TNC-Pi Assembly Instructions & Operating Tips

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Website

http://tnc-x.com/TNCPi.htm

Contents

Introduction

Thank you for purchasing a TNC-Pi: TNC-X for Raspberry Pi or TNC-Pi 2.

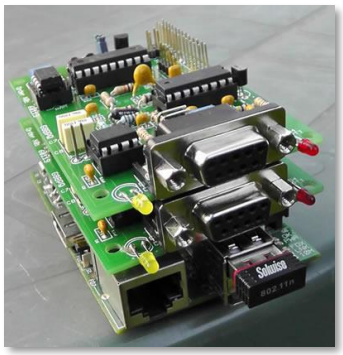


Figure 1: Two TNC-Pi's stacked on one Raspberry Pi

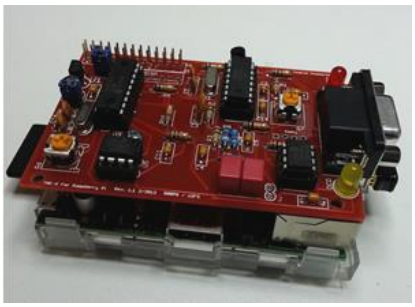


Figure 2: TNC-Pi mounted on a Raspberry Pi

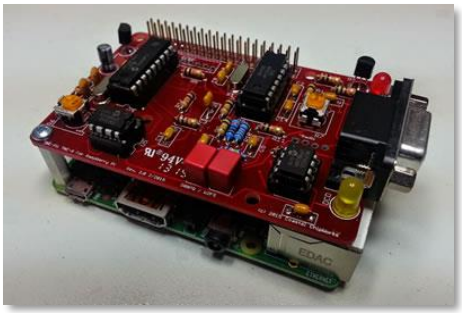


Figure 3: TNC-Pi 2 mounted on a Raspberry Pi 2.

Assembly Instructions

Parts List

Your kit should come with the parts listed in the table below. You can use the two columns of checkboxes to track your progress. As you inventory your parts, put a checkmark in the first column. Once you've installed a part, put a checkmark in the second column.

Inventoried	Installed	Designation	Description	Notes
☐	☐	C1	4.7 uf or 10 µf electrolytic	Polarized
☐	☐	C2, C4, C5, C6, C11, C14, C15, C21	0.1 µf monocap	
☐	☐	C7, C8	0.01 µf 2.5%	Red and yellow or grey; if grey marked 10 nF
☐	☐	C9, C10	18 pf ceramic disk	
☐	☐	C12, C13	22 pf ceramic disk	
☐	☐	C3	100 pf ceramic disk	
☐	☐	R1, R2, R3	100K resistor	Brown, black, yellow
☐	☐	R4, R17, R19,	1K resistor	Brown, black, red
☐	☐	R5, R11, R14, R16, R18	10K resistor	Brown, black, orange
☐	☐	R8	24.9K resistor	Red, yellow, white, red, brown

☐	☐	R9	9.31K resistor	White, orange, brown, brown, brown
☐	☐	R10	18.7K resistor	Brown, grey, purple, red, brown
☐	☐	R6, R7	10K trimmer potentiometer	Orange or Blue
☐	☐	X1	3.57 MHz crystal	
☐	☐	X2	20.00 MHz crystal	
☐	☐	D4	Red LED (PTT)	Polarized
☐	☐	D5	Yellow LED (DCD)	Polarized
☐	☐	Q1	PN2222 transistor	3 pin, flat side (don't confuse with U1)
☐	☐	U1	MCP1700-33 or MCP1700-30 Regulator	3 pin, flat side
☐	☐	U2	CML MX-614 Modem	16 pin IC
☐	☐	U3	PIC16F1847 microcontroller	18 pin IC
☐	☐	U4	MCP6023 Op Amp	8 pin IC
☐	☐	U5	23K640 Memory	8 pin IC
☐	☐	IC Sockets	For U2, U3, U4, U5	One 16-pin, one 18-pin and two 8-pin sockets
☐	☐	JP3, JP4	2-pin header Not included in newer kits	Combined into one 2x2 pin header
☐	☐		2 x 13 extra long header 2 x 20 in TNC-Pi 2	

☐	☐		9 Pin D-Sub connector	
☐	☐		Printed Circuit Board	
☐	☐		2 shorting jumpers Not included in newer kits	

Assembly

Note: John McDonough has published a number of high quality photos of various stages in the assembly process. See http://www.qsl.net/wb8rcr/BuildingTheTNC-Pi.html

☐ Start by installing the parts that lie flat on the board. This includes:

a. all of the 0.1uf monocaps and

b. all of the resistors except for R6 and R7.

R10 and R11 have pads that are rather close together. Be careful that you do not accidently create a solder bridge between them. Note that all of the components except for the 26 (or 40 in TNC-Pi 2) pin header are installed on the side of the board with the silk screen.

