SHAWN BILLINGS / PS

product review

Satlab SL600 & SL-55

It's fair to say that RTK is not suitable for *every* surveyor. The particular type of work a surveyor may perform, the cost of the equipment in dollars and in training time, and even the proximity of a surveyor to retirement may give rise to questions of the cost/benefit ratio of the investment. But I'm convinced that these concerns are diminishing—substantially and rapidly.

RTK processors are becoming impressively robust, which has a direct impact on the number of applications for the technology. Lately I've spoken with more and more surveyors, whom, having attained an age in which most would be thinking about fishing and condos, are investing their treasure and time in RTK. My hat is off to you, gentlemen. It's not just a young surveyor's domain and the benefits of RTK are appealing to an ever widening circle of surveyors. As with most things technological, the features are improving, the cost is dropping and the field of choices is steadily rising, all of which are good for you, the consumer. Enter Satlab Geosolutions of Sweden.

Satlab is a relatively new company that has developed several GNSS receivers and data collection hardware for the Geospatial community. I was pleased to have the opportunity to evaluate their flagship GNSS system – the SL600, along with their SL-55 data collector. The SL600 is a *6G* receiver, capable of tracking the US GPS constellation, the Russian GLONASS constellation, the Chinese Beidou constellation, the European Galileo constellation, the Japanese QZSS constellation (technically a SBAS system), and SBAS, a generic abbreviation for several Space-Based Augmentation Systems, such as the FAA's WAAS system and the European EGNOS system. Currently, for US surveyors, the most significant constellations are GPS and GLONASS, but watch for this to change as the Chinese continue to add satellites to its Beidou constellation. The number of systems being tracked helps ease concerns about obsolescence to potential buyers and makes the system more robust in challenging environments.

The Satlab SL600 configuration incorporates several eye-catching features. The receiver board is the same as found in the latest Trimble receivers on the market: the BD970, utilizing the 220-channel Maxwell 6 ASIC. This is a very good, proven receiver board. As tested, the integrated radio modem is a PacCrest XDL, with a maximum output of 2 Watts. On-board power is supplied by two hot-swappable 10,000 mAh batteries. A reasonable 1Gb of internal memory is good for many days of recording raw GNSS data for post processing. Also included is an easily accessible microSD card slot, which is shielded from the elements within one of the two battery compartments. A 3.5G GSM modem (SIM) is also available for receiving corrections via cellular internet. My testing was strictly with UHF, but Internet accessibility (in areas with good cell coverage) gives RTK greatly expanded potential, whether from a network RTN or single baseline RTN.

The SL-55 Data Collector with Carlson Software SurvCE or MicroSurvey Field Genius controls the SL600 system.

The SL600 receivers can be configured as a base (reference station) or rover. Here the SL600 is setup as a reference station.

The plastic Xenoy housing has a durable feel. In physical construction, I could find no flaws. The battery latch was secure, easily opened and reliable. The recessed external UHF antenna connection was somewhat protected at the bottom of the housing. While users will still need to take care not to

The SL600 system comes packaged in well-constructed hard-shell cases suitable for carrying everything needed for RTK surveying except for the rover pole and tripod.

snag the antenna when navigating through the brambles, the design provides better than average UHF antenna protection. Users have direct visual and tactile interface with the receiver via three LED illuminated buttons on the faceplate. A voice prompt lets the user know what mode of operation the receiver is currently in upon boot-up as well as when changes are made via the buttons or external data collector. The receiver is also equipped with two LEMO ports (5 pin and 8 pin) and an external power port.

Regarding power, the SL600 really impresses. I prefer receivers that can provide two days of operation without charging. This reduces charging cycles and provides a measure of grace should I commit the unpardonable and forget to charge the receiver every day. Many (not all) receivers currently on the market will provide 12 hours of battery life on internal batteries when operated as a rover. However, when operated as a base, which requires much more power for broadcasting corrections, my experience has been that most will usually expire in six to eight hours of operation. You can imagine my surprise when I observed that the SL600 running as a base, broadcasting at its maximum 2 Watts of power, operated on its internal batteries for an incredible 16 hours. According to data sheets, the rover is expected to run for 24 hours, which after seeing the endurance of the base, I'm confident this estimate is realistic. This would equate to two hard days in the field without changing any batteries or recharging!

I am no expert in radio communications, but I've learned a few things from experience over the years. Range is particularly dependent on your environment. Radio interference and terrain will affect range as well as obstructions such as buildings and trees. The other thing I've observed is that output power is not directly proportional to range. A 2 Watt radio will not double the range of a 1 Watt radio. In my experience, the ratio seems to be based on inverse squares, so that whatever range you would expect from a 1 Watt radio, you might expect about 1.4x from a 2 Watt, or 2x from a 4 Watt, or 6 times from a 35 Watt. This seemed to be confirmed with the XDL. I observed about a 1.4x increase in range over a 1 Watt radio. In places where I generally have seen about a mile with a 1 Watt, I was getting about 1.4 miles. There were some places (with terrain obstructing the radio transmission) that I could not get a mile. Such is the problem with specifying a range, but I am confident that the 2 Watt output power is a significant (if not proportionate) benefit over 1 Watt. Considering that the SL-600 delivers the battery endurance I observed while broadcasting a signal with 40% more range over 1 Watt base stations, this is an noteworthy feat. The 2 Watt radio should be a real help to those needing the extra range to break down a section.

