

ALL cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

# PacketRadio®

**This Handbook is dedicated to the PacketRadio System Node Operator (SNO)**

by

Buck Rogers, K4ABT

**A Guide to PacketRadio operating and X-1J4 TheNET Node implementation.**



This manual will serve as a multi-function handbook that supports digital networking and communications. As a PacketRadio handbook, this manual can provide a "heads-up" for the new PacketRadio user with a wealth of information that applies directly to the interfacing, installation, and operation of a PacketRadio station, and the implementation of the X-1J4 TheNET node.

This handbook will become a ready-reference in your day-to-day, PacketRadio operations. It is my intent to provide the this manual as a final gesture of friendship to my many friends of the SEDAN. I hope these documents and tools serve you well, and may God smile on you as you continue to experience the fun within this wonderful, fun-filled facet of Amateur Radio.

**Buck Rogers** K4ABT

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PacketRadio Editor, *CQ Magazine*

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# A PacketRadio Primer !

By

**Buck Rogers K4ABT**  
**Digital Editor; CQ Magazine**

**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 must 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.; MMY CCAALLL) 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**

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**This Packet Radio Handbook is FREE and is to be freely distributed without any commercial association.**

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*

The comport connector to TNC (RS-232 interface) cable should be wired using the *RTS, CTS, Txd, Rxd, and Signal Ground* leads, then set the *XFLO* command *OFF*. When using the **PicturePacket** program, you should turn **XFLO and FLO OFF**.

### **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. For PicturePacket Picture, and/or Audio transfers, select one of the PacketRadio frequencies not often used in your area. For best results, use the highest baudrate that your transceiver and TNC are capable of.

**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, 145.779**

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. These are good frequencies to use 9600 bauds in.**

**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.**

Included in the ARRL future band plans are several simplex (64 kB), 100 kHz backbone frequencies within the 219 to 220 (FCC approved 16 March 1995 with restrictions, see **CQ Magazine Packet User's Notebook, June 1995 and October 1997**) Mhz UHF band;

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.***

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**The Fun Is Only Beginning:**

This PacketRadio Primer is only a starting point. I've written several handbooks for both the new PacketRadio user and the seasoned veteran. 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) | <b>PACKET RADIO OPERATOR'S</b>             | <b>HANDBOOK (MFJ Publications)</b>      |
| 2) | <b>PACKET RADIO OPERATOR'S</b>             | <b>MANUAL (CQ Publications)</b>         |
| 3) | <b>PacketRadio with Sound and Pictures</b> | <b>CD ROM from BUX Comm Consultants</b> |

Be sure to visit the PacketRadio Networks Home page(s) at:

**<http://www.packetradio.com>**

**or**

**<http://www.packetradio.org>**

Advanced levels of Packet include transmitting and receiving high resolution color pictures and audio in varying levels of fidelity, including stereo! All these are sent and received in the error free, PacketRadio AX.25 environment. PacketRadio digital transmissions are not limited to picture and audio only. The PicturePacket program also supports large ASCII and binary files.

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, and is supported in **PicturePacket™**.

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## **A PacketRadio FREQUENCY GUIDE FOR THE 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 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 primarily used 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 145.790 Mhz is used with Automatic Packet Reporting Systems (APRS), and as a DXCluster or DX spotting network frequency.

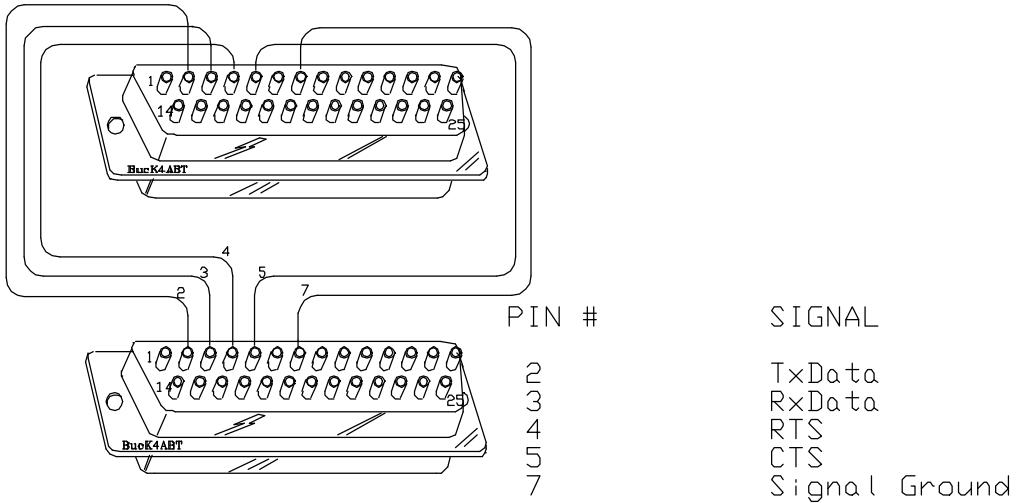
**222 MHz**  
**223.52-223.64** Packet

# Computer to TNC ComPort Interfacing

This DB25 to DB25 interface cable illustrates the 5 signals required for TNC to Computer Comport Hardware Handshaking.

## TECHNICAL NOTES & ILLUSTRATIONS:

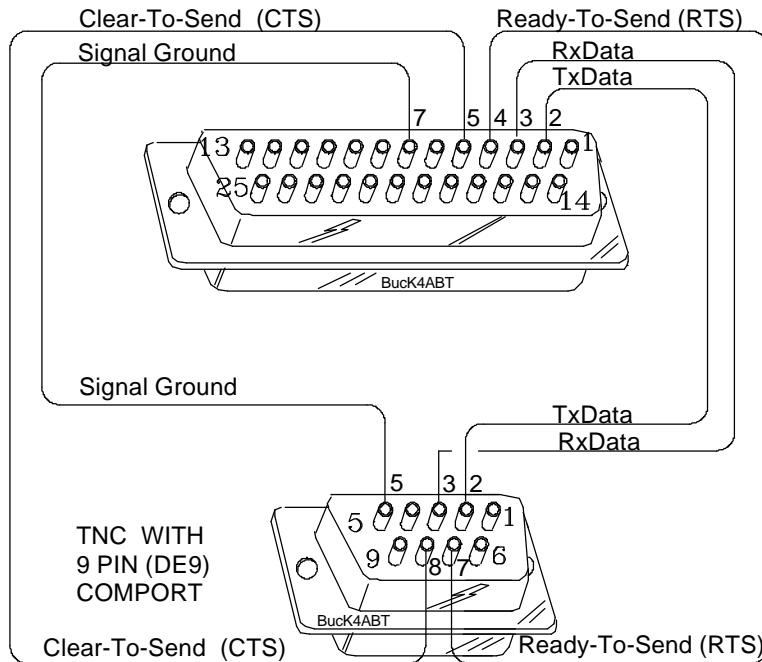
Comport 2



## DB-25 to DB-25 COMport signals required for PicturePacket

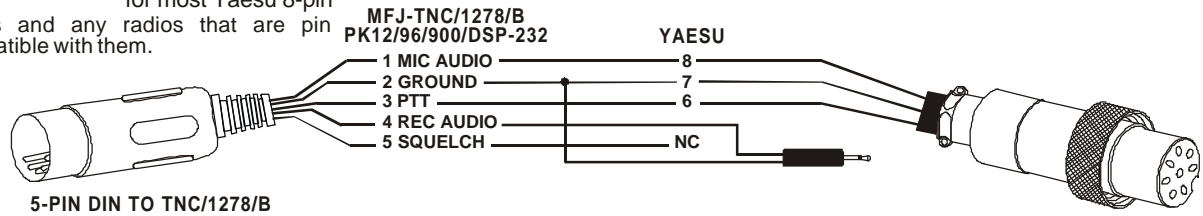
Comport 1

This Computer to TNC interface represents the method to interface TNCs with 9 pin (DE9) Comports.

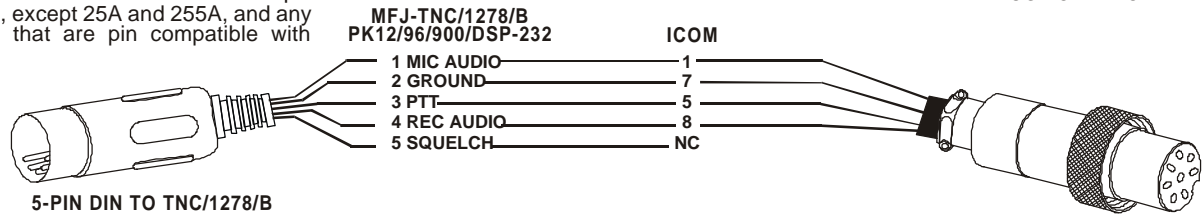


## TNC to Transceiver Diagrams

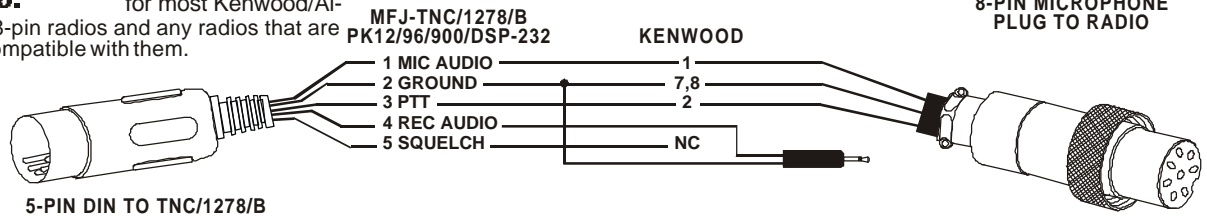
**080:** for most Yaesu 8-pin radios and any radios that are pin compatible with them.



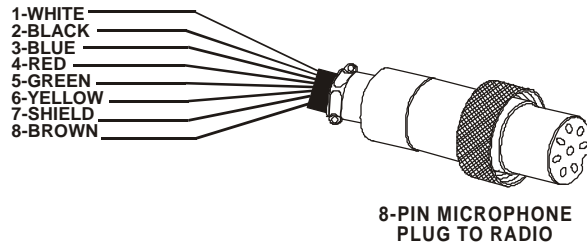
**084:** for most Icom 8-pin radios, except 25A and 255A, and any radios that are pin compatible with them.



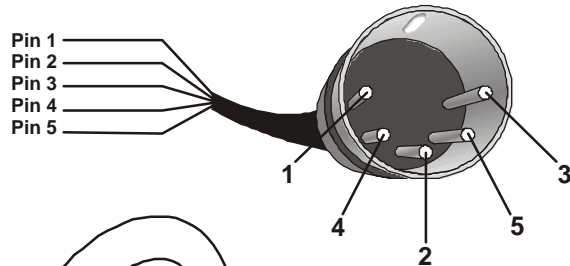
**5086:** for most Kenwood/AI-inco 8-pin radios and any radios that are pin compatible with them.



**5082:** Pre-wired 8-pin connector with cables.



**205:** Open end 5-pin Din connector.



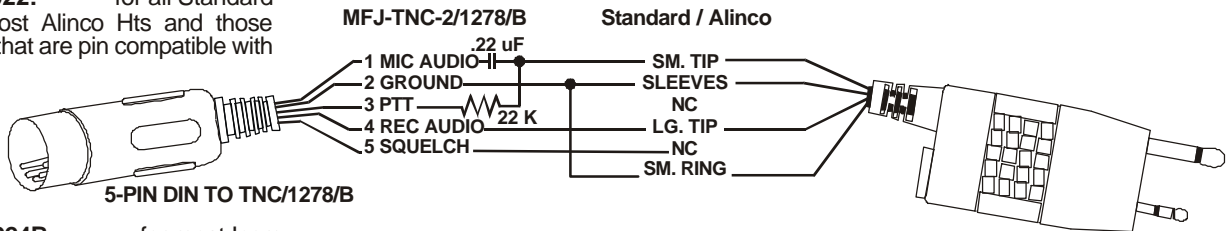
**268:** Pre-wired 8-pin radio module plug with cable.



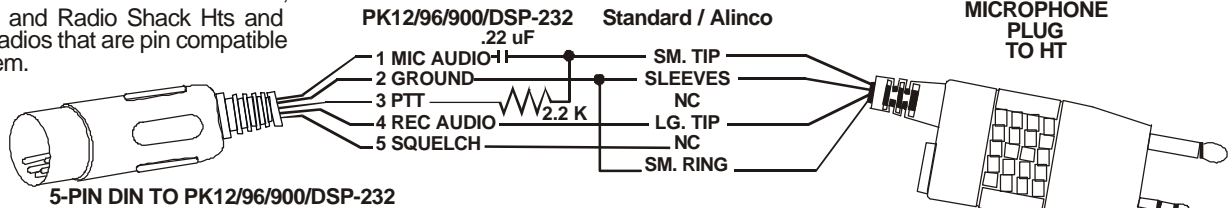
\* The cable you receive may be color coded as listed in A or B. Please verify before using.

## TNC to Transceiver Diagrams

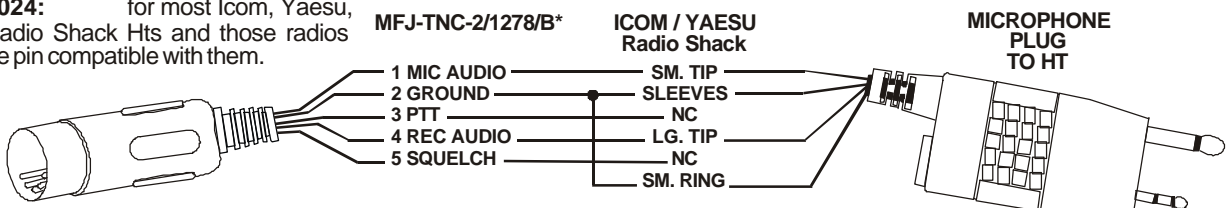
**022:** for all Standard and most Alinco Hts and those radios that are pin compatible with them.



**024B:** for most Icom, Yaesu, and Radio Shack Hts and those radios that are pin compatible with them.



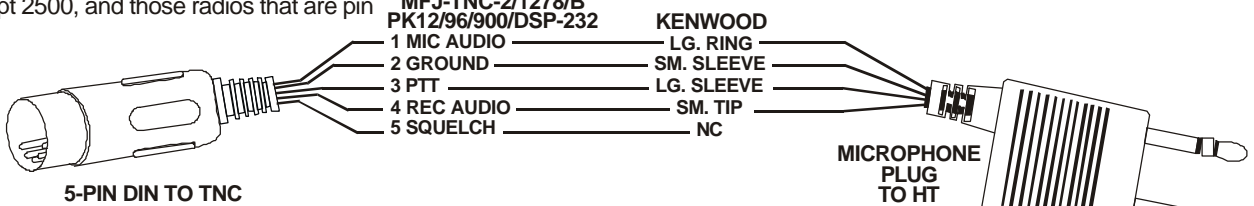
**024:** for most Icom, Yaesu, and Radio Shack Hts and those radios that are pin compatible with them.



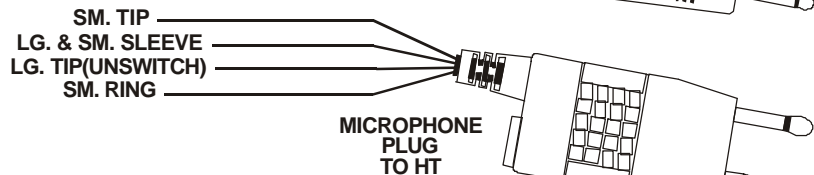
\* For MFJ-1278 Install JMP L for Radio Port 1 and JMP K for Radio Port 2

\* For MFJ TNC-2 Install JMP K

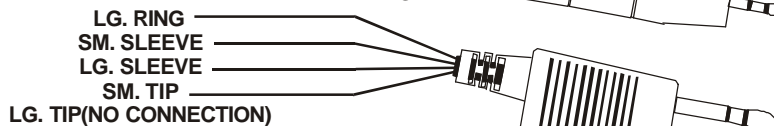
**026:** for most Kenwood Hts, except 2500, and those radios that are pin



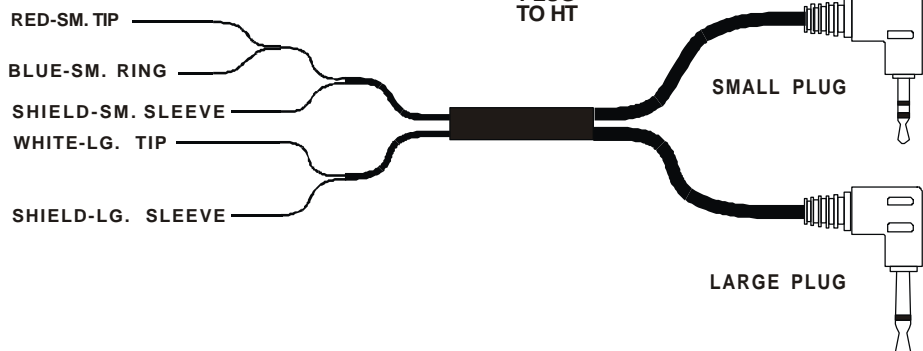
**224:** Open end Ht plug/cable for most Icom/Yaesu/Radio Shack/Alinco 560 Hts and those radios that are pin



**226:** Open end Ht plug/cable for most Kenwood Hts, except 2500, and those radios that are pin compatible with them.



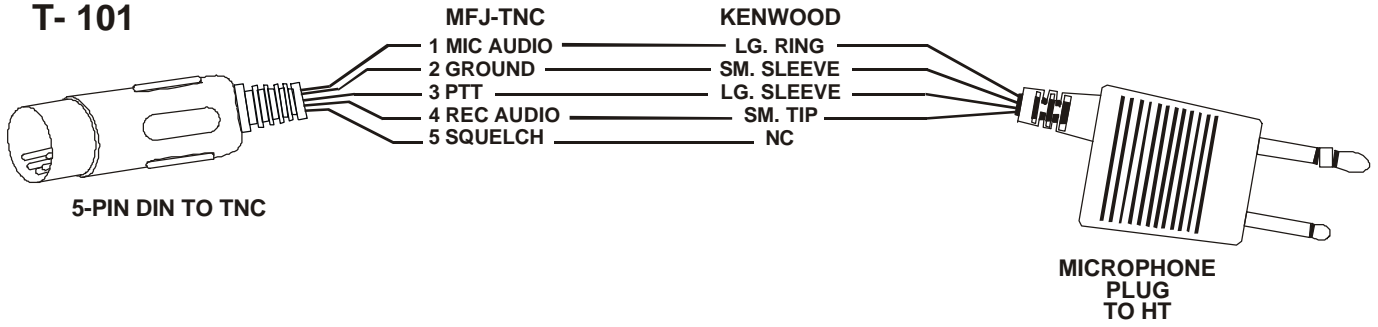
**222:** Open end Ht plug/cable for most Hts with split connectors, including Alinco DJ-160.



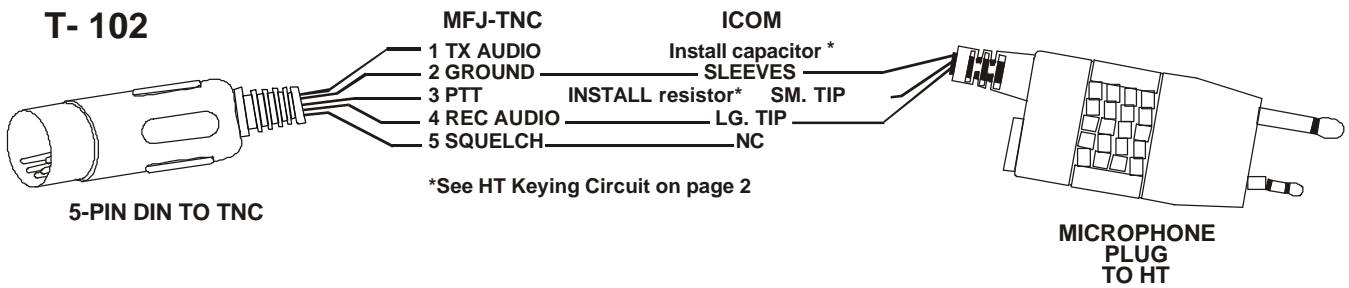


## TNC to Transceiver Diagrams

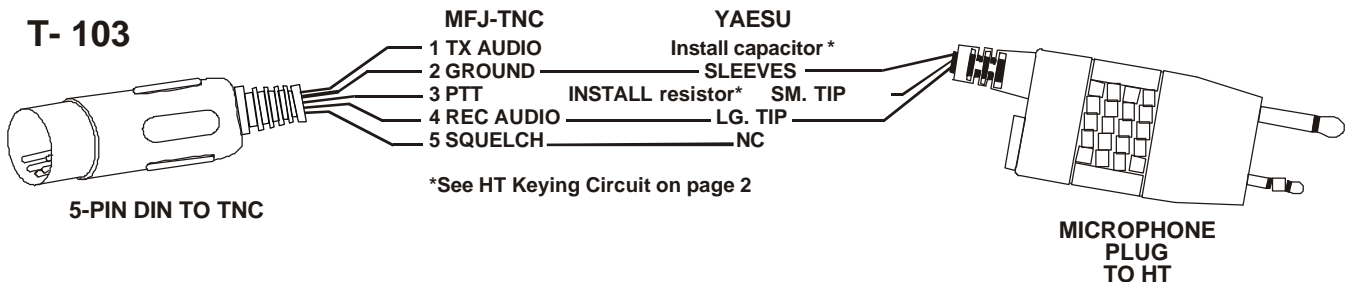
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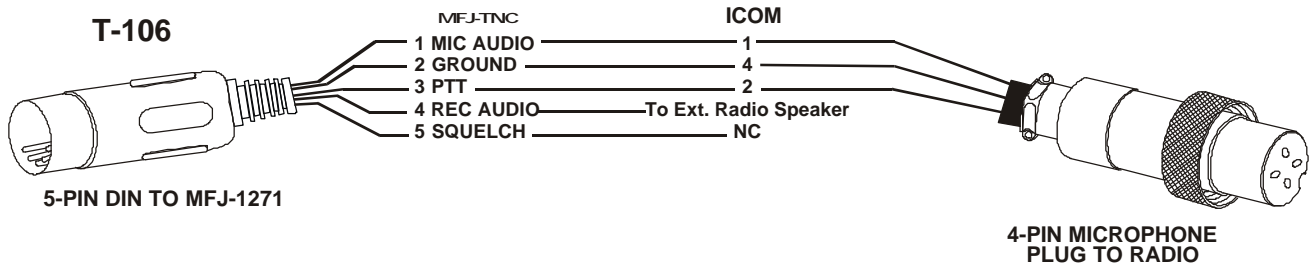
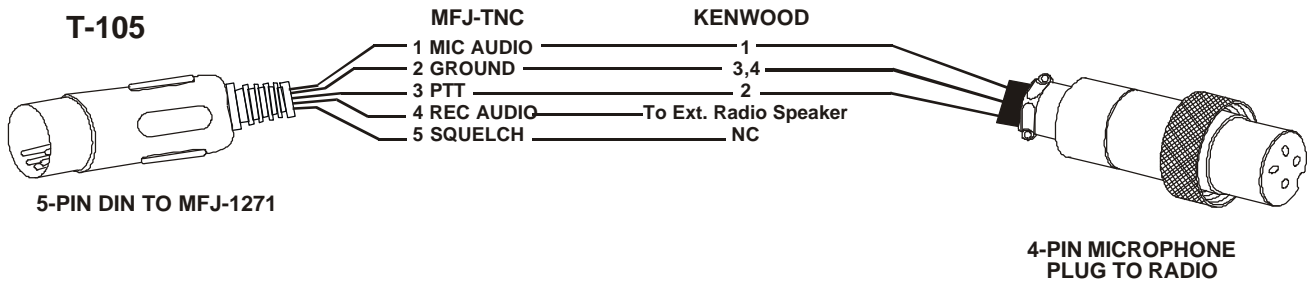
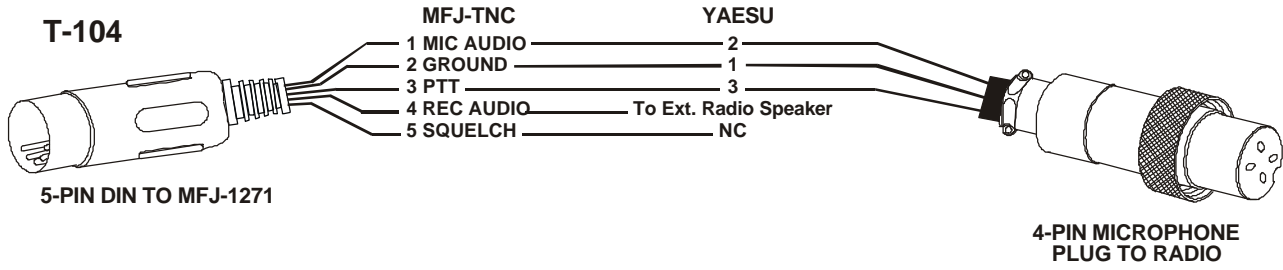
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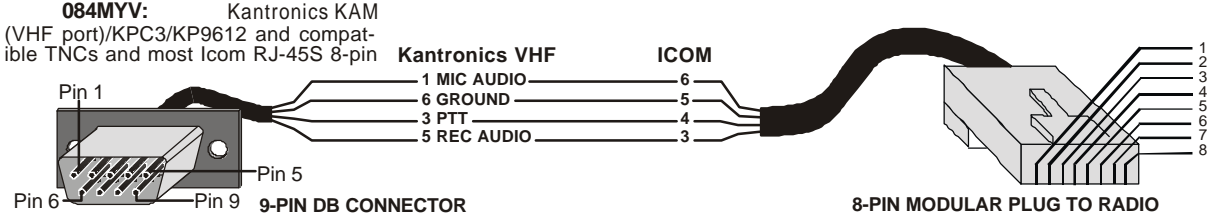
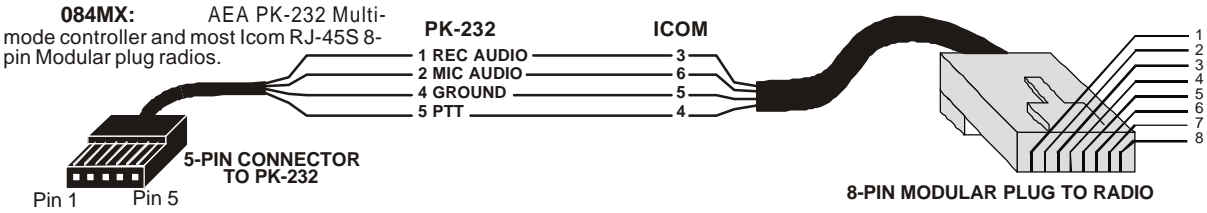
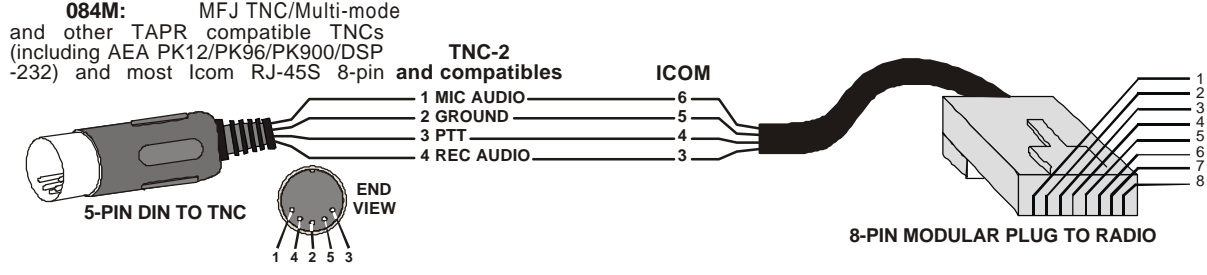
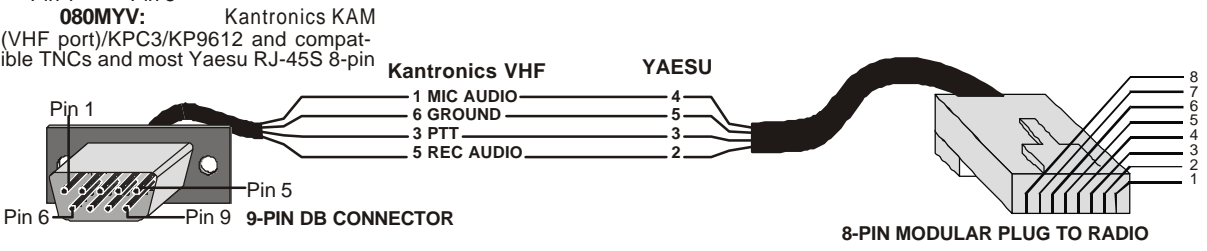
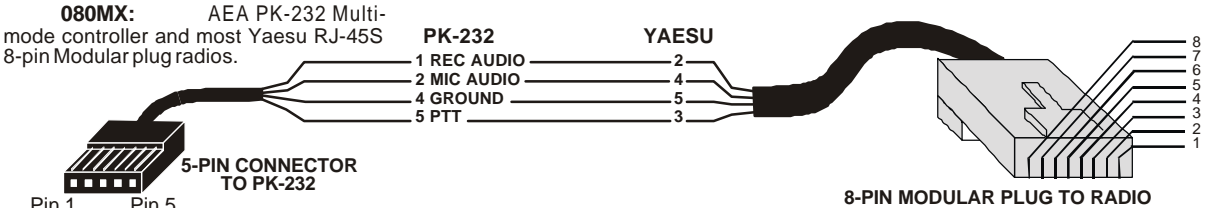
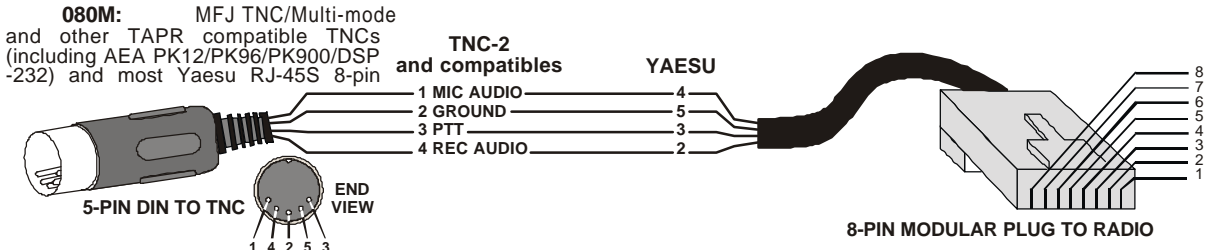
### T- 103



