Product Manual

CSI-DSP85-252-C/P &
CSI-DSP85I-255-C/P
Installation Manual

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Product Registration Information

Document Purpose / Intended Users

The purpose of this document is to provide a step-by-step procedure to help the experienced technician/engineer install and commission an in-building wireless enhancement repeater system using CSI's Digital Repeaters. Following the procedures outlined will minimize risks associated with modifying a live system and prevent service interruptions. This document assumes the technician/engineer understands the basic principles and functionality involved with Repeater and in-building systems. It is geared to the practical concerns of the installer.

Application

This guide should be applied whenever a need exists to add Digital Repeater capability to an existing system or when this capability is being included with a new installation.

Radio and Television Interference

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. In order to maintain compliance with FCC regulations shielded cables must be used with this equipment. Operation with non-approved equipment or unshieled cabled is likely to result in interference to radio & television reception. Changes and Modifications not expressly approved by Cellular Specialties can void your authority to operate this equipment under Federal Communications Commissions rules.

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 Digital Repeater system is designed to operate from 100-240 VAC 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
      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. Use of a suitable lightning arrester, such as CSI's model number CSI-CAP, is very strongly recommended.

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, Toll Free (USA) 1-877-844-4274**.

Important Safety Information

Antennas used for the purpose of radiating signals indoors are limited to a *maximum* gain of 3dBi. The outdoor antenna used for the purpose of communicating to the wireless infrastructure is limited to 14dBi gain, or any combination of gain and loss that equates to 14dB at input. 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 antennas must be placed such that, under normal conditions, personnel cannot come within 122 cm (~4.0 ft.) from any inside antenna. Adhering to 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.

OUTDOOR antenna must be positioned such that, under normal conditions, personnel cannot approach closer than 183 cm. (~6 ft.). A directional antenna having a maximum gain of 14 dBi is used, precautions should be taken to prevent personnel from routinely passing through the main radiation beam at a distance closer than specified.

Terms used in this manual

AGC= Automatic Gain Control   **ERP**= Effective Radiated Power
APC= Automatic Power Control   **FCS**= Feedback Cancellation System
AUI= Attachment Unit Interface   **FPGA**= Field Programmable Gate Array

CPU= Central Processing Unit   **LED**= Light Emitting Diode
CSI= Cellular Specialties, Inc.   **OIP3**= Third-Order Intercept Point
DAS= Distributed Antenna System   **RF**= Radio Frequency
DHCP= Dynamic Host Configuration Protocol   **SBC**= Single Board Computer
SNMP= Simple Network Management Protocol

DSP= Digital Signal Processing   **TMI**= Text Menu Interface
EEPROM= Electrically Erasable Programmable read-only Memory   **USB** = Universal Serial Bus
UHCI = Universal Host Controller Interface
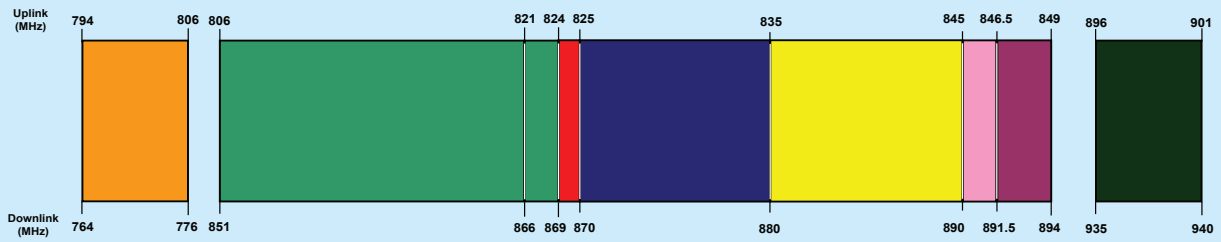
Product Introduction

Cellular Specialties, Inc. (CSI) developed the DSP85-252 and DSP85I-255 digital repeaters 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 Digital Repeater is connected to an external antenna, usually on the roof, and to one or more internal antennas placed strategically throughout the area where wireless service is desired.

The external antenna typically is directional, such as a "yagi". Internal antennas are typically omnidirectional, although various other types may be used depending on the coverage application. The CSI DSP Repeater amplifies both the "uplink" (phone to tower) & "downlink" (tower to phone) signals thus facilitating communications to and from the intended wireless infrastructure.

With a maximum total of +85dB nominal gain on both the up and down links, gain can be adjusted over a range from +53.5dB to +85dB in 0.5dB steps. Control of the repeater is achieved utilizing a computer connected to com port 1 or 2 or via a Crossover Ethernet cable connected to the Ethernet port. There is an LED to indicate ALARM status and power.
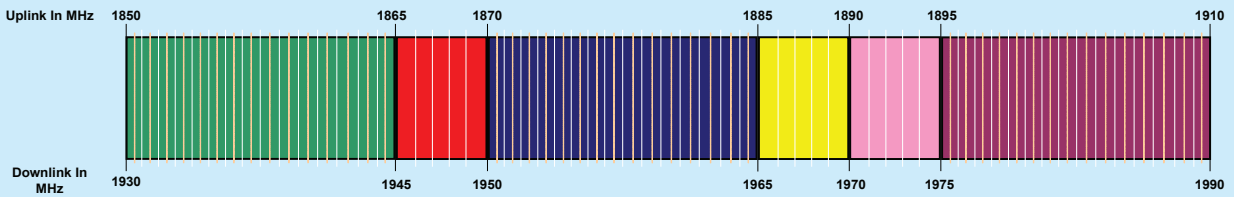
A specific filtering process modifies each amplification chain. This process digitally converts the assigned spectrum and then applies digital signal processing (DSP) techniques. DSP is used to create passbands that selects the RF energy passing through either the uplink or downlink paths. After the 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 repeater are specific to the network service providers' requirements. If these requirements change, only the DSP configuration parameters need change in order to adapt. Configuration parameters are created at the factory and supplied as files that may be downloaded to the repeater. The filter set configurations stored in memory determine the unit's adaptability to various field applications. The following pages describe the Cellular and PCS band plans as well as the convention CSI uses to identify and store the files that make up the filter set. All CSI repeaters are shipped with an active filter set that is programmed according to the ordering parties' specifications. In most cases, the installer will not be required to program a filter.

Cellular Frequency Band Plan

Uplink (MHz)	794	806	806				821	824	825		835		845	846.5	849		896	901

Downlink (MHz)	764	776	851				866	869	870		880		890	891.5	894		935	940

Public Safety	SMR 800 iDEN	SM800	A"	A	B	A'	B'	SMR 900
UL 794-806	UL 806-821	UL 821-824	UL 824-825	UL 825-835	UL 835-845	UL 845-846.5	UL 846.5-849	UL 896-901
DL 764-776	DL 851-866	DL 866-869	DL 869-870	DL 870-880	DL 880-890	DL 890-891.5	DL 891.5-894	DL 935-940

PCS Frequency Band Plan

Uplink In MHz	1850	1865	1870	1885	1890	1895	1910

Downlink In MHz	1930	1945	1950	1965	1970	1975	1990

A Full	B Full	C Full
UL 1850-1865	UL 1870-1885	UL 1895-1910
DL 1930-1945	DL 1950-1965	DL 1975-1990

A2	A1	B2	B1	C2	C1
UL 1850-1857.5	UL 1857.5-1865	UL 1870-1877.5	UL 1877.5-1885	UL 1895-1902.5	UL 1902.5-1910
DL 1930-1937.5	DL 1937.5-1945	DL 1950-1957.5	DL 1957.5-1965	DL 1975-1982.5	DL 1982.5-1990

A3	A4	A5	D Full	B3	B4	B5	E Full	F Full	C3	C4	C5
UL 1850-1855	UL 1855-1860	UL 1860-1865	UL 1865-1870	UL 1870-1875	UL 1875-1880	UL 1880-1885	UL 1885-1890	UL 1890-1895	UL 1895-1900	UL 1900-1905	UL 1905-1910
DL 1930-1935	DL 1935-1940	DL 1940-1945	DL 1945-1950	DL 1950-1955	DL 1955-1960	DL 1960-1965	DL 1965-1970	DL 1970-1975	DL 1975-1980	DL 1980-1985	DL 1985-1990

A6	A7	A8	A9	A10	A11	D2	D1	B6	B7	B8	B9	B10	B11	E2	E1	F2	F1	C6	C7	C8	C9	C10	C11

UL 1850-1852.5
DL 1930-1932.5
UL 1852.5-1855
DL 1932.5-1935
UL 1855-1857.5
DL 1935-1937.5

UL 1857.5-1860
DL 1937.5-1940
UL 1860-1862.5
DL 1940-1942.5
UL 1862.5-1865
DL 1942.5-1945

UL 1865-1867.5
DL 1945-1947.5
UL 1867.5-1870
DL 1947.5-1950

UL 1870-1872.5
DL 1950-1952.5
UL 1872.5-1875
DL 1952.5-1955
UL 1875-1877.5
DL 1955-1957.5

UL 1877.5-1880
DL 1957.5-1960
UL 1880-1882.5
DL 1960-1962.5
UL 1882.5-1885
DL 1962.5-1965

UL 1885-1887.5
DL 1965-1967.5
UL 1887.5-1890
DL 1967.5-1970

UL 1890-1892.5
DL 1970-1972.5
UL 1892.5-1895
DL 1972.5-1975

UL 1895-1897.5
DL 1975-1977.5
UL 1897.5-1900
DL 1977.5-1980
UL 1900-1902.5
DL 1980-1982.5

UL 1902.5-1905
DL 1982.5-1985
UL 1905-1907.5
DL 1985-1987.5
UL 1907.5-1910
DL 1987.5-1990

CSi
cellular specialties, inc.

Note: All frequencies are shown in MHz

Cellular Filter Naming Convention

POSITION:	1	2	3	4	5	6	7	8	9	10	11	12
Definition:	Band	Mod Type	Block 1	Sub Block 1	Block 2	Sub Block 2	Block 3	Sub Block 3	Block 4	Sub Block 4	Separator	Variant/Guard Band
					Note: These position columns are added as additional blocks are needed.							
	c = Cellular	g = GSM c = CDMA w = WCDMA I = IDEN	A -B	0 = Full p = prime (') d = double prime (")	A -B	0 = Full p = prime (') d = double prime (")	A -B	0 = Full p = prime (') d = double prime (")	A -B	0 = Full p = prime (') d = double prime (")	-	Standard Guard Band (see charts) 0 = CDMA 500 KHz (-1dB point in from band edge) GSM - 100 KHz (-1dB point in from band edge)

Notes:
Modulation type determines the guard band at the edges of each passband. Modulation type field will also be used to indicate a carrier who has unique sub-block designation.

Up to four sub-blocks may defined, resulting in a maximum filename length of 12 characters.

Example: ccAdAp-0 (Cellular band, CDMA Mod typ, A", A' with the -1dB point 600 KHz in from band edge.)

Note: All Variant/Guard Band designations other than 0 and F are user defined custom filters

Cell Blocks	Uplink(MHz)	Downlink(MHz)
A"	824-825	869-870
A	825-835	870-880
A'	845-846.5	890-891.5
B	835-845	880-890
B'	846.5-849	891.5-894

PCS Filter Naming Convention

POSITION:	1	2	3	4	5	6	7	8	9	10	11	12
Definition:	Band	Mod Type	Block 1	Sub Block 1	Block 2	Sub Block 2	Block 3	Sub Block 3	Block 4	Sub Block 4	Separator	Variant/Guard Band
					Note: These position columns are added as additional blocks are needed.							
	p = PCS	g = GSM c = CDMA u = UMTS w = WCDMA	A -F	0 = Full 1-11 = Sub	A -F	0 = Full 1-11 = Sub	A -F	0 = Full 1-11 = Sub	A -F	0 = Full 1-11 = Sub	-	Standard Guard Band (see charts) 0 = CDMA 500 KHz (-1dB point in from band edge) GSM - 100 KHz (-1dB point in from band edge)

Notes:
Modulation type determines the guard band at the edges of each passband. Modulation type field will also be used to indicate a carrier who has unique sub-block designation.

Up to four sub-blocks may defined, resulting in a maximum filename length of 12 characters.

