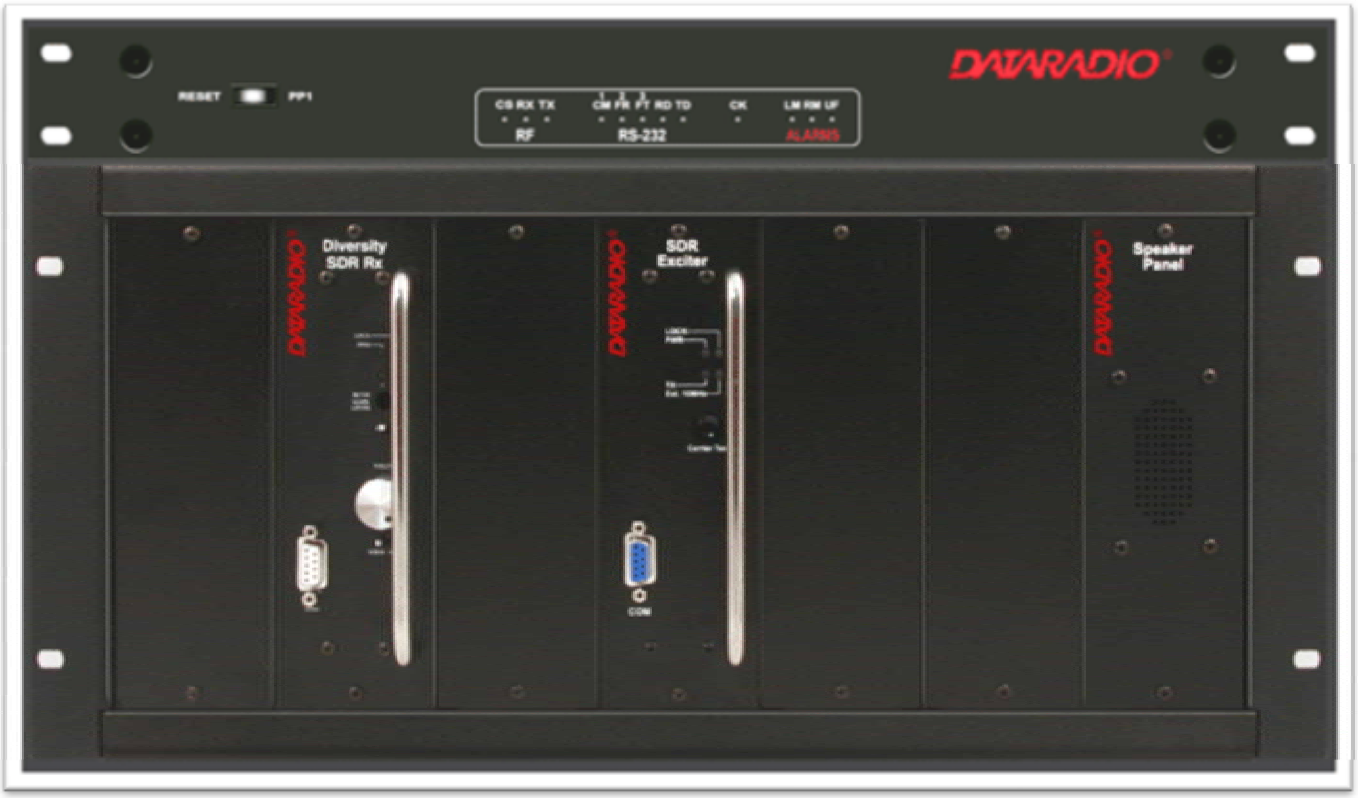

DATARADIO PARAGON4^{PD+}
DIGITAL BASE STATION

CalAmp®

USER MANUAL
PN 001-P4PD-000 REV 1
RELEASED DECEMBER 2010

Revision History

Revision 0	2010 September Initial Release
Revision 1	2010 December Updates to Section 2.5, 3.4.2.3.4, 4.0 and 5.0

Table of Contents

Important Notice

Because of the nature of wireless communication, transmission and reception of data can never be guaranteed. Data may be delayed, corrupted (i.e., have errors), or be totally lost. Significant delays or losses of data are rare when wireless devices are used in a normal manner with a well-constructed network. This product should not be used in situations where failure to transmit or receive data could result in damage of any kind to the user or any other party, including but not limited to personal injury, death, or loss of property. CalAmp accepts no responsibility for damages of any kind resulting from delays or errors in data transmitted or received, or for the failure to transmit or receive such data.

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User Manual Statement

Every effort is taken to provide accurate, timely product information in this user manual. Product updates may result in differences between the information provided herein and the product shipped. The information in this document is subject to change without notice.

About CalAmp

CalAmp is a leading provider of wireless equipment, engineering services and software that enable anytime/anywhere access to critical information, data and entertainment content. With comprehensive capabilities ranging from product design and development through volume production, CalAmp delivers cost-effective high quality solutions to a broad array of customers and end markets. CalAmp is the leading supplier of Direct Broadcast Satellite (DBS) outdoor customer premise equipment to the U.S. satellite television market. The Company also provides wireless connectivity solutions for the telemetry and asset tracking markets, public safety communications, the healthcare industry, and digital multimedia delivery applications.

For additional information, visit www.calamp.com.

1 PRODUCT OVERVIEW

This document provides information required for the setting up, operation, testing and trouble-shooting of the Paragon4^{PD+} Base Station.

1.1 INTENDED AUDIENCE

This document is intended for engineering, installation, and maintenance personnel.

1.2 GENERAL DESCRIPTION

Paragon4^{PD+} is a factory-integrated industrial-grade data base station used in mobile networks. Designed specifically to fit the needs of vehicular applications, it features dual receivers for added data decode sensitivity in multi-path and fading environments. When used with Gemini^{PD+} mobiles, the system delivers high-speed data performance and unmatched effective throughput.

All Paragon4^{PD+} models are supplied in a rack-mount configuration that includes:

- (1) Full-duplex Radio Assembly with SDR (Software Defined Radio) Diversity Receiver, SDR Exciter and Speaker Panel
- (1) Power Amplifier
- (1) High-speed Base Station Data Link Controller (BDLC^{PD+})

Additional components/requirements include:

- Duplexer and backup power units are custom furnished items
- Wire line modem(s) are optional items
- Laptop PC and its application software are user-supplied items

Product Features:

- Parallel Decode® featuring dual receivers for added decode sensitivity in multi-path and fading environments
- Sophisticated DSP-based modem design provides added system performance, fewer retries and more effective throughput
- Full duplex operation
- Power output of 50-100W for UHF and 35-70W for 800 MHz
- Up to 43.2 kb/s
- 12.5, NPSPAC and 25 kHz channel spacing
- Supports high-efficiency Dataradio DBA over-the-air protocol
- Out-of-band signaling enables transmission of GPS reports with no effect on system performance
- Four (4) times more DSP memory than previous models to handle higher rate modulation types
- Flash programmable firmware
- Modular design
- Factory-configured based on customer's network system requirements

1.2.1 NETWORK SPEEDS AND MODULATION

The Paragon4^{PD+} supports data speeds on the RF network of up to 43.2 kb/s by modulating the RF carrier. Lower speeds are produced by a 2-level modulation (DGMSK), middle and higher speeds by 4-level (xRC4FSK) and 8-level (xRC8FSK) modulations. Some network speeds have more than one choice of modulation. System Engineering selects and informs the customer of the network speed and modulation that best meets the customer's requirements of throughput, range and robustness.

Table 1 - On-air data speeds and modulation types

Modulation Type[1]	12.5 kHz Channel Spacing	NPSPAC Channel Spacing	25 kHz Channel Spacing
DGMSK	9.6 kb/s		19.2 kb/s
	8.0 kb/s		9.6 kb/s
xRC4FSK	16 kb/s	16 kb/s	32 kb/s[2]
	14.4 kb/s		25.6 kb/s
			19.2 kb/s
xRC8FSK [2]	21.6 kb/s	24 kb/s	43.2 kb/s

1.3 TECHNICAL SUPPORT

The Technical Support department provides customer assistance on technical problems and serves as an interface with factory repair facilities. Standard support is available Monday – Friday 9:00 AM to 5:00 PM EST. Extended support plans are available.

CalAmp Wireless Networks
299 Johnson Avenue, Ste 110
Waseca, MN 56093

Tel (507) 833-8816 x 6701 or Toll Free (800) 992-7774 x 6701
Fax (507) 833-6748
Email wngsupport@calamp.com

1.4 PRODUCT WARRANTY

It is our guarantee that every Paragon4^{PD+} will be free from physical defects in material and workmanship for ONE YEAR from the date of purchase when used within the limits set forth in Section 5: Specifications. The standard manufacturer's warranty statement is available in APPENDIX A– PRODUCT WARRANTY.

Extended warranty plans are available. Contact your CalAmp representative for options.

[1] Networks must use common modulation, bit and baud rates.
[2] Available with Paragon^{PD+} and Gemini^{PD+} products only

1.5 REPLACEMENT PARTS

This product is generally not field-serviceable, except by the replacement of individual radio modules. Specialized equipment and training is required to repair logic, modem boards, and radio modules.

Contact Technical Support for service information before returning equipment. A support representative may suggest a solution eliminating the need to return equipment.

1.6 FACTORY REPAIR

When returning equipment for repair, you must request an RMA (Returned Material Authorization) number. Contact our Customer Service Department at (800) 992-7774 to obtain an RMA number. The support representative may ask you several questions to clearly identify the problem. Please give the representative the name of a contact person who is familiar with the problem should a question arise during servicing of the unit.

BE SURE TO HAVE THE EQUIPMENT MODEL, SERIAL NUMBER, AND BILLING & SHIPPING ADDRESSES AVAILABLE WHEN CALLING. You may also request an RMA number online at www.calamp.com.

Customers are responsible for shipping charges for returned units. Units in warranty will be repaired free of charge unless there is evidence of abuse or damage beyond the terms of the warranty. Units out of warranty will be subject to service charges. Information about these charges is available from Technical Support.

1.7 PACKAGING

Each Paragon4^{PD+} is packaged with the following:

(A1) Radio Assembly 	**(C5) BDLC^{PD+} to Radio Assembly Backplane Power Cable** 
(A2) Power Amplifier 	**(C1) Power Amplifier DC Power Cable*** 
(A4) Redundant Power Supply with AC Power Cable*  	**(C2) Power Amplifier Fused DC Power Cable** 
(C6) BDLC^{PD+} to Radio Assembly Backplane Data Cable 	**(C3) Radio Assembly Backplane DC Power Cable** 
(A3) BDLC^{PD+} 	**(C4) Type N Right Angle to Type N Straight RG223/U Cable** 
Paragon P4^{PD+} Start Up Disc with User Manual and Maintenance & Testing Programs 	

**** Power Supply is included only if ordered as an option. If ordered with power supply, Cable C1 is included to replace Cable C2.***

Frequently, components are staged by System Engineering and are partially assembled prior to delivery. Final installation is done at the customer's location.

Cabinetry may be supplied in one of several custom rack-mount configurations that may also include fan, backhaul modems, duplexer/filters/combiners, and ancillary equipment.

If damage has occurred to the equipment during shipment, file a claim with the carrier immediately.

