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Safe Mobile Mounting, Diode Voltage Drops, and Battery Power Demand

Mobile Mounting and Modern Auto Safety Devices

Statistics from the National Highway Traffic Safety Administration prove that driver distraction is the leading cause of vehicle crashes. This fact prompted ARRL® to adopt a *Mobile Amateur Radio Operation* policy statement, which can be viewed by entering "Mobile ARS Policy" in the "Website Search" box at the top of the ARRL home page and clicking on the "Policy Statement" link. As mobile operators, we must do our part, by installing our radio gear in a safe manner, while also minimizing distraction to the driver.

By any measure, it is becoming more difficult to install Amateur Radio gear in and on modern vehicles. There are a myriad of reasons for this, not the least of which are the safety devices installed in new vehicles.

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Airbags are the major mitigating factor; they deploy at speeds as fast as 200 mph. As many as a dozen are installed in an average vehicle, all designed to protect the passengers from front, rear, and side impacts. Collapsible steering columns, inflatable and/or power retracting seat belts, and automatic adjusting headrests add to the mix of safety devices.

Other innovations like Engine Idle Shutoff (EIS) require the inclusion of a battery monitoring system. This fact complicates power wiring, as discussed in my previous article.[1] Shock-absorbing bumpers and aerodynamic body designs add complications to antenna mounting. Predictably, prospective mobile operators look for workarounds, but all too often end up decreasing the effectiveness of these modern vehicle innovations, especially airbags!

No doubt the greatest infraction is mounting control heads atop the dashboard. This is especially true when magnets, spring clamps, suction cups, and bungee cords are used for attaching them. Mounting control heads and whole transceivers in overhead storage bins where dangling cables interfere with the driver's vision is a close second.

Whatever means are used, gear should be placed to minimize distraction — the greatest single cause of vehicle crashes. Interference to vehicle controls should also be avoided. This includes dangling microphone and power cords.

The difficulty in mounting extends to the outside of the vehicle as well. Nowadays, there is a great reluctance to drill holes in a car's body to properly mount antennas. As a result, magnetic and trailer hitch mounts are often employed as a workaround. Modern vehicles are designed to absorb the energy of a crash by collapsing in a controlled manner. Arguably, these workarounds can produce a reduction in this collision protection.

All of these issues point out the need to plan every installation as if your life (and the lives of your family members) depends upon it — because it does! This author cannot describe the necessary steps for every vehicle make and model. However, there are some salient points that can be made regarding any mobile installation:

1. Plan your installation. Write down everything you think you'll need, and have it on hand before starting. This includes wire terminals and fuses, coax and connectors, ground strapping, cable ties, and proper tools.

2. Don't hurry! An average transceiver/antenna installation may take well over a day to complete.

3. Admittedly, finding a safe, convenient, and distraction-free interior mounting location isn't easy. The best place is low in the center console, well away from exploding airbags.[2] Footwells, cubby holes, and storage bins should not be used, as they may not provide sufficient ventilation. Do not use any mounting style that doesn't use bolts and/or screws to hold gear solidly in place.

4. Microphone cords and interconnect cables must not interfere with vehicle controls and should be securely restrained.

5. Proper wiring is essential. Never use existing vehicle wiring — especially accessory sockets — to power radio gear. This includes using sockets to charge secondary batteries. After all, there is always a way to route wiring through the firewall when necessary.

6. For both safety and efficiency, antennas should be permanently through-hole mounted. Improper mounting, particularly on HF, can result in common mode current flow, which causes both receive and transmit RFI issues. If you're reluctant to punch holes, seek professional help. Two-way radio or car stereo shops are good resources.

Obviously, these are only a few of the important installation parameters. But if it isn't apparent, the single attribute that should be kept in mind at all costs is the value of your life, and the lives of your passengers. In other words, we all need to exercise due prudence when undertaking any mobile installation. In short, be an operator, not a statistic. — *73, Alan Applegate, KØBG, 3202 Notting Hill, Roswell, NM 88201-0403*, **k0bg@arrl.net**

Diode Voltage Drops Raise Battery Power Drain

The May/June issue of *Elektor* magazine (**www.elektormagazine.com**) reminds us that it is important to consider the forward voltage drop (V_f) of rectifier diodes used

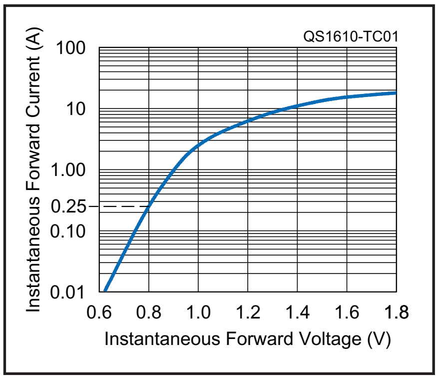

Figure 1 — This typical I-V characteristic curve for a 1N4001 diode shows that at 250 mA, the V_f will be about 0.8V. While 0.8 V is low, it still represents a significant loss of battery energy as heat.

