Paragon3 (700MHz)
Data Base Station
(With Crescend 70W PA)
User Manual
Version 1.03

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History

Version 1.03: December 2007

- Introduces "Crescend" power amplifier of 70 Watts
- Updates Web interface screen captures
- Updates NAT Overview

Version 1.02: November 2006

- Updates Definition pages
- Updates Figure 14 - Radio Backplane Assembly
- Adds backplane Table 4 – Test Points
- Updates Table 9 - Checklist B (General)
- Adds Table 10 – Carrier Deviations
- Revises sensitivity specifications (section 7 Specifications.

Version 1.01: April 2006 –

- Revision of terminology in Section 6 "Specifications" for Receiver "Sensitivity" entry.
- Revision of trademark terminology usage throughout manual.
- New captures of Figures 1, 5, and 6
- Update of power ranges in Tables 4 and 5

Version 1.00: January 2006 –

- Initial release of Paragon3 700MHz radiomodem User Manual.

About Dataradio

For over 25 years, Dataradio has been a recognized and innovative supplier of advanced wireless data products and systems for mission-critical applications. Public safety organizations, utilities, local government, water management, and other critical infrastructure operations depend on Dataradio to ensure that vital wireless data reaches the people who need it, when they need it most. From mobile data systems and radio modems, to analog radios and telemetry devices, Dataradio products are found at the heart of private wireless networks around the world.

www.dataradio.com

Dataradio provides product brochures, case studies, software downloads, and product information on our website at http://www.dataradio.com

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.

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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.

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Definitions

AAVL	Autonomous Automatic Vehicle Location. Feature that involves using GPS (Global Positioning System) signals from the mobile unit by the Host PC.
Access Point	**C**ommunication hub for users to connect to a wired LAN. APs are important for providing heightened wireless security.
AES	Advanced Encryption Standard (AES) - uses 128-bit encryption to secure data.
Airlink	Physical radio frequency connections used for communication between units and protocol (see E-DBA)
ARP	Address Resolution Protocol – Maps Internet address to physical address.
Backbone	The part of a network that connects most of the systems and networks together, and handles the most data.
Bandwidth	The transmission capacity of a given device or network.
Base	Designates products used as base stations in VIS systems. They currently include the Paragon family of products up to the Paragon3.
Browser	An application program that provides a way to look at and interact with all the information on the World Wide Web.
BSC	Base Station Controller - An async controller-modem designed for the radio base station in mobile systems. A component of Paragon3™ base station.
COM Port	RS-232 serial communications ports of the Paragon3 wireless radiomodem.
Cycle Mark	Signal transmitted on an E-DBA network that keeps the network synchronized.
Default Gateway	A device that forwards Internet traffic from your local area network.
DHCP	Dynamic Host Configuration Protocol - A networking protocol that allows administrators to assign temporary IP addresses to network computers by "leasing" an IP address to a user for a limited amount of time, instead of assigning permanent IP addresses.
DNS	Domain Name System – The on-line distributed database system used to map human-readable machine names into IP addresses.
Domain	A specific name for a network of computers.
Dynamic IP Addr	A temporary IP address assigned by a DHCP server.
Ethernet	Ethernet is a frame-based computer networking technology for local area networks (LANs). It defines wiring and signaling for the physical layer, and frame formats and protocols for the media access control (MAC)/data link layer of the OSI model. Ethernet is mostly standardized as IEEEs 802.3
Firewall	Specialized hardware or software designed to secure a computer or network from unauthorized access.
Firmware	The programming code that runs a networking device.
Fragmentation	Breaking a packet into smaller units when transmitting over a network medium that cannot support the original size of the packet.
FTP	File Transfer Protocol - A protocol used to transfer files over a TCP/IP network.
Gateway	A device that interconnects two or more networks with different, incompatible communications protocols and translates among them.
GeminiG3	High specs dual DSP mobile radiomodem with Dataradio Parallel Decode™ technology
HDX	Half Duplex. Data transmission that can occur in two directions over a single line, using separate Tx and Rx frequencies, but only one direction at a time.

HTTP	HyperText Transport Protocol - The communications protocol used to connect to servers on the World Wide Web.
IPCONFIG	A Windows 2000 and XP utility that displays the IP address for a particular networking device.
MAC ADDRESS	Media Access Control - The unique address that a manufacturer assigns to each networking device.
NAT	Network Address Translation - NAT technology translates IP addresses of a local area network to a different IP address for the Internet.
Network	A series of computers or devices connected for the purpose of data sharing, storage, and/or transmission between users.
Network speed	This is the *bit rate* on the RF link between units.
Node	A network junction or connection point, typically a computer or work station.
OIP	Optimized IP – Compresses TCP and UDP headers, and filters unnecessary acknowledgments. This makes the most use of the available bandwidth.
OTA	Over-The-Air - Standard for the transmission and reception of application-related information in a wireless communications system
Paragon3	IP-based data radio base station used in mobile networks and designed specifically to fit the needs of vehicular applications. Runs up to 128 kb/s
Parallel Decode	Patented technology used by GeminiG3 and Paragon3 featuring dual receivers for added data decode sensitivity in multi-path and fading environments. *(United States Patent No: 6,853,694 B1)*
Ping	Packet INternet Groper - An Internet utility used to determine whether a particular IP address is online.
PLC	Programmable Logic Controller. An user-provided intelligent device that can make decisions, gather and report information, and control other devices.
Roaming	Movement of a wireless node (GeminiG3) amongst Multiple Access Points (Paragon3). GeminiG3 supports seamless roaming.
Router	A networking device that connects multiple networks together.
RS-232	Industry–standard interface for data transfer.
Smart Combining	Digital processing method used to combine "Spatial Diversity" signals to optimize performance. (See Parallel Decode)
SRRC*n*FSK	Square Root Raised Cosine (*n* = level) Frequency Shift Keying. Type of frequency modulation of data signals performed by the Paragon3 radiomodem.
Spatial Diversity	Composite information from independent diversity branches using antennas spaced apart is used with "Smart Combining" to minimize fading and other undesirable effects of multipath propagation. (See Parallel Decode)
Static IP Address	A fixed address assigned to a computer or device that is connected to a network.
Static Routing	Forwarding data in a network via a fixed path.
Subnet Mask	An address code that determines the size of the network.
Switch (Ethernet)	Computer-networking device that allows sharing a limited number of ports to connect computing devices to host computers. Replaces network hubs *(layer1)*, switches *(layer2)*, routers *(layer3)*.
Sync	Data transmitted on a wireless network that keeps the network synchronized.
TCP/IP	Transmission Control Protocol/Internet Protocol - A transport *(layer4)* protocol for transmitting data that requires acknowledgement from the recipient of data sent. Handles retries and flow control.
Telnet	Network (layer5) protocol used on the Internet or on LAN connections.

TFTP	Trivial File Transfer Protocol - A version of the protocol that has no directory or password capability. Depends on UDP and is used on local network.
Topology	The physical layout of a network.
Transparent	A transparent unit transmits all data without regard to special characters, etc.
UDP	User Datagram Protocol - A transport *(layer4*) protocol for transmitting data that does not require acknowledgement from the recipient of the data that is sent.
Upgrade	To replace existing software or firmware with a newer version.
URL	Universal Resource Locator - The address of a file located on the Internet.
VIS	Vehicular Information Solutions – Dataradio's name for a series of products specially designed for mobile data. VIS = CARMA-M, VIS2 = DBA, and VIS3 = E-DBA
WINIPCFG	A Windows 98 and Me utility that displays the IP address for a particular networking device.
WLAN	Wireless Local Area Network - A group of computers and associated devices that communicate with each other wirelessly.

1. PRODUCT OVERVIEW

This document provides information required for the setting up, operation, testing and trouble-shooting of the Dataradio® Paragon3™ radio-modem base station.

1.1 Intended Audience

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

1.2 General Description

The Paragon3 radio base station is a factory-integrated industrial-grade IP-based data product used in mobile networks and is designed specifically to fit the needs of vehicular applications. The 700MHz version features diversity Software Defined Radio (SDR) receivers for added data decode sensitivity in multi-path and fading environments.

When used with Dataradio's state-of-the-art GeminiG3 mobile IP data solution, the system delivers unequaled high-speed data performance and unmatched effective throughput.

All Paragon3 models are supplied in a rackmount configuration that includes:

- A Paragon3 full-duplex radio-modem assembly that includes a Next generation high-speed Dataradio third generation "Base Station Controller" module (BSC) fitted in the radio chassis assembly.
- A 70W power amplifier manufactured by Crescend Technologies supplied in a stand-alone rackmount configuration. It is DC-powered by the Paragon3 unit.
- 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.

1.2.1 Features

- Parallel Decode (PD) technology featuring a diversity SDR receiver module for added decode sensitivity in multi-path and fading environments.
- Fully IP-based product line, using an optimized IP layer that reduces IP overhead for the RF link
- Sophisticated dual DSP-based modem design provides added system performance, fewer retries and more effective throughput.
- 700MHz / 50 kHz channels for the Public Safety band of operation:

  767-773 MHz TX (under FCC part 90) and 762-764 MHz TX (under FCC part 27)
- Full duplex operation in the 700MHz frequency band
- Base Station with 70W RF Power Amplifier (user adjustable from 35W)
- On-air data speeds and modulation types supported:

Table 1 - On-air data speeds and modulation types

Modulation type	Channel spacing – 50 kHz
SRRC4FSK	64 kb/s
SRRC8FSK	96 kb/s
SRRC16FSK	128 kb/s

- Uses Dataradio's Next generation high-efficiency Enhanced-DBA over-the-air protocol
- Over-the-air compatible with GeminiG3 mobile products
- Out-of-band signaling enables transmission of GPS reports with no effect on system performance.
- Flash programmable firmware, including over-the-air programming capability
- Paragon3 units are factory-configured based on each customer's network system requirements

1.2.2 Configuration

Paragon3 units are factory-configured. Configuration changes or upgrades are WEB-based.

1.3 Factory Technical Support

The Technical Support departments of DATARADIO provide customer assistance on technical problems and serve as an interface with factory repair facilities. They can be reached in the following ways:

For Canada and International customers:

DATARADIO Inc.

5500 Royalmount Ave, suite 200
Town of Mount Royal
Quebec, Canada H4P 1H7

Technical support hours: Monday to Friday 9:00 AM to 5:00 PM, Eastern Time

phone: +1 514 737-0020
fax: +1 514 737-7883

Email address: support@dataradio.com

or

For U.S. customers:

DATARADIO Corp.

6160 Peachtree Dunwoody RD., suite C-200
Atlanta, Georgia 30328

Technical support hours: Monday to Friday 9:00 AM to 5:00 PM, Eastern Time

phone: 1 770 392-0002
fax: 1 770 392-9199

Email address: drctech@dataradio.com

1.4 Product Warranty

Warranty information may be obtained by contacting your sales representative.

1.5 Replacement Parts

This product is usually 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 Technical Support representative may suggest a solution eliminating the need to return equipment.

1.5.1 Factory Repair

When returning equipment for repair, you must request an RMA (Returned Material Authorization) number. The Tech Support representative will 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.

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.

1.6 Packaging

Each Paragon3 – 700MHz product normally leaves the factory packaged as follows:

- A Dataradio base station “Radio-modem assembly”.
- A rackmount Crescend 70W power amplifier assembly.
- One MECA brand RF Attenuator
- Two standard seven-foot 120VAC power cord.
- DC power harness to connect the radio assembly to the power amplifier rackmount assembly.
- Co-ax cable to connect the Exciter module to the power amplifier.

Frequently, Paragon3 product components are field-assembled prior to customer delivery.
The cabinetry may then 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.

2. Installation

Figure 1 - Typical rack-mount multi-modules "Radio Assembly"

2.1 Overview

The cabinet and rack-mount housing the Paragon3's radio-modem and Power Amplifier is generally installed in a sheltered facility. Occasionally located adjacent to the nerve center of the user's network, it is 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 covers the radio-modem assembly and the power amplifier.

2.2 Location

Be sure to place the Paragon3 unit in such a way that:

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

2.3 Amplifier

Model using Crescend Technologies power amplifier *(Illustrations not drawn to scale)*.

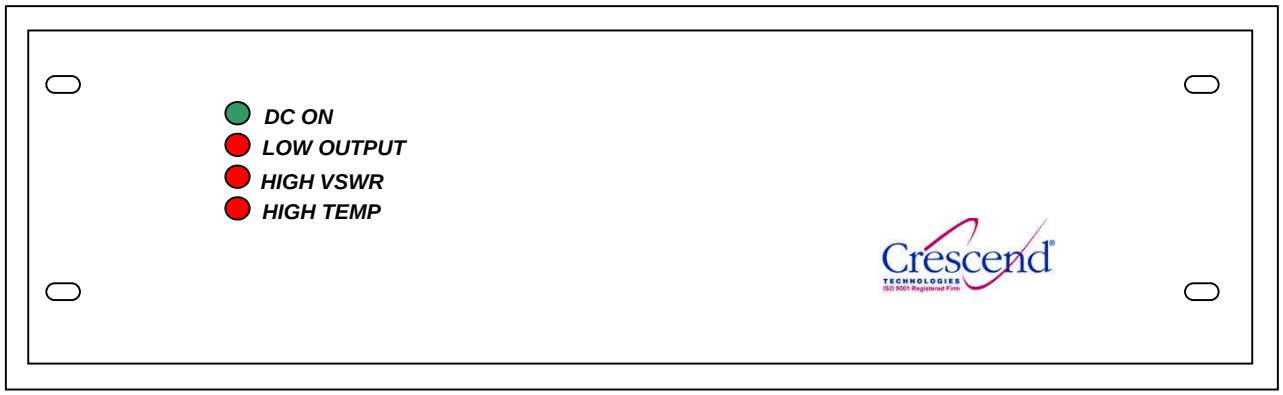


Figure 2 - Crescend Technologies 70W Power Amplifier

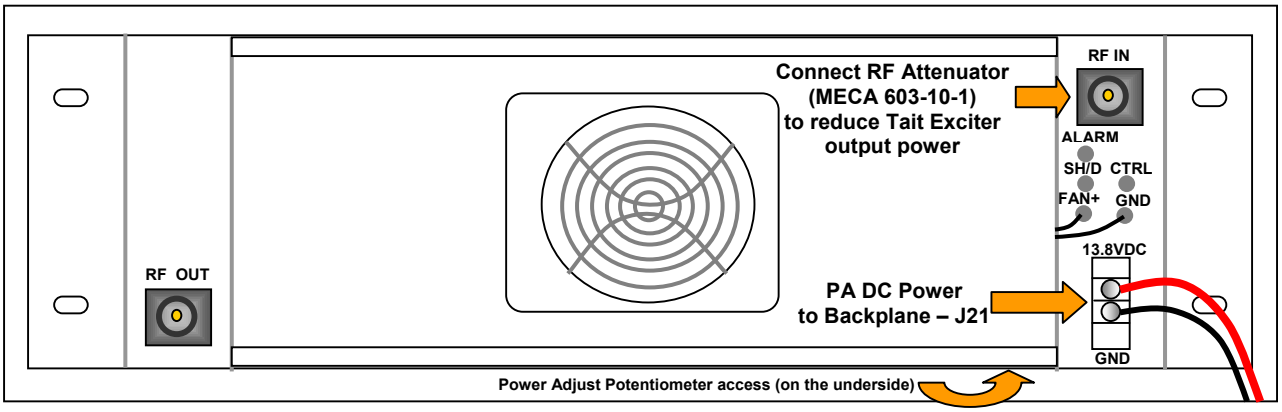


Figure 3 - Power Amplifier Rear Connections

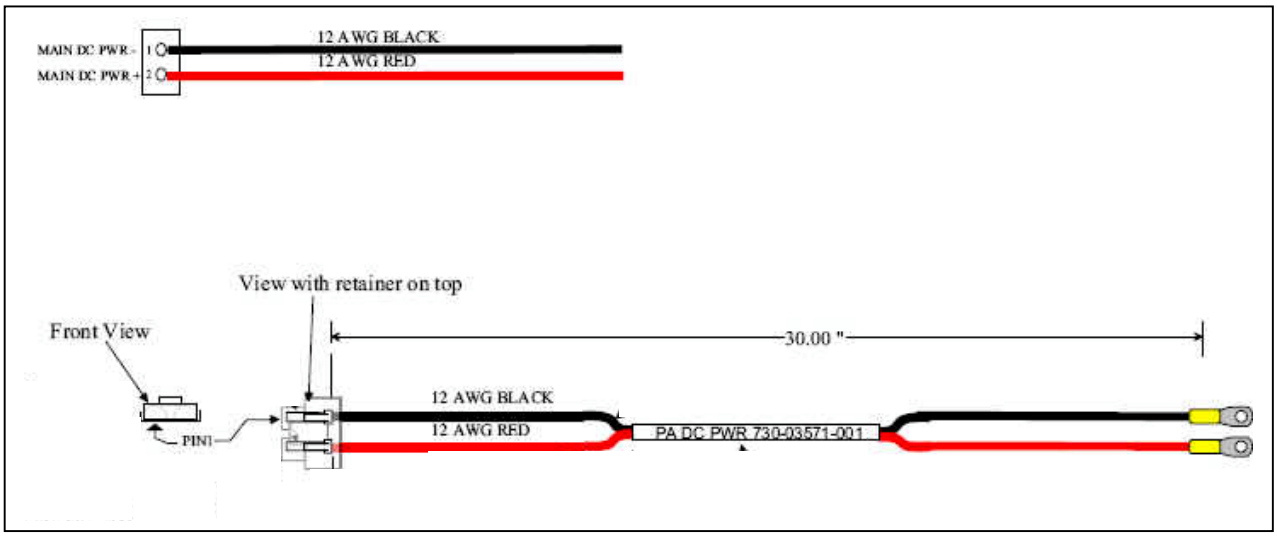


Figure 4 - Power Amplifier's DC Power cable (730 03571-001)

2.4 Rear View

Figure 5 - Paragon3 unit rear view

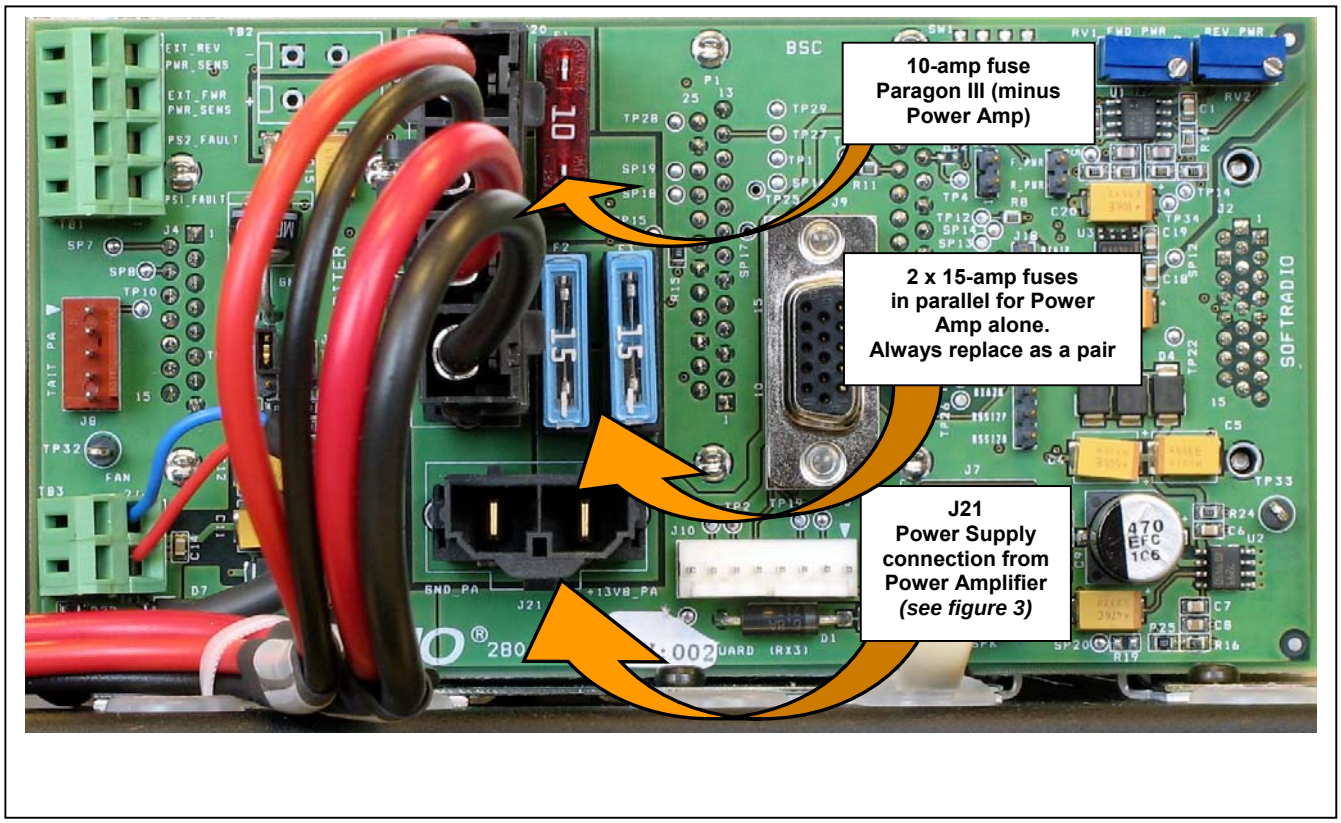


Figure 6 - Backplane

2.5 Electrical

Standard 120 VAC electrical power is required. It should be capable of providing at least 10A to power Paragon3 unit (<6A) and ancillary equipment.

2.5.1 Paragon3 Assembly Power

There are two separate power configurations commonly used:

- Paragon3 Base Station Standard Assembly *(rear view shown in the preceding pages)*.
  This prevailing configuration is described in paragraph 2.5.1.1 below.
- Paragon3 Base Station Assy. with 3rd party DC supply *(not illustrated)*.
  This configuration has wiring variations and typically uses both a third-party power supply and an optional DC-powered BSC setup. Refer to Dataradio System Engineering for further details.

2.5.1.1 Standard Power Supply Configuration

The Radio assembly unit receives 13.8 VDC power inputs from two "T809 " power supply modules powered at 120 VAC. Normally used at room ambient temperatures, it can operate within its specifications over a range of –10 to +60 °C.

Note: Internal over-temperature protection shuts down the main transformer above 105° Celsius.

Both power supply modules are internally connected to ground via their individual, rear-connected, seven-foot standard 120 VAC power cords. The Radio Assembly chassis requires a secure ground connection. A threaded grounding binding post fitted with a knurled binding-nut is provided on the chassis next to DC input 2.

- For the Radio Assembly chassis, install the grounding lead's lug over the binding post and firmly hand-tighten the binding-nut.
- If a –DC rail (0V) is installed as part of the system, the grounding leads may alternatively be fitted to the rail terminal.

Caution:

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.

2.5.1.1.1 DC Power Supply Connection & Torque Settings

Warning:

> *Securing the DC Power Supply cable into the DC connector to provide a good electrical connection is essential. Over time, the wires tend to compress in the DC connector resulting in an increasingly poorer connection. Consequently, as high current is drawn, the connector heats up increasing the resistance thereby causing still more heat until the connector eventually burns up.*

Although screws securing DC cables to the Power Supply terminals are tightened to the torque settings given below prior to new system delivery, they must be re-tightened as part of the commissioning process and re-tightening is also part of the regular maintenance schedule.

Prior to replacing a Power Supply module into an existing system, inspect the cable and re-terminate the DC wires if the strands have previously been twisted together or show any sign of damage.

> *Cut the wire at the end of the insulation and then strip approximately .43 inch (11mm) of insulation off the cable. DO NOT TWIST THE WIRE STRANDS. Insert the DC cable into the screw terminal and tighten the screw to secure the cable as per the torque settings given below.*

DC Power Supply Torque Settings:

The manufacturer recommends torque setting all power supply terminal screws to a minimum of:

- 1.5 Nm (or 13.28 In*lb or to 1.107 ft*lb)

Note: Dataradio uses a Sturtuvan Richmont 29-piece adjustable torque screwdriver model CAL36/4K.

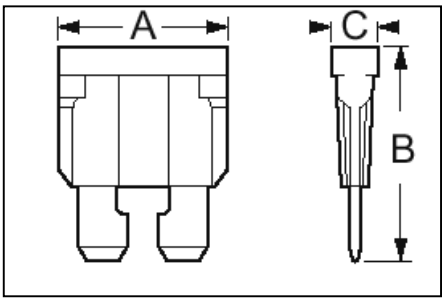
After tightening, pull on the cable to check the cable is secured tightly into the screw terminal.

2.5.1.1.2 Power Indications

Both red-colored translucent power switches located on the front of the power supply modules illuminate when AC power is available. Toggle both to ON to distribute power to the Radio Assembly and to the Power Amplifier. The LED immediately below the switches light green indicating normal DC power operation.

2.5.1.2 Backplane Fuses

Blade fuses (Maxi-Fuse) are used on the Radio assembly backplane:



Fuse Type	Dimensions – Inch (mm)		
	A	B	C
Maxi-Fuse	1.15 (29.21)	1.35 (34.29)	.35 (8.89)

Fuse #	F1	F2	F3
Values	10A	15A*	15A*

* Always replace the two 15A fuses as a pair.

Figure 7 - Maxi-Fuse

2.6 Crescend 70W Power Amplifier

The power amplifier is maintenance free, only LED indications are present on the front panel and one adjustment is located on the underside. Refer to Figure 3 above for the location of the DC power terminal block, the "RF In" as well as the "RF Out" connectors, and the adjustment slot.

Important: at the RF "In" connection, install the supplied RF attenuator (p/n 603-10-1 manufactured by MECA) to reduce the Exciter output power to a safe level for the power amplifier. Connect the T881 Tx module output to the power amplifier's attenuator input using the Dataradio (p/n 727 03468-001) RG223 provided cable. For the power amplifier output, Dataradio recommends a 50-ohm, low-loss, double-shielded grade RF cable such as RG214 or 1/4" Heliax.

Caution:

Ensure that the 10dB Attenuator is present at "RF In" before connecting the Exciter output cable. Nominal input with the attenuator in place is: 1.5 W

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

"The amplifier module delivers 70W and 28dB gain (at 100mW input) over a large nominal bandwidth (500-1000MHz) designed platform. 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. ."

Power output is normally set to 70W *(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. *Dataradio does not recommend adjusting below 35 watts.*

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.

Caution:

Do not operate this unit in a completely enclosed cabinet.

Crescend Terminal Block Torque Settings:

Although the manufacturer does not specify definite torque settings for its terminal block screws, the following values can be used:

- 8 In/lb (9 maximum).

Table 2 - 70W 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.

2.7 Antenna

2.7.1 Overview

Paragon3 unit 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.

2.7.2 Cabling and Connection

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 Paragon3 Radio assembly.

2- Terminate the RX-1 (bottom) and RX-2 (top) cable-ends at the SDR module rear position with N-type connectors.

3- Similarly, terminate the TX cable-end at the Power Amp's module rear position 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.

2.8 Completing the physical Installation.

Paragon3 products are factory-configured to user's requirements and are shipped ready to run.

After new installations:

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

You are now ready to check for normal operation (as per paragraph 2.9) and to run the Dataradio web interface (described in section 4) for testing or trouble-shooting.

Any change(s) to the settings must be done via files saved on diskette and loaded into the unit using the web interface program.

2.9 Checking out Normal Operation

1- Check that power is applied.

2- Check Radio assembly lights for proper operation as per section 3.1.1

3- Check for proper operation of the BSC's LEDs.

4- Using the web interface program and an in-line wattmeter, check forward & reverse power to confirm main antenna installation.

5- Using the web interface, check the RF Data Link with a mobile that can be heard.

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 Radio Assembly

The Radio assembly component of each Paragon product is made up of high performance synthesized radio base station designed for single operation. The Radio Assembly's modules are commonly installed in a standard, 19-inch wide rack frame.

The complement of modules is:

- 1 x SDR module
- 1 x 5W Transmitter
- 1 x BSC (controller-modem)
- 1 x Speaker panel
- 2 x Power Supplies
- 1 x 80-Watt Power Amplifier 19" rackmount assembly

3.1.1 Diversity SDR RX Module

The Diversity SDR Rx module front panel controls and indicators are:

- RCVR GATE LEVEL - Mute threshold adjustment.
- 1 / 2 Switch – Manual selection of Channel 1 or 2 audio.
- Monitor Volume – Audio level adjustment. Always set volume knob to minimum when not in use.
- NORM-MON Switch – Manual selection between audio unmuted (continuous monitor) or when audio is above the manually adjusted mute threshold.
- COM – For factory use.

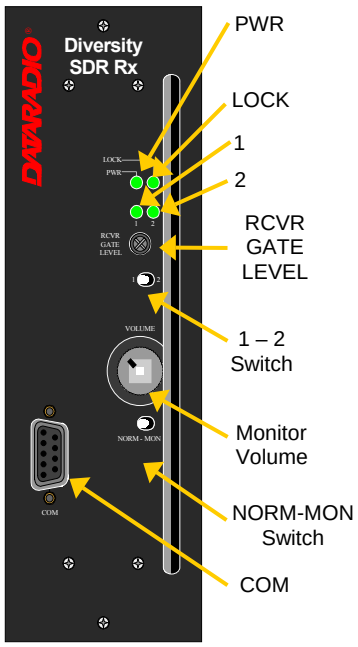


Figure 8 - Receiver module

Table 3 - Diversity SDR LEDs

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 on audio channel 1 is above manually adjusted mute threshold**
	Off	**RF carrier signal on audio channel 1 is below manually adjusted mute threshold**
2 LED	**Green**	**RF carrier signal on audio channel 2 is above manually adjusted mute threshold**
	Off	**RF carrier signal on audio channel 2 is below manually adjusted mute threshold**

3.1.2 5W Transmitter module

The Exciter's front panel controls and indicators are:

- Carrier Switch - momentarily keys the transmitter ON while pressed (used for test purposes only).
- On LED - is lit when transmitting
- Line Sensitivity – not used.
- Supply LED - is lit when DC power is applied. Fast Flashes when linked with PGM800Win. Slow Flashes indicates VCO (synthesizer) out of lock. Unequal Flashes indicates internal communication error.
- Microphone Socket – not used.