☐ Next install the two crystals.
Ensure that the 20 MHz crystal is the one nearest the 18 pin IC.

☐ Next install the IC sockets.
Ensure that the notch on the socket lines up with the notch on the IC outline on the PC board.

Do not plug the chips into the sockets at this point.

☐ Next install the rest of the capacitors.
With C1, make sure that the longer lead is placed in the hole marked with a +.

☐ Next install the two potentiometers (R6 and R7). You may find these to be a bit of a tight fit. If so, take a pair of needle nose pliers and flatten the leads before inserting them into the board.

☐ Next install the two LEDs.
Ensure the shorter leads on the LEDs go through the holes closest to the flat side of the LED outline.

The LEDs can be installed with bent legs so the LEDs point toward the front of the board. This makes them easier to see when TNC-Pis are stacked one on top of the other.

☐ Install the transistor.
Ensure you are installing the transistor rather than the voltage regulator… they look a lot alike.

☐ Now install the voltage regulator.
It goes in the three holes above C1. Install it so that the flat side of the regulator faces away from U3.

☐ Now install the 9 pin D-Sub connector.
Ensure that you push it all the way in so that it is flush against the board. In addition to soldering the pins, you'll gain mechanical stability by soldering the pins that go into the large round holes on the sides of the connector.

Note: The D-Sub connector is optional. You can install the Radio header to connect your radio to the TNC-Pi instead. See the section, Connecting the Radio, for more information.

☐ Solder in the 2 x13 header. With the TNC-Pi 2 kit this is a 2 x 20 header. This part is somewhat tricky. It is the only part that is installed through the bottom of the board.

a. Start by installing this jumper on your Raspberry Pi and then

b. Lower the TNC-Pi board onto the connector so that the body of the connector is on the BOTTOM of the TNC-Pi board.

c. Now you'll need to solder the board about a half millimeter from all the way down in order to prevent the board from bumping into the USB connector on the Pi. It is not necessary to solder all of the pins. You should at least solder the 4 pins in the corners (for stability) and the first five pins on each row (pins 1 – 10).

Your best bet is to carefully trim the solder leads on the part of the TNC-Pi board that will be on the USB connector side of the Pi to get as much clearance as possible. You might also want to put a piece of insulating tape

on top of the USB connector just to be on the safe side. You can then solder the pins that come through the top of the board.

These pins will allow you to stack a second TNC-Pi on top of the first one if you choose to do so.

☐ Now install the 2 x 2 jumper (JP3 and JP4). If your board has a JP7 location, also take a short piece of wire and solder it in here to make a permanent jumper. Note: If you are building a TNC-Pi 2, none of these jumpers are needed or included in the kit. If you are building a newer kit from the original version JP3 and JP4 will also be missing, but you may need to put a wire across JP7.

☐ I've included 2 4-40 screws and a 5/8" spacer. If you have one of the Raspberry Pi Rev. B and the original TNC-Pi kit, or if you have the Rev. B+ or Pi 2 and the TNC-Pi 2 kit, you can use this to provide some additional mechanical stability by putting it between the hole in the Pi and the hole in the TNC-Pi. If you have a Pi B+ board and the original TNC-Pi kit, these parts are not needed. There will be plenty of mechanical support from the extra USB jacks on the Pi board, but you will want to use insulating tape on these jacks to keep them from shorting the TNC board.

If you are stacking 2 or more TNC's you might also find it preferable to use a spacer that is a male to female, rather than female to female. These male to female spacers are available on the TNC-Pi website.

☐ Now install jumpers at JP4 and JP3.
They should be installed so they are parallel to the body of the 2x13 pin connector. If you are building a TNC-Pi 2 or newer original TNC-Pi, none of these jumpers are needed or included in the kit.

Leave the board connected to the Raspberry Pi and power up the Pi. Check the voltage between pin 5 (negative) and pin 14 (positive) on U3. It should read about 3.3 volts. With the notch at the top of the chip, these pins are the ones half way down the left side (negative) and right side (positive) of the chip.

<u>If the voltage check is not successful, find and fix the fault before proceeding.</u>

☐ Power down the Pi and remove the TNC-Pi board from the Pi, then install the 4 ICs.

