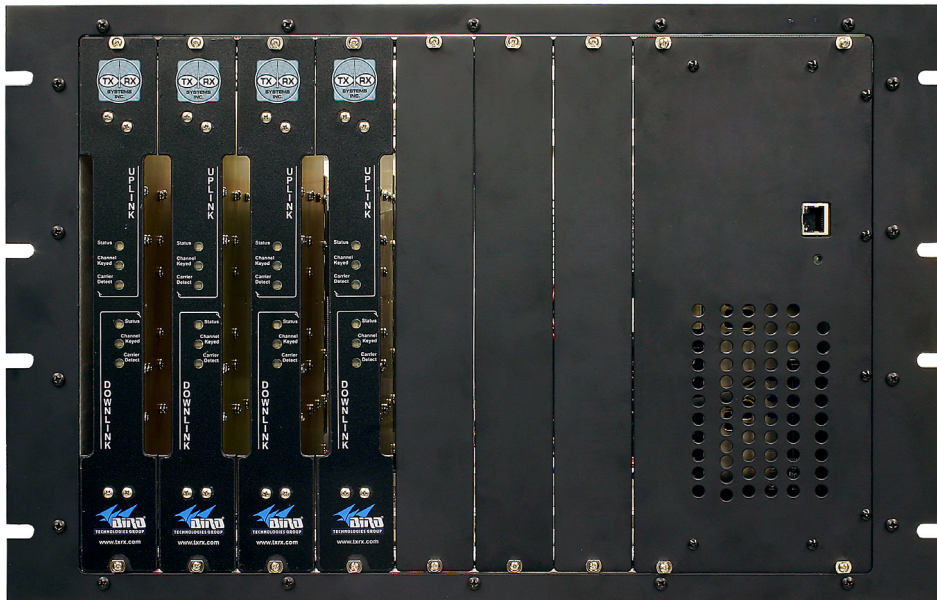# Installation and Operation Manual for the SBIII Channelized Signal Booster Model 611-70A

**Manual Part Number
7-9469**

SIGNAL *BOOSTER* III

Warranty

This warranty applies for one year 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.

TERMS AND CONDITIONS OF SALE

PRICES AND TERMS:
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.

QUOTATIONS:
Only written quotations are valid.

ACCEPTANCE OF ORDERS:
Acceptance of orders is valid only when so acknowledged in writing by the seller.

SHIPPING:
Unless otherwise agreed at the time the order is placed, seller reserves the right to make partial shipments for which payment shall be made in accordance with seller's stated terms. Shipments are made with transportation charges collect unless otherwise specified by the buyer. Seller's best judgement will be used in routing, except that buyer's routing is used where practicable. The seller is not responsible for selection of most economical or timeliest routing.

CLAIMS:
All claims for damage or loss in transit must be made promptly by the buyer against the carrier. All claims for shortages must be made within 30 days after date of shipment of material from the seller's plant.

SPECIFICATION CHANGES OR MODIFICATIONS:
All designs and specifications of seller's products are subject to change without notice provided the changes or modifications do not affect performance.

RETURN MATERIAL:
Product or material may be returned for credit only after written authorization from the seller, as to which seller shall have sole discretion. In the event of such authorization, credit given shall not exceed 80 percent of the original purchase. In no case will Seller authorize return of material more than 90 days after shipment from Seller's plant. Credit for returned material is issued by the Seller only to the original purchaser.

ORDER CANCELLATION OR ALTERATION:
Cancellation or alteration of acknowledged orders by the buyer will be accepted only on terms that protect the seller against loss.

NON WARRANTY REPAIRS AND RETURN WORK:
Consult seller's plant for pricing. Buyer must prepay all transportation charges to seller's plant. Standard shipping policy set forth above shall apply with respect to return shipment from TX RX Systems Inc. to buyer.

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.

Bird Technologies Group　　　　　　　　　　　　　**TX RX Systems Inc.**

Symbols Commonly Used

WARNING

ESD Electrostatic Discharge

CAUTION or ATTENTION

Hot Surface

High Voltage

Electrical Shock Hazard

Heavy Lifting

NOTE **Important Information**

Changes to this Manual

We have made every effort to ensure this manual is accurate. If you discover any errors, or if you have suggestions for improving this manual, please send your comments to our Angola, New York facility to the attention of the Technical Publications Department. This manual may be periodically updated. When inquiring about updates to this manual refer to the manual part number and revision number on the revision page following the front cover.

Contact Information

Sales Support at 716-217-3113

Customer Service at 716-217-3144

Technical Publications at 716-549-4700 extension 5019

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Figures and Tables

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For Class A Unintentional Radiators

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 resonable 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.

WARNING: **Changes or modifications which are not expressly approved by TXRX Systems Inc. could void the user's authority to operate the equipment.**

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.

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 TXRX model 611-70A channelized signal booster is designed to operate in the 450 to 512 MHz range. The system is based on a module design with each module capable of handling one uplink and one downlink channel simultaneously. The size of the system can be tailored to the customers needs by increasing or decreasing the number of modules 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 frequency via software interface. Specifications for the 611-70A family of channelized signal boosters are listed in **Table1**.

Down / Up Conversion

A channelized 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.

|	
Frequency Range	450 - 512 MHz
Number of Carriers per Channel	1 Uplink 1 Downlink
Nominal Passband Gain Downlink Uplink High Power Uplink Low Power	 120 dB 120 dB 100 dB
Channel Bandwidth	Standard 25 KHz; can be programmed to meet group delay requirements (User Selectable)
Rated Power Downlink Uplink High Power Uplink Low Power	 + 39 dBm ERP + 39 dBm ERP +18 dBm ERP
Maximum Input Level	-40 dBm
RF In/Out Impedance	50 Ohms
Alarms	Form-C Contacts Module LED's
Power	90 - 250 VAC, 50/60 Hz or 28 VDC (+/- 5%)
Operating Temperature Range	-30°C to +60°C
Table 1: Specifications	
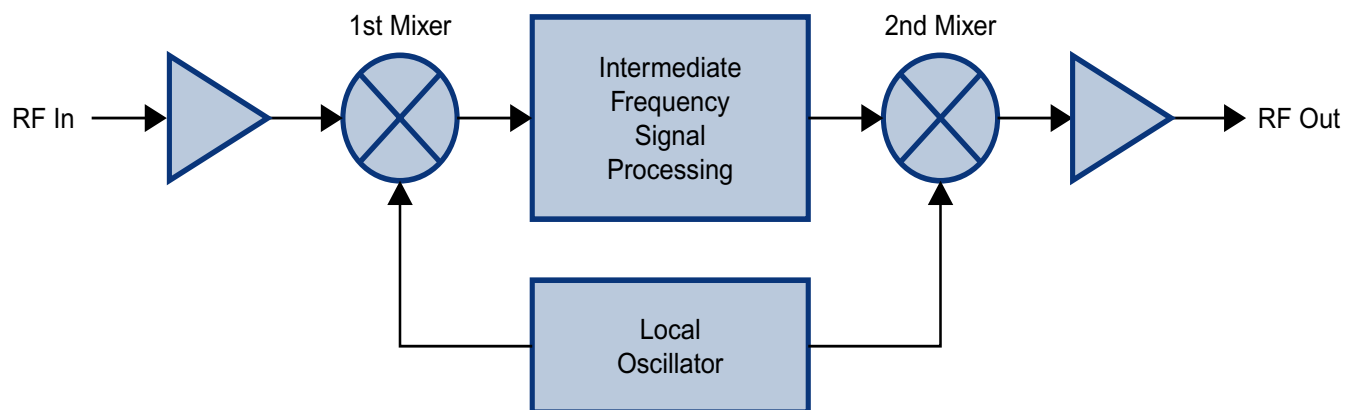
Figure 1: The down converter / up converter process.

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:

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

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

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

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

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

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 carrier immediately. It is the customers responsibility to file damage claims with the carrier 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 ventilation fans at the rear of the module cabinet are unobstructed. The various subassemblies within the module 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.