1.8 MODULE VIEWS

Figure 1 - Radio Assembly (Front View)

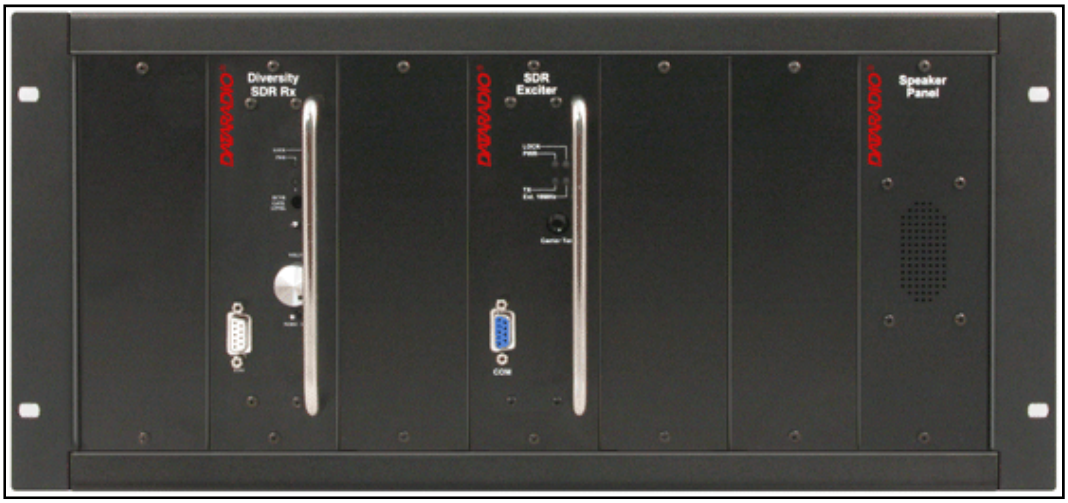


Figure 2 - Radio Assembly (Rear View)

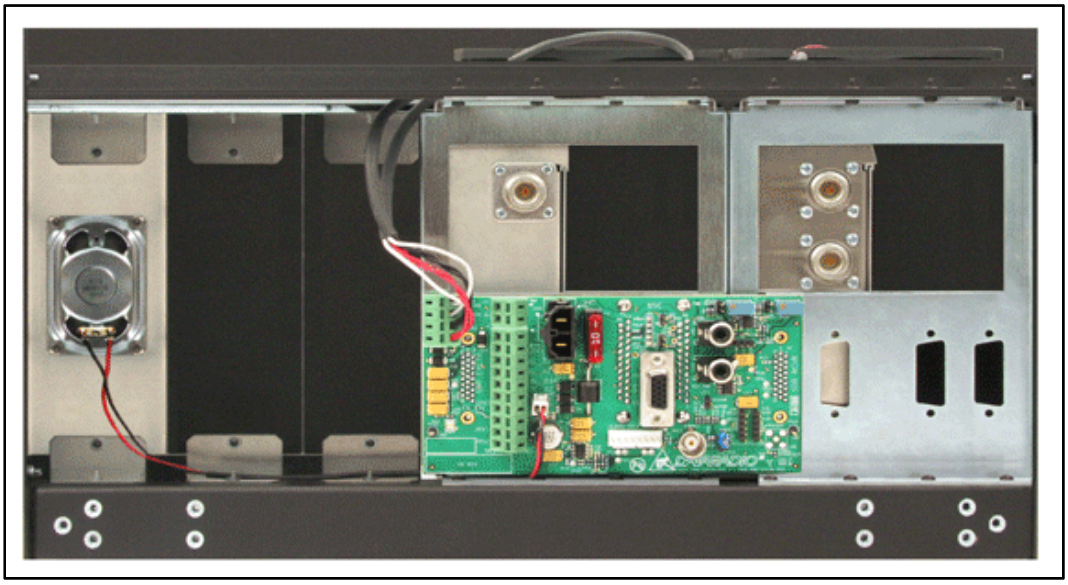


Figure 3 - Power Amplifier (Front View)

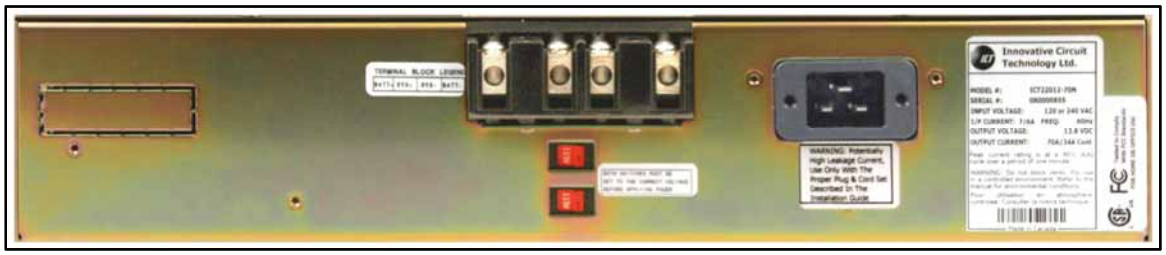
Figure 4 - Power Amplifier (Rear View)

Figure 5 - BDLC^{PD+} (Front View)

Figure 6 - BDLC^{PD+} (Rear View)

Figure 7 - Redundant Power Supply (Front View)

Figure 8 - Redundant Power Supply (Rear View)



2 INSTALLATION

2.1 OVERVIEW

The cabinet and rack-mount housing Paragon4^{PD+} is generally installed in a sheltered facility. Occasionally located adjacent to the nerve center of the user's network, it is more often located near tower sites or at remote locations where it operates unattended.

Furnishings needed include power, cabling, and installation of antenna, landline or microwave modem, and host PC or portable computer. Details of these are outside the scope of this manual. This manual only covers the Radio Assembly and the BDLC^{PD+} component that includes the modem.

2.2 LOCATION

Be sure to place the Paragon4^{PD+} equipment in such a way that:

- The LEDs can be seen (as an aid in troubleshooting).
- Access to the antenna connectors and to the back connectors is possible without removing the unit.
- Sufficient air may flow around the unit to provide adequate cooling.

2.3 ELECTRICAL

Standard 120/240 VAC electrical power capable of providing at least 13A (120V) or 9.3A (240V) is required to power the base station and ancillary equipment.

The standard configuration for supplying the required +13.8 VDC to the Paragon4 base station and the Power Amplifier is shown below. The Radio Assembly and the power amplifier receive 13.8 VDC power inputs from the 120 VAC power supply module. Illustrations and diagrams provided reference the optionally supplied rack-mounted power supply (Model ICT 22012-70N).

