



AgGPS[®] Autopilot System

GPS-BASED GUIDANCE SYSTEM AUTO-STEERING FOR YOUR TRACTOR

An innovative and rugged tractor guidance/control system designed to help farmers maximize the speed, precision and efficiency of farm operations. Trimble AgGPS Autopilot expands the workday and takes the guesswork out of field layout, planting, cultivation and chemical application. As a result, crop rotation times are shorter, and crop uniformity and productivity are improved—benefits that show up on your bottom line.

A COMPETITIVE EDGE

WHY AgGPS AUTOPILOT?

It's a global economy. Competition is intense and profit margins tight, particularly for those involved in large-scale production of high-value, high-input crops such as cotton, sugar beets, vegetables and legumes.

Trimble's AgGPS Autopilot is an innovative precision agriculture tool designed to help farmers maintain their competitive edge. The concept is simple—a GPS-based navigation system automatically steers your tractor along a precise path with centimeter-level precision. Rows and irrigation systems are straight and uniformly spaced. Inputs, such as fertilizers and pesticides, are delivered exactly where they are needed. AgGPS Autopilot can be used for bed and irrigation system layout, planting, cultivation, tillage, fertilization, spraying, and other operations where precision is important.

AgGPS Autopilot allows for the efficient use of labor and equipment. Crews can work in low-visibility conditions. Extended hours of operation ensure you make the most of capital investments. In addition, this safe and easy-to-use navigation system lets crews work faster and more efficiently by allowing the operator to focus on other in-field operations.

The payoff is uniform, high-quality crops produced in the shortest possible time.

WHY TRIMBLE?

The Trimble AgGPS Autopilot System gives you the power of advanced Trimble Global Positioning System (GPS) technology. Founded in 1978, Trimble is a world leader in the development of innovative global positioning (GPS) technology-based products for a wide range of applications including agriculture, mining, construction, survey, GIS, military, marine and vehicle tracking.

Trimble's AgGPS systems combine in-field guidance and intelligent farm management to help grow your bottom line. With Autopilot you get cutting edge technology. You also get the great service and reliability you've come to expect from Trimble and our extensive system of distributors. In addition to

on-site training, we provide 24-hour customer support—worldwide.

THE SYSTEM

How It Works

Autopilot is powered by Trimble's high-performance GPS-based navigation controller. The Navigation controller is mounted on the tractor and is connected to your tractor's power-steering mechanism.

The combination of your tractor and the Trimble AgGPS Autopilot system, takes the drudgery and the fatigue factor out of precision work.

An in-cab display lets the driver quickly define implements, set up field patterns and view operating parameters.

After the first pass is defined, just push a button and AgGPS Autopilot goes into action. The automated steering mechanism lines up the tractor at the beginning of each row and guides it smoothly down the row. Beds go in straight and accurate the first time, every time. No more guess rows; no more overlaps; no more running over rows.

The system is easy to learn, so all of your drivers can do precision work. A dead-man switch and steering override ensure operating safety. Just a slight turn of the steering wheel is all that is required to return steering control to the operator, the same way that touching the brake disables your car's cruise control.



From top left: Virtual Terminal Display, TRIMCOMM 900 Radio, GPS Antenna, Navigation Controller, External Keypad and Data Logger (RDL), AgGPS 214 Receiver, Lightbar



THE COMPONENTS

AgGPS 214 Rover Receiver RTK GPS receiver pinpoints the tractor's location in the field to the centimeter level.

Navigation Controller Embedded Controller Unit (ECU), mounted on the tractor chassis, controls Autopilot operation. It also contains the electronic components used to measure tractor roll.

Display Easy-to-use graphical display mounted in the tractor cab allows the operator to interface with the Autopilot system. Multiple views of field operations set per operator preference.

Lightbar Electronic display uses bright color light emitting diodes (LEDs) and a text display to allow the operator to visually track performance or position the tractor manually.

