



ELECRRAFT® KPA1500

1500-WATT AMPLIFIER

OWNER'S MANUAL

Revision B1, February 12, 2019

E740301

Copyright © 2018, Elecraft, Inc.

All Rights Reserved

Introduction

On behalf of our entire design team, we'd like to thank you for choosing the Elecraft KPA1500 amplifier.

The KPA1500 offers a unique combination of features. It's one of the smallest 1500W amplifiers available. The power supply is in a separate enclosure for ease of station layout.

The KPA1500 is capable of fully automatic operation, yet has an alphanumeric display and a full complement of front panel switches for precise manual control. A comprehensive remote-control command set is also included.

The KPA1500 can be used with nearly any transceiver, thanks to its instantaneous RF-based band switching, advanced protection circuitry, adjustable ALC, and extensive parametric monitoring. It also has inputs that allow direct band switching from many popular transceivers. TR is completely noise-free thanks to the use of PIN-diode switching.

The KPA1500 comes with a built-in Automatic Antenna Tuner (ATU) that can handle a load SWR up to 3:1 at the full 1500 watt output in any mode.

Of course, the KPA1500 is an ideal companion for the Elecraft K3S and K3 transceivers, both physically and electrically. The Elecraft K3S or K3 can sense whether the amp is in standby or operate mode, then select the appropriate per-band power settings. This allows you to set up the K3S or K3 for "barefoot" operation at one power level on each band, and then switch the amp to operate and set up optimal drive levels for full 1500W output. The K3/KPA1500 combination is also capable of extremely fast break-in, especially when the K3S or K3 is placed in QRQ (high-speed CW) mode. The two are so well-integrated that you can use the per-band switches on the amplifier to change bands at the transceiver.

If you use the KPA1500 with both the K3S or K3 transceiver and P3 panadapter – our new "K-Line" – you'll enjoy a high degree of operating convenience, along with world-class performance *and* the power to get the job done.

73,

Wayne, N6KR

Eric, WA6HHQ

Contents

Introduction.....	2
FCC-Mandated Part 15 Notice for the Computer Interface Ports	6
Note for European Users	6
In the Box	7
Specifications.....	8
Customer Service and Support	10
Installation	11
Positioning the KPA1500 RF Deck and Power Supply.....	13
Cabling – Power Supply.....	13
Cabling – RF Deck.....	13
Operation	18
RF Deck Front Panel Controls	18
Power On.....	19
Antenna Selection	20
Transmitting: Initial Steps	20
Automatic Level Control (ALC).....	21
Automatic Antenna Tuner (ATU).....	22
Initiating a Full Search Tune	24
Amplifier Monitoring and Status Indicators	27
Menu Items.....	29
Fault Types, Conditions and Messages	33
KPA1500 Remote Operation	35
KPA1500 Firmware Updates.....	37
Checking your Firmware Version.....	37
Forcing a Firmware Load.....	38
Theory of Operation	39

Wattmeter Calibration Procedure.....	42
Interfacing to Other Transceivers	43
Elecraft KPAK3AUX Interface Cable.....	44
Icom Transceiver Interfacing	44
Icom Remote Tuner Control Socket to KPA1500 TUNE Jack.....	46
Elecraft KX3, KX2 and Non-Elecraft Rigs to KPA1500 XCVR SERIAL Port.....	47
Kenwood Transceiver to KPA1500 XCVR SERIAL Port	49
Yaesu Transceivers to KPA1500 AUX Port	49
Flex Transceivers.....	50
Initiating KPA1500 Tune via the CW Key TUNE Jack	50
In Case of Difficulty	51
Appendix A — KPA1500 Tuner Frequency Segments.....	52

WARNING


Dangerous Voltages are Present Inside the KPA1500 and its Power Supply

Do not turn on or operate the amplifier or power supply with the covers off.

Before opening the KPA1500 RF Deck or Power Supply enclosures:

1. Turn off the KPA1500 by tapping the RF Deck front panel ON switch.
2. Turn off the power supply breaker switch (on the rear panel).
3. Disconnect the two Power Supply cables at the RF Deck rear panel before opening the RF Deck enclosure.
4. Disconnect the Power Supply from the mains before opening the cover.

Key to Symbols, Abbreviations and Text Styles

 Important – read carefully

 Operating tip

TEMP *Tap* switch function (labeled *above* a switch; press for less than 1/2 second)

PK HOLD *Hold* switch function (labeled *below* a switch; press for at least 1/2 sec. to activate)

POWER ON Rear panel switch, connector or jack.

ATU IN Front panel LED indicator example.

INHIBIT Typical text appearing on the LCD.

ALARM TONE Menu item

“Copy Firmware Files from Elecraft” Item to click to enable or select a function on software programs (*KPA1500 Utility*) or the Elecraft website

CAUTION

Follow the instructions under a Caution to avoid damage to the equipment.

WARNING

Follow the instructions under a Warning to avoid serious personal injury.

FCC-Mandated Part 15 Notice for the Computer Interface Ports

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment to an outlet on a different circuit from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Regarding the computer interface: Changes or modifications not expressly approved by Elecraft could void the user's authority to operate the equipment.

Note for European Users



For private households: This symbol means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product to designated collection points where it will be accepted free of charge.

Alternatively, in some countries, you may be able to return your products to your local retailer upon purchase of an equivalent new product.



Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

Please contact your local authority for further details of your nearest designated collection point. Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

For professional users in the European Union, if you wish to discard WEEE, please contact your dealer or supplier for further information.

Elecraft Inc.
125 Westridge Dr.
Watsonville, CA 95076
+1 (831) 763-4211
www.elecraft.com

In the Box


Included

Item	Reorder Part Number
RF Deck	--
Power Supply with AC Line Cable	--
DC Power Cable	E770024
DA-15 Control Cable	E770017
Phono-Phono Key Line Cable	E100416
USB A-B Cable	E980299
Owner's Manual	E740301

Optional

Item	Elecraft Part Number
KPAK3AUX Cable kit for K3s or K3	KPAK3AUX
Enhanced Mode cable for Flex, Icom, Kenwood, and Yaesu transceivers	visit www.elecraft.com for details

Specifications

 *The following performance specifications are guaranteed only within the Amateur bands.*

Frequency Range	All Amateur bands from 1.8 to 29.7 MHz and 50 to 54.2 MHz
Supply Voltage and Current	200 to 250 VAC, 50/60 Hz up to 20A
RF Deck Weight	22 lbs. (10 kg)
RF Deck Size	Enclosure only, 4.5 x 13.5 x 11.5 in., HWD (11.5 x 34 x 29 cm)
Power Supply Weight	17 lbs. (7.5 kg)
Power Supply Size	Same as RF Deck: Enclosure only, 4.5 x 13.5 x 11.5 in., HWD (11.5 x 34 x 29 cm) excluding feet and protrusions
Power Output	1500 W PEP CW/SSB/Data
Duty Cycle at 1500 Watts	100% ICAS for 100% duty cycle modulation modes (FM, RTTY, FT8, JT65, etc.) 1.8-30 MHz: Maximum 5 minutes key down / Minimum 5 minutes receive (after 5 minute TX) 50 MHz: Maximum 50 seconds key down / Minimum 50 seconds receive
Drive Power	50-60 W, typical, for 1500 W output
Input VSWR	Less than 1.5:1
ALC Out	Negative-going, adjustable
Metering	Power output, SWR (bargraph and on the LCD display), supply voltage and current, temperature, frequency band
Heat Sink Temperature	110°C, maximum
Key In (Transmit Enable)	+5V maximum, open circuit on receive, closed to ground on transmit (5 mA max.)
Efficiency	Approximately 50%. Efficiency varies by band.
Antenna Tuning Unit Matching	1.8 — 2 MHz 1500 W into 16 Ω to 150 Ω (3:1 SWR)

Range and Power Limits

	750 W into 12 Ω to 200 Ω (4:1 SWR)
3 — 30 MHz	1500 W into 16 Ω to 150 Ω (3:1 SWR)
	750 W into 5 Ω to 500 Ω (10:1 SWR)
30 — 54 MHz	1500 W into 16 Ω to 150 Ω (3:1 SWR)
	500 W into 10 Ω to 250 Ω (5:1 SWR)

Matching specified to a 1.0:1 to 1.6:1 output SWR

Autotune Power Range

10 W —1500 W

For better matching accuracy, tune with >20 W

Customer Service and Support

Technical Assistance

You can send e-mail to support@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 e-mail and phone support, so please try that route first as we can usually help you find the problem quickly.)

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

Using external fan(s) on the KPA1500 amplifier may defeat temperature control sensing and may cause damage that is not covered under warranty.

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 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.

Installation

Installation consists of the following:

- Positioning the KPA1500 RF Deck and Power Supply to provide proper cooling.
- Connecting the KPA1500 RF Deck and Power Supply.
- Cabling the KPA1500 RF Deck to your other station equipment.

The KPA1500 RF Deck rear panel is shown in Figure 1. The connectors and controls are described following the figure.

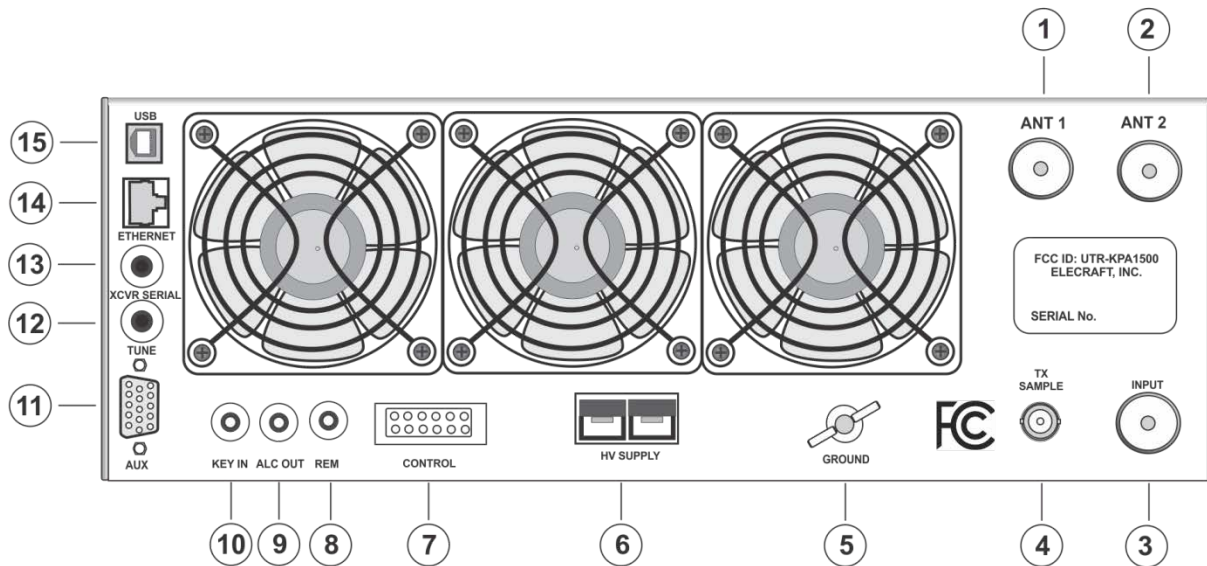


Figure 1. KPA1500 RF Deck Rear Panel.

- ① and ② SO-239 connectors to antenna systems or a dummy load.
- ③ SO-239 connector for RF input from the driving transceiver.
- ④ Low level (-60 dBm/+10 dBm at 1500W) KPA1500 transmit signal output for transceivers supporting closed-loop pre-distortion techniques (Pure Signal) to reduce IMD. The signal comes from the internal directional coupler.
- ⑤ Station ground attachment.
- ⑥ High voltage connection to the KPA1500 power supply.
- ⑦ Control circuit connection to the KPA1500 power supply.
- ⑧ Accepts a 12V input signal for remote control applications to command the KPA1500 to turn on or off. Can also be connected to K3/K3S rear panel 12V DC OUT RCA connector so the KPA1500 turns on when the transceiver turns on. See Remote Operation, page 35.
- ⑨ Negative-going voltage for transceivers that require ALC. (Elecraft transceivers do not require this connection.)
- ⑩ Enables the KPA1500 to transmit when grounded. When grounded, the source must be able to sink 5 mA, 5 VDC or open circuit inhibits the KPA1500.
- ⑪ Enables Enhanced Operation with the Elecraft K3S or K3 via the optional KPAK3AUX cable.
- ⑫ Tune signal to send RF power from a transceiver to the KPA1500 internal automatic antenna tuner (ATU). Emulates an Icom® AH-4 signal. May be used with other radios by connecting the tip (key) to a transceiver's straight key connector. When the ATU needs RF power to tune, the amplifier grounds the key and the transceiver sends a CW carrier to the KPA1500.

- ⑬ Selectable CI-V for Icom radios or RS232 level information for transceivers such as the K2, KX2, KX3, Flex Radio, and Kenwood transceivers. Radio type is selected in the menu. May also be used as XCVR SERIAL HOST connector, so devices that support RS-232 may use this connector for the KPA1500 serial command set (programming reference).
- ⑭ Ethernet connection for local or remote operation applications. Provides access to a TCP server and a UDP server for the KPA1500 serial command set (same command set as USB and XCVR SER). Firmware cannot be installed via the Ethernet connection.
- ⑮ USB connection creates virtual COM port for use with the *KPA1500 Utility* and other computer-based programs. Use the USB port to install firmware into the KPA1500.

The KPA1500 Power Supply Deck rear panel is shown below. The connectors and controls are described below.

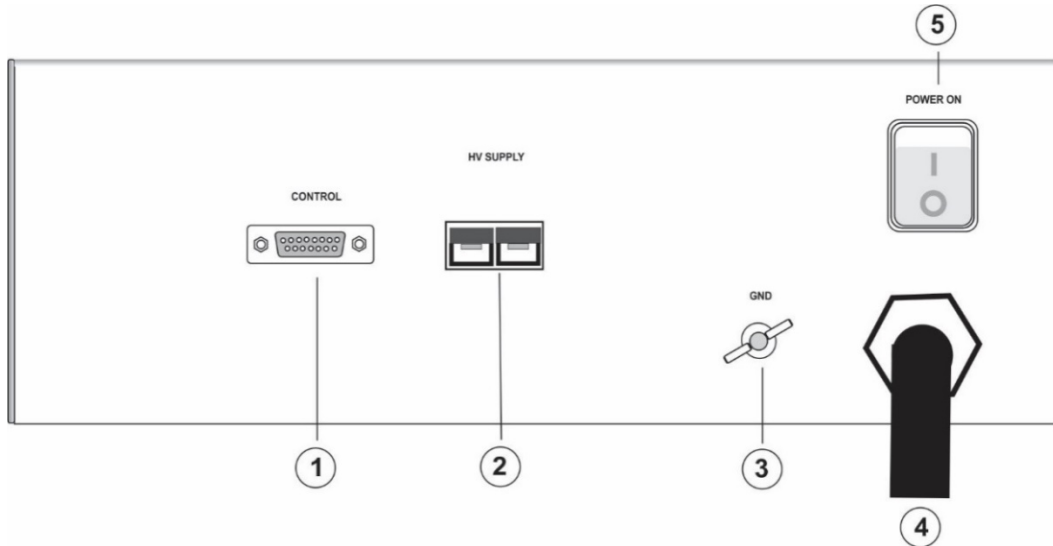


Figure 2. KPA1500 Power Supply Deck Rear Panel.

- ① CONTROL: DA-15 cable with control and low voltage supplies to the RF Deck.
- ② HV SUPPLY: Main DC power output for the RF Deck
- ③ GROUND: Connection to the station ground.
- ④ AC Power Cable: Supplied with a NEMA 6-20 molded plug. If needed, replace with a suitable 20A connector for your installation.
- ⑤ POWER ON Switch and Circuit Breaker: Must be in the ON position for the RF Deck power switch to function.

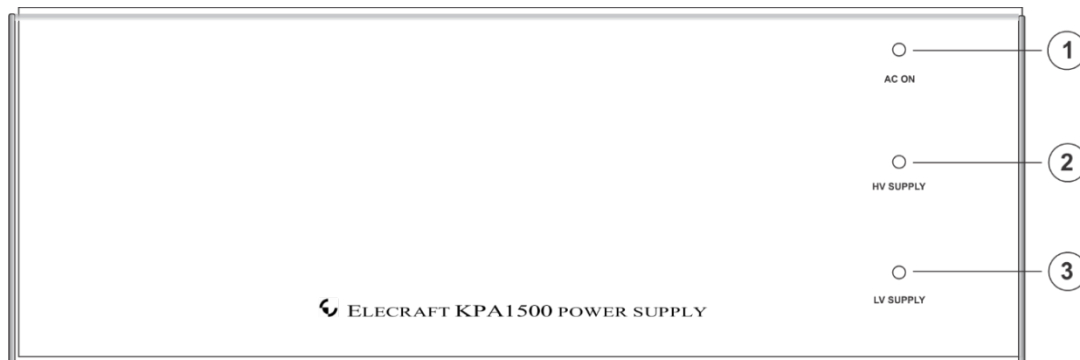


Figure 3. Power Supply Front Panel.

- ① AC ON LED: Lights green whenever the power supply is connected to AC power and the rear panel main power switch is on (up).
- ② HV SUPPLY LED: Lights green when the high current 50V supply is within operating tolerance. Lights red when the output voltage is below specification. During power down, it will turn red for a few seconds. If this LED turns red during operation, excessive current is being drawn and the amplifier is bypassed for protection. Turn off power and wait until the LED goes dark (about 15 seconds) before turning power back on again.
- ③ LV SUPPLY LED: Lights green when the Control System power supply is within operating tolerance.

