BYONICS

BFoxCon Manual

Version 0.2 – October 30, 2017

Overview

The Byonics BFoxCon is a radio controller board designed to pair with a Baofeng UV-5R to create a transceiver for hidden transmitter hunts, also called T-hunts, foxhunts, and ARDF. It mounts on the back of the radio, connects to the SP/MIC jack, and is powered by the radio's battery. The UV-5R was chosen because it is a low cost, easy to find radio that can transmit either 3W or 6W, but the BFoxCon can be adapted for use with any hand held (HT) or mobile radio. It can be remote controlled via DTMF and configured via DTMF or a computer, and can be adjusted with many tones, durations, and duty cycles.

The transmissions consist of a looping sequence as follows:

- **an off the air pre-tones delay** to support multiple sequenced transmitters
- **a looping tones transmission** is user configurable and played during the majority of the hunt
- **a Morse code message** or ID to legally identify the transmitter
- **an off the air delay** to allow DTMF control, lower duty cycle, or other transmitters to be heard

In addition to the sequence above, it also supports:

- **an initial delay** to start the transmitter when the hider is not present
- **a total runtime** to limit the length of the hunt

Battery Wiring

The BFoxCon can be ordered either fully assembled and ready to connect to the UV-5R, or as a PCB requiring the user to solder the interface wiring to the battery and the SP/MIC jack. The BFoxCon can by powered by the UV-5R battery, or any 7V - 12V supply when interfacing to another radio.

There are 2 ways to power the BFoxCon from the UV-5R battery. The first requires the BL-5L 7.4V 3800mah extended battery. This battery has a charging jack near the top that can also be used to power external devices. Using a cable with a 1.7mm x 4mm right angle plug, cut the wire to about 1½" long (2¼" when including the plug), strip and tin ⅛", and solder to the tops of the + & - pads on the PCB, and not inserted through the pad holes. The plug center conductor is connected to +. The BFoxCon can be powered by plugging this cable into the BL-5L battery.

The other way to power will work with any battery, but requires soldering to the radio itself, and could damage the radio if done incorrectly. With the battery removed from the radio, there are 4 spring terminals exposed. The 2 nearest the SP/MIC jack are the + contacts. Solder a 2" 24 AWG wire to the tip of the one terminal nearest the SP/MIC jack. Be careful not to let the soldering iron touch the terminal for more than about 1 second at a time, or the plastic case will melt. Solder the other end of the wire to the top of the + pad on the PCB, and not inserted through the pad hole. Do not connect to

the - terminal or pad. Possibly file a small notch in the corner of the radio so the wire is not crimped when the battery is connected. The BFoxCon can be powered by plugging in the SP/MIC plug which will provide the ground connection.

Audio Wiring

The UV-5R typically ships with a ear/mic headset, and this cable can be used to wire the BFoxCon to the SP/MIC jack. These headsets can be purchased for about $1. Cut the wire to about 3" long (4¾" when including the plug), strip off ⅜" of the outer black insulation to expose the 4 wires inside. These wires each have an enamel polymer film insulation that should be melted off. Create a large bead of solder on the tip of the soldering iron, and hold the last ⅛" of each wire in this bead for about 5 seconds. This should melt off the insulation and tin the wire. The four wires can then be soldered to the tops of G, R, P, & T pads on the PCB, and not inserted through the pad holes. The colors of the wires are not universal, so use an ohmmeter to determine which color goes to each pad. The audio and power cables can be zip tied together to help strain relief each other.
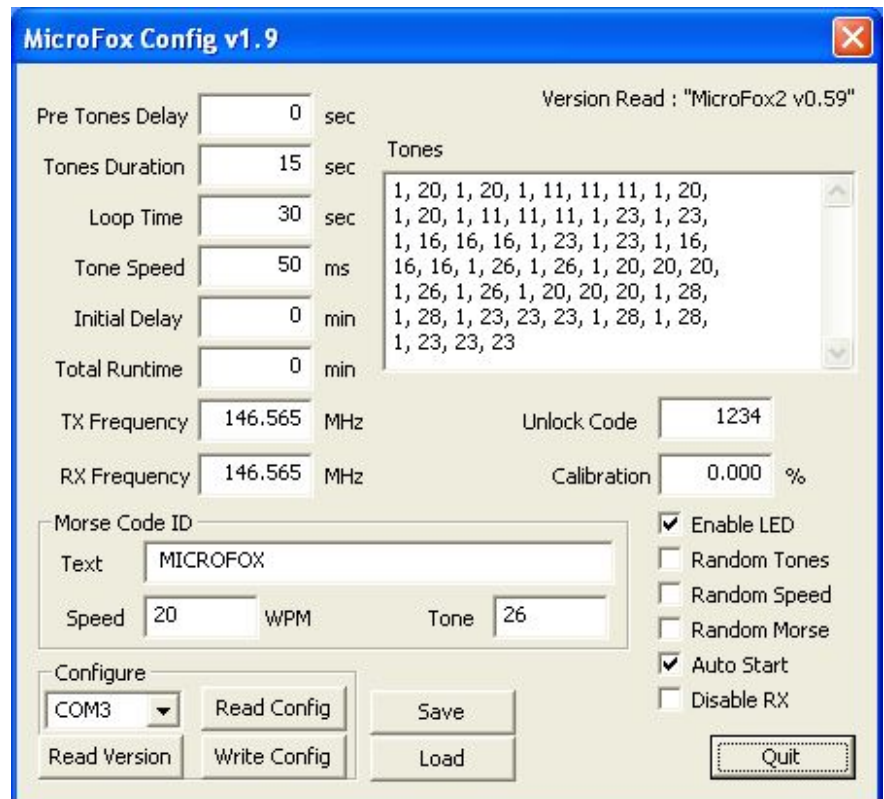
Plug Contact	Function	Pad
2.5mm sleeve	Ground	G
2.5mm tip	Receive Audio	R
3.5mm sleeve	Push To Talk	P
3.5mm ring	Transmit Audio	T

