Brass Tacks

An in-depth look at a radio-related topic

Selecting a power supply

Being the proud owner of a ham radio, you're aware that you also need a way to power that radio. If your radio is an HT (handheld transceiver), chances are, it was packaged with a rechargeable battery pack that lets you take the HT wherever it's reasonable to use one. But if your radio is a mobile or base radio, it's likely going to require a power source that's external to the radio. We refer to that power source as a ***power supply*** or *PSU* (power supply unit), and that external PSU can be one of several kinds, depending on your power requirements and usage.

The purpose of a power supply is to convert some form of energy into electrical energy that your radio and other equipment are designed to use. As will be discussed, there are a number of energy sources that must be converted into electrical energy, for them to be useful to us, but our focus will be the conversion of household AC (alternating current) electricity into DC (direct current) electricity that your equipment requires. To make an informed decision about the types that are appropriate for your equipment, let's break down the choices into the most popular types, and go from there.

Before you go searching for a PSU, however, the first two most important parameters you'll need to arm yourself with, are the ***voltage requirement*** and the ***current requirement*** of the equipment you're attempting to supply power to. I'm going to omit the *power requirement* because that often leads to confusion between the power specification of the radio and the power capability of the PSU, as I'll explain later.

Most modern ham radios specify 13.8 volts for a supply, plus or minus 15%, which will range from 11.73 volts to 15.87 volts. This means a power source that presents 12 volts will work fine for most rigs, but might leave little margin, depending on your rig's current demand. In fact, you might find that most 12-volt batteries will charge to around 13.5 volts when they're fully charged, so the 12-volt range will be our nominal (meaning *by name only*) voltage starting point.

Power supply types

There are basically three types of desktop power supplies that hams use, to provide electrical energy to their radios. These are *linear power supplies (LPS)*, *switched-mode* (nicknamed *switching*) *power supplies (SMPS)*, and *batteries*. There are definitely others, but these three tend to be the ones hams use most.

Linear power supply

A *linear power supply*, like the one pictured above, is called such because the output voltage is converted proportionally (linearly) from the input to the output. Its input is typically household AC into a step-down transformer, which can make the PSU relatively heavy, especially if the load at the output requires a large, steady current. Once the voltage is stepped down, it's fed

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into a bridge rectifier, which converts the AC into rippled DC.

The DC is then filtered by capacitors and resistors, such that the RC constant is much larger than the time it takes for the signal to drop back to zero, resulting in a large reduction of the ripple. Because of the dependence on the time constant, the larger the capacitors, the longer the time constant, and therefore the smaller the ripple. The resulting voltage is then further filtered through a regulator for a consistent output.

The internal circuitry of a linear PSU tends to be very simple compared with that of a switching PSU. This leaves very few parts that can fail, and as a result, most linear PSUs have a legacy of reliability, and last a lifetime or more. On the other hand, beside the weight, there are other disadvantages to linear PSUs, including typically high cost, bulky size, audible transformer hum, heat dissipation, and relative inefficiency when compared with that of switching PSUs.

Switched-mode power supply

A *switching power supply*, as we often call it, works by rectifying and filtering the input AC house current, then uses (typically MOSFET) transistor switching to turn the voltage into a high-frequency (10 kHz to 1 MHz) pulse. The pulse is stepped down by a transformer, then rectified and filtered once more through a regulator at the PSU output.

As mentioned, the switching PSU has many advantages over a linear PSU, including size, weight, cost, and efficiency. But its greatest drawback is noise. Not audible noise, but RF (radio frequency) noise, generated primarily by the switching circuitry. Once a major concern when supplying power for amateur radio equipment, most modern switching PSUs tend to have very robust noise filtering designed into them, practically eliminating that disadvantage.

Battery

A *battery* is an electrical storage device that's typically portable, and can be used through one lifetime (*Primary Type*) or many (*Secondary Type*), and provides a very steady power source. Secondary batteries must be recharged, by either a power supply or a solar panel. Non-rechargeable batteries cannot be recharged, and so can only be used until its charge is exhausted. While often conveniently portable, the focus of this discussion is on power supplies that convert commercial power to DC power, so we'll address using batteries as a portable power source on another day.

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Power supply applications

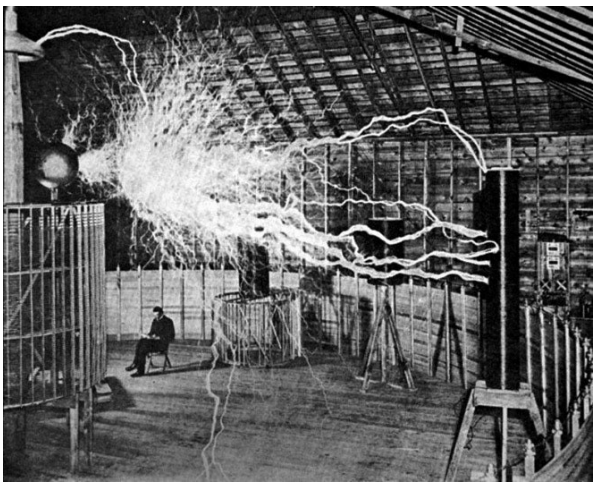
The power supply you select will depend on your application, and the two largest application concerns tend to be whether your equipment should be *home-based* or *portable*. Home-based gear is typically installed somewhat permanently in your home, be that your house, your apartment, or your RV. Portable gear is typically installed in a vehicle or not installed at all, but might be carried in your vehicle from once place to another. Still, many find it useful to install some gear permanently, with the option of quickly disconnecting it for portable operation.

