µSmartDigi™ & TNC-X Assembly and Testing

General Procedures

First assemble and test the TNC-X before installing the µSmartDigi. Follow the construction and checkout procedures in the TNC-X manual included with your kit. This manual can be found here http://www.tnc-x.com/TNCx.doc and the optional USB installation here http://usmartdigi.com/#usb and here http://www.tnc-x.com/USB4.htm. Below are the procedures for completing the assembly and testing of both units.

TNC-X Assembly

Follow the assembly instructions in the TNC-X manual with the exception of the installing of the LM78L05 low current regulator. Since the µSmartDigi consumes about 200 mA you **MUST** install the substitute 7805 TO-220 style regulator and either heat sink it or mount it to the TNC-X enclosure. Instructions on how to do this can be found here http://usmartdigi.com/#regulator and the *µSmartDigi Getting Started Guide* enclosure shipped with the µSmartDigi and also the latest found here http://usmartdigi.com/uSmartDigi%20Digi%20Getting%20Started%20Guide%20V2.62.pdf

You **MUST** power the TNC-X from an external source and **NOT** via the USB power when using the µSmartDigi! Therefore, the TNC-X USB power jumper at JP4 MUST be jumpered Pins 1+2. Pin 1 is closest to the voltage regulator.

TNC-X Testing

Test the TNC-X before installing the µSmartDigi! The TNC-X manual indicates a number of tests to perform before and after final PCB assembly. You will need to set the baud rate jumpers to 19200 by removing jumpers at TNC-X JP1 and JP2.

You can check to see that the TNC-X draws the correct current by either measuring your external supply current or you can use the TNC-X JP4 jumper to insert an ammeter. Normally JP4 must be jumpered Pin 1 to Pin 2. You can remove this jumper and use an ammeter between Pin 1 and Pin 2 to measure the TNC-X and µSmartDigi current. At this stage you should complete testing of the TNC-X before installing the µSmartDigi. The TNC-X by itself draws about 15 mA. Later you can perform this current check with the µSmartDigi installed where the current will be approximately 200 to 230 mA. Don't forget to replace the jumper on JP4 Pin 1 to Pin 2 when you are finished checking the current.

The next step you will perform is a Data and Audio Loopback through the TNC-X modem and PIC. This tests the modem, PIC and the PTT circuit.

There are six connectors on the rear of the µSmartDigi+TNC-X:

DC Power	Coaxial Plug 5.5mm OD, 2.5mm ID, 10mm Long (Radio Shack N, 274-1573)
Main Serial Port	DB-9R DCE
Aux Serial Port	3.5mm Stereo Jack
Receive Audio	3.5mm Mono Jack
Transmit Audio + PTT	3.5mm Stereo Jack
Optional USB Main Port	USB

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DC power is applied to the 5.5mm plug, positive on the center pin. Using a well heat sinked 7805 regulator the DC input voltage can approach 35 volts. The minimum is about 7.5 volts. The higher the input voltage the more power and heat will have to be dissipated by the regulator and heat sink.

Cables are described here http://usmartdigi.com/uSmartDigi%20Cables.pdf. You will need to connect to the Receive Audio 3.5mm Mono Jack connector on the rear of the TNC-X. You can optionally connect a PC speaker to the Transmit Audio on the TNC-X 3.5mm Stereo Jack. This will allow you to hear the modem audio for the test.

Make a wire jumper and install it on the TNC-X 8-pin header, JP5, going from Pin 1 to Pin 3. This creates a loopback that eliminates the USB, serial chip and external serial connectors.

Next, connect the Receive Audio signal to your radio or to a speaker output on your PC. You can use live audio from the radio or play an APRS recording from your PC. The 25-minute APRS recording from Los Angeles is here http://usmartdigi.com/APRS%20LA%20Nov%202005.wav. Warning- this is 260 Mbytes.

Now play the PC test audio file with an appropriate application, such as Windows Media Player, or live audio from your APRS radio. The modem audio output level is adjusted using TNC-X pot R12. You may set this high to hear it for the test but you **MUST** later set the operating level using the transmitting radio as described in the TNC-X manual. If all is working correctly you will hear the modem and see the Yellow LED come on when receiving a packet and the Red LED come on indicating it is transmitting this packet. In this test it is a loopback so all incoming packets are transmitted without alteration! When the Red LED is on the PTT signal on the rear TNC-X 3.5mm Stereo Jack will be pulled to ground. You can confirm this using a voltmeter.

