TechnicalNotes

*Ag*GPS 170 Field Computer

RUGGED FIELD COMPUTER FOR PRECISION AGRICULTURE

The *Ag*GPS® 170 Field Computer works with Trimble's *Ag*GPS Parallel Swathing Option and *Ag*GPS receivers, saving time and costs in various mobile agricultural applications such as field guidance, field and feature mapping, soil sampling, variable rate application, as-applied coverage logging, and automated record-keeping. All recorded information is compatible with most agricultural GIS software. The *Ag*GPS 170 Field Computer is your key to efficient operation.

Trimble®
ADDING VALUE TO GPS

The *Ag*GPS 170 Field Computer saves time and money. It removes the need for foam marker systems and other traditional forms of guidance, while maximizing field application efficiency, automating record-keeping, and enabling the creation of field maps. The system completes your site-specific needs by performing variable rate applications and soil sampling.

The *Ag*GPS 170 Field Computer offers multiple guidance patterns that enable the operator to reduce skip and overlap in all field operations. Plus, the system provides sophisticated automated record-keeping – a bonus when it comes to customer billing, communications with environmental authorities, and GIS (Geographic Information System) data analysis.

HARDWARE

The robust and compact *Ag*GPS 170 Field Computer is designed to withstand the environmental extremes that agricultural vehicles endure. The *Ag*GPS 170 Field Computer has a fully sealed cast aluminum waterproof housing. The high-resolution color screen is readable in bright daylight conditions, and its brightness is easily adjusted for use at any time, day or night. The keypad is backlit for maximum visibility. The hardware operates with a wide input voltage range and runs on both 12 and 24 volt systems. If power is lost, data integrity is preserved since the field computer performs a graceful shutdown saving all data. Data is stored on a removable CompactFlash data card for easy transfer to the office computer.

Rear view of AgGPS 170 Field Computer on a pole mount

THE MODULAR *Ag*GPS FIELD MANAGEMENT SYSTEM

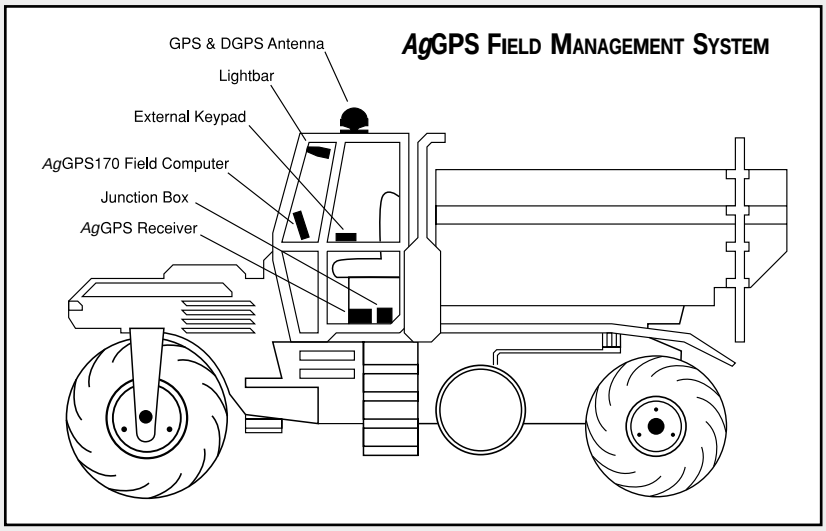
The modular *Ag*GPS Field Management System includes the *Ag*GPS 170 Field Computer, *Ag*GPS receiver, and *Ag*GPS Parallel Swathing Option. The resultant system is a top-of-the-line precision agriculture solution—providing precise guidance, variable rate, as-applied coverage logging, soil sampling and agricultural mapping capabilities.

The *Ag*GPS Field Management System is easy to set up and use. The *Ag*GPS 170 Field Computer connects via a Junction Box to the *Ag*GPS receiver and the Parallel Swathing Option lightbar. The six-button external keypad ensures easy field use.

AgGPS Field Management System

Benefits of the *Ag*GPS Field Management System

- The system is used in a wide range of agricultural applications such as planting, spreading, spraying, cultivating, variable rate treatments, soil sampling.
- The system covers many guidance situations including contour following, guidance around obstacles,



irregular shaped fields and guidance along pre-defined lines.

