
# ELECRAFT® KX3

## ULTRA-PORTABLE
## 160-6 METER, ALL-MODE TRANSCEIVER

### OWNER'S MANUAL
### [PRELIMINARY]

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# Introduction

On behalf of our entire design team, we'd like to thank you for choosing the Elecraft KX3.

The KX3 is a compact, 160-6 meter, all-mode transceiver that's ideal for both new and experienced operators. Its unique features meet the requirements for home station use, portable, mobile, and even hand-held operation.

Since the KX3 is a software-defined-radio (SDR), you'll be able to extend its capabilities using computer applications, and add new features via free firmware upgrades. But the KX3 is also the only small transceiver that combines the flexibility of an SDR with a full-size front panel and display, allowing operation with or without a computer.

Despite its small size, the KX3 can be configured as a fully self-contained amateur station, with an internal antenna tuner, battery charger, 2-meter module, and attached CW keyer paddle. These options can be added at any time. Current drain is also very low for a full-featured transceiver, reflecting our commitment to no-compromises field operation. For higher-power mobile and home-station use, you can boost the KX3's output to 100 watts with the optional KXPA100 amplifier.

When it's time to take on the challenge and adventure of amateur radio, your KX3 will be ready.

73,

Wayne, N6KR
Eric, WA6HHQ

## Key to Symbols and Text Styles

| | |
|---|---|
| ⚠ | **Important – read carefully** |
| ℹ | Operating tip |
| **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** | Rotary control function |
| ⏲ [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 |

# Installation

## ⚠ CAUTION

- Avoid operating in wet conditions (rain, snow, ocean spray, etc.). The KX3 is not waterproof.
- Avoid operating in very high temperatures. If case temperature is too high, the KX3 may reduce output power or turn itself off.
- **The KX3 can be damaged by electrostatic discharge (ESD). Prior to opening the case, touch a grounded, unpainted metal surface.**

## Operating Position

All controls are located on the top of the KX3's enclosure. This provides ample space for controls and display, despite the transceiver's small size.

Tilt legs are provided in the back to position the controls and display for ease of use, as shown below. Be sure to tighten the two rear thumb screws to lock the tilt legs in place. When all four thumb screws are loosened (not removed), the top and bottom halves of the cabinet can be separated.

⚠ **DO NOT unplug the cable joining the two large printed circuit boards except as instructed during kit assembly or option installation. The cabinet can be opened up and laid flat for battery change, leaving the cable connected.**

ⓘ The KX3 can be conveniently operated with one hand, in a manner similar to writing in a notebook. If you're right-handed, rotate the radio slightly counter-clockwise (see cover illustration). If you're left-handed, rotate the KX3 clockwise.

## Power Supply

For fixed-station use, a low-noise 12-14 V linear power supply or battery is recommended. Avoid "wall-warts" and unshielded switching supplies. These may generate hum or RF noise that affect both receive and transmit signal purity.

For lightweight portable operation, the KX3's internal 8-AA-cell battery pack can be used. See **Using Internal Batteries**, pg. 24.

⚠ **Maximum power output varies with supply voltage and other parameters. For full power (10+ W), 12-14 V is required.**

A power cable with a 2.1-mm plug is supplied (center lead positive). Trim the cable to the desired length. Plug the cable into the **9-15 VDC** jack, shown at left in the illustration below.


## CW Key / Keyer Paddle

The KX3 has two CW keying inputs:

**KEY Jack:** This 3. 5 mm jack on the left side can be used with a hand key, keyer paddle, or other keying device, as selected by the *CW KEY1* menu entry. (See **Using the Menu**, pg. 9.)

**KXPD3 Keyer Paddle:** The KXPD3 is an optional high-quality keyer paddle that attaches at the front of the KX3 via two thumb screws. The dot and dash paddles can be electrically reversed or configured as a hand key using the *CW KEY2* menu entry. Allen wrenches are supplied for contact adjustment.

⚠ **Avoid using bulky connectors or adapters that could put excessive stress on side-panel jacks.** Lightweight cables, preferably with right-angle plugs, are strongly recommended.

## Headphones and Speakers

The 3.5-mm **PHONES** jack, on the left side panel, accommodates mono or stereo headphones. You can also plug in one or two amplified (or *powered*) external speakers here. Mono or stereo plugs can be used. Stereo headphones or dual speakers allow the use of *audio effects*, providing an enhanced listening experience (pg. 28).

The KX3 includes a small built-in speaker for use in quiet operating environments. Plugging in headphones disables the speaker and its amplifier. (This is an easy way to extend battery life.)

**Mobile installations:** The interior of most vehicles is too noisy for use with the KX3's built-in speaker. One or two amplified mobile speakers can be plugged into the **PHONES** jack, or you can connect this jack to your car stereo's AUX input. Another alternative is to use a device that retransmits the KX3's audio output in the FM broadcast band.

## Microphone

The **MIC** jack is compatible with the Elecraft MH3 hand mic, which provides PTT as well as VFO UP/DN buttons. For the MH3, set the *MIC BIAS* menu entry to **ON**, and *MIC BTN* to **PTT UP.DN**.


**MH3 Mic Pinout**

**Sleeve:** Shield

**Ring2:** Logic ground

**Ring1:** PTT/UP/DN

**Tip:** Mic audio

**Using other microphones and headsets:** The KX3 is compatible with many headset-mics that have separate 3.5-mm plugs for mic audio and receive audio. You can also use some "mini" mics intended to plug directly into a laptop computer. Refer to the *MIC BIAS* and *MIC BTN* menu entries to set up the KX3 for use with your mic or headset.

## Computer/Control Port (ACC1)

The 3.5-mm **ACC1** jack allows firmware updates, configuration, and remote control of the KX3 via a computer. The jack can be connected to a PC's USB port via the Elecraft model **KXUSB** cable, or to an RS232 port via the model **KXSER** cable.

Elecraft provides the following KX3 configuration programs:

***KX3 Utility*** is required for KX3 configuration and firmware updates (pg. 23). It also provides a CW/data terminal function.

Our ***K3 Memory*** PC application can be used to set up frequency memories more easily than with the radio's memory-store function.

Many logging, contesting, and control programs are available from third parties. If the KX3 is not specifically supported by a given program, try selecting **Elecraft K3** or **K2**.

## Keyline Out and GPIO (ACC2)

The 2.5-mm **ACC2** jack provides a *keyline* output that can be used for transmit/receive switching of linear amplifiers and transverters.

ACC2 also includes a general-purpose input/output signal, GPIO, that can be set up for various equipment control functions. For example, it can send band-change information to Elecraft XV-series transverters. See the *ACC2 IO* menu entry for the full list of possible uses for this signal.

The ACC2 jack's ***tip*** contact is GPIO, and ***ring*** is KEY OUT. For voltage/current limits, see **Specifications**.

## Quadrature Outputs (RX I/Q)

The 2.5-mm **RX I/Q** jack provides quadrature outputs from the receive mixer (I=in-phase, Q=quadrature). These outputs can be used with computer-based *software-defined radio* (SDR) programs to extend the capabilities of the KX3. For example, a *spectral display* application can give you a graphic view of signals across a range of frequencies. See **SDR Applications** (pg. 25).

## Antennas

You can use any resonant antenna having a 50-ohm (approximate) load impedance with the KX3. Examples can be found in the *ARRL Antenna Handbook* and other sources. For 160-6 meters, a simple inverted "V" or dipole can be very effective.

**Antenna jacks:** The BNC antenna jack, identified at right, is used on 160-6 meters. The SMA jack shown is supplied with the optional 2-meter module (**KX3-2M**, pg. 23). The basic KX3 has a hole plug at this location.

**Field Antennas:** Field operation often calls for non-resonant, ad-hoc wire antennas. For example, you might use a single wire of 20' (6 m) or longer, tossed in a tree using a fishing weight or large hex nuts. Another popular field antenna is the short, loaded whip. Interchangeable loading coils or taps can provide multi-band operation.

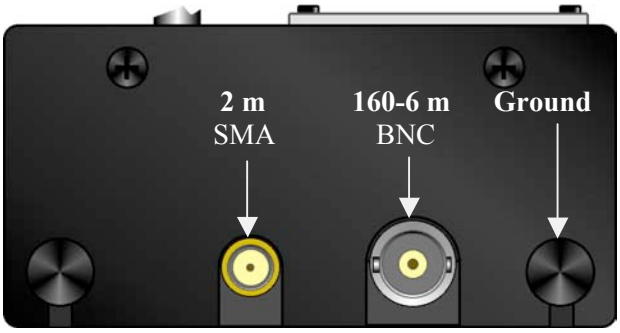
**SWR:** One measure of how close an antenna is to resonance is its *SWR* (standing wave radio). The KX3 displays SWR in TUNE mode (pg. 14). An SWR of 1.0:1 (**1.0-1** on the KX3's display) is considered a "perfect" match. To ensure safe operation, the KX3 may automatically reduce power if the SWR exceeds 2.0:1.

**Using An Antenna Tuner (ATU)):** An ATU will allow the KX3 to "see" a good match (i.e., a low SWR) even with non-resonant antennas. This allows the transmitter to deliver full power, and can improve receiver sensitivity. An ATU may also allow one antenna to be used on multiple bands. You can use an external ATU (e.g., an Elecraft T1 or KXAT100) or internal (e.g., the KXAT3 option, pg. 23). The KXAT3 stores matching information at multiple points within each band.

**Feedline:** It is possible to connect a wire antenna directly to the KX3 without any coax or other *feedline*. (A male BNC to binding-post adapter is useful for this.) However, many antennas will function better when their feed point is well above ground. A multi-band, random-length antenna can be fed with twin-lead, then connected to a *balun* (balanced-to-unbalanced converter, such as the Elecraft BL1 or BL2), which in turn is connected directly to the transceiver.

## Grounding and ESD Protection

A ground system using buried rods and/or a ground *counterpoise* (wires radiating out from the antenna) can improve transmit efficiency, reduce receive interference, and help prevent electrical shock or damage due to ESD (electrostatic discharge). The *ARRL Antenna Book* provides examples. The ground can be connected to the KX3 at the thumb screw indicated below, on the right side panel. The back thumb screw on the left side can also be used.




**Portable Station Ground:** When you're operating from a temporary location, you should use one or more radials as a ground counterpoise. This can simply be a set of wires tied together at one of the KX3's ground points, then laid out on the ground in all directions. When possible, use at least one 1/4-wavelength radial for each band used. The length in feet can be calculated from 234 divided by F, where F is the operating frequency in MHz. On 20 meters (14-14.35 MHz), the length would be about 16.5 feet.

**Pedestrian Mobile Ground:** The KX3 can be operated hand-held—even while walking—with a short whip antenna. Such antennas may provide acceptable performance in receive mode without a ground. However, if you plan to transmit, you'll need a *trailing ground wire* to serve as a minimal counterpoise and greatly improve your transmitted signal. This is true even if the KX3 indicates a low SWR in TUNE mode (without a counterpoise, the SWR reading can be misleading). 13' is a good choice for a trailing ground wire. This length is about optimum on 20 meters, and is usable on 40-6 meters as well, assuming you're using a multi-band whip (or an antenna tuner). Small-diameter coax such as RG-174 works well for a trailing wire because it resists getting tangled while you walk.

# Control Panel Reference

This section summarizes all KX3 controls. For details, see **Basic Operation** and **Advanced Operating Features**.

***To Turn Power ON/OFF:*** **Hold** both the BAND- and ATU TUNE switches for 2 seconds. (See **ON/OFF** label on left side.)
***Tap Functions:*** **Tap** a switch or knob briefly to activate the function labeled on or above it, e.g. RATE .
***Hold Functions:*** **Hold** the control for about 1/2 second to activate the function labeled below, e.g. KHZ .
***Numeric Keypad:*** Switches and knobs at lower-left form a keypad (0-9/decimal/enter). Used with FREQ ENT, etc.

## Band Selection

BAND+ / BAND- Band up/down, pg. 10
RCL / STORE Frequency memories, pg. 17
*per-band:* tap 1-4; ***general purpose (00-99):*** use VFO A
FREQ ENT Direct freq. entry (use # keys, then ↵), pg. 10
SCAN Scan from VFO A to VFO B, pg. 17

## Display, pg. 8

## Operating Mode and VFO Setup

MODE Basic mode; ALT Alternate mode (e.g. LSB/USB), pg. 10
DATA Data submode, pg. 18; TEXT Text decode setup, pg. 19
A / B VFO A/B swap, pg. 11; REV VFO/repeater reverse, pg. 11
A ► B Copy VFO A to B, pg. 11; SPLIT Split RX/TX, pg. 19
RIT / XIT RX/TX offset, 11; PF1 / PF2 Prog. function, pg. 19


ON / OFF

## Transmit / ATU Control

MSG / REC Message play/record, pg 16
ATU TUNE Start auto antenna tune, pg 14
ANT Select ANT 1/2 (KXAT100 opt.), pg. 14
XMIT Enter transmit mode (PTT), pg. 14
TUNE Transmit CW carrier at PWR level (or *MENU:TUN PWR* level, if lower), pg. 14

## Transmit Settings

KEYER/MIC WPM, pg. 14; mic gain, pg 14
PWR Set power level, pg. 14
CMP Speech compression, pg. 15 *
PITCH CW sidetone, pg. 16; FM tone, pg. 15*
DLY CW QSK delay, pg. 16; VOX delay, pg. 16*
VOX VOX/PTT (CW/voice separate), pp. 16, 15

## Offset / VFO B and Misc.

OFS/VFO B RIT/XIT/VFO B, pg. 11
CLR Clear RIT/XIT offset, pg. 11
RATE Select 1/10 Hz VFO steps, pg. 11
KHZ Select coarse VFO steps, pg 11
DISP Show voltage etc. on VFO B, 11 *
MENU Use VFO B to select, A to edit

## Receive Settings

AF / RF-SQL Receiver gain control, pg. 12
MON Monitor & switch tones volume, pg. 12
PRE Preamp, pg. 13 ; ATTN Attenuator, pg. 13
NR Noise reduction, pg. 13 *
NB Noise blanking, pg. 13 *
PBT I/II Passband tuning (**I**=WIDTH/LO, **II**=SHIFT/HI), pg 12
NORM Filter passband normalization (per-mode), pg. 12
APF Audio peaking filter, pg. 13; SPOT CW spot tone, pg. 13
NTCH Autonotch (SSB) or manual notch (CW), pg. 13 *
CWT CW/DATA tuning aid (uses upper portion of S-meter), pg. 13

## VFO A, pg. 11

Transmit LED, pg. 14
Delta-F LED, pg. 11

* To adjust the parameter for this switch function, use the knob immediately above the switch.

## Display (LCD)

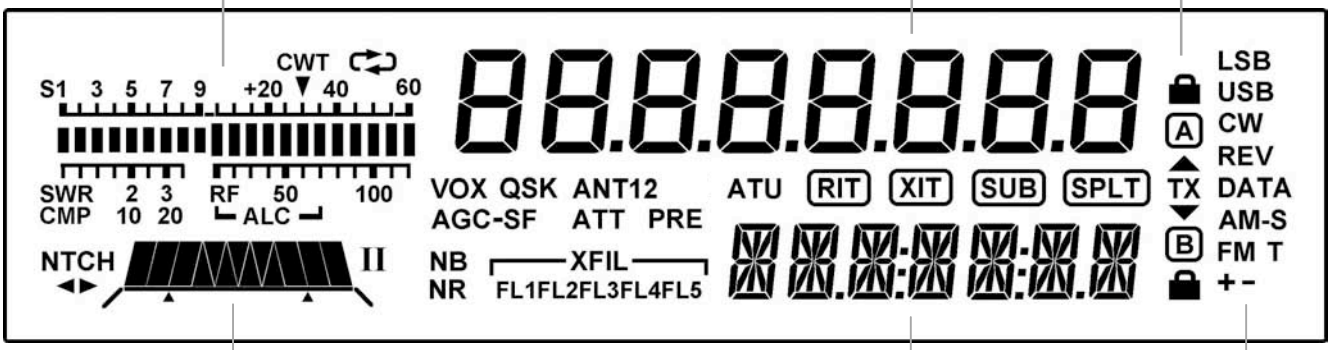
**Bar graph, receive mode:** Normally acts as an S-meter. If **CWT** is turned on, the right half of the S-meter becomes a tuning aid (pg. 13). Reducing RF gain adds a moving reference segment (pg. 12).

**Bar graph, transmit mode:** Normally shows **SWR** and **RF** output. In voice and data modes, the bar graph shows **CMP** (compression) and **ALC** whenever mic gain or compression are adjusted.

**VFO Icons:** Shows that a VFO or menu entry is locked. The **TX** icon points to the transmit VFO:

A ▲ TX — *VFO A is the transmit VFO*

TX ▼ B — *VFO B is the transmit VFO; see* **SPLIT**




**Filter Passband Graphic:** Shows location of receive filter passband (pg. 12)

**Filter Icons:**

| | |
|---|---|
| **NTCH** | Auto or manual notch (**NTCH**, pg. 13) |
| ◄► | Manual notch (**NTCH**, pg. 13) |
| **I / II** | PBT filter function (**I/II**, pg. 12) |
| **XFIL** | Filter selection (**FL1**-**FL5**, pg. 12) |

**Mode Icons**

Basic modes (**LSB** or **USB**, **CW**, **DATA**, **AM**, or **FM**) are selected by tapping **MODE**. Alternate modes (**CW REV**, **DATA REV**, **AM-S**, **FM +/-**) are selected by holding **ALT**. **LSB** and **USB** are alternates of each other. In SSB mode, the **+** icon indicates ESSB (pg. 22). **T** indicates FM/tone (pg. 15) or CW/DATA text decode (pp. 16, 19).

