SURVEY PRO

GPS Quick Start Guide

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Before You Leave the Office

- Make sure your software is registered. Go to <u>Register Modules</u> on the <u>Files</u> menu. Check to see that at least the Standard and GPS modules are registered.

- If you are using a geoid model, make sure the correct *.GGF data file is on the data collector.

- If you are using a grid datum transformation, make sure the correct pair of *.DGF files are on the data collector.

Note: Geodetic data files must be in the proper geodata folder. For Windows Mobile 5 devices, this will be 'My Device\Geodata'. For Pocket PC 2003 devices, this will be 'Built-in Storage\Geodata'. For Windows CE.net devices, this will be 'Disk\Geodata'.

- Make sure your equipment all works together. Some equipment settings can not be configured using Survey Pro. You should set up your base and rover and do a short test session to ensure:

  - ➢ The base and rover modems are programmed with the correct channels and protocols. Although you can change some modem parameters with Survey Pro, you need to make sure they are correctly configured with the manufacturer's software application.

  - ➢ The GPS receivers' internal data storage has been backed up and emptied. Although you can download and delete receiver files from some brands of receiver, this function is not available on all receiver brands and models supported in Survey Pro..

  - ➢ The base and rover receivers support compatible RTK correction formats. This is especially important when using older and newer base and rover pairs, or mixing equipment from different manufacturers.

  - ➢ All additional equipment, such as batteries, cables, GPS antennas, external data modems and antennas, range poles, tribrach adapters, etc… are in working order.

Survey Method: RTK or Post Processing

This section describes:

- ➤ The two different types of GPS data collection supported in Survey Pro.
- ➤ How to make a GPS receiver profile for an RTK base, RTK rover, Ntrip rover, and post processing receiver.

Using GPS for precise surveying requires data from two receivers collected at the same time. Survey Pro supports two different methods of GPS data collection: Real Time Kinematic (RTK) data collection and post processing data collection. The RTK method uses a modem to send data from a base receiver to a rover receiver, and the measurements are combined at the rover receiver to calculate positions in real time. The post processing method involves logging the raw GPS measurements to a file on a disk, and then combining the measurements using PC software to calculate positions some time after the data is collected in the field.

The active receiver profile will set the method of data collection in Survey Pro. Creating a receiver profile for an RTK base, RTK rover, Ntrip rover, and post processing only receiver is described below. RTK and post processing data collection are described in the following section.

Receiver Setup

Before you can start surveying, you need to create a receiver profile. A receiver profile describes the mode and settings used when that receiver is the active instrument. The Receiver Setup screen is used to create or edit receiver profiles.

The easiest way to create a receiver profile is to start a survey, then tap Create New Receiver when prompted to connect to an instrument. You can also access this button from the Job | Settings | Receiver screen.

Choose a name for this profile, and select the brand and model. Next, set the communication parameters for this receiver. Usually you can just tap Defaults and then connect to your equipment. However, if your equipment has been configured before with different communication parameters,

you can use Autodetect to determine what the current settings are in the receiver. To change the receiver communication settings, select the new parameters and tap Set Rx Comms.

Bluetooth Note: You can use Bluetooth to connect to a Bluetooth enabled receiver. In some cases, you can also use Bluetooth to connect to a cellular phone to use as a data modem. How to use Bluetooth to connect to the receiver and/or the phone will depend on the data collector platform you are using. Consult the users and reference manual for more detailed information on Bluetooth setup and operation within Survey Pro.

Once you are sure you are talking with the receiver, tap Receiver settings… to open the Receiver Settings screen.