- Saves time and money in planting and application operations by maximizing efficiency and minimizing overlaps and skips in field work.
- Automates field operation record-keeping and assists with staff timesheet collection.
- Ensures your agri-business is able to identify and remedy skips before you leave the field, avoiding costly call backs.
- Easy-to-follow lightbar reduces operator fatigue.
- Hours of operation are extended because of the ability to work at night or in fog.
- Saves time and avoids hassles with data management by directly working with ESRI Shapefiles. Prescription and field maps from a wide range of ag GIS software can be used.
- Displays field location via background layers† to avoid field misapplication.

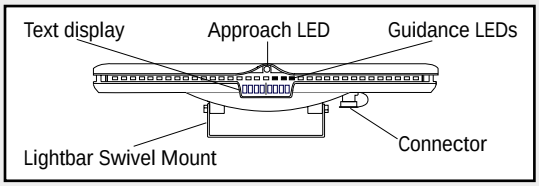
AgGPS Parallel Swathing Option, AgGPS 170 Field Computer, and AgGPS Receiver

*Ag*GPS Receivers

Trimble offers a number of *Ag*GPS receivers that have been specifically designed for agriculture. You can choose a receiver that best meets your accuracy and budget requirements. Contact your nearest Trimble sales representative for more details about Trimble's *Ag*GPS receivers.

*Ag*GPS Parallel Swathing Option

The *Ag*GPS Parallel Swathing Option lightbar provides clear and immediate guidance along swath lines. The lightbar has a row of bright lights (LEDs) that indicate the vehicle's distance offline, and an eight-character text screen to display user-selected information such as swath number and ground speed. It is easily mounted on the dash or from the ceiling of any spray truck, spreader, or tractor cab. The lightbar's bright LEDs ensure clear guidance in daylight. A dimmer feature enables the intensity to be reduced for night operations.



SOFTWARE

The *Ag*GPS 170 Field Computer runs the Microsoft Windows CE operating system that is designed for mobile applications.

The *Ag*GPS 170 Field Computer software package includes:

Field Guidance

- Multiple patterns: Straight line, curve, spiral, headlands, racetrack, skip N, circle, squeeze, and guidance along line features
- Automatic snap-to-swath selection
- Guidance back to material out or reload points

Mapping

- Points, Lines or Areas
- Field boundaries
- Material out or reload points

Variable Rate Application

- Multiple Controllers: Mid-Tech, Raven, DICKEY-john, Rawson/New Leader
- Import prescriptions from multiple office packages: ESRI Shapefile-compatible software including *ArcView*, *SSToolbox* and *AgLink*

Soil Sampling

- Grid sampling
- Zone or directed sampling
- Interface to RS232 bar code reader

Record-Keeping

- As-applied coverage logging and applied rate information
- Detailed logging of elevation data for topographic mapping or liability purposes

Office Management of Field Work

- Electronic work orders to save time for operators

Field History Tables

- A summary list of field event details

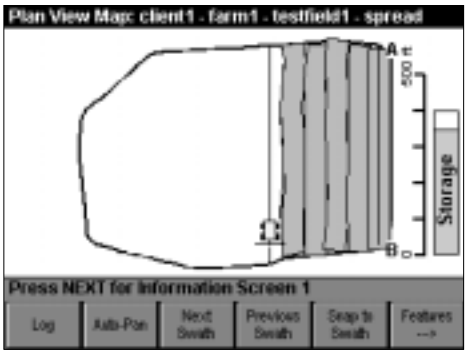
Display for Navigation

- Background map display to locate your position relative to surrounding features†
- Sample points, previously mapped features and material refill points during applications
- Automatic screen scaling

