Elecraft® KX3

KXFL3 Roofing Dual-Bandwidth Filter
Installation and Calibration Instructions

Revision A2, June 14, 2012

Introduction

The KXFL3 is a high-performance, narrow-band analog filter module that helps reject strong signals that could cause receiver blocking (desense) or intermodulation distortion. It adds two additional bandwidths to the KX3 that are automatically selected as the receive bandwidth is adjusted.

Installation involves installing the KXFL3 plug-in module in your KX3 and then calibrating the filter for proper operation. No test equipment is required to calibrate the filter although a signal generator may be used, if available.

⚠ *CAUTION*

The KXFL3 module and many components inside your KX3 may be damaged by Electrostatic Discharge (ESD) simply by touching them or a circuit board containing them unless you take specific steps to prevent such damage. See *Preventing Electrostatic Discharge Damage* on page 2 before opening the package containing the KXFL3 module or working inside your KX3.

Specifications

Filter type: Two filters, each having dual balanced Butterworth sections

Gain/phase match: Typ. 0.1%. Additional matching accuracy provided by DSP techniques.

FL2: 1500 or 3000 Hz low-pass, depending on demodulation method in use.*

FL1: 500 or 1000 Hz low-pass, depending on demodulation method in use.*

* The narrower bandwidths apply in all modes except when Weaver-mode SSB demodulation is being used. Filters switch in at predetermined points in each mode, varying with passband center pitch, width, and shift amount.

Setup and Operation

If you haven't already done so:

- Follow the instructions below to install your KXFL3 module.

- Turn to page 4 to calibrate the KXFL3.

With the KXFL3 installed and enabled, the KX3 will automatically use its narrow filters, FL2 and FL3, whenever possible. Some receive settings require the roofing filters to be bypassed, which automatically selects FL1. These include: AM and FM modes, dual watch (DUAL RX menu entry), RX I.F. shift (RX SHFT menu entry), and some noise blanker settings. Refer to the KX3 owner's manual for details.

Installing the KXFL3 Module

Preparing for Installation

Preventing Electrostatic Discharge Damage

ESD damage may occur with static discharges far too little for you to notice. A damaged component may not fail completely at first. Instead, the damage may result in below-normal performance for an extended period of time before you experience a total failure.

We strongly recommend you take the following anti-static precautions (listed in order of importance) to ensure there is no voltage difference between the components and any object that touches them:

- Leave the KXFL3 module in its anti-static packaging until you install it.

- Wear a conductive wrist strap with a series 1-megohm resistor that will constantly drain off any static charge that accumulates on your body. If you do not have a wrist strap, touch a ground briefly before touching any sensitive parts to discharge your body. Do this frequently while you are working. You can collect a destructive static charge on your body just sitting at the work bench.

⚠ WARNING

DO NOT attach a ground directly to yourself without a current-limiting resistor as this poses a serious shock hazard. A wrist strap must include a 1-megohm resistor to limit the current flow. If you choose to touch an unpainted, metal ground to discharge yourself, do it only when you are not touching live circuits with any part of your body.

- Use a grounded anti-static mat on your work bench (see below).

- If you pick up a pc board that was not placed on an anti-static mat or in an anti-static package, touch first a ground plane connection on the board such as a connector shell or mounting point.

- If you use a soldering iron to work on a circuit board, be sure your iron has an ESD-safe grounded tip tied to the same common ground used by your mat and wrist strap.

Choosing an Anti-Static Mat

An anti-static mat must bleed off any charge that comes in contact with it at a rate slow enough to avoid a shock or short circuit hazard but fast enough to ensure dangerous charges cannot accumulate. Typically, a mat will have a resistance of up to 1 Gigaohm (10^9 ohms). Testing a mat requires specialized equipment, so we recommend that you choose an anti-static mat that comes with published resistance specifications and clean it as recommended by the manufacturer. Testing has shown that many inexpensive mats that do not specify their

resistance have resistance values much too high to provide adequate protection, even after they were cleaned and treated with special anti-static mat solutions.