**Other Icons:**

| | |
|---|---|
| **CWT** | CW/data tuning aid on (**CWT**, pg. 13) |
| ⟲ | Message play/rec (**MSG** / **REC**, pp. 16, 21) |
| **VOX** | VOX enabled (**VOX**, pp. 15, 16) |
| **QSK** | Full break-in CW enabled (**DLY**, pg. 16) |
| **NB** | Noise blanker on (**NB**, pg. 13) |
| **NR** | Noise reduction on (**NR**, pg. 13) |
| **ANT** | Antenna 1/2, KXAT100 (**ANT**, pg. 23) |
| **RX** | Automatic RX gain reduction in effect (pg. 13) |
| **ATT** | Attenuator on (**ATT**, pg. 13) |
| **PRE** | Preamp on (**PRE**, pg. 13) |
| **ATU** | ATU enabled (**ATU TUNE**, pg. 14) |
| **RIT** | RIT on (**RIT**, pg. 11) |
| **XIT** | XIT on (**XIT**, pg. 11) |
| **SUB** | Dual-watch enabled (*DUAL RX*, pg. 20) |
| **SPLT** | Split mode in effect (**SPLIT**, pg. 19) |

# Basic Operation

This section describes basic KX3 controls and features. Once you've mastered the basics, you'll be ready to explore the **Advanced Operating Features** section (pg. 17), which covers built-in text decode, frequency memories, dual watch and other topics.

## Getting Started

Before using the KX3, you'll need to connect a power supply and an antenna, at minimum. See **Installation** (pg. 4) for more details.

### *Turning the KX3 On/Off*

To turn the KX3 on or off, press and hold the BAND- and ATU TUNE switches simultaneously for about two seconds, then release. Left side labeling identifies these two switches (see below). This power on/off method reduces the likelihood of accidental activation in a backpack or carrying case.

⚠ If you see any error messages on the display (starting with **ERR**), see **Troubleshooting** (pg. 39).


### *Switch TAP and HOLD Functions*

All KX3 switches have two functions:

- ***Tap*** to activate the function labeled ***on or above*** a switch, e.g. RATE
- ***Hold*** for about 1/2 second to activate the function labeled ***below*** a switch, e.g. KHZ

### *AF Gain and other Knob Functions*

Each small knob has a primary function that is in effect when you turn on the KX3. For example, the knob at far left, ⏲ AF / RF-SQL, normally controls receiver **AF gain** (volume). As you rotate this knob, the AF gain setting is displayed in the VFO B area.

***Tapping*** this knob briefly switches to its secondary function, **RF gain** (squelch in FM mode). ***Holding*** the knob—pushing it for over 1/2 second—switches to a third function, ⏲ MON (volume setting for transmit monitor and switch tones).

The small knobs are also used in conjunction with nearby switches. For example, if you tap DISP, rotating the knob directly above it (OFS / VFO B) will scroll through several special displays, including time, supply voltage, current drain, etc.

### *Using the Menu*

The menu is used to tailor the transceiver to your operating preferences.

**To access the menu,** hold MENU until the *BKLIGHT* (LCD brightness) menu entry appears in the VFO B area. The *parameter*, in this case the brightness level, appears in the VFO A area.

**To change the value of a menu parameter,** rotate VFO A (large knob). In the case of *BKLIGHT*, rotating the knob will select backlight **ON** or **OFF**.

**To scroll through menu entries,** use the small knob above the menu switch, ⏲ OFS/VFO B.

**To exit the menu,** hold MENU again.

ⓘ While in the menu, tapping DISP shows information about the present menu entry.

### *Configuration and Calibration Functions*

Now that you know how to use the menu, you may wish to review the **Configuration** section (pg. 28) to make sure the KX3 is configured properly for your installed options and operating preferences.

⚠ **Your KX3 must be calibrated to ensure it meets receive and transmit specifications. Calibration steps (pg. 30) are normally completed at the factory or during kit assembly.**

## Band Selection

The KX3 covers the 160-6 m amateur bands. Characteristics of each band are summarized below. For further information, see the ARRL *band plan*:

http://www.arrl.org/band-plan-1

You can change bands using **BAND+** or **BAND-** , memories (pg. 10), or **FREQ ENT** (see below).

ℹ You can remove bands you don't use from the **BAND +/-** switch group using *MENU:BND MAP*.

| Band (m) | Range (MHz) | Day/ Night | Other Characteristics |
|---|---|---|---|
| 160 | 1.8-2.0 | Night | Challenging "Top Band"; high power often used to counter noise |
| 80 | 3.5-4.0 | Night | Excellent regional band; many CW and SSB nets; AM ~3.870 |
| 60 | 5.3-5.4, channelized | Both | Shared with government services; power level and modes restricted |
| 40 | 7.0-7.3 | Both | Excellent local CW/SSB band by day; DX by night; QRP 7.03-7.04 |
| 30 | 10.0-10.15 | Both | DX possible anytime; no contests |
| 20 | 14.0-14.35 | Both | Very popular DX & contest band; many nets on SSB; Data modes: PSK31 ~14.070; RTTY ~14.085 |
| 17 | 18.068-18.168 | Day | Long-haul DX band; no contests; "HF Pack" at 18.1575 (often QRP) |
| 15 | 21.0-21.45 | Day | DX/contest band; low power very effective when band is open |
| 12 | 24.89-24.99 | Day | Excellent DX band; no contests |
| 10 | 28.0-29.7 | Day | Great DX band when open; CW beacons 28.2-28.3; FM 28.6-28.7 |
| 6 | 50-54 (VHF) | Both | Active night or day during rare DX openings; some FM repeaters |

### *Direct Frequency Entry*

The controls shown below function as a numeric keypad when used with **FREQ ENT**.


First, tap **FREQ ENT** . Then enter up to three **MHz** digits, optionally followed by a decimal point (**ATU TUNE** switch) and up to three **kHz** digits. Next tap ↵ (**MSG** switch) to accept, or any other switch to cancel. **Examples:**

14.255 MHz: **FREQ ENT** 1 4 . 2 5 5 ↵

7.000 MHz: **FREQ ENT** 7 ↵

## Mode Selection

Tap **MODE** one or more times to select SSB, CW, AM, or FM mode. **DATA** selects data modes. **ALT** selects alternate modes, such **CW reverse**. Each mode is described briefly below. Later sections cover each mode in detail.

ℹ If you don't plan to operate in AM or FM modes, you can turn them off individually using the *AM MODE* and *FM MODE* menu entries (pg. 33).

**SSB** (single sideband, pg. 15) is a narrow-banded voice mode that conserves space in crowded band segments. It's the most popular operating mode overall. LSB (lower sideband) is usually used on 160, 80, and 40 meters, while all other bands use USB (upper sideband). You can override the default sideband using **ALT**.

**CW** mode (pg. 16) uses on-off keying of the carrier. CW requires very little bandwidth, providing a high signal-to-noise ratio that's ideal for low-power (QRP) use. It's also a popular mode for DXing and contests. Holding **ALT** switches to **CW REV** (CW reverse), reversing the received sideband in CW mode from LSB to USB. This may reduce the level of interference (QRM).

**DATA** modes (**Advanced Operating Features,** pg. 18) typically use a PC or keyboard connected to the transceiver. However, the KX3 includes two built-in data modes that don't require a computer: **FSK D** (narrow-shift RTTY) and **PSK D** (PSK31). These modes use the KX3's built-in display for receive, and a keyer paddle for transmit, converting the CW you send into data. Once DATA mode has been selected, you can select a data sub-mode (e.g. **FSK D** or **PSK D**) by tapping **DATA** again, then rotating ⏲ **OFS/VFO B** .

**AM** mode (amplitude modulation, pg. 15) is characterized by its good fidelity or warmth. It is much less power-efficient than SSB. AM amateur operation is often found on 80 meters, around 3.870 MHz, and occasionally on 160, 40, and 10 meters.

**FM** mode (frequency modulation, pg. 15) is most often used for local communications, and can be found on 10 m and up (see ARRL band plan). The KX3 supports simplex and repeater operation, including tone encoding. Many repeaters can be found on the 2-meter band (144-148 MHz), which is covered by the KX3-2M option module (pg. 23).

## VFOs A and B

The KX3 provides two *VFOs* (see glossary, pg. 47). Use of VFO B is optional. The VFO knobs are located in the area shown below. Each VFO has independent frequency, mode, and filter settings.


**VFO A** normally controls both the receive and transmit frequency. Most contacts occur between stations tuned to about the same frequency, so if you use VFO A to tune in a signal clearly, there's a good chance they'll hear you when you transmit.

**VFO B** can serve as a holding register for a second frequency of interest, then swapped with VFO A as needed (see A / B at right). To tune VFO B directly, first make sure the **B** LED above the knob is lit. If not, tap the ⏲ OFS/VFO B knob. Also see SPLIT (pg. 19) and **Dual Watch** (pg. 20).

**Tuning rates:** Tapping RATE selects either 1 Hz or 10 Hz VFO tuning rate. Holding KHZ selects a per-mode coarse tuning rate (see *MENU:VFO CRS*, pg. 29). SSB stations often align on 0.5 or 1.0 kHz boundaries. AM broadcast stations are typically spaced at 5, 9, or 10 kHz.

**To lock VFO A:** Hold KHZ for about 3 seconds. Tap RATE to unlock. To lock VFO B, swap it with A first, lock, then swap back.

ⓘ You can use the ⏲ OFS/VFO B control to tune VFO A in coarse steps, while the VFO A control itself is still set up for fine steps. First, make sure the **OFS** LED is lit (tap the ⏲ OFS/VFO B knob one or two times). RIT and XIT (described at right) must also be turned off. To disable the VFO offset-tuning feature off, see *MENU:VFO OFS*.

**To copy VFO A's frequency to VFO B**: Tap A ► B. Tapping a second time copies VFO A's mode and filter settings to VFO B as well.

**VFO A and B swap:** Tap A / B to exchange VFO frequencies, modes, and all other settings.

**VFO A/B temporary reverse:** Sometimes you'll want to swap the VFOs temporarily to look for an open transmit frequency when operating split (pg. 19). In this case, hold REV. The VFOs will be swapped back as soon as you release the switch. **In FM mode,** REV swaps receive/transmit frequencies and the repeater offset direction (pg.15).

## RIT and XIT (Incremental Tuning)

RIT, or *receiver incremental tuning*, provides a means of adjusting the receive frequency without affecting your transmit frequency. This control is sometimes called a *clarifier* since it can be used to tune in SSB voice signals. But RIT can also be used in CW and DATA modes, in the event that a station calls you slightly off-frequency. RIT and XIT use the tuning rate (1/10 Hz) selected for the VFOs.

XIT, or *transmit incremental tuning*, adjusts the transmit frequency without affecting the receive frequency. See **Split and XIT**, pg. 19.

**Δ F (Delta-F) LED ●:** Whenever an RIT or XIT offset is in effect, or during split operation, the **Δ F** LED turns on as a reminder that your receive and transmit frequencies are different.

**To use RIT or XIT:** First, tap RIT or XIT. This turns on the **RIT** or **XIT** icon on the display, as well as the **OFS** LED (above ⏲ OFS/VFO B). Then adjust the offset using ⏲ OFS/VFO B.

**To zero the RIT/XIT offset:** Hold CLR.

ⓘ You can still use the ⏲ OFS/VFO B control to tune VFO B, even if RIT or XIT is turned on. Just tap the knob to switch its function back to VFO B (the **B** LED will turn on). The RIT/XIT icons on the LCD will retain their current states.

## Special VFO B Displays

The VFO B display area can show several useful parameters. To see these, tap DISP, then rotate the ⏲ OFS/VFO B control. This will cycle through several displays including time, supply voltage, current drain, power amplifier temperature, synthesizer temperature, audio voltmeter, and relative audio (dBV) meter. For details see pg. 22.

## Receive Settings

The **RX** control group, shown below, is used to set up the KX3's receiver. Directly above these controls is the *filter passband graphic*, which shows the shape and position of the receiver's passband. This determines what pitch range you'll hear.


### *AF Gain, RF Gain, and Squelch*

The ↻ AF / RF-SQL knob normally controls receiver **AF gain**. Tapping the knob switches its function to **squelch** (FM Mode only) or **RF gain** (all other modes).

**RF gain** is normally left at maximum (**-0 dB**). Reducing RF gain may be useful in some strong-signal conditions. If you reduce RF gain more than a few dB, a separate segment of the S-meter turns on as a reminder. The segment used varies with the amount of RF gain reduction. (A high S-meter reading may hide the RF gain indicator segment.)

**Squelch** is used to mute the receiver until a signal appears. It is most often used with repeaters. The control adjusts the signal threshold required for squelch to "open," unmuting the receiver.

### *Voice Monitor/CW Sidetone Level (MON)*

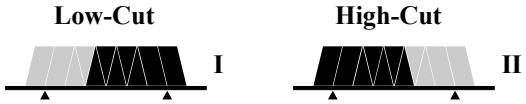
Holding ↻ AF / RF-SQL temporarily switches its function to ↻ MON, which controls how much of your own signal you hear when transmitting. Transmit monitor setup is covered on pg. 14.

ⓘ Switch activation tones, if used, have the same volume level as the CW sidetone (as set in CW mode using ↻ MON). Switch tones can be set to off, on, or Morse code characters at various speeds using the *SW TONE* menu entry.

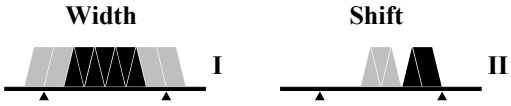
### *Passband Tuning Functions (PBT I/II)*

The ↻ PBT I/II control is used to shape the KX3's receive filter passband. In general, a narrow passband reduces interference (QRM) and noise (QRN), while a wider passband improves fidelity.

In voice modes, tapping ↻ PBT I/II selects *low-cut* (function **I**) or *high-cut* (function **II**). These functions remove low- or high-pitched interfering signals. Examples of filter graphic segments that might turn off as the result of a low-cut or high-cut are shown in light gray below.




In CW and DATA modes, the passband functions are *width* (**I**) and *shift* (**II**). The effect of these functions is illustrated below. Reducing the width or shifting the passband may attenuate an interfering signal above or below the desired one.




Holding ↻ PBT I/II *normalizes* the passband (NORM), centering it and setting it to the default width for the current mode. Two small "anchors" appear at the left and right ends of the graphic. Holding NORM again restores the previous settings.

### *Roofing Filters (XFIL)*

The **XFIL** icons, to the right of the filter passband graphic, show whether the optional *roofing filters* (**FL2**, **FL3**) are in use. These filters, located on the KXFL3 option module, can reject strong nearby signals that might interfere with reception of weaker ones.

In SSB, CW, and DATA modes, **FL2** (3000 Hz) and **FL3** (1000 Hz) will be automatically selected, when possible, based on the settings of the filter controls.

The roofing filters are bypassed (indicated by **FL1**) in AM, FM, and ESSB modes, when a bandwidth over 3000 Hz is needed. The bandwidth with FL1 in effect is about 15 kHz.

### *Preamp and Attenuator*

PRE turns on the RF preamp. It should be used only when signals are very weak. Preamp gain can be set on a per-band basis using *MENU:PREAMP*. ATTN turns on the 15-dB RF attenuator, which can protect the receiver from strong interfering signals.

The KX3 will automatically reduce receive gain in the presence of very strong signals. The receive overload icon (**RX**) will alert you to this (pg. 8).

### *Noise Reduction*

*Noise reduction* (NR) removes random background noise (hiss or static). It has a characteristic "hollow" sound. Higher settings may attenuate weak signals.

Holding NR turns on noise reduction and displays its setting, which can be adjusted using the knob above the switch. Tap any switch to exit the setting display. Hold NR again to turn noise reduction off.

### *Noise Blanking*

*Noise blanking* can eliminate repetitive noise such as that from power lines, appliances, and vehicle ignitions systems. Use the lowest effective setting to avoid unwanted signal/noise interaction.

NB turns on the noise blanker. The NB setting is adjusted in the same way as NR (see above).

### *Audio Peaking Filter (APF)*

APF turns on a special 30-Hz filter that improves copy of very weak CW signals buried in noise. The filter graphic changes to that shown below. With APF on, PBT function **I** still adjusts the overall passband width; function **II** tunes the APF center pitch. 1-Hz VFO tuning is automatically selected.

### *Notch Filtering*

Holding NTCH turns on manual notch filtering and displays its pitch. Adjust the pitch, using the knob above the switch, until an interfering carrier is reduced in volume. Tap any switch to exit the notch pitch display, or hold NTCH again to turn it off.

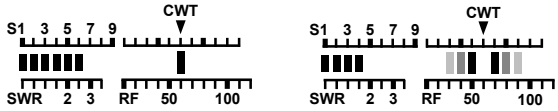
In SSB modes, *auto-notch* (NTCH) is also available. If you set the parameter to **AUTO**, the KX3 will find and suppress carriers automatically.

### *CW/DATA Tuning Aid (CWT)*

Accurate tuning of received signals is required before you call a station, or when you're using built-in text decode (TEXT, pg. 16). Tuning can be done by ear. But CWT, in conjunction with **Auto-SPOT** (below), can often tune in stations for you. When you hold CWT , the upper half of the S-meter becomes a receive VFO tuning aid for CW and some data modes.

A CW signal will appear as a single bar in the CWT display, as shown in the left example below. Use VFO A to tune in the signal until the bar directly under the CWT pointer is turned on. A narrow filter width is recommended (100-400 Hz). This display also applies to PSK31 (PSK D, pg. 18).

**CW and PSK31** **RTTY**




In RTTY or *radioteletype* modes (FSK D, AFSK A; pg. 18) mark and space tones are represented by three bars on either side of the CWT pointer. If no RTTY signal is present, you'll see the "ghosting" effect shown above. As you tune in an RTTY signal, the number of solid bars will increase. Keep tuning until you see a rough balance between left and right solid bars during an RTTY transmission.

### *SPOT and Auto-SPOT*

You can use SPOT to manually tune in a CW or PSK31 signal, matching it to your sidetone pitch. First turn off CWT if it is on. Then, tap SPOT and adjust VFO A until the signal pitch matches the sidetone. Use MON to adjust the sidetone volume level.

**To use auto-spot:** First turn on CWT . Tapping SPOT will then automatically tune in a received signal that falls within the CWT display range.

Auto-SPOT may not be usable if more than one signal is in the CWT range, or if the signal is very weak or noisy. Try using a narrower bandwidth in this case.

## Transmit Settings

The **TX** control group is used to set up the KX3's transmitter. To the right of these controls is the transmit indicator LED (**TX**).


### *Keyer Speed/Mic Gain and Power Output*

In CW mode, ⏲ **KEYER/MIC** sets the internal keyer speed in words per minute (WPM). In voice modes, it sets mic gain (pg. 7). Holding the control changes its function to ⏲ **PWR** (power, in watts).

