

FREQUENCY AGILE DIGITAL REPEATER

OPERATIONAL MANUAL

Model DR85-1WP

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Product Certification/Registration Information

The serial number may be found on the label on the rear panel of the unit. For your convenience, note this number below. Retain this manual, along with proof of purchase, to serve as a permanent record of your purchase for future reference or in the event of theft.

MODEL NUMBER

SERIAL NUMBER

DATE OF PURCHASE

POINT OF SALE COMPANY

Safety Guidelines

The general safety information in this guideline applies to both operating and service personnel. Specific warnings and cautions will be found in other parts of this manual where they apply, but may not appear in this summary. Failure to comply with these precautions or specific warnings elsewhere in the manual violates safety standards of design, manufacture, and intended use of equipment. Cellular Specialties, Inc. assumes no liability for the customer's failure to comply with these requirements.

Grounding

This amplifier system is designed to operate from 120 VAC @ 1.3A max current and should always be operated with the ground wire properly connected. Do not remove or otherwise alter the grounding lug on the power cord.

Explosive Atmospheres

This product has an integral circuit breaker, which may cause an electrical flash if the breaker should reset. To avoid explosion or fire, do not operate this product in the presence of flammable gases or fumes.

Lightning Danger

Do not install or make adjustments to this unit during an electrical storm.

No User Serviceable Parts Inside

HAZARDOUS VOLTAGES ARE PRESENT WHEN THE COVER IS REMOVED. Opening the chassis will void your warranty. If you suspect a malfunction with this product, call your dealer or the Cellular Specialties Support Line at (603) 626-6677.

DISCLAIMER: All information and statements contained herein are accurate to the best of the knowledge of Cellular Specialties, Inc. (CSI), but Cellular Specialties makes no warranty with respect thereto, including without limitation any

results that may be obtained from the products described herein or the infringement by such products of any proprietary rights of any persons. Use or application of such information or statements is at the users sole risk, without any liability on the part of Cellular Specialties, Inc. Nothing herein shall be construed as license or recommendation for use, which infringes upon any proprietary rights of any person. Product material and specifications are subject to change without notice. Cellular Specialties' standard terms of sale and the specific terms of any particular sale apply.

Product Description

Cellular Specialties, Inc. (CSI) developed the Frequency Agile Repeater (FAR) for use within enclosed structures where sufficient signal from local cell sites to operate cell phones is unavailable. Adequate signal must be available outside the structure as a prerequisite to achieving in-building coverage. The FAR is connected to an external antenna, usually on the roof, and to one or more internal antennas placed strategically throughout the area where wireless services are desired.

The external antenna typically is a directional type such as a "yagi". Internal antennas are usually omni-directional, although various other types may be chosen depending on the coverage application. The FAR amplifies both the "uplink" (phone to tower) and "downlink" (tower to phone) signals thus facilitating communications to and from the intended wireless infrastructure.

There are seven amplification stages on either the downlink or the uplink creating a total of +85 dB nominal gain on each link. Gain can be adjusted over a 31 dB range utilizing the local PLED display and soft switches. There are also LED indicators near the display to indicate power overload, gain reduction, and shutdown that may be invoked by built-in automatic protection processes.

Each amplification chain is interrupted by a specific filtering process. This process digitally converts the assigned spectrum and then applies digital signal processing (DSP) techniques. DSP is used to create passbands that limit the RF energy passing thru either the uplink or downlink paths. After the digital processing is complete, the information is converted back to an analog signal that is applied to the remaining stages of amplification. The resulting signals emitted by the FAR are specific to the network service providers' license requirements. If these requirements change, only the DSP configuration parameters need to change in order to adapt. Configuration parameters are created at the factory and supplied as files that may be downloaded to the FAR. Up to 30 different paired filter parameters can be stored within FAR memory making it ready for varied applications.

Functional Description Overview

- Front Panel "Soft-key" Display (Power, Gain, Feature Control, Fault)
- Keypad for User feature selection
- Network Configuration and Control
- User gain control (effects all bands)
- Automatic Level Control
- Automatic Power Control
- Oscillation Protection
- Over Drive Protection (requires input power detect)
- Under/Over voltage Protection
- Low Gain detection on PA (rev 2.0)

- Fault protection (rev 2.0)
- Alarm Notification – Local/Remote
- Fan speed and Temperature Control
- Upgrade Support – Local/Remote
- External Interfaces: USB/Ethernet/Serial
- Field Re-loadable filters
- Web-based monitoring and control - Local/remote
- Persistent Status and Error information
- Over Temperature Protection
- System Logging w/timestamp