Example: pgA4D0B4-0 (PCS band, GSM Mod Typ, A4, D Full, B4 with a standard guard band.)

Note: All Variant/Guard Band designations other than 0 and F are user defined custom filters

PCS Blocks	Uplink(MHz)	Downlink(MHz)
A	1850-1865	1930-1945
D	1865-1870	1945-1950
B	1870-1885	1950-1965
E	1885-1890	1965-1970
F	1890-1895	1970-1975
C	1895-1910	1975-1990

Note: Filter file names will be from six to twelve characters long. Each character position in the filter file name is used to define the characteristics of the filter as shown above. All frequencies are shown in MHz

Functional Overview

CSI digital repeaters incorporates the following features for convenient operation, access, protection, and control.

- Network Configuration and Control using either a webpage style GUI through any standard browser or a menu driven user interface using the serial port. Note: GUI does not require Internet access.
- User Gain Control (affects all passbands)
- Automatic Gain Control
- Automatic Power Control
- Oscillation Protection
- Over Drive Protection (P.A. limiting)
- Under/Over Voltage Protection
- Fault Protection
- Alarm Notification - Local/Remote
- Upgrade Support - Local/Remote
- External Interfaces - USB/Ethernet/Serial
- Re-loadable filters - Local/Remote
- Web-based monitoring and control - Local/Remote
- Persistent Status and Error information

LED Indicator

Automatic safety precautions are built into the amplifier system. In the case of a catastrophic system event, a shutdown circuit is incorporated that will disable all emissions should the uplink input or downlink input be over driven or should an oscillation or output overpower event occur. The amplifier will periodically attempt to recover from the detected condition automatically. Warning light indicators are as follows:

When a boot up is complete and no alarm conditions exist, the LED indicator will be illuminated green. Should a fault condition develop the LED will illuminate red and the user may check the status page of the GUI for the nature of the fault.*

*Note: During Power up, the repeater will require a approximately three minutes for the internal computer to boot up. During this time the LED on the front panel may light and go out several times.

Do not unplug the unit while it is in the boot up process!

Local Communication Interface Ports

To allow monitoring and control, the repeater is equipped with four ports that provide external communication access (1 Ethernet CAT-5, 2 DB-9 serial, and 1 USB). The Ethernet, CAT-5 port is provided as a primary communications port to the PC. One serial interface provides communications to local PC and the second to an external modem when provided. The USB interface provides a means to download files from a memory device and may also be used by an external modem. The DB-9 pin assignments conform to the standard Electronic Industries Association (EIA232) specification. A diagram of the pin descriptions is provided on this page for reference.

Connecting a null modem cable to one of the COM ports and using a terminal emulation program with a PC will allow communication to the control processor's Text Menu Interface (TMI). See command line interface section for further detail.

EIA232 Pin Specifications

DB9 FEMALE PINOUT REFERENCE
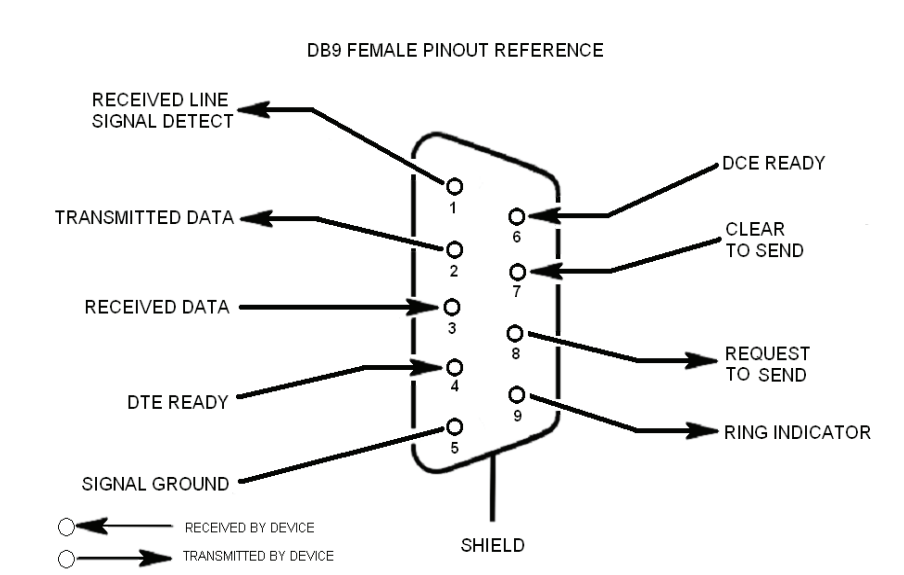
The diagram above is for reference only, it's intended to provide a quick source for pinout information in the event it should be necessary to adapt your serial cable because of an unusual connector configuration. In the vast majority of cases this information will not be needed.

USB Interface

The Universal Serial Bus (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 and can be used for software updates and filter file uploads.

Ethernet

The Ethernet AUI conforms to IEEE 802.3 and is capable of supporting 10/100 Mbps communications speeds. This port is used to provide access to the GUI.

Monitoring & Alarms

There are no physical connections provided to specifically communicate system or alarm status. This information is embedded in the information accessible via the communication ports described earlier.

System Set-Up Considerations

All cables should be checked for shorts and opens. Also verify that there are no cables with loose or poor connections. RF leakage could cause oscillation to occur under some conditions.

The rooftop antenna (Donor Antenna), if directional, should be checked for proper alignment along the calculated compass heading. Typically, the directional antenna would be aimed at the same site that your handset uses, but it may not always be so. **It is critical the installer contact the service provider for information on, and approval of the cell site he or she has selected before the system is turned on.**

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

Selection of external attenuators to be used in line with the Repeater Antenna Port(s):
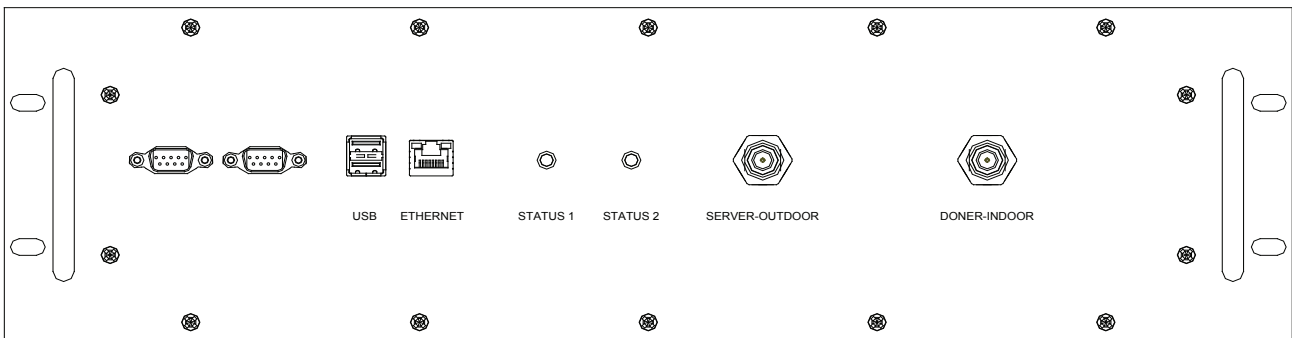
<u>1:1 PORT CONFIGURATION</u>

<u>Input:</u> One dual band duplex port, from the dual band donor.

<u>Output:</u> One dual band duplex port, to the DAS.

DONOR PORT

If a repeater is installed in an area with very strong desired and/or undesired signals, it is important to ensure that the overall signal levels are optimized to be within the best operating range of the repeater. Additionally, de-sensing of a nearby base station site must be avoided. These goals can be accomplished by properly attenuating the antenna port(s) in the path of the donor antenna(s). In effect, one can imagine that the particular repeater deployment is electrically moved farther from the base station using attenuators that are equivalent to increasing the path loss from the donor antenna to the base station.

The following potential outcomes result from the use of attenuators on the donor port(s) of the repeater: Uplink output power, as reported by the unit, is reduced by the value of the attenuation, protecting nearby base stations. Downlink signal to noise ratio is high at the point of the attenuator, resulting in slight but negligible reduction in downlink performance. Other performance is essentially unchanged.

SERVER PORT

Server port attenuation may also be necessary, particularly where a powered DAS is present. The selection guidelines below apply to both server and donor ports. In order to properly measure uplink signal strength, a signal generator should be used. If a signal generator is not available, placing a test call while under the server antenna with the least path loss to the repeater should provide reasonable data.

The following potential outcomes result from the use of attenuators on the server port(s) of the repeater: Downlink output power, as reported by the unit, is reduced by the value of the attenuation. Uplink incoming power from the DAS is reduced, along with potentially strong and/or harmful out-of-band signals (including noise) that are generated by the DAS.

Attenuator Selection Guidelines:

Accurate attenuator values need to be chosen to ensure that the maximum total power (higher of Composite or In-Band Input) applied to the donor and server port(s) does not exceed the following thresholds:

Input Signal	Max Gain	Input Signal	Max Gain
$\leq$-45 dBm	85 dB	-32.2 dBm	69 dB
-44.3 dBm	84 dB	-31.4 dBm	68 dB
-43.6 dBm	83 dB	-30.6 dBm	67 dB
-42.9 dBm	82 dB	-29.8 dBm	66 dB
-42.2 dBm	81 dB	-29 dBm	65 dB
-41.5 dBm	80 dB	-28.2 dBm	64 dB
-40.6 dBm	79 dB	-27.4 dBm	63 dB
-39.7 dBm	78 dB	-26.6 dBm	62 dB
-38.8 dBm	77 dB	-25.8 dBm	61 dB
-37.9 dBm	76 dB	-25 dBm	60 dB
-37 dBm	75 dB	**-24.4 dBm**	**59 dB***
-36.2 dBm	74 dB	**-23.8 dBm**	**58 dB***
-35.4 dBm	73 dB	**-23.2 dBm**	**57 dB***
-34.6 dBm	72 dB	**-22.6 dBm**	**56 dB***
-33.8 dBm	71 dB	**-22 dBm**	**$\leq$ 55 dB***
-33 dBm	70 dB		

*We recommend padding this level due to potential for fluctuating signal.

-25 dBm is the maximum input signal level that should be applied to the repeater, even if the gain is lower than 55 dB. Input signals exceeding these thresholds will result in composite input attenuation, called **"ADC Protect"** (**A**nalog to **D**igital **C**onverter **P**rotection). Output power is reduced whenever the above thresholds are exceeded by reducing the gain by 1dB for each 1 dB that the threshold is exceeded. ADC Protect should not be confused with **AGC** (**A**utomatic **G**ain **C**ontrol), which reduces gain to prevent **In-Band** (measured) output power from exceeding the specified maximum output level.

To determine the total power applied to the donor and server ports, please reference the "Composite Input" values as reported in the Web ("System Status") or Menu ("Link Status") interfaces (depicted and explained later in this manual).

**Large delta's between in-band and composite input signals:**

Care should be taken to isolate the best donor site to ensure the least possible delta between in-band and composite downlink signals.
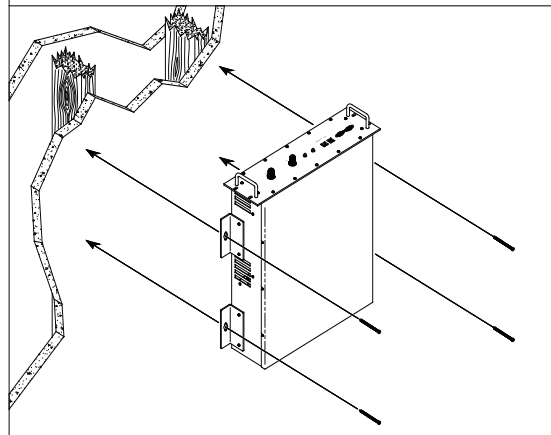
Mounting the Digital Repeater

The following diagrams illustrate the methods for mounting the repeater in a typical wall or rack installation. Brackets provided serve for both options.