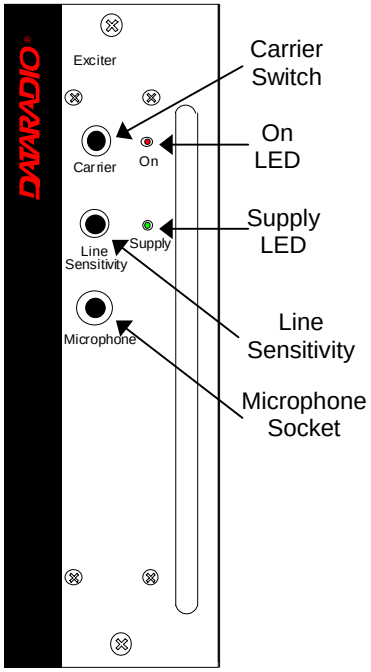


Figure 9 - 5W Exciter module

3.1.3 BSC module

The BSC's front panel connectors and indicators are:

	Green	**Normal operation**
	Amber	**Step 2 in uMon boot-up – lights for <1 sec.**
	Red	**Step 1 in uMon boot-up – lights for <1 sec.**
	Green	**Flashes for each data packets received**
	Red	**Discard RX packet (factory-use)**
	Green	**Flashes for each data packets transmitted**
	Amber	**Flashes for each data packets transmitted (check for lost Host connection)**
	Red	**Continuously ON for TXON test (max. 20 secs.) Flashes ON for CWID key-up event**
	Off	**Check if in "AirLink down mode"**
	Green	**Flashes each time PF1 or PF2 is pressed**
	Amber	**Flashes each second PF1 is kept pressed *Toggles "AirLink down mode" after 4 seconds***

- 2x DE-9 RS-232 ports for setup and user data
- 1X rocker switch (positions PF 1 and 2) to select various test modes *(see section 5.3.2 for details)*
- 2x Ethernet ports – for setup and user data
- 2x Ethernet LEDs (status & activity)
- USB port – reserved.

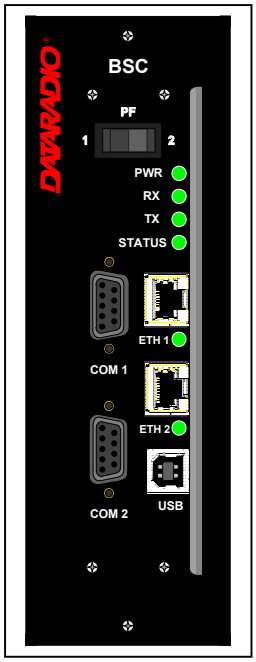


Figure 10 - BSC module

3.1.4 Power Supply Modules

Two switched mode pulse width modulated T-809 power supply modules are used but not connected in parallel.

Both power supply units have an ON-OFF switch and an output voltage adjust potentiometer (13.5 to 18 VDC).

Their circuit protection features are:

- Inrush current limiting
- Over-current (short-circuit)
  - 37 to 48A constant current limiting
  - Reset = auto recovery
- Over-voltage
  - 18 to 21 VDC = shutdown
  - Reset = Power OFF and ON
- Over-temperature
  - shutdown of output voltage
  - auto recovery with temperature reduction
  - temperature sensed on transistors and diodes

Front Panel Indications	
Power Switch	Illuminates when the unit is connected to AC power and voltage is available
ON LED	- Lights bright green when voltage output is normal - Lights faint green when module has entered over-current mode - Green LED is OFF, but power switch is ON indicates module has shut down due to over-temperature or over-voltage conditions.

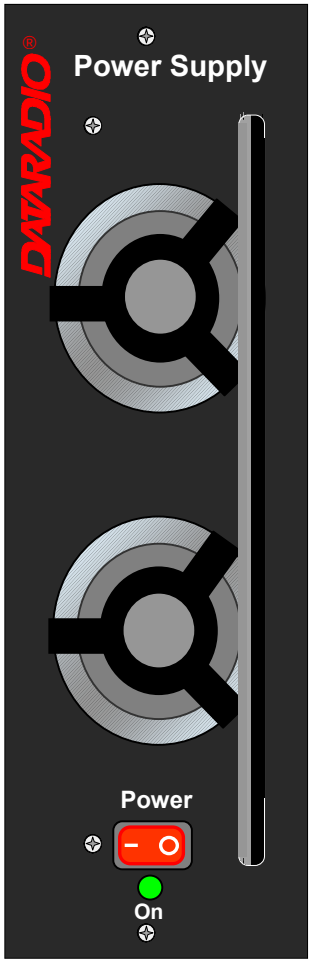


Figure 11 - T-809 Power Supply Module

3.1.5 Speaker panel

The speaker panel is fitted with a four-Ω speaker.
The RJ11 connector is used to allow programming the radio transmitter module (only) from the front of the unit via a programming lead.
If the speaker panel needs to be removed, a mirror programming port connector is provided on the backplane.

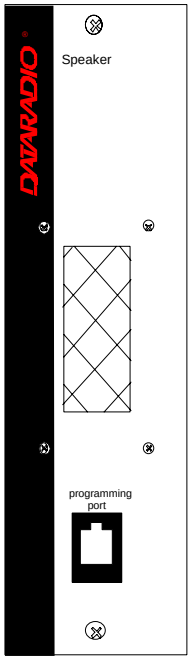


Figure 12 - Speaker module

3.1.5.1 Power Supply Rear Connections

The rear panel connections are:

- Auxiliary Inputs –

  The DE-9 connector on the T809-10 rear panel provides access to the remote control of the power supply *(reserved for future use)*.

- Output Voltage Adjust –

  The output voltage of the power supply can be increased (up to 18V approximately) to compensate for the voltage drop lost along the cable. Access the trim-pot through a small hole on the rear panel.

  To adjust the output voltage use a trimmer tool with a Phillips head or 3mm blade *(do not use a standard flat blade screwdriver to make the adjustment)*:

  • To increase the output voltage, turn the trim-pot clockwise.

  • To decrease the output voltage, turn the trim-pot counterclockwise.

  If the output voltage is increased on a power supply operating at, or close to, full load, the power supply loading must be reduced accordingly or the module may overheat and shut down.

- Feedthrough Terminal Block –

  The DC Output Terminal block on the rear of the T809-10 is a Phoenix Contact HDFKV 10. This is a screw-type terminal connector that uses a cage mechanism to clamp the conductor(s). *See section 2.5.1.1.1 for recommended torque settings.*

- Protective Bonding Terminal –

  The Radio Assembly requires a secure ground connection. See section 2.5.1.1 for connection details.

- 120 VAC Connector –

  Use the supplied 10A-rated IEC type power cord.

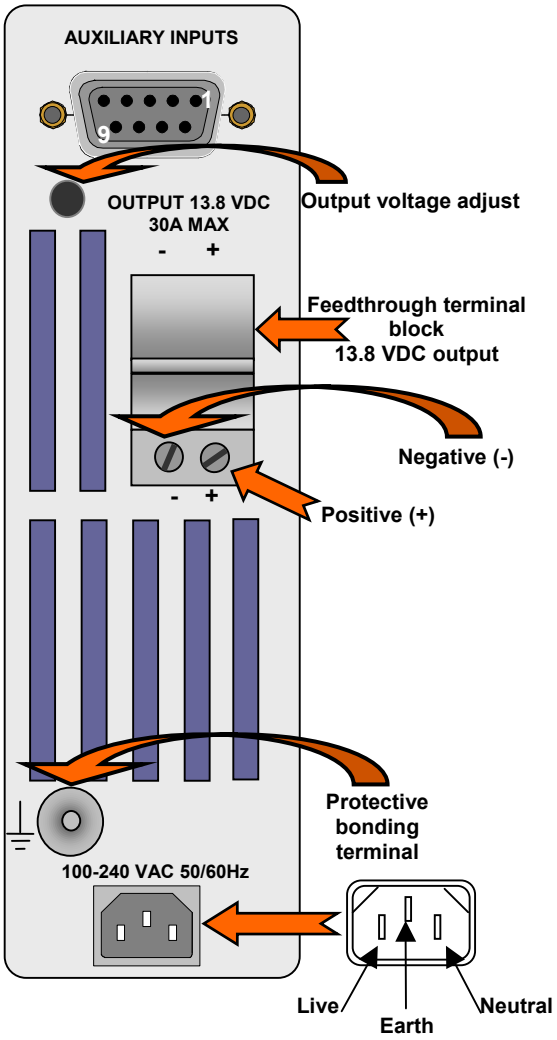


Figure 13 - T809 Rear panel

3.1.6 Radio Backplane Assembly

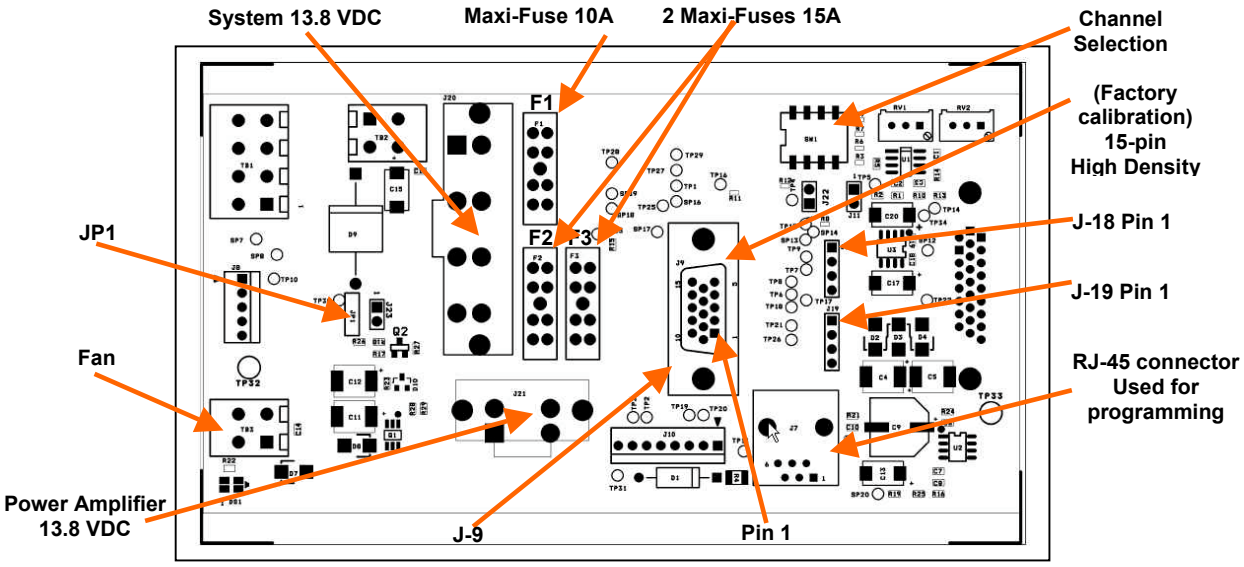


Figure 14 - Radio Backplane Assembly

Table 4 – Test Points

Backplane Test Points			
Test		**Pinout**	**Alternate Pinout**
Ground		**J-9 – Pin 14**	**JP1 – Pin 3**
SINAD	**RX1**	**J-9 – Pin 3**	**J-18 – Pin 1**
SINAD	**RX2**	**J-9 – Pin 4**	**J-19 – Pin 1**
Distortion	**RX1**	**J-9 – Pin 3**	**J-18 – Pin 1**
Distortion	**RX2**	**J-9 – Pin 4**	**J-19 – Pin 1**
RSSI	**RSSI 1**	**J-9 – Pin 1**	**J-18 – Pin 3**
RSSI	**RSSI 2**	**J-9 – Pin 2**	**J-18 – Pin 3**

4. Operation & Configuration

4.1 Browser-Based Setup and Status

A built-in web server makes configuration and status monitoring possible from any browser-equipped computer, either locally or remotely. Status, configuration, and online help are available without requiring special client software. Setup is password-protected to avoid tampering or unauthorized changes.

Both the configuration parameters and operating firmware can be updated remotely, even over the RF network itself, using the standard FTP protocol.

4.2 Default IP Settings

- Paragon3 radio modem supports the Router (IP Forwarding) mode

4.2.1 Ethernet Interface 1 (DATA)

- MAC: 00:0A:99:XX:YY:ZZ
- IP ADDR: 192.168.202.1
- NETMASKS: 255.255.255.0
- Default Gateway: 0.0.0.0
- DHCP Client Disabled
- RIPv2 Disabled

4.2.2 Ethernet Interface 2 (SETUP)

- MAC: 00:0A:99:XX:YY:ZZ + 1
- IP ADDR: 192.168.203.1
- NETMASKS: 255.255.255.0
- DHCP Server Disabled
- NAT Disabled

4.2.3 RF Interface

- MAC: 00:XX:YY:ZZ
- IP ADDR: 10.XX:YY:ZZ
- NETMASK: 255.0.0.0
- Compression Enabled
- Encryption Disabled

4.3 IP Network Settings

4.3.1 IP Network Settings (with Host)

Referring to Figure 15 below, set the Paragon3 base station. Set the "Data" port Eth1 IP addresses (for "Setup" port set Eth2) and IP netmask of both Base and Mobile(s).

Keep the RF IP setting as is, providing customer is not using the 10.0.0.0 IP network.

Add routes in the Host (route add…)

In the illustration, Host and PC are part of different IP subnet

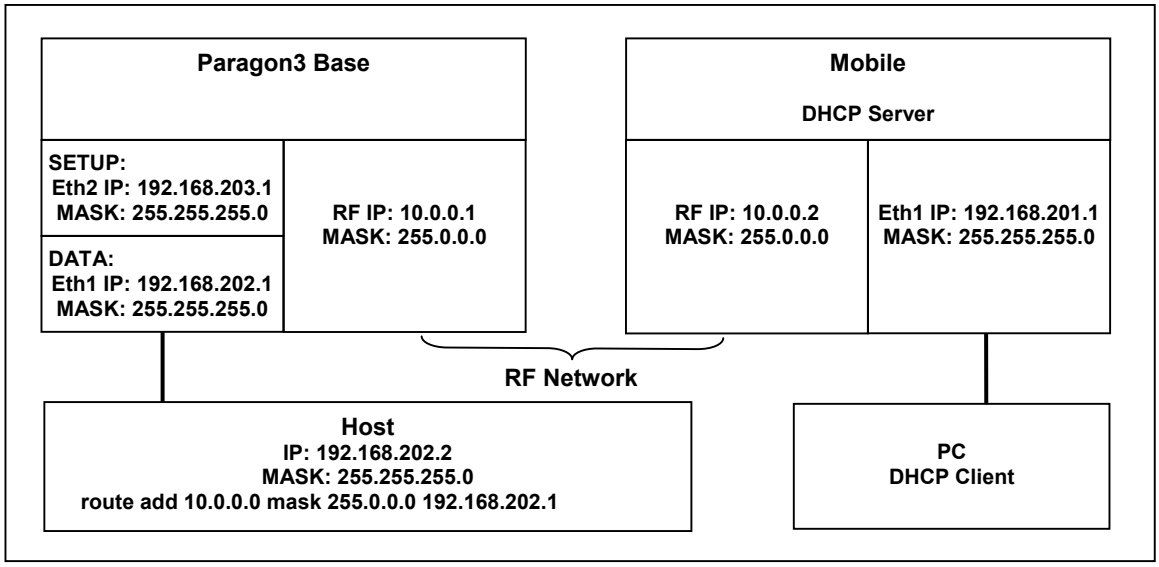


Figure 15 - IP Network Settings in Router Mode (with Host)

4.3.2 IP Network Settings (with Router)

Referring to Figure 16 below, set the Paragon3 base station. Set the "Data" port Eth1 IP addresses (for "Setup" port set Eth2) and IP netmask of both Base and Mobile(s).

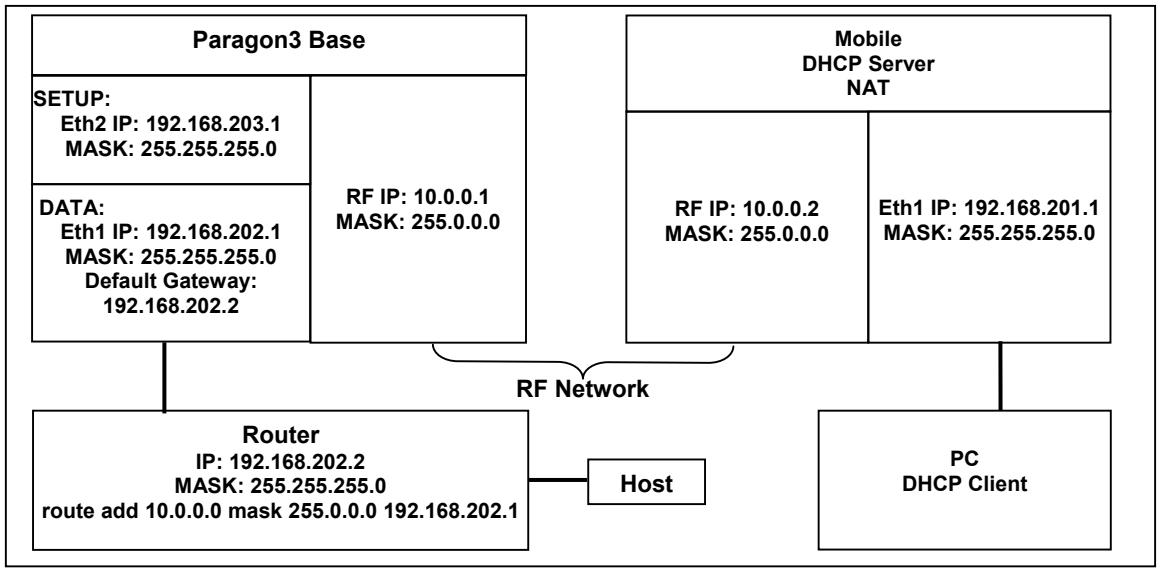


Figure 16 - IP Network Settings in Router Mode (with Router)

Keep the RF IP setting as is, providing customer is not using the 10.0.0.0 IP network.

Enable RIPv2 on Base station

In the illustration, Host and PC are part of different IP subnet.

4.4 LAN Setup

On a PC running MS-Windows with an existing LAN connection, connect either to the ETH1 (Data) or to ETH2 (Setup) RJ-45 input of the Paragon3 base station.

1. Click Start ➔ Settings ➔ Control Panel ➔ Network and Dial-up Connection
2. Click on the relevant Local Area Connection
3. On the Local Area Connection Status screen, click Properties
4. On the Local Area Connection Properties screen, scroll the List Box until "Internet Protocol (TCP/IP)" is highlighted, click Properties
5. On the Internet Protocol (TCP/IP) Properties screen, follow either method below:
   A) If using ETH2 (Setup LAN), select "Obtain an IP address automatically"
   B) Select "Use the following IP address" ➔ Enter 192.168.202.2 *(if ETH2 enter 192.168.203.2)* in the IP address field ➔ 255.255.255.0 in the Subnet mask ➔Leave the Default gateway blank.
6. Click the OK button

   Note: On computers running Windows 9X, reboot to complete the connection process.

   Steps above specifically apply to MS-Windows 2000. Modify as necessary for the OS you are running

4.5 Login Screen

On the Address line of the Internet browser of your choice, type the factory-default IP addresses given to all Paragon3 radiomodem units: 192.168.20*x*.1 *(where x is 2 for the ETH1 Data port and 3 for the ETH2 Setup port)*. Press Enter. The Enter Network Password screen opens.

Figure 17 - Enter Network Password screen – ETH1 Data port shown

4.5.1 Initial Installation Login

For an initial installation, enter a User Name of 1 to 15 characters and the default Password ADMINISTRATOR *(upper case letters)*. Click OK. The Web interface "Welcome" screen opens Figure 19.

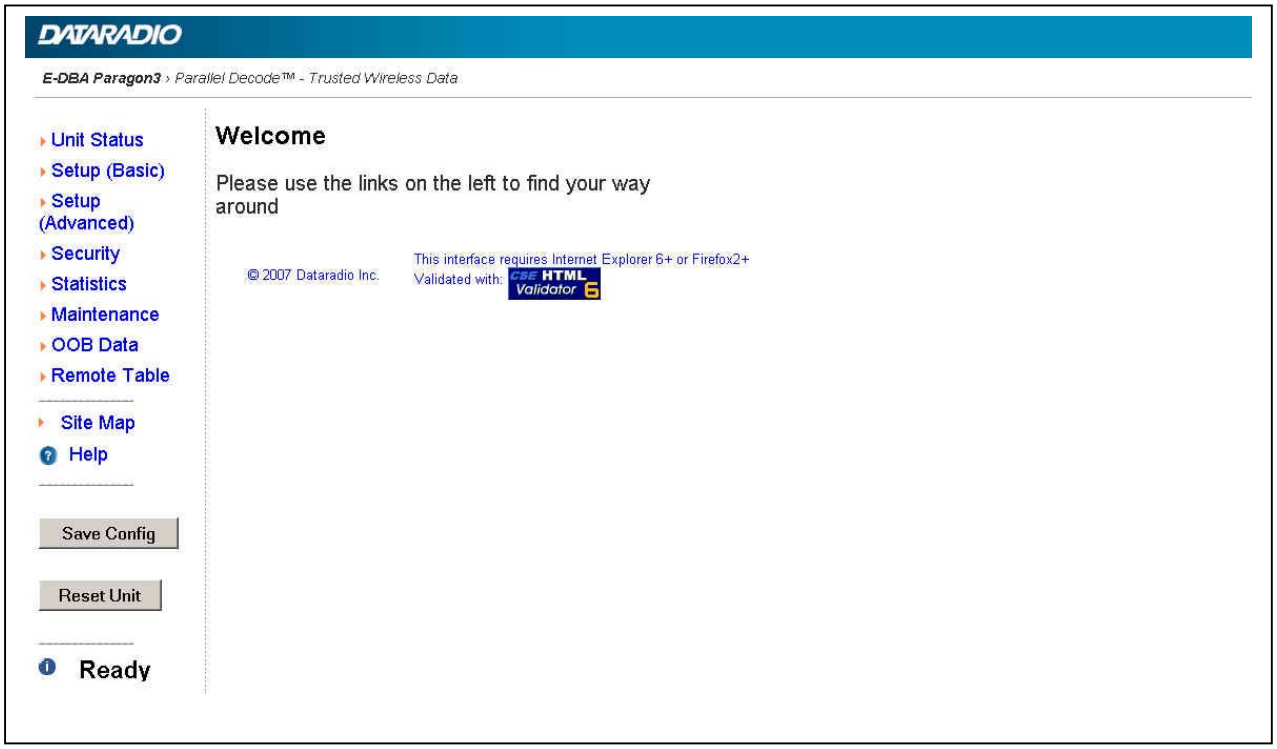


Figure 18 - Web User Interface – Welcome Screen

For subsequent access to the Paragon3 unit, use the User Name and Password that you will have configured.

Notes:

User Name field can be left blank. It only serves to identify the person gaining access.

Password is common and affects all User Name entries.

4.6 Interface

The Paragon3 user interface (Figure 18) (Figure 19) is used to configure and view your network settings.

To navigate, use the top-level menus on the left, some of which expand to offer submenus, and display the first submenu in the right-hand frame. Click the current submenu entry to refresh the right-hand frame. The tables starting at section 4.7.1 below list action of each function. The interface main screen lists available selections for the selected menu or presents instructions.

Notes:

Screen captures used throughout this document may vary from actual screens.

At any time, click the Help Icon in the navigation pane to open a help text relating to the window being displayed.

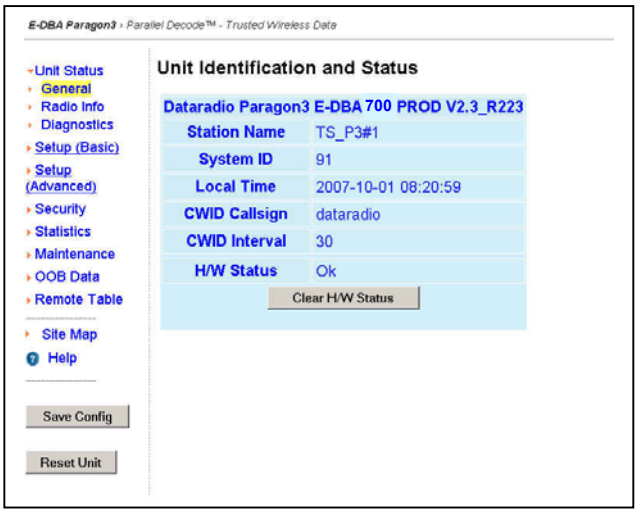


Figure 19 - Web User Interface

4.6.1 Apply, Cancel, Save Config, and Reset Unit Buttons & Help Icon

Several submenus have "Apply" and "Cancel" buttons. 

The navigation area has "Save Config", "Reset Unit" buttons and a Help icon. 

If you "Apply" changes to any parameters marked  you will need to do a "Save Config" and a "Reset Unit".

Make an entry into a dialog box. When satisfied, click on Apply to temporarily apply the value(s) entered to the relevant parameter(s). If not satisfied, click on Cancel button to restore to the value(s) present before a change was made.

Note: Cancel command only affects the dialog boxes or radio buttons in the opened window.

If needed, go to other submenu(s) and make more entries. Click Apply before leaving each window. When finished, click the Save Config button to make all changed entries permanent.

Notes:

Failure to use the "Apply" command button before leaving a web page will result in the loss of temporarily entered selections, addresses, and values.

Failure to use the "Save Config" command button before doing a Reset Unit will result in the loss of temporarily entered parameters.

If there are changes to be saved, saving occurs automatically.

- Click on Save Config button:
- If there are no changes to be saved, a window prompts user to confirm saving.

Click on "Reset Unit" button:

- If there are changes to be saved, a window prompts user to confirm resetting.
- If there are no changes to be saved, resetting occurs automatically.

A "Station Reset" 20-second timer counts down while the status reports: "Working…"

When done, the status reports: "Ready".

4.7 Advanced IP Settings

4.7.1 Unit Identification and Status

Displays values that identify the unit and show its basic operating condition.

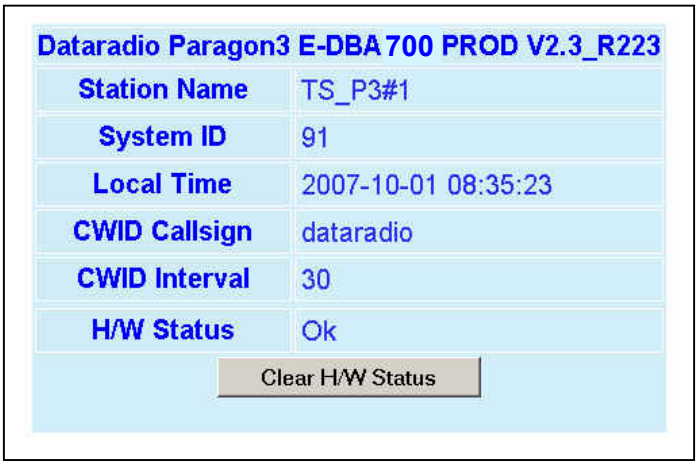
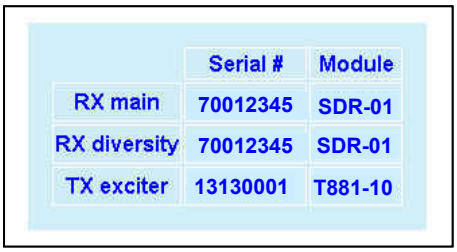


Figure 20 - Unit Identification and Status

Item	Description
Banner	**Displays Paragon3 software revision information retrieved from the connected unit. Have this information handy if contacting Dataradio support.**
Station Name	**Displays name of connected unit.** **Configured under Setup Basic ➔ General ➔ Station Name**
System ID	**Displays System's unique identification number** **Configured under Setup Basic ➔ General ➔ System ID**
Local Time	**24-hour clock format display of the GMT time and date adjusted to the specified time zone.** **Configured under Setup Advanced ➔ Time Source ➔ SNTP**
CWID Callsign	**Continuous wave ID - Way of sending FCC license ID using Morse code.** **Continuous Wave Identification uses Morse Code to automatically send out the station ID periodically to identify the owner of the transmitting repeater. This satisfies the requirements of the FCC.**
CWID Interval	**Interval between CWID messages in minutes.** **Zero = never.**
H/W Status	**Normally displays "Ok" in the message area.** **Displays various warnings or messages in the event of hardware failure,** **If indications persist, have the status information handy if contacting Dataradio support.**
Clear H/W Status button	**Press this button to clear the H/W Status message area.**

4.7.1.1 Unit Status ►Radio Info

Radio Information read-only table displays the serial number and model number of the installed radio modules. Paragon3 models that have both receivers combined into a single module will show the same information in the RX main and RX diversity rows.

