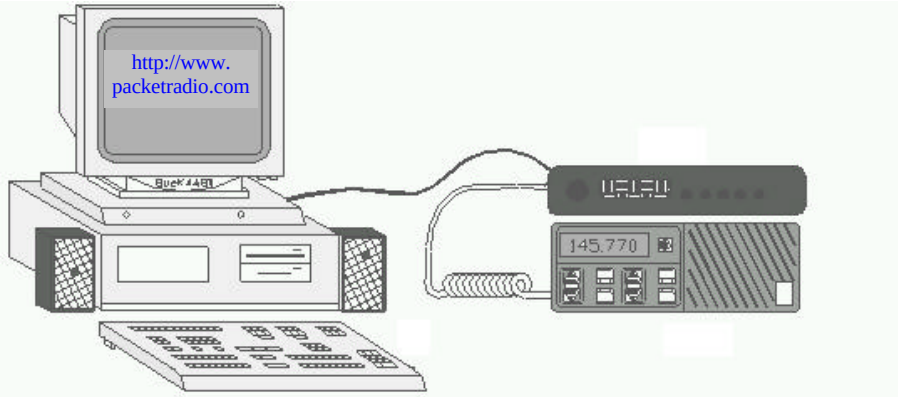
Two Packet Radio Books In One Cover

Section I

A Primer for the

Packet Radio

BEGINNER



Section II

A HANDBOOK for the ADVANCED

Packet Radio

System Node Operator

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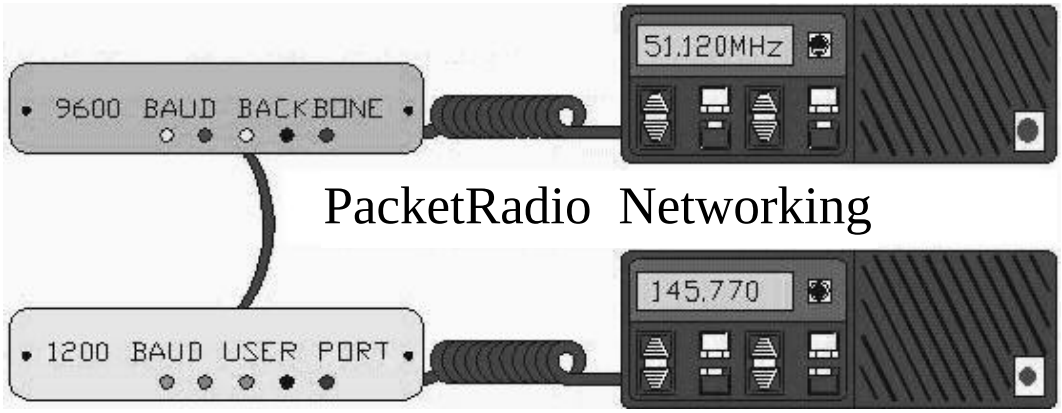

by

Buck Rogers K4ABT

E-Mail k4abt@packetradio.com PacketRadio Editor, ***CQ Magazine***

About The Author
(Semper Fidelis)

Proud to claim the title of former United States Marine, the Corps' own motto, ***Semper Fidelis***, serves as a good description of G. E. "Buck" Rogers' own attitude toward family, work, and humanitarian service… "always faithful." Married to Jean Ann (Dyson) Rogers for over 41 years, Buck and Jean Ann (WB4EDZ) have two children, Glynn E. Jr.(WB4RHO), and Janice Evelyn (Rogers) Mata, and six grandchildren.

In addition to spending time with his family Buck provides technical support and inspiration for the Southeastern Emergency Digital Association Networks (***SEDAN***), a humanitarian organization comprised of licensed radio amateurs dedicated to helping others in times of disaster. In fact, it was Buck's youthful interest in Ham radio that eventually led to his present career position as Senior Systems Engineer for Ericsson Communications.

Buck is a recognized world-class expert in the field of RF communications, having been instrumental in the design and implementation of the U.S. Air Force ***Local Area Network, Wide Area Network, and Global Information Networks*** (LAN, WAN & GIN). His credentials in other fields of RF communications also include terrestrial microwave systems design, television and radio broadcast station design, and Public Service Specialized Communications systems design. His communications consulting travels have taken him throughout the United States, Europe, Asia and other countries around the world.

Buck, K4ABT, is highly respected in the Amateur Radio community both as a pioneer of Packet Radio and noted author, having published twelve books and written many feature articles for the leading Amateur radio, commercial and trade publications. He is Packet Radio Editor of **CQ MAGAZINE** and every month authors the **"PACKET USERS NOTEBOOK,"** a popular column in **CQ MAGAZINE** distributed world-wide and translated into several languages.

Buck is a licensed radio Amateur for over 50 years and holds the "lifetime" Commercial FCC First Class license, now called the General Class Commercial license. He conducts forums and seminars on packet radio and digital communications, and is the author of twelve books, some of which include:

- Packet Radio Basics: The Beginners Guidebook
- Packet Radio X1J4 System Node Operator's Handbook
- Packet Radio Operator's Handbook (The PRO)
- Packet Radio Operators Manual (PROM, from CQ Publications)
- Packet Radio: General Information Handbook
- The Advanced Packet Radio Handbook

Buck also grows the world's best backyard tomatoes.

Richard Card, KD4JKX
President, **Southeastern Emergency Digital Association Networks (*SEDAN*)**
July 1999

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This handbook is dedicated to the people I love, and to the hobby and profession that I enjoy.

G. E. Rogers Sr

"Buck" K4ABT

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AN INTRODUCTION TO

PACKET RADIO:

by

Buck Rogers K4ABT

PACKET RADIO IS:

Communications between computers using radio (RF) as the medium rather than wires or solid mediums. Your personal computer in your ham shack coupled to your VHF or UHF transceiver via a terminal node controller (TNC) is the makeup of the Packet Radio station. Computer terminal programs enable computers to send and receive Ax.25 Packet along with other well know digital modes such as CW and RTTY. The mode we are most interested in it called "Packet Radio."

Packet Radio is faster and is completely error-free as compared to CW and RTTY. This mode of data communications allows us to deliver ASCII text, binary data, and even digital video via this high speed and error-free communications medium.

One of the many benefits of using Packet Radio is that it preserves spectrum by allowing several stations can share one frequency at the same time. By using the X-1J4 network node base described later in this book, you will discover other ways that Packet radio can link your State, Country, or even the World into one massive network. One of the elements or off-springs of Packet communications is the internet. Much like Packet radio, the internet uses every conceivable type or kind of medium to transverse from point A to destination B. The internet uses longer packets with a protocol based on Transmission Control Protocol (TCP) with Internet Protocol (IP) addressing.

THE TERMINAL NODE CONTROLLER (TNC):

By now you have heard the phrase, "terminal node controller" or "TNC" several times. The terminal node controller (TNC) performs as an interface between the computer and the transceiver. The TNC combines a modem and a packet assembler/disassembler that accepts information from your computer and sends received data to your computer. The TNC (prior to 1983 it was called a "PAD" or packet assembler/disassembler) breaks data into "packets." These packets are normally 128 letters or characters in length. In our Packet TNC we have the option to increase this packet length up to 255 characters in length. The TNC command that allows us to make this change is called "***PacLen***."

Once the TNC has received the data from your computer, it then breaks it into packets about 100 characters long and combines additional (bytes) information to the outgoing data. The added bytes include the destination addressing, error-checking, and frame control information. Address and destination information that is added in by the TNC includes the callsign of the target station and the callsign of the station sending the packet (data). This same frame or data packet will also contain the path or nodes that is used between the two connected stations. The forward error-checking intelligence within the AX.25 Packet frame enables the target station to ascertain that the was received without any errors. If errors were received, the receiving station sends a non-acknowledge (NACK) Packet indicating to the sending station that it must repeat the Packet again or until the Packet is received "error free." Once the Packet is received error-free, the receiving station will send an "ACKnowledge" packet to indicate that the data was received as sent.

DIGIPEATERS & NODES:

Any packet radio station can act as a digipeater. A digipeater is a "store-and-forward" Packet station. Most TNC's are setup to digipeat automatically without any effort on the part of the station being used as a digipeater. To reach a distant station, we connect to any remote node that is in range of our station. From this point on, we use the remote node as if we have a long cable between our computer and the remote node. Once connected to the remote node we can instruct the node to connect our station to a distant Packet station. The node will "ACKnowledge" packets between our station and the target or destination station. The node is also a "store-and-forward" device that may be located atop a mountain or tall structure that enables it to hear Packet stations that are beyond our stations reach. This handbook has a complete section dedicated to the construction, configuration, operation, and use of nodes. Read on as you are about to discover how much fun and enjoyment Packet Radio

Chapter One

Packet Radio 2008 "*The Easy Way* !"

PACKET RADIO:

The Easy Way !©

by Buck Rogers K4ABT
© 1986 Updated; 1990, 1997

When I first wrote "PACKET RADIO*: The Easy Way!"* in *1986*, I felt that somehow the new or prospective Packeteer would not feel comfortable with an attempt at setting up his or her Packet station without some means of tutorial. That was when I decided to write this tutorial. I had to give the ham who might be willing to give Packet Radio a try, a head start by taking them around the pitfalls that I had experienced when I set up my first Packet station. When I began my Packet Radio hobby, there were no neighbor Packeteers, Packet books or tutorials that might provide guidance for a beginning Packeteer. Here then, is a brief and easy to understand guide for the first time Packet Radio operator.

WHAT DO YOU NEED TO BEGIN OPERATING PACKET?

The equipment needed to get on the air is a VHF transceiver, a computer or terminal, and *a terminal node controller* (TNC). There is packet activity on HF, but VHF is the best place to start out in Packet Radio. The TNC contains a modem similar to the modem used to connect your computer to the phone lines, except that it also contains special firmware especially designed for Packet radio.

When you take the TNC out of the carton, most of the time you'll find cables are provided with the TNC connectors supplied. The other end of the cables that attach to the transceiver and computer are not supplied. The reason is that the TNC manufacturer has no idea what kind of radio you might be connecting the TNC to.

The burden is on the user to purchase the correct connector for the transceiver and computer that will be used with the TNC. Determine the kind of microphone, speaker jack, and computer serial comport connectors that you're going to use. In some cases the TNC manufacturer furnishes only the connector for the TNC.

This means that you must also furnish the cable that connects the TNC to your computer or terminal. In most cases, a 25 pin RS-232 serial cable is used between the TNC and computer. The later models employ a 9 pin serial connector, thus you will need a 9 pin connector/cable.

This may vary depending on the type and make of computer terminal being used. Check the serial comport of your computer to be sure of the type connector that you will need. DO THIS BEFORE GOING TO THE PARTS SUPPLY HOUSE!

In most cases the computer will have either a 9 pin male connector, or a 25 pin male connector as the RS-232 serial comport. If this is the case, you will have to supply the female connector for the computer end of the cable. Be sure to note the number of pins on the computer/terminal connector.

The operating manuals supplied with most TNC provide adequate directions for use of various computers. Look for the computer to terminal node controller (TNC) interface section in the TNC manual. In most applications the cable for your TNC to computer may be purchased "ready-made" for many computer vendors.

When all else fails read the manual and set up procedures for your TNC very carefully. The manual that is supplied with your TNC may have information that is specific to the personality of your TNC.

LADIES AND GENTLEMEN, START YOUR .....tee N cee's

Once you have everything wired and connected together, turn on the computer, load a terminal program. There are lots of terminal programs available for use with Packet radio.

If you do not have a Packet terminal program, then send an MS/DOS formatted disk and a self addressed and postage paid return mailer to me and I will provide you with a copy of **BUXTERM.EXE** along with the BUXTERM manual.

IT IS FREE ! There is no "catch", it is FREE! ***You supply the disk, mailer, and return postage.***

Mail **TO:** **BuxTerm**
115 Luenburg Drive
Evington, Virginia 24550

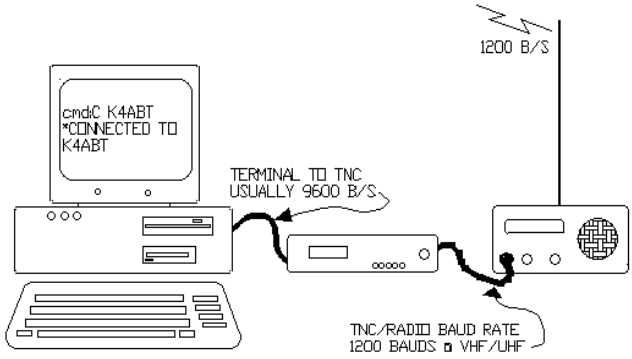
You can also download BUXTERM from one of my web sites at; **www.PacketRadio.com**

Next we switch on the VHF transceiver and turn the volume up a quarter turn or just above the "9:00 o'clock position." Make sure the squelch is not set too tight. The squelch should be set to a position where the transceiver is quite. The squelch is set in a similar manner that you would use for voice operation.

There are two communication speeds that are used in Packet Radio. It is necessary that each new Packeteer be aware of the meaning of each speed, and the relationship to his/her Packet station. The first speed is the terminal to TNC baudrate. The second speed is the "ON-AIR" or radio (VHF) baudrate.

Since we are about to begin operating in the VHF region we will begin with an on-air baudrate of 1200 baud's. **ABAUD** refers to the terminal to TNC, and **HBAUD** refers to the RADIO or ON-AIR baudrate. Most computer and TNCs will operate at an Abaud of 9600 baud's.

The following figure will give you an idea of two communication functions that we are discussing.



1 ***2*** ***3***

1. **Computer or Dumb Terminal**
2. **Packet Radio Terminal Node Controller (TNC)**
3. **VHF or UHF Transceiver**

NOW LET'S BEGIN HAVING FUN:

If you've followed the setup procedures outlined in the manual that comes with your TNC, then you are ready to take the plunge into the wonderful world of operating Packet.

Verify that all control, signal and ground wires (PTT, RECEIVE, AFSK, and SIGNAL GROUND) are connected to the correct connector pins.

TURN ON THE TNC!

When you first turn on the TNC you may see garbled text on the screen. This is usually because the terminal to TNC baudrate is not set to the same parameters. Some TNCs will do a "search" mode to find the setting that you have your terminal program set to/for. If at first you see garbage on the screen then clear text begins to appear, you should follow the instructions that appear on the screen. If you are unable to establish communications with the TNC, then review the TNC manual for further instructions. The baud rate of the TNC has to match the baud rate used by your computer terminal program and is easily adjusted. When the terminal to TNC parameters are correct, a message will appear on the screen showing the TNC manufacturer's name, firmware version, and date of EPROM program.

Perform a "control C" (press Ctrl and the letter C at the same time); this places the TNC into command (cmd:) mode.
This is where all commands are issued from you to the TNC. Any command that is typed while in the "cmd: mode is received by the TNC as a direct order.

Once in the command mode, you can press the [Enter] key and each time you press the [Enter] key a "cmd:" prompt should appear on the screen. This is an indication that you have control (command) of the TNC.

The next step will be to set our callsign into the TNC. To put our call sign into the TNC, at the cmd: prompt, we type and [Enter] the following:
***MY** (my call) or (your call)*

I send my call sign to my TNC in the following manner. Type and [Enter] to the keyboard/TNC: (the [Enter] simply means I pressed the Enter key).

MY K4ABT [Enter]
You may now test the TNC to see if your call sign is indeed set into the TNC. To do so, type:

MY [Enter] and the TNC should respond with:
MYCALL K4ABT

This lets us know that the computer and TNC are communicating.

Now that you have entered your call sign as we have just described, followed by a carriage return, (CR or [Enter], we are ready to set other commands into our TNC. If there is no response when you type MY, then try typing:

ECHO ON [Enter]

The :cmd:" should appear on the screen again, with a message similar to the following:

ECHO was OFF

NOTE; If you are seeing double letters (i.e.; MMYY CCAALLLL) displayed when you type, this indicates that the ECHO command should be turned ***OFF***. Type the following :

ECHO OFF

The TNC may respond with:

ECHO was ON

Here are some other commands that we should make active; Type them in as I have shown them below:

MON ON
MCOM ON
MCON OFF
MRPT ON

If you've wired the RS-232 interface cable using the ***RTS, CTS, Txd, Rxd, and Signal Ground*** leads, then *set the* ***XFLO*** *command* ***OFF***. If you **did NOT** ***use the RTS, and CTS*** signals, then *make sure the* ***XFLO command is ON.***

THE MOMENT OF TRUTH:

The most used frequency for VHF Packet Radio operation is 145.010 MHz; However there are many other frequencies that are set aside for Packet Radio use. The ***SouthEastern Digital Association Networks (SEDAN)*** is operating at 145.770 Mhz..

The following is a list of other VHF, and UHF Packet Radio *simplex* frequencies (In Mhz):

144.91, 144.93, 144.95, 144.97, 144.99, *145.01*, 145.03, 145.05, 145.07, 145.09, 145.51, 145.53, 145.55, 145.57, 145.59, 145.61, 145.63, 145.65, 145.67, 145.69, 145.71, 145.73, 145.75, 145.770.

Included in the ARRL future band plans are several simplex (64 kB), 100 kHz backbone frequencies within the 219 > 220 Mhz UHF band, (FCC approved 16 March 1995 with restrictions, see CQ Magazine PUN June 1995)

Below are a few frequencies that are set aside for Packet Radio use in the 420 > 450 Mhz band:

430.050, 430.150, 430.250, 430.350, 430.450, 430.550, 430.650, 430.850, 430.950, 440.975, 441.000, 441.025, 441.050, 441.075, 446.500.

As I mentioned earlier, make sure the MONITOR command is ON, then watch the screen. If you have tuned to one of the Packet frequencies mentioned above and you are not yet seeing data appear on the screen, then try the SEDAN 1200 baud access Packet frequency of 145.770.

When all else fails call a Packet friend and ask them to connect to your call. If you are using an *SSID of your call, be sure to include this in the information that you give the friend. While you are about it, ask if he/she uses an SSID.

AWW SSID !

Now that I have you wondering; "What is an *SSID*?" Here is a brief explanation for the "***Secondary Station IDentification" (SSID)***. In Packet Radio you can have up to 15 *Secondary Station IDentifiers* (SSID's), an example is K4ABT-1 through K4ABT-15. K4ABT without an SSID extension, is considered the 0 (zero) *SSID*, thus we could have sixteen different stations/calls on the air at the same time using our single call sign. That's where the numbers in the call sign come into play. The added dash numbers (-1 etc...) numbers are used to distinguish the various station(s) or node(s).

To connect to a station or node which uses an SSID, it is important that we know what the SSID is before attempting a connect to that station. To try connecting to a station or node without having the appropriate SSID included in the connect sequence would be like trying to place a long-distance telephone call without using an area code. A crude analogy, but you get my drift.

You are about to embark upon the most fun filled facet of Ham Radio. Give it a try.

LET'S BEGIN:

This is where you will find this handbook to be helpful. I've written this handbook to serve as a guide to get you started in Packet Radio. After you have your station assembled, and working, you may wish to learn about the more advanced levels of Packet operating.

There are books that provide detailed information for the advanced levels of Packet operating and projects for the more advanced levels of operating. Books for the advanced Packet operator are:

1) **PACKET RADIO OPERATOR'S HANDBOOK** (**MFJ Publications**)
2) **PACKET RADIO OPERATOR'S MANUAL** (**CQ Publications**)

Be sure to visit the PacketRadio Networks Home page(s) at: http: //www.packetradio.com and at: http: //www.packetradio.org

Advanced levels of Packet include transmitting and receiving high resolution color pictures (error free), transmission of large ASCII and binary files, and how to build and use nodes with Packet Radio.

Included in the books just mentioned, is information on many other uses and applications for digital communications.

YAPP is a protocol that is universally used to transfer binary files to and from the BBS system. YAPP is not supported in BUXTERM, however, YAPP protocol is supported in the MFJ **MULTICOM.EXE** software.

NOW we are ***having more fun already!***

73 de **BucK**4ABT

A PacketRadio FREQUENCY GUIDE FOR THE NEW PACKET OPERATOR:

This guide is for information purposes only, and is subject to change. Some changes in future band-plans may cause changes in the application of certain Packet frequencies. A possible change in the 219.050 to 219.950 is one example of Packet frequency changes. The 219 Mhz band is allocated for future trunks and backbone "only." Some frequencies are used for specific Packet modes. Note that frequencies are in MHz:

80 Meters

3.606 Packet
3.630 Packet
3.642 Packet

40 Meters

7.090-7.100 Packet

30 Meters

10.145-10.150 Packet

20 Meters

14.101-14.110 Packet
14.230 SSTV

17 Meters

18.100-18.110 Packet

15 Meters

21.099-21.105 Packet

10 Meters

28.099-28.105 Packet
28.150 -28.190 1200 baud Packet

6 Meters

50.60-51.78 Packet
50.62 Packet calling freq
51.12 9600 baud “backbone only”

2 Meters

144.910-145.090 Packet (every 20 kHz)
145.510-145.790 Packet (every 20 kHz)

144.910 through 144.950 Mhz used for DX Spotting and NOS operations.

144.970, 144.990, 145.030, 145.070 145.530, 145.550, 145.570, 145.590, 145.610, 145.630, 145.650, 145.670, 145.690, 145.730, and 145.750 Mhz are used as Local Area Network (LAN's) and often ported into high-speed backbones and trunks.

145.010, & 145.050 is most often used as BBS forwarding and local BBS connects.

145.090, 145.510, & 145.710 are sometimes employed as DX spotting nets.