⚠ Maximum power output varies with heatsink temperature, supply voltage, current drain, and load SWR. A reduced-current transmit mode is automatically used when possible. This is indicated by a decimal point after the "W" (e.g. **3.0 W.**).

⚠ If power output is lower than expected, you can use the special VFO B displays (pg. 11) to check supply voltage, current drain, and PA temperature. The parameter will remain displayed on VFO B during **TUNE** (pg. 11). SWR is shown on the VFO A display when you hold **TUNE**.

### *Other Transmit Settings*

Hold ⏲ **MON** to set the transmit monitor volume (speech in voice modes, sidetone in CW mode).

**CMP** sets the amount of *speech compression*, which increases average power output, making your voice sound louder. Adjust compression using the knob above the switch; to finish, tap **CMP** again.

**PITCH** is used to set the sidetone pitch in CW mode, and the tone-encode pitch in FM mode (pg. 15). It displays the mark or center pitch and data shift in some data modes.

**DLY** sets the VOX (voice-operated transmit) delay time in voice modes (pg. 15). In CW mode, **DLY** sets the break-in or *QSK* delay (pg. 16).

**VOX** selects the keying mode: PTT (push-to-talk) or VOX (voice- or keying-operated transmit). With PTT selected, the transmitter must be enabled by tapping **XMIT** or by holding the PTT button on the mic. With VOX selected, the **VOX** icon turns on, and transmit starts by speaking (voice modes) or when keyed via the KEY jack or an attached paddle (CW mode).

Also see **DLY** (at left) and *MENU:VOX GN* (p. 33).

## Transmit and ATU Control

The switches in the group shown below perform various transmit control functions.


**MSG** and **REC** play and record messages in all modes. See pgs. 16 and 21.

**ATU TUNE** starts automatic antenna matching if a KXAT3 internal ATU is installed (pg. 23). Antenna matching takes an average of 4 seconds, initially, but settings are then recalled instantly on band change.

ℹ Tapping **ATU TUNE** a second time within 5 seconds starts a more extensive search. This may result in a lower SWR.

**ANT** controls **ANT1/2** selection on the KXAT100 external ATU. **ANT** does not switch between antenna jacks on the KX3 itself**.** The BNC jack is always used on the 160-6 m bands, and the SMA jack is used only with the KX3's 2-meter module.

**XMIT** is equivalent to PTT (push-to-talk). Tapping this switch places the KX3 into transmit mode.

**TUNE** is used to put out a CW signal at the power level selected by the ⏲ **PWR** control. This is useful with external wattmeters and antenna tuners. If the *TUN PWR* menu entry is set to a numeric value, rather than **NOR**, then this value—if lower--overrides the power control setting.

## Voice Modes (SSB, AM, FM)

### *Basic Voice-Mode Setup*

ⓘ To avoid transmitting on the air during this procedure, you can set ⏲ PWR to 0.0 watts.

- **Choose a mode:** Tap MODE to select **LSB**/**USB**, **AM**, or **FM** mode. In SSB modes, ALT alternates between **LSB** and **USB**.
- Hold ⏲ MON to set the voice monitor level. A setting of about 5 is a good starting point.
- Tap CMP and set it to **0** for now using the knob above. Tap it again to exit the CMP display.
- **Enable transmit:** Tap XMIT or hold in the mic's PTT switch.
- **Adjust mic gain level:** While speaking into the mic, adjust ⏲ KEYER/MIC (mic gain). This will automatically turn on the transmit **CMP** and **ALC** bar graphs. While speaking, adjust mic gain for about 5 ALC bars (see below).


- **Set up speech compression (optional):** To use speech compression, tap CMP and adjust the level using the knob above the switch. The **CMP** scale (see above), shows approximate compression level. Low settings (1 to 10) will preserve a more natural voice sound.
- **Set the power level:** Exit transmit mode and adjust ⏲ PWR to the desired level.

### *Voice Mode VOX Setup*

VOX selects push-to-talk (PTT) or voice-operated (VOX) transmit (**VOX** icon on). VOX hold time is set with ⏲ DLY (pg. 7).

*MENU:VOX GN* (VOX gain) should be set to trigger at normal speech level, but not in response to incidental noise. Start with low settings (10-20).

*MENU:VOX INH* (VOX inhibit, or *anti-vox*) can prevent speaker audio from triggering VOX. With the mic closer to the speaker than normal, increase *ANTIVOX* until the KX3 doesn't switch to TX mode when listening to a strong signal.

### *Transmit Metering in Voice Modes*

Normally, the SWR/RF bar graph is active during transmit in all modes. In voice modes, you can switch to the **CMP** / **ALC** bar graphs by tapping ⏲ KEYER/MIC. This also occurs automatically if you adjust mic gain or speech compression.

### *FM Operation*

ⓘ If you don't use FM mode, you can disable it by setting *MENU:FM MODE* to **OFF**.

To setup for repeater use:

- Hold ALT to select simplex, TX up (**+** icon), or TX down (**-** icon). If an offset is in effect, REV swaps RX/TX frequencies and offset direction.
- Set up the required repeater offset using *MENU:RPT OFS*.
- Select a coarse VFO step size for FM mode using *MENU:VFO CRS*.
- Hold PITCH to set up PL tone encode, if required by the repeater. VFO A selects the tone pitch in Hz; VFO B turns tone encode on or off. If **1750** Hz is selected (for European repeaters), an 0.5-second tone burst is sent at the start of each transmission if squelch wasn't already open. Or, you can hold PITCH during TX to manually generate a longer tone burst.
- To change the FM deviation level for voice and PL tones, use *MENU:FM DEV*.
- **Squelch:** Tap ⏲ AF / RF-SQL, then rotate the knob to select the desired squelch threshold. (In all other modes, this controls RF gain.) Tap the knob again to return to the AF gain function.

### *AM Operation*

AM receive on the KX3 uses traditional envelope detection. You can also listen to AM signals using LSB or USB modes, which may provide better copy during fading conditions.

Transmit efficiency is much lower in AM mode than SSB as discussed on pg. 10. If you don't plan to transmit in this mode, you may wish to disable AM (see below).

ⓘ To disable AM mode, set *MENU:AM MODE* to **OFF**.

# CW Mode

## *Basic CW-Mode Setup*

- **Mode selection:** Tap MODE to select **CW** (CW normal). In some cases an interfering received signal can be eliminated by switching to **CW REV** (CW reverse) using ALT. This doesn't affect transmit.
- **Transmitter keying method:** The VOX switch selects either VOX or PTT keying for CW mode. Most operators use VOX, allowing the transmitter to be keyed immediately whenever a hand key or keyer paddle is used. To select manual transmitter keying via the XMIT switch, select PTT.
- **Set sidetone pitch** using PITCH. The ideal pitch for most operators falls in the range of 400-600 Hz. The receiver's passband will be centered at the pitch you select.
- Set sidetone volume using ⏲ MON.
- **Adjust the break-in delay:** Tap DLY to set the break-in or *QSK* delay (the time before the receiver recovers after key-up). A setting of 0 provides "full break-in" or "full QSK." (The QSK icon will appear.) This allows the receiver to recover quickly so you can hear another station transmitting between your characters.

## *CW Receive Filtering*

As conditions change, you may need to adjust the filter passband as described on pg. 12. Also, you'll find the audio peaking filter (APF) to be very useful with weak CW signals.

### *Off-Air Code Practice*

If PTT-CW is selected (VOX turned off in CW mode), CW sent via any method will produce a sidetone but will not actually transmit. This is useful for code practice or keyer speed adjustment. Another option is to set power output level to 0.

### *CW-Mode Menu Settings*

Use the menu to set up iambic keying mode *(CW IAMB)*, paddle norm/reverse or hand key *(CW KEY1* and *CW KEY2)*, and keying weight *(CW WGHT)*. The default values will suffice in most cases.

## *CWT, SPOT and Auto-Spot*

When calling a station, you should try to match your frequency to theirs. To facilitate this, the KX3 provides both manual and automatic spotting for CW, FSK-D, and PSK-D signals. See pg. 13.

## *CW Text Decode/Display*

The KX3 can decode transmitted and received CW signals, displaying the text on VFO B (pg. 8). This is especially useful when you're learning CW, or if someone who doesn't know CW is looking over your shoulder while you make CW QSOs. It's also indispensable for CW-to-DATA operation (pg.18).

## *CW/DATA Message Record/Play*

There are 6 text message buffers, each holding up to 250 characters. These apply to CW and to DATA modes FSK D and PSK D.

⚠ Messages can only be recorded using the KX3's internal keyer, not by using a hand key or external keyer.

**Message Record:** To start recording, hold REC , then select a message buffer by tapping any of switches 1 through 6 on the numeric keypad. The remaining buffer space will be displayed as you send. Tap MSG to terminate record.

**Message Play:** To play, tap MSG , then select a message buffer (1 through 6). To cancel, tap XMIT or hit the keyer paddle or hand key.

**Message Erase:** Hold REC , then select a message buffer (1 through 6), then hold CLR.

**Auto-Repeat:** To auto-repeat a message, tap MSG , but then *hold* rather than *tap* a message switch (1 through 6). *MENU:MSG RPT* sets the message repeat interval (1 to 255 seconds).

**Chaining:** *Tapping* a message switch during playback chains another message onto the message being played. *Holding* a message switch during playback chains a repeating message.

# Advanced Operating Features

## Frequency Memories

The KX3 has 100 general-purpose frequency memories (**00**-**99**), plus four *quick memories* on each band, accessed by tapping 1 - 4 on the numeric keypad. Each memory stores VFO A and B frequencies, modes, and other settings.

Quick memories provide an easy way to get to segments used for each operating mode. For example, you could use quick-memory 1 as an SSB starting point, use 2 for CW, 3 for data, etc., on each band.

**To store a general-purpose memory** (**00**-**99**): First hold STORE , then locate the desired memory by rotating the VFO A knob. The VFO A frequencies presently stored in each memory will be shown as you scroll through them. When you reach the desired memory number, hold STORE again to finish, or tap any other switch to cancel.

**To recall a general-purpose memory:** Hold RCL (recall), then select memory **00**-**99** using VFO A. Tap any switch to exit.

**To store a per-band quick memory:** Hold STORE, then tap the target quick memory (1 - 4).

**To recall a per-band quick memory:** Hold RCL, then tap the target quick memory (1 - 4).

**To erase a general-purpose memory:** While scrolling through memories to save or recall, hold CLR. (Not applicable to quick memories.)

**To add a text label to a general-purpose memory:** First hold RCL , then select a memory (**00**-**99**) using VFO A. Next, rotate VFO B to select each text label position in turn as indicated by the flashing cursor. Use VFO A to change label characters (A-Z, 0-9, and various symbols). After editing, hold STORE to finish the operation.

ⓘ Adding an asterisk (*) at the start of a label designates a memory that is part of a channel-hopping group (described at right).

ⓘ The ***K3 Memory*** program (pg. 27) can be used to simplify setup and labeling of memories.

## Scanning

Scanning allows the KX3 to tune any portion of a band continuously. Normal scanning mutes the receiver until a modulated signal is found. “Live” scanning keeps the receiver unmuted, and is stopped by the operator. This is useful on very quiet bands.

**To use scanning:**

- Set VFO A and VFO B to the desired start/end frequencies. Also select an operating mode.
- Select a tuning rate for the scan using RATE (10 Hz or 100 Hz), or KHZ (for fast scanning).
- Store this setup in any frequency memory.
- To start scanning:
- Recall a scanning memory using RCL.
- Hold SCAN to start scanning. To scan with the receiver live (unmuted), continue to hold SCAN until you see **AF ON** (about 2 seconds).

**To stop scanning:** Rotate VFO A or tap any switch. To restart, hold SCAN.

### *Channel Hopping*

Scanning (or manually tuning) among a group of memories is referred to as **channel hopping**. This is most useful on channelized bands (60, 6, and 2 meters). The memories in the group must all be in the same band, but can have different modes.

**To set up channel hopping:**

- Set up VFO A for the first target frequency and mode. Store this setup in a general-purpose memory (**00**-**99**) as described at left.
- Set up and store the remaining frequencies ***in the next successive numbered memories***.
- Add a text label to each memory in the group, using an asterisk (*) as the first character.

To start manual channel hopping, RCL any one of the memories in the target group. VFO A will now hop among the grouped memories as you turn it.

You can then start scan (or live scan) among the grouped memories using SCAN. To disable channel hopping, tap RATE or change bands.

## Data Modes

The KX3 supports data operation via a computer and special software. But it can also receive and transmit in **RTTY** and **PSK31** modes *without* a computer. All data modes are described below.

**5.0 watts or lower is recommended in data modes.** The KX3 will reduce power, if necessary, to maintain a safe operating temperature.

### *FSK D Mode (RTTY)*

FSK D (RTTY[1]) is the easiest data mode to use:

- Tap DATA to select data mode.
- Tap DATA again and rotate OFS/VFO B to select the **FSK D** sub-mode. Tap the switch again to exit the sub-mode display. A dual-passband (mark/space) filter will appear:

- Hold TEXT to turn on text decode.
- Hold CWT to turn on the tuning aid (pg. 13).

You'll now be able to copy RTTY signals. RTTY can often be found on 20 meters from 14080-14090 kHz. (If you see only numbers and punctuation, try tapping DATA twice, which does a *letters* "shift.")

**To transmit in FSK D mode (CW-to-Data):** Plug a keyer paddle into the KEY jack, or attach a KXPD3 paddle. (See the *CW KEY1* and *CW KEY2* menu entries.) When you send CW, the KX3 will convert it to RTTY. (You'll hear the CW sidetone as well as the RTTY tones.) You can use CW message memories in FSK D mode. Also see *KX3 Utility's* **Terminal** function (pg. 27).

The KX3 adds a 4-second "idle time" after you stop sending; at the end of this period, the receiver is re-enabled. To terminate the idle signal quickly, send the character • • – • – in CW. This "IM" *prosign* can also be inserted at the end of message buffers. (It will not be transmitted on the air when messages are played in CW mode.)

[1] FSK stands for *frequency-shift keying*, the modulation method used with RTTY (radioteletype). The KX3 uses the most common shift, 170 Hz. RTTY signals are encoded using a 5-level code called *baudot*, at a baud rate of 45 baud, or about 60 words per minute.

### *PSK D Mode (PSK31)*

PSK D is the KX3's implementation of PSK31[2], a narrow-band data mode which is reliable even at very low power levels. 5 watts or less is strongly recommended to keep distortion low.

To use PSK D, set up the KX3 as described at left for FSK D, but select the **PSK D** sub-mode. Before attempting to transmit in this mode, you should practice tuning in signals. Try 14070-14073 kHz. CWT can be used in this mode (see pg. 13).

### *DATA A and AFSK A (Audio Data Modes)*

Many audio-based data modes can be heard on the bands, including Pactor, Olivia, MFSK, JT65, etc. A computer, sound card, and appropriate software is required to use these. You could use SSB for this purpose, but **DATA A** is a better choice. It disables compression and RX/TX EQ, and optimizes for low bit error rate. Upper sideband is the default.

For audio-based RTTY, you can use **AFSK A**, which provides the same dual-passband RTTY filter as FSK D, as well as text decode. The VFO displays the mark frequency. Lower sideband is the default.

To use these audio data modes:

- Tap DATA twice; rotate OFS/VFO B to select the **DATA A** or **AFSK A**. Tap the switch again to exit the sub-mode display.
- In **AFSK A** mode, optionally hold TEXT to turn on text decode, and CWT to turn on the CW/data tuning aid.
- Connect your computer's audio output to the MIC jack. (You can either wire the plug to activate the PTT line on transmit, or use VOX.) Connect the KX3's PHONES jack to your computer's audio input. High-quality shielded cables should be used. You may need an attenuator if the drive levels are too high.
- Refer to your data communications software manual to determine how to set up the KX3's VFO for accurate frequency display.
- While transmitting audio data, adjust MIC gain for 4 to 5 bars of ALC indication.

[2] PSK stands for *phase-shift keying*. 31 refers to the baud rate, 31.25 baud. PSK31 signals are encoded using a very efficient representation called *varicode*.

## Text Decode And Display

The KX3 can decode CW, PSK31 (PSK D) and RTTY (FSK D). Decoded text is displayed on VFO B. If no signal is tuned in, random characters may be displayed.

**To set up text decode:**

- Select the desired mode (CW, FSK D, or PSK D) using MODE or DATA.
- If a special VFO B display mode is in effect, cancel it by tapping DISP.
- Hold TEXT . In DATA modes, this will turn text decode on or off (the **T** mode icon appears when it is on). In CW mode, use VFO B to select **TX ONLY** or the desired CW speed range, then tap any other switch to exit. The **TX ONLY** setting displays only CW characters you send using the internal keyer.
- You'll probably want to turn on CWT as a tuning aid (pg. 13). This also enables auto-spot, which can automatically tune-in signals.
- A narrow filter bandwidth may improve text decode.
- For further details on data modes, see pg. 18.

## Programmable Function Switches

Menu entries used often can be assigned to programmable function switches PF1 and PF2.

To set up a programmable function switch:

- Hold MENU and rotate VFO B to find the target menu entry.
- Hold PF1 or PF2 to assign it to this menu entry. For example, if you hold PF1, you'll see **PF1 SET**.
- Exit the menu.

If a parameter has only two values, accessing it with a PF1 or PF2 will automatically change the value and exit the menu. This is useful with menu entries such as *AGC SPD* (AGC slow/fast selection).

## Split and XIT

Sometimes you'll hear a DX station being called by many other stations. To ensure that he has a clear transmit channel, the DX station may say "UP" or "DOWN" to indicate that he's *listening* above or below his transmit frequency. For example, in CW mode he may transmit on 7025 kHz, but listen in the vicinity of 7027 kHz. In this case he would periodically say "UP 2" (or just "UP") as a reminder of where to call him. SSB split operation is similar but may occur over a much wider range.

To use split, first tap A ► B twice to set VFO B to the same mode, frequency, and filter settings as VFO A. Then tune VFO B up about 2 kHz. Finally, hold SPLIT (the **SPLIT** icon will turn on). The **TX** icon's arrow will now point at VFO B, since VFO B is now controlling your transmit frequency.

Before you transmit using split, you may need to fine-tune your VFO B frequency. Setting it 2 kHz above VFO A is a good start, but many other stations may be trying to call at exactly this same location. The DX operator will be aware of this and will tune up and down from this nominal frequency when searching for callers. He'll probably tune up in small steps as he "picks off" each station.

