUX2,AUX1 Switch position
Control Messages			
18 40	Redundancy Mode	None	B_{MODE}= **30** for MANUAL **31** for AUTO
	TO SET:	B_{MODE}: As above	No response
Command Messages			
19 40	Switch Control	$B_{POL1}[B_{POL2}]$ B_{POLn}= **30** no change **31** Primary unit **32** Standby unit	No Response

Table 2-2 EXTENDED OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
Status Messages			
07	Get Unit Type	None	B_{TYPE} = **32** for RSC controller
08	Get Faults	None	0100$b_{L3}b_{L2}b_{L1}$0 0100$b_{A3}b_{A2}b_{A1}$0 b_{L3}: Latched controller fault b_{L2}: Latched unit current fault b_{L1}: Latched external fault b_{A3}: Active controller fault b_{A2}: Active unit current fault b_{A1}: Active external fault
16 40	Get Unit Currents	None	N_1,N_2[,N_3[,N_4[,N_5]]] Current reading for each configured unit, in mA
16 41	Get Power Supply Voltages	None	N_{PS1},N_{PS2} Voltage reading for each power supply, in volts.
16 42	Get External Fault Inputs	None	01 b_{L6} b_{L5} b_{L4} b_{L3} b_{L2} b_{L1} 01 b_{A5} b_{A5} b_{A4} b_{A3} b_{A2} b_{A1} 010 b_{L8} b_{L7} 0 b_{A8} b_{A7} b_{Ln}: Latched external alarm input b_{An}: Active external alarm input
16 43	Get Unit Current Settings & Window Width	None	N_1,N_2[,N_3[,N_4[,N_5]]],N_{WIDTH} Nominal current for each configured unit, in mA. Width is average width for all units, since actual window is a percentage of nominal.

Table 2-2 EXTENDED OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
16 44	Get Configuration	None	$B_7B_6B_5B_4B_3B_2B_1B_0$ $B_{15}B_{14}B_{13}B_{12}B_{11}B_{10}B_9B_8$ B_7: Priority POL (1:2 only) **30** None (or not 1:2) **31** POL 1 **32** POL 2 B_6: Latch Faults (**30** N, **31** Y) B_5: REMOTE disables LOCAL (**30** N, **31** Y) B_4: AUTO disables MANUAL (**30** N, **31** Y) B_3: Any Internal alarms enabled (**30** N, **31** Y) B_2: Any External faults enabled (**30** N, **31** Y) B_1: Controller type **31** 1:1 **32** 1:2 **33** DUAL 1:1 **34** 1:2 w/ TRACKING UNIT B_0: Noise diode 1 (**30** N, **31** Y) B_{15}: Auto Revert (**30** N, **31** Y) B_{14}: Remote Control Panel detected (**30** N, **31** Y) B_{13}: Noise diode 2 (**30** N, **31** Y) B_{12}: Tracking unit configured (**30** N, **31** Y) B_{11}: Parallel IO present (**30** N, **31** Y) B_{10}: Channel preference, POL1 **30** None (or not 1:1 or dual 1:1) **31** unit 1 **32** unit 2 B_9: Channel preference, POL2 **30** None (or not dual 1:1) **31** unit 1 **32** unit 2 B_8: Audible alarm enabled (**30** N, **31** Y)
16 45	Get Firmware Version Information	None	"*mask_num version_num*" (single space between mask and version numbers)
16 46	Get Controller Fault Codes	None	B_{CONTR}… = specific controller fault code(s) in a list (see description in text)

Table 2-2 EXTENDED OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
Configuration Messages			
17 41	Remote Disables Local & Auto / Manual	None	B_{RDL} B_{ADM} **30** off **31** on
17 41	TO SET:	B_{RDL} [B_{ADM}] : as above	No Response
17 42	**RSC-1200:** Auto Revert & Priority Channel -or- **RSC-1100 or –1111:** Auto Revert & Channel Preference	None	$B_{AUTOREVERT}$ B_2 [B_3] **RSC-1100:** 2 bytes $B_{AUTOREVERT}$: Auto Revert (**30** off, **31** on) B_2 : Channel Preference, POL1 (**30** None, **31** Unit 1, **32** Unit 2) **RSC-1111:** 3 bytes $B_{AUTOREVERT}$: Auto Revert (**30** off, **31** on) B_2 : Channel Preference, POL1 (**30** None, **31** Unit 1, **32** Unit 2) B_3 : Channel Preference, POL2 (**30** None, **31** Unit 3, **32** Unit 4) **RSC-1200:** 2 bytes $B_{AUTOREVERT}$: Auto Revert (**30** off, **31** on) B_2 : Priority Channel (**30** None, **31** POL 1, **32** POL 2)

Table 2-2 EXTENDED OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
17 42	TO SET:	$B_{AUTOREVERT}$ [B_2][B_3] **RSC-1100:** $B_{AUTOREVERT}$: Auto Revert **30** off **31** on B_2 : Pol 1 Channel Preference **30** Off **31** Unit 1 **32** Unit 2 **RSC-1111:** $B_{AUTOREVERT}$: Auto Revert **30** off **31** on B_2 : Pol 1 Channel Preference **30** Off **31** Unit 1 **32** Unit 2 B_2 : Pol 2 Channel Preference **30** Off **31** Unit 3 **32** Unit 4 **RSC-1200:** $B_{AUTOREVERT}$: Auto Revert **30** off **31** on B_1 : Priority Channel **30** Off **31** POL 1 **32** POL 2	No Response

Table 2-2 EXTENDED OPERATIONAL MESSAGES

Instr/ Sub-instr	Description	Parameters Received	Parameters Sent
17 43	Latch Faults & Internal / External Fault Enable	None	$B_{LATCH\ FAULTS}$ 01 0 b_{I5} b_{I4} b_{I3} b_{I2} b_{I1} 01 b_{E6} b_{E5} b_{E4} b_{E3} b_{E2} b_{E1} 01 0 0 0 0 b_{E8} b_{E7} $B_{LATCH\ FAULTS}$ **30** off **31** on b_{Ix} : Internal Fault enable X (1 = on) b_{Ey} : External Fault enable Y (1 = on)
17 43	TO SET:	$B_{LATCH\ FAULTS}$ 01 0 b_{I5} b_{I4} b_{I3} b_{I2} b_{I1} 01 b_{E6} b_{E5} b_{E4} b_{E3} b_{E2} b_{E1} 01 0 0 0 0 b_{E8} b_{E7} as above	No Response
17 44	Unit Current Window	None	B_{WINDOW} B_{WINDOW} **30:** ±5% of nominal setting **31:** ±10% **32:** ±15% **33:** ±20% **34:** ±25%
17 44	TO SET:	B_{WINDOW} : as above	No Response
Control Messages			
0E	Local Lockout	None	B_{LLO} = **30** Local enabled **31** Local Lockout
0E	TO SET:	B_{LLO}: As above	No Response
18 41	Control Noise Diodes	None	B_{DIODE1} [B_{DIODE2}] **30** off **31** on
18 41	TO SET:	B_{DIODE1} [B_{DIODE2}]: As above	No Response
Command Messages			
04	Reset Controller	None	No Response
09	Clear Service Request	None	No Response
0A	Reset Latched Faults	None	No Response
0B	Run Internal Diagnostic Tests	None	No Response
19 41	**FUTURE USE** Switch AUX	B_{AUX1}[B_{AUX2}] B_{AUXn}= **30** no change **31** Primary unit **32** Standby unit	No Response

3. Message Details

3.1 Reset (04)

This command forces a reset of the microprocessor in the addressed controller. If this command is sent with an ACK request, the unit will send its ACK response first, and then reset. Otherwise, there is no response to a RESET command.