Installing the Booster

The channelized booster system is shipped to the customer in sections which must be assembled into the rack before use. The sections which must be installed in the rack for a standard system include the module cabinet and filters. High-power systems may also require the installation of a hybrid combiner assembly. To install the channelized booster into the rack perform the following steps.

1) Install the filter assemblies at the bottom of the rack using the supplied mounting screws. Face the cable connectors towards the back of the rack.

2) Install the module cabinet in the rack with the supplied screws. Place the module cabinet above the filters. Leave enough room above the module cabinet to install a second cabinet if required.

3) For high powered systems install the hybrid combiner assembly in the rack using the supplied mounting screws. For convenience its best to place the combiner in the middle of the rack between the filters and the module cabinet.

4) Interconnect the sections with the supplied cables. The cable ends are tagged at the factory before shipment to help you make the correct interconnections.

Connections

All RF cabling connections to the booster should be made and checked for correctness prior to powering up the system. Connectors are available from the filter assemblies for connection to the signal distribution system. Make sure the correct branch of the distribution 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.

The booster is designed to be plugged into a single phase AC line (90 - 250 VAC at 50/60 Hz) or a + 28 Volt DC source. A connector will be available at the back panel of the module cabinet for connecting either the AC or DC source voltage. At the time of manufacture the equipment will be configured for either AC or DC operation as per the customers request and only one of the connectors, AC or DC, will be available on the back panel. Additionally, the AC connector has a 5 Amp fuse for protection.

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 passband.

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 2**. 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 2, 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 may have to be narrowed and it's 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.
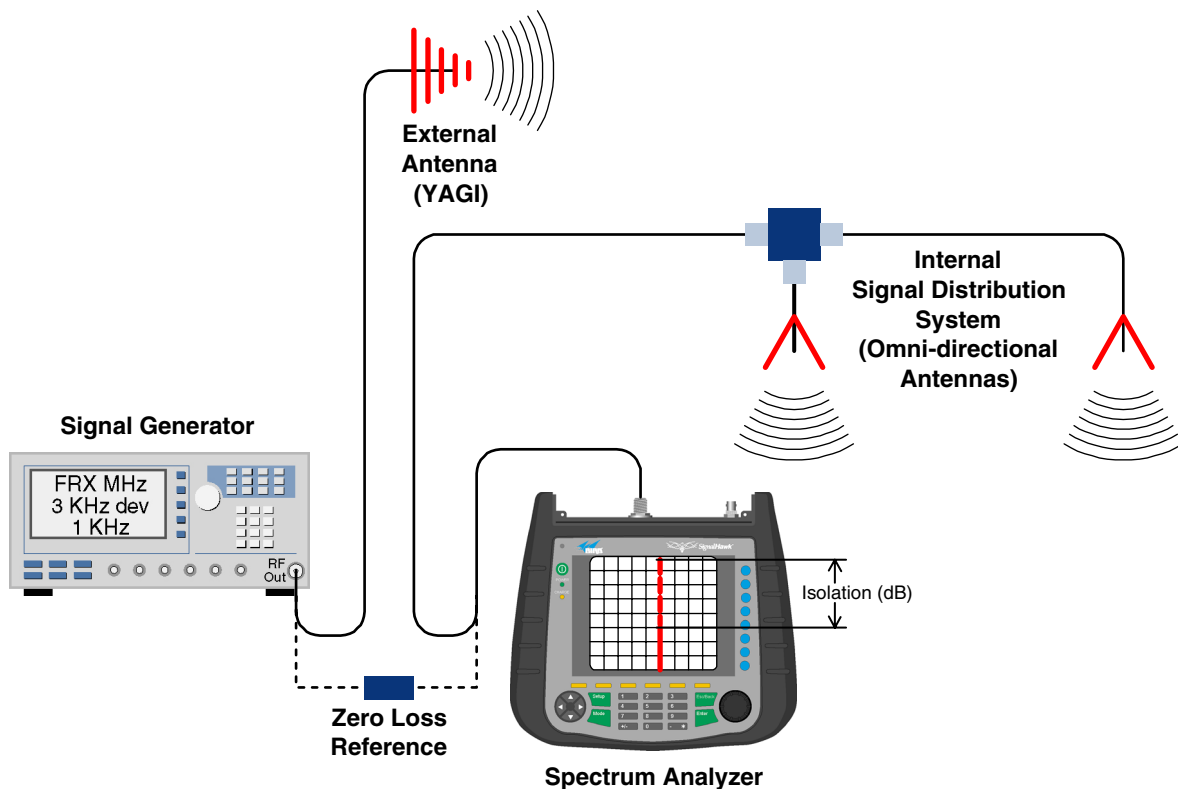
Figure 2: Typical test equipment interconnection for measuring antenna isolation.

RF EXPOSURE

To comply with FCC RF exposure compliance requirements, a separation distance of at least 100 cm must be maintained between the antenna of this device and all persons. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

FUNCTIONAL BLOCK DIAGRAM

Figure 3 is the functional block diagram of the standard channelized signal booster model 611-70A. **Figure 4A and 4B** show the front and rear views of the booster cabinet.

Downlink / Uplink Input Signals

Downlink and Uplink input signals are applied to a distribution amplifier. This is an ultra-low noise high linearity amplifier with a gain of 18.9 dB. Following the distribution amp is a 6-way power divider which is used to distribute the signal to individual channel modules within the booster cabinet. Downlink signals are applied to the down converter board of a downlink branch while uplink signals are applied to the down converter board of an uplink branch.

Downlink / Uplink Output Signals

Downlink output signals leave the channel module at the DL OUT connector and are applied to an active combiner. The active combiner amplifies and combines signals from multiple modules. Signals output from the active combiner are applied to the filter assemblies. Uplink output signals leave the channel module at the UL OUT connector and are also applied to an active combiner. The active combiner amplifies and combines signals from multiple modules. Following the active combiner are the filter assemblies.