This is where the REV switch comes in: it reverses the A and B VFOs so that you're temporarily *receiving* on your transmit frequency. During this time, tune VFO A around a bit to see if you can identify who is presently working the DX station, then position yourself just above this frequency.

REV remains in effect as long as you hold it down. As soon as you've released it, the VFOs will be swapped back, and you'll once again be listening to the DX station. With any luck your next transmission will occur right where he's listening.

**XIT as an alternative to split:** If you're trying to preserve VFO B as a holding register tuned someplace else in the band, you may want to use XIT rather than split in the above situation. In this example, you'd turn on XIT and rotate the offset control to about +2.00 kHz. You'll then be transmitting 2 kHz higher than the frequency shown on VFO A. To do the equivalent of REV, you can briefly turn RIT on as well. Turn off RIT to listen to the DX station.

## Audio Effects

If you have stereo headphones or stereo external speakers, you can take advantage of the KX3's DSP *audio effects* (AFX). These create an illusion of greater acoustic "space," resulting in a less-fatiguing receiver sound and in some cases better copy of weak signals.

*MENU:AFX MD* is used to select the desired AFX setting. Available selections include **OFF**, **DELAY** (simulated stereo), and **PITCH** (which "maps" signals from left to right according to pitch).

If dual watch is turned on (see below), you won't be able to hear the audio effects. This is because dual watch is already in stereo, with different material routed to the left and right audio channels.

## Dual Watch

Dual watch allows you to listen to both VFO A and VFO B frequencies at the same time, as if you had two receivers. VFO A is heard in the left ear, and VFO B in the right.

Dual watch is very useful when working DX using split mode (pg. 19). However, it is not necessary to be in split mode to use dual watch. You can also use it to listen to two frequencies at the same time, as long as they are within the allowed range (see below). For example, you might be waiting for one station to complete a QSO on VFO A, while tuning a short distance up or down the band using VFO B to look for other stations. If you decide to work the station at VFO B, you can tap **A / B** to make this the VFO A frequency, then call the station.

**To turn on dual watch:** Set *MENU:DUAL RX* to **ON**. This turns on the **SUB** ("sub receiver") icon. If you turn dual watch on/off frequently, you may wish to assign it to **PF1** or **PF2** (see pg. 19).

**Dual Watch Limitations:**

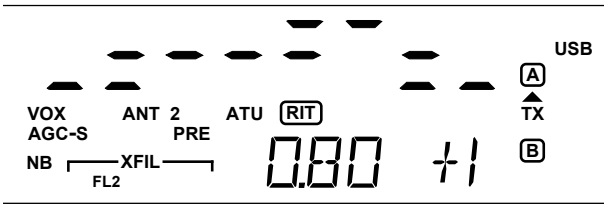
- The frequency span between VFO A and B is limited to about 10 kHz by the sample rate of the KX3's A-to-D converter. The KX3 will warn you if you tune outside the allowed range.
- A wider roofing filter than normal will be selected automatically, if required, based on the frequency span between VFO A and B.

## Receive Audio Equalization (RX EQ)

The KX3 provides 8 bands of receive audio equalization via the *RX EQ* menu entry. RX EQ can compensate for physical acoustics (of the room, headphones, internal speaker, external speaker), tailoring the audio to your personal preference.

Two receive EQ setups are provided: one for CW mode, and the other for all voice modes. RX EQ does not apply to DATA modes.

In the *RX EQ* menu entry, the VFO A display shows 8 individual vertical bar graphs. The example below shows various amounts of EQ for each band.




The center frequencies of the 8 audio EQ bands are 50, 100, 200, 400, 800, 1600, 2400, and 3200 Hz. To select a band to change, tap **1**-**8** on the keypad. For example, tapping **1** selects the 50-Hz band.

Next, rotate VFO A to specify boost or cut (+/- 16 dB). The illustration above shows the 800 Hz EQ band (**0.80** kHz) being set to **+1** dB of boost.

You can tap **CLR** to reset all of the *RX EQ* bands to **0** dB (no cut or boost).

## Transmit Audio Equalization (TX EQ)

Transmit audio equalization can compensate for microphone and voice variations. *MENU:TX EQ* works exactly the same as *RX EQ*, and can be used during transmit.

Two transmit EQ setups are provide: one for SSB, the other for wideband voice modes (ESSB, AM, FM). TX EQ is not applicable to CW or DATA modes.

While adjusting *TX EQ*, you can monitor your voice using headphones (use ⏲ **MON** to set the level), or listen to your transmitted signal on another receiver.

## SSB/CW VFO Offset

The KX3 can automatically offset the VFO frequency when you switch from SSB to CW mode, so other stations will hear the correct CW pitch. See *MENU:CW WGHT* for details.

## Digital Voice Recorder (DVR)

The KX3's built-in DVR function lets you record up to two short voice messages, such as your call sign or a CQ, and play them back one time or with auto-repeat. DVR messages are recorded and played in the same manner as CW/data messages, using MSG and REC (pg. 16), except that only message buffers 1 and 2 are available.

It is not necessary to use the microphone's PTT switch or the XMIT switch when recording a DVR message. Recording starts as soon as you hold REC, then tap a numbered switch.

MIC gain cannot be adjusted during DVR message play. The gain setting at time of recording is used.

## Transmit Noise Gate

The noise gate function mutes mic audio below a selected threshold; that is, if you stop talking, your on-air signal will drop to zero rather than transmit wind noise, etc. This is useful in vehicles and when operating in noisy outdoor environments. See *MENU:TX GATE* for details.

## Transmit Inhibit

The GPIO pin of the ACC2 connector can be configured as a transmit inhibit input by setting *MENU:ACC2 IO* to **LO=Inh** (0 V) or **HI=Inh** (5 V). Holding this pin at the selected state will then prevent transmit.

## Cross-Mode Operation

Cross-mode operation is possible in some cases. For example, you could set up VFO A for SSB receive, and VFO B for CW transmit, then enter SPLIT.

ⓘ You can send CW when SSB mode is selected for VFO A just by hitting the key or paddle; there's no need to use cross-mode split in this case. The SSB station will hear the signal at your sidetone pitch. See *MENU:CW WGHT* for details (pg. 33).

## Transverter Bands

Nine user-definable bands are provided for use with transverters. These can be used with the Elecraft KX3-2M internal 2-m module, Elecraft XV-Series, or other transverters.

⚠ **The KX3 does not have a low-level transverter output; transverters are driven from the main antenna jack.** This requires the use of transverters that have a common receive/transmit antenna jack and associated T/R switching. Consult the transverter manual for drive power limitations and switching requirements.

The ACC2 jack provides a keyline output for keying transverters. The ACC2 jack also provides a GPIO pin that can be used to select among multiple transverters based on the band selected at the KX3. This is further explained below.

### *Transverter Band Setup*

Transverter bands are set up using the *XV* menu entries, as follows:

- Locate the *XV**n** ON* menu entry. Tap 1 – 9 to specify which transverer band to configure. Set the parameter to **YES** to enable band ***n***.
- *XVn RF* sets the operating frequency (MHz).
- *XVn IF* specifies the I.F. band (7, 14, 21, 28, or 50 MHz). Use **50** MHz for the KX3-2M option.
- *XVn PWR* sets maximum KX3 power output for the current transverter band in watts (0-1). Use **0.3** watts for the KX3-2M option.
- *XVn OFS* can compensate for frequency offset in the transverter's oscillator. (An offset is not required for the KX3-2M module, since its oscillator signal is derived from the KX3's main synthesizer. If there is a frequency error, calibrate synthesizer using *REF CAL*.)
- *XVn ADR* should be set to **TRN 0** for use with the KX3-2M module. It can also be used to specify an optional Elecraft XV-series transverter selection address. Only addresses **TRN1**-**TRN7** are recognized for this purpose. To select XV-series transverters using this method, set *MENU:ACC2 IO* to **TRN CTRL**, and connect the ACC2 jack's GPIO pin to the transverter's auxBus line.

## Special VFO B Displays

The KX3 can continuously display time of day or one of several operational parameters on the VFO B display. To access these displays, tap DISP, then rotate the OFS/VFO B control.

The available special displays are listed below.

- **24-hour time** obtained from the real-time-clock on the KXBC3 option module. If a KXBC3 is not installed, the time since last power-on will be displayed. To set the time, use the *TIME* menu entry. You can also set an alarm time anytime in the next 24 hours using the *ALARM* menu function. This may be useful as a reminder of a contest or operating schedule. **The alarm will turn the KX3 on if it occurs when power is off.**
- **Supply voltage.** If you have an internal battery pack installed in addition to an external supply, the voltage shown will be the greater of the two. This and the next three parameters stay visible even in transmit mode, so you can check key-down conditions.
- **Supply current.** Typical receive-mode current is 0.15-0.2 amps (150-200 mA). It will be higher with the backlight, preamp, or isolation amp on, or when using the internal speaker. Transmit current is typically 1-2.5 A.
- **Power amplifier (PA) temperature.** The PA temperature will rise gradually as you transmit. The KX3 automatically reduces power if the PA temperature is too high.
- **Synthesizer (OSC) temperature.** This parameter is used by the KX3 to adjust the synthesizer (or oscillator) frequency as temperature varies. If the ambient temperature is very low, it can take several seconds for the reading to stabilize, during which some drift in the oscillator frequency may be observed. A few degrees of additional temperature rise is also normal during transmit.
- **Audio Signal level (AFV).** This display shows the approximate level of the KX3's audio output, prior to the AF gain control (in other words, the AF gain control has no effect on the reading). The reading will vary with preamp and attenuator settings as well as the RF gain control. AFV is normally used in conjunction with the **dBV** function (at right).
- **Relative audio signal (dBV).** This display can be used to measure receiver sensitivity or gain/loss of various stages, or compare two signals. To use it, first select **AFV** (described at left) and allow the voltage reading to stabilize. (This may not be possible with modulated or rapidly changing signals.) Once the signal appears stable, select **dBV**. You should now see a reading of around 0 *dBV* (see **Glossary**) relative to the last **AFV** reading. If you change the setting of the preamp or attenuator, you should see this reading change. However, it may not change as much as you expect unless you turn AGC off using the *AGC* menu entry. **(Be sure to turn AF gain down before turning AGC off, as the signal may become very loud.)** Measurement of receive sensitivity (MDS) requires a calibrated 1-µV signal source such as an Elecraft XG1/2/3. These sources include instructions for measuring MDS.

## Extended Single Sideband (ESSB)

An increase in SSB voice bandwidth may improve fidelity and reduce listening fatigue. However, this also increases signal bandwidth, and is not appropriate for use when bands are crowded.

The KX3's normal SSB receive bandwidth is about 2.8 kHz. This can be widened by using the lo-cut and hi-cut controls (PBT functions I and II, respectively).

**ESSB transmit is set up as follows:**

- Locate the *TX ESSB* menu entry. Tap 1 to turn ESSB on, then use VFO A to select the desired transmit bandwidth. The **+** icon will turn on in the mode area of the LCD.
- ESSB, AM, and FM have separate TX EQ from regular SSB, allowing you to optimize the transmit passband for these wider-bandwidth modes. See the *TX EQ* menu entry for details.
- You may wish to assign the *TX ESSB* menu entry to a programmable function switch if you'll be turning it on/off frequently.

# Options and Accessories

This section describes all available KX3 options and accessories. Option modules are easily user-installable, in any order, without soldering.

**MH3 Hand mic:** The MH3 was designed specifically for the KX3. It includes a high-quality mic element, rugged right-angle plug, PTT switch, and VFO UP/DN function buttons.

**KXPD3 Keyer paddle:** The KXPD3 is an adjustable precision paddle that attaches directly to the front of the KX3. It can be easily removed for storage or transport. The paddles are designed for both left- and right-handed use, and can be electrically reversed or used as a hand-key.

**KXBC3 Internal NiMH battery charger and real-time clock:** If you install NiMH cells in the KX3's internal battery pack, you can charge them using the KXBC3 module (see **Internal Batteries**, pg. 24). The KXBC3 also includes a real-time clock with an alarm function. The time can be displayed in the KX3's VFO B area by tapping **DISP**. The alarm can be used to turn the KX3 on at a specified time, or simply to remind the operator of a schedule or contest-start time.

**KXFL3 Dual-bandwidth roofing filter module:** A roofing filter is a narrow-band analog filter that better rejects strong signals that could cause receiver blocking (desense) or intermodulation distortion. When the KXFL3 is installed, the KX3 automatically selects the appropriate roofing filter as the bandwidth is adjusted (pg. 12).

**KXAT3 Wide-range internal automatic antenna tuner (ATU):** With a KXAT3 installed, you can use of non-resonant and narrow-band antennas on multiple bands. Using an ATU can improve transmit power transfer as well as receive sensitivity. (See pg. 6 for antenna suggestions.) The KXAT3 also includes an automatically tuned filter for the AM broadcast band that tracks the VFO, improving image rejection for signals in the 0.3-1.0 MHz range.

**KX3-2M Internal 2-meter module:** Future option.

**KXPA100 100-W amplifier:** Future option.

# Firmware Upgrades

New features and improvements are available to all KX3 owners via firmware upgrades. Upgrades may also be required when you install option modules.

Please visit the Elecraft KX3 software page (www.elecraft.com/KX3/KX3_software.htm) to obtain our free firmware download application, ***KX3 Utility***. This program runs on PCs, Macs, and Linux platforms. In addition to firmware downloading, ***KX3 Utility*** provides automated RX and TX gain calibration, a custom sign-on banner, configuration save/restore, CW/DATA message editing, and a CW/DATA terminal function.

⚠ Some applications or peripheral devices may interfere with KX3 downloads; check the Help information in *KX3 Utility* if you have difficulty.

### *Checking your Firmware Revision*

Use the *FW REVS* menu entry to determine your firmware revision. The serial number of your transceiver, if needed, can be obtained using the *SER NUM* menu entry.

### *KX3 Firmware Self-Test*

If the KX3 detects an error in its firmware (an incorrect *checksum* of all bytes in the program), it will flash the **TX** LED and show **MCU LD** on the LCD.

If this occurs, connect the KX3 to your computer, then run *KX3 Utility*, which will reload the firmware. While firmware is loading, the Delta-F LED (**Δf**) will flash. When the download is complete, the KX3 should reset and run normally.

### *Forcing a Firmware Download*

If you accidentally load an old or incompatible firmware version and find the KX3 unresponsive, do the following: (1) Unplug the KX3 from the power supply. If internal batteries are installed, also remove one battery. (2) Plug a power supply in (or reinstall the removed battery). (3) hold the KX3's **BAND-** and **ATU TUNE** together for about 10 seconds, after which you'll see the **TX** LED flash (you'll also see **MCU LD** on the LCD). (4) Connect the KX3 to a computer and run *KX3 Utility*, which will load new firmware.

# Internal Batteries

KX3's internal battery pack can be used with eight 1.2-1.6 volt AA cells of any type. The pack typically provides 4-8 hours of casual operation, ideal for field use or as backup during power outages. An internal NiMH charger is available.

### *Recommended Battery Types*

**Lithium** non-rechargeable batteries (e.g., Energizer L91) are expensive, but their flat discharge curve and 3 amp-hour rating provides maximum operating time. In receive, the pack voltage will be about 12 V. In transmit, it will drop to 9-10 V due to the cells' high internal series resistance. This voltage is still sufficient for operation at up to 5.0 watts.

**NiMH** (nickel-metal hydride) batteries have a flat discharge curve, like lithium cells, but a lower pack voltage (typically 10 V receive, 8.5-9 V transmit). They typically provide about 70-80% as much operating time as lithium cells. Power output of 5.0 W is possible, but 3.0 W or less is recommended. The big advantage of NiMH cells is that they can be recharged hundreds of times, either externally (in as little as 1 to 2 hours), or internally (typically 8-12 hours) using the KXBC3 option module.

⚠ **Alkaline** batteries can be used if there's no other alternative, but they have several disadvantages. They should always be used with power output set to 3.0 W or less to minimize transmit current drain. They have a steep discharge curve, so the pack will drop from 12 V to 8 V in about half the time of Lithium or NiMH cells. They're also prone to leakage, and should be removed after use. **Damage caused by battery leakage is not covered by the warranty.**

### *Maximizing Battery Life*

Follow these suggestions to maximize battery life:

- Use the lowest effective transmit power level. Set power to 3.0 watts or less to take advantage of the KX3's high-efficiency transmit mode.
- Turn off the backlight during daytime operation (*BKLIGHT* menu entry, pg. 33).
- Use headphones.
- Use the auto-off timer (*AUTO OFF*, pg. 28).

### *BAT LOW Warning*

The KX3 can periodically remind you when batteries are nearing end of charge. Refer to the *BAT MIN* menu entry for recommended BAT LOW warning thresholds for different battery types. The KX3 turns itself off below 8 V.

### *KXBC3 Internal NiMH Charger*

⚠ **The KXBC3 cannot automatically detect the type of cells installed. Do not attempt to charge any cell type other than NiMH.**

The KXBC3 module provides a convenient way to keep internal NiMH batteries charged. You can continue to operate while batteries are charging. The KXBC3 also includes a real-time clock for 24-hour time display (see *MENU:TIME*, pg. 33, and **DISP**, pg. 11).

To ensure safe charging of all NiMH cell types, the KXBC3 uses a "C/10" charge rate (about 200-250 mA, or $1/10^{th}$ of typical cell capacity in milliamp-hours). **A 13-volt or higher power supply capable of supplying about 400 mA must be connected during charging.**

**To enable the KXBC3 after installation:** Set the *BAT CHG* menu entry from **NOT INST** to **OFF**. Exit the menu. Turn power off and back on.

**To start charging:** Set the *BAT CH*G parameter to the desired charge time. If the batteries are fully depleted, use 10-12 hours. To "top off," use 1-2 hours. Then exit the menu. You can cancel charging by setting *BAT CHG* to **OFF**. (This menu entry can be assigned to a programmable function switch for quick access, if desired. See pg. 19.) If the KX3 is turned off during charging, it will "hibernate," showing the remaining battery charge time on the display. The KX3 will turn itself off when charging is complete.

⚠ **Preserving clock registers during battery swap:** The real-time clock (RTC) registers maintained by the KXBC3 will be preserved during a battery swap if you connect an external supply *or* complete the swap within about two minutes. If the RTC information is lost, use the *TIME* menu entry to reset the time.

