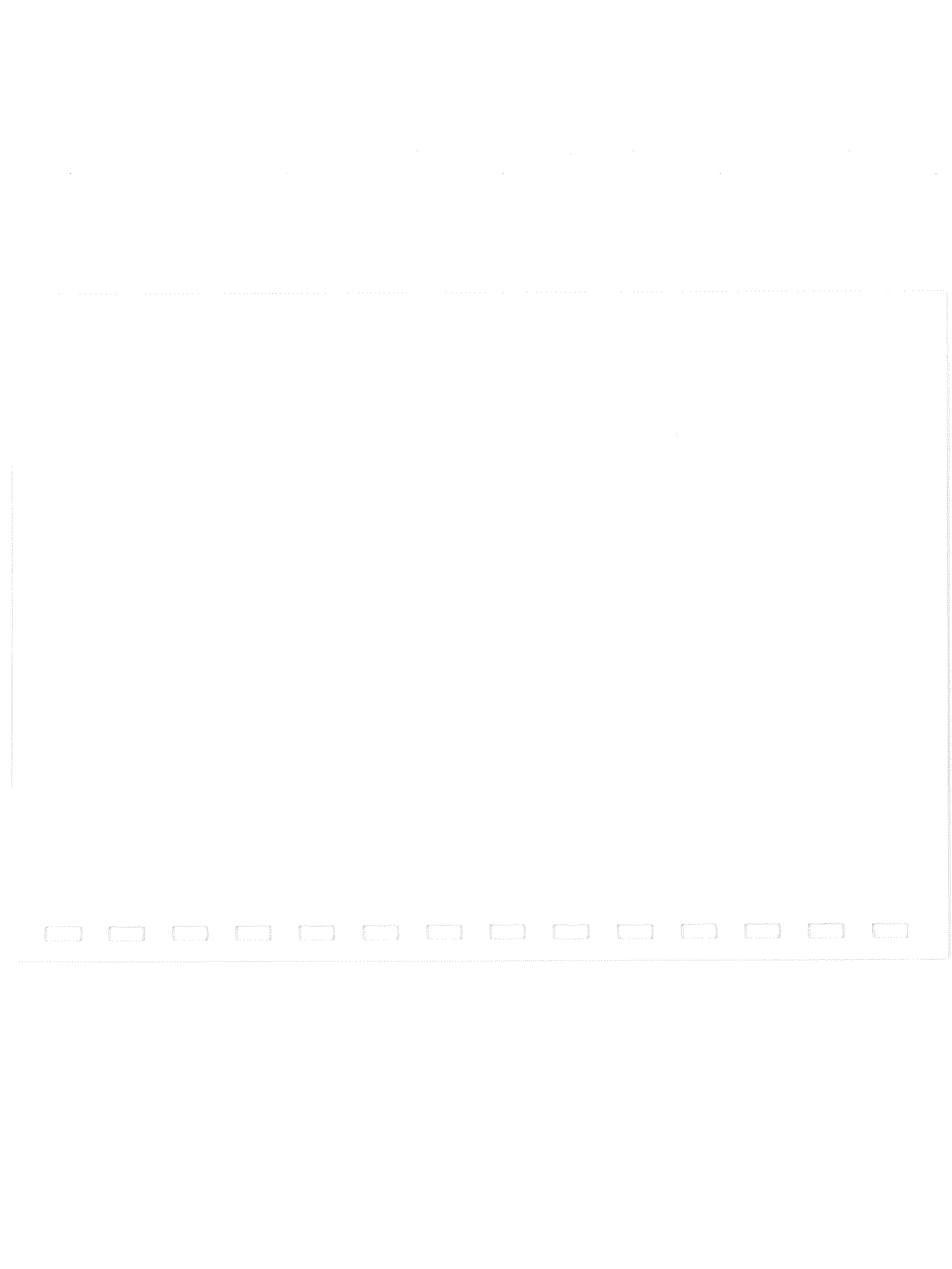
Nikon

AP800

FIELD INFORMATION SYSTEM SOFTWARE

Reference Manual



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Chapter 1

PreStart

Please Read Me!

You should only have to read this chapter once. ***BUT*** *make certain that you read it.* The information is provided to increase your productivity in the field and office.

Overview

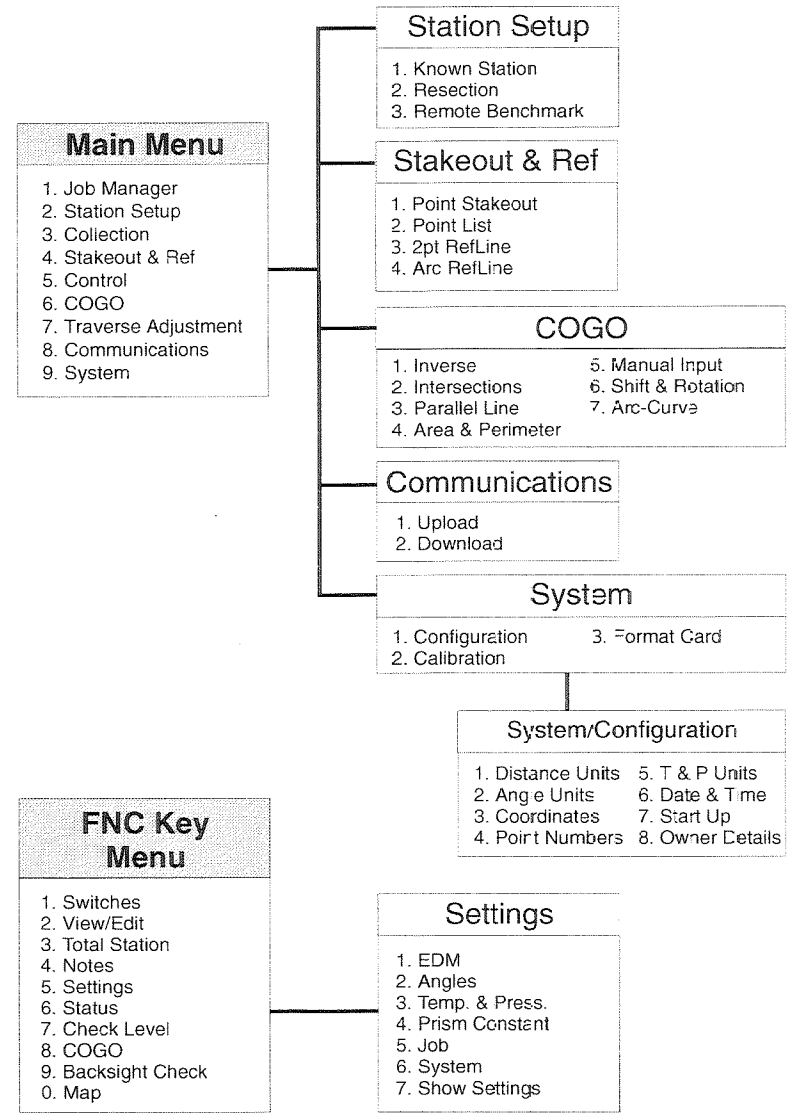
PreStart introduces the surveying, management, and technical programs you will use with the Nikon Field Stations DTM-851/DTM-831/DTM-821. You learn how the software communicates with you and how to respond.

Main Functions

The main functions of AP800 can all be accessed from the main menu. You will use most of the menu items frequently, with the exception of "System". A menu tree of the main functions and their respective programs is shown on the next page.

When the instrument is first turned ON or after a power reset the main menu is displayed. At other times the instrument resumes at the place where it was powered off from (for more information refer to "Resume" on page 2-14).

Menu Tree for the AP800 Application Software



Job Manager — *Manages Your Survey Data*

Enables you to open or create jobs, and to copy coordinates between jobs.

Station Setup — *Contains Surveying Programs*

Enables you to setup over a known or unknown station.

Collection — *Measures and Records Data*

Designed to optimize data collection in the field.

Stakeout & Ref — *For Staking Out Points and Reference Line Calculations*

Enables you to stakeout points and measure offsets from a reference line.

Control — *For Increased Measuring Accuracy*

Enables you to take multiple readings on both faces for increased accuracy.

Traverse Adjustment — *For Tracing and Adjusting Traverses*

Checks the misclose for closed traverses and can adjust the coordinates.

Cogo — *For Coordinate Geometry*

Contains a number of functions which enable you to calculate new design points while in the field, and inspect and work with your field measurements. In addition COGO allows you to manually input coordinates.

Communications — *Transfers Survey Data*

For uploading coordinates to the database and downloading raw data or coordinates from the database.

System — *For Customizing, Checking and Duplicating*

Allows you to: customize the software to your requirements; periodically check and if necessary adjust the hardware; and format data cards.

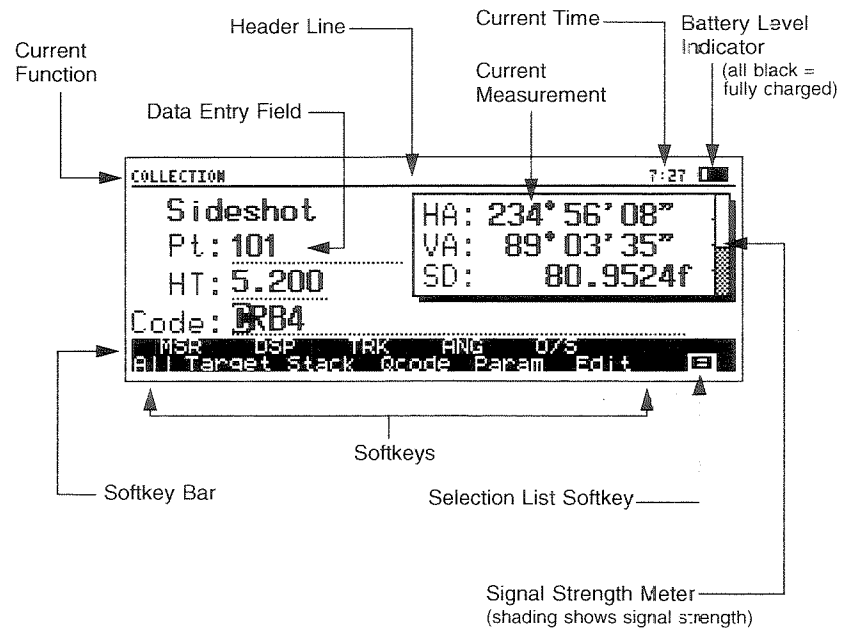
FNC Key — *For Swapping Functions*

Temporarily suspends the current function and allows you to:

Take a quick measurement; do a backsight check; map and graphically inspect points and observations; change tolerances; view and edit your data, and much more.

NOTE: You use the "FNC" key to display the FNC Key Menu.

Typical AP800 Screen

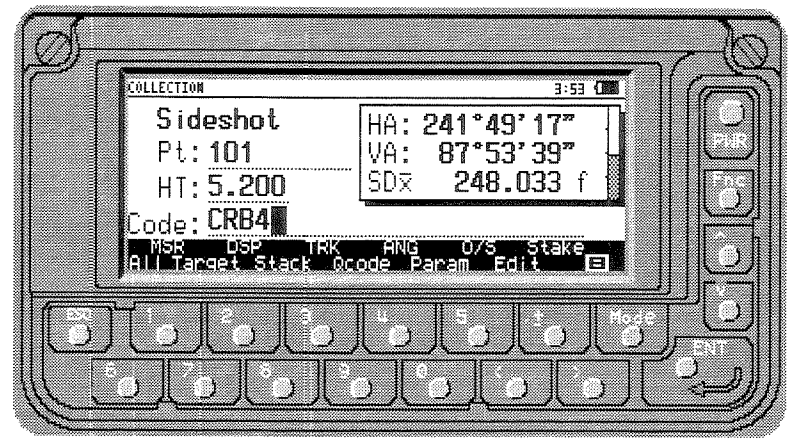


AP800 Keys

This section describes all the keys you can use with the AP800 software.

Keyboard Keys and Softkeys

Most keys on the keyboard have multiple functions. The active function of each key is shown in the softkey bar.



Keyboard Keys — Keys which have characters etched on them, e.g., "1," "ESC," and "↓".

Softkeys — Characters displayed in the softkey bar (the bottom two rows of the screen). There are alpha softkeys ("ABC" and "abc"); special character softkeys ("*#"); highlight movement softkeys ("PgUp"); and special softkeys for functions ("TRK") and feature codes ("TREE").

Survival Keys

PWR — Turns on and off the hardware and the AP800 software. The instrument can be turned off, under any circumstances, if the PWR key is held down for 5 seconds.

ESC — Exits the current window or screen.

Special note for data entry windows: — If you change the data in a field and you press the "ESC" key, AP800 deletes the data in the field and restores the previous value (shown in reverse video-white characters on a black background). Pressing the "ESC" key again exits the current window and AP800 asks you if you want to save any changes you may have made to other fields.

ENTER — Moves the cursor to the next field. Accepts all the data on the screen when the cursor is on the *last* field. Also records measurements within the "Collection" function.

Keys for Displaying and Selecting Softkeys

Mode — Changes the softkey mode to alpha, numeric, or measurement and displays the softkey labels in the softkey bar.

Alpha Softkey Mode

Includes the special character softkey "char" (displays *\?.:;&@! etc.) The Mode key exits the list of special character softkeys.

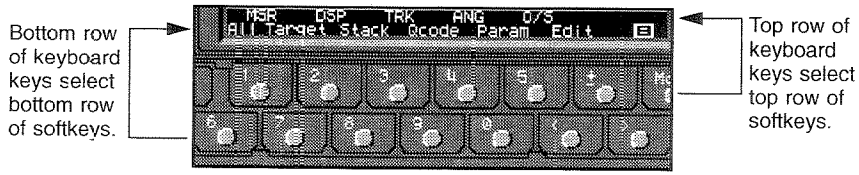
Numeric Softkey Mode

Measure Softkey Mode

How to Select a Softkey

With the exception of the "ESC" and "ENTER" keys, the bottom two rows of keyboard keys are used to select a softkey.

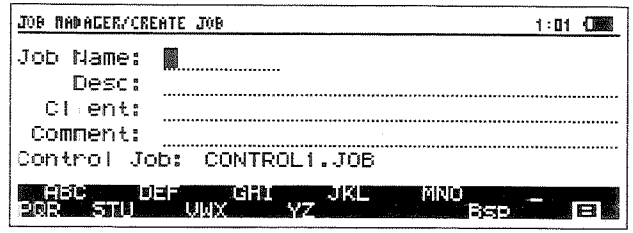
The top row of softkeys correspond with the top row of keyboard keys. In the example shown in the next figure, pressing the "1" keyboard key selects the "MSR" softkey, "2" selects "DSP", and so on.



Similarly, the bottom row of keyboard keys select the bottom row of softkeys. The "6" keyboard key selects the "ALL" softkey, "9" selects "Stack," and "→" opens the selection list.

NOTE: Sometimes there is only one row of softkeys displayed in the softkey bar (not shown). In such cases you use the top row of keyboard keys to make your selection.

How to Type Using the Softkeys



Typing the First Character — Alpha characters and symbols are normally grouped in threes on a softkey. One key press selects the first character (e.g., the "A" in "ABC"), two presses selects the "B", etc. When you hold down an alpha softkey, AP800 cycles through the alpha characters at a rate of one character every 0.5 seconds.

Typing Two Identical Characters — Select the first character and release the key. The cursor will automatically move to the right one space after a brief delay (the "System/Keyboard" setting enables you to alter this delay time, refer to page 13-13). Now press the same alpha softkey to display the correct character.

Typing a Different Character — When you press a *different* softkey the cursor automatically moves to the right one space and the first character on the softkey appears in the field. Pressing the same softkey again displays the next character.

Typing a Blank Space — Press the "spc" key. If it is not displayed, change to Alpha softkey mode and select "char," then press the "spc" key.

Typing Lower Case Alpha Characters — Change to Alpha softkey mode, then press "char," twice. Press the appropriate key.

☞ You can enter a *numeric* character in either Alpha Softkey mode or from within the special character set ("char"). Even though the numeric keys are *not* displayed, AP800 inputs the corresponding numeric when you press a softkey *four* times.

Example: Pressing the "ABC" or the "*\?" softkey repeatedly displays the following sequence of keys: A B C 1 or * \ ? 1.

When You Cannot Select a Softkey

The current function and data entry field determine which softkeys you can and cannot select. For example, AP800 will not accept an alpha character in a numeric field, such as "Stn Pt" (station point).

Keys for Moving Around

All Screens and Conventional Selection Lists

↑ and ↓ — Move the cursor or highlight up or down a menu and selection list.

Menus and Conventional Selection Lists

← and → — Move the cursor to the adjacent column in a menu and selection list. (The → also opens the selection list when it is available.)

Data Entry Fields

← — If the data is in reverse video, the cursor moves to the right of the last character in the field. Pressing "←" again moves the cursor to the left one character if the left arrow key is set to "←" (refer to page 13-21).

→ — if the data entry field is in reverse video, the cursor moves to the first character in the field. Pressing "→" again moves the cursor to the right one character.

Keys for Deleting Characters

Pressing any alpha or numeric softkey when the data is in *reverse video* deletes everything in the field and inputs the first character on the softkey.

When the field is in *normal video*, the "←" deletes the character to the left of the cursor if the left arrow key is set to "Bsp" (refer to page 13-21) and "bsp" is displayed in the softkey bar.

If you change the data in a field and you press the "ESC" key, AP800 deletes the current value and restores the previous one.

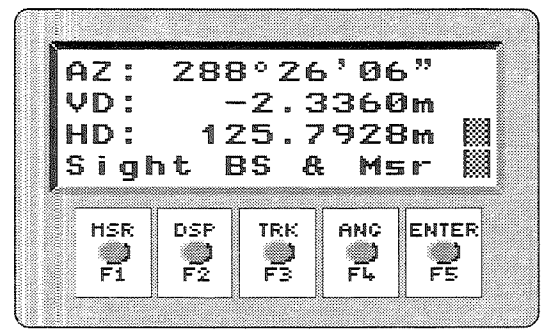
For the "Pt" (Point) field only: the ".+" key selects the "spc" softkey and replaces the character at the cursor position with a blank space.

Key for Selecting Special Functions

FNC — Displays a menu of special functions (see "FNC Key – For Swapping Functions" on page 1-4). You can press the "FNC" key at any time from within any program.

Keyboard Keys on the Rear Display Panel

The "MSR", "DSP", "TRK", "ANG", and "ENTER" keys perform prescribed functions. They perform the same functions as the softkeys on the front display panel.



Key and Procedural Conventions

From this point on the manual uses the following conventions when telling you which keys to press, actions you should take, or choices you can make.

HT — Bold text without square brackets normally refers to data entry fields or menu items where you are to type data or select an item.

[ESC] — Bold text between square brackets refers to a keyboard key you are to press.

[MSR] — Bold italic text between square brackets refers to a softkey you are to press.

• — A circular bullet refers to a step you are to carry out within a procedure.

>> — Small angle brackets refer to menu options.

☞ Tips and special notes to improve field productivity will be shown like this.

Using Menus and Selection Lists

How to Select from a Menu

Menu selections are made using the corresponding numeric key on the keyboard or by moving the highlight to the item using the [↑], [↓], [←], [→] keys, then pressing **[ENTER]**.

Using Selection Lists

Selection lists are field-specific and resemble menus. They may contain feature codes, station points, record types, and other data. There are two types of selection lists: "Conventional" and "Circular". They operate differently and have different icons.The selection list icon is displayed in the softkey bar when a selection list is available.

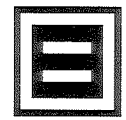
How to Open a Selection List

The cursor must be located at the beginning of the field before you can open the selection list. You open the selection list by selecting the keyboard key which matches the selection list icon in the softkey bar, such as the [→] key.

Conventional Selection List

Conventional selection lists normally contain many items, such as feature codes. "SELECT" appears in the top right corner when the list is open.

"NEXT" and "PREVIOUS" are shown if there are more items below or above those displayed. You select items from the list as you would from a menu.



Conventional Selection List Icon

Circular Selection List

Circular selection lists have relatively few items, such as "ON" or "OFF." Pressing the [←] or [→] key automatically inserts the previous item or next item in the list into the field.

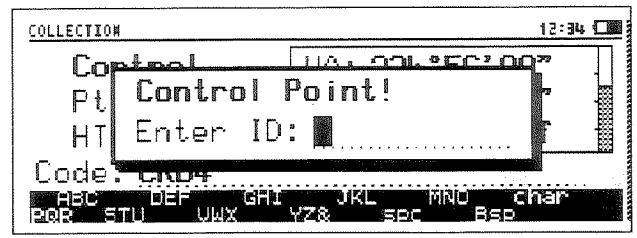
Circular Selection List Icons

How the Software Communicates with You

AP800 communicates with you through its data entry windows, status windows, question windows and error windows.

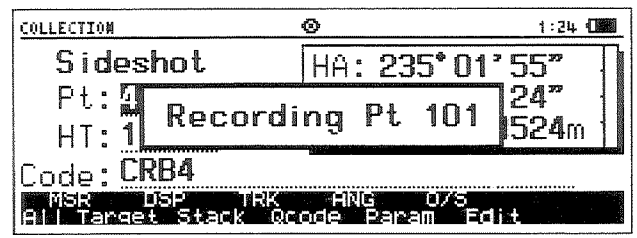
Data Entry Window

The flashing cursor in a data entry field prompts you for data. You may type or use a selection list depending on the data required.



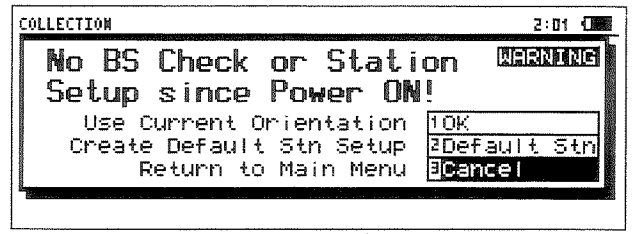
Status Window

Keeps you informed about what the program is doing, such as measuring or recording. No action on your part is necessary.



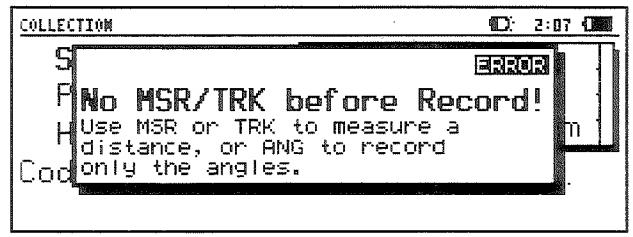
Choice Window

When the program requires you to make a decision it displays a warning message or asks you a question and gives you a choice of responses.



Error Window

Tells you the program has a problem with your input and may suggest corrective action. Use [ESC] or any other key to remove the window.



Chapter 2

Getting Started

Introduction

This section explains how to prepare the AP800 application software for use with Nikon Field Stations DTM-850/DTM-830/DTM-820. You are also introduced to the field procedures which AP800 can perform.

Loading the AP800 Application Software

Warning

Do not insert the data card at this point. It has not been formatted and will cause the instrument to hang.

Turn Power ON or OFF

Turn Power ON

- To turn on the instrument and start the AP800 application software, press the **[PWR]** button.

Turn Power OFF

Warning

To prevent data loss do not turn off the power when AP800 is recording a point to the data card. An "eyeball" symbol is displayed on the header line during recording.

- To turn off the system, press **[PWR]**, then press **[ENTER]**.

See also "Power Saving and System Reset Features" on page 2-15.

Tilt the Telescope

After you turn on the power, AP800 prompts you to "Tilt Telescope."

Prior to reading an angle you must locate and reset the vertical 0° position. You do this by tilting the telescope to the horizontal line in the Face Left position. The tilt telescope screen is optional. If turned off (see page 11-10) then the telescope can be tilted at any time before you start to measure.

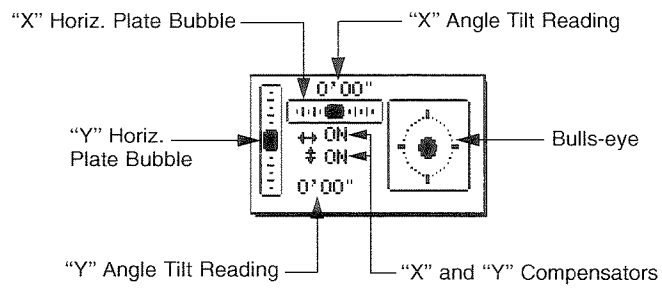
This screen also shows the date, time, contrast, and battery level. You can change all these settings except the battery level (see "Setting Up the AP800 Software" on page 2-5).

After you tilt the telescope AP800 prepares itself and displays the "Check Level" screen.

Check Level

This screen allows you to accurately level the instrument using the AP800 software and turn the leveling compensators on or off. Once the instrument is leveled, and assuming that the compensators are reading (turned on and adjusted within their working tilt range), the measured angles will be accurate.

NOTE: The leveling window pops up automatically during measuring if the instrument goes out of level while the compensators are turned on.



Leveling the Instrument

Three on-screen devices are available to help you to level the instrument. *You still use the instrument's leveling screws to adjust the level of the instrument.*

Bull's-Eye and X and Y Horizontal Plate Bubbles — Center the bull's-eye and bubbles.

X and Y Tilt Angle Readings — AP800 displays each reading *if* the compensator is turned "ON." Additionally, the leveling window pops up if the instrument goes out of level.

When a measurement is made, the X tilt angle compensates the horizontal angle and the Y tilt angle compensates the vertical angle.

Horizontal and Vertical Compensators

You can turn the horizontal and vertical compensators on or off. Use the ↑ and → to change the status of the compensators in the order **ON/ON, OFF/ON**, and **OFF/OFF**. (↓ and ← reverses the order.)

Warning

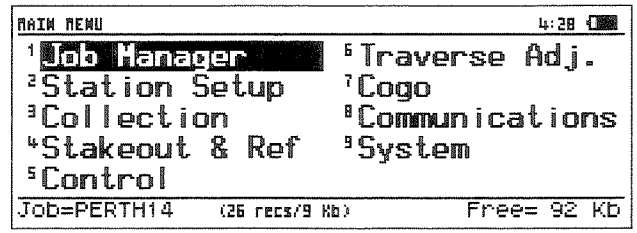
If you turn the compensators off they will remain off until you turn them on again. The current state of the compensators is maintained even if you turn the instrument's power off, then on again.

Closing the Leveling Window

- Press **[ENTER]** or *[Esc]* to close the window.

*NOTE: The software **will** allow you to close the window when the instrument is out of level, regardless of whether the compensators are on or off.*

Main Menu



The bottom line contains the name and size of the open job, for example, "PERTH14" and "DEFAULT" (discussed later). The AP800 software also reports the space remaining on the data card.

Error Message Received

AP800 reminds you to close the drive door or to insert the data card when it detects either problem.

- Take the appropriate corrective action.
- Press **[2]** to **Retry** starting the system.

Understanding Terms and Finding Functions

Glossary

A helpful Glossary of abbreviations and terms used by the AP800 software is found on page G-1.

Index

The Index at the end of the manual is designed to help you quickly find terms and functions.

Prepare the New Data Card

Format the Data Card

Survey data cannot be stored on the new data card until it has been formatted. You do not have to format a data card more than once. Formatting takes only two seconds and the procedure is covered on page 11-15.

Copy the Files to the Data Card

Copy the code file (**NIKON.COD**) and parameter file (**NIKON.PAR**) to the data card. Follow the procedure given in "Copying Binary Files to AP800" on page A-11.

Setting Up the AP800 Software

"Settings" and "System/ Configuration" Functions

These two functions allow you to customize AP800 to your requirements. "Settings", which can be accessed and altered at any time using the FNC key, lets you specify the code files, precision mode, tolerances, corrections, EDM power saving mode, and much more.

"System/Configuration", which is available via the main menu, lets you set distance and angle units, coordinate types, point number lengths, etc.

Please turn to page 11-1 and page 13-1 to familiarize yourself with these useful features.

"Switches" Function

You can also adjust the LCD light, sound volume, reticle light, and heater by using the "Switches" function (see page 12-3).

Owner Details

In order to personalize the software, you can enter the name and telephone number or address of the owner of the AP800 software. The "Owner Details" screen belongs to "System/Configuration". To enter the owner details:

- Select **System**, then select **Configuration**.
- Select **Owner Details**.
- For more information, please read "Owner Details" on page 11-11.

Managing the Job

You can create directories and jobs in a similar way as you would on a PC running DOS. AP800 can also read the directories and jobs you create using your computer. For more information, please refer to "Job Manager" on page 3-1.

Open Job

AP800 can be set to automatically open the last job (see "Start Last Job" on page 11-10) or you can use the job called "DEFAULT". Additionally you can use "Job Manager" to rename the "DEFAULT" job or open another job (see page 3-1).

Attaching Control Jobs

Control jobs give you access to established survey data that you can use in your current job to save time. For information on these special jobs, refer to "Attach a Control Job to the Current Job" on page 3-7.

Transfer Data

You can transfer data to and from an ASCII file on a computer or data card (see "Communications" on page 10-1).

Point (Record) Types

AP800 uses two-letter codes to identify the records for a job. For example, "ST" is a station setup record and "CP" is a shot to a control point. The record types are described in detail on page 12-6.

Copy Points

Survey points can be copied between jobs (see "Copy Coordinates Between Jobs" on page 3-10).

Check Data

"View/ Edit" allows you to search, check, and edit your data (see page 12-5).

Search Rules

The AP800 software frequently searches the job for specific points. Usually such searches are for the point with a known point number. However, the job can contain many measurement records with the same point number.

A well defined search rule enables AP800 to always find the correct point. For more information refer to "AP800 Search Rules" on page A-12.

Entering Long Point Numbers

AP800 allows you to use point numbers up to 9 digits. You can also define two parts of the point number. The first part or *repeating part* can be used to designate a particular survey, such as an area code for a cadastral survey.

The second part or *incrementing part* is automatically incremented by AP800 for each new point number. You define both parts of the point number in "Point Numbers" on page 11-7.

Using Point Numbers with a Repeating Part

Any point that is manually input or found in the open job is always displayed in the *current* point number configuration. The repeating part for a new point may be the same or different from the repeating part of a point number that already exists in the job.

When AP800 increments the point number in Station Setup or in Collection, it also assigns the repeating part of the last displayed point. *However, you must manually input the repeating part of the point number when you create a new job.* You only need to type the significant digits in the *incrementing part* because AP800 will insert the necessary zeros to correctly format the full point number.

Example: Suppose you type the repeating part **9876**, followed by the incrementing part, **23**, and press **[ENTER]**. AP800 displays the point number as **987600023** (assuming the point number is configured for 9 digits).

Additionally, when you move the cursor to a point number field, AP800 positions the cursor at the *first* digit in the *incrementing part* (e.g., **987600099**). To change the incrementing part, you type only the significant digits. For example, typing **23** and pressing **[ENTER]** displays, **987600023**.

You can also change the repeating part by using the ***[Bsp]*** softkey and retyping *both* the repeating part and incrementing parts.

Measuring With AP800

Measure Keys

You can measure to the prism by using *[MSR]*, *[TRK]*, *[ALL]*, *[ANG]* or **[ENTER]**.

Each measure key, except *[ANG]*, is user-defined and has three precision settings. You can also set the number of "distance averaging" measurements for each key, including "Continuous." *[ANG]* measures only the horizontal and vertical angles.

You press the same measure key to start and stop the instrument in "Continuous" measurement mode. Similarly, you can stop multiple measurements by pressing the key you started measuring with.

If you press **[ENTER]** during a multiple measurement, the process is interrupted and the last measurement displayed on the screen is recorded.

AP800 also allows you to change measurement modes while it is measuring. When you press another measure key the instrument measures in the mode defined by that key. For example, you can go from continuous mode to a single measurement or from single to multiple measurements.

For more information see "MSR-TRK-ALL" on page 14-5.

Measure Angle Only

You use *[ANG]* to measure only the angles to the prism or to set only the orientation. In some situations, **[ENTER]** can be used to do this.

Show Measurement Data

AP800 provides you with alternative measurement data in "Collection," "Stakeout," and "Total Station." Up to five data display windows contain this information.

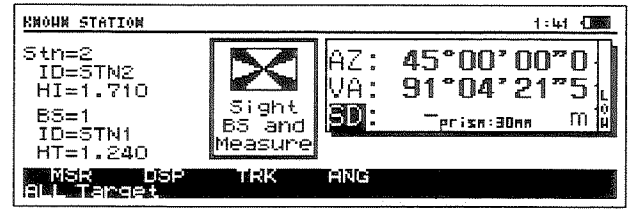
For example, in "Total Station" there are data display windows for the "Az"\"VD"\"HD", the "SD"\"VD"\"HD", and the "N"\"E"\"Z". You press *[DSP]* to cycle through the windows.

Dynamic SD

During a measurement the last distance label flashes and a "–" or ")" moves through the field, over the prism constant in use displayed in the background. The "–" is displayed when the target defined as a prism and ")" for sheet. When multiple measurements are taken, AP800 displays the average "SDx" after the last measurement.

Low Signal

AP800 displays the message "LOW" when there is insufficient signal strength to complete the measurement.



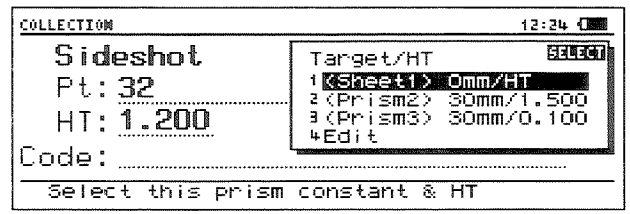
Using Quick Targets

You can quickly change the target definition by using quick targets. This can be particularly useful if you have prisms with different prism constants, or if you sometimes swap between reflector sheets and prisms in the one job. Quick Targets can also be used to swap between different target heights, for example an upright or inverted prism pole.

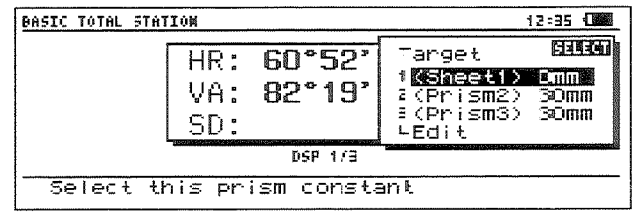
Selecting a Quick Target

You have access to three Quick Target selections.

- If necessary, press the **[Mode]** key until the measuring softkeys are displayed.
- Press the ***[Target]*** key to display the small Quick Targets list.



On measuring screens that allow you to change the HT: field, the list will be a combination of prism constant and height of target.



When no height of target is available on the measuring screen, only the prism constant part of the Quick Target is displayed.

- Using the numeric keys or [↑], [↓] and **[ENTER]** make your selection.

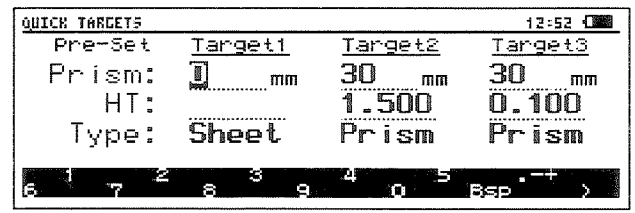
In a selection with no height of target value displayed, only the prism constant will be changed, the height of target value on the measuring screen will be unaffected, ie. "1<Sheet1> 0mm/HT" will only change the prism constant.

When you make a selection containing a height of target value the "HT:" field will update, and if a measurement is displayed, it will be recalculated and shown.

When you select a different prism constant, a note record is added to the current job detailing the change and the measurement will be cleared.

Editing Quick Targets

With the Quick Targets list displayed, select "4.Edit".



You may now enter the prism constant and height of target values you want defined.

Note: Leaving the "HT:" field blank indicates that you do not want the "HT:" field on the measuring screen to change when the item is selected.

Note: The "Type:" field, used to select the type of target, will only be available if you work on the DTM-851/831/821.

Field Procedures

This section references the various field procedures you can perform with the AP800 software.

Check Level (page 2-2)

Three on-screen bubbles help you to accurately level the instrument.

Horizontal and Vertical Compensators (page 2-3)

You can turn the horizontal and vertical compensators on or off.

Angle and Tilt Calibration (page 11-13)

To maintain the highest accuracy for angle and tilt measurements, you should periodically check the index errors.

Station Setup (page 4-1)

Known Station (page 4-2) — To set up over a known station and backsight to a known point or azimuth.

Resection (page 4-16) — To setup over an unknown point and calculate the instrument's position by measuring to two, or more, known points.

Remote Benchmark (page 4-39) — To determine the station elevation, the height of instrument, or the instrument elevation.

Collection (page 5-1)

To take measurements and record the data.

Stakeout (page 6-1)

To stake out points in the field.

Control (page 7-1)

To take multiple readings on both faces for increased accuracy.

Two Point Reference Line (page 6-20)

To measure at an offset from a line.

Arc Reference Line (Page 6-33)

To measure at an offset from an arc.

Traverse Adjustment (page 8-1)

To check the misclose for closed traverses and adjust the coordinates.

Cogo (page 9-1)

A variety of coordinate geometry functions for calculating the relative positions of points.

Total Station (page 12-19)

To operate the DTM as a basic total station, i.e., to take quick measurements without recording them.

Backsight Check (page 12-33)

To check, or reset, the horizontal angle to the backsight point.

Map (page 12-35)

To graphically inspect measured and coordinate points.

Power Saving and System Reset Features

Sleep

You can put the instrument into "sleep" mode from within most functions and save power. This feature powers down the instrument but does not switch off completely.

- To save power, press **[PWR]**.

*You can cancel the operation by selecting **[ABORT]**.*

- Press **[3]** to select *[PWR SAVE]*.
- Press any key to restore full power and to resume the function you were at before you pressed **[PWR]**.

Auto Power-off

AP800 will automatically power off after a designated period of inactivity. You can use the "Settings /System/Power Saving" option to adjust or disable this feature (see page 13-24).

When you restore power, the instrument will resume at the functional location that it was at when Auto Power-off operated.

EDM Power Save

You can save power by setting AP800 to switch automatically to "stand-by mode" if there is no measurement activity after a period of time. You can use the "Settings/EDM/Power Saving" option to adjust or disable this feature (see page 13-7).

Resume

Your DTM-800 instrument has a feature known as the "Resume" feature. The instrument stores all the *software* related information for the instrument just before the power is switched OFF so that you can resume immediately at the place where you powered off.

"Resume" only remembers the software settings. All the hardware switches, such as the backlight, reticle and Lumiguide are switched OFF and remain OFF when the instrument is restarted.

☞ You can use the "Resume" feature when you wish to change the battery or stop measuring for any length of time.

When "Resume" doesn't seem to work.

Under certain circumstances, the instrument will be unable to "Resume" at the point when it was switched OFF. The circumstances are:

- When you carry out a full system reset (pressing the **[PWR]** key again after turning ON the instrument, and select "SYS-RST");
- When you switch ON the instrument with a different data card inserted in the drive;
- When the files on the existing data card have been modified since the instrument was switched OFF.

Maintaining the Orientation During a Battery Change

You must take care to maintain the orientation of the instrument, to ensure correct HA readings, when you change the battery. One option is to perform a backsight check when you switch the power back on, **before** you resume measuring. Alternatively, AP800 will allow you to maintain the orientation of the instrument.

This procedure is particularly helpful if you are using the "Collection" or "Stakeout" functions:

- Clamp the horizontal plate.
- Turn the power off.
- Replace the battery carrying-handle.
- Turn the power on.

Alternatively, the backsight can be accurately reset after changing the battery by doing a backsight check, **[Fnc]** ***[9.BS Check]***, before continuing measuring.

QuickStart Surveying

This section provides concise instructions for performing the following types of tasks and surveys:

1 Creating a Job.

2 Opening an Existing Job.

3 Viewing and Editing Survey Data.

4 Uploading Data.

5 Topographic Survey.

6 Stakeout Survey.

7 Downloading Data.

Before You Start...

Check the AP800 setup to ensure that the "System/Configuration" (page 11-3), "Calibration" (page 11-12) and "Settings" (page 13-1) options are correct, e.g., measurement units, code file, etc.

In the following instructions menu selections and functions are listed sequentially starting from the **AP800 Main Menu**. In most instances you can increase productivity by using the selection lists to input data into the fields.

1. Creating a Job

1.1 Select **[1] Job Manager**.

1.2 If necessary, move the highlight to the directory you want the job to branch from.

1.3 Press *[CrJob]*.

1.4 Type the job information.

1.5 Press **[ENTER]** on the "Comment" field to create and open the job.

2. Opening an Existing Job

2.1 Select **[1] Job Manager**.

2.2 If necessary, move the highlight to the directory which contains the job you want to open, and press **[ENTER]**.

2.3 Move highlight to the job and press **[ENTER]**.

2.4 Confirm job, and select **OK** to open.

3. Viewing and Editing Survey Data

3.1 Press **[FNC]** from any function.

3.2 To select "View/ Edit," press **[2]**.

3.3 Use softkeys to scroll or search data.

3.4 To edit data, move highlight to the record, and press **[ENTER]** or ***[Edit]***.

3.5 To return to the "View" screen via the "FNC Key Menu," press **[ESC]** or **[FNC]** repeatedly.

4. Uploading Data

4.1 Select **[8] Communications**.

4.2 Select **[1] Upload**.

4.3 Specify source and data fields (must match the order of fields in the data to be uploaded.)

To exit with changes, move cursor to last field and press **[ENTER]**.

☞ Tip: Uploading and Downloading data from an ASCII file on the data card is by far the most efficient method (see page 10-7).

Check Comm. Settings

4.4 Check, and if necessary, change the communications settings to match those of the sending device.
To exit with changes, move cursor to last field and press **[ENTER]**.

4.5 When uploading is finished, press [ESC] to exit.

4.6 *Optional:* To check uploaded data, see "3. Viewing and Editing Survey Data" above.

5. Topographic Survey

Job Management

5.1 Open job or create new one (refer to item 1 or 2 of this section).

Station Setup - Known Station

5.2 Select [2] **Station Setup**.

5.3 Select [1] **Known Station**.

5.4 Enter **Stn Pt** (station point) or **Stn ID** (station identifier).

5.5 Accept or change **Temp** and **Pressure**.

5.6 Enter either the **BS Pt** (backsight point), **BS ID** (backsight ID) or the **BS Az** (backsight azimuth).

5.7 Input **HT** (height of target), if known, and press [ENTER].

5.8 Sight to backsight and measure using *[MSR], [TRK], [ALL]* or *[ANG]*.

Collection

5.9 Select [3] **Collection**.

5.10 If sighting to a control point, change the point type to **Control** ("Sideshot" = default).

5.11 Input **Pt, HT**, and **Code** (and if applicable, the code parameter).

5.12 Sight to point and measure using *[MSR], [TRK]*, or *[ALL]*.

5.13 If the measure keys are displayed, record the measurement by pressing [ENTER]. Repeat for other observations.

5.14 Use [ESC] to exit to "Main Menu."

6. Stakeout Survey

Job Management

6.1 Open job or create new one (refer to item 1 or 2 of this section).

Station Setup - Known Station

6.2 Select **[2] Station Setup.**

6.3 Select [1] **Known Station.**

6.4 Enter **Stn Pt** (station point) or **Stn ID** (station identifier).

6.5 Accept or change **Temp** and **Pressure.**

6.6 Enter either **BS Pt** (backsight point), **BS ID** (backsight ID) or the **BS Az** (backsight azimuth).

6.7 Input **HT** (height of target), if known, and press **[ENTER].**

6.8 Sight to backsight and measure using *[MSR], [TRK],* or *[ALL].*

Stakeout

6.9 Select **[4] Stakeout & Ref.**

6.10 Select **[1] Point Stakeout.**

6.11 Enter number of point to stake out or use *[PtLst]* to build a stakeout list.

6.12 Follow on-screen instructions, use appropriate softkeys, and direct rodman to the point.

6.13 *Optional:* Record the point by pressing **[ENTER].**

6.14 When stakeout is finished, use **[ESC]** to exit to the "Main Menu."

7. Downloading Data

7.1 Select **[8] Communications.**

7.2 Select **[2] Download.**

Download Options

7.3 Specify destination, data format, data type, and time stamps (if appropriate)

To exit with changes, move cursor to last field and press **[ENTER]**.

Comm. Settings

7.4 Check, and if necessary, change the communications settings to match those of the receiving device.

To exit with changes, move cursor to last field and press **[ENTER]**.

7.5 When downloading is finished, use **[ESC]** to exit.

Chapter 3

Job Manager

AP800 organizes your survey data into a database, known as a *job*. In addition, you can use special jobs, called "Control Jobs", to store common survey data that may be used by several jobs.

NOTE: AP800 also stores associated job files which are hidden from view (see "AP800 File Types" on page A-35).

Introduction

Job Manager lists your jobs, control jobs and other files used by the AP800 software. You can open a job, attach a control job, create a new job, make a directory, copy point coordinates between jobs, and display and copy header information. Jobs, files, and directories can also be renamed and deleted.

AP800 can be set to automatically open the last job (see page 11-10). Alternatively, you can use the "DEFAULT" job and rename it after the survey (see page 3-8).

NOTE: The bottom line of the "Main Menu" displays the open job.

Roadmap

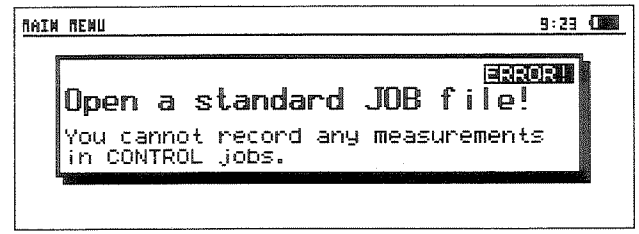
Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

Common Control Jobs

A control job database stores survey data (such as control points) that may be used by several jobs as the source of common data. This facility saves time when surveying a region that already has known points.

A control job has the same format as a standard AP800: it can be opened and modified but it will not accept measured data. When you try to use those functions that take measurements, you see this message.



Location of Control Jobs

AP800 can store up to 37 control jobs. All control jobs must exist in the root directory in order to be available to other jobs (see "About the Directory Structure" on page 3-14).

Control Job File Names

As stated above, AP800 can store up to 37 control jobs in the root directory. They are identified by special names, as follows:

- CONTROL.JOB 1 job
- CONTROL[0-9].JOB 10 jobs
- CONTROL[A-Z].JOB 26 jobs

NOTE: You may use any of the names in the set in any order.

Using Data from Control Jobs

Before you can use the data in a control job, you must attach it to the current job (refer to "Attach a Control Job" on page 3-7). Whenever you call up a point, AP800 examines the control job and the current job then completes a verification process (see below) to determine which source of data to use.

NOTE: Only one control file can be attached at a time.

AP800 always searches for coordinates before measured records and follows this (simplified) process:

- If a coordinate for a point number exists in the control job but not in the current job, the point is copied to the current job.
- If a coordinate record for the point exists, AP800 examines the point data to determine if there are any required elements missing (e.g. an elevation (Z)). If necessary, AP800 will continue searching the current job for a measurement record to best satisfy the point requirement.

Basic Job Handling Options

- View the open job.
- Use the open job.
- Open a different job.
- Create a new job.
- Manually add points to the open job.
- Copy points to the open job.
- Select a control job.

Create Jobs and Directories

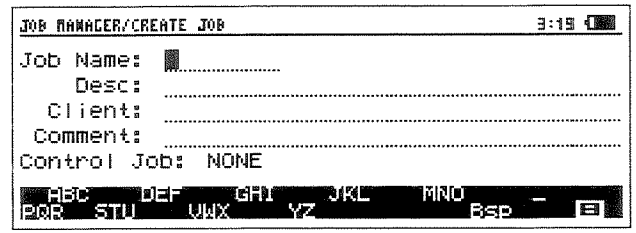
A job is created under the directory that is displayed near the top left corner of the Job Manager screen. You can change directories or create a new one for your job.

Change Directory Move the highlight bar to the directory name and press **[ENTER]**.

Create a Directory A new directory can branch from any directory.

- Move the highlight bar into the directory, then press *[CrDir]*.
- Type the **Directory Name** (max. eight characters).

Create New Job Press *[CrJob]*. (Displays the "CREATE JOB" screen shown below.)



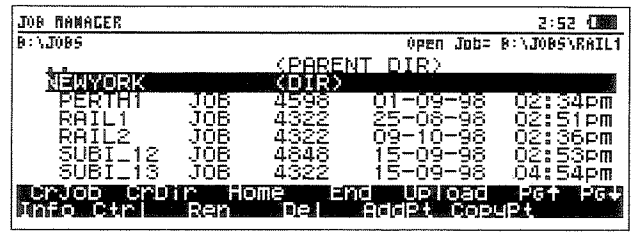
You must provide a job **Name** but the other fields are optional. The job name cannot exceed eight characters.

☞ *Shortcut:* The selection list for the "Name" field enables you to copy *all* the job information from another job into the new job. When asked, simply select the job from the appropriate directory; then you can edit the fields in the new job as required.

To save the job with the job information, move the cursor to the **Comment** field and press **[ENTER]**.

Attach a Control Job The "Control Job" field displays the control job that is currently selected. To select a different control job, move the cursor into the "Control Job" field, use the selection list to choose the job then press **[ENTER]**.

Open a Different Job



The JOB MANAGER screen allows you to change the open job.

Confirm Open Job

The program displays the path and name of the open job in the *top right* corner of the screen. (A brief explanation of the job management system is provided at the end of this section: see "About the Directory Structure" on page 3-14)

Move Highlight to Another Job or Directory

- Use the following keys: Up and down one line [↑] and [↓]; up and down one page ***[PgUp]*** and ***[PgDn]***; and to the top and bottom of the directory ***[Home]*** and ***[End]***.

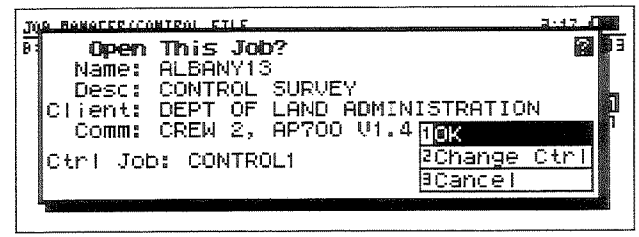
  Note that the current working directory is displayed near the *top left* corner of the screen.

Display Directory Contents

- Move the highlight to the directory and press **[ENTER]**. "Job Manager" displays all the jobs within the directory.

Select the Job

- Move the highlight to the job and press **[ENTER]**.



You confirm this is the job you want to open.

- To open the job, select **OK**. (The open file is displayed on the Job Manager screen.)
- To change the control job from the one displayed select **Change Crtl**. (For more information about changing control job, refer to page 3-7.)

Display Job Information

- To obtain information about a job *without* opening the job, move the highlight to the job and press ***[Info]***.
- To exit this screen, press **[ESC]** or **[ENTER]**.

Attach a Control Job to the Curr

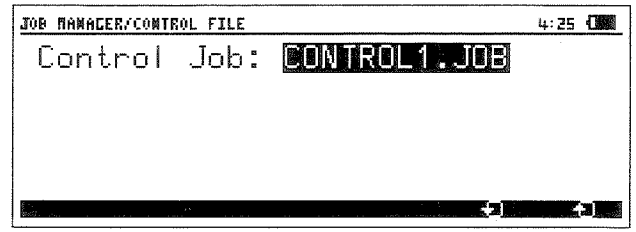
When you attach a control job to the current job, you
current job all the data that is stored in the control job. As yo
the current job, AP800 examines the control job to see if the data a
(see "Using Data from Control Jobs" on page 3-3). If it does, AP800 a
data automatically to the current job.

NOTE: AP800 accesses the control job only when it requires data. When the control data is accessed, the data is copied from the control job to the current job. From that time, the copied data in the current job is the data that AP800 processes and not that in the control job.

Attach a Control Job

To attach a control job to the current job:

- Press the ***[Ctrl]*** softkey in the Job Manager screen.



This screen displays the control job that is currently attached. Use the selection list to choose a job and press **[ENTER]** to accept the selection.

Rename Jobs, Files, and Directories

- Highlight the job, file, or directory on the Job Manager screen and press ***[Ren]***.
- Edit or type the **name** (max. eight characters) and the **extension** (you need only do this if the extension is not ".JOB"; max. three characters).
- To save your changes and exit this screen, press **[ENTER]**.

Delete Job, File, or Directory

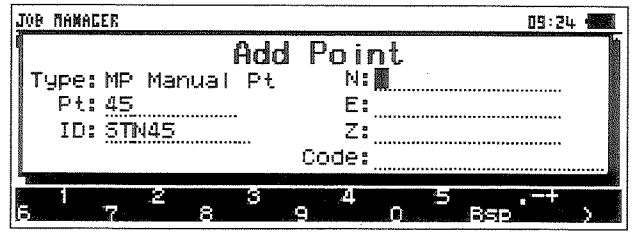
- Highlight the job, file, or directory on the Job Manager screen and press ***[Del]***.

NOTE: You must individually delete all the jobs under a directory before you can delete the directory.

- When asked to confirm the deletion, select **OK** to proceed or **Cancel**.

Add Points to the Open Job

Points can be manually input to the open job by pressing the *[AddPt]* softkey.



AP800 automatically increments the highest point number in the open job by one and assigns this number to the new point. You can change the point number and the point type.

NOTE: This function works in the same way as the "Add Point" function in FNC/View/Edit (see page 12-16).

Input the Point Details

- Type the **ID** (optional), Northing, Easting, station elevation (**Z**) and the **Code** (optional).

Record the Point

- To add the new point to the open job, move the cursor to the last field and press **[ENTER]**.

Exit

- Press **[ESC]** to exit this function.

Copy Coordinates Between Jobs

Coordinates can only be copied between jobs or to a job from an ASCII file. (To get the coordinates from an ASCII file you must use the "Upload" function. See pages 3-16 and 10-2.)

The "Copy Points" function allows you to specify a point range, a point type, a feature code, or any combination of these. Points can also be renumbered during copying.

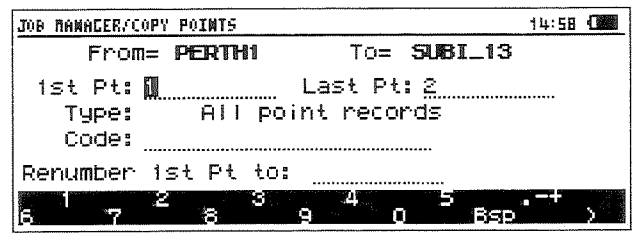
Choose Job to Copy From

The "Copy Points" function copies points to the open job from any job you nominate.

- Make certain the correct job is open (this is the destination job for the copied points).
- Move the highlight to the job you want to copy the points from (source job). ***Do not*** *press* ***[ENTER]****, otherwise you will open the source job.*

Display Copy Points Screen

- Select ***[CopyPt]***. (Pressing [ESC] will return you to the "Job Manager" screen without copying points.)



In this example, points will be copied from the source job PERTH1 to the open job SUBI_13.

You may use any combination of the following delimiters to select the points to be copied:

Specify Point Range

AP800 automatically enters the first and last points in the open job.

- In the **1st Pt** and **Last Pt** fields type the first and last point numbers in the range of points you want to copy.

NOTE: To copy only one point, you need only specify the first point (leave the "Last Pt" field blank).

Specify Point Type

Use the circular selection list to select the type of point required.

Specify Code

- Type the code.

NOTE: Part codes will match. For example, specifying a code of "BLD" will select codes "BLD1," "BLD2," etc.

Renumber First Point

You can type or use the selection list to renumber the starting point number.

Renumber by Typing —

You can specify any number and each successive point number will automatically be incremented by one.

Renumber by Selection List —

You have three choices:

Do not renumber. — Blanks the field and does not renumber the points as they are copied.

Next highest number — The *last* point number in the destination job is incremented by one and renumbering of the copied points begins with this number.

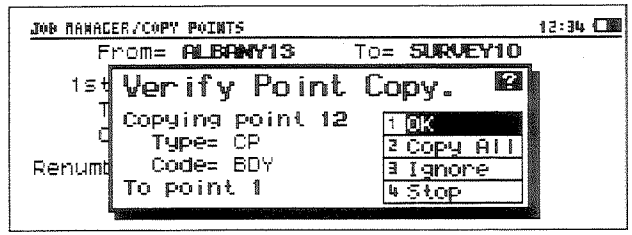
Lowest available number — AP800 searches for a gap between unused points. If the gap is large enough to accommodate all the points to be copied, renumbering begins with the first unused point number.

Copy the Points

- To copy all points which match your specifications, move the cursor to the "Renumber 1st Pt to" field, then press **[ENTER]**.

Verify Matching Points

You are given the option to verify each point before it is copied.



The "Verify Point Copy" window reports the point number, point type, and code of each matching point.

OK — Copies the point shown in the window.

Copy All — Copies all matching points without asking for verification.

Ignore — Does not copy the point.

Stop — Stops copying all points, including the current one.

NOTE: All points already copied will be in the open job. ([ESC] has the same result.)

Duplicate Point

If there is a point in the open job with the same number as the incoming point, you are given three choices:

Ignore — Does not copy the point.

Overwrite — The incoming point replaces the one in the open job. The former point is marked in the open job as DELETED.

Stop — Stops the copy operation. All points already copied will be in the open job.

Duplicate Station ID

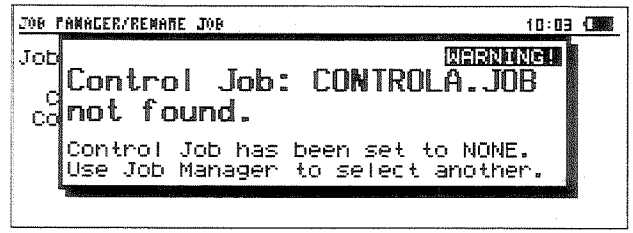
If there is a point in the open job with the same "Stn ID" as the incoming point, you are given two choices:

OK — Copies the point with the same "ID" value.

Stop — Stops the copy operation. All points already copied will be in the open job.

Missing Control Jobs

If a control job that is currently attached is renamed, deleted or is moved from the root directory, AP800 warns you that the control job is missing. Job Manager also sets the attached control job to "None".

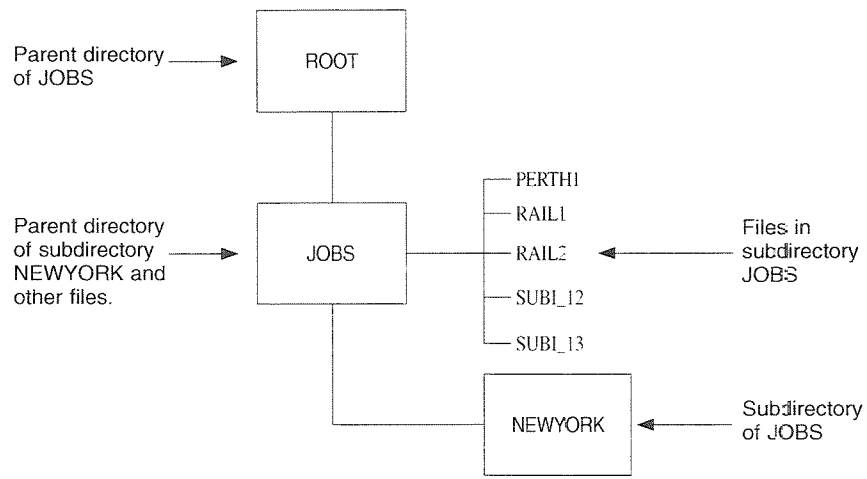


If you wish to restore the control job, you must make sure that the job exists in the root directory. If the job is present then you must restore a backup copy of the job to the root directory. Otherwise, you may continue without a control job attached or select another.

About the Directory Structure

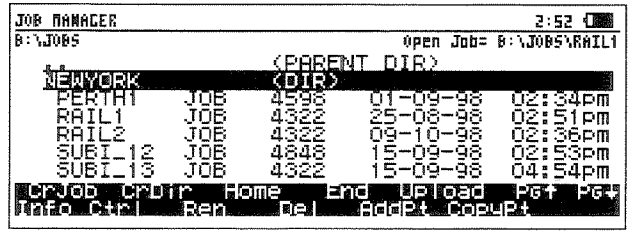
Jobs are stored on the data card in a directory tree. The tree can be divided into directories where you may hold related jobs. These directories originate from the "root directory".

A directory can store files and other directories. Branching directories are called **subdirectories**, and the directory they branch from is the **"PARENT"** directory. Therefore, the root directory isthe parentof any directory branching from it (see below).



In the above figure, the "JOBS" subdirectory branches from the root directory. "JOBS" itself contains the subdirectory "NEWYORK" and a collection of job files.

AP800 presents this tree structure in column form (see the next figure). On the instrument, the open directory and its path (described later) are shown near the *top left* corner of the screen.



The "JOBS" directory is open and it contains the directory "NEWYORK" and the following jobs: "PERTH1"; "RAIL1"; "RAIL2" etc.

Jobs can be stored in the root directory, in a directory, and in a subdirectory. The location of the job is specified by the "path" to the job.