145.770 ***Nationwide Keyboard to keyboard and emergency Packet communications only. Some areas use 145.770 Mhz for*** emergency communications in addition to keyboard to keyboard communications.

In some east coast areas 144.390 Mhz is used with Automatic Packet Reporting Systems (APRS), and as a DXCluster or DX spotting network frequency.

222 MHz
223.52-223.64 Packet

Chapter Two

LEARNING ABOUT PACKET CONTROLLERS

The TERMINAL NODE CONTROLLER (TNC)

By now you have heard the phrase, "terminal node controller" or "TNC" several times. The ***terminal node controller*** (TNC) performs as an interface between the computer and the transceiver. The TNC combines a modem and a packet assembler-disassembler (PAD), that accepts information *from* your computer and sends received data *to* your computer.

The TNC (prior to 1983 it was called a "PAD" or packet assembler/disassembler) that breaks data into "packets." Since 1983, the "PAD" has become known as the "tink" or TNC.

Packets are normally 128 letters or characters in length. In our Packet TNC we have the option to increase this packet length up to 255 characters in length. The TNC command that allows us to make this change is called "***PacLen***."

Once the TNC has received the data from your computer, it then breaks it into packets about 100 characters long and combines additional (bytes) information to the outgoing data. The added bytes include the destination addressing, error-checking, and frame control information. Address and destination information that is added in by the TNC includes the callsign of the target station and the callsign of the station sending the packet (data).

THE ALL-MODE CONTROLLERS:

These are controllers that transmit and receive PACKET and other digital modes, such as:

PACKET, PACTOR, AMTOR, RTTY, CW, FAX (WeFax), Slo-Scan TV (SSTV), and NavTec. They also offer multiple ports for VHF and HF operations. The **MFJ-1278**B is one such "multimode" controller that fits into this category. The features may differ from one "all-mode" controller to the next, so it would be in your best interest to investigate the options which best suit your needs.

THE PACKET CONTROLLERS*:*

If you plan to operate packet only, but you wish to use both HF and VHF packet, you may want to look for a controller which has a tuning indicator for use on the HF bands. The MFJ-1274B is one such Packet only controller that operates HF and VHF Packet.
It has a Packet tuning indicator for use when operating at HF. Most of these controllers operate both HF and VHF Packet.

Almost all Terminal Node Controllers (TNC) operate both HF and VHF, but to try operating HF packet without a tuning indicator is like fishing without bait, your chances of catching anything are, little to none.

Now if you just want to operate VHF packet, there are numerous TNCs to fill your fancy. As of this writing, just about every TNC now supports the "MAILBOX " feature. This allows the user to set the MAILBOX or PBBS command ON while the computer or terminal is being used for other tasks, such as letter writing, and data processing. The mailbox will receive and store messages while you are using the computer off-line or away.

If your desire is to use the ultimate in a digital, all-mode controller, then check into the MFJ-1278 and the companion software terminal program, MultiCom for Windows.

Once you've used this combination, the rest are paled by comparsion.

KEYBOARD-TO-KEYBOARD CONTACTS:

The number one use of Packet radio is probably keyboard to keyboard contacts through a Packet network. Like other digital communications modes, Packet radio can be used to talk to other amateurs. For those who cannot use HF frequencies, two Packet stations can talk to each other across long distances using a PACKET radio network.

EMERGENCY COMMUNICATIONS:

Keyboard to keyboard Packet communications is where Packet radio excels. Packet has proven many times over its usefulness as an emergency communications medium. The use of Packet radio as a *sky-warn* or *weather-watch* tool has become a standard operating proceedure.

In areas where earthquakes, hurricanes, tornadoes, storms, flood and other natural disasters have occurred, Packet radio has been used to relay information, requests for food, medicines, and help from the destressed area to the proper authorities.

In a disaster area a voice repeater may be lost due to high winds, flood, or other causes, an emergency Packet node or station can be setup at a moments notice. Emergency and disaster communications can be enabled immediately.

In some regions of the country, dedicated Packet networks are in use specifically for this purpose. One such network is the Southeastern Emergency Digital Association Networks (**SEDAN**) that reaches from Washington DC well into south Florida. Much of the **SEDAN** covers the eastern coast of the United States and inland as far as Alabama and Mississippi. This network is made up of over 200 nodes and provides continuity into all the major cities where the Red Cross emergency operations centers are located.

When disaster relief and medical teams call for supplies of a specific type or category and where the spelling of a medical title is important, the printed (Packet text) word will prevail over the spoken word. With the error-free nature of the AX.25 Packet protocol, the message is clear and concise.

PACKET BBS OPERATIONS:

Many cities have a PACKET Bulletin Board System (BBS) included on their Packet local area network (LAN). Amateurs can check into the BBS's and read messages from other Packet users on almost any topic. BBS's are networked together over the Packet network to allow messages to reach a broader user base than your local BBS users. Private messages may also be sent to other Packet operators, either locally or who use other BBSs.

Most BBS's have the latest Amateur radio news bulletins and propagation bulletins posted. Many BBS's have a file section containing various text files full of information on amateur radio in general.

DX PACKET SPOTTING NETWORKS:

The use of Packet radio for DX spotting has become a tool that enables the serious DXer to make DX contacts almost as easy as "shooting fish in a barrel." HF operators connect to the local DX Packet node for the latest reports on DX. Often a user will "spot" some hot DX and distribute the DX report real time throughout the DX spotting network.

FILE TRANSFER (ASCII, TEXT, & BINARY) :

Using special like BUXTERM, MULTICOM, PACPRO, YAPP and many others, amateurs can pass any binary files to other amateurs. This may also be accomplished using TCP/IP (NOS) communications, and other specialized protocols.

PACKET PICTURE TRANSFER:

To add more fun to our Packet Radio hobby, we can send and receive high resolution, color pictures via Packet Radio. The method of transfer in many programs allow the pictures to be transferred and while they are being received, they are displayed on the screen in 256 or more colors. At the same time the picture is being saved to disk for future viewing or sending to another station. When exchanging high resolution Packet pictures with other Packet stations, both stations must be using the same software (terminal program).

SATELLITE COMMUNICATIONS:

The amateur radio satellites contain microcomputers that provide special information to amateurs. Some satellites contain TV cameras that allow users to download images of the earth and the stars. Others provide store and forward Packet mailboxes that enable message transfers over vast distances. Some satellites use AX.25, some use special Packet protocols developed for satellite communications. Transmissions are both AX.25 Packet using FM transceivers, and others use Single Sideband.

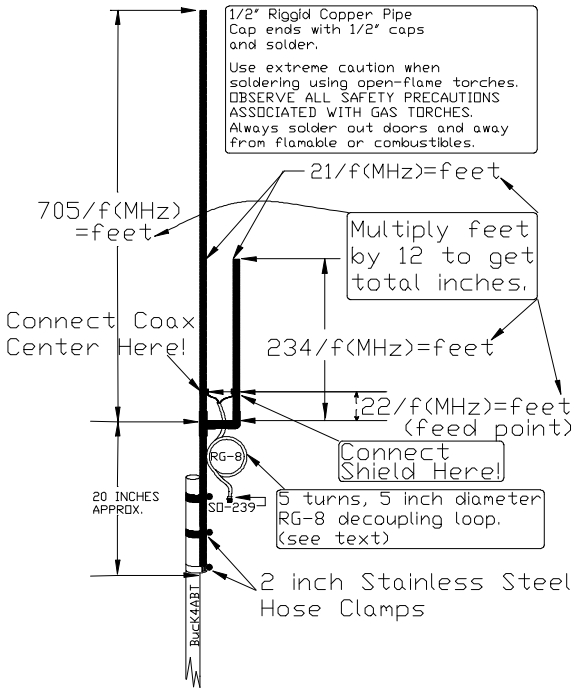
Chapter Three

Antennas For Packet

I'm not suggesting that any digital radio user should select one antenna over another. Use whatever you have, or choose the antenna that best favors your needs and environment.

This chapter deals with the specifics related to various types of antenna. We will consider everything from an isotropic radiator (Dipole) to a J-Pole.

Packet radio is one of those communications modes that will reflect on the system operator if he or she fails to provide the antenna that has the best radiating and capture effect to it. In fact, if the antenna is not constructed and erected so as to provide good capture to signals and have the lowest noise component with respect to terrestrial noise, then no one is to blame except the operator who is in charge of the installation.



I am as meticulous as A.J. the day before race day. Don't just walk the race track, look for the bumps and crevices. The antenna for your packet station is about to become your doorway to the world. Every one who has spent any time around me will affirm that, "Buck won't skimp when it comes to his **antenna."**

I am very particular where my antennas are concerned. When I go to buy cable and connectors, I purchase the best available coax and connectors. When I go to buy cable or connectors, I specify silver flashed connectors and cable of the best quality. Over the years, that is the part of my station that will get the least attention after it is installed, so I want it to withstand the elements and provide dependable communications for a long time.

I am very picky about the antennas and associated components of my antenna system. With over forty years as a amateur, and over forty five years as a Senior Telecommunications Engineer, I've learned a very valuable lesson early on. SIGNAL QUALITY begins at the tip of the antenna, and it travels down through the transmission-line and reflects off the operator at the other end. Let your reflection be a good one.

RADIATION and RESONANCE:

Antennas can be constructed to radiate with directional, omni- directional, and bi-directional patterns.

The kind of pattern desired, depends on the coverage area requirements. Likewise, the type antenna selected, will determine the kind of pattern you will have. Another major factor in antenna selection and installation is the distance above the ground that an antenna is suspended.

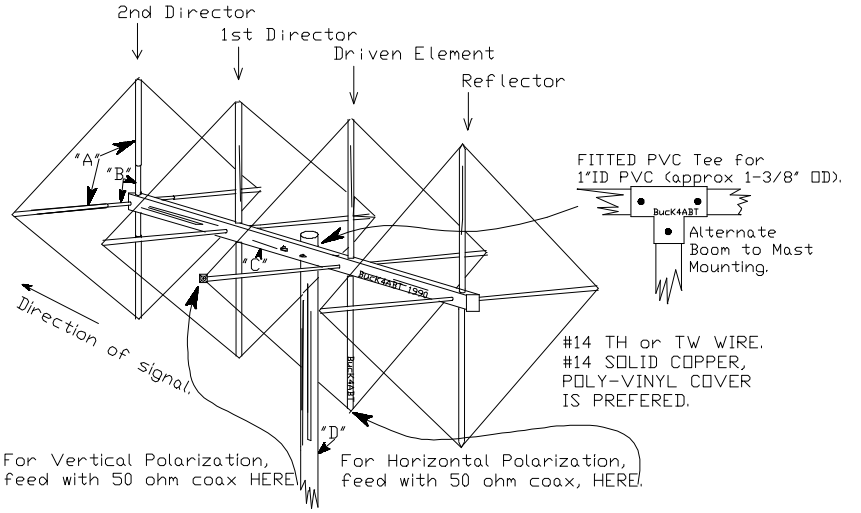
Antenna theory as related to antennas suspended in free space states simply that the ground below will provide a reflection or mirror effect. This mirror effect gives an antenna the appearance of having greater gain when the antenna is mounted at distances that are "in- phase", or a given wavelength above the earth. The greater the height, the greater the gain.

It goes without saying, (but I will anyway) HF beam antennas with long elements, and towers with guy-wires affixed near the top, don't work well together when the beam is vertically polarized. Something will have to bend or break, either the guy-wire or the element that are in each others path. For this and other reasons, most HF beams are horizontally polarized.

VOICE vs DIGITAL:

Don't be deceived by the heading of this section. I am not about to begin a rebuttal between these two modes. My intention is to look into the types of antenna that is best suited for the digital mode of communications, as related to the antenna commonly used for voice communications. From the beginning of this chapter, we have moved in this direction.

If it is distance you want, then the class of beam antenna that we use for voice will be sufficient. If it is coverage you prefer, again I prefer the beam type antenna as a power booster. I tend to try for a happy medium with respect to the digital and/or packet modes. The yagi type antenna, in a horizontal configuration is one way to go if you want coverage, and reduced wind resistance.



"A" = 1/2" ID hot/cold PVC. PVC should fit securely over 1/2" OD wooden dowel "B."

"B" = 1/2" OD wooden dowel 2 ft long through 1" ID boom. Dowel should extend approximately 9-1/2" out from each side of 1" ID boom. Fit 1/2" PVC ("A") over dowel. Make sure spreader is long enough to support each wire element length as determined by the calculations below. Once PVC is in place over the wooden dowels, drill with small bit and use short wire or picture hanger nail to secure on the dowel. Hot glue may be used as an additional keeper over the wire or nail head.

"C" = Boom may be made from square fiberglass or from round PVC 1" ID. Boom is drilled with 1/2" bit at points where wooden dowels are to be inserted.
NOTE: Make sure the vertical and horizontal dowel holes are drilled offset so the dowels will by-pass each other inside the boom. Drill dowels with 1/16" (or smaller) bit each side of boom and secure with small nail or wire to hold (centered) in place. BOOM is thick wall "Sked 40" 1" ID PVC.

"D" = 1" ID (sked 40/Thick wall) PVC 48" long. Use "fitted" wooden dowel inside to make it more rigid and provide "body" to area where "U" bolts may be attached (rotor head and to boom). See alternate boom mounting.

That happy medium I spoke of takes the form of a vertically polarized yagi and/or a cubical quad. My preference is the latter; primarily because the "QUAD" is well known for its favorable gain/bandwidth characteristics.

There is a second, and more important reason I chose the cubicle QUAD. The cubicle quad offers a better signal to noise ratio because influence from terrestrial noise is greatly reduced when receiving with a cubicle quad antenna. **This inherent rejection to terrestrial noise is one of the reasons we might consider the quad for use in a digital data medium.**

THE ANTENNA IS THE KEY "ELEMENT":

The antenna for digital as well as any other modes of communications is only as good as the transmission line that feeds the antenna. Consult the handbooks and the catalogs for the latest and greatest coax or transmission feedline. Look at the manufacturers printed specifications for a given type of feedline or coax. When the (VHF/UHF) coaxial cable runs are less than 100 feet, I spec for Belden 9913. When the VHF/UHF cable runs require MORE than 100 feet, I spec for Andrew LDF-4-50 or larger "heliax."™ hardline.

The main points of interest are the specs regarding the loss factor (expressed in DB) per hundred feet, the velocity factor, and the frequency at which the measurement was taken. Over the long haul, the "hard- lines" or multiple shielded coax cables will prove to be the better value.

The coaxial (coax) cable or the transmission line plays a major role in the antenna performance. The coax is a very vital part of the overall antenna system, but the coax has a personality of its own and can reek havoc if it is not cut to or "tuned" for optimum performance along with the antenna. It is even more important to say that antenna performance will depend on the behavior of the transmission line at the time of antenna tuning or setup. In other words, if the coax is not prepared before the antenna is tuned, then tuning of the antenna will not render optimum performance.

The coax is the "life-line" that delivers the energy to the antenna. since the energy is handled by the coax, this means that the coax is either an external extension of the "tank circuit" or it is part of the antenna, but which is true.

This is not a trick question, but a way to make a statement that can be easily remembered. The antenna feed line is BOTH; Because the complete antenna system is part of the tank circuit.

Wow! Now we are beginning to understand why the antenna should be tuned.

Chapter Four

USING A PACKET BBS:

Because there are so many variations and versions of Packet Bulletin Board Systems (BBS), I've put together a composite of the most used BBS commands. In the list of commands that follow, I will address instructions that are in general use with most of the full service Packet BBS types. These commands are closely associated with, but not related to, the common telephone type BBS.

As a matter of interest to the Packet BBS user, there is no waiting period to access other "WHAT" files sections of a Packet BBS. Packet BBSes allow the immediate access to all levels of the BBS where the telephone BBSes often require a 24 or 48, hour (and sometimes a week) waiting period after initial access, before the user is allowed full BBS operating privileges.

Once you have answered the four questions, BBS access is there ready and waiting at your service. Just remember that other users await access to the BBS so limit yourself. This same consideration may be in your favor at a later time.

Some BBSes allow multiple connects to them. When this is the case, BBS activity may slow down while multiple users are downloading files from the BBS.

A connect to your local area network (LAN) BBS is made in the same manner as a connect to another Packet station. If this is your first connect to the BBS, you will need to provide some information about yourself. There are four questions, and the answers to them are short, so the time spent answering these questions are not like the complex answers that were needed when you accessed a telephone BBS.

If it is your first time on the bbs you will be asked to enter your **NAME, QTH, ZIP CODE and HOME BBS**. The format is as follows.

N BUCK
NQ LYNCHBURG, VA
NZ 24550
NH WD4ELJ

The **N** command can be used to register your name or QTH. You should enter both of these. To enter your name type N yourname.

Example: **N BUCK**

To enter your QTH, use the command NQ your QTH.

Example: **NQ EVINGTON, VA**

To enter your ZIP or Postal Code, use NZ code.

Example: **NZ 24550**

To enter the BBS that you use to receive mail at, use NH callsign.

Example: **NH [Your home BBS]**

The BBS will then greet you using your name; In some cases the BBS greeting will contain both the name and callsign. After the greeting a list of abbreviated commands will appear on the screen.

The greeting may appear similar to the following:

WD4ELJ> Hello BUCK, K4ABT Welcome to WD4ELJ BBS [BBS type/number]
WD4ELJ> A,B,C,D,G,H,I,J,K,L,M,N,P,R,S,U,V,W,X,?,*

The following is a list meanings for the abbreviated command letters shown above.

B - Bye	**C** - Conference	**D** - Download	**G** - File search	**H** - Help
I - Information	**J** - Calls heard	**K** - Kill message	**L** - List Messages	**M** - Message of
N - Enter name/qth	**P** - Path to call	**R** - Read message	**S** - Send Message	**U** - Current users
V - VERSION/INFO about BBS		**W** - What files	**X** - Expert	
?x- Info about command x		***** - Comment line		

The **A**bort command can be used to abort the output from many of the BBS commands, like **D**ownload, **L**ist and **R**ead for example.

The **B**ye command disconnects you from the BBS. Use it when you are done!

The Conference command should not be used on the BBS if it is on a LAN frequency with high usage. The conference mode of a BBS can present a grid-lock situation if the BBS is being accessed by other users at the same time the conference is in use.

The Download command is used to read a file stored on the system. The format of the command is "**D filename**" where [filename] is the name of the file to down load.

To see what files are available for downloading, use the **W** command. To download a file in a subdirectory, use D FILENAME.

I by itself gives hardware configuration of the system.

ID gives a list of the ports and digipeaters/gateways available.

The **J** command lists stations recently heard on the various ports and stations that recently connected. Use the **P** command for path to stations that have connected recently.

The **K** command is used to kill (delete) old messages from the system. You can kill only those messages that are to or from your station. The format of the command is K, space, and then the number of the message to delete. You can also use the command **KM** to delete all messages **TO** you that have been read.

Use the command **KT**[msg#] to kill NTS traffic you are going to deliver.

The List command lists selected message headers. The following formats are available:

- L - List messages since you last used the B command
- LB - List bulletins (all of them, use with care!)
- LM - List messages to or from you (List Mine)
- LN - List messages with type of N (List New)

LL # - List the last # messages ***Example*: LL 10** **L<** callsign - List messages from callsign

Example: **L< K4ABT** [This would list all messages FROM K4ABT] **L>** callsign - List messages to callsign
Example: **L> K4ABT** [This would list all messages TO K4ABT]

For a short description of the commands at your Packet BBS, use **H** command. For more information about a particular command, type ?x where x is the letter of the command.

Putting * at the beginning of a line makes it a comment. It also suppresses the next command prompt (but the system will be waiting for another command). * is useful to answer the SYSOP if you get a MESSAGE FROM SYSOP ...

ONE FINAL NOTE: After you read any messages directed to you, please kill that message using the **KM** command.

SECTION II; The X-1J4 System Node Operator's Handbook!

Chapter Five

WHAT IS A PACKET NODE ?

The X1 node is beginning to attract many users, and it is a "natural" for our Local Area Networks (LAN) frequencies. Not only can it be used as a node to connect out of the LAN. It also doubles for use as round-table packet session when using the "TALK" command/mode.

In version X1J, there is an add-on hardware modification that allows the users to examine their deviation (modulation) level. If there is too much or too little deviation, the users can adjust it accordingly. Further connects to the node will allow them to determine when the Frequency Modulation (FM) is set to the correct swing.

The outgrowth of this node can be used for networking, in a network of several nodes. There are many features that time and space prohibit explanation here. To find out more about this new networking node see the August and September 1993 issues of CQ magazine.

The X1J code is burned into a 27C512 EPROM which fits into the TAPR TNC-2 or clones, such as the MFJ-1270C, and MFJ-1274C.

By now you are aware of the need for an EPROM burner. One of the EPROM burners that I'm most familiar with is the PB-10 from Needham Electronics. The PB-10 EPROM burner supports the latest EPROMS for user friendly program for EPROM maintenance.

As I described in the August 1993 issue of CQ magazine (PACKET USERS NOTEBOOK), the EPROM for the X1 node is burned into a 27C512 EPROM in two parts. The **Needham Electronics EPROM burner** makes the process easy because we can set the first address to blow the EPROM from 0000 to 7FFF, then the second half of the EPROM is burned from address (HEX) 8000 to FFFF.

The EPROM programmer makes the job easy is through if it has a Zero Insertion Force (ZIF) socket.

The ZIF socket of the Programmer should accept several sizes of EPROMS including the ONE MEGABYTE EPROMS (27C1001, 27C1010 etc).

INITIALIZING:

Once the EPROM is installed into the TNC2 or clone, the initializing process is easy. Turn it ON, set the parameters, the rest is history.

