INTRODUCTION

The TAPR TNC 1 Upgrade is a kit designed to bring the owners of early TAPR and TAPR-based TNCs to the latest standards in high-performance packet operation.

The upgrade essentially adds the digital circuitry of the TAPR TNC 2 to the TNC 1, while retaining use of the TNC 1's power supply, modem, RS232 level shifters, I/O connectors and case.

With the upgrade installed, any software update EPROMs for the TNC 2 will operate in your TNC. This includes the present KISS, TNC 2 1.1.x software, WA8DED software, NET/ROM, etc. When AX.25 Level 2 Version 2.1 is introduced for the TNC 2, you will be able to upgrade immediately!

When the upgrade is installed in a TNC 1 (or Heath HD-4040 or AEA PKT-1 or even an original TAPR "Beta" TNC), the TNC may operate as a TNC 1 or as a TNC 2. In the TNC 2 mode, the following unique, enhanced features are provided:

- Software selectable ABAUD and HBAUD rates.
- Selectable firmware (two sockets for two sets of TNC 2 firmware).
- Optional second set of battery-backed parameters.
- Retention of all TNC 1 functions.
- Two modem disconnects for external modems.

Construction and check-out of the TNC 1 Upgrade will probably take you only an evening or two.

Warm up your soldering iron, take your time, and continue to be one of the very few packeteers who can claim you built your own TNC!

Enjoy!

Parts List

Please check the enclosed parts with this list. Check off each item in the space ( ) provided. The number following the check-off space is the quantity required.

The TAPR part numbers referenced below are not necessarily marked on the parts. Rather, they are provided for reference when ordering replacement parts from TAPR.

Parts Sorting

As you sort the parts, you may find it convenient to place them in a muffin tin, egg carton or other compartmentalized container for ready access.

Resistors

1/4 watt, 5%			TAPR P/N
( ) 5	10k ohm	(brown-black-orange-gold)	CFR1/4-103
( ) 2	100k ohm	(brown-black-yellow-gold)	CFR1/4-104
( ) 1	10M ohm	(brown-black-blue-gold)	CFR1/4-106

Capacitors

Mylar or Monolithic

Capacitors may be marked in various ways. The typical markings are given but may vary. Find all that match the typical markings given and the remaining ones, if any, should become apparent by elimination.

( ) 2	20 pF	(20, 20J or 200)	MONO-200
	OR		
( ) 2	22 pF	(22, 22J or 220)	MONO-220
( ) 2	470 pF	(471)	MONO-471
( ) 14	0.1 uF	(104)	MONO-104

Integrated Circuits

Integrated Circuits come from various manufacturers and may have differing prefixes and/or suffixes. For example, if the part is listed as a 74LS00, it may be marked SN74LS00N or MC74LS00P or DM74LS00N or F74LS00P or some other variation. The key is that the sequence **74LS00** appears in the part number. A four-digit number, such as 8834, indicates the year and week of manufacture and should not be confused with the part number.

NOTE: Do not handle the ICs at this time! Carefully remove the black foam carrier with ICs from the anti-static bag and verify the ICs against this list. Then return the foam with the ICs to the anti-static bag.

			TAPR P/N
( )	1	8400A or 84C00A or 70008 Z80 CPU	Z8400
( )	1	74HC139 or 74HCT139 Dual Decoder	74HC139
( )	1	74HC4060 Oscillator/Divider	74HC4060
( )	1	74HC393 or 74HCT393 Dual Binary Divider	74HC393
( )	2	74HC86 or 74HCT86 Quad Exclusive-Or Gate	74HC86
( )	1	74HC21 or 74HCT21 Quad Dual AND Gate	74HC21
( )	2	74HC74 or 74HCT74 Dual D Flip-Flop	74HC74
( )	1	DS1210 bbRAM Controller	DS1210
( )	3	74HC157 or 74HCT157 Quad Multiplexer	74HC157
( )	1	8440A or 84C40A Z80 SIO/0	8440
( )	1	27C256 EPROM with TNC 2 firmware (not included)	
( )	1	62256L or 43256L 32k-byte Static RAM (not included)	

Sockets

( )	1	08-pin DIP Socket	DIPS-08
( )	6	14-pin DIP Socket	DIPS-14
( )	5	16-pin DIP Socket	DIPS-16
( )	5	28-pin DIP Socket	DIPS-28
( )	2	40-pin DIP Socket	DIPS-40

Connectors

( )	5	3-pin male header	HM-03
( )	12	Jumper, Push-On	JMP-02
( )	2	20-pin male header	HM-20
( )	1	20-pin female header	HF-20
( )	1	4-pin male header with "wall"	HMW-04
( )	1	Molex Connector Housing	MOL-04
( )	4	Molex Connector Pins	MOL-04P
( )	1	28-pin IC Adapter	DIPH-28

Miscellaneous

( )	1	4.9152 MHz Crystal, HC-18/U	XTAL-049
( )	1	Length 10-wire ribbon cable	

Packed Separately

WARNING! The Lithium battery used in the TNC 1 Upgrade must be handled with <u>extreme</u> care. **NEVER ALLOW A SHORT CIRCUIT ACROSS THE BATTERY TERMINALS OR THE BATTERY COULD EXPLODE AND CAUSE SERIOUS INJURY!** Leave the battery in its envelope until called for in the instructions.

( )	1	Battery, Lithium, 3-volt	CN1/3-FT
( )	1	Printed Circuit Board, Upgrade, Rev B	UPGPC-R2
( )	1	Assembly Manual, Upgrade	UPGM-ASM
( )	1	TNC 1 Upgrade Commands and Messages	UPGM-COM

ASSEMBLY
IC Sockets

NOTE: If any socket pins are bent, carefully straighten them with a pair of long-nose pliers before assembly. Some types of IC sockets have crimps in the pins to hold them in place when automatic wave-soldering is performed. These sockets may be tricky to install if you are not familiar with them. If your kit contains these sockets, you may want to straighten the pins before attempting to insert them into the PC board.

When installing IC sockets, tack-solder two diagonally opposite corners first (such as pins 1 and 8 on a 14-pin socket). Double check to ensure that the socket is seated properly against the board with the notch, beveled corner or "1" towards the silkscreened reference (U1, U2, etc.). Be sure that all IC socket pins are showing on the solder side of the board.

Then solder the remaining pins of that socket before proceeding to the next one.

NOTE: Take care now to avoid solder bridges!

If you find a socket is difficult to install, remove it and double-check for a bent pin.

Install the following IC sockets.

( ) U1 40-pin
( ) U2 28-pin
( ) U3 28-pin
( ) U4 28-pin
( ) U5 28-pin
( ) U6 40-pin
( ) U18 16-pin
( ) U15 16-pin
( ) U14 28-pin **(NOT P1!)**
( ) U7 16-pin
( ) U16 16-pin
( ) U12 14-pin
( ) U13 14-pin
( ) U19 14-pin
( ) U17 08-pin
( ) U8 14-pin
( ) U9 16-pin
( ) U10 14-pin
( ) U11 14-pin

Now check your work. All leads should be soldered. There should be no solder bridges (a blob of solder that shorts two adjacent soldered connections) or cold (gray and/or grainy looking) solder connections. You should have no IC sockets remaining.

( ) OK so far.

Resistors

Install the following 5% resistors on the board. The leads are on 1/2" centers. A lead forming jig (or an old TAPR ALJ-1000) may be used for neater construction.

( )	R4	10k ohm	(brown-black-orange-gold)
( )	R2	10k ohm	(brown-black-orange-gold)
( )	R3	100k ohm	(brown-black-yellow-gold)
( )	R6	10k ohm	(brown-black-orange-gold)
( )	R1	10k ohm	(brown-black-orange-gold)
( )	R5	10k ohm	(brown-black-orange-gold)
( )	R7	10M ohm	(brown-black-blue-gold)
( )	R8	100k ohm	(brown-black-yellow-gold)

WARNING! Be careful when clipping leads, as they have a tendency to fly towards your eyes! Take appropriate precautions (grasp leads and wear eye protection).

( ) Solder and clip the leads (16 total)

Capacitors

NOTE: All capacitors should be mounted as nearly flush to the board surface as practical without stressing the leads.

