CW/SSB Rig Frequency

By G8MNY (Correction Sep 13)

Rigs frequency readouts are not all what they seem. Here is an explanation of why they can be wrong. With the older pre PLL rigs, tiny frequency errors of a few 100Hz was considered irrelevant, but with 10Hz digital readouts it looks so bad. A rig should be warmed up before any re-calibration is done!

MASTER OSCILLATOR
On modern PLL rigs there is an oscillator that is used to lock the VFO to. Changing this will alter all the Tx/Rx frequencies.

INTERPOLATION
This is a pre calibrated offsets of a crystal oscillator (often the master one) Sometimes used for just a 5kHz FM rig shift, but more sophisticated may be up to 256 fine steps.

More typically 100x 10Hz steps to fill in frequency gaps of a 1kHz PLL step oscillator. Correctly set up the result can be perfect, but incorrect it will give uneven jumps for each PLL step.

So the gain of the interpolation offset steps needs to be just right, so that at the PLL step exactly equals the interpolation frequency jump. An error here may CORRUPT the PLL Master Oscillator calibration!

IF OFFSET
For direct conversion rigs the PLL is used directly as the Rx & Tx frequency in SSB, but there is a Rx offset to generate a CW tone on Tx.

For superhets the Rx LO frequency is offset from the Tx frequency by the IF, so the PLL is setup to do that.

In an FM only system, the PLL will be asked to jump to the Tx frequency on Tx.

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(N.B. it must not Tx while jumping frequency!).
In a multimode the Tx signals are made at the IF frequency & may share the IF filter for bandwidth limiting.

AM & FM

With these modes the Tx frequency is the same as the dial. If the rig uses a Tx IF for these, it's frequency will need setting up to generate the dial frequency. If this is not done after the PLL is set up, & the Tx freq used for PLL calibration a frequency scaling error will occur & the PLL will be out at other frequencies!

SSB FREQUENCY

As well as the LO being offset by the IF frequency the modulation & demodulation uses an IF BFO in the product detector/mixer. So there is another frequency to set up. With USB & LSB modes it is placed above or below the IF filter. The PLL system is programed with these mode offsets....

On non PLL rigs the BFO is normally set up to place the IF filter at it's best place for good communications frequencies e.g. 300-2600Hz. But with a PLL design a BFO frequency error will put the dial out!

An exacting way of checking this is to tune into an accurate AM broadcast signal & select AM, USB, & LSB modes, & see if there is any pitch difference, there should be none. (If the rig display is one that jumps in frequency between modes, it will need resetting to the station's frequency when U change mode.)

Use the RIT to eliminate USB/LSB pitch difference. Fixed RIT difference may indicate the PLL is off, a different amount of RIT for USB than LSB indicates the IF BFOs are off.
IF SHIFTS/WIDTHS

Rigs using double conversion & 2 IFs it is possible to overlap filters of different frequencies to change the BFO to IF frequency without an apparent frequency shift or to get variable IF widths.

To do this the BFOs/LO are mixed together so that the overall IF difference is nil.

Different makers use different controls for these functions. Simple ones let you narrow the width by removing top or bottom bandwidth in a single control, more complex ones use 2 controls to give a full combination of the 2 functions.

When set up properly IF shift & bandwidth should not affect calibration, but they will need calibration in them selves, so that the filters do overlap fully for the widest IF, say when the control is in the middle. This may have consequences for the Tx IF/SSB tone.

NOTCH FILTER

This is a crystal that is tunable across the IF to filter out unwanted signals on spot frequencies.

It will not affect frequency calibration, except to itself so the centre of control is centre of IF.

CW MODE

Note this is a split frequency mode! In Rx the offset PLL or IF frequency is set up to produce a CW tone ideally equal to the CW Tx sidetone say 700Hz.

Like the SSB mode to do this the PLL or IF BFOs are shifted between Tx & Rx & the 2 frequencies will need setting up if the rig is being calibrated.
Then tuning in to a CW station at the same pitch has your CW Tx sidetone you will be able to Tx EXACTLY on the same frequency & not a few 100Hz out!

If there is a narrow CW IF filter then the BFO will need to be calibrated for that to do the same.

CONCLUSION
Of course the above is all true for DSP as well, except that all the calibrations are in the software, so if the master PLL is OK all should be OK.

But generally to calibrate a Rig's frequency there are several BFO oscillators to set up. USB, LSB, CW Tx, CW Rx, AM Tx & FM Tx, as well as the PLL master oscillator. VHF/UHF sets may have other up mixer oscillators as well.

See also my TECH buls on "Calibrating Frequency", & "Off air lock ref osc".

Why don't U send an interesting bul?

73 de John GB7CIP