Suitable anti-static table mats are available from many sources including:
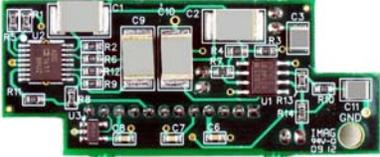
- U-line (Model 12743 specified at 10^7 ohms)

- Desco (Model 66164, specified at 10^6 to 10^8 ohms)

- 3M™ Portable Service Kit (Model 8505 or 8507, specified at 10^6 to 10^9 ohms)

Tools Required

1. ESD Protection (see *Preventing Electrostatic Discharge Damage*, pg 2).

2. #1 size Phillips screwdrivers. To avoid damaging screws and nuts, a power screwdriver is *not* recommended.

3. Soft cloth or clean, soft static dissipating pad to lay cabinet panels on to avoid scratching.

Parts Supplied

Be sure you have the following components in your kit. If anything is missing, contact Elecraft customer support (pg 12).

ILLUSTRATION	DESCRIPTION	QTY.	ELECRAFT PART NO.
	KXFL3 Module ⚠ **ESD SENSITIVE!**	1	E850492
	Test Antenna	1	E850543
	Screw, 1/2" (13mm), Flat Head, Black	1	E700178

Installation Procedure

☐ Disconnect all cables attached to the KX3 and remove the KXPD3 paddles if installed.

☐ Open the KX3 just as you would to install or remove batteries (see *Internal Batteries* in your Owner's Manual for details about how to do this).

☐ Remove the internal batteries (if present).

☐ Taking ESD precautions, remove the KXFL3 and plug it into J3 on the KX3 RF board as shown in Figure 1. The screw is there only to ensure the KXFL3 module cannot be knocked out of its socket by rough handling of the KX3. It does not provide a ground return or other function.
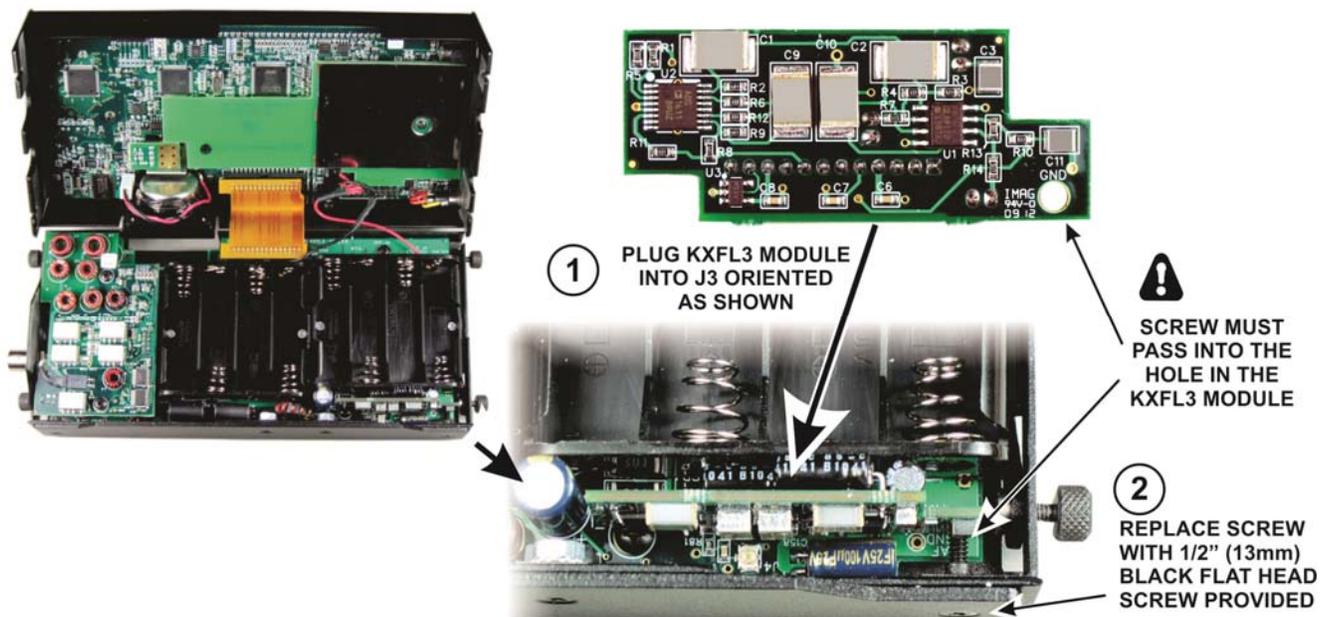

