STONEX

R25/R25LR

Total Station

User Manual

(August 2018)-Ver.1-Rev.1 – Firmware Version: 1.1.8.9G (20180615)

www.stonex.it

Dear Customer,

Congratulations! We, STONEX, are proud to present you with these series instrument.

Your total station is a rugged and reliable instrument whose performance and design are not surpassed.

To fully appreciate and protect your investment, we suggest that you take the necessary time to read and fully understand this manual. We have a dedicated service organization. If the need arises, please don't hesitate to contact us.

Thank you for your trust and confidence.

Contents

1. Precautions for safety

1.1. Note

Don't collimate the sun directly

Avoid insolating the instrument, and don't collimate the sun directly for protecting eyes and instrument.

Avoid the vibrations on the instrument

When transporting, keep the instrument in the case and try your best to lighten vibrations.

Carry the instrument

When carrying, the instrument handle must be hold tight.

Check the battery power

Before using it, you should check the power whether it is enough.

Battery maintenance

If the instrument is not used for a long time, the battery should be taken out from the instrument and stored in separate place. Meantime, the battery should be charged every month.

Take out the battery

It is not suggested to take out the battery when the instrument is on, otherwise, the stored data may be lost, so it is better to replace the battery after having powered off the instrument.

Set up the instrument on the tripod

When using it please insure the connection between tripod and instrument is firm. It is better to work with wooden tripod for the measurement accuracy.

Assemble the tribrach on the instrument

The setting of tribrach would influence the accuracy. The tribrach should be checked frequently, the screw which connects the tribrach and alidade must be locked tightly. And the central fixing screw should be tight.

High temperature condition

Don't put the instrument in high temperature condition for a long time, it is bad for the instrument performance.

Temperature changing sharply

The sharp temperature changing on the instrument or prism will shorten the distance measurement range, for example, after taking the instrument out from a warm car to a cold condition, wait for some time, it can be used when it adapts the surrounding condition.

The noise from the instrument

While the instrument working, it is normal hearing the noise from instrument motor. This will not affect the instrument work.

Stored data responsibility

STONEX should not be held liable for the lost data because of wrong operation.

1.2. Definition of indication

For the safe of your product and prevention of injury to operators and other persons as well as prevention of property damage, items which should be observed are indicated by an exclamation point within a triangle used with WARNING and CAUTION statements in this manual.

The definitions of the indication are listed below. Be sure you understand them before reading the manual's main text.

 WARNING:	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.
 CAUTION:	Ignoring this indication and making an operation error could possibly result in death or serious injury to the operator.

 WARNING:

- Do not perform disassembly or rebuilding. Fire, electric shock or burns could result. Only STONEX authorized distributors can disassemble or rebuilt.
- Do not collimate the sun directly. The eye injury or blind could result.
- Do not cover the charger. Fire could be result.
- Do not use defection power cable, socket or plug. Fire, electronic shock could result.
- Do not use wet battery or charger. Fire, electronic shock could result.
- Do not close the instrument to burning gas or liquid, and do not use the instrument in coal mine. Blast could be result.

- Do not put the battery in the fire or high temperature condition. Explosion, damage could result.
- Do not use the battery which is not specified by STONEX. Fire, electric shock or burn could result.
- Do not use the power cable which is not specified by STONEX. Fire could result.
- Do not short circuit of the battery. Fire could result.
- When this product encounters disturbance of severe Electrostatic Discharge, perhaps it will have some degradation of performance like switching on/off automatically and so on.

CAUTION:

- Do not touch the instrument with wet hand. Electric shock could result.
- Do not stand or seat on the carrying case, and do not turn over the carrying case arbitrarily, the instrument could be damaged.
- Be careful of the tripod tiptoe when setup or move it.
- Do not drop the instrument or the carrying case, and do not use defective belt, agraffe or hinge. Instrument damage could result.
- Do not touch liquid leaking from the instrument or battery. Harmful chemicals could cause burn or blisters.
- Please assemble the tribrach carefully, if the tribrach is not stable, series damage could result.
- Do not drop the instrument or tripod, series damage could result. Before use it, check if the central screw is tight.

1.3. Safety standards for laser

R25 series adopt the class of Laser Product according to IEC Standard Publication 60825-1 Amd. 2:2001. According this standard, EDM device is classified as Class 3R Laser Product when reflect less measurement is selected, when the prism and reflective sheet is selected as target, the output is equivalent to the safer class 1. Follow the safety instructions on the labels to ensure safe use.

CAUTION: CLASS 3R LASER RADIATION WHEN OPEN
AVOID DIRECT EYE EXPOSURE.
CAUTION: CLASS 2 LASER RADIATION WHEN OPEN
DO NOT STARE INTO THE BEAM

NOTE FOR SAFETY:

WARNING
• Never point the laser beam at other's eyes, it could cause serious injury. • Never look directly into the laser beam source, it could cause permanent eye damage. • Never stare at the laser beam, it could cause permanent eye damage. • Never look at the laser beam through a telescope or other optical devices, it could cause permanent eye damage.

1.4. About user

This product is for professional use only!

1. The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user manual and safety instructions, before operating, inspecting or adjusting.
2. Wear required protectors (safety shoes, helmet, etc.) when operating.

1.5. Exceptions from responsibility

- The user of this products is expected to follow all operating instructions and make periodic checks of the product's performance.
- The manufacturer assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage, and loss of profits.
- The manufacturer assumes no responsibility for consequential damage, and loss of profits by any disaster, (an earthquake, storms, floods, etc.).
- The manufacturer assumes no responsibility for any damage, and loss of profits due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.

- The manufacturer assumes no responsibility for any damage, and loss of profits caused by usage except for explained in the user manual.
- The manufacturer assumes no responsibility for damage caused by wrong transport, or action due to connecting with other products.

2. Nomenclature

2.1. Parts of the instrument


Instrument
height mark
Model label
R25
Measure
button
RS-232C port
Horizontal
motion screw
Circular level
Objective
Vertical motion
screw
Leveling screw
Tribrach clamp

2.2. Keyboard

Fixed Keys	**Name**	**Functions**
F1~F4	Select key	Select the functions matching the softkeys
0~9/ A~!	Alphanumeric keypad	Enter letters numerical values or other characters
SHIFT	Shift key for character entry	• Shift between number and alphabet when inputting • Shift targets model when measuring
★	Star key	Essential configurations (including illumination etc) can be set here
USER	User key	Each function from the FUNC menu can be set as the {USER} key (see 5.4. Function key).
PAGE	Page key	Scroll to next page when a dialogue consists of several pages.
MENU	Menu key	Access comprehensive menu display including measuring programs, specific settings, the data manager, adjustments, communications parameters, system information and data transfer.
ENT	Enter key	Confirm an entry or selection
ESC	Escape key	Quit a screen or edit mode without saving changes.
FUNC	Function key	Perform sorts of fast function settings defined by program screen
POWER	Power key	Turn on/off the instrument

3. Preparation before measurement

3.1. Power on/off

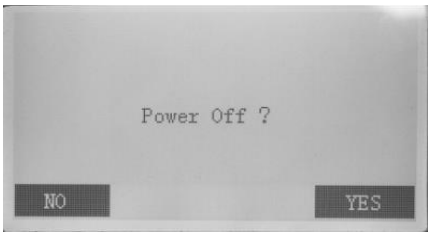
Power on

Confirm the instrument is leveling, then press the {Power} red key and it will be turned on in no time.

The instrument will display the status screen.

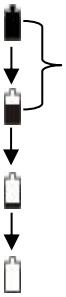
Power off

Press the {Power} key again and the screen will remind whether to power off.



3.2. About battery

3.2.1. Battery power symbol



Measurement is possible

The battery is lower, it is better to replace or recharge it

Measurement is impossible, it is necessary to replace or recharge battery

NOTE:

- The working time of battery will be affected by many factors, such as ambient temperature, recharging time, recharging and discharging times. On the data safe side, we suggest the users recharge the battery full or prepare several full batteries before operation.
- The battery symbol only indicates power capability for current measurement mode. The power consumption in distance measurement mode is more than in angle mode, if the instrument enters the distance measurement mode from angle mode, the power maybe auto-off because of lower battery.
- The symbol only indicates the supply power but not the instantaneous power change. And if the measurement mode changes, the symbol will not show the power's decrease or increase immediately.
- It is suggested to check every battery power before field work.

3.2.2. Replace the battery

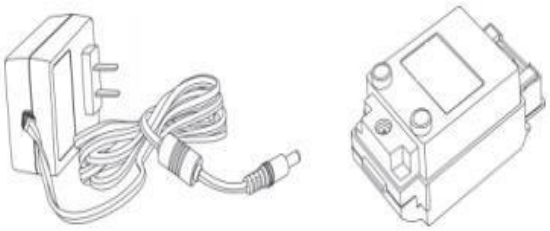
1) Remove the battery

- Press the button downward as shown left;
- Remove the battery by pulling it toward you.

2) Mount the battery

- Insert the battery to the instrument;
- Press the top of the battery until you hear a Click.

3.2.3. Recharge the battery

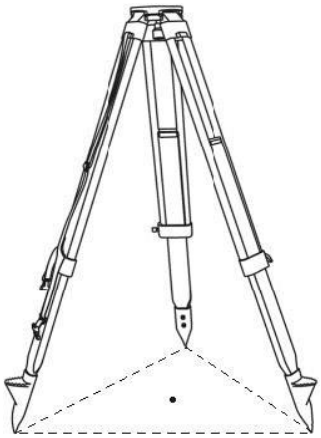


As above figures show, connect the charger and the battery, then plug the charger into the outlet of 100V-240V AC power supply, recharging will begin.

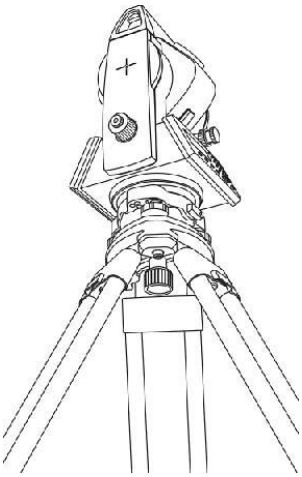
NOTE:

- For a new (or long time no use) battery, in order to fully extend its capacity, it is absolutely necessary to carry out 3 to 5 complete charging/discharging cycles, and the charging time must be 10 hours at least each time.
- The indicator light on the charger will illuminate three separate colors for varies mode conditions:
  - Solid Red Light — indicates that the charger is working;
  - Solid Green Light — indicates that the charge has finished;
  - Flashing Red Light — indicates no battery on charging; poor connection or some problems exist.
- It is recommended to continue charging for 1 or 2 hours after the light turns green.
- Once the red-light flashes constantly after the charger is plugged into the outlet of 100V-240V AC power supply, please remove the battery and reconnected it after 3 or 5 min.

3.3. Setting up the instrument



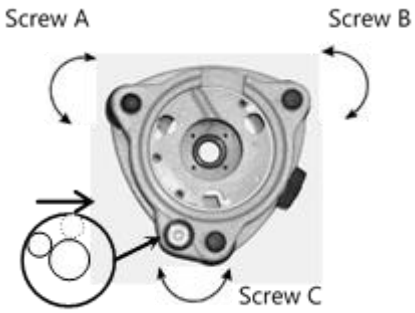
Set up the tripod first: extend the extension legs to suitable lengths and tighten the screws on the midsections. Make sure the legs are spaced at equal intervals and the head is approximately level. Set the tripod so that the head is positioned over the surveying point. Make sure the tripod shoes are firmly fixed in the ground.



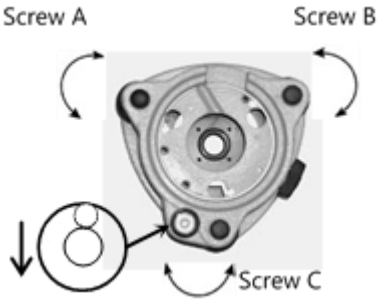
Mount the instrument on the tripod head. Supporting it with one hand, tighten the centering screw on the bottom of the unit to make sure it is secured to the tripod.

3.4. Centering and levelling-up

Basic levelling-up with the circular level

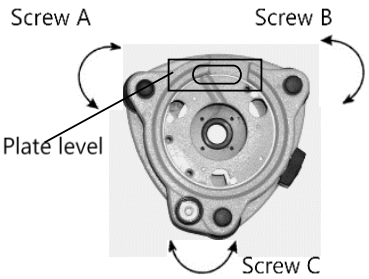


Move the foot screws A and B in opposite direction till the circular bubble is perpendicular to a line shaped with screw A and B. The direction of rotation in left thumb indicates the movement of the circular bubble.

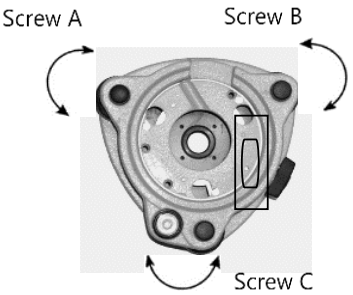


Move the bubble to the center of the circle by turning screw C.

Accurate levelling-up with the plate level



Loosen the horizontal motion clamp and turn the instrument till the plate level is parallel to a line shaped with screws A and B. Adjust the screws A and B to make the bubble in the center of the level.



Turn the instrument approximately 90°. Adjust screw C, till the bubble in the center of the level.

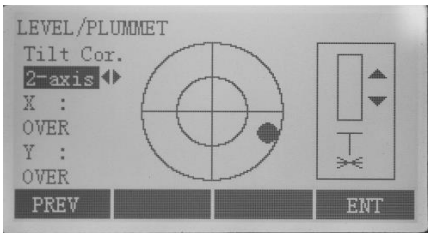
Repeat above steps until the bubble remains in the center of the plate level while the instrument is rotated to any position.

Accurate levelling-up with electronic level on screen

It is convenient for R25 series to level-up with electronic level, especially when it is difficult to observe the circular level and plate level.

Firstly, power on the instrument, press {FUNC} button, and then select "F1(Level/Plummet)". The electronic level displays on screen.

Secondly, level it by turning three-foot screws and ensure the bubble is in the plate level. Make sure that the black spot is in the center.

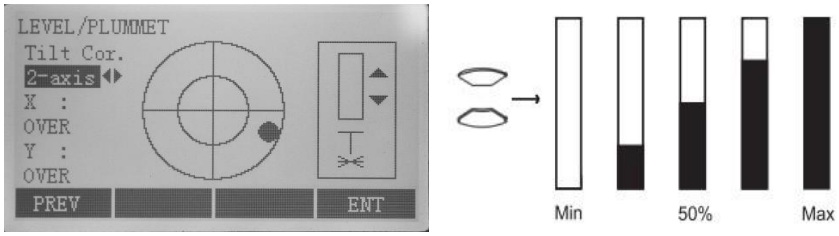


NOTE:

- On this menu you can turn on/off the X/Y compensator by pressing ◄/► keys.
- If the instrument is equipped with laser plummet, opening this menu, the laser plummet adjusting bar will display. With pressing ▲/▼ keys the laser lightness can be adjusted.

Centering with laser plummet

External influences and the surface conditions may lead to the requirement of the adjustment of the laser intensity. The laser can be adjusted in 25% steps as required. If the instrument is equipped with laser plummet, after activating electronic level, the laser plummet adjusting bar will display. With pressing ▲/▼ keys the laser lightness can be adjusted.



Press the {FUNC} key, and then click F1 or (1) keys to enter the display shown in the upper figure. With pressing ▲/▼ keys you can turn on or off laser plummet and set it as four levels of brightness. Thus, that laser emitting downwards can be seen.

Loosen the center screw of tripod, and move the base plate on tripod head until the laser spot coincides with ground mark point. Then tighten the center screw.

Repeat leveling and two steps until the instrument keeps leveling and the laser spot coincides with ground mark point when rotating alidade of instrument in any direction.

After centering, please turn off laser plummet to save power.

3.5. Assembling and disassembling for three-jaws tribrach

It is convenient to assemble or disassemble the instrument from tribrach by loosen or tighten the tribrach clamp.

Disassemble

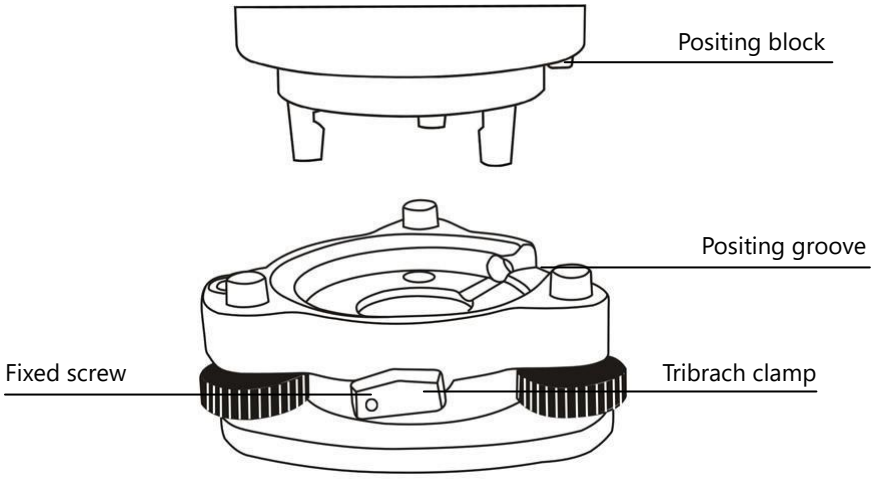
Rotate the tribrach clamp anticlockwise until the lever is loosen.

One hand holds up the tribrach, another hand holds the carry handle of the instrument and lift out the instrument from the tribrach.

Assemble

Put the instrument into the tribrach lightly, let the communication port against in the indentation of the tribrach.

Rotate the tribrach clamp clockwise until the lever is tighten.



NOTE: Fix the tribrach clamp: if the instrument doesn't need assembly or disassembly from tribrach frequently, it is necessary to fix the tribrach clamp by fixed screw to avoid the disassembly by accident.

Screw out the fixed screw by driver to fix the clamp.

NOTE: These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.

4. Basic functions

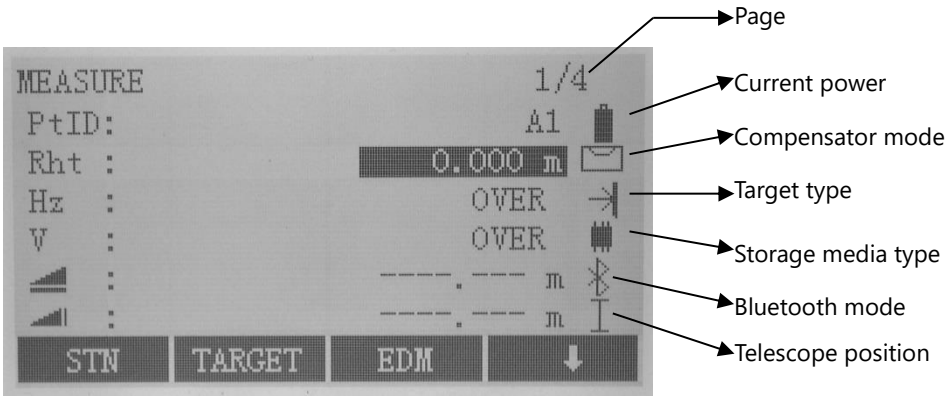
4.1. Display

R25 series is equipped with two large LCD screens (240×128dots). The LCD could display 8 lines with 24 characters per line.

NOTE: Do not touch the screen with sharp things.

Once you switch on the instrument, the measure mode is shown on the display directly. As alternative, it is possible to set another page (such as the electronic bubble display) at every start, see 5.6. Start-up sequence for more information.

Status screen



Symbols:

Function	Symbol	Description
Current power		Level of the remaining battery
Compensator mode		The compensator is on
		The compensator is off
Target type		Distance measurements with prism
		Long range distance measurements with prism
		Distance measurements with sheet
		Distance measurements with no prism

Storage media		The internal card is the current storage media
		The external SD card is the current storage media
Bluetooth mode		The Bluetooth is on
Telescope position	I	The telescope eyepiece is positioned on face left
	II	The telescope eyepiece is positioned on face right

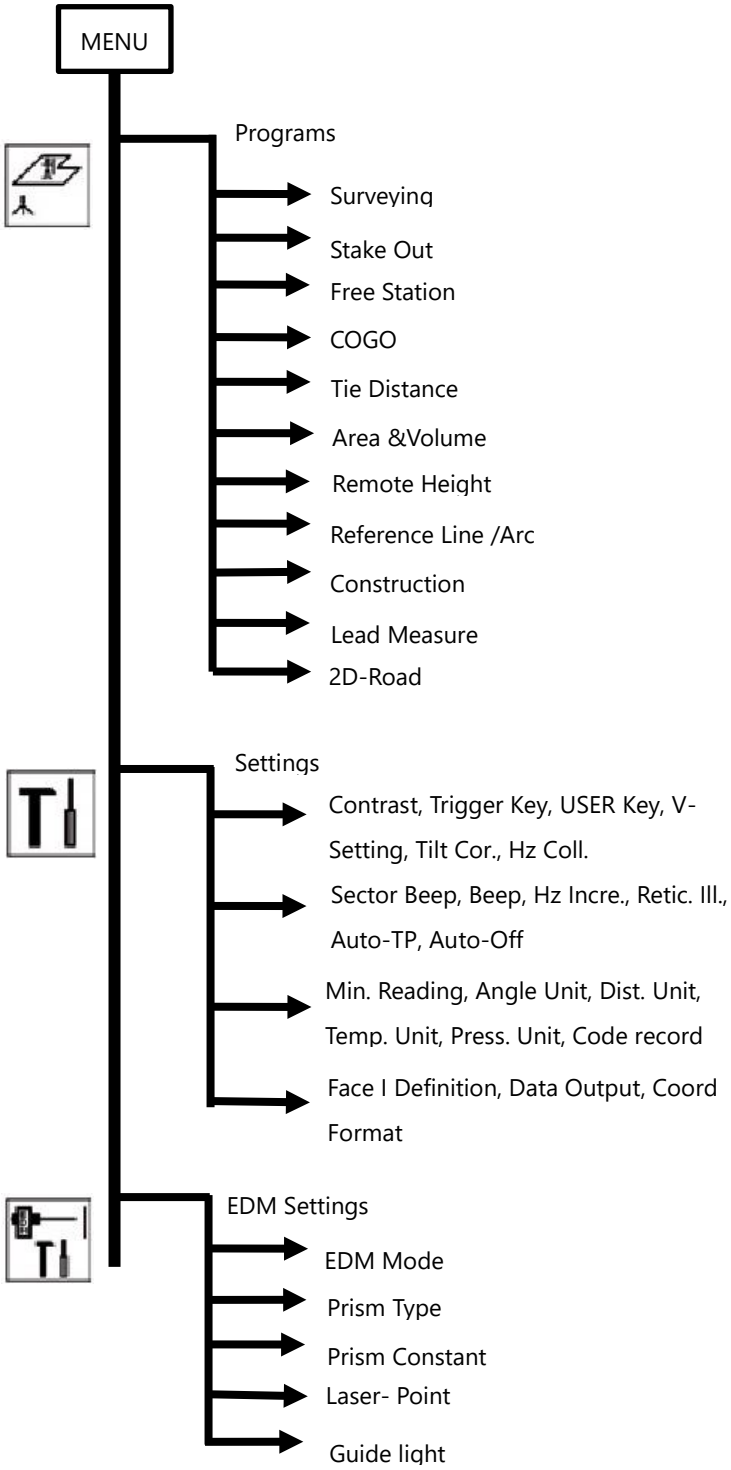
Softkeys

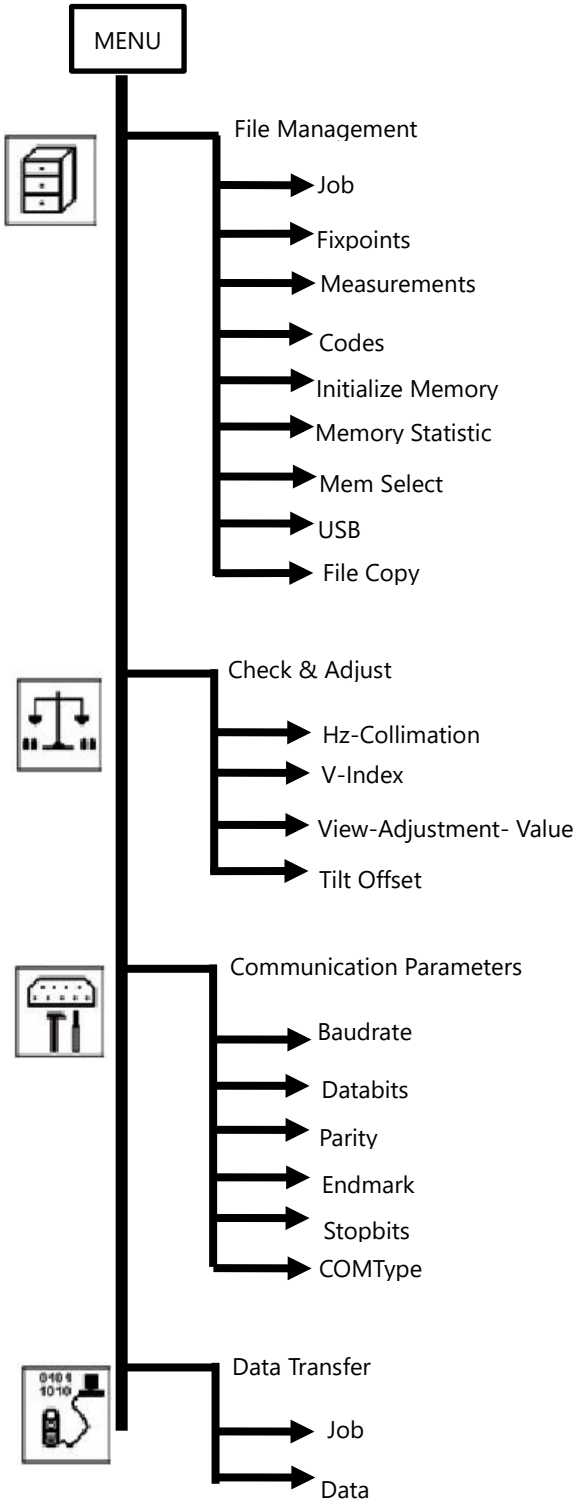
A selection of commands and functions is listed at the bottom of the screen. They can be activated with the corresponding function keys; press the key F4[↓] to scroll. The available scope of each function depends on the applications currently active.

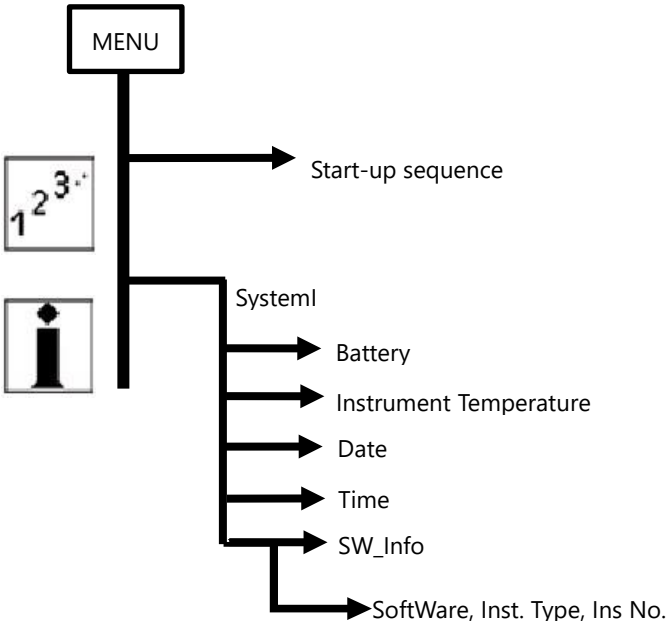
Softkeys	**Description**
[ALL]	Start distance and angle measurements and saves measured values.
[DIST]	Start distance and angle measurements without saving measured values.
[REC]	Save displayed values
[STN]	Set station coordinates
[TARGET]	Select the target type
[EDM]	Display EDM settings.
[TILT]	Select the tilt correction
[HSET]	Set the horizontal angle

4.2. Menu diagram

Press the {MENU} key to enter the main menu. F1-F4 can be used to confirm menu selection. Scroll to next page with the {PAGE} key.

