QRP Guys universal digital VFO

Operating instructions

This universal VFO can be used as the Local Oscillator in either a single conversion or Direct Conversion (DC) receiver with a frequency range of 500 kHz to 55 MHz. It can also generate a transmit signal at the currently displayed frequency. Transmitting is limited to be within the Ham bands. Tuning can be done with either the on-board push switches or with an optional external rotary encoder.

Operation:

- On initial power up, the display will do a segment test by lighting up all segments and decimal points on the display for one second.
- If this is the very first time the VFO is powered up, you must select which band you want as the default power up band.
- Display [bn xx] where xx is the band in meters. (Initially 16 for 160 meters)
- Use the tune up/down switches to advance to the desired default band.
- Click the Function switch to store the band selection and start the VFO.

Tuning S2/S3):

- The tune up (S2) and tune down (S3) switches are used to change the operating frequency at the currently selected tuning rate.
- Holding the tune button down for longer then one second will auto increment/decrement at a rate of 10 a second.
- An optional mechanical rotary encoder can also be used.

The Function switch (S1) menu:

Clicking and holding closed the Function switch (S1) will advance through the menu of functions. Release the switch when the desired function is displayed.

Tuning rate:

- Tap the Function switch to advance the tuning rate. The selected decade with blink off as it is selected.
- The tuning rate which can be selected depends on whether the display is in MHz or kHz display mode.
- In MHz digits displayed mode
  - tuning rates are
  - 100 kHz
  - 10 kHz
  - 5 kHz (double blink)
  - 1 kHz
- In kHz digits displayed mode
  - 10 kHz
  - 1 kHz
  - 100 Hz
  - 10 Hz
- When switching between display modes, the tuning rate will be set to 1kHz.

RIT:

- Hold Function switch closed for 1 second
  - The display with now read [r -0.00]
  - The tuning rate is automatically set to 10 Hz
  - The tuning rate can be changed to 100 Hz or 1 kHz by tapping the function switch.
  - RIT range is +/- 10.0 kHz.
- Hold the function switch closed for one (1) second to exit to original operating frequency and tuning rate.

Display shift:

- Hold Function switch closed for 2 seconds
- Release switch when display shows [dS]
- The frequency readout will now toggle between displaying MSD (xx.xx MHz) and LSD (xxx.x kHz) The decimal point shifts accordingly.

Band select:

The CW QRP calling frequencies are used as the initial starting frequency for each band. When changing bands, the current operating frequency is temporarily stored and then recalled if that band is later re-selected.

- Hold the Function switch closed for 3 seconds.
- Release the switch when display shows [bn]
- When the switch is released the display will now show the currently selected band [bn xx]
- Use either tuning switch to advance to the next band
- Tap Function switch to load selected band

Calibration:

Unless an optional 25 MHz TCXO is used as the PLL reference, the output frequency can be off by a significant amount. Doing a calibration is highly recommended so that the operating frequency matches the display. The simplest way to do this is with a frequency counter. However, as part of a Direct Conversion receiver, you can zero beat a SWBC station or use WWV. A detailed explanation is located at the end of this manual. Calibration is done at the current operating frequency.

- Signal output will be on the C0 output. The signal here is attenuated. Depending on the counter's sensitivity, you may need to use the un-attenuated signal available on the end of R2, towards the side of the board.
- Hold the function switch closed for 10 seconds.
- Release the switch when display shows [CAL]
- The lest least significant frequency digits will be displayed, prefixed by “C” to indicate cal mode.
- Use the tuning switches to adjust the output frequency to match the displayed frequency.
- Tap the Function switch when done to store the calibration data and restart the VFO

Storing an IF frequency:

This function will store the current operating frequency which will be added to the displayed frequency to facilitate a direct reading display for a single conversion receiver. Once this function is selected, the frequency is stored when the switch is released. There isn't a y/n test to confirm or exit the function, so only active this function if you really mean it. It can only be undone by doing a EEPROM erase, which also clears the initial band and calibration data.

- Hold the Function switch closed for 15 seconds.
- Release when the display reads [S-IF]
- When the switch is released, the frequency is stored and VFO restarts with the offset added to the displayed frequency.

EEPROM erase:

- Hold the Function switch closed for 20 seconds.
- Release when the display reads [rESt]
- Release the switch and the EEPROM data is erased and VFO is restarted in the factory default state.

Transmitting:

- Grounding the A3 pin enables transmitting.
- The transmit signal is outputted on the C1 clock output and is a 3.3V square wave at the displayed frequency. The signal simply needs to be amplified by buffers, the first stage ideally being a logic gate.
- A 600 Hz square wave side tone is generated on A2.

Adding a rotary encoder:

- The encoder is wired to the A0, A1 and ground pins. Depending on the type of encoder, the frequency may advance every other “click”.

Calibration using a direct conversion receiver:

If you don't have a frequency counter or a direct conversion receiver, it is worth building a simple receiver to do the calibration. A SA612 mixer, a LM386 audio amp and a few capacitors is all it takes. An inexpensive DC receiver kit which mounts on a tuna tin is available from Rex at QRPme.com

- Tune in a SWBC station, enter calibration mode and then zero beat it. The 5 kHz tuning rate is included to make tuning SWBC stations quicker.
- Zero beat occurs when the audio no longer sounds wobbly.
- Tap the function switch to exit CAL mode.
- You can also use WWV and a waterfall display on a PC.
- Tune to one of the WWV frequencies.
- Enter CAL mode
- Adjust so that the 1 kHz tone lines up with the 1 kHz marker on the waterfall.
- Tap the function switch to exit CAL mode.