

Heatherington 56KB R.F. Modem  
Interconnection List  
Revision 10/8/87

DE-9S TNC to Modem Connector

Pin	Signal
1	TDE *RTS and RDD Enable
2	RDD RXD (receive data)
3	RDD RXC (receive clock)
4	TDE TXD (xmit data)
5	TDE TXC (xmit clock)
6	TDE/RDE ground
7	N/C
8	RDD CD (carrier detect)
9	N/C

RDD - Receiver Data Decoder

TDE - Transmitter Data Encoder

Transmitter Data Encoder Board

Socket P-1 Pin	Signal
1	*RTS
2	+5 volt
3	-5 volt
4	TXC
5	TXD
6	Ground

Socket P-2 Pin	Signal
1	I modulation
2	Q modulation
3	RTS
4	Ground
5	+5 volt
6	-5 volt

## Receiver Data Decoder Board

Socket P-1 Pin	Signal
1	Enable
2	+5 volt
3	-5 volt
4	RXC
5	RXD
6	Ground
7	*CD
8	N/C

Socket P-2 Pin	Signal
1	N/C
3	Ground
4	+5 volt
5	Ground
6	N/C

## Tranceiver RF Board

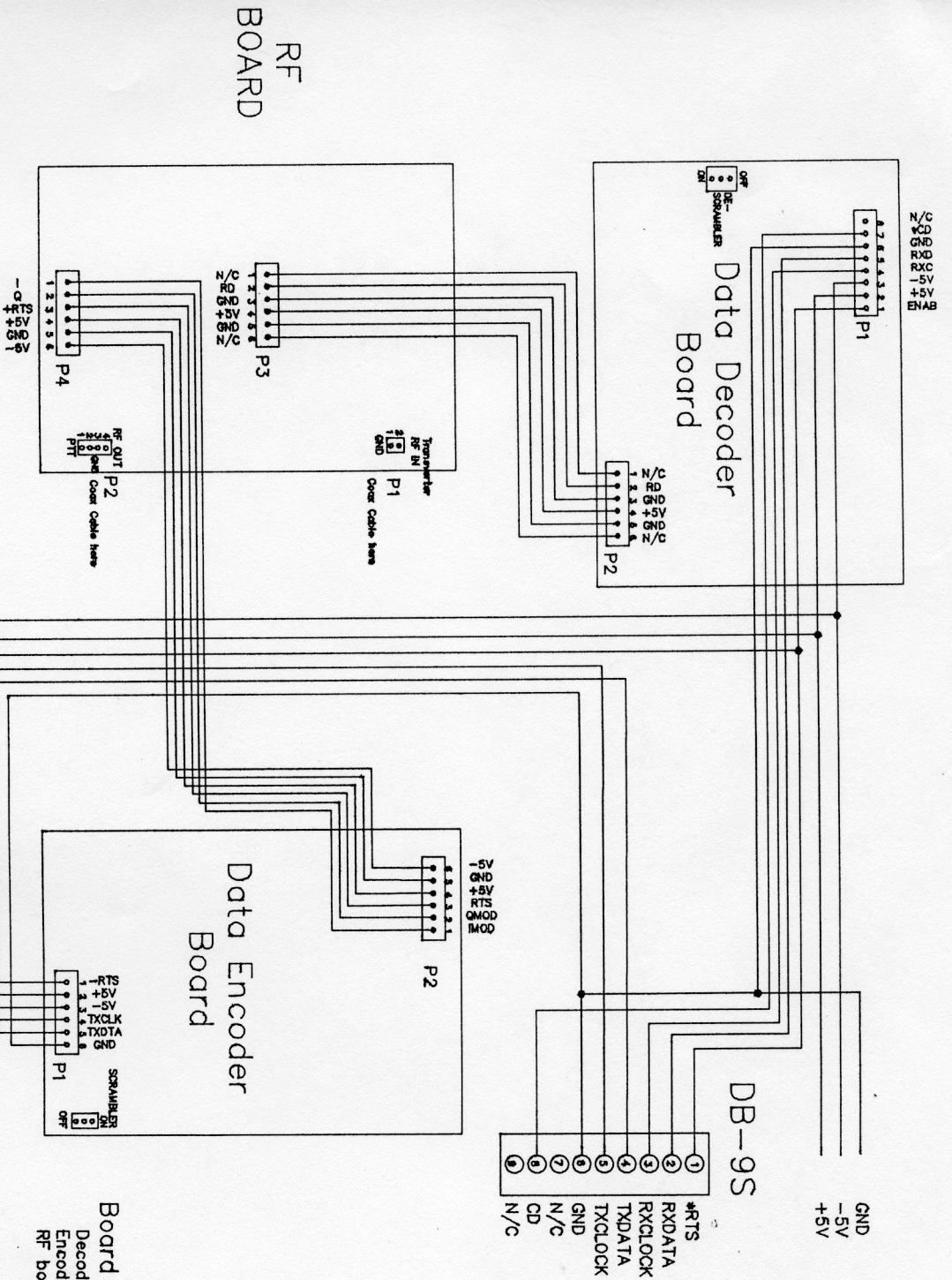
Receiver RF Socket	Signal
1	N/C
2	Discriminator
3	Ground
4	+5 volt
5	Ground
6	N/C