For example, the path to the jobs shown above begins with the drive letter (B:) and the root directory(\). It continues through the "JOBS" directory and displays the contents in the list.

The path to a job created in directory "NEWYORK" would include the drive letter, the root directory, the "JOBS" directory and the "NEWYORK" directory as follows, B:\JOBS\NEWYORK\MyNewJob.

(AP800 displays the path to the opened job in the *top right* of the screen.)

Similarly, if job "MEADOW" was created in subdirectory "JOBS" in the above example, its path would include the root directory and the "JOBS" directory as follows, B:\JOBS\Meadow (the same path for the existing jobs).

*NOTE: All backslash (" \ ") characters after the first backslash are used to separate directories and subdirectories. Only the **first** backslash in the path represents the root directory.*

You can also open the parent directory of a subdirectory. The parent directory is always represented by double dots " .. ". In our example, selecting the parent directory of "JOBS," (i.e. the root directory) would display all the directories and files (if any), branching from the root.

To select the parent directory using AP800, you move the highlight to:

".. **<PARENT DIR>** " and press **[ENTER]**.

Uploading Coordinates From a File

The uploading procedure transfers coordinates data from an ASCII file on the data card to the current job.

Highlight an ascii coordinate file on the Job Manager screen and press *[Upload]*.

Summary of Job Manager Function Keys

Job Manager	
AddPt	Manually adds new points to the open job.
CopyPt	Copies point coordinates from the highlighted job to the open job.
CrDir	Creates a new subdirectory of the current directory.
CrJob	Creates a new job in the current directory.
Ctrl	Select a control job.
Del	Deletes the highlighted job or directory.
End	Moves the highlight on to the last job.
Home	Moves the highlight on to the first job.
Info	Displays header information on the highlighted job.
PgUp	Scrolls up one full page.
PgDn	Scrolls down one full page.
Ren	Renames the highlighted job or file.
UPLOAD	Upload the highlighted text file to the current job.

Chapter 4

Station Setup

This chapter describes two ways of setting up the instrument, **Known Station** and **Resection**, as well as **Remote Benchmark** which enables you to determine the station elevation, the height of instrument, or the instrument elevation.

Normally you must set up over a known station or calculate the station coordinates by measuring to two, or more, known points (resection) *before* you can proceed to any form of survey work.

However, it is possible to enter other functions without performing a station setup if desired. You will be given the option to "Use Current Orientation" or, in the case of collection, you can create a Default Station Setup.

NOTE: You should only select "Use Current Orientation" if all of the following conditions are true. The instrument:

*1. was clamped **before** you last powered off;*

2. has not been moved while turned off; and,

3. was still clamped when you turned the power back on.

The system will use the last performed station setup details. This would typically be performed while changing a battery. A backsight check is recommended.

Known Station

Introduction

Use this section if you are setting up over a known station and backsighting to a known point or azimuth. The known station and backsight points may be found in the *current job* or *manually input*.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Station Setup Menu

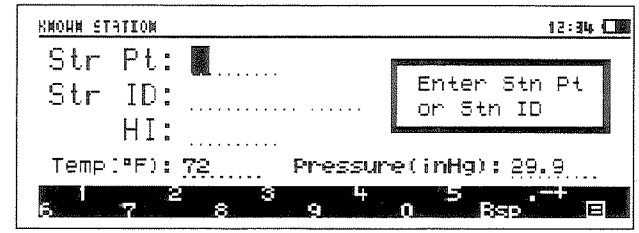
Known Station
Resection
Remote BM

NOTE: AP800 automatically opens the last job used (see page 12-11) or you can use the job called "DEFAULT." You may open a different job, create a new one, or rename the "DEFAULT" job after the survey (see "Job Manager" on page 3-1).

Setup Sequence

- Enter station point information.
- Enter backsight point details.
- Sight and measure to backsight point.
- Repeat the measurement using face 2 (optional).

Enter Station Point Information



You begin by entering either the station point number or the station ID.

Station Point or Station ID

AP800 allows you to set up on a point that already exists in the open job or you can define a new point.

- Type, or use the control point selection list, to enter either the **Stn Pt** number or **Stn ID** (max. 10 chars.).

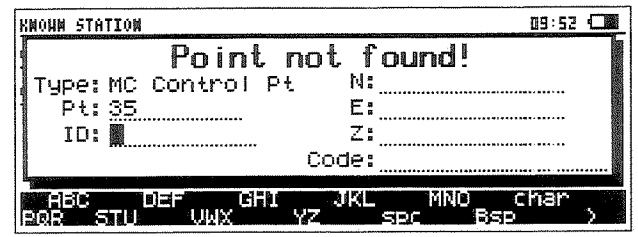
NOTE: The control point selection list will display the Pt numbers and ID's of all UC, MC, CP and RE records in the current job. The list will always be displayed in Pt number order.

The program only searches for the Station "Pt" and Station "ID" after you input one of the values and press **[ENTER]**.

Point Found — The screen displays the coordinates if the point is found in the current job. For more information, see "Point Found / New Point Recorded" on page 4-4.

Point Not Found — AP800 asks you to manually enter the coordinates if it cannot find the point. See page 4-4.

Point Not Found



AP800 could not find the point in the open job. You are required to manually input the station point data or you can use "Job Manager" to copy the point to the current job (see page 3-10).

Manually Enter Station Point Data

Type — Use the selection list to choose either **MC Control Pt** or **MP Manual Pt** (point types are defined on page 12-6).

Pt — Contains the point number you entered previously or the next available point number in the open job. You can change the point number.

ID — If the field is blank, type or use the selection list to enter the station ID (max. 10 chars.).

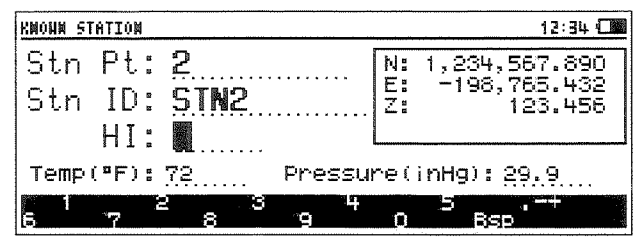
Code — Type or use the selection list to input the code.

N, E, Z — Type the coordinates (if you leave "N" and "E" or "Z" blank, AP800 will ask you if you want to store the partial data or input the data again).

Record New Point

- To record the point to the open job, move the cursor to the "Z" field and press **[ENTER]**.

Point Found / New Point Recorded



This screen displays the station point data including the point coordinates (if known) and the code.

Height of Instrument

- Enter the **HI**. (optional).

NOTE: You can configure the software, using the HI/HT Defaults setting in Settings/Job/Station Setup (see page 13-14), to automatically swap the HI and HT when you move station.

NOTE: The "HI" field does not appear if AP800 is configured for 2D coordinates (see page 11-6).

If you leave the HI field blank you will be given the following options —

- Calculate the HI later (select **Later**):

(1) from the backsight observation in "Known Station" (only possible if the station "Z," backsight "Z," and "HT" are known); or,

(2) by entering the HI in "View/Edit,"; or,

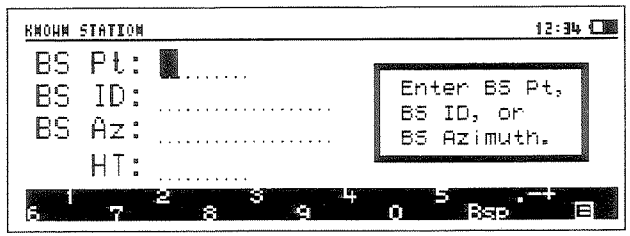
(3) using the "Remote Benchmark" function (see page 4-39).

- Return now to the station point input screen and enter the HI (select **Cancel**).

Temperature and Pressure

Accept the previous **Temp** and **Pressure** or enter new values.

Enter Backsight Point or Azimuth



Enter either the backsight point, backsight ID, or the backsight azimuth.

BS Pt, BS ID, or BS Az

- Type or use the selection list to enter either the **BS Pt** number or **BS ID** (max. 16 chars.). The program searches for the point after you input one of the values and press **[ENTER]**. Alternatively, you can just input the **BS Az** value.

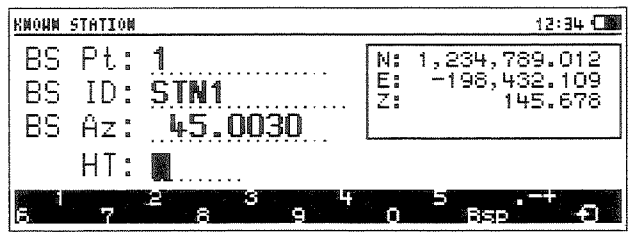
Backsight Point Found

The screen displays the coordinates and the computed backsight azimuth if the point is found in the current job. See "Existing Backsight Point Found" below.

Backsight Point Not Found

If the point cannot be found you can manually enter the coordinates for the point, or you can use "Job Manager" to copy the point to the current job and repeat the above procedure.

Existing BS Point Found



The "BS Az" field contains the azimuth calculated from the station and backsight points.

No BS Azimuth

AP800 cannot calculate the azimuth and coordinates if the station point, the backsight point coordinates, or both are unknown. You can type in the BS Azimuth or leave it blank.

If the "BS Az" field is left blank all azimuth and coordinate display fields will be blank. Additionally, any function that requires a backsight azimuth or coordinates cannot be used, such as "Stakeout" and certain "Cogo" functions.

Height of Target

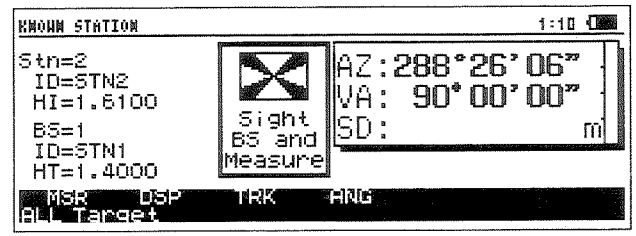
- Type or use the selection list to enter the **HT**.

NOTE: You can configure the software, using the HI/HT Defaults setting in Settings/Job/Station Setup (see page 13-14), to automatically swap the HI and HT when you move station.

NOTE: The "HT" field does not appear if AP800 is configured for 2D coordinates (see page 11-6).

When you press **[ENTER]** without typing values for both "HI" and "HT", AP800 displays a notification that the values are both blank. At this point, you have the option to select the operating mode for all measurements that you take after this time. The options are "2D mode" and "Continue" (remain in 3D mode). The default selection is "2D mode". For more information about the operating mode, refer to "2D / 3D Coordinates" on page 11-6.

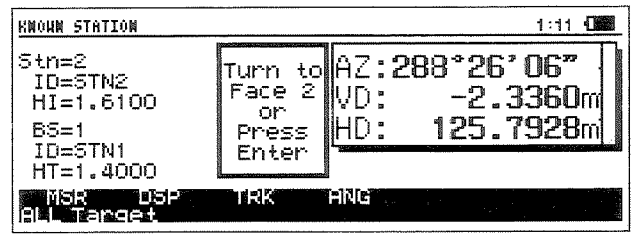
Sight Backsight and Measure



Take a full measurement or measure only the angle.

Measure HA, VA, and SD

- *Use [MSR], [TRK],* or *[ALL]* to measure to the prism. Pressing *[Target]* will allow you to select a prism constant from the available Quick Targets. (For assistance, see page 2-8 and page 13-5.)
- *[DSP]* may be pressed to switch between the AZ:VA:SD and AZ:VD:HD displays.

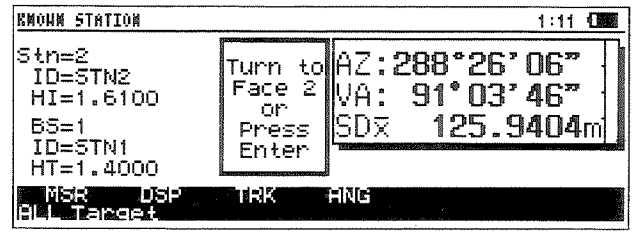


- Press **[ENTER]** to accept the current distance. *If there is no distance, AP800 measures only the horizontal angle.*

Measure Angle Only

- Use *[ANG]* or **[ENTER]** to measure only the direction (no distance) to the backsight point and set the orientation.

MSR / TRK Distance Measurement Completed



You have four options:

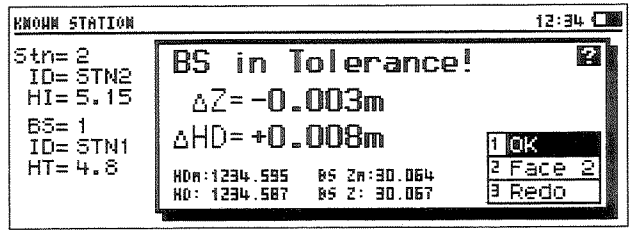
- Accept the measurement — press **[ENTER]**. (AP800 reports the delta VA and delta HD. and tells you if they are within tolerance.)
- Turn to Face 2 and re-measure (see "Face 2 Measurement (Optional)" on page 4-11).
- Measure again — press **[MSR]**. *[TRK]*, or *[ALL]*.
- Discard the distance measurement and accept the current angles — press *[ANG]*. Only sets the orientation of the instrument.

Backsight Checks

AP800 computes and checks the vertical and horizontal distances if you have taken a full measurement to the backsight. You are told whether the backsight observation is in or out of tolerance. (To change the BS Shot Tolerance, refer to page 13-14.)

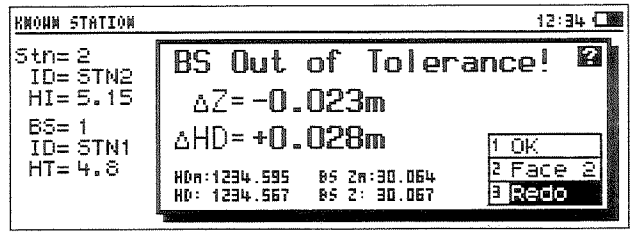
NOTE: If you have only measured the direction to the backsight point, the program reports only the BS Azimuth. No checks are possible.

Backsight in Tolerance



Accept the measurement, go to Face 2, or re-measure to the backsight point on Face 1. (Blank fields indicate there was insufficient information to compute the value.)

Backsight Out of Tolerance



You can accept the measurement, go to Face 2, or re-measure to the backsight point on Face 1. (Blank fields indicate there was insufficient information to compute the value.)

Station Setup Complete

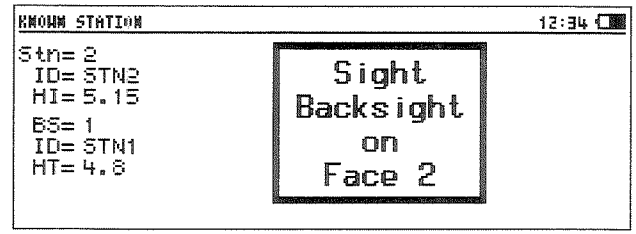
After you accept the data ("OK") AP800 displays "Station Recording" and you are returned automatically to the Main Menu.

Face 2 Measurement (Optional)

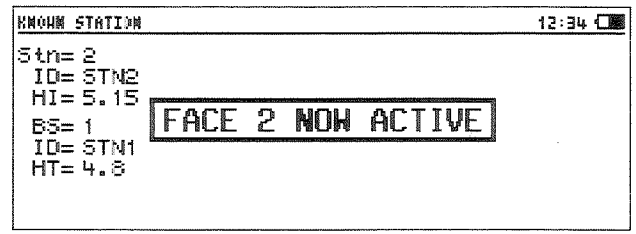
You can take a Face 2 measurement after any measurement on Face 1.

Prepare Instrument for Face 2

- Select **Face 2** from menu (when available) *or* plunge the telescope.

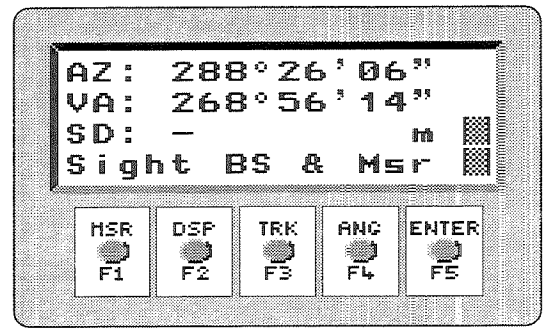


AP800 displays this message if you select "Face 2." To continue, plunge the telescope.



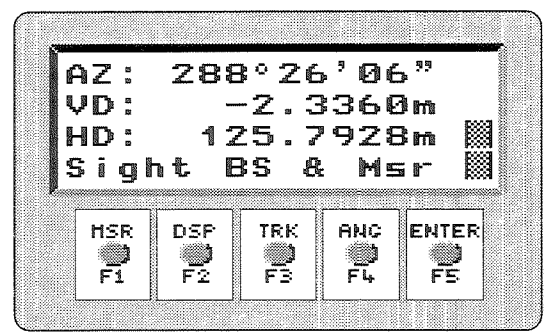
AP800 displays this message after you plunge the telescope.

Measuring on Face 2



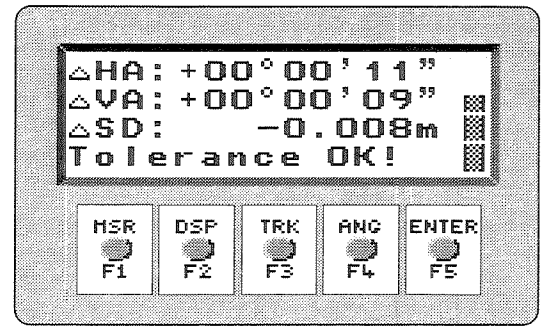
This is the Face 2 measuring screen.

- Sight to previous point and measure by pressing the **[MSR]**, **[TRK]**, or **[ANG]** key on the Rear Display keyboard.
- **[DSP]** may be pressed to switch between the AZ:VA:SD and AZ:VD:HD displays.



- Press **[ENTER]** to accept the measurement.

Check Face 1/Face 2 Delta Values

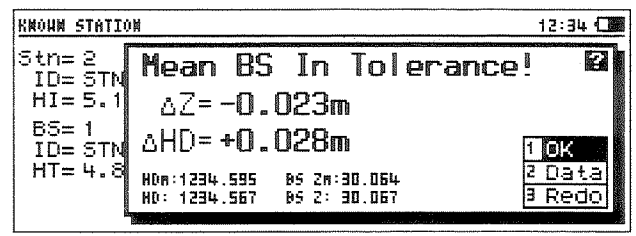


AP800 tells you whether or not the Face 1 / Face 2 delta values are in or out of tolerance.

At this stage, you have three options:

- **Redo the measurement on Face 2** — Sight backsight and re-measure using the [MSR], [TRK], or [ANG] key (discards previous Face 2 measurements).
- **Return to Face 1** — Plunge the telescope and rotate the instrument.
- **Display Previous Measurement** — Press [DSP].

Confirm Sighting to BS Point



AP800 reports the mean BS tolerance status and other measurement data when you return to Face 1.

Options During Station Setup

2D Surveys

If you only want to carry out a 2D survey — Set the "Configuration/Coordinates" setting to **2D** (see page 12-6). AP800 will not ask you to input the "HI," "HT", and "Z" for the station.

Compute Station "Z"

If you want to compute the station elevation from the backsight—Leave the "Z" field blank at station setup. AP800 will automatically compute the station elevation and give you the option to save it to the open job.

Compute HI

If you want to compute the height of instrument from the backsight—Leave the "HI" field blank at station setup. AP800 will automatically compute the height of instrument and give you the option to save it to the open job.

NOTE: The Remote Benchmark feature described at the end of this chapter can also be used to calculate Station Z, Station HI and Instrument Z.

Leveling

If you want to use the total station like a level-Leave the station "Z" and "HI" fields blank during station setup. AP800 calculates the elevation for each observed point from the backsight.

Warning

This method uses HI=0 and gives an erroneous value for the station point because AP800 calculates "Z" for the instrument rather than the station point. You should ***never*** *use the "Z" for the station point.*

Station Move

If you set "HI/HT Defaults" to "YES" in "Settings/Jobs/Station Setup" (page 13-14), AP800 automatically swaps the "HI" and "HT" at each station setup.

Summary of Known Station Softkeys

Known Station	
ALL	User-defined measure key. Measures and records single or multiple measurements.
ANG	Measures the angle only.
DSP	Switches displayed values.
MSR	User-defined measure key. Measures single, multiple, or continuous measurements.
Target	Quick target selection to change the prism constant.
TRK	User-defined measure key. Measures single, multiple, or continuous measurements.

Resection

Introduction

Resection enables you to setup at an unknown position and calculate the instrument's station coordinates by making sets of Face 1 and Face 2 measurements (distance or angles) to a number of known points. The function's ability to handle multiple readings increases the geometrical and mathematical accuracy of the derived coordinates.

The resection procedure results in a coordinate and ST record for the station point and a record of all measurements taken. To achieve the coordinate and ST record for the station, you must use a minimum of two points with at least one distance measurement.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Station Setup Menu

Known Station
Resection
Remote BM

NOTE: AP800 automatically opens the last job used (see page 11-10) or you can use the job called "DEFAULT." You may open a different job, create a new one, or rename the "DEFAULT" job after the survey (see "Job Manager" on page 3-1).

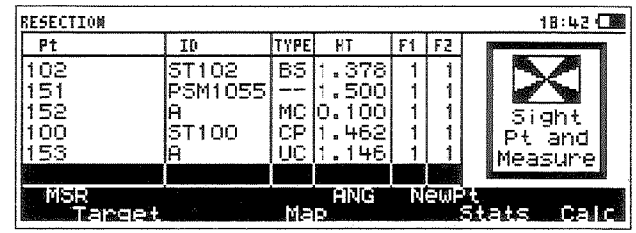
Resection Sequence

- Enter new station point information.
- Sight to the first point and measure.
- Sight to additional points and measure. Take full "sets" of measurements if required.
- Calculate the resection station coordinates and record the data to the job.

Overview

Resection begins by asking you to input the station point number for the new point with unknown coordinates. This is the point that you are setting up on and want to obtain an ST record for.

Once these details are entered and accepted, the software will then prompt you to build a list and measure to a number of known coordinate points, commencing with the backsight point. The points list which you define, and the number of measurements that you make, are displayed on the screen in tabular form.



Typical Resection Screen. The "TYPE" column indicates the point type; a -- entry in this column is a new point which is unknown to the open job database.

The F1 and F2 columns detail the number of times that the point has been measured on Face 1 or Face 2.

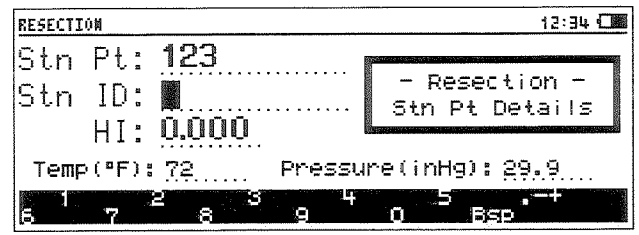
Points are added to the list in one of two ways: adding a new point before measuring using the *[NewPt]* softkey, or: measuring to a point and then completing the point information (refer to "Enter New Point Details" on page 4-20).

You then proceed to record "sets" of measurements; that is, Face 1 and Face 2 measurements to all the points in the list. The number of points that you can survey in resection is limited to 10, and the number of sets of measurements that you can make during any resection session is limited to 16 (32 shots to each point). For example, if you identify six points on the list, you can measure to each of the six points 16 times on Face 1 and 16 times on Face 2.

Resection allows you to view comprehensive statistics of all your shots throughout the session (see page 4-30). When you are satisfied with the number, and accuracy, of measurements made you can then calculate the final coordinates of the new station point. These details can then be recorded to the job database.

Additional features include the ability to suspend resection sessions (for example to change a battery) and resume them at a later time, and the feature "Map" (see page 4-29) which provides you with geometrical layout information.

Enter New Station Point Information



You begin by entering details for the new station point. The station ID and HI are optional.

New Station Point

- Type the **Stn Pt** number. (AP800 enters a default Stn Pt which is the last known point number incremented by 1.)

NOTE: Resection cannot commence if this field is blank. Additionally, the Stn Pt number input must be a ***new*** *point number.*

Station ID

- *Optional:* Type the **Stn ID** (max. 10 chars.). If another point exists with the same "Stn ID," you will be alerted and asked if you want to change it.

Height of Instrument

- *Optional:* The HI defaults to 0. Type the **HI** or accept the default value.

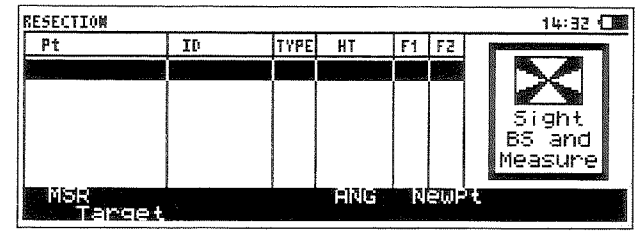
Temperature and Pressure

- Accept the **Temp** and **Pressure** values shown or enter new values.

Accept Station Point Details

- Move the cursor to the **Pressure** field and press **[ENTER]**.

Sight Backsight and Measure



This is the initial measuring screen. Note the tabular layout and the area on the right for messages and data.

You can sight and measure to the backsight point **before** identifying the point, or you can use the *[NewPt]* softkey now to identify the point and then measure (see page 4-20). If desired, you can identify all the points using *[NewPt]* before any measurements are taken.

As you define new points their details are added to this table in the order of addition.

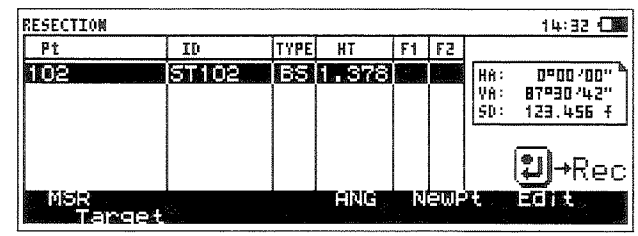
Measure HA, VA, and SD

- Use *[MSR]* to measure the direction and distance to the point. Pressing *[Target]* will allow you to select a prism constant from the available Quick Targets. (For assistance, see page 2-8 and page 13-5.)

Measure Angle Only

- Use *[ANG]* or [ENTER] to measure only the direction to the backsight point.

NOTE: Throughout the resection procedure both the Face 1 and Face 2 screens are active and available for measuring. However, this initial shot to the BS point when starting the first set ***must*** *be made on Face 1.*



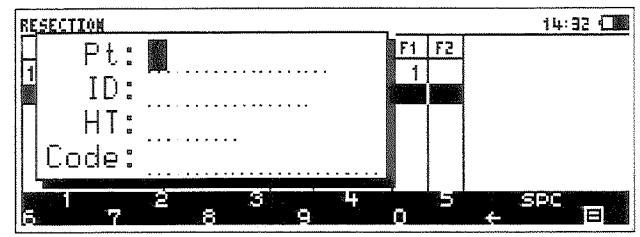
This is the screen displayed after measuring to the backsight is completed. The point shown (102) was input before measuring using *[NewPt]*.

Record Measurement

- Press **[ENTER]** to record the measurement.

(Pressing [ESC] will cancel the measurement and return you to the "Sight Backsight and Measure" screen.)

Enter New Point Details



This is the "Point Identification" window displayed after pressing ***[NewPt]***. (This window is also automatically displayed when you measure to a point which has not yet been added to the resection points list.)

AP800 allows you to enter a point that already exists in the open job or you can define a new point.

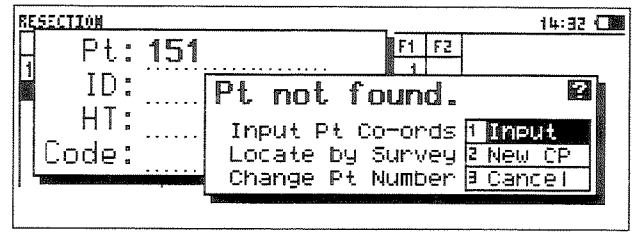
NOTE: The number of points that you can measure to in resection is limited to 10, of which only eight can be full distance and angle measurements. The remaining two must be angle only shots.

- Type or use the selection list to enter either the **Pt** number or **ID** (max. 10 chars.). The program only searches for the "Pt" and "ID" after you input one of the values and press **[ENTER]**.

Point Found — The screen confirms that the point is found in the current job and updates the "Point Identification" window with the point's details. The HT field will be blank for your input.

Point Not Found — AP800 alerts you that it has failed to find the defined point in the database.

Point Not Found



AP800 has failed to find the defined point in the database.

You have several options:

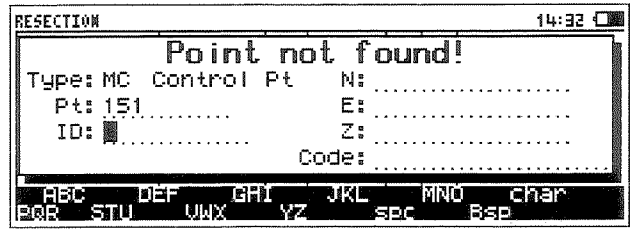
Input Pt Co-ords Selecting **Input** opens the normal "Point not found" window (see page 4-22) which enables you to manually input the details of a point.

Locate by Survey Selecting **New CP** assumes that you want to identify a new point by survey observation. You are returned to the "Point Identification" window (see page 4-20) to enter the new point details.

*NOTE: A new point identified by survey observation will **not** be a coordinate point and will therefore **not** be used in the resection calculation.*

Change Pt Number Cancel returns you to the "Point Identification" window so that you can change the Pt number.

Input Point Coordinates



This is the normal "Point not found" window. You are required to manually input the point data.

Manually Enter Point Data

Type — Use the circular selection list to choose either **MC Control Pt** or **MP Manual Pt** (point types are defined on page 12-6).

Pt — Defaults to the point number that you entered on the previous screen. You can change the point number to a new number.

ID — *Optional:* Type in the point **ID** (max. 10 chars.).

N, E, Z — Type the coordinates. N and E must be specified (if you leave Z blank, AP800 will ask you if you want to store the partial data or input the data again).

Code — *Optional:* Type or use the selection list to input the code.

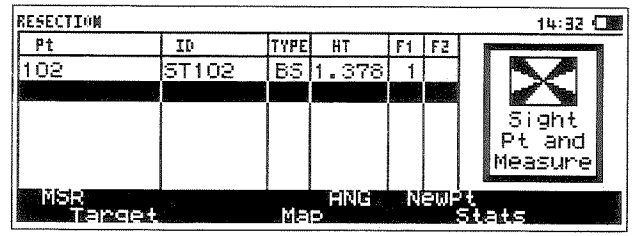
Record New Point

- To record the point to the open job, move the cursor to the "Code" field and press **[ENTER]**. You will be returned to the "Point Identification" window which will have been updated with the new point information.

Pressing **[ESC]** at this screen will return you to the "Point Identification" window with all fields blank except the point number.

Sight Pt and Measure

After sighting and recording the backsight point, the following screen is displayed.



You can now sight and measure to the remaining points that you have chosen and complete the first set. The procedure for measuring to these points is exactly the same as for the backsight point with the exception that, should you choose, you can commence measuring on Face 2.

In addition, the features "Map" and "Stats" have been added to the softkey bar and are now available (see page 4-29 and page 4-30).

Overwrite Existing Shot

If, during the current set, you measure to a point which has already been measured to on that face, you will be asked whether you want to use this shot or cancel it.

Edit Existing Point

If the highlight bar is positioned on an existing point, the ***[Edit]*** softkey is active. Pressing this softkey will open the "Point Identification" window with the selected point's details as defaults. This window can then be used to view or edit the point's details.

There are limitations as to which fields can be edited, depending on the point type selected:

BS Point — Only the **HT** and the **Code** can be changed.

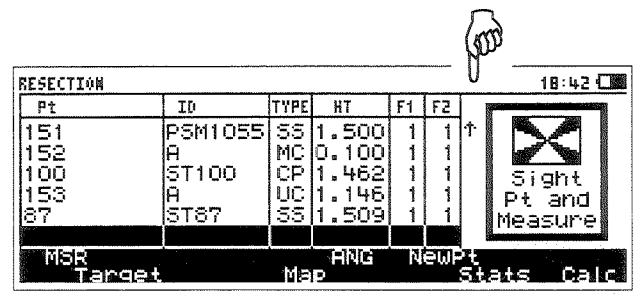
Existing Database Point — For known points which existed before resection was started, only the **HT** and the **Code** can be changed. However, you can change the point number to identify a different point, enabling you to edit other fields (see note).

New CP Point — For points created during this resection session, all fields can be changed (see note).

NOTE: If a point number is changed using the edit feature, the new point will replace the highlighted point. All previous measurements to the old point will be assigned to the new point.

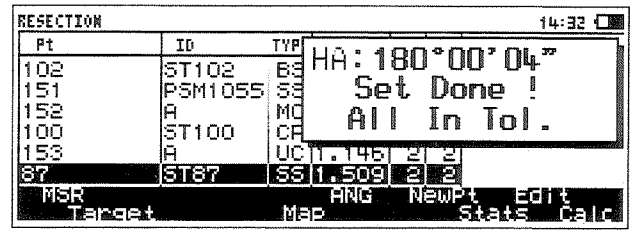
Screen Display Format

The tabular screen format is only capable of displaying information for six points. If a seventh point is added, the information for the first point scrolls off the screen. Arrows will appear in the message area to indicate that there is point information contained above, or below, the visible screen.



Set Done

The following window is displayed when AP800 determines that the set has been completed.



The window indicates that the set has been completed.

*NOTE: The message "All in Tol." only indicates that the Face 1 and Face 2 delta values for shots taken **in this set** are in tolerance. It does not indicate that measurements are in tolerance with those collected in other sets.*

"Out Tol."

The message "Out Tol." in the Set Done window indicates that one, or more, F1/F2 delta values for this set are out of tolerance.

You cannot return to this set to reshoot to the points, but you can use the ***[Stats]*** key, and the Observed Data screens, to view and if necessary inactivate the out of tolerance shots (see page 4-30).

If you want to change the tolerance settings for F1/F2 pairs of shots, refer to page 13-6.

It is important to understand how, and if, AP800 determines that the set is complete.

During the First Set

The software can only determine that the first set is complete when **both** of the following criteria have been met:

1. The first two shots of the set are made on Face 1: **and**,
2. All points listed in the resection table have been measured on Face 1 and Face 2. *(The order of making these measurements is not critical.)*

For example, if you measure to all the points on Face 1 first, and then make all your Face 2 measurements, the software will be able to determine when the set is complete.

However, if you choose to measure F1 and then immediately measure F2 for each point, AP800 cannot determine when the first set is complete. Under these circumstances you would have to force the start of the next set (see "Starting a New Set" on page 4-27).

NOTE: Once the Set Done criteria have been met, and this screen is displayed, you cannot return to this set to make more measurements or add new points.

During Subsequent Sets

The software can only determine that subsequent sets are complete when **both** of the following criteria have been met:

1. All Face 1 and Face 2 shots made during the first set have been repeated (*not necessarily in the same order*) in this set: **and**,
2. All points added to the resection table during this set have been measured on Face 1 and Face 2.

NOTE: Any points added during subsequent sets are appended to the first set record and are used to determine the "Set Done" status from then on.

Starting a New Set

A new set can be started at any time by making a same face remeasurement to the backsight point. If this is the second shot to the BS point during this set, on the same face, the following screen is displayed.

This window is only displayed when you try to record the shot.

This window is designed to alert you to the fact that, if you continue, you will be starting a new set and you cannot return to the previous set. If this is a mistake you should select **Cancel**.

Your options are:

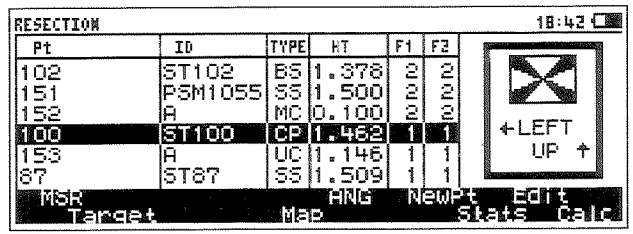
Continue the New Set Selecting **OK** will start the new set and record the current measurement (to the BS point) as the first shot of the new set.

NOTE: Any shots from the previous set which did not have "same face" backsight shots will be ignored when calculating the resection or displaying statistics.

Discard this Shot Cancel will return you to the resection table screen.

Measuring After the First Set

This is an example of the screen displayed in subsequent sets when AP800 is ready for you to measure to a point.



Note the aiming assistance to the right of the screen.

Measuring Order

The software anticipates that you will be shooting to the points in the same order you used in the first set. The highlight bar has moved to the next point in order, and aiming assistance to that point is provided.

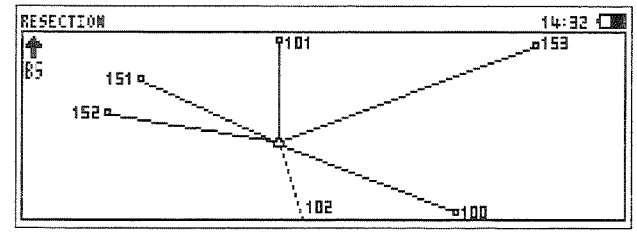
If you choose to shoot to a different point than the one highlighted, AP800 will move the highlight bar to the point which matches the measured data. Aiming assistance will recommence from this point.

Aiming Assistance

The aiming assistance is general and does not give an indication how far you need to turn and tilt the telescope. However, once you are set up within ±15′ of the point the word sight will replace the aiming indicators.

Map

The resection feature "Map" is provided so that you can view the geometrical layout of the points being measured. Pressing the *[Map]* softkey will open the Map screen.



The map is scaled to fit all the measured points on the screen. "Angle Only" shots are displayed as dotted lines.

The position of the station point (shown as a triangle) is given assumed coordinates by the software for the purpose of displaying this map. The other points are shown relative to the station point using the measurements taken.

The backsight is given an assumed azimuth of 0°00′00″ for the map, indicated by the BS symbol in the top left of the screen.

- Press **[ESC]** or **[ENTER]** to return to the main resection screen.

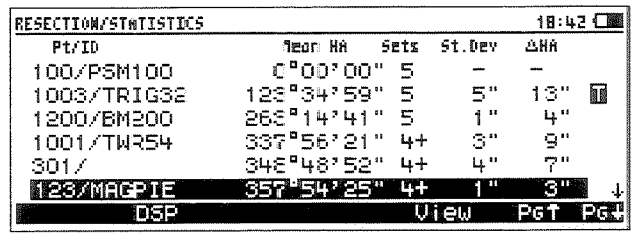
Statistics

The resection statistics feature provides information screens for Mean HA, Mean VA and Mean SD as well as Observed Data information for any point.

The statistical information is available during resection at any time once you have measured and recorded the backsight point in the first set.

Mean HA, Mean VA and Mean SD

To access the statistics screens, press the *[Stats]* softkey at the main resection screen.



The first screen displayed is the Mean HA screen. The scroll arrow on the right-hand side of the screen indicates that there is further information contained below the visible screen.

A separate screen is available for HA, VA and SD. Use the *[DSP]* softkey to move from one screen to the next. The data is presented in the same format on each of the screens.

NOTE: On statistics screens, the backsight point HA values will always be shown as 0°00'00" (Mean HA), — (St.Dev) and — (DHA) because backsight point measurements are adjusted to 0 during resection. This enables comparison of the other HA values.

NOTE: However, the values displayed on the measuring screens, and recorded in the job database, will be the true values measured when the point is shot.

Pt/ID

This column contains the point number and point ID separated by a slash. The points are displayed in the same order as they are on the main resection screen.

Mean HA (VA or SD)

The mean angle or distance value for each point is displayed in this column.

NOTE: An "inverse T" mark shown to the right of the screen indicates that the F1/F2 measurements, for at least one of the sets, are out of tolerance. On the Mean HA screen shown, this is true for point 1003.

NOTE: If you want to change the tolerance settings for F1/F2 pairs of shots, refer to "Tolerances (Face 1/Face 2 Slope Distance)" on page 13-6.

Sets

The "Sets" value for each point shows the number of completed sets during which this point was measured and recorded, regardless of whether it was shot on F1, F2 or both.

Additionally, if you are viewing the Stats screen whilst in the middle of an incomplete set, the "Sets" value will be adjusted for shots made during the current incomplete set.

If the point has be measured on **either** F1 or F2 during the current set, a plus sign "+" is displayed next to the "Sets" value. For example, point 1001 on the Mean HA screen shown has been shot to in four previous completed sets, and has been shot to on **either** F1 or F2 during the current set.

St. Dev

This column displays the standard deviation of the angles or distance measurements for each point (see note below).

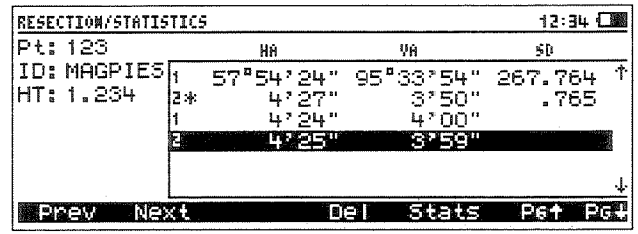
ΔHA (VA or SD)

The value shown here is the maximum difference of all measurements to this point (HA, VA or SD) taken during this resection session (i.e. ΔHA = maxHA - minHA, etc.).

NOTE: If only one measurement has been made to a point, the St.Dev and ΔHA (VA or SD) values will be "0".

Observed Data Statistics

Observed Data Statistics are available for any point by pressing *[View]* on one of the Mean HA, VA or SD screens. The point which is highlighted when *[View]* is pressed will be the first point displayed. You can then access the data for other points by pressing *[Prev]* or *[Next]*.



Pressing *[Stats]* will return you to the previcus screen.

The following screen features should be noted:

Face 1/Face 2

The first column of numbers inside the data window indicates which face (1 or 2) the measurement was taken on.

*NOTE: Pressing the **[Del]** softkey will mark the highlighted measurement as inactive and an asterisk is displayed next to the face indicator (as for the second shot shown above). This measurement will not be used in the Mean HA, VA or SD calculations. Pressing **[Del]** again will reactivate the point.*

*NOTE: If you inactivate a backsight point in this way, **all** the same face shots, made during the same set as the backsight point, will be marked as inactive.*

HA, VA and SD

The remaining three columns give HA, VA and SD values for each measurement taken.

The HA values are corrected for the face; that is, Face 1 shots are calculated from the Face 1 backsight and Face 2 shots from the Face 2 backsight.

In addition, Face 2 VA values are displayed as if they were taken on Face 1.

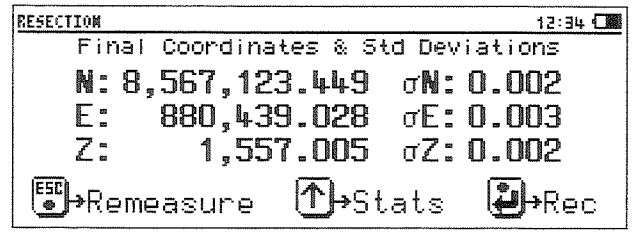
Computing Resection Station Coordinates

Once you have completed all the measurements you intend making to coordinate points, you can begin the resection coordinate calculations by pressing *[Calc]*.

Warning screens will inform you if either of the following situations are true:

- the current set is incomplete and some shots will not be used in the calculation because they do not have a corresponding backsight shot; or,
- the resection calculation has failed because of insufficient or inconsistent data (see "Failure To Calculate Coordinates" on page 4-34).

When AP800 has completed the calculations this screen is displayed.



The final coordinates and standard deviations are given for the calculated station point. If no Z value is shown, see "Failure To Calculate Coordinates" on page 4-34.

At this point you have three options:

Remeasure Pressing **[ESC]** will return you to the resection screen to continue measuring or, if necessary, to inactivate one or more measurements.

Stats Pressing [↑] will enable you to view the HA, VA, SD and Z residual screens (see page 4-36).

Rec Pressing **[ENTER]** accepts the calculation and starts the final recording operation. However, the data is not written to the job database until you press **[ENTER]** on the next screen.

Failure To Calculate Coordinates

AP800 will not be able to complete the resection calculation, and compute station coordinates, if:

1. In a two point resection where one point does not have a distance measured to it, the distance between the two known points is less than the measured distance from the telescope to one point; or,

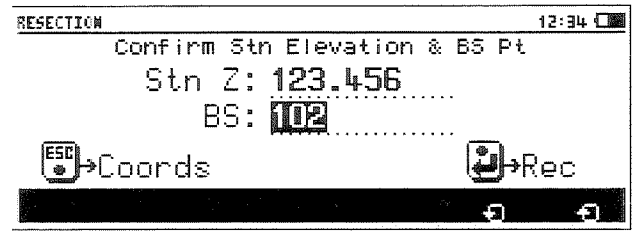
2. you made "angle only" measurements to three, or more, known points **but** all these points are located on a line intersecting the instrument point.

Missing Z Value

AP800 will not be able to calculate a Z coordinate for the station point if you have taken full measurements to less than two points with known elevations. In this case, the function Remote Benchmark could be used to obtain Z.

Confirm Elevation and BS Point

This screen provides you with the opportunity of changing or confirming the calculated station elevation and backsight point before recording the data.



Change/Confirm Stn Z

The value shown is the Stn Z calculated by the resection procedure. You can accept this value or enter a new value if a more accurate elevation is known for the point.

Change/Confirm BS

This field allows you to enter or confirm the backsight point for the station setup. The BS Pt shown will be the first known point measured during the resection procedure.

If you wish to change the BS Pt, you can use the circular selection list softkeys to select any other control point which was measured during the resection procedure.

Coords Pressing **[ESC]** will return you to the final coordinates screen (see page 4-33).

Rec Pressing **[ENTER]** will record the resection data.

The following data is written to the job database, in groups, for all points shot during the session:

- The point number and the HA, VA and SD standard deviations;
- The number of sets during which the point was measured and the HA, VA and SD MaxΔ's.
- The HA, VA, SD and HT mean values;
- The HA, VA and SD residuals;

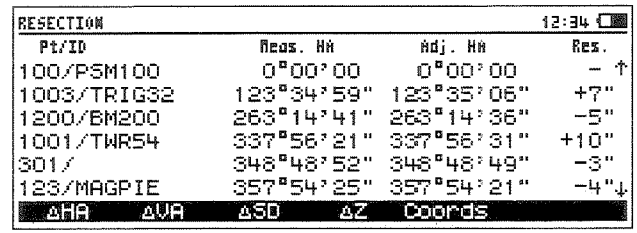
Following these records in the database, the calculated resection station point information is recorded:

- The standard deviation of the calculated N, E and Z coordinates;
- A resection (RE) record of the calculated coordinates;
- An ST record for the new station point.

NOTE: A "CO" record (note) indicating the start of the resection session and all the F1 and F2 shots are written to the job database as they are shot.

Residual Data Screens

The residual data screens are displayed by pressing [↑] (Stats) on the final coordinates screen (see page 4-33). A separate screen is available for the HA, VA, SD and Z residuals, and these are viewed by pressing the appropriate softkey on each screen.



This is the first screen displayed, the HA residuals screen.
Press *[ΔVA]*, *[ΔSD]* or *[ΔZ]* to view the other residual screens.

Information given for each point comprises the Measured HA, the Adjusted HA and the Residual. The format for all the residual screens is the same.

Pressing *[Coords]* will return you to the final coordinates screen.

Summary of Resection Softkeys

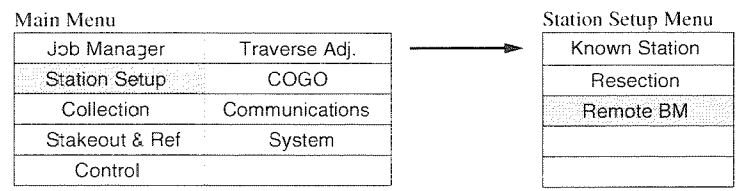
Resection	
ANG	Measures the angle only.
Calc	Calculates the resection station coordinates. This key appears only when there is sufficient data to calculate the resection.
Coords	Returns you to the final coordinates screen.
Del	Marks the measurement as inactive.
DSP	Displays the next statistics screen.
Edit	Allows you to edit the highlighted point's details.
Map	Operates the "Map" function which gives a geometrical layout of the points measured.
MSR	Measures the direction and distance to the point.
NewPt	Enables you to add a new point to the resection list.
Next	Displays the information for the next point.
Prev	Displays the information for the previous point.
Stats	Operates the "Statistics" function which gives you access to Mean HA, VA and SD information.
Target	Quick target selection to change the prism constant.
View	Enables you to view the observed data statistics for individual points.
ΔHA	Selects the HA residuals screen.
ΔVA	Selects the VA residuals screen.
ΔSD	Selects the SD residuals screen.
ΔZ	Selects the Z residuals screen.

Remote Benchmark

Introduction

Remote Benchmark lets you determine the station elevation, the height of instrument, or the instrument elevation. You can use any point with a known elevation even if the Northing and Easting coordinates are unknown. To increase accuracy, AP800 supports multiple Face 1 / Face 2 readings and measurements to different remote benchmarks.

Roadmap

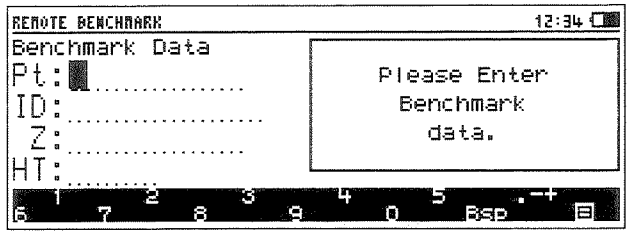


NOTE: You must do a station setup before you can use Remote Benchmark or you can use the last station setup (see "Known Station" or "Resection" in this chapter).

Remote Benchmark Sequence (for Calculating Station Z)

- Enter benchmark data.
- Enter HT, Z, or both (if requested).
- Sight and measure to benchmark.
- Remeasure or measure to new point.
- Record Station Z.

Enter Benchmark Data



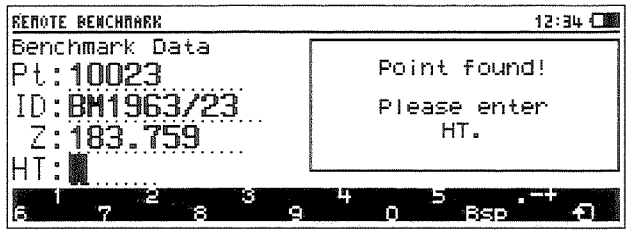
This screen appears when you select "Remote Benchmark" from the "Station Setup Menu." The station point has been previously established with Known Station or Resection with a specified HI. The station elevation may or may not be known.

Benchmark Point or ID

- Type or use the selection list to enter either the **Pt** number or **ID** (max. 10 chars.).

The program searches only for the Benchmark "Pt" and "ID" after you input one of the values and press **[ENTER]**.

Point Found

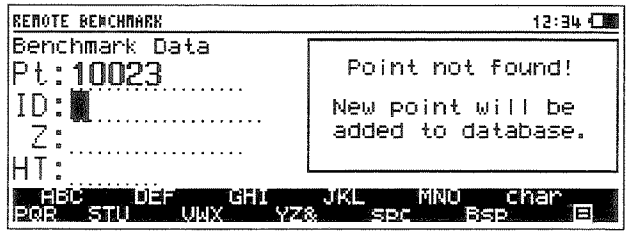


AP800 asks you to enter the **HT**, **Z**, or both. (The "→" key inputs **HT** values from the stack, if there are any.)

Point Found But Z Unknown

If a point number or **ID** has been entered and found in the database, but the elevation is not known, you will be asked to enter the **Z** and **HT**.

Point Not Found

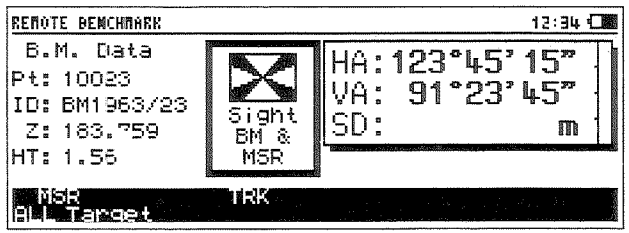


This screen allows you to specify the benchmark data and add it to the current job. Alternatively, you can enter a different point number.

- Enter the **ID** (optional), **Z**, and **HT**. Then press **[ENTER]**.

AP800 records the point with unknown Northing and Easting coordinates. You can use "View /Edit" to add this data to the benchmark point record.

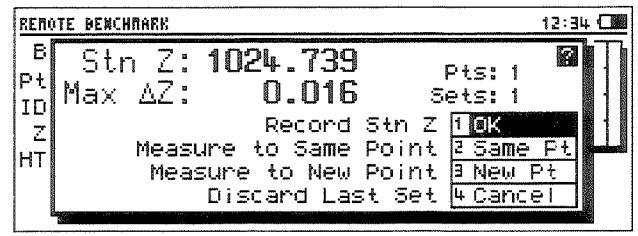
Sight Benchmark and Measure



Sight to the benchmark and measure using **[MSR]**, **[TRK]**, or ***[ALL]***.

If you selected ***[MSR]*** or ***[TRK]***, AP800 gives you the option to do a Face 2 measurement.

Stn Z Value & Statistics Report



AP800 reports the "Stn Z" and "Max delta Z" after every measurement set.

On the screen shown above, the **Pts** value is the number of different benchmark points that you have measured to. The **Sets** value is the number of F1/F2 (or just F1) measurements taken.

For example, if you measure to BM100 three times, and to BM101 four times, the **Pts:** value would be 2 and the **Sets:** value would be 7.

You have several options:

Record Stn Z

AP800 only lets you record the Stn Z if a station point was established before you entered "Remote Benchmark."

However, AP800 does not automatically replace the existing station elevation (if there is one). You will be asked to confirm the replacement.

- Select **OK** to record the Stn Z. A note is written to the job database detailing the new calculated Z.

Measure to Same Point

- You can take repeat measurements (including Face 2 readings) to the same point by selecting **Same Pt**.

AP800 reports the new "Stn Z" and "Max delta Z" for all sets of readings.

Measure to New Point

Selecting **New Point** gives you the opportunity to calculate the Stn Z from more than one remote benchmark.

Discard Last Set

- To discard the last set of measurements and display the previous values or to remeasure to the benchmark, select CANCEL.

Remote Benchmark Options

Calculate Stn HI

AP800 can calculate the HI instead of the station elevation. The software automatically searches the station setup record and if it cannot find the HI, AP800 asks you if you want to compute it.

The procedure is similar to the one for calculating the station elevation as described in this section. In this case, AP800 reports the Stn HI value and Max delta HI.

Calculate Instrument Z

AP800 can calculate the Instrument Z and set HI to zero instead of computing the ground elevation of the station point. The software automatically searches the station setup record and if the Stn Z and Stn HI are unknown, AP800 asks you if you want to compute it.

The procedure is similar to the one for calculating the station elevation as described in this section. In this case, AP800 reports the Inst Z value and Max delta Z.

Calculate Stn Z without NEZ Coordinates

AP800 allows you to do a station setup and save the record with unknown coordinates. You are given the option in the "Station Setup" function to calculate the Z later.

You can use "Remote Benchmark" to calculate the Z value and "View / Edit" can be used to manually enter the N and E coordinates.

Summary of Remote Benchmark Softkeys

Remote Benchmark	
ALL	User-defined measure key. Measures and accepts single or multiple measurements.
MSR	User-defined measure key. Measures single, multiple, or continuous measurements.
Target	Quick target selection to change the prism constant
TRK	User-defined measure key. Measures single, multiple, or continuous measurements.

Chapter 5

Collection

This chapter describes how to use the AP800 software to collect your survey data.

Introduction

Use this section if you are taking measurements and recording the data.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

Basic Measuring / Recording Sequence

- Enter point information.
- Sight and measure to target.
- Record the measurement.

No BS Check or Station Setup since Power ON!

AP800 will allow you to start collection without performing a BS check or station setup since power on. You may want to do this if you are not interested in provisional field coordinates and the instrument is not set up over a survey point.

When you enter collection under these circumstances, a warning screen is displayed alerting you, and giving you three options:

1. You can use the instrument's current orientation — this assumes that the instrument was not rotated while powered off;
2. You can ask AP800 to create a default station setup (see below); or,
3. You can exit collection and return to the main menu.

Default Station Setup

When you select **Default Stn**, AP800 creates a dummy coordinate record (MC) and station record (ST) in the job database. Both of these records are given the next available point number.

The dummy MC coordinate record has **no** ID or Code. The N, E, Z values are 0.000.

The dummy ST station record has the following details:

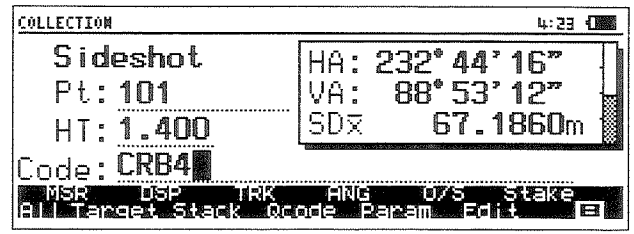
Pt Number: same as the MC record.
ID and HI: none.
BS Az: current instrument azimuth.
BS Pt and ID: none.
HT: 0.000.
Temp and Press: current system values.

NOTE: The station coordinates, details and HI may be input later using View/Edit if they become available.

Enter Point Information

When you first enter the Collection screen (shown below), AP800 automatically increments the highest point number in the open file by one. The unused point number is placed in the "Pt" field. Additionally, the software inputs the last used "HT," and the "Code" field is blank.

After the first point AP800 updates all measurements and increments the point number by one. The cursor moves to the "Code" field and AP800 is ready for your next input.



The Collection screen showing the last measurement, e.g., to Pt 101. Note the cursor in the "Code" field, and the measure softkeys are active.

Warning

Pressing [ENTER] when the measure keys are displayed records the measurement (see "Recording a Measurement" on page 5-10).

Moving to Another Field

- To move the cursor to another field, press [↑] or [↓].

(Notice that the mode changes automatically and the softkey bar displays the appropriate softkeys. You can always change to measurement mode by pressing **[Mode]**.)

Changing the Point Type

- If you are taking a shot to a control point you can use the selection list to change the point type from **Sideshot** to **Control**.

When you leave this screen AP800 asks you for a control point **ID**. If you do not want to supply an identifier, press **[ENTER]**.

Pt Number

- Although AP800 has incremented the point number by one, you can enter a different number if required.

To take a check shot to an existing point, just change the point number before recording. AP800 will display the difference between the current shot and the searched point number. The point number field is also manually overridden when taking a second angle shot to create a new point (see page 5-5).

HT

- Type the **HT** or use the selection list or ***[Stack]*** (operates in the same way as it does for codes. See "Using Stacked Codes" on page 5-12).

Changing the Code and Code Parameter

- When the cursor is in the "Code" field you can use the **[Mode]** key to change to **123** (numeric), **ABC** (alpha), or measurement mode.

The selection list, ***[Stack]*** and ***[Qcode]*** are available for entering codes. You can also use ***[Param]*** to enter a feature code parameter. Manual input is also possible.

(For more information, see "Entering Feature Codes and Code Parameters" on page 5-12)

NOTE: The code and code parameter selection lists only operate if there is a code file and code parameter file on the data card. For more information see "Setting Up Feature Code and Code Parameter Files" on page A-2.

Taking a Measurement

Measuring to a Point

- Sight to point.
- If necessary, use **[Mode]** to display the measurement softkeys.
- Pressing ***[Target]*** will allow you to select a prism constant and height of target combination from the available Quick Targets. (For assistance, see page 2-9).
- Press ***[MSR]***, ***[TRK]***, or ***[ALL]*** to measure to the prism. (For assistance, see page 2-8 and page 13-5).

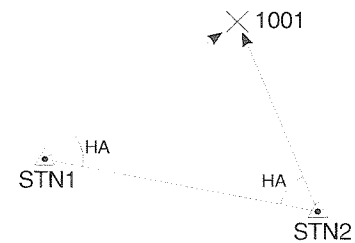
☞ Shortcut: ***[ALL]*** also records the point to the data card. Normally you press **[ENTER]** after a *MSR* or *TRK* measurement to record the measurement.

Hint: You can change any field while a measurement is in progress, e.g., change the code from "TREE" to "KERB."

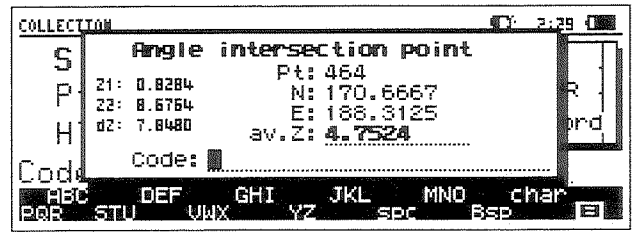
NOTE: To measure and record only the "HA" and "VA" angle values and leave the "SD" blank, use [ANG].

Calculate Point Coordinates Using Angles

You can calculate the coordinates of a point by measuring only the angles to the point from two known points. AP800 calculates the point's coordinates based on the intersection of the two lines.



To calculate the coordinates using this method, take the angular measurement ***[ANG]*** to the same point from two stations. When you take the second measurement, AP800 displays the following screen.