GNSS performance was impressive. The specifications list the receiver having a precision of 8mm+1ppm (presumably at 1sigma) horizontal and 15mm+1ppm vertical. My brief testing found these values to be entirely realistic. Within the extreme practical range of the internal XDL radios (let's call it 2 miles), the 1ppm translates to only 0.01 foot, plus the additional 0.026 foot (8mm) gives a 68% likelihood that a point collected under favorable conditions will be within 0.036 foot horizontally from the base. Two points located 2 miles from the base would deliver a 1 sigma positional tolerance (horizontally) of 0.05 foot, or reckoned at 2 sigma, this would be 0.08 foot. It's an amazing time to be a surveyor when one can determine the direction and distance between two points that are four miles apart to an accuracy of less than a tenth in the matter of a few minutes!

As impressive as this accuracy is in good conditions, most surveyors often find themselves working in unfavorable conditions, near obstructions, under canopy, near sources of multipath. It is in these conditions that **a surveyor must exercise caution and employ redundancy to prove his results are good**. I was impressed however to see the SL-600 was so resistant to providing a bad fix in difficult areas. The receiver provided good fixed positions under light deciduous canopy reliably. Under more difficult pine canopy (which is well known to be the most challenging canopy for GNSS), the receiver simply provided no fix at all rather than provide a bad fix. My time testing for bad fixes was limited, but within this limited time, I could not force the

The SL600 receivers have a durable feel. The LED panel gives the user the receiver's status at a glance and provides three buttons for controlling commonly accessed features.

The placement of the UHF antenna in a recess on the bottom of the receiver provides some protection from incidental contact which commonly occurs during field use.

Two dual bay chargers are provided with the system allowing for four batteries to be charged at a time. Once charged, the system is ready for up to 16 hours of operation when operated as a base or 24 hours as a rover.

receiver to give a bad fix. I would not rely on the receiver always giving only good fixes nor encourage users to blindly accept any RTK fix in canopy, but I would expect that a fix from this receiver is very reliable.

Part of my testing included recording raw data for submission to OPUS. The 3 hour file was easily downloaded from the receiver to my PC using a supplied LEMO to USB cable. The results from OPUS were in excellent agreement with my known position: dN 0.025'; dE 0.030'; dU 0.023'. With such easily gathered, downloaded and processed data, there is no reason RTK surveyors should be leaving their surveys related to autonomous positions. Imagine all of your work being on the same coordinate reference system and being related to every other survey you do, and knowing these relationships to this kind of accuracy. This represents a real investment in your future. Stop leaving your work related to autonomous base positions!

For controlling the SL-600, I used an SL-55 data collector with the ever-popular Carlson SurvCE software. The SL-55 is a Windows Mobile handheld with an 806MHz processor, 256MB of RAM and an 8GB internal Flash drive, with a micro-SD card slot. It's equipped with WiFi as well as Bluetooth communications, which the latter allowed me wireless accessibility to the SL-600 base and rover. The battery life is a little less stunning as compared to the SL-600 at only 8 hours, but the battery is user accessible and field replaceable for long days. Best of all, it charges through the microUSB port, making it extremely easy to charge from a car DC outlet just like a cell phone. It also has a 5MP camera that can be used to document field conditions.

A handy feature of the SL-55 is the internal GNSS receiver (GPS, GLONASS and Galileo, L1) which can give an accuracy of around 5 meters. With its diminutive size and Carlson software, this would make a dandy tool for reconnaissance. There were two things that I would have liked to see in the SL-55: a better screen and a full size Host USB port. The screen was passable in full sun, but with such an overall great system, I would have preferred a brighter screen with a matte finish. A Host USB port would allow me to exchange files by thumb drive.

The robustness of the RTK processor in terms of real-time accuracy and reliability in tough environments was noteworthy. The battery endurance is a real standout particularly when pushing 2 Watts of UHF output. The base-rover system comes well packaged in two very durable, hard shell cases. I was pleased to find that when I needed support, the technical support staff was available, helpful and knowledgeable from industry veterans. Based on price sheets I was provided, the price point is very competitive with similar systems on the market. Increasingly surveyors are finding RTK to be indispensable to their work, and I have no doubt that the SL-600 will be a popular choice. ■

The battery latches proved easy to manipulate and secure. The compartments house the batteries as well as the SIM card and MicroSD card slots. The two standard LEMO ports provide access serial connections to external controllers and radio modems.

Shawn Billings is a licensed land surveyor in east Texas and works for Billings surveying and Mapping Company, which was established in 1983 by his father, J. D. Billings. Together they perform surveys for boundary retracement, sewer and water infrastructure routes, and land development.