WHAT IS GPS?

Simply put, GPS (Global Positioning System) is a group of satellites (currently 24) orbiting approximately 11,000 miles above the earth. Each satellite sends out a radio signal at a known wavelength and time so precise (from an atomic clock) that the distance to each satellite can be measured to less than 1/16 of an inch—Wow!!

Okay, so we know where the satellite is. What good is that when you're wanting to know where you (or your equipment) is located on Earth? Well, if you can receive signals from at least four satellites at the same time, then our software can measure the distance to each one and accurately calculate where you are on the face of the earth (or in the air). Pretty neat stuff—but, as usual, it's not as simple as it sounds.

GPS was originally put in place as a navigation system for the U.S. military, and it is still used for that purpose. Likewise, the Russian government put a similar system in place called GLONASS. Together, these two systems create the Global Navigation Satellite System (GNSS).

Even though the primary purposes of both was for military guidance, the system's benefit for everyday purposes soon became obvious.

- Companies can pinpoint the location of their delivery trucks;
- Boat owners can navigate with the comfort of knowing their exact position at any given moment; and
- A husband will never have to ask for directions and his wife will never have to read a map again with a GPS-equipped automobile.

Because of the tremendous economic and security advantages, both governments made the decision to allow civilian use of the satellite signals. Today, anybody can use the information transmitted by the Global Navigation Satellite Systems, as long as they know how to use them!

PRECISION HAS A PRICE

There are many factors associated with using the system and getting the precision you require. There's a huge difference between knowing where you are within 30 feet (10 meters) and knowing where you are within 1/4 inch (6mm). You can buy an inexpensive, handheld GPS receiver for around $100 that will provide location information within a horizontal tolerance of ±30 feet (10 meters). However, a system that can provide accuracy to within 1/4 inch (6mm) requires much higher sophistication and a much larger investment.

But why is that? They both use the same satellite signals, right? Simply put, a basic system must deal with a few obstacles such as:

- Satellite drift;
- "Multipath" (false signals that are generated when a true signal bounce off the ground or nearby structures)
- Refraction of the radio waves as they go through the earth's atmosphere (see Fig 1);
- Radio and other interference

To overcome these obstacles, Topcon has developed a system, we call it GPS+, that provides many standard features and options to give the most precise, real-time positioning information for your application.

To compensate for satellite drift, we maintain the position of all the satellites in view, and reference their precise orbits relative to each other. This way, we can correct for drift.

To eliminate multipath errors, we design antennas that "look" nowhere but up, and utilize filtering software that kicks out suspected "signal bounce."

To eliminate errors caused by the earth's atmosphere, we set up a secondary receiving station called a "base station" over a known, surveyed point. This known coordinate is input into the base station, then as it receives satellite information, it compares that data to its known location and continually transmits "correction" data to the "roving" GPS+ users on the job site (like your 3D-GPS+ equipped dozer). This correction data is then used in conjunction with the satellite signals received by the rover to provide high precision information even though the rover is in motion!