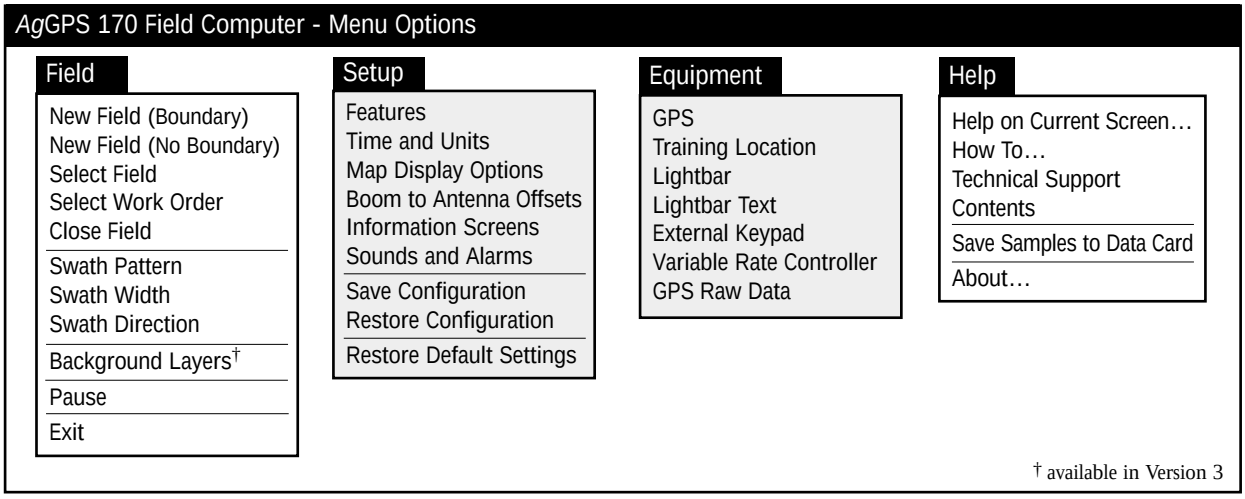
All data is stored on a CompactFlash data card, for easy removal at the completion of the field operation. The *Ag*GPS 170 Field Computer records data directly into the ESRI (Environmental Systems Research Institute) Shapefile formats (Shape (SHP) and dBase (DBF)). This format can be easily imported into most farm mapping software for data analysis, storage, or report generation. dBase files can be opened in a dBase editor such as Microsoft Excel. ESRI's ArcExplorer software is provided for viewing and printing field data.

The *Ag*GPS 170 Field Computer software has two main screens that are used during field operation—the **Plan View Map** and **Information Screens**.

Plan View Map is a graphical screen that displays a "bird's eye" view of the field being worked, including the field boundary, any mapped features, the vehicle location, the current prescription map, and the coverage logging or the soil sampling pattern being performed. At all stages of a field application, cultivation, or planting, the **Plan View Map** displays the complete status of the field job. This allows you to identify any gaps in field treatment, and take immediate corrective action. In variable rate applications, both the target prescription rate and the actual application rates are displayed on the **Plan View Map**. When used for soil sampling, sample points and key navigation information are displayed making it easy to navigate to each



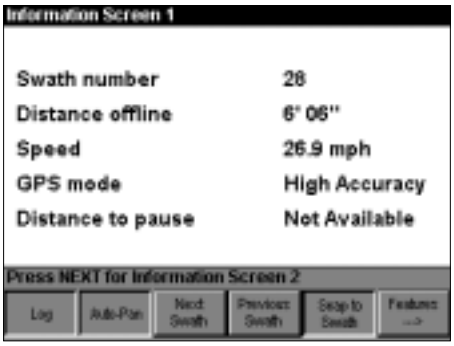
Plan View Map



The AgGPS 170 Field Computer menu structure

sample point. A scale bar and a data storage indicator can be displayed. To zoom in and out, simply press [+] and [−] on the *Ag*GPS 170 Field Computer's keypad. Softkeys for commonly-used swathing, logging and mapping functions are displayed along the bottom of each main screen.

Information Screens display user-selectable text information that suits the specific field operation. A wide range of information can be assigned to these screens including current swath or headland number, latitude and longitude, number of satellites, ground speed, distance off the current swath line, distance and direction to a point, total time, and total area covered.



Information Screen

*Ag*GPS Field Computer Menus

The *Ag*GPS 170 Field Computer has an easy-to-use graphical interface. Drop-down menus are accessible via a **Menu** key. From the menu, you can access many screens, such as: field definition and guidance functions, equipment and software configuration and diagnostic tools, and online help.

Configuration Menus: The *Ag*GPS 170 Field Computer software uses default settings to ensure easy configuration. Using the **Setup** and **Equipment** menu options, you can configure the *Ag*GPS 170 Field Computer to suit specific equipment and operational requirements. For example, you can:

- assign features to softkeys for on-the-go mapping
- set **Plan View Map** and **Information Screen** display options
- change measurement units
- adjust alarms and warning settings
- alter antenna position offsets
- update settings for connected equipment (i.e. GPS, lightbar, external keypad, and variable rate controllers)

Generally, there is no need to alter these setup options once they are established. A manager can choose to hide the **Setup** and

Equipment menus so field operators access fewer menu options, reducing the chance of configuration settings being inadvertently changed during field operations. Once all settings are made these can be saved and named. This way a unique configuration can be easily restored for use, to suit different vehicles or different operators.

