Equipment**Review**

By Shawn Billings, LS

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Spectra Precision EPOCH 25 GPS System

The EPOCH 25 GPS System, manufactured by Spectra Precision, is a unique system that markets to a unique customer base. Priced in the neighborhood of $25k for a complete system, the term *return on investment* doesn't sound so daunting–especially for those who are only now considering entering the GPS market. Of course, anytime you think "competitive pricing" the next thought begs the question "What am I giving up?" Surprisingly, very little.

Spectra Precision took a new approach in designing the physical configuration of the EPOCH 25 rover. While some systems can interchange base and rover, the EPOCH 25 receivers are dedicated to their purpose. The base is designed to be a base and the rover a rover.

With most manufacturers opting for a completely integrated system, Spectra Precision designed the rover to be mostly integrated. Within the rover, the very compact blue box below the antenna houses an internal lithium-polymer battery, a UHF radio receiver and the GPS receiver itself. On the bottom side of the box is an antenna connector for the UHF radio, an antenna connector for the GPS antenna, as well as two 9-pin serial ports. The antenna mounted above the receiver box is the legendary Zephyr antenna.

The receiver is a 24-channel, GPS only (no GLONASS, Galileo, etc.), with dual frequency reception (L1 code, and L1/L2 carrier), and can output a position at a rate of up to 5 hertz. Supported correction formats include RTCM, versions 2.x and 3.x, as well as Trimble's CMR+.

The base station is generally the same in outside appearance as the rover, except for the lack of the UHF radio antenna

Here the Epoch 25 base station is connected to the Pacific Crest 35-watt base radio. With this combination I was able to maintain a fixed solution at the rover nearly five miles away.

connector. Internally, there is no battery or radio. Corrections are transmitted from an external UHF radio. In our testing, we used the Pacific Crest 35-watt base station. An external 12v battery was also necessary to power the base and the radio. This was accomplished using a "Y" cable that connected to the battery, the radio and the receiver.

In the shipping packages there were actually two very similar "Y" cables. One, packed with the receiver kit, was labeled with a "CAUTION Do not connect this cable to a computer serial port" sticker, and the other, packed with the radio kit, was unlabeled. I later discovered that the marked cable allowed power to go from the battery to the 9-pin port (which could be potentially unpleasant if plugged into a PC) but is necessary for powering the EPOCH 25 base. At first I attempted to use the unmarked cable to hook the base, radio and battery together, but discovered that the cable did not provide power to the 9-pin. This resulted in the base station not powering up. Once I discovered my error, I used the "not for PC" cable and the base worked flawlessly.

When I began opening the packaging for the base radio system, there were a lot of wires, antennas, cables, bags, extensions, and brackets. As I sorted through it all, I wondered just how all of these pieces could possibly fit together. After playing with it for a while though, I realized that there were a number of *extra* parts meant to allow the user greater flexibility depending on his or her needs. For instance, you may only be working a short distance from the base, in which the included compact rubber duck antenna should provide sufficient gain, or you may be stretching out a few miles and need something a little more substantial. All the parts you need are right there and available.

Also included in the package were two Bluetooth adapters (also know as dongles). These little guys plugged right into the serial ports on the bottom of the receivers. Although technically there is a small pigtail coax cable that goes from the receiver to the Zephyr antenna, the system is virtually cable free at the rover using the Bluetooth adapter. I did experience some intermittent trouble connecting the TDS Nomad to the base via Bluetooth. In those cases I used a serial cable and was able to take care of the base configuration. The rover never gave me any trouble with the Bluetooth, and I really enjoyed the cable free use at the pole.

In this photo, the blue LED on the bottom of the Epoch 25 base indicates that the unit is on. Also visible are the two 9-pin serial plugs and the GPS antenna connection.

As previously mentioned, one of the two 9-pin ports on the bottom of the base are used to power the base. Similarly, the rover internal battery is charged through one of its 9-pin ports. The provided charger looks like a standard serial cable on one end and has an AC plug on the other. While I might have a couple of critiques of the system (such as cable labels) I had only one real complaint–power management.

With the unit I reviewed, when plugged in, there was no outward indication that the unit was charging. This is a pet peeve of mine. I like the security of seeing a flashing LED telling me that everything is plugged in and I should have power for my work day tomorrow. But beyond that, I could charge the rover overnight and the next day the rover would indicate it was fully charged, however, within 20 or 30 minutes, it would indicate that it was at half capacity. I was able to work for about three and a half hours. I don't know if the problem was in the battery itself or in the power management system within the receiver that determines when the battery is fully charged, but it was annoying. Because the battery is internal, there is no way to charge multiple batteries and have a spare available for a long day or to replace a worn out cell without a trip to the shop *(Note: I checked with TDS after my review, and discovered that this was an issue with early units and has now been fixed. There is a new battery pack that provides consistent power. The new charger has LEDs that show the battery is charging and when it is fully charged. Battery life and stability has been very good since this change.)*

Located on the bottom of both the base and rover receiver is the power button and LED display. Three LEDs inform the user

The rover is set up on an iron rod approximately two miles from the EPOCH 25 base station and is being controlled wirelessly via Bluetooth by the TDS Nomad using Survey Pro. The setup is compact, neatly arranged on the pole and well balanced.

about the status of the receiver. A blue LED indicates that the receiver is turned on. A slow steady flashing amber LED indicates that the receiver is tracking more than four satellites and is therefore ready for positioning. And a green LED displays that RTK correction data is being received.