An alternate PTT test is to connect a pullup resistor to the unconnected PTT signal on the TNC-X 3.5mm Stereo Jack and hook the power end of the resistor to a power point within the TNC-X, such as on either end of the diode D2. Then connect a voltmeter or oscilloscope to the PTT. A low voltage indicates PTT is “pushed”.

To measure or set the Transmit Delay use the following procedure. Connect an oscilloscope to pin 11 of the modem chip U1 or pin 9 of U3. Use the 25-minute audio test file or the 2-packet audio test file here http://usmartdigi.com/APRS%20Test%202%20Packets.wav and set your Media Player to continuous-play (repeat) mode. Set your scope input to 2V/div, trigger 1V rising edge. To better distinguish the initial change from control to data set the scope to under sample at approximately 1000 s/sec. On the scope you will see a near 0 voltage when the PTT is OFF. While there is a high voltage the PTT is ON. The Transmit Delay is the time from when this signal goes high until the data appears following the initial uniform control signal. Adjusting pot R13 will result in a change in this time after a few seconds lag time. Adjust this pot to get the specific Transmit Delay needed for a given radio. The range is typically 0 to 440 milliseconds. With the pot R13 midway it will be about 240 milliseconds as shown below. This is the recommended setting.

Using a second channel on the scope you can simultaneously show the PTT with either the Red LED or the PTT resistor pullup method.

Shown in the image below the cursor X1 is the point where PTT goes high. Cursor X2 is where the data begins. The time difference is the Transmit Delay. Notice the uniform control signals between the cursors.

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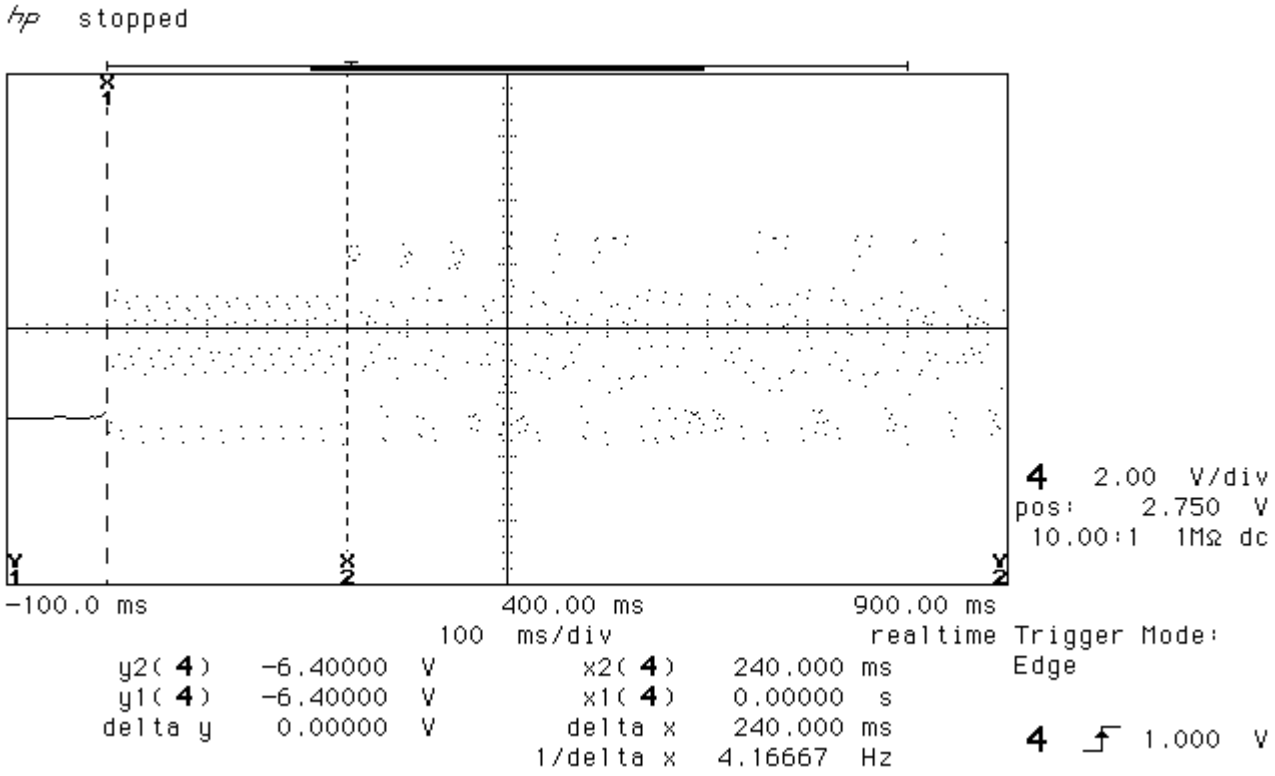

