PENTAX **V-100N** Series Total Station

User Manual

TI Asahi Co., Ltd.

V2.0

Thank you for purchasing PENTAX V-100N Series Total Station.

This manual includes important safety directions and instructions for setting up and using the product. Before using this product, be sure that you have thoroughly read and understood this instruction manual to ensure proper operation. After reading this manual, be sure to keep in a convenient place for easy reference.

Exemption clause

1) TI Asahi Co., Ltd. (TIA) shall not be liable for damage caused by Acts of God, fire, alteration or servicing by unauthorized parties, accident, negligence, misuse, abnormal operating conditions.

2) TIA shall not be liable for changes or disappearance of data, loss of company profit or interruption of company operation incurred by the use of this product or malfunction of it.

3) TIA shall not be liable for damage caused by usage not explained in the instruction manual.

4) TIA shall not be liable for damage to this product caused by other equipment connected to this product.

Symbols

The symbols and formats used in this Manual have the following meanings:

Symbols & Formats	Description
DANGER	Indicates a very serious hazardous situation, ignoring this warning and performing incorrect operations could result in serious injury or death.
WARNING	Indicates a more serious hazardous situation, if not avoided, could result in minor injury to the operator or serious damage to the equipment or the environment.
CAUTION	If you ignore this tip and do not operate it properly, it may cause slight damage to the equipment or the environment, or may result in loss of work results or decrease in work efficiency.
	Indicates tips or instructions that need to be taken into account for more efficient operation of the equipment.
	Refer to other chapters or paragraphs in this manual.
	Terminology, technical notes.
[ENT]	The keys on the instrument's keypad are indicated in [ ].
【DST】	The contents of the softkey commands displayed on the display are indicated in 【 】.
〈VA〉	The contents of the fields displayed in the function area of the display are indicated in 〈 〉.
{Surveying}	The name of the current application, menu, or step in the status bar of the display interface is indicated in { }.

Basic operating instructions

- This product must be operated by professional. The user must be a professional measurer or a person with equivalent knowledge of measurement in order to be able to accurately understand this user manual and the relevant safety instructions and to use, check and calibrate the instrument correctly.
- Always use the instrument in a safe environment and wear the necessary safety equipment (e.g., helmet, reflective vest, safety shoes, etc.) properly.

The scope of using this instrument

- Operate instruments to observe, indicate, or direct the displacement of a specific target.
- Measure horizontal and vertical angles.
- Measure the Distance to a specific target.
- Record, store and edit measurement data.
- Calculate data using built-in applications.
- Data exchange using USB storage devices.
- Communication with the instrument using Bluetooth.
- The necessary calibration.
- Other operations guided by this manual.

The scope of this instrument does not apply to

- Perform instrument operation in unsafe environments or where instrument weathering requirements are exceeded.
- Do not follow the Dangers and Warnings in the manual.
- Do not operate the instrument in accordance with the manual.
- Use the instrument beyond its capabilities.
- Adjustment, disassembly of instruments beyond what is specifically allowed.
- Repair or modification of instruments.

Safety directions

Laser damage

The instrument uses a visible red laser for Distance measuring. The laser is emitted from the center of telescope objective when measuring or laser pointer is turned on.
The instrument's laser plummet uses a visible red laser to indicate the position of the vertical axis. The laser is emitted from the bottom of the instrument along the center axis during leveling and centering operations.

In accordance with the state of the international standard IEC 60825-1(2014-05), the product is classified as different Laser class on different working mode.

Working Mode	Laser Class
Distance measuring with reflector prism and tape	Class 1
Distance measuring without reflector	Class 3R
Laser plummet	Class 2

DANGER Direct laser beams can cause eye discomfort, temporary blindness and residual images. Prolonged exposure to laser beams can cause permanent damage to the eyes.

- Do not look directly at the laser beam at any time, and do not use optical equipment such as binoculars to view the laser beam.
- It is prohibited to direct a laser beam at another person.
- Do not stare at the spot of laser for a long time at close range.
- Avoid direct the laser at any highly reflective object that is not a reflector prism or tape, such as windows, mirrors, traffic signs, etc.
- Turn off the pointer and plummet laser as much as possible when not working on Distance measuring or centering.

Glare damage

DANGER Looking directly at hard light can cause eye discomfort, temporary blindness and residual images, and prolonged exposure to direct bright light can cause permanent damage to the eyes.

- Viewing the sun through the instrument's telescope is prohibited at any time.
- Avoid using instruments to aim at objects that are strongly reflecting sunlight, such as mirrors, glass, water, car surfaces, etc.
- Avoid observing strong lights and other light sources.

Fire risk

DANGER The design and manufacture of the instrument and its accessories follow the relevant standards and directives to avoid as much as possible the danger of high temperature, fire and other dangerous conditions in normal operation. However, using the instrument under special conditions, using it irregularly and disassembling it may lead to localized high temperature, fire or even explosion.

- The use of this instrument in coal mines is prohibited.
- When there are dangerous, flammable or explosive gases or liquids in the vicinity of the workplace, it is prohibited to operate the instruments.
- Do not use the instrument in a hot environment or near flames.
- Batteries must not be placed in fire or high temperature environments.
- The battery should not be covered by any object during charging to avoid the risk of overheating and fire.
- The battery must not be disassembled.
- Avoid keys, metal objects connected to the electrodes of the battery, or the electrodes of the charger.
- Avoid the use of unqualified, faulty or damaged sockets when charging, and prohibit any operation that uses wires directly connected to the plug.

- Avoid contact of the instrument, batteries, chargers, adapters, power cables, etc. with any liquid. Avoid using, storing, or charging the instrument in a raining, dripping, or wet environment.
- Batteries shall be transported in proper packaging.
- Do not use any batteries, chargers, adapters, power cables, etc. that are not supplied by the Company.
- If any abnormality or damage is found in batteries, chargers, adapters, cables, etc., stop using them immediately and dispose of them properly.
- Keep batteries, chargers, etc. clean to avoid excessive dust accumulation.
- Do not make any modifications to the instrument, batteries, chargers, adapters, cables, etc.

Contents

1.Introduction

Technical Terms and Abbreviations

Technical terms / Abbreviations	**Descripition**
Telescope	Optical telescope for observation and aiming, also the collimated part of the Electronic Distance Meter (EDM).
Collimation Axis / CA	Line from the reticle to the centre of the objective, as well as telescope axis and EDM laser axis.
Standing Axis / SA	Vertical rotation axis of the instrument.
Tilting Axis / TA	Horizontal rotation axis of the telescope.
Instrument Center (Zero Point)	The intersection point of CA, SA and TA, as well as the zero point of EDM.
Zenith	The top point of the direction which gravity is through the Instrument Center, as well as Plumb Line and plummet laser axis.
Zenith Angle / ZA	The angle between CA and Zenith.
Vertical Angle / VA	The angle between CA and horizontal line.

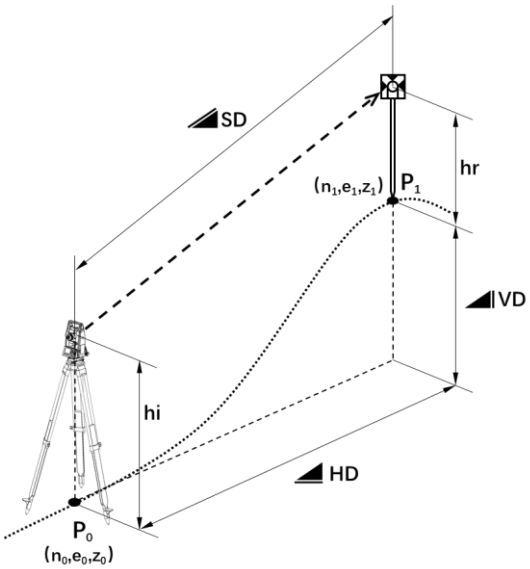
Under ideal instrumentation and set-up conditions, the following properties are desirable:

- The SA, the laser plummet axis, and the zenith/plumbline are co-linear and pass through the current station point.
- The tubular level and the circular level are perpendicular to the SA.

- The CA is coaxial with the EDM laser axis and perpendicular to the TA.
- The TA is perpendicular to the SA.
- The CA, SA and TA intersect at the instrument center.

The actual non-ideal condition, the instrument and set up will also have various errors.
By carefully setting up the instrument, double-sided observation, automatic compensation and correction, the impact of errors on measurement can be partially eliminated.

Refer to **2.3. Tilt Compensation**, **8. Calibration**.



Technical terms / abbreviations	**Description**
P_0	Station.
P_1	Target point.
(n_0,e_0,z_0)	Station coordinates

(n_1,e_1,z_1)	Coordinates of target point
hr	Reflector height above ground (target point).
hi	Instrument height above ground (station).
SD	Atmospheric corrected slope Distance between instrument center and centre of prism / laser dot (reflectorless mode).
HD	Atmospheric corrected horizontal Distance.
VD/	Atmospheric corrected height between station and target point.

2.Preparation & Setting up

Unpacking

Open the transport case, remove instrument and check for completeness:

(The following list is for reference only)

(1) Total station with tribrach
(2) User manual
(3) Battery charger
(4) Cable of the charger
(5) Battery × 2
(6) Toolkit
(7) USB Stick
(8) Reflector tape
(9) Objective lens cap

Product Label

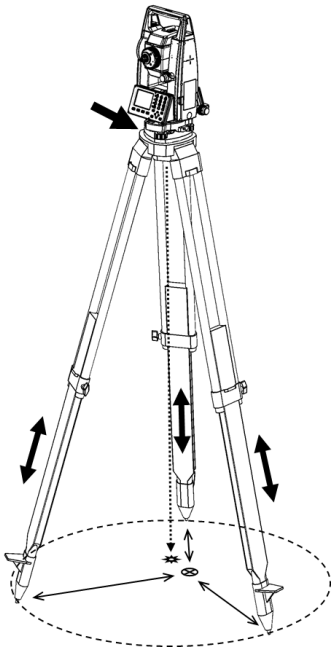
There is a product labels in the battery compartment. The label contains important information such as the model number and the serial number of the instrument. When contacting a service center or authorized service center when repair or calibration services are required, customer service may require you to provide the instrument's serial number information.

2.1 Power on / off

Press and hold **[⏻]** for more than 1 second in the power off state, the instrument will start and automatically enter the measurement interface. Press and hold **[⏻]** for more than 2 seconds in the power-on state, the instrument will prompt to turn off the power and save the current settings, press **[ENT]** to confirm and turn off the power.

 Ensure that the battery is charged and properly installed as required

2.2. Setting / Leveling up and Centring



Setting up the Tripod and Instrument

① Adjust the tripod's three legs to nearly equal lengths that meet the height requirements for comfortable measurement.

② Position the tripod over the station point. The three toes are firmly supported on the ground as equiMeasantly as possible, the center of the circle formed by the toes is close to the station point, and the tripod plate is nearly horizontal.

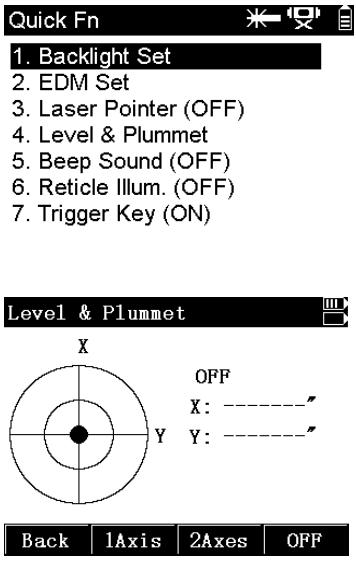
③ Take out the instrument and make sure that the instrument and its tribrach are firmly connected. Place the instrument onto the top plate of the tripod, fix the instrument with one hand, align the central knob of the tripod with the center hole of the tribrach with the other hand and tighten it.

④ Gently push the tribrach to make sure it is securely attached to the tripod

plate.

Leveling up and Centring

① Press and hold **[⏻]** to power on the instrument. If tilt compensator is on, the laser plummet will automatically light up and project a red spot on the ground and **{level & Plummet}** will automatically appear.

Operation	Interface
If the interface of **{leveling & Plummet}** does not appear automatically, press **[★]** in the general measurement interface to enter **{Quick Fn}** menu, then press **[4]** 〈**level & Plummet**〉 enter **{level & Plummet}**. Press **[-]** in the measurement interface also provides quick access to **{level & Plummet}**. The electronic circular level diagram on the left indicates the current leveling state, while the dot at the bullseye indicates leveling. 〈**2-Axes**〉: Indicates the current setting status of tilt compensation, **2-Axes**/ **1-Axis**/ **off**. 〈**X**〉: Indicates the tilt angle of the SA in the X direction, backward positive forward negative. 〈**Y**〉: Indicates the tilt angle of the SA in the Y direction, right positive left negative. 〈☀〉: Indicates the brightness level of the	

plummet laser. Press **[◀]** / **[▶]** can adjust the levels with **0-4**. **0** means off. **[F1]【OFF】**: Switch off tilt compensator and exit. **[F2]【1Axis】**:Switch on single axis tilt compensation, automatically compensate the VA error caused by the SA inclination in X direction. **[F3]【2Axes】**: Switch on dual-axis tilt compensation, automatically compensate the VA/HA error caused by the SA inclination in both directions. **[F4]【Back】**: Close **{level & Plummet}**.	

② Adjust the tripod legs and the tribrach footscrews to centre the plummet laser spot over the station point.

③ Adjust the tripod legs to level the circular level of tribrach.

④ Turn the tribrach footscrews to precisely level the instrument by using the electronic level or tubular level.

⑤ Slightly loosen the central knob, observe the relative position of the laser spot and the station point, slowly push the tribrach to slide on the tripod plate until the laser spot is precisely aligned with the station point, and then tighten the central knob.

⑥ Repeat steps ④ and ⑤ until the required accuracy of leveling and centering is achieved.

If you can't level the instrument by the tubular level, please calibrate the tubular level.

WARNING Avoid looking directly at the laser or its strong reflective light.

Under different lighting and ground conditions, the plummet laser spot on the ground may be too bright or too dark to affect centring judgments. In this case, you need to adjust the brightness of the laser. In **{level & Plummet}**, use the **[◀]** / **[▶]** to directly adjust the laser brightness level, each key press will be adjusted by 25%.

2.3. Tilt Compensation

When using the instrument for measurement, since the instrument is not precisely leveled up, that is, the SA of the instrument still has an inclination relative to the direction of the zenith (plumbing), this will bring errors to the measurement of VA/HA. The SA tilt is not the error of the instrument itself, which cannot be eliminated by double-faced observation. The automatic tilt compensation function of the instrument can reduce the influence of SA tilt on the measurement accuracy.
When the function of **〈2-Axes〉** in **{level & plummet}** is switched on, the instrument can automatically correct the error caused by the SA tilt, i.e., it can compensate the VA/HA automatically.

