

K3, KPA500 and KAT500 Operational Set-Up Manual

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Material in this short guide to setting up your K3, KPA500 and KAT500 station is extracted from *The Elecraft KPA500 Amplifier and KAT500 Tuner – The K-Line Dream Station* by KE7X. It will be available soon.

K3, P3, KPA500, and KAT500 Rear Panel Connections

All cables to interconnect the K3, P3, KPA500 and KAT500 are on the rear of each piece of equipment.

K3 Rear Panel

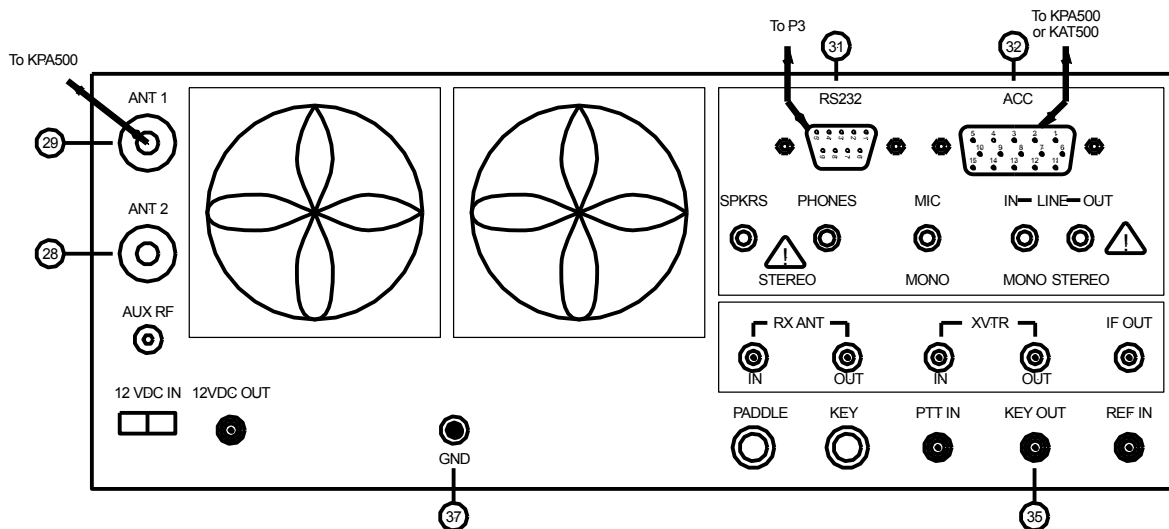


Figure 1. K3 Rear Panel.

- 28 and 29: Either of these two K3 antenna connections will be connected to the KPA500.
- 31: **RS232**. The K3's RS232 connector is connected to either the computer or the Elecraft P3 Panadapter.
- 32: The K3's **ACC** connector contains signals used by the KPA500 and KAT500.
- 35: The K3's **KEY OUT** RCA jack is used in some cases (Basic Band Switching) to key the KPA500.
- 37: Ground.

The P3 Panadapter Rear Panel

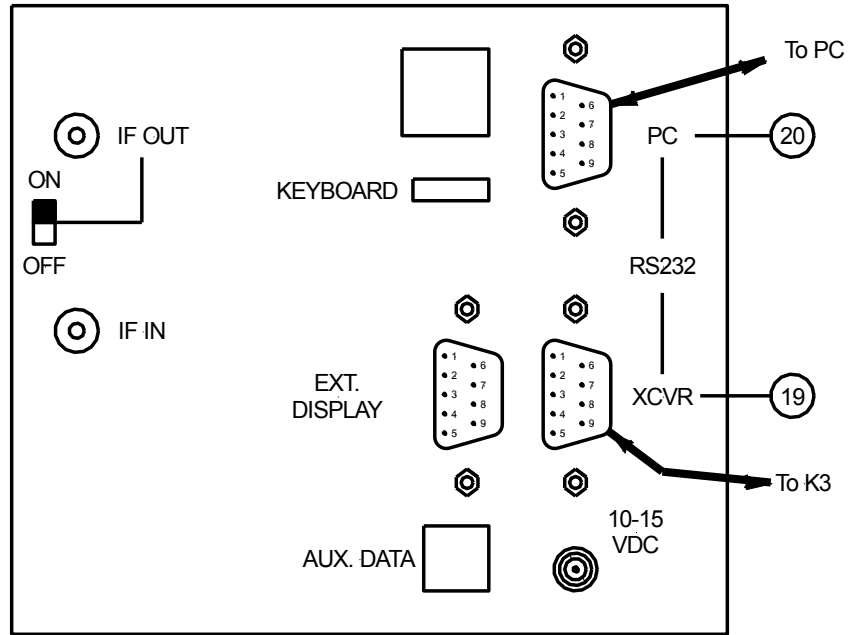


Figure 2. P3 Rear Panel.

- ①9: **RS232 XCVR**. This connects to the K3's RS232 connector.
- ②0: **RS232 PC**. This connects to the PC's RS232 serial COM port or to a USB-to-Serial adapter.