Figure 9 - Simple AC-to-DC Power Configuration Block Diagram

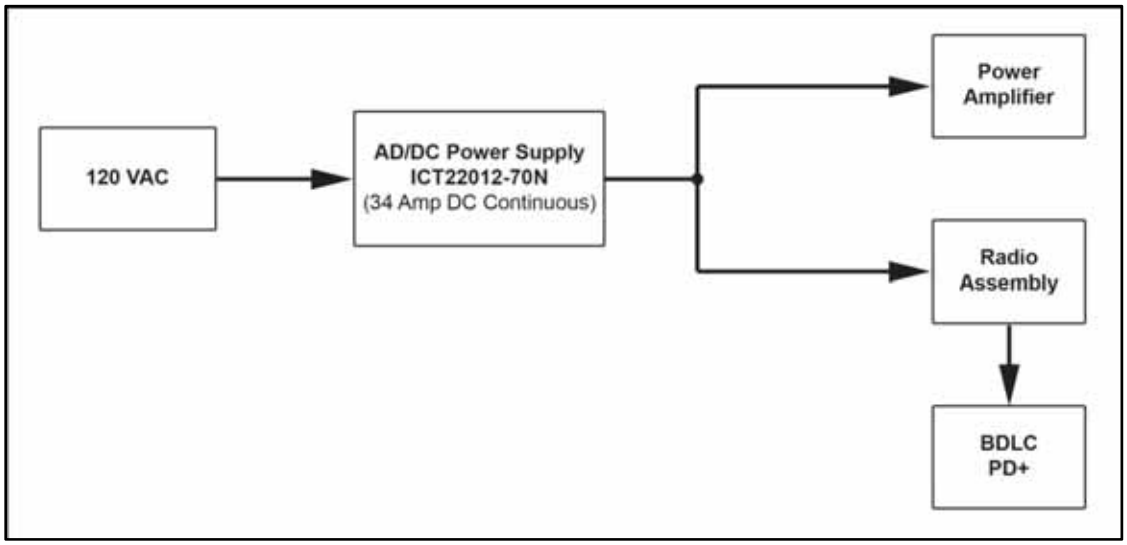


Figure 10 - Standard Connections Using ICT 22012-70N Power Supply

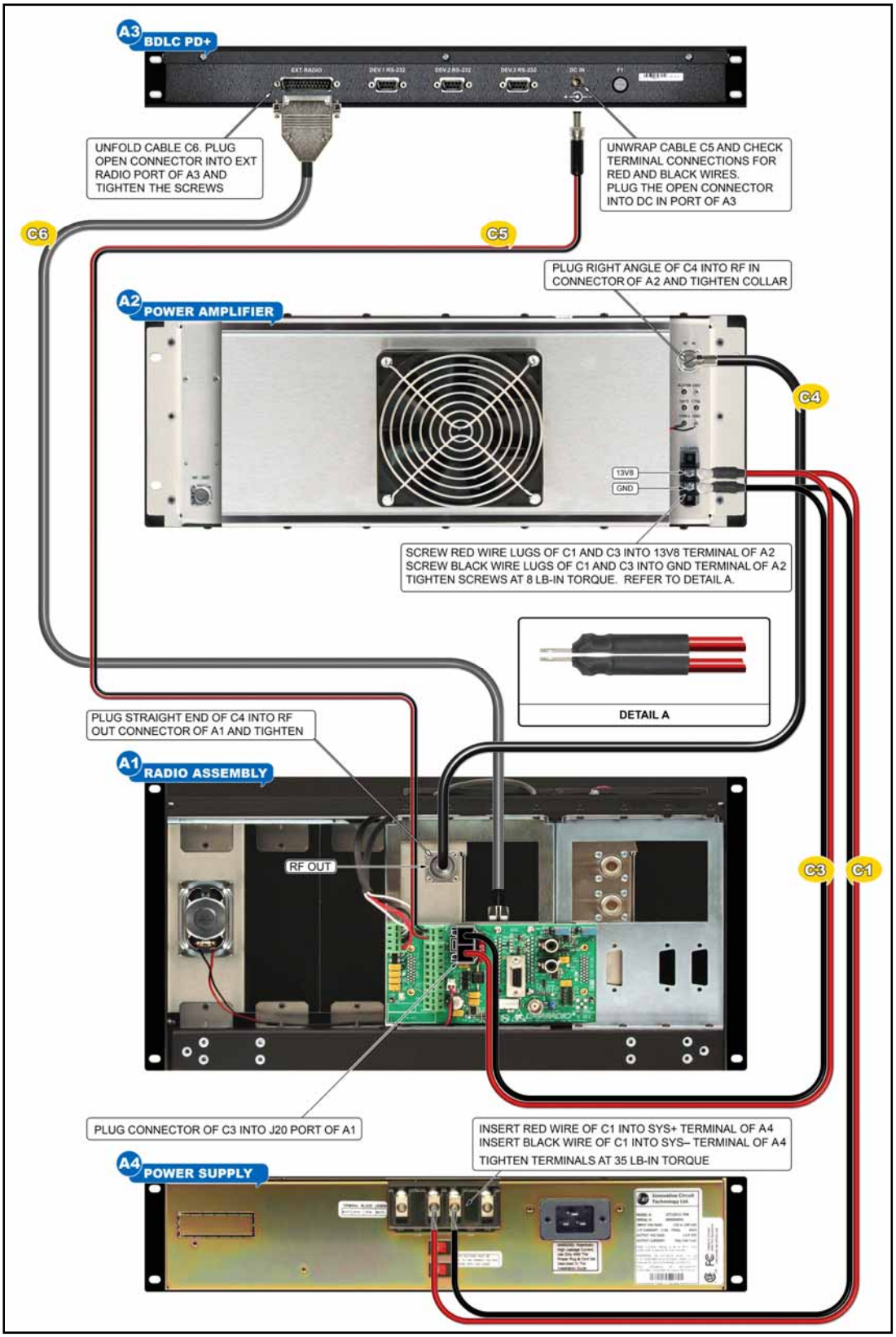
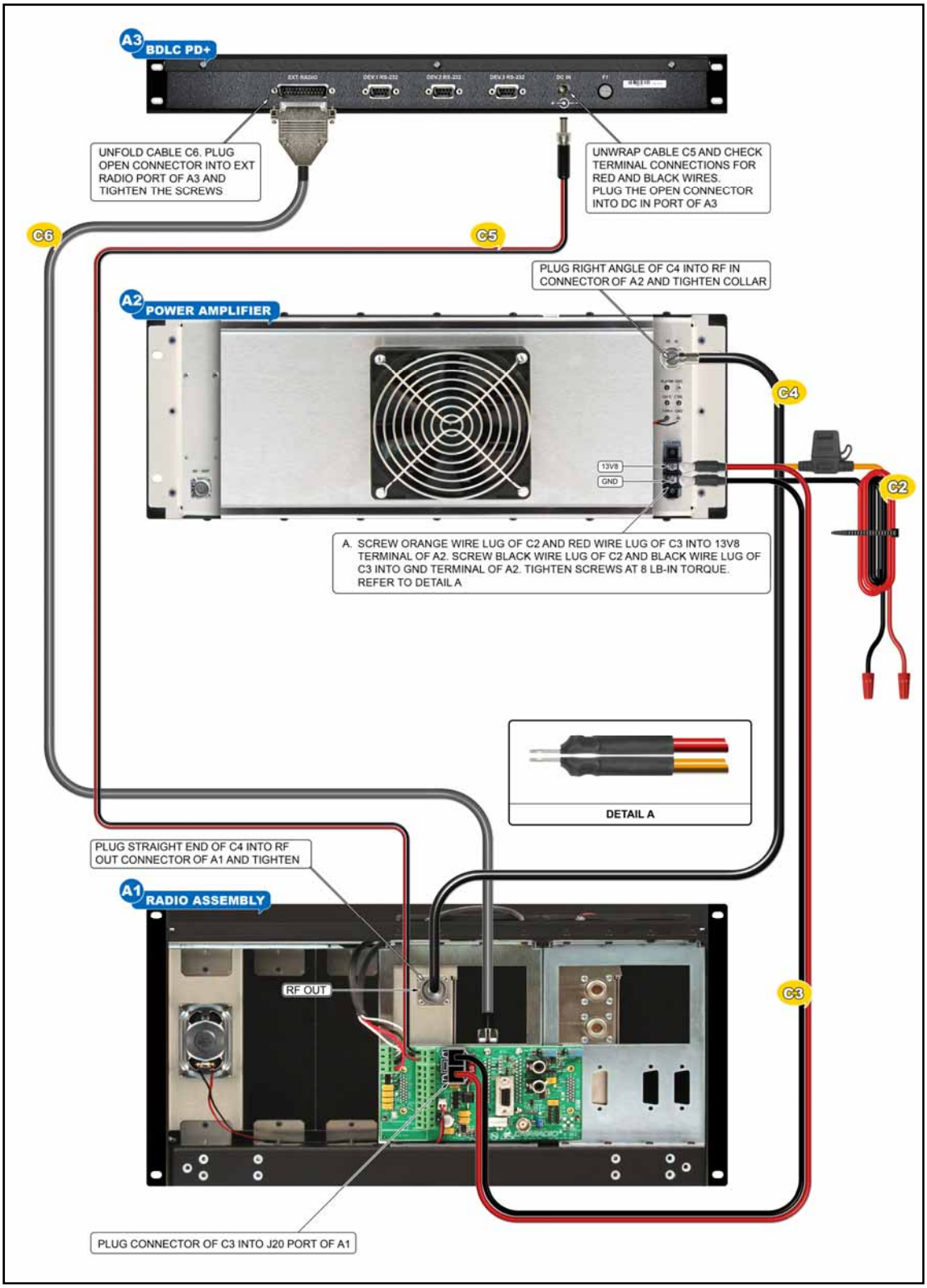


Figure 11 - Standard Connections Using Customer Provided Power Supply



2.3.1 POWER SUPPLY CONNECTIONS

Model number ICT 22012-70N is a rack-mounted power supply unit provided by CalAmp as an option. It consists of a backplane and two modules. Each module provides 450 Watts of continuous DC power output at 13.8V/32.6A. The system is designed with active sharing technology to distribute the load current among the modules. Each module is equipped with a high power Schottky OR-ing diode for true redundancy. If a module failure occurs, the other module will continue to supply power.

The module is protected in several ways:

- Fuse against over current on the AC input.
- Current Limit and Foldback – Prevents the load from drawing current above the maximum allowed value.
- Sudden energy surges on each module – Thermistor against inrush current.

Prior to powering up, ensure that both voltage selection switches (located on the back) are set to the proper voltage for your operation. Available settings are 120 or 220 volts. The Power Supply metal enclosure is internally connected to earth ground via its individual, rear-connected, 120 VAC (NEMA 5-15p plug to IEC 60320-C19 receptacle) power cord. Therefore, the system must be operated from an outlet with a proper grounding connection. Improper grounding between power supply case and rack frame may result in harmful voltage potentials and/or miscellaneous power supply switching noise problems in both receivers and transmitter.

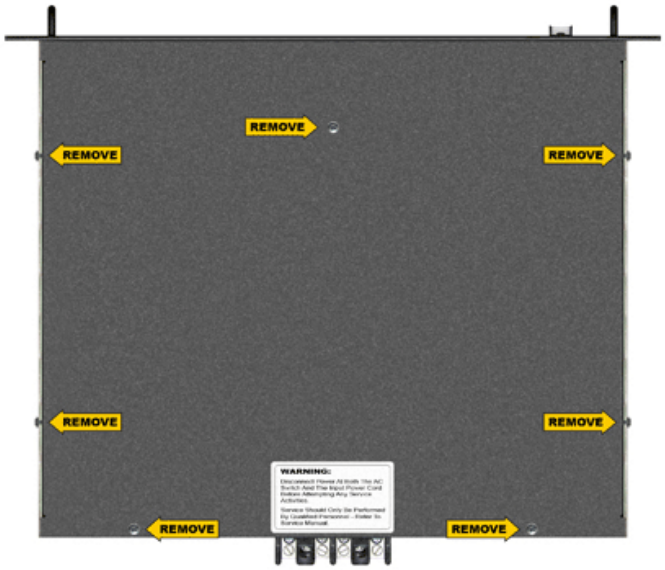
Caution:

- ***High current leakage, use only the cord supplied with this equipment for power.***
- ***If accessing modules, power at both the switch and the AC inlet must be disconnected to ensure operator safety.***
- ***It is important that the side ventilation holes are unobstructed at all times. Do not operate this unit in a completely enclosed cabinet.***

2.3.2 POWER SUPPLY FUSE REPLACEMENT

To access the Power Supply fuses, the unit cover must be removed. Be sure that all power to the unit is removed. As shown in Figure 12, remove the three top screws and four side screws with washers and then slide the top cover off.

Figure 12 - Power Supply Screw Removal Detail



There is one 250V 10A fuse for each module board assembly (shown in Figure 13 and Figure 14) and one 250V 1A fuse on the backplane board assembly (shown in Figure 15) for the fans. Locate each fuse and replace as needed. **To protect against fire or electrical shock, replace with only the same type and ratings of fuse.** Only hand tighten the eight screws when replacing the cover.

Figure 13 - Power Supply Module Assembly

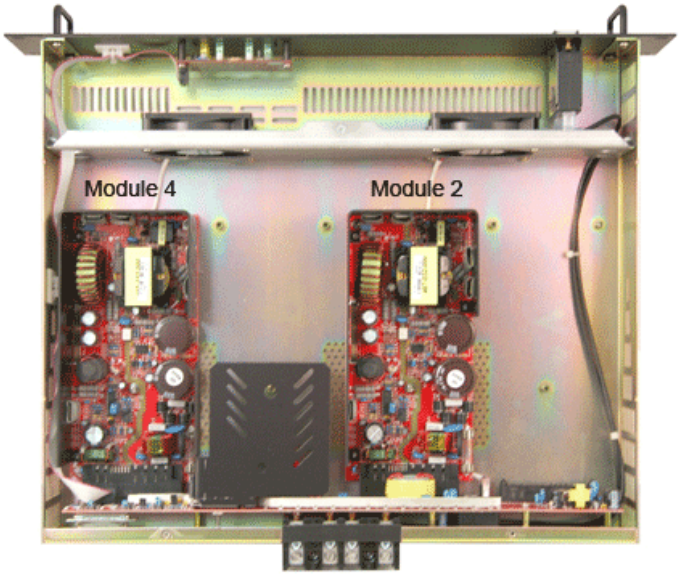


Figure 14 - Module 2, Module 4 Fuse Detail

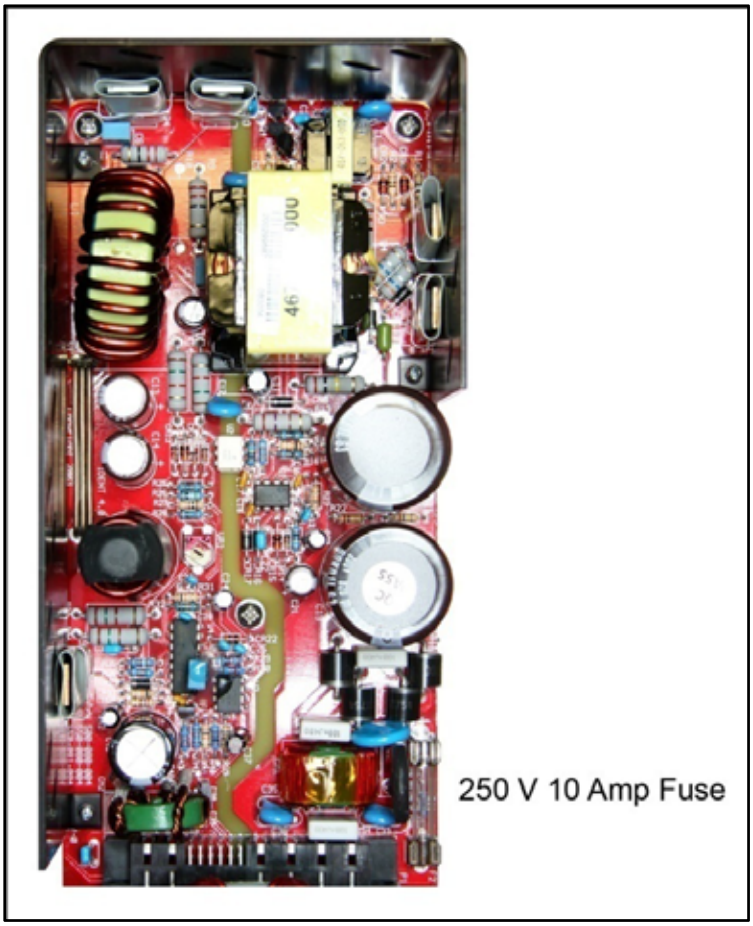


Figure 15 - Power Supply Backplane Assembly Fuse

2.3.3 POWER AMPLIFIER CONNECTIONS

The Power Amplifier is maintenance free with only LED indicators present on the front panel and one adjustment located on the underside. The DC power terminal block, RF In and RF Out are located on the back side of the module.

