

# QSO

News From The World Of  ELECRAFT

## In This Newsletter

- Elecraft Linear Amplifier Buyers Guide
- KPA1500 Update
- K-POD Macro Book By Fred Cady Now Available!
- November Specials

# Elecraft Linear Amplifier Buyers Guide

## Buying and Installing

By David Shoaf / KG6IRW

Elecraft International Distribution Manager

Linear amplifiers do just what they're called: They take an RF input and amplify it, with very little distortion. If you plot input RF vs. output RF, you'll find that the resulting picture is almost a straight line – hence the name. We measure amplifier gain in dB.

### **Why purchase a linear?**

The fun answer is: "There are times when you'll want to turn it up to 11," from the movie [This is Spinal Tap](#). Here's a frame from the movie, a 'mockumentary' showing what all hams have experienced at some point:



As with any hobby, more power is an aspiration but, depending on your operating preferences, you may or may not find yourself operating at full output all the time. Let's explore purchasing a linear for your needs.

### **How much power do I need?**

In the U.S., as in many parts of the world, the 'legal limit' output from a linear amplifier is 1500 Watts. However, in other parts of the world,

operators are limited to 400 or 500 Watts. For many, operating QRP is fun, but it can be frustrating to call CQ or try to bust a pile up at 5 or 10 watts.

For that reason, Elecraft's line of linear amplifiers covers from 100 watts to the 1500 watt legal limit.

I want to go From/To	Model	Connect to any transceiver?	Auto Tuner available?	Price (Kit/Factory)	Power supply?
QRP → 100 W	KXPA100	Yes	Yes, optional	KXPA100-K - \$749.95 KXPA100-F - \$799.95	13.6 vDC @ 20 amps
~50 W → 500 W	KPA500	Yes	Yes, optional	KPA500-K - \$2099.95 KPA500-F - \$2299.95	Built-in, 120/240 AC switchable
~50 W → 1500 W	KPA1500	Yes	Built in, included in price	\$5995 (introductory price)	220/240 AC only

### Why not go straight from QRP to full legal limit?

Linear amplifiers manufactured in the U.S. are limited by FCC mandate to a maximum gain of 15 dB. Roots of this regulation date back to the mid-70s when there was substantial abuse of linear amplifiers on 11 meters (the CB segment). Thus, you cannot just hook up a QRP radio to a conforming legal-limit amplifier and get 1500 watts output.

### Solid state (SS) amplifiers vs tube amplifiers

Tube linear amps can be cost effective, but they require a warm-up period and manual adjustment. You have to select a frequency to transmit on, then tune up the radio's finals and the linear's finals before transmitting. SS amps, in contrast, can be ready to use within a couple of seconds of power-up and generally require no tuning. Up until about 10-15 years ago, most SS linear amps would cover only 160 to 10 meters. Today, however, solid state devices have improved, allowing coverage of 6 meters as well. This is true of all three Elecraft linear amps.

### Are the amplifiers compatible with my radio?

Most amplifiers today can be connected to most any current transceiver. Most of today's transceivers provide at least basic connections to do so.

### Arming the amplifier for transmit via transceiver control

In the U.S., all linear amplifiers are required to respond to a signal from the transceiver for when to go into transmit. For Elecraft, the term KEY OUT or PA KEY is used to name this signal. For other transceiver vendors, other terms are used to refer to the same signal. For instance, Icom refers to this signal as SEND or HSEND in their documentation. Yaesu and Kenwood use different terms, but all refer to the same function.

### Integration: How amplifiers figure out what band has been chosen

Generally, we break up Integration capabilities into two segments. All Elecraft linear amps can operate in either Basic or Enhanced modes. It depends on how the cabling is implemented.

Integration Mode	Definition	What is the difference?	How is it accomplished?
Basic	In basic mode, the amplifier uses its ability to sense the RF signal that appears at its input. It detects RF, determines what frequency you're on, and selects the correct band.	Requires that the transceiver go into transmit first so that the linear can figure out what band and frequency has been chosen.	Frequency Counter built into the Linear and tuner
Enhanced	Enhanced mode uses signaling between the transceiver and the linear to determine what band and/or frequency that the transceiver will be using. For Elecraft radios, Enhanced mode also means that the integrated Auto Tuner can also read the VFO frequency and pre-select the tuning elements needed to be prepared to transmit as soon as the operator lands on a new frequency.	Knows what band has been chosen before the onset of RF from the transceiver.	<u>Example Signal Methods</u> <ul style="list-style-type: none"> <li>● Kenwood: RS232 via COM port</li> <li>● Yaesu: BCD Band Data signals</li> <li>● Icom: CI-V or Band Voltage</li> <li>● Flex: Basic or 3<sup>rd</sup>-party apps</li> <li>● Elecraft: Unique AuxBus system</li> </ul>

We have a list of [Application Notes on Integrating Transceivers to the Elecraft KPA500 linear amp and its matching auto-tuner, the KAT500 on the Power Combo page here.](#)

### Considerations for Installing a Linear Amplifier

#### Is there 120 V or 240 V available in the shack?

There's a tipping point around 500-600 watts that will require 220/240 volts in your shack. For legal-limit linear amplifiers, this means that you'll definitely be operating on 220/240 VAC.