Receiver Settings

Use the three cards of the Receiver Settings screen to set the following parameters:

Receiver Mode and Correction Formats

Survey Pro can control a GPS receiver in one of four modes:

> ➢ RTK Base
> ➢ RTK Rover
> ➢ Ntrip Rover
> ➢ Post Processing

If you are using an RTK base or RTK rover, you must specify the RTK Correction Format to broadcast from the base to the rover over the modem. Choices here will depend on your receiver model. You must choose the same format for the base and rover. If you are using an RTK rover, you can set any special rover handling options. If you are using an Ntrip rover, the correction format and special handling is chosen when you connect to the server. If you are using a post processing receiver, no correction format setting is required. This card is also used to set the elevation cutoff for tracking satellites.

Data Modem

For RTK base, RTK rover, and Ntrip rover receivers, you must choose a data modem type and configure the communication settings between the receiver and the modem hardware. The choices of data modem will be different for base and rover, and will vary between brands. If your specific modem hardware is not listed in the interface, you can choose Generic Serial and set the baud rate and parity for the receiver to send data to the modem device.

General Settings

This card is used to pick brand and model specific settings. The settings on this page will depend on the receiver model. For more information, see the Reference Manual.

Post Process Settings

The Job | Settings | Post Process card is used to set the recording interval for logging GPS data for post processing. If you wish to setup logging of raw GPS data for post processing, either simultaneously with RTK data collection or for post processing only data collection, go to the Post Process settings card and select a Recording Interval.

RTK Data Collection and Stake Out

This section describes:

➢ How to start RTK data collection using the Start GPS Survey wizard.
➢ How to setup receiver logging for post processing data collection simultaneous with RTK.
➢ How and when to collect control points to solve a localization coordinate system adjustment.
➢ How to use the different data collection functions
➢ How to use the different stake out functions
➢ How to select a map projection zone and how to setup a Ground Coordinate system.

Start GPS Survey

This function is your starting point for any RTK survey. The Start GPS Survey wizard will guide you through all the steps to pick a coordinate system, set up GPS equipment, solve any required coordinate system adjustment, and begin collecting data.

Start GPS Survey is located on the Survey menu when in GPS mode. Also, if you attempt to start any data collection or stake out function before you complete all the required GPS steps, the Start GPS Survey wizard will open to guide you through the setup.

The steps to complete GPS setup with the Start GPS Survey wizard will depend on what has been done in a job already. Each step is described below from the beginning of a new GPS survey.

Start GPS Survey - Choose One Point Setup

One point setup is a special case of the Start GPS Survey wizard. You can use one point setup any time you open a brand new job, and you want to start a new survey with ground level distances. Survey Pro will use Ground – TDS Localization mode to set a default coordinate system for ground distances, and then automatically solve the localization adjustment using your one job file point.

To start a job with one point setup, tap Start Survey with One Point Setup>, and then follow the prompts to set your base and rover GPS receivers. Upon completion of the rover setup you are ready to collect data

If you do not wish to use one point setup, choose Start Survey with Regular Setup> to choose a projection mode.

Start GPS Survey - Choose Projection Mode

If you are not starting a new job with one point setup, you need to choose one of two projection modes: Ground TDS Localization, or Mapping Plane. Choose to Use Ground TDS Localization> if your local coordinate system is a ground level survey, with no projection and no datum to define the relationship between geodetic and local positions. Choose to Select a Mapping Plane Zone> if your local coordinate system is defined by a conformal map projection and geodetic datum which you can choose from the database. The two projection modes are described below:

Ground TDS Localization Mode

In this mode, a default map projection is created with your first base setup. This default map projection is scaled for ground distances at the base height. You then collect GPS measurements on local control points and solve the localization adjustment. The localization adjustment is a 2D similarity transformation which translates, rotates and scales the default map projection's (y,x) into your local coordinates (N,E).

Mapping Plane Mode

In this mode, you setup a conformal map projection with a geodetic datum. This map projection and datum define the relationship between the geodetic positions (LLh) from the GPS receiver and local coordinates (N,E,Elev). You can select a mapping plane zone and geodetic datum from the coordinate system database, or you can key in your own custom projection.