The SA tilt of the instrument is the angle between the direction of the SA and the direction of the zenith (plumbing), which can be decomposed into two rectangular components, i.e., the X and Y direction tilt angle.
X direction tilt angle: The X-plane is the plane formed by rotation of the SA along the TA of the instrument. The SA tilt angle projected in the X-plane, i.e., the X direction tilt angle.
Y direction tilt angle: The Y-plane is the plane formed by SA and TA of the instrument. The SA tilt angle projected in the Y-plane, i.e., the Y direction tilt angle.

When the instrument is in operation, if the 2-Axis tilt compensation is on, the instrument will compensate and correct the VA and HA readings in real time. If the SA tilt angle out of the compensation range and continues for more than 5 seconds, the instrument will pop up **{Level & Plummet}** to guide the operator to check the tilt status of the instrument and to level it.
The tilt compensation function can be set in either **{Level & Plummet}** or **{Setting}** - **{Angle Setting}**.

CAUTION To avoid accidental tilting of the instrument which may affect the measurement accuracy, it is recommended that the user always switch on the dual-axis compensation function during normal operation.
If the instrument is set up on an unstable base (e.g. on a shaking platform, ship, etc.), tilt compensation should be switched off. This avoids unexpected error messages and interrupting the measuring process.

2.4. Touch Trigger Key

The trigger key is a special area on the side cover of the instrument near the horizontal drive. The trigger key is touch driven. It is designed to trigger the measurement function by lightly touching the area with the thenar eminance or any finger.
In the actual operation, the right hand is often held at the horizontal drive when aimming, so that when a measurement is required it can be triggered by simply touching the trigger area. Due to the fixed position and near to the the hand during operation, there is no need to move the hand away from the horizontal drivel or to take the eye off the eyepiece to determine the position of a function key on keypad. Neither the eye nor the hand needs to leave the working position, which is a significant efficiency gain for continuous and

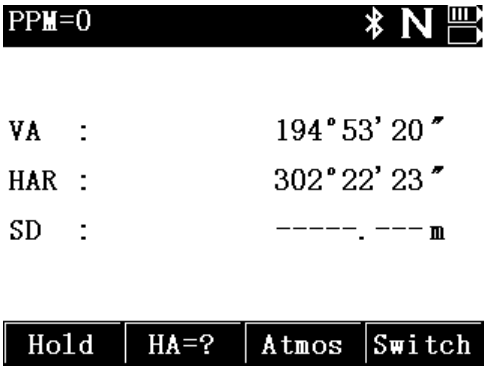
extensive measurement work.

The trigger key's function can be set as the function of softkey【**Meas**】or 【**All**】or inactive.

Refer to **6.7 Other Setting**.

2.5. Display & Main Menu

When the instrument is switched on, the display will show different interfaces in different working procedures. Generally the interface is divided into three areas from top to bottom, including status bar, workspace and softkey bar.



Status bar: Displays the current measurement status information icons under the measurement interface. Other interfaces indicate the name of the current interface or procedure, as well as necessary information icons.

Workspace: Displays current measurement data, options, input areas, menus, lists, dialogs, and other work content. Guides the operator to read, record, select, confirm, input, and so on.

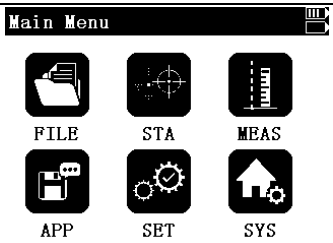
Softkey bar: Displays the softkeys for the current interface, which can be activated by the corresponding function keys **[F1-F4]**. If there are more than four options, the rightmost softkey will usually be the page down function. The actual functionality represented by each of the soft keys will vary from different

interfaces and procedures.

The workspace content, status icons and softkeys may vary slightly depending on the firmware version of the instrument.

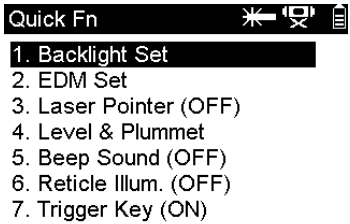
The measurement interface is the basic interface of the instrument, and the display will enter the measurement interface after power on. Pressing **[ESC]** several times in most of the working interfaces will also eventually return to the measurement interface.

For more instrument operation, you need to go to **{Main Menu}** to make a selection.

Operation	Interface
In the measurement interface, press **[M]** to enter **{Main Menu}**. There are six icons to choose from. Use the navigation keys to select an icon and press **[ENT]** to enter or press the numeric key corresponding to the icon's serial number to enter directly. 〈**FILE**〉: Enter {**FILE Manager**}. 〈**STA**〉: Enter **{Set Station}**. 〈**MEAS**〉: Enter **{Measure&Stake Out}**. 〈**APP**〉: Enter **{Applications}**. 〈**SET**〉: Enter **{Setting}**. 〈**SYS**〉: Enter **{System Infrormaton}**.	

2.6. Quick Functions

Some common functions can be called directly from the measurement related interface by pressing **[★]** .

Operation	Interface
Press **[Fn]** in the measurement related interfaces to enter **{Quick Fn}**. Use **[▲] [▼]** to highlight an option and press **[ENT]** to execute, or press the numeric key corresponding to the option's serial number to execute directly.	

Item	Description
〈1. Backlight Set〉	Enter **{Backlight}** to set the lightness of the display. Press **[◀]** / **[▶]** can adjust the lightness from 0% to 100% with a gradient of 10%.
〈2. EDM Set〉	Enter **{EDM Setting}** for EDM related settings.
〈3. Pointer Laser〉	Switch on/off the red pointer laser to indicate the collimation point at short range.
〈4. Level & Plummet〉	Enter **{level & Plummet}** to switch on and set the plummet laser, set tilt compensation mode, and perform leveling.
〈5. Beep Sound〉	Switch on/off the buzzer. When switch on, the key tone and beep will be actived.
〈6. Reticle Illum.〉	Switch on/off the illumination of the reticle.
〈7. Trigger Key〉	Switch on/off the function of the trigger key.

2.7. Edit

Input

In some procedures, the operator is required to input numbers or characters.
Input numbers: In the input field, press **[F4]【123】** to switch to numeric input mode. Only numbers and the "**-**" and "**.**" symbols can be entered. A short press on a numeric key will input the corresponding number or character in the active input box on the display.
Input characters: In the input field, press **[F4]【ABC】** to switch to character input mode. Capital letters, numbers and common symbols can be entered. Click a numeric key to enter the letter, number or symbol corresponding to the key. A quick repetitive press will switch and cycle between the numbers and the letters and symbols printed above the keys. For example, the key **[1]**, press once to input "**S**", press again to input "**T**", press again to input "**U**", press again to input "**1**", press again to input "**S**", ···

Edit

Existing strings in the input field can be edited.

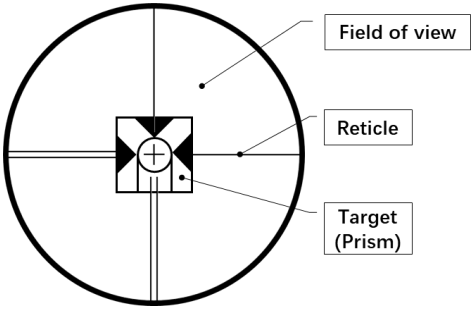
Key	Description
[◀]	Move the cursor to the left.
[▶]	Move the cursor to the right.
[F1]【Select】	Toggle the input mode between insert and modify. The cursor state is either a vertical line between characters or a block covering a character, respectively.
[F2]【Delete】	Delete a character to the left of the cursor.
[F3]【Clear】	Clear all the characters of the current input field.
[F4]【123/ABC】	Switch the numeric input or character input mode.

Search

In the interface that supports search, the softkey **[Search]** will be available. Search is used in FILE management or applications to find specific measured or fixed points in memory. The search function requires entering the exact point name.

The search can be limited to a specific job or to all records. A fixed point that satisfies the search criteria is always displayed before the measured point. If there are more than one point that meet the search criteria, the results are sorted by the date they were recorded, with the newest point at the top of the search results.

2.8. Focusing and Collimating



General focus and collimate process

① Diopter adjustment

Looking through telescope at a bright monochromatic background. Turn the eyepiece's diopter ring clockwise to the end, observe the reticle, slowly turn the ring counterclockwise until the reticle image is sharp and clear.

② Rough targeting

Release the horizontal and vertical lock triggers counterclockwise, rotate the

telecope to aim for the target with the optical sight, observe from the eyepiece to confirm that the target is in the field of view, then lock both triggers clockwise.

③ Focusing

Observe the target from the eyepiece, slowly turn the focusing ring until the target image is sharp and clear.

④ Precisely collimating

Observe the target from the eyepiece, adjust the horizontal and vertical drive to aim the reticle precisely at the center of the target. The final direction of rotation of the drives are always recommended to be clockwise.

⑤ Repeat ③ and ④, until the target and reticle image are all clear, and both centers are precisely aligned.

⑥ Start measuring.

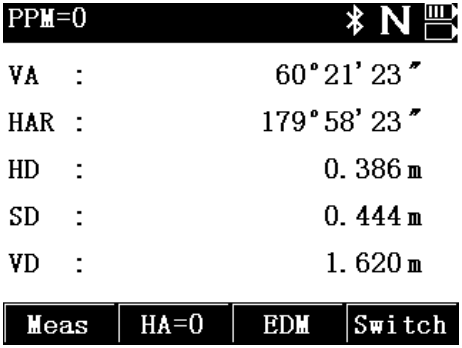
3.Measurement

3.1. Measurement Interface

The measurement interface is the basic interface of the instrument, and the display will enter the measurement interface after power on. Pressing **[ESC]** several times in most of the working interfaces will also eventually return to the measurement interface.
The measurement interface has three modes. Press fixed functions keys (**[4/1/0]** multifunctional keys) can switch the measurement interface to Angle/Distance/Coordinates modes.


The default measurement interface can be set as angle measurement or Distance measurement, please refer to **6.3 Default Interface**.


If tilt compensator is on and the SA tilt angle out of the compensation range and continues for more than 5 seconds, the instrument will pop up **{Level & Plummet}** to guide the operator to check the tilt status of the instrument and to level it.



Measurement Status Icons

There are some current measurement status icons in the status bar of the measurement interface.

Icon	Description
Atmospheric Correction Value	
PPM=N	The current PPM value is N, i.e., the atmospheric correction value is N, which not include projection scale factor and inputted PPM.
Bluetooth Status: Indicates the current status of bluetooth function (no icon is displayed when it is off).	
	Indicates that the instrument's bluetooth function is turned on.
Telescope Position: Indicates the current status of telescope position/face (**I** or **II**).	
	Telescope is on position/face **I**.
	Telescope is on position/face **II**.
EDM Type: Indicates the current target type of EDM.	
	Current target is reflector prism. The prism offset (constant) can be set by the user.
	Current target is reflectorless.

	Current target is reflector tape.
Tilt Compensator Status	
Battery Capacity: Indicates the estimated remaining battery capacity.	
	Show current battery capacity in four levels.
 Due to various environmental conditions and different working modes, the remaining battery capacity is only a reference value and cannot accurately indicate the remaining operating time of the instrument. When the icon shows one cell or less, please replace or charge the battery promptly.	

Softkeys of Measurement

In the measurement interfaces, the soft keys correspond to different functions in different measurement modes.

Angle Measurement:

Press the **[]** fixed function key in the measurement interface to enter the angle measurement mode.

Page	Key	Softkey	Function
1	[F1]	【HA=0】	Set the horizontal angle to 0°00′00″.
	[F2]	【Hold】	Lock current horizontal angle.
	[F3]	【HA=?】	Input custom horizontal angles.
	[F4]	【P1/3】	Turn to the 2nd page of softkeys.
2	[F1]	【Level】	Enter **{level & Plummet}.**
	[F2]	【ReMeas】	Enter **{Re-measure}** to HA's repeative measurement.
	[F3]	【V%】	Display vertical angle in percentage slope mode.
	[F4]	【P2/3】	Turn to the 3rd page of softkeys.

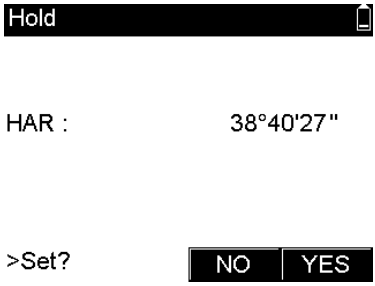
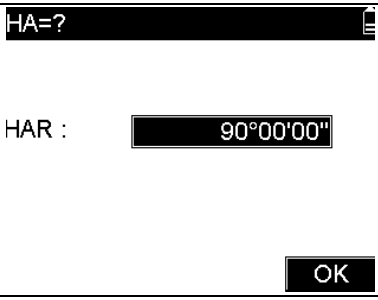
3	[F1]	【R/L】	Convert HA incrementation between right and left, i.e., clockwise and counter-clockwise directions.
	[F3]	【VA/ZA】	Vertical angle display format, switch between horizontal zero and zenith zero.
	[F4]	【P3/3】	Turn to the 1st page of softkeys.

Distance Measurement:

Page	Key	Softkey	Function
1	[F1]	【Meas】	Trigger Distance measurement.
	[F2]	【HA=0】	Set the horizontal angle to 0°00'00".
	[F3]	【EDM】	Enter **{EDM Setting}**.
	[F4]	【P1/2】	Turn to the 2nd page of softkeys.
2	[F1]	【Offset】	Enter **{Offset}**.
	[F2]	【StOut】	Enter **{Stake Out}**.
	[F3]	【m/ft】	Convert Distance units between meters and inches.
	[F4]	【P2/2】	Turn to the 1st page of softkeys.

3.2. Angle Measurement

Operation	Interface
Hold the HA: Set the HA by locking current HA value.	

① Rotate the instrument, use the horizontal drive to adjust to the required HA value. ②Press **[F2]【Hold】** enter **{Hold}**, the HA will be locked and not changed with the rotation of the instrument. ③Aim at the target, press **[F4]【YES】** back to angle measurement interface , the HA will remain the locked value. **[F3]【NO】**: return to the previous interface.	
Input Custom HA: Horizontal angle setting via keyboard input.	
①Aim at the target. ②Press **[F3]【HA=?】** enter **{HA=?}**. ③Input the HA value needed, e.g. **90°00′00″,** Press **[ENT]** then press **[F4]【OK】** to confirm setting.	

When **{Unit Setting}** **〈AngleUnit〉** is set to **〈°′″〉**, the integer part of the inputted angle value is degrees, the first two decimal places are minutes, three and four decimal places are seconds, and five decimal places and subsequent numbers will be rounded off.

〈Ht〉 can be angle values over 360 degrees. The maximum value of **〈Ht〉** is 3600°00′00″.

If the absolute value of the difference between this round angle value and the current **〈Hm〉** value is greater than 10″, "**Aiming error. Ignore.**

Release again!" will pop up. Then you need to press **[F3]【Leave】** and aim the target more precisely again.
〈ZA〉 is the vertical angle that defines the zenith as zero. 〈VA〉 is the vertical angle that defines the horizontal as zero. Each time the **[F3]** key is pressed, the mode switches alternately. This softkey is not available when the vertical angle is switched to slope.