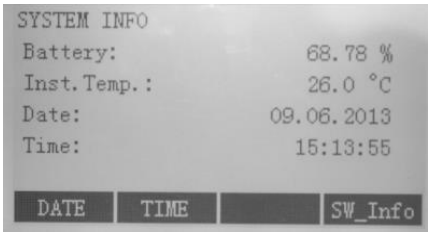

MENU
Programs
Surveying
Stake Out
Free Station
COGO
Tie Distance
Area &Volume
Remote Height
Reference Line /Arc
Construction
Lead Measure
2D-Road
Settings
Contrast, Trigger Key, USER Key, V-Setting, Tilt Cor., Hz Coll.
Sector Beep, Beep, Hz Incre., Retic. Ill., Auto-TP, Auto-Off
Min. Reading, Angle Unit, Dist. Unit, Temp. Unit, Press. Unit, Code record
Face I Definition, Data Output, Coord Format
EDM Settings
EDM Mode
Prism Type
Prism Constant
Laser- Point
Guide light


MENU
File Management
Job
Fixpoints
Measurements
Codes
Initialize Memory
Memory Statistic
Mem Select
USB
File Copy
Check & Adjust
Hz-Collimation
V-Index
View-Adjustment- Value
Tilt Offset
Communication Parameters
Baudrate
Databits
Parity
Endmark
Stopbits
COMType
Data Transfer
Job
Data


MENU
Start-up sequence
SystemI
Battery
Instrument Temperature
Date
Time
SW_Info
SoftWare, Inst. Type, Ins No.

4.3. System information

Press {MENU} key on panel to enter the menu mode. Turn to the third page using the {PAGE} key and select F1[INFO]. Display helpful information and date/time can be set here.



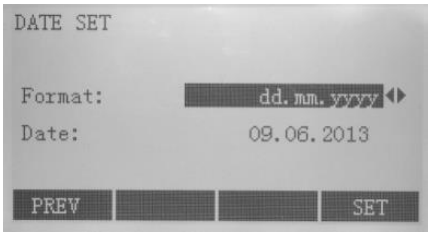
Battery: Remaining battery power (e.g. 90.26%).

Inst. Temp: Measured instrument temperature.

Date: The current date.

Time: The current time.

[DATE]: Press F1 to edit the change of date or to select a format:

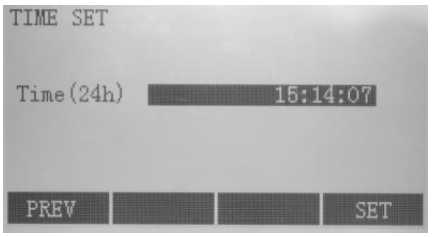


There are three formats; select it through the ◄/► keys:

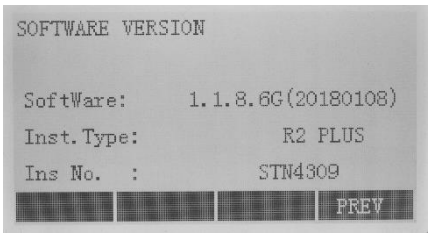
- DD.MM.YYYY;
- MM.DD.YYYY;
- YYYY.MM.DD.

Press F4[SET] to save.

[TIME]: Press F2 to modify the time. Insert the time with the following format: HH:MM:SS. Then, press F4[SET].



[SW-Info]: Press F4 to see some instrument characteristics:



Here:

Software: current software version;

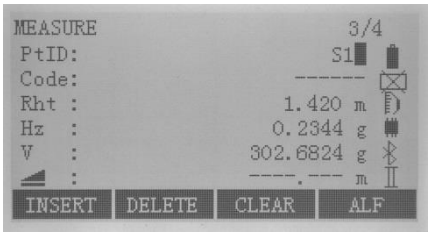
Inst. Type: indicates the specific type of this instrument;

Ins No.: is the instrument serial number.

4.4. How to input number and alphabet

Due to the alphanumerical keypad you can enter characters directly.

- Numeric fields: can only contain numerical values .By pressing a button of the numeric keypad the number will be displayed.
- Alphanumeric fields: can contain numbers and letters. By pressing a button of the alphanumeric keypad the input opens. By pressing several times you can toggle through the characters. For example: 7->A->B->C->7->A...



[INSERT]: If a character was skipped (e.g. 13 instead of 123), you can insert it later. Place cursor on "1", insert an empty character on the right of "1" pressing F1[INSERT] key. Input the new character "2" and confirm input.

[DELETE]: Place cursor on character to be deleted. Delete this character pressing F2 key.

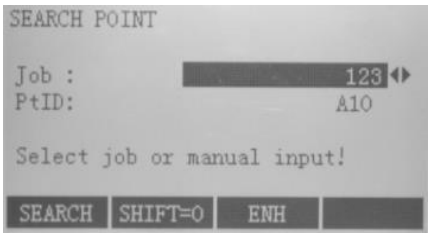
[CLEAR]: Place cursor on any position among character fields. Clear characters pressing F3 key.

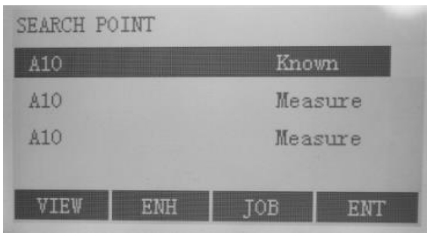
[ALF] / **[NUM]:** By pressing F4 key you can switch between numbers and letters .Here at entry status pressing F4 is equivalent to pressing {SHIFT} key.

4.5. Point search

Point search is a global function used by applications, e.g. to find internally saved measured or fixed points. It is possible for the user to limit the point search to a particular job or to search the whole storage. The search procedure always finds before measured fixed points that fulfill the same search criteria. If several points meet the search criteria, then the points are listed according to their age. The instrument finds the most current (youngest) fixed point first.

By entering an actual point number (e.g. "A10") and pressing F1[SEARCH] all points with the corresponding point number are found.

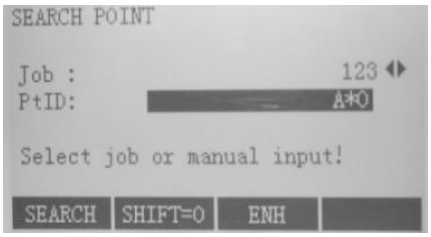




Select one of the following softkeys:

- F1[VIEW] to displays the coordinates of the selected point;
- F2[ENH] for manual input of coordinates;
- F3[JOB] to select a different job;
- F4[ENT] to confirm selected point.

Wildcards are always used if the point number is not fully known, or if a batch of points is to be searched for. The Wildcard search is indicated by a "*". The asterisk is a place holder for any following sequence of characters.



EXAMPLES:

*: All points of any length are found.

PT: All points with exactly the point number "PT" are found.

PT*: All points of any length starting with "PT" are found (e.g.:PT1, PT12, PTAB).

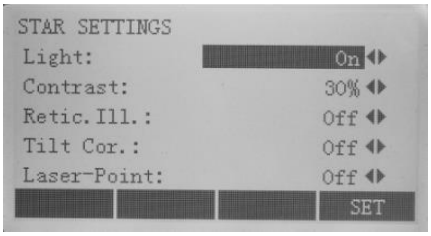
*1: All points of any length with a "1" as the second character are found (e.g.: A1, B12, A1C).

A*1: All points of any length with an "A" as the first character and a "1" as the third character are found. (e.g.: AB1, AA123, AT17).

5. Instrument settings

5.1. Basic settings

Press key [★] on panel to access star settings mode and do some basic essential settings. Change settings if necessary: use ▲/▼ keys to select items and utilize ◄/► keys to set the options. Before leaving the page, press F4[SET] to set the changed options.



Light: it turns on or off the backlight of the screen.

Contrast: it adjusts the LCD display contrast. There are ten levels (10%-100%) which can be set.

Retic. Ill.: it turns on or off the reticle illumination

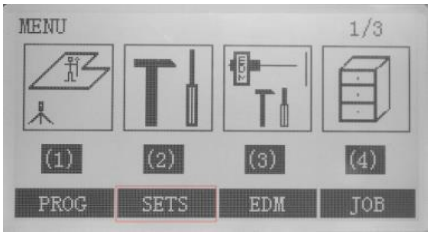
Tilt Cor.: it adjusts the tilt correction, choosing between three options:

- 1-axis: the tilt correction is activated on the x direction
- 2-axis: the tilt correction is activated on both x and y axes direction;
- Off: no tilt correction is activated.

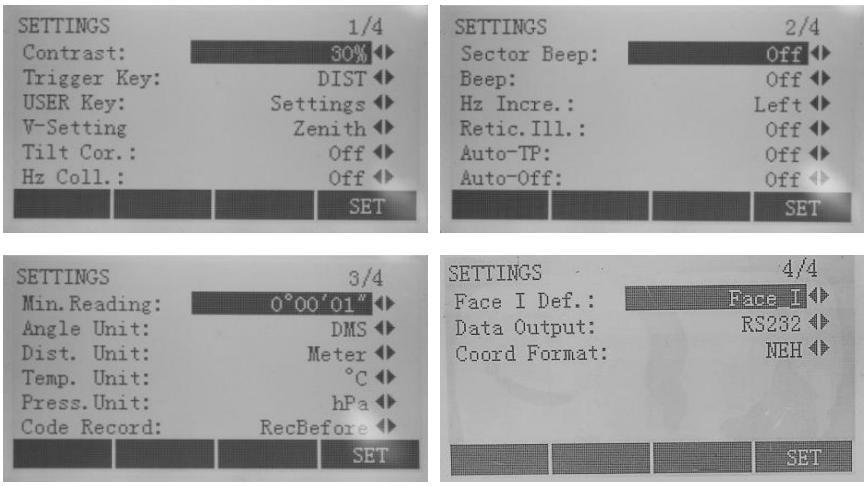
Laser-Point: it turns on or off the laser beam for pointing target.

5.2. Settings

Press {MENU} key on panel to enter the comprehensive menu mode:



Select [SETS] item, where relevant parameters can be set. Press {PAGE} key to scroll all the commands and use ◄/► keys to set the options.



Contast: It's possible to set the constrast in the same way as in the Star setting (see 5.1. Basic settings).

Trigger Key: it is possible to turn on/off the red {MEAS} button on the lateral side of the intrument. Select one of the following options:

- **ALL**: distance and angle measurements saving measured values;
- **DIST**: distance and angle measurements without saving measured values;
- **Off**: the red button doesn't work. The measure is possible through the softkeys on the display.

USER Key: each function from the function menu can be set as the {USER} key, which makes {USER} key on keypad act as a shortcut key. For more informations, see 5.4. Function key.

V-Setting: the zero of the vertical angle can be set with the following options:

- **Zenit**: the 0 is set when the objective is turned upwards in the vertical direction. Zenith=0°, Horizontal=90°;

- **Horizon**: the 0 is set when the objective is turned in the horizontal direction. Zenith=90°, Horizontal=0°;
- **V-(%)**: the angles are shown in percentage values. It is possible to measure angles smaller or equal to ±45°, otherwise "OVER" appears on the display. 0 is set when the objective is turned in the horizontal direction: 45°=100%, Horizontal=0°.

Tilt Cor: it is possible to set the same tilt correction as in the Star settings (see 5.1. Basic settings).

Hz Coll.: it adjusts the horizontal collimation:

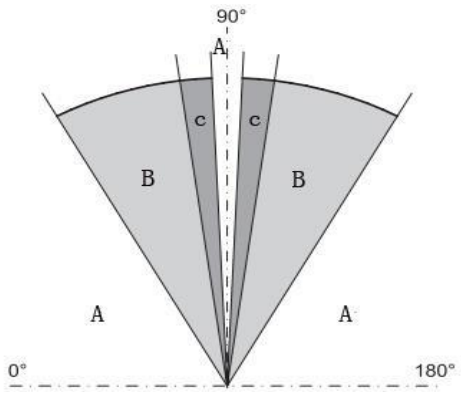
- **On**: Hz Collimation is switched ON;
- **Off**: Hz Collimation is switched OFF.

If Hz Collimation is On, each measured Hz-angle is corrected (depending on V-angle). For normal operation the Hz-collimation remains switched on.

Sector Beep: if this option is on, an acoustic signal sounds at right angles (0°, 90°, 180°, 270° or 0, 100, 200, 300 gon).

Example Sector Beep:

From 95.0 to 99.5 gon (or from105.0 to 100.5 gon) a "fast beep" sounds while from 99.5 to 99.995 gon (or from 100.5 to 100.005 gon) a "permanent beep" sounds.



A:	No beep
B:	Fast beep
C:	Permanent beep

Beep: it is an acoustic signal after each key stroke. Choose between on/off.

Hz Incre.: it allows to set the measurement direction:

- **Right**: Set right Hz for "clockwise direction measurement";
- **Left**: Set left Hz for "anti-clockwise direction measurement" ."Anti-clockwise" directions are only displayed but saved as "clockwise direction".

Retic. Ill.: it is possible to set the same reticle illumination as in the Star settings (see 5.1. Basic settings).

Auto-TP: LCD heating helps with normal working under cold conditions

- On: When LCD heating is switched on;
- Off: LCD heating is switched off.

Auto-Off:

- On: The instrument is switched off after 20 minutes without any action;
- Off: The instrument is switched on permanently. Battery discharges quicker.

Min. Reading: the diplayed minimum angle format can be selected in the following way:

- For DMS (Degree, Minute, Second): 0°00'01"/0°00'05"/0°00'10";
- For DEGREE: 0.0005°/0.001°/0.0001°;
- For GON: 0.0005 gon/0.001 gon/0.0001 gon;
- For MIL: 0.01 mil/0.05 mil/0.10 mil.

Angle Unit: The setting of the angle units can be changed at any time and the actual corresponding displayed values are converted according to the selected unit. Choose between:

- DMS (Degree, Minute, Second): possible angle values are from 0° to 359°59'59'';
- DEGREE(degree decimal): possible angle values are from 0° to 359.999°;
- GON: possible angle values are from 0 gon to 399.999 gon;
- MIL: possible angle values are from 0 to 6399.99mil.

Dist. Unit: the distance unit can be selected in:

- Meter;
- ft-in1/16: US-feet-Inch-1/16 inch;
- US-ft: US-feet;
- INT-ft: International feet.

Temp. Unit: the temperature unit can be selected in:

- °C: Celsius Degree;
- °F: Fahrenheit Degree.

Press. Unit: the pressure unit can be selected in:

- Mbar: millibar;
- hPa: hectoPascal;
- mmHg: millimeter mercury column;
- inHg: inch mercury column.

Code Record: the codeblock can be saved before or after the measurement.

Face I Def.: the following two options can be set to define face I:

- Face I, which is the one where the plate level is positioned; often it is referred to as left face;
- Face II, which is the one where the spherical level is positioned; often it is reffered to as right face.

Data Output: the following two options can be set:

- RS232: data is recorded via the serial interface. For this purpose, a data storage device must be connected;
- Intern: all data is recorded in the internal memory.

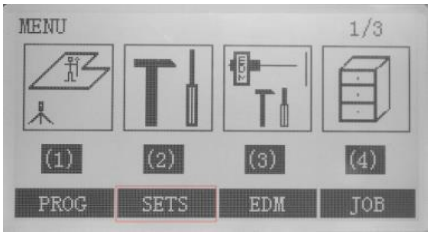
Coord Format: It is possible to choose between two coordinate formats:

- N-E-Z;
- E-N-Z.

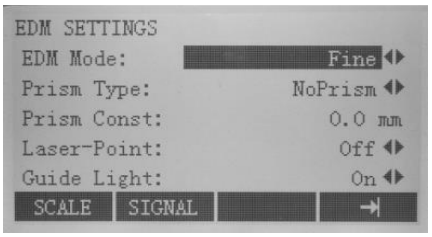
After selecting the options, press key F4[SET] to save.

5.3. EDM settings

Press {MENU} key on panel to enter the menu mode.



Select [EDM] item, where the electronic distancemeter options can be defined. Press F2[SET] to save and return into the menu.



EDM Mode: It possesses three sorts of modes (Quick, Track and Fine) for availability. Worth noting that along with selected measuring mode the selections of prism types are different.

Quick	Quick measuring mode with higher measuring speed and reduced accuracy
Track	Continuous distance measuring
Fine	Fine measuring mode for high precision measurements

Prism Type: With this option, it is possible to define the prism constant. Different options are available, depending on the following target types selected in the function menu (see 5.4. Function key):

- NoPrism: choose between "NoPrism" and "User Define" options (if no targets are used, select "NoPrism");
- Sheet: choose between "Sheet" and "User Define" options (if no targets are used, select "Sheet");
- Prism: choose between one of the default prism types (see table below) or select "User Define" to set manually the prism constant

STONEX Prisms	Constants [mm]
Circle Prism	-34.4
MINI	-17.2
JPMINI	0

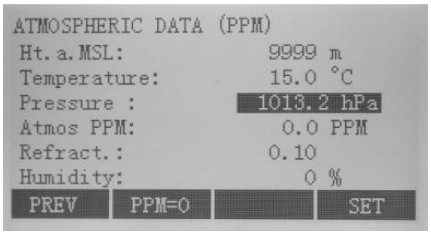
360º	-11.3
360ºMini	-4.4
User Define	Self-adjustment

Prism Const: Entry of a user specific prism constant can only be made if the prism type is in "User Define" mode. Limit value: -999.9 mm to +999.9 mm.

Laser-Point: it is possible to set the same laser pointer as in the Star settings (see 5.1. Basic settings).

Guide Light: the person can be guided by the flashing lights directly to the line of sight. The light points are visible up to a distance of 150 meters. This is useful when staking out points.

[ATMOS]: in the EDM setting menu press F1 to enter the atmospheric data (PPM). Distance measuring is influenced directly by the atmospheric conditions of the air; in order to take into consideration these influences, distance measuring is corrected using atmospheric correction parameters.



Ht. a. MSL: height above sea level at instrument location;

Temperature: air temperature at instrument location;

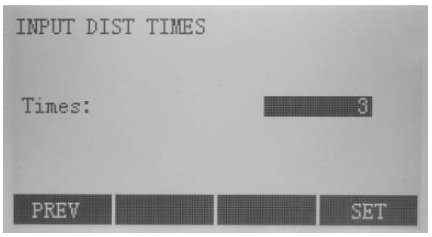
Pressure: air pressure at instrument location;

Atmos PPM: calculated and indicated atmospheric PPM (see Appendix I: Atmospheric correction formula and chart);

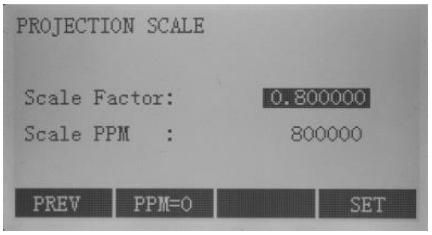
Refract: refraction coefficient for the atmospheric conditions. The refraction correction is taken into account in the calculation of the height differences and the horizontal distance (see Appendix II: Correction for refraction and earth curvature);

Humidity: atmospheric humidity at instrument location.

[TIMES]: in the EDM setting menu press F2 to input the distance measuring times.



[SCALE]: in the EDM setting menu press F4[↓] to scroll the black bar at the bottom of the display and then press F1[SCALE] to enter the projection scale menu:

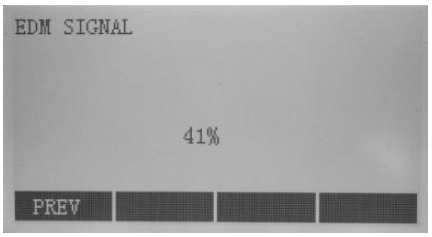


Scale Factor: Measured values and coordinates are corrected with the PPM parameter. Limit value: 0.50 to 1.999999;

Scale PPM: Input of individual scaling parameters;

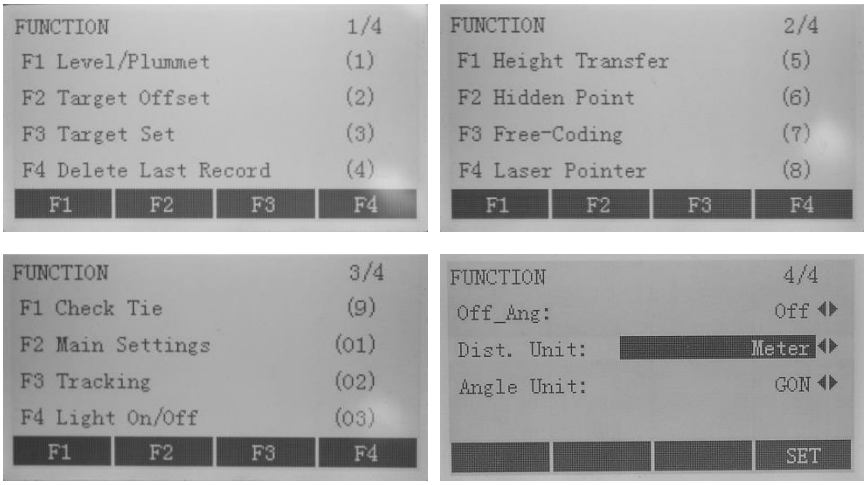
[PPM=0]: Press F2 to set default parameters (Scale Factor=1; Scale PPM=0).

[SIGNAL]: in the EDM setting menu press F4[↓] to scroll the black bar at the bottom of the display and then press F2[SIGNAL]. The EDM signal intensity (reflection intensity) is displayed in steps of 1%. It permits optimal aiming at distant barely visible targets.



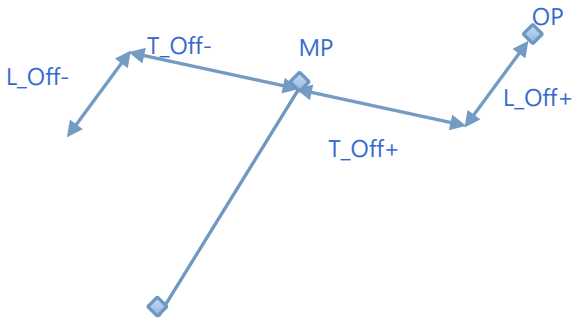
5.4. Function key

Press {FUNC} key to activate several functions. Use the {PAGE} key to scroll all the pages. The detailed applications are described below.



Level/Plummet: this function triggers the electronic bubble and enables the settings of intensity for the laser plummet (see 3.4. Centering and levelling-up).

Target Offset: if it is not possible to set up the reflector directly or it is not possible to aim at the target point directly, the offset values (length, cross and/or height offset) can be entered. The values for the angle and distances are calculated directly for the target point.



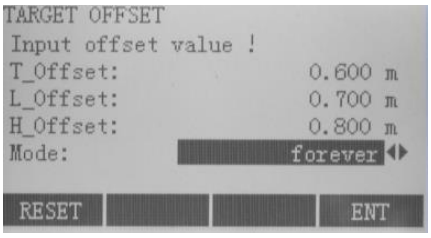
MP: Measurement point

OP: Offset point

T_Off: Length offset

L_Off: Cross offset

H_Offset+: Height offset



Input the offset values according to the sketch above:

- T_Offset is the length offset;
- L_Offset is the cross offset;
- H_Offset is the height.

In “Mode” row, define the period during which the offset is to apply. Two modes are available:

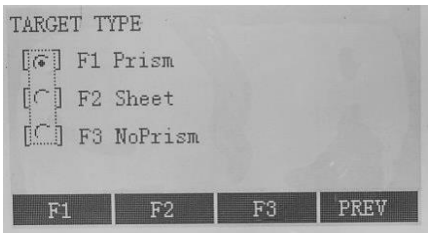
  - Reset: The offset values are reset to 0 after the point is saved;
  - Forever: The offset values are applied to all further measurements.

The item F1[RESET] sets eccentricity to zero.

Selecting F4[ENT] the corrected values are calculated. The corrected angle and distances are displayed once a valid distance measurement has been triggered.

Target Set: change between three target types:

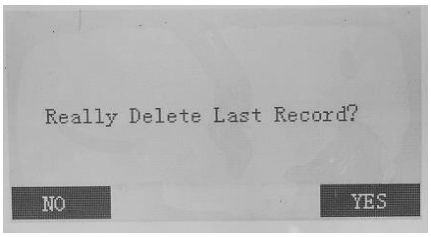
- Prism: Distance measurements with prisms;
- Sheet: Distance measurements with sheets;
- NoPrism: Distance measurements without prisms.



After type selection, press “F4” to return previous page and simultaneously save setting result.

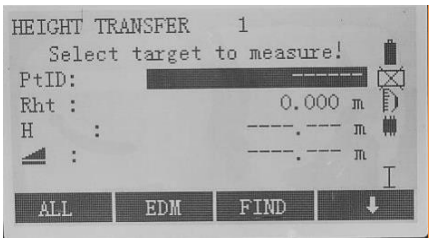
The target type can be changed directly from the measure menu, pressing the {SHIFT} key.

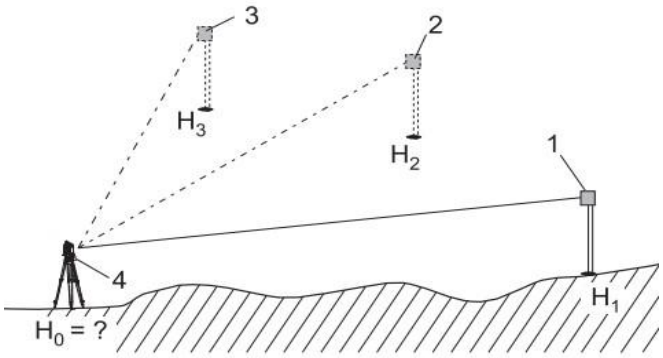
Delete Last Record: this function deletes the last recorded data block. This can be either a measurement block or a code block.



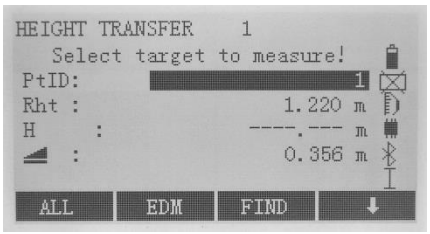
NOTE: Deleting, the last record is not reversible! Only records which were recorded in "Surveying" or in "Measuring" can be deleted.

Height Transfer: this function determines the height of the instrument from measurements to a maximum of 5 known target points, in two faces.



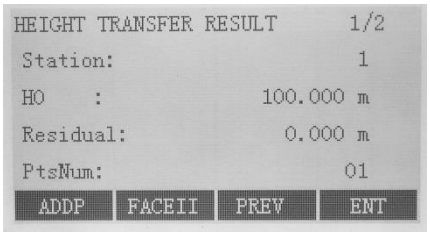


1. Reflector 1
2. Reflector 2
3. Reflector 3
4. Instrument



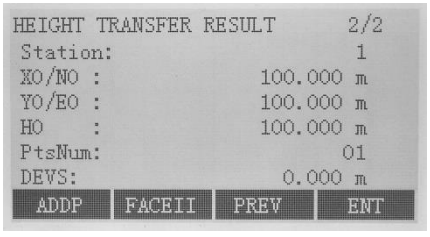
Select known point through [FIND]/[LIST] or enter point coordinates using the [ENH]softkeys.

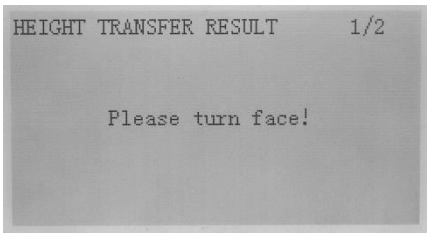
Input reflector height (Rht) and press F1[ALL] to measure



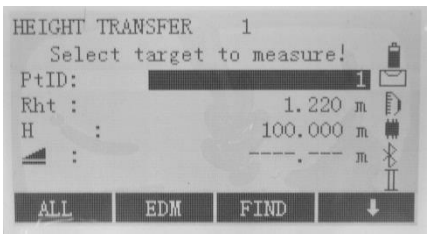
The calculated instrument height "H0" is displayed. Press {PAGE} key to see the calculated coordinates and other results. Select:

- [ADDP] to add another height of a known point;
- [FACEII] to measure the same target in the second face;
- [PREV] to turn to the previous page;
- [ENT] to save and set the station.

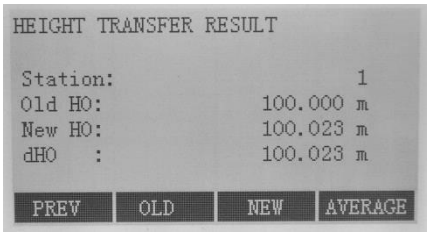




If F2 [FACEII] has been selected, it is required to turn instrument face.



