

**Installation and Operation Manual**

**NXU-2A  
Network Extension Unit**

Designed and Manufactured by:

**Raytheon Company**

5800 Departure Drive

Raleigh, NC 27616

Email: [voip.sales@raytheon.com](mailto:voip.sales@raytheon.com)

## FEDERAL COMMUNICATIONS COMMISSION

### (FCC) COMPLIANCE NOTICE:

#### RADIO FREQUENCY INTERFERENCE NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case users will be required to correct the interference at their own expense.

#### CAUTION

Changes or modifications to this equipment not expressly approved by Raytheon could void the user's authority to operate this equipment.

#### NOTICE

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#### Raytheon Company

5800 Departure Drive

Raleigh, NC 27616

Email: [voip.sales@raytheon.com](mailto:voip.sales@raytheon.com)

Phone: (919) 790-1011

Fax: (919) 790-1456

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## *Glossary*

<i>Glossary</i>		
<b>COR</b>	Carrier Operated Relay	A signal from a receiver that gives a positive indication that a carrier or signal is being received and that the receiver is unscelched. It has the same function as Carrier Operated Squelch (COS).
<b>COS</b>	Carrier Operated Squelch	See COR.
<b>DHCP</b>	Dynamic Host Configuration Protocol	A method of automatically assigning an IP address to an Ethernet device at startup time. This method conserves IP addresses in networks where devices do not stay connected permanently.
<b>DSP</b>	Digital Signal Processor	A type of microprocessor, which is optimized for signal processing functions.
<b>IP</b>	Internet Protocol	A protocol designed to allow communications between computers on different networks.
<b>LAN</b>	Local Area Network	A group of computers and associated devices that share a common communications line, typically within a small geographic area.
<b>PTT</b>	Push-to-talk	A signal to a radio transmitter, which controls the actual transmission of radio frequency energy over the air. Also called a keyline.
<b>TCP</b>	Transmission Control Protocol	An additional layer to the Internet Protocol, which ensures delivery of packets, sent across the network. It can handle situations such as lost packets or packets arriving out of order.
<b>UDP</b>	User Datagram Protocol	An additional layer to the Internet Protocol which does not ensure delivery of packets but which offers much lower transmission overhead than TCP.
<b>VoIP</b>	Voice over Internet Protocol	Also called Voice over Packet (VoP), a method of sending voice communications across a digital network.
<b>WAN</b>	Wide Area Network	A network, which is spread out over a wider area, such as around a city or state. It may include other public or shared networks.

# 1 General Information

## 1.1 Scope

This instruction manual provides the information necessary to install and operate the NXU-2A Network Extension Unit.

## 1.2 Description

### 1.2.1 NXU General

NXU stands for Network Extension Unit. NXU units connect communications equipment to a digital network using VoIP (Voice over Internet Protocol) technology. NXU units use our proprietary technology, embodied in a family of hardware and software products that enable voice communications devices to be interconnected via a network across the room or around the world. VoIP is a means of digitizing voice signals and transmitting them over a digital network, such as a LAN, WAN, or even the Internet itself.

#### 1.2.1.1 Advantages of NXU Technology

- Enables the design of low cost, extremely flexible radio communications networks.
- Multiplexes voice audio and data over a standard Ethernet network.
- Uses existing network infrastructure eliminating the need for leased lines and microwave sites.
- Eliminates the requirement for pilot tones and other in-band signaling.
- Facilitates centralized control of a communications network from a single computer.

### 1.2.2 NXU-2A Description

The NXU-2A is intended for use with radio communications consoles, communications radios, and Raytheon products such as the ACU-1000 Interconnect Unit. A general-purpose stand-alone device interfaces full duplex audio, one RS-232 port, and three status bits onto an Ethernet network. A pair of NXU-2As can form a simple system that creates a transparent communications link between the two. The NXU-2A at one end (usually the equipment end) is the *server*; the one at the other end (usually the operator end) is the *client*. The audio, RS-232, and status bits are transparently transferred between the server and the client.

Any NXU-2A can be set up as a server or as a client depending on system needs. The RS-232 interface allows for different baud rates between the server and the client.

The NXU-2A monitors its network connection and adjusts its parameters automatically to provide optimum performance under varying network conditions. Front panel indicators display the unit's status. Initial configuration is done through the NXU-2A's serial port, but

following this initial setup, a standard web browser can be used over the network to view and change the unit's settings and also to perform diagnostic tests.

Designed for years of continuous operation in mission-critical applications and remote locations, the NXU-2A has no moving parts and requires no periodic shutdown or maintenance. Start up upon power on is typically 5 seconds.

### 1.3 Network Details

The NXU-2A is a 10/100BASE-T Ethernet device and each unit has a unique Ethernet address and an RJ-45 physical interface jack. A 10/100BASE-T device operates at either 10 or 100 Mbps and interconnects to an Ethernet hub or switch using standard CAT 5 twisted pair cable, also known as UTP. The maximum cable length between an NXU-2A and its hub port is 100 meters. With the right connective equipment (recommended or supplied by Raytheon), the NXU-2A's Ethernet port can be linked with virtually any LAN, WAN, or the Internet, no matter which topology or cabling system is in use.

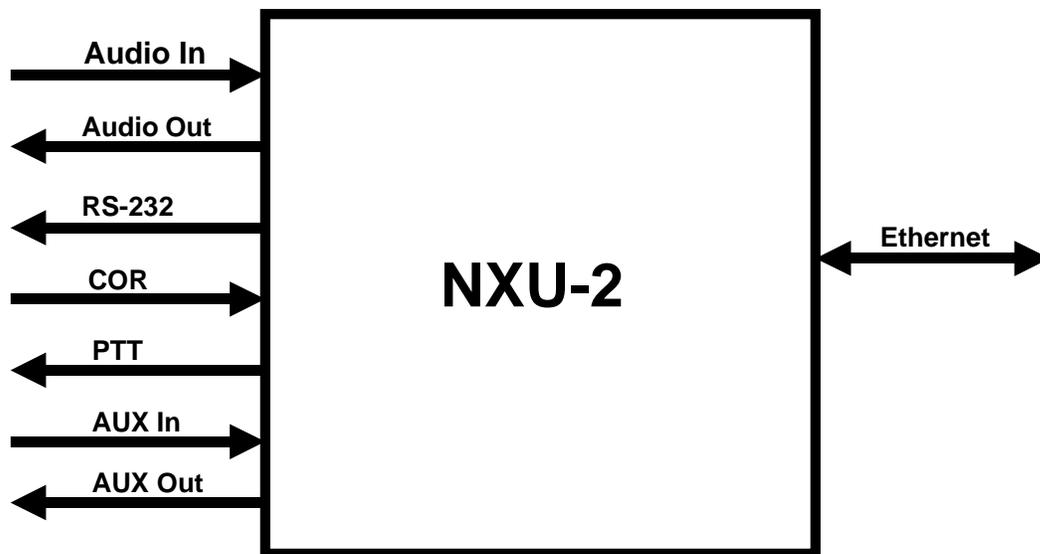
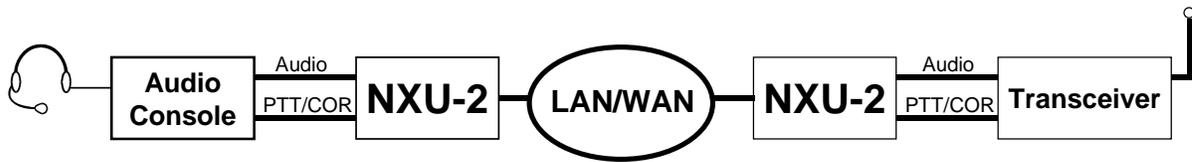


Figure 1-1 NXU-2A Basic Block Diagram

### *1.4 Applications*

Figure 1-2 below illustrates a basic NXU-2A application in which a communications transceiver is connected via a network to a remote audio console. The transmit/receive audio and PTT/COR signals are transported digitally across the network and appear at the other end. The network data transfer is transparent to the user, and the operator at the audio console can use the radio as if it were located right beside him.



*Figure 1-2 Simple NXU-2A Radio System*

## 1.5 Specifications

<i>Table 1-1 Specifications</i>	
<b>RX Audio Input</b>	
Input impedance	Balanced 47k ohms, transformer coupled.
Input Level	Incoming signals adjustable from -30 to +11 dBm to set 0 dBm nominal input; +15 dBm clipping. +20 dB boost configurable
Frequency Response	10 Hz to 3600 Hz +/- 2dB.
<b>TX Audio Output</b>	
Output Impedance	Unbalanced 10 ohms, AC Coupled.
Output Level	Adjustable from -30 to +11 dBm, 0 dBm nominal factory default; +15 dBm clipping into a 600 ohm load.
Frequency Response	10 Hz to 3350 Hz +/- 2dBm.
Distortion	0.5% or less (excepting Vocoder).
<b>COR &amp; AUX Input</b>	
Input impedance	47k ohm pull-up to +5V.
Polarity	COR: Selectable active low or active high; AUX Inputs: Active low.
Threshold	+2.5V nominal.
Protection	Up To + 100 VDC.
<b>PTT and AUX Output</b>	
Output Type	Open drain, 47k ohm pull-up to +5V.
Maximum Sink Current	100 mA.
Max Open Circuit Voltage	+60 VDC.
<b>Serial Interface</b>	
Interface Type	RS-232, Asynchronous, Full Duplex.
Baud Rates	300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps.
Connector	DB-9 Male, Standard PC/AT DCE Pinout.
<b>Network Interface</b>	
Interface Type	10/100BASE-T Ethernet, 10 or 100 Mbps; RJ-45 Connector.
Protocols	Audio and status-UDP, RS-232- TCP.
Audio Vocoder	Selectable, 13, 16, 24, 32, or 64 Kbps data rate.
<b>General/Environmental</b>	
Programming/Configuration	Web, Telnet, or RS-232 Interface.
Front Panel	Power, Link Active, Channel Active, and Audio Level LEDs.
Rear Panel	Audio/Data, Serial, Network, and Power Connectors.
Audio/Data Connector	DB-15 Female.
Input Power (12 VDC Nom)	+11 to +15 VDC @ 0.5A max. Wall-cube supplied operates on 100-240 VAC.
Power Connector	Coaxial Jack, 2.5 mm ID, 5 to 5.5 mm OD; Center Pin Positive; Reverse Polarity Protected.
Size and Weight	1.4" H x 8"W x 6.8"D (3.55 x 20.3 x 17.3 cm). 1.1 lbs. (0.5kg).
Temperature	Operating: -20 to +60 degrees C. Storage: -40 to +85 degrees C.
Humidity	Up to 95% @ 55 degrees C.
Shock	MIL-STD-810D, Method 516.3, Procedure VI.
Vibration	MIL-STD-810D, Method 514.3, Category 1.

**1.6 Equipment and Accessories Supplied**

<i>Table 1-2 Equipment and Accessories Supplied</i>																	
<b>NXU-2A Shipping Level - P/N 5041-200000</b>																	
<b>Quantity</b>	<b>Item</b>	<b>P/N</b>															
1	NXU-2A Final Assembly Includes the NXU-2A enclosure containing these modules: NXU-2A PCB Assembly 5041-201100	5041-201000															
1	DC Power Supply [100 to 240 VAC, 47-63 Hz to +12 VDC, 500 mA ]	1620-120600															
1	Operation & Maintenance Manual	5041-200200															
1	NXU-2A Setup Utility CD	5041-200100															
1	Accessory Kit	5000-600150															
	Consisting of: <table border="0"> <thead> <tr> <th><i>Qty</i></th> <th><i>Part Number</i></th> <th><i>Description</i></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0313-070000</td> <td>Network Cable, 6 ft.</td> </tr> <tr> <td>1</td> <td>0313-080000</td> <td>RS-232 Serial Cable, 6 ft.</td> </tr> <tr> <td>1</td> <td>0360-015100</td> <td>Connector, cable type, D-15 plug</td> </tr> <tr> <td>1</td> <td>0313-080515</td> <td>Audio Crossover Adapter</td> </tr> </tbody> </table>		<i>Qty</i>	<i>Part Number</i>	<i>Description</i>	1	0313-070000	Network Cable, 6 ft.	1	0313-080000	RS-232 Serial Cable, 6 ft.	1	0360-015100	Connector, cable type, D-15 plug	1	0313-080515	Audio Crossover Adapter
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1	0313-080515	Audio Crossover Adapter															

**1.7 Optional Equipment - Not Supplied**

<i>Table 1-3 Optional Equipment - Not Supplied</i>		
<b>Item</b>	<b>P/N</b>	<b>Description</b>
N/A	N/A	N/A
At this time, there are no options for the NXU-2A		

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## **2 Installation**

### ***2.1 General***

This section provides the instructions for unpacking, inspection, installation and set-up. Also included are directions for reshipment of damaged parts or equipment.

