Band and PTT outputs using K3 RS232 signals

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The most annoying "feature" of the Elecraft K3 is the lack of a separate PTT output for each band, especially when using it as a transverter driver for many microwave bands.. Previously I had used a PIC to decode the band data appearing on the K3 accesory socket pins. However every time I reconfigured the transverter "XV" assignment I needed to reprogram the PIC which was unacceptable. It was realised that the RS232 stream from the K3 showed the frequency is on irrespective of transverter assignment, so it was decided to use this information to drive the new unit. It would allow a "1 of 8" open collector output to switch the appropriate external device per microwave band and also a "1 of 8" open collector PTT output for the appropriate band. To keep an eye on the switch status a 16x2 LCD display would be used. To avoid issues with RS232 levels a true RS232 level converter (MAX232) was employed, despite the extra cost.

First question was what RS232 string to look for from the K3? In the manuals I found a config:autoinf =1 which causes the k3 to send an IF sentence out every time the frequency changes. This change can be caused be tuning the radio with vfo or pressing band up or down. The IF sentence gives the following into (from k3 programmers guide)

IF (Transceiver Information; GET only)

RSP format: IF[f]*****+yyyyrx*00tmvspbd1*; where the fields are defined as follows:

[f] Operating frequency, excluding any RIT/XIT offset (11 digits; see FA command format)

* represents a space (BLANK, or ASCII 0x20)

+ either "+" or "-" (sign of RIT/XIT offset)

yyyy RIT/XIT offset in Hz (range is -9999 to +9999 Hz when computer-controlled)

r 1 if RIT is on, 0 if off

x 1 if XIT is on, 0 if off

t 1 if the K3 is in transmit mode, 0 if receive etc

Naively as the “t” character reflects Receive or Transmit state I assumed the IF sentence would be sent when changing RX-TXor TX-RX **WRONG.. it doesnt!** I asked Wayne N6KR if the transistion between transmit and receive state could trigger an output but he said the RS232 port was already busy enough! So as well as looking at the RS232 port I would have to take the PTT signal out of the k3 and monitor it as well

Thoughts then turned to which PIC, A PIC with more pins than the previous 16F628 would be needed, the 16F886 was chosen as it had been used in other amplifier monitoring projects. It turned out that even this did not have enough output pins for what I needed so a high current SPI interface shift register was used (TPIC6B595 as used in the Elecraft KRC2) for the band output signal and the directly driven (quicker) ULN2803 for the band specific PTT. The bands decoded were the USA VHF/UHF/Microwave bands. The initial circuit was built on a PCB produced by express PCB and tried.

Initial testing was good, band outputs switched as designed but the PTT output wasnt behaving sensibly. It was soon realised that if the PIC was looking all the time for RS232 data coming in then it could not also be looking at the PTT signal. Time to get acquanted with external Interrupts (not used since my GPO introduction microcontrollers class in 1984!). Unfortunately the external interrupt pin (21) on the 16F886 was already used for the LCD port so some pin juggling (and a new PCB) would be needed. The final circuit is as follows:-