If using the BFoxCon with a radio other than the UV-5R, just connect each of the pads to the appropriate radio connection. If using a radio that doesn't have a PTT connection, such as a Yaesu or Icom HT, leave that connection out, and short the J1 jumper with a solder blob. The R8 pot can be used to adjust the transmit audio level.

Computer Configuration

The BFoxCon settings can be configured via DTMF tones or with the a USB serial cable and the Windows MicroFoxConfig program version 1.9 or later. The cables and software are available from www.byonics.com/mf. PL2303 USB drivers can be found at www.prolific.com.tw. The configuration program can only be used within 3 seconds powering the BFoxCon.

The default settings that appear when the configuration program is started are recommended for a basic hunt with the BFoxCon transmitting tones for 15 seconds, and then a Morse

MicroFox Config v1.9

Version Read : "MicroFox2 v0.59"

Pre Tones Delay: 0 sec
Tones Duration: 15 sec
Loop Time: 30 sec
Tone Speed: 50 ms
Initial Delay: 0 min
Total Runtime: 0 min
TX Frequency: 146.565 MHz
RX Frequency: 146.565 MHz

Tones:
1, 20, 1, 20, 1, 11, 11, 11, 1, 20,
1, 20, 1, 11, 11, 11, 1, 23, 1, 23,
1, 16, 16, 16, 1, 23, 1, 23, 1, 16,
16, 16, 1, 26, 1, 26, 1, 20, 20, 20,
1, 26, 1, 26, 1, 20, 20, 20, 1, 28,
1, 28, 1, 23, 23, 23, 1, 28, 1, 28,
1, 23, 23, 23

Unlock Code: 1234
Calibration: 0.000 %

Morse Code ID
Text: MICROFOX
Speed: 20 WPM
Tone: 26

☑ Enable LED
☐ Random Tones
☐ Random Speed
☐ Random Morse
☑ Auto Start
☐ Disable RX

Configure
COM3
Read Config
Read Version
Write Config
Save
Load
Quit

code ID. It then will stop transmitting, and repeats every 30 seconds. The only setting users must change is the Morse Code ID text to be their assigned amateur radio callsign.

The TX Frequency, RX Frequency, and Disable RX settings are not applicable to the BFoxCon, as the RF frequencies are set on the connected radio. The Calibration option is available in the Config program but not via DTMF commands. It can be used to tweak the long term timing of a BFoxCon. Positive calibration numbers make the unit run faster. If you determine that the BFoxCon is running 0.03% slow, set the calibrate to +0.03% to correct.

The BFoxCon will work with a TTL or RS232 serial cable. The cable must be connected to a 1x4 0.1" pitch header in the following order:

Pin	Function	Typical Color
1 (square pad)	Ground	black
2	Serial In	green
3	+3V to +5V power	red
4	Serial Out	white

After installing the USB drivers, inserting the USB cable, and setting the desired options in the configuration program, select the connected cable COM port, connect the 1x4 plug cable to the J2 PCB holes such that ground/black is in the square pad, press Read Version, then Write Config to apply the settings. The serial cable will power the BFoxCon, and the program can only communicate to the BFoxCon within the first 3 seconds of it getting power.

Note: When using a TTL serial cable, the BFoxCon will not operate until it receives the first serial command from the config program, so do not be surprised when the LED doesn't flash on powerup.