### ***2.2 Unpacking and Inspection***

After unpacking the unit, retain the carton and packing materials until the contents have been inspected and checked against the packing list. If there is a shortage or any evidence of damage, do not attempt to use the equipment. Contact the carrier and file a shipment damage claim. A full report of the damage should also be reported to the Customer Service Department. The following information should be included in the report:

- Order Number
- Equipment Model and Serial Numbers
- Shipping Agency
- Date(s) of Shipment

The Customer Service Department can be reached by phone at (919) 790-1011, by fax at (919) 790-1456. Upon receipt of this information, we will arrange for repair or replacement of the equipment.

### ***2.3 Reshipment of Equipment***

If it is necessary to return the equipment to the manufacturer, a Returned Material Authorization (RMA) number must first be obtained from us. This number must be noted on the outside of the packing carton and on all accompanying documents. When packing the unit for reshipment, it is best to use the original packaging for the unit; if this is not possible, make sure that adequate packing material is used to prevent excessive shocks during transport and handling.

Shipment should be made prepaid consigned to:

**Raytheon**  
**Customer Service Department**  
**5800 Departure Drive**  
**Raleigh, North Carolina 27616**  
**USA**

Plainly, mark with indelible ink all mailing documents as follows:

**GOODS RETURNED FOR REPAIR**

Mark all sides of the package:

**FRAGILE - ELECTRONIC EQUIPMENT**

Inspect the package prior to shipment to be sure it is properly marked and securely wrapped.

## 2.4 Installation Overview

**NOTE:** NXU-2A installation requires knowledge of Ethernet network fundamentals as well as a basic understanding of Internet Protocol (IP). As with any network-connected device, improperly configuring and installing the NXU-2A could disrupt proper network operation. Please seek the assistance of your network administrator or other knowledgeable person if you are unsure about how your network is configured.

Six steps are needed to properly install the NXU-2A. These steps are:

1. Determine the IP address, subnet mask, and (if applicable) the gateway address for the unit. You may have to contact the network administrator for your organization to obtain this information.

**NOTE:** Operation of the NXU-2A is not possible without the information requested above.

2. Provide the proper primary power for the unit.

**NOTE:** Use only the Class 2 power supply provided with the equipment.

**REMARQUE:** Utilisez seulement la Class 2 de la generation electrique qui est inclus avec l'equipement.

3. Interconnect the unit with the communications system via the NXU-2A's rear panel connectors. J7 provides the audio and control lines necessary to interface the NXU-2A to your audio equipment.
4. Configure the unit's operational parameters per Sections 3.2 Serial Port Configuration through 3.6 Network Configuration.
5. Connect the unit to your Ethernet network using the supplied Ethernet cable per Section 2.8.4 Network Connection, J3
6. Set the input and output audio levels per Section 4.4.2 Input/Output Level Adjustments.

The NXU-2A is then ready to use.

### *2.5 Installation Considerations*

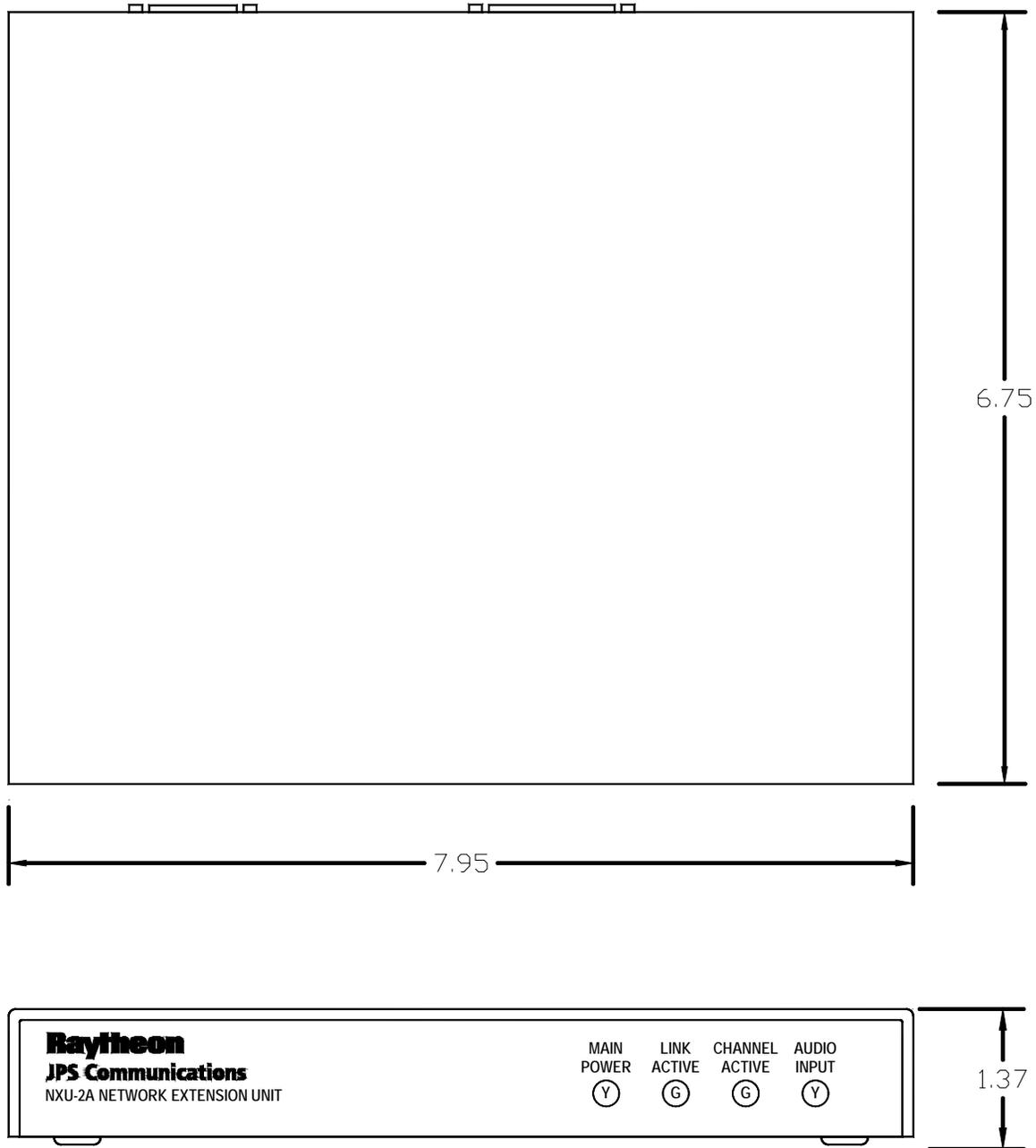
Careful attention to the following installation suggestions should result in the best unit/system performance. Figure 2-1 provides overall unit dimensions.

The NXU-2A must be installed in a structure that provides both protection from the weather and assurance of ambient temperatures between -10 and +55 degrees C. Since the unit is neither splash proof nor corrosion resistant, it must be protected from exposure to salt spray. When the unit is mounted in a cabinet with other heat-generating equipment, the use of a rack blower is suggested to keep the cabinet interior temperature rise to a minimum.

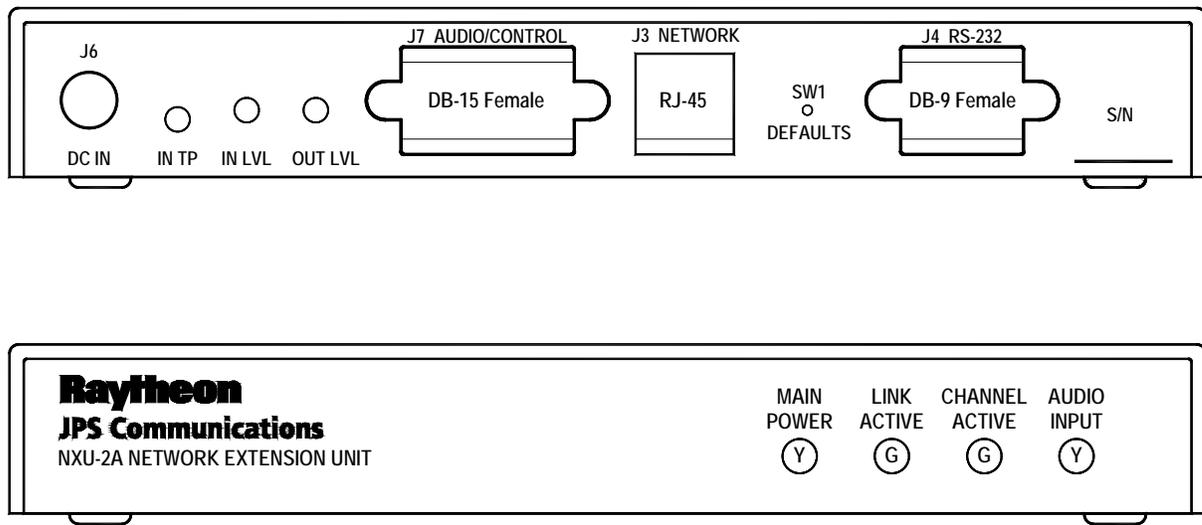
**NOTE:** If the NXU-2A is installed in a high RF environment such as repeater system or other transmitter site, it is recommended that all cable assemblies be individually shielded, with the shield grounded to the ground pin on the terminal block for that module. For all D-subminiature connector cable assemblies, cable shields should be connected to connector shells so that they make contact with the grounded D-subminiature connector shells on the NXU-2A.

**NOTE:** For the DC input, the plug is the equipment disconnect device.

**REMARQUE:** Pour deconnecter le DC, retirez la prise qui est couramment connecte a l'equipement.



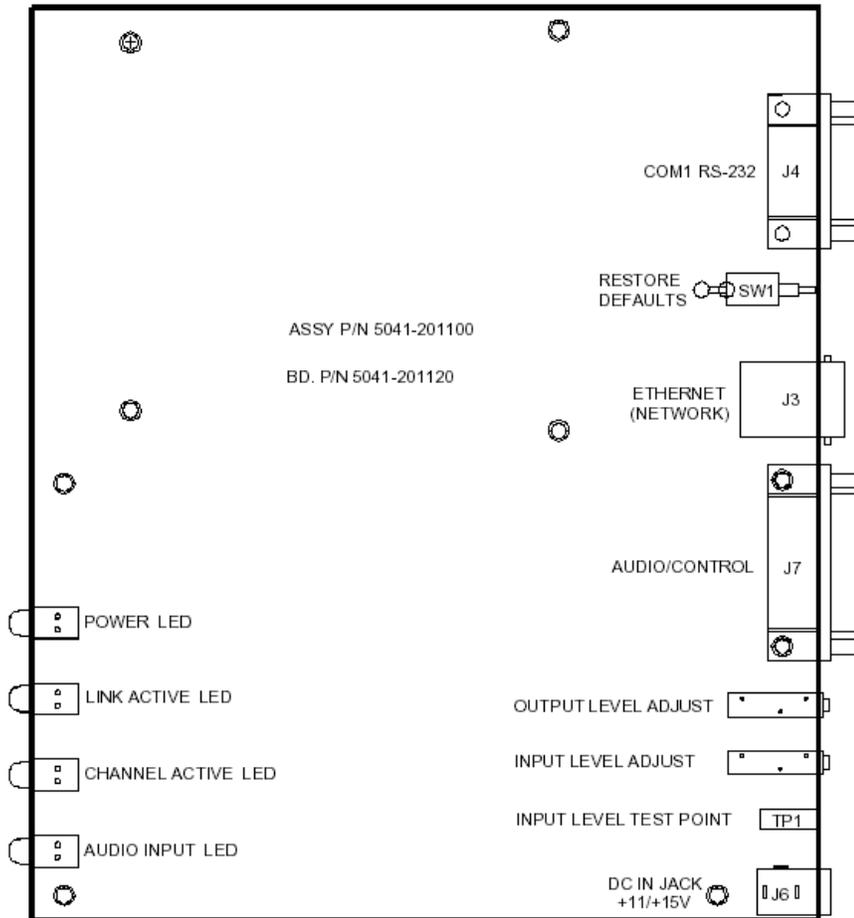
*Figure 2-1 Outline Dimensions*



*Figure 2-2 Control and Connector Locations*

## 2.5.1 Internal Configuration

The illustration below shows the NXU-2A with its top cover and rear panel removed. There is normally no reason to remove the top cover, as the NXU-2A has no internal user-serviceable configuration controls.



*Figure 2-3 NXU-2A Internal View*

## 2.6 Power Requirements

The NXU-2A is designed to operate from a nominal +12V DC supply. The unit will meet all of its specifications over a voltage range of +11 to +15 VDC and will be damaged by a DC source that delivers a constant (non-transient) DC voltage above this range. The DC power consumption is 500 mA maximum. The AC adapter provided with the unit meets these specifications.