External Keypad and Data Logger Movable keypad with data storage on a compact flash card puts control conveniently at the operator's fingertips.

GPS Antenna The antenna for the AgGPS 214 Rover receiver ensures maximum GPS accuracy and availability.

TRIMCOMM 900 Rover Radio License free high-performance 900 MHz radio receives corrections from a GPS base station.

Autopilot Hydraulic Valve Electric-over-hydraulic valve, connected to the tractor's steering circuit, is used by Autopilot to steer the tractor. (Not required on fly-by-wire vehicles.) The system is engineered with safety over ride.

Steering Position Sensor Wheel-position sensor, connected to the front axle, measures the turn angle of the front wheels. (Wheeled vehicles only.)

Base Station Base station for AgGPS 214 RTK GPS receiver includes the MS750 Base receiver, TRIMCOMM+ 900 Base radio, and L1/L2 GPS antenna.

AgGPS AUTOPILOT BENEFITS AND ADVANTAGES

Accurate

When you raise high-value crops, accuracy matters. AgGPS Autopilot provides centimeter-level positioning in all three dimensions. The result is rows that are straight and evenly spaced, and inputs such as irrigation, planting, cultivating, fertilizers and herbicides—are precisely placed.

Rugged and Durable

AgGPS Autopilot is designed tough. Trimble uses industrial grade components. With years of experience in the mining, construction and agricultural industries Trimble knows what works in harsh environments. All of the electronic components in the AgGPS Autopilot system are sealed and climate controlled. An absence of moving parts such as fans or disc drives eliminates the potential for mechanical failures.

Easy To Use

An easy-to-use graphical interface makes set up and operation easy. Bright LED's and text display on the Trimble light bar instantly tell the operator how accurately Autopilot is steering the tractor. Snap-to-swath technology and automatic steering—forward and reverse—increase operating ease. For operator safety, the AgGPS Autopilot System incorporates a dead-man switch and steering override.

Increased Utilization of Capital Assets

Tractors, sprayers and seeders are expensive. Autopilot expands the window of operation to allow you to make the most of your investment. You work when you need to work.

Increase Crop Productivity

AgGPS Autopilot helps you get to the field quicker because you don't need to see rows in the field to begin work. Precise row placement maximizes land utilization and minimizes the chance for crop or irrigation system damage during seasonal operations. And because inputs are precisely placed, crop uniformity and value are improved.

Flexible

With AgGPS, you only purchase the pieces you need for your tractor. Key components can easily be moved from one tractor to another.

TRIMBLE AgGPS AUTOPILOT KEY COMPONENTS

AgGPS 214 High-Accuracy Receiver

Precision agriculture reaches a new level with the Trimble AgGPS 214 high-accuracy receiver. Although submeter differential GPS (DGPS) satisfies many agricultural applications, there are some situations where centimeter-level precision is needed to achieve optimal performance and productivity. Bed installation or layout of irrigation systems for high value/high input crops are just two examples where high-accuracy Real Time Kinematic (RTK) GPS is useful. It can also be handy in large-scale farming operations where the ability to work in low-visibility situations helps ensure cost-effective use of labor and equipment.



RTK vs. DGPS

Real-time Differential GPS (DGPS) uses a telemetry link between the base station and a roving GPS receiver to generate position data that is accurate to the sub-meter level.

In contrast, Real-Time Kinematic (RTK) GPS systems, such as the one used in AgGPS Autopilot deliver centimeter-level accuracy.

See our web page to learn more about how the GPS works. Go to www.trimble.com and click on "All about GPS".

Navigation Controller

AgGPS Autopilot's Navigation controller or Embedded Controller Unit (ECU) houses Autopilot's inertial components used to accurately measure tractor pitch and roll. The Navigation controller is completely sealed and is mounted on the outside of the tractor cab on the chassis to maximize measurement precision.



Steering Interface

In order for AgGPS Autopilot to steer some tractors, it is necessary to add a steering interface. Tractors with a mechanical link to a hydraulic steering pump require that a hydraulic valve be plumbed into the Autopilot system. Those without a mechanical link (often called fly-by-wire systems) do not require the valve.