Positioning the KPA1500 RF Deck and Power Supply

Provide at least 4" (10 cm) clearance behind the RF Deck fans and above the Power Supply top cover. Allow at least 1" (2.5 cm) clearance around the top and sides of the RF Deck and around the sides of the Power Supply for normal cooling air flow.

The supplied cables allow the Power Supply and RF Deck to be placed up to 66" (167 cm) apart. The Power Supply can be operated remotely so there is no need for it to be within the operator's reach.

The power supply fans operate whenever the KPA1500 is on, so you can place the Power Supply under the operating desk or elsewhere to minimize fan noise.

⚠ Do not use an external fan on top of the KPA1500 RF deck. External cooling will delay or may prevent the amplifier's built-in fans from turning on.

⚠ Cabling – Power Supply

Be sure the POWER ON switch ⑤ is off before connecting any cables to the Power Supply or RF Deck.

An AC power cable with the popular NEMA 6-20P connector is supplied attached to the Power Supply. The NEMA 6-20P connector is compatible with NEMA 6-20R receptacles. Replace the connector if you need a different connection to your mains supply. Elecraft recommends a 200/240 volt AC, 20 amp circuit for proper operation of the KPA1500.

Connect the Power Supply to the RF Deck with the supplied 66" (167 cm) cable. Plug the Anderson PowerPole® connector into the HV SUPPLY connector ⑥ on the RF Deck rear panel (Figure 1) and the corresponding connector on the Power Supply ②, Figure 2. Observe the polarity; match the colors on the plug with the connectors.

⚠ Make sure the PowerPole connectors mate completely to prevent intermittent or erratic operation. The 75A PowerPole connectors click twice when inserted. The connection is not reliable until the second "click."

Connect the 15-pin connector to the Power Supply and the CONTROL connector ⑦ on the RF Deck rear panel. Ensure the captive screws securing the connectors are tight and the connectors are fully seated.

Cabling – RF Deck

⚠ Always turn the KPA1500 off via the rear panel switch/circuit breaker or disconnect the AC mains cable on the Power Supply before attaching or removing cables.

The KPA1500 may be used with the Elecraft K3S, K3, K2 or any HF/6 meter transmitter with a keying output meeting the requirements shown under Note 4 below. Interconnections with transceivers are shown in Figure 4, Figure 5 and Figure 6. The driving transceiver must provide at least 50 watts of RF for full output and the output power must be adjustable as described in the *Transmitting* section.

1. Connect your station ground to the GND terminal ⑤. A good station ground is important for safety and to minimize local radio frequency interference (RFI).
2. Connect RF INPUT ③ to the output of your driving transceiver or transmitter using a 50 Ω coaxial cable with a PL-259 connector on the KPA1500 end.
3. Attach a suitable load with an SWR of less than 1.5:1 to the ANT 1 ① or ANT 2 connector ②. A 50 Ω 1500 W dummy load is recommended for initial testing. Be sure to select the correct ANT connector using the front panel ANTENNA switch before transmitting.
4. The driving transmitter must ground the KEY IN line during transmit while sinking up to 5 mA. This is compatible with virtually all amateur transmitters and no key line buffer is required. If the transmitter Key Output is not a contact closure or equivalent, it must be at a level between +4 and +16 VDC during receive.

Enhanced Mode Operation with a K3S or K3

The optional KPAK3AUX cable kit provides closer integration with a K3S or K3 by sharing band information between the KPA1500 and the transceiver and vice versa, see Figure 4.

The KPAK3AUX cable kit enables all enhanced features described under Operation, including coordinated band switching, antenna selection and ATU memory setting recall between the transceiver and the KPA1500 amplifier.

The KPAK3AUX cable kit also incorporates the KEY IN line. If you need access to this line so that other equipment can bypass the amplifier, you can install the Key Line Interrupter supplied with your KPAK3AUX cable and use a separate key line as shown in Figure 5.

A remotely tuned antenna is an example situation where key line interruption is necessary. The antenna's remote tuning control box should open the key line while the antenna is tuning, preventing high power operation until the antenna is ready.

⚠ You must use the Key Line Interrupter when using a separate key line with the KPAK3AUX cable kit. Otherwise any external equipment inserted into the key line will not be able to inhibit the amplifier.

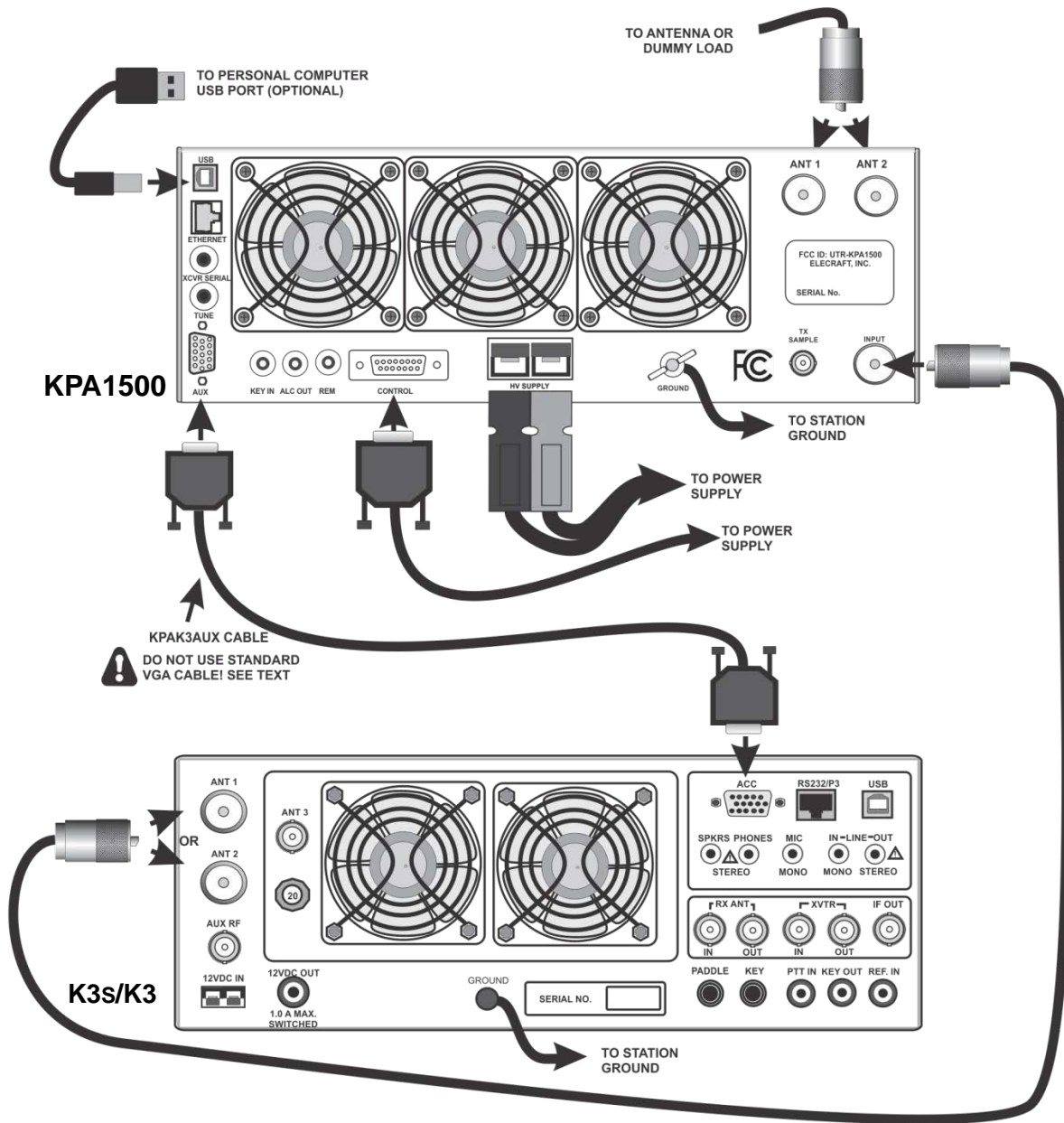


Figure 4. K3s/K3Enhanced Cabling Using KPA3AUX Cable, Without Interrupter.

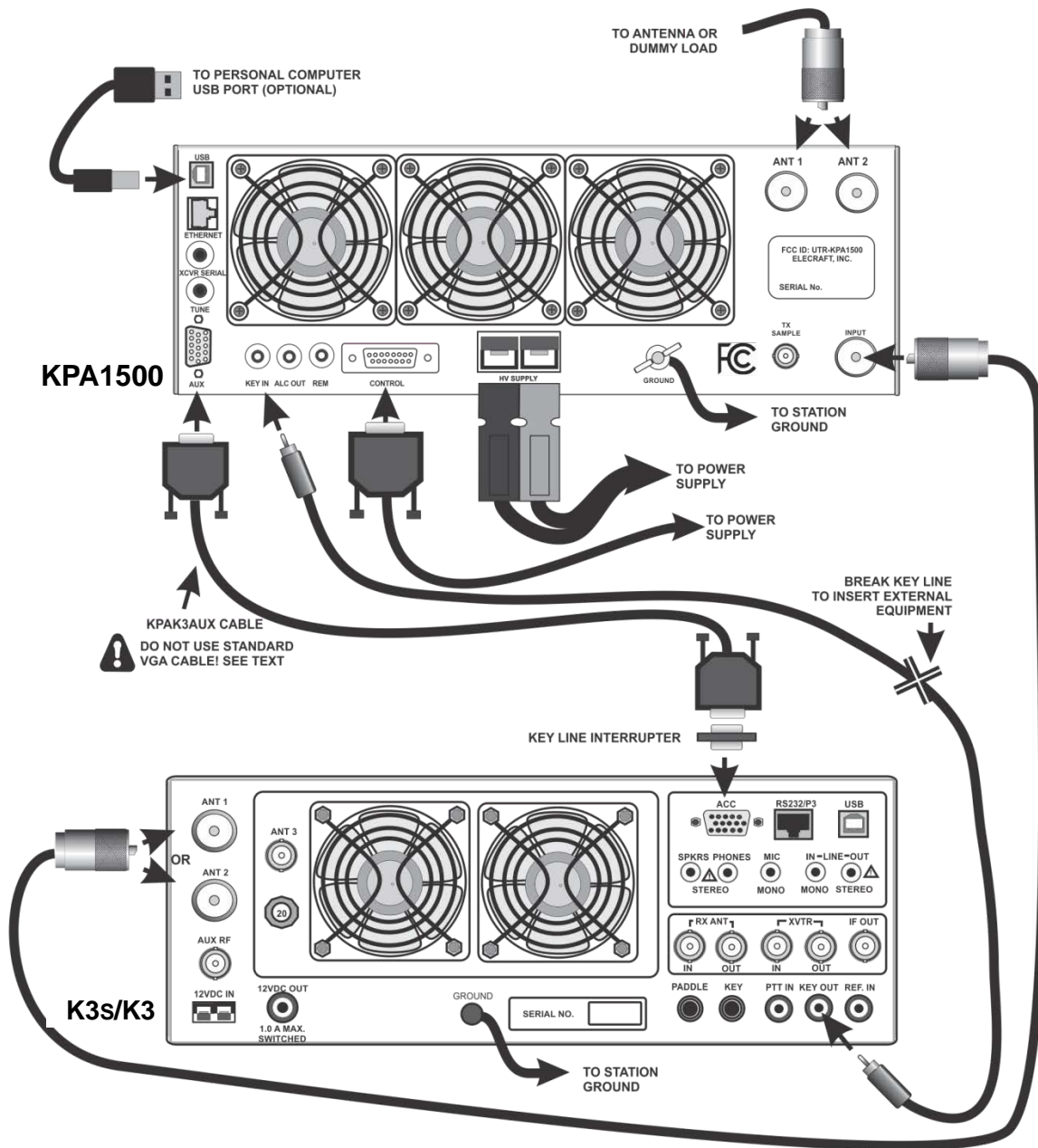


Figure 5. K3s/K3 Enhanced Cabling Using KPAK3AUX Cable and Separate Key Line, With Interrupter.

i Enhanced Mode Operation with Non-Elecraft Transceivers

See *Interfacing to Other Transceivers* on page 43.

Connecting the KPA1500 to Any HF Transceiver

Connections from any HF to 6m transceiver are shown below. Elecraft does not recommend the use of ALC unless the transceiver manufacturer specifically requires it.

The transmitter must ground the KEY IN line circuit during transmit while sinking up to 5 mA. A key line buffer is not required.

If the transmitter Key Output (STBY) is not a contact closure or equivalent, it must be at a level between +4 and +16 VDC during receive.

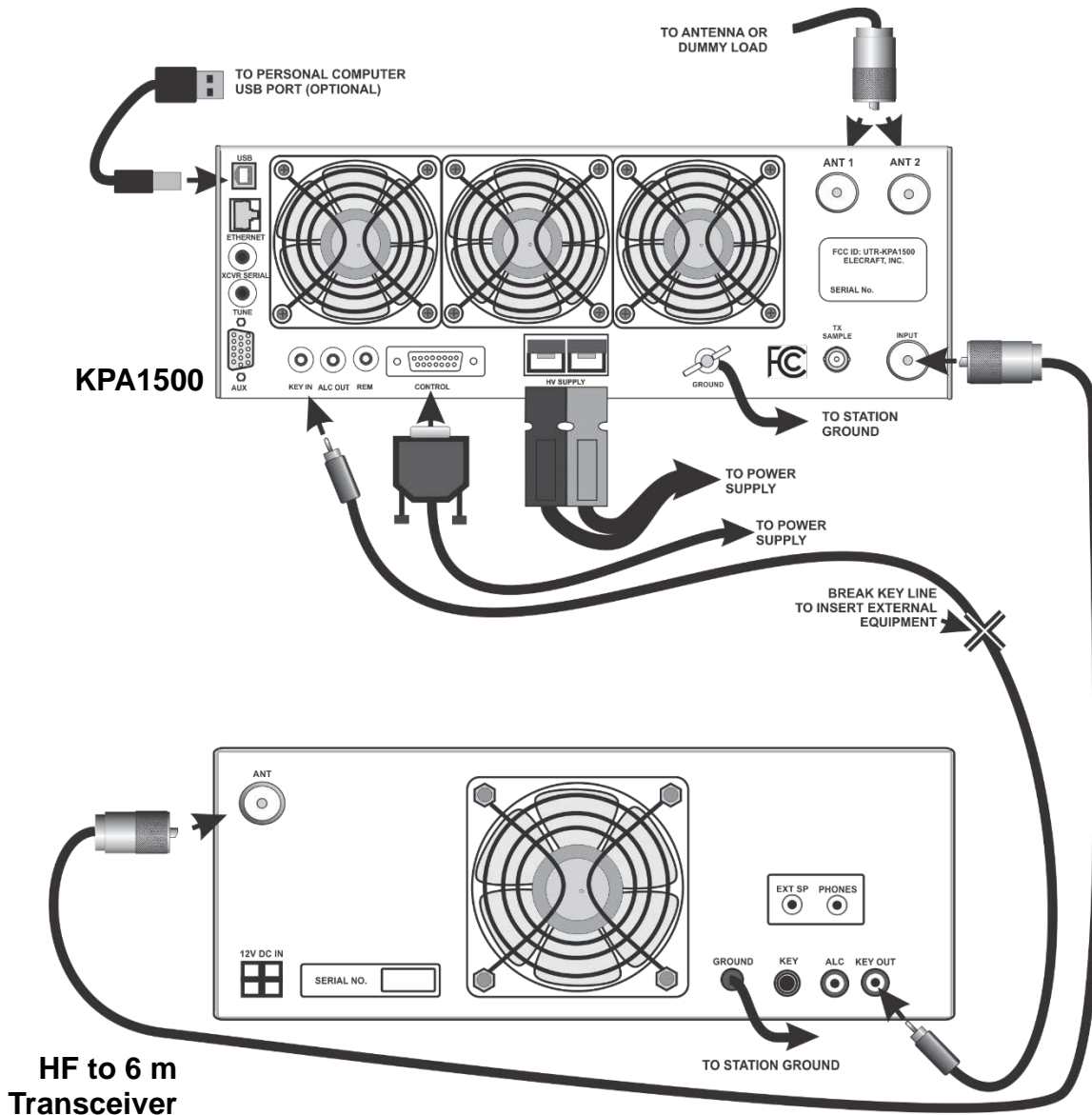


Figure 6. Basic Cabling Diagram for Any Transceiver.

Operation

RF Deck Front Panel Controls

The front panel switches and indicators are described below.