3.3. Distance Measurement

Operation	Interface
Press **[Disp]** in the measurement interface to enter the Distance measurement mode. Workspace contain 〈ZA〉, 〈HAR〉, 〈SD〉, 〈HD〉, 〈VD〉. Aim at the target, press **[F1]【Meas】** to trigger the Distance measurement and get result. **[F3]【EDM】**: enter **{EDM setting}**. 2nd page of softkeys **[F3]【m/ft】**: Convert Distance units between meters and inches.	PPM=0 VA : 60°21'23" HAR : 179°58'23" HD : 0.386 m SD : 0.444 m VD : 1.620 m Meas | HA=0 | EDM | Switch
For details on EDM settings, refer to **6.4 EDM setting**.	

EDM is the abbreviation for Electronic Distance Meter. The total station has a built-in laser EDM, which uses the red visible laser emitted by the telescope coaxially to reach the target and then return to measure the Distance.

There can be three types of EDM targets:

- **Prism:** The targets are various specialized reflector prisms which may

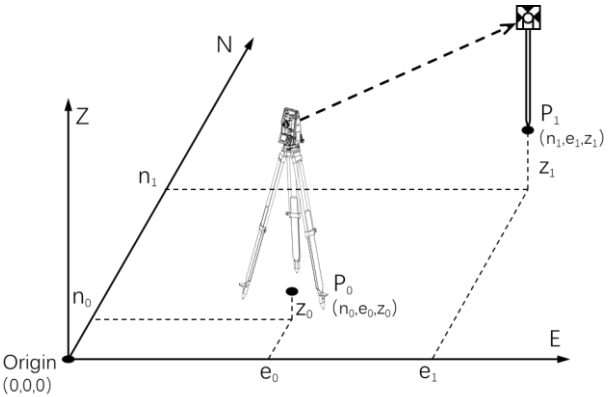
have different prism constant.

- **Tape:** The targets are specialized reflector tapes which can adhere to the target suface.
- **NonPrism:** Reflectorless. The targets are on the surface of objects.

CAUTION

- When performing Distance measurements, if there are any obstacles (such as passing pedestrians, cars, or dust, smoke, leaves etc. that affect the passage of laser) on the optical path where the Distance is measured, the EDM function may not work, or the measured result may be the Distance to the nearest obstacle
- Avoid objects such as glass, water, traffic signs, etc. near the measurement target or light path, that may alter the light path
- Do not use 2 instruments to measure a single target at the same time.
- Avoid measuring any strongly reflective targets that are not reflector prisms, such as traffic lights, traffic signs, etc., in prism mode.
- When using a reflector tape for Distance measurement, the laser beam is required to be as perpendicular to the tape as possible to ensure measurement accuracy.
- Precise measurement operations must be carried out in the prism mode and the correct prism constant must be set according to the prism type.

3.4. Coordinates Measurement

<table>
<tr><th>Operation</th><th>Interface</th></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td>Press [Disp] in the measurement interface to Switch to the coordinate measurement mode.
Aim at the target, press[F1]【Meas】 to trigger the Distance measurement and get the coordinates.</td><td>PPM=0

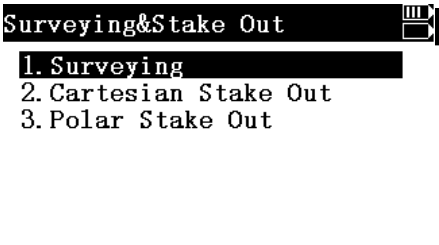
N : 0.386 m
E : -0.000 m
Z : 1.620 m

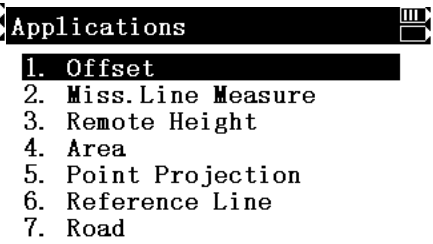
Meas | HA=0 | EDM | Switch</td></tr>
<tr><td colspan="2">If no station is set, the default coordinate of current station P_0 is the origin (0,0,0).</td></tr>
</table>

4.Applications

Applications are programs that perform various specific surveying, stake out, and calculation functions.

The aplications are divided into two categories, which are in **〈MEAS〉** and **〈APP〉** in **{Main Menu}** .The most commonly used **{Measure}** and **{Stake Out}** are in the **〈MEAS〉{Measure & Stake Out}** , while the rest are in **〈APP〉 {Applications}**.



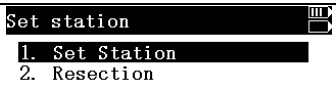


4.1.Application Pre-settings

Before performing an application task, some necessary preparations are generally required (e.g., set station, job, orientation). After accessing an application (**Suveying**, **Stake Out**, **Offset**, **Reference Line**, etc.), the corresponding pre-setting programs are accessed, which allows the operator to select and follow the step-by-step instructions to set them up.

Operation	Interface

For example, in the measurement interface, press **[M]** to enter **{Main Menu}**, use the navigation keys to select 〈**STA**〉 and press **[ENT]** to enter **{Set Station}**. Then select 〈**1.Set station**〉 and press **[ENT]**



Set Station:

The station coordinates can be read from the instrument memory or set by manual input.

① press **[1]** 〈**1.Set Station**〉 to enter **{Set Station}.** The workspace displays current station's information.

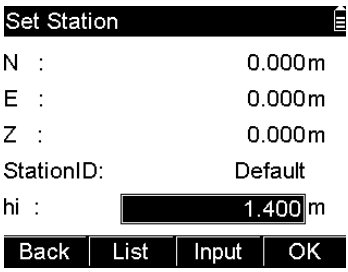
②Input 〈**hi**〉 (instrument height).

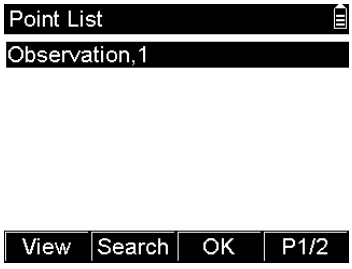
[F1]【Back】: Back to previous interface.

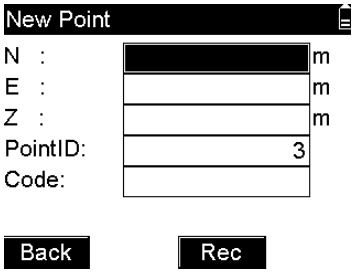
[F2]【List】: Enter **{Point List}** to select a known point as the station.

[F3]【Input】: Enter **{New Point}** to create a station point by manual input.

[F4]【OK】: Set the station.



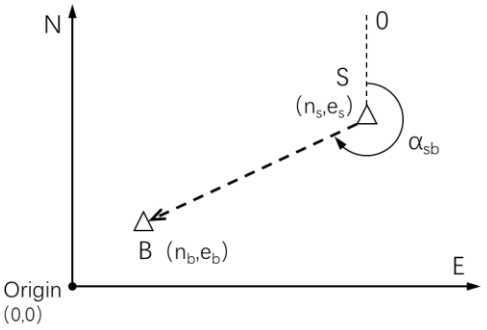




The applications' measurements, coordinates, and calculations are related to the current station coordinates, which should contain at least the plane coordinate (N, E) and, if required for the job, the height (Z).
If the application is started without setting station, the instrument defaults to the last setup station as the current station.

Set Orientation:

With the orientation, the horizontal direction angle can be set by manual input or set by known point coordinates.

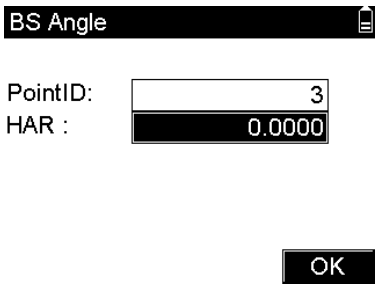
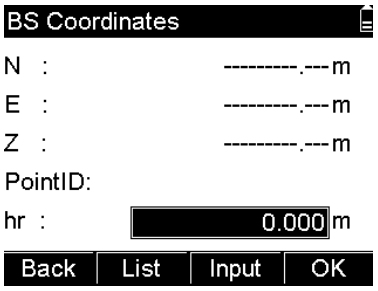
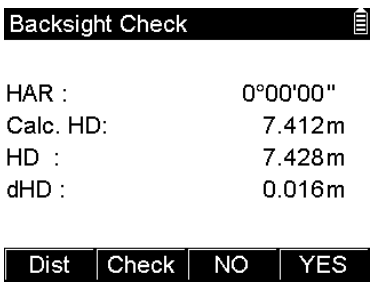


S: Station
(n_s, e_s): Station coordinates
B: Backsight point
(n_b, e_b): Known coordinates
α_{sb}: HA of S-B direction

Angle Orientation:

Set orientation by directly inputting an orientation HA of the direction from current station to the backsight point.

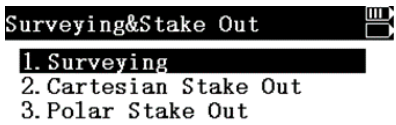
①In **{Surveying}** press **[3]〈3.Set Orientation〉** to enter **{Back Sight}**.
②Press **[1]〈Angle Orientation〉** to enter **{BS Angle}**.
③Input the **〈PointID〉** and **〈HA〉** value then Press **[F4]【OK】**.
④ Aim at the backsight point and press **[ENT]〈YES〉** to set the orientation.

<table>
<tr><td></td><td> 
</td></tr>
<tr><td colspan="2">Coordinates Orientation:
Set orientation by known point's coordinates. The coordinates can be read from the instrument memory or set by manual input.</td></tr>
<tr><td>①In {Surveying} press [3]〈3.Set Orientation〉 to enter {Back Sight}.
②Press [2]〈Coord Orientation〉 to enter {BS Coordinates}.
[F1]【Back】: return to the previous interface.
[F2]【List】: Enter {Known Point List} to select a known point as the backsight point.
[F3]【Input】: Enter {New Point} to create a known point by manual input.
③Input 〈hr〉 (prism height) then press [F4]【OK】.</td><td> 
</td></tr>
<tr><td>④ Aim at the backsight point and press[ENT]〈YES〉 to set the orientation.
⑤Enter {Backsight Check}. Workspace display the HA and calculated HD.
⑥Press [F1]【Meas】 to trigger the measurement. Check the measured HD deviation, press[F4]【OK】 to set the orientation.</td><td> 
</td></tr>
</table>

〈**HAR**〉: HA to the backsight point. 〈**Calc. HD**〉: Calculated HD to backsight point. 〈**HD**〉: Measured HD to backsight point. 〈**dHD**〉:The deviation between 〈**Calc. HD**〉 and 〈**HD**〉. **[F2]【Check】**:View the backsight coordinates. **[F3]【NO】**: Ignore current setting result and back to **{BS Coordiantes}**. **[F4]【YES】**: Set the orientation.	

4.2.Surveying

Application to measure a point and record the data.

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select 〈**MEAS**〉 and press **[ENT]** to enter **{Surveying & Stake Out}**. Press **[1]** to enter **{Surveying}**. ③Perform pre-settings. ④Press **[4]** to enter **{Surveying}**. Input the 〈**PointID**〉 and 〈**hr**〉. ⑤Aim at the target then trigger the measurement. **[F1]【All】**: Trigger the Distance measurement and record the result. Then 〈**PointID**〉 automatically adds 1. **[F2]【Code】**: enter **{Code List}** to	

select code as the current code.

[F3]【↑】: To edit pointID and hr.

[F4]【P1/3】:Turn to the 2nd page of softkeys.

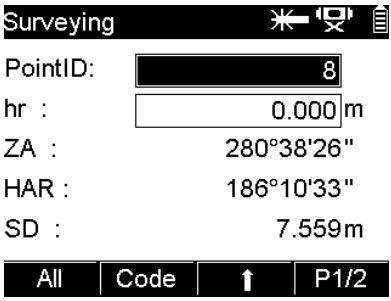
2nd page of softkey

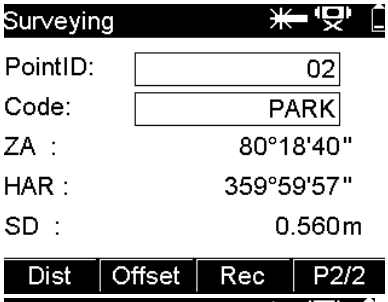
[F1]【Meas】: Trigger the Distance measurement and display the result.

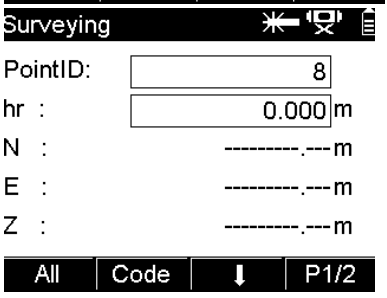
[F2]【Offset】: Enter **{Offset}**, please refer to **4.4 Offset**.

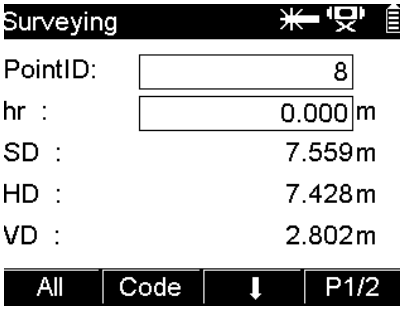
[F3]【Rec】: Record the measurement result. and **〈PointID〉** automatically adds.

[F4]【P2/2】:Turn to the 1st page of softkeys.









If not perform Distance measurement and directly press**[F3]【Rec】**, only the angle data would be recorded (no Distance and coordinates data . In angle mode interface, **〈Code〉** can be inputted or select form **{Code List}**. Press **[ESC]** to back to the initial **{Surveying}** interface.

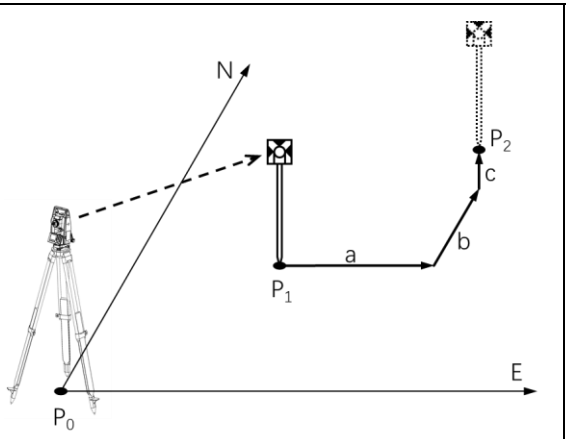
4.3.Stake Out

This application calculates the required parameters to position the required stakeout point. The stakeout point data can be read from the instrument memory or set by manual input. The program guides the user step by step from the current point to the correct point by continuously displaying the relative position relationship between the current prism point and the point to be stake out.

There are two methods for the process of stake out: the cartesian method and the polar method.