AP800 calculates the coordinates of the point and an average Z value based on the Z values of the two original stations.

Display Measurement Data

Updated measurements, averaged values, or both are available for VD/HD and N/E/Z. Use *[DSP]* to cycle through the measurement display boxes.

- If you are not measuring a distance offset and you want to record the measurement, press **[ENTER]** (the measure keys must be displayed *before* recording).

Measuring By Offsets

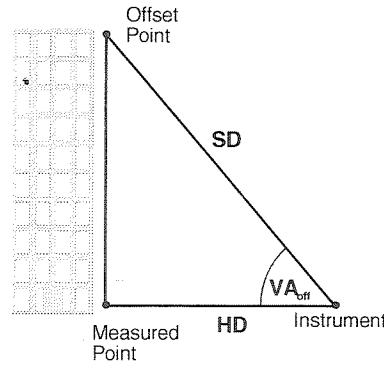
There are two ways to locate a point by using offsets:

Angle Offset Method and *Taped Offset Method.* The *Angle Offset Method* can be used when the point is visible but you cannot exactly position the prism.

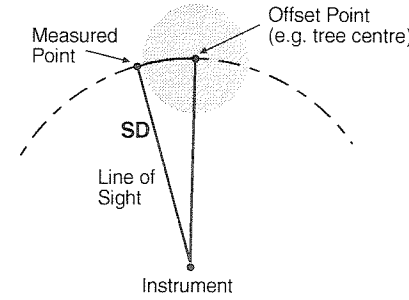
The *Taped Offset Method* is more applicable when you cannot sight to the point but you can locate it by using an offset tape.

About Angle Offsets

AP800 measures to the prism, then changes the horizontal angle (horizontal offsets) or vertical angle and slope distance (vertical offsets) before recording.



Vertical Offset: AP800 records the VA of the offset point and the HA of the measured point. A new SD is calculated based on the HD and the VA_{off}.



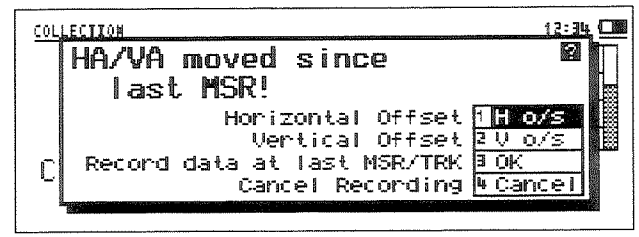
Horizontal Offset: AP800 records the HA of the offset point but the VA and SD of the measured point.

Using the Angle Offset Method

- Advise the rodman to position the prism as shown in the figure above.
- Measure to the offset point using the procedure described under "Measuring to a Point" on page 5-5). Do *not* record the measurement.
- Sight to the offset point. Make certain the measure softkeys are displayed, then press **[ENTER]**.

NOTE: When you turn the instrument and exceed the "HA" or "VA" tolerance, AP800 asks you to confirm that you are measuring an offset (see next figure).

NOTE: The tolerance applied here is a special HA/VA Moved Tolerance (see page 13-15). It is not the standard HA and VA tolerance.



If you do not want this warning to appear, you can change the angle tolerance setting to zero. (See "Angle Offsets" on page 5-10.)

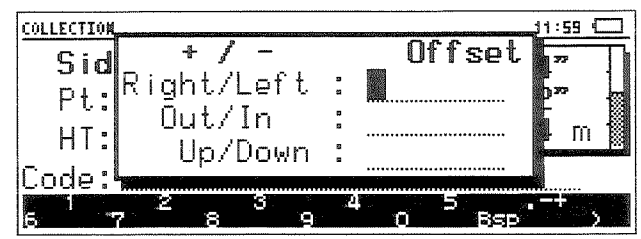
Selecting **H o/s** records the new HA and the VA/SD of the measured point.

Selecting **V o/s** computes and records the new SD/VA and adds a note to identify the new SD. The HA of the measured point is recorded.

OK records the HA, VA, and SD of the measured point.

Taped Offset Measurements

- Measure to the offset point using the procedure described under "Measuring to a Point" on page 5-5).
- Use *[O/S]* in measurement mode to display the "OFFSET" window.



You enter any combination of taped offset distances to specify the offset.

- The direction of the taped offsets are always from the *instrument person's viewpoint*:

In — From the prism toward instrument.

←**Left** — Left of the prism when looking from the instrument to the prism.

Up — Above the prism.

Out — From the prism away from the instrument.

Right→ — Right of the prism when looking from the instrument to the prism.

Down — Below the prism.

- To calculate the point position, move the cursor to the **Down** field and press **[ENTER]**.

AP800 asks you to "Record" the calculated distance or discard it.

NOTE: You can change the data in any field before recording the point.

- To record the point, make certain the measure keys are displayed, then press **[ENTER]**.

Recording a Measurement

You must display the measure keys before you can record a measurement.

- Press **[Mode]** to display the measure keys, then press **[ENTER]** to record the measurement.

*NOTE: If you have just taken a measurement with **[MSR]** or **[TRK]**, press only **[ENTER]** to record.*

☞ Shortcut: If all the data on the screen is correct, you can measure *and* record automatically by pressing *[ALL]*.

If any of the following conditions exist, AP800 asks you some questions to verify what is being recorded —

Angle Offsets **The angles being recorded differ from when the last distance was measured, and exceed the tolerance value.** This may occur if you are doing an *offset* measurement or remote elevation, or if you move the telescope *before* recording the measurement. (To change the tolerance in "Settings", see "Moved HA/VA Tolerance" on page 13-15).

Multiple Codes **Trying to record without taking a measurement.** You may change the code and record without taking a measurement.

Close Points **The measurement is within a specified tolerance in N, E, and Z of the last point.** (see "Close Point Tolerance" on page 13-15). You are asked to confirm that this is a *different* point and should be recorded.

Modifying Records

Sometimes it may be necessary to modify one or more records while you are collecting data. You modify information using the "View/Edit" functions which are fully described in "View / Edit" on page 12-5.

To modify information, select the ***[Edit]*** softkey on the "Collection" main screen. AP800 displays the "View/Edit" screen where you can view and modify information that you have recorded.

To return to "Collection" from "View/Edit" mode, press ***[Esc]***.

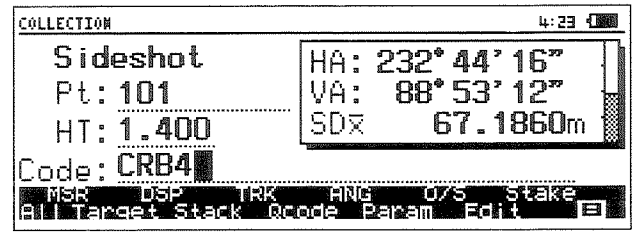
*NOTE: Selecting **[Edit]** from the "Collection" main screen performs the same action as selecting **[FNC], [2]**.*

You can also use this feature to enter data for measurements that you have taken manually (i.e. taped measurements). To do this, record an ANG shot and then use "View/Edit" to edit the SD value for the point.

Entering Feature Codes and Code Parameters

You can quickly input frequently used feature codes using the *Stack* and *Quick Codes* functions. Likewise you can use the *Parameter* function to select a feature code parameter. Selection lists are available for feature codes and code parameters.

When a feature code is selected it is added to the "Code:" field. If a code already exists it will be overwritten by the new code. Code parameters are added to the end of the existing code information.



Collection screen showing the "Stack," "Qcode" (Quick Codes), and "Param" (Parameter) softkeys in measurement mode.

NOTE:
When you select an option from the "Code Selection List", the selection replaces whatever is in the "Code" field. Selecting an item from the "Param" list, results in the selection being added to the end of the existing code.

Using Stacked Codes

Each time you enter a code it is automatically "stacked" and stored for future use. The stack may contain up to 30 codes. AP800 puts the last used code at the *bottom* of the stack and displays the code on the screen.

To select the previous code, press the ***[Stack]***, then use [↑] to move upwards through the stack. The [↓] key moves down through the stack and blanks the field when it goes past the most recent code.

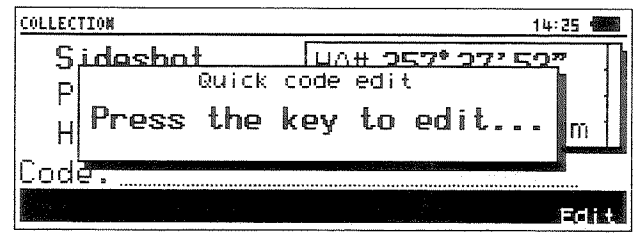
*NOTE: You can select **[Stack]** when the cursor is located in any field.*

Using Quick Codes

Making the First List of Quick Codes

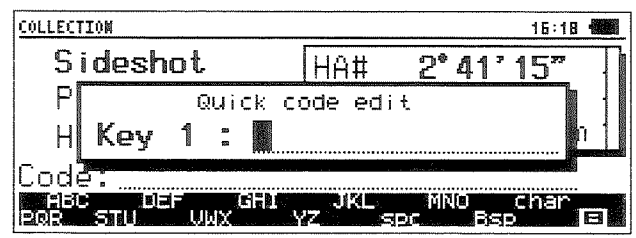
You can create five lists and each list may contain up to 12 "Quick Codes." AP800 allows partial lists.

- If necessary, move the cursor to the **Code** field and use **[Mode]** to display the "MSR" softkeys.
- To start the Quick Code edit function, select ***[Qcode]***, then press ***[Edit]***.



AP800 asks you for the key you want to assign a quick code. The softkey bar below the instruction window is blank when there are no quick codes in the list.

- Press the key you want to assign a quick code (or **[ESC]** to exit to "MSR" mode).



AP800 displays the key you selected and waits for you to enter a code.

- Type the code (max. 16 chars.) or use the conventional feature code selection list. Then press **[ENTER]** to accept the code and save the assignment (or cancel using **[ESC]**). AP800 displays the quick code in the list.

NOTE: When you return to the Collection screen, only the first five characters will be displayed as quick code softkey labels.

- Repeat the above procedure until the list is full or you want to create another quick code list. (To exit this function and return to "MSR" mode, press **[ESC]**.)

Making the Next Quick Code List

- To display a blank list of quick codes in the softkey bar, press **[Mode]**.
- Follow the above procedure to assign quick codes to keys.

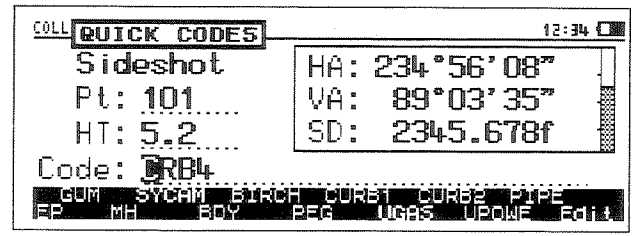
Editing Quick Codes

You can change or delete any quick code on any list.

- If necessary, move the cursor to the **Code** field and use **[Mode]** to display the "MSR" softkeys.
- To start the Quick Code edit function, select ***[Qcode]***, then press ***[Edit]***.
- Use **[Mode]** to display the list that contains the quick code you want to edit.
- Press the key to edit, then select another code or delete the code. To accept and save any changes, press **[ENTER]** (or **[ESC]** to cancel).

Entering a Quick Code in the Code Field

- To display the first list of quick codes in the softkey bar, select *[Qcode]*.



The bottom two lines display the Quick Code softkey labels.

- Press **[Mode]** to change quick code lists as required.
- Use the softkeys to select the appropriate quick code.

AP800 puts the code into the "Code" field. After you record the measurement, AP800 assumes you will select another quick code and displays the quick code softkey labels again.

☞ You can make AP800 automatically take a measurement as soon as it accepts the quick code. For more information see "QCode = Code plus " " " on page 13-17.

Using Feature Code Parameters

A feature code parameter is a device that can reduce the number of shots in the field and gives you the freedom to take shots in the most efficient manner. They also control the shape of the lines between points, such as a curve.

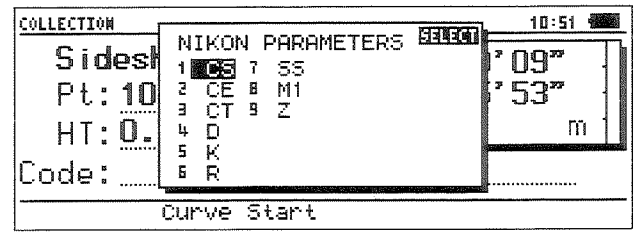
Feature code parameters normally operate with strings, such as roads and boundaries, and they are frequently used in surveying buildings, walls, and other structures.

Feature code parameters are added to feature codes and have a one or two character identifier. For more information you should refer to the mapping software that handles your feature code parameters, such as Nikon's "NS-95."

Adding a Feature Code Parameter

The feature code parameter is inserted after the existing feature code.

- To open the list of feature code parameters, press ***[Param]***.



*NOTE: You can select **[Param]** when the cursor is located in any field.*

- Select the feature code parameter from the selection list.

Collection Options

Measurement on Face 2

- To increase accuracy do a Face 2 reading. (If you require assistance, refer to "Face 2 Measurement (Optional)" on page 4-11.)

Record a Note

- Press **[FNC]** and select **Notes**. This function is described in "Notes" on page 12-27.

Check Backsight

- Press **[FNC]** and select **Backsight Check**. This function is described on page 12-33.

Summary of Collection Softkeys

Collection	
ALL	User-defined measure key. Measures and records single or multiple measurements.
ANG	Measures the angle only.
DSP	Displays updated measurements.
Edit (Main Screen)	Switch AP800 to View/Edit mode.
Edit (Quick Codes Screen)	Allows you to create or change the quick code values.
MSR	User-defined measure key. Measures single, multiple, or continuous measurements.
O/S	Enables you to use the taped offset measurement method.
Param	Opens the selection list of feature code parameters.
Qcode	Changes the softkeys to Quick Codes
Stack	Selects recently used feature codes from the stack.
Stake	Shortcut key to go directly to stakeout.
Target	Quick target selection to change the prism constant and/or height of target.
TRK	User-defined measure key. Measures single, multiple, or continuous measurements.

Chapter 6

Stakeout & Reference Line

This chapter describes how to perform a **Point Stakeout**, prepare a **Point List** for staking out later, and measure offset distances to reference lines using **2Pt Reference Line** and **Arc Reference Line**.

Typically Stakeout is used to mark out positions based upon known design points. The reference line functions are used to measure points in relation to a design reference line or arc.

Point Stakeout

Introduction

This section shows you how to stakeout individual points and how to create a customized list of points to stakeout. You are also shown how to assemble and display the data you would like to see when staking out a point.

Roadmap

Main Menu

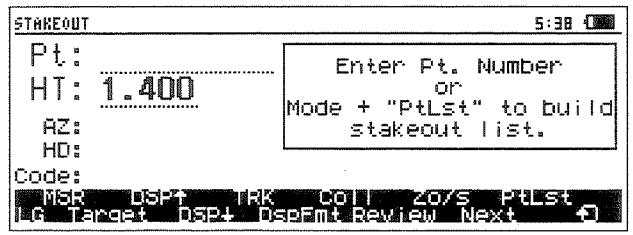
Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Stakeout & Ref

Point Stakeout
Point List
2Pt RefLine
Arc RefLine

Main Point Stakeout Screen



Stakeout Sequence

- Make certain all the points you want to stake out are in the open job or the attached control job. If necessary, upload the coordinates (see page 10-2), copy the points from another job (see page 3-10), or manually enter the coordinates (see "View / Edit" on page 12-5).
- Set up over a known station (see page 4-2) or resection at an unknown point (see page 4-16).
- Type the point number or build a stakeout list (see page 6-11) and select a point.
- If applicable, enter the offset elevation (Zo/s).
- Move the rodman either on-line or close to the point using the information displayed and the Lumi-Guide (optional).
- Measure to the first point.
- Move rodman on line.
- Re-measure and repeat as necessary.
- Check tolerances.
- Record the measurement.
- Enter the next point.

Individual Points or a Stakeout List

The size and complexity of the job determines which data entry method you will use in the stakeout. You have the choice of typing the point numbers or selecting the point numbers from a stakeout list.

Typing the Point Numbers

Using this method you choose the stakeout point from a plan or some other source and type its point number.

Using a Stakeout List

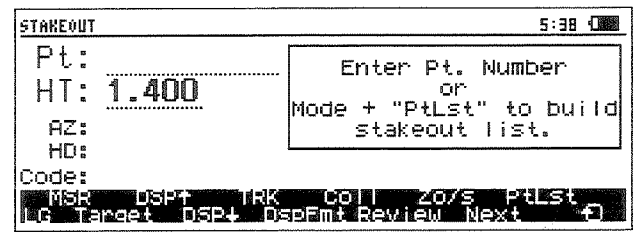
This method allows you to stake out a specified range of points from a job. You build a stakeout list based on your own criteria, for example, proximity to the instrument point or points with similar features.

The procedure for building a stakeout list is detailed in "Building a Stakeout List" on page 6-11.

Starting the Stakeout

Enter Point Number

You begin a stakeout by entering the point number in the main stakeout screen.



- In the **Pt** field, type the point number *or* if you have created a stakeout list, press *[Next]*.
- To update all fields and display the first data display screen, press **[ENTER]** or [↓].

Enter Z Offset (optional)

- To display the "Offset Elevation" window, press *[Zo/s]*.
- Type the offset elevation above the design elevation. Then press **[ENTER]** to accept your input. If the field is *blank*, the "Zo/s" is set to zero.

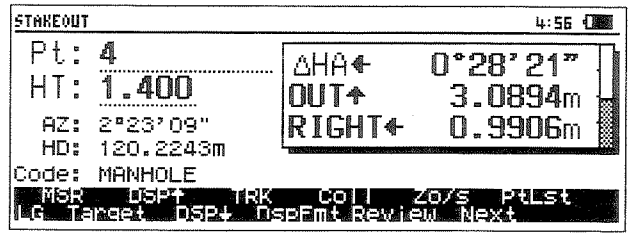
*NOTE: Zo/s is **only** applied to the Z value when calculating ΔVA, and not to any other vertical data, for example CUT/FILL.*

NOTE: The current offset elevation remains in effect until you change it or open another job. The offset is displayed in the "Zo/s" field in the main stakeout screen.

Stakeout First Point

Turn Instrument

You will see an arrow next to the "ΔHA" field and the "ΔVA" field (no arrow is shown if the value is 0°00′00″).



Turn the instrument in the direction of the arrow until the angle reads 0°00′00″.

Display Data Screens

You may have up to five different user-defined data screens. Use *[DSP↑]* or *[DSP↓]* to cycle through them. For more information, see "Customizing the Data Display Screens" on page 6-15.

Stakeout ΔVA Handling

During stakeout, ΔVA is calculated assuming an HT of 0.0. This feature enables you to sight exactly to the stakeout point and reduce your ΔVA to 0, without having to first change your HT to 0.

If you prefer to measure to the prism and reduce your ΔVA to 0, you can enter a positive Zo/s equal to the HT of the stakeout point to achieve this (see page 6-4).

Turn On Lumi-Guide

Additionally, the "Lumi-Guide" can help the rodman to align the prism.

If the Lumi-Guide is set to *automatic mode*, it turns on when the horizontal angle is within one minute of the point.

The Lumi-Guide automatically turns off when the measured distance is within one metre (3 ft.) of the point.

If the Lumi-Guide is set to *manual mode*, you must use *[LG]* to turn the Lumi-Guide on or off each time.

For more information, see "Lumi-Guide Operation" on page 13-17.

Lumiguide Assistance

When the lumiguide is turned on it can be used to assist the rodman in positioning the target over the point being staked out.

By positioning the target to where the flashing and constant light appear to cross over the target will be in-line with the instrument.

In addition to this, the flashing light can be used to convey move in and move out information. After each measurement the lumiguide flash rate will change according the following flash rates:

No measurement	normal - one flash per second
Move in	**slow** - one flash every two seconds
Move out	**fast** - rapid flashing
Within tolerance	**normal** - one flash per second

Note: The different flash rates will only be available on instruments that support this.

Note: You may need to experiment with this to see if it is suitable for your needs.

Save Power

- You can set the EDM to switch to "standby mode" automatically after a specific period of inactivity (see "EDM Power Save" on page 13-7.)

Measure to First Point

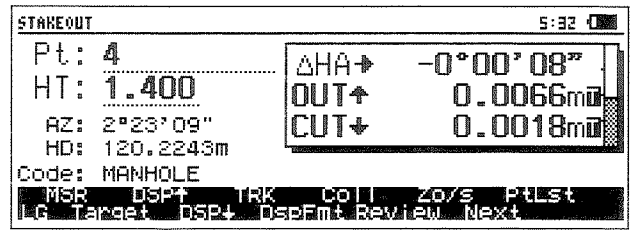
- If necessary, use **[Mode]** to display the measure keys. Use ***[MSR]*** or ***[TRK]*** to measure to the prism as required.

Do *not* press **[ENTER]** until you are satisfied with the measurement, i.e., when the rodman is on line and at the correct distance.

*NOTE: Pressing **[Target]** will allow you to select a prism constant and height of target combination from the available Quick Targets.*

Measurement Within Tolerance

If the measurement is within tolerance, the display data window shows an inverse "T" (white on black background). (You can change the tolerance values for the vertical and horizontal positions. See "Horizontal Tolerance and Vertical Tolerance" on page 13-18.)



Here the difference between the measured distance and the computed design distance ("OUT") and the distance above the design elevation ("CUT") are within tolerance.

- Advise the rodman to adjust the prism position until all the inverse "T's" appear. The number of tolerance symbols depends on which data types are displayed.

Record the Measurement

- *Optional:* If necessary, use **[Mode]** to display the measure keys. Press **[ENTER]** to record the point.

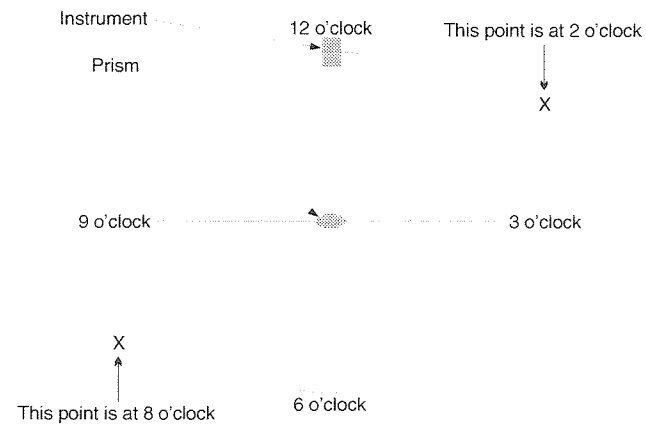
NOTE: AP800 will increment the original point number by 1000 when assigning the stake out point number. This is the default, but you can change this in "Settings" (See page 13-18).

Stakeout Second Point

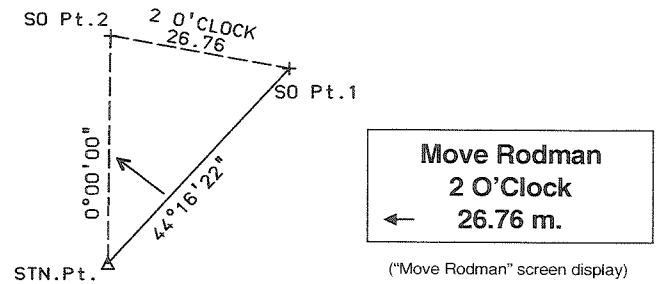
Follow the above procedure to stake out the second point and subsequent points. Additionally, AP800 helps you to orientate the rodman and the instrument.

Move Rodman/Turn Instrument

The "Move Rodman" display tells you how to direct the rodman to the next point, using the clock face principle shown below.



In addition, an arrow tells you which way to turn the instrument and a distance value tells you how far to move the rodman. In the figure below, the surveyor is about to stake out the second point ("SO Pt. 2"). The arrow on the display tells the surveyor to turn the instrument to the left until the angle reads 0°00′00″, and the message indicates that the rodman should move 26.76 m (HD from PT 1 to Pt 2) at 2 o'clock.



("Move Rodman" screen display)

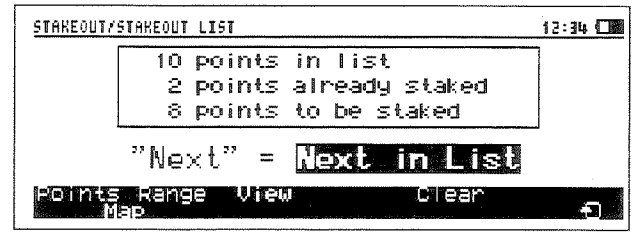
Report Stakeout Status (For Stakeout List Users Only)

If you are using a *stakeout list* you can easily view the points remaining to stake out. You can inspect all the unstaked points or you can display a map showing both staked out points and those yet to be staked out.

All this information is accessed from the "Stakeout List Screen."

Display Stakeout List Screen

- To display the "Stakeout List Screen," select *[PtLst]* at the Main Stakeout Screen (see page 6-4).



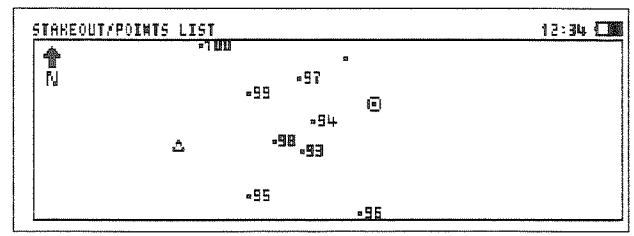
The Stakeout List Screen reports the status of the points in the stakeout list.

List Unstaked Points

- To list the points remaining to stakeout, press *[View]*. (The "Points List Screen" shows the point number, code, Northing, and Easting for each point.)

Display Stakeout Map

- To map both staked and unstaked points, select *[Map]*.



AP800 maps all the points in the stakeout list on the screen. The scale is determined automatically. The legend for this map is given next.

Legend:

Staked Point — Dot *without* a point number.

Unstaked Point — Dot *with* a point number.

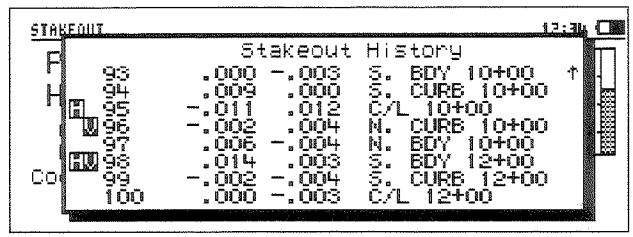
Circle — Prism location at the last measurement, i.e., last staked point.

Triangle — Instrument location. (Shown only if it falls on the map. The stakeout list and the prism position determine the map limits.)

Show Stakeout History

At any time you can view all the points you have measured *and* recorded since the last station setup. These points may have been typed in or selected from a stakeout list.

- To open the "Stakeout History" window, select ***[Review]*** from the Main Stakeout Screen (see page 6-4).



The "Stakeout History" includes the out of tolerance indicators, recorded point number, "ΔN," "ΔE," and code for each record. ("Settings" determines the coordinate order. See page 12-6.)

The window shows the inverse "H" and the inverse "V" if the point was *out* of horizontal or vertical tolerance when it was recorded.

Stakeout Finished

"Finished" is displayed in two situations: After the *last* point in the stakeout list is recorded, or if you are staking points directly from the database file and there are no coordinate points within the next 25 records.

NOTE: "Finished" appears only if you staked out points from the stakeout list.

You have three choices:

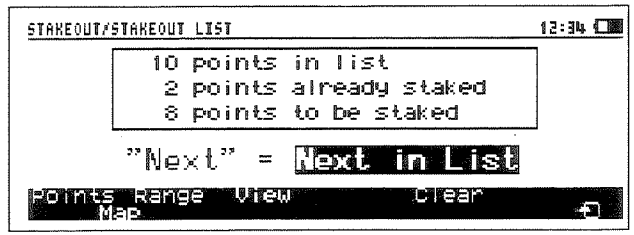
- Leave stakeout — Press **[ESC]**.
- Type a point number to stake.
- Build another stakeout list — Press ***[PtLst]***.

Building a Stakeout List

You can restrict the points you want to stakeout by creating a list of points which meet certain criteria. For example, you may want to limit the survey to a fixed range of points (by point number), or perhaps to those points within a specific radius of the instrument point. It is also possible to build a list of points which have the same code.

- To show the stakeout status: If necessary, press **[Mode]** at the Main Stakeout Screen to change to "MSR" mode.
- Press ***[PtLst]***.

Stakeout Status



The Stakeout List Screen shows the status of ten stakeout points. Only two of the ten points have been staked out.

The "Stakeout List Screen" has a threefold purpose:

- To display the current status of the stakeout list.
- To build a stakeout list.
- To inspect the stakeout list (shows points remaining to stake).

Set Stakeout Order

The order of the points you stakeout is controlled by the "**Next**" field in the "Stakeout List Screen."

This field corresponds to *[Next]* (available at the main stakeout screen). *[Next]* puts the next closest point or the next sequential point in the "Pt" field.

- Use the selection list to input either **Next in List** or **Next Closest**.

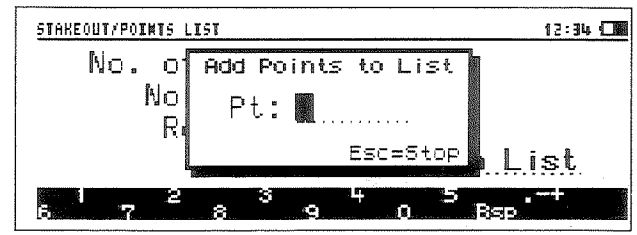
NOTE: To exit this screen without building a stakeout list, press [ESC].

Create Stakeout List

You can add points one at a time or you can add a range of points to the stakeout list. *Only points currently in your job or the attached control job can be included in the list.*

Add Individual Points

- To display the "Add Points to List" window, press *[Points]* at the "Stakeout List Screen".

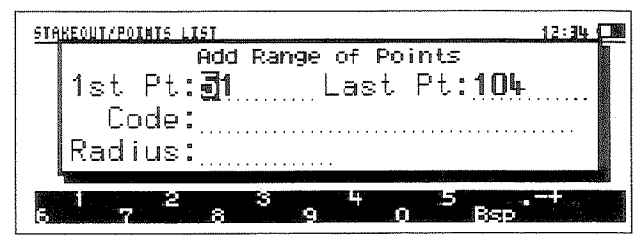


Here you enter the number of the point you want to place in the stakeout list.

- Type the point number, then press **[ENTER]** to accept your input.
- Repeat until all point numbers have been added to the stakeout list.
- To *save* the list and *exit* this screen, press **[ESC]**.

Add Range of Points

To display the "Add Range of Points" window, press *[Range]* at the "Stakeout List Screen" (see page 6-12).



Here you set the criteria for selecting a range of points to add to the stakeout list.

You may use any combination of these fields to construct your stakeout list. In addition, you can repeat this function and add a different combination until your customized stakeout list is complete.

To *exit* this screen and add all qualified points to the stakeout list, move the cursor to the **Radius** field and press **[ENTER]**. (Use **[ESC]** to cancel any changes to the criteria.)

Lowest and Highest Point Numbers —

- Use the **1st Pt** field to input the lowest point number in the range. Type the highest point number in the **Last Pt** field.

Code —

- Type or use the selection list to input the code.

NOTE: Part codes will match. For example, specifying a code of "BLD" will select codes "BLD1," "BLD2," etc.

Radius —

- All points within the specified radius will be added to the stakeout list. Type the radius.

View Stakeout List

You may view the points that have been added to the stakeout list at any time. *Take note that only the points remaining to stake are listed.*

- To view the current stakeout list, press ***[View]*** at the "Stakeout List Screen" (see page 6-12).

Remove Points from List

- To discard all the points in the stakeout list, press ***[Clear]*** at the "Stakeout List Screen" (see page 6-12).

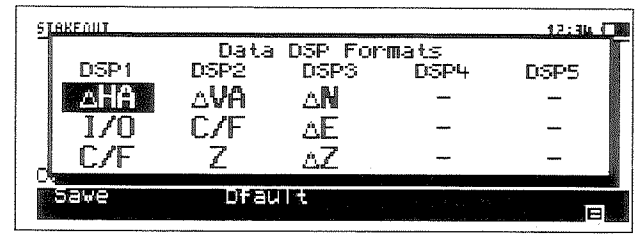
Customizing the Data Display Screens

This section explains how to customize up to five data display screens. They help you to direct the rodman to the stakeout point.

NOTE: You can cycle through the default data display screens using [DSP↑] or [DSP↓].

How to Modify the Data Display Screens

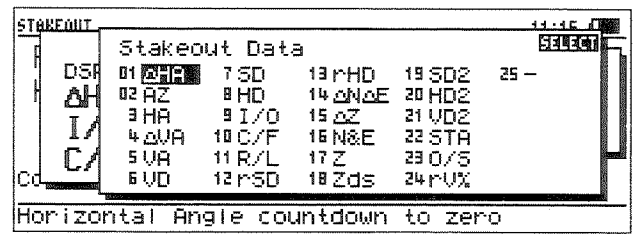
Open the DSP Data Formatting Window



From the main stakeout screen, select ***[DspFmt]***. This screen shows the default data for all data display windows.

Help for Data Types

All the data types are found in the selection list. The one-line help describes the highlighted data type.

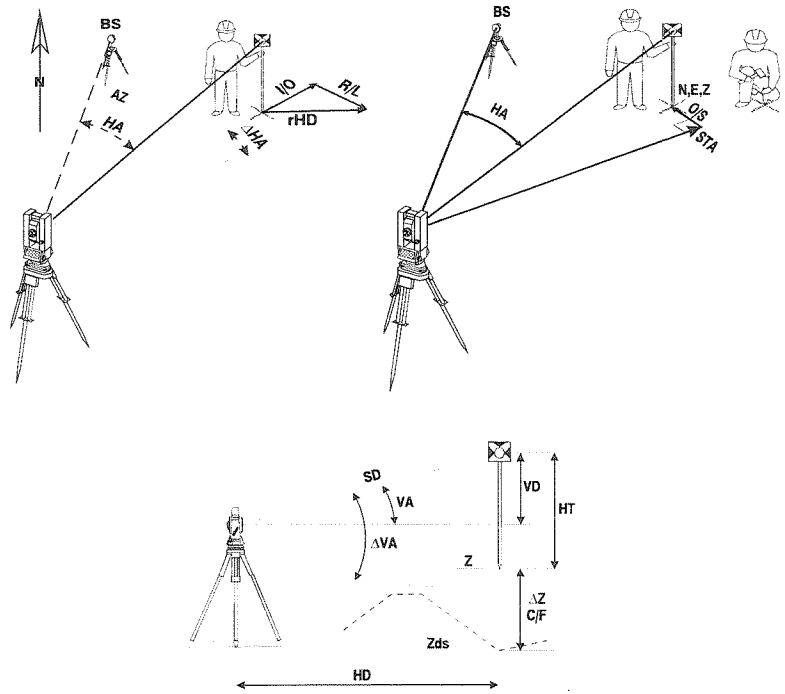


Stakeout ΔVA Handling

During stakeout, ΔVA is calculated assuming an HT of 0.0. This feature enables you to sight exactly to the stakeout point and reduce your ΔVA to 0, without having to first change your HT to 0.

Data Type Definitions

The following three diagrams illustrate the data types available for selection from this list.



Change Data Types

- Move the cursor to the appropriate column (data display window) and on to the field you want to change. You *must* use the selection list to change data types.

Note that ΔNΔE and N&E occupy two fields when selected as data types. All fields, except the design elevation ("Zds"), change after each measurement.

- When you have finished, you save or cancel any changes. Use ***[Save]*** or press [**ESC**] and select **Save** or **Discard**. You can also use ***[Dfault]*** to change the data type settings to the AP800 default values.

Point List

Introduction

Point List allows you to prepare a list of points to be staked out matching your selection criteria. You may want to do this in preparation for a Points Stakeout you intend to perform at a later time.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Stakeout & Ref

Point Stakeout
Point List
2Pt RefLine
Arc RefLine

Using Point List

The Points List function is a short cut to the action within Point Stakeout. It allows you to create a points list without having to enter Point Stakeout. For further details on how to use the Points List refer to "Building a Stakeout List" (see page 6-10 through 6-14).

Summary of Stakeout Softkeys

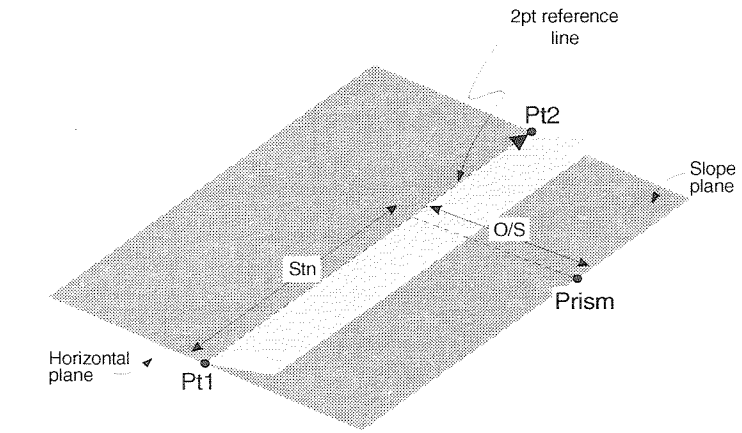
Stakeout	
Clear	Discards all points in the stakeout list.
Coll	Shortcut key to jump directly to Collection.
Dfault	Changes the data DSP formats to the AP800 default values.
DSP ↑ **DSP ↓**	Cycles forward and backward through the data display windows.
DspFmt	Opens the DSP data formats window.
LG	Turns the Lumi-Guide "ON" or "OFF."
MAP	Maps all staked and unstaked points on the screen.
MSR	User-defined measure key. Measures single, multiple, or continuous measurements.
Next	Specifies the next closest point or the next point in the list to stake out.
Points	Adds individual points to the stakeout list.
PtLst	Displays the status of the stakeout list and enables you to add points to the stakeout list.
Range	Adds a range of points to the stakeout list.

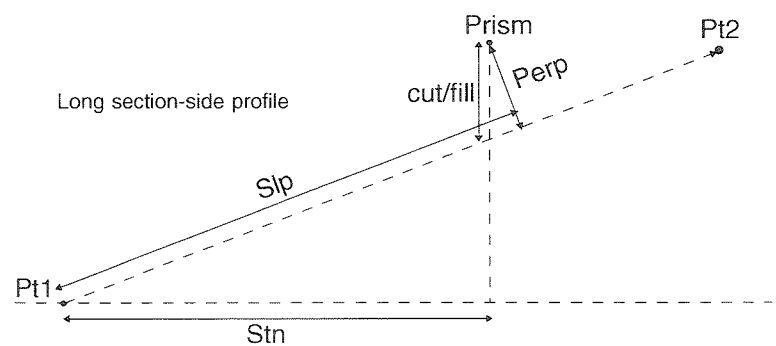
Stakeout (continued)	
Review	Displays a "history" of staked out points since the last station setup.
Save	Saves the data DSP formats.
Target	Quick target selection to change the prism constant and/or height of target.
TRK	User-defined measure key. Measures single, multiple, or continuous measurements.
View	Shows both the staked out and unstaked points in the stakeout list.
Zo/s*	Enables you to specify the offset elevation above the design elevation.

* Zo/s is **only** applied to the Z value when calculating ΔVA, and not to any other vertical data, for example CUT/FILL.

2 Point Reference Line

Using 2 Point Reference Line, you can measure the offset distances to a point in relation to an imaginary line between two points and the plane that the line sits on.





Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Stakeout & Ref

Point Stakeout
Point List
2Pt RefLine
Arc RefLine

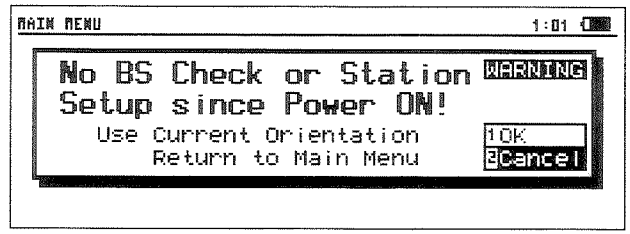
Starting 2 Point Reference Line

When you select the **2pt RefLine** option from the Stakeout & Ref menu, AP800 checks two items before starting the functions:

- that a Station Setup has been carried out, and
- that there is a job currently loaded.

Incomplete Station Setup

2 Point Reference Line cannot function without a Station Setup. When you try to start this feature without first setting up the instrument, AP800 displays the following message.



For information on the actions to take when you see this message, refer to *'Station Setup'* in the main AP800 Reference Manual.

No Current Job

AP800 displays an error message when there is no job currently loaded. To proceed using 2 Point Reference Line, create or open a job.

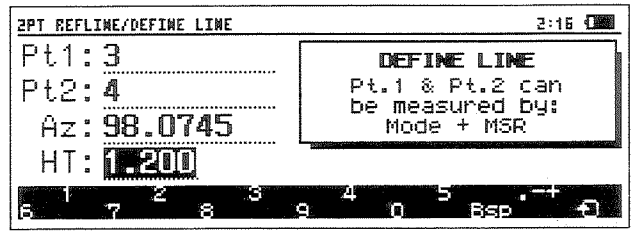
Define the Reference Line

The "Define Line" screen that you see when you start 2 Point Reference Line prompts you to enter the two points that will be the start and end points for the line. You can define the points in three ways:

- Specify points that already exist in the database. These can be points in the Control job or the current job.
- Take a measurement to the points.
- Use point 1 as the start point for an azimuth line definition.

Using Current Points

To use a line between two existing points in the database, enter the number for each point into the two point fields. If only one point has a 'Z' coordinate, AP800 assumes that both points are at the same elevation.

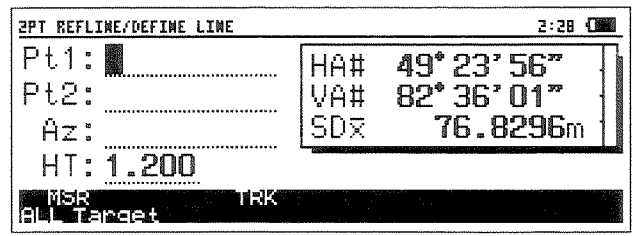


As you move the cursor through the fields, AP800 enters the Azimuth value automatically.

Measuring to a Point

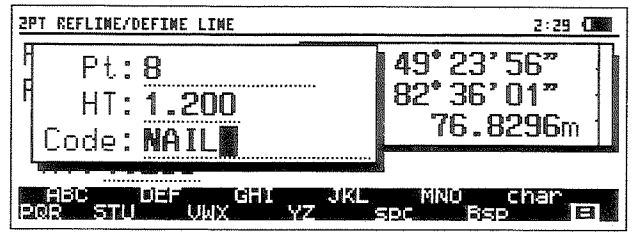
To use a new point, you can take a measurement to it. To do this:

1. Enter the correct value in the "HT:" field.
2. Position the cursor in the field for the point you want to measure.
3. Press the *[Mode]* key and take the measurement.



AP800 displays the measured values on the right of the screen.

When you press [ENTER], AP800 prompts you to create this point in the job.



The cursor is in the code field. Type the code for this point or select a code from the available code list.

NOTE: When you save this point, AP800 stores it as an SS record.

By default, AP800 offers the next available point number in the job. However, you may change the value in the "Pt:" field manually. When the number you enter is that of an existing point in the job, AP800 displays the following message.

When you see this message, you must type a different point number in the "Pt:" field.

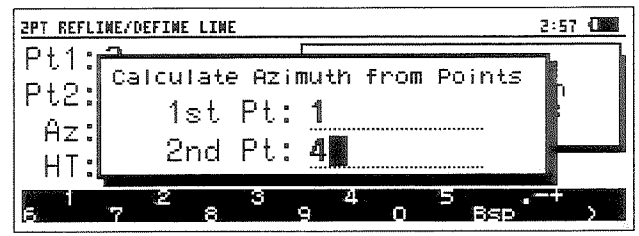
Using Point 1 and an Azimuth

The reference line can also be defined using just "Pt1" and an azimuth value. The azimuth value may be:

- an arbitrary azimuth value that you enter;
- the azimuth from point 1 to another point, or
- the azimuth between two other existing points in the job.

To enter an arbitrary azimuth, type its value in the "Az:" field.

To use the azimuth between two points, press the *[Pts]* key. Enter the point numbers for the two points that you wish to use for the azimuth and press **[ENTER]**.



If you have specified point 1 in the "Define Line" screen, this appears by default as the first point in the azimuth definition. However, you may enter any point number you choose.

When the point number does not exist

If a point number that you enter in the "Calculate Azimuth" box does not exist, AP800 lets you enter the point details manually.

Specifying the HT Value

At this point, you can set the HT value for the measurement to the offset point. With the cursor in the "HT:" field, enter the value and press **[ENTER]** .

☞ To save time completing the "HT:" field, use the right arrow to scroll through HT values that you have used for other measurements in the current session.

NOTE: The "HT:" field does not appear when you use AP800 in 2D coordinate mode.

Viewing the "Measuring" Screen

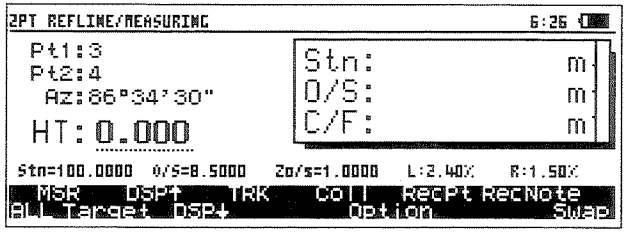
When you have completed the relevant fields in the "Define Line" screen, position the cursor in the "HT:" field and press **[ENTER]**. AP800 displays the next screen (see page 6-25).

NOTE: AP800 will not display the "Measuring" screen until the 2 point reference line is correctly defined.

Taking the Measurement

The "Measuring" Screen

The "Measuring" screen shows the information about the 2 Point Reference Line and any non-zero base offsets that you have defined.



NOTE: There are no Face 2 operations using 2 Point Reference Line and the Face 2 screen remains blank while you are using this feature.

Change the HT Value

You can change the HT value at this point if necessary. To do so, either press the ***[Mode]*** key or the [↓] key. The cursor appears in the "HT:" field and the softkeys display changes to numeric input.

Change the "HT:" field to the required value and press **[ENTER]**. AP800 displays the measuring mode softkeys.

Taking the Measurement

Use the standard keys (***[Msr]***, ***[Trk]***, or ***[All]***) to take the measurement to the offset point. Pressing ***[Target]*** will allow you to select a prism constant and height of target combination from the available Quick Targets.

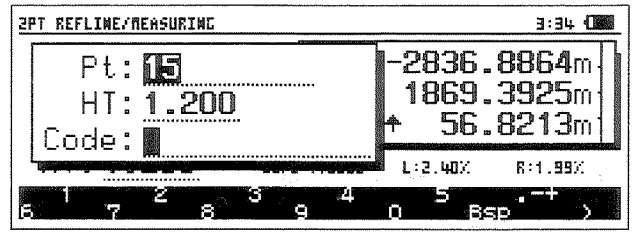
When you measure to the offset point, the cursor flashes over the "C/F:" field label to indicate that the instrument is measuring.

When the measurement is complete, the values are displayed in the box on the right side of the screen. The default values are displayed in relation to the reference line. You can view the data in several ways using the ***[DSP]*** softkey (see "Changing the Display of Data" on page 6-28).

NOTE: The "C/F:" field label changes to "CUT↓" or "FILL↑" depending on the direction to the offset point.

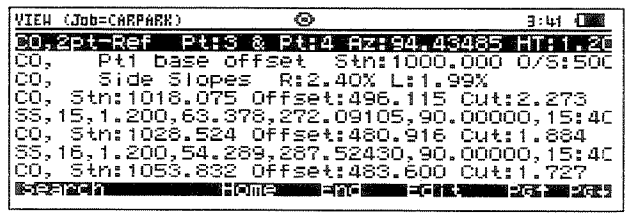
Storing the Offset Point Data

To store the data about the point into the job, press the *[RecPt]* softkey. AP800 offers the next available record in the database and positions the cursor in the "Code:" field. If a code was entered previously during the current session, AP800 displays the code in the "Code:" field.



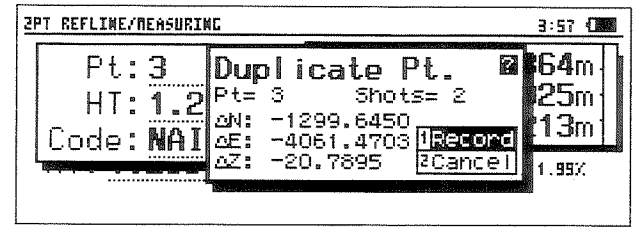
Pressing **[ENTER]** when the cursor is in the "Code:" field stores the data about the offset point as an SS record. The SS record contains the measured HA, the current VA and a recalculated SD value based on the current VA. The "RecPt" function also adds notes to the job which contain information about the reference line and, when defined, the constant values used in the measurements.

On the note record containing "Cut:"/"Fill:" the label will be changed to "Cut#"/"Fill#" when the telescope has been moved from the measured position, but only when moved enough to affect the c/f value shown.



The Notes precede the record (in this case the record is SS 15).

If you try to store the data without taking a measurement, AP800 displays an error message. If you change the point number to that of a point already in the database, AP800 displays the error below.



Storing Notes About the Offset Point

The *[RecNote]* softkey inserts the notes data about the measurement into the job. The notes contain the same information about the measurement as when you *record* the point data (see the previous page) but without storing the actual point.

Changing the Display of Data

Pressing the *[DSP]* softkey repeatedly causes AP800 to cycle through five different types of data about the offset point. The displayed data shows the relationship of the offset point to either the reference line or the instrument station point. The data related to the reference line is displayed as:

- Stn, O/S, C/F;
- Slp, O/S, Perp.

See the diagrams on page 6-20 for the meaning of "Stn", "O/S", "C/F", "Slp" and "Perp".

NOTE: The "Slp" and "Perp" values are calculated at an offset of zero on the line's vertical plane.

When you view the offset point data as related to the instrument station point, the way the data appears is determined by the settings that you configure in the "Job/Settings/Collection" option within the instrument's "Function Settings".

- HA, VA, SD;
- Az, VD, HD;
- N, E, Z, V%.

Specifying Fixed Values

AP800 enables you to modify all the measurements based on fixed datum values using the "Base Offset" screen. To specify these values select the ***[Option]*** softkey. The fields in the "Base Offset" screen are described in "Specifying Datum Constants" on page 6-29.

Viewing the Data in the Opposite Direction

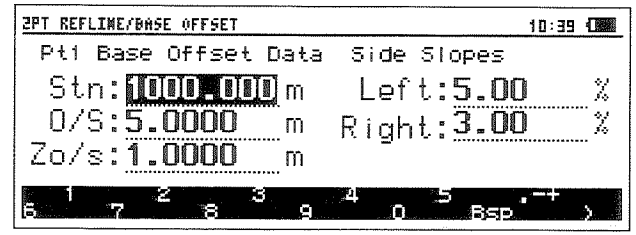
Information in the 2 Point Reference Line feature is always displayed as if viewed from point 1. To view the data about the offset point from the opposite viewpoint, use the ***[Swap]*** softkey. The results that are displayed depend on how you initially defined the reference line. Both calculations have the same effect, they are just achieved differently.

- If you defined the line using two points, AP800 switches points 1 and 2 so that the data appears as if viewed from the opposing point;
- If you defined the line using one point and an azimuth, AP800 switches the azimuth definition by 180° so that the data appears as if viewed in the opposite direction.

Specifying Datum Constants

For all the measurements you take, there may be datum constants that you require to add or subtract from the readings. AP800 allows you to set the *Base Offsets* for all the possible variables in the 2 Point Reference Line calculations.

To set the base offset constants, press the ***[Option]*** key in the "Measuring" screen.



All values are based on point 1 looking along the reference line and are zero by default when used for the first time since the instrument was switched ON.

Any values that are non-zero are displayed in the "Measuring" screen (see the illustration on page 6-25).

Base Offset Values The values that the offsets modify and their possible values are as follows (refer to the illustration on page 6-20).

Stn: includes a constant value to be added to the distance from point 1 to the intersection between the reference line and a perpendicular line to the prism. Valid entries are from -999.9999 to 9999.9999 (metres). Negative values represent distances in the opposite direction to the reference line when viewed from point 1.

O/S: includes a constant value to be added to the perpendicular distance from the prism to the reference line. Valid entries are from -99.9999 to 999.9999 (metres). Negative values represent distances on the left of the reference line when viewed from point 1.

Zo/s: includes a constant value to be added to the vertical measurement that enables you to specify the offset elevation above the design surface. Valid entries are from -99.9999 to 999.9999 (metres). Negative values represent distances below the plane of the reference line.

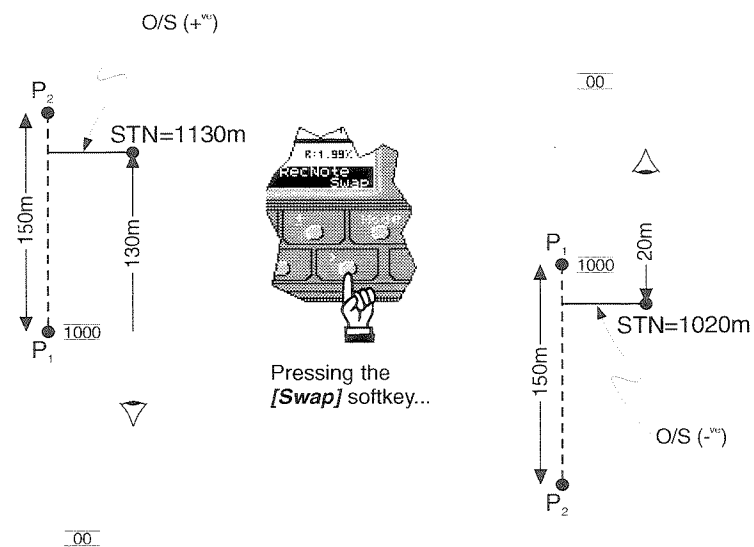
NOTE: The horizontal angle of the plane of the reference line is dependent on the side slope values (see next).

Left: and **Right:** modifies the side slope values on either side of the reference line. Valid entries are from -999.99 to 999.99 (% incline). Negative values represent declines downwards from the horizontal plane.

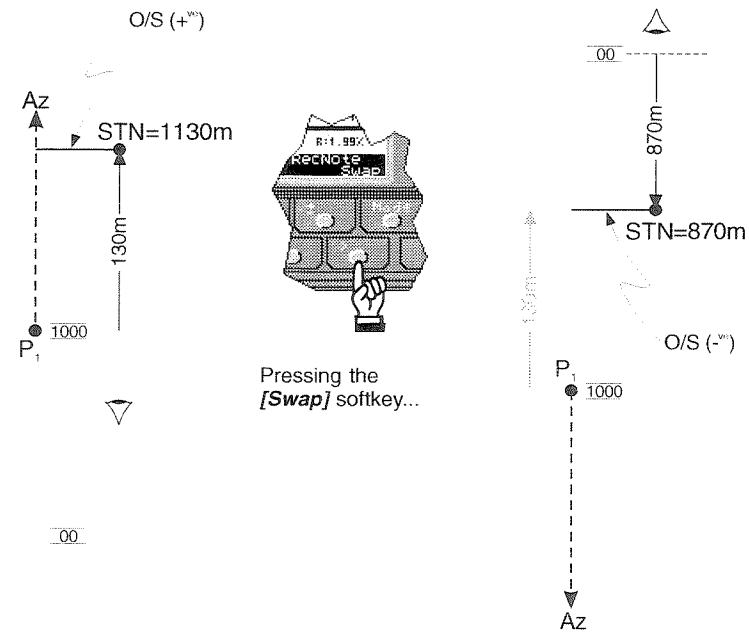
Values are Based on Point 1

Remember that all the calculated values are based on point 1 and the offsets are applied to point 1. This means that:

- using the "Swap" function when the reference line is defined using two points will swap the assignment of the points and apply the offsets to the new point 1 (the old point 2);



- selecting "Swap" when the line is defined using one point and an azimuth will maintain the distance offset of point 1 but adjust all other measurements as if viewed in the opposite direction.

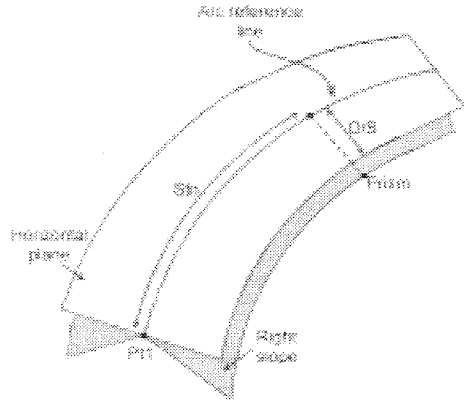


2 Point Reference Line Softkeys

2 Point Reference Line	
Coll	Jump to collection.
RecPt	Store the offset point data to the open job. Also performs a RecNote function (see next).
RecNote	Stores the information about the 2pt RefLine, the base offset and the offset point as notes.
Option	Enter information about fixed offsets for all values.
Swap	Reverses the direction of the 2pt RefLine and recalculates all values.
Target	Quick target selection to change the prism constant and/or height of target.

Arc Reference Line

Using Arc Reference Line, you can measure the offset distance to a point along an arc. Looking at the station, offset and cut/fill values calculated after a measurement, you could easily verify your arc surface.



Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

Stakeout & Ref

Point Stakeout
Point List
2Pt RefLine
Arc RefLine

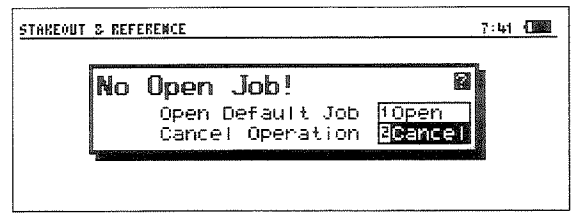
Starting Arc Reference Line

When you select the Arc RefLine option from the Stakeout & Ref menu, AP800 checks two items before starting the function:

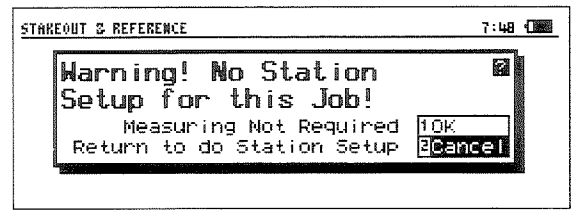
- that there is a job currently open, and
- that a Station Setup has been carried out.

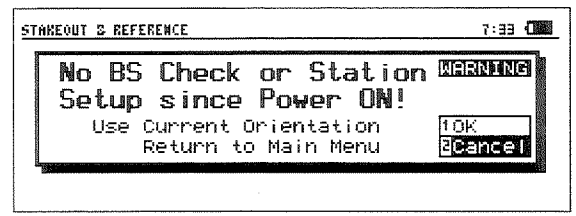
No Current Job

AP800 asks if you would like to open the default job. To proceed using Arc Reference Line, select Open Default Job. Alternatively, you may return back to the main menu and select Job Manager to create or open a job of your choosing.



Incomplete Station Setup

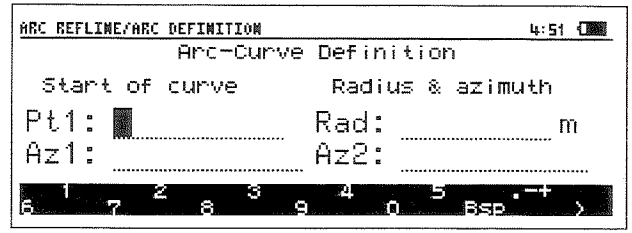




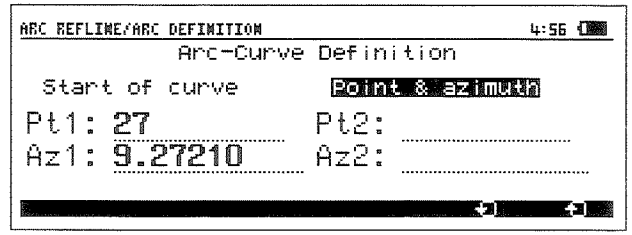
Whenever you see either of these messages it indicates that AP800 needs to confirm that instrument position and orientation. It is recommended that you return to the main menu and select station setup or **[Fnc]** ***9.BS Check*** if you have already done a station setup and only need to confirm the backsight. Selecting Measuring Not Required will limit what you can do in Arc Reference Line.

Define the Arc

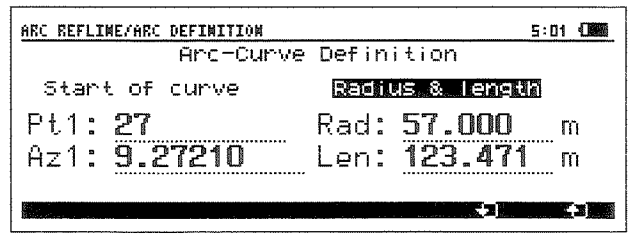
The "Arc-Curve Definition" screen that you see when you start Arc Reference Line prompts you to enter point and arc information to define the reference arc.