# SDR Applications

The KX3 provides a special receiver output jack, **RX I/Q**, for use with *software-defined radio* (SDR) applications[3] running on a computer.

The primary benefit of such applications is providing a real-time display of a band of frequencies above and below the signal to which the KX3 is tuned. You can use this display to quickly find signals of interest, examine modulation and noise characteristics, etc. (This capability can also be found in dedicated instruments called *panadapters* or *spectrum analyzers*.)

Since the KX3's RX I/Q signal is analog, it must be converted to a digital signal by means of an *analog-to-digital converter* (ADC). Most PCs have this in the form of a built-in stereo sound-card. ***It is important that the input to the PC be in stereo.*** Most "mic" inputs are mono, and cannot be used. Most "line inputs" are stereo, and can be used.

If your PC lacks a suitable input, there are third-party soundcards available for USB, PCI, PCIe, Fireware and other expansion buses.

There are many PC-based SDR applications available as freeware. The quality of the spectrum display they provide depends heavily on the quality of the soundcard's ADC inputs. An excellent reference on potentially suitable sound cards may be found on the web by searching for "LP-PAN sound card tests".

A cable with a 2.5mm (5./32") plug on one end and a plug that matches your sound card input on the other end (typically 3.5mm [1/8"] stereo) is required. Elecraft provides a cable suitable for most soundcards in the KX3 Accessory Cable kit.

Once you have a cable and soundcard, you'll need to download suitable software and load it on your PC. Follow the directions supplied by the program, usually in the form of a help file.

A program suitable for most purposes, and certainly for demonstration purposes, is HDSDR. It is available as of this writing at

http://www.hdsdr.de

Follow the directions provided by the HDSDR program for setup and operation.

Tips for setting up SDR Programs with the KX3:

- When you first run the SDR program, the frequency displayed may be incorrect, but the spectrum display will still be accurate in terms of offsets. Setting the center frequency display to 1.000 or 10.000 MHz, for example, will make it easy to see how many kHz above or below the current KX3 frequency that another signal is.
- Select the correct soundcard input for the program. If your PC has an internal soundcard but you are using an add-on card, you must configure the program to use the correct soundcard.
- Set the correct sampling rate. Use of 48 kHz sampling will result in a display of almost 48 kHz: 24 kHz above and 24 kHz below the frequency to which the KX3 is tuned. 96 kHz sampling will yield approximately +/- 48 kHz of spectrum, and 192 kHz sampling will yield a display of about +/- 96 kHz.
- Enable the RX IQ output from the KX3 by setting *MENU: RX I/Q* to **ON**. (This increases the KX3's receive-mode current drain by about 10-15 mA.)
- The RX I/Q outputs from a receiver are not "flat" over an infinite frequency range; the signal-conversion process results in some slope (decrease in gain) as you move farther from the center frequency. In the case of the KX3, the signal will be reduced by about 2.5 dB at +/- 24 kHz, 4 dB at +/- 48 kHz, and +/- 7 dB at 96 kHz. The spectrum amplitude on the display, including the apparent noise floor of the receiver, will "roll off" by these amounts.
- If you have an accurate signal level source (such as an Elecraft XG-series signal source or a signal generator), you can calibrate the signal amplitude following directions provided by the program.

[3] The RX I/Q jack's analog signal is in *I* and *Q* format. I and Q refer to the two parts of a phase-quadrature signal, which simply means the two signals are 90 degrees apart in phase. Software applications can use this information to mathematically reconstruct the signals for display purposes.

- After you are comfortable with setting up and using the spectrum display, you can connect the USB/serial cable between the PC and the KX3.
- Typically, some spectral noise will appear in the display in the form of "spikes" or modulation sidebands. These can arise from several sources, including nearby power supplies, ground noise, or the computer and its peripherals. You can often use isolation transformers, improve grounding, and use shielded cables to reduce the amplitude of these signals.
- The HDSDR program can also display the actual frequency range in use if it is set up to communicate with the KX3. To do this, set up the program to use KX3, K3, or Kenwood protocol, and connect the KX3's ACC1 jack to a USB or RS232 port on the computer (see pg. 5). The program should then correctly display the actual signal frequencies as you tune the KX3. You may also be able to tune the KX3 from the program, depending on the program's features.

# Remote Control of the KX3

With appropriate software, any computer with an RS232 or USB port can be used to control the KX3. Connections needed for computer communications are covered on pg. 5.

Third-party logging and contesting software is available for various computers and operating systems. Select KX3 as the target radio when available. If not, select K3 or K2.

For a list of KX3-compatible software applications, including configuration requirements, please visit

www.elecraft.com/KX3/KX3_software.htm

### *Remote-Control Commands*

The KX3 has a rich set of remote-control commands. These remote-control commands use ordinary ASCII characters, so they can be easily tested using a terminal emulator or the Command Tester screen in *KX3 Utility*. For example, the command "**FA;**" returns the current VFO A frequency. Using the same command, you can *set* the VFO A frequency, e.g. "FA00007040000;" sets the VFO to 7.040 MHz.

Many specialized commands are provided in addition to the core set of commands supported by the K3 and K2. Please refer to the ***K3/KX3 Programmer's Reference*** for further details.

### *Remote Power On/Off*

To turn the KX3 ***on***, a remote-control system can place 8 to 12 volts DC on the KX3's PTT line for 100-1000 ms. (PTT is a pin on the mic jack). To turn it ***off***, the controller must send the KX3 a "**PS0;**" command via the ACC1 jack (RS232 or USB, depending on the cable used). If the controller also turns off the KX3's power supply, it should first allow 100 ms for the KX3 to shut down.

### *Automatic Antenna Control*

Some antenna control units (e.g., those used with SteppIR™ antennas) can track the KX3's band and frequency by watching for "**IF;**" (rig information) packets from the transceiver. Some computer logging/contesting applications set up the KX3 to output these messages periodically, allowing the antenna control unit to "eavesdrop."

If you're not using such software, or if you're not using a computer at all, you can still set up the KX3 to output "**IF;**" packets periodically to an antenna controller. To do this, set *MENU:AUTOINF* to **AUTO 1**. The packets are sent once per second while the VFO frequency is being changed, as well as on any band change.

⚠ If you're using logging/contesting software, check with the manufacturer before setting *AUTOINF* to **AUTO 1**. Some applications may not be tolerant of unsolicited "IF;" packets.

### *CW/DATA Terminal Applications*

The KX3 directly supports CW/PSK31/RTTY ASCII text transmit and receive via its ACC1 port (RS232 or USB). Our ***KX3 Utility*** application includes a *Terminal* function that lets you use these modes with your computer's keyboard and monitor. At the KX3, select FSK-D data submode for RTTY, and PSK-D for PSK31. Then follow the Help instructions within *KX3 Utility*.

### *K3 Memory* Program

The KX3's frequency memories (pg. 17) can be easily viewed and changed using our ***K3 Memory*** PC application. This program shows the contents of all 100 regular memories and the per-band quick-memories in a spreadsheet format.

You can also set VFO A directly to a memory from within the K3 Memory program.

# Configuration

You'll need to set up **Option Module Enables** (see below) anytime you add one or more option modules. This is done at the factory for factory-installed options.

Other **Menu Settings** (at right, and on the following page) can be modified at any time. However, you'll probably want to set up some of them when you first receive a factory-assembled KX3, or upon completing kit assembly.

## Option Module Enables

Whenever an option is installed, use the associated menu entry to set it up (see below).

- **KXAT3 Antenna Tuner (ATU):** Set *ATU MD* to **AUTO**. Exit the menu and turn the KX3 off, then back on. See pg. 6 for recommended antennas and pg. 14 for ATU controls.
- **KXFL3 Roofing Filter Module:** Set *RX XFIL* to **NOR**. Exit the menu and turn the KX3 off for 5 seconds, then back on. ***You must then perform the*** **Receive Sideband** calibration step (pg. 31).
- **KXPD3 Keyer Paddle:** Set *CW KEY2* to **LEFT** paddle **= DOT** (normal) or **= DASH** (reverse). If you set it to **HAND**, either paddle can be used as a hand key. Note that the **KEY** jack on the left side panel is configured using the *CW KEY1* menu entry. The keying device plugged into **KEY** is completely independent of the KXPD3.
- **KXBC3 Internal NiMH Battery Charger:** Set *BAT CHG* to **NOR**. Exit the menu and turn the KX3 off for 5 seconds, then back on. See **Using Internal Batteries** (pg. 24) for battery recommendations and charging instructions.
- **KX3-**2M **2-Meter Module:** Future option.
- **KXPA100 External 100-W amplifier:** Future option.

⚠ **After changing option enables, use *KX3 Utility* to save your present configuration.** The configuration can then be restored later if later required.

## Menu Settings

The menu entries described in this section can be used to tailor KX3 operation to your own needs. You can also review the full list of menu entries, starting on pg. 33.

⚠ **After changing menu settings, use *KX3 Utility* to save your present configuration.** The configuration can then be restored later if required.

### *Audio Effects*

If you sometimes use stereo headphones or two external powered speakers, try setting the audio effects mode (*AFX MD*) to **DELAY**. (This has no effect on the internal speaker.) **DELAY** creates a simulated stereo effect that can reduce listening fatigue. If you encounter a pile-up of CW signals, try the **PITCH** setting, which "maps" signals from left to right in the audio space based on their pitch.

### *AM and FM Mode Disable*

If you don't plan to use AM and/or FM modes, you can disable them individually using the *AM MODE* and *FM MODE* menu entries.

### *Auto Power-Off*

The KX3 can turn itself off after a specified period of inactivity (i.e., no use of the controls). This is most useful when the unit is running from a small battery. Use the *AUTOOFF* menu entry to select the time period in minutes. The default is **INFINITE**.

⚠ If battery charging is in progress, the KX3 won't turn itself completely off; it will "hibernate" until charging is complete (pg. 24).

### *Low-Battery Warning*

You can set *BAT MIN* to warn you when an internal or external battery is approaching end of charge. **BAT LOW** is displayed periodically when this level is reached. The default voltage (**11.0** V) is appropriate for most 12-V batteries. For suggested low-battery warning levels for other battery types, see the *BAT MIN* menu entry.

### *Band Map*

If there are some bands you don't plan to use, you can remove them from the band-switch rotation using *BND MAP*. This can save time when switching bands. Within the *BND MAP* menu entry, you can switch bands using **BAND+** and **BAND-**. Set each band to **IN** or **OUT** as desired.

### *CW Iambic Mode*

CW users can specify Iambic mode A or B using the *CW IAMB* menu entry. The default is mode **A**, which is a little more forgiving for first-time operators. Mode **B** may be preferred by operators who learned to do "squeeze-keying" with another keyer having this or a similar mode. Both modes provide dot- and dash-memories—enabling fast code speeds—but with slightly different timing.

### *Microphone Settings*

If you plan to use voice modes, set up *MIC BIAS* and *MIC BTN* to match your microphone (pg. 33).

### *Preamp Gain (Per-Band)*

The default (and recommended) preamp gain is **20 dB** on all bands. However, you can select **10 dB** if 20 dB is too much gain on a given band. (Operating with the preamp turned off may be a better choice in such cases.) The 10-dB preamp adds about 15 mA to receive-mode current drain, while the 20-dB preamp adds only about 5 mA.

⚠ A **30 dB** selection is also available that turns on *both* preamps. However, this setting increases susceptibility to strong signals. It would typically be used only on 6 meters, where the combination of the two can improve sensitivity by 1 to 2 dB.

### *Switch press Tones*

Switch press tones are enabled by default. Using the *SW TONE* menu entry, you can turn tones **OFF**, or select Morse code switch feedback at various speeds (**CODE nn**). Switch tone volume is the same as CW sidetone volume, which can be adjusted in CW mode (pg. 12).

### *Setting the Time*

*MENU:TIME* sets the 24-hour real-time-clock (RTC) if a KXBC3 module is installed. If no KXBC3 is installed, the displayed time will start at **00:00:00** when the KX3 is turned on.

While in the menu entry, tap **1** / **2** / **3** to select HH/MM/SS (hours/minutes/seconds), respectively. Then use VFO A to adjust the value. *KX3 Utility* can also be used to accurately set the time.

Tap **DISP** and rotate VFO B to display the present time.

### *VFO Setup*

Several menu entries are provided to control VFO behavior:

- *VFO CRS* sets up the **KHZ** tuning increment for each mode (coarse tuning) on a per-mode basis.
- *VFO CTS* specifies the number of counts per knob turn (VFO A and B): **128** or **256.** The lower setting makes fine-tuning easier, especially for mobile use. The higher setting allows quicker tuning.
- *VFO OFS*, if set to **YES**, allows the OFS/VFO B knob to do coarse tuning of VFO A. (This only applies if the knob is not being used for RIT, XIT, or to select VFO B display modes. See pg. 33.)

### *TUNE Power Level*

If you're using an external antenna tuner or amplifier with the KX3, you may need to limit the power level used during **TUNE**. The *TUN PWR* menu entry can be used to set the desired power level. For example, with an Elecraft T1 ATU, the best tuner power level is about 3.0 watts.

ⓘ If you have the KXAT3 internal ATU installed, power is automatically set to 3.0 watts during antenna tuning. There's no need to configure *TUN PWR* for this purpose.

### *VOX (Voice Operated Transmit) Setup*

If you plan to use VOX in voice modes, you'll need to set up the *VOX GN* and *VOX INH* (anti-VOX) menu entries as described on pg. 33.

# Calibration

**⚠ CAUTION: Calibration steps are normally completed at the factory, or during kit assembly. Each step must be performed exactly as specified to ensure that the KX3 meets its specifications.**

***If you have just completed kit assembly,* you must perform all calibration steps, in the order listed here, except those marked as optional.**

Calibration procedures use **Tech-Mode** menu entries. To view these, hold MENU, then rotate the rotate ⏲ OFS / VFO B to locate the *TECH MD* menu entry. Change the parameter to **ON**. Exit the menu by again holding MENU.

**To change a tech-mode parameter,** locate the desired menu entry, then hold KHZ until you see the lock symbol (🔒) turn off (about 3 seconds).

## Reference Frequency (optional)

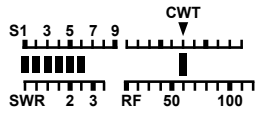
The first time you turn on the KX3, the reference self-calibrates based on information stored in the synthesizer. This results in accuracy of about +/- 5 or 10 ppm. Using the calibration procedure below, you can improve accuracy to better than +/- 1 ppm.

This procedure requires a highly-accurate signal generator, or an on-air signal at a known frequency, such as WWV at 5, 10, or 15 MHz. The carrier of a commercial AM broadcast station can also be used.

ⓘ During the procedure, you'll have a choice of two methods for adjusting the reference frequency: **(1) automatic tuning**, or **(2) manual tuning**. Method (2) may be slightly more accurate but requires "zero-beating" of two signals, which some operators may find difficult to do. (You can easily restore the original self-calibration setting, if necessary, as explained at the end of the procedure.)

- Select CW mode by tapping MODE.
- If you're connecting a signal generator to the antenna jack, set ⏲ PWR to 0.0 watts to avoid accidental damage to the generator.
- Use direct frequency entry (pg. 10) to set VFO A to the exact frequency of your signal generator or on-air signal source. This will also switch to the required band.
- Set AF gain for a comfortable listening level. You should be able to hear a carrier.
- **Method 1 (automatic tuning):** 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.

  **Method 2 (manual tuning):** This method requires manually matching the pitch of the received signal to the CW sidetone pitch using SPOT. To prepare for this, you may need to increase sidetone volume. See pg. 12.
- Locate the **I/II** icons, at the right end of the filter passband graphic. If function **II** is selected, tap PBT I/II to select function **I** (bandwidth).
- Rotate the ⏲ PBT I/II control to set the bandwidth to 0.25 kHz (**BW 0.25**).
- Tap PBT I/II to switch to function **II** (shift).
- Rotate the ⏲ PBT I/II control until the filter passband is centered in the filter graphic.
- Hold MENU, then rotate ⏲ OFS / VFOB to locate the *REF CAL* menu entry.
- Hold KHZ for about 3 seconds to unlock the parameter. If the parameter has just one digit to the right of the right-hand decimal point, tap RATE to select the slower tuning rate.
- **Method 1 (automatic tuning, CWT on):** 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.




  **Method 2 (manual tuning, CWT off):** Tap SPOT and manually adjust the *REF CAL* parameter using VFO A until the received signal pitch matches the sidetone pitch. Adjust for zero-beat.
- If you have difficulty with this procedure, or if you're not sure that it worked correctly, you can hold CLR (hold function of the OFS/VFO B control) to return the *REF CAL* parameter to its original self-calibration value.
- Exit the menu by holding MENU.

## Receive Sideband

**⚠ This procedure is normally completed during kit assembly or at the factory. However, if you install a KXFL3 module anytime after initial calibration, you'll need to re-do the procedure.**

Receive sideband calibration suppresses (or nulls) the received *opposite-sideband image* response. If this step is not completed, you'll hear unwanted images of strong signals when tuned a short distance from their frequency.

**⚠ A strong on-air signal (CW or AM) or a stable high-level signal source is required. The signal used must be between 13 and 15 MHz** (ideally 14.0-14.3 MHz)**.** You can use a stable RF signal generator of any kind for this purpose, including an Elecraft XG3 or any transmitter or transceiver covering the 20-meter ham band. Various methods of obtaining a suitable signal are covered in the procedure.

*[To be completed.]*

## Transmit Bias

This fully automated procedure sets the bias current of the 10-watt amplifier stage for CW and voice modes. No external test equipment is needed.

**⚠ A 12-14 volt external power supply or battery should be used during this procedure.**

- Hold MENU, then rotate ⏲ OFS / VFOB to locate the *TX BIAS* menu entry.
- Hold KHZ for about 3 seconds to unlock the parameters.
- Select CW mode by tapping MODE one or more times.
- Tap XMIT to start CW bias calibration. This takes as long as 5-10 seconds. If an error message appears at the end (**ERR nnn**), see Troubleshooting.
- Select SSB (LSB or USB) mode by tapping MODE one or more times.
- Tap XMIT to start SSB bias calibration. This takes as long as 5-10 seconds. If an error message appears at the end (**ERR nnn**), see Troubleshooting.
- Exit the menu by holding MENU.