KPA500 Rear Panel

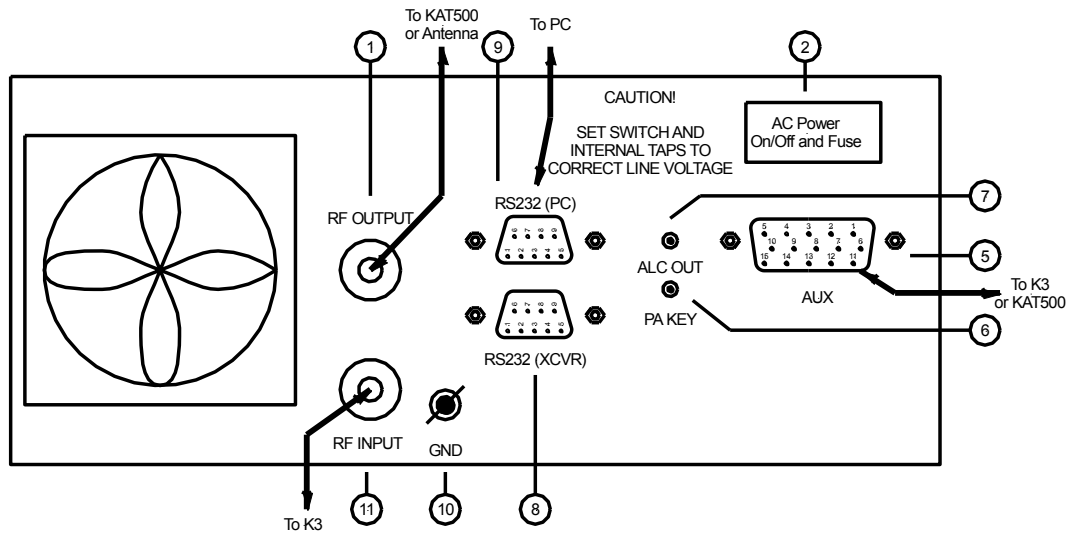


Figure 3. KPA500 Rear Panel.

- ①: **RF OUTPUT.** Connect to a dummy load, antenna, or the KAT500 XMTR connector.
- ②: The KPA500's AC power connector, On/Off switch, and fuse block.
- ⑤: **AUX:** Connects to either the K3 (when no KAT500 is used) or to the KAT500.
- ⑥: **PA KEY.** The amplifier's RCA jack keying line input. This is in parallel with a keying signal in the cable connected to AUX.
- ⑦: **ALC OUT.** RCA jack ALC output to be used by the driving transceiver.
- ⑧: **RS232 (XCVR).** This can be connected to a Kenwood transceiver to transfer band data to the amplifier. This is NOT used to connect to the K3.
- ⑨: **RS232 (PC).** Connects to the computer to transfer firmware updates and to change the amplifier configuration.
- ⑩: **Ground.**
- ⑪: **RF INPUT.** Connect to the K3's ANT1 or ANT2.

KAT500 Rear Panel

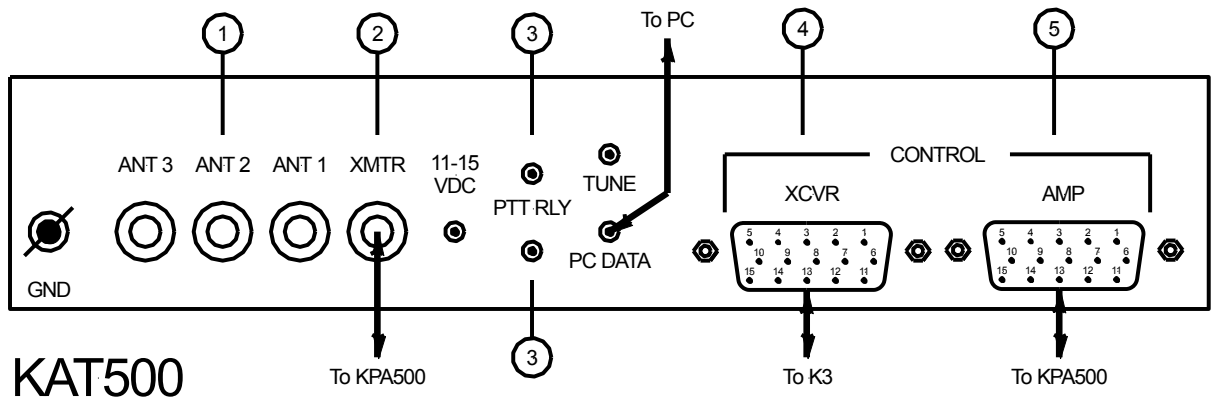


Figure 4. KAT500 Rear Panel

- ①: **ANT 1, ANT 2, ANT3:** Connect to any of three antennas.
- ②: **XMTR:** Connect to the KPA500 RF OUTPUT.
- ③: **PTT RLY:** These two RCA jacks connect to the relay that interrupts the KPA500 keying line.
- ④: **CONTROL XCVR:** This is connected to the K3's ACC connector.
- ⑤: **CONTROL AMP:** This is connected to the KPA500's AUX connector.

Computer Connections

Before considering the control and RF signal connections for the KPA500 and KAT500, a computer connection for all units should be set up to use each device's Utility program for configuring and updating firmware. You should configure the KAT500 *Amplifier Key Interrupt Power* before using the KAT500 with a KPA500.

