

Pro Audio Engineering

PAE-Kx33 Low-RFI DC Power Supply



Owner's Manual

Rev 2.2
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Thank you for purchasing the PAE-Kx33 Low-RFI AC Power Supply. We designed the Kx33 to address a very specific need: a small, light, easily portable high-power DC supply which has low AC input to DC output coupling. This is critical to minimize RFI due to common-mode currents often found with temporary antennas such as end-fed or verticals.

The Kx33 was specifically designed for the needs of high-performance HF transceivers and communications equipment requiring a low-noise source of DC. It is perfect for use with any device designed to operate from DC 12-14 V at up to 4 A continuous, 5 A thermally limited.

This supply features an innovative design which inherently minimizes RFI. In addition the Kx33 features multiple filters to further reduce emissions, while paying particular attention to voltage regulation. The Kx33 has very low voltage undershoot and overshoot due to load transients in order to protect attached devices. The result is a power supply offering the small size and light weight advantages of a switching supply without the common disadvantages of RF noise, poor regulation and others. For full information on its specifications, design and performance capabilities, please visit: <https://proaudioeng.com/products/pae-kx33-low-rfi-ac-power-supply/>

We welcome any and all comments regarding the design, operation or performance sent to: info@proaudioeng.com

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IMPORTANT NOTES:

This power supply must be operated from a 50-60 Hz power source between AC 100 V and 250 V ONLY. Operate in an environment away from direct sunlight or moisture. This supply should not be used to directly charge a battery; damage, injury or fire may result. The Warranty will not cover damage due to these actions or the resulting damage to person and/or property.

Operation:

We suggest you plug the PAE-Kx33 power supply into an AC source before turning on the attached equipment. If you are using the Kx33 to power more than one piece of equipment at the same time, turn on the one with the largest power requirement first. For optimum noise elimination it is useful to place the supply at the full DC power cord length away from the rig being powered.

The Kx33 is rated at 4 A output, but will produce 5 A for one minute to several minutes depending on ambient temperature. This capability allows it to drive large capacitances and transient loads without over-current fold-back.

The Kx33 offers comprehensive protection circuitry including input over and under-voltage, output over-current, over-temperature and short-circuit protection. These have been incorporated into the Kx33 to protect your equipment, but they should not be relied on as a replacement for proper wiring or fusing.

At loads less than 25 mA the Kx33 enters a skip-cycle mode in order to maintain voltage regulation. When in this mode there can be additional noise on the output. For lowest noise it is recommended that a load of greater than 25 mA be maintained. This is standard behavior for most switch-mode supplies.

Some antenna systems, especially end-fed antennas generate large imbalance potentials and will encourage common-mode coupling through the power supply. This can result in an apparent increase in noise, but thanks to the Kx33's very low input to output coupling, it is easily remedied by the use of a common-mode choke. This can be made easily by running the DC power cable 3-4 turns through the mix 31 Snap-It core provided with the Kx33.

If your common-mode issue is not resolved with the ferrite core included and requires additional cores, Pro Audio Engineering offers a range of Fair-Rite products at very low cost: <https://proaudioeng.com/fair-rite-ferrites/>

****Please read the following section on RFI and AC power supplies for more information.****

AC Power Supplies and RFI:

When powering a DC 12 V receiver from an AC line power source you may occasionally find the receive noise floor becomes contaminated with noise of various sorts which are not present when powered by a battery and isolated from the AC power system. It is a common misconception that all linear power supplies powered from the AC mains are as quiet as batteries and all switching power supplies are noisy. The truth is more complicated due to the multiple routes by which RF Interference (RFI) can be induced into a receiver, and these are:

1: Transverse or Differential-mode conduction.

This is RF ripple superimposed on the DC output which can introduce RFI into the equipment being powered. It is critical for the designer of a supply to resolve this source of noise inside the supply as it can cause radiated RFI if allowed to propagate on the DC power cord. We specifically designed the Kx33 to have extremely low RF ripple on the DC output and to date have not had any of this type of RFI reported.

2: Common-mode currents from the antenna system.

These currents can use the coax feedline shield as a counterpoise and conduct through the rig, then through the power supply DC cable and power supply to the AC line. Whether this coupling introduces noise depends on two main factors:

a. Balance and common-mode potential of the antenna system.

An antenna is a two-terminal device, which means the current flowing in each conductor will be equal and 180° out of phase from each other. This is the physical mechanism by which an antenna sets up the electromagnetic field it radiates. Many antenna systems have an impedance imbalance between for example, the two halves of a dipole, or between the main radiator and counterpoise as is the case with most end-fed antennas. In these cases the imbalance current flows back down the **outside** of the coax feedline shield turning it into an active part of the antenna system. This will affect the antenna pattern in both receive and transmit as well as allow the feedline to receive ambient noise. The rig chassis, the power supply, and AC mains are then all in a series path for these common-mode currents making them an active part of the antenna system as well.

Inserting a high impedance in this series current path will greatly reduce or eliminate the current. A common-mode choke in the antenna feedline at the antenna feedpoint is the best way to reduce or eliminate this common-mode current flow. Choking the DC power lead is a second-best solution. An excellent reference on this subject can be found on K9YC's site: <http://audiosystemsgroup.com/RFI-Ham.pdf>

b. The AC input to DC output impedance of the power supply.