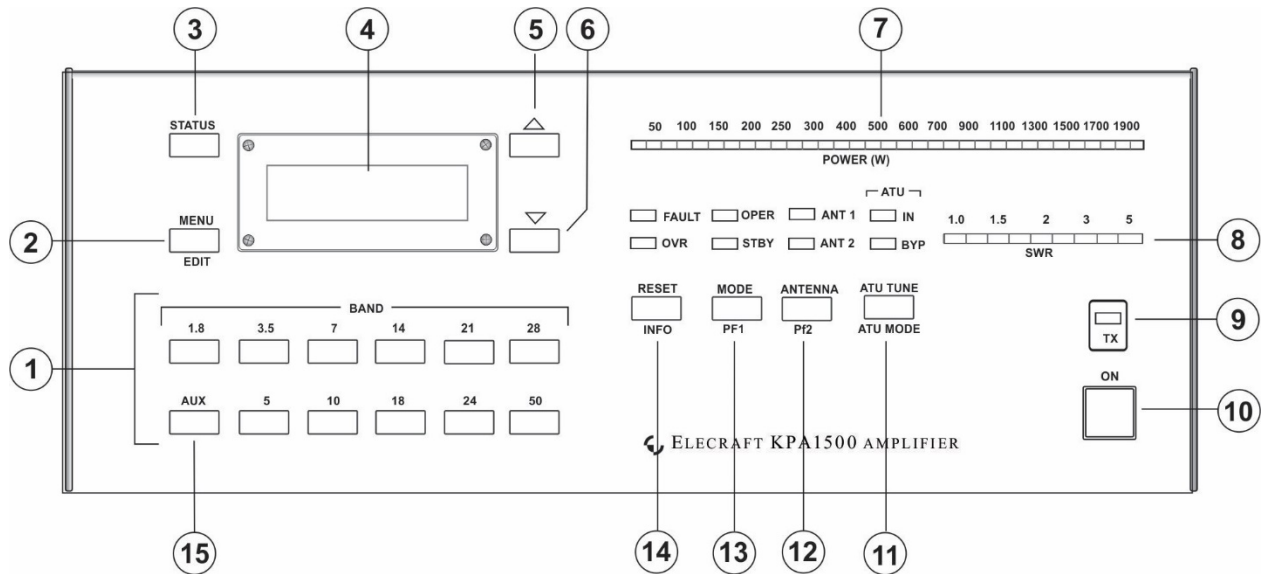


Figure 7. KPA1500 RF Deck Front Panel Controls and Indicators.

⚠ Switches with a legend above and below have two functions:

Tap (press briefly) to activate the function labeled above a switch.

Hold to activate the function labeled below the switch.

In the text, tap functions are shown like this: MENU. An example of a hold function is EDIT.

- ① BAND select switches: Tap to manually select a band.
- ② MENU/ **EDIT** switch: Tap to enter the KPA1500 MENU system. Hold to **EDIT** the selected menu parameter.
- ③ STATUS switch: Tap to display Status pages showing amplifier Fault Messages (see page 34).
- ④ Liquid Crystal Display (LCD): Shows various menu items, status and error messages.
- ⑤ ⑥ \triangle and ∇ : Use to scroll through the Status or Menu screens. Press and hold to scroll rapidly.
- ⑦ POWER Output wattmeter bargraph with a “peak-hold” function. See Menu Items, page 29.
- ⑧ SWR bargraph: The SWR LEDs are green from 1 to 1.5. The 1.5 to 2 LEDs are yellow and the LEDs above 2 are red.
- ⑨ TX LED: Lights whenever the amplifier is in operate mode (OPER) and the rear panel KEY IN signal is pulled low (transmit enabled).
- ⑩ ON pushbutton switch: Toggles the RF Deck power on or off.

- ⑪ ATU TUNE/ATU MODE switch: Tap to enable the ATU Tune function. Hold to place the internal ATU in or out of the signal path. The IN and BYP LEDs above the switch indicate ATU status.
- ⑫ ANTENNA / PF2 switch: Tap to toggle between the ANT1 and ANT2 outputs. The ANT 1 or ANT 2 LEDs indicate which antenna output is selected. Hold to select user-Programmable Function 2. Refer to the KPA1500 *Programming Reference*.
- ⑬ MODE / PF1 switch: Tap to switch between OPER and STBY modes. LEDs above the switch verify amplifier mode. Hold to select user-Programmable Function 1. Refer to the KPA1500 *Programming Reference*.
- ⑭ RESET / INFO switch: Tap to reset a fault condition. Hold to display information about the last fault on the LCD. The FAULT and OVR LEDs are associated with the RESET key to correct a fault condition. See “Fault Types, Conditions and Messages,” page 33.
- ⑮ AUX switch: Hold for 10 seconds to force a firmware load (see page 38).

Power On

IMPORTANT

When the KPA1500 is turned off using the front-panel switch ⑩, part of the control circuitry remains on as long as AC mains power is applied to the Power Supply.


Keeping the control circuitry energized allows the KPA1500 to be turned on and off remotely as well as from the front-panel switch. If you do not need to control the KPA1500 remotely and would prefer to save the small amount of power required for the control circuitry, either switch the Power Supply off using the rear panel switch or provide an external mains power switch capable of handling 20A.

1. A dummy load is recommended for initial tests. Ensure a suitable 50 Ω load is attached to the ANT 1 or ANT 2 connector on the rear panel. Tap the front panel ANTENNA switch to select the antenna connector used. The associated LED illuminates.
2. Enable the power supply by placing the rocker switch on the power supply module in the ON (I) position.
3. Tap the ON switch ⑩. The LCD ④, ANT 1 or ANT 2 and the OPER or STBY LEDs should light. By default, the KPA1500 enters STBY mode at power on. You can change the default to start in OPER mode using the *POWER ON MODE* menu item, see page 31.

 If the FAULT LED ⑦ lights and/or the alarm tone sounds at any time, see “Fault Types, Conditions and Messages,” page 33.

Band switching may be done automatically or manually as follows:

Automatic Band Switching via Frequency Counter: The KPA1500 measures the incoming RF frequency and automatically selects the proper band. The KEY IN input must be connected and pulled to ground to the driving transmitter to enable the KPA1500’s counter.

 The automatic band selection via frequency counter is active whenever the KEY IN is low (transmit mode) and the transceiver is delivering RF drive to the KPA1500. The automatic band selection function overrides band selection made by any other means to protect the KPA1500 from damage by wrong-band operation.

Manual Band Switching: Tap any of the front-panel BAND switches to manually switch the KPA1500 to that band. If the incorrect band is selected, the built-in frequency counter will automatically select the proper band for the RF frequency presented to the Input.


Coordinated K3s or K3 and KPA1500 Band Switching: When the optional AUX cable (page 14) is connected between the KPA1500 and the K3s or K3:

- The KPA1500 will follow the band selected on a K3s or K3 transceiver without the need to transmit.
- Tapping a BAND switch on the KPA1500 will cause the K3s or K3 to change bands accordingly.

The KPA1500 can automatically follow band selection from certain non-Elecraft transceivers such as Flex Radio, Icom, Kenwood and Yaesu (BCD) without transmitting when the appropriate control cable is used. This is called Enhanced Mode operation. However, control is one-way: The KPA1500 cannot command the transceiver to change bands as it does when connected to a K3s or K3 with the optional AUX cable.

See “Interfacing to Other Transceivers,” page 43.

Antenna Selection

Tap ANTENNA  to select the desired rear panel antenna connector. Either ANT 1 or ANT 2 LED illuminates to indicate the selection.

You may designate either ANT1 or ANT2 on a per-band basis. By default, the KPA1500 will return to the last used choice when returning to that band.

You can also disable one of the antenna outputs for selected bands. See *ANTENNA ENABLE* and *ANTENNA PREFER* menu items on page 30.

The menu selection applies only to the current band. The *KPA1500 Utility* makes it easy to configure this menu function for several bands.

- If an ANT connector is disabled on any band, tapping the ANT button blinks the ANT LED, but will not change to the disabled antenna.

 **When the KPA1500 is turned off, the Input port is connected directly to the ANT1 port, even if ANT1 is disabled.**

Transmitting: Initial Steps

The POWER (W) and standing wave ratio (SWR) bar graphs are functional when the amplifier is in STBY. Twenty five watts from the driving transceiver will illuminate the first POWER LED. You may run up to 200 watts through the KPA1500 in STBY.

 ***Even if the antenna connected to the amplifier is resonant (low SWR), the KPA1500 ATU must be “trained” for optimum performance. See “Initiating a Full Search Tune,” page 24.***

- **If you attempt to drive the KPA1500 on a frequency range of 26 to 28 MHz, the KPA1500 automatically switches to STBY, the red FAULT LED lights and a tone emits from the speaker.**
 - **Correct the condition and tap the RESET switch to restore normal operation.**
 - **The tone can be turned off using the Menu entry *ALARM TONE*. The default setting is ON.**
1. Be sure you have an antenna or dummy load connected to the active antenna output (see *Antenna Selection* above) and your driving transceiver is on a frequency within an Amateur band.

2. To make the KPA1500 switch from STBY to transmit, it must be in OPER mode and keyed. Use either KEY IN pulled low (contact closure to ground) or with the optional KPAK3AUX cable connected between the KPA1500 AUX connector and the K3S/K3 ACC connector.
3. If you have a 50 Ω dummy load or an antenna that you know presents a low SWR to the KPA1500, press and hold the **ATU MODE** switch to put the ATU in bypass (BYP LED lights).
 - a) If you are not sure of the SWR, press and hold the **ATU MODE** switch to enable the ATU (IN LED lights).
 - b) Tap *ATU TUNE* to initiate a tuning cycle. Apply 25 to 50 W of transmitter drive during this tune cycle.
4. Tap the MODE switch **13** as needed so the OPER LED lights.
5. Apply a few watts of RF drive and watch the *POWER (W)* **7** bargraph illuminate to indicate RF output power.
6. Normal drive levels to produce the full 1500 W output will be about 50 W but start with a much lower level to observe how the KPA1500 behaves.
7. Slowly increase the drive power and confirm the *SWR* bargraph **8** indicates less than 1.5 while the output indicated by the *POWER (W)* bargraph **7** increases.

⚠ *During heavy use, you may hear clicking sounds as amplifier components heat and cool. This is normal. The rear panel fans will turn on and increase speed as needed automatically. If desired, you can keep the fans running at all times using the FAN SPEED MIN menu setting.*

8. When driving the KPA1500 with an Elecraft K3S or K3, use the per-band power control to set the amplifier output just below the desired peak output on each band. Do not rely on ALC to control the power output, see below.

In the K3S or K3, program *CONFIG:POWER SET* to *Per Band* and adjust the power level for each band. See *Per-Band Power Control* in the Owner's Manual for further details. (Requires K3S/K3 firmware version 4.82 or later).

⚠ *If you use the AUX cable interface between the K3S or K3 and KPA1500 (Figure 4, page 15 or Figure 5, page 16) and you have RADIO TYPE set to K3S or K3, the KPA1500 will send the OPER/STBY status to the K3S or K3.*

i This means you can set two per-band power levels with the K3S or K3. One to drive the KPA1500 when it is in OPER mode and another for pass-through transmitting when the KPA1500 is in STBY. The transceiver will automatically return to your preset power levels as you switch the KPA1500 between OPER and STBY.

Automatic Level Control (ALC)

Automatic Level Control (ALC) is a useful safety mechanism, but do not use ALC as the principle power control. Doing so causes many of the unwanted transmit dynamics you often hear on the air including excessive intermodulation distortion (IMD) and clicks.

Elecraft recommends using the K3S or K3 *PWR SET-PER BAND* function to set proper drive levels, not ALC. The Elecraft K3S and K3 ALC intentionally have a slow attack and much slower decay to avoid adding more distortion or dynamics problems than necessary. However, not all of the negative effects of ALC action can be avoided. It is still best to set the ALC threshold and then adjust the RF drive from the transceiver to avoid ALC action in normal operation.

If you choose to use ALC, set your transmitter power output correctly (60 W or less) as described under *Transmitting: Initial Steps* and adjust the ALC so it does not affect output power in normal operation.

1. Drive the KPA1500 to the desired output.
2. Adjust menu item *ALC THRESH* until power just starts to drop and then set *ALC THRESH* one or two units above this setting so it does not affect the output power in normal operation.
3. Repeat on each band. *ALC THRESH* is set and saved separately on each band.

Automatic Antenna Tuner (ATU)

The internal ATU may be used with the KPA1500 in either STBY or OPR mode. When the KPA1500 is in STBY mode, power from the driving transceiver is passed directly to the ATU. Press and hold **ATU MODE** to select whether the ATU is active (IN) or bypassed (BYP). The corresponding LED above the switch will light.

The ATU is active during receive. This may provide a small improvement in signal strength or better rejection of adjacent bands, due to a more-optimal match between the antenna and transceiver.

i The ATU evaluates and decides whether or not it should be active or bypassed. For operating convenience, it is best to keep the ATU active (IN) at all times.

⚠ *The maximum bypass power through the KPA1500 INPUT connector is 200 W.*

At lower amplifier outputs up to about 800 W, or when using your driving transceiver “barefoot” at 100 W, the ATU will match loads up to an SWR of 10:1 on 80 through 10 meters and 5:1 on 160 and 6 meters. At 1500 W the tuner will match an SWR of about 3:1.

High antenna SWR and high output power causes a hard fault and the amplifier will protect its antenna tuner by going into STBY mode.

To prevent or correct this fault, here are some things to try:

- 1) Check antenna SWR at the desired operating frequency. For example, trying to use a random-length wire loop on 160 m may be out of range for the ATU (SWR exceeds 3:1).
- 2) Train the tuner for the antenna and operating frequency.
- 3) Decrease power to about 800 W. Remember that your feedline may overheat when operated with high power at high SWR.

Derating graphs for frequency, power and SWR are shown in Figure 8.

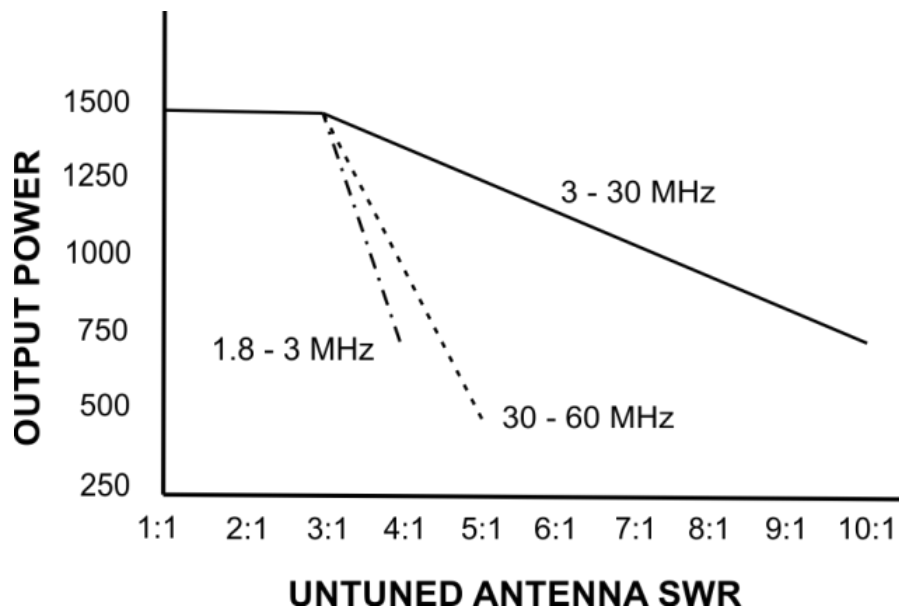


Figure 8. Antenna Tuner Matching Capability.

The ATU recalls tune solutions based on the frequency reported by an interfaced radio or by the KPA1500 frequency counter when the KEY IN line is held low.

This tune feature works in both STBY and OPER modes. Frequency information from the interfaced transceiver may be used to select an ATU setting without transmitting.

Manual Tune Operation

1. Tap **ATU TUNE** to initiate an ATU tune cycle. The ATU IN light will flash.
2. Supply 10-50 W of RF from your transceiver.

Relays in the ATU operate to switch values of inductance (L) and capacitance (C) to match the antenna impedance to a value close to 50 Ω non-reactive for the KPA1500 or for the driving transceiver when the KPA1500 is in STBY.

The SWR LEDs indicate how close the antenna impedance is matched to the transceiver. The L and C values switched in will provide a good match for most situations.

In some cases, especially with an antenna that is very sharp or narrow, the ATU may not be able to find the best dip in SWR. In this case, tap the **ATU TUNE** again within three seconds after tuning is completed to initiate the fine tune process. Fine tuning makes smaller L and C steps to find a suitable solution not possible with coarse tuning steps. This may result in a lower SWR. You must not interrupt the RF from the transceiver for this function to complete properly. Once the tuning operation is complete, un-key your transceiver.

If the SWR is 1.2 or less when a tune operation begins, the KPA1500 bypasses the matching network without searching for a tuning solution. The ATU IN and the ATU BYP LEDs both illuminate to show the tuner is bypassed for this frequency. When returning to the selected frequency, the internal ATU will recall the bypass mode, and both ATU IN and the ATU BYP LEDs will be illuminated.

You can change the default bypass SWR threshold with the *ATU BYPASS* parameter in the Menu. Subsequent ATU TUNE attempts will use the new threshold to determine when the internal ATU is placed into Bypass mode.

ATU Memories

After successfully tuning, the KPA1500 stores L and C or Bypass settings and the ANT1 or ANT2 selection in memory. They are recalled when returning to that frequency.

The entire spectrum from 1.8 through 54.2 MHz is divided into frequency segments and tuning information is stored for each successfully tuned segment. These are called memory “bins.”

This allows rapid band changing even when more than one antenna is used on a given band. Please see the Appendix, page 52 for a list of the center frequencies of each of the memory bins.

i **ATU memories can be used to accommodate different factors such as multiple antennas on one connector, weather conditions (rain, snow, ice), beam headings or antenna height.**

Re-tuning to maintain a low SWR is normally required over a narrower frequency range on the lower frequencies. Band segments are:

- Below 4.8 MHz the segments are 10 kHz wide.
- From 4.8 MHz through 26 MHz the segments are 20 kHz wide.
- From 26 MHz to 38 MHz the segments are 100 kHz wide.
- Above 38 MHz the segments are 200 kHz wide.

When starting a tune operation for a frequency segment that has no tuning solution, the KPA1500 first tries settings in the nearest frequency segment with tuning data.

ATU data stored after a successful Full Search Tune can be viewed using menu items *ATU BYPASS SWR*, *ATU CAP*, *ATU IND*, and *ATU SIDE*. The *KPA1500 Utility Command Tester* can also be used to view ATU settings.