Figure 5 shows a computer using USB ports and USB-to-Serial adapters to connect the computer to the K3/P3 and the KPA500 and KAT500. The K3, P3 and KPA500 use "standard" DE9 connectors while the KAT500 uses an Elecraft designed 3.5 mm TRS plug. Table 1 shows serial adapters that can be purchased from Elecraft.

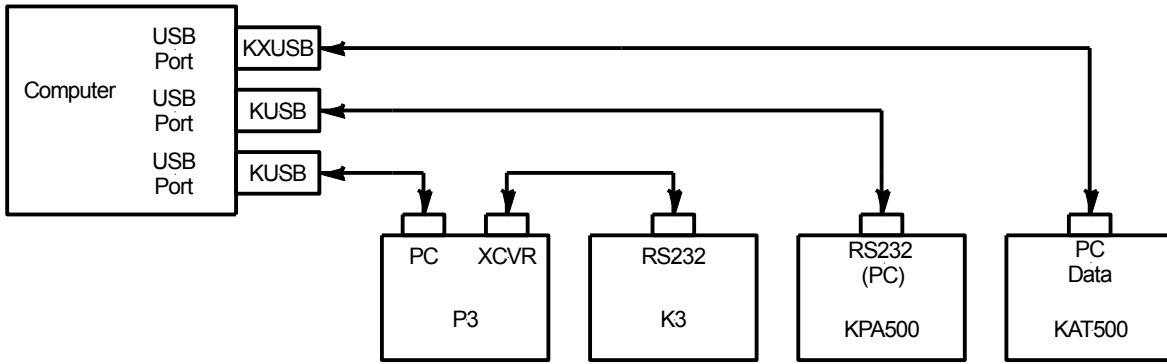


Figure 5. K3, P3, KPA500, and KAT500 Computer Connections.

Table 1. Serial Cables.

Serial Cable	Adapter Type	Elecraft Name	Used For
USB — KXUSB / KXUSBa — RS232 3.5 mm	USB-to-3.5 mm Serial Adapter	KXUSB, KXUSBa	KX3, KAT500, XG3, W1, W2
RS232 DE9S — KXSER / KXSERa — RS232 3.5 mm	DE9-to-3.5 mm Serial Adapter	KXSER, KXSERa	KX3, KAT500, XG3, W1, W2
USB — KUSB — RS232 DE9P	USB-to-DE9 Serial Adapter	KUSB	K3, KPA500.

The K3 and KPA500 Station

The KPA500 and KAT500 must know the operating band because the KPA500 has tuned circuits that it must switch in for each band and the KAT500 stores its tuner values and antenna used for each band. There are two ways that the amplifier and tuner can determine what band you are on – *Basic Band Switching* and *Enhanced Band Switching*.

Basic Band Switching

The KPA500 and KAT500 automatically measure the frequency of the RF drive signal and switch to the proper band. This happens in a very short time (a few milliseconds) and occurs in the KPA500 when the amplifier is keyed and RF is present. Similarly, when RF is present at the KAT500, whether or not the amplifier is keyed, it also measures the frequency and switches in the needed L and C values to create the needed tuning.

Basic Band Switching is always active as a safety measure to ensure the amplifier operates on the same band as the exciter transceiver.

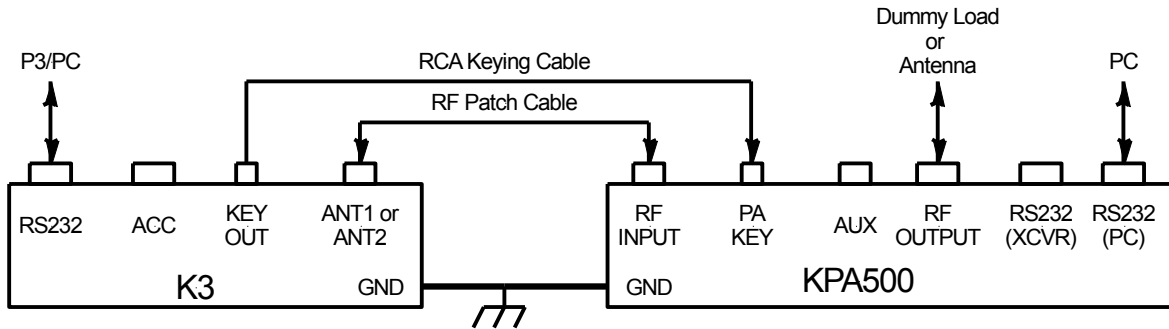


Figure 6. K3 -- KPA500 basic connections.

Figure 6 shows the connections needed for Basic Band Switching. This is the simplest of all configurations and can be used with any transceiver.

Only two cables are required.

- An RCA – RCA Keying Cable from the K3's KEY OUT jack to the KPA500's PA KEY jack.
- A PL259 RF Patch Cable from the K3's ANT 1 or ANT 2 to the KPA500's RF INPUT connector.

When the K3 transmits, the KPA500 measures the K3's RF and automatically switches to the correct band. It does this in a few milliseconds.

The K3's output power must be adjusted manually (using its **PWR** knob) to avoid overdriving the KPA500.

Enhanced Band Switching

When the K3—KPA cable in the optional KPAK3AUX cable set is used, band data from the K3 carried on this cable enables Enhanced Band Switching features. When this cable is used, the KPA500 does not need to measure RF to determine the operation band. In addition, this cable pathway from the KPA500 to the K3 allows the K3 to be closely integrated with the KPA500 to automatically control the power output of the K3.