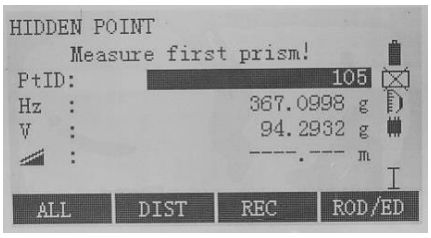
Repeat the measure in face II, pressing F1[ALL].

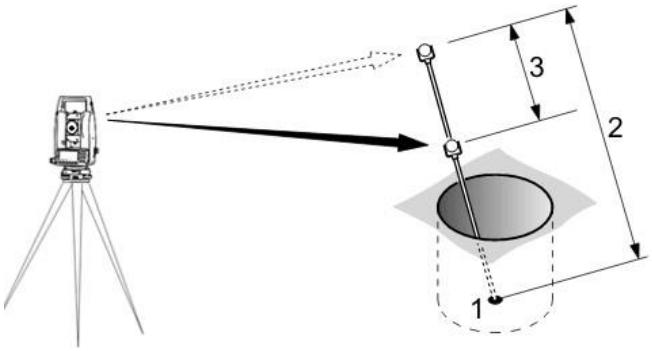


Results from the measurements are shown: choose which one you want to conserve between old, new or average.

Hidden Point

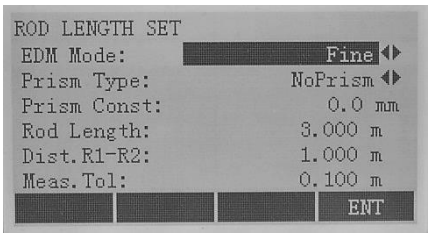
The program allows measuring a point that is not directly visible, using a special hidden point rod.





1. E, N, H of hidden point
2. Rod length
3. Distance R1-R2

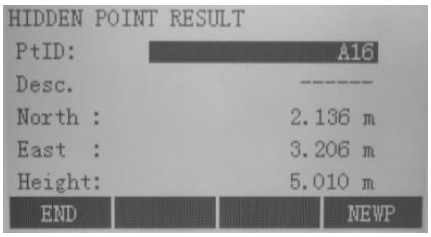
Start defining the rod and the EDM settings, using the F4[ROD/ED] key:



- **EDM Mode**: change the EDM Mode (see 5.3. EDM settings for more details);
- **Prism Type**: change the prism type (see 5.3. EDM settings for more details);
- **Prism Const**: display the prism constant. It is possible to edit it only if the "User Define" option is set in "Prism type" (see 5.3. EDM settings for more details);
- **Rod Length**: define the total length of hidden-point rod;
- **Dist. R1-R2**: define the space between the centers of reflector R1 and prism R2;
- **Meas. Tol**: define the limit for the difference between the given and measured spacing of the reflectors. If the tolerance value is exceeded, the program will eject a warning.

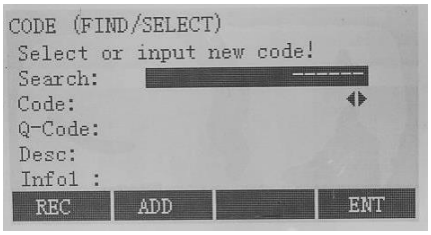
Press F4[ENT] to save and turn to the previous page.

Measure the first prism pressing the F1[ALL] key. It will be asked to measure the second prism: to do that, press again F1[ALL]. Otherwise, if you want to re-measure the first prism, select F4[PREV]. Results are displayed:



Press F1[END] to return calling application; press F4[NEWP] to return the procedure beginning.

Free-Coding: select code from the code list or enter a new code.



Laser Pointer: switch on or off the visible laser beam for illuminating the target point. The new settings are displayed for about one second and then saved.

Check Tie: calculation and display of the slope and horizontal distance, height difference, azimuth, grade, and coordinate differences between the last two measured points. Valid distance measurements are required for the

calculation. If there exist less than 2 valid measurements, the values can't be calculated, and the following message appears "Need two measure values!"

Main Settings: it enables you to change the most important settings which all exist in Settings (see 5.2. Settings).

Tracking: switch on or off the tracking measurement mode. The new setting is displayed for approximately one second and then set. The function can only be activated from within the same EDM mode and prism type. The last active measurement mode remains set when the instrument is switched off.

Light On/Off: turn on/off display illumination (the same function can be activated from the Star settings, see 5.1. Basic settings).

Off_Ang: turn on/off the angle offset measurements. It is useful, in the surveying program, to get the final coordinate of points, where prism can not be set up.

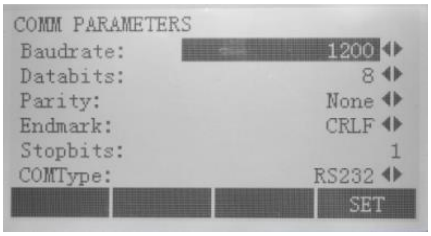
Units: in the 4th page of the function menu the current distance and angle units are displayed. Change them by ◄/► keys, see 5.2. Settings.

5.5. Communication port setting

Please set communication parameters before connecting your computer. Press {MENU} key on panel to enter the menu mode. Press {PAGE} key to scroll the page and F2[COM] to modify the communication parameters.

NOTE: The values have to be set in the same way as on your computer.

Press ▲/▼ keys to select items and ◄/► to set options:



Baudrate: it is the data transfer speed. Choose between 1200/2400/4800/9600/19200/TOPCON/SOKKIA.

Data bits: choose between:

- 7: Data transfer is realized with 7 data bits. It is set automatically if parity is "Even" or "Odd";
- 8: Data transfer is realized with 8 data bits. It is set automatically if parity is "None".

Parity: choose between "Even" or "Odd" if data bits is set to 7, "None" if data bits is set to 8.

Endmark: choose between:

- CRLF: Carriage return; line feed;

- CR: Carriage return.

Stopbits: fixed setting 1;

COMType: choose between RS232 and Bluetooth.

Press F4[SET] to save and return to the menu.

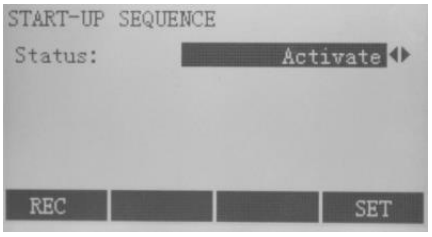
NOTE:

- All the options are changeable only if RS232 is set a COMType;
- The Bluetooth can be used if the 9600 option is set as Baudrate.

5.6. Start-up sequence

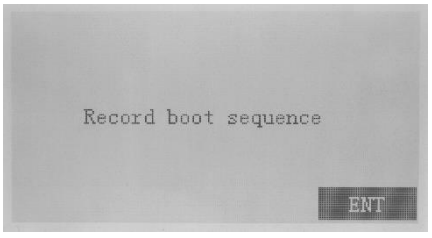
In the second menu page, select F4[START] to set the start-up screen. The following two options are settable:

- End: after switching on the instrument, the measure mode appears on the display;
- Activate: it allows to choose a status to be displayed after the instrument starting.



Choose one of the two options and press F4[SET] to store the current setting: it will return to the menu.

In the case you have selected the "Activate" option, re-enter the start-up sequence through F4[START] and press F1[REC]. Confirm the record boot sequence pressing F4[ENT] and the Measure screen is displayed.



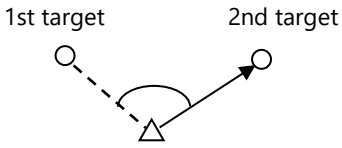
A maximum of 16 of the next key presses are stored. The sequence is ended with [ESC].

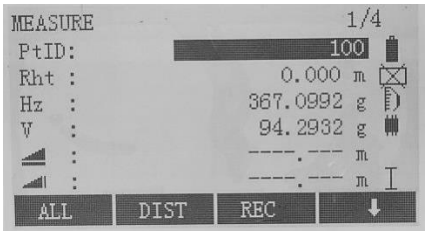
If the start sequence is modified, the stored key presses will be executed automatically when the instrument is switched on.

6. Measurement

6.1. Angle measurement

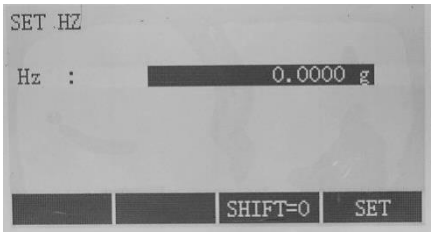
6.1.1. Measure a horizontal angle of two points



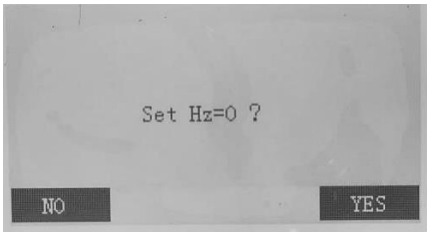


Sight the 1st target.

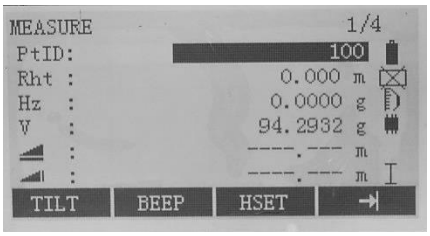
Press F4[↓] twice and F3[HSET].

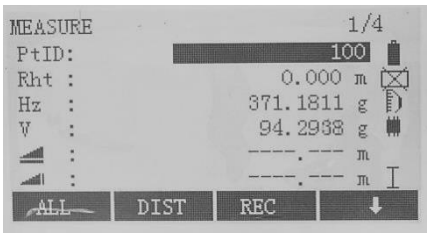


Use the F3[SHIFT=0] key to set the 1st target as 0° in the measure mode.



Confirm pressing F4[Yes]





Sight the 2nd target. The displayed Hz value is the included angle between two points.

6.1.2. Set the horizontal angle to a required value

Take your instrument sight the 1st target.

Press F4[↓] to scroll the softkeys on the display. Press [HSET] key and edit the required value. Set it using F4[SET] key.

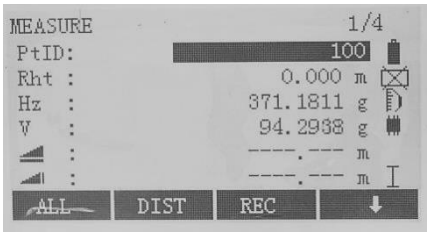
The range and format of the input value are:

- gon: 0~399.9999;
- degree: 0~359.5959;
- mil: 0~6399.990.

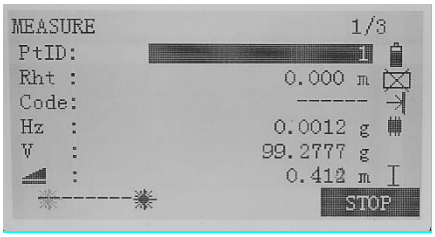
6.2 Distance measurement

Please set the following items before distance measurement:

- Measurement condition (See 5.2. Settings);
- EDM (See 5.3. EDM settings).



Aim at the target and press F1[ALL] or F2[DIST] to start measuring distance.



The symbol "*" moves continually when measuring distance.

Press F4[STOP] to finish measurement.

The "SD", "HD", and "VD" will display

Press {PAGE} key and the display mode of basic measurement will change: slope ( ), vertical ( ), horizontal ( ) distances or coordinates (North, Easth, Height) are shown.

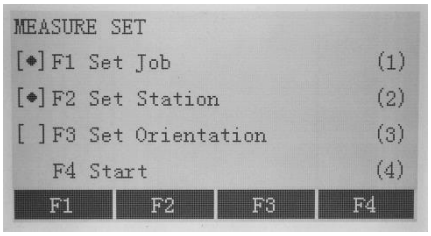
Press {PAGE} key to change display status if it is in distance mode.

NOTE:

- Make sure that the target setting in the instrument matches the type of target used.
- If the objective lens is dirty, it will affect the accurate of measured results. Dust it off with your special brush and wipe it with your special cloth (in your carrying case) before putting away.
- If an object with a high reflective factor (metal, white surface) exists between the instrument and the target when measuring, the accuracy of the measured results will be affected.
- An angle is also able to be measured while distance measurement is in course.
- Measurement will automatically stop after a single measurement if the EDM mode is single.

7. Pre-setting application

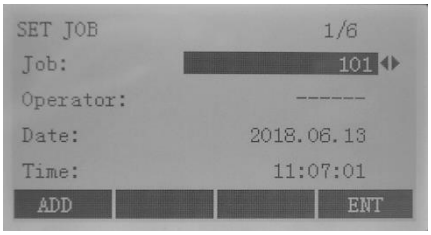
These are programs that precede the application programs and are used to set up and organize data collection. They are displayed after selecting an application. The user can select the start programs individually.



On the left of the options, [•] means that the settings are made; [ ] settings are not made.

7.1. Setting job

All data is saved in JOBS like directories. Jobs contain measurement data of different types (e.g. fixed points, measurements, codes, stations, ...) and are individually manageable and can be readout, edited or deleted separately.



Press F1 to set the job, then:

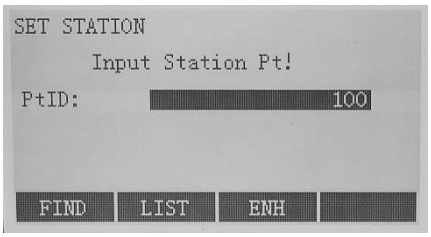
- Use ◄/► keys to select an existing job
- Select F1[ADD] to create a new job: enter the job name, the operator and notes.

Press F4[ENT] to save and go back to start-up programs menu.

NOTE: All recorded data is stored in this job. Besides, if no job has been defined and an application have been started or if [ALL] key has been triggered, the system would automatically create a new job and name it as "DEFAULT".

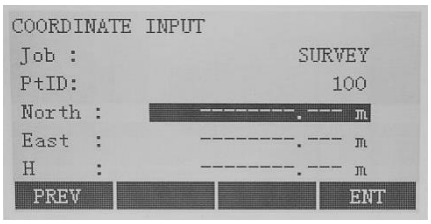
7.2. Setting station

Each coordinate computation relates to the set station. At least plan coordinates (E, N) are required for the station; the station height can be entered if required. The coordinates can be entered either manually or read from the internal memory.

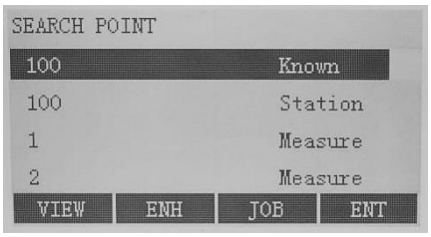


Press [F2] to set the station. Afterwards choose either of the two following methods to complete the application of setting station.

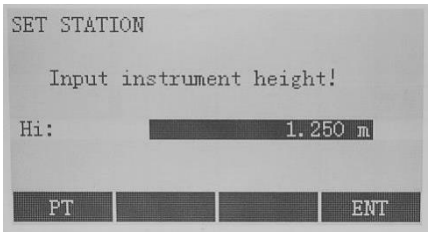
- Set manually: Select F3[ENH] to call up manual coordinate input dialogue. Input PtID and coordinates (North, East and H) and choose F4[ENT] to save station coordinates.



- Known Point: press F1[FIND] or F2[LIST] to select a PtID stored in internal memory.

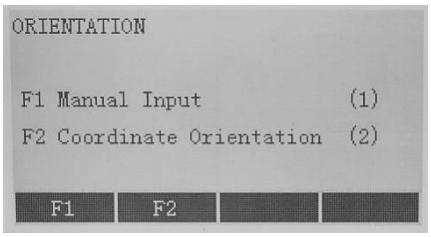


Input the instrument height and press F4[ENT] to finish station setting.



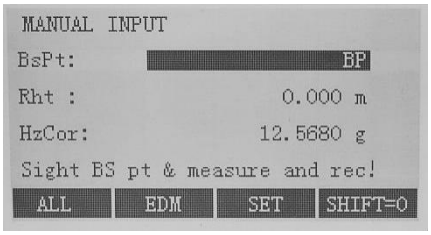
7.3. Setting orientation

With the orientation, horizontal direction can be input manually or points with known coordinates can be set.

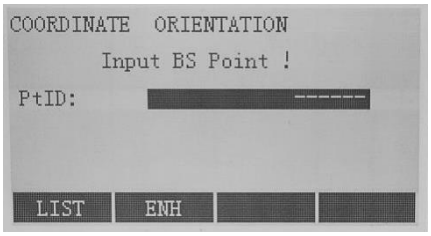


Press F3 to set orientation, then choose between:

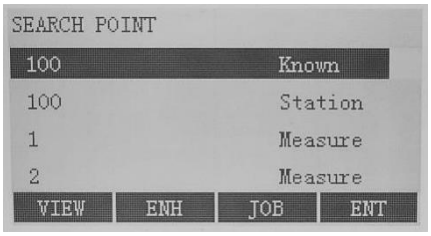
1. Manual input: press [F1] key. It is required to input the backsight Point ID (BsPt), the reflector height (Rht) and Hz-direction or azimuth (HzCor). Press F4[SHIFT=0] to set the horizontal angle to 0.
   Press F1[ALL] to start trigger measurement, data saved and orientation set.



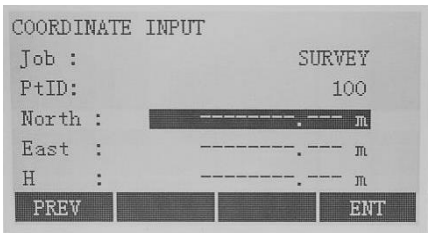
2. Coordinate orientation: press [F2] key. Orientation coordinates can be either obtained from the internal memory or entered manually.



   - Input the orientation point number and determine the point found before. To determine the orientation, a target with known coordinates can be used. Thus, press F1[LIST] to read out PtID stored in internal memory.



   - Press F2[ENH] to input backsight PointID and coordinate, after confirming this input continue entering reflector height and meantime sighting the target. At last press [ALL] to start trigger measurement, data saved and orientation set.



At the end of these procedures, press F4 in the start-up programs menu.

8. Programs

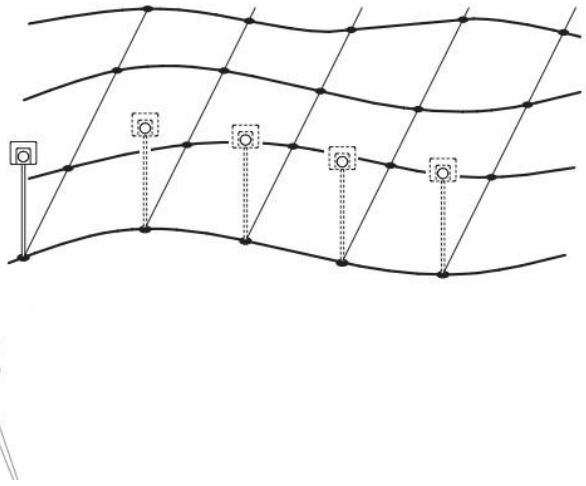
Predefined programs that cover a wide spectrum of surveying duties and facilitate daily work in the field are available. To access press {MENU} fixed key and then press F1[PROG] key.

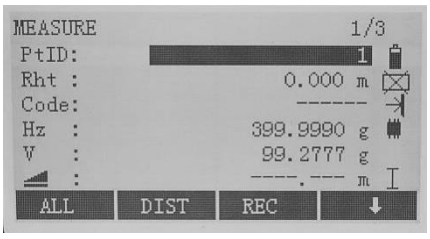
Use F1-F4 keys to call up applications and activate start programs. Press {PAGE} fixed key to scroll to next page.

In many programs it is required to set up and organize data collection: see 7.Pre-setting application for instructions.

8.1. Surveying

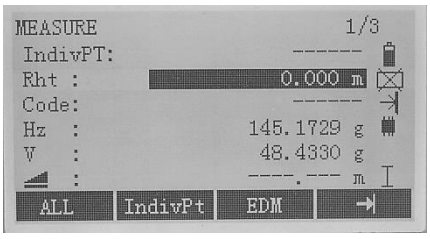
With this program the measurement of an unlimited number of points is supported. It includes stationing, orientation and coding.





Input PtID, reflector height (Rht) and codes if demanded. Aim to the point and press F2[DIST] to measure and F3[REC] to store the point. Otherwise it is possible to press F1[ALL] to trigger and record measurements in the same time.

The point ID auto increases after each storage.



Press F4[↓] three times, until when the [IndivPt] softkey appears in the black bar at the bottom of the display. Press it to switch between individual and current point ID. With this function, it is possible to shift from continuous point collection to individual point collection. Edit the individual point ID and press F1[ALL] key to measure and record it.

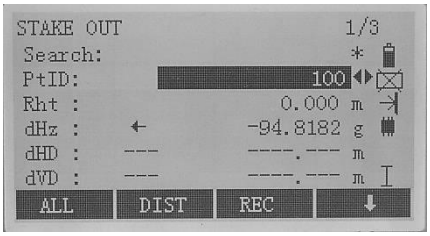
Then, it will return to the PtID mode, with the name point as the one left before changing the mode.

Three coding methods are available:

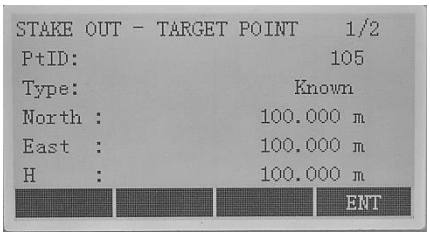
- Simple coding: input a code into the relevant box. The code is stored along with the corresponding measurement.
- Expanded coding: press the [CODE] softkey. The code that was input can be searched for within the code list and it gives the possibility to add attributes to the code.
- Quick coding: press the [Q-Code] softkey and enter the shortcut to the code. The code is selected, and the measurement starts.

8.2. Stake out

This program calculates the required elements to stake out points from coordinates or manually entered angles, horizontal distances and heights. Stake out differences can be displayed continuously.

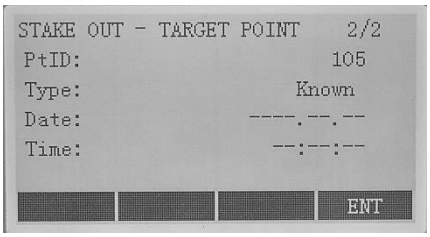


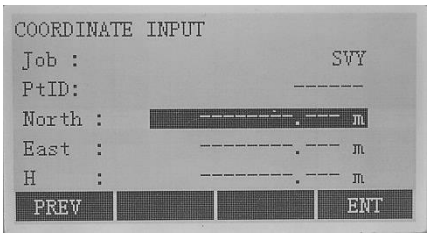
Select the point to stake out using the ◄/► keys in the PtID row or editing the point name in the Search row. For the latter, write the name and press [ENT] key to search the point.



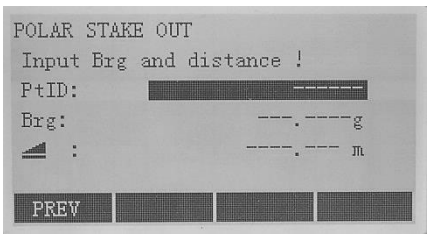
Use the F4[↓] key to scroll the black bar at the bottom of the display.

Select the [VIEW] softkey to see the coordinates and info of the selected point.

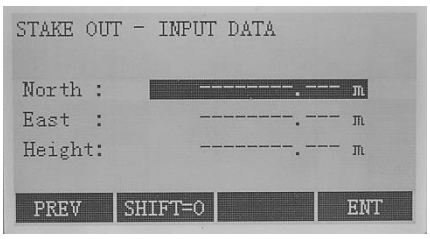




If you want to insert coordinates of a new point to stake out, select the [ENH] softkey and edit name and coordinates.



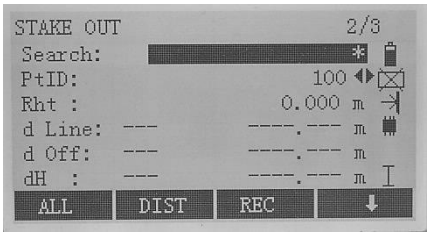
Select [B&D] softkey to input the angle and the longitudinal distance offsets.

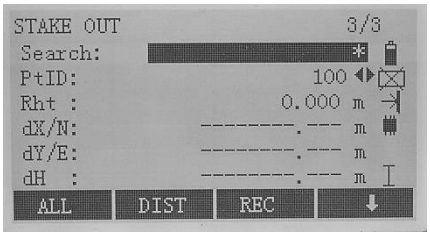


Select [MANUAL] softkey to input the easting, northing and height offsets. You can press F2[SHIFT=0] to set all the values to 0.

To start staking out, in order to have enough time to find the point, it useful to change the EDM setting, applying a higher number of measurements. Press [EDM] softkey, then F2[TIMES] and set the number you prefer (refer to 5.3. EDM settings for more details).

Press F1[ALL] or F2[DIST] to start measuring. Near the offsets, arrows (↓, ↑, ←, →) indicate the direction, in which you have to move the telescope and/or the target in order to find the interested point.

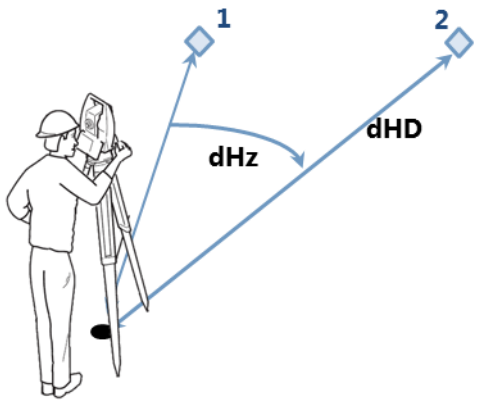




Press the {PAGE} key to scroll all the offset types:

- In the first page: polar stake out offsets;
- In the second page: orthogonal stake out offsets;
- In the third page: cartesian stake out offsets.

Polar stake out



1: Actual point

2: Point to stake out

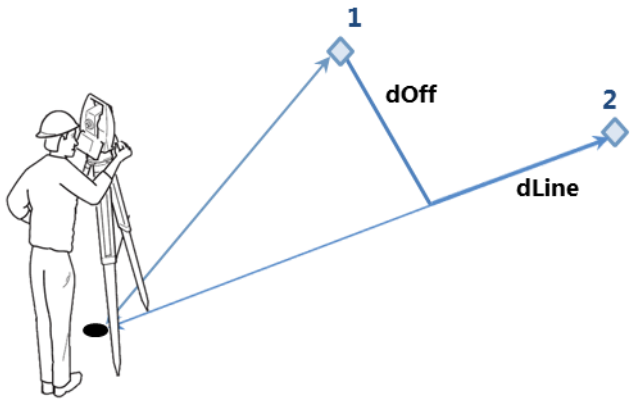
dHz: Angle offset (positive if point to stake out is to the right of the actual direction)

dHD: Distance offset (positive if point to stake out is further away)

dVD: Height offset (positive if point to stake out is higher than measured point)

Orthogonal stake out

The position offset between measured point and stake out point is indicated in a longitudinal and transversal element.



1: Actual point

2: Point to stake out

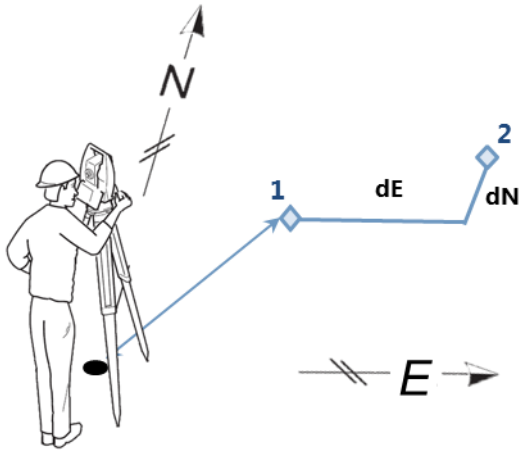
dLine: Longitudinal offset (positive if nominal point is further away)

dOff Transversal offset, perpendicular to line-of-sight (positive if nominal point is to the right of measured point)

dH: Offset height

Cartesian stake out

Stake out is based on a coordinate system and the offset is divided into a north and east element.