The exact filter assemblies used in your channelized booster system will depend upon the overall communications system design and your particular RF environment. A system level drawing will be supplied with your booster which details the filter assemblies used and their interconnections.
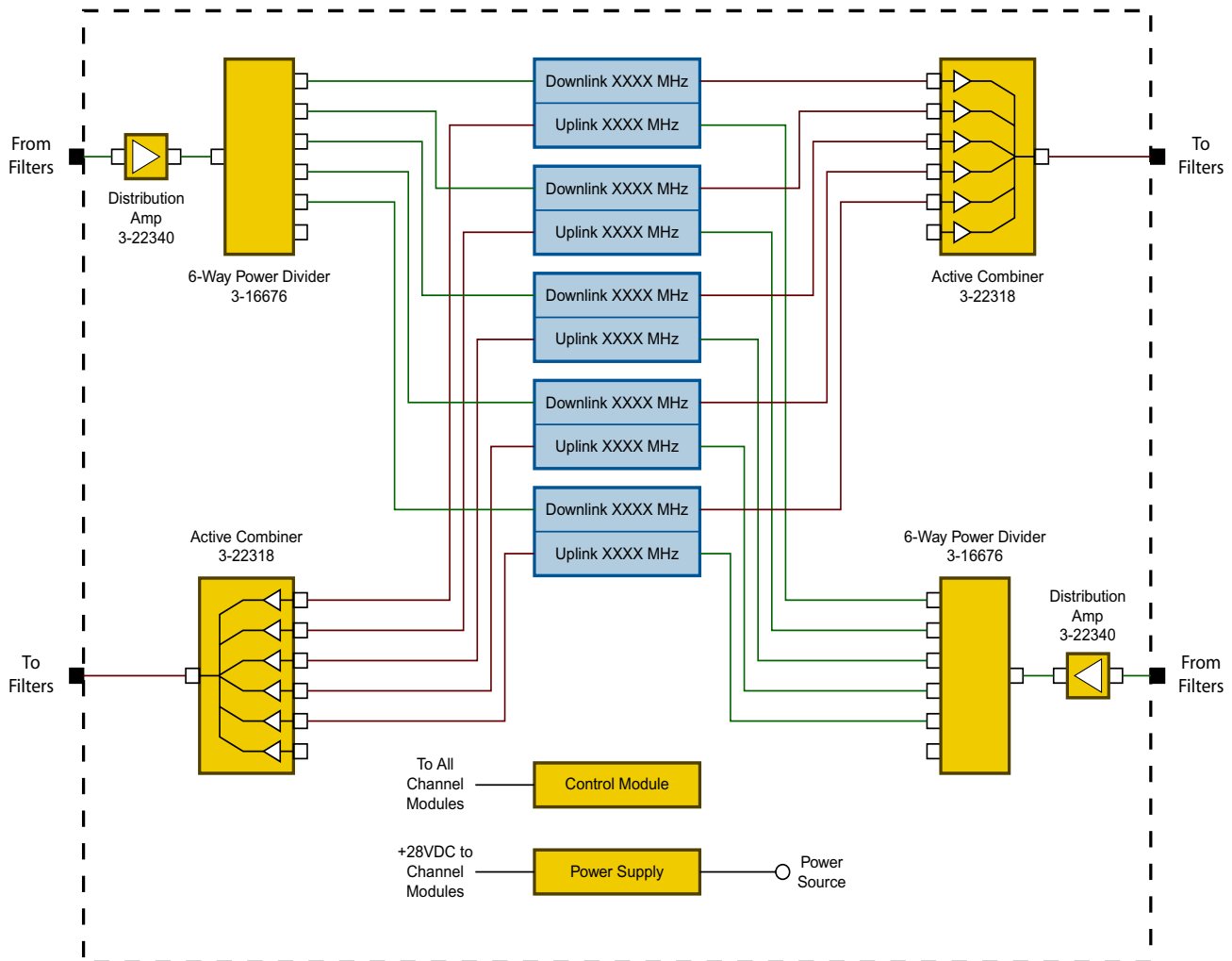
Figure 3: Functional block diagram of the standard channelized signal booster.
Five channel system shown as an example.

Channel Module

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 set of circuit boards are used in each branch. The uplink and downlink branches may be programmed to any frequency in the appropriate band, 450-470, 470-491, or 491-512 MHz. It is not recommended to program an uplink and downlink to the same frequency or feedback may occur. Within the channel module, input signals are down converted, digitized, and DSP filtering is performed. Then the analog signal is recreated and up converted to the original frequency.

OPERATION

Power is applied to the channelized booster by plugging in the AC or DC power cord (depending on how the system was configured for input power). There is a Power-ON LED located on the front of the unit (near the user interface connector) which will illuminate when power is applied to the cabinet. The ventilation fans at the rear of the cabinet will be continuously on when power is applied.

Module LED's

There are six LED indicators on the front of each channel module, 3 for the uplink branch and 3 for the downlink branch. The function of each of these indicator LED's are listed in **Table 2**.
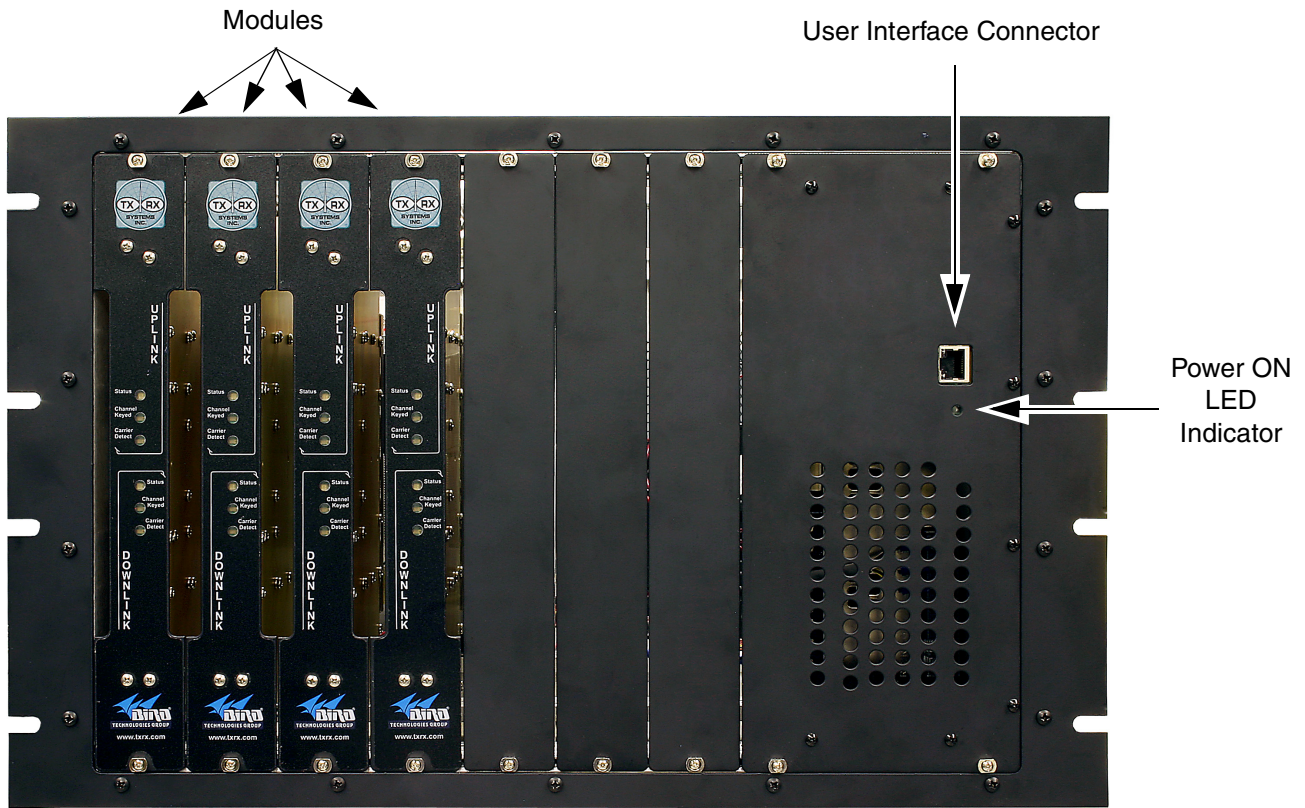
Modules

User Interface Connector

Power ON
LED
Indicator

Figure 4A: Booster cabinet front view (four channel system shown as an example).
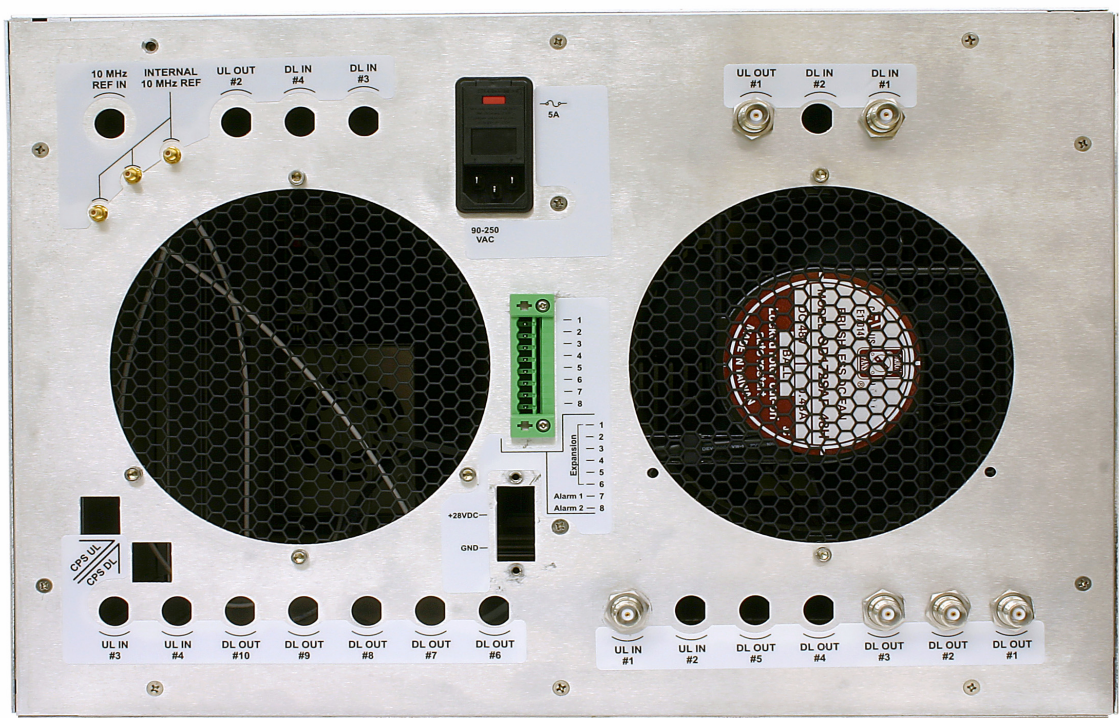
Figure 4B: Booster cabinet rear view.