LED Indicators

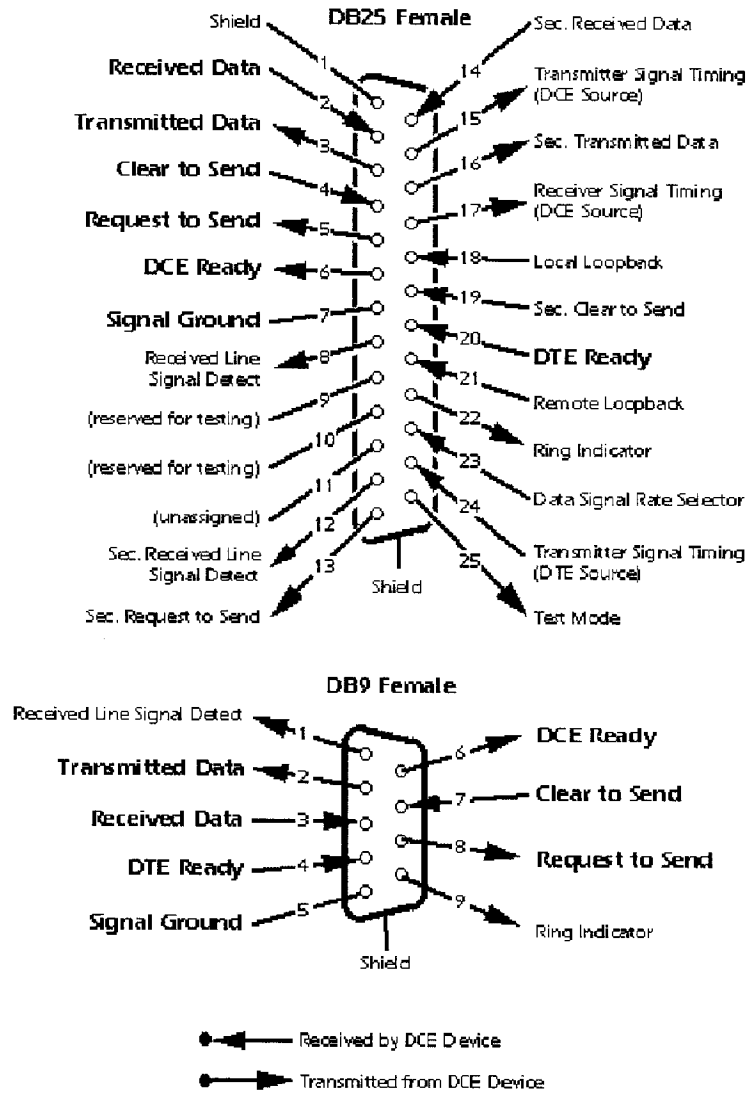
- Warning:* The unit has sensed instability due to insufficient isolation between the inside antenna and the outside antenna, and has reduced the gain of the amplifier. This is done to prevent oscillation, which can interfere with the handsets in the covered area and/or the wireless service provider's base station.
- Fault:* The gain of the unit has been reduced to a minimum in order (Red) to prevent very strong input signals from overloading the amplifier. The amplifier will attempt to recover from this condition, initially at fifteen-second intervals and then at four-minute intervals.
- Power:* Primary power is indicated by an illuminated green LED. The repeater is not provisioned with an ON/OFF power switch.

As described previously, various automatic safety precautions are built into the amplifier system. As a catastrophic response, a shutdown circuit is incorporated that will effectively disable all emissions should the uplink or downlink be overdriven or should an oscillation event occur. The amplifier will periodically attempt to recover from the detected condition based on time and various system measurements performed automatically.

Local Interfaces

To facilitate monitoring and control, the FAR is equipped with four ports that provide external communication access (2 DB-9 serial, 1 USB, and 1 Ethernet). One serial interface provides communications to a local PC and the second to an external modem. The USB interface provides a means to download files from a memory device. Ethernet is provided as an optional communications port to the PC in lieu of serial communications. The DB-9 pin-outs follow the standard Electronic Industries Association (EIA232) specification.

EIA232 Pin Specifications



USB Interface

The Universal Serial Port (USB) interface conforms to Intel's Universal Host Controller Interface (UHCI) version 1.1 dated March 21, 1996. This interface will support data transfer rates up to 12 Mbps.

Ethernet

The Ethernet AUI conforms to IEEE 802.3 and is capable of supporting 10/100 Mbps communication speeds.

Monitoring & Alarms

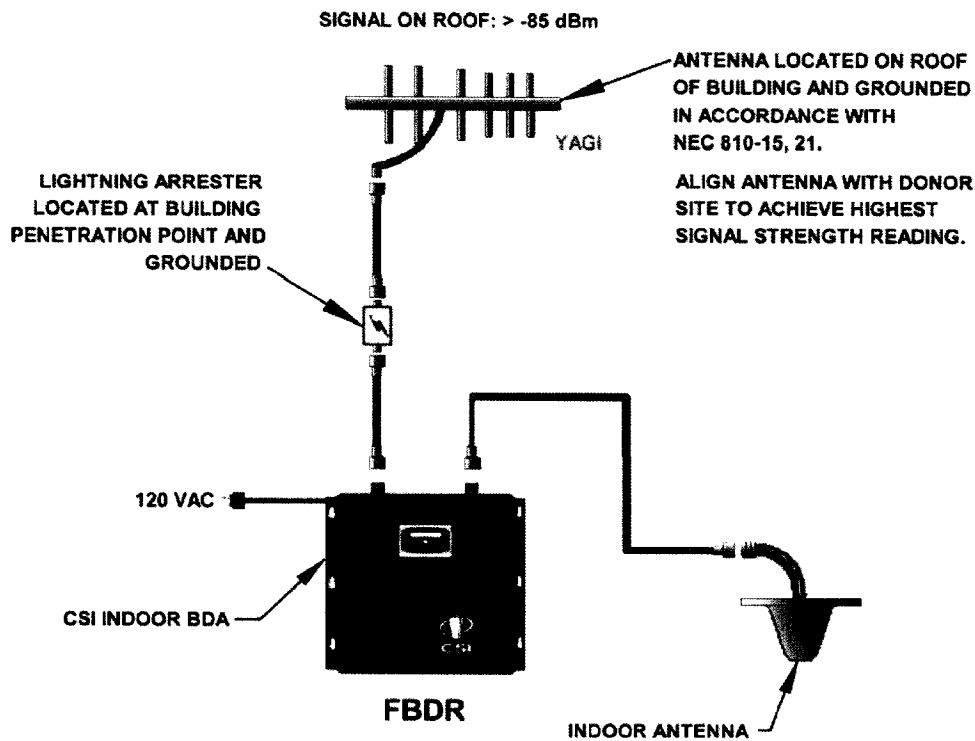
There are no physical connections specific to communicating system states or alarm status. This information is shared on the communication ports described earlier.