TRIMCOMM® 900 Radio Modem

The TRIMCOMM 900 radio modem provides a versatile means of establishing a wireless broadcast network for real-time, high-precision GPS applications.

This high-speed, 902 to 928 megahertz spread-spectrum radio modem can be used as a reference transmitter, a repeater, or a rover unit. It is capable of broadcasting data up to 10 kilometers (6 miles) line-of-sight under optimal conditions.

Lightweight and power efficient, TRIMCOMM 900 is fully sealed against the elements. No radio license applications or fees are required for its use.

The ability to broadcast over a broad range of frequencies ensures that signals remain strong and clear despite interference. Multiple network settings make it possible to have separate base stations in the same area at the same time without interfering with one another.

The dual frequency AgGPS 214 RTK High Accuracy Receiver, tracks both standard code and carrier phase GPS signals as well as an additional carrier phase signal. The ability to pick up two carrier phase signals lets the receiver output precise data very quickly—at rates up to twenty times per second. Trimble pioneered the commercial use of RTK in 1992. Since that time it has been used on thousands of projects throughout the world, with the most recent applications being in agriculture.



AgGPS Lightbar

The AgGPS lightbar provides the tractor operator with clear and immediate guidance along track lines. A row of super-bright color lights or LEDs indicate off-line distance. The light bar also makes it easy for the operator to stay on course in manual mode (used for initial set up and for turning around at row ends). An eight-character text screen displays user-selected information such as swath number and ground speed.



HOW TO USE AgGPS AUTOPILOT

Tractor Setup

A Trimble authorized AgGPS Autopilot dealer will install the Navigation Controller, AgGPS 214 rover receiver, GPS antenna, RTK radio link, AgGPS lightbar, the Autopilot display, and if required the hydraulic valve and wheel position sensor. (See page 3.)

The AgGPS 214 has a front panel 2-line, 16-character LCD display showing all the status information of the GPS receiver. The keypad and display can be used to configure all of the AgGPS214 receiver and I/O setting such as the NMEA message output for an external device.

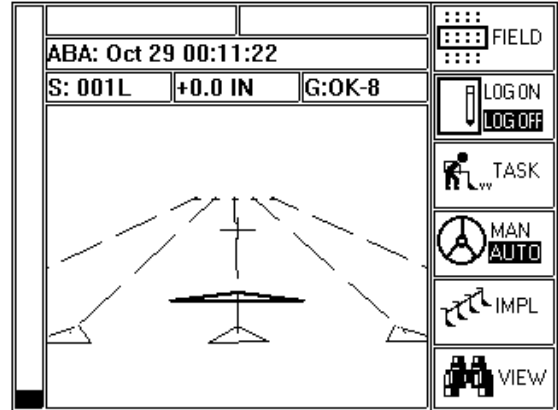
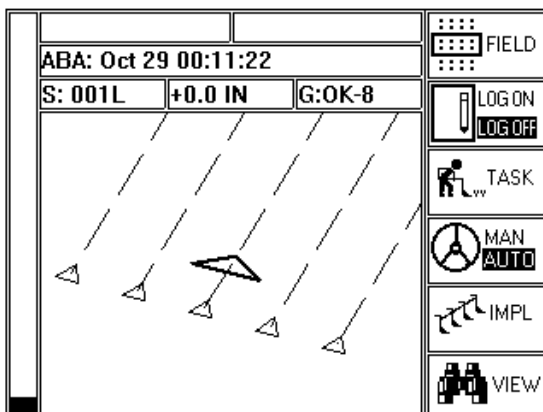
Base Station Setup

Set up the AgGPS 214 Base Station antenna and the TRIMCOMM 900M radio at known location within 10 km (6 miles) of the area you will be working in. This location should have a clear, unobstructed view of the sky and of the field.