## TNC to Transceiver Diagrams



## TNC to Transceiver Diagrams




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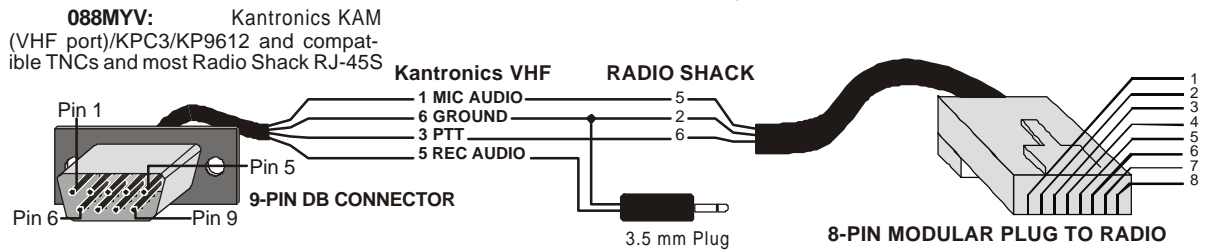
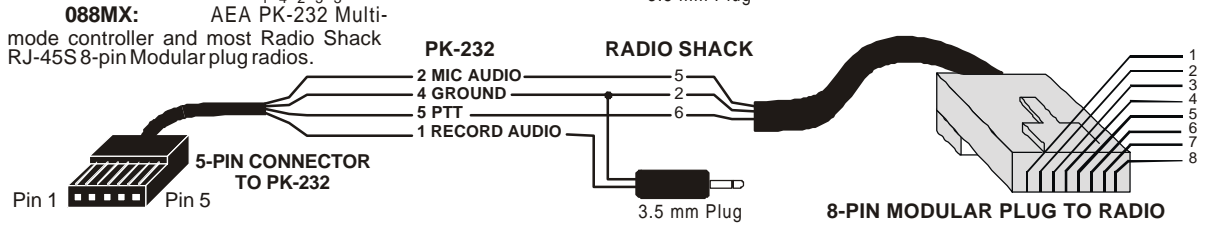
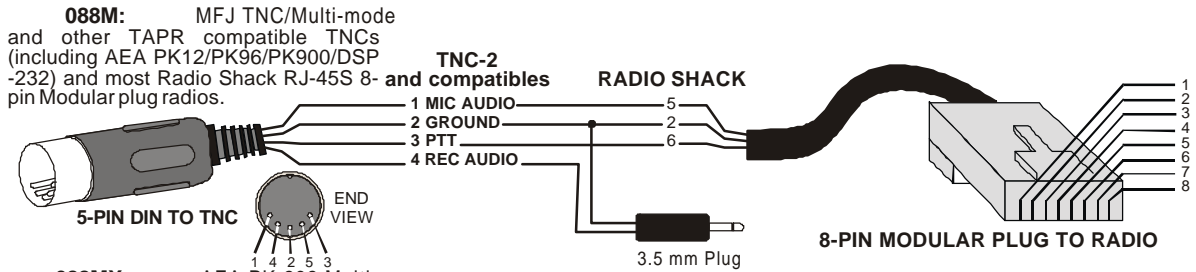
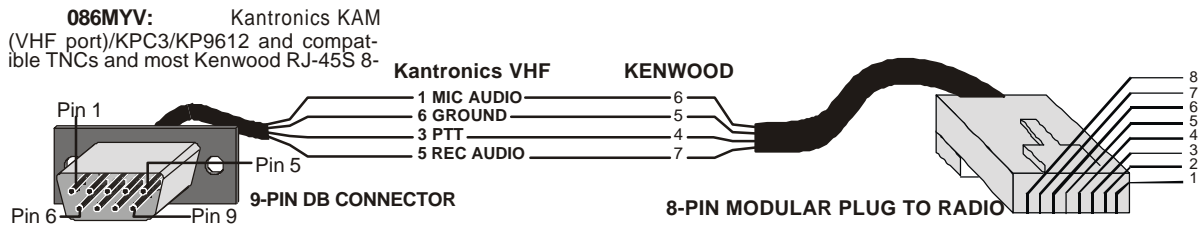
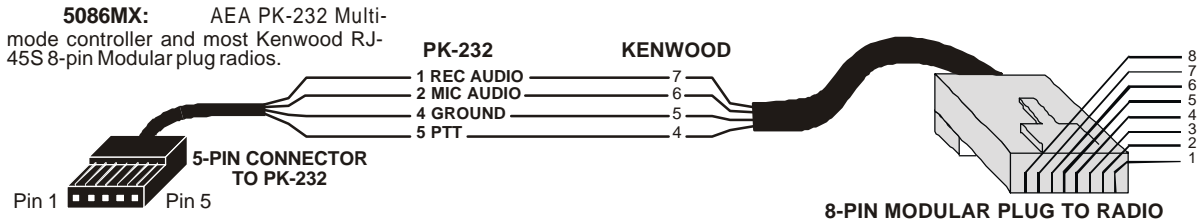
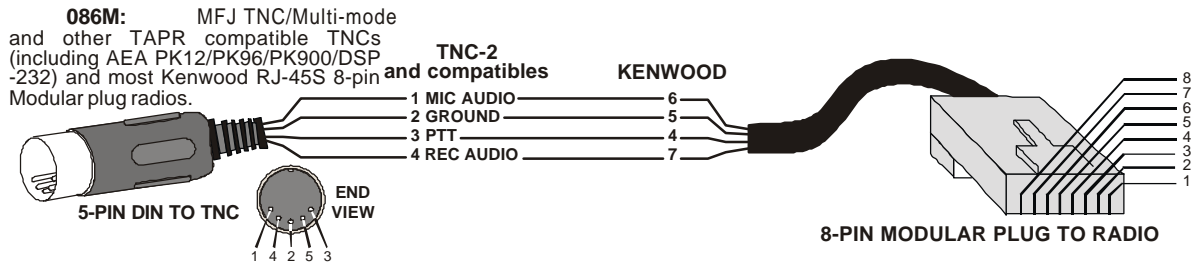
\* Kenwood cables are compatible with the following radios and those radios that are pin compatible with them :  
 TM-732A, TM-741A, TM-742, TM-641A, TM-942

\* ICOM cables are compatible with the following radios and those radios that are pin compatible with them :  
 IC-2340, IC-281H, IC-2000H NOTE: Not compatible with D-100H and IC-2700H

\* Yaesu cables are compatible with the following radios and those radios that are pin compatible with them :  
 FT-2400H, FT-2500M

## TNC to Transceiver Diagrams

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\* Kenwood cables are compatible with the following radios and those radios that are pin compatible with them :  
TM-732A, TM-741A, TM-742, TM-641A, TM-942

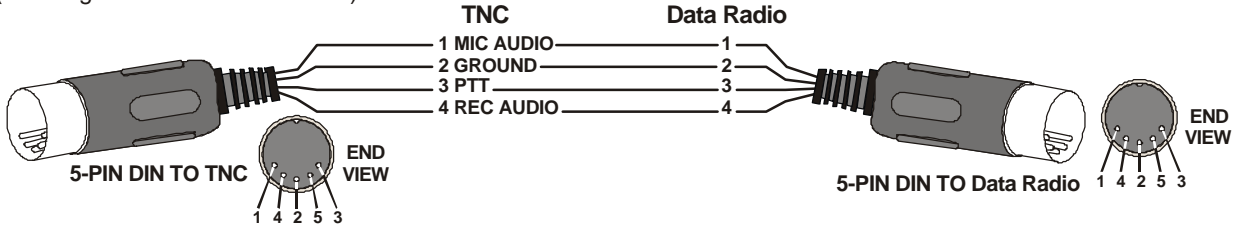
\* Icom cables are compatible with the following radios and those radios that are pin compatible with them :  
IC-2340, IC-281, IC-2000H      NOTE: Not compatible with D-100H and IC-2700H.

\* Yaesu cables are compatible with the following radios and those radios that are pin compatible with them :  
FT-2400H, FT-2500M

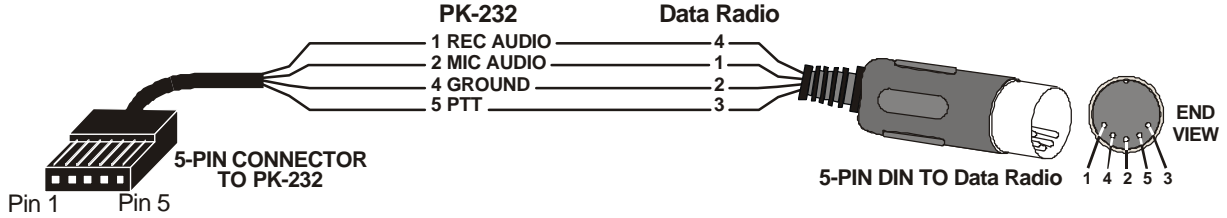
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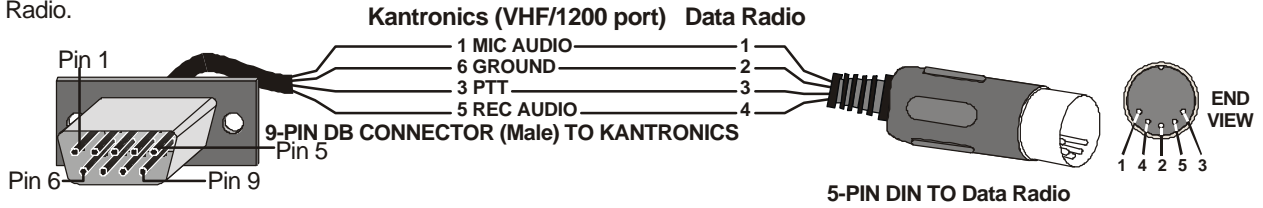
**100:** MFJ TNC/Multi-mode and other TAPR compatible TNCs (including AEA PK12/PK96/PK900) and



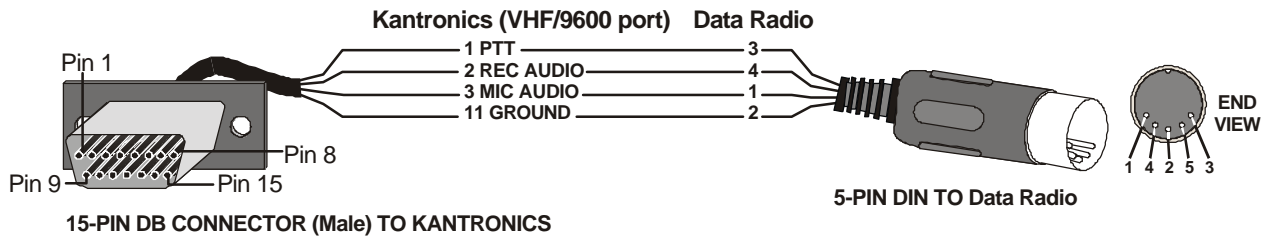
**100X:** AEA PK-232 Multi-



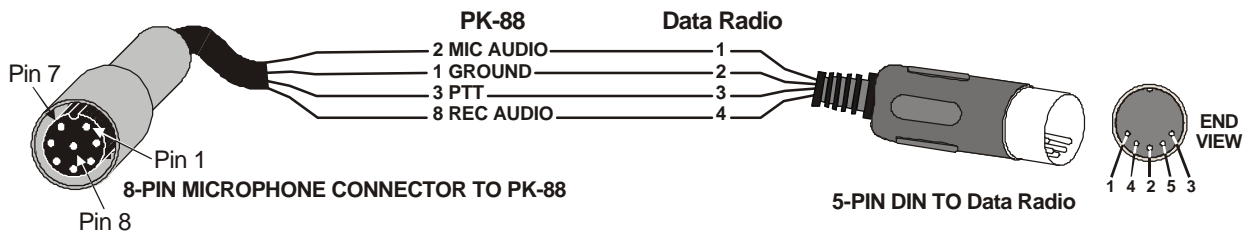
**100YV:** Kantronics KAM (VHF/1200 port)/KPC3/KP9612 and compatible TNCs and MFJ Data Radio.



**100YH:** Kantronics KAM (HF/9600 port)/KP9612 and compatible TNCs and MFJ Data Radio.



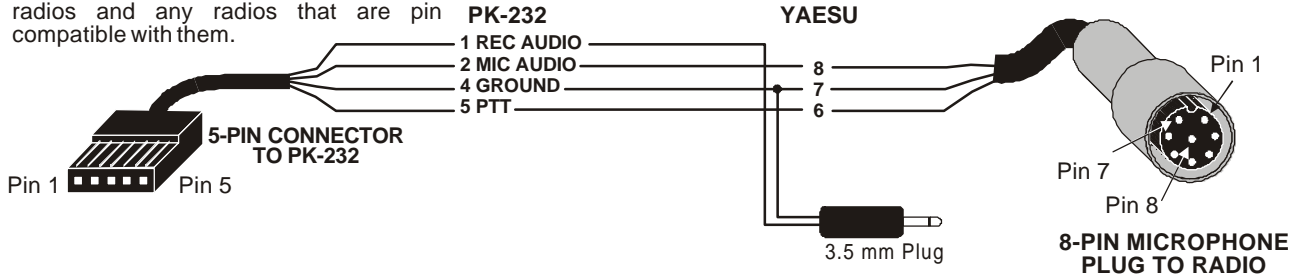
**100Z:** AEA PK-88 TNC and MFJ-Data Radio.



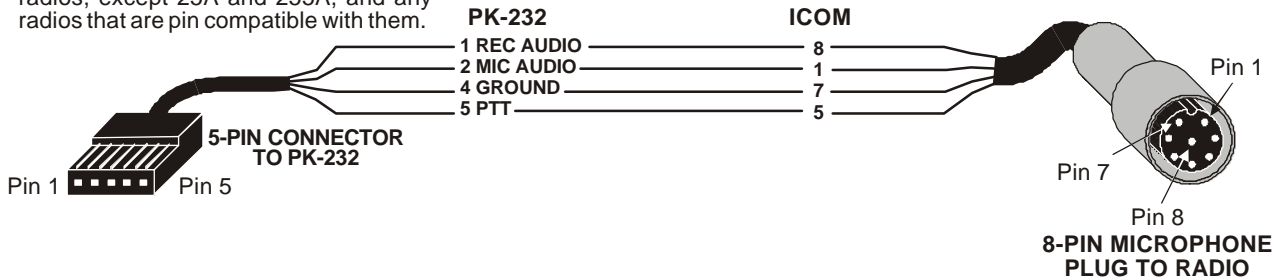
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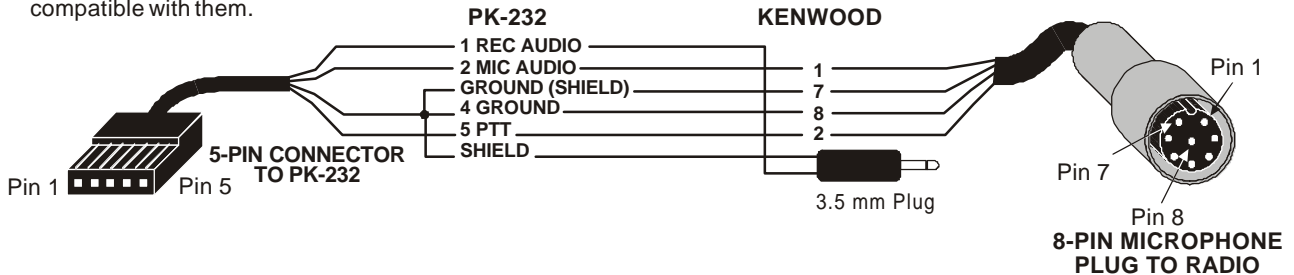
**080X:** for most Yaesu 8-pin radios and any radios that are pin compatible with them.



**084X:** for most Icom 8-pin radios, except 25A and 255A, and any radios that are pin compatible with them.



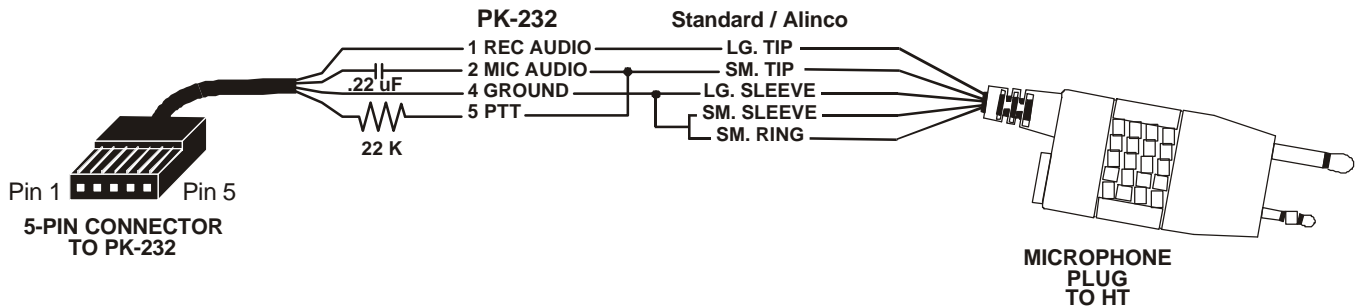
**086X:** for most Kenwood/Alinco 8-pin radios and any radios that are pin compatible with them.



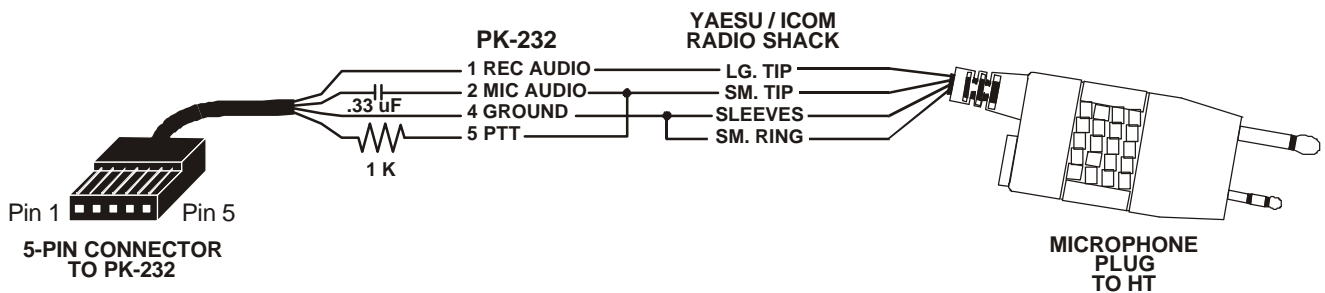
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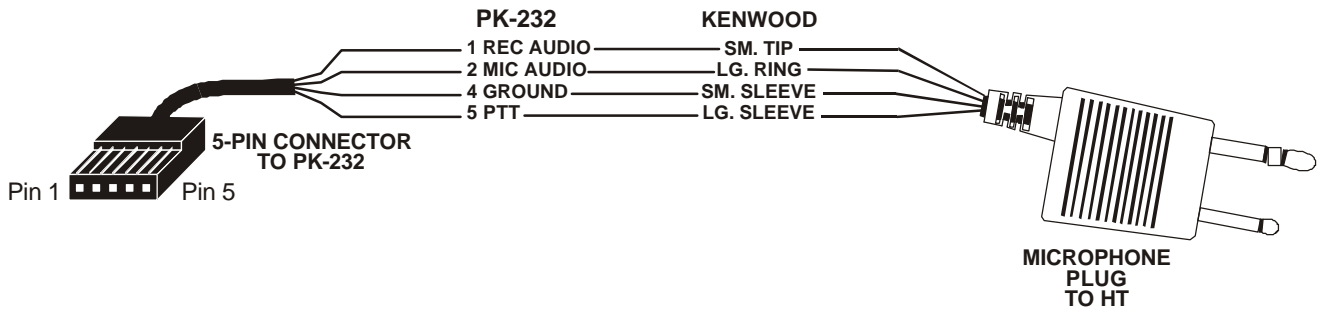
**022X:** for all Standard and most Alinco Hts and those radios that are pin compatible with them.



**024X:** for most Icom, Yaesu, and Radio Shack Hts and those radios that are pin compatible with them.



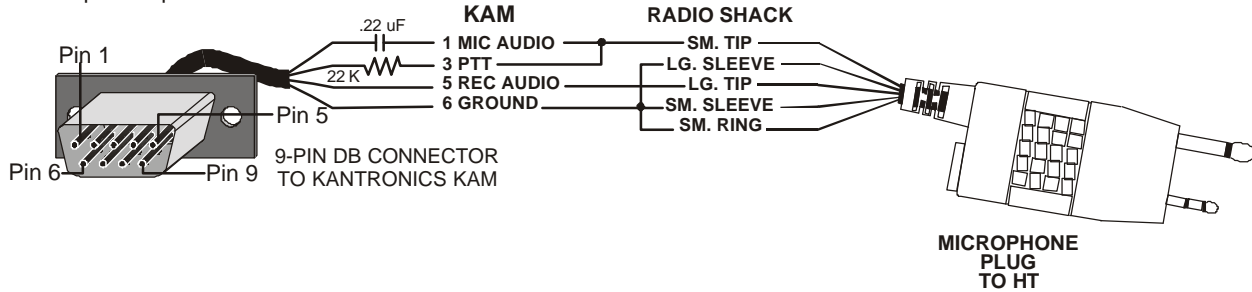
**026X:** for most Kenwood Hts, except 2500, and those radios that are pin compatible with them.



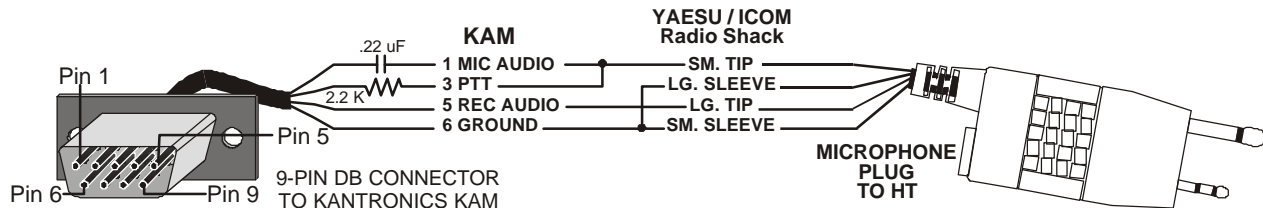
## TNC to Transceiver Diagrams

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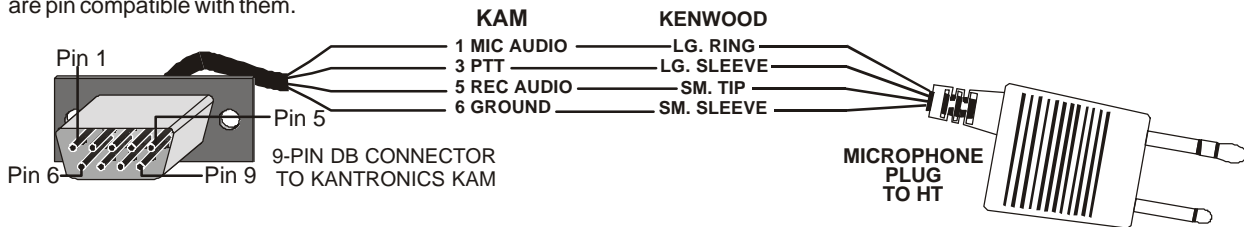
**028YV:** for KAM VHF port to all Standard and most Alinco Hts, and any radios that are pin compatible with them.



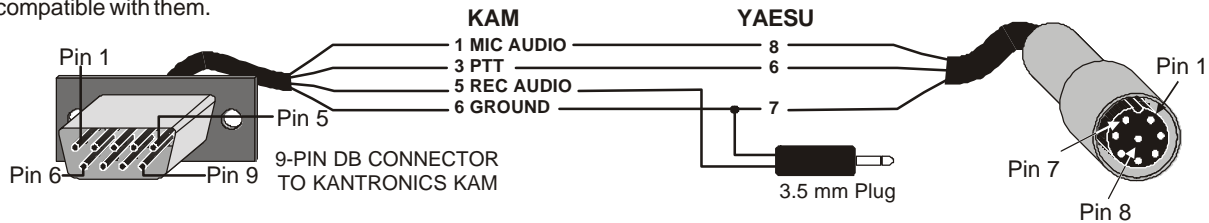
**024YV:** for KAM VHF port to most Icom, Yaesu, or Radio Shack Hts and any radios that are pin compatible with them.