Figure 1. Installing the KXFL3 Module.

☐ You must run the calibration procedure below for proper filter operation. You can use an external signal generator to pick up a calibration signal internally. If you do not have an external signal generator, leave your KX3 open until you have installed the test antenna.

Calibration

Calibration adjusts the gain and phase of each filter to provide optimum rejection of the opposite-sideband image.

The procedure requires a signal source in the 14-MHz range that can provide a signal level of between approximately -73 and -33 dBm. This can be provided by an external signal generator such as an Elecraft XG1, XG2 or XG3. If you do not have a signal generator you can use an internal signal picked up by the antenna assembly provided with your KXFL3 that will "sniff" adequate signal from a 16 MHz oscillator inside the KX3.

Installing the Antenna to Pick Up the Internal 16 MHz Oscillator

If you have an external signal generator you wish to use, skip this section and turn to *Setup for Calibration* on page 6.

☐ Disconnect all cables attached to the KX3 and remove the KXPD3 paddles if installed.

☐ Open the KX3 just as you would to install or remove batteries (see *Internal Batteries* in your Owner's Manual for details about how to do this). If any batteries are installed, remove them.

☐ Position the antenna wire loop around the 16 MHz oscillator crystal as shown in Figure 2 and route the wire behind the battery retainer and out next to the VFO encoder as shown. Loosen the screw shown as necessary to give you room to fit the cable, but do not remove the screw entirely to avoid accidentally damaging the battery retainer. The retainer will hold the loop in place as you close the KX3 later.

Figure 2. Positioning the Test Antenna at the 16 MHz Oscillator.

☐ Connect the loose end of the test antenna to the KX3 antenna input as shown in Figure 3 if no KXAT3 is installed or as shown in Figure 4 if a KXAT3 is installed.
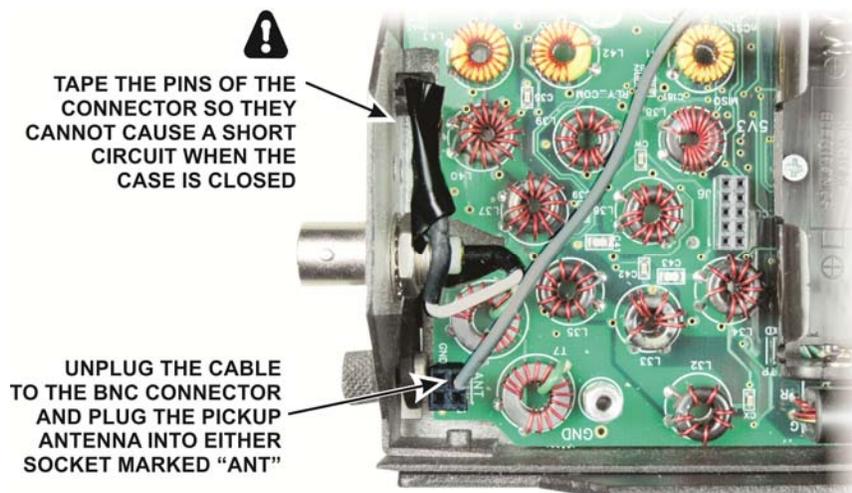