( )	BP	0.1 uF	(104)	@U2
( )	BP	0.1 uF	(104)	@U3
( )	BP	0.1 uF	(104)	@U4
( )	BP	0.1 uF	(104)	@U5
( )	BP	0.1 uF	(104)	@U6
( )	BP	0.1 uF	(104)	@U18

( ) Solder and clip the leads (12 total)

( )	BP	0.1 uF	(104)	@U15
( )	BP	0.1 uF	(104)	@P1
( )	BP	0.1 uF	(104)	@U14
( )	BP	0.1 uF	(104)	@U16
( )	BP	0.1 uF	(104)	@U16
( )	BP	0.1 uF	(104)	@U12
( )	BP	0.1 uF	(104)	@U13

( ) Solder and clip the leads (14 total)

( )	C4	470 pF	(471)
( )	C2	20 or 22 pF	(20, 22, 200 or 220)
( )	C1	20 or 22 pF	(20, 22, 200 or 220)
( )	BP	0.1 uF	(104) @U10
( )	C3	470 pF	(471)

( ) Solder and clip the leads (10 total)

Now check your work. All leads should be soldered. There should be no solder bridges or cold solder connections. You should have no resistors or capacitors remaining.

( ) OK so far.

Remaining Components

NOTE: When installing jumper strips, be sure that the shorter pins are soldered to the PC board and the longer pins stick up.

WARNING! Don't grip the jumpers with your fingers while soldering. The pins quickly get very hot!

( ) JP2 Install a 3-pin header.

( ) JP3 Install a 3-pin header.

( ) JP4 Install a 3-pin header.

( ) JP5 Install a 3-pin header.

( ) JP1 Install a 3-pin header.

( ) T1 Install a 20-pin male header **(not J1!)**.

( ) T2 Install a 20-pin male header.

( ) P2 Install a 4-pin male header with the "wall" towards T2.

( ) X1 Install the 4.9152 MHz crystal. Do not overheat! The crystal should be installed with the leads bent up about 1/16" away from the bottom of the crystal case, then looped downward through the holes to form a strain relief.

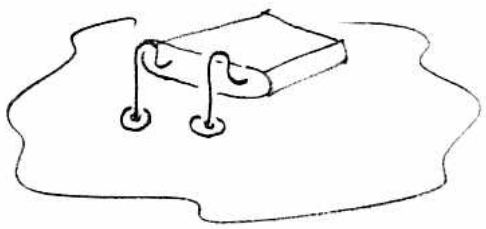


Fig. 1 - Crystal Leads

Bottom of PC board

There are two connectors which are mounted to the bottom side of the PC board. The silkscreened locations are on the top of the board. The components will be inserted from the bottom side of the board and soldered to the pads on the top side.

NOTE: If the upgrade is to installed in a TAPR Beta TNC, do NOT install the female header at J1!

( ) J1 Install the 20-pin female header. Be sure it is square with the PC board.

The placement of P1 is critical! Please read through the following steps before performing them. Use the directions that apply to the unit you are upgrading.

TAPR Beta TNC

The Beta TNC has a number of differences from the later TNC 1 and clones. In order to install the TNC 1 Upgrade in a Beta TNC, the power supply regulator will have to be removed from the TNC PC board and relocated to a suitable heat sink (such as a cabinet rear wall). Detailed directions for this are not included here.

The Beta TNC has no modem disconnect header. Wires will have to be added to disconnect the modem from the 1933 HDLC chip and connected to the appropriate points at J1 on the upgrade board. Directions for performing this operation will be given later.

The following steps will allow you to install the 28-pin header which provides much of the interconnect between the Beta TNC and the TNC 1 Upgrade.

( ) Observing static precautions, carefully remove U14 (6551) and insert in on the backside of the black foam containing the ICs included in your upgrade kit.

( ) Observe the 28-pin header supplied with the upgrade kit. The end with the short pins plugs into the IC socket on the Beta TNC PC board; the long pins are to be soldered into the upgrade PC board.

( ) Carefully insert the 28-pin header into socket U14 on the Beta TNC PC board. Align the notch in the header with the pin 1 end of U14.

( ) Now, install the upgrade PC board by threading the 28 pins of the header through the upgrade PC board at P1. It may be easiest to angle the upgrade PC board so the "rear" of the board installs first. Be certain that the connector pins at P1 are aligned, and that the Upgrade PC board clears all the various headers and components on the Beta TNC.

( ) Verify the upgrade PC board is parallel to the Beta TNC PC board.

( ) Carefully tack solder the four corner pins of P1 on the top of the upgrade PC board.

( ) Again verify that the upgrade PC board is parallel to the Beta TNC PC board.

( ) Carefully remove the upgrade PC board from the TNC.

( ) Solder the remaining 24 pins of P1 in place. This is tricky, so take your time and be certain all joints are soldered to the pins and the pads. You may find it helpful to clip the excess lead length from the pins at P1 above the upgrade PC board before soldering.

( ) Double check that all pins of P1 are soldered, and that there are no solder bridges shorting adjacent pins.

( ) Proceed to **UPGRADE DIRECTIONS, PART TWO.**

TAPR TNC 1

( ) Verify the TNC is operational.

( ) Remove power from the TNC.

( ) Remove the top lid of the case.

( ) Disconnect and remove the front panel.

( ) Remove the jumpers from the 20-pin modem disconnect header, J5.

( ) If there are ejector latches at J5, carefully remove them (or cut them or break them out of J5).

( ) Observing static precautions, carefully remove U14 (6551) and insert in on the backside of the black foam containing the ICs included in your upgrade kit.

( ) Observe the 28-pin header supplied with the upgrade kit. The end with the short pins plugs into the IC socket on the TNC 1 PC board; the long pins are to be soldered into the upgrade PC board.

( ) Carefully insert the 28-pin header into socket U14 on the TNC 1 PC board. Align the notch in the header with the pin 1 end of U14.

( ) Now, install the upgrade PC board by inserting J1 into TNC 1 J5, at the same time threading the 28 pins of the header through the upgrade PC board at P1. It may be easiest to angle the upgrade PC board so the "rear" of the board installs first. Be certain that the connectors at J1 and P1 are aligned.

( ) Verify the upgrade PC board is parallel to the TNC 1 PC board.

( ) Carefully tack solder the four corner pins of P1 on the top of the upgrade PC board.

( ) Again verify that the upgrade PC board is parallel to the TNC 1 PC board.

( ) Carefully remove the upgrade PC board from the TNC 1.

( ) Solder the remaining 24 pins of P1 in place. This is tricky, so take your time and be certain all joints are soldered to the pins and the pads. You may find it helpful to clip the excess lead length from the pins at P1 above the upgrade PC board before soldering.

( ) Double check that all pins of P1 are soldered, and that there are no solder bridges shorting adjacent pins.

( ) Proceed to **UPGRADE DIRECTIONS, PART TWO.**

Heath HD-4040

( ) Verify the TNC is operational.

( ) Remove power from the TNC.

( ) Remove the case lid.

( ) Remove the jumpers from the 20-pin modem disconnect header, J5.

( ) If there are ejector latches at J5, carefully remove them (or cut them or break them out of J5).

( ) If C14 on the TNC PC board is taller than the shroud of J5, then C14 must be replaced with a low-profile part.

( ) Observing static precautions, carefully remove U14 (6551) and insert in on the backside of the black foam containing the ICs included in your upgrade kit.

( ) Observe the 28-pin header supplied with the upgrade kit. The end with the short pins plugs into the IC socket on the HD-4040 PC board; the long pins are to be soldered into the upgrade PC board.

( ) Carefully insert the 28-pin header into socket U14 on the HD-4040 PC board. Align the notch in the header with the pin 1 end of U14.

() Now, install the upgrade PC board by inserting J1 into HD-4040 J5, at the same time threading the 28 pins of the header through the upgrade PC board at P1. It may be easiest to angle the upgrade PC board so the "rear" of the board installs first. Be certain that the connectors at J1 and P1 are aligned.

( ) Verify the upgrade PC board is parallel to the HD-4040 PC board.

