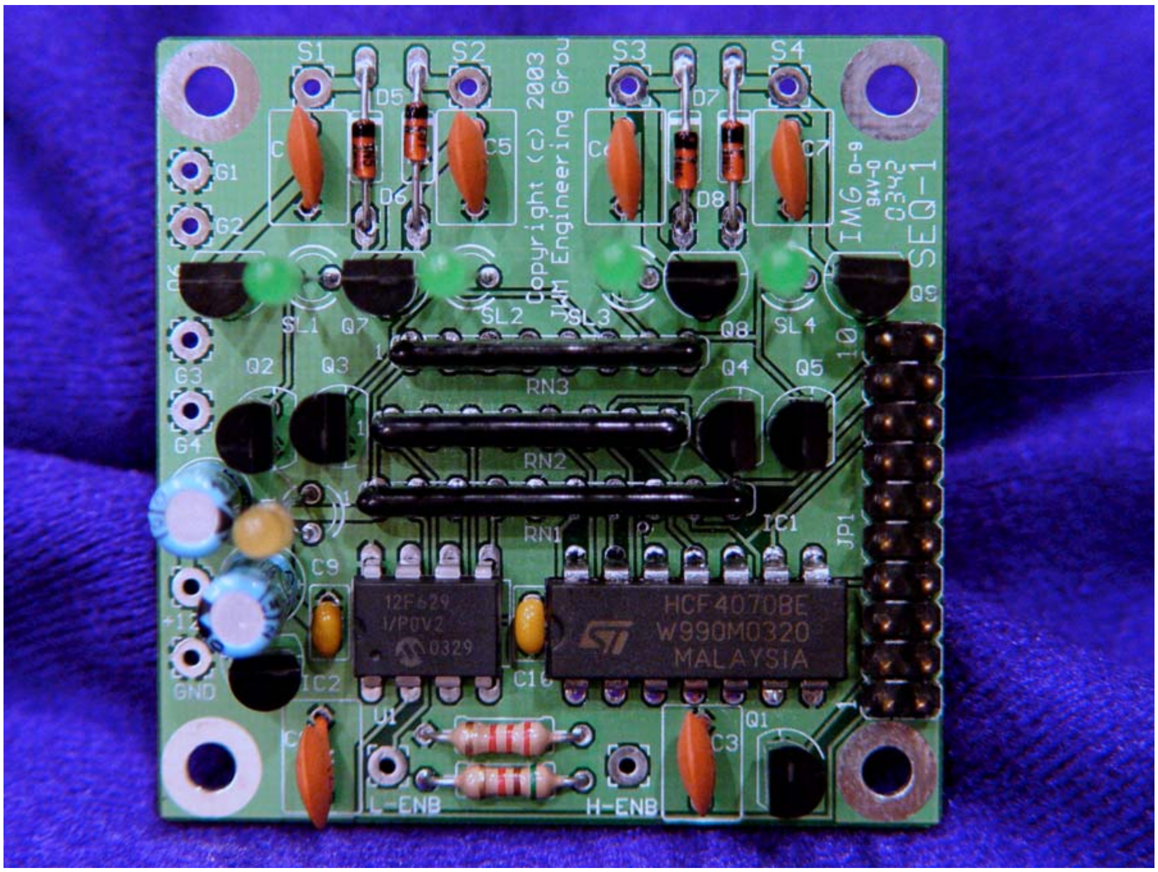
Model SEQ-1 T/R Sequencer



The Model SEQ-1 Transmit/Receive Sequencer is the first microprocessor controlled sequencer on the market. It provides one heartbeat and four visual outputs for confirmation of operation, plus the ability to program a different time delay value for the outputs sequences. The one Second Heartbeat is used to give a visual indication that the SEQ-1 is functioning properly. The four green LED's give a visual indication of the sequence and step operations.

Today's modern transverter use very low-noise front-ends to provide the best possible signal to noise ratio possible. These low-noise front-ends will not survive the high transmit power levels found in most transverter systems. Especially during the switching from receive to transmit and back to receive. A sequencer is needed to protect these low-noise front-ends from the potentially destructive transmit power levels, and normal relay contact bouncing found in every RF antenna change over relay.

The SEQ-1 provides four sequenced open collector outputs to control your transverter sub-systems switching requirements. Each open-collector output is capable of switching up to 35 volts at 600 ma continuously. Using open-collector outputs allows for direct control of relay coils. Using additional analog circuitry, other switching schemes are possible with the SEQ-1 sequencer. Also provided is the ability to invert the active Output State of any of the four open-collector outputs.