To maximize the range of the radio at the base, locate it as high as is practical on the site. If you plan to make repeat visits to the field, it's a good idea to set up a permanent base station so you don't have to set up for each operation.

The Display

The AgGPS Autopilot display is the primary interface between the user and the system. It provides an overview of system operation and performance, as well as a view of the task being executed in the



field. Use it for system calibration, configuration, troubleshooting, and for map display.

The extensive diagnostic systems enable trained personnel to monitor every aspect of Autopilot performance from the seat of the cab, making calibration, operation, and trouble shooting very efficient. Diagnostic Screens allow the user to analyze independent Autopilot systems. Graphic Screens display information pertaining to the task and the field being worked including maps.

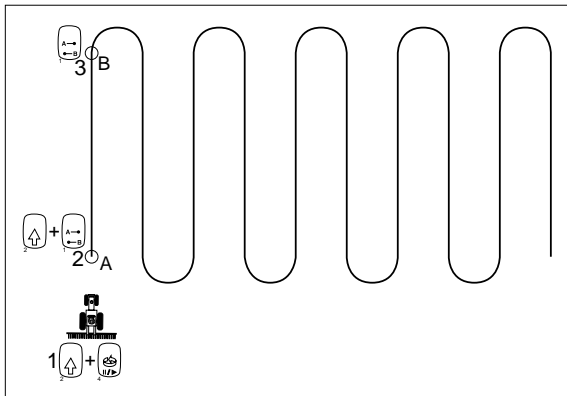
High-Precision Guidance

AgGPS Autopilot currently provides three high-precision straight line guidance patterns:

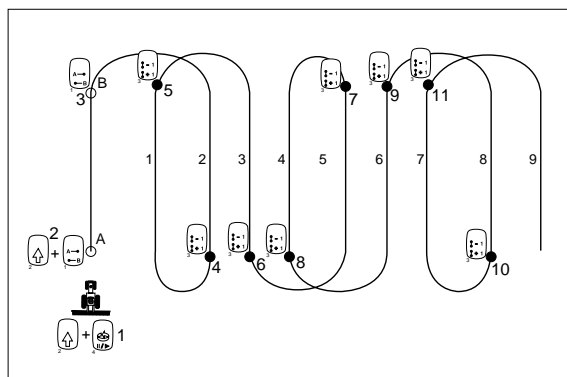
- A-B: This pattern is computed by connecting two points with a straight line. Successive passes are computed by the implement width and arranged parallel to the A-B line.
- A-B-A: This pattern is computed by connecting point A to B along heading in degrees from true North. The heading component from the initial A-B line is saved, when a new A point is entered the stored heading is recalled for use with the new A without setting a new B so the new line is parallel to the A-B line.
- Row Intelligence: AgGPS Autopilot's ability to keep track of the tractor's position within a field enables the operator to drive any pass in a field based on the A-B line at any time. Race track or

skip patterns are examples of two ways one may want to work a particular field with Autopilot.

As additional functionality and capabilities are developed, downloadable updates will be provided.



Parallel A-B



Skip N Racetrack

Field Operation

To begin operation, simply set the swath width to that of your equipment width and designate the initial point A and B line. Start AgGPS Autopilot and sit back. An alarm will sound when a row end is reached. Resume manual operation and turn the tractor around using the lightbar to help line up on the next row.

The row intelligence built into Autopilot keeps track of where your are in the field. This means that you may drive any swath in the field at any given time—there is no required sequence.

For example, an operator may choose to skip every other pass across the field and thread back through

to keep the force on the implement uniform across it's width. This type of pattern also allows multiple AgGPS Autopilot systems to work in the same field at the same time.

Safety Features

AgGPS Autopilot contains a number of important safety features:

- A “dead-man” alarm requires interaction from the operator at a specified interval.
- Three manual disengage options allow the operator to disengage the system. The operator can move the steering wheel, or push a disengage key on the keypad or the AgGPS display.
- An end-of-row alarm will remind the operator to resume control to turn the tractor around at the end of each row.
- Hardware Fault Detection continuously monitors components such as: the primary navigation processor, hydraulic valve, IMU, steering sensor, and cable connections.