**NOTE:** Use only the Class 2 power supply provided with the equipment.

**REMARQUE:** Utilisez seulement la Class 2 de la generation electrique qui est inclus avec l'equipement.

The NXU-2A is a microprocessor-controlled device. As with any such equipment, a very short loss of power can cause operational problems and/or cause the unit to reset. The communications link will be inoperable during the reset period. We recommend the NXU-2A and associated equipment be connected to an AC power source that utilizes an uninterruptible power system (UPS). If the overall site does not have UPS capability, the NXU-2A should be plugged into a smaller UPS, such as those used for personal computer systems

## 2.7 Installation Checklist

<i>Table 2-1 Basic Installation Checklist</i>	
Determine NXU-2A network parameters such as IP address, subnet mask, and gateway address.	You must assign these values. If you are not sure how to determine these values, see the network administrator for your organization.
Provide suitable power for the device.	See section 2.6 Power Requirements.
Make interconnections.	See Section 2.8.2 Audio Level Adjustment Potentiometers and Input Test Point for External Interconnect Information.
Configure NXU-2A parameters.	See Section 3 Configuration.
Adjust audio levels.	See Section 4.4.2.

## 2.8 Rear Panel Adjustments and Connectors

Refer to Figure 2-2 for a view of the NXU-2A Rear Panel. All rear panel connectors and adjustment potentiometers are explained in the section below, starting at the left side of the panel.

### 2.8.1 DC Input Connector, J6

The NXU-2A operates on a nominal +12 VDC. The power is applied through J6 via the “Wall Cube” AC adapter provided with the unit.

## 2.8.2 Audio Level Adjustment Potentiometers and Input Test Point

A test probe may be inserted into the test point to measure the level of the incoming audio. See Section 4.4.2 for input and output audio level setting instructions.

## 2.8.3 Connection to Radio or Other Four-Wire Device (J7)

The interface between the NXU-2A and associated radio or other audio device is made via J7 (Audio/Control) on the rear panel. J7 is a female DB-15 connector.

Note: an *Audio Crossover Adapter*, part number **0313 080515** is included with the NXU-2A. This DB-15 male to DB-15 female adapter allows the use of radio cables developed specifically for the ACU-1000 Intelligent Interconnect system to be used with the NXU-2A. It provides a crossover of transmit and receive audio as well as COR and PTT control signals. *You only need this adapter if you are planning to connect an NXU-2A to a radio and you are using a cable specifically designed to connect an ACU-1000 to that radio.* The adapter makes the NXU-2A audio connector pinout match the one found on the ACU-1000. If you are wiring your own cable, or if you are connecting the NXU-2A directly to an ACU-1000 then you don't need the Audio Crossover Adapter.

<b>PIN</b>	<b>Signal</b>	<b>Description</b>
1	Ground	Ground connection.
2		Not used.
3	/AUX In 0	Auxiliary Input 0 - Active low.
4	/AUX Out 0	Auxiliary Output 0 - Active low.
5	Ground	Ground connection.
6	Audio Input	Balanced audio input.
7	Analog Ground	Analog ground.
8	Audio Output	Unbalanced Audio output.
9		Not used.
10	/AUX In 1	Auxiliary Input 1 - Active low; general purpose.
11	/AUX Out 1	Auxiliary Output 1 - Active low; general purpose.
12	/COR Input	Input from radio COR, programmable active high or low.
13	/PTT Out	Output to radio PTT, active low, open drain.
14	Audio Input	Balanced audio input.
15	Analog Ground	Analog ground.

## 2.8.4 Network Connection, J3

The NXU-2A is connected to the Ethernet network via rear panel connector J3 using a standard RJ-45 Ethernet Patch Cable (non-crossover). A six-foot long cable is included with the unit.

### 2.8.5 Serial Port Connection, J4

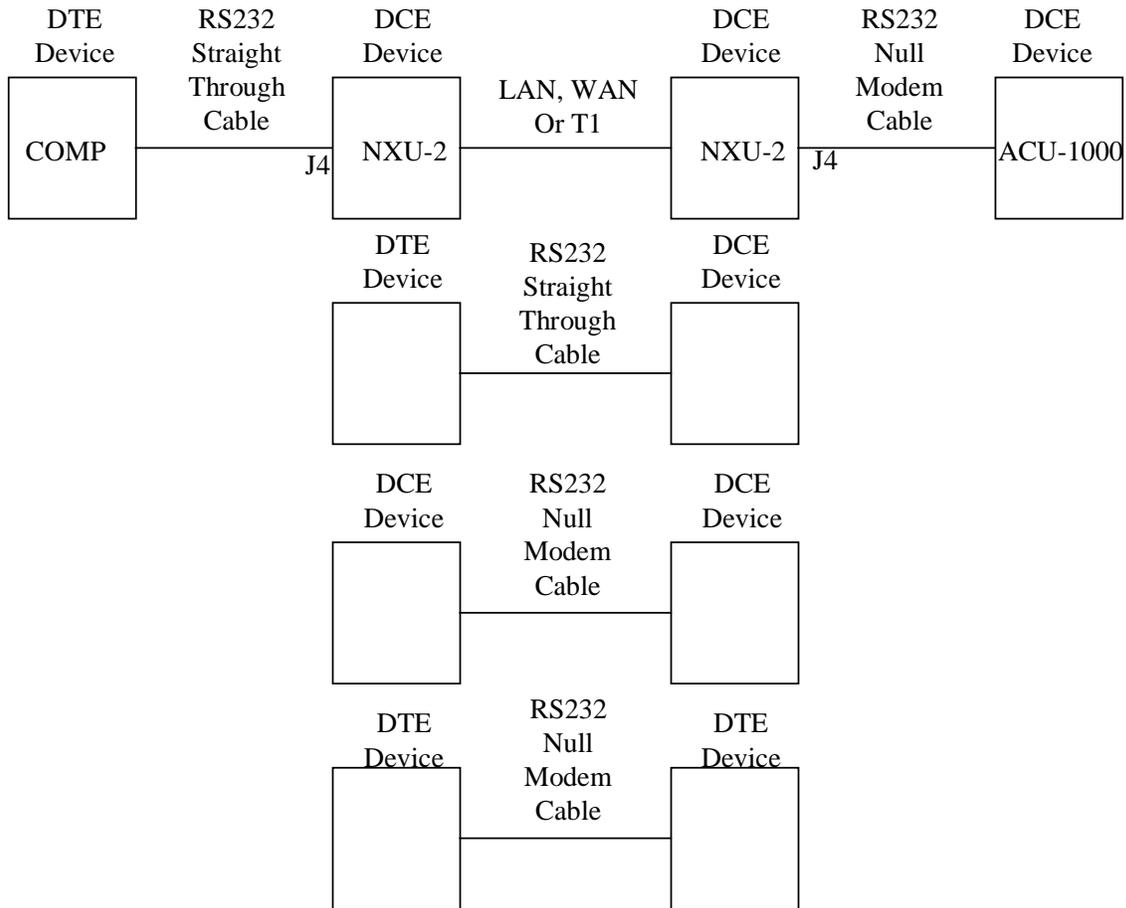
J4 is a standard RS-232 DCE serial port. It is a female DB-9 connector, and can be interfaced to most PCs, typically standard DTE serial ports, using the DB-9 straight-through serial cable included with the NXU-2A.

<b>J4 pin</b>	<b>Description</b>
2	TX data
3	RX data
5	Ground

### 2.8.6 Connecting Equipment and Computers to an NXU-2A

The RS-232 serial cable supplied with the NXU-2A is a straight-through cable used to connect the NXU-2A to a PC serial port. In order to connect the NXU-2A port to an ACU-1000, you need a DB-9 male-male null modem cable, also called a crossover cable.

RS-232 serial devices are divided into two types. Devices which provide control information are called DTE (Data Terminal Equipment) devices. Devices which accept control information are called DCE (Data Communication Equipment) devices. In the "old days" the DTE devices were terminals and computers, while the DCE devices were modems. The RS-232 standard specified that DTE devices would connect to DCE devices using a straight-through cable. If you wanted to connect two like devices (DTE to DTE or DCE to DCE) then you needed a null modem (crossover) cable. The PC is a DTE device, and the NXU-2A and ACU-1000 are DCE devices. That is why you need a crossover cable for connecting an ACU-1000 to an NXU-2A. The following drawing shows typical cable requirements for connecting different devices to an NXU-2A. See Figure 2-4 DTE Versus DCE Serial Cables.



*Figure 2-4 DTE Versus DCE Serial Cables*

## 3 Configuration

### 3.1 General

This section explains all settings and level adjustments that configure the NXU-2A. It is not necessary to remove the NXU-2A cover to configure the unit.

### 3.2 Configuration Details

Configuring an NXU-2A or pair of NXU-2As requires that you allocate an IP address for each unit, and that you designate one unit as a Client and one unit as a Server (explained in subsequent paragraphs). Initial configuration is accomplished by attaching a serial RS-232 terminal to J4. If the unit already has an IP address and is on a network, configuration may be done by connecting to the unit's IP address via telnet or with a web browser. Each method of configuration is discussed below.

**NOTE:** The NXU-2A comes from the factory configured as a Server with the following default settings:

IP Address: 192.168.1.200

Subnet Mask 255.255.255.0

Gateway IP 0.0.0.0

*If the above network parameters are compatible with your network then you may attach the NXU-2A to your network and use your web browser or telnet client to configure the NXU-2A as outlined in Section 3.6 Network Configuration.*

**NOTE:** To restore the factory default conditions, remove and reapply power to the unit while rear panel switch "SW1" (*DEFAULTS*) is depressed. When the front panel LED's have blinked, release the switch, and the unit will be operational using the factory default parameters. ***Any previously assigned user parameters will be lost during this process.***

### 3.3 Serial Port Configuration

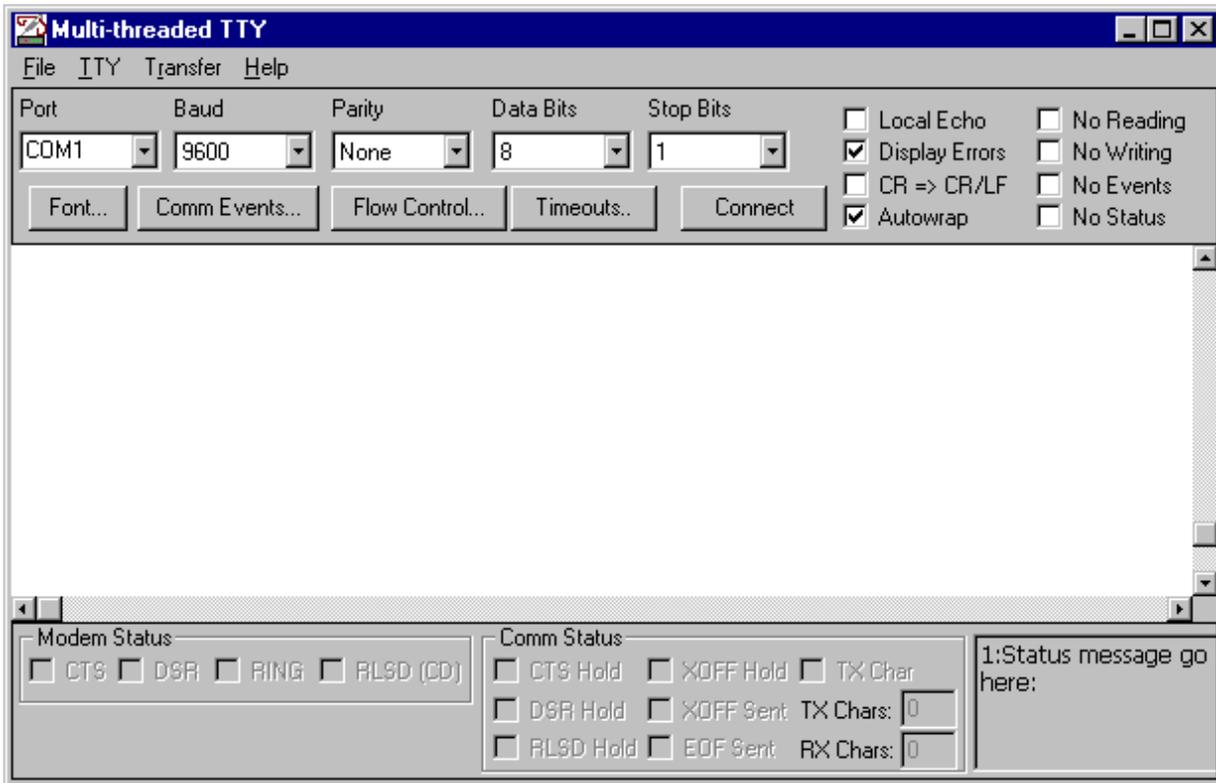
To configure the NXU-2A using the serial port, connect a standard serial cable from a suitable COM port on your PC to J4 on the NXU-2A rear panel. A standard DB-9 straight-through cable (which should work on most PCs) is included with the NXU-2A. The NXU-2A comes pre-configured with the serial port set at 115200-baud, 8 data bits, no parity, and 1 stop bit. No hardware flow control is used or needed. In order to configure the NXU-2A you will need to know which COM port you are connected to on your PC.