The node sends out update broadcasts to inform other nodes that it is active. The operating parameters are set in the firmware and are available for easy changing by the SYSOP. The parameters shown under the "P" command of the X1 nodes parameters are similar to those used in the early thenet 1.01 node. However, in the X1J4, there are additional commands contained in 6 other parameter sections. These are associated with specific functions and features like the **MODE (17 commands), METER (10 commands), MTU, IP addressing, ACL, and ADC 1&2.**

The credit for this new network node firmware goes to the developers; They are:

Dave Roberts G8KBB

Dave is the author of the X1 code. The X1 version is based on the original thenet 1.01 platform that was developed by the Nord><Link group.

Neville Pattinson G0JVU

Neville supports the hardware projects associated with the X1 node(s).

Chapter Six

Reviewing the New Features of the X1J4 Node

1. An S-meter function in the heard list
2. A Voltmeter function for the other two ADC channels
3. The ability to change the user's command prompt list
4. The ACL function has had a feature added to speed it up
5. A complete IP router,
6. The Receive Deviation meter,
7. Control of 'Slime Trails',
8. Information text messages 160 characters long,
9. Multiple line INFO, CTEXT and BTEXT messages,
10. Nodes broadcasts occur 60 seconds after power up,
11. Optional reconnect to the node after remote disconnect,
12. PARMS, MODE etc may be managed by offset & value,
13. Digipeat uplink & downlinks may be selectively enabled,
14. Level 4 retries (min) is now 1,
15. An MTU command allows MTU settings to be changed for IP use,
16. Node alias handling is optionally case sensitive,
17. TALK will optionally pass 8 bit data,
18. The ability to remotely set the node's alias,
19. The ability to listen for 3 extra aliases & invoke BBS etc,
20. Selective node broadcast control for 'hash' nodes,
21. A UI command to send arbitrary UI commands,
22. Access control list capabilities,
23. Multi-user conferencing (the 'TALK' command),
24. A CWID keyer,
25. Better SYSOP authentication,
26. MHeard list showing callsigns, packets heard & time since last heard,
27. MHeard list shows whether a station is a node and / or TCP/IP station,
28. A Closedown command to remotely shut the node down,
29. A DXCluster command that operates like the BBS & Host commands,
30. A Btext command to set the node's beacon text message,
31. A Ctext command to set an optional alias connect text message,
32. The ability to enable or disable any command,
33. Improved command prompting with only valid commands shown,
34. Routes show optionally as alias:callsign or callsign alone,
35. Additional control over system reset,
36. KISS as an alternative to the crosslink protocol,
37. Hardware handshake controlled host mode operation,
38. MODE command for configuring additional parameters,
39. BBS command to auto connect to a remote BBS,
40. HOST command to auto connect to another BBS or Host,
41. BYE or QUIT commands to disconnect,
42. STATS command to display internal statistics,
43. MANAGER command for system manager access,
44. AUDIT command to set system audit levels,
45. Changes to the NODES command,
46. An improved nodes broadcast algorithm for the crosslink port,
47. Split port nodes broadcast intervals,
48. Ability to enable & disable nodes broadcasts selectively on each port,
49. CQ apologises nicely if disabled,
50. Most Escape commands have been replaced with MODE parameters,
51. Beacon messages may be digi'd,
52. CALIBRATE command for remote checking of Tx deviation,
53. LINKS command to show current level 2 links,
54. Configuration of the beacon period,
55. Auto routing of 'connect' to either BBS, DXCluster or HOST,
56. Remote dump of entire neighbor lists for all nodes.
57. The ARP table is automatically updated from ARP requests & replies
58. The node maintains a second heard list of L3 Netrom nodes that gateway through the node
59. The RxDeviation & Smeter ADC channels may also be used as arbitrary inputs instead
60. A defensive port flush function added
61. Link list integrity checking has been extended to check reverse links
62. The USER list shows circuit choke status for patchcord connections.
63. The ADC* text messages are now 12 characters long
64. The ACL checks the end user call as well as the node call in accepting connections.
65. Lines that start with '#' are ignored by the switch
66. A default IP route entry may be made
67. Support for the TexNet '*** LINKED to' syntax

DEFINING A FEW OF THE X-1J4 FEATURES:

MHeard

If enabled, the heard list shows the last few stations heard. The number of entries is limited and set by the sysop so any stations not heard for a while may get pushed out of the list by others heard.

Assuming that a station is not pushed out in this manner, the display shows the number of packets heard from that station since it appeared in the list and the time since it was last heard. The time is hours, minutes and seconds.

The list also shows the port on which the station was heard (port 0 is the radio port), and if it hears IP frames or Net/Rom frames, it adds a note to show that the station is a node and/or a TCP/IP station.

If the list is long enough so that a station is not heard for 12 hours, it will get deleted anyway.

The list may also show a column headed 'Dev.'. This will only be present where the sysop has added to the node a small hardware add-on that measures the received signal audio level. Specifically, it gives an indication of the peak audio level.

By means of a software configuration control and prior calibration, this gets converted into an indication of the transmitting station's signal deviation. It does this by sampling the audio level after every valid packet.
Care must be taken over its interpretation. It does not measure independently the two tone levels - it is assumed that whatever local standards that relate to pre-emphasis (i.e. use it or not) have been implemented.

PACKET MODULATION / DEVIATION IS IMPORTANT:

The 1200 baud Packet modulation / deviation is important. In contrast to the 5 KHz deviation of VHF FM voice, Packet modulation should be set to, or just below 3 KHz.

Often, packet stations are set up, and the audio level tweaked until it appears to work reasonably error free. The idea of this add-on is that, having done that, you then connect to the node and display the heard list to see an indication of your actual deviation. It may then be fine tuned to set it correctly. Local advice must be taken over the correct setting as it depends on the channel spacing being used (e.g. 12.5, 25 or other KHz).

The **METER** command is set ON, or made active by the sysop when the system manager sets the meter command to a value other than 0 (zero). He enters the command mode using the password and then sets the sysop "METER" command to a number above 0 (zero) and below 256.

The sysop first calibrates the deviation meter within the node while it is on the work bench before installation at the node site. Setting the METER command to 0 (zero) will turn the deviation feature OFF.

Provided the meter is calibrated according to the sysops "DEVIATION" manual, the sysop might set the METER command to 20. Thus the reading would be multiplied by 255, and equate to about 5 KHz for full scale reading.

METER 10 would therefore support a reading of 2.5 KHz full scale. eg; 10 X 255 = 2550 Hz or 2.55 Khz.
Once he has put the node at the final site, the METER command may be used to tweak the DEVIATION for the final reading that corresponds to the deviation from a known source.

ONCE THE DEVIATION Analog to Digital Converter is installed into the TNC, and calibrated, the receiver volume should not be moved! To change the input to the ADC will cause erroneous readings for users of the DEV X-1J node.

In addition, the deviation reading will give the wrong answer when the following conditions exist:

- If the transceiver modulation contains too much distortion.
- If the transceiver too far off frequency.

The list of features in the X1 node is too long to cover here, however you can find a full explanation of the X1 node in the August and September 1993 issues of CQ magazine.

In addition, the new X1J **release 2** node has added the ***Voltage meter, the "S" meter, and Temperature sensor*** to the node firmware.

The sysop can easily install this feature filled PC board add-on.

The add-on unit cost is less than $50, wired and tested. See **JUNE 1994 CQ Magazine, PACKET USERS NOTEBOOK.**

TALK:

The Talk command allows a group of users to hold a conference call. It also allows a user to send a message to another user of the node provided that user is connected to the switch but is not patched through to another station and is not currently trying to connect to another station.

A user enters the conference by giving the command 'talk'. He/she gets a message informing them of this and reminding them that the command to escape from the talk command is '/exit'. Any other users currently in the conference get a message from the node telling them of the callsign of the user who has joined them.

At this point, every line sent by a user in the conference is copied to all other users in the conference, preceded by their callsign.

To exit from the conference, the command '/exit' is used. This causes a message to be sent to the user.

At the same time, all of those left in the conference get a message from the node telling them of the station who has left the conference.

If you force a disconnect, the other stations are not told of your departure.

A string of text may be entered on the same line as the talk command when the command is given.

If this is done, before the user is connected to the conference, that string of text is sent to all the other users of the node who appear in the "**user**" list but are not connected to anything else.

For example if while I'm connected to the node as a user, and W4WWQ connected to the node and typed:

> **TALK , Hello Buck can we have a chat? If so, PSE type TALK**

Then I would receive the following on my screen. Additionally, and other users connected to the node, and not connected through would see the following:

W4WWQ > K4ABT>>**TALK ,Hello Buck can we chat? If so, PSE type TALK**

Each user in a round-table receives all the information from every other user in the NET or round-table.
The only exception to this is that sysops are not sent the message.

OTHER SOURCES OF INFORMATION FOR THE DIGITAL HAM:

To keep abreast of the many useful devices for the digital ham, be sure that he or she has a current subscription to **CQ magazine**. The **PACKET USERS NOTEBOOK** in **CQ magazine** gives the digital Amateur a first hand look at what is happening in the world of digital communications.

CQ de BucK4ABT

Chapter Seven

Understanding theNET X-1J 4 Node

TheNET **X1** supports multi-frequency operation without the need for unconventional multi-port digipeater hardware. A dual-frequency node, for example, consists of a two TNC2 (with **X1** in each) connected together with an RS232 interface cable.

Configuring a TheNET **X1** node for three or four frequencys is just as easy; A TNC2 is used for each frequency (or baud/speed), and the multiple TNCs are interconnected via their RS232 ports using a diode-matrix interface.

In addition, it is possible to configure a dual-frequency TheNET **X1** node in
which the two TNC2s are not co-located. Instead of an RS232 cable, the TNC interconnect can employ a dedicated telephone line, fiber optics or other media as a high-data rate backbone.

TheNET **X1** uses an asynchronous variant of AX.25 over the interconnect, it is not necessary that it be an error-free connection. This opens up fascinating possibilities, such as a fiber-optic or satellite linked dual-frequency node which may be accessed from any point coast to coast.

AUTOMATIC ROUTING:

TheNET **X1** automatically takes care of the routing of traffic between one node and another. A user needs to specify just the desired destination, not the route.
Each node keeps track of the other nodes in the network and the various possible paths that may be used to reach them. If a node or path becomes unusable due to equipment failure or poor propagation, TheNET **X1** automatically switches to an alternate route (if available) to circumvent the outage. Conversely, when a new node is placed on-line, other nodes automatically incorporate the new node into the network routing structure. Such routing changes are handled dynamically, without disrupting user connections in progress.

TheNET **X1** supports three methods of updating its routing information: local, remote, and automatic. Initial routing information may be entered manually by an on-site operator using a local terminal.

Routing changes may be made remotely by a SYSOP or network manager over an ordinary packet radio connection randomized verification algorithm effectively prevents changes by unauthorized operators. In addition,

TheNET **X1** nodes broadcast routing information to each other as defined in the Param and Mode settings. Furthermore the nodes can be set to "locked-path" settings, thus eliminating the need for any broadcast at all. In any case, the node(s) may be enabled to incorporate new nodes and to bypass outages in real-time without manual control.

THE "CQ" FEATURE:

TheNET **X1** allows a user to broadcast a CQ from a local or distant node, and enables other stations to replay to the CQ using the high-level facilities of the network. A user's CQ request remains active for up to 15 minutes, during which time it appears in the node's user directory.

NODE IDENTIFIERS:

Each TheNET **X1** node is identified in two ways: by a valid amateur callsign
permanently encoded into each copy of TheNET **X1**, and by an arbitrary node identifier established by the node's sysop. Identifiers may be up to six characters long or three-letter city designators similar to those used by airports to identify the neighboring city or location. Some examples of these are ATL for Atlanta, MCN for Macon, CHI for Chicago, or JVLfor Jacksonville, etc.

Node identifiers appear in node station identification beacons, and are passed to other nodes during the periodic routing broadcasts (PARAMS Parameter number 7).

Despite its internal advanced networking capabilities, TheNET **X1** is exceptionally easy to use. A new user needs to learn only one command, CONNECT, to establish cross links to other nodes or downlinks to other user stations.

More sophisticated users may wish to use the NODES command to list the callsigns and identifiers of other network nodes, and the USERS command to find out who else is using the node.

When a Packet network user or the system node operator (SNO) issues the "U" or users command, the node will respond with the nodes; alias, callsign, SSID and a number enclosed in parentheses; e.g. (721)

is the actual number of free buffers in the node. One buffer consists of
32 bytes data and 4 bytes for linkage, 36 bytes in total. All stored
information uses buffers within the nodes memory (RAM) and the list of
other known nodes takes up buffers too.

The reason why this number of free buffers is made known to the user, is to tell him the load on that node. If for any reason TheNet X-1J4 runs out of free buffers, a reset will be made causing all users to be disconnected.

During regular operation this is almost impossible, as with the X-1J4 TheNet where the parameters are properly set, there will never be a shortage of buffers (you cannot load too many packets one after the other into the node).

SYSTEM NODE OPERATOR OR "SNO"

The System Node Operator (SNO) can use Manager or SYsop command to validate the SysOp/MAnager privilege in the node. This enable the SNO to make manual changes to the routing table, IDENT, to establish a mnemonic node identifier, PARMS to set or display various node parameters.

The RESET command can allow the SNO to perform a warm-start, or by issuing "RESET *" the node can be "cold-started" thereby resetting all the parameters to the default settings that were originally burned into the **X1J4** EPROM.

Each TheNET **X1** node also supports the functions of an ordinary AX.25 digipeater. Users need not make use of the high-level networking functions of TheNET **X1** unless they want to. Digipeater owners can upgrade their sites to TheNET **X1** nodes without disrupting users. Multi-frequency TheNET **X1** nodes provide multi-port digipeating as well. Node identifiers may be used in lieu of node callsigns when specifying a digipeated path.

When you issue a BYE, QUIT, or disconnect from the node where you made access to the system, TheNET **X1J4** automatically takes care of disconnecting your circuit to the nodes you used to downlink to the destination station.

THE FOLLOWING ARE DEFINITIONS OF TERMS DEFINITIONS ASSOCIATED WITH THE X1J4 NODE:

- **DIGIPEATER** - A station capable of digitally repeating AX.25 frames as specified in the AX.25 protocol specification. Generally, refers to an unattended, wide-coverage digital repeater, often located on a hilltop.

- **NODE** - A packet radio station utilizing TNC2 hardware and implementing an EPROM that contains the theNET **X1** firmware. In most applications, this refers to an unattended, wide-coverage station located at high elevations such as a hilltop, mountain, tall-tower, local water supply tower, or high-rise building.

- **SYSOP** - The node ***SYS***tem ***OP***erator, or the Network MAnager who performs administrative configuration of the X1 node.

- **USER** - Any amateur packet radio station using AX.25 protocol. In the context of this document, a BBS or other automated server is considered a "user".

- **DUAL-FREQUENCY** Node - A pair of TheNET **X1** nodes operating on two different frequencies, and coupled together by means of an RS232 cable.

- **MULTI-FREQUENCY** Node - Three or more TheNET **X1** nodes operating on different frequencies, and interconnected via their RS232 ports using a diode-matrix coupler.

- **LINK** - An AX.25 connection involving a node at one or both ends. Node-to-node links always use AX.25v2 protocol. User-to-node links use AX.25v2 protocol if the user's TNC supports it, otherwise AX.25v1.

- **UPLINK** - An AX.25 connection between a user and a node, initiated by the user. An uplink is usually a direct connection, but may be digipeated if necessary.

- **DOWNLINK** - An AX.25 connection between a node and a user, initiated by the node. A downlink is usually a direct connection, but may be digipeated if necessary.

- **CROSSLINK** - An AX.25 connection between two adjacent nodes. A crosslink is usually a direct connection, but may be digipeated if necessary. A crosslink between two nodes is initiated by one of the nodes when first establishing a circuit which traverses the route segment between the two nodes.

- **LOCKED ROUTE** - A path or route that has been installed into the route and/or node table of a TheNET node. This method of route control presents the node sysop with a means of "locking" routes between nodes. Locking routes also serves as a safeguard that assures the sysop that the nodes will use the same route(s) regardless of atmospheric conditions or "lift" propagation.

Chapter Eight

Using the advanced features of the X1J4 Node

Suppose you are a user with access to a local node, and you want to contact another user station who is also within range of the same node. You can, of course, connect to the other station "the old way" by using the node as a digipeater. To take advantage of the store-and-forward capabilities of the node, however, you would use this two-step procedure: (1) connect to the node ("uplink"); then, (2) issue a CONNECT command with the callsign or identifier of the other user station ("downlink").

***UPLINK-DOWNLINK* CONNECTIONS**:

All AX.25 frames include the callsigns of both the originating station and the destination station. When you request a downlink, the node "adopts" your callsign as the originating station (rather than using its own callsign). This is necessary so the destination station can properly identify you as the connecting user station. The node does NOT use your "exact" callsign, but if it did, and, if there happened to be a direct path between your station and the destination station, that station would then see two stations using the same callsign. This can create confusion at the destination station or on the network... BIG-TIME!

To avoid this problem, the down linking node "adopts" your basic callsign, by changing the SSID (or adding a callsign suffix) from N to 15-N. For example, if your callsign is NT4XXX, the downlink uses NT4XXX-15; if your callsign is W4KGS-2, the downlink uses W4KGS-13; and so forth. To utilize the full store-and-forward capability of the nodes, you would use a three-step procedure:

(1) Connect to your local node; then.
(2) Issue a CONNECT command with the callsign or node identifier of the distant node.
(3) Issue a CONNECT command with the callsign of the other user station.

UPLINK, CROSSLINK, AND DOWNLINK, CONNECTIONS:

When you perform step (2) of this procedure, you are asking your local node to create a "circuit" for you between your local node and the distant node. If the two nodes are sufficiently far apart, the circuit may have to pass through several intermediate nodes. In any case, the routing is performed automatically by the node. Your circuit is carried by a series of AX.25 "crosslinks" between pairs of adjacent nodes.

USING THE "CQ" FEATURE:

The CQ command is used to broadcast a short text message from a node, and to enable other user stations that receive the broadcast to connect to the station that originated the broadcast. An example is:

***CQ* This is George, Connect to me at the CALL & SSID displayed**

All text after the ***CQ*** is optional and can be any string up to 77 characters long.

In response to a CQ command, the node broadcasts the specified message in "unproto" mode, using the callsign of the originating user (with a translated SSID) as the source and "CQ" as the destination. The broadcast is made in the form of an AX.25 UI-frame.

If WA4GSO in Wadesboro, North Carolina sent the CQ through several nodes to a node in Macon, Georgia, the display at the Macon node would appear similar to the following:

WA4GSO-15>CQ: George in Wadesboro, NC

After making the broadcast in response to the CQ command, the node "arms" a mechanism to permit other stations to reply to the CQ.

A station wishing to reply may do so simply by connecting to the displayed callsign shown in the local Macon node broadcast (WA4GSO-15). A CQ command remains "armed" to accept replies for 15 minutes provided that PARMS Parameter 15 is set to 900, or until WA4GSO issues another command or if he drops the link (disconnects).

Any station connected to the MCN node at Macon, Georgia can determine if there are any other stations awaiting a reply to a CQ by issuing the USERS command. If there is an "armed" CQ at MCN node, the station who issues the USERS command will see:

(Circuit, WA4GSO-7 Uplink) **<-->** ***CQ WA4GSO***

The station may reply to such a pending **CQ** by issuing a CONNECT to the user callsign; In our example; C WA4GSO-15, the callsign and SSID specified in the CQ(...) portion of the USERS display. It is not necessary for the station to disconnect from the node and reconnect.

Users of the CQ command are cautioned to be patient in awaiting a response. Your CQ will remain armed for 15 minutes and will be visible to any user who issues a USERS command during that time. Consequently there's no point in issuing additional CQs - give other stations a chance to reply to your first one! Note the setting of PARAMETER 15 for duration of the CQ call, time-to-live.

Chapter Nine

Constructing, Installing, and Configuring TheNET X1J/4 NODES

DUAL AND MULTI-FREQUENCY NODE (STACK) OPERATION:

To realize the full potential of TheNET **X1**'s high-level networking capabilities, it is an excellent idea to minimize
interference between local (uplink/downlink) and long-haul (crosslink) traffic. One good way to accomplish this is to reserve one radio frequency exclusively for inter-node traffic, to provide end-user access to the nodes on one or more separate frequencies, and to discourage (ideally, to prevent "ACL") end-users from using the inter-node "backbone" frequency. This approach requires network nodes that can access two or more frequencies.

A REAL "SIX-PACKet." NODE-STACKS PERFORM CROSSLINKING BETWEEN TWO OR MORE FREQUENCIES OR BAUDRATES. SIX MFJ-1270C's EQUIPPED WITH X-1J4 EPROM .

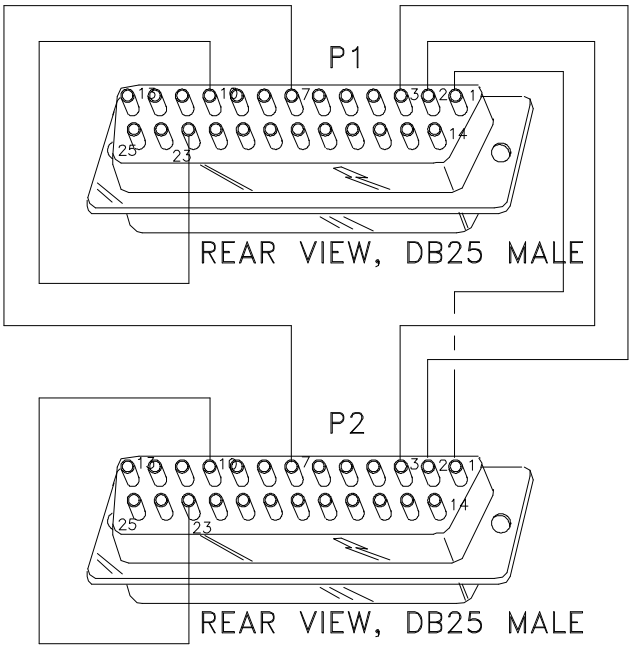
The node stack shown here is located atop 3000 foot, "No Business mountain" in central Virginia.