To minimize the tune operation while moving from one frequency to another, you can “train” the ATU at different points across each band. The KPA1500 memorizes the L and C settings and antenna selected. The KPA1500 ATU will not require a full search tune operation again unless the antenna or feedline changes.

Normally you won’t need to perform a tune operation in every segment shown in the Appendix. If you transmit in a segment where there is no tuning solution, the ATU automatically checks solutions for adjacent segments to see if they produce an acceptable SWR.

The KPA1500 features upper and lower SWR thresholds or limits, which determine how the amplifier behaves. Thresholds can be set per band using the *ATU BYPASS* (default: 1.2:1) and the *ATU HiSWR RETUNE* (default: *RETUNE OFF*) and the *ATU RETUNE SWR* (default: 1.8:1) menu items.

The KPA1500 ATU may be set so it is not engaged at all (ATU bypass – BYP) under certain low SWR conditions. That is, when running a Full Search Tune, if the tuner finds that the SWR is below 1.2:1, the tuner memorizes that frequency and goes into BYP. Subsequent visits to that frequency require no tuning for full power output, so both ATU IN and BYP LEDs are lit, indicating the ATU is engaged for normal operation, but on that frequency, the ATU is bypassed.

i **Initiate Full Search tune to train the KPA1500 ATU for your favorite portions of each band and antenna combination.**

Initiating a Full Search Tune

1. Tap the **ATU TUNE** button. The ATU IN light will begin to flash to indicate it is waiting for RF from the transceiver.
2. Apply 10 to 50 W of transmit drive. You will hear the relays searching for a match.
3. When the relays stop, the ATU IN LED stops flashing, indicating Full Search Tune success.

4. The resulting match is automatically stored in the appropriate memory bin. If a match cannot be found, the red **FAULT LED** illuminates, *NO MATCH* is shown on the LCD, and no settings are stored. The ATU can create a match for SWR as high as 10:1. If no match is found, make sure the correct frequency band and antenna are selected.
5. You can use the *KPA1500 Utility* “Operate” panel to observe Full Search Tune activity and transmission line / antenna system SWR.
6. If you have multiple antennas on one or more bands, repeat this procedure for each antenna and frequency combination.

With *ATU HiSWR AUTO RETUNE* set to *ENABLED* and an antenna SWR higher than the retune threshold, the KPA1500 will search previous tuner settings until one is found that is as good as or better than the SWR threshold. Once found, the setting is stored and the amplifier quickly resumes operation.

Note the ATU will not automatically begin a full-search tune. It recalls previous or adjacent-segment tuning solutions to enable the fastest frequency changes.

Multiple Antennas and External Antenna Switches

Some stations have several antennas, all sharing the same KPA1500 antenna connector, switched externally. The ATU memory feature is great for antenna installations with multiple antennas on the same band, or in situations where the match changes with rain, ice or some other condition.

In other words, for any one operating frequency and “N” different antennas with “N” different tuning solutions, the KPA1500 ATU automatically selects the correct match for each antenna, environmental condition and tuning solution.

The KPA1500 ATU memory allows up to 31 settings for each frequency segment. On any one given frequency, three (or six, or “N”) different antennas with N different tuning solutions are accommodated, with the tuner automatically selecting the correct match for each, as long as the SWR is higher than the “retune” setting, which defaults to 1.8:1.

For example, you may have a tri-band Yagi, a 40 m dipole, a G5RV and a multi-band trap vertical connected to an external coax switch going to the ANT1 connector. When operating on 15 meters, the KPA1500 stores separate tuning solutions for all three antennas. See Figure 9.

Train the tuner for each antenna, coax switch and ANT1 or ANT2 combination using the *Training the ATU Using Full Search Tune* procedure.

When *ATU HiSWR RETUNE* is enabled and you key the transmitter, the match is evaluated. If it is higher than the *ATU HiSWR RETUNE* threshold (default: 1.8:1), the ATU rapidly searches saved solutions for this frequency segment. The first match lower or equal to the *ATU HiSWR RETUNE* threshold is applied and the amplifier is enabled.

The 31 ATU settings are not dedicated to either antenna connector. You may store any combination of settings totaling 31. For example, you can set 25 ATU settings for ANT1 and 6 settings for ANT2.

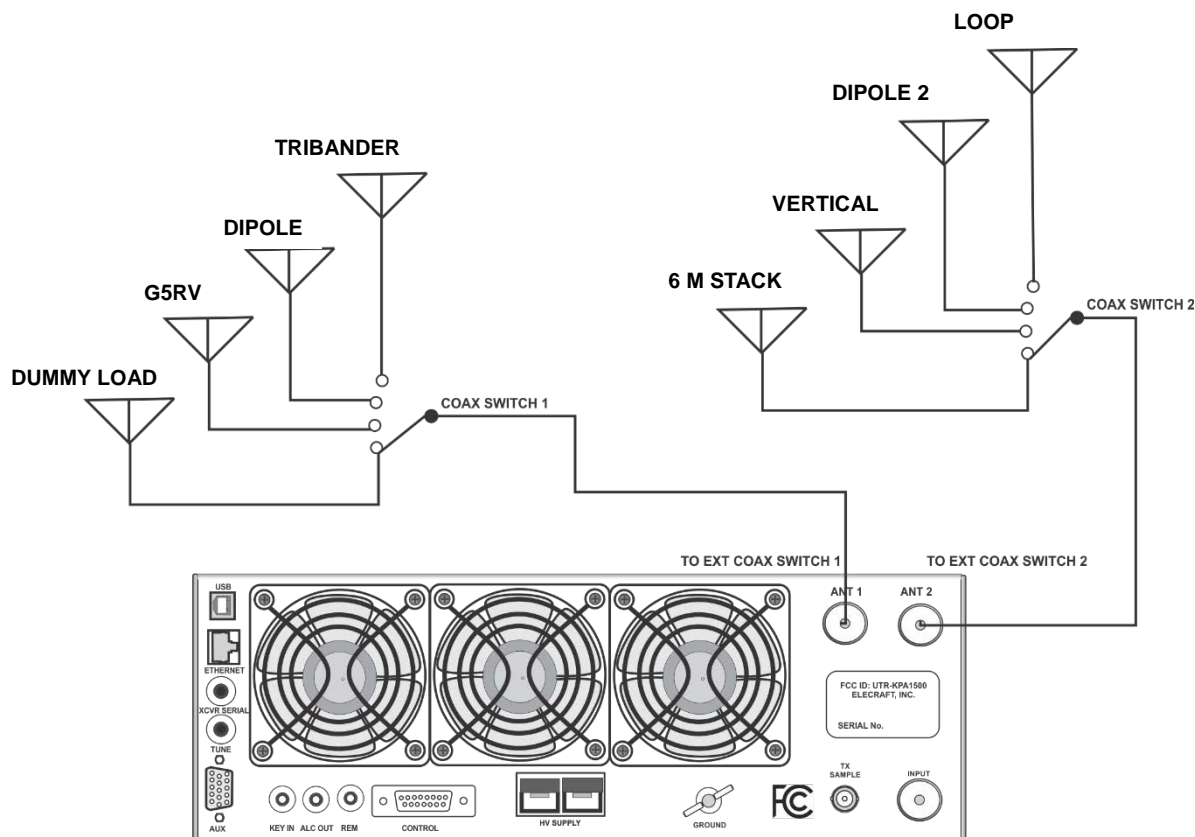


Figure 9. Multiple Antennas and External Coax Switches.

Frequency Tracking with an Elecraft K3S or K3 Transceiver

When used with a K3S or K3 and interfaced using the optional KPA3AUX cable kit, the KPA1500 may be configured to track frequency changes without transmitting. When the transceiver changes bands, the KPA1500 changes bands and vice versa, providing virtually instantaneous amplifier and ATU setting changes as you tune the receiver across different bands.

To use frequency tracking:

1. Connect the KPA1500 and K3S or K3 using the AUX interface cable as shown in Figure 4 or Figure 5.
2. Ensure the transceiver is equipped with firmware revision 4.82 or later. See Firmware Upgrades in the Owner’s Manual for more details.
3. Enable frequency tracking on the transceiver:

Select *CONFIG: KAT3* and then tap the switch to select *KAT500Y* (KPA1500 connected and frequency tracking enabled). Menu selection *KAT500N* (no KPA1500) disables frequency tracking.

i This is the same procedure that enables frequency tracking with the KAT500 tuner.

Frequency Tracking with Other Transceivers

If a driving transceiver is equipped to exchange CI-V or serial data, KPA1500 frequency tracking may be possible. See “Interfacing to Other Transceivers,” on page 43.

Amplifier Monitoring and Status Indicators

LEDs

The amplifier reports antenna SWR and output power on LED bargraph displays. The right-most LED in the bargraph varies as power varies through its range. The bargraphs are color-coded green for normal, yellow for marginal and red for excessive levels.

Excessive levels may trigger a fault and switch the KPA1500 to STBY (see *Fault Conditions*, page 33). The FAULT LED lights if a fault condition occurs and LEDs indicate whether the amplifier is in STBY or OPER mode.

ANT 1 and ANT 2: Indicates which antenna connector is active. When the KPA1500 is turned off, ANT 1 is always selected, even if it is disabled in firmware or no antenna is connected.

ATU IN and ATU BYP: When an antenna with low SWR is used and the antenna tuner is enabled, **both** ATU IN and ATU BYP LEDs are illuminated; indicating BYP is the best tune solution, even when the ATU is engaged (ATU IN). When the KPA1500 is turned off, the ATU is bypassed.

Internal Speaker Alarm Tones

The internal speaker emits an alarm tone for hard or soft faults. The *ALARM TONE* menu item default is *ON* and a hard fault is a steady tone and a soft fault is an intermittent beep. Tap the **RESET** key to silence the alarm.

LCD Notification Messages

Messages are temporarily displayed on the LCD when certain events occur.

When the band is changed, the LCD shows the new band for about one and a half seconds, for example: *BAND 7 MHz*.

When the ATU TUNE switch is pressed, *NEED TUNE PWR, Key Exciter* is displayed as a reminder to provide RF for ATU tuning. You may tap ATU TUNE again to cancel the full search tune request. *TUNE CANCELLED* appears briefly on the LCD. When ATU tuning finishes normally, the LCD shows *TUNE COMPLETE* briefly.

LCD Message	Meaning
<i>BAND n MHz</i>	Amplifier now operating on the “n” MHz band.
<i>NEED TUNE PWR Key Exciter</i>	ATU is in full-search tune mode and needs RF power from the transceiver to perform the tune.
<i>TUNE COMPLETE</i>	ATU full search tune successfully found a match.
<i>TUNE CANCELLED</i>	ATU TUNE button pressed during a full search tune and halted the process.
<i>RF IN, NO KEY IN PWR 30W</i>	Reports when the KPA1500 is used with antennas with auto-tuners (for example, SteppIR controllers). The PA is bypassed but is not a fault condition. Input power is displayed on the second line.
<i>FUNCTION UNASSIGNED</i>	Button has no operation programmed.

Status and Menu Items

Tap STATUS to display various amplifier operating parameters.

Tap MENU to call the menu display.

Tap the Δ or ∇ keys to scroll through STATUS or MENU items. Press and hold the Δ or ∇ keys to scroll quickly. Press and hold **EDIT** to enable the Δ or ∇ keys to edit (change) MENU parameters.

Tap MENU again to save the parameter and enable Menu Item Selection.

LCD *TECH MODE* is normally *DISABLED* (Off). Two main screens plus transitory screens (text that displays for a second or so after something changes) are visible.

When *TECH MODE* is *ENABLED* (On), additional text is available and can be viewed by tapping the Δ or ∇ keys.

Example displays are shown below. Actual values will vary according to your operating conditions.

Tech Mode	Display Panel Text	Display Format, Two Lines	Definition
<i>DISABLED</i>	<i>3.5MHz 50A 42C</i> <i>PWR 1234W 1.7:1</i>	Band, Current, Heat Sink Temp RF Power, SWR	Band: Operating frequency band Current: 50V supply current Heat Sink Temp: In degrees C RF Output: Measured by the internal wattmeter SWR: From forward and reflected power coupler
<i>DISABLED</i>	<i>FWD PWR: 1234W</i> <i>REFL PWR: 23</i>	Forward Power Reflected Power	FWD PWR: Forward power REFL PWR: Reflected Power

Tech Mode	Display Panel Text	Display Format, Two Lines	Definition
<i>ENABLED</i>	<i>XCVR FREQ 14028</i> <i>TX COUNT 14024</i>	Exciter Frequency from Data Port Exciter Frequency from Internal Counter	XCVR FREQ: From AUXBUS or XCVR SERIAL port (transceiver data). TX COUNT: Drive frequency with 8 kHz resolution. This frequency is used to recall stored ATU tuning solutions.
<i>ENABLED</i>	<i>ELECRAFT</i> <i>KPA1500</i>	Banner	Text appears briefly on the LCD when the amplifier is switched on. Customize this text with the <i>KPA1500 Utility</i> "EDIT CONFIGURATION" and select the "Banner" tab.
<i>ENABLED</i>	<i>F: 983W 56%</i> <i>50V 34A 23C</i>	Forward Power, Efficiency PA Voltage, Current, Temperature	F: Forward power, efficiency, PA voltage, current, temperature in Celsius. Efficiency is RF output power divided by DC input power.

Tech Mode	Display Panel Text	Display Format, Two Lines	Definition
<i>ENABLED</i>	<i>ATU IN 1.2:1</i> <i>160nH 61pF TX</i>	ATU Status L and C Combinations	ATU IN: ATU is active and the SWR after match is displayed. Inductance is 160 nH. Capacitance is 61 pF. The capacitors are on the TX (source) side of the inductor. When the ATU is in BYP, the capacitor and inductor banks are disconnected.

Menu Items

Tap MENU ^② to toggle between *STATUS* and *MENU* displays to select *MENU*. The Menu function allows the various parameters to be set. With the menu function enabled, tap the \triangle and ∇ switches to scroll through the menu items. Tap and hold either key to scroll quickly. The menu items are in alphabetical order.

To change a parameter, press and hold **EDIT** and the parameter on the LCD will blink. Then tap the \triangle and ∇ switches to change the parameter. Tap MENU again to save the parameter and return the \triangle and ∇ switches for menu selection.

Tapping STATUS ^③ also exits the menu.

i Menu Item Notes

- Some menu items are “per band”; these menu items show the frequency band along with the parameter on the LCD. Changing a band parameter changes it only for the band being displayed.
If you wish to change a parameter for more than one band, tap the BAND switch while editing the menu item to view and change the configuration for each band.
- You may use the *KPA1500 Utility* program to modify several settings on multiple bands.
- Some menu items, such as serial number and firmware revision, may not be edited.
- Some menu items appear only when *TECH MODE* is enabled.


Menu Entry	Default	Description
ALARM TONE	ON	An internal speaker sounds a tone on faults. The menu choices are <i>OFF</i> , <i>FAULT</i> , <i>OVR</i> and <i>FAULT, OVR</i> . When enabled, a hard fault is a steady tone and a soft fault is an intermittent beep. When an <i>ALARM TONE</i> menu item is changed, a sample tone is produced.
ALC THRESH (Per Band)	127	KPA1500 provides an ALC voltage between 0 and –12V, a function of output power and this per-band <i>ALC THRESH</i> value. See page 21 for more information.
ANTENNA ENABLE (Per Band)	BOTH	Antenna connectors ANT1 or ANT2 may be enabled or disabled, per band. You cannot disable both ANT1 and ANT2. A disabled antenna connector cannot be selected by the front panel ANTENNA switch.
ANTENNA PREFER (Per Band)	LAST USED	Antenna preference when switching bands: <i>ANT 1</i> , <i>ANT 2</i> or <i>LAST USED</i> .
ATTEN RELEASE (Tech Mode Only)	3 SEC	When the attenuator switches in due to excessive drive power, there is a delay after the excessive power condition is corrected before the attenuator switches out. This delay can be adjusted in steps of 100 ms between 1.4 sec to 5 sec.
ATU BYPASS (Per Band)	1.2:1	If measured antenna SWR is less than this value, the tuner automatically selects BYPASS as the tuning solution (see page 22).
ATU CAP (Tech Mode Only)	—	Enables manual selection of the capacitance used by the ATU. Capacitance in pF and the corresponding SWR is displayed on the LCD. Normally, the ATU selects the correct value automatically.
ATU HiSWR RETUNE (Per-Band)	OFF	When SWR exceeds the <i>ATU RETUNE SWR</i> value, the ATU examines previously stored tuning settings for the current frequency and chooses the first one that meets the SWR STOP threshold. This does not start a full search tune. When <i>ON</i> , the amplifier pulls down (grounds) the TUNE connector's KEY line (tip) and can also send a message to a K3s / K3 to provide TUNE POWER (CW carrier) for ATU tuning.
ATU IND (Tech Mode Only)	—	Enables manual selection of the inductance used by the ATU. Inductance in nH and the corresponding SWR is displayed on the LCD. Normally, the ATU selects the correct value automatically.
ATU MEM ERASE	—	Clears all ATU settings for the currently selected band and antenna and sets the ATU to <i>BYP</i> . You may change ANT and BAND while using this setting.
ATU MODE SWITCH	—	The ATU mode is either in line or bypassed. This menu item chooses between one setting for all bands and antennas, or individual ATU mode by band and antenna. This is intended for owners of externally-tuned antennas that are matched separately from the KPA1500 ATU. ATU MODE SWITCH All Bands: ATU Mode does not change as bands and antennas are changed. ATU MODE SWITCH Per-Band Per-Ant: ATU Mode will be same as you last connected to that band and antenna.
ATU NO MATCH SWR (Tech Mode Only)	3.0:1	When an ATU search completes, the best setting the ATU can find may be too high for practical use (e.g., ATU attempting to match an open antenna connector). If the ATU search cannot find an SWR below the <i>ATU NO MATCH SWR</i> threshold, a <i>NO MATCH</i> fault is generated.
ATU RETUNE SWR (Per Band)	1.8	Threshold mismatch used to determine an adequate impedance match when <i>ATU HISWR RETUNE</i> is enabled.
ATU SETTINGS/BIN (Tech Mode Only)	4	Number of ATU settings to consider in each bin (frequency segment, 1 to 31, default 4).