Operation Menus: If a manager chooses to hide the **Setup** and **Equipment** menus, there are only two menus visible while operating: **Field** and **Help**. As the operator drives to new field jobs, or uses different equipment, some swathing parameters (such as desired guidance pattern, swath line direction, swath width, or displayed background layer) may change. The **Field** menu allows the operator to easily alter these parameters.

Beginning a Field Event

Each field can have any number of events. An event is any operation on one field such as cultivation, planting, pesticide or fertilizer applications, a soil sampling or field mapping session.

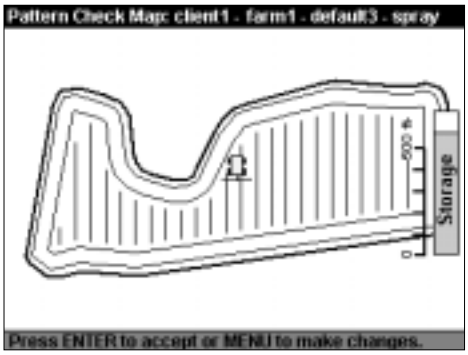
To begin a field event, the operator opens a new field. If **New Field (Boundary)** is selected, the operator will map the boundary by driving the field perimeter. Once the boundary is established, swathing, soil sampling or mapping can begin. Alternatively, an operator can select an existing field or select **New Field (No Boundary)**. In new fields with no boundary, the operator can immediately begin swathing, collecting soil samples or mapping features.

For each event, the operator can enter descriptive information, such as the client, farm, field, and event names. Other data can be entered, such as the:

- operator's name or identification (e.g. a custom applicator's certified applicator number)
- type of agricultural material being applied (e.g. pesticide or fertilizer name, corn or wheat seed variety)
- crop type
- weather conditions
- extra notes about the job

To facilitate input of this information, the *Ag*GPS 170 Field Computer softkeys display previously used data entries. Any simple text editor like Microsoft Notepad can be used to set up these client, farm, field event details in advance so they appear on the softkeys, saving time for field operators.

After entering the client, farm, field, and event information, the **Pattern Check Map** graphical screen is displayed. This screen can be used as a final check to ensure the swath pattern, swath width, and field boundary settings are correct and to orient oneself in the field before starting the field event.



Pattern Check Map for headland parallel guidance (pattern)

Field Boundary Mapping

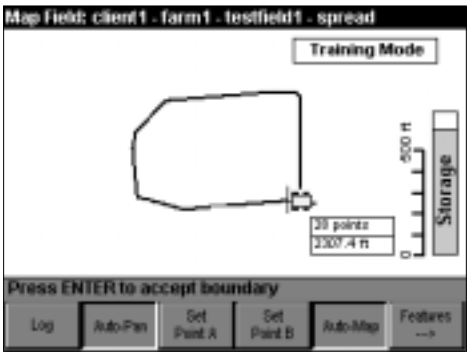
Field boundary mapping is usually completed before operations such as guidance, mapping and soil sampling. The *Ag*GPS 170 Field Computer software enables fields to be defined in one of two ways:

- **Field boundary:** This type of field definition is usually performed as the first field headland or first pass around the outside of the field is

driven. The field is defined by starting the auto-map function and driving the boundary. It is not necessary to return to the starting point to close the field boundary as the software will automatically close the field from the point where auto-mapping is turned off.

• **No field boundary:** This field definition technique does not require the boundary to be driven. You simply set an A and B point in the field to form a straight baseline along one edge of the field. If you select a curve guidance pattern, then the path driven between the setting of the A point and the B point will be recorded. Guidance lines are then generated from the straight A-B baseline. Curve guidance is generated from the last swath driven, allowing for obstacle diversion and guidance like a 'virtual foam marker'.