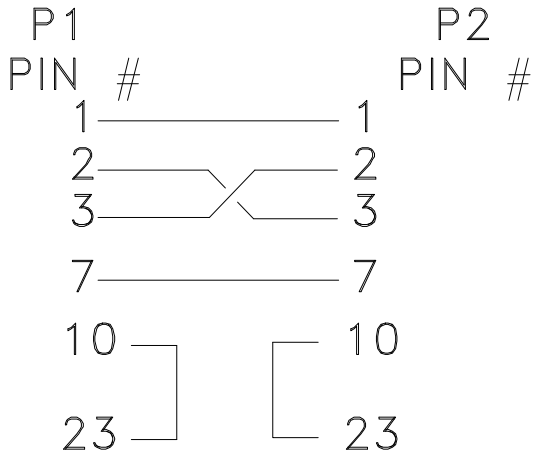
The MFJ-1270"C" can be equipped with the add-on MFJ-9600 (9600 baud) Modem. The MFJ-1270CQ Turbo is a complete 300, 1200 or 9600 baud TNC. All MFJ-1270 "B" / "C" and PacComm TNC2 clones are X-1J4 TheNET node compatible.

Chapter 10 Section II

DUAL AND MULTI-FREQUENCY NODE OPERATION:

TheNET **X1** supports such multi-frequency operation without the need for exotic multi-port digipeater hardware. A dual-frequency node, for example, consists simply of a pair of standard TNC2s (with TheNET **X1** in each) connected together with a simple RS232 cable. Each TNC takes responsibility for handling traffic on a single frequency; cross-frequency traffic is passed over the cable between TNCs at relatively high speed. (See installation instructions for wiring of the interface cable below.)



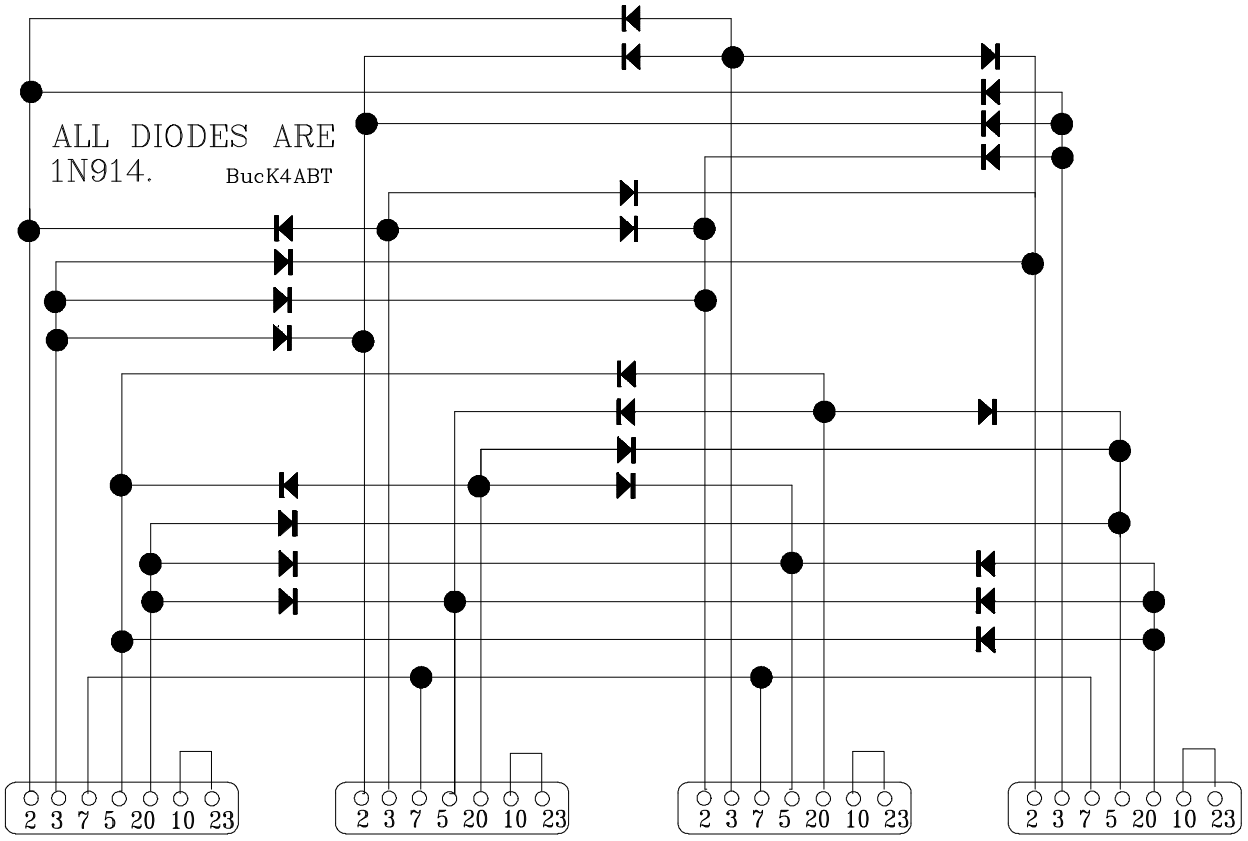


This gateway interface cable enables node communications between two X-1J4 nodes, port to port. This configuration allows the SNO to bridge from one frequency to another, or from one baud rate to another, OR BOTH.

Set the DIP switches to the same RS-232 port baud rate. The DIP switches are located at the rear of the MFJ-1270B and MFJ-1270C TNC's.

Most applications at VHF have the 1200 baud node DIP switches 5 & 7 ON and all others OFF. On the 9600 baud node/port set DIP switches 5 * 8 ON, all others OFF.

On the late model MFJ-1270"CQ" Turbo TNC's the RS-232 baud rate can be set at 19,200 baud. Be sure that both TNC's have this capability, otherwise, use the RS232 port setting of 9600 baud.



Configuring a multi-frequency TheNET **X1** node for three or more frequencys is almost as easy as dual-frequency operation. A TNC2 with TheNET **X1** installed is used for each frequency. Once again, the TNCs are interconnected via their RS232 ports. Interconnecting three or more TNCs requires nothing more elaborate than some isolation diodes between the RS-232 ports.

DIGIPEATERS VS. NODES:

The AX.25 protocol was originally designed for point-to-point (non digipeated) connections. AX.25 was subsequently extended to accommodate one digipeater, and later extended again to allow up to eight digipeaters. As all experienced packet radio users know, however, AX.25 is practically unusable for digipeat paths exceeding two or three "hops". The reason for this is that AX.25 digipeaters do not fully provide error control. For an AX.25 packet to traverse a multi-hop path, it must not fall victim to a collision or other error during any of the hops; otherwise, it must be retransmitted by the originating station and start its journey all over again.

The probability that a data packet can complete its journey through several ***digipeaters*** deteriorates rapidly as the number of hops increases. Since the usual time for a five-hops of digipeating is 35 seconds, the average elapsed time to get the packet through will average about 75 seconds.

Using TheNET **X1** ***nodes*** instead of ordinary ***digipeaters*** changes this situation dramatically for the better. When the Wadesboro, North Carolina user transmits a packet destined for Macon, Georgia, it is received by the local TheNET **X1** node serving Wadesboro, North Carolina. That node immediately passes the packet to its neighboring node to the south, and sends an acknowledgment back to the user. This process is repeated five times in all. As a result, the average elapsed time to get a packet through decreases to less than 15 seconds, about 700% improvement in throughput. For longer paths, the payoff is even more dramatic.

Chapter 11 Section II *Revised 9, 9, 2009*

THE MOST FREQUENTLY USED *SysOp & User* COMMANDS:

The Command Interpreter within the node firmware supports several commands including; ***CONNECT, TALK, MHeard, ROUTES, NODES, USERS, PARMS, INFO, RESET, and SYSOP.*** Here are a few of the more commonly user level commands.

The **CONNECT** command enables a user to request a circuit to a distant node, a downlink to a user station, or a direct connection to the local host terminal (if there is one) attached to the node.

The **NODES** command permits a user to obtain a list of other nodes for which the local node has routing information, and to examine the routing details to any particular node. It also allows an authorized SysOp to add, delete, or change routing table entries manually.

The **USERS** command displays a summary of the current activity at the node, including information about active uplinks, downlinks, circuits, patch cords, and users in command mode.

The **PARMS** command displays a series of numeric node parameters, and allows an authorized sysop or network manager to change the values of these parameters. The **INFO** command displays information about the node which has been uploaded by the node sysop or network manager. TheNET **X1** allows a sysop to change the information remotely. To delete current INFO from the node, the sysop (while in the sysop command mode) may enter an "I" followed by an asterisk i.e.; I *. A space is placed between the I and the asterisk.

The **MHeard** command enables the user to see a list of stations recently **HEARD** by the node. In addition, it the **X1** node is equipped with the Suffolk Data Group (MFJ model MFJ-52) DEV add-on PC board, the MHeard list will reveal the users deviation, signal strength, voltage at the site, and the temperature at the site.

The **RESET** command permits a sysop to reset (warm-start) the node remotely. To place the node firmware at DEFAULT, perform a **RESET**<space> ***(asterisk).**

Simply stated: RESET *

Another way to perform the reset is to send the node: **RESET** <space> **RESET** <Enter>

Stated: RESET RESET

SYSOP VALIDATION:

Authorized sysops can make manual updates to routing table entries with the NODES command, modify various node parameters with the INFO, MODE, PARAMS, and other node commands or do full "cold-starts" and "warm-start" using the RESET command.

To do these things remotely, a sysop must first validate his credentials by means of the SYSOP password, otherwise, the remote update commands are locked out.

A password string up to 80 characters long is entered into the node by an on-site operator via a local terminal. The password string cannot be changed remotely. When a remote operator enters the SYSOP command, the node replies with a list of five random numbers. The sysop must then enter the five characters that correspond to the numbered character positions in order to have sysop privileges. The section that follows will explain how the sysop deals with the password.

Chapter 12 Section II

SYSOP VALIDATION: (HANDLING THE PASSWORD)

The ***SYSOP*** command allows an authorized sysop or network manager to validate his credentials prior to making privileged changes using the PARAMS, MODE, NODES, ROUTE, INFO, CTEXT, BTEXT or the many other commands associated with the X-1J release 4 of a TheNET node. This also includes allowing the sysop or manager to perform a "warm" or "cold-start" of the node using ***RESET or RESET *.***

SYSOP uses a randomized validation algorithm which makes it difficult for an unauthorized user to masquerade as a sysop or network manager. The following text explains how the X1J4 password is applied and executed by the X1J sysop or network manager.

Here is an example of an X1J4 node password:

T H I S I S A P A S S W O R D

Using our password example, we number the password letters in numerical order:

T H I S I S A P A S S W O R D
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

If you need to set *parameter*s, change *beacon text*, *connect text*, set *DEV*iation meter calibration or make "**MODE**" changes; connect to the node and TYPE **SY**sop or **MA**nager. You should receive five (5) numbers. These numbers correspond to a sequence of letters or characters that are used in your password. The following is an example of the reply from the node after I connect to the node and send the word ***SY***sop or ***MA***nager to the node:

The node responds with; **7 8 15 1 2**

Comparing the numbers received to the letter above that number, in my password string, I respond to the five numbers with:

APDTH <Enter>

Notice there are **no spaces** when I send the corresponding five characters to the node. **THERE WILL NOT BE A REPLY FROM THE NODE**. You may also enter letters or numbers before or after the five letters of the password as long as you make sure the five characters are in the order called for by the numbering sequence of the password. In addition, they must be all together, there are no spaces, and they are in the correct ***case*** (CAPS ..etc), as that of the password programmed into the node.

Another example of my response could be: V***APDTH***ERE <Enter>

To determine if you have entered the correct sequence of letters or numbers, use the "**P**" or parameter command to make a test of the password entry. Send a **P**, then wait for the 26 parameters to be sent to you from the node as shown in the following example:

007:K4ABT-7} *100* 86 86 255 9 5 900 32 180 3 2 60 4 4 2000 64 10 5 4 10 200 0 0 0 2 1

If the first number is ***100***, try sending another number to the node, as in this example:

P 66 <Enter>

If your PASSWORD entry was correct, the node will allow you to make a change in the first number of the parameter list, and you should see the following appear on your screen:

007:K4ABT-7} *66* 60 60 255 7 5 900 16 180 2 2 120 4 4 900 64 10 5 3 10 50 18000 0 0 2 1

*Notice that the first number changed from **100** to **66**. Be sure to return parameter number one back to its original value by sending the P and the original number. e.g. P 50 [Enter].*

CORRECTING MISTAKES WHEN MAKING TEXT ENTRIES TO TheNet X-1J4 NODE:

If at any time you make a mistake when setting BBS, CText, BText, INFO or other text entries, use the asterisk (*) to erase or delete the text and re-enter it again. As an example, if I mistakenly send; ***CT** SEDAn **node etc. .***

To clear the **Connect Text** (Ctext) error; *SEDAn node ect...* I would send the node; **CT *** [CT asterisk] This will clear the CText entry. I would then repeat the entry with the correct case, spelling, etc.... This same procedure applies to other text entries..e.g. BText, Info, etc….

Chapter 13 Section II

HOST MODE:

The Host mode supports a local terminal attached to the node. It permits the local terminal to access all of the same capabilities that a remote user can access. In addition, it supports some specialized "host commands" available only from the local terminal. For example, it allows
local entry of the password string used by the SYSOP command to validate sysop or network manager credentials.

1) **Esc C** Connects to the HOST node.

2) **Esc P** Returns PASSWORD

3) **Esc D** Disconnects (So does; *Bye, Quit, & RESET*)

Often a problem occurs at the end of a QSO when one station wants to disconnect, but not before making certain that the other station has successfully received the first station's concluding information frames. This often resolves itself with a last-minute flurry of closing remarks. TheNET **X1** solves this problem in a more respectable fashion.

If two stations are connected to one another via the network and one of the stations disconnects, TheNET **X1** automatically maintains its connection to the other station until all in-transit information frames have been successfully delivered to that station. TheNET **X1** disconnects only after all in-transit information has been delivered, or after 15 minutes has
elapsed without any "forward progress" in delivering such information.

AUTOMATIC ROUTING:

When you ask one node for a circuit to a distant node, your CONNECT command specifies the callsign or identifier of the destination node, but the routing is handled automatically by TheNET **X1**. Automatic routing is handled by the Routing Manager, and is controlled by its routing table.

The routing table within a node contains a list of all other nodes "known" to the node, together with their mnemonic identifiers. You can ask to see this list by using a parameter NODES command. The routing table can keep track of hundreds of other nodes (limited only by the size of available memory and any constraints imposed by the network manager).

If you want to connect to an especially distant node, it is possible that your local node doesn't know of its existence as it is not listed in the local NODES display.

In this case, you can use CONNECT to obtain a circuit to a known node nearer the desired destination, and then issue another NODES command to get a list of the nodes known to that node. This process can be repeated if necessary. For each known node, the routing table can contain up to three alternate ways to route traffic to that node. The node knows the quality of each alternate route, and always attempts to use the "best" (i.e., highest quality) route to a destination. However, if a node or path becomes unusable due to equipment failure or poor propagation, the Routing Manager automatically switches to an alternate route (if available) to circumvent the outage. Such routing changes are handled dynamically, usually without disrupting circuits in progress.

The routing table maintained by each node consists of two dynamically allocated threaded lists: the destination list and the neighbor list. The destination list contains an entry for every other node "known" to this node. This is the list displayed by the NODES command. The neighbor list contains an entry for only those "neighboring" nodes to which this node has a direct link.

For each node in the destination list, the routing table up to three routes to that destination node. In this context, a route simply identifies a neighboring node that is a step closer to the ultimate destination. For each route, the destination list maintains a "radio port" quality value in the range 192 (best) to 0 (worst).

Routes are maintained in sorted order by quality, and TheNET **X1** always attempts to use the highest-quality route available. It also keeps an obsolescence count , which enables TheNET **X1** to purge paths from its routing table when it has become unusable and remained so for a protracted period of time.

If you are the sysop or network manager, you may observe a more complete routing list with in the **X1** node by entering the sysop command level and sending an "N * *" to the node. The node will return a complete list of all the nodes contained in the NODES LIST. This list will be displayed in ascending order with up to three nodes to the right of each node showing the routes and routing order to the neighbor nodes and their neighbor nodes. A user may obtain the route(s) to a single node by sending the node a single-node path request using the following format:

N<space>[*nodename*] <Enter>

For instance if the user were connected to a node at Martinsville, Virginia, and wants to know what path the Martinsville node (MVA) uses to reach the Salisbury, North Carolina (SNC) node, the entry to node MVA would be:

N SNC

Since each node keeps track of many other nodes and the available routes to those nodes, it is important that this routing information be kept up-to-date to reflect the current state of the network. TheNET **X1** supports three methods of updating its routing table: local, remote, and automatic.

Chapter 14 Section II
ROUTE QUALITY ANALYSIS:

For each route in its routing table, TheNET **X1** maintains a route quality value in the range 255 (best) to 0 (worst). This allows it to keep alternate routes in order of quality, and to select the best available route to a destination. A route quality value can best be visualized as a fraction (the value divided by 256) which quantifies the speed and reliability of a particular route in comparison to a theoretically perfect route (an infinitely fast and perfectly error-free path) of quality 256.

For example, a route of quality 230 can be thought of as being "90% perfect" in speed and reliability (230/256 = 0.90). The quality of each frequency used by a TheNET **X1** node is established by the sysop of the node. As a starting point, we suggest the following values to be used as baud/quality/parameters:

Baudrate **Description**	**Quality**	**% Perfect**
9600-baud RS232 wire interconnect (2-port)	**255**	**99%+**
9600-baud RS232 satellite interconnect (2-port)	**252**	**98**%
9600-baud RS232 wire interconnect (3-port)	**248**	**97**%
9600-baud HDLC isolated inter-node backbone	**240**	**94**%
1200-baud HDLC isolated inter-node backbone	**224**	**88**%
1200-baud HDLC user-accessed frequency	**192**	**75**%
1200-baud HF frequency	**180**	**70**% (Not recommended)
300-baud HDLC HF frequency	**128**	**50**%

The quality of a multi-segment route is simply the product of the qualities of each individual segment, where quality values are treated as fractions with an implicit denominator of 256. For example, a four-segment route that consists of two 9600-baud RS232 interconnect segments (quality 255) and two 1200-baud HDLC backbone segments (quality 224) has a calculated quality of 194 (255/256 times 255/256 times 224/256 times 224/256 equals 194/256). Quality calculations are rounded to the nearest 256th.

In practice, I have found that path quality for a 1200 baud neighbor node should be locked at 192 and path quality for a 9600 baud backbone neighbor node should be locked at 240.

Chapter 15 Section II
DIGIPEATING: & HOST INTERFACE

NOTE: **Since digipeating takes priority over other node's network activities, in today's modern network, this is *un*desirable. For proper network operation *it is recommended that the digi function (parameter #23) be set to off.***

Each **X1** node supports the functions of an ordinary AX.25 digipeater. Users need not make use of the high-level networking functions of TheNET **X1** unless they want to. Digipeater owners can upgrade their sites to TheNET **X1** nodes without notifying the user population. The users won't notice any change. Furthermore, each multi-frequency node is also a multi-port digipeater. Each frequency is assigned a different callsign.

Often, the same basic callsign will be used, but with different SSID suffixes for each frequency. (For example, K4ABT-7 is used for the node at 145.770 MHz. The backbone gateway node to 9600 baud's at the same location is K4ABT-9. Since the 9600 baud backbone node is in the 440 MHz band, the call/SSID may well have been K4ABT-4. In the latter case, K4ABT-4 was already in service thus the call/SSID of K4ABT-9 was used instead.

Users who have the mailbox option inside their TNCs make it easy for distant users to know what their ***mailbox call/SSID is by employing the SSID of "-1". This format has become a universal user mailbox addressing scheme. It allows a distant user to connect a node local to a station and issue the call/SSID of a known station in the area of the node using the stations callsign and adding the -1 SSID.*** The chances are great that a connect to the mailbox of the known station will be made.

INITIAL CONNECTIONS TO THE NODE IN HOST MODE:

PARAMETER SETUP: After setting up the TNC2 hardware, connect a terminal to the RS232 port. Power up the TNC2 and make sure you see the TheNET **X1** sign-on message. Then perform the following steps:

VERIFY THE NODE'S CALLSIGN: The callsign of the node (as burned into the EPROM) is displayed in the TheNET **X1** sign-on message. Make sure it is correct!
Host command lines begin with an ESC character (echoed as "* "). Valid host commands are: C, D, and P.

Esc-C CONNECT

The ESC-C command connects the host terminal to the node. When connected, the host terminal acts like a user that has been uplinked to the node. All ordinary node commands (CONNECT, INFO, NODES, PARMS, RESET, SYSOP, and USERS) may then be entered as information lines. However, the host connection automatically has sysop/manager privileges, so using the SYSOP command is ***not*** necessary!