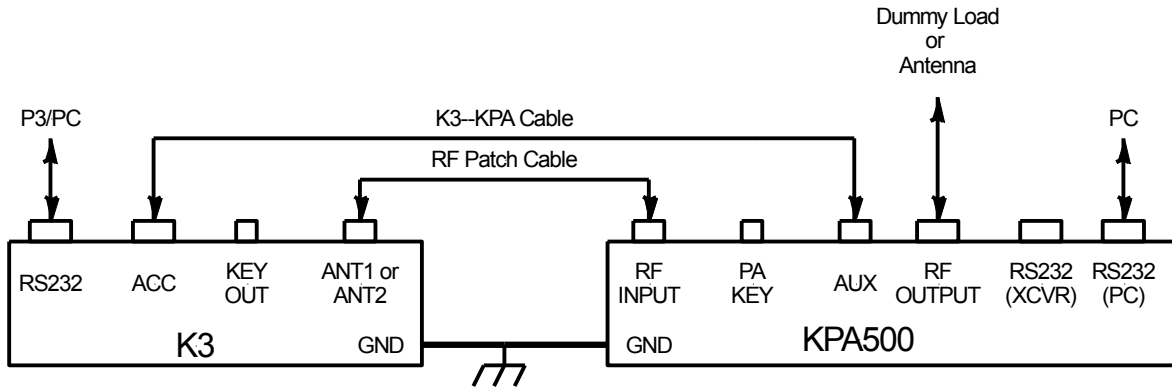


Figure 7. Enhanced band switching.

Figure 7 illustrates the connections for Enhanced Band Switching. The K3 – KPA Cable is part of the optional KPAK3AUX Cable Set. It carries band data and keying to the KPA500 and allows the amplifier to communicate its Operate or Standby status to the K3.

- Only two cables are required.
 - A K3–KPA Cable that can be purchased from Elecraft (KPAK3AUX option).
 - A PL259 RF Patch Cable from the K3’s ANT 1 or ANT 2 to the KPA500’s RF INPUT SO239 connector.
- Both the RCA Keying Cable shown in Figure 6 and the K3–KPA Cable shown in Figure 7 should NOT normally be used. Use only one of these cables for keying except when using a TX Keying Line Interrupter.
- The K3 sends the band data to the KPA500 so it can change bands without having to measure a transmitted RF signal. Basic Band Switching by measuring the frequency is always active as a safety feature.
- If a band change is made on the KPA500, the K3 will automatically change to that band.
- The KPA500 sends its operation mode – Operating or Standby – to the K3.
- If the K3’s **PWR SET** configuration menu is set to **Per bAnd**, the K3’s power can be adjusted to provide a low power output to drive the amplifier to a desired output power when the amplifier is Operating or adjusted to 100 watts output for barefoot operation when the amplifier is in Standby mode.
- The KPA500 can send fault information to be displayed on the K3’s VFO B area.

Using a TX Keying Line Interrupter

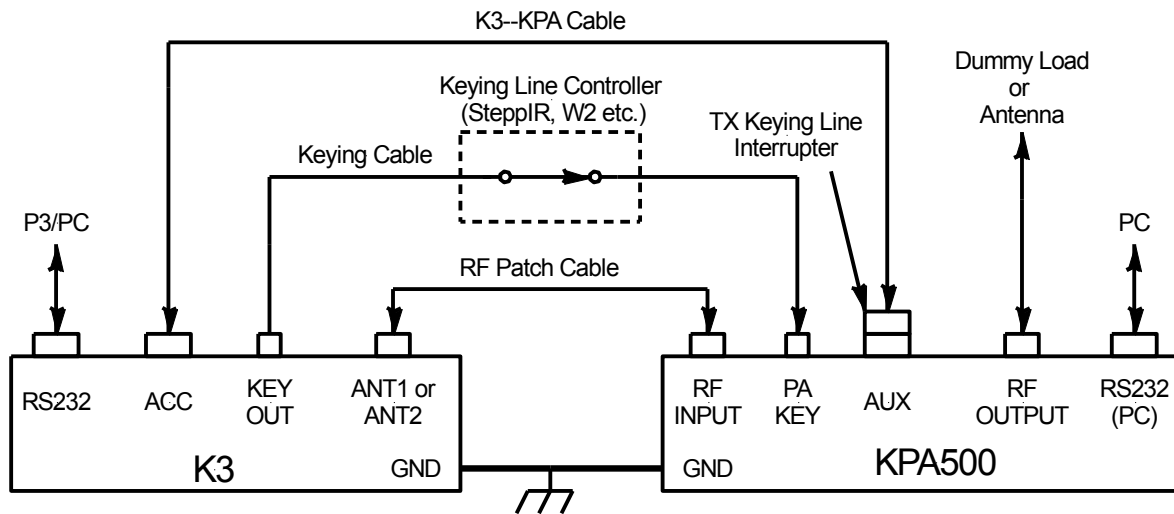


Figure 8. Using the TX Keying Line Interrupter.

