Calibration of Sandwich VFO

11 April 2017

The current firmware dated February 26, 2017 supports two modes: Normal mode and Calibration mode. At power on, you can easily tell the mode from the color of the LED: red for Normal mode and orange for BFO calibration mode.

In normal mode, pressing the encoder button will toggle between step 1 kHz and 100 Hz, and it is good enough for SSB application. In 1 kHz step mode, LED green means 1, 3, 5, 7, 9 kHz, LED out means 2, 4, 6, 8 kHz, and LED orange means 10, 20, 30, 40, 50, 60, 70, 80, 90 kHz, and LED red means 100 kHz, 200 kHz, and LED red also means out of band. In 100 Hz step mode, every 2, 4, 6, 8 kHz, you can also see green.

See the following table to understand it better.

70 90	70 91	70 92	70 93	70 94	70 95	70 96	70 97	70 98	70 99	71 00	71 01	71 02	71 03	71 04	71 05	71 06	71 07	71 08	71 09	71 10

Calibration

Power should be off initially before going into calibration mode.

Press and hold the button on the rotary encoder, then power on the radio.

You will see that the LED is orange meaning it is in BFO calibration mode. In calibration mode, pressing the encoder button can toggle between BFO calibration and crystal calibration. Pressing the rotary encoder will also memorize the last setting to EEPROM.

In BFO calibration mode the LED is orange unless it is tuned out of range (red), and the step is 100 Hz.

Crystal Calibration

Press button again to enter crystal calibration mode. This mode adjusts the clocks of the Si5351-B to give us the proper frequencies.

In crystal calibration mode, LED is green, and the step is 20 Hz.

Carefully hook a frequency counter to JP8 (right pin). JP8 connects to the SDA pin of the Si5351-B.

Turn the encoder counter-clockwise for about 70 steps and monitor the frequency counter to read as close to 10.000000 MHz as you can get, then press the button to memorize the crystal calibration setting. This will also return to the BFO calibration mode.

Remove power supply from radio.

BFO in Radio Calibration
Setup the radio for BFO calibration by connecting the radio as described.

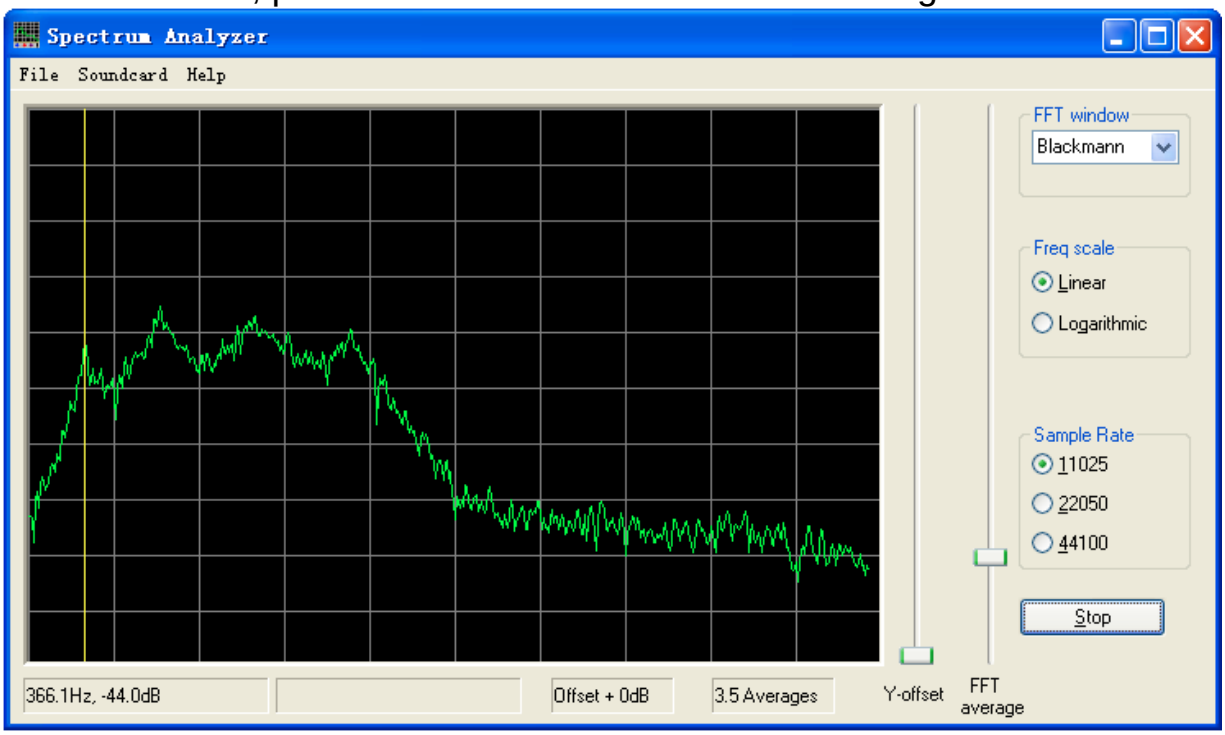
Re-enter BFO calibration mode by pressing and holding the button and power on again. Same as KN-Q7A, you will need to download an audio spectrum analyzer software from:
http://www.qsl.net/zl1an/Software/Spectrum3.zip

Unzip and double click the spectrum2.exe file to run. Connect the speaker out to the microphone input of the sound card on PC. You will also need to connect a noise generator or simply an antenna to the antenna connector, and apply power supply to KN-Q7A radio.

Follow the setup on the screen capture below, and click start, you will see a similar audio spectrum. If not, you may need to turn clockwise or counter clockwise the IF GAIN control. In BFO calibration mode, tune encoder to move the pass-band to the left or to the right. You can use the cursor to read the frequency and level of the signal (on the left bottom corner) to identify the low and high end of the pass-band, so you can get about 350 Hz~2200 Hz range. If you have wider or narrower range, please make sure you still set the lower end of 350 Hz. Please note that, if you are using an antenna to do this, you should tune away from any signal to use the band noise as a random noise source, or the spectrum will jump up and down making the measurement very difficult.

Please also note, both LSB and USB will be possible since the BFO calibration range is wider now.

If you can see correct audio spectrum range, but cannot receive clear voice signal of the intended side band, you might need to tune encoder again to use the correct side band. Normally, the default value should be very close to the intended mode. Just a few steps tuning should be okay.
Once it is done, press the button to memorize the setting to EEPROM.



Modification Possibilities

Sandwich is a small kit providing the basic feature as a digital VFO. If you know Arduino and electronics quite well, you might want to add a few features by yourself.

On the Osc board, you can find a few unused pins of Arduino board, including analog pin A3 and digital pin D6 (PWM output possible). You probably need to detect TX or RX status, so you can show different LED colors, or provide TX/RX offset for CW mode. You probably also need to detect SWR, RF power and other analog parameters. Another great idea might be adding an audio Morse Code reporter of the current frequency instead of counting all the time.

The fun of a kit is not only building but modifying and sharing. Please share your great ideas to the team at:
http://groups.yahoo.com/group/CHINA_QRP/