All AC line powered supplies appear to RF as a capacitor between the AC line input and the DC output. This can be a path for RF energy to take if a difference in potential exists between the two. When using a linear supply the RF current will be modulated at the AC line frequency, leading to the hum commonly heard in older single-conversion receivers. When using a switching supply the coupling can be modulated by the switching action and can cause RFI. Measurements taken of many power supplies show most linear and switching supplies offer on average ~1000 pF of capacitive coupling between the AC input and DC output. At <80 pF the Kx33 greatly minimizes this coupling and the magnitude of this common-mode RFI current. This makes choking common-mode currents much easier with the Kx33 than with other power supplies.

For cases where an antenna system may present common mode potential we include a Fair-Rite mix 31 Snap-It core which can be used to make a common-mode choke by winding the small diameter DC output cable of the Kx33 through the core 3-4 turns. This will effectively increase the common-mode impedance through the Kx33 by 800 to 1000 ohms @10 MHz, effectively minimizing this current path through the supply. If additional ferrite products are desired we offer a range of Fair-Rite Ferrite Snap-It and toroid cores at low cost to our customers at: <https://proaudioeng.com/fair-rite-ferrites/>

We made the decision not to integrate a large ferrite choke inside the Kx33 itself in order to minimize size and weight. For 99% of all users, the RFI performance of the Kx33 itself will be sufficient, and if additional common-mode choking is required the additional core can be employed.

3. Radiated RFI.

This RFI can come from many sources and can be picked up by the antenna system or many other cables with poorly designed shield terminations and appear as a signal in the receiver. In a well-designed supply like the Kx33,

the external fields from all internal circuitry are extremely small. We have not yet had a report of a Kx33 radiating RFI, however, in order to minimize the pickup of any radiated RFI we recommend placing the supply the full length of the DC supply cord away from the rig.

We are sure you will be happy with the Kx33 or we will refund both your initial purchase and shipping costs. There is no risk other than a small amount of your time evaluating it.

Maintenance:

Clean with a dry cloth, use no solvents, cleaners or water.

Do not attempt to open your Kx33, there are no user adjustments inside.

If the supply is not performing as expected, please contact us at:

info@proaudioeng.com

Accessories for the Kx33:

33-100 - DC Power Splitter

Allows a Kx33 to power two devices like the Elecraft KX3 and PX3 simultaneously.



33-120 - 4.0 mm x 1.7 mm DC Power Adapter

Adapts the output of the Kx33 for use with the Yaesu FT-817/818 and others.



33-140 - 5.5 mm x 2.5 mm DC Power Adapter

Adapts the output of the Kx33 for use with the Icom IC-705, Flex1500, Softrocks and others.



33-155 - Mini-Tamiya DC Adapter

Adapts the output of the Kx33 for use with the Xiegu G90 and others.



33-160 - PowerPole to Female DC Adapter

Adapts the output of the Kx33 for use with any DC 12-14 V device requiring a PowerPole connector such as the Elecraft K3/10 and many others.



33-175 - GX12-2 DC Adapter

Adapts the output of the Kx33 for use with the Lab599 TX-500 and others.



33-180 - 28-piece DC Power Adapter Kit

Adapts the output of the Kx33 for use with many devices requiring DC 12-14 V.



Fair-Rite Ferrite Mix 31 Cores - Useful for choking common-mode RFI from RF coax, USB, Ethernet and power cables. Mix 31 is optimized for HF use.

22-400 - Snap-It (0.933"OD x 0.4"ID x 1.55"L)

22-405 - Snap-It (1.22"OD x 0.514"ID x 1.55"L)

22-410 - Snap-It (1.52"OD x 0.722"ID x 1.87"L)

22-420 - Snap-It (2.22"OD x 1.01"ID x 1.69"L)



22-430 - Toroid Core (2.4"OD x 1.4"ID x 0.5"L)

22-440 - Toroid Core (4.0"OD x 3.0"ID x 1.0"L)



For more information, other products and many other accessories go to:

<https://proaudioeng.com/dc-power-accessories/>

Specifications:

Input Voltage: AC 100-250 V, auto-switching

Input Current: 0.7 A : AC 115 V full-load,
0.3 A : AC 230 V full-load.

Input Frequency: 50 Hz ~ 60 Hz

Output Voltage @ plug (+/- 0.1V): DC 14.4 V no load,
DC 14.4 V at 0.2 A load,
DC 14.0 V at 4.0 A load.
DC 13.9 V at 5.0 A load

Output Current: 4 A maximum continuous, 5 A for 30 seconds min..

Maximum Ripple: 10 mV (30 MHz BW).

Protection: over-voltage, over-current, over-temperature, short-circuit.

MBTF: >50,000 hours.

Approvals: UL, FCC GS, TUV, CE, PSE, KC, SAA, CCC

Dimensions (excluding cables): 2" x 1.25" x 4.5" (50 mm x 32 mm x 114 mm)

Cable Length: AC line cord - 58" (1400 mm),
DC power cable - 78" (2000 mm)

Weight: supply: 9.3 oz. (264 g), AC cord: 3.4 oz. (96 g),
total: 12.7 oz. (360 g)

Warranty: 1 year from date of purchase.

Pro Audio Engineering reserves the right to make changes to product specifications which preserve or improve performance and do not affect suitability for the intended use powering HF communications equipment.