DTMF Configuration and Control

The BFoxCon can be remote controlled and configured by sending DTMF tones from either the connected radio, or a separate radio on the same frequency. The transmitting radio needs to be able to send all 16 DTMF tones : 0-9, *, #, and A-D. On some radios, the A-D keys may not be labeled. The receiver volume may need to be adjusted for best DTMF decoding. Sending DTMF 3 and watching the LED is a good way to find a suitable volume level. The LED will flash quickly while DTMF tones are being decoded and at a medium speed during configuration. The BFoxCon can be DTMF locked to prevent other DTMF controls or configuration until it received the unlock code, default 1234.

Note: Some UV-5R radios have a bug in the firmware that send a DTMF 0 when the DTMF D key (EXIT) is pressed. When this is the case, a separate radio with a functioning DTMF D key will be required to activate the Lock DTMF function.

DTMF Control Codes

DTMF tone	Function
1	Start transmission
2	Toggle transmission
3	Stop transmission
D	Lock DTMF control

DTMF Configuration Codes

DTMF configuration is divided into 3 command sets. The A commands take 6 DTMF digits, the B commands take 4 DTMF digits, and the C commands are a variable length, and terminate with the # tone.

A1mmss	**Set the pre-tones off the air delay to mm minutes and ss seconds.** The default is off, and can be set with A10000.
A2mmss	**Set the tones duration to mm minutes and ss seconds.** The default is 15 seconds, and can be set with A20015.
A3mmss	**Set the loop time to mm minutes and ss seconds.** This should be set to at least the duration of the tones, plus the time to send the morse ID. The default is 30 seconds, and can be set with A30030.
A4hhmm	**Set the initial delay to hh hours and mm minutes.** The default is off, and can be set with A40000.
A5hhmm	**Set the total runtime to hh hours and mm minutes.** The default is off, and can be set with A50000.
A6xxxx	**Set the transmit frequency to 14x.xxx MHz.** Power must be cycled for the new value to take effect. The default is 146.565 MHz and can be set with A66565.
A7xxxx	**Set the receive frequency to 14x.xxx MHz.** It doesn't need to be the same as the transmit frequency. Power must be cycled for the new value to take effect. The default is 146.565 MHz and can be set with A76565.
A8xxxx	**Set the 4 digit unlock code.** The default is 1234 and can be set with A8 1234.
B1xx	**Set tone duration in 5 ms units.** This controls the tone sequence speed. The default is 50 ms and can be set with B110.
B2xx	**Set morse code speed in words per minute.** Valid settings are between 03 and 31 wpm. The default is 20 wpm and can be set with B220.
B3xx	**Set morse tone to tone code xx.** This sets the audio frequency of the morse code ID. Refer to the DTMF Tone Codes table below. The default code is 24 (784 Hz) and can be set with B324.
B4xx	**Set flags bits to xx.** This sets various on/off options. The possible flags codes are: • 1 for Random tones, instead of the C2 sequence. • 2 for Random tone speed, instead of the B1 setting.

		● 4 for Random morse tone, instead of the B3 setting. ● 8 for Auto-Start right after powerup, rather than waiting for a DTMF 1 or 2. ● 16 for Disable LED, to make the transmitter more difficult to visually see. To set more than 1 flag, just add the codes together, for example, to enable random tone speed and auto-start (2+8=10), send B410. The default flags are just auto-start and can be set with B408.
C1 xx xx xx .. #		**Set the morse code message/callsign.** Use the DTMF Morse Codes table below. To keep the transmissions legal, a valid amateur radio callsign should be included in this message. Each character is entered as a 2 digit code and the message is terminated with a #. Maximum message length is 60 characters. For example, to set to N6BG enter C1 14 36 02 07 #.
C2 xx xx xx .. #		**C2 xx xx xx .. # - Set the tone sequence.** This sets tones that are repeated during the tone sequence. Each note is entered as a 2 digit code from the chart below and the sequence is terminated with a #. Maximum tone sequence length is 160 notes. The default tone sequence can be set with C2 01 20 01 20 01 11 11 11 01 20 01 20 01 11 11 11 01 23 01 23 01 16 16 16 01 23 01 23 01 16 16 16 01 26 01 26 01 20 20 20 01 26 01 26 01 20 20 20 01 28 01 28 01 23 23 23 01 28 01 28 01 23 23 23 #.

DTMF Morse Codes

code	char	code	char	code	char	code	char	code	char	code	char	code	char	code	char
00	space	07	G	14	N	21	U	28	.	35	5	42	SK	51	,
01	A	08	H	15	O	22	V	29	/	36	6	43	$		
02	B	09	I	16	P	23	W	30	0	37	7	45	AS		
03	C	10	J	17	Q	24	X	31	1	38	8	46	'		
04	D	11	K	18	R	25	Y	32	2	39	9	47	(		
05	E	12	L	19	S	26	Z	33	3	40	!	48	)		
06	F	13	M	20	T	27	-	34	4	41	"	50	AR		

SK, AS, and AR are procedural signs.