Esc -D DISCONNECT

The ESC-D command disconnects the host terminal from the node.

NOTE: For unattended operation, be sure to disconnect the host interface with ESC-D.

Esc -P password

The ESC-P command sets the "password string" used by the SYSOP command to validate the credentials of sysops. The phrase may be up to 80 characters long (any excess is ignored), and may include spaces and control characters (except for CR and LF). Upper- and lower-case letters are treated as distinct from one another in the password string.

Esc -P with no parameter displays the current password string.

Lines that don't start with an ESC are interpreted as information lines. If the host interface is connected, information lines are sent across the connection; otherwise, they are discarded.

HOST INTERFACE MESSAGES:

The following messages may be displayed by the host interface:

CONNECTED to callsign
DISCONNECTED from callsign
CONNECT REQUEST from callsign
INVALID COMMAND

Chapter 16 Section II
GATEWAY INTERFACING & SETUP:

***(NOTE: T**his modification does not apply to TNC2's or clones manufactured after July 1990)! (see the illustration of this modification in the illustrations at the back of this handbook).*

The following modification is required for TNCs that will be used in dual-or multi-frequency TheNET **X1** configurations. Since it does not impair normal operation in any way, we recommend it for all TNCs to be used with TheNET **X1**. You may want to upgrade to dual-frequency operation later.

To make this modification, connect one end of a wire to pin 23 of the RS232 connector. Connect the other end of the wire to pins 1-2-3 of JMP9 (these three pins are already hooked together on the circuit board).

This modification allows the TheNET **X1** firmware to be configured for multi-frequency operation by jumping RS232 pins 10 and 23 together in the TNC-to-TNC cable.

SET BAUD RATE SWITCHES:

Follow the switch-setting instructions in the TNC2 manual. I have performed extensive reliability testing of TheNET **X1** at HDLC and RS232 baud rates up to 9600; it runs reliably at these high baud rates even at slow CPU clock speed.

For dual- or multi-frequency operation, I suggest setting the RS232 speed at 9600 baud (or the highest RS-232 port baudrate i.e.; 19,200 baud's for MFJ-1270"C") it makes a big difference in cross-frequency performance!

WIRE TNC-TO-TERMINAL CABLE:

To connect a host terminal to the TNC2, almost any standard RS232 cable will do (as long as pins 9, 10, and 23 are not used).

CONFIRM TNC/NODE OPERATION:

Install the **X1** EPROM; If you have the add-on DEViation PC board, install it while the TNC is open. Connect a terminal to the TNC, power it up, and make sure that you get a sign-on message and that the unit still appears OK. Note the ***STA***tus LED should glow at half brilliance when compared to the other LEDS.

If it doesn't:

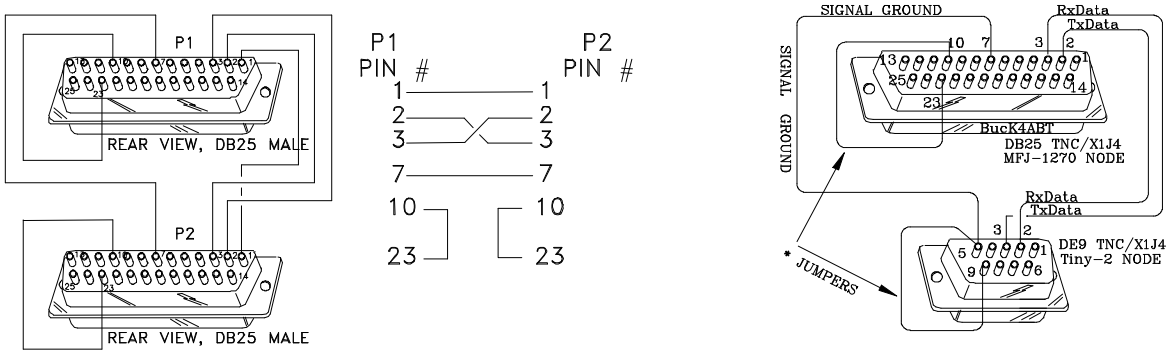
(1) You have made an error.
(2) You have installed a bad EPROM.
(3) Your TNC won't run at the fast CPU clock speed.
(4) HAVE YOU INSTALLED THE WIRE FROM PIN ONE (1) OF THE **X1** EPROM TO PIN 8 OF THE MODEM HEADER?

NOTE: Step number 4 does not apply when using MFJ-1270"C" REV 11 or above!

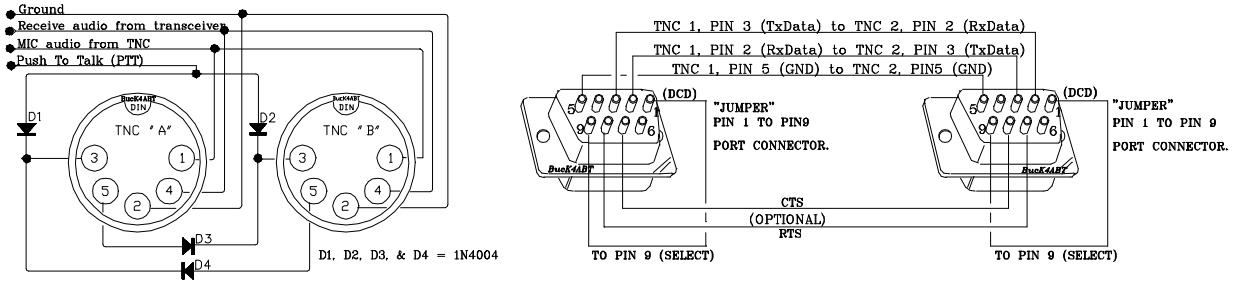
DUAL-OR MULTI-FREQUENCY OPERATION:

To install a dual or multi-frequency TheNET **X1** node, you should follow the previously described steps for each TNC. Make certain that each TNC has a different callsign (often, only the SSID suffix changes). Verify that each TNC is functioning correctly as a single-frequency node before attempting to interconnect the TNCs.

For a dual-frequency node, simply connect the two TNCs together, using a special RS232 cable wired as shown in the diagram. (Don't try to use the host-terminal cable - it won't work!) A node/gateway interface cable is constructed using the following diagram:



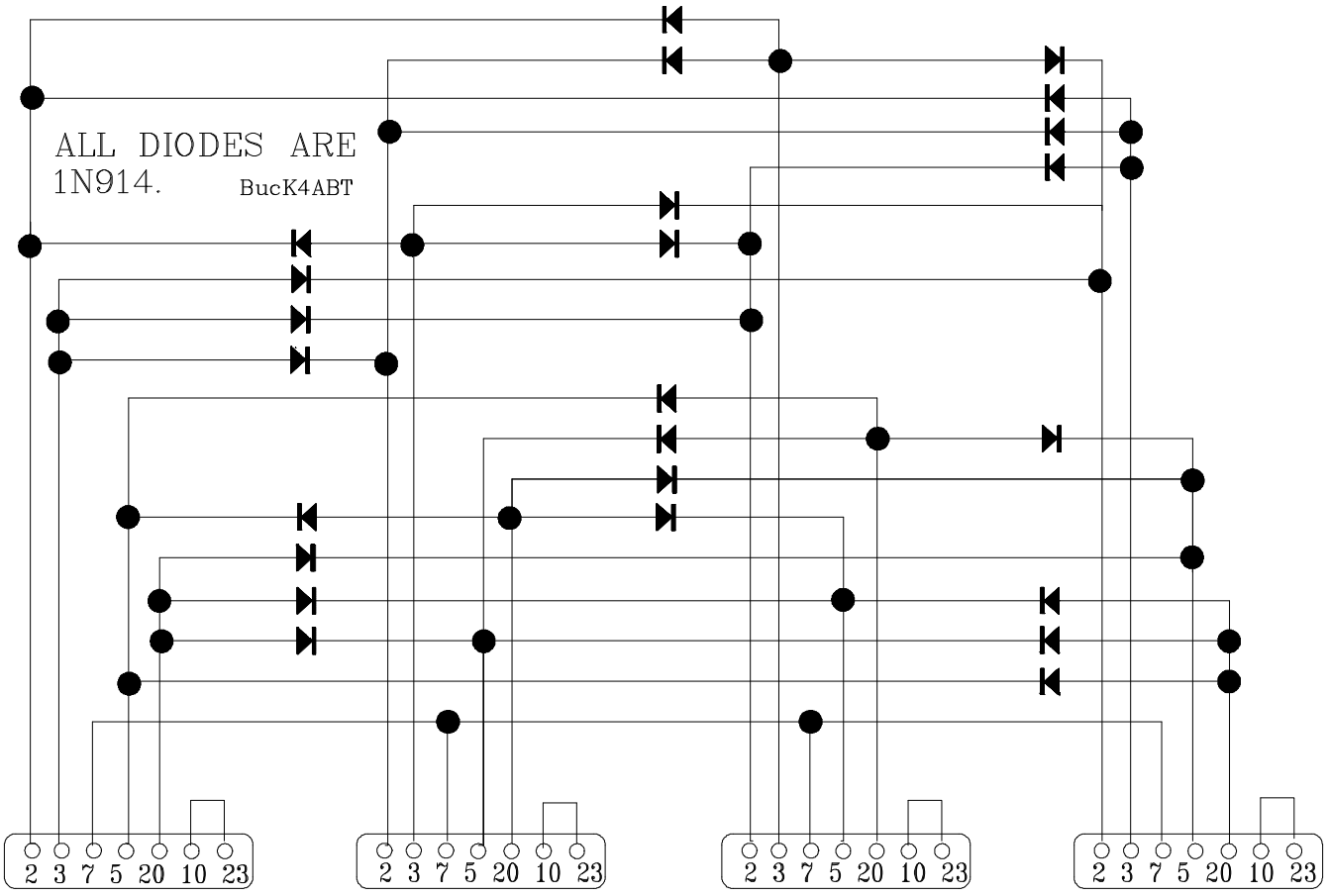
This gateway interface cable enables node communications between two X-1J4 nodes, port to port. This configuration allows the SNO to bridge from one frequency to another, or from one baud rate to another, OR BOTH. Set the DIP switches to the same RS-232 port baud rate. The DIP switches are located at the rear of the MFJ-1270B and MFJ-1270C TNC's. Most applications at VHF have the 1200 baud node DIP switches 5 & 7 ON and all others OFF. On the 9600 baud node/port set DIP switches 5 * 8 ON, all others OFF. On the late model MFJ-1270"CQ" Turbo TNC's the RS-232 baud rate can be set at 19,200 baud. Be sure that both TNC's have this capability, otherwise, use the RS232 port setting of 9600 baud.



This drawing illustrates how a user TNC and a node can be interfaced to one radio. Some node sysops utilize the home QTH transceiver for both their Packet station TNC and the node TNC.

The interface cable above illustrates how the TNC2 clones that use the 9 pin (DE 9) RS-232 comports are connected for gateway. This gateway application can enable communications between two different frequencies, two different baudrates, or both.

To interconnect three or more TNCs as a multi-frequency node-stack, you should build a diode-matrix coupler. A schematic for a four-frequency coupler is shown below. It uses 24 diodes (1N4148, 1N914 or equivalent).



Configuring a multi-frequency TheNET **X1** node for three or more frequencies is almost as easy as dual-frequency operation. A TNC2 with TheNET **X1J4 EPROM** installed is used for each frequency. Once again, the TNCs are interconnected via their RS232 ports. Interconnecting three or more TNCs requires nothing more elaborate than some isolation diodes between the RS-232 ports.

Chapter 17 Section II
X-1J/+ PARAMETERS

This section defines the function of the 26 parameters that the sysop can change remotely using the PARAMETERS command.

No.	*Description of Parameter*	LAN	*BackBone**	*Min*	*Max*
1.	Max destination list entries	**100**	*100*	1	400
2.	Minimum quality for auto-updates	**86**	*141*	0	255
3.	HDLC (Radio, port 0) quality	**86**	*141*	0	255
4.	RS232 (crosslink, port 1) quality	**255**	*255*	0	255
5.	Initial value for obsolescence counter	**9**	*9*	0	255
6.	minimum obsolescence count for broadcast	**5**	*5*	1	255
7.	Auto-update broadcast interval	**1800**	*900*	0	65535
8.	Network "time-to-live" initializer	**32**	*32*	0	255
9.	Transport timeout (seconds)	**180**	*180*	5	600
10.	Transport level 4 maximum tries	**3**	*3*	2	127
11.	Transport level 4 ack delay(seconds)	**2**	*2*	1	60
12.	Transport level 4 busy delay (seconds)	**60**	*60*	1	1000
13.	Transport level 4 requested window size	**4**	*4*	1	127
14.	Level 4 Congestion control threshold	**4**	*4*	1	127
15.	No-activity timeout (Level 7 seconds)	**1800**	*1800*	0	65535
16.	Persistence threshold(P/256)	**64**	*255*	0	255
17.	Slot time (10ms increments)	**10**	*1*	0	127
18.	Link level 2 T1 timeout "FRACK" (seconds)	**4**	*1*	1	15
19.	Link level 2 TX window size "MAXFRAME"	**2**	*3*	1	7
20.	Link level 2 maximum tries (0=try forever)	**11**	*15*	0	127
21.	Link level 2 T2 timeout (10ms increments)	**200**	*100*	0	6000
22.	Link level 2 T3 timeout (10ms increments)	**0**	*0*	0	65535
23.	AX.25 level 2 digipeating (1=enabled)	**0**	*0*	0	1
24.	Validate callsigns (1=enabled)	**0**	*0*	0	1
25.	Station ID beacons (2=on, 1=active, 0=off)	**2**	*1*	0	2
26.	CQ broadcasts (1=enabled, 0=disabled)	**1**	*1*	0	1

*** Backbone at 9600 baud**

The following definitions provide a short explanation of the purpose and use of the 26 parameters listed in the above table.

Parameter 1

Max destination list entries (minimum=1, maximum=400)

Defines the maximum allowable number of destinations in the node's routing table. Each destination consumes 32 bytes of RAM. The sysop or network manager can use this parameter to limit the amount of RAM that is allocated to the routing table, thus ensuring that sufficient space remains for frame buffering.

Parameter 2

Worst quality for auto-updates (minimum=0, maximum=255)

Defines the poorest route quality that will be automatically added to the node's routing table. The network manager can use this parameter to limit the automatic routing update function to accept only higher-quality routes.

In addition, the automatic update function can be disabled altogether by setting this parameter to zero.

Parameter 3

Radio port 0 (HDLC) quality (minimum=0, maximum=255)

Defines the quality of the radio frequency connected to the node's HDLC port. The network manager should set this parameter to an appropriate quality value in accordance with the speed, reliability, and congestion anticipated on the frequency. The default value of 192 is appropriate for a 1200-baud user-accessible frequency...if the actual frequency quality is better (e.g., a UHF backbone frequency) or worse (e.g., an HF link), the parameter value should be changed accordingly.

Parameter 4

Comm port 1 (RS232) quality (minimum=0, maximum=255)

Defines the quality of the TNC-to-TNC interconnect frequency connected to the node's RS232 port. The network manager should set this parameter to an appropriate quality value in accordance with the speed, reliability, and congestion anticipated on the frequency. The default value of 255 is appropriate for a 9600-baud two-modem interconnect cable...if the actual frequency quality is worse (e.g., a three- or four-port interconnect, or a satellite link), the parameter value should be changed accordingly.

Parameter 5

Obsolescence count initializer (minimum=0, maximum=255)

Defines the initial value given to the obsolescence count of a route that has been newly added or updated by the node's automatic routing table update mechanism. The obsolescence count of a route is also reinitialized to this value whenever the route is actually used successfully. The obsolescence count of a route is decremented once each auto-update broadcast interval (see parameter 7 below). However, such periodic decrementing of route obsolescence counts can be disabled altogether by setting this parameter to zero.

Parameter 6

Obsolescence count minimum to be broadcast (minimum=1, maximum=255)

Defines the minimum obsolescence count threshold below which a route will not be included in the node's automatic routing broadcasts. The purpose of this threshold is to prevent the node from broadcasting "stale" routing information to other nodes. Under normal circumstances, this parameter should be assigned a value no greater than the value of parameter 5 (obsolescence count initializer); if it is greater, the node's broadcasts will include no destinations other than itself.

Parameter 7

Auto-update broadcast interval (seconds) (minimum=0, maximum=65535)

Defines the number of seconds between automatic routing broadcasts issued by the node. The default value of 3600 specifies an hourly broadcast. In addition, broadcasts can be disabled altogether by setting this parameter to zero.

Parameter 8

Network "time-to-live" initializer (minimum=0, maximum=255)

Defines the initial value of the "time-to-live" field in the Network Header of all network-layer frames originated by this node. The time-to-live field is decremented by each intermediate node that relays the frame. If the time-to-live value ever reaches zero, the frame is discarded. This protects the network against frames persisting forever as the result of a routing loop. The value of this parameter should be a bit larger than number of "hops" in the longest legitimate route in the network.

Parameter 9

Transport timeout (seconds) (minimum=5, maximum=600)

Defines the number of seconds between transport-layer retries.

Parameter 10

Transport maximum tries (minimum=2, maximum=127)

Defines the maximum number of transport-layer tries attempted before a circuit failure is reported.

Parameter 11

Transport acknowledge delay (seconds) (minimum=1, maximum=60)

Defines the number of seconds' delay used by the transport layer from the time it receives an information message until it sends an information acknowledge message. The purpose of this delay is to give the acknowledgment an opportunity to be "piggybacked" upon an outgoing information message.

Parameter 12

Transport busy delay (seconds) (minimum=1, maximum=1000)

Defines the maximum number of seconds that the transport layer will remain "choked" as the result of an incoming message that has the choke flag bit set. The purpose of this timeout is to prevent an indefinite hang-up in the event that the "unchoke" message is lost.

Parameter 13

Transport requested window size (frames) (minimum=1, maximum=127)

Defines the maximum number of incoming out-of-sequence information messages that the transport layer will buffer while waiting for the next expected information message to arrive. Also defines the maximum number of outgoing information messages that the transport layer will send without receiving acknowledgment.

Parameter 14

Congestion control threshold (frames) (minimum=1, maximum=127)

Defines the maximum allowable backlog of messages that the transport layer will buffer before it sends a choke message.
Also defines the maximum allowable backlog of frames that the link layer will buffer before it sends an RNR control frame.

Parameter 15

No-activity timeout (seconds) (minimum=0, maximum=65535)

Defines the maximum number of seconds that a transport-layer circuit or a link-layer connection can remain idle (i.e., no information transfer in either direction) before it is automatically disconnected.

Parameter 16

P-persistence (p=/256) (minimum=0, maximum=255)

Together with slot time (parameter #17), defines the exponential delay algorithm used by the node when keying up its transmitter. When the node has something to transmit and the frequency is clear, the node generates a random integer in the range 0 - 255. If the random number is less than or equal to the P-persistence parameter, the node keys up its transmitter immediately. Otherwise, the node delays for one slot time, generates a new random number, and repeats the procedure. The default value of 64 corresponds to a probability of 0.25.

Parameter 17

Slot time (10ms increments) (minimum=0, maximum=127)

Together with P-persistence (parameter #16), defines the exponential delay algorithm used by the node when keying up its transmitter. The default value of 10 corresponds to a slot time of 100 milliseconds.

Parameter 18

Link T1 timeout "FRACK" (seconds) (minimum=1, maximum=15)

Defines the number of seconds between link-layer retries. When digipeating is used, this value is multiplied by 2D+1, where D is the number of digipeaters.

Parameter 19

Link transmit window size "MAXFRAME" (frames) (minimum=1, max=7)

Defines the maximum number of outgoing information frames that the link layer will send without receiving acknowledgment.

Parameter 20

Link maximum tries (minimum=0, maximum=127)

Defines the maximum number of tries that the link layer will attempt before reporting a link failure. If this parameter is set to zero, the link layer will retry forever (not recommended).

Parameter 21

Link T2 timeout (10ms increments) (minimum=0, maximum=65535)

Defines the delay (measured in 10-millisecond increments) used by the link layer from the time it receives an information frame until it sends an acknowledgment
(RR, RNR, or REJ) control frame. The purpose of this delay is to give the acknowledgment an opportunity to be "piggybacked" upon an outgoing information frame.

Parameter 22

Link T3 timeout (10ms increments) (minimum=0, maximum=65535)

Defines the maximum no-activity period (measured in 10-millisecond increments) permitted by the link layer before it issues a poll to make sure the link is still intact. This timeout is also used to break link-layer choke deadlocks. NOTE: This parameter is the same as the CHECK command in many TNCs, and can be defaulted to 0 as a means of reducing "Node QRM".

Parameter 23

AX.25 digipeating (1=enabled, 0=disabled), *(minimum=0, maximum=1)*

Defines whether or not the node will perform AX.25 digipeating. The default value of 1 causes digipeating to be enabled.

Parameter 24

Validate callsigns (1=enabled, 0=disabled) (minimum=0, maximum=1)

Defines whether or not the node will perform validation checks on amateur callsigns. The default value of 1 causes callsign validation to be enabled. NOTE: If callsign validation is turned OFF (0), users will experience long delays if they request connects to inactive nodes before getting back a "Failure with" response.

Parameter 25

Station ID beacons (2=on, 1=conditional, 0=off) (minimum=0, maximum=2)

Defines whether or not the node will broadcast station-identification beacons. The default value of 2 causes station identification to be broadcast every 10 minutes. The value of 1 causes station identification to be broadcast only if the node has transmitted since the last beacon. The value 0 disables station identification beacons altogether.

