CrossBand Repeater Controller Operating Manual 2/16/18

1.0 Introduction

A crossband repeater controller differs considerably from a standard repeater controller.   A standard repeater controller interfaces 1 receiver to 1 transmitter. It provides timeout and ID functions for 1 transmitter. A crossband repeater controller interfaces 2 receivers to 2 transmitters. It is essentially 2 standard repeater controllers in 1. It provides timeout and ID functions for 2 transmitters. Note that a crossband repeater controller can be used as a standard repeater controller (if desired) with some functions left unused.

A crossband repeater has a receiver on one band and its transmitter on another band. For example, the receiver may be in the 446 MHz band and its associated transmitter may be in the 146 MHz band. This is so the transmitter does not interfere with the receiver (with no duplexer filter). The crossband repeater also has a second receiver in one band and its associated transmitter in another band. Continuing this example, the second receiver would be in the 146 MHz band and its associated transmitter would be in the 446 MHz band.

This controller adds the CW ID to the voice audio going between each receiver/transmitter pair. Both the audio level and the CW ID level can be adjusted independently in the controller so that the voice audio can be heard while the CW ID is active.   i.e. The voice is not blocked while the CW ID is active.

All settings to the controller are made by setting voltages with a Volt Ohm Meter (VOM) and a small screwdriver (such as an eyeglasses screwdriver) or by holding down combinations of buttons during power-on time. No computer software is used to set up the controller. The following functions are settable:

1) input the CW ID (i.e. your call sign) into non-volatile memory
2) select whether the CW ID is to be sent by one, both, or no transmitter(s)
3) set CW ID speed between 13wpm and 20wpm
4) set time interval for sending the CW ID (1 to 10 minutes) (typically 10 minutes)
5) set timeout timer for transmitter 1 (3 to 35 minutes)
6) set timeout timer for transmitter 2 (3 to 35 minutes)

By not requiring computer software to change the controller settings, the user does not have the problem of installing new drivers, etc. when the computer operating system updates or is replaced.

2.0 Setting up the CrossBand hardware

The following example assumes that the crossband repeater will to be used to implement a 446 MHz simplex channel and a 146 MHz local repeater access using two Baofeng UV-5R handheld radios. Of course, there are a lot of other types of crossband setups possible. However, most implementations would be similar to this example.

Insert the Radio 2 plug into the 2 meter radio and insert the Radio plug 1 into the 440MHz radio.

The audio levels between the radios are adjusted by two potentiometers. The MIC1 potentiometer adjusts the audio level going from the radio 2 speaker jack to the radio 1 microphone jack. Similarly, the MIC2 potentiometer adjusts the audio level going from radio 1 speaker jack to radio 2 microphone jack.

To set the audio level, first adjust the (UV-5R) speaker volume control on the actively receiving radio so that the 'audio level LED' barely lights up on voice peaks. This is the volume level that the receive radio should always be adjusted to. Since this sets the volume out of the receiving radio to a known level, the MIC potentiometer can be set just once and left fixed from then on.   Next, adjust the associated MIC potentiometer to achieve the desired level into the transmitting radio.   If an oscilloscope is available, the desired audio level into the transmitting (UV-5R) radio is approximately 50mV on voice peaks.

These adjustments are required for the audio going in the both directions. using   MIC1 and MIC2 potentiometers are adjust to achieve the correct volume level.

Lastly, the ID volume level is adjusted for both directions. The ID volume level should be set to be loud enough to be heard, but so loud that it interferes with the voice audio on the crossband. There are ID1 and ID2 potentiometers to adjust the ID level in both directions.   The desired ID level will be about 5mV peak-to-peak on an oscilloscope.

3.0 Setting up the Controller

The following sections describe how to set program the CW ID and how to set all the options.

3.1 Selecting the transmitters to send CW ID

The following method is used to select ID1, ID2, both, or none to be active. The potentiometer controlling Active CW ID is labelled "ID Select" located above pin 14 of the PIC uP. The voltage is measured on microprocessor pin 8. ID1 is added to the voice audio level controlled by MIC1.   Similarly ID2 is added to the voice audio level controlled by MIC2.

ID Select					
uP pin	**no ID's**	**ID2 only**	**ID1 only**[1]	**ID1 & ID2**	**Potentiometer location**
pin 8 voltage	**4.3 V**	**3.1 V**	<u>**1.9 V**</u>	**0.4 V**	ID Select.is above ***uP pin 14***

Notes: (1) default ID Select setting.   ID1 is transmitted on 440MHz link.