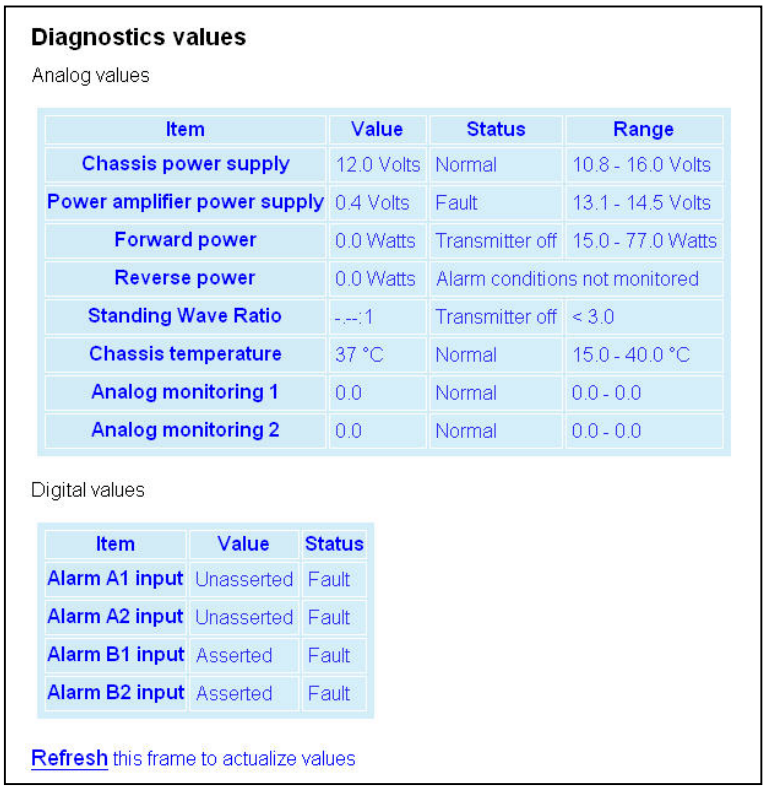


	Serial #	Module
RX main	70012345	SDR-01
RX diversity	70012345	SDR-01
TX exciter	13130001	T881-10

Figure 21 - Unit Status - Radio Information

Item	Description
RX main	**Indicates the Serial Number and Module model of the main receiver module**
RX diversity	**Indicates the Serial Number and Module model of the diversity receiver**
TX exciter	**Indicates the Serial Number and Module model of the transmitter/exciter module**

4.7.1.2 Unit Status ►Diagnostics



Diagnostics values

Analog values

Item	Value	Status	Range
Chassis power supply	12.0 Volts	Normal	10.8 - 16.0 Volts
Power amplifier power supply	0.4 Volts	Fault	13.1 - 14.5 Volts
Forward power	0.0 Watts	Transmitter off	15.0 - 77.0 Watts
Reverse power	0.0 Watts	Alarm conditions not monitored	
Standing Wave Ratio	-.--:1	Transmitter off	< 3.0
Chassis temperature	37 °C	Normal	15.0 - 40.0 °C
Analog monitoring 1	0.0	Normal	0.0 - 0.0
Analog monitoring 2	0.0	Normal	0.0 - 0.0

Digital values

Item	Value	Status
Alarm A1 input	Unasserted	Fault
Alarm A2 input	Unasserted	Fault
Alarm B1 input	Asserted	Fault
Alarm B2 input	Asserted	Fault

Refresh this frame to actualize values

Figure 22 - Unit Status – Diagnostics

Item	Description
Analog Values	
Chassis power supply	**Displays chassis power supply voltage**
Power amplifier power supply	**Displays power amplifier power supply voltage**
Forward power (J8-Tait_PA)	**Displays forward power when the optional external power sensor assembly (p/n 030-03547-xxx) is installed.** **Note: Power measurement units (dBm or Watts) are user defined under Setup Advanced ►User Settings**

$$\frac{1+\sqrt{\frac{ReversePower}{ForwardPower}}}{1-\sqrt{\frac{ReversePower}{ForwardPower}}}$$

Reverse power (J8-Tait_PA)	**Displays reverse power when the optional external power sensor assembly (p/n 030-03547-xxx) is installed.** **Note: Power measurement units (dBm or Watts) are user defined under Setup Advanced ►User Settings**
Standing Wave Ratio	**Displays Standing Wave Ratio. Standing Wave Ratio (SWR) is computed as:** **Note: SWR is always computer based on the forward and reverse power values in Watt, regardless of the power measurement unit chose for display.**
Chassis temperature	**Displays the internal unit chassis temperature. That temperature is usually 10 to 15°C higher than ambient room temperature. Default range: 15 to 40°C** **Note: Temperature measurement units are user defined under Setup Advanced ►User Settings**
Analog monitoring 1 (Ext_Fwd_Pwr_Sens)	**Generic Analog input (0 – 8VDC)** **Displays user supplied analog input's measurement values**
Analog monitoring 2 (Ext_Rev_Pwr_Sens)	**Generic Analog input (0 – 8VDC)** **Displays user supplied analog input's measurement values**
Digital Values	
Alarm A1 input (PS1_Fault)	**Generic Alarm input. Signal goes low ("unasserted") to indicate a fault.** **Used with older Power Supplies versions (P/N: T807-10 & T808-10).**
Alarm A2 input (PS2_Fault)	**Generic Alarm input. Signal goes low ("unasserted") to indicate a fault.** **Used with older Power Supplies versions (P/N: T807-10 & T808-10).**
Alarm B1 input (J8-Tait_PA)	**Legacy support to Tait T859 & T889 PA Low Forward Power Alarm.**
Alarm B2 input (J8-Tait_PA)	**Legacy support to Tait T859 & T889 PA High Reverse Power Alarm.**
Status	**For all digital and analog alarms displays alarm status: Normal or Fault.** **For Forward Power and Standing Wave Ratio (SWR), displays "Transmitter off" when the transmitter is off. Disregard the diagnostic value for SWR, Forward Power, and Reverse Power if the transmitter is off.**
Range	**Displays range of values for all monitored analog diagnostic parameters. User-configurable under Setup (Advanced) ►Diagnostics. Recommended nominal ranges are:** **Chassis Power Supply** 10.8 - 16.0 Volts **Power Amplifier Power Supply** 13.1 - 14.5 Volts (Operating) **Forward Power (700MHz)** 15. 0 - 77.0 Watts

4.7.1.2.1 External Analog/Digital Inputs Monitoring

The user can connect and monitor two external analog and two external digital inputs to the backplane TB1 connector terminals (Figure 23 and Figure 24).

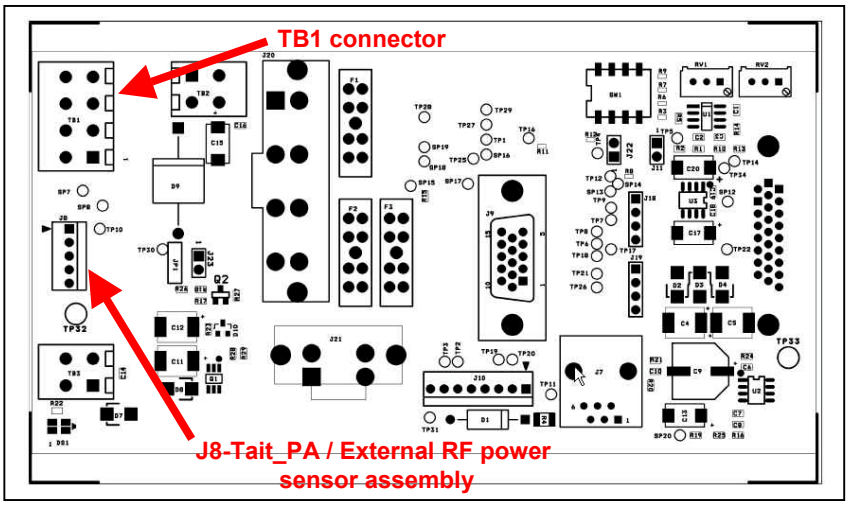
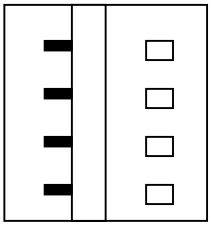


Figure 23 - Backplane -TB1 connector

TB1



Analog monitoring 2 (generic analog input)
Analog monitoring 1 (generic analog input)
Alarm A2 (generic digital input)
Alarm A1 (generic digital input)

Figure 24 - TB1 connector

An external analog device's voltage must not exceed 8 Volts. The default units of measure used for monitoring an external device are volts. It is possible to change the default units by creating a look-up table for the desired unit of measure. This look-up table is created following the guidelines in section 4.7.3.10.1 and is uploaded into the Paragon3 unit using FTP transfer. Refer to section 4.7.3.10 for more details.

Note 1: TB1 connector labeling differs on Figure 24 from the actual backplane:

TB1 / Web page name(s)	TB1 / Backplane name	Voltage input ranges
Analog monitoring 2 / Analog 2	Ext_Rev_Pwr_Sens	0 – 8 VDC
Analog monitoring 1 / Analog 1	Ext_Fwd_Pwr_Sens	0 – 8 VDC
Alarm A2 input	PS2_Fault	Active high*, > 4.75V to 30VDC
Alarm A1 input	PS1_Fault	Active high*, > 4.75V to 30 VDC

* An open condition or less than 2.0 VDC applied on those inputs is needed to guaranty the alarms won't trigger.

Note 2: The monitoring at the backplane J8-Tait_PA connector is usually not meaningful unless the optional external power sensor assembly (p/n 030-03547-xxx) is purchased. That connector provides the base station Forward Power and Reverse Power monitoring signals as reported on the Paragon3 Diagnostics Web pages.

4.7.2 Setup (Basic)

4.7.2.1 Setup (Basic) ► General

Used to set four basic operating fields on the connected unit.

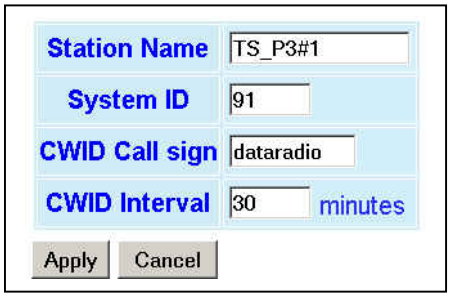


Figure 25 - Setup (Basic) – General Setup

Item	Description
Station Name	**Station name identifier – Enter string up to forty characters in length**
System ID	**Factory default ID is zero. To prevent collision and to minimize interference from remote systems that may be present on the same frequency, Dataradio recommends changing the System ID to some other value unique to each network.** **Upper limit is 255**
CWID Call sign	**Historically called "Continuous wave ID" – Way of sending FCC license ID using Morse code**
CWID Interval	**Interval between CWID messages in minutes** **Zero = never.**

4.7.2.2 Setup (Basic) ► Basic IP Configuration

Sets the IP characteristics of the primary, or only, Ethernet port.

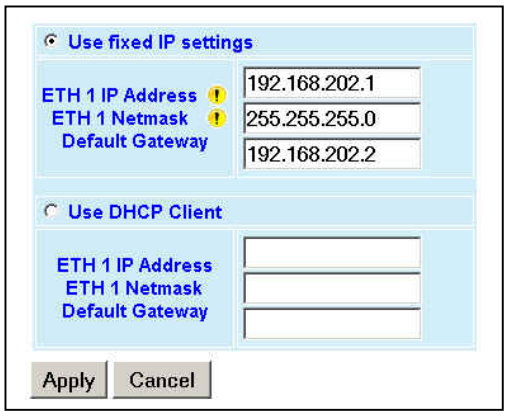


Figure 26 - Setup (Basic) – Basic IP Configuration

Item	Description
Use fixed IP settings	**Creates a fixed TCP/IP address connection. *You may need to ask your network administrator for the appropriate IP settings.***
ETH 1 IP Address	**Set to valid unique IP address for each individual unit.** **Factory default is 192.168.202.1 for all Paragon3 units connected to their ETH1 port.** **For ETH2 configuration, see Setup Advanced ➔ LAN IP**
ETH 1 Netmask	**Set to valid IP netmask for each individual unit *(may be same or different depending on customer's IP network topology)*.**
Default Gateway	**Set to valid Default Gateway.** **May change for different groups or locations**
Use DHCP Client	**Dynamic Host Configuration - Dynamically assigns an IP address**
ETH 1 IP Address **ETH 1 Netmask** **Default Gateway**	**These three read-only fields display the IP addresses obtained from the DHCP Server**

4.7.2.3 Setup (Basic) ► Serial Ports Setup

The Paragon3 base station serial ports can be logically connected to local and remote services to aid in configuration and troubleshooting, or they can be connected to a remote Host application or even to the serial port of a remote unit.

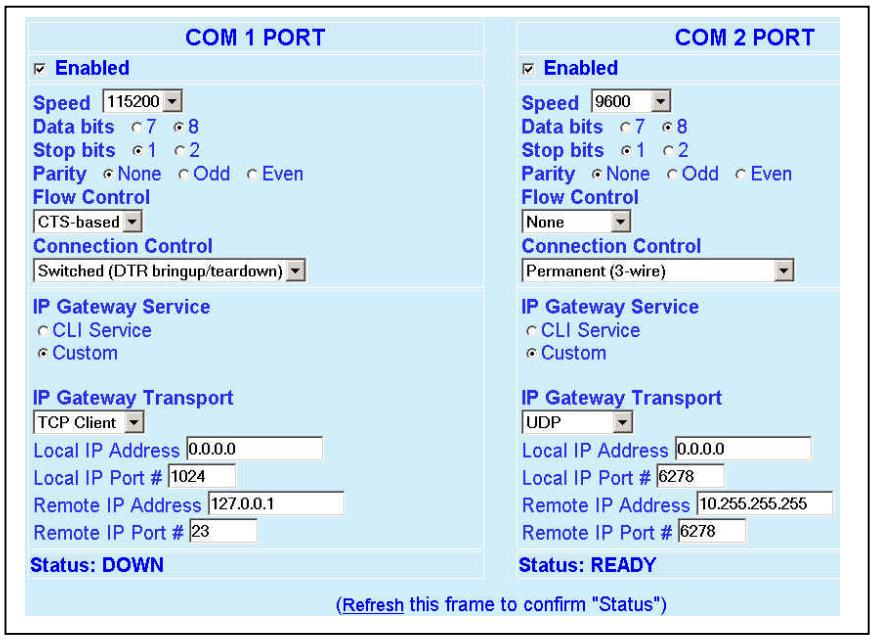


Figure 27 - Setup (Basic) – Serial Ports Setup

Item	Description
Enabled	Independent check boxes to activate COM-1 PORT and/or COM-2 PORT
Speed	Select 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud Rate
Data Bits	Number of bits making up the data word. Set according to Host configuration. Default is 8.
Stop Bits	Mark the end of the serial port data type. Default is 1.
Parity	Added to identify the sum of bits as odd or even. Default is None.
Flow Control	Select None or CTS-based *(RTU dependent)*
Connection Control	Select Permanent (3-wire) or Switched (DTR bringup/teardown) *(RTU dependent)*
IP Gateway Service	Select one of: CLI Service (Command line interface) RS-232 connection to Host PC (Default = SETUP) Custom – Choosing Custom enables the IP Gateway Transport configuration
IP Gateway Transport	Available only if IP Gateway Service selection is Custom, choose the socket connection mode from the drop-down list box choices of TCP Server, TCP Client, or UDP.
Local IP Address	Valid unicast or multicast IP address, including the local Loopback interface address. Default local IP address is set to 0.0.0.0 and can be changed dynamically without a unit reset.
Local IP Port	For TCP Client and UDP socket connections, set to any value between 1 and 65535. For TCP Server socket connections, set to any value between 1 and 65535 but must not be set to one of the following values or fall within the following ranges of values: 20, 21, 23, 123, 520, 5002, 6254 to 6299, 7000 to 7100. Otherwise, the parameter configuration will be accepted, but no socket connection will be established to accept connection from remote endpoints. Default local port value is set to 1024 and can be changed dynamically without a unit reset.
Remote IP Address	Default remote IP address is the Loopback interface address, 127.0.0.1 and can be changed dynamically without a unit reset
Remote IP Port	For socket connection modes (TCP active, UDP), set to any value between 1 and 65535. Default local port value is 23 and can be changed dynamically.
Status	Can be UP, READY, or DOWN. Click on the "Refresh" word in the "(Refresh this frame to confirm "Status") sentence to update Status condition.

4.7.3 Setup (Advanced)

4.7.3.1 Setup (Advanced) ► LAN (IP)

Allows the setting of IP characteristics beyond those set in "Setup (Basic)" ➔ "Basic IP".

When a mobile registers with a new base, the base may send a message to each of its neighbor to assure that their Internet tables are up-to-date. Up to 32 neighbors can be entered. *An empty or incomplete table may cause IP routing problems when the mobile roams.*

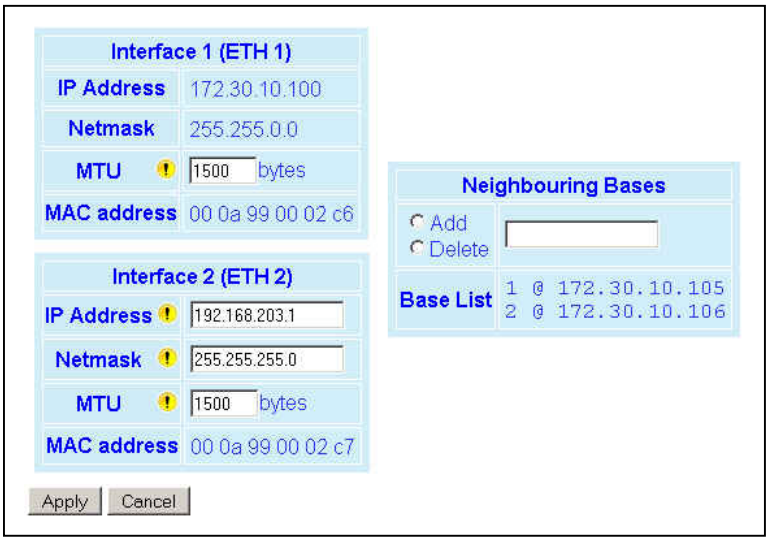


Figure 28 - Advanced IP Configuration - LAN (IP)

Item		Description
Interface 1 (ETH1)	IP Address Netmask	Read-only fields showing "IP Address" and "Netmask address" defined earlier in "Setup (Basic)" ➔ "Basic IP".
	MTU	Ethernet Interface MTU - Default 1500. – For optimal performance, set at 1500. Entering a value lower than 1500 may reduce system performance. Flexibility of using lower values may be useful in testing or for particular operational conditions. Range is 576 to 1500.
	MAC address	Ethernet Interface MAC address in HEX format *(factory-set)*.
Interface 2 (ETH2)	IP Address	Set to valid unique IP address for each individual unit. Factory default is 192.168.203.1 for all Paragon3 units connected to their ETH2 port. For ETH1 configuration, see Setup Basic ➔ Basic IP Configuration.
	Netmask	Set to valid IP netmask for each individual unit *(may be same or different depending on customer's IP network topology)*.
	MTU	Ethernet Interface MTU - Default 1500. – For optimal performance, set at 1500. Entering a value lower than 1500 may reduce system performance. Flexibility of using lower values may be useful in testing or for particular operational conditions. Range is 576 to 1500.
	MAC address	Ethernet Interface MAC address in HEX format *(factory-set)*.
Neighboring Bases	Add	Type in the "Neighboring Bases" field the IP address in dot decimal format of the base to be added to the neighboring "Base List" table.
	Delete	Type in the "Neighboring Bases" field the IP address in dot decimal format of the base to be deleted from the neighboring "Base List" table.
	Base List	Read-only listing. Dynamic window expands downward as needed to show all addresses added to the list or shrinks as addresses are removed. Shows "Table is empty" if no address is present in the Base List.

4.7.3.2 Setup (Advanced) ► RF (IP)

At the time of manufacture, each Paragon3 base station and Gemini G3 radiomodem is provided with a unique MAC address for its Ethernet and RF interfaces. These addresses cannot be changed. The RF interface is also provided with a unique Factory RF IP address. If this IP address conflicts with any existing IP network, it can be overridden.

Figure 29 - Advanced IP Configuration - RF (IP)

Item	Description
RF MAC	**RF Interface MAC address in HEX format *(factory-set)*.**
RF IP Address	**Displays factory-assigned address: nnn.nnn.nnn.nnn "Factory"**
	Entering 0.0.0.0 sets the RF IP Address to the factory default and highlights the "Factory" name (active address) **Entering nnn.nnn.nnn.nnn (RF IP Address of your choice) overrides the factory default and highlights the "Override" name (active address)**
RF Net Mask	**Set to valid common IP netmask for all units within a Paragon3 network**
RF MTU	**RF Interface MTU - Default 1500. – For optimal performance, set at 1500.** **Entering a value lower than 1500 may reduce system performance. *Flexibility of using lower values may be useful in testing or for particular operational conditions.*** **Range is 576 to 1500.**
Airlink Speed	**Lists the choice of Airlink speeds, the nominal speed at which data packets are transmitted over-the-air in E-DBA.** ***The mobile will automatically adapt to the base station.*** **e.g.: At 700MHz Full Channel, the choices are:** ♦ **128K High speed standard** ♦ **96K Wider coverage and increased robustness** ♦ **64K Widest coverage and robustness**

4.7.3.3 Setup (Advanced) ► Roaming

The “Host Link Active” feature allows a base to assure the communication backhaul is operating. If not, the base indicates to mobiles on the channel that they should promptly roam to another base

The “Base Loaded” feature monitors the amount of network traffic during the previous 10-second period. If there are more than a certain number of mobiles actively sending data and the channel is occupied above a certain percentage, then the base indicates that a portion of the registered mobiles should roam to other bases, until channel loading falls below the thresholds.

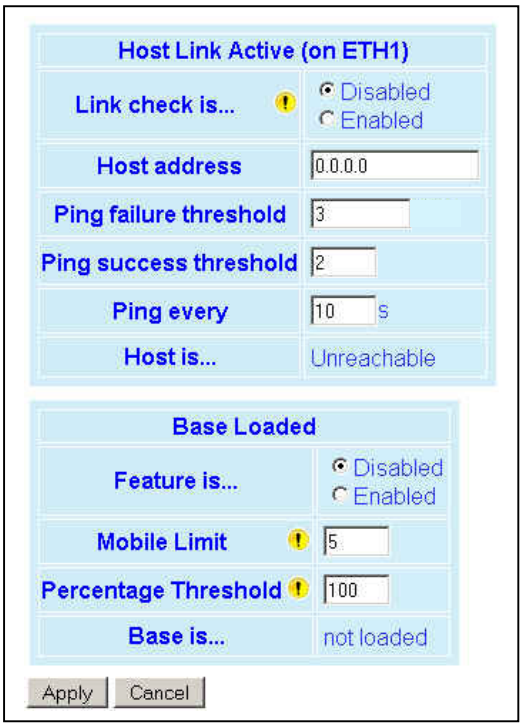


Figure 30 - Advanced IP Configuration – Roaming

Host Link Active (on ETH1)	
Link check is…	**Disabled (Default), Enabled**
Host address	**IP address of a router/host to be pinged periodically**
Ping failure threshold	**This many failed pings in a row are needed to mark the “Host is…” field as “Unreachable”**
Ping success threshold	**This many successful pings in a row are needed to mark the “Host is…” field as” Reachable”**
Ping every	**How often to send a ping**
Host is …	**Current status of the host link (blank if disabled)**
Base Loaded	
Feature is…	**Disabled, Enabled**
Mobile Limit	**Minimum number of active mobile before channel can be considered “Loaded”**
Percentage Threshold	**Minimum percentage of data capacity before channel can be considered “Loaded”**
Base is…	**Current status of the base (blank if disabled)**

4.7.3.4 Setup (Advanced) ► IP Services Setup

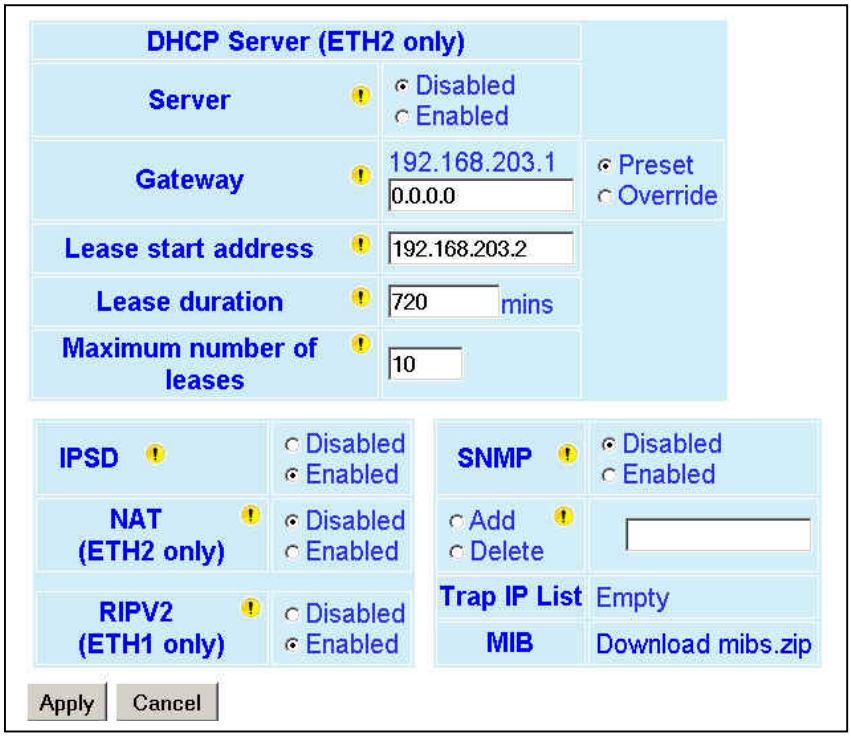


Figure 31 - Advanced IP Configuration – IP Services Setup

Server	**DHCP Server Disabled, Enabled (Default). The Dynamic Host Configuration Protocol provides a framework for passing configuration information** **E.g.: IP address to Hosts (i.e. PC/RTU) on a TCP/IP network.**
Gateway	**Gateway address handed out by the DHCP Server to the DHCP Client. The default value is set to the IP address of the Ethernet 2 interface. If the gateway is set to 0.0.0.0, no gateway address will be handed out by the DHCP Server.**
Lease Start Address	**Pool of addresses allocated for DHCP purpose. If a unit is configured as DHCP Server, this field represents the start IP address pool managed by the DHCP Server. Normally, Paragon3 automatically calculates the Lease Start Address (equal to Ethernet IP Address plus one).**
Lease Duration	**The period over which the IP Address allocated to a DHCP client is referred to as a "lease". Lease Duration is the amount entered in minutes.** **A value of "0" indicates an infinite lease.**
Maximum number of leases	**Maximum number of DHCP client(s) a unit can serve.**
IPSD	**I/P Services Delivery – Disabled (Default), Enabled.** **Allows or disallows the generation of locally provided IP Services such as online diagnostics, alarms, etc…**
NAT (ETH2 only)	**Network Address Translation - Disabled, Enabled (Default)** **NAT technology is a method by which IP addresses are mapped from one address space to another. In Paragon3, it is normally used on the WAN side of an IP network to hide local IP addresses from an external IP network (i.e. Internet).**
RIPV2 (ETH1 only)	**Router Information Protocol v2 - Disabled, Enabled (Default)** **RIPv2 is a dynamic IP routing protocol based on the distance vector algorithm and is only used in Router mode.**

SNMP	**Simple Network Management Protocol – Disabled, Enabled (Default)** ***Only displays when the relevant optional feature key software option is purchased as indicated in* Figure 78*or on the sales/work order.*** **SNMP provides means to monitor, collect, and analyze diagnostic information. Enabling SNMP allows the MIB (Management Information Base) in the Paragon3 to be viewed using an external MIB browser or network management software.** **Trap IP List** **After reset, the Paragon3 sends a WARMSTART trap to all of the IP addresses defined in the Trap IP list. It signifies that the system has started.** **To add an address to the Trap IP List: Select *Add* and type the new IP address to be added to the read-only Trap IP list. The window will expand downward to show all addresses in the list.** **To delete an address to the Trap IP List: Select *Delete* and type the new IP address to be deleted from the read-only Trap IP list.**
MIBS	**Management Information Base -used to assemble and interpret SNMP messages.** **The Dataradio Paragon3 MIB is bundled with each unit's firmware. Click "Download mibs.zip" and a pop-up dialog box will appear in your browser asking you to open or save the file to your PC. Save the zip file to a desired location. Unzip the contents of mibs.zip file to a location where your SNMP manager can find it.** ***Note: SNMP must be enabled in order for the host PC SNMP manager to work*.**

4.7.3.4.1 NAT Overview

The purpose of the "Network Address Translation" (NAT) protocol is to hide a private IP network from a public network. The mechanism serves both as a firewall function and to save IP address space.

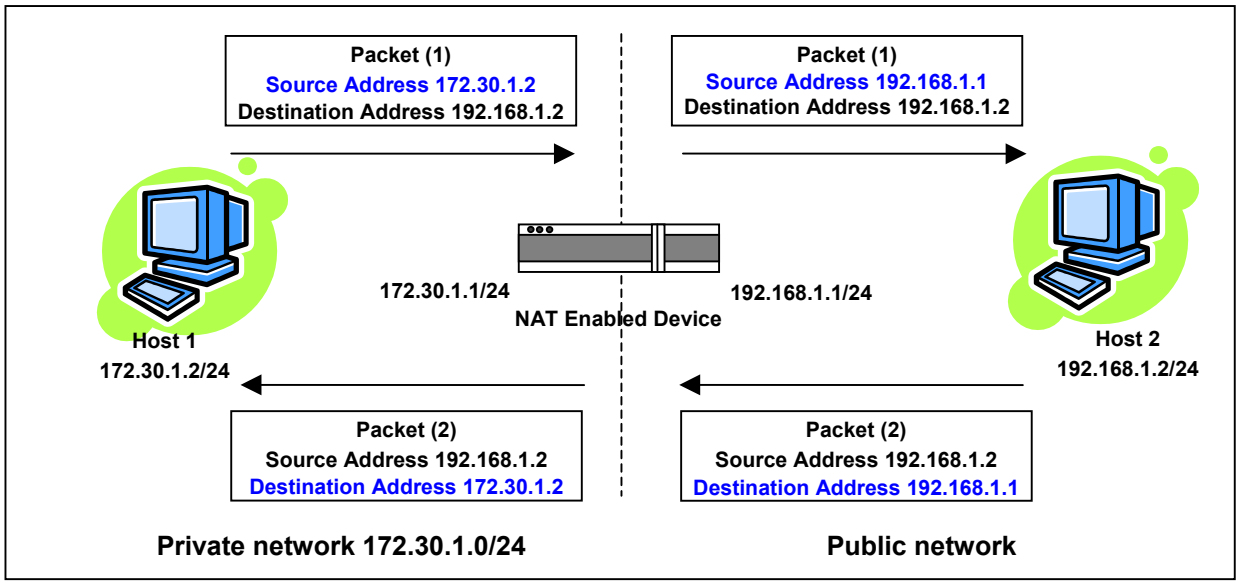


Figure 32 - IP Source Address Translation - Belonging to Private Network

Packets with an **IP source address belonging to the private network** that are forwarded from the private network to the public network get their IP source address replaced by the IP address of the outgoing interface of the NAT enabled device.

