



**Installation and Operation Manual for
the SBIII Digital Signal Booster
Model 614**

**Manual Part Number
7-9558-2.3**



WARNING: This is **NOT** a consumer device. It is designed for installation by **FCC Licensees** and **Qualified Installers**. You must have an **FCC license** or express consent of an FCC Licensee to operate this device. This booster can be configured as either a Class A or Class B signal booster. If configured as a Class B signal booster (as defined in 47 CFR 90.219), you **MUST** register this signal booster online at www.fcc.gov/signal-booster/registration. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of \$100,000 for each continuing violation.

Warranty

This warranty applies for five years from shipping date

TX RX Systems Inc. warrants its products to be free from defect in material and workmanship at the time of shipment. Our obligation under warranty is limited to replacement or repair, at our option, of any such products that shall have been defective at the time of manufacture. **TX RX Systems Inc.** reserves the right to replace with merchandise of equal performance although not identical in every way to that originally sold. **TX RX Systems Inc.** is not liable for damage caused by lightning or other natural disasters. No product will be accepted for repair or replacement without our prior written approval. The purchaser must prepay all shipping charges on returned products. **TX RX Systems Inc.** shall in no event be liable for consequential damages, installation costs or expense of any nature resulting from the purchase or use of products, whether or not they are used in accordance with instructions. This warranty is in lieu of all other warranties, either expressed or implied, including any implied warranty or merchantability of fitness. No representative is authorized to assume for **TX RX Systems Inc.** any other liability or warranty than set forth above in connection with our products or services.

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Prices are FOB seller's plant in Angola, NY domestic packaging only, and are subject to change without notice. Federal, State and local sales or excise taxes are not included in prices. When Net 30 terms are applicable, payment is due within 30 days of invoice date. All orders are subject to a \$100.00 net minimum.

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DISCLAIMER

Product part numbering in photographs and drawings is accurate at time of printing. Part number labels on TX RX products supersede part numbers given within this manual. Information is subject to change without notice.

Manual Part Number 7-9558
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 First Printing: June 2014

Version Number	Version Date
1	06/16/14
1.1	07/14/14
1.2	09/23/14
1.3	11/13/14
2.0	02/23/15
2.1	04/07/15
2.2	04/29/15
2.3	05/14/15

Symbols Commonly Used



WARNING !!!



High Voltage



CAUTION or ATTENTION



Hot Surface



Important Information



ESD Electrostatic Discharge



Training Video Available



Electrial Shock Hazard



Heavy Lifting



Safety Glasses Required

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For Class A or Class B Unintentional Radiators

This equipment has been tested and found to comply with the limits for a Class A or Class B 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 the user will be required to correct the interference at his own expense.

Pour Classe-A ou Classe-B Radiateurs Involontaires

Cet équipement a été testé et jugé conforme avec les limites de la Classe-A ou Classe-B des appareils numériques, suivants à la Partie 15 des règlements de la FCC. Ces limites sont conçues pour fournir une protection raisonnable contre les interférences dangereuses lorsque l'équipement est utilisé dans un environnement commercial. Cet équipement génère, utilise et peut émettre des fréquences radio et, s'il n'est pas installé et utilisé conformément aux instructions du manuel, ceci peut causer des interférences dangereuses aux communications radio. Le fonctionnement de cet équipement dans une zone résidentielle est susceptible de causer des interférences mauvaises dans lequel l'utilisateur sera tenu pour responsable de corriger l'interférence à sa propre discrétion.

WARNING: Changes or modifications which are not expressly approved by Bird Technologies could void the user's authority to operate the equipment.

AVERTISSEMENT: Les changements ou modifications qui ne sont pas approuvés par Bird Technologies pourrait annuler l'autorité de l'utilisateur de faire fonctionner l'équipement.

ATTENTION: This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

ATTENTION: Cet appareil est conforme à la Partie 15 des règlements de la FCC. L'opération doit se conformer aux deux conditions suivantes: (1) cet appareil ne peut causer d'interférences nuisibles et (2) cet appareil doit accepter toute interférence reçue, y compris les interférences qui peuvent provoquer un fonctionnement indésirable.

OVERVIEW

Signal boosters extend radio coverage into areas where abrupt propagation losses prevent reliable communication. The system receives an RF signal, raises its power level, and couples it to an antenna so that it can be re-radiated. The Bird Technologies 614 family of signal boosters is designed to operate in either the 450 - 470 MHz range or the 470 - 488 MHz range. The system is based on a module design with each module capable of handling 14 or 30 filters in the uplink and downlink direction. The signal booster is available in a variety of configura-

tions as shown in **Table 1**. The product model number is used to describe each configuration available. Model number nomenclature is described in table 1.

The size of the system can be tailored to the customers needs by increasing or decreasing the number of filters used. Each module is bi-directional with one downlink and one uplink signal branch. Each of the two branches in a module are independently tunable to their required pass frequencies via software interface. The booster uses

614-XX-YY-UD-Z-P-Options (nomenclature breakdown)	
614	Product Description UHF Digital Signal Booster
XX	Designates operating frequency band 70 = 450 - 470 MHz 70A = 470 - 488 MHz
YY	Designates how many modules used and number of filters available A = 1 module with 14 filters B = 1 module with 30 filters AA = 2 modules with 14 filters each BB = 2 modules with 30 filters each AB = 1 module with 14 filters and 1 module with 30 filters BA = 1 module with 30 filters and 1 module with 14 filters
UD	Designates the type of output for the uplink and downlink HH = high power uplink and downlink HL = high power uplink and low power downlink LH = low power uplink and high power downlink LL = low power for both uplink and downlink FH = fiber output uplink and high power downlink FL = fiber output uplink and low power downlink HF = high power uplink and fiber output downlink LF = low power uplink and fiber output downlink DP = dual port head-end DPR = dual port remote-end
Z	Designates mounting style G1 = Grey Steel G2 = Stainless N = NFPA / Red Steel
P	Power Options B = AC with DC backup (standard) D = DC only (24 VDC option) A = AC only (option)
Options	Designates the options that have been added Blank = no options added P = 10 MHz high precision reference
Table 1: Model number nomenclature.	

Parameter	Specification
Frequency Range (MHz)	450 - 470 MHz ; 470 - 488 MHz
Number of Carriers per Module Low Density Model High Density Model	14 uplink and downlink 30 uplink and downlink
Gain Low Power Version High Power Version	80 dB (max) 95 dB (max)
Maximum RF Bandwidth 450 - 470 MHz module 470 - 488 MHz module	3 MHz 1.5 MHz
Output Level Low Power High Power	22 dBm composite (max) 34 dBm composite (max)
Maximum Continuous Input Level	Operational: -20 dBm Static w/o damage: -10dBm
RF In/Out Impedance	50 Ohms
Alarms	Form-C Contacts and SNMP v3
Power	90 - 250 VAC, 50/60 Hz with +24 VDC back-up
Operating Temperature Range	-30°C to +60°C 95% RH (non-condensing)
Table 2: Specifications for the UHF SBIII system.	

digital processing techniques to provide a wide range of filter choices to the end user. It is possible to program digital filters as narrow as 5 KHz and as wide as 1.5 MHz centered at any frequency within the licensed range.

The SBIII Digital Signal Booster is capable of operating as either a Class A booster (no filters greater than 75 KHz passband width) or as a Class B booster (having filters with a greater than 75 KHz passband width). The boosters operating class (A or B) is user determined via configuration. Class B operation must be enabled by the customer and the customer is responsible for registering a booster operated as Class B with the FCC. System specifications for the 614 family of signal boosters are listed in **Table 2**.

Down / Up Conversion

A signal booster has much in common with a superheterodyne (superhet) receiver. The incoming signal is converted to a lower frequency so that

single channel selectivity can be obtained. It is then filtered. Unlike the superhet receiver however, the signal is not demodulated. Instead, it is up-converted back to its original frequency where it is further amplified to reach a useful power level.

Figure 1 shows a simplified block diagram that illustrates the down/up conversion principle. An incoming signal at (Freq IN) is amplified and applied to the first mixer along with a signal from a local oscillator (Freq LO). A third signal at an intermediate frequency (Freq IF) is produced as a result of the mixing. The intermediate frequency is given by the following relationship:

$$(1) \text{ Freq IF} = \text{Freq IN} - \text{Freq LO}$$

The IF signal from the mixer then passes through digital filtering with single channel bandwidth before being amplified and passed on to the second mixer. The second mixer also receives the same local oscillator signal (Freq LO). The result is

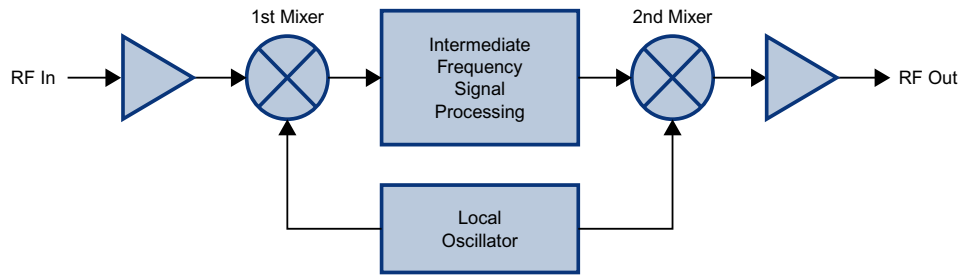


Figure 1: The down converter / up converter process.

a mixing product frequency at the output of mixer 2. The output frequency (Freq OUT) is given by the following relationship:

$$(2) \text{ Freq OUT} = \text{Freq IF} + \text{Freq LO}$$

Substituting equation (1) for the “Freq IF” term in equation (2) allows the “Freq LO” terms to be canceled yielding:

$$(3) \text{ Freq Out} = \text{Freq IN}$$

The implication of equation (3) is that the frequency stability of the signal that is processed by this type of signal booster is not affected by the frequency stability of the signal booster itself. Frequency stability depends only on the stability of the signal source producing the signal to be boosted. A shift in the LO frequency will cause the center of the filter bandwidth to move with respect to the signal. For very narrow filter widths, the channel modules LO may be locked to a high stability 10 MHz reference.

UNPACKING

It is important to report any visible damage to the shipping company immediately. It is the customers responsibility to file damage claims with the shipping company within a short period of time (1 to 5 days). Care should be taken when removing the unit from the packing box to avoid damage to the unit.

INSTALLATION

The following sub-sections of the manual discuss general considerations for installing the booster. All work should be performed by qualified personnel and in accordance with local codes.

Location

The layout of the signal distribution system will be the prime factor in determining the mounting location of this unit. However, safety and serviceability are also key considerations. The unit should be located where it can not be tampered with by the general public, yet is easily accessible to service personnel. Also, consider the weight of the unit and the possibility for injury if it should become detached from its mounting for any reason.

The booster needs to be installed such that there can be unobstructed air flow around the equipment. Insure that the heat sink fins are unobstructed. The various subassemblies within the equipment cabinet will stay warm during normal operation so in the interest of equipment longevity, avoid installation locations that carry hot exhaust air or are continually hot.

Mounting

Figure 2 shows the mounting hole dimensions and layout for the cabinet. Mount the cabinet using 3/8” (10 MM) diameter steel bolts (not supplied). We recommend flat washers on both ends and a lock washer under the nut. Nut and bolt mounting is preferred to the use of lag bolts. Use backer blocks where necessary to spread the force over a larger area. In areas of known seismic activity, additional devices such as tether lines may be necessary.

Because Bird Technologies cannot anticipate all of the possible mounting locations and the structure types where these devices will be located, we recommend consulting local building inspectors, engineering consultants or architects for advice on how to properly mount objects of this type, size and weight in your particular situation. It is the customers responsibility to make sure that these devices are mounted safely and in compliance with building codes.

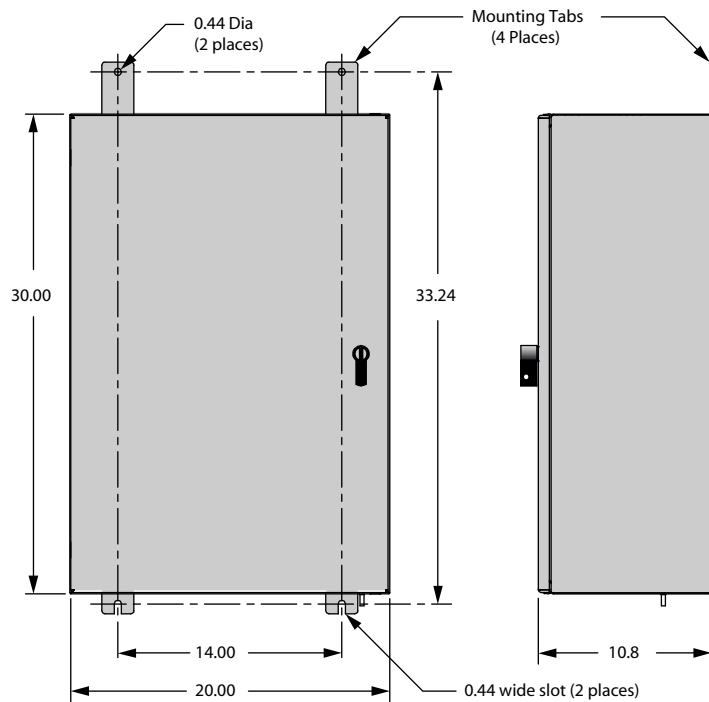


Figure 2: Cabinet mounting hole layout.

Lockable Door Latch (user supplied padlock)

Note: To open the door handle insert a slotted screw driver into the silver slot and turn to the vertical position. At the same time turn the black handle. This will release the latching mechanism and the door can now be opened. When the door is closed and the black handle is turned down, the silver slot will reset to the horizontal position re-enabling the latching mechanism.

Connections

All RF cabling connections to the booster should be made and checked for correctness prior to powering up the system. N(f) bulkhead connectors are available at the top of the booster enclosure box for connection to the system antennas. Make sure the correct branch of the antenna system is connected to its corresponding uplink/downlink connector or the system will not work properly. Using high quality connectors with gold center pins is advised. Flexible jumper cables made of high quality coax are also acceptable for connecting to rigid cable sections.



Caution: The ERP (effective radiated power) from the booster system must not exceed +37 dBm (5 Watts) in order to remain compliant with FCC regulations.



Caution: The maximum continuous input power level for this booster is -20 dBm. Stronger input signals will cause the unit to exceed it's IM specifications. Static input signals greater than -10 dBm may damage the unit.

Models of the booster are available for either AC, DC, AC/DC operation. Based on the model number (see table 1) the booster is designed to be plugged into either a single phase AC line (110 VAC at 50/60 Hz) or a 24 Volt DC source. A connector is available at the top of the equipment box for connecting the AC or DC source voltage.

Antenna Isolation

Antenna isolation between uplink and downlink should be measured before connecting the signal booster to the antenna system. This step is necessary to insure that no conditions exist that could possibly damage the signal booster and should not be skipped for even the most thoroughly designed system.