Menu Entry	Default	Description
<i>ATU SIDE</i> (Tech Mode Only)	—	The ATU uses a series inductance with a shunt capacitance on either the source (TX) or antenna (ANT) side. Use the the \triangle and ∇ keys to manually switch the shunt capacitance into the TX or ANT side of the L-network inductance. Normally, the ATU selects the correct side automatically.
<i>ATU STOP TUN SWR</i> (Per Band)	1.2:1	When an <i>ATU HiSWR RETUNE</i> is started, up to 31 stored ATU settings and the current or near frequencies are examined. <i>ATU STOP TUNE SWR</i> tells the ATU when an acceptable match has been found. If an acceptable ATU setting is found, the search stops. If SWR is not low enough, a NO MATCH fault may occur (see <i>ATU NO MATCH SWR</i> menu item), and you should tap the KPA1500 front panel ATU TUNE switch to start a Full Search Tune.
<i>ATU XCVR KEY</i> (Tech Mode Only)	ON	Used when a K3s/K3 (MCU version 5.93 and later) is connected with an AUX cable. When ON, the KPA1500 sends an AUXBUS message when needed for TUNE POWER (carrier) for the ATU to complete tuning. The KPA1500 sends another message to stop tuning. Also used when performing an <i>ATU HiSWR RETUNE</i> or a Full Search Tune (press of the front panel ATU TUNE switch).
<i>BANDCHANGE->STBY</i>	NO	Chooses whether to switch from OPER to STBY when changing bands. YES will switch the KPA1500 to STBY when changing bands. Useful if you use a manually operated external antenna tuner.
<i>DEMO MODE</i> (Tech Mode Only)	OFF	Used only for non-transmitting demonstrations where proper mains power is not available. When keyed shows nominal SWR and full power output even though no RF is being generated.
<i>FAN SPEED MIN</i>	0	Sets the minimum fan speed on the RF deck independent of heat sink temperature. This setting does not affect the power supply fan.
<i>FIRMWARE VERSION</i>	—	Displays the KPA1500 firmware version.
<i>LCD BACKLIGHT</i>	7	Adjusts the brightness of the LCD backlight from 0 to 50.
<i>LCD CONTRAST</i>	23	Adjusts the contrast of LCD characters from 0 to 50.
<i>LED BRIGHTNESS</i>	22	Adjusts the brightness of the front-panel LEDs from 0 to 50.
<i>NET GATEWAY</i> (Tech Mode Only)	—	Shows the IP address of the router as provided by a DHCP server when the KPA1500 is connected to a TCP/IP network. Leading zeros are removed from each octet.
<i>NET IP ADDRESS</i> (Tech Mode Only)	—	The network IP address assigned to the KPA1500 by a DHCP server.
<i>NET MAC</i> (Tech Mode Only)	MAC	Displays the unique media access control (MAC) address assigned by the microcontroller manufacturer.
<i>NET MASK</i> (Tech Mode Only)	—	DCHP-assigned Subnet Mask in dotted octet format.
<i>NET WAKE on LAN</i> (Tech Mode Only)	ENABLED	KPA1500 will turn power on when a Wake on LAN “magic packet” with the amplifier’s MAC address is received on its LAN Ethernet connector.
<i>PEAK HOLD</i> (Tech Mode Only)	1.2 SEC	Power bargraph peak hold time, adjustable between 0.1 and 9.9 seconds.
<i>POWER ON MODE</i>	STBY	Selects whether the amplifier powers on in OPER or STBY mode.
<i>RADIO POLL</i>	OFF	ON enables KPA1500 polling of the transceiver frequency via XCVR SERIAL port. Applies only when <i>RADIO TYPE SERIAL</i> is selected.

Menu Entry	Default	Description
RADIO TYPE	K3s OR K3	Provides frequency information and communication between a transceiver and KPA1500. K3s / K3s: Select which transceiver is connected via the 15-pin AUX cable to the KPA1500. BCD: The four BAND lines on the ACC connector carry band information in BCD format. ICOM: The XCVR SERIAL connector is configured for CI-V protocol, and ACC connector BAND VOLTAGE and BAND REF VOLTAGE are examined for frequency information. Serial: A Kenwood, Yaesu, Elecraft K2, K3, K3s, KX2, or KX3 or FlexRadio transceiver that responds to IF; FB; polls with frequency and VFO information.
SERIAL NUMBER	—	Displays the KPA1500 serial number. Not editable.
SERIAL SPEED HOST	230400 bps	The speed of the Host PC (labeled USB) connection. The KPA1500 incorporates a USB-to-Serial adapter that appears as a COM port to computer software. The speed range is 4800 to 230,400 bits/second. Use the highest reliable speed. <i>KPA1500 Utility</i> finds the KPA1500 at any of its speeds.
SERIAL SPEED XCVR	38400 bps	The speed of the 3.5mm TRS connector labeled XCVR SERIAL and depends on RADIO TYPE selection.
TECH MODE	DISABLED	Some status and menu items are shown only when TECH MODE is enabled.
TR ADDED TIME (Tech Mode Only)	0 msec	Delay added to the receive recovery if the transceiver has an RF envelope that continues after its KEY OUT signal goes high. For the K3s / K3 and most other transceivers use the default of 0 ms.
TX INHIBIT (Tech Mode Only)	DISABLED	Chooses whether to enable or disable the ACC connector INHIBIT line, pin 11. When enabled and the INHIBIT line is pulled down, the PA stage is bypassed. The MODE LED will remain in OPER.
VOLTS (Tech Mode Only)		Displays the measured power supply voltages (5, 10, 12, -12 and 50V).
WMTR ADJUST (Per Band, Tech Mode Only)	100	User-adjustable Wattmeter Calibration. Note: The KPA1500 Wattmeter is factory-calibrated on all bands. WMTR ADJUST affects only the displayed power (LCD & LED, <i>KPA1500 Utility</i> operate page). Factory calibrated fault thresholds are not affected.
XCVR SERIAL HOST (Tech Mode Only)	DISABLED	When enabled the XCVR SERIAL connector can accept the same KPA1500 command set as the USB and Ethernet connectors. May be used by computer connections that must use RS-232 rather than USB.
XCVR SERIAL LOOP (Tech Mode Only)	OFF	Loopback test of XCVR SERIAL connector. Used with a plug that shorts tip to ring.

Fault Types, Conditions and Messages

If the amplifier is operated beyond its ratings, it will enter one of two fault conditions to protect itself from damage.

Fault Type	Conditions	Indicated By
Soft	<p>Relatively minor (soft) faults, such as excessive reflected power, cause an internal 3 dB attenuator to be switched into the RF drive path to protect the KPA1500.</p> <p>When a soft fault occurs, the OVR LED blinks, an intermittent tone is produced* and the cause is displayed on the LCD.</p> <p>When the overdrive situation is removed (by decreasing drive power), the LED turns off and the attenuator is removed from the circuit.</p> <p>The KPA1500 tests the condition and will return to normal operation automatically after the cause is removed.</p> <p>If the fault persists or if it is severe, a hard fault will occur, and the amplifier must be reset (Press RESET button or reset via remote control software).</p> <p>*See <i>ALARM TONE</i> menu item.</p>	<p>OVR LED blinks and alarm tone sounds*.</p> <p>LCD reports the reason.</p>
Hard	<p>Hard faults automatically switch the KPA1500 into STBY to protect it.</p> <p>Extremely high reflected power, excessive drive power, unauthorized frequency operation or failure of a critical component such as a power supply are possible causes.</p> <p>When a hard fault occurs, the FAULT indicator lights, the speaker sounds* and the cause is displayed on the LCD.</p> <p>When the condition is corrected, tap the OPER/STBY switch to return the KPA1500 to normal operation, or tap the RESET switch to return the KPA1500 to STBY mode.</p> <p> Hard Faults require the operator to correct the condition and reset the amplifier.</p> <p>*See <i>ALARM TONE</i> menu item.</p>	<p>FAULT LED on and alarm tone sounds*.</p> <p>Cause displayed on LCD.</p>

LCD Fault Messages and Descriptions

The two-line alphanumeric LCD messages indicate fault conditions and, in most cases, actual measurements of the condition, such as RF power, voltage or SWR to further help diagnose soft or hard faults.

LCD Message	Fault	Fault Type
<i>LPF VMON</i>	Incorrect bias voltages at the TR switch.	Hard
<i>NO MATCH 4.3</i>	ATU unable to match to the load (SWR exceeds 3:1) at the selected ANT connector. Measured SWR is displayed on the second line.	Hard
<i>PA CURRENT 68 Amperes</i>	Excessive PA current.	Soft
<i>PWR DISS 2050 Watts</i>	Power amplifier is dissipating excessive output or reflected power.	Hard
<i>PWR SWRBYP 4.3</i>	Tuned antenna SWR exceeds safe limits at selected power.	Soft
<i>PWR FWD 2005 Watts</i>	Excessive forward power measured.	Soft
<i>HIGH GAIN RATIO 33</i>	Ratio of input power to forward power too high.	Hard
<i>LOW GAIN RATIO 2</i>	Unexpectedly low gain.	Hard
<i>FREQUENCY 26123KHZ</i>	RF from the driving transceiver is between 26 and 28 MHz or other frequencies as required by local regulations.	Hard
<i>PWR INPUT 65 Watts</i>	Excessive power from the driving transceiver.	Soft
<i>PWR REFL 180 WATTS</i>	Excessive reflected power detected.	Soft
<i>HIGH SWR 19.3</i>	SWR extremely high (open load detected).	Hard
<i>HIGH TEMP 112 degrees C</i>	Heat sink temperature too high.	Hard
<i>5V SUPPLY 3.2 Volts</i>	5V supply out of range	Hard
<i>50V SUPPLY 42.123 Volts</i>	50V supply out of range.	Hard
<i>10V SUPPLY 4.8 Volts</i>	10V supply out of range	Hard
<i>12V SUPPLY 10.5 Volts</i>	12V supply out of range	Hard
<i>-12 SUPPLY</i>	-12V supply out of range	Hard

KPA1500 Remote Operation

The KPA1500 is capable of remote control and operation via the rear panel USB or ETHERNET port and a computer and a local area network (LAN) or wide area network (WAN).

Simple “on/off control” can be accomplished via the rear panel REM jack or a connection to the AUX connector.

⚠ *Elecraft recommends using a USB connection to the KPA1500 and a remote server to control the amplifier. Port forwarding may also be used to access a LAN or WAN.*

Although there is no personal information in the amplifier and it cannot be made to transmit RF without an exciter keying it, it is always best to be diligent against data breaches or hacking.

Port forwarding is specific to the router manufacturer and model. Refer to the manufacturer’s instructions for port forwarding configuring. One helpful website is <http://portforward.com/>

For users that wish to access their amplifier remotely, Elecraft recommends using Host Remote/Connect Remote (Server/Client) and forward just one Transmission Control Protocol port (default 4526 TCP). This connection does not require the Wake on LAN (WOL) feature.

Configuring WOL to work across the Internet requires a router to have ARP binding. Not all consumer type routers have ARP binding and without it, WOL will not reliably work across the Internet.

The “KPA1500 Remote” Program

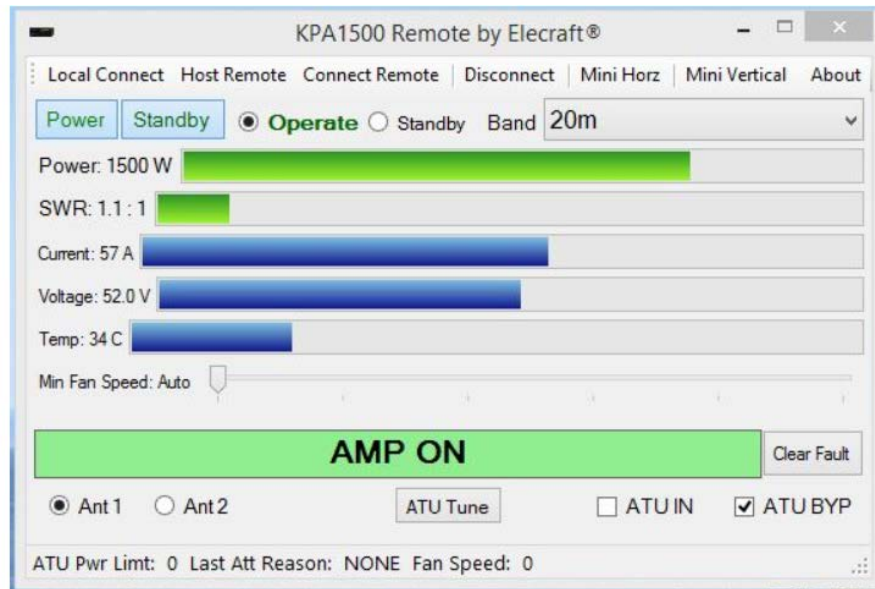


Figure 10. KPA1500 Remote Program Screen Capture.

The KPA1500 Remote program enables remote monitoring and controlling of the amplifier from a computer in the shack or from across the internet. Either the rear panel USB or the ETHERNET port (IP address on a network) can be used.

Recommended Minimum Requirements

KPA1500 firmware 2.05 or newer.

Windows XP SP3 or later with .NET 4.0 Framework. The .NET Framework will be installed if needed. Windows 7 and later should have .NET installed already.

Pentium 1GHz processor, 512 MB RAM or better.

Vista and later have their own minimums that are higher than .NET requirements.

Visit the Elecraft website to download the program and to view the latest updates and changes.

The “KPA1500 Utility” Program

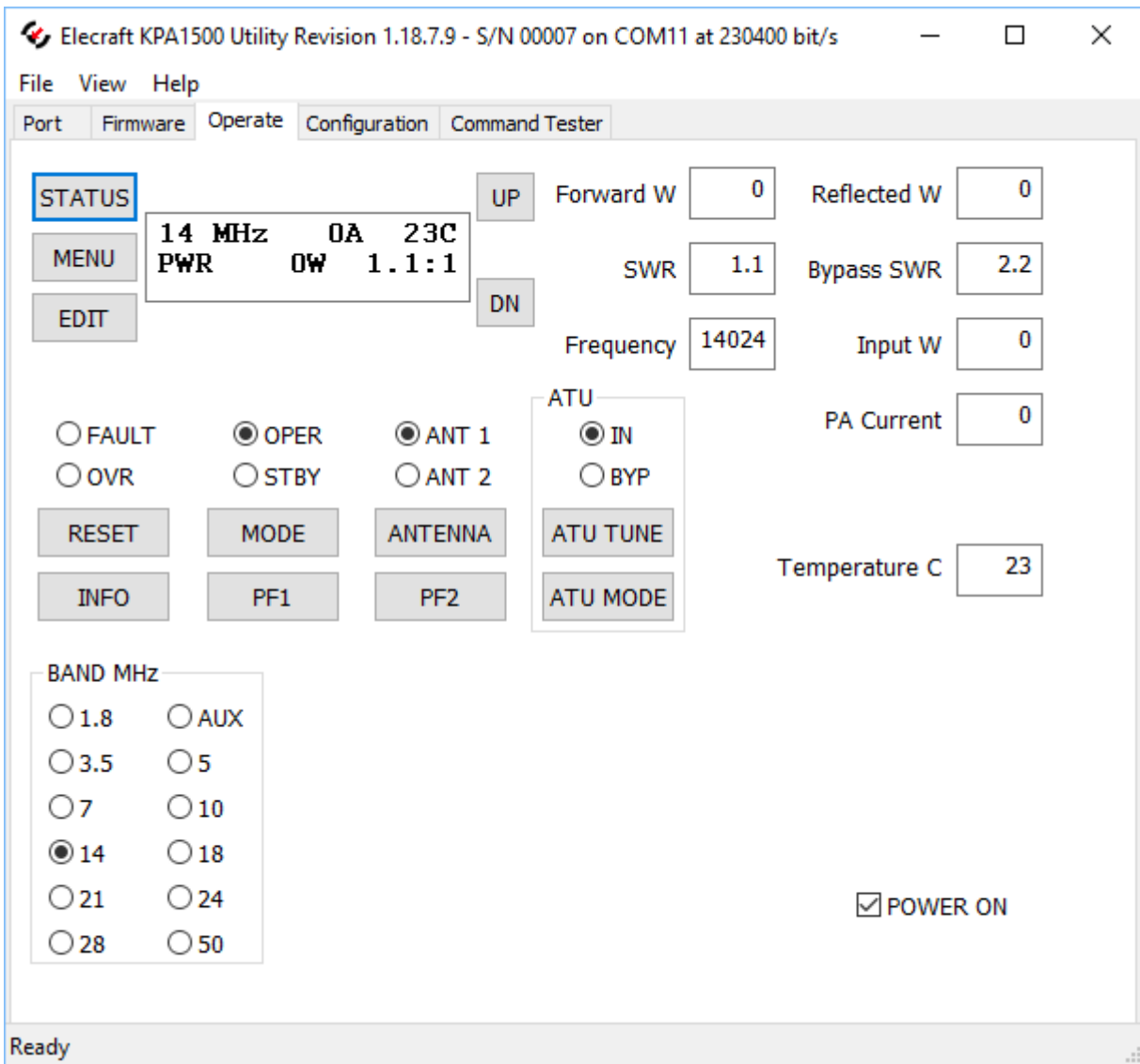


Figure 11. KPA1500 Utility “OPERATE” Tab Screen Capture.