In a standard configuration, the Power Amplifier receives its +13.8 VDC power from the Power Supply through a 10 AWG DC power cable. There is no in-line fuse between the power supply and power amplifier. All short-circuit and foldback protection is done by the Power Supply.

For the 800 MHz model, the power output is normally set to 70W *(or lower depending on the work order)* and for the UHF model, it is set to 100W *(or lower depending on the work order)* at time of manufacture or via RMA. However, to allow for field adjustment of the output power to meet the ERP granted by the transmission site license, a potentiometer is accessible via a small round opening on the underside of the power amplifier. Adjust using a small tuning screwdriver. *CalAmp does not recommend adjusting below 35W for the 800 MHz model and 50W for the UHF model.*

As per Industry Canada Radio Standard Specification #131, paragraph 5.3:

> *"[…]The manufacturer's rated output power and power tolerance of this equipment is for single carrier operation in the specified frequency range. It should not be used for multiple carrier operations or outside its specified range[…]"*

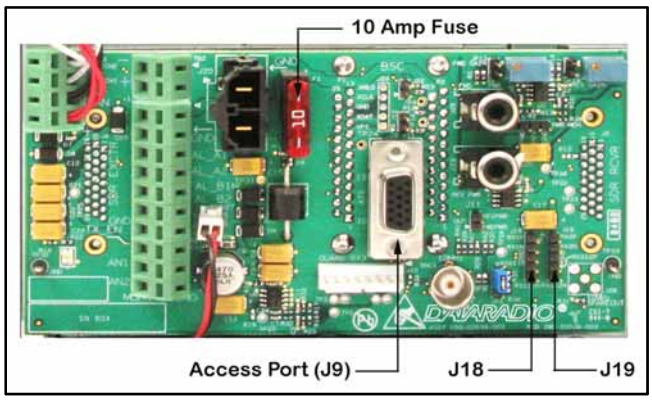
2.3.4 RADIO ASSEMBLY CONNECTIONS

The BDLC^{PD+} and Radio Assembly (Diversity SDR Rx, SDR Exciter and Speaker modules) receive their +13.8 VDC power via the backplane PCB. A 12AWG DC power cable provides power to the backplane PCB at the heavy duty power connector J20.

The base station requires a secure ground connection. A grounding 8-32 threaded through-hole pemstud fitted with a 8-32 screw, lock washer and nut is provided on the bottom-rear of the chassis, behind the speaker panel.

- Install a 3-4 ft 10AWG grounding wire, crimped on both sides with terminal rings. Place one side over the 8-32 screw on the non-exposed chassis side and firmly tighten with the lock washer and nut.
- Place the other side on the rear side the power supply metal case, near the 25-pin connector. Use a ½ in 4-40 screw with lock washer to secure the terminal ring to the metal case.
- If a –DC rail (0V) is installed as part of the system, the grounding lead may alternatively be fitted to the rail terminal.

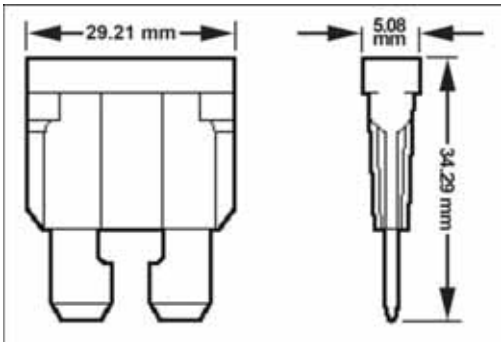
Figure 16 - Radio Assembly Backplane



2.3.4.1 BACKPLANE FUSES

10A Blade fuses are used on the Radio Assembly backplane.

Figure 17 - ATO Blade Fuse



2.3.5 ANTENNA CABLING AND CONNECTION

Paragon4^{PD+} commonly uses three antennas (one transmit and two receive) unless a duplexer is used with one of the receive antennas; then only two antennas would be needed. They should be mounted according to any guidelines supplied with the antennas. For antennas placement and spacing, consult System Engineering.

1. Route good quality 50-ohm double-shielded coaxial cable(s) (e.g. RG-214 or Heliax) from the selected antenna position(s) to the Paragon4^{PD+} Radio Assembly.
2. Terminate the RX-1 and RX-2 cable-ends at the Receiver modules rear position with an N-type connector.
3. Similarly, terminate the TX cable-end at the Power Amp module's RF Out connector with an N-type connector.

Caution:

- ***When terminating RF cables use brand-name crimping tools (such as AMP, Jensen, Crimp-Master, etc…) of the correct size for the cable and type of connector used.***
- ***Common pliers are NOT acceptable.***

2.4 COMPLETING THE PHYSICAL INSTALLATION

Paragon4^{PD+} models are factory-configured to meet specific user requirements and are shipped ready to run. After new installations:

- Re-check that all connections are secure on all assemblies (antennas, PC, power cords, etc.).
- Check that fuses are inserted.
- Turn the power supply power ON.

You are now ready to check for normal operation.

2.5 CHECKING NORMAL OPERATION

1. Check that power is applied.
2. Check for proper operation of the power supply unit LEDs as per Section 3.1.
3. Check Radio Assembly lights for proper operation as per Section 3.3.
4. Check for proper operation of the BDLC unit LEDs as per Section 3.4.2.3.
5. Using the WinRIS program and an in-line wattmeter, check forward & reverse power to confirm main antenna installation (as per Section 4.3)
6. Using WinRIS, check the RF Data Link with a mobile that can be heard (Refer to Section 4.4.2).

If user application and mobiles are available, test the installation by going through a normal sequence of transmitting and receiving messages.

3 OPERATING DESCRIPTION

3.1 POWER SUPPLY

Normally used at room ambient temperatures, the Power Supply unit operates within its specifications over a range of -30° to +52° C. Although it is a high efficiency switched mode power supply, a considerable amount of heat is generated during normal operation. While in use, ensure that an adequate flow of cooling air is able to circulate around the power supply, and that the air intake vents on the sides of the unit are not inadvertently covered. **Do not operate this unit in a completely enclosed cabinet.**

LED indicators located on the front panel provide module information as described in Table 2.

Table 2 - ICT 22012-70N LED Module Status Display

GREEN	YELLOW
AC line voltage is present	Module is not present in the slot
DC output voltage is present	Module is not producing any output
Module voltage is present	

3.2 POWER AMPLIFIER

Do not operate this unit in a completely enclosed cabinet. Although a rear-mounted fan brings in air from the back and blows it across the heatsink fins, a considerable amount of heat is generated during normal operation. The amplifier must have a minimum of 3 inches of open space behind the rear fan to allow adequate ventilation. The air inlets and outlets should be checked every 30 days and cleaned if necessary. If dust and dirt are allowed to accumulate, the cooling efficiency will be diminished. Using either compressed air or a brush with soft bristles, loosen and remove accumulated dust and dirt from the air inlet panels.

Table 3 - Power Amplifier Indicators

LED	Function
DC ON	Lights green when DC power (+13.8 VDC) is applied.
LOW OUTPUT	Lights red when output power drops to approximately 80-85% of set output power.
HIGH VSWR	Lights red when VSWR exceeds approximately 2.5:1. At which point, the amplifier output is reduced. The higher the load VSWR, the more the output power is reduced.
HIGH TEMP	Lights red when the amplifier exceeds a safe operating temperature. (Operating temperature range = -30 °C to +60 °C) When the heatsink reaches an unsafe level, the output power of the amplifier is reduced by approximately 50%. This keeps the channel on-air while providing some short-term protection. Address the underlying cooling issue as soon as possible.

3.3 RADIO ASSEMBLY

Commonly installed in a standard 19-inch wide rack frame, modules included in the Radio Assembly are:

- (1) SDR Diversity Receiver module
- (1) SDR Exciter module

- (1) Speaker Panel fitted with a 4Ω speaker

3.3.1 SDR DIVERSITY RECEIVER MODULE

The SDR Diversity Receiver module (Receiver) has the following front panel controls and indicators:

- **RCVR GATE LEVEL**. Mute threshold adjustment. It sets the RF signal level required to open the mute gate and allow audio to pass to the speaker.
- **1/2 Switch.** Manual selection of RX-1 or RX-2 audio.
- **Volume.** Audio output delivers up to 1 watt to the speaker. Always set volume knob to minimum when not in use to reduce current consumption.
- **NORM-MON Switch.** Manual selection between audio un-muted (continuous monitor) or when audio is above the manually adjusted mute threshold.
- **COM.** DE-9 RS-232 port for setup.
- **LED Indicators.** Defined in Table 4.

Figure 18 - SDR UHF Receiver Module

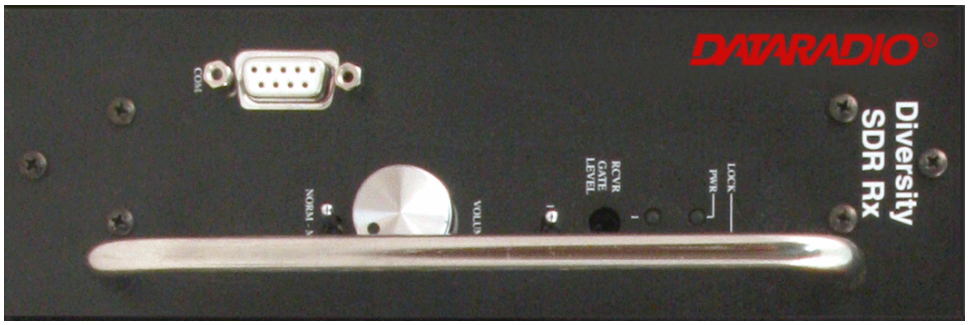
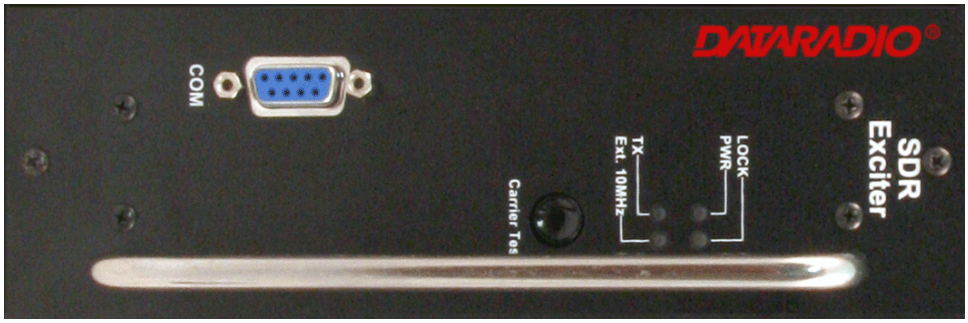


Table 4 - SDR Diversity Receiver Module LEDs

LED Indicator		Description
PWR LED	Green	Normal operation
	Amber	Bootloader program running
	Red	Malfunction/Reset
LOCK LED	Green	PLL locked
	Red	PLL not locked
1 LED	Green	RF carrier signal from receiver RX-1 is above is above manually adjusted mute threshold
	Off	RF carrier signal from receiver RX-1 is below is above manually adjusted mute threshold
2 LED	Green	RF carrier signal from receiver RX-2 is above is above manually adjusted mute threshold
	Off	RF carrier signal from receiver RX-2 is below is above manually adjusted mute threshold