## Transmit Carrier

In some modes, the KX3's transmitted signal is offset a small distance from the carrier or local oscillator frequency. The carrier must be suppressed (or nulled) enough that it cannot be easily heard by other stations.

**⚠ To accurately null the transmit carrier, you'll need a stable CW or SSB receiver that covers the 20-meter ham band (14.0-14.3 MHz).** Consumer-grade receivers providing shortwave coverage often provide only AM mode, which cannot be used for this purpose, and have poor selectivity and stability. On the other hand, virtually any amateur-radio receiver or transceiver covering the 20-meter band will suffice.

If a receiver is not currently available, you can temporarily skip this step. The default *TXCRNUL* menu setting will provide a useful amount of transmit carrier suppression.

*[To be completed.]*

## Transmit Gain

This procedure compensates for per-band transmit gain variations at two different power levels, and **must be done on every band**. A fully-automated transmit gain procedure is provided by the *KX3 Utility* program as described below.

**⚠ A 12-14 volt external power supply or battery should be used during this procedure.**

### *Automated Transmit Gain Calibration*

If a computer is available, you can use the automated transmit gain calibration procedure. Connect the KX3 to a computer, run ***KX3 Utility***, and select the ***Calibration*** tab. Click on **Calibrate Transmitter Gain** and follow the on-screen instructions.

### *Manual Transmit Gain Calibration*

- Use direct frequency entry (pg. 10) to set the KX3's operating frequency to 1.9 MHz (160 meters).
- If you have the KXAT3 ATU option installed, put it into bypass mode (*MENU:ATU MD*).
- Set the *TUN PWR* menu entry to NOR.

- Connect a dummy load to the BNC jack.
- Set ⏲ PWR to exactly 4.0 watts (pg. 14).
- Hold TUNE ; wait until VFO B shows **4.0** W.
- Tap XMIT to exit TUNE.
- **Repeat the above procedure on 80-6 meters.** Use approximately the following frequencies: 3.7 MHz (80 m), 5.4 MHz (60 m), 7.1 MHz (40 m), 10.1 MHz (30 m), 14.1 MHz (20 m), 18.1 MHz (17 m), 21.2 MHz (15 m), 24.9 MHz (12 m), 52 MHz (6 m).
- **Repeat transmit calibration at 6.0 W on all bands.**

## Transmit Sideband

In some modes, the KX3's transmitted signal includes an opposite-sideband image offset a small distance from the normal sideband. Like the transmit carrier, this image must be suppressed (nulled) to a significant degree.

⚠ **To accurately null the transmit sideband image, you'll need a stable CW or SSB receiver.** Receiver requirements are the same as described for **Transmit Sideband** calibration (pg. 32).

If a receiver is not currently available, you can temporarily skip this step. The default *TXSBNUL* menu setting will provide a useful amount of transmit opposite-sideband suppression.

*[To be completed.]*

⚠ **After performing one or more Calibration steps, use *KX3 Utility* to save your present configuration.** The configuration can then be restored later if required.

# Menu Functions

Hold MENU to enter the KX3's menu. Tap or hold this switch to exit. Menu entries that you'd like quick access to can be assigned to programmable function switches (pg. 19).

### *Menu Help Information*

Holding MENU for about 3 seconds while in the menu shows information about the present menu entry on VFO B. For most entries, the default parameter value is shown in parentheses at the start of the help text. Tap the switch to terminate the help text display.

### *Tech-Mode menu entries*

The 🔒 symbol in the table below indicates a ***tech mode*** menu entry. These are typically used for calibration, and their parameter values are locked by default, as indicated by the same lock symbol on the display. To see tech-mode menu entries, set *MENU:TECH MD* to **ON**. To change any tech-mode parameter, you must first unlock it by holding KHZ for about 3 seconds. This turns off the lock symbol.

| Entry | Default | Description |
|---|---|---|
| 2 TONE 🔒 | OFF | Enables built-in 2-tone generator for SSB transmit tests. The internal 2-tone generator only works if LSB or USB mode is selected. After setting 2-tone **ON**, exit the menu and tap XMIT. You can use ⏲ MIC to adjust the amplitude of one of the tones; the other's amplitude is fixed. |
| AF LIM | NOR | Adjustable AF output limiter for use when AGC is turned off. This can protect your ears if a large signal appears. Signals or noise above the threshold will sound highly distorted due to the limiting action, reminding you to back down the AF or RF gain. Typical settings for those who often turn AGC off are 17 to 23; some experimentation will be required. |
| AFX MD | Delay 5 | Audio Effects. Selections: **DELAY 1-5** (quasi-stereo); **BIN** (L/R phase shift) |
| AGC MD | ON | Some operators prefer to turn AGC off and control gain manually using the RF gain control; see pg. 12. (When AGC is off, the AGC icons on the LCD change to **AGC-** , with the "minus" sign meaning "off".) This increases your risk of having an uncomfortably-strong signal appear in your headphones or speaker. To reduce the impact of this, you should set the AF limiter to the desired threshold (see *AF LIM*). The limiter is only used when AGC is turned off. |
| AGC SPD | SLO | This setting is stored per-mode. The default for CW mode is **FAST**, and for other modes, **SLO**. The setting is indicated by the **AGC S** and **F** display icons. |
| AGC*THR | 005 | Note: This is a temporary placeholder for several AGC menu entries. You can tap the '1' through '5' switches to access the following parameters: **THR**, **ATK**, **HLD**, **DCY** (affected by *AGC SPD* selection), and **SLP**. Details pending. |
| ALARM | OFF | Set alarm/Auto-Power-On time. Tap 1 to turn alarm on/off; tap 2 / 3 to set **HH**.**MM**. If a KXBC3 option module is installed and an internal battery is installed, time will be maintained when power to the transceiver is turned off. Otherwise the time registers will reset to **00:00:00** on power-up.<br>At the alarm time, the KX3 will emit three short beeps. If power had been turned off, AF output will then be restored to the last-used level. |
| AM MODE | ON | Set to **OFF** if AM operation is not planned. You can still copy AM signals using SSB modes even if AM is turned off. |

| | | |
|---|---|---|
| ATU MD | Not Inst | KXAT3 ATU mode (or KXAT100, if connected to the KX3). This is normally set to **BYP** or **AUTO**. Modes **L1-L8**, **C1-C8**, and **Ct** are used to test the KXAT3's relays and L-network. Tapping **CLR** clears stored LC data for the present band. |
| AUTO INF 🔒 | NOR | If set to **AUTO 1**, the KX3 will send band data ("automatic info") to its ACC1 port for use with devices such as the SteppIR™ antenna. The data is actually sent on every band change, and once per second if the VFO is being moved. (**AUTO 1** may not be compatible with PC applications that use the "AI" command.) |
| AUTO OFF | INFINITE | Sets auto-power-off time in minutes. If set to **INFINITE**, power is never turned off. A setting of **5** or **10** minutes is recommended when running from batteries. |
| BAT CHG | Not Inst | If the KXBC3 option is installed (NiMH charger and real-time clock), set to **NOR**. Other settings are used for battery charging; see pg. 24. |
| BAT MIN | 11.0 | Low-battery warning threshold. The default (**11.0** volts) is sufficient for use with most 12 V batteries. For NiMH internal batteries, a setting of **8.2** V is recommended. For internal alkaline or nonrechargeable lithium batteries, **9.0** V. If the internal battery or external supply/battery voltage drops below this level, the operator will be alerted with a **BAT LOW** message. The KX3 will turn itself off if the supply voltage drops below 8.0 V. For tips on extending battery life, see pg. 24. |
| BKLIGHT | ON | LCD backlight on/off. The display is transflective, so it can be seen in sunlight with the backlight turned off. Turning it off will extend battery life. |
| BND MAP | {band} In | Allows you to remove one or more bands from the **BAND** rotation. Use **BAND** up/down to select bands, then set them to **In** or **Out** using VFO A. (Works with transverter bands, too.) You can still get to mapped-out bands using memory recall, direct frequency entry, or computer-control commands. |
| COR LVL 🔒 | NOR 0.1 | Sets the carrier-operated-relay (COR) threshold. The COR is used to detect, and protect the KX3's receiver from, a transmitter being used nearby. **0.1** watts is the default and recommended level. See **Troubleshooting** for other suggestions. |
| CW IAMB | A | Iambic keying mode (**A** or **B**). The default is mode **A**, which is a little more forgiving for first-time operators. Mode **B** may be preferred by operators who learned to do "squeeze-keying" with another keyer having this or a similar mode. Both modes provide dot- and dash-memories—enabling fast code speeds—but with slightly different "element-insert" timing. |
| CW KEY1 | TIP=DOT | Specifies whether the left keyer paddle (***tip*** contact on the **KEY** jack) is **DOT** or **DASH.** A third selection, **HAND**, allows either tip or ring to function as a hand key, or as an input for an external keying device (keyer, computer, or keyboard). |
| CW KEY2 | LFT=DOT | Specifies whether the **left** lever of the optional KXPD3 keyer paddle is **DOT** or **DASH.** A third selection, **HAND**, allows either lever to function as a hand key, or as an input for an external keying device (keyer, computer, or keyboard). |

| | | |
|---|---|---|
| CW WGHT | 1.25 | Adjusts element/space timing ratio (weight) for the internal keyer.<br>**Additional functions of this menu entry, via numeric keypad:**<br>Tap 1 to select **SSB -CW** (default) or **SSB +CW** (allows CW in SSB modes).<br>Tap 2 to select **@ = STOP** ('@' character terminates KY-packet transmission; default) or **@ = 'AC'** ('@' in a KY packet is sent as **.--.-. [@]** in CW mode).<br>Tap 4 to select **VOX NOR** (default) or **AUTO OFF**. The **AUTO OFF** setting turns CW VOX *off* on power-up, avoiding accidental keying by attached PCs, etc.<br>Tap 5 to select automatic VFO offset on SSB/CW mode change (**VFO OFS**) or no offset (**VFO NOR**, default). Automatic offset is often used on 6 meters, where mixed-mode QSOs are necessary during fading. **Note:** Pitch matching will be more accurate if USB is paired with CW REV, and LSB with CW normal. |
| DUAL RX | OFF | Set to on to enable *Dual Watch* (pg. 20). The **SUB** icon will turn on. |
| FM DEV 🔒 | 5.0 | FM voice deviation in kHz. Tap 1 to change the function to *PL DEV* (PL tone deviation). **Note:** The deviation setting for sub-audible tones (CTCSS) is separate from that for the European standard tone (1750 Hz). Before adjusting *PL DEV*, select the desired pitch with the **PITCH** switch. |
| FM MODE | ON | If set to **OFF**, FM will be removed from the mode selections. |
| FW REVS | N/A | Rotate VFO A to see firmware revisions: MCU (**µC**, shorthand for *micro*controller), and DSP (**dSP**). |
| LCD TST | OFF | Rotate VFO A to turn on all LCD segments for test purposes. |
| MIC BIAS | ON | Set to **ON** for the Elecraft MH3. You may need to try both *MIC BIAS* settings to see which works best with your mic. Monitor your transmitted signal with another receiver when testing mic audio. |
| MIC BTN | PTT<br>UP.DN | If your mic has both a PTT switch and UP/DN buttons, set the parameter to **PTT UP.DN**. This applies to the Elecraft MH3. If the mic has PTT but no UP/DN buttons, use **PTT**. Otherwise, use **OFF**. This applies to most headset-mics, including the Heil models available from Elecraft. Third-party mics may not have a KX3-compatible PTT (push-to-talk) switch. You can still key the transmitter either by tapping the XMIT switch or by using VOX (pg. 15). |
| MSG RPT | 6 | Message repeat interval in seconds (**0** to **255**). To repeat a message, ***hold*** M1 – M4 rather than ***tap***. A 6 - 10 sec. interval is about right for casual CQing. Shorter intervals may be needed during contests, and longer for periodic CW beacons. |
| PREAMP | 20 dB | Sets preamp gain to **10**, **20**, or **30 dB** on a per-band basis. (30 dB is typically used only on 6 meters, where it improves sensitivity by 1-2 dB. This setting should only be used if necessary, since it increases susceptibility to overload.)<br>There are actually two preamps: the 20 dB low noise amp (LNA) and the 10 dB setting of the *isolation amp* (see *RX ISO*, below). Use the 20-dB preamp when possible, since it has a better noise figure and lower current drain. If you select 10 or 30 dB, the isolation amp is also turned on, adding ~15 mA to current drain. |
| REF CAL 🔒 | ~114 MHz | Used to calibrate the KX3's synthesizer. VFO A is used to set the reference frequency in Hz. Refer to pg. 30 for synthesizer calibration details. |
| RPT OFS | 600 | Sets the transmit offset (in kHz) for repeater operation, from **0** to **5000** kHz. Stored per-band and per-memory. Use ALT to select +/- offset or simplex. |
| RS232 | 4800 b | RS232 (or USB) communications rate in bits per second (bps). During firmware download (via the KX3FW PC program), the baud rate is set automatically to 38400 baud, but it is then restored to the value selected in this menu entry. |

| | | |
|---|---|---|
| RX EQ | +0 dB, each band | Receiver audio graphic equalizer. VFO A is used as an 8-band bar graph, showing boost or cut (**-16** dB to **+16** dB in 1 dB increments) for each AF band. The 8 bands are 0.05, 0.1, 0.2, 0.4, 0.8, 1.6, 2.4 and 3.2 kHz. Tap **1**-**8** to select an AF band. VFO A selects boost/cut. Tap **CLR** to reset all bands to +0 dB.<br>**CW and voice mode RX EQ are separate.** Not applicable to DATA modes. |
| RX I/Q | OFF | Set to **ON** to use the KX3 with SDR (software-defined radio) applications; pg. 25. |
| RX ISO | OFF | Set to **ON** if you're using the KX3 nearby other receivers operating on the same band, ***and*** a strong carrier from the KX3 is heard when its VFO is tuned to the same frequency as the other receiver's. The isolation amplifier is between the antenna jack and the mixer, preventing leakage from the KX3's local oscillator. |
| RXSBNUL | GAIN nnn | Used to null (attenuate) the opposite-sideband signal of each of the KX3's analog filter paths. See the **Receive Sideband** calibration procedure pg. 31. |
| RX XFIL | Not Inst | Set to **NOR** if a KXFL3 roofing filter module is installed. The *RXSBNUL* calibration procedure must be performed when this module is installed (pg. 31). |
| SER NUM | N/A | Your KX3's serial number, e.g. **05000**. Cannot be changed. |
| SMTR MD 🔒 | NOR | S-meter mode: When set to **NOR**, turning the preamp or attenuator on/off will affect the S-meter reading. If set to **ABS**, the S-meter reading will stay fairly constant with different preamp and attenuator settings. |
| SW TEST 🔒 | OFF | To turn on switch test, rotate VFO A until the parameter becomes **SCN ADC**. Then hold any switch to see its scan row and column ADC reading. You can also rotate any of the four potentiometers to see their associated ADC readings (main/sub AF gain and main/sub RF gain). If the SUB RF pot is mapped to main/sub squelch, you must switch to FM mode to see its readings. |
| SW TONE | OFF | If set to **ON**, switch presses generate audible feedback tones. If set to **CODE nn**, Morse code characters are generated, for both switch presses and knob rotation, at **nn** words per minute. See **Switch Press Tones** (pg. 29).<br>Switch tone volume is the same as CW sidetone volume. It must be adjusted in CW mode, using ⏲ **MON**.<br>**Tones generated**: In general, a *low-to-high* tone pair is generated when a switch function is turned on, and *high-to-low* when it is turned off. Following **ATU TUNE**, SWR <= 2:1 results in a normal tone; <= 3:1 a medium-pitch tone; and over 3:1, a high-pitched tone. If *MENU:RIT CLR* is set to **UNDO ON**, tapping **CLR** a second time (RIT clear "un-do") produces a unique low-to-high tone pair.<br>Some switches do not generate tones because they might interfere with received or transmitted audio. |
| TECH MD | OFF | Set to **ON** to view ***Tech Mode*** menu entries (those marked with 🔒 in this list). |
| TIME | N/A | Real-time-clock view/set. Tap **1** / **2** / **3** to set HH / MM / SS. To see the time and other displays during normal operation, tap **DISP** (see pg. 11). Time is only maintained if a KXBC3 option module and an internal battery are installed. |
| TUN PWR | NOR | If set to **NOR**, **TUNE** power level follows the POWER knob. Otherwise, establishes a fixed power level for **TUNE**, overriding the present POWER knob setting. **Note1:** *TUN PWR* does not pertain to **ATU TUNE**, which always uses 5 or 10 W and is internally controlled. It also does not apply to transverter bands using the low-power KXV3 output (XVTR OUT). **Note2:** see *MENU:PWR SET* for per-band power control. |
| TX BIAS 🔒 | ppp qqq | Transmit bias constants. See the **Transmit Bias**, pg. 31. |
| TXCRNUL 🔒 | 1 -nnnnn | Used to null the transmit carrier. See **Transmit Carrier**, pg. 31. |

