

## Lab Notes

Conducted By Steve Ford, WB8IMY, Assistant Technical Editor

### Emergency Power

*It's nearly time for the most popular operating event of the year-Field Day! Of course, our Technical Information Service (TIS) staff is prepared for the inevitable questions about Field Day operating. Many of the questions revolve around one topic -- emergency power. This month the entire Lab staff-Ed Hare, WIRFI, Zack Lau, W1VT, Mike Gruber, WIMG, and our Assistant Contest Manager, Warren C. Stankiewicz, NF1J -- have combined their expertise to answer the most common questions about emergency power.*

### **Our club is considering a Field Day operation this year and we want to use portable emergency power. I'm responsible for setting up the station. Where should I begin?**

Start by considering your power source. When it comes to power there are two classes of Field Day operation: *generator and battery*. In the generator class, the rules require that all transceivers be powered from a source independent of commercial ac mains. Although you're permitted to use commercial power for things like station lights and accessories, there are bonus points available for using emergency power for the entire station.

In the battery class, all transceivers must have an output power of five watts or less and the power source must be other than commercial mains or *motor-driven* generators. Battery class can also include non-battery power sources such as hand-powered generators, solar power, wind-, steam-, human-, or water-powered generators. It is highly advised that you visit the current [Field Day rules](#).

### **If enough people are interested, we'll probably want to use a generator. I have a small 600-watt model available. Will that be enough for four transceivers?**

Not if they're typical "100-watt" transceivers. That's only 400 watts, you say? Not exactly. You'll have to calculate the total power requirements for all the equipment you intend to use, including the station lights and accessories. To claim bonus points for 100% emergency-power operation, you'll need enough reserve to run everything used in the station.

To determine how much generator power you need, start by making a list of the power consumption of your station equipment (which will be much more than its RF power output). If you're lucky, some of the equipment may have its power consumption listed in the owner's manual or on the enclosure. If only current consumption is provided, multiply the current in amps by 120 volts to determine the power consumption in watts. *QST* product reviews usually include this information.

If there is no information available on the unit's power consumption, two rules of thumb may help: A transmitter will usually operate at about 50% efficiency, so double the RF output to obtain the amount of power required. The equipment fuse is usually rated at 150- to 200% of the actual current draw, so multiply the fuse value by 0.5 to 0.67 to calculate the approximate current consumption. Use one of these steps for all station equipment, including accessories and lighting.

Now, determine how much of this equipment will be operated simultaneously -- perhaps four transceivers, two 100-watt lights, and several accessory items such as CW keyers, voice keyers, etc. If you are going to use the generator to power a piece of non-station equipment, such as a coffee pot for late-night guests, you'll need to include it as well. Some equipment may require more power than you have calculated, so adding a few hundred watts to your estimate is a good idea.

Let's look at a typical calculation based on using only one HF transceiver:

Transceiver	400 watts
Laptop computer	40 watts
Lamp	60 watts
Soldering iron	100 watts
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TOTAL	600 watts

Some generators have a continuous power rating and an intermittent power rating. If you find that the total station requirement exceeds the available generator power, remember that transceivers draw full power only in transmit, and that they're not going to be in transmit 100% of the time. They could, however, all be in transmit simultaneously, so you need to make sure that the total possible power consumption doesn't exceed the intermittent power rating of the generator.

**I've discovered that two of our club members have generators they're willing to donate. With a combination of generators, we should have enough power for the station. Should I ask the members to bring their generators to the Field Day site a few hours before the start of the contest?**

There is no time of the year when Murphy's Law is more manifest than Field Day weekend! Test those generators weeks before you need them. Make sure the gasoline (or other fuel) is fresh. If they need a tune-up or oil change, do it now. Check the spark plugs carefully. Bring some spare plugs, too. (A spark plug's life can be notoriously short!) The air cleaners should be checked and cleaned according to manufacturer's instructions.