Wall Mounting

Step 1: Install the wall mount brackets as shown in the drawing to the right.
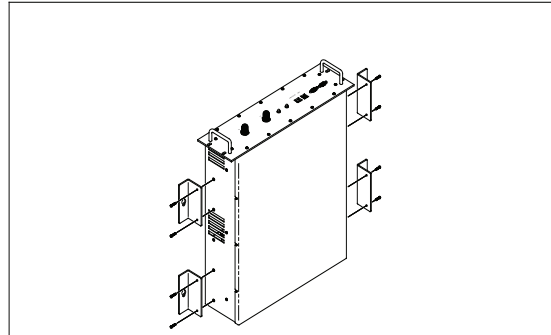
Step 2: Mark the location of the wall anchoring holes and drill. The wall anchoring system you use for the repeater will need to be able to support at lease 46 lbs/ 21kg. Install wall anchors and hang repeater as shown.

19" Relay Rack Mounting

Mount the repeater as shown and secure front panel with screws. Note: the CSI digital repeaters must be supported in the 19" Relay Rack system with a shelf. **Do not rely on the front panel mount exclusively to support all the weight of the unit.**
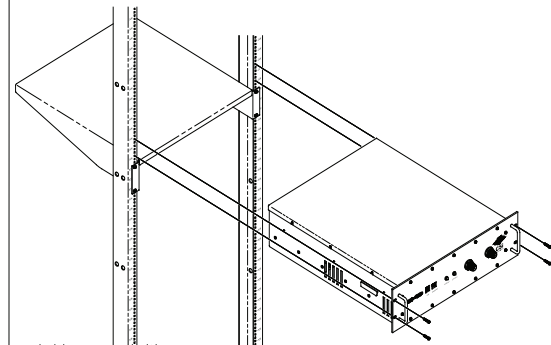
19" Four Post Rack Mounting

Install slid brackets on repeater as shown in the tapped holes provided. Slid repeater into the receiving brackets and secure with screws. The repeater must be supported in the rack system with slide rail. **Do not rely on the front panel mount exclusively to support all the weight of the unit.**
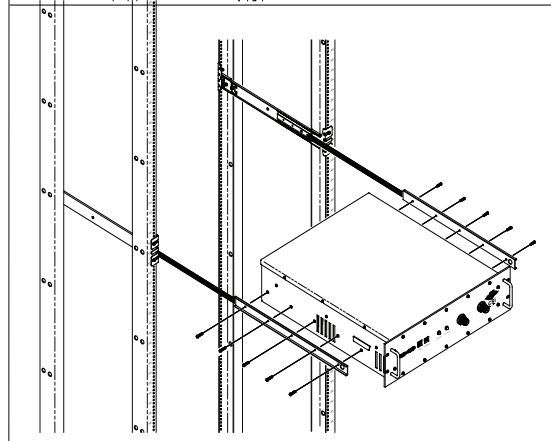
Optional Accessories

A complete line of accessories is available from Cellular Specialties, Inc. Check with your CSI distributor for any additional items needed. Below are just a few examples suitable for most in-building needs.

•**Outside Donor Antenna**
   PCS - model number: **CSI-AY/1.85-1.99/10**
   Cellular - model number: **CSI-AY/806-960/14**
•**Inside Omnidirectional Antenna**
   Quad-band - model number: **CSI-AO/700/2.7K/3**
•**Power Dividers**
   2:1 - model number: **CSI-SPD2/700-2.5K/N**
   3:1 - model number: **CSI-SPD3/700-2.5K/N**
   4:1 - model number: **CSI-SPD4/700-2.5K/N**
•**Grounding Kit** - model number: **CSI-GKIT**
•**Lightning Arrestor** - model number: **CSI-CAP**
•**Directional Couplers**
   6dB - model number: **CSI-DC6/700-2.5K/N**
   10dB - model number: **CSI-DC10/700-2.5K/N**
   15dB - model number: **CSI-DC15/700-2.5K/N**
   20dB - model number: **CSI-DC20/700-2.5K/N**
   30dB - model number: **CSI-DC30/700-2.5K/N**

•**UPS**
 Battery backup, 2 hr Single band
   1 hour dual band - model number: **CS48-985-600**

   Battery backup, 4 hr Single band
 2 hour dual band - model number: **CS48-985-601**
•**Cross Band Couplers**
  Quad band Rack Mount: **CSI-CM250-7/C/AW/P**
  (700 LTE, Cell, AWS and PCS)
  Quad band Wall Mount: **CSI-CBC/696-2170/N**
  (700 LTE, Cell, AWS and PCS)
  Tri band Rack Mount: **CSI-CM250-U7C/C/P**
  (700 Upper C LTE, Cell and PCS)
  Tri band Wall Mount: **CSI-CBC21/740-1990/N**
   (700 Upper C LTE, Cell and PCS)
  Tri band Rack Mount: **CSI-CM250-L7AB/C/P**
  (700 Lower A/B LTE, Cell and PCS)
  Tri band Wall Mount: **CSI-CBC21/696-1990/N**
  (700 Lower A/B LTE, Cell and PCS)

Important Installation Notes

•   Inadequate isolation between the outside and inside antennas may cause regenerative feedback in the system. This 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 Guidelines section on page 4 and the Important Safety Information section on page 5 for proper antenna selection and installation. To avoid serious injury or death and damage to the repeater, do not install donor or server antennas near overhead power lines or high power components.   Allow enough distance so that if antennas should fall they will not come in contact with those components.
•   Close proximity to the donor or server antennas with the repeater in operation may expose the user or installer to RF fields that exceed FCC limits for human exposure.
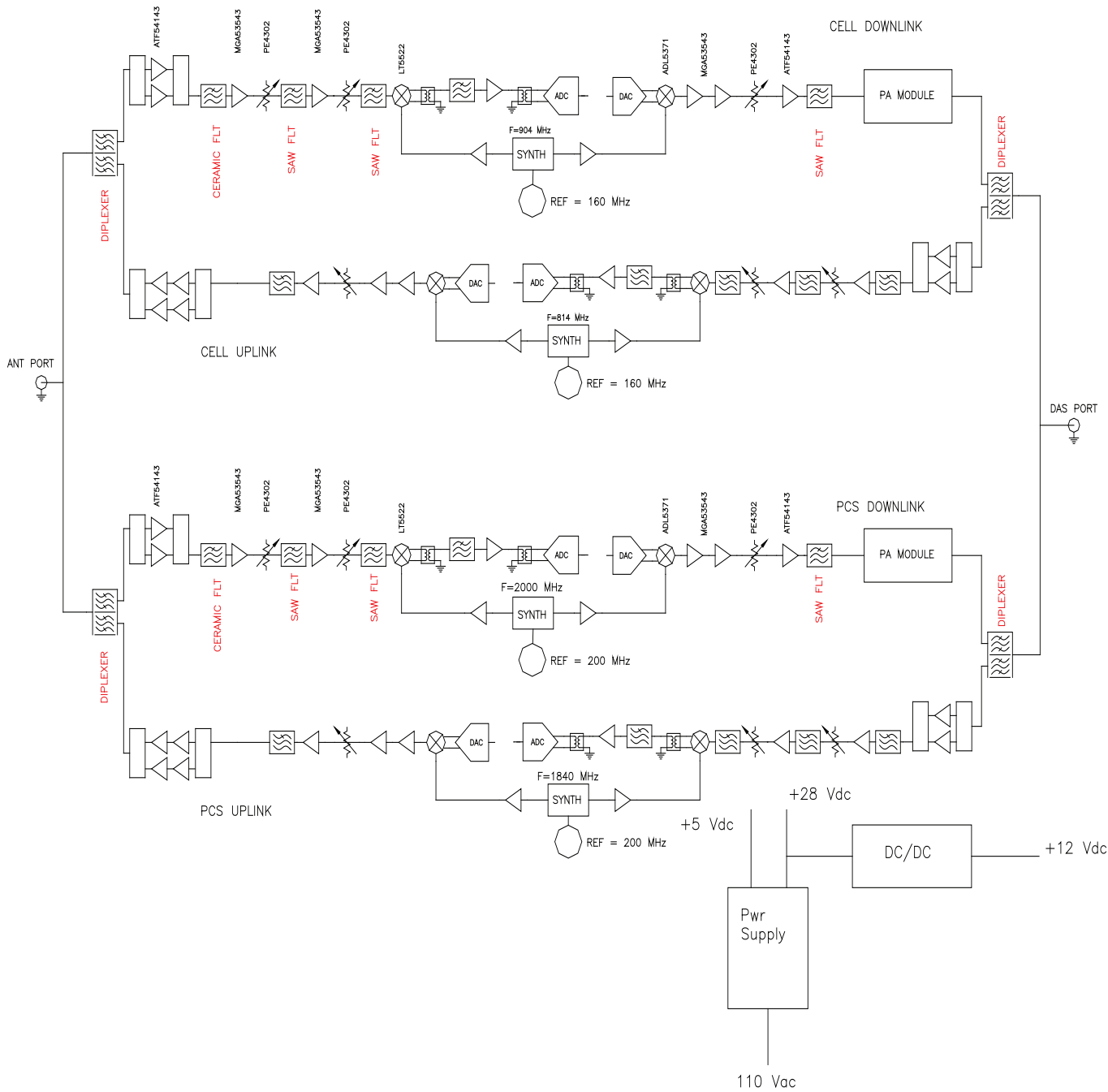
WARNING! AMPLIFIER OR HANDSET DAMAGE **MAY** OCCUR IF A HANDSET IS CONNECTED DIRECTLY TO THE REPEATER OR THE COAX THAT LEADS TO THE REPEATER.

Circuit Operational Description

The repeater uses a single down-conversion/up-conversion scheme. There are multiple RF amplifier stages prior to each down-converting mixer. The down-converting mixers are followed by a single IF amplifier. A Digital Signal Processor block then processes the resultant digitized IF signal that was previously generated by an Analog-to-Digital Converter. The processed (filtered) digital signal is fed to a Digital-to-Analog converter and then up-converted to RF. A driver amplifier and a final power amplifier make up the final gain stages before application to the diplexer. The maximum total system gain (diplexer input to diplexer output) is nominally 85 dB for either the downlink or the uplink paths with both links having independent manual and automatic gain controls (AGC).

AGC reacts to analog power detection on both the input and output of the uplink and downlink RF chains. A control algorithm continuously monitors these detected values and dynamically adjusts various gain stages such that the net system gain value, entered manually, is optimally maintained without either exceeding FCC parameters or over driving the A/D converters.

An LED on the front panel provide immediate visual indication of the unit's primary power alarm status. The repeater features automatic shutdown protection as a safety measure should excessive drive be applied to the input or an oscillation condition occur. When in a protected mode, a control algorithm determines the appropriate method of recovery to a normal, previously defined state, or maintains the protection until manually reset. If recovery has been established, the LED will be illuminated green or available to be reset. The events that trigger the error will be saved in the event log.