Figure 8 shows a special case where both an RCA Keying Cable and the K3–KPA Cable are used. If there are other devices, such as a SteppIR™ tunable antenna that must interrupt the amplifier's keying so that it does not apply full power when the antenna is tuning, an RCA Keying Cable can be used to control keying and a K3–KPA Cable with a TX Keying Line Interrupter to give the amplifier band data information without keying it. In this case, the external Keying Line Controller is in series with the K3's KEY OUT signal and can interrupt the amplifier keying. In Figure 8 keying is accomplished with an RCA Keying Cable routed from the K3's KEY OUT RCA jack through the external Keying Line Controller to the KPA500's PA KEY input.

IMPORTANT: When using an RCA Cable for keying AND a K3–KPA Cable to achieve Enhanced Band Switching, the TX Keying Line Interrupter (as shown) **MUST** be used or pin-10 must be broken out of the K3–KPA Cable.

Using a Y-Cable

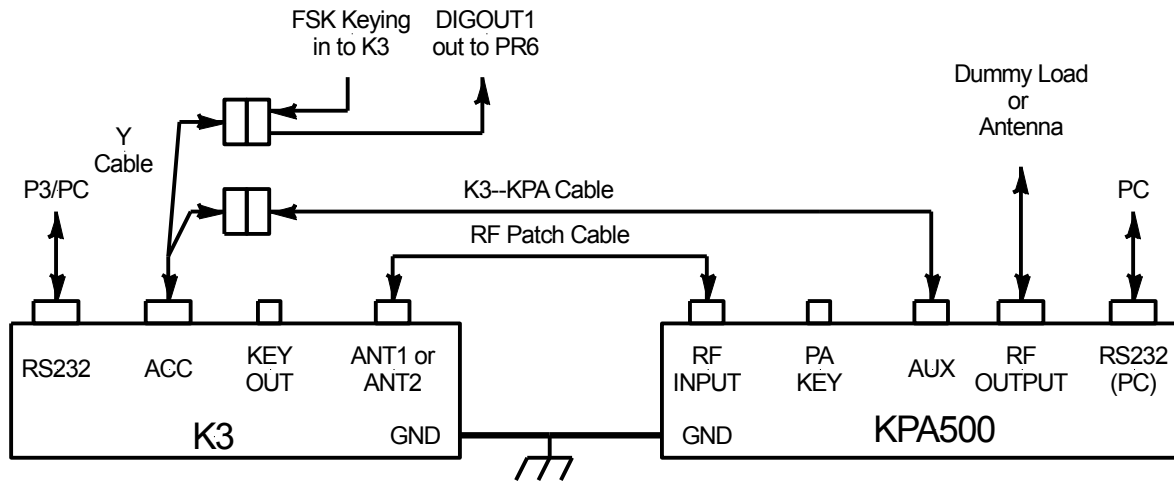


Figure 9. KPA500 control with a Y-cable splitter.

The K3's ACC socket contains a variety of signals that can be used for control purposes. For example, the K3's FSK Keying In is on pin-1. Also DIGOUT1, on pin 11, may be used to control the six-meter PR6 preamplifier and the BAND3 – BAND0 outputs may be used to drive a decoder to automatically switch antennas. A convenient way to access these signals is to use a 15-pin, Y-cable splitter. One of these is included with the KPAK3AUX optional cable package and additional ones can be purchased.¹ Figure 9 shows a Y-cable to split out control signals used in the K3.

¹ Elecraft part number E980190 Extra DB15 Y- Cable. DO NOT use a SVGA monitor splitter cable.

Adding the KAT500

Basic KPA500 and KAT500 Band Switching

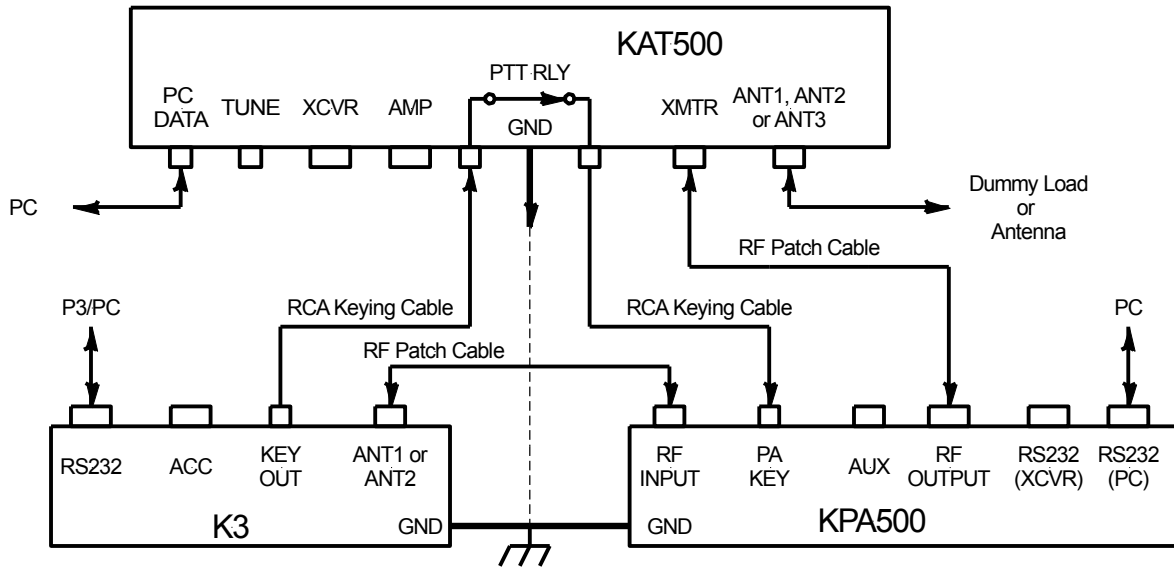


Figure 10. K3, KPA500 and KAT500 Basic Band Switching.