The sequencer is enabled by using either the Low-Enable input, or the High-Enable input pins. The Low-Enable input is a connection taken to ground to cause the sequencer to activate. The High-Enable input connection requires a positive input voltage from +2.0 to +14 volts to cause the sequencer to activate.

Provision has been made to allow the user the ability to re-program the time delay value used to control the sequencer on/off steps. This allows the user to fine-tune the delay time for the environment being controlled. For example, if your RF switching is all solid state, like PIN diode switching, then a smaller time delay value would be appropriate. If you are using mechanical relays, a longer time delay would be required to allow for contact settling. What’s more, the time delay value can be programmed right in the circuit. No need to remove the SEQ-1 from your system to change the delays.

NOTE: The default delay value is 32 milliseconds for each step.

SEQ-1 Connections:

Figure 1 is an image of the silkscreen. The pads labeled S1, S2, S3, and S4 are the open-collector outputs used to drive your relays. An input voltage of +12 to +14 volts is connected to the pad called +12V. There are nine ground pads on the board, GND, G1, G2, G3, and G4 and the four mounting holes in each corner of the board. The two pads labeled L-ENB and H-ENB, are the low enable input, and the high enable input respectively, which activate the sequencer. The four Green LED's are labeled SL1, SL2, SL3 and SL4. The Yellow Heartbeat LED is called HB1 on the silkscreen. The delay time programming and output polarity selection is changed using the jumpers on JP1.