Normally, a spurious reset would be reported as a controller fault. If the reset is due to this command being sent, however, a controller fault will not be reported.

Example, RESET command to unit with ACK request:

SEND TO UNIT: **02 06 01 44 45 03**
UNIT RESPONDS: **02 06 01 3F 40 03** (then RESETS)

While the unit resets, no serial I/O communications will be possible.

This command is ignored in LOCAL mode.

3.2 Module Type (07)

This message requests the module type information from the unit. The controller will return a message with module type '2' (**32**).

3.3 Get Faults (08)

There are two sets of flags maintained for all faults detected by this unit. Each bit in the set of flags represents one possible fault condition. One set of flags is called the Latched Faults, in which a bit being set means that the indicated condition has occurred since the last time faults were reset.

The second set of flags is called the Active Faults, in which a bit set means the indicated condition still exists. Bits in the Latched Faults are reset by the Reset Latched Faults command (see Section 3.5).

Both sets of flags are returned by this message. Two bytes containing bit data are returned. The first byte contains the Latched Faults, and second contains the Active Faults. The bytes are in the format:

$0\ 1\ 0\ b_{L4}\ b_{L3}\ b_{L2}\ b_{L1}\ 0$ $0\ 1\ 0\ b_{A4}\ b_{A3}\ b_{A2}\ b_{A1}\ 0$

Where:

b_{L4}: Latched external fault 6,7,8 (auxiliary external faults)
b_{L3}: Latched controller fault
b_{L2}: Latched unit current fault
b_{L1}: Latched external fault 1-5

b_{A4}: Active external fault 6,7,8 (auxiliary external faults)
b_{A3}: Active controller fault
b_{A2}: Active unit current fault
b_{A1}: Active external fault 1-5

Faults are always latched in the Latched Faults, even if configuration settings call for non-latched faults. These bits are set so that you can detect faults, even if you do not used latched faults in the controller. Your software may ignore the latched bits, if you wish.

3.4 Clear Service Request (09)

This command clears a service request, and causes the service request contacts on the serial I/O connector to stop indicating a fault condition. The service request contacts will then remain in their non-fault state unless a new fault occurs.

This command differs from the Reset Latched Faults command. This command does not attempt to clear any faulting conditions. It simply causes the service request to stop being reported, so the host does not have to keep responding to an un-clearable fault condition.

The service request contacts can also be cleared by sending a Reset Latched Faults instruction (see section 3.5), if no faulting condition still exists.

Note that this command will operate in Local mode.

3.5 Reset Latched Faults (0A)

This message is used to reset ALL latched faults being reported by the unit. Note that if any alarming condition still exists, the fault will not be cleared.

If certain controller faults exist when this command is received, a self-test will automatically be run before clearing faults. Since the self-test delays operation of the controller's logic for a few seconds, do not issue this command repeatedly while controller fault exists.

There are no parameters with this command. If no fault condition still exists, the service request contacts will also be cleared.

This command will be ignored in LOCAL mode.

3.6 Run Internal Diagnostic Tests (0B)

This command runs the microprocessor diagnostic tests that are normally run on power-up. Any failure will be reported as a controller fault by the normal fault reporting mechanisms. The self tests may take a few seconds to run.

Many controller operations will be suspended during self tests, and the self tests may interfere with normal operation of the controller. Make sure that this command is not issued frequently, and only when the system can tolerate disturbances to unit power, parallel IO, serial IO, etc.

This command will be ignored in LOCAL mode.

3.7 Local Lockout (0E)

This message returns the state of the Local Lockout feature or turns the feature on or off. When Local Lockout is turned ON, the operator will not be able to operate the controller from the front panel. Only the Panel Test button will be operable. The REMOTE LED will blink to indicate that Local Lockout is turned ON.

When this message is sent with no parameters, it returns the state of the Local Lockout feature. It returns one byte which is an enumerated value:

30: Local Lockout OFF
31: Local Lockout ON (front panel controls disabled)

When this message is sent with one parameters, it turns the Local Lockout feature on or off. The one byte parameter is an enumerated value:

30: Turns Local Lockout OFF
31: Turns Local Lockout ON (front panel controls disabled)

In LOCAL mode, this command can read the state of Local Lockout, but it cannot turn Local Lockout on or off.

3.8 Measured Parameter Data Query (16 xx)

The message from the controller to the unit must contain a message body, with two bytes as follows:

... XX 2A ...

where **XX** is the sub-instruction code that identifies which measured parameter is being requested, and **2A** is the required asterisk terminating the message body. Any sub-instruction code not listed below will result in the entire message being ignored.

The response from the unit will have the same instruction code (**16**), and will contain a message body whose first byte is the same sub-instruction code. The rest of the message body will contain the data requested by the sub-instruction code.

*3.8.1 UNIT Currents (**16 40**)*

A current measurement for each unit is returned as an unsigned analog value. The number of values returned depends upon the controller type and whether a tracking unit is configured.

- 1:1 controllers return two values, for the currents of UNIT 1 and UNIT 2 respectively.
- 1:2 controllers return 3 analog values, representing the currents of UNIT 1, UNIT 2, and UNIT 3 (the standby unit).
- Dual 1:1 controllers return four analog values, representing the currents of UNIT 1 POL 1, UNIT 2 POL 1, UNIT 1 POL 2, and UNIT 2 POL 2.

If a tracking unit is configured, an additional measurement for that unit will be appended to the other unit measurements.

Currents are measured from nominally 0 to 1000 mA, in 1 mA steps. Currents are represented in milliamps.

*3.8.2 Power Supply Voltages (**16 41**)*

The voltages of the two power supplies, as measured on the logic board are returned as two analog values.

Power supply voltages are measured from nominally 0 to 25.6 volts, in 0.01 volt steps. Voltages are represented in volts.