PLED Model Mechanical Drawing

See Manual for Image

Installation:

Example: Standard Single Internal Antenna System Design



Optional Accessories

Accessories are available directly from Cellular Specialties, Inc. or any of CSI's distributors.

- Outside Gain Antenna
PCS – model number (Tessco Part No. 59090))

- Inside Omnidirectional Antennas
 - PCS – model number (CSI-AS/1.85-1.99/2)
 - SMR – model number (CSI-AS/806-866/4)
 - Tri-Band – model number (CSI-AO/800/2.5K/3)
- Power Dividers
 - 2:1 - model number (CSI-S2BSC)
 - 3:1 - model number (CSI-S3BSC)
 - 4:1 - model number (CSI-S4BSC)
- Grounding Kit - model number (CSI-GKIT)
- Lightning Arrestor - model number (CSI-CAP)
- Directional Couplers and Cross Band Couplers are also available

Important Installation Notes

- inadequate isolation between the outside and inside antennae may cause re-generative feedback in the system. Without a detection and control mechanism, feedback can cause the amplifier to emit a continuous signal at maximum amplitude and, in some cases, interfere with normal operation of the cell site. Careful consideration of the layout and placement of the system is imperative.
- The Installer should refer to the *Safety Precautions*, in the following section, for proper antenna selection and installation

WARNING! AMPLIFIER OR HANDSET DAMAGE **MAY** OCCUR IF A HANDSET IS CONNECTED DIRECTLY TO THE REPEATER OR THE COAX THAT LEADS TO THE REPEATER.

Important Safety Information

Antennae used for the purpose of radiating signals indoors are limited to a *maximum* gain of 3 dBi. The outdoor antenna used for the purpose of communicating to the wireless infrastructure is limited to 8 dBi gain. Each antenna must be positioned to observe minimum separation requirements from all users and bystanders. The following guidelines should be used when considering separation distances.

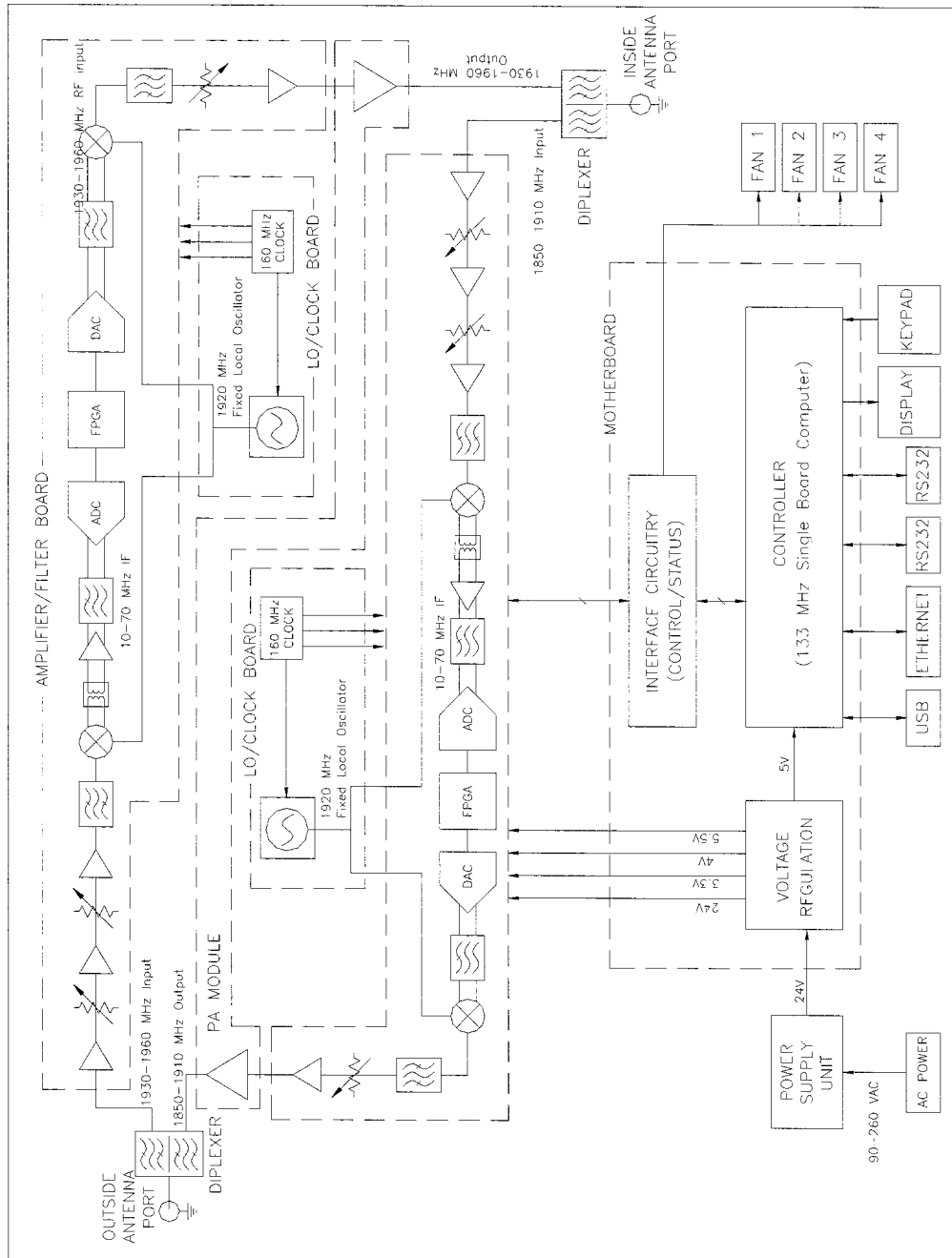
INDOOR antennae must be placed such that, under normal conditions, all personnel cannot come within 20 cm. (~ 8.0 in.) from any inside antenna. Exceeding this minimum separation will ensure that the employee or bystander cannot exceed RF exposures beyond the maximum permissible limit as defined by section 1.1310 i.e. limits for General Population/Uncontrolled Exposure.

