



## ***TNC-X Assembly Instructions and Operating Tips***

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## **TNC-X Assembly Instructions and Operating Tips**

### **Parts List:**

The following parts should be included with your kit:

#### Capacitors:

|                        |   |
|------------------------|---|
| C1, C22                | 10 uf electrolytic ( <b>polarized!</b> )  |
| C3                     | 100 pf ceramic (marked 101J)  |
| C2, C4, C5, C6, C11    |   |
| C14, C15, C21, C22     | .1 uf monicap (small yellow - may be marked 104z)   |
| C16, C17, C18, C19 C20 | .1 uf monicap (if U5 is an SP232A) OR<br>1.0 uf cap (if U5 is a MAX232IN)<br>(small blue – may be marked 105) |
| C7, C8 .               | 01 uf polyproplene (red/yellow block)   |
| C9, C10                | 18 pf ceramic (marked 18)   |
| C12, C13               | 22 pf ceramic (marked 22)   |

Resistors: (note: there are no R5, R6 or R7 in this kit)

|                          |   |
|--------------------------|---|
| R1, R2, R3               | 100k ohm (brown, black, yellow)                   |
| R8                       | 24.9 K ohm 1% (red, yellow, white, red, brown)    |
| R9                       | 9.31K ohm 1% (white, orange, brown, brown, brown) |
| R10                      | 18.7K ohm 1% (brown, grey, purple, red, brown)    |
| R11, R16 and             |   |
| R 14, R18, R20           | 10k ohm (brown, black, orange)                    |
| R12, R13                 | 10k ohm potentiometer                             |
| R4, R15, R17,<br>and R19 | 1k ohm (brown, black, red)                        |

Diodes: (note: there is no D3 in this kit)

|    |                                  |
|----|----------------------------------|
| D1 | green LED ( <b>polarized!</b> )  |
| D2 | 1N4001 ( <b>polarized!</b> )     |
| D4 | red LED ( <b>polarized!</b> )    |
| D5 | yellow LED ( <b>polarized!</b> ) |

- 1 5 pin DIN Jack
- 1 length of hookup wire

Headers, Jumpers:

- JP1, JP2 2 Pin Header
- JP3, JP4 3 Pin Header
- JP5 8 Pin Header
- 6 Shorting blocks for the above headers.

Other:

- X1 3.57 MHz Crystal (may be labeled A035)
  - X2 20 MHz Crystal (may be labeled A200)
  - Q1 NPN Transistor (2N2222 or similar) **(polarized!)**
  - U1 CML 614 Modem Chip - 16 pin **(polarized!)**
  - U2 23K640 Memory chip – 8 pin **(polarized!)**
  - U3 PIC16F1847 - 18 pin **(polarized!)**
  - U4 MPC6023 Op Amp - 8 pin **(polarized!)**
  - U5 SP3232A - 16 pin **(polarized!)**
  - U6 LP2950 Voltage Regulator – 3 pin (looks like a transistor) **(polarized!)**
- Sockets for U1, U2, U3, U4 and U5 (1- 18 pin, 2 – 16 pin, 2 – 8 pin) **(polarized!)**
- DB9 and Coaxial power connectors
- Printed Circuit board

In addition, if you have purchased the USB option you should also have:

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- USB connector
  - IC1 FT232RL USB interface chip **(pre-installed on PC board)**
  - L1 Ferrite Bead (looks like a 1N4001 diode, but no stripe)
  - C26 .01 monicap (small, yellow, marked 103. Not on ammo strip)
  - C24 4.7 uf electrolytic **(polarized!)**
  - C23, C25 .1 uf monicap (small yellow – marked 104. On ammo strip.)
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In addition, if you purchased the enclosure option, you should also have:

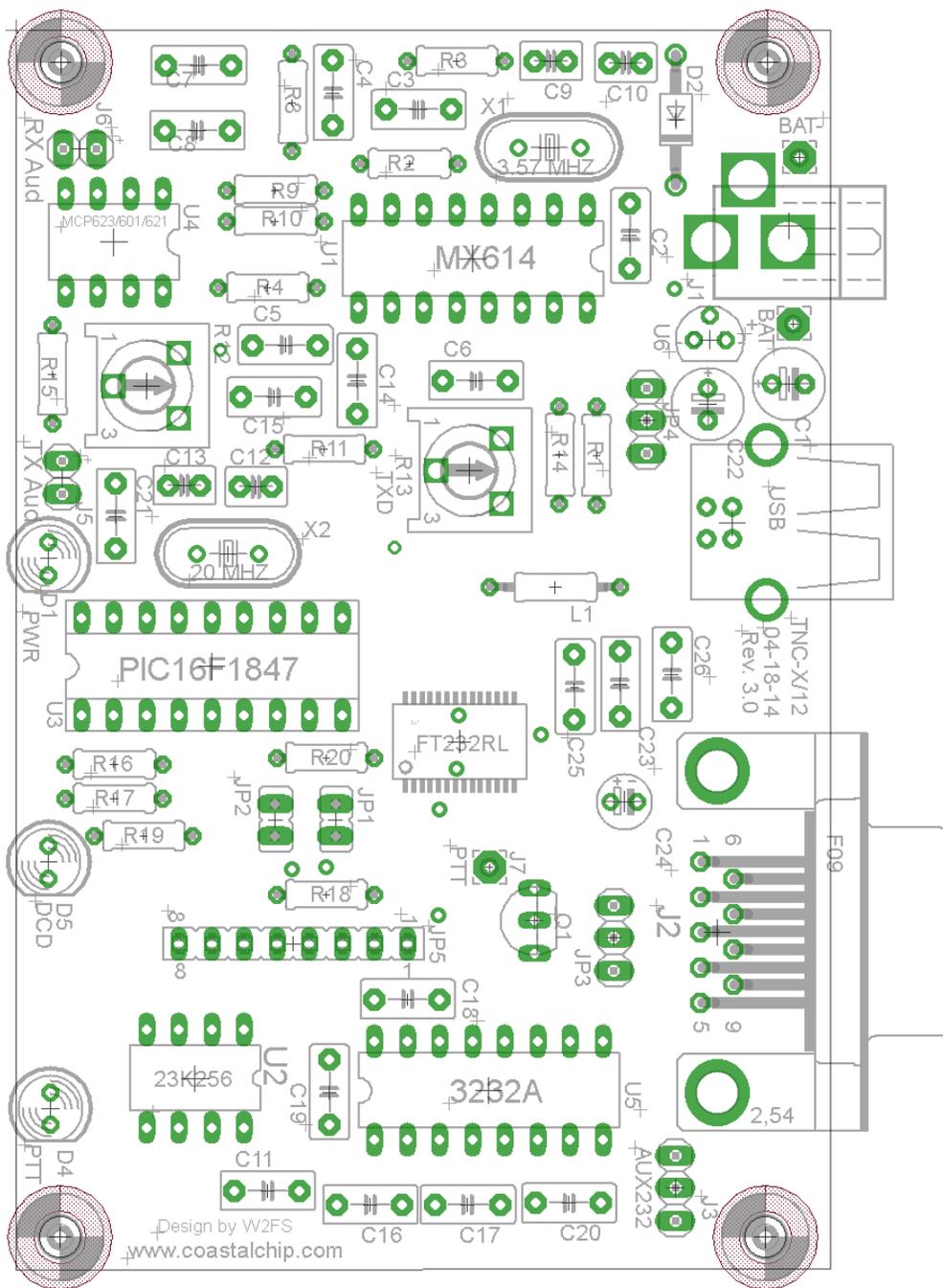
- 1 TNC-X aluminum enclosure. + 4 screws and 4 feet.
- 2 Mounting screws and nuts for the PC Board + 2 spacers
- 1 Stereo Phone Jacks (three solder terminals)

## Assembly Instructions

Begin by verifying that all of the parts are present. Soldering the parts in the board is fairly straightforward, but here are a few tips:

1. Be very very certain that you have installed the correct part in the correct position before soldering. The printed circuit board in this kit uses plated through holes. If a part is improperly soldered into such a hole it is very difficult to remove. It is much easier to take your time and triple check to make sure the part is installed correctly, than it is to remove a misplaced part. In addition to the silkscreening of the part numbers on the printed circuit board, it would also be useful to have the parts placement diagram available to you when you construct the unit. These diagrams are both included in this manual.
2. The soldering pads on the PC Board for this project are fairly small. This can make cold solder joints somewhat harder to spot than they otherwise would be. Carefully heat the joint before you apply solder.
3. A number of the parts in the parts list are marked **(polarized!)**. This means that it is very important not to solder these parts in backwards. Note in particular:
  - a. The longer lead on the electrolytic capacitors (C1, C22, C24) should go in the hole nearest the + sign.
  - b. Diodes D1, D4 and D5 should be installed so that the shorter lead goes through the hole nearest the flat side of the outline on the PC Board. The line on diode D2 should go towards the same side that the line appears on the outline on the PC board.
  - c. The NPN transistor and the voltage regular look very similar. Make sure you verify the part numbers before installing. The voltage regulator (U6) should be installed so that the flat side lines up with the flat line on the PC board.
  - d. D2 and L1 also look similar. D2 has a stripe; L1 does not.
  - e. The notches on the ends of the sockets for the ICs should match the notch on the part outline on the PC board. Later,

when you install the ICs, make sure the notch on the chip lines up with the notch on the socket.