3.3.2 SDR EXCITER MODULE

Figure 19 - SDR Exciter Module



The SDR Exciter module (Exciter) has the following front panel controls and indicators:

- **Carrier Test.** Momentarily keys the transmitter ON while pressed (used for test purposes only). If the Carrier is pressed for 4 seconds or more the exciter starts the test mode and keeps transmitting until the next press of the button.
- **COM.** DE-9 RS-232 port for setup.
- **LED indicators**. Defined in Table 5**.**

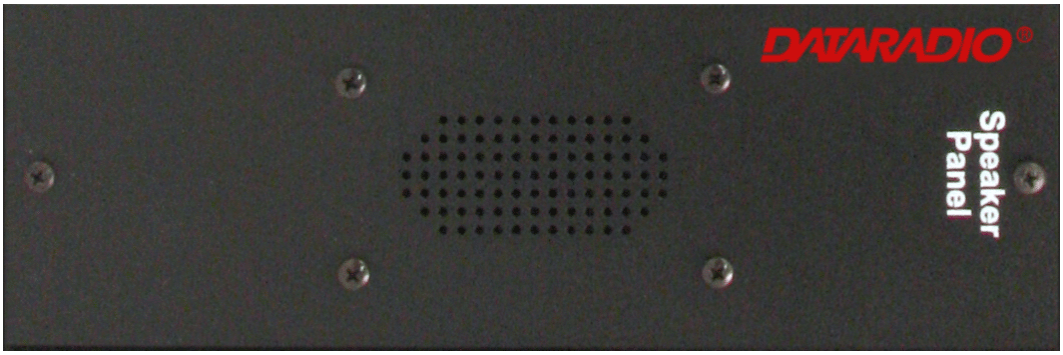
Table 5 – SDR Exciter Module LEDs

LED Indicator	Description			
	Green	**Red**	**Flashing Amber**	**Off**
Lock	Normal; Synthesizer lock	Fault ; Synthesizer unlock	Programming mode	-
Power	Normal	Fault	Warning	-
TX	-	Transmit	Test Mode	Idle
Ext. 10 MHz	Always off			

3.3.3 SPEAKER PANEL

The speaker panel is fitted with a 4Ω speaker.

Figure 20 - Speaker Module



3.4 BDLC^{PD+}

The BDLC^{PD+} module is a rack-mounted one unit arrangement. Housed in a metal case, there are no internal serviceable parts. Unit configuration is stored in flash memory.

The front panel has one spring-loaded switch with a center position detent and two positions labeled RESET and PF1. LED indicators are located in the center of the front panel.

Figure 21 - BDLC^{PD+}

3.4.1 FRONT SWITCH (RESET)

Pressing Reset produces the same result as restarting module power, initiating approximately 10 seconds of bootstrap and self-diagnostics.

Expect an additional two second delay for CK to start flashing and the UF indicator to come ON if the Radio Assembly is not connected or not powered (Refer to Section 3.4.2.3.4 for Alarm details).

3.4.2 FRONT SWITCH (MULTI-FUNCTION PF 1)

- Clears LED error indications
- Initiates test transmissions
- Sets the function of the RS-232 LEDs

Major and minor error LED indications remain lit on the front panel until:

- The unit is RESET
- The unit is powered OFF and ON again
- PF1 is pressed

The PF1 switch can be pressed at any time to clear an error display without affecting normal operations.

3.4.2.1 TEST TRANSMISSIONS

To select a pattern and begin transmission, press and hold the PF1 switch. Observe all five RS-232 LEDs light. After two seconds, the RS-232 LEDs turn OFF to indicate the unit has entered TX Select mode. Release PF1 switch.

Following release:

- Start of selection must be made within two seconds. If not, the unit will default to Pattern 1 and start test transmitting.
- PF1 may be pressed more than once. The number of times it is pressed determines the type of pattern that will be transmitted according to Table 7 (DGMSK) and Table 8 (xRC4FSK/xRC8FSK).

- Each time you press the PF1 switch, the two-second timer is extended.
- The three rightmost RS-232 LEDs are used to indicate TX mode selection as shown in Table 6

Table 6 - Binary TX Mode Selection LED Indications

Pattern	FT LED	RD LED	TD LED
1	Off	Off	On
2	Off	On	Off
3	Off	On	On
4	On	Off	Off
5	On	Off	On
6	On	On	Off
7	On	On	On

Table 7 - DGMSK Test Transmissions

Pattern	Data Rates		
	8000 b/s	9600 b/s	19200 b/s
1	2000 Hz Dotting	2400 Hz Dotting	4800 Hz Dotting
2	4000 Hz	4800 Hz	9600 Hz
3	100 Hz Square wave		
4	Random data		
5	Unmodulated		
6	1000 Hz sine wave; beacon mode		
7	1000 Hz sine wave; adjustment tone		

Table 8 - Test Transmissions xRC4FSK/xRC8FSK

Pattern	xRC4FSK / xRC8FSK				
	32000 b/s	**25600 b/s 43200 b/s**	**19200 b/s**	**16000 b/s 24000 b/s**	**14400 b/s 21600 b/s**
1	4000 Hz Dotting*	3200/3600 Hz Dotting*	2400 Hz Dotting*	2000 Hz Dotting*	1800 Hz Dotting*
2	Do not use				
3	100 Hz Square wave				
4	Random data				
5	Unmodulated				
6	1000 Hz sine wave; beacon mode				
7	1000 Hz sine wave; adjustment tone				

* Dotting with reduced amplitude

Notes:

- For DGMSK models, a dotting pattern consists of an alternating series of bits.
- For the xRC4FSK and xRC8FSK models, a dotting pattern consists of an alternating series of bits where only the lowest-level symbol's modulation is used.
- The square wave is used to check transmitter low frequency balance.

- Pattern 6 produces repeated transmissions of approximately 55 seconds followed by about 55 seconds of silence. The Initial transmission in a sequence may be shorter than 55 seconds. TX LED stays steadily red for duration of the test. Press PF1 to terminate beacon mode.

Once the type of transmission is selected, stop pressing PF1 and allow the two-second timer to run down. Automatically, the BDLC turns its transmitter ON, sends the selected "test pattern" for 55 seconds, and turns its transmitter OFF. The TX LED in the RF group of indicators lights in red while test transmitting. If PF1 is pressed while the 55 seconds test is in progress, the test will stop.

At the end of test transmission BDLC operation returns to normal and the RX LED lights green to indicate it is monitoring normal transmitter activity.

3.4.2.2 RS-232 LED FUNCTION SELECTION

The PF1 switch may be used to select the RS-232 display mode as follows:

- If pressed *ONCE* (do not hold pressed):
  - Clears Alarm indications.
  - CK LED stops flashing for 2 seconds.
  - During this time, one or all of the RS-232 numbered LEDs will light. If one LED lights, it denotes the port to which the subsequent display applies. If all numbered LEDs light, it denotes that the normal 3-port display mode is active.

The selected display remains active until manually changed or until RESET is pressed or until power up.

Table 9 - RS-232 LED Function Selection Sequence

RS-232 LED Function Selection Sequence	
ALL 1 2 3 4 (reserved) 5 (reserved)	TX LED in RF group lights with any and all transmission
ALL 1 2 3 4 (reserved) 5 (reserved)	TX LED in RF group only lights with an ACK or DATA transmission

- If, during the 2 seconds period that CK is not flashing, PF1 is pressed a second time, the LED functions will advance one step from top to bottom through the available options in the order shown in the table above.
- PF 1 may be pressed repeatedly during the 2 second period (extended with each press) to advance to the desired numbered LED function option.

Once the desired RS-232 LED function is selected, stop pressing PF1 and allow the two-second timer to run down. The BDLC returns to normal operation using the newly selected display.

3.4.2.3 LEDS AND INDICATIONS

LEDs are used to indicate BDLC operation status. They are grouped by function.

Figure 22 - BDLC^{PD+} Front Panel Details

3.4.2.3.1 RADIO NETWORK INDICATORS

The Radio Network (RF) Group of LEDs indicates radio network activity. All displays are green except TX also uses red.

- **CS (Carrier Sense).** Flashing green indicates that an incoming data signal is being detected by the DSP modem. CS signal is not user-adjustable.
- **RX (Receive Data).** Flashing green indicates unit is receiving data from the radio network.
- **TX (Transmitter ON).** Flashes green to indicate: (a) a data packet or ACK (packet acknowledgment) is being transmitted, or (b) an idle packet, data packet or ACK is being sent. Indication is dependent on display mode selected. Steady red indicates a test transmission in progress.

3.4.2.3.2 RS-232 INDICATORS

The RS-232 LEDs display serial port status in green. Refer to Section 3.4.2.2 to select display mode.

- **CM (Command Mode).** LED lights and remains lit while the selected port is accessing the Command Processor. It lights ON and OFF while being configured.
- **FR (Flow Control on Receive).** The radiomodem has received a flow control signal from the device connected to it. When it lights, BDLC^{PD+} has stopped sending data to the DTE. When LED goes out, the port terminal is again ready to receive data. Steady green can indicate that the DTE device is not connected.
- **FT (Flow Control on Transmit).** The radiomodem has sent a flow control signal to the DTE asking it to stop sending data. The LED remains lit as long as the terminal is being held off.
- **RD (Receive Data).** When lit, Receive Data (pin 2) is active. BDLC^{PD+} modules are configured as DCE, it means that the DTE is receiving data from the BDLC^{PD+} module.
- **TD (Transmit Data).** When lit, Transmit Data (pin 3) is active; The DTE is sending data to the BDLC^{PD+} module.

3.4.2.3.3 CHECK AND POWER LEDS

CK (Check)

- Rapid blink (~6x/sec) indicates power is applied and microprocessors are working correctly.
- Slow blink (~1x/sec) indicates the parameter contents of the flash memory have been corrupted. The module automatically loads its set of factory default parameters and starts beeping at 20 seconds intervals.
- Not flashing indicates unit is not functioning.

3.4.2.3.4 ALARM INDICATORS

The ALARMS group of LEDs displays fault status in red; all alarm conditions will cause the BDLC^{PD+} to light one or more of the LED indicators. LEDs remain on until cleared by either pressing PF 1 (without affecting operation of the unit) or RESET (powering unit OFF and ON).

LM (Local Minor) - when lit, indicates the presence of any of the following minor faults:

- Parity, framing or overrun error at any RS-232 port.
- Out of buffers. No memory available to accept data from a local terminal device. Usually denotes a flow control problem.
- Flash memory error. At power-up or reset, the unit detected a change in non-volatile memory.

RM (Remote Minor) - when lit, indicates any of the Local Minor Alarms listed above have taken place at the remote end of the link (i.e. the mobile the local base station is currently communicating with). It will also light when a protocol error has been detected on the network.

In a network using the "Host Link Active" (MSC) feature, the RM LED, flashing in-sync with the CK LED, indicates that the link is down.

UF (Unit Failure) - when lit, the unit requires attention:

- The BDLC^{PD+} unit is not operable; may indicate detection of a system software error trap.