ATF54143

MGA53543 PE4302 MGA53543 PE4302

LT5522 ADL5371 MGA53543 PE4302 ATF54143

CELL DOWNLINK

DIPLEXER

CERAMIC FLT SAW FLT SAW FLT

ADC DAC

SAW FLT

PA MODULE

DIPLEXER

F=904 MHz

SYNTH

REF = 160 MHz

DIPLEXER

DAC ADC

CELL UPLINK

F=814 MHz

SYNTH

REF = 160 MHz

ANT PORT

DAS PORT

ATF54143

MGA53543 PE4302 MGA53543 PE4302

LT5522 ADL5371 MGA53543 PE4302 ATF54143

PCS DOWNLINK

DIPLEXER

CERAMIC FLT SAW FLT SAW FLT

ADC DAC

SAW FLT

PA MODULE

DIPLEXER

F=2000 MHz

SYNTH

REF = 200 MHz

DIPLEXER

DAC ADC

PCS UPLINK

F=1840 MHz

SYNTH

REF = 200 MHz

+5 Vdc

+28 Vdc

DC/DC

+12 Vdc

Pwr
Supply

110 Vac

Functional Block Diagram

Mechanical Specifications

Parameter	Specification	Notes
Repeater Size		
Height	5.25 in.	3RU
Width	19.00 in.	
Depth	20.00 in.	
Weight	31.0 lbs / 14.1 kg	
Thermal Management	Fan Cooled	
Surface Coating	Powder Coat	
Color	Satin Black	

AC Power Specifications

Parameter	Specification	Notes
AC Voltage	100 - 240 VAC	External Power Supply
AC Current	3.2 Amps 1.7 Amps	@ 120 VAC @ 230 VAC
AC Power Frequency	47 - 63 Hz	
Heat Output	1000 BTU/Hr	

Environmental Requirements

Parameter	Specification	Notes
Temperature Range	0° to 50° C (32° to 122° F)	
Relative Humidity	5% to 95%	Non-condensing

Dual Band Operating Power Parameters

Parameter	Specification	Notes
Maximum RF input Power without damage	+10 dBm	
Linear Gain	85 dB	Factory Calibrated Gain
Pass Band Ripple	+/-1.5 dB	
Automatic Gain Control	30dBmax range	In 0.5 dB steps
Manual Gain Control	53.5-85 dB	In 0.5 dB steps
Linear Output Power (CSI-DSP85-252-C/P Down Link)	+33 dBm max CELL +32 dBm PCS +32 dBm	
(CSI-DSP85-252-C/P Up Link)	+ 30dBm max CELL +29 dBm PCS +28 dBm	
Linear Output Power (CSI-DSP85-255-C/P Down Link)	+ 37 dBm max CELL +36 dBm PCS +36 dBm	
(CSI-DSP85-255-C/P Up Link)	30dBm max CELL +29 dBm PCS +28 dBm	
OIP3 (CSI-DSP85-252-C/P Down Link) (CSI-DSP85-252-C/P Up Link)	+ 51 dBm + 41 dBm	Measured with 2 CW tones at 14 dBm/tone
(CSI-DSP85-255-C/P Down Link) (CSI-DSP85-255-C/P Up Link)	+ 57 dBm + 41 dBm	Measured with 2 CW tones at 14 dBm/tone
Noise Figure (Avg)	6.0 dB	At Maximum Gain
Input VSWR (Typ)	<2.0:1	
Propagation Delay	<2.5 usec	
RMS Vector Error (EVM)	3% max	TDMA,EDGE,W-CDMA,CDMA2000
CDMA RHO	0.98 min	CDMA2000, 1x-EVD0
Connectors	N-Female	
Spurious Emissions & Applicable Documents FCC Industry Canada	-13 dBm max -13 dBm max	Per FCC part 2, 22, 24

Mechanical Drawing

FCC ID and
IC Label

5.1600

16.7500

22.2570

20.2770

5.2200

USB   ETHERNET   STATUS 1   STATUS 2   SERVER-OUTDOOR   DONER-INDOOR

5.2200

2.2500

18.5600

19.0000
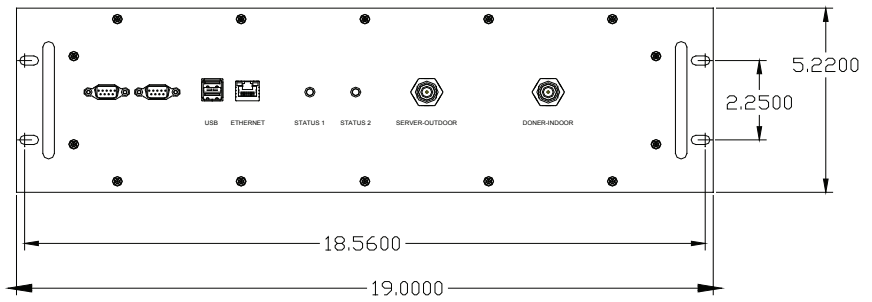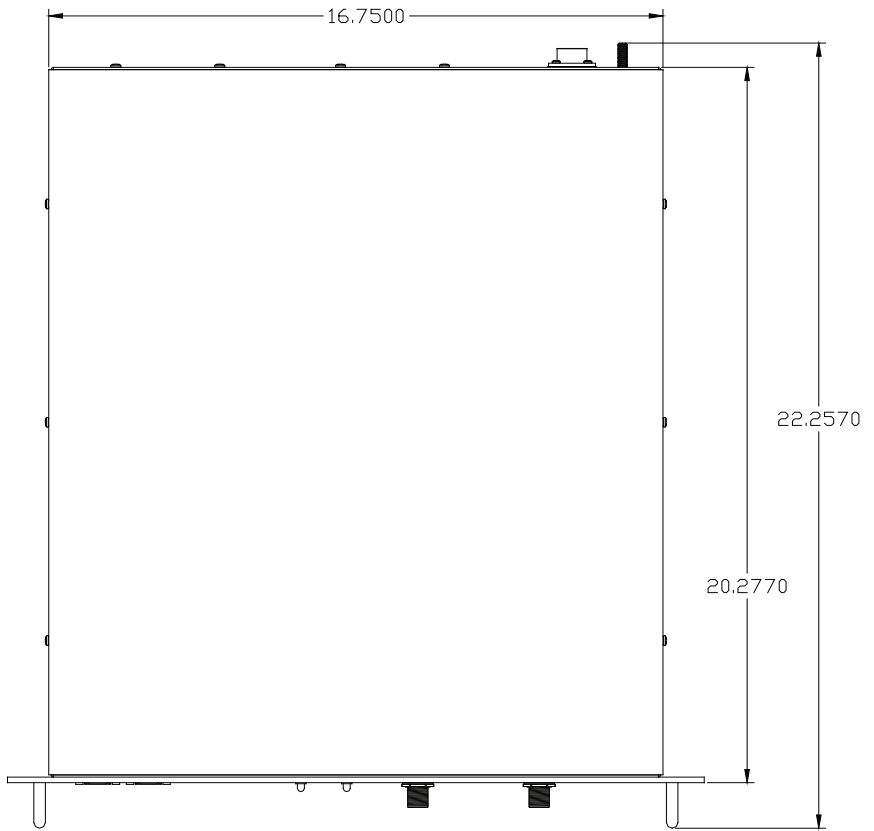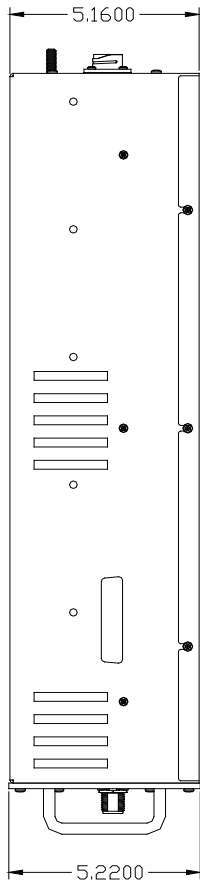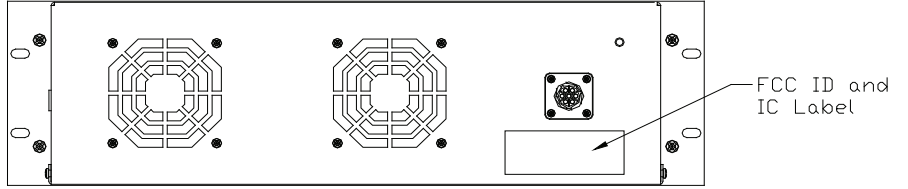
Web based GUI Session

Primary access to the repeater is gained using a LAN connection and a web browser program such as Firefox by Mozilla, or Internet Explorer from Microsoft. The repeater ships with the default IP address of 192.168.1.100, but it can be changed later if required.

If connecting directly to the repeater from a laptop or PC **with a crossover CAT-5E cable** or over a LAN the user types the IP address of the repeater into the browser address line to connect. (Note: Most users will need to update the TCP/IP settings on their computer to enable connection to a host that has a static IP. Select "Use the following IP Address" and enter the IP Address as follows: 192.168.1.x, where "x" = any number from 2 to 254 inclusive other than 100. The subnet mask is 255.255.255.0. Questions pertaining to these settings should be referred to the user's IT department or you may refer to the Additional Tips section at the end of this manual.) When connection is made the user will be prompted for a user name and password. For the purpose of the GUI session, the default user name is **webuser** and the password is **csi1234**. This can also be changed as required. Internet access is not required to use the GUI. (Note: If you are connecting using a laptop, verify that your Ethernet port is powered. Some laptops will not allow Ethernet connection when on battery power. If this is the case with the laptop you are using you will need to plug it in or update the power settings.)
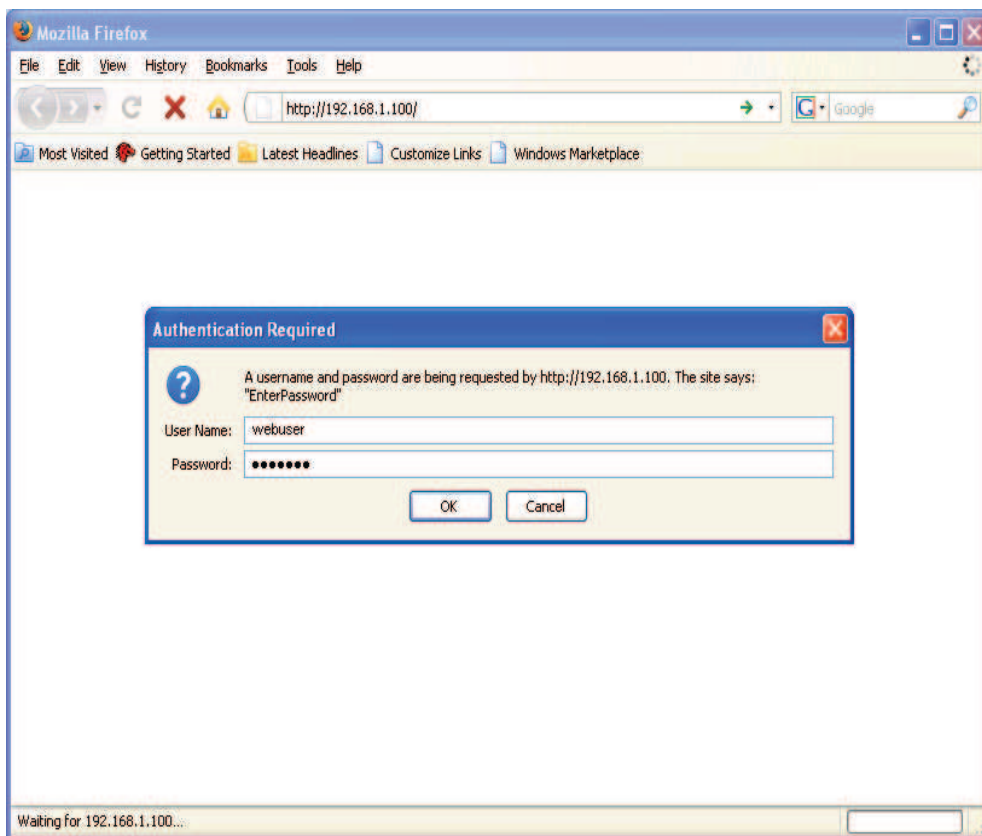
System Status:

When login is complete the user is brought to the system status page. The links on the page are activated by clicking on them.
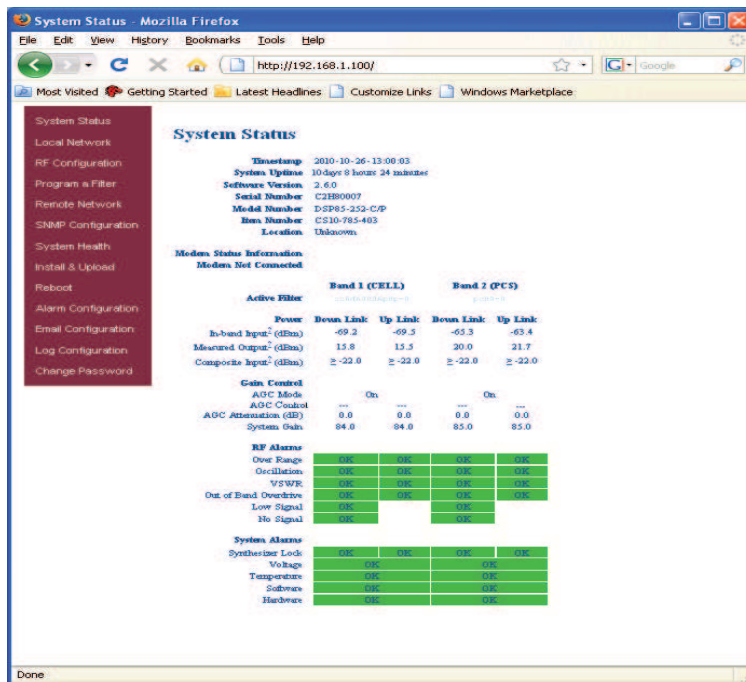
Local Network:

If the user selects Local Network from the System Status page, the following screen is displayed and from here network configuration can be modified as required. The default is set to Static. Check with your IT department for explanation and approval of the DHCP and DHCP Server options you plan to use before you select them. *NOTE: In units with software version 2.2.4 or prior, only letters, numbers and underscores are acceptable nomenclature. In units with software version 2.3.0 and up, Underscores are not acceptable; however, hyphens **are** acceptable.
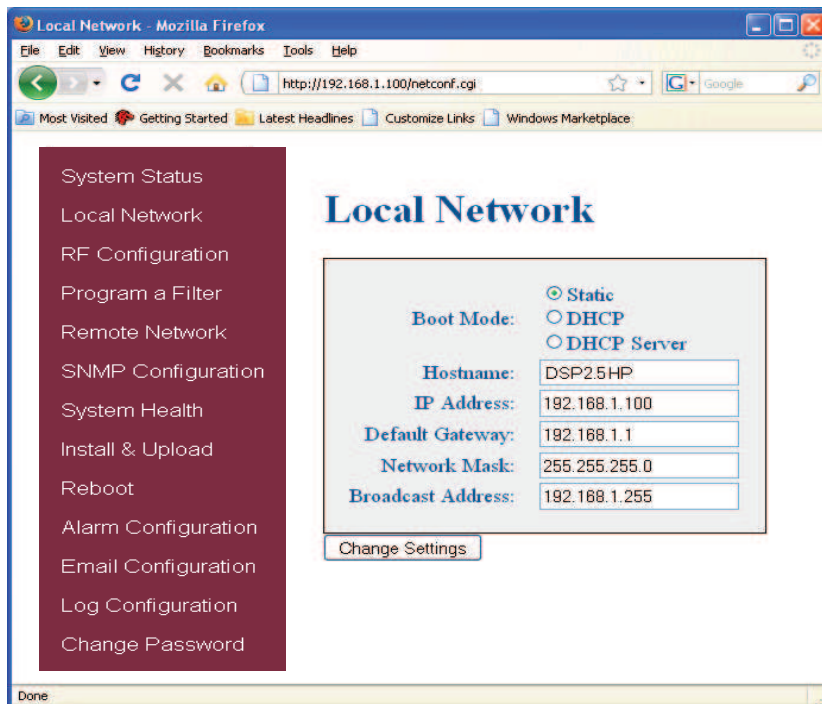
After changes are made, press the refresh button to review the fields and ensure the change made is correct. Note: changing network settings will cause the current TCP/IP connection to fail because change will take effect immediately. From here the user may return to the System Status screen or click on the other options.

RF Configuration:

If the user would like to modify RF configuration, click on the words RF Configuration in the navigation box and the screen below is displayed.

To change gain settings the user will select the Uplink only or Uplink and downlink radio buttons. The user then inputs the gain value desired. Gain values from 53.5 dB to 85.0 dB may be selected. The repeater will not allow values outside this range. By pressing the Change Settings button the gain change is implemented.

Program a Filter:

When a new filter set is required, it may be selected by clicking Program a Filter in the navigation box. The user may select the desired filter by pressing the band/sub-band and modulation selection buttons. Undesired bands/sub-bands, if lit, will require the user to manually "deselect" them before programming. To aid the user a clear all button is provided on the PCS band and will deselect all band and sub-bands simulta-neously. Pressing the Program button will complete the selection and load the desired filter. The time required to complete this process will take just a few moments. Note: If the filter desired is not currently in the unit, additional filters along with instructions on how to load them, are available by contacting CSI.
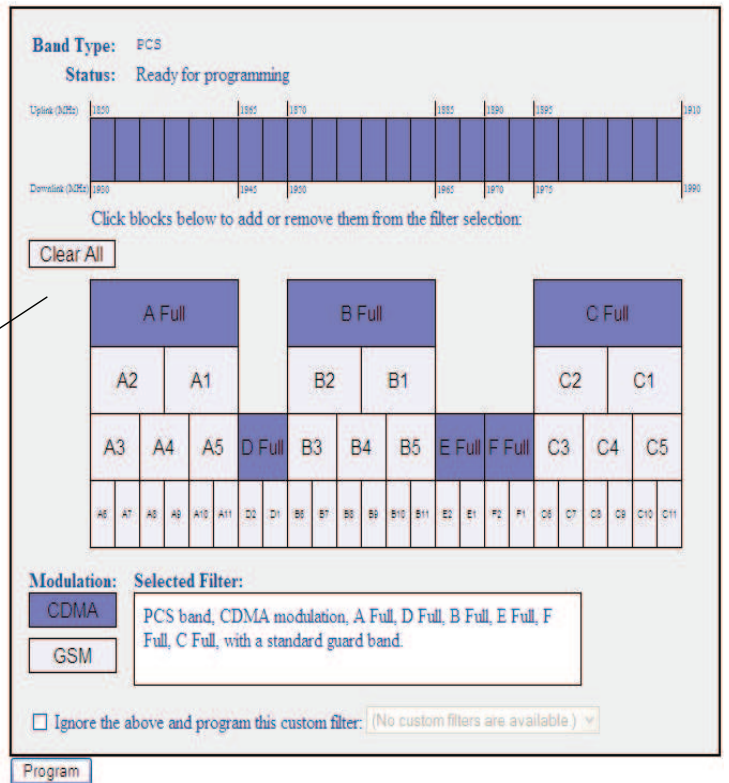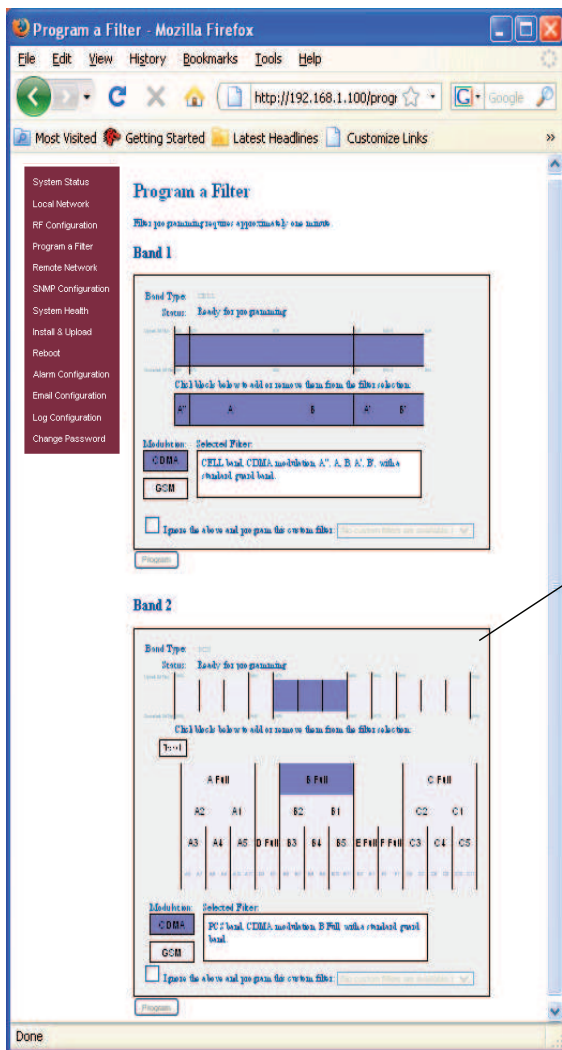
Remote Network:

If the repeater includes a USB modem kit, click on Remote Network in the navigation box and the screen below is displayed. Highlight the carrier on whose network the repeater and modem will be configured and click the Change Settings button. Refer to the documentation included with the modem kit for additional information on configuring the modem. If the repeater is connected to an ethernet device for remote access and/or monitoring, this feature must be disabled.
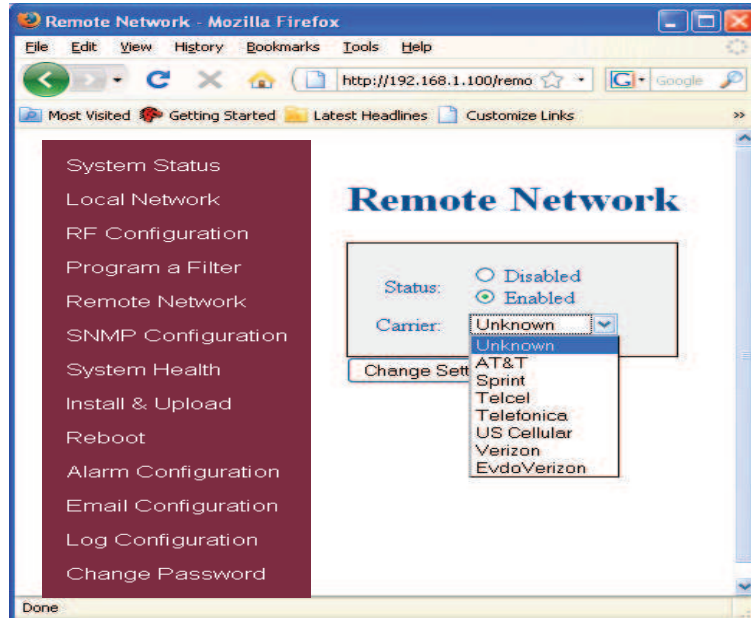
SNMP Configuration:

To change SNMP settings click SNMP Configuration in the navigation box, the screen below will be displayed. If the user is not well versed in Simple Network Management Protocol he or she should check with their IT professional for proper setting requirements.
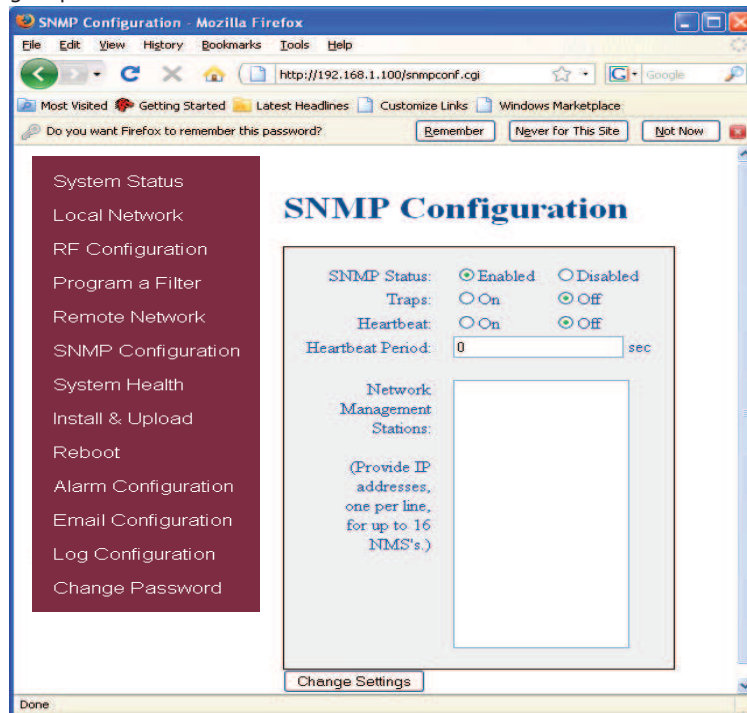
System Health:

By clicking System Health the current state of the repeater can be reviewed.

***The user may clear LED indicators, alarms and the Event Log by clicking the Clear Log button.

**** If required in your market, visit the "System Health" screen and click on "Trigger Test Alarm" and wait for confirmation that the Wireless Service Provider representative that is responsible for monitoring the repeater has been notified of the alarm. Be sure to "Clear All Logs" prior to logging out of the Web Interface.