Define the arc, using one of three possible combinations of data.



After entering the Az1 value the 2nd column heading will highlight allowing you to select the combination that best suits your data.



Complete the screen with the applicable data from the following information:

Pt1

- Type the point number of the point defining the start of the arc. The point may be in the current job or control job if you have it open. Typing the point number of an unknown point will tell AP800 that you want to manually enter the point coordinates. Alternatively, press **[Mode]** to measure and record a new point.

Az1

- Type the azimuth of the incoming tangent defining the start of the arc. To calculate the azimuth between two points press the ***[Pts]*** key. Alternatively, press **[Mode]** to take an azimuth reading.

Radius

- Type the radius of the arc. A positive radius indicates a right curve (clockwise); a negative radius indicates a left curve (anti-clockwise). Alternatively, press **[Mode]** to measure a distance.

Az2

- Type the azimuth of the exit tangent defining the end of the arc. If the azimuth entered is the same as Az1 it will be flipped when the next screen is entered; the result is a semi-circle. To calculate the azimuth between two points press the ***[Pts]*** key. Press **[Mode]** to take an azimuth reading.

Pt2

- Type the point number of any point on the exit tangent of the arc, the point may be in the current job or control job if you have it open. Typing the point number of an unknown point will tell AP800 that you want to manually enter the coordinates. Alternatively, press **[Mode]** to measure and record a new point.

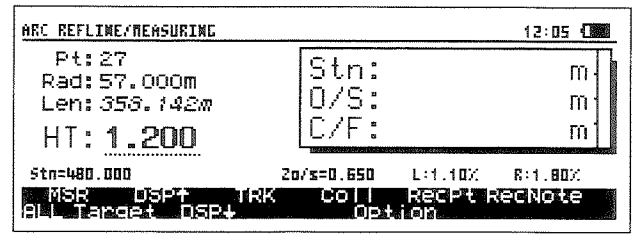
Length

- Type the arc-length of the arc, only a positive arc-length is acceptable. If the arc-length is greater than the calculated circumference it will be shortened to the circumference when the next screen is entered.

Taking a Measurement

The "Measuring" Screen

After entering the arc definition the remaining definition values are calculated and displayed in the background of this Measuring screen, along with any non-zero base offsets that you have defined. A Len value shown in the italic font indicates that it has been modified from what was originally entered. See Define the Arc, on page 6-34, for further details.



Note: There are no Face 2 operations using Arc Reference Line and the Face 2 screen remains blank while you are using this feature.

Change the HT Value

You can change the HT value at this point if necessary. To do so, either press the **[Mode]** key or the [↓] key. The cursor appears in the "HT:" field and the softkeys change to numeric input.

To quickly change the HT value to one that you entered previously press the [ ] softkey to cycle through the remembered values.

After changing the HT to the required value press **[ENTER]**. AP800 will display the measuring softkeys again.

Taking the Measurement

Before taking the measurement you can change the target definition (prism constant and height of target) by pressing the ***[Target]*** softkey.

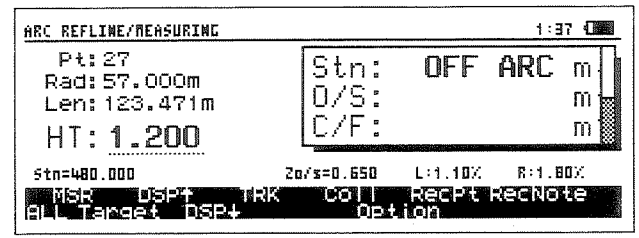
Use the standard keys (***[MSR]***, ***[TRK]***, or ***[ALL]***) to take the measurement to the offset point.

When you measure to the offset point, the cursor flashes over the "C/F:" field label to indicate that the instrument is measuring.

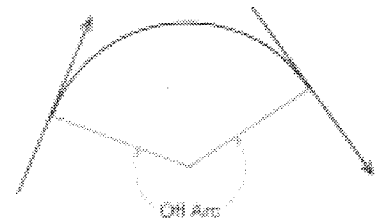
When the measurement is complete, the values are displayed in the measure display box on the right side of the screen. You can view the data in several ways using the *[DSP↑]* or *[DSP↓]* softkeys (see "Customizing the Data Display Screens" on page 6-15).

NOTE: the "C/F:" field label changes to "CUT↓" or "FILL↑" depending on the direction to the offset point.

Measurements off the Arc

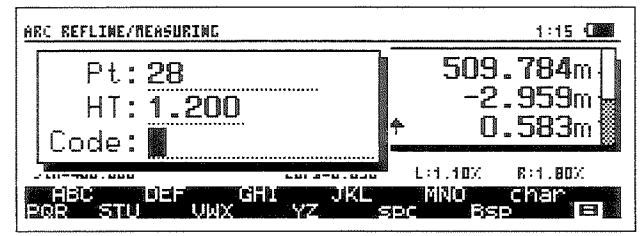


If after taking a measurement the "OFF ARC" message is displayed, it means that the point measured to is outside your arc definition.



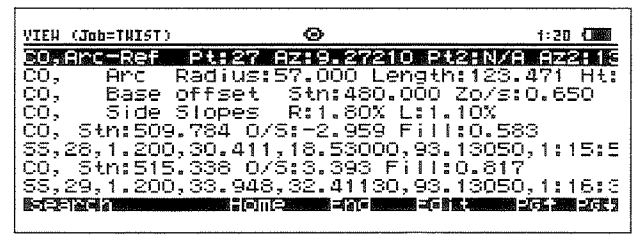
Storing the Offset Point Data

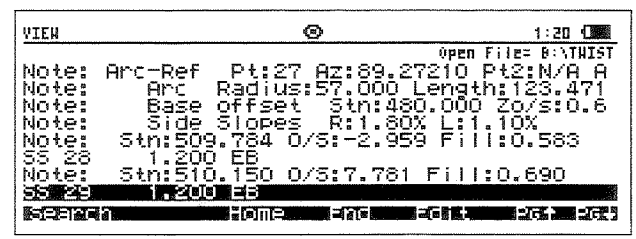
To store the measured data, press the *[RecPt]* softkey. AP800 offers the next available point number in the job and positions the cursor in the "Code:" field. If a code was entered previously during the current session, AP800 displays the code in the "Code:" field.



Pressing **[ENTER]** when the cursor is in the "Code:" field stores an SS record. The SS record contains the measured HA, the current VA and a recalculated SD value based on the current VA. The "RecPt" function also adds notes to the job containing information about the reference arc, and when defined, the constant values used in the measurements.

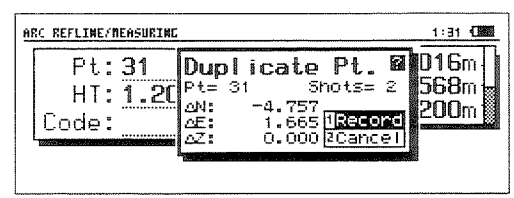
Also saved before each SS record is a note detailing the relationship between the arc and the measured point (stn, o/s and c/f values). On this line the "Cut:"/"Fill:" label will be changed to "Cut#"/"Fill#" when the telescope has been moved from the measured position, but only when moved enough to affect the c/f value shown.





The Notes precede the record (in this case the record is SS 28).

If you try to record a point without first taking a measurement, AP800 reminds you. If the point number you entered is already in use, you will be shown duplicate point information.



Storing Notes About the Offset Point

The *[RecNote]* softkey adds the notes data about the measurement to the job. The notes contain the same information about the measurement as when you record the point data (see the previous section) but without the SS record.

Changing the Display of Data

Pressing the *[DSP↑]* or *[DSP↓]* softkeys repeatedly makes AP800 cycle through four different types of data about the offset point. The displayed data shows the relationship of the offset point to either the reference arc or the instrument position. The data related to the reference arc is displayed as:

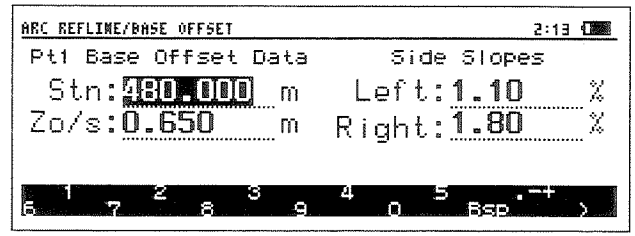
- Stn, O/S, C/F.

When you view the offset point data as related to the instrument position, the way the data appears is determined by the settings that you configure in "Job/ Settings/Collection".

Specifying Datum Constants

For all the measurements you take, there may be datum constants that you require to add or subtract from the readings. AP800 allows you to set the *Base Offsets* for most of the variables in the Arc Reference Line calculations.

To set the base offset constants, press the ***[Option]*** key in the "Measuring" screen.



All values are based on point 1 looking along the reference arc and are zero by default when used for the first time.

Any values that are non-zero are displayed in the "Measuring" screen.

Base Offset Values

The values that the offsets modify and their possible values are as follows (refer to the illustration at the start of Arc Reference Line).

Stn: includes a constant value to be added to the calculated station value (from point 1 to the measured points intersection on the arc). Valid entries are from –999.9999 to 9999.9999 metres. Negative values represent distances in the opposite direction to the reference arc when view from point 1.

Zo/s: includes a constant value to be added to the vertical measurement that enables you to specify the offset elevation above the design surface. Valid entries are from –99.9999 to 999.9999 metres. Negative values represent distances below the reference arc

Left: and **Right:** modifies the side slopes on either side of the reference arc. Valid entries are –999.99 to 999.99 (%incline). Negative values represent declines downward from the arc.

Arc Reference Line Softkeys

Arc Reference Line	
MSR	Measure key. Measure action taken is defined in the settings.
TRK	Measure key for tracking. Measure action taken is defined in the settings.
ALL	Measure and record key. Measure action taken is defined in the settings.
Target	Quick target selection to change the prism constant and/or height of target.
DSP↑ **DSP↓**	Cycles forward and backward through the data display windows.
Coll	Jump to collection
RecPt	Store the offset point data to the open job. Also performs a RecNote function (see next).
RecNote	Stores the information about the arc definition, offset and slope options, and the measured offsets.
Option	Enter information about fixed offsets and slope details.

Chapter 7

Control

Introduction

The control function should be used to take multiple readings on both faces when it is necessary to increase measuring accuracy. This feature would typically be used to establish "control networks", taking a number of "sets" of shots to a number of points.

Control can also be used for simple traversing, i.e. BS and FS, where multiple readings are required for increased accuracy.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

Control Sequence

- Enter station and backsight point information.
- Sight to the backsight and measure.
- Sight to "sets" of points and measure.
- Record the control data to the job database.

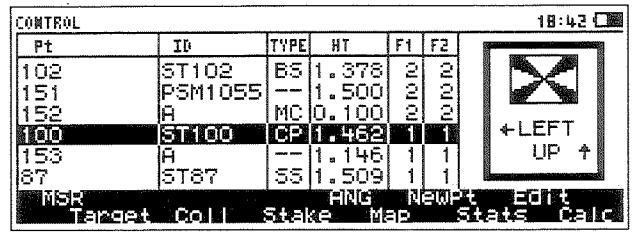
NOTE: A "CO" record (note) indicating the start of the control session, the ST record and all the F1 and F2 shots are written to the job database as they are shot. The remaining data is only recorded after the control calculation is complete.

Overview

Control begins by asking you to input the station and backsight point information. This procedure is very similar to the start of Known Station.

When using this function you **must** enter station and backsight point numbers, but the points can have unknown coordinates. A control survey can be conducted even when the position of the station point, the backsight point, or **both** are unknown.

Once these details are entered and accepted, the software will prompt you to build a list and measure to a number of points, commencing with the backsight point. The points list which you define, and the measurements that you make, are displayed on the screen in tabular form.



Typical Control Screen. The "TYPE" column indicates the point type; a - - entry in this column is a new point which is unknown to the current job database. The F1 and F2 columns detail the number of times that the point has been measured on Face 1 or Face 2.

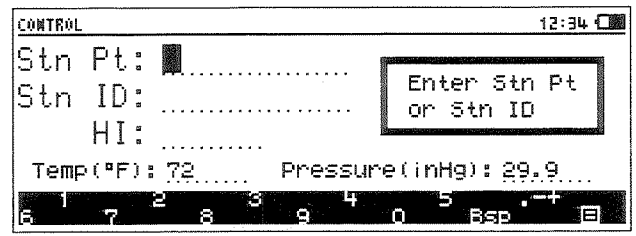
Points are added to the list in one of two ways: adding a new point before measuring using the *[NewPt]* softkey, or; measuring to a point and then completing the point information (refer to "Enter New Point Details" on page 7-11).

You then proceed to record "sets" of measurements; that is, Face 1 and Face 2 measurements to all the points in the list. The number of points that you can survey in control is limited to 10, and the number of sets of measurements that you can make during any control session is limited to 16 (32 shots to each point). For example, if you identify six points on the list, you can measure to each of the six points 16 times on Face 1 and 16 times on Face 2.

Control allows you to view comprehensive statistics of all your shots throughout the session (see page 7-23). When you are satisfied with the number, and accuracy, of measurements made you can then record the control data to the job database.

Additional features include the ability to suspend control sessions (for example to change a battery) and resume them at a later time, the option of jumping out to collection or stakeout, and the feature "Map" (see page 7-22) which provides you with geometrical layout information.

Enter Station Point Information



You begin by entering details for the station point. The station ID and HI are optional.

Station Point

- Type the **Stn Pt** number. This can be an existing control point in the current job or a new point number.

NOTE: Control cannot commence if this field is blank.

Station ID

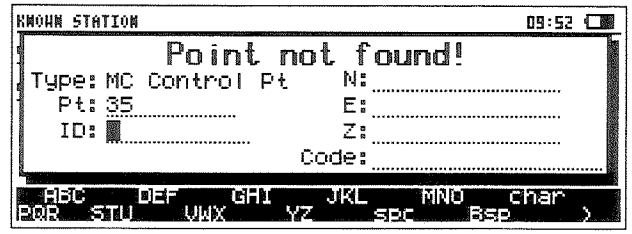
- *Optional:* Type the **Stn ID** (max. 10 chars.). If another point exists with the same "Stn ID," you will be alerted and asked if you want to change it.

The program only searches for the Station "Pt" and Station "ID" after you input one of the values and press **[ENTER]**.

Point Found — The screen displays the point details if the point is found in the current job or the attached control job. For more information, see "Point Found / New Point Recorded" on page 7-5.

Point Not Found — AP800 asks you to manually enter the point details if it cannot find the point. See page 7-5.

Point Not Found



AP800 could not find the point in the current job. You are required to manually input the station point data.

Manually Enter Station Point Data

Type —Use the circular selection list to choose either **MC Control Pt** or **MP Manual Pt** (point types are defined on page 13-6).

Pt — Contains the point number you entered on the previous screen. You can change the point number.

ID — *Optional:* Type the station ID (max. 10 chars.).

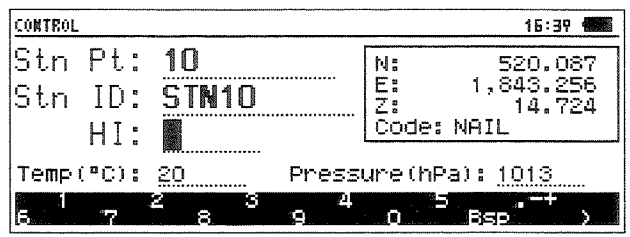
Code — *Optional:* Type or use the selection list to input the code.

N, E, Z — *Optional:* Type the coordinates (if you leave "N" and "E" or "Z" blank, AP800 will ask you if you want to store the partial data or input the data again).

Record New Point

- To record the point to the current job, move the cursor to the "Code" field and press **[ENTER]**.

Point Found / New Point Recorded



This screen displays the station point data including the point coordinates (if known) and the code.

Height of Instrument

- Enter the **HI.** (optional).

NOTE: You can configure the software, using the HI/HT Defaults setting in Settings/Job/Station Setup (see page 13-14), to automatically swap the HI and HT when you move station.

NOTE: The "HI" field does not appear if AP800 is configured for 2D coordinates (see page 11-6).

If you leave the HI field *blank* you will be given the following options —

- Determine the HI later (select **Later**):
  (1) by entering the HI in "View/Edit."; or,
  (2) by using the "Remote Benchmark" function (see page 4-39).

- Return now to the station point input screen and enter the HI (select **Cancel**).

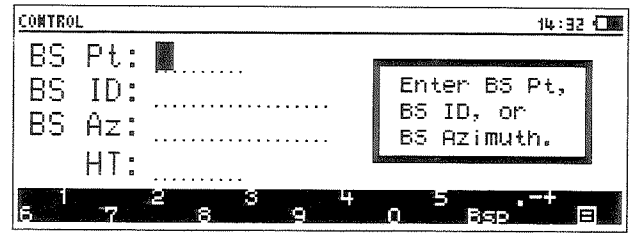
Temperature and Pressure

- Accept the **Temp** and **Pressure** values shown or enter new values.

Record Station Point

- Move the cursor to the **Pressure** field and press **[ENTER]** .

Enter Backsight Point Information



Enter details for the backsight point. The backsight ID, azimuth and HT are optional.

BS Pt

- Type or use the selection list to enter the **BS Pt** number. This can be an existing control point in the current job or a new point number.

NOTE: Control cannot commence if this field is blank.

BS ID

- *Optional:* Type, or use the selection list, to enter the **BS ID** (max. 10 chars.).

The program searches for the point after you have input one of these values and pressed **[ENTER]**.

BS Az

- Type the **BS Az**.

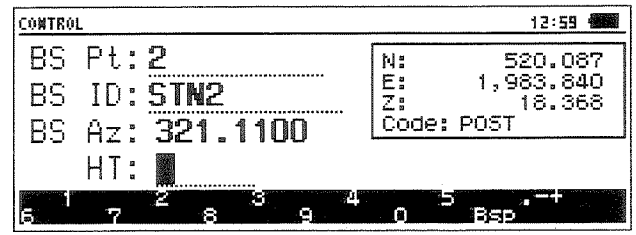
Backsight Point Found

The screen displays the coordinates and the computed backsight azimuth if the point is found in the current job or the attached control job. See "Existing Backsight Point" below.

Backsight Point Not Found

If the point cannot be found you can manually enter the point details, or you can use "Job Manager" to copy the point to the current job and repeat the above procedure.

Existing BS Point Found



The "BS Az" field contains the azimuth calculated from the station and backsight points.

No BS Azimuth

AP800 cannot calculate the azimuth and coordinates if either the station point or backsight point coordinates are unknown. You can type in the BS Azimuth or leave it blank.

If the "BS Az" field is left blank all azimuth and coordinate display fields will be blank.

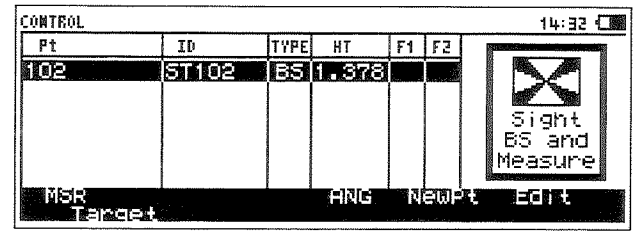
Height of Target

- Type or use the selection list to enter the **HT**.

NOTE: You can configure the software, using the HI/HT Defaults setting in Settings/Job/Station Setup (see page 13-14), to automatically swap the HI and HT when you move station.

NOTE: The "HT" field does not appear if AP800 is configured for 2D coordinates (see page 11-6).

Sight Backsight and Measure



This is the initial measuring screen. Note the tabular layout and the area on the right for messages and data.

You should now sight and measure to the backsight point. However, before measuring you can use the ***[Edit]*** softkey if you need to edit the backsight point details, or the ***[NewPt]*** softkey to identify other points (see page 7-11).

If desired, you can identify all the points using ***[NewPt]*** before any measurements are taken. As you define new points their details are added to this table in the order that you identified them.

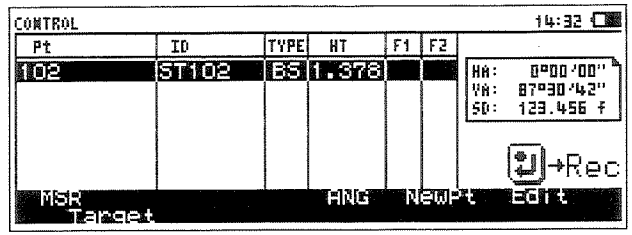
Measure HA, VA, and SD

- Use ***[MSR]*** to measure the direction and distance to the point. Pressing ***[Target]*** will allow you to select a prism constant from the avialable Quick Targets. (For assistance, see page 2-8 and page 13-5.)

Measure Angle Only

- Use ***[ANG]*** or **[ENTER]** to measure only the direction to the backsight point.

NOTE: Throughout the control procedure both the Face 1 and Face 2 screens are active and available for measuring. However, this initial shot to the BS point when starting the first set ***must*** *be made on Face 1.*



This is the screen displayed after measuring to the backsight is completed.

Record Measurement

- Press **[ENTER]** to record the measurement (see "Backsight Checks" below).

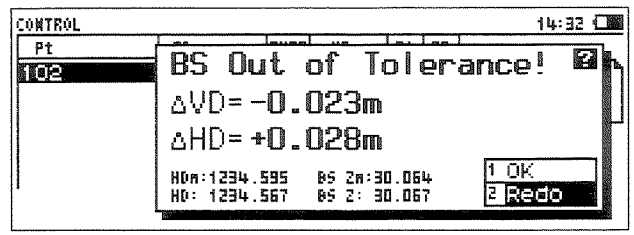
(Pressing **[ESC]** will cancel the measurement and return you to the "Sight Backsight and Measure" screen.)

Backsight Checks During First Set

When you record the backsight shot *during the first set*, AP800 compares and checks the vertical and horizontal distances with any known station and backsight coordinates. You are told if the backsight observation is out of tolerance. (To change the BS Shot Tolerance, refer to page 13-14.)

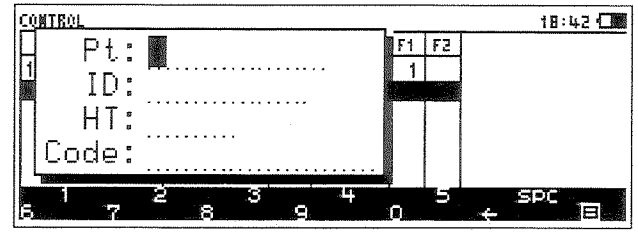
NOTE: If you have only measured the direction to the backsight point, the program reports only the BS Azimuth. No checks are possible.

Backsight Out of Tolerance



You can accept the measurement or re-measure to the backsight point on Face 1. (Blank fields indicate there was insufficient information to compute the value.)

Enter New Point Details



This is the "Point Identification" window displayed after pressing ***[NewPt]***. (This window is also automatically displayed when you measure to a point which has not yet been added to the control points list.)

AP800 allows you to enter a point that already exists in the current job or you can define a new point.

NOTE: The number of points that you can measure to in control is limited to 10.

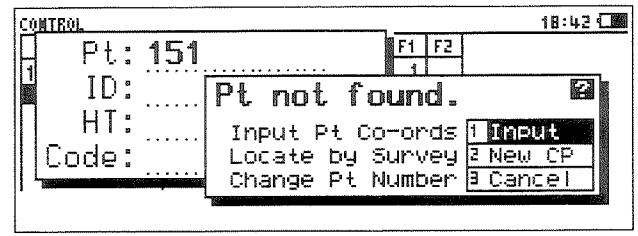
- Type or use the selection list to enter either the **Pt** number or **ID** (max. 10 chars.).

The program only searches for the "Pt" and "ID" after you input one of the values and press **[ENTER]**.

Point Found — The screen confirms that the point is found in the current job or the attached control job and updates the "Point Identification" window with the point's details. The HT field will be blank for your input.

Point Not Found — AP800 alerts you that it has failed to find the defined point in the database.

Point Not Found



AP800 has failed to find the defined point in the database.

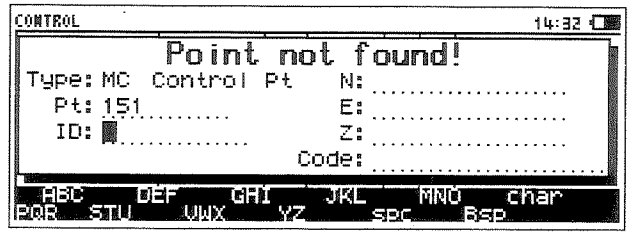
You have several options:

Input Pt Co-ords Selecting **Input** opens the normal "Point not found" window (see page 7-13) which enables you to manually input the details of a point.

Locate by Survey Selecting **New CP** assumes that you want to identify a new point by survey observation. You are returned to the "Point Identification" window (see page 7-11) to enter the new point details.

Change Pt Number Cancel returns you to the "Point Identification" window so that you can change the Pt number.

Input Point Coordinates



This is the normal "Point not found" window. You are required to manually input the point data.

Manually Enter Point Data

Type — Use the circular selection list to choose either **MC Control Pt** or **MP Manual Pt** (point types are defined on page 13-6).

Pt — Defaults to the point number that you entered on the previous screen. You can change the point number to a new number.

ID — *Optional:* Type in the point **ID** (max. 10 chars.).

N, E, Z — Type the coordinates. N and E must be entered (if you leave Z blank, AP800 will ask you if you want to store the partial data or input the data again).

Code — *Optional:* Type or use the selection list to input the code.

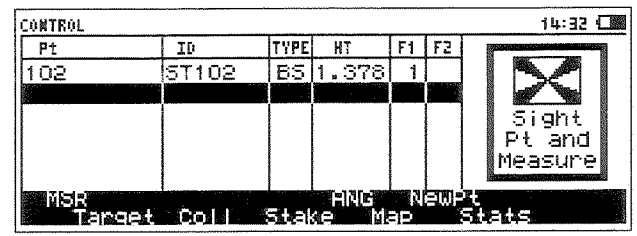
Record New Point

- To record the point to the current job, move the cursor to the "Code" field and press **[ENTER]** . You will be returned to the "Point Identification" window which will have been updated with the new point information.

  Pressing **[ESC]** at this screen will return you to the "Point Identification" window with all fields blank except the point number.

Sight Pt and Measure

After sighting and recording the backsight point, the following screen is displayed.



You can now sight and measure to the remaining points that you have chosen and complete the first set. The procedure for measuring to these points is exactly the same as for the backsight point with the exception that, should you choose, you can commence measuring on Face 2.

In addition, the features "Coll" (jump to collection), "Stake" (jump to stakeout), "Map" and "Stats" have been added to the softkey bar and are now available (see page 7-20, page 7-22 and page 7-23).

Overwrite Existing Shot

If, during the current set, you measure to a point which has already been measured to on that face, you will be asked whether you want to use this shot or cancel it.

Edit Existing Point

If the highlight bar is positioned on an existing point, the *[Edit]* softkey is active. Pressing this softkey will open the "Point Identification" window with the selected point's details as defaults. This window can then be used to view or edit the point's details.

There are limitations as to which fields can be edited, depending on the point type selected:

BS Point — Only the **HT** and the **Code** can be changed.

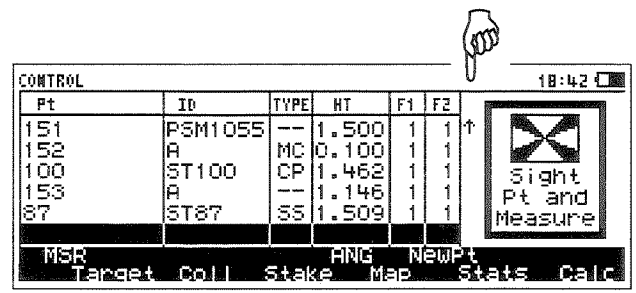
Existing Database Point — For known points which existed before control was started, only the **HT** and the **Code** can be changed. However, you can change the point number to identify a different point, enabling you to edit other fields (see note).

New CP Point — For points created during this control session, all fields can be changed (see note).

NOTE: If a point number is changed using the edit feature, the new point will replace the highlighted point. All previous measurements to the old point will be assigned to the new point.

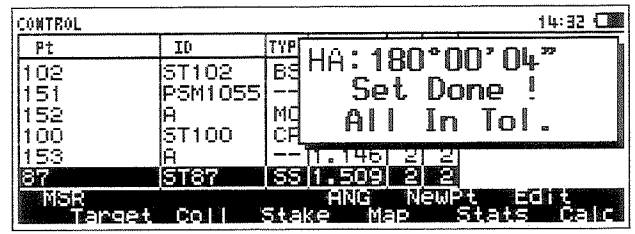
Screen Display Format

The tabular screen format is only capable of displaying information for six points. If a seventh point is added, the information for the first point scrolls off the screen. Arrows will appear in the message area to indicate that there is point information contained above, or below, the visible screen.



Set Done

The following window is displayed when AP800 determines that the set has been completed.



The window tells you that the set has been completed.

*NOTE: The message "All in Tol." only indicates that the Face 1 and Face 2 delta values for shots taken **in this set** are in tolerance. It does not indicate that measurements are in tolerance with those collected in other sets.*

"Out Tol."

The message "Out Tol." in the Set Done window indicates that one, or more, F1/F2 delta values for this set are out of tolerance.

You cannot return to this set to re-shoot to the points, but you can use the ***[Stats]*** key, and the Observed Data screens, to view and if necessary inactivate the out of tolerance shots (see Statistics on page page 7-23).

If you want to change the tolerance settings for F1/F2 pairs of shots, refer to "Tolerances (Face 1/Face 2 Slope Distance)" on page 13-6.

It is important to understand how, and if, AP800 determines that the set is complete.

During the First Set

The software can only determine that the first set is complete when **both** of the following criteria have been met:

1. The first two shots of the set are made on Face 1: **and,**
2. All points listed in the control table have been measured on Face 1 and Face 2. *(The order of making these measurements is not critical.)*

For example, if you measure to all the points on Face 1 first, and then make all your Face 2 measurements, the software will be able to determine when the set is complete.

However, if you choose to measure F1 and then immediately measure F2 for each point, AP800 cannot determine when the first set is complete. Under these circumstances you would have to force the start of the next set (see "Starting a New Set" on page 7-18).

NOTE: Once the Set Done criteria have been met, and this screen is displayed, you cannot return to this set to make more measurements or add new points.

During Subsequent Sets

The software can only determine that subsequent sets are complete when **both** of the following criteria have been met:

1. All Face 1 and Face 2 shots made during the first set have been repeated *(not necessarily in the same order)* in this set: **and,**
2. All points added to the control table during this set have been measured on Face 1 and Face 2.

NOTE: Any points added during subsequent sets are appended to the first set record and are used to determine the "Set Done" status from then on.

Starting a New Set

A new set can be started at any time by making a same face remeasurement to the backsight point. If this is the second shot to the BS point during this set, on the same face, the following screen is displayed.

This window is only displayed when you try to record the shot.

This window is designed to alert you to the fact that, if you continue, you will be starting a new set and you cannot return to the previous set. If this is a mistake you should select **Cancel**.

Your options are:

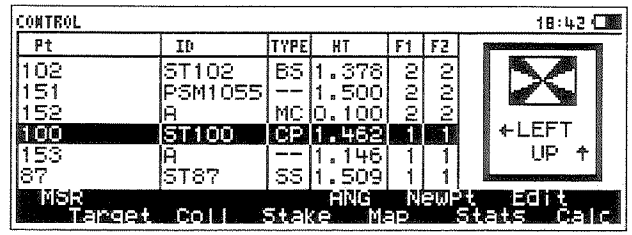
Continue the New Set Selecting **OK** will start the new set and record the current measurement (to the BS point) as the first shot of the new set.

NOTE: Any shots from the previous set which did not have "same face" backsight shots will be ignored when displaying statistics.

Discard this Shot Cancel will return you to the control table screen.

Measuring After the First Set

This is an example of the screen displayed in subsequent sets when AP800 is ready for you to measure to a point.



Note the aiming assistance to the right of the screen.

Measuring Order

The software anticipates that you will be shooting to the points in the same order you used in the first set. The highlight bar has moved to the next point in order, and aiming assistance to that point is provided.

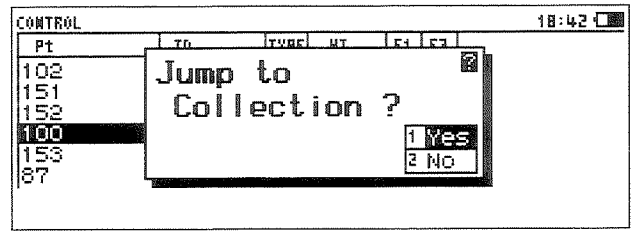
If you choose to shoot to a different point than the one highlighted, AP800 will move the highlight bar to the point which matches the measured data. Aiming assistance will recommence from this point.

Aiming Assistance

The aiming assistance is general and does not give an indication how far you need to turn and tilt the telescope. However, once you are set up within +/-15′ of the point the word sight will replace the aiming indicators.

Jump To Collection or Stakeout

Once the backsight point has been measured, and recorded, it is possible to jump out of control and into collection or stakeout by pressing the ***[Coll]*** or ***[Stake]*** softkeys.



Question screen displayed when you press ***[Coll]***.

When you exit from collection or stakeout, you will automatically be returned to control, at the measuring screen, ready to measure the next point.

NOTE: If you jump out of control after measuring ***but before recording*** *an observation, that observation will be lost and will have to be re-measured.*

HA Handling While Using Control

It is important to understand how the HA is dealt with while using the control function, and is **especially** so when using the jump to collection or stakeout features.

In control, the HA is set to zero when you first measure to the backsight and thereafter is not adjusted. If you choose to rotate the horizontal circle between sets (refer to "Starting a New Set" on page 7-18) the HA will no longer be zero at the backsight.

However, when you jump to collection or stakeout from control the HA displayed and stored will always be zero at the backsight, that is, it will be based on a zero HA the last time that the backsight was measured (on Face 1) from within control.

The result of this is that the HA value may change as you move in and out of the control function, but the HA will always be the logical value that you would expect.

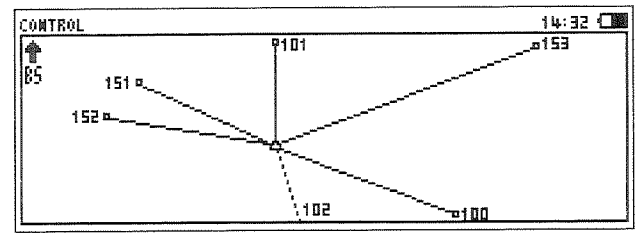
To ensure that the HA is always computed correctly when using control, it is **essential** to observe the following two rules:

1. **Never** reset the HA at the backsight by using the "Backsight Check" function while a control survey is being performed.

2. **Never** use the ***[Coll]*** or ***[Stake]*** softkeys to jum from control *after* turning the horizontal circle but *before* measuring to the backsight to the next set. You must measure to the backsight immediately after turning the horizontal circle.

Map

The control feature "Map" is provided so that you can view the geometrical layout of the points being measured. Pressing the ***[Map]*** softkey will open the Map screen.



The map is scaled to fit all the measured points on the screen. "Angle Only" shots are displayed as dotted lines.

The position of the station point (shown as a triangle) is given assumed coordinates by the software for the purpose of displaying this map. The other points are shown relative to the station point using the measurements taken.

The backsight is given an assumed azimuth of 0°00′00″ for the map, indicated by the BS symbol in the top left of the screen.

- Press **[ESC]** or **[ENTER]** to return to the main control screen.

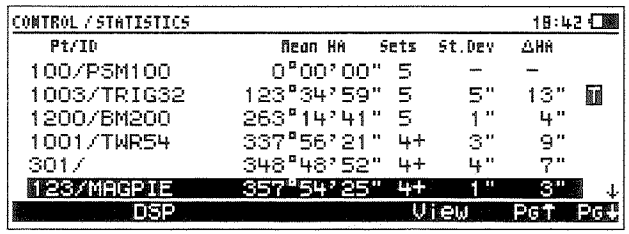
Statistics

The control statistics feature provides information screens for Mean HA, Mean VA and Mean SD as well as Observed Data information for any point.

The statistical information is available during control at any time once you have measured and recorded the backsight point in the first set.

Mean HA, Mean VA and Mean SD

To access the statistics screens, press the *[Stats]* softkey at the main control screen.



The first screen displayed is the Mean HA screen. The scroll arrow on the right-hand side of the screen indicates that there is further information contained below the visible screen.

A separate screen is available for HA, VA and SD. Use the *[DSP]* softkey to move from one screen to the next. The data is presented in the same format on each of the screens.

NOTE: On statistics screens, the backsight point HA values will always be shown as 0°00'00" (Mean HA), — (St.Dev) and — (ΔHA) because backsight point measurements are adjusted to 0 during control. This enables comparison of the other HA values.

NOTE: However, the values displayed on the measuring screens, and recorded in the job database, will be the true values measured when the point is shot.

Pt/ID

This column contains the point number and point ID separated by a slash. The points are displayed in the same order as they are on the main control screen.

Mean HA (VA or SD)

The mean angle or distance value for each point is displayed in this column.

NOTE: An "inverse T" mark shown to the right of the screen indicates that the F1/F2 measurements, for at least one of the sets, are out of tolerance. On the Mean HA screen shown, this is true for point 1003.

Sets

The "Sets" value for each point shows the number of completed sets during which this point was measured and recorded, regardless of whether it was shot on F1, F2 or both.

Additionally, if you are viewing the Stats screen whilst in the middle of an incomplete set, the "Sets" value will be adjusted for shots made during the current incomplete set.

If the point has been measured on **either** F1 or F2 during the current set, a plus sign "+" is displayed next to the "Sets" value. For example, point 1001 on the Mean HA screen shown has been shot to in four previous completed sets, and has been shot to on **either** F1 or F2 during the current set.

St. Dev

This column displays the standard deviation of the angles or distance measurements for each point (see note below).

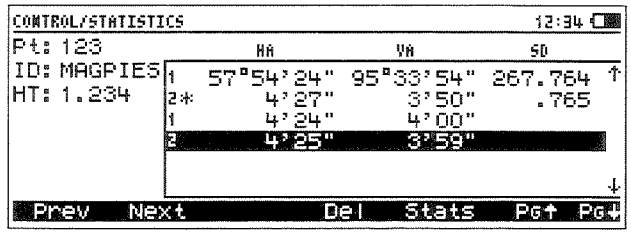
ΔHA (VA or SD)

The value shown here is the maximum difference of all measurements to this point (HA, VA or SD) taken during this control session (i.e. ΔHA = maxHA - minHA, etc.).

NOTE: If only one measurement has been made to a point, the St.Dev and ΔDHA (VA or SD) values will be "0".

Observed Data Statistics

Observed Data Statistics are available for any point by pressing *[View]* on one of the Mean HA, VA or SD screens. The point which is highlighted when *[View]* is pressed will be the first point displayed. You can then access the data for other points by pressing *[Prev]* or *[Next]* .



Pressing ***[Stats]*** will return you to the previous screen.

The following screen features should be noted:

Face 1/Face 2

The first column of numbers inside the data window indicates which face (1 or 2) the measurement was taken on.

*NOTE: Pressing the **[Del]**. softkey will mark the highlighted measurement as inactive and an asterisk is displayed next to the face indicator (as for the second shot shown above). This measurement will not be used in the Mean HA, VA or SD calculations. Pressing **[Del]** again will reactivate the point.*

*NOTE: If you inactivate a backsight point in this way, **all** the same face shots, made during the same set as the backsight point, will be marked as inactive.*

HA, VA and SD

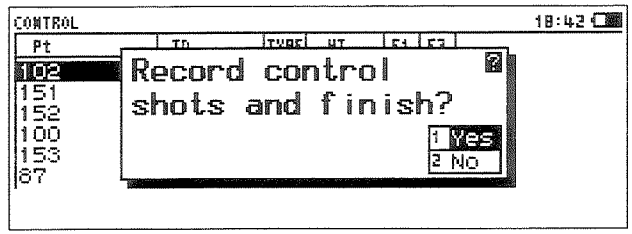
The remaining three columns give HA, VA and SD values for each measurement taken.

The HA values are corrected for the face: that is, Face 1 shots are calculated from the Face 1 backsight and Face 2 shots from the Face 2 backsight.

In addition, Face 2 VA values are displayed as if they were taken on Face 1.

Exiting Control

Once you have completed all the measurements you intend making you can write the control data to the job database, and exit control, by pressing *[Calc]*.



A warning screen will inform you if the current set is incomplete and that some shots will not be used because they do not have a corresponding backsight shot.

The following data is written to the job database, in groups, for all points shot during the session:

- The point number;
- The HA, VA and SD standard deviations;
- The number of sets during which the point was measured and recorded;
- The HA, VA and SD Max Δ's;
- A Control Point (CP) record for the point.

NOTE: A "CO" record (note) indicating the start of the control session, the ST record and all the F1 and F2 shots are written to the job database as they are shot.

Summary of Control Softkeys

Control	
ANG	Measures the angle only.
Calc	Writes the control data to the job databases and exits control.
Coll	Enables you to jump from control to collection.
Del	Marks the measurement as inactive.
DSP	Displays the next statistics screen.
Edit	Allows you to edit the highlighted point's details.
Map	Operates the "Map" function which gives a geometrical layout of the points measured.
MSR	Measures the direction and distance to the point.
NewPt	Enables you to add a new point to the control list.
Next	Displays the information for the next point.
Prev	Displays the information for the previous point.
Stake	Enables you to jump from control to stakeout.
Stats	Operates the "Statistics" function which gives you access to Mean HA, VA and SD information.
Target	Quick target selection to change the prism constant.
View	Enables you to view the observed data statistics for individual points.

Chapter 8 Traverse Adjustment

Introduction

This function allows you to check the closures for *closed* and *loop* traverses before you leave the survey site. You can also adjust the traverse if the coordinates for the end points are known.

Definitions

Closed Traverse — Starts and finishes at points with known coordinates.

Loop Traverse — Starts and ends at the same point.

NOTE: AP800 cannot calculate the closure for a traverse which does not start and end at a point with known coordinates (i.e., open traverse). A station setup must have been performed on at least one of the known coordinate points in the traverse.

Roadmap

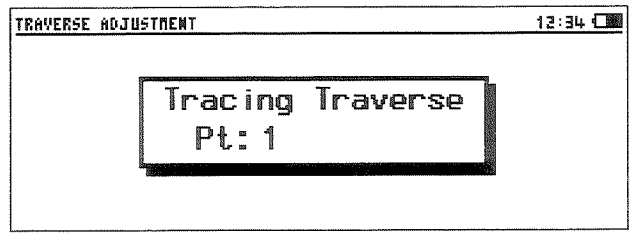
Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

Traverse Calculation & Adjustment Sequence

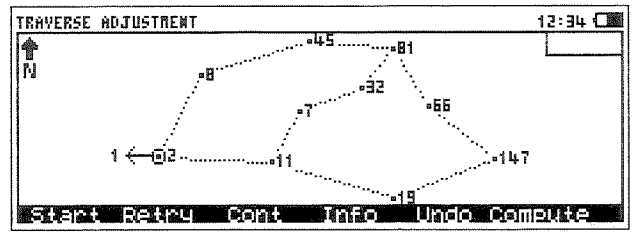
- Open the job which contains the traverse you want to adjust.
- Specify the starting point of the traverse.
- Specify the path through the correct traverse.
- Compute the misclose of the defined traverse.
- Adjust the coordinates (*optional*).

Tracing Traverse



When you select **Traverse Adjustment** on the Main menu, AP800 traces all the traverses in the open job, then displays the "Initial Traverse Adjustment Screen" (shown below). This operation may take several seconds.

Initial Traverse Adjustment Screen



This map shows all the traverses you have surveyed. You specify the traverse for which you want to compute the misclose.

Legend

Point with Fixed Coordinates — Dot with a circle around it.

Adjustable Surveyed Point — Dot.

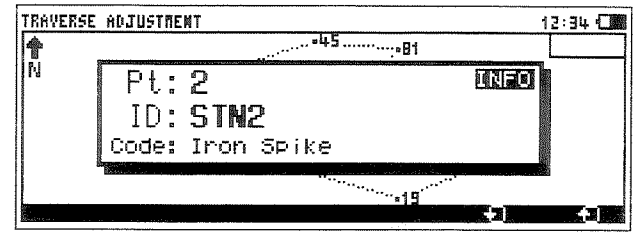
Surveyed Line — Dotted line.

Backsight and Foresight Point — Arrow and point number for non-station points (not shown to scale).

Last Defined Traverse Point — Displayed in a box in the upper right corner (refer to the figure on page 8-4).

Obtaining More Point Information

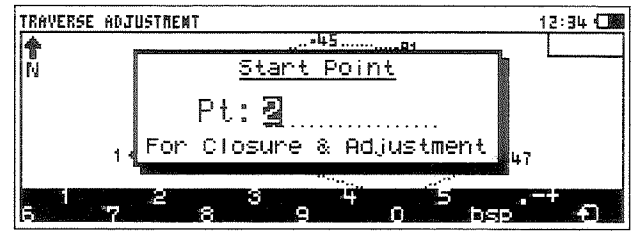
- To find out more about any point, press the *[Info]* key.



Use the ← and → keys to cycle through the points shown on the traverse map.

Specify the Starting Point of a Traverse

- To specify the starting point of a traverse, press the *[Start]* key.



AP800 calculates the misclose and adjusts the coordinates for one traverse at a time. This means you must define each traverse separately. You begin by entering the point number of the start point for one of the traverses.

- Use the selection list or type the number of the **Start Point**. AP800 beeps if you enter a point number that is not on the map.

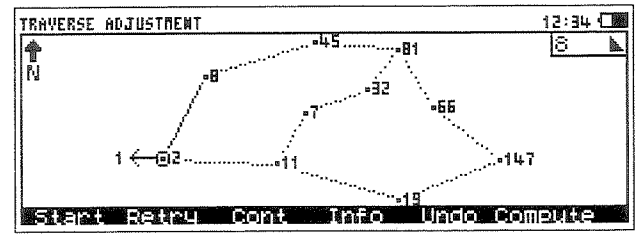
If you use the *selection list*, AP800 tells you whether a traverse started at that point may be—

Adjusted — "For Closure & Adjustment" or

Limited to a closure calculation — "For Loop Closure Only."

- To accept the specified point, press **[ENTER]**. AP800 attempts to draw the path through the traverse.

Confirm or Change Selected Path



AP800 draws a solid line through the entire traverse or stops when it reaches a branch point. Since the traverse is not yet closed in this example, AP800 displays a solid triangle in the box in the upper right corner. The last defined traverse point is also shown in this box.

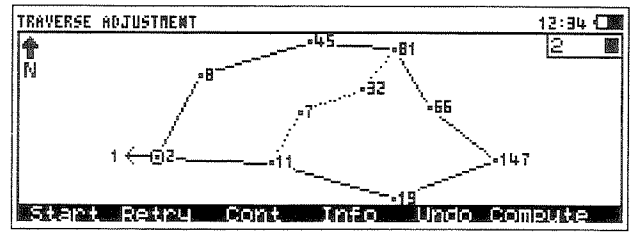
Change Path

- If the solid line has gone down the wrong path, use *[Retry]* to change to the desired branch. In the example shown above, you may wish to start the traverse from point 2→11 rather than 2→8.

To Continue

- To extend the traverse to the next branch point or to the end of the traverse, press *[Cont]* or **[ENTER]**.

Traverse Fully Defined

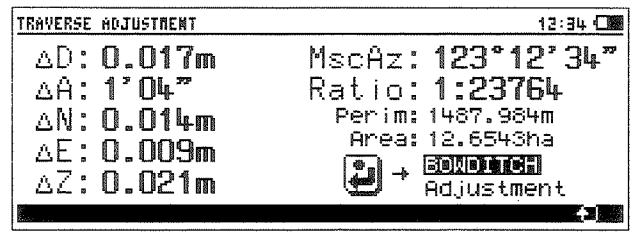


Shows the first fully defined traverse. Notice the solid square in the upper right corner. This tells you that the traverse is now closed onto either a point with known fixed coordinates or onto the starting point of the traverse.

Compute Misclose and Display Closure Report

- To calculate the closure, press *[Compute]*. Status windows will tell you whether or not the angles can be balanced. If the closure is successful, the Closure Report will be displayed.

Closure Report



This report shows the results of the closure calculation.

Adjust the Traverse

Select Adjustment Method

- Use the selection list to choose either **.Bowditch, Compass** or **Transit**.

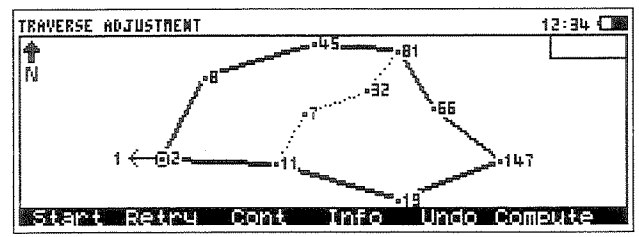
Adjust Coordinates

- To perform the adjustment, press **[ENTER]**. AP800 tells you that it is "Adjusting Coordinates."

You *cannot* cancel the adjustment once it starts and the operation may take several seconds. When the adjustment is complete, AP800 displays the map with the adjusted traverse in bold (see figure below).

Do Not Adjust

- To discard the closure report *without* adjusting the traverse, press **[ESC]** .



The adjusted traverse is shown as a bold solid line.

Define Next Traverse

AP800 allows you to define the next traverse whilst ***saving*** the previously adjusted traverse. You follow the same procedure as before, using *[Start]* to specify the start point for the next traverse.

All Traverses Adjusted

- To exit "Traverse Adjustment" and return to the Main menu when all traverses have been adjusted, press *[ESC]* or **[ENTER]**, then select **OK**.
- To re-display the traverse "map" screen, select **CANCEL**.

Discard Traverse Adjustments

- Press *[Undo]* to discard *all* previously adjusted traverses.
- To re-compute all coordinates from the raw survey data, select **OK**, or **CANCEL** this operation.

Summary of Traverse Adjustment Softkeys

Traverse Adjustment	
Compute	Attempts to balance the angles of the traverse and presents closure data and misclose information.
Cont	Extends the traverse to the next branch point or to the end of the traverse.
Info	Used to access more information about points shown on the traverse map.
Retry	Used to change the traverse to a different path.
Start	Opens the start point window so that the starting point of a traverse can be entered.
Undo	Discards all the previously adjusted traverses.

Chapter 9

COGO

This chapter describes the coordinate geometry features available within the AP800 software. COGO provides you with a number of functions which enable you to calculate new design points while in the field, and inspect and work with your field measurements.

COGO is available from both the main menu and by using the FNC key. However, if you are using the feature via the main menu, it **cannot** be accessed using FNC at the same time. You cannot run two simultaneous COGO sessions.

Inverse

Introduction

Use this function to perform Pt-Pt Inverse calculations (see page 9-3) or Pt-Line Inverse calculations (see page 9-5).

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

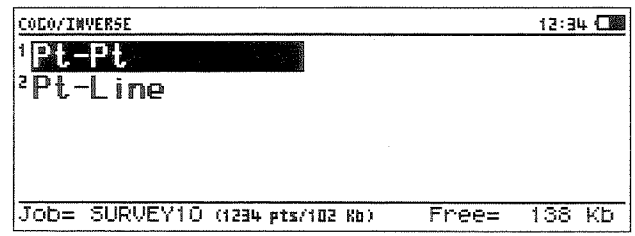
COGO Menu

Inverse	Shift & Rotation
Intersections	Arc-Curve
Parallel Line	
Area and Perimeter	
Manual Input	

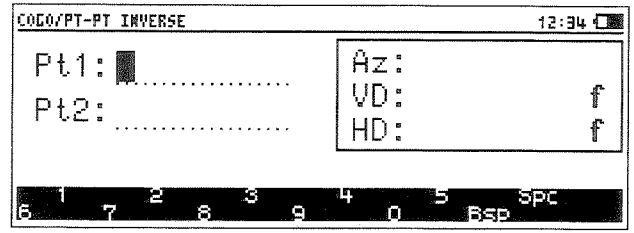
NOTE: COGO is also available via the FNC menu.

NOTE: AP800 automatically opens the last job used (see page 11-10) or you can use the job called "DEFAULT". You may open a different job, create a new one, or rename the "DEFAULT" job after the survey (see page 3-1).

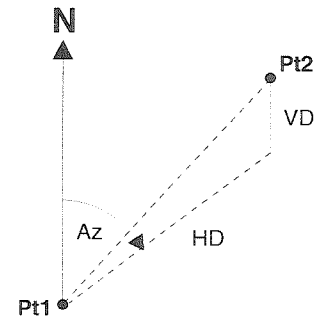
Inverse Menu



Pt-Pt Inverse (Point - Point)



Pt-Pt allows you to enter any two points from the open job or the attached control job. AP800 calculates the inverse (Az, VD and HD) between the two points that you enter.



1st Pt

- Type the first point number. Press **[Mode]** to measure a new point.

2nd Pt

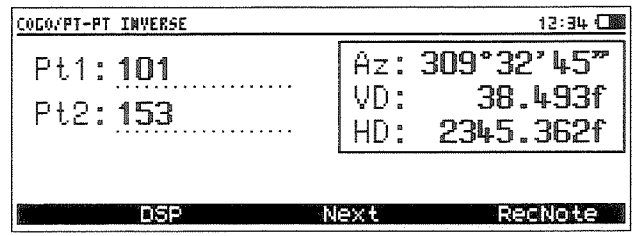
- Type the second point number. Press **[Mode]** to measure a new point.

Point Not Found

- If the point does not exist, AP800 will open the "Point Not Found" window, giving you the option to enter the point's details manually. This is true throughout COGO when a point is entered which does not exist in the current job database or the attached control job.

Calculate Inverse

- When the cursor is in the Pt2: field, press **[ENTER]** to calculate the inverse.



AP800 reports the Az, VD and HD in the data window; if you press **[ENTER]** or ***[Next]***, the cursor moves to the Pt1: field so you can repeat the procedure for a new inverse.

You have a number of options:

Change Format

Pressing the ***[DSP]*** softkey will change the calculated data to an alternative format. The inverse will now be shown as SD, V% and GD (grade), where:

$$\mathbf{GD} = \frac{\mathbf{HD}}{\mathbf{VD}} \quad \textbf{and} \quad \mathbf{V\%} = \frac{\mathbf{100}}{\mathbf{GD}}$$

NOTE: This alternative format is only available if you are using 3D coordinates.

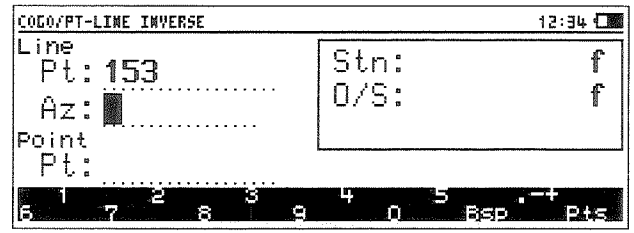
Record Note

Pressing ***[RecNote]*** will automatically record a note of the inverse Points, Az, VD and HD to the job database. The cursor moves to the Pt1: field so you can repeat the procedure for a new inverse.

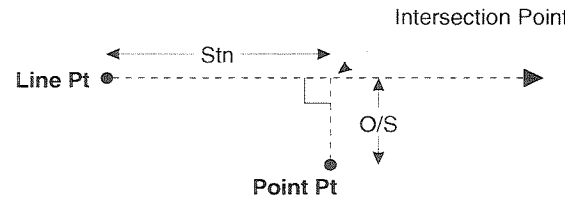
New Inverse

Pressing ***[Next]*** (or **[ENTER]**) returns you to the previous screen with these points as defaults.

Pt-Line Inverse (Point - Line)



Pt-Line will calculate an inverse between a defined line (Line Pt and Az) and a defined point (Point Pt). AP800 calculates the Station (along the line) and Offset (from the line) and will allow you to record the calculated intersection point.



Line Pt

- Type the point which starts the line. Press **[Mode]** to measure a new point.

Line Az

- Type the azimuth for the line. Press **[Mode]** to take an azimuth reading.

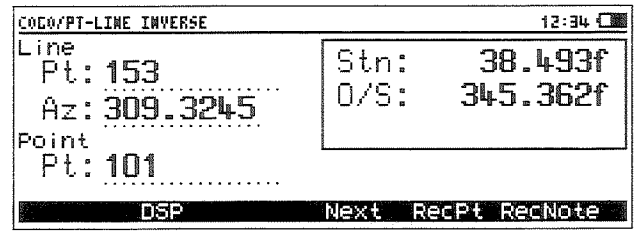
*NOTE: If desired, the azimuth can be calculated from two known points by pressing **[Pts]** and entering the point numbers. This is true throughout COGO for all azimuth fields.*

Point Pt

- Type the point number. Press **[Mode]** to measure a new point.

Calculate Inverse

- When the cursor is in the Point Pt: field, press [ENTER] to calculate the inverse.



After the calculation, AP800 reports the inverse as a Stn and O/S in the data window. If the Point Pt is to the left of the line, the O/S value will be negative.

You have a number of options:

Change Format

Pressing the *[DSP]* softkey will change the calculated data to an alternative format. The inverse will now be shown as N, E and Z coordinates of the intersection point.

Record Note

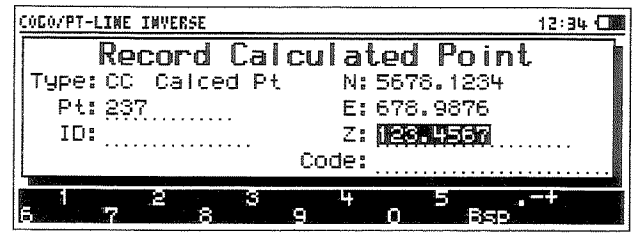
Pressing *[RecNote]* will automatically record a note of the inverse Point Pt, Line Pt, Line Az, Stn and Offset to the job database. The cursor moves to the Line Pt: field so you can repeat the procedure for a new inverse.

New Inverse

Pressing *[Next]* (or [ENTER]) returns you to the previous screen with these points and azimuth values as defaults.

Record Point

Pressing *[RecPt]* will bring up the "Record Calculated Point" window, enabling you to record the intersection point to the job database.



You can edit the Type, Pt, ID, Z and Code fields before you record the point by moving the cursor to the Code field and pressing **[ENTER]**. The Z field will be blank *unless* AP800 is able to calculate the elevation from previously supplied and known information.

Intersections

Introduction

Intersections provides you with three functions which enable you to calculate the position of new points using a variety of point, distance and bearing combinations.

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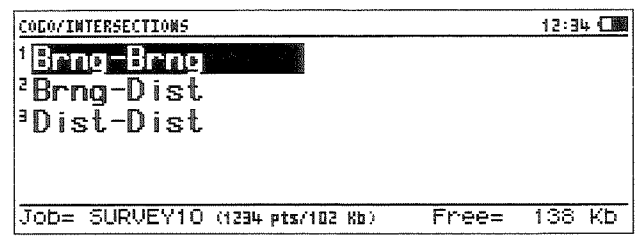
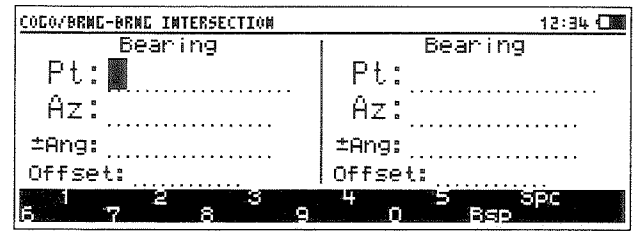
Manual Input	

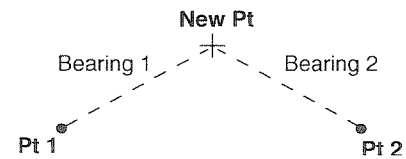
Intersections Menu



Brng - Brng Intersection (Bearing - Bearing)



The Brng - Brng Intersection function will calculate a point at the intersection of two lines, each defined by you as an azimuth through a point. The calculated point is stored in the job database.



Complete the screen with the following information (for both points):

Pt
- Type the point number. Press **[Mode]** to measure a new point.

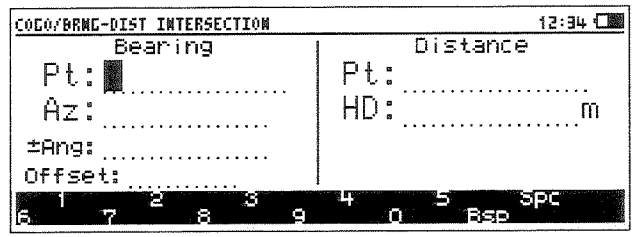
Az
- Type the azimuth for the line. Press *[Pts]* to define the azimuth from two points. Press **[Mode]** to take an azimuth reading.

+/- Ang
- *Optional:* If desired, you can adjust the azimuth by specifying an angular rotation here.