*3.8.3 External Fault Input Status (**16 42**)*

Three bytes are returned, containing bit data which represents the latched and present states of external fault inputs. A bit set indicates the input is in its faulted state, or not connected to ground. A bit cleared indicates the input is in its unfaulted state, or closed to ground.

The bytes are in the format:

$01\ b_{L6}\ b_{L5}\ b_{L4}\ b_{L3}\ b_{L2}\ b_{L1}$ $01\ b_{A5}\ b_{A5}\ b_{A4}\ b_{A3}\ b_{A2}\ b_{A1}$ $010\ b_{L8}\ b_{L7}\ 0\ b_{A8}\ b_{A7}$

Where:

b_{LX}: Latched external fault X

b_{AY}: Active external fault Y

The Reset Latched Faults message (section 3.5) will clear the latched fault bits.

If external faults are disabled in the configuration, the eight external inputs can be used as general purpose indicators. The latched function still operates.

When external faults are enabled, the first two to five inputs map to UNIT faults depending on controller type and whether a tracking unit is configured. This is shown in the table below.

	Controller Model and Type		
External Alarm Input	RSC-1100, 1:1	RSC-1200, 1:2	RSC-1111, DUAL 1:1
1	Unit 1	Unit 1	Pol 1, Unit 1
2	Unit 2	Unit 2	Pol 1, Unit 2
3	unused	Unit 3	Pol 2, Unit 1 (Unit 3)
4	unused	unused	Pol 2, Unit 2 (Unit 4)
5	Tracking unit *	Tracking unit *	Tracking unit *
	(*) if Tracking unit configured		

This function reports the states of all eight external inputs, regardless of controller type configured.

*3.8.4 UNIT Current Settings and Window Width (**16 43**)*

An analog value representing each UNIT's nominal current setting is returned, followed by an analog value representing the current-window width. All currents are represented in milliamps.

The nominal current setting of each unit is the current measured when a unit is calibrated by pressing the SHIFT button and then the unit's button.

The current-window width returned is an average for all configured units. The actual current window for each unit is a percentage of that unit's nominal current setting. The percentage is determined by a configuration setting, and is the same for all units.

Values are returned in the following order, depending on controller type:

1:1	UNIT 1, UNIT 2, Average window width
1:2	UNIT 1, UNIT 2, UNIT 3, Average window width
DUAL 1:1	Pol 1 Unit 1, Pol 1 Unit 2, Pol 2 Unit 1, Pol 2 Unit 2, Average window width

*3.8.5 Configuration (**16 44**)*

The controller's configuration is returned as a sequence of enumerated values as described in the following sections.

3.8.5.1 Priority Channel

Indicates if a priority channel (Pol) has been selected in 1:2 controllers. The priority channel is the Pol to which the standby Unit will be switched if faults occur on both Units 1 and 2. If no priority channel is selected, the first Unit to fault will get the standby Unit.

30 = No priority channel, or not 1:2 controller
31 = Pol 1 is priority
32 = Pol 2 is priority

3.8.5.2 Latched Faults

Indicates whether faults are latched in the system. If faults are latched and an UNIT fault is reported, it will continue to be treated as faulted, even if the condition goes away. The unit will not be considered "un-faulted" until the condition is fixed and faults are reset by the operator.

30 = Faults are not latched
31 = Faults are latched

3.8.5.3 Remote Disables Local

Indicates whether selecting REMOTE mode on the front panel controls disables LOCAL controls.

30 = REMOTE does NOT disable LOCAL controls
31 = REMOTE disables LOCAL controls

3.8.5.4 Auto Disables Manual

Indicates whether selecting AUTO mode (from front panel or via remote control) disables MANUAL controls. In AUTO mode, a bad UNIT will never be switched on-line, regardless of this setting. This setting determines whether any UNIT switch commands will be accepted when the controller is in AUTO mode.

30 = AUTO does NOT disable MANUAL controls
31 = AUTO disables MANUAL controls

3.8.5.5 Internal Faults Enabled

Indicates whether <u>any</u> internal faults are enabled as UNIT faults.

An internal fault is defined as a UNIT current which measures outside of its configured window. When an internal fault is enabled and becomes active, it is reported as a UNIT fault, and can cause the controller to switch the faulted unit off-line if in AUTO mode.

NOTE: This command is included for compatibility. Individual internal faults can be enabled and disabled, and their settings read, via the configuration instructions.

30 = all internal faults disabled
31 = one or more internal faults enabled

3.8.5.6 External Faults Enabled

Indicates whether <u>any</u> external fault inputs are enabled.

An external fault is defined as an external fault input which is not connected to ground. When an external fault is enabled and becomes active, it is reported as a UNIT fault, and can cause the controller to switch the faulted unit off-line if in AUTO mode.

NOTE: This command is included for compatibility. Individual external faults can be enabled and disabled, and their settings read, via configuration instructions.

30 = all External faults disabled
31 = one or more External faults enabled

3.8.5.7 Controller Type

Identifies the controller type which is configured. If the configuration cannot be detected or is a type not specified here, it will appear as unknown.

31 = 1:1
32 = 1:2
33 = Dual 1:1
34 = 1:2 with Tracking Unit configured
3F = Unknown

Note: Other types may be added in the future.

3.8.5.8 Noise Diode 1

Indicates whether noise diode 1 is present. The state of noise diode power can be queried and controlled using Control Message **18 41**.

30 = Noise diode 1 control not present
31 = Noise diode 1 control present

3.8.5.9 Auto Revert Enabled

Indicates whether the Auto Revert function is enabled.

30 = Auto revert disabled
31 = Auto revert enabled

3.8.5.10 Remote Control Panel detected

Indicates whether a remote control panel is detected. The RCP will not be considered detected unless it is both connected and operating properly.

30 = No remote control panel detected
31 = Remote control panel detected

3.8.5.11 Noise Diode 2

Indicates whether noise diode 2 is present. The state of noise diode power can be queried and controlled using Control Message **18 41**.

30 = Noise diode 2 control not present
31 = Noise diode 2 control present

3.8.5.12 Tracking Unit

Indicates whether a tracking unit is configured.

30 = No tracking unit configured
31 = Tracking unit is configured

3.8.5.13 Parallel IO

Indicates whether a parallel IO option is detected.

30 = Parallel IO not detected
31 = Parallel IO is detected

3.8.5.14 Channel Preference, Pol 1

Indicates if a channel preference has been selected for Pol 1 of a 1:1 or dual 1:1 controller. The channel preference indicates which Unit gets placed online if faults occur on both Units. If no channel preference is selected, the last Unit to fault will be left online.