1: Actual point

2: Point to stake out

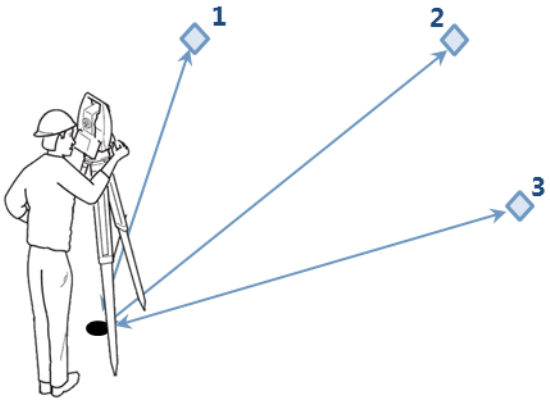
dE: Easting offset between stake out and actual point.

dN: Northing offset between stake out and actual point.

dH: Offset height

8.3. Free station

This application is used to determine the instrument position from measurements of known point (minimum two, maximum five).



The following measurements sequences to target points are possible:

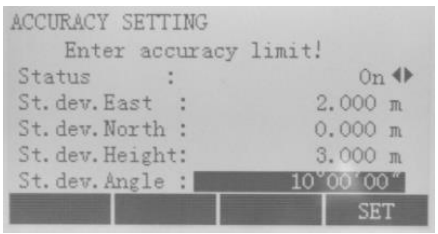
- Horizontal and vertical angles only;
- Distances and horizontal and vertical angles;
- Horizontal and vertical angles to some point(s) and horizontal and vertical angles plus distances to other point(s).

The final computed results are Easting, Northing and Height of the present instrument station, including the instruments Horizontal Circle Orientation. Standard deviations and residuals for accuracy assessments are provided.

COMPUTATION PROCEDURE:

- The measuring procedure automatically determines the method of evaluation.
- Easting and northing is determined by the method of least squares, including standard deviation and improvements for horizontal direction and horizontal distances.
- The final height (H) is computed from averaged height differences based on the original measurements.

Before starting, in the start-up program menu it is required to set an accuracy limit: press F2 to enter the accuracy setting.



Here:

Status: using ◄/► keys select if activate or not the accuracy limit;

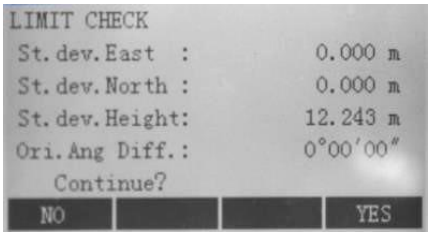
St. dev. East: enter a limit for the standard deviation values in the East direction;

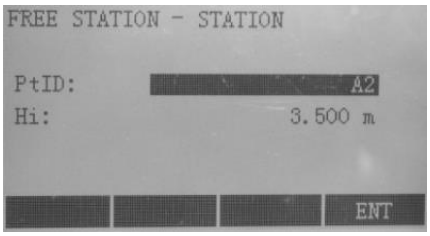
St. dev. North: enter a limit for the standard deviation values in the North direction;

St. dev. Height: enter a limit for the standard deviation values for the height;

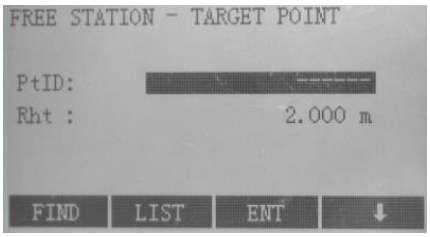
St. dev. Angle: enter a limit for the standard deviation values for the Azimuth.

If the calculated deviation exceeds the limit, a warning dialog box ejects, which reminds you whether to proceed or not.

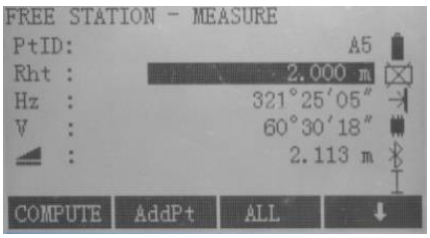




Input of the name of the station (PtID) and the height of the instrument (Hi). Press F4[ENT].



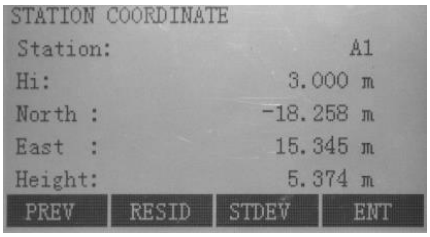
Input of the target ID (PtID) and the reflector height (Rht).it is also possible to select a point from the memory through F1[FIND] or F2[LIST] or to input coordinates pressing F4[↓] and F1[ENH]. Press F3[ENT].



It will enter the Measure mode.

The following options are available:

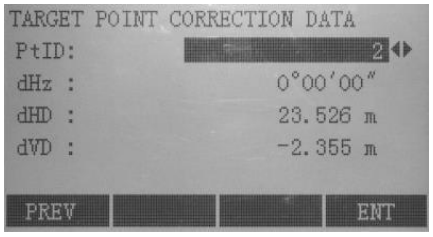
- [ALL]: Trigger angle and distance measurements (3-point resection);
- [REC]: Save horizontal direction and vertical angle (resection);
- [AddPt]: Input another backsight point;
- [COMPUTE]: It'll calculate and display the station coordinates, if at least 2 points and a distance are measured.



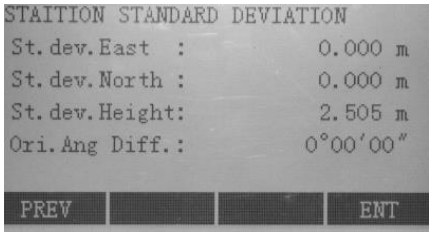
The calculated station coordinates are displayed.

Press:

- F1[PREV] to return at the previous page;
- F2[RESID] to display residuals (Residual = Calculated value - Measured value). With the {FUNC} key scroll between the residuals of the individual backsight points:



- F3[STDEV] to display standard deviation values:



St.dev. East, North, Height: Standard deviation of the station coordinates;

Ori. Ang Diff.: Standard deviation of the orientation.

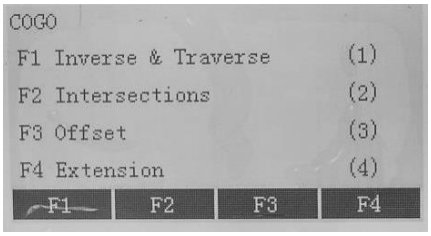
- F4[ENT] to set the displayed coordinates and instrument height as new station.

NOTE:

- Measurements are possible using face I or II, as long as the same face is used for all the measurements;
- No specific point sequence is required;
- If a target point is measured several times in the same telescope position the last valid measurement is used for computation;
- Target points with 0.000 height are discarded for height processing. If target points have a valid height of 0.000 m, use 0.001 m to enable it for height processing.

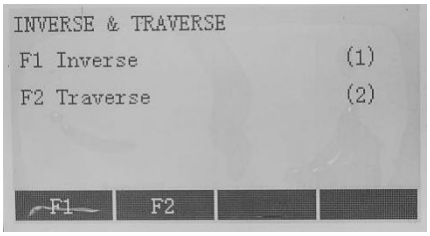
8.4. COGO

COGO is an application program able to perform coordinate geometry calculations such as coordinates of points, bearings between points and distances between points.

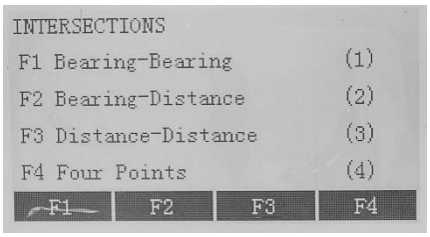


Select one of the following COGO calculation methods, pressing the respective keys:

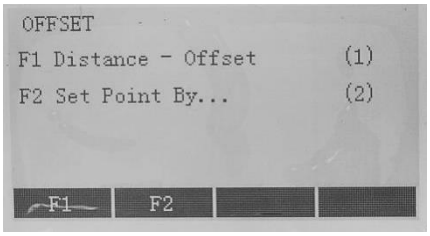
1. Inverse & Traverse:



2. Intersections (Bearing-Bearing, Bearing-Distance, Distance-Distance, Four points)



3. Offset (Distance- Offset, Set Point By...)



4. Extension

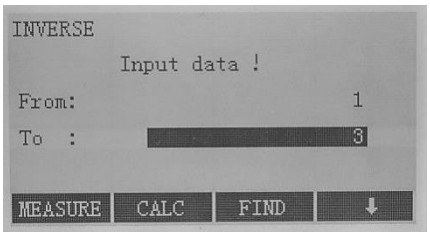
The explanation for the softkeys given below are valid for all pages, unless otherwise stated.

Depending on the selected method, it will be required to input the following data:

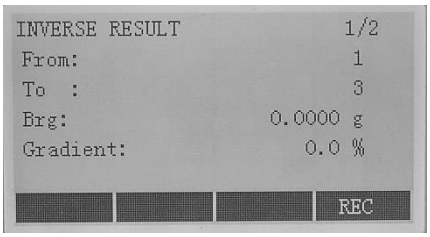
- **Point:** it is possible to:
  - Measure a new point: press F1[MEASURE] to enter the measure mode;

- Select an existing point form the memory: edit the point ID and press F3[FIND] or press F4[↓] to scroll the softkeys and select F1[LIST] to enter the search point menu;
- Input a new point: press F4[↓] to scroll the softkeys and select F2[ENH] to enter the coordinate input mode.

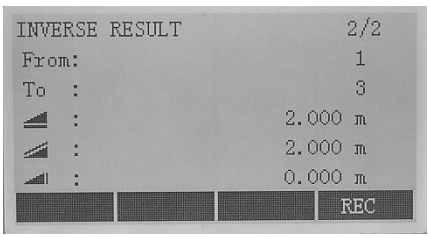
- **Brg**: input the direction (angle with respect to the orientation)
- **HD**: input the horizontal distance between two points
- **Offset**: input the lateral deviation
- **Line**: input the horizontal distance from the baseline start point



After having filled all the fields, press F3[CALC] to start the calculations.

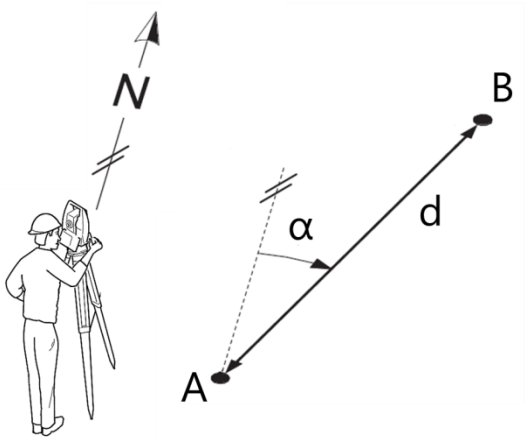


Use the {PAGE} key to see all the results on the screen.



Press F4[REC] to save.

Inverse



Known:

A First known point

B Second known point

Unknown:

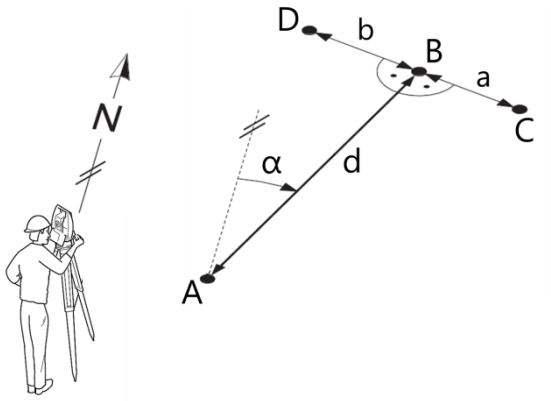
α Direction from A to B

Slope distance between A and B

Horizontal distance between A and B

Height difference between A and B

Traverse



Known:

A Known point

α Direction from A to B

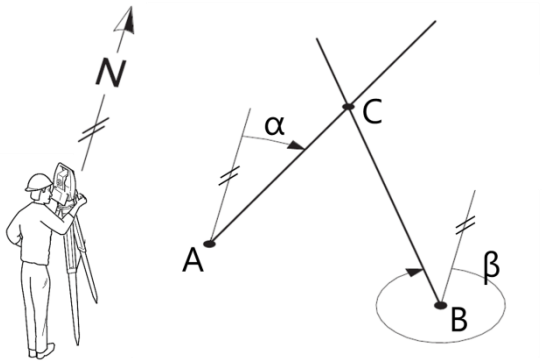
d Distance between A and B

a/b Positive or negative offsets

Unknown:

C/D points with offset

Bearing – Bearing



Known:

A First known point

B Second known point

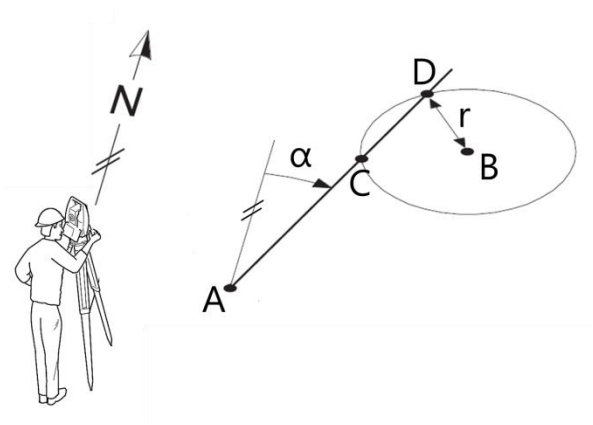
α Direction from A to C

β Direction from B to C

Unknown:

C Unknown point

Bearing – Distance



Known:

A First known point

B Second known point

α Direction from A to D

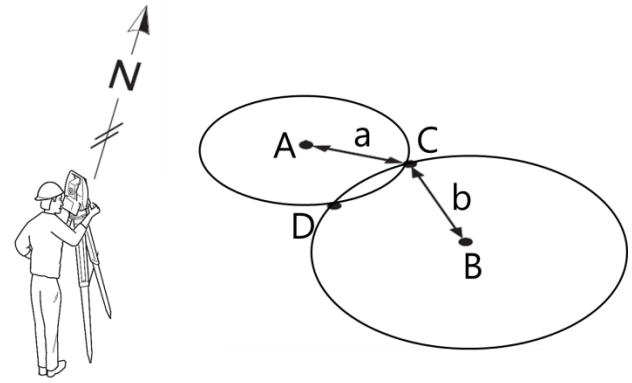
r distance from B to D

Unknown:

C First unknown point

D Second unknown point

Distance – Distance



Known:

A First known point

B Second known point

a Distance from A to C

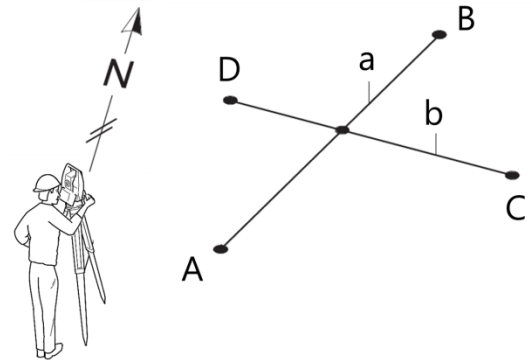
b Distance from B to C

Unknown:

C First unknown point

D Second unknown point

By points



Known:

A First known point

B Second known point

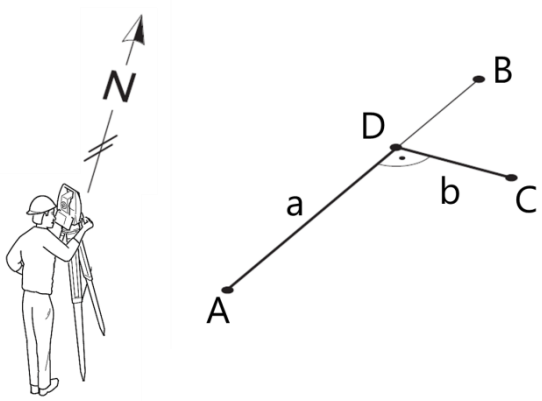
C Third known point

D Fourth known point

Unknown:

E Cross road point

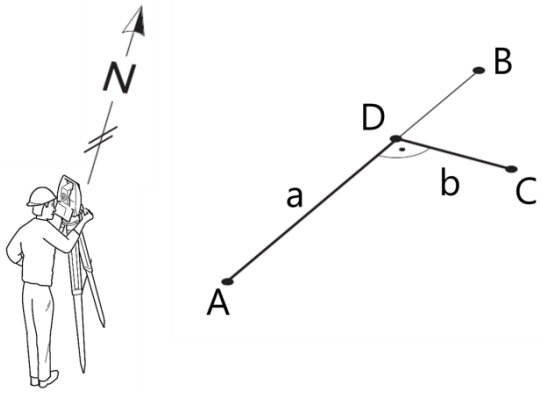
Distance – Offset



Known:
A Baseline start point
B Baseline end point
C Lateral point

Unknown:
a Difference in length/abscissa from the baseline start point
b Lateral deviation/ordinate (Offset)

Set point by...



Known:
A Baseline start point
B Baseline end point
a Difference in length/abscissa from the baseline start point
b Lateral deviation/ordinate (Offset)

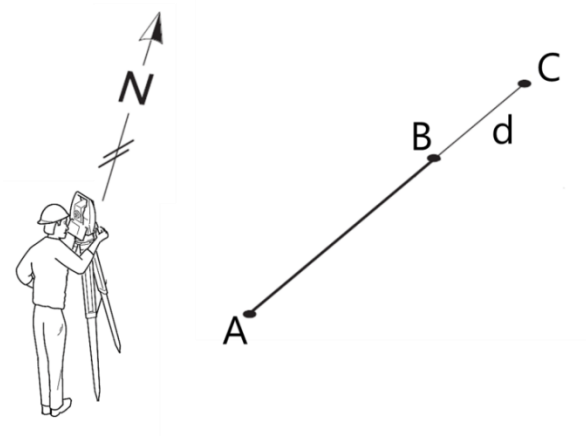
Unknown:
C Lateral point

Extension

This routine compute extend point from baseline.

In addition, with respect to the previous methods, it is required to select:

- **BP**: use the ◄/► keys to select the baseline point from which start the extension.
- **HD**: edit the horizontal distance. To find a point inside the baseline, negative HD values are also editable.



Known:

A Baseline start point

B Baseline end point

d Distance

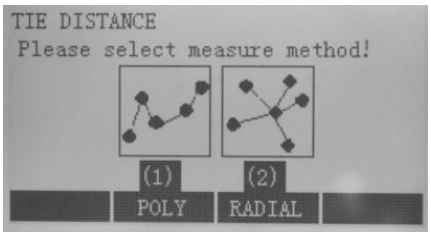
Unknown:

C Extended point

8.5. Tie distance

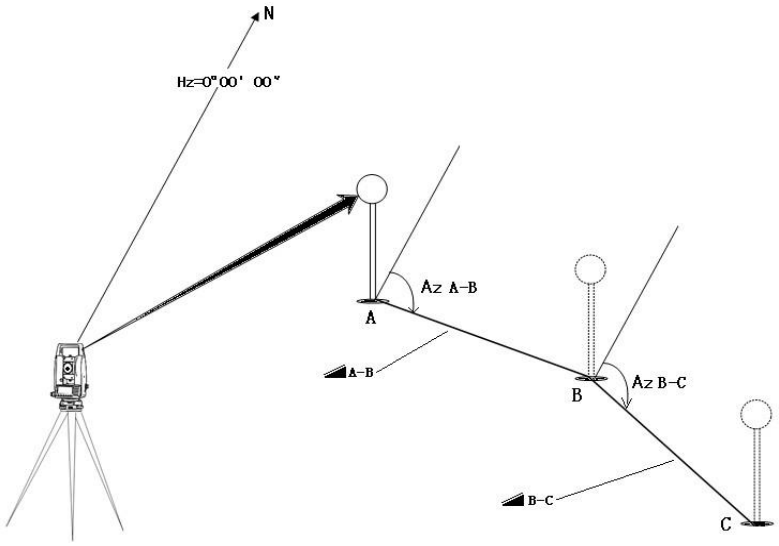
The application calculates slope distance, horizontal distance, height difference and azimuth of two target points measured in real time, selected from Memory or entered using the Keypad.

The instrument can accomplish this in two ways:



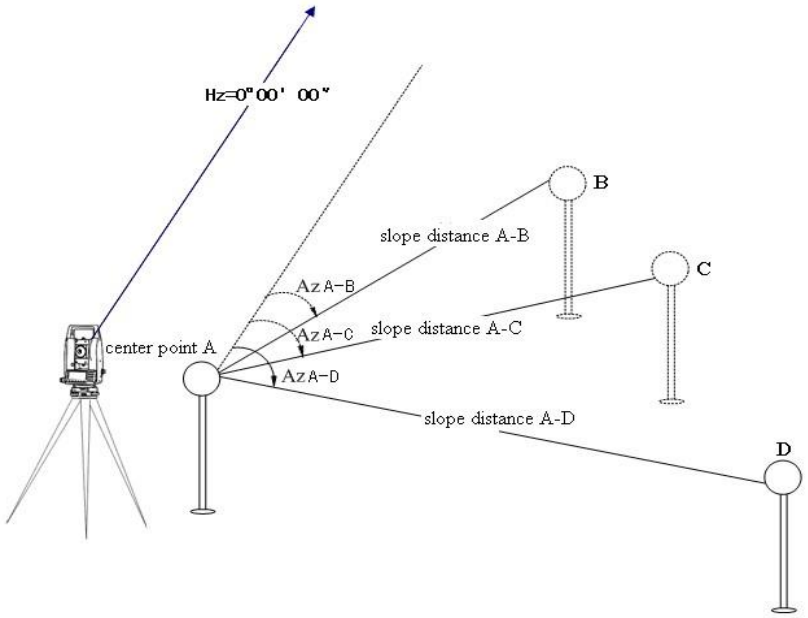
- Polygonal method: Measurement is A-B, B-C, C-D, etc...

  Press F2[POLY] to select it



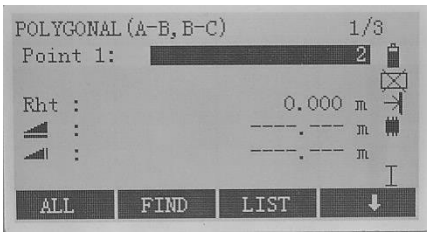
- Radial (A-B, A-C): Measurement is A-B, A-C, A-D, etc.

  Press F3[RADIAL] to select it.

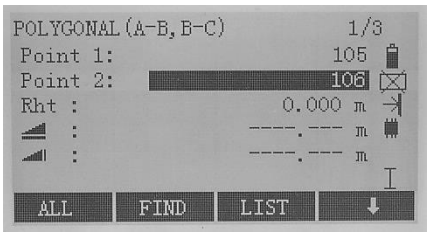


Procedure of both the methods are the same; any differences will be described.

After selecting the method, determine the first target point.

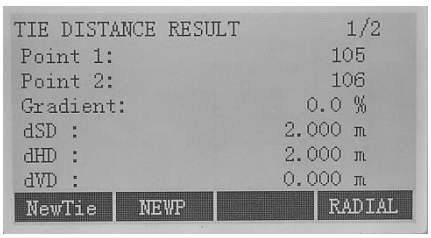


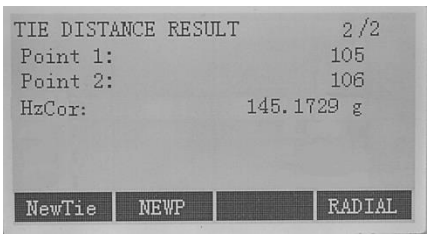
Select F1[ALL] to start measuring the target point or F2[FIND] to search for certain entered point from memory.



Determine the second target point. Proceed as for the first target point.

Results are displayed:





Here:

Gradient: Grade [%] between point1 and point2.

dSD: Slope distance between point1 and point2

dHD: Horizontal distance between point1 and point2

dVD: Height difference between point1 and point2.

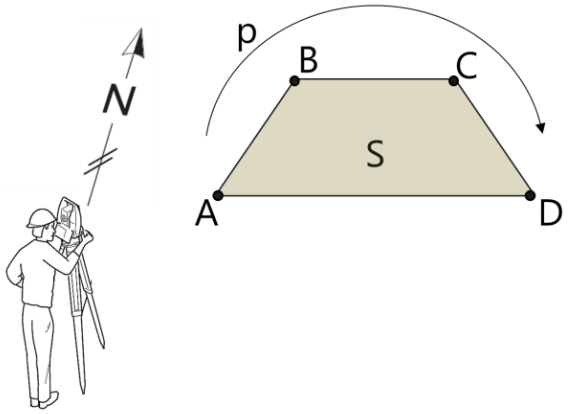
HzCor: Azimuth between point1 and point2

The softkeys at the bottom of the results page are the following:

- In polygonal method:
  - [NewTie]: an additional missing line will be computed. Program starts again from the first target point;
  - [NEWP]: point 2 is set as starting point of a new missing line. Program starts from the second target point;
  - [RADIAL]: switch to radial method.
- In radial method:
  - [CentPt]: determine new central point;
  - [RadPt]: determine new radial point;
  - [POLY]: switch to polygonal method.

8.6. Area & volume

The application is used to calculate areas of points connected by straights in real time. The target points can be measured in real time, selected from memory or entered via keypad.



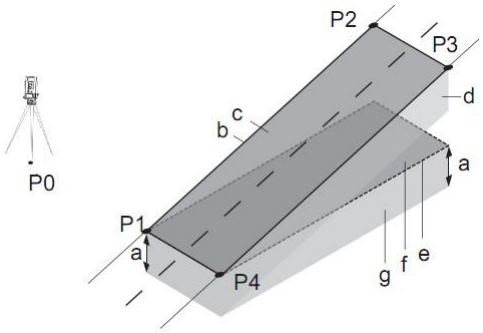
A: Start point

B, C, D: Target points

p: Polygonal perimeter, length from start point to the current measured point.

S: Calculated area always closed to the start point.

The calculated area is projected onto the horizontal plane (2D) or projected onto the sloped reference plane defined by 3 points (3D). Furthermore, a volume with constant height can be calculated with respect to the area (2D/3D).



P0: Station

P1-4: Target point which defines the sloped reference plane

a: constant height

b: Perimeter (3D), polygonal length from the start point to the current measured point of the area (3D)

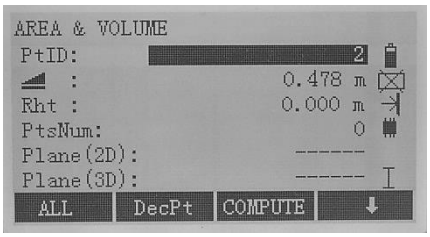
c: Area (3D), projected onto the sloped reference plane

d: Volume (3D) $d = a \bullet c$

e: Perimeter (2D), polygonal length from the start point to the current measured point of the area (2D)

f: Area (2D), projected onto the horizontal plane

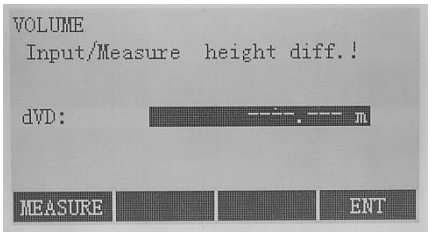
g: Volume (2D) $g = f \bullet a$



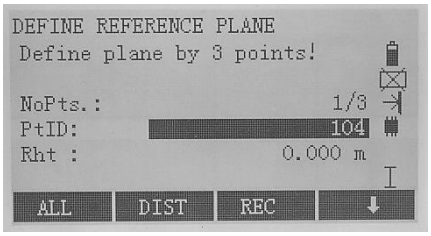
After selecting “Area & Volume” in the programs menu, determine area points.

Choose between the following softkeys (scroll the black bar at the bottom of display using F4[↓] key:

- [ALL]: Edit the point name (PtID) and height (Rht) and press [ALL] to start measuring.
- [DecPt]: Undo measurement or selection of last point.
- [COMPUTE]: Display and record additional results (perimeter, volume).
- [VOLUME]: Calculate a volume with constant height which has to be input in the “dVD” row or measured through the F1[MEASURE] key.



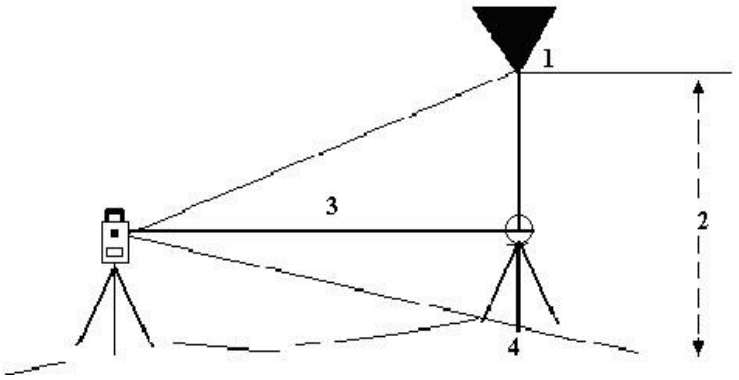
- [Def. 3D]: Define the sloped reference plane by measuring ([ALL] or [DIST]+[REC] softkeys), selecting ([LIST] softkey) or editing ([ENH] softkey) three points.