After selecting a mapping plane zone from the database, if your RTK base is set on a known location, no additional steps are necessary to solve the coordinate system. However, if your base is set at a new point, and the survey was started from an autonomous GPS position, you will need to solve a localization adjustment for the mapping plane. The mapping plane localization adjustment is a 2D similarity transformation which translates, rotates and scales the inaccurate map projection coordinates calculated from your autonomous base setup into the correct coordinate system.

Start GPS Survey - Choose Base Setup

You have three choices for base setup:

Use Current Base

This choice is only available when you have already set a base in this Survey Pro job. Choose to Use Current Base> to skip the Base Setup screen and proceed to the next required step in the process (Rover Setup, Solve Localization, or Data Collection).

Set New Base

Use this choice when you need to connect to a base receiver, set it to begin broadcasting RTK corrections over the modem, and configure the base reference position in Survey Pro. After base setup, the next step is always Rover Setup.

Use Remote Base

Use this choice when an RTK base is already setup and broadcasting corrections. This includes using a GPS network server as your source for base corrections. This choice will open the Rover Setup page where you will set the rover receiver, get the base coordinate from the rover data link, and configure the base reference position in Survey Pro.

After rover setup, if the coordinate system is set and properly adjusted, you will go directly to Data Collection. If you need to solve a localization adjustment, your next step will be to collect control points and then solve the coordinate system adjustment.

Start GPS Survey - Connect to Receiver

Before you proceed with the Start GPS Survey wizard, you will be prompted to select a receiver to activate with the Connect to Receiver screen, which will show a list of either: RTK base profiles; RTK rover plus Ntrip rover profiles; or post processing receiver profiles. If you have used your equipment with this data collector before, then your profile is remembered and you can proceed by tapping Connect>. You can also tap Create New Receiver to make a new profile, or Receiver Settings to modify properties of an existing profile.

Base Setup

Use the <u>Base Setup</u> routine to set an RTK base receiver to begin broadcasting GPS measurements over the modem data link, and to configure the base reference position in Survey Pro. At the <u>Base Setup</u> screen, measure the base antenna and choose a point for the base station. You can enter a new point name to start the base from an autonomous position, or you can enter a point with known coordinates and start the base on a known location. Tap Next> to set the base.

Set Base at Known Position

If you select an existing point with geodetic coordinates, or if you have a coordinate system solved and you pick an existing point where we can compute geodetic coordinates, you can start the base with a known position. Tap Set to set the base and configure the reference position in Survey Pro. If you have a Recording Interval set, a file will be opened to log raw GPS data for post processing, and the point name and antenna height will be written to the file for this static session.

Get Autonomous Position and Set Base

If your base point is a brand new point in this job, or, if it is an existing point with local (NEE) coordinates but you do not yet have a valid coordinate system solved, then you can start the base with an autonomous position. Tap GET Position From Receiver to get the latest autonomous coordinates (+- 10m) at the base and use this as the initial reference position in your survey. Tap Set to set the base and configure the reference position in Survey Pro. If you have a Recording Interval set, a file will be opened to log raw GPS data for post processing, and the point name and antenna height will be written to the file for this static session.

You will always have to solve a localization adjustment before collecting data from an autonomous base.

Start GPS Survey - Rover Setup

Once the base is set, or if a remote base is already set and broadcasting, you can proceed to the <u>Set Rover</u> screen. You are prompted to connect to a receiver. If you choose an RTK

rover receiver, you will proceed directly to the Set Rover screen. If you choose an Ntrip rover, you are prompted to select an Ntrip service, then you proceed to the to the Set Rover screen.

Select Ntrip Service

When using an Ntrip rover, Survey Pro opens the internet connection, queries the GPS base server for the available Ntrip services, and displays these services in a list. Pick a service and tap Connect > to proceed to the Set Rover screen.

Set Rover

Measure the rover antenna height, then tap Set>. The receiver will be put in RTK rover mode, and will monitor the data link until it receives the base reference position. Survey Pro will check the point database for a matching point. If you are using a remote base, we will find a matching point or prompt you to store a new point. If you are using the base station you just set in the previous step, then this check serves as error detection.