( ) Carefully tack solder the four corner pins of P1 on the top of the upgrade PC board.

( ) Again verify that the upgrade PC board is parallel to the HD-4040 PC board.

( ) Carefully remove the upgrade PC board from the HD-4040.

( ) Solder the remaining 24 pins of P1 in place. This is tricky, so take your time and be certain all joints are soldered to the pins and the pads. You may find it helpful to clip the excess lead length from the pins at P1 above the upgrade PC board before soldering.

( ) Double check that all pins of P1 are soldered, and that there are no solder bridges shorting adjacent pins.

( ) Proceed to **UPGRADE DIRECTIONS, PART TWO.**

AEA PKT-1

( ) Verify the TNC is operational.

( ) Remove power from the TNC.

( ) Open the case and expose the component side of the PC board.

NOTE: Near U17 is an area marked J7. This is where the modem disconnect is installed. There may not be a 20-pin male header installed on the PKT-1 circuit board, in which case you will have to install one. You may obtain one from a local source, AEA or from TAPR (order 20-pin Male Header, TAPR Part Number HM-20). In addition, you will need eight (8) 2-pin push-on jumpers (order TAPR Part Number JMP-02). The following 22 steps guide you through the process of J7 header installation.

( ) Remove the PC board from the PKT-1 case to perform the following ten (10) steps:

( ) Cut the trace between J7 pin 1 and J7 pin 2.

( ) Cut the trace between J7 pin 5 and J7 pin 6.

( ) Cut the trace between J7 pin 7 and J7 pin 8.

( ) Cut the trace between J7 pin 9 and J7 pin 10.

( ) Cut the trace between J7 pin 11 and J7 pin 12.

( ) Cut the trace between J7 pin 13 and J7 pin 14.

( ) Cut the trace between J7 pin 17 and J7 pin 18.

( ) Cut the trace between J7 pin 19 and J7 pin 20.

( ) Install a 20-pin male header at J7. If the header you purchased has ejector/latches, remove them from the header.

( ) Carefully inspect your work to be sure no traces were cut that shouldn't have been, and that all that should have been are, and that there are no solder blobs or splashes.

( ) Reinstall the PC board into the case.

( ) Place a push-on jumper across J7 pins 1 and 2.

( ) Place a push-on jumper across J7 pins 3 and 4.

( ) Place a push-on jumper across J7 pins 7 and 8.

( ) Place a push-on jumper across J7 pins 9 and 10.

( ) Place a push-on jumper across J7 pins 11 and 12.

( ) Place a push-on jumper across J7 pins 13 and 14.

( ) Place a push-on jumper across J7 pins 17 and 18.

( ) Place a push-on jumper across J7 pins 19 and 20.

( ) Connect a radio, apply power and verify that the PKT-1 radio modem performs as before.

( ) Remove power and disconnect the radio.

( ) Remove the jumpers from J7.

( ) Observing static precautions, carefully remove U14 (6551) and insert in on the backside of the black foam containing the ICs included in your upgrade kit.

( ) Observe the 28-pin header supplied with the upgrade kit. The end with the short pins plugs into the IC socket on the PKT-1 PC board; the long pins are to be soldered into the upgrade PC board.

( ) Carefully insert the 28-pin header into socket U14 on the PKT-1 PC board. Align the notch in the header with the pin 1 end of U14.

( ) Now, install the upgrade PC board by inserting J1 into PKT-1 J7, at the same time threading the 28 pins of the header through the upgrade PC board at P1. It may be easiest to angle the upgrade PC board so the "rear" of the board installs first. Be certain that the connectors at J1 and P1 are aligned.

( ) Verify the upgrade PC board is parallel to the PKT-1 PC board.

( ) Carefully tack solder the four corner pins of P1 on the top of the upgrade PC board.

( ) Again verify that the upgrade PC board is parallel to the PKT-1 PC board.

( ) Carefully remove the upgrade PC board from the PKT-1.

( ) Solder the remaining 24 pins of P1 in place. This is tricky, so take your time and be certain all joints are soldered to the pins and the pads. You may find it helpful to clip the excess lead length from the pins at P1 above the upgrade PC board before soldering.

( ) Double check that all pins of P1 are soldered, and that there are no solder bridges shorting adjacent pins.

UPGRADE DIRECTIONS, PART TWO

NOTE: The following steps deal with the Upgrade PC board, not the TNC PC board.

( ) If you have an ohmmeter available, verify that there is more than one thousand ohms of resistance between U15 socket pins 8 and 16. (The ohmmeter may momentarily register a lesser resistance as the various bypass capacitors charge up - this is normal.)

( ) If you are not upgrading a Beta TNC, proceed to **PRELIMINARY TEST.**

BETA TNC

These directions are for the Beta TNC only. They provide the functionality of the later TNC's modem disconnect header.

If you wish to be able to completely remove the Upgrade PC board, you will need to make the following connections through some sort of disconnect installed in the wire-wrap area. The following directions assume no disconnect is to be used.

It is recommended that, after this modification is performed, any external modems be connected to the "T2" modem disconnect on the Upgrade board. This is because the "T1" disconnect will not be a true reflection of the standard TNC 1 modem disconnect.

NOTE: It is assumed that no modem modifications have been made to the Beta TNC. If modifications have been made, be sure that the RxD and DCD lines referred to in the following instructions referencing Beta TNC U18 tie to points which are pulled up to +5 volts and not +12 volts! Failure to observe this warning will damage your Upgrade and void any warranties!

You will need at least two (2) push-on jumpers to operate the TNC after these modifications. If you do not have spare jumpers, order TAPR Part Number JMP-02.

( ) Isolate Beta TNC U17 pin 39.

( ) Connect a wire from U17 pin 29 of the Beta TNC to Upgrade J1 pin 1.

( ) Connect a wire from Beta TNC U18 pin 5 to Upgrade J1 pin 2.

( ) Isolate Beta TNC U17 pin 5.

( ) Connect a wire from Beta TNC U17 pin 5 to Upgrade J1 pin 5.

( ) Connect a wire from Beta TNC U25 pin 13 to Upgrade J1 pin 6.

( ) Connect a wire from Beta TNC U17 pin 31 to Upgrade J1 pin 12.

( ) Connect a wire from Beta TNC U17 pin 27 to Upgrade J1 pin 17.

( ) Connect a wire from Beta TNC U18 pin 7 to Upgrade J1 pin 18.

( ) Remove the jumper at Beta TNC JP3.

( ) Isolate Beta TNC U17 pin 25.

( ) Connect a wire from Beta TNC U17 pin 25 to Upgrade J1 pin 19.

( ) Connect a wire from Beta TNC U25 pin 9 to Upgrade J1 pin 20.

NOTE: The following steps deal with the Upgrade PC board, not the TNC PC board.

PRELIMINARY TEST

( ) Temporarily short the end of R1 nearest U6 to ground.

( ) Install the 6551 IC removed from the TNC into the U14 socket on the Upgrade PC board.

( ) Install a 74HC157 IC at U15.

( ) Install a 74HC157 IC at U18.

NOTE: Push-on jumpers at T1 pins 5/6, 9/10, 11/12 and 13/14 are <u>not</u> required for Beta TNCs modified as above.

NOTE: Use push-on jumpers removed from the TNC, not the push-on jumpers supplied with the Upgrade kit.

WARNING! T1 is <u>not</u> numbered like an IC. Pins 1 and 2 are across the top of the connector, and pins 19 and 20 across the bottom. All odd-numbered pins are next to J1 and all even-numbered pins next to T2.

( ) Place a push-on jumper at T1 pins 1 and 2.

( ) Place a push-on jumper at T1 pins 5 and 6.

( ) Place a push-on jumper at T1 pins 9 and 10.

( ) Place a push-on jumper at T1 pins 11 and 12.

( ) Place a push-on jumper at T1 pins 13 and 14.

( ) Place a push-on jumper at T1 pins 17 and 18.

( ) Place a push-on jumper at T1 pins 19 and 20.

( ) Install the Upgrade on the TNC by plugging into the TNC U14 socket. Verify all pins engage and are correctly aligned.

( ) Connect a radio, apply power and verify that the TNC operates normally.