Module Configuration

The channelized signal booster provides front panel Ethernet connectivity that allows access to a web-based interface for programming the individual modules. Programming will require connecting your laptop computer to the User Interface connector on the front of the booster cabinet. Figure 4A shows the interface connector (LAN). A standard Ethernet crossover cable is used to make the connection between your laptop and the booster cabinet. Refer to **Appendix A** at the back of this manual for detailed instructions on how to properly connect your computer to the LAN port of the booster.

Once your laptop is properly connected to the signal booster, if password protection is enabled, the password request box will appear in your web browser as shown in **Figure 5**. Type in your password and press the OK button. The password box will disappear and the web-based interface screen will appear as shown in **Figure 6**.
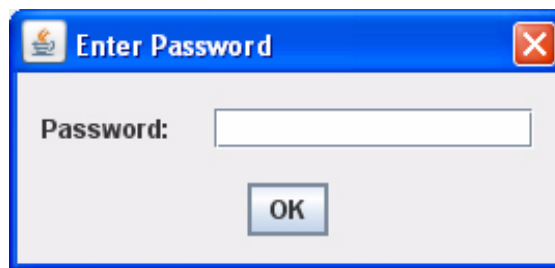
Figure 5: Enter your password.

NOTE

Once your password has been entered and validated a 15 minute inactivity timer is started. If the user does not make any changes to the web page interface the system will re-arm security once the inactivity timer expires. The user will then need to re-enter the password.

Status LED	
Green (flashing fast)	Unit Identification (for several seconds only on command from User Interface)
Orange (slow flash)	Unprogrammed unit (no settings set)
Off	Unit disabled (no output from module)
Red (slow flash)	External reference selected but is absent or not locked
Red (solid ON)	Alarm of some kind (current or temp out of limits, LO not locked, filter not set)
Green (solid ON)	all is OK
Channel Keyed	
Slow Flash	Unprogrammed unit (no settings set)
ON	Unit will transmit signal if CTCSS and DCS disabled then signal present on input above carrier squelch threshold Else if one is enabled then it means that the selected CTCSS or DCS code has been detected
OFF	Unit will not transmit signal
Carrier Detect	
Slow Flash	Unprogrammed Unit (no settings set)
ON	Signal present on input above carrier squelch threshold
OFF	No signal present on input above carrier squelch threshold
Table 2: Channel Module Indicator LED's	

Figure 6: The Web-Page Interface screen.

Password protection is disabled by default when your system leaves the factory. To enable password protection for your system perform the following steps;

1) Launch the web page interface in your web browser.

2) Click the "Admin" tab at the top of the interface screen (see figure 6).

3) Enter your password. Write your password down somewhere for safe keeping in case you forget it. If you do forget your password you will need to contact Bird Technologies Group to obtain a default password.

4) Click the submit button to apply the changes.

The web-based interface screen is divided into two functional areas which include a row of command buttons running down the left side of the screen as well as display/interface areas on the right side of the screen. The web-based interface is designed to interact with one module at a time. The module which has been selected for interaction appears in the top of the drop down box in the upper left corner of the screen underneath the heading "Channel Modules". To change the selected module click on the arrow to display the full drop down box, as shown in **Figure 7**. Scroll down the list until the desired module is highlighted and click on it.
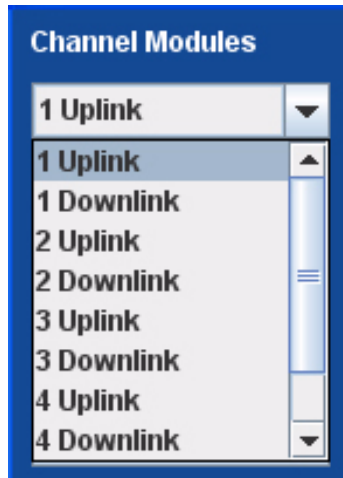
Figure 7: Selecting a module.

COMMAND BUTTONS

Clicking on a command button (located on the extreme left hand side of the screen) 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 on the web-page interface screen to the selected booster module, but only after the button is pressed.

MESSAGE BARS

There are two message bars at the bottom of the web-page screen. The rightmost message bar displays connection status messages and the leftmost message bar displays system status messages. The connection status messages reveal the relationship between the LAN interface and the control board within the booster cabinet. Without a properly functioning connection you will not be able to interface with the control board or individual modules. All of the possible connection status messages are listed in **Table 3** along with a brief description of what each message means. The system status messages vary depending on what aspect of the booster system you are interacting with. All of the possible system status messages are listed in **Table 4**.

DISPLAY/INTERFACE AREAS

The display/interface area of the web-based interface is divided into five functional areas including;

Settings - this is a user interactive area where the field engineer can program the operating characteristics of the selected module. 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 which can be displayed in a message box by clicking on the question mark symbol next to the parameter. The parameters are self-explanatory. Remember the changes you make are only applicable to the selected channel module. 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 module itself.

Filters - this area allows you to modify the characteristics of the digital filtering used by the channel module. Parameters that can be changed include the occupied bandwidth, adjacent channel offset, passband ripple, adjacent channel rejection, and delay.

When the "Design Filter" button is pressed a custom design template will be displayed as shown in **Figure 8**. Remember the changes you make are only applicable to the selected channel module. 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 module itself.

Information - this area is non-interactive and is used to display basic information about the selected channel module.

Data - this area is also non-interactive and displays detailed technical parameters. The polling function can be changed between either enabled or disabled. Click on the bubble next to the function to change the polling status. In the example shown in figure 6 the polling is currently disabled. To enable polling you would point at the bubble next to the enable label and right click.

Status - this area is used to give a quick overview of eight channel module parameters. Each parameter can be in one of three states; alert, active or inactive. Each state is color coded as shown in figure 6.

Message	Context
Ready to connect	The Applet has finished loading and has not attempted to connect to the control board.
Network connection established	Upon successful connection to the control board.
Not connected	The Applet either is not connected or has failed to connect to the control board.
No network connection	Unable to reconnect to the control board.
Table 3: Connection status messages.	