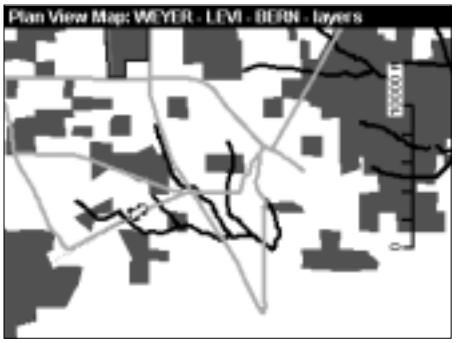
The field boundary files contain information collected to summarize the field:
- Field name
- Field area and units (acres or hectares)
- Field perimeter (feet or meters)
- Field creation start date or time
- Line type (with or without boundary, i.e. continuous field boundary, A-B line or curve)
- AB length and units (feet or meters)
- Productive area (when area features are subtracted from the total field area)
- Software version number



Plan View Map showing field boundary mapping

Background Map Display†

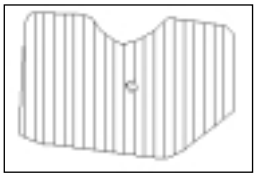
Background layers† can be displayed on the Plan View Map to help operators find the right field for their applications, avoid existing obstacles such as waterways or to help guide soil sampling. Any ESRI Shapefile can be loaded onto the CompactFlash data card and displayed as a background layer to assist navigation.



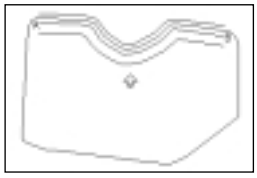
Plan View Map showing background layers

Guidance

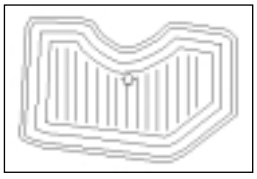
The *Ag*GPS 170 Field Computer offers a variety of guidance patterns. These include:
- Straight line parallel guidance
- Curve parallel guidance
- Headland (end row) guidance
- Spiral guidance
- Racetrack (half-field and crop-circle)
- Skip N
- Squeeze
- Line feature guidance†



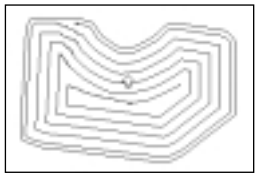
STRAIGHT LINE PARALLEL GUIDANCE PATTERN



CURVE PARALLEL GUIDANCE PATTERN



HEADLAND PARALLEL GUIDANCE PATTERN



SPIRAL GUIDANCE PATTERN

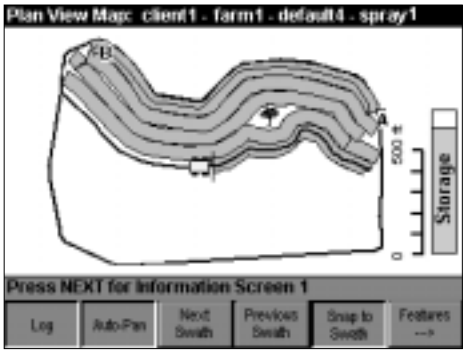
The lightbar is mounted on the dash or suspended from the cab roof so it is easy to see in the operator's peripheral vision. A row of bright lights (Light Emitting Diodes or LEDs) along the lightbar display off-track error to the operator which are then used to steer back onto the center of the current swath line.

The *Ag*GPS 170 Field Computer Plan View Map display helps orient the operator by depicting the field boundary with any completed or uncompleted swaths shown plus any marked features or obstacles in the field. You can minimize soil compaction with your field work since swath pattern and swath width settings are saved with each field.

Record-Keeping

The *Ag*GPS 170 Field Computer automatically records a number of records for each field event. This information is stored directly onto a CompactFlash data card in ESRI Shapefile format. Other data can be stored if configured for special applications. The following data may be collected:

Event logging coverage maps: During field guidance operations the *Ag*GPS 170 Field Computer automatically creates a coverage map for each field event. When logging is on (i.e., while applying or planting), the coverage map is recorded. Logging can be manually controlled via softkeys or automatically controlled via external master spray or spreader switches.



Plan View Map with coverage logging during curve guidance

Event coverage maps are useful to graphically display the quality of the field operation. On the *Ag*GPS 170 Field Computer, swaths are colored according to the GPS status during the field event. For example, high accuracy sub-meter (less than 3 ft.) DGPS positions are shown as green; lower accuracy 1-10 m (3 – 30 feet) DGPS positions (high DOP or old DGPS correction age) are shown as yellow; positions collected with no differential correction are shown as orange; no GPS or invalid GPS positions are shown as red. The GPS status values are recorded in the coverage file for each DGPS position, allowing managers to check system performance for each event.