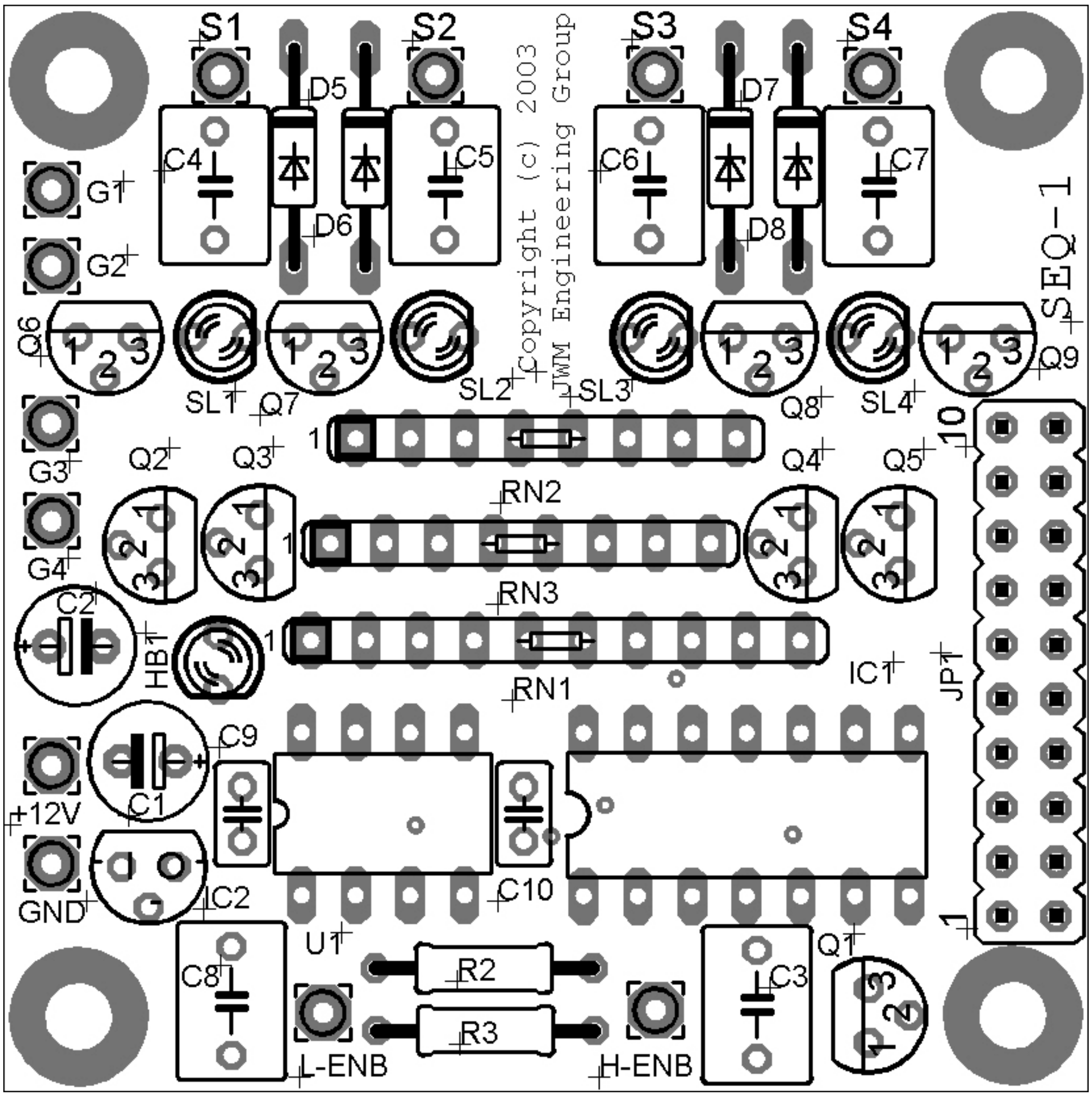


Figure 1

Mounting Dimensions:

Figure 2 shows the mechanical dimensions for mounting the board to a front panel if desired. All dimensions are in inches. The lead lengths of all the LEDS is set for a ½" round or hex 4-40 threaded spacer. This will allow approximately 1/16" of LED protruding through the front panel after the SEQ-1 is mounted. Measure and drill the appropriate holes as shown in figure 2. The board is exactly 2.0 inches x 2.0 inches.