Message	Context
Obtained startup data successfully	Connection to control board has been established and data and settings for the active module uplink/downlink have been successfully obtained.
Failed to connect to booster	Initial attempt to connect to the control board failed.
Network client restarting	Reconnecting to the control board.
Network connection restarted	Reconnected to the control board successfully.
The page was reloaded	Successful reload of settings or data for a page (Admin, System, CPS)
Submitting network settings	User clicked the "Submit" button to send the network settings to the control board.
Failed to submit network settings	An error occurred while sending network settings to the control board.
Network settings updated successfully	The network settings have been sent and applied successfully.
Password settings updated successfully	The password settings have been sent and applied successfully.
Failed to update password settings	An error occurred while sending password settings to the control board.
Requesting device readings	Requesting data from the control board for the active module (temperature, current measurements, etc...)
Obtained device readings	Obtained data successfully
Submitting system settings	User clicked the "Submit" button to send the system settings to the control board.
System settings submitted	The system settings have been sent and applied successfully.
Failed to submit system settings	An error occurred while sending system settings to the control board.
Data Sequencer : Error submitting query	General communication message error.
Sending the factory reset command	User clicked the "Factory Reset" button.
The factory reset command was sent	The control board has restored factory default settings.
Sending the device ID command	User clicked the "Send ID" button.
The device ID command was sent	The control board has executed the "Send ID" command.
Sending the device clear errors command	User clicked the "Clear Errors" button.
Table 4 (part 1): System status messages.	

| Message	Context
The device clear errors command was sent	Errors have been cleared successfully.
Submitting the settings	User clicked the "Submit" button on the channel modules page.
The settings have been submitted successfully	The settings have been sent to the control board and saved successfully.
Reloading the admin values	User clicked the "Reload" button on the admin page.
Reloading the system values	User clicked the "Reload" button on the System page.
Reloading the CPS values	User clicked the "Reload" button on the CPS page.
Starting the test signal with X deviation	User clicked the "Start Test Signal" button.
Stopping the test signal	User clicked the "Stop Test Signal" button.
Test signal started with X deviation	The test signal has been started for the active channel module.
Test signal stopped	The test signal was stopped.
Enabling module	The user clicked the "Enable Uplink/Downlink" button.
Disabling module	The user clicked the "Disable Uplink/Downlink" button.
Module enabled	The module has been enabled successfully.
Module disabled	The module has been disabled successfully.
Requesting startup data	Polling channel module settings and data for the selected uplink/downlink.
Requesting device list	Requesting a list of uplinks and downlinks from the control board.
The software failed to find any devices. Please check your cables.	No uplinks or downlinks have been found.
Obtained device list	A device list has been gathered. initialization will continue.
Disabling all channel modules	The user clicked the "Disable All" button.
Disable all modules command sent	The command to disable all modules has been sent. Results will be displayed in a message box.
Failed to clear errors	An error occurred while clearing errors.
Failed to restore factory settings	An error occurred while restoring factory settings.
Failed to send device ID	An error occurred while identifying a module uplink/downlink.
Failed to start the test signal	An error occurred while starting the test signal.
Failed to stop the test signal	An error occurred while stopping the test signal.
Failed to save settings	An error occurred while saving settings.
Failed to acquire module list	An error occurred while acquiring a list of uplink/downlinks.
Failed to enable module	An error occurred while enabling a module uplink/downlink.
Failed to disable module	An error occurred while disabling a module uplink/downlink.
Failed to load settings	An error occurred while loading settings.
Error loading filter coefficients	An error occurred while loading filter coefficients from a resource file.
Failed to acquire filter settings	An error occurred while reading filter settings from a module uplink/downlink.
Table 4 (part 2): System status messages.	
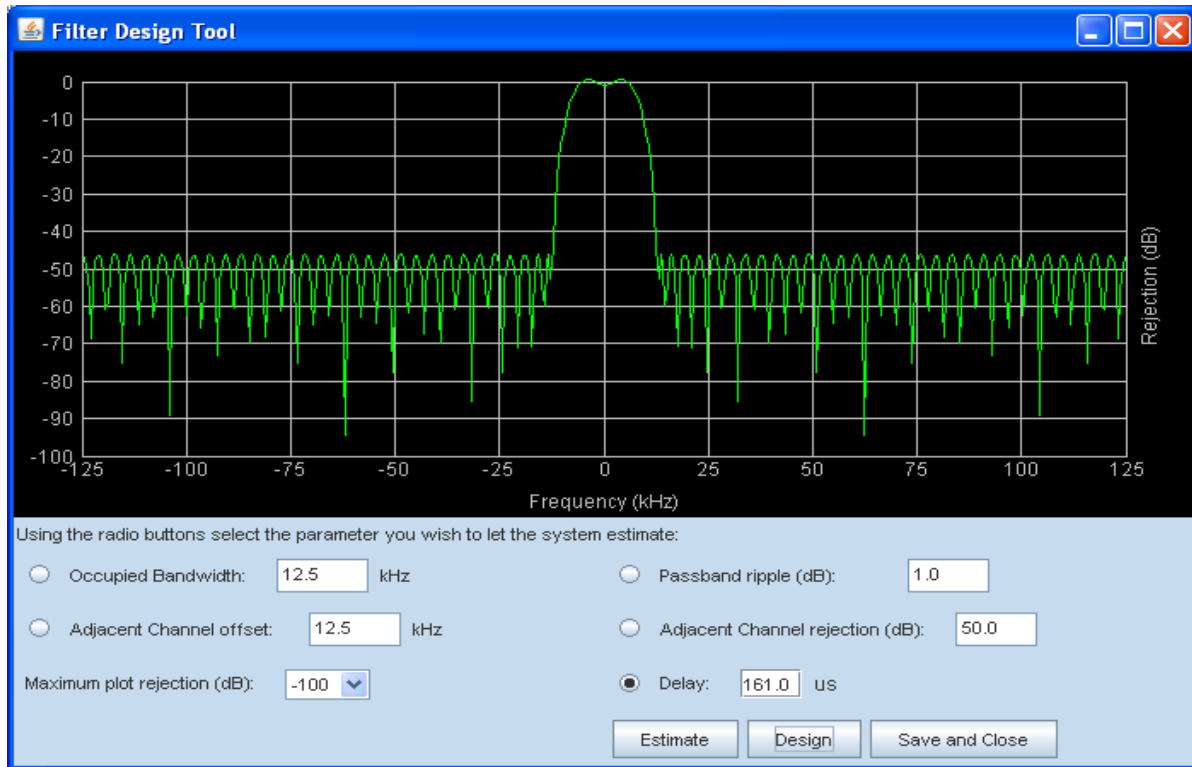
Figure 8: The design filter interactive display screen.

ADDITIONAL INTERACTIVE PAGES

In addition to interfacing with the individual channel modules the web-based interface also provides access to two additional areas of interaction including Admin and System. Access to these additional areas is through the tabs at the very top of the display/interactive area. When a tab is clicked the page associated with that tab will be displayed and you can interact with the functions.

Admin - the admin page allows the user to change the boosters network settings and 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.

System - the system page lists the applet and control board software versions. A customer designated location name can be recorded and the number of modules installed in the system is displayed. There is also a system logbook available on this page.

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 channelized 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.