A basic remote operating capability is built into the *KPA1500 Utility* “OPERATE” tab. The *Utility* also provides an interface for firmware updates, configuration parameter settings and firmware command communication.

The *KPA1500 Utility* is available for downloading free from Elecraft at www.elecraft.com. It is essential for updating your KPA1500 firmware and may be used to quickly edit various parameter settings.

The *KPA1500 Utility* may also be used to edit the amplifier's configuration, save and restore configuration and has an "Operate" page (tab) that duplicates the front panel controls. Other main tabs are "Port," "Firmware," "Operate" and "Command Tester."

Some advanced amplifier configuration features cannot be performed from the front panel and require the utility, such as static IP address, port number and other items.

i Another useful feature of the program is the ability to download the Fault Log if the amplifier malfunctions. The log can be a valuable tool when troubleshooting or contacting Customer Support.

1. Download the *KPA1500 Utility* program and install it in your computer.
2. Connect the USB interface cable supplied with your KPA1500 between the KPA1500 rear panel USB port and your personal computer.

Recommended Minimum Requirements

KPA1500 firmware 2.05 or newer.

Windows XP SP3 or later with .NET 4.0 Framework. The .NET Framework will be installed if needed. Windows 7 and later should have .NET installed already.

Pentium 1GHz processor, 512 MB RAM or better.

Vista and later have their own minimums that are higher than .NET requirements.

KPA1500 Firmware Updates

From time to time updated and improved firmware may become available for the KPA1500 and can be downloaded from www.elecraft.com and installed using the *KPA1500 Utility*.

Be sure to check the notes supplied with the new firmware. They may include changes that affect the instructions in this manual.

Checking your Firmware Version

Use the Menu entry *FIRMWARE VERSION* to determine the currently-installed firmware. This is also shown on the *KPA1500 Utility* "Firmware" tab as the "installed" version.

⚠ *Note that firmware upload to the KPA1500 is not supported via Ethernet or the XCVR SERIAL connector. The rear panel Host USB connector must be used for firmware updates.*

To download firmware:

1. Connect your personal computer to the KPA1500 via the USB port **15** and launch the *KPA1500 Utility*. Click "Port," highlight the serial port representing your amplifier, and click "Test Communications."
2. Click the "Firmware" tab and then click "Copy Firmware Files from Elecraft" to download the latest production-released firmware.
3. Beta firmware is made available prior to it going into full production at Elecraft. Follow the instructions on the KPA1500 Firmware page if you would like to try it.

To install new firmware in your KPA1500:

1. Connect your computer to the USB port **15** on the rear panel to upload firmware into the KPA1500.
2. Using the *KPA1500 Utility*, click "Send Firmware to the KPA1500" to start the transfer. Follow the on-screen instructions.

3. During download the LCD will display *FIRMWARE LOAD*. The KPA1500 will return to its normal power on state when the transfer is completed.

Forcing a Firmware Load

If the KPA1500 becomes unresponsive, you may force a re-load of its operating firmware. Connect a computer running the KPA1500 as described above. Press and hold the front-panel **AUX** key for more than 10 seconds and the hardware bootloader will run. Click “*Utility Test Connection*” and then click “*Send Firmware to the KPA1500*” to start the transfer.

If the firmware re-load is interrupted for some reason (like a power failure during the process), turn off the Power Supply at the rear panel, wait a few seconds until after all power supply LEDs are dark, and then turn the power back on. Then use the KPA1500 Utility tab “*TEST COMMUNICATIONS*” function and then reload firmware.

Rear Panel REM Jack and AUX Connector

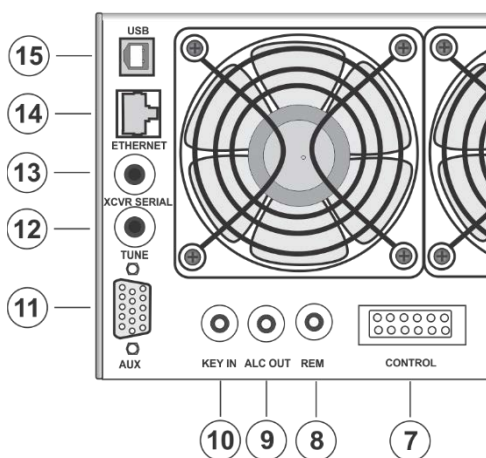


Figure 12. The Rear Panel REM Jack, Item 8.

The rear panel REM (RCA jack) enables remote on and off switching. When 12 VDC is applied to the KPA1500 REM connector, the amplifier is turned on. Removing 12 V turns the amplifier off. Less than 1 mA is required. The 12V DC OUT jack on the K3S/K3 can be used for this function.

The AUX (DE-15 male) connector can also be used to turn the amplifier on or off. Pulse pin 8 low to turn the KPA1500 on or off.

⚠ *When using pin 8 to turn the amplifier on or off, do not hold the signal low.*

Theory of Operation

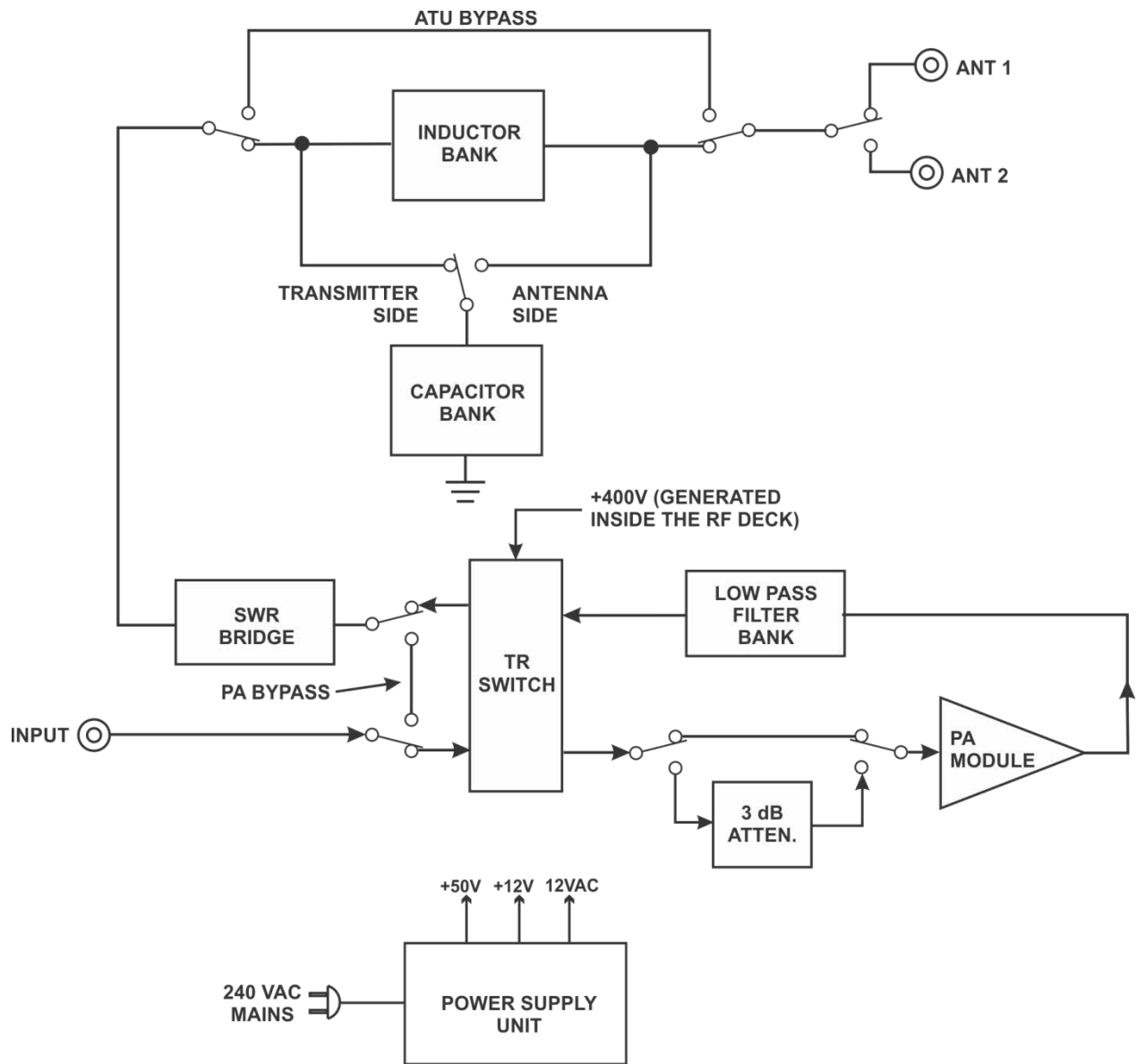


Figure 13. KPA1500 Block Diagram.

Switching

When the KPA1500 is in OPER mode, the transmit receive (TR) switch routes RF from the driving transceiver to the power amplifier (PA) module where it is amplified by a pair of LDMOS (Laterally Diffused metal oxide semiconductor) transistors. The Low Pass Filter Bank suppresses harmonic energy. The TR switch then routes the high-level RF power to the SWR Bridge.

In receive mode the TR switch connects the input directly to the SWR bridge, bypassing the amplifier circuits entirely. When the power is off the bypass relay performs this function.

With power turned off, the ATU is bypassed and the INP port is directly connected to the ANT1 port. The ANT2 port is not available for antenna switching with the power turned off.

SWR Bridge and Antenna Tuner Unit (ATU)

RF from the SWR Bridge is sent to the ATU which converts the impedance seen at the antenna connector to a 50 Ω non-reactive load as measured by the standing wave ratio (SWR) bridge.

The ATU uses an “L” matching network with series inductance and shunt capacitance. Combinations of eight capacitors in the Capacitor Bank and seven inductors in the Inductor Bank are switched in by relays to provide up to 2624 pF of capacitance and up to 8370 nH of inductance. An algorithm operates relays to select the inductors and capacitors required and chooses whether the capacitors are placed on the transmit side or antenna side of the inductors to arrive at a tuning solution for the current operating frequency. This is called a Full Search Tune.

When the ATU relays are changing capacitors or inductors, the amplifier circuit is kept in receive mode (RF routed through the TR switch but not the PA module), using only the RF power from the driving transceiver to monitor the SWR.

The antenna tuner is available when the amplifier is on, in both OPER and in STBY, for use by the barefoot transceiver. The tuner is relay-bypassed when the KPA1500 is off.

Control Logic and Fault Conditions

A microcontroller unit (MCU) controls and monitors critical operating conditions. The MCU also controls the ATU functions.

- When a key line low is sensed, the amplifier is switched into transmit mode if no fault conditions are present, the input signal is not in the 26 to 28 MHz range and an ATU tune operation is not underway.
- When RF drive is applied, the frequency is measured and the correct low pass filter is switched into the signal path.
- The KPA1500 exchanges band data with the Elecraft K3S or K3 and automatically selects the proper low pass filter, enabling rapid band changes. The MCU does not need to detect the frequency input for filter selection.
- Band data changes can also occur as a result of a frequency message from other transceivers using the XCVR SERIAL port (Flex, Icom CI-V, Kenwood serial or Elecraft KX3/KX2 serial data).

However, RF frequency sensing does take priority if a tuning solution does not agree with the band data to avoid transmitting into an incorrect bandpass filter. The optional KPAK3AUX cable kit is needed to enable this feature, as shown in Figure 4, page 15 or Figure 5, page 16.

Under fault conditions, the MCU protects the amplifier to prevent damage or improper operation. There are two fault conditions (soft and hard), and are triggered by the following conditions:

- **Soft:** A 3 dB attenuator is automatically switched in if excessive the RF drive power is applied or if other conditions occur such as excessive RF output, reflected power (high SWR) or current is drawn by the finals.
- **Hard:** If an unauthorized frequency is transmitted, the KPA1500 switches to STBY until RF drive is removed. This fault will automatically reset if a valid frequency is applied.

When a fault condition is detected, the TR switch is inhibited so no RF power reaches the PA module. If RF drive is high enough to possibly damage the TR switch, the amplifier is switched to bypass, protecting the TR switch.

The amplifier is always switched to STBY during hard faults. A hard fault requires the operator to remove or correct the condition and press the RESET key to return the amplifier to normal service.

Tuning Solutions Memory

To facilitate very rapid frequency changes, tuning solutions are stored in memory and recalled when returning to that frequency. Settings are recalled almost instantly when returning to that frequency later.

The spectrum from 1.8 through 54.2 MHz is divided into various frequency segments. Successful tune settings are stored for each band segment. Memory is allocated for 31 settings per frequency segment.

When starting a tune operation for a new frequency segment, the ATU first tries settings in the nearest frequency segments that do have tuning data for the antenna connector in use. See *ANTENNA ENABLE* and *ANTENNA PREFER* menu items.

The Tuning Segments

Since retuning is normally required over a narrower frequency range on the lower frequencies to maintain a low SWR, lower frequencies have narrower segments assigned as follows:

- Below 4.8 MHz the segments are 10 kHz wide.
- From 4.8 MHz through 26 MHz the segments are 20 kHz wide.
- From 26 MHz to 38 MHz the segments are 100 kHz wide.
- From 38 MHz to 60 MHz the segments are 200 kHz wide.

The center frequencies for each segment are listed in the Appendix.

Amplifier Cooling

CAUTION

Using an external fan on top of the KPA1500 RF Deck is not recommended and may damage the amplifier. Although the external fan will cool the heat sink, it may delay or prevent the amplifier's fans from turning on. This is a problem because the KPA1500 fans cool both the heat sink and the interior of the amplifier.

Due to power levels in the amplifier, many components on the PC boards require cooling, including low-pass filter inductors, relays and high wattage resistors in the TR switch and attenuator.

Remember, the amplifier heat sink will become warm or even hot but is rated to 110°C maximum.

Fan speed increases as the temperature increases. Excessive temperature will trigger a hard fault, protecting the amplifier.

External Power Supply

The external power supply provides 50 VDC, 12 VDC, and 12 VAC to the amplifier.

Wattmeter Calibration Procedure

The KPA1500 wattmeter is factory calibrated. The calibration is done per-band so you can make adjustments for individual bands without affecting the others. Elecraft recommends checking with Customer Support (support@elecraft.com) before changing Wattmeter Calibration.

⚠ Wattmeter calibration affects the displayed forward power only. Changing the wattmeter adjustment does not affect any power-related fault thresholds.

An external wattmeter and a known-good 50 Ω dummy load capable of handling 1500 watts are needed to calibrate the internal Wattmeter.

1. Connect the wattmeter directly to either ANT1 or ANT2 using short length of 50 Ω coaxial cable.
2. Connect the dummy load to the wattmeter.
3. Select the band you wish to calibrate.
4. Tap ANTENNA on the KPA1500 to select the ANT output where you connected the wattmeter and dummy load.

⚠ Depending upon your menu preferences, the antenna output may change when you change bands.

5. Bypass (disable) the ATU by pressing and holding **ATU MODE** so the ATU BYP LED lights.
6. Transmit briefly at 1500 watts output into the external wattmeter and dummy load and compare the reading with the KPA1500 Wattmeter.
7. If you wish to adjust the power displayed on the KPA1500 LCD and LEDs, hold **MENU** and tap switches next to the Δ and ∇ symbols until *PWR ADJ* is displayed on the LCD.
8. Press and hold **EDIT**. A number between 80 and 120 will be displayed on the LCD. Write this number in the Factory Cal. column for the band you are calibrating in case you wish to return to the factory calibration later.

Band	Factory Cal.	User Cal.
1.8		
3.5		
5		
7		
10		
14		

Band	Factory Cal.	User Cal.
18		
21		
24		
28		
50		

9. If the power displayed on the KPA1500 Wattmeter needs to be higher, tap the Δ switch. If the power displayed on the KPA1500 needs to be lower, tap the ∇ switch. The number displayed indicates the percentage change in the power reading. For example, changing 100 to 110 will result in a 10% increase in the power indicated.
10. Tap MENU twice to exit the menu. The current band will be displayed on the LCD.
11. Transmit again and compare the readings on the KPA1500 and the external wattmeter. Repeat the procedure as needed and write the new calibration numbers under User Cal. in the table for future reference.

Interfacing to Other Transceivers

This section describes how to interface the KPA1500 to non K3s/K3 transceivers, including the Elecraft KX3, KX2 and rigs made by other manufacturers.

Go to www.elecraft.com for the latest information on KPA1500 interfacing and related accessories.

 **Do not attach a common VGA cable to the AUX connector.**

There are two data interfaces on the KPA1500: The AUX port, a DE-15 male connector containing various frequency and amplifier control signals and the XCVR SERIAL port, a 3.5mm tip, ring, sleeve (TRS) jack that provides RS232 data for transceivers such as the Elecraft K2 and some non-Elecraft transceivers.

The rear panel TUNE jack may also be used for some interface functions. It is a 3.5mm TRS jack. Grounding the tip initiates a tune cycle.

KPA1500 AUX Connector (DE-15 Male)

Refer to the *RADIO* menu item to enable communications via the AUX connector.