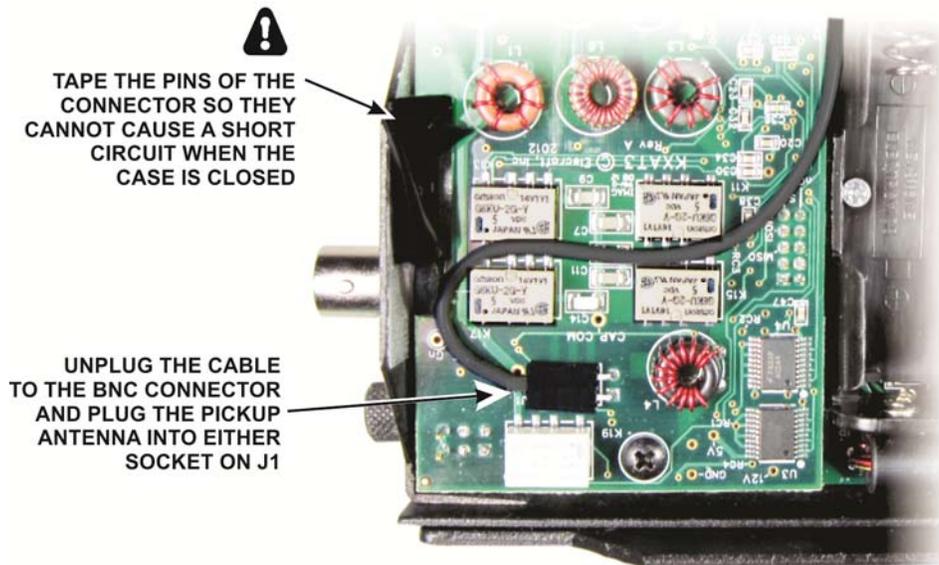Figure 3. Connecting the Test Antenna to the KX3 Input - No KXAT3.

TAPE THE PINS OF THE
CONNECTOR SO THEY
CANNOT CAUSE A SHORT
CIRCUIT WHEN THE
CASE IS CLOSED

UNPLUG THE CABLE
TO THE BNC CONNECTOR
AND PLUG THE PICKUP
ANTENNA INTO EITHER
SOCKET ON J1

Figure 4. Connecting the Test Antenna to the KX3 Input – With KXAT3.

☐ Close the KX3 case again, taking care to ensure that the loop remains in place around the crystal and the end of the wire remains plugged into the connector.

Setup for Calibration

This procedure is written for someone using a KX3 for the first time, but it is not a comprehensive tutorial. Complete operating instructions are in the KX3 Owner's Manual.

The following symbols are used throughout the procedure to indicate KX3 front panel operations:

LSB	Display icon or text
⏎	*Enter* keypad function
🔒	Lock indicator (applies to VFO or menu parameter)
XMIT	*Tap* switch function (labeled *on* a switch)
TUNE	*Hold* switch function (labeled *below* a switch; hold for about 1/2 second)
○ **MIC**	Function of a rotary control (knob)
○ **OFS / B**	*Tap* switch function of a rotary control (labeled *above* a knob)
○ **CLR**	*Hold* switch function of rotary control (labeled *below* a knob; hold for 1/2 second)
BKLIGHT	Menu entry

☐ Disconnect anything connected to the KX3 antenna BNC connector.

☐ Connect power and tap the **BAND-** and **ATU TUNE** switches simultaneously to turn the KX3 on. Allow the KX3 to warm up about 15 minutes before beginning to make the nulling adjustments on page 9.You can continue with the setup procedure below while the KX3 is warming up.

☐ Hold ○ **PWR** and set the output power to **0.0W** on the display. Tap ○ **PWR** again to exit.

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☐ Switch the KX3 to the 20 meter band using direct frequency entry as follows:

- Tap `FREQ ENT` . The display will show six dashes**: - - - - - -**

- Using the switches along the bottom of the front panel, enter 14.000.