Install & Upload:

Should a software install or upgrade be needed it can be done from the Install & Up-load screen shown below. As with the other screens it can be reached by clicking the words in the navigation box. Contact CSI for updates and instructions.
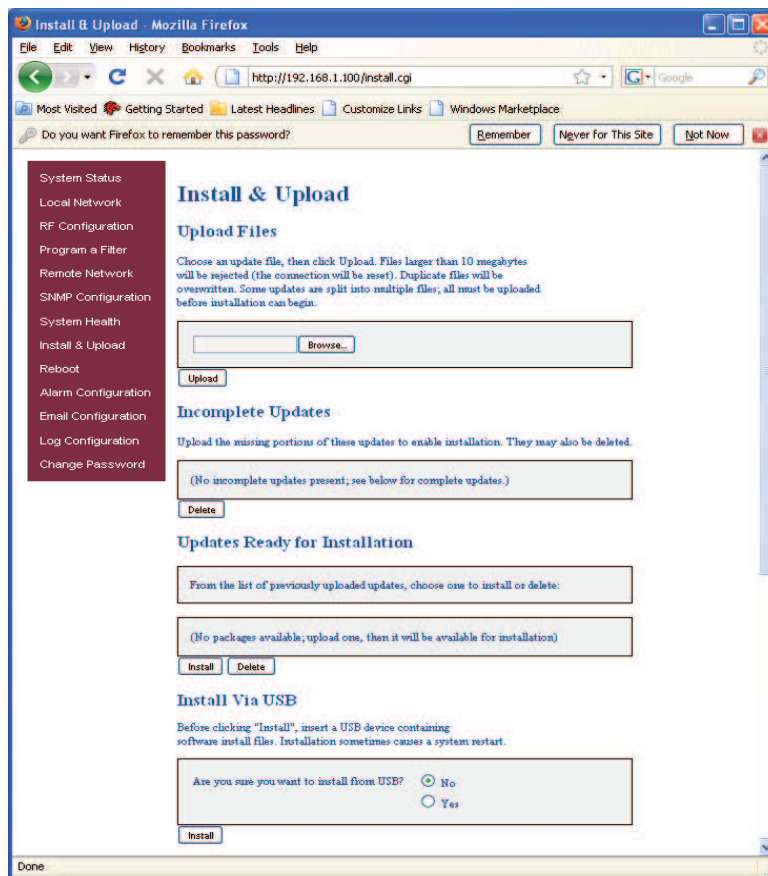
Reboot:

If a reboot of the repeater becomes necessary click on the Reboot option in the navigation box and the Reboot page is displayed. Note: a reboot will take 3-5 minutes to complete.
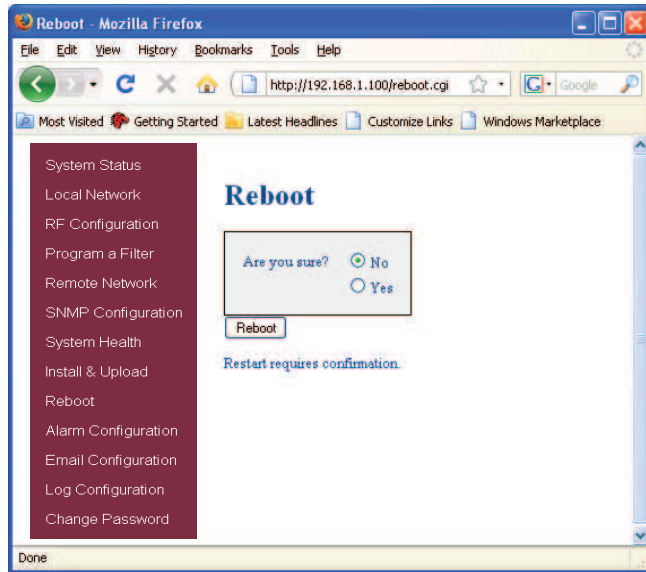
Alarm Configuration:

The Alarm Configuration page allows the user to specify what events will trigger an alarm.

*NOTE: **Letters, numbers & hyphens** are the only acceptable nomenclature for the Location field and hyphens may not be used as the first or last character.
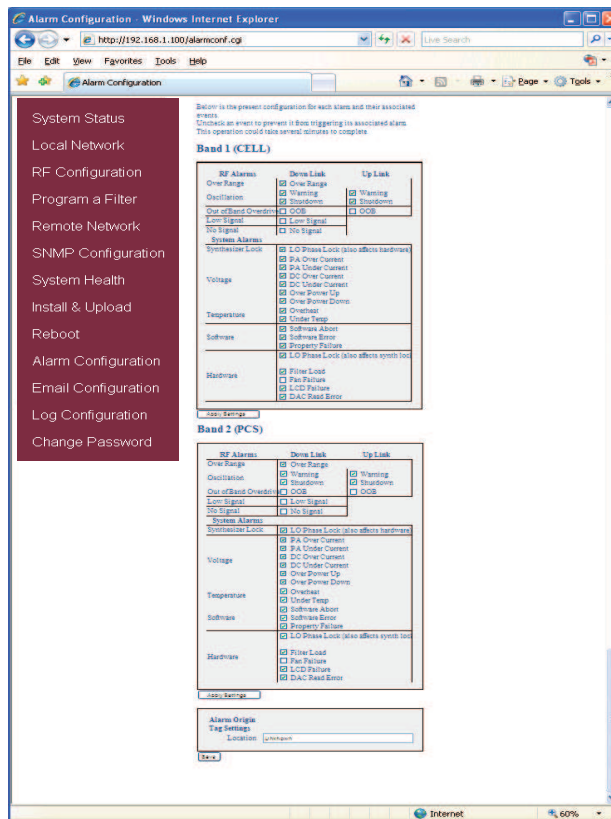
E-mail Configuration:

E-mail Configuration page allows the user to enter up to five E-mail addresses to which the repeater can send specified alarm messages when the repeater is connected via ethernet or wireless modem and E-mail Alarm Notification or Remote Networking are enabled. *NOTE: In all fields the software will not allow the user to enter invalid characters.

Log Configuration:

The Log Configuration page provides the user with the means to change three aspects of how log files are created and stored as shown below.

Change Password:

By clicking on the Change Password link the user is brought to the Change Password page. From here he or she can quickly and easily reset the password for the unit. A word of warning here be careful when setting the new password. If you forget what you set your password to you'll need to contact CSI at 1-877-844-4274 for assistance.
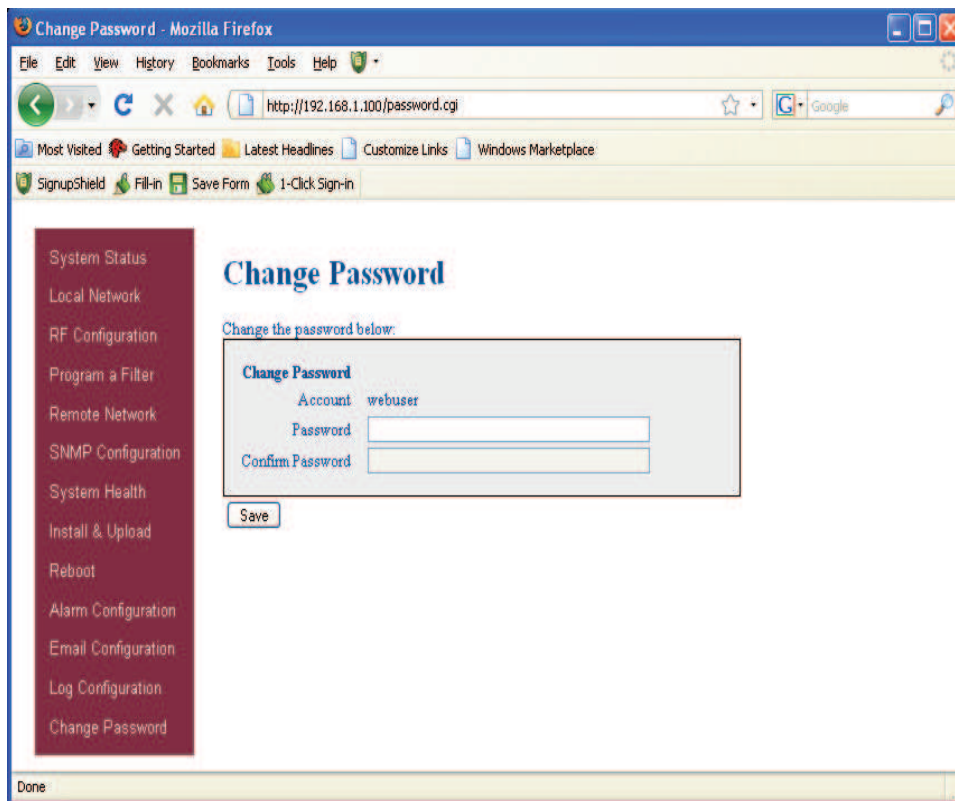
To end the session exit the browser, the user will be automatically logged out.

Text Menu Interface (Local Access)

Local access to the repeater TMI, also known as the console interface, is made by connecting a serial cable (optional), as shown in Figure 1, from the serial connector of the laptop to either of the serial ports on the repeater. These connectors are labeled COM 1 and COM 2. In some cases, if the gender of the connector is not the same as shown in figure 1, a null modem adapter (optional) as shown in Figure 2 may also be required.


Figure 1

Figure 2

- 26 -

Many terminal emulation programs will work if properly configured. In the following description, "TeraTerm" is used to establish the TMI session. This program is readily available via the Internet and is free from Ayera Technologies at: http://www.ayera.com/teraterm/

TeraTerm Pro Web works on Windows 95/98, 2000, XP. Here is the latest TeraTerm Pro Web release: Version 3.1.3, October 8, 2002. ttpro313.zip

When the program is started, the following screen is displayed.
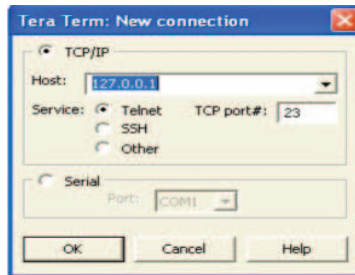
Select the Serial radio button and press OK as shown below.
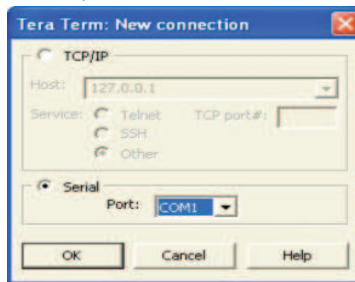
Note: It may be necessary, in the System Properties section of the control panel; using Device Manager to determine what COM port your computer uses for the communications port. In this case it is COM 1. This is not to be confused with the serial port on the bottom panel of the unit labeled COM 1.
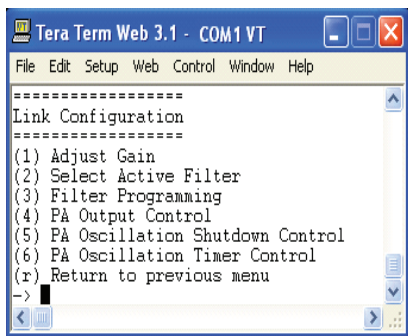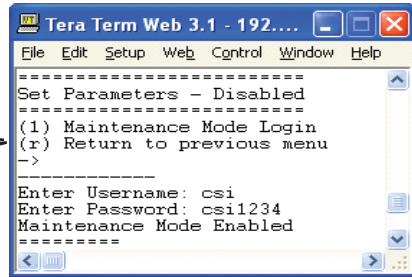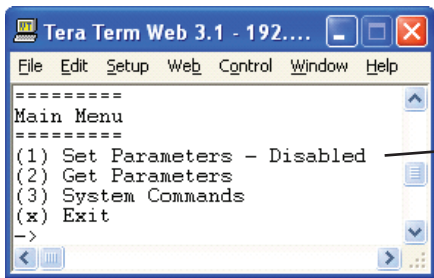
Pressing "OK" will open up a blank dialog screen. Go to the setup dropdown menu and select "Serial port" to make changes to the serial port setup.
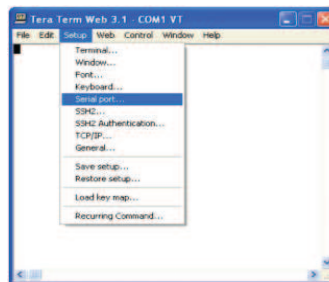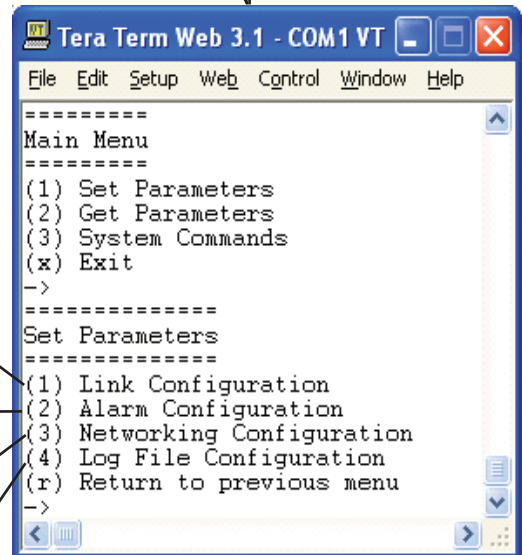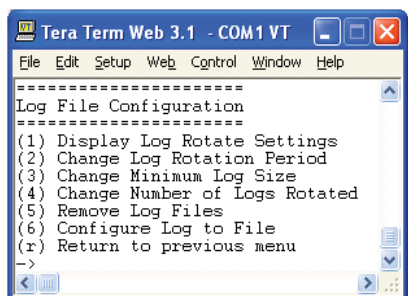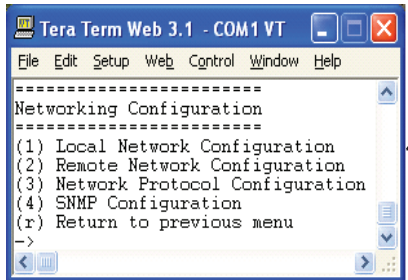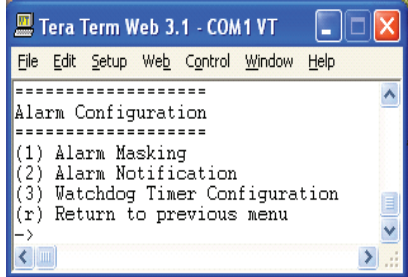