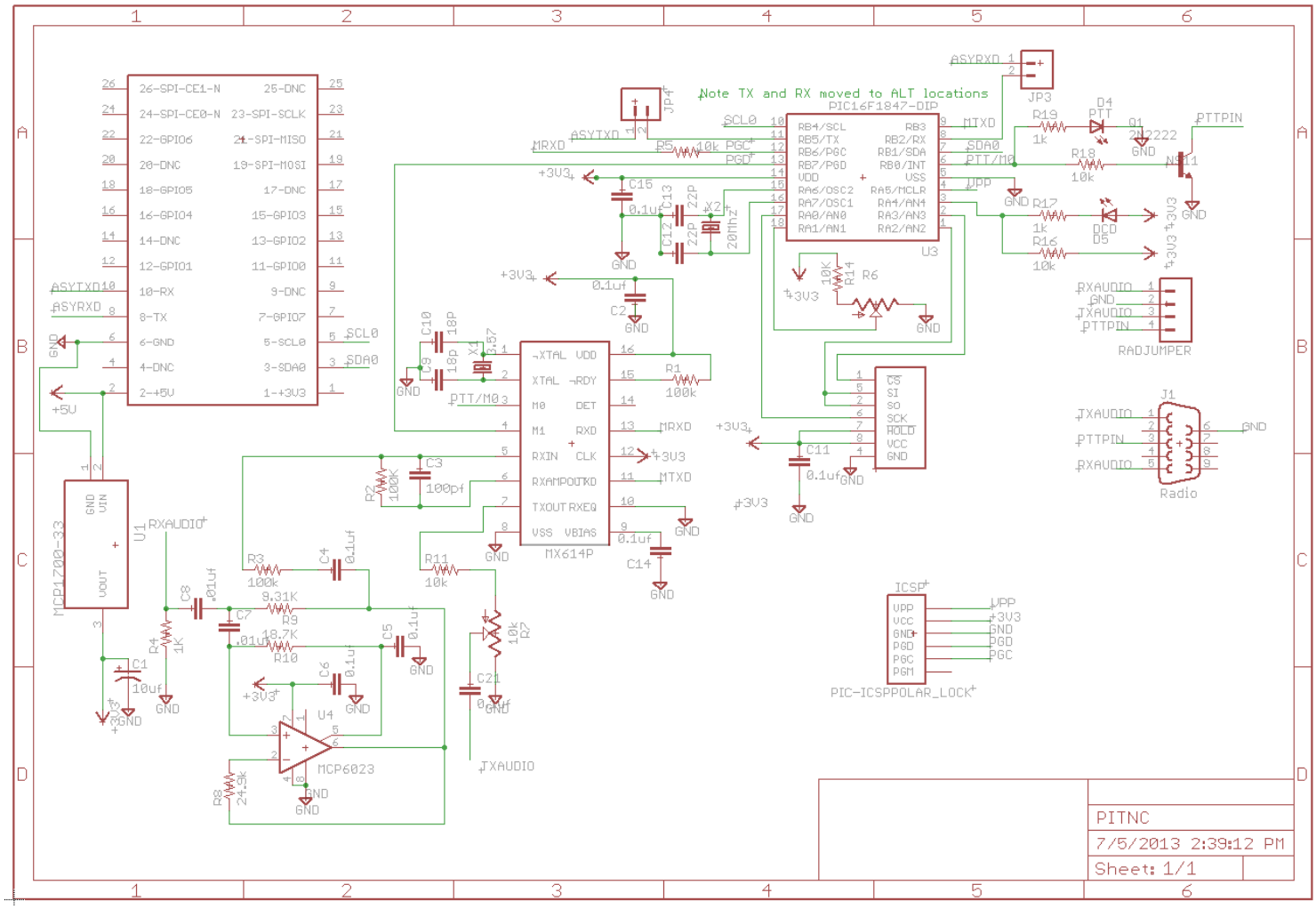
You may wish to bend the pins of the four ICs slightly inward to facilitate inserting them into their sockets.

Ensure the notch on the top of each chip lines up with the notch printed on the PC board. Also make absolutely certain that you do not mix up the two 8 pin chips and plug them into the wrong sockets.

Note: Nothing will be installed at the 6 pins marked **ICSP** or the pins marked **J**.