Cartesian Stake Out:

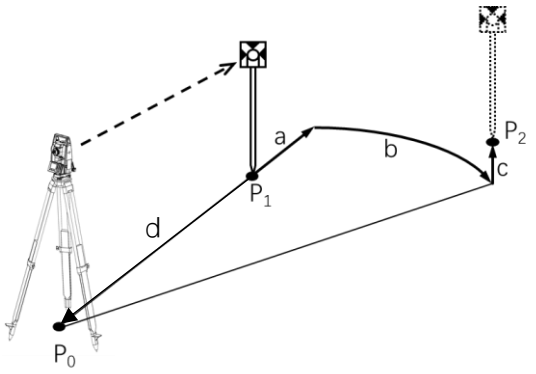
Stake out method which is based on a cartesian coordinate system. The calculated offset is divided into three orthogonal Distance elements.



P_0: Station
P_1: Current point
P_2: Stakeout point
a: dE (East offset)
b: dN (North offset)
c: dZ (Height offset)

Polar Stake Out:

Stake out method which is based on a polar coordinate system. The calculated offset is divided into one angle and two Distance elements.



P_0: Station
P_1: Current point
P_2: Stakeout point
a: dHD (Longitudinal offset)
b: dHA (HA offset)
c: dh (Height offset)
d: HDm (Longitudinal offset to the station)

Operation	Interface
①In the measurement interface, enter **{Main Menu}**. ②Press **[Meas]** to enter **{Surveying & Stake Out}**. ③ress **[2]** or **[3]** to choose the stakeout method **〈Cartesian Stake Out〉** or **〈Polar Stake Out〉**	Surveying&Stake Out 1. Surveying 2. Cartesian Stake Out 3. Polar Stake Out

Cartesian Stake Out:

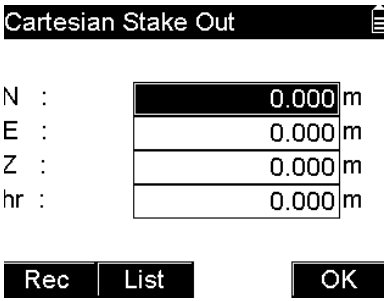
The stakeout point coordinates can be read from the instrument memory or set by manual input.

Press **[2]** to enter **{Cartesian stake out}**. Input stakeout point coordinates 〈**N**〉, 〈**E**〉, 〈**Z**〉 and 〈**hr**〉.

[F1]【Rec】: Record the inputted coordinates point.

[F2]【List】: Enter **{Known Point List}** to select a known point as the stakeout point.

[F4]【OK】: Confirm point data and enter **{Stake Out}** to perform stake out process.



{Stake Out} default workspace is performing cartesian method process. Aim at the target.

[F1]【Meas】: Trigger the Distance measurement and display the result.

〈**dN**〉: North offset.

〈**dE**〉: East offset.

〈**dZ**〉: Height offset.

〈**HAR**〉: Current HA.

〈**dHA**〉: HA offset.

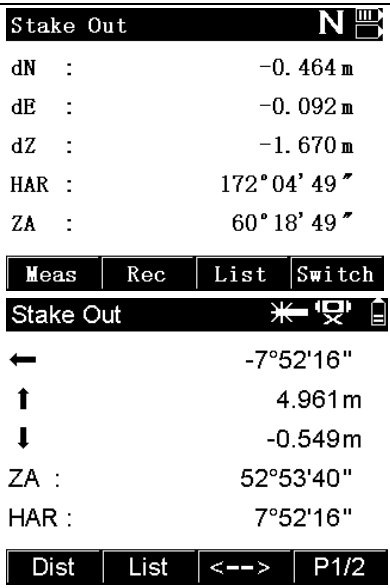
When the 〈**dHA**〉 is 0°00'00", it means that the direction of staking out is correct.

[F2]【List】: Enter **{Known Point List}** to select a known point as the stakeout point.

[F3]【<-->】: Convert the workspace to stakeout guidance interface.

[F4]【P1/2】to 2nd page of softkeys.

2nd page of softkey



[F1]【Rec】: Record the current point measurement result.

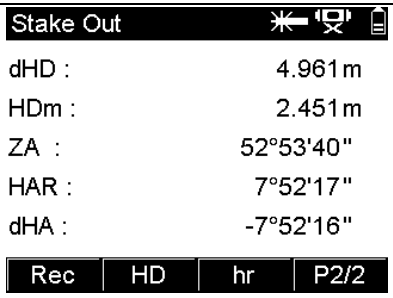
[F2]【HD】: Switch the method between cartesian and polar.

〈**dHD**〉: Longitudinal offset.

〈**HDm**〉: Longitudinal offset to the station.

[F3]【hr】: Input the prism height.

[F4]【P2/2】to 1st page of softkeys.



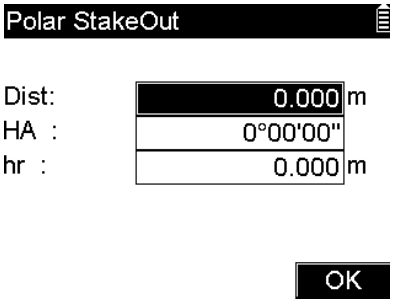
Polar Stake Out:

Input the longitudinal offset and HA offset to define the stakeout point.

Press **[5]** to enter **{Polar Stake Out}**.

Input〈**Meas**〉,〈**HA**〉,〈**hr**〉to define the stakeout point.

press **[F4]【OK】** to enter **{Stake Out}** guidance interface to perform stake out process.



Stake Out Guidance:

Indicates the direction and offset value of target's movement by the polar method.

First line: Arrow guide to move left/right and **dHA**.

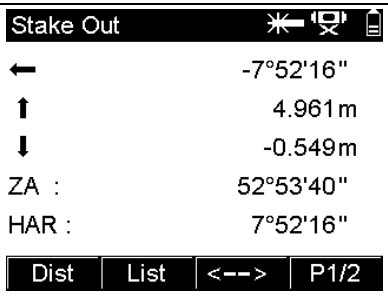
Second line: Direction arrow guide to move and **dHD**.

↓: Move towards the station.

↑: Move away from the station.

Third line: Direction arrow guide to move and **dZ**.

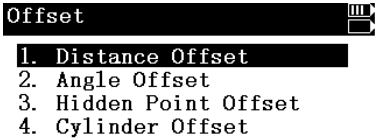
↓: Move higher.

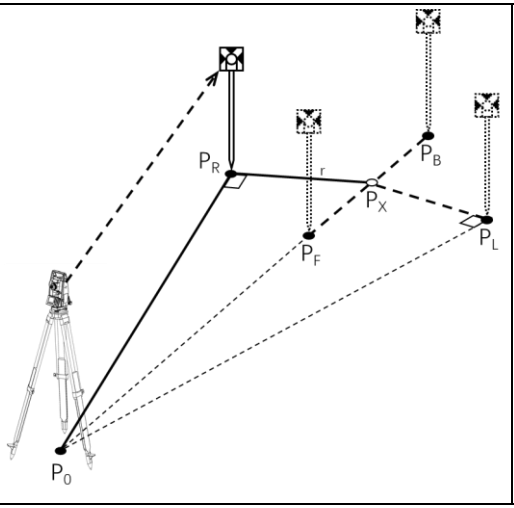


↑: Move lower. After moving the target according on the guidance, aim at the target again. Then press **[F1]【Meas】** to trigger the Distance measurement again. Repeat the movement and measurement until the offset values meet the requirements	

4.4.Offset

In some measurement tasks，it is not easy to set up the reflector prism directly, or it is not possible to aim the target point directly. The offset application can work out the target point by measureing some related offset points which can be measured easily.

Operation	**Interface**
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ②Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[4] to enter {Applications}.** ③Press **[1]** to enter **{Offset}**. ④Perform pre-settings.	



P_0: Station
P_X: Target point
P_R: Measurement point (right)
P_L: Measurement point (left)
P_F: Measurement point (front)
P_B: Measurement point (back)
r: Offset Distance

Distance Offset:

Distance offset program requires that the measurement point and the target point are equal in height, and the offset disrtance is known. It is usually used when the target point is not in view.

①Press **[4]〈4.Distance Offset〉** to enter **{Distance Offset}**.

②Use the navigation keys to select **〈Offset〉** and input the offset Distance.

③Select **〈Deviation〉** then use **[◀] [▶]** to change the direction.

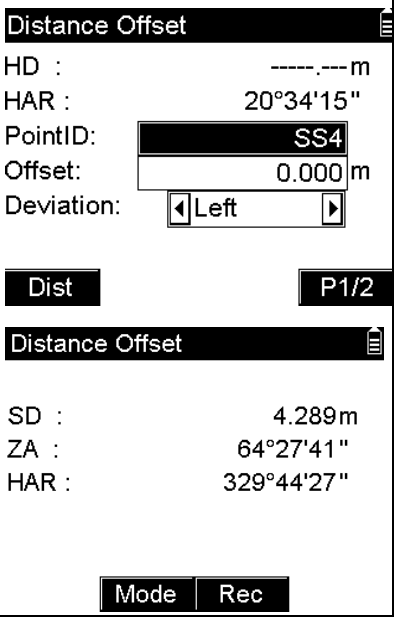
〈Left〉: The measurement point is to the left of the target point.

〈Right〉: The measurement point is to the right of the target point.

〈Front〉: The measurement point is in front of the target point.

〈Back〉: The measurement point is on the back side of the target point.

④Aim at the measurement point and

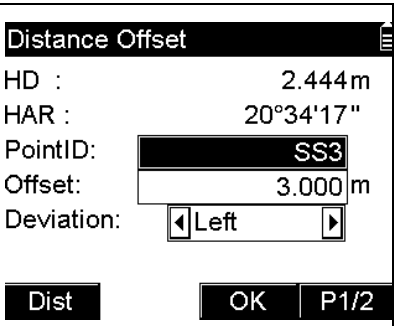


press **[F1]【Meas】**to trigger the Distance measurement. Then press **[F3]【OK】**.

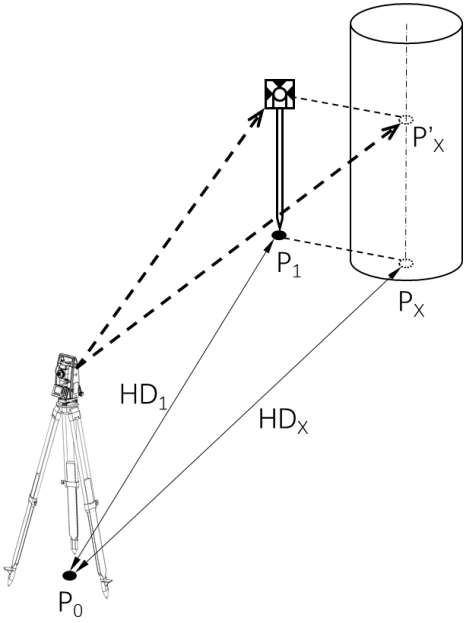
⑤Workspace display the calculated result of the target point.

[F2]【Mode】: Convert the display data format between polar and coordinates.

[F3]【Rec】: Record the result data of target point.



When the measurement point is to the left or right of the target point, the angle between the measurement point and the target point and the line between the measurement point and the station should be approximately equal to 90 degrees. When the measurement point is located to the front or back side of the target point, the measurement point should be located on the line between the target point and the station.



P_0: Station

P_X: Target point

P_1: Measurement point

P'_X: Virtual points in the same direction with target point

HD_1: HD of the measurement point

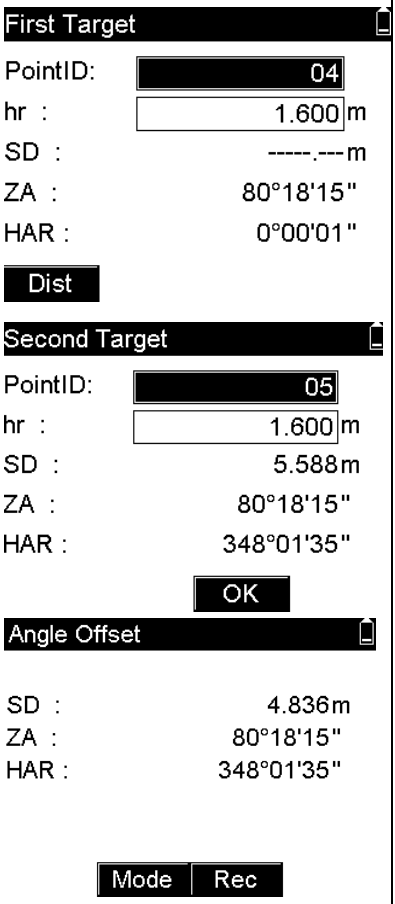
HD_X: HD of the target point

$HD_1=HD_X$

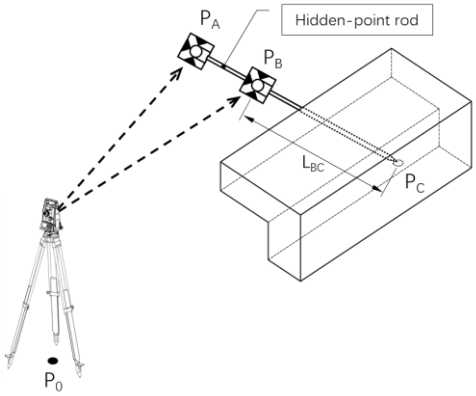
Angle Offset:

Angle offset program requires that the target point and the measurement point are equal in height, and have same Distance to the station. For the measurement point, the Distance and HA needs to be measured. For the target point, only the HA needs to be measured. The application will calculate the coordinates of the target point based on the Distance value of the measurement point and the angle value of the target point. This method can be used to measure the centre of cylindrical targets such as piers, poles or trees.

①Press **[5]〈5.Angle Offset〉** to enter **{First Target}**, input **〈PointID〉** and **〈hr〉**.
②Aim at the measurement point and press **[F1]【Meas】** to trigger the Distance measurement.
③Rotate the instrument horizontally to aim at the point which have the same orientation at the target point. Then press **[F3]【OK】**.
④Workspace display the calculated result of the target point.
[F2]【Mode】: Convert the display data format between polar and coordinates.
[F3]【Rec】: Record the result data of target point.



The measurement point should be as close as possible to the left or right of the target point. The Distance from the measurement point to the station should be equal to the Distance from the target point to the station.



P_0: Station
P_C: Hidden point
P_A: Prism A of rod
P_B: Prism B of rod
L_{BC}: Length of B-C (known)

Hidden Point Offset:

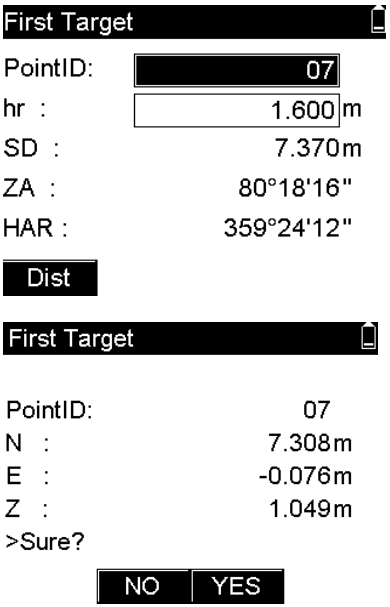
Hidden point is a target point that is not directly visible. By using a special hidden-point rod whose length was known, hidden point program can be measured indirectly.