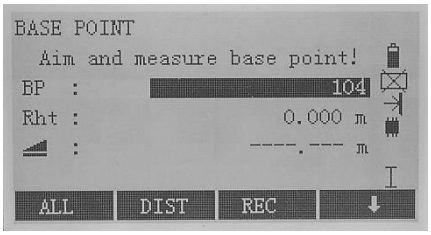
- [FIND]/[LIST]: Search for point from internal memory.
- [ENH]: Input the coordinates manually.

8.7. Remote height

The remote height program calculates the height difference of a remote object relative to ground. When using a prism height, the measurement will start from the prism (reference point). If no prism height is used, the measurement will start from any reference point in which the vertical angle is established. In both modes, the reference point should be perpendicular to the remote object.

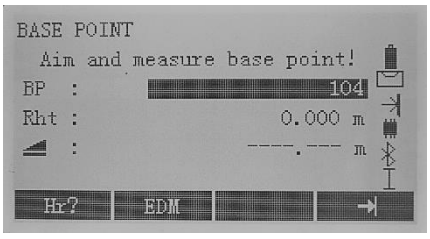


1) Remote point
2) Height difference
3) Horizontal distance
4) Base point



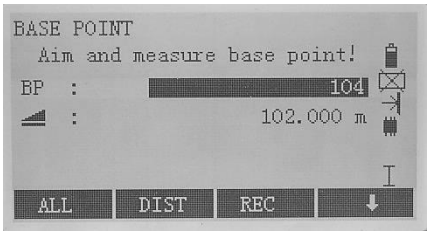
It is possible to measure the height starting from the prism position or from the base point.

Height with respect to the prism

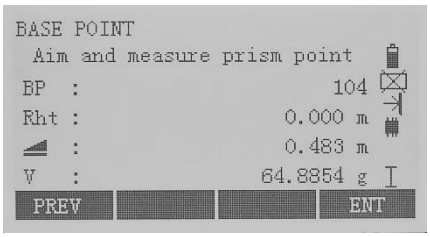


In the remote height main page press F4[↓] key to scroll the softkeys.

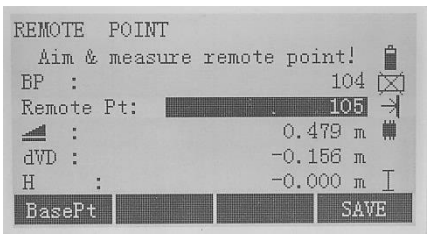
Then, F1[Hr?] key to start the program that determines an unknown prism height.



Start measuring base point with F1[ALL] or F2[DIST]+F3[REC].



Aim the top of prism and confirm with F4[ENT].



Aim at inaccessible remote point.

On the display:

BP indicates the base point name;

Remote Pt indicates the remote point name;

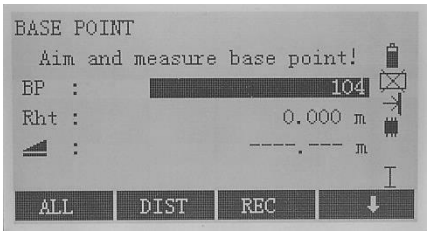
indicates the horizontal distance;

dVD is the height difference between the ground and the inaccessible remote point;

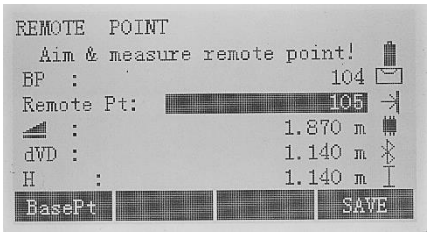
H is the height with respect to the prism.

Edit the remote point name and save the measured data pressing F4[SAVE]. Otherwise, press F1[BasePt] to input and start measuring a new base point.

Height with respect to the base point



Press F1[ALL] or F2[DIST]+F3[REC] to start measuring base point.



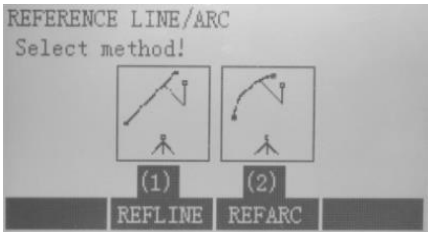
Then, aim at inaccessible remote point

On the display the same items as in the previous method are shown, except for the **H** which, as **dVD**, is the height difference between the ground and the inaccessible remote point.

Edit the remote point name and save the measured data pressing F4[SAVE]. Otherwise, press F1[BasePt] to input and start measuring a new base point.

8.8. Reference line/arc

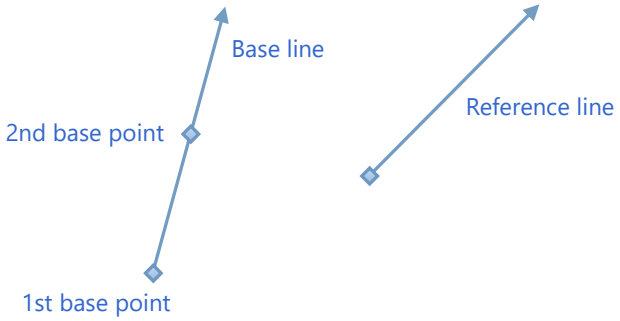
This program facilitates the easy stake out or checking of lines for buildings, sections of road, simple excavations, etc. Two methods are available: reference line and reference arc.

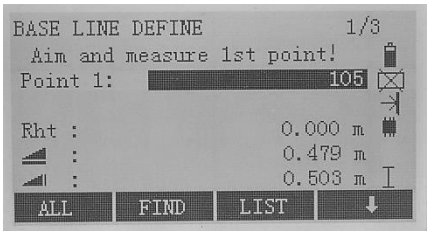


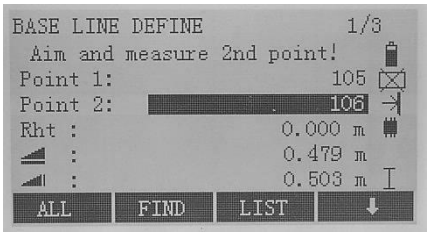
8.8.1. Reference Line

A reference line can be defined by referencing a known base line. The reference line can be offset either longitudinally, in parallel or perpendicularly to the base line, or be rotated around the first base point as desired. Besides the reference height can be selected as first point, second point or interpolated along the reference line.

Press F2[REFLINE] and, as first, it will be required to define the Base line



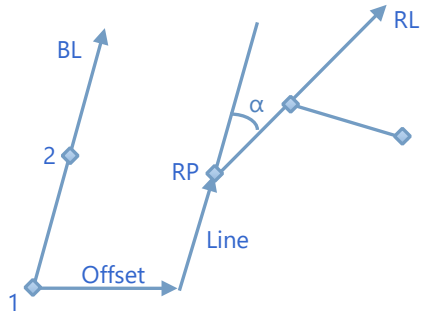




The base line is determined by two base points that can be defined in three ways:

- Measured points: Input PtID and measure base points with F1[ALL] or F2[DIST]+F3[REC];
- Input coordinates manually: Press [ENH] to input;
- Find points from memory: Press [FIND] to search for PtID entered or press [LIST] to choose from a series of points.

After defined, the baseline can be offset longitudinally, in parallel and perpendicularly or rotated. This new line is called the reference line: all measured data refers to the reference line.



1, 2: Base points

BL: Baseline

RP: Reference point

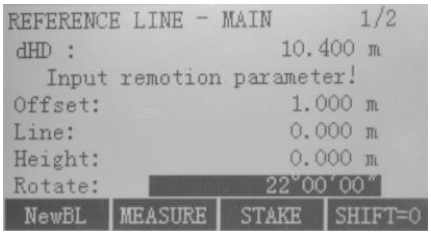
RL: Reference line

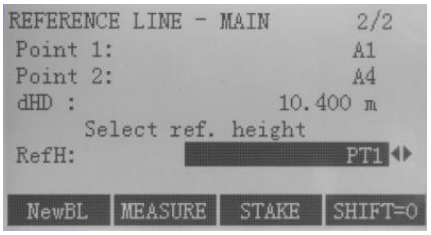
Offset: Parallel offset

Line: Longitudinal offset

α: Rotation parameter

Input remotion parameter in both the pages, scrolling through the {PAGE} key.





Here:

dHD: Represents the horizontal distance between the two points, used to define the baseline;

Offset: Parallel offset of the reference line to the right, referred to the base line (BP1-BP2);

Line: Longitudinal offset of the reference point of the reference line in the direction of base point BP2;

Height: Height offset. The reference line is higher than the selected reference height;

Rotate: clockwise rotation of the reference line around the reference point;

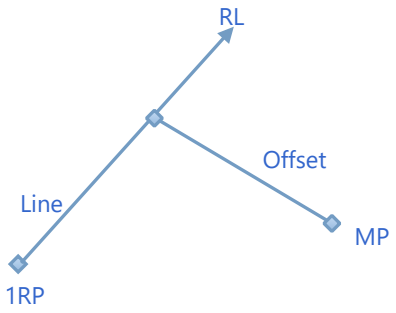
RefH: Select reference height; use ◄/► keys to choose between:

- PT1: Height differences are computed relative to the height of the 1st base point;
- PT2: Height differences are computed relative to the height of the 2nd base point;
- Interpolation: Height differences are computed along the reference line;
- NoH: Height differences are not computed and shown.

Then, decide to measure or stake out. Press F2[MEASURE] key to activate Line & Offset measuring or press F3[STAKE] key to start the application to stake out. Use F1[NewBL] to change the base line.

Line & Offset Measuring

The "Line & Offset" application calculates from measurements or coordinates longitudinal, parallel and height offsets of the target point in relation to the reference line.



1RP: 1st reference point

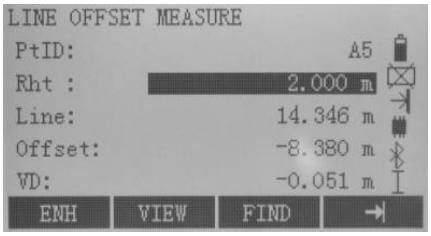
MP: Measured point

RL: Reference line

Line: Longitudinal offset

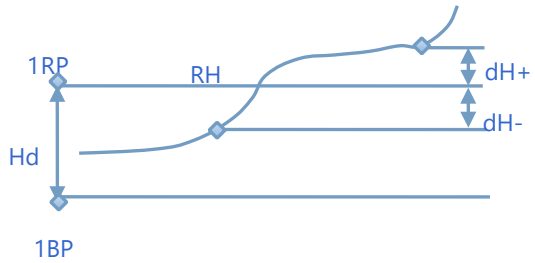
Offset: Parallel offset

Press F2[MEASURE] key from the line-main menu:



The calculated height difference is relative to the selected reference height (**VD**).

Example relative to "first reference point"



1RP: 1st reference point

1BP: 1st base point

RH: Reference height

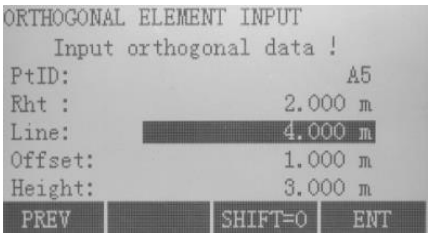
Hd: Height difference between reference and base point

dH: Height difference from reference height (positive or negative)

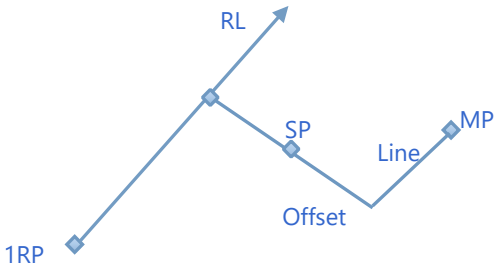
"Stake out" application

You can enter longitudinal, transverse and height offsets for the target points to be set-out relative to the reference line. The program calculates the difference between a measured point and the calculated point. The program displays the orthogonal (Line, Offset, dVD) and the polar (dHz, dHD, dVD) differences.

Press F2[MEASURE] key from the line-main menu. It will be required to input the orthogonal stake out elements.



Press [ENT] to confirm data entry and start calculation. The orthogonal stakeout menu will be shown.



1RP: 1st reference point

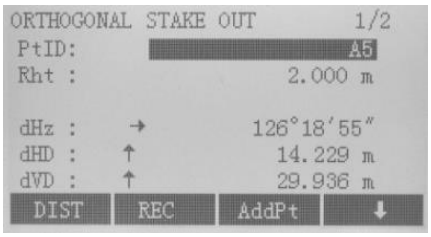
MP: Measured point

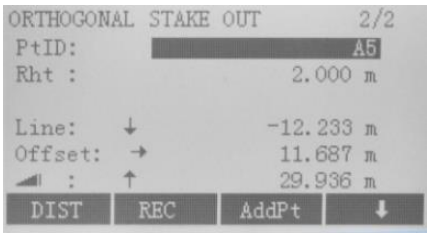
SP: Stake out point

RL: Reference line

Line: Longitudinal offset

Offset: Parallel offset





Here:

dHz is the angular distance from the reference point. If it is positive (arrow right) turn telescope clockwise to the stake out point;

dHD is the distance from the reference point. If it is positive (arrow up), the stake out point is further away than the reference point;

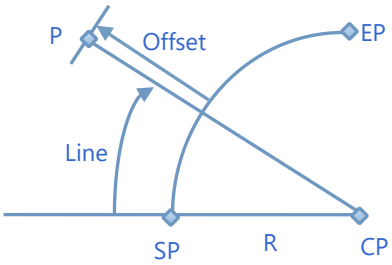
dVD is the height difference. If it is positive (arrow up), the stake out point is higher than the reference point;

Line is the longitudinal offset. If it is positive (arrow up), the stake out point is further away than the reference point;

Offset is the transversal offset. If it is positive (arrow right), the stake out point is on the right of the reference point.

8.8.2. Reference Arc

This application permits the user to define a Reference Arc and then measure or stake out in relation to the arc.



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

P: Point to stake

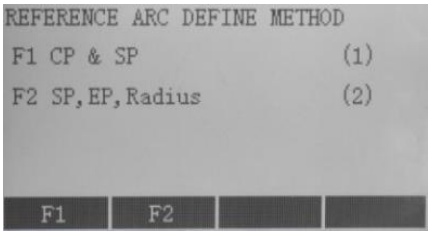
R: Radius of circle

Line: Distance from start of arc along with the curve

Offset: Vertical distance from arc

Press F3[REFARC] to start defining the arc.

When starting the application, you were offered two methods to define reference arc: “Center Point & Start Point” (CP&SP) or “Start Point, End Point, Radius” (SP, EP, Radius).



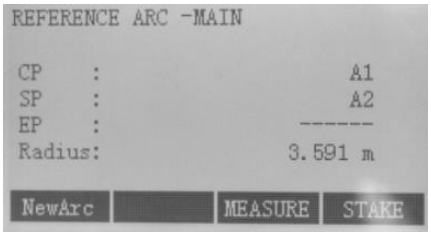
Depending on the type you have chosen, you also have to define points to determine the arc and proceed.

For the former, press F1. It will be asked to measure the center and the start points.

For the latter, press F2. It will be asked to measure the start and the end points and the arc radius. The created arc will be concave respect to the station position (for a convex arc use the previous method).

In both the cases, points have to be defined in one of the following ways:

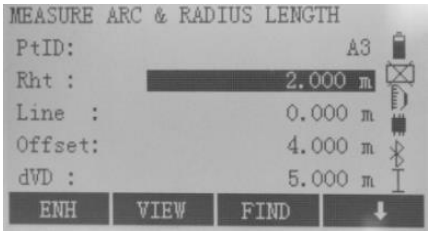
- Measured points: Input PtID and measure base points with [ALL] or [DIST]+[REC];
- Input coordinates manually: Press [ENH] to input;
- Find points from memory: Press [FIND] to search for entered PtID or press [LIST] to choose from a series of point.



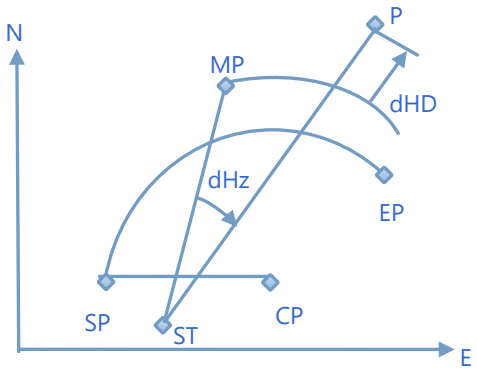
Then, decide to measure or stake out. Press F3[MEASURE] key to activate Line & Offset measuring or press F4[STAKE] key to start the application to stake out. Using F1[NewArc] it is possible to change the arc.

"Line & Offset" Measuring

Here you can measure, select points from memory or input coordinates manually and then Line and Offset values referring to the arc will display.



"Stake Out" application



ST: Station

SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

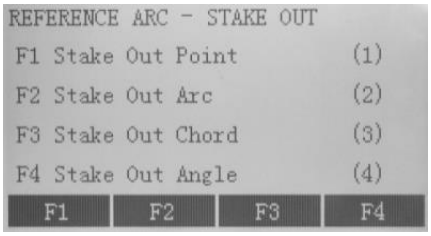
P: Point to stake out

MP: Measured point

dHz: Difference in horizontal angle

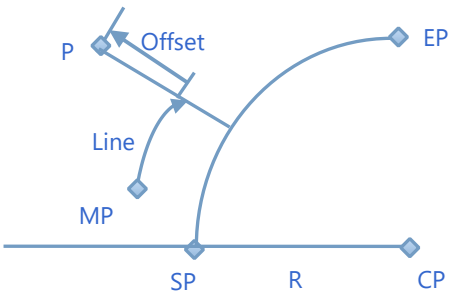
dHD: Difference in distance measurement

Notably there are four ways available for this application: Stake Out Point, Stake Out Arc, Stake Out Chord and Stake Out Angle.



1. **Stake Out Point**

This allows to stake out a point by entering a line and an offset value. Also negative values are editable.



SP: Start point of arc

EP: End point of arc

CP: Centre point of circle

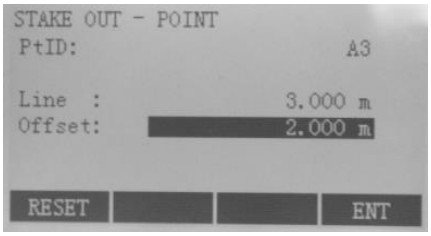
P: Point to stake out

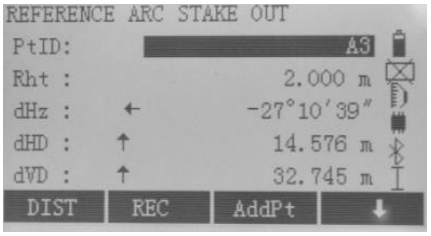
MP: Measured point

R: Radius of circle

Line: Distance from start of arc along with the curve

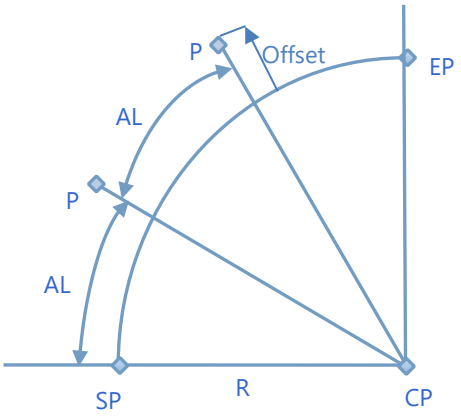
Offset: Vertical distance from arc





2. Stake Out Arc

This gives possibility to stake out a series of equidistant points along with the arc.



SP: Start point of arc

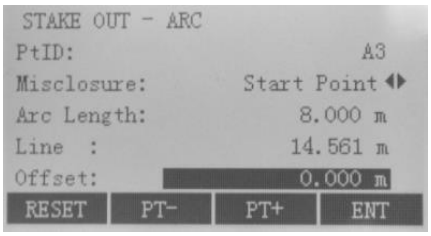
EP: End point of arc

CP: Centre point of circle

P: Point(s) to stake out

AL: Arc length

Offset: Vertical distance from arc



Here:

Misclosure: if the input arc length is not an integer of the whole arc, there will be a closure. And three distribution ways are provided: Start Point, End Point and Average.

- Start Point: All of the closure will be added to the first segment of arc;
- End Point: All of the closure will be added to the last segment of arc;
- Average: The closure will be equally distributed among all segments.

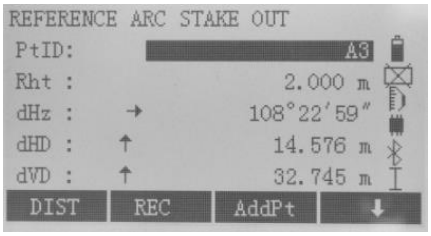
Arc Length: Input the length of the arc-segment which you want to stake out.

Line: Display the line-value of the stake out point. This is calculated by the arc length and the selected closure distribution.

Offset: Input the offset value here.

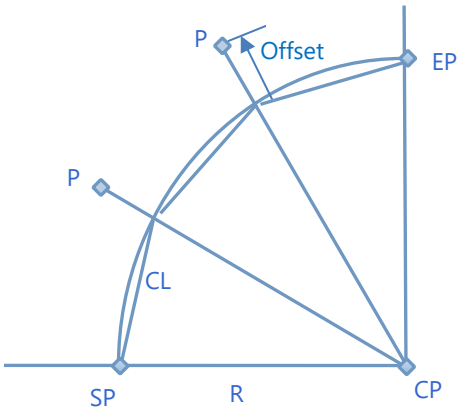
Use the softkeys:

- F1[RESET] to set all values to 0;
- F2[PT +]/F3[PT -] to toggle through the calculated stake out points;
- F4[ENT] to proceed to Stake Out display:



3. Stake Out Chord

This allows to stake out series of equidistant chords along with the arc. The contents and the softkey functions are the same as described in "Stake Out Arc" section.



SP: Start point of arc

EP: End point of arc

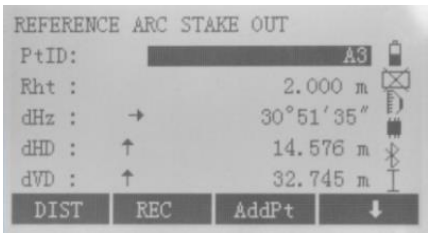
CP: Centre point of circle

P: Point(s) to stake out

CL: Chord length

R: Radius

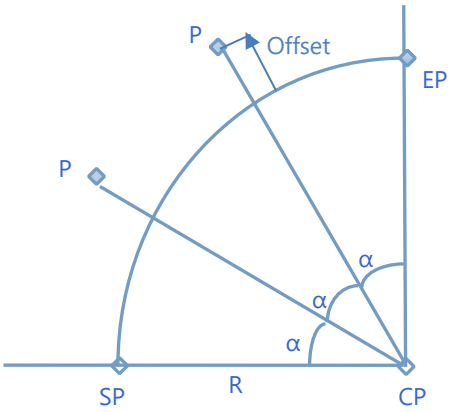
Offset: Vertical distance from arc



4. Stake Out Angle

This allows to stake out series of angles which are determined by the points of arc and whose values are equal angle.

The contents and the softkey functions are the same as described in "Stake Out Arc" section.



SP: Start point of arc

EP: End point of arc

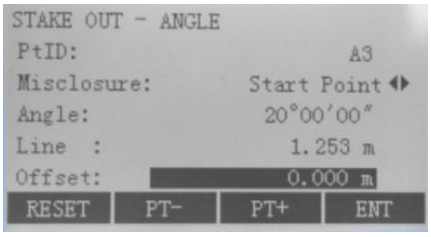
CP: Centre point of circle

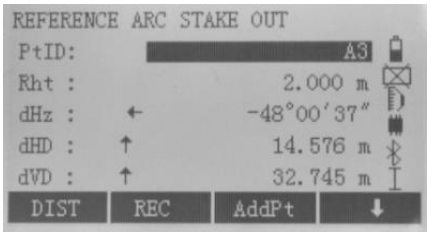
P: Point(s) to stake out

R: Radius

α: Angle

Off: Vertical distance from arc



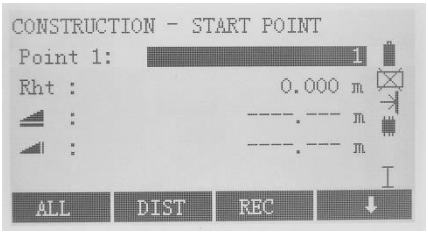


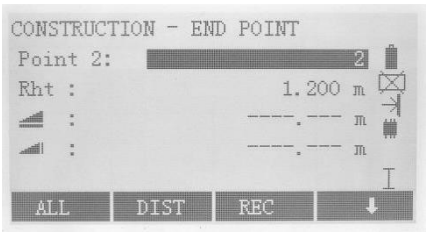
8.9. Construction

This application allows defining a construction site by combining set-up of the instrument along with a construction line, measuring and staking out points relative to the line. After starting this program, there will be four options provided:

- Set Job (see 7.1. Setting job);
- Set EDM (see 5.3. EDM settings);
- New construction site;
- Continue previous site.

8.9.1.New construction site

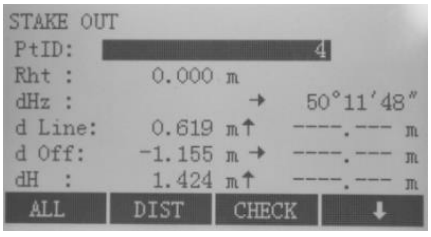




Define start and end points of this construction line in one of the following ways:

- Measure points: input PtID and measure base points with [ALL] or [DIST]+[REC];
- Input coordinates manually: press [ENH] to input.

Automatically, stake out display is shown: here you can search or enter points (in the same way as in the previous step) to stake out.



Move the instrument, according to the indicated arrows to find the point position:

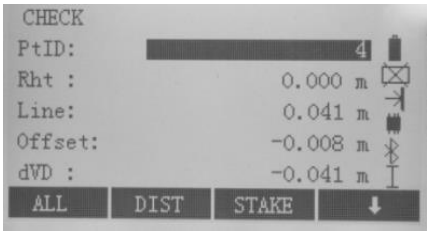
dHz is the horizontal angle;

d Line is the longitudinal offset. If it is positive (arrow up), the target point is further away than the line;

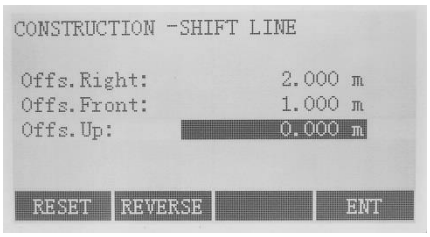
d Off is the transversal offset. If it is positive (arrow right), the target point is on the right of the line;

dH is height difference. If it is positive (arrow up), the target point is higher than the line.

Use F4[↓] to scroll all the softkeys at the bottom of the display and select: [MAxis] to input values for shifting the line or [CHECK] to switch to check mode.

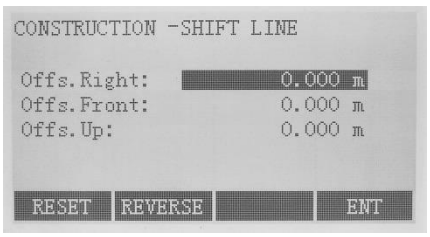


Press F3[CHECK]; the display will show you the line offset (**Line**), the transversal offset (**Offset**) and the height (**dVD**) of a measured point in relation to the line.

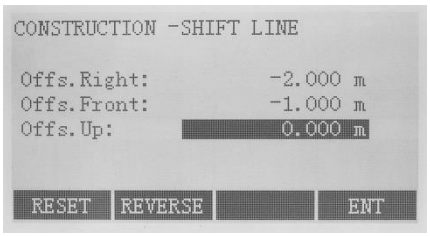


Press F4[↓] and F3[MAxis] keys to input values for shifting the line.

Insert the shifting distances by keyboard.



Press F1[RESET] if you want to set to 0 all the values



Press F2[REVERE] to switch from positive to negative (and vice versa) the values.

Press F4[ENT] to save the settings and turn to the stake out interface.