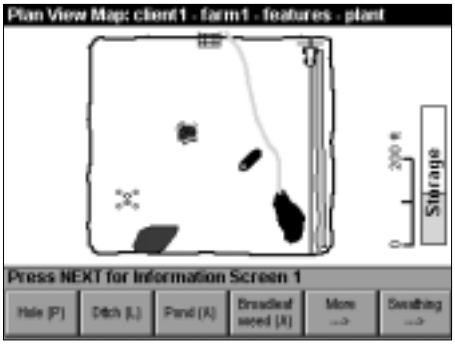
In addition to the swath width, an application width can be set to account for application areas being wider than the swath or boom width—coverage logging will show the actual application area. Some variable rate controllers can report which boom sections are active at any given time. For these controllers, the width of the coverage logging varies according to the currently active boom sections.

As-applied coverage maps: During field applications the *Ag*GPS 170 Field Computer records as-applied rates fed back from any supported application controllers. As-applied information from up to 10 channels can be relayed back and recorded in the *Ag*GPS 170. This applied information is stored as point data in Shapefiles at a user-specified log interval. Whether a prescription map is being used to apply materials or not, the *Ag*GPS 170 Field Computer will record the as-applied rate information relayed back from the controller.

Feature mapping: The *Ag*GPS 170 Field Computer enables fast and easy mapping of points, lines and area features. A default set of features, icons and colors are provided for agri-

cultural point, line and area mapping or you can set up your own unique features to suit your operation. When features are marked, they are shown on the **Plan View Map** as icons representing the feature. For example, a point icon is drawn on the screen for a weed plant, an area feature such as a pond is shown as a blue area, or a line feature such as a stream is shown as a blue line on the **Plan View Map**.

All features can be offset by a user-specified distance so it is easy to map features which are difficult to reach. Once a field is selected the color **Plan View Map** and **Information Screens** can be used to navigate back to selected features. If desired, area features such as ponds and rocks can be subtracted from the field area to calculate productive field areas. Features are logged in separate ESRI Shapefiles so they are easy to identify in the GIS.



Plan View Map showing point, line and area features

Detailed logging: An optional set of information can be collected to store point elevation data for topographic mapping, troubleshooting, and liability purposes. When detailed logging is on the following information is logged:

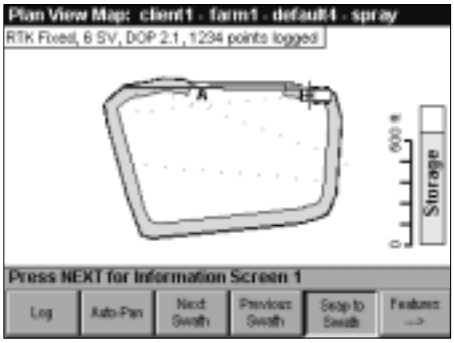
- Software version number, date and local time
- GPS status
- Ground speed (km/h or mph)
- Logging status (on = 1 or off = 0)
- UTC (Universal Time Coordinated) Time
- Antenna WGS84 latitude & longitude position
- Antenna height (Height Above Ellipsoid, HAE)
- Ground height (HAE)
- Mean Sea Level (MSL) height
- Heading
- Left hand boom size
- Right hand boom size
- DOP (Dilution of Precision) as a measure of GPS position quality
- Number of GPS satellites
- Swath number
- Correction age
- Units
- Offline distance
- Along line distance

Detailed logging can be used when troubleshooting your *Ag*GPS 170 Field Computer. If a problem is reported, a support technician may ask you to collect some sample data with detailed logging on to enable quick and accurate technical support.