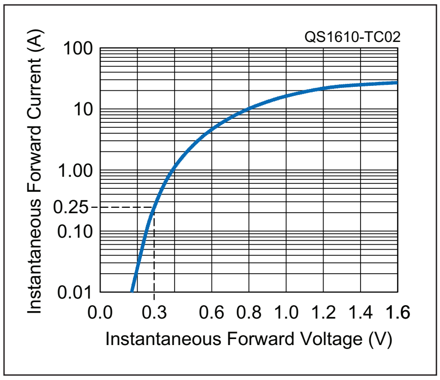

Figure 2 — This typical I-V characteristic curve for a 1N5819 diode shows that at 250 mA, the V_f will be about 0.3 V, much lower than the 1N4001 diode, but still dissipating battery energy as heat.

for reverse-polarity protection in series with the power source. This is a common technique for battery-powered equipment that is regularly disconnected and reconnected to power sources. Because power dissipation is $P = V_f \times I_{avg}$, that simple diode can eat up a lot of a battery's stored energy. For example, a typical Instantaneous Forward Voltage Characteristics curve for a 1N4001 diode (see Figure 1) shows that at 250 mA of average current, the garden variety 1N4001 (50 V, 1 A rating) dissipates 0.8 V × 0.25 A = 0.2 W. Although manufacturers' data for Schottky diodes, such as the 1N5819 (40 V, 1 A rating), show them to have a lower forward voltage drop (0.3 V_f) than silicon junction diodes (see Figure 2), they still dissipate a significant amount of power (0.075 W). Also, while it may be counterintuitive, smaller diodes of any type often have a higher V_f for the same current as larger ones.

Regardless of whether you use silicon junction or Schottky diodes, the voltage drop can be reduced by wiring several diodes in parallel to keep all of them operating at a point where V_f does not increase as steeply with current. For example, if you use four 1N4001 diodes in parallel, this will reduce the average current in our example to 62.5 mA per diode, which, in turn, reduces V_f from 0.8 V to about 0.7 V, a power savings of 10% at a cost of pennies per diode. This assumes an equal division of current between the diodes, so it is best to use diodes all purchased from the same manufacturing batch — so buy a large number all at once from one vendor. You also need to have a reasonably good idea of the maximum current to be drawn so you can pick the right number of diodes.

At currents above an ampere or two, consider using a MOSFET with its much lower ON resistance as described in *The ARRL Handbook*'s "Reverse-Polarity Protection Circuits" section of the "Power Sources" chapter. The chapter also includes information on other polarity protection techniques that may work better for your application. — *73, H. Ward Silver, NØAX*, **n0ax@arrl.org**

Measure Battery Power Demand

Battery endurance during portable or emergency operations can be difficult to predict. Instead of attempting to predict how much power you will require, measure it directly. This is easy to do with a dc inline power meter. Simply connect it between your battery and transceiver and it will immediately begin directly displaying total Ah consumed. Spend an hour operating in a manner similar to when you are portable, and you will have an accurate baseline measurement of the power consumption that you can easily extrapolate from.

The meter I use is available from Powerwerx (**powerwerx.com**) for around $50, or you can save some money by buying the similar Turnigy 180A from Hobby King (**www.hobbyking.com**). (I chose the latter, but had to install the Powerpole connectors myself.) The meter is simple to use — you just plug it in and it continuously monitors your battery. Keep in mind that these meters are not self-powered and they have no memory, so do not remove the meter from the power source until your measurements are complete. (You can turn the radio on and off, just don't disconnect the meter from the battery.) The meter itself consumes a trace amount of current, on the order of microamperes.

The meter constantly displays instantaneous voltage, current, and power. The lower left part of the Turnigy 180A display alternates between peak voltage, peak current, peak power, and the reading we are interested in, a running total of ampere-hours.

Most of my operating is portable, and I always bring the meter with me — it's compact and light. I typically use an Elecraft KX3 and a 4.2 Ah LiFePO4 battery. Using the meter, I have discovered that this battery is more than adequate for a typical weekend backpacking trip, as I typically find that I have 1.5 – 2 Ah "left in the tank." The meter is also extremely useful when I set up a solar-powered station for Field Day. It tells me how much power my panel is delivering under different sky conditions, and how much current is being delivered to my battery. I never leave home without it. — *73, Mark Volstad, AI4BJ, 6098 Tosha Dr, Burlington, KY 41005-9303*, **mvolstad@twc.com**

Notes

[1]A. Applegate, KØBG, "The Modern Mobile," *QST*, May 2015, pp 35 – 36.

[2]A few vehicles made in 2016 have a center airbag (extending between the front seats) as added protection in the event of a side impact crash. If control heads are properly mounted low in the center console area, they should be out of this airbag's coverage area, but check your vehicle's manual to be sure.