Just like the feedback squeal that can occur when the microphone and speaker get too close together

in a public address system, a signal booster can start to self oscillate. This can occur when the isolation between the Uplink and Downlink antennas does not exceed the signal boosters gain by at least 15 dB. Oscillation will reduce the effectiveness of the system and may possibly damage amplifier stages. Isolation values are relatively easy to measure with a spectrum analyzer and signal generator.

REQUIRED EQUIPMENT

The following equipment is required in order to perform the antenna isolation measurements.

- 1) Signal generator for the frequencies of interest capable of a 0 dBm output level. Modulation is not necessary.
- 2) Bird Technologies "Signal Hawk" spectrum analyzer which will cover the frequencies of interest and is capable of observing signal levels down to -100 dBm or better.
- 3) Double shielded coaxial test cables made from RG142, RG55 or RG223 coaxial cable.

MEASUREMENT PROCEDURE

To measure the antenna isolation perform the following in a step-by-step fashion.

- 1) Set the signal generator for a 0 dBm output level at the center frequency of the boosters pass-band.
- 2) Set the spectrum analyzer for the same center frequency and a sweep width equal to or just slightly greater than the passband chosen earlier in step 1.
- 3) Temporarily connect the test leads of the signal generator and spectrum analyzer together using a female barrel connector, see **Figure 3**. Observe the signal on the analyzer and adjust the input attenuator of the spectrum analyzer for a signal level that just reaches the 0 dBm level at the top of the graticule.
- 4) Referring to figure 3, connect the generator test lead to one side of the antenna system and the spectrum analyzer to the other then observe the signal level. The difference between the observed level and 0 dBm is the isolation between the sections. If the signal is too weak to observe, the spectrum analyzer's bandwidth

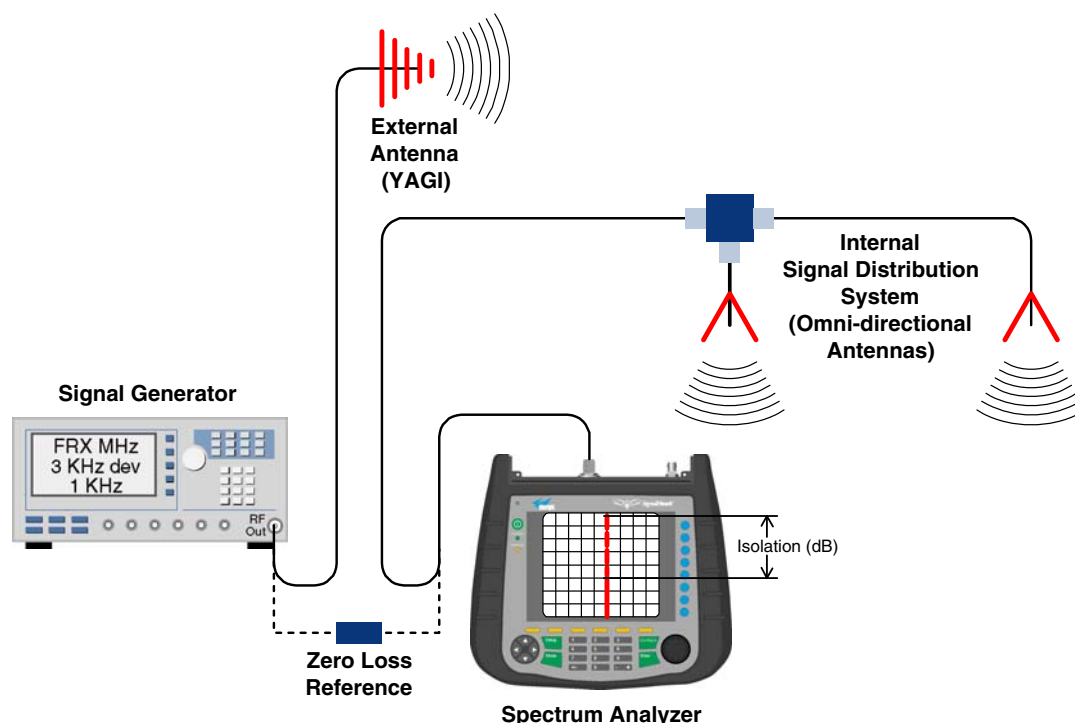


Figure 3: Typical test equipment interconnection for measuring antenna isolation.

may have to be narrowed and its input attenuation reduced. The isolation value measured should exceed the signal booster's gain figure by at least 15 dB.

- 5) Repeat step 4 again with the signal generator set at the passband edges in order to see if the isolation is remaining relatively constant over the complete width of the passband.
- 6) Repeat the isolation measurements if necessary at other system passbands to determine the overall minimum isolation value for the system. Physical modification of the antenna system maybe required in order to reach an acceptable minimum value.

RF EXPOSURE

To comply with FCC RF exposure compliance requirements, a separation distance of at least 90 cm must be maintained between the Donor antenna of this device and all persons. To comply with FCC RF exposure compliance requirements, a separation distance of at least 22.2 cm must be maintained between the DAS antenna of this device and all persons. This device must not be co-

located or operating in conjunction with any other antenna or transmitter.

EXPOSITION RF

Pour conformer aux exigences d'exposition de FCC RF, une distance de séparation d'au moins 90 cm doit être maintenue entre les Donor antenne de cet appareil et toutes les personnes. Pour conformer aux exigences d'exposition de FCC RF, une distance de séparation d'au moins 22.2 cm doit être maintenue entre les DAS antenne de cet appareil et toutes les personnes. Cet appareil ne doit pas être co-localisé ou exploités en conjonction avec toute autre antenne ou transmetteur.

SIGNAL FLOW BLOCK DIAGRAM

Figure 4 is the signal flow block diagram of the standard signal booster model 614. **Figure 5** shows the front view of the booster cabinet. In the Digital Booster design the channel modules are bi-directional with each module containing one downlink branch and one uplink branch. The branches are functionally identical because the same circuit board designs are used in each branch. The uplink and downlink branches may be programmed to any frequency in the appropriate band.

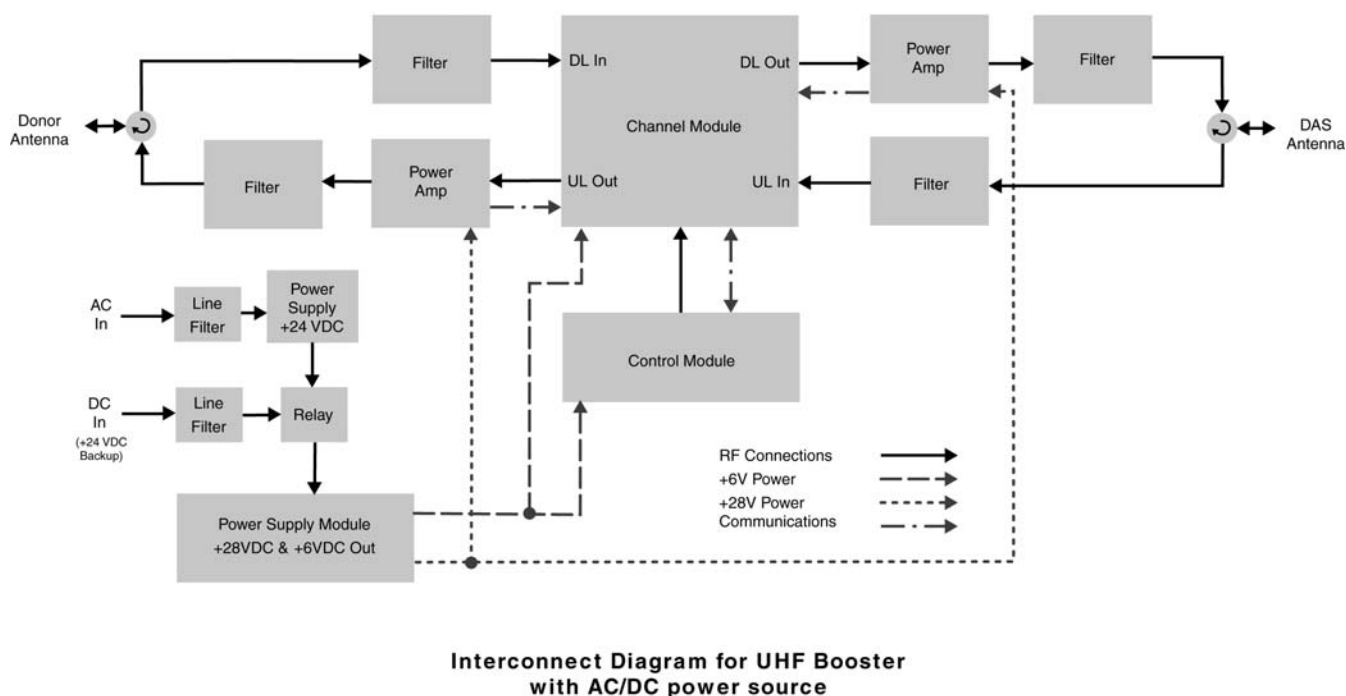


Figure 4: Signal flow block diagram of the signal booster.

Uplink and Downlink Input Signals

Uplink input signals are picked up by the DAS antenna and are passed through an isolator before being applied to a bandpass filter. The signals pass through the filter and are fed into the uplink input port of the channel module. Downlink input signals are picked up by the Donor antenna and are passed through an isolator before being applied to a bandpass filter. The signals pass through the fil-

ter and are applied to the downlink input port of the channel module.

Channel Module

The uplink input signals and the downlink input signals are applied to a down-converter board when they enter the channel module. Within the channel module input signals are down converted, digitized, and DSP filtering is performed. There are two styles of Channel modules available, a 14 filter ver-

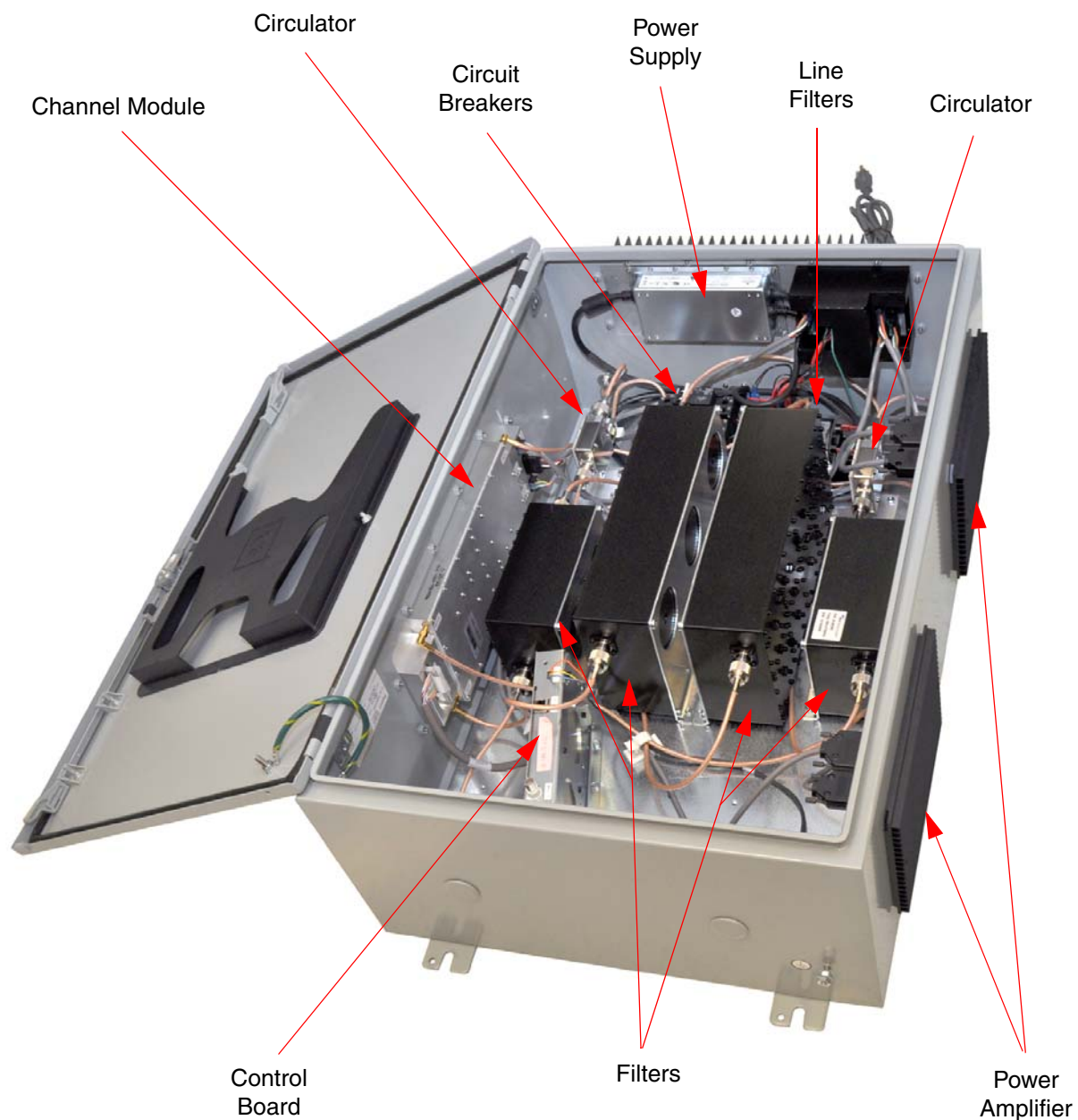


Figure 5: Front view of the booster.

sion and a 30 filter version. After DSP filtering the analog signal is recreated and up converted with an up-converter board to the original frequency before being output from the channel module at the downlink and uplink output ports.

Up converter boards are available in two different styles including low level and high level. If the signal booster is a high-power model then a low level

up converter board is used in the channel module. If the booster is a low power model then high level up converter boards are used. Signal booster models that have the fiber-optic option installed in them have enhanced down-converter boards that are capable of dealing with the low level signals from the optical conversion.

Location	Label	Possible States	Causes	Action to take
Bottom of channel module	DL/UL PWR	Green solid	FPGA successfully loaded	None
Bottom of channel module	DL/UL PWR	Off	Issue with board	Return to factory
Bottom of channel module	DL/UL COM	Red flashes	Exchanging data with control board	None
Bottom of channel module	DL/UL COM	Red solid	Exchanging data with control board	None
Bottom of channel module	DL/UL COM	Off	No data exchanging	None
Bottom of channel module	DL/UL COM	Always Off and it is expected to flash	No data exchanging	Check cabling; return control board to factory
Bottom of channel module	DL/UL DAC	Red solid	DAC overflow	Lower output power setting
Bottom of channel module	DL/UL DAC	Off	DAC normal operation	None
Bottom of channel module	DL/UL ADC	Red solid	ADC overflow	Increase down converter attenuation
Bottom of channel module	DL/UL ADC	Off	ADC normal operation	None
Control board	Ctrl LED	Off	no power, no bootloader, no program	Return to factory
Control board	Ctrl LED	Orange	bootloader installed, no program	return to factory or perform field update
Control board	Ctrl LED	Red	Control board detected a fault	Address fault condition. Contact factory
Control board	Ctrl LED	Green solid	Control board normal operation	None
Power Amplifier	PWR	Green solid	6 VDC supply to Amplifier is OK	None
Power Amplifier	PWR	Off	No supply voltage	check power supply and cabling
Power Amplifier	PA OFF	Off	Power Amp normal operation	None
Power Amplifier	PA OFF	Red solid	Over current, over temp	Amp shut down, contact factory
Table 3: Subassembly LED descriptions.				