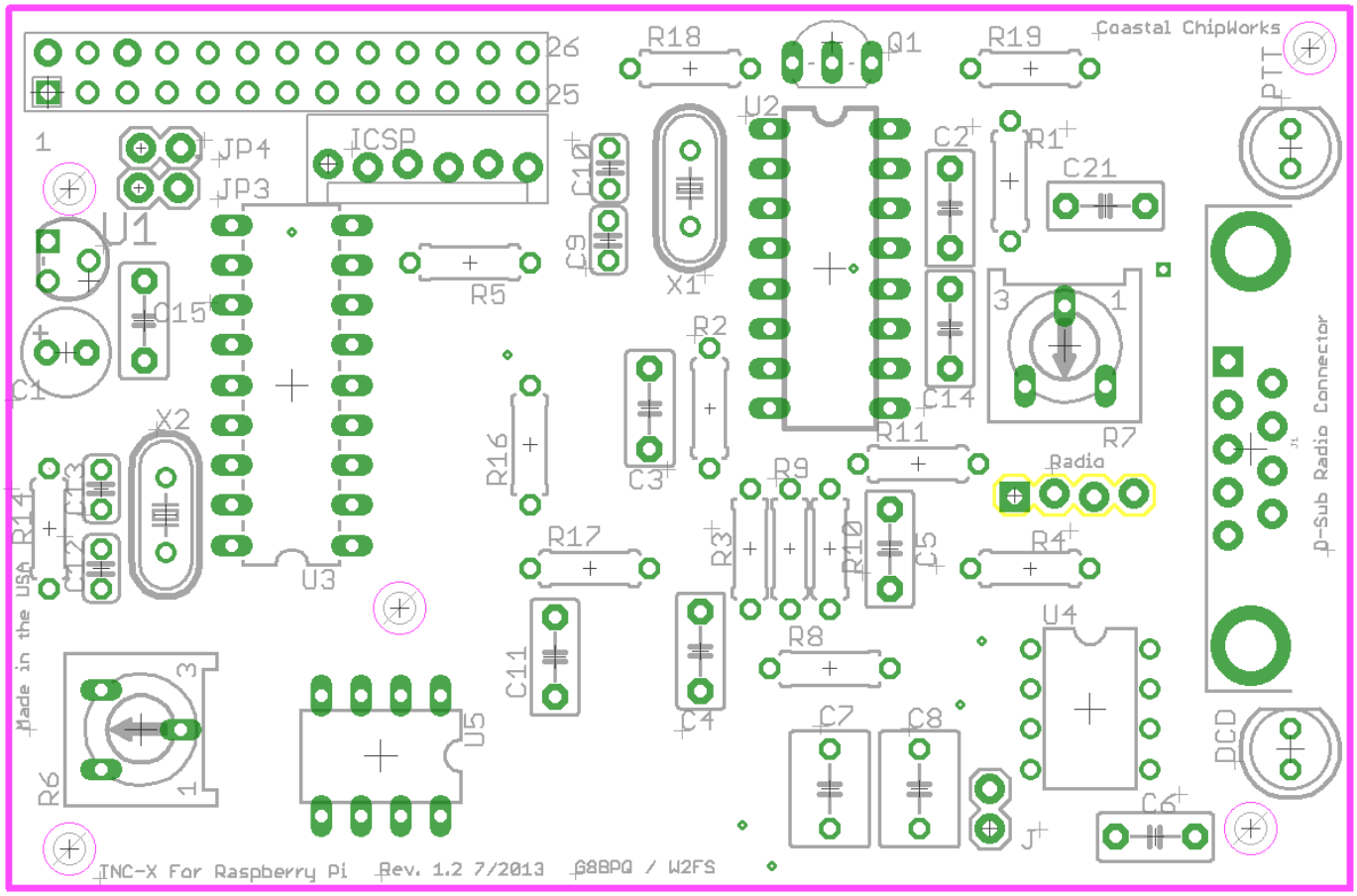
Congratulations, you're done assembling the TNC-Pi.