When working with generators, keep safety foremost in your mind. Gasoline is a dangerous chemical and there is no room for carelessness. Fuel should be stored only in the proper containers, well away from the generator and out of the sun. Make sure the generator is turned off and cool before you add new fuel. (The exhaust-system components can be hot enough to quickly vaporize and ignite gasoline.) If you have a gasoline spill, clean it up before you start the generator. Gasoline and oil soaked rags should be disposed of properly. If they are tossed in a heap, they could catch fire by spontaneous combustion. Keep a fire extinguisher near the generator at all times. Don't allow anyone to smoke near the generator while it is being fueled or is in use.

It's a good idea to give the generator a functional check a week or so before Field Day. Start the generator and carefully check it for proper operation. If there are any fuel leaks, turn it off immediately and get the problem fixed. Check the muffler, too. In areas where there is a high forest-fire danger you may need to use a spark-arrestor type muffler. In any event, a noisy generator will detract from your Field Day operation-and may result in "quiet hours" being imposed by local authorities! Watch out for moving parts. Ensure that all protective covers are in place. Check the output voltage and frequency if possible. If the generator doesn't have a built-in over-voltage protector, make sure the voltage is correct before you use the generator to power your equipment.

Finally, check the generator for radio noise. Some generators are not fully suppressed for ignition noise. You would rather find this out now than at the Field Day site! If there is a problem, it may be possible to use resistor-type spark plugs or spark-plug wires. Check the owner's manual. You can also connect the generator to a good earth ground with a ground rod.

**Do you have any suggestions for setting up generators at the Field Day site?**

Sure do! Start by designating someone to be responsible for the proper operation of the generator. Make sure this person will be available at 3 AM when the generator runs out of gas! (A bunch of people standing around the generator and scratching their heads will not improve your score.)

Check all your extension cords for fraying and other damage before you fire up the generator. Always put a generator under some kind of cover (they don't like rain!). Select a location for the generator that's properly ventilated, too. The exhaust fumes can be deadly! Ensure that your extension cords are heavy-duty, all-weather types that can handle heavy current loads.

At the first hint of a thunderstorm, turn the generator off immediately! A lightning strike to your generator can ruin your whole day!

**Do we need to ground the generator? An electrician friend we know says it isn't required by the National Electrical Code.**

Your friend is right—NEC 250.34 says that under certain conditions, a portable or vehicle generator need not be grounded. This OSHA Fact Sheet, [Grounding Requirements for Portable Generators, explains the NEC code.](#)

**It sounds like we'll have an exciting Field Day operation, if everyone shows up. If not, my buddy and I may want to try a low power operation. Can we get extra points for running 5 watts or less?**

Yes, operating in the 5-watt battery class gets you a point multiplier of five! But this only applies to stations that use a power source other than commercial mains or motor-driven generators.

**That's great! If the generators don't show up, we'll just grab my car battery and go at it!**

Keep in mind that an automotive lead-acid battery was designed for one task -- to deliver a lot of current for a brief period of time. Its output voltage does not remain constant during its discharge cycle, and it is not a good idea to discharge it completely. An automobile battery won't tolerate too many deep-discharge cycles before it's ruined!

A deep-discharge lead-acid battery is much better suited to your needs. It can be discharged repeatedly without damage, and will maintain full output voltage over much of its discharge cycle. You'll find this type of battery at automobile- and marine-parts supply outlets. They are not much more expensive than regular automobile batteries and are designed to deliver moderate current for long periods of time.

**Is it possible to operate using batteries with a 100-watt transceiver?**

Yes, but you won't be able to use the 5 x multiplier and you may find that a 100-watt station is a heavy drain on your battery. A car battery would probably last only a few hours--less if it's cold. (Cold batteries lose up to 70% of their capacity.) A deep-cycle battery has a typical capacity of 1000 watt-hours, but you may not be able to use all of this capacity with a transmitter or receiver. As the battery discharges, its output voltage drops. When it drops below 12 volts or so, most amateur equipment will not function properly.