Receiver Socket (2 pin)	Signal
1	Ground
2	RF in

Transmitter RF Socket	Signal
1	I modulation
2	Q modulation
3	RTS
4	Ground
5	+5 volt
6	-5 volt

Transmitter Socket (4 pin)	Signal
1	PTT
2	Ground
3	Ground
4	RF Output





RF  
BOARD

56KB RF Modem  
Interconnection Diagram

Rev: 020188 Drawn: wd4agc

#### Board Revisions:

Decoder board - 021987-A  
Encoder board - 110386  
RF board - 082286





This document applies to:

Transmit encoder board Rev. A  
RF board Rev. B  
Receive decoder board Rev. B

### Transmit Data Encoder Adjustment

OBJECTIVE: Adjust pots R9, R11, R15 for equal and zero centered I and Q modulation waveforms.

- 1) Power and jumper connections.
  - A) Connect power to connector P1. Leave P2 disconnected.  
P1-2 = +5vdc      P1-3 = -5vdc      P1-6 = GND
  - B) Jumper the scrambler pins ON. (JP1)
  - C) Enable the encoder by grounding P1-1 (-RTS).
  - D) Set baud rate switches for the desired rate (all OFF for 56 kB)
  - E) Apply power.
  - F) Momentarily ground P1-5 (TXD) to start the scrambler.
- 2) Connect dual trace scope channel 1 to P2-1 ( I-Mod )  
Connect channel 2 to P2-2 (Q-Mod)
  - A) Set Horz. sweep rate to 20 us/div.  
Set CH-1 and CH-2 to 2 volts/div.  
trigger from CH-1. Waveforms like fig. 1 should now be present.
  - B) Adjust R9 to align the zero crossings of CH-1 with the zero volt reference graticule.
  - C) Adjust R11 to align the zero crossings of CH-2 with the zero volt reference graticule.
  - D) Adjust R15 for equal amplitudes on CH-1 and CH-2.

Static alignment on the transmit encoder is complete. Small adjustments to R9, R11, and R15 will be required during the final alignment procedure.

### Alignment of the RF board transmitter (Rev. B)

- 1) With power off, connect the 6 conductor cable from P2 on the transmit encoder board to P4 on the RF board.  
Do steps 1-A through F as described above to initialize the transmit encoder.
- 2) Connect a scope probe to test point TP-1.  
Adjust slug tuned coil L9 for max RF voltage. You should see a 29 mHz sine wave 0.7 volts peak to peak.
- 3) Connect a scope probe to test point TP-2 on the RF board.  
Adjust coil L10 for max RF voltage on TP-2.  
The signal should be about 1.5 volts peak to peak at 29 mHz with some amplitude modulation. At this point the transmitter alignment is almost complete. The receiver must be aligned before completing transmitter alignment.

### RF board receiver alignment (Rev. B)

The RF receiver gets power from the Receiver Decoder board. The partially aligned transmitter will be used as a signal generator for receiver alignment. THE TRANSMITTER AND RECEIVER MUST BE CRYSTALLED FOR THE SAME FREQUENCY FOR THIS PROCEDURE TO WORK! This is basically an analog loopback test mode.