Schematic Diagram

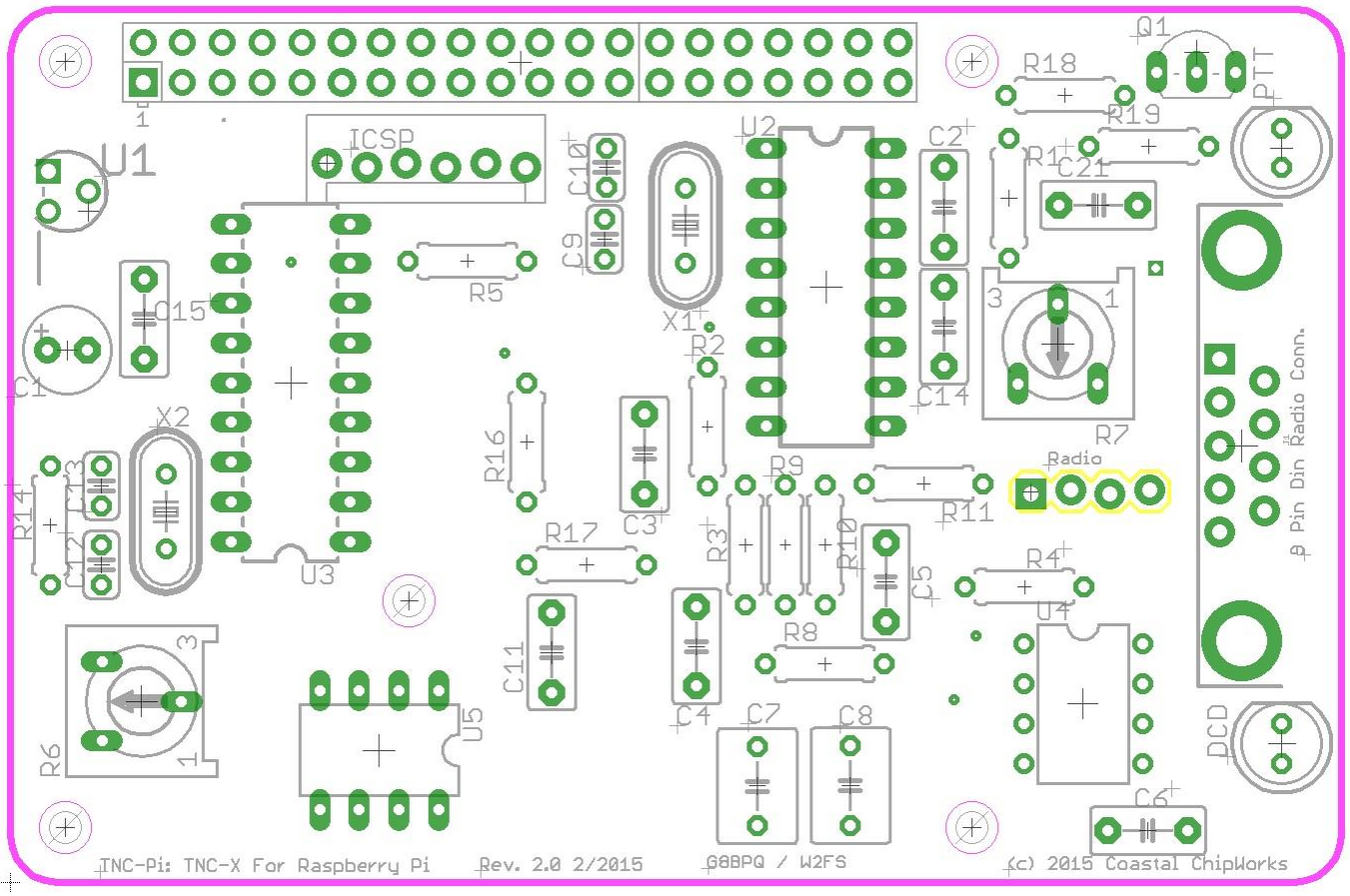


(see next page for parts layout diagram)

Parts Layout (for TNC-Pi)



Parts Layout (for TNC-Pi 2)



Connecting the Radio

You can either wire up a 9 pin D-Sub plug to mate with the one on the TNC-Pi, or, if you'd prefer, you can use the four holes below **R7** labeled **Radio** to hard wire a radio connection. (No header is provided in the kit for this.)

If you use the 9 pin D-Sub connection, it should be wired as follows:

Pin 1 (the square pad): TX Audio
Pin 3: Push to Talk (PTT)
Pin 5: Receive Audio
Pin 6: Ground

If you are using the holes marked "Radio" the connections should be:

Pin 1 (the square pad): Receive Audio
Pin 2: Ground

Pin 3: TX Audio
Pin 4: Push to Talk (PTT)

Adjust transmit audio output

Potentiometer **R7** adjusts the level of the transmit audio output. Most people will find that they need to set it fairly near the minimum setting.

One way to set this is to use two radios, one to monitor the transmitted signal and the other connected to the TNC-Pi.

1. Key the radio connected to the TNC-Pi manually by pushing the PTT button on it.
2. On the other radio you will hear a continuous tone (even though no data is being transmitted… you don't need to be running any software on the Raspberry Pi to do this).
3. Turn R7 all the way down and the tone will go away.
4. Then slowly turn it up until the volume doesn't increase any further in the monitor receiver.
5. When you reach this point, back it off just a little and you should have it about right.

Set the transmit delay

The transmit delay (**TXDelay**) can be set either in software or using **R6**. The default is to set it in software. To change the **TXDelay** parameter, you'll need to use the **pitnc_setparams** program as explained below in the section, Using Xastir.

If you set the value of **TXDelay** to 0 using the **pitnc_setparams** program, you can then use **R6** to set the **TXDelay**.

Most users will find the default setting for TXDelay to be just fine.

Configuring the Raspberry Pi

The following instructions were based on a downloaded image of the "Jessie" version of the operating system. I did this by downloading Raspbian, not NOOBs.

It might be a good idea to make sure your Pi operating system is up to date. You can do this from the command line by entering the following (this assumes you have either hard wired or wireless network connectivity):

sudo apt-get update
sudo apt-get upgrade

In order to use the TNC-Pi with the Raspberry Pi serial port, you will need to make a couple of changes to the Pi configuration. Edit the **/boot/cmdline.txt** file in the boot directory and make the following change:

Remove the following (if it exists): **console=serial0,115200**

Note: cmdline.txt is a single line of text.

Edit the **/boot/config.txt** file to make the following change:

Add the following: enable_uart=1

In addition, if you are using a Raspberry Pi 3 do the following (in red):

Add the following lines to /boot/config.txt:

dtoverlay=pi3-miniuart-bt
core_freq=250

Add the following lines to /lib/systemd/system/hciattach.service (*Note: this file does not exist in the most recent version of the OS. In that case, create the file in the directory listed above and copy these lines into it*).:

[Unit]
ConditionPathIsDirectory=/proc/device-tree/soc/gpio@7e200000/bt_pins
Before=bluetooth.service
After=dev-ttyS0.device

[Service]
Type=forking
ExecStart=/usr/bin/hciattach /dev/ttyS0 bcm43xx 921600 noflow -

[Install]
WantedBy=multi-user.target

You may have read some material on line saying the serial port will show up as ttyS0 on the Pi 3. The above changes will cause it to show up as port ttyAMA0, just as it did with the Pi 2 and earlier. Bluetooth will be moved to ttyS0.