**Well, I can recharge the battery during the contest, right?**

Field Day rules stipulate that battery-class stations cannot recharge their batteries while they are being used to power your station (mobile stations are the exception). When you recharge your battery, you must do it from a source other than commercial mains. You can, as a battery-class station, disconnect your battery and charge it from a gasoline-powered generator. Some hams avoid this practice because they feel it violates the spirit of battery-class operation. These purists choose an alternative source of charging power, such as solar panels or wind-driven generators. If you are operating in a class other than battery class, you can recharge your batteries any way you want.

**Note:** This rule was changed in 1999 to allow a battery to be floated across a charger.

**If I use the alternative charging method, does that count for the natural-power bonus points?**

Yes. Any station can earn bonus points for using power that isn't obtained from commercial mains or petroleum sources. According to the rules, this includes batteries charged by a natural power source. Many people use a solar-charged battery to make the five QSOs they need to qualify. Others use hand-cranked or bicycle generators. Of course, if you're recharging your battery class station from an alternative power source, all of your QSOs are natural power!

**Solar power sounds interesting. Is a solar panel difficult to use?**

No. Solar panels have only two wires to connect to your battery or circuit – one positive, one negative. Some solar panels have a diode in series for polarity protection and to reduce current flow from the battery back through the solar panel. This is no longer the case with many modern panels, particularly the larger ones where efficiency is important. Tests have shown the diode causes more energy loss during the day than the very small wattage dissipated in the solar panel at night.

Solar panels typically deliver 15 to 18 volts at 600 to 1500 mA in full sunlight. This will not damage a high-capacity battery, such as a deep-cycle unit. All you need do is hook up the battery, put the solar panel in full sunlight, and charge away. The battery will regulate the maximum voltage from the panel.

If you're going to use a solar panel to recharge a smaller battery, such as a Nickel-Cadmium (NiCd) battery or gelled-electrolyte lead-acid battery (more on this beastie later), you'll need to pay a bit more attention to detail. These types of batteries can suffer damage if charged too quickly, so a regulated charge is necessary. The ARRL Handbook has several solar-panel charging and regulator circuits.

**What if we decide to operate from a mountaintop? A large lead-acid battery sounds a bit heavy. Are there any other types of batteries that we can use?**

It depends on how long you want to operate. If You're planning only a few hours of low-power operation, you might be able to get away with dry cells, either standard carbon-zinc or alkaline. (Don't forget that a carbon-zinc or alkaline battery should not be recharged!) An alkaline cell can deliver quite a bit of current and will last a surprisingly long period of time. NiCd batteries are usually not suitable for sustained operation above a few watts, but if you are planning to recharge them from solar power, they may

be good for quite a few hours of fun. If you do use NiCd batteries, do not allow them to become fully discharged. This can cause permanent damage.

Medium capacity lead-acid batteries are made with a gelled electrolyte. These are commonly called gel cells. In most cases, they are completely sealed and can be operated in any position. They are available in a variety of sizes, ranging from 1 Ah to about 50 Ah. The smaller ones are much easier to tote up a mountain than a deep-cycle battery! Gel cells are a good compromise between portability, capacity and ease of use. They must be charged properly, though. If you charge them too fast, bubbles can develop in the electrolyte, permanently damaging the battery. They should be charged at no more than about 10% of their output rating in ampere-hours.

**Someone told me that there is a device that will convert 12 volts from a battery to 120 volts ac. Why can't I use one of these?**

You can! The device is known as a dc-ac converter, or inverter. It converts 12 volts to a square-wave ac output at approximately 60 Hz. Inverters are limited to about 100 to 400 watts, however, and some equipment (especially motors!) cannot be powered by a square wave. An inverter will run a few light bulbs or a small soldering iron and can be a useful addition to a battery-class station. Some newer ones use switching technology and are quite lightweight! (Test them ahead of time, though. They may generate RF noise or run pretty darn hot at full output.)

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