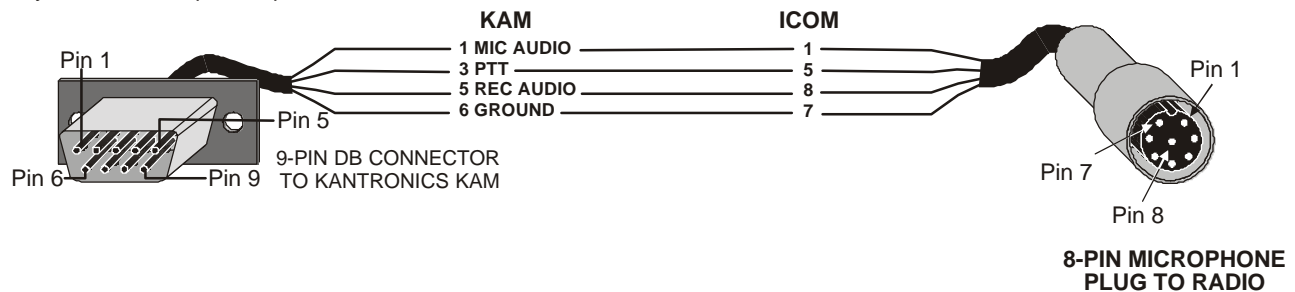
**026YV:** for KAM VHF port to most Kenwood Hts, except 2500, and any radios that are pin compatible with them.



**080YV:** for KAM VHF port to most Yaesu 8-pin radios, and any radios that are pin compatible with them.



**084YV:** for KAM VHF port to most Icom 8-pin radios (except 25A and 255A), and any radios that are pin compatible with them.

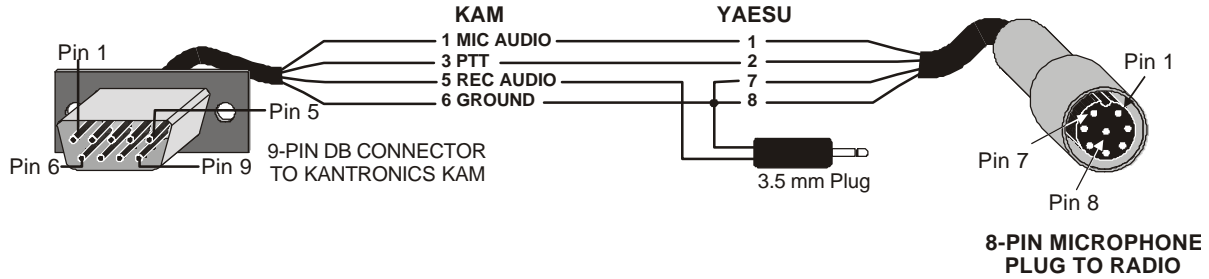




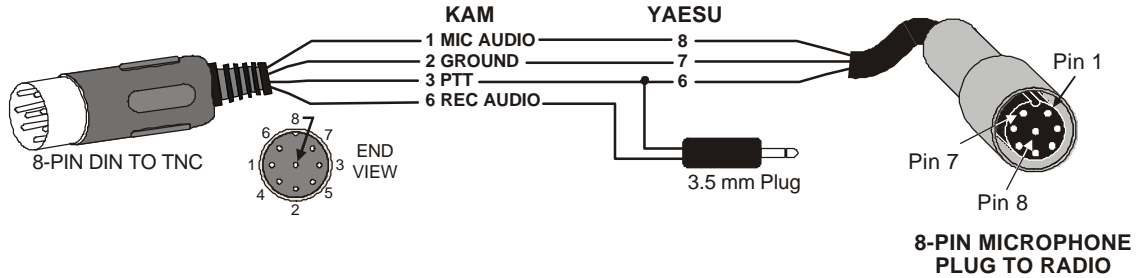
## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

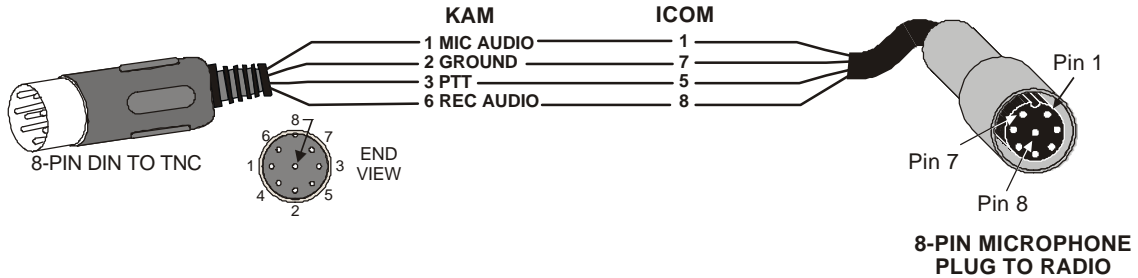
**086YV:** for KAM VHF port to most Kenwood / Alinco 8-pin radios, and those radios that are pin compatible with them.



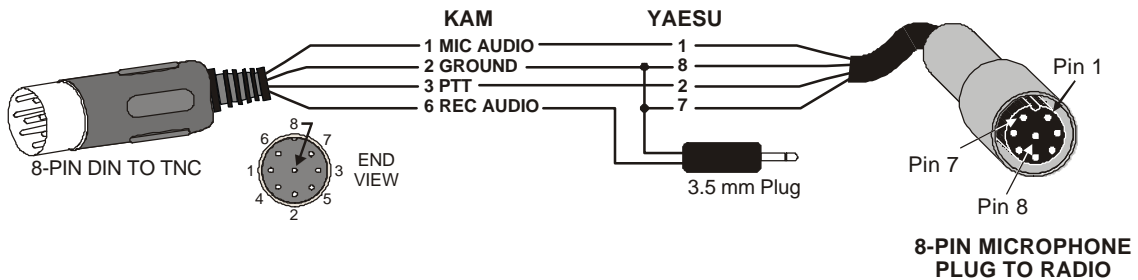
**080YH:** for KAM HF port to most Yaesu 8-pin radios, and those radios that are pin compatible with them.



**084YH:** for KAM HF port to most Icom 8-pin radios, except 25A and 255A, and those radios that are pin compatible with them.



**086YH:** for KAM HF port to most Kenwood / Alinco 8-pin radios, and any radios that are pin compatible with them.



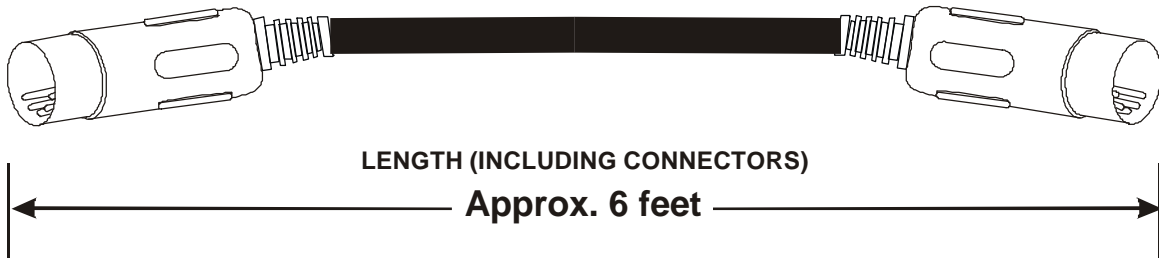
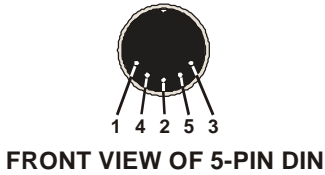
## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

### 025B THIS CABLE NORMALLY USED FOR MFJ TNC TO MFJ DataRadio Description: Shielded 5-pin Din male-to-male cable

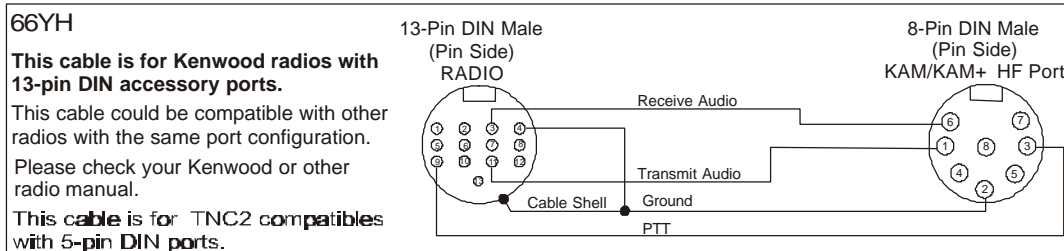
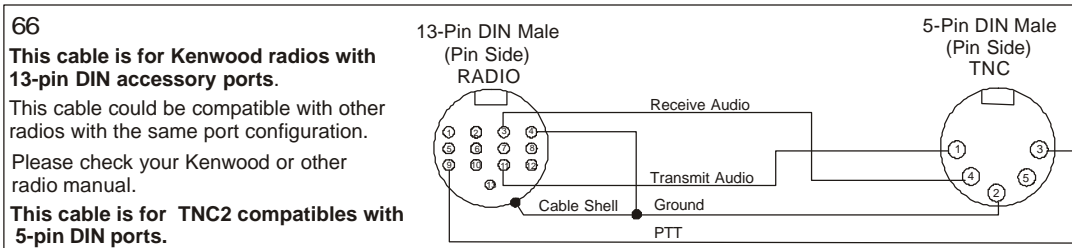
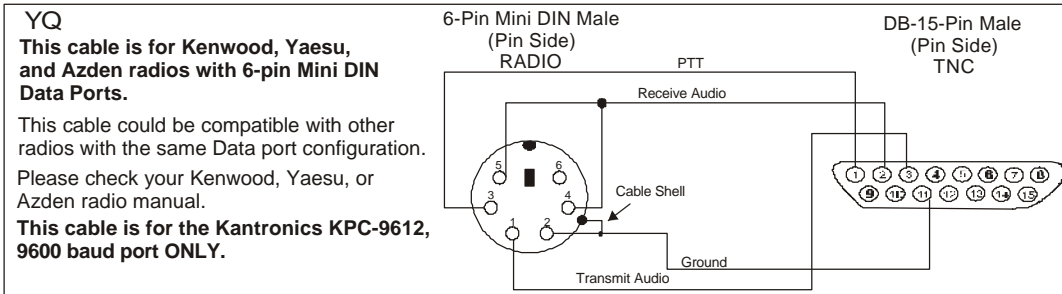
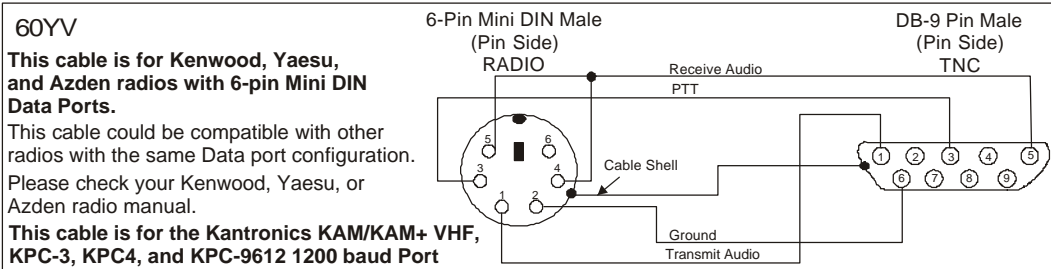
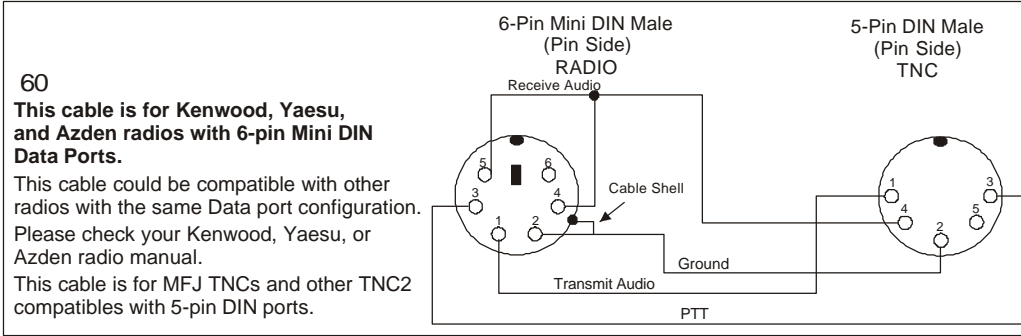
#### Cable connections as follows:

5-Pin Din Male	to 5-Pin Din Male	Wire Color
Pin 1	— Pin 1	Black
Pin 2	— Pin 2	Green
Pin 3	— Pin 3	Red
Pin 4	— Pin 4	Yellow
Pin 5	— Pin 5	White
Shell	— Shell	Shield



**Note: Cable must have shield wires connected to the shell of both connectors.**

## TNC to Transceiver Diagrams



## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

**106**

**Pre-Wired Open ended 6-Pin Mini DIN cable**

Always check continuity between wire colors and cable pins using an ohmmeter.

- Pin 1: Orange
- Pin 2: Yellow
- Pin 3: Red
- Pin 4: Green
- Pin 5: Brown
- Pin 6: Black
- Shell: Bare

6-Pin Mini DIN Male  
( Pin Side )

**205**

**Pre-Wired open ended 5-pin DIN cable**

Always check continuity between wire colors and cable pins with an ohmmeter.

- Pin 1: Black
- Pin 2: Bare
- Pin 3: White
- Pin 4: Yellow
- Pin 5: Red
- Shell: Green

5-Pin DIN Male  
( Pin Side )

**208**

**Pre-Wired open ended 8-pin DIN cable**

Always check continuity between wire colors and cable pins with an ohmmeter.

- Pin 1: Yellow
- Pin 2: Red
- Pin 3: Black
- Pin 4: Green
- Pin 5: Blue
- Pin 6: Bare
- Pin 7: White
- Pin 8: Brown

8-Pin DIN Male  
( Pin Side )

**213**

**Pre-Wired open ended 13-pin DIN cable**

Always check continuity between wire colors and cable pins with an ohmmeter.

- Pin 1: Lt. Green
- Pin 2: Lt. Blue
- Pin 3: Pink
- Pin 4: Black
- Pin 5: White
- Pin 6: Gray
- Pin 7: Violet
- Pin 8: Blue
- Pin 9: Green
- Pin 10: Yellow
- Pin 11: Orange
- Pin 12: Red
- Pin 13: Brown
- Shell: Shield

13-Pin DIN Male  
( Pin Side )

**020**

This cable is for **Yaesu hand-held radios** with the single pin microphone connector similar to the FT-50R and FT-50RD. This cable could be compatible with other radios with the same port configuration. Please check your Yaesu or other radio manual. This cable is for **MFJ TNCs and other TNC2 compatibles with 5-pin DIN ports.**

5-Pin DIN Male  
( Pin Side )

**020**

This cable is for **Yaesu hand-held radios with the single pin microphone connector** similar to the FT-50R and FT-50RD. This cable could be compatible with other radios with the same port configuration. Please check your Yaesu or other radio manual. This cable is for the **Kantronics KAM/KAM+ VHF, KPC-3, KPC4, and KPC-9612 1200 baud Port**

DB-9 Pin Male  
( Pin Side )

**220**

**Pre-wired open ended single pin mic cable**

Always check continuity between wire colors and cable pins with an ohmmeter.

- Tip: Blue
- Ring1: Green
- Ring2: Red
- Sleeve: Shield

Sleeve

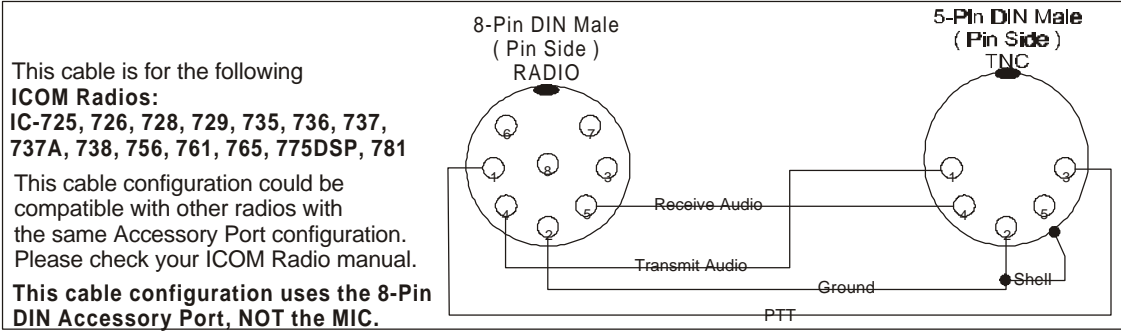
TIP

RING2

RING1

## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

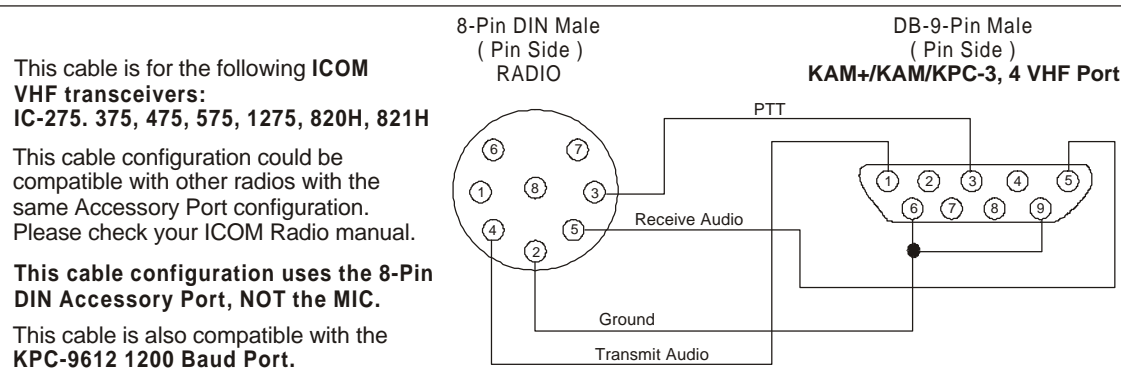
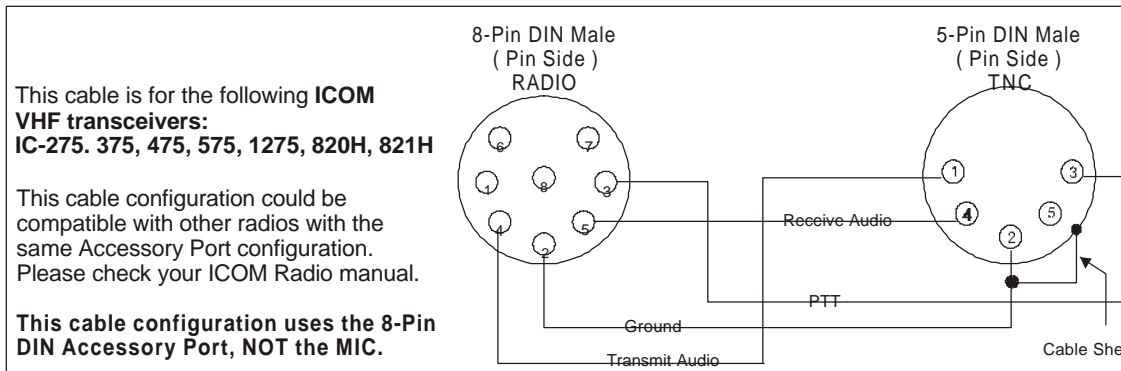


### 5063YH

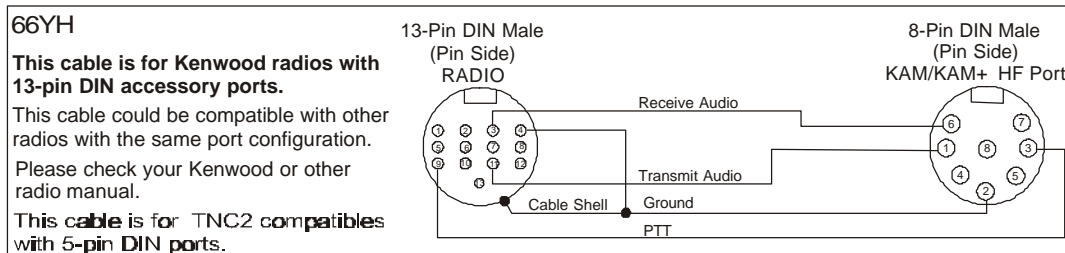
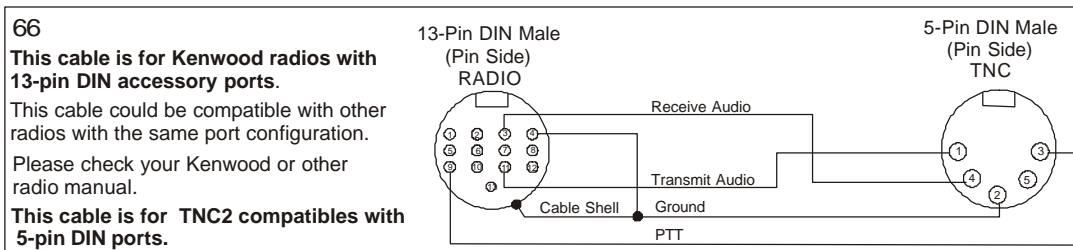
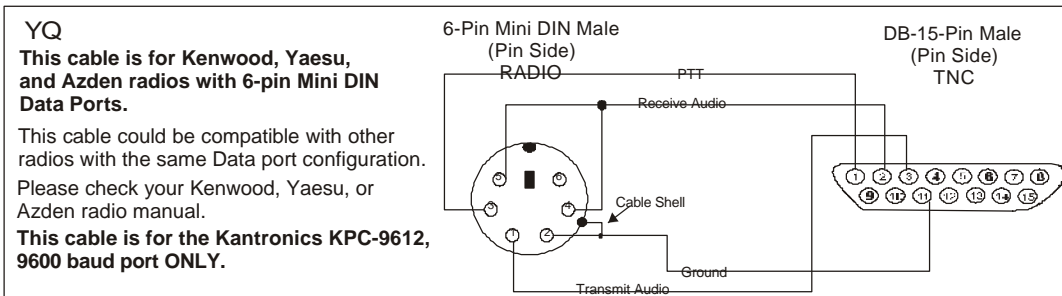
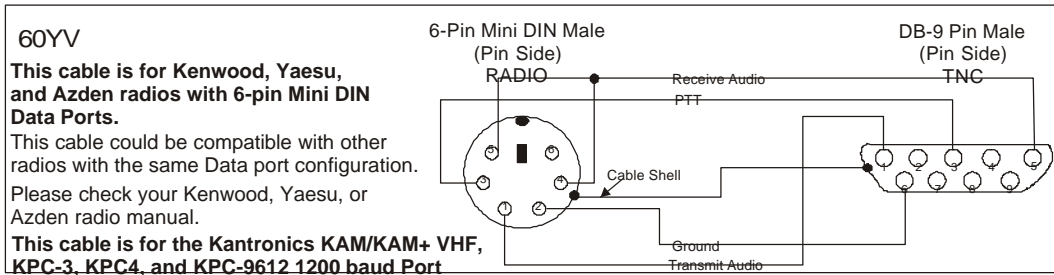
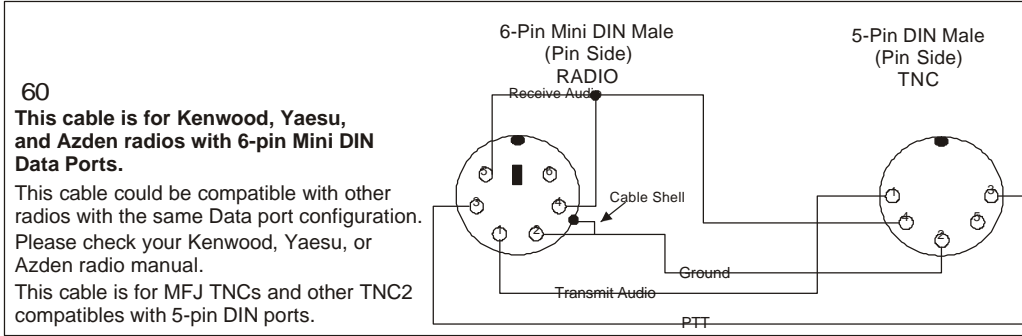
This cable is for the following **ICOM Radios:**  
**IC-725, 726, 728, 729, 735, 736, 737, 737A, 738, 756, 761, 765, 775DSP, 781**

This cable configuration could be compatible with other radios with the same Accessory Port configuration. Please check your ICOM Radio manual.

**This cable configuration uses the 8-Pin DIN Accessory Port, NOT the MIC.**

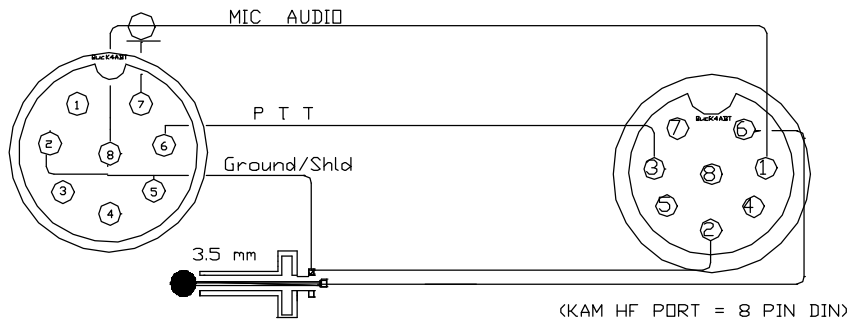


## TNC to Transceiver Diagrams



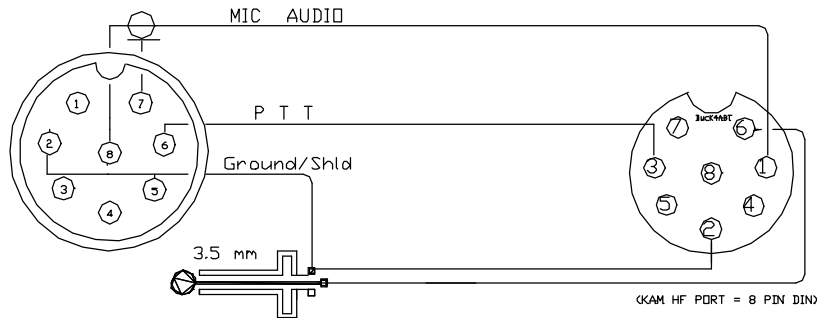
## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)



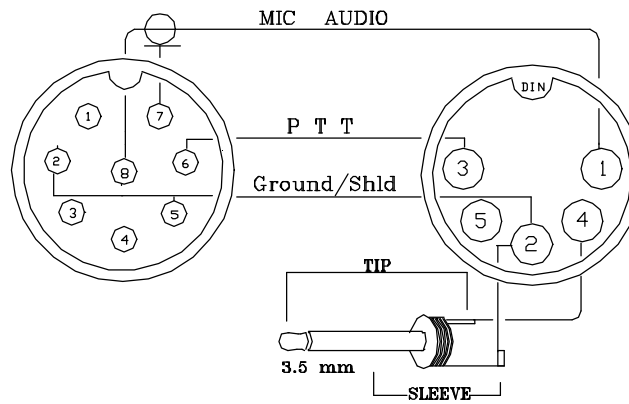
YAESU FT-747 TO KANTRONICS KAM HF PORT.