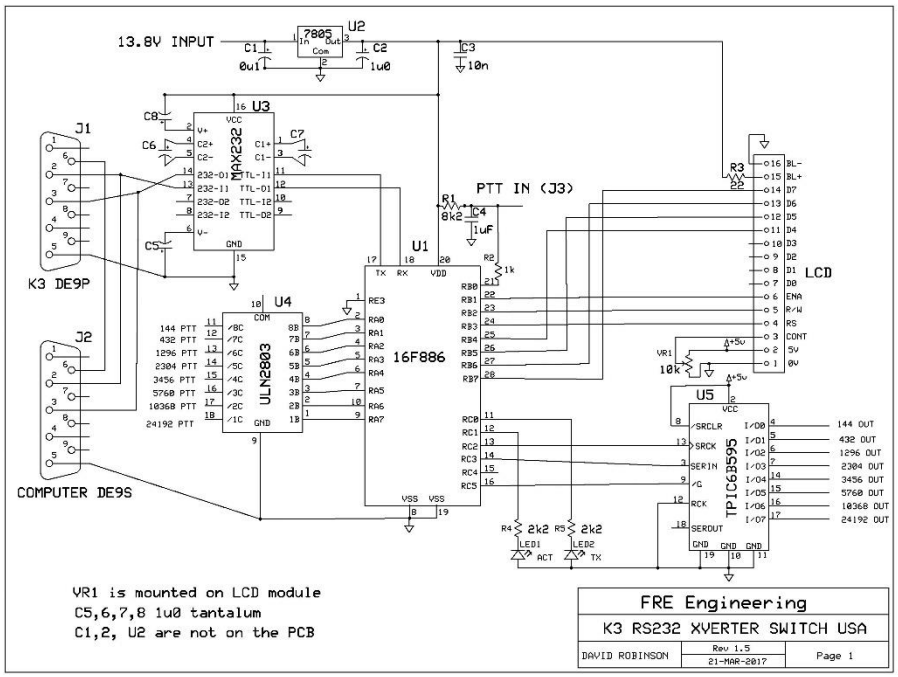

Figure 1 Circuit diagram

Circuit

The PIC monitors the RS232 port and uses the data to send the appropriate band through the PICs SPI port to the TPIC6B595. If the PTT input signal goes low (ie the rig is on Transmit) an interrupt is generated that causes the PIC to switch the band applicable ptt open collector output. During this period, it ignores what is happening on the serial port so if you move frequency while you are on Transmit (very unsociable) or hit the band up button on transmit (hope you have a good sequencer!) the band will not be updated. Debounce circuitry (R1/R2/C4) is applied to the PTT port. With Pin 1 earthed the unit expects 38400 baud data from the K3. If it is connected to +5V the unit expects 9600 Baud data from the K3

Construction

A small 4" x3" PCB was designed and the original PCB produced by Expresspcb. However the design has been ported to Robot room copper connection software allowing gerbers to be produced and the PCB made by OSHPark in a stunning purple! The circuitry is boxed in a 5x3x2" aluminium box. The front panel contains the LCD, activity LED and Transmit LED. The rear panel has two 9 pin connectors DE9P and DE9S for RS232 in and out (to allow the decoder to be used inline with other devices), a DE25S 25 pin connector for the decoded outputs, an RCA connector for PTT input and a 12 connector