8.10. Lead measure

This application is used for survey of hierarchical control traversing and mapping traversing etc. and adjustment and computation of closure.

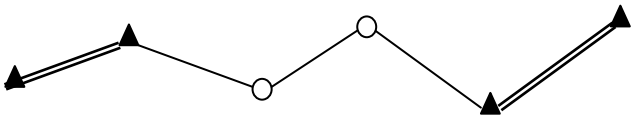
The program is provided of the following capacity:

- Six sets of observation are upper limit to every survey station.
- The maximum number of observing directions is 2 as for survey station (i.e. only traverse point measuring supported except for branch point measuring).
- The maximum number of survey stations is 30 as for single lead.

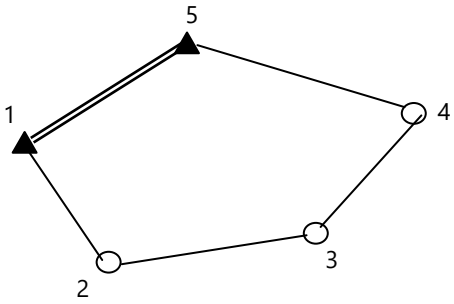
The following lead type are available:

▲ Point whose coordinate is known	Side whose azimuth is known
○ Point whose coordinate is unknown	Side whose azimuth is unknown

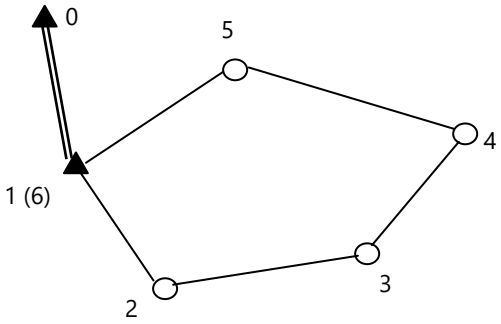
1. Open traverse: coordinates of occupied point and backsight point of the first survey station are known, so are coordinates of occupied point and foresight point of the last survey station.



2. Closed traverse: coordinates of the first traverse point (point 1) and the last one (point 5) on the lead are known

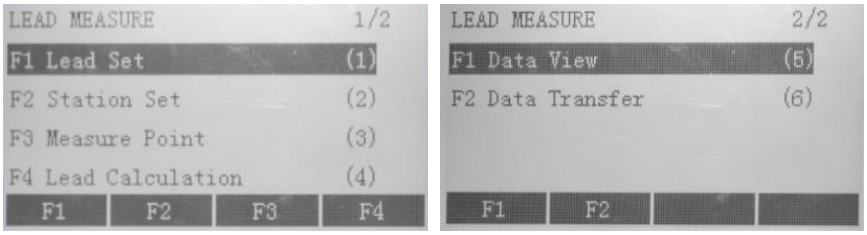


3. Closed traverse with a branch: coordinates of the first traverse point (point 1) and another point (point 0) are known.



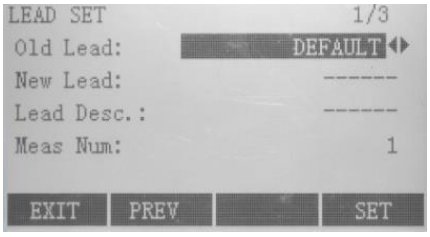
NOTE: As to this type of traverse measuring, the last survey station must be measured again on where point 1 is, but occupied point can't be set to point 1, otherwise this operation will make measurements of the first survey station covered. For example, occupied point of the last survey station can be set to point 6 whose coordinate inputting is the same as point 1's.

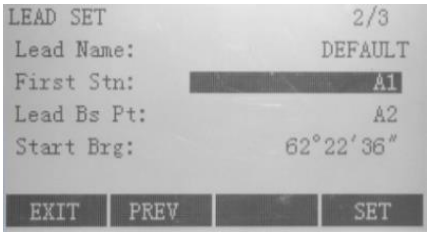
Lead measure menu contains two pages, as shown, through which you can toggle by {PAGE} key.



8.10.1. Lead set

On the first page of "Lead Measure" press F1 to activate lead setting which consists of three pages (toggle by {PAGE} key).





Old Lead: select the existed old lead name. If you want to repristinate the old lead, select it and press F4[SET]

New Lead: edit the new lead name

Lead Desc: edit the lead description

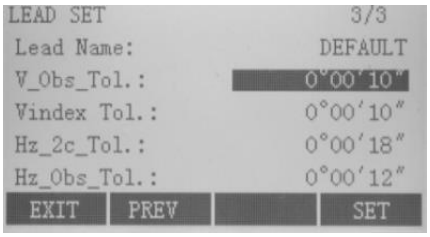
Meas Num: input the number of observation sets

Lead Name: the lead name is reported

First Stn: enter the name of the first survey station, from which the first observations will be done

Lead Bs Pt: enter the name of the lead backsight point

Start Brg: input the initial azimuth



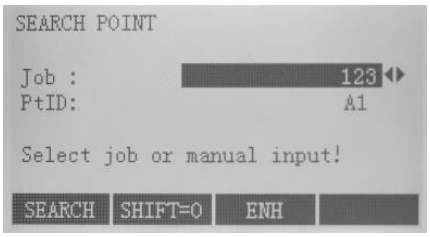
V_Obs_Tol: Discrepancy tolerance of vertical angles among observation sets

Vindex Tol: Discrepancy tolerance of vertical index error

Hz_2c_Tol: Discrepancy tolerance of horizontal collimation error C

Hz_Obs_Tol: Discrepancy tolerance of horizontal angles among observation sets.

NOTE: When moving screen cursor to "First Stn" and "Lead Bs Pt" rows, press {ENT} key to search and import the points you need, as shown.



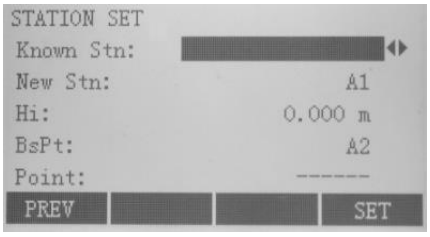
Press:

- F1[SEARCH] to search existing known point;
- F2[SHIFT=0] to set all coordinates to 0;
- F3[ENH] to input coordinates manually.

Press F4[SET], once defined the lead.

8.10.2. Station set

On the first page of "Lead Measure" dialog press F2 to activate station setting, as shown.



Known Stn: Known survey station

New Stn: New survey station, from which the next observations will be done

Hi: Instrument height

BsPt: Backsight point

Point: Foresight point

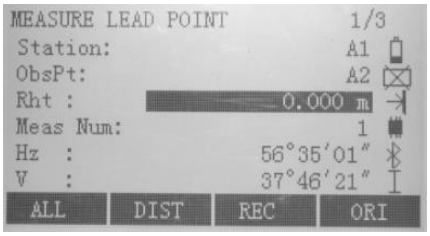
Then press F4[SET] key to finish station setting and return "Lead Measure" dialog.

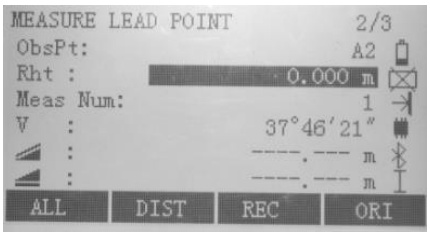
NOTE:

- Here foresight point must be input.
- It's worth noting that instrument height is defaulted to 0. And you must input accurate "Hi" before pressing "SET", otherwise the buzzer sounds and proceeding operation is impossible.
- If mistake is found after station setting succeeds, you need to press {ESC} key to quit the entire program and reenter.

8.10.3. Measure points

On the first page of “Lead Measure” press F3 to access “Measure Lead Point” dialog which consists of three pages, as shown.





Station: Current survey station;

ObsPt: point to observe;

Rht: Prism height;

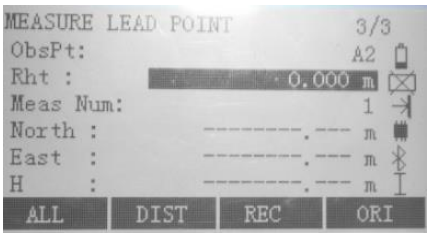
Meas Num: The number of observation sets;

Hz: Horizontal angle;

V: Vertical angle;

: slope distance between the station and the observed point;

: horizontal distance between the station and the observed point;



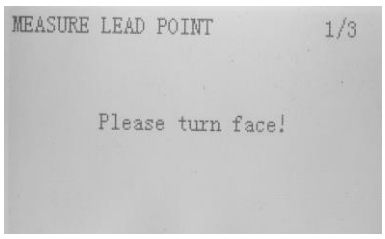
North: Ordinate of measured lead point;

East: Abscissa of measured lead point;

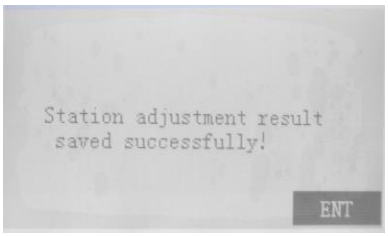
H: Elevation of measured lead point.

The procedure to measure lead points is suggested from the instrument: collimate the point indicated in the “Obs.Pt” row with the instrument in face I and press F1[ALL] or F2[DIST]+F3[REC] to measure and save.

After having measured the backsight and the foresight points, the following popup dialog displays:



Turn the instrument to face II and repeat the measures: the following popup dialog displays:



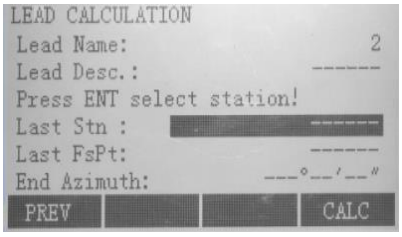
Press F4[ENT] key to return “Lead Measure” dialog.

NOTE: Prism heights of foresight and backsight must be input during the first semi observation of the first observation set. It's worth noting that these prism heights are defaulted to 0. And you must input accurate “Rht” before pressing [DIST] or [ALL], otherwise the buzzer sounds and proceeding operation is impossible.

All foresight observed points need distance measuring unless foresight points are known. Distance measuring of backsight points can be ignored, but it is proposed.

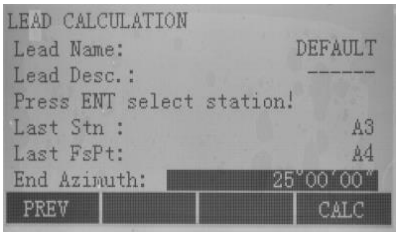
8.10.4. Lead calculation

Repeat “Station Set” and “Measure Point” until all station surveys are complete. Thus, lead calculation can be carried on.

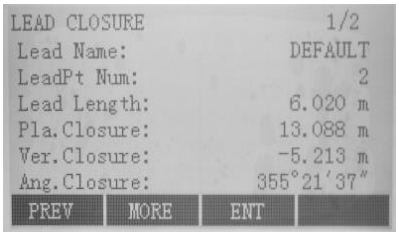


Similar with “Lead Set”, when moving screen cursor to “Last Stn” and “Last FsPt”, you can press [ENT] key to search the point you need or input coordinates.

End Azimuth: Final azimuth (insert a value if an open traverse has been used)



NOTE: If the lead belongs to branch traverse, directly press F4[CALC] key to compute coordinates of each lead point of branch traverse.



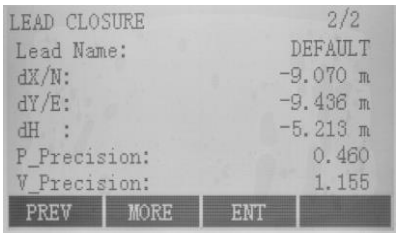
After pressing F4[CALC], a dialog about lead closure will eject.

Lead Length: total length of all leads

Pla. Closure: Horizontal misclosure

Ver. Closure: Vertical misclosure

Ang. Closure: Azimuth angle misclosure



Press {PAGE} key to switch to page 2, as shown.

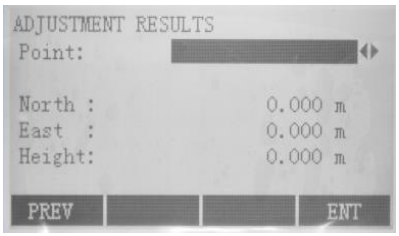
dX/N: misclosure of X coordinate increment

dY/E: misclosure of Y coordinate increment

dH: Vertical elevation closure

P_Precision: Plane precision

V_Precision: Vertical elevation precision



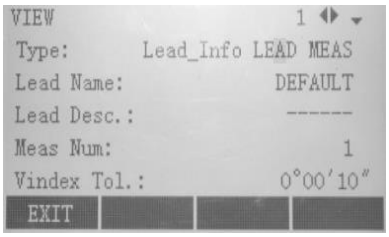
Press F2[MORE] to check “calculation results”, especially coordinates of each lead point after computing.

With the {FUNC} key scroll between observed points.

8.10.5. Data view

Press {PAGE} button to turn to second page of Lead Measure program, and then select [F1] key to enter “Data View”, where you can know about information according to the lead you choose.

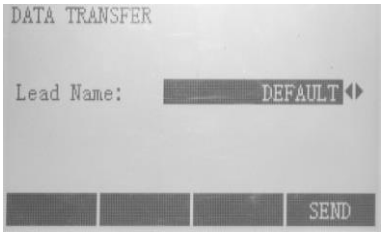
Select the Lead Name using the ◄/► keys and press F4[VIEW].



Scroll all the measures using the ◄/► keys and see all the details about the measure through the {PAGE} key.

8.10.6. Data transfer

It allows to send Lead Measure data to PC through RS232 port. Press {PAGE} button to switch to the second page of Lead Measure program, and then select [F2] key to enter “Data Transfer”.



Connect the cable to your computer and select, using the ◄/► keys, the Lead Measure to be output.

Press the F4[SEND] key to start transferring data.

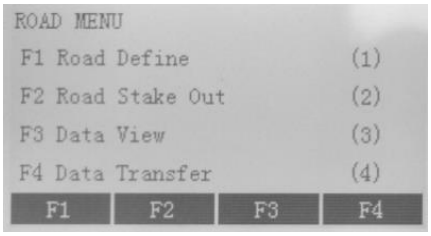
NOTE:

- To use this data transfer option, it is necessary to have installed a proper software on your computer, able to receive data from a RS232 port;
- Be sure that the communication port settings are set in the same way as on your computer;

- It is always possible, as alternative, to transfer data to PC using the USB or the external SD memory: on the PC open the “LEAD” folder to see results.

8.11. 2D-road

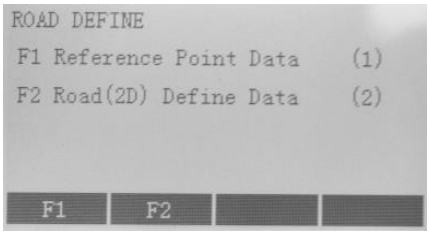
Start the program “2D-Road” to enter the road menu which includes Road Define, Road Stake Out, Data View and Data Transfer.



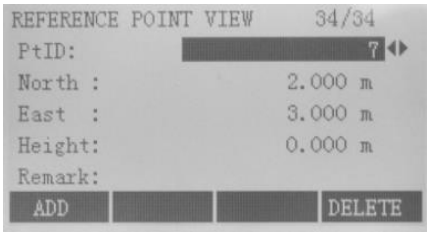
8.11.1. Road define

Press F1 key to enter the road define menu.

Reference point data

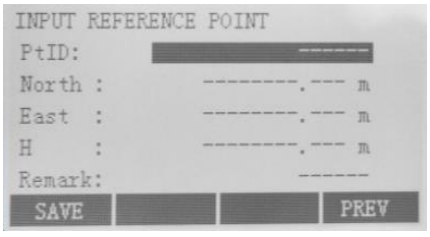


Then press F1 “Reference Point Data”. Point here means reference point that can be used for setting station and orientation.



In the dialog of reference point view the existing reference points can only be available for scan and deletion but not for edit. Press:

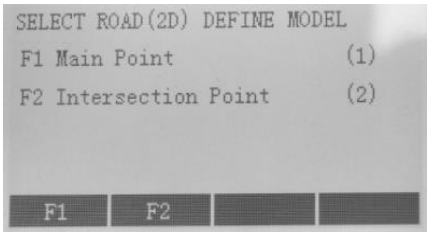
- F1[ADD] to input of new reference point, as shown in the below figure;
- F4[DELETE] to delete current displayed reference point. Erased data can’t be resume.



In the input reference point dialog, press F1[SAVE] to save the new input of reference point; F4[PREV] to return to road define menu.

NOTE: under input reference point mode, press the {ESC} fixed key to withdraw and return to reference point view menu.

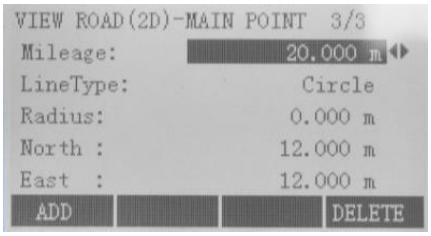
Road 2D define data



Press F2 "Road(2D) Define Data". This application is used to describe and determine road centerlines. As shown, there are two models available for Road(2D) definition: "Main Point" and "Intersection Point".

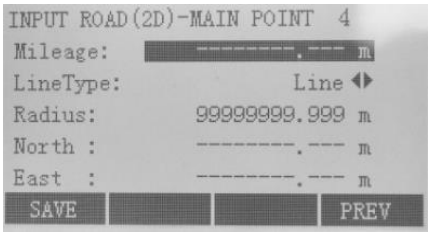
1. Main Point:

Press F1 key. This application utilizes main point information relative to the line to describe the entire road. Main point is the key point where the line type changes along with the line. It includes start point, end point and so on. This method can solve any complicated line type including ramp.



In the "View road(2D)-main point" dialog, press:

- F1[ADD] to input new main point. After inputting, press F1[SAVE];
- F2[EDIT] to modify the selected point;
- F4[DELETE] to delete current displayed main point. Erased data can't resume.



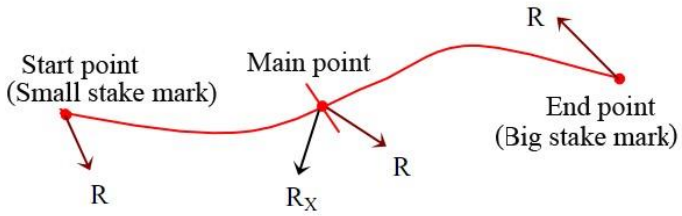
Here:

Mileage is the stake mark of main point on the road centerline. Within the input format can't be included certain characters "K", "k" and "+" etc. For example, 2224.224 can be input instead of K2+224.224;

Line Type is the line type of route preceding main point (Big stake mark direction) can be selected from four options: Line, Circle (Round Curve), Spiral (Easement Curve) and End Point;

Radius*:* except the end point of route, the "Radius" of any point represents the radius of curvature ("R" in the below figure) of one side preceding main point (Big stake mark direction). When route turns left,

the radius will be negative; When route turns right, the radius will be positive. When radius of curvature is infinite, the radius value should be set to: 99999999.999 or -99999999.999;



North is the ordinate of main point;

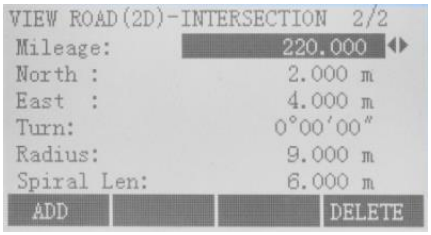
East is the abscissa of main point.

Press F1[SAVE] to save the new input of main point or F4[PREV] to return to Road Define menu.

NOTE: under main point inputting mode, press the {ESC} fixed key to withdraw and return "View Road (2D) Main Point".

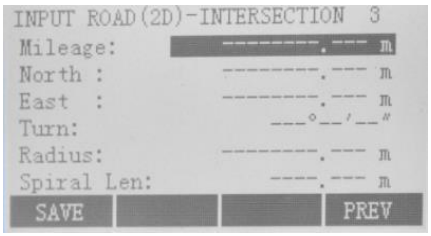
2. Intersection Point

Press F2. This application is to describe the entire road with information of intersection point of the route. This method is appropriate for the line type whose intersection points are symmetrical and start point and end point of the route must be on the straight-line segment or its vertex points. That intersection points are symmetrical means their corresponding tangent lines are equal long.



In the "View road (2D)-intersection" dialog, press:

- F1[ADD] to input of new intersection point. After inputting, press F1[SAVE];
- F2[EDIT] to modify the selected point;
- F4[DELETE] to delete current displayed intersection point and other intersection points whose mileage is larger than the current one, the erased data can't resume. It's worth noting that, different from main point method, pressing DELETE key may lead to erase of several intersection points.



Here:

Mileage is the stake mark of intersection point. Within the input format can't be included certain characters "K", "k" and "+" etc. For example, 2224.224 can be input instead of K2+224.224;

North is the ordinate of intersection point;

East is the abscissa of intersection point;

Turn is the angle of one intersection point relative to the route (Turn angles of start point and end point should be set to 0);

Radius is the radius of curvature of circular curve corresponding to intersection point. When route turns left, the radius will be negative; Conversely, the radius will be positive. At the place of start point and end point of route, the curvature radius value must be set to: 99999999.999 or -99999999.999;

Spiral Len is the easement curve length relevant to intersection point. Set to 0 in the situation where there's no easement curve.

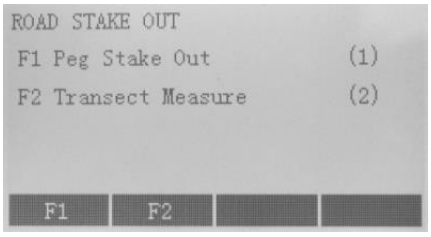
NOTE:

- When using intersection point method, input data successively in accordance with mileage (small to large) of intersection point. And the first and the last intersection point must be on the straight-line segment of the road centerline.
- When using main point method, you can input data out of accordance with mileage of main point, but don't miss out any main point finally. It's recommended to input data successively according to mileage magnitude in support of check and verification.
- The datum input with main point method can't be viewed and edited in the form of intersection point method, i.e., intersection point method will be disabled if import in the form of main point; But differently the datum entered in the form of intersection point can be viewed and added in the form of main point, except for deletion.
- Affected by precision of turn angle, there may exists deviation in main point datum converted by intersection point datum.
- No matter what kind of method (main point or intersection point) you choose, normal stake out and measuring can be executed based on the requirement of input of at least two valid records (two valid main points or intersection points).

- It is advisable to input data with main point method and directly upload plane alignment data to instrument with desktop tool. The plane alignment data uploaded directly can't be viewed and edited in the form of intersection point.
- No matter what kind of method (main point or intersection point), its maximum mileage mustn't be greater than 4294000.000 m, i.e., the route's maximum mileage mustn't be more than K4294+000.000m.

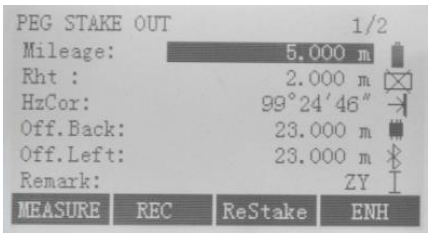
8.11.2. Road stake out

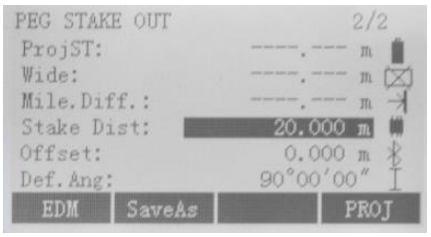
In the road menu press F2 key and then display Road Stake Out dialog. As shown, this function is mainly used to realize Peg Stake Out and Transect Measure.



Peg Stake Out

On "Road stake out" display, press F1 key to access "Peg Stake Out" dialog. Before staking out, as required press {PAGE} key and switch to the second page in order to set "Stake Distance", "Offset" and "Deviation Angle".





Here:

Mileage is the stake mark of point to be stake out. Within the input format can't be included certain characters "K", "k" and "+" etc. For example, 2224.224 can be input instead of K2+224.224;

Rht is the accurate prism height before measuring;

Hzcor is the included angle between current collimation axis direction and theoretical direction (point to the point to be stake out). That this value becomes 0 means the instrument points to the point to be stake out;

Off.Back is the direction where prism worker faces the instrument as reference direction. And if the value is positive, prism worker should be aloof from the instrument. Conversely, prism worker should be close to the instrument;

Off.Left is the direction where prism worker faces the instrument as reference direction. And if the value is positive, prism worker should move left. Conversely, prism worker should move right;

Remark is a simple description of the current point;

ProjST is the stake mark corresponding to current measured point projected onto route centerline;

Wide is the offset distance that current measured point deviates from centerline;

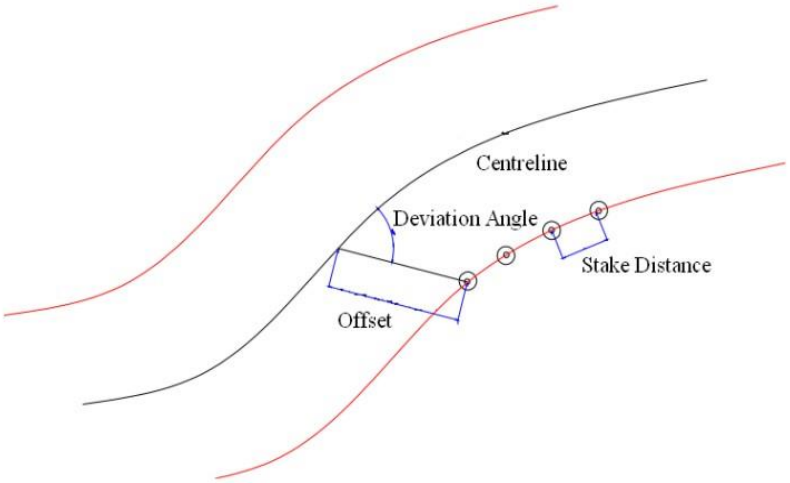
Mile.Diff is the difference between ProjSt and Mileage;

Stake Distance is the mileage increment when stake out. And this value will be negative when stake out from big stake mark to small stake mark;

Offset is the distance between the point to be stake out and its corresponding mileage of centerline (not always the perpendicular distance from stake out point to centerline). That this value is 0 indicates middle-stake. But if this value is negative, it means left side-stake; otherwise, it means right side-stake;

Def.Ang (Deviation Angle) is the included angle generated from centerline and connecting line between the point to be stake out and its corresponding mileage of centerline. Its range is (0, π). It's necessary to refer to deviation angle when set out particular point (such as bridge pier) and side-stake whose connecting line is not orthogonal but intersected with the route.

Specific meaning with respect to Stake Distance, Offset and Deviation Angle is shown in the figure below:



In "Peg Stake Out" dialog, you can find the following softkeys:

- [MEASURE] to measure distance and angle.
- [REC] to save stake out result and make stake mark increase by stake distance.
- [ReStake] to make stake mark decreased by stake distance.
- [ENH] to access "Stake Out Point Coordinates" dialog, and view design coordinates of point to be stake out.

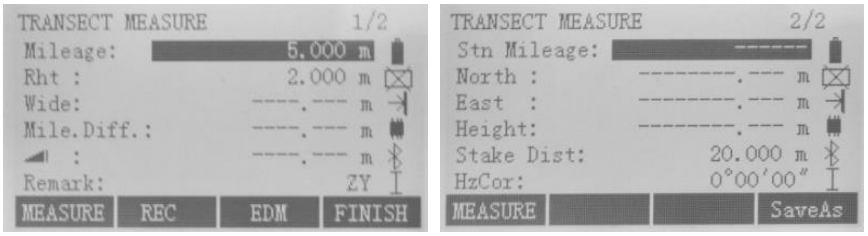
- [EDM] to switch to “EDM Settings” dialog. (see 5.3. EDM settings)
- [SaveAs] to store current measured point as reference point (control point) whose name is current mileage.
- [PROJ] to set mileage as current ProjST (projection stake). This function is useful when add stakes on terrain or surface features to set out.

NOTE:

- Make sure Offset, Deviation Angle and Stake Distance are set correctly when peg stake out.
- With the increment of main point datum of plane alignment, running speed of certain links during peg stake out can be slowed down.
- Peg stake out result can be used as transect measure result.

Transect Measure

On “Road stake out” display, press F2 key to access “Transect measure” dialog.