Hold the tip of the hidden-point rod against the target point, orient the prism towards the instrument and keep the rod still.

①Press **[6]〈6.Hidden Point Offset〉** to enter **{First Target}**,input **〈PointID〉** and **〈hr〉.**

②Aim at the prism A of rod and press **[F1]【Meas】** to trigger the Distance measurement. Check the result then press **[F2]【No】** to return to the previous interface.

[F3]【Yes】 to record.

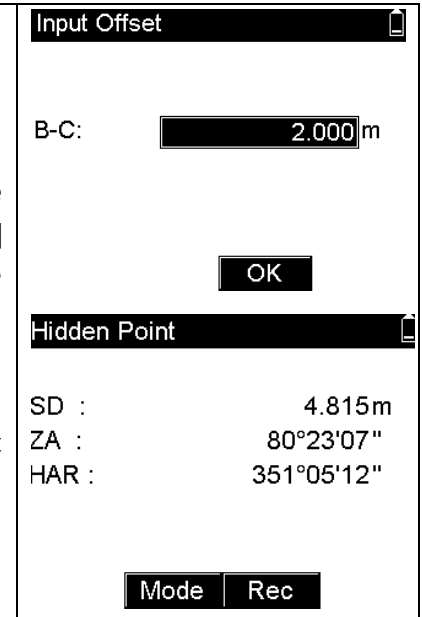


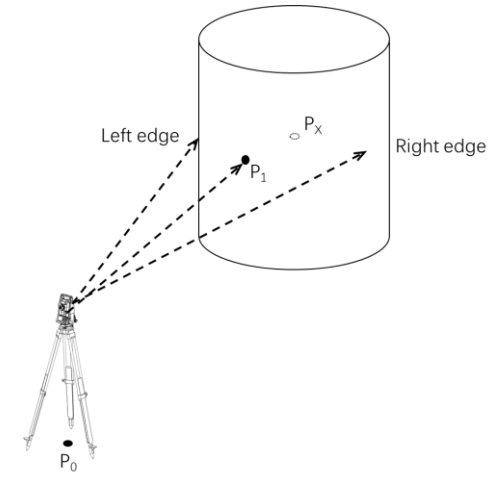
③Aim at the prism B of rod and press **[F1]【Meas】** to trigger the Distance measurement. Check the result then press **[F3]【Yes】** to record.

④Input the known length between the prism B and the rod tip C. Press **[F3] [OK]** to display the calculated result of the target point.

[F3]【Mode】: Convert the display data format between polar and coordinates.

[F4]【Rec】: Record the result data of target point.





P_0: Station

P_X: Target point

P_1: Surface point

Cylinder Offset:

By measuring a surface point and two edges, cylinder offset program can calculate the center coordinates and the radius of the cylinder.

①Press **[7]〈7.Cylinder Offset〉** to enter **{Surface Point}**,input**〈PointID〉**and**〈hr〉.**

②Aim at a surface point of the cylinder and press **[F1]【Meas】** to trigger the Distance measurement. Check the result then press **[F3]【OK】** to record.

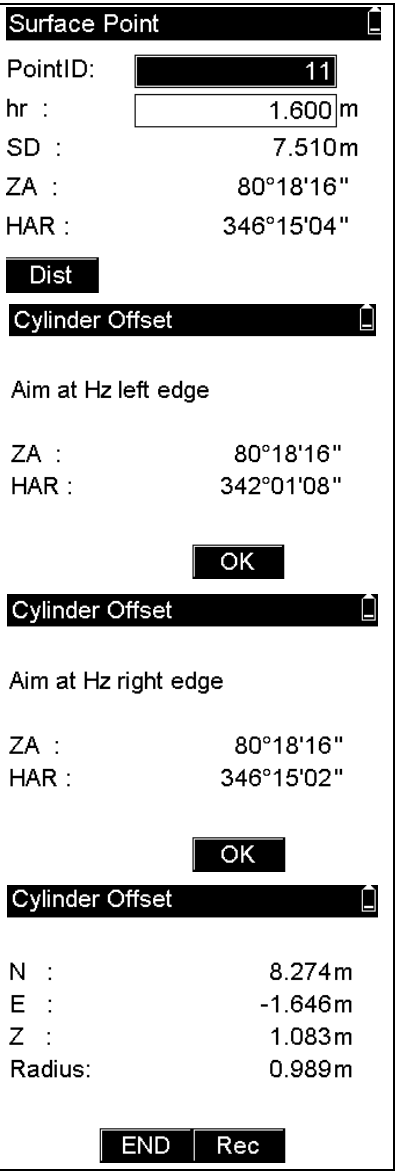
③Rotate the instrument horizontally to aim the reticle at the left edge of the cylinder. Then press **[F3]【OK】**.

④Rotate the instrument horizontally to aim the reticle at the right edge of the cylinder. Then press **[F3]【OK】**.

⑤ Workspace display the calculated center coordinates and the radius of the cylinder.

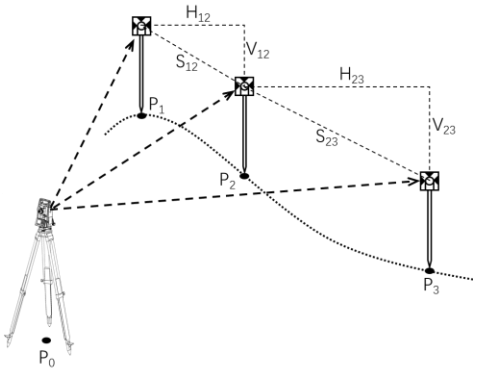
[F2]【END】: Exit the program.

[F3]【Rec】: Record the center point coordinates.



4.5.Missing Line Measurement

This application is used to measure and calculate the SD/HD/VD of two target points.



P_0: Station
P_1: First point 1# (Start point)
P_2: Second point 2# (New start point)
P_3: Third point 3# (New second point)

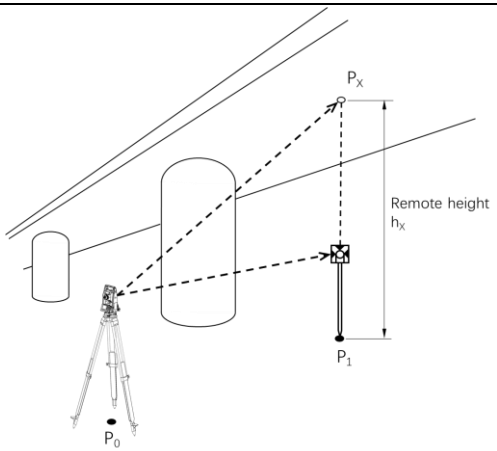
S_{12}: SD between 1# and 2#
H_{12}: HD between 1# and 2#
V_{12}: VD between 1# and 2#
S_{23}: SD between 2# and 3#
H_{23}: HD between 2# and 3#
V_{23}: VD between 2# and 3#

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[4] to enter {Applications}.** ③Press **[2] 〈2.Miss. Line Measure〉** to enter **{MLM First Point}.** ④Aim at the first point (start point) and press **[F1]【Meas】**to trigger the Distance measurement.	Applications 1. Offset 2. Miss.Line Measure 3. Remote Height 4. Area 5. Resection 6. Reference Line 7. Inverse

⑤Aim at the second point and press **[F4]【MLM】** to trigger the Distance measurement and enter **{MLM Second Point}.** ⑥ Workspace display the calculated Distance between the two points and the data of the second point. **〈ML-SD〉**: SD between the two points. **〈ML-HD〉**: HD between the two points. **〈ML-VD〉**: VD between the two points. **〈HD〉**: HD between the second point and station. **〈HAR〉**: HAR of the second point. **〈hr〉**: Input the prism height. **[F1]【Meas】**: Measure a new start point. **[F2]【Move】**: Set the last measured point as new start point. **[F3]【SD/Slope】**: Switch the display modes between SD and slope. **[F4]【MLM】**: Re-measure the second point or aim then measure the new second point (remain the same first point).	MLM First Point HD : -----.---m ZA : 80°18'16" HAR : 8°51'05" hr : 1.600 m Dist MLM MLM Second Point ML-SD 0.171m ML-HD 0.169m ML-VD -0.022m HD : 0.418m HAR : 8°51'05" hr : 1.600 m Dist Move Slope MLM
When press **[F2]【Move】** to transform the start point. Workspace display the coordinates of the last measured point. **[F3]【NO】**: Back to the last MLM result and remain the old start point. **[F4]【YES】**: Set the last second point as new start point and begin new MLM.	MLM First Point Set to start point? N : 7.171m E : -2.503m Z : 1.098m NO YES

4.6.Remote Height

This application is used to measure a target point where a prism cannot be set up easily, but there is a measurable point directly below (or above) this point.



P_0: Station
P_X: Target point
P_1: Measurement point (directly below the target point)
h_X: Remote height

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ②Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[4] to enter {Applications}.** ③Press **[3] 〈3.Remote Height〉** to enter **{Remote Height}.** ④Set up the prism on the measurement	Applications 1. Offset 2. Miss.Line Measure 3. Remote Height 4. Area 5. Resection 6. Reference Line 7. Inverse

point (which is directly below or above the target point). Input the 〈**hr**〉.

⑤Aim at the prism and press **[F1]【Meas】** to trigger the Distance measurement.

⑥Rotate the telescope vertically and aim at the target point, then Press **[F4]【RHM】**. Workspace display the height and coordinates of the target point.

〈**hx**〉: The height of target point. The value is updated in real time by rotating the telescope vertically.

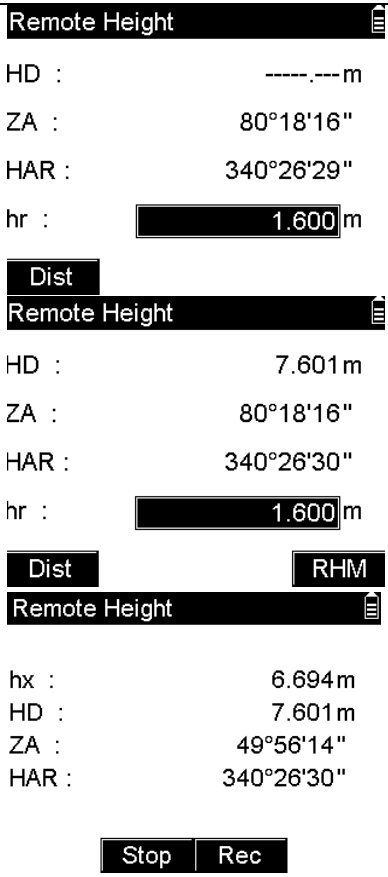
〈**HD**〉: HD of the target point.

〈**ZA**〉: ZA of the target point.

〈**HAR**〉: HA of the target point.

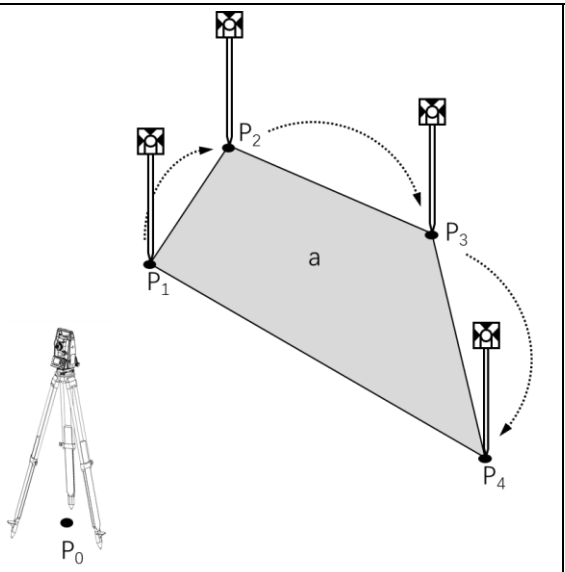
[F2]【Stop】: Back to previous interface.

[F3]【Rec】: Record the target point coordinates.



4.7.Area

This application is used to calculate an area enclosed by max 50 vertices and straight edges. The vertice coordinates can be measured, selected from memory or input manually.



P_0: Station
P_1: Start point 1#
P_2: Target point 2#
P_3: Target point 3#
P_4: Target point 4#
a: Area closed by P_1-P_4

All the target points must be Measributed continuously in clockwise or anti-clockwise order, otherwise the area calculation will not give the correct result.

Operation	Interface

①In the measurement interface, press **[M]** to enter **{Main Menu}**.

②Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[3]** to enter **{Applications}**.

③Use the navigation keys to select **〈4.Area〉** and press **[ENT]**, or Press **[4]** to enter **{Area Calculate}.**

Workspace display the list of target points.

[F1]【Meas】: Enter in the point measurement interface to measure a target point.

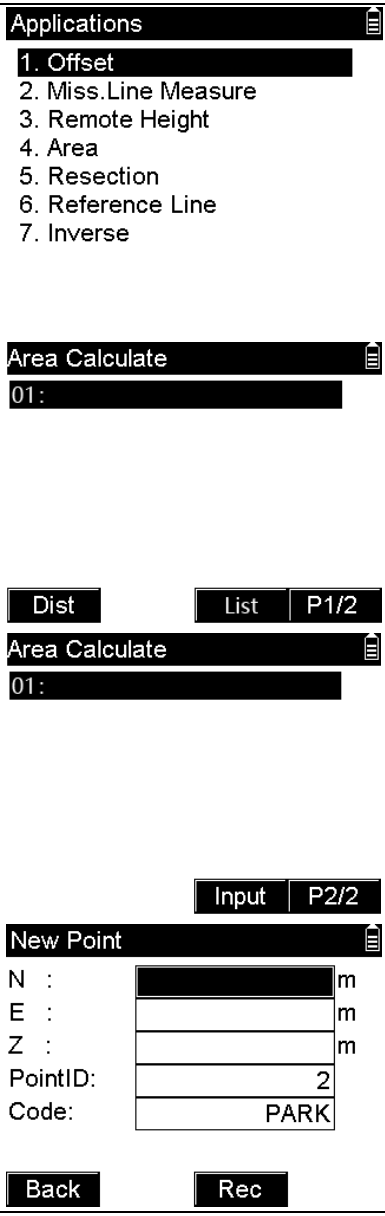
[F3]【List】: Enter **{Point List}** to select a known point as the target point.

[F4]【P1/2】: To 2nd page of softkeys.

2nd page of softkey

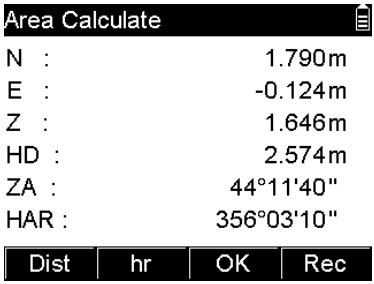
[F3]【Input】: Enter **{New Point}** to create a target point by manual input.