NOTE: Many sysops set this parameter (#25) to 0 as a means to reduce unnecessary node QRM on the frequency. The node sends an ID's each time it sends a packet, so no legal requirement to have ID's turned on.

As an example; In the MODES PARAMS, setting BEACON time to 600 will cause an ID by the X-IJ+ node every 10 minutes, or set it to 3600 and it will ID once each hour.

Parameter 26

CQ Broadcasts (1=0n, 0=off) (minimum=0, maximum=1)

Defines whether or not the node will broadcast AX.25 UI-frames in response to the CQ command. Even if such broadcasts are disabled by setting this parameter to zero, the other features of the CQ command continue to operate normally. The default value of 1 causes CQ broadcasts to be enabled.

Chapter 18 Section II

The SEVENTEEN X1J4+ *MODE* COMMANDS AND DEFINITIONS

With the new X1-J version of theNET firmware, there also comes a set of 17 added command features. The application of these 17 features can increase the effectiveness of your network when they are properly applied.

SEDAN	MIN	MAX	DEFINITION
0	0	1	Host Control to enable HARDWARE HANDSHAKE; MODE FLAG in HOST MODE **Enables the use of the *Esc C* and *Esc D* commands when using the RS-232 port.**
0	**0**	**3600**	CW ID repeat period in seconds. **0** **Disables CW ID**
6	4	10	CW ID speed (10 milliseconds per DOT)
3	**0**	**3**	Nodes broadcast enable flags: **0=None, 1=HDLC only, 2=RS-232 only, 3=Both ports.** **3 = both ports if backbone access; 2=matrix; 1 if LAN or user port.**
0	0	3	Crosslink select: 0=None, 1=HDLC, 2=KISS,+selectCopy, 3=KISS+ALLcopy **MATRIX mode for node stack use.**
35	0	255	TX keyup delay (TXDELAY) in ten millisecond increments. **35 = 350 milliseconds; for most transceivers,** add 5 mSec for radios with relays nodes using external power amplifier.
0	0	1	Full Duplex enable. **0 if node is operated in simplex (normal) operation.**
500	0	65535	RS-232, PORT 1, node broadcast period in seconds. **600 Updates nodes every 10 minutes.**
0	0	3	Node broadcast algorithm flag; 0=off, 2=RS-232 port; 1 or 3 not used.
600	600	3600	Beacon interval in seconds. **600 Although beacons are enabled in PARAMS to ID only during or after use.**
1	0	2	Connect redirect to BBS 0 **Controls the use/action of the "C" command, and what it will do when issued.**
27	0	127	Help messages enable flag, 8 bit in TALK mode & case sensitive. **19 Enables:** **PLEASE WAIT.** (1) + all sysop commands, (2) +Routes are: ALIAS:CALLSIGN
0	0	3	Hash node broadcast disable (1 bit per port) 3 will disable all #node broadcasting.
0	0	1	If set, will enable extra alias monitoring. **0=WILL NOT recognize BBSalias,** DXalias, HOSTalias, set to 1 on user port if BBSalias is set.
1	0	1	Enables automatic node reconnection after remote disconnect. **1** **Enable on user accessed ports and #nodes**; Disable on network step points (BBS..etc).
0	0	3	Slime trail control. Each bit controls a function; Bit 0 hides; Bit 1 causes slime to be ignored. **3** **Set on non gateway port(s).**
3	0	3	Digipeat control. Each Bit controls a function: Bit 0 Node refuses L2 uplink digis. Bit 1 Node refuses digi downlinks.

APPENDIX "A"

FINAL NODE "CHECKLIST:"

When installing your 9600 baud nodes back on-line, and if you are using the small "rinky-dink" wall supply to power the TNC/NODE, then check the power from the small wall type supply to be sure the supply is supplying over 14 volts. When it is attached to the TNC, the voltage will drop to around 12 to 13 volts under load. If the supply is not delivering sufficient power (voltage) to the TNC, the node will not perform properly and may not decode 9600 bauds. The same scenario applies to the 1200 baud TNC and supply.

At my installations I chop the wall transformer wire off about 3 inches from the transformer/DC supply and attach it to the 12 volt DC power source that is used to power the radio for the node. ***Usually the wire with the small "white" tracer on it is the positive lead, however, I'd ring it out with an ohm meter to be sure that the TNC center pin is connected to "PLUS" (+)12 volts.*** The TNC needs less than half an ampere at 12 volts to make it work, so the load to the supply for the radio should carry the extra load of the TNC well.

A low voltage problem may be experienced with the 9600 baud nodes more often than with the 1200 baud nodes. The reason is; The 9600 baud node has the added load of the internal 9600 baud modem piggy back board. It adds to the supply load with extra power requirement of the 9600 baud modem, and this is where I have some beef with the supplier.

CAVEATE ; In some recent mail and truck deliveries to my QTH, I have seen...(HEARD) rattling inside the TNC's prior to opening them. Seems the carriers uses them for base ball practice, and toss them hard enough to make the EPROM pop out of socket U 23. This same scenario may be occurring with other deliveries of TNC and nodes to you. If you have any problem at all, remove the (4) screws from the cover of the TNC/node and check all the IC's to be sure they are inserted securely into their respective socket.

ONCE YOUR TNC IS BUILT INTO A NODE; At the rear of the TNC/NODE is a set of 8 switches, called a inline 8 DIP switch. DIP switch number ***5*** determines the baudrate of the ***RS232*** port(s). Make sure both nodes have DIP switche(s) number 5, in the **ON** position. Remember that some older TNC have the DIP switches **UP =ON** and DOWN=OFF. On some of the later (most) "C" versions, the DIP switches are **DOWN=ON** and *UP=OFF*. The principal idea is to make sure the TNC/NODEs are talking between the 1200 and 9600 baud NODE ports (GATEWAYING) properly.

DIP switch number ***8*** **is "ON," on the** ***9600*** baud node. **DIP number** ***7*** **is ON on the** ***1200*** baud node. This is the switch that determines the ***RADIO*** port speed.

So; here is what you should have:

the **1200** baud TNC/NODE;	DIPs **5 &** ***7*** **are ON**..	all others are OFF.
the **9600** baud TNC/NODE	DIPs **5 & 8 are ON**..	all others are OFF.

The following apply to both 1200 and 9600 baud VHF & UHF nodes:

Be sure you have the "UMBILICAL" cable is connected between the 1200 and 9600 baud RS232 ports.

The **BLACK** (HF/VHF) button on the rear of ***all*** MFJ-TNCs is ***OUT*** = OFF.
Make sure power is connected and **ON**; the **RED** button (Off/On) is ***ON*** = IN.

VISIT the ***SEDAN*** Packet Radio Networking Pages at: http://www.PacketRadio.com

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APPENDIX "B"

LOCKING ROUTES AND SETTING "FIXED" NODE PATHS:

Configuring nodes and locking node routes and paths is an art. some say the art is lost, but just ask any dedicated node sysop and you may discover a wealth of knowledge and learn that the art of node configuration is "alive and well." In this section we will pass along some of this artistic *node knowledge* to the new and aspiring node sysop.

NODE ROUTING BASICS, or *"Choosing Your Node's Neighbors"*:

Nodes are dumb! Several system node operator's (SNO's) and Packet radio author's in other publications have stated that nodes are intellegent and should be left to attend to the automatic routing to and from all its neighbors. Nothing could be further from the truth!

What happens when long ground wave and extended night-time "lifts" occur, then later the band changes or daylight returns the VHF F1 & F2 layers to short-range propogation. The co-called intelligent group of network nodes has gathered large node tables of nodes that can no longer be heard.

How quickly we learn that nodes are not so intellegent after all. This is where we begin our next level of node education. Rather than to Lock OUT the Nodes you don't want, why not "lock in" the nodes that we do want as neighbor nodes. Below, I have listed several ways to make the decision as to which nodes are neighbor nodes and which nodes we should lock in! This kind of node housekeeping is called "locked routing" and thus removes the guess work that occurs when the routing is left to the so-called "automatic routing" that is built into the node firmware.

When you first set up your LAN node on the network (not the backbone) or just after performing a "cold-start" (hard reset = RESET *), set the first seven of the twenty six parameters to:

For 1200 baud nodes; P ***100 81 81 255 9 5 1800*** 16 180 3 2 60 4 4 1800 64 10 4 2 10 200 0 0 0 2 1

For 9600 baud nodes; P ***100 162 162 255 9 5 900*** 16 180 3 2 60 4 4 900 255 1 1 3 15 100 0 0 0 1 1

Let the node run this way for at least 24 hours. Once it has had ample time to gather a reliable routes table, PLEASE notice that I said "reliable," then look at the ***MHeard*** list (not the nodes or routes table) between the hours of 3:00 PM and 6:00 PM EST (I'll explain the time of day *bit* in the next few paragraphs) also make a record of the routes table that is displayed.

It is important to note which of the "nodes" in the ***MHeard*** list display the highest number of received repeat numbers. By "received repeat number" I'm referencing the number of consecutive times the node has heard a node that is also listed in the routes list. In the example below, I've indicated the nodes that have a higher number of NODES HEARD in the Mheard list. These nodes become the first nodes that I lock into the routes table.

Here is a ROUTES list from node "EVA: WB4EDZ-7," I'm Connected and I issue the "R"outes command; The node returns:

EVA: WB4EDZ-7} Routes:
0 DFVA:N4OMC-1 60 *4
0 1200:K4ABT-8 60 *12
0 MTLAKE:KD4BNQ-7 60 *9
0 MVA:KC4SUE-7 60 *11

After the initial 24 hours has passed, I pull an Mheard listing and read the numbers of consective received repeat numbers.

Any number that is 2 or above, I ***set*** in the node using the "routes lock" technique as shown in the example below:

R 0 [neighbor node] + [route quality]

The syntax of the ROUTES command is as follows:

- **Route, Port, Callsign, + Quality**
- **Route = command**
- **Port = port number (0=radio & 1=RS-232)**
- **Callsign = Neighbornode Call/SSID**
- **+ = plus sign**
- **Pathquality = 192 for LAN nodes or 224 for backbone nodes**

Because I know that a very good route exists between node EVA:WB4EDZ-7 and node 1200:K4ABT-8, I lock the route between EVA and 1200 in the follwoing manner;

R 0 K4ABT-8 + 192

As a rule, I don't lock a route to a node that has a receive repeat number in the Mheard list below 6 unless that node route is the only route in the table, or all the Mheard list show low receive repeat numbers for all the nodes shown. Even then I try to use a common sense approach and note the proximity and connectivity of the nodes that I *lock in*.

When determining which node is truly a neighbor node, use a common sense approach. By this I mean; Look at the number of times the neighbor node is shown in the Mheard list, and try to make the determination at a time of day when propagation is low. I find this time to be between the hours of 2:30 PM and 5:00 PM eastern time.

1) Pick your real neighbor nodes from the routes table and lock them in at the recommended default quality (192 for 2m, 224 for backbones.)

2) Where there is a "gateway" (2 nodes via RS-232) neighbor node lock these routes at 255. If you are locking 3 nodes in a node stack (via RS-232 using a diode matrix), set each of the locked routes at 245. When locking 4 nodes in a node stack, set each nodes route at 235. With 5 nodes, set (lock) their routes at 225. DO NOT LOCK ANY NODES IN A NODE STACK BELOW 225. Remember that 224 is the locked route quality for neighbor "backbone" nodes.

3) Reduce Parameter 3 (Default radio link quality given to new nodes) to a value equal to Parameter 2 (Minimum quality to accept.)

NOTE: When locking RS-232 routes remember to use the 232 port number 1 (one) instead of the radio port number 0 (zero). Example: ***R "1" K4ABT-2 + 255***

Here is how it works. Your real neighbors have the full quality value that you have assigned to them. Nothing changes there, but by reducing parameter 3 to the same level as parameter 2, new nodes that are heard are given a quality on the threshold of acceptance. This means that the new nodes in the broadcast will have their name and callsign entered into the node table, but all its related node path information will have qualities too low to be shown or used. Only the node itself will be allowed into the node table and nodes associated with the routing. Because the node is at the point of quality acceptance, it won't expand to other nodes because its quality is degraded to a point that will fall below the minimum quality of neighbor nodes.

The purpose for "Locking" the qualities of your real neighbor nodes, is to preserve their quality rating as true neighbors. If one of your true neighbors goes down, it will be removed from the node table, however it will not be removed from the "locked routes listing" unless you remove it.

To delete a locked route listing use the minus (-) sign where you used the plus sign (+) in the routes listing; Here is an example of how I would remove the locked routes we entered earlier (quotation marks are mine):

R 0 K4ABT-8 "-" 192

It is viatlly important to the proper operation of the network that each SNO who locks in a route to a neighbor node not his own, to notify the neighbor node SNO that he has down so. Ask the neighbor node SNO to lock his node in using the same locked route quality as you have used. This insures good link quality and fewer retries between nodes. In many cases, it prevents the familiar;

"RETRIED OUT AT NODE ....."

SUMMARY; SETTING *NODE* ROUTES:

The Node command may be used to make a manual entry in the node table. When this is done, it may also make an entry in the routes table if necessary. The syntax of the command is :

NODE, Callsign, +, Ident, Quality, Count, Port, Neighbor

- callsign is the callsign of the destination node
- ident is the alias of the destination node
- Quality is the node quality for the entry
- Count is the obsolescence count to be given to the entry
- Port is the level 2 port (0 for radio, 1 for RS232)
- Neighbour is the callsign of the neighbouring node to route through

So to make an entry that will never expire to ANODE:K4ABT-7 where the node is accessed directly on the radio port with a quality of 192, enter

NODE K4ABT-7 + ANODE 192 0 0 K4ABT-7

If the same station is not heard directly but is accessed through node WB4EDZ-7 over the radio, and the entry will expire when its obsolescence drops to zero from an initial count of 8, enter :

NODE K4ABT-7 + ANODE 192 8 0 WB4EDZ-7

An entry may be deleted by substituting - (minus) for + (plus).

IMPORTANT NOTE:

LOCK 1200 baud neighbor (radio (zero 0) port) nodes to each other at a value of 192
LOCK 9600 baud neighbor (radio (zero 0) port) nodes to each other at a value of 240

APPENDIX "C"

The MFJ-52B DEViation and ADC meter for the X-1J4 NODE

The following addendum of this handbook is excerpted from the X1J4 overview documentation by Dave Roberts and Neville Pattinson. The purpose of this addendum is to give the X1J4 sysop a jump-start to configure the addition of the MFJ-52A PC Board in the X1J4 node. For a much more detailed set of X1J4 documentation, print the OVERVIEW.TXT file from the original X1J/2 disk.

- ♥ METER
- ♥ ADC (S meter)
- ♥ ADC1 (Temperature)
- ♥ ADC2 Voltage)

METER COMMAND:

This command's syntax is similar to the PARMS command, and includes the new syntax as described in the X1J4 overview guide, section 3.32.

It allows the following parameters to be controlled. Note that the parameter list differs from TheNet X-1J, where the first (and only) parameter was the deviation meter scaling factor.

1 The meter mode flags
2 The deviation meter *scaling* factor
3 The signal strength meter noise floor value
4 The S meter display format multiplier
5 The dBm meter display format multiplier
6 The dBm noise floor value
7 The voltmeter channel 1 multiplier
8 The voltmeter channel 2 multiplier
9 The voltmeter channel 1 offset value
10 The voltmeter channel 2 offset value

IMPORTANT NOTE ! If you are **NOT** using the MFJ-52B deviation, temperature, volt, and S meter add-on PC board, then set the METER command to:

ME 0 0 0 0 0 0 0 0 0 0

THE METER MODE FLAGS

Each bit of this parameter controls a different aspect of the meters as shown below

BIT	If set, then ....
0	The deviation meter is enabled
1	The signal strength meter is enabled
2	The signal strength is shown as S points rather than dBm
3	ADC channel 3 is enabled (voltmeter channel 1)
4	ADC channel 4 is enabled (voltmeter channel 2)
5	Voltmeter channel 1 divisor is 1000 rather than 100
6	Voltmeter channel 2 divisor is 1000 rather than 100
7	Voltmeter channel 1 displays fine resolution rather than integers
8	Voltmeter channel 2 displays fine resolution rather than integers

THE DEVIATION METER SCALING FACTOR

This is the parameter previously described in section 3.31 of the overview guide. It scales the deviation meter display. One change however from X-1J. Setting it to zero does not disable the deviation meter - bit 0 of the meter mode word as described above controls whether it is enabled.

When set to a value in the range 1 - 255, the meter is enabled and the value is used as a scaling factor. The ADC is an 8 bit device, so it will give a response in the range 0 - 255, corresponding to an ADC input voltage in the range 0 - 3 volts DC. If optimally configured, this corresponds to the maximum audio level possible for the given receiver discriminator.

The ADC reading (0 - 255) is multiplied by the meter parameter value (1 - 255) to give an answer in the range 0 to 65 KHz (approx.). This is the value displayed in the MHeard list.

Hence, if, for example, a DC voltage of 2 volts at the input to the ADC corresponds to 3.4 KHz deviation, the ADC reading will be 171 (+- a few) and the Meter parameter will need setting to 20 (i.e. to 3400 / 171).

If the ADC reading is 254 or higher, then in order to indicate an overrange, the symbol '>' will precede the corresponding deviation entry in the heard list.

The signal strength meter noise floor value

This parameter sets the 'no signal' offset applied to input readings from the signal strength meter. It is subtracted from the count read from the ADC to give a reading based on a no signal value of zero. If the no signal (noise) reading is, for example 0.65V, corresponding to an ADC count of 256 * 0.65 / 3 or 54, then 54 is subtracted from each ADC signal strength reading to give an integer from 0 to 201 for an input reading between 54 and 255.

The S meter display format multiplier

This parameter operates in a similar manner to the dBm multiplier (section 3.31.5) but having divided the intermediate result by 256, that value is displayed as an integer in the range 0 to 9 preceded by the letter 'S'. If the value exceeds 9, it is displayed as 'S9+'. If the dBm multiplier has been set up correctly, then set this parameter to the dBm multiplier divided by the number of dB per S point.

The dBm meter display format multiplier

This parameter is used to convert an ADC reading for the signal strength meter into a dB count. The ADC reading is converted into a count from 0 to n, according to the description contained in section 3.31.3. It is then multiplied by this parameter and divided by 256. When added to the dBm noise floor value (section 3.31.6), this gives the displayed dBm value in the heard list.

The dBm noise floor value

This is the noise floor (dBm) reading that corresponds to the zero count in section 3.31.3. It is entered as a positive count corresponding to a negative value. For example, if the zero point in the example of section 3.31.3 is -113 dBm, the noise floor value entered is 113.

The voltmeter channel 1 multiplier (Temperature sensor)

This is the multiplier that controls voltmeter channel 1 (ADC channel 3). It is set as described in section 3.34 of the X1J4 overview doc.

The voltmeter channel 2 multiplier

This is the multiplier that controls voltmeter channel 2 (ADC channel 4). It is set as described in section 3.34 of the X1J4 overview doc.

The voltmeter channel 1 offset value

This is the value subtracted from the ADC reading before it is multiplied by the multiplier parameter. It is described more fully in section 3.34 of the X1J4 overview doc.

The voltmeter channel 2 offset value

This is the value subtracted from the ADC reading before it is multiplied by the multiplier parameter. It is described more fully in section 3.34 of the X1J4 overview doc.

IMPORTANT NOTE (again)!

If you are **NOT** using the MFJ-52**B** deviation, temperature, volt, and S meter add-on PC board, then set the METER command to:

ME 0 0 0 0 0 0 0 0 0 0

No further input for the MEter command is necessary.

Here is an example of the Meter BIT settings of my ADC/MFJ-52B at K4ABT-7:

ME 351 96 50 10 50 120 106 62 32

APPENDIX "D"

The ***Access Connect Limiting*** (ACL) command is a useful feature of the X-1J+ nodes. It enables the sysop to set node backbones to allow only access by other backbone nodes and the sysop's call(s).

In other instances, the ACL feature may be used to restrain an offending station to a node, or network of nodes by invoking the feature of the X-1J+ node.

At some point in time we are all faced with a situation that calls for action on the part of the X-1J node sysop to invoke the Access Connect Limiting (ACL) command. Please try to resolve any conflict with any network or node offender before turning to the use of the ACL to exclude his or her access to the node or network.

In one case, a BBS sysop who had just moved to the area from a distant State was hoping to establish another BBS so the area users would have a means to handle local traffic. He began operation of his node on 145.770 the nationwide Emergency and keyboard to keyboard frequency. He was informed of the purpose of the frequency of 145.770 MHz, and without additional dialog, he moved his BBS to another LAN frequency.

In another case, an unscrupulous operator set up operation on the frequency and proceeded to use the system for DX spotting during an ongoing weather-watch activity. After all else had failed did we invoke the ACL feature and excluded his node, callsigns, and SSID's from the network.

This won't be the last time this problem surfaces in any network.

TACT & DIPLOMACY:

If you find that you as a sysop are confronted with a similar situation, try first to remedy the situation with a kindness approach. A bit of tact and diplomacy goes a long way.

If it appears that no reconcilable solution can be found then let the rest of the sysops know of your plight.
A deluge of letters from the sysops to the offender may help change his/her attitude toward your network. Where emergency communications are concerned an act of malicious mischief is frowned on by both the ARRL and the FCC.

If all efforts for resolve fail, then remember that we have the ACL feature in the X1J+ code. ACL is a feature that we don't care to implement (and please don't abuse it) unless it is absolutely your last recourse.

