By Shawn Billings, LS

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.

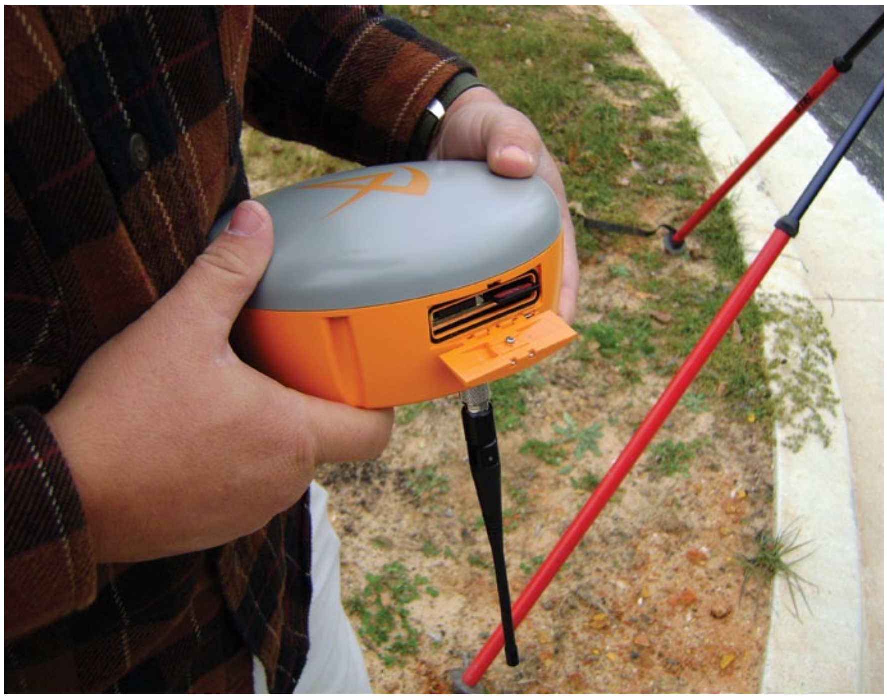
Altus APS-3

A few short years ago it appeared that the precision GPS equipment manufacturing market was going to be controlled by just three or four companies. Mergers, acquisitions and partnerships consolidated the market at a rapid pace, with no new companies entering the scene. Altus Positioning Systems is one company aiming to reverse this trend. Not just a rebranded product from an existing manufacturer, Altus is a brand new player and has developed a unique product to the market with ground up technology.

Their first product, the APS-3, is a fully integrated GNSS RTK receiver. The design concept of the APS-3 reveals some commendable forethought, credited to a design team with decades of experience.

The receiver board is an AsteRx 2 with 66 channels, capable of receiving dual frequency GPS, GLONASS and SBAS, and is produced by Septentrio Satellite Navigation of Belgium. Every receiver is built identically, so there is no dedicated base or rover. Each can act as a base or a rover. Positions can be output at a rate of up to 10 hertz which is very handy for stake-out and other mobile applications.

One of the features I really like about the APS-3 is the removable SD (secure digital) card for memory. With gigabyte SD cards now available at most discount stores at the check-out counter, one really doesn't need the huge amounts of data storage capacity in high-end RTK systems or be billed thousands of dollars to have a unit capable of storing several hours of data for post processing. Having said that, I would advise anyone buying an SD card to spend the extra five bucks for a name brand. Losing data from a hard day's work due to an inferior storage card would not be fun.



Lightweight and compact, the APS-3 allows easy access to the SIM and SD cards. The SIM card allows pick up of Internet RTK corrections; the SD card provides generous, inexpensive storage capability.

I also like the Altus battery arrangement. The unit has two user-accessible Lithium Ion batteries that slide into the unit. User-accessible batteries can be replaced easily if a cell wears out. Furthermore, if you work a long day or forget to charge the batteries the night before, you can replace them with spares and keep working. Internal batteries do not afford such luxuries.

The user has a lot of flexibility with the internal Bluetooth, two LEMO serial ports, and a LEMO external power port. The external power port allows the user to plug the receiver into an external battery for long duration set-ups such as a base station or a long static session. The serial port labeled "SER1" is for cabled data collectors and PCs, and the serial port labeled "SER2" is for an external radio.