Topographic Mapping

Using the *Ag*GPS 170 Field Computer with the *Ag*GPS 214 high accuracy receiver makes the collection of accurate topographic maps very easy. The detailed logging and field boundary files can be loaded into GIS tools such as:

- ESRI's *ArcView* plus extensions *Spatial Analyst* and *3D Analyst*
- SST Development Group's *SSToolbox* and *SSToolbax Lite*
- Agris's *AgLink*



Plan View Map while collecting topography data

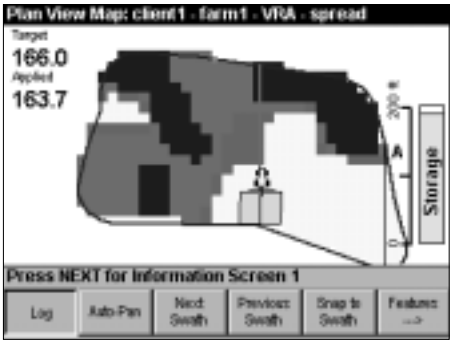
Use the lightbar to ensure even coverage and collection of elevation points across the field. While collecting topo data, the Plan View Map provides you with additional information—number of points collected and the high accuracy status (RTK Fixed, RTK Float or DGPS)—so you can be sure you're collecting the highest quality data for your topographic map.

Variable Rate Application

The *Ag*GPS 170 Field Computer enables site-specific variable rate applications and planting. Prescription maps can be loaded from a range of agricultural GIS software into the *Ag*GPS 170 Field Computer as ESRI Shapefiles. GIS software supported includes:

- ESRI's *ArcView*.
- Agris's *AgLink*
- SST Development Group's *SSToolbox* and *SSToolbox Lite*
- Agronomy Service Bureaus's *AgInfo*

Once loaded, the prescription maps are displayed on the **Plan View Map** showing rates as different colors. Current target and actual application rates are also displayed in the upper left hand corner of the **Plan View Map** so operators can quickly monitor rate changes.



Plan View Map showing variable rate prescription map

The *Ag*GPS 170 Field Computer currently interfaces to the following controllers:

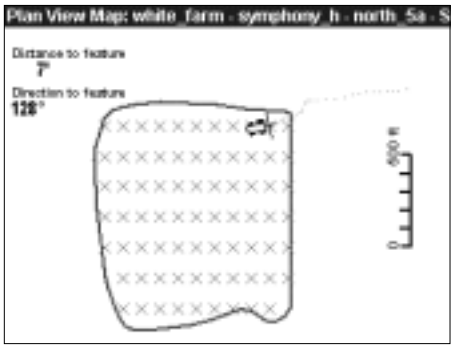
- Mid-Tech *(TASC 6000, 6100, 6200, 6300, 6500, 6600, version 4.0 new format)*
- Raven *(SCS 440, 450, 460, 660, 700, 710, 750, 760)*
- Rawson *(Accu-Plant, Accu-Rate)*
- New Leader *(Mark III and Mark IV)*
- DICKEY-john *(Precision Control System PCS, Land Manager I, Land Manager II)*
- Teejet *(844)*

Office Management of Field Work

Work orders can be created to specify event details (client, farm, field name, prescriptions, variable rate controller equipment settings etc), minimizing the hassle for field operators with many jobs ahead. If a work order is on the data card, job or event information will appear on the *Ag*GPS 170 allowing the operator to quickly select which event they want to do next. This saves time–operators simply need to select the job and check its details rather than entering all details. Managers can use any dBase editor, such as Microsoft Excel to create the work order in the office.

Soil Sampling

Soil sampling schemes can be loaded from a GIS as ESRI Shapefiles or generated using sample grids or background layers† to direct zone-based sampling. Specifying the closest point or the point number initiates the navigation. The selected point is highlighted and is easy to navigate to with sample point information (e.g. sample number, distance to sample point and bar code info) and sampling pattern displayed on the **Plan View Map**. The lightbar also displays critical information to help operators navigate to the correct sample point. If obstacles or sampling problems exist at a particular point it is easy to mark the actual sample location using the softkeys. The *Ag*GPS 170 Field Computer interfaces to an RS-232 bar code reader to facilitate sample collection.



Soil Sampling grid and navigating to points on the Plan View Map

GIS Data Transfer

All *Ag*GPS 170 Field Computer data is recorded directly in ESRI Shapefiles enabling efficient data transfer to a wide range of office software including:

- ESRI's *ArcView* and *ArcExplorer*
- Microsoft's *Excel* (dBase editing)
- Agris's *AgLink*
- SST Development Group's *SS Toolbox* and *SSToolbox Lite*
- Agronomy Service Bureau's *AgInfo*
- Farm Works' *Site Pro*

The ESRI ArcExplorer software is included with the *Ag*GPS 170 Field Computer and is recommended for simple viewing and printing. Most agricultural GIS packages today can import and use Shape and dBase files, enabling widespread easy access and transfer of the *Ag*GPS 170 Field Computer data. The summary data for each field event can be used to generate simple reports for you and your customers.