- Tap `↵` . The frequency will appear on the LCD.

☐ Hold `MENU` to access the menu. *BKLIGHT* will appear on the display if the menu hasn't been accessed since power was turned on. Rotate the ○ `OFS / B` knob (above the `MENU` switch) to set the following menu parameters. Change each parameter as needed by rotating the large VFO knob (note that the menu entries are in alphabetical order):

- Set *AGC MD* to **ON**.

- If the KXAT3 is installed, set *ATU MD* to **BYP.**

- Set *DUAL RX* to **OFF.**

- Set *RX SHFT* to **NOR.** If you need to change the parameter, you must first unlock it by holding the `KHZ` switch for at least 3 seconds (the lock symbol will disappear and *UNLOCK* will appear briefly on the LCD). Note that this is a per-band setting as indicated by the **14.0** on the display. You only need to set it for the 14 MHz band.

- Set *RX XFIL* to **NOR.**

- Set *SMTR MD* to **NOR.**

- Tap the `DISP` switch to exit the menu.

- Tap the `BAND-` and `ATU TUNE` switches simultaneously to turn the KX3 off for 3 seconds, minimum, then tap them again to turn the KX3 on. This causes certain parameters that you many have changed in the menu to take effect. Doing this will not affect your warm-up period.

☐ Tap the `MODE` switch to select CW as shown on the LCD.

☐ If **REV** appears below **CW** on the LCD, hold the `MODE` switch until it disappears.

☐ If **ATT** appears on the LCD (directly above **XFIL** near the center of the display), tap `ATTN` to turn the attenuator off.

☐ Tap the ○ `AF/RF-SQL` knob and rotate it so that **RF - - 0** is displayed (this is the setting for maximum RF gain).

☐ Tap the ○ `AF/RF-SQL` knob and rotate it so that **AF 15** is displayed. This is a moderate audio frequency gain setting. You can adjust it as desired throughout this procedure.

☐ Hold `PITCH` and then rotate the ○ `KEYER/MIC` knob until the LCD displays a pitch of **530 HZ.** Tap the ○ `KEYER/MIC` knob to exit.

☐ Locate the passband graphic display in the lower left corner of the LCD. To the right of it will be either a **I** or **II**. If **II** is displayed, tap the ○ `PBT I/II` knob to display **I**.

☐ Rotate the ○ `PBT I/II` knob to display **BW 0.30** on the LCD. That sets the receive bandwidth to 0.3 KHz.

☐ Tap the ○ `PBT I/II` knob to display **II** on the LCD.

☐ Rotate the ↻ **PBT I/II** knob to display **FC ✳0.53.** The ✳ indicates that the passband is centered on the 530 Hz pitch frequency you entered earlier. While adjusting the control you may notice that the bandwidth graphic on the LCD moves between the two passband limits as well.

Signal Generator Input

Do this <u>only</u> if you are using an external signal generator and have not installed the internal test antenna as described on page 5. Otherwise skip directly to *Internal 16 MHz Signal Input* below.

☐ Connect the signal generator to the KX3's BNC antenna input.

☐ Set the signal generator to any convenient frequency in the 14 MHz range.

☐ Use direct frequency entry to tune the KX3 to the signal generator's frequency. Note that the numbers 7, 8 and 9 are entered by tapping the three encoders directly above the numbered switches.

☐ Turn off any modulation of the signal generator, if applicable.

☐ Set the signal generator output as follows:

- If the output can be set to -33 dBm (e.g. XG3), do so. On the KX3, tap **PRE** to turn the KX3 preamp off (**PRE** will appear on the LCD when the preamp is on and disappear when the preamp is off).

- If the output can be only set to -73 dBm (e.g. XG1, XG2), do so. On the K3tap **PRE** to turn the KX3 preamp on.

16 MHz Signal Input

Perform the following if you have installed the test antenna as described on page 5.