The NXU-2A includes a Windows program (the *NXU-2A Setup Utility*). It provides a graphical user interface for configuring the unit via the serial port. This program allows NXU-2A settings to be chosen from a menu and then sends the appropriate commands to the device. Alternatively the NXU-2A may be configured manually using any RS-232 terminal program. Both methods are described. If you want to use the *NXU-2A Setup Utility* you may skip to Section 3.5.2.

### 3.3.1 Configuration Using an RS-232 Terminal Program

A terminal program is needed to communicate with the NXU-2A for initial configuration. A suitable Windows terminal program, MTTY.EXE, is included with the unit. This program may be run directly from the floppy diskette or it may be copied to your hard drive and executed from there. This program is also available from the website.

After running MTTY and setting the parameters listed above your screen should look like this:



*Figure 3-1 MTTY Terminal Screen*

Choose the COM port appropriate for your computer and then click the Connect box.

Note: When using MTTY you must click the Connect box to enable serial communications.

With the serial cable connected and the PC running a terminal program set to the above parameters, apply power to the NXU-2A. Wait at least 10 seconds after power up of the NXU-2A and type +++ (three plus signs) on your keyboard. You must type all 3 '+' characters within 1 second. Do not type anything else, only the 3 '+' characters. The NXU-2A should respond with 'OK'. At this point, you are in *Command Mode*, and you will be able to issue configuration commands to the NXU-2A.

**NOTE:** If you type the three plus signs into your terminal program and they appear on the screen, the NXU-2A is already in the COMMAND Mode.

### Configuration Mode Command Set

Type HELP and press the ENTER key. The NXU-2A should respond with:

NXU-2A Commands:

BAUD	BCAST	CMDPORT	CONMODE
CONN	COR	CORINH	DATA
DISC	DUPLEX	ECHO	GATEIP
HANGTM	HELP	MAC	MYIP
NAME	PARITY	PASS	PORT
REBOOT	SAVE	SECURITY	SRVRIP
SRVRPORT	STAT	STOP	SUBNET
TRAN	VER	VOCODER	WHAT
BOOST	RXDELAY	TXDELAY	VSENSE

Type HELP followed by a command to get help on that command.

Save changes with the SAVE command.

**NOTE:** If you decide that you don't want to make any changes to the NXU-2A settings then you should place the NXU-2A back into the TRANSPARENT Mode. The TRAN command should be used to do this, placing the unit back into the data mode.

## 3.3.2 Command Summary

This is a full list of the commands available in the NXU-2A command mode. More detail is given on the following pages. You can get a one-line summary of each command by typing HELP followed by the command.

- BAUD <rate> - Set the serial port baud rate
- BCAST <mode> - Sets the broadcast mode (0) Normal (1) Connectionless (2) Multicast
- CMDPORT <port number> - Set the port used to receive telnet and WAIS commands
- CONMODE <0/1> - Places unit in CLIENT (0) or Server (1) mode
- CONN <IP address> - Connect this client to a server at IP address
- COR <0/1/2/3> - Sets COR active low (0), high (1), VOX (2), or VMR (3)
- CORINH <time> - Set COR inhibit time to 0,500,1000,2000,3000, or 4000 mS
- DATA <7/8> - Set the serial port data bits
- DISC - Break this client's current connection
- DUPLEX <0/1> - Select either full duplex (0) or half duplex (1) for audio
- ECHO <ON/OFF> - Enables/disables character echo to console
- GATEIP <ip address> - Set gateway IP address for this unit
- HANGTM <time> - Set VOX hang time to 500,1000,2000,3000, or 4000 mS
- MAC - Return the Ethernet MAC address of this unit
- MYIP <ip address> - Set the IP address of this unit
- NAME <text description> - Give this unit a name
- PARITY <O/E/N> - Set the serial port parity to Odd, Even, or None
- PASS <password> - Assign a password for web access
- PORT <port number> - Set the IP port used by this unit
- REBOOT - Restart this unit
- SAVE - Save NXU-2A settings to FLASH memory and restart
- SECURITY <security level> - Set the security level (0-255)
- SRVRIP <ip address> - Set the IP address of the NXU-2A server
- SRVRPORT <port number> - Set the port where to send VOIP traffic
- STAT - Return this client's current connection status

STOP <1/2> - Set the serial port stop bits

SUBNET <ip address> - Set IP subnet mask for this unit

TRAN - Place this unit's serial port in transparent mode

VER - Print the software version information for this unit

VOCODER <number> - Select the voice compression method (1-5)

WHAT - Print a description of this unit's settings

BOOST <0/1> - Select either no boost (0) or +20 dB boost (1) on audio input

RXDELAY <0-9999> - Set the received audio delay in milliseconds

TXDELAY <0-9999> - Set the transmitted audio delay in milliseconds

VSENSE <0/1/2> - set the VOX/VMR sensitivity to low (0), medium (1), or high (2)

### **3.3.3 Setting Unit IP Address**

The first thing you should do is to set the IP address of the unit. The NXU-2A comes from the factory with a default IP address set to 192.168.1.200. Set the address by typing:

```
MYIP <IP address>
```

Where <IP address> is the IP address of the unit in dotted quad notation. All configuration commands are entered by a carriage return. In this example, if your desired IP address is 192.168.1.1 you would type MYIP 192.168.1.1 and press ENTER

### **3.3.4 Setting Unit Subnet Mask and Gateway Address**

Now set your subnet mask using the SUBNET command. If you are using a gateway, set the gateway address (the address of your router) using the GATEIP command. If on a LAN with no gateway, leave the gateway address set at the default address 0.0.0.0.

### **3.3.5 Using DHCP to Assign IP Parameters**

If you have a DHCP server on your network, you may configure the NXU-2A to obtain its IP address, subnet mask, and gateway address via DHCP. Setting the NXU-2A IP address to 0.0.0.0 will cause it to attempt to contact a DHCP server on power-up. NOTE: Using DHCP is not recommended for NXU-2A Server units since the IP address assigned by the DHCP server is not generally known and is subject to change. If DHCP is to be used, it should only be used on client NXU-2A units.

### **3.3.6 Setting VoIP Port (Optional)**

The port used by the NXU-2A for receiving audio from the network which defaults to 1221. Under normal circumstances, this should not be changed. The default value may be changed, if necessary, by using the PORT command. Type PORT <port number> and press ENTER to select a new VoIP port. The port number must range from 1 to 65535 and be different from the command port.

## 3.3.7 Client/Server Selection

Whether the unit will be a client (a unit which can make and break connections) or a server (a unit which only accepts connections from a client) will need to be decided. This selection is made with the CONMODE command. CONMODE 0 configures the unit as a client, while CONMODE 1 configures the unit as a server. For a client unit, you also need to set the IP address and port of the corresponding server with the SRVRIP and SRVRPORT commands. For example, if a client unit is going to be connected to a server NXU-2A at address 192.168.1.10 and port 1221, then the commands must be issued:

```
SRVRIP 192.168.1.10
```

```
SRVRPORT 1221
```

On the client unit, if you do not want the client unit to connect to a server automatically at power-up then set the server IP address to 0.0.0.0 by typing SRVRIP 0.0.0.0.

Note: The server port on a client unit corresponds to the VoIP port on the server unit that the client unit is going to connect to. Also, the client unit's VoIP port does not need to match the server unit's VoIP port (or client unit's server port) for the two units to communicate. The server unit will automatically determine where to send audio so the client unit receives it.

## 3.3.8 COR and VOX Settings

The NXU-2A uses the COR (Carrier Operated Relay) or equivalent signal from your radio to determine when to send audio data across the network. When the COR input is active, audio is transferred to the other side of the network. The COR command allows you to select the polarity of the COR input. If a COR output signal is not available, you may select VOX (Voice Operated Switching). VOX operation uses the detection of an audio signal from your radio or other audio device to control the flow of audio from the NXU-2A.

Select the polarity of the COR input by using the COR command. **COR 0** selects active low COR, while **COR 1** selects active high COR sense. **COR 2** selects VOX mode. In VOX mode, no connection to the NXU-2A COR input is required, since the audio input level itself is used to determine when a signal is present. **COR 3** selects VMR (Voice Modulation Recognition) mode. In VMR mode the unit must detect speech content before a signal is determined to be present. In order to conserve network bandwidth, digital audio packets are only sent when COR is active. If using the NXU-2A in an application where the connected equipment does not support the COR line, then the COR line must either be tied to its active state (in which case audio will be sent across the network continuously) or you must select VOX or VMR mode. *In any case, the COR, VOX, or VMR mode must be set properly since the NXU-2A uses this setting to determine when to send audio data across the network.*

## 3.3.9 Duplex Setting

The NXU-2A allows full-duplex audio operation. Audio can be received and transmitted at the same time. In some applications this is required, but in other applications this may not be desirable. For example, if the system echoes back the transmitted audio to provide sidetone monitoring the resulting audio will be slightly delayed. Listening to a delayed version of your own voice can be distracting, and in such cases it would be better to use half-duplex audio. Use the DUPLEX command to set full- or half-duplex. **DUPLEX 0** selects full-duplex operation

(the default) while **DUPLEX 1** selects half-duplex. **NOTE: When half-duplex operation is selected the NXU-2A will not receive incoming audio while its COR or VOX is active.** [Audio from where????](#)

### **3.3.10 VOX Hang Time**

When VOX mode is enabled, you may also adjust the VOX hang time. This is the amount of time the VOX remains active after the input signal falls below the VOX threshold, and may be set to 500, 1000, 2000, 3000, or 4000 milliseconds. This is useful to prevent the VOX from dropping out between words or syllables. Use the HANGTM command followed by 500, 1000, 2000, 3000, or 4000 to select the hang time. The factory default is 500 milliseconds.

### **3.3.11 COR Inhibit Time**

In some applications it may be necessary to inhibit the NXU-2A's response to the COR input (whether hardwired COR or VOX) for a brief period of time (and under certain circumstances) in order to avoid problems with the "ping pong" effect.

The "ping-pong" effect can occur when the COR output of a device is activated momentarily by the device when it switches out of the TX mode. There are varieties of reasons why this can happen (including squelch tails on some radios), and it may occur with COR or VOX, but the result is the same.

To illustrate the problem, assume that there are two radios connected over a network by a pair of NXU-2As. An active COR at one end of the network creates an active PTT at the other end. When the COR of Radio 1 is active, Radio 2 is transmitting, and vice versa. Consider what can happen when the switch out of the TX mode causes a momentary active COR output:

Radio 1 COR becomes deactivated, so the Radio 2 switches out of the TX mode and activates its COR output momentarily. This momentary Radio 2 active COR signal causes Radio 1 to switch momentarily to TX mode, and when it quickly drops back out of the TX mode its own COR output is momentarily activated. This will once again put Radio 2 in the TX mode, causing an endlessly repeated cycle where the radios "ping-pong" back and forth and in and out the TX mode.

The COR Inhibit feature prevents this problem by ignoring any active COR input that occurs just after the NXU's TX output command is de-activated. The unit ignores the COR input (whether hardwired or VOX) only in the specified interval immediately following the inactivation of its PTT output. Use the CORINH command followed by 500, 1000, 2000, 3000, or 4000 to select the COR inhibit time in milliseconds. Type CORINH 0 to disable the COR inhibit feature. The COR inhibit time should be set as long as required to prevent the "ping-pong effect", but no longer, or the beginning of a valid audio signal being transferred might be lost.

### **3.3.12 Serial Port Settings**

The serial port baud rate may be set using the BAUD command. Valid baud rates are 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200. The number of data bits may be programmed to 7 or 8 using the DATA command, while the number of stop bits may be

programmed to 1 or 2 using the STOP command. The serial port parity may be programmed to odd, even, or none by typing the PARITY command followed by O, E, or N.

### 3.3.13 Voice Compression Settings

In order to send voice information over an IP network efficiently the NXU-2A uses digital signal processing algorithms to compress the voice information so that it requires less network bandwidth. The NXU-2A offers several different voice compression methods to support a variety of applications. For example, some compression methods work well with voice and provide a high amount of compression, but do not handle signaling tones very well. Other methods handle tones and voice, but use more network bandwidth because they offer less compression. You may select the method from the following voice compression schemes that optimizes the trade-offs for your particular application:

**1. GSM 13Kbps** - Suitable for voice communications only. Should not be used if any tone signaling is required. Offers the greatest compression with reasonable voice quality. This is the default setting.

**2. ADPCM 16Kbps** – Suitable for voice or tone signaling. Offers good voice compression, but the voice quality is lower than the other compression methods.

**3. ADPCM 24Kbps** – Suitable for voice or tone signaling. Offers less compression than ADPCM 16Kbps but the voice quality is higher.

**4. ADPCM 32Kbps** – Suitable for voice or tone signaling. Offers still less compression, but the voice quality is the best of the ADPCM compression types.