However, with a 500 watt linear, you have your choice of operating them at 120 or 220/240 volts. This is good news for those operators who cannot extend a 220/240 volt AC line from their load panel.

### How do I keep the amp cool?

This is the single most important item to consider in your shack. Virtually all high-power amplifiers have cooling fans. With the trend to smaller cabinets, the issue of air flow becomes more critical.

There are two considerations for air flow: *Into* and *Out Of* the cabinet. Of the two, the most important is *Out Of*. You must be sure there's plenty of room for the air to get out of the cabinet and not be recycled back through without cooling off first. There is no use in putting extra fans on the intake if the output of the linear does not have enough room to exhale the air.

### What about grounding?

When operating with high power, the need for safety becomes even more important. Grounding helps to ensure that all peripherals in the shack stay at the same potential, while providing a way to bleed off energy safely.

For all shack installations, Elecraft recommends Star Grounding techniques for shack grounding systems. These are well-discussed and used grounding systems. [The ARRL's Grounding book](#) is an excellent starting point. Your local home building store is an excellent place to find the items you'll need.

**Remember:** For maximum safety, your shack must conform to [National Electric Code](#) (NEC) and local electrical codes.

## Top Buying Criteria Key features to look for in a linear

Auto band switching both in Basic and Enhanced Modes	<ul style="list-style-type: none"> <li>• Can the amplifier operate in Basic mode?</li> <li>• Can it also operate in Enhanced mode?</li> <li>• Does it use a frequency counter on the RF input?</li> </ul>
Built-in Auto-Tuner	<ul style="list-style-type: none"> <li>• For 1500 watt linear amps, is there a built-in tuner?</li> <li>• Can the tuner be trained to remember tuning elements on a per frequency basis?</li> <li>• Does the tuner have ways to automatically select the antenna of your choice on each band?</li> </ul>
No relay switching between TX and RX. Lightning fast T/R switching.	<ul style="list-style-type: none"> <li>• Does the linear use relays to switch between Transmit and Receive?</li> <li>• Diode switching methods provide far higher speed – especially if you want to operate high speed CW.</li> </ul>
Fully instrumented to protect the gear if antenna systems fail.	<ul style="list-style-type: none"> <li>• Is the linear designed for you to monitor the important operating meters at a glance?</li> </ul>
Logging of faults to figure out what might have gone wrong.	<ul style="list-style-type: none"> <li>• Does the linear record what the meters are reading when it encounters a problem that causes it to stop operating?</li> <li>• What does the linear do when it encounters a problem? Go off line or keep operating?</li> <li>• Can the log be inspected to learn more about what happened?</li> <li>• Can the log be pulled out of the linear to email to Customer Support?</li> </ul>
Remote diagnosis and recovery facilities	<ul style="list-style-type: none"> <li>• Can the linear be fully operated remotely?</li> <li>• Are there ways to recover from failures without having to go to the remote site?</li> </ul>

\* All of Elecraft's stand-alone amplifiers meet these criteria.

Our technical staff would be happy to discuss any of the topics in this article with you. Feel free to email us ([support@elecraft.com](mailto:support@elecraft.com)) or call (831-763-4211), and ask for tech support.

## KPA1500 Update

### KPA1500 Recent Contest Experiences at K6KR

Dick Dievendorff, Member of the KPA1500 Engineering Team

For years, I've used tube-based legal limit amplifiers and a separate manual ATU. Both were adorned with colored stickers with presets. I was constantly fiddling with the knobs. I avoided 40-meter phone because it was too much work to constantly retune with wide splits.

I had moved to a KPA500 and KAT500, which allowed me to move all over the band, changing just the transceiver VFO with the amp and ATU following along. I found this so convenient that my legal limit amp is packed up.

This last couple of weekends (CQWW Phone & SS CW), I've relearned that there is a real difference between 500 and 1500 watts. I hear my call sign returned in a crowd regularly and more quickly. I can hold a run frequency. My KPA1500 prototype is just as convenient as the KPA500 + KAT500 combination, and there's only one box on the desktop to connect and watch. The size and weight are a far cry from my old tube linear and ATU. The K-line integration is like KPA500 + KAT500; the KPA1500 with its ATU follows the K3. We're also able to track frequency information from several other popular transceivers. Newer memory technology gives the KPA1500 room to store many more ATU settings for externally switched antennas. When I switch from a beam to a vertical, connected through the same KPA1500 antenna connector, the ATU can quickly recall a pretuned setting.