> **NOTE**
> 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.
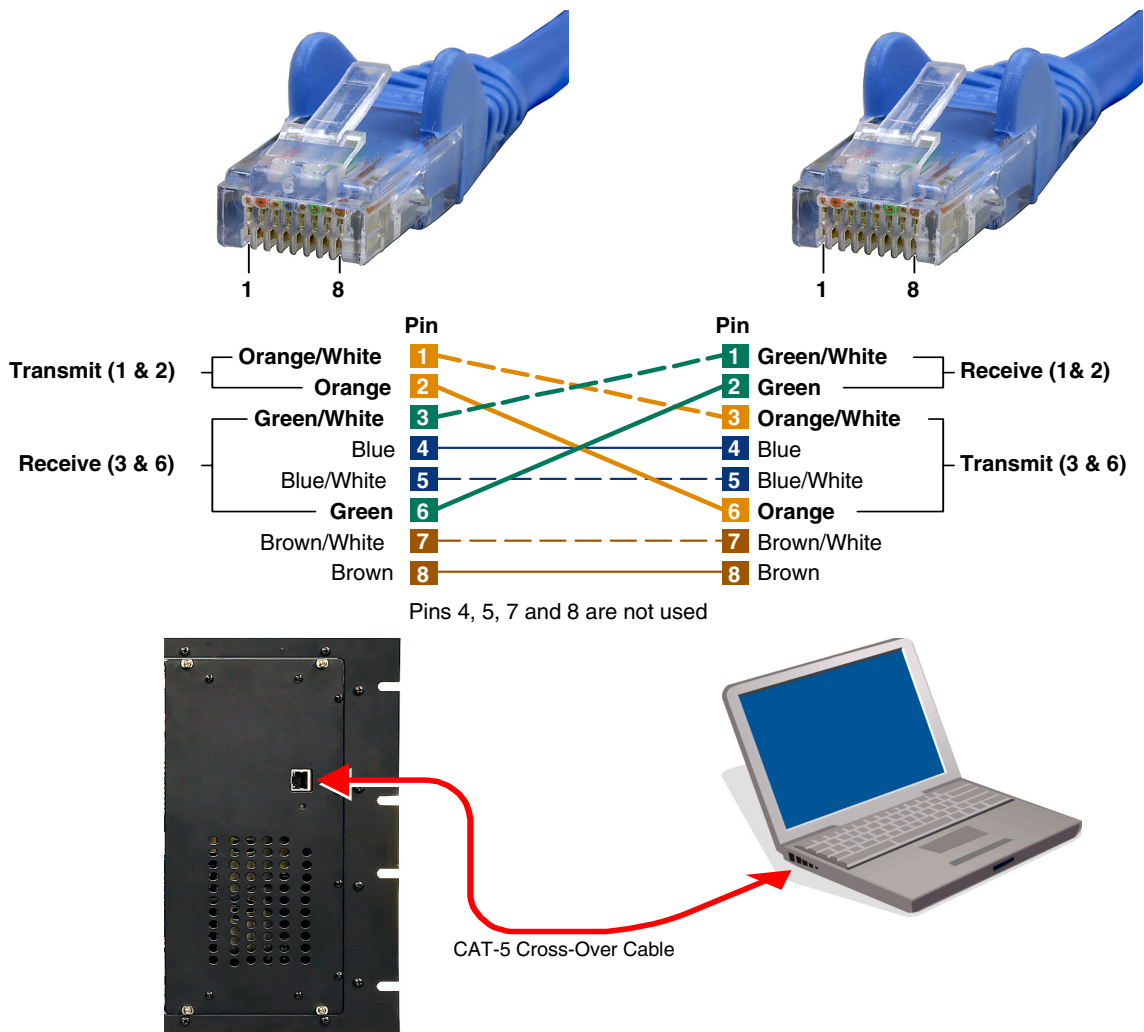
Pin   **Pin**

Transmit (1 & 2) — Orange/White   1 ⟶ 1   Green/White — Receive (1& 2)
Orange   2 ⟶ 2   Green
Receive (3 & 6) — Green/White   3 ⟶ 3   Orange/White
Blue   4 —— 4   Blue — Transmit (3 & 6)
Blue/White   5 —— 5   Blue/White
Green   6 ⟶ 6   Orange
Brown/White   7 —— 7   Brown/White
Brown   8 —— 8   Brown

Pins 4, 5, 7 and 8 are not used

CAT-5 Cross-Over Cable

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

5) Launch your web browser software on the laptop.

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
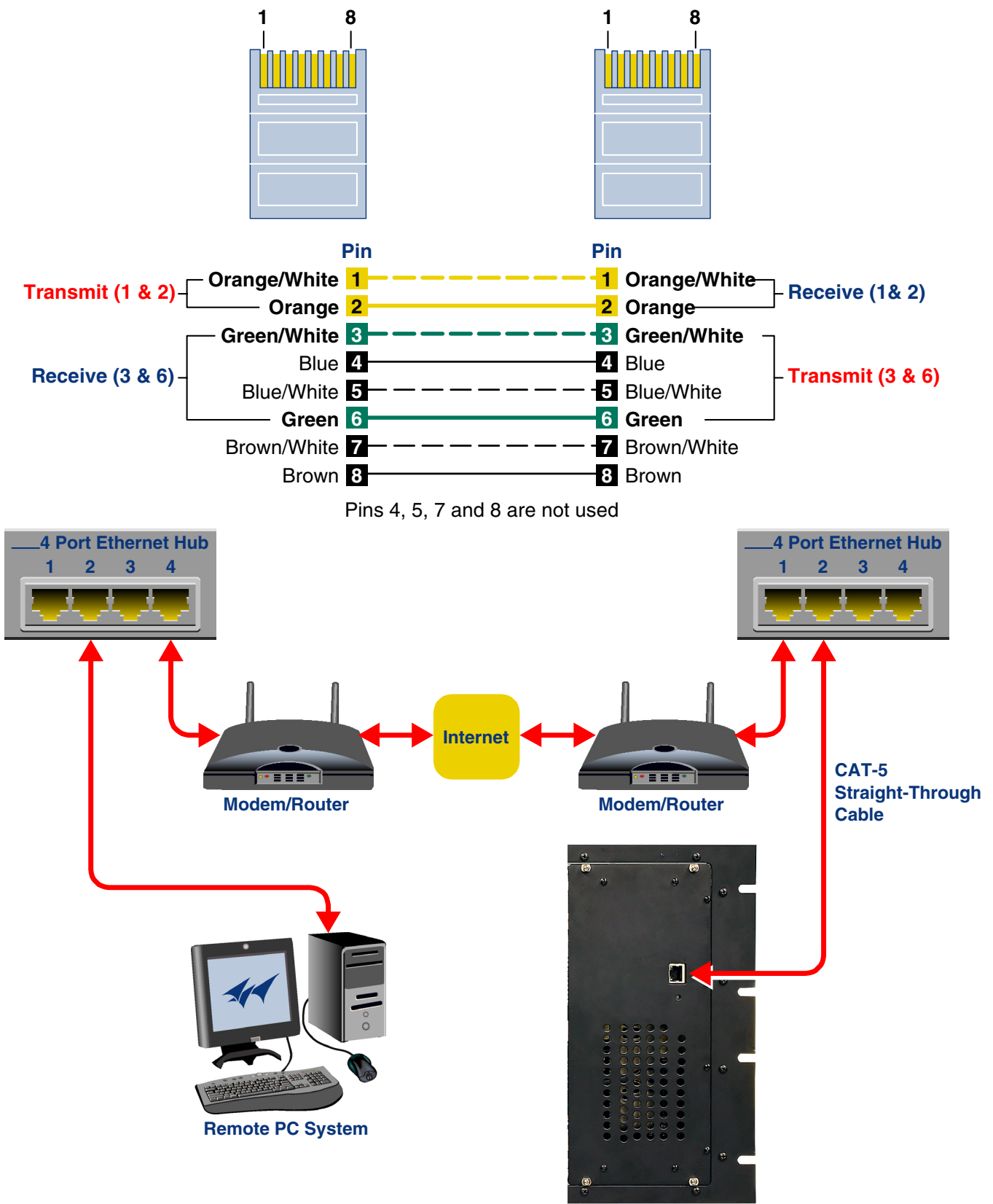Laptop Computer with a network interface card installed. In addition, the JAVA run-time environ-

Pin   **Pin**

Transmit (1 & 2) — **Orange/White** 1 - - - - - - 1 **Orange/White** — **Receive (1 & 2)**

Orange 2 ────── 2 **Orange**

Green/White 3 - - - - - - 3 **Green/White**

Receive (3 & 6) — Blue 4 ────── 4 Blue — **Transmit (3 & 6)**

Blue/White 5 - - - - - - 5 Blue/White

Green 6 ────── 6 **Green**

Brown/White 7 - - - - - - 7 Brown/White

Brown 8 ────── 8 Brown

Pins 4, 5, 7 and 8 are not used

4 Port Ethernet Hub
1 2 3 4

4 Port Ethernet Hub
1 2 3 4

Internet

Modem/Router   **Modem/Router**

**CAT-5
Straight-Through
Cable**

Remote PC System

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

ment version 1.6.0 or later, and a web browser such as Internet Explorer must also be installed on the laptop.