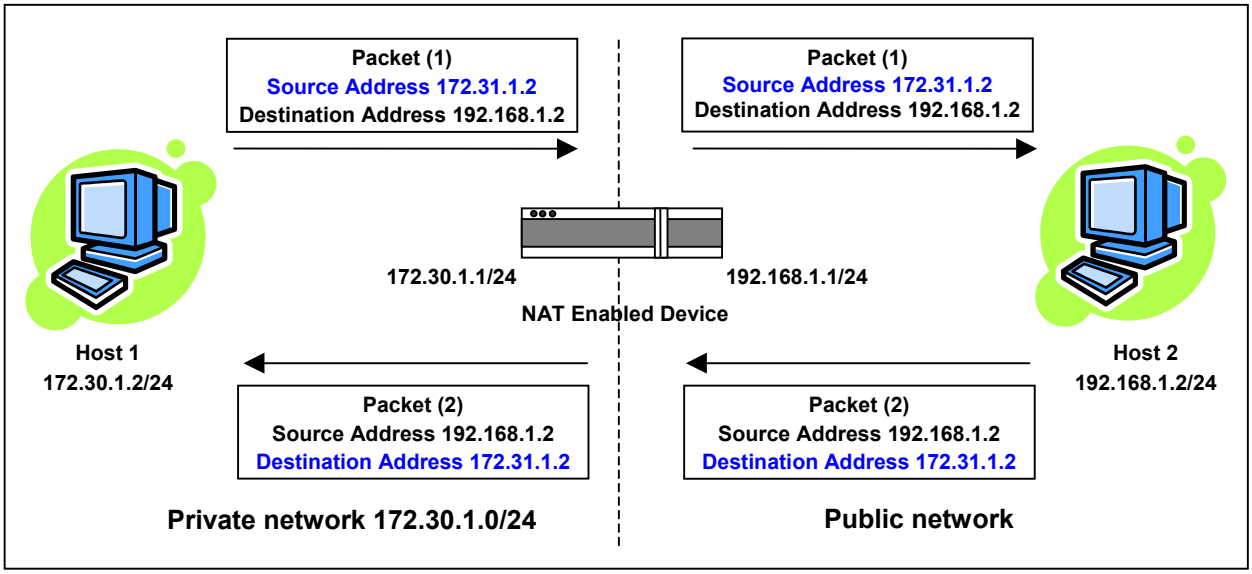


Figure 33 - IP Source Address Translation - Not Belonging to Private Network

Packets with **IP source address NOT belonging to the private network** that are forwarded from the private network to the public network DO NOT get their IP source address replaced by the IP address of the outgoing interface of the NAT enabled device. Host 1 may be routing packets from other networks or sending packets with different IP source addresses.

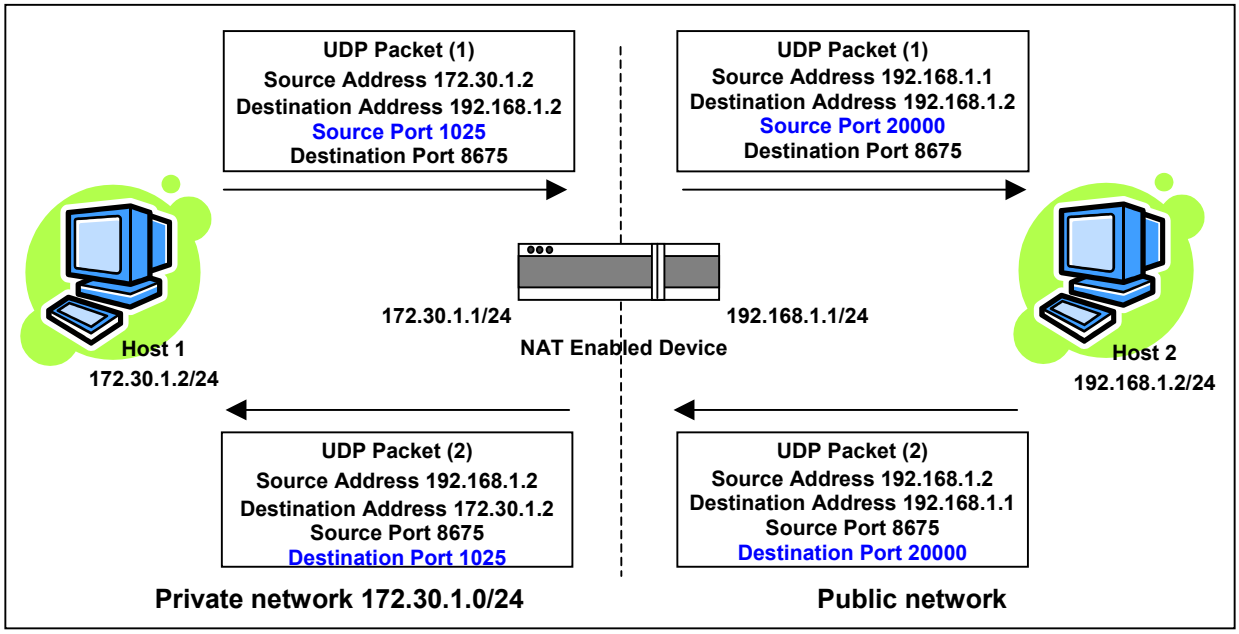


Figure 34 - UDP/TCP Source Port Translation

For UDP/TCP packets, when the **IP source address is translated**, the UDP/TCP source port also gets translated.

4.7.3.4.1.0 NAT Sessions and Timeout

The NAT enabled device maintains a session table to be able to perform the translation of IP source address and UDP/TCP source port numbers from the private address space to the public address space.

NAT sessions are deleted when idle (no traffic) as follows:

- TCP: 43200 seconds (default)
- UCP: 900 seconds (default)
- ICMP: 30 seconds (default)

4.7.3.4.1.1 NAT on the Base Unit (Paragon3)

When NAT is enabled on the P3, the private network (from the point of view of the Base station) is the IP network associated to the Ethernet 2 interface.

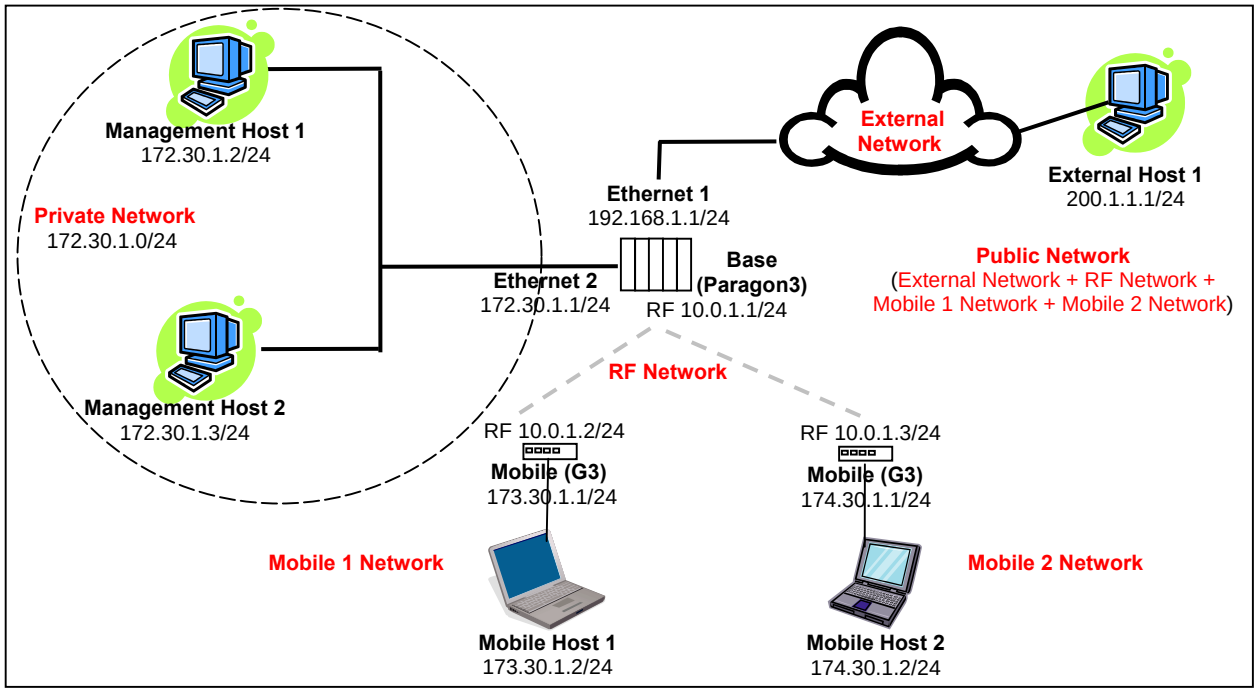


Figure 35 - NAT Enabled on Paragon3

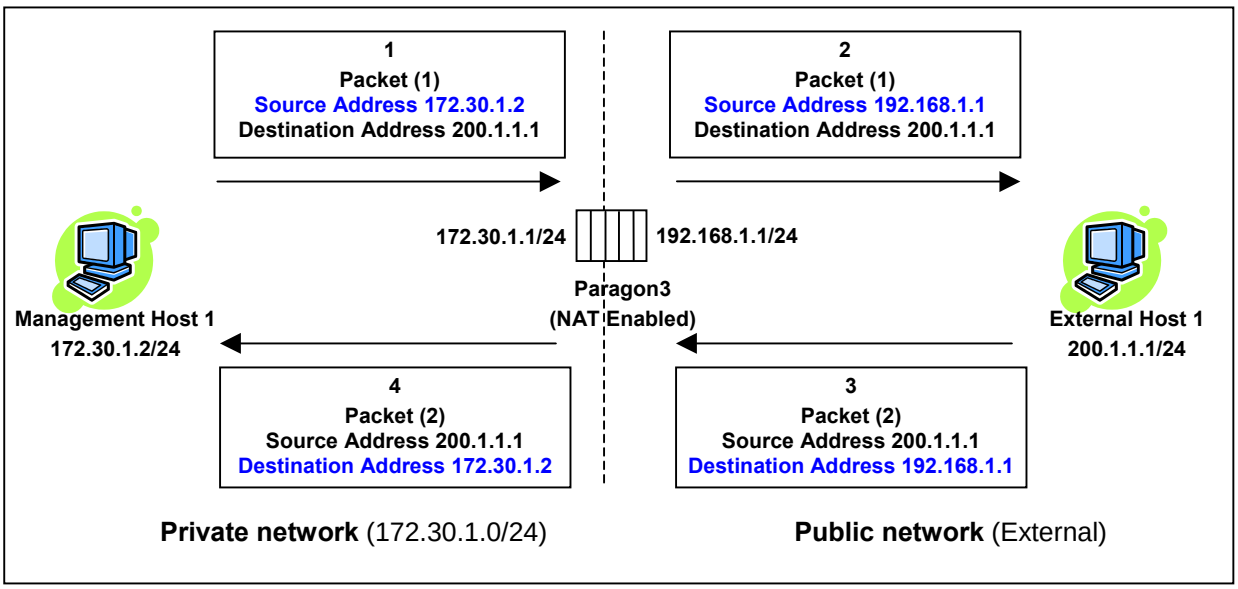


Figure 36 - Paragon3 - Example 1

In example 1, Management Host 1 sends Packet (1) to External Host 1. Since the source IP address of Packet (1) comes from the private network, it gets replaced by the IP address of the Ethernet 1 interface of the Base station.

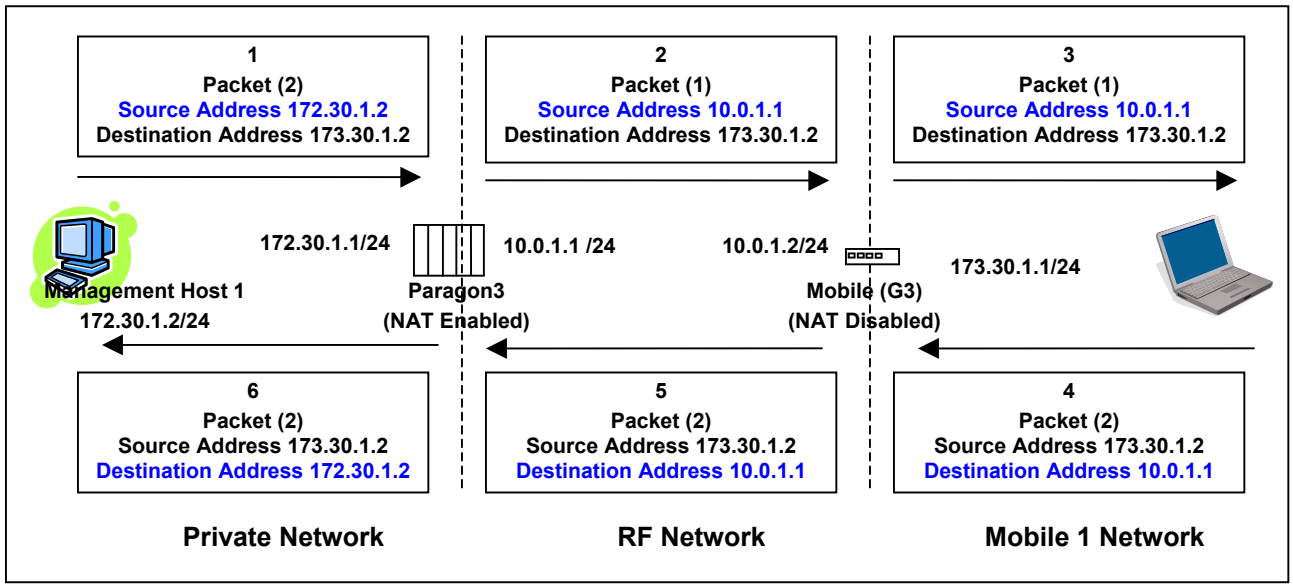


Figure 37 - Paragon3 - Example 2

In example 2, Management Host 1 sends Packet (1) to Mobile Host 1. Since the source IP address of Packet (1) comes from the private network, it gets replace by the IP address of the RF interface of the Base station.

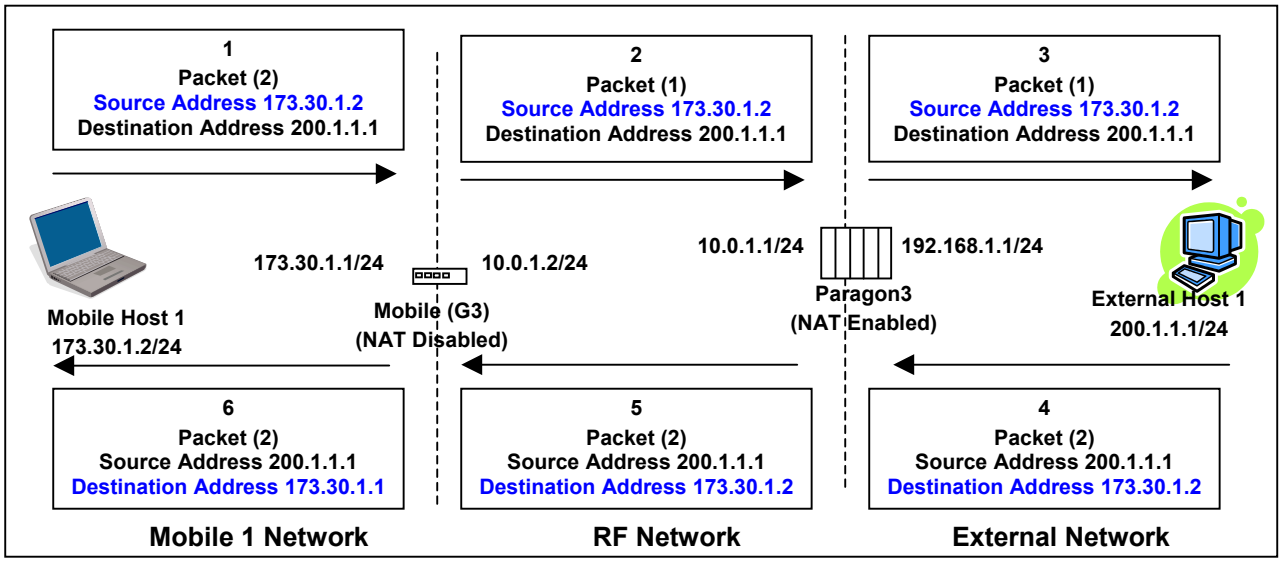


Figure 38 - Paragon3 - Example 3

In example 3, Mobile Host 1 sends Packet (1) to External Host 1. Since the source IP address of Packet (1) does not come from the private network, it doesn't get replaced by another IP address by the Base station.

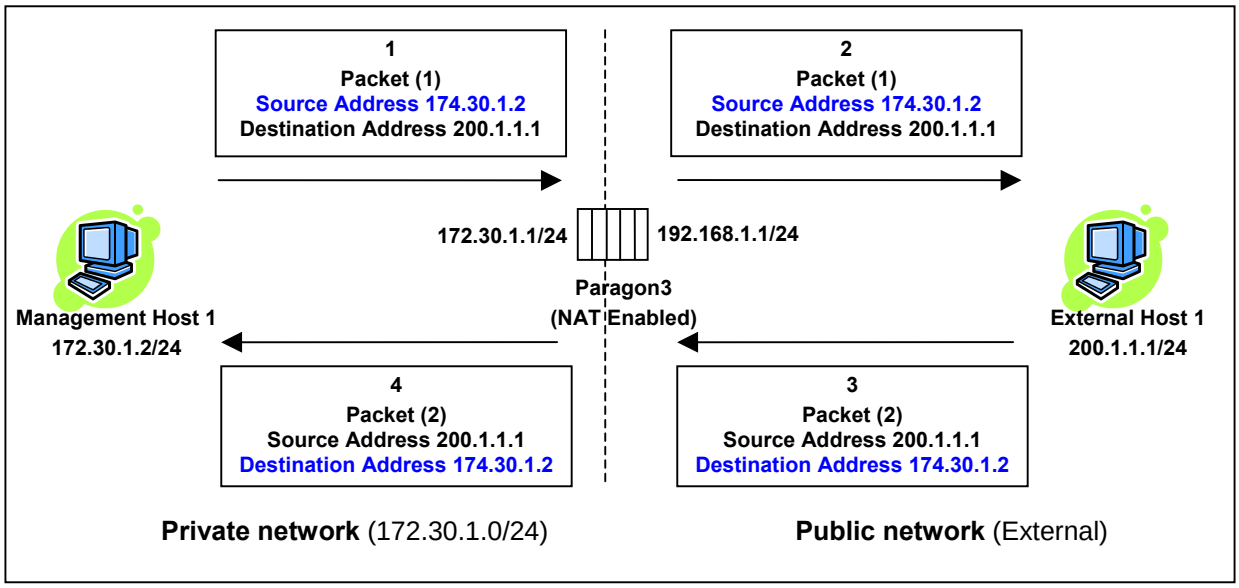


Figure 39 - Paragon3 - Example 4

In example 4, Management Host 1 sends Packet (1) to External Host 1. Even though the packet comes from the private network, the source IP address does not. The Base station does not replace the source IP address of Packet (1).

4.7.3.4.1.2 NAT on the Mobile Unit (GeminiG3)

When NAT is enabled on the Mobile Unit, the private network (from the point of view of the Mobile unit) is the IP network associated to the Ethernet 1 interface.

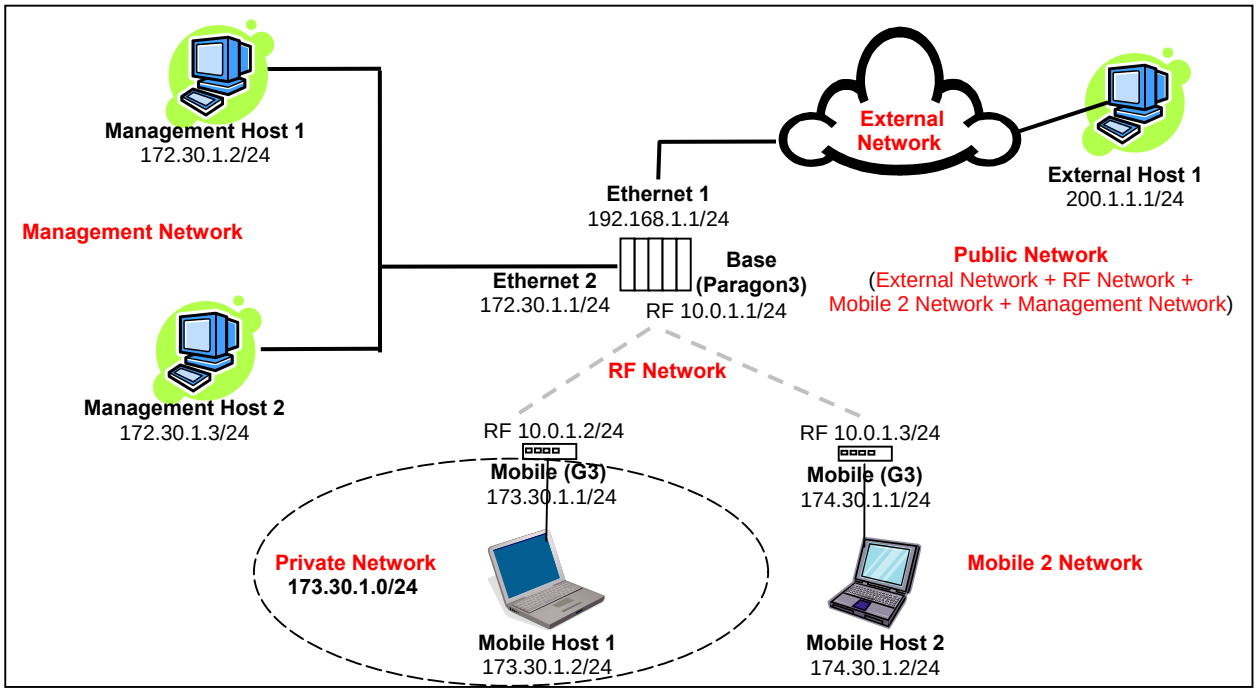


Figure 40 - NAT Enabled on GeminiG3

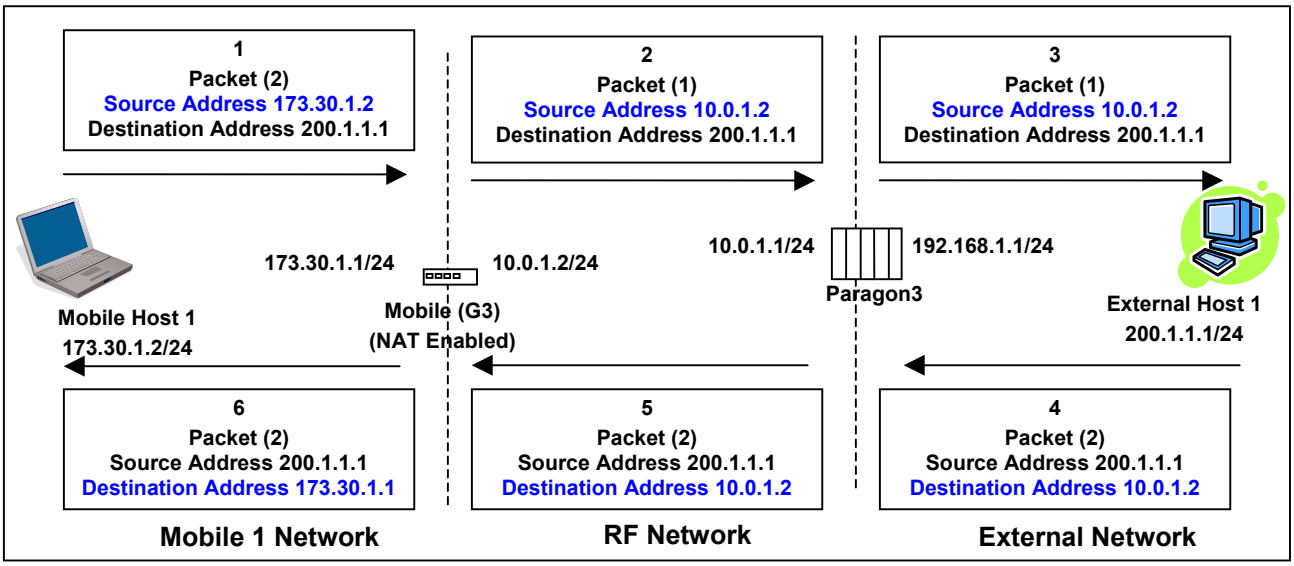


Figure 41 - GeminiG3 - Example 1

In example 1, Mobile Host 1 sends Packet (1) to External Host 1. Since the source IP address of Packet (1) comes from the private network, it gets replaced by the IP address of the RF interface of the Mobile unit.

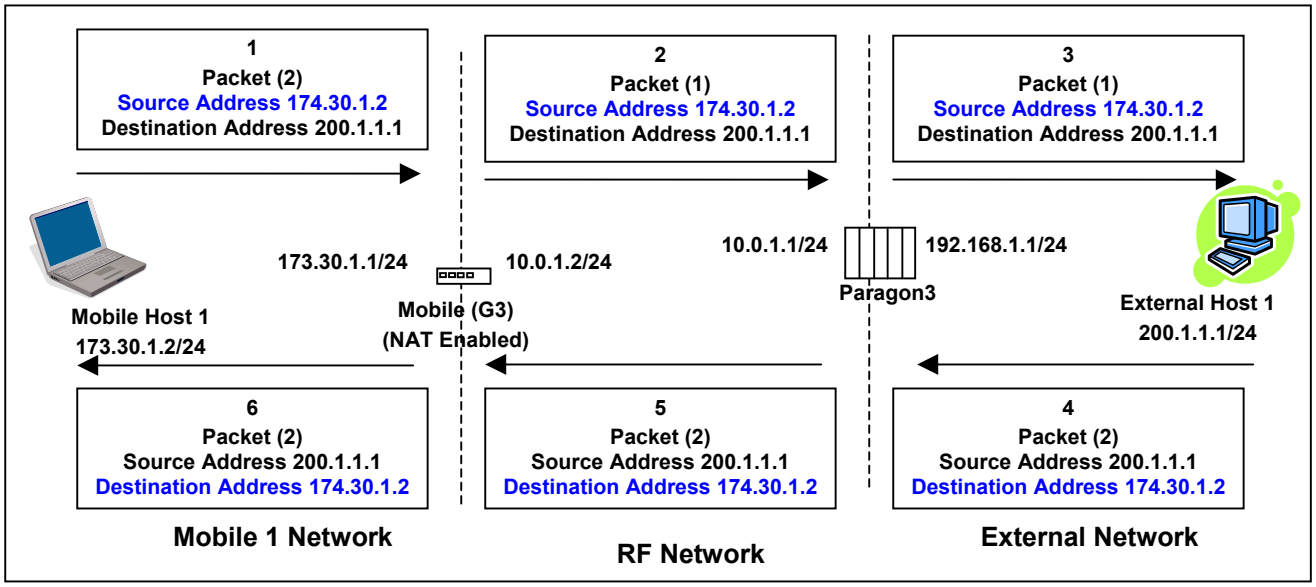


Figure 42 - GeminiG3 - Example 2

In this example, Mobile Host 1 sends Packet (1) to External Host 1. Although the packet comes from the private network, the IP source address is not part of the private network. The source IP address of Packet (1) does not get replaced by the Mobile unit. Please note that for Packet (2) to come back to Mobile Host (1), the appropriate routes must be set in the GeminiG3 and Paragon3 units.

4.7.3.4.2 SNMP Overview

SNMP (Simple Network Management Protocol) is used by network management systems to manage and monitor network-attached devices. SNMP is based on the manager/agent model consisting of a manager, an agent, a database of management information, managed objects, and the network protocol. The manager provides the interface between the human network manager and the management system. The agent provides the interface between the manager and the physical devices being managed (Figure 43). SNMP uses basic messages (*such as GET, GET-NEXT, SET, and TRAP*) to communicate between the manager and the agent.

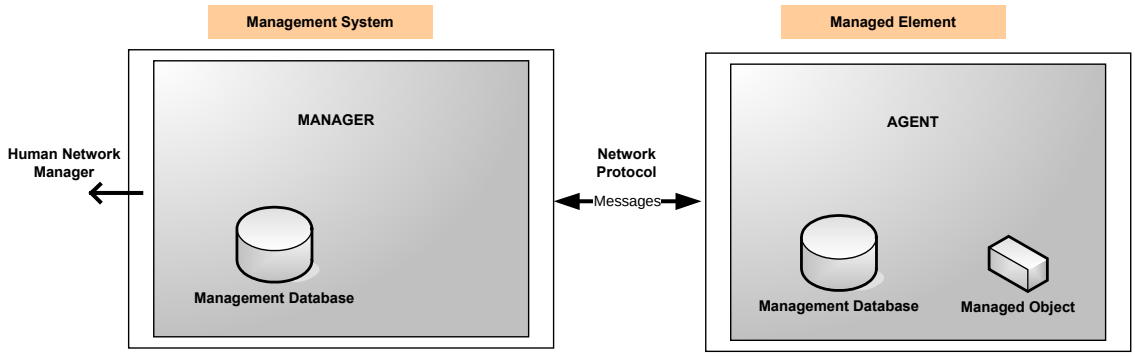


Figure 43 - SNMP: manager/agent model

4.7.3.4.2.1 MIB

The manager and agent use a Management Information Base (MIB), a logical, hierarchically organized database of network management information. MIB comprises a complete collection of objects used to manage entities in a network. A long numeric tag or object identifier (OID) is used to distinguish each variable uniquely in the MIB and SNMP messages.

4.7.3.4.2.1.1 ParagonP3 MIB File

Each ParagonP3 unit firmware package is bundled with three MIB files (found inside mibs.zip file):

- *dataradio-regs.mib*: contains a top level set of managed object definitions aimed at managing Dataradio products.
- *1213.mib*: contains a set of managed object definitions aimed at managing TCP/IP-based internets.
- *bsc.mib*: contains a set of managed object definitions aimed at managing Dataradio bsc radio base stations.

4.7.3.4.2.1.2 OID

In SNMP, each object has a unique OID consisting of numbers separated by decimal points. These object identifiers naturally form a tree. Figure 44 illustrates this tree-like structure for *1213.mib,* which comes bundled with every ParagonP3 unit package. A path to any object can be easily traced starting from the root (top of the tree). For example, object titled "SNMP" has a unique OID: 1.3.6.1.2.1.11. The MIB associates each OID with a label (e.g. "SNMP") and various other parameters. When an SNMP manager wants to obtain information on an object, it will assemble a specific message (e.g. GET packet) that includes the OID of the object of interest. If the OID is found, a response packet is assembled and sent back. If the OID is not found, a special error response is sent that identifies the unmanaged object.