The *OUTDOOR* antenna must be positioned such that, under normal conditions, all personnel cannot approach closer than 120 cm. (~ 4 ft.). If a directional antenna having a *maximum* gain of 8 dBi is used, precautions should be taken to prevent personnel from routinely passing through the main radiation beam at a distance closer than specified.

Circuit Description

The FAR uses a single down-conversion/up-conversion scheme (see Figure 1). There are three RF amplifier stages prior to the down-converting mixer. The mixer is followed by a single IF amplifier. The IF signal is fed to an Analog to Digital Converter, and the digitized output is processed by a Digital Signal Processor block. The processed digital signal is fed to a Digital to Analog Converter and then up-converted to RF. A driver amplifier and a final power amplifier stage follow this. Total nominal gain is 85 dB for both the downlink and uplink paths, and both links have manual and automatic gain control. LEDs on the top panel provide power, major and minor alarm indication. The FAR features automatic safety shutdown, which will disable the power amplifiers should excessive intermodulation or oscillation occur.

Fig. 1 Functional Block Diagram, Model DR610



Specifications

Operating Power Parameters

Parameter	Specification	Notes
Maximum RF input Power without damage	+10 dBm	.
Nominal Gain	85 dB	90 dB max
Gain Flatness	+/-2.0 dB	(+/- 1.0 dB typical)
Gain Stability	+/-1.0 dB	Gain vs. Temperature
Automatic Level Control (ALC)	31 dB max range	In 0.5 dB steps
Manual Gain Control	65-90 dB (max)	In 0.5 dB steps
Minimum Composite Output power PCS/UMTS SMR/Cell	+27 dBm +30	Uplink and Downlink
Noise Figure	5.0 dB (max)	At Maximum gain
OIP3	45 dBm	Measured with 2 CW tones at 14 dBm/tone
RMS Vector Error (EVM)	3%	TDMA, EDGE, W-CDMA, CDMA2000
CDMA RHO	98%	CDMA 2000, 1x-EVDO
Group Delay	2.5 usec (max)	Typical delay including 400 tap filter < 2.5 usec.
VSWR	2:1 Max	(1.5:1 typical)
Spurious Emissions FCC Industry Canada	-13 dBm (max) -13 dBm (max)	Per FCC part 2, 22,24,90 Per UC RSS 131

AC Power Specifications

Parameter	Specifications	Notes
AC Voltage	90 – 260 VAC	Specification SP-200-24
AC Current	3.5 Amps 1.7 Amps	@ 115 VAC @ 230 VAC
AC Power Frequency	47 – 63 Hz	
Power Consumption	285 Watts (Max)	

Mechanical Specifications

Parameter	Specifications	Notes
Box size		
<i>Height</i>	9.117 in.	
<i>Width</i>	15.12 in.	
<i>Depth</i>	18.5 in.	
Box weight	27.5 / 12.5 lbs/kg	
Mounting Brackets	Description needed	
Box Thermal Management	External Air	4 Variable speed fans Temperature controlled
Surface Coating	Powder Coating	
Color	Sherman Williams #_____	Satin Black
Label	See Label Diagram	
Battery Backup	None	
Acoustic Emission	N/A	