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**".

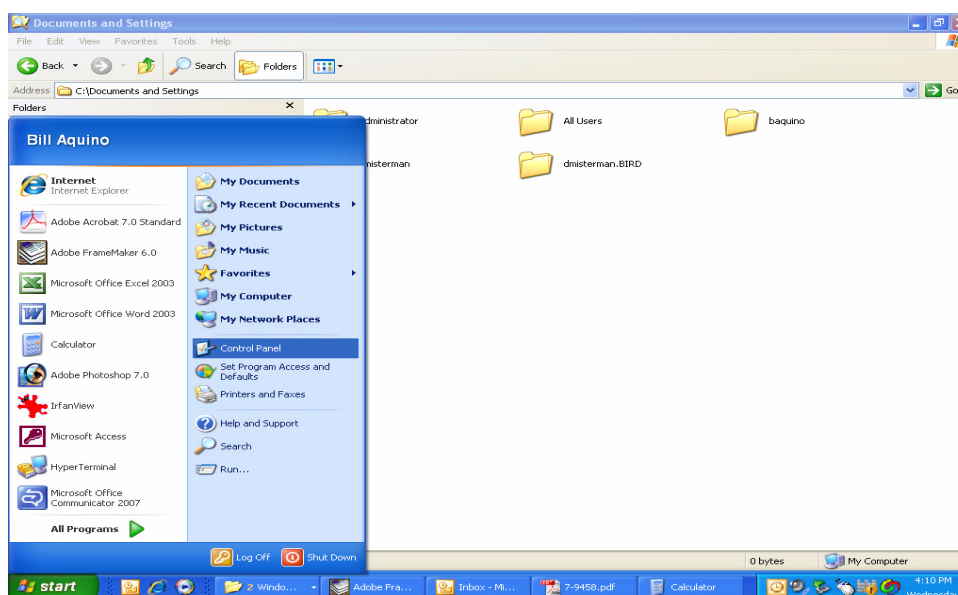9) Click on the "OK" tab to initiate the changes. This completes the procedure. Close any open boxes.

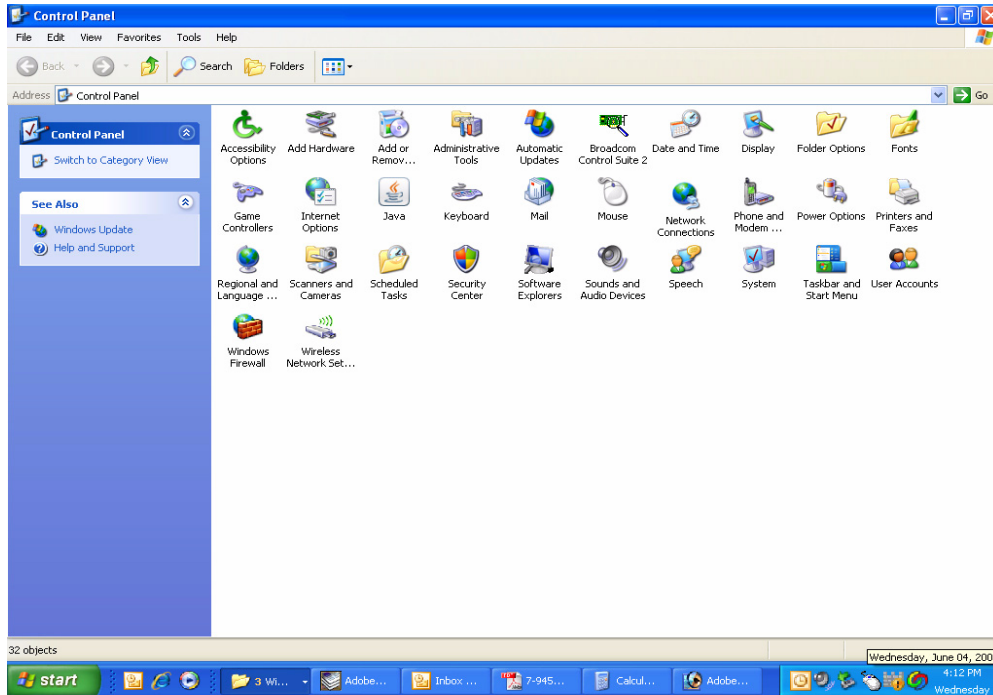**Figure B1:** Choose the "Control panel" icon.
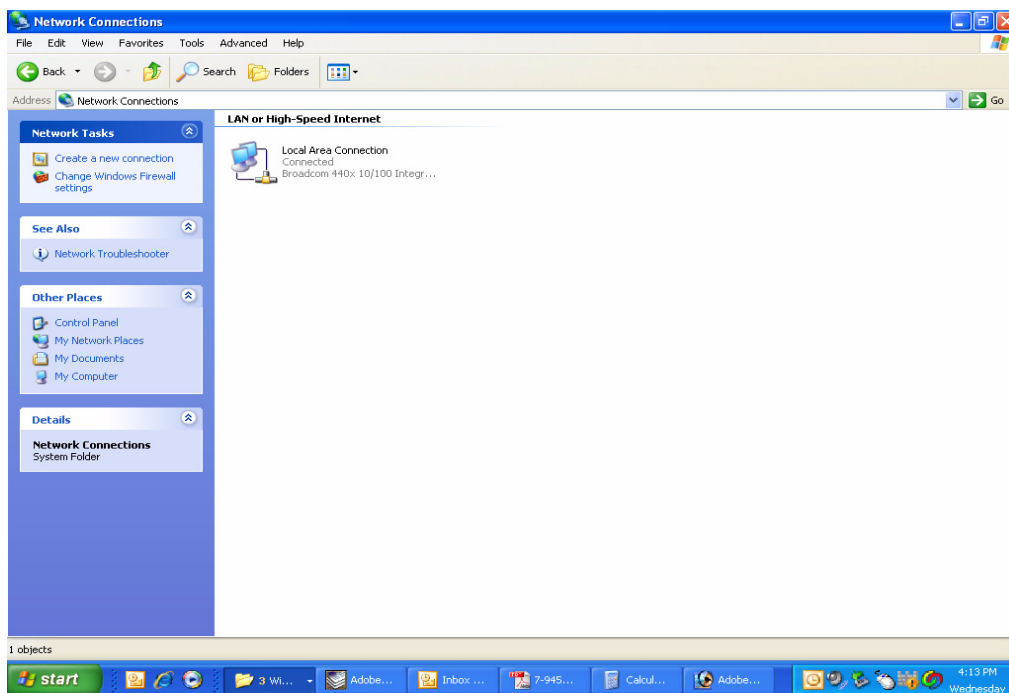
Figure B2: Select the "Network Connections" icon.