☐ Use direct frequency entry to tune the KX3 to 16.000 MHz.

☐ On the KX3, tap **PRE** to so that **PRE** appears on the LCD, meaning that the preamp is on.

Tuning in the Test Signal

☐ Using the large tuning knob, tune in the test signal so that you can hear it and see it indicating on the S-meter display in the upper left corner of the LCD. You may find another signal just over 1 kHz below the main signal. That will be the opposite sideband response that will be suppressed by this calibration procedure. Tune in the higher-frequency signal and for the strongest indication on the S-meter.

☐ Note the signal level on the S-meter. It should be between S9+10 and S9+30. When using an external signal generator, adjust its output level as needed. If using the internal test antenna or your external signal source cannot be adjusted, you can increase the preamp gain if needed as follows:

- Hold **MENU** to access the menu and rotate the ↻ **OFS / B** knob to display *PREAMP* **o**n the LCD.

- The display will indicate **14.0** (the band selected) followed by **10 db** or **20 db** indicating the amount of preamp gain on this band. Rotate the VFO knob to increase the gain by 10 dB. You can set it as low as 10 dB or as high as 30 dB.

- Tap **DISP** to exit the menu.

☐ Tap `RATE` if needed to display three digits to the right of the second decimal point.

☐ Hold `CWT` to enable CW auto-spot. Note that the S-meter display above S-9 changes to a line with **CWT** above an arrow at the center.

☐ Tap `SPOT`. AUTO will appear briefly on the LCD and the KX3 will automatically tune to center the signal in the passband, indicated by the vertical bar on the **CWT** display lining up directly under the **CWT** arrow.

☐ Tap `RIT` to enable receive incremental tuning. The **OFS** LED will light and `RIT` will appear below the main frequency on the LCD.

☐ Turn the knob below the **OFS** LED until the LCD indicates exactly **- - 1.06**. This is the frequency of the opposite sideband. You may hear the signal as you tune it in if the opposite sideband suppression is poor enough. If heard, do not try to peak the signal. Set the RIT to exactly **- - 1.06.**

☐ Hold `RATE` until the lock symbol appears in the upper right corner of the LCD (approximately 3 seconds). This will ensure that you do not accidentally change the tuning of the main VFO or the RIT while performing the rest of the calibration. If you are using an external signal generator, be sure you do not change its frequency.

Nulling the Opposite Sideband Signal

☐ Hold `MENU` to access the menu and rotate the ↻ `OFS / B` knob to display *RXSBNUL* on the display.

☐ Hold `KHZ` until the lock icon in the upper right corner of the LCD disappears to unlock the *RXSBNUL* parameter adjustment.

☐ Without leaving the menu, tap `ATTN`. The LCD will display **PHASE** followed by a number.

☐ Adjust the VFO to find the phase number at which the signal is weakest. It is often easiest to find the weakest setting by listening to the signal rather than watching the S-meter indication.

> ⚠ If the strength of the signal does not change as you adjust the VFO knob, check to be sure RIT is still on (the `RIT` symbol should be displayed on the LCD, as before). If not, tap `RIT` to turn it on. If RIT is on, double-check the tuning you did in the first two steps to be sure the RIT offset is exactly **- - 1.06.**

☐ Tap `PRE`. The LCD will display **GAIN** followed by a number.

☐ Adjust the VFO to find the gain number at which the signal is weakest.

☐ Continue to tap `ATTN` and `PRE` to alternately switch between **PHASE** and **GAIN,** while adjusting the VFO for the weakest signal, until no further improvement is obtained.

☐ Record the phase and gain values below. Having these values will allow you to reset them in the event they are ever changed accidentally without re-running the whole calibration procedure:

FL3: Gain: _____ Phase:_____

☐ Check the passband tuning indicator just to the left of graphic bandwidth display in the lower left corner of the LCD. It should display **I**. If **II** is shown, tap the ↻ `PBT I/II` knob to display **I**.