If you have a Recording Interval set, a file will be opened to log raw GPS data for post processing. This file will be opened for stop and go sessions, so the antenna heights and point names will be written to the file simultaneously with each RTK point occupation.

Start GPS Survey – Solve Localization

You need to solve a localization adjustment whenever you start a survey from an autonomous GPS position. Step one is to use the Control Points screen to collect GPS measurements on points with known local coordinates. Step two is to use the Solve Localization wizard to calculate the localization adjustment parameters. You can also tap Start Now> to begin surveying right away with a temporary localization adjustment.

Collecting Control

Tap Collect Control> to launch the GPS Control Collection screen. Choose existing points from your job to use as GPS control points, and occupy those points with the rover receiver.

You need a minimum of two horizontal control points to solve a Ground – TDS Localization mode horizontal adjustment. You need a minimum of one horizontal control point to solve a Mapping Plane mode horizontal adjustment. You need a minimum of one vertical control points to solve a vertical adjustment using a geoid model. You need a minimum of three control points to solve a vertical adjustment without a geoid model.

Once you have the minimum required number of points, you will see a prompt. You can solve the adjustment at that time, or you can choose to collect more control, and then tap Projection to solve the adjustment later.

Solve Localization

Once you have collected the required number of horizontal and vertical control, you can solve the localization adjustment. Tap Solve Localization... to open the Solve Localization wizard where you can pick from the available control points to calculate the coordinate system adjustment.

Once you have solved the adjustment you are ready to start data collection or stake out.

Start Now

When a localization is required, but you do not have the necessary control information in the field, or if you want to begin collecting data and you wish to occupy the required control later in the survey, you can also tap Start Now> to begin surveying right away. In this case, you start surveying with a temporary localization to get you close to local coordinates. You may then solve the localization at any time during the survey field work, or even after the field work is finished, and all GPS collected points will be updated to the proper local coordinate.

Mapping Plane Zones and Ground Scale

If your horizontal projection mode is Ground – TDS Localization, you do not need to worry at all about map projections, datums, or scale for ground distances. The default projection and localization adjustment take care of that for you.

If you are using Mapping Plane mode, you need to select a map projection from the database, and if you going to measure distances on the ground with an EDM, you need to apply a scale factor. Applying a scale factor can be done in one of two ways :

➢ You can use the selected mapping plane zone, with or without a localization adjustment, and apply a combined scale factor. When you use mapping plane and a combined scale factor, the horizontal distances are scaled to the map grid. To set the combined scale factor, go to the <u>Job</u> | <u>Settings</u> | <u>Surveying</u> screen, check the Use Scale box and tap Compute Scale. Select your conventional occupy point and follow the wizard instructions.

➢ You can use the selected mapping plane zone, with or without a localization adjustment, and setup a Ground Coordinates system. The Ground Coordinate system will scale the mapping plane coordinates to ground level. When you use Ground Coordinates, the horizontal distances are 1:1 to the grid. To set a Ground Coordinates system, go to the <u>Survey</u> | <u>Projection</u> screen and tap Setup Ground Coordinates… . Follow the wizard instructions to set up Ground Coordinates and adjust all of the job file points to the new system.

Data Collection

Data Collection Settings

Use the <u>Job</u> | <u>Settings</u> | <u>Measure Mode</u> screen to control how the receiver collects data, what raw data to write for each point, and what criteria to check before accepting GPS positions.

Receiver Dynamics:
- ➢ Static on Occupy: will set the receiver to 'static' mode for point occupations. When in static mode, the receiver assumes no antenna movement and uses advanced averaging techniques to compute the most precise position possible.
- ➢ Dynamic Always will leave the receiver in 'dynamic' mode for point occupations.