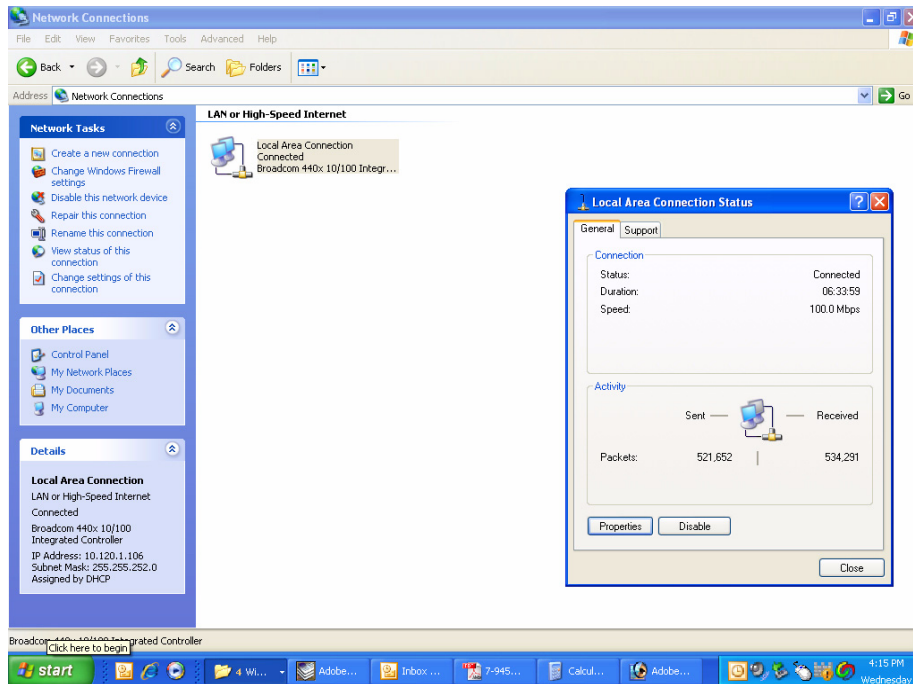**Figure B3:** Select the "Local Area Connection" icon.
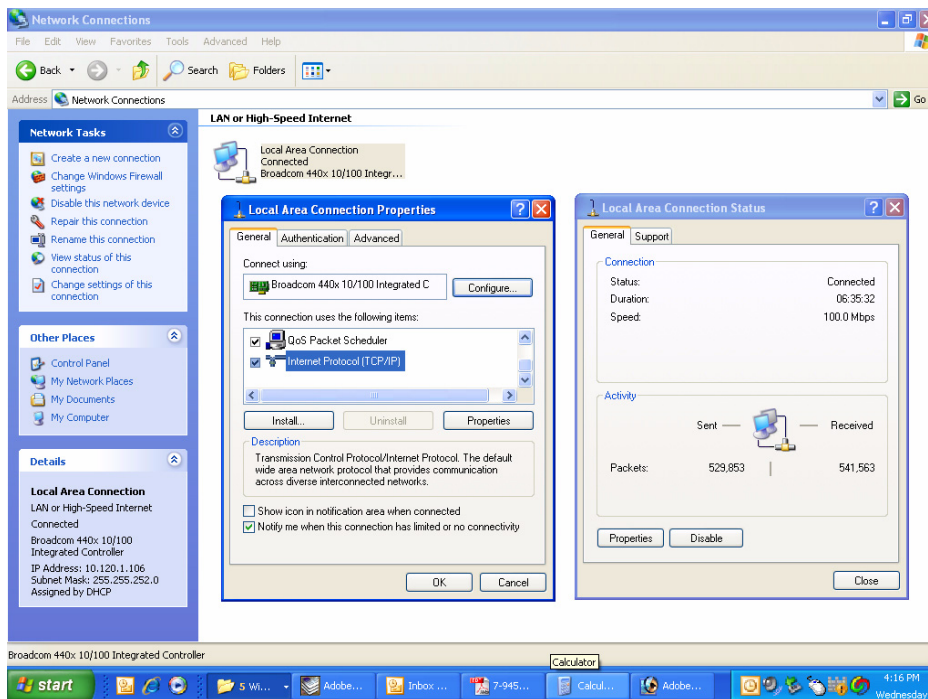
Figure B4: Select the "Properties" tab.

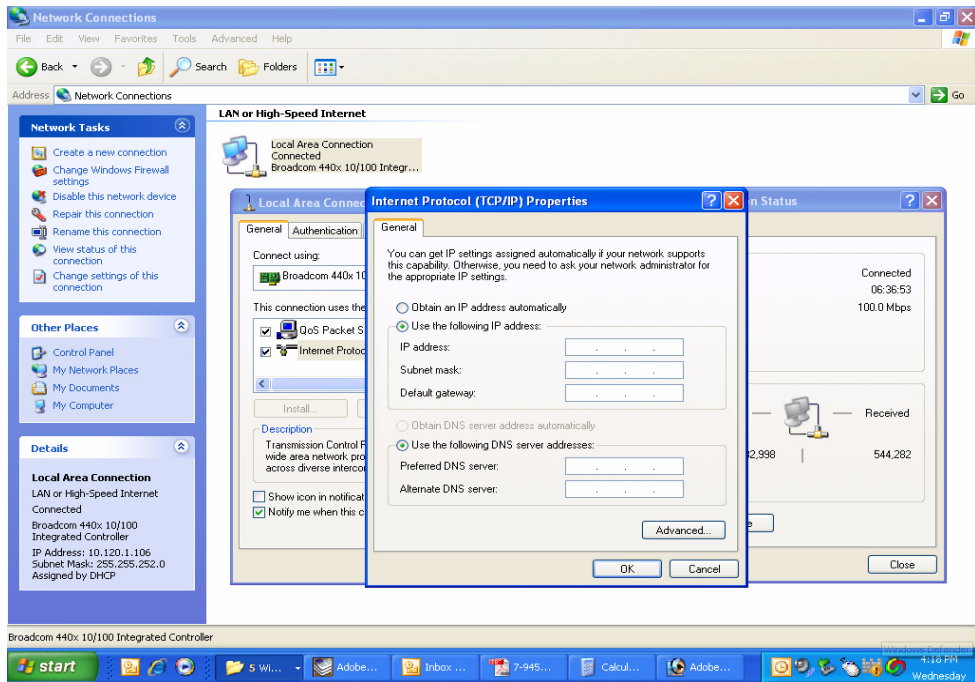**Figure B5:** Make sure the "Internet Protocol (TCP/IP)" choice is highlighted. Then select "OK".
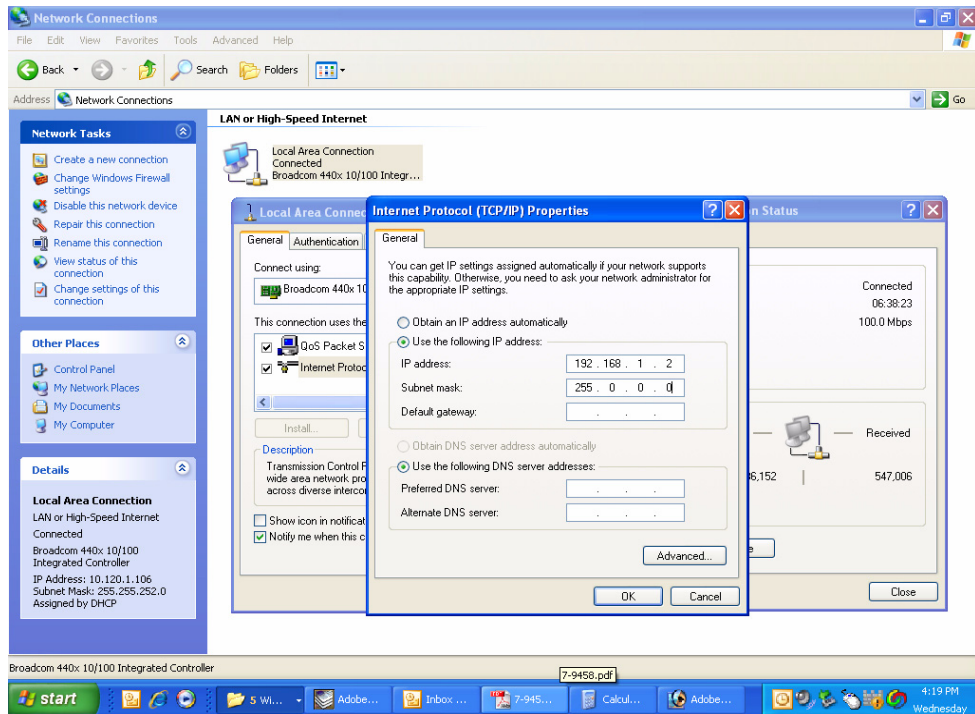
Figure B6: Select "Use the Following IP Address".

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

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 = 10log P/1mW
Where P = power (Watt)

Insertion Loss

Input Power (Watts)

Insertion Loss	50	75	100	125	150	200	250	300
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 + 20log D + 20log F
Where D = distance in miles and F = frequency in MHz