30 = No channel preference, or not a 1:1 or dual 1:1 controller
31 = POL 1 is channel preference
32 = POL 2 is channel preference

3.8.5.15 Channel Preference, Pol 2

Indicates if a channel preference has been selected for Pol 2 of a dual 1:1 controller. The channel preference indicates which Unit gets placed online if faults occur on both Units. If no channel preference is selected, the last Unit to fault will be left online.

30 = No channel preference, or not a dual 1:1 controller
31 = Main (Unit 3) is channel preference
32 = Standby (Unit 4) is channel preference

3.8.5.16 Audible Alarms

Indicates if audible alarms are enabled. When audible alarms are enabled, a controller fault will cause an alarm beeper to sound.

If Latched Faults are enabled, the alarm will sound until:
- a front panel key is pressed
- a remote control panel key (if present) is pressed
- a Reset Latched Faults serial io message is sent, and the fault is no longer present

If Latched Faults are disabled, the alarm will sound until:
- **the fault goes away**
- a front panel key is pressed
- a remote control panel key (if present) is pressed

When Audible Alarms are enabled, the beeper will also sound briefly at the conclusion of a Panel Test.

The Audible Alarm setting is transferred to the Remote Control Panel (RCP) whenever a valid link exists between the RSC and RCP.

30 = Audible alarms are not enabled
31 = Audible alarms are enabled

3.8.5.17 Future Expansion

Additional configuration data may be added in future versions. User programs should allow for this.

3.8.6 Firmware Version Information (**16 45**)

The mask number and version of the firmware installed in the unit are returned as two ASCII strings, separated by a space (**20**). The length of the mask number and version number are variable.

Example, mask number is "021A" and version number is "2.01":

SEND TO UNIT: **02 08 01 16 45 2A 98 03**

UNIT RESPONDS: **02 11 01 16 45 30 32 31 41 20 32 2E 30 31 2A 4D 03**

*3.8.7 Controller Fault Codes (**16 46**)*

Enumerated values are returned, one for each controller fault that has been detected. If no controller faults are presently detected, **30** (NONE) is returned. Controller fault codes are cleared by issuing a Run Internal Diagnostic Test command (section 3.6), or a Reset Latched Faults (section 3.5) command.

The following is a list of codes that can be returned:

30	No Controller Fault
31	ROM Checksum Test Failed
32	RAM test failed
33	EEPROM Data Checksum Bad
34	EEPROM Write Failed
35	Invalid or Spurious Interrupt
36	Spurious Reset
37	Stack Overflow
38	Reset Circuit Failure
39	Controller Type Unknown
3A	Low Power Supply Voltage
3B	Switch Attempt Failed
3C	Switch Position Unknown
3D	Drive Circuitry Test Failed

NOTE: Other fault code values may be added in future versions.

3.9 Configuration (17 xx)

Configuration messages are used to configure options of the controller and query the states of options. There are no configuration jumpers for setting options: all configuration is done in software, either through serial IO or front panel functions.

In general, configuration commands can be one of two forms. The first form queries the value of a particular setting. The second will set the value of that setting.

The message body used to query a value is as follows:

... XX 2A ...

where **XX** is the sub-instruction, and **2A** is the required terminator to the message body.

The unit will respond with a message containing the same instruction code and sub-instruction, and a message body that contains data in the same format used to set the values.

The message body used to set a value is as follows:

... XX (sub-instruction data format) **2A ...**

where **XX** is the sub-instruction, and **2A** is the required terminator to the message body. The data format depends on the sub-instruction.

Unless an ACK is requested in the instruction byte, there will be no response to a message with this format. It is recommended that an ACK request be sent with messages with this format, to verify that the unit "heard" you. If there is no immediate response, then either there was a communication error, or something was wrong with the message format.

3.9.1 *Configure Remote Disables Local / Auto Disables Manual (**17 41**)*

This message can be used to read or control the states of Remote Disables Local and Auto Disables Manual features.

When used with no parameters, this function returns the configuration of the Remote Disables Local function and Auto Disables Local function by way of two bytes in the format:

B_{RDL} B_{ADM} where the bytes are enumerations with the meanings:

B_{RDL}

30 = Remote Disables Local function is disabled
31 = Remote Disables Local function is enabled

B_{ADM}

30 = Auto Disables Manual function is disabled
31 = Auto Disables Manual function is enabled

If the function is sent with one or more byte parameters, the first parameter sets the configuration of the Remote Disables Local function as follows:

30 = Remote Disables Local function is disabled
31 = Remote Disables Local function is enabled

CAUTION! When Remote Disables Local is enabled using this message, front panel controls will be immediately disabled, since the controller must already be in Remote mode for this message to have effect.

If the function is sent with two byte parameters, the second parameter sets the configuration of the Auto Disables Manual function as follows:

30 = Auto Disables Manual function is disabled
31 = Auto Disables Manual function is enabled

In LOCAL mode, the configuration can be queried by this message, but not changed. Switch to REMOTE mode to change configuration using this message.

3.9.2 *Configure Auto Revert / Priority Channel / Channel Preferences (**17 42**)*

When used with no parameters, this function returns the configuration of the Auto Revert function, followed by the Priority Channel or Channel Preferences, depending on controller type. The configuration in returned in the format:

$B_{AUTO\text{-}REVERT}$ / B_2 [B_3]

For all controller models, the first byte returned indicates the configuration of the Auto Revert function as follows:

30 = Auto Revert disabled
31 = Auto Revert enabled

For a 1:2 controller, the second byte returned indicates the Priority Channel configuration:

30 = No Priority Channel
31 = Priority Channel is Pol 1
32 = Priority Channel is Pol 2

For a 1:1 or dual 1:1 controller, the second byte returned indicates the Channel Preference for Pol1 as follows:

30 = No Channel Preference
31 = Channel Preference is UNIT 1
32 = Channel Preference is UNIT 2

For a dual 1:1 controller a third byte is returned, indicating the Channel Preference for Pol2 as follows:

30 = No Channel Preference
31 = Channel Preference is UNIT 3
32 = Channel Preference is UNIT 4

When used with parameters, the function sets the configuration of the Auto Revert function, Priority Channel (for a 1:2 controller), and Channel Preferences (for a 1:1 or dual 1:1 controller). The parameters are passed in the format:

$B_{AUTOREVERT}\ B_2\ [\ B_3\ ]$

If only the first byte is sent, it configures the Auto Revert function:

30 = Auto Revert disabled
31 = Auto Revert enabled, Priority Channel is Pol 1
32 = Auto Revert enabled, Priority Channel is Pol 2

For a 1:2 controller, if a second byte it sent, it configures the Priority Channel:

30 = No Priority Channel
31 = Priority Channel is Pol 1
32 = Priority Channel is Pol 2

For a 1:1 controller, if a second byte parameter is sent, it sets the Channel Preference for Pol 1:

30 = No Channel Preference
31 = Channel Preference is UNIT 1
32 = Channel Preference is UNIT 2

For a dual 1:1 controller, if second and third byte parameters are sent, they set Channel Preference for Pol 1:

30 = No Channel Preference
31 = Channel Preference is UNIT 1
32 = Channel Preference is UNIT 2

and Channel Preference for Pol 2:

30 = No Channel Preference
31 = Channel Preference is UNIT 3
32 = Channel Preference is UNIT 4

In LOCAL mode, the configuration can be queried by this message, but not changed. Switch to REMOTE mode to change configuration using this message.