Uplink and Downlink Output Signals

Uplink output signals leave the channel module at the UL OUT port. The signals are then passed on to a power amplifier stage. The output of the power amplifier is passed through a filter then radiated from the donor antenna. *Note: When the booster is operated at the maximum uplink output power level (+37 dBm) the gain of the donor antenna should be limited to 0 dBi.*

Downlink output signals leave the channel module at the DL OUT port. The signals are then passed on to a power amplifier stage. The output of the power amplifier is passed through a filter then radiated from the DAS antenna. *Note: When the booster is operated at the maximum downlink output power level (+37 dBm) the gain of the DAS antenna should be limited to 0 dBi.* We recommend the use of a Ceiling Mount DAS Antenna from Fractal Antenna Systems inc. part # UACM.

SYSTEM SETUP

The filter bandwidths can be programmed up to 3 MHz wide occupied bandwidth as long as operating in Class B mode. If in Class A mode the occupied filter bandwidth is limited to 75 KHz.

Typically the filter bandwidth is usually kept small, such as one of the predefined bandwidths of 12.5

KHz, 25 KHz, or 12.5 KHz low delay. In areas where group delay is a concern the filter rejection bandwidths or rejection amount can be modified using the filter design tool.



When programming a filter for wide-band it is important to note that the filter cannot be programmed wider than the hardware filter being used in the booster design (typically 1.5 MHz for the 470-488 range and 3 MHz for the 450-470 range).

When the booster is shipped from the factory it is programmed in a generic fashion as follows; the first wideband filter will be set to 500 KHz above the lowest frequency in the band, the second wideband filter will be set to the center frequency of the band, and the third wideband filter will be set to 500 KHz below the highest frequency in the band. All of these filters will be set up as 12.5 KHz low delay filters. Changes to this initial setup are the customer's responsibility. If you need help with programming your frequencies please contact your sales representative at Bird Technologies.

OPERATION

Power is applied to the digital booster by plugging in the AC or DC power cord (depending on how the system was configured for input power), then turning the circuit breakers inside the cabinet to the ON position. The breakers are ganged so they function as a 2-pole switch, see **Figure 6**.



Figure 6: On/Off Circuit breakers.

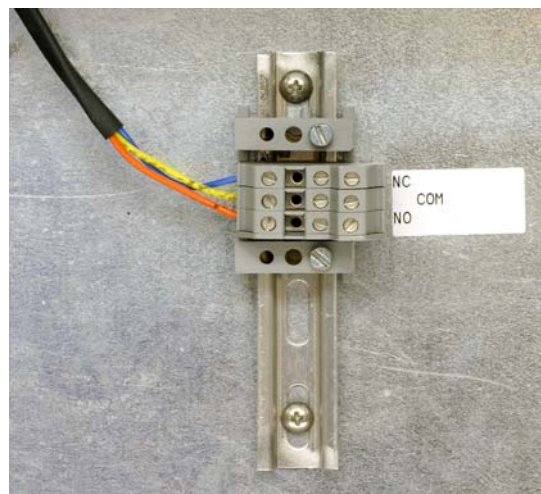


Figure 7: Alarm Form-C Contacts.

When the unit is powered ON there are LED's located on several of the subassemblies within the cabinet that will become illuminated to indicate the ON condition. The function of each of these indicator LED's are listed in **Table 3**.

Alarm Form-C Contacts

The ALARM Form-C relay contacts are located on the back panel of the unit as shown in **Figure 7**. These screw terminals are intended for connection to the customer's supervisory and data acquisition system. Both normally open and normally closed contacts are available. The system will alarm when an over current or high temperature event occurs in a channel module or power amplifier. Also, a DAC overflow condition can cause the alarm contacts to change state.

NFPA Compliant Signal Booster

The NFPA style booster system is designed to be compliant with the national public safety in-building codes issued in the International Fire Code (IFC 2009) and the National Fire Protection Association (NFPA-72 2009). The booster system accomplishes compliance when used in conjunction with an appropriate battery backup unit. An optional battery backup unit is available from Bird Technologies, model number 6160-H-48-NG. Detailed installation and operating instructions for the battery backup unit are included with the backup unit when it ships from the factory.

The system consists of a signal booster unit as well as the optional battery backup unit which can provide up to 24 hours of emergency battery operation for the booster. The NFPA compliant signal booster is designed to easily interface to fire alarm panels. Five alarms are provided which are accessible through a convenient terminal block location. The terminal block provides a common access point to

the alarm signal relay contacts. Available alarm functions include;

SB Failure - this is a summed alarm that is active when any number of fault conditions arise within the booster unit such as when an over current or high temperature event occurs in a channel module or power amplifier. Also, a DAC overflow condition can cause the alarm contact to change state.

Loss of AC Power - active when the booster switches from operating on the AC power supply to operating on the DC battery backup voltage.

Low Battery Capacity - the source of this alarm is the battery backup unit and it indicates that the battery backup voltage level has dropped significantly. The optional battery backup unit is capable of providing at least 24 hours of continuous backup power for the booster.

Charge Fail - the source of this alarm is the battery backup unit and it indicates failure of the battery charger. If the battery charger loses AC power this alarm will be active. It will also indicate when the battery will not properly charge.

Antenna Malfunction - indicates there is a loss of cable connection integrity between the signal booster unit and the remote antenna line sensor. The alarm terminal strip uses screw terminals for ease of connection. Route the alarm wires through one of the access holes in the bottom of the box, strip about 3/16" of insulation from each end, loosen the screw terminal, insert and retighten. Use #20 or #22 gauge insulated wire.

All five of the alarms use "supervising" alarm circuits. A supervised circuit includes technology that will detect open or shorted circuits regardless of

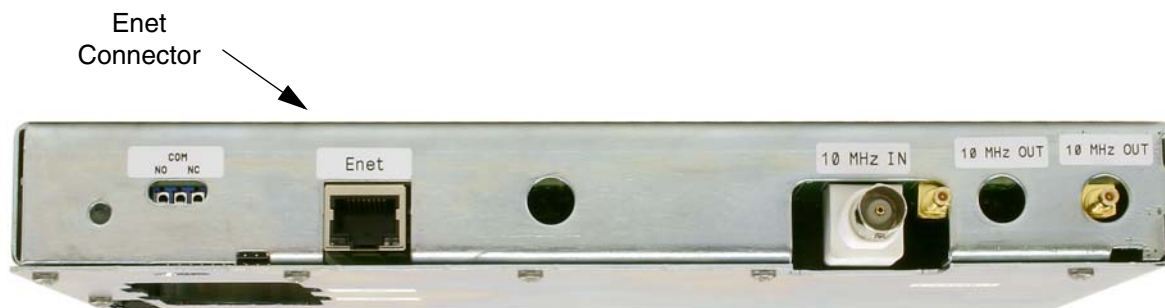


Figure 8: Enet connector on the control board.

the alarm status. This is accomplished by using EOL (end-of-line) resistors at the alarm terminal strip in the signal booster cabinet. The value of the EOL resistors is a function of the alarm panel so you should consult the manual for the alarm panel when you are determining the resistor value.

COMMUNICATING WITH THE BOOSTER

The booster provides Ethernet connectivity that allows access to a web-based user interface for communicating with the control board, programming the individual filters, checking system status, etc. Communications will require connecting your laptop computer to the Enet connector on the control board. **Figure 8** shows the connector. A standard Ethernet crossover cable is used to make the connection between your laptop computer and the booster cabinet. Refer to **Appendix A** at the back of this manual for detailed instructions on how to properly connect your laptop computer to the Enet port of the booster.

System Summary Submenu

Once your laptop computer is properly connected to the signal booster the web-based user interface screen will appear as shown in **Figure 9**. This is the System Summary page which shows the IP and MAC address of the control module. On the left-hand side of the screen are a list of the major submenus available to the user including System Summary, Control Panel, Network Configuration, SNMP Configuration, and User Administration.



When the webpage first comes up, the Control Panel menu choice will not be displayed. The user needs to go to the User Administration Page and type in the default user name (admin) and default user password (admin). After this login function is performed the Control Page menu choice will appear.

Place your cursor over a particular menu heading and left click to make a selection. Each submenu page contains a group of related functions. With password protection enabled the user will only be allowed to view the pages, however the user will not be able to make changes without entering a password. After entering a valid password via the Admin submenu the pages will switch from read-only to fully interactive.



Password protection is disabled by default when your system leaves the factory. To enable password protection for your system refer to the ADMIN submenu page for specific instructions.

Control Panel Submenu

The Control Panel submenu gives the user the ability to interface with and adjust the RF parameters of the booster. Five tabs are available on the Control Panel Page including FILTERS, FILTER DETAIL, LINK, FFT, and SYSTEM. Each page con-

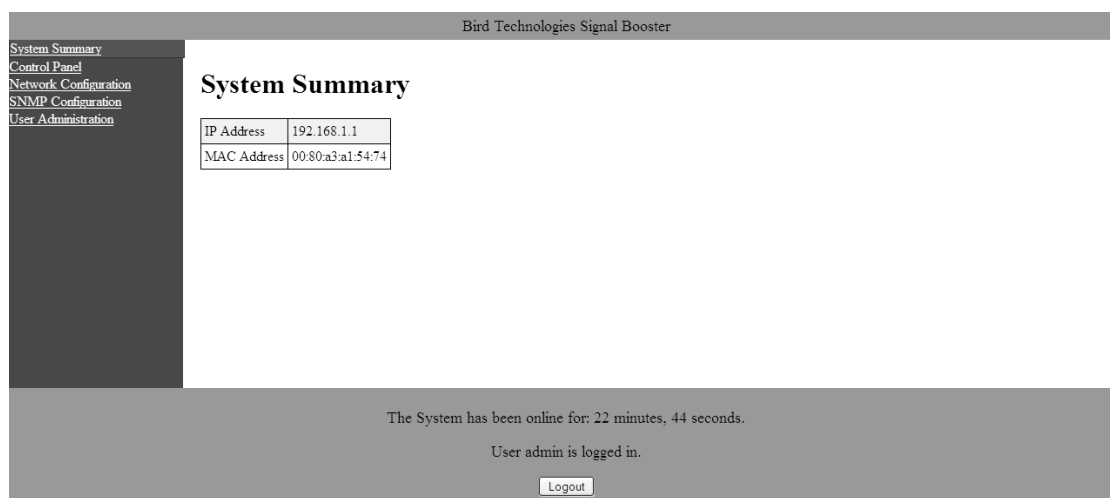


Figure 9: System Summary page.

tains a group of related user functions. Each tab of the Control Panel presents a new screen. Selection is made by placing your cursor over the tab and performing a left click.

FILTERS TAB

The Filters page gives an overview of all the filters associated with each branch in the booster system. Refer to **Figure 10**. The link drop-down box allows you to select which branch you want to overview. Press the down arrow button and highlight the desired branch. Each filter is accorded one row in the display. The first row of displayed data is used to provide a summation of the input and output power for the branch. The parameters displayed for each filter include; Center frequency, Bandwidth, Channel enabled, Test signal, Squelch, Input signal level as both a numeric value and a bar graph, Maximum allowed output level, and Output signal level as both a numeric value and a bar graph. Changes to the filters are made from the Filter Detail page.

A check mark in the box for enable, test signal, and squelch indicates that function is turned on while no check mark indicates the function is turned off. The All Filters area at the top of the page allows the user to adjust the Maximum Output Level of all the filters in a branch simultaneously. Use the up or down arrow to set the level change amount then press the submit button.



On start-up, the booster validates the widths of programmed filters. If any are configured wider than 75 KHz and the booster is set to Class A mode an error message as shown in **Figure 11** will appear. The offending filter or filters must be corrected or the booster must be switched to Class B mode. Refer to the System Page discussion later in this manual for instructions on switching from Class A to Class B mode of operation.

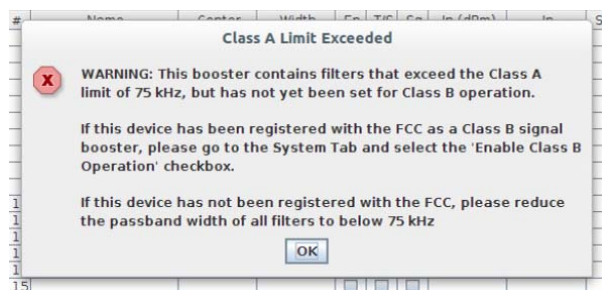


Figure 11: Class A limit exceeded warning message.

FILTER DETAIL TAB

The Filter Detail page is divided into three functional areas which includes two drop down boxes and a row of command buttons running down the left side of the screen, a filter details area in the middle of the screen, and a status area on the right side of the screen as shown in **Figure 12**. Once

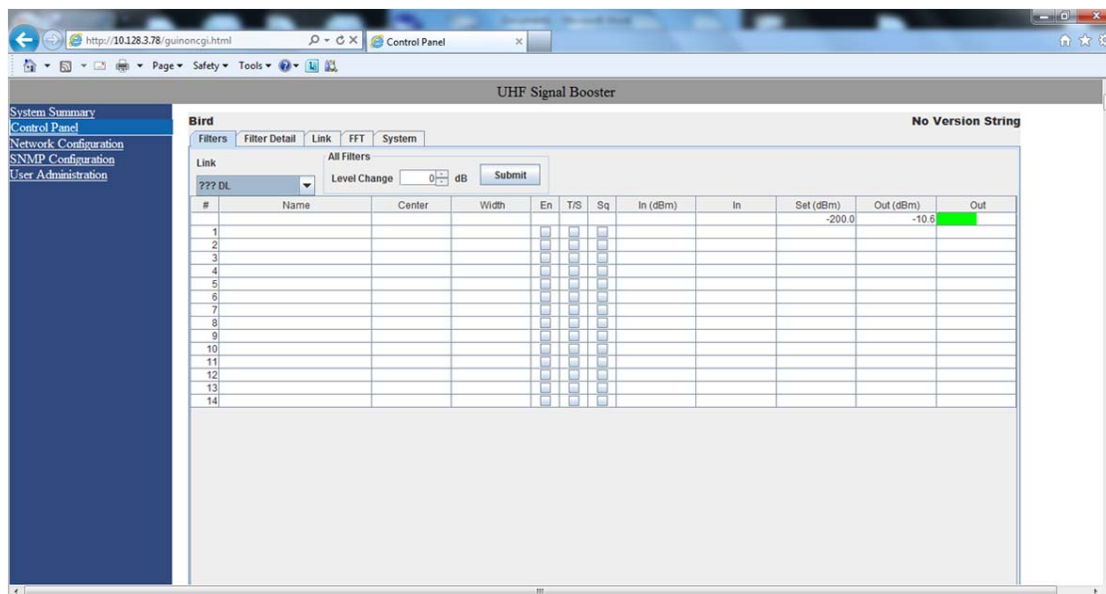


Figure 10: Filters page.

you have interactive access to the Filter Detail page you can begin programming the individual filters that you want the booster to pass in the uplink and downlink directions.

