

Digital and Analog Operation of a TKR-750/850 Repeater

Here is a way to convert a little-used analog only repeater to a combined analog and multi-mode digital repeater while retaining full analog operation capability.

This is a simple way to implement a combined analog and multi mode digital repeater using a Kenwood TKR-750/850 radio. A Zimmerman MMDVM Pi-Hat was used for our modem, but the idea has been implemented using other modems. A programming trick is utilized to allow the internal analog controller to be used on both Ver 1 and Ver 2 radios. D-Star, DMR, and YSF digital modes were enabled in this configuration. Other combinations of D-Star, DMR, YSF, P-25, and NXDN can be used, but a maximum of 3 modes is suggested.

The radio is programmed as a normal analog repeater but has the default encode CTCSS tone set to NONE. The multi-CTCSS tone is enabled and set to both encode and decode the desired tone frequency. Set the multi tone to CONSTANT to enable operation for this application. A caution to keep in mind is that apparently the D-Star digital signal has enough 100 Hz signal content to occasionally trigger the tone decode, so 100 Hz should be avoided in both the default and desired tone frequency. A default tone frequency of 67 Hz has been tried with no false triggering from a digital signal on the receiver input.

Sample code plug and Pi-Star configurations are included to allow operation in this combined mode. The modem interconnect cable schematic is also included for the Zimmerman board, but can be used with the appropriate pin changes for other modems.

This is the third iteration of combined analog and digital operation with our TKR-x50 radios. The first used a sequencer to allow a Ver 2 radio to use the internal controller. This was a very awkward implementation and required a logic element to be constructed. The second iteration used an external set of jumpers and special programming for some input/output pins on the radio. This was a much simpler configuration, but had no squelch tail and courtesy tone, and was also usable only on Ver 2 radios. This third iteration allows normal analog operation with a squelch tail and courtesy tone along with the digital function. This also allows operation with either a Ver 1 or a Ver 2 radio with a very simple cable.

Rob, WX1N came up with the idea of using the multi table to fool the radio into operating without an encode tone when the digital mode is operating. Rob uses a Ver 1 radio and a different digital board, but had the same results. One other station who contacted me also uses a Ver 1 radio and this code plug but with a modem that uses a HIGH signal to inhibit the digital operation instead of the low going signal used by the Zimmerman board and some other implementations. The TOR output of the TKR radio was simply programmed to provide a HIGH signal when the incoming CTCSS tone is detected instead of the LOW output. This is easily accomplished in the code plug for the TKR radios.

Provision is made in the code plug for a remote transmit inhibit signal controlled by Touch Tone input to the analog controller in the radio. A RESET function is also programmed. Unfortunately the Touch Tone control is not available in Ver 1 radios.

Analog users of the repeater should use tone squelch on their radios to avoid hearing the digital 'buzz'. Analog users will not hear the CW ID from the repeater since the tone encode is not transmitted during the CW ID. Since this is only for the FCC, the users need not hear it. The CW ID should be disabled in the Pi-Star configuration. By hooking the tone detect to the digital modem inhibit pin (SQ), an incoming analog call on the repeater will override the digital input and normal analog operation is possible. If this pin is not connected, there will be no analog override, and simultaneous digital and analog can be present, making the transmission useless. One or the other should have priority.

Here is the simple cable interconnect for the Zimmerman MMDVM Pi-Hat or USB board. This cable works for all 3 versions of the board.