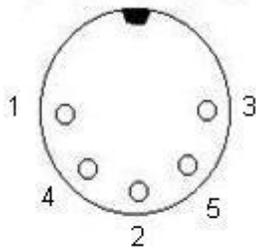


4. Start by installing the parts that are flattest against the PC Board. These would include all of the resistors, the .1 uf caps, C26, L1, diode D2 (observe the correct polarity!), and the crystals.
5. Next install the IC sockets. It is a good idea to first solder two pins in the corners diagonally from each other and then check to make sure that the socket is flush against the board. If it isn't you can reheat these two pins while pressing the socket toward the board. Then solder the remaining pins.
6. Next install the two potentiometers. They should only fit one way.
7. Next install the rest of the capacitors.
8. Install the transistor (Q1) and voltage regulator (U6). Observe the correct polarity!
9. Install the LEDs. **If you are installing the TNC in the custom drilled enclosure, you will probably want to install these so that the leads are fairly long to make sure that they will reach the holes**
10. Install the headers. Follow the diagram on the board to install headers JP1 – JP5.
11. Install connectors J1, J2 and the USB connector.

### Installing in the Enclosure

If you purchased the enclosure kit, this would be a good time to install the TNC-X board in the enclosure. Use the enclosed wire to connect three 3cm lengths of wire to the board at J3 (AUX232). Then attach a 13 cm length of wire in 4 places: to the two holes marked J6 (RX Aud), to the + hole on J5 (TX Aud) and to J7 (PTT). These wires will be connected to the 5 pin DIN socket as described below. Make sure the + wire on J6 is connected to Pin 4 on the 5 pin DIN.

The included stereo jack goes on the top left and is used for J3 (the Auxiliary Serial Port) If you use this with XTrack, data from the GPS should be feed into the ring, and ground should be sleeve. On the TNC-X, connect the wire in the left hole to shield, the middle hole to tip and the right hole to sleeve. This is the same configuration as the GPS jack on a Kenwood D700. The enclosed 5 pin DIN jack is installed in the large hole on the left of the back panel. Note there is a small slot on the top of the hole that causes the connector to not rotate. The 4 wires that you installed above should be soldered to this connector as shown in the diagram below. It shows the view of the connector pins *from the inside of TNC-X*:



| Pin | Description   |
|-----|---------------|
| 1   | TX Audio      |
| 2   | Ground        |
| 3   | PTT           |
| 4   | RX Audio      |
| 5   | No Connection |

Install the TNC-X PC board in the box using the two screws on the DB-9 connector. Do not fully tighten these screws yet. Now place the 3/16 inch spacers under the holes near the front panel of the box so they line up with the holes in the PC board. Run the 1/2 inch screws through the bottom of the box, through the spacers and then through the PC board. Secure with the 2 #4 nuts. Now tighten everything up including the screws on the sides of the DB-9 connector. Bend the LED leads so they will fit in the front panel holes.

After set-up and testing (see below) you can install the top on the box using the 4 metal screws. These screws will be difficult to tighten the first time you screw them in as they are creating threads in the box. You can finish the project by adding the enclosed feet.

### Radio Interfacing Without the Enclosure

If you are providing your own enclosure (or not using an enclosure at all) The radio connections are made at points J5, J6, and J7. J5 contains the connections for transmit audio (note ground is the pin closest to D1). Receive audio should be connected to J6 (ground is closest to the edge of the board). The (push to talk) PTT line is connected at J7.

### Initial Setup

JP1 and JP2 determine the serial port speed for the link between the TNC and the computer. The following settings are allowed:

| <u>JP1</u> | <u>JP2</u> | <u>Port Speed</u> |           |
|------------|------------|-------------------|-----------|
| On         | On         | 1200 baud         | (default) |
| On         | Off        | 4800 baud         |           |
| Off        | On         | 9600 baud         |           |
| Off        | Off        | 19200 baud        |           |

Note that this setting does not affect the over the air data speed (which is always 1200 baud) it merely affects the data speed between the TNC and the computer. Note also that if you set this baud rate faster than 1200 baud, it is possible for data to be fed into the modem faster than it can transmit it over the air. This may eventually result in the transmit buffer filling up.

Next, decide whether you are planning to initially use the TNC using a standard serial port or using the USB option. If you have purchased the USB option, there are five additional parts to install, C23, C24, C25, C26 and L1. Make sure you observe the correct polarity on capacitor C24.

### Setup if You Are Using USB

If you have elected to purchase the USB option to provide data communications to your PC, you should begin by acquiring and installing the drivers for the PC and operating system that you are using. These can be obtained from a link on the <http://www.tnc-x.com> page. The driver you will receive is a Virtual Com Port (VCP) driver. It will make the TNC appear as an additional com port on your computer so that you can use any packet radio software that supports a KISS TNC connected to a standard serial port.