The user doesn't necessarily need to use an external radio. The unit has an option of either an internal spread spectrum radio or an internal UHF radio. Also, the unit has a SIM (Subscriber Identity Module) slot that allows the unit to receive RTK corrections from the Internet via a cell phone network.

Looking Past the Specs

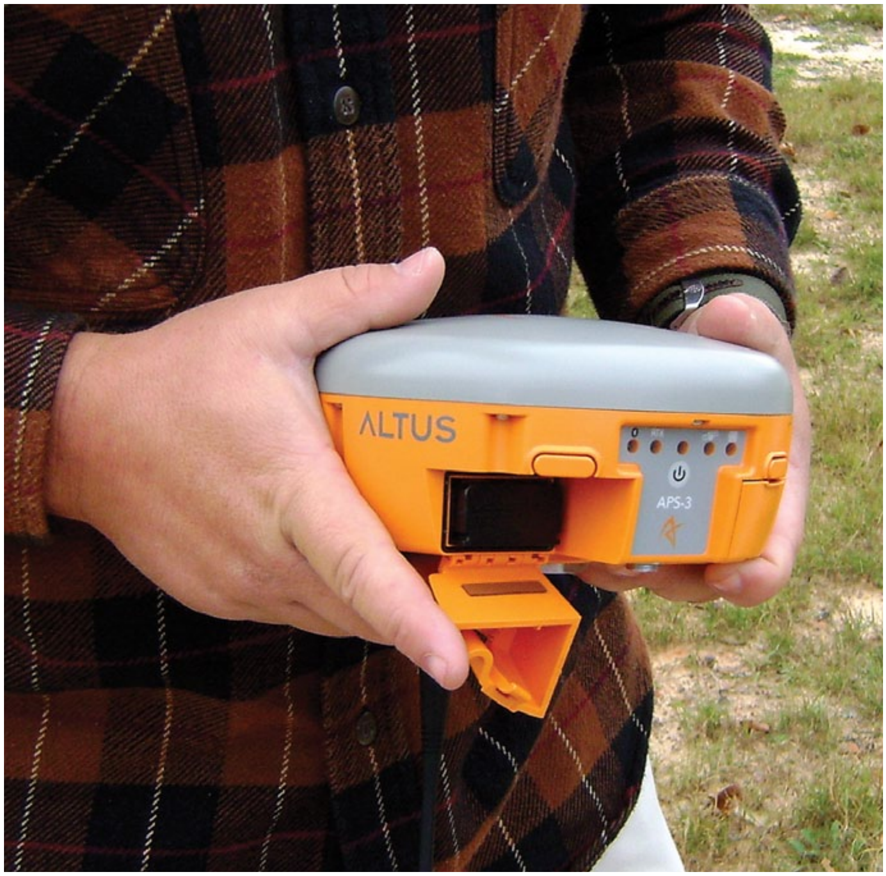
Everything fits neatly into one compact hard shell Pelican case–that includes both units, the data collector, the two rubber duck antennas, a tribrach and pole clamp for the DC. Theoretically, a tripod and a fixed-height pole (or two fixed-height poles if you prefer) and the case would be everything you'd need to be up and running.

Taking the units out of the box, I was impressed by the weight and compact size of the receivers. They seemed well-made and well-sealed from the elements (rated to IPX67 for protection against dust and water immersion). The piano hinges on the battery compartment doors and the SD card/SIM card access door appear to be very sturdy. The coin slot, twist lock action on the SD card/SIM card compartment seemed reliable and durable. The battery doors offer single-hand access, which is handy if you want to change a battery on-the-fly while holding the pole with the other hand. By pressing the release button the spring loaded battery presses the door open automatically. Slide the battery out, replace with a fresh one, close the door, and you're back in business.

