Be Aware of Battery Holder Voltage Drops

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As most of us are aware, NiMH batteries continue to drop in price, while mah capacity continues to increase. Recently I found 2300mah NiMH batteries on sale for 12/$16. This seemed just the ticket for me to be able to build up a 10-cell 12V NiMH battery for battery-portable operation of my IC-703. The IC-703 needs at least 11 volts for the full 10-watts output, and 9-volts minimum for 5-watts output. Further, the life of a 10-cell pack should be very good in my application, since the battery could be discharged to 0.9 volts/cell, the recommended NiMH discharge voltage limit, before the IC-703 gives its "low battery" warning. So I purchased the batteries and a 10-cell AA battery holder (Mouser 12BH309 @ $2.00 each). Photo 1 shows an empty battery holder, as well as a battery holder with the 10 AA cells installed.

After charging my new battery pack, I was surprised to find that the IC-703 would jump between 10-watts and 5-watts output, indicating that the voltage was fluctuating around the 11-11.5V level. I measured the voltage at the battery output using some power resistors as a load and found that the voltage sagged 1.4 volts at 1.6 amps of current (1.6 amps needed for 5-watts output). At 2.1 amps of current (needed for 10-watts output), the voltage sagged 1.8 volts. With a fully charged pack, I measured 1.3 volts across each cell (13 volts total), which quickly moved to 1.25 volts/cell (12.5 volts total) under full load. With a 1.8 volt drop at 2.1 amps, this would put you at 10.8 volts, which is below the voltage that will permit operation at 10-watts output. However, this is even a problem when running the IC-703 at the 5-watt output level, since you can only discharge the batteries to 1.04 volts/cell instead of 0.9 volts/cell. This will impact your operating time. This would be more of a problem for a 9.6V 8-cell home-made pack, probably making it unusable in this application.

I made some additional measurements to try to get a feel as to where the voltage drops were occurring. I measured adjacent battery terminals in the battery pack, which would just include the spring contacts and the steel wire interconnect between the batteries. See photo 2 for a close-up of the spring/wire interconnect. I averaged 100 millivolts drop across each of the spring/wire interconnects at 1.6 amps, which accounts for 1-volt drop through the ten sets of these interconnects. At 2.1 amps, I measured 130-150 millivolts of drop across each of these connections. This all implies that the spring/wire connections are about 0.06-0.07 ohms each.

Finally, I measured an AA 8-cell Radio Shack NiMH battery pack which uses welded contacts, as well as a 12V 3500mah NiMH laptop battery also using welded battery contacts. With both of these batteries, I measured only about a 0.3 volt drop from the nominal voltage under the full 2.1 amp current.

The bottom line: Standard inexpensive battery holders can have significant voltage drop at the current levels we can use in a QRP transceiver. You are probably much better off sticking with the commercially available welded-tab battery packs.

10-cell AA battery cases


Close-up of spring/wire interconnects