The Filter Detail page is designed to interact with one filter at a time. To program individual filters you must select the branch and the filter of interest using the Link and Filter boxes on the left side of the screen. Once the filter has been selected for interaction a label can be assigned to the filter by typing into the name box. Three groups of characteristics need to be defined including frequency band, OLC, and filter. Frequency band is selected from a drop down list. Center Frequency and Desired Output Power must be entered by the user by clicking in the box and typing in the desired value. Likewise OLC style is determined with a drop down box. The two choices are Custom and APCO 25 Phase 2. OLC Hold time and OLC Decay time must be entered by the user.

Filter specifics are selected from a drop down list that includes Custom, 12.5 KHz, 25 KHz, 12.5 KHz Low Delay, and XML File. Four parameters are customer adjustable including Occupied Bandwidth, Adjacent Channel Offset, Passband Ripple, and Adjacent Channel Rejection. Delay time is calculated by the software. The four adjustable parameters are setup using the Design tool, see the following section of this manual for details.



If a filter passband is selected that exceeds the Class A limit of 75 KHz and Class B operation is not selected (see discussion in System Page section of this manual) then a warning message will appear as shown in **Figure 13** You MUST set the booster to the Class B mode of operation if you have any filter with a passband greater than 75 KHz.

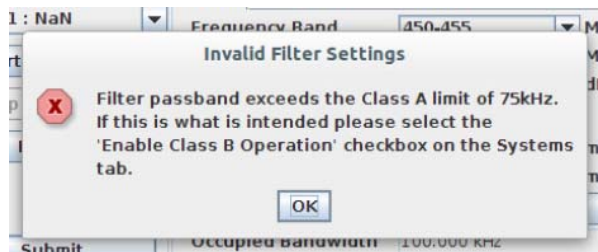


Figure 13: Invalid filter settings warning message.

Design Button

When the Design Filter button is pressed a custom design template will be displayed as shown in **Figure 14**. Boxes for the four required filter parameters mentioned earlier are shown along with a graphical representation of the filter's response curve. Enter into the four boxes the parameters you want. Click

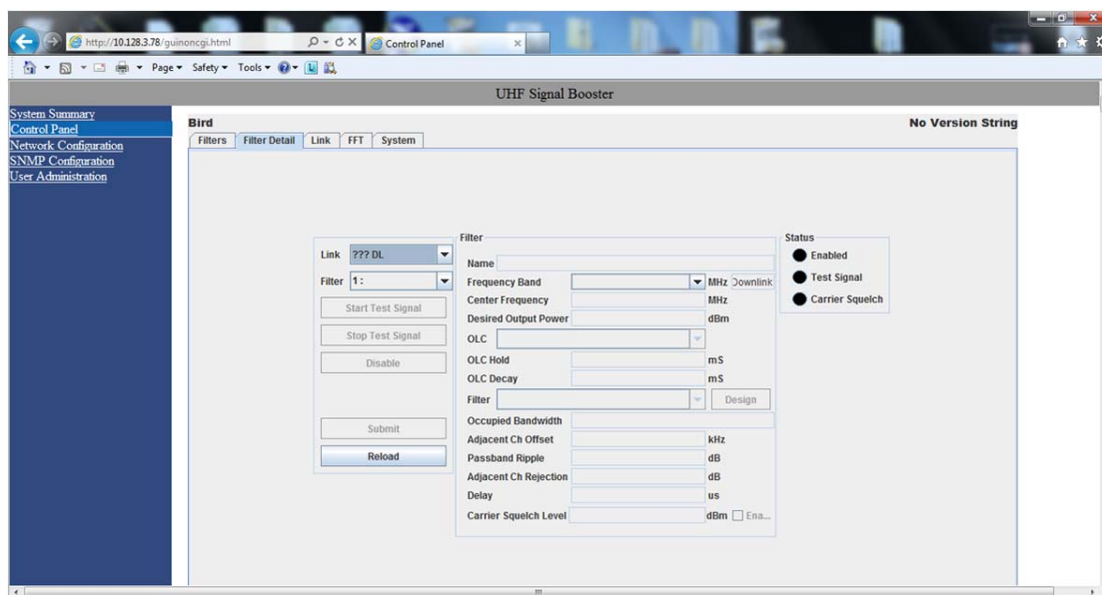


Figure 12: Filter Detail page.

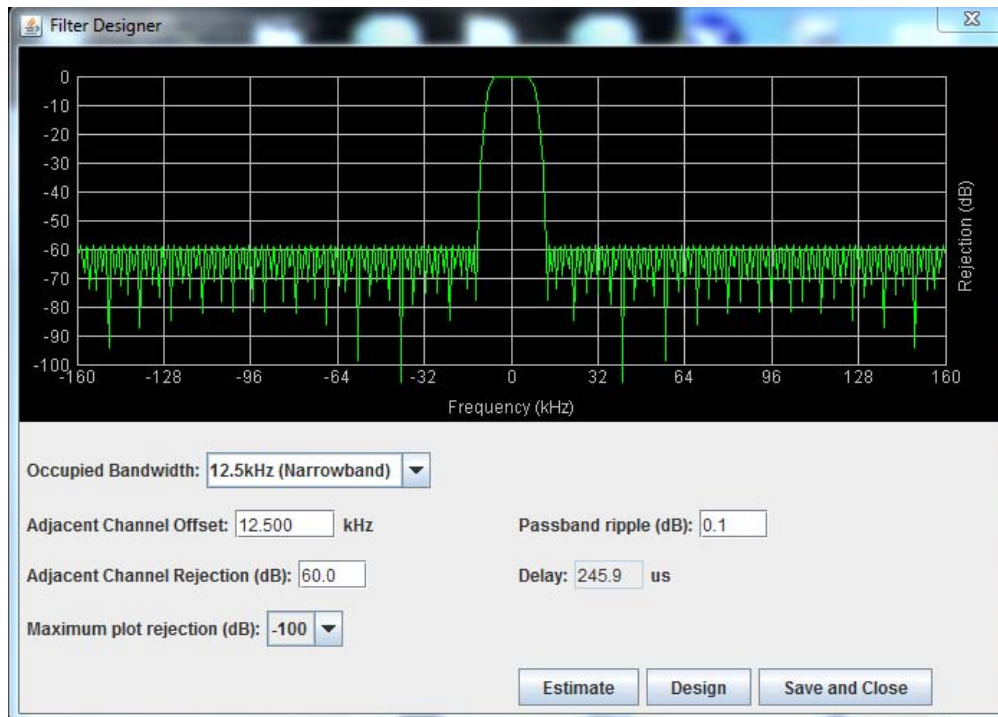


Figure 14: The design filter interactive display screen.

on the Estimate button at the bottom of the screen and the software will calculate the Delay time for you. Press the Design button to design the filter. The rejection scale of the display can be changed by making a selection from the “maximum plot rejection” drop down list. Choices include -10, -50, and -100 dB scale. When the display is to your satisfaction and does not violate any parameter ranges press the Save and Close button to exit back to the filters page then load the design into the selected filter by pressing the Submit button.

Status Area

The status area of the Filter Detail page uses status indicators to let the user know whether the channel is enabled, if the test signal is on, and if the carrier squelch is on. When the status indicator is illuminated the feature is on and when it is dark the feature is off. The Carrier Squelch status indicator will be green if the channel is squelched. The Carrier Squelch status indicator will stay dark if there is no squelching even if the Carrier Squelch radio button is set to enabled. A test signal can be generated for any channel within the system or every channel simultaneously. The output power box displays the output power for the channel mod-

ule. This value should be close but not necessarily exactly the same as the “Desired Output Level” discussed earlier. The box showing output power is only displayed if the filter is giving output power. If the filter is not enabled or there is no signal present then there would be no value to display.

LINK TAB

The link page is divided into four functional areas including a row of command buttons running down the left side of the screen, a link and settings area in the middle of the screen, and a status area on the right side of the screen as shown in **Figure 15**. The link page is designed to interact with one branch of a module at a time. The branch that is selected for interaction is determined by the Link box on the upper left of the screen. To change the branch that you are going to interact with click on the arrow to display the full drop down box. Scroll down the list until the desired branch is highlighted and click on it. The data displayed in the link area of the display screen will now be for the selected branch.

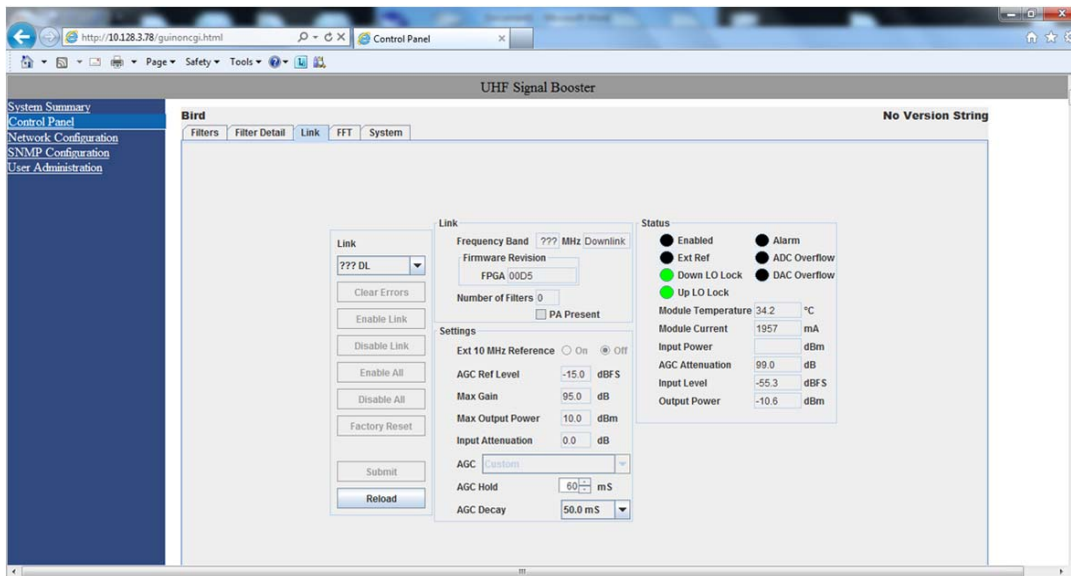


Figure 15: The Link page.

Command Buttons

Clicking on a command button (located on the extreme left-hand side of the filters page) performs the associated task immediately. The Submit and Reload buttons in the bottom left corner allow any changes you make to the display/interface boxes to be downloaded to the booster. The Submit and Reload buttons act like a trigger sending any changes you made in the interface boxes to the channel module as well as updating any displayed data from the module, but only after the button is pressed. Individual branches or all branches can be enabled or disabled using the enable/disable buttons.

Link and Settings Area

The link portion of the area displays status information for the branch. The Settings area is a user interactive area where the field engineer can program the operating characteristics of the selected branch. Each parameter in the settings area can be changed by clicking in the box and typing in the new values or by pointing at an arrow to display a drop down box. Most of the adjustable parameters have adjustment limitations as applicable.

The parameters include turning on/off the use of an external 10 MHz reference signal when an external reference is available. If an external reference is

not available then leave this feature off and the system will operate from the internal 10 MHz signal. The AGC Reference Level should be set to the calibration value which is -15 dBFS. The ADC reference level can be adjusted when excessively strong input signals are present. The Maximum Output Power is the desired output power level from the booster for the selected branch. The Max Gain allows the user to determine the maximum operating gain of the booster. This can be adjusted based on your antenna isolation.

The changes you make in the Settings area are only applicable to the selected branch. After you have made changes to the various parameters press the Submit command interface button (lower left corner of the screen) in order to copy the changes into the channel module itself.

Status Area

The status area of the link page lets the user know the status of the channel module and power amplifier if a power amplifier is used in the system design. The status for seven parameters are conveyed by the status indicator next to the parameter name. When the status indicator is green it indicates that the parameter is on and when it is black it indicates the parameter is off. In the case of the Alarm (Summed Alarm), ADC Overflow, and DAC

overflow, the status indicator will turn red during a fault condition.



When the Summed Alarm indicator is red, if the cursor is placed over the indicator, a message tab will appear briefly describing the reason for the alarm condition.

Seven additional parameters are displayed with numerical values. The first group of parameters using a status indicator include; Enabled which indicates whether the branch is on or off, Ext Ref which indicates whether the system is running on an external or internal 10 MHz clock signal, and Down and Up LO Lock which indicate if the down converter and up converter local oscillators are synchronized to their respective RF signals. The second group of parameters using a status indicator will be black under normal conditions and will turn red to indicate a fault. The Alarm indicator is a summed alarm and will activate when either the module or power amplifier temperature/current exceeds their normal range. Also, the Form-C contacts inside the cabinet will change states. ADC or DAC Overflow indicator shows that the input power to the branch is too high.

The first four numerical parameters are real-time indications of the module and power amplifier tem-

perature/current values. AGC Attenuation updates in real-time and provides an indication of what the AGC is doing. Input Power is a summation of all the input signals to the branch. Output power also updates in real-time and indicates the composite power output for the branch. If a fault occurs, press the Clear Errors button on the left side of the screen. If the error reappears right away then troubleshooting will need to take place.

FFT TAB

A Fast Fourier Transform feature is built into the system software. This feature allows the user the ability to display the output spectrum of the booster in an amplitude versus frequency display. Pressing the FFT tab will display the FFT screen as shown in **Figure 16**. The FFT screen allows the user to look at one link at a time. All of the signals input or output from that link of the channel module can be displayed. Also, any filters that are enabled can be shown (see white waveform in example).

SYSTEM TAB

The system tab lists the control board software versions. A customer-designated location name can be recorded and is useful in situations where multiple boosters are used in the overall system design. There is also a system logbook available on the bottom of this page for use by field engineers when working on the system. Refer to **Figure 17**.