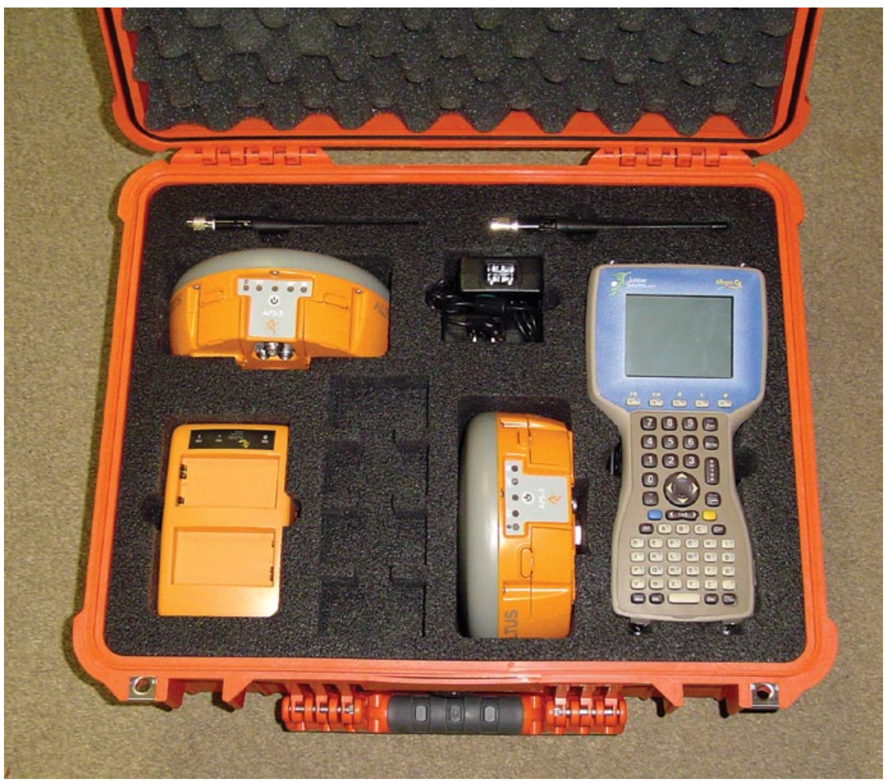
While several data collection manufacturers now support the APS-3, I was supplied with Carlson SurvCE for the review. This was fine with me as Carlson is a fine choice for data collection. The Bluetooth synchronization was impressive between the Juniper Systems' Allegro I used and the APS-3. Bonding was almost immediate and switching from base to rover and back again during the set up procedure was pain free. I felt very comfortable with the cable free operation throughout the review.

Setting the base up in the data collector was a simple step-by-step process and I was able to quickly have the receiver send corrections and log data for OPUS processing later. Next I went through the quick procedure of bonding with the rover and setting it up to receive corrections from the base. In a matter of minutes I was off and running.

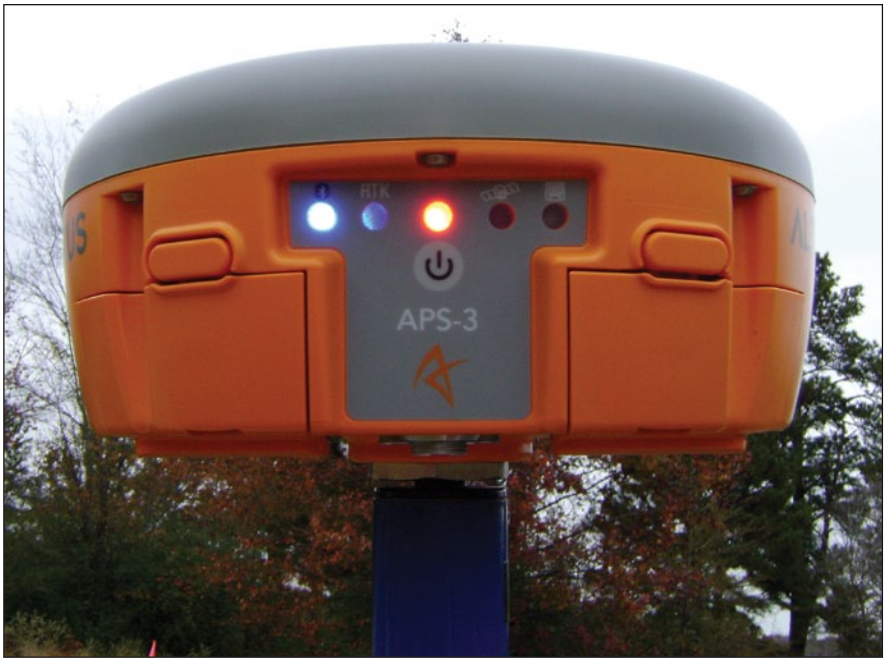
The unit has five LED lights across its front panel and a single power button. Left to right, blue indicates Bluetooth synchronization, the orange flashes intermittently to indicate that RTK corrections are being received, the middle red indicates the receiver is on, green flashes slowly to indicate the receiver is searching for satellites or rapidly to indicate it is ready to work, the red light