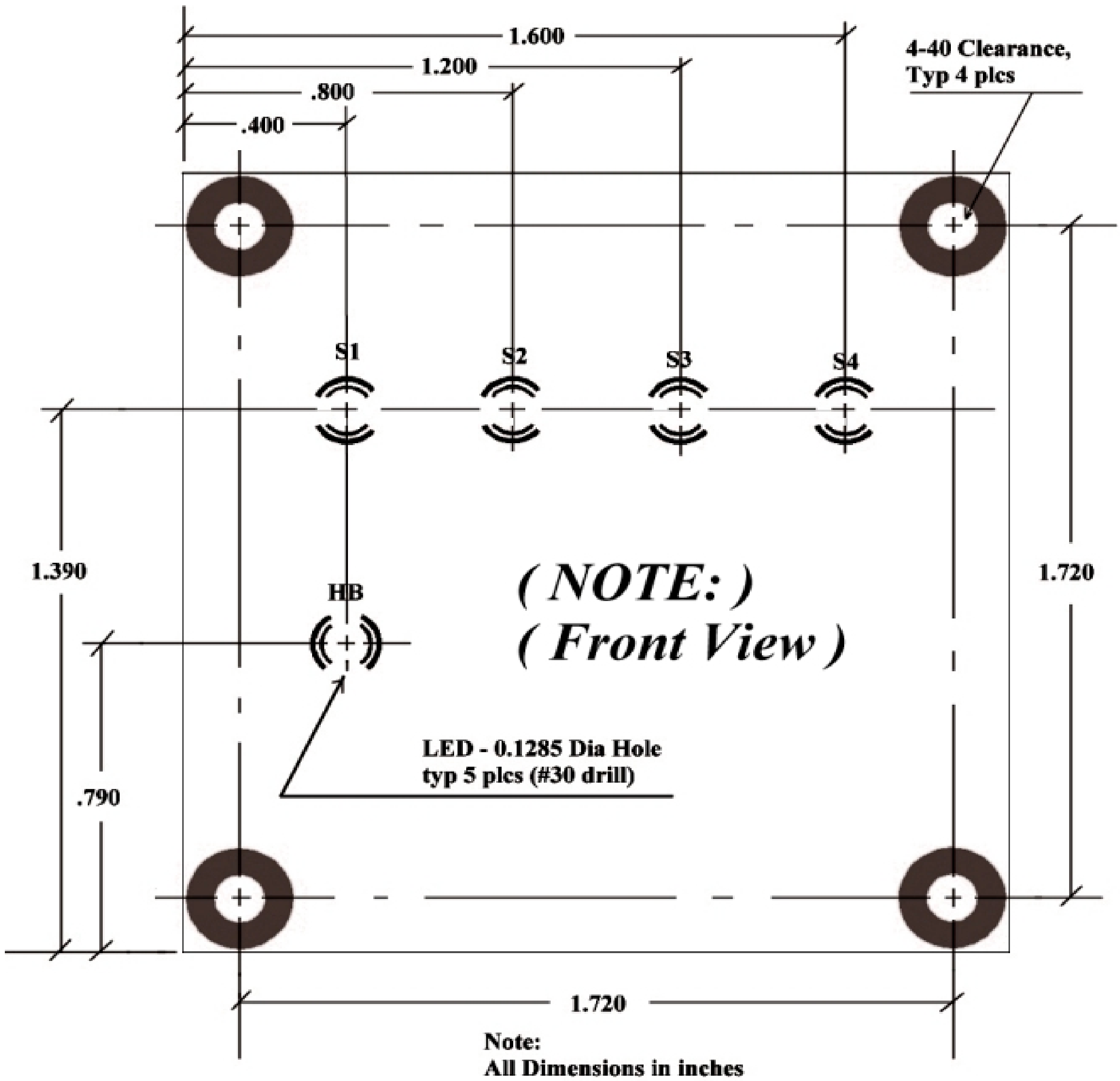


Figure 2

Programming Options:
The SEQ-1 has a programming capability that will allow the user to set the amount of delay between steps on the S1 to S4 outputs. This capability can be performed while in your system, so the SEQ-1 does not have to be removed to make the programming changes. All four outputs will have the same amount of delay programmed.

The amount of delay is adjustable from 4 msec to 128 msec per sequence step. Figure 3 shows a table of delay step values that may be programmed on jumper JP1. Below are the steps to follow so the on-board programming will work correctly. Proceed as follows:

__ 1.) Power down the SEQ-1.
__ 2.) Jumper JP1 –1 with a shunt provided.
__ 3.) Select the amount of Delay in milliseconds from the table in Figure 3.
__ 4.) Set the jumper selection on JP1 2-6 for the desired delay wanted in step 3.
__ 5.) Apply voltage to the SEQ-1 and observe that the Heartbeat LED is on solid.
__ 6.) Wait for about 5 seconds for programming to complete.
__ 7.) Remove power from SEQ-1 and remove all shunts from JP1 pins 1 to 6.

The new delay value is now saved in the memory of the microprocessor and will be used each time the SEQ-1 is powered on.

***NOTE: If you leave any jumpers on JP1 pins 2 to 6, the Heartbeat LED will flash 5 short ON cycles followed by 5 long ON cycles. This will repeat until the jumper(s) on JP1 pins 2 to 6 are removed. . This is a safety precaution and the sequencer will not function correctly until this is completed*.**

JP1 Pin Selection

2	3	4	5	6	Delay (msec)	2	3	4	5	6	Delay (msec)
O	O	O	O	O	**128**	O	S	O	O	O	**64**
O	O	O	O	S	**124**	O	S	O	O	S	**60**
O	O	O	S	O	**120**	O	S	O	S	O	**56**
O	O	O	S	S	**116**	O	S	O	S	S	**52**
O	O	S	O	O	**112**	O	S	S	O	O	**48**
O	O	S	O	S	**108**	O	S	S	O	S	**44**
O	O	S	S	O	**104**	O	S	S	S	O	**40**
O	O	S	S	S	**100**	O	S	S	S	S	**36**
S	O	O	O	O	**96**	S	S	O	O	O	**32**
S	O	O	O	S	**92**	S	S	O	O	S	**28**
S	O	O	S	O	**88**	S	S	O	S	O	**24**
S	O	O	S	S	**84**	S	S	O	S	S	**20**
S	O	S	O	O	**80**	S	S	S	O	O	**16**
S	O	S	O	S	**76**	S	S	S	O	S	**12**
S	O	S	S	O	**72**	S	S	S	S	O	**8**
S	O	S	S	S	**68**	S	S	S	S	S	**4**

Figure 3

Notes:
O = Jumper Removed, S = Jumper Installed
Remove JP1 pin 1 to pin 6 for proper operation after programming delay value

State 1 to 4 Output Polarity Selection:

Each open collector output, S1 to S4, has the ability to have an inverted output state independent of the other outputs. Normally the S1 to S4 states when active, pull down a circuit to activate it. Typically, this is the bottom end of a relay that is connected to +12 volts on its other terminal. Under normal conditions, if the sequencer is not active, the output of S1 to S4 will be disabled, de-energizing the relay. There are situations where it is desirable to have a relay energized when the sequencer is not active, and when the sequencer is activated, the relay will become de-energized. This option may be selected by jumper JP1, pins 7, 8, 9, or 10. The table in figure 4 illustrates what happens to each output pin, S1 to S4, when the inversion is selected verses normal polarity. An output port is inverted when a shunt jumper is placed on any JP1 pin 7 to pin 10 connection.