Signal Name	Pin	Direction	Notes
BAND VREF (ICOM)	1	IN	Reference for Icom input
AUXBUS I/O	2	OUT	K3s/K3
BAND1 IN	3	IN	BCD Band Input – Bit 1*
NC	4		Not connected
GND	5		
BAND V (ICOM)	6	IN	Uses Icom standard band voltages
ALARM OUT	7	OUT	Drives low for fault input Not used by K3s/K3. Must not be connected to K3s/K3.
POWER ON/OFF	8	IN	Pulse low to turn KPA on or off – do not hold low!
BAND2 IN	9	IN	BCD Band Input – Bit 2*
KEY	10	IN	Low enables amplification. Internally pulled up to +5V. Sources 1 mA when pulled to ground. Diode isolated from the KEY IN RCA jack.
INHIBIT#	11	IN	Low inhibits amplifier operation
GND	12		
BAND0 IN	13	IN	BCD Band Input – Bit 0*
BAND3 IN	14	IN	BCD Band Input – Bit 3*
ALC	15	OUT	ALC output to transceiver

*BCD band codes used by the KPA1500 are on page 49.

Elecraft KPAK3AUX Interface Cable

The KPAK3AUX cable set includes:

- KPAK3AUX Cable, 59.5” (1.5 m) long. May be ordered separately (part number E850463).
- 15-pin Y cable that allows access to the K3S or K3 AUX port for other devices. May be ordered separately (part number E980190).
- 15-pin male-female Key Line Interrupter.

KPAK3AUX cable wiring. Pins not shown have no connection.

KPA1500 AUX CONN. Pin	K3 AUX CONN. Pin	Signal
2	2	AUXBUS
3	3	BAND 1
5	5	GND
9	9	BAND 2
10	10	PTT (See Note 1)
11	11	Inhibit
12	12	GND
13	13	BAND0
14	14	BAND3
15	15	ALC (see page21)

Notes:

1. If you have devices that need access to the PTT Line (e.g. an external ATU, SteppIR controller, etc.), use the Key Line Interrupter supplied with your KPAK3AUX cable set. The interrupter breaks the key line (PTT, pin 10) so you can use the separate KEY IN cable routed through external equipment, see Figure 5, page 16.
2. Pin 4 is not used but the wire is included in the KPAK3AUX cable.

Icom Transceiver Interfacing

There are three different interfacing methods for Icom transceivers: CI-V, Band Voltage System and Remote Tuner connection.

i The recommended method is CI-V if your Icom transceiver supports it (such as IC-7610, IC-7300). An interface cable for CI-V is available from Elecraft.

Connection Method	Pros	Cons	Elecraft Cable Available?
CI-V (Recommended)	KPA1500 can determine VFO frequency prior to transmitting. This allows the tuner to pre-select tuning elements and be ready to transmit without tuning delays.	Elecraft recommended connection method.	Yes. Included with optional cable set CBL1500IC and CBL1500IC-M
Icom Band Voltage System	KPA1500 tracks band changes on the Icom	KPA1500 must wait for RF to determine VFO frequency of the ATU segment. Does not support WARC bands (60m/17m/12m).	No.
Icom Remote Tuner Connection	Allows the operator to use the TUNE button on the transceiver. The KPA1500 appears as an Icom remote tuner to the transceiver. VFO frequency is determined when the TUNE button on the transceiver is pressed.	Cannot be used to train the Tuner. Operator must press TUNE once VFO frequency is selected.	No.

Icom CI-V to KPA1500 XCVR SERIAL Port

The XCVR SERIAL connector is configured for CI-V protocol, and the KPA1500 accepts frequency messages from the Icom exciter in its CI-V “transceive” mode to switch bands and select ATU settings on in-band QSY. The transceiver CI-V data speed must match the *SERIAL SPEED XCVR* menu item setting.

⚠ *The KPA1500 does not send data to an Icom radio via CI-V: Control signals go only one way, from the Icom radio to the Elecraft KPA1500.*

The optional E980229 cable (3.5mm TRS plug on each end) can be used with Icom’s CI-V interface. This cable is included with the CBL1500IC and CBL1500IC-M cable sets.

To set up an Icom CI-V system follow these steps:

1. Connect an Elecraft E980229 cable from the Icom Remote jack to the KPA1500 XCVR SERIAL jack.
2. On the KPA1500, enter the *MENU* and select:
 - a. *RADIO = ICOM*
 - b. *SERIAL SPEED XCVR = 4800*
3. On the Icom radio, set it for:
 - a. CI-V baud rate = 4800
 - b. CI-V Transceive = ON
 - c. CI-V Output = ON

Note: No CI-V address is required for use with the KPA1500.

Icom Band Voltage System to KPA1500 AUX Port

While it is supported for legacy Icom products, Elecraft does not recommend the Icom Band Voltage System because it does not distinguish between the 5, 18 and 24 MHz bands.

Various models of Icom radios use either a 13-pin DIN or an 8-pin DIN connector. Be sure to use the connector that is correct for your radio. Pins not shown have no connection.

KPA1500 AUX CONN. Pin	Icom DIN13 CONN. Pin	Icom DIN7 CONN. Pin	Signal
1	1	1	8V REFERENCE
5	2	2	GND
6	5	4	BAND VOLTAGE (NOT CI-V)
10	3	3	HSEND
15	6	5	ALC (OPTIONAL, SEE PAGE21)

Some Icom radios provide an 8V fixed band reference voltage and a variable band voltage, scaled to the band reference voltage. If the band reference voltage is far from 8V, band voltage is ignored.

This band voltage scheme does not provide unique voltages for each band. KPA1500 chooses 7, 21 and 28 MHz when there is ambiguity but the KPA1500 internal frequency counter will override these voltages to select the proper band if there is a conflict.

The band voltages accepted are:

Voltage	Band
0-1 V	10 MHz
1-2 V	50 MHz
2-3 V	24 or 28 MHz
3-4 V	18 or 21 MHz
4-5 V	14 MHz
5-6 V	5 or 7 MHz
6-7 V	3.5 MHz
7-8 V	1.8 MHz

Icom Remote Tuner Control Socket to KPA1500 TUNE Jack

Several Icom transceivers have an AUTO TUNE switch intended to control an Icom AH-4 Antenna Tuner. The Icom AUTO TUNE switch can be used to start a KPA1500 ATU TUNE operation.

The KPA1500 TUNE port is a 3.5mm TRS jack that supports automatic antenna tune requests from Icom radios.

TIP = RF Request Output, RING = Start Tune Input, SLEEVE = Ground.

To enable this function, build or buy a cable to connect the transceiver's Molex four-pin in-line "Tuner Control Socket" connector to the KPA1500 TUNE jack.

With this connection, the KPA1500 provides an “AH4 KEY” logic level signal to cause the Icom transceiver to generate steady RF carrier for ATU tuning. When tuning completes, the KPA1500 removes the AH4 KEY signal to un-key the Icom transceiver, putting the KPA1500 in STBY.

A *This cable implements the use of the Icom transceiver TUNE button on many of their transceivers. However, you must train the tuner using 10 to 50 W first before using it. See “Initiating a Full Search Tune” on page 24.*

4-Pin Molex Icom Xcvr Tuner Control Socket	Signal	3.5mm TRS Elecraft KPA1500 TUNE Jack	2.1mm Coaxial Power Connector
PIN 1 (Angled)	KEY is an open collector transistor output, normally pulled up by the transceiver. Low means “key down.”	TIP	NO CONNECTION
PIN 2	START, pulled up to +5V by the KPA1500, low means “start.”	RING	NO CONNECTION
PIN 3	+12V DC	N/C	CENTER
PIN 4	Ground	SLEEVE	OUTER SHELL

Elecraft KX3, KX2 and Non-Elecraft Rigs to KPA1500 XCVR SERIAL Port

The XCVR SERIAL port provides serial control data for transceivers such as the Elecraft KX3 and KX2 and some Icom, Kenwood, and other transceivers.

The XCVR SERIAL port is a 3.5mm TRS jack. Via the *RADIO* menu item, it is programmed to operate in either *ICOM* or *SERIAL* Mode.

When the KPA1500 is configured for *ICOM Mode*, it operates as a 2-terminal CI-V compatible port that works with Icom and some TenTec transceivers:

Icom Mode: CI-V Compatible Port 3.5mm TRS Plug	
TIP	DATA
RING	NC
SLEEVE	GND

Serial Mode: TTL Level Serial Port 3.5mm TRS Plug	
TIP	TX DATA
RING	RX DATA
SLEEVE	GND

SERIAL Mode is compatible with KX3, KX2, FlexRadio and many Kenwood transceivers that respond to IF; FB; polls with frequency and VFO information.

For a KX3 or KX2, make a cable with 3.5mm TRS plugs on each end. Cross over tip to ring as shown in Figure 14 below.

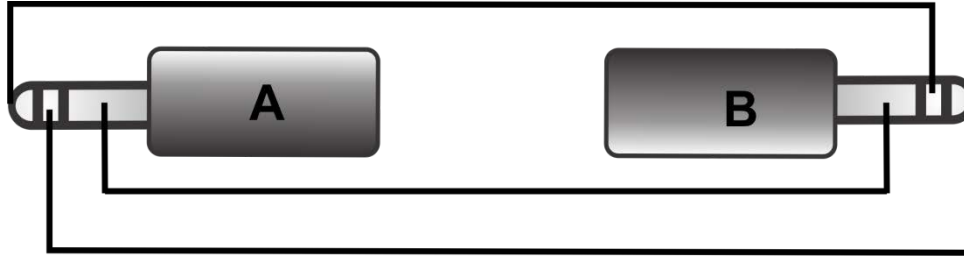


Figure 14. Serial Data 3.5mm TRS Plug Cross-Over Cable for KX3 and KX2.

3.5mm TRS Plug A	3.5mm TRS Plug B
TIP	RING
RING	TIP
SLEEVE	SLEEVE

For transceivers using DE-9 connectors, use a female DE-9 connector and a shielded two-wire cable to a 3.5mm phone plug into the KPA1500 XCVR SERIAL port. The KPA1500 does not support hardware handshaking. Select a baud rate slow enough to ensure buffer overflows do not occur.

DE-9 Pin	Function	KPA1500 3.5mm Plug
2 (RXD)	Radio sends to KPA1500	TIP
3 (TXD)	KPA1500 sends to radio	RING
5 (GND)	Ground (Shield)	SLEEVE
7 (RTS)	Request to send (RTS) Jumper to Pin 8 (CTS)	N/C
8 (CTS)	Clear to send (CTS) Jumper to Pin 7 (RTS)	N/C

Kenwood Transceiver to KPA1500 XCVR SERIAL Port

Kenwood transceivers that respond to IF; FB; polls with frequency and VFO information can be interfaced via the KPA1500 XCVR SERIAL port, using the connections shown below.

Set the KPA1500 *RADIO* menu item to *SERIAL* Mode.

Serial Mode: TTL Level Serial Port 3.5mm TRS Plug	
TIP	TX DATA
RING	RX DATA
SLEEVE	GND

The optional cable set CBL-KENSER1500 includes keying and serial control cables for recent Kenwood transceivers. See www.elecraft.com for ordering information.

Yaesu Transceivers to KPA1500 AUX Port

Most Yaesu radios provide band information using BCD signals, a 4-wire system (BAND0 through BAND3) that can be used to tell the KPA1500 that a band change has occurred, even before transmitting.

Although various models of Yaesu radios use either DIN8/262 or a MiniDIN8 connector, pin numbering and the naming convention is the same. Pins not shown have no connection for the KPA1500. See the table below. Other Yaesu radios use a MiniDIN10 or a DA15 connector.

Elecraft presently offers four cables supporting all current Yaesu transceivers. These cables provide both amplifier keying and the BCD band signals.

KPA1500 AUX Conn. Pin	Yaesu Conn. Pin	Signal
3	5	BIT 1
5	3 & 8	GND Note: Yaesu pin 8 must be grounded or TX is inhibited.
9	6	BIT 2
10	2	KEY
13	4	BIT 0
14	7	BIT 3

BCD Interface

The following are the band codes used by the KPA1500:

Band (Meters)	Bit 3 (Pin 14)	Bit 2 (Pin 9)	Bit 1 (Pin 3)	Bit 0 (Pin 13)
60m	0	0	0	0
160m	0	0	0	1
80m	0	0	1	0
40m	0	0	1	1
30m	0	1	0	0
20m	0	1	0	1
17m	0	1	1	0
15m	0	1	1	1
12m	1	0	0	0
10m	1	0	0	1
6m	1	0	1	0

Flex Transceivers

Currently, all of the Flex 6000 series radios are supported with an Elecraft KXUSB cable. Order CBL-FLEXKEY.

Initiating KPA1500 Tune via the CW Key TUNE Jack

The KPA1500 TUNE jack may be used with non-Icom transceivers by connecting the tip to the CW Key input of the radio. Grounding the tip initiates a tune cycle. Figure 15 shows how to make this cable.

The amplifier's ATU TUNE switch or an *ATU HiSWR* retune can cause the K3 and most other transceivers to provide Tune Power (transmit CW carrier) for the duration of the ATU tuning operation. This works automatically in CW mode.

Enable the K3S/K3 *CW-In-SSB-Mode* menu feature to allow amplifier tuning in single sideband mode. This is accomplished in the K3S and K3 by accessing the *CONFIG* menu, selecting *CW WGH*T and tapping the numeric keypad 1 to select *SSB +CW*.

Connect the cable to the KEY jack (1/4" phone) on the K3S/K3 and the other end to the KPA1500 TUNE jack.



Figure 15. CW Key Tune Cable. Use stereo (TRS) plugs as shown, mono plugs may short adjacent terminals.

Signal	3.5mm TRS to KPA1500 Tune	1/4" Phone Plug to HAND KEY IN on Transceiver
KEY	TIP	TIP
RING	N/C	N/C
GROUND	SLEEVE	SLEEVE

In Case of Difficulty

Problem	Action
No Power Top green LED Off	Check line cord is connected to live 200-250 VAC outlet capable of 20A. Power supply rear panel switch/circuit breaker in the ON (up) position.
Power Supply HV LED Red or Off	<p>Make sure both high current red/black and DA-15 multi-wire umbilical power cables are firmly connected to both Power Supply and RF deck, then press power button on front of RF deck.</p> <p>The large-gauge cable connectors are Anderson PowerPole connectors. They must be fully seated. Two clicks are heard and felt when installing the connectors. Make sure they are fully seated with two noticeable clicks.</p> <p>50V supply has faulted. Turn off power (front panel RF Deck switch) and wait until red LED has extinguished. Turn power back on.</p> <p>If amplifier still does not work, turn off main power switch (rear panel of power supply). Wait 30 seconds. Turn on Power Supply main power switch. Press RF Deck front panel power switch to power on.</p>
LV LED Off	Amplifier is turned off. Press RF Deck front panel power switch. Reseat 15-pin cable at both the Power Supply and RF Deck. Ensure both ends are tightened and fully seated.
Power supply Lights OK, RF Deck Not On	<p>Press RF Deck front panel power switch.</p> <p>Check both power cables.</p> <p>If using a K3s or K3 remotely, verify 12V DC OUT to KPA1500 REM cable is firmly plugged in.</p> <p>Cycle power on the K3s or K3.</p>
50V FAULT Displayed on LCD	Make sure the 75A PowerPole connectors are firmly installed. Listen for two “clicks” verifying a reliable electrical connection is made.
12V FAULT Displayed on LCD	Verify the DA-15 Control Cable is firmly installed on both Power Supply and RF Deck. Tighten thumbscrews fully.
No RF Amplification	<p>Amplifier should be in OPER mode</p> <p>Verify the KEY IN signal line is connected and the red TX LED on the RF Deck is illuminated.</p> <p>Confirm coax cable is connected between driving transmitter/transceiver and KPA1500 RF IN.</p>
ATU IN and ATU BYP LEDs Both ON	Indicates the antenna selected has low SWR and the best ATU setting is “BYPassed.” This is normal.
OVR LED On	Indicates a Soft Fault has occurred. Reduce drive from transmitter.
FAULT LED On	<p>Indicates an unsafe operating condition has occurred and the amplifier has switched offline. Review text displayed in the LCD for specific fault and take appropriate action.</p> <p>Bring up the <i>KPA1500 Utility</i> to inspect the Fault Log. This will provide details on what the KPA1500 saw when it determined the Fault condition.</p>

Appendix A — KPA1500 Tuner Frequency Segments

Information presented in this section applies to KPA1500 capability and is subject to changes. The segment center frequencies shown are not necessarily legal for transmission. Always comply with the amateur radio rules and regulations in your area.