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YAESU FT-757 GTX-II TO KANTRONICS KAM HF PORT

T - 108

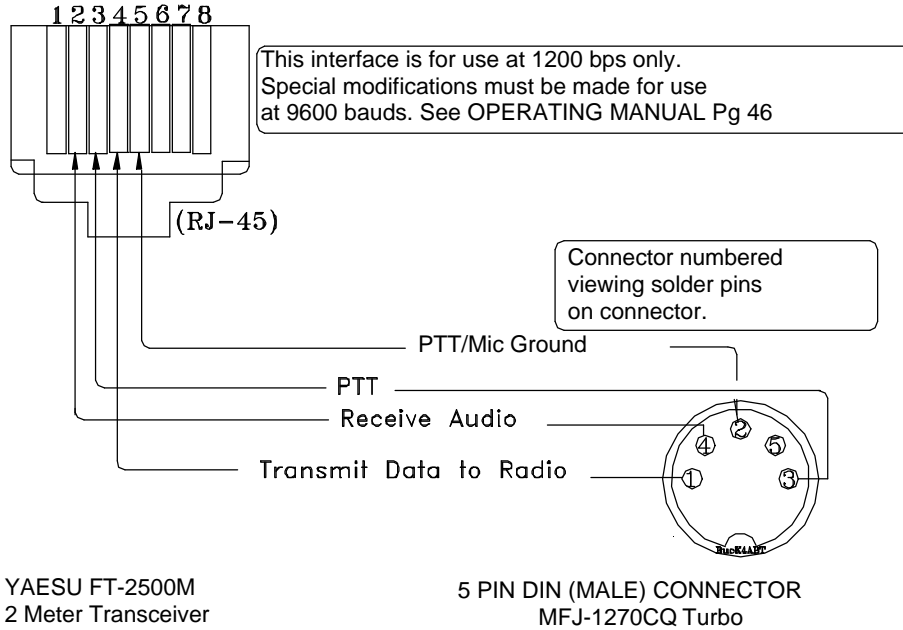


YAESU FT-757 GXII

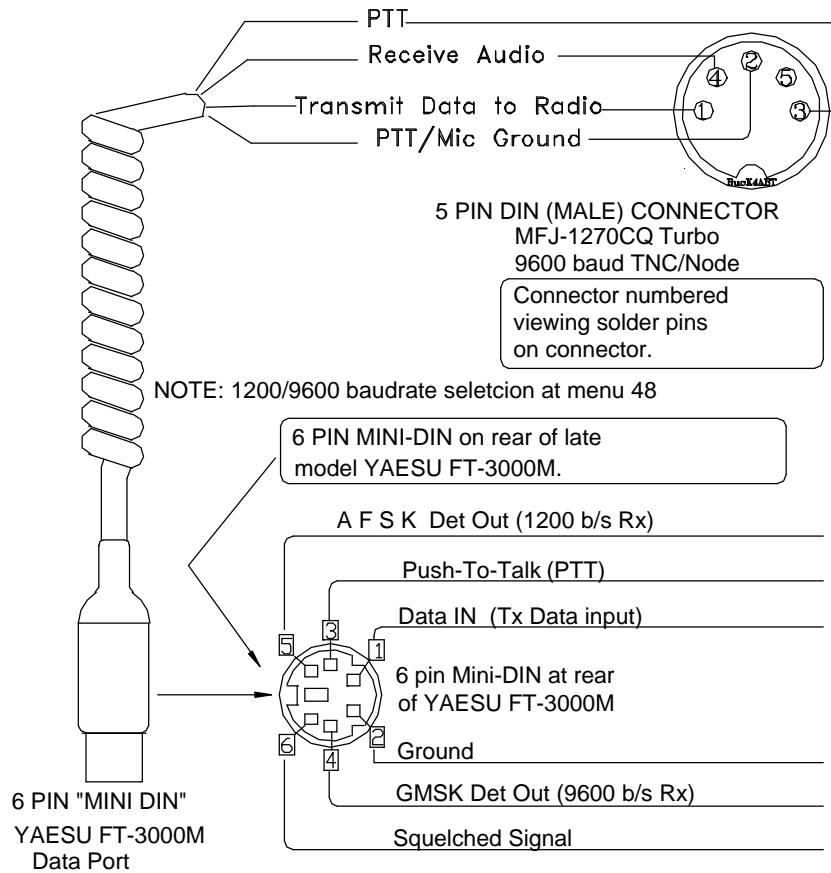
TAPR TNC2

T - 109

## TNC to Transceiver Diagrams



T - 110

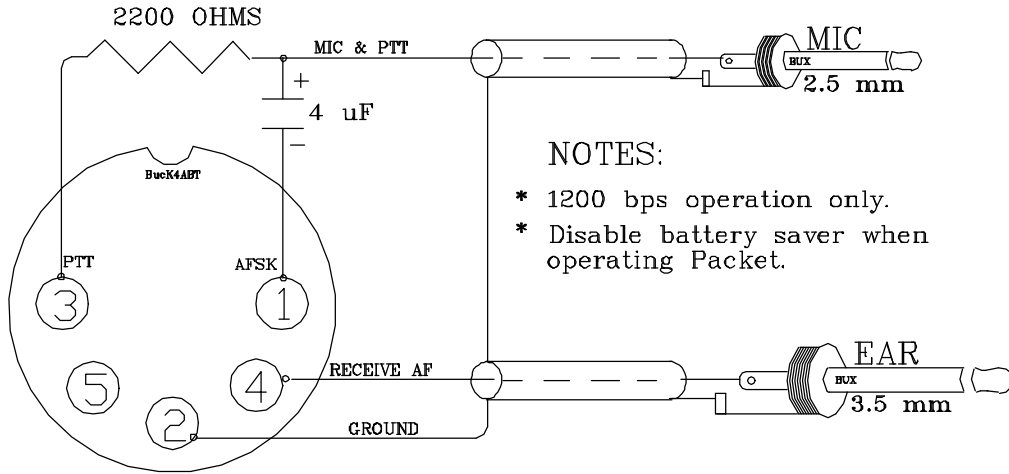


T - 111



## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

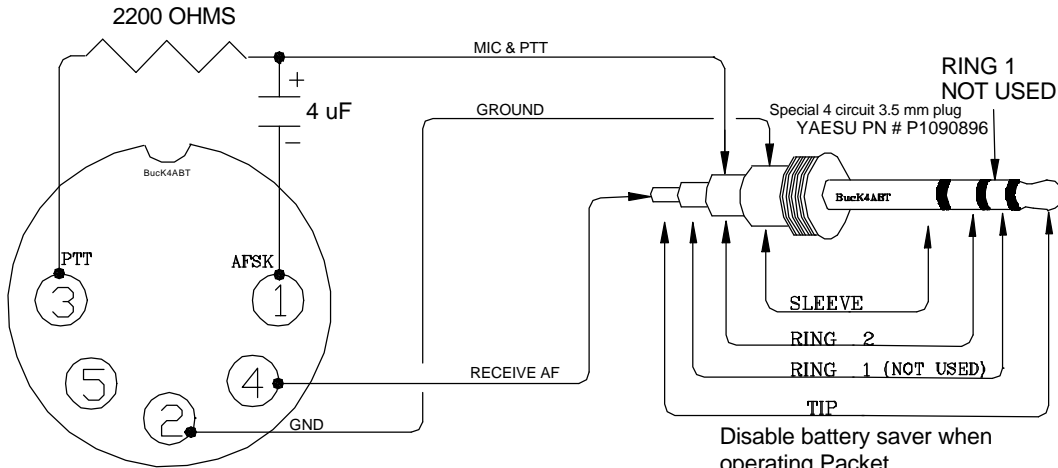


**NOTES:**  
 \* 1200 bps operation only.  
 \* Disable battery saver when operating Packet.

TNC standard 5 pin DIN  
 MFJ-1270/PK-96/PacComm etc...

**YAESU FT-51R**  
 Hand-Held  
 Dual-Band Transceiver

### T - 112



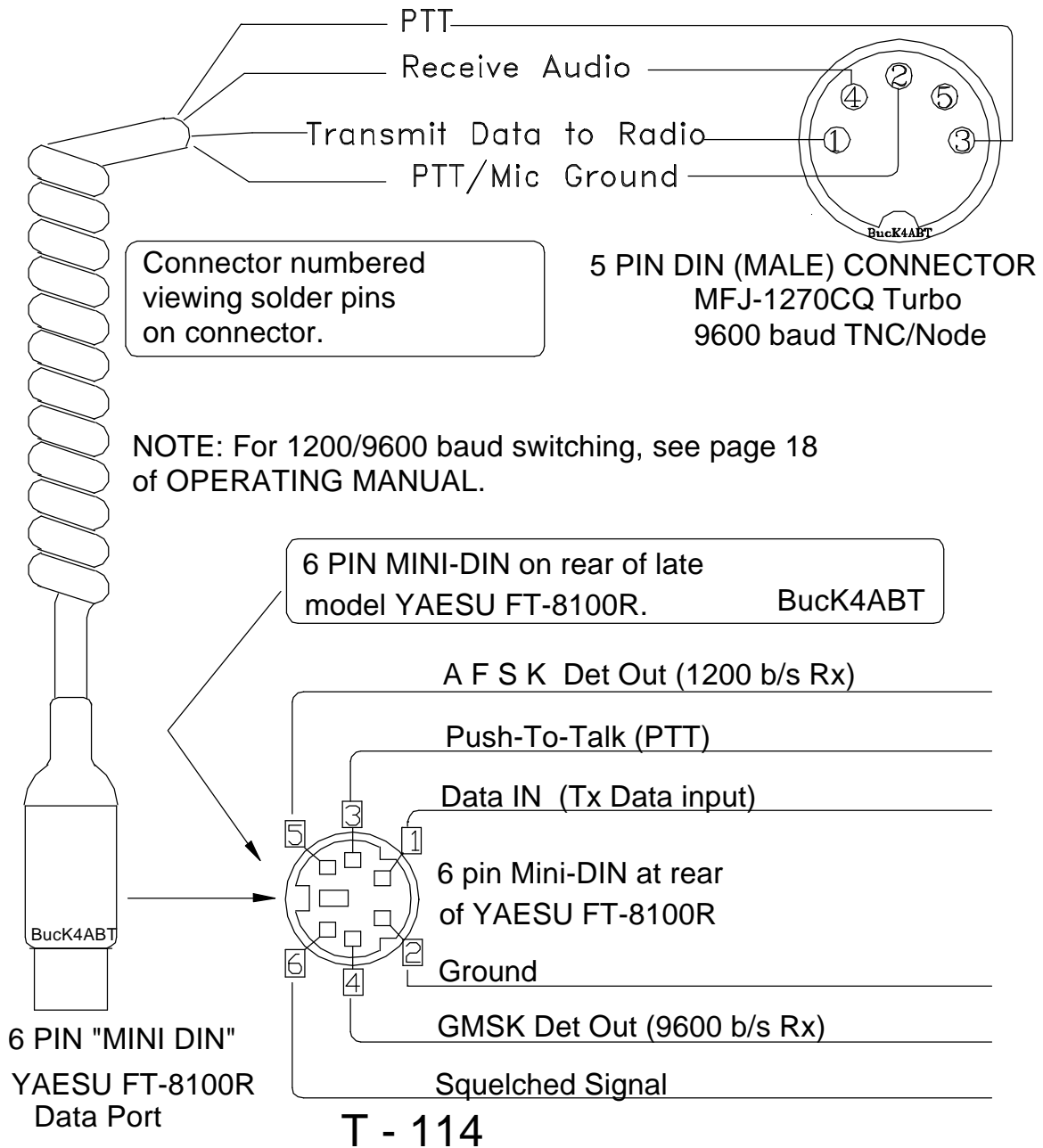
Disable battery saver when operating Packet.  
**YAESU FT-10R (VHF)**  
**and FT-40R (UHF)**  
 Hand-Held Transceivers

TNC standard 5 pin DIN  
 MFJ-1270/PK-96/PacComm etc...

### T - 113

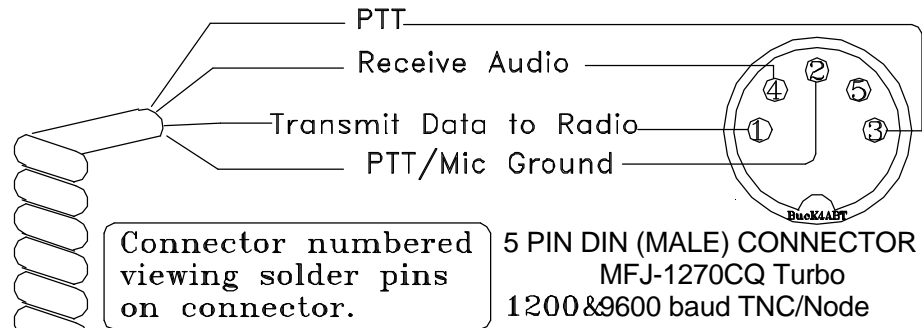
## TNC to Transceiver Diagrams

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

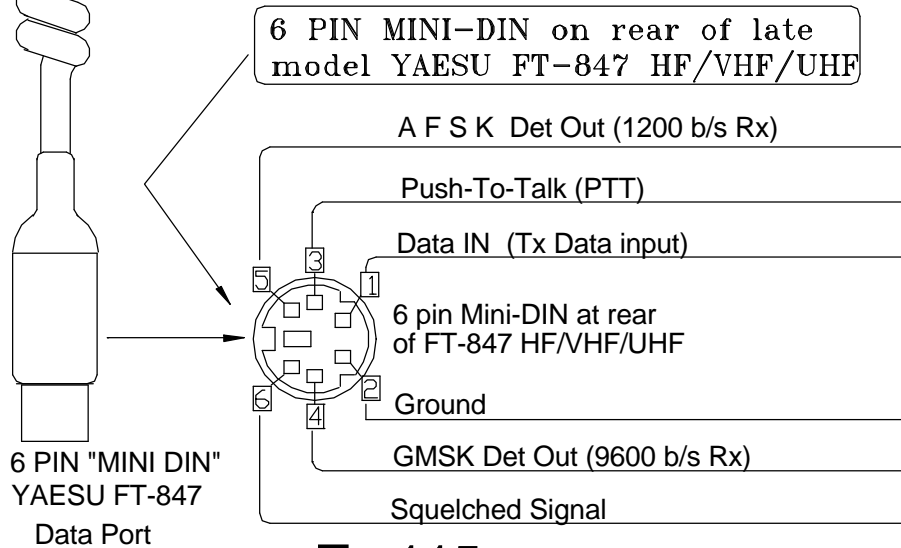


## TNC to Transceiver Diagrams

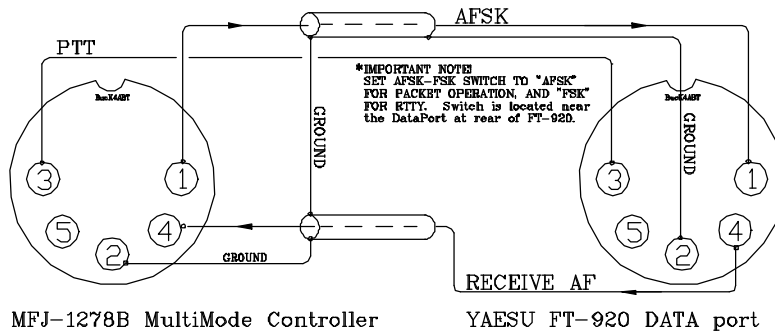
All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)



NOTE: 1200/9600 baud switching instructions are on page 17 of FT-847 operating manual.



T - 115

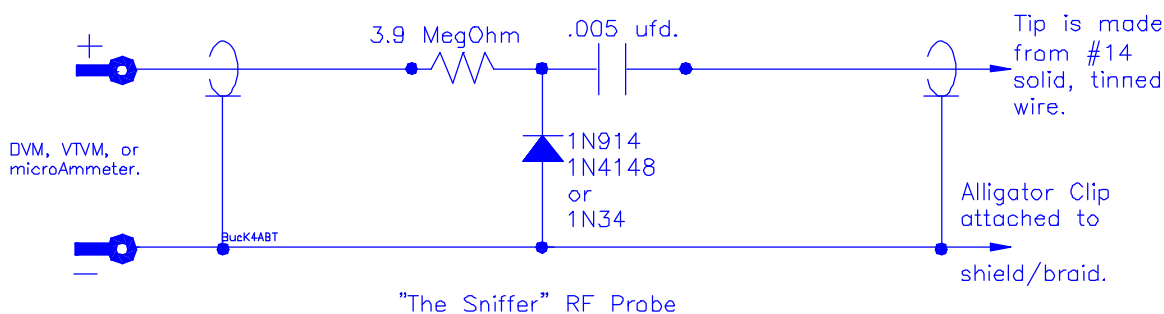


T - 116

## An RF Probe for the Technician and the System Node Operator

### The "SNIFFER"

Often referred to as an RF probe, the "sniffer" is a simple RF demodulator or diode detector built into a small cylinder (the one I use resembles the metal casing of a pocket flashlight I saw at a nearby, "dollar-store), or metal tube. In the drawing below, I've illustrated the component values and the simplicity of its construction.



This valuable tool can be built in less time than it takes to think about it, and as you will soon discover, it will become one of your most valued service tools. The "sniffer" is plugged into your digital volt-meter or if you are so lucky; into an old fashioned vacuum tube volt meter (VTVM).

Now the next time you begin tuning a radio that you've just installed new rocks into, or moved the frequency across most of the visible light spectrum, you can find those missing watts. Whoops... better make that the missing "milliwatts." For in the beginning, when you begin looking for the power that is NOT there, you'll need to begin looking around the first stages of RF. This is where the RF probe comes into play.

Actually the first place you want to look for any sign of RF is at the output of the crystal oscillator. Once you have power there, move to the next stage, whether it is a buffer stage or a stage in the FM multiplier chain. It won't take long to find that you have the perfect tool to begin the tune-up of both the transmitter and receiver crystal oscillator stages. Tune for optimum power out of each stage and then move to the next stage.

Moving always away from the crystal oscillator stage towards the PA section. It won't be long before you see RF power showing up on your watt meter. You know, the watt meter that you have connected to the coax connector at the radio output. Oh, you know, the one that connects the radio into the "DUMMY" load.

The sniffer will also prevent lots of cracked ferrite bobbins and coil slugs by helping you find RF before you've cracked every bead in the exciter.

The RF probe I use is one that my son Glynn WB4RHO built about 20 years ago. It uses the old 1N34 diode, however the sniffer can be built with just about any of the 1N914's or 1N4148's from your local Radio Shack or Tech America store. If you are fortunate enough to get your hands on the old 1N34, it seems to be more sensitive to RF detection than the "fast-switching" diodes like the 1N4148's.

The lead from the meter into the RF sniffer is a piece of small coaxial cable. I think Glynn used a piece of small phono shielded cable at both the goes-inntance and the comes-outtance of the probe. The comes-outtance part of the shield is ONLY the shield. The tip is made from a one inch piece of number 14 tinned (solid) wire. The shield is bonded to the inside of the metal case of the sniffer. I have a short (3 inch) piece of the flexible shield extending from the probe (tip) end of the sniffer. Attached to the shield is a small alligator clip for easy attaching to a ground near the area where I'm tuning.

If you happen to have a D'arsonval (meter with the pointer/needle) try the sniffer with it. If you have only the digital volt meter, then you are on your own, as here you will have to interpolate the readings high and peak to meter low or signal digress.

I picked up a Radio Shack meter, an AutoRange VOM model 22-216 for under 50 dollars. Not only is this meter useful as a all purpose bench VOM, it also works very well with my sniffer.

# The System Node Operator's Networking Handbook

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TM

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*Buck Rogers* K4ABT Digital Editor **CQ Magazine**



This publication is a composite of the documentation required to build, configure and operate the X1J4 nodeware. Visit the PacketRadio Network pages at:  
<http://www.packetradio.com>

In this manual we will cover several topics about Packet Radio networking and the X1 nodeware. These topics will cover both the technical and the operating levels of of the X1 node implementation and configuration. Therefore this journal will be of interest to both the Packet user, and system node operator (SNO). The X1's extended support for all areas of Packet Radio from the Local Area Networks, Wide Area Networks, Backbones, Trunks, Emergency Networks, up to and including TCP/IP, has indeed provided a full-service node capability for every facet of digital communications that relate to the AX.25 protocol.

Take the time to read and understand the QUICK Reference. Then study the MODE and PARAMETER commands of the X-1 system.

My thanks to Dave Roberts G8KBB and Neville Pattinson G0JVU of the Suffolk Data Group for the enjoyment they have afforded the users of this outstanding networking tool. The foundation for the X-1J code comes from the Nord-<Link group. To these authors we owe a debt of gratitude for theNet and theNet X1J4 Plus.

EDITOR: Buck Rogers K4ABT

## INTRODUCING the X-1J4 Network Node

TheNet X-1J extends TheNet X-1H with a number of additions as detailed below. The main change, however, is support for a simple deviation meter that shows each station's deviation in kilohertz in the heard list, by measuring the receive audio level with an A-D converter at the end of each packet.

The other changes are: Control of slime trails; The information text in RAM has been doubled in size; The info, ctext and btext messages may be multiple lines; Nodes broadcasts occur 60 seconds after power up; Optional reconnect to the node following remote disconnect; PARMs, MODE etc. parameters may be changed by specifying parameter number and value; Digi up and downlinks may be selectively en/disabled; Level 4 retries ( min ) has been reduced to 1 and an MTU command has been introduced to set MTU data. The handling of node aliases may be made case sensitive and TALK may be configured to pass 8 bit data. The bug in RESET has been found ( finally ) and corrected.

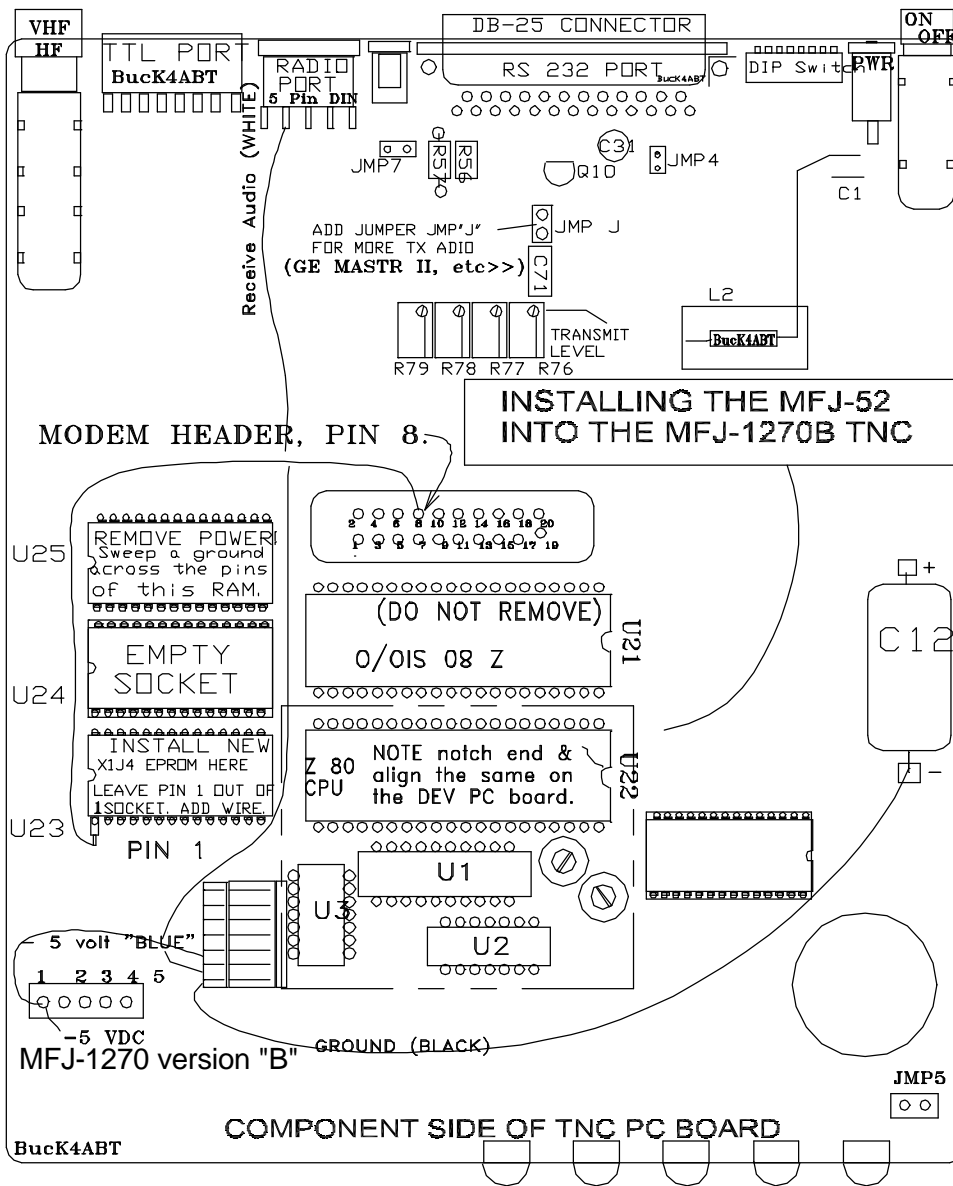
TheNet X-1H did not extend the functionality of X-1G, but fixed 3 bugs. In addition, the ARP digi bug patch released earlier this year has been included in X-1J, as has another bug in the IP checksum routine.

A menu driven windowing patch utility with context sensitive help is also included.

The previous releases introduced the following :

- A complete **IP router**,
- The ability to **remotely set the node's alias**,
- The ability to listen for **3 extra aliases** & invoke BBS etc,
- Selective node broadcast control for 'hash' nodes,
- A **UI** command to send arbitrary UI commands,
- Access control list capabilities,
- Multi-user conferencing ( the '**TALK**' command ),
- A **CWID** keyer,
- **Better SYSOP authentication**,
- **MHeard** list showing callsigns, packets heard & time since last heard,
- MHeard list shows whether a station is a node and / or **TCPIP** station.
- A **CLOSEDOWN** command to remotely shut the node down
- A **DXCluster** command that operates like the BBS & Host commands.
- A **Btext** command to set the node's beacon text message
- A **Ctext** command to set an optional alias connect text message
- The ability to enable or disable any command,
- Improved command prompting with only valid commands shown,
- Routes show optionally as alias:callsign or callsign alone,
- Additional control over system reset,
- **KISS** as an alternative to the crosslink protocol,
- Hardware handshake controlled host mode operation,
- **MODE** command for configuring additional parameters,
- **BBS** command to auto connect to a remote BBS,
- **HOST** command to auto connect to another BBS or Host,
- **BYE or QUIT** commands to disconnect,
- **STATS** command to display internal statistics,
- **MANAGER** command for system manager access,
- **AUDIT** command to set system audit levels,
- Bug fixes ( e.g. info messages too long ),
- Changes to the **NODES** command,
- An improved nodes broadcast algorithm for the crosslink port
- Split port nodes broadcast intervals,
- Ability to enable & disable nodes broadcasts selectively on each port.
- **CQ** apologizes nicely if disabled.
- Most Escape commands have been replaced with MODE parameters.
- **BEACON** messages may be digi'd
- **CALIBRATE** command for remote checking of Tx deviation
- **LINKS** command to show current level 2 links
- Configuration of the beacon period
- **Auto routing** of 'connect' to either BBS, DXCluster or HOST
- Remote dump of entire neighbor lists for all nodes

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)



This drawing illustrates the installation of the X1J4 EPROM and the MFJ52B Deviation PCB. Notice that pin 1 of the EPROM is left OUT of the socket at U23. A small wire is attached to pin 1 and routed to pin 8 of the modem header.

---

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

### BANKSWITCHING FOR TheNet X1

What follows is two versions of how to do the bankswitching. Saying things in two different ways is a neat way of making sure that ambiguities are exposed, so here goes.

---

For the reduced TNC2 version, the instructions are simply as follows :

1. Bend out pin 1 of the EPROM so that when inserted into the socket it will not contact pin 1 of the socket or any other pin.
2. Connect a wire from the SIO-0 DTRA pin ( pin 16 ) to the bent out pin ( pin 1 ) of the eprom. The DTRA signal should also appear on pin 8 of the TAPR modem disconnect header.