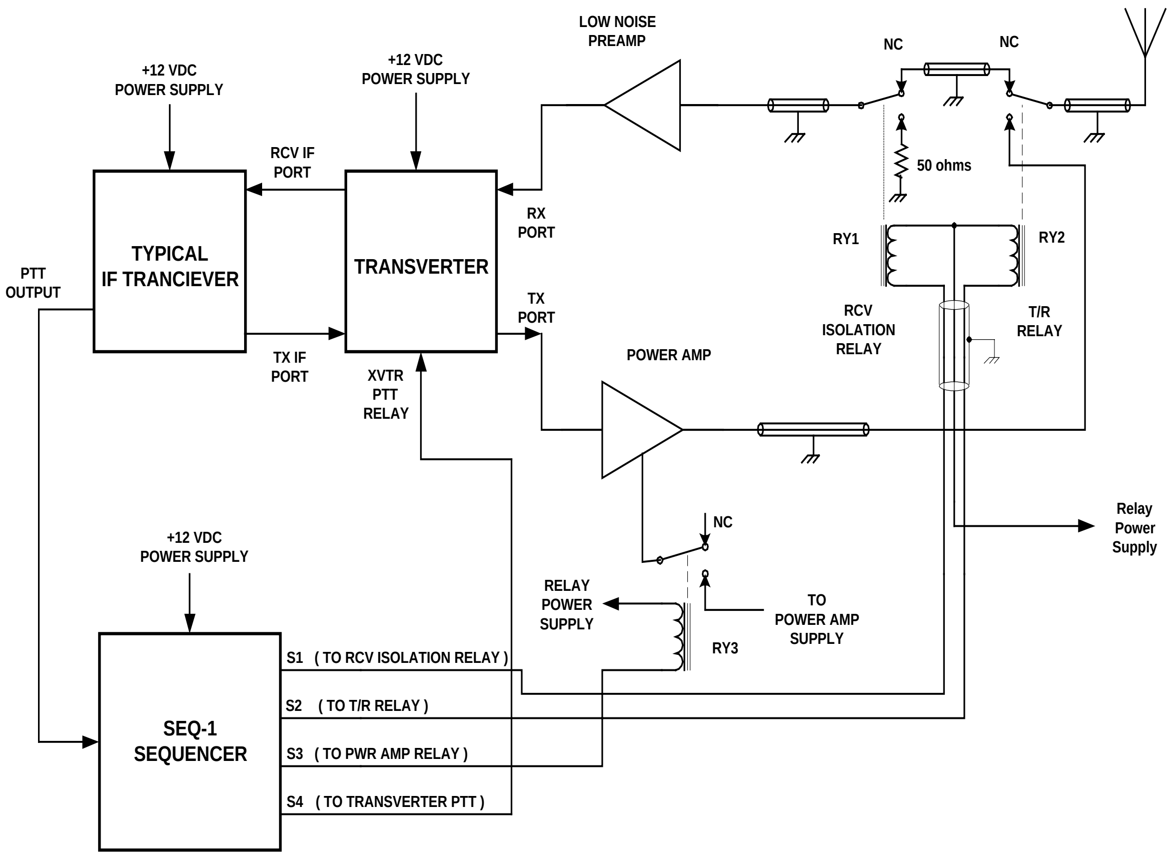
JP1 Pin	S1 Output		S2 Output		S3 Output		S4 Output	
7 - Open							**Inactive**	
7 - Short								**Active**
8 - Open					**Inactive**			
8 - Short						**Active**		
9 - Open			**Inactive**					
9 - Short				**Active**				
10 - Open	**Inactive**							
10 - Short		**Active**						

Figure 4

The Table shown in Figure 4 represents the idle state of the sequencer. In other words, the sequencer is not activated. When an inversion is selected, the LED indication of the inverted channel will also be inverted. Normally the four LED’s are off when the sequencer is not activated. If a state is inverted using one of the jumpers on JP1 7 to 10, then that state LED will be on when the sequencer is inactive, becoming off when the sequencer is activated. So the LED State will be inverted as well. This allows the user to see that a state has been inverted simply by looking at the LED’s.

Typical Use:

Figure 5 depicts a typical VHF/UHF/Microwave Transverter station. In this example the receive input from the antenna is always active when not in a transmit state. So if the relay power is off for example, you can still receive signals because RY1 and RY2 are in the normally closed state. Many people prefer this condition for normal operation. There is a down side to this arrangement. If the power supply for RY1 and RY2 fails for some reason, there is the risk of destroying the low noise pre-amp when the transmitter is activated. Especially if the power amplifier is capable of several hundred, to thousands of watts of output power. If RY1 doesn’t switch to protect the low noise pre-amp, by terminating the input to ground with the 50 ohm termination, the leakage between the contacts of RY2 could allow enough transmit power to destroy the low noise pre-amp. Also, your power amplifier at that point will be transmitting into an open circuit, not a good thing to do with most amplifiers.