I'm a member of the KPA1500 engineering team, and I've been working with prototypes for the last few months. I particularly enjoy working on products that I would want to own.

Dick, K6KR

### It's Happening Here in Watsonville, CA!

We've been overwhelmed with the orders and we're sure all those who stepped in line for the KPA1500 are interested in seeing how we're doing. So, let's look at some of the production going on now.

Our Production team is already working to build up sub-assemblies.



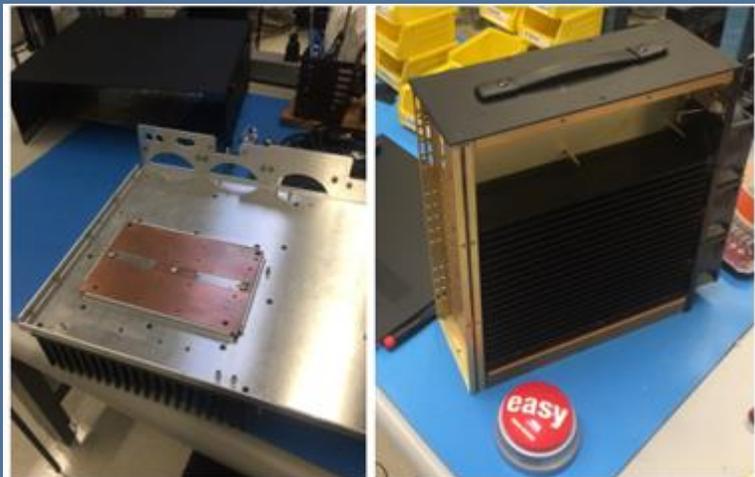
**Installing the Antenna Tuner**



**One of the firmware test units**

In the pictures above, the copper heat spreader holds the final LDMOS devices and ensures fast, efficient conducting of heat into the black, finned heat sink. By combining to two together, we can easily remove heat from the PA Deck with the fans.

Since the KPA1500 has 2 separate cabinets, we can build more sub assemblies for both easily.



**KPA1500 Copper heat spreader (left) and finned heat sink with fans (right)**

We're also testing every day and revising firmware on almost an hourly basis.



**We're always looking for good dummy loads for Productions!**

We're very excited to have the KPA1500 nearing a big milestone. Our thanks to the many customers awaiting to receive their KPA1500.

#### ✿ KPA1500 Shipping Change in Conjunction with Reduced Fan Noise

Like many amplifiers in this class, we use a commercially available switching module in our power supply. Our amplifier team has found a way to significantly reduce the fan noise of the switching module by using different fans with a much quieter noise profile. The new design cools the power supply more efficiently, and has a more pleasant sound than the stock fans. Our test operators love the change, so we've decided to phase it into production immediately. As a result, first shipments will begin in mid-to-late December. This is in keeping with our goal to give our customers the best possible amplifier.

We will contact everyone who ordered a KPA1500 to reconfirm orders and shipping addresses prior to shipping. Learn more about [KPA1500 here](#).

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## Macro Book By Fred Cady Now Available!

The K-POD is an excellent performer for the DXer and Contester who need to keep their hands close to



the keyboard of th

air logging system. By making all the right

controls available, they can minimize hand movement while bagging the contacts. However, there's far more value to unlock with the K-POD in the programmable buttons using Macros.

For some operators, however, developing and using Macros can be a challenge. This is where Fred Cady/KE7X's excellent new book on Macros will help. Using his well-regarded learning system, any operator can take advantage of Macros to up their game and unlock extra value in the K-POD. [Order the Macro Book here.](#)

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## November Specials

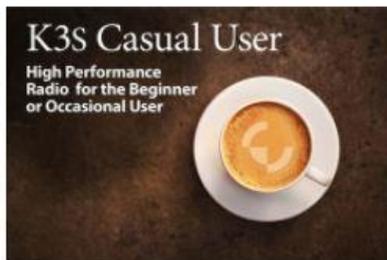
\$25 Discount on a K3/0 – Mini Control Head for K3-Remote system

\$10 Discount on a K-POD

\$5 Discount on MH3 or MH4

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### Our Most Popular K3S Configurations Packaged to Fit Your Operating Style!



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\*Free UPS Ground shipping with the Continental U.S. for November Specials. Discounts not retroactive for orders placed prior to receiving the offer. Not valid in combination with any other discounts. Offer ends November 30, 2017. Subject to change.

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