

## DIGITAL REGENERATOR MODIFICATION FOR THE TNC-2A

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### ABSTRACT

Others have pointed out the network efficiency advantage of using duplex regenerators as compared to simplex digipeaters (Ref 1 & 4). However, the use of packet duplex regenerators entails added expense which may be the reason they have not found common usage in LAN and backbone systems. In addition to the expense of a duplexer for in-band operation, previous implementations of regenerators have required either dual TNCs or the use of a high quality land line modem as well as a TNC. This paper describes a way to make multiple use of a TNC in this application, with a realized savings in cost and simplification in equipment configuration. Furthermore, if the regenerator was set up for cross-band operation, the expense then would be comparable to a simplex digipeater since a duplexer would not be required.

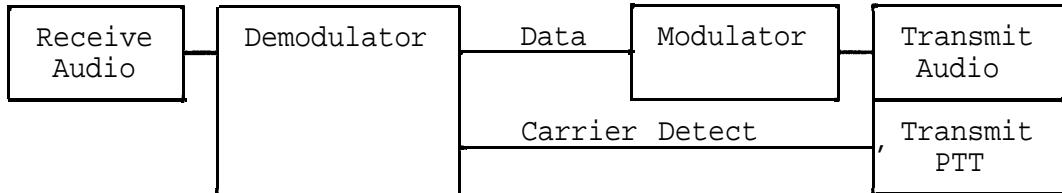
This paper describes the conversion of a TNC-2A to serve as both a digital regenerator and a network node. The conversion has been in use on the 144.51-145.11 SVALAN:N700-4 repeater/node for several months.

### INTRODUCTION

The necessary parts required to perform the functions of both a node and a digital regenerator are available on the standard TAPR TNC-2A. This includes the TNC-2A clones which incorporate the modem disconnect header. The only additional parts are a 20-pin header and plug and the 4053 IC. The following discussion will be referenced to the MFJ 1270B TNC-2A clone. The modem disconnect header provides the interface between these components and the simple circuit required for the conversion. The TNC had the NETROM node changes, the DCD modification, and the modem disconnect header added prior to this conversion (Ref 2 & 3).

### THEORY OF OPERATION

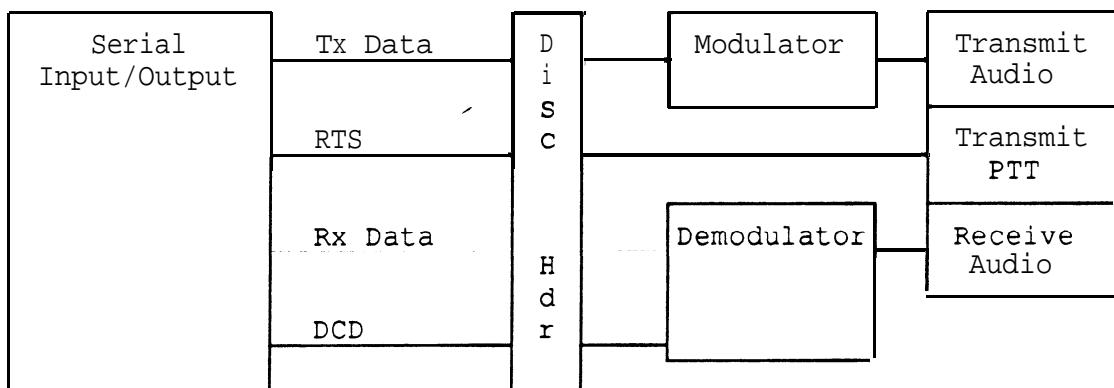
A digital regenerator requires the output of the demodulator to feed the modulator and the data carrier detect (DCD) signal to trigger the push-to-talk (PTT) on the transmitter (See Figure 1).



Digital Regenerator

Figure 1.

In a normal TNC the serial input/output (SIO) transmit data (TxD) line feeds the modulator while the request to send (RTS) line triggers the PTT of the transmitter. The demodulator drives the SIO receive data (RxData) line while the DCD is sensed by the SIO carrier detect (CD) line (See Figure 2). These signals are available at the modem disconnect header.



TNC-2A Data Flow Diagram

Figure 2.

To provide both functions, the modulator input and PTT control must be switched between the SIO signals and the demodulator signals. Since the TNC software will not allow the SIO to transmit while there is CD present, using the CD signal from the demodulator to switch the lines to the modulator is acceptable.

With this circuit, the modulator will transmit all packets seen by the demodulator. The packets are also sensed by the SIO to see if they are addressed to the node. The node can transmit through the modulator whenever the channel is clear.