3.4.3 BDLC^{PD+} REAR PANEL

The rear panel of the BDLC^{PD+} unit has the following connectors:

- Three DE-9F connectors:
  - DEV1 - to user's application - DMP or MSC-P 38400 or 19200 baud for single-site installations (38400 baud is recommended)
  - DEV2 - usually connected to Dataradio's WinRIS program (Dedicated or DMP at 19200 baud)

  - DEV3 - Dedicated (up-to 9600 baud)
- One DB-25M connector:
  - EXT RADIO - to the Radio Assembly through the radio interface cable
  - RS-232 Signal Levels

In the description of RS-232 data signals, the following conventions are used:

Table 10 - RS-232 Signal levels

Term	Alternates	Signal level
ON	Asserted, spacing	+3V to +15V
OFF	Dropped, marking	-3V to -15V

3.4.3.1 RS-232 PIN FUNCTIONS

Table 11 - DTE Port 9-Pin Functions

DE-9 F Pin#	Function (RS-232 signal levels)
1	DCD – from BDLC^{PD+}, normally asserted
2	RXD – data from BDLC^{PD+}
3	TXD – data to BDLC^{PD+}
4	DTR – to BDLC^{PD+}, handshaking
5	Ground
6	DSR – from BDLC^{PD+}, tied to VCC through current limiting resistor
7	RTS - to BDLC^{PD+}, handshaking
8	CTS – from BDLC^{PD+}, handshaking
9	Reserved

4 MAINTENANCE & TESTING

4.1 EQUIPMENT REQUIRED

- In-line RF power meter in the 0.5W range for the 150 mW exciter module power output. Consider wattmeter in the -10W range for the reflected power and in the -150W range for the forward power of the power amplifier.
- Radio service monitor (IFR-120B with option 03: 30KHz IF filter or equivalent).
- Short RG-223 cable (<2ft) with N-Type male connector to connect the exciter module to the service monitor if necessary. Short RG-214 cable (<1 foot) with N-Type male connector to connect the power amplifier module to the service monitor if necessary.
- RF load 50Ω 150W.
- Paragon4^{PD+} Installation CD-Rom.

Before proceeding make sure that the service monitor has been calibrated recently and has warmed up for at least the time specified by its manufacturer. Some reported frequency and deviation problems have actually been erroneous indications from service monitors that have not adequately warmed up. This is particularly likely when field service is done during winter months.

4.2 MAINTENANCE PROGRAMS

The Paragon4^{PD+} comes with a number of programs to perform maintenance and test operations. The programs are available on a CD that is included with your shipment.

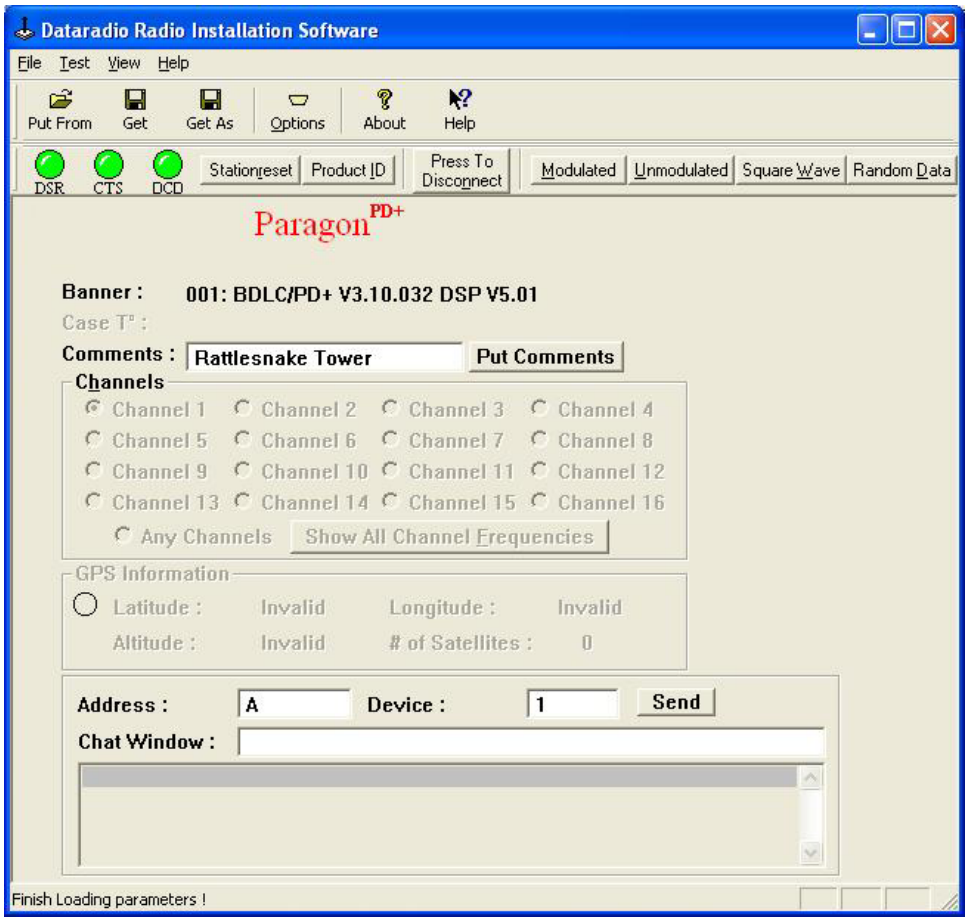
These programs are:

- WinRIS.exe
- 4PDPLUS_SDR_Tx_Freq.exe
- 4PDPLUS_SDR_Rx_Freq.exe

WinRIS provides online Help to describe in detail the menu and button actions. Operation of the other programs is described below.

4.2.1 WINRIS.EXE

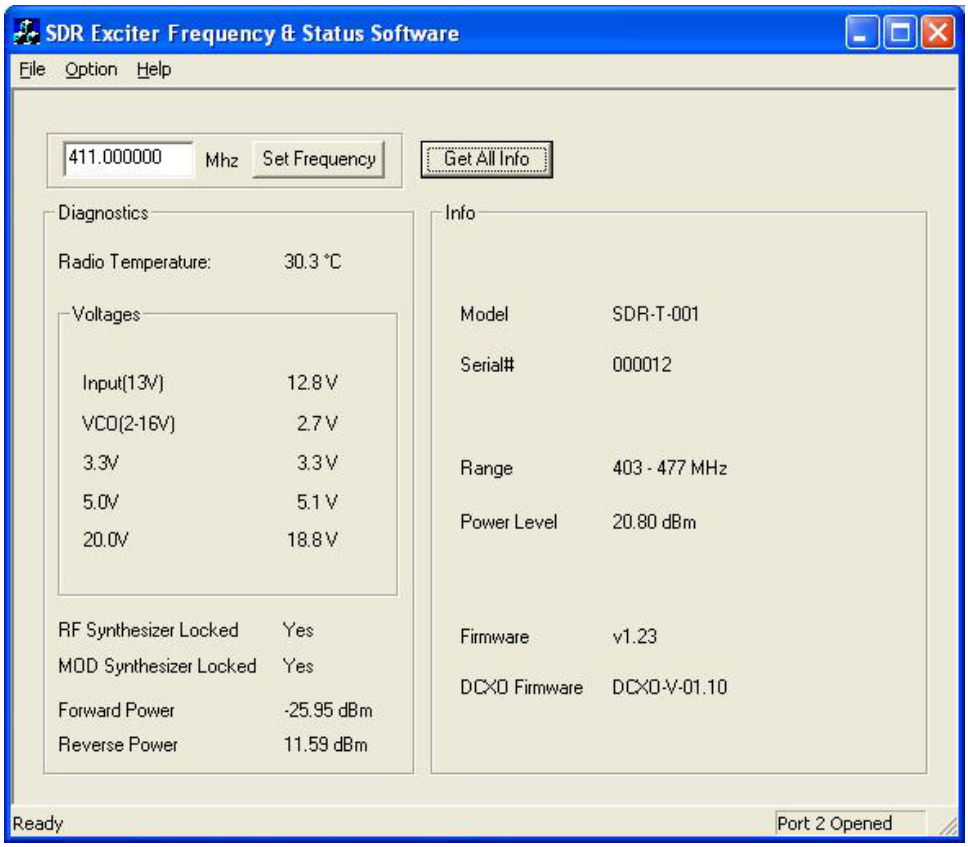
This program, when connected to DEV 1 of the BDLC module, allows the operator to assign a unique Comment or description to a tower. It can be used to backup (Get/Get As) and restore (Put From) the configuration of a unit. The configuration file is also useful when contacting Technical Support.



As detailed later in this chapter, WinRIS allows the sending of various patterns (Modulated/Unmodulated/Square Wave/Random Data) for testing & tuning the Exciter and Power Amp modules, and to send data messages to remote units to confirm full operation of the system.

4.2.2 4PDPLUS_SDR_TX_FREQ.EXE

This program allows the operator to interrogate and change the operating transmit frequency of the SDR Exciter module and to display diagnostic and status info that may be useful when contacting Tech Support or System Engineering.

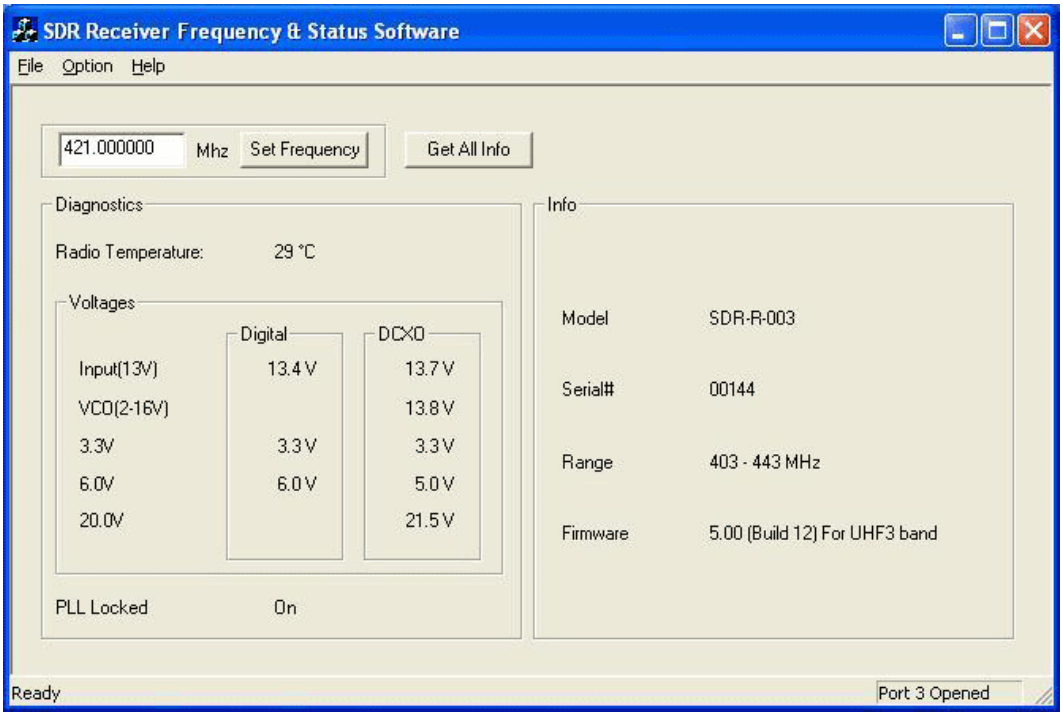


To use this program, connect a serial cable to the port on the front of the module. Start the program and, if necessary, select the appropriate port via the Option | COM Port... menu choice. The program will interrogate the module and fill out the page. The values can be refreshed by clicking the Get All Info button. Note that Forward and Reverse Power values may be inaccurate if the module has not transmitted since it was last powered on. Also the Input (13V) value is the output of a 13V +/-0.3V (factory adjusted) internal voltage regulator, not the actual input DC supply source to the unit.