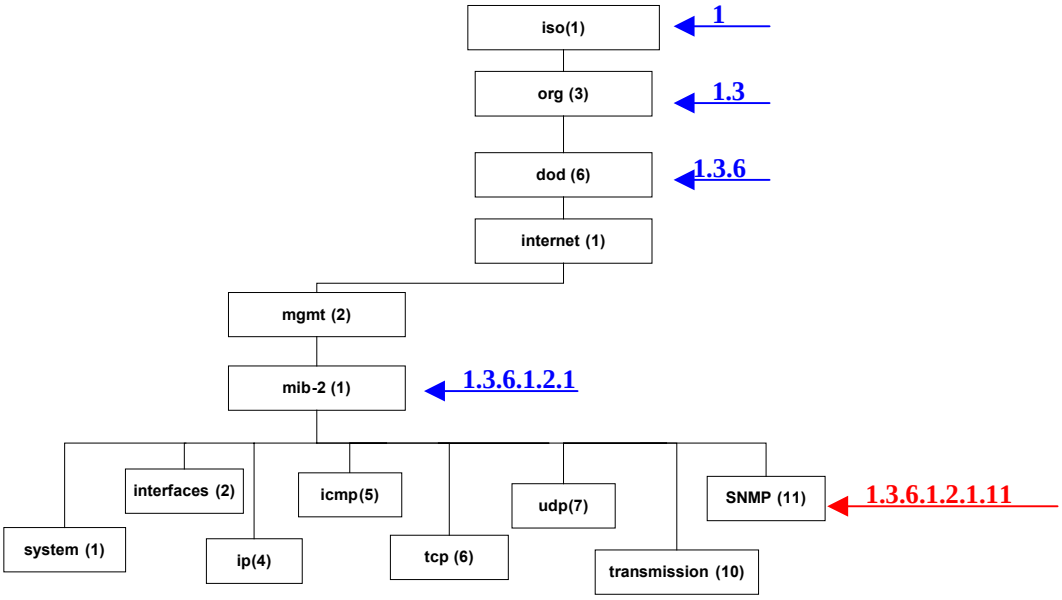


Figure 44 - Branch of the 1234.mib OID tree

Viewing MIB files

To view the hierarchy of SNMP MIB variables in the form of a tree and view additional information about each node, Dataradio recommends opening all MIB files with a MIB browser. In a MIB browser, each object (*or node*) can be selected and its properties (*including its OID*) can be observed. For simple networks, a basic, free application such as ”iReasoning MIB browser” could be used.

However, for managing complex networks, Dataradio recommends a more advanced software application, one capable of browser function as well as being a full-featured SNMP manager, such as the optional “Castle Rock SNMPc Network Manager”. Refer to Dataradio Network Management using SNMP User Manual (Part no. 120 47001-nnn for more details).

bsc.mib

Figure 45 shows top-level objects of the bsc.mib file:

- *bscIdentity*
- *bscRadioIdentity*
- *bscStatistics*
- *bscDiagnostics*
- *bscControl*
- *bscMobileTable*

These six branches expand into additional branches and leaves. Again, all bsc.mib objects can be accessed through a MIB browser.

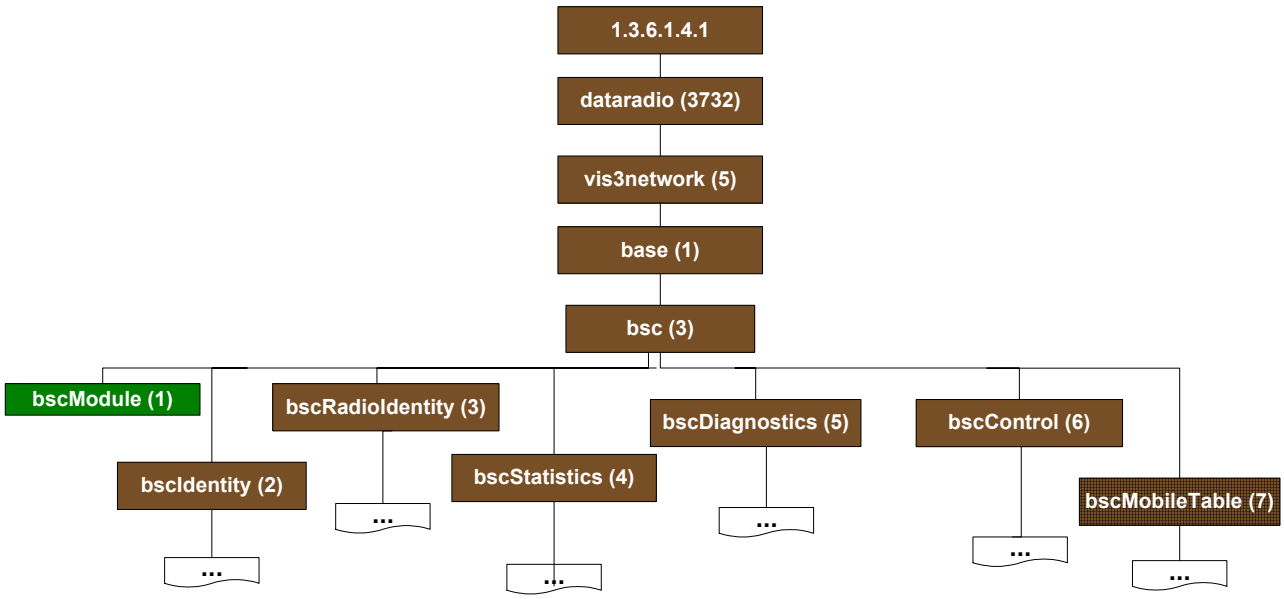


Figure 45 - bsc.mib Tree

Note: For more details on Network Management using SNMP refer to Dataradio Network Management using SNMP User Manual (Part no. 120 47001-nnn)

4.7.3.5 Setup (Advanced) ► IP addressing modes

For a description of the broadcast and multicast features of the Paragon3 radio modem, please refer to paragraph 4.7.3.5.1 below.

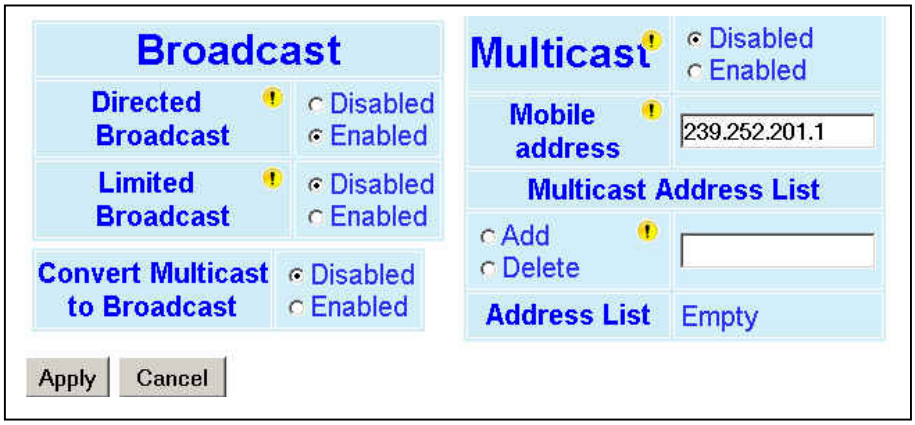


Figure 46 - Advanced IP Configuration – IP addressing modes

The IP Addressing web page contains two sections, the one on the left controls the forwarding of IP broadcast packets and the other, on the right, controls IP multicast packets.

Each section acts independently.

Item		Description
Broadcast	**Directed Broadcast**	**Disabled, Enabled (Default) – Controls forwarding of Directed Broadcast packets**
	Limited Enable	**Disabled (Default), Enabled – Controls forwarding of Limited broadcast packets**
Multicast	**Multicast**	**Disabled (Default), Enabled – Controls forwarding of Multicast packets (based on the "Multicast Address List")**
	Mobile address	**Multicast address associated to remote unit**
	Multicast Address List Control – Add / Delete Address	**Select the Add button and type in the dialog box the new address to be added to the "Multicast Address List". Valid range of Multicast IP addresses is 224.0.0.1 to 239.255.255.255** **Select the Delete button and type in the dialog box the address to be deleted from the "Multicast Address List"**
	Multicast Address List	**Read-only listing. Dynamic window expands downward as needed to show all addresses in the list.** **When an IP packet is received on the Ethernet side of the unit and the destination IP address matches one of the multicast IP addresses in this list, it is forwarded over the RF interface.** **Remote units will send it over their Ethernet interface.**
Convert Multicast to Broadcast		**Disabled (default)/Enabled** **When enabled, broadcasts all packets sent to a multicast destination address.**

4.7.3.5.1 IP Broadcast/Multicast Overview

When an IP packet needs to reach more than one unit, the destination address can be set to either a broadcast address or a multicast address.

4.7.3.5.1.1 Broadcasts

Figure 47 - Broadcast Window Detail

There are two types of IP broadcast addresses:

- **Directed broadcast**

  A directed broadcast address is an IP address where the host portion is all ones (for instance 172.30.1.255 is the directed broadcast address for the network 172.30.1.0/24, 172.30.1.207 is the directed broadcast address for the network 172.30.1.192/28).

- **Limited broadcast**

  The limited broadcast address is 255.255.255.255.

  Note:

  Routing equipment (to prevent broadcast storms) do not by default forward limited broadcast packets (255.255.255.255). On the other hand, directed broadcast packets are by default forwarded because these packets are routable like any other unicast packets.

4.7.3.5.1.1.1 Directed Broadcast

Each interface of a unit has its own IP address and netmask. From the IP address and netmask, it is easy to calculate the broadcast address associated to the interface. For instance, if the Ethernet interface address of a GeminiG3 radiomodem is 172.30.1.1/24 and the RF interface address is 10.0.1.2/24, then the broadcast address of the Ethernet interface is 172.30.1.255 and the broadcast address of the RF interface is 10.0.1.255.

The "***Directed Broadcast***" option buttons let the user select whether the unit must forward (or not) *directed broadcast* packets. Upon reception of a *directed broadcast* packet, the unit takes the following actions:

If the directed broadcast address matches with one of the unit's interface broadcast addresses:

- Keep a copy for itself (pass to internal applications, if any).
- If directed broadcast packets can be forwarded (Directed Broadcast is enabled):
  Forwards the packet according to the routing table.
- If directed broadcast packets cannot be forwarded (Directed Broadcast is disabled):
  Silently discards the packet.

Note:

*Occasionally, the unit cannot determine that the packet is actually a **directed broadcast**. In such a case, the packet is normally routed.*

Example (Directed Broadcast forwarding enabled)

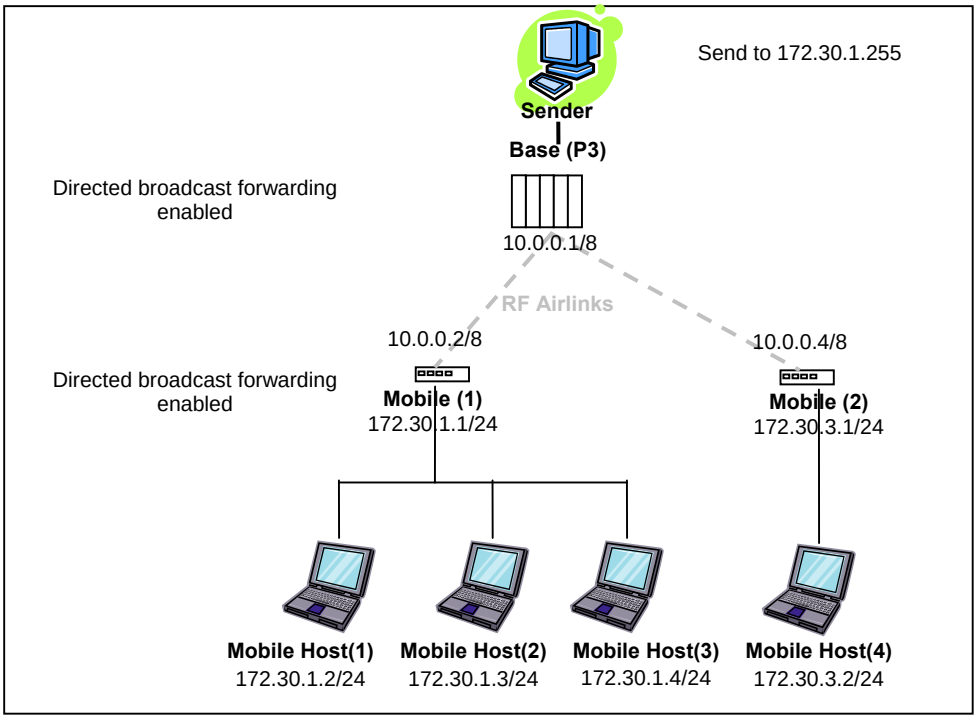


Figure 48 - Example of Directed broadcast forwarding enabled

In this example (Figure 48), directed broadcast forwarding is enabled on the **Base** unit and on **Mobile (1)** unit. If **Sender** wants to reach **Mobile Host (1)**, **Mobile Host (2)** and **Mobile Host (3)** with a single packet, he can send to destination address 172.30.1.255.

Example (Directed Broadcast forwarding disabled)

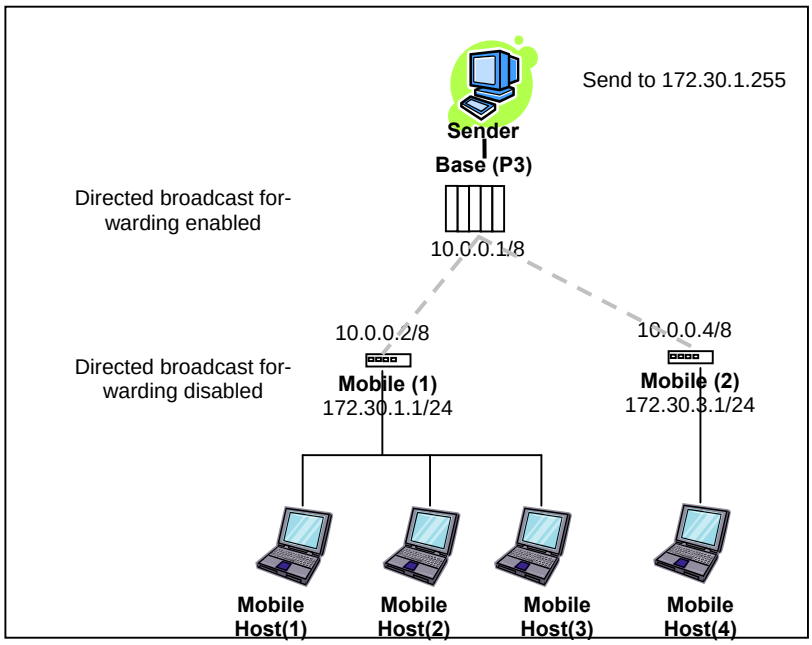


Figure 49 - Example of Directed broadcast forwarding disabled

In this example (Figure 49), directed broadcast forwarding is enabled on the **Base** unit and disabled on the **Mobile (1)** unit. If **Sender** sends a packet to destination address 172.30.1.255, the packet would be discarded by **Mobile (1),** it would not reach **Mobile Host (1), Mobile Host (2)** and **Mobile Host (3).**

If the user wants the **Base** unit to do the discarding of the directed broadcast packets, then the directed broadcast forwarding must be disabled on the **Base** unit itself.

4.7.3.5.1.1.2 Limited Broadcast

The "***Limited Broadcast***" enabled/disabled option buttons control *limited broadcast* packets forwarding. When enabled, the unit forwards *limited broadcast* packets.

Upon reception of a *limited broadcast* packet, the unit takes the following actions:

- Keeps a copy for itself (passes to internal applications, if any).
- If *limited broadcast* packets can be forwarded (Limited Broadcast is enabled):
  Sends a copy of the packet out to all the interfaces with the exception of the interface where the packet was received.
- If *limited broadcast* packets cannot be forwarded (Limited Broadcast is disabled):
  Silently discards the packet.

Example (Limited Broadcast forwarding enabled)

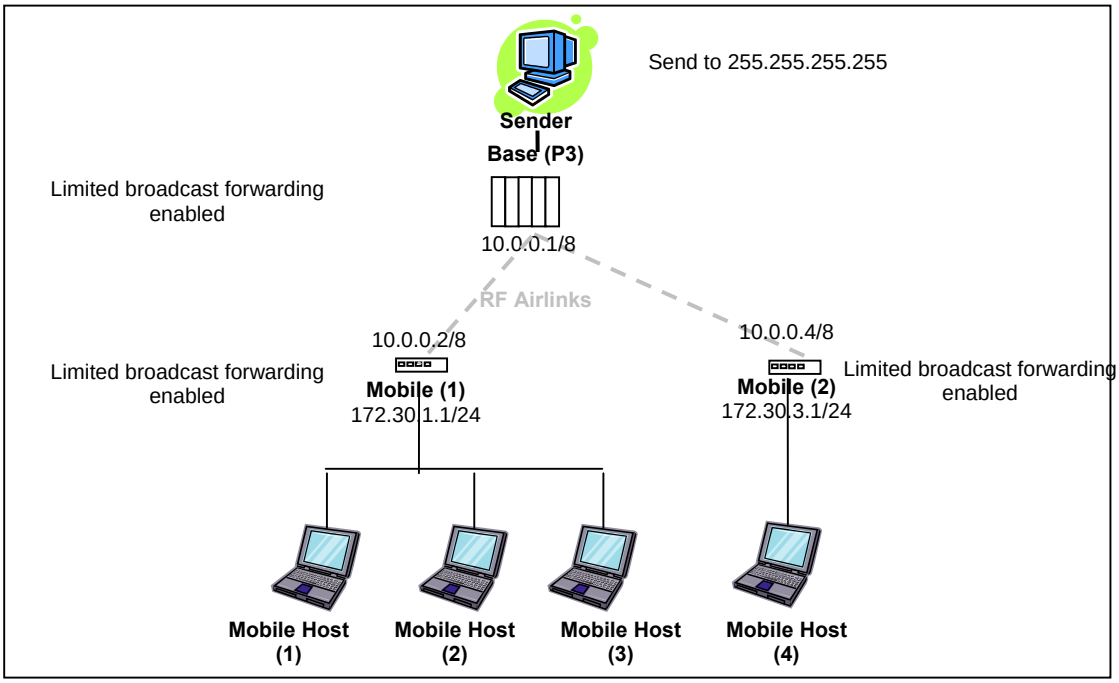


Figure 50 - Example of Directed broadcast forwarding enabled

In this example, (Figure 50) limited broadcast forwarding is enabled on the **Base** unit and on all **Mobile** units. **If Sender** wants to reach **Mobile Host (1)**, **Mobile Host (2) and Mobile Host (3)** and **Mobile Host (4)** with a single packet, he can send to destination address 255.255.255.255.

Notice that **Sender** and **Base** units are on the same LAN (routing equipment does not usually forward limited broadcast packets).

Example (Limited Broadcast forwarding disabled)

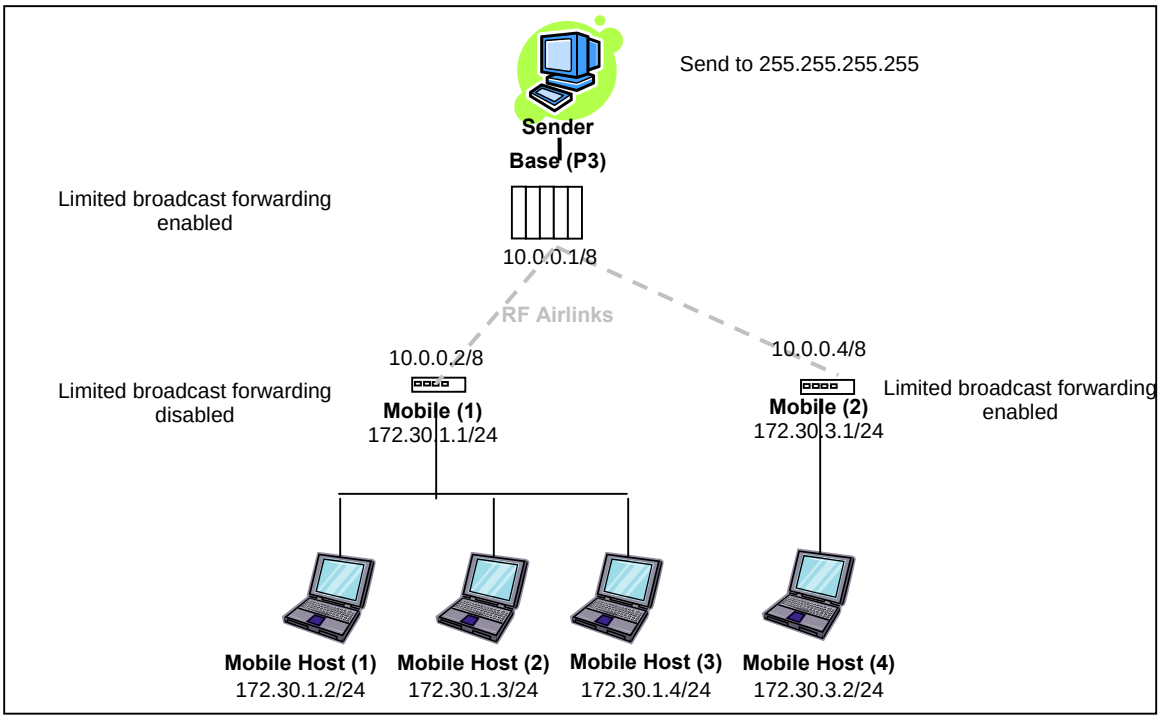


Figure 51 - Example of Limited broadcast forwarding disabled

In this example (Figure 51), limited broadcast forwarding is enabled on the **Base** unit, disabled on the **Mobile (1)** unit and enabled on the **Mobile (2)** unit. If **Sender** sends a packet to destination address 255.255.255.255, the packet would reach **Mobile Host (4)** only. The **Mobile (1)** unit would discard any limited broadcast packet it received from the **Base** unit.

If the user wants the **Base** unit to do the discarding of the limited broadcasting packets, then the limited broadcast forwarding must be disabled on the **Base** unit itself. Then no **Mobile Host** unit would ever be receiving a limited broadcast packet.

4.7.3.5.1.2 Multicast

IP multicast addresses are in the range 224.0.0.0 to 239.255.255.255. These addresses are used to represent logical groups of units that may or may not reside on the same networks.

Multicast is used when “one-to-many” communication is required. For instance, a radio station might offer a music channel on the Internet in real time. To receive the music a receiver-host must know the multicast group (multicast address) used by the radio station sender-host and add itself as a member of this group. In the IP realm, a host uses the IGMP protocol to do this. The routers inside the Internet are using IGMP and other multicast routing protocols to build the proper path from the sender to the receivers (a tree-like path is formed from the sender to the receivers).

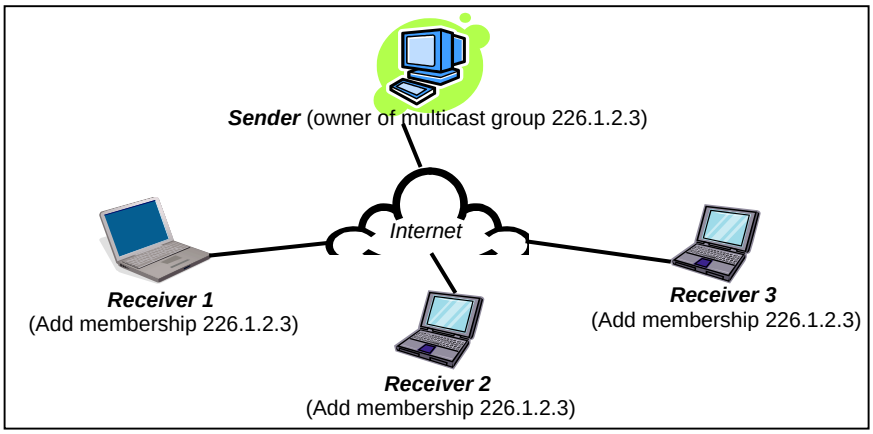


Figure 52 - Registration to multicast group (First step)

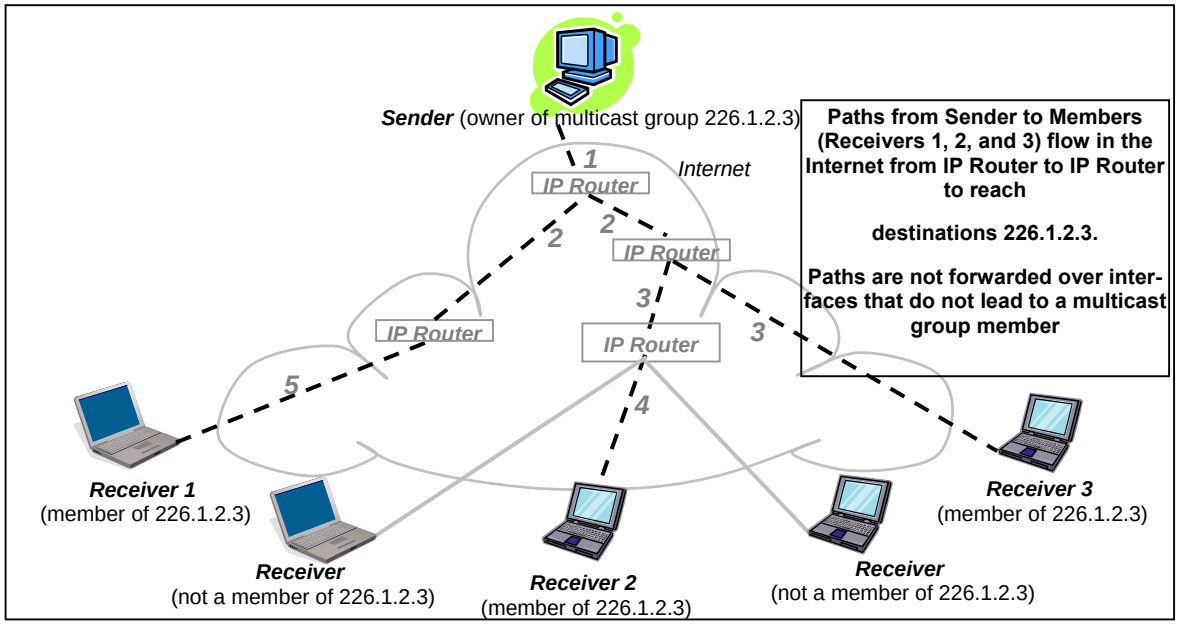


Figure 53 - Reception of multicast packets (Second step)

In the E-DBA environment, an outside sender-host might be interested in sending multicast packets to any one of the following groups:

- "All Base" group.
- "All Mobile" group.
- Various "Mobile Host" groups.

The Base (P3 in the illustration) units are directly connected to the outside network. ALL multicast groups MUST be identified in the Base because the Base unit uses IGMP to register the memberships to the multicast groups on behalf of the other units (Mobile units, Mobile Host units).

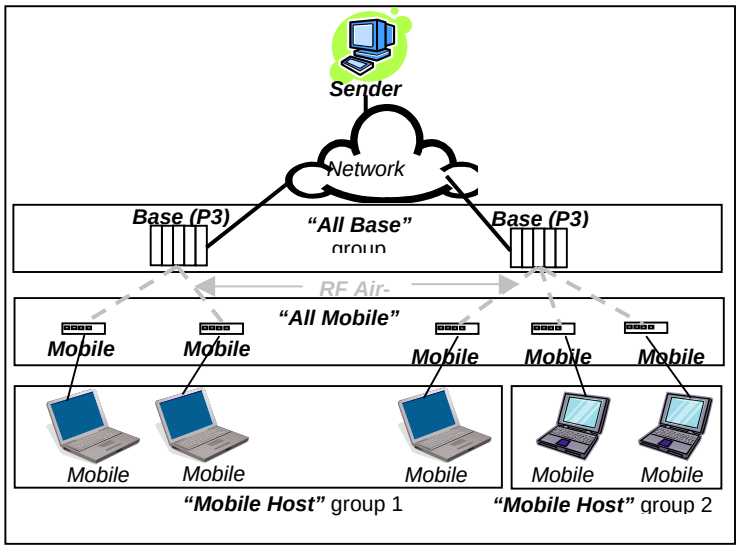


Figure 54 - Typical E-DBA Multicast Groups

The following setup example would allow the "Sender" unit to communicate with different multicast groups. The settings shown in Figure 55 below, and also represented in
Figure 56, would enable the Sender unit to reach all entities of the various groups.

Figure 55 - Multicast Window Details (On the Base station)

Multicast (Enabled/Disabled)	**Enables or disables the registration of the multicast groups by the Base**
Base address	**Indicates the "All Base" multicast group**
Outbound unit address	**Indicates the "All Mobile" multicast group**
Multicast Address List	**Indicates the various "Mobile Host" groups**

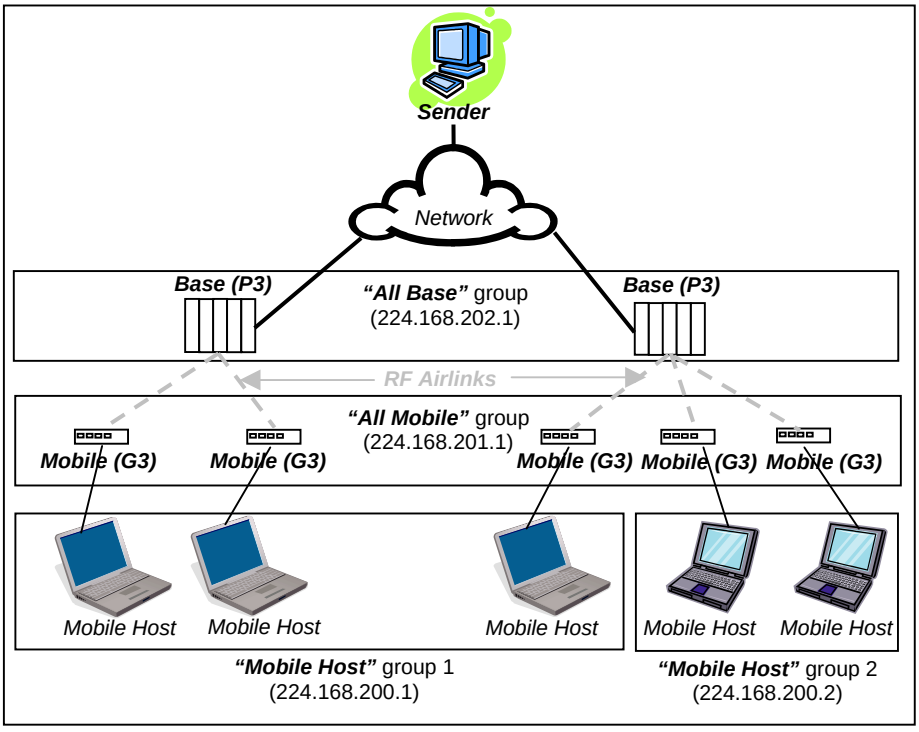


Figure 56 - Typical E-DBA Multicast Groups (with addresses)

4.7.3.6 Setup (Advanced) ► IP Optimization & Tuning

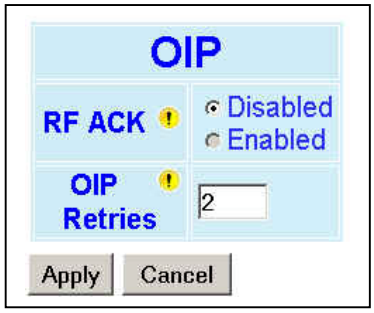


Figure 57 - Advanced IP Configuration - IP Optimization & Tuning - OIP (Router Mode)

Item	Description
RF ACK	**Disabled (Default) - TCP packets are always RF acknowledged regardless of this option setting.** **Enabled - Use when packets need to be acknowledged at the RF level by the remote unit (destination unit). This option is applicable to all packet types other than TCP.**
OIP Retries	**Number of OIP retries. Default = 2**

4.7.3.7 Setup (Advanced) ► IP Routing

Displays the table of IP routes that are active in the Paragon3 base station.