Store GPS Raw Data:
- ➢ Lat, Lng, Ht will store an EP record in the .RAW file for each point accepted.
- ➢ EP + Bl,CV will store an EP record, plus the raw base line and variance covariance information in the .RAW file (or .OBN file for Ashtech users)
- ➢ EP + Bl,CV + Rx Raw will store the EP,BL,CV records in the .RAW file (or .OBN file for Ashtech users), and send the station information to the observation file for GPS post processing data collection.
- ➢ EP + Rx Raw will store an EP record in the .RAW file and send the station information to the observation file for GPS post processing data collection.

Accept Solution Quality and Criteria:
- ➢ Select to Accept either Fixed RTK only, or Code, Float, or Fix positions.
- ➢ Choose a measurement criteria. Any non-zero values will be used to check positions before they are stored.
- ➢ If you want to automatically store points that meet your criteria after five epochs of data collection, check the Automatically accept data collection points box.

Epoch Averaging:
This setting controls how many epochs of data Survey Pro will use to average the final position. It should usually be set to 1.

Note: Epoch Averaging should not be used when you Receiver Dynamics are set to Static on Occupy. With any current GPS firmware, a receiver in static mode will use a least squares technique to give a progressively more precise position with each subsequent epoch. Epoch Averaging in Survey Pro is a simple averaging technique intended for old firmware or when you are set to Dynamic Always.

Data Collection Functions

There are different methods to collect data:

Point : Use this function to take the most precise measurement to a point. Depending on your settings, this function will put the receiver into static mode, mark the event in the post processing logging file, and open the Occupy Data Points screen where you can remain in static mode for the desired length of time and store the point.

Store SS : Use this function to quickly store a point with slightly less precision. This function will use the latest receiver position from the status message to store a point. The receiver is not set to static mode and the Occupy Data Points screen is not opened.

Offset : Use this function when you can not occupy the point of interest directly with the RTK rover. This function allows you to occupy a reference point and then measure an offset distance (manually or with a laser range finder) to the point of interest.

Feature : Use this function to collect multiple points with an auto incremented point name. You can use a time or distance interval to collect points continuously all with the same description, layer, and attributes, or you store points manually and be prompted for descriptions, layers, and attributes for each point.

Control : Use this function to launch the GPS Control Points screen, where you can add control points to your localization adjustment, or take a check measurement to an existing control point.

Post Process : Use this function to launch the RTK Rover Session screen, where you can collect a separate stop and go session in the receivers post processing log file. This function is only applicable when you are doing simultaneous RTK and post processing data collection.

Stake Out

Stake out with GPS is very similar to stake out with conventional instruments. See the User's Manual for details

on the different staking procedures. Below is a description of the two special features of stakeout with GPS.

o ⬚ >Roving ⬚ / ⬚ >Occupying ⬚

➤ When you first open any GPS staking screen, the GPS receiver is in dynamic (moving) mode. This is necessary as you navigate to the design point, and is indicated on the screen with the toggle button in the ⬚ >Roving ⬚ position.

➤ When you arrive at the design point, if you want to take a more precise measurement, you can switch the receiver to static mode by tapping the toggle to ⬚ >Occupying ⬚ . This will change the receiver dynamics (depending on your setting) and allow for the most precise measurement on the design or as built point.

Note: When Store GPS Raw Data on the <u>Job</u> │ <u>Settings</u> │ <u>Measure Mode</u> screen is set to + Rx. Raw (and / or +OBN for Ashtech), switching from ROVING to OCCUPYING will start a session in the receiver, so you will be prompted for a point name and description. The receiver session will be completed and the measurement stored when you tap ⬚ Done ⬚.