KPA1500 ATU Segment Center Frequencies – All Segments

160 Meters, 10 kHz Steps

1.805	1.815	1.825	1.835	1.845	1.855	1.865	1.875	1.885	1.895	1.905	1.915	1.925
1.935	1.945	1.955	1.965	1.975	1.985	1.995						

80 Meters, 10 kHz Steps

3.505	3.515	3.525	3.535	3.545	3.555	3.565	3.575	3.585	3.595	3.605	3.615	3.625
3.635	3.645	3.655	3.665	3.675	3.685	3.695	3.705	3.715	3.725	3.735	3.745	3.755
3.765	3.775	3.785	3.795	3.805	3.815	3.825	3.835	3.845	3.855	3.865	3.875	3.885
3.895	3.905	3.915	3.925	3.935	3.945	3.955	3.965	3.975	3.985	3.995		

60 Meters, 20 kHz Steps

5.330	5.350	5.370	5.390	5.410								
-------	-------	-------	-------	-------	--	--	--	--	--	--	--	--

40 Meters, 20 kHz Steps

7.010	7.030	7.050	7.070	7.090	7.110	7.130	7.150	7.170	7.190	7.210	7.230	7.250
7.270	7.290											

30 Meters, 20 kHz Steps

10.110	10.130	10.150										
--------	--------	--------	--	--	--	--	--	--	--	--	--	--

20 Meters, 20 kHz Steps

14.010	14.030	14.050	14.070	14.090	14.110	14.130	14.150	14.170	14.190	14.210	14.230	
14.250	14.270	14.290	14.310	14.330	14.350							

17 Meters, 20 kHz Steps

18.070	18.090	18.110	18.130	18.150	18.168							
--------	--------	--------	--------	--------	--------	--	--	--	--	--	--	--

15 Meters, 20 kHz Steps

21.010	21.030	21.050	21.070	21.090	21.110	21.130	21.150	21.170	21.190	21.210	21.230	
21.250	21.270	21.290	21.310	21.330	21.350	21.370	21.390	21.410	21.430	21.450		

12 Meters, 20 kHz Steps

24.890	24.910	24.930	24.950	24.970	24.990							
--------	--------	--------	--------	--------	--------	--	--	--	--	--	--	--

10 Meters, 100 kHz Steps

28.050	28.150	28.250	28.350	28.450	28.550	28.650	28.750	28.850	28.950	29.050	29.150	
29.250	29.350	29.450	29.550	29.650								

6 Meters, 200 kHz Steps

50.100	50.300	50.500	50.700	50.900	51.100	51.300	51.500	51.700	51.900	52.100	52.300	
52.500	52.700	52.900	53.100	53.300	53.500	53.700	53.900					

KPA1500 ATU Segment Center Frequencies – All Segments

Center frequencies in MHz. **Amateur band frequencies shown in red.**

160 Meters, 1.5 to 3.0 MHz, 10 kHz Steps

1.505	1.515	1.525	1.535	1.545	1.555	1.565	1.575	1.585	1.595	1.605	1.615	1.625
1.635	1.645	1.655	1.665	1.675	1.685	1.695	1.705	1.715	1.725	1.735	1.745	1.755
1.765	1.775	1.785	1.795	1.805	1.815	1.825	1.835	1.845	1.855	1.865	1.875	1.885
1.895	1.905	1.915	1.925	1.935	1.945	1.955	1.965	1.975	1.985	1.995	2.005	2.015
2.025	2.035	2.045	2.055	2.065	2.075	2.085	2.095	2.105	2.115	2.125	2.135	2.145
2.155	2.165	2.175	2.185	2.195	2.205	2.215	2.225	2.235	2.245	2.255	2.265	2.275
2.285	2.295	2.305	2.315	2.325	2.335	2.345	2.355	2.365	2.375	2.385	2.395	2.405
2.415	2.425	2.435	2.445	2.455	2.465	2.475	2.485	2.495	2.505	2.515	2.525	2.535
2.545	2.555	2.565	2.575	2.585	2.595	2.605	2.615	2.625	2.635	2.645	2.655	2.665
2.675	2.685	2.695	2.705	2.715	2.725	2.735	2.745	2.755	2.765	2.775	2.785	2.795
2.805	2.815	2.825	2.835	2.845	2.855	2.865	2.875	2.885	2.895	2.905	2.915	2.925
2.935	2.945	2.955	2.965	2.975	2.985	2.995						

80 Meters, 3.0 to 4.8 MHz, 10 kHz Steps

3.005	3.015	3.025	3.035	3.045	3.055	3.065	3.075	3.085	3.095	3.105	3.115	3.125
3.135	3.145	3.155	3.165	3.175	3.185	3.195	3.205	3.215	3.225	3.235	3.245	3.255
3.265	3.275	3.285	3.295	3.305	3.315	3.325	3.335	3.345	3.355	3.365	3.375	3.385
3.395	3.405	3.415	3.425	3.435	3.445	3.455	3.465	3.475	3.485	3.495	3.505	3.515
3.525	3.535	3.545	3.555	3.565	3.575	3.585	3.595	3.605	3.615	3.625	3.635	3.645
3.655	3.665	3.675	3.685	3.695	3.705	3.715	3.725	3.735	3.745	3.755	3.765	3.775
3.785	3.795	3.805	3.815	3.825	3.835	3.845	3.855	3.865	3.875	3.885	3.895	3.905
3.915	3.925	3.935	3.945	3.955	3.965	3.975	3.985	3.995	4.005	4.015	4.025	4.035
4.045	4.055	4.065	4.075	4.085	4.095	4.105	4.115	4.125	4.135	4.145	4.155	4.165
4.175	4.185	4.195	4.205	4.215	4.225	4.235	4.245	4.255	4.265	4.275	4.285	4.295
4.305	4.315	4.325	4.335	4.345	4.355	4.365	4.375	4.385	4.395	4.405	4.415	4.425
4.435	4.445	4.455	4.465	4.475	4.485	4.495	4.505	4.515	4.525	4.535	4.545	4.555
4.565	4.575	4.585	4.595	4.605	4.615	4.625	4.635	4.645	4.655	4.665	4.675	4.685
4.695	4.705	4.715	4.725	4.735	4.745	4.755	4.765	4.775	4.785	4.795		

60 Meters, 4.8 to 6 MHz, 20 kHz Steps

4.810	4.830	4.850	4.870	4.890	4.910	4.930	4.950	4.970	4.990	5.010	5.030	5.050
5.070	5.090	5.110	5.130	5.150	5.170	5.190	5.210	5.230	5.250	5.270	5.290	5.310
5.330	5.350	5.370	5.390	5.410	5.430	5.450	5.470	5.490	5.510	5.530	5.550	5.570
5.590	5.610	5.630	5.650	5.670	5.690	5.710	5.730	5.750	5.770	5.790	5.810	5.830
5.850	5.870	5.890	5.910	5.930	5.950	5.970	5.990					

40 Meters, 6 to 9 MHz, 20 kHz Steps

6.010	6.030	6.050	6.070	6.090	6.110	6.130	6.150	6.170	6.190	6.210	6.230	6.250
6.270	6.290	6.310	6.330	6.350	6.370	6.390	6.410	6.430	6.450	6.470	6.490	6.510
6.530	6.550	6.570	6.590	6.610	6.630	6.650	6.670	6.690	6.710	6.730	6.750	6.770
6.790	6.810	6.830	6.850	6.870	6.890	6.910	6.930	6.950	6.970	6.990	7.010	7.030
7.050	7.070	7.090	7.110	7.130	7.150	7.170	7.190	7.210	7.230	7.250	7.270	7.290
7.310	7.330	7.350	7.370	7.390	7.410	7.430	7.450	7.470	7.490	7.510	7.530	7.550
7.570	7.590	7.610	7.630	7.650	7.670	7.690	7.710	7.730	7.750	7.770	7.790	7.810
7.830	7.850	7.870	7.890	7.910	7.930	7.950	7.970	7.990	8.010	8.030	8.050	8.070
8.090	8.110	8.130	8.150	8.170	8.190	8.210	8.230	8.250	8.270	8.290	8.310	8.330
8.350	8.370	8.390	8.410	8.430	8.450	8.470	8.490	8.510	8.530	8.550	8.570	8.590
8.610	8.630	8.650	8.670	8.690	8.710	8.730	8.750	8.770	8.790	8.810	8.830	8.850
8.870	8.890	8.910	8.930	8.950	8.970	8.990						

30 Meters, 9 to 13 MHz, 20 kHz Steps

9.010	9.030	9.050	9.070	9.090	9.110	9.130	9.150	9.170	9.190	9.210	9.230
9.250	9.270	9.290	9.310	9.330	9.350	9.370	9.390	9.410	9.430	9.450	9.470
9.490	9.510	9.530	9.550	9.570	9.590	9.610	9.630	9.650	9.670	9.690	9.710
9.730	9.750	9.770	9.790	9.810	9.830	9.850	9.870	9.890	9.910	9.930	9.950
9.970	9.990	10.010	10.030	10.050	10.070	10.090	10.110	10.130	10.150	10.170	10.190
10.210	10.230	10.250	10.270	10.290	10.310	10.330	10.350	10.370	10.390	10.410	10.430
10.450	10.470	10.490	10.510	10.530	10.550	10.570	10.590	10.610	10.630	10.650	10.670
10.690	10.710	10.730	10.750	10.770	10.790	10.810	10.830	10.850	10.870	10.890	10.910
10.930	10.950	10.970	10.990	11.010	11.030	11.050	11.070	11.090	11.110	11.130	11.150
11.170	11.190	11.210	11.230	11.250	11.270	11.290	11.310	11.330	11.350	11.370	11.390
11.410	11.430	11.450	11.470	11.490	11.510	11.530	11.550	11.570	11.590	11.610	11.630
11.650	11.670	11.690	11.710	11.730	11.750	11.770	11.790	11.810	11.830	11.850	11.870
11.890	11.910	11.930	11.950	11.970	11.990	12.010	12.030	12.050	12.070	12.090	12.110
12.130	12.150	12.170	12.190	12.210	12.230	12.250	12.270	12.290	12.310	12.330	12.350
12.370	12.390	12.410	12.430	12.450	12.470	12.490	12.510	12.530	12.550	12.570	12.590
12.610	12.630	12.650	12.670	12.690	12.710	12.730	12.750	12.770	12.790	12.810	12.830
12.850	12.870	12.890	12.910	12.930	12.950	12.970	12.990				

20 Meters, 13 to 17 MHz, 20 kHz Steps

13.010	13.030	13.050	13.070	13.090	13.110	13.130	13.150	13.170	13.190	13.210	13.230
13.250	13.270	13.290	13.310	13.330	13.350	13.370	13.390	13.410	13.430	13.450	13.470
13.490	13.510	13.530	13.550	13.570	13.590	13.610	13.630	13.650	13.670	13.690	13.710
13.730	13.750	13.770	13.790	13.810	13.830	13.850	13.870	13.890	13.910	13.930	13.950
13.970	13.990	14.010	14.030	14.050	14.070	14.090	14.110	14.130	14.150	14.170	14.190
14.210	14.230	14.250	14.270	14.290	14.310	14.330	14.350	14.370	14.390	14.410	14.430
14.450	14.470	14.490	14.510	14.530	14.550	14.570	14.590	14.610	14.630	14.650	14.670
14.690	14.710	14.730	14.750	14.770	14.790	14.810	14.830	14.850	14.870	14.890	14.910
14.930	14.950	14.970	14.990	15.010	15.030	15.050	15.070	15.090	15.110	15.130	15.150
15.170	15.190	15.210	15.230	15.250	15.270	15.290	15.310	15.330	15.350	15.370	15.390
15.410	15.430	15.450	15.470	15.490	15.510	15.530	15.550	15.570	15.590	15.610	15.630
15.650	15.670	15.690	15.710	15.730	15.750	15.770	15.790	15.810	15.830	15.850	15.870
15.890	15.910	15.930	15.950	15.970	15.990	16.010	16.030	16.050	16.070	16.090	16.110
16.130	16.150	16.170	16.190	16.210	16.230	16.250	16.270	16.290	16.310	16.330	16.350
16.370	16.390	16.410	16.430	16.450	16.470	16.490	16.510	16.530	16.550	16.570	16.590
16.610	16.630	16.650	16.670	16.690	16.710	16.730	16.750	16.770	16.790	16.810	16.830
16.850	16.870	16.890	16.910	16.930	16.950	16.970	16.990				

17 Meters, 17 to 19 MHz, 20 kHz Steps

17.010	17.030	17.050	17.070	17.090	17.110	17.130	17.150	17.170	17.190	17.210	17.230
17.250	17.270	17.290	17.310	17.330	17.350	17.370	17.390	17.410	17.430	17.450	17.470
17.490	17.510	17.530	17.550	17.570	17.590	17.610	17.630	17.650	17.670	17.690	17.710
17.730	17.750	17.770	17.790	17.810	17.830	17.850	17.870	17.890	17.910	17.930	17.950
17.970	17.990	18.010	18.030	18.050	18.070	18.090	18.110	18.130	18.150	18.168	18.190
18.210	18.230	18.250	18.270	18.290	18.310	18.330	18.350	18.370	18.390	18.410	18.430
18.450	18.470	18.490	18.510	18.530	18.550	18.570	18.590	18.610	18.630	18.650	18.670
18.690	18.710	18.730	18.750	18.770	18.790	18.810	18.830	18.850	18.870	18.890	18.910
18.930	18.950	18.970	18.990								

15 Meters, 19 to 23 MHz, 20 kHz Steps

19.010 19.030 19.050 19.070 19.090 19.110 19.130 19.150 19.170 19.190 19.210 19.230
19.250 19.270 19.290 19.310 19.330 19.350 19.370 19.390 19.410 19.430 19.450 19.470
19.490 19.510 19.530 19.550 19.570 19.590 19.610 19.630 19.650 19.670 19.690 19.710
19.730 19.750 19.770 19.790 19.810 19.830 19.850 19.870 19.890 19.910 19.930 19.950
19.970 19.990 20.010 20.030 20.050 20.070 20.090 20.110 20.130 20.150 20.170 20.190
20.210 20.230 20.250 20.270 20.290 20.310 20.330 20.350 20.370 20.390 20.410 20.430
20.450 20.470 20.490 20.510 20.530 20.550 20.570 20.590 20.610 20.630 20.650 20.670
20.690 20.710 20.730 20.750 20.770 20.790 20.810 20.830 20.850 20.870 20.890 20.910
20.930 20.950 20.970 20.990 **21.010 21.030 21.050 21.070 21.090 21.110 21.130 21.150**
21.170 21.190 21.210 21.230 21.250 21.270 21.290 21.310 21.330 21.350 21.370 21.390
21.410 21.430 21.450 21.470 21.490 21.510 21.530 21.550 21.570 21.590 21.610 21.630
21.650 21.670 21.690 21.710 21.730 21.750 21.770 21.790 21.810 21.830 21.850 21.870
21.890 21.910 21.930 21.950 21.970 21.990 22.010 22.030 22.050 22.070 22.090 22.110
22.130 22.150 22.170 22.190 22.210 22.230 22.250 22.270 22.290 22.310 22.330 22.350
22.370 22.390 22.410 22.430 22.450 22.470 22.490 22.510 22.530 22.550 22.570 22.590
22.610 22.630 22.650 22.670 22.690 22.710 22.730 22.750 22.770 22.790 22.810 22.830
22.850 22.870 22.890 22.910 22.930 22.950 22.970 22.990

12 Meters, 23 to 26 MHz, 20 kHz Steps

23.010 23.030 23.050 23.070 23.090 23.110 23.130 23.150 23.170 23.190 23.210 23.230
23.250 23.270 23.290 23.310 23.330 23.350 23.370 23.390 23.410 23.430 23.450 23.470
23.490 23.510 23.530 23.550 23.570 23.590 23.610 23.630 23.650 23.670 23.690 23.710
23.730 23.750 23.770 23.790 23.810 23.830 23.850 23.870 23.890 23.910 23.930 23.950
23.970 23.990 24.010 24.030 24.050 24.070 24.090 24.110 24.130 24.150 24.170 24.190
24.210 24.230 24.250 24.270 24.290 24.310 24.330 24.350 24.370 24.390 24.410 24.430
24.450 24.470 24.490 24.510 24.530 24.550 24.570 24.590 24.610 24.630 24.650 24.670
24.690 24.710 24.730 24.750 24.770 24.790 24.810 24.830 24.850 24.870 **24.890 24.910**
24.930 24.950 24.970 24.990 25.010 25.030 25.050 25.070 25.090 25.110 25.130 25.150
25.170 25.190 25.210 25.230 25.250 25.270 25.290 25.310 25.330 25.350 25.370 25.390
25.410 25.430 25.450 25.470 25.490 25.510 25.530 25.550 25.570 25.590 25.610 25.630
25.650 25.670 25.690 25.710 25.730 25.750 25.770 25.790 25.810 25.830 25.850 25.870
25.890 25.910 25.930 25.950 25.970 25.990

10 Meters, 26 to 38 MHz, 100 kHz Steps

26.050 26.150 26.250 26.350 26.450 26.550 26.650 26.750 26.850 26.950 27.050 27.150
27.250 27.350 27.450 27.550 27.650 27.750 27.850 27.950 **28.050 28.150 28.250 28.350**
28.450 28.550 28.650 28.750 28.850 28.950 29.050 29.150 29.250 29.350 29.450 29.550
29.650 29.750 29.850 29.950 30.050 30.150 30.250 30.350 30.450 30.550 30.650 30.750
30.850 30.950 31.050 31.150 31.250 31.350 31.450 31.550 31.650 31.750 31.850 31.950
32.050 32.150 32.250 32.350 32.450 32.550 32.650 32.750 32.850 32.950 33.050 33.150
33.250 33.350 33.450 33.550 33.650 33.750 33.850 33.950 34.050 34.150 34.250 34.350
34.450 34.550 34.650 34.750 34.850 34.950 35.050 35.150 35.250 35.350 35.450 35.550
35.650 35.750 35.850 35.950 36.050 36.150 36.250 36.350 36.450 36.550 36.650 36.750
36.850 36.950 37.050 37.150 37.250 37.350 37.450 37.550 37.650 37.750 37.850 37.950

6 Meters, 38 to 54.2 MHz, 200 kHz Steps

38.100 38.300 38.500 38.700 38.900 39.100 39.300 39.500 39.700 39.900 40.100 40.300
40.500 40.700 40.900 41.100 41.300 41.500 41.700 41.900 42.100 42.300 42.500 42.700
42.900 43.100 43.300 43.500 43.700 43.900 44.100 44.300 44.500 44.700 44.900 45.100
45.300 45.500 45.700 45.900 46.100 46.300 46.500 46.700 46.900 47.100 47.300 47.500
47.700 47.900 48.100 48.300 48.500 48.700 48.900 49.100 49.300 49.500 49.700 49.900
50.100 50.300 50.500 50.700 50.900 51.100 51.300 51.500 51.700 51.900 52.100 52.300
52.500 52.700 52.900 53.100 53.300 53.500 53.700 53.900 54.100