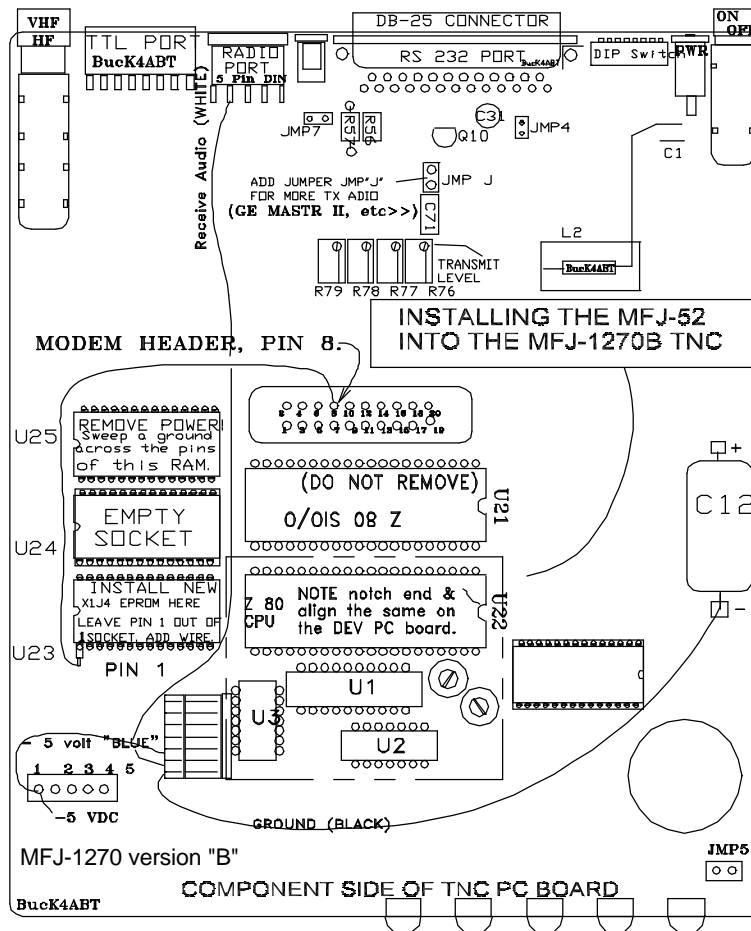
The status led will flicker as it now shows the state of the bankswitch signal.

One word of caution - if you can, just check the signal on pin 1 of the eprom - make sure it switches fast and cleanly - I suspect that if it does not, errors will occur.

---

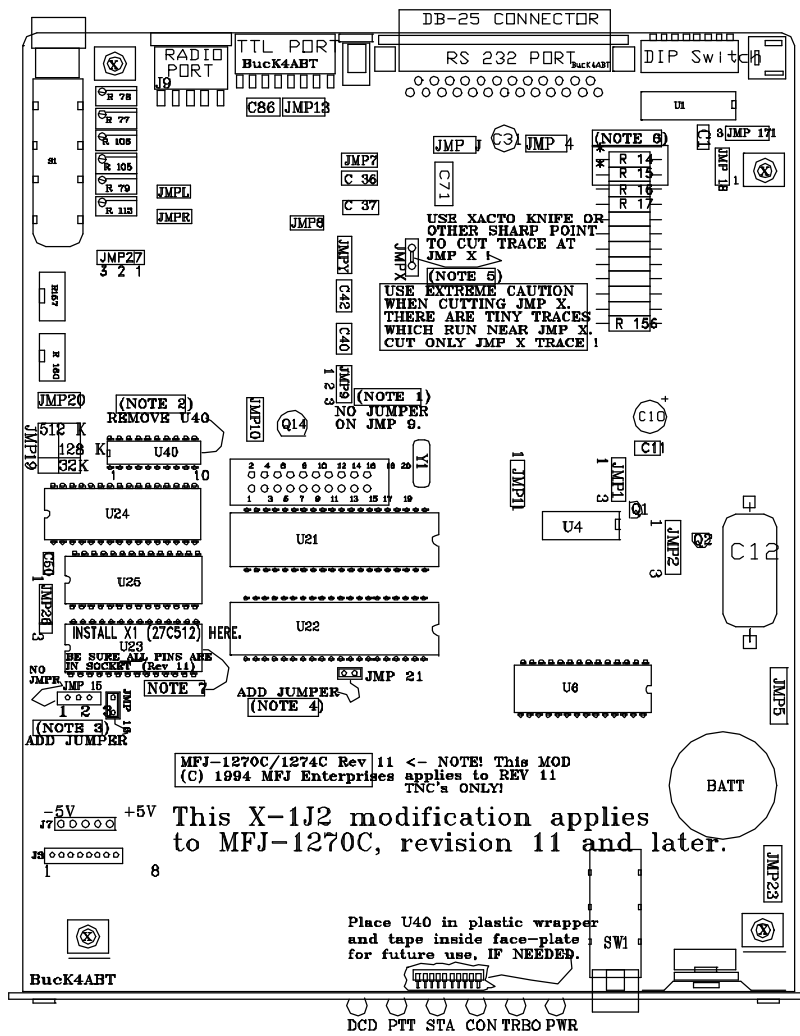


The following drawing illustrates the BANKSWITCH connections in the TNC2 or clone.



This drawing illustrates the installation of the X1J4 EPROM and the MFJ52B Deviation PCB. Notice that pin 1 of the EPROM is left OUT of the socket at U23. A small wire is attached to pin 1 and routed to pin 8 of the modem header.

The TNC/Node shown here is the MFJ-1270C, revision 10. The 1270C, revision 11 uses jumpers to make the EPROM pin one connection. Thus no soldering is required with MFJ-1270C Rev 11.



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

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

NOTE 3 Remove any jumpers at JMP 15. ADD JUMPER at JMP 16.

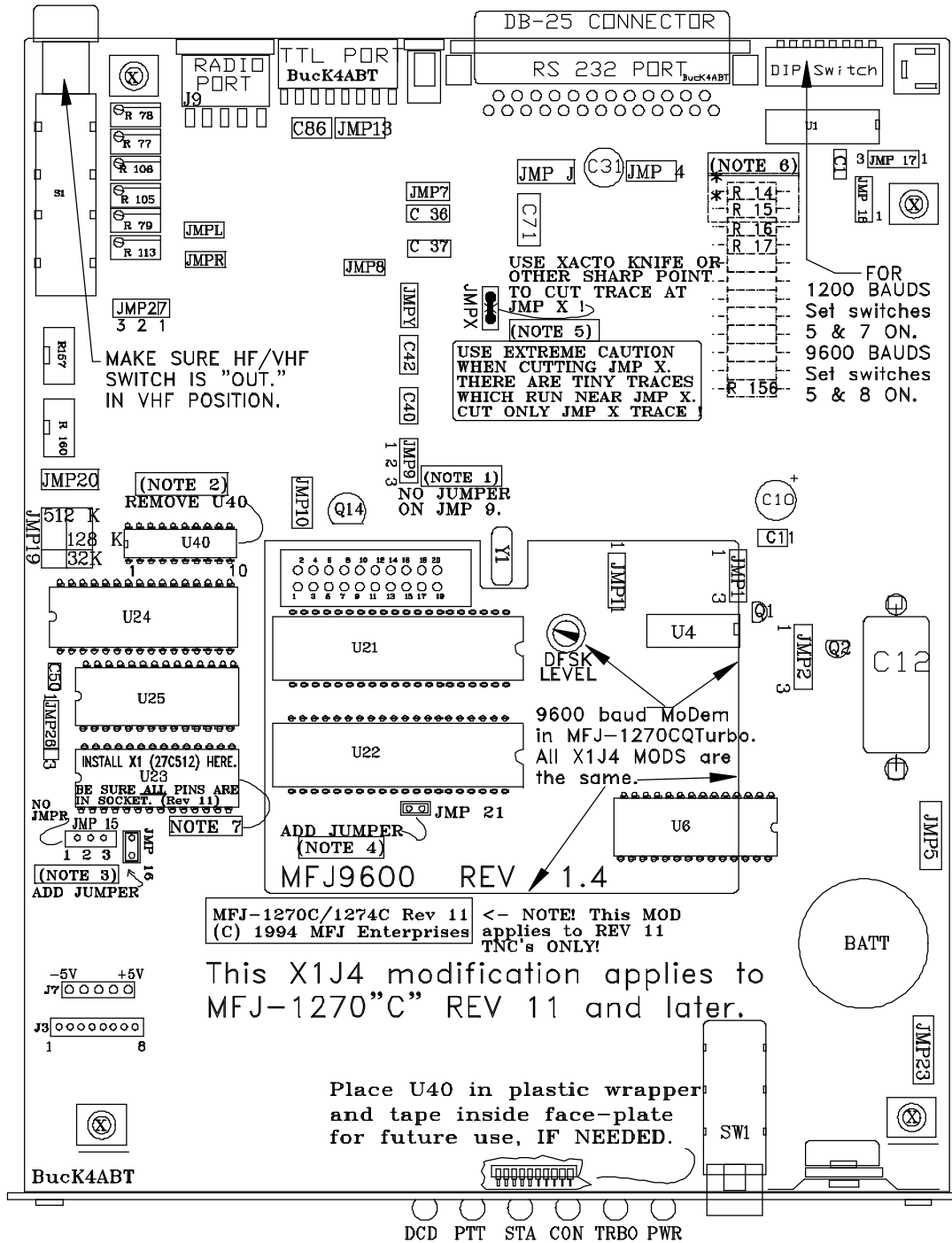
NOTE 4 ADD JUMPER at JMP 21.

NOTE 5 Cut trace between pads of JMP X. Use extreme caution when cutting JMP X. Notice that tiny traces are close to JMP X; DO NOT CUT any other trace. CUT ONLY THE TRACE AT JMP X! Use a sharp point Xacto knife or similar tool. Exercise caution when handling this type tool!

NOTE 6:  
If TNC is to be used as a GATEWAY between two frequencies or baudrates, insure that R14 & R15 are installed. If they are not, then remove the PC board to add R14 and R15. R14 and R15 are 100 ohms @ 1/4 watt each

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. They are shown in the drawing using this symbol:

NOTE 7 REMOVE EPROM at IC U23. CAREFULLY install new X-1J2 EPROM into socket at U23. BE SURE ALL PINS ARE IN SOCKET HOLES. No pins are left out of pin 1 as was done with older revisions of this TNC. This modification applies to MFJ-1270C "Rev 11" and later versions.



**Installation and modification of the MFJ-9600 to make the MFJ-1270 into the MFJ-1270CQ Turbo, 9600 baud TNC/X1J4 node.**

# PacketRadio Networking Handbook for the SNO

## TheNet X-1J

### CONFIGURATION OF THE EPROM IMAGE

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

#### 1. INTRODUCTION

This document describes the build process for creating a ROM image for TheNet X-1J. This process differs from the previous versions of TheNet-X in that it is delivered as two files rather than three. This is in response to a number of requests for a simpler process. In addition the patcher has been considerably changed and utilities for hex conversion are included.

#### 2. Files.

The ROM image comes as two files,

### **THENET1.X1J** **THENET2.X1J**

These two files are loaded into memory as described below.  
Before loading them however, both should be configured as described in section 3.

In addition, the following files are provided :

**PATCH.EXE**  
**INTEL.EXE**  
**INTEL.C**

**PATCH.EXE** is the windowing patch utility for the ROM images. **INTEL.EXE** are utilities that are designed to convert binary files into hex notation, in the Intel Intellec and Motorola S formats.

The ROM image consists of two halves, one for the lower half of a 512K EPROM, and one for the upper half. The files are loaded as shown :

FILENAME	LOAD beginning at HEX address
THENET1.X1J	0000
THENET2.X1J	8000

No information on how to load the files into a programmer is presented as all are different. Typical scenarios are however given in section 5.

#### 3. CONFIGURATION

Each of the two halves of the ROM image contains two different parts, a common set of drivers & interrupt routines and part of the functionality of the node. Part 1 contains the level 2, 3 and 4 software. Part 2 contains the switch. Each must be patched in an identical way to reflect the desired operation as each part contains an identical section at the start of the file for configuration data. This patching may be done manually or it may be done with the patcher. The first part of the ROM images is identical to TheNet 1.01 in its configuration. These parameters are followed by additional ones for the extended version as shown :

## The PATCH utility

The patch utility will not assist in changing the help text. That text is positioned at the end of THENET2.X1J. It is a null terminated string of characters. Newlines are represented by the value 0xd ( decimal 13 ). It can be as long or as short as you like, but don't forget that it causes the node to be a source of data and if very long could crash the node. ( Not likely in this version given the space available!).

The patch utility is designed to help configure the two ROM images in a manner that is not as user hostile as hand crafting a binary image. It is invoked as follows :

**PATCH [ file1 file2 ]**

If no parameters are given, it will look for files THENET1.X1J and THENET2.X1J in the current directory. It will stop if it cannot load them. If the images are renamed, they may be given as parameters. If this is done, both files must be given, with file1 corresponding to part 1 and file2 corresponding to part 2. The program is menu driven, with extensive help provided on the operation of the program and each parameter. It also tries to make sure that only valid data is entered.

The program may also be instructed to load and save textual representations of the parameters. These consist of ASCII files, with one parameter per line. Each parameter consists of the name of the parameter, and equals sign, and the value for that parameter. The values are mainly numeric, with the obvious exceptions of things like the callsign, alias, password, info message etc. To get an example of the format, use the patcher to dump a file and look at it. The idea of this is not simply to load and dump whole images, but to load partial configurations such as passwords & info messages only or parameters only. The file may be edited to remove or add lines as desired. Note that each parameter **MUST** only occupy one line. For the information message, whitespace before the first printable character is ignored by the program, and if a newline is to be included, it is denoted by the sequence \m ( i.e. backslash followed by the letter m ). Similarly, to include the backslash character itself, a double backslash must be entered, i.e. \\.

### 5. Programming examples

There are two utilities included to facilitate conversion to hex for use in programming eproms. The source of both is also included if anyone wants a different file type. The programs have been compiled with Turbo C++. Each has the same method of invocation,

**INTEL infile outfile [ address ]**

These create INTELLEC or S1 type records respectively. Each reads an input binary file and outputs a hex version. The starting address assumed for the file will be 0000 unless specified otherwise in the command line.

#### 5.1 Intel format, loading as two halves

1. Use the patch program to create the desired image.
2. execute :  
**INTEL TheNet1.x1j part1**  
**INTEL TheNet2.x1j part2**
3. load part1 into the programmer and program the lower half of the ROM.  
load part2 into the upper half.

## TheNet X1J4

# OVERVIEW OF OPERATION

### 1. INTRODUCTION

This section introduces the main features of TheNet X-1J. This is an update to the previous paper on version X-1H, and includes a number of changes including the following :

- Support for a simple receive signal deviation meter
- Control over 'slime trailing'
- Info, BText and CText messages may span several lines
- Nodes broadcasts occur 60 seconds after power-up
- An optional 'reconnect to node' following remote disconnect is supported
- PARMS, MODE etc may be changed with offset & new value instead of '\* \* \* 'etc
- Optional control over digi uplink & downlink is supported
- Transport retries ( min ) has been dropped to 1
- An MTU command has been added to allow easy changes to MTU sizes for IP users
- Information Messages in RAM may be up to 160 bytes long
- Tke TALK command may be set to pass 8 bit data instead of clearing bit 8
- Node aliases, at the switch, may be made case sensitive

The software is a derivative of TheNet 1.01 by NORD><LINK. Additional commands and bug fixes have been included in the release.If your reaction is 'What I really want is .....', then please read on anyway, especially section 6.

### 2. STRUCTURE

One of the problems to extending TheNet is the 32 K EPROM limitation imposed by the architecture of TNC2 clones. The solution to this is to implement bankswitching. For the MFJ1270B TNC and similar TNC2 clones, this can be achieved by the addition of a single wire as detailed in the bankswitch modification file. This is at the expense of the HIGH and LOW commands. The other version that was previously available with HIGH and LOW in it is no longer supported as it is incompatible with the deviation meter.

# PacketRadio Networking Handbook for the SNO

## 3. NEW COMMANDS

The following commands have been added to the release

<b>BYE</b>	<b>BBS</b>
<b>HOST</b>	<b>STATS</b>
<b>MHEARD</b>	<b>MODE</b>
<b>MANAGER</b>	<b>AUDIT</b>
<b>TALK</b>	<b>CALIBRATE</b>
<b>LINKS</b>	<b>ACL</b>
<b>CLOSEDOWN</b>	<b>BTEXT</b>
<b>DXCLUSTER</b>	<b>HELP</b>
<b>CTEXT</b>	<b>ALIAS</b>
<b>BBSALIAS</b>	<b>HOSTALIAS</b>
<b>DXCALIAS</b>	<b>QUIT</b>
<b>IPROUTE</b>	<b>ARP</b>
<b>IPSTATS</b>	<b>IPADDRESS</b>
<b>IPBROADCAST</b>	<b>UI</b>
<b>MTU</b>	<b>METER</b>

The following commands have been changed

**CQ**  
**NODES**  
**RESET**  
the <escape> commands  
**SYSOP**

The following features have been added to the code

**An Internet Router**  
**Ability to respond to three additional aliases**  
**A CWID keyer**  
**The command processor has been extended**  
**KISS mode operation on the RS232 port**  
**HOST mode support on the RS232 port**  
**Remote configuration of all parameters**  
**Additional textual help messages**  
**Support for a 4 channel ADC used for measuring RX deviation**  
**Other changes as detailed herein.**

In addition, a number of small changes have been implemented to satisfy the needs of specialist situations such as the ability to digi beacon packets.

Network management in this context does not just mean 'setting parameters remotely'. It means the ability to set, read and interpret various monitors and diagnostic tools. Version X-1C included the first part of the network management, the MANAGER privilege and the AUDIT process. Version X-1D extends the auditing and statistics significantly including internal CPU monitors.

---

Version X-1E includes most of the additions that are planned, and version 2 will complete the functions. No other release before version 2 was planned, but the need to produce a version with an IP router has prompted this release. The opportunity to experiment with additional features was therefore taken. The next version was intended to include significant changes attributable to Hayden Bate G8AMD, but again due to other requirements, another interim version has been produced ( the main driver being the need locally for the Deviation Meter ).

### 3.1 BYE or QUIT

There are no parameters to these commands. When entered, they terminate the session. Both commands do the same thing.

### 3.2 BBS

The syntax of the command is :

**BBS [ \* | ? | callsign ]**

With no parameter, the command connects to a station previously specified by the sysop. Setting the BBS destination is done by the use of the BBS command with a callsign as a second parameter. Setting the BBS to allow this may only be done by a sysop. The '\*' option may also only be executed by the sysop, this command clears a previously specified BBS.

The '?' option ( or any text if not sysop ), prints out the current BBS station setting.

If no BBS is set, the command issues an error message if it is invoked with no other parameters.

The idea of this command is that, like with the 'BBS' command of the 'BPQ software, a user may connect to the local BBS from the node.

### 3.3 HOST

The syntax of the command is :

**HOST [ \* | ? | callsign ]**

This command is very similar to the 'BBS' command. It allows connection to a local host, BBS or other server. The difference however, is that as long as the TNC is not in 'crosslink' mode ( ie pin 23 on the RS232 port is high ), and if a callsign is not set, the 'host' command connects to the local port.

The idea of this command is that, like with the 'BBS' command of the 'BPQ software, a user may connect to the local BBS, another node or server from this node. For example, if a print server were connected to the node in 'host' mode, this command would allow connection to it ( like the 'connect' command with no other parameter ). In KISS mode, setting a callsign or node alias allows connection to another system.



# PacketRadio Networking Handbook for the SNO

## 3.4 STATS

The STATS command has no parameters. It prints a number of internal TNC statistics. In this version, this is limited to the level 1 stats of the radio channel and the internal clocks, the level 2 ( AX.25 ), 3 and 4 statistics, and the CPU health checks.

For level 1, six pairs of numbers are printed, corresponding to the percentage of time the transmitter was on followed by the percentage of time the receiver DCD was on, for each of the last six 10 minute periods. The data is presented most recent period first. Two pairs of numbers are then displayed showing the transmitter underrun and receiver overrun. These are formatted as per the level 2 stats with port 0 followed by port 1 for the current hour followed by the totals for the previous hour. In the case of the RS232 port, underruns are not possible, and an additional error ( framing ) is included. The RX overrun includes overruns and framing errors.

For level 2, the following are displayed :

Frame checksum errors	Total packets heard
Total packets received by the node ( ie sent to it )	Total packets sent by the node
Total receiver not ready packets sent	Total reject packets sent
Total receiver not ready packets received	Total reject packets received
Total number of link timeouts	

For each of the level 2 statistics, four numbers are shown. The first two are cumulative totals over the period of one hour, incrementing in real time. The last two are the totals for the previous hour. Each pair of numbers is the total for the radio port followed by the total for the RS232 ( crosslink ) port.

For checksum errors, port 0 shows CRC errors and port 1 shows ( when in 'crosslink' protocol mode only ), checksum errors. As HDLC errors can be triggered by noise, acceptance of CRC errors is conditioned by the state of the DCD line. If DCD is on and an error is signalled, it will be added to the count. This reduces the false counts, but does not eliminate them. Distant stations that keep the squelch open ( just ) without being properly heard will result in lots of apparent errors.

For level 3, the number of level 4 frames gatewayed between nodes is displayed.

For level 4, the number of transport frames sent and received by the node are shown.

For level 3 and 4 statistics, two numbers are shown. The first is the number of frames accumulating for this hour, and the second number is the total number of frames for the previous hour.

For CPU health checking, two statistics are shown, the CPU loading and the buffer usage. Each looks like the level 1 stats with 6 numbers corresponding to the last six 10 minute periods.

The CPU loading shows the number of times, divided by 100, that the CPU makes it around its basic internal scheduler. For a node just switched on, receiving nothing, this will be about 470 ish for a 4.9 MHz clock. With lots of nodes, a heard list of 20 stations and 70-80% activity on the radio channel for it to listen to, this can drop to about 350ish. If it drops to double figures, worry, as the CPU is beginning to thrash. At low double figures, the CPU is pretty much working flatout. Time to up its clock rate !.

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The BUFFERS statistic shows the minimum number of free buffers that the software had available to it during the last six 10 minute period. This indicates whether the TNC is failing to deliver data passed to it for onwards transmission, as well as how much data is backed up waiting.

Additional stats needed to analyse this properly are not yet being collected.

The display also shows the elapsed time since the last warmstart followed by the running time since the last coldstart. Each number is the number of hours of operation.

### 3.5 MODE

This command is similar to the PARMS command, and includes the new syntax described in section 3.32.

It allows a number of other features of the software to be configured remotely. It removes the need for most of the host mode <escape> commands.

The following parameters may be configured :

- The host mode
- The CWID send period
- The CWID keyer speed
- The port nodes broadcast control
- The crosslink / kiss control
- The Tx delay
- The full duplex flag
- The RS232 port node broadcast interval
- The node broadcast algorithm
- The beacon period
- The 'connect' redirector
- The 'help message enable' flags, case sensitivity & TALK 8 bit flag
- The 'hash' node broadcast port control
- Whether the node will listen for the extra aliases
- Whether remote disconnect causes reconnection to the switch
- Control over 'slime trails'
- Control over digipeating up/down links

In operation, it behaves just like the PARMS command.

The mode parameters are as follows :

#### 3.5.1 Host mode control

This parameter controls the 'host' mode. This is the mode of operation of the RS232 port when pin 23 is 'high'

The valid values are 0 or 1.

In mode 0, the port operates as per the standard node specification. Mode 1 is designed to allow connection to hosts or modems or similar equipment that expects a 'CD' type of signal to signify that an incoming / outgoing connection is called for.

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In mode 1, the <escape> C and <escape> D commands are disabled and the other <escape> commands do not operate when connected. Instead, hardware handshakes are used to control connections to and from the TNC.

The TNC monitors pin 20 to determine the state of the host, and signals state changes to the host with pin 5. When an incoming connect request is received ( by the 'c' command with no parameters or by the 'host' command ), the TNC raises pin 5 to signal the connection and expects pin 20 to change state in response.

When the host wishes to connect to the TNC, it signals on pin 20 and the TNC responds with by changing the state of pin 5.

It handles disconnects in a similar manner. Either the node or the host may initiate disconnects.

This mode is experimental, changes may be made to its operation. It is designed for modems, print servers or hosts such as UNIX system TTY login drivers.

### 3.5.2 CWID control

The next two parameters control the CWID keyer.

The first parameter is the CWID repeat period in seconds. Valid values are 0 to 3600. 0 disables it but do not set it below 120 apart from to disable it.

The second parameter controls the keyer speed. Specifically, it sets the number of 10 millisecond periods per dot and per inter symbol delay.

The speed of sending is  $120/n$ , so setting  $n$  to 6 gives 20 wpm. Valid values are 4 to 10, corresponding to speeds of 30 and 12 wpm respectively.

### 3.5.3 Node broadcast control

This parameter allows control to be exercised over which ports nodes broadcasts are sent. Valid settings are 0 - 3.

Value 0 disables node broadcasts. Value 3 ( the default ) works as normal. A value of 1 enables broadcasts on the HDLC port only whilst a value of 2 enables broadcasts on the crosslink port only.

### 3.5.4 Crosslink / kiss

This parameter is used to set the communications protocol used on the crosslink port when pin 23 is tied low.

The valid values are 0, 1, 2 or 3

Mode 0 - standard crosslink protocol enabled  
Mode 1,2,3 - use KISS instead of crosslink.

In mode 1, KISS simply replaces the crosslink protocol In mode 2, packets received from the radio part that are not intended for the node are copied to the RS232 port in KISS mode. Similarly packets received on the RS232 port that are not intended for the node are sent to the radio port.

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In mode 3, all packets received on one port are copied to the other port as well as being analysed by the node. These modes are not simply KISS implementations that replace the node, they run with the node.

Mode 2 is designed to allow a KISS application and a node to share a radio without interference with each other. The point is that the PC TCP/IP system can be switched off whilst leaving the node running to allow others to use it.

Mode 3 is a debugging mode. One problem when faultfinding on a node is that it is impossible to see what the node is seeing on the channel without replacing the ROM. By setting this mode, it is possible to connect a KISS application to the RS232 port and observe what the node is seeing.

Mode 3 is also designed to allow a PC running AXSTATS to be connected to the RS232 port to allow logging and analysis of channel performance from the node itself. Note that packets initiated by the node for one port will not get copied to the other.

### 3.5.5 Tx keyup delay

This parameter sets the TX keyup delay in 10's of milliseconds. This was previously done using an escape command.

### 3.5.6 Full Duplex

This parameter sets or clears the full duplex control flag. This was previously done using an escape command.

### 3.5.7 RS232 nodes broadcast interval

When a crosslinked TNC is reset, it takes some time to learn about the nodes that the other TNCs can hear. Also, nodes heard by one TNC can take an hour to be notified to the others.

In order to improve this, this parameter may be used to change the frequency of nodes broadcasts on the RS232 port. When set to 0, the node operates as normal. When set to a non zero value, it will broadcast the nodes on the RS232 port at that interval. Hence setting it to 600 would cause nodes broadcasts at 10 minute periods.

The nodes broadcasts on the radio port will continue to occur at the basic rate set by the PARMS setting. The obsolescence count will be decremented at the basic rate, not at the faster RS232 rate.

### 3.5.8 Node broadcast algorithm

This value controls the algorithm used. Bits within the value set have significance as shown below. There is a problem with the nodes broadcast algorithm when many TNCs are crosslinked on RS232. In order to address this a variation to the algorithm has been implemented for experimental purposes. Feedback on its use is requested. Bit zero affects the HDLC port and bit 1 affects the RS232 port. When a bit is set to 1, the node broadcast algorithm is modified so that it will not rebroadcast on the same port a node heard on that port when the best quality neighbour is on that port. It makes little sense to use it on the HDLC port but what the heck, it is implemented for completeness. The only settings therefore that make sense are 0 and 2. These correspond to 'normal' and 'modified on the RS232 port' respectively. Setting it to 1 or 3 will result in some pretty weird effects.