ArcExplorer showing AgGPS 170 Field Computer data layers

CONCLUSION

Trimble's *Ag*GPS 170 Field Computer is a highly accurate precision agricultural guidance, field and feature mapping, variable rate, soil sampling and record-keeping system that is designed to enhance your existing precision agricultural equipment. With it, you can save both time and costs by improving efficiency, offering the full range of site-specific services and ensuring the accuracy and maintenance of your records.

The *Ag*GPS 170 Field Computer builds on the successful *Ag*GPS Parallel Swathing Option and *Ag*GPS receiver technology. It is this full functionality and modular structure, combined with innovative hardware design, simple operation and installation procedures, that enables the *Ag*GPS 170 Field Computer to set the standard in precision agriculture applications today.

EQUIPMENT SPECIFICATIONS

*Ag*GPS 170 Field Computer

Weight	< 2.72 kg (<6 lb) excluding mount
Size	180 mm W × 228 mm H × 89 mm D (7.1" × 9.0" × 3.5")
Display	140 mm (5.5") diagonal, QVGA (320 × 240) active matrix LCD, 16 color sunlight-readable scratch-resistant low-glare glass
Software	*Ag*GPS 170 Guidance, Variable Rate, Mapping & Soil Sampling Software v3
Power	Range 9-32 volts, reverse-polarity, over voltage and load-dump protected. Typical 20 watt input. Maximum 25 watt input.
Ports	Single rear-mounted Mil-C-26482 connector providing: 3x RS-232 serial ports, 2x CAN 2.0B (J1939/ISO 11783) ports 3x switched input ports 1x audible alarm port 38400 baud IrDA port
Keypad	Display keypad has 6 softkeys, 4 arrow keys, 1 power key; 17 keys total. External keypad has 6 keys.
Operating Temperature	–22°F to 140°F (–30°C to +60°C)
Humidity	100% condensing humidity, unit fully sealed
Housing	Dust proof, waterproof, shock resistant, fully sealed Cast aluminum housing with rear heat sink
Data Storage	Removable CompactFlash data card and PC card adapter provided
Other	FCC Class B, CE Mark

Optional Accessories for the AgGPS 170 Field Computer

CompactFlash PC Card Adapter	**Part Number 38364**
8 MB CompactFlash Card	**Part Number 38363**
Cable and Junction Box	**Part Number 38776-00**

MODULAR *Ag*GPS FIELD MANAGEMENT SYSTEM

The Trimble *Ag*GPS Field Management System can be custom built by combining a number of Trimble *Ag*GPS products. You choose the components to create an *Ag*GPS Field Management System that suits your needs. To form the top-end *Ag*GPS Field Management System, you need each of the following three items:

- *Ag*GPS 170 Field Computer System
- *Ag*GPS Parallel Swathing System
- *Ag*GPS Receiver

AgGPS 170 Field Computer System **Part Number 38381-00**

- Field Computer
- Cable and Junction Box
- CompactFlash PC Card Adapter
- CompactFlash data card
- Shock Resistant Tilt and Swivel Pole Mounting Bracket
- *Ag*GPS 170 Field Computer User's Guide
- Quick Reference Card
- ESRI ArcExplorer software

AgGPS Parallel Swathing Option **Part Number 34623-00**

An _AgGPS Receiver* of choice

- Contact a Trimble representative for model numbers and order details

RELATED INFORMATION

- *Ag*GPS Parallel Swathing Option Datasheet
- *Ag*GPS Precision Agriculture Solutions Interactive CD
- *Ag*GPS 214 Technical Notes
- Trimble's *Ag*GPS web site - http://www.trimble.com/precise/agri

* When an *Ag*GPS receiver is connected to the *Ag*GPS 170 Field Computer, the Everest™ and Fast Rate™ options are automatically activated. A number of options exist for each receiver—see specific *Ag*GPS receiver product literature for more details.

Alternative DGPS receivers can be used with the *Ag*GPS 170 Field Computer, by setting them to output a NMEA GGA and ZDA, or GGK message to the field computer. However, additional cabling is not provided to interface to alternative DGPS receivers and GPS performance is not guaranteed with non-Trimble sensors.

† Available in *Ag*GPS 170 Version 3 software.

Trimble®
ADDING VALUE TO GPS

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