Typically, display shows routes for RF, ETH1, and ETH2.

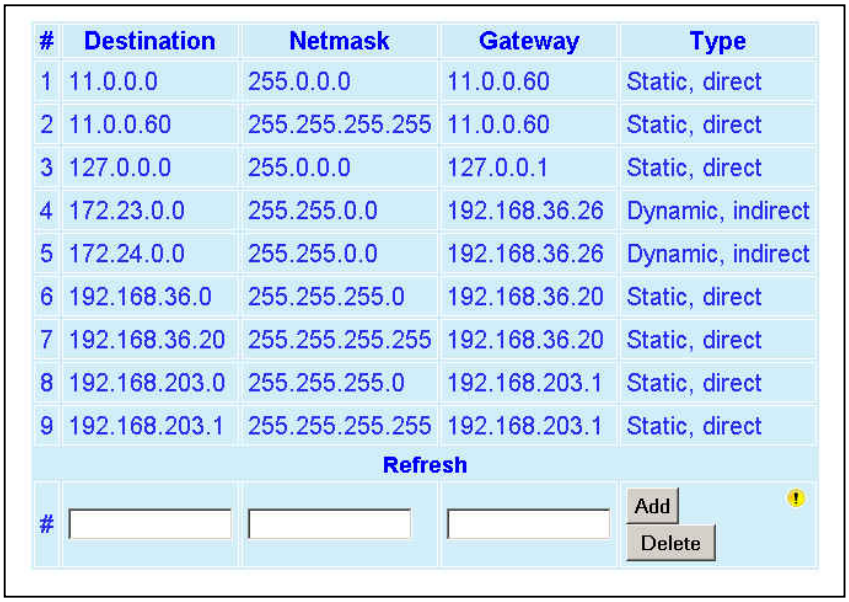


Figure 58 - IP Routing

Item	Description
Destination	**IP address of a route.**
Netmask	**Netmask of a route**
Gateway	**Gateway of a route**
Type	**Static routes: A paragon3 base station only contains Static routes. These routes are created by the interfaces of the Paragon3 base station (ETH1, ETH2, and RF), and are added by registered mobiles or can be manually entered by the user. Direct routes describe addresses that are directly reachable by one of the interfaces. Indirect routes describe addresses that cannot be reached directly by any of the interfaces (i.e. addresses that are more than one hop away).**
Add / Delete	**Allows the user to add or remove routes manually to/from the table. The interface routes, which are direct routes that have a 255.255.255.255 netmask, cannot be removed. Warning: Manipulate this table with caution!**

4.7.3.8 Setup (Advanced) ► Time Source

To facilitate tracking of events in a network, the Paragon3 base station and the GeminiG3 unit can initialize their real-time clocks using a number of protocols. At reset time, the Paragon3 can use the SNTP protocol (RFC2030) to pick up the current UTC (Universal) time. Setting the "TimeZone" and "Daylight Savings" options allows displaying the correct local time in the "Unit Identification and Status" page.

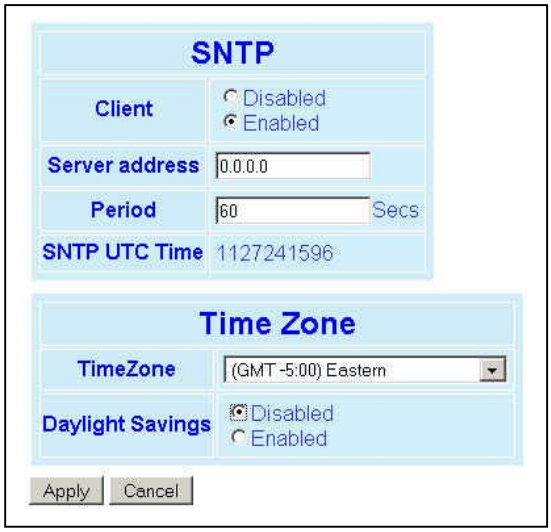


Figure 59 - Advanced IP Configuration – Time Source

Item		Description
SNTP	Client	Disabled (Default), Enabled
	Server address	IP of the SNTP Server in dot decimal format
	Period	Period at which the SNTP Server is polled
Time Zone	TimeZone	Select from drop-down list
	Daylight Savings	Disabled (Default), Enabled

4.7.3.9 Setup (Advanced) ► Ethernet (PHY)

The Ethernet port(s) must be configured in a mode that is compatible with the other local devices.

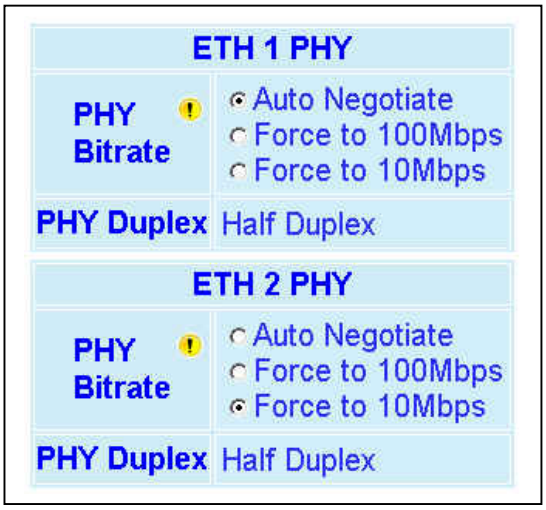


Figure 60 - Advanced IP Configuration – Ethernet (PHY)

Item		Description
ETH1 PHY	PHY Bitrate	**Auto Negotiate** **Force to 100 Mbps** **Force to 10 Mbps (Default)**
	PHY Duplex	**Displays factory configured mode of operation: Auto Negotiate**
ETH2 PHY	PHY Bitrate	**Auto Negotiate** **Force to 100 Mbps** **Force to 10 Mbps (Default)**
	PHY Duplex	**Displays factory configured mode of operation: Half Duplex**

4.7.3.10 Setup (Advanced) ►Diagnostic Settings

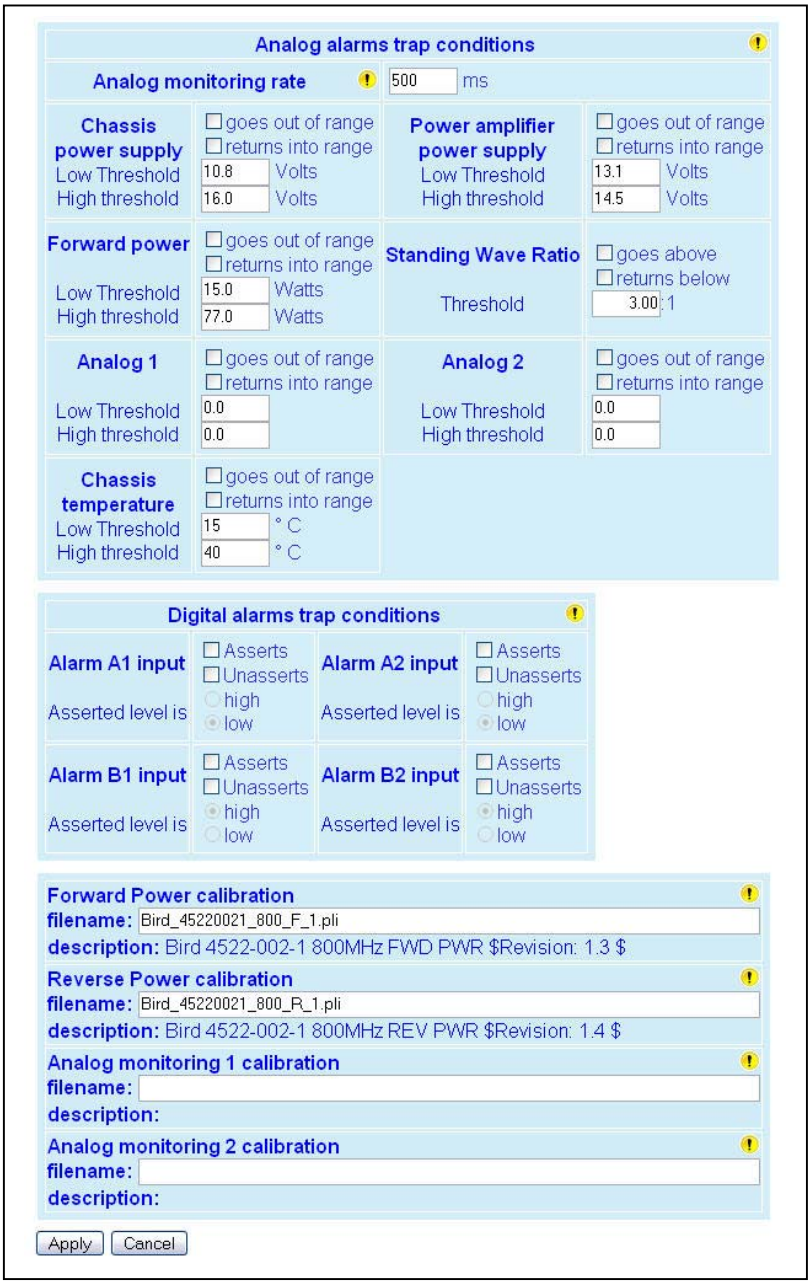


Figure 61 - Advanced IP Configuration – Diagnostic Settings

Item	Description
Analog alarms trap conditions	
Analog Monitoring Rate	**Frequency at which internal values are updated and checked against the alarm boundary conditions. Ranges from 100milliseconds to infinity. Default = 500ms**
Analog alarms settings	**For each diagnostic value displayed, the user can control alarms trap conditions in the following ways:** ▪ **Set acceptable range of values by entering the low and high thresholds** ▪ **Choose to be notified when the value goes out of acceptable range by selecting the "goes out of range" check box** ▪ **Choose to be notified when the value returns into acceptable range by selecting the "returns into range" check box** **All monitoring combinations are possible**
Digital Alarms trap conditions	
Digital Alarms settings	**For all digital alarms, the traps can be sent when:** ▪ **"Asserted: -The digital signal changes from low to high** ▪ **"Unasserted"-The digital signal changes from high to low** **All monitoring combinations are possible**
Calibration Files	
Calibration Files	**All Paragon3 unit firmware comes bundled with two interpolation files used for forward and reverse power calibration. These files are required to be used with the optional external power sensor assembly (p/n 030 03547-xxx).** **Caution:** ***Forward & reverse power readings will not be accurate without the optional external power sensor assembly*** **(p/n 030 03547-xxx).** ***Refer to your Dataradio sales channel for details.*** **The file names entered in this section should match the file names in your unit** ***(Note: file names are case sensitive.)*** **These files are needed to properly display the Forward and Reverse power values.**

4.7.3.10.1 Calibration Files

Special electrical sensors are used to measure the values of real world quantities such as forward or reverse RF power. These sensors represent all measurements in Volts and require a conversion to proper units where applicable. This conversion is achieved by use of mathematical transfer functions, which also provide a way of calibrating the sensor hardware.

The transfer function can be represented by a simple look-up table that approximates a continuous function by a series of data points. Each data point represents an $\{X_{in}, Y_{out}\}$ pair, where X_{in} is the sensor's output-a measurement in Volts, and Y_{out} is the corresponding value in a desired unit of measurement. Linear interpolation is used to generate Y_{out} values for any given X_{in} value in between the data points supplied in the look-up table.

The series of data points in a look-up table are listed in a text calibration file and is read by the Piecewise Linear Interpolation Calibrated Conversion (PWLICC) software module, employed in Paragon3 radio base station to convert the sensor output into a desired value.

Dataradio supplies look-up tables for forward and reverse power measurements. These tables contain a set of values in Volts (X_{in}) with their corresponding values in Watts (Y_{out}). Similar look-up tables need be created for user-supplied external analog devices connected to the base station's backplane for diagnostics and monitoring if other than voltage measurement units are preferred.

An example of a look-up table is presented in Table 5 with a corresponding graph in Figure 62

Table 5 - Sample Interpolation endpoints

X_{in} (Volts)	Y_{out} (Desired Units)
0.0	0.0
0.2	1.0
0.375	2.0
0.530	3.0
0.530	4.0

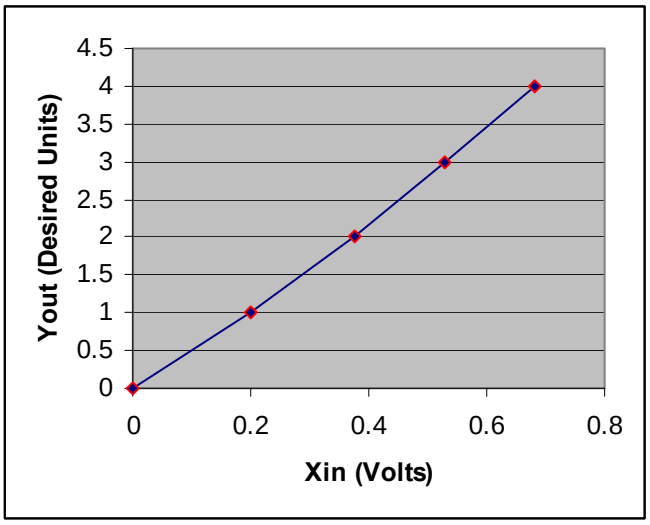


Figure 62 - Sample Interpolation curve

Values in-between the data points are calculated using a straight line between the closest two known data points. At least 2 data points are required; however 10 or 20 data points (up to 50) are usually necessary (depending on the curves behavior).

A look-up table can be created with a simple text editor, such as MS-Notepad, carefully following the guidelines presented below. The basic syntax is summarized in Table 5.

- // symbol preceding any entry denotes comments.
- [c] symbol preceding a string of up to 80 characters denotes file description. This string will be displayed under "description" field on the "Diagnostics Settings" page of the Pargon3 web interface.
- [u] symbol preceding a string of up to 15 characters denotes the desired unit of measure.
- [n] symbol preceding an integer denotes the number of entries in the look-up table.
- Data points are filled in as {X_{in}, Y_{out}} pairs. Each pair occupies a line and counts *one* space in between its elements:

  X_{in1} Y_{out1}
  X_{in2} Y_{out2}
  X_{in3} Y_{out3}
  ……..
- The number of {X_{in}, Y_{out}} pairs must correspond to the index ([n]) entered.
- Empty lines are not accepted-use comments for formatting.
- Duplicate X_{in} values are not accepted.
- When complete, use the "Save As" command.

- The file name is case-sensitive and spaces are not allowed.
- The file name should be saved under .pli extension.
- The file should be uploaded into a unit using FTP transfers.
- The file's name should be entered under "Analog monitoring 1 calibration" (and/or "Analog monitoring 2 calibration") field on the Diagnostic page of the Paragon3 web interface.

Table 6 - PLICC Syntax

Syntax	Description	
// <comment>	Comments.	Optional
[c] <name>	Descriptive name of the look-up table (string of 80 characters max). This field will appear under the "description" field on the Diagnostics Settings" page of the Pargon3 web interface.	Optional
[u] <unit>	Unit of measure (string of 16 char maximum).	Optional
[n] <index>	Number of entries in the table (2 minimum, 50 maximum).	Required

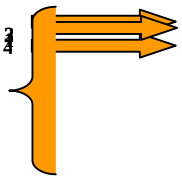
Failure to comply with the guidelines described above may result in the following errors:

Table 7 - Possible Error messages

Error	Description
No file found	The file name entered is not found on the unit.
Bad header or bad file format found.	Syntax Error .
No data found.	No data entered in the file (less than 2 data points).
More than 50 segments found in file.	The file counts more than 50 data points.
Duplicate X values found in data.	The file contains duplicate X_{in} values.

A sample calibration file is presented in Figure 63. Please note the following:

1. "V*olts to watts conversion*" will appear under the "description" field on the "Diagnostics Settings" page of the Pargon3 web interface.
2. This look-up table contains a set of values in Volts with their corresponding values in Watts.
3. This look-up table contains five data points.
4. The number of data points should correspond to the index (entered under [n]). All X_{in} entries (voltage values) must be unique.



```
// file name: sample_calibration_file.pli
// Revision: N.NN
// Date: YYYY/MM/DD
// Other Comments
[c]Volts to watts conversion
[u]Watts
[n]5
0.000 0.0
0.200 1.0
0.375 2.0
0.530 3.0
0.530 4.0
```

Figure 63 - Sample calibration file

4.7.3.11 Setup (Advanced) ►User Settings

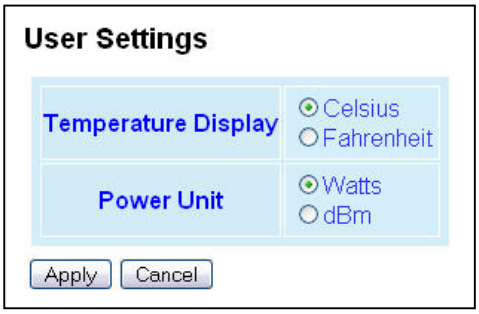


Figure 64 - Advanced IP Configuration - User Settings

Item		Description
Temperature Display	**Celsius (default)/Fahrenheit**	**Select desired temperature scale. Where applicable, the temperature will be displayed in selected temperature scale.**
Power Unit	**Watts (default)/ dBm**	**Select desired power scale. Where applicable, the power will be displayed in selected power scale.**

4.7.4 Security

4.7.4.1 Security ► Password and Encryption Control

The Setup web pages, the CLI (command line interface) and the FTP server all require a password to prevent unauthorized users from changing a unit's configuration. At the time of manufacture, the password is set to "ADMINISTRATOR" but Dataradio strongly suggests that the password be changed as units are installed.

Figure 65 - Security – Password and Encryption

Item	Description
User ID	**Enter a string of any letters or numbers of at least 1 and not exceeding 15 characters** ***The User Name entry is currently not an access-limiting factor. It only serves to identify the person gaining access. User Name may be required by future versions.***
Old Password	**For an initial installation, enter the default Password ADMINISTRATOR *(all upper case letters)*. For subsequent access, use the Password that you will have configured.**
New Password	**Enter a string of any letters or numbers of at least 8 and not exceeding 15 characters** **CAUTION: Do not lose the new password or you will not be able to gain access to the unit; you will need to contact Dataradio for support as detailed in section 1.3 earlier.**
New Password (confirm)	**Re-enter the new password string.**
Encryption	**Disabled, Enabled (Default).**
Encryption Pass Phrase	**String of characters used to create a 128-bit AES encryption key. The Pass Phrase can be up to 160 characters long. Using a length of at least 128 characters should provide an adequate security level for most users.** ***A good pass phrase mixes alphabetic and numeric characters, and avoids simple prose and simple names.***
Encryption Key	**All units in a network must have the same key.** ***READ ONLY - Displayed in pairs separated with spaces.***

4.7.4.2 Security ► Access Control

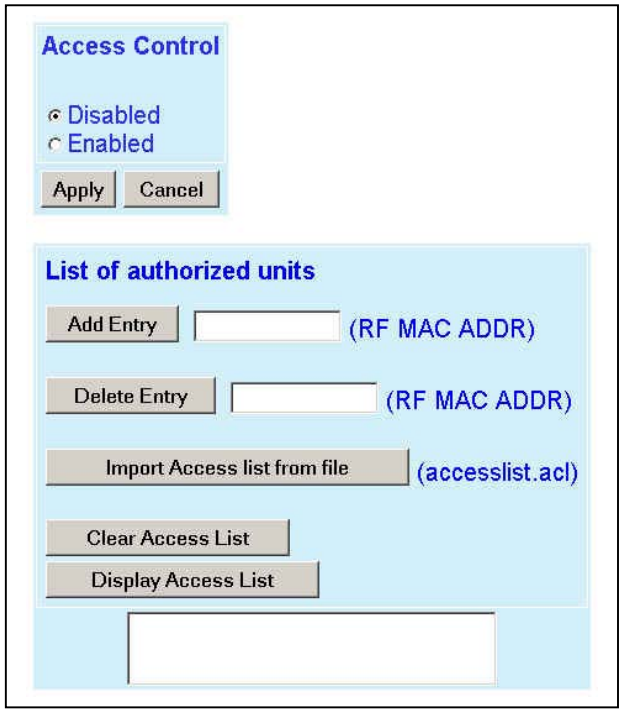


Figure 66 - Security - Access List

Item		Description
Access List Control	**Access List Control**	**Access List is used to keep unauthorized unit(s) away from Dataradio RF network. Maximum number of Access List entries = 100.** **The Access List Control takes the following values:** **Disabled (Default)** **Enabled – Authorized units only. Requests from any unit(s) outside this list will be rejected.**
Access List Management	**Add Entry**	**Adds entry in the Access Control List**
	Delete Entry	**Deletes entry in the Access Control List**

	Import Access list from file	**Imports Access List from file – Populates Access Control table from the file "`accesslist.acl`. It is basically a text file that contains a list of RF MAC addresses.**
		E.g.:
		`0x1234`
		`abcd`
		`2345`
		where, `0x1234`, `abcd`, **and** `2345` **represent RF MAC addresses in HEX**
		To use this feature:
		-Create a text file "accesslist.acl" with a list of RF MAC addresses
		-Upload the file from a host PC via an FTP program
		-Click on "Import Access list from file" button
		-Click on "Display Access List" button to view the imported access list

	Clear Access List	**Clears entire Access Control table.**
	Display Access List	**Clicking this button opens the access list in the message window**

4.7.5 Statistics

Statistics web pages allow the user to view data transmission statistics (Interfaces) and base station performance (Channel Utilization).

4.7.5.1 Statistics ► Interfaces

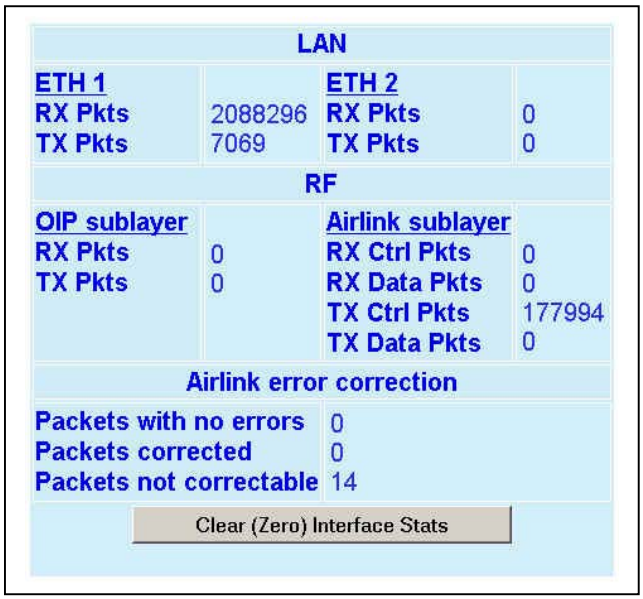


Figure 67 - Statistics – Interfaces

Item		Description
LAN(ETH1)	RX Pkts	Total number of packets received by Ethernet 1 interface
	TX Pkts	Total number of packets transmitted by Ethernet 1 interface
LAN(ETH2)	RX Pkts	Total number of packets received by Ethernet 2 interface
	TX Pkts	Total number of packets transmitted by Ethernet 2 interface
RF	RX Pkts (RF-OIP)	Total number of packets received by RF-OIP interface
	TX Pkts (RF-OIP)	Total number of packets transmitted by RF-OIP interface
	RX Ctrl Pkts (RF-Airlink)	Total number of control packets received by RF-Airlink interface
	RX Data Pkts (RF-Airlink)	Total number of data packets received by RF- Airlink interface
	TX Ctrl Pkts (RF-Airlink)	Total number of control packets transmitted by RF- Airlink interface
	TX Data Pkts (RF-Airlink)	Total number of data packets transmitted by RF- Airlink interface
Airlink error correction	Packets with no error	Number of E-DBA packets, control or data, received over-the-air with zero error.
	Packets corrected	Number of E-DBA packets, control or data, received over-the-air with correctable errors.
	Packets not correctable	Number of E-DBA packets received over-the-air with errors that could not be corrected. These packets were discarded.

4.7.5.1.1 Interface Statistics Conventions

To reduce their design complexity, most networks are organized as a series of layers or levels, each one built upon its predecessor. Layer *n* on one machine carries on a conversation with layer *n* on another machine. The rules and conventions used in this conversation are collectively known as the layer *n* protocol. The number of layers, the name of each layer, the contents of each layer, and the function of each layer differ from network to network.

Figure 68 below illustrates layers and protocols applicable to Dataradio network architecture implementation. The five basic layers are:

- Physical Layer
- Datalink Layer
- Network Layer
- Transport Layer
- Application Layer

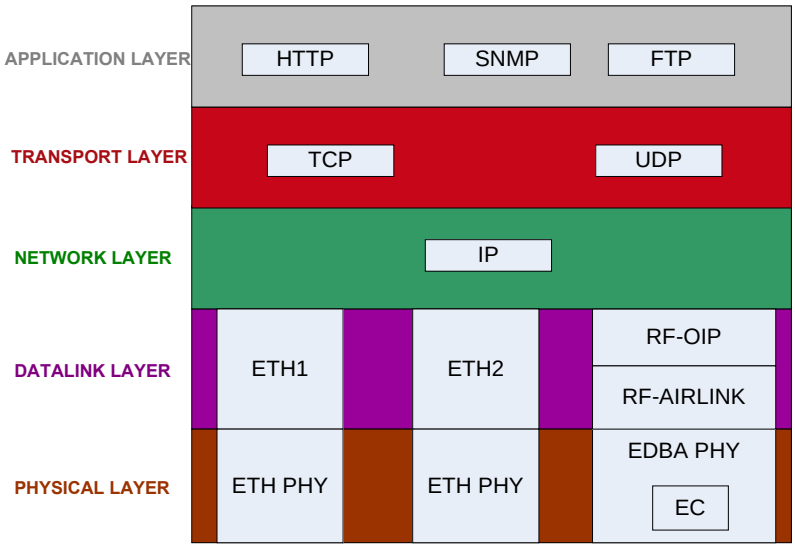


Figure 68 - Layers and protocols applicable to Dataradio implementation

In reality, no data are directly transferred from layer *n* on one machine to layer *n* on another machine. Instead, each layer passes data and control information to the layer immediately below it, until the lowest layer is reached (Figure 69).

Paragon3 radio base station web interface presents data transmission statistics for the Datalink layer. Network and Transport layers statistics are not accessible through the web interface; they are provided in 1213 MIB and can be accessed through a MIB browser or an SNMP manager (see section 4.7.3.4.2: SNMP Overview for more details on 1213 MIB).

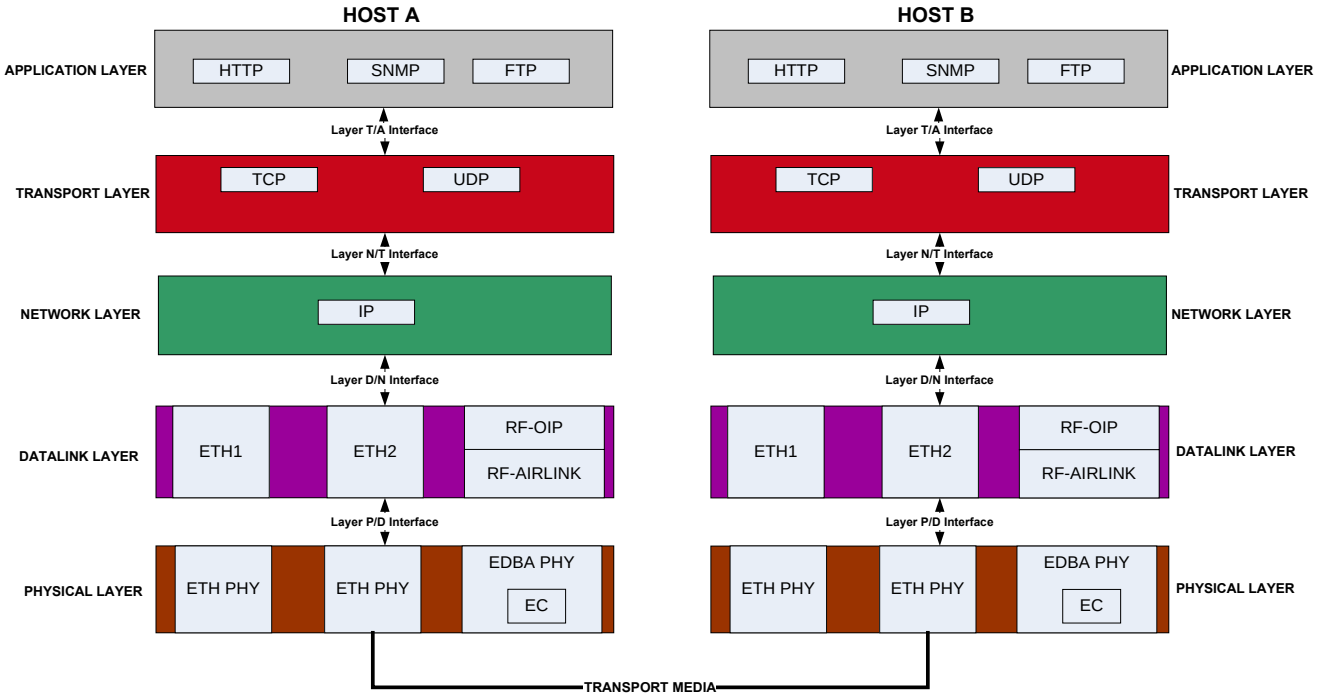


Figure 69 - Layer, protocols, and interfaces applicable to Dataradio implementation

All statistics presented by Dataradio follow a convention presented in Figure 70. Layer *n* statistics are given with respect to the layer immediately below it: layer *n-1*. RX (Receive) or IN refers to data received by layer *n* from layer *n-1*. Transmit (TX) or OUT refers to data transmitted by layer *n* to layer *n-1*.