The ACL feature is activated by first setting the mask ON. To do so, enter the sysops command mode using your node password. To set the "mask"; Send the following command to the node:

ACL & 127

Your next entry is to set (ACL) the offending call sign:

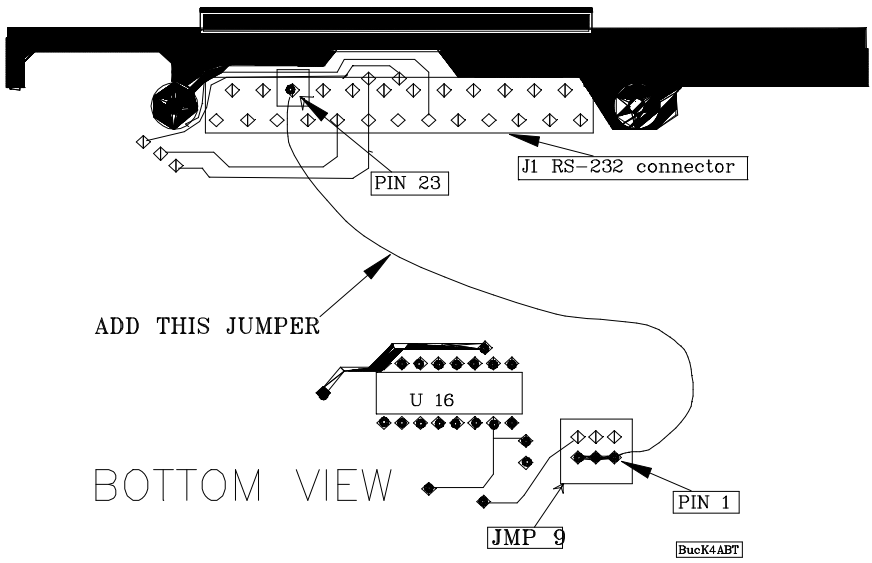
ACL [offending CALL sign] + 127

The offending node or station is history. The "127" sees to it that the call and/or any SSID of the offending call is denied access to your node.

To remove the call from the ACL list, use the minus sign in the ACL string instead of the Plus (+) sign i.e.

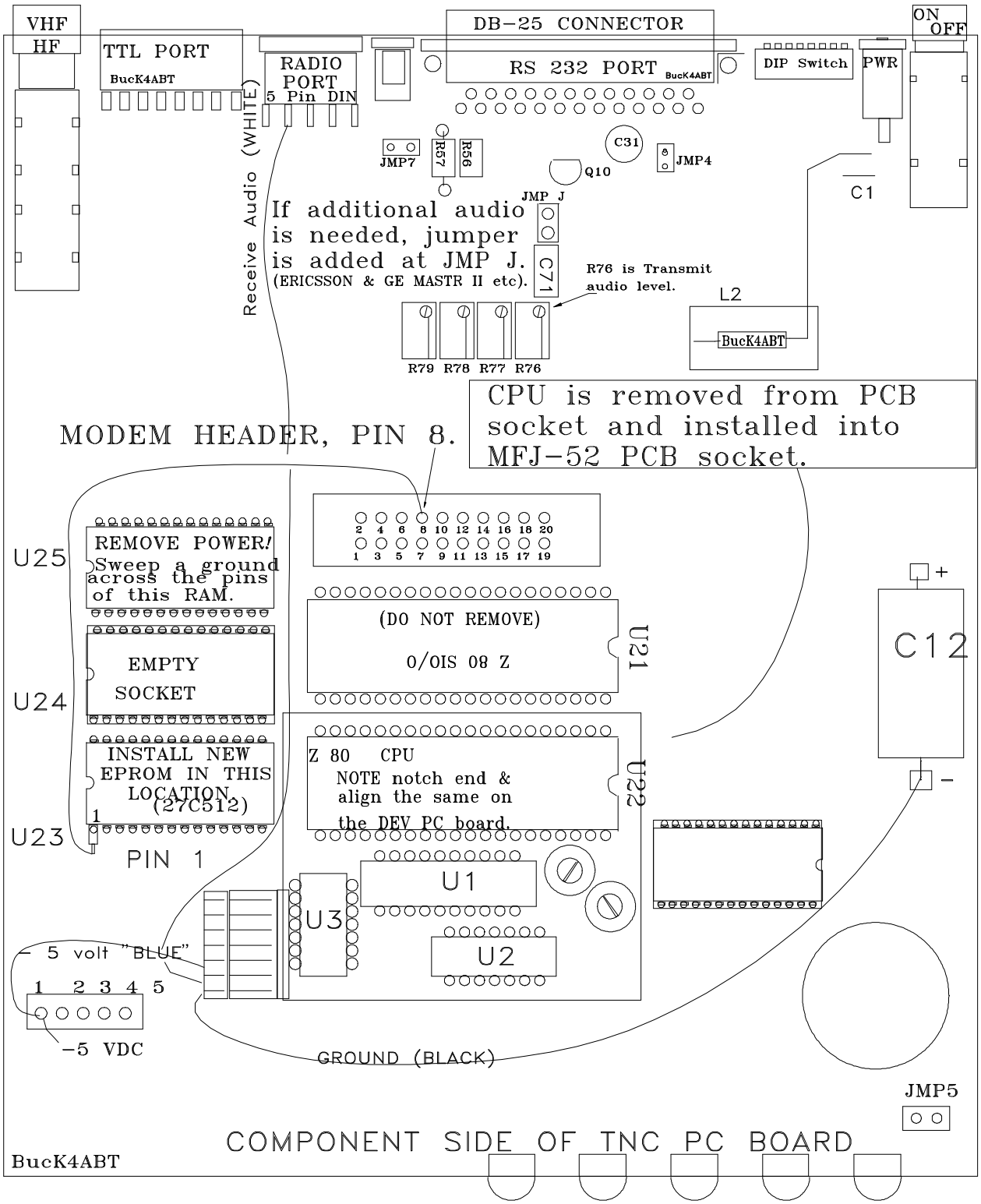
ACL [CALL] - 127

The user of the call sign now has all node privileges restored.

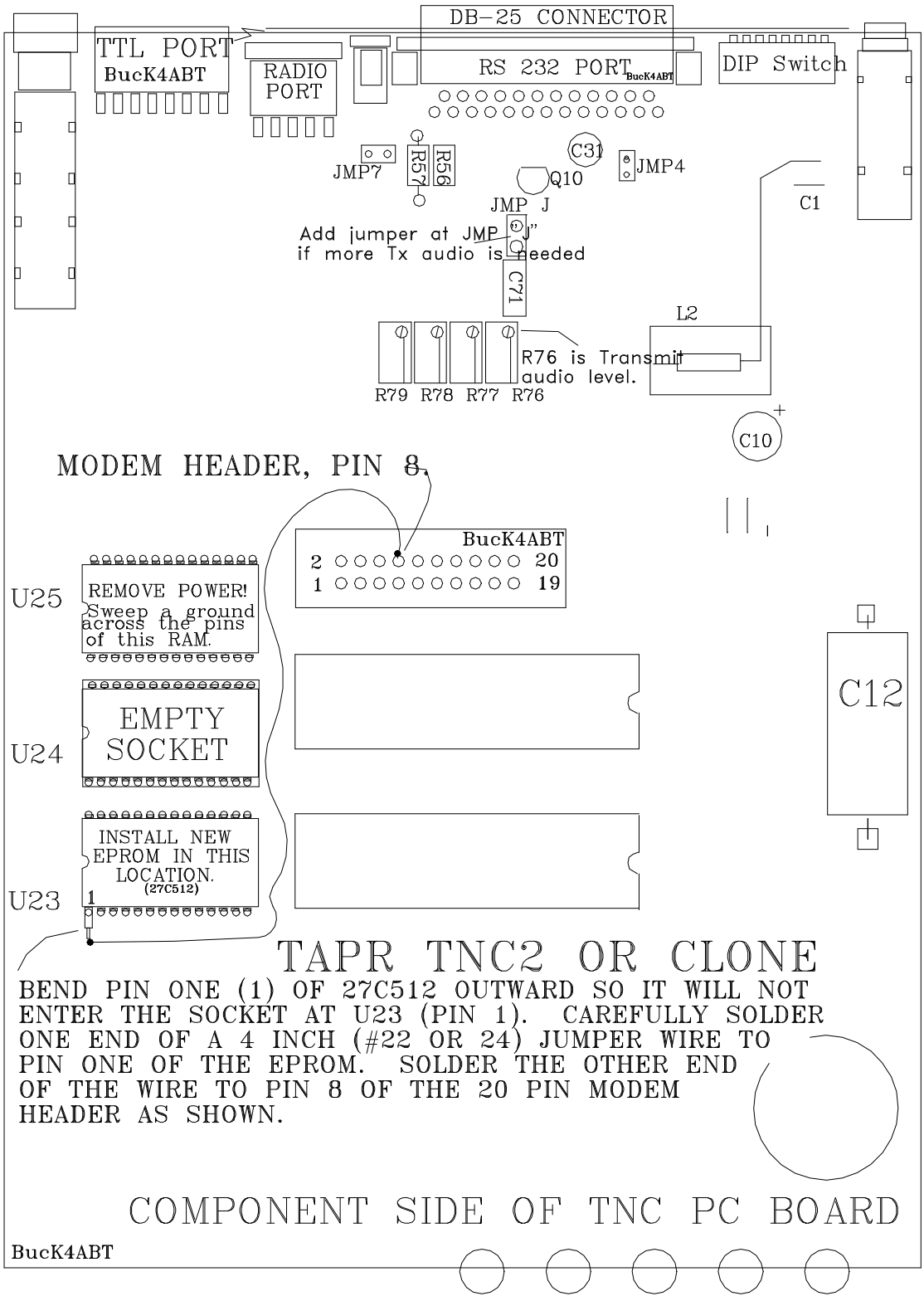


This modification is added to the TNC2 and clones manufactured prior to 1990. It is only required when the node is connected as one port of a gateway.

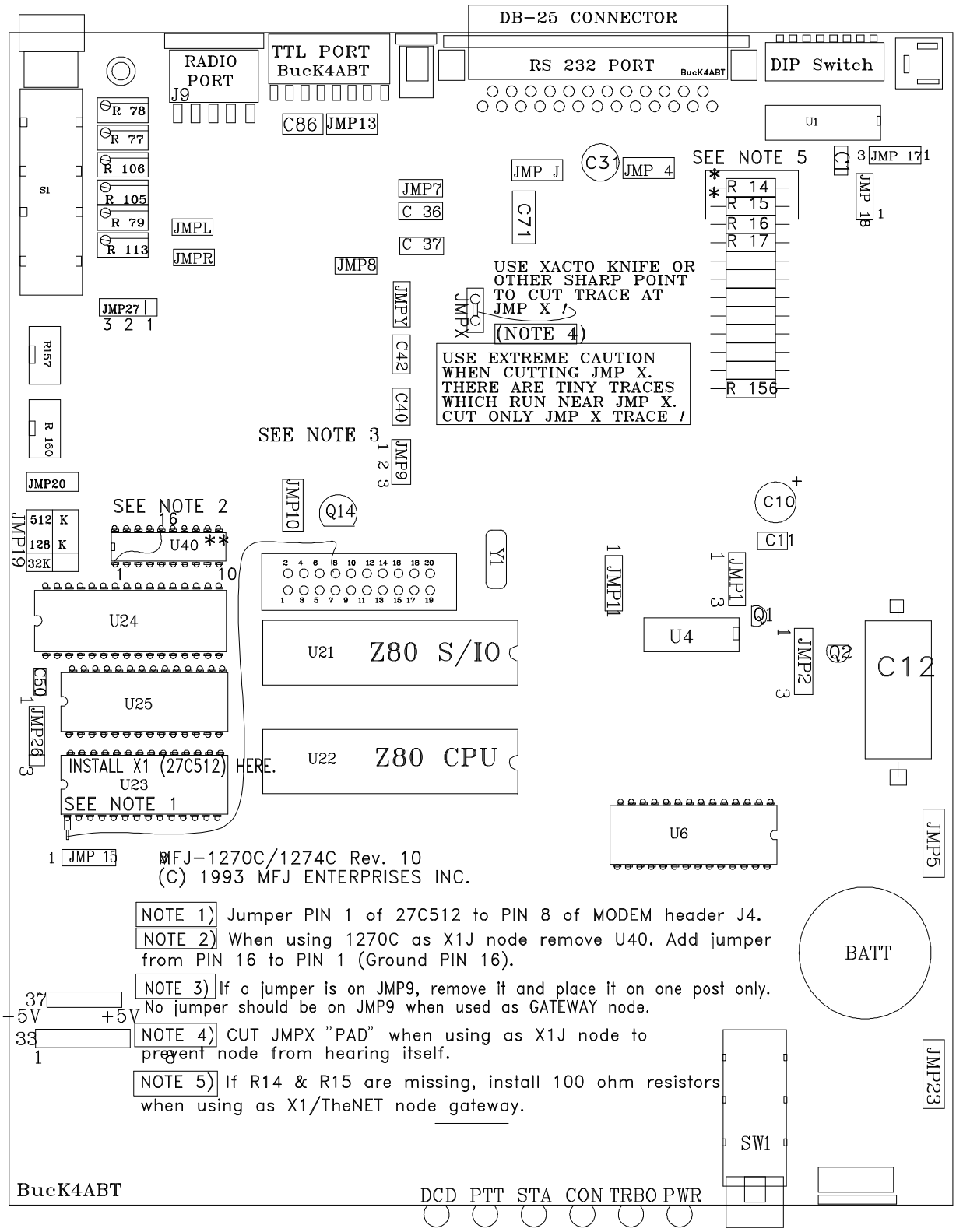
This modification is for the older, pre 1990, (no suffix), MJF-1270. Most MFJ-1270"B" versions and all "C" versions are already configured with this feature. To perform this modification, connect one end of a wire to pin 23 of the RS232 connector. Connect the other end of the wire to pins 1-2-3 of JMP9 (these three pins are already connected together on the circuit board). This modification allows the TheNET **X1** firmware to be configured for multi-frequency operation by jumpering RS232 pins 10 and 23 together in the TNC-to-TNC cable.



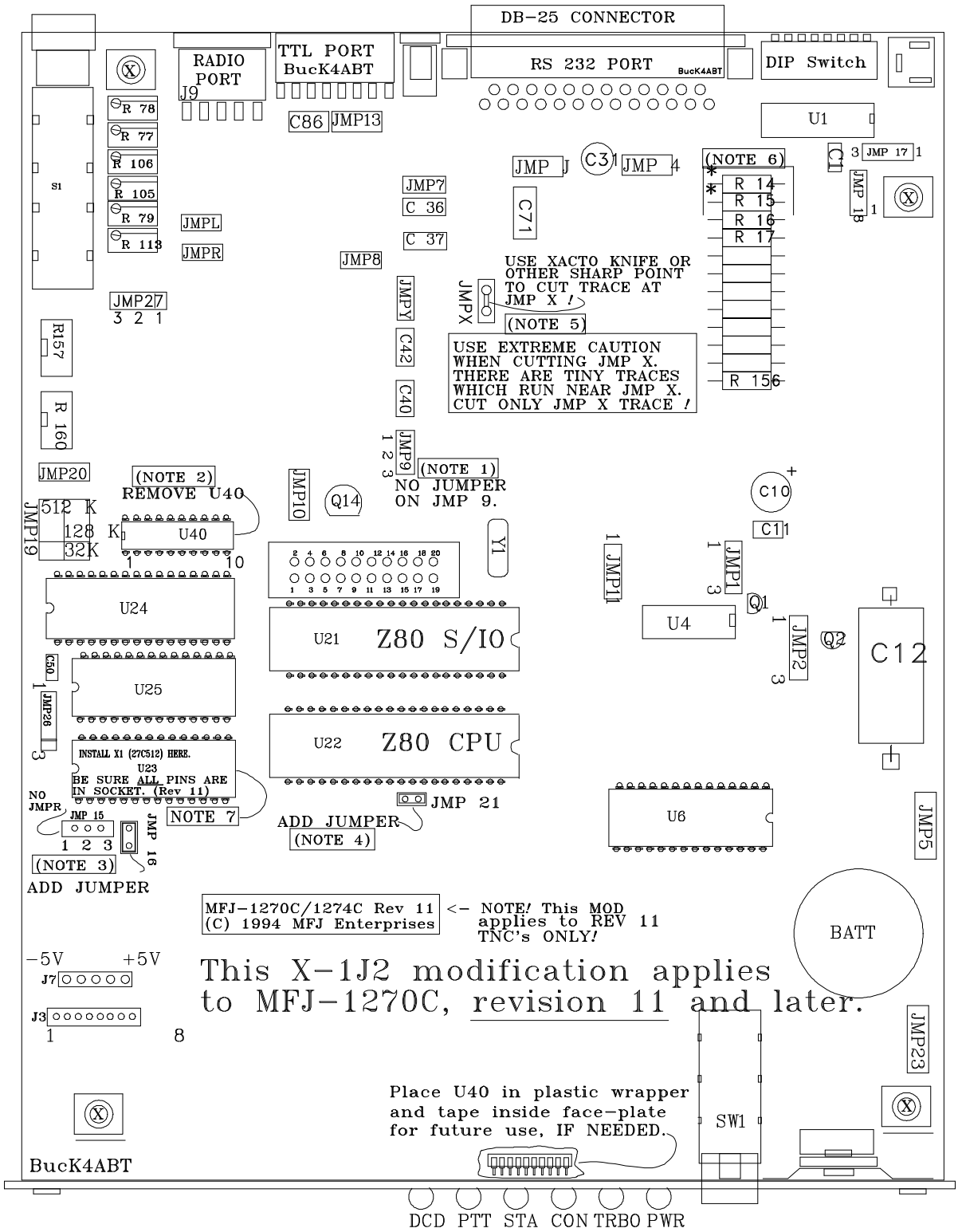
This drawing illustrates how the X-1J4 EPROM is installed and connected in the MFJ-1270B TNC. Note that PIN one of the EPROM is not inserted into the socket at U23. Pin one (1) also has a wire attached to it and is routed to pin 8 of the MoDem header. This mod also illustrates how the MFJ-1270"B" version is configured with the MFJ-52B DEViation meter installation.



Another overview of how the X-1J4 EPROM is installed and connected in the MFJ-1270B and earlier. See following pages for the installation of the EPROM in MFJ-1270"C" Rev 10. The MFJ-1270"C" REV 11 and later follows the REV 10 illustration.



An overview of how the X-1J4 EPROM is installed and connected in the MFJ-1270"C" ***Rev 10*** . See next drawing for the installation of the EPROM in MFJ-1270"C" ***Rev 11 and later***.



In this drawing I have outlined how the X-1J4 EPROM is installed and connected in the MFJ-1270"C" Rev 11(latest) version. A detailed list of **procedures to transform the MFJ-1270C REV 11 into a node are on the following page.**

The following steps outline the procedures to transform the MFJ-1270C REV 11 (shown on the previous page) into an X1J4 node

1. ***Remove*** jumper from all pins of JMP 9. Jumper may be used later in this TNC to X-1J2 node modification.

2. ***Remove*** IC U40. After the modification is complete, place U40 into a plastic wrapper and tape inside the front face-plate for use if the node is ever returned to normal TNC service.

3. ***Remove*** jumper from JMP 15. ***ADD*** A JUMPER at JMP 16. ***ADD*** JUMPER at JMP 21.

4. ***Cut trace*** at JMP "X" Notice that tiny traces are close to JMP X: DO NOT CUT any other trace. *Cut ONLY the trace between pads of JMP X*. Use extreme caution when cutting. This step is optional and may not be necessary unless you are concerned with the node hearing itself in RF rich environments.

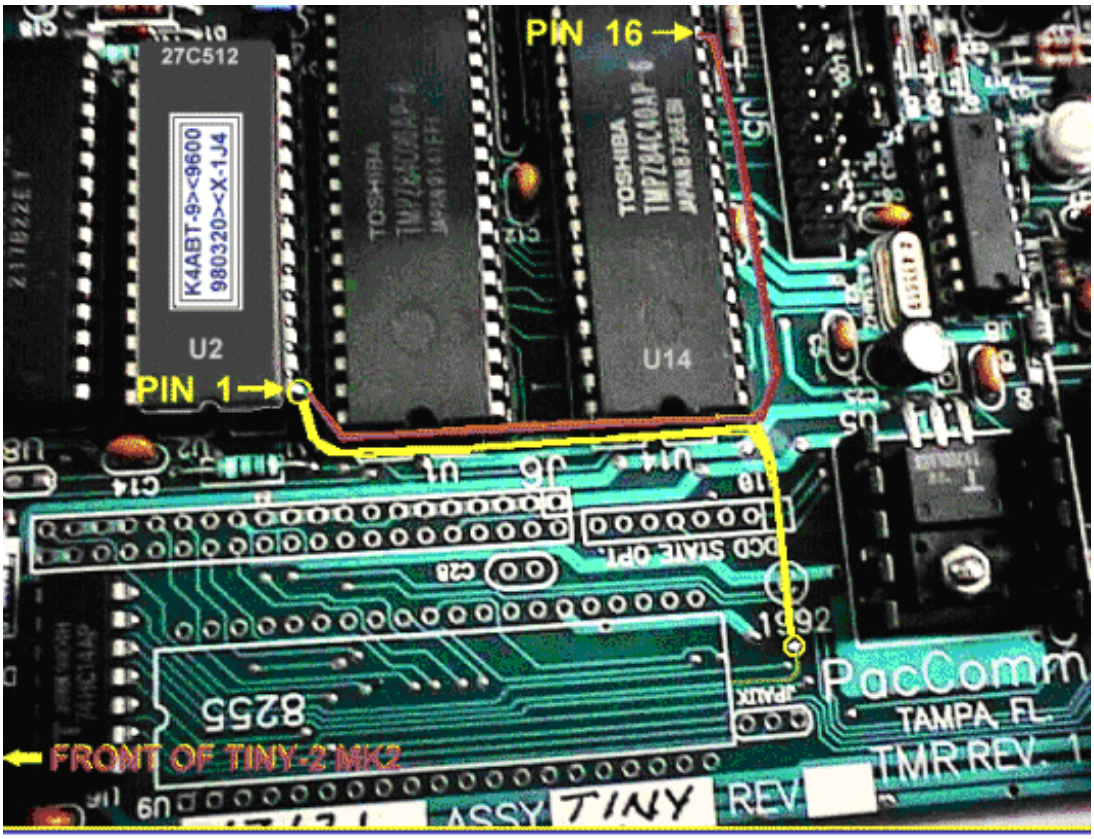
5. If TNC is to be used as a GATEWAY between two frequencies or baud rates, insure that R14 & R15 are installed. If they are not, remove the PC board and ***add R14 and R15***. R14 and R15 are 100 ohms @ 1/4 watt each.