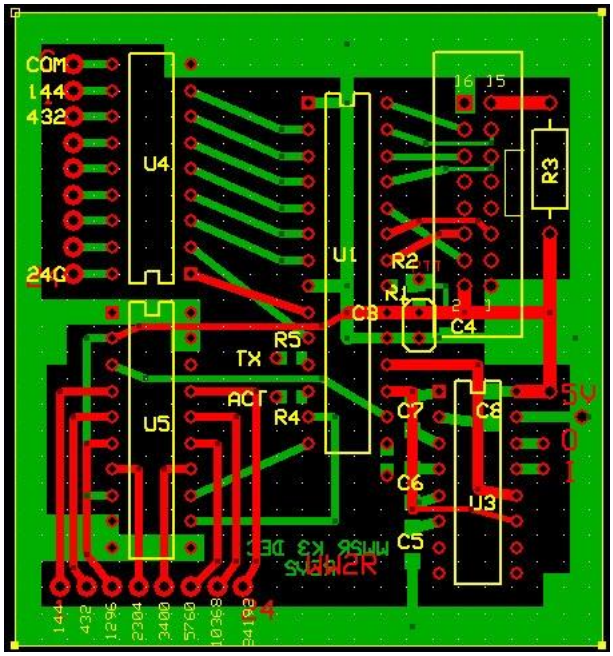

Figure 2 PCB Overlay

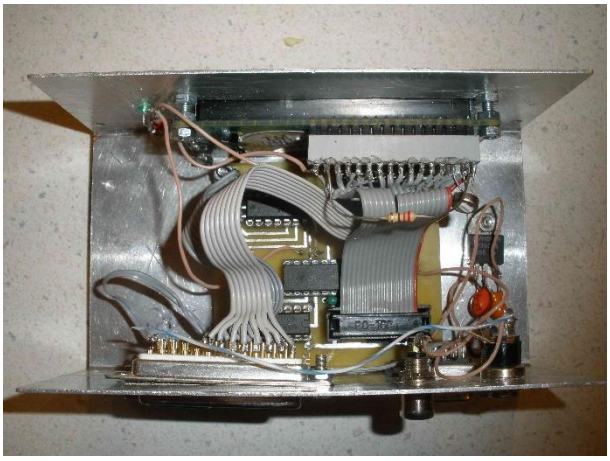

Figure 3 Internal view of the decoder

Figure 4 Rear Panel view of the decoder

Figure 5. The decoder in use on 6cm

Figure 6. The decoder in use on 9cm

To test the outputs I connected two ten segment LEDS to the two sets of outputs with the common of each connected through a 2k2 resistor to 12V. A segment would illuminate when the output goes low. The following is what happens on 6cm:-

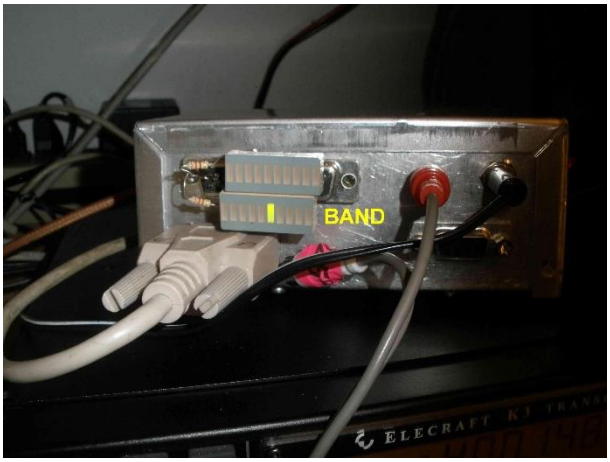

Figure 7 Receiving on 6cm

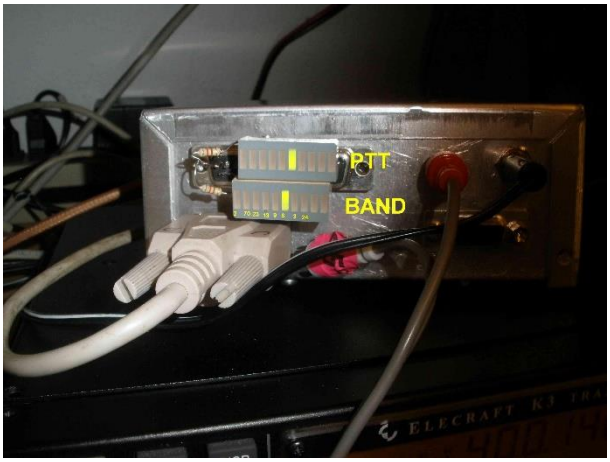

Figure 8 Transmitting on 6cm

Deployment

In the K3 menus

Set CONFIG:AUTOINF to 1

Make sure CONFIG: RS232 is set to 38400

Connect the RS232 cable coming out of the K3 that would normally go to the computer to J1

Connect the PTT out from the K3 to the PTT Input of the decoder (J3)

Connect 8-14 volts to the unit

Turn on the K3. it should produce an IF sentence and update the frequency on the display. If not move the VFO knob, even 1Hz which will cause the display to update

If you have setup transverters for 2m (internal or external; it does not matter) 70cm 23cm 13cm 9cm 6cm 3cm and 1.2cm as you step through them the band output will conduct to ground. On Transmit only the specific band ptt output will conduct to ground. It does not matter which transverter is set up in the K3 menus as XV1, XV2 XV3 through XV9 as only the operating frequency is read

Anything below 100MHz is considered HF and no output is provided. the LCD will however show "HF"

Note that the actual frequencies designated to be on each band are not overly specific. Example 13cm can be 2301, 2304, 2310, 2320 2402 or 2424MHz. The decision is made on whether "Units of GHz=2". Similarily 24G can be 24048 or 24192. The decision is made on whether "Tens of GHz=2"

Conclusion

Objective met for VHF/UHF/microwaves. The design also works with the KX3.