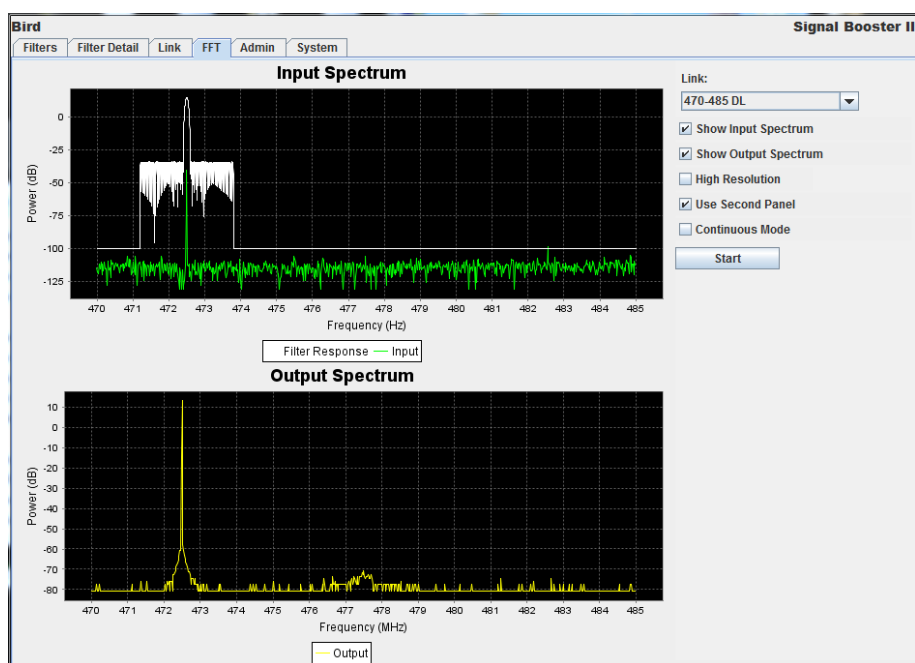


Figure 16: The FFT page.

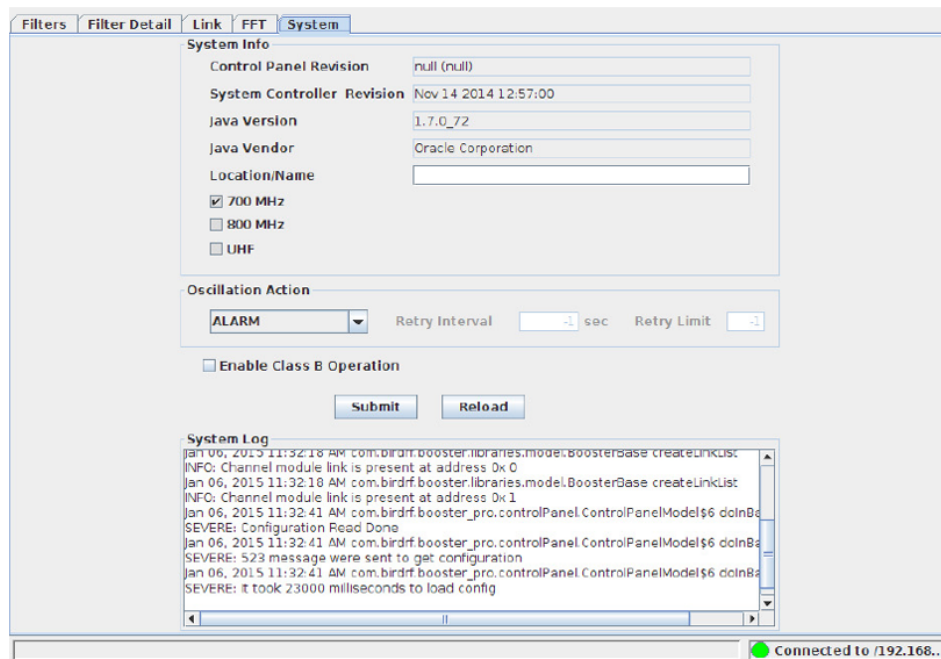


Figure 17: The System page.

Oscillation Detection

This feature shuts off the output signals from the booster for both the uplink and downlink whenever an oscillation condition is detected. Oscillation detection occurs whenever port to port isolation falls down to 25 dB or less. For normal operation the port to port isolation needs to be at least 10 dB greater than the gain of the booster. There are four modes of operation for the Oscillation Detection feature including Ignore, Alarm, Shutdown, and Shutdown/Retry.

In the Ignore mode the booster will ignore oscillation events. In the Alarm mode the booster will generate a alarm notification by illuminating (turn RED) the alarm button on the Link Tab and illuminating (turn RED) an LED indicator on the control module. The Shutdown mode is the same as Alarm mode except the booster shuts off the output signals in both the uplink and downlink direction. The shutdown continues until the filters are re-enabled and the alarm is reset. The Shutdown/Retry mode is the same as the Shutdown mode except the booster will retry operation the number of times specified by the user. This is called the retry limit which is entered into the associated box on the System Page. How long the booster waits between each retry attempt is determined by the retry interval. After the retry limit is reached, if the booster is still experiencing an oscillation condition, the

booster will enter the regular shutdown mode. The Shutdown/ Retry mode is useful in situations where brief transient overdrive signals are occurring.

Class B Enable

In order to operate the booster with a filter pass-band greater than 75 KHz the booster MUST be configured as a Class B booster and the customer must register the booster online with the FCC. Class B operation is enabled by checking the box labeled "Enable Class B Operation". When the box is checked a warning message will be displayed as shown in **Figure 18** reminding the user to register the booster with the FCC.

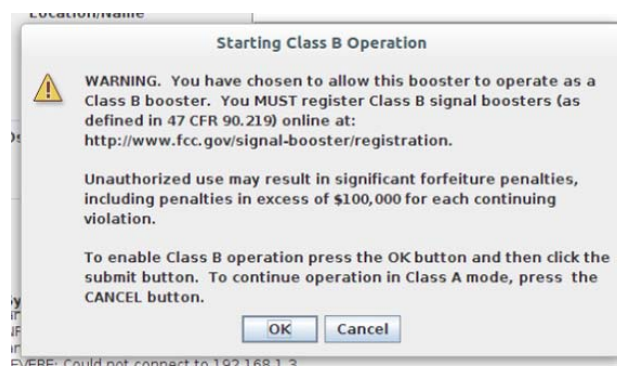


Figure 18: Starting Class B operation message.

Bird Technologies Signal Booster													
System Summary	Network Configuration <table border="1"> <tr> <td>DHCP Enabled</td> <td>☐</td> </tr> <tr> <td>IP Address</td> <td>192.168.1.1</td> </tr> <tr> <td>Netmask</td> <td>255.255.255.0</td> </tr> <tr> <td>Gateway</td> <td>192.168.1.0</td> </tr> <tr> <td>MAC Address</td> <td>00:80:a3:a1:54:74</td> </tr> <tr> <td colspan="2"> Submit </td> </tr> </table>	DHCP Enabled	☐	IP Address	192.168.1.1	Netmask	255.255.255.0	Gateway	192.168.1.0	MAC Address	00:80:a3:a1:54:74	Submit	
DHCP Enabled		☐											
IP Address		192.168.1.1											
Netmask		255.255.255.0											
Gateway		192.168.1.0											
MAC Address	00:80:a3:a1:54:74												
Submit													

| Control Panel |
| Network Configuration |
| SNMP Configuration |
| User Administration |
| The System has been online for: 24 minutes, 8 seconds. User admin is logged in. | |

Figure 19: The Network Configuration display.

Network Configuration Submenu

Values for IP Address, Netmask, the Gateway and MAC Address are displayed on the network configuration page. Refer to **Figure 19**.

The network configuration page allows the user to enable or disable DHCP. The Dynamic Host Control Protocol (DHCP) is a standardized networking protocol used on IP networks for dynamically distributing network configuration parameters, such as IP addresses for interfaces and services. With DHCP, computers request IP addresses and networking parameters automatically from a DHCP

server, reducing the need for a network administrator or a user to configure these settings manually.

The DHCP (Dynamic Host Configuration Protocol) is either active or inactive. When DHCP is active the values for IP address, netmask, and gateway are set to zero. When the DHCP is inactive (default setting from the factory) the IP address, netmask, and gateway values can be modified by the user by typing the desired values into the associated box and pressing the submit button. The customer should consult with their IT department to determine whether DHCP should be active or inactive.

Bird Technologies Signal Booster							
System Summary	User Administration <table border="1"> <tr> <td>Username:</td> <td> </td> </tr> <tr> <td>Password:</td> <td> </td> </tr> <tr> <td colspan="2"> Submit </td> </tr> </table>	Username:		Password:		Submit	
Username:							
Password:							
Submit							

| Network Configuration |
| SNMP Configuration |
| User Administration |
| The System has been online for: 27 minutes, 47 seconds. | |

Figure 20: The Admin Page.

User Administration Submenu

The User Administration submenu allows the user to enable password protection for the web-based interface program. The boxes on this page are interactive. To make changes click inside the box and a cursor will appear. Refer to **Figure 20**. The user is queried for a User Name and Password. The default user name is “**admin**” and the default password is “**admin**”. Once the correct user name and password are entered then a menu box for creating a new user will be presented. To create a new user enter the new user name and associated password. Confirm the new password by entering it again and then press the Submit button. Make sure you write down the new user name and password for safe keeping.

SNMP Configuration Submenu

The SNMP feature is designed to provide reliable internet notification of an alarm occurrence or a change in operational status of the TTA system. Simple Network Management Protocol (SNMP) is an Internet-standard protocol for managing devices on IP networks. In order to configure the booster as an SNMP device the following values need to be entered; the IP address, Authentication type, User name (this field must have a value or traps will not be sent), Password, Encryption type, and the Encryption passphrase. **Figure 21** shows the SNMP Configuration display.

The three destination IP addresses that are entered into the table should be the IP addresses of the computers that you want the traps to be sent to. The destination computer must have trap receiver software installed and running. The trap receiver software is available for download. Authentication type can be either none or MD5. The User Name field must have a value entered with the associated user name password optional. Encryption type can be either none or MD5 with the associated encryption passphrase as optional. Whenever values in the SNMP Configuration screen are changed you must click on the submit button to save the changes.

INITIAL SETUP

When the TTA system is installed the SNMP feature should be setup for proper communications. There are several steps required for proper setup of the SNMP feature as listed below.

- 1) Connect a laptop directly to the TTA deck. Refer to **Appendix A** for detailed instructions on how to make a direct connection. The TTA deck is shipped from the factory setup for static IP addressing with a default IP address of “192.168.1.1” and the factory default subnet mask is “**255.255.255.0**”. Change the factory default IP address of the TTA deck to one provided by your IT department.

IP Address	Authentication Type	User Name (or Community)	Password	Encryption Type	Encryption Passphrase
192.168.1.10	NONE	public		NONE	
	NONE	public		NONE	
	NONE	public		NONE	

Submit

The System has been online for: 21 minutes, 22 seconds.

User admin is logged in.

Logout

Figure 21: SNMP Configuration Page.

- 2) Use the Network Configuration to setup the DHCP as either active or inactive. When DHCP is inactive the deck will be using a static IP and the user must enter values for IP address, net-mask, and gateway. Make sure you consult with your IT department regarding setting DHCP active or inactive.
- 3) Use the SNMP Configuration to enter up to three destination device addresses. These are addresses where the SNMP feature will send traps whenever a qualifying event takes place. Qualifying events are listed in the section of this manual under the title Trap Receiver GUI.
- 4) Load trap receiver software into the destination SNMP computer/manager(s), so it will be able to decipher the SNMP traps. The trap receiver software (called a MIB file) will be supplied by Bird Technologies as a downloadable file.



The SNMP feature does not send traps when the web page is operational.

When a qualifying event occurs in the system a trap message is formulated and sent to the destination computer. Typical trap messages are shown in figure 19. To interpret the meaning of the trap message it must be examined in detail for an integer value which is imbedded in the message. Double clicking on the message will allow you to see the imbedded details. When a trap message is double clicked a details window will be presented as shown in **Figure 23**. The details window will display the integer in the value column of the Variable Bindings table. The definition of what the integer means is listed in **Table 4**. Closing the Trap Details window will return the user to the Trap Receiver GUI.

TRAP RECEIVER GUI

The trap receiver software (MIB file) provides a GUI interface for the user so that traps sent from the TTA deck can be received and displayed for viewing. The trap receiver software must be downloaded from Bird Technologies and installed on your computer (destination computer). The software must be running on your machine in order to receive and display traps from the TTA deck. The GUI interface is shown in **Figure 22**.

Integer	Fault Description
Value	TBD
Value	TBD
Value	TBD

Table 4: Integer fault definitions.

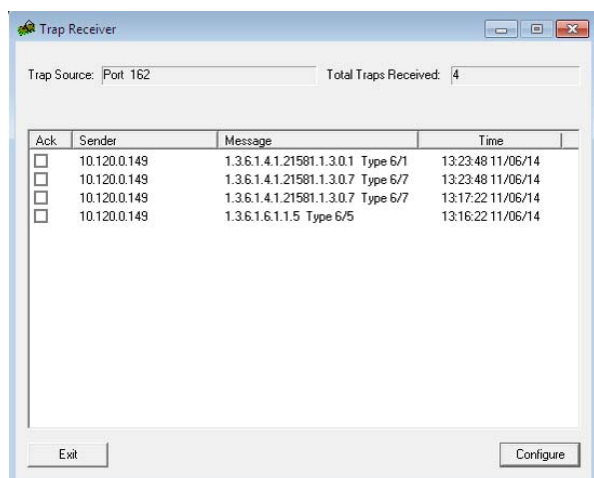
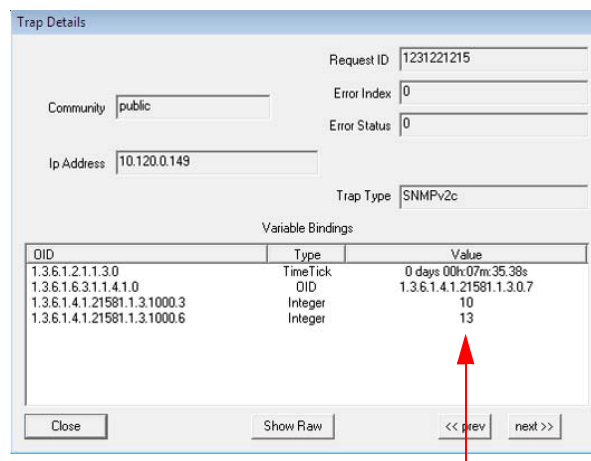


Figure 22: Trap Receiver GUI interface.



Integer
Value

Figure 23: Trap details.

MAINTENANCE AND REPAIR

Signals boosters manufactured by Bird Technologies can perform for years with little maintenance and repair. However, if the amplifiers are subjected to excessively high signal levels, power surges or lightning strikes, failures may occur. The following procedures may be followed for detecting a malfunctioning subassembly or as part of a periodic maintenance program.

- 1) Heatsink areas should be clear of dust and debris.
- 2) Inspect the unit to see that all LED indicators are illuminated correctly. Check all hardware and cable connections for tightness.
- 3) Compare system performance to initial performance levels measured when the system was installed.

Power Amplifier Replacement

The SBIII power amplifiers are field replaceable. Follow the steps listed below in sequential order. The required tools are a 3/32" hex head driver.

- 1) Turn off power to the signal booster.