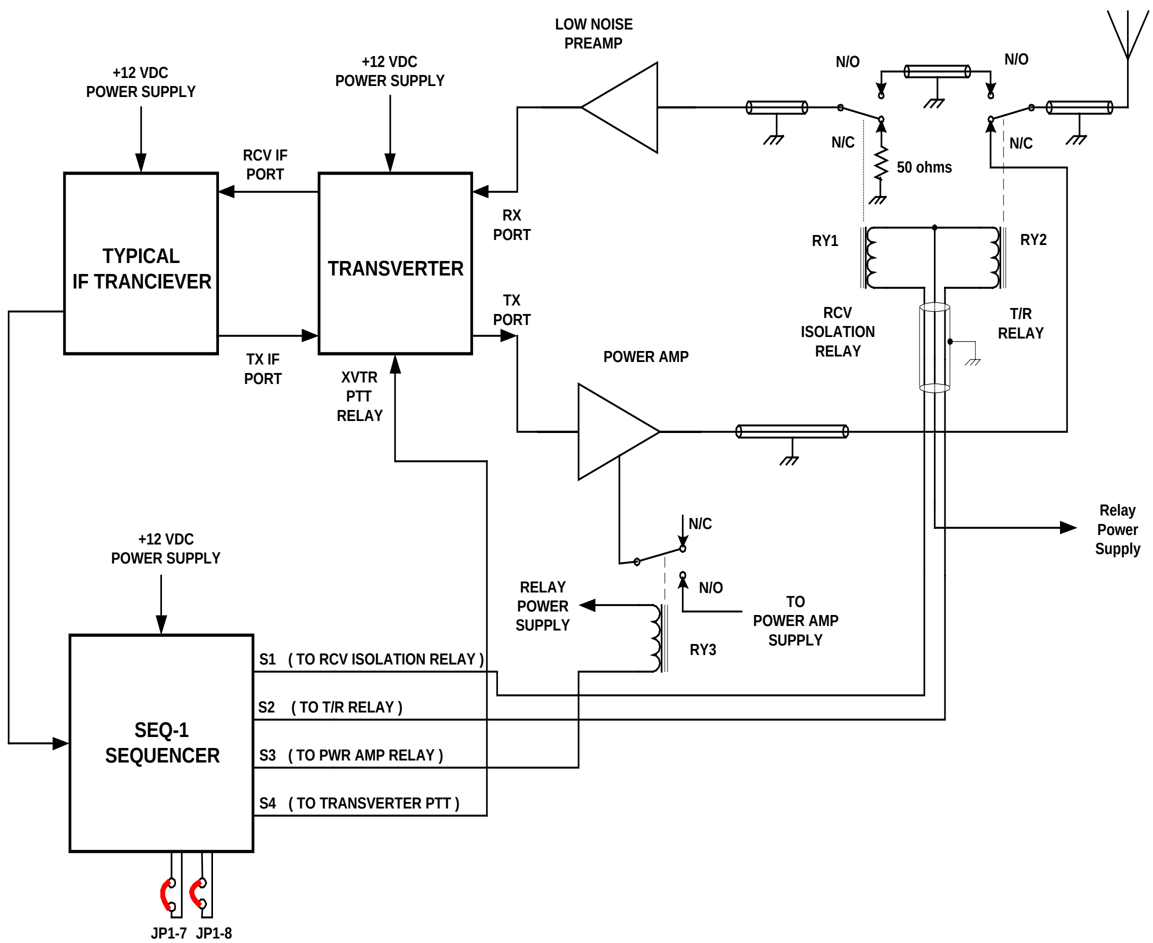


BLOCK DIAGRAM OF A TYPICAL VHF/UHF/MICROWAVE TRANSVERTER STATION

Figure 5

The SEQ-1 has the capability to directly handle just this kind of situation. The solution is to use the inverting option for S1 and S2 using shunts for PJ1 pin 7 and pin 8 to invert the State condition for RY1 and RY2. This means that RY1 and RY2 would be wired for the N/O condition instead of the N/C condition. In other words, RY1 and RY2 have to be energized to receive signals. This way if you lose the power supply for RY1 and RY2, the low noise Pre-amp will not be destroyed when a transmit takes place, and the power amplifier will see a good match to transmit into. Figure 6 depicts this failsafe arrangement. Also, your first clue that you have a problem with your relay system, RY1 and RY2, is you will not have the normal receive noise level you have when the relays are activated normally.