- 1) Connect a cable from P2 on the Receiver Decoder to P3 on the RF board. Apply power to the Receiver Decoder through P1.  
P1-2 = +5vdc P1-3 = -5vdc P1-6 = gnd.
- 2) Power and initialize the transmitter encoder and RF boards.
- 3) Connect a scope probe to test point TP-3.  
Adjust coil L2 for max RF voltage (39 mHz, 4.5 vpp typical).
- 4) Connect a 10K ohm resistor between P1-2 (29 mHz input) and P2-4 (29 mHz RF output). (connects transmitter to receiver)  
Connect a scope probe to test point TP-4.  
Adjust coil L1 for max signal.  
Adjust coils L6, L7, L8 for max signal. You may have to adjust these coils several times because they interact slightly.  
You should have a 100 mVpp, 455 kHz modulated sine wave when done.
- 5) Connect a voltmeter to test point TP-5 ( MC3359, recov. audio).  
Adjust coil L5 for a reading of +2.5 volts.



## Received data decoder board alignment

- 1) Connect a 10K ohm resistor between P1-2 (29 MHz input) and P2-4 (29 MHz RF output). (connects transmitter to receiver) (This should have been done in step 4 above.)  
This will supply a random bit stream to the receiver for alignment of the decoder board. Be sure the scrambler is working before proceeding. Ground P1-5 on the transmit encoder board to start the scrambler if necessary.
- 2) Connect a scope probe to TP-1 on the decoder board.  
Set vert. for 1 v/div.  
Set horz. for 10 uS/div.

Adjust VR2 (DC offset adj.) so the signal is centered around zero volts. This signal is the EYE pattern and should be about 3 volts peak to peak. It may have some distortion as in figs. 3 & 4. Don't worry, further adjustments later will fix that.

- 3) Clock recovery PLL adjustment.

Set vert. for 500 mV/div. and connect scope probe to TP-3. TP-3 is the VCC (Voltage Controlled Clock) control voltage.

You will likely see 2 vpp of noise unless the PLL is locked. Slowly adjust VR-1 (VCC frequency) until the noise drops to about 250 mVpp. Carefully adjust VR-1 so the noise is centered around Zero volts. Connect a frequency counter to TP-4. The frequency here should be equal to the baud rate (56,000 kHz). Note: If a 3.579545 MHz color burst crystal was used in the transmit encoder board, the actual frequency will be 55.930 kHz.

- 4) This step "fine tunes" the modems transmitter and receiver.

Connect scope probe, channel 1 to TP-4 (clock).  
Connect scope probe, channel 2 to TP-1 (eye)  
Set horz. for 10 uS/div.  
Set Ch 1 vert for 5 v/div.  
Set Ch 2 vert for 1 v/div.  
Trigger from CH 1, rising edge.

You should see the 56 kHz clock on channel 1 and the eye pattern on channel 2 as shown in Fig. 2, 3 or 4. The following adjustments are made for the least distortion in the eye.  
The waveform of fig. 2 is your goal.



Adjust R9, R11, and R15 on the transmit encoder for best looking eye pattern. Adjust L13 and L14 on the RF board for best eye pattern. Go back over these adjustments several times for best results. L13/L14 and R15 will interact with each other. L13 and L14 are in series. Their effects are summed. ie: if the slug in L13 is turned clockwise one turn and the L14 slug is turned counter clockwise one turn there will be no net effect.

Adjust VR1 on the Decoder board until the falling edges of the clock are aligned with the centers (peaks) of the eye pattern.

- 5) Connect the scope or voltmeter probe to U11, pin 3. Adjust VR3 (squelch) for +200 mV at U11, pin 3.

Connect a scope probe to TP2. You should see less than +100 mV DC. Un-ground the -RTS line on the transmit encoder board (P1-1). The transmitter should now be off and the voltage at TP2 should rise to about +500 mV DC. You can now check the -carrier detect pin on the receive decoder (P1-7). It should be logic low when the transmitter is on and logic high with no signal.

Note: Receive decoder P1-1 (enable) must be open or logic high before the carrier detector will work. During normal simplex operation P1-1 will be connected to the -RTS lead on the transmit encoder board. This prevents the receiver from demodulating the modems own transmitted data.

You can now check to see if data is getting from the TXDATA pin (P1-5) on the transmit encoder to the DATA pin (P1-5) on the receiver decoder.

Ground -RTS (P1-1) on encoder board.

Be sure the descrambler (decoder board) is jumpered ON.

Connect scope to DATA (P1-5) on the decoder board.

Observe the scope while grounding and un-grounding the TXDATA lead on the encoder board (P1-5).