Two battery bays on the side are accessed by the press of a button, making it possible to change batteries with one hand.



In one hand a solo operator can tote the entire APS-3 RTK system in a medium-sized Pelican case, and in the other hand tote a tripod, GPS pole, or that fourth cup of coffee.



Even in bright sunlight, a highly visible LED display indicates the status of Bluetooth connectivity, RTK correction reception, power, satellite reception and data storage.

on the far right indicates the receiver is logging data to the SD card.

The LEDs are set back from the panel windows, making it possible to see the flashing light from an LED in the adjoining window when the unit is viewed from an angle. I would like to see some barrel inserts inside the unit that block the LEDs visibility from the side.

The internal UHF radios allowed me a little more range than spread spectrum radios have over the same area, but I was still a little disappointed. In the dense Piney Woods found here in East Texas, I was able to only get 2,500-3,000 feet reliably. Along vectors with few obstructions, I was able to stretch out to 5000 feet. I was unable to test this because I did not have the proper parts, but I was told that using a high gain antenna (such as those supplied with Pacific Crest base radios) connected to the antenna port on the receiver dramatically improves the range. This would definitely be worth checking out should you decide to demo the gear.

In the Field

We reviewed the equipment with two different firmware versions installed. The first version we tested allowed for some of the most aggressive fixed solutions I've yet seen in an RTK receiver,as the following will explain. The second firmware version made the receiver much more conservative in its ability to gain a fixed signal and thus improved the reliability of reporting a fixed solution. With the second firmware installed, the receiver behaved very much like its competitors–certainly no worse, but not nearly as assertive as it was initially. It would be nice to be able to select between the more conservative settings and the more robust (albeit more incident-prone) settings to address various work situations.

Recently we established stake-out control using a conventional total station around subdivision work we are performing. The newly established control was adjusted, with great results, by least squares.

Some of these control points were in the open and some were in places I wouldn't trust a long static session to resolve due to heavy overhead canopy. I wanted to test the Altus to see how it would perform in canopy and also to see how reliable its fixed status indicator was. I tied into fourteen points with the base set up on a fifteenth (relieving me of the need to perform a localization). The longest vector was 1,934 feet. The unit maintained lock impressively well.

In my experience, pine trees are perhaps the worst canopy for GPS work. Some have theorized that the pine needles are approximately the length of the L1 signal (roughly 19 centimeters or 7½ inches) and that this attenuates the signal. I'm not a physicist, so I'll leave that to sharper minds than mine, but it seems logical and it would certainly agree with our experience using GPS for these past nine years. Given that, I certainly would not have expected the APS-3 to give the results it gave on Point 133.

Point 133 is no more than six feet to the southeast from a 15-inch pine tree, with many more medium pine trees all around. I expected a float or a false fixed solution, however my coordinates agreed to within 0.06 foot horizontally and only 0.08 foot vertically. Of the 14 points tested, 12 gave similar results, both in the open or under trees–it didn't seem to matter much. The results were only slightly degraded in the canopy. The two other points were definitely reminders that the Altus is not invincible. These two points gave fixed solutions in the field, however they were most definitely "floaters" when compared back at the office. One was in a relatively open spot compared to many of the others tested, but resulted in a horizontal bust of 0.9 foot and a vertical of 1.4 feet. The other also indicated a fixed solution and yet was off by 9.5 feet horizontally and 4.0 feet vertically. This point was in a deep "canyon" of trees, clear only straight overhead, where I typically would not expect to get good results with an RTK observation. However, in comparison to the other points I was able to observe, this one seemed pretty tame.