- 2) Disconnect the 28 VDC power cable.
- 3) Disconnect the COM cable.
- 4) Disconnect the RF In cable.
- 5) Disconnect the RF Out cable.
- 6) Remove the 12 hold down screws (3/32" hex head) that hold the power amplifier assembly to the cabinet. The screw heads are accessible from the heatsink side of the assembly. Refer to **Figure 24**.
- 7) Remove the assembly by pulling it away from the cabinet.
- 8) To install the replacement amplifier reverse steps 7 thru 2. When replacing the RF cables do not overtighten the SMA connectors. They should be tightened just slightly more than hand tight or to the specification of 7 in/lbs. The amplifier assembly comes with an O-ring gasket which must press up against the outside of the cabinet firmly and squarely in order to provide a correct moisture seal.

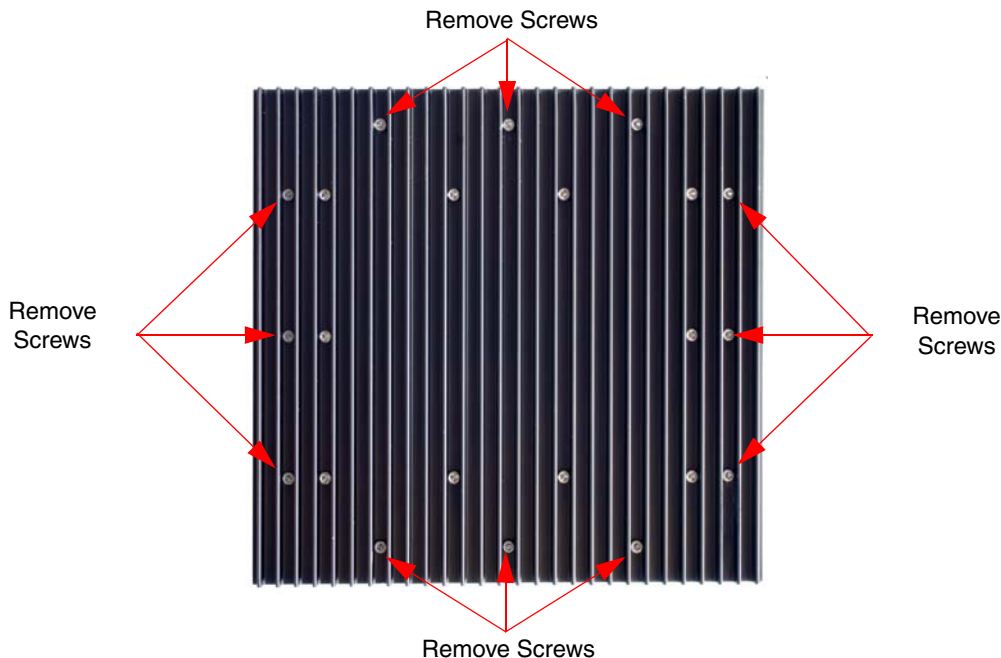


Figure 24: Remove mounting screws to detach power amp from cabinet.

Channel Module Replacement

The SBIII channel module is field replaceable. Follow the steps listed below in sequential order. The required tools are a 5/32" hex head driver.

- 1) Turn off power to the signal booster.
- 2) Disconnect the 6 VDC power cable. The power input cable is located at the top of the module next to the LED indicators.
- 3) Disconnect the COM cable. The COM cable is located at the top of the module next to the LED indicators. There may be one or two COM cables depending on the boosters configuration. It is important to re-attach the correct COM cable to the correct plug so it is a good idea to mark the cables as you remove them from the module so as to avoid confusion later during re-installation.
- 4) Remove the control cable. The control cable is located at the bottom of the module and has a white plastic pull tab on it.
- 5) Disconnect the downlink and uplink RF cables.

- 6) Remove the 12 hold down screws (5/32" hex head) that hold the channel module assembly to the cabinet. The screw heads are accessible from the heatsink side of the assembly. Refer to **Figure 25**.

- 7) Remove the assembly by pulling it away from the cabinet.

- 8) To install the replacement channel module reverse steps 7 through 2. When replacing the RF cables do not overtighten the SMA connectors. They should be tightened just slightly more than hand tight or to the specification of 7 in/lbs. The channel module assembly comes with an O-ring gasket which must press up against the outside of the cabinet firmly and squarely in order to provide a correct moisture seal.

Control Module Replacement

The SBIII Control Module is field replaceable. Follow the steps listed below in sequential order. The required tools are a 5/16" nut driver, a #2 Phillips screwdriver, and a small flat blade screwdriver (jewelers screwdriver).

- 1) Turn off power to the signal booster.

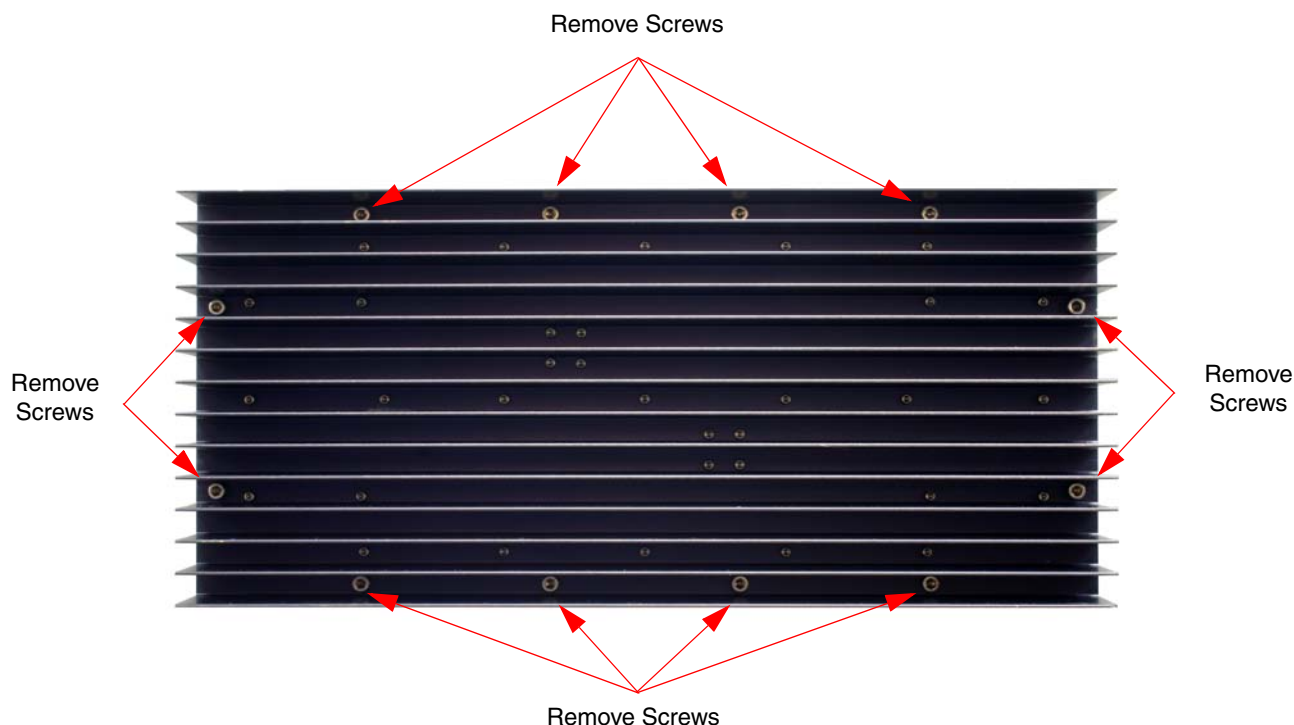


Figure 25: Remove mounting screws to detach channel module from cabinet.

- 2) Disconnect the 6 VDC power connector on the lower left side of the module.
- 3) Disconnect the control cable (one for each channel module). The control cable is located at the lower left side of the control module and has a white plastic pull tab on it.
- 4) Disconnect (3) Form-C control lines from the top of the module. The lines are connected to a terminal strip on the control module. The terminal screws can be accessed through a slot on the front of the control module. Use a small flat blade screw driver (jewelers screwdriver).
- 6) The control module is held in place with either mounting bolts or Phillips screws. Use a 5/16" nut driver to remove mounting bolts or a #2 Phillips screwdriver to remove mounting screws. Lift the module up and out of the cabinet.
- 7) Reverse steps 6 through 2 to install the new control module assembly.
- 2) Disconnect the AC plug on the right side of the supply.
- 3) Disconnect the three (6 Volt) DC Output plugs on the left side of the supply.
- 4) Disconnect the three (28 Volt) DC Output plugs on the left side of the supply.
- 5) Remove the 12 hold down screws (5/32" hex head) that hold the power supply assembly to the cabinet. The screw heads are accessible from the heatsink side of the assembly. Refer to **Figure 26**.
- 6) Remove the assembly by pulling it away from the cabinet.
- 7) To install the replacement power supply reverse steps 6 through 2. The power supply assembly comes with an O-ring gasket which must press up against the outside of the cabinet firmly and squarely in order to provide a correct moisture seal.

Power Supply Replacement

The SBIII Control Module is field replaceable. Follow the steps listed below in sequential order. The required tools are a 5/32" hex head driver.

- 1) Turn off power to the signal booster.

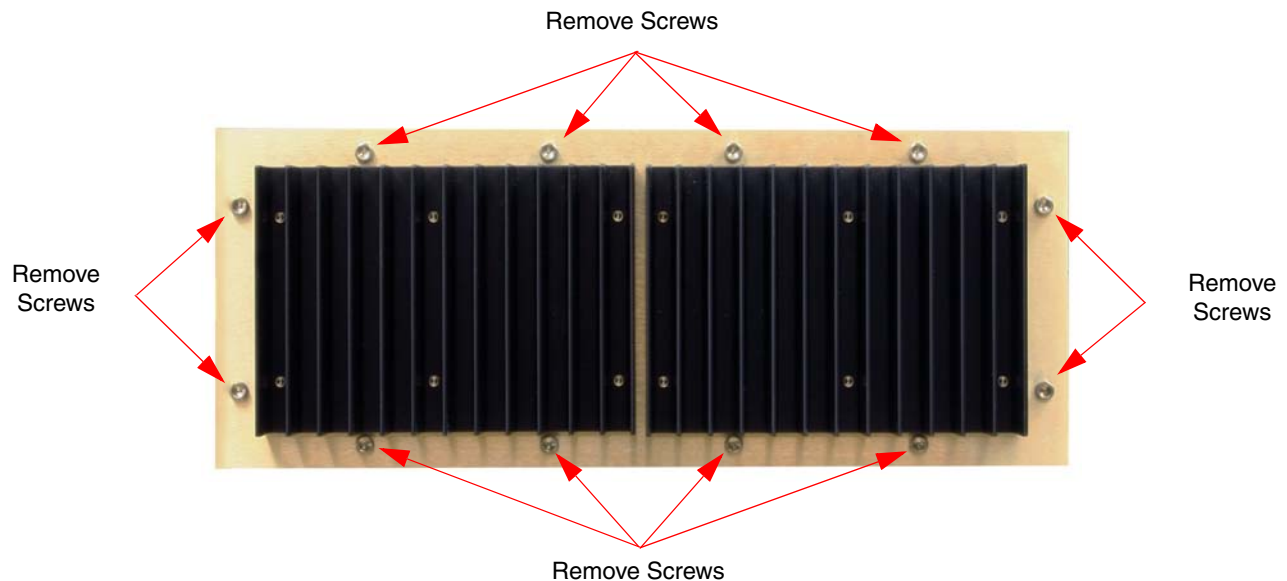


Figure 26: Remove mounting screws to detach power supply from cabinet.

APPENDIX A

Front Panel Ethernet Connectivity

ETHERNET CONNECTIVITY

The front panel User Interface connector on the booster provides for 10/100 BASE-T Ethernet connection using the TCP-IP protocol. This product feature allows access to a web-based interface for programming the individual modules within the booster. The web based interface requires a JAVA runtime environment (version 1.6.0 or later) to be installed on your laptop. The JAVA software can be downloaded free of charge from the Sun Microsystems website found at "http://java.com/en/download/index.jsp". The booster is shipped from the factory with a default IP address of "192.168.1.1".

Two connection schemes are discussed including a direct connection from your laptop computer to the booster front panel as well as connecting the booster to a networked environment. A direct connection (at the installation site) should be established the first time you interface to the booster using the fixed IP mentioned above. Once the initial communications are established the IP address in the booster can be changed to permit a networked connection (from a remote site such as your office).

Direct Connection

Your initial connection to the booster system should be a direct connection to the front panel using an Ethernet crossover cable. **Figure A1** shows the proper way to interconnect the equipment as well as the pinout for a CAT-5 crossover cable.

REQUIRED EQUIPMENT

Cat-5 Crossover Cable

Laptop Computer with a network interface card installed. In addition, the JAVA run-time environment version 1.6.0 or later, and a web browser such as Internet Explorer must also be installed on the laptop.

PROCEDURE

To connect your laptop computer to the front panel LAN port and access the web page interface, perform the following steps;

- 1) Insure the JAVA runtime environment software is installed on your laptop.

- 2) Connect your laptop network port to the LAN connector on the booster front panel using a standard CAT-5 Crossover cable.



The front panel LAN connector has two built-in bi-color status LED's which will aid you in establishing communications. The meaning of each LED is shown in **Table A1**.

LINK LED (left side)		ACTIVITY LED (right side)	
Color	Meaning	Color	Meaning
Off	No Link	Off	No Activity
Amber	10 Mbps	Amber	Half-Duplex
Green	100 Mbps	Green	Full-Duplex

Table A1: LAN port status LED's

- 3) The left-most (LINK) status LED built-in to the LAN port connector should illuminate amber or green indicating that a good physical connection is established between your computer and the booster.
- 4) Insure that your laptop's IP address is compatible with the default address of the signal booster system. This may require changes be made to the Ethernet adaptor address on your laptop (refer to **Appendix B**). Your laptop's IP address will need to be set to "192.168.1.2" along with a subnet mask of "255.255.255.0". The right-most (ACTIVITY) status LED built-in to the LAN port connector will turn amber or green indicating good TCP-IP communications are established between the laptop and the booster.
- 5) Launch your web browser software on the laptop.