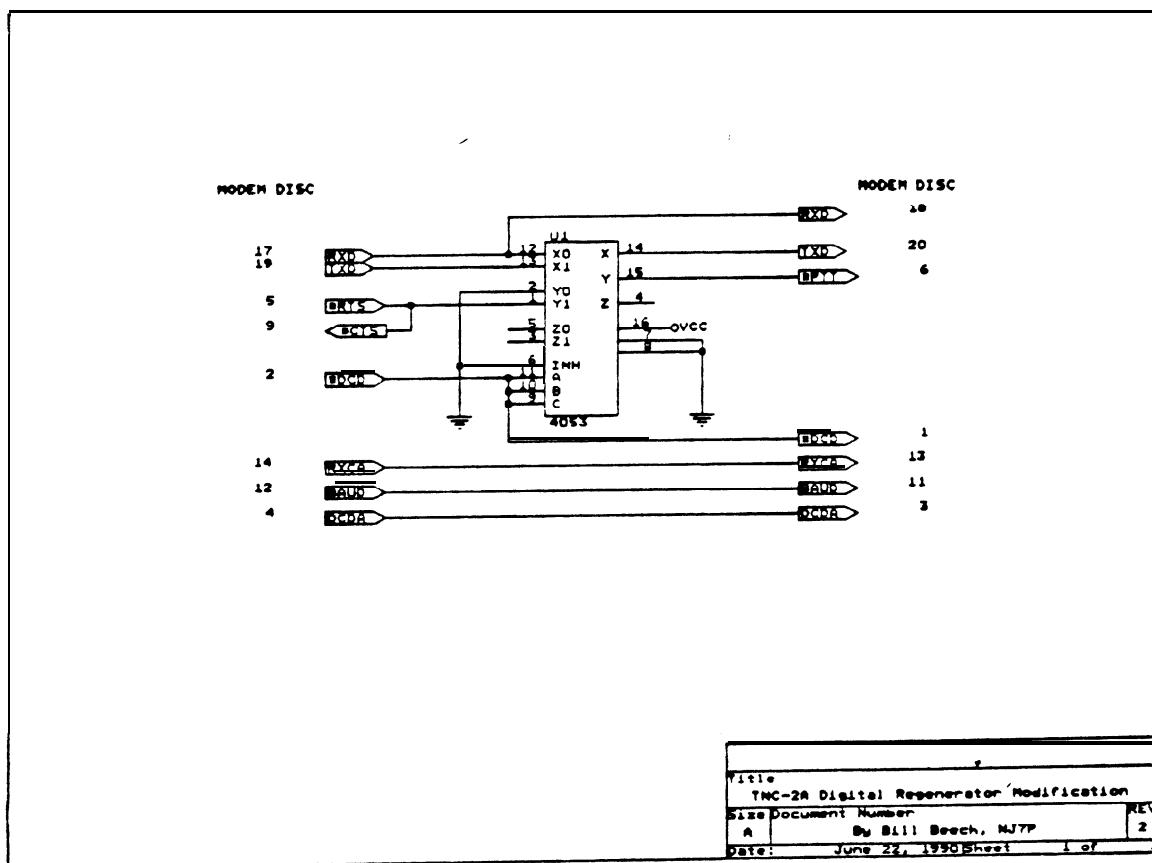
Originally a 74LS157 quad 2-input multiplexer was used in this conversion. It was found to provide an unacceptable load to the demodulator when exposed to operating temperatures in excess of 100 degrees F. The currently used CMOS 4053 triple 2-channel multiplexer has operated satisfactorily in a high temperature environment.

The modified TNC can either be used in a multinode stack or in a stand alone mode. The unit described here is currently operating in a multiple node stack. The node has performed satisfactorily for several months, once the temperature loading problem noted above was rectified.

## CONVERSION

Install the modem disconnect header by cutting the pin to pin circuit trace jumpers (e.g 1-2, 5-6, 9-10, 11-12, 13-14, 17-18 and 19-20) on the J4 modem disconnect header at the underside of the board. Install the 20-pin header plug on the pads on the top of the board.

The 4053 is mounted piggyback on U9, a 74HC14. Power (4053-16) and ground (4053-8) are connected to pins 14 and 7 of U9 respectively. The remaining pins of the 4053 are bent out at a 45 degree angle. Signal lines are brought out on three inch long wires from the modem disconnect header plug. Three pairs of the wires from the header plug must be connected together. Four wires from the header plug are not connected. The rest of the wires are connected to the 4053 as noted on the diagram in figure 3.



TNC-2A Digital Regenerator Modification  
Figure 3.

## OPERATIONAL TEST

It is recommended the standard TAPR TNC modem tone alignment be conducted prior to placing the unit into operation. This modification converts the TNC for duplex operation. If connected to a simplex radio, all valid incoming packets will attempt to be regenerated on the channel. Don't do that! We tried it and it made a great chatter test of the PTT. Instead, connect the TNC (standard audio/PTT configuration) to a radio capable of duplex operation. The SVALAN repeater radio is a Motorola MICOR modified such that A+ is applied continuously to the oscillator and all stages except

for one driver. The TNC PTT line directly keys the driver, resulting in a TXD of approximately 5 Milliseconds. Adjacent channel splatter was not detected on a spectrum analyzer. Checkout consists of observing normal operation when connecting either through the repeater or to the node.

This modified TNC should work well with any duplex radio and is not dependent on the MICOR. The switching time is not critical if users set the AXDELAY parameter to match the keyup time. We have used AXDELAY of 0 for the MICOR with no problems.

The TNC can be restored to original operation simply by removing the modem disconnect header plug and reconnecting the disconnect header jumpers with jumper blocks. U9 can be replaced or the 4053 removed from it to restore the TNC.

## **SUMMARY**

Network improvements have not kept pace with the growth of user developments. Duplex digital regeneration techniques have demonstrated worthwhile improvements in throughput, as compared to simplex operation. This paper describes one approach to controlling a duplex regenerator/node by adding a simple low cost modification to a standard TNC-2.

## **References**

1. "A Duplex Packet Radio Repeater Approach to Layer One Efficiency," Robert Finch, N6CXB, ARRL Sixth Computer Networking Conference Proceedings, August 1987.
2. "Installation," Software 2000, Inc, NET/ROM Version 1.3 Documentation, September 1987.
3. "DCD Modification for the TAPR TNC-2," Eric Gustafson, N7CL, TAPR Packet Status Register, August 1988.
4. "A Duplex Packet Radio Repeater Approach to Layer One Efficiency, Part Two," Scott Avent, N6BGW and Robert Finch, N6CXB, ARRL Seventh Computer Networking Conference Proceedings, October 1988.