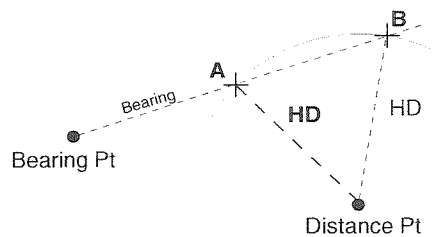
Offset
- *Optional:* The line can be offset from the point by a specified distance. Enter a positive value to offset to the right of the line; a negative value to offset to the left.

Calculate Point
- Move the cursor to the last field (right-hand offset field) and press **[ENTER]**. This will calculate the point and present the "Record Calculated Point" window for you to complete (see page 9-7).

Brng - Dist Intersection (Bearing - Distance)



The Brng - Dist Intersection function will calculate a point at the intersection of a line (defined as an azimuth through a point), and a circle (defined as a distance from a point). The calculated point is stored in the job database.



Complete the screen with the following information:

Bearing Pt
- Type the point number. Press **[Mode]** to measure a new point.

Bearing Az
- Type the azimuth for the line. Press ***[Pts]*** to define the azimuth from two points. Press **[Mode]** to take an azimuth reading.

Bearing +/- Ang
- *Optional:* If desired, you can adjust the azimuth by specifying an angular rotation here.

Bearing Offset
- *Optional:* The line can be offset from the point by a specified distance. Enter a positive value to offset to the right of the line; a negative value to offset to the left.

Distance Pt

- Type the point number which is the centre of the circle. Press **[Mode]** to measure a new point.

Distance HD

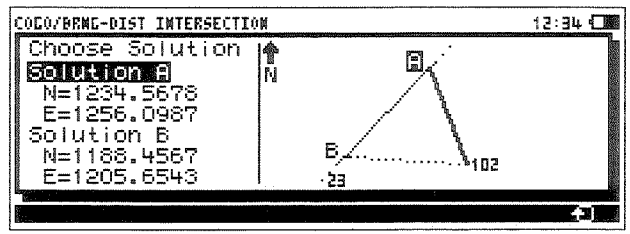
- Type the horizontal distance value which will describe the circle (radius). Press **[Mode]** to measure a distance.

*NOTE: If desired, the HD can be calculated from two known points by pressing **[Pts]** and entering the point numbers. This is true throughout COGO for all HD fields.*

Calculate Points

- Because of the geometry involved, there will always be two solutions to the intersection. Press **[ENTER]** when the cursor is in the HD field to calculate the points and offer you the solutions to choose from.

Select Solution and Record Point

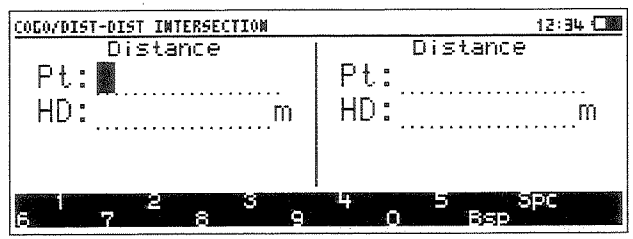


This screen displays the two solutions generated by the intersection and the data associated with each solution.

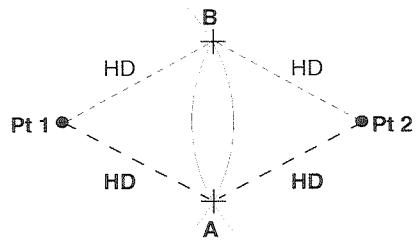
Choose Solution

- Use the circular selection keys to toggle between solution A and B and select the appropriate solution. When your choice is highlighted, press **[ENTER]**. This will accept the point and present the "Record Calculated Point" window (see page 9-7).

Dist - Dist Intersection (Distance - Distance)



The Dist - Dist Intersection function will calculate a point at the intersection of two circles (both defined as a distance from a point). The calculated point is stored in the job database.



Complete the screen with the following information (for both points):

Distance Pt

- Type the point number. Press **[Mode]** to measure a new point.

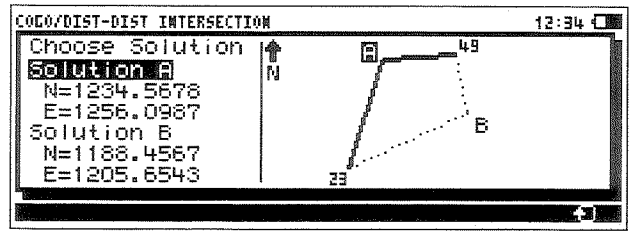
Distance HD

- Type the horizontal distance value which will describe the circle (radius). Press ***[Pts]*** to define the HD from two points. Press **[Mode]** to measure a distance.

Calculate Points

- Because of the geometry involved, there will always be two solutions to the intersection. Press **[ENTER]** when the cursor is in the right-hand HD field to calculate the points and offer you the solutions to choose from.

Select Solution and Record Point



This screen displays the two solutions generated by the intersection and the data associated with each solution.

Choose Solution

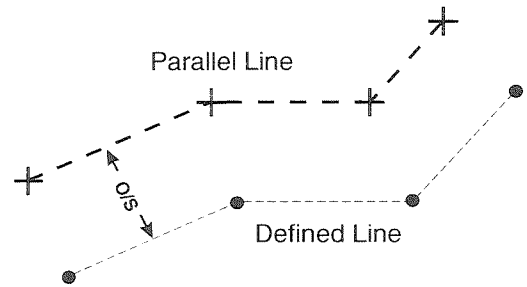
- Use the circular selection keys to toggle between solution A and B and select the appropriate solution. When your choice is highlighted, press **[ENTER]**. This will accept the point and present the "Record Calculated Point" window (see page 9-7).

Parallel Line

Introduction

The parallel line function enables you to define a traverse by listing points, and then calculates the position of new points offset (by a distance that you define) to the left, right or both sides of the traverse.

The first and last points of the traverse are offset perpendicularly to the traverse. The intermediate points are all offset on the half angle. Consequently, the new traverse(s) is parallel, and offset by the specified distance, to the original.



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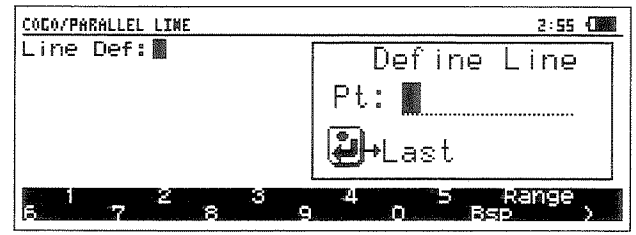
Define the Line



This is the first screen in this function. Using this screen, you can identify points individually or as a range, to define the traverse. As you define the points, they will be displayed in the **Line Def:** area on the left of the screen.

Defining Individual Points on the Line

To insert the points individually:

- Type the point number for the first point of the line. Press **[ENTER]** to accept the point.
- Repeat this until you have defined all the points in the line, then press **[ENTER]**. Pressing **[ENTER]** tells the software that you have finished defining the line. If you do not wish to edit the points defined, proceed to "Define the Offset Distance and Direction" on page 9-17.

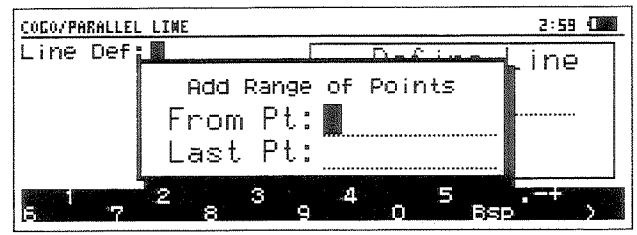
Describing a Line Using a Range of Points

AP800 allows you to enter two points that describe the start and end points in a range. When you have defined the two points, AP800 automatically selects all the points between the start and end, and displays them in the left half of the screen.

NOTE: AP800 will display only as many points as can fit on the screen although all the selected points are added to the job. To signify that there are more points, AP800 displays "..." as the last entry on the screen.

To insert a range of points:

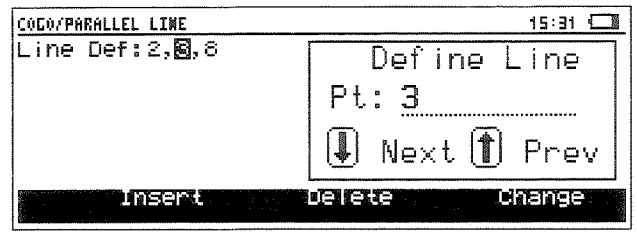
- Press the ***[Range]*** softkey to view the "Add Range of Points" screen.



- Enter the point numbers for the first and last points in the range and press **[ENTER]**.

AP800 displays all the currently stored points in the range.

Edit the Line



Once you have started defining the line, it is possible to edit the points that you have identified. Use the [↑] and [↓] keys to select the points to be edited.

NOTE: When AP800 is showing a range of points that exceeds the available space on the screen, the cursor stops on the '...' symbol. The only way you have to identify the currently selected point is to view the "Pt:" field in the "Define Line" box.

Insert a Point

Pressing ***[Insert]*** will clear the Pt field for you to add a new point. When you add the point, it will be inserted **before** the point which was highlighted when you pressed ***[Insert]***.

For example, if you wish to insert a point between 2 and 3 in the screen shown, you should highlight point 3 and press ***[Insert]***.

Delete a Point

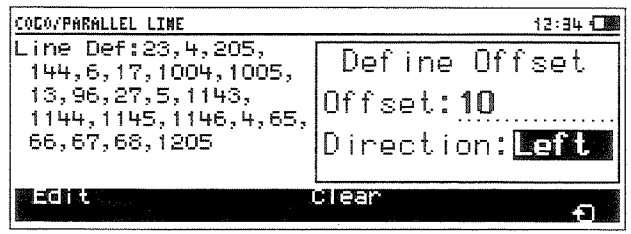
Pressing ***[Delete]*** will remove the currently highlighted point from the list (see note below).

Change a Point

Pressing ***[Change]*** allows you to change the currently highlighted point to a new point number. Type the new number and press **[ENTER]** to change the point.

NOTE: Pressing [Delete] or [Change] will not delete or alter points in the job database.

Define the Offset Distance and Direction



This screen shows the line fully defined. You can now select the offset distance and direction.

Offset (Distance)

- Enter the distance that you want the new line offset from the defined line.

Direction

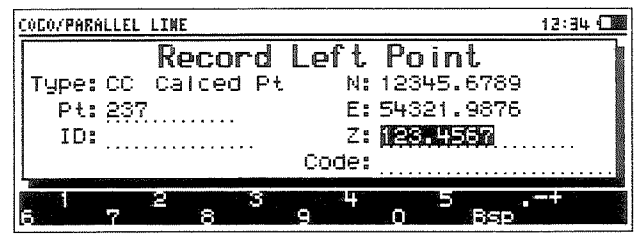
- Use the circular selection key to select the direction that you want the new line offset from the defined line. The options are **Left**, **Right** and **Both**.

Edit the Line If you want to add, delete or change points in the line you can press the *[Edit]* softkey to reopen the line definition box (refer to "Edit the Line" on page 9-16).

Discard the Line Pressing *[Clear]* will discard the entire line and return you to the initial Parallel Line screen.

Calculate the Offset and Record Points

Once you are satisfied with the line definition and you have entered the offset direction and distance, you can calculate the position of all the offset points by pressing **[ENTER]** at the previous screen.



The "Record Point" window is now displayed enabling you to record all the offset points.

You can edit the Type, Pt, ID, Z and Code fields for each point.

*NOTE: If you selected "Both" as your offset direction, **all** the left points are recorded first, followed by **all** the right points.*

NOTE: Pressing [ESC] during this operation will interrupt the recording of the offset points. The points which have been recorded will remain in the job database.

Default Z

The Z value will default to the Z of the point which is being offset. However, if you alter a Z value and record a point, AP800 displays a screen to warn you that the amount you have changed the elevation by, for this point, will be added to the default Z for all following offset points.

This warning will only appear once, unless you change a Z value again.

Record All Points Automatically

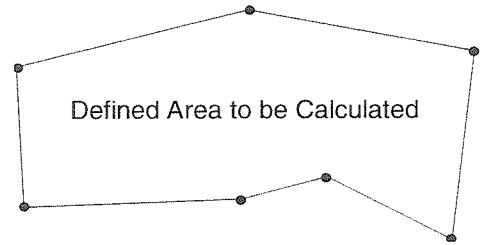
If you record two sequential points without editing any of the fields (except the point number, which must increment), AP800 will ask you if you want to record all the points with the default values.

If your offset direction is "Both", AP800 will record all the left offset points and then stop. You will be returned to the screen shown above (with the heading changed to "Record Right Point") enabling you to repeat the procedure for the remaining points.

Area and Perimeter

Introduction

The Area and Perimeter function enables you to define a lot (loop traverse) by listing points, and then calculates the area and perimeter of the defined lot.



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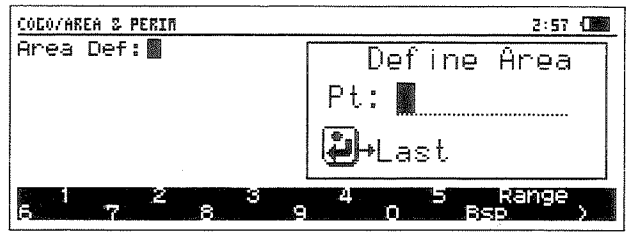
Define the Area



This is the first screen in the Area and Perimeter function. Using this screen, you can identify points individually or as a range, which define the loop traverse. As you add points they will be displayed in the **Area Def:** box on the left of the screen.

Defining Individual Points for the Lot

To insert the points individually:

- Type the point number for the first point of the lot. Press **[ENTER]** to accept the point.
- Repeat this until you have defined all the points in the lot, then press **[ENTER]** to calculate the area and perimeter.

NOTE: By default, AP800 closes the area using the last point in the list and the first point in the list. However, you can close the lot manually by entering the first point again as the last point.

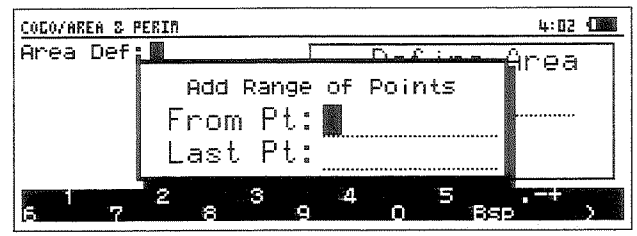
Describing an Area Using a Range of Points

AP800 allows you to enter two points that describe the start and end points in a range. When you have defined the two points, AP800 automatically selects all the points between the start and end, and displays them in the left half of the screen.

NOTE: AP800 will display only as many points as can fit on the screen although all the selected points are added to the job. To signify that there are more points, AP800 displays "..." as the last entry on the screen.

To insert a range of points:

- Press the ***[Range]*** softkey to view the "Add Range of Points" screen.



- Enter the point numbers for the first and last points in the range and press **[ENTER]**.

  AP800 displays all the currently stored points in the range.

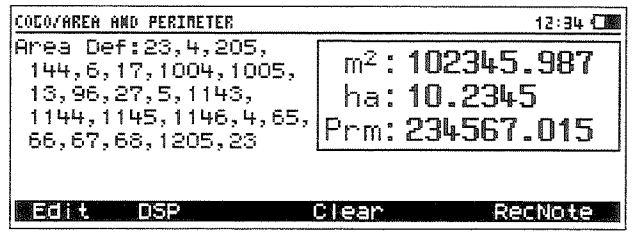
- Press **[ENTER]** to calculate the area and perimeter of the lot.

Editing Points

The "Edit" feature for Area and Perimeter operates in exactly the same way as the "Edit" feature in the Parallel Line function. Please refer to "Edit the Line" on page 9-16 for details of how to add, change or delete previously defined points.

Area and Perimeter Calculation

The following screen is displayed when the area and perimeter calculation is complete:



The units displayed will the primary distance units as selected in System/Configuration (see page 11-4).

You have several choices:

Edit the Lot If you want to add, delete or change points in the lot you can press the *[Edit]* softkey to reopen the area definition box (refer to "Edit the Line" on page 9-16).

Discard All Points Pressing *[Clear]* will discard all the points and return you to the initial Area and Perimeter screen.

Record Note Pressing *[RecNote]* will automatically record a note of the calculated area, perimeter and all the defined points, to the job database.

Change Format Pressing *[DSP]* will change the data window to display the area and perimeter in an alternative format. For the screen shown above, the area would change to be shown in ft^2 and acres, and the perimeter in feet.

Exit Press [ESC] to return to the COGO main menu.

Manual Input

Introduction

This function provides you with three ways of manually inputting new points to the job database: Coordinates (page 9-24), Brng & Dist (page 9-26) and Line & Offset (page 9-28).

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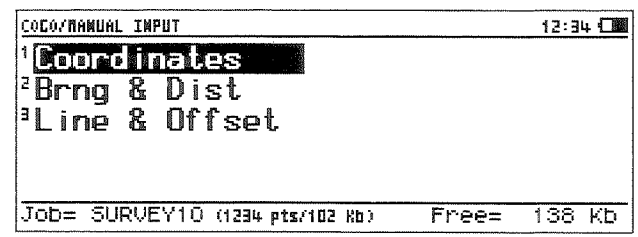
Manual Input Menu

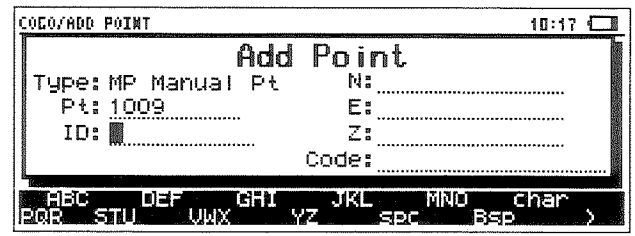


Coordinates

Introduction

Coordinates enables you to manually input the coordinates for a new point to the open job database.

Enter New Point Information



AP800 automatically increments the highest point number in the open job by one and assigns this number to the new point. You can change the point number and the point type (MP or MC).

NOTE: This function works in the same way as the "Add Point" function in FNC/View/Edit (see page 12-16).

Input the Point Details

- Enter the **ID** (optional), the Northing, Easting, and station elevation (**Z**), and the **Code** (optional).

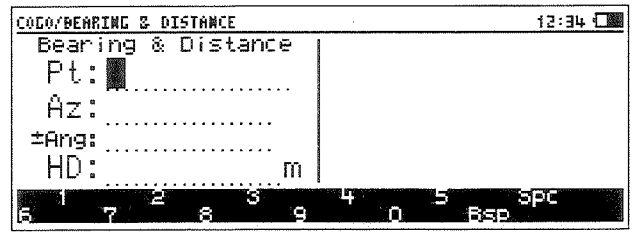
Record the Point

- To add the new point to the open job, move the cursor to the last field and press **[ENTER]**.

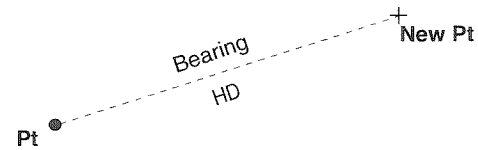
Exit

- Repeat for the next point, or press **[ESC]** to exit this function.

Brng & Dist (Bearing & Distance)



This function enables you to identify and record a new point by specifying a bearing and distance from a known point. The calculated point is stored in the job database.



Complete the screen with the following information:

Bearing Pt
- Type the point number. Press **[Mode]** to measure a new point.

Bearing Az
- Type the azimuth for the line. Press *[Pts]* to define the azimuth from two known points. Press **[Mode]** to take an azimuth reading.

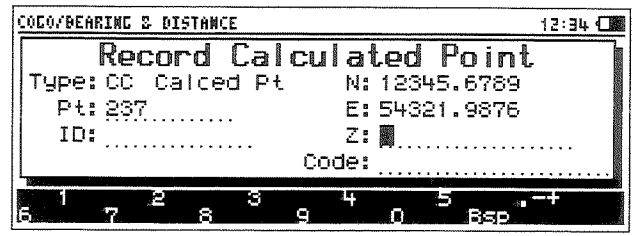
+/- Ang
- *Optional:* If desired, you can adjust the azimuth by specifying an angular rotation here.

HD
- Type the horizontal distance value. Press *[Pts]* to define the HD from two known points. Press **[Mode]** to measure a distance.

Calculate New Point
- Press **[ENTER]** when the cursor is in the HD field to calculate the new point's coordinates.

Record Point

The "Record Calculated Point" window enables you to complete the point's details and record the point to the job database.



You can edit the Type, Pt, ID, Z and Code fields before you record the point by moving the cursor to the Code field and pressing **[ENTER]**.

Default Z

The Z field will be blank *unless* AP800 is able to calculate the elevation from previously supplied and known information. A Z value will only be available if all of the following conditions are true:

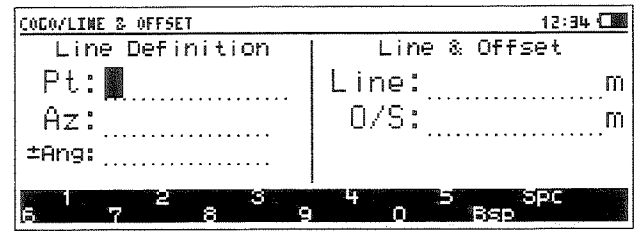
1. the azimuth was defined by a points reference (i.e. using *[Pts]*);

2. the first of these reference points is the same point as the Bearing Pt;

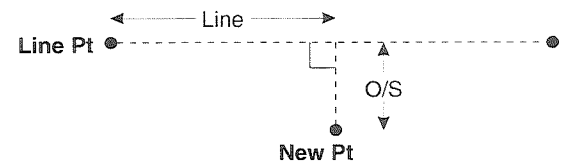
3. both the reference points have known elevations; and,

4. the calculated point lies **between** the two reference points.

Line & Offset



This function enables you to identify and record a new point by specifying its distance along, and offset from, a defined line. The calculated point is stored in the job database.



Complete the screen with the following information:

Line Pt
- Type the point which starts the line. Press **[Mode]** to measure a new point.

Line Az
- Type the azimuth for the line. Press *[Pts]* to define the azimuth from two known points. Press **[Mode]** to take an azimuth reading.

+/- Ang
- *Optional:* If desired, you can adjust the azimuth by specifying an angular rotation here.

Line
- Type the distance along the line to the intersection point.

O/S
- Type the distance that the point is offset from the line. If the offset is to the left of the line, enter a negative value.

Calculate New Point

- Press **[ENTER]** when the cursor is in the O/S field to calculate the new point's coordinates. The "Record Calculated Point" window will be displayed for you to complete (see page 9-7).

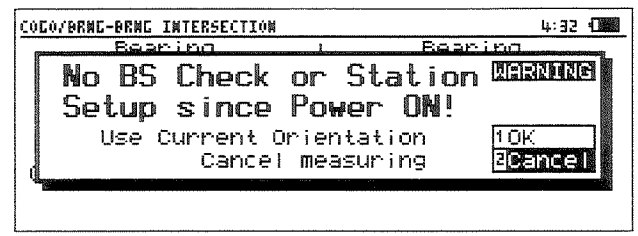
The Z value for the first point calculated will be blank (no default). However, for all subsequent new points calculated from the same line definition (but different line and offset values), the Z will default to the value of the previous point.

Taking a Measurement

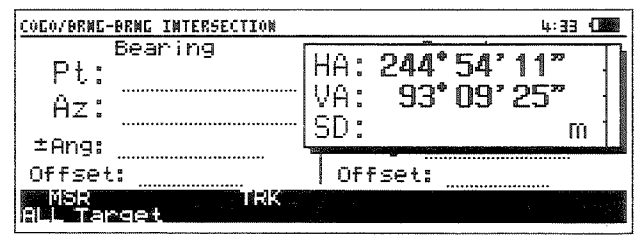
Measuring to a point

You can sight and measure a new point from any point (Pt:) field and use this in the calculation.

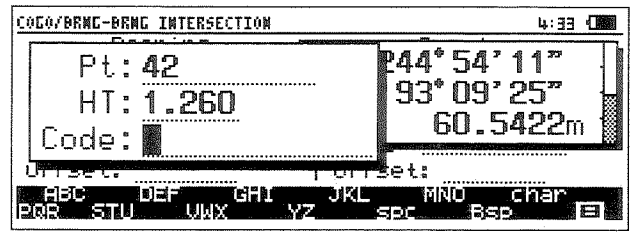
Note: As this is a measure and record function the instrument orientation may need to be established before measuring if this has not already been done.



- Press **[Mode]** to display the measuring screen.



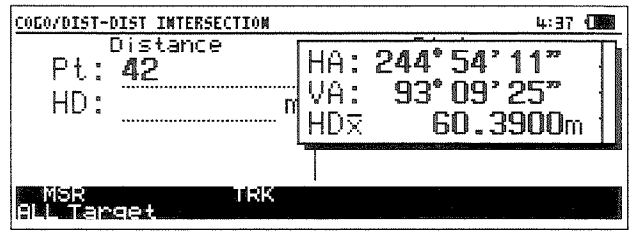
- Sight to a point.
- Press *[MSR]*, *[TRK]*, or *[ALL]* to measure to the prism. (For assistance, see page 2-8 and page 13-5).
- Press **[Enter]** after a *[MSR]* or *[TRK]* to record the point and move from the Pt: field on the Cogo screen.



Measuring a Horizontal Distance

For any of the horizontal distance (HD:) fields you can measure the distance and use it in the calculation.

- Press **[Mode]** to display the measuring screen.
- Sight to the prism.
- Press *[MSR]*, *[TRK]*, or *[ALL]* to measure to the prism. (For assistance, see page 2-8 and page 13-5).

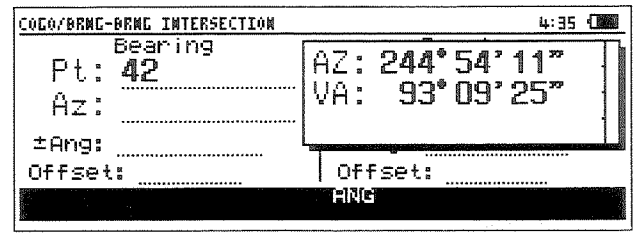


- Press **[Enter]** after a *[MSR]* or *[TRK]* to place the measured distance into the HD: field and move from that field on the Cogo screen.

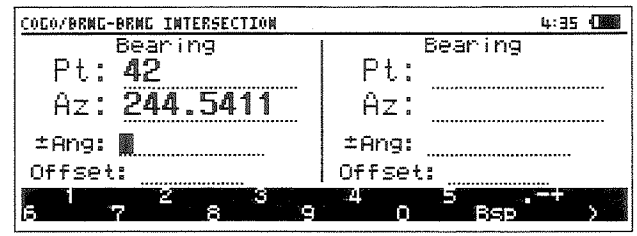
Taking an Azimuth Reading

On any of the Azimuth (Az:) fields you can take an azimuth reading for use in the calculation.

- Press **[Mode]** to display the angle data.
- Sight to the target.
- Press *[ANG]*.



After a one second pause, to ensure a stable reading, the azimuth value is placed in the Az: field and the cursor advanced to the next field.



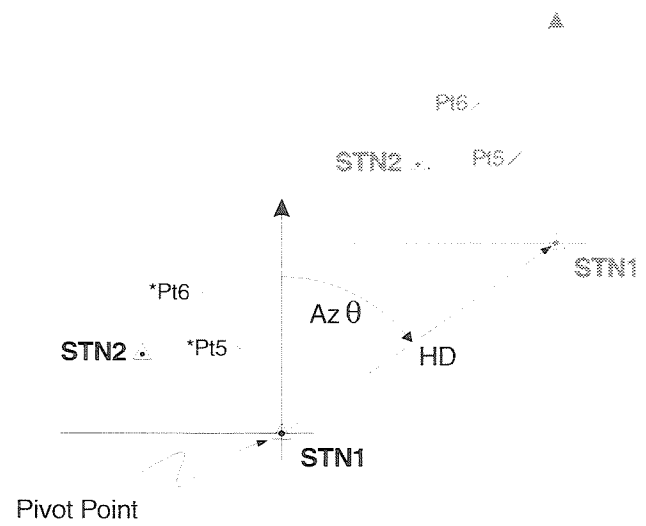
Shift & Rotation

Introduction

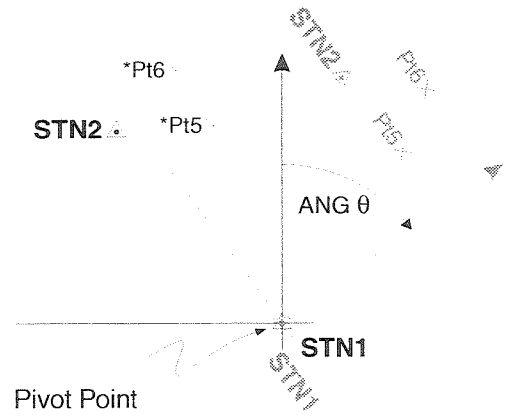
The Shift & Rotation function enables you to alter the values of a range of points by shifting them by a pre-defined offset, rotating them to a new axis or both. This facility may be necessary when for example, you want to apply corrections to the measured data or adjust coordinates to a different system.

Using Shift & Rotation, you can shift *and* rotate points on the horizontal plane, and only shift points on the vertical plane.

Shift



Rotation



Roadmap

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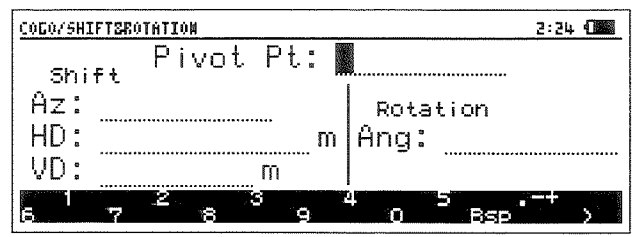
Control	

→

COGO Menu

Inverse	Shift & Rotation
Intersections	Arc-Curve
Parallel Line	
Area and Perimeter	
Manual Input	

Applying a Shift and Rotation



The Shift and Rotate screen provides fields for angles and distances that AP800 will use to calculate the new points. When you leave a field blank (by pressing **[ENTER]**), AP800 inserts a zero.

Enter the Pivot Point

The Pivot Point field is a mandatory field and represents the originating point for the shift and rotation calculations.

- Enter the point number that you want as the originating point.

Shifting and Rotating

- To apply a shift adjustment, enter values in the fields on the left-hand side of the screen (refer to "Entering the Shift Values" on page 9-35).
- To apply a rotation adjustment, enter an angular value in the "Ang:" field on the right-hand side of the screen (refer to "Entering the Rotation Values" on page 9-36).
- To carry out both adjustments in one operation, enter values in all the fields.

Entering the Shift Values

When you shift a point or set of points, you apply a linear adjustment to each point based on the Azimuth of the adjustment and the distance (HD and VD) from the Pivot Point.

AP800 requires that there is a non-zero value in either the "HD:" field or the "VD:" field. You can not proceed past the initial Shift & Rotate screen until you enter a value in one or both of these fields (even if there is an entry in "Az:").

Specify the Azimuth

- To specify the Azimuth, type a value into the "Az:" field. The value must be positive.

*NOTE: To use the Azimuth from one existing point to another, press the **[Pts]** key and enter the point numbers in the fields provided. These points do not have to be involved in the current operation.*

Enter the Distances

- Type the horizontal distance, that you want to move the points, in the "HD:" field and the vertical distance in the "VD:" field. The distance can be positive or negative.

*NOTE: To use the distance between two existing points, set the cursor in the relevant field and press the **[Pts]** key. Enter the point numbers in the fields provided. These points do not have to be involved in the current operation.*

NOTE: When you specify a value in the "VD:" field, AP800 adds or subtracts it from the point's existing 'Z' value.

Entering the Rotation Values

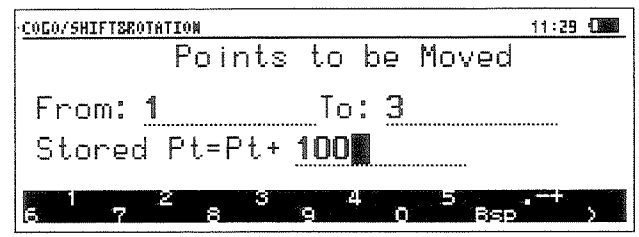
Specify the Angle

To specify the angle of rotation for the points, type an angle into the "Ang:" field. The value can be positive or negative.

Applying the Adjustment

When you have entered the values for Shift, Rotation or both, press **[ENTER]**.

Specify the Points to Move



Define the start point and end point for the range of points you wish to move. The point numbers must be in ascending order. AP800 selects all the points that exist between the points you specify.

☞ You can also use point numbers that do not exist to obtain the range. For example, if you don't remember the point number for the last point in the job, you can guarantee to include it by typing a number much higher than the last point could possibly be (e.g. 999999) in the "To" field.

Specifying the Add Constant

To prevent conflicts with existing point numbers, you should use an Add Constant. This field is optional and requires an integer that is added to the point number being moved to obtain the number for the new point. For example, a moved point 3 when added to an Add Constant of 100 becomes point 103.

- To use an Add Constant, enter a number in the "Stored Pt" field as the Add Constant.

Warning

You must enter a value that is equal to or greater than the last point number in the range. If you do not, AP800 displays an error message.

NOTE: If you do not specify an Add Constant, AP800 marks the existing point as deleted and creates the new point with the same number as the old point (providing you select this option — see "When Point Numbers Conflict" on page 9-38).

☞ To avoid conflicts between new and existing point numbers, use an Add Constant that is sufficiently high to create point numbers outside the range of existing numbers.

Calculate the New Points

When you have entered the range of points and the Add Constant, press **[ENTER]**. AP800 converts all the points in the range. For each point, AP800 prompts you to verify the creation of the point, resolve conflicts with other points or both.

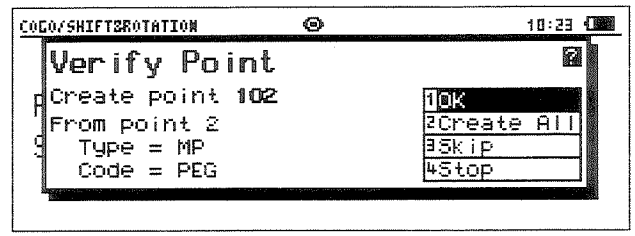
To remind you that only coordinate records will be moved and that CP and SS records will be recalculated, AP800 displays a message before commencing the calculations. To continue, select *[1]*.

Cancelling the Operation

To abort the processing, press *[2]* (Abort) or *[Esc]*. You are returned to the initial Shift & Rotate screen with your current values in the fields.

Confirming New Points

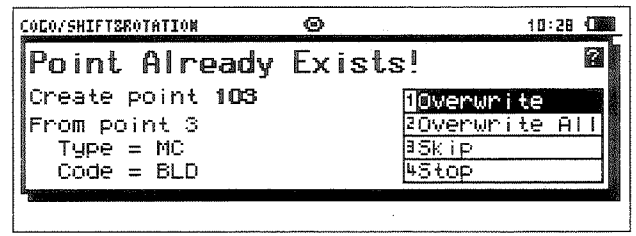
As each new point is created, AP800 prompts you to confirm or verify that you want the point added to the job.



To add the new point select *[1]*. To continue and create *all* the remaining points without displaying this message again, select *[2]*. Press *[3]* to ignore this new point and move to the next point. To cancel the operation from this point on, press *[4]*.

When Point Numbers Conflict

AP800 makes you aware of conflicts between new and existing points by displaying the following screen.



To continue and overwrite the conflicting point select *[1]*. To continue and overwrite *all* the conflicting points without displaying this message again, select *[2]*. Press *[3]* to ignore this new point and move to the next point. To cancel the operation from this point on, press *[4]*.

NOTE: When the calculation resumes, AP800 will display the "Verify" screen for the next point, irrespective of whether you chose the "Create All" option or not.

Viewing the Results

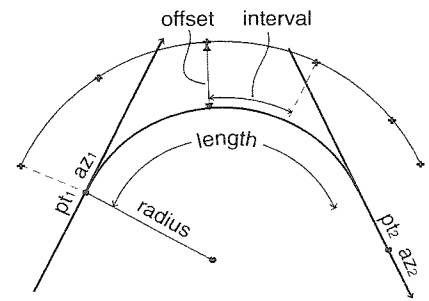
AP800 creates a new set of points with the adjustments applied. To view the results, select *[View/Edit]* from the "FNC" menu (see "View / Edit" on page 12-5). The listing includes the following items as records of this operation:

- 'Note' entries stating which Shift & Rotate functions were applied;
- Calculated coordinate records for the new points;
- The previous records for the moved points, marked with an asterisk (*) to show that they have been overwritten (although not completely deleted).

Arc-Curve

Introduction

The arc-curve function enables you to define an arc, and then calculate new points along the arc at an offset and interval that you specify.



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COGO menu

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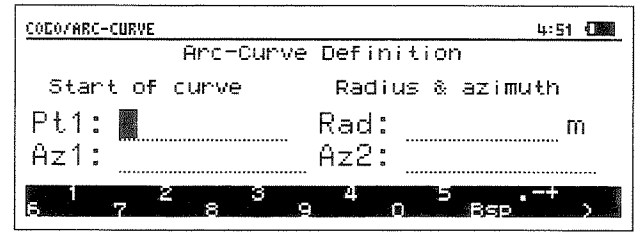
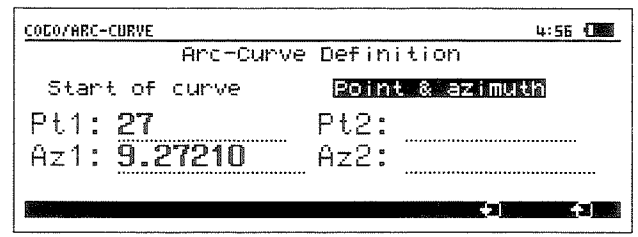
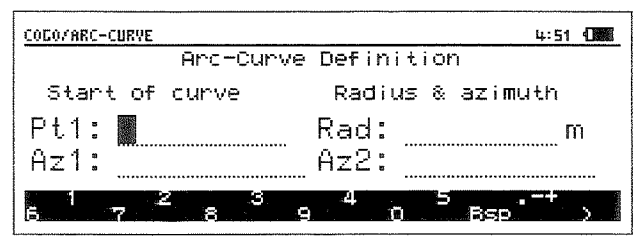
Define the Arc



From this screen you are able to define the arc, using one of three possible combinations of data.



After entering the Az1 value the 2nd column heading will highlight allowing you to select the combination that best suits your data.



Complete the screen with the applicable data from the following information:

Pt1

- Type the point number of the point defining the start of the arc. Press **[Mode]** to measure a new point.

Az1

- Type the azimuth of the incoming tangent defining the start of the arc. To calculate the azimuth between two points press ***[Pts]*** the key. Press **[Mode]** to take an azimuth reading.

Radius

- Type the radius of the arc. A positive radius indicates a right curve (clockwise); a negative radius indicates a left curve (anti-clockwise). Press **[Mode]** to measure a distance.

Az2

- Type the azimuth of the exit tangent defining the end of the arc. If the azimuth entered is the same as Az1 it will be flipped when the next screen is entered; the result is a semi-circle. To calculate the azimuth between two points press the ***[Pts]*** key. Press **[Mode]** to take an azimuth reading.

Pt2

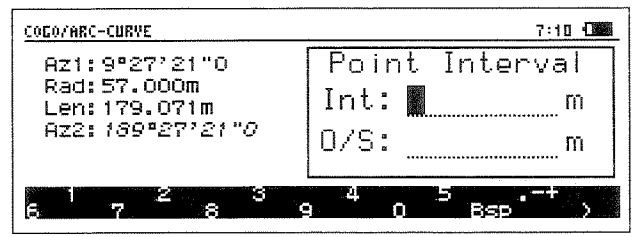
- Type the point number of any point on the exit tangent of the arc. Press **[Mode]** to measure a new point.

Length

- Type the arc-length of the arc, only a positive arc-length is acceptable. If the arc-length is greater than the calculated circumference it will be shortened to the circumference when the next screen is entered.

Specify the Point Interval and Offset

After entering the arc definition the remaining definition values are calculated and displayed in the background of this Point Interval screen. Values shown in the italic font indicate that they have been modified from what was originally entered; this only applies to Len and Az2, see Define the Arc, on page 9-41, for further details.



You may now enter the interval and offset to define the position the new points will be calculated at in relation to the arc.

Complete the Point Interval screen with the following information:

Int

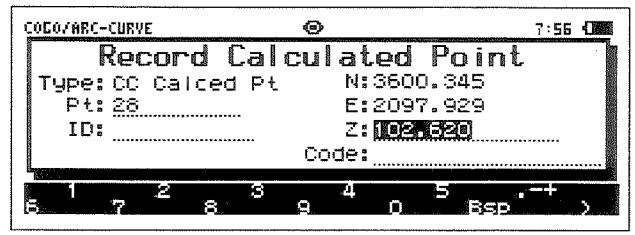
- Type the interval distance along the arc to calculate the new points at. The interval must be a value greater than zero.

O/S

- Type the offset distance away from the arc to calculate the new points at. A positive offset places the new points outside the arc; a negative offset places them inside the arc. Press **[Mode]** to measure a distance.

Calculate and Record the New Arc Points

Once you have entered the values on the Point Interval screen pressing **[ENTER]** in the O/S field will initiate the calculate and record process.



The "Record Calculated Point" window is now displayed enabling you to record the new arc points.

You can edit the Type, Pt, ID, Z and Code fields for each point.

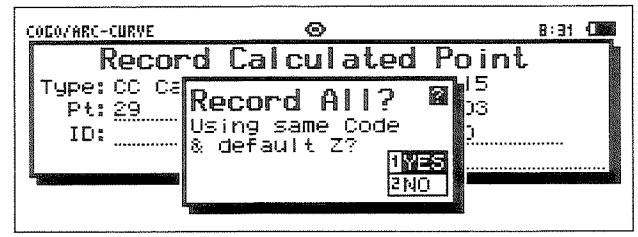
Note: *Pressing **[ESC]*** during this operation will interrupt the recording of the new arc points. Points already accepted will remain in the job.

Default Z

The Z value will default to the Z of the start of arc point (Pt1). If Pt2 is specified in the Arc Definition and its position is the end of arc (with a 5cm tolerance), the Z value will be graded from the start to the end of the arc.

If you alter a Z value and record the point, AP800 displays a message to inform you of the difference in Z value change. This Z value change is applied to following points. The message only appears when you change the Z value.

Record All Points Automatically



If you record two sequential points without editing any of the fields (except the for the point number, which will increment), AP800 will ask if you want to record all the points with the default values.

Note Records

Before the calculated points are added to the job two note records will be written detailing the arc definition.

```
CO,Pt:27 Az:9.27210 Pt2:N/A Az2:133.34031
CO,Arc Radius:57.0000 Length:123.4710
```

Preceding each calculated point will be a station and offset note record. The station value is the arc-length from the start of the defined arc.

```
CO,Stn:5.0000 O/S:2.1000
CC,29,,3605.415,2099.003,102.620,CURVE2
```

Summary of COGO Softkeys

COGO	
ALL	User-defined measure key. Measures and records a point or measures a horizontal distance.(Measuring).
ANG	Take an azimuth reading. (Measuring).
Change	Change the highlighted point (Parallel Line and Area & Perimeter).
Clear	Discard all the defined points (Parallel Line and Area & Perimeter).
Delete	Delete the highlighted point (Parallel Line and Area & Perimeter).
DSP	Changes the format of the displayed data.
Edit	Edit the defined points (Parallel Line and Area & Perimeter).
Insert	Insert a point before the highlighted point (Parallel Line and Area & Perimeter).
MSR	User-defined measure key. Measures single, multiple, or continuous measurements. (Measuring).
Next	Enter the next Pt - Pt or Pt - Line inverse.
Pts	Define an azimuth or horizontal distance from two known points.
RecNote	Records a note to the job database.
RecPt	Records the point to the job database.
Range	Enter two points that describe the start and end points in a range.
TRK	User-defined measure key. Measures single, multiple, or continuous measurements. (Measuring).

Chapter 10

Communications

Introduction

Use this section to transfer survey data to and from your computer or data card. You can specify the type of data you want to transfer.

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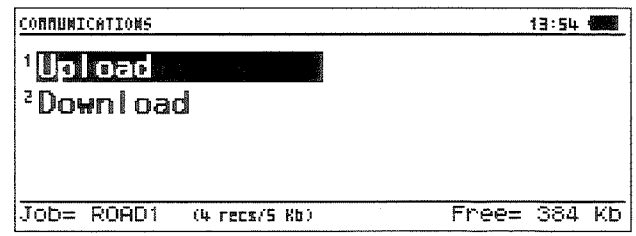
The Communications Menu



Basic Data Transfer Sequence

- Open the job you want to transfer data to or from.
- Set up AP800 to send or receive the data.
- Check the communications settings.
- Upload or download the data.

Uploading TO the Instrument

The uploading procedure transfers data from an ASCII file on the data card or on your computer and puts the coordinates into the open job.

Warning

You cannot use this function to upload **binary** files, such as code and parameter files, to the instrument. To upload this type of file you should copy the binary file onto your data card using a card reader/writer.

NOTE: If you do not want to upload all the points for a job you can either modify the ASCII file, or upload into a new job and use "Job Manager" to copy only selected points (see page 3-10).

PreStart Notes

Uploading Using a Data Card

Before you begin to upload from an ASCII file on a data card, make certain the ASCII file is located in the *same directory* as the open job, has the same filename as the job name and has the file extension **.UPx**, where x can be any number 1-9.

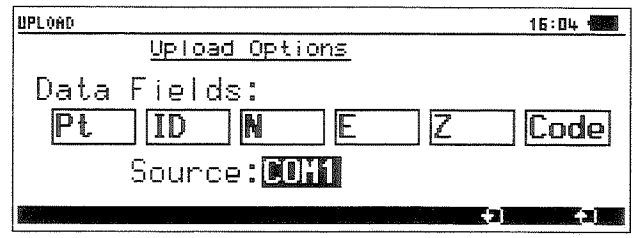
PC Based Software

Nikon's PC based software package NS-95 can help you to automate the uploading and downloading of data, and give you more options. For example, NS-95 will allow you, as one of its options, to read raw survey data **directly** from the AP800 binary database. For more information, contact your Nikon dealer.

Setting Up AP800 to Upload Your Data

Set the Upload Options

- AP800 displays the "Upload Options" screen when you select **Upload** from the "Communications Menu."



Here you set up AP800 to upload your survey data. Use the selection list key to change the values. Notice the cursor in the "Source" field.

Specify the Data Source

You can upload data from an ASCII file on your computer through the instrument's **COM1** port. Alternatively, you can upload the data from an ASCII **FILE** on the data card.

Do not press **[ENTER]** when the cursor is on the "Source" field unless you are satisfied with the "Data Fields" values. See "Data Fields" below.

☞ It is much easier to use a *PCMCIA card drive* to transfer the file from your computer to the data card. The card drive is like a floppy disk drive and enables you to copy the file to your data card. Thus, you do not have to bring the instrument to the computer each time you transfer data.

Data Fields

Each data record to be uploaded may contain up to seven different types of data (e.g., "Pt," "ID," "N," "E," "Z," "Code," and a blank). The data in a record may be separated by either a comma or a blank space.

Use "Data Fields" to specify the order of the data within each record to be uploaded. The fields must match *exactly* the order of the incoming data types. The "Upload" function ignores multiple blank spaces between data.

You may wish to consult the manual that is supplied with your mapping software for the correct data format.

If you do not want to upload all the data in each record, then leave the corresponding box in the "Data Fields" blank.

NOTE: (1) All uploaded records, which do not match the expected data format, are recorded as notes. AP800 reports the "Number of Notes".

NOTE: (2) The ASCII upload file should be terminated with a standard DOS end-of-file character (decimal 26). If this character is not there the completion message will be delayed a few seconds.

NOTE: (3) If the code in the records you are uploading contains either commas or blanks then it must be the last data item in the record.

NOTE: (4) The minimum requirement for the data fields is "N" and "E", or "Z" alone.

NOTE: (5) If "Pt" is not specified or the data has missing point numbers, AP800 automatically uses the next available point number.

Change Data Fields

- Use t he "↑ " to move the cursor *from the "Source"* field to the **Data Fields**.
- Use the selection list to input the data type or blank. Then press **[ENTER]**. Repeat for each data field. *(Each field must contain a different value.)*

Exit Upload Options

- If the cursor is in a "Data Field" box, press **[ENTER]** repeatedly until the cursor moves to the **Source** field.
- To accept any changes to the "Upload Options" screen, press **[ENTER]**. ([ESC] cancels any changes.)

Communications Settings

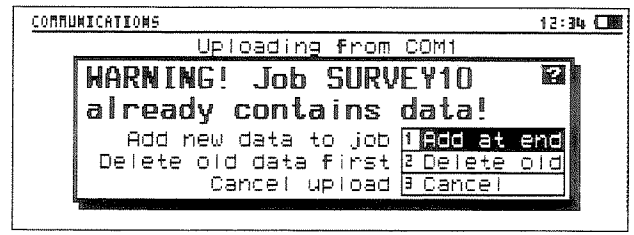
Change Communications Settings

Data transfer will fail unless the communications settings match between the instrument and your computer. For more information, please refer to page 10-12.

Communications Settings Okay

- To continue, move the cursor to the last field, then press **[ENTER]**.

Warning - Job Already Contains Data!

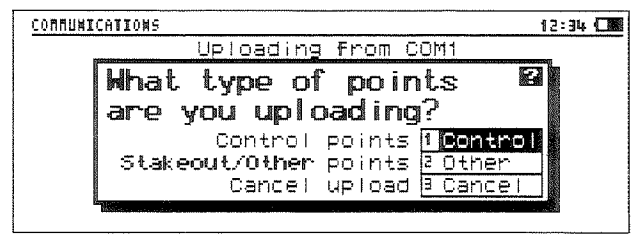


This window appears only if the open job contains data.

Add at end — Adds the uploaded data to the end of the job.

Delete old — Deletes only the coordinate data in the open job before uploading the new data. AP800 will *not* allow you to delete survey data during an Upload operation, i.e., "ST," "CP," "SS," or "SO" records. (If you want to delete survey data, you must use "File Manager" (see page 3-8.)

What Type of Points are You Uploading?



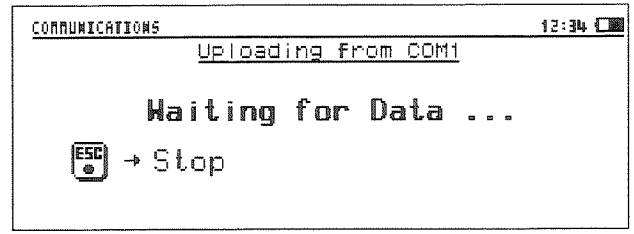
This information tells AP800 how to classify the points and where to use them.

Control — Control points are assigned the "UC" record type and will appear in the control point selection list.

Stakeout/Other points — These points are assigned the "UP" record type.

NOTE: If you are uploading from the data card, see "Uploading From an ASCII FILE on the Data Card" on page 10-7.

Uploading From Your Computer Through COM1



AP800 is waiting for you to send the data from your computer.

Ready Your Computer and Send Data

- Check the cables and set your computer to send the data. ***Do not*** commence sending data from your PC until the "Waiting for Data..." screen is displayed on the instrument.

Progress Report

AP800 reports the number of uploaded records as it receives the data. You can stop the operation at any time by pressing [ESC].

You are warned if the point number being uploaded exists in a "UC," "UP," "MC," or "MP" record. You can skip this point and not upload it or you can overwrite the point in the open job. However, you cannot overwrite a point that has been used by an "ST" or "SO" record.

Upload Complete

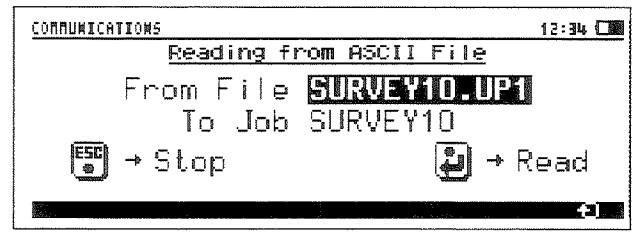
AP800 reports the number of uploaded records and notes when all data has been received.

Uploading From an ASCII FILE on the Data Card

AP800 will allow you to upload data from any ASCII file which meets the following criteria:

1. the file must be located in the same directory as the current open job;
2. the filename must match the job name (as in SURVEY10 on the screen below);
3. the file extension must be **.UPx**, where x can be any number 1-9.

NOTE: If the desired ASCII file does not conform, it can be renamed using Job Manager.



This window shows the ASCII file to be read "From" and the job to be written "To". The ASCII file displayed is the first file found which meets the convention detailed above.

Change ASCII File The selection list can be used to choose from all the files available for upload.

Start Uploading

- Press **[ENTER]** to upload your data. You can stop the operation at any time by pressing **[ESC]**.

Upload Complete AP800 reports the number of uploaded records and notes when all the data has been received.

Upload From Another ASCII File to the Same Job Data from more than one ASCII file can be uploaded *to the same job*. You just choose the next file using the selection list and repeat the upload procedure.

Downloading FROM the Instrument

The downloading procedure converts, formats, and places your measurement data or calculated coordinates into an ASCII file on your computer or data card. The data is always transferred from the *current job* (open job).

Warning

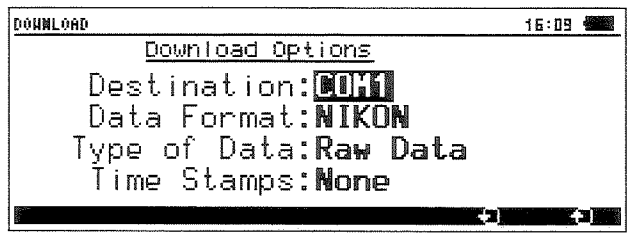
1. When you download as raw data, ***only Temperature and Pressure correction and Prism Constant corrections*** are applied to your data. These corrections, if active, are applied to your slope distances at the time they are measured. No other corrections (C & R, Map Projection or Sea Level) are made to downloaded raw data, regardless of their settings.

2. When you download as coordinate data, all corrections that are switched on **at the time of the download** will be applied to the calculated coordinates. Therefore, to ensure that the coordinates downloaded are true, you should check that the correction settings at the time of download match the settings when you performed the survey.

Setting Up AP800 to Download Your Data

Set Download Options

AP800 displays the "Download Options" screen when you select **Download** from the "Communications Menu."



Here you set up AP800 to download your survey data. You use the selection list key to change the values.

Specify the Destination

You can send data to the instrument's **COM1** port or to an ASCII **FILE** on the data card.

☞ It is much easier to use a *PCMCIA card drive* to transfer the file from the data card to your computer. The card drive is like a floppy disk drive and enables you to copy the file to your hard disk. Thus, you do not have to bring the instrument to the computer each time you transfer data.

Data Format

- Choose the data format that you wish to download in: **NIKON, SDR, TDS or DXF**. This enables your mapping software to read the data correctly. (For more information, see the Appendix.)

Type of Data

- Select the type of data you want to download: **Raw Data** (measurement data), calculated **Coordinates** or **HA/VD/HD** (raw distance data). (The Appendix describes the downloaded records in the Nikon and SDR formats.)

Time Stamps

- You can output the date and time each point was surveyed or after a specific time interval measured from the initial station setup. The following options are available:

  Only Station Setup
  Every Record
  Every 15, 30, or 60 minutes
  None

  For more information refer to page A-20.

Exit Screen

- Move the cursor to the last field and press **[ENTER]**. (**[ESC]** cancels any changes.)

Communications Settings

Change Communications Settings

Data transfer will fail unless the communications settings match between the instrument and your computer. For more information, please refer to page 10-12.

Communications Settings Okay

- To continue, move the cursor to the last field, then press **[ENTER]**.

NOTE: If you are downloading to the data card, see "Downloading to an ASCII FILE on the Data Card" on page 10-11.

Downloading To Your Computer Through COM1

Prepare your computer to receive the data.

Ready Your Computer

- Check the cables and set your computer to receive the data using the DOS command *COPY /A COM1: FILENAME.DAT.*

Start Downloading

- Press **[ENTER]** to download your data.

Progress Report

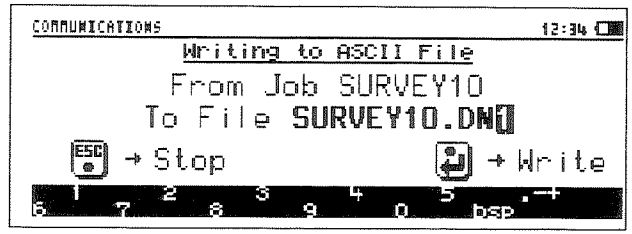
AP800 updates the number of downloaded records as each record is sent. You can stop the operation at any time by pressing **[ESC]**.

Finished!

After downloading is complete AP800 beeps and reports the number of downloaded records.

- To return to the "Communications Menu," press any key.

Downloading to an ASCII FILE on the Data Card



This window shows the job to be read "From" and the ASCII file to be written "To." Note the default file extension ".DN1".

Change File Extension or File Name (Optional)

Recommended only if you have already downloaded some data and plan to download more data from the same job. Changing the file specification prevents the file from overwriting another file with the same name and extension.

- To change the extension, type another character. To delete more characters, use ***[Bsp]***. (Press **[Mode]** to change between alpha and numeric keys.)

Start Downloading

- Press **[ENTER]** to download your data. You can stop the operation at any time by pressing **[ESC]**.

You are warned if the download job already exists on the data card. You can "Overwrite" the existing job or "Cancel" the operation.

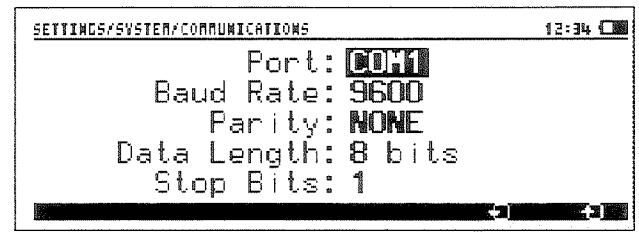
Finished!

- After downloading is complete AP800 beeps and reports the number of downloaded records.
- To return to the "Communications Menu," press any key.

Communications Settings

The communications settings enable you to correctly configure the instrument to transfer survey data between itself and another device, such as your computer.

NOTE: These are the same settings as those found in "Communications" on page 13-22. *You do not have to change the communications settings in both locations.*



Use the selection list key to change the values. To exit with changes, move cursor to the last field and press ***[ENTER]***.

Data is transferred through the instrument's **COM1** port, and the **Baud Rate**, **Parity**, **Data Length**, and **Stop Bits** must match those of the other device (your computer). *Data transfer will fail if the communications settings do not match.*

NOTE: When you upload or download data via COM1, activate "Xon/Xoff" settings of the terminal program on your computer as well as above communication settings.

NOTE: The manual supplied with the destination device should contain information on how to change the communications settings.

Chapter 11

System

Introduction

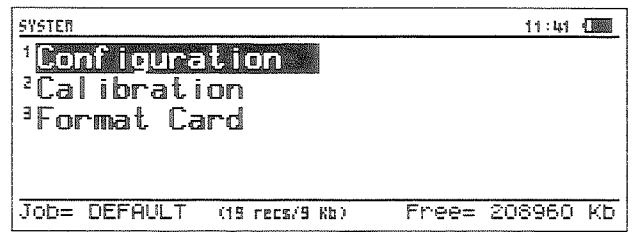
This chapter describes a range of user definable instrument and software settings, including vertical, horizontal and tilt calibration, that effect how measurements are taken, corrected, checked, and presented to you. The procedure for formatting a data card is also covered.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

The System Menu



Overview

Configuration — Enables you to configure the software to use your preferred distance, angle, temperature and pressure units, coordinate and point number types and date/time formats. Also controls the start up routine of the instrument and allows you to input owner details. (See page 11-3)

Calibration — Enables you to check the vertical, horizontal and tilt index errors and adjust the calibrations. (See page 11-12)

Format Card — Formats a new card so that you can store survey data on the card. (See page 11-14)

How to Change the Settings

You change most settings using the circular selection list. The /←/ and /→/ softkeys display the item in the data entry field. Sometimes you will type the required setting. A numeric input field shows dots under the field.

Changes made to any setting will remain until they are changed again.

How To Exit a Data Entry Window

[ENTER] on the *last* field — Saves any changes and returns the *previous* menu.

[ESC] — If any changes have been made you are asked if you want to save or cancel the changes; then you return to the *previous* menu.

Configuration

Introduction

Use Configuration to set the distance units, angle units, coordinate labels and order, point number length, temperature & pressure units, date & time, automatic start-up, and owner details.