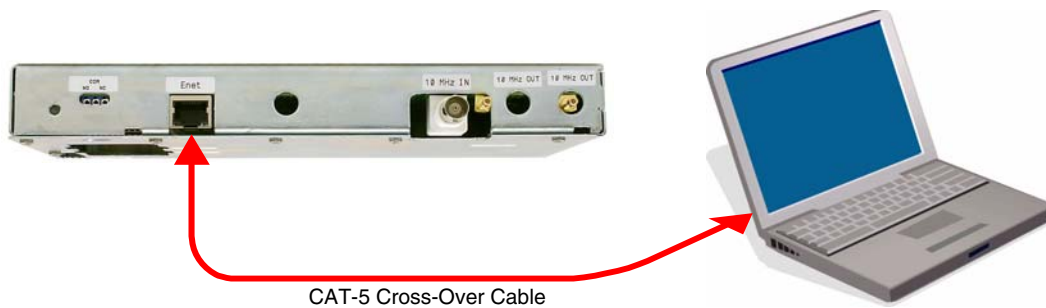
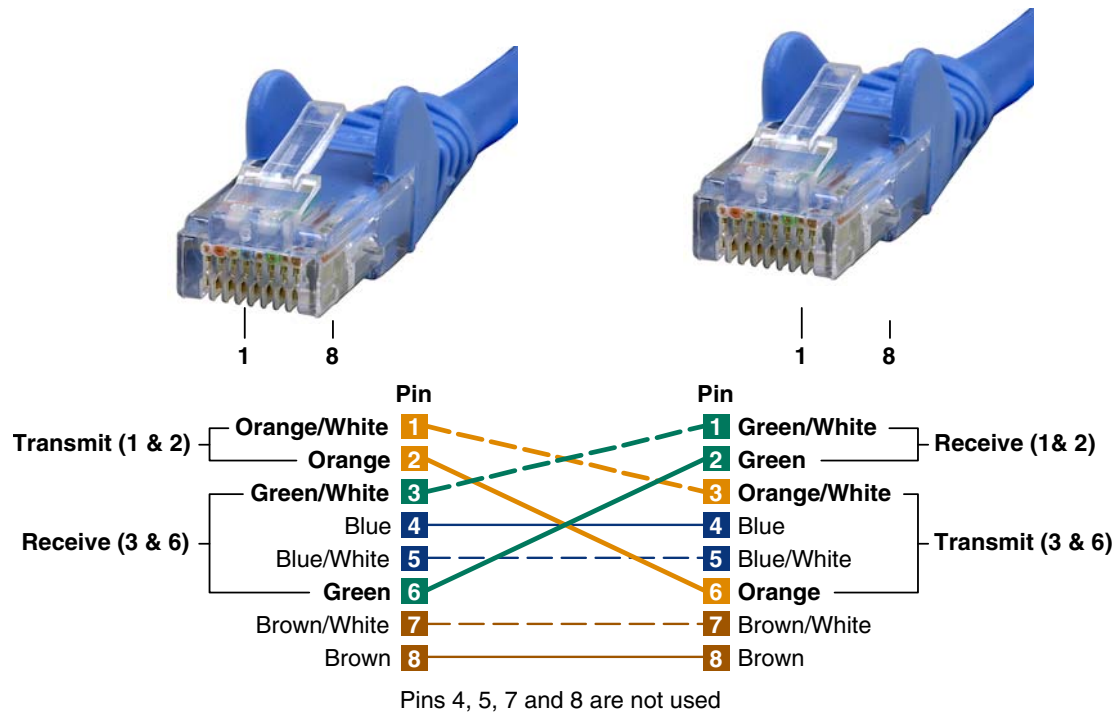


Figure A1: Direct connection to the booster using crossover cable.

- 6) In your web browsers address box type-in the address of the booster "http://192.168.1.1" and press the ENTER key. The web page interface to the booster should appear in your laptop's browser window. When you launch the web page you may notice that the JAVA applet will load first.

Networked Connection

Before attempting a networked connection to the signal booster system consult with your IT support personnel for information concerning the correct IP address to use and any additional connectivity issues such as firewalls. Once you have the correct IP address you will need to direct connect to the booster system as discussed in the earlier section

of this appendix and reconfigure the booster LAN port with this new address. You can then connect the signal booster system using a straight-through CAT-5 cable to the networked environment and interface to it from a remote computer. **Figure A2** shows the proper way to interconnect the equipment for a networked connection as well as the pinout for a straight-thru CAT-5 cable.

REQUIRED EQUIPMENT

Cat-5 Straight-thru Cable

Laptop Computer with a network interface card installed. In addition, the JAVA run-time environment version 1.6.0 or later, and a web browser such as Internet Explorer must also be installed on the laptop.

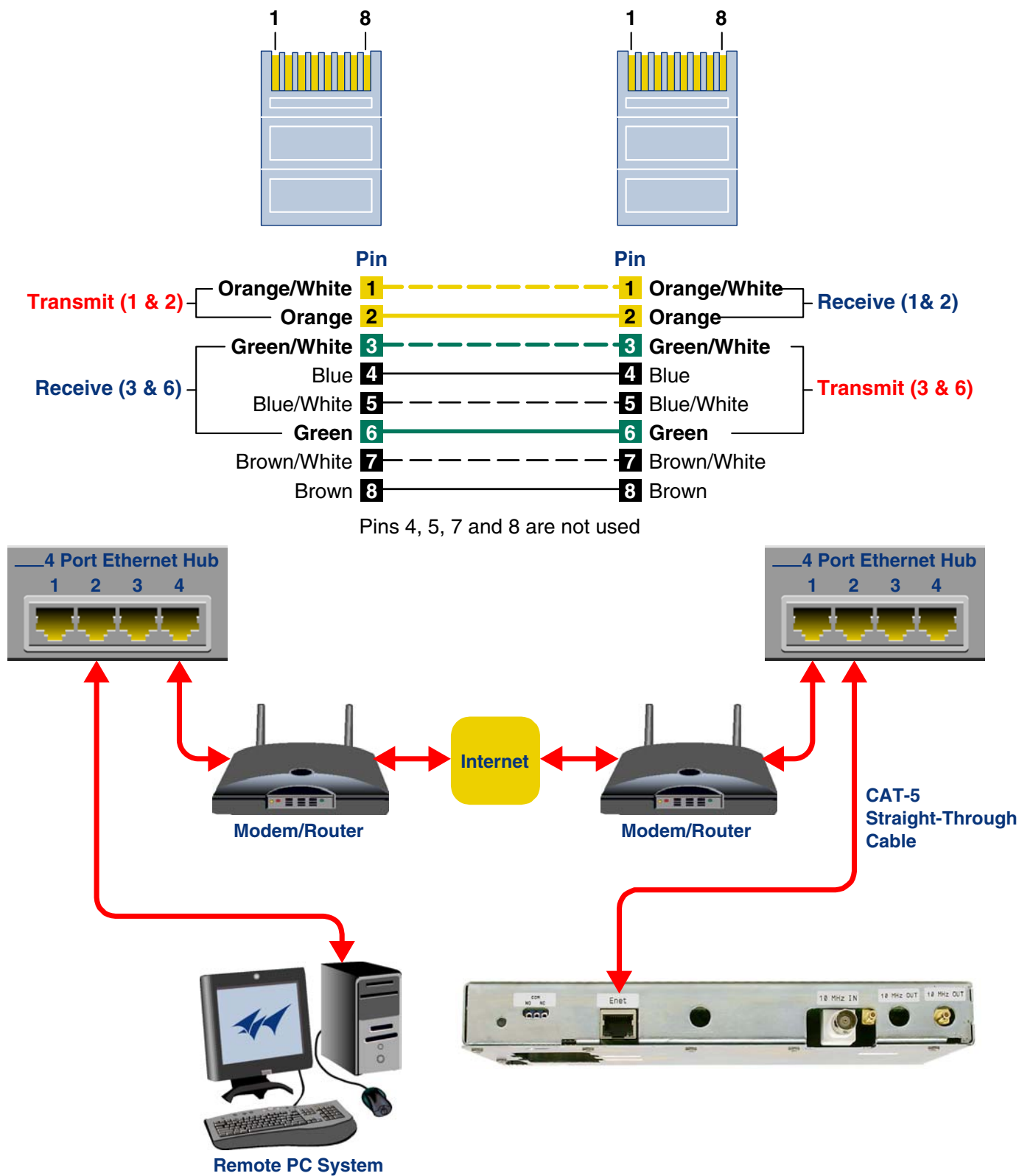


Figure A2: WAN connection to the booster using straight-through cable.

PROCEDURE

Before a networked connection can be established, the booster LAN Port must be changed to an IP address that's compatible with your network. If you are unsure how to determine this address check with your IT support personnel. To connect the booster LAN port to a networked environment and access the web page interface, perform the following steps;

- 1) Change the boosters LAN port IP address. To do this, direct connect your laptop to the booster as discussed in the earlier section of this appendix titled "Direct Connection" and follow steps 1 through 4.
- 2) Launch the configuration Applet in your web browser.
- 3) Click the "Admin" tab at the top of the interface display screen.
- 4) To be safe, take note of the settings currently displayed.
- 5) Select the "User Static IP" radio button.
- 6) Enter the following settings provided by your network administrator;
 - A) IP Address
 - B) Subnet Mask
 - C) Gateway Address
- 7) Click the "Submit" button to apply the changes.
- 8) Once the changes have been successfully applied close your web browser.
- 9) Launch the configuration Applet in your web browser using the newly entered IP address.

APPENDIX B

Changing Your Service Computers IP Address

When you initially direct connect your laptop service computer to the booster it will be necessary to change the computers IP address. The procedure for doing this varies depending upon your operating system. As an example, this appendix illustrates how to make the change using the Microsoft XP operating system. The procedure for other operating systems will vary slightly from this example. Consult with your IT support personnel if needed. To change the IP address (assuming the Microsoft XP operating system is being used) perform the following in a step-by-step fashion;

- 1) Select "Start" from the status menu.
- 2) Single click the "Control Panel" choice from the "Start" pop-up menu as shown in **Figure B1**.
- 3) From the "Control Panel" icon selections double click on the "Network Connections" icon. Refer to **Figure B2**.
- 4) When the "Network Connections" folder opens double click on the "Local Area Connection" icon. See **Figure B3**.
- 5) The "Local Area Connection Status" box will open. Single click the "Properties" tab as shown in **Figure B4**. **Note:** If you do not have the cable connected between the service computer and the booster front panel the "Local Area Connection Status" box will not open. Instead proceed to step 6.
- 6) The "Local Area Connection Properties" box will open. Use the arrow buttons to scroll down the list until the "Internet Protocol (TCP/IP)" choice is highlighted as shown in **Figure B5**. Click the "Properties" tab at the right-center of the box.
- 7) Select the "Use the following IP address" bubble. Make sure the circle is filled-in. Refer to **Figure B6**.
- 8) Enter the new IP address and subnet mask values as shown in **Figure B7**. To interface your computer to the signal booster use an IP address of "192.168.1.2" and a subnet mask of "255.255.255.0".
- 9) Click on the "OK" tab to initiate the changes. This completes the procedure. Close any open boxes.

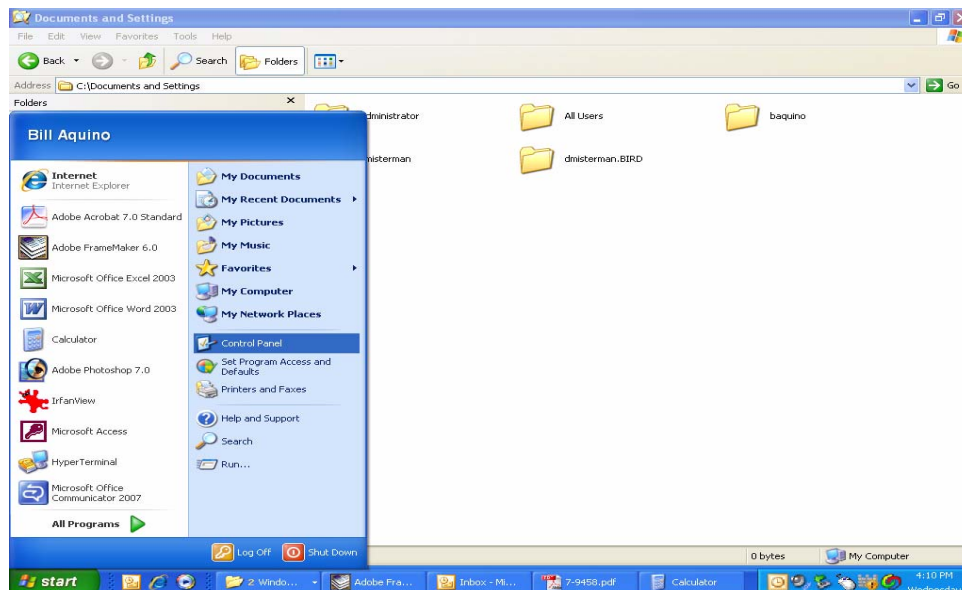


Figure B1: Choose the "Control panel" icon.

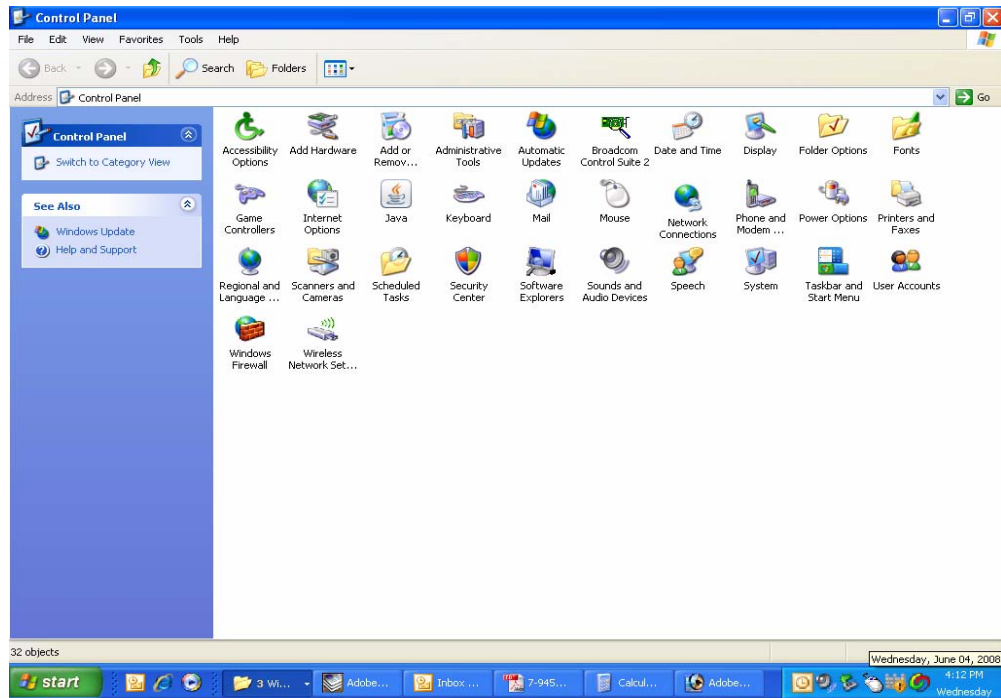


Figure B2: Select the “Network Connections” icon.