**5. PCM 64Kbps** – Suitable for voice or tone signaling. Offers the highest quality of all compression methods, but provides the least compression. *You should use this method only if your network offers low latency and good throughput.*

You may select a compression method with the VOCODER command followed by the number of the compression method (1-5). If you are only using voice in your application, you should select GSM 13Kbps (1). If you plan to use any tone signaling, you should select 2, 3, 4, or 5 in accordance with your network bandwidth and voice quality requirements.

### 3.3.14 Security Settings

The NXU-2A may be configured, monitored, and controlled remotely via its network interface using a web browser or a telnet client. In some instances, it may be desirable to limit access via one or both of these methods, or to selectively limit the things that may be done remotely. The SECURITY command allows various levels of security to be set in order to limit remote access. Additionally, a password may be assigned to limit access via a web browser. Refer to the chapter on Security for detailed information on setting the NXU-2A security parameters.

### 3.3.15 Ethernet MAC Address

The Ethernet MAC address of the NXU-2A may be read using the MAC command. When MAC is typed the 48-bit Ethernet MAC address will be printed as a sequence of two digit hexadecimal numbers separated by dashes. No two NXU-2A units have the same MAC

address, so this may be used as an electronic serial number if desired. It cannot be changed by the user.

### **3.3.16 Command Port**

The port used by the NXU-2A for receiving commands via the telnet protocol or from a WAIS Controller. The value defaults to 23 and under normal circumstances should not need to be changed. If necessary, the command port may be changed by using the CMDPORT command. Type CMDPORT <port number> and press ENTER. The port number must range from 1 to 65535 and must be different than the VoIP port.

### **3.3.17 Input Level Boost +20db**

The receive input level may optionally be boosted by +20db in order to accommodate low level signal sources. Provisioning via the web interface allows selecting either “No Boost” or, “Boost +20db” in the ‘RX Boost Mode’ field.

### **3.3.18 TX Delay**

Additional delay may be provided to the transmit audio path. Via the web interface ‘TX Delay (mS)’ field, the user may introduce up to 10 seconds of delay, in specified in 1 mS increments. Upon editing the field with numeric data, the NXU-2A will round to the nearest 100mS interval. When additional delay is used, the PTT\ signal will be asserted prior to the delayed audio being presented, allowing LMR trunking systems to be accessed without audio loss.

### **3.3.19 RX Delay**

Additional delay may be provided to the receive audio path. Via the web interface ‘RX Delay (mS)’ field, the user may introduce from 0 to 10 seconds of delay, specified in 1 mS increments. Upon editing the field with numeric data, the NXU-2A will round to the nearest 100mS interval. When additional delay is used, the received audio will be delayed before being sent to the network.

### **3.3.20 VMR**

Voice Modulation Recognition has been added to allow interfacing with radios which do not provide a separate COR signal. VMR provides a more robust method of ‘COR Sensing’ than VOX alone. VMR mode may be selected via the web interface ‘COR Sense’ field pulldown menu. When VMR mode is chosen, the hardware COR signal is ignored, and audio content with the appropriate speech characteristics is allowed to simulate the COR signal.

### **3.3.21 VOX and VMR Sensitivity Adjustments**

When either VOX or VMR COR sensing is selected, three levels of sensitivity adjustments are provided to allow greater flexibility. Via the web interface, “Low” sensitivity requires more signal content to recognize and simulate COR activity. “High” sensitivity requires less signal content to recognize and simulate COR activity. The default sensitivity is “Medium”.

### **3.3.22 Restoring Factory Defaults**

The NXU-2A allows the user to restore the original factory default operating conditions. This may be useful if the unit has been incorrectly configured, and it is necessary to return to a well defined state. To restore the factory default conditions, the power to the unit needs to be removed and restored while rear panel switch “SW1” (*DEFAULTS*) is depressed. When the front panel LED’s have blinked, the switch may be released, and the unit will be operational

using the factory default parameters. The IP address will return to “**192.168.1.200**”, which will allow web configuration. All other previously assigned user parameters will be lost during this process.

### ***3.4 Network Management: SNMP support***

The NXU-2A has the capability to support Simple Network Management Protocol (SNMP). By default, the SNMP process (agent) is enabled and running, but may be disabled by changing the “SECURITY” Setting (see section on SECURITY). The Management Information Database [MIB] associated with the NXU-2A may be obtained by contacting customer support.

### ***3.5 Communications Mode***

The NXU-2A has three communications modes: Normal, Connectionless, and Multicast.

The default mode is Normal; this consists of a TCP connection initiated by a client unit to a server unit for traffic to be exchanged between the two units' serial ports along with a unicast UDP channel for VoIP traffic. This is the standard mode and should be used for one-to-one unit operations.

Connectionless mode consists solely of a unicast UDP channel for VoIP traffic (along with the status bits such as PTT and COR) between the NXU-2A and another unit. No serial traffic is exchanged. This mode is reserved for special applications such as the Raytheon WAIS (Wide Area Interoperability System) and should not be used for day-to-day operation.

Multicast is a network routing technique that allows IP packets to be sent simultaneously from a single source to multiple destinations. Rather than sending the packet to each destination independently, the packet is sent to a multicast group identified by a single, specialized, Class D IP address. This is an IP address in the range of 224.0.0.0 to 239.255.255.255. Multicast mode on the NXU-2A consists of a multicast UDP channel for VoIP and status bit traffic. No serial traffic is exchanged. It can be used whenever more than two units wish to hear each others' audio.

The NXU-2A communications mode can be set using the BCAST command. BCAST 0 sets the unit to Normal mode, BCAST 1 sets the unit to Connectionless mode, and BCAST 2 sets the unit to Multicast mode. Once again, Connectionless mode is reserved for special applications and should not be used for day-to-day operation. Its use outside the advisement of Raytheon is not supported.

To use a set of NXU-2As in Multicast mode, they must all be put into the same multicast group. To do this, first select a Class D IP address, port, and vocoder for use by the entire group.

Then configure each NXU-2A in the group so that:

- Its server IP address is the IP address of the multicast group
- Both its server port and VoIP port are the ports selected for the multicast group
- It's set to use the vocoder selected for the group.

Once these configuration steps are complete, packets sent by any unit in a multicast group will be received by all other units in that group.

Please note that multicast operation is guaranteed to work only in LAN environments or private WANs where multicast enabled routers are in use. Multicast mode will not work over the Internet because not all routers on the Internet are multicast enabled.

### 3.5.1 Store Setup Changes with SAVE Command

After any configuration changes have been made, SAVE must be typed in order to store the new settings in memory. The NXU-2A will automatically restart after changes have been saved. If you do not make any changes and want to return the serial port to the data mode, type TRAN to place the serial port in transparent mode.

### 3.5.2 NXU-2A Configuration Using the NXU-2A Setup Utility

Included with the NXU-2A is a CD containing a program called NXU-2 Setup Utility. This program, which runs under Windows 95, 98, NT, 2000, or XP, can be copied to the user's hard drive and executed from there. No installation is required. With the NXU-2A connected via the serial cable to a suitable serial port on the PC, apply power to the NXU-2A. You should see the lights on the front panel blink in succession. Then run the NXU-2A Setup Utility by double-clicking on the program or by using the Run command from the Windows Start menu. You should see the following screen:

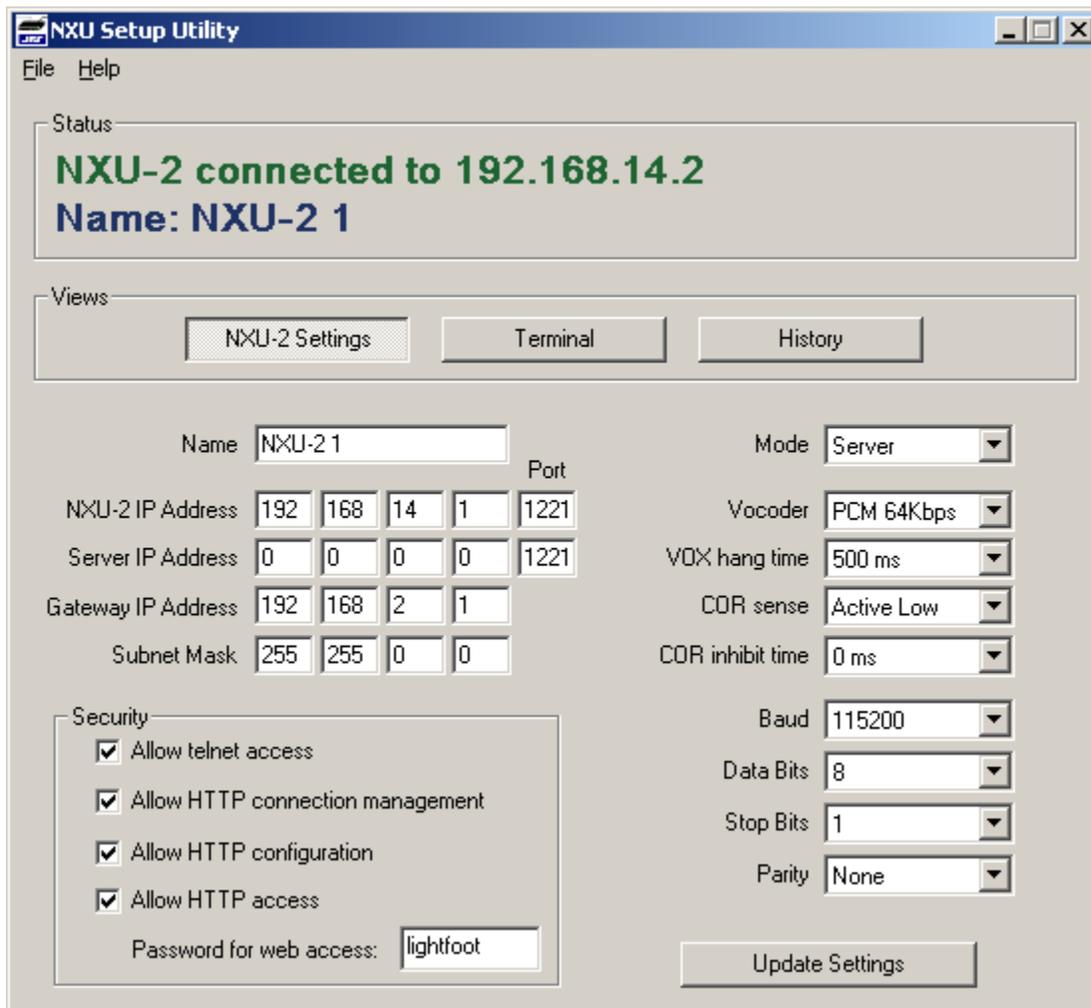
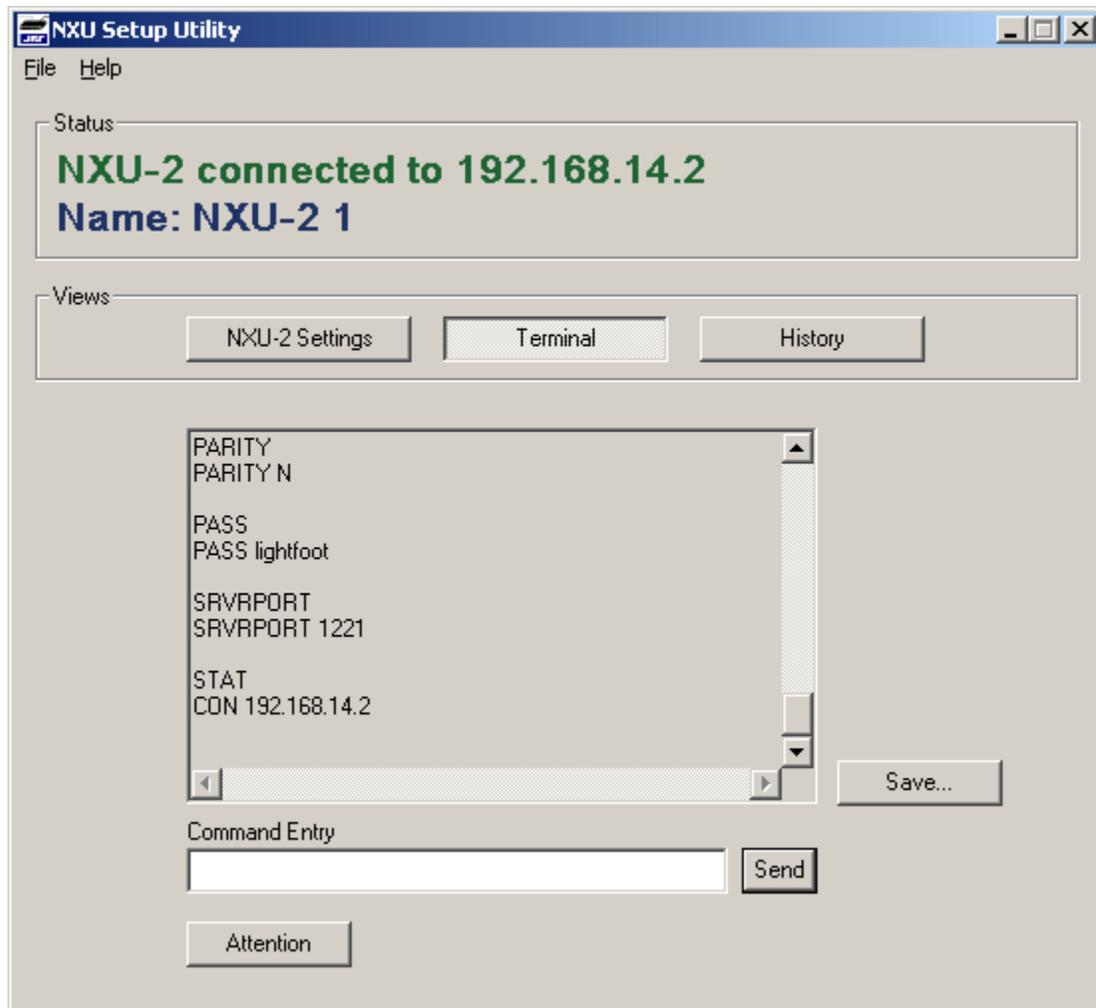


Figure 3-2 NXU-2A Setup Screen

**NOTE:** The program defaults to serial port COM1. If you are using a different serial port you must select the appropriate serial port from the File menu.