Enclosure Drawings

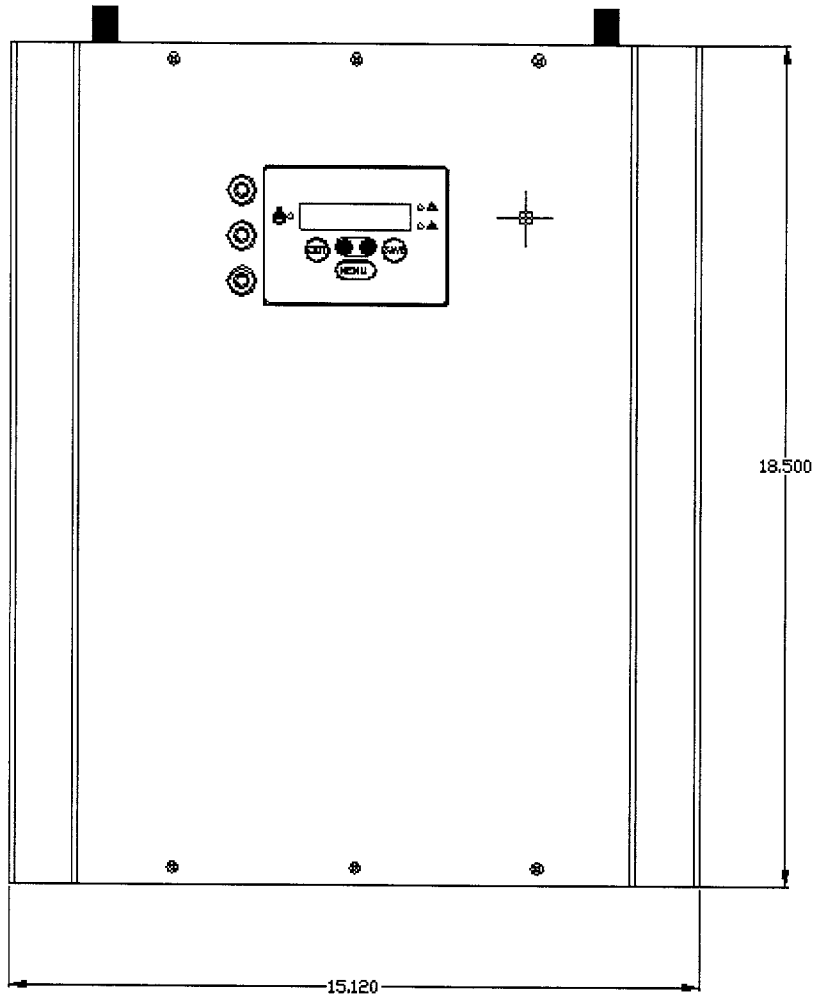
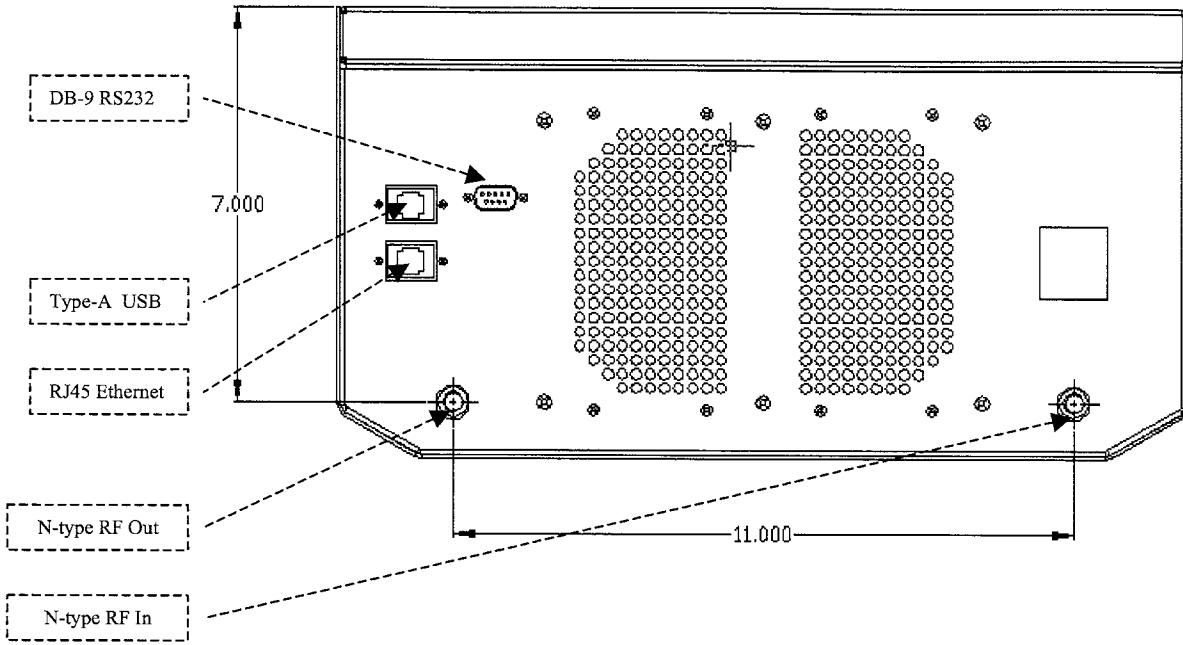
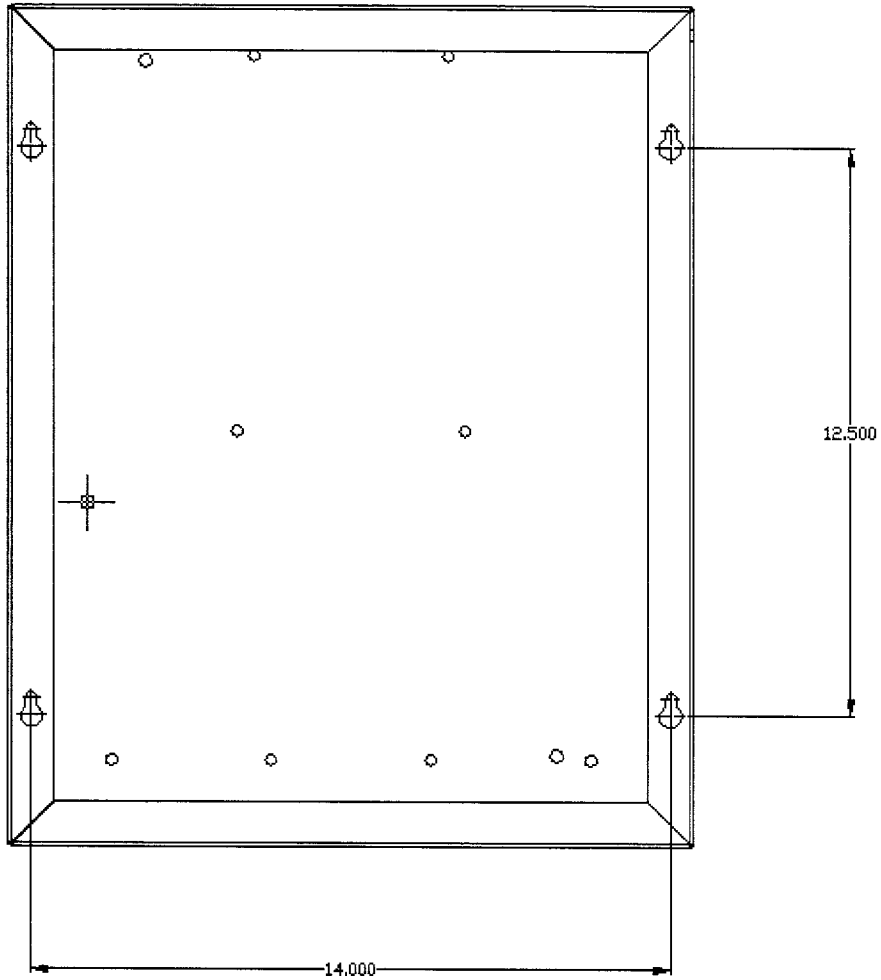