Roadmap

Main Menu

Job Manager	Traverse Adj.
Station Setup	COGO
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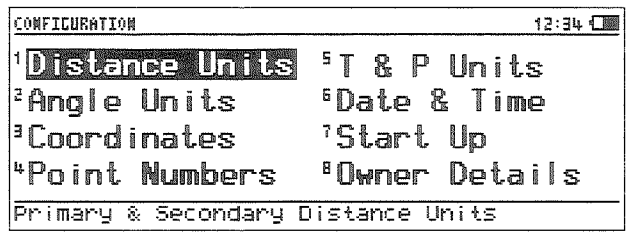
→

System Menu

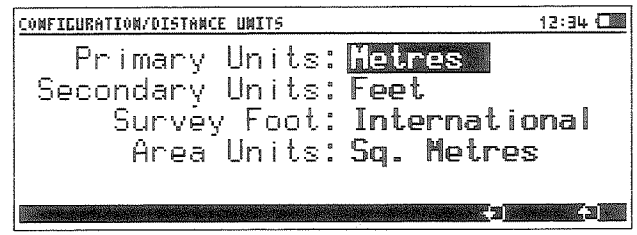
Configuration
Calibration
Format Card

The Configuration Menu



Most of these functions have sub-menus. Note the one-line help message at the bottom of the screen.

Distance Units



Primary Units These are the units you will use under normal circumstances. Distances are measured in **Metres** (m) or **Feet** (f) (see also "Survey Foot" below).

Secondary Units In "Collection" and other functions you can display the "SD," "VD," and "HD" in alternate units by using *[Dsp]*.

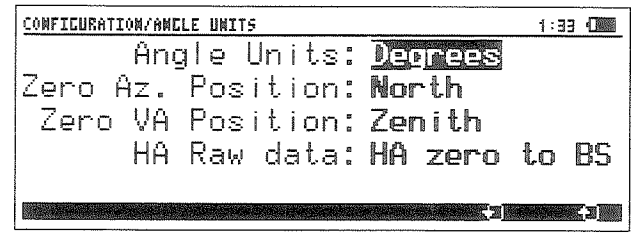
NOTE: If you change to "Feet" AP800 automatically converts all other settings into feet using the appropriate conversion factor (see "Survey Foot" below).

Survey Foot AP800 uses either the **International** or the **US** conversion factor to convert feet into metres. This command is relevant only if the "Primary Unit" or "Secondary Unit" is *Feet*.

Area Units Your choices are: **Sq. Metres, Sq. Feet**, or **Acres**.

NOTE: If the Area Units are Sq. Metres, and the area is greater than or equal to 10,000 sq. m., the area is displayed in hectares, e.g., 1.0000 ***ha****.*

Angle Units



Angle Units

Angles can be displayed in **Degrees**, **Quadrant**, **Gons** or **Mils**. "Degrees" sets the display format for angles and azimuths to "DDD°MM′SS″."

*NOTE: If you choose "Mils," AP800 will ask you to select the number of Mils per 360°: **6000** or **6400**.*

Zero Az. Position

The zero azimuth position can be **North**, **South** or **South (LO)**.

*NOTE: If you choose South(LO), AP800 displays all maps with South up and West to the right, all calculations are performed as per the **North** setting.*

Zero VA Position

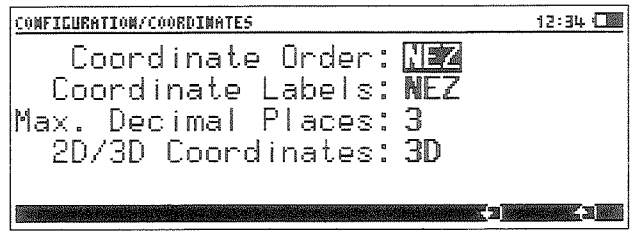
You can set the zero vertical angle position to **Zenith** or **Horizon**.

HA Raw Data

The HA Raw Data option can be set to **HA zero to BS** or **Azimuth**.

*NOTE: The option that you choose affects the format of the SS and CP records that are downloaded to your PC. Choose the option that is compatible with your PC's software. This setting does not affect F1 and F2 records which are always based on **zero to BS**.*

Coordinates



Coordinate Order You can display the coordinates in **NEZ** or **ENZ** order.

Coordinate Labels If the coordinate order is NEZ, AP800 can label the coordinates as either **XYZ**, **YXZ**, or **NEZ**.

If the coordinate order is ENZ, AP800 can label the coordinates as either **XYZ**, **YXZ**, or **ENZ**.

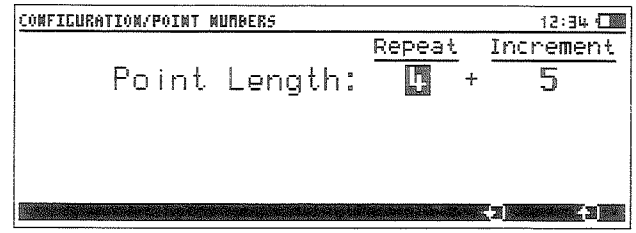
Max. Decimal Places You set the *maximum* number of decimal places (**2**, **3**, or **4**) which can be displayed for all measured and calculated distance and coordinate values.

NOTE: Measurements taken in "Highspeed mode" are reported to two decimal places only. Therefore, the coordinates are displayed to two decimal places only, regardless of this setting.

2D / 3D Coordinates AP800 calculates and displays the northing, easting and elevation coordinates when the setting is **3D**. If you want to compute and display only the northing and easting coordinates, select **2D**. AP800 will not ask you to input the "HI," "HT", and "Z" for the station.

Point Numbers

You can define a point number comprising a repeating part followed by an incremental part. This is useful if you are accustomed to having an area code as part of the point number, e.g., cadastral point numbers.



The total length of the point number (repeating and increment parts) must be less than or equal to 9. (Use the selection list to change each setting.)

Point Length

Repeat — This is the repeating part of the point number. For example you could set the "Repeat" length to 4 digits for an area code (9876).

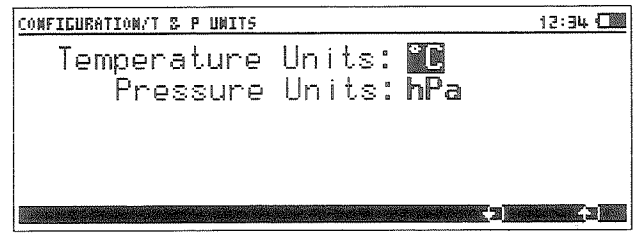
The instructions for inputting point numbers with repeating parts into a point field are found on page 2-7.

If you set the "Repeat" field to **0**, there is *no* repeating number and the incremental part of the point number can be up to 9 digits.

Increment — This is the variable part of the point number that AP800 increments automatically for each new point. The maximum length of this part is 9 minus the length of the repeating part.

For example, when you input the number 23, the full point number, including the repeating part used in the above example, would be 987600023 (assuming the point length is set to the maximum of 9 digits).

T & P Units

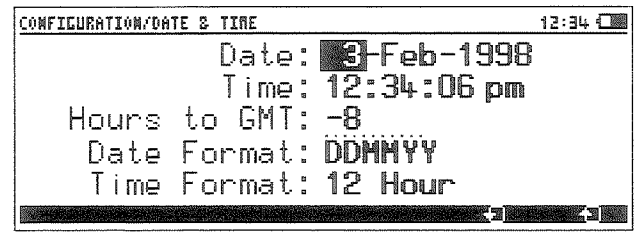


Temperature Units You have the choice of °C or °F.

Pressure Units You can use **mmHg**, **inHg**, or **hPa** (hectopascals, formerly millibars).

NOTE: AP800 automatically recalculates the ambient temperature if you change the pressure units.

Date & Time



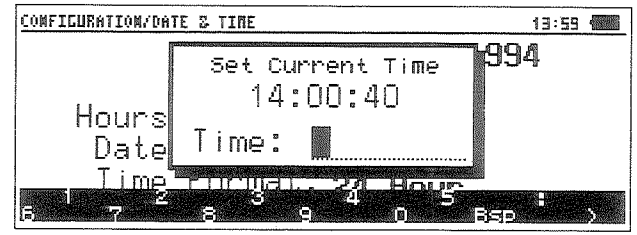
Date and Time Settings Screen

Date "Date" is divided into three fields, one each for the day (DD), month (MM) and year (YY). The "Date Format" field sets the order of these fields. The selection list is available to change each field.

Time

You can reset the time in the format specified in the "Time Format" field.

- Move the highlight to the **Time** field.
- Press /←/ or /→/ to display the "Set Current Time" window. The window shows the system time at the instant you pressed the softkey.



Set Current Time Window. Displays the time when you pressed the *[←]* or *[→]* softkey.

You may use any combination of one or two digit numbers, separated by a colon, to input the hours, minutes and seconds. For example: ***H:M***, ***HH:M***, ***HH:MM***, **H:M:S**

- To change the time, type the new value and press **[ENTER]**. The clock restarts at the instant you pressed [ENTER]. ([ESC] returns to the previous screen without changing the time.)

Hours to GMT

You can set the time relative to the GMT using the range -12 to +12 (fractional hours can be specified, e.g., 10.5 means 10 hours and 50 minutes).

Date Format

Two date formats are available: **DDMMYY** and **MMDDYY**.

Time Format

You can display the time in the **12** or **24 Hour** clock format.

Start Up

Tilt Telescope

Prior to reading an angle you must locate and reset the vertical 0° position. You do this by tilting the telescope to the horizontal line in the Face Left position. This command controls *when* AP800 asks you to tilt the instrument.

To make AP800 ask you to tilt the telescope when you:

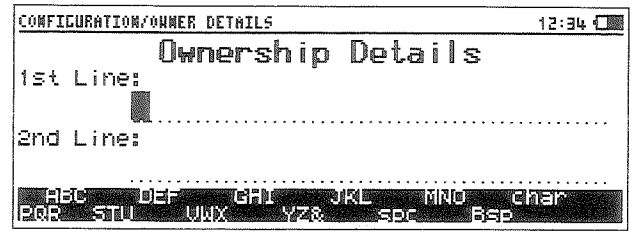
- Turn on the instrument — **At Start Up**.
- Read the first angle — **When Needed**.

Start Last Job

You can have AP800 software reopen the last job when you turn on the instrument. The job can be reopened unconditionally or if the instrument is turned on within a set time period.

- To always reopen the last job — **Yes**.
- To reopen the job if the instrument is turned on *within* a specific time period — **Within 1, 2, 4, 8, 12,** or **24 hours**.
- Never reopen the last job — **No**.

Owner Details



Use this screen to enter details about the instrument owner, e.g., name and address.

This information is displayed each time you turn on the instrument.

Calibration

Introduction

This section shows you how to accurately determine the vertical, horizontal and tilt index errors and adjust future angles.

NOTE: This procedure can be performed with the leveling compensators turned ON **or** *OFF.*

NOTE: By performing this routine, you will be re-calibrating the vertical, horizontal ***and*** *tilt correction values.*

NOTE: You should periodically check these index errors to maintain the highest accuracy for angle and tilt measurements.

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System Menu

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Format Card

Angle and Tilt Calibration

Sight to Object

- On Face 1 sight to a clearly defined point.
- Record the vertical angle, the horizontal angle and the tilt offset by pressing **[ENTER]**.

Face 2 Measurement

- Go to Face 2, sight again to the same object, and press **[ENTER]**.

Check Corrections

- Return to Face 1 and check the ΔVA, ΔHA, ΔX and ΔY Correction.

NOTE: If the ΔHA or ΔVA value is reported as "Calibration Out of Limit", it is possible that your hardware reticule needs adjusting to be within tolerance. Refer to your DTM-800 hardware manual or your Nikon dealer.

Save or Cancel Calibration

- If you select **SAVE**, the instrument automatically corrects all future angle and tilt measurements using this correction value until you change it.
- **Abort** cancels the procedure and the instrument uses the existing correction value, if there is one.

Format Card

Introduction

This command formats the data card so that survey data may be stored on it. You must format a new data card in the drive *before* you can use it. AP800 can format data cards of any capacity.

Warning

Do not insert an unformatted card in the drive until you are ready to format the card. When you switch ON the instrument with an unformatted card in the drive, the instrument may hang.

Roadmap

Main Menu

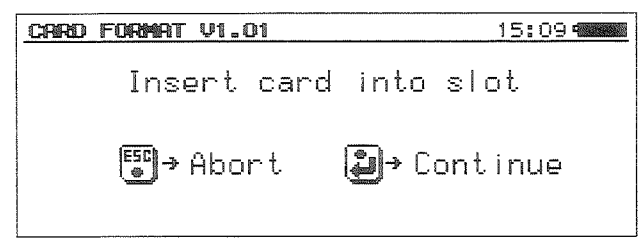
Job Manager	Traverse Adj.
Station Setup	COGO
Collection	Communications
Stakeout & Ref	System
Control	

→

System Menu

Configuration
Calibration
Format Card

Format Card Initial Screen



Formatting a Data Card

Warning
Formatting deletes ALL existing data on the card!!.

Remove Write Protection

- Check to see if the data card is write-protected, and if necessary, remove the write protection. (See the "Instruction Manual for the Field Station DTM-850/830/820.")

Insert Data Card

- Insert the **data card** in the drive and close the drive door.
- Press **[ENTER]**.

Confirm Formatting

- If you are certain you want to format the card, press **[ENTER]**. To cancel the operation, press **[ESC]**.

NOTE: Formatting takes only two seconds.

Format Finished

AP800 reports the formatted capacity of the data card.

- *To continue, press* **any key**.
- Remove the data card from the drive.
- Repeat the procedure with another data card, or press **[ESC]** to return to the "System Menu."

Chapter 12

FNC Key Menu

The "FNC Key Menu" can only be opened using the [FNC] key. It gives you quick and easy access to several diverse functions. When you leave any FNC function you are returned to the "FNC Key Menu." All measurements and data that were current when you pressed [FNC] are restored when you exit the "FNC Key Menu."

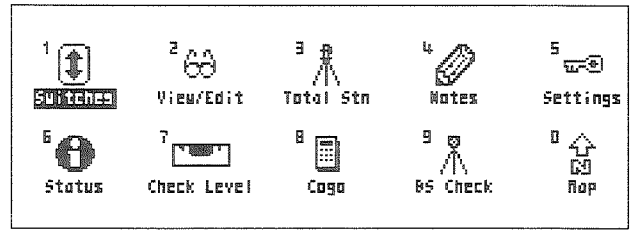
NOTE: The "COGO" and "Settings" functions, although available through the "FNC Key Menu", are not described in this chapter. Refer to COGO (Chapter 9) and Settings (Chapter 13).

Roadmap

To go to the "FNC Key" menu from any function, press

FNC

The FNC Key Menu



You can select a function by pressing the numeric key that corresponds to the number next to the icon, or by moving the highlight to the icon and pressing [ENTER].

Overview

Switches — Sets the LCD light, reticle light, Lumi-Guide, heater, sound volume, and contrast (see page 12-3).

View / Edit — Allows you to view, search for and edit topographic, traverse, and stakeout data. (see page 12-5).

Total Stn — Enables you to take a quick measurement without recording any data (see page 12-19).

Notes — Allows you to add a note after any record (see page 12-27).

Settings — Contains a diverse range of instrument settings that effect how measurements are taken, corrected, checked, and presented to you (refer to Chapter 13).

Status — Describes the current job and the status of the data card (see page 12-30).

Check Level — Assists leveling the instrument and controls the compensators (see page 12-31).

Cogo — Describes the coordinate geometry functions and the input coordinate function (refer to Chapter 9).

BS Check — Used to confirm that the backsight measurement taken during station setup has not changed. You can reset the backsight if the instrument was disturbed (see page 12-33).

Map — Graphically displays the points and observations in the current job. You can map all or only a portion of the survey area or only selected types of points (see page 12-35).

How To Exit the FNC Key Function

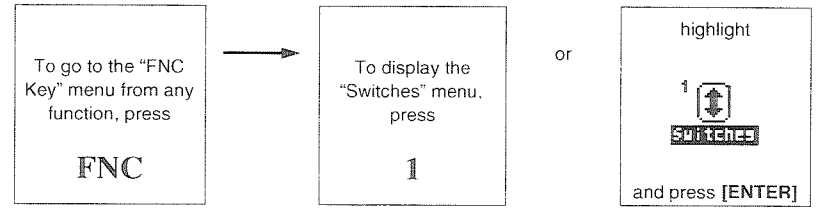
You can exit the FNC Key function using either [ESC] or [FNC]. Both keys give you the option to save or abandon any changed setting. Afterwards, pressing [ESC] or [FNC] repeatedly displays the "FNC Key Menu" and eventually returns to the function that you were originally using. All measurements and data are restored completely.

Switches

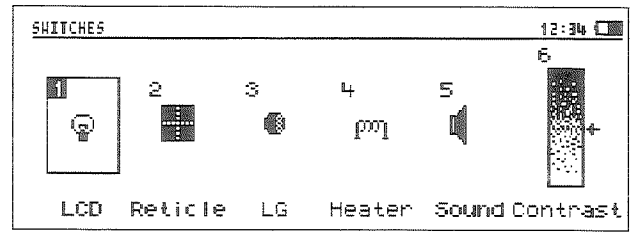
Introduction

"Switches" controls the LCD light, reticle light, Lumi-Guide, heater, sound volume, and contrast.

Roadmap



Switches Menu



Most switches have multiple levels.

How to Select Functions and Set Levels

There are two ways to choose each function:

1. **Numeric Keys** — You *select* a function by pressing the numeric key that corresponds to the function.

NOTE: Pressing [3] and [4] ***select and set*** *the Lumi-Guide ("LG") and "Heater," respectively.*

2. ← **and** → — Move the cursor to the previous or next function. Additionally, [ENTER] moves the cursor to the right.

There is only one way to set each function:

With the exception of the Lumi-Guide and Heater, you *set* the level by pressing the [↑] and [↓] keys until the desired setting is achieved.

The Switches

1. LCD Light — This switch sets seven brightness levels and turns the LCD light on or off.

2. Reticle Light — Four levels control the brightness of the reticle.

3. Lumi-Guide — This switch turns the Lumi-Guide on or off. (See also "Lumi-Guide Signal" on page 13-15 and "Lumi-Guide Operation" on page 13-17.)

4. Heater — This switch turns the heater's thermostat on or off. When set to **ON** (icon's "heat waves" moving) the heater will come on when the LCD temperature drops to 0°C. Setting the thermostat to "off" prevents the heater from turning on. (See also "Auto. LCD Heater" on page 13-23.)

5. Sound Vol. — You can set the sound to low, high, or off.

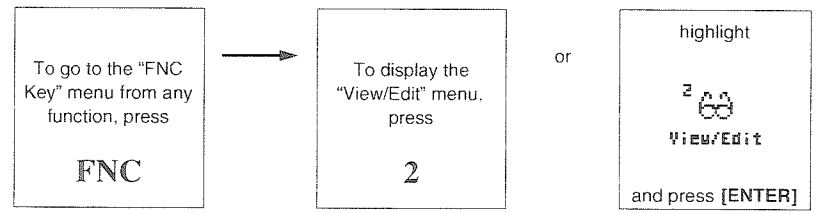
6. Contrast — Sets 256 contrast levels on the front display only.

View / Edit

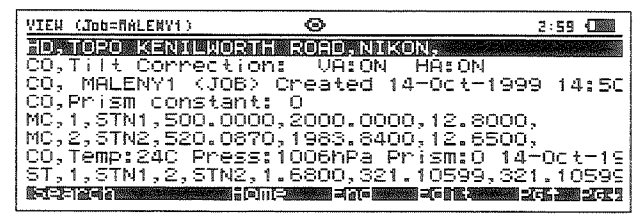
Introduction

This chapter shows you how to view, search for, and edit your survey data. (To change the open job, refer to "Job Manager" on page 3-1).

Roadmap



The View Screen



This screen shows the *beginning* of the open job "MALENY1." All records are prefixed by their type (e.g., "MC").

Viewing the Data

When you first view the data you will see the last records in the job. You can use the softkeys to scroll through the records (see "Scrolling the Record List" on page 12-7) and search for records (see "Searching For Records" on page 12-8). Pressing the arrow keys allows you to move up and down one record at a time or pan from left to right.

The "View Screen" shows you the Nikon Raw formatted data you would get if you were to download the job. You can use *[Edit]* or **[ENTER]** to enter editing mode for the highlighted record (see"Editing the Open Job" on page 12-10).

Record Types

The first two characters of each record specify the record type:

HD — Header record that contains information about the open job, e.g., description and client.

ST — Station setup records.

CP — Shots to control points (traverse shots) recorded with the "Collection" function.

SS — Topo shots (sideshots). All "Collection" shots except those with a type of CP.

SO — Stakeout shots. Shots taken using the "Stakeout" function. If the shot was out of tolerance horizontally or vertically the record contains the "out of tolerance" indicator (inverse "SO").

UC — Uploaded coordinates of control points (CP).

MC — Manually input coordinates of control points (CP).

UP — Uploaded point coordinates which are not to be in the control points selection list, e.g., points to be staked out.

MP — Manually input coordinates of points which are not to be in the control points selection list, e.g., points to be staked out.

CC/RE — Calculated coordinates. Points calculated using "COGO" or "Resection."

F1/F2 — Measurement data.

CO — A note or comment added to the job by the surveyor.

For information about the record format, refer to "Record Formats" on page A-16.

Scrolling the Record List

You use the softkeys to scroll through the job:

To view the previous 7 records, [*PgUp*]. — The top record becomes the bottom record of the new screen but the highlight remains where it is.

To view the next 7 records, [*PgDn*]. — The bottom record becomes the top record of the new screen but the highlight remains where it is.

To move to the top record of the job, [*Home*].

To move to the last record of the job, [*End*].

Quit View/ Edit

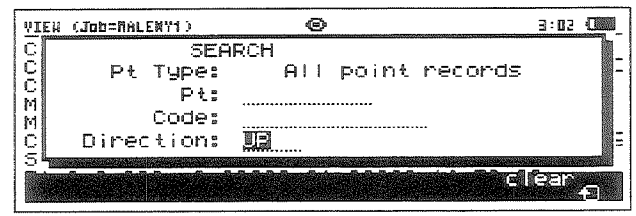
Use [ESC] or [FNC]. Either key returns to the "FNC Key Menu."

Searching For Records

You can search for records by their type, point number, code, or by any combination of these.

Open Search Window

- Select *[Search]*.



The fields in the Search window are blank the first time you open the window. The search data you enter remains until you change it.

Search by Point Tyoe

You can type the point type (e.g., SS) or use the selection list. (The selection list includes a blank item "".)

Search by Pt

Type the point number.

Search by Code

Type the feature code.

Change Direction

Use the selection list to search **UP** or **DOWN** from the highlighted record. You can also use **ALL** to search upwards from the end of the job.

Start Searching

- Move the cursor to the **Direction** field; then press **[ENTER]** to search the job in the specified direction.

If the search is successful the matching record is highlighted.

NOTE: A search is successful if the record matches any one of the search fields.

- To search for the next matching record, select ***[Search]*** and press **[ENTER]**.

Clear all Search Fields

AP800 remembers the previous search data. You can use ***[Clear]*** to clear all the search fields at once. The cursor moves to "Pt Type."

Lumiguide Assistance

When the lumiguide is turned on it can be used to assist the rodman in positioning the target over the point being staked out.

By positioning the target to where the flashing and constant light appear to cross over the target will be in-line with the instrument.

In addition to this, the flashing light can be used to convey move in and move out information. After each measurement the lumiguide flash rate will change according the following flash rates:

No measurement	normal - one flash per second
Move in	**slow** - one flash every two seconds
Move out	**fast** - rapid flashing

Note: The different flash rates will only be available on instruments that support this.

Note: You may need to experiment with this to see if it is suitable for your needs.

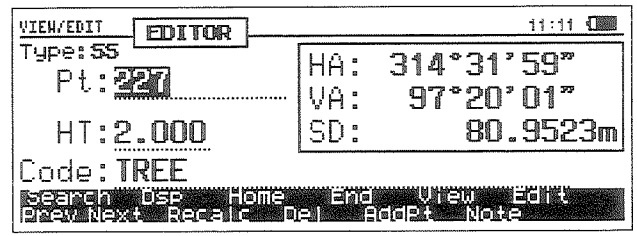
Editing the Open Job

Use this section to view a full record and to edit, add, and delete records in the open job. AP800 displays the highlighted record on the "View Screen" when you open the "Edit Screen."

Open the Edit Screen

- Select *[Edit]* or press [ENTER] at the "View Screen" (see page 12-5).

The Edit Screen



This screen shows the Edit window for a sideshot record (SS type).

Operating the Edit Screen

Using the softkeys you can:

- Display the previous record, *[Prev]*.
- Display the next record, *[Next]*.
- Move the cursor to the beginning *[Home]* or end *[End]* of the job, and search *[Search]* for a record. (These keys are described on page 12-18).
- Display additional data, such as station coordinates, *[Dsp]*. Repeat to display more data boxes, if any, and to return to the original data box. Not available for the "HD" and "CO" record types.
- Return to the "View Screen," *[View]* or [ESC].
- Recalculate the station coordinates (if necessary) following the editing of data, *[Recalc]* (see page 12-16).
- Edit the raw data for a point, *[Edit]* (see page 12-12).

Edit a Field

AP800 allows you to edit any field that is displayed with a row of dots beneath it. The following record tables list the fields which *can* be edited and any conditions imposed.

*NOTE: The edited or new record is added to the job but the original record is never modified. The old edited record or deleted record always remains in the job. Old records are shown with an asterisk between the record type and the point number, e.g., SS*6.*

"ST" Edit Fields

Field	Condition/Result
ID	Will offer to recalculate station coordinates.
HI	Will offer to recalculate station coordinates.
Pt	Will offer to recalculate station coordinates.
BS Az	If there is a BS point, its information is removed.

"CP" and "SS" Edit Fields

Field	Condition/Result
Pt	Only if the point is not referenced by another record.
ID	Will search other points and display a warning if the new ID already exists.
HT	Will offer to recalculate station coordinates if referenced by another record.
Code	None.
HA VA SD	Will offer to recalculate station coordinates if referenced by another record.

"F1" Edit Fields

Field	Condition/Result
Pt	Only if the point is not referenced by another record.

"SO" Edit Fields

Field	Condition/Result
Pt	Only if the point is not referenced by another record.

"UC, MC, UP, MP, CC" and "RE" Edit Fields

Field	Condition/Result
ID	Will search other points and display an error if the new ID already exists.
N/E/Z	Will offer to recalculate station coordinates.
Code	None.

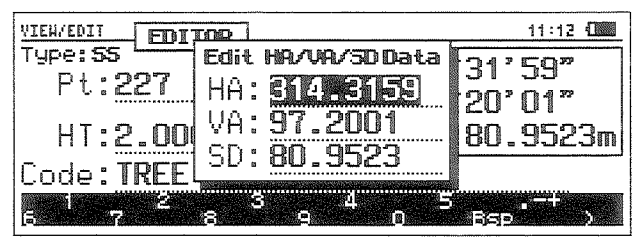
Edit the Raw Data (CP & SS Records)

AP800 allows you to edit *all* the data relating to CP and SS records, including the raw data.

Warning

Even though AP800 keeps a backup record of all data, be aware that modifying data may affect the calculation of coordinates in the job. However, AP800 does warn you before recalculating any data (see "Recalculate Station Coordinates" on page 12-16).

You edit the displayed fields on the left hand side of the screen (refer to "Edit a Field" on page 12-11). To edit the raw data for the point, select the *[Edit]* softkey. The raw data appears in an editing box.



Edit any or all of the values in this screen and press **[ENTER]**. The changes that you made are displayed in the box on the right hand side of the "Editor" screen.

NOTE: These changes are not applied to the job until you exit the "Editor" screen or press **[ENTER]** *to accept the data.*

There are two ways to apply the changes, depending on how you wish to proceed.

- To exit the "Editor", press *[Esc]*. AP800 prompts you to save the changes. Select the save option that you require and press **[ENTER]** to return to the previous screen.

- To stay in the "Editor", press **[ENTER]**. AP800 saves the changes and displays the new record data. The contents of the old record are marked as deleted but are still available. To view the data for the old point, press *[Prev]*. AP800 displays the previous record with the "Deleted" block on the right hand side of the screen.

Editing Station and Backsight Points (ST and BS Records)

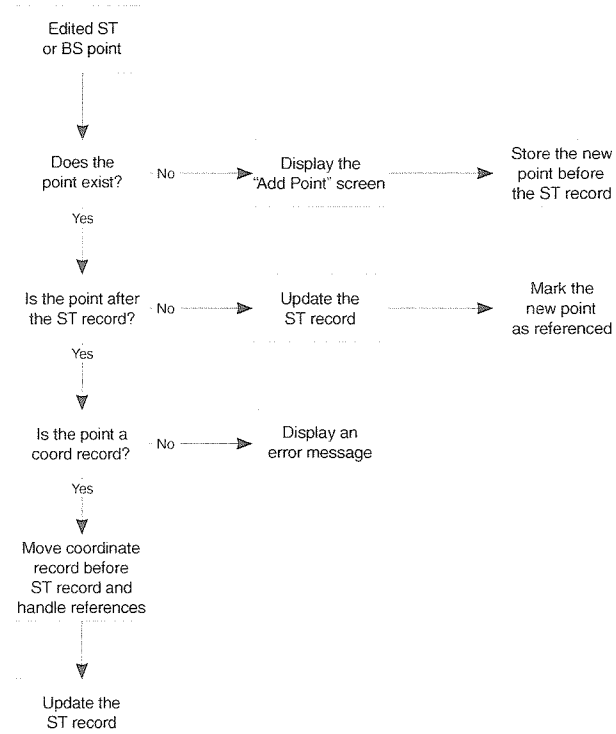
When you change a point number for either an ST or the BS point, AP800 uses the existing data for the new point and recalculates the azimuth to the BS point. If there is no BS point, AP800 does not change the azimuth value.

NOTE: Whenever you change the point number for an ST record, AP800 recalculates all the measurements that were recorded after the ST record.

Rules associated with editing ST and BS points

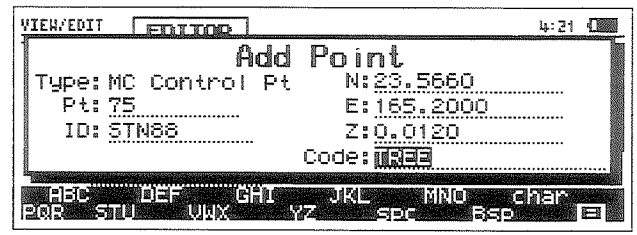
To maintain the integrity of the data, AP800 applies certain rules to determine whether changing an ST point, a BS point or both is valid. The illustration next shows how AP800 determines the validity of your update.

NOTE: AP800 displays an error message when it is unable to reference SS or CP records that were obtained after the station point that you are editing.



To edit a station point number:

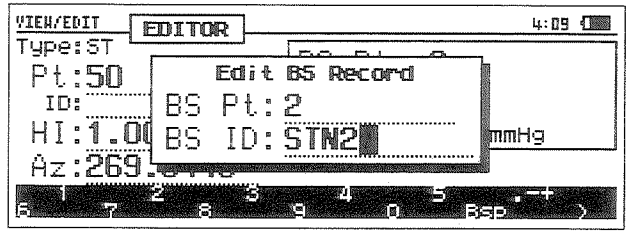
- Select the point in the job listing and press **[ENTER]** or select the *[Edit]* softkey.
- Type the new number for the point and press **[ENTER]**.



If the point does not already exist, the "Add Point" screen appears. Enter the NEZ values for the new point and press **[ENTER]** .

To edit the associated BS point number:

- In the "Editor" screen, select the *[BS]* softkey.



When you see this screen, enter a value for the new BS point *or* the new BS point's ID and press *[ENTER]* .

To apply the changes:

- When you have modified the required fields for the station point, the BS point or both, you can apply the changes by pressing *[Esc]* or **[ENTER]** until you see the "Recalculate Station Coordinates" confirmation screen (see page 12-16).

*NOTE: AP800 saves the changes and displays the new record data. The contents of the old record are marked as deleted but are still available. To view the data for the old point, press **[Prev]**.*

Edit F1 and F2 Records

You can edit the point number only for F1 and F2 records.

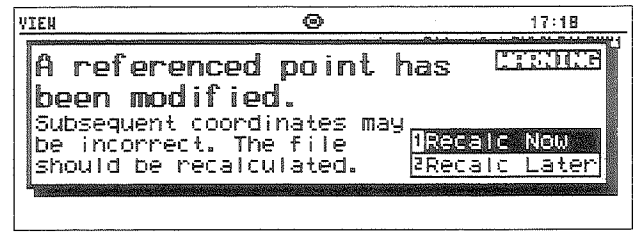
To edit the point number:

- Select theF1 or F2 record that you wish to change from the list and press **[ENTER]** or the *[Edit]* softkey.
- Type the new point number in the "Pt:" text field.
- To apply the changes, press **[ENTER]**. AP800 saves the changes and displays the new record data.

Recalculate Station Coordinates

Some of the data edit functions available in "View/Edit" will result in the need for the recalculation of the station coordinates.

AP800 will alert you to this requirement by displaying the following warning when you *leave* the current record (either by leaving "Edit" or by moving to another record edit screen).



You have the option of performing the recalculation now or, if you have further editing to perform, when you leave "View/Edit".

Delete a Record

Use *[Del]* to delete the current record.

NOTE: You cannot delete a point that is referenced by another record, i.e., a point that has been used during a station setup either as the station point or the backsight point.

Deleted records are labelled "DELETED" on the right side of the "Edit Screen."

Undelete a Record

When you display a deleted record, ***[Undel]*** replaces *[Del]*. Any deleted record can be undeleted if it does not conflict an existing record (e.g., two different types of records with the same point number).

Adding a New Point

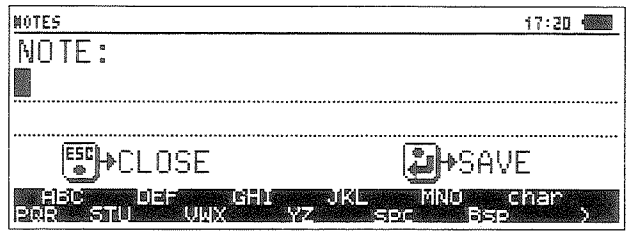
Use ***[AddPt]*** to manually key in data for coordinates of control points ("MC" records) and non-control points, e.g., stakeout points ("MP" records). The background screen is the same as the record type which is current when you press **[AddPt]**.

- If necessary, return to the "View Screen" and select a record of the same type you want to add. Then press *[Edit]* and *[AddPt]*.
- AP800 asks you for the type of point you are about to add, e.g., if it is *not* a control point, select **Stakeout/Other**.
- Type the data in the fields - there are *no* selection lists.
- When you have finished, move the cursor to the "Code" field and press **[ENTER]**, or you can use **[ESC]** to cancel the record without adding it.

Add a Note

Notes are recorded *after* the current record, i.e., after the record which is shown on the "Edit Screen" when the note is recorded. The note is stored in the job as record type **"CO"**.

- Select *[Note]* from the "Edit Screen."



Although the screen shows two lines, the note will be displayed as one line on the "View Screen."

NOTE: You can also use [FNC] to access this screen.

- Type the note (max. 64 characters).
- To save the note and return to the "Edit Screen," press **[ENTER]**.
- To exit the screen without saving the note, press **[ESC]**.

Summary of View / Edit Softkeys

View / Edit	
AddPt	Enables you to manually input data for coordinates of control points and other point types.
char	Displays special characters, such as * AND #.
Del	Deletes the current record.
DSP	Displays alternative measurement data.
Edit (View Screen)	Displays the full record and allows you to edit the data.
End	Moves the highlighted on to the last record in the job.
Home	Moves the highlight on to the first record in the job.
Next	Displays the next record.
Note	Enables you to add a note after the current record.
PgDn	Displays the next seven records.
PgUp	Displays the previous seven records.
Prev	Displays the previous record.
Rcalc	Recalculates the station coordinates.
Search	Allows you to search for records using several criteria.
View	Displays the View screen.
Edit (Editor Screen)	Edit the CP and SS record information.

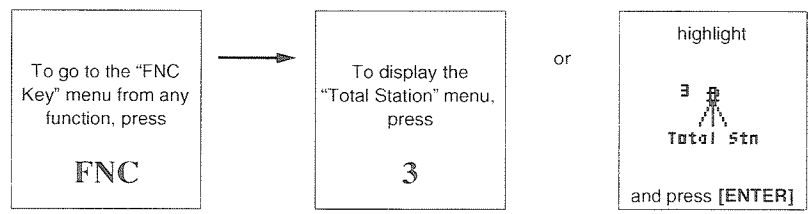
Total Station

"Total Station" is a stand-alone measuring system that operates like any standard total station without a data recorder. This function does *not* access information from a job or store information in a job.

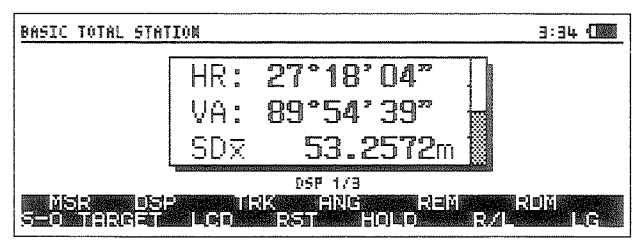
Introduction

Use this section if you want to measure distances or angles only, perform a basic stakeout or take a remote elevation or remote distance measurement.

Roadmap



Initial Total Station Screen



Identical data and signal strength indicators are displayed on the front and rear screens.

Common Softkey Functions

[LG] — Turns the Lumi-Guide on or off.

[LCD] — Turns on or off the backlight to the display.

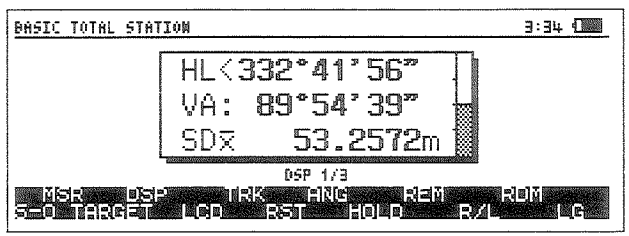
[DSP] — Displays alternative measurement data.

Measuring Angles Only

The following functions are available for angle measurements:

Toggle Right and Left Angles

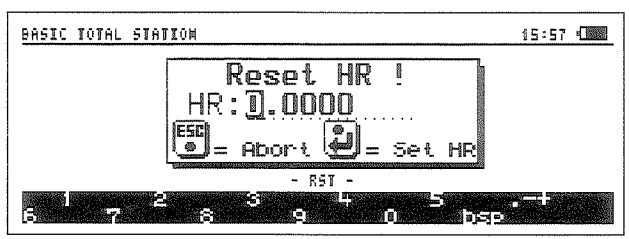
You can use *[R/L]* to repeatedly switch between right and left angles.



After you press *[R/L]*, the "HR:" field changes to "HL" and shows the left angle.

Set Horizontal Angle to Zero

You press *[RST]* to display the "Reset HR" window.



You can accept the zero "HR" or change the value.

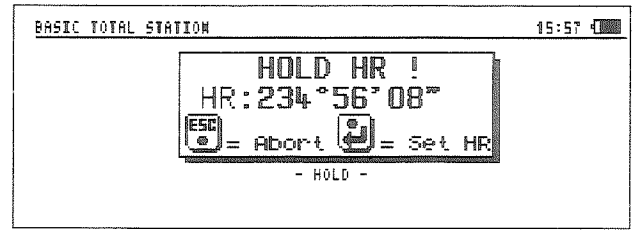
You have two options:

Sight to a backsight point, then press **[ENTER]** to set the horizontal angle to zero, or;

Type the known horizontal angle value for the sighting before you press **[ENTER]**.

Hold the Horizontal Angle

You press ***[HOLD]*** to display the "Hold HR" window.



This screen shows the horizontal angle at the time you pressed ***[HOLD]***.

- You can plunge the instrument and resight the telescope.
- To release the horizontal angle, press **[ENTER]**.

Face 1 and Face 2 measurements may be made. (If you require assistance, refer to "Face 2 Measurement (Optional)" on page 4-11.)

Measuring Distances

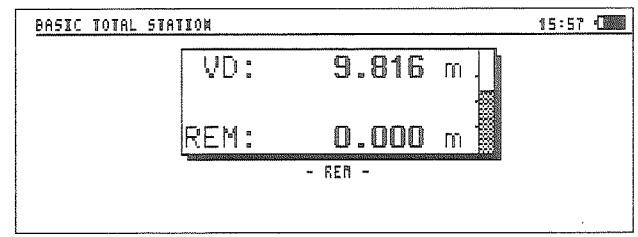
The following functions are available for distance measurements:

Normal Measurements

You can use *[MSR]* and *[TRK]* to measure distances on Face 1 and Face 2. These keys measure according to their "Settings" configuration (see page 13-5).

Remote Elevation Measurement (REM)

This function calculates the vertical difference between the base or reference point and an arbitrary point on the vertical line through the reference point.



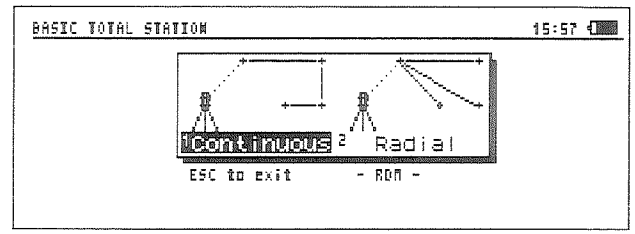
The "REM Window" shows the first set of data after taking a measurement. The "VA" has changed to "VD" and the window also shows the calculated "REM."

- Use *[MSR]* or *[TRK]* to take a full measurement to the object, e.g., building.
- Select *[REM]* to display the "REM" window.
- Move the telescope up or down. The "REM" value is "+" or "-" from the prism position.

Remote Distance Measurement (RDM)

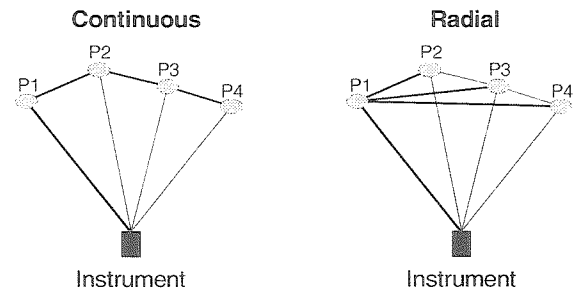
This function calculates the horizontal distance, vertical difference, and slope distance between two points.

- Press *[RDM]* to display the "RDM" window.



RDM window.

- Select either the **Continuous** or the **Radial** method (see illustration and comment below).



Continuous method - The latest two points are used for calculation.

Radial method - The first point is used as a base point for calculation.

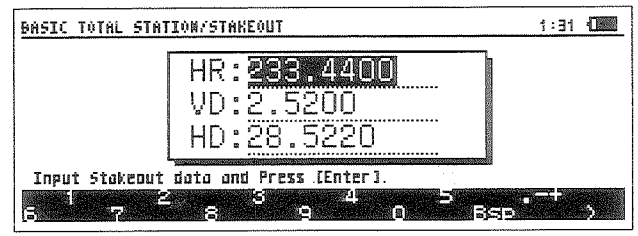
- Sight and use *[MSR]* or *[TRK]* to measure to the first point.
- Repeat for other points.

Staking Out Points

This function enables you to stakeout individual points by specifying an angle and distance from your current position. It does not access information from a job or store information in a job. To perform a stakeout that reads and stores data in a job, refer to the 'normal' Stakeout function in Chapter 6.

Enter the Data

To enter data into the FNC Stakeout utility, press *[S-O]* on the "Total Station" screen.

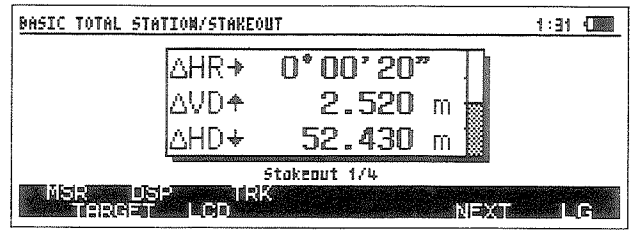


The "Stakeout" screen has fields that you must type data into.

- Enter the required values for HR, VD and HD, then press **[ENTER]**. Type 0.000 for any field for which you don't want to display Stakeout values. Doing this means that the Stakeout values are equal to the raw measured values.

AP800 displays the results screen showing an arrow next to the "ΔHR" field (no arrow appears if the value is 0° 00′00″).

- Turn the instrument in the direction of the arrow until the angle reads 0°00′00″.
- Move the rodman until the prism is aligned with the telescope.
- Press *[MSR]* or *[TRK]* to measure the distances ("ΔVD" and "ΔHD").



AP800 displays the results screen showing the direction and distance that the rodman must move.

- Move the prism in the direction of the arrows and re-measure the distances until the prism is at the desired point.
- Stake out the point.

Staking Out Multiple Points

To stake out another point, press the *[Next]* key. AP800 displays a blank "Stakeout" screen ready for your input.

When you have finished staking out points, use the *[Esc]* key to return to the main screen.

Summary of Total Station Softkeys

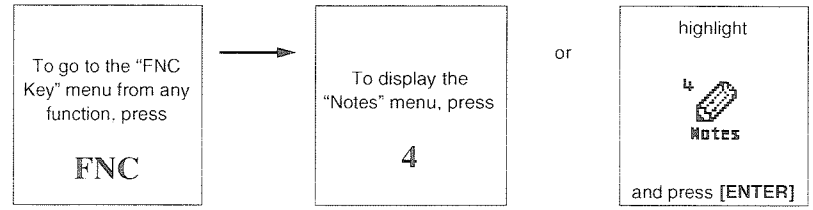
Total Station	
ANG	Measures the angle only.
DSP	Displays alternative measurement data.
HOLD	Hods the horizontal angle until released.
LCD	Turns "ON" or "OFF" the backlight to the display.
LG	Turns the Lumi-Guide "ON" or "OFF".
MSR	User-defined measure key. Measures single, multiple or continuous measurements.
RDM	Enables you to take a remote distance measurement.
R/L	Switches between right and left angles.
REM	Enables you to take a remote elevation measurement.
RST	Sets the horizontal angle to zero or any value.
TRK	User-defined measure key. Measures single, multiple or continuous measurements.
S-O	Stakeout points that are not part of the job data.
Next	Stakeout the next point (only in the S-O screen).

Notes

Introduction

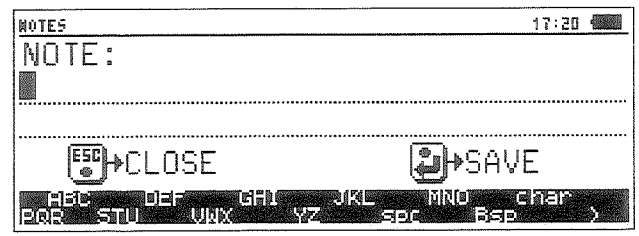
Allows you to add a note after any record. (You can also add a note using "View/ Edit.")

Roadmap



Adding a Note

Notes are recorded *after* the current record, i.e., after the record which is shown on the "Edit Screen" at the time you enter the note. The note is stored in the job as record type "CO".



Although the Notes screen shows two lines, the note is recorded, and displayed, as one line.

NOTE: You can also use the View/ Edit function to access this screen (see page 12-17).

- Type the note (max. 64 characters).
- To save the note and exit to the "FNC Key Menu," press **[ENTER]**.
- To exit the screen without saving the note, press **[ESC]**.

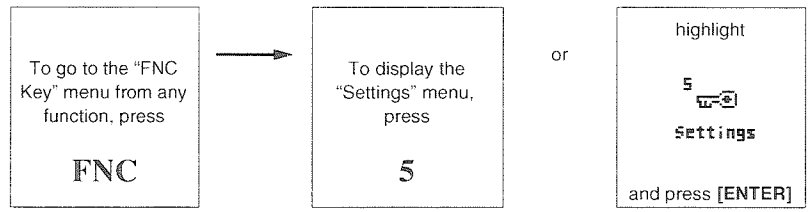
Settings

Introduction

"Settings" includes a diverse range of instrument and software settings that effect how measurements are taken, corrected, checked, and presented to you.

Details of the available "Settings" are contained in Chapter 13.

Roadmap

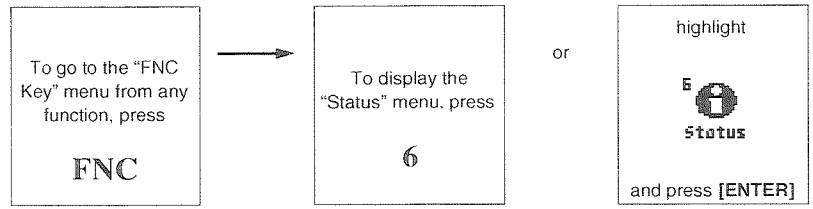


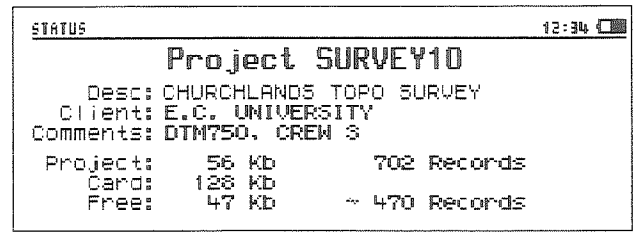
Status

Introduction

"Status" describes the open job and the status of the data card.

Roadmap





This read-only function describes the open job, including its size in kilobytes (Kb) and the number of records.

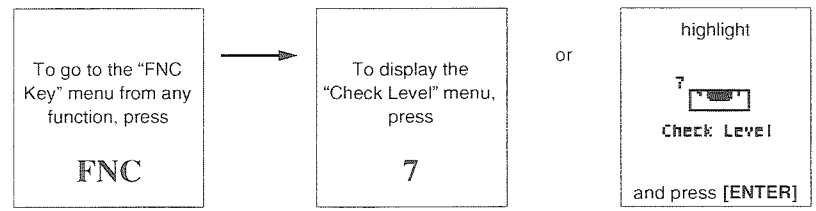
The last line shows the approximate number of points that can be surveyed based on the space remaining on the data card.

Check Level

Introduction

This function allows you to accurately level the instrument using the AP800 software. You can also turn the leveling compensators on or off. The leveling window is displayed automatically during "Station Setup," "Collection," and "Stakeout" if the instrument goes out of level and the compensators are turned on.

Roadmap



See page 2-2 for detail.

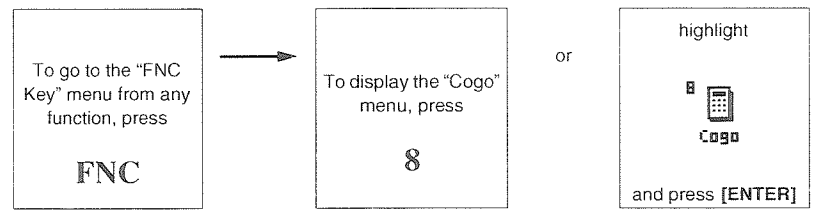
Cogo

Introduction

Cogo contains the coordinate geometry functions: **"Inverse", "Intersections", "Offset to Line" and "Area and Perimeter."** The **"Manual Input"** function is also available.

Details of the available "Cogo" functions are contained in Chapter 9.

Roadmap



Backsight Check

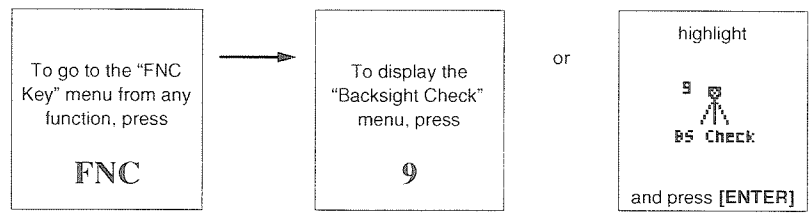
Introduction

You can use this function at any time to confirm that the backsight measurement taken during station setup has not changed. Additionally, you can reset the backsight if the instrument was disturbed (e.g. after changing a battery).

Warning

***Never** use the "Backsight Check" function while a "Control" survey is being performed.*

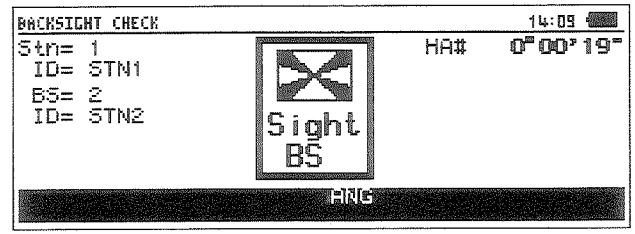
Roadmap



Backsight Check Sequence

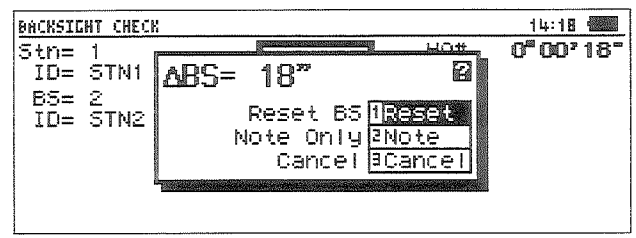
- Open a job.
- Do a station setup and take measurements.
- Sight and measure to backsight point.
- Reset the backsight horizontal angle or record a note to the open job.

Sight and Measure to Backsight Point



The Check Backsight screen allows you to measure the angle to the backsight point. AP800 displays the horizontal angle in the top right corner.

- To measure the angle, select *[Ang]* or press [ENTER].



This window reports the delta value between the known backsight point (BS Azimuth) and the current measured angle.

Reset BS Records the backsight check, resets the horizontal angle to *zero*, and records the reset value. *Does not affect previous measurements. Applies only to future measurements.*

Note Only Records only the backsight check (does *not* reset the horizontal angle).

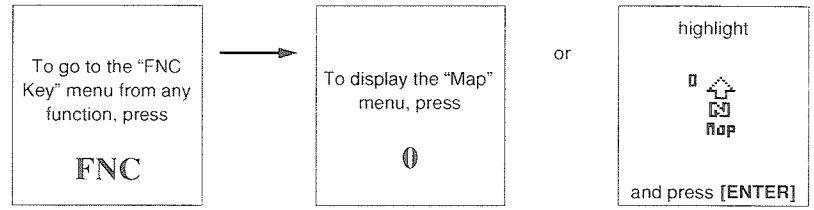
Cancel Cancels the current screen and gives you the opportunity to resight to the backsight point and re-measure the horizontal angle.

Map

Introduction

"Map" allows you to graphically inspect the points and observations in the current job at any time. This is useful when you want to find out if you have observed all the detail. You can map all or only a portion of the survey area or only selected types of points.

Roadmap

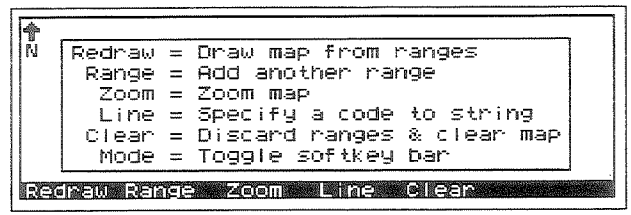


NOTE: AP800 displays the "Map" screen with a softkey menu or it displays the previously drawn map based on the open job. Creating or opening another job automatically deletes the last map and AP800 displays the "Map" screen shown on page 12-36.

Basic Mapping Sequence

- Open the job which containing the points you want to map.
- Map all points or specify ranges of points to map.
- Draw Map.
- Zoom and pan map as required.
- Specify line string codes and redraw.

The Map Screen



AP800 displays this screen when you first enter "Map" and after a clear map action.

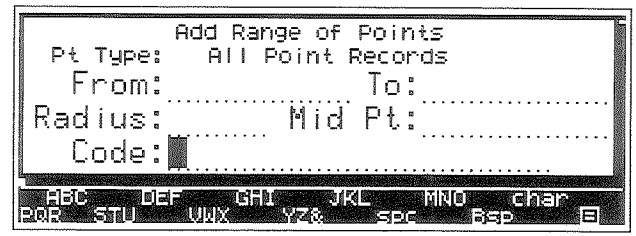
Using Map

In "Map" the first thing you need to decide is whether you want to draw all points in the job or select ranges of points to map. To map all points go straight to "Drawing the Map". To specify a range of points before drawing the map read the following "Specifying Ranges of Points to Map".

Specifying Ranges of Points to Map

In AP800 you can specify up to 20 different point selection ranges. You can define ranges before a map is drawn or add more afterwards, in each case you will need to select *[Redraw]* to display the newly selected range of points.

- Press *[Range]*.



Six fields allow you to specify the range of points to map. You can specify up to 20 different ranges.

☞ If all the fields are *blank* and the cursor is on the "Code" field, you can specify all points in the open job by pressing **[ENTER]**.

Pt Type

- Leave blank to map *all* point types or use the selection list to specify the type of points you want to map.

From

- Leave blank to specify the *lowest* **point number** or type the number of the first point in the range to be mapped.

To

- Leave blank to specify the *highest* **point number** or type the number of the last point in the range to be mapped.

☞ If you leave the "To" field blank, AP800 will map any future observations in the current job the next time you redraw the map.

Radius

AP800 maps all the points within the radius of the specified mid-point. The last used radius and mid-point are inserted automatically.

- Accept the current value, type the **radius**, or leave the field blank for *no* radius *and* no mid-point.

Mid Pt

You can only enter a mid-point if you have specified a radius.

- Accept the value supplied by AP800, or leave the field blank to center the map around the *last* surveyed point, or type a new point number for the **mid-point**.

Code

- Leave field blank to specify points with *any* **code**, or type or use the selection list to enter a **code**. The code you enter here will be a prefix for points to select. For example, when you enter a code of "C" points with a code of "C", "CL1", "CL2", ... will be selected.

Specify Next Range

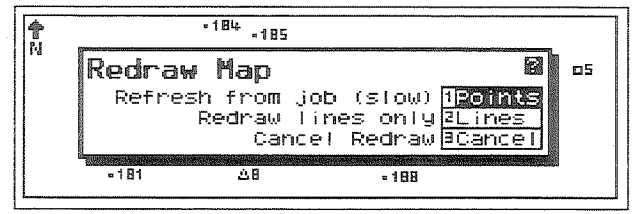
- When you are on the map screen select ***[Range]*** to add another range.

Drawing the Map

- To draw the map press *[Redraw]*.

When drawing the map for the first time AP800 will either notify you that it is "Mapping all Points", or start searching for points in the ranges before drawing the map. The map drawn will show all points centered on the screen.

While AP800 is drawing the map the North pointer will pulse to let you know the map is still being drawn. You may press **[ESC]** at anytime to stop drawing if you are satisfied with the points shown. If **[ESC]** is used to stop drawing, future zoom and line drawings will only work with the points shown.



This "Redraw Map" question is displayed when a map is already available.

When a map is already displayed AP800 will ask you whether you would like to "Refresh from job" or "Redraw lines only".

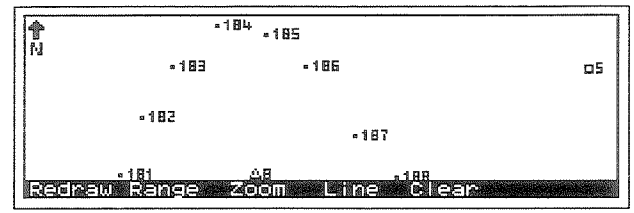
Refresh from job

Selecting "Refresh from job" will redraw the map by getting the points from the job, this refreshes the internal mapped points list. You should select this option if you have added new ranges, edited data in the job or recorded more points which you now want displayed. This redraw action will maintain the current zoom and map position.

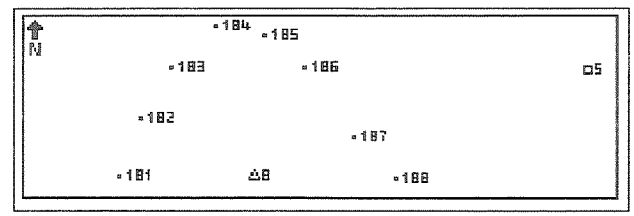
Redraw lines only

Selecting "Redraw lines only" will redraw all the points maintained in the internal mapped points list adding any new lines specified. This redraw action will maintain the current zoom and map position.

Hiding the Softkeys



An example of a map. To show or hide the softkeys, press **[Mode]**.



The same map with the softkeys hidden after pressing **[Mode]**.

NOTE: Map softkeys are always active even when they are not displayed on the "Map" screen.

Map Legend

Current Station Point (ST record) — Small triangle.

Control Points (CP, UC, MC, RE and other ST records) — Small square.

All Other Points — Dot with point number.

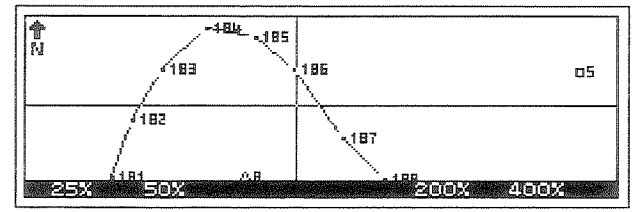
☞ AP800 will remember the map shown as long as you don't change jobs or restart AP800. This means that you can visit other AP800 areas and return to the same map.

Panning

To pan the map use the arrow keys. The amount of panning that can be done is limited so you may need to unzoom and re-zoom to move the map position, showing points off the screen.

Zooming in on the Map

- Select *[Zoom]*.