Make the appropriate changes by selecting the various menu options. When you have finished making configuration changes, click the *Update Settings* button to save the new configuration information in the NXU-2A. The NXU-2A will restart and the new settings will then be in effect.

The *NXU-2A Setup Utility* allows the user to see the actual commands being sent to and received from the NXU-2A. Click on the Terminal button to bring up the terminal window. If you wish to enter an NXU-2A command manually you may type it into the *Command Entry* window and click *Send*. If an NXU-2A has been disconnected or powered down (and is no longer in command mode) it may be placed in command mode by clicking the *Attention* button.



*Figure 3-3 NXU-2A Terminal Screen*

The NXU-2A Setup Utility may also be used to keep records on various NXU-2A devices. Once an NXU-2A has been configured, click on the *History* button to bring up the history window as shown below. To add the current unit to the configuration history, type a name for the unit into the box beside the *Add Current* button and click the button. The NXU-2A will be added to the list of units shown in the *NXU-2A List* window. To review the settings for a particular unit, simply choose it from the list and the settings will be displayed. To remove a unit from the list, highlight the unit and click *Remove*.

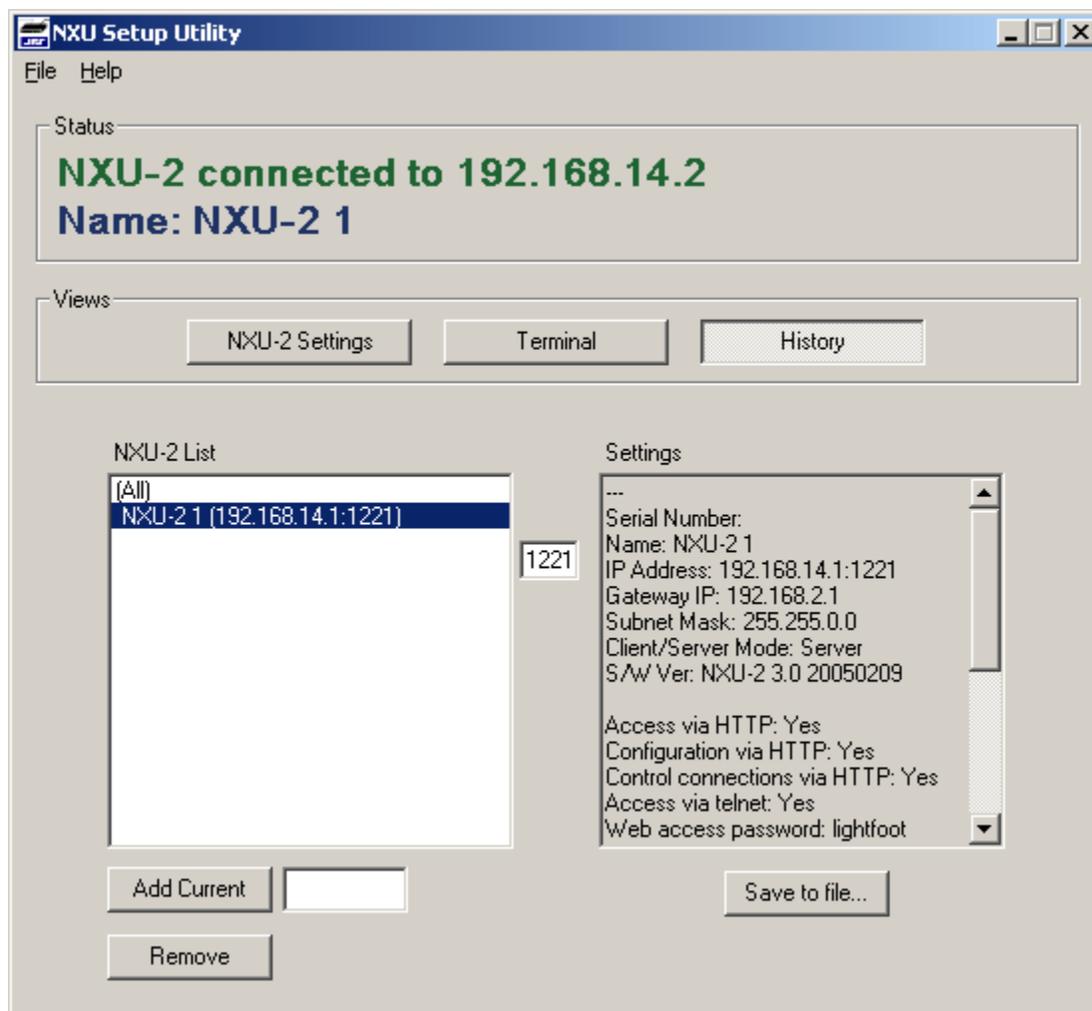


Figure 3-4 NXU-2A History Screen

### 3.6 Network Configuration

After the NXU-2A has been assigned a valid IP address and is on the network, you may configure it via telnet or a web browser. For telnet, use your PC's telnet client to connect to the IP address of the NXU-2A. Once a telnet connection is made, configuration of the NXU-2A is identical to configuration via the serial port as described in Section 3.3 except that there is no need to type +++ to enter command mode. The telnet connection to the NXU-2A will automatically disconnect after two minutes of no activity, or LOGOUT may be typed to disconnect the telnet connection manually.

A web browser may also be used to browse the IP address of the NXU-2A. From the opening page select NXU-2A Configuration. The following page will be seen where configuration changes can be made and saved.

The screenshot shows the 'NXU-2A Configuration Utility' web interface. The browser window title is 'NXU-2A Configuration Utility Configuration - Mozilla Firefox'. The address bar contains '192.168.1.200'. The page features a blue header with the Raytheon logo and 'JPS Communications' on the left, and 'NXU-2A Configuration Utility Configuration' on the right. Below the header, there are five tabs: 'Configuration', 'Connection Management', 'Connection Status', 'Information', and 'Manual'. The 'Configuration' tab is active, displaying various settings in a two-column layout. The left column includes fields for Name, Unit is a, Communications mode, VOIP Port, Command Port, Serial port baud rate, Serial port data bits, Serial port stop bits, Serial port parity, VOXVMR Hangtime (mS), RX Delay (mS), RX Boost Mode, and VoIP QOS DSCP value. The right column includes fields for IP Address, Subnet Mask, Gateway IP, Remote IP, Remote Port, Voice Compression, Duplex, COR Inhibit Time (mS), COR sense, VOXVMR Sensitivity, and TX Delay (mS). At the bottom of the configuration area, there are 'Save Changes' and 'Clear Changes' buttons. A copyright notice 'Copyright © 2006 Raytheon Corporation. All Rights Reserved' is centered at the bottom of the page.

*Figure 3-5 Network Configuration Screen*

### 3.7 I/O DESCRIPTIONS

This section provides detailed explanations of the NXU-2A's audio interfaces and its parallel control inputs and outputs.

## 3.7.1 Audio Input

The NXU-2A audio input is 47K ohm, balanced. It can be used as an unbalanced input by grounding one half of the balanced pair and connecting the single-ended input to the remaining half. The use of balanced inputs and shielded cables is recommended for superior immunity to noise.

The audio input will accept signal levels from  $-30$  to  $+11$  dBm. Internal circuitry is used to amplify or attenuate this input as necessary to optimize the level to the DSP. The signal level is adjusted by the IN LVL potentiometer accessible from the rear panel. The input is set to 0 dBm when shipped. This means the IN LVL potentiometer is adjusted so that an audio input of 0 dBm provides the correct level to the DSP circuitry.

## 3.7.2 Audio Input Test Point

Access to an audio test point, TP1, is provided via the rear panel so the actual audio signal voltage applied to the A/D converter can be measured with an AC voltmeter. The correct level for best operation as measured at TP1 is about 0.2V or  $-12$ dBm (600 ohm reference.)

## 3.7.3 Audio Output

The audio output from the NXU-2A is a low impedance (10 ohm) unbalanced AC coupled output. The output level is adjusted by the OUT LVL potentiometer accessible from the rear panel. This output provides a 0 dBm nominal level;  $+15$  dBm clipping into a 600 ohm load. The audio output will supply signal levels from  $-30$  to  $+11$  dBm.

## 3.7.4 COR Input

The COR input to the NXU-2A is a high impedance input and can be programmed to be active high or active low. In the active low configuration the input is pulled up to  $+5$ V DC internally through a 47K ohm resistor. In the active high configuration the input is pulled down to ground through a 22K ohm resistor. The logic threshold is 2.5V DC nominal, and the input is protected from momentary surges up to  $+100$  V DC.

## 3.7.5 AUX Inputs

The AUX inputs (AUX IN0 and AUX IN1) are high impedance inputs, and are always active low. They are pulled up to  $+5$ V DC internally through a 47K ohm resistor. The logic threshold is 2.5V DC nominal, and the input is protected from momentary surges up to  $+100$  V DC.

## 3.7.6 PTT Output

The PTT output from the NXU-2A is an open drain type. It can sink up to 100 mA of current, and can withstand open-circuit voltages up to  $+60$ V DC. In order to avoid conflicts with internal pull-up resistors on the PTT lines of some radio equipment, there is no internal pull-up resistor on the NXU-2A PTT output.

## 3.7.7 AUX Outputs

The AUX outputs from the NXU-2A (AUX OUT0 and AUX OUT1) are open drain types. They can sink up to 100 mA of current, and can withstand open-circuit voltages up to  $+60$ V DC. These lines are pulled up to  $+5$ V DC through a 47K ohm resistor.

## **4 Operation**

### ***4.1 General***

This Section contains information and instructions required for proper operation of the NXU-2A. Refer to Figure 2-2 Control and Connector Locations for views of controls and connectors.

### ***4.2 Front Panel Indicators***

All front panel indicator LEDs are explained below, starting at the left side of the unit.

#### **4.2.1 Power LED**

This yellow LED is lit whenever DC power is applied to the unit.

#### **4.2.2 Link Active LED**

The green Link Active LED is illuminated whenever the NXU-2A has an IP connection open to another NXU-2A on the network. If this indicator is not lit, either the NXU-2A does not have an active VoIP connection or the connection has been lost.

#### **4.2.3 Channel Active LED**

This green LED is lit whenever COR is active. This also indicates that the NXU-2A is sending audio data across the IP link.

#### **4.2.4 Audio Input LED**

This yellow LED is provided as a visual aid in setting the proper input audio level for optimal operation. See Section 4.4.2 Input/Output Level Adjustments for instructions.

### ***4.3 Rear Panel Connectors, Adjustments and Level Potentiometers***

Section 2.8 Rear Panel Adjustments and Connectors contains full explanations and pin-outs for all rear panel connectors. Figure 2-2 displays connector locations.

### ***4.4 NXU-2A Operation***

Basic operation and control of the NXU-2A is discussed in the following paragraphs. These instructions assume the NXU-2A has already been correctly configured per Section 3 Configuration.

## 4.4.1 Operation at Power-Up

When the units have been connected and configured and are attached to the network the client will automatically connect to the server when power is applied.

If no default server has been specified for the client to contact (using the SRVRIP command; see Section 3.3.7, Client/Server Selection), the client unit will wait until a manual connection is requested, either via serial or telnet commands or via the web interface. If the client is able to connect to the server, the LINK ACTIVE indicator will light indicating that a connection has been made.

## 4.4.2 Input/Output Level Adjustments

At this point, the audio input level to the NXU-2A may be set by adjusting the IN LVL control on the rear panel. With normal audio input applied at J7, adjust the IN LVL control until the AUDIO INPUT indicator flashes on voice peaks. The OUT LVL control sets the audio output level from the NXU-2A and may be adjusted to the level suitable for the equipment connected to the unit.