Take special notice in figure 6 that JP1-7 and JP1-8 are jumpered to invert the Output State of S1 and S2 respectively.



BLOCK DIAGRAM OF A TYPICAL VHF/UHF/MICROWAVE TRANSVERTER STATION

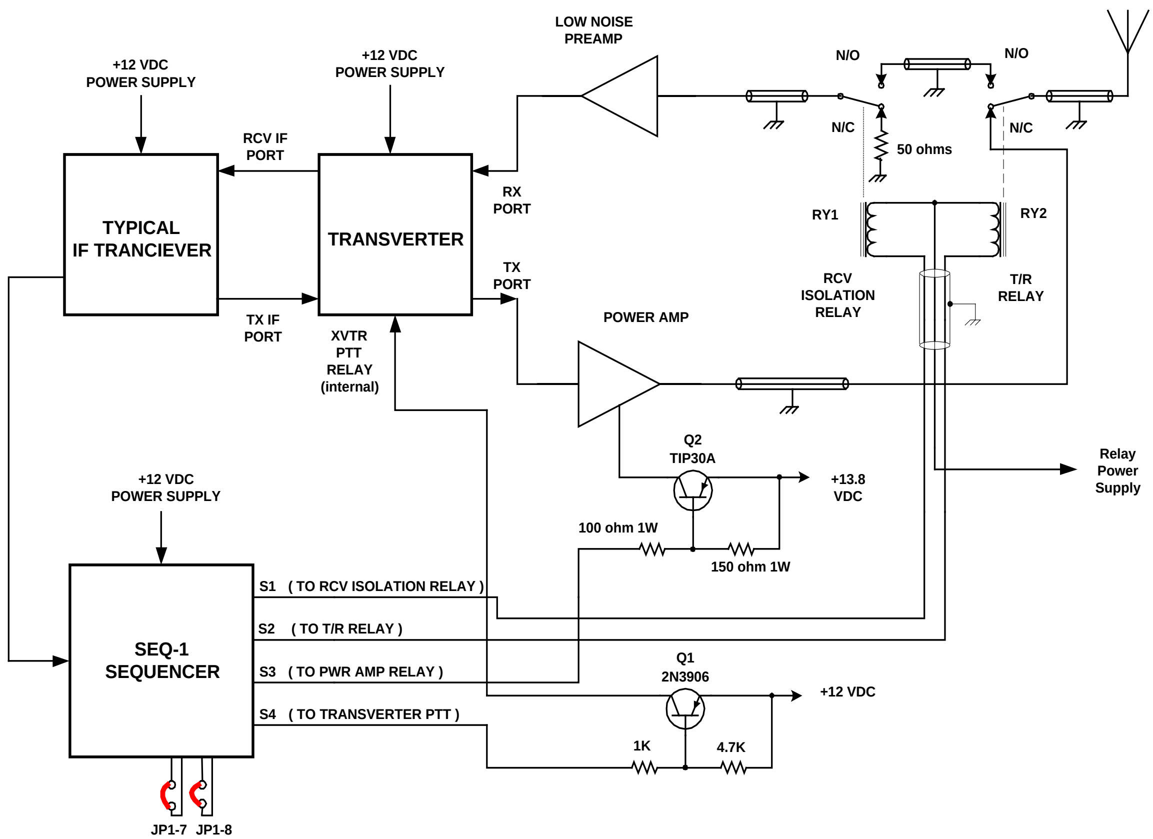
Figure 6

A word of caution related to RF relays that are always in a constant energized state. Most of these relays are not designed to be energized for long periods of time, and will require a good heatsink to dissipate the heat that can build up. Transco "Y" relays for example can be energized for several hours at a time when mounted to an aluminum plate about 12 inches square or so, by ¼ inch to 3/8 inch thick. To provide the best possible heat transfer, use transistor thermal heatsink compound when you mount the relays to the aluminum plate.

You may have a requirement to provide a positive switched voltage to control a RF relay that is used in a transverter, instead of having to provide a grounded enable signal. Figure 7 shows an example of using PNP transistors for positive voltage switching. Q1 is used to provide a plus 12 volt switched enable signal for a transverter from S4 of the sequencer.