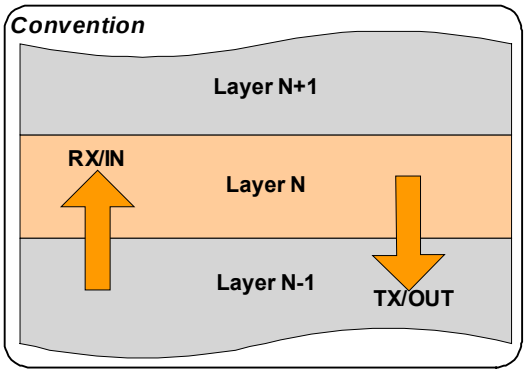


Figure 70 - RX and TX Convention

4.7.5.1.1.1 Datalink Layer Statistics

Datalink layer comprises two Ethernet interfaces (Ethernet1 and Ethernet2) and an RF interface. Ethernet1 and Ethernet2 interfaces statistics are illustrated in Figure 71.

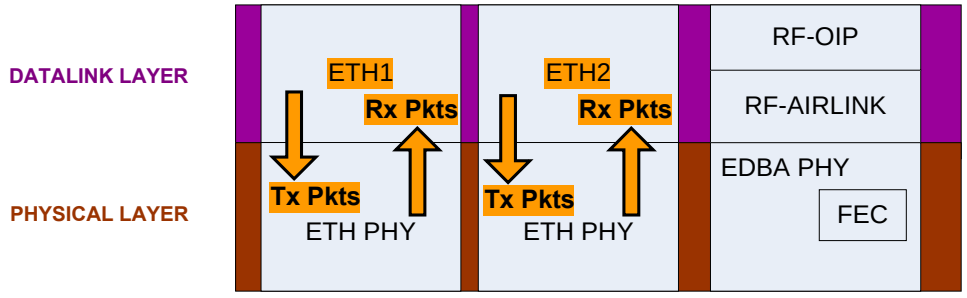


Figure 71 - Datalink Ethernet Statistics

RF interface is further subdivided into two sub-layers: OIP sub-layer and Airlink sub-layer. OIP (Optimized IP) sub-layer is concerned with compression, optimization, TCP proxy control, and IP roaming. Airlink sub-layer is where Dataradio's Enhanced Dynamic Bandwidth Allocation (E-DBA) Airlink protocol resides.

RF interface statistics are illustrated in Figure 72. Each E-DBA cycle consists of a fixed number of control packets (e.g.: Requests, Acknowledgements, etc...) and a dynamically allocated number of data packets. This is why both Data and Control packets count appear at the Air link sub-layer.

RF interface statistics also include error correction statistics for all incoming packets. The corrections are accomplished with a forward error correction (FEC) module. The advantage of forward error correction is that retransmission of data can often be avoided.

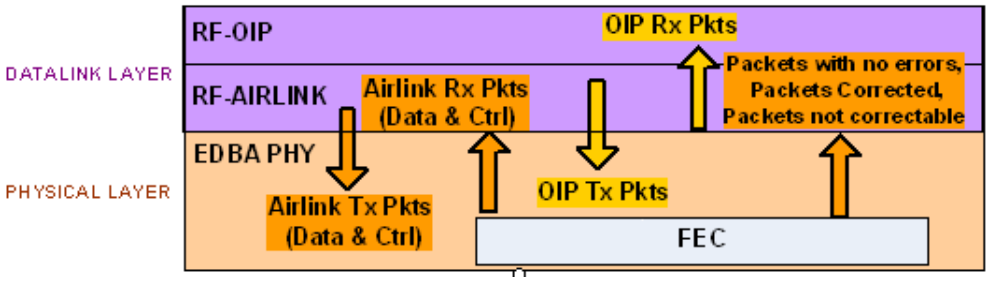


Figure 72 - Datalink RF Statistics

4.7.5.2 Statistics ► Performance

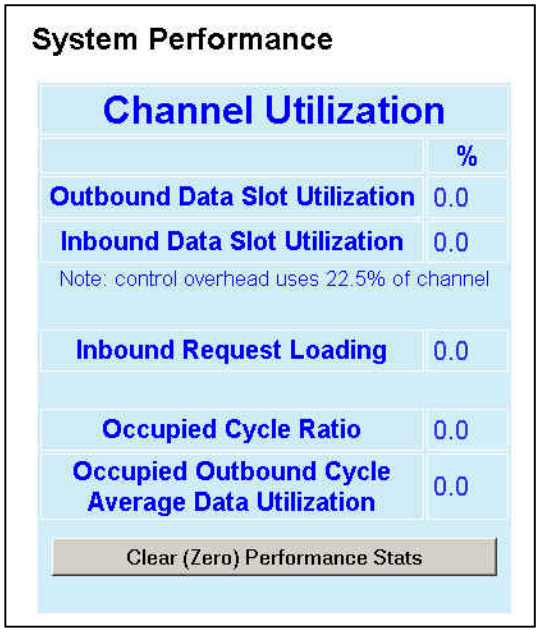


Figure 73 - Statistics – Airlink – Channel Utilization

Item	Description
Channel Utilization	**Outbound Data Slot Utilization** **The percentage of occupied outbound data slots.** $\frac{OccupiedOutboundDataSlots}{OccupiedOutboundDataSlots + EmptyOutboundDataSlots} \times 100$
	Inbound Data Slot Utilization **The percentage of occupied inbound data slots.** $\frac{OccupiedInboundDataSlots}{OccupiedInboundDataSlots + EmptyInboundDataSlots} \times 100$
	Inbound Request Loading **The percentage of air-time available for requests from mobiles in which request packets were actually received, relative to the theoretical maximum for Slotted-ALOHA (36.8% of total capacity). Under certain conditions, this value can exceed 100%.**
	Occupied Cycle Ratio **The percentage of E-DBA transmit cycles with one or more data packets.** $\frac{OccupiedCycles}{EmptyCycles + OccupiedCycles} \times 100$ **This value can reach 100% on a light- or medium-loaded system if the number of data packets in each cycle is small (See Occupied Outbound Cycle Average Data Utilization).**
	Occupied Outbound Cycle Average Data Utilization **The average size of occupied E-DBA transmit cycles, expressed as a percentage of the maximum.** $\frac{ActualNumberofPacketsTransmitted}{MaxOutboundAllocatedNumberofPackets} \times 100$

Note:

A low percentage of utilization does not imply reduced performance. Percentage of utilization reports on channel occupancy and will vary depending on various data traffic conditions.

4.7.6 Maintenance

4.7.6.1 Maintenance ► Ping Test

To aid in trouble-shooting IP connectivity issues, the Paragon3 base stations and the GeminiG3 mobiles can transmit ping packets to a given IP address. Four packets are sent and the time taken for each to reach the destination and return is displayed.

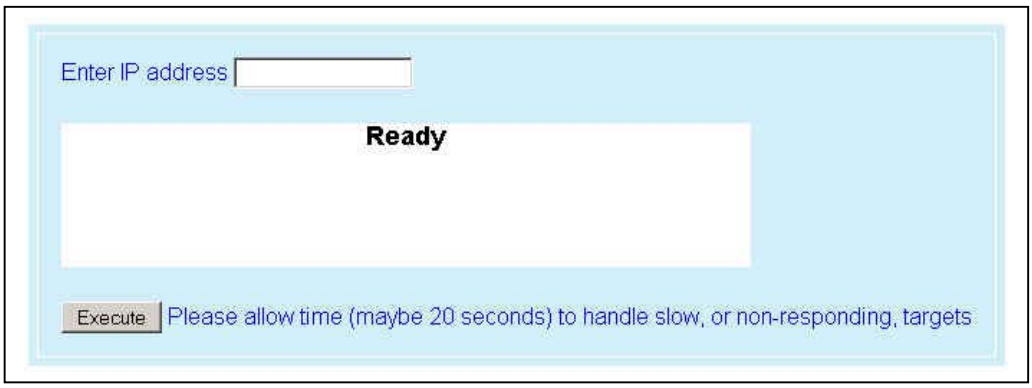


Figure 74 - Maintenance – Ping Test

Item	Description
Enter IP address	**Enter IP address to ping, in dot decimal format**
Execute	**This button executes the ping command. Ready field displays the out-come of the ping command.**

4.7.6.2 Maintenance ► Config Control

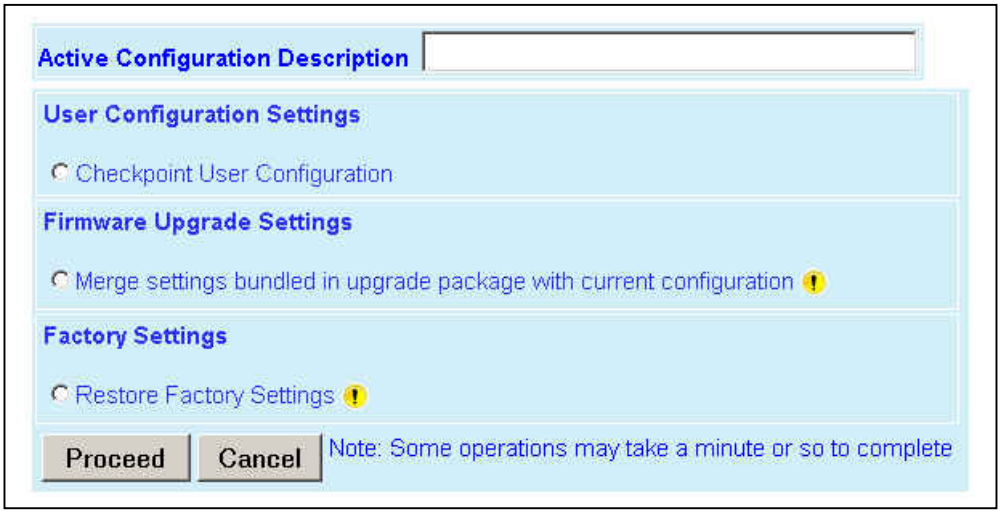


Figure 75 - Maintenance -Configuration Control (Initial screen)

Item	Description
Active Configuration Description	**Active Configuration Description Field – Available by selecting "Checkpoint User Configuration" in the "User Configuration Settings " portion of this window *(described below)*.** Enter descriptive title of up to 40 characters, to help identify the configuration settings saved.
User Configuration Settings	**Checkpoint User Configuration – Allows saving a set of the current user configuration settings in the Paragon3.** **For initial use, click on the radio button to activate the "Description" field. Enter a descriptive title (user choice). Click on "Proceed" to save the settings to the unit.** For subsequent use, click on the top radio button to activate the "Description" field. Change the title in the Description field to identify the settings about to be saved. Click on "Proceed" to overwrite the previously saved set with the new set.
	Restore User Configuration Checkpoint – (Button is available when a "User Configuration Settings" has been saved). Click the button, check the title of the settings about to be restored. Click on "Proceed" to restore the settings to the unit.
Firmware Upgrade Settings	**Merge settings bundled in upgrade package with current configuration** **Note: the "firmware update" process will end up replacing an existing configuration file with the one that came bundled with the firmware upgrade package.** **Should you decide to "restore factory settings" instead of "merge with bundled settings", perform the firmware upgrade then click on "Restore Factory Settings" radio button on the menu and click on "Proceed".**
Factory Settings	**Restores Factory Settings.** **Important note:** ***Activating "Restore Factory Settings" will reset the IP address of the unit. Have your record of all the original Paragon 3 factory settings handy before proceeding with restoring to factory settings.***

4.7.6.3 Maintenance ► Package Control

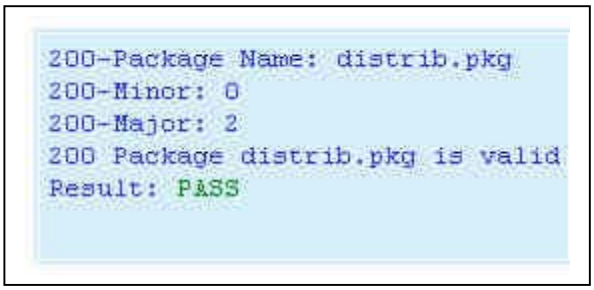


Figure 76 - Maintenance – Package Control

Item	Description
Package Control	**Used for verifying the field upgrade of the Paragon3 radio modem firmware.** **The firmware transfer procedure outlined in section 5.4.1 instructs to "Click on** Maintenance / Package Control **to verify integrity and wait a few moments for the results to display".** **Figure 76 above shows a "Pass" result indication.** **If an upgrade problem arises and persists, click the "Package Control" once more and have the resulting indications handy if contacting Dataradio system engineering.**

4.7.6.4 Maintenance ► RF Tests

Test Tones:

Select the desired test tone, press the "Execute" button to transmit a test signal on the channel selected for 20 seconds or until the "Cancel current test" button is pressed.

The functions of all the other buttons are inoperative during test transmissions.

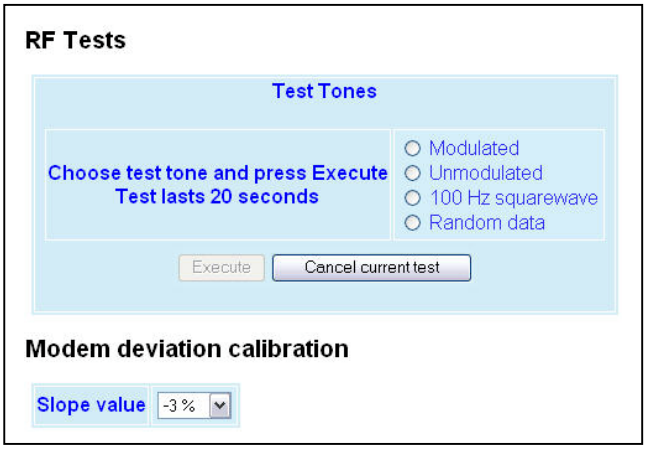


Figure 77 - Control - RF Tests

Test Tones	**Modulated**	**Test transmission generates a carrier modulated with a 1 kHz test tone to check deviations. For specific deviation values, see Table 10.**
	Unmodulated	**Test tone is an unmodulated carrier that gives a clear carrier and used for checking:** **♦ Frequency error** **♦ Forward and reverse power** **Power check:** **Connect an in-line power meter between the radio and the antenna.** **Measure the forward (nominal 70W) and reflected power levels by pressing the Execute button. For reflected power, never exceed 5% of forward power or as specified by System Engineering.**
	100 Hz square wave	**Starts a test transmission of a carrier modulated by a square wave. Used to check low-frequency balance at a frequency of 100 Hz**
	Random Data	**Starts a 20-second test transmission with a carrier modulated with random data** **Random data test transmissions are used for checking low-frequency balance and maximum deviation over data.** **• Low-frequency balance check:** **Helps to determine if the radio transmitter is well balanced for data transmission.** **Refer to the User manual for values indicated in adjustment tables under "Low Frequency Balance" step.** **• Maximum deviation check:** **Helps to verify if the unit is within FCC regulation emission masks.** **Refer to the User manual for values.** **Random data test requires the use of an IFR COM-120B service monitor with option 03= 30 kHz IF filter and its DC coupled demodulator output selected.**
	Modem deviation calibration	**Frequency reprogramming may cause the transmitter deviation to change slightly from that originally set by the factory.** **The Slope Value control allows the user to adjust the current deviation setting by up to +/- 10%.** **After selecting a slope value and clicking "Apply", the user should perform a test tone to measure the deviation with a service monitor to assure that it is within governing regulations.**

4.7.6.5 Maintenance Feature Options

Refer to your Dataradio technical support or sales representative for options availability and cost.

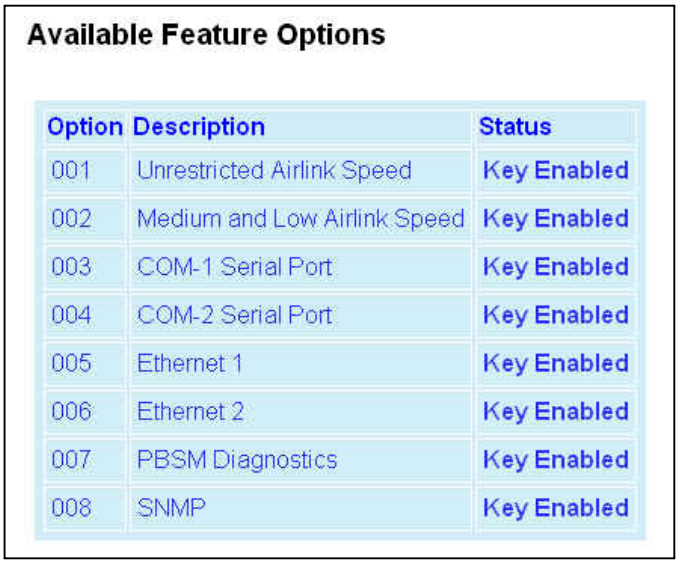


Figure 78 - Maintenance – Available Key Features Options

4.7.6.6 Maintenance ► RSSI Table

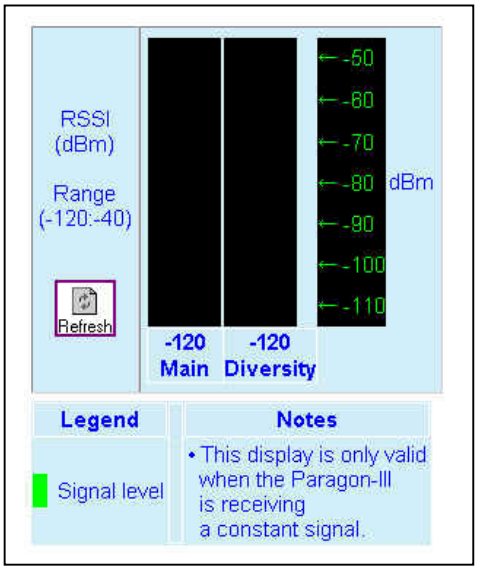


Figure 79 - Maintenance – Spectrum – RSSI Display

Item		Description
RSSI	RSSI Table	**Main -120 = dBm value from main radio receiver** **Diversity -120 = dBm value from diversity radio**
	Range	**-120 to –40 dBm**
	Thresholds	**-90 to –60 dBm**

4.7.7 OOB Data

4.7.7.1 OOB Data ► Out of Band

Figure 80 - Out-Of-Band

Item		Description
GPS Delivery	Delivery Options	Drop-down box for selecting the desired format for the Local Port GPS data delivery
	Add/Delete UDP Host	Dynamic window expands as Hosts are added or shrinks as Hosts are deleted. Up to five UDP Hosts may be added: ♦ Enter dot decimal format address of the Host in the address field box. ♦ If adding, add the port number in the Port box, click on the "Format" drop-down box and select appropriate format. ♦ Select the Add or the Delete radio button. ♦ Click on Apply.

4.7.8 Remote Table

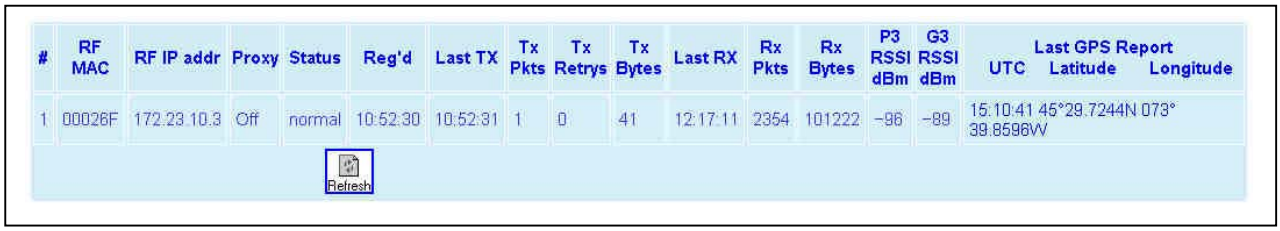


Figure 81 - Remote Table

Item	Description
#	Index of the displayed entry. Up to 25 entries will be displayed at a time. "Previous" and "Next" buttons will appear as necessary.
RF MAC	RF MAC address of the mobile
RF IP addr	RF IP address of the mobile
Proxy	Indicates when the TCP Proxy has been enabled for that mobile (On/Off)
Status	Indicates the current state of the mobile. Most common values are: ♦ Normal – Mobile is registered to this base ♦ Handoff – Mobile is roaming to another base
Reg'd	Indicates the time the mobile registered on the base
Last TX	Indicates the time of last transmitted packet
TX Pkts	Count of data packets sent to the mobile
Tx Retrys	Count of RETRYs for packets transmitted to the mobile
Tx Bytes	Count of bytes transmitted to the mobile
Last Rx	Indicates the time of the last received packet
Rx Pkts	Count of data packets received from the mobile
Rx Bytes	Count of bytes received from the mobile
P3 RSSI dBm	RSSI (in dBm) of the last data received from the mobile.
G3 RSSI dBm	RSSI (in dBm) of a recent data from the base by the mobile *(This information is transmitted to the base along with the GPS report)*
Last GPS Report: ♦ UTC ♦ Latitude ♦ Longitude	In normal operation, indicates the last Time & Position reports recently transmitted to the base from the mobile. Indicates "GPS report missing or not valid" when originally registered if reporting has not yet begun. Could last up to 3 – 4 minutes. Indicates "No Fix" when validly reporting and stops receiving valid information.

4.7.9 Help

Figure 82 - Help Icon

Item	Description
Help Icon	**Click the Help Icon in the navigation pane to open a help text relating to the window being displayed.**

5. Trouble-Shooting and Testing

The checks described below should be done at time of installation, annual intervals, or whenever deterioration in performance is noted.

5.1 Equipment Required

- In-line wattmeter (10 W range) for the 5W-transmitter module as well as for the reflected power and (100W range) for the power amplifier.
- Radio service monitor (IFR-120B with option 03: 30kHz IF filter or equivalent).
- RG-214 or RG-223 cable with N-Type male connector to connect Paragon3 base station to the service monitor.

Important note: 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***.**

5.2 Recommended Checks

A) After an installation (see Table 8**)**

1. Power-up LED Sequence
2. Transmit power output
3. Reflected power output
4. RF Link test between Paragon3 unit(s) and mobile unit(s) (PING test from the unit Web page as per paragraph 4.7.6.1 or PING test as per paragraph 5.3.4)

B) For annual maintenance & trouble-shooting (see Table 9**)**

Same checks as A) plus:

5. Carrier frequency error
6. TX Deviation
7. Low frequency balance
8. 12dB SINAD
9. Receiver distortion
10. Main RX and Aux. RX RSSI
11. Verify power supply connections & terminals torque settings (see paragraph 2.5.1.1.1)

Table 8 - Checklist A (After installation)

CHECKLIST A (Paragon3) Recommended Check out after Installation				
Step	**ACTION**	**EXPECTED RESULTS at 25°C**	**MEASURE WITH**	**IF NOT?**
1	**Normal Power-up Sequence** **BSC**	PWR LED lights red for four second, turns amber for one second, and stays green thereafter. TX LED flashes green once about fifteen seconds after power-up then keeps flashing in-tune to the cycle marker RX LED remains OFF STATUS LED remains OFF ETH 1 LED – if connection present – lights green. Flashes amber with activity ETH 2 LED – If connection present – lights green. Flashes amber with activity		
	Receivers	GATE LED must remain steady red SUPPLY LED must remain steady green		
	Transmitter	SUPPLY LED must remain steady green ON LED lights red for one second, turns OFF for 10 seconds, and stays red thereafter		
For steps below, on the Radio ➔ Set Up Web page, press the "test" button to enable Test Tone function				
2	**Power Amplifier Output Power** From the Maintenance unit WEB "Test Tone" page, Select ***Unmodulated*** and press "Execute"	70 watts nominal (user settable from 35W) Tolerance: +15% -20%	Service monitor set to read power or 100W in-line watt-meter installed as close as possible to the unit antenna connector.	Check for bad connections, damaged coax cable, etc.
3	**Transmitter Reflected Power** Select ***Unmodulated -*** Execute	< 5% of forward power or as specified by System Engineering.	10W in-line wattmeter	Check for bad connections, damaged coax cable, etc.

Table 9 - Checklist B (General)

CHECKLIST B (Paragon-3) General Check out				
Paragon3 units are set and characterized at the factory to optimize performances. 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.**				
Step	**ACTION**	**Expected Results at 25°C**	**MEASURE WITH**	**IF NOT?**
1	**Normal Power-up Sequence** **BSC**	PWR LED lights red for four second, turns amber for one second, and stays green thereafter. TX LED flashes green once about fifteen seconds after power-up then keeps flashing in-tune to the cycle marker RX LED remains OFF STATUS LED remains OFF ETH 1 LED – if connection present – lights green. Flashes amber with activity ETH 2 LED – If connection present – lights green. Flashes amber with activity		
	Receivers	GATE LED must remain steady red SUPPLY LED must remain steady green		
	Transmitter	SUPPLY LED must remain steady green ON LED lights red for one second, turns OFF for 10 seconds, and stays red thereafter		
For steps below, on the Radio ➔ Set Up Web page, press the "test" button to enable Test Tone function				
2	**Transmitter Output Power** From the Maintenance unit WEB "Test Tone" page, select ***Unmodulated* –** Press Execute	Adjustment range: 35 - 70 watts Tolerance: +15% -20%	Service monitor set to read power or 100W in-line wattmeter installed as close as possible to the unit antenna connector.	Adjust "Power" on the power amplifier front panel (Figure 3, page 6)
3	**Transmitter Reflected Power** From the Maintenance unit WEB "Test Tone" page, select ***Unmodulated* –** Press Execute	< 5% of forward power or as specified by System Engineering.	10 W in-line wattmeter	Check for bad connections, damaged coax cable, etc.
4	**Carrier Frequency Error** From the Maintenance unit WEB "Test Tone" page, select ***Unmodulated* –** Press Execute	< ±300 Hz	Service monitor set to read frequency error	Adjust TCXO (IC700) (see inside Exciter module at, Figure 88
5	**TX Deviation (kHz)** From the Maintenance unit WEB "Test Tone" page, select ***Modulated* –** Press Execute Carrier will be modulated with a 1 kHz tone.	Refer to Table 10 for TX Deviation details **Tolerance is +5%, -10%**	Service monitor set to read deviation. (IF filter set to Mid or 30 kHz position)	
6	**Low Frequency Balance** From the Maintenance unit WEB "Test Tone" page, select ***Random data* –** Press Execute	a) Record deviation level read from step 5 b) Record deviation read from *TX Random test* c) Difference between a) and b) should be: < 2.5 kHz (SRRC16FSK)	Service monitor set to read deviation (IF filter set to Mid or 30 kHz position, all audio filtering disabled)	

7	**12dB SINAD** (Dataradio wide band measurement method: no audio filtering) Set deviation to ±6 kHz.	Better than -105 dBm including cable loss (Typically -106 dBm)	Backplane test points as detailed in Table 4 and Figure 14	
8	**Receiver distortion** (Dataradio wide band measurement method: no audio filtering) Set service monitor RF Gen output to –70 dBm *Deviation level as per SINAD above.*	≤ 3.0 % (Typically < 2.5 %)	Backplane test points as detailed in Table 4 and Figure 14	
9	**RSSI** Apply to each receiver input a RF level of -110dBm	1.4 VDC (+/- 0.2VDC) BSC must be connected to the radio during the measurements	Backplane test points as detailed in Table 4 and Figure 14	

5.3 Additional test details

5.3.1 Carrier Deviations

Table 10 – Carrier Deviations

Carrier Modulation					
SRRC4FSK		**SRRC8FSK**		**SRRC16FSK**	
			Tone		**Tone**
Network Speed (kb/s)	**Typical deviation in kHz** (1000Hz test tone)	**Network Speed** (kb/s)	**Typical deviation in kHz** (1000Hz test tone)	**Network Speed** (kb/s)	**Typical deviation in kHz** (1000Hz test tone)
Wide Channel (700MHz) 50kHz bandwidth					
64.0	± 4.6	**96.0**	± 5.8	**128.0**	± 5.8

5.3.2 PF Switch

Nearly all test "Actions" described in tables 5 and 6 above can be done by selecting the relevant test tone via the "Radio ► Tests" page of the web interface. However, stopping the Airlink for a test is done in a different manner. It requires the use of the BSC's front-mounted PF key rocker switch *(see Figure 10 above and detailed PF operation in the next paragraph*). The PF switch can also be used as an alternate way of selecting Test Tones or if a web connection is unavailable.

5.3.2.1 Stopping the Airlink and Alternate Test Tone Selection Method

Located on the BSC module, the PF key is a horizontally mounted rocker switch with a center detent and spring-loaded positions "1" and "2". Pressing the switch to position "1" causes the "Status" LED to blink green once only followed by amber blinks at one-second intervals as long as it is held pressed. Pressing the switch to position "2" is used to select test tones as shown in Table 11 below.

Figure 83 - PF Switch Rocker Detail (one side pressed)

- If PF is pressed to position “1” for approximately four seconds *(visually count the amber blinks)* and released, it brings the Airlink down, PTT is released, no data traffic is scheduled, and CWID is suppressed. The Airlink will remain down for a maximum of one hour and automatically come back up, unless PF is pressed to position “1” once more for four seconds to force toggle the Airlink to “up” status.
- If PF is pressed to position “1” for approximately one amber blink, PF operation goes into “monitor mode” where “position 2” is monitored and each successive pressing of position “2” results in a different test tone selection as detailed in the table below.
- If PF is pressed to position “1” while a test is in progress, PF “monitor mode” operation is cancelled.

Note:

If PF is not in “monitor mode” pressing to position “2” has no effect.