Note: The behavior for stake out is to start all staking screens in 5 Hz update mode. This sets the receiver to update positions five times a second to make it easier to find the design point when in ⬚ >Roving ⬚ mode. However, the receiver is always less precise in 5 Hz mode, so when you toggle to ⬚ >Occupying ⬚, we automatically set the receiver to 1 Hz updates to allow for the most precise measurement

Post Processing Data Collection

Data collection for post processing involves storing GPS raw data to a file on disk. The file is usually stored on the receiver's internal memory, but for certain brands and models, you can also store the data to a file on the data collector. Raw data from multiple receivers is combined and then PC software is used to process the base line measurements. This section describes:

> ➢ How to open a data file and start recording GPS raw data for post processing.
> ➢ How to start and stop static (fast static) as well as stop and go data collection.
> ➢ What to do with the data.

Note: If you wish to log post processing data simultaneous with RTK data collection, please see the previous section.

Post Processing Receiver and Settings

To do post processing data collection, you need to make sure recording is not set to Off when setting up the receiver you want to do post processing data collection with. You can also go to the Job | Settings | Post Process screen to select a special layer for post processing points, and to turn on the Session Monitor to warn you if data collection criteria is exceeded during post processing sessions.

Start Receiver Recording

To open a data file and begin logging GPS raw data, go to the Survey | Post Processing screen. Choose the recording interval and then choose Start Static > if you intend to leave the receiver stationary over a point for the entire session, or choose Start Stop/Go > if you intend to move around with the receiver and stop on data collection points.

If an antenna height is already known, it will be entered for you, otherwise enter the antenna height and enter the site ID and description. If you start a static file, the Static Receiver

Session screen is opened. Tap Apply to write the information to the post processing file. You can remain connected to the receiver to monitor the entire session, or you can leave it to log the data file unattended. If you start a stop and go file, the Static Receiver Session screen is opened for post processing data collection as described below.

If the connected receiver is already recording data, you can tap Stop Recording to end logging.

Post Processing Data Collection

After recording is started, the Static Receiver Session screen is opened. You can also access this screen by going to the Survey | Data Collection menu and choose to connect to a post processing receiver. Use the following controls for post processing data collection:

Store Point In:

> ➢ Receiver and job file will mark the event in the post processing logging file, and store a point in the Survey Pro job. You can use this mode to save attribute or layer information in the Survey Pro job file.

> ➢ Receiver file only will only mark the event in the post processing logging file. In this mode, the Site ID does not need to be a unique point name, and nothing is stored in the Survey Pro job file. A note record is made for this occupation in the Survey Pro raw file.

NOTE: By default, post processing points are stored in the Survey Pro job file are put on a special layer to distinguish them from other data collected points. Points stored in Survey Pro job file will have a plane coordinate of (0,0,0) and a geodetic coordinate from the receiver's autonomous position.

Session Duration:

> ➢ Enter 0 or check Log Until Stop to have this session run until you tap Stop.

> ➢ Enter the session time if you want Survey Pro to mark the end of the session automatically after the timed interval has elapsed.

Note: If you choose to do a timed session, you should not exit from the <u>Static Receiver Session</u> screen until the timed session is stopped.

- Tap $\boxed{\text{Start}}$ to mark the beginning of this site occupation in the receiver's raw data. If you are also storing the point in the Survey Pro job file, it is written to the file and to the RAW data now.

- Tap $\boxed{\text{Stop}}$ to end a session. You can also end a timed session before the interval has elapsed.

Note: Most receivers do not support 'canceling' a point occupation event after it is started. Therefore, even if you cancel the occupation in Survey Pro, you will still likely see the point occupation when the file is post processed.

End a Post Processing Session

When you want to stop recording post processing data and close the file, go to Survey > End GPS Survey screen. Once you tap $\boxed{\text{End}}$, recording session is stopped with the active receiver and you will be given the opportunity to download the post processing file to the data collector.

File Processing

- Use the software supplied by the receiver manufacturer to download the files to your PC.

- Use your GPS baseline processing software to combine the raw data from different receivers and generate GPS base lines.

Note: See the documentation supplied with your PC software for details on downloading and processing GPS raw data from the receiver's internal memory.