The basic connections between the K3, KAT500, and the KPA500 are shown in Figure 10:

- Simple connection – only four cables are required.
 - Two RCA – RCA Keying Cables; one between the K3's KEY OUT jack to the KAT500's PTT RLY jack and then another on to the KPA500's PA KEY jack.
 - Two PL259 RF Patch Cables; one connecting the K3's ANT 1 or ANT 2 to the KPA500's RF INPUT connector and one between the KPA500 RF OUTPUT and the KAT500's XMTR connectors.
- When the K3 transmits, both the KPA500 and the KAT500 measure the RF and automatically switch to the correct band. They do this in a few milliseconds. Basic Band Switching is always active, even when using Enhanced Band Switching. This is a safety measure to ensure that the KPA500 and KAT500 always operate on the same band as the exciter transceiver.
- If the KAT500 has detected the transmitted RF signal before, it will automatically switch to the antenna last used on this band and switch in the previously determined and stored L and C values for the correct tuning.
- If antenna tuning is needed, the KAT500 opens (interrupts) the amplifier's keying line to stop it from transmitting to protect both the KPA500 and the KAT500 from excessive voltages that can be generated while tuning.
- At the end of the tuning cycle, if a sufficiently low VSWR was achieved, the KAT500 closes the keying line and full output power transmission can begin.
- If the VSWR is not suitably low at the end of tuning, the KAT500 displays a fault and continues to hold the KPA500's keying line interrupted.
- The K3's output power must be adjusted manually (using the PWR ∅ knob) to avoid overdriving the KPA500.

Enhanced KPA500 and KAT500 Band Switching

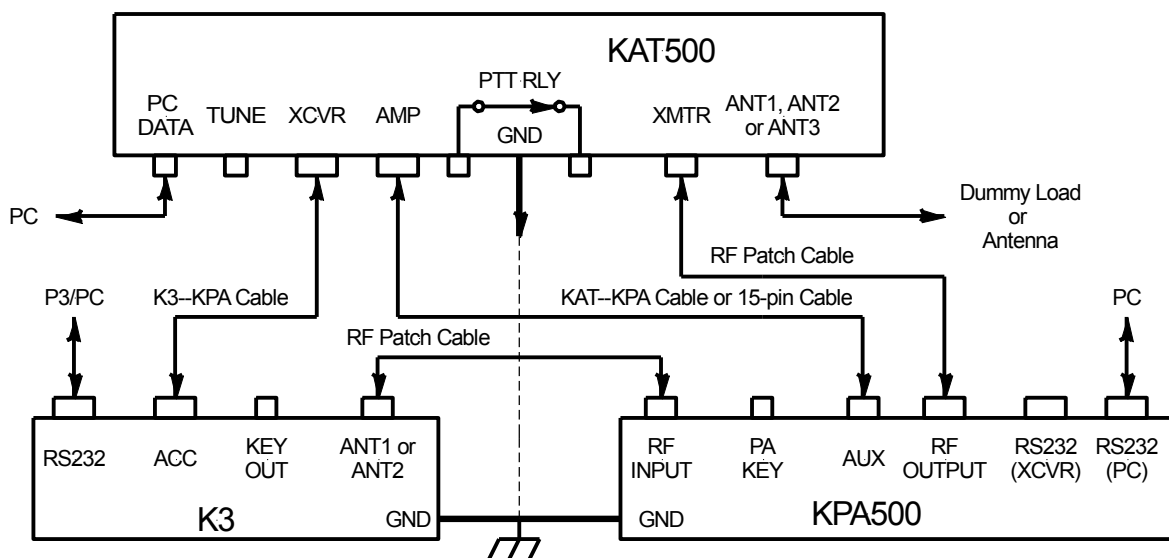


Figure 11. Enhanced KPA500 and KAT500 band switching.

When the K3 – KPA cable in the optional KPAK3AUX cable set and the E850463 Optional KAT – KPA Cable that can be ordered with the KAT500 are used, band data and operating frequency information carried on these cables enable Enhanced Band Switching features. When these cables are used, neither the KPA500 nor the KAT500 need to measure RF to determine the operation band.

With K3 firmware 4.83, KAT500 firmware 1.58, and KPA500 firmware 1.37, the K3 sends the VFO A (or VFO B if in split) operating frequency, even while receiving, to the KAT500. RF measurements do not have to be made by the KAT500 to find your operating frequency if you are using this scheme. You must enable it by entering the K3 **CONFIG:KAT3** menu and tapping the 1 key to show **KAT500Y**.

In addition, this cable pathway from the KPA500 through the KAT500 to the K3 allows the K3 to be closely integrated with the KPA500 to automatically control the power output of the K3.

KPA500 and KAT500 Enhanced Band Switching connections between the K3, the KPA500, and the KAT500 are shown in Figure 11. The K3–KPA Cable carries band data and operating frequency information and keying FIRST to the KAT500 (XCVR connector) and THEN (with a KAT–KPA Cable) to the KPA500 (AUX connector). This allows band data, operating frequency, and keying to be transferred to the amplifier and the tuner and the amplifier's Operate or Standby status back to the K3.