Table 11 – Test Tones Generation

20-Second Test Tones - PF key generated
For a MODULATED test tone: **Press PF to “1” for approximately 1 amber blink and release. Immediately press PF to “2” one time. Test tone starts.** **To cancel test tone, press PF to “1” and release.**
For an UNMODULATED test tone: **Press PF to “1” for approximately 1 amber blink and release. Immediately press PF to “2” two times. Test tone starts.** **To cancel test tone, press PF to “1” and release.**
For a SQUARE WAVE test tone: **Press PF to “1” for approximately 1 amber blink and release. Immediately press PF to “2” three times. Test tone starts.** **To cancel test tone, press PF to “1” and release.**
For a RANDOM DATA test tone: **Press PF to “1” for approximately 1 amber blink and release. Immediately press PF to “2” four times. Test tone starts.** **To cancel test tone, press PF to “1” and release.**

Each pressing at position “2” must be made within one second.

E.g.: For Unmodulated, press twice within 2 seconds, for Random Data, press four times within 4 seconds.

5.3.3 Windows/Unix Tools

5.3.4 Network Connectivity

- PING

  The `ping` command determines whether a specific IP address is accessible. It works by sending a packet to the specified address and waiting for a reply. It is useful for troubleshooting "end-to-end" reachability, network connectivity, and network latency.

  The ping test is also convenient to verify more specifically the RF link between a mobile and a known base station

  Available for MS-Windows 9x, ME, NT, 2000, and XP as well as Unix & Free BSD.

  EXAMPLE:

  `ping 192.168.204.1 –w 3000` displays the response with turn around time in milliseconds.

- TRACERT (WINDOWS)

  The `tracert` command is used to visually see a network packet being sent and received and the amount of hops required for that packet to get to its destination.

  Available for MS-DOS 6.2, MS-Windows 9x, ME, NT, 2000, and XP.

  Note:

  Users with MS-Windows 2000 or XP who need additional information on network latency and network loss may also use the `pathping` *command.*

  EXAMPLE

  `tracert www.yahoo.com` at the command prompt displays the intermediate routers between local host to the ww.yahoo.com site.

5.3.5 Configuration Information

- WINIPCFG (WIN95/98), IPCONFIG (WIN2K) or IFCONFIG (UNIX)

  `Ipconfig` is a DOS utility which can be used from MS-DOS or a MS-DOS shell to display the network settings currently assigned and given by a network. This command can be utilized to verify a network connection as well as to verify network settings.

  Available for MS-DOS, MS-Windows 9x, ME, NT, 2000, and XP.

  EXAMPLE

  `ipconfig/all` at the command prompt displays the Ethernet MAC address, IP address, IP netmask, default IP gateway, DNS server… information.

- ARP

  View and update the system ARP table

  The Address Resolution Protocol (ARP) is used with the IP protocol for mapping a 32-bit Internet Protocol address to a MAC address that is recognized in the local network specified in RFC 826. Once recognized the server or networking device returns a response containing the required address.

  Available for MS-Windows 9x, ME, NT, 2000, and XP.

  EXAMPLE

  `arp-a` displays all entries in the ARP cache. *Useful in manipulating ARP caches.*

- ROUTE

  View and update the system routing table

  The function and syntax of the Windows ROUTE command is similar to the UNIX or Linux route command. Use the command to manually configure the routes in the routing table.

  Available for MS-Windows 9x, ME, NT, 2000, and XP.

  EXAMPLE

  `route ?` displays help

  `route print` displays the routing table

5.3.6 Statistics Information

- NETSTAT (WINS & UNIX)

  The netstat command symbolically displays the contents of various network-related data structures, i.e. IP, TCP UDP …

  Available for MS-Windows 9x, ME, NT, 2000, and XP.

  EXAMPLE

  `netstat ?` displays help

  `netstat -a` display TCP and UDP connections and listening ports information

For further information on TCP/IP troubleshooting, please visit:
http://www.windowsitlibrary.com/Content/466/14/1.html

5.4 Firmware Upgrading

The Paragon3 radiomodem firmware is field-upgradable using the unit's Ethernet port. The process involves connecting to the IP address of the base from a host PC and transferring the firmware files via an FTP program.

5.4.1 Procedure

1. Using a file decompression program, such as WinZIP™ or WinXP's right-click & select the "Expand to…" option, expand the contents of the firmware upgrade package to a directory of your choice on the host PC.

   Warning:

   Be aware that base and mobile's firmware archives are often distributed at the same time. Files intended for the Paragon3 radiomodem are labeled in the form `Paragon3_edba_Vx.x_Rx.xx.zip`. Be careful not to transfer firmware into the wrong unit!

2. Using an FTP client program of your choice, establish a connection to the base IP address. Please refer to paragraph 4.7.4.1 for "Username" and "Password" usage.
3. Transfer all the files in the upgrade package. Occasionally, long pauses, on the order of 30 to 45 seconds, are possible when storing the file in the unit's flash file system.
4. Once the file transfer is complete, cycle the base power and allow the unit to boot. The unit should return to the state it was in when the update was started.

   Note:

   After resetting, the PWR LED remaining lit steady amber or red indicates the FTP transfer was not successful or that the firmware is corrupt. Please contact Dataradio system engineering for assistance.

5. Verify the integrity of the newly transferred files.

a) Connect to the base's IP address using an Internet browser such as IE (5.0 or later) or Mozilla.

b) Enter the `user name` and `password` *(in the usual manner)* and allow the **Welcome** page to load.

c) In the left pane, click on **Unit Status**. The **Unit Identification and Status** pane should display the newly upgraded firmware in its **Banner** *(should correspond to the upgrade package version)* and the **H/W Status** should also show **Ok**.

d) In the left pane, click on **Maintenance**, then on **Package Control**. Wait a few moments for the results to display. Figure 76 shows a “Pass” result indication.

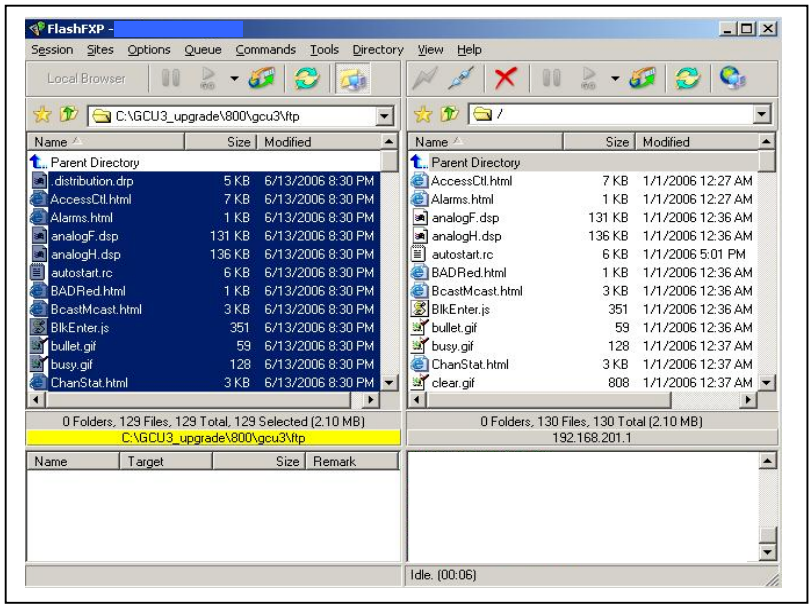


Figure 84 - Sample FTP program

5.4.1.1 File Integrity Failure

If the message in the result screen points out that file(s) failed the integrity check, retry the FTP transfer for the failed files(s) again.

If the problem persists, please have the **Package Control** result screen indications handy and contact Data-radio system engineering for assistance.

6. Radio Programming and Adjustments

6.1 T881-10 Radio Transmitter Programming

This procedure describes the steps needed to program the Paragon3 radio transmitter module.

6.1.1 Recommended Items

- 486 PC or better, MS-Windows 98 © or later
- T800win programming kit for Series II:
- PGM800Win programming software user's manual
- PGM800Win Windows based programming software version 3.0 or later
- T800-01-0002 programming cable (DB-25 to RJ-45 cable)
- Standard 25-pin parallel cable (terminated Male/Female)

6.1.2 T881-10 Module Programming

Before starting programming, have a PC running MS-Windows © and the Tait PGM800Win software for Series II Base station.

This program supports the use of a mouse but may be used without one if required. Keyboard access follows the conventional MS-Windows © method as briefly described below:

- Press and hold the “Alt” key while pressing at the same time the relevant hotkey as indicated by an underlined letter on the menu command.
- On a drop-down menu, press only the hotkey without pressing the “Alt” key.
- Use the “Tab” key to cycle available fields and the “Enter” key to validate entries. *E.g. Pressing “Alt”+F opens the File drop-down menu and pressing “A” opens the Save As directory service box.*

The transmitter VCO alignment will be required when new transmitter frequency is programmed outside the radio tuning range: ± 4.0 MHz from previous center frequency. The legal frequency ranges for this transmitter are:

762-764 MHz and 767-773 MHz. The retuning of the VCO will normally only be required when passing from one range to the other.

1. Connect the PC, via the supplied programming lead, to the speaker panel’s front-mounted RJ11 connector.
2. Run Tait PGM800Win program and follow instructions found in the T800 Programming Software User’s Manual to select the proper module to be programmed.
3. Program required channel's frequencies.
   - Do not program any CTCSS tones on channels.
   - Do not change any other parameters.
   - Refer to Figure 85 and Figure 86 for screen program examples.
4. Save the base station programming info to a file for further reference.

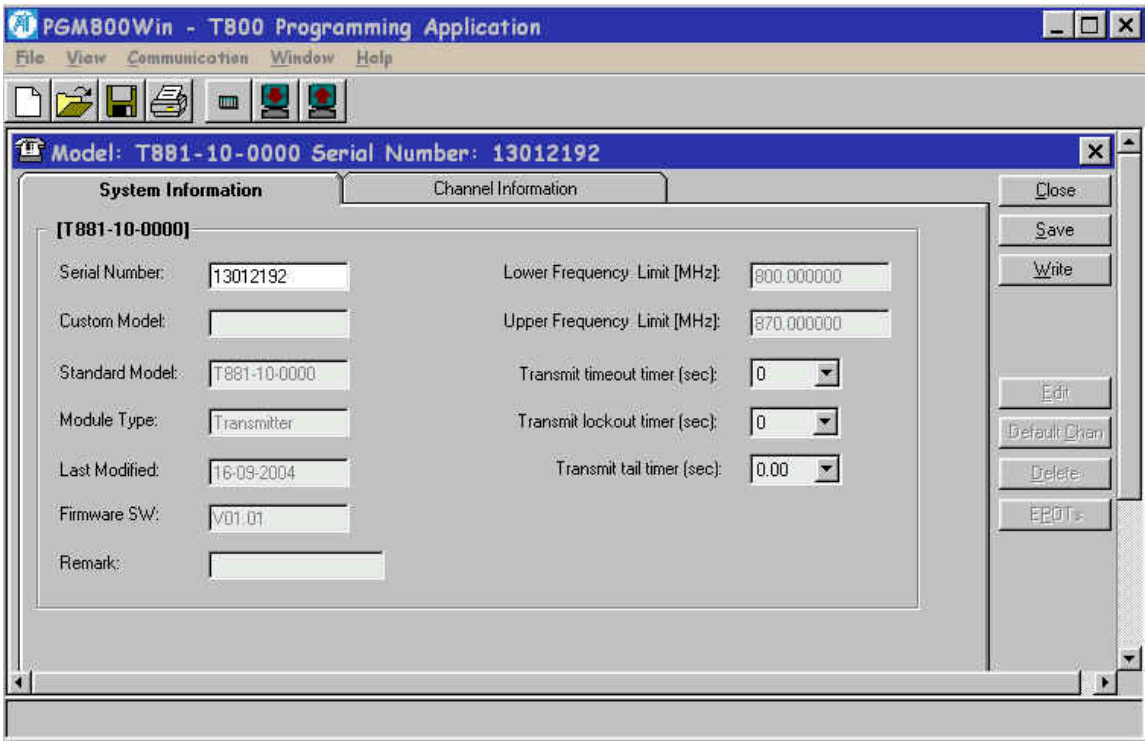


Figure 85 - Exciter System Infomation Sample

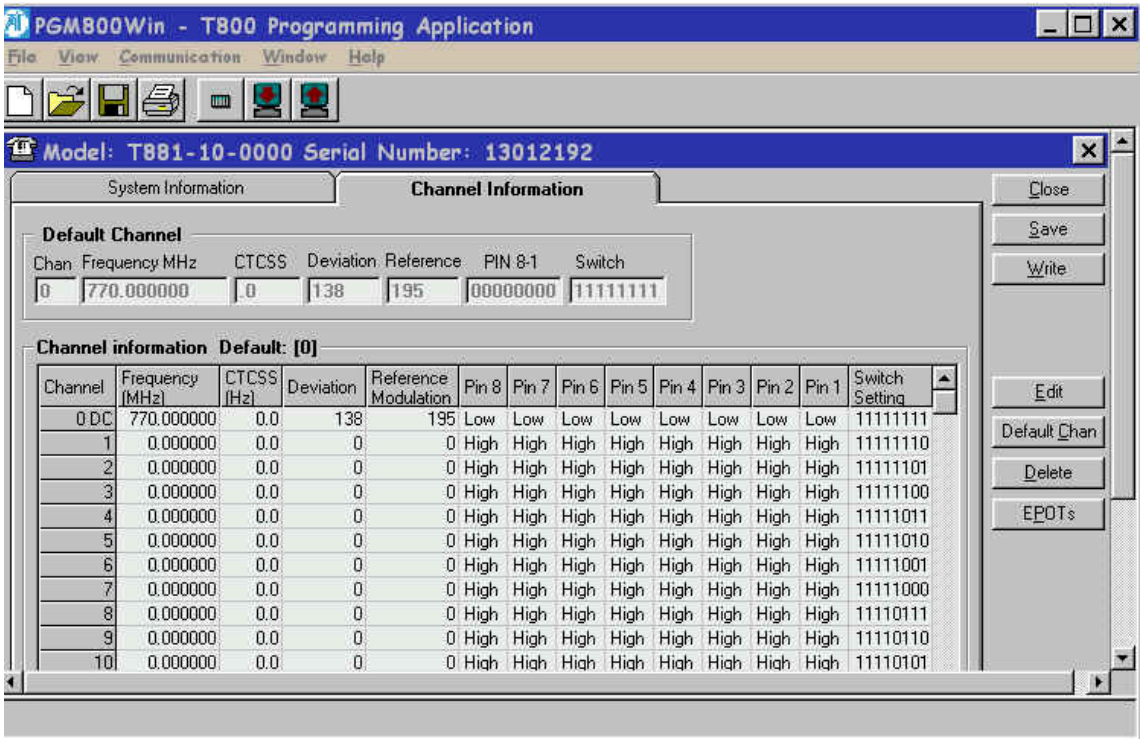


Figure 86 - Exciter Channel Information Sample

6.1.3 Channel Selection via DIP Switches

The backplane-mounted DIP switch settings override the default channel programmed by PGM800Win.

To set a default channel via the software, all DIP switches must be set to "OFF" (i.e. 0000).

When a switch is "Off", its binary count is active; when a switch is "ON" its binary count is inactive. The various DIP switch combinations of ON or OFF make up a binary total, which identifies the channel number.

To select a channel, set the appropriate DIP switch or switches to "OFF" to make the binary count total the channel number you want. Set all other switches to "ON".

Example: To select channel 5, set the DIP switches as shown below:

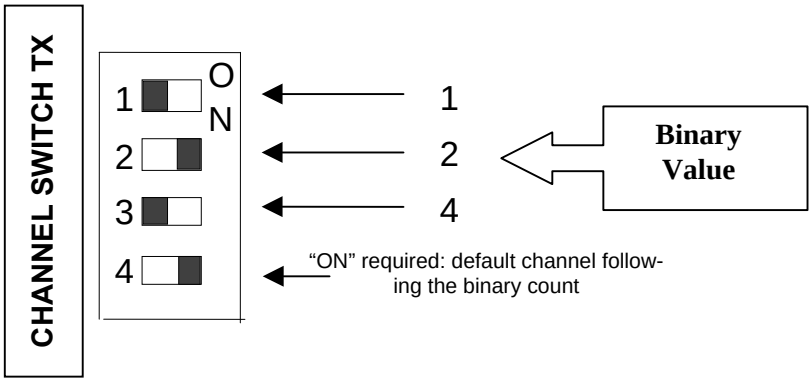


Figure 87 - Backplane DIP switches example – Channel 5 selected

6.2 Transmitter Radio Tuning

- This section covers the basic Series II base station 700MHz transmitter radio module and PA radio tuning and verification.

Note: Usually, this section is never done unless called for in section 6.1 "Series II - Radio Programming" or in Table 9 **"Checklist B" (General).**

6.2.1 Test Equipment

- Digital Multimeter & probes (e.g. Fluke 77)
- 1 HP 34330A Shunt 30A (UHF only, used for transmitter current measurement)
- Digital or Analog calibrated Oscilloscope & scope probes (X1, X10 selectable)
- Calibrated COM-120B (.001ppm OCXO and 30kHz IF options)
- 3-foot length of double-shielded N-M to BNC-M cable (RG-214 or RG-223)
- 2x 'BNC' to 'N' type adapters (e.g. Amphenol, Greenpar).
- Bird RF power meter with 150W / 50 ohm dummy load (optional)
- 3dB 150–watt attenuator
- 1x Torx screwdriver #T-10 and #T-20
- Pozidriv screwdriver #1 & #2
- 1x Six-inch adjustable wrench
- RF tuning/trimming tools.
- Extender Rail Kit for Series II chassis (T800-13-0000)
- 1x 6" coax cable N-M to BNC-M (comes with the radio to connect the exciter to the PA)

6.2.2 Transmitter Module (T881-10-xxxx)

Note 1: Refer to Figure 88 (T881).

Note 2: When the synthesizer is unlocked, the front panel green LED called "Supply" will flash indicating that it needs re-tuning.

Warning:

The LED will also flash when the unit is in setup mode while connected to the PGM800win program.

6.2.2.1 Initial Setup

1. Shut down power to the base station.
2. Prepare the Multimeter to DC Volts.
3. Remove the exciter (T881) module from the base station rack frame.
4. Remove the exciter top cover (nearest the handle).
5. Connect a 3 feet long double-shielded cable (N-M to BNC-M) between the IFR T/R output and the exciter antenna connector.
6. Connect the Paragon3 Extender Rail Kit to the empty chassis exciter slot.
7. Apply power to the base station.

6.2.2.2 Synthesizer Alignment

Single channel: Connect the Multimeter to either side of L309 (T881).

- T881 (700 MHz) Tune VCO trimmer CV300 for a synthesizer loop voltage of 10V DC.

Multiple channels (adjusting as shown for single channel above):

- T881 (700 MHz) Adjust the VCO loop to 10V using the middle frequency channel.

All channels should lie within the upper and lower limits of 16V and 3V respectively for the T881.

Note:

Normally, the fast TX key option is installed and the synthesizer is always energized. In the case where that option was not fitted, key the transmitter by pressing the front panel Carrier button to make the above adjustment possible.

6.2.2.3 Low-Frequency Balance Adjustment

Note:

- *PGM800Win version 3.00 or later must be used. Electronic potentiometer (256 step) is used to allow channel adjustment of two-point modulation (Low freq. balance).*

1. Apply the following settings to the IFR:

– Receiver mode and Oscilloscope display (Source Demod out connector, DC coupled).
– IFR RX frequency to match the radio transmit frequency
– IF Filter set to 30 kHz
– Zoom the Deviation window: select 10 kHz Range and DC coupling.

2. Select the active or, the lowest (in the case of multi-channel base) frequency channel (via dip switch, refer to Figure 87).
3. From the web interface “Radio” page (“RF Test Tone”), select 100 Hz square wave – Press Execute. Transmit a square wave and follow the procedure outlined in Table 9 at step 7.
4. Via PGM800Win, press EPOTs button. Adjust IC220 “reference modulation” to obtain the best square wave, no damping, no overshoot. (You can use either the mouse or up and down arrow keys). Record the deviation read.
5. If transmission has not ended by itself, select “*Cancel current test”* to stop it. For single-channel unit, proceed to step 8.
6. For multi-channel unit, select the highest frequency channel. From the web interface “Radio” page (“RF Test Tone”), select 100 Hz square wave – Press Execute. Transmit a square wave and follow the procedure outlined in Table 9 - Checklist B (General) at step 6. Record deviation again.
7. The difference in deviation between the two channels should be less than ±300 Hz. If not, re-adjust IC220 to "average" the square wave shape on both channels until the spec is met.
8. To confirm the adjustment, select the active, or the lowest frequency channel. Compare the deviation produced between 1000 Hz sine wave test tone and Random data test pattern

   The difference between the test tone and the test pattern should be: < 2.5 kHz

   For multi-channel unit, repeat this step for each frequency channel.

Select the active channel. From the web interface “Radio” page (“RF Test Tone”), select modulated – Press Execute and follow the procedure outlined in Table 9 step 6. *Make sure that deviation level read on the IFR corresponds to model and bit rate in use as shown in the second column from the left.* Re-adjust deviation as necessary referring to Checklist B (Table 9) at step 6.

6.2.2.4 TX Frequency Error Adjustment

1. Apply the following settings to the IFR:
   - Receiver mode
   - IFR RX frequency to match the main radio TX frequency
   - IF Filter set to 30kHz
   - Zoom the RF Error window: select 10kHz range
2. Key the transmitter by pressing the front panel TX-Key button and measure the carrier output frequency. It should be within ±300 Hz. If it is not, adjust the TCXO (IC700) to trim to meet the requirement, preferably within 100Hz.

6.2.2.5 Exciter Power Output

1. Apply the following settings to the IFR:
   - Receiver mode, Output T/R
   - IFR RX frequency to match the main radio TX frequency
   - IF Filter set to 30kHz
   - Select auto range in the *Power reading* window
   - Connect the coaxial cable from the IFR T/R to the Exciter output connector
2. Key the Exciter by pressing the module PTT button. The output power at the coaxial cable end connecting to the power amplifier should be:
   - T881 = 5W +0/-300mW (RV502, Figure 88)

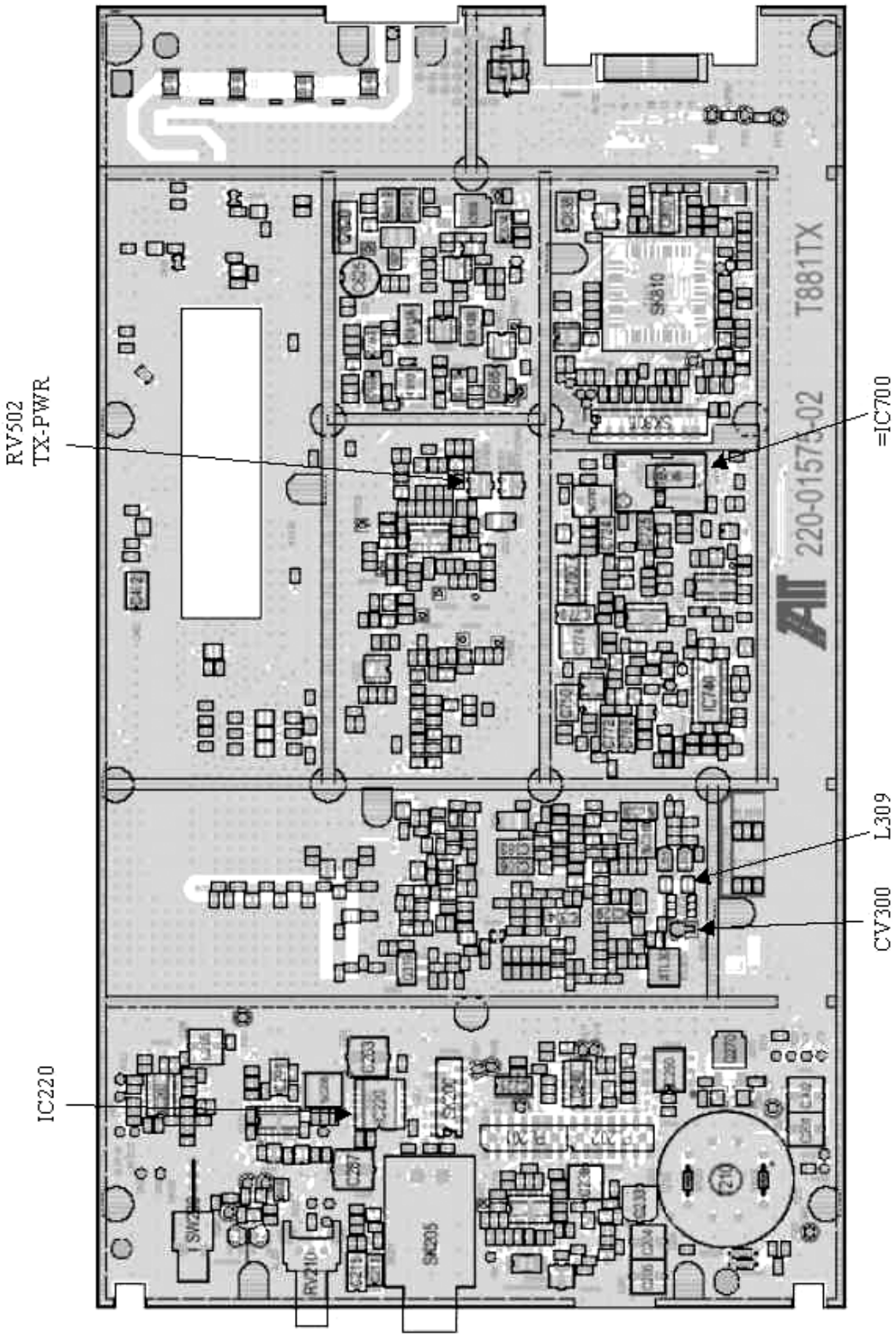


Figure 88 - T881-0200 Transmitter Tuning Controls location

7. Specifications

GENERAL

Frequency	762 -764 MHz Tx / 792-794 MHz Rx (FCC Part 27) 767- 773 MHz Tx / 797-803 MHz Rx (FCC Part 90) 764 – 770 MHz / 794 – 800 MHz (Industry Canada, RSS119)
RF/Modem Assembly Size	(Rackmount) 19.0” W x 10.5.0” H x 12.5” D + 2.0” connector allowance
PA Assembly Size	(Rackmount) 19.0” W x 5.25”H x 10.5” D
Cabinet Size	22.06” W x 75.82” H (without leveling feet) x 27.06” D
Frequency Stability	1.0 ppm (-4°F to +140°F / -20°C to +60°C)
Supply Voltage	13.8 VDC nominal (negative ground) (12.6 to 14.6 VDC) or 120 VAC
Circuit protection (radio backplane)	Main fuse (F1): Blade fuse (Maxi-Fuse) 10A : Power amp. fuse (F2 & F3): Blade fuses (Maxi-Fuse) 2 x 15A (30A total) Crowbar diodes for reverse polarity protection
RX Current Consumption @ 13.8 VDC	2.5A max. with speaker monitoring)
TX Current Consumption @ 13.8 VDC	4.0A max – 4 to 5W Exciter T881, 24A DC max. – 70W PA
Base Station Power Consumption @ 120 VAC	120 VAC / 6A max., 60 Hz
Channel spacing	50 kHz
Operating Temperature Range	-22°F to +140°F / -30°C to +60°C (deleted power supply, catalog number with 0 in second to last digit) +14°F to +140°F / -10°C to +60°C (with standard Dual Power Supply assy., catalog number with 2 in second to last digit)
Interface Connectors	Dual Ethernet RJ45 Auto MDIX 10-100/T with LED status indicators Dual RS-232 DB-9F Serial Ports configured as Terminal Servers USB Port (future use) Native TCP/IP and built-in router

RECEIVER

Frequency	792-794 MHz Rx (FCC Part 27) 797-803 MHz Rx (FCC Part 90) ; 794 – 800 MHz (Industry Canada, RSS119)
Adjacent Channel Selectivity	75 dB (Typical) @ 50 kHz
Sensitivity For 1% Packet Error Rate (PER) with Parallel Decode at carrier frequency	-94 dBm @ 128 kbps -100 dBm @ 96 kbps -106 dBm @ 64 kbps
Spurious Response Rejection	100 dB (Typical)
Intermodulation Rejection - EIA (50 kHz)	80 dB (Typical)

TRANSMITTER

Frequency	762-764 MHz Tx (FCC Part 27) 767-773 MHz Tx (FCC Part 90) ; 764-770 MHz Tx (Industry Canada, RSS119)
Rated Continuous RF Power	70W nominal
Range of Adjustment	35W – 70 W (user adjustable)
Spurious Emissions: - transmit - standby	-53 dBm to 1GHz, -17 dBm to 4GHz -57 dBm to 1GHz, -47 dBm to 4GHz
Load VSWR Tolerance	20:1 (Max), 30 seconds
Adjacent Channel Power (ACP) Transmitter Sideband Noise	Unmodulated: -85dBc typical @ 50kHz With data modulation: -40 dBc @ 50kHz -65dBc @ 50kHz
FM Hum & Noise	-45dB (300Hz to 3kHz) EIA
Operation	Full duplex
Protocol	Dataradio Proprietary E-DBA with OOB AAVL support
Data rates and Modulation type	SRRC16FSK (128 kb/s) SRRC8FSK (92 kb/s)* SRRC4FSK (64 kb/s)*
Duty Cycle	100% (Continuous)
RF Power Adjustment	-3dB (Nominal)
output Impedance	50 ohms
output connectors	Type N female
Storage & Transport	-40°F to +158°F / -40°C to +70°C
Humidity	80% at +40 degree C. (non-condensing)
Altitude	10,000 feet maximum

* Subset of 16-Level FSK

FCC / IC CERTIFICATIONS	FCC	IC (DOC)
762-764MHz and 767-773MHz (FCC) 764-770 MHz (IC)	EOTBDP3-T881 – 5W exciter T881 EOTBDP3-AMP – 70W PA option AMP	773A-BDP3-T881

EMISSION DESIGNATORS

Bit rate	***Baud rate***	***Modulation***	***700MHz***
128 kb/s	32000	SRRC16FSK	30K0F1D
96 kb/s	32000	SRRC8FSK	30K0F1D
64 kb/s	32000	SRRC4FSK	30K0F1D

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