( ) Remove power and disconnect the radio.

( ) Remove the Upgrade PC board from the TNC and remove the temporary jumper between R1 and ground.

4-WIRE CABLE FABRICATION

( ) Separate the ribbon cable between the yellow and the green wires.

( ) Discard the 6-wire cable (green through black wires).

( ) Prepare one end of the 4-wire cable by separating the individual wires for a distance of 1/2", then stripping the individual wires for a distance of 1/8".

( ) Tin the four individual wires.

( ) Install a Molex pin on the brown wire by folding the short tabs over the conductor, and the longer tabs over the insulation. See Fig. 2.

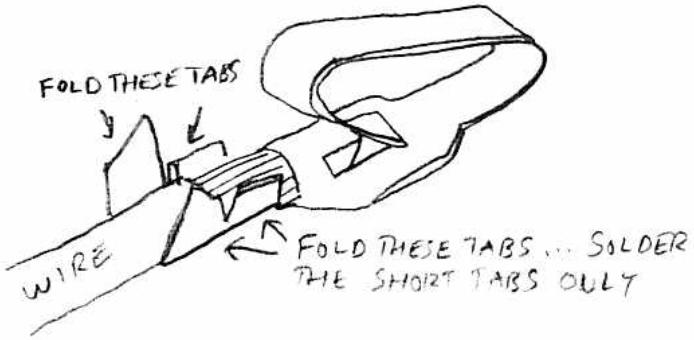


Fig. 2 - Molex Pin Connection

( ) Solder the wire to the pin, using a very small amount of solder. Be sure no solder flows to the outside of the pin, or down into the working part of the pin.

( ) In like manner, install a pin on the red wire.

( ) Similarly, install a pin on the orange wire.

( ) Install a pin on the yellow wire.

NOTE: The "Pin 1" location of the Molex housing is the location that, when engaged with the 4-pin plug at P3 on the Upgrade board, is away from the edge of the PC board.

( ) Insert the brown wire pin at Pin 1 of the Molex housing. The "ears" of the housing are at the end of the housing where the pin will "seat" - DO NOT INSTALL THE WIRE FROM THIS END! There is a little metal tab on the pin which will "clock" into a slot in the housing when the pin is properly seated. See Fig. 3.

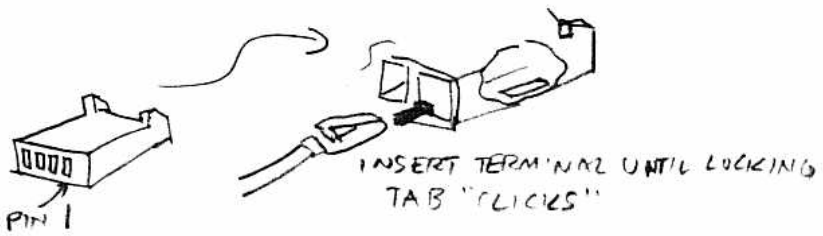


Fig. 3 - Molex Pin Installation

( ) Similarly, install the red wire at pin 2, the orange wire at pin 3 and the yellow wire at pin 4.

( ) Plug the 4-wire cable into P3 on the Upgrade board to ensure it engages properly.

( ) Unplug the 4-wire cable.

4-WIRE CABLE INSTALLATION

Connection of the free end of the 4-wire cable will vary depending on the TNC you are upgrading. Please refer to directions under the heading of your particular TNC.

Beta TNC

( ) Connect the brown wire to the ungrounded side of S1 (ROM/NOVRAM parameters) or a front panel switch wired in parallel with S1. This switch will enable normal Beta TNC operation when the TNC is run with this switch ON (ROM) and enable the Upgrade TNC 2 operation when this switch is OFF (NOVRAM).

NOTE The following connections are optional, but recommended for maximum flexibility of operation.

( ) Connect the red wire to one side of S4 (spare) or a front panel equivalent. This switch will toggle between memory banks on the upgrade TNC.

( ) Connect the other terminal of this switch to ground.

The remaining lines from the cable are intended to drive a "STATUS" LED (indicating that the TNC 2 has sent data which has not yet been acknowledged from the other station) and a "CONNECTION" LED (indicating that the TNC 2 is in the connected state). TNC 2s also have LEDs for "PTT" (indicating the transmitter has been keyed), "DCD" (indicating the modem is decoding a transmission) and "POWER".

If you wish to add these LEDs to your Beta TNC, install a 74HC04 chip in the wire-wrap area. Wire it per Fig. 4, below.

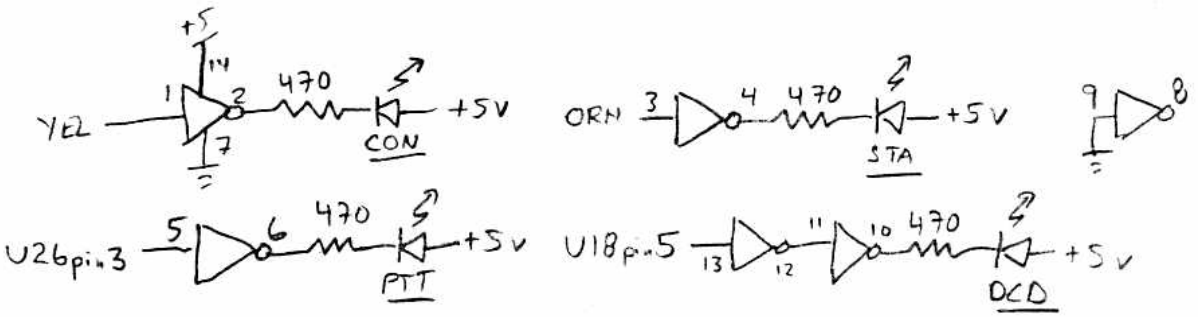


Fig. 4 - Additional LEDs - Beta TNC

( ) Proceed to **UPGRADE DIRECTIONS, PART THREE.**

TAPR TNC 1

( ) Remove the TNC 1 PC board from its case.

( ) On the bottom of the TNC PC board, attach the following wires of the 4-wire cable:

NOTE: DIPswitch SW on the TNC PC board is not numbered like an IC. Pins 1, 3, 5 and 7 are near U6.

( ) Red to switch SW pin 1 (SW1 ungrounded side).

( ) Brown to switch SW pin 3 (SW2 ungrounded side).

( ) Orange to U21 pin 13.

( ) Yellow to U21 pin 11.

( ) Using a sharp knife, cut the trace between U6 pin 39 and U21 pin 11.

( ) Route the 4-wire cable to the side of the TNC 1 PC board near U31.

( ) Reinstall the TNC 1 PC board into the case. Leave the front panel off the case.

( ) Proceed to **UPGRADE DIRECTIONS, PART THREE.**

Heath HD-4040

( ) Remove the HD-4040 PC board from the case.

( ) On the bottom of the TNC PC board, attach the following wires of the 4-wire cable:

NOTE: DIPswitch SW on the TNC PC board is not numbered like an IC. Pins 1, 3, 5 and 7 are near U6.

( ) Red to switch SW pin 1 (SW1 ungrounded side).

( ) Brown to switch SW pin 3 (SW2 ungrounded side).

( ) Orange to U21 pin 13.

( ) Yellow to U21 pin 11.

( ) Using a sharp knife, cut the trace between U6 pin 39 and U21 pin 11.

( ) Route the 4-wire cable to the side of the HD-4040 PC board near U31.

( ) Reinstall the HD-4040 PC board into the case.

( ) Proceed to **UPGRADE DIRECTIONS, PART THREE.**

AEA PKT-1

( ) Remove the TNC PC board from the case.

( ) On the bottom of the TNC PC board, attach the following wires of the 4-wire cable:

( ) Red to switch SW1 contact that connects to U6 pin 2.

( ) Brown to switch SW2 contact that connects to U27 pin 17.

( ) Isolate U21 pin 9.

( ) Orange to U21 pin 9.

( ) Isolate U21 pin 1.

( ) Yellow to U21 pin 1.

( ) Route the 4-wire cable to the side of the PKT-1 PC board near U30.

( ) Reinstall the TNC PC board into the case.