☐ Rotate the ⟳ `PBT I/II` knob to display **BW 0.60** (0.6 KHz). Note that the **XFIL** display changes from **FL3** to **FL2**.

☐ Tap `ATTN` and `PRE` to switch between **PHASE** and **GAIN** and set the VFO to enter the values you recorded for FL3 above as a starting point.

☐ Continue to tap `ATTN` and `PRE` to alternately switch between **PHASE** and **GAIN,** while adjusting the VFO for the weakest signal, until no further improvement is obtained.

☐ Record the phase and gain values below:

<div align="center">FL2: Gain: _____ Phase:_____</div>

☐ Rotate the ⟳ `PBT I/II` knob to display **BW 2.20** (2.2 KHz). Note that the **XFIL** display changes from **FL2** to **FL1**.

☐ Tap `ATTN` and `PRE` to switch between **PHASE** and **GAIN** and set the VFO to enter the values you recorded for FL2 above as a starting point.

☐ Continue to tap `ATTN` and `PRE` to alternately switch between **PHASE** and **GAIN,** while adjusting the VFO for the weakest signal, until no further improvement is obtained. **Note that the final values for FL1 may be significantly different from those established for FL2 or FL3.**

☐ Record the phase and gain values below:

<div align="center">FL1: Gain: _____ Phase:_____</div>

Final Steps

☐ If you changed the preamp gain setting to get a higher S-meter reading, turn the ⟳ `OFS / B` knob to display *PREAMP* **o**n the LCD and then turn the VFO knob to display **14.0 20 db** to return the gain to its default setting.

☐ If you have the KXAT3 installed, turn the ⟳ `OFS / B` knob to select *ATU MD* on the menu and then turn the VFO knob to *AUTO.*

☐ Tap `DISP` to exit the menu.

☐ Tap `RATE` to unlock the VFO. The lock symbol in the upper right corner of the LCD will disappear.

☐ Tap `RIT` to turn receive incremental tuning off. The RIT on the LCD will disappear.

☐ Tap the `BAND-` and `ATU TUNE` switches simultaneously to turn the KX3 off and disconnect external power from the KX3. **Note: Always turn the KX3 off using these switches before removing external power (when no batteries are installed) to ensure an orderly shutdown of the KX3. Disconnecting power without turning the KX3 off can result in some settings being lost or other unexpected changes.**

☐ If you installed the internal test antenna to use the internal 16MHz signal for calibrating, open the KX3 and carefully remove it.

- Be sure to tighten the screw on the battery retainer (see Figure 2, page 5).

- Remove the protective tape from the plug to the BNC connector and replace it in the RF board connector (see Figure 5) or, if installed, the KXAT3 connector (see Figure 6).

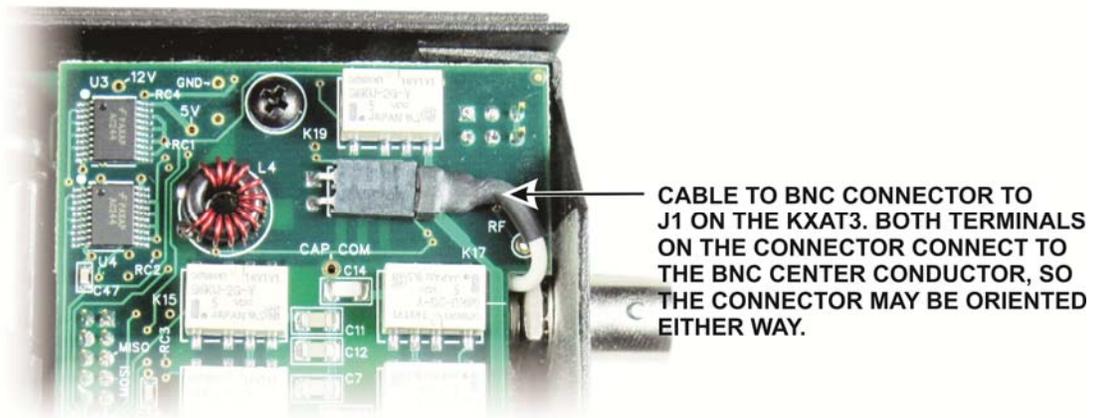Figure 5. Connecting the Antenna Plug to the RF Board - No KXAT3 Installed.