Q2 in figure 7 is an example of using a high power PNP transistor to provide a positive +12 Volts to a power amplifier. Of course, you must be sure to use a PNP transistor capable of handling the required power requirements for the circuit being switched. You also need to be aware of the possible higher Vce voltage drop across the power PNP transistor when designing a switch for high power circuits. The Vce drop across a high power PNP could be as high as 3 volts under high current conditions. Your power supply will have to provide the extra voltage to maintain the proper voltage for the amplifier circuit. The bias resistors will also have to be designed to provide the proper operating point for the PNP switch.

NOTE: be sure to use protection diodes across all relays in your system. Especially those controlled by transistor switches. Other wise you may possibly destroy switching transistors from back EMF voltages created when the relay is turned off.



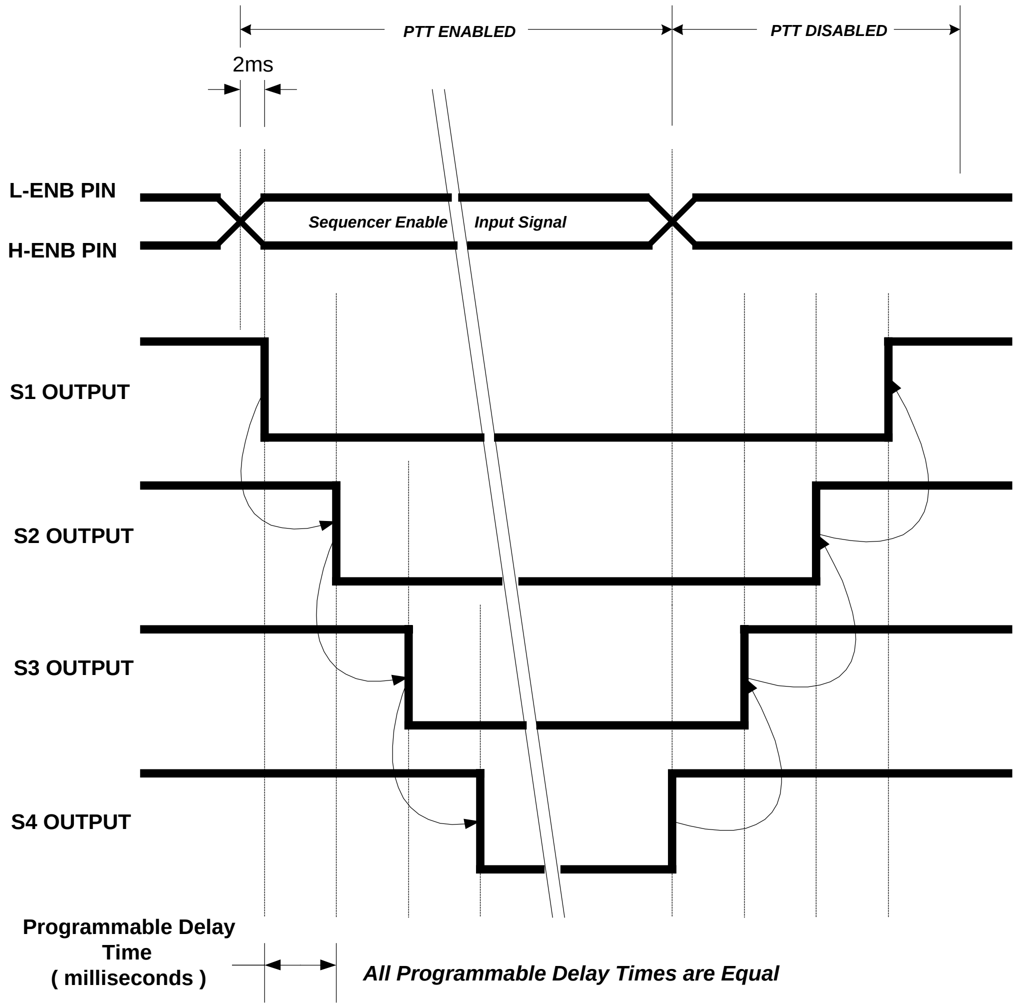
BLOCK DIAGRAM OF A TYPICAL VHF/UHF/MICROWAVE TRANSVERTER STATION

Figure 7

Timing Diagram:

Figure 8 shows the Sequencers timing states. The states are shown for the case where the inversion option is not used, so the open collector outputs at S1, S2, S3 and S4 are active low when enabled. The 2 millisecond delay shown in the input enable signal is programmed into the microprocessor to prevent chatter or false triggering when the PTT line is pushed on the IF Transceiver.

Note: S1, S2, S3, S4 open collector outputs are active low when enabled



Sequencer State Transition Timing Diagram

Figure 8

Warranty

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