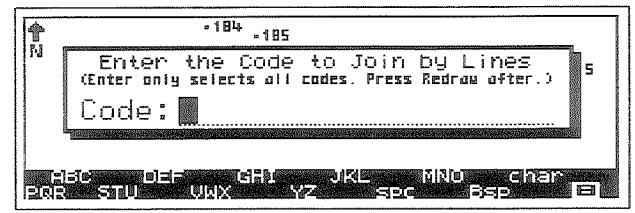
This screen shows the zoom crosshair and softkeys. You may press **[Mode]** to hide or show the softkeys.

- Using the arrow keys move the crosshair to the position you want to zoom at.
- Select a zoom factor *[25%]*, *[50%]*, *[200%]* or *[400%]*. pressing [**ENTER**] will zoom at 200%. The map will now redraw using the zoom factor you selected and the position you moved the crosshair to will be centered.

Drawing Lines

"Map" will allow you to specify code prefixes for string lines. String lines selected will be shown in the next draw action, whether it is ***[Redraw]*** or ***[Zoom]***. The string lines will be drawn between points with the same code, so long as the code starts with one of the code prefixes you specify in ***[Line]***.

- Select ***[Line]*** from the map screen.



This screen is shown when ***[Line]*** is selected.

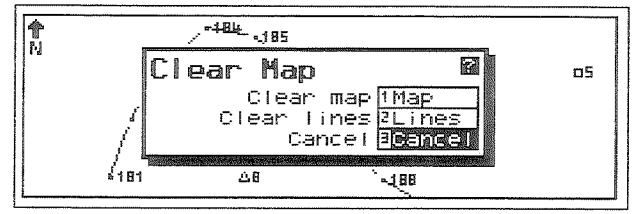
- Type in a code prefix for the string lines you want to show or use the selection list to select one from the points drawn on the map. For example, a code prefix of "C" will select string lines for "C", "CL1", "CL2", ...

☞ To specify all string lines you should leave the "Code" field *blank* and press [ENTER].

- To draw the string lines select ***[Redraw]*** or ***[Zoom]*** from the map screen.

Clear Map

- *Optional:* Press **[Mode]** to display the softkeys.
- Select ***[Clear]*** from the map screen.



This screen is shown when ***[Clear]*** is selected.

Clear map

- To erase the map and return to the "Map" screen with a menu of options, select "Clear map".

Clear lines

- Selecting "Clear lines" will clear the codes prefixes you specified using ***[Line]*** and redraw the map, without the lines.

Summary of Map Softkeys

Map	
Clear	Clears the map area and discards all existing Range commands.
Line	Opens the Lines window for you to add a new Code for string lines.
Range	Opens the Range window for you to add a new Range.
Redraw	Clears the map area and redraws the map from the Range commands in the map range file.
Zoom	Redraws the existing map at 2X, 4X, 1/2, or 1/4 Zoom.

Chapter 13

Settings

Introduction

This chapter describes a diverse range of instrument and software settings which effect how measurements are taken, corrected, checked and presented to you.

Roadmap

To go to the "FNC Key" menu from any function, press

FNC

→

To display the "Settings" menu, press

5

or

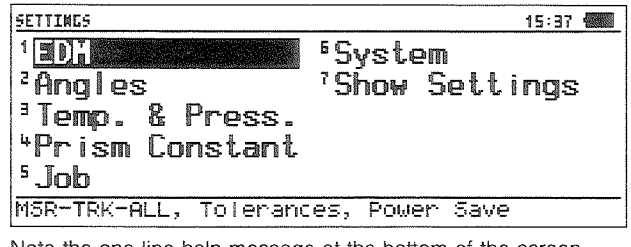
highlight

5

Settings

and press [ENTER]

The Main Settings Menu



Note the one-line help message at the bottom of the screen.

Overview

EDM — Sets the measurement precision, EDM power saving delay, measurement units and F1/F2 SD tolerances. (See page 13-4.)

Angles — Controls the angle display resolution, units, zero azimuth, zero VA positions and tolerances. (See page 13-8.)

Temp. & Press. — Controls the temperature and pressure corrections. (See page 13-10.)

Prism Constant — Allows you to set the prism constant. (See page 13-11.)

Job — Sets tolerances applicable to "Station Setup," "Collection," and "Stakeout." Controls the HI/HT defaults, Lumi-Guide operation, and coordinate display order. Also specifies the code file, code parameters file, distance scale, sea level and earth C&R corrections. (See page 13-12.)

System — Sets the date and time. Controls the keyboard defaults, power saving devices, LCD heater and the communications for data transfer. (See page 13-19.)

Show Settings — Shows the settings for the measure keys, temperature & pressure corrections, system and EDM power save, and much more. (see page 13-25.)

About Tolerances

AP800 uses the tolerances you set as your checking mechanism. You receive a warning if any measured distance or angle is outside your specified tolerance. For example, you have set the horizontal stakeout distance tolerance to 0.01m and staked out a point. If you take a check shot and the design and measured distance varies by 0.011, AP800 displays a warning window.

NOTE: If a value of "0" is entered in a tolerance field, ***no*** *tolerance checks will be made for those measurements.*

How to Change the Settings

You change most settings using the circular selection list. The /←/ and /→/ softkeys display the item in the data entry field. Sometimes you will type the required setting. A numeric input field will display with a row of dots under the field.

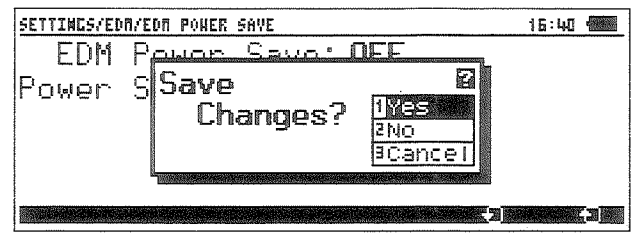
Changes made to any setting will remain until they are changed again.

How To Exit a Data Entry Window

There are three ways you can exit any "Settings" window:

[ENTER] on the *last* field — Automatically saves the changes and displays the previous menu.

[ESC] or **[FNC]** — If you have changed any setting, AP800 asks you if want to save the changes.



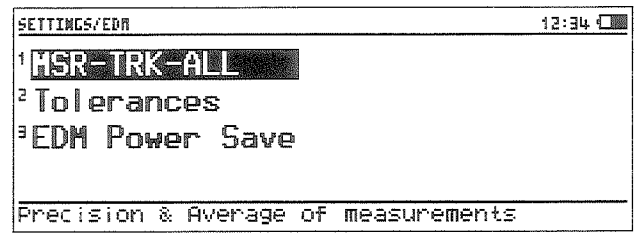
Yes — Saves the changes and returns to the previous menu.

No — Does *not* save the changes and returns to the previous menu.

Cancel — Does *not* save the changes and displays the *same* settings screen with the changes you had made.

(Alternatively, you can use **[ESC]** or **[FNC]** to cancel this screen.)

EDM



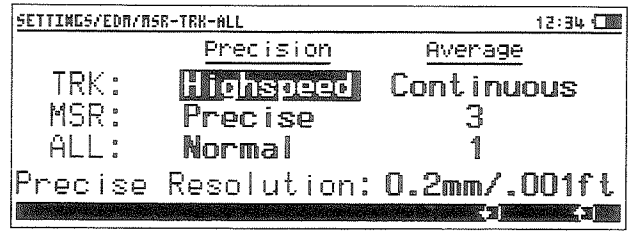
Overview

MSR-TRK-ALL — Sets the measurement mode's precision and number of distance measurements to be taken.

Tolerances — Sets the tolerance value that is used when AP800 compares Face 1 and Face 2 slope distance measurements.

EDM Power Save — Switches to "stand-by mode" after a period of inactivity.

MSR-TRK-ALL



You can set "TRK," "MSR," and "ALL" to any of the three precision modes:

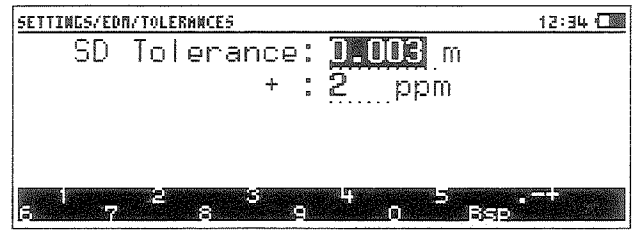
- **Precise** — Completes the measurement in 2.8 second ±0.2 mm or ±0.001 ft.
- **Normal** — Completes the measurement in 0.8 second ±1.0 mm or ±0.002 ft.
- **Highspeed** — Completes the measurement in 0.5 second ±10.0 mm or ±0.02 ft.

Additionally, you can specify the number of measurements to be *averaged* for each mode: **Continuous, 1, 2, ...99.** See also "Measure Keys" on page 2-8.

NOTE: "ALL" cannot be set to "Continuous."

Precise Resolution — You can set the display resolution for distances measured with the "Precise" option to **0.2mm/.001ft** or **1.0mm/.002ft**.

Tolerances (Face 1/Face 2 Slope Distance)



AP800 uses this tolerance value when it compares the Face 1 and Face 2 slope distance measurements. You are warned if the difference between the Face 1 and Face 2 measurements (Face 1/Face 2 Δ value) is equal to, or exceeds, the tolerance setting.

The tolerance setting is divided into two parts: a *fixed* or base value (SD Tolerance), plus a *variable* value (+). The "final tolerance" applied is a combination of these two parts.

The variable value (+) is used by AP800 to increase the final tolerance as the distance of the shot increases, for example:

Using the values shown in the figure above, and measuring over a distance of 500 m, the resulting tolerance would be ±0.004 m. (This is derived from ±0.003 + [2 ppm x 500]).

Similarly, measuring over a distance of 1000 m, the resulting tolerance would be ±0.005 m. (±0.003 + [2 ppm x 1000]).

SD Tolerance

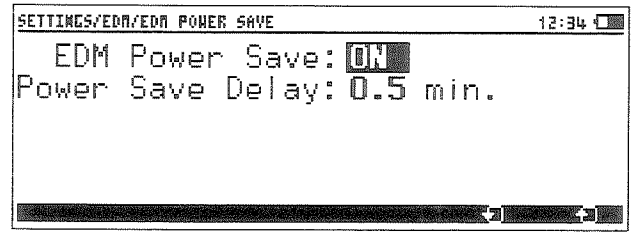
- Type in the SD tolerance value (0 to 65.0 m/215.0 ft; max. 5 digits). This is the fixed value.

+

- Type in the + value (0 to 999). This is the variable value in parts per million.

NOTE: If the tolerance and + values are set to "0", tolerances are ***not*** *checked.*

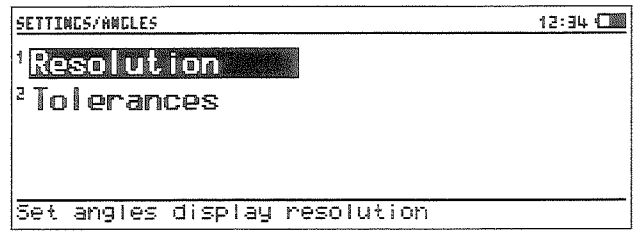
EDM Power Save



EDM Power Save You can save battery power by setting AP800 to switch automatically to "stand-by mode" if there is no measurement activity after a set period of time. Select **ON** to save power, then set the "Power Save Delay."

Power Save Delay The delay after a measurement before the EDM switches to "stand-by mode" can be **0**, **0.1**, **0.5**, **1**, **3**, or **5** minutes. Select **0** to activate "stand-by mode" immediately after a measurement.

Angles



Overview

Resolution — Sets the angle display resolution of the instrument.

Tolerances — Sets the horizontal angle and vertical angle tolerances.

Resolution

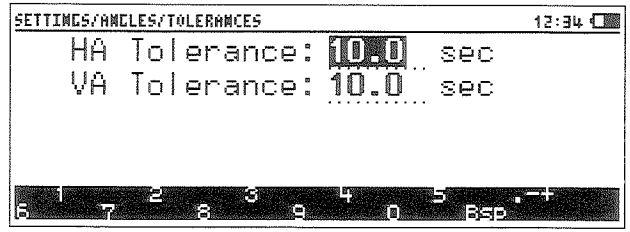
You cannot set the angle display resolution to a value which is less than the instrument's resolution. Listed below are the maximum resolutions for the DTM-800 Field Stations and, in brackets, the choices AP800 gives you:

DTM 850 — 1″ (**1″/0.2mG** or **5″/1mG**)

DTM 830 — 1″ (**1″/0.2mG** or **5″/1mG**)

DTM 820 — 1″ (**1″/0.2mG** or **5″/1mG**)

Tolerances (Angles)

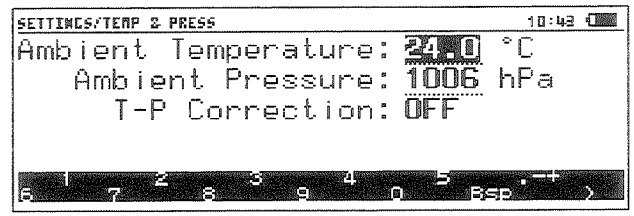


VA and HA Tolerances

The acceptable range for both tolerances is **0 to 6500 sec / 2 gons / 30 mils**.

- Type the tolerance values (max. 5 digits).

Temp. & Press.



This screen allows you to change the temperature and pressure settings.

Ambient Temperature

You can set the current temperature using this command *or* you can change the temperature when you set up over a known station. In both cases, the temperature you set is fixed until you change it again.

- Type the ambient temperature (**–42°C to 57°C**).

NOTE: This function does allow you to enter a temperature value to one decimal place. However, the software will round the value to the nearest whole number when you leave this screen.

Ambient Pressure

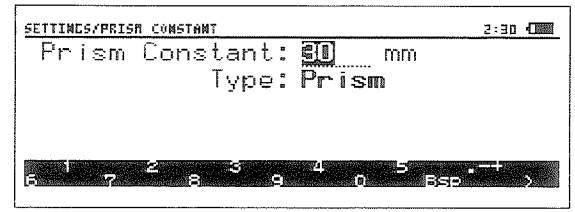
You can set the current pressure using this command *or* you can change the pressure when you set up over a known station. In both cases, the pressure you set is fixed until you change it again.

- Type the ambient pressure (**527 hPa to 1338 hPa**) .

T-P Correction

Measurements are corrected for the ambient temperature and pressure if this command is set to **ON.**

Prism Constant



This screen allows you to set the prism constant and select the type of target.

Prism Constant

You can set the prism constant in ±mm.

- Type the prism constant **(–999 to 999 mm).**

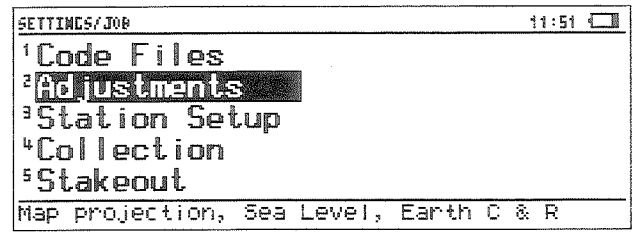
Type

You can select the type of target that you will be measuring to.

- Select **PRISM** or **SHEET**, for reflective sheeting.

Note: This "Type:" field will only be available if your instrument has the ability to select the different measuring modes for the target.

Job



Overview

Code Files — Sets the codes file and the code parameters file.

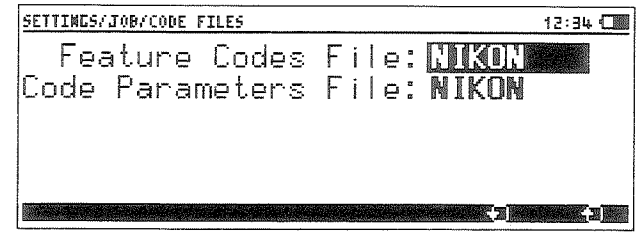
Adjustments — Controls the distance scale, sea level and earth C&R corrections.

Station Setup — Sets the tolerances for the backsight horizontal distance, backsight vertical distance, and the azimuth check. Also sets the HI/HT defaults.

Collection — Sets the Lumi-Guide, and sets the tolerances affecting the movement of the instrument and the proximity of two recorded points.

Stakeout — Sets the Lumi-Guide operation and the horizontal and vertical tolerances.

Code Files



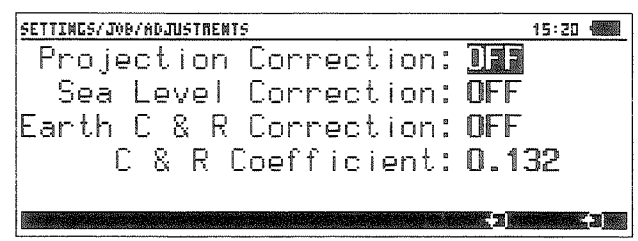
Feature Codes File You select the code file that AP800 will use to generate the codes selection list. If you do not want to use code files, you can select "NONE".

NOTE: The feature code and code parameters files (see below) must be present on each data card. (Refer to "Setting Up Feature Code and Code Parameter Files" on page A-2.)

Code Parameters File Select the code parameters file that AP800 will use to generate the code parameters selection list. If you do not want to use parameter files, you can select "NONE".

For more information you should refer to the mapping software that handles your feature codes and feature code parameters, such as Nikon's "NS-95" or "DR-Link+ ".

Adjustments



Projection Correction

You can use a distance scale factor by setting this command to **ON**. When you leave this field, either by pressing [ENTER] or by moving down to the next field, AP800 asks you to input the map projection **Conversion Factor**.

Sea Level Correction

The sea level correction is the adjustment of distances measured at an elevation to the corresponding distance at sea level.

You can turn the sea level correction **ON** or **OFF**.

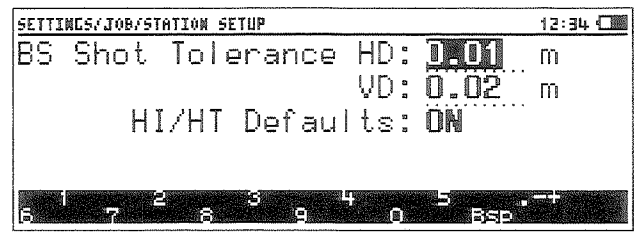
Earth C & R Correction

You can turn the curvature and refraction correction **ON** or **OFF**.

C & R Coefficient

The instrument's "C & R Coefficient" can be set to either **0.132** or **0.200**.

Station Setup



BS Shot Tolerance HD and VD

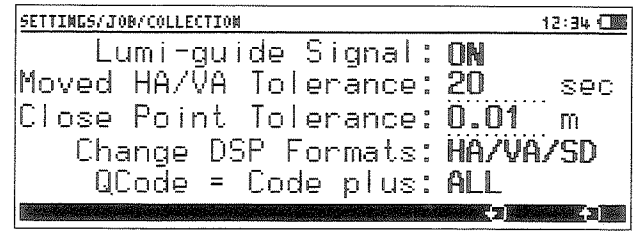
- Type the distance tolerance you want AP800 to check for **(0 to 65.0 m / 215.0 ft)** . For instance, to check for a tolerance of 20 mm you would type 0.020.

HI/HT Defaults

You can automatically swap HI and HT when you move station (see "Station Move" on page 4-14). For instance, in traversing when you swap the instrument and prisms between tribrachs.

If set to **ON**, the "HI" in "Station Setup" will default to the previous "HT." The "HT" of the backsight will default to the "HI" of the previous station.

Collection



Lumi-Guide Signal

The Lumi-Guide can be used to tell the rodman when a measurement has been recorded. Setting the "Lumi-Guide Signal" to **ON** turns the Lumi-Guide on for 5 seconds as a measurement is recorded in "Collection".

- Use the circular selection list to change the setting.

Moved HA/VA Tolerance

This tolerance applies to any changes in horizontal or vertical angles between the measurement and the recording. The acceptable tolerance range is **0 to 6500 sec/2 gons/30 mils**. Setting the tolerance affects the point at which the instrument alerts you and gives you options to record the angle offsets or to record the data as at the last MSR/TRK.

- Type the tolerance value (max. 5 digits).

Close Point Tolerance

This tolerance compares the horizontal and vertical distance between the last recorded point and the point currently being recorded. The vertical distance tolerance is set to one-half of the horizontal tolerance by default. The tolerance may be in the range **0 to 65.0 m / 215.0 ft**.

- Type the horizontal tolerance value (max. 5 digits).

Change DSP Formats

AP800 gives you the option to display measurement values in three different formats or configurations in Collection. Each format may contain up to three measurement values.

Your choice of values is:

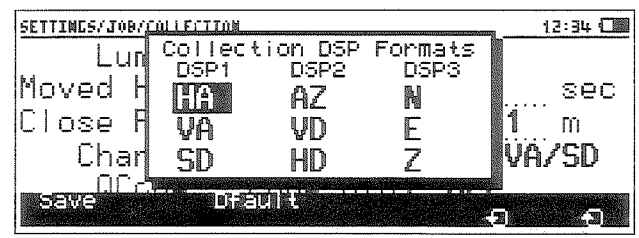
HA — Horizontal Angle
VA — Vertical Angle
SD — Slope Distance
AZ — Azimuth
VD — Vertical Distance (instrument to prism)
HD — Horizontal Distance
N — Northing
E — Easting
Z — Elevation
V% — Percentage of Slope
- — Blank

The three default data formats are: **HA/VA/SD** (this is the first data format), **AZ/VD/HD**, and **N/E/Z**.

(In Collection you use the *[DSP]* softkey to cycle through the formats, see page 5-6.)

To view the Collection DSP formats:

- Use the ← or → to open the DSP formats window.



There are three Collection DSP Formats: DSP1, DSP2, and DSP3. The "N" and "E" are shown according to the "Configuration/Coordinates" setting (see page 12-6).

To change the Collection DSP Formats:

- Use↑ and ↓ to move the cursor to the field you want to change. Then use the ← and → to cycle through the values.

- If you want to revert to the default Collection DSP settings, press *[Dfault]*.

- To save your changes, press *[Save]*.

QCode = Code plus ""

You can set AP800 to automatically take a measurement when you select a quick code (see "Entering a Quick Code in the Code Field" on page 5-15):

Code Only — No measurement is taken.

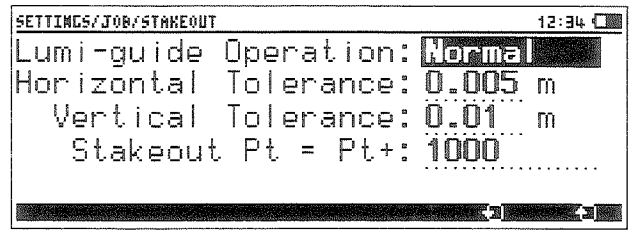
MSR — To take a "MSR" measurement.

TRK — To take a "TRK" measurement.

ALL — To take an "ALL" measurement.

(For more information about these measurement modes, see "MSR-TRK-ALL" on page 13-5.)

Stakeout



Lumi-Guide Operation

This command controls when the Lumi-Guide turns on and off in Stakeout. You have three choices:

- **Manual** — You must *manually* turn the Lumi-Guide on and off using *[LG]*.
- **Normal** — To turn the Lumi-Guide on automatically when the telescope is sighted *within one minute* of the point. The Lumi-Guide turns off automatically when the point is recorded. You can use *[LG]* to override the operation.

- **Low Power** — Similar to "Normal" operation except the Lumi-Guide turns off automatically when the measured distance is *within one metre/three feet* of the point. You can use *[LG]* to override the operation.

Horizontal Tolerance and Vertical Tolerance

These tolerances compare the measured coordinates of the staked point to the known coordinates of the point. Both tolerances can be in the range **0 to 65.0 m / 215.0 ft**.

- Type the tolerance values (max. 5 digits).

Stakeout Pt = Pt +

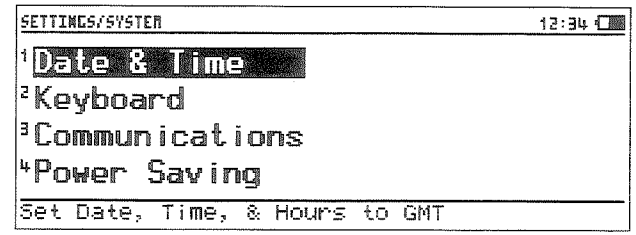
AP800 allows you to give the recorded stakeout point a number that is different from the original. You specify a constant which will be added automatically when the stakeout point is recorded.

The default is **1000** but you can change it to any number up to 999999999.

NOTE: The constant is added to the incrementing part of the point number. Therefore, the number of digits of the constant cannot exceed the length of the incrementing part (see page 11-7 and page 2-7).

If set to "**0**", AP800 records the stakeout point with the *same* number as the original.

System



Overview

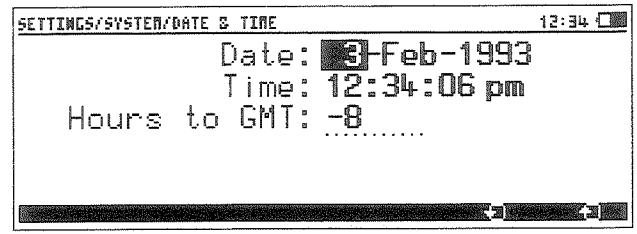
Date & Time — Sets the date and time.

Keyboard — Sets the default softkey mode for the "Code" field.

Communications — To set up the instrument so that survey data can be transferred to and from your computer.

Power Saving — Turns off the power to the instrument, and controls the LCD heater.

Date & Time



Date and Time Settings Screen.

Date

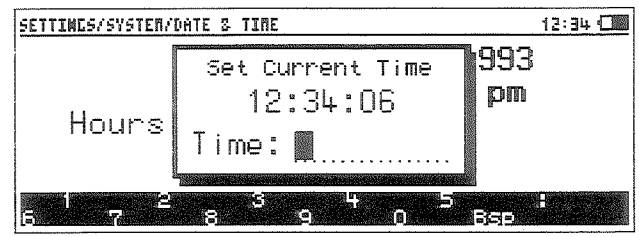
"Date" is divided into three fields, one each for the day (DD), month (MM) and year (YY).

The "Date Format" field sets the order of these fields (see "Date & Time" on page 11-8). The selection list is available for each field.

Time

You can reset the time in the format specified in the "Time Format" field (see "Date & Time" on page 11-8).

- Move the highlight to the **Time** field.
- Press /← / or / → / to display the "Set Current Time" window. The window shows the system time at the instant you pressed the softkey.



Set Current Time Window. Displays the time when you pressed the *[←]* or *[→]* softkey.

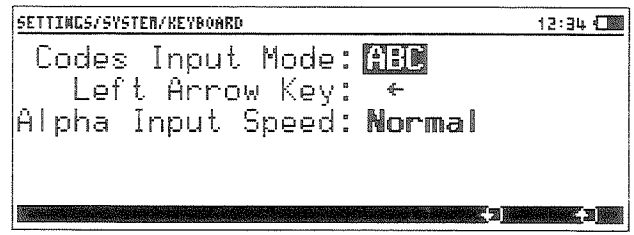
You may use any combination of one or two digit numbers, separated by a colon, to input the hours, minutes and seconds. For example: **H:M, HH:M, HH:MM, H:M:S**

- To *change* the time, type the new value and press **[ENTER]**. The clock restarts at the instant you pressed [ENTER].

([ESC] returns to the previous screen without changing the time.)

Hours to GMT You can set the time relative to the GMT using the range -12 to +12 (fractional hours can be specified, e.g., 10.5 means 10 hours and 50 minutes).

Keyboard



Codes Input Mode When the cursor is in the "Code" field and you press **[Mode]** in "Collection," you can have either alpha **(ABC)** or numeric **(123)** softkeys as your first choice. Make your selection with the circular selection list.

Left Arrow Key You can use the " ← " as a backspace key when "Bsp" is displayed in the softkey bar and there is no selection list. Alternatively, the " ← " can be used as a cursor movement key.

- Use the circular selection list to choose **Bsp** (backspace) or " ← " (cursor movement).

Alpha Input Speed When you press and release an alpha softkey, AP800 pauses before moving the cursor to the right. You change this delay time to suit your input speed (see page 1-7).

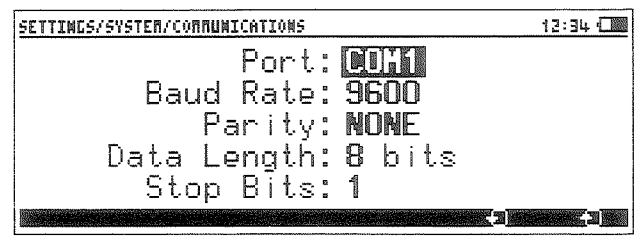
- Use the circular selection list to choose one of the three alpha input speeds:

Fast (time delay of 0.5 sec)
Normal (time delay of 1.0 sec)
Slow (time delay of 1.5 sec).

Communications

The communications settings enable you to correctly configure the instrument to transfer survey data between itself and another device, such as your computer.

NOTE: You can also change these settings from within the Communications "Upload" and "Download" functions, but you do not need to set them in both places.



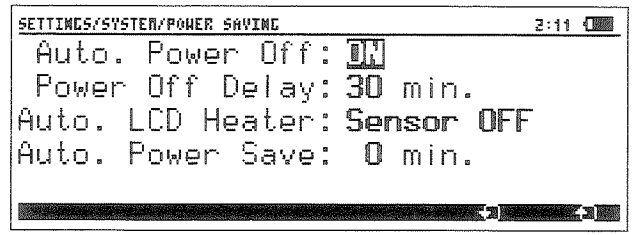
Use the selection list key to change the values. To exit with changes, move cursor to the last field and press **[ENTER]**.

Data is transferred through the instrument's **COM1** port, and the **Baud Rate, Parity, Data Length,** and **Stop Bits** must match those of the other device (your computer). *Data transfer will fail if the communications settings do not match.*

NOTE: When you upload or download data via COM1, activate "Xon/Xoff" settings of the terminal program on your computer as well as above communication settings.

NOTE: The manual supplied with the destination device should contain information on how to change the communications settings.

Power Saving



Auto. Power Off If you select **ON**, AP800 automatically "shuts down" all power to the instrument according to the "Power Off Delay" setting (see below).

You must always turn the power off manually if you set this field to **OFF**.

Power Off Delay If "Auto Power Off" is set to "ON" you can have the instrument turn off after a specific period of inactivity:

- Number of minutes of inactivity — **5**, **10**, **15**, **30**, or **60**.

Auto. LCD Heater This setting turns the heater thermostat on or off. If set to **Sensor ON**, the heater will automatically turn on when the LCD temperature falls below 0°.

You can also operate the heater using "Switches" in the "FNC Key Menu" (see page 12-4).

Auto. Power Save

To save power when you are not using the instrument without switching it off, AP800 provides a power saving utility. You can set the power save function to operate after one of the following delays: **0** mins, **2** mins, **5** mins and **10** mins. This function displays a floating cup on the screen until you press a key.

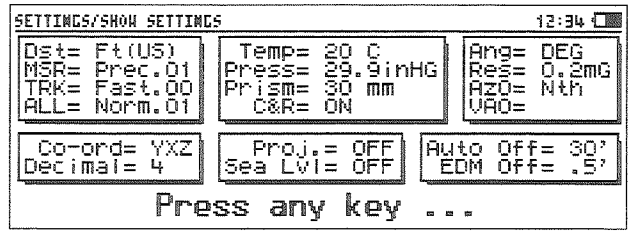
0 minutes is the default setting. This means that the power save function is set to **OFF** and does not operate.

NOTE: All new instruments are equipped with the Auto Power Save feature. Certain instruments using earlier versions of AP800 do not have Auto. Power Save.

To "wake up" the instrument, simply rotate it or press any key on the keypad.

Show Settings

This feature will display the current instrument settings for the survey software. The "Show Settings" screen includes the settings for the measure keys, temperature & pressure corrections, and system and EDM power save.



Appendix

Setting Up Feature Code and Code Parameter Files

AP800 Feature Code and Code Parameter Files

As part of the software package, AP800 includes the standard feature code file **NIKON.COD** and the code parameter file **NIKON.PAR**. These files are stored on the NS-95 floppy disk that accompanies AP800 and have been included to enable you to start surveying with your instrument after a minimal setup.

To use these files, you must copy them to the data card.

- To copy the files to your data card refer to "Copying Binary Files to AP800" on page A-11.

The structures of **NIKON.COD** and **NIKON.PAR** are identical; they differ only in their content and how they are used in Collection (see page 5-12).

The **NIKON.COD** code file contains many useful codes under the sublists: Survey Marks, Surface Features, Vegetation, Structures, Roads, Railroads, Utilities and General Codes. The **NIKON.PAR** file includes parameter choices such as Curve Start, Curve End, Start New String, etc. These standard files are fully compatible with Nikon's PC based software NS-95, but new files can easily be created to work with other systems.

To supplement these files, you can create your own personal code and parameter files for use with AP800 software. There are two methods for creating your own files:

- the PC based surveying software packages **DR-Link**$^+$, **WesLink**$^+$ and **NS-95** all include utilities which allow you to create, and convert, your own code files. For further information you should contact your Nikon distributor;

- you can create code and parameter files simply by entering the information, in the correct specified format, into an ASCII text file on your PC. This procedure is detailed in the following section.

NOTE: If you have created new files as ASCII files, you will have to convert them to a binary format before loading them into AP800. See "Converting ASCII Code Files to Binary Files" on page A-10.

Creating Custom Files in the ASCII Format

This procedure details how to create your own feature code or code parameter files. You must create an ASCII file in the prescribed format, using your PC and a standard ASCII file editor, such as the Windows Notepad. The ASCII file may have any filename and extension.

NOTE: The format for the feature code and code parameter files is identical with the exception of the first line keyword. For this reason, only a feature code file is used to illustrate the format.

The following is an extract of the NIKON feature code file:

```
#"feature_codes","NIKON CODE LIST","SELECT"
"SURVEY","","          Survey Marks","SURVEY"
"SURFACE","","         Surface Features","SURFACE"
"VEGETATION","","        Vegetation","VEGETATION"
"STRUCTURES","","        Structures","STRUCTURES"
"ROADS","","          Roads","ROADS"
"RAILROADS","","        Railroads","RAILROADS"
"UTILITIES","","        Utilities","UTILITIES"
"GENERAL","","         General Codes","GENERAL"
#"SURVEY","SURVEY MARKS","SELECT"
"BM",,"          Bench Mark"
"CP",,"          Control Point"
"HUB",,"         Hub & Tack"
"H/T",,"         Hub & Tack"
"IP",,"          Iron Pin"
"IPF",,"         Iron Pin Found"
```

First Line

Sublist Lines

Sublist Identification Line

Code Lines

The following sections explain each line entry, the format for the line and how AP800 will interpret, and display, the information.

NOTE: The sublist and sublist identification lines, shown above, enable AP800 to generate sublists of codes when you open the selection list. If you do not want sublists, you should omit these lines and place the code lines immediately after the first line.

First Line

#"feature_codes","NIKON CODE LIST","SELECT"

The first line of the file includes three fields which specify the type of file, a main heading and the selection list label. Note that the fields are separated by a comma and are enclosed in double quotation marks.

*NOTE: When creating code and parameter ASCII files it is **essential** to conform to the punctuation rules shown in this section.*

Keyword

The first field of this line, the keyword, identifies the type of selection list as feature code or parameter. It must be entered in the following format:

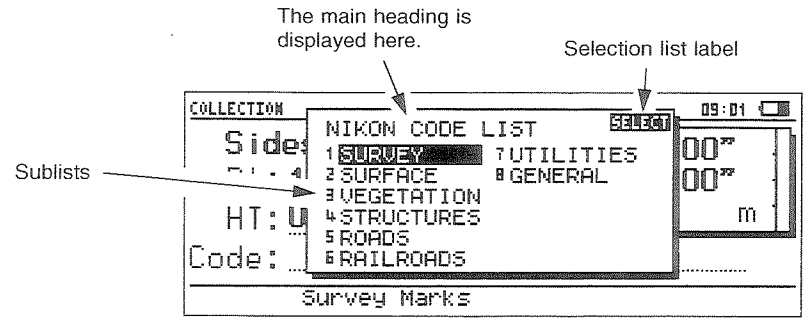
#"feature_codes" *(for a Feature Code list), or;*

#"parameters" *(for a Code Parameter list).*

Note the hash mark (#), double quotes (") and the underline character (_). Keywords must be enclosed in double quotation marks and may not contain spaces.

Main Heading (Optional)

The second field of this line is the main heading. Whatever you type in this field will be displayed by AP800 at the top of the code selection list window.



☞ If you do *not* want a heading to appear, type "" in the heading field.

Selection List Label

The third field of the first line identifies the selection list window, and you should type "SELECT". It will appear in the top right corner of the selection list window (see figure on page A-5).

Sublist Line (optional)

"SURVEY","","Survey Marks","SURVEY"

If desired, you can create a menu of sublists and place codes under each of them. The sublists will appear when you open the selection list (as with the screen shown on page A-7). Alternatively, you can place the codes directly under a main heading.

The sublist lines (one line should be entered for each sublist) should be placed immediately under the first line and must contain four fields: the sublist name, a code prefix, a "one-line" help message and the sublist keyword. Again, each field is separated by a comma.

Sublist Name

In the first field enter the sublist name (enclosed in double quotation marks). This is the name that will appear on the sublist menu, such as SURVEY or SURFACE shown below.

Code Prefix

This field enables you to enter a code prefix. Text from this field will be stored as the point's **Code** when you select this sublist. When you subsequently make a selection from the code list, the code name will be added to the prefix.

For example, if your sublist line reads:

"PEGTYPES","PEG","Peg Types","PEGTYPES"

the word PEG will initially be stored as the point's Code when you select this sublist.

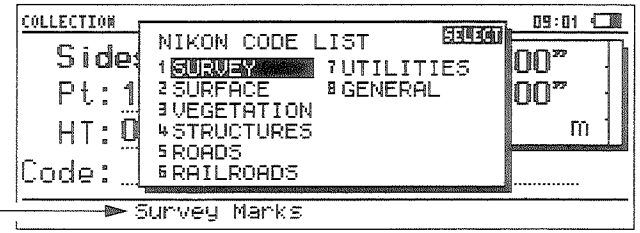
If you then select IRON from the list of codes available in the PEGTYPES sublist, the point's Code would be stored as PEG IRON.

If you do not want to use this field you should only enter the two double quotation marks.

One-line Help

The next field should contain a one-line help message which will appear at the bottom of the screen.

NOTE: The series of spaces, typed before the help statement text, are optional and align the text with the selection list window.



Sublist Keyword

The last field in this line is the sublist keyword which links this line to its respective sublist of codes. What you type here must exactly match what you type in the first field of the sublist identification line (see below).

When you select a sublist AP800 searches for an identification line that begins with the identical sublist keyword.

Sublist Identification Line

#"SURVEY","SURVEY MARKS","SELECT"

Sublist identification lines mark the start of the codes for each sublist. The format of these lines is similar to that of the first line format shown on page A-4. In this case, the first field (sublist keyword) must match the last field of the sublist line (see above). The second field is the sublist heading and the last is the selection list label.

Code Line

"BM",,"Bench Mark"

The feature code lines follow the sublist identification line, or the main heading line (if you are not using sublists).

The code line contains the *feature code name* or *code parameter name* (the first field) and the following options: (1) *reference identifier, or reference identifier and feature definition,* and (2) *one-line help message.*

Feature Code Name / Code Parameter Name

The first field is the code name which appears on the selection list. This code is added to the point data if you **do not** have a "Reference Identifier" in the code line (see below)

Reference Identifier

The reference identifier, if used, follows immediately after the feature code name. When you select the code from the menu list, AP800 adds the reference identifier to the point's code field, **instead of the code name.**

The reference identifier can be the same as, or different to, the feature code name. If you do not want to use this field you should omit it from the code line, including its two double quotation marks, for example:

"IP","456","Iron Pin" *(with reference identifier)*

"IP",,"Iron Pin" *(without reference identifier)*

Feature Definition (optional)

You can use the feature definition to add more information to the code, such as the girth of a tree.

If you include this field, AP800 will automatically ask you to input the feature definition data when you select the code from the selection list. To enable this, you must use the following format in the reference identifier field:

"**IDENTIFIER <Prompt:LengthA/Nsoftkeys>**"

where:

IDENTIFIER is the reference identifier.

Prompt is the prompt text that will be displayed in the AP800 data input window.

Length is the maximum number of characters AP800 will accept when you enter information into the data input window (maximum 10).

A/N softkeys specifies whether the alpha or numeric softkeys will be initially displayed. Enter A for alphas and N for numerics.

The example below shows the full code line format, including the feature code name:

"**FIRTREE**","**FIRTREE <Girth:10N>**", "**Douglas Fir Tree**"

When you select FIRTREE from the code selection list, AP800 displays a data entry window and asks you for the tree's girth. Your entry will be in numeric characters (unless you manually change to the alpha softkeys). You may input up to 10 characters.

"Douglas Fir Tree" is the one-line help displayed at the bottom of the screen (see explanation below).

One-Line Help Message (Optional)

The last field is the one-line help which briefly describes the highlighted code in the selection list. The bottom line of the screen contains the one-line help (see page A-7).

The one-line help message may be up to 42 characters.

Converting ASCII Code Files to Binary Files

Before you copy your new code and parameter text files to the data card for use with AP800, you must first convert them to the binary format. This is achieved by using a conversion program called **SLISTGEN.EXE** which is located on the NS-95 floppy disk that accompanies your AP800 software.

Copy Conversion Program

Copy the file **SLISTGEN.EXE** to the directory which contains your ASCII code and parameter files.

Convert ASCII File

To convert your ASCII file to the binary format, enter the following command at the DOS prompt:

```
C:\DIR>SLISTGEN ASCII.TXT MYCODES.COD
```

where "ASCII.TXT" is the name of your ASCII file and "MYCODES.COD" is the name of the binary file (see note).

NOTE: If you are creating a Feature Code file, you must give the binary file the extension ***.COD****. For a Code Parameter file, you must give the binary file the extension* ***.PAR****.*

Copying Binary Files to AP800

Your code files can be stored on either the program card or a data card. However, the files should be copied to different directories depending on which card you use.

Data Card — Create the **\CODES** directory on the *data card* and then copy your feature code and code parameter binary files to this directory.

Program Card — Copy the feature code and code parameter binary files to the *root directory* on the program card.

Your code files can be stored on a data card. Create a **\CODES** directory on the *data card* and then copy your feature code and code parameter binary files to this directory.

Setup the AP800 Software

Before you can make use of your new code files, you will have to set up the AP800 Software. This is a simple procedure and is explained on page 13-13.

AP800 Search Rules

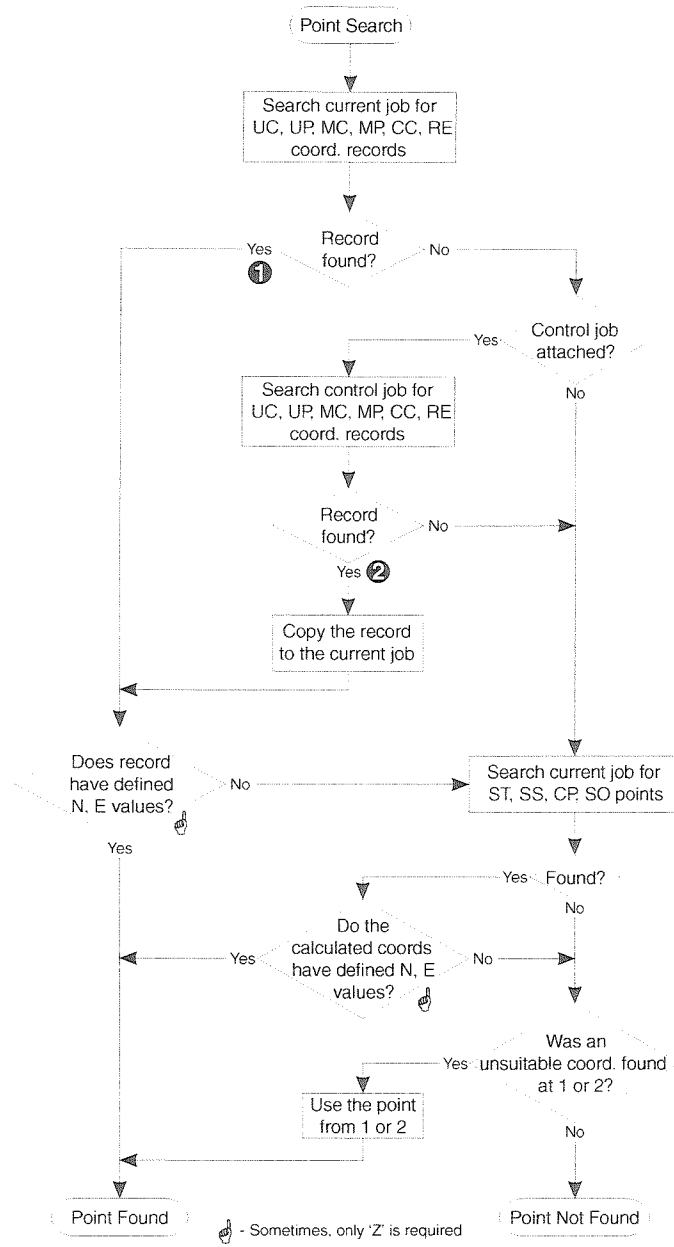
AP800 frequently searches the database for specific points. Usually such searches are for a point with a known point number. A database can contain many points with the same point number. For example, the surveyor may measure several times to an uploaded control point. Each observation would generate a separate measured point with the same point number.

The only limitation placed on duplicate point numbers is that there cannot be two coordinate records (MC, UC, etc.) with the same point number. However, there can be any number of raw data records with the same point number, and raw data records can have the same point number as a coordinate record.

Because of this ability to hold multiple information for the same point, there are well defined search rules to ensure that the correct information is always found when the AP800 software searches for a point.

Search Rules

The following illustration shows the process that AP800 follows until the point is found or the search has failed.


Point Search
Search current job for UC, UP, MC, MP, CC, RE coord. records
Record found?
Yes
1
No
Control job attached?
Yes
No
Search control job for UC, UP, MC, MP, CC, RE coord. records
Record found?
No
Yes
2
Copy the record to the current job
Does record have defined N, E values?
No
Search current job for ST, SS, CP, SO points
Yes
Found?
Yes
No
Do the calculated coords have defined N, E values?
Yes
No
Was an unsuitable coord. found at 1 or 2?
Yes
Use the point from 1 or 2
No
Point Found
Point Not Found
- Sometimes, only 'Z' is required

Nikon Download Format

Overview

The Nikon standard data format is not a database format, but instead a data format for communicating with other systems and 3rd party software.

When you download data using AP800, you have the choice of selecting "Raw Data" or "Coordinate" type download. The differences between these download types is explained in the following sections.

Warning

1. When you download as raw data, ***only Temperature and Pressure correction and Prism Constant corrections*** are applied to your data. These corrections, if active, are applied to your slope distances at the time they are measured. No other corrections (C & R, Map Projection and Sea Level) are made to downloaded raw data, regardless of their settings.

2. When you download as coordinate data, all corrections that are switched on **at the time of the download** will be applied to the calculated coordinates. Therefore, to ensure that the coordinates downloaded are true, you should check that the correction settings at the time of download match the settings when you performed the survey.

Raw Data Download

If raw data is selected, **all** the records from the job database are downloaded (see "Basic Record Types" below for a brief description of the data). The coordinate records may be UC, UP, MC, MP, RE or CC records. CC records are calculated using COGO and RE records during a resection session.

All CP, SS, SO, F1 and F2 records are downloaded as raw data; that is, coordinates are not calculated for them. Station setups are downloaded using the ST record format.

Basic Record Types

There are seven basic raw data download record types:

Coordinate Records — Used for uploaded, manually input, and calculated coordinates. Although there is only one basic coordinate record, different record types in the AP800 database are used to identify the source of the coordinates.

Station Records — These provide station setup details.

Control Point Records — These record observations to control points. Control points are the *only* measured records used in selection lists for Known Station, Control and Resection. When copying points from one job to another, it is possible to select control points only to be copied.

Sideshot Records — These record observations to all points which are not control points or stakeout points.

Stakeout Records — These are check shots to staked out points.

F1 and F2 Records — These are Face 1 and Face 2 check shots, and all shots taken during resection and control sessions.

Comments/Notes — These will include all other information.

NOTE: The difference between "control points" and "sideshots" is only for the benefit of the field and office surveyors. There is no reason why "sideshots" cannot be used as control points, and "control points" do not need to be used as instrument stations.

However, some 3rd party software may not process the data correctly if shots to station points are not identified as "control points." Users must tailor their field use of "control points" and "sideshots" to suit their field and office requirements.

Record Formats

Coordinate Records

Record Type, pt, id, northing, easting, elevation, code

where:
Record Type = one of the following types:
- UC (Uploaded Control)
- UP (Uploaded Point)
- MC (Manually input Control)
- MP (Manually input Point)
- CC (Calculated Coordinate)
- RE (Resection Point)

pt = Point Number
id = Optional Point Identifier
code = Feature Code

Station Records

ST, *stnpt, stnid, bspt, bsid, hi, bsazim, bsha (*)*

where:
stnpt = Station Point Number
stnid = Station Identifier
bspt = Backsight Point Number
bsid = Backsight Identifier
hi = Height of Instrument
bsazim = Backsight Azimuth
bsha = Backsight Horizontal Angle

Control Point Records

CP, *pt, id, ht, sd, ha, va, time, code*

where:
pt = Point Number
id = Point Identifier
ht = Height of Target
sd = Slope Distance
ha = Horizontal Angle
va = Vertical Angle
time = 24 Hour Time Stamp
code = Feature Code

Sideshot Records SS, *pt, ht, sd, ha, va, time, code*

where:
pt = Point Number
ht = Height of Target
sd = Slope Distance
ha = Horizontal Angle
va = Vertical Angle
time = 24 Hour Time Stamp
code = Feature Code

Stakeout Records SO, *pt, sopt, ht, sd, ha, va, time,*

where:
pt = Recorded Point Number
sopt = Original Number of Point Staked
ht = Height of Target
sd = Slope Distance
ha = Horizontal Angle
va = Vertical Angle
time = 24 Hour Time Stamp

F1 / F2 Records F1, *pt, ht (*), sd, ha, va, time*

where:
F1= Face of Shot (F1 or F2)
pt = Point Number
ht = Height of Target
sd = Slope Distance
ha = Horizontal Angle
va = Vertical Angle
time = 24 Hour Time Stamp

Comment/Note Records CO, *note text*

NOTE (*) is added after Nikon RAW data format V2.00.

AP800 Comment/Note Records

The comment/note record is used extensively by the AP800 software. Much information, which is stored as special records in other formats such as SDR2x, is put into comment/note records in the Nikon format.

This does not mean this information is not accessible by 3rd party software. It is uniformly formatted and can easily be used.

The following comment/note records are be generated by the AP800 software as the first records in the downloaded data:

CO, ***Nikon RAW data format V2.XX***

The format version information. This is added after V2.00, which is output from AP800 V2.03 or later.

CO, ***pathname***

The full pathname of the AP800 file being downloaded. This is only to uniquely identify the data which has been downloaded.

CO, Description: ***text***

The file (job) description.

CO, Client: ***text***

The file client information.

CO, Comments: ***text***

The file creation comment.

CO, Downloaded 03-Feb-98 12:34:06pm

This is to identify the date and time the data was downloaded.

CO, Software: ***text***

The software version currently loaded.

CO, Instrument: ***text***

The instrument name and model details.

CO, Dist Units: ***distunits***

The distance units can be Metres or Feet.

CO, Angle Units: ***angunits***

The angle units can be DDDMMSS or Gons.

CO, Zero azimuth: ***North***

Can be North or South.

CO, Zero VA: ***Horizon***

Can be Horizon or Zenith.

CO, Coord Order: ***NEZ***

Can be NEZ or ENZ.

CO, HA Raw Data: ***HA zero to BS***

Can be HA zero to BS or Azimuth. This setting controls the format for SS and CP records when you download them and should be set to the option that is most compatible with your PC's software. Regardless of the setting, F1 and F2 records are always formatted as zero to BS.

NOTE: These comment records will be followed by any comments stored at the top of the job database.

In addition to these records, which are generated at the top of the download file, the following comment type is downloaded before all station (ST) records:

CO, Temp: ***20 C*** **Press:** ***1012 hPa*** **Prism:** ***0*** **17-Aug-1999 16:15:54**

Temperature units can be Centigrade or Fahrenheit. Pressure units can be inHg, mmHg, or hPa. Prism Constant is always shown in mm.

Date & Time Stamps

The AP800 software generates date and time stamps in the database while you are collecting survey data. When you download data in the Nikon raw data format, you have a number of options for downloading these stamps.

NOTE: Date and time stamps are more commonly used when downloading in the SDR formats. CP, SS, SO, F1 and F2 records include a time stamp as one of their record fields (see page A-16) and this information is always downloaded when using the Nikon raw data format.

All optional date and time stamps that you choose to download will be in the form of a comment/note (CO record).

Your options are:

1. **No date and time stamps**, except the standard download date and time comment record at the start of the file.

2. A date and time stamp before each **ST record**.

3. A date and time stamp before **every record**. (In the Nikon format, this selection is effectively the same as selection 2 above.)

4. A date and time stamp before each **ST record** plus an additional date and time stamp **every 15, 30, or 60 minutes.**

The time stamp always marks the time that the next record was surveyed. The time intervals are measured from the first station setup of the session.

For example, suppose station setups were at 8:30 and 9:10, and other observations were made at 8:40, 8:45, 8:53, 9:05, 9:12, 9:19, 9:30, 9:38, and 9:46.

If you selected **every 15 minutes** for your time stamps, the comments would be output at 8:30 (SS), 8:45, 9:05, 9:10 (SS), 9:19, 9:30 and 9:46.

Deleted Records

Deleted records are downloaded with an asterisk in column 1. That is, deleted records are formatted normally, then an asterisk (*) is placed in column 1.

Sample of Downloaded Raw Data

```
CO,Nikon RAW data format V2.00
CO,B:\EXAMPLE5
CO,Description: SAMPLE OF DOWNLOADED RAW DATA
CO,Client: NIKON
CO,Comments: MANUAL EXAMPLE
CO,Downloaded 18-Jun-1999 16:54:10
CO,Software: AP800 version: 2.20
CO,Instrument: Nikon DTM850
CO,Dist Units: Metres
CO,Angle Units: DDDMMSS
CO,Zero azimuth: North
CO,Zero VA: Zenith
CO,Coord Order: NEZ
CO,HA Raw data: HA zero to BS
CO,Tilt Correction:  VA:ON  HA:ON
CO, EXAMPLE5 <JOB> Created 18-Jun-1999 08:43:21
MC,1,STN1,100.000,200.000,10.000,
CO, Temp:27C Press:760 mmHg Prism:0 16-Jun-1999 08:45:19
ST,1,STN1,,,1.400,55.4500
F1,,,0.0000,90.0000,16:45:58
SS,3,1.200,33.706,326.2708,90.0000,08:47:46,SIGN
*SS,4,1.200,79.193,30.0847,90.0000,08:48:24,TREE
SS,4,1.200,79.193,28.0032,90.0000,08:48:24,TREE
CO,Pt: 3 SO deltas N:0.000 E:0.000 Z:0.000 In Tolerance
SO,3,3,1.200,33.706,326.2708,90.0000,08:52:42,
```

Coordinate Data Download

If coordinate data is selected a single record is downloaded for every coordinate record (MC, UC, etc.), and every station point with adjusted coordinates (the result of a traverse adjustment).

In addition to the known and adjusted coordinate records, a record is downloaded for every CP, SS and SO record (for which coordinates can be calculated) **that does not have** a corresponding known or adjusted record. Points of this type which are surveyed more than once will result in multiple coordinate records, as for points 3 and 4 in the sample shown below.

All coordinate download records follow the same format:

Coordinate Download Records

pt, ***northing, easting, elevation, code***

where:
pt = Point Number
code = Feature Code

NOTE: Coordinate download records do not have a record type identifier.

The number of decimal places shown in the coordinate download is dependent upon the settings in System/Configuration/Coordinates/ Decimal Places.

Sample Downloaded Coordinate Data

1,100.0000,200.0000,10.0000,
2,200.0000,300.0000,20.0000,
3,116.9239,216.9140,11.8425,TRAIN PLATFORM
4,126.6967,206.2596,11.2539,RAMP
11,100.0045,199.9958,10.0000,
13,116.9203,216.9113,11.7157,
14,126.6955,206.2579,10.9908,
21,100.0103,199.9958,10.0000,
31,100.0013,200.0005,10.0000,
41,100.0224,200.0331,9.9000,
3,116.9263,216.9165,11.8016,TRAIN PLATFORM
4,126.7042,206.2871,10.8193,RAMP
42,116.9266,216.9160,11.8028,
43,126.7046,206.2845,10.8213,CP POINT

SDR Download Formats (2x and 33)

Overview

AP800 gives the option of downloading your data in two SDR formats, **SDR2x** (which is compatible with SDR2, 20, 22 and 24) and **SDR33**. This section explains the format of the download options.

The SDR2x and 33 download formats are acceptable to most 3rd party software. SDR2x is a very stable format which has been used by most, if not all, Sokkia data recorders for many years.

The important difference between the two formats is that the SDR2x format supports 4 character point numbers and 10 character coordinates, distances, angles, etc., whereas SDR33 supports 16 character point numbers and 16 character coordinates, distances, angles, etc. These differences in field lengths are detailed in the "Record Formats" section (see page A-25).

As with the Nikon format, SDR formatted data can be downloaded as either raw or coordinate data.

NOTE: This document refers to the "Nikon Download Format" section in this Appendix, and should be read in conjunction with that information (see page A-14).

SDR Raw Data Download

When you select raw data as the download format, all records from the job database are downloaded. The format and content of the record types, and how these records relate to the Nikon formats, are discussed in the following sections.

Basic Record Types

Not all of the many record types defined in the SDR formats are supported.

Many of the SDR record formats are not relevant to the data generated by AP800. Some are handled by comment records to reduce the number of different types of records which need to be supported by 3rd party developers when processing AP800 data. The following record types are supported.

Type code 00 (File header) — Records the SDR download version, date and time, angle units, distance units, temperature units, pressure units and coordinate order.

Type code 01 (Instrument details) — Records the EDM type, instrument type and serial number, mounting type and Zero VA.

Type code 02 (Station details) — Records the station point number, coordinates, HI, and description of a station point.

Type code 03 (Target details) — Records the HT.

Type code 07 (Backsight bearing details) — Records the orientation of the instrument, i.e., the backsight point and backsight azimuth.

Type code 08 (Coordinates) — Records the point number, coordinates and description (feature code).

Type code 09 (Observation) — Records raw measurements and description (feature code).

Type code 10 (Job identifier) — Records the job name.

Type code 13 (Note) — This will be used extensively. Most of the comment/note records in the proposed Nikon format will have corresponding SDR note records.

NOTE: There are no records specifically for CP and SO records. These will be downloaded as 09 or 08 records without any special identification other than the point number.

Record Formats

The record formats are very similar for SDR2x and SDR33, the main difference being the length (number of characters or digits allowed) for some of the fields. The position and length of each field are indicated in this section as follows: (2x:5-8) (33:5-20), or just (5-8) if they are the same for both formats. (5-8) would indicate that the field begins at the fifth column, extends to the eighth column allowing a maximum of four characters.

*NOTE: SDR2x format will only handle 4-digit point numbers. 9-digit AP800 point numbers are reduced to their **last 4 digits** when downloaded in the SDR2x format. For example, an AP800 Pt No. 101.009364 will download as 9364.*

Header Record **00NM** ***ver 0000 datetime ang dist press temp door 1***

where:

ver (5-20) = The SDR Download Version. SDR2x will read SDR20V03-05. SDR33 will read SDR33V04-01.
0000 (21-25) = Not Used.
datetime (25-40) = Download Date and Time (seconds are not shown).
ang (41) = Angle Units. Degrees:1, Gons:2, Quadrant Bearings:3, Mils:4.
dist (42) = Distance Units. Meters:1, Feet:2.
press (43) = Pressure Units. MmHg:1, InchHg:2, mbar:3.
temp (44) = Temperature Units.
coor (45) = Coordinate Order. NEZ:1, ENZ:2.
1 (46) = Not Used.

Instrument Record **01KI1** ***instr serNo. instr serNo. 1 zeroVA 0.000***

where:

instr (6-21) and (28-43) = Instrument Make/Model.
serNo. (22-27) and (44-49) = Instrument Serial Number.
1 (50) = Not Used.
zeroVA (51) = Vertical Angle. Zenith:1, Horizon:2.
0.000 (52-61), (62-71) and (72-81) = Not Used.

Station Details Record

02KI ***stnpt northing easting elevation hi desc***

where:

stnpt (2x:5-8) (33:5-20) = Station Point Number.
northing (2x:9-18) (33:21-36)
easting (2x:19-28) (33:37-52)
elevation (2x:29-38) (33:53-68)
hi (2x:39-48) (33:69-84) = Height of Instrument.
desc (2x:49-64) (33:85-100) = Station Description.

Target Details Record

03NM ***ht***

where:

ht (2x:5-14) (33:5-20) = Height of Target.