- Four cables are required.
 - One is a K3–KPA Cable² connecting the K3 ACC connector to the KAT500 XCVR connector.
 - One is either a KAT–KPA Cable³ or a 15-pin cable (not an SVGA cable) connecting the KAT500 AMP connector to the KPA500 AUX connector.

² KPAK3AUX cable set option.

- The third and fourth are the PL259 Patch Cables from the K3 ANT 1 or ANT 2 to the KPA500 RF INPUT and from the KPA500 RF OUTPUT to the KAT500 XMTR SO239 connectors.
- The K3 sends the band data defining which band it is on to the KAT500 and the KPA500 so they can change bands without having to measure a transmitted RF signal.
- The K3 sends the VFO A (VFO B if in split mode) frequency to the KAT500 so it can switch in the required L – C components for that frequency if the tuner has been previously trained. RF transmissions do not need to occur for this to happen.
- If a band change is made on the KPA500, the K3 and the KAT500 will automatically change to that band.
- The KPA500 sends its operation mode – Operating or Standby – to the K3.
- If the K3's **PWR SET** configuration menu is set to **Per bAnd**, the K3's power output can be adjusted to provide a low power output to drive the amplifier to a desired output power when the amplifier is Operating, or adjusted to 100 watts output for barefoot operation when the amplifier is in Standby mode. Once this is done the K3's output power does not have to be adjusted manually as in the Basic Band Switching mode.
- The KPA500 can send fault information to be displayed on the K3's VFO B area. The KAT500 does not send fault information to the K3.
- When RF is detected by the KAT500, it continuously measures the VSWR and if it exceeds a configurable value it opens the amplifier's keying line to stop it from transmitting (to protect both the KPA500 and the KAT500 from excessive voltages that can be generated while tuning).
 - The KAT500 first switches in stored L–C values and checks the VSWR again.
 - If the VSWR is still too high, the tuner enters a Full Search Tuning process if the tuner is in AUTO mode.
- At the end of the tuning cycle, if a sufficiently low VSWR was achieved, the KAT500 closes the keying line and full output power transmission can begin.
- If the VSWR is not suitably low (< 3:1) at the end of tuning, the KAT500 displays a fault and continues to hold the KPA500's keying line interrupted.

K3 Configuration

K3 Power Set Per Band

When setting up the K3 to operate with the KPA500, set the K3's **CONFIG:PWR SET** to **Per bAnd**. This saves the output power used on each band and allows the power to be adjusted on each band to produce full power output from the KPA500 to compensate for individual band power gains in the amplifier. Plus, when using a K3–KPA Cable between the K3 and KPA500, separate K3 power output levels can be set for when the amplifier is operating and when it is not.

³ Elecraft part number E850463. This cable is identical to the K3–KPA cable in the KPAK3AUX cable set.

K3 Tune Power

Set the K3's **CONFIG: TUN PWR** to *nor*, so the K3's output power during tuning (when holding its **TUNE** button) is set by the **PWR ∅** knob.

Setting the K3's Power for Operating with the KPA500

When using the K3–KPA Cable as shown in Figure 7, two different power output levels can be set in the K3 that are selected by the KPA500 in Operate and Standby mode respectively. To do this:

- Set the K3's **CONFIG:PWR SET** menu to *Per bAnd*.
- Set the K3's **CONFIG:TUN PWR** to *nor*.
- Set the K3 output power to about 10 watts.
- Place the KPA500 in Operate mode.
- Hold the K3's **ATU** to put its internal tuner in **ByPASS** mode. The KPA500 will present an SWR of 1.5:1 or less on all bands so the transceiver's antenna tuner can be bypassed.
- Hold the K3's **TUNE** button and set the K3's output power to give the required KPA500 output power.
- Stop transmitting.
- Return the KPA500 to Standby mode.
- Hold the K3's **TUNE** button and set the K3's output power to give the desired barefoot (no amplifier) operation power.
- Repeat this for all bands.

KAT500 Configuration

The KAT500 Utility must be used to set and change the KAT500's configuration. From time-to-time update the KAT500 Utility program to the latest version. Sometimes firmware changes are made that require the latest version of the utility.

Execute the KAT500 Utility program. When the program finds the correct serial port for the tuner, click on the *Configuration* tab and then on *Save Configuration* so that an old configuration can be retrieved if there is something wrong in the new one. When done, click on *Edit Configuration...*

Amplifier Key Interrupt Power

Before starting to operate with the KAT500, use the KAT500 Utility program to set the *Amplifier Key Interrupt Power*. Because the KPA500 is designed to be hot switched, ensure that this parameter is 1500 watts.

Initial Power

Checking *Power On when DC power applied* will turn the KAT500 on when power is applied. When unchecked, hold the KAT500 **MODE** switch or use a computer control command.

Idle Sleep

The KAT500 microcontroller's crystal oscillator can generate a signal at about 28.004.5 MHz. This birdie can be eliminated by checking the *Sleep When Idle* box. Uncheck the box if using a computer program to control the KAT500 which does not send a "wake up" command before sending commands.