UPGRADE DIRECTIONS, PART THREE

Observing static precautions, install the following ICs in the Upgrade PC board:

( ) U1 8400A (Z80A CPU)
( ) U3 27C256 w/TNC 2 firmware
( ) U4 62256L 32k byte static RAM
( ) U6 8440A (Z80A SIO/0)
( ) U7 74HC139
( ) U16 74HC157
( ) U12 74HC74
( ) U13 74HC86
( ) U19 74HC86
( ) U17 DS1210

( ) U8 74HC21
( ) U9 74HC4060
( ) U10 74HC74
( ) U11 74HC393

Be sure all ICs are seated in their sockets, there are no bent or folded IC leads, polarity of ICs are correct and that the correct IC is in the correct socket in all cases. Take your time!

( ) All ICs OK.

( ) Carefully remove the Lithium battery from its envelope and solder it onto the Upgrade PC board at BT1. **OBSERVE POLARITY!**

Install push-on jumpers on the Upgrade PC board at the following locations:

( ) JP1 pins 1 and 2.
( ) JP2 pins 1 and 2.
( ) JP3 pins 2 and 3.
( ) JP4 pins 2 and 3.
( ) JP5 pins 2 and 3.

The above jumper settings configure your TNC Upgrade for a single EPROM, single RAM chip and battery-backup of RAM.

WARNING! T2 is <u>not</u> numbered like an IC. Pins 1 and 2 are across the top of the connector, and pins 19 and 20 across the bottom. All odd-numbered pins are next to T1 and all even-numbered pins toward the edge of the PC board.

Install push-on jumpers at modem disconnect T2 as follows:

( ) Pins 1 and 2.
( ) Pins 5 and 6.
( ) Pins 9 and 10.
( ) Pins 11 and 12.
( ) Pins 13 and 14.
( ) Pins 17 and 18.
( ) Pins 19 and 20.

( ) Install the Upgrade PC board onto the TNC PC board making sure P1 and J1 are properly aligned.

NOTE: The mechanical assembly of the upgrade onto the TNC 1 and HD-4040 may be secured using a 1/2" spacer and #6 hardware at the provided location between Upgrade ICs U3 and U4.

You are now ready to check the operation of the TNC and Upgrade.

TNC 1 OPERATIONAL CHECK

( ) Attach a radio and a computer or terminal to the TNC as before the modifications.

( ) After powerup, place the switch which is attached to the red 4-wire cable lead to the closed position.

AEA PKT-1	NOVRAM/PROM	PROM
Heath HD-4040	SW1	ON
TAPR TNC 1	ROM/RAM	ROM
TAPR Beta TNC	S1	ON

The TNC will have powered up and used its normal reset parameters (RAM or ROM depending on your normal method of use). Setting the indicated switch selects the TNC 1 function.

( ) Operate the TNC and verify it operates as before. Some LEDs may operate differently - this is normal and will be explained in the TNC 2 mode check-out which follows.

NOTE: When operating in the TNC 1 mode, you will normally power the unit on (or RESET it) with the switch in the opposite position to that indicated above. This is because you will normally not want to use the ROM defaults for the serial port to your computer or terminal. The Upgrade was designed in this manner because this will result in normal powerup in the TNC 2 mode.

If you normally use EPROM defaults which include the autobaud routine, please select your preferred terminal parameters (in particular, the ABAUD command or its equivalent in the TNC 1 firmware you use) and PERM them before proceeding. See your TNC manual for details.

( ) ABAUD PERMed.

TNC 2 OPERATIONAL CHECK

You are now ready to verify the TNC 2 mode of the Upgrade. This will probably be the mode which you use most often. If you have not added front panel switches to your Beta TNC or HD-4040, this will be the default mode.

NOTE: The TNC 2 with TAPR firmware will default to 7 bits, even parity.

The BANK switch must be in Bank 0 for the upgrade to operate properly. If you are operating the Upgrade with no front panel switches or controls (omitting the 4-wire harness, for example) set the jumpers to: JP2 and JP4 @ 2-3; JP3 and JP5 @ 1-2 and install the 32k RAM chip at U5 (not U4).

( ) Place the switch which is attached to the red 4-wire cable lead to the open position.

AEA PKT-1	NOVRAM/PROM	NOVRAM
Heath HD-4040	SW1	OFF
TAPR TNC 1	ROM/RAM	RAM
TAPR Beta TNC	S1	OFF

( ) Press the RESET button on the TNC.

AEA PKT-1	HARD RESET	RESET, then NORMAL
Heath HD-4040	SW3	CLOSED, then OPEN
TAPR TNC 1	RESET	PRESS, then RELEASE
TAPR Beta TNC	S3	CLOSED, then OPEN

The TNC 2 should sign-on with its normal sign-on message. See the **TNC 1 UPGRADE COMMANDS AND MESSAGES** manual if you are using TAPR 1.1.X firmware, or the release notes for other software you may be using (WA8DED, NET/ROM, etc.). If it does not, hit a carriage return or two.

( ) TNC 2 signs on.

While the TNC 2 provides numerous additional features over the TNC 1, operation with TAPR 1.1.X firmware is almost identical to the TNC 1 with TAPR 3.X firmware.

( ) Load your callsign into the TNC with the MYCALL command.

( ) Connect to another station. Note the CON LED lights.

AEA PKT-1	TXD	
Heath HD-4040	SPARE	
TAPR TNC 1	(unlabeled)	
TAPR Beta TNC	CON	new LED, if added

( ) Send a packet to the other station. Note that the STA LED illuminates when the packet is sent, and extinguishes when the other station acknowledges.

AEA PKT-1	CW-ID	
Heath HD-4040	RESET	
TAPR TNC 1	RESET	
TAPR Beta TNC	STA	new LED, if added

( ) Disconnect from the other station. The CON LED will extinguish.

( ) Remove power from the TNC.

( ) Disconnect the radio and computer or terminal.

You have now verified operation of the TNC 2 portion of the Upgrade. The next section will complete the upgrade of your TNC.

FINAL STEPS

( ) Verify all ICs are firmly seated in their sockets.

( ) Verify the Upgrade PC board is mechanically secure on the host TNC PC board.

( ) Re-assemble the TNC cabinetry.

Your TNC upgrade is now complete! The next section of this manual describes operating differences that you should know when using your upgraded TNC in **either the TNC 1 or the TNC 2 mode.** Please read this section before using your upgraded TNC.

OPERATING DIFFERENCES WITH THE UPGRADED TNC

1) User serial port and radio port baud rates (TNC 1 ABAUD and HBAUD commands) are not present in TNC 2 firmware. As a result, these parameters must be PERMed into the TNC 1 NOVRAM. If you wish to change these settings, you must drop into TNC 1 mode and change them, then PERM them, then return to TNC 2 mode.

2) The switch settings for recalling the PERMed parameters will also cause the Upgrade to operate in the TNC 2 mode.

3) If you wish to operate in TNC 1 mode as default, but you wish to use the PERMed parameters, you must either (a) power up in TNC 2 mode, then manually select TNC 1 mode or (b) add an additional switch to your TNC to select between the two TNCs available. Connect the RED wire from the 4-wire cable to this new switch, and connect the other side of the switch to ground.

4) Any time you change BANKs, the TNC 2 will do a power-up reset, even if you are in TNC 1 mode.

5) The TNC 1 must be operational for the TNC 2 to function. This is because the TNC 2 depends on the clocks from the TNC 1 for ABAUD and HBAUD speeds.

If you wish to use the upgrade in a TNC 1 which does not work, you may do the following:

a) verify that the +12, -12 and +5 volt power supplies are functional.

b) verify that the RS-232 buffers are functional.

c) verify that the modem is functional.

d) verify the power-up reset circuit is functional.

e) hardwire the ABAUD rate by adding a jumper from the 74HC4060 chip (upgrade U9) to the SIO chip (upgrade U6) pin 27 as follows:

ABAUD	U9 pin
300	15
600	13
1200	14
2400	6
4800	4
9600	5
19200	7

f) hardwire the HBAUD rate by adding a jumper from the 74HC4060 chip (upgrade U9) to the 74HC74 chip (upgrade U10) pin 11 as follows:

HBAUD	U9 pin
150	15
300	13
600	14
1200	6
2400	4
4800	5
9600	7

NOTE: If you plan on using the TNC at a data rate other than that for which the TNC 1 on board modem is set (typically 1200 baud) or which the on-board modem is incapable of operating (faster than 1200), an external modem must be attached to the T2 modem disconnect.

g) remove the 6551 chip from the upgrade (U14).

h) remove the 6522 chip from the TNC.