Backsight Bearing Details Record

07KI ***stnpt bspt bsazim ho***

where:

stnpt (2x:5-8) (33:5-20) = Station Point Number.
bspt (2x:9-12) (33:21-36) = Backsight Point Number.
bsazim (2x:13-22) (33:37-52) = Backsight Azimuth.
ho (2x:23-32) (33:53-68) = Horz. Observation
(When the setting is HA=zero to BS, then ho=0)

Coordinates Record

08KI ***pt northing easting elevation desc***

where:

pt (2x:5-8) (33:5-20) = Point Number.
northing (2x:9-18) (33:21-36)
easting (2x:19-28) (33:37-52)
elevation (2x:29-38) (33:53-68)
desc (2x:39-54) (33:69-84) = Feature Code.

Observation Record

09MC ***stnpt pt sd va ha desc***

where:

stnpt (2x:5-8) (33:5-20) = Station Point.
pt (2x:9-12) (33:21-36) = Observed Point.
sd (2x:13-22) (33:37-52) = Slope Distance.
va (2x:23-32) (33:53-68) = Vertical Angle.
ha (2x:33-42) (33:69-84) = Horizontal Angle.
desc (2x:43-58) (33:85-100) = Feature Code.

Job Identifier Record

10NM ***jobid 1 incZ T&Pcorr C&Rcorr refcon sealev***

where:

jobid (5-20) = Station Point Number.

NOTE: The following fields are all SDR33 format only.

1 (21) = Point ID Length option set to 14.
incZ (22) = 2D or 3D coordinates. 2D:1, 3D:2.
T&Pcorr (23) = Atmospheric Correction. Off:1, On:2.
C&Rcorr (24) = Curvature and Refraction Correction. Off:1, On:2.
refcon (25) = Refraction Constant. 0.132:1, 0.200:2.
sealev (26) = Sea Level Correction. Off:1, On:2.

Note Record

13NM ***note***

where:

note (5-64) = Note/Comment Text.

Conversion of AP800 Records to SDR Records

There is no one-to-one relationship between the AP800 database records and the SDR download records. The following AP800 database records require special handling:

HD (job header record):

The first 16 characters of the File (Job) description are used to construct the SDR Job Identifier record (Type code 10). The description, client, and comment information is also downloaded, in comment record form, as it is for the Nikon download format.

CO (comment/note records)

These are output as SDR note records. If a comment is more than 60 characters it is output as two SDR note records. In addition, all automatically generated comment records output according to the Nikon download format are also output as SDR note records.

ST (station setup records)

The station coordinates and HI are used to construct the SDR Station Details (Type code 02) record. The coordinates are calculated from a shot to the station point or extracted from the relevant uploaded or manually input coordinate record. The feature code from the shot to the station or the coordinate record are used as the description in the SDR record.

The backsight point and backsight azimuth are used to construct the SDR Back Bearing Details record (Type code 07). The horizontal observation of this record is set to zero. The station and backsight identifiers are lost, i.e., they are not downloaded.

SS (Sideshot records)

The HT is used to construct an SDR Target Details record (Type code 03) whenever the height of target changes. This record precedes the SDR Observation record which uses the new HT value.

The station point number, observed point number, slope distance, vertical angle, horizontal angle, and feature code are used to construct the SDR Observation record (Type code 09).

CP (Control point records)

These are treated exactly like SS (Sideshot) records. There is no information in the downloaded information to identify an SDR Observation record as a control point.

The control point identifier is lost, i.e., is not downloaded.

SO (Stakeout records)

These are also treated exactly like SS (Sideshot) records. There is no information in the download information to identify an SDR Observation record as a staked out point.

F1/F2 (Face 1 or Face 2 records)

These records are downloaded as SDR comment records (Type Code 13).

Date & Time Stamps

The SDR formats provide no data fields for date and time stamps except as note records. The user has three options:

1. **No time stamps** except the download date and time note record.
2. A date and time stamp **before each Station Details record** (Type code 02).
3. A date and time stamp **before each Station Details record** (Type code 02) plus a date and time stamp before records at approximately **15, 30, or 60 minute intervals**. See the "Nikon Download Format" document for details.

Deleted Records

Deleted records are output as note records. That is, the Type code of all deleted records are changed to 13. The data in deleted records is not changed in any other way.

This method of downloading deleted records has been chosen so that 3rd party software will automatically ignore deleted records in the same way they ignore note records.

Sample of Downloaded Raw Data

```
00NMSDR20V03-05    000011-Apr-98 10:39:111211
10NMTEST JOB
01KI1   Nikon DTM850000000   Nikon DTM85000000012 0.000 0.000 0.000
13NMDownloaded 11-Apr-98 10:39:22
13NMSoftware: AP800 version: 2.01
13NMInstrument: Nikon DTM850
13NMDist Units: Metres
13NMAngle Units: Degrees
13NMZero azimuth: North
13NMZero VA: Horizon
13NMCoord Order: NEZ
13NMClient: ME
13NMDescription: MONDAY MORNING
13NMTilt Correction:  VA:OFF HA:OFF
13NM P_0509 <JOB> Created 10-Apr-98 05:15:04
13NMPrism constant: 0
08KI0001100.000  200.000  10.000
08KI0002200.000  300.000  20.000
02KI0001100.000  200.000  10.000   0.100
07KI0001000245.0000  0.0000
13F100000002<null>   <null>   0.0000
13F200000002<null>   <null>   179.9639
13NMBacksight Check to Pt:2       HA:359.3525     05:21:39
13NMBacksight Pt:2       Reset to HA:  0.0000     05:21:41
13F10000000323.990   4.1694   0.0000
13F20000000323.990   175.8403  180.0028
03NM0.000
13F10001000323.990   4.1653   359.9833  TRAIN PLATFORM
13F10001000427.445   2.4097   328.1958  RAMP
13NMStart of Resection from Pt: 11
13F10000000427.445   2.4097   0.0000
13F10000000323.991   4.1542   31.8042
13F10000000427.430   1.8583   121.4306
13F10000000323.976   3.8625   153.2306
13NMPt: 4        StDev: HA=0.0000   VA=0.2324   SD=0.0109
13NMSets= 2   MaxDeltas: HA=0.0000   VA=0.3305   SD=0.0154
13NMMean Values:  HA=0.0000   VA=87.5158  SD=27.4377  HT:0.00
13NMResiduals:  HA=0.0019  VA=0.0443  SD=0.0000
13NMPt: 3        StDev: HA=0.0011   VA=0.1222   SD=0.0103
13NMSets= 2   MaxDeltas: HA=0.0015   VA=0.1730   SD=0.0146
13NMMean Values:  HA=31.4808  VA=85.5930  SD=23.9837  HT:0.00
13NMResiduals:  HA=0.0019  VA=0.0406  SD=-0.0003
13NMStd Dev of Coords: N: 0.0138    E: 0.0244    Z: 0.0233
08KI0011100.005  199.996  10.000
02KI0011100.005  199.996  10.000   0.100
07KI0011000344.9980  0.0000
13NMFinish of Resection from Pt: 11
```

Coordinate Data Download

When you select coordinate data download, AP800 will download records using the same selection criteria as for the Nikon Format (see page A-21). All Coordinate records, ST, CP, SS, and SO AP800 database records are downloaded as SDR Coordinate records (Type code 08).

SDR coordinate format does include all the Type code 13 note records.

Sample of Downloaded Coordinate Data

```
00NMSDR20V03-05   000011-Apr-98 10:40:111211
10NMTEST JOB
01KI1   Nikon DTM850000000   Nikon DTM85000000012 0.000 0.000 0.000
13NMDownloaded 11-Apr-98 10:40:06
13NMSoftware: AP800 version: 2.01
13NMInstrument: Nikon DTM850
13NMDist Units: Metres
13NMAngle Units: Degrees
13NMZero azimuth: North
13NMZero VA: Horizon
13NMProjection correction: OFF
13NMC&R correction: OFF
13NMSea level correction: OFF
13NMCoord Order: NEZ
13NMClient: ME
13NMDescription: MONDAY MORNING
13NMTilt Correction:  VA:OFF HA:OFF
13NM P_0509 <JOB> Created 10-Apr-98 05:15:04
13NMPrism constant: 0
08KI0001100.000  200.000  10.000
08KI0002200.000  300.000  20.000
13NMBacksight Check to Pt:2       HA:359.3525     05:21:39
13NMBacksight Pt:2       Reset to HA:  0.0000     05:21:41
08KI0003116.924  216.914  11.843  TRAIN PLATFORM
08KI0004126.697  206.260  11.254  RAMP
13NMStart of Resection from Pt: 11
13NMPt: 4        StDev: HA=0.0000   VA=0.2324   SD=0.0109
13NMSets= 2   MaxDeltas: HA=0.0000   VA=0.3305   SD=0.0154
13NMMean Values:  HA=0.0000   VA=87.5158  SD=27.4377  HT:0.00
13NMResiduals:  HA=0.0019  VA=0.0443  SD=0.0000
13NMPt: 3        StDev: HA=0.0011   VA=0.1222   SD=0.0103
13NMSets= 2   MaxDeltas: HA=0.0015   VA=0.1730   SD=0.0146
13NMMean Values:  HA=31.4808  VA=85.5930  SD=23.9837  HT:0.00
13NMResiduals:  HA=0.0019  VA=0.0406  SD=-0.0003
13NMStd Dev of Coords: N: 0.0138    E: 0.0244    Z: 0.0233
08KI0011100.005  199.996  10.000
13NMFinish of Resection from Pt: 11
```

TDS Download Format

TDS (Tripod Data Systems) is another download option available with AP800 software. This file format, which is the standard output format for many hand-held data collectors, is widely used and is supported by many 3rd party software packages.

As with the previous download formats discussed, you can download as TDS raw data or coordinate data. If you select raw data your output file will contain all the AP800 records. If you select coordinate data, AP800 will only download those records whose coordinates are known, or can be calculated.

NOTE: TDS coordinate data download is in a similar format to Nikon, showing only the Point Number, Northing, Easting, Elevation and Code.

Most of the AP800 record types are converted to a direct TDS equivalent as follows:

AP800 Record Type		TDS Record Type
MC, MP, UC, UP, RE and CC	⇨	SP (Store Point Record)
ST (station point details)	⇨	OC (Occupy Record)
ST (backsight point details)	⇨	BK (Backsight Record)
ST (HI and HT details)	⇨	LS (Line of Sight Record)
CP	⇨	SS (Sideshot Record)
SS	⇨	SS (Sideshot Record)
SO	⇨	SK (Stakeout Record)
CO	⇨	— (Note Record)

NOTE: All deleted shots, F1 and F2 shots, "angle only" shots and AP800 comments/notes are downloaded as TDS Note Records.

For more detailed TDS file information you should refer to your data collector or 3rd party software documentation.

Sample of Downloaded Raw Data

```
JB,NMB:\NIKON\P_0509,DT04-07-1998,TM10:42:16
MO,AD0,UN1,SF1.000000,EC0,EO0.0000,AU0
--Description: TEST JOB
--Client: ME
--Comments: MONDAY MORNING
--Tilt Correction:  VA:OFF HA:OFF
-- P_0509 <JOB> Created 10-Apr-98 05:15:04
--Prism constant: 0
SP,PN1,N 100.0000,E 200.0000,EL10.0000,--
SP,PN2,N 200.0000,E 300.0000,EL20.0000,--
OC,OP1,N 100.0000,E 200.0000,EL10.0000,--
BK,OP1,BP2,BS45.0000,BC0.0000
LS,HI0.1000,HR0.0000
--2,FD0.0000,ZD,SD0.0000
--2,FV179.5750,ZR,SD0.0000
--Backsight Check to Pt:2        HA:359.3525     05:21:39
--Backsight Pt:2        Reset to HA:  0.0000     05:21:41
--3,FD0.0000,ZD4.1010,SD23.9904
--3,FV180.0010,ZR175.5025,SD23.9904
SS,OP1,FP3,AR359.5900,VA4.0955,SD23.9904,--TRAIN PLATFORM
SS,OP1,FP4,AR328.1145,VA2.2435,SD27.4450,--RAMP
--Start of Resection from Pt: 11
--4,FD0.0000,ZD2.2435,SD27.4454
--3,FD31.4815,ZD4.0915,SD23.9910
--4,FD121.2550,ZD1.5130,SD27.4300
--3,FD153.1350,ZD3.5145,SD23.9764
--Pt: 4        StDev: HA=0.0000   VA=0.2324   SD=0.0109
--Sets= 2   MaxDeltas: HA=0.0000   VA=0.3305   SD=0.0154
--Mean Values:  HA=0.0000   VA=87.5158   SD=27.4377   HT:0.0000
--Residuals:   HA=0.0019   VA=0.0443   SD=0.0000
--Pt: 3        StDev: HA=0.0011   VA=0.1222   SD=0.0103
--Sets= 2   MaxDeltas: HA=0.0015   VA=0.1730   SD=0.0146
--Mean Values:  HA=31.4808   VA=85.5930   SD=23.9837   HT:0.0000
```

Sample of Downloaded Coordinate Data

```
1,100.0000,200.0000,10.0000,
2,200.0000,300.0000,20.0000,
3,116.9239,216.9140,11.8425,TRAIN PLATFORM
4,126.6967,206.2596,11.2539,RAMP
11,100.0045,199.9958,10.0000,
13,116.9203,216.9113,11.7157,
14,126.6955,206.2579,10.9908,
21,100.0103,199.9958,10.0000,
31,100.0013,200.0005,10.0000,
41,100.0224,200.0331,9.9000,
3,116.9263,216.9165,11.8016,TRAIN PLATFORM
4,126.7042,206.2871,10.8193,RAMP
42,116.9266,216.9160,11.8028,
43,126.7046,206.2845,10.8213,CP POINT
```

DXF Download Format

Selecting DXF as your download format will generate a file which can be imported to AutoCAD and any other software which accepts the AutoCAD DXF file format.

The DXF download record format is the same, regardless of whether you select raw or coordinate data, giving only the Point Number, Northing, Easting, Elevation and Code for each AP800 record downloaded.

The point's details are downloaded to different layers in the DXF file, as shown in the following table:

Layer No.	Layer Name	Point Information	Layer Entity
1	PT	Coordinates	Point
2	PN	Point Number	Text
3	EL	Elevation	Text
4	DE	Code	Text

When downloading as raw data and coordinate data, AP800 will generate a DXF record for every known (MC, MP, UC, etc.) and adjusted coordinate record, and a record for every CP, SS and SO record (for which coordinates can be calculated) **that does not have** a corresponding known or adjusted record.

For more detailed DXF file information you should refer to your 3rd party software documentation.

AP800 File Types

There are several types of file created or used by the AP800 software. All files, *except* the hidden "Job Files" (see below), can be listed in Job Manager (see page 3-1).

Job Files

AP800 creates and stores these hidden job files in the directory specified by the user.

.DBM — Database file which contains the survey data.

.DBC — Holds the codes and comments used by the survey data in the database file.

.DPI,.DII,.DCI, and.DTI — Index files used by AP800 to search the database file.

Upload Data File

The user stores the upload data file under the same directory as the job file which has, or will receive, the uploaded data.

JOBNAME.UPx — An ASCII file on the data card that contains coordinate data ("x" is a number 1-9 specified by the user).

Download Data File

AP800 creates the download data file in the same directory as the open file.

JOBNAME.DNx — An ASCII file that contains coordinate or raw survey data in the Nikon, SDR, TDS or DXF format ("x" is a number 1-9 specified by the user). The filename and extension can be changed by the user.

Feature Code and Code Parameter Files

The user must store the code and parameter files in the "\CODES" directory on the data card, or on the program card's root directory.

.COD — Contains the Nikon feature codes or user-defined codes.

.PAR — Holds the Nikon field parameters or user-defined parameters.

Generated Code Files

AP800 stores the generated code files in the root directory.

CODSTACK.AP7 — Contains a list of the last 30 codes used by the user.

QCODES.AP7 — Stores the quick codes defined by the user.

Last Job File Used

AP800 creates this file in the root directory if the software is set to automatically open the last used job and the currently attached control job.

LAST_JOB.AP7 — Contains the name of the last open job and the currently attached control job.

Stakeout Files

AP800 creates the stakeout files in the same directory as the job database. They are in binary format and cannot be viewed directly by the user.

.STK — Contains all staked out points and those remaining to be staked out.

.STH — Holds all the stakeout points which have been measured and recorded since the last station setup.

Map File

MAPRANGE.AP7 — Contains details of all point ranges used to generate the map screen in the FNC/Map feature.

Control Database File

.CTL — A suspended Control session database file.

Resection Database File

.RSC — A suspended Resection session database file.

Mathematical Formulae

Overview

This section provides details of the mathematical formulae used by the AP800 software to perform calculations, corrections and make adjustments.

Units

Distance Units

1 international foot = 0.3048 metres
1 US foot = 0.3048006095 metres

Measurement Mode	Minimum Increment (high/low accuracy)
Precise	
Metres	0.0001m/0.001m
US Feet	0.0005ft/0.002ft
Int'l Feet	0.0005ft/0.002ft
Normal	
Metres	0.001m
US Feet	0.002ft
Int'l Feet	0.002ft
Highspeed	
Metres	0.010m
US Feet	0.020ft
Int'l Feet	0.020ft

Angle Units

Degrees, Minutes, Seconds
360 degrees in a circle
60 minutes in a degree
60 seconds in a minute
Format: DDD.MMSS 359.5959

Gons
400 Gons in a circle
Format: GON.DDDD 399.9998

Mil6000
6000 mil in a circle
Format: MIL.DDD 5999.995

Mil6400
6400 mil in a circle
Format: MIL.DDD 6399.995

Instrument /Angles	Minimum Increment (high/low accuracy)
DTM-851	
Degrees	0.5″/1″
Gons	0.1mgon/0.2mgon
Mils	0.005MIL/0.02MIL
DTM-831	
Degrees	1″/5″
Gons	0.2mgon/1.0mgon
Mils	0.005MIL/0.02MIL
DTM-821	
Degrees	1″/5″
Gons	0.2mgon/1.0mgon
Mils	0.005MIL/0.02MIL

Temperature

Units	Range	Minimum Increment
Celsius	-40°C...+55°C	1°C
Fahrenheit	-40°F...+131°F	1°F

Pressure

Units	Range	Minimum Increment
hPa	533hPa...1332hPa	1hPa
mmHg	400mmHg...999mmHg	1mmHg
inHg	15.8inHg...39.3inHg	0.1inHg

Notation

Vertical angles are assumed to be measured from the zenith (that is 0° at Zenith and 90° at the horizon) for the formulae in this manual.

The following base values are obtained directly from the instrument:

SD = slope distance. HA = horizontal angle. VA = vertical angle.

$HD = SD \bullet sin\ (VA)$ $\qquad$ $VD = SD \bullet cos\ (VA)$

GD = grade.

hi = height of the instrument station. ht = height of the target prism.

Z_{stn} = elevation of the station point. N_{stn} = northing of the station point.

E_{stn} = easting of the station point. BS_{Az} = backsight azimuth.

VA, HA and Tilt Calibration

Determined by accurately sighting a point using both the Face 1 (F1) and Face 2 (F2) telescope positions.

VA Offset

$$VA_{offset} = \frac{(VA_{F1} + VA_{F2} - 2\pi)}{2}$$

VA displayed on both faces is $VA_{circle} - VA_{offset}$

HA Offset

$$HA_{offset} = \frac{(HA_{F2} - HA_{F1} - \pi)}{2}$$

HA displayed on F1 is $HA_{circle} - HA_{offset}$

HA displayed on F2 is $HA_{circle} + HA_{offset}$

Tilt Offset

$$TX_{offset} = \frac{(TX_1 + TX_2)}{2}$$

$$TY_{offset} = \frac{(TY_1 + TY_2)}{2}$$

The tilt offset value in the X direction (ΔTX) is given by:

$$TX_{circle} - TX_{offset}$$

The tilt offset value in the Y direction (ΔTY) is given by:

$$TY_{circle} - TY_{offset}$$

Corrections

Corrections are applied to various readings which are subsequently used to calculate other values. Whether or not each correction is applied depends on its setting in the AP800 software.

The corrections are applied in the following order:

1. Temperature and Pressure
2. Instrument and Prism Constant
3. Curvature and Refraction
4. Sea Level
5. Map Projection

Temperature and Pressure Corrections

T & P corrections are applied to all measured distances if the user selected "ON" in "Settings".

K = Compensation coefficient
P = Pressure in mmHg
T = Temperature in °C

$$K = 275 - \frac{106P}{(273 + T)}$$

$$TP_{SD}(SD) = \left(1 + \frac{K}{1000000}\right)SD$$

NOTE: A temperature of 20°C and pressure of 760mmHg (1013hPa) will result in a 0_{ppm} correction.

Curvature and Refraction

C & R corrections are applied to both HD and VD if the user selected "ON" in "Settings".

R_e = 6372000m
K = curvature and refraction constant (either 0.132 or 0.200, set by user)

$$CR_{HD}(HD) = HD - \frac{SD^2 \sin(2VA)}{2R_e}(1 - K/2)$$

$$CR_{VD}(VD) = VD + \frac{HD^2}{2R_e}(1 - K)$$

Sea Level Correction

Sea level correction is applied to the HD if the user selected "ON" in "Settings". (See also the *Note* under "Map Projection Correction" below.)

R_e = 6372000m

$$SL_{HD}(HD) = \frac{HD \bullet R_e}{R_e + Z_{STN} + \frac{VD}{2}}$$

Map Projection Correction

Map projection correction is applied to the HD if the user selected "ON" in "Settings".

sf = the map projection scale factor (supplied by user).

$$MP_{HD}(HD) = HD \bullet sf$$

NOTE: If turned ON, sea level and map projection corrections are applied to all measured horizontal distances (except those measured inside the Total Station function). Also, all input coordinates or distances are then assumed to be map coordinates or map distances.

Constant Corrections

C_{Inst} = the instrument constant (set internally by the factory).

C_{Prism} = the prism constant (supplied by the user).

$$CO_{SD}\ (SD) = SD - C_{Inst} - C_{Prism}$$

Corrected Forms

As more than one correction may be applied, the AP800 applies the corrections in the order shown below:

$$SD' = CO_{SD}\ (TP_{SD}\ (SD))$$

$$HD' = MP_{HD}\ (SL_{HD}\ (CR_{HD}\ (SD' \bullet sin\ (VA))))$$

$$VD' = CR_{VD}\ (SD' \bullet cos\ (VA))$$

These corrected forms are used throughout this Appendix and are distinguished from other measurements by an apostrophe (').

Coordinate Calculation

$$N = N_{STN} + HD' \bullet cos\ (BS_{AZ} + HA\ )$$

$$E = E_{STN} + HD' \bullet sin\ (BS_{AZ} + HA\ )$$

$$Z = Z_{STN} + hi - ht + VD'$$

Face1/Face2

$$\overline{SD} = \frac{(SD'_{F1} + SD'_{F2})}{2}$$

$$\overline{HA} = \frac{((HA'_{F1} - BS'_{F1}) + (HA')_{F2} - BS'_{F2})}{2}$$

$$\overline{VA} = \frac{(VA'_{F1} + (2\pi - VA'_{F2}))}{2}$$

$$\Delta VA = (2p - VA'_{F2}) - VA'_{F1}$$

$$\Delta HA = (HA'_{F2} - BS'_{F2}) - (HA'_{F1} - BS'_{F1})$$

$$\Delta SD = (SD'_{F2} - SD'_{F1})$$

Known Station

If the height of the instrument is to be calculated from the backsight, then:

$$hi = bs_Z + ht - Z_{STN} - VD'$$

If the station Z is to be calculated from the backsight, then:

$$Z_{STN} = bs_Z + ht - hi - VD'$$

The backsight azimuth is calculated by:

$$BS_{AZ} = \tan^{-1}\left(\frac{E_{BS} - E_{STN}}{N_{BS} - N_{STN}}\right)$$

Resection

Mean values for each point are calculated as:

$$\overline{HA} = \frac{\sum_{i=1}^{n} HA_i}{n}$$

$$\overline{VA} = \frac{\sum_{i=1}^{n} VA_i}{n}$$

$$\overline{SD} = \frac{\sum_{i=1}^{n} SD_i}{n}$$

Where:

n = number of measurements to the point in all sets.

Standard Deviation values for each point are calculated as:

$$\text{Standard Deviation of } HA = \sqrt{\frac{\sum_{i=1}^{n} (HA_i - \overline{HA})^2}{n-1}}$$

$$\text{Standard Deviation of } VA = \sqrt{\frac{\sum_{i=1}^{n} (VA_i - \overline{VA})^2}{n-1}}$$

$$\text{Standard Deviation of } SD = \sqrt{\frac{\sum_{i=1}^{n} (SD_i - \overline{SD})^2}{n-1}}$$

Resection Calculation (least squares)

The least squares method of adjustment is a rigorous technique which attempts to find the best solution for the data input. This 'best solution' is the one which produces the smallest changes to the input field measurements and can be achieved by minimising the sum of the squares of the corrections to the measurements:

i.e. $v^2 \rightarrow$ minimum;

where v are the corrections (residuals) applied to the measurements.

Coordinates for the resection point are estimated using part of the measurement data. The adjustment is then performed, using ***all*** of the observed measurement data from known coordinate points, to obtain the best coordinates for this point.

The adjustment is performed by constructing residual equations for each set of measurement data from the known co-ordinate points. These can be represented in matrix form as:

$$Av = f$$

where:

v= n x 1 vector of residuals for the field measurements;
A = u x n matrix containing combinations of field measurement data;
f = u x 1 vector of numerical terms derived from the measurements and computed values of measurements;
u = number of unknowns;
n= number of measurements.

The least squares estimate can be achieved by minimising the function $v^T Wv$ where W is a weight matrix. This weight matrix is associated with the measurement data, and each diagonal element of the matrix is the weight assigned to the corresponding measurement.

Because of the non-linearity of the problem, minimising the function $v^T Wv$ can be achieved by introducing a vector of Lagrange multipliers (K) and using calculus to solve the following function.

$$v^T Wv - 2K^T (Av - f)$$

For this function to be a minimum, the partial derivative with respect to v $(v^T W - 2K^T A)$ must equal 0. By rearranging this we can obtain an equation in terms of v.

$$v = W^{-1} A^t K$$

This can be used to substitute back into the original equation to obtain the following:

$$AW^{-1} A^T K = f$$

Because matrices A, W and vector f are known, K (the matrix of Lagrange multipliers), can now be calculated. This then allows the vector of residuals (v) to be computed. Once both of these values (K and v) have been obtained, the adjusted coordinates and adjusted observation data can be calculated in turn.

Because of the non-linearity of the problem, the solution needs to be iterated; however if the adjustment converges properly, the number of iterations needed should only be small.

A legitimate measure of accuracy of the adjusted resection point can be obtained by examining the variance factor which results from the adjustment. This variance factor can be calculated as:

$$\frac{v^T W^{-1} v}{r}$$

where r is the degrees of freedom.

In a least squares adjustment, the degrees of freedom equals the number of redundant observations in the model (i.e. $n - u$).

Remote Benchmark

Let:

$\overline{VA}_i, \overline{SD}_i$ = Means of the F1 and F2 readings to a benchmark for set i. If a set is only measured on one face, those measurements are used as the mean values for that set.

$$VD_i = \overline{SD}_i \cos(\overline{VA}_i)$$

$$HD_i = \overline{SD}_i \sin(\overline{VA}_i)$$

Stn Z is calculated as:

$$Z_i = Z_{BM} - VD_i + ht_{BM} - hi$$

$$StnZ = \frac{\sum_{i=1}^{n} \frac{Z_i}{HD_i}}{\sum_{i=1}^{n} \frac{1}{HD_i}}$$

Stn HI is calculated as:

$$hi_i = Z_{BM} - VD_i + ht_{BM} - StnZ$$

$$StnHI = \frac{\sum_{i=1}^{n} \frac{hi_i}{HD_i}}{\sum_{i=1}^{n} \frac{1}{HD_i}}$$

Instrument HI is calculated as:

$$Z_i = Z_{BM} - VD_i + ht_{BM}$$

$$InstZ = \frac{\sum_{i=1}^{n} \frac{Zi_i}{HD_i}}{\sum_{i=1}^{n} \frac{1}{HD_i}}$$

The maximum Δ values are calculated from the Z_i or hi_i values.

Total Station

REM - remote elevation measurement.

The REM value is set to 0 at the prism position. The REM value is then the distance above the prism position.

HD and *VD* = measurements to the prism position.

VA = angle to the REM point.

$$REM = \left(\frac{HD}{\tan(VA)}\right) - VD$$

RDM Continuous

$$dist = \sqrt{(N_i - N_{i-1})^2 + (E_i - E_{i-1})^2}$$

RDM Radial

$$dist = \sqrt{(N_i - N_1)^2 + (E_i - E_1)^2}$$

Gradient

$$grade = \frac{HD}{VD}:1$$

Percentage Slope

$$V\% = \frac{VD}{HD} \bullet 100$$

Collection

Angle - Angle Intersection

Let

N_{ST1} , E_{ST1} , Z_{ST1} = Coordinates of the first station point.

N_{ST2} , E_{ST2} , Z_{ST2} = Coordinates of the second station point.

To calculate the azimuths to the point:

$$AZ_1 = BS_{AZ1} + HA_1$$

$$AZ_2 = BS_{AZ2} + HA_2$$

To determine the matrices A [2][2] and B[2]:

If $((AZ_1 > \pi/4$ *and* $AZ_1 < 3\pi/4)$ *Or* $(AZ_1 > 5\pi/4$ *and* $AZ_1 < 7\pi/4))$

Then

A [1][1] = 1.0

A [1][2] = $-\tan(\pi/2 - AZ_1)$

B [1] = $N_1 - E_1 * \tan(\pi/2 - AZ_1)$

Else

A [1][1] = $-\tan(AZ_1)$

A [1][2] = 1.0

B [1] = $E_1 - N_1 * \tan(AZ_1)$

If $((AZ_2 > \pi/4$ *and* $AZ_2 < 3\pi/4)$ *Or* $(AZ_2 > 5\pi/4$ *and* $AZ_2 < 7\pi/4))$

Then

$A\ [2][1] = 1.0$

$A\ [2][2] = -\tan\ (\pi/2 - AZ_2)$

$B\ [2] = N_2 - E_2 \circ \tan\ (\pi/2 - AZ_1)$

Else

$A\ [2][1] = -\tan\ (AZ_2)$

$A\ [2][2] = 1.0$

$B\ [2] = E_2 - N_2 \circ \tan\ (AZ_2)$

To calculate the intersection coordinates:

$$N = \frac{(B[1] \circ A[2][2] - B[2] \circ A[1][2])}{(A[1][1] \circ A[2][2] - A[2][1] \circ A[1][2])}$$

$$E = \frac{(A[1][1] \circ B[2] - A[2][1] \circ B[1])}{(A[1][1] \circ A[2][2] - A[2][1] \circ A[1][2])}$$

To calculate the mean Z coordinate:

$$\Delta N_2 = N_{ST2} - N$$

$$\Delta E_2 = E_{ST2} - E$$

$$HD_2 = \sqrt{\Delta N_2^{\,2} + \Delta E_2^{\,2}}$$

$$\Delta Z_2 = HD_2 \bullet \tan(VA_2)$$

$$Z_2 = HI_2 + Z_{ST2} + \Delta Z_2 - HT_2$$

$$\Delta N_1 = N_{ST1} - N$$

$$\Delta E_1 = E_{ST1} - E$$

$$HD_1 = \sqrt{\Delta N_1^{\,2} + \Delta E_1^{\,2}}$$

$$\Delta Z_1 = HD_1 \bullet \tan(VA_1)$$

$$Z_1 = HI_1 + Z_{ST1} + \Delta Z_1 - HT_1$$

$$\bar{Z} = \frac{(Z_1 + Z_2)}{2}$$

Vertical Angle Offset

When a vertical angle offset is specified, the current VA is used with the HA to the prism. A new SD is calculated perpendicular to the prism intersecting with the new VA.

VA_{OFF} = VA to the offset point.

$$SD_{ADJ} = \frac{HD_{MEAS}}{\cos(VA_{OFF})}$$

NOTE: The ht is set to zero for VA offset readings, hence the Z calculated will be to the sighted point.

Taped Offsets

A taped offset measures the distance from the prism to the point.

out = the horizontal distance in the direction of the shot (positive away from the station, negative toward the station).

right = the horizontal distance perpendicular to the direction of the shot (positive to the right, negative to the left).

up = the vertical distance (positive upward, negative downward).

$$HD_{OUT} = HD_{MEAS} + out$$

$$\Delta HA = \tan^{-1}\left(\frac{right}{HD_{OUT}}\right)$$

$$HA_{ADJ} = HA + \Delta HA$$

$$HA_{ADJ} = \frac{HD_{OUT}}{\cos(\Delta HA)}$$

$$VD_{ADJ} = VD_{MEAS} + up$$

$$SD_{ADJ} = \sqrt{HD^2_{ADJ} + VD^2_{ADJ}}$$

$$VA_{ADJ} = \sin^{-1}\left(\frac{VD_{ADJ}}{SD_{ADJ}}\right)$$

Stakeout

Within stakeout there are additional values:

N_{SO} , E_{SO} , Z_{SO} = design coordinates of the point to be staked out.

N_P , E_P , Z_P = calculated coordinates from the measurement to the prism. The Z is dynamic based on the current VA reading.

HD_{SO} = horizontal distance to the point to be staked out.

HD_P = horizontal distance to the prism.

AZ_{SO} = azimuth to the point to be staked out.

AZ_P = azimuth to the prism.

$Z_{O/S}$ = a constant applied to all Z values when calculating ΔVA.

NOTE: $Z_{O/S}$ is not applied to any other vertical data, e.g. CUT/FILL.

$$AZ_P = BS_{AZ} + HA$$

$$\Delta HA = AZ_P - AZ_{SO}$$

$$\Delta VA = VA - \tan^{-1}\left(\frac{HD_{SO}}{Z_{SO} + Z_{O/S} - Z_{STN} - hi}\right)$$

In/Out

Negative values imply the rodman must move out (move the prism away from the instrument) by the specified amount.

$$in = HD_P - (HD_{SO} \bullet \cos(\Delta HA))$$

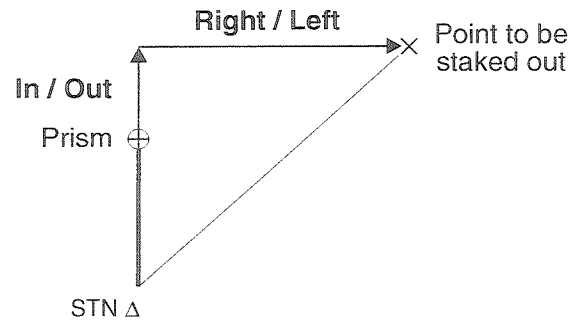
Negative = Out (move away from the instrument).
Positive = In (move towards the instrument).

Right/Left

$$right = HD_{SO} \bullet sin\ (\Delta HA)$$

Negative = Left (rodman move prism to *left* when looking at the instrument).

Positive = Right (rodman move prism to *right* when looking at the instrument).



Cut/Fill

Negative values imply the rodman must raise the prism by the specified amount.

$$cut = Z_P - Z_{SO}$$

Negative = Fill (prism is below design).

Positive = Cut (prism is above design).

Radial Distance

Horizontal distance from the point to be staked out to the point defined by the last measurement.

$$rdist = \sqrt{(N_{SO} - N_P)^2 + (E_{SO} - E_P)^2}$$

STA

The station value is the distance along the instrument to SO Point Line to form a right angle to the prism.

$$sta = HD_P \bullet \cos(\Delta HA)$$

OS (Offset)

The right angle distance from the instrument to SO Point Line to the prism. Negative values imply the rodman must move to the left of the prism (when looking from the instrument) by the specified amount.

$$os = HD_P \bullet \sin(\Delta HA)$$

Control

Mean values for each point are calculated as:

$$\overline{HA} = \frac{\sum_{i=1}^{n} HA_i}{n}$$

$$\overline{VA} = \frac{\sum_{i=1}^{n} VA_i}{n}$$

$$\overline{SD} = \frac{\sum_{i=1}^{n} SD_i}{n}$$

Where:

n = number of measurements to the point in all sets.

Standard Deviation values for each point are calculated as:

$$\text{Standard Deviation of } HA = \sqrt{\frac{\sum_{i=1}^{n} (HA_i - \overline{HA})^2}{n-1}}$$

$$\text{Standard Deviation of } VA = \sqrt{\frac{\sum_{i=1}^{n} (VA_i - \overline{VA})^2}{n-1}}$$

$$\text{Standard Deviation of } SD = \sqrt{\frac{\sum_{i=1}^{n} (SD_i - \overline{SD})^2}{n-1}}$$

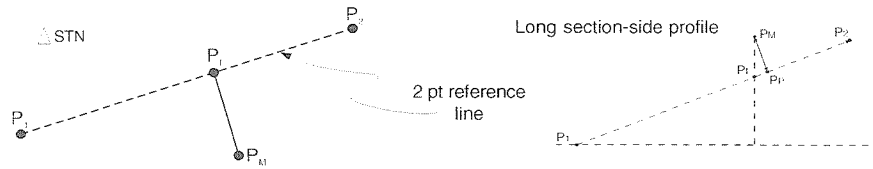
2 Point Reference Line

Overview

This section provides details of the mathematical formulae used by the AP800 software to perform calculations, corrections and make adjustments.

Remember that HA and VA are measured angles.

SD´, HD´ and VD´ are corrected for Temperature & Pressure, Instrument & Prism Constants, Curvature & Refraction, Sea Level, and Map Projection.



P_1 = Point 1

P_2 = Point 2

P_I = Intersection Point

P_M = Measured Point

P_P = Perpendicular to line Intersection Point on the line's vertical plane

Formulae Definitions

The formulae used in 2 Point Reference Line calculations are as follows:

$$AZ = BS_{AZ} + HA$$

$$N_M = N_{STN} + HD' \bullet cos\ (AZ)$$

$$E_M = E_{STN} + HD' \bullet sin\ (AZ)$$

$$Z_M = Z_{STN} + hi - ht + VD'$$

$$AZ_{1\text{-}2} = \tan^{-1}\left[\frac{(E_2 - E_1)}{(N_2 - N_1)}\right]$$

$$AZ_{1\text{-}M} = AZ_{1\text{-}2} + \pi/2$$

if $(AZ_{1\text{-}2} > \frac{\pi}{4}$ and $AZ_{1\text{-}2} < \frac{3\pi}{4})$ or $(AZ_{1\text{-}2} > \frac{5\pi}{4}$ and $AZ_{1\text{-}2} < \frac{7\pi}{4})$ then

$$A[1]\ [1] = 1.0$$

$$A[1]\ [2] = -\tan\ (\frac{\pi}{2} - AZ_{1\text{-}2})$$

$$B[1] = N_1 - E_1 \bullet \tan\ (\frac{\pi}{4} - AZ_{1\text{-}2})$$

else

$$A[1]\ [1] = -\tan\ (AZ_{1\text{-}2})$$

$$A[1]\ [2] = 1.0$$

$$B[1] = E_1 - N_1 \bullet \tan\ (AZ_{1\text{-}2})$$

if $(AZ_{I\text{-}M} > \frac{\pi}{4}$ and $AZ_{I\text{-}M} < \frac{3\pi}{4})$ or $(AZ_{I\text{-}M} > \frac{5\pi}{4}$ and $AZ_{I\text{-}M} < \frac{7\pi}{4})$ then

$$A[2]\ [1] = 1.0$$

$$A[2]\ [2] = -\tan\left(\frac{\pi}{2} - AZ_{I\text{-}M}\right)$$

$$B[2] = N - E \bullet \tan\left(\frac{\pi}{2} - AZ_{I\text{-}M}\right)$$

else

$$A[2]\ [1] = -\tan\left(AZ_{I\text{-}M}\right)$$

$$A[2]\ [2] = 1.0$$

$$B[2] = E - N \bullet \tan\left(AZ_{I\text{-}M}\right)$$

$$N_I = \frac{B[1] \bullet A[2]\ [2] - B[2] \bullet A[1]\ [2]}{A[1]\ [1] \bullet A[2]\ [2] - A[2]\ [1] \bullet A[1]\ [2]}$$

$$E_I = \frac{B[2] \bullet A\ [1]\ [1] - B\ [1] \bullet A\ [2]\ [1]}{A[1]\ [1] \bullet A[2]\ [2] - A[2]\ [1] \bullet A[1]\ [2]}$$

$$STN_M = \sqrt{(N_1 - N_I)^2 + (E_1 - E_I)^2}$$

$$Z_I = Z_1 + \frac{STN_M}{\sqrt{(N_2 - N_1)^2 + (E_2 - E_1)^2}} \bullet (Z_2 - Z_1)$$

$$|O/S_M| = \sqrt{(N_I - N_M)^2 + (E_I - E_M)^2}$$

$$AZ'_{I-M} = \tan^{-1}\left[\frac{(E_M - E_I)}{(N_M - N_I)}\right]$$

if $O/S_M > 0$ then

$$C/F_M = Z_M - (Z_I + |O/S_M| \bullet Slope_R)$$

else

$$C/F_M = Z_M - (Z_I + |O/S_M| \bullet Slope_L)$$

$$STN = STN_M + STN_{base}$$

$$O/S = O/S_M + O/S_{base}$$

$$C/F = C/F_M + Zo/s_{base}$$

$$V\% = \frac{VD}{HD} \bullet 100$$

NOTE: V% is calculated from uncorrected HD and VD.

$$if(Z_1 = Z_2)$$

then

$$Perp = C/F_M$$

$$Slp = STN_M$$

else

$$Ang_{MIP} = \tan^{-1}\left(\left|\frac{HD_{1-2}}{Z_2 - Z_1}\right|\right)$$

$$Perp = \sin\,(Ang_{MIP}) \bullet (Z_M - Z_I)$$

$$Slp_{I-P} = \cos\,(Ang_{MIP}) \bullet (Z_M - Z_I)$$

$$if\ (Z_2 < Z_1)$$

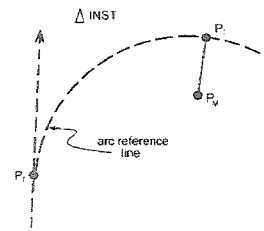
$$Slp_{I-P} = -Slp_{I-P}$$

$$Slp_{1-I} = \frac{STN_M}{\sin\,(Ang_{MIP})}$$

$$Slp = Slp_{1-I} + Slp_{I-P}$$

O/S, STN, C/F, HA, VA, SD´, AZ, VD´, HD´, E_M, N_M, Z_M, V%, Slp and Perp can all be displayed.

Arc Reference Line



P_1 = Point 1
P_2 = Point 2. Any point on the exit tangent. Not shown.
P_I = Intersection point
P_M = Measured point

N_M, E_M, Z_M = coordinates of the measured point

N_I, E_I, Z_I = coordinates of the intersection point

AZ_{start} = azimuth from the centre of the arc to P_1.

N_{centre}, E_{centre} = coordinates at the centre of the arc.

$AZ_{centre.M}$ = azimuth from the centre of the arc to the measured point.

$HD_{centre.M}$ = horizontal distance from the centre of the arc to the measured point.

STN_M = distance along the arc to the intersection point.

STN = distance along the arc to the intersection point including a base station offset.

O/S = offset from the measured point to the arc.

C/F_M = cut/fill value of the measured point

C/F = cut/fill value including the vertical offset constant.

$Z_{o/s}$ = vertical offset constant applied to C/F.

$Slope_R$ = percentage slope applied to C/F when P_M is to the right of the arc.

$Slope_L$ = percentage slope applied to C/F when P_M is to the left of the arc.

O/S = distance from the centre of the arc to the measured point.

$$AZ = BS_{AZ} + HA$$
$$N_M = N_{INST} + HD' \bullet \cos(AZ)$$
$$E_M = E_{INST} + HD' \bullet \sin(AZ)$$
$$Z_M = Z_{INST} + hi - ht + VD'$$

if $(radius > 0)$

$$AZ_{start} = AZ_1 - \pi/2$$

else

$$AZ_{start} = AZ_1 + \pi/2$$

$$N_{centre} = N_{pt_1} - |radius| \bullet \cos(AZ_{start})$$
$$E_{centre} = E_{pt_1} - |radius| \bullet \sin(AZ_{start})$$

$$AZ_{centre.M} = \tan^{-1}\left(\frac{(E_M - E_{centre})}{(N_M - N_{centre})}\right)$$

$$|HD_{centre.M}| = \sqrt{(N_N - N_{centre})^2 + (E_M - E_{centre})^2}$$

if $(radius > 0)$

$$STN_M = 2\pi \bullet radius \bullet \left(\frac{AZ_M - AZ_{start}}{2\pi}\right)$$

$$O/S = radius - HD_{centre.M}$$

else

$$STN_M = 2\pi \bullet |radius| \bullet \left(\frac{AZ_{start} - AZ_M}{2\pi}\right)$$

$$O/S = HD_{centre.M} + radius$$

$$STN = STN_M + STN_{base}$$

$$N_I = N_{centre} + radius \bullet \cos(AZ_{centre,M})$$
$$E_I = E_{centre} + radius \bullet \sin(AZ_{centre,M})$$
if (Pt_2 *is end of curve*)

$$Z_I = Z_{pt_1} + (Z_{pt_2} - Z_{pt_1}) \bullet \frac{STN_M}{arclen}$$

else

$$Z_I = Z_{pt_1}$$

if ($O/S > 0$)

$$C/F_M = Z_M - Z_I - (|O/S| \bullet Slope_R)$$

else

$$C/F_M = Z_M - Z_I - (|O/S| \bullet Slope_L)$$

$$C/F = C/F_M + Z_{O/S}$$

COGO

Inverse

Pt-Pt (Point - Point)

Primary Data Display

$$Az = \tan^{-1}\left[\frac{(E_2 - E_1)}{(N_2 - N_1)}\right]$$

$$VD = Z_2 - Z_1$$

$$HD = \sqrt{|(N_2 - N_1)^2 + (E_2 - E_1)^2|}$$

Alternative Data Display

$$SD = \sqrt{|(N_2 - N_1)^2 + (E_2 - E_1)^2| + (Z_2 - Z_1)^2}$$

$$GD = \frac{HD}{VD} \qquad V\% = \frac{100}{GD}$$

Pt-Line (Point - Line)

Let:

N_P , E_P , Z_P = Coordinates of point Pt.

N_{L1} , E_{L1} , Z_{L1} = Coordinates of 1st Line Pt.

N_{L2} , E_{L2} , Z_{L2} = Coordinates of 2nd Line Pt.

The azimuth of a line through point Pt. and perpendicular to the line. is calculated as:

$$Az_P = Az_L + \frac{\pi}{2}$$

The intersection point (N_1, E_1) of the two lines is calculated using the Brng-Brng intersection routine (see page A-69).

The Stn and O/S values are then calculated using the Pt-Pt HD formula (see page A-67).

$$Stn = HD_{P,\,1}$$

$$O/S = HD_{L1,\,1}$$

The elevation of the intersection point is calculated as:

$$Z_1 = Z_{L1} + VD_{L1,\,L2} \bullet \left(\frac{Stn}{HD_{L1,\,L2}} \right)$$

NOTE: The elevation is only calculated if the coordinates for each end of the line are known.

Intersections

Brng-Brng (Bearing - Bearing)

To calculate the bearings of the lines:

$$Brng_1 = AZ_1 + Ang_1$$

$$Brng_2 = AZ_2 + Ang_2$$

and the offset points:

$$N'_1 = N_1 + Offset_1 \bullet \cos\left(Brng_1 + \frac{\pi}{2}\right)$$

$$E'_1 = E_1 + Offset_1 \bullet \sin\left(Brng_1 + \frac{\pi}{2}\right)$$

$$N'_2 = N_2 + Offset_2 \bullet \cos\left(Brng_2 + \frac{\pi}{2}\right)$$

$$E'_2 = E_2 + Offset_2 \bullet \sin\left(Brng_2 + \frac{\pi}{2}\right)$$

To determine the matrices $A[2][2]$ and $B[2]$:

If $((Brng_1 > \pi/4$ *and* $Brng_1 < 3\pi/4)$ *Or* $(Brng_1 > 5\pi/4$ *and* $Brng_1 < 7\pi/4))$

Then

$A[1][1] = 1.0$

$A[1][2] = -\tan(\pi/2 - Brng_1)$

$B[1] = N'_1 - E'_1 \bullet \tan(\pi/2 - Brng_1)$

Else

$A\ [1]\ [1] = -\tan\ (Brng_1)$

$A\ [1]\ [2] = 1.0$

$B\ [1] = E'_1 - N'_1 \circ \tan\ (\mathrm{Brng}_1)$

If $((Brng_2 > \pi/4\ and Brng_2 < 3\pi/4)\ Or\ (Brng_2 > 5\pi/4\ and Brng_2 < 7\pi/4))$

Then

$A\ [2]\ [1] = 1.0$

$A\ [2]\ [2] = -\tan\ (\pi/2 - Brng_2)$

$B\ [2] = N'_2 - E'_2 \circ \tan\ (\pi/2 - Brng_2)$

Else

$A\ [2]\ [1] = -\tan\ (Brng_2)$

$A\ [2]\ [2] = 1.0$

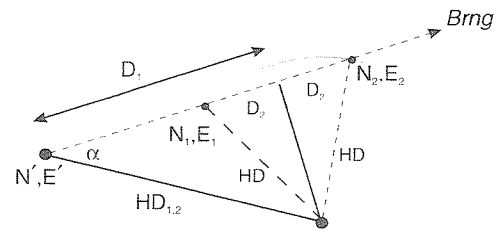
$B\ [2] = E'_2 - N'_2 \circ \tan\ (Brng_2)$

To calculate the intersection coordinates:

$$N = \frac{(B[1] \circ A[2][2] - B[2] \circ A[1][2])}{(A[1][1] \circ A[2][2] - A[2][1] \circ A[1][2])}$$

$$E = \frac{(A[1][1] \circ B[2] - A[2][1] \circ B[1])}{(A[1][1] \circ A[2][2] - A[2][1] \circ A[1][2])}$$

Brng-Dist (Bearing - Distance)



$$Brng = Az + Ang$$

$$N' = N_B + Offset \bullet \cos\left(Brng + \frac{\pi}{2}\right)$$

$$E' = E_B + Offset \bullet \sin\left(Brng + \frac{\pi}{2}\right)$$

$$D_1 = HD_{1.2} \bullet \cos(\alpha)$$

$$D_2 = \sqrt{D_1^2 - HD_{1.2}^2 + HD^2}$$

$$D' = D_1 - D_2$$

$$N_1 = N' + D' \bullet \cos(Brng)$$

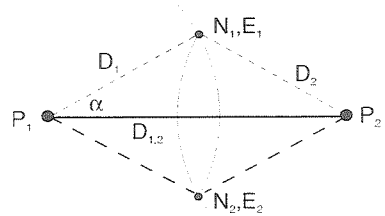
$$E_1 = E' + D' \bullet \sin(Brng)$$

$$D' = D_1 + D_2$$

$$N_2 = N' + D' \bullet \cos(Brng)$$

$$E_2 = E' + D' \bullet \sin(Brng)$$

Dist-Dist (Distance - Distance)



$$\alpha = \cos^{-1}\left(\frac{D^2_1 + D^2_{1.2} - D^2_2}{2D_1 \bullet D_{1.2}}\right)$$

$$N_1 = N_{P1} + D_1 \bullet \cos(Az_{1.2} - \alpha)$$

$$E_1 = E_{P1} + D_1 \bullet \sin(Az_{1.2} - \alpha)$$

$$N_2 = N_{P1} + D_1 \bullet \cos(Az_{1.2} + \alpha)$$

$$E_2 = E_{P1} + D_1 \bullet \sin(Az_{1.2} + \alpha)$$

Parallel Line

Coordinates of the first offset point are calculated as:

$$N_1 = N_{P1} + Offset \bullet \cos\left(Az_{1.2} + \frac{\pi}{2}\right)$$

$$E_1 = E_{P1} + Offset \bullet \sin\left(Az_{1.2} + \frac{\pi}{2}\right)$$

Coordinates of the offset points from point 2 to point n-1 inclusive, are calculated as:

$$Ang_{i-1,i,i+1} = 180 - (Az_{i,i+1} - Az_{i-1,i})$$

$$Dist = \frac{Offset}{\sin\left(\frac{Ang_{i-1,i,i+1}}{2}\right)}$$

$$N_i = N_{Pi} + Dist \bullet \cos\left(Az_{i,i+1} + \frac{Ang_{i-1,i,i+1}}{2}\right)$$

$$E_i = E_{Pi} + Dist \bullet \sin\left(Az_{i,i+1} + \frac{Ang_{i-1,i,i+1}}{2}\right)$$

Coordinates of the last offset point are calculated as:

$$N_n = N_{Pn} + Offset \bullet \cos\left(Az_{n-1,n} + \frac{\pi}{2}\right)$$

$$E_n = E_{Pn} + Offset \bullet \sin\left(Az_{n-1,n} + \frac{\pi}{2}\right)$$

Area and Perimeter

Let:

n = the number of points defined;

$HD_{i,i+1}$ = the horizontal distance between the ith and the next point;

E_i = the easting of the ith point;

N_{i-1} = northing of the previous point. If i=1, northing of the nth point;

N_{i+1} = northing of the next point. If $i=n$, northing of first point.

Perimeter of the defined polygon is calculated as:

$$Perim = \sum_{i=1}^{n} HD_{i,i+1}$$

Area of the defined polygon is calculated as:

$$Area = \frac{1}{2}\sum_{i=1}^{n} |E_i \bullet (N_{i-1} - N_{i+1})|$$

Manual Input

Brng & Dist (Bearing and Distance)

$$Brng = Az + Ang$$

$$N = N_P + HD \bullet \cos(Brng)$$

$$E = E_P + HD \bullet \sin(Brng)$$

Line & Offset

$$Brng = Az + Ang$$

$$N = N_P + Line \bullet \cos(Brng) + Offset \bullet \cos\left(Brng + \frac{\pi}{2}\right)$$

$$E = E_P + Line \bullet \sin(Brng) + Offset \bullet \sin\left(Brng + \frac{\pi}{2}\right)$$

Shift and Rotation

Let

N_P , E_P = coordinates of the pivot point.

N_{SR} , E_{SR} , Z_{SR} = coordinates of the point being shifted and rotated.

AZ_R = rotation angle.

AZ_S = horizontal shift azimuth.

HD_S = horizontal distance shift.

VD_S = vertical distance shift.

Angle Rotation

$$\Delta N = N_{SR} - N_p$$

$$\Delta E = E_{SR} - E_P$$

$$HD_R = \sqrt{\Delta N^2 + \Delta E^2}$$

$$AZ = \tan^{-1}\left[\frac{\Delta E}{\Delta N}\right] + AZ_R$$

$$N_{SR} = \Delta N + \cos(AZ) \bullet HD_R$$

$$E_{SR} = \Delta E + \sin(AZ) \bullet HD_R$$

Horizontal Shift

$$N_{SR} = N_{SR} + cos\ (AZ_S) \bullet HD_S$$

$$E_{SR} = E_{SR} + sin\ (AZ_S) \bullet HD_S$$

Vertical Shift

$$Z_{SR} = Z_{SR} + VD_S$$

Arc-Curve

Let:
AZ_1 = incoming tangent azimuth at the start of the arc.
N_{pt1}, E_{pt1} = coordinates of the start of arc.
radius = arc radius.
arclength = arc length to calculate the new point at. Incremented by the interval until the end of arc is reached for each new point.
AZ_{start} = the azimuth from the centre of the arc to the start point.
N_{centre}, E_{centre} = coordinates at the centre of the arc.
dist = the combined offset from the centre of the arc to calculate the new points at.

if $(radius > 0)$

$$AZ_{start} = AZ_1 - \pi/2$$

else

$$AZ_{start} = AZ_1 + \pi/2$$

$$N_{centre} = N_{pt_1} - |radius| \bullet \cos(AZ_{start})$$
$$E_{centre}\ E_{pt_1} - |radius| \bullet \sin(AZ_{start})$$

if $(radius > 0)$
  $dist = radius - offset$
else
  $dist = offset - radius$

$$N = N_{centre} + dist \bullet \cos\left(AZ_{start} + 2\pi \bullet \frac{arclength}{2\pi \bullet radius} \right)$$

$$E = E_{centre} + dist \bullet \sin\left(AZ_{start} + 2\pi \bullet \frac{arclength}{2\pi \bullet radius} \right)$$

Traverse Adjustment

Closing distance of the traverse is calculated as:

$$\Delta D = \sqrt{\Delta N^2 + \Delta E^2}$$

Angular misclose, for closed polygons, is calculated as:

$$\Delta A = \left(\sum_{I=1}^{N} A_I \right) - (N-2) \bullet \pi$$

where:

A_i = the angle measurement at each station point;

n = the number of station points.

Angular misclose, for open polygons, is calculated as:

$$\Delta A = Az_{CAL} - Az_{KNOWN}$$

Perimeter is calculated as:

$$Perim = \sum_{i=1}^{n} D_i$$

where:

D_i = the distance measured for each traverse leg;

n = the number of traverse legs.

Area of the traverse (where the traverse forms a closed polygon) is calculated as:

$$Area = \frac{1}{2}\sum_{i=1}^{n}[E_i \bullet (N_{i-1} - N_{i+1})]$$

where:

n = the number of station points;

E_i = *the easting of the* ith point;

N_{i-1} = northing of the previous point. If i=1, northing of the nth point;

N_{i+1} = northing of the next point. If i=n, northing of the first point;

Coordinate Adjustment

Let:

j = the point in the traverse to be adjusted.

Bowditch Adjustment

$$N'_j = N_j + \frac{\sum_{i=1}^{j} D_i}{\sum_{i=1}^{n} D_i} \bullet \Delta N$$

$$E'_j = E_j + \frac{\sum_{i=1}^{j} D_i}{\sum_{i=1}^{n} D_i} \bullet \Delta E$$

Transit Adjustment

$$N'_j = N_j + \frac{\sum_{i=2}^{j} |N_i - N_{i-1}|}{\sum_{i=2}^{n} |N_i - N_{i-1}|} \bullet \Delta N$$

$$E'_j = E_j + \frac{\sum_{i=2}^{j} |E_i - E_{i-1}|}{\sum_{i=2}^{n} |E_i - E_{i-1}|} \bullet \Delta E$$

Z Adjustment (Bowditch and Transit)

$$Z'_j = Z_j + \frac{\sum_{i=1}^{j} D_i}{\sum_{i=1}^{n} D_i} \bullet \Delta Z$$

Glossary

2D Survey	Record only information on the horizontal plane. No reference to the vertical plane.
ASCII File	A text file normally created by using a text editor or word processor.
Az	Azimuth.
BS	Backsight.
BS Az	Backsight azimuth.
BS HT	Backsight height of target.
BS ID	Backsight identifier (alpha-numeric).
BS Pt	Backsight point.
Cancel	Discards any changes to the current screen.
Code	Feature codes used by mapping software to draw topographic features.
CP	Control point.
delta E	Easting difference.
delta HA	Horizontal angle difference.
delta HD	Horizontal distance difference.
delta HDx	Averaged horizontal distance difference.
delta HR	Horizontal right angle to the right.

delta N	Northing difference.
delta SD	Slope distance difference.
delta VA	Vertical angle difference.
delta VD	Vertical distance difference.
delta VDx	Averaged vertical distance difference.
delta Z	Elevation difference.
E	Easting.
f	Feet.
F1	Face 1.
F2	Face 2.
HAx	Averaged horizontal angle.
HD	Horizontal distance.
HDm	Horizontal distance measured.
HI	Height of instrument.
HL	Horizontal angle to the left.
HR	Horizontal angle to the right.
ID	Station or control point identifier.
m	Metre.
Msr	Measure to point.
N	Northing

OK	Accept data or current status.
Open Job	Current working job.
Out Tol!	Distance or angle measurement exceeds the specified tolerance value.
Pt	Point.
Record	Collection of information, such as the point number and NEZ, which define a survey point.
Rec Type	Eleven types of records are stored in the data base, e.g., CP (control point).
RDM	Remote distance measurement.
REM	Remote elevation measurement.
rGD	Grade ratio between remote distance measured points (RDM).
rHDx	Averaged horizontal distance between remote distance measurement points (RDM).
rSDx	Averaged slope distance between (RDM) points.
rVDx	Averaged vertical distance between (RDM) points.
rV%	Percentage grade between (RDM) points.
SD	Slope distance.
SDx	Averaged slope distance.
Stn HI	Instrument height at station.
Stn ID	Station identifier, e.g., STN3.
Stn Pt	Station point.
Stop	Terminates current operation. Data transferred or copied prior to termination is not affected.

VA	Vertical angle.
VAx	Averaged vertical angle.
VDm	Vertical distance measured.
V%	Percentage grade between two points.
Z	Station elevation.
Z dsgn	Design elevation.
Z o/s	Elevation offset.

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