Antennas

The *Antennas* configuration tab allows you to choose antennas that can be selected for each band. With the *Band* and *Enabled* panels the KAT500 can be configured to avoid switching to an inappropriate antenna for a particular band. The *Preferred* panel lets the KAT500 choose either the last used antenna for a band or one that can be configured.

Amplifier Key Interrupt VSWR Threshold

This setting may be used to interrupt the amplifier keying line whenever the VSWR exceeds this threshold value. Set it to a high value if you do not want the KAT500 to interrupt the amplifier key line when it detects high VSWR. The default threshold of 3.0:1 is suitable for most normal operations.

Autotune VSWR Threshold

This threshold is used to determine when the KAT500 should attempt to retune when in AUTO Mode. KAT500 firmware may limit this configuration setting to a minimum value. The factory default value is 1.80:1. This threshold is the trigger to cause the tuner to start tuning. Once started, the tuner seeks the best VSWR it can find.

Bypass VSWR

The KAT500 tuning algorithm first measures the VSWR of the antenna with the KAT500 bypassed. If the antenna VSWR is acceptable – "good enough" – on this frequency, the quickest and quietest KAT500 setting is to bypass all the inductors and capacitors. This VSWR threshold is used to choose your notion of "good enough". The factory default value for this threshold is 1.30:1. With the KPA500 amplifier it is safe to set this to nearly 2:1.

Erase Memories

Use this tab to erase memorized tuner settings for one or more antennas on a single band or all bands. Select the *Band* and *Antenna(s)* you wish to erase then click *Apply*.

Auto Fine Tune

Some High Q antennas have narrow ranges of matching inductance and capacitance and the full search "coarse" phase may fail to find a good starting point, even though one may be available between its tested values. If the KAT500 fails to find an acceptable match automatically with its normal coarse tune step size, a smaller step size, which requires more steps and a longer tune, may find an acceptable match. Select "Auto Fine Tune" for those bands where this more exhaustive tuning effort is needed.

Tune on QSY

MAN Mode. In the manual mode after switching to a band and the tuner has done its Memory Recall Tune, it continuously monitors the operating frequency and performs Memory Recall Tunes as the operating frequency changes. If it is preferred that the tuner not attempt to change settings when QSYing in-band based on the transmit frequency count, uncheck the *Memory Recall Tune on QSY in Mode MAN* checkbox.

In MAN mode if the VSWR exceeds the *Autotune VSWR Threshold* the tuner interrupts the keying line but DOES NOT perform Full Search Tunes unless the **TUNE** button is pressed.

AUTO Mode. In automatic tuning mode the KAT500 continuously monitors the transmit frequency and performs Memory Recall Tunes as the operating frequency changes by selecting the memory closest to the current frequency.

If it is preferred that the tuner not attempt to change settings for in-band QSY based on the transmit frequency count, uncheck the *Memory Recall Tune on QSY in Mode AUTO* checkbox.

The tuner always performs Memory Recall Tunes on band and antenna changes in MAN and AUTO modes.

In AUTO mode the tuner also changes tuner settings based on VSWR. When the current VSWR exceeds the *Autotune VSWR Threshold*, the tuner first performs a Memory Recall Tune, followed by a Full Search Tune if needed to bring the VSWR below the threshold.

Choosing the KAT500's Operating Mode

Up until the development of K3 firmware revision 4.83 and KAT500 firmware revision 1.58, some operators were finding that when they selected AUTO mode and fully initialized the tuner's memories, occasionally the tuner proceeded to a Full Search Tune even though the L-C values in memory should be the correct ones to use. This may have been caused in SSB mode by the tuner taking forward and reverse power measurements at different times in the SSB waveform. These operators suggested the following:

- Initialize your tuner's memory segments for all frequencies in all bands.
- Choose the manual mode for normal operation.

The new firmware has fixed these mostly transient problems but this strategy is still a good idea because it provides a way for the tuner to react if a serious antenna problem, such as the wrong antenna selected on a remote switch, occurs. It is safe to use because if the VSWR limits are exceeded, the tuner holds the keying line open and illuminates the fault LED. You can then take correction action manually, determining first if the wrong antenna is selected or if there has been an antenna failure.

Training the KAT500 Tuner

When the tuner has determined the operating frequency and tuned the antenna to achieve an appropriate VSWR, it stores the L and C values and the antenna being used to be recalled the next time that frequency is encountered. This allows the tuner to very quickly retune itself – without going through a lengthy retuning cycle – when changing change bands or changing frequencies within a band. Every time you change the K3's VFO A (VFO B if in split) the frequency is sent to the KAT500. This is converted to a segment number in the present band that is used to look up L-C settings stored for that segment. If L-C settings need to be changed, they will be, typically in less than 50 ms.

Table 2 shows the memory segments used for each of the frequency bands from 1.8 to 60 MHz. The memory segments are smaller for the lower frequency bands because antennas for these bands are more sharply resonant and need to have the tuning changed in narrower segments.

Table 2. KAT500 memory segments.

Frequency Band	Memory Segment Width
Below 3 MHz	10 kHz
3 MHz – 26 MHz	20 kHz
26 MHz – 38 MHz	100 kHz
38 MHz – 60 MHz	200 kHz

It is useful to set-up the tuner for all bands so that it does not have to go through a Full Search Tuning cycle each time frequency or band changes require retuning. Do this for at least your favorite operating frequencies.