Figure 1 Mechanical Drawing - Front



Mechanical Drawing - Rear



Mechanical Drawing - Back

Performance Adjustment

The performance menu system can be navigated with five keypad buttons: *UP*, *DOWN*, *SOFT KEYS*, and *ESC*. There are two soft keys located either side of the UP/DOWN keys. Feedback is given to the operator through the PLED display panel.

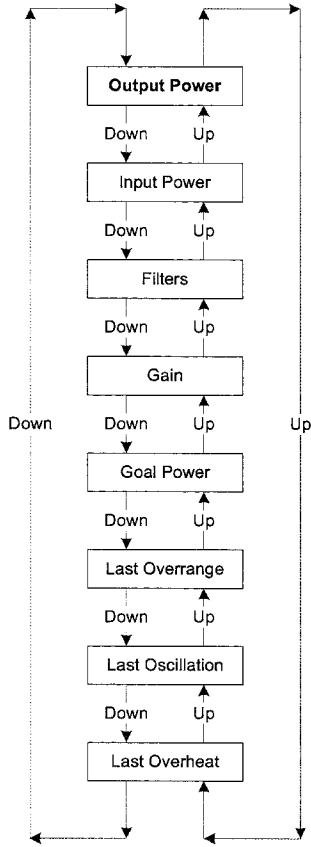
The default display is the *Screen Saver* as described later in this document. Entering the repeater command Interface is accomplished by pressing any key on the pad.

The purpose of the initial menu system is to view current settings and values. Continually pressing the UP or DOWN arrow buttons will move the display through the complete menu system after which the user will be returned to the top of the menu (see View Menu Series diagram). No soft keys are displayed while in this menu loop.

The first information displayed after exiting the Screen Saver is the downlink and uplink output power levels associated with the current outdoor and indoor environments (View Menu top). The displayed values imply the power emitted toward the cell site on the uplink and toward the mobile on the downlink. The format is **DN OUT X.XX dBm** and **UP OUT X.XX dBm**. Selecting a DOWN or UP arrow repeatedly will scroll thru current system information.

What follows is an exploration of each menu series in detail, and how each menu represents and interprets data.

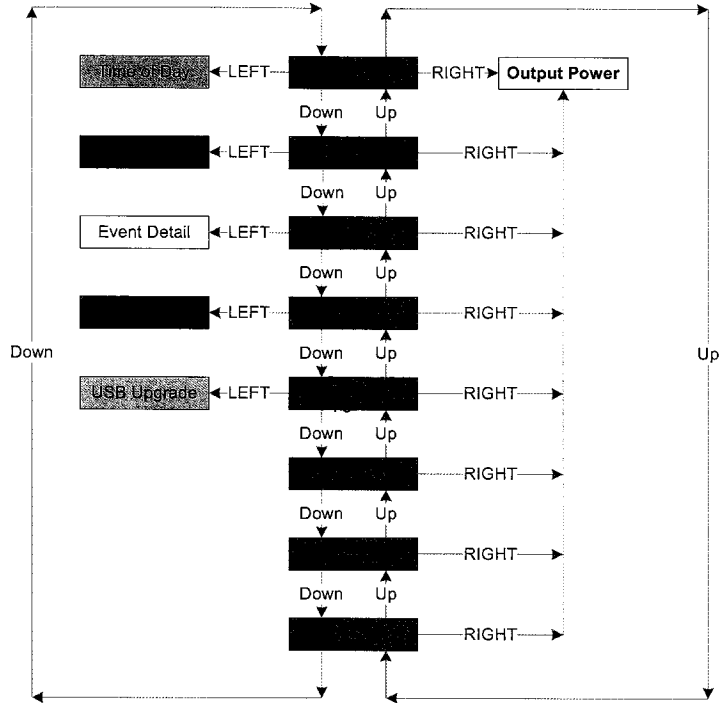
The View Menu Series



*Pressing **ESC** in any of these menus will take you to Show Config*

*The **LEFT** and **RIGHT** softkeys have no effect in any of these menus*

And Configuration Menu Series



*Pressing **ESC** in any of these menus will take you to Output Power*

Screen Saver Display

Upon powering up the FAR, a display resembling this will appear on the PLED display panel:



An example of the *Screen Saver Display* is shown above. The name is derived because the FAR will revert to this display if there has been no activity detected on the keypad for at least ten minutes. If this occurs, the PLED will dim to save power and to prolong the life of the display LEDs. Pressing any key while in the *Screen Saver Display* will brighten the display, and advance the menu to the *Power Readout Display*

The first row of the Screen Saver contains the network name of the repeater; this allows the user to distinguish multiple devices uniquely in a meaningful fashion. The name can be changed to whatever the user desires, and can contain blank spaces, capital letters, lowercase letters, and numerals. It is limited to sixteen characters to facilitate ease of use and interoperability with other devices.

Power Readings Displays

The first two menu locations show the instantaneous power readings in the FAR, as well as whether or not Automatic Gain Control (AGC) is actively attenuating the gain. As indicated previously, the displayed values of the Output Power screen imply the power emitted toward the cell site on the uplink and toward mobiles on the downlink within the allocated passbands. The format is **DN OUT X.XX dBm** and **UP OUT X.XX dBm**.

Likewise, the next screen (Input Power) indicate the input power received from the cell site on the downlink and from the mobiles on the uplink. The format is **DN IN X.XX dBm** and **UP IN X.XX dBm**.

Typical Power Reading Displays might appear as below:

DISPLAY RENDITION TO BE INSERTED (2)
(Typical information TBD)

It should be noted that when the power through a channel is less than power detectors resolution ability, the display will show "<0" in the location where the reading usually appears. This prevents spurious power readings from occurring because of random noise.

Pressing the DOWN arrow will move to the next display.

Filter Display

The purpose of this display is to view information about the filter currently loaded into the DSP. To minimize interpretation, information will be related to the start and stop bands.

A typical display might look like this:

DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow once again will move to the next display.

Gain Display

This display shows the system gains established in the uplink and downlink paths. Gain can be asymmetrical if an offset is required.

A typical gain display might look like this:

DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow will advance the user to the Goal Power display.

Goal Power Display

This display indicates the target output power desired on the uplink and downlink. When set, the repeater will attempt to maintain that power setting if other internal operational parameters can be met. The power is the composite power within the allocated passbands. These values would likely differ if an offset has been applied. Goal Power can be disabled.

A typical gain display might look like this:

DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow will advance the user to the Last Overrange display.

Last Overrange Display

The over-range display indicates the number of times the Analog-to-Digital has been over driven. *Over-range* is a measure of specific bits that have been incremented due to excessive signal power being applied to the analog-to digital converter. Excessive drive is a serious problem that must be prevented.

A typical over-range display might look like this:

DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow will move to the Last Oscillation display.

Last Oscillation Display

If an oscillation event has been detected, Information about that event will appear here. An oscillation event alarm is triggered by the following condition....

A typical oscillation event display might look like this:

DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow will advance the user to the Last Overheat display.

Last Overheat Display

If an overheat condition or potential overheat condition has been detected, information about that event will appear here. Four continuously monitored functions can trigger a overheat event alarm: FPGA processors (two locations), power amplifier, and cooling fan operation. Thermal conditions or fan service degradation can trigger the event.

A typical overheat event display might look like this:

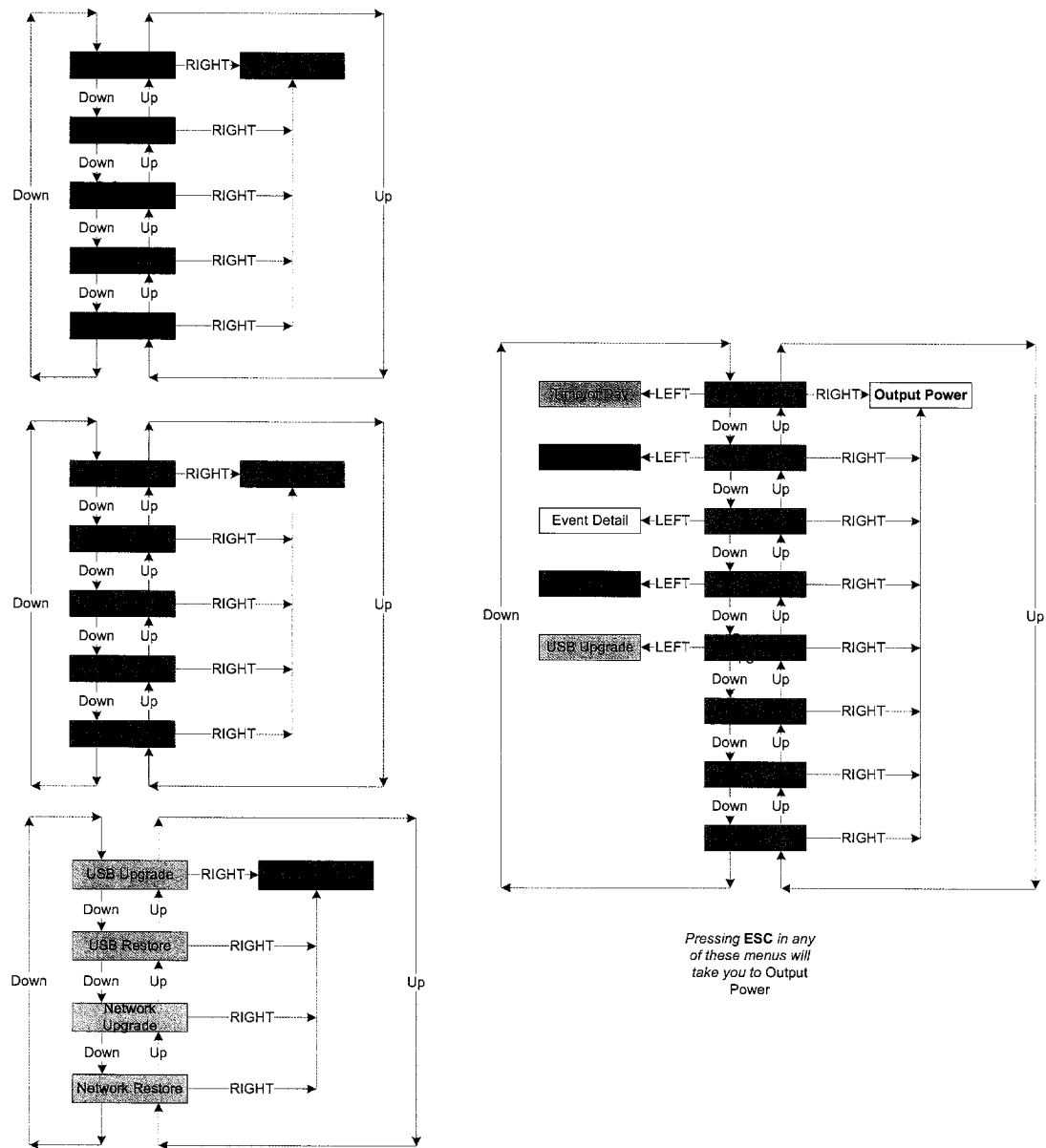
DISPLAY RENDITION TO BE INSERTED
(Typical information TBD)

Pressing the DOWN arrow will return to the initial output power display.

The Configuration Menu Series

Show Config Display

Pressing ESC from within the VIEW menu places the user in the configuration menu series (Show Config). Similar to the view menu, using the arrow keys will continually scroll the menu items. At any one of the menus within the loop, if sub-menus exist, a Select soft key will appear. Selecting the Left soft key will provide additional menu choices. Selecting the right soft key will return to the Show Config menu loop.



Troubleshooting

All cables should be carefully checked for "shorts" and "opens".

The rooftop antenna (Donor Antenna), if directional, should be checked for proper alignment along the calculated compass heading. Typically, the directional antenna should be aimed at the same site that your handset uses in the area where the outside antenna is placed.

If cables and alignment are acceptable, it may be necessary to use a spectrum analyzer to examine the signal environment in which the FAR is operating. The existence of strong analog signals within the frequency bands can cause the AGC to reduce the amplifier's gain particularly on the downlink. In some cases additional filtering might be required to reject these unwanted signals. In some instances the directional outside antenna can be reoriented, horizontally to place the interfering source in an antenna pattern "null". There also may be some cases where the interference from outside signals is so great that they can not be filtered or otherwise reduced or eliminated without expensive and possibly prohibitive measures. In these cases it may not be practical to use the FAR for providing coverage at these sites.

One Year Limited Warranty

Seller warrants that its products are transferred rightfully and with good title; that its products are free from any lawful security interest or other lien or encumbrance unknown to Buyer; and that for a period of one year from the date of installation or fifteen months from the date of original shipment, whichever period expires first, such products will be free from defects in material and workmanship which arise under proper and normal use and service. Buyer's exclusive remedy hereunder is limited to Seller's correction (either at its plant or at such other place as may be agreed upon between Seller and Buyer) of such defects by repair or replacement at no cost to Buyer. Transportation costs in connection with the return of products to Seller's plant or designated facility shall be paid by Buyer. The provisions of this warranty shall be applicable with respect to any product which Seller repairs or replaces pursuant to it. SELLER MAKES NO WARRANTY, EXPRESS OR IMPLIED, OTHER THAN AS SPECIFICALLY STATED ABOVE. EXPRESSLY EXCLUDED ARE THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PURPOSE. THE FOREGOING SHALL CONSTITUTE ALL OF SELLER'S LIABILITY (EXCEPT AS TO PATENT INFRINGEMENT) WITH RESPECT TO THE PRODUCTS. IN NO EVENT SHALL SELLER BE LIABLE FOR SPECIAL, CONSEQUENTIAL OR INCIDENTAL DAMAGES, INSTALLATION COSTS, LOST REVENUE OR PROFITS, OR ANY OTHER COSTS OF ANY NATURE AS A RESULT OF THE USE OF PRODUCTS MANUFACTURED BY THE SELLER, WHETHER USED IN ACCORDANCE WITH INSTRUCTIONS OR NOT. UNDER NO CIRCUMSTANCES SHALL SELLER'S LIABILITY TO BUYER EXCEED THE ACTUAL SALES PRICE OF THE PRODUCTS PROVIDED HEREUNDER. No representative is authorized to assume for Seller any other liability in connection with the products.

Industry Certifications/Registration Numbers:

FCC: NVRCSI610-S9; NVRCSI610-S89

NVRCSI510-S9; NVRCSI510-S89