JUMPERS, SWITCHES, INDICATORS AND T2 MODEM DISCONNECT

This section describes the functions of the various jumpers, switches and indicators of your upgraded TNC. It includes information you will need to know if you decide to add additional banks of RAM or firmware, or an external modem to your Upgrade board.

Jumpers

All jumpers are three terminal, with two possible positions for the push-on shunt. Jumper terminal 1 is indicated on the PC board with a small + symbol.

NOTE: It is very important that a shunt be installed on at JP1. Failure to do so may result in damage to your upgrade!

JP1 BATTERY

1-2	Enables Lithium battery to backup stored parameters in upgrade RAM.
2-3	Disables Lithium battery and protects DS1210 chip from damage.

JP2 RAM1

1-2	U4 selected for Bank 1 only
2-3	U4 selected for Bank 1 and for upper 24k of Bank 2.

JP3 RAM2

1-2	U5 selected for all 32k of Bank 2.
2-3	U5 selected for lower 8k of Bank 2 only.

JP4 ROM2

1-2	U3 selected for Bank 2 only.
2-3	U3 selected for Bank 1 and Bank 2.

JP5 RSIZE

1-2	32k RAM may be used at U5.
2-3	8k RAM may be used at U5.

The most common configurations for JP2 through JP5 are:

EPROM1 U3	EPROM2 U2	RAM1 U4	RAM2 U5	JP2	JP3	JP4	JP5
32k	none	32k	none	*	*	2-3	*
32k	none	32k	8k	2-3	2-3	2-3	2-3
32k	none	32k	32k	2-3	1-2	2-3	1-2
32k	32k	32k	8k	1-2	2-3	1-2	2-3
32k	32k	32k	32k	2-3	1-2	1-2	1-2

NOTE: * means position doesn't matter but a shunt MUST be present.

NOTE: It is not possible to have two EPROMs and only one RAM!

Switches

Switches are external to the upgrade PC board and, in most cases, are redefined functions of existing switches. The switch functions required to make full use of the features designed in the Upgrade are:

SELECT

The SELECT switch allows the operator to use the host TNC (TNC 1 or equivalent) or the Upgrade TNC (TNC 2 equivalent).

BANK

The BANK switch allows the operator to select between firmware and/or user parameters (RAM) when operating in the TNC 2 mode.

The switches used are:

TNC Model	SELECT	TNC2 Position	BANK
AEA PKT-1	NOVRAM/PROM	NOVRAM	NOVRAM BANK
Heath HD-4040	SW1	OFF	SW2
TAPR TNC 1	ROM/RAM	RAM	BANK1/BANK0
TAPR Beta TNC	S1	OFF	S4

Indicators

The Upgrade adds the TNC 2 LED indicators CON and STA.

CON

The CONnect LED indicates when the TNC 2 is connected to another station.

STA

The STAtus LED indicates the TNC 2 has sent frames (or packets) to another station but has not yet received acknowledgment of receipt from the other station. In conjunction with the DCD and PTT LEDs, the user may quickly determine channel quality (or congestion) and take whatever action may be appropriate (change timing parameters, PACLEN, disconnect., etc.).

The LEDs used in the Upgrade often involve disconnection of the LED's original function and re-use as a CON or STA LED:

TNC Model	CON	STA
AEA PKT-1	TXD	CW-ID
Heath HD-4040	SPARE	RESET
TAPR TNC 1	(unlabeled)	RESET
TAPR Beta TNC	CON	STA

NOTE: TAPR Beta TNC LEDs are added, not re-used.

Modem Disconnect - T2

The modem disconnect, T2, on the Upgrade PC board is provided for using an external modem with the TNC. This allows use of higher-speed modems, such as 9600 baud, or more sophisticated, higher-performance modems for OSCAR or other uses. (The T1 modem disconnect repeats the TNC 1 disconnect - refer to your TNC manual for details.)

The following information is primarily for those who wish to interface external modems to the TNC. Familiarity with modem and serial data channel terms is assumed.

A physical connector for T2 is not supplied with the Upgrade. Any standard 20-pin header for use with IDC cable connectors should work. Suitable parts are the Ansley 609-2027, the 3M 3428-6202, etc.

When installing the connector, be sure to line up the marked pin (pin 1) of the header with the mark on the T2 header silk-screened on the PC board.

The signals used at connector J4 are at standard TTL interface levels. A TTL high, or 1, is greater than +2.4 volts but less than +5.25 volts. A TTL low, or 0, is less than 0.8 volts but greater than -0.4 volts. **DO NOT connect an RS-232C level modem directly to J4!**

NOTE: The modem disconnect is similar, but not identical to that used in TNC 1. Be very careful about interfacing an external modem using the same cabling you may have prepared for use with TNC 1!

The connector pin-outs are as follows.

Pin 1 Carrier Detect Input

This pin tells the SIO radio port that a valid data carrier has been detected. It should be pulled high when no carrier is detected and low when a carrier is present. This line must be implemented unless the software release notes indicate otherwise. It is normally jumpered to pin 2 when the host TNC modem is used.

Pin 2 Carrier Detect Output

This pin is an output from the the on-board modem and satisfies the requirements outlined for pin 1 above. It is normally jumpered to pin 1 when the host TNC modem is used.

Pin 3 SIO Special Interrupt Input

This signal is routed to the radio port DCD input pin on SIO U6. This signal is normally used during modem calibration. It may also be used for other purposes; if so, these functions will be listed in the software release notes. This pin is normally jumpered to pin 4 when the host TNC modem is used.

Pin 4 SIO Special Interrupt Generator Output

This signal is an output from the on-board modem. It is normally used for modem calibration only. If it is used for other functions, they will be stated in the software release notes. This pin is normally jumpered to pin 3 when the host TNC modem is used.

Pin 5 SIO RTS Output

This signal is used for transmitter activation. The SIO will pull this output low when the TNC wants to transmit; otherwise it will remain high. This pin is normally jumpered to pin 6 when the host TNC modem is used.

Pin 6 Transmitter Key Input

This signal is an input to the host TNC modem. It activates the PTT pin of the radio connector via the watch-dog timer. It should be left high and pulled low only when transmission is desired. This pin is normally jumpered to pin 5 when the host TNC modem is used.

Pin 7 CONNECT Status Output

This pin is an output from the SIO. It is normally low and goes high only when the TNC is in the connected (error-free) mode with another packet station. Its status is monitored via the CON LED.

Pin 8 Unacknowledged Packets Pending Status Output

This pin is an output from the SIO. It is normally low and goes high only when this TNC has unacknowledged packets in its transmit buffer. Its status is monitored via the STA LED.

Pin 9 CTS Input

This pin is an input to the SIO. It is high when the attached modem is <u>not</u> ready to accept data, and low when the attached modem <u>is</u> ready to accept data. The TNC will not attempt to send data when this pin is high. This pin is normally jumpered to pin 10 when the host TNC modem is used.

Pin 10 Transmitter Key Input

This pin is physically tied to pin 6, above. It is used in conjunction with pin 9, above, to allow the TNC to use the host TNC modem whenever the transmitter is activated.

Pin 11 Transmitter Clock (16x) Input

This pin is tied to the NRZ-to-NRZI converter, which expects a clock signal at 16 times the desired radio port data rate, e.g., 4800 Hz for 300 baud. This pin is normally jumpered to pin 12 when the host TNC modem is used.

Pin 12 Transmitter Clock (16x) Output

This pin is tied to the radio baud rate switch network. It provides a clock at 16 times the desired radio port data rate. This pin is normally jumpered to pin 11 when the host TNC modem is used.