*3.9.3 Configure Latched Faults and Enable Internal / External Alarms (**17 43**)*

When used with no parameters, this function returns the configuration of Latched Faults and Internal/External Alarms by way of four bytes in the format:

$B_{\text{LATCH FAULTS}}$ 010 b_{I5} b_{I4} b_{I3} b_{I2} b_{I1} 01 b_{E6} b_{E5} b_{E4} b_{E3} b_{E2} b_{E1} 010000 b_{E8} b_{E7}

The first bytes indicates the configuration of Latched Faults as follows:

30 = Latched Faults are disabled
31 = Latched Faults are enabled

The following three bytes indicate configuration of Internal and External Alarms as follows:

b_{Ix} : Internal alarm X

0 = Corresponding internal UNIT alarm is disabled
1 = Corresponding internal UNIT alarm is enabled

b_{EY} : External alarm input Y

0 = Corresponding external alarm input is disabled
1 = Corresponding external alarm input is enabled

When the function is used with one or more parameters, the first byte configures Latched Faults as follows:

30 = Latched Faults are disabled
31 = Latched Faults are enabled

When three additional bytes are sent, they configure Internal and External Alarms according to the scheme shown above.

In LOCAL mode, the configuration can be queried by this message, but not changed. Switch to REMOTE mode to change configuration using this message.

External alarms which are not enabled may still be used as external status inputs. They can be read using the Get External Alarm Inputs command, 16 42.

*3.9.4 Configure Unit Current-Window Width (**17 44**)*

When used with no parameters, this function returns a byte which is an enumated value representing the configuration of the Current-Window Width, where:

30 = ± 5% of nominal current
31 = ± 10% of nominal current
32 = ± 15% of nominal current
33 = ± 20% of nominal current
34 = ± 25% of nominal current

The same window width (in percent) is used for all units.

If the function is sent with one byte parameter, that parameter sets the configuration of the Current-Window Width according to the values listed above.

In LOCAL mode, the configuration can be queried by this message, but not changed. Switch to REMOTE mode to change configuration using this message.

When this function is executed, each unit's current-window limits are immediately re-calculated, based on their nominal current settings at that time.

3.10 Control (18 xx)

The CONTROL message can be used to set or query the state of various controls on the unit. Control messages can either control a setting or read the setting back.

In general, commands sent to the unit can be one of two forms. The first form will query the value of a particular setting. The second will set the values.

The message body used to query a value is as follows:

... XX 2A ...

where **XX** is the sub-instruction, and **2A** is the required terminator to the message body.

Units will respond with a message containing the same instruction code and sub-instruction, and a message body that contains the data in the same format which is used to set the values.

The message body used to set a value is as follows:

... XX (sub-instruction data format) **2A ...**

where **XX** is the sub-instruction, and **2A** is the required terminator to the message body. The data format depends on the sub-instruction.

Unless an ACK is requested in the instruction byte, there will be no response to a message with this format. It is recommended that an ACK request be sent with messages with this format, to verify that the unit "heard" you. If there is no immediate response, then either there was a communication error, or something was wrong with the message format.

*3.10.1 Redundancy Mode (**18 40**)*

This message controls the controller's operating mode. A single enumerated value is sent or returned:

30: MANUAL mode
31: AUTO mode

The setting of this control can be queried but not changed if the unit is in LOCAL mode.

In MANUAL mode, UNITs are never switched by the controller in response to fault conditions, and UNITs are only switched on-line or off-line by manual commands (LOCAL mode), or parallel I/O and serial I/O commands (REMOTE mode).

In AUTO mode, faulted UNITs are automatically switched off-line, and replaced with non-faulted standby UNITs, if available. MANUAL UNIT switching controls (front panel buttons, parallel I/O inputs, and the serial I/O Switch UNITs command) are ignored if AUTO disables MANUAL is configured.

*3.10.2 Noise Diode 1 / 2 (**18 41**)*

The message controls noise diode power, or returns the state of noise diode power.

Sending the command with no parameters returns a byte representing the state of power for each configured noise diode. Zero, one, or two bytes can thus be returned, depending on the number of noise diodes configured. The bytes are enumerated values as described below.

30: Noise diode OFF
31: Noise diode ON

Sending the command with one or two parameters controls power to configured noise diodes. The first byte sent controls power to noise diode 1. If a second byte is sent with noise diode 2 configured, that byte will control power to noise diode 2. Each byte sent is an enumerated value as described below.

30: Noise diode OFF
31: Noise diode ON

In LOCAL mode, the setting of noise diode power can be queried but not changed.

3.11 Command (19)

The COMMAND instruction allows various operational functions to be carried out, such as switching UNITs. There is no response to a COMMAND instruction, unless an ACK response is requested. It is strongly recommended that the COMMAND instruction be sent with an ACK response, so that you can verify that the unit got the message.

*3.11.1 Switch Control **(19 40)***

This command controls the UNIT switch. In AUTO mode, the UNIT switch will not always end up in the commanded position, as a faulted UNIT will not be allowed ON-LINE, if avoidable.

If a command is issued that would switch a faulted UNIT on-line, the command will be acknowledged (if an ACK request is sent) but the message will be ignored. You can use the Unit Status message to identify whether a switch cycle is complete, and whether the switch ended up where you intended.

The command has one or two parameters. For 1:1 controllers only one parameter needs to be sent. The second parameter, if any will be ignored. The parameter is a single enumerated value:

30: Leave this POL unchanged, if possible
31: Switch POL 1 to Main UNIT
32: Switch POL 1 to Standby UNIT

For 1:2 or Dual 1:1 controllers, two parameters are sent to the unit. The first controls which UNIT should be switched on POL 1, the second controls which UNIT should be switched on POL 2.

30: Leave this POL unchanged, if possible
31: Switch POL 2 to Main UNIT
32: Switch POL 2 to Standby UNIT

In 1:2 systems, UNIT 3 is the Standby UNIT for both POLs.

In 1:2 systems, the combination **32 32** will cause the UNIT controller to switch the UNITs into a normally unused state, with POL 1 on UNIT 3 and POL 2 on UNIT 1 (UNIT 2 will be off-line).