If you use the USB port, you should not supply any power to the TNC... it can satisfy its rather limited needs directly from the USB bus. If you are using the USB option, set the board jumpers as follows:

**JP3** On the left two pins (toward C24).

**JP4** Connect the center pin to the pin that is closest to the center of the board.

**JP5** Jumper pins 1 and 2 (the end closest to Q1) and pins 3 and 4 unless you are using a daughterboard.

## Setup If You Are Using the TNC's Serial Port

If you plan to connect the TNC to a standard computer serial port, set up the jumpers as follows:

**JP3** On the right two pins (toward U5)

**JP4** Connect the center pin to the pin closest to C22.

**JP5** Jumper pins 1 and 2 (the end closest to Q1) and pins 3 and 4 unless you are using a daughterboard.

If you are using the on board serial port, you must supply power to the TNC. This can be done in one of two ways. There is a coaxial power jack on the board (center is positive) that can be used to receive anything from 8 to about 15 volts. Alternatively you can hook a battery (9 volts will work fine) to the location marked BAT. Make sure you observe the correct polarity.

## Initial Checkout and Troubleshooting

TNC-X is a fairly complex product and I suggest you check it out stage by stage to see if there are any problems with the unit and correct them as you go along. First (before you install the ICs!) check the voltage between pins 5 (-) and 14 (+) of U3 (these pins are directly across from each other). You should see a voltage of approximately 3.3 volts.

Assuming the voltage checks correctly, remove power, reinstall and install the IC's. Be careful about two things. First, there are 2 16 pin chips and two 8 pin chips. Make sure you get the correct chips in the correct sockets. Second, carefully note the orientation of the chips. Some of the chips are "upside down". This was done to make the PC board traces shorter and more direct. Carefully line up the notch on the chip with the notch on the socket with the notch on the PC board.

Hook up a receiver audio source to the receive pins on the board (or the DIN jack if you are using the enclosure). Make sure audio goes to the +

pin. Make sure the squelch is left open. When a data packet is received, you should see the yellow LED light briefly and go out. Even when no data is being received it is normal for the yellow LED to flicker. However, it should come solidly on when a packet is received. Assuming this checks out, run a serial program of some kind on your PC, set the baud rate to whatever baud rate to whatever baud rate you specified with JP1 and JP2. Confirm that you are receiving data (note, this will be raw KISS frames so much of it may look like garbage, but you should see some recognizable data). Note that if you are using the USB option, you must the USB drivers loaded on your computer. These can be obtained from a link on the <http://www.tnc-x.com> page.

If you don't see the yellow light come on, first confirm that audio is getting to the TNC (a scope or a small headphone may be useful for this). If it is, verify that audio is coming out of Pin 6 of U4. Assuming this is working, if you have a scope or frequency counter, measure the frequency on Pin 1 of U1. It should read about 3.57 MHz. While you are at it, check Pin 16 of U3. It should read about 20 MHz. If at any point you don't get the measurement you expect, carefully check the solder joints in that part of the board.

If the yellow light comes on but you see no data on your PC, start at Pin 8 of U3 and trace the data signal to header Pin 1, to header Pin 2 and on to Pin 10 of U5. It should come out at Pin 7 of U5.

Next check out the transmit chain. The TXDelay is set by R13. Start by setting it at about halfway (which will correspond to a TXDelay of about 240 ms (or a setting of 25 on most TNC's). At this point you need to be running a program on your PC that supports KISS mode. The TNC-X webpage ([www.tnc-x.com/documentation.htm](http://www.tnc-x.com/documentation.htm)) has a program called TXTest, which is a very simple program that can be used to test your transmit chain.

When you transmit a packet, you should see the red LED come on briefly. Hook the transmit audio and PTT up to a radio and try transmitting. You can use R12 to adjust the transmit audio level. If you don't have a means of measuring the deviation, monitor your signal on a receiver and slowly increase R12 until you hear no further increase in volume on the receiver. Then back it off a bit. Even if the TNC is not connected to a radio, you should see the red light come on when you transmit data via the TNC.

Many people use TNC-X for APRS applications. There are many good software programs available for this application (UI-View for Windows, for example). Or YAAC or Xastir for Linux users. For Winlink, RMS Express is an excellent choice.

If you have any problems with any of this, contact me at [john@hansen.net](mailto:john@hansen.net) and I'll try to help you through it. There is also a TNC-X support group on groups.yahoo.com.

Additional information will be posted on the [www.tnc-x.com](http://www.tnc-x.com) website as it becomes available.