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## 3.5.9 Beacon period

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This parameter sets the beacon interval in seconds. In TheNet 1.01, this was fixed at 10 minutes ( 600 seconds ). In this version, this parameter may be used to change it according to the prevailing license conditions.

## 3.5.10 'Connect' redirector

In TheNet 1.01, when 'connect' is given with no destination callsign, the node attempted to connect to the local host port.

In a crosslinked system, this vanished down a black hole. In previous versions of this code, the node attempted to connect to the station set by the HOST command, only trying the local host port if no destination was set by HOST. With this version, the node may be configured to connect to the station set by the BBS, DXCLUSTER or the HOST command depending on this parameter. When zero, connect attempts will go to the HOST station, when set to '1', it will attempt to connect to the BBS callsign. When set to 2 it will attempt to connect to the DXCLUSTER callsign.

## 3.5.11 'help message enable' flags

This word controls the sending of help messages, with each bit of the word controlling a separate function. Currently, only 6 bits are effective, these being as follows :

BIT	FUNCTION
0	Whether the 'please wait, trying xxxx' operates
1	Whether all commands appear in help for sysop
2	Whether the 'goodbye' message is given
3	Whether a welcome message is enabled ( CTEXT )
4	Whether nodes are shown as 'alias:callsign'
5	If set, TALK data is passed as 8 bit data rather than clearing the most significant bit
6	If set, node aliases are deemed to be case sensitive

When bit 0 is set, and the BBS, HOST or DXcluster commands are given, then a message is sent from the node telling the user that a connect attempt is being made. This does not affect the 'connect' command itself, unless the command is given with no parameter as this is then equivalent of the BBS or HOST command.

When **bit 1** is set, and if a sysop gives an incorrect command, the help screen shows all commands possible, including those currently disabled ( as by definition they are not disabled for the sysop ! ).

When **bit 2** is set, then the use of the 'bye' command will solicit a 'goodbye' message from the node.

**Bit 3** switches on and off the 'CTEXT' message. When enabled, and when a CTEXT message is set, then whenever someone uplinks to the node alias, the ctext message is sent immediately on connect.

**Bit 4** switches the way in which nodes are shown when the ROUTES command is used. When set to '1', nodes are shown as 'alias:callsign'. When set to 0, they are shown only as 'callsign'.

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**Bit 5** controls only the passing of data in TALK mode. Normally, all data sent to the node has its most significant bit cleared, to eliminate parity or similar problems. This is not ideal for those countries that use the extended character set. When this bit is set, and only when in TALK, data is passed as 8 bit data. Note that this does not apply to an initial message sent on the same line as the TALK command.

**Bit 6** makes node handling case sensitive. Normally, node aliases are forced to upper case for searching in the table and for user 'connect requests'. If this bit is set, these operations will become case sensitive. This could be very confusing for users unless they are aware of it and expect it. It allows node aliases to be entered as lower case, for example in setting the node alias and in forcing routes. Don't set this bit unless it is actually needed !.

### 3.5.12 'hash' node port control

In certain networks ( notably the American ), there is a need to restrict the propagation of local nodes. This is done by using node aliases that start with a hash character ( # ) and instructing specific nodes not to broadcast routes to nodes that start with this character. This parameter does this by enabling each port to be individually enabled or disabled in respect to 'hash' node broadcasts. Bit 0 controls the radio port and bit 1 controls the RS232 port. When one of these bits is set, hash nodes will never be broadcast on that port.

### 3.5.13 Extra aliases

If this is set to '1', then the node will listen for ( and accept uplinks to ) the aliases set in HOSTALIAS, DXCALIAS and BBSALIAS if they are set. If this parameter is set to '0', or if the respective aliases are not set, it will do nothing. If you do not use the aliases, set it to 0 to avoid wasting processor time.

### 3.5.14 Reconnect to Switch

If this parameter is set to 0, the node operates as normally. If set to a non zero value ( i.e. set to '1' ), it operates in 'reconnect' mode. When a station connects to the switch, then uses the BBS, HOST, DXCluster or Connect commands to connect to another station, and then causes that remote station to disconnect them, then they are automatically reconnected to the node with a 'welcome back' message.

### 3.5.15 NoSlime

This parameter controls 'slime trails'. A 'slime trail' is caused when a remote node, whose identity is not known to the node, sends a transport connect request to the node. Subject to the settings of the port qualities, the node may make an entry in the node table in order to reply to them. Such entries are typified by having no alias associated with them.

Each bit in the NoSlime parameter controls a different function. Bit 0, if set, causes any stations without aliases to be 'hidden' when a nodes command is given. Bit 1, if set, causes the node to refuse to make slime trail entries in the node table. Before you use this feature, be careful to make sure that you understand the implications of doing so, as without fixed entries the node will refuse to accept level 4 connections from a station until it has heard their node broadcast.

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## 3.5.16 NoDigi

This parameter controls the node's willingness to accept digipeated level 2 connections or to allow digipeated downlinks from the node. Each bit of the parameter controls a different function, as shown below :

<b>BIT</b>	<b>FUNCTION</b>
0	If set, do not allow digipeated connections to the node
1	If set, do not allow digipeated downlinks from the node switch

## 3.6 MHEARD

The TNC can be instructed to keep a list of the last 'nn' stations heard, where 'nn' is an integer between 1 and 100. It can also be disabled. The syntax of the command is :

### ***MHEARD [ nn ]***

The parameter is optional and only operates for the sysop. It sets the maximum length of the list. Setting to zero disables the function.

The heard list uses free buffers for the list, so a large setting means less RAM for the node software.

The list is maintained as linked list, with the most recently heard station first. The display shows the number of packets heard from that station and the time since it was last heard, in hours minutes and seconds. In addition, it shows the port on which the station was heard together with an indication as to whether the station is a node and / or a TCP/IP station. It does this by examining the PID byte.

Every hour the list is checked for stations that have not been heard for 12 hours, and any such stations are removed from the list.

To disable the internal updating of the list ( and thereby stop the CPU expending effort on the function ), set the size to zero rather than just disabling the command as described in 3.8. Note though that the node will not clear the list as updates have been disabled, so it will be up to 12 hours

before the buffers used are freed. To accelerate this process, set the size to 1, wait until it has heard a station ( any one will do ) then set it to zero. This will free up all but one buffer immediately.

The heard list is the user interface to the receive deviation meter. Its operation is explained in section 3.31. If enabled ( ie if the METER parameter is not set to 0 ), then an additional column will be displayed in the heard list that will show the received deviation in kilohertz ( as nn.n ). It must be remembered that this is derived by measuring the received signal audio level, and will not be correct in the case of a badly distorted signal.

## 3.7 CQ

When CQ is disabled, the command now reports apologetically rather than simply ignoring the request.

## 3.8 ALL COMMANDS

There is often a requirement to be able to disable the connect command whilst allowing level 3 relaying. This is achieved

by the use of a command qualifier, the syntax of which is :

### ***CONNECT [ + / - ]***

If '-' is entered by the sysop, then the connect command will politely refuse to work. This can be reversed by the '+' command.

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This has no effect of layer 3 relaying. Also, the BBS and HOST commands will still allow connections to be made if they are enabled and set.

Further, the syntax is valid for ALL commands, for example the CQ command can also be disabled in the same way. Be careful though. The command is only accepted from the sysop, so if you disable the sysop and manager commands you will lock out remote management !.

### 3.9 NODES

When information on a node that is not known is requested, the program prints out an error message rather than giving the names of all known nodes.

When a node entry is made by the sysop, callsign checking is forced ON rather than being determined by the callsign checking parameter.

Don't forget that node alias handling may be case sensitive - see section 3.5.11.

The entire contents of the node table routes may be obtained by the sysop or manager by the command

***NODES \*\****

This will dump info on all nodes, one node per line, with the following format:

**Alias:call**  
***route1 route2 route3***

where route1, route2 and route3 comprise the quality, obsolescence count and port followed by the neighbour callsign for each of the 3 route entries for that node. If any of the routes are in use, a chevron will be shown by that route.

The extended command is only for sysop use as it, like auditing and conferencing, causes the node to be a source of a significant amount of data

(dumping a large number of node details can consume hundreds of buffers !!!).

It is quite possible that used indiscriminately, it could cause a warmstart of the node. Be careful.

### 3.10 RESET

The syntax of the command is now

**RESET [ anything-else ]**

Entering the reset command alone will do a warmstart. If any other parameter is entered, a coldstart is performed.

### 3.11 MANAGER

The MANAGER command gives the user extra privileges. In this version, this amounts to the ability to receive audit messages from the node. The level of auditing is set by the AUDIT command.

The privilege remains in force until cleared by a command that affects the user state. Specifically, these are, entering the TALK state, executing the SYSOP command, entering the MANAGER command and getting the password wrong, or disconnecting from the node. Failing to get the second password right when using the closedown command will also remove the manager privilege.

If the MANAGER command is executed by a user who connected to the node by a level 4 circuit rather than by a level 2 circuit, and if the level 2 timeout is less than the no activity timeout, the connection will never timeout as the clearing and reconnecting of the level 2 circuit will keep the process alive provided level 2 auditing is enabled. This allows the operation of the node to be logged remotely and continuously.



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Alternatively, if the level 4 timeout is greater than 10 minutes, level 1 or CPU auditing will keep it alive if level 2 is switched off. NOTE : I have a nasty feeling that there is something not quite right here - the link sometimes dies !.

A user with MANAGER privilege also has SYSOP privilege.

The syntax of the audit command is :

### AUDIT [ new-value ]

where new value is an integer value. If no value is given, or the user does not have SYSOP status, the current mask value is displayed. Otherwise, the mask is updated and the new value displayed.

### 3.12 AUDIT

The mask controls the auditing of various events in the node. Not all values are used yet, but those that are, are :

BIT	USE
=====	
<i>Level 1 statistics on 10 minute pdates</i>	
1	Level 2 connects & disconnects
2	reserved for future use
3	Level 4 connects & disconnects
4	Level 7 limited events ( use of sysop )
5	Full level 7 auditing
6	CPU auditing messages ( 10 minute updates )

It is suggested that the usual settings can simply be 0 or 255.

*For level 1, messages are sent every 10 minutes showing the percentage of time that the receiver detected carrier and the percentage of time that the transmitter was on.*

**At level 2 & 4, the messages are of all connects and disconnects, shown in 4 different ways :**

- C Connect message received by node
- CA Connect message sent / Acknowledge received
- D Disconnect message received by node
- DA Disconnect message sent / Acknowledge received

In each case, 2 callsigns are shown. At level 2 these are the source and destination of the AX.25 link. At level 4, it is the remote node callsign and user callsign. Each message is preceded by an indication of the source of the message, such as "L2" or "L4".

At level 7, with bit 4 set and bit 5 clear, the only event currently audited is the use of the Sysop command, either directly or via the manager command. If bit 5 is set, then all commands given to the switch are audited, preceded by the callsign of the user who entered the command.

Bit 6 controls CPU health check auditing. If set, then whenever the internal CPU statistics are updated, messages are sent showing the CPU processor loading total and the minimum buffers level ( see STATS for more information ).

The audit mask value should be set to 0 when not actually being used. Do not leave it set to another value as this wastes processor time. Note also that full auditing on a busy node makes things worse. Treat it as a debugging feature !.

**IN THE TEXT THAT FOLLOWS WE WILL LEARN THE USE OF A NEW FEATURE WITHIN THE X-1J NODE. HOWEVER GOOD OR BAD OUR NETWORKS PERFORM, MAY RELY ON THE INFORMATION THAT YOU ARE ABOUT TO ACQUIRE!**

THE "TALK" MODE IS A GOOD FEATURE WHEN USED AS AN ADJUNCT TO WEATHER-WATCH NETS OR ROUNDTABLES. IT ALSO PROVIDES A MEANS WHEREBY "ARES" AND OTHER NETS MAY CONDUCT TRAFFIC HANDLING OR HAVE ROLL CALL, ETC...

As a supporter of reliable packet communications, I must point out to the prospective sysop the major difficulty that may occur when activating the "talk" mode in your node(s). This applies to those nodes that are part of a high traffic lan or network. Just as I've written in my books and articles in the past, i'm again repeating here;

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**"A CONFERENCE OR CONVERSE TYPE NODE CAN, AND WILL BRING A NETWORK TO ITS KNEES."**

**The SYSOP may disable the "TALK" feature by entering the remote sysop password, and type TALK - The minus sign disables, and plus enables.**

**WHEN MORE THAN FOUR USERS ARE CONNECTED INTO THE "TALK" MODE OF THE X-1 NODE, THE NETWORK BECOMES VIRTUALLY USELESS TO THROUGHPUT TRAFFIC.**

***PLEASE REMEMBER!*** For every connected station into the "TALK" mode, each station receives each packet from every connected station. In addition each connected station issues an ACKnowledgement for each packet it receives.

Have fun de Buck4ABT

**All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)**

### **3.13 TALK**

Talk is a conferencing command. It allows a number of stations to hold a simultaneous conference ( a bit like the CONFERENCE command of a DX cluster ). There is only one conference, and stations may connect to it by connecting to the node and issuing the TALK command. It may be exited by disconnecting or issuing the command '/EXIT' at the start of a line. ( /EXIT may be abbreviated to /EX, and it is not case sensitive ).

Each line sent by a user is copied to all other users in the conference, preceded by the callsign of the user. The data will be sent as 7 bit data ( ie the most significant bit will be cleared ) unless the appropriate bit is set in the help flags ( see section 3.5.11 ).

Whenever a new station enters the conference, or a station leaves the conference using the '/EXIT' command, the other conference users get a message informing them of the event. These status messages are sent with the callsign of the node rather than the user.

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Finally, when entering the TALK command, a message may be sent to all those users who are connected to the node but not otherwise doing anything. For example if Rick, KD4JKX connects to a X1 node that I'm connected to and enters the line

**TALK Hello Buck, can I have a chat, type 'TALK'**

Then all other stations connected to the node, present in the USER list but idle, get the message

**KD4JKX >> Hello Buck, can I have a chat, PSE type 'TALK'**

is displayed on their terminal.

Note that merely connecting to the node does not constitute being connected to the switch. Stations connected to the switch appear in the USER list.

### 3.14 SYSOP

The SYSOP command has been enhanced to increase the level of security offered. One problem of the old system is that the password is easily visible unless the user repeats the SYSOP command a number of times. Even then, correlation between passwords is easy, so the password needs frequent changing. To reduce the change period, and make it harder to discover, the node will accept a string of characters and scan it for the password. Hence a response of, say, 30 or 40 characters can be sent, with a random number of random characters preceding the actual data and a random number following it. This does not eliminate such attacks, but if used carefully, it makes it quite a bit harder to attack.

### 3.15 LINKS

This command shows the current level 2 links to the node. Displayed one per line, the two callsigns are shown followed by the link state, port number and current retry count.

### 3.16 CALIBRATE

This command allows remote calibration checks of the transmitter deviation. Its syntax is:

### CALIBRATE period [ toggle ]

The period ( 1 to 60 seconds ), is the time for which the transmitter will key up for with constant tone. It is undefined as to which tone will be sent. If the second parameter is given, the node will toggle between the tones every [toggle] seconds. The toggle must be between 1 and [period] seconds. If a period is not given, the user is not sysop or manager, or if it is out of range, the command is ignored.

If the tone generator is busy because it is about to send a CWID sequence, a 'busy' message is returned. Note - quite often it can appear that the node has locked up having failed to transmit the full calibrate period. In fact, this is usually the hardware PTT watchdog in the TNC. The node thinks it is still sending but the hardware timer has removed the PTT signal.

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## 3.17 DXCLUSTER

The DXCLUSTER command operates just like the BBS command in that it may be used to effect a connection to a DXcluster (assuming there is one nearby). It should be disabled if it is not intended to be used to access a cluster.

The syntax of the command is :

### **DXCLUSTER [ \* | ? | callsign ]**

With no parameter, the command connects to a station previously specified by the use of the DXCLUSTER command with a callsign as a second parameter. Setting the DXCLUSTER to allow this may only be done by a sysop. The '\*' option may also only be executed by the sysop, this command clears a previously specified DXCLUSTER.

The '?' option ( or any text if not sysop ), prints out the current DXCLUSTER station setting.

If no DXCLUSTER is set, the command issues an error message if it is invoked with no other parameters.

The idea of this command is that, like with the 'bbs' command of the 'BPQ software, a user may connect to the local DXCLUSTER from the node.

## 3.18 HELP

The HELP command gives a message from the ROM. In general, it is expected that the message will be designed to assist new users in understanding the operation or configuration of the node.

The message may span many lines, and may be changed when the ROM is programmed. As delivered, it contains a brief help screen detailing the main ( user ) changes to the code.

## 3.19 CTEXT

The CTEXT command sets or displays a message sent to a user who connects to the node by uplinking to the node's alias.

The syntax of the command is :

### **CTEXT [ \* | message ]**

With no parameter, the current message is displayed. If the user is also a sysop, and if text follows the command, that text is added to the current connect text.

If the message starts with a '\*', the connect text message is deleted. Hence, to clear the message, type the command 'ctext \*'. This is a change in version X-1J from previous versions. For further information, see section 3.33

A message is only sent if there is a ctext message set and if the relevant bit is set in the mode command parameter as described in section 3.5.11.

## 3.20 BTEXT

The BTEXT command sets or displays the additional beacon text sent along with the beacon packets.

The syntax of the command is :

### **BTEXT [ \* | message ]**

With no parameter, the current message is displayed.

If the user is also a sysop, and if text follows the command, that text is added to the current beacon text. If the message starts with a '\*', the beacon text message is deleted. Hence, to clear the message, type the command 'btext \*'. This is a change in version X-1J from previous versions. For further information, see section 3.33

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Normally, beacon packets are UI frames that contain the node callsign and alias. If a beacon message is set, the text of the message follows the alias in the same packet. It is strongly suggested that beacon packets be kept brief !!!.

different events. The ACL contains two types of entry, a default value and zero or more callsigns, each of which are associated with a value.

### 3.21 ACL

This is probably the most complex additional command in the program. It should be used with care, and only when you really understand its operation - mistakes can result in the need to go out to a remote site ( probably when it is cold and wet ) to reconfigure the node.

When one of the controlled events occurs ( such as an incoming level 2 connection or a nodes broadcast ), the ACL is scanned for an entry that matches the callsign of the sender. If a match is found ( but see below ), the value associated with that callsign is used to determine the action the node will take. If no match is found, the default value is used.

The ACL command allows selective control, based on callsign, of a list of

**Each bit of the value controls a different function, as shown below :**

BIT	OPERATION
0	bar incoming level 2 connection
1	bar outgoing level 2 connection ( downlink )
2	ignore nodes broadcasts from this station
3	bar gatewaying at level 3 to/from this station
4	bar incoming level 4 connections
5	bar outgoing level 4 connections
6	ignore SSID in matching an entry

So if for example an entry exists for a callsign WB11XXX of 6, then the node will not allow outgoing level 2 connections to the node ( downlinks ), and will ignore node broadcasts from that station. Note that these commands only operate on the events themselves - if WB11XXX creates a level 2 connection, the node will quite happily use it itself.

The 'ignore ssid' bit is used to match a callsign without regard to its SSID. This makes life interesting when finding a match, so the list is scanned twice, once for an exact match, and then for a match ignoring SSID if an exact match is not found. There can only be one exact match, but when searching for a match without using SSID, the first entry found will be used.

The syntax of the command is as follows ( 3 versions )

**ACL \* value**  
**ACL callsign + value**  
**ACL callsign -**

If you are not sysop, or if ACL is given on its own, the current contents of the ACL are shown.

The first form of the command changes the default value, the second form makes an entry in the list, the last form removes an entry from the list. It complains about syntax errors.

Here is another caveat to be dealt with when you are the sysop of an X-1 node(s). NOTICE in the following paragraph, the distinct possibility that a sysop can in fact; lock him/herself out of his/her own node.

HAVE FUN de Buck4ABT

A few moments thought will show that the sequence of commands

### **Connect To Node**

Execute Sysop Or Manager Command

Type the command ACL \* 127

(If you like to travel, and you feel macho) DISCONNECT!

### **You have just performed a step that IS QUITE CATASTROPHIC!**

You will not be able to get back in again apart from via the host port and noone will be able to connect to or from the node. If you intend to experiment with the command, you should start by entering your own callsign with a value of zero to ensure that you can get back in again !!!.

The list can be used as an 'accept' or 'reject' list by judicious use of the default. To create a list that excludes specific calls, put them into the list with the required bits set in the value. The default should be zero. To create an 'accept' list, put entries in with the required bits zero and set the corresponding bits in the default. Individual bits may be used to create accept or reject lists for each function.

The command steals buffers at a rate of one buffer per four entries in the ACL. Also, a long ACL will slow the node down nicely - so think before you enter a long list.

This command is for experimental purposes - if you find any bugs, let me know please ( I have not fully tested the gateway bit for example ). Also, it is not intended for malicious use but to allow fine control to be exercised over backbone networks. If I get lots of

negative responses back, the command will go !

### **3.22 CLOSEDOWN**

The closedown command is used to shut down the node remotely. If successfully executed, the node will effectively stop operating until it is reset ( eg by a power up ). The node's configuration ( routes, messages etc ) are not destroyed - the node simply hits a HALT instruction. You must be sysop to execute the command.

The syntax of the command is:

#### **CLOSEDOWN A**

The node will respond with 5 numbers just as for when the sysop or manager command was executed. Yes, you guessed, the node expects another password. Give it correctly and the node closes down completely. Get it wrong and you lose your sysop status. This obtuse and awkward syntax is designed to make sure it is not accidentally executed.

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## 3.23 ALIAS

The ALIAS command allows the node's alias to be changed. The syntax is :

**ALIAS [ \* | new-alias ]**

If no parameter is given, or if the user is not SYSOP or MANAGER, the current alias is displayed.

If the alias is deemed to be a valid alias, the node's alias is changed to the new one entered.

Note that the algorithm that checks for the alias structure is a bit queer. It is however, the original algorithm of TheNet and I am loth to change it for fear of side effects. Note too that the companion CALLSIGN command is NOT included - chaos is not something I crave. If the sysop gives the parameter of '\*', the node's alias is cleared.

## 3.24 BBSALIAS HOSTALIAS DXCALIAS

These commands are used to enable the node to respond to up to three additional aliases.

The syntax of each is the same, and by way of example the BBSALIAS syntax is :

**BBSALIAS [ \* | new-alias ]**

If not sysop, if no new alias is specified, or if it does not pass the weird alias syntax checker ( see 3.23 ) then the current alias is displayed. If not, the alias is changed. If '\*' is given, the alias is cleared.

The aliases so entered are nothing to do with the node's identity. If a BBS alias is set, for example to MXMBBS, then the node will listen for level 2 connects to that alias. It will respond to them and will automatically invoke the BBS command.

The use will also get the optional welcome (ctext) message and 'trying to connect to ....' messages if enabled by the appropriate 'mode' parameter.

The idea is that where a node sits on a channel that does not have access to the local host, BBS or cluster, the normal aliases of those stations may be enabled in the node to allow consistent access to the local services. Note that the three stations do not have to be a BBS, Host and cluster, it could be three BBSes or any other combination.

## 3.25 IPSTATS

The IPstats command has the same basic syntax as the PARMS and MODE commands. When invoked without parameters, it displays the current stats. Each statistic may also be altered by sysop, as defined in section 3.32.

In addition to the standard IP MIB, there is an additional parameter used to set the level 2 default modes, and the first entry in the MIB is used to enable or disable the router.

The complete set of IP MIB stats are included for compatibility with other IP systems, but several are not used. Also, the stats are 16 bit counters not 32 bit counters as in NOS.

Like NOS however, the stats do not reset every hour, they must be cleared by the sysop. They will however wrap around at zero.

The entries are:

- 1 Port default modes
- 2 Enable / Disable the IP router fuctions
- 3 Default IP Time To Live
- 4 IP Received frames
- 5 IP Header Errors
- 6 IP Input Address Errors
- 7 IP Forwarded Datagrams
- 8 IP Unknown Protocols
- 9 IP input frames Discarded

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- 10 IP Input frames Delivered
- 11 IP Output Requests
- 12 IP Output Discards
- 13 IP Output No Routes errors
- 14 IP Reassembly Timeout errors
- 15 IP Reassembly Required errors
- 16 IP Reassembly OKs
- 17 IP Reassembly Fails
- 18 IP Fragmentations completed OK
- 19 IP Fragmentation Failures
- 20 IP Fragmentation Creates

The default mode word may be set to 0, 1, 2 or 3. Each bit controls a port, with bit 0 controlling port 0 ( radio port) and bit 1 controlling port 1 ( RS232 port ). When set to 1, the default mode for that port when sending on a level 2 connection will be Datagram. When set to 0 it will be by Virtual Circuit.

The default mode is used when no other information is given, either by the ARP table or by the TOS bits in the IP header.

The enable / disable word may be set to 0 or 1. When set to 0, the operation of the router is stopped, when set to 1 the router functions.

The IP Time To Live ( TTL ) word is used to set the number of routers through which an IP frame may pass before it is discarded. It is similar to the node layer 3 TTL word. It may be set to any value up to 255, but values below 2 make no sense and are therefore not permitted.

The IP fragmentation reassembly timeout counter is not used as the node is just a router. It is left set to 30 seconds just to show which one it is !

The rest are just statistics. The patient user can have hours of fun working out which ones are not used ( or just think about it for a second or two ).

### 3.26 IPADDRESS & IPBROADCAST

These commands are used to set or display the IP addresses used by the node. The syntax of each is (by way of example):

**IPADDRESS [ ipaddress ]**

where ipaddress is in the form

**nnn.nnn.nnn.nnn**

where nnn is an integer in the range 0..255

So to set the node IP broadcast address to that used over here, the command would be:

**IPBROADCAST 44.131.0.0**

The IPADDRESS is the address that the node will respond to. It is used only as detailed in section 7. The IP broadcast address is the one used to denote broadcast packets that will be largely ignored. Note that port addressing is NOT currently supported.

### 3.27 IPRROUTE

This is one of the two main databases used by the node. The IP Route table is used to tell the router where to send a frame for a specific destination. It maps addresses or address ranges to a gateway IP address and to sub-network ports.

The ARP database then tells the node what station corresponds to that address and protocol. The node supports two subnet protocols, AX25 and Net/Rom.

The database is stored in an ordered list, in decreasing order of the number of relevant bits. This is to permit searching of the database when trying to find a specific destination. Given an address, it scans addresses with decreasing numbers of bits until it finds a match.



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The syntax of the command is as follows :

**IPROUTE [address [ / bits ][ + port [gateway [metric]]]]**

or

**IPROUTE [address [/bits][-]]**

In the first form, it makes an entry in the table, in the second it deletes one. Only sysop or manager may effect such a change.

The parameters are as follows :

<b>Address</b>	The amprnet address in the form nnn.nnn.nnn.nnn
<b>bits</b>	The number of significant bits (eg 44.131.0.0 / 16)
<b>port</b>	The port, either 0 or 1 for AX25 or n for Net/Rom
<b>gateway</b>	The optional gateway for this dest. nnn.nnn.nnn.nnn
<b>metric</b>	Currently not used, a numeric value

When an entry is made with a specific number of bits, the address is 'masked off' to that many bits, so enter an address of 44.131.16.31 / 24 and it will get entered as 44.131.16.0. The valid range for the number of bits is 1 - 32.