Pin 13 Receive Clock Input

This pin is tied to the SIO receive clock input pin. It expects a clock at the desired data rate (1200 Hz for 1200 baud), of the proper phase relationship to the received data. This pin is normally jumpered to pin 14 when the host TNC modem is used.

Pin 14 Receive Clock Output

This pin is the received data clock signal derived from the NRZI-to-NRZ conversion logic. This pin is normally jumpered to pin 13 when the host TNC modem is used.

Pin 15 Upgrade Ground Reference

This pin ties to the TNC digital ground system, at the SIO.

Pin 16 No Connection

This pin is unused.

Pin 17 Receive Data Input

This pin is the received data input to the NRZI-to-NRZ conversion logic. This pin is normally jumpered to pin 18 when the host TNC modem is used.

Pin 18 Receive Data Output

This pin provides receive data from the host TNC modem. This pin is normally jumpered to pin 17 when the host TNC modem is used.

Pin 19 Transmit Data Output

This line is the NRZI data output. This pin is normally jumpered to pin 20 when the host TNC modem is used.

Pin 20 Transmit Data Input

This input line accepts data to be be transmitted by the modem. This pin is normally jumpered to pin 19 when the host TNC modem is used.

If you elect to use an off-board modem, be sure to properly shield the interconnecting cables for RFI protection.

HARDWARE DESCRIPTION

This section includes detailed specifications and a functional description of the hardware design of the TAPR TNC Upgrade.

TNC Upgrade Specifications

Processor CMOS Z-80A

Clocks Processor master clock input frequency: 4.9152 MHz

User Port Clock: Derived from host TNC "ABAUD" command. Radio Port Clock: Derived from host TNC "HBAUD" command.

Memory All memory in industry-standard JEDEC Byte-Wide sockets.

Standard complement of ROM: 32k = 1 x 27C256

Standard complement of RAM: 32k = 1 x 62256LP

ROM complement jumper selectable for one or two 32k-byte parts. RAM complement jumper selectable for one 32k-byte, one 32k-byte and one 8k-byte or two 32k-byte parts.

Serial Port Z8440A SIO/0 port B configured as UART using host TNC TTL-to-RS-232C signal level interface.

Baud rates supported: 50, 75, 110, 135, 150, 300, 600, 1200, 1800, 2400, 3600, 4800, 7200, 9600 and 19,200.

Modem Utilizes host TNC modem.

An external modem may be attached via a single connector which completely bypasses the host TNC modem.

bbRAM Non-volatile storage of all important operating parameters is accomplished by using a battery backed-up system for the entire 32k bytes of system RAM.

Protocol AX.25 Level 2 is supported. Pre-Version 2.0 support is compatible with earlier TAPR TNCs running 3.x software. Full support of Version 2.0 protocol is provided. Full duplex radio link operation is supported.

Operating Modes Command Mode: accepts commands via user port.

Converse Mode: accepts digital data, transmits and receives packets, permits terminal editing features (character delete, line delete, input packet delete, output packet delete and redisplay input) via special characters trapped by the TNC. Escape to command mode via special character or BREAK signal. Optional use of packet completion timer as in Transparent mode.

Transparent Mode: accepts digital data, transmits packets via packet completion timer or buffer full only, and receives packets. No local editing features permitted. Escape to command mode via specially timed character sequence or BREAK signal.

Power Required Supplied by host TNC.

General Description

The TNC Upgrade is based on the Zilog Z80 (tm) family of microprocessor components. All parts used in the Upgrade should be readily available to the Radio Amateur.

Major electronic devices in the Upgrade include a CPU (Central Processing Unit) for controlling the Upgrade and an SIO (Serial Input/Output) chip for providing serial interface ports to the host TNC modem (which connects to your radio) and to the RS-232C serial terminal port (which connects to your computer or terminal).

The Upgrade also includes two types of memory. ROM (Read Only Memory) stores the program that tells the TNC how to implement the AX.25 protocol. Battery backed-up RAM (Random Access Memory) provides a scratch-pad area for temporary data as well as non-volatile storage for operating parameters such as your station call sign. The battery back-up feature enables the TNC to "remember" these values when power is off so you don't have to enter them every time you want to operate.

Other integrated circuits are used for functions including clock oscillator, memory-space decoder, clock recovery, and TNC1/TNC2 selection logic. Refer to the schematic diagram while reading the following circuit descriptions.

Detailed Circuit Description

Oscillator/Divider

U9 (74HC4060), R7, C1, C2, and X1 provide an accurate crystal-controlled oscillator for system timing.

R7 forces an inverter within U9 into its linear region and provides a load for crystal X1. Dividers within U9 provide a 600 Hz signal to the SIO. During normal operation, the SIO will be programmed to interrupt the CPU on every transition of this 600 Hz signal. This interrupt occurs 1200 times a second, and is used for protocol and calibration timing functions.

CPU Complex

EPROM U3 (and optionally U2) provides system ROM for program storage. Selector U7a acts as a memory decoder, mapping the ROM into the CPU's memory address space beginning at address 0.

Static RAM U4 (and optionally U5) provides system RAM for temporary scratch-pad storage, message buffers, etc. Also, because the RAM is backed up by a battery and will not lose its contents when the main power is removed, it is used to provide semi-permanent storage of user-supplied information (such as your call sign). Selector U7a acts as a RAM address decoder, with RAM starting at address 8000 hex.

Jumpers JP2 through JP5 allows selection of various memory models as discussed in the Jumpers section of this manual, above.

U16 and U17 provide protection of RAM contents when main power is removed. This ensures that the contents of the RAM are not accidentally scrambled as the CPU loses power; it also ensures that the RAM is in the "power-down" state for minimum battery power consumption.

Serial Interface

Serial Input/Output (SIO) device U6 provides two channels of serial I/O.

The B SIO channel is used for the computer or terminal interface. Appropriate TTL level signals are routed via multiplexer U15 to the host TNC for RS-232-C buffering.

The A SIO channel is used for the radio/modem interface and is normally operated as a full duplex HDLC channel for compatibility with the AX.25 protocol specification. U10b divides the x32 clock from the host TNC to an x16 clock needed for the SIO. U10a, U11a and U13c comprise an NRZ-to-NRZI encoder for transmitting data. U13a, U13c and U13d, along with U11b and U12 provide NRZI-to-NRZ clock and data recovery from the incoming signal. The derived clock and data information are applied to the SIO A channel. This conversion between NRZ formatted data

and NRZI formatted data is necessary because the AX.25 protocol specification requires NRZI operation while the SIO is only capable of NRZ. (A detailed description of the operation of the NRZ-NRZI conversion logic was presented in PSR #30 for January 1988, beginning on page 3.)

RS-232C Handshaking Protocol

The CTS and RTS lines of the host TNC RS-232C port are used for hardware "handshaking" protocol to control the flow of data between the terminal (DTE) and the TNC Upgrade (DCE).