This command will be ignored in LOCAL mode. This command will also be ignored in AUTO mode if AUTO DISABLES MANUAL is configured. This command will be ignored in AUTO mode if the commanded switch would put a faulted UNIT on-line.

3.11.2 (FUTURE USE) AUX Switch Control (19 41)

This command controls an Auxiliary (AUX) switch or switches. Note that the switch may not always end up in the commanded position.You can use the Unit Status message to identify whether a switch cycle is complete, and whether a switch ended up where you intended.

The command has one or two parameters, which are enumerated values:

30: No change to Aux 1
31: Switch Aux 1 to Main
32: Switch Aux 1 to Standby

30: No change to Aux 2
31: Switch Aux 2 to Main
32: Switch Aux 2 to Standby

This command will be ignored in LOCAL mode. This command will also be ignored in AUTO mode if AUTO DISABLES MANUAL is configured.

3.12 Unit Status (20)

This message requests the major information from the unit in the form of bit flags. The data is returned as three bytes in the message body. The most significant two bits in each byte will be '0' and '1' respectively. The remaining six bits in each of the two bytes will contain the data.

FIRST BYTE	SECOND BYTE	THIRD BYTE	FOURTH BYTE
0 1 b_5 b_4 b_3 b_2 b_1 b_0	0 1 b_{11} b_{10} b_9 b_8 b_7 b_6	0 1 b_{17} b_{16} b_{15} 0 b_{13} b_{12}	0 1 0 0 b_{21} b_{20} b_{19} b_{18}

Each bit is a flag indicating the following conditions, if set:

b_0 Unit 1 fault, or Pol 1 Unit1 fault in Dual 1:1 controllers
b_1 Unit 2 fault, or Pol 1 Unit 2 fault in Dual 1:1 controllers
b_2 Unit 3 fault in 1:2 controllers, or Pol 2 Unit 1 fault in Dual 1:1 controllers
b_3 Pol 2 Unit 2 fault in Dual 1:1 controllers
b_4 Power Supply 1 fault
b_5 Power Supply 2 fault

b_6 Controller fault
b_7 Remote mode
b_8 Auto mode
$b_{10}b_9$ Switch positions, Pol 2 / Pol 1 (see tables below)
b_{11} Switch in progress on Pol 1 or Pol 2

b_{12} Remote Panel Lockout
b_{13} Future use: Switch in progress on Aux 1 or Aux 2
$b_{16}b_{15}$ Switch positions known, b_{16} for Pol 2, b_{15} for Pol 1
b_{17} Tracking unit fault

$b_{19}b_{18}$ Future use: Switch position(s) known, b_{19} for Aux 2, b_{18} for Aux 1
$b_{21}b_{20}$ Future use: Switch positions, Aux 1 / Aux 2: b_{21} for Aux 2, b_{20} for Aux 1

Any UNIT fault bits which are not used in a particular type of controller will be 0.

Bits b_{10} and b_9 indicate the switch positions for Pol 1 and (if used) Pol 2. Bit b_9 represents POL 1, and bit b_{10} represents POL 2. In general, a bit set to 0 means the primary UNIT is on that POL, and bit set to 1 means the standby UNIT is on that POL.

1:1 CONTROLLER: (bit b_{10} is not used)
b_9=0 UNIT 1 ON-LINE
b_9=1 UNIT 2 ON-LINE

1:2 CONTROLLER:

b_{10}	b_9	POL 2	POL 1
0	0	UNIT 2	UNIT 1
0	1	UNIT 2	UNIT 3
1	0	UNIT 3	UNIT 1
1	1	UNIT 1	UNIT 3

DUAL 1:1 CONTROLLER:
b_9 indicates which UNIT is ON-LINE for POL 1 (as per 1:1 CONTROLLER)
b_{10} indicates which UNIT is ON-LINE for POL 2 (as per 1:1 CONTROLLER)

Both bits will be set to '0', and a controller fault will be reported if the switch position cannot be determined. Bits b_{16} b_{15} , which correspond to b_{10} b_9 (respectively), indicate that the switch position IS known. These bits will be 0 if the switch position is unknown.

NOTE: Other bit flags may be added to this message in future versions.

4. Faults and Alarms

One of the major functions of Serial I/O is reporting problems to the host controller. When a problem occurs, the controller generates an "alarm".

The controller may generate an "alarm" for several reasons:

- the current drawn by a unit measures outside its set limits
- a unit's external alarm input becomes active
- the controller's diagnostics detect a "fault" internal to the controller or its wiring

It is important to understand that the first two conditions do not indicate problems with the controller itself, but rather with the units connected to the controller. The third condition does indicate a problem with the controller or its wiring.

4.1 Unit Alarms

Unit alarms are generated when a unit appears to be faulted. Unit alarms may be configured to occur based on conditions internal to the controller, external, or a combination of both.

An internal unit alarm occurs when the controller measures the current drawn by a unit and finds it outside that unit's current window. The unit's current window is defined by the unit's nominal current setting (set by CALIBRATION) and the window width setting in the configuration. Each internal alarm can be enabled or disabled by configuration.

An external unit alarm occurs when an external alarm input is active (disconnected from ground) and that external alarm is enabled. Each external alarm can be enabled or disabled by configuration.

If both internal and external alarms are enabled for a unit, the controller will generate a unit alarm if *either* the current drawn by the unit is outside that unit's current window *or* the unit's external alarm input is active (disconnected from ground).

If neither internal nor external alarms are enabled for a unit, the controller will never generate a unit alarm for that unit.

It is important to understand that Unit Alarms do not indicate a hardware fault within the controller itself.

4.2 Reporting of Faults

If a fault condition is detected by the controller, the following actions are taken:

- The bit corresponding to the detected condition is set in the Latched Fault Mask.
- The same bit is set in the Active Fault Mask.
- The service request relay contact is closed.

The host can detect the fault either by monitoring the service request relay contact, or by polling the unit using the Get Faults message (see section 3.3). The host computer can clear the service request relay contact by issuing a Clear Service Request command (see section 3.4). This contact will not close again unless another fault condition occurs. This command does not disturb the state of any other fault indicators.

When the fault condition clears, either because it has been repaired or it went away by itself, the following actions are taken:

- The Active Fault Mask bit corresponding to the condition is cleared.
- If the fault is of a non-latched type, the same bit in the Latched Fault Mask is cleared.
- If all faults in the Latched Fault Mask are cleared, the service request relay contacts are cleared.

After the fault condition has been corrected, bits can be cleared in the Latched Fault Mask by issuing a Fault Reset command (see section 3.5). A latched fault can only be cleared if the faulting condition no longer exists. Latched faults can also be cleared from the front panel, or using a parallel I/O Fault Reset input. When latched faults are reset:

- All Latched Fault Mask bits that do not have corresponding bits set in the Active Fault Mask are cleared.
- If all bits are cleared in the Latched Fault Mask, the service request contact is cleared.