To change the transmit frequency, enter a value in the allowable Range and with the correct channel spacing then click Set Frequency. Note that a frequency change will be rejected if the module is transmitting. It is recommended to disconnect the DC IN plug at the rear of the BDLC. After the frequency has been successfully changed, reconnect DC IN and use the test tone buttons in WinRIS to measure and confirm the new frequency.

4.2.3 4PDPLUS_SDR_RX_FREQ.EXE

This program allows the operator to interrogate and change the operating receive frequency of the Diversity SDR Rx module and to display diagnostic and status info that may be useful when contacting Tech Support or System Engineering.



To use this program, connect a serial cable to the port on the front of the module. Start the program and, if necessary, select the appropriate port via the Option | COM Port... menu choice. The program will interrogate the module and fill out the page. The values can be refreshed by clicking the Get All Info button. Note the Input (13V) value is the actual input DC supply source to the unit, but internally fused and filtered.

To change the transmit frequency, enter a value in the allowable Range and with the correct channel spacing then click Set Frequency.

4.3 POST INSTALLATION CHECKS

The checks described below should be done at the time of installation and at annual intervals. They should also be performed whenever performance deterioration is noted.

1. LED Indications
2. Using WinRIS; Save “unit config” to file
3. Transmitter Output Power
4. Transmitter Reflected Power
5. RF Link test between Paragon4^{PD+} and mobile unit(s)

Paragon4^{PD+} units are set and characterized at the factory for optimal performance. It is not recommended to try readjusting units unless it is really required. Misadjusting a unit may result in significant performance losses. The proposed adjustments in the "If Not?" column below, should be tried ONLY if system data performance degradation is noticed combined with out-of-tolerance items.

Table 12 - Post Installation Checklist

Test	Action	Expected Results at 25°C	Measure With	If Not?
Check 1 LED Indications	Normal Power-up Sequence.	Refer to Section 3.4.2.3 for proper LED functionality.		
Check 2 Save “unit config” to file	In WinRIS, click the Get (or Get As) button.	As per WinRIS Help content.		
Check 3 Transmitter Output Power	Press PF1 1+5 times. (Refer to Section 3.4.2.1); In WinRIS, click Unmodulated.	50–100 Watts* for UHF 35–70 Watts* for 800 MHz +10%, -10%	Service monitor set to read power or 150W in-line wattmeter installed as close as possible to the unit’s antenna connector.	Verify if PA front panel LEDs are off, except PWR LED on green. If not Check for bad connections, damaged coax cable, etc. Also check power at exciter module output. Should be in the range of 100-200mW.
Check 4 Transmitter Reflected Power	Press PF1 1+5 times. (Refer to Section 3.4.2.1); In WinRIS, click Unmodulated.	< 5% of forward power or as specified by CalAmp System Engineering.	10W in-line wattmeter.	Same as check 3.
Check 5 RF Link Test	Use the mobile address function and Send button to dynamically test the link.	Look for Delivery Confirmed on the Status bar.	Refer to 4.4.2 and to WinRIS Help content.	Mobile is out of range; Refer to factory technical support.

Note. Readings may appear less than factory calibrated values due to losses in cables used during testing. Also, check your wattmeter frequency calibration curve before adjusting power on the Power Amplifier.

4.4 ANNUAL & PERIODIC TESTING

In addition to the tests detailed in Section 1.3, the following should be done at least once per year.

6. Carrier Frequency Error
7. TX Deviation
8. Low Frequency Balance
9. 12 dB SINAD
10. Receiver Distortion
11. RSSI Check
12. Verify power supply connections and terminal torque settings as detailed in Figure 10.

Table 13 lists the backplane test points referred to by the Maintenance Checklist steps in Table 14.

Table 13 - Backplane Test Points

Backplane Test Points Rx				
		Access Port	Alternate Pin-out	
Test		J9	J18	J19
Ground		Pin 14	Pin 3	Pin 3
SINAD & Distortion	RX1 – Differential	Pin 3(P), Pin 8(N)	Pin 1(P), Pin 2(N)	–
SINAD & Distortion	RX2 – Differential	Pin 4(P), Pin 9(N)	–	Pin 1(P), Pin 2(N)
RSSI	RSSI 1 – Differential	Pin 1(P), Pin 6(N)	Pin 4(P), Pin 5(N)	–
RSSI	RSSI 2 – Differential	Pin 2(P), Pin 7(N)	–	Pin 4(P), Pin 5(N)

Table 14 - Maintenance Checklist (General)

Test	Action	Expected Results at 25°C	Measure With	If Not?
Check 6 Carrier Frequency Error	Press PF1 1+5 times (Refer to Section 3.4.2.1). In WinRIS, click Unmodulated.	< ±300 Hz	Service monitor set to read frequency error.	If the carrier frequency error is found to be out-of-specs, contact CalAmp technical support.
Check 7 TX Deviation	Press PF1 1+7 times (Refer to Section 3.4.2.1).. In WinRIS, click Modulated. Carrier will be modulated with a 1 kHz tone.	Refer to **Table 15** per bit rates. Tolerance is +5%, -10% for all bit rates. Record the deviation level.	Service monitor set to read deviation. (IF filter set to Mid or 30 kHz position).	If the TX deviation is found to be out-of-specs, adjust according to Section 4.4.1.1 or contact CalAmp technical support.
Check 8 Low Frequency Balance	Press PF1 1+4 times (Refer to Section 3.4.2.1). In WinRIS, click Random Data.	Record the deviation level. Compare the difference between check 7 & 8. It should be: <700 Hz (DGMSK) <1.6 kHz (xRC4FSK, xRC8FSK : HC & NPSPAC) < 2.1 kHz (xRC4FSK, xRC8FSK : FC)	Service monitor set to read deviation. (IF filter set to Mid or 30 kHz position, all audio filtering disabled).	If the low frequency balance is found to be out-of-specs, contact CalAmp technical support.

Test	Action	Expected Results at 25°C	Measure With	If Not?
For the following tests, connect a 50 ohm dummy load to the transmitter output and set the service monitor to generate on the selected receive frequency. Verify alternately for both receivers. The carrier should be modulated with a 1.0 kHz tone at deviation level specified below:				
Check 9 12 dB SINAD	(Recommended wide band measurement method: no audio filtering) For Full channel unit, set deviation to ±3 kHz. For Half channel unit, set deviation to ±1.5 kHz.	Better than -109 dBm for 12.5KHz channel and -110 dBm for 25KHz channel using a 2ft RG-223 coax cable.	Backplane corresponding to the receiver being verified: J18 pin 1 for RX1 or J19 pin1 for RX2. GND pin available at TP33. Service monitor (IFR) set to SINAD. IFR IF filter set to MID position or 30 kHz wide filter.	If the 12 dB SINAD is found to be out-of-specs, check for bad connections, damaged coax cable, etc. If not OK, contact CalAmp technical support.
Check 10 Receiver Distortion	(Recommended wide band measurement method: no audio filtering) Set service monitor RF Gen output to –70 dBm *Deviation level as per SINAD above.*	≤ 3 %	Backplane corresponding to the receiver being verified: J18 pin 1 for RX1 or J19 pin1 for RX2. GND pin available at TP33. Service monitor (IFR) set to DISTORTION. IFR IF filter set to MID position or 30 kHz wide filter.	If the Distortion is found to be out-of-specs, check for bad connections, damaged coax cable, etc. If not OK, contact CalAmp technical support.
Check 11 RSSI Check	Apply to each receiver input the following RF level: -80dBm, unmodulated. -→ -110dBm, unmodulated. -→	BSC2 must be connected to the radio during the measurements: 2.75 VDC (±0.2 VDC) 1.45 VDC (±0.2 VDC)	Backplane corresponding to the receiver being verified: J18 pin 4 for RSSI1 or J19 pin 4 for RSSI2. GND pin available at TP33. DC Voltmeter measurement.	Refer to CalAmp technical support only if RX data performance degradation is noticed combined with out of tolerance RSSI readings.
Check 12 RCV GATE LEVEL Check	Apply to receiver RX-1, a RF level of -110dBm modulated with a 1KHz tone at specified deviation level. Set the RF level to -116dBm, the channel 1 LED should go off. Repeat above steps for receiver RX-2.	The channel 1 LED should be ON green. The channel 1 LED should be off.		Using a small flat head screwdriver, turn the RCV GATE LEVEL control counter clockwise until the channel 1 LED is ON. Similarly, turn the control clockwise until the 1 LED is off.

Table 15 - Carrier Deviations for Tone or Data Modulation

Carrier Modulation								
DGMSK			**xRC4FSK**			***x*RC8FSK**		
	Tone	Data		Tone	Data		Tone	Data
Network Speed (b/s)	Typical deviation in kHz (1000 Hz test tone)	Maximum deviation in kHz	Network Speed (b/s)	Typical deviation in kHz (1000 Hz test tone)	Maximum* deviation in kHz	Network Speed (b/s)	Typical deviation in kHz (1000 Hz test tone)	Maximum* deviation in kHz
Full Channel (UHF)								
19200	± 3.7	± 4.2	32000	± 4.3	± 6.0			
9600	± 4.2	± 4.7	25600	± 3.9	± 5.4	43200	± 4.3	± 6.0
			19200	± 4.3	± 6.0			
Half-Channel (UHF)								
8000	± 2.1	± 2.6	14400	± 2.3	± 3.3			
9600	± 2.0	± 2.5	16000	± 1.9	± 2.8	21600	± 2.2	± 3.2
Full Channel (800 MHz)								
			32000	± 2.8	± 3.9	43200	± 3.2	± 4.5
NPSPAC Channel (800 MHz USA-only)								
			16000	± 2.5	± 3.7	24000	± 2.5	± 3.7
*Data deviation shown may seem higher than tone deviation, however they fall within the appropriate FCC/IC masks limits								

4.4.1.1 PARAGON4^{PD+} DEVIATION ADJUST

The Paragon4^{PD+} base station has an auto-deviation feature that is exclusive to native xRC4FSK and xRC8FSK bit rates. It is factory-calibrated within the radio transmitters tuning range. The manual procedure outlined below may ONLY be carried out if:

- The deviation readings are found to be out of spec.
- Legacy DGMSK bit rates.

Manual adjustment procedure:

1. Using WinRIS, press **Modulated** button and record deviation level as read on the IFR.
2. Using Windows Notepad, edit the .bp2 file named with the corresponding BDLC^{PD+} serial number (e.g. abcd.bp2). "Save as" to another file name and keep it in case something goes wrong while changing a parameter.
3. Locate the line labeled "Dev0 Par85=" and record the value beside the "=" sign. This is the corresponding parameter value to the deviation read in step 1.
4. Apply the following formula to determine the new parameter value to be set:
   (New Par85 value) = [(initial Par85 value) X (target deviation) / (deviation read)] + 2
5. Change the value in the file, "Save as" using the BDLC^{PD+} unit serial number file name.
6. Run WinRIS again and do a "Put From". From the opened window, select the file that you just made the change to and then press "OK".
7. Again, check deviation level while pressing **Modulated** button.

If the level is now correct, press *Stationreset* to make the change permanent. Otherwise do step 5 again, changing the value entered in the file by 1 or 2 digit(s) up or down, fine-tuning directly the Par85 (DSP deviation) parameter. Do steps 6 and 7 again to confirm acceptance. *This last step may have to be repeated once or twice while varying the entered value up or down. If unable to obtain the correct level after editing up and/or down by no more than 2, contact System Engineering.*

Note: Dev0 Par 85 is set to zero for auto-deviation mode.

