ELECRAFT KX3
EXTENDED VFO TEMPERATURE COMPENSATION PROCEDURE

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Introduction

The KX3 standard VFO temperature compensation is entirely adequate for most operating modes. However, narrowband data modes such as JT65 can benefit from the extended temperature compensation procedure described here, especially on the higher bands. The procedure takes about 30 minutes to complete, not counting possible warm-up time for the signal source.

Equipment Required

1. **Stable signal source:** During calibration, an RF carrier at about 50 MHz will be injected into the transceiver's antenna jack. T**he Elecraft XG50 is specifically designed for this purpose.** If another signal source is used it should be as temperature stable as possible. Note that the Elecraft XG3 lacks the necessary stability and is not recommended. A high-quality signal generator with a stabilized oscillator is preferred. Alternatively a ham-band transmitter covering 6 meters can also be used, if it can be operated key-down in CW mode for up to 30 minutes at very low power. Another possibility is to use the 5th harmonic of a 10-MHz lab reference.
2. **Heat gun (or hair dryer):** The KX3 will first be cooled by placing it in a refrigerator, and then warmed up gradually by about 30º C as VFO compensation data is collected. To speed up this process and attain the desired maximum temperature, the transceiver must be heated with the heat gun or hair dryer. A 100W lamp may also be used.

Important Operating Note Regarding JT65 and Similar Modes

The KX3's heat sink can handle maximum transmit power easily when used with modes such as CW and SSB where transmit times are short or PA duty cycles are fairly low. In contrast, JT65 and similar modes have very long transmitting times. If long transmissions are required, the KX3 should be operated at lower power and/or lower supply voltage, especially if the higher bands are to be used. This will greatly extend the time you can transmit before the maximum heat sink temperature is reached. For example, when using JT65 mode on 6 meters, we recommend using 1 to 2 watts and a max supply voltage of 13-14 V, or 3 watts and a supply voltage of 10-11 V. On 20 meters, power efficiency is higher; with a 13-14 V supply, you should be able to use 3 watts or more depending on ambient temperature. Some experimentation may be required.

Temperature Compensation Procedure

Equipment Setup

- **If using the Elecraft XG50 for the first time, an 8 hour power-on aging cycle is recommended but not required.**
- Turn on the signal source (signal generator or ham-band transmitter or transceiver). Allow warm-up as recommended by the manufacturer. Any drift in the signal source will result in less accurate temperature compensation. Ideally, the signal source should not drift more than +/- 2 Hz over 30 minutes once stable.
- Set the signal source to exactly 50.000 MHz (alternatively, any accurately-known frequency in the 49-51 MHz range can be used). Select un-modulated carrier output, at a level of about –80 to –50 dBm (20-700 µV, or S8 to S9+20 dB). If you're using a transmitter or transceiver, turn it on, but do not yet go into transmit mode.
- Turn on the KX3 and select the 6-meter band. Allow it to warm up for at least 10-15 minutes.
- Locate a heat gun or hair dryer. **Do not turn it on at this time**. Position it behind the KX3, with the nozzle aimed at about the middle of the KX3's heat sink. The nozzle should be at least 12 inches away. (If you're using a device with only one heat setting, you may need to position it farther away from the KX3 to avoid heating it too quickly.) The heat gun will be used later, during data collection. Alternatively, a 100W lamp can be used. Position it so that the bulb is approximately 3" (8 cm) from the back of the KX3's heat sink.
- Connect a computer to the KX3 and run *KX3 Utility*. Check your KX3's firmware revision. If you don't have revision 1.18 or later, install it now.
- Click on the **Command Tester** tab in *KX3 Utility*. (During data collection, the KX3 will then send all data to the screen. The data can then be captured for analysis as described later.)

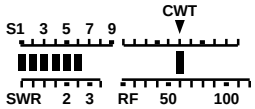
Initial Reference Calibration

In this procedure, the KX3's synthesizer will be calibrated to the known frequency of the signal source, ***at room temperature***. This provides a starting point for the extended temperature compensation steps.

NOTE: This procedure must be performed even if REF CAL calibration has been done previously (whether kit or factory assembled).

- Select CW mode by tapping MODE.
- Disable PRE amp.
- Set the side tone pitch to 550 Hz using PITCH and the knob directly above it.
- Hold MENU. Rotate ⏲ OFS / VFOB to find the *DUAL RX* menu entry. Set it to **OFF**.
- Locate the *AUTO OFF* menu entry and set it to **INF** (infinite; fully clockwise).
- Locate the *RX SHFT* menu entry. Set it to **NOR**. Exit the menu.
- Set ⏲ PWR to 0.0 watts to avoid accidental damage to the generator.
- Connect the signal source to the KX3's antenna jack. If you're using a ham-band transmitter or transceiver instead of a signal generator, put it into key-down mode now, transmitting into a dummy load. To get some signal into the KX3, connect a wire to the KX3's antenna jack and drape it near the dummy load. You may need to adjust the length or position of this wire later. **If the Elecraft XG50 is being used, ensure that it is located at least 3' (1 M) away from the KX3, away from any heat source. This will help minimize any temperature changes to the XG50 during the compensation process.**
- Set VFO A to the ***exact* frequency of the signal source** (50.000 MHz or other accurately known frequency). **If using the Elecraft XG50, set the VFO A to 49.380 MHz.** You may not yet be able to hear the signal since the *REF CAL* menu entry still needs to be adjusted.
- Lock VFO A by holding KHZ for about 3 seconds. The lock symbol will turn on.
- Set AF gain so you can hear some background noise. Headphones are recommended.
- Hold CWT. The upper half of the S-meter becomes a tuning aid, with the **CWT** icon turned on. This enables the *auto-spot* function to be used below.
- Use the ⏲ PBT I/II control, function **I**, to set the WIDTH to 1.20 kHz (**BW 1.20**). The filter graphic should be centered. If not, tap the control to switch to function **II**, SHIFT, and center it.
- Locate the *REF CAL* menu entry. A frequency in the 114-MHz range will be shown on VFO A.
- Hold KHZ for about 3 seconds to unlock the parameter. **Note:** This unlocks only the *REF CAL* frequency parameter, not the regular VFO A frequency.
- If you see only 7 digits, tap RATE to see the 8th digit.
- Tap CMP to switch temperature compensation from **STANDRD** to **CUSTOM**. When **CUSTOM** is selected, the menu entry name will change to **REF?CAL**. If it changes to **REF*CAL** (with an asterisk): hold PITCH to temporarily switch to the temperature compensation display (e.g. **t30 F550**), then tap PRE. **DISABLE** will be flashed, and the menu entry name should now be **REF?CAL**.
- Hold CLR (hold function of the OFS/B knob) to load the default value of *REF CAL* for your KX3's synthesizer. **RESET** will be flashed.
- Enable RF output from the signal source on, if it was disabled. If using a transmitter or transceiver, put it into key-down mode now.