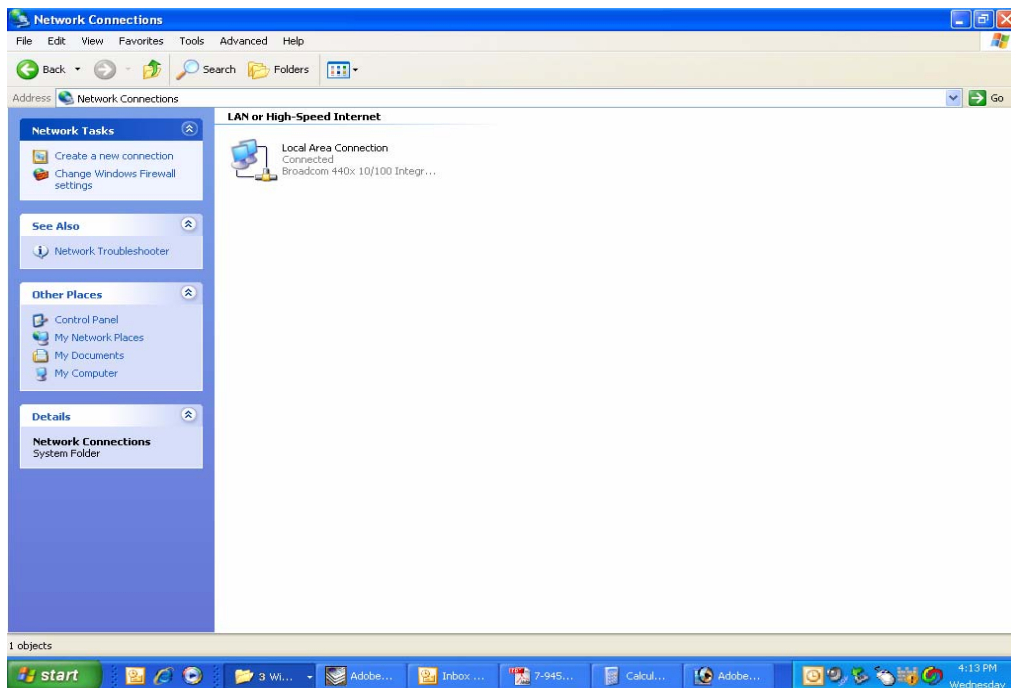


Figure B3: Select the “Local Area Connection” icon.

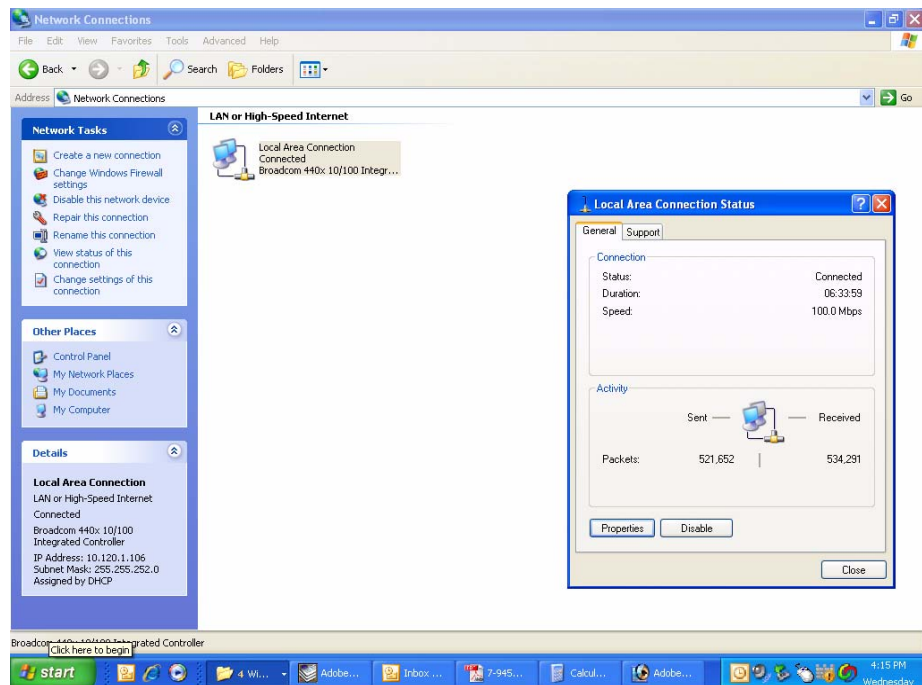


Figure B4: Select the “Properties” tab.

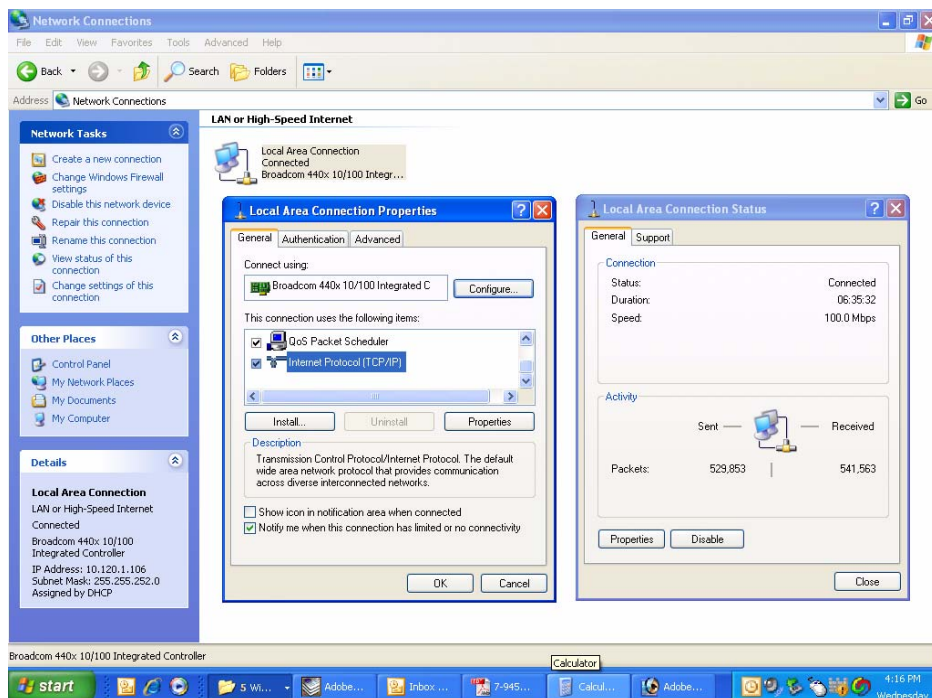


Figure B5: Make sure the “Internet Protocol (TCP/IP)” choice is highlighted. Then select “OK”.

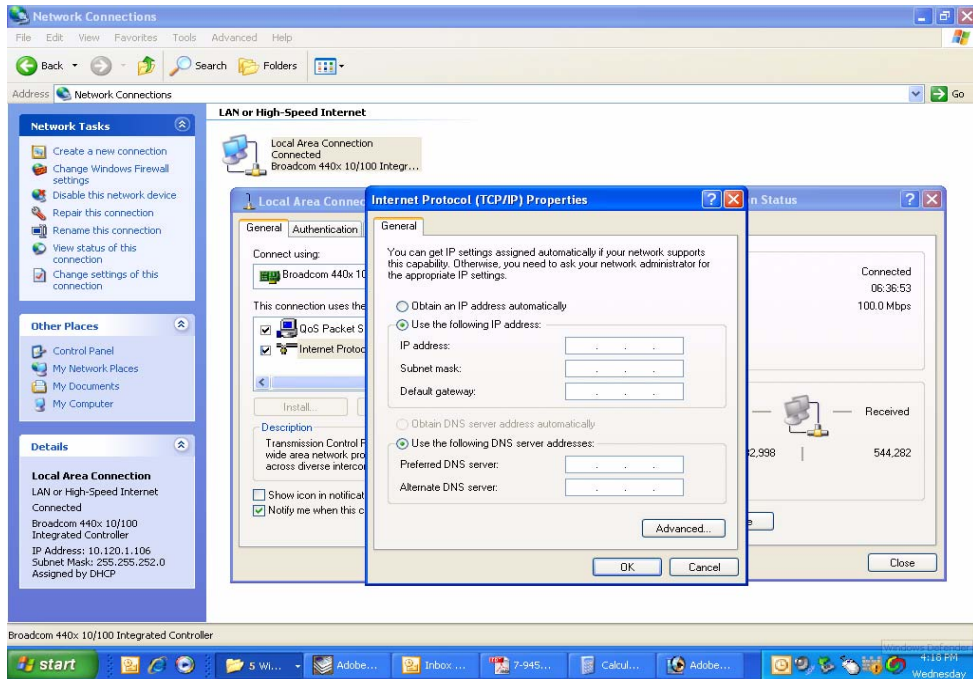


Figure B6: Select “Use the Following IP Address”.

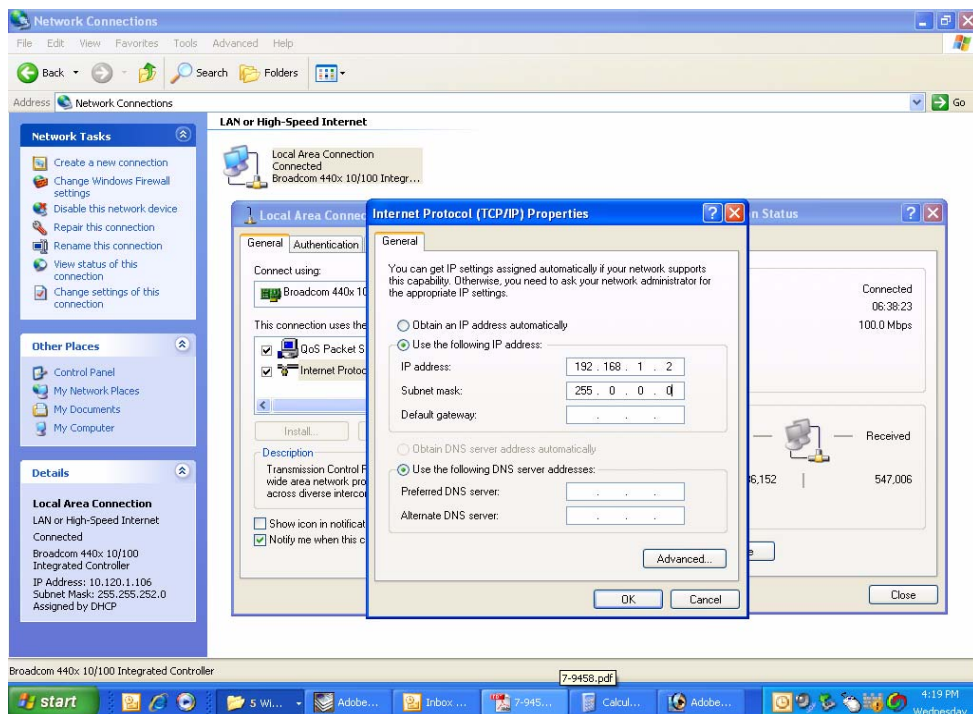


Figure B7: Enter the new IP Address and Subnet mask Values.

Celsius to Fahrenheit Conversion Table

CELCIUS	FAHRENHEIT
105	221.0
104	219.2
103	217.4
102	215.6
101	213.8
100	212.0
99	210.2
98	208.4
97	206.6
96	204.8
95	203.0
94	201.2
93	199.4
92	197.6
91	195.8
90	194.0
89	192.2
88	190.4
87	188.6
86	186.8
85	185.0
84	183.2
83	181.4
82	179.6
81	177.8
80	176.0
79	174.2
78	172.4
77	170.6
76	168.8
75	167.0
74	165.2
73	163.4
72	161.6
71	159.8
70	158.0
69	156.2
68	154.4
67	152.6

CELCIUS	FAHRENHEIT
66	150.8
65	149.0
64	147.2
63	145.4
62	143.6
61	141.8
60	140.0
59	138.2
58	136.4
57	134.6
56	132.8
55	131.0
54	129.2
53	127.4
52	125.6
51	123.8
50	122.0
49	120.2
48	118.4
47	116.6
46	114.8
45	113.0
44	111.2
43	109.4
42	107.6
41	105.8
40	104.0
39	102.2
38	100.4
37	98.6
36	96.8
35	95.0
34	93.2
33	91.4
32	89.6
31	87.8
30	86.0
29	84.2
28	82.4

CELCIUS	FAHRENHEIT
27	80.6
26	78.8
25	77.0
24	75.2
23	73.4
22	71.6
21	69.8
20	68.0
19	66.2
18	64.4
17	62.6
16	60.8
15	59.0
14	57.2
13	55.4
12	53.6
11	51.8
10	50.0
9	48.2
8	46.4
7	44.6
6	42.8
5	41.0
4	39.2
3	37.4
2	35.6
1	33.8
0	32.0
-1	30.2
-2	28.4
-3	26.6
-4	24.8
-5	23.0
-6	21.2
-7	19.4
-8	17.6
-9	15.8
-10	14.0
-11	12.2

CELCIUS	FAHRENHEIT
-12	10.4
-13	8.6
-14	6.8
-15	5.0
-16	3.2
-17	1.4
-18	-0.4
-19	-2.2
-20	-4.0
-21	-5.8
-22	-7.6
-23	-9.4
-24	-11.2
-25	-13.0
-26	-14.8
-27	-16.6
-28	-18.4
-29	-20.2
-30	-22.0
-31	-23.8
-32	-25.6
-33	-27.4
-34	-29.2
-35	-31.0
-36	-32.8
-37	-34.6
-38	-36.4
-39	-38.2
-40	-40.0
-41	-41.8
-42	-43.6
-43	-45.4
-44	-47.2
-45	-49.0
-46	-50.8
-47	-52.6
-48	-54.4
-49	-56.2
-50	-58.0

Return Loss vs. VSWR

Return Loss	VSWR
30	1.06
25	1.11
20	1.20
19	1.25
18	1.28
17	1.33
16	1.37
15	1.43
14	1.50
13	1.57
12	1.67
11	1.78
10	1.92
9	2.10

Watts to dBm

Watts	dBm
300	54.8
250	54.0
200	53.0
150	51.8
100	50.0
75	48.8
50	47.0
25	44.0
20	43.0
15	41.8
10	40.0
5	37.0
4	36.0
3	34.8
2	33.0
1	30.0

dBm = $10\log P/1\text{mW}$
Where P = power (Watt)

Insertion Loss

Input Power (Watts)

		50	75	100	125	150	200	250	300
Insertion Loss	3	25	38	50	63	75	100	125	150
	2.5	28	42	56	70	84	112	141	169
	2	32	47	63	79	95	126	158	189
	1.5	35	53	71	88	106	142	177	212
	1	40	60	79	99	119	159	199	238
	.5	45	67	89	111	134	178	223	267

Output Power (Watts)

Free Space Loss

Distance (miles)

Frequency (MHz)		.25	.50	.75	1	2	5	10	15
	150	68	74	78	80	86	94	100	104
	220	71	77	81	83	89	97	103	107
	460	78	84	87	90	96	104	110	113
	860	83	89	93	95	101	109	115	119
	940	84	90	94	96	102	110	116	120
	1920	90	96	100	102	108	116	122	126

Free Space Loss (dB)

Free space loss = $36.6 + 20\log D + 20\log F$
Where D = distance in miles and F = frequency in MHz



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