CABLE TO BNC CONNECTOR TO J1 ON THE KXAT3. BOTH TERMINALS ON THE CONNECTOR CONNECT TO THE BNC CENTER CONDUCTOR, SO THE CONNECTOR MAY BE ORIENTED EITHER WAY.

Figure 6. Connecting Antenna Plug to KXAT3 Board.

☐ Replace the batteries (if desired), close the case and tighten all four thumb screws.

☐ Replace the KXPD3 paddles (if desired). **Take care not to bend the connector pins in the KX3**.

That completes the Calibration Procedure.

Customer Service and Support

Technical Assistance

You can send e-mail to **k3support@elecraft.com** and we will respond quickly – typically the same day Monday through Friday. If you need replacement parts, send an e-mail to **parts@elecraft.com**. Telephone assistance is available from 9 A.M. to 5 P.M. Pacific time (weekdays only) at 831-763-4211. Please use e-mail rather than calling when possible since this gives us a written record of the details of your problem and allows us to handle a larger number of requests each day.

Repair / Alignment Service

If necessary, you may return your Elecraft product to us for repair or alignment. (Note: We offer unlimited email and phone support, so please try that route first as we can usually help you find the problem quickly.)

IMPORTANT: You must contact Elecraft before mailing your product to obtain authorization for the return, what address to ship it to and current information on repair fees and turnaround times. (Frequently we can determine the cause of your problem and save you the trouble of shipping it back to us.) Our repair location is different from our factory location in Aptos. We will give you the address to ship your kit to at the time of repair authorization. *Packages shipped to Aptos without authorization will incur an additional shipping charge for reshipment from Aptos to our repair depot.*

Elecraft 1-Year Limited Warranty

This warranty is effective as of the date of first consumer purchase (or if shipped from the factory, the date the product is shipped to the customer). It covers both our kits and fully assembled products. For kits, before requesting warranty service, you should fully complete the assembly, carefully following all instructions in the manual.

Who is covered: This warranty covers the original owner of the Elecraft product as disclosed to Elecraft at the time of order. Elecraft products transferred by the purchaser to a third party, either by sale, gift, or other method, who is not disclosed to Elecraft at the time of original order, are not covered by this warranty. If the Elecraft product is being bought indirectly for a third party, the third party's name and address must be provided at time of order to ensure warranty coverage.

What is covered: During the first year after date of purchase, Elecraft will replace defective or missing parts free of charge (post-paid). We will also correct any malfunction to kits or assembled units caused by defective parts and materials. Purchaser pays inbound shipping to us for warranty repair; we pay shipping to return the repaired equipment to you by UPS ground service or equivalent to the continental USA and Canada. For Alaska, Hawaii, and other destinations outside the U.S. and Canada, actual return shipping cost is paid by the owner.

What is not covered: This warranty does not cover correction of kit assembly errors. It also does not cover misalignment; repair of damage caused by misuse, negligence, battery leakage or corrosion, or builder modifications; or any performance malfunctions involving non-Elecraft accessory equipment. The use of acid-core solder, water-soluble flux solder, or any corrosive or conductive flux or solvent will void this warranty in its entirety. Also not covered is reimbursement for loss of use, inconvenience, customer assembly or alignment time, or cost of unauthorized service.

Limitation of incidental or consequential damages: This warranty does not extend to non-Elecraft equipment or components used in conjunction with our products. Any such repair or replacement is the responsibility of the customer. Elecraft will not be liable for any special, indirect, incidental or consequential damages, including but not limited to any loss of business or profits.