4.4.2 RF DATA LINK TEST

A link test between a mobile and a base station can be done using the WinRIS "Address" and "Send" functions. The "Address" and "Device" fields, the "Send" button and the "Chat" message screen are used to send messages to specific mobile to text connectivity on the RF channel.

1. Specify the Address of the mobile (its Electronic Serial Number, consisting of uppercase letters between A and P).
2. Enter the Device number for mobile (usually 1).
3. Press the Send button. The Chat window reports "Sent to xx mobile" (where xx is mobile address).
    a. If test is successful, Status line reports "Delivery confirmed”.
    b. If test is unsuccessful:, Chat window reports "Waiting"…Status line reports "Delivery Failed".

5 SPECIFICATIONS

GENERAL	
Frequency Range (MHz)	FCC (Part 90) 406.1 – 512 Rx/Tx; 806-824 Rx, 851-869 Tx IC (RSS-119) 406 – 430 Rx/Tx & 450-470 Rx/Tx; 806-824 Rx, 851-869 Tx
Channel Spacing	12.5 or 25 kHz for UHF NPSPAC or 25 kHz for 800 MHz
Mode of Operation	Full Duplex, 100% duty cycle
Cabinet Size (WxHxD)	22.06 x 75.82 x 27.06 inches (without leveling feet)
Radio Assembly Size	(Rackmount) 19.0" W x 10.5" H x 12.5" D + 2.0" connector allowance
BDLC PD+ Size	(Rackmount) 19.0" W x 1.7" H x 6.1" D
PA Assembly Size	(Rackmount): 19.0" W x 7.0" H x 6.0" D
Power Supply Assembly Size	(Rackmount): 19.0" W x 3.5" H x 16.5" D (AC/DC Power supply, optional)
Frequency Stability	1.0 ppm (-30°C to +60°C)
Supply Voltage	120 VAC / 6A max, 60 Hz to 13.8 VDC or 13.8 VDC nominal, negative ground (13.1 to 14.5 VDC range for rated PA power)
Circuit protection	Radio backplane: Main fuse (F1) 10A Blade fuse & crowbar diodes for reverse polarity protection Power Amplifier: Fuse protected, overvoltage protected & current limited via optional AC/DC power supply, or PA power cable with in-line 30A fuse for customer supplied DC power source BDLCPD+: Fuse protected, 1A 250V
RX Current Consumption @ 13.8 VDC	2.5A max. (Two receivers with speaker monitoring)
TX Current Consumption @ 13.8 VDC	24A DC typical @ 25C, 450 MHz & 100W (26.5A DC max for -30° to +60°C, 406.1-512 MHz & 100W) 23A DC typical @ 25C, 860 MHz & 70W (26A DC max for -30° to +60° C, 851-869 MHz & 70W)
Operating Temperature Range	-30°C to +60° C, except for optional AC/DC Power Supply rated for-30°C to +50° C

RADIO	
Receiver Sensitivity @ 12-dB SINAD (Psophometrically weighted)	-116 dBm
Selectivity (25KHz /12.5KHz)	85 dB / 67 dB (typical) for UHF & 85 dB / 85 dB NPSPAC (typical) for 800 MHz
Spurious Response Rejection	100 dB (typical)
Intermodulation Rejection (25KHz/ 12.5KHz)	83 dB / 80 dB (typical) for UHF & 83 dB / 83 dB NPSPAC (typical) for 800 MHz
Receiver Frequency range	406.1 – 512 MHz for UHF and 806-824 MHz for 800 MHz
Transmitter Frequency range	406.1 – 512 MHz for UHF and 851-869 MHz for 800 MHz
Power Output (field service adjustable)	50-100W for UHF 40-70W for 800 MHz
Spurious Emissions: - transmit - standby	 <-36 dBm to 1 GHz, <-30 dBm to 3.2 GHz <-57 dBm to 1 GHz, <-47 dBm to 3.2 GHz
VSWR Stability	> 5:1 mismatch

Operation	Full duplex			
Protocol	Dataradio Proprietary DBA with OOB AAVL support			
Data Rates and Modulation Type	DGFSK (8000 b/s, 9600 b/s, 19200 b/s) SRRC4FSK (14400 b/s, 16000 b/s,19200b/s, 25600 b/s) RC4FSK (32000 b/s) SRRC8FSK (21600 b/s, 24000 b/s, 43200 b/s)			
Rx Sensitivity (for 1% Packet Error Rate with Parallel Decode, at carrier frequency)	UHF Full Channel	800 MHz Full Channel	UHF Half Channel	800 MHz NPSPAC Channel
	–112 dBm @ 19.2 kb/s			
	–110 dBm @ 25.6 kb/s		–112 dBm @ 14.4 kb/s	
	–108 dBm @ 32 kb/s	–108 dBm @ 32 kb/s	–109 dBm @ 16 kb/s	–113 dBm @ 16 kb/s
	–106 dBm @ 43.2 kb/s	–105 dBm @ 43.2 kb/s	–108 dBm @ 21.6 kb/s	–111 dBm @ 24 kb/s

Approvals & Certifications	
FCC Part 90	CWWUHFP10XXUL1 (PA, 100W, 403-470 MHz) TBD (PA, 100W, 450-512 MHz) EOTBDP4-EXCT403 (Exciter, 0.4W, 403-477 MHz) EOTBDP4-EXCT438 (Exciter, 0.4W, 438-512 MHz) EOTBDP3-CRE800 (PA, 70W, 851-869 MHz) EOTBDD4-EXT8 (Exciter, 0.4W, 851-869 MHz)
IC (RSS119)	7291A-UHFP10XXUL1 (PA, 100W, 403-470 MHz) 731A-BDP4EXCT403 (Exciter, 0.4W, 403-477 MHz) 773A-BDP3CRE8 (PA, 70W, 851-869 MHz) 773A-BDD4EXT8 (Exciter, 0.4W , 851-869 MHz)

Table 16 – Emission Designators

Bit rate	Baud rate	Modulation	UHF	
43200	14400	SRRC8FSK	16K0F1D (C)	13K4F1D (H)
32000	16000	RC4FSK	15K6F1D (C)	13K4F1D (H)
25600	12800	SRRC4FSK	14K7F1D (C)	
24000	8000	SRRC8FSK		10K0F1D (H)
21600	7200	SRRC8FSK	8K10F1D (D)	
19200	9600	SRRC4FSK	15K9F1D(C)	
16000	8000	SRRC4FSK	7K50F1D (D)	10K0F1D (H)
14400	7200	SRRC4FSK	8K10F1D (D)	

Emission designators for legacy DGMSK modulations are available on certificates.

APPENDIX A– PRODUCT WARRANTY

CalAmp warrants to the original purchaser for use ("Buyer") that data telemetry products manufactured by DRL ("Products") are free from defects in material and workmanship and will conform to DRL's published technical specifications for a period of, except as noted below, one (1) year from the date of shipment to Buyer. DRL makes no warranty with respect to any equipment not manufactured by DRL, and any such equipment shall carry the original equipment manufacturer's warranty only. DRL further makes no warranty as to and specifically disclaims liability for, availability, range, coverage, grade of service or operation of the repeater system provided by the carrier or repeater operator. Any return shipping charges for third party equipment to their respective repair facilities are chargeable and will be passed on to the Buyer.

If any Product fails to meet the warranty set forth above during the applicable warranty period and is returned to a location designated by DRL. DRL, at its option, shall either repair or replace such defective Product, directly or through an authorized service agent, within thirty (30) days of receipt of same. No Products may be returned without prior authorization from DRL. Any repaired or replaced Products shall be warranted for the remainder of the original warranty period. Buyer shall pay all shipping charges, handling charges, fees and duties for returning defective Products to DRL or DRL's authorized service agent. DRL will pay the return shipping charges if the Product is repaired or replaced under warranty, exclusive of fees and duties. Repair or replacement of defective Products as set forth in this paragraph fulfills any and all warranty obligations on the part of DRL.

This warranty is void and DRL shall not be obligated to replace or repair any Products if (i) the Product has been used in other than its normal and customary manner; (ii) the Product has been subject to misuse, accident, neglect or damage or has been used other than with DRL approved accessories and equipment; (iii) unauthorized alteration or repairs have been made or unapproved parts have been used in or with the Product; or (iv) Buyer failed to notify DRL or DRL's authorized service agent of the defect during the applicable warranty period. DRL is the final arbiter of such claims.

THE AFORESAID WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED AND IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DRL AND BUYER AGREE THAT BUYER'S EXCLUSIVE REMEDY FOR ANY BREACH OF ANY OF SAID WARRANTIES IT AS SET FORTH ABOVE. BUYER AGREES THAT IN NO EVENT SHALL DRL BE LIABLE FOR INCIDENTAL, CONSEQUENTIAL, SPECIAL, INDIRECT OR EXEMPLARY DAMAGES WHETHER ON THE BASIS OF NEGLIGENCE, STRICT LIABILITY OR OTHERWISE. The purpose of the exclusive remedies set forth above shall be to provide Buyer with repair or replacement of non-complying Products in the manner provided above. These exclusive remedies shall not be deemed to have failed of their essential purpose so long as DRL is willing and able to repair or replace non-complying Products in the manner set forth above.

This warranty applies to all Products sold worldwide. Some states do not allow limitations on implied warranties so the above limitations may not be applicable. You may also have other rights, which vary from state to state.

EXCEPTIONS

THIRTY DAY. Tuning and adjustment of telemetry radios
NO WARRANTY: Fuses, lamps and other expendable parts

Effective 1/2008

APPENDIX B – DEFINITIONS

The following terms are used throughout this document.

Asynchronous	Information that can be sent at random times, and not synchronized to a clock. Transmission characters begin with a "start" bit and end with a "stop" bit.
AVL	Automatic Vehicle Location. Optional feature that involves using GPS (Global Positioning System) signals from the mobile unit by the Host PC.
BDLC	Base Station Data Link Controller. An ASYNC radio modem designed to control the base station in mobile systems.
DBA	Dynamic Bandwidth Allocation protocol designed for short-inquiry/long response applications such as dispatch systems. Latest enhancements include support for occasional long messages inbound, and for Out-of-Band data for AVL reports with no extra overhead.
DCE	Data Communications Equipment. This designation defines the direction (input or output) of the various RS-232 interface signals. Modems are always wired as DCE.
DTE	Data Terminal Equipment. This designation defines the direction (input or output) of the various RS-232 interface signals. Most user equipment, as well as PCs, are wired as DTE.
Gemini^{PD+}	Mobile radio modem designed for use with the Paragon^{PD+} base station. Runs up to 43.2 kb/s
Network Speed	This is the bit rate on the RF link between units. Could be different from COM port baud rate.
Paragon4^{PD+}	High performance base station. Runs up to 43.2 kb/s. Uses CalAmp Software Defined Radios (SDR).
Parallel Decode®	Patented technology used by the Paragon and Gemini product families. Features dual receivers for added data decode sensitivity in multi-path and fading environments.
Radio Assembly	Modules included in the radio assembly of the Paragon4^{PD+} base stations include the SDR Diversity Receiver, SDR Exciter, and Speaker Panel.
SDR	Software Defined Radio. A **software-defined radio** system is a radio communication system where components that have been typically implemented in hardware (e.g. mixers, filters, amplifiers, modulators/demodulators, detectors, etc.) are instead implemented by means of software on a personal computer or embedded computing devices.
RS-232	Industry–standard interface for serial data transfer.
VIS	Vehicular Information Solutions. Trademarked name for a series of products specifically designed for mobile data.
WinRIS	Windows Radio Installation Software. This software allows basic tests, unit configuration, and troubleshooting.