Any target point can be created by one of the three methods.

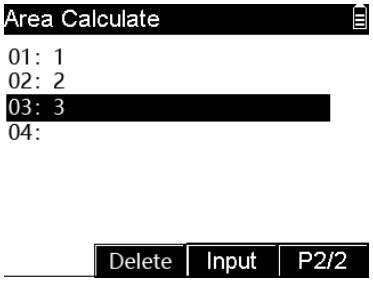


Press **[F1]【Meas】** to measure a target point.

Aim at the target point then press **[F1]【Meas】** to measure it. Press **[F2] 【hr】** Input the prism height.Press **[F4]【Rec】** to record the coordinates then press **[F3]【OK】** back to the target point list interface. The point serial number will plus 1 automatically.

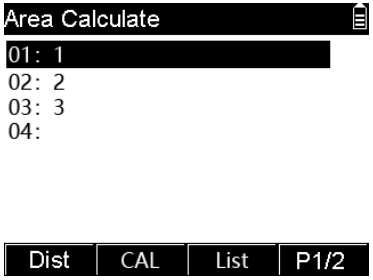


After measuring or inputting some target points, the list will display all the point records.



Press **[▲]**to highlight the last point record, then press **[F4]【P1/2】** to 2nd page of softkeys, **[F2]【Delete】** will be available to delete the last point.

When the point records in the list are 3 or more, **[F2]【CAL】** will be available.

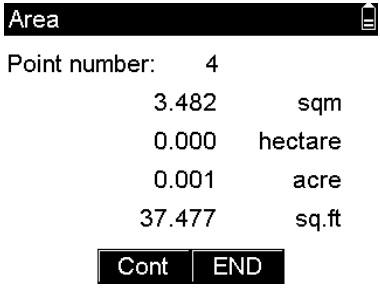


After getting all the target points,

Press **[F2]【CAL】** to calculate and display the area result.

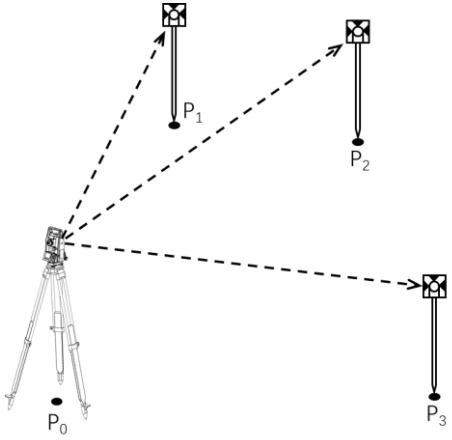
[F2]【Cont】: back to the point list and continue to add more points.

[F3]【END】: Exit the program.



4.8.Resection

This application is used to determine the station (instrument) coordinates by measuring and back-calculating some known points. The calculation requires between 2 and 5 known points.

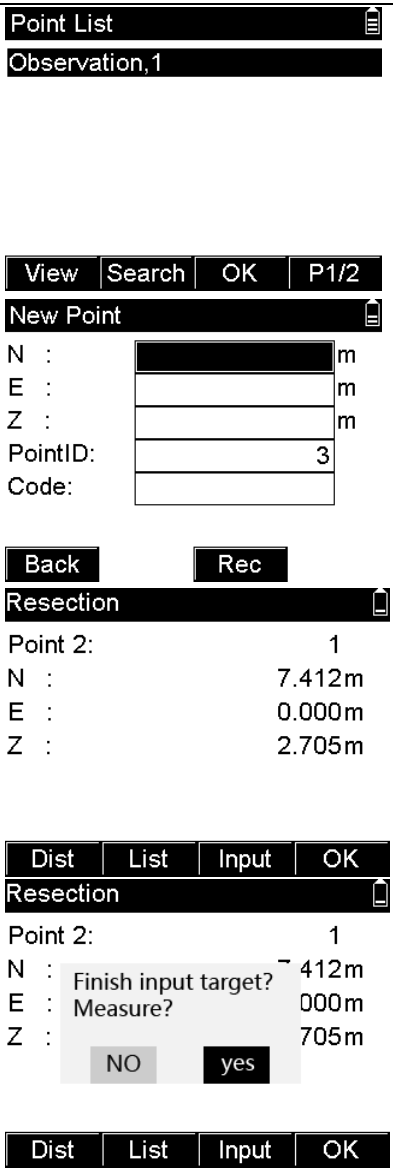


P_0: Station
P_1: Known point 1#
P_2: Known point 2#
P_3: Known point 3#

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select 〈**STA**〉 and press **[ENT]**, or simply press the numeric key **[7]** to enter **{Set station}**. ③Press **[2]** 〈**2.Resection**〉 to enter **{Resection}**. Workspace guide to get the point 1 coordinates. Two methods can be used. **[F2]**【**List**】: Enter **{Point List}** to select a known point as the target point.	Set station 1. Set Station 2. Resection Resection Point 1: N : --------.---m E : --------.---m Z : --------.---m Back List Input OK

[F4]【Input】：Enter **{New Point}** to create a known point by manual input.

④ After getting point 1 coordinates, press **[F3]【OK】** to the point 2 interface.
⑤Enter point 2, point 3, etc. up to 5.
After getting point 2, **[F1]【Meas】** will be available.
⑥Press **[F1]【Meas】** then Press **[ENT]** to confirm points and enter resection measurement interface.



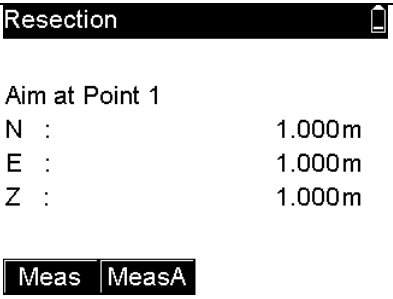
Resection measurement can be implemented by two methods.

[F1]【Meas】: Enter Distance method.

[F2]【MeasA】: Enter angle method.

Distance method will measure the Distance and the angle of known point.

Angle method will measure the angle only.



The Distance method requires at least two known points to calculate the result. Angle method requires at least three known points for calculation.

Distance Method: Press **[F1]【Meas】** to enter Distance method interface.

Aim at the known point 1 and press **[F1]【Meas】** to trigger the measurement.

[F1]【Meas】: Remeasure the point.

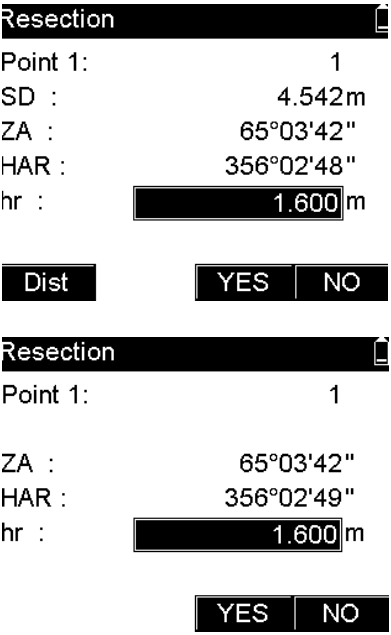
Angle Method: Press **[F2]【MeasA】** to enter angle method interface.

Aim at the known point then press **[F3]【YES】** to measure and record the angle data.

[F3]【YES】: Record the data and enter the next point measurement.

[F4]【NO】: Back to last step.

Repeat the steps to measure all the known points.



While the known points measured are enough to calculate the result, **[F2]** **【CAL】** will be available. Press **[F2]** **【CAL】** to enter in **{Resection Result}**.

Workspace display the calculated coordinates of station.

Press **[F4]【P1/2】**to 2nd page of interface, Workspace display the residuals of each direction.

〈PointID〉 : Station point name.

〈hi〉: Instument height.

〈N〉: Station coordinates N.

〈E〉: Station coordinates E.

〈Z〉: Station coordinates Z.

〈dN〉 : The residual of N.

〈dE〉 : The residual of E.

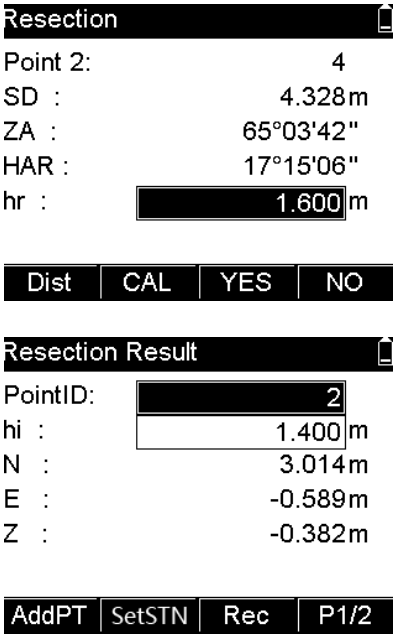
〈dZ〉 : The residual of Z.

[F1]【AddPT】 : Add known point and perform resection again.

[F2]【SetSTN】: Set the calculated result as the current station coordinates.

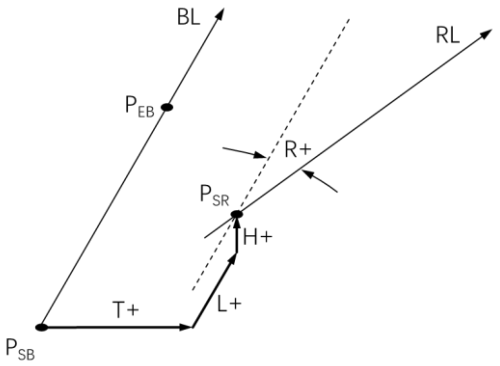
[F3]【Rec】: Record the calculated result.

[F4]【P1/2】 : Turn to the 2nd page of interface.



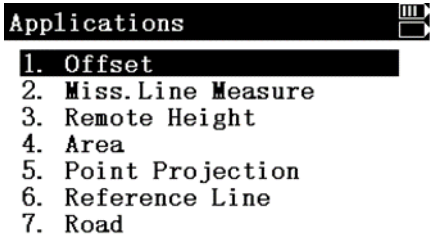
4.9.Reference Line

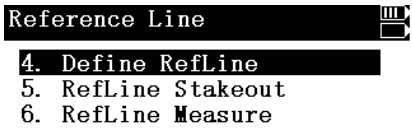
This application can easily stake out or checking of lines for buildings, sections of road, simple excavations, etc. After defining a reference line by two points, the user can use the programs to stake out or measure based on the reference line.



P_{SB}: Start base point
P_{EB}: End base point
BL: Base line
T+: T-Offset
(Transverse offset)
L+: L-Offset
(Longitudinal offset)
H+: H-Offset
(Height offset)
P_{SR}: Start reference point
R+: Rotate angle
RL: Reference line

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ②Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[4]** to enter **{Applications}**. ③Press **[6] 〈6.Reference Line〉** to enter **{Reference Line}**. ④Perform pre-settings.	Applications 1. Offset 2. Miss.Line Measure 3. Remote Height 4. Area 5. Point Projection 6. Reference Line 7. Road





Define Reference Line:

Reference line is defined by a base line or offset base line. The base line is defined by two base points. The base point can be measured, selected from memory or input manually.

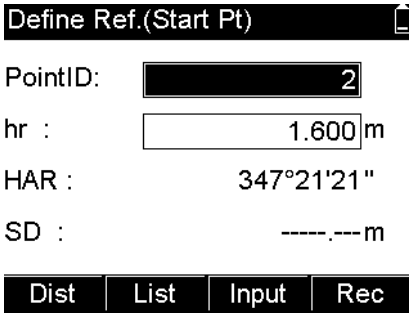
①Press**[4]〈4.Define RefLine〉** to enter in **{Define Ref. (Start Pt)}**.Define the start base point by one of three methods.

[F1]【Meas】: Aim at the start point then press to measure it.

[F2]【List】: Enter **{ Point List}** to select a known point as the start point.

[F3]【Input】: Enter **{New Point}** to create a start point by manual input.

After entering the start point, press



[F4]【Rec】 to Record the coordinates. Enter in **{Define Ref. (End Pt)}**

②Define the end base point by one of three methods in **{Define Ref. (End Pt)}** . Press **[F4]【Rec】** to Record the coordinates. Enter in **{Define Refline(1)}** to check the base line.

〈HA〉 : Horizontal direction of the base line.

〈HD〉 : HD between the start and end point.

〈VD〉 : VD between the start and end point.

〈Slope〉 : Slope of the base line.

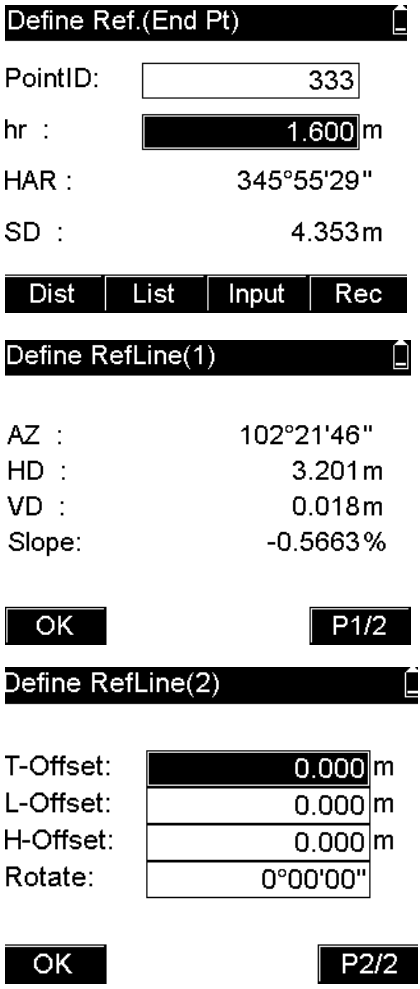
③Press **[F4]【P1/2】** to enter in **{Define Refline(2)}**. The reference line can be offset either longitudinally, transversely or vertically to the base line, or be rotated around the start base point as required.

〈T-Offset〉 : Transverse (parallel) offset of the base line. Rightward is positive.

〈L-Offset〉 : Longitudinal offset of the start base point. Direction from the start point towards the end is positive.

〈H-Offset〉 : Height (vertical) offset of the start base point. Upward is positive.

〈Rotate〉 : Horizontally rotate angle of the base line based on the start point.



④ After inputting the offset values, press **[F1]【OK】** to confirm the reference line and back to **{Reference Line}**.

Reference Line Stakeout:

The program calculates the stakeout point coordinates by offset values of the reference line, then stake out the target point.

After defining a reference line.

①Press**[5]〈5.RefLine Stakeout〉** to enter in **{RefLine Stakeout}**. Input the stakeout point's offset values of the reference line.

〈T-Offset〉: Transverse offset of the reference line. Right side is positive.

〈L-Offset〉: Longitudinal offset of the start reference point. Direction from the start point towards the end is positive.