The proper audio input level may also be set by connecting an AC voltmeter to the test point TP1 on the rear panel and adjusting the IN LVL control for an average audio level of about 0.2V or -12dBm.

## 4.4.3 COR Input Description

The COR input on J7 controls the flow of data across the network. When COR is not active the units will send a keep-alive packet every 4 seconds just to keep the connection from timing out. If a unit has an active COR input, that unit's audio input will be transferred across the network and will appear at the audio output on J7 at the other unit. **As long as the COR input of this NXU-2A remains active, the PTT output will remain active on the unit it's connected to.** The audio channels are independent, and full duplex operation is possible. If the radio or other audio equipment does not have a COR output, it's possible to tie the NXU-2A COR input line to the active state so that data will be transmitted continuously.

## 4.4.4 RS-232 Serial Data

RS-232 data at J4 is sent across the network connection to the RS-232 connector on the unit at the other end of the link. Any data input to the RX DATA line on one end will appear at the TX DATA line on the other end. The serial port data may be sent even while audio is being transmitted as the two functions are independent. Audio and RS-232 data are multiplexed over the same IP connection.

**Note:** If data is to be transferred across the IP link, the NXU-2A serial port must not be in the Command Mode (see Section 3.3.1). Be sure to return the unit to the Transparent Mode (by issuing a TRAN command) if you have placed the unit in Command Mode.

#### 4.4.5 Auxiliary I/O

The NXU-2A has two sets of independent inputs and outputs that may be used for control of the user's equipment. AUX IN 0 and AUX IN 1 are active-low inputs which, when activated on one end, will cause AUX OUT 0 and AUX OUT 1 on the other end to become active. The AUX OUT lines are open drain devices and each is capable of sinking 100 mA. *Note: the auxiliary I/O lines are designed for switching and control applications, and do not have quick enough response times to send or receive data.*

### 4.5 Controlling Connections

Normally the NXU-2A client automatically connects to the preprogrammed NXU-2A server when power is applied. The user may also manually control the connection state of the NXU-2A client. This can be done via the serial port (by entering command mode as described in Section 3.3.1) or via the network using Telnet or a Web Browser.

#### 4.5.1 Serial or Telnet Control

When using the serial port (in command mode) or Telnet, the user may disconnect a client from a server by typing:

**DISC**

A connection may be made to a server by typing:

**CONN** <IP address>

The status of these commands may be viewed by typing:

**STAT**

STAT returns the following responses:

**CON** <IP address>    The unit is connected to an NXU-2A at address <IP address>

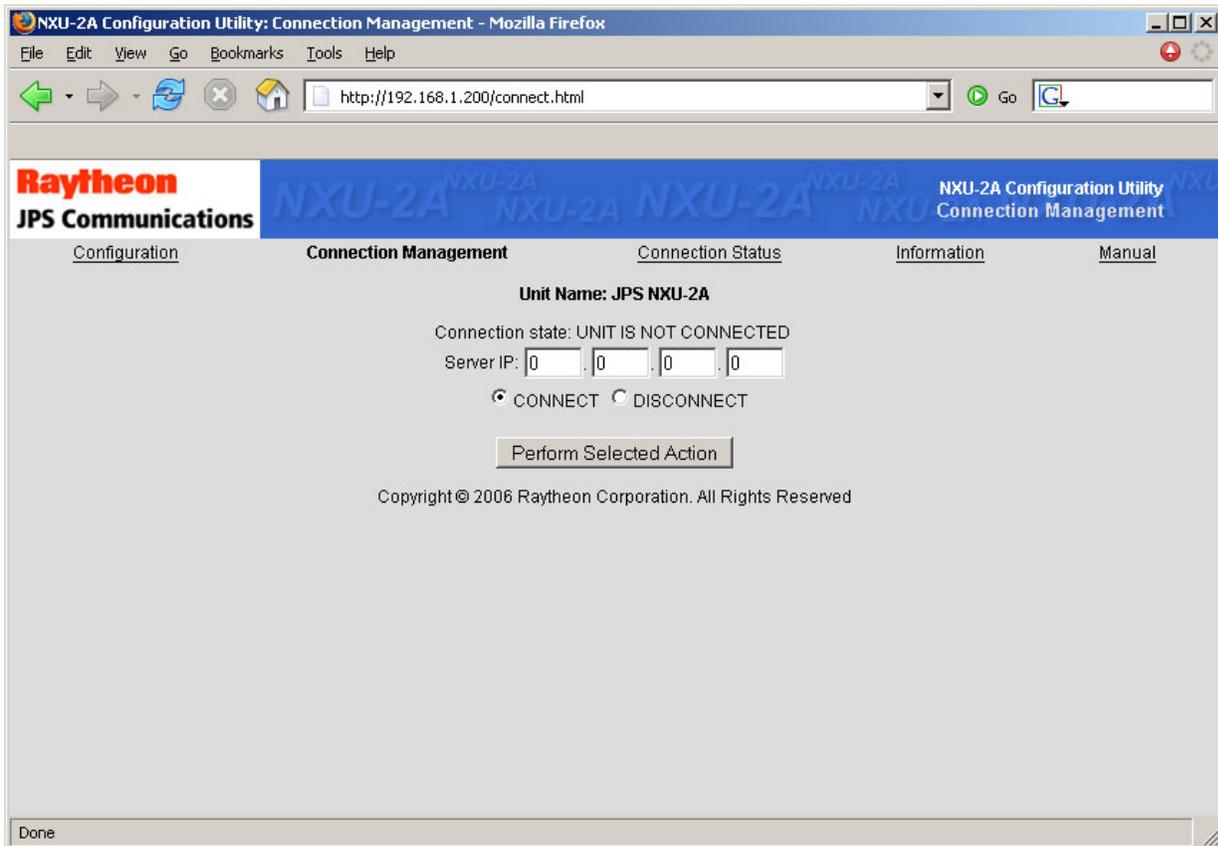
**DIS**                    The unit is not connected

**ATT** <IP address>    The unit is attempting a connection to <IP address>

Depending upon the characteristics of the network, the CONN and DISC commands may not take effect immediately. In order to determine when a CONN or DISC command has completed, issue the STAT command repeatedly to poll the status of the connection.

## 4.5.2 Web Browser Control

The NXU-2A client connection may be managed by browsing to the NXU-2A client IP address and selecting the Connection Management menu option. The user may then issue connect or disconnect commands via the web browser.



*Figure 4-1 NXU-2A Connection Management Screen*

## 4.6 Security

In some applications, it may be desirable to restrict network access to the configuration or connection management features of the NXU-2A. The NXU-2A can be programmed to one of several different levels of security by using the SECURITY command in the command mode. Possible settings are listed below:

<b>SECURITY 0</b>	Full access via serial port, telnet, or web browser
<b>SECURITY 8</b>	Telnet access disabled
<b>SECURITY 16</b>	Password required for HTTP (web) access
<b>SECURITY 32</b>	Connection management via HTTP disabled
<b>SECURITY 64</b>	Configuration via HTTP disabled
<b>SECURITY 128</b>	All HTTP (web) access disabled

The above numbers may be added together to select various security options. For example, setting the security level to 136 (128+8) disables both telnet and HTTP access. Setting security to 96 (64+32) allows the connection status to be monitored by HTTP, but no configuration or connection changes may be made via HTTP. Setting security to 24 (8+16) disables telnet access and requires the user to enter a password for HTTP access.

<p>Note: The default security setting from the factory is SECURITY 0, which places no restrictions on network access to the NXU-2A.</p>
---

### 4.6.1 Password Setting

The NXU-2A security level may be set to require a password for HTTP access. The password may be programmed while in the command mode using the PASS command followed by the desired password. Typing PASS with no password specified will report the current password. Passwords are case-sensitive. You must type SAVE while in the command mode in order to save the new password. The default factory setting for the NXU-2A password is “lightfoot”.

## 4.6.2 Web Access with Password Protection

When the NXU-2A security level is set to require a password, any attempt to access the unit via HTTP will result in the web browser displaying the following dialog:



*4-2 Network Password Dialog*

In order to access the NXU-2A you must enter the password that was previously programmed using the PASS command. The User Name is not required – you may enter anything or nothing in this field, but the password must be entered correctly in order to access the unit. Once you have entered the password you will not need to enter it again unless you exit your web browser.

**Note:** The security level and password must be programmed via the serial port.

**5 NXU-2A Troubleshooting**

The following table may be used to troubleshoot any problems you may encounter during installation or operation of the NXU-2A.

<i>Table 5-1 Troubleshooting</i>	
<u>Symptom:</u>	<u>Possible Causes:</u>
Main Power LED is not illuminated	Check that AC adapter is operational and firmly plugged in.
Cannot place the unit into Command Mode as outlined in Section 3.3	<p>Check RS-232 connections Verify terminal settings: 115200 baud, 8 data bits, 1 stop bit, no parity</p> <p><i>(Note: if you have previously used Command Mode to set the serial port baud rate to a value different than 115200 then you must use the new baud rate to enter Command Mode.)</i></p> <p>Verify that no flow control, either hardware or software, is being used in your terminal program. Make sure you wait at least 5 seconds, and then type +++ (three plus signs) within 1 second.</p>
Settings made in Command Mode do not appear to take effect.	You must issue a SAVE command after making changes in order to save the new settings and restart the NXU-2A.
Client and Server units are properly configured and online but LINK ACTIVE is not on.	<p>Verify that both the Client and Server NXU-2A units are “visible” on the network by “pinging” their IP addresses from a network-connected computer.</p> <p>Verify that the Server’s IP address has been programmed into the Client using the SRVRIP command per Section 0 The port used by the NXU-2A for receiving audio from the network which defaults to 1221. Under normal circumstances, this should not be changed. The default value may be changed, if necessary, by using the PORT command. Type PORT &lt;port number&gt; and press ENTER to select a new VoIP port. The port number must range from 1 to 65535 and be different from the command port.</p>

**Table 5-1 Troubleshooting**

(Continued)	<p>Client/Server Selection- OR -                  If there is not a default server programmed into the client, verify that a manual connection has been entered per Section 4.5 Controlling Connections.                  Verify that the PORT has not been changed from the default value of 1221, or if it has, make sure the PORT value is the same on both Client and Server.                  Verify that any network firewalls in place allow traffic on UDP and TCP port 1221.                  Verify that another NXU-2A client is not already connected to the server.</p>
LINK ACTIVE is on, but no audio is transmitted.	Verify that the COR line is active. Audio is only transmitted when COR is active.
CHANNEL ACTIVE indicator is on continuously.	<p>Verify that the COR polarity is programmed properly. See section 3.3.8.                  If NXU-2A is attached to a radio COR line, make sure the radio squelch is set properly.</p>
Audio has pauses and/or gaps in it.	Check for low bandwidth or excessive latency on the network by running a trace route from a network-connected PC to the NXU-2A at the other end of the link.
Cannot browse to the NXU-2A's IP address	Check the NXU-2A SECURITY setting; this activity may not be allowed. See section 4.6 Security for security settings.
Cannot Telnet to the NXU-2A's IP address	Check the NXU-2A SECURITY setting; this activity may not be allowed. See section 4.6 Security for security settings
RS-232 data is not being transmitted across the IP link	<p>Verify LINK ACTIVE indicator is on.                  Verify that neither NXU-2A is in Command Mode; issue a TRAN command to place the RS-232 port in transparent mode if necessary.</p>

## **6 NXU-2A FAQ (Frequently Asked Questions)**

### ***6.1 General***

This section provides answers to some frequently asked questions about the installation and operation of the NXU-2A.

#### ***How much network bandwidth does the NXU-2A consume?***

The NXU-2A bandwidth usage varies depending on the application. When COR is inactive and no audio is being transmitted across the link, the bandwidth usage is essentially zero, since a small “keep-alive” packet is only sent every 4 seconds. When COR is activated and the default voice compression method is used, audio will be sent across the link at approximately 15Kbps. If a full-duplex connection is active (COR is active on each end) then the total bandwidth usage for audio will be approximately 30Kbps. Selecting a different voice compression method will increase the bandwidth accordingly. Voice compression method 2 will require approximately 18Kbps (half-duplex), method 3 will require 27Kbps, method 4 will require 36Kbps, and method 5 will require approximately 70Kbps. If RS-232 data is being sent simultaneously then the bandwidth will be increased by the RS-232 data rate, plus the TCP overhead.

#### ***Can I use the NXU-2A on a dialup connection?***

No. The NXU-2A’s network connection is via Ethernet. Most dialup (telephone line) modems only provide RS-232 connections, but even if an Ethernet connection to a dialup is available, the NXU-2A may not operate properly since the connection speed is not guaranteed on a dialup connection. Poor telephone lines or varying line conditions may cause a dialup modem to reduce its connection speed without the user being aware of this condition. For this and other reasons, dialup connections are not supported by the NXU-2A.