The base and rover are both equipped with 2 megabytes of internal memory for raw data storage. Logging data at the base to later process to the CORS network on your own or through the OPUS utility is pretty easy to do. Or if you find yourself beyond radio range, you could log a file for post processing at the rover. TDS designed a unique and impressive way to upload these files to your computer. Using a TDS data collector, the user uploads the raw files from the receiver to the data collector. This can be done by wire or Bluetooth. Then, using Microsoft's ActiveSync software, you can download the file to your computer. The file is a proprietary Trimble *.T01 file. Use of the Trimble Convert to RINEX utility, which is freely available online, allows the user to convert the file to an OPUS palatable RINEX file. I went through this procedure and was very pleased with the smooth process and results.

With the base set up and the rover receiving corrections, I began testing the system's RTK capability, beginning with points near the office and then moving further and further away. The 35-watt base radio allowed me to cover a huge area. With the relatively low profile antenna shown, I was able to get fixed observations on points nearly five miles away. The radio reception was somewhat sporadic at that range though, so I probably wouldn't want to do a topographic survey with those kinds of vectors. Having said that, performing a multi-point or even a single-point localization at those distances would be very handy.

I was impressed by the accuracies I was seeing as well. I tied into several city GPS control monuments that were originally positioned by static GPS observations and have been verified by additional static observations. I began with Station 122 only 6300 feet from our office control point where the base was located. I missed the published coordinates by only 0.02' horizontally and 0.09' vertically. Emboldened, I went to Station 15, some 24,685 feet away from our office control point. I only missed this one by 0.03' horizontally and by 0.01' vertically. Last, I tied into Station 8, located 17,652 feet from the office control point. Horizontally, the EPOCH reported coordinates 0.04' from the published horizontal values and vertically by 0.14'. One thing I noticed in Survey Pro during this was that the radio signal strength reported was either 100% or 0%, not depicting any variability in between.

Next, I went to the southern extents of our town to a small vacant tract we were hired to survey. It was located just a shade over 2 miles west/southwest from the office. I tied-in each boundary point with the EPOCH and then later tied-in each one conventionally from a static-observed pair of control points. One point, located under a lazy elm tree, only differed 0.07' horizontally and 0.13' vertically between the two independent observations. Of the eleven points compared, only three exceeded 0.05'

Beneath the dense canopy of this water oak tree, the EPOCH 25 was able to deliver repeatable fixed observations.

A close-up of the rover shows the "rubber ducky" UHF receiver antenna, the GPS antenna connection, an unused 9-pin serial port, the blue "on" LED light, and the Bluetooth adapter for wireless communication.

horizontal and/or 0.10' vertical (including the point under the elm).

Back at the office I wanted to test the system under canopy. Although I didn't push this system excessively into harsh multipath environments, I did feel that I pressed it as hard as I would expect RTK GPS to perform, and was not disappointed. Observing a point under a dense water oak tree, I poked a hole in the dirt with the tip of the pole. I moved away from the canopy, forced a reinitialization, and returned to the point once I regained a fix (just a few seconds). I placed the pole point in the hole and performed a stake out to the stored coordinates from my first occupation. Incredibly, the stake out directions remained in the few hundredths of a foot range horizontally and within 0.15' vertically.

Throughout all of my testing, the system did a good job of maintaining a fixed solution. When the system lost lock (generally due to being on the edge of radio range) or when I forced a reinitialization, it regained a fixed solution very quickly, typically within just a few seconds.

Physically, the system was well balanced on the pole. I always guessed the receiver to be much bulkier and heavier from the ad photos I've seen. However, it was surprisingly compact and relatively light. The TDS Nomad I used for the review complimented the system very well.

Although I did not test this capability for this review, the system is also capable of being used within an RTK network, used as either a single base or with a VRS. In this configuration, the user connects the data collector to a cellular modem via cable or Bluetooth, and also connects to the rover. The data collector receives the corrections from the cellular modem and then sends these corrections to the rover. The rover then returns the computed positions. In the case of the TDS Nomad, the cellular modem can be installed right inside of the data collector, sealed against the elements, and maintaining the neat pole arrangement.

In the June 2008 issue of the magazine, the "Wow Factor" column detailed a new Sprint cellular modem that can be plugged into the USB host port inside the cap of a Nomad 800LD. So not only could you send and receive files from the office, as well as having access to handy online data, but you could also work with an EPOCH rover in an RTK network. In town, where cell coverage and Network RTK may be available, you don't even need a base station.

Some of you in the "hinterlands" may laugh at the idea of being in an RTN. However, here in East Texas we were just recently incorporated into a network–something I didn't think would happen for another five or ten years. The times are changing rapidly. Increasing needs for improved infrastructure, as well as demands for new sources of energy and the delivery infrastructure needed for that energy, are likely to push this trend much faster than any of us expect, which will be a direct benefit to surveyors in all segments of the profession.

While you might find that there are systems on the market with more features, this system is everything it was meant to be. Suitable for static observations, RTK, and RTN, including VRS, it fits the bill for most survey work. With the base station plugged into the Pacific Crest 35-watt base, you can work for miles. With this dual-frequency receiver you can expect very fast reinitialization times as well as access to the NGS OPUS Static and Rapid Static utilities (to which dual frequency data is a prerequisite). Considering all of its capabilities and the price point, the Spectra Precision EPOCH 25 bears consideration for anyone interested in an entry-level RTK system.