

## **Backup Battery Considerations with Motorola Oncore GPS Receivers**

Frequently, backup batteries are used with Oncore GPS receivers. Use of a backup battery is not mandatory, but can be useful for saving setup information and increasing the speed of satellite acquisition and fix determination when the receiver is powered up after a period of inactivity. Oncore receivers may either be ordered with rechargeable lithium cells onboard, or use external cells. A trap many users fall into is that they do not plan ahead for the inevitable day when the system is energized and the battery is discharged.

### **What Does the Backup Battery Do?**

In a nutshell, the battery keeps the RAM and the Real-Time Clock (RTC) in the receiver alive, saving a plethora of useful setup and status information. Time, Date, Last Calculated Position, Almanac, and Ephemeris information, along with receiver specific parameters and Output Message configuration are all saved, making resumption of operation once main power is restored pretty much automatic. In this "Warm Start" scenario the power comes back on, the receiver looks to the RTC to see how much time has elapsed since power was removed, calculates which satellites should now be visible using the stored almanac information, and then proceeds to develop fix information, outputting data in the same formats that were active when power was removed.

### **What Happens if the Battery Runs Down?**

As you might expect, with no backup power none of the good info mentioned above is available to the receiver upon restart. The receiver must now perform a "Cold Start", which basically means that the receiver doesn't know where it is, what time it is, or even which satellites are above the horizon and therefore usable. Note that this is not a serious problem, but Time To First Fix (TTFF) will be somewhat longer than if the information had been available.

The **BIG** thing that many users fail to consider is that a receiver that is coming up cold comes up defaulted in Motorola Binary protocol, with **NO MESSAGES ACTIVE**. Sure, the receiver is happily running through its normal housekeeping routines, developing new fix data, etc., but it will not send any of this data out of the serial port until you ask for it. Now, instead of a GPS receiver, you have a \$100 paperweight.....

### **What to Do?**

The answer to this question really depends on your end use. If your receiver is being used as part of a larger system where you have access to the receiver's serial port through application software (SynTAC, WinOncore12, TAC32, etc.), you can simply use the software to reinitialize the receiver into the desired mode, and go happily on your way.

Embedded developers have to be much more careful since they typically do not have direct access to the receiver's serial port. In this case the best thing to do is to ASSUME that the receiver will always wake up in a defaulted condition and include code in your software to initialize the receiver every time power is cycled. This code may be as simple as merely directing the receiver to output a standard Motorola binary Position/Status/Data message (@@Ea or @@Ha for instance), or may possibly involve uploading a stored almanac, switching the receiver over to NMEA mode and initializing the desired NMEA strings. No matter, the effect is still the same: if the receiver wakes up with all setup information intact, there's no harm done, the initialization commands merely reinforce the configuration data already present in RAM. If

the receiver wakes up defaulted, the initialization code ensures that the receiver operates in the manner intended.

### **What are Common Battery Options?**

As mentioned previously, you can either specify a receiver fitted with a rechargeable Lithium cell onboard, or you can supply your own backup power externally.

The lithium cells provided on the VP, GT+, and UT+ series of receivers are rated at 25 mAh, normally enough capacity for about six months of backup (less in high temperatures.) The SL and M12/M12+ receivers are fitted with much smaller 2 mAh cells, sufficient for 2 weeks to a month, again depending on temperature. Note that these cells ARE rechargeable types, and in order to charge them the receiver MUST be powered up. A factory fresh receiver should be allowed to run for 24-36 hours to provide the battery with an initial full charge.

If you supply your own backup power, and have sufficient room, you can provide backup power for a much longer period of time. As a general rule of thumb, the VP, GT+, and UT+ receivers require about 15uA of backup current, while the SL and M12/M12+ require about 5uA.

### **CAVEAT**

*Receivers fitted with onboard batteries CANNOT utilize external backup power. In order to prevent the user from accidentally overcharging the onboard cell, these receivers are populated differently and the external backup pin on the 10 pin header (Pin 1 on VP, UT, GT, and SL – Pin 6 on M12/M12+) is open circuited on the receiver board.*

### **Are There Times When I Shouldn't Use a Receiver with an Onboard Battery?**

Although there are many reasons for not using a receiver fitted with a battery, the three instances that most often come up are:

1. Remote systems that are expected to run unattended for long periods of time. The most common example of this type of situation is in the timing receivers used to keep CDMA cell sites synchronized. These systems are expected to operate for 10-20 years in remote areas, and the last thing the service people want to have to deal with is chasing down 10-year-old batteries that may start to leak, damaging the receiver, or otherwise causing problems.
2. Operation in continuous high temperatures. Although all Oncore receivers are rated for operation at 85°C, the lithium cells have a service ceiling of 60°C.
3. Operation at low duty cycles. A common example of this type of application is oceanographic buoys. These might typically turn on the GPS receiver once a day for a few minutes, get a fix, and then power the receiver back down. The end result is that the battery is never allowed to charge up between power cycles and slowly discharges over time. A better choice in this situation might be an external battery with sufficient capacity, or use of a "SuperCap" or "UltraCapacitor" as a backup power source. Since these can be charged up in a matter of seconds while the receiver is getting it's daily fix, loss of capacity over time is not an issue.

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