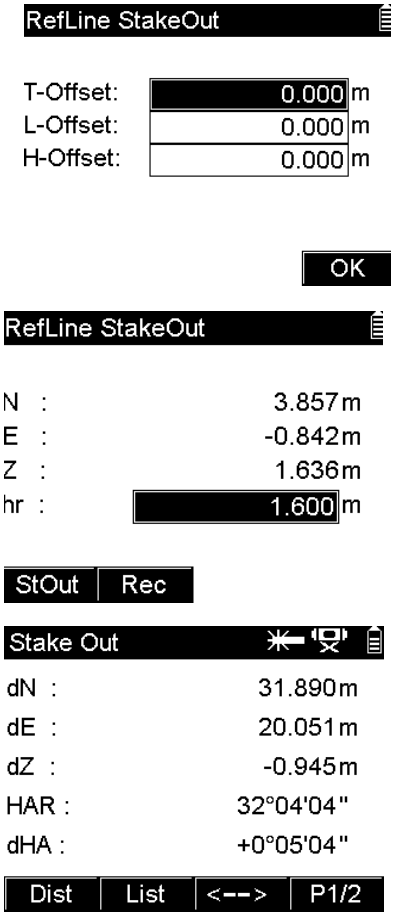
〈H-Offset〉: Height (vertical) offset of the reference line. Above is positive.

②Press **[F4]【OK】** to calculate and display the coordinates of stakeout point.

③Press **[F1]【StOut】** to enter in **{Stake Out}** program. Following the guide to stake out the target point.

Refer to **4.3 Stake Out**

[F3]【Rec】: Record the target point coordinates.



Reference Line Measurement:

The program measures a target point and calculates its offset values of the reference line.

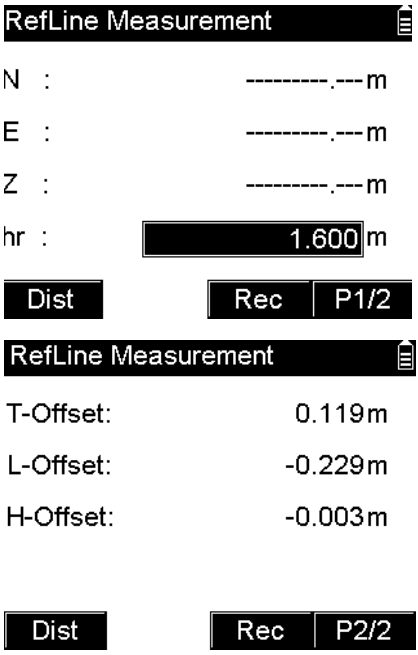
After defining a reference line.

①Press**[6]〈Refline Measure〉** to enter in **{Refline Measurement}**.

②Aim at the target point then press **[F1]【Meas】** to measure it. Worksapce will display the coordinates.

③Press**[F4]【P1/2】** to the 2nd interface. Worksapce will display the target point's offset values of the reference line.

[F3]【Rec】: Record the target point coordinates.



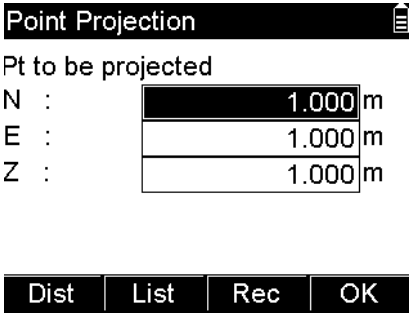
Point Projection:

The program can project a target point orthogonally onto the reference line and calculate the coordinates and offset of the projection point. The target point coordinates can be measured, selected from memory or input manually.

After defining a reference line.

①Press**[7]〈Point Projection〉** to enter in **{Point Projection}**.

②The target point can be inputted directly, selected from **{Point list}** or measured. After entering the coordinates, press **[F4]【OK】** to calculate the coordinates of projection



point on reference line.

[F1]【Meas】: Aim at the target point then press to measure it.

[F2]【List】: Enter **{Point List}** to select a known point as the start point.

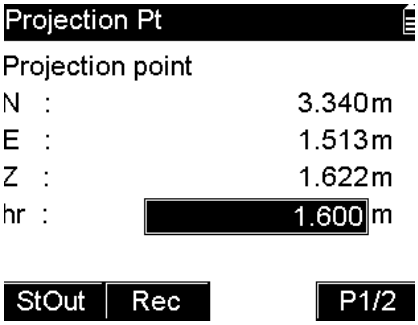
[F3]【Rec】: Record the target point coordinates.

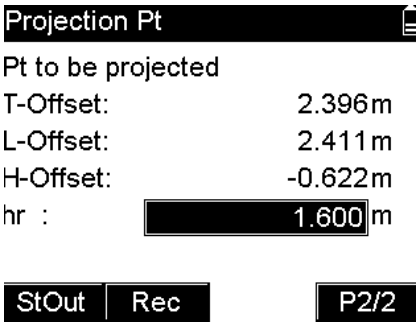
③Worksapce displays the projection point's coordinates. Press**[F4]【P1/2】** to the 2nd interface. Worksapce will display target point's offset values of the reference line.

④Press **[F1]【StOut】** to enter in **{Stake Out}** program. Following the guide to stake out the projection point.

Refer to **4.3 Stake Out**

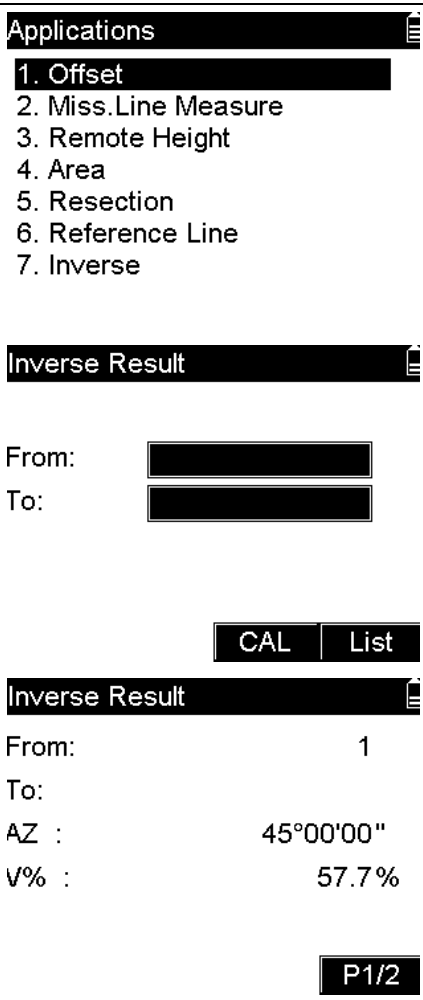
[F2【Rec】: Record the projection point coordinates.

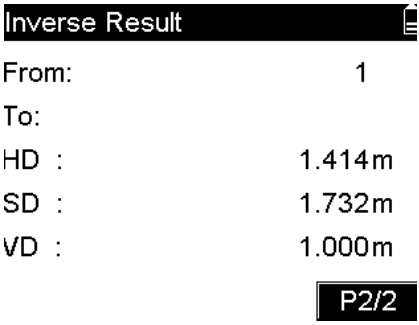




4.10.Inverse

This application can calclute azimuth and Distance between two points. Points only can be selected from memory.

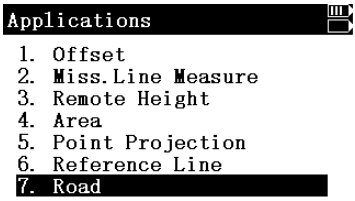
Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ②Use the navigation keys to select **〈APP〉** and press **[ENT]**, or simply press the numeric key **[4] to enter {Applications}.** ③ Press **[7] 〈 7.Inverse 〉** to enter **{Inverse Result}.** ④Use the navigation keys to select **〈From〉,** Press **[F4]【list】** Enter **{Point List}** to select a known point as the start point. ⑤Use the navigation keys to select **〈To〉,** press **[F4]【list】** Enter **{Point List}** to select a known point as the end point. ⑥Press **[F3]【CAL】** the interface will display the results. ⑦Press**[F4]【P1/2】** to the 2nd interface. Worksapce will display the Distance between two points. **AZ:** azimuth between two points **V%:** vertical angle in percentage slope mode between two points **HD:** slope Distance between two	

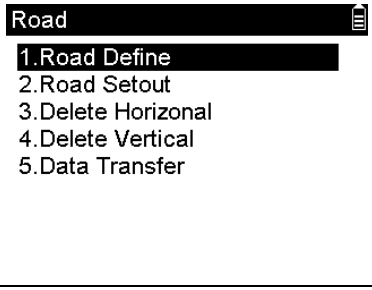
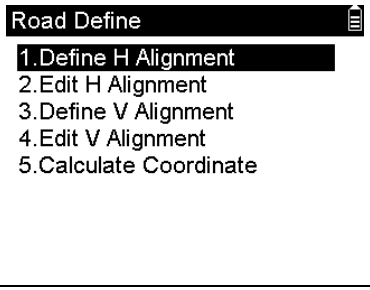
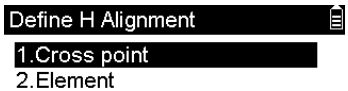
points. **SD:** horizontal Distance two points. **VD:** height between two points.	

4.11.Road

This application can define a line, curve or transition curve as a reference to measure or stake out.

The left and right of the road are relative to the forward direction of road.

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ②Use the navigation keys to select 〈**APP**〉 and press **[ENT]**, or simply press the numeric key **[4] to enter {Applications}.** ③Press **[7]** 〈**7.Road**〉 to enter **{Road}.** ④Perform pre-settings.	
If you don't perform surveying or staking-out ， station setup and orientation can be skipped.。	

⑤Press **[1]〈start〉** to enter **{Road}.**	
Road Define	
Press **[1]〈Road Define〉** to enter **{Road Define}**	
Define H Alignment: H Alignment is a set of data that can be used to describe and determine the exact location of the road.	
Press **[1]〈Road Define〉** to enter **{Define H Alignment}**; There are two ways to define h alignment: Cross point or Element	
Cross point: This way define the road by the cross point position and curve characteristic information.	

Press**[1]〈Cross point〉** to enter **{Start Point}**

Input chainage and the coordinates of start point, press **[F4]【OK】**, enter **{Cross Point}**.

〈N〉: Cross point coordinates N.

〈E〉: Cross point coordinates E.

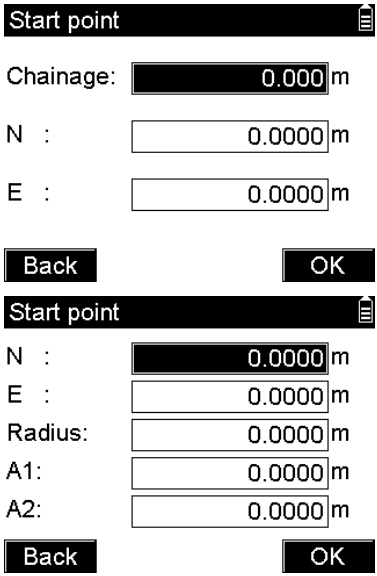
〈Radius〉: The radius of the curve contained at the cross point. When the curve turns right, the radius value is positive; otherwise, it will be negative.

〈A1〉: Initial transition curve parameter.

〈A2〉: End transition curve parameter. A1 and A2 must be positive.

[F1]【Back】: Exit without saving data.

[F4]【ok】: Save data, enter the next input page.



Example FILE format of cross point:

```
0.0000,106.006,6.016
310.224,516.066,90.000,282.843,244.949
316.616,561.646,
```

The first line: 0.000 represents the chainage of the starting point, 106.006 is the N coordinate of the starting point, and 6.016 is the E coordinate.

The second line: 310.224, 516.066 are the coordinates N, coordinates E of the cross point, 90.000 is the radius, 282.843 is the initial transition curve parameter, 244.949 is the end transition curve parameter.

The third line：represent the ending point，316.616，561.646 are the coordinates N, coordinates E of the ending point.

The first line must be the parameter of start point，then each line represents a cross point. The exported and imported FILEs are in the same format. You can just import a FILE within 20 lines include starting point and ending point.

Element：

This way defines a road by the characteristic data of each element.

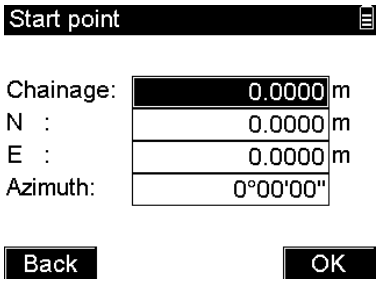
Press **[1]〈Road Define〉** to enter **{Define H Alignment}**；Then press**[2]〈Element〉** to enter **{Start point}.**

〈chainage〉：the chain number of start point.

〈N〉：Cross point coordinates N.

〈E〉：Cross point coordinates E.

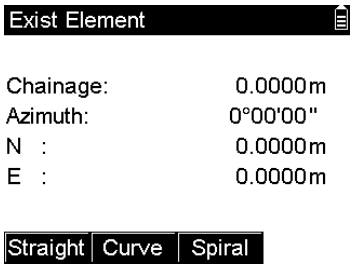
〈Azimuth〉：Tangent azimuth of the line behind the starting point



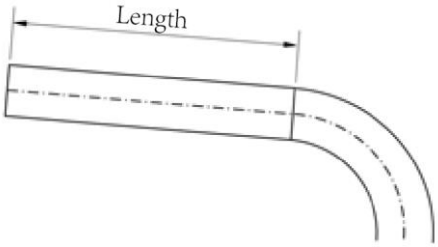
Chainage must be mumbers, eg: K6+116.016 should be inputted as 6116.016。

After entering start point，press **[F4]【**ok**】** to enter **{** Exist Element **}**.

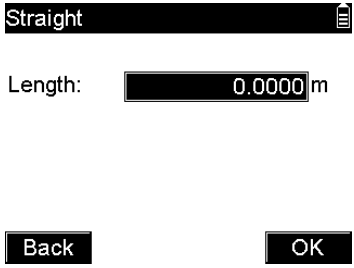
The interface displays the chainage at the end of the current alignment data, the 〈 azimuth〉of the tangent line and 〈 N 〉, 〈 E 〉coordinates of the point. **[F1]【Straight】**：Add a straight

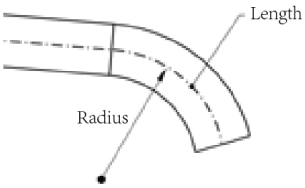


line at the end of the current alignment data.
[F2]【Curve】: Add a curve at the end of the current alignment data.
[F3]【Spiral】: Add a transition curve at the end of the current alignment data.
When you complete an entering of the elements, press **[F4]【ok】** to save and back to this interface



Straight line: Press **[F1]【Straight】** to enter **{ Straight }**.
Input length of the straight line, press **[F4]【ok】** to save.