The old adage remains true–measure twice cut once. If I were to have performed this job with GPS, particularly in such a hostile environment, I would feel obligated to visit each point twice with at least thirty minutes of separation between observations. This would have immediately put me on notice if I had unknowingly collected a position with a float solution.

In less daunting environments, here at our Stumpwater R&D testing facility, the Altus performed very well. I performed a short, 4+ hour precision test that indicated some impressive potential from these units. As regular readers will perhaps know, while evaluating RTK receivers I set up the base and rover a short distance apart and set up the data collector to collect a point once every minute until the battery runs out, which in this case was a little over four hours. I then compare each recorded point (or epoch) to the average of all the epochs combined, of which there were 252 recorded points. Of these 252 recorded points, only 26 exceeded one centimeter (0.033 foot) horizontally, with none exceeding two centimeters (0.067 foot). This represents only 10 percent of the observations exceeding one centimeter in 2D. Vertically, as expected, the results were a little looser. Of the 252 recorded points, 93 exceeded one centimeter (0.033 foot), of those 31 exceed two centimeters (0.067 foot) and nine exceeded three centimeters (0.098). The worst, vertically, exceeded the average by five centimeters (0.18 foot).

Twice, while performing an RTK session, I had the base log a raw data file to the SD card for submission to OPUS. The raw file is stored in the Septentrio proprietary *.sbf file format. Getting the file from the receiver to my PC was a simple matter of removing the SD card, popping it into my SD card reader and copying the file over. From there, I used the SBF Converter utility from Septentrio to convert the file to a RINEX file. Whether it is still the case or not, OPUS at one time would choke on files with GLONASS data in them, so I make it a habit of removing the GLONASS data from the RINEX file before submitting it to OPUS. The SBF Converter had options for this and OPUS accepted the file and returned a position without incident.

Working Within an RTN

Recently our area was incorporated into a Real Time Network (RTN). As I mentioned earlier, the Altus has a SIM card holder for being able to receive correction data from the Internet. My contact from Carlson Desktop Solutions, John Clark, a distributor for Altus, was able to get me connected to this new network.

Once I was trained on the workflow by my contact from Altus Positioning Systems, Jason Deshon, and had all of the settings entered on the data collector, I was ready to work. I was very impressed by just how easy and fast working with an RTN is. Turn on the units, load the saved RTN profile from the data collector and literally start collecting shots within a minute or two after stepping out of the truck. There was no base to worry about, and I was working with real coordinates immediately with no control to run in.

The receiver worked flawlessly as far as I could tell, however I did have a couple of annoyances with the RTN workflow. For one, working in areas that have spotty cell phone coverage, the receiver would lose its connection and ultimately its corrections. Instead of reacquiring the connection automatically, I had to do it myself through the data collector which would take a few seconds to a minute to do. Also, the accuracy did not seem as good as working from an onsite base, delivering precision in the range of three centimeters horizontally. This is probably due more to working with a station that was 30 miles away, which is pretty amazing on reflection.

On one particular job we needed to locate and flag the corners of a 28-acre tract. All of the corners were in challenging environments. We used the APS-3 to navigate to the iron rods marking the corners. Several of the rods were demagnetized (or “dead” in our usual parlance) and could not be picked up with the metal detector. In one afternoon we were able to locate the 11 points defining the boundary without a base and still have enough accuracy. Even in moderate canopy we were able to recover the monuments, many of which were "dead" and had not been seen in over ten years.

While RTN operation may not be a panacea for every survey task, it is an incredible tool that will no doubt continue to improve. Since the Altus receivers are identical you can work in a base/rover configuration on today's job and on tomorrow's job (provided you have two RTN subscriptions, two SIM cards, and two data collectors) split the two receivers up and work both in an RTN.

In a world of pick and choose options, Altus sells the APS-3 fully loaded, removing questions about which options you need and which you don't. This might seem unattractive to some who really don't want to pay for more receiver than they need, but at the price point of around $30K for a full setup, you get a lot of bang for the buck.

Altus eventually plans to market other surveying equipment besides precision GPS receivers. If that is the case, I suspect the ingenious design, capability and price point of the APS-3 will go a long way in generating some serious brand loyalty for years to come.