

## Application Note: Calibrating the K2's 4 MHz Master Oscillator

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**Here's a technique that allows C22 (Master Oscillator Calibration Capacitor) on the K2 Control Board to be set to precisely to the correct position, with no guesswork, and no external test equipment.**

This method relies on the following simple observation: If you tune in an on-air signal at a known frequency, the difference between the "measured" VCO and BFO (using CAL FCTR) *must* equal that frequency, or C22 is not set correctly. (Actually, this holds for 160M-17M; but on 15M-10M it's the sum, or VCO + BFO, that must equal the signal's frequency. But it's much easier to do the adjustment of C22 using a frequency between 160M and 17M because you don't have to do any math at all, as will be explained below.)

This procedure requires revision 2.xx firmware, and assumes that you have already completed "Alignment and Test, Part II", from the K2 manual, at some previous point in time.

### **C22 Alignment Procedure**

1. Turn the K2 on and allow it to 'warm up' for at least five minutes, longer if the room temperature is less than about 65° F (18° C).
2. Remove the six (6) screws securing the K2 top cover and remove the top cover.
3. Connect an external antenna to the K2 antenna input jack.
4. Tune in a signal at a known frequency. Select a frequency that's at an \*exact\* kHz boundary, so you can easily see when the VCO and BFO readings match in the following steps. For the rest of this application note, we will refer to this signal as the 'standard carrier' signal.

If possible, use WWV at 10, 15, or 20 MHz. Select the USB or LSB mode rather than CW, so that there will be no CW receive offset. Use a signal which is relatively strong and 'noise quieting' so that you can more easily hear the very low frequency of the beat note.

Example: In the case of the K2 which was used to prove this calibration technique, the VFO read 10000.17 MHz (170 Hz high) when the WWV signal was tuned in perfectly. If it had read 10000.00 MHz, no further improvement would have been possible.

Zero-beat the carrier of the standard carrier signal precisely, or listen to a voice signal and adjust the VFO for the best quality. The more accurately you tune in the signal, the more accurately you'll be able to set C22, below.

When tuning the receiver for a zero-beat of the standard carrier signal, when you get to within about 10Hz-15Hz of actually having the receiver zero beat with the signal you should notice two things:

- 1) you can hear the individual beats of the received carrier in the receiver. They will cause a slight variation in the background noise as they beat against the received signal, and...

- 2) you will see the rightmost lighted LED blink on and off in step with the beat note, which should be 15 Hz or less in frequency. If the received signal is quite strong, the rightmost lighted LED may stay brightly lighted, but with even a small amount of signal fluctuation (QSB), you should see the LED blink in step with the beat.

Tune the receiver to obtain the slowest beat note (or LED flicker rate) you can hear or see. You may have to rock the tuning back and forth +/- 10Hz of the center frequency in order to confirm that you have the signal properly tuned in. Once you have the signal properly zero beat, do not touch the VFO knob again.

5. With the K2 receiving the standard carrier signal, press [MENU] and run CAL FCTR.

Alternately move the K2's internal frequency counter probe between TP1 (VCO) and TP2 (BFO), comparing the kHz and Hz digits of the two frequencies. If the two frequencies do not match, adjust C22 a *small* amount and again compare the two frequencies. Repeat until the kHz and Hz digits at the two test points match as closely as possible. In the test case, the two readings matched at 14913.60 and 4913.60. The difference is exactly 10000.00 - the frequency of the on-air (standard carrier) signal.

**TIP:** When adjusting C22, if the frequency difference between TP1 and TP2 gets larger as you adjust C22, then you are turning C22 in the wrong direction.

6. Connect the K2's frequency counter probe to TP1 (VCO), switch to 40 meters, and run CAL PLL.
7. Connect the frequency probe to TP2 (BFO) and run CAL FIL.

**For each operating mode and filter bandwidth**, vary each filter (or BFO) setting up 1 count, then back down to its original value, then press [XFIL] to force the K2 to take a new BFO measurement for each and store it in EEPROM, and to move to the next filter bandwidth selection.

Once you have completed running CAL FIL for each mode and filter bandwidth (don't forget CW REV), the VFO dial should now be very well calibrated.

8. Return the receiver to the standard carrier frequency to confirm that the signal is now at or very close to being zero beat on the desired frequency.
9. Remove the frequency counter probe from TP2 and store it in a safe place for future reference.
10. Reinstall the top cover of the K2.