Configure the terminal program for the correct COM port, in this case COM 1 and 115200 baud rate as shown below.
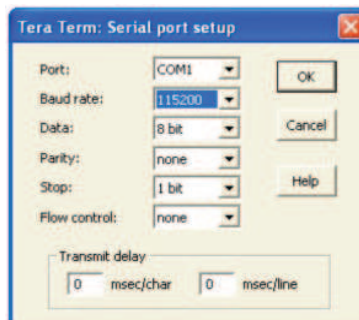
After completing the serial port changes (pressing the enter key will be required to complete the action) the user will be prompted for a user name and password. In dual band units each band is changed independently and requires an independent login. To make changes to the cellular band, the default user name is **"cellband"**. The user name for changing the PCS band is **"pcsband"**. The password for both bands is **"csi1234"**. After entering the password and pressing return the TMI main menu will appear. Note: by default the Set Parameters option is disabled. To re-enable the user will press 1 and will be prompted for a user name and password.   The default user name is **csi** and the password is **csi1234.**

```
==== Tera Term Web 3.1 - 192....
File  Edit  Setup  Web  Control  Window  Help
=========
Main Menu
=========
(1) Set Parameters - Disabled
(2) Get Parameters
(3) System Commands
(x) Exit
->
```

```
==== Tera Term Web 3.1 - 192....
File  Edit  Setup  Web  Control  Window  Help
=========================
Set Parameters - Disabled
=========================
(1) Maintenance Mode Login
(r) Return to previous menu
->
-------------
Enter Username: csi
Enter Password: csi1234
Maintenance Mode Enabled
=========
```

```
==== Tera Term Web 3.1 - COM1 VT
File  Edit  Setup  Web  Control  Window  Help
==================
Link Configuration
==================
(1) Adjust Gain
(2) Select Active Filter
(3) Filter Programming
(4) PA Output Control
(5) PA Oscillation Shutdown Control
(6) PA Oscillation Timer Control
(r) Return to previous menu
->
```

The actions displayed are self-explanatory. Pressing "1" will continue to expand this session screen and allow the following parameters to be set.

```
==== Tera Term Web 3.1 - COM1 VT
File  Edit  Setup  Web  Control  Window  Help
=========
Main Menu
=========
(1) Set Parameters
(2) Get Parameters
(3) System Commands
(x) Exit
->
==============
Set Parameters
==============
(1) Link Configuration
(2) Alarm Configuration
(3) Networking Configuration
(4) Log File Configuration
(r) Return to previous menu
->
```

```
==== Tera Term Web 3.1 - COM1 VT
File  Edit  Setup  Web  Control  Window  Help
===================
Alarm Configuration
===================
(1) Alarm Masking
(2) Alarm Notification
(3) Watchdog Timer Configuration
(r) Return to previous menu
->
```

```
==== Tera Term Web 3.1 - COM1 VT
File  Edit  Setup  Web  Control  Window  Help
========================
Networking Configuration
========================
(1) Local Network Configuration
(2) Remote Network Configuration
(3) Network Protocol Configuration
(4) SNMP Configuration
(r) Return to previous menu
->
```

```
==== Tera Term Web 3.1 - COM1 VT
File  Edit  Setup  Web  Control  Window  Help
======================
Log File Configuration
======================
(1) Display Log Rotate Settings
(2) Change Log Rotation Period
(3) Change Minimum Log Size
(4) Change Number of Logs Rotated
(5) Remove Log Files
(6) Configure Log to File
(r) Return to previous menu
->
```
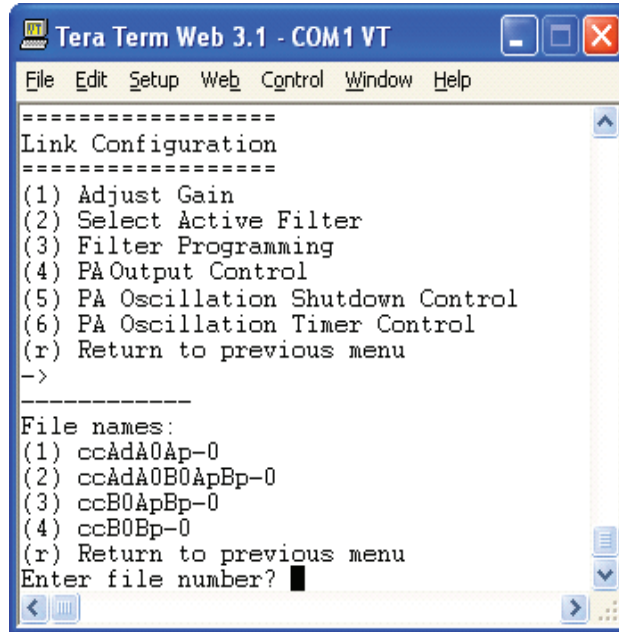
Each "Set Parameter" selection, when chosen will be expanded to allow changing or setting of that parameter. For example from the Link Configuration menu on the previous page, selecting 1 - Adjust Gain will display the menu shown below.
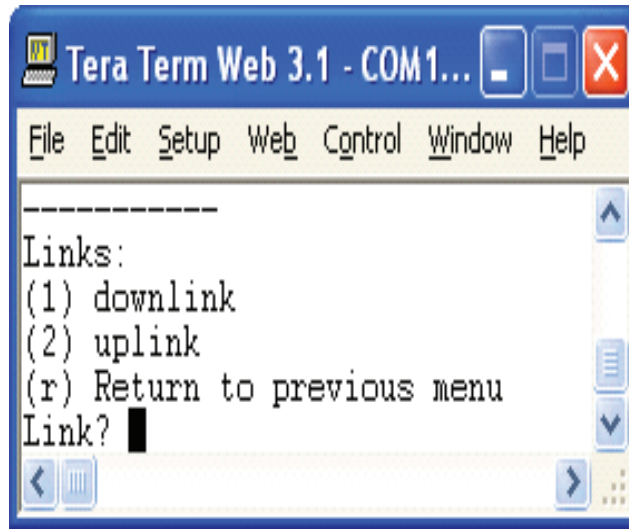
After selecting option 1, downlink, the current user gain is displayed and the option to change it is accomplished by typing the desired gain at the prompt. The user is then returned to the previous menu.
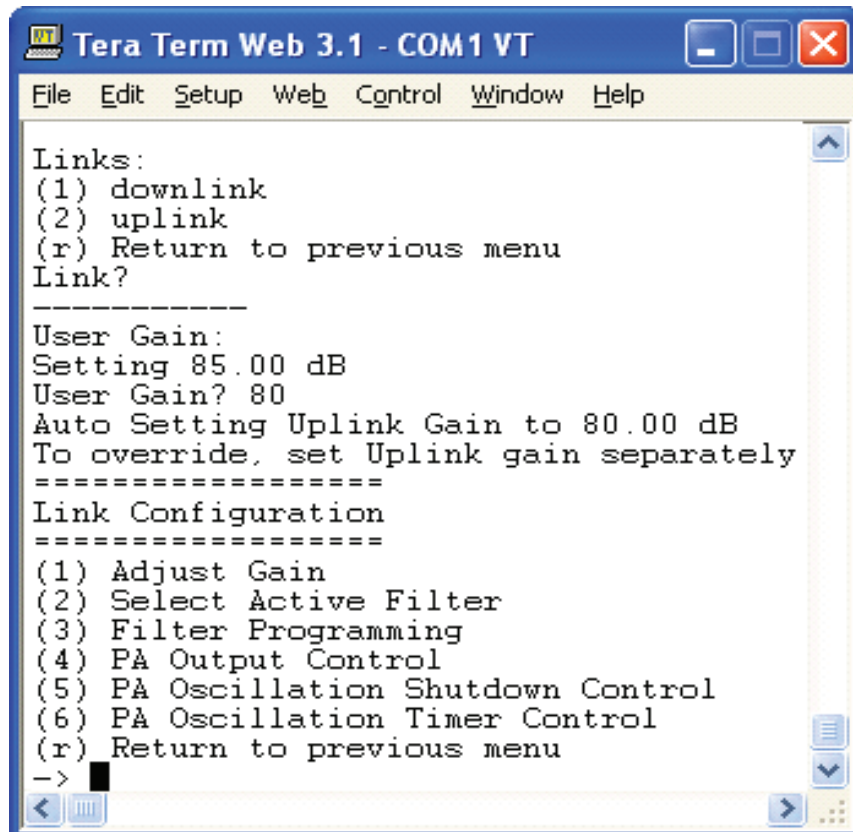
All the other options operate in much the same way. Some of the options will offer the user additional selections and will be self-explanatory. Below is one example of these additional options, the one shown below is the result of selecting (3) Filter Programming.

```
================
Link Configuration
================
(1) Adjust Gain
(2) Select Active Filter
(3) Filter Programming
(4) PA Output Control
(5) PA Oscillation Shutdown Control
(6) PA Oscillation Timer Control
(r) Return to previous menu
->
-----------
File names:
(1) ccAdA0Ap-0
(2) ccAdA0B0ApBp-0
(3) ccB0ApBp-0
(4) ccB0Bp-0
(r) Return to previous menu
Enter file number? █
```

Note: Graceful session termination is important. Use Disconnect under the file drop-down menu to terminate a session, otherwise the port may become disabled and force the system to be rebooted.