Here:

Mileage is stake mark corresponding to transect to be measured;

Rht is the accurate prism height before measuring;

Wide is the offset distance that current measured point deviates from centerline;

Mile.Diff means the one that is the projection onto current sideline of difference between mileage corresponding to current measured point and specified mileage. The value will be positive if mileage corresponding to current measured point is greater than specified mileage. Conversely, it is negative. Prism worker can move the prism to specified transect according to this field value;

 is the height difference between current measured point and the last one;

Remark: it can be used when saved as reference point, and its simple description of the reference point to be stored;

Stn Milelage is the stake mark of current occupied station point (pressing [SaveAs], this field will made as point number);

North is the ordinate of current measured point;

East is the abscissa of current measured point;

Height is the elevation of current measured point;

Stake Distance is mileage increment when transect measuring. And this value will be negative when measuring from big stake mark to small stake mark;

HzCor is the included angle between current collimation axis direction and "normal" direction of mileage of occupied point which is perpendicular to the transect route. If measuring the transect where occupied point lies, adjust this angle to 0 degree or 180 degrees.

In the "Transect measure" dialog, you can find the following softkeys:

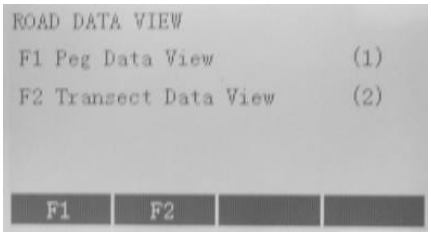
- [MEASURE] to measure distance and angle;
- [REC] to save current measurement result;
- [EDM] to switch to "EDM Settings" dialog (see 5.3. EDM settings);
- [FINISH] to complete current transects measuring and make mileage successively increase to next transect by stake distance;
- [SaveAs] to store current measured point as reference point (control point) whose name is Stn Mileage.

NOTE:

- During stake out and measuring, if the elevation of occupied point is unknown, this value will be defaulted to "-9999.000" meters.
- During transect measuring, if current measured point is not within the control of plane alignment, valid width and mileage difference can't be calculated, thus this measured point will not be saved.

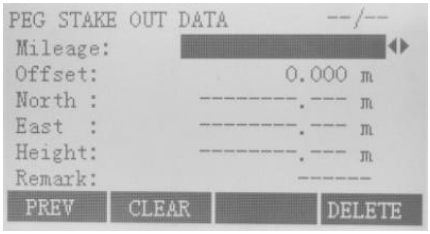
8.11.3. Data view

Under Road Menu, press F3 key, and then display "Road Data View" dialog. As shown, this function is to realize data view of peg stake out and transect measure. All the results can be available for scan and deletion but not edit and modification.



Peg data view

On “Road data view” menu, press F1 key to access “Peg data view” menu.



Here:

Mileage is mileage of specified stake out points;

Offset is the offset distance that specified stake out point deviates from centerline, namely, “Offset” on “Peg Stake Out” display;

North is the ordinate of actual measured point;

East is the abscissa of actual measured point;

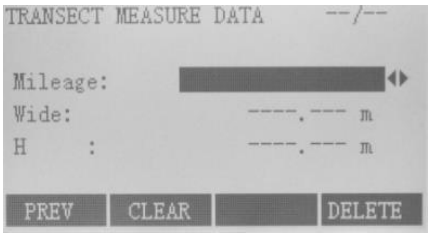
Height is the elevation of actual measured point;

Remark is a simple description of actual measured point.

Press F1[PREV] to return “Road Data View” dialog, F2[CLEAR] to delete all results of peg stake out in current job or F4[DELETE] to delete current displayed records. Deleted data can’t resume.

Transect data view

On “Road data view” menu, press F2 key to access “Transect data view” menu.



Here:

Mileage is the mileage corresponding to the transect;

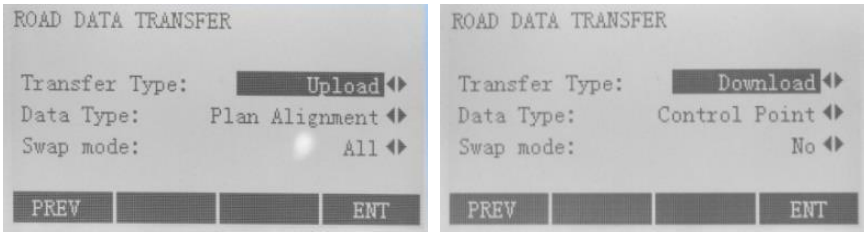
Wide is the offset distance that cross-sectional point deviates from centerline;

H is the actual elevation of this measured point.

Press F1[PREV] to return to "ROAD DATA VIEW" menu, F2[CLEAR] to delete all results of transect measure in current job or F4[DELETE] to delete current displayed records. Deleted data can't resume.

8.11.4. Data Transfer

Under Road Menu, choose softkey F4 or number key 4, and then display "Data Transfer" dialog. This function is to realize known data uploading (Control point and Plane alignment) and results downloading of stake out and measuring.



Transfer type contains two options:

- **Upload:** it helps to upload data to total station via PC. And this operation is only appropriate for known data (Control point and Plane alignment);
- **Download:** it helps to send data to PC via total station, and this operation is appropriate for all types of data.

Data type contains four options: Control point, Plane alignment, Cross-sectional and Stake out Results. Only "Control point" and "Plan alignment" are selectable when "Upload" is the transfer type.

Swap mode only includes two choices:

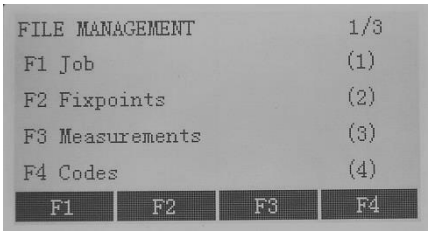
- **All**: it will delete the same types of all existed data in current job. It is only selectable with "Upload" transfer type
- **No**: it won't delete the same types of existed data. It is only selectable with "Download" transfer type.

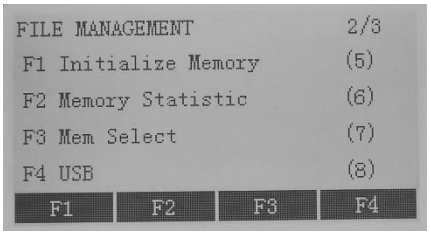
Press F4[ENT] to save the new settings or F1[PREV] to go back to the Road menu.

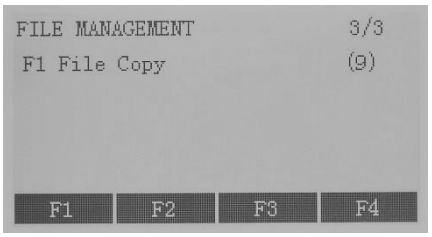
9. Data management

9.1. File management

Press the {MENU} key and F4[JOB] to enter the File Management menu, which contains all functions for entering, editing and checking data in the field.



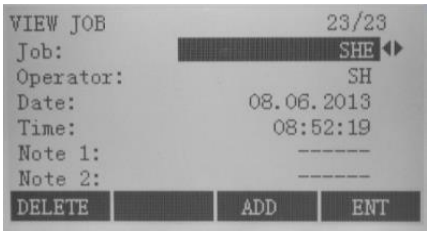




9.1.1. Job management

Jobs are a summary of data of different types, e.g. fixed points, measurements, codes, results, etc. Press F1 in the file management menu to view jobs.

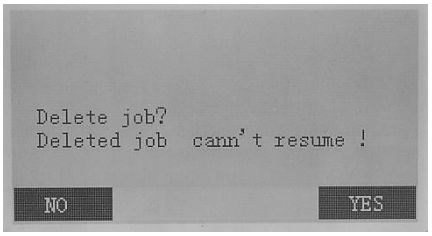
The job definition consists of inputting the job name and user. Additionally, the system generates time and date at the moment of creation.



In the view job mode use the ◄/► keys to select a job, then press:

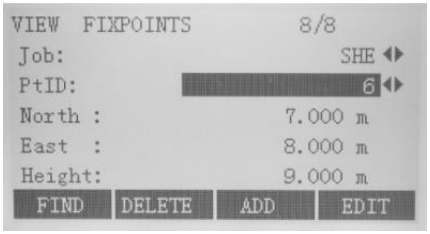
- F1[DELETE] to delete it;
- F3[ADD] to start a new job;
- F4[ENT] to set it.

NOTE: Deleting, the job can't be undone. After confirming the message all data will be lost permanently.



9.1.2. Fixed points management

Press F2 key in the file management menu to view fixed points:



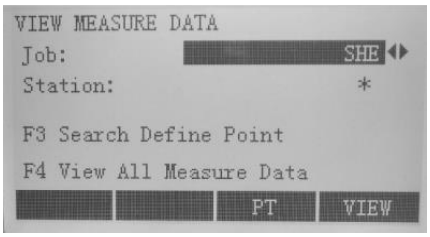
Select the job and/or the point ID (PtID) through the ◄/►keys. Valid fixed points contain at least the PtID and the coordinates (East, North) or (Height). Press:

- F1[FIND] to start point search. Exact PtIDs can be entered or the * wildcard-criteria used;
- F2[DELETE] to delete selected fixed point. A warning message will appear: press F4[YES];
- F3[ADD] to enter a new PtID and coordinates. Save with F4[SAVE];
- F4[EDIT] to edit known data. Save with F4[SAVE].

9.1.3. Measurements management

Press F3 in the file management menu to view measurements:

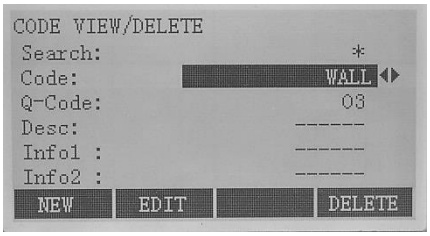
Measurement data stored in the internal memory can be searched, displayed or erased.



Select the job in which you want to search the measurement through ◄/► keys. Press F3[PT] to start point search dialogue or F4[VIEW] to display all measurements.

9.1.4. Codes management

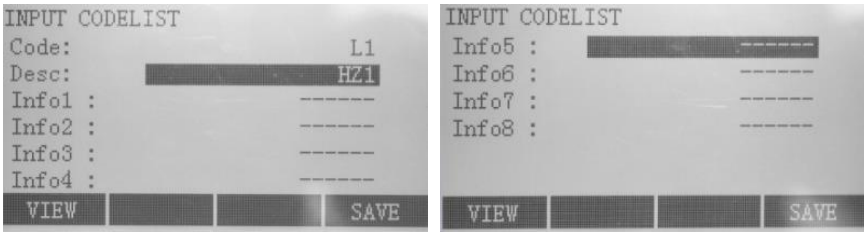
Press F4 in the file management menu to view codes:



Select the code using ◄/► keys or editing the code name in the "Search" space. Code, Q-Code (which is an ID for the code), corresponding description and its maximum of 8 attributes (from Info1 to Info8) with up to 16 characters are shown.

Here, press:

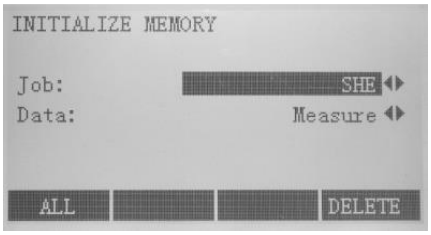
- F1[NEW] key to create a new code. After entering the info, save with F4[SAVE] key, otherwise go back to the view menu using F1[VIEW] key



- F2[EDIT] key to modify an existing code. After entering the info, save with F4[SAVE] key, otherwise go back to the view menu using F1[VIEW] key.
- F4[DELETE] to cancel the selected code. This operation is irreversible and no confirm dialogue will appear.

9.1.5. Initialize memory

Press F1 in the second page of the file management menu:



Initializing memory, you can cancel:

- Jobs: use ◄/► keys to select:
  - Job: the job name;
  - Data: "Job".

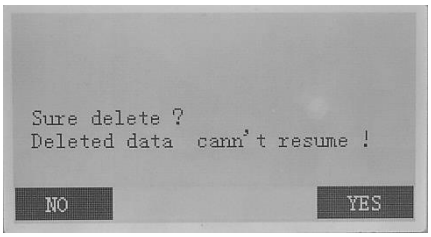
  Press F4[DELETE] and F4[YES] to confirm.

- Single data areas of a job: use ◄/► keys to select:
  - Job: the name of the job;
  - Data: choose between "Measure" or "Know Point".

  Press F4[DELETE] and F4[YES] to confirm.

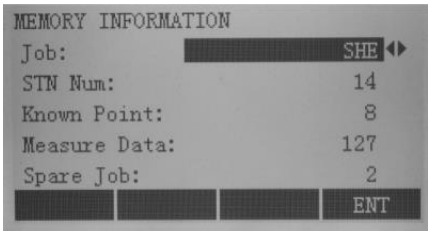
- All data: press F1[ALL]. All data will be lost!

NOTE: Deleting, the memory can't be undone. After confirming the message all data will be lost permanently.



9.1.6. Memory statistic

Press F2 in the second page of the file management menu:



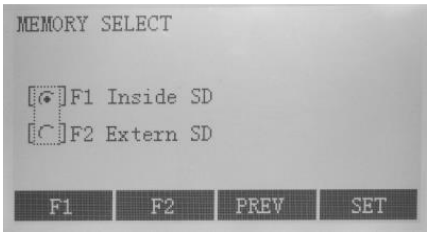
Select the job through◄/► keys, its specific memory information is displayed:

- STN Num: Number of stations;
- Known Point: Number of stored known points;
- Measure Data: Number of recorded data blocks (measured points, codes, etc.);
- Spare Job: Number of free or not defined jobs.

Press F4:[ENT] to return to the file management menu.

9.1.7. Memory select

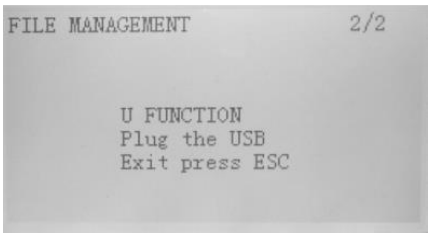
Press F3 in the second page of the file management menu.



Two methods of memory selecting are available: Inside SD and Extern SD. Select the former using F1 key, the latter using F2 key.

9.1.8. USB

Press F4 in the second page of the file management menu.



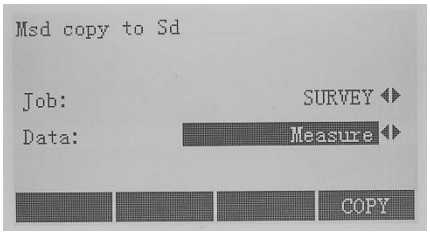
Conveniently, plug flash disk into the USB interface for data sending and selecting. By USB connection you can see the internal memory of the Total Station like a hard disk. The internal structure is of following type:

- FILE: directory with the survey jobs;
- LEAD: directory with the lead measurement files;
- CODE: directory with the code files;
- ROAD: directory with the road files.

NOTE: the USB connection is possible only following the above instructions.

9.1.9. File copy

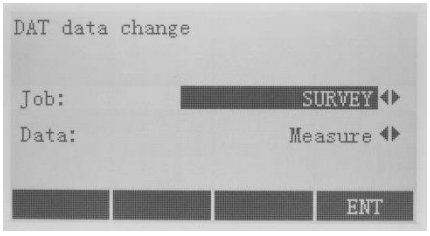
Press F1 in the third page of the file management menu.



This function gives the possibility to copy a survey job from internal MSD to external SD. Please note that it is not possible to do the opposite operation. Only Survey files can be exported using this option. Select the Job and the Data which you want to copy using ◄/► keys and press F4[COPY]

9.1.10. DAT data change

This function can be used to convert measured point or known points into .DAT format.



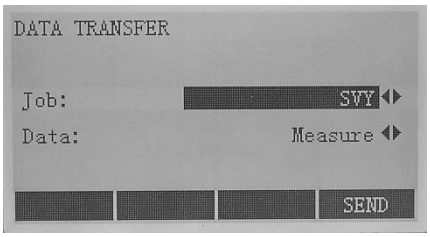
Select the Job and the Data which you want to copy using ◄/► keys and press F4[ENT].

"Measure" and "Known Points" are available as data types.

If you connect the instrument with your computer, through the USB function, the converted measure data are stored in the "CASSMEAS" folder; the converted known point are in the "CASSCORD" folder.

9.2. Data transfer

Press the {MENU} key and F3[DOWNL] at the second page of the menu to transfer data via RS232 port.



Connect the cable to your computer and select, using the ◄/► keys, the job and the data to be output.

Press the F4[SEND] key to start transferring data.

NOTE:

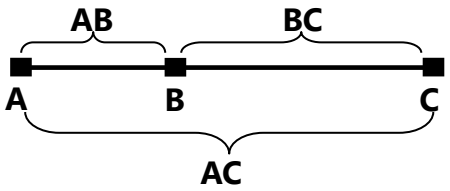
- to use this data transfer option, it is necessary to have installed a proper software on your computer, able to receive data from a RS232 port;
- be sure that the communication port settings are set in the same way as on your computer.

10. Check and adjustment

10.1. The instrument constant

I. Check

It is suggested to observe and compare the instrument with a testing baseline which is set on stable ground with a particular accuracy, though error is not generally included in the instrument constant. If the testing line is unavailable, you can select a flat place and set up the instrument and a target at the same height.



1. Select a point B on the approximately horizontal line AC with about 100 meters long. Measure the distances of lines AB, AC and BC.
2. The instrument constant can be calculated:

$$Instrument\ constant\ = AB + BC - AC$$

3. Repeat steps 1 and 2 ten times, and get the average value for instrument constant, if the average value is within ±3mm, adjustment is unnecessary.
4. If the difference is over ±3mm after the preceding operations, it is necessary to reset the instrument constant.

II. Adjustment

If it is necessary to reset the instrument constant, please contact STONEX service representative to perform that.

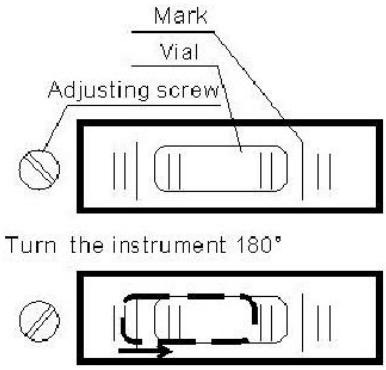
10.2. Plate level

I. Check

1. Mount the instrument on a stable device (as tripod, adjusting device) and fix it.
2. Level the instrument until the plate level is parallel to a line linking leveling foot screws A and B, then adjust the two screws to center the bubble.
3. Turn the instrument 180°/200gon, observe the moving direction of the bubble, if it is still centered, no adjustment is necessary, if not, you have to adjust it.

II. Adjustment

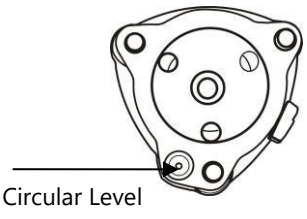
1. Mount the instrument on a stable device and fix it.
2. Level it roughly.
3. Turn the instrument and make the tubular level be parallel to a line linking two leveling foot screws, then adjust the two screws to center the bubble.
4. Turn the instrument 180°/200gon, adjust the Adj-screw with adjustment pin slightly to correct half of the bubble's displacement when it doesn't move.
5. Repeat operations 3, 4 until the bubble remains centered in any position.



10.3. Circular level

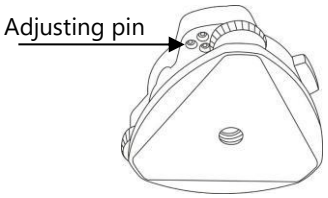
I. Check

1. Mount the instrument on a stable device and fix it.
2. Level it accurately by the plate level.
3. Observe the bubble of the circular level, if it is centered, no adjustment is necessary, if not, you have to adjust it.



II. Adjustment

1. Mount the instrument on a stable device and fix it.
2. Level it accurately by the plate level.
3. Adjust the three adj-screws to center the bubble by a wrench.



NOTE: Be careful when adjusting the three screws, and the tightening tension is identical for them.

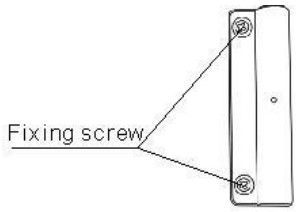
10.4. The optical sight

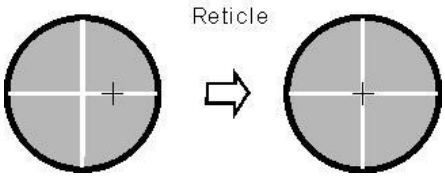
I. Check

1. Mount the instrument on a tripod and fix it.
2. Set a cross mark target which apart from the instrument about 50m.
3. Take the telescope sight the cross mark.
4. Observe the optical sight collimator whether collimating the cross mark, if collimate the mark, adjustment is not necessary; if not, adjust it.

II. Adjustment

1. Mount the instrument on the tripod and fix it.
2. Set a cross mark target which apart from the instrument about 50m.
3. Take the telescope sight the cross mark. Loosen two fixing screws, adjust and fix the two screws again.





10.5. Laser plummet

I. Check

1. Set the instrument on stable device and fix it.
2. Set a cross mark on the ground under the instrument.
3. Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground.
4. Rotate the instrument 180°(200gon) around and check the laser spot and cross mark if they coincide, adjustment is not required. Otherwise, adjust it.

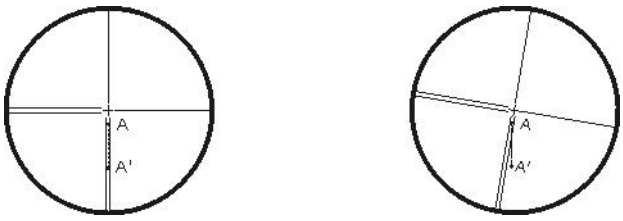
II. Adjustment

1. Set the instrument on stable device and fix it.
2. Set a cross mark on the ground under the instrument.
3. Turn the three leveling screws until the instrument keeps leveling and the laser spot coincides with the cross mark on the ground.
4. Rotate the instrument 180°(200gon) around and take off the protecting cover of the laser plummet, adjust the three adjusting screws with the screwdriver to move the laser spot to the cross mark, correct only one-half of the displacement in this manner.
5. Repeat operations 3 and 4 until the instrument keeps leveling and the laser spot coincides with the cross mark when rotating alidade of instrument to any direction.

10.6. Vertical cross-hair on telescope

I. Check

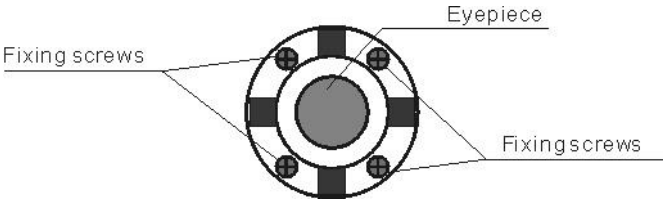
1. Set the instrument up the tripod and carefully level it.
2. Set a point A front the instrument 50m apart.
3. Collimate the point A and adjust the vertical tangent screw; If the point appears to move continuously on the hair, adjustment is not required. Otherwise, adjust it.



II. Adjustment

1. Set the instrument and set the point A front the instrument 50m apart.
2. Take off cover of telescope eyepiece, there are 4 screws for the reticle part.
3. Loosen all four fixing screws slightly with the cross screw-driver.
4. Revolve the eyepiece section so that the vertical cross-hair coincides to point A, finally, re-tighten the four screws.
5. Repeat the checking and adjusting until there is no deviation.

NOTE: After the adjustment of cross-hair, please check the collimation error and vertical index error, see 10.10. EDM optical axis and the telescope sighting axis error.



10.7. Tilt sensor

If the tilt angle shown on the display shifts from tilt angle 0° (zero point), the instrument is not correctly leveled. This will adversely affect angle measurement. Perform the following procedures to cancel the tilt zero-point error.

I. Check

Wait a few seconds for this display to stabilize, then read the automatically compensated angles X1 and Y1.

Rotate the instrument 180°/200 gon. Wait a few seconds for the display to stabilize, then read the automatically compensated angles X2 and Y2.

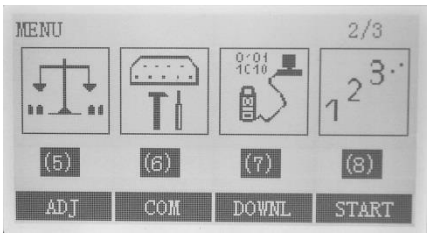
Calculate the following offset values (tilt zero-point error):

$$Xoffset = \left(\frac{X1 + X2}{2}\right)$$

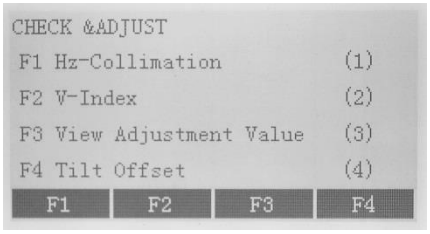
$$Yoffset = \left(\frac{Y1 + Y2}{2}\right)$$

When the offset value falls within the range ±20", adjustment is not necessary. If one of the offset values (Xoffset, Yoffset) exceeds ±20", adjust the value as follows.

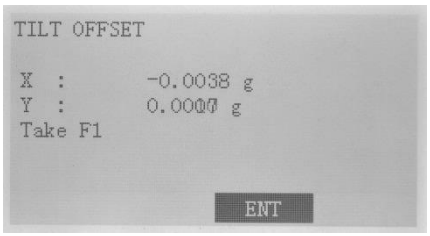
II. Adjustment by program



In the second page of the menu select F1[ADJ],

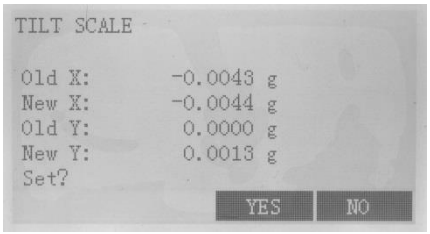


Then, F4 "Tilt Offset" to adjust the tilt.



Press F3[ENT] to set the horizontal angle to 0°.

"Take F2" is displayed. Rotate the top of instrument 180°/200gon. Wait a few seconds for the display to stabilize, then press F3[ENT].



If both correction constant are in the range, press F3[YES] to renew the correction angle, or press F4[NO] to give up this adjustment,

10.8. Horizontal collimation error C

If the telescope's sight line isn't perpendicular to the horizontal axis, the collimation error will appear. The assembling, transportation and operation will cause this error.

I. Check

1. Set-up the instrument on tripod or adjustment platform and leveling accurately.

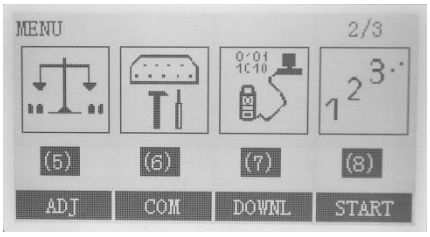
2. Aim at the cross-hairs of collimator or the obvious target at a distance. Gets the face left angle reading Hl and the face right angle reading Hr.

3. Calculating the horizontal collimation error C according to:

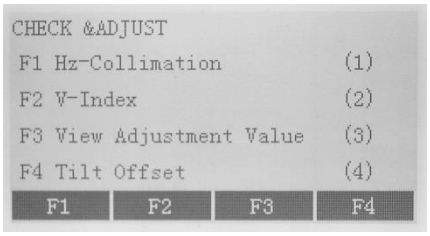
$$C = \frac{Hl - Hr \pm 180°}{2}$$

if C<8", no adjustment will be necessary. If C>8", proceed with the following adjustment.

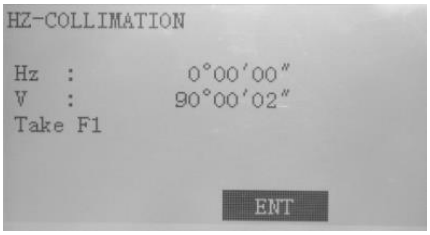
II. Adjustment by program



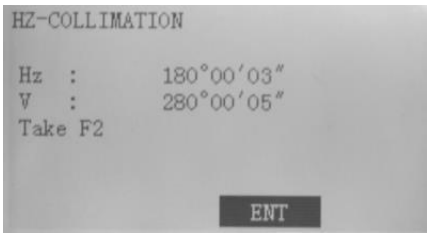
In the second page of the menu select F1[ADJ].



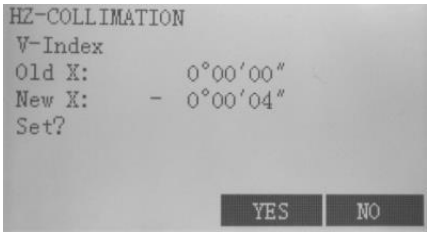
Then, F1 "Hz-Collimation" to access collimation error process.