Resetting latched faults will also cause the fault to stop being reported on the front panel, and on the parallel I/O port relay contacts.

Also, note that powering the controller off will reset any latched faults, so if the unit was switched off to repair a problem, resetting faults may not be necessary.

4.3 Service Request Contacts

A relay contact available on the serial I/O connector provides a service request indicator which will be actuated if any fault occurs, whether it is a controller fault, power supply failure, UNIT fault, etc. This contact can be used as a status signal to alert the status monitor system that a condition requires attention. The unit can then be polled to determine the nature of the problem.

The service request contact can be cleared either by sending a Clear Service Request (section 3.4) command, or (if the faulting conditions have ceased) a Reset Latched Faults command (section 3.5).

Appendix B Glossary

Term	Definition
A	Ampere
AC or ac	Alternating current
AUTO	Automatic; refers to mode of operation
°C	Degrees Celsius
CMOS	Complementary Metal-Oxide Semiconductor
DC or dc	Direct current
DMM	Digital multimeter
EEPROM	Electrically erasable, programmable read-only memory
EIA	Electronic Industries Association
EXT	External
ft	Feet
GHz	Gigahertz
gnd	Electrical ground; earth
Hz	Hertz
in	Inches
INT	Internal
I/O	Input/output
IC	Integrated circuit
IEC	International Electrotechnical Commission
K	Degrees Kelvin
LED	Light emitting diode
LNA	Low noise amplifier
LNB	Low noise block converter
LOC	Local; refers to mode of operation
m	Meter

(continues)

Term	Definition
mA	Milliampere
MAN	Manual; refers to mode of operation
mm	Millimeter
ms	Millisecond
mV	Millivolt
PCB	Printed circuit board
p-p	Peak-to-peak
PVC	Polyvinyl chloride
Pos	Position
RAM	Random access memory
REM	Remote; refers to mode of operation
RF	Radio Frequency
ROM	Read-only memory
SEL	Select
S/N	Serial number
Std	Standard
TTL	Transistor-transistor logic
UV	Ultraviolet
V	Volt
Vac	Volts alternating current
Vdc	Volts direct current
VSWR	Voltage standing wave ratio
1:1	Redundant configuration where there is one standby unit for one main unit
1:2	Redundant configuration where there is one standby unit for two main units
Dual 1:1	Redundant configuration with two independent 1:1 systems controlled by a single controller

Appendix C Fault Codes

1:2 Redundant LNA/LNB Systems

Fault Group	Fault Number	Name
A	0	power supply 1
	1	power supply 2
	2	front panel not detected
	3	parallel io not detected
	4	ADC diagnostics
	5	unknown controller model
	6	drive failure
	7	service relay
B	0	serial port driver voltage
	1	serial port driver loopback
	2	capacitors too low
	3	hiside drive 1
	4	hiside drive 2
	5	front panel readback
	6	unit 1 power
	7	unit 2 power
C	0	unit 3 power
	1	unit 4 power
	2	tracking unit power
	3	noisediode 1 power
	4	noisediode 2 power
	5	switch 1 failed
	6	switch 2 failed
	7	switch 1 disconnected
D	0	switch 2 disconnected
	1	illegal opcode
	2	spurious reset
	3	stack overflow
	4	invalid interrupt
	5	watchdog timer failure
	6	ROM checksum
	7	RAM test
E	0	EEPROM read
	1	EEPROM checksum
	2	EEPROM write
	3	EEPROM backup
	4	processor_ADC
	5	-
	6	pio_RELAY1
	7	pio_RELAY2
F	0	pio_RELAY3
	1	pio_RELAY4
	2	pio_RELAY5
	3	pio_RELAY6
	4	pio_RELAY7
	5	pio_RELAY8
	6	pio_RELAY9
	7	pio_RELAY10

A0, A1 Power Supply 1,2

This fault indicates that one of the two power supplies has dropped outside the 13.5-to-16.5-volt range. If the condition continues to exist, you will observe that one of the indicators (PS1 or PS2) is lit. This fault may occur if you power the unit up one supply at a time.

First check that the power supply is turned on. Check the AC line fuses and power cord. If the fault still cannot be reset, check the power supplies, and adjust them if needed (see Section 5.4.1).

This fault can only be cleared if the power supply voltage is corrected.

A2 Front Panel not detected

This fault indicates the controller cannot properly communicate with the front panel. Normally, this fault code will not be seen from Fault Display mode, because the fault would prevent the front panel display from working at all.

If this fault occurs, press the PANEL TEST button to see if the LEDs light. Press buttons to check that they function. If the front panel does not operate as expected, check the cables between the logic board and front panel.

This fault can only be cleared if the front panel is correctly detected.

If this fault occurs repeatedly, the front panel board, and possibly the main logic board or entire controller, should be replaced.

A3 Parallel I/O not detected

This fault indicates the controller cannot properly communicate with a Parallel I/O board, when one is configured to be present.

This fault is most likely to occur because a controller is used with a Parallel I/O board installed, and the board is then removed from the controller. If that is the case, manually change the controller configuration so the controller does not expect a Parallel I/O board (see 2.7.3.10 Configuration Function J).

This fault may also occur due to a failure of the Parallel I/O board (if present), or cabling between the main logic board and Parallel I/O board. Press a front panel button such as Local/Remote and use an ohmmeter to determine if the Local/Remote contacts of the Parallel I/O Outputs change state. If possible, place the controller in Remote mode, and use the Parallel I/O inputs to try to change between Auto and Manual mode. If possible, execute the Serial I/O Self Test command, which tests each relay on the Parallel I/O board. If a fault is reported for every relay, check the cable between the main logic board and Parallel I/O board.

This fault can only be cleared if the Parallel I/O board is detected correctly, or if Parallel I/O is not configured.

If this fault occurs repeatedly, the Parallel I/O board should probably be replaced.

A4 ADC Diagnostics

This fault indicates the Analog to Digital Converter used to measure currents and voltages within the controller has failed a self test. This is an unlikely fault.

If this occurs, measurements made by the controller could be invalid. Unit alarms could occur when Units are actually operating correctly, or Power Supply faults could be reported when the power supplies are operating correctly. If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

This fault can only be cleared if the ADC passes its self tests.

A5 Unknown Controller Model

This fault indicates that the front panel connected to the controller is not configured for a valid controller type (1:1, 1:2, or Dual 1:1). The controller type is normally read from a jumper setting on the front panel PCB. This fault could occur if the jumper is moved, or if the front panel board is damaged or defective. The jumper is installed at the factory, and should never be moved.

If the controller type is unknown, NONE of the position indicators will be lit, nor will any unit status indicators light.

