



## ANTENNA SOLUTIONS FOR PRECISION AGRICULTURE

### Wireless Technology for Precision Agriculture

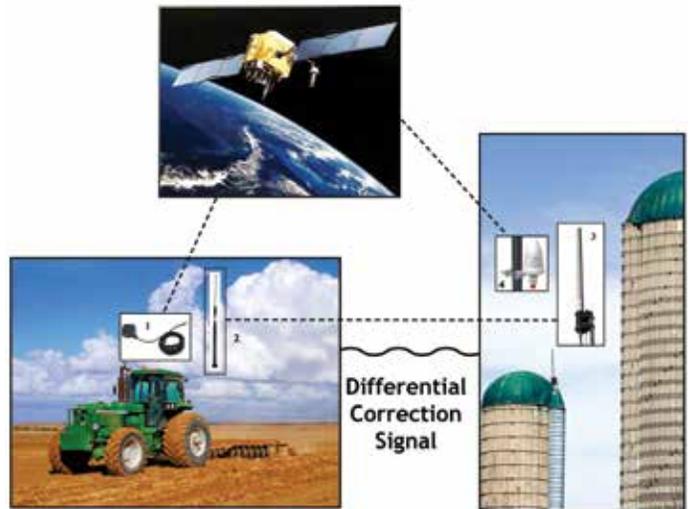
#### Optimizing Efficiency and Reducing Costs

Driven by wireless technology, agriculture continues to evolve into an even more precise industry. During the past several years, Precision Agriculture systems have incorporated GNSS and other wireless communications technologies. Market factors will drive efforts to improve efficiency and reduce costs in an increasingly competitive agricultural market for years to come.

Agricultural applications for GPS go well beyond traditional uses based on the geographical location of equipment, such as optimizing the tractor path in swath-to-swath widths during a harvest. While GPS has been used to optimize and even automate Parallel Tracking for tractors, it is equally important for the driver to understand the terrain itself. Field Mapping has saved farmers money in tractor repairs by being able to record and map the location of rocks, potholes, power lines, broken drain tiles, poorly drained regions and other obstructions. Using this technology, a farmer will also be able to record and understand geographic areas where there are pest infestations or high weeds, as well as map soil-sampling locations for contour maps showing fertility variations throughout the field.

Wireless technology can also help farmers manage water usage. According to the U.S. Department of Agriculture, roughly 80% of all water consumed in the United States is consumed by agriculture. This has brought increased attention to agricultural water usage over the past few years. For example, states such as California have implemented restraints on the overuse of water in irrigation. The once-common practice of field flooding has been curtailed. Field flooding is not only wasteful, but also destructive, as the overflow can drown crops and have significant pesticide and fertilizer runoff.

Fortunately, better irrigation techniques have emerged over the last three decades, utilizing sensors to record moisture levels in soil, so farmers can irrigate appropriately. Wireless technology further improves the efficiency of these irrigation systems. A farmer can now measure and gauge the soil moisture from a remote location as often as once per minute and redistribute water as needed without having to manually inspect meters in the field. GPS antennas positioned on center pivot sprinkler systems allow these automated systems to evenly distribute and cover massive crop circles without over-watering.



*PCTEL's 3910D antenna (1) gets positioning information from the satellites. PCTEL's elevated feed antenna (2) not only relays the positioning information to the management center but also receives the differential signal from PCTEL base station omnidirectional BOA series antenna (3). This allows the farmer to improve his accuracy to the sub-meter level. PCTEL's GPS-TMG antenna (4) may also be used for redundancy in positioning to mitigate errors caused by multipath and achieve pin-point accuracy.*



APPLICATION  
**NOTE**

The most efficient agriculture systems need sub-meter accuracy in order to work adequately between subsurface irrigation lines or to plant in narrow strip-till furrows. With the increasing price of crop seeds, accurate GPS and GNSS systems can reduce cost by minimizing double planting and increasing overall crop yield. In order to achieve this level of accuracy, GPS systems must mitigate the slightest errors in GPS location caused by signal delay, multipath, satellite orbit error and timing synchronization discrepancies. This can be accomplished by using various methods of differential correction.



*The GPS-LB12GL-MAG antenna is designed to meet DO-160 standards for airborne equipment.*

*The Arinc 743 form factor is robust with a hermetic seal for long lasting, trouble free deployment and durability.*



*This 4G LTE heavy duty mobile antenna features a rugged, flexible design for high-vibration or high-impact applications. It is suitable for mobile or fixed applications.*

provides both of these types of antennas. At any given time, a GPS antenna must pick up the signal of at least three separate satellites in order to triangulate its latitude and longitude position and a fourth satellite to determine elevation. With 24 satellites covering the globe in the GPS L1 frequency band, an antenna should always be able to acquire signal

lock on 8-9 satellites. Antennas with high out-of-band rejection and wideband coverage, such as PCTEL's 8111D-HR, minimize harmonic interference caused by adjacent antenna propagation and can keep a greater number of satellites in lock with GLONASS constellation compatibility, therefore improving receiver accuracy. PCTEL also offers GPS products with low noise characteristics in the event that the GPS antenna may interfere with other on-board system communications.

One method of differential correction is to use a dual-band GNSS system. Dual-band GNSS systems utilize multiple satellite constellations such as GPS L1 along with GPS L2, L5, GLONASS, and EGNOS/ GALILEO. These systems require multiband GNSS antennas, which PCTEL provides. A



*PCTEL base station omnidirectional BOA series antenna and PCTEL's GPS-TMG antenna placed at the silo elevator and distribution station. This allows the farmer to improve his communication accuracy.*

second method of differential correction is to use base station GPS reference antennas to create a DGPS (Differential Global Positioning System). In this solution, each rover is equipped with mobile GPS and communications antennas. PCTEL provides mobile

multiband antennas that provide all of these functions in a single radome. The mobile antennas communicate with a reference base station. This base station, which has to be within 5 miles of the rover for optimized accuracy, contains a GPS base station reference antenna, as well as an omnidirectional base station antenna that would transmit the differential signal to the rover. PCTEL

In addition to these unique electrical properties, antennas used on spray systems and rovers must be mechanically engineered to survive exposure to harsh chemicals, diesel fuel, axle grease, and petroleum-based products that eat away at rubber compounds. They must also be robust enough in order to survive the extreme vibration specifications that are induced through navigation in uneven and rocky terrain. All products designed by PCTEL undergo full environmental testing to ensure that the antennas not only perform through vibration and agrochemical exposure, but are also immune to water and dust ingress that may cause latent damage to the antenna's electronic components.

Farmers face growing pressures to boost their yield while minimizing cost in an increasingly competitive market. Current wireless platforms have not only improved yield and efficiency by as much as eight-fold, but they also allow the farmer to automate many of the labor-intensive processes they had deployed in the past. Farmers now have the ability to identify pest and disease infestations and track the amount of pesticides that are used, significantly reducing the room for human error. GPS antennas and wireless data transfer are making large farms more efficient, cost effective, and environmentally friendly.

## CONTACT PCTEL FOR ASSISTANCE WITH AGRICULTURE ANTENNA SOLUTIONS

PCTEL, Inc. is a customer-focused company dedicating its research and development to create high performance antenna products to meet market needs.