3.2 How to Input Your Call Sign

The CW ID is programmed one character at a time. The character can be a dit, dah, or space. The dit and dah have their own buttons. The space is created by depressing both the dit and dah buttons.   First the correct dit and/or dah buttons are depressed. Then the clk button is pushed and released to temporarily store that input. The remaining characters are programmed similarly. There is limited storage so long CW ID's are not recommended. If the CW ID is too long, the microprocessor locks up and will not allow any additional inputs.   If this happens, remove the power and start again with a shorter CW ID.   After the call sign is programmed, it is stored in nonvolatile memory by pressing and releasing the clk button alone with neither the dit or dah button depressed.

To start programming the ID, hold down the dit, dah, and clk buttons before applying power. Continue holding down the 3 switches for two seconds following power up. Release the clk button first, and then release the dit and dah switches. The ID1 LED should be on. Start the ID input by pressing down (1) dit, (2) dah, or (3) both dit & dah buttons for a space. Then press and release clk to temporarily retain the first character. The input is read upon the release of the clk button. Next press down dit, dah, or space for the second character. Press and release clk to temporarily save the second character, etc. All the input is saved into non-volatile memory at one time at the end of input by pressing and releasing clk with neither the dit or dah button depressed. If a mistake is made, start over by removing power and depressing the dit, dah, and clk buttons before power up, etc.

Example of programing the call sign K3HZP.

The call is first translated into Morse code. The Morse code will be stored in non-volatile memory in the microprocessor. The following is for my CW ID.

K3HZP example																							
dah	dit	dah	space	dit	dit	dit	dah	dah	space	dit	dit	dit	dit	space	dah	dah	dit	dit	space	dit	dah	dah	dit
clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk	clk

Each dit, dah, and space are followed by a clk press and release as shown in the second row above. Lastly the ID is saved permanently by pressing the clk only with no dit or dah button depressed.

3.3 Setting ID Timeout, PTT1 Timeout & PTT2 Timeout timers

The table below shows how to access the ID timer, the timeout timer for PTT1 (440MHz Tx), and the timeout timer for PTT2 (2M Tx), and how to start a new CW ID input. The correct combination of dit, dah, and clk buttons are depressed before power on and held for 2 seconds after power on for CW ID input.

function	buttons depressed before 'power on'	range	'Extra Pot' Adjustment (voltage on **pin 11 of uP**)
CW ID start	clk + dit + dah	(Input New ID)	-----
2M PTT2 timer	clk + dit	3min → 35min	5min: 0.352V (step=5/64V)
440 PTT1 timer	clk + dah	3min → 35min	20min: 2.695V (step=5/64V)
ID timers	clk only	1min → 17min	10min: 2.891V (step=5/32V)
stop ID with PTT drop	(1) hold: 'ID timers' clk only (2) press: (dit + dah), (3) release all 3 buttons	toggles between: (1) ID stops with Rcv stop (2) ID & PTT continue after Rcv stop (default)	------

For example, let's set the 2M PTT2 timeout timer for 8 minutes. First the desired voltage is calculated. The voltage adds time to the minimum time. For PTT2, the table above shows the minimum time is 3 minutes. The voltage must be set to add 5 minutes to the minimum. The table shows that the step size is 5/64 volts for each additional 0.5 minute. Then 5 minutes will require 10 steps. We add an extra 0.5 step to make the voltage setting a little less critical. This makes the required number of steps for 5 minutes to be 10.5 steps. The voltage to add 5 minutes is (5V)/(64 steps) x (10.5 steps) = 0.8293V. The potentiometer labelled 'Extra

POT' is adjusted to set 0.829V on pin 11 of the uP chip. The new value must be stored into nonvolatile memory before it will take effect.   To store this new timeout new, power must be disconnected. Next, only the clk and dit buttons are both depressed before the power on. Next, power is applied. Finally, the buttons are released 3 seconds after power is applied. After the buttons are released, the new timeout value takes effect and is stored in nonvolatile memory.

The last option is a little different. It allows terminating the CW ID if activity on the channel stops after the CW ID has started.   With the default setting, if the ID starts when the PTT is depressed, it will continue until it is finished and keep the PTT depressed. This option allows stopping the ID immediately when the PTT is released. It will not ID again until the next ID timer period expires. To invoke this option, depress clk only before power up. Next, power up the controller. Then, while keeping the clk button depressed, depress the dit and dah buttons together. Then release the clk button and then release the dit and dah buttons. Each time that you do this, it will toggle this option on and off. If it is off, it will toggle on. If it is on, it will toggle off.

Cross Band Repeater Example

Cross Band Repeater controller