| | | |
|---|---|---|
| TX EQ | +0 dB, each band | Transmit audio graphic equalizer (voice modes only). Functions the same as *RX EQ*, above. TX EQ can be adjusted during transmit. **SSB TX EQ is separate from TX EQ for other voice modes.** Not applicable to CW or DATA modes. |
| TX ESSB | OFF 3.0 | Extended SSB transmit bandwidth (**3.0** to **4.0** kHz) or **OFF**. Tap 1 to turn on/off and rotate VFO A to select the bandwidth. (Also see pg. 22.) |
| TX GAIN 🔒 | ALC nn | Shows transmit gain constant for the present band and power setting. Two gain constants are used: one for PWR settings of 5.0 watts or less, and the other for PWR settings of 5.1 watts or higher. The gain constants are calibrated whenever the **TUNE** function is activated at exactly **4.0** or **6.0** W. See **Transmit Gain** calibration procedure, pg. 31. |
| TX GATE | OFF 0 | The TX noise gate can be used to suppress transmitted audio below a certain level, e.g. that of an amplifier fan. Tap 1 within the *TX GATE* menu entry to turn the noise gate on/off. Use VFO A to set the desired threshold. Since there's no visual indication that transmit audio is below the threshold, you should adjust it using the transmit voice monitor (MON), ideally while using headphones. Set the threshold high enough to cut off transmit audio due to local noise, but not so high that it causes your voice to drop out too frequently. |
| TXSBNUL 🔒 | GAIN nnn | Used to null transmit opposite sideband. See **Transmit Sideband**, pg. 32. |
| VFO CRS | Per-mode | Per-mode coarse tuning rate (hold **KHZ** and tune VFO A or B). Tap 1 to turn rounding on/off. Also applies to the RIT/XIT tuning knob if *MENU:VFO OFS* is set to **ON**, and both **RIT** and **XIT** are turned off. |
| VFO CTS | 128 | VFO counts per turn. Use **128** for easier fine-tuning of VFO; use **256** for faster tuning. Note: The **KHZ** tuning rate always uses 128 counts per turn. |
| VFO OFS | OFF | If **ON**, the RIT/XIT offset control can be used to tune VFO A in large steps when **RIT** / **XIT** are off and the OFS function of the OFS/VFO B knob is selected. Step sizes vary by mode (see *VFO CRS*), and are the same as the **KHZ** tuning rates. |
| VOX GN | 025 | Adjusts the sensitivity of the VOX to match your mic and voice. |
| VOX INH | 000 | Adjusts immunity of the VOX circuit to false triggering by speaker audio. (Also known as anti-vox.) A setting of about 30 is a good starting point. If receive audio from a speaker trips the vox, increase the setting. |
| WATTMTR 🔒 | 100 | Wattmeter calibration parameter. The default setting is recommended. If an external, known-accurate wattmeter reads lower than the KX3's wattmeter, decrease the parameter value (and vice-versa). **Note:** The ATU (KXAT3), even when bypassed, may cause a small amount of loss (typically less than 0.5 dB). Internal wattmeter accuracy may vary by up to 1 dB, varying with band. |
| XVn ON 🔒 | NO | Tap 1 – 9 to select the applicable transverter band (**1 - 9**). Set parameter to **YES** to turn the transverter band on. |
| XVn RF 🔒 | 144 | Lower edge for transverter band n (**1-9**); **0-24999** MHz. (Tap 1 – 9 to select applicable transverter band.) Normally, **144** would be used for the K144XV internal 2-m module. But if the K144XV is being used as an IF for a higher-band transverter, you can set it to the lower edge of the higher band. |
| XVn IF 🔒 | 28 | Specify KX3 band to use as the I.F. for transverter band n (**1-9**). (Tap 1 – 9 to select the transverter band.) I.F. selections include **7**, **14**, **21**, **28**, and **50** MHz. Use **50** MHz for the K144XV internal 2-m module. |
| XVn PWR 🔒 | H 0.1 | Sets upper limit on power level in watts for XVTR band n. Applicable only to external transverters, not the KX3-2M module. Tap 1 – 9 to select band.<br>The KX3 does not have a low-level transverter port, so external transverters must have their own T/R switching and be able to handle the specified power level. |

| | | |
|---|---|---|
| XVn OFS 🔒 | 0.00 | Offset (**–9.99** to +**9.99** kHz) for transverter band n (**1**-**9**). (Tap **1** – **9** to select transverter band.) Compensates for oscillator/multiplier chain errors in external transverters. Not applicable to the internal KX3-2M module, which derives its signal from the KX3's synthesizer. |
| XVn ADR 🔒 | TRNn | Assigns optional band-decode addresses to transverter bands. Addresses **TRN1**-**7** can be used to select Elecraft XV-series transverters if the *ACC2* IO menu entry is set to **TRNS ADR** and the transverters are connected to the ACC2 jack (tip=auxBus, ring=key out). TRN0 is used with the KX3-2M module (internal). Tap **1** – **9** to select the transverter band; rotate VFO A to select the address.<br><br>To configure an Elecraft KX3-2M 2 m module as XVTR band 1, set *XV1 ON* to **YES**, *XV1 RF* to **144** MHz, *XV1 IF* to **50** MHz, and *XV1 ADR* to **TRN0**. The *XV1 OFS* and *XV1 PWR* menu entries are not applicable in this case. |

# Troubleshooting

The most common symptoms and their causes are listed below, in three categories (general, transmit, and receive). Most problems are related to control settings. If the problem persists, please contact Elecraft support (see pg. 50) or post a question on our email reflector.

### *General*

- **ERR** (error) message appears in the VFO B area (**ERR nnn**): Refer to **Error Messages** (pg. 42). If a large number of error messages are seen at power-on, the ribbon cable between the RF and control panel boards may be partially unplugged.
- **BAT LOW is flashed periodically:** Check the battery voltage (tap **DISP** and rotate VFO B until the supply voltage display appears). If the batteries are at their normal voltage, you may have *MENU:BAT MIN* set to the wrong low-battery warning level. See this menu entry for recommendations.
- **Can't turn power on:** Check the power cable. If running from internal batteries, make sure they're installed, seated properly, oriented in the right direction, and charged.
- **Can't turn power off:** If the display remains on, or the unit is otherwise unresponsive, disconnect the power supply. (If internal batteries are in use, remove one battery.) Allow 5-10 seconds, then reconnect power and try turning the unit on.
- **General problem with transmit and/or receive:** Many problems can be caused by low power supply voltage or by a noisy or intermittent supply. Check your power supply's on/off switch, voltage, fuses (if applicable), and DC cabling. The KX3 provides both voltage and current monitoring (pg. 11). Also see ***Transmit*** and ***Receive*** troubleshooting sections, below.
- **General problem with firmware behavior:** (1) Check all menu settings (see menu listings in the previous section). In addition to the information in the manual, each menu entry provides help text by holding **MENU** for about 3 seconds. (2) Try loading the latest microcontroller and DSP firmware. Review the release notes for changes that may be related to your symptoms. (3) If the above suggestions don't help, you can try reinitializing the firmware (pg. 41). **Be sure to save your configuration first, using KX3 Utility.**
- **Bands missing from BAND switch rotation:** See *MENU:BND MAP*.
- **N/A message (Not Applicable)**: The function you're trying to use does not apply in the present context.
- **Mode icon flashes**: This is a reminder that you're about to set the KX3 up for cross-mode SPLIT operation (VFOs in different modes). Tap any key to clear. To view and change VFO B's mode, tap **A / B**.
- **VFO A or B display doesn't change when the knob is rotated:** You may have the affected VFO locked. Tap **RATE** to unlock.

### *Transmit*

- **BND END:** Attempt to transmit out of the allowed ham band.
- **TX LED on all the time:** This could indicate that PTT is being held on by external equipment. Try disconnecting everything connected to the left side panel except the power supply. VOX gain (*VOX GN* menu entry) may be set too high.
- **HI CUR** or **HI SWR warning:** Check supply voltage. If voltage is low and/or a low-impedance antenna load is present, current can go up for a given requested power level. Reduce power if necessary. (The KX3 may do this automatically. If this doesn't reduce the current or reflected power to safe levels, the KX3 will drop out of transmit mode.)

- **HI TEMP warning:** PA heat sink temperature has exceeded the safe operating limit. Use DISP to check power supply voltage, current drain, and PA temperature. Allow heat sink to cool. Reduce power if necessary. (The KX3 may do this automatically. If that doesn't reduce the temperature, the KX3 will drop out of transmit mode.)
- **KX3 enclosure is hot to the touch on the back edge:** During hand-held or lap-top operation at high power or high duty cycle, the enclosure may feel uncomfortably warm. Reduce power or use shorter transmissions. **Note:** At 3.0 watts or lower, the KX3 uses a high-efficiency (lower-current) transmit mode, reducing the rate of heating and extending battery life.
- **An asterisk (*) appears in the PWR setting display (VFO B):** Transmit ALC has been turned off. To turn it back on, go to *MENU:TX GAIN* , unlock the parameter by holding KHZ for 3 seconds, then tap DLY. This will turn off the (**-**) sign in front of **ALC**.
- **Can't transmit in CW mode:** (1) Make sure the key or keyer paddle is plugged into the correct jack. (2) You must have VOX selected (**VOX** icon on) in order to use hit-the-key CW. (3) You may be in SPLIT mode, with VFO B set for a voice or data mode. Tap A/B or use BSET to check VFO B's mode.
- **Can't use the mic in voice modes:** You may be in SPLIT mode, with VFO B set for CW or data mode rather than a voice mode. Tap A/B to check VFO B's mode.
- **No power output:** Try redoing **Transmit Gain** calibration (pg. 31).
- **Excessive transmit carrier leakage:** The voice- and data-mode carrier will typically be down 60 dB or more at 10 watts output. If it is significantly higher than this level, redo the **Transmit Carrier** calibration step (pg. 31).

### *Receive*

- **HI RFI warning, preamp turns off, or RX icon turns on**: The KX3 protects itself from high received signal levels. First, the preamp is turned off, if it was on. (You may be able to avoid this by using the 10-dB preamp rather than the 20-dB preamp on the current band. See *MENU:PREAMP*.) The second step taken by the KX3, if necessary, is to turn on a 15-dB attenuator stage in the I.F. section, ahead of the receiver's A-to-D converter. The receive overload icon (**RX**), near the **ANT** icon, will turn on. Once signals return to a safe level for 5 seconds, this attenuator will be turned back off. Also see COR (next item).
- **Carrier-operated relay activated (a relay is heard, and the RX icon turns on):** The carrier-operated-relay (COR) may be activated due to the signal from a nearby transmitter. This is usually due to close proximity between your antenna and the other station's antenna. The COR is actually the relay for the present low-pass filter. When the relay opens, signals will drop by 40 to 60 dB, protecting the KX3. The relay will close again shortly after the signal drops. If the COR is being repeatedly activated, try moving the antennas farther apart. You can also increase the COR threshold, at your discretion; see *MENU:COR LVL*.
- **HI CUR warning**: **HI CUR** usually indicates that speaker volume is too high; the KX3 will automatically reduce gain in this case. It may also indicate a short or other unsafe operating condition. In this case the KX3 will power itself off.
- **No received signal:** Check (1) antenna connectors; (2) squelch (FM mode); (3) RF gain too low (set RF gain control fully clockwise, to **–0 dB**); (4) bandwidth too narrow (PBT I/II control); (5) *MENU:REF CAL* parameter not adjusted properly; (6) *KXFL3* menu entry set to **NOR** but module not installed.
- **Received signal level too low:** (1) check headphone and speaker plugs and cables; (2) make sure that *MENU:RX EQ* settings are either flat or have not been set for a large amount of cut; (3) verify that *MENU:REF CAL* is properly adjusted; (4) make sure RF gain is set to maximum; (5) preamp set to 10 dB rather than 20 dB (*MENU:PREAMP*).
- **Spurious signals ("birdies"):** All receivers exhibit some birdies. Most will be inaudible with an antenna connected. In the KX3, there may be significant birdies or harmonics of birdies at the following frequencies

due to internal signal sources: 16000 +/- 5 kHz (MCU clock frequency), 300-900 kHz (DC-DC converter oscillators, CMOS RF switches). In the unlikely event that a birdie interferes with operation, try CW reverse, manual notch, or (in voice modes) auto-notch.

- **Opposite-sideband images heard:** Opposite-sideband image suppression is typically 50-60 dB. If sideband images appear too high in amplitude, carefully redo the **Receive Sideband** calibration procedure (pg. 31). If sideband image rejection is poor only for FL2 and/or FL3, but not FL1, the KXFL3 roofing filter module may be at fault.
- **Low-level signals are heard that don't change as the VFO is rotated:** In a receiver, it's possible for extremely strong signals to mix with other signals (or their own sidebands) to create audible low-level products that are not affected by tuning the VFO. If this occurs, turn off the preamp. If the condition persists, turn on the attenuator. If the source of such signals is a nearby transmitter (such as at Field Day), try reorienting or moving one of the antennas.
- **KX3 VFO heard in a nearby receiver:** If a nearby receiver is picking up the KX3's own local oscillator signal, turn on the isolation amp (*RX ISO* menu entry). **Note:** This increases current drain by about 15 mA if the isolation amp was not already being used as a 10-dB preamp. Turn *RX ISO* off when not needed.
- **AM broadcast signals in the 300-700 Hz range appear to be off-frequency:** Broadcast signals that appear not to tune in at even multiples of 1 kHz may actually be *harmonic images* of AM broadcast signals higher up in the band. You can eliminate most of these images by installing the KXAT3 ATU option, which includes a high-Q broadcast band filter that tracks the VFO.

## Parameter Initialization (EEINIT)

It is possible, though rare, for EEPROM parameters to become altered in such a way as to prevent the firmware from running correctly. If you suspect this, you can reinitialize parameters to defaults, then restore a previously-saved configuration (or re-do all configuration steps manually; no test equipment is required).

- **IMPORTANT:** Run the ***KX3 Utility*** program, then use the **Save Configuration** function to save your present firmware configuration. **(Failure to do this will result in the need to re-do all calibration steps after EEINIT.)**
- Turn the KX3 OFF (using the KX3's on/off switch combination, not your power supply).
- While holding in the **PBT I/II** knob with your right hand (which is also labeled **NORM** below the knob), turn power on with your left hand by holding **BAND-** and **ATU TUNE** together for about 2 seconds, then release. Release the **PBT I/II** knob after another few seconds. You should now see **EE INIT** on the LCD.
- When **EE INIT** completes after a few seconds, you may see **ERR nnn** messages due to initialization. Tap **DISP** to clear each message.
- Restore all parameters using the **Restore Configuration** function of the ***KX3 Utility*** program. Then turn power off and on again.
- See if the original problem has been resolved.

## Error Messages (ERR nnn)

Error messages may be displayed on VFO B at power-up or during normal operation. In many cases error messages are due to a problem with a single option module or incorrect firmware configuration.

**If you see an error message on VFO B (ERR NNN):** Write down the error message, as well as any associated error data shown on the VFO A display (e.g. **d=005**). Then tap any switch to clear the error code. Multiple errors may occur; in this case, write down each of the messages and VFO A data, if any, before you clear them.

See Error Message table below for details on specific **ERR** messages and associated data values, if any.

| Error Msg | Problem | Troubleshooting steps |
|---|---|---|
| ERR ATC<br>ERR ATD<br>ERR ATI | KXAT3 module not accessible:<br>ATC = I/O expander C<br>ATD = I/O expander D<br>ATI = I/O address mismatch | If the module is not actually installed, set *MENU:ATU MD* to **NOT INST**. If the module is installed, remove it and re-install it, making sure both connectors are correctly lined up with their mating connectors on the RF board. |
| ERR ATR | KXAT3 relay failure (on VFO A, **d=nnn** identifies the failing relay, e.g. **001** for relay K1) | Turn power off for 10 seconds, then back on. Remove and re-install the KXAT3 option module, making sure both of its connectors are correctly lined up with their mating connectors on the RF board. If this doesn't correct the problem, replace the module. |
| ERR DS1 | No DSP SPI command echo | Turn power off for 10 seconds, then back on. Reload MCU and DSP firmware. If this doesn't correct the problem, ***save your configuration using KX3 Utility***, then perform an **EEINIT** (pg. 41). If this corrects the problem, restore your configuration using *KX3 Utility*. If error codes persist, the Control Panel module may have to be replaced. Write down all error codes and associated data values (displayed on VFO A) before contacting Customer Support. |
| ERR DS2 | DSP SPI echo not inverted | |
| ERR DSE | DSP command timeout | |
| ERR DSP | DSP, CODEC, or ADC power-up self-test failed | |
| ERR DSX | Extended DSP command timeout | |
| ERR EE1 | On-chip EEPROM read/write test failed | The main microcontroller (MCU) may be defective. Follow the steps shown for ERR DS1. |
| ERR EE2 | External EEPROM read/write test failed | EEPROM may be defective. However, this message may also appear if power is turned off/on too rapidly, or if the power supply voltage "bounces" during turn-on due to inadequate regulation. If the power supply is not at fault, follow the steps shown for ERR DS1. |
| ERR FW2 | General firmware problem | Follow steps shown for ERR DS1. |

| | | |
|---|---|---|
| ERR IOA<br>ERR IOB | RF board I/O expander A or B unresponsive. | Turn power off and open the KX3's enclosure. Make sure the cable between the Control Panel board and RF Board is fully seated at both ends and is not damaged in any way. Close the enclosure. Turn power on. Reload MCU and DSP firmware. If this doesn't correct the problem, ***save your configuration using KX3 Utility***, then perform an **EEINIT** (pg. 41). If this corrects the problem, restore your configuration using *KX3 Utility*. If error codes persist, turn power off, remove all option modules (KXAT3, KXFL3, etc.), and turn power back on. Turn off the associated option module enables in the menu (pg. 33), then turn power off and back on. If this corrects the problem, re-install the option modules one at a time to see which one may be causing the problem. If errors still persist, the Control Panel or RF Board may have to be replaced. Write down all error codes and associated data values (displayed on VFO A), before contacting Customer Support. |
| ERR KEY<br>ERR PTT | Attempt to key the transmitter or activate PTT during power-on sequence | Usually caused by an incorrect setting of *MENU:MIC BTN* for the current microphone, or an external device shorting the KEY or PTT line to ground, or a shorted KXPD3 keyer paddle. Turn power off, then disconnect the KXPD3 (if applicable) and everything plugged into the left side panel, except for the power supply. Turn power back on. If the problem has disappeared, plug devices back in one at a time to see which one caused the error. |
| ERR OSC | Synthesizer IC unresponsive | Follow steps for ERR IOA. |
| ERR TX6<br>ERR TX7 | Transmit power MOSFET Q6 or Q7 bias out of range | Follow steps for ERR IOA. |
| ERR TXG | Transmit gain constant out of range | If this only occurs on one or two bands, there could be a problem with a band-pass or low-pass filter. Also try re-doing **Transmit Gain** calibration (pg. 31). |
| ERR TXC<br>ERR TXS | Transmit attempted without first calibrating TX BIAS in CW (TXC) or SSB (TXS) mode | Perform **Transmit Gain** calibration (pg. 31). **Note:** If you just completed kit construction, you must perform ***all*** calibration steps. If instead you performed an EEINIT to clear up a firmware issue, you can restore your configuration using *KX3 Utility*, if you did a configuration save. (If not, you'll need to re-do all calibration steps.) |
| ERR TXN | Transmit attempted without first nulling the transmit carrier | Perform **Transmit Carrier** calibration (pg. 31). Also see **Note** above for ERR TXC. |
| ERR TXP | Transmit attempted without first calibrating transmit gain | Follow steps for ERR TXC. |
| ERR TOS<br>ERR TPA | Synthesizer or power amplifier temperature sensor out of range | Follow steps for ERR IOA. |
| ERR RFB | RF board may be disconnected from Control Panel board | Follow steps for ERR IOA. |
| ERR RFK | RF board relay test failure (on VFO A, **d=nnn** identifies the failing relay, e.g. **001** for relay K1) | Follow steps for ERR IOA. |

# Theory Of Operation

This section includes:

- a functional description of the KX3's RF, control panel, and option PC boards
- block diagram of the KX3 (pg. 46)
- glossary of selected technical terms (beginning on pg. 47)

Additional information including an FAQ (answers to frequently asked questions) can be found on the Elecraft web site.