### 3.28 ARP

The ARP table maps a pair of address+port to hardware address+subnetwork mode. The address is either a destination or a gateway in the form nnn.nnn.nnn.nnn. The protocol is either Net/Rom or ax25. The hardware\_address is a callsign and the subnetwork mode is DG or VC (only has significance for level 2 links).

The syntax of the command is :

**ARP [ destination [ + [P] protocol callsign [mode ]]]**

or

**ARP [ destination [ - protocol ] ]**

In the first form an entry is made in the table, in the second an entry is deleted. This is only permitted for sysop or manager.

The parameters are :

destination	An address of the form nnn.nnn.nnn.nnn
P	If present, marks the entry as 'published'
protocol	AX25 or Net/Rom
callsign	A valid amateur callsign, e.g. G8KBB-5
mode	DG or VC

If 'P' is entered, then the node will publish the address. Specifically, if an ARP request is seen by the node for a station with the address given, it will send a response advising the caller of the callsign to be used.

More details on the operation of the router are contained in section 7.

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## 3.17 DXCLUSTER

The DXCLUSTER command operates just like the BBS command in that it may be used to effect a connection to a DXcluster (assuming there is one nearby). It should be disabled if it is not intended to be used to access a cluster.

The syntax of the command is :

### **DXCLUSTER [ \* | ? | callsign ]**

With no parameter, the command connects to a station previously specified by the use of the DXCLUSTER command with a callsign as a second parameter. Setting the DXCLUSTER to allow this may only be done by a sysop. The '\*' option may also only be executed by the sysop, this command clears a previously specified DXCLUSTER.

The '?' option ( or any text if not sysop ), prints out the current DXCLUSTER station setting.

If no DXCLUSTER is set, the command issues an error message if it is invoked with no other parameters.

The idea of this command is that, like with the 'bbs' command of the 'BPQ software, a user may connect to the local DXCLUSTER from the node.

## 3.18 HELP

The HELP command gives a message from the ROM. In general, it is expected that the message will be designed to assist new users in understanding the operation or configuration of the node.

The message may span many lines, and may be changed when the ROM is programmed. As delivered, it contains a brief help screen detailing the main ( user ) changes to the code.

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## 3.19 CTEXT

The CTEXT command sets or displays a message sent to a user who connects to the node by uplinking to the node's alias.

The syntax of the command is :

### **CTEXT [ \* | message ]**

With no parameter, the current message is displayed. If the user is also a sysop, and if text follows the command, that text is added to the current connect text.

If the message starts with a '\*', the connect text message is deleted. Hence, to clear the message, type the command 'ctext \*'. This is a change in version X-1J from previous versions. For further information, see section 3.33

A message is only sent if there is a ctext message set and if the relevant bit is set in the mode command parameter as described in section 3.5.11.

## 3.20 BTEXT

The BTEXT command sets or displays the additional beacon text sent along with the beacon packets.

The syntax of the command is :

### **BTEXT [ \* | message ]**

With no parameter, the current message is displayed.

If the user is also a sysop, and if text follows the command, that text is added to the current beacon text. If the message starts with a '\*', the beacon text message is deleted. Hence, to clear the message, type the command 'btext \*'. This is a change in version X-1J from previous versions. For further information, see section 3.33

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### 3.31 METER command

The Meter command is used to control the ADC functions of the software. In this version, this is limited to the Deviation meter, but future releases may extend this, for example to configure a signal level meter.

The syntax is as for the PARMS and MODE commands, as defined in section 3.32. It currently has only one parameter.

When set to 0, the deviation meter is disabled.

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 ( ie 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.

### 3.32 PARM, MODE, MTU, METER & IPSTATS command syntax

The syntax of these commands has changed.

All use the same syntax, which may be either of two types, the original TheNet 1.01 syntax ( as used in versions previous to X-1J ) or an 'offset & value' type.

The original syntax was, by way of example,

```
PARM { [ * | new_value ] [ * | new_value ] ..... }
```

so to set the 10th PARM ( the L4 retries ) to 1, the syntax would be :

```
PARM ***** 1
```

The equivalent new syntax command would be :

```
PARM /10 1
```

The '/' command signifies that what follows is the parameter number followed by the new value. As for the old command syntax, the complete list of parameters is displayed. Setting the parameters may only be done by a Sysop. Note that BOTH command syntaxes are supported - you can use whichever you prefer.

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In section 3.33 that follows you will learn how to easily set text into your X1J4 node from a remote location. The "INFO" text can be used to identify the node and its location, sysop, elevation, geographic coordinates etc...

CText may be used to give specific instructions to enter for other services; ie; BBS, HOST, DXCluster or other announcements. The CText is displayed when the node is connected to by local users.

BText may be used to make area announcements. The Beacon Text may be set to broadcast at various times. Normally the sysop sets the beacon broadcast period to 3600 equals one hour. The text may announce a club meeting, event or the date of an up-coming hamfest.

Have fun de Buck4ABT

### 3.33 BTEXT, INFO AND CTEXT COMMAND SYNTAX

In Version X-1J, the syntax of these commands changed. In addition, the Info message was doubled in size to 160 bytes.

If someone who is not Sysop uses the command, the current settings are displayed.

If a Sysop uses it without any additional parameters, the current setting is displayed.

If a Sysop enters one of the commands followed by a parameter of '\*', the current message is deleted.

If a Sysop enters a string of text, that text is added to the current message, followed by a newline.

It is therefore possible to build up multiple line messages. If you wish to start a message with a blank line, enter a message with a non display ( or innocuous display ) character such as control-A. It will get entered followed by a newline. On most systems this will not display. On some systems such as PCs running NOS, it will display as a smiley face.

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## 4. OTHER CHANGES

### 4.1 Command Processor

The command processor has been altered. In general, but not in all cases, commands only appear on the 'help' menu when they are enabled, so for example the 'BBS' command will not be shown unless it has been enabled with the 'BBS +' command. The exception is the sysop commands, like MODE, LINKS and PARMS, which are never shown to users but are of interest to them. If the appropriate bit is set however in the MODE command ( see 3.5.11 ), then for the sysop or manager, all commands appear in the help prompt - EVEN IF DISABLED.

The help screen now shows commands in a combination of upper and lower case characters.

### 4.2 Beacon digi

It is possible to set a digi in the address used for beacon packets. Details of how to do this are contained in the configuration guide. Note that this is provided for those rare occasions when there is a genuine need. This is rarely the case and should not be done unless really necessary.

### 4.3 Nodes Broadcasts after power-up

The node will now broadcast its node table 60 seconds after power-up. This is to ensure that the network is back to an operational state as soon as possible following a node reset. The reason for the short delay is to cater for the situation where the Sysop switches on the node before the radio.

## 5. CWID keyer.

The CWID keyer sends the station callsign in CW by alternating between the two modem tones.

This section covers the other miscellaneous changes to the software.

This is nominally sent at 20 wpm once every 30 minutes, but the speed and period can be changed remotely.

After a delay of 30 minutes, the callsign is sent appended to the end of the next data packet that is sent over the air. There is a 500 ms delay after the end of the data packet before the call is sent.

The program prefers to send CWIDs appended to ordinary data packets. However, if one minute after the CWID has supposed to be sent it is still pending because no data packets have been sent, it will key up the transmitter anyway. Persist, TxDelay and other parameters are honored, but the process involves changing the SIO mode and this will have an annoying effect on any packets being received in full duplex mode.

## 6. Version X-2.

X-1 was the first release of this code. The objective is to get some practical feedback and test the code before the full release, version X-2, which I hope will be very similar to this release ( X-1J ). I have been saying this for some time now, but things keep getting added. The next version will hopefully be a significant change with extensions from G8AMD, but this may be some time off yet...

Version X-1A added the escape-N command and the change to the connect, nodes and reset commands. The timers were also added to the stats command.

Version X-1B removed all the escape commands apart from C,D and P. It also added the MODE command and extended the + and - command qualifiers to all commands.

## PacketRadio Networking Handbook for the System Node Operator

Version X-1C added TALK, MANAGER and AUDIT. The SYSOP command was enhanced and the INFO command was altered to limit the length of a message ( a bug in the original version of TheNet ). The help screen was changed to display commands in a combination of upper and lower case.

Version X-1D extended the auditing and statistics to cover auditing everything but level 3, and statistics of the CPU, Level 1, Level 2 and timers.

Version X-1E added beacon timer control, the connect redirector, the nodes dump facility, level 3 & 4 statistics and the LINKS and CALIBRATE commands.

Version X-1F added the CLOSEDOWN, DXCLUSTER, ACL, CTEXT, HELP and BTEXT commands. Another parameter was added to the MODE command to control textual messages. The mod suggested by DF2AU to correct the DCD latchup was included. Additional statistics were added covering CRC errors, receiver overrun, transmitter underrun and framing errors.

Version X-1G added mainly the IP router, with the following commands to control it - IPRROUTE, ARP, IPSTATS, IPADDRESS, IPBROADCAST. In addition, the ALIAS, BBSALIAS, HOSTALIAS and DXCALIAS commands crept in, as did QUIT as an alternative to BYE. The help messages extended to enable nodes in the routes list to appear as alias:callsign, and an extra byte on the MODE command allowed '#' nodes to be selectively NOT broadcast. The order of HELP and HOST commands changed so that 'h' on its own gave help not host. The code was optimised with some time critical parts being recoded in assembler and a peephole optimiser being used for additional improvements.

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Version X-1H fixed 3 bugs in X-1G.

Version X-1J added the deviation meter support with the Meter command and Mheard changes. In addition, parameters were added to the MODE command for slime trail control, control of digipeating and reconnection to node. The command syntax of Info, Btext and Ctext was changed to support multiple lines and the Info message space was doubled to 160 bytes. Nodes broadcasts now occur 60 seconds after power up and the ARP Digi bug fix was included. The level 4 minimum retries was dropped to 1 and the PARM, MODE, IPSTATS, METER and MTU command syntax was extended to support 'offset & value' type operation. An MTU command was added to allow IP MTU limits to be changed under software control. The node alias case sentivity bit and TALK 8 bit data bits were added.

### 7. The IP router

The IP router co-exists in the node with the other software. It is connected to the L2 and L3(Net/Rom) protocol machines, and is managed from the L7 switch. It will accept data from L2 Datagrams, L2 Virtual Circuits or NOS protocol extended Net/Rom frames. It will output to these 3 depending on the setting of the IProute and ARP tables.

The router supports the IP options of NOS and also does IP fragmentation. Level 2 segmentation is not supported. In addition, ICMP is implemented in so far as it is needed to respond to errors or PINGs. No higher layer support is provided, i.e. TCP is not implemented, ip\_send() and ip\_receive are only implemented in so far as they are needed for ICMP. You can therefore PING it but anything else will solicit an ICMP error message.

It will respond to ARP & REV\_ARP requests but will never initiate them.

The default MTU is 256 for AX.25 and 236 for Net/Rom. It will accept longer datagrams than this and fragment the output but it is not recommended as it merely wastes RAM. The MTU command may be used to change this.

It is possible to be creative in the use of L2 datagram and virtual circuits by use of the port default settings and the ARP table. The algorithm used is :

When a frame is to be sent, the ARP table is scanned for the appropriate entry. The entry tells it what callsign to use. For Net/Rom encapsulation, it is send to the Net/Rom protocol handler.  
For AX.25 encapsulation the following applies.

The ARP table may indicate DG or VC. In this case, that mode is taken. If there is no DG or VC entry, the TOS bits are examined. If the delay bit is set, a datagram mode is selected. If not, and the reliability bit is set a virtual circuit is selected. If neither bit is set, the default mode for that port is used to select a mode ( see IPstats command, first parameter ).

Port addressing is not supported at the moment.

The IP router is manually controlled - no rspf or rip, or even ARP requests. This is because 32K of RAM does not allow such niceties as queuing frames while waiting for address resolution.

## X-1J4 REMOTE SNO'S PARAMETERS & DEFINITIONS

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

*Parameter 1*

### DESTINATION LIST LENGTH

Limits the maximum number of nodes, both hidden and non-hidden, that will accumulate in the ROUTES table. This table contains an alphabetical listing by alias of distant (destination) nodes picked up during neighbor node(s) broadcasts. This is the same listing a user sees in response to a NODES command. The term "Destination" implies a user is able to make a single connect to any of the nodes listed in the 'destination table'. With each node listed, the amount of "free buffers" within the node's memory space is reduced by 36 bytes. Depending upon the number of nodes in the table, the node's memory could become temporarily depleted. Should this happen, the response to certain commands will be "Node busy". The number of free buffers is shown in parenthesis during the USERS command response.

Free buffer depletion is not normally a problem with the typical node when the maximum table size is limited to 100. If the Minimum Quality for Update, parameter 1, is sized to limit the number of nodes to those that are "connectable", the NODES table will normally contain far fewer than 100 limit.

**Suggested value is "30".** *Range: 1-400)*

*Parameter 2*

### MINIMUM QUALITY FOR UPDATE

Sets the minimum path quality value of other nodes that will be accepted into the routing table. Nodes included in the broadcasts will be limited to those with path quality values equal or greater than this parameter. If the value is set low, distant nodes with lower path values (poorer probability of connect) will be allowed into the tables. Higher values will improve the probabilities of a successful connection. A setting of "0" disables the automatic update function and does not allow ANY nodes to be recognized (not recommended). The value selected will depend on several factors. These include the purpose of the node, network type and size.

**A suggested value for a multi-user simplex configured node is "64."** *(Range: 0-255)*

*Parameter 3*

### HDLC CHANNEL QUALITY

HDLC is an OSI level 2 function and is what the AX.25 protocol is based upon. Here, the term is synonymous with RADIO PATH QUALITY. Certain types of packet networks (wire links, HF/VHF/UHF radio with varying user access) are more efficient than others. The most ideal packet link is a full duplex wire line between two TNCs.



This is because there is no outside interference to corrupt the circuit. Least ideal is a multi-user accessed HF link subject to interference and changing propagation conditions between the two TNCs. Through observations and studies the following conventions were established:

**TYPE OF PATH BETWEEN TNCs    PATH QUALITY    RELIABILITY**

RS-232 wire line (2 port)	255	99
Satellite link	252	98
RS-232 wire line (3 port) link	248	97
UHF radio non-user radio link	240	94
VHF radio non-user radio link	224	88
VHF/UHF user accessed radio link	192	75
TEN Meter (1200 B/S) user link	188	70
HF user accessed radio link	128	50

*It should be remembered these path quality values are for ideal situations. Path congestion and propagation conditions will lower the values accordingly. But by convention, the above values will be used in parameters 2 and 3 throughout the system. The above chart explains why it is undesirable to allow user access to backbone trunks. By doing so, the path quality is degraded.*

**Recommended** default for a 1200 baud VHF/UHF user accessed simplex radio link is **100**. A reliable neighbor should be locked to **192**. (Range: 0-255)

*Parameter 4*

**RS-232 CHANNEL QUALITY**

Describes the path (or port) via the RS-232 connector (DB-25 or DB-9) at the rear of the TNC. If configured for multi-node operation, this connector ordinarily attaches to either another TNC/node, or to a diode matrix connecting three or more TNC/nodes. As indicated in the above chart, the probability of a successful connection is highest for two TNCs RS-232 connected. Therefore, the highest path quality value is assigned to this configuration. Diode matrix connected TNC's have a lower probability of connect. This is because any one given TNC may be held off while an active packet is in process to another TNC on the matrix. Thus throughput over diode matrixed TNCs is not as high as two direct connected TNCs. Path quality values for this parameter ordinarily are set at **255 for two nodes**, and perhaps as low as **245 for several diode matrixed nodes**.

- NOTE: SYSOPing the existing value of Params 2 and 3 to a different value on
- active nodes showing in the ROUTES will not be immediately shown. If these
- nodes decrement fail and later come back, they will reappear with the new
- SYSOPed Path Quality value assigned to them.

A procedure to get the new value to quickly go into effect without a reset of the node, would be to lock the routes. The following illustrates how HDLC (radio) CHANNEL QUALITY and RS-232 CHANNEL QUALITY are displayed in response to a (R)outes command:

**AGA:AA4UA-7} Routes:**  
**0 MLJ:WB4ILR-5 150 16**  
**1 BLY:AA4UA-5 255 15**  
**1 UA96:AA4UA-9 255 15**

The 0 and 1's seen in the left column correspond to the port identifiers listed in parameters 2 and 3.

The 0 means it is a radio port and the 1 is an RS-232 TNC port. The 3rd column is the default settings

in this example for parameters 2 and 3. Here we note the NodeOp has determined the radio path to MLJ is not a good "standard" 192 quality path. Therefore he has assigned it a value of 150. If a neighbor node had a good quality path, parameter 2 would be set for 192. Then the ROUTES locking technique would be used to set MLJ to the 150 value. In this example, the NodeOp has assigned RS-232 CHANNEL QUALITY values of **255** to both the BLY and UA96 nodes. The last column indicates the number of destination routes via the path shown.

**(Range: 0-255)**

#### Parameter 5

### OBS COUNT INITIAL VALUE

The initial value for the NODES obsolescence counter. This counter displays how current a path is to a destination node. The node keeps track time-wise of all nodes heard during neighbor broadcasts. By convention, this counter is normally defaulted to "6." If for some reason a known node isn't heard upon receipt of the next neighbor broadcast, the obsolescence value for that node will decrement to "5." If not heard at the next broadcast, it goes to "4," etc. Once the value goes to "0," knowledge of that node is removed from the routing table. If the node IS heard before the value falls to "0," it automatically is reassigned a "6." By comparing the broadcast timer value in parameter 6 against the obsolescence count, one can calculate how "fresh" a path is.

The purpose of the obsolescence counter is to purge failed nodes from the routing tables. With half hour broadcast cycle (**1800 seconds**), an initial value of "6" will allow a failed node to remain in the routing tables of immediate neighbors for up to 3 hours. Depending upon the parameters of more distant nodes, the failed node may appear within the network for a longer period before finally being decremented out.

Nodes configured as HF gateways are subject to variable and sometimes sudden, propagation shifts. An initial obsolescence counter value of "5" on the HF node and on adjacent RS-232 connected VHF/UHF nodes will hasten the purging of stale nodes from the system. **(Range: 0-255)**

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*Parameter 6*

**OBSOLESCENCE COUNT MINIMUM FOR NODE BROADCAST**

Sets a limit on the minimum obsolescence value associated with other nodes to be included in the NODES broadcast. For instance, if a neighbor has not heard the RVNC:K4000-7 node for 2 or 3 broadcast periods, the likelihood is high RVNC has failed. Thus it is good network practice to avoid sending out useless node data. By setting parameter 6 to a value of one less than that of parameter 5, freshly failed nodes will not be included in the forthcoming broadcast. Knowledge of the missed node will remain until decremented out by parameter 5. Therefore, if the broadcast was simply missed due to QRM, distant users would still be able to connect to that node.

**If parameter 6 is set to a value higher than parameter 5, the NODES destination table will include only itself. (Range: 1-255)**

*Parameter 7*

**NODES BROADCAST INTERVAL**

The NODES broadcast interval controls the "heart" of TheNet's dynamic routing process. It is this timer that sets the frequency of broadcasts that includes node aliases, callsigns, routing, and obsolescence information. The broadcast timer also initiates action to systematically decrement failed nodes from the routing tables. For proper synchronization of network actions, it's recommended the value selected for the broadcast interval be the same on all nodes in the system. Short intervals will insure greater network routing reliability but at the expense of increased network overhead. Longer intervals decrease overhead but yields poorer routing reliability.

The suggested value of **1800** seconds (*30 minutes*) achieves a reasonable balance. A 30 minute interval will cause failed nodes to be decremented out of neighbor routes tables within 3 hours or less. A setting of "0" will disable the timer and is not recommended.

*(Range: 0-65535)*

*Parameter 8*

**TIME-TO-LIVE INITIALIZER (Level 3)**

Routing paths may exist in a network that will route frames in an endless loop. To prevent this, it's desirable to set a maximum limit on the number of nodes a frame can be directly routed through. The time-to-live parameter limits the number of hops that network layer frames originating from this node will travel before being terminated. The function of this parameter is to reduce network congestion should a connect request to a distant node get caught in a routing loop.

Connect requests directed to destination nodes beyond the number of hops allowed, will be quietly ignored. The value selected should be several hops longer than the longest "direct connect" in the system. A

**Suggested value is 64.** (Range: 0-255)

*Parameter 9*

**TRANSPORT TIMEOUT (Level 4)**

Sets the time period for acknowledgement failure prior to sending a level 4 transport layer retry. As an example, assume a user is connected hop-by-hop through a moderately busy system to a destination node 20 hops away. With each connect, level 4 transport information frames are exchanged between the user and the current destination node. Every information frame requires a level 4 ack. As the circuit grows longer, so does the time for the acknowledgement to arrive.

Should the transport timeout be set too short, there is danger of creating excessive information frame retries and corresponding increase in circuit congestion. Set too long, throughput could suffer while waiting for the retry, if a frame is abandoned somewhere along the circuit.

**Suggested values that help prevent congestion are 180 - 240 seconds.**

(Range: 5-600)

*Parameter 10*

**TRANSPORT MAXIMUM RETRIES (Level 4)**

Establishes the maximum number of times the transport layer will be tried before a circuit failure response is given. The value selected will cause the node on the sourcing side of the failed circuit to try for a number of times equal to the product of the values set in parameters 9 (link maximum tries) and 19 (transport maximum tries). If the number of transport tries is set high, link congestion results.

**Suggested value is "2".**

(Range: 2-127)

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*Parameter 11*

**TRANSPORT ACKNOWLEDGE DELAY (seconds)**

Sets the number of seconds the end-to-end level 4 transport circuit has in sending an acknowledgement to an information frame. If the delay is too short, the node will key-up on every ack. If set too long, delay in throughput could be noticeable. Finding just the "right delay" is a function of network type, circuit length, circuit loading, and baud rates. Some delay is an advantage as it reduces the node's key-up cycle by permitting transport acks to ride along with outgoing information frames.

**Suggested values are from 3 seconds.**

*(Range: 1-60)*

*Parameter 12*

**TRANSPORT BUSY DELAY (seconds)**

Limits the number of seconds an incoming level 4 frame shall be held if its choke flag is set. When the circuit isn't cleared within the allocated time, the frame is discarded. The purpose of the transport busy delay is to act as a fail-safe timer to prevent circuit lockups. If the delay is too long, the circuit will be slow to respond to route failures. If too short, unnecessary L4 information frame retries may be sent causing congested circuit conditions. The delay should be somewhat longer than the worst node-to-node round trip time in the network.

**Suggested value is 180 seconds.**

*(Range: 1-1000)*

*Parameter 13*

**TRANSPORT WINDOW "FRAME" SIZE (Level 4)**

Transport window size (TRANSPORT LAYER (level 4) MAXFRAME) performs two functions.

It limits the number of non-acknowledged level 4 information frames heading toward the destination node. It also sets a limit to the number of incoming out-of-sequence information frames that will be temporarily buffered. If this limit is exceeded, a circuit choke response is sent toward the sourcing node. A small window size requires a short acknowledgement timer, parameter 20. A larger window size would benefit from longer ack delay times by reducing the number of overhead frames sent through the network. Too low of a value will increase the node's key-up cycle and, a high value impacts thruput.

**MAXFRAME [buffer] size of 4 is suggested.** *(Range: 1-127)*

*Parameter 14*

**CONGESTION CONTROL THRESHOLD "Frames" (Level 4)**

The congestion control threshold also performs two functions. It limits the number of level 2 link layer frames that will be held before issuing a Receive Not Ready (RNR) response. It also sets the maximum number of transport layer frames (in sequence or not) that will be accepted before sending a circuit choke response toward the source node. Too low of a value can delay LAN throughput if the backbone is moderately busy. This buffer should be set to agree with parameter 13.

**Suggested value is 4 frames.** (*Range: 1-127*)

*Parameter 15*

**NO-ACTIVITY TIMEOUT (Level 7) "seconds"**

The no-activity timeout timer performs several missions. The node monitors activity on either of level 2 and level 4 circuits. If no activity is detected during the period the timer is set for, the circuit is disconnected. In conjunction with circuit activity, the timer sets the life of the "activity arrow" seen on the ROUTES response. It also sets the maximum period a CQ command can be observed in the USERS response. Setting the timeout to zero disables the timer (not recommended).

**Suggested value is 900 seconds (15minutes)** (*Range: 0-65535*)

*Parameter 16*

**P-PERSISTENCE THRESHOLD**

Parameters 25 and 26 work together to set up a random delay determining when the node will key up following a DCD decision that the channel is clear. This is an anti-collision technique. When the node is ready to transmit, a number between 0 and 255 is internally generated. If this number is equal or less than the value set by **Parameter 25**, the node keys immediately upon sensing a clear channel. If the internally generated number is greater than the value of parameter 25, the node waits for a period of time equal to the slot time and then internally generates a new number, etc.

**A value of 64 is 25% of 255 and thus sets the percentage of time the node will immediately key-up when a clear channel is sensed.**

Protected trunking nodes would have faster throughput if random key-up delays were eliminated. Set parameter 16 to a value of **255** will accomplish this.

**Suggested setting is 64.** (*Range: 0-255*)

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*Parameter 17*

**PERSISTANCE "SLOT TIME" DELAY (In 10 millisecond increments)**

The slot time interval is adjusted in consonance with P-Persistence to establish a variable delay node key-up algorithm designed to prevent collisions. Since the variable key-up delay algorithm only impacts WHEN the node is keyed, it has no relationship to either node or user TXDs. On single transmitter channels, slot time is disabled when P-Persist is set to 255.

**In multiple transmitter environments and with P-Persist set to 64, a slot time of 10 (100 milliseconds) is suggested. (Range: 0-127)**

*Parameter 18*

**LINK T1 TIMEOUT "FRACK" (seconds)**

Specifies the time in seconds a point-to-point level 2 frame retry will be sent to a node or a user if a previous frame isn't acknowledged. The value chosen will vary with the type of service the node performs. Small values may unnecessarily increase the node key-up cycle in multi-user environments. Large values on single transmitter links will slow throughput. **Suggested value(s) for multi-user service are "4" and, "2" for single/dual transmitter links. (Range: 1-15)**

*Parameter 19*

**LINK LEVEL 2 WINDOW SIZE "MAXFRAME" (frames)**

Specifies the maximum number of point-to-point level 2 frames that can be sent to a node or a user without acknowledgement. Small values on busy high-speed links will dramatically increase the node key-up cycle due to increased frame acknowledgement requirements. Larger values on solid links will allow improved throughput efficiency. If SEDAN keyboard operators are being prematurely disconnected on access nodes, over-aggressive server TNC parameters may be at fault.

**Suggested value is 6 frames. (Range: 1-7)**

*Parameter 20*

**LINK MAXIMUM TRIES**

Sets the number of attempts a point-to-point level 2 circuit will be tried between a user or a node before a failure is reported. When level 4 transport end-to-end circuits are involved, the number of times the node transmitter is keyed on a failed link is the product of the values for parameters 9 and 19.

**Suggested value is 7 tries. (Range: 0-127)**

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*Parameter 21*

**LINK T2 TIMEOUT**

Link T2 timeout is the node's equivalent to a TNC's RESPONSE TIME parameter. It sets the amount of delay following receipt of a level 2 info frame before an acknowledgement is sent. A little delay is desirable as it gives a chance for the ack to ride along on the next info frame. Too much delay will slow throughput.

**Suggested value is "100" (1 second).** (*Range: 0-6000*)

*Parameter 22*

**LINK T3 TIMEOUT (In 10 millisecond increments)**

Link T3 timeout is the node's equivalent to a TNC's CHECK parameter. Its purpose is to send out a level 2 "check packet" following a specified period of inactivity, to verify the link layer is still connected. If a response isn't received prior to completion of the retry sequence, the circuit is disconnected. Should the timer value (10 ms increments) be set too short, the check packets add unnecessarily to link congestion. This command is also used to break link lockups.