Those who install radio gear in a vehicle often supply it with power from the vehicle battery or other onboard power system. However, many choose to bring an external power supply that they can plug into an outlet at a pavilion, in their travel trailer, or on a generator. Instead of lugging a heavy linear PSU between home and vehicle whenever it's time to hit the road, most who bring along an external PSU find it a lot more convenient to use a switching PSU.

Power supply features

Since we've already established the fact that your radio gear requires 12 nominal volts (13.8 specified volts) from the PSU to operate properly, perhaps the next most important feature in a power supply is its current capability (*amperage*). To determine what capacity of PSU you need, you first need to understand the current requirements of your gear, then add about ten percent for *inrush current*, which is the *peak current draw* (also called *surge*) when you first power up the devices or when you key up your rig at full power.

For example, say you want to power an **Icom IC-7300** (21 amps), an **LDG AT-100proII** tuner (½ amp), a **Daiwa CN-901HP** external SWR meter (½ amp), and a **Yaesu FTM-400DR** (½ amp) mobile radio simultaneously, assuming you won't be transmitting on both rigs at the same time. That adds up to 21 amps + ½ amp + ½ amp + ½ amp = 22.5 amps. Add ten percent (2.5 amps) for inrush, to give you 25 amps peak. This means you're going to need a PSU capable of supplying 22.5 continuous amps and 25 peak amps. The Powerwerx SS-30DV and MFJ-4230MVP switching PSUs both supply 25 continuous amps and 30 peak amps, and so will probably meet your requirements, if this is your setup.



There are occasions in which your current needs might be rather large, like that for an amplifier, or for a larger array of equipment that must be powered all at the same time. In those cases, you might need to select a linear PSU, such as the Astron RS-50M (37 continuous amps and 50 peak amps) or even the Astron RS-70M (57 continuous amps or 70 peak amps), because there are very few switching PSUs available, capable of providing that kind of current, especially for a reasonable price.

In our entire discussion, we haven't discussed the power requirements of your equipment or the power capability of your PSU. On one hand,

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the power requirements of your gear can easily be calculated as (total amps required) x (13.8 volts). From our example, we see that we'll need to supply a maximum of (25 amps) x (13.8 volts) = 345 watts of power.

On the other hand, if you were to purchase a 350-watt power supply, it might not meet your requirements, since those "350 watts" might refer to the *power consumed*, rather than the *power provided*, the difference (actually, the ratio) being what we call *efficiency*. This means that if the power supply type is 75% efficient (typical for many linear PSUs), you'll require a (345 watts) ÷ (0.75) = 460-watt PSU to actually provide your equipment with the power it needs. So, judging a PSU by its *current* capability is typically a more consistent and convenient yard stick than its power rating.

Other PSU features include meters, voltage adjustments, protection circuitry, pretty enclosure, external connectors, bells, and whistles. While short-circuit ("crowbar"), or high-current protection is important, the other features might simply be a matter of choice. Also, the external connector type can be a great source of convenience or frustration, depending on your needs. Many PSUs present two-terminal binding posts, often with banana plug options. Because an increasing number of hams are becoming aware of them (and because they've become an ARES standard), many tend to install *Anderson Powerpole connectors* on their PSUs, if they aren't already equipped with them.

Anderson Powerpoles

Powerpole connector

Other power supply options

There are many ways to supply electricity to your equipment from commercial home power. Besides the ones we've discussed (primarily linear PSUs and switching PSUs), some rely on AC adapters (also known as *wall warts*), which tend to provide low current DC. Some use laptop or game console power supplies, which tend to supply a little more current.

Many have also turned to solar (panels, charge controllers, batteries, etc.) for viable permanent or portable power solutions, but once again, the focus here is on the conversion of commercial AC power into equipment DC power.

Common wall wart

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Quickly gaining popularity is the inexpensive computer PSU, which is a clone of the Megawatt S-360-12 switching power supply. Depending on when you make your purchase, you might end up with one that's either perfect, generates RF noise, or has a noisy fan, a kind of hit-and-miss power adventure.

Many have experimented by building their own power supplies out of "ATX" computer power supplies, which can often provide a lot more current than laptop or AC wall adapters. Most of these ATX types focus much of their output on +5 VDC, and are often lacking on the current output for +12 VDC. Still, it's an educational, practical, and fun exercise, and you'll get a power supply out of it.

Computer "ATX" power supply

Final recommendations

In the end, you'll need to find the power supply that suits your needs and situation best. Assuming your equipment requires a nominal 12 volts, your job is to total the amount of current required by all of it, then add ten percent to calculate the maximum required current. Match that requirement to a PSU that can supply *at least that much current continually*.

Here are a few store-bought power supplies I recommend, to power your ham radio gear, as of the date of this publication. There are other good ones on the market, and many good ones have come and gone, but at this time, these are the biggest bang for your buck, IMO:

Powerwerx SS-30DV ($120) 25 A / 30 A [SMPS]

MFJ MFJ-4230MVP ($120) 25 A / 30 A [SMPS]

Samlex SEC-1235M ($145) 30 A / 35 A [SMPS]

MFJ MFJ-4245MVP ($150) 40 A / 45 A [SMPS]

Alinco DM-330MVT ($170) 30 A / 32 A [SMPS]

Astron RS-50M ($370) 37 A / 50 A [LPS]

Astron RS-70M ($380) 57 A / 70 A [LPS]

MFJ-4275MV 75-amp PSU

To avert any potential questions about them, notably missing from this list are the RandL RLPS30M, TekPower TP30SWI, JetStream JTPS31MA2, and MFJ MFJ-4275MV. I don't believe they are bad products in any way; I simply can't recommend them because I'm unfamiliar with them. Maybe you can investigate these, and others, then let me know what you find about their reliability versus their costs.

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