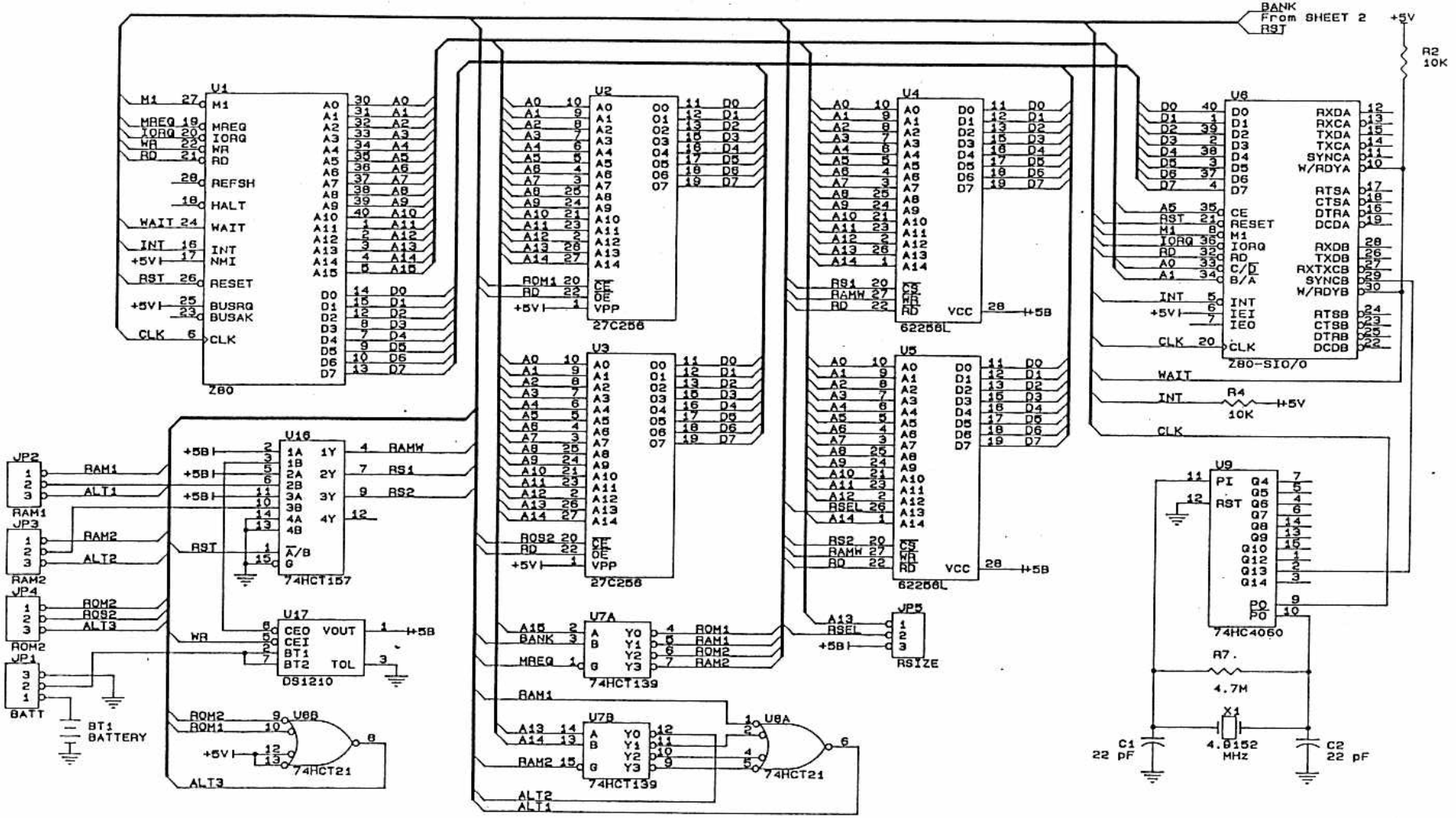
The terminal indicates it is ready to receive data from the TNC by asserting its Request To Send (RTS) output, via the host TNC serial port pin 4. The TNC will send data when it has data to send and RTS is asserted. If the terminal is not ready to receive data, it should negate (make false) RTS to the TNC. Thus, data flow from the TNC to the terminal is controlled by the use of the RTS line.

The TNC asserts its Clear To Send (CTS) output, via the host TNC serial port pin 5, whenever it is ready to receive data from the terminal. If the TNC's buffers fill, it will negate CTS, signaling the terminal to stop sending data. The TNC will assert CTS when it is again ready to receive data from the terminal. Thus, data flow from the terminal to the TNC is controlled by the use of the CTS line.

Some serial I/O ports do not implement CTS and RTS handshaking. If these pins are not connected at the terminal end, they will be pulled up (and thus asserted) by resistors at the TNC end. However, a non-standard serial connector may use some pins for other purposes, such as supplying power to a peripheral device, so be sure that your system either implements the CTS/RTS handshake or has no connections to these pins of the host TNC serial port whatsoever. Note that reference to RS-232C "compatibility" or the presence of a DB-25 type connector does not guarantee that you have a full RS-232C serial port!

The TAPR TNC 1 Upgrade supports most standard baud rates from 50 through 19200. The port supports standard parity options as well as 7- or 8-bit character lengths. Setting these terminal parameters is discussed in your TNC manual and the COMMANDS AND MESSAGES manual provided with the Upgrade.

If you want to interface your TNC with a device configured as DCE, such as a telephone modem or another TNC, a so-called "null modem" cable may be constructed to interchange the data and handshake signals. See for example Byte, February, 1981, page 198.



TUCSON AMATEUR PACKET RADIO		
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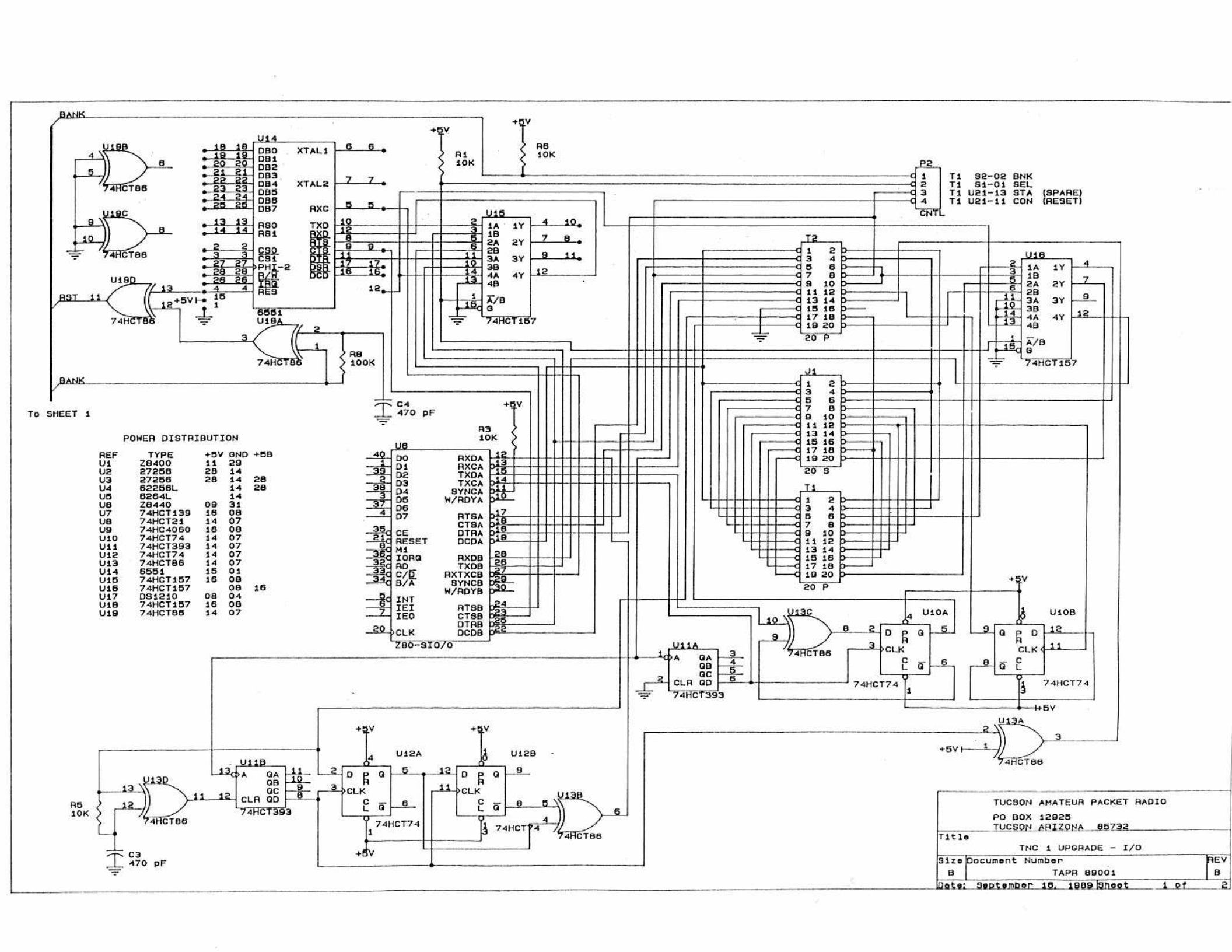
Title: TNC 1 UPGRADE - Processor		
Size: B	Document Number: TAPR 89001	REV: B
Date: September 16, 1989	Sheet 1 of 2	



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