Telnet Session (Remote Access)

Remote access to the repeater may be gained through a LAN connection and a terminal emulation program for TCP/IP. As with the serial connection, many terminal emulation programs will work, if properly configured. In the following description, "TeraTerm" is used to establish the Telnet session. Also, it will be required that the network configuration of the computer and the repeater being controlled be set up with the same Sub Net and Sub Net Mask in order to establish a link. In other words, the IP addresses of both the computer used and the repeater must use the same group of IP address number sets. For example, the repeater ships with the default IP address of 192.168.1.100 and a Sub Net Mask of 255.255.255.0. In order to connect, the computer to be used for the link would normally need an IP address of something like 192.168.1.12 with a Sub Net Mask of 255.255.255.0, the same Sub Net Mask as the repeater. In this example note: the last digit of the IP address may be any number except 1,100 and 255. Configuring your PC is normally fairly straight forward but it does vary somewhat with the operating system involved. If you require assistance, contact your IT department and they will be able to set up your PC for you or you may review the Additional Tips Section at the end of the manual.
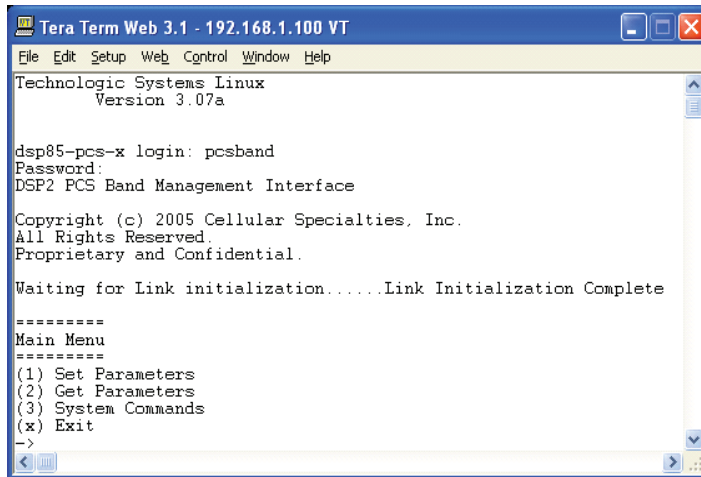
When the TeraTerm program is started, the following screen is displayed. Change the default host IP address to the IP address of the repeater to be controlled. In the case of a new install, the default address is 192.168.1.100 and has been assigned at the factory. Select the service Telnet. The TCP Port must be 23.
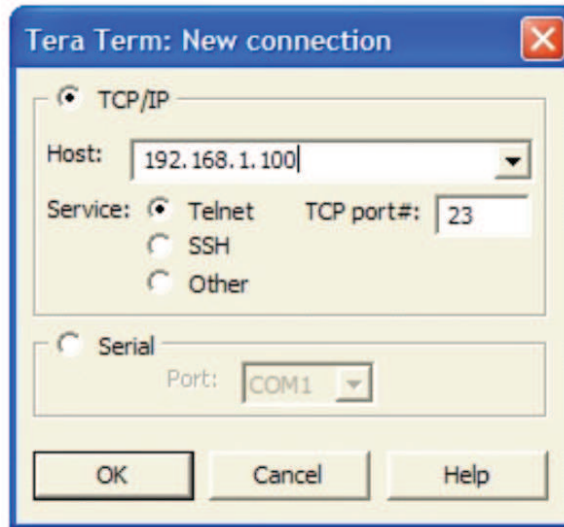
Pressing the "OK" button will bring the user to the following screen, which will require the user to log in. In dual band units, each band is changed independently and requires an independent login. To make changes to the cellular band the default user name is **"cellband"**. The default user name for changing the PCS band is **"pcsband"**.
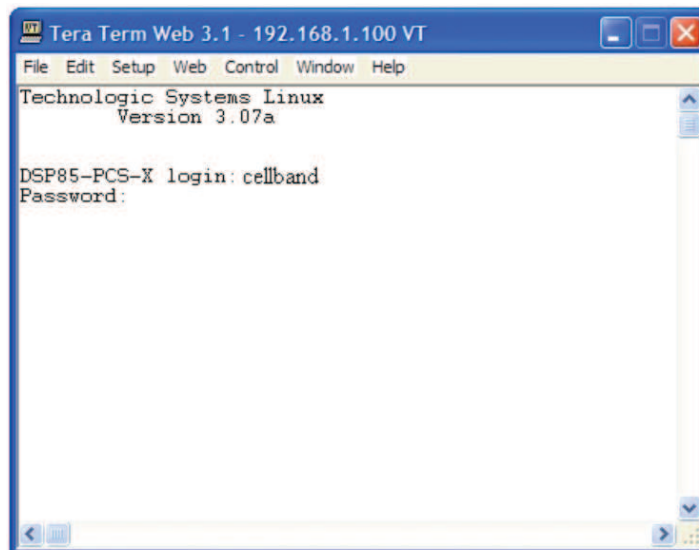
In the field after the prompt type the user name for the band to be changed. The default password is **"csi1234"** for both bands. After typing the password press the enter key and the main menu will be displayed as shown next.

```
Tera Term Web 3.1 - 192.168.1.100 VT

File  Edit  Setup  Web  Control  Window  Help

Technologic Systems Linux
        Version 3.07a


dsp85-pcs-x login: pcsband
Password:
DSP2 PCS Band Management Interface

Copyright (c) 2005 Cellular Specialties, Inc.
All Rights Reserved.
Proprietary and Confidential.

Waiting for Link initialization......Link Initialization Complete

=========
Main Menu
=========
(1) Set Parameters
(2) Get Parameters
(3) System Commands
(x) Exit
->
```

Telnet and serial sessions both provide access to the same Text Menu Interface. This manual has already discussed many of the options available, those as well as the options not covered are self explanatory, so they will not be repeated in the Modem Interface section.

Modem Interface (Remote Access with login)

A modem can also be used to gain remote access to the unit provided the repeater has been properly equipped. A selection of modems is available as an option. If the modem requires a SIM card for activation, special requirements must be met for the SIM card to become fully functional, contact the service provider. In addition, an IP address must be obtained and entered into the repeater.

Once the modem has been installed and activated, it can be accessed from any terminal emulation program just as in the serial and Telnet examples provided earlier. Access response time will depend on many factors, some of which are:

- Quality of the connection (RF signal in the case of wireless modems)
- Technology (CDMA, EDGE, GPRS, etc.)
- Network congestion (Throughput)

When a connection has been established, the same login screen shown in both the serial and Telnet examples is presented.
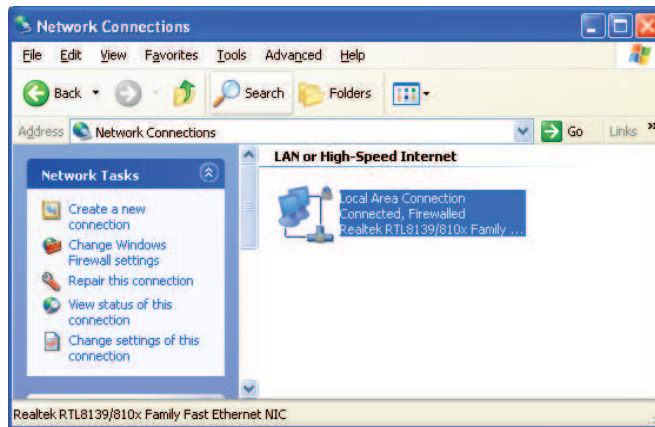
Additional Tips

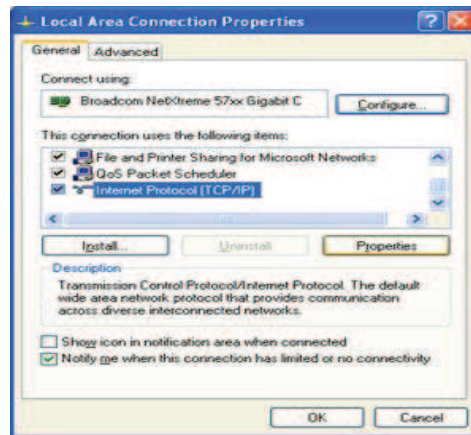**Instructions to change TCP/IP settings on your Windows computer.**

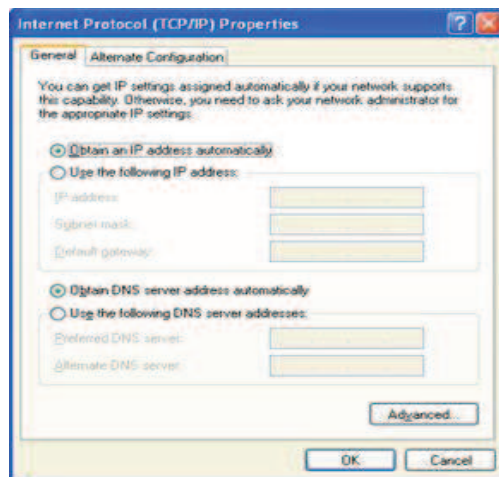Click in the Network Connections Icon in the Control Panel. See below.
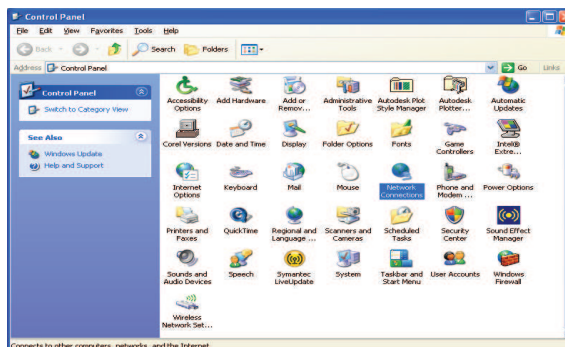
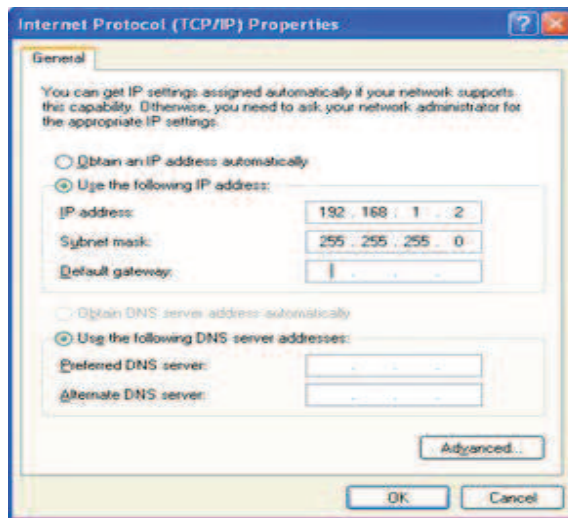Right click on Local Area Connection - and select "Properties".

Scroll down and highlight "Internet Protocol (TCP/IP) and click on the "Properties" button.

If you are set up to use DHCP, the window shown below will be displayed.

Select "Use the following IP address:" and enter "192.168.1.2." The subnet mask should automatically populate to "255.255.255.0.

Nothing else will need to be chosen or entered. Click "OK", then "OK" again and retry connection.

A crossover Ethernet cable (supplied) must be used for Web Interface access. As a reminder, you must verify the Ethernet port on your laptop is powered. If your laptop is on battery power, the Ethernet port may be inactive by default. If this is the case simply plug in the laptop to a 110vac source or change the power settings to enable the Ethernet port when the laptop in using battery power.

Suggested spectrum analyzer setting:

When troubleshooting RF issues, and when surveying challenging RF environments, it's important to have a spectrum analyzer capable of measuring the frequency that you are working with. An attenuator should be used to protect the input when connected to a source of RF power such as the repeater or a powered DAS.

Both Uplink and Downlink should be measured. Downlink should be measured on the donor cable and at the output (server) port of the powered up repeater, and Uplink at the lead from the DAS (on fiber/powered DAS's, where the lead would connect to the server port on the repeater) and at the donor port with the repeater powered up. Measurements may also be necessary at server antenna locations. Your spectrum analyzer will need to be equipped with a whip antenna for this.

Resolution Bandwidth (RBW) should be set at 200 kHz for GSM and 1 MHz for CDMA. If you cannot select these values, the closest available values should be used. Video filter should be about one tenth of RBW. Other settings like span are whatever is appropriate. One should also make sure that there are no signals above the top of the screen.

If you cannot see an adjacent out of band signal when using the 1 MHz RBW filter, you can decrease the RBW, to see the close-in-frequency signals. Be sure to set the RBW back when you want to measure the power level.

RF Notes:

To prevent overload of the DSP input stages, the maximum measured level of in-band or out of band signals should be less than -50 dBm when the DSP gain is set to 85 dB, -40 dBm when set to 75 dB, etc. This applies when there is one dominant signal and applies TO BOTH THE DOWNLINK AND UPLINK. If there are two dominant signals, and the gain is set to 85 dB, then the level of each signal should be kept to less than -53 dBm. With three signals, each should be less than -55 dBm. With ten signals each should be less than -60 dBm. This latter reduction prevents the composite power of the multiple signals from exceeding an acceptable level. Add fixed attenuators in line with the donor antenna line/DAS feed to keep signals below the levels indicated above.

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 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.

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