CONCLUSION

AgGPS Autopilot is a powerful and cost-effective tractor guidance system designed for agricultural applications that require high precision or have a finite operating opportunity. By automatically steering your tractor, this navigation system increases the precision and efficiency of many farm operations while enabling the operator to extend the hours of operation. This easy-to-use system lets even inexperienced operators handle precision work with significantly less fatigue. Rows are straight and spacing is exact so crop damage during cultivation and other cultural activities is minimized. In addition, crops are uniform because inputs are precisely applied. Because crews can work in low-visibility conditions, capital investments are maximized. The result is an improved bottom line.

To learn more about Trimble's AgGPS Autopilot system, visit www.trimble.com/gis or call your local Trimble representative.

AgGPS AUTOPILOT TECHNICAL SPECIFICATIONS

Trimble Components:

- AgGPS® 214 RTK Rover Receiver and antenna
- Steering Position Sensor (Wheeled tractors only)
- Navigation Controller
- Hydraulic Valve (Mechanical steering only)
- Autopilot Display
- AgGPS 70 RDL Keypad and Data Logger
- AgGPS Lightbar
- TRIMCOMM 900M Rover Radio and antenna
- Mounting Brackets

Also required:

- AgGPS 214 Base Station System with TRIMCOMM 900M Base Station Radio

Standard Features:

AgGPS 214

- Centimeter accuracy
- Real-Time Kinematic processing
- 9 channel L1/L2 full cycle carrier
- CMR & RTCM correction input
- RTK Fixed, RTK Float, and DGPS modes
- Three programmable RS-232 ports
- 1PPS output

Navigation controller

- +/- 90 degree Tilt/Roll compensated
- Internal data storage
- Water proof
- Externally mounted
- Fully integrated design
- Attitude sensors
- Embedded controller (no moving parts)

Autopilot display

- 31 keys with 10 digit numeric keypad
- 6 inch high resolution LCD display
- Water Proof

AgGPS 70 RDL Keypad and Data Logger

- Compact Flash Memory card
- Splash proof
- 2 x 16 line character display
- Two Programmable RS-232 ports
- CAN 2.0B (J1939) Port
- 9 volt battery for data integrity
- A-B line logging
- Coverage Logging
- 3-D position or Topo logging
- Job download/upload

Performance Characteristics:

AgGPS 214 Receiver

General	Dual 12 channel dual frequency Carrier phase receiver
Update Rate	10 Hz Standard: 20 Hz Optional With MS750 upgrade package
Carrier Phase	
Position Accuracy	1 cm+ 2ppm baseline distance - Horizontal 2cm+2ppm baseline distance - Vertical
Time to Fix	<30 sec, typical

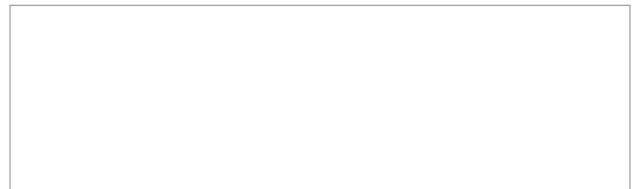


Trimble Navigation Limited
Corporate Headquarters
645 North Mary Avenue
Sunnyvale, CA 94086
+1-408-481-8940
+1-408-481-7744 Fax
www.trimble.com

Trimble Navigation Limited
Agricultural Division
9290 Bond Street, Suite 102
Overland Park, KS 66214
913-495-2700
800-865-7438
913-495-2750 Fax
precision_ag@trimble.com

Trimble Navigation
Australia Pty Limited
+61-7-3216-0044
+61-7-3216-0088 Fax

Trimble Navigation Europe
Limited
+44-1256-760-150
+44-1256-760-148 Fax



TRIMBLE AUTHORIZED DISTRIBUTOR