- If you can't hear the signal, adjust the *REF CAL* frequency up and down using VFO A until you locate it. The signal should be quite strong (between S8 and S9+20). If not, adjust the level of the signal source (if using a transmitter or transceiver, adjust the antenna wire connected to the KX3.) Make sure you find the strongest signal—not the opposite sideband signal, which should be much weaker.
- Tap **SPOT** to *auto-spot* the signal. The *REF CAL* parameter value should automatically move up or down a small amount. When it finishes moving, the bar directly beneath the **CWT** icon should be turned on as shown below. The reference will then be closely calibrated.



- Hold **PITCH** to switch to the **temperature compensation display**. VFO A should now show temperature in º C on the left and audio signal pitch in Hz on the right (example: **t30 F550**).
- If the pitch shown is not in the range of 530-570 Hz, hold **PITCH** again to return to the REF CAL **frequency display**. Do AUTO-SPOT again, as explained above (or turn off CWT and spot the signal manually). Then hold **PITCH** to switch back to the temperature compensation display.
- Hold **CLR** for about 2 seconds and release. **CLEAR** will be briefly displayed on VFO B once this is complete. (This erases all temperature compensation data in preparation for data gathering.)
- Exit the menu.
- Turn off the KX3.
- **DO NOT TURN OFF POWER** to the signal source. It must be powered to ensure it is stable when data collection begins (next page). However, if you're using a transmitter or transceiver, un-key it at this time.

Temperature Compensation Data Collection

The KX3 will now be cooled down, then gradually heated up while VFO offset data is collected. At approximately every 0.1º C, the KX3 will measure the audio frequency of the reference signal to the nearest Hz and save it in a table of compensation values. Once oscillator temperature has reached about 52-54º C, data collection can be terminated, and the new data enabled for use. If the KX3 is connected to a PC running KX3 Utility, data will be sent to the Command Tester screen.

- Turn off the KX3. Disconnect all cables from it.
- Place the KX3 in a refrigerator (**NOT** a freezer) for about 30 minutes.

The following five steps should be completely quickly to ensure that data gathering begins while the KX3's oscillator stage is still at a low temperature.

- After cooling is complete, return the KX3 to the original operating position and quickly reconnect all cables.
- Enable the reference signal source. (If you're using a transmitter or transceiver, key it now.)
- Turn on the KX3. Immediately go into the *REF CAL* menu entry and unlock it (by holding KHZ for about 3 seconds).
- Hold PITCH to switch to the temperature compensation display (e.g. **t20 F750**). You should see a temperature below 20º C, and a pitch well above 550 Hz. (Values of 1,000 Hz and above are possible, but the '1' will not be displayed.) Both values may be changing slowly.
- Tap APF until you see **SAVING** appear on VFO B (you may need to tap it twice). This begins data collection. As data is collected, you should see an asterisk (*) flash briefly on VFO B. The temperature and tone pitch will continue to change as the KX3 warms up.

In the following steps, the KX3 will be allowed to gradually heat up as data collection continues. The oscillator temperature will climb to about 30-35º C due to self-warming. Supplemental heating is needed to reach the desired maximum of 52º C.

- Turn on the heating device. Adjust the distance between the heating device and the KX3 until you just reach the point where the temperature is too hot to hold your hand near the KX3's heat sink.
- Observe the temperature display. It should rise at a rate of about 1º C every one or two minutes. If it is rising too quickly, or if you see a **HI TEMP** warning flashed on VFO B, move the heating device farther away. (Data collection will be accurate no matter how long it takes for the KX3 to heat up.)
- Turn off the heating device when the indicated temperature reaches **52º C** or higher.
- Tap APF to terminate data collection (you may need to do this twice). **STOP** will be flashed. The **SAVING** message will turn off.
- Tap PRE (preamp) to enable use of the custom temperature compensation data. **ENABLE** will be flashed, and the menu entry name will change from *REF?CAL* to *REF*CAL*. If the KX3 is still hot, you'll hear the pitch shift back up to something close to 550 Hz, since compensation is now applied.
- **Optional:** Hold CMP to return to the temperature compensation display to verify that as the KX3 cools down, the pitch remains fairly constant. This indicates that the new compensation algorithm is functioning correctly. Typically the pitch will not vary by more than a few Hz over the range of 25-50ºC
- Exit the menu. Disable (or un-key) the signal source.
- **Be sure to perform the REFCAL calibration at room temperature, as described in your KX3 manual.**