6. To remove the PC board, remove the front face-plate (2 screws), then remove the screw which attaches Q3 (regulator) heat-sink to the front of the TNC. Next remove the four (4) screws which hold the PC board in place. The locations of the screws are shown in the drawing as a circled "X" symbol.

7. ***Remove*** the EPROM at IC U23. *CAREFULLY* install the new X-1J4 EPROM into socket at U23. BE SURE ALL PINS ARE INSERTED INTO THE SOCKET. The number 1 pin is NOT left out of socket pin 1 as with earlier revisions of this TNC. ***This modification applies to MFJ-1270C "Rev 11" and later versions***.

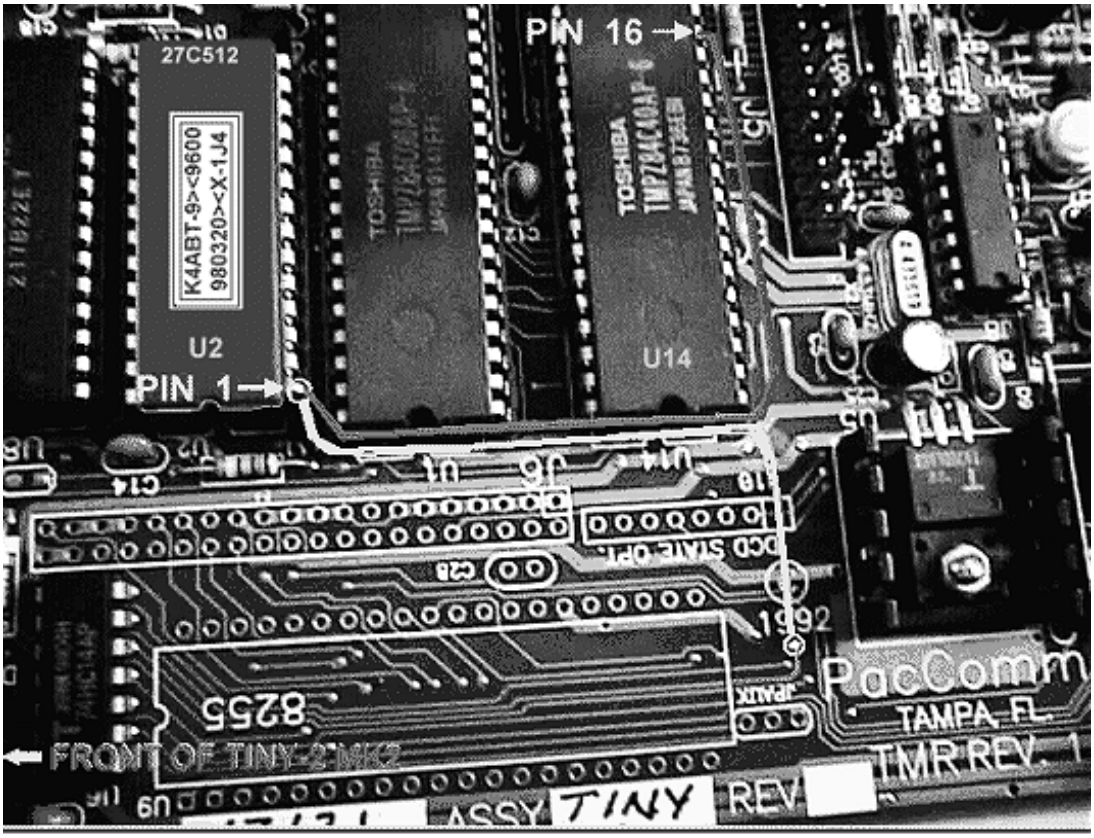
The TINY-2 Mark II is a TNC-2 Clone comes ready to operate 300 and 1200 bauds. An internal MoDem disconnect header to enable faster baud rates.

The TINY-2 is TheNET X-1J4 EPROM compatible. See photo below:



INSTALL X-1J4 (27C512) EPROM AT U2. BE SURE PIN 1 OF THE NEW EPROM IS OUTSIDE THE SOCKET. "NOTE" POSITION OF THE EPROM NOTCH. SWITCH MARKED "OPTION EPROM" IS "OUT" CAREFULLY SOLDER A #20 (SMALL) WIRE TO PIN 1 OF THE EPROM. THIS IS THE PIN LEFT OUT OF THE EPROM (U2) SOCKET. BE SURE IT DOES NOT TOUCH ANY NEARBY PINS OR CONNECTIONS. ROUTE THE WIRE TO ONE OF THE TWO POINTS SHOWN IN THE PHOTO. ONE OF THE POINTS IS JUST BELOW THE "9" IN 1992. THE POINT I PREFER TO USE IS TO "CAREFULLY" SOLDER IT DIRECTLY TO PIN 16 OF U14. ALL PINS OF U14 ARE PLUGGED INTO THE SOCKET.

Buc K4ABT



INSTALL X-1J4 (27C512) EPROM AT U2. BE SURE PIN 1 OF THE NEW EPROM IS OUTSIDE THE SOCKET. "NOTE" POSITION OF THE EPROM NOTCH. SWITCH MARKED "OPTION EPROM" IS "OUT" CAREFULLY SOLDER A #20 (SMALL) WIRE TO PIN 1 OF THE EPROM. THIS IS THE PIN LEFT OUT OF THE EPROM (U2) SOCKET. BE SURE IT DOES NOT TOUCH ANY NEARBY PINS OR CONNECTIONS. ROUTE THE WIRE TO ONE OF THE TWO POINTS SHOWN IN THE PHOTO. ONE OF THE POINTS IS JUST BELOW THE "9" IN 1992. THE POINT I PREFER TO USE IS TO "CAREFULLY" SOLDER IT DIRECTLY TO PIN 16 OF U14. ALL PINS OF U14 ARE PLUGGED INTO THE SOCKET.

BucKAABT

The System Node Operator's Guidelines to configuring TheNET X-1J4 Nodes

Our thanks to Ron Raikes WA8DED (NetROM/Software 2000), Hans Georg Giese DF2AU (TheNET/NORD-LINK), Dave Roberts G8KBB, Neville Pattison G0JVU (X-1J+TheNET/ Suffolk Data Group) and Bill Beech NJ7P for the implementation of this outstanding networking tool. The foundation for the X-1J+ code comes from the NORD-LINK Group. To these authors we wish to express our gratitude.

Buck Rogers K4ABT

TheNet X-1J4 and TheNet Plus is a derivative of NORD-LINK's TheNet 1.01 by G8KBB & G0JVU.
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- TheNet 1.01 Software © NORD-LINK
- X-1J Software © Dave Roberts, G8KBB, 1993-97 - Hardware ©
- Neville Pattinson, G0JVU, 1993-97
- Bill Beech NJ7P, TheNet Plus

X-1J4 "TheNET" NODE PARAMS

Click on a PARAMETER number to jump to the definition for that parameter. For "LOCKED" node applications and information, click on the blue "1200 Baud or 9600 Baud" headers. *The settings shown for the 1200 baud user port and the 9600 baud backbone are the node settings and are shown as example only.*

The hierarchy shown allows a "natural" migration of data packets from the user port onto the backbone. This is an exception and not the rule. Other networks may use a different concept and the author does not endorse any particular routing scheme as "too many cooks have already spoiled the broth" by trying to make network configuration complicated. It is true that a measure of "node" common-sense, should be applied when setting up a network.

Parm #	Purpose	Default	Minimum	Maximum	1200 Baud	9600 Baud
1	**Size of destination node table**	100	1	400	100	100
2	**Minimum auto update quality**	60	0	255	60	143
3	**HDLC (radio port) quality**	60	0	255	60	143
4	**RS-232 (Crosslink) port quality**	255	0	255	255	255
5	**Initial obsolescence count**	9	0	255	9	9
6	**Minimum Obsolescence to broadcast**	5	0	255	5	5

7	**Nodes broadcast interval (seconds)**	1800	0	65535	1800	900
8	**Initial time-to-live**	16	0	255	16	16
9	**Transport FRACK timeout (seconds)**	180	5	600	220	220
10	**Transport RETRY counter**	3	1	127	3	3
11	**Transport (L4) ack delay (seconds)**	2	1	60	2	2
12	**Transport busy delay (seconds)**	60	1	1000	60	60
13	**Transport window size (frames)**	4	1	127	4	4
14	**Transport overfill limit (frames)**	4	1	127	4	4
15	**No-Activity time-out (seconds)**	900	0	65535	900	900
16	**Persistance (n/256)**	64	0	255	64	255
17	**Slottime (x 10ms)**	10	0	127	10	1
18	**FRACK (T1) time**	5	1	15	5	1
19	**AX.25 windowsize (L2 MAXFRAME)**	2	1	7	3	3
20	**AX.25 (L2) retries**	10	1	127	10	15
21	**ACK (T2) time (L2 RESPTIME)**	100	0	65535	200	100
22	**Active check (T3) (x10ms)**	0	0	65535	0	0
23	**Digipeat**	0	0	1	0	0
24	**Callsign validation**	1	0	1	0	1
25	**Beacon mode control**	2	0	2	2	2
26	**CQ broadcasts**	1	0	1	1	0

X-1J4 PARAMETER DEFINITIONS

Parameter 1 Max destination node list size; *(default=100, minimum=1, maximum=400)*

Defines the maximum number destination nodes allowed in the node's routing table. Each destination consumes 32 bytes of RAM. The system node operator (SNO) can use this parameter to limit the amount of RAM that is allocated to the routing table, thus ensuring that sufficient space remains for other node buffers. *Normally there are 720 free buffers in the X-1J4 node at startup.*

Parameter 2 Worst quality for auto-update; *(default=60, minimum=0, maximum=255)*

Defines the poorest route quality that can be added to the node's automatic routing table. The system node operator (SNO) can use this parameter to limit the automatic routing update function to accept only higher-quality routes. In addition, the automatic update function can be disabled altogether by setting this parameter to zero.

Parameter 3 Channel 0 (Radio Port) quality; *(default=60, minimum=0, maximum=255)*

Defines the quality of the radio channel connected to the node's HDLC port. The system node operator (SNO) should set this parameter to an appropriate quality value in accordance with the speed, reliability, and congestion anticipated on the channel. The default value of 192 is appropriate for a 1200-baud user-accessible frequency.

Parameter 4 Channel 1 (RS232 Port) quality; *(default=255, minimum=0, maximum=255)*

Defines the quality of the TNC-to-TNC interconnect channel connected to the node's RS232 port. The system node operator (SNO) should set this parameter to an appropriate quality value in accordance with the speed, reliability, and congestion anticipated on the channel. The default value of 255 is appropriate for a 9600-baud two-modem interconnect cabled gateway.

Parameter 5 Obsolescence count initializer; *(default=9, minimum=0, maximum=255)*

Defines the initial value given to the obsolescence counter of a route that has been recently added or updated by the node's automatic routing table. The obsolescence count of a route is also reinitialized to this value whenever the route is successfully used or when the period set to the noted value shown in the STATS table of the X-1J4 node. The obsolescence count of a route is decremented once each auto-update broadcast interval (see parameter 7). Periodic decrementing of route obsolescence counts can be disabled altogether by setting this parameter to zero (0).

Parameter 6 Obsolescence count minimum to be broadcast *(default=5, minimum=1, maximum=255)*

In the X-1J4 node, this parameter defines the minimum obsolescence count threshhold below which a route will not be included in the node's automatic routing broadcasts. The purpose of this threshhold is to prevent the node from broadcasting out dated routing information to other nodes. Under normal circumstances this parameter should be assigned a value no greater than the value of parameter 5. If parameter 5 is greater, the X-1J4 node's broadcasts will NOT include destination nodes other than itself.

Parameter 7 Auto-update broadcast interval (seconds) *(default=1800, minimum=0, maximum=65535)*

Defines the number of seconds between automatic routing broadcasts issued by the node. The default value of 3600 specifies an hourly broadcast. X-1J4 node broadcasts can be disabled altogether by setting this parameter to zero (0).

Parameter 8 Network *TIME TO LIVE* initializer *(default=16, minimum=0, maximum=255)*

Defines the initial value of the ***time-to-live***; field in the Network Header of all network-layer frames originated by this node. The time-to-live field is decremented by each intermediate node that relays the frame. If the *time-to-live* value ever reaches zero, the frame is discarded. This protects the network against frames *living* forever as the result of a routing loop.

Parameter 9 Transport timeout (seconds) *(default=180, minimum=5, maximum=600)*

Defines the number of seconds between transport-layer retries.

Parameter 10 Transport maximum tries *(default=3, minimum=2, maximum=127)*

Defines the maximum number of transport-layer tries attempted before a circuit failure is reported.

Parameter 11 Transport acknowledge delay (seconds) *(default=2, minimum=1, maximum=60)*

Defines the number of seconds' delay used by the transport layer from the time it receives an information message until it sends an information-acknowledge message. The purpose of this delay is to give the acknowledgement an opportunity to be added to another outgoing information frame or packet.

Parameter 12 Transport busy delay (seconds) *(default=60, minimum=1, maximum=1000)*

Defines the maximum number of seconds that the transport layer will remain ***choked***; as the result of an incoming message that has the *choke flag bit* set. The purpose of this timeout is to prevent an infinite hangup in the event that the *unchoke* message is lost.

Parameter 13 Transport requested window size (frames) *(default=4, minimum=1, maximum=127)*

Defines the maximum number of incoming, out-of-sequence, information messages that the transport layer will buffer while waiting for the next expected information message to arrive. Also defines the maximum number of outgoing information messages that the transport layer will send without receiving acknowledgement.

Parameter 14 Congestion control threshhold (frames) *(default=4, minimum=1, maximum=127)*

Defines the maximum allowable backlog of messages that the transport layer will buffer before it sends a choke message. Also defines the maximum allowable backlog of frames that the link layer will buffer before it sends an *receive-not-ready* (RNR) control frame.

Parameter 15 No-activity timeout (seconds) *(default=900, minimum=0, maximum=65535)*

Defines the maximum number of seconds that a transport-layer circuit or a link-layer connection can remain idle (i. e., no information transfer in either direction) before it is automatically disconnected.

Parameter 16 P-persistence (p=/256) *(default=64, minimum=0, maximum=255)*

Together with slot time (parameter #17), defines the exponential delay algorithm used by the node when keying up its transmitter. When the node has something to transmit and the channel is clear, the node generates a random integer in the range 0 - 255. If the random number is less than or equal to the P-persistence parameter, the node keys up its transmitter immediately. Otherwise, the node delays for one slot time, generates a new random number, and repeats the procedure.

Parameter 17 Slot time (10ms increments) *(default=10, minimum=0, maximum=127)*

Together with P-persistence (parameter #16), defines the exponential delay algorithm used by the node when keying up its transmitter. The default value of 10 corresponds to a slot time of 100 milliseconds. ***NOTE to the wise... and maybe the "unwise," setting this parameter to 0 (zero) may make the node respond fast! Maybe too fast.***

Parameter 18 Link T1 timeout ***frack***; (seconds) *(default=5, minimum=1, maximum=15)*

Defines the number of seconds between link-layer retries. When digipeating is used, this value is multiplied by 2 x D+1, where D is the number of digipeaters.

Parameter 19 Link transmit window size ***maxframe***; *(default=3, minimum=1, maximum=7)*

Defines the maximum number of outgoing information frames that the link layer will send without receiving acknowledgement.

Parameter 20 Link maximum tries *(default=10, minimum=0, maximum=127)*

Defines the maximum number of tries that the link layer will attempt before reporting a link failure. If this parameter is set to zero (0), the link layer will retry forever (we recommend that this parameter is ***NEVER*** set to zero (0)).

Parameter 21 Link T2 timeout (10ms increments) *(default=200, minimum=0, maximum=65535)*

Defines the delay (measured in 10-millisecond increments) used by the link layer from the time it receives an information frame until it sends an acknowledgement (RR, RNR, or REJ) control frame. The purpose of this delay is to give the acknowledgement an opportunity to be attached to another outgoing information frame.

Parameter 22 Link T3 timeout (10ms increments) *(default=0, minimum=0, maximum=65535)*

Defines the maximum no-activity period (measured in 10-millisecond increments) permitted by the link layer before it issues a poll to make sure the link is still intact. This timeout is also used to break link-layer choke deadlocks. **NOTE**: This parameter is the same as CHECK, and can be defaulted to 0 as a means of reducing node QRM.

Parameter 23 AX.25 digipeating (1=enabled, 0=disabled) *(default=0, minimum=0, maximum=1)*

Defines whether or not the node will perform AX.25 digipeating. The default value of 1 causes digipeating to be enabled.

Parameter 24 Validate callsigns (1=enabled, 0=disabled) *(default=1, minimum=0, maximum=1)*

Defines whether or not the node will perform validation checks on amateur callsigns. The default value of 1 causes callsign validation to be enabled.

NOTE; If callsign validation is turned OFF (0), users will experience long delays if they request connects to inactive nodes before getting back a *FAILURE WITH*, response.

Parameter 25 Station ID beacons (2=on, 1=conditional, 0=off) *(default=2, minimum=0, maximum=2)*

Defines whether or not the node will broadcast station-identification beacons. The default value of 2 causes station identification to be broadcast every 10 minutes. The value of 1 causes station identification to be broadcast only if the node has transmitted since the last beacon. A zero (0) will disable station identification.

NOTE; Many sysops set this parameter to 0 as a means to reduce unnecessary node QRM on the channel. The X-1J4 node ID's itself each time it sends a packet, so no legal requirement to have ID's turned on.

Parameter 26 CQ Broadcasts (1=0n, 0=off) *(default=1, minimum=0, maximum=1)*

Defines whether or not the node will broadcast AX.25 UI-frames in response to the CQ command. Even if such broadcasts are disabled by setting this parameter to zero, the other features of the CQ command continue to operate normally. The default value of 1 enables CQ broadcasts. **NOTE**; When a station connected to an X-1J4 node through several distant nodes issues a ***UI QRA*** command, the distant node will poll stations that have the QRA feature for an ID. After about 40 seconds, the station that sent the polling (UI QRA) can issue the Mheard command and receive a list of the station that identified in the area of the distant X-1J4 node that was polled.

MODE SETTINGS FOR THE X-1J4 NODES

MODE No.	Function	1200 BAUD NODE/ PORT	9600 BAUD NODE/ PORT
1	Host mode control (RS-232 port,hardware handshake).	0	0
2	CWID repeat period (seconds)	0	0
3	CWID keyer speed (10 milliseconds per dot)	6	6
4	Nodes port broadcasts (RS232 and/or HDLC)	3	3
5	RS-232 crosslink protocol	0	0
6	Transmit keyup delay/TXDelay X 10 milliseconds (*Depends on radio PTT to full output power, time.)	35	20 *
7	Full duplex (0=OFF 1=ON)	0	0
8	Crosslink node broadcast interval (seconds)	450	600
9	Node broadcast algorithm port control flag	2	2

10	Beacon interval (seconds)	3600	3600
11	Connect redirect flag	1	1
12	User help message control flags	27	27
13	Hash node broadcast port control (1 bit per port)	0	0
14	Enable/Disable extra alias monitoring	0	0
15	Enable auto-reconnect to node after "bye" from mailbox or neighbor node.	1	1
16	Control of slime trails (Bit 0 hides slime trails)	0	0
17	Digipeat control (Disable L2 Uplink & Downlinks)	3	3

***LOCKING ROUTES**, (when using the parameters shown above).*

1200 Bauds

When locking (radio port = 0) paths between 1200 baud neighbor nodes, use a "locked path" quality of 192. Be sure both neighbor nodes are locked to each other and use the same value (192).

Locked route example: R 0 [NeighborNodecall&SSID] + [port quality (192)

9600 Bauds

When locking (radio port= 0) paths between 9600 baud neighbor nodes, use a "locked path" quality of 240. Be sure both neighbor nodes are locked to each other and use the same value (240).

Locked route example: R 0 [NeighborNodecall&SSID] + [port quality (240)

LOCKING (RS232) GATEWAYS

When locking gateway (1200-9600) neighbor nodes (nodes connected via port 1/RS232) umbilical, use a route quality of 255.

Example: R [neighbor nodecall] + [port quality (255)]

NOTE: Port 0 (zero)=radio. Port 1 (one)=RS-232 port.

To remove a locked route, substitute the - (minus) sign for the + (plus) sign.

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