The next test sequence is to test the serial communications side of the TNC-X, isolating it from the modem and PIC. You will need to decide whether to use the USB or Main comm. ports.

For USB:

- Install the appropriate USB Windows drivers from the selections in the table here http://usmartdigi.com/#usb
- Install the TNC-X USB jumper JP3 on Pins 1+2. Pin 1 is closest to the USB module. On older TNC-X PCB with only 2 pins on JP3 simply remove the jumper.

For Main:

- Install the TNC-X USB jumper JP3 on Pins 2+3. Pin 3 is closest to the MAX232 serial chip. On older TNC-X PCB with only 2 pins on JP3 simply install the jumper.

Remove the wire jumper on the 8-pin header from the previous test and install it on the TNC-X 8-pin header, JP5, going from Pin 2 to Pin 4. This creates a loopback that eliminates the TNC-X PIC and modem and isolates the serial communications for testing.

Next configure on your PC Hyperterm or some other terminal emulator as follows:

1. 19200 Baud, 8 data bits, 1 stop bit, no parity
2. “Send line ends with line feeds" and "Echo typed characters locally" in Hyperterm
3. Comm. Port for either the USB virtual comm. port or the physical serial comm. port.

You should now see double characters typed into the Hyperterm window. This confirms the PC, USB/Serial Port and TNC-X serial port wiring for the USB/Serial Port. You are now ready to proceed to the testing of the µSmartDigi.

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µSmartDigi Testing

The µSmartDigi has two jumpers at J3 to select how the µSmartDigi's transmit and receive serial data is connected to these external TNC-X connectors. These jumpers basically connect the separate transmit and receive to one or either of the Main (DB-9R or USB) or Aux (3.5mm Stereo Jack) TNC-X connectors.

When using the Digipeater, one does not need any external serial connections. However, you can connect a GPS to the Aux configured for the receive data to the µSmartDigi. You can also connect a PC using the DB-9R for transmit data so an application such as Hyperterm can monitor the activity. If both GPS and Monitor are connected you will need to split the transmit and receive connectors, one on Main and one on Aux, by using the µSmartDigi J3 jumpers.

For initial testing only use the Hyperterm for both sending and receiving the serial data on the Main or USB port as follows:

1. Remove the TNC-X power and USB cable.
2. Install on µSmartDigi jumpers at J3 Pins 1+2 and 4+5.
3. Remove any jumpers on TNC-X 8-pin header.
4. Install the µSmartDigi onto the TNC-X 8-pin header.
5. Cable the Main serial port or the USB.
6. Start up Hyperterm with the settings from the previous test.
7. Power up TNC-X.

At this point you should see the µSmartDigi startup banner and command prompt. You should be able to configure your call sign and other parameters. µSmartDigi will not repeat anything without first setting your call sign. You cannot configure Rules here. You must use the PC Utility to perform this.

A list of commands are here http://usmartdigi.com/#MonitorCommands and can also be displayed on the terminal screen with the ? command.

Version 2.7 and later contains built-in serial port testing features. This can be used with Hyperterm or the PC Utility. To make this work you must have the serial communications working to the extent that commands can be sent to the µSmartDigi.

To use with Hyperterm enter the following µSmartDigi command:

uSmart> serialtest

Now you can type characters that will be echoed. Typing a <ctrl>-c will terminate the test.

To use the PC Utility, start the program and enter the following commands:

Command> connect com_port [baud]
Command> serialtest iterations

Where the baud is optional and iterations is the number of trials to test. This will send a block of characters repeated iterations times. This test is automatic and will report any errors.