The scope should show 0 vdc when TXDATA is grounded and +5vdc when open.

YOU NOW SHOULD HAVE A WORKING MODEM BOARD SET.

Microwave Modules transverters need to have a 22 uF cap. removed from their ptt switching circuits. The 432 Mhz units work without this capacitor but 220 Mhz units need to have it replaced with a .01 uF cap. If you don't do this modification the T/R switching time will be VERY slow.

Also, they must be configured for LOW POWER input by installing a jumper. See instructions with your transverter for details.

We have discovered that the receiver front ends in these units are very suseptable to intermodulation interference. You may need a selective cavity filter in some situations.

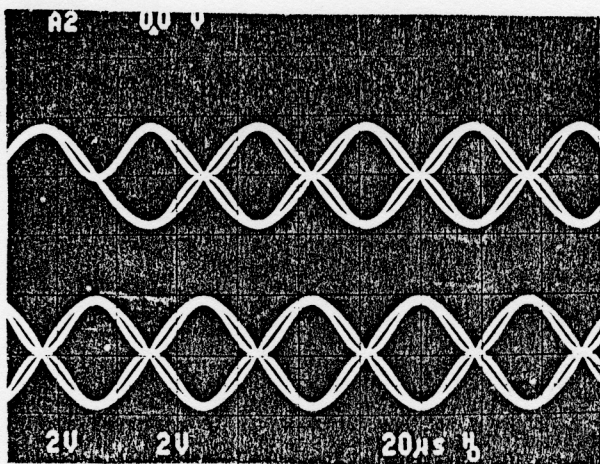


FIG. 1

I and Q modulation  
Transmit encoder P2-1 & P2-2

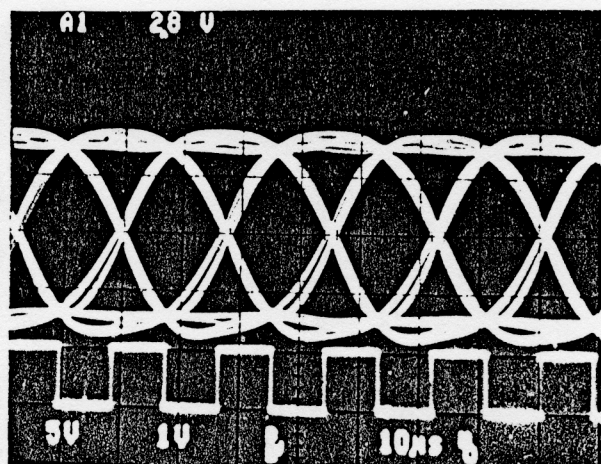


FIG. 2

Correctly adjusted eye pattern

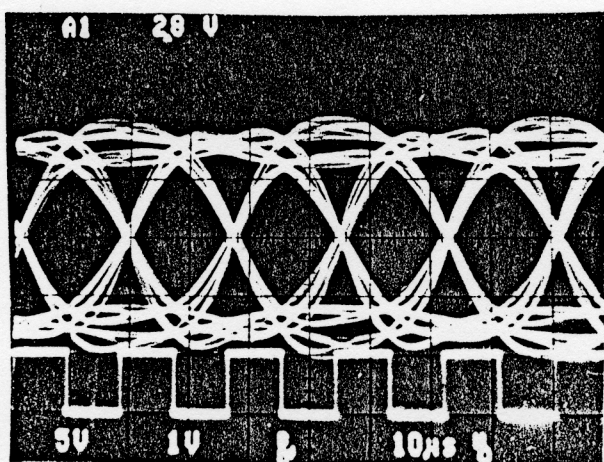


FIG. 3

Eye pattern with incorrect  
adjustment of R9 and/or R11

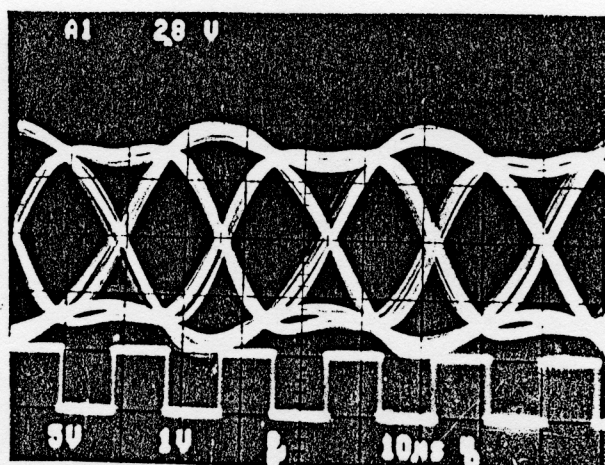
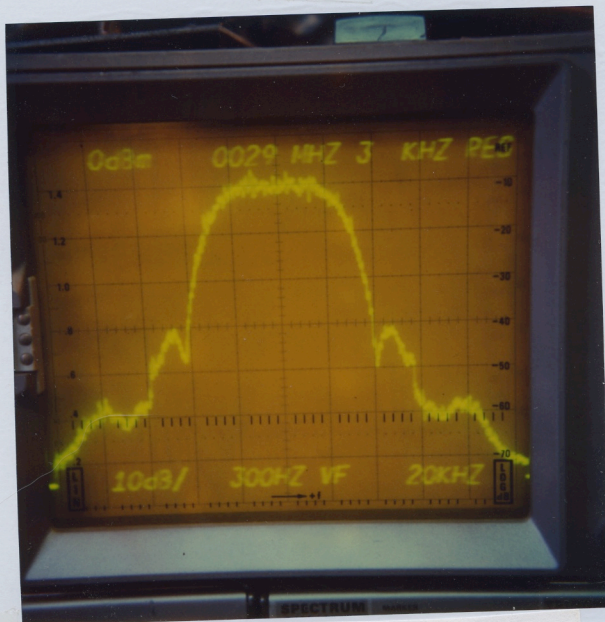


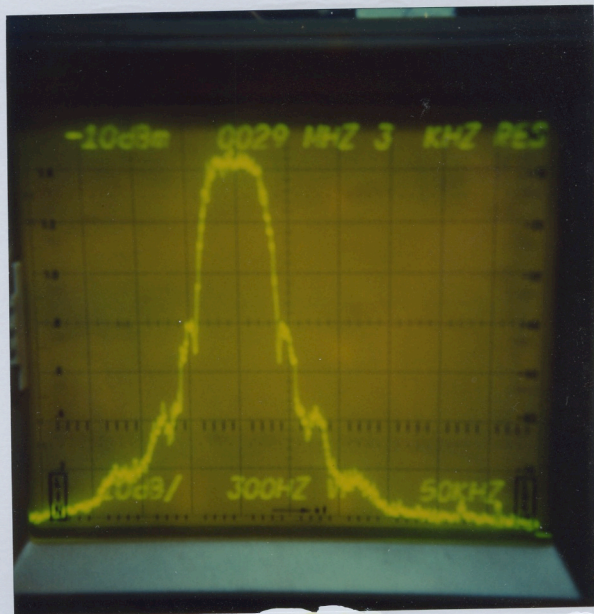
FIG. 4

Eye pattern with incorrect  
adjustment of R15 and/or L13/L14





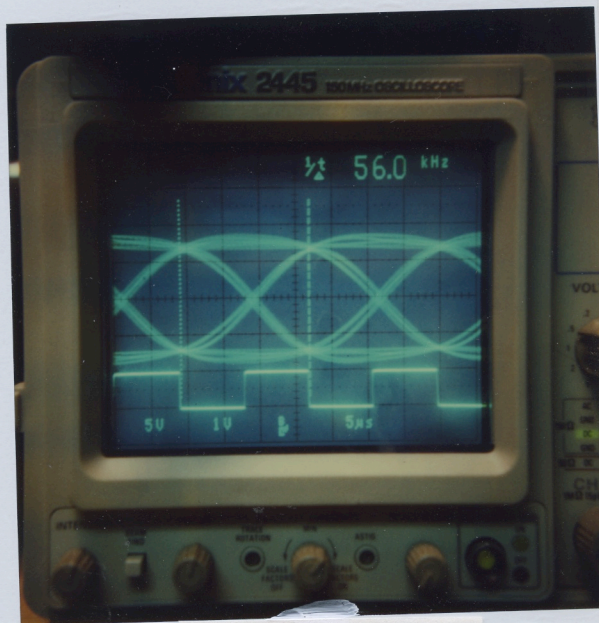
SPECTRUM (20 KHz /div)



SPECTRUM (50 KHz /div)



SIGNAL CONSTELATION



56 KBAUD EYE