## RF Board

The RF PCB (Printed Circuit Board) contains all of the KX3's RF circuitry as well as low-level baseband (AF) stages in the receive path. The Control Panel (CP) board (following page) generates all digital control signals for band switching, T/R, signal path routing, etc.

The relay-switched **low pass filters** are used during both transmit and receive. A few of the filters are dedicated to one band but most cover two bands. The signal on the antenna side of the filters pass through a forward/reflected power and SWR bridge to the HF-6 meter antenna jack (BNC), or to the optional KXAT3 automatic antenna tuner. Latching relays are used to minimize power consumption.

**Transmit/receive** (T/R) switching splits the common signal path from the antenna and low pass filters to either the transmitter power amp or receiver input. It also allows sharing the band pass filters between receive and transmit. All T/R switching is done with high-power PIN diodes and CMOS switches to facilitate high speed transitions between receive and transmit.

The synthesized, digitally controlled **local oscillator** (LO) provides quadrature signals to the transmit and receive mixers, as well as a reference signal to the optional KX3-2M module. The LO has very good phase noise performance and can cover a very wide frequency range. Since the KX3 uses a "zero IF" architecture, the KX3's LO frequency is always very close to the operating frequency.

The **RF band-pass filters** are used for both transmit and receive. Filters are selected with low-loss CMOS RF switches. The band pass filters significantly attenuate receive signals at harmonics of the RX frequency, particularly the odd harmonics.

Following the band pass filters and T/R switching are two **RF preamplifiers** and an **attenuator**. These provide various tradeoffs between RF gain and noise figure (or MDS), as well also local oscillator (LO) isolation. The latter would be useful in situations where another receiver in close proximity could be tuned to the same frequency. A problem inherent in most direct conversion (zero IF) receivers is that some LO energy leaks to the antenna and is radiated. This can be a problem when another receiver & antenna is in very close proximity and is tuned to the same frequency. The isolation preamp in the KX3 (*RX ISO* menu entry) virtually eliminates this signal leakage.

The **RX mixer** converts the RF signal to quadrature baseband (AF I and Q signals), which are low-pass filtered and amplified before being passed to the CP board for analog to digital conversion (ADC). I and Q baseband signals (**I**n-phase and **Q**uadrature) from the mixer are also buffered and sent to the RX I/Q output. This allows attaching the KX3 to a PC or similar device running SDR software (pg. 25).

The main AF amplifier section also interfaces to the optional **KXFL3 filter module** that provides narrower analog filter bandwidths for improved dynamic range performance with nearby strong interfering signals.

The **TX AF Amp and TX mixer** block converts baseband (AF I and Q) modulating signals to an RF signal which is then routed to the T/R switching and band pass filters. This signal provides excitation to the 10W power amplifier. The 10W amplifier (PA) uses a pair of RF power MOSFETs. Temperature monitoring of the

MOSFETS allows automatic reduction of power if they become too hot during long transmit periods at high power levels and high ambient temperature.

The optional **KXAT3 automatic antenna tuner** (ATU) option connects between the BNC antenna jack and the RF board's SWR/power bridge and low pass filters. It uses a latching relay-switched "L network" with eight inductors and eight capacitors capable of matching a wide range of antenna impedances. The KXAT3 also serves as a preselector for operating frequencies below 160 meters, significantly improving reception in the AM broadcast band and below.

Another option, the **KXFL3 roofing filter module**, provides two additional balanced analog filters in the baseband AF I/Q amplifier path. These are much narrower than the default bandwidth. The result is a significant performance improvement in rejecting extremely strong interfering signals that are just a few kHz away from the received signal.

## Control Panel (CP) Board

The CP (Control Panel) circuit board contains all of the KX3's control circuitry as well as high-level baseband (AF) stages for the transmit and receive paths. It contains two on-board microcontrollers: one to manage the radio (MCU), and another to process all transmit and receive signals digitally (DSP).

The **DSP** is a 32-bit, floating-point device. All modulation, demodulation, AGC, filtering, equalizing, and other signal processing functions are handled by this IC.

The incoming baseband (audio) signal from the RF board is provided in low-level phase quadrature, or **I**n-phase and **Q**uadrature (I/Q). These signals are digitized by a very low power, high-performance analog-to-digital converter (ADC), then passed to the DSP for processing.

The baseband transmit signal is likewise provided in I/Q format to the RF board. A dedicated, high-performance **digital-to-analog converter** (DAC) is used to generage a very clean transmitted signal.

DSP program storage is by means of a 2 megabyte **FLASH memory** device. This IC also provides storage of operator messages for the DVR function of the KX3 (pg. 21).

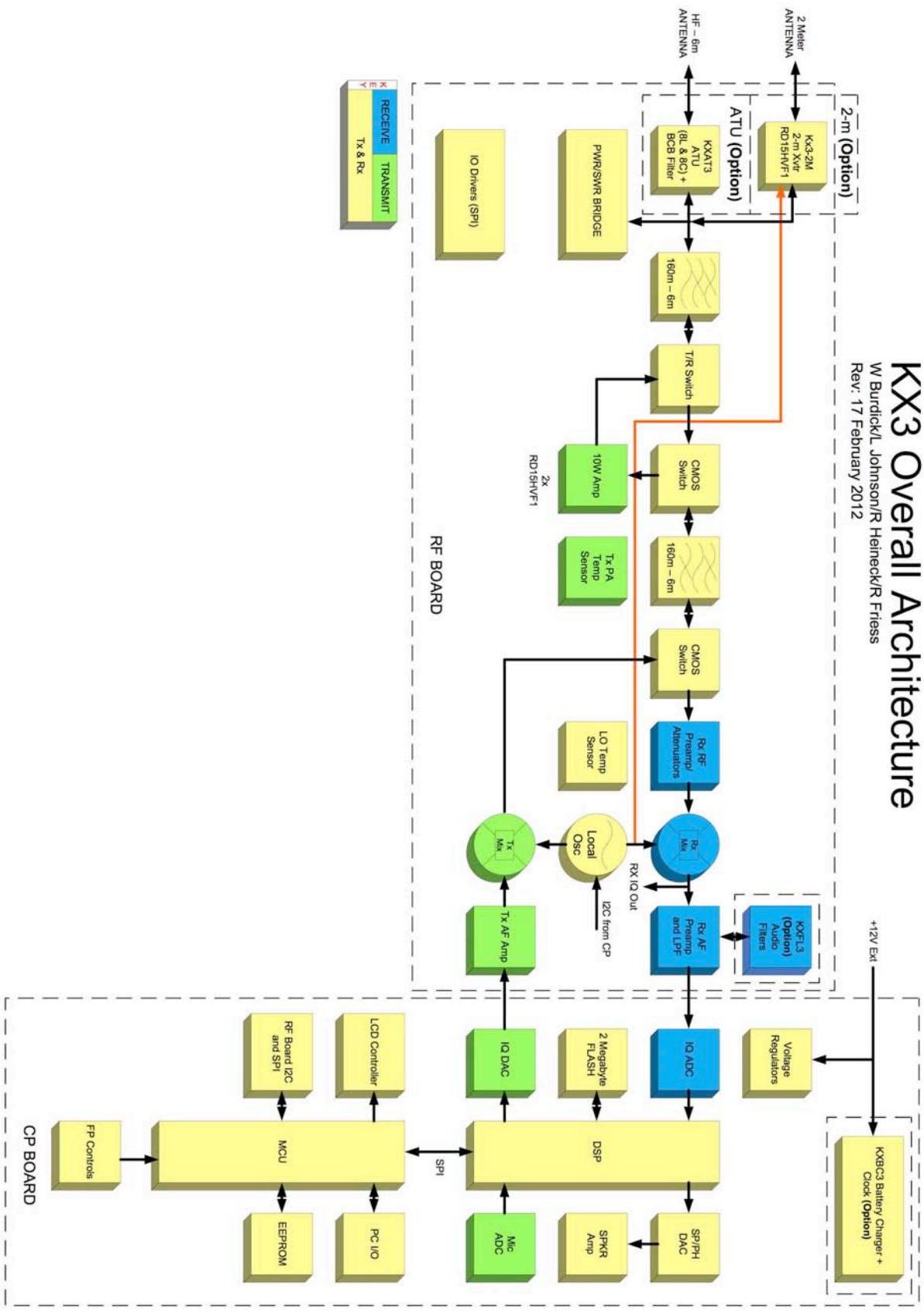
Stereo (two-channel) audio from the DSP is converted to analog signals for use with headphones or dual external speakers (PHONES jack). The use of stereo allows special processing to help reduce operator fatigue (**Audio Effects**, pg. 20), and also provides **dual watch** capability (pg. 20), where the signals from VFOs A and B are routed to the left and right channels. If the internal speaker is used, the audio is monophonic, and is boosted by a separate speaker amplifier IC. Microphone audio (or low level audio from a computer or or other source) is uses another ADC that runs at all times to enable voice-operated transmit (VOX) operation.

The **microcontroller unit (MCU)** handles all user interface functions for the KX3, including twenty switches and five shaft encoders. It also handles timing, sequencing, and overall management of the entire radio. The MCU uses EEPROM (electrically erasable, non-voltatile memory) to store operator preferences, message keyer (CW/RTTY/PSK) messages, and control settings. A **serial port (ACC1)** provides an interface between the MCU and an attached personal computer (PC), with both RS232 and USB cabling options.

The MCU uses two industry-standard **serial protocols** to control circuits on the RF board. **I2C** (pronounced I-squared-C) control the synthesizer. **SPI** handles bandswitching, changeover between receive and transmit, etc. The driver for the **liquid-crystal display** (LCD) is also controlled via the I2C port.

The **KXBC3 battery charger** is an optional module that plugs into the CP board. It manages charging of NiMH AA cells (if applicable). The emphasis on the design is safety, so relatively low charging currents are employed. The KXBC3 also incorporates a **real-time clock** (RTC) function, useful for logging and time keeping. The RTC also allows the KX3 to function like a clock radio, turning itself on at a predetermined time (see the *ALARM* menu entry).

## KX3 Block Diagram



## Glossary of Selected Terms

The following terms are often used in the discussion of amateur radio transceivers and related equipment. All are directly applicable to the KX3, which is used here to illustrate some of the concepts. A much larger glossary of terms can be found in the *ARRL Handbook* and on numerous web sites.

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**A-to-D or ADC (analog-to-digital converter):** An integrated circuit that converts analog electrical signals such as audio or RF into digital form. The digital signals can then be processed by a digital signal processor, or *DSP* (see below).

**Attenuator:** A circuit that reduces signals to a safe level for use by subsequent stages in a receiver. The KX3 includes two switchable attenuators, one under control of the user (pg. 13), the other switched in automatically as needed (pg. 40, under **COR**).

**ATU (automatic antenna tuner):** A device inserted between a transmitter (or transceiver) and an antenna that establishes an optimal match between the two, thus allowing full power transfer. (See KXAT3, pg. 23.)

**D-to-A or DAC (digital-to-analog converter):** An integrated circuit that converts digital signals into analog form, such as audio or RF. Also see *DSP*, below.

**dB (decibel):** A measure of signal increase or decrease, or of one signal relative to another signal. In human terms, one dB represents a "just noticeable difference" between two signals (or a just-noticeable increase or decrease). Mathematically, dB is derived from the ratio of two signals. Receivers must handle signals over a huge range—in excess of 100 dB. ***dBm*** is a more specific term that means "dB relative to 1 *m*illiwatt." 1 milliwatt is considered to be a "0 dBm" signal in this case.

**DC-to-DC converter:** A device that converts one DC voltage into another. For example, the KX3 includes a very efficient DC-to-DC converter that converts 12 V (nominal) at the DC input jack to 3.3 V for use by its low-voltage circuitry. The advantage of a DC-DC converter is that when it steps voltage down, it steps current up (or vice-versa). In this case, the 300 mA the KX3 consumes at 3.3 V might require only 100 mA at the 12-V power source.

**DSP (digital signal processor):** A highly specialized numeric computer, implemented on a single integrated circuit, that processes signals digitally. Inputs *to* the DSP must generally be converted from analog to digital form (see *A-to-D*, above), while outputs *from* the DSP must be converted from digital to analog (see *D-to-A*). Use of DSP techniques can result in greater versatility and smaller size compared to the equivalent analog circuitry. The KX3 uses a very advanced, power-efficient DSP.

**ESD (electrostatic discharge):** An event during which high voltages or currents appear within a radio or other electronic device, potentially causing damage. Antennas, control cables, or the operator's body are all potential ESD sources. Damage can be avoided through handling and grounding techniques.

**HF (high-frequency):** Signals in the range of 3 to 30 MHz. In amateur radio, *HF* is also shorthand for *160-10 meters* (1.8 to 29.7 MHz), or the "HF bands." 160 meters actually falls in the *LF* range (0.3 to 3 MHz). The 6-meter band (50-54 MHz) is often included in "HF" transceivers, though it is actually in the *VHF* (*very high-frequency*) range of 30-300 MHz.

**IMD (intermodulation distortion):** Unwanted signal products that are created in the various stages of a receiver or transmitter. If all stages were entirely "clean," there would be no IMD. In reality, every stage contributes some distortion, with the amount of distortion being proportional to signal level. Radio designers go to great lengths to minimize distortion, trading off circuit cost and complexity against the benefit of reduced interference.

**Keyer:** A device that partially automates the sending of Morse code, allowing for faster code speeds. The KX3 has a built-in keyer function, as well as an optional attached *keyer paddle* (KXPD3, pg. 23).

**MCU (microcontroller unit):** A computer or controller usually integrated onto a single integrated circuit. A modern amateur transceiver usually has one main MCU that controls most radio functions. It may have other

smaller MCUs or *co-processors* that perform specific functions. The KXBC3 option module has its own MCU (pg. 23). The DSP in the KX3 is a form of co-processor.

**MDS (minimum discernable signal):** A measure of a radio's sensitivity, expressed in dB (decibels) relative to 1 milliwatt (0 *dBm*). For example, the user of a KX3 with the 20-dB *preamp* turned on, can typically copy a CW signal at about -137 dBm, or 137 dB *below* 1 milliwatt.

**Preamp:** A *pre*-amplifier that increases RF signals to a higher level for use by subsequent stages in a receiver. A preamp is generally designed to contribute little noise of its own, so that it improves the noise figure of the radio (also see *MDS*). The KX3 includes two different preamps for use in different situations (pg. 13).

**Roofing Filter:** A filter built with analog components that rejects some out-of-band signals which could cause overload or distortion. The roofing filter appears *ahead* of the A-to-D converter and DSP in a receiver's signal chain, protecting them to some degree. The KX3 has an optional dual roofing filter (see KXFL3, pg. 23.)

**SDR (software-defined radio):** A receiver or transceiver whose operating characteristics can be modified or controlled using a computer (pg. 25).

**VFO (variable frequency oscillator):** A signal source used to select a radio's operating frequency. The KX3's large knob controls VFO A, while a smaller knob controls VFO B (see Using VFOs A and B, pg. 11).

# Specifications

## GENERAL

| | |
|---|---|
| **Frequency Range** | 310 kHz - 32 MHz and 44-54 MHz; 144-148 MHz with KX3-2M option (transmit excluded in some ranges as required) |
| **Frequency Stability** | +/- 1 ppm typical over 0-50 C |
| **Antenna** | 50 ohms; HF: BNC jack; 2 meters: SMA (with KX3-2M option) |
| **Modes** | USB, LSB, AM, FM, CW, DATA; built-in PSK/RTTY/CW text decode/display |
| **VFOs** | Dual VFOs (weighted VFO A knob); 150+ memories; scanning/channel hopping |
| **Supply Voltage and Current** | 8 V min, 15 V max. 1 to 2 A typical in transmit; 150 mA minimum receive (backlight off, preamp off, no signal) |
| **Size and Weight** | Size: 3.5 x 7.4 x 1.6", HWD (8.8 x 18.8 x 4.1 cm); weight: 1.5 lbs. (0.68 kg) less options |

## RECEIVER*

| | |
|---|---|
| **Sensitivity (MDS)** | -138 dBm (typ.), 20 dB preamp, 500 Hz bandwidth; -140 dBm typ. on 6 m with 30-dB preamp |
| **Dynamic Range** | Final RX performance measurements TBD |
| **Image and I.F. Rejection** | Final RX performance measurements TBD |
| **Audio Output** | Internal speaker, 0.5 W typ.; headphones/ext. speaker jack, 0.1 W/channel (stereo) |
| **Receive Features** | 8 band RX EQ, tunable I.F. passband width/shift, optional roofing filters (KXFL3) |

## TRANSMITTER*

| | |
|---|---|
| **Output Power** | 12 W max, HF-10 m; 10 W max, 6 m; 2 m (KX3-2M): TBD W, 144-148 MHz |
| **Voice Transmit Features** | Split-band, adjustable speech compression; 8-band TX EQ; VOX; 2 DVR messages |
| **CW Transmit Features** | Full and semi CW break-in with adjustable delay; diode T/R Switching; 6 messages |
| **Carrier Suppression** | > 50 dB typ. |
| **Harmonic / Spurious Outputs** | > 50 dB below carrier @ 10 W (> 60 dB on 6 meters) |
| **CW Sidetone/Transmit offset** | 400-700 Hz, adjustable (filter center frequency tracks sidetone pitch) |
| **Keyline Output (ACC2)** | 30 V, 100 mA max |

*** Receive and transmit specifications preliminary. May be different outside ham bands. Measurements taken with a supply voltage of 13.8 VDC unless otherwise noted.**

# Customer Service and Support

### *Technical Assistance*

You can send e-mail to **KX3support@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: (1) REMOVE BATTERIES before shipping. (2) 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 turn around 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.

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