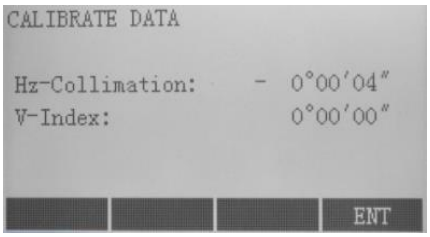
Aim at the cross-hair of collimator at telescope left, and it'll display the horizontal and vertical angles.



Aim at the cross-hair of collimator at telescope right, and it'll display the horizontal and vertical angles



The software will calculate the new collimation error and vertical index error automatically. press F3[YES] to renew the correction, or press F4: [NO] to give up this adjustment,



In the Check and adjustment menu press F3 "View adjustment data" to see calibration data.

NOTE: The adjustment can be performed by the program when C<30", if C>30", adjust the reticle.

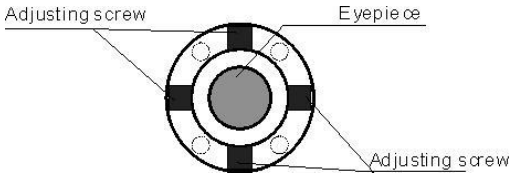
III. Reticle adjustment

1. Rotate the instrument in face right position, turning horizontal tangent screw until:

$$Hr' = Hr + C$$

2. Loosen the shield of telescope's reticle.

3. Adjust two screws at left and at right until the vertical hairs of telescope's reticle coincides with the cross-hairs of collimator or target.



4. Repeat the check and adjustment procedure until the error is accepted.

NOTE:

- When adjusting the screws of reticle, firstly loosen the screw on the moving direction of reticle, secondly tighten another screw by the same mount, clockwise turning is for tightening, and anticlockwise turning is for loosening, the turning mount for tightening or loosening should be same.
- After the reticle adjustment, it is necessary to adjust the vertical index error by program, see 10.9. Vertical index error.

10.9. Vertical index error

The deviation between vertical circle zero position and horizontal direction is vertical index (i), it is necessary to concern this error when measure vertical angle. The instrument program applied a formula to correct this error.

WARNING: Before starting this operation, be sure to read this manual carefully, otherwise it may cause data faulty. Because of the close relationship between vertical index and compensator zero position, it is necessary to check and adjust compensator zero position before adjusting vertical circle, the value should be stable when reading.

I. Check

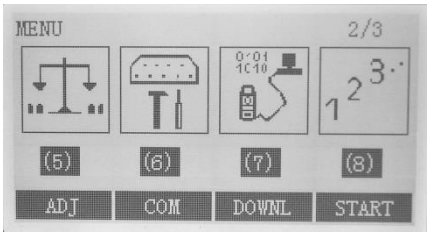
Please adjust the reticle of telescope and correct the collimation error before this operation.

1. Mount the instrument at the tripod or a stable device and level it accurately, then turn on the instrument.
2. Aim at the cross-hairs of collimator or the obvious target at a distance, VA should be about ±10°. Read the face left angle Vl and face right angle Vr.
3. Calculate the index error according to the formula below:

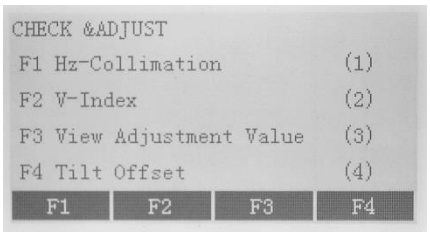
$$i = \frac{(Vl + Vr - 360°)}{2}$$

4. If i <10", no adjustment is necessary, otherwise you have to adjust it.

II. Adjustment by program

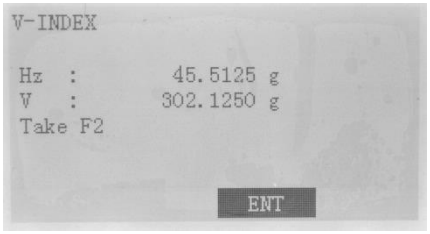


In the second page of the menu select F1[ADJ].

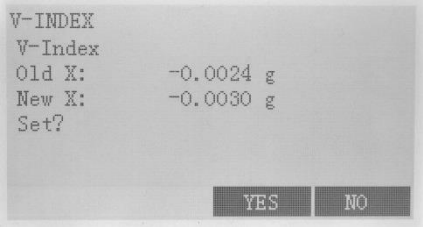


Then, F2 "V-Index" to access vertical index error process.

Aim at the cross-hair of collimator at telescope left, and it'll display the horizontal and vertical angles. Press F3[ENT] to take face I.



Aim at the cross-hair of collimator at telescope right, and it'll display the horizontal and vertical angles. Press F3[ENT] to take face II.



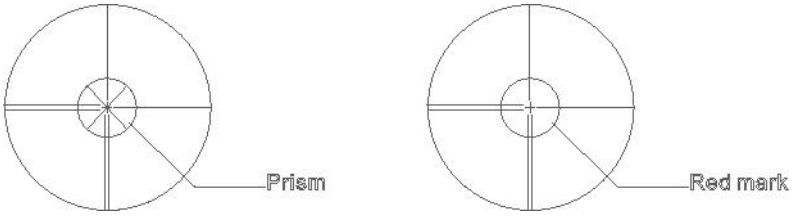
The software will calculate the new collimation error and vertical index error automatically. Press F3[YES] to renew the correction or press F4[NO] to give up this adjustment.

10.10. EDM optical axis and the telescope sighting axis error

It is necessary to check this error after the adjustment of telescope reticle error.

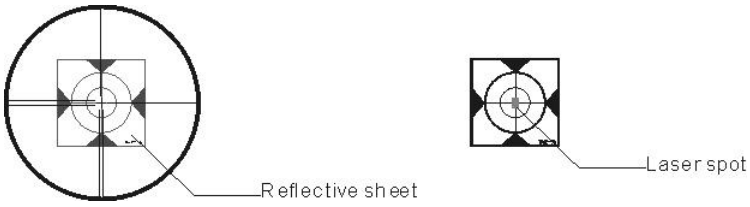
I. EDM optical axis check

1. Install the instrument at the tripod or a stable device and level it accurately, then turn on the instrument's power on.
2. Set a prism about 2m far away from the instrument.
3. Aim at the prism center with telescope reticle
4. Enter EDM signal testing screen, see 5.3. EDM settings.
5. Observe through eyepiece, turn the focusing knob until the read mark is clear, if the deviation between mark and cross-hair is not over 1/5 of red mark diameter, adjustment is unnecessary.



II. Telescope sighting axis error check

1. Install the instrument at the tripod or a stable device and level it accurately, then power on the instrument.
2. Set a reflective sheet about 5m-20m far away from the instrument.
3. Aim at the sheet cross-mark with telescope reticle.



5. Enter EDM signal testing screen, see 5.3. EDM settings

6. Observe the laser spot, if the laser spot coincides with the cross-mark of reflective sheet, adjustment is unnecessary.

NOTE:

- Laser radiation—Avoid direct eye exposure.
- If the instrument needs adjustment, please contact your local dealer.

11. Technical features

ANGLE MEASUREMENT

Accuracy[1]	2″
Reading system	Absolute encoder
Display resolution (selectable)	1″ /5″ /10″ 0.0001g/0.0005g/0.001g 0.01mil/0.05mil/0.1mil
Angle Units	DEG 360°/GON 400/MIL 6.400

TELESCOPE

Magnification/ Field of view	30x/1°30′
Tube length	156 mm
Minimum focus distance	1.0 m (3.26 ft)
Reticle	ON/OFF
Objective aperture	ϕ 45 mm
Laser pointer	Red light, coaxial

TILT SENSOR

Type	Electronic, dual-axis
Compensation range/accuracy	± 3.0'/1″

DISTANCE MEASUREMENT RANGE[2]

Standard mode prism	3.000 m [3]
Long mode prism	5.000 m [4]
Reflective sheet (6cm x 6cm)	800 m [4]
Reflectorless	600 m [4] 1.000 m [4-5]

DISTANCE MEASUREMENT ACCURACY[6]

Standard mode prism	2 mm + 2 ppm
Long mode prism	2 mm + 2.5 ppm
Reflective sheet (6cm x 6cm)	3 mm + 2 ppm
Reflectorless	3 mm + 2 ppm

MEASUREMENT TIME

Standard mode/Prism (Tracking/Fast/Fine)	0.4/0.6/1.0 sec
Reflectorless	1.5÷5 sec

DISTANCE MEASUREMENT

Distance Unit	m/US ft/INT ft
Display Resolution	0.001m 0.01ft

LASER PLUMMET

Laser type	635nm semiconductor laser
Accuracy	1mm/1.5 m
Spot	± 1.5mm/1.5 m

LEVEL VIAL SENSITIVITY

Plate level	30″/2mm
Circular level	8′/2mm

ENVIRONMENTAL CONDITIONS

Operating Temperature	-20° C +50° C
Storage Temperature	-40° C +70° C
Waterproof/Dustproof	IP55

PHYSICAL SPECIFICATION

Dimensions	206 x 203 x 360 mm
Weight including battery and tribrach	6.0 Kg

POWER

Battery Voltage/Capacity	7.4V/3.400mAh Li-ion
Operating time (angle measurement)	13 hours
Operating time (distance meas. every 30 sec)	12 hours
Operating time (angle + distance meas.)	6 hours
Battery charger	110/220V, charging time 4h

OTHER SPECIFICATIONS

Display/Keyboard	Two sides, LCD 240x128 Dots/Alphanumeric
Memory	4Gb internal SD card (max 16Gb)
Interface	RS-232C/mini USB/SD card/ Bluetooth
Sensor	Temperature/Pressure

ON BOARD FIELD APPLICATION PROGRAMS

Data recording and management, Stake out, Area & volume, Target offset, Hidden point, COGO, Tie distance, Remote height, Height transfer, Free station, Line/Arc stake out, Construction, Lead measure, Road

Specifications subject to change without notice.

[1] Standard deviation based on ISO 17123-3
[2] Good condition: no haze, visibility about 40km, no heat shimmer, breeze. Under optimal conditions on Kodak Grey Card (90% reflective)
[3] Class 1
[4] Class 3R
[5] R25LR Model
[6] Standard deviation based on ISO 17123-4

12. Kit components

- R25 Series Total Station
- Carrying case
- Carrying strap x2
- Battery x2
- Battery charger
- USB communication cable
- Lens cap
- Tools kit
- Cleaning cloth
- User Manual
- Reflective sheet/RP30 x4
- Reflective sheet/RP60
- Laser caution sign board
- Silica gel
- Certification

Appendix I: Atmospheric correction formula and chart

Factory setting: temperature: 20℃, pressure: 1013hPa, 0ppm

The correction:

$$\mathrm{Kpt} = \frac{274.417 - 0.2905 \cdot \mathrm{p}}{(1 + 0.0036 \cdot \mathrm{t})}$$

$$\mathrm{Kpt} = \frac{278.960 - 0.2902 \cdot \mathrm{p}}{(1 + 0.0036 \cdot \mathrm{t})}$$

Where:

p: Pressure value (hPa)

t: Temperature value (℃)

Kpt: Atmospheric correction (ppm)

Example:

t=20℃, p=1013hpa, L0=1000m.

Then: Kpt=0ppm

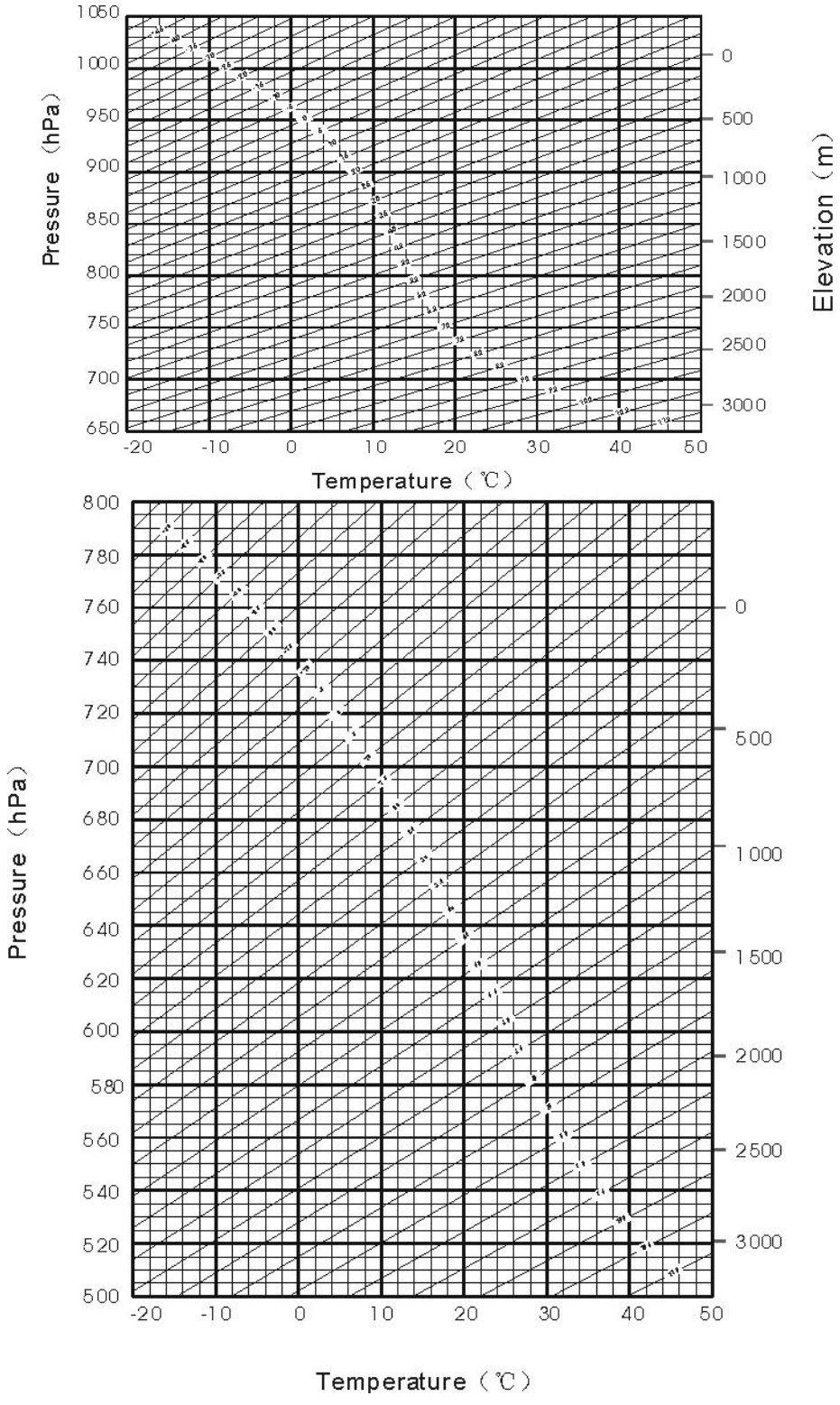
Kpt=4ppm

L=L0(1+Kpt)=1000×(1+0×10-6)=1000.000m

L=L0(1+Kpt)=1000×(1+4×10-6)=1000.004m

The atmospheric value is obtained easily with the atmospheric correction chart. Find the measured temperature in horizontal axis, and pressure in vertical axis on the chart.

Read the value from the diagonal line, which is the required atmospheric correction value.


Pressure（hPa）
1050
1000
950
900
850
800
750
700
650
-20
-10
0
10
20
30
40
50
Temperature（℃）
0
500
1000
1500
2000
2500
3000
Elevation（m）
Pressure（hPa）
800
780
760
740
720
700
680
660
640
620
600
580
560
540
520
500
-20
-10
0
10
20
30
40
50
Temperature（℃）
0
500
1000
1500
2000
2500
3000
Elevation（m）

Appendix II：Correction for refraction and earth curvature

The factory setting for the refraction coefficient K is 0.142.

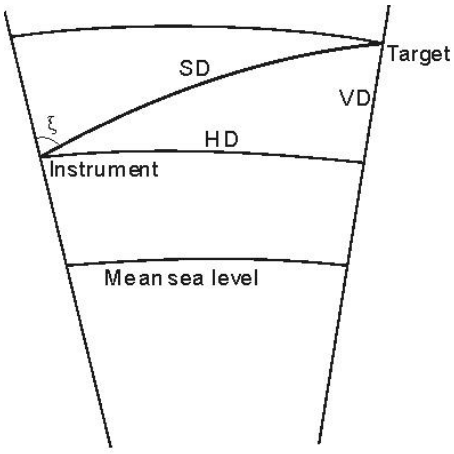
Considering the correction of refraction and earth curvature for distance measurement, the formula for slope distance, horizontal distance and vertical distance applied in the instrument are as followings:

$SD = D_0 \times (1 + ppm \times 10^{-6}) + mm$

SD——Displayed slope distance（m）
D_0——Real measured distance（m）
ppm——Scale coefficient（mm/km）
mm——Target constant (mm)

$HD = Y - A \times X \times Y$
$VD = X + B \times Y^2$

HD——Horizontal distance（mm）
VD——Vertical distance（mm）
$Y = SD.|\sin \xi|$
$X = SD.\cos \xi$
ξ ——Zenith angle



Elevation measurement

$$A = \frac{1 - K/2}{R}$$

$$B = \frac{1 - K/2}{2R}$$

K = 0.142 or 0.20

$R = 6.37 \times 10^6$（m）

The conversion formula for horizontal and vertical distance is as follows when correction for refraction and earth curvature is not applied:

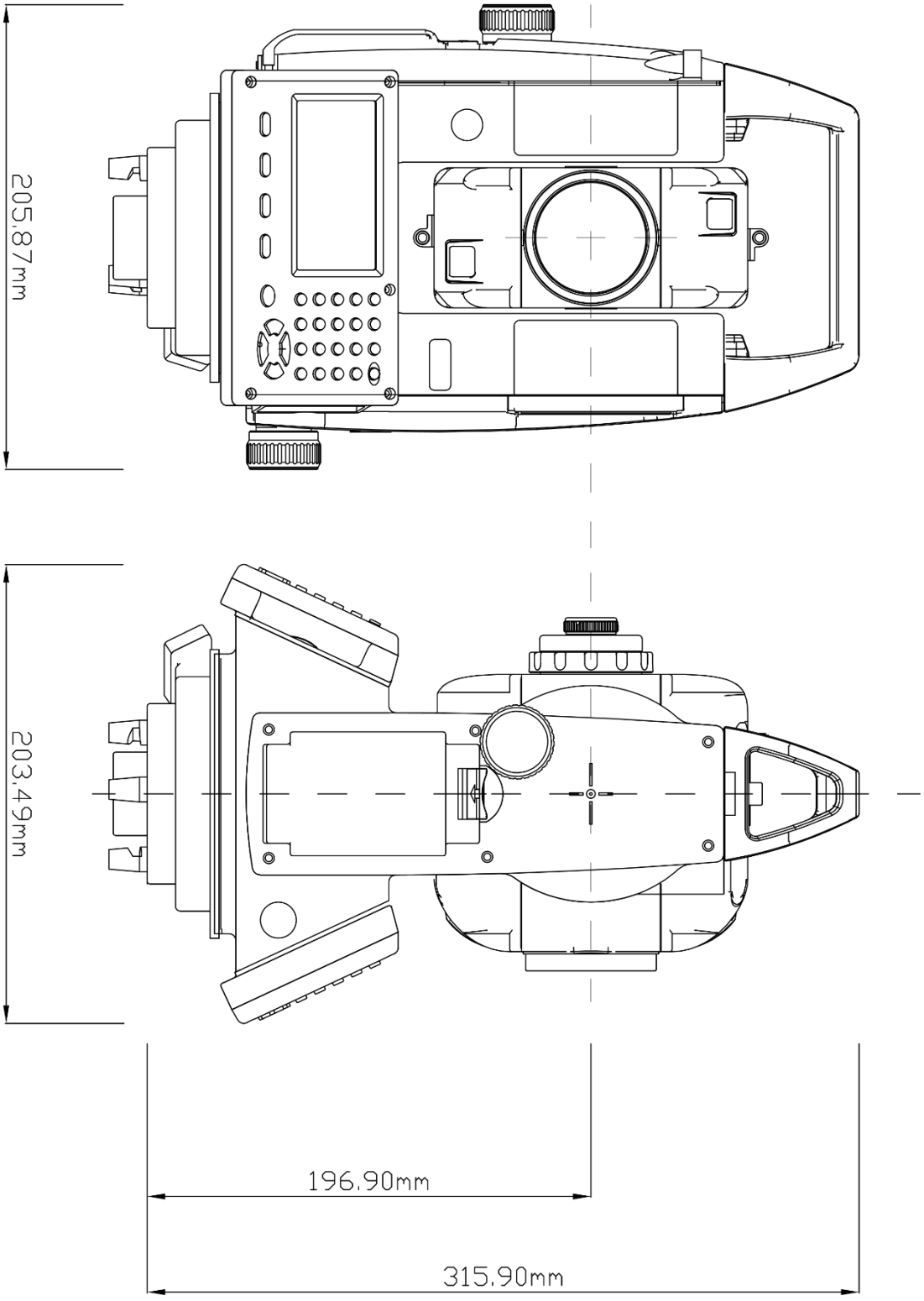
$$HD = SD \cos \xi$$

$$VD = SD \ |\sin \xi|$$

NOTE:

- Refer to the 5.3. EDM setting to change the value.
- These designs, figures and specifications are subject to change without notice. We shall not be held liable for damages resulting from errors in this instruction manual.

Appendix III: Technical drawing



Limited warranty standard

General warranty for instruments.

The terms and conditions of this Limited Warranty constitute the complete and exclusive warranty agreement between The Customer or Dealer and STONEX® for the Product and it supersedes any prior agreement or representation made in any STONEX® sales document or advice that may be provided to Customer by any STONEX® representative in connection with Customer's purchase of the Product. No change to the conditions of this Limited Warranty is valid unless it is made in written form and signed by an authorized STONEX® supervisor.

STONEX ® warrants that:

1. Products are free from defects in materials or workmanship for generally 1/2 year except for accessories or specific parts for which different limited warranty period shall apply.

2. Products have been tested/calibrated in proper working status prior to shipment.

The warranty period starts from date of first sale of the instruments. At its sole discretion, under the warranty period, STONEX® will repair the product or send parts for replacement at its expense. STONEX® agree to repair or replace the defected instrument within thirty (30) days, only if STONEX® recognizes that the defects of the instrument are not caused by human factors or no obvious damage to its surface is visible. STONEX® warrants any new replaced parts or products are warranted to be free from defects in materials and workmanship for thirty (30) days or for the remainder of the Limited Warranty Period of the Product in which they are installed, whichever is longer. Faulty Parts or Products replaced under this Limited Warranty shall become property of STONEX®.

All products that have to be repaired have to be returned to our technical representative office location via any delivery company the customer prefers.

NOTE: STONEX® is not accountable for the unlikely event that the Products gets lost in transit.

Any damage inflicted by the customer or by third party after the products has been delivered to the customer is excluded from the limited warranty as well any damage arising from an improper use, from any action or use not provided for in the enclosed user guides and/or manuals.

Shipping policy

The Customer or the dealer is required to pay for the charges for shipping of fault

parts or instruments to STONEX® representative office and STONEX® (will provide) the shipping for return. Dealers needs to follow STONEX® repair/service procedure to achieve a better and prompt service result.

Return policy dead on arrival instruments

All returned products have to be shipped to STONEX® representative office.

The original Purchaser has a period of seven (7) days, starting from date (data) of purchasing to signal the existence of a defect in the instrument for a full refund (less shipping and handling), provided the merchandise is in new, resalable condition and returned in the original, undamaged packaging. Customer has to pay for both the return and the original freight fees, regardless of the original freight paid by the Company. All warranty books, instruction manuals, parts and accessories must be included as well as the original box in which the item was shipped. We recommend placing the original carton inside another box, to avoid any additional damage to the carton itself. In some cases, returns of special items will require a re-stock fee. Acceptance of returned merchandise is final only after inspection by STONEX®.

Above terms and (policy shall apply as for hardware.) Dealers needs to follow STONEX® repair/service procedure to achieve a better and prompt service result.

Firmware/Software warranty.

Stonex doesn't warrant that operation of Firmware/Software on any instruments will be uninterrupted or error-free, or that functions contained in Firmware/Software will operate to meet your requirements.

Stonex will forward the Software/Firmware Fix to the dealer or customer. Firmware/software Fix means an error correction or other update created to fix a previous firmware version that substantially doesn't conform to the instruments specification.

Over warranty repair(s) policy.

Customer shall pay the standard repair fees for any service (whether part replacement or repairs) and performed by STONEX® under request and explicit authorization of the customer itself. In this case the customer is charged for return shipment's fees as well.

Disclaimer and limitation of remedy.

All other express and implied warranties for this product, including the implied warranties of merchantability and fitness for a particular purpose and/or noninfringement of a\ny third party's rights, are hereby disclaimed. Stonex® expressly disclaims all warranties not stated in this limited warranty. Any implied warranties that may be imposed by law are limited in duration to the term of this limited warranty. Some jurisdictions do not allow the exclusion of implied warranties or limitations on how long an implied warranty lasts, so the above exclusions or limitations may not apply to customer. Customer must read and follow all set-up and usage instructions in the applicable user guides and/or manuals enclosed. If customer fails to do so, this product may not function properly, and may be damaged. Customer may lose data or sustain personal injuries. Stonex®, its affiliates and suppliers do not warrant that operation of this product will be uninterrupted or error free; as do all electronics at times. If this product fails to work as warranted above, customer's sole and exclusive remedy shall be repair or replacement. In no event will STONEX®, its affiliates or suppliers be liable to customer or any third party for any damage in excess of the purchase price of the product. This limitation applies to damages of any kind whatsoever including (1) damage to, or loss or corruption of, customer's records, programs, data or removable storage media, or (2) any direct or indirect damages, lost profits, lost savings or other special, incidental, exemplary or consequential damages, whether for breach of

warranty, contract, tort or otherwise, or whether arising out of the use of or inability to use the product and/or the enclosed user guides and/or manuals, even if STONEX®, or an authorized STONEX® representative, authorized service provider or reseller has been advised of the possibility of such damages or of any claim by any other party. Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages for some products, so the exclusions or limitations may not apply to customer. This limited warranty gives customer specific legal rights, and customer may also have other rights which vary from country/state/jurisdiction to country/state/.

Two years on STONEX® Product:

Total Station R25 excluding battery and power supply accessories (6 months).

Repair/Service procedure for dealers.

1. S/N of the instrument and a detailed description of the defect (sometimes pictures or video) will be required to indicate the cause and problem.

2. If dealer wants to repair an instrument under warranty period on their site:

3. If dealers (don't) have the part in stock they have to send an official order to STONEX® and pay for it and then so STONEX® will send the new part to them so they can repair the instrument.

4. When the repair is over dealer has to fill the "Spare Part Refund" module and send it to the dedicated mail address:

    a. Wait for STONEX®'s authorization SPR no;

    b. When dealer receives the SPR authorization number they can send back to STONEX® appointed office the broken part with attached the SPR module;

    c. When STONEX® receive the broken part STONEX® shall verify it and if everything is ok the cost of the part shall be refund (refund will be done only after check of the failure part and final approval of STONEX®).

5. If the instrument needs to be sent back to STONEX® for repair/replacement, dealers/customers has to send to STONEX® a "Returned Merchandise Authorization (RMA)" before they send back the fault instrument. STONEX® shall, at its sole discretion, decide on the place of performance for work under warranty.

Environmental recycling

The cardboard box, the plastic in the package and the various parts of this product have to be recycled and disposed of in accordance with the current legislation of your Country.

FOR COUNTRIES IN THE EUROPEAN UNION (EU)

The disposal of electric and electronic device as solid urban waste is strictly prohibited: they must be collected separately.

Contact Local Authorities to obtain practical information about correct handling of the waste, location and times of waste collection centers. When you buy a new device of ours, you can give back to our dealer a used similar device.

The dumping of these devices at unequipped or unauthorized places may have hazardous effects on health and environment.

The crossed dustbin symbol means that the device must be taken to authorized collection centers and must be handled separately from solid urban waste.

FOR COUNTRIES OUTSIDE EUROPEAN UNION (EU)

The treatment, recycling, collection and disposal of electric and electronic devices may vary in accordance with the laws in force in the Country in question.

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