The following applies to all versions of the Pi:

After making these changes you will have to reboot the Pi so they can take effect. Unless you like to do command line editing, the easiest way to edit these file will be to start the raspberry Pi GUI interface. Then run LXTerminal and type the following:

sudo leafpad

So, for example to edit the cmdline.txt file type:

sudo leafpad /boot/cmdline.txt

This will run a very nice GUI editor with superuser privileges to allow you to edit system files.

Keyboard to Keyboard Connections (note: if you want to run Xastir, skip this section and go to the application notes section below)

Note: For the following steps the Raspberry Pi must be connected to the internet.

You can use the Linux AX.25 routines to do connected mode packet. To do this you need to install the ax25 apps and tools. From the command line enter the following:

sudo apt-get install ax25-tools
sudo apt-get install ax25-apps

You'll need to configure it for your callsign by editing the **/etc/ax25/axports** file. You'll find two lines that allow you to enter your callsign. I did so as follows:

1 W2FS-1 19200 236 2 TNC 1
2 W2FS-2 19200 236 2 TNC 2

The serial rate must be at **19200**, because that is the only baud rate support by TNC-Pi. The next two values (**236** and **2** in the above example) are the values for **paclen** and **maxframe**. **Don't leave any blank lines in this file.**

Now attach the serial port to the AX.25 system using **kissattach**:

sudo kissattach /dev/ttyAMA0 1 10.1.1.1

The number in blue above matches the port number from the axports file above. The number in red is an IP address. It's required here even though you aren't using the IP protocol on it.

Note: If you are using the IP protocol on your TNC-Pi your address should conform to the local convention for IP routing. The address in that case will almost certainly start with 44.

You can monitor packets on this channel by entering:

sudo axlisten –a

You can connect to another station for keyboard to keyboard QSO's as follows:

axcall 1 hiscall

where **hiscall** is the call station of the station to which you want to connect.

There seems to be a bug in the axcall routine. The first time you use it after calling kissattach, it will take significantly longer for the Pi to send a valid connect string to the TNC than it does in subsequent attempts. You may have to wait 10 – 15 seconds. Further attempts occur instantaneously. You can abort this first try by issuing a **Ctrl-C** and then issuing the **axcall** command again. It will then connect immediately.

Support

If you have any questions about your TNC-Pi or are having hardware issues with it, please contact John Hansen, W2FS at john@coastalchip.com. Software issues, particularly with regard to the Linux version of BPQ are best addressed to the author, John Wiseman, G8BPQ.

Additional information can be found on the TNC-Pi website: http://tnc-x.com/TNCPi.htm

The configuration programs **setparams** and **getparams** are available here:

www.tnc-x.com/pitnc.zip

Application Notes

Using Xastir

Thanks to M0HPJ for the following information

Another popular packet program that works well on the Pi is the APRS program Xastir.

Note: For the following steps the Raspberry Pi must be connected to the internet.

Update the package list

To install Xastir from the command line, first update the package list as follows:

sudo apt-get update

Then install Xastir

sudo apt-get install xastir

Kill kissattach

If you have been using the AX25 apps, you'll need to unload **kissattach** before Xastir will work. You can do this by simply rebooting the Pi, or you can kill the **kissattach** process from the command line. To do the latter, first find out what process number it is by using a **ps** command to list running processes:

ps –A|grep kissattach

Inspect the list to see the process number of the **kissattach** process, then kill the process using the **kill** command. For example, if the process number is 2335, issue the command:

sudo kill 2335

At this point it may be a good idea to rerun the **ps** command to be certain that the **kissattach** process was successfully killed.

Note: If you have not been using the AX25 apps, it is still necessary to edit the cmdline.txt and **inittab** files as described in the section on configuring the Pi.

Start Xastir

Then start the X-Windows GUI system with the following command:

startx

Xastir can be found in the programs menu under "other". The first time you run Xastir you'll be asked to put in your station parameters. Then you'll need to specify the port that the TNC-Pi is on. Click on Interface and then Interface Control. Click "Add" and pick "Serial KISS TNC" off the list. Push Add and it will bring up a properties list. Under TNC Port enter:

/dev/ttyAMA0

Running Xastir

Everything else is pretty self-explanatory. Do make sure you change the baud rate to 19200. This is not the default. You can select "Maps" and the Map Chooser to select a better set of maps than the default. If you currently have internet connectivity, one of the cloud map options is probably best. If you select a new map option, you should deselect the old one. I haven't yet explored the option of caching the maps to the local SD card so that I don't need an Internet connection, but I expect to look into that soon.