**Suggested value is "18000" (timer disabled).**

(*Range: 0 - 65535*)

*Parameter 23*

**DIGIPEAT**

**Digipeating YES = 1 NO = 0**

*Parameter 24*

**VALIDATE CALLSIGNS**

Determines if incoming callsigns will be verified against the internal callsign validation routine. It's to both user and NodeOp's advantage to implement callsign validation. If not enabled, a distant user mistyping a node alias, may have to wait a considerable length of time before receiving an appropriate node response. If the Node Sysop is desiring to allow user downlinks to KA-node aliases, possibly these alias could be selected to satisfy the callsign verification.

**Suggested default is "1."**

(*Range: 0-1*)

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*Parameter 25*

**STATION ID (BEACONS)**

Defines whether the node transmits an ID beacon.

The following options are available:

- 0** = OFF, Disabled (ID's OFF)
- 1** = CONDITIONAL, Used (ID's every 10 minutes when the frequency is in use)
- 2** = ON, Enabled (ID's broadcast every 10 minutes)

ID beacons contribute to network poop. (**See beacon period in MODES table**).  
On backbone & trunks frequencies they can be turned off.  
On user/LAN nodes, ID's are useful for MHeard support.

**Suggested value is "1".**

*(Range: 0-2)*

*Parameter 26*

**CQ BROADCASTS ENABLE FLAG**

Controls whether or not the UNPROTO text sent by a CQ user will be broadcast from the node. This parameter does not affect the listing seen in response to a USERS command should someone be inviting a CQ contact.

- 0 = Disabled (no UNPROTO broadcasts)
- 1 = Enabled (UNPROTO broadcasts allowed)

**Suggested value is "1".**

*(Range: 0-1)*

## TheNET X-1J4 QUICK REFERENCE GUIDE

### SWITCH COMMANDS

```

⇒ ACL      [{ CALLSIGN + VALUE } | { CALLSIGN - VALUE } | { * VALUE } ]
⇒ ALIAS    [ * | NEW_ALIAS ]
⇒ ARP      [ipaddr [{ - ptcl } | [ + [ P ] ptcl callsign [ DG | VC ]]]
⇒ AUDIT    [ NUMBER_FROM_0_TO_255 ]
⇒ BBS      [ CALLSIGN | * | ? ]
⇒ BBSALIAS [ * | NEW_ALIAS ]
⇒ BTEXT    [ * | BEACON_MESSAGE_TEXT ] (see note 6)
⇒ BYE
⇒ CALIBRATE [ PERIOD_VALUE_FROM_1_TO_60 [ TOGGLE_VALUE_1_TO_PERIOD ] ]
⇒ CLOSEDOWN A
⇒ CONNECT  [ CALLSIGN [ [V] DIGILIST ... ]
⇒ CQ       [ MESSAGE_FOR_CQ_PACKET ]
⇒ CTEXT    [ * | CONNECT_MESSAGE_TEXT ] (see note 6)
⇒ DXCLUSTER [ CALLSIGN | * | ? ]
⇒ DXCALIAS [ * | NEW_ALIAS ]
⇒ HELP
⇒ HOST     [ CALLSIGN | * | ? ]
⇒ HOSTALIAS [ * | NEW_ALIAS ]
⇒ INFO     [ SYSOP_SET_MESSAGE ] (see note 6)
⇒ IPADDRESS [ NEW_IP_ADDRESS ]
⇒ IPBROADCAST [ NEW_IP_ADDRESS ]
⇒ IPROUTE  [ipaddr [ /bits ] [ - | + port [ ipgateway [ metric ] ]]]
⇒ IPSTATS  [ { NEWPARAM | * } { NEWPARAM | * } ..... ] (see note 5)
⇒ LINKS
⇒ MANAGER
⇒ METER    [ new_value ] (see note 5)
⇒ MHEARD   [ NUMBER_FROM_1_TO_100 ]
⇒ MODE     [ { NEWPARAM | * } { NEWPARAM | * } ..... ] (see note 5)
⇒ MTU      [ list_of_parameters ] (see note 5)
⇒ NODES    [ * [*] | NODECALL {+|-} IDENT QUAL COUNT PORT NEIGHBOUR [DIGIS]]
⇒ PARMS    [ { NEWPARAM | * } { NEWPARAM | * } ..... ] (see note 5)
⇒ QUIT
⇒ RESET    [ ANY_CHARACTER ]
⇒ ROUTES   [ PORT NODECALL [ DIGILIST ... ] { + | - } PATHQUALITY ]
⇒ STATS
⇒ SYSOP
⇒ TALK     [ STRING ]
⇒ UI       DEST STRING_OF_TEXT_TO_BE_SENT_IN_UI_FRAME
⇒ USERS
    
```

**Note 1** Any command may be enabled or disabled by the use of the '+' or '-' modifier, as shown below:  
 ANY\_COMMAND [ + | - | THAT\_COMMANDS\_PARAMETERS ]

**Note 2** IP addresses are of the form nnn.nnn.nnn.nnn  
 where nnn is a number 0..255

**Note 3** IProute port paramter takes the form 0 or 1 for radio or rs232 AX.25 or Net/Rom for Net/Rom ( May be abbreviated )

**Note 4** ARP ptcl parameter is AX.25 or Net/Rom ( may be abbreviated )

**Note 5** The commands will accept the 'old' syntax of '\* \* \* value...' or the new offset & value syntax of '/ parameter\_number value'

All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)

### HOST 'ESCAPE' COMMANDS

```
<escape> C
<escape> D
<escape> P [ NEW_PASSWORD ]
```

### UNDERSTANDING ACL VALUES | UNDERSTANDING AUDIT BITS

Bit	Function	Bit	Function
0	Bar all incoming L2 connects	0	Issue L1 stats every 10minutes
1	Bar outgoing L2 downlinks	1	Audit L2 connects & disconnects
2	Ignore nodes broadcasts	2	unused
3	Bar gatewaying at level 3	3	Audit L4 connects & disconnects
4	Bar incoming L4 connects	4	Audit L7 use of sysop command
5	Bar outgoing L4 connects	5	Audit all L7 switch commands
6	ignore SSID in searching	6	Issue CPU stats every 10minutes
7	unused	7	unused

### PARMS PARAMETERS

#### Number Min Max Function

1	1	400	Maximum number of destination nodes
2	0	255	Minimum quality for auto update
3	0	255	HDLC ( radio, port 0 ) default quality
4	0	255	RS232 ( crosslink, port 1 ) default quality
5	0	255	Initial value for obsolescence counter
6	1	255	Minimum obsolescence for node broadcast
7	0	65535	Auto update broadcast interval ( seconds )
8	0	255	Level 3 ( network ) Time To Live Initialiser
9	5	600	Level 4 ( transport ) timeout ( seconds )
10	1	127	Level 4 ( transport ) retries
11	1	60	Level 4 ( transport ) acknowledge delay (seconds)
12	1	1000	Level 4 ( transport ) busy delay ( seconds )
13	1	127	Level 4 ( transport ) window size ( frames )
14	1	127	Level 4 ( transport ) congestion control threshold
15	0	65535	Level 7 ( switch ) inactivity timeout ( seconds )
16	0	255	Persistence for transmit delay
17	0	127	Persistence slottime delay (10's of milliseconds)
18	1	15	Level 2 ( link ) T1 timeout, ie FRACK ( seconds )
19	1	7	Level 2 ( link ) window size ( packets )
20	0	127	Level 2 ( link ) retries
21	0	6000	Level 2 ( link ) T2 timeout (10's of milliseconds)
22	0	65535	Level 2 ( link ) T3 timeout (10's of milliseconds)
23	0	1	Level 2 ( link ) digipeat enable flag
24	0	1	Callsign validation flag
25	0	2	Node beacon control (0=off, 1=if active,2=always)
26	0	1	CQ broadcasts enable flag

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NO.	MIN	MAX	MODE PARAMETERS
1	0	1	Hardware handshake host control mode flag
2	0	3600	CWID repeat period ( seconds )
3	4	10	CWID speed ( 10's msec per dot )
4	0	3	Nodes broadcast channel enable flags where 0=none, 1=HDLC only, 2=RS232 only, 3=Both ports
5	0	3	Crosslink protocol selection 0=crosslink, 1=KISS, 2=KISS+selcopy, 3=KISS+allcopy
6	0	255	TX keyup delay ( 10's of milliseconds )
7	0	1	Full duplex enable flag
8	0	65535	RS232 ( port 1 ) node broadcast period ( secs )
9	0	3	Node broadcast algorithm control flags 0=off, 2=RS232 port, 1 & 3 not normally used
10	600	3600	Beacon interval ( seconds )
11	0	2	Connect redirection to BBS flag
12	0	127	Help messages enable flags, 8 bit TALK & case
13	0	3	Hash node broadcast disable ( one bit per port )
14	0	1	Enable extra aliases monitoring if set
15	0	1	Enable auto reconnection to node after remote dis
16	0	3	Slime trail control. Each bit controls a function, Bit 0 if set hides slime trails in nodes listing Bit 1 if set causes slime trails to be ignored
17	0	3	Digipeat control. Each bit controls a function... Bit 0 set causes node to refuse digi'd L2 uplinks Bit 1 set, node refuses to allow digi downlinks

IPSTAT PARAMETERS			
Number	Min	Max	Function ( Those marked '*' are not used )
1	0	3	ip L2 AX.25 Modes ( 1 bit per port, 1=DG )
2	0	1	ip Forwarding, 1=enable router, 0=disable
3	2	255	ip Default TTL
4	0	0	ip In Receives
5	0	0	ip In Header Errors
6 *	0	0	ip In Address Errors
7	0	0	ip Forwarded Datagrams
8	0	0	ip In Unknown Protocols
9 *	0	0	ip In Discards ( TTL exceeded )
10 *	0	0	ip In Delivers
11	0	0	ip Output Requests
12 *	0	0	ip Output Discards
13	0	0	ip Output No Routes
14 *	1	30	ip Reasm Timeout
15 *	0	0	ip Reasm Requireds
16 *	0	0	ip Reasm OKs
17 *	0	0	ip Reasm Fails
18	0	0	ip Frag OKs
19 *	0	0	ip Frag Fails
20	0	0	ip Frag Creates

Number	Min	Max	Function
1	64	1024	IP Port 0 ( Radio Port ) Level 2 AX.25 MTU
2	64	1024	IP Port 1 ( RS232 Port ) Level 2 AX.25 MTU
3	64	236	IP Net/Rom port MTU
4	257	1025	Level 2 Max data bytes in a packet before error
5	328	1096	Level 2 Total max packet size in bytes

## USER GUIDE FOR TheNet X-1J4

This brief note is intended for users of TheNet X-1J, and explains the basic commands. Configuration and sysop features are not covered fully.

TheNet X-1J is an extension of TheNet 1, and provides a number of new features. The switch provides the following user commands :

- ▲ Connect
- ▲ Info
- ▲ Nodes
- ▲ Routes
- ▲ Users
- ▲ Talk
- ▲ CQ
- ▲ BBS
- ▲ Host
- ▲ MHeard
- ▲ Bye
- ▲ DXcluster
- ▲ IProute
- ▲ ARP
- ▲ QUIT

Not all commands may be available on every node as certain commands might have been disabled. If a command has been enabled, it will be displayed when you type an invalid command such as '?'. In addition, there are some commands that are available but are not displayed. The main ones of interest are :

- ▲ Links
- ▲ Mode
- ▲ Pams
- ▲ Stats
- ▲ IPAddress
- ▲ DXCAlias
- ▲ BBSAlias
- ▲ HostAlias
- ▲ MTU

In general, commands take parameters, for example to connect to GB7MXM, the command to be entered is CONNECT GB7MXM followed by return. Usually, commands are not case sensitive ( although node aliases may be ), and commands may be abbreviated.

### Connect

If the connect command is given on its own, then assuming that the sysop has set it up correctly, you will get connected to the local BBS.

If you give another callsign, either of a local station or a node, the node will attempt to connect you to that station either by a level 4 connection or by downlinking. If you are downlinking, you may also specify digipeaters.

In either case, you get either a connected message or a message telling you of the failure to connect. If you enter any other command at this stage, the connection attempt will be aborted.

If you attempt to downlink with digipeating, or attempt to downlink to an invalid callsign such as a node alias with an SSID, you may get an error message depending on how the Sysop has configured the node.

Finally, if you connect to the node, then connect to another station, and that station disconnects you ( e.g. connect to a BBS and use the 'Bye' command of the BBS ), you will either get reconnected to the node or disconnected completely depending on the configuration of the node.

If you enter a node alias and get an 'invalid call' message, it can either be because the node is not recognised or it can be because the Sysop has made node aliases case sensitive.

#### Info

This command gives information about the node as a combination of a message stored in the EPROM and a message entered by the Sysop.

#### Nodes

This command gives information about the distant nodes that this node thinks it can get to. With no parameter, it shows the alias and callsign of all the nodes except those starting with a '#' character. If a parameter of '\*' is given, those 'hidden' nodes will also be shown.

If a callsign or alias is given that the node does not know, it gives an error message. If the callsign or alias of a known node is given, the node gives details of the routes it knows about that lead to that destination. The display shows one option per line, each of which consists of the path quality, obsolescence count and port followed by the callsign of the neighbour. If any route is in use, a chevron is shown against the appropriate entry.

If so configured by the Sysop, 'Slime trails' i.e. nodes without aliases that have not been the subject of a valid node broadcast, may be omitted from the nodes list.

#### Routes

This command gives information about the neighbouring nodes that can be heard. For each neighbour, the display shows the port number, the callsign, the path quality and the number of nodes accessible through this neighbour. If a route has been 'locked' by the sysop, then a '!' character is shown after an entry. The sysop may have configured the node to display nodes as callsign or as alias:callsign. If so configured, then if a node is shown as a callsign alone it means that it is not currently reachable as its node broadcasts are not being received.

#### Users

This shows who is using the node. It does not show other nodes that are using the node as a level 3 relay, nor does it show those users who have connected to the node but otherwise have done nothing.

The display shows the through connections, followed by those users who are connected to the switch and 'idle'. It also shows those users who are connected to the conferencing facility. The latter stations are shown connected to a destination called 'Talk', whilst in the case of connections, the two endpoints are shown.

For connections, two symbols are used, '<-->' and '<.>'. The former is used for established connections whilst the latter is used for connections being established.

#### 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 response message to be sent to the user, and 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 GxABC were to type :

**TALK GyXYZ, Hello fred can I have a chat - type TALK**

then other users of the node ( including presumably Fred, would get the message :

**GxABC>> GyXYZ. Hello fred can I have a chat - type TALK**

on their screens. The only exception to this is that sysops are not sent the message.

Note that the TALK command will pass 8 bit data if set to by the Sysop.

## CQ

This command is used to broadcast a CQ message. In addition, the fact that you are calling CQ is indicated in the USER list. The callsign will be your own with a different SSID, and anyone else can connect to you by connecting to the callsign with the appropriate SSID.

The CQ remains 'primed' for a while, and if any other command is given to the node the CQ will be cancelled.

## BBS

When you issue the BBS command, assuming that the sysop has configured it, you will be connected to the local BBS.

If you enter the command 'BBS ?', then the current setting of the BBS will be displayed.

## Host

The HOST command operates just like the BBS command. It may have been disabled by the sysop, it may have been set to connect to the same station as the BBS, or it may have been set to connect to another host system. If you enter the command 'HOST ?', then the current setting of the HOST will be displayed.

## 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.

**All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)**



## PacketRadio Networking Handbook for the System Node Operator

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 will give the wrong answer on the following conditions :

- A badly distorted audio signal
- Badly off frequency
- Incorrect adherence to local pre-emphasis standards
- A noisy signal

If you connect, then correct your deviation to the correct display then find performance has deteriorated, it indicates one of the above problems. It is not that the meter doesn't work, it is an indication of a fault elsewhere.

It is in your own interest for those around you to use the correct deviation. The list also allows you to see the deviation of others - so apply peer pressure if someone over or under deviates. Remember it is NOT a case of the higher or the lower the better - it is having the setting RIGHT.

The system may also be used to migrate users towards a lower deviation in advance of moving to narrower channel spacing.

### Links

The LINKS command shows the level 2 connections to the node. This is usually of academic interest, but I use it in testing. The display shows the links, one per line, with the two callsigns, the link state, the port number and the current number of retries.

## Mode

The MODE command is a bit like the PARMS command. It shows a number of additional parameters. These are as follows as shown by example :

```
MODE  
THENET:G8KBB-5> 0 1800 6 3 2 20 0 600 2 900 1 31 0 1 1 0 0
```

with the following meanings :

0	Host mode protocol ( 0 = standard, 1 = DCD mode )
1800	CWID period. Delay in seconds between CWID
6	CWID speed 10's of msec per dot. 6 equals 20 wpm
3	Enable / disable nodes broadcasts mask.
2	RS232 protocol, 0 = crosslink, 1,2 or 3 are KISS
30	TxDelay in 10's of milliseconds ( Centiseconds ?? )
0	Full duplex control. 0 equals simplex
600	RS232 port nodes broadcast interval in seconds
2	Nodes broadcast algorithm port mask
900	Beacon period in seconds
1	'connect' redirector. 0 is to HOST, 1 is to BBS
31	Each bit controls one of the 'user' help messages, 8 bit TALK & case sensitivity
0	This byte controls the broadcasting of 'hash' nodes
1	This byte enables / disables the extra alias operation
1	If set to '1', a remote disconnect on a circuit will cause a node reconnection
0	The bits of this controls the operation of the node with regard to 'slime trails'
0	The bits of this control whether digi uplinks and downlinks are permitted

If you want additional details, ask the sysop for a copy of the overview guide.

## Parms

This shows the node parameters as per TheNet 1.01 ( See ADDENDUM "A" of this manual ).

## Bye and Quit

These commands disconnects you from the node, closing the link. It says goodbye before disconnecting you if it has been so configured by the sysop. Quit does just the same as Bye does.

## DXcluster

If there is a local DXcluster, this command may have been configured by the sysop to connect you to it. It therefore operates in a manner very similar to the BBS command.

## Stats

The stats command gives lots of data about the node operation. A full description of the information is contained in the overview document.

## IProute

This command is used by the sysop to configure the IP route table. It may also be used to display the router table.

## Arp

This command is similar to the IProute command, but shows the Arp table. The Arp table provides a translation from Ip address to callsign.

## IPaddress

This command is used to set or display the current node IP address.

BBSAlias  
HostAlias  
DXCAlias

These commands are used to set additional aliases for the node. It can be configured by the sysop to accept connect requests ( uplinks ) to the node callsign, the node alias, or the 3 aliases shown by these commands. When the node accepts a connection to one of these aliases, it will immediately invoke the BBS, DXC or HOST commands for you. The way this would normally be used is as follows. Suppose your local ( for example ) BBS was not accessible on the frequency that the node operates on. The BBS alias can be configured to provide easy access across other nodes to the BBS. Hence in the case of the Ipswich nodes, GB7MXM does not have a port on 144.650, but the node IPS2 on 144.650 can get to it by means of another node and a 9600 baud link. If IPS2 is set to accept the extra aliases, and if BBSAlias is set to MXMBBS, then anyone who tries to uplink to MXMBBS in the Ipswich area would be automatically connected to GB7MXM. It goes without saying that if GB7MXM had a port on 144.650 itself, then chaos would ensue.

MTU

This command allows configuration of the MTUs for IP users. The parameters have the following meanings :

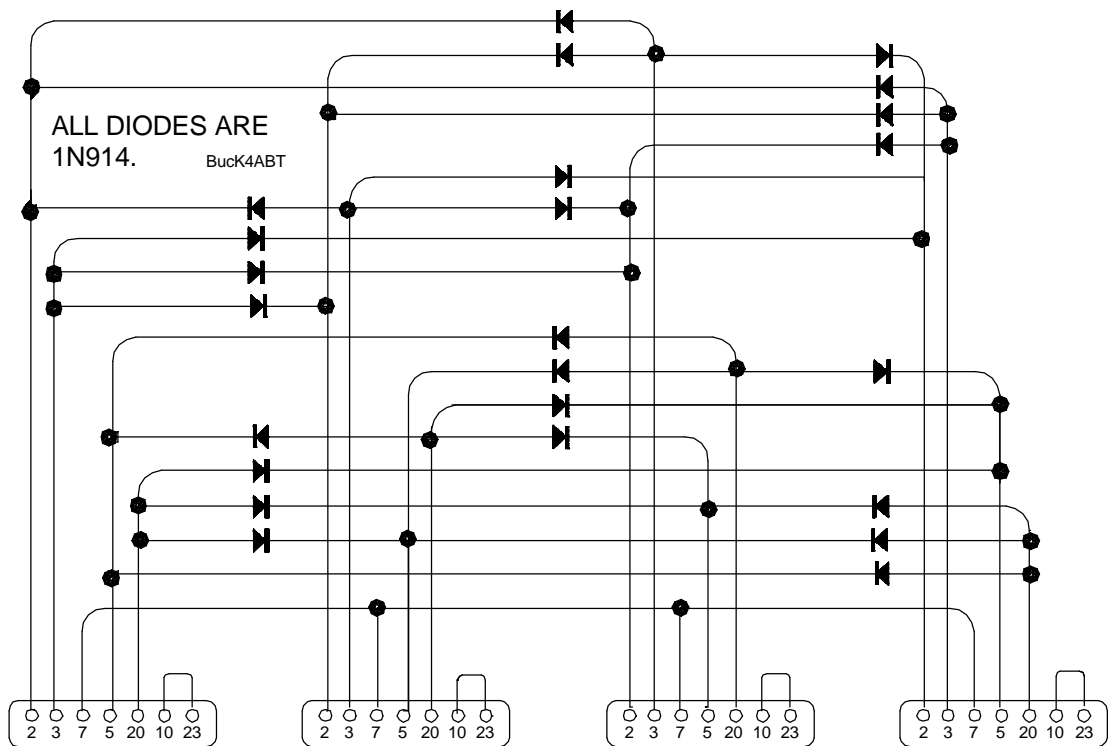
Parameter	Default	Controls
1	256	The MTU for the radio port, AX.25 encapsulation
2	256	The MTU for the RS232 port, AX.25 encapsulation
3	236	The MTU for the Net/Rom encapsulation
4	257	The maximum number of data bytes in a received L2 frame
5	328	The maximum number of bytes in a received L2 frame

For more details on the IP router, consult the 'overview' is the first section of this manual.

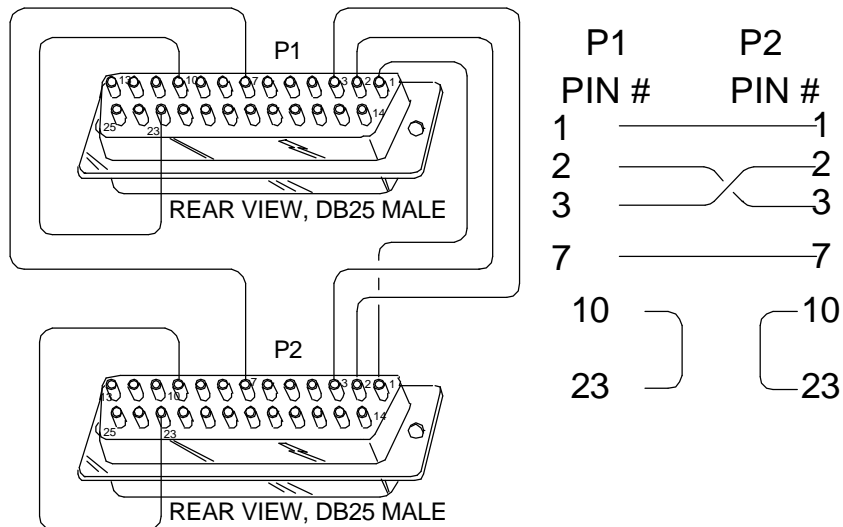
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**Thank you, es 73 de Buck4ABT      G. E. "Buck" Rogers Sr.**



When more than two X-1 nodes are linked to gateway from band to band, or from 1200 to 9600 bauds, use this diode matrix to interface the RS-232 ports together. An unused port will not affect other ports that are in use.



GATEWAY RS-232 connector configuration for use with X-1 NODE. This interface cable will enable gateway between two frequencies, or LAN to BACKBONE trunks.

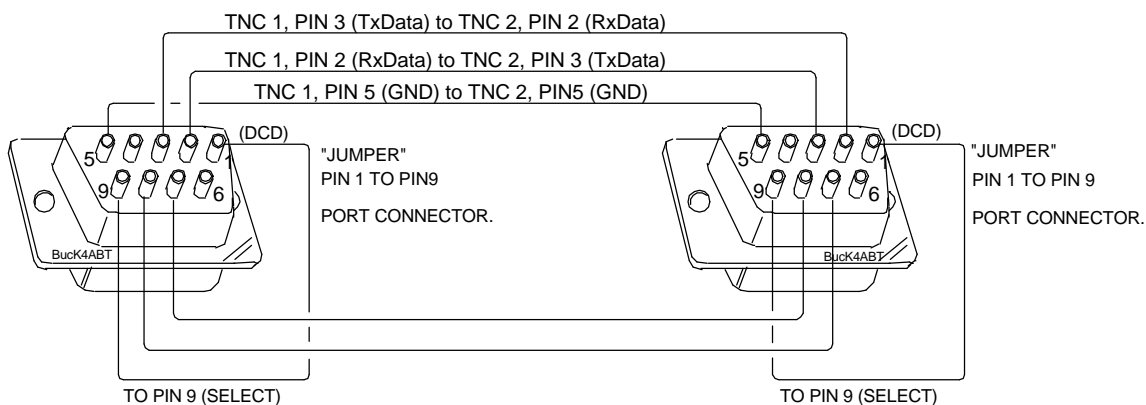
Be sure the DIP switches on each TNC2 or clone is set for the same terminal speed or baudrate. Both nodes must be set to the same baudrate for communications between the nodes. Usually switches 5 and 7 are ON, all others are OFF.

When the X-1 node is turned ON the first time, the STA LED should glow bright, and after about 3 seconds it will flicker and glow at half brilliance. If this does not occur then turn the node OFF and ON again until the STA LED settles to a dim glow with a faint flicker. The flicker may not be noticeable, but the dim LED is enough sign that the node is behaving properly.

Be sure power is OFF, and power cable disconnected when performing the memory erase at IC socket U25. IC socket U24 remains empty.

\*\*\* WHEN INSTALLING THE EPROM AT U23, MAKE SURE IT IS INSTALLED WITH THE NOTCH IN THE CORRECT POSITION. TO INSTALL THE EPROM BACKWARDS WILL DESTROY THE EPROM WHEN POWER IS APPLIED!

MODIFICATION OF TNC2 TO ALLOW USE OF 27C512 AND ENABLE BANK-SWITCHING FOR USE WITH X-1 TheNet MULTI-FUNCTION NODE FIRMWARE.



This drawing illustrates the interface cable used with TNC's having DE9 serial ports. The X1 nodes having DB25 connectors can easily be interfaced to the X1 nodes having DE9 connectors. Observe the correct signal line connections when intermixing DE9 to DB25 X1 serial ports.

## X1 BankSwitch Modification

- 1) Bend pin 1 of 27C512 so that it will not enter socket U2. Insert X1 EPROM into socket U2.
- 2) Solder one end of a 5-inch piece of small wire to pin 1 of EPROM.
- 3) Solder the other end to pin 16 of SIO at U4. Pin 16 remains in socket.

**All cables and interfaces shown in this book are available at: [www.HamRadioExpress.com](http://www.HamRadioExpress.com)**

**NOTES:**

ALINCO

AZDEN

ICOM

KDK

KENWOOD

MIDLAND