#### ***My application does not provide a COR line. What should I do?***

COR is usually obtained from a radio and indicates that a signal is being received. If you do not have a COR line, or a line that performs this function, then you can either tie the NXU-2A COR line to its active state or you can use VOX mode. VOX mode is preferred since enabling COR permanently will cause data to flow continuously across the link, even if no audio is present.

#### ***I have a 100 Mbps Ethernet. Can I connect the 10 Mbps port on the NXU-2A to my network?***

Most 100Mbps equipment (hubs, switches, routers) will work with either 10Mbps or 100Mbps connection, so it should work without any problems. Check with your network administrator if you’re unsure about your network equipment capabilities.

#### ***Where can I find a description of the VoIP protocol used by the NXU-2A?***

The NXU-2A protocol is proprietary and not available to end-users.

***My system uses pilot tones and/or tone keying. Does the NXU-2A support this?***

Yes. Pilot tones and keying tones are not normally needed on the NXU-2A (due to its support for hardware COR and PTT lines), but are supported and will work with the proper vocoder selection. Tones are not supported when using the 13 Kbps vocoder (VOCODER 1). You must use one of the higher bit-rate vocoders to use any type of tone signaling.

***Can I hook one NXU-2A directly to another via their Ethernet ports?***

Yes, if you use a *crossover* Ethernet patch cable. A straight-through patch cable (such as the one supplied with the unit) can only be used to attach the NXU-2A to network interface equipment such as hubs, switches, or routers. You can directly connect a pair of NXU-2A units up to 100 meters apart using a CAT5 crossover cable. When directly connecting NXU-2A units in this fashion you should set the subnet mask to 255.255.255.0 and the gateway IP address to 0.0.0.0.

***After losing power on one end of an NXU-2A link, it takes a while for the units to re-establish communications. Why is this?***

The NXU-2A will wait up to 20 seconds before determining that the link has been disconnected. After that, it will attempt to close the IP connection, which may take several seconds. Then it has to open a new connection. This process may take 30 to 45 seconds, depending on your network.

***What is the difference between a static IP address and a dynamic IP address?***

On an IP network such as the Internet, the IP address is like a phone number. It is a unique number that identifies the network device, and it allows connections to be made between network devices. There are two kinds of IP addresses, those that are permanently assigned and those that are assigned temporarily. Permanently assigned IP addresses are called static IP addresses, while temporary IP addresses are called dynamic IP addresses. Static and dynamic IP addresses work the same way, but a dynamic IP address is like having a telephone number that nobody else knows; it effectively limits you to making outgoing calls only.

***Why do we need static and dynamic IP addresses? Why not just assign addresses permanently like phone numbers?***

One problem with IP addresses is there are not enough to go around. There are "only" about 4 billion IP addresses available. On the surface that would appear to be enough, but some companies use a lot of them, the military uses a lot of them, and all the millions and millions of people using the Internet use a lot of them. To ease this problem, many Internet providers only assign an IP address to a computer when someone actually dials in to connect to the Internet. When they disconnect, the IP address goes back into the pool of addresses so someone else can use it. This makes sense in cases where computers might sit for a long time without needing to access the Internet, as there is no point in tying up an IP address when it's not being used. There are plans for an upgraded IP addressing system that will fix the problem of too few IP addresses, but for now it is a limitation we must live with.

***What kind of IP address does the NXU-2A need?***

NXU-2As are configured to be either a client (the one that establishes the connection) or a server (the one that accepts the connection.) The client can have either a static or a dynamic IP address, but the server **MUST** have a static IP address. However, it is best if both units have static IP addresses.

***Who assigns IP addresses?***

For Internet access, your Internet Service Provider (ISP) will assign IP addresses to you. If you are on a private network, (like a WAN or LAN) then your network administrator will assign IP addresses. You should never program an IP address into an NXU-2A without checking with the ISP or network administrator first.

***What happens if two NXU-2As have the same IP address (or an NXU-2A has the same address as some other device)?***

Bad things will happen. Well, not bad things, but obviously it will not work properly. Both units will respond at the same time, causing network errors. The extreme case would be if an NXU-2A is programmed to have the same IP address as an existing computer on the same network. This would likely render that computer unusable for network functions, and could cause other users to have problems as well. The bottom line is that two devices on the same network cannot share the same IP address.

***What is a firewall?***

A firewall is a device that prevents people outside of a network from accessing computers of devices inside the network. It's a security device. A company firewall prevents incoming network connections, so no one outside the company can access the company's computers via the Internet.

***How does a firewall affect the NXU-2A?***

A firewall may prevent a connection between two NXU-2As if one is behind the firewall and the other is not. This may occur if the client unit is outside the firewall as the firewall is intended to prevent connections initiated from outside the firewall. See subsequent FAQs for more information.

***Should I use a firewall with the NXU-2A?***

Strictly speaking from the standpoint of the NXU-2A, there is no reason to use a firewall with the NXU-2A. The NXU-2A is a stand-alone network device which poses minimal security risks. However, if the network the NXU-2A is on is shared with computers, servers, or other network devices, then a firewall may be advisable. Talk to your network administrator about such situations.

## ***What do I do if my network has a firewall?***

If you know (or suspect) the network you are on has a firewall, go ahead and try to connect the two units. The firewall may already be properly configured. If it is not, then the following things should be considered.

If a server unit is behind a firewall, then the server unit's VoIP port needs to be opened on the firewall for both TCP and UDP. This is called "opening a hole in the firewall" and should only be done by (or with the cooperation of) the network administrator. This will allow TCP and UDP packets through the firewall so they can be received by the server unit. There is no security risk in doing this since the NXU-2A cannot be made to access files or forward information to or from other systems.

If a client unit is behind a firewall, then nothing needs to be configured on the firewall. Most firewalls will allow traffic back through them that is related to a connection that was initiated by a computer on its network.

## ***What is NAT?***

NAT (Network Address Translation) is a scheme by which many network devices can share one IP address. The NAT router translates packets passed through it between the single public IP address it holds and the private IP addresses used by devices on its network. This means that no computers behind the NAT router are directly accessible from outside the network since none of them have public (or routable) IP addresses.

## ***How does NAT affect the NXU-2A?***

Using NAT does not directly affect the operation of the NXU-2A. Special considerations should be made only in the event that multiple server units will be located behind a NAT router. In that case, each unit will need to be assigned a different VoIP port and the NAT router configured to allow both TCP and UDP traffic for the VoIP ports of all the units behind it. Client units are not affected by NAT and no special considerations need be made.

## ***Should I use NAT with the NXU-2A?***

The only time it is advisable to use NAT with the NXU-2A is when you wish to have multiple units on a network, but have only one public IP address. An example of this would be a bank of NXU-2As sharing a broadband type connection such as DSL or cable modem where only one IP address is allocated by your ISP.

## ***After installing a pair of NXU-2A's, the LINK ACTIVE light comes on, stays on for about 20 seconds, and then goes out. This cycle repeats endlessly. What's going on?***

The most likely cause is a firewall, which is preventing UDP traffic on port 1221. See the question above about firewall configuration.

***I want to connect my NXU-2A serial port to the ACU-1000 serial port, but the cable you supplied doesn't work. What kind of cable do I need?***

The RS-232 serial cable supplied with the NXU-2A is a straight-through cable used to connect the NXU-2A to a PC serial port. In order to connect the NXU-2A port to an ACU-1000 you need a DB-9 male-male null modem cable, also called a crossover cable.

***Why do I need a null modem cable to connect the NXU-2A to the ACU-1000? I don't need one when I connect my PC.***

RS-232 serial devices are divided into two types. Devices that provide control information are called DTE (Data Terminal Equipment) devices. Devices that accept control information are called DCE (Data Communication Equipment) devices. In the "old days" the DTE devices were terminals and computers, while the DCE devices were modems. The RS-232 standard specified that DTE devices would connect to DCE devices using a straight-through cable. If you wanted to connect two like devices (DTE to DTE or DCE to DCE) then you needed a null modem (crossover) cable. The PC is a DTE device, and the NXU-2A and ACU-1000 are DCE devices. That is why you need a crossover cable for connecting an ACU-1000 to an NXU-2A.

***Can I change the vocoder on the NXU-2A?***

Yes. This is the voice compression method used to convert the audio signal into a digital format. There are times when the user may want or need higher voice quality or transparency to certain kinds of signaling tones. The VOCODER command allows the selection of different vocoders, albeit at the expense of network bandwidth.

***Can I pass modem tones over the voice port of the NXU-2A?***

Some types of modem tones (such as FSK) will work if you select one of the higher bit rate vocoders, such as VOCODER 4 or VOCODER 5. Complex modem waveforms (such as 56K modem data) will not pass no matter what vocoder is selected. Pilot tone, keying tones, and other similar signaling tones will work properly with the 24, 32, and 64 Kbps vocoders.

In general data should be sent via the RS-232 port.

***I've connected my radio to the NXU-2A, I have the levels turned all the way up, and can still barely hear the audio. What's wrong?***

The NXU-2A uses balanced audio on the input. If, instead of connecting to both balanced input lines, you connect your audio to one audio input and ground, you'll get the effect described above. There is enough leakage in the transformer to get some audio through, but it won't work properly. The solution is to ground one side of the NXU-2A balanced input.

***I've connected my radio to the NXU-2A and it works, but the audio sounds very "tinny" and doesn't have much bass.***

Make sure you haven't used the discriminator output, which is sometimes available on FM receivers and transceivers. Discriminator audio is pre-emphasized, and there is no de-emphasis circuitry in the NXU-2A. You'll need to use your regular audio output instead.

*I've connected the NXU-2A to my computer serial port as described in Section 3.3 of the NXU-2A manual, but I can't put the NXU-2A into Command Mode as described in 3.3.1. What do I do now?*

First, if you're using HyperTerminal (the serial terminal program included with Windows) you need to make sure that you have the flow control set to 'None' in the serial port configuration menu. In addition, you may have to exit HyperTerminal and start the program again in order for program configuration changes to take effect. Second, you must follow the instructions in Section 3.3.1 exactly. Wait 10 seconds and then type three plus signs +++ and nothing else. If you type more than three plus signs the procedure won't work. Wait a few seconds and try again. In addition, the three plus signs must be typed within a one second period in order to be recognized. You may have better results using the *NXU-2A Setup Utility* which is supplied with the NXU-2A and allows convenient menu driven setup on Windows computers.

*I've configured my terminal program (or the NXU-2A Setup Utility) and followed the procedure exactly, and I still can't get the 'OK' prompt telling me that the NXU-2A is in Command Mode. Now what?*

If the NXU-2A has been configured previously and the baud rate was changed to something other than the factory default of 115200 then you'll need to set your terminal program (or the *NXU-2A Setup Utility*) to use the new baud rate in order to enter the Command Mode.

## **7 Theory of Operation**

The NXU-2A Network Extension Unit consists of two main circuits – the network processor and the digital signal processor (DSP). The network processor, a Motorola Coldfire MCF5272, handles all the Internet Protocol (IP) related tasks, and provides an Ethernet interface to the network. The DSP, a Texas Instruments TMS320VC5409A, handles all the audio-related tasks, including the voice compression and decompression.

The NXU-2A can be configured as a client or a server. Servers can only accept IP connections from clients, and clients can only make and break connections from servers. Once a connection is established, however, the operation of an NXU-2A is the same regardless of whether it's a client or a server. This operation is outlined below.

When power is applied to an NXU-2A it either waits for a connection (if it's a server) or attempts a connection to a server (if it's a client). The server it attempts to connect to is the one that has an IP address identical to the SRVRIP address programmed in the client. This connection is a standard TCP/IP connection on port 1221. Once a connection is established, each NXU-2A DSP begins converting analog data into digital data and compressing it to reduce the amount of bandwidth it will take to send it across the network to the associated unit. This conversion/compression process runs continuously, even if data is not currently being sent across the network. The network processor on each NXU-2A shares a common area of memory with the unit's DSP processor, allowing data to be exchanged between the two processors quickly and easily. When the network processor sees the unit's COR input line go active it collects the frames of compressed digital audio from the DSP and packages them into packets for transmission across the network. These audio packets are sent to the NXU-2A at the other end of the link using UDP on port 1221. In addition to the audio information, the packets also contain information about the status of the COR and AUX IN lines.

When these packets are received at the other end of the link, the receiving network processor separates the audio from the status information and updates the unit's PTT output and AUX OUT lines based on this status information. The audio frames are then sent to the DSP for decompression. When the DSP has completed the decompression of a frame, it sends the resulting samples to the digital-to-analog (D/A) converter; the resulting analog audio signal is available at the units audio output port. This process can run in both directions simultaneously since the NXU-2A is capable of full duplex operation.

Transmission of RS-232 data is handled solely by the network processor, and is sent using TCP on port 1221. If COR is not active the NXU-2A will send an empty packet every four seconds in order to keep the connection from timing out.

The DSP master clock is the source of timing for A/D and D/A conversions as well as for transmission of packets across the network. The buffer management software in the NXU-2A can account for slight differences in master clock frequencies on each end, and can account for network jitter or packets which arrive late.

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