More information

A much more detailed discussion of running Xastir on the Pi in a mobile environment is contained in a paper presented at the 2013 ARRL/TAPR Digital Communications Conference. It can be found at:

http://www.tnc-x.com/DCC2013.doc.

Note: In this paper I discussed using maps that were available from Cloudmade. Since the time that this paper Cloudmade has discontinued free access to these maps. However, the same maps are available from the following source:

http://download.geofabrik.de

The procedure for obtaining and using the maps is the same as those referenced in the paper for Cloudmade.

Configuring TNC-Pi for Use with the I2C Protocol

The TNC-Pi can be configured to communicate with the Raspberry Pi using the I2C protocol. To configure the TNC-Pi for I2C, you will need a configuration programs **pi_tncsetparams** and **pi_tncgetparams**. The **getparams** program reads the parameters from the TNC-Pi while the **setparams** program allows you to set them. These programs are available at:

www.tnc-x.com/pitnc.zip

Setup

Before using them, however, it will be necessary to make some additional configuration changes to the Pi. First, make the following changes to the following files:

1. In the **/etc/modprobe.d/raspi-blacklist.conf** file,
   remove the line: **blacklist I2C-bcm2708**
2. In the **etc/modules** file,
   add the line: **i2c-dev**

Get and set parameters

Note: Before running the **getparams** and **setparams** programs, ensure that **kissattach** is not running.

The **pitnc_getparams** program lists the values for all of the user-settable parameters. Its syntax is:

pitnc_getparams b d

where:

`b` is the number of the I2C bus and

`d` is the number of the I2C device on that bus.

TNC-Pi is shipped with both of these parameters set to 0. An I2C device number of 0 means the TNC is using the serial port rather than the I2C port.

The **pitnc_setparams** program writes values to the TNC-Pi. Its syntax is:

pitnc_setparams b d p v

where

once again **b** and **d** are the bus and device,

p is the parameter number (1 – 7) and

v is the new parameter value.

The parameters that you are most like to use are:

Parameter value	*Description*	*Notes*
1	Sets the **TXDelay**	With TNC-Pi, you can set the **TXDelay** either in software using the **pitnc_setparams** program or in hardware using R6. Setting this parameter to 0 causes the TNC-Pi R6 potentiometer to determine the value.
7	Sets the I2C address	Setting this to 0 causes data communication on the serial port (default), any other value up to 63 will cause I2C to be used with the TNC using this address. This permits you to use multiple TNC's with the same Raspberry Pi.

The BPQ software for Raspberry Pi is currently in beta and can be found at:

http://www.tnc-x.com/InstallingLINBPQ.htm

If you ever need to reset these parameters to their original factory values, this can be done by powering down, turning the TXDelay potentiometer all the way to minimum and then powering back up. You should see the yellow LED flash once per second. When you see it flash, you'll know that the parameters have all been reset. The power the device back down, move the TXDelay off of minimum and power the device back up.

Running Applications other than LinBPQ with TNC-Pi in `I2C` mode.

John Wiseman, G8BPQ, sends along the following information about running other applications using I2C:

The TNC-Pi can be used with applications that use the Linux ax.25 stack, or applications that expect to see a KISS TNC on a serial port. Program `I2ckiss` converts the `I2C` protocol to a standard KISS presentation on a virtual serial (pty) port. It is available here:

https://dl.dropboxusercontent.com/u/31910649/i2ckiss

One copy is run for each TNC-Pi. The first two parameters to I2ckiss are `I2C` bus, `I2C` device. If using the kernel ax.25 code, then specify the port number (from axports) and the ip address. To use with other software, specify symlink and a symbolic name - I suggest com1 - com255

For example, to use with the Linux ax.25 stack:

sudo ./i2ckiss 0 16 1 10.1.1.1

i2ckiss will create a **pty** pair, and execute kissattach on the slave half, using the 3rd and 4th parameters

To use with a KISS application

./i2ckiss 0 16 symlink com1

i2ckiss will create a **pty** pair, then create a **symlink** to com1. The application would then be configured to use port **com1**.

Note: On Version 1 Pi boards (without mounting holes) the I2C bus number is zero, for the Version 2 boards it is 1.

Steps to create an APRS receive-only igate using the Raspberry Pi and TNC-Pi

by Paul Fischer, KC9RGZ

Equipment needed

a) Raspberry Pi model B
b) TNC-Pi (from Coastal ChipWorks at http://tnc-x.com)
c) Power Supply
d) Blank SD card (4 GB?)
e) Windows PC to format and load the SD card
f) Ethernet cable and router/switch with access to the Internet
g) USB Keyboard
h) Monitor (I use an old analog TV with RCA jack input)
i) USB Mouse – only if you want to run the graphics environment on the Pi. Not required for text only setup.
j) 2M radio or scanner set to 144.39MHz (at least that's the frequency here in the USA!)