DTMF Tone Codes

code	note	freq	code	note	freq	code	note	freq	code	note	freq	code	note	freq
01	silence		11	$F^{\#}_4$	370	21	E_5	659	31	D_6	1175	41	C_7	2093
02	A_3	220	12	G_4	392	22	F_5	698	32	$D^{\#}_6$	1244	42	$C^{\#}_7$	2218
03	$A^{\#}_3$	233	13	$G^{\#}_4$	415	23	$F^{\#}_5$	740	33	E_6	1318	43	D_7	2350
04	B_3	247	14	A_4	440	24	G^5	784	34	F_6	1397	44	$D^{\#}_7$	2489
05	C_4	262	15	$A^{\#}_4$	466	25	$G^{\#}_5$	831	35	$F^{\#}_6$	1480	45	E_7	2636
06	$C^{\#}_4$	277	16	B_4	494	26	A_5	880	36	G_6	1568	46	F_7	2793
07	D_4	294	17	C_5	523	27	$A^{\#}_5$	932	37	$G^{\#}_6$	1661	47	$F^{\#}_7$	2960
08	$D^{\#}_4$	311	18	$C^{\#}_5$	554	28	B_5	987	38	A_6	1760	48	G_7	3136
09	E_4	330	19	D_5	587	29	C_6	1046	39	$A^{\#}_6$	1864	49	$G^{\#}_7$	3323
10	F_4	349	20	$D^{\#}_5$	622	30	$C^{\#}_6$	1109	40	B_6	1975			

LED

The LED will show the various states of the BFoxCon. It flashes 3 times on powerup. If a TTL serial connection is found, it flashes 3 more times (but only after the first serial data is received). If it is jumpered for a system restore, it will flash 3 more times. The LED can be disabled to make the fox more difficult to find. The list below shows the LED meaning during operation.

- **LED on Solid** - Transmitting
- **LED Fast Flash (20Hz)** - Receiving DTMF
- **LED Medium Flash (5 Hz)** - Receiving configuration tones
- **LED Slow Flash (1 Hz)** - In a transmit sequence but currently off the air.
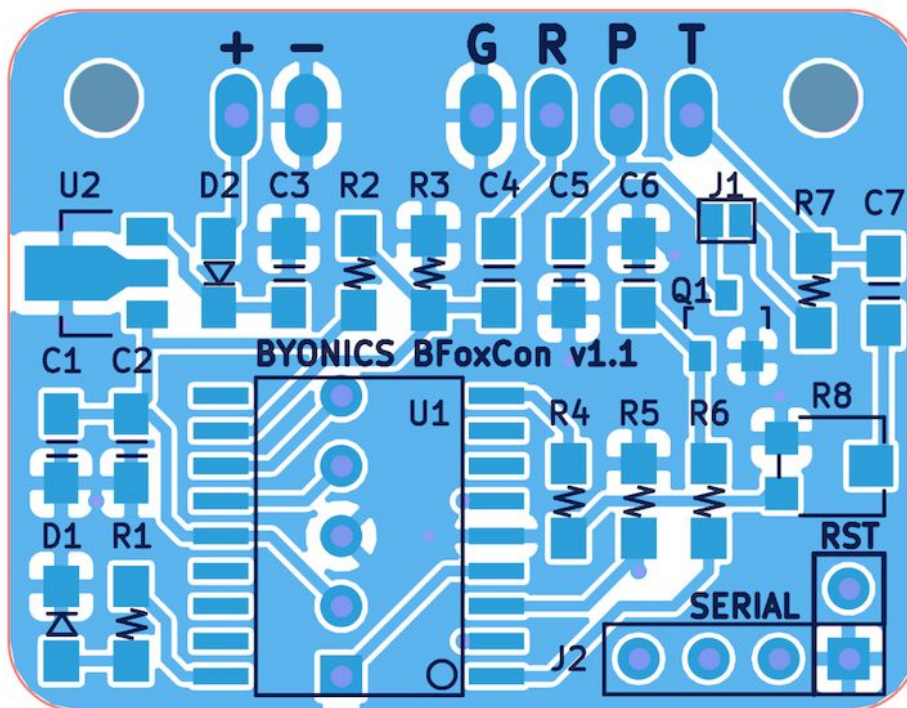- **LED Off** - Not in a sequence

Restore

The BFoxCon can restored to factory settings by temproarily shorting 2 pins marked RST and applying power. There will be 3 extra LED flashes to show the settings have been restored. Starting the config program, and writing all the default values is an additional way to restore settings.

Notes

- If the assigned COM port is not showing in the config software, it can be manually entered, or the COM port can be changed with Windows Device Manager.
- Disabling the FIFO buffer in the Com Port settings may improve serial communication.
- We recommend leaving a note with the transmitter identifying it as an Amateur Radio, and listing a contact telephone number. These days, your transmitter may cause undue alarm if found by a member of the public and outside agencies are contacted.

PCB

Schematic