This fault is cleared only by attaching a good front panel with the "type" jumper properly installed.

A6 Drive Failure

(Not currently used.)

A7 Service Relay Failure

This fault indicates the Service Relay may not be operating correctly. Using an ohmmeter, check whether the Service Relay contacts are in the correct position. With no faults reported, the relay should be energized. With any fault reported, the relay should be de-energized.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

B0, B1 Serial Port Driver Voltage, Serial Port Driver Loopback

These faults indicate a problem with the driver chip used for the Serial I/O and RCP Link interfaces. If you are using Serial I/O or a Remote Control Panel, communication problems may occur.

Check cabling to Serial I/O and RCP Link connectors, looking for shorts on the wiring or any other conditions which could cause excessive current to flow through the ports.

This fault can only be cleared if the serial drivers pass their selftests.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

B2 Capacitors Too Low

This fault indicates that capacitors used to store energy for driving the waveguide switches cannot generate sufficient voltage to switch. In that case, the controller could be unable to switch between Units.

The most likely cause of this fault is a wiring problem between the main logic board and the power capacitors. Verify that the cable between the two is correctly attached.

This fault can only be cleared if the capacitors generate the correct voltage.

If this fault occurs repeatedly, the main logic board, power capacitors, or entire controller should be replaced.

B3, B4 Hiside Drive 1,2

This fault indicates an internal selftest of the waveguide switch drive circuitry has failed.

The most likely cause of this fault is a wiring problem with the plate cable or plate assembly. Verify that cabling is correct, and that there are no shorts on the plate cable or plate wiring. Although the controller drive circuitry is well protected, a fault on the plate wiring could perhaps damage the drive circuitry.

This fault can only be cleared if the drive circuitry passes the internal tests.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

B5 Front Panel Readback

This fault indicates an internal selftest of the front panel circuitry has failed. This is an unlikely fault.

If this fault occurs repeatedly, the front panel or entire controller should be replaced.

B6,B7,C0,C1 Unit Power 1,2,3,4

This fault indicates that the circuitry which supplies power to Units cannot be controlled properly.

The most likely cause of this fault is a problem with Unit wiring in the plate cable or plate assembly. Verify that cabling is correct, and that there are no shorts on the plate cable or plate wiring. Although the controller circuitry is well protected, a fault on the plate wiring could perhaps damage the drive circuitry.

This fault can only be cleared if the Unit power circuitry works properly.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

C2 Tracking Unit Power

When the Tracking Unit is configured, this fault indicates that the circuitry which supplies power to the Tracking Unit cannot be controlled properly.

The most likely cause of this fault is a problem with Tracking Unit wiring in the plate cable or plate assembly. Verify that cabling is correct, and that there are no shorts on the plate cable or plate wiring. Although the controller circuitry is well protected, a fault on the plate wiring could perhaps damage the drive circuitry.

This fault can only be cleared if the Tracking Unit power circuitry works properly.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

C3, C4 Noise Diode Power 1,2

When Noise Diode 1 or 2 is configured, this fault indicates that the circuitry which supplies power to the Noise Diodes cannot be controlled properly.

The most likely cause of this fault is a problem with Noise Diode wiring in the plate cable or plate assembly. Verify that cabling is correct, and that there are no shorts on the plate cable or plate wiring.

This fault can only be cleared if the Noise Diode power circuitry works properly.

If this fault occurs repeatedly, the main logic board or entire controller should be replaced.

C5,C6 Switch 1,2 Failed

This fault indicates an attempt to electrically move a waveguide switch has failed.

If the controller tries to switch to another unit, either because of a command or because a unit has faulted in AUTO mode, and the switch does not move, this fault is reported. If the switch was initiated by a command, the attempt is only made once. If the controller is switching because of AUTO mode, it will continue to attempt to switch.

If this fault was generated because a command failed, it should be obvious, as you will observe that the system did not switch as you requested. If this fault was generated because an AUTO mode switch failed, you may observe that a faulted unit is not being switched off-line from the front panel indicators.

The most likely cause of this fault is a switch which is stuck or is being manually held at the plate. Other possible causes are a wiring fault (e.g. excessive wire resistance), low supply voltage, or defective power capacitors, although the latter two problems should cause other fault codes to occur.

This fault can only be cleared after the controller has successfully performed a switch.

If this fault occurs repeatedly, and no problem is found with plate wiring or the waveguide switch(es), the main logic board, power capacitors, or entire controller should be replaced.

C7, D0 Switch 1,2 Disconnected

This fault indicates the position of a waveguide switch cannot be detected. All indicator arrows will be lit red on the Pol which is affected.

The most likely causes of this fault are a disconnected switch or a defect in the wiring to the switch.

This fault can only be cleared if the controller properly detects the position of the switch.

If this fault occurs repeatedly, and no problem is found with plate wiring or the waveguide switch(es), the main logic board or entire controller should be replaced.

D1 – D5 Various Microprocessor Faults

This fault indicates a hardware or firmware problem with the microprocessor. If this fault occurs repeatedly, the unit should be returned for repair.

This fault is cleared by a fault reset command.

D6, D7 ROM test, RAM test

A self-test is performed on ROM and RAM at power-up. These tests can also be run from a serial I/O command. If any of these memory tests fail, a controller fault is reported.

ROM is memory that contains the program that runs the controller. RAM memory contains data such as measurements that occur during normal operation.

This fault can be cleared only by a successful test of whichever area of memory failed.

E0,1,2,3 EEPROM Errors

Whenever you reset the nominal unit currents, or change one of the mode settings, this information must be written to EEPROM. EEPROM is memory that retains the data even when power is removed. Data is verified as it is written, and if a failure occurs, this fault is reported.

If this happens, it is an indication that the EEPROM memory may be wearing out. This is not likely to happen during normal operation.

This fault can be cleared by a successful write to EEPROM, or by a fault reset command.

E4 Processor ADC

This fault indicates a selftest of the Analog to Digital Converter in the microprocessor has failed. This is an unlikely fault.

The microprocessor ADC is used only for internal diagnostics. A failure would probably cause false faults of the Service Request Relay and Serial Port Driver.

This fault can only be cleared if the microprocessor ADC passes its internal tests.

If this fault occurs repeatedly the main logic board or entire controller should be replaced.

E6,7, F0 – 7 Parallel I/O Relay

These faults indicate a Parallel I/O relay is not in the expected state.

These faults will only be indicated after the Serial I/O Self Test command is issued. These faults are not used if Parallel I/O is not present. If this fault occurs on all relays, check the cable between the main logic board and Parallel I/O board.

These faults can be cleared after the Serial I/O Self Test command is completed.

If this fault occurs repeatedly the Parallel I/O board should be replaced.