Instructions

1. Download the boot image for Raspbian "wheezy" (2013-05-25-wheezy-raspbian.zip) from http://www.raspberrypi.org/downloads and extract the image (.img) file.

2. On a Windows PC, format the SD card using **SDFormatter4exe.zip** – also available from http://www.raspberrypi.org/downloads. Use the options Format Type "**QUICK**" and Format Size Adjustment "**ON**".

3. On a Windows PC, use **Win32DiskImager** to write the image on an SD card (also downloadable from above site). Click the folder icon to the right of the Image file box to select the image file from step #1. Use the pull down tab to select the SD card and hit the "Write" button. This process takes a few minutes.

4. Put the SD card in the Rpi; connect the network cable, monitor and keyboard. Then the power supply and it should boot into the **raspi-config** application. This application can be run again once logged in by running "sudo raspi-config").

5. In the **raspi-config** program set these things:
    a. Internationalisation Options; Change_locale – choose "**en_US. UTF-8 UTF-8**"
    b. Internationalisation Options; Change_timezone – **America; Central**
    c. Internationalisation Options; Configure_keyboard – set to "**Generic 105-key (Intl) PC; Other; English (US) – English (US,alternative international)"**
    d. Overscan (Advanced Settings) – set to **enable**
    e. Hit right arrow key and select the "**Finish**" key
    f. Reboot: "**sudo shutdown –r now**"

6. Login with login "**pi**" and password "**raspberry**"

7. Upgrade to root privileges "**sudo su**"

8. If the monitor doesn't display well (mine didn't), edit the file /boot/config.txt and uncomment the line:

overscan_left=16

And then re-boot. The above line will move the display to the left 16 pixels. You can play with the other settings as well until you are happy with the display.

9. Verify the software is up to date (this could take a while)

apt-get update
apt-get upgrade

10. Edit the file /boot/cmdline.txt and remove the following parts of the line:

console=ttyAMA0,115200 kgdboc=ttyAMA0, 115200

11. Edit the file /etc/inittab and remove the line that says:

T0:23:respawn:/sbin/getty –L ttyAMA0 115200 vt100

12. Reboot the device using the command:

shutdown –r now

Then log back in using **userid** and **password** listed above and upgrade to root privileges again.

13. Get the aprx digi/igate software:

cd /usr/src

wget http://ham.zmailer.org/oh2mqk/aprx/aprx-2.05.svn485.tar.gz

Note: This version of aprx was current at the time these instructions were originally written. There is almost certainly a more recent version available now. To find out what the number of the current version is, go to: ham.zmailer.org/oh2mqk/aprx and look for a file that is similar to the one above with a more recent version number and svn number. Then issue the wget command for that file instead of the one referenced above.

tar xvf aprx-2.05.svn485.tar.gz
cd aprx-2.05.svn485/
./configure
make
make install
mkdir /var/log/aprx

14. Save a copy of the original aprx configuration file

cp /etc/aprx.conf /etc/aprx.conf.orig

15. Edit the file /etc/aprx.conf and make sure the following lines are included (please use your own call sign and latitude/longitude). Many of these lines are already included, others just need to be uncommented. Just make sure all of these are included:

```
mycall KC9RGZ-11
<aprsis>
server noam.aprs2.net
</aprsis>
<logging>
pidfile /var/run/aprx.pid
rflog /var/log/aprx/aprx-rf.log
aprxlog /var/log/aprx/aprx.log
</logging>
<interface>
serial-device /dev/ttyAMA0 19200 8n1 KISS
</interface>
<beacon>
beaconmode aprsis
cycle-size 10m
beacon symbol "/&" lat "4124.57N" lon "09041.26W" comment "RasPi Rx-only
iGate"
</beacon>
```

16. Verify the serial port is available:

```
chmod 666 /dev/ttyAMA0
```

17. Add the following lines to the end of the /etc/rc.local file to start the aprx program:

```
printf "Start the igate daemon... \n"
aprx
```

18. Reboot

```
shutdown –r now
```

19. Log back in and verify the processes are running

```
ps aux|grep aprx
```

20. Connect the radio and ensure you are gating data to the aprs network (check the files in **/var/log/aprx**)

21. Enjoy!

Notes:

1. Before the final move to "production", you should change the password of the "pi" userid!

2. To backup the SD card (after you have it all working, so you don't have to run the above instructions again!) – On a Windows PC, run the program HDDRAWCopy1.02Portable.exe (available from http://hddguru.com/software/HDD-Raw-Copy-Tool/).
   Select the SD card as the SOURCE and hit Continue. Double Click the "File" line to specify the name and location of the backup file (ex. 2013-07-03-wheezy-raspbian-backup). Use a file type of "Raw image (dd image) (*.img)". Hit Continue, then Start.

3. Restore is done by reversing the source and destination (use the file as the source and the SD card as the destination).