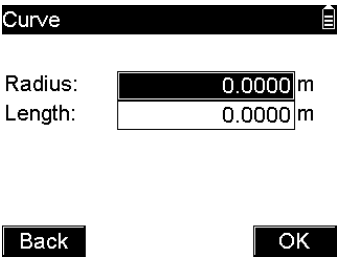


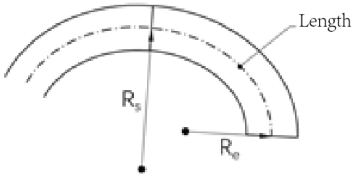


Curve: Press **[F2]【Curve】** to enter **{ Straight }**.

Input length and radius of the curve, press **[F4]【ok】** to save.

When the curve turns right, the radius value is positive; otherwise, it will be negative.





Spiral: Press **[F3]【Spiral】** to enter **{ Spiral }.**

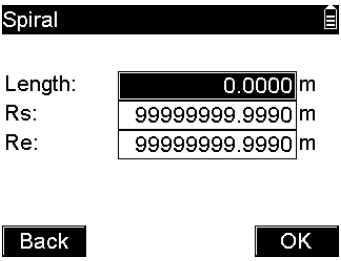
Input parameters of transition curve, press **[F4]【ok】** to save.

〈Length〉: length of the transition curve.

〈Rs〉: Initial radius of the transition curve.

〈Re〉: End radius of the transition curve.

When the curve turns right, the radius value is positive; otherwise, it will be negative.



Example FILE format of element:

```
0,0.0000,106.006,6.016,166.12136
1,300.000
3,420.000,99999999.999,200.000
2,200.000,157.000
3,76.060,-200.000,-90.000
```

The first line：0 indicates that this line is the parameters of the starting point. 0.0000 present the chainage of the starting point, 106.006 is the N coordinate of the starting point, and 6.016 is the E coordinate. 166.12136 is the azimuth. 166.12136 means 116 degrees 12 minutes and 13.6 seconds

The second line：1 indicates that this line is the parameters of a straight line，300.00 means the length of the straight line.

The third line：3 indicates that this line is the parameters of a transition curve，420.000 means the length of the transition curve，99999999.999 means the initial radius of the transition curve（The maximum value represents a straight-to-curve connection），200.000 means the end radius of the transition curve. The radius value positive means it turns right.

The fourth line：2ndicates that this line is the parameters of a curve，200.000 means the radius of the curve, the radius value positive means it turns right，314.000 means the length of the curve.

The fifth line：3 indicates that this line is the parameters of a transition curve，76.060 means the length of the transition curve，-200 means the initial radius of the transition curve，-90.000 means the end radius of the transition curve. The radius value negative means it turns left.

The first line must be the parameter of start point, then each line represents an element. The exported and imported FILEs are in the same format. You can just import a FILE within 60 lines include starting point.

Edit H Alignment:

You can edit the H Alignment data that saved before, Take the element method for example.

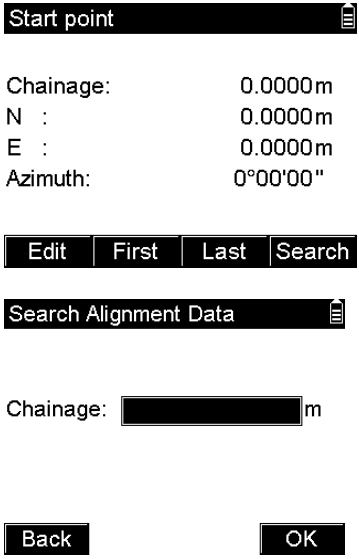
In **{Road Define},** press **[2] 〈Edit H Alignment〉** to enter **{ Start Point }**.

[F1]【Edit】: Edit the current parameters displayed.

[F2]【First】: Turn to the first data of the road.

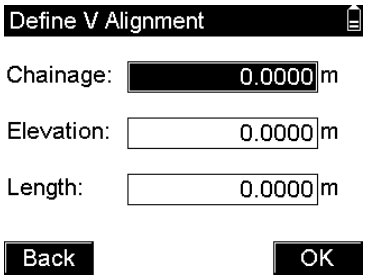
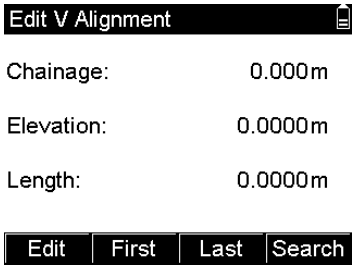
[F3]【Last】: Turn to the last data of the road.

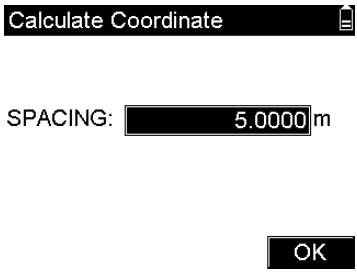
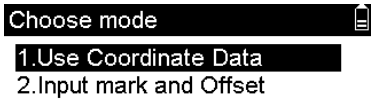
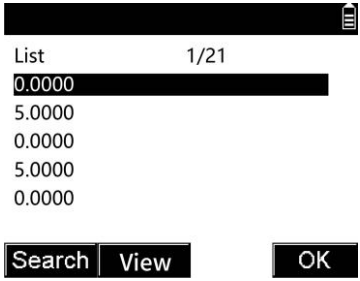
[F4]【Search】: Turn to the specified data by input the chainage.

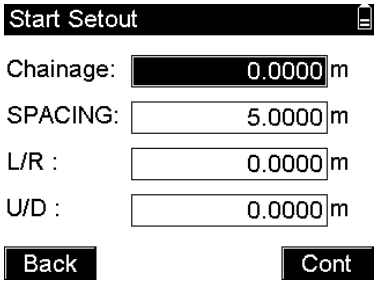


Define V Alignment:

A vertical alignment consists of a series of intersections, including a chainage, elevation and curve length. The length of start point and end point must be zero

In **{Road Define},** press **[3] 〈Define V Alignment〉** to enter **{ Define V Alignment }**. Input〈chainage〉、〈elevation〉and〈length〉(curve length.)。 **[F1]【Back】**: Exit without saving data. **[F4]【OK】**: Save data, enter the next input page.	
Edit V Alignment: You can edit the V Alignment data that saved before.	
In **{Road Define},** press **[4] 〈Edit V Alignment〉** to enter **{ Edit V Alignment }** **[F1]【Edit】:** Edit the current parameters displayed. **[F2]【First】**: Turn to the first data of the road. **[F3]【Last】**: Turn to the last data of the road. **[F4]【Search】**: Turn to the specified data by input the chainage.	
Calculate Coordinate: You can calculate the coordinates and elevation of the road center line, when you get the h alignment and v alignment inputted. The elevation of the road center line will be 0 when v alignment not exist.	

In **{Road Define},** press **[5] 〈Calculate Coordinate〉** to enter **{ Calculate Coordinate}** .Press **[ENT]** to start calculating. Each calculation will overwrite the previous data. 〈SPACING〉: You need to enter the chainage interval, and the chainage interval parameter must be greater than zero.	
Road Setout: Use Coordinate Data or Input mark and Offset to preform road setout.	
In **{Road },** press **[2] 〈Road Setout〉** to enter **{ Choose mode }** .	
Use Coordinate Data: Use the coordinate calculated to setout	
In **{ Choose mode },** press **[1] 〈Use Coordinate Data〉** to enter chainage list. [F1]【Search】: search data by input chainage. [F2]【View】:check the highlighted data. [F4]【OK】: choose this data to perform setout.	
Input mark and Offset: Input chainage and offset to identify target point and perform setout.	

In **{ Choose mode },** press **[2] 〈Input mark and Offset〉** to enter **{Start Setout}.** 〈Chainage〉: The chainage of the starting point. 〈SPACING〉: Chainage interval 〈L/R〉: Offset, the rightside is positive, the leftside is negative 〈U/D〉: Elevation difference, Higher than the central line is positive, lower than the central line is negative. 〈L/R〉 and 〈U/D〉 can be 0 to set out the central line. Press[F4]【Cont】to enter **{Angle SO 1/3}.**	

Use **[▲] [▼]** to switch angle setout,chainage setout or coord setout.

〈dHR〉: The HA offset. When the 〈dHR〉 is 0°00'00", it means that the direction of staking out is correct

〈dHD〉: Longitudinal offset.

〈HDc〉: Longitudinal offset between target point and station

〈dChainage〉: The difference in chainage between target point and current point.

〈dOffset〉: The offset between target point and current point.

〈HDm〉: Longitudinal offset to the station.

〈dX〉: Coordinate N difference.

〈dY〉: Coordinate E difference.

〈dz〉: Elevation difference.

Key assignment:

[F1]【Meas】: Aim at the target point then press to measure it.

[F2]【hr】: Input the prism height.

[F3]【Rec】: Record the measurement result.

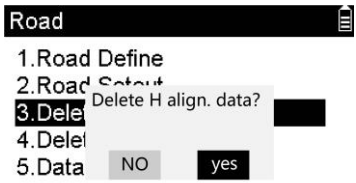
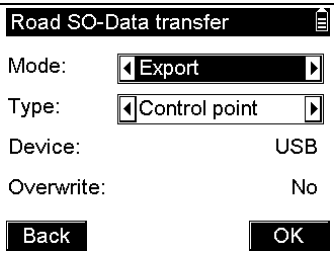
[F4]【P1/2】: to 2nd page of softkeys.

2nd page of softkey

[F1]【Back】: Back to **{Start Setout}.**

[F2]【List】: Display the list of record.

[F3]【Coord】: Display the coordinate of target point.

[F4]【P2/2】: to 1st page of softkeys.	
Delete Horizontal/Delete Vertical	
In **{Road },** press **[3] 〈Delete Horizontal〉** to delete h aligment; Press **[4] 〈Delete Vertical〉** to delete v aligment. Use [◀] [▶] choose 【YES】/ 【NO】,Press [ENT] to confirm.	
〈Delete Horizontal〉 will delete the records that calculated before at the same time.	
Data Transfer: Import H aligments or export the records of setting out.	
In **{Road },** press **[5 〈Data Transfer〉** to enter **{ Road SO-Data transfer}.** 〈Mode〉: 〈Import〉: Transfer data from USB Stick to total station, this operation is only applicable to known data (control point and horizontal alignment data); 〈Export〉: Transfer data from total station to USB Stick. 〈Type〉: 〈Control point〉 : Points with chainage and elevation. 〈Road SO result〉 :Road set out results. 〈H alignment〉 :Cross point or element. 〈Overwrite〉: 〈Yes〉 :Will delete previous data.	

〈NO〉:Will Create a new FILE without overwriting previous data.	

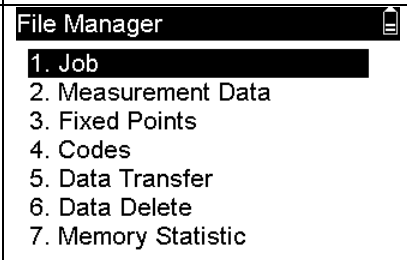
Import may delete previous data, you must export the data you inputted before.

When you import data from USB Stick to total station, you need to place the FILEs in the “Road” folder. FILEs contain h alignments must be named ”Road-E” ,FILEs contain control points must be named ”Road-C”.All the FILEs are TXT FILEs.

The use of USB Stick please refer to **{Data Transfer}**

5.FILE Management

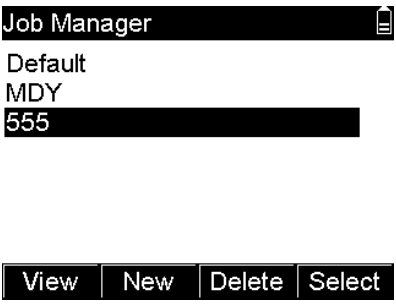
The FILE manager provides management functions for checking, editing and transmitting data in the instrument.

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select 〈**FILE**〉and press **[ENT]**, or simply press the numeric key **[6]** to enter **{FILE Manager}**.	

5.1.Job Management

Jobs are like folders of different types of data, e.g., measured points, fixed points, codes, calculated results, etc.

All the various data of the instrument are stored in jobs. And all applications must work based on a job.

Operation	Interface
①In **{FILE Manager}**press **[1]**〈**1.Job**〉to enter **{Job Manager}**. The workspace list all the jobs available. The current job will be highlighted. ②Use **[▲] [▼]** to highlight a job name and press **[ENT]** or **[F4]**【**Select**】to set it as the current job. **[F1]**【**view**】: Display the summary of the	

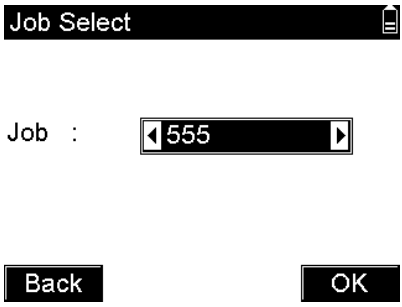
highlighted job. **[F2]【New】**: Create a new job. **[F3]【Delete】**: Delete the highlighted job. The current set job can not be deleted. **[F4]【Select】**: Selcet the highlighted job as current job.	

The system supports up to 30 jobs.

The job named〈**Default**〉is created automatically by the system.
New job definition consists of job name and user. The name is required. The system will automatically generate the number of records and the date/time of creation.

5.2.Measurement Data

The measurement data contains all the recorded data in the instrument internal memory. All the measurement data can be checked, searched or deleted.

Operation	**Interface**
①In **{FILE Manager}** press **[2]** 〈**2.Measurement Data**〉to enter **{Job Select}**. The current job will be selected by default. ②Use **[◀] [▶]** to toggle the jobs available. Then press **[ENT]** or **[F4]【OK】** to select one and enter **{Measured List}**.	

③Use **[▲] [▼]** to highlight a record and press **[ENT]** or **[F1]【View】** to display the detail information.

[F1]【view】: Display the drtail of the highlighted record.

[F2]【Search】: Enter **{Search}** to input a 〈**PointID**〉 then press **[F4]【OK】** to find the related records.

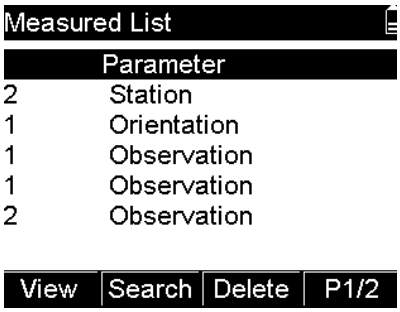
[F3]【Delete】: Delete the highlighted record.

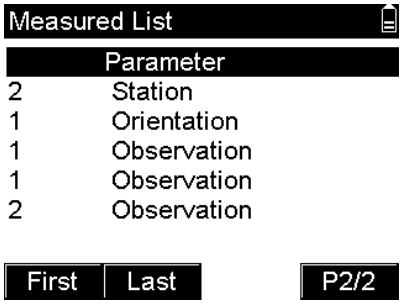
Press **[F4]【P1/2】**to 2nd page of softkeys,

[F1]【First】: Turn to the first page of the list and highlight the first record.

[F2]【Last】: Turn to the last page of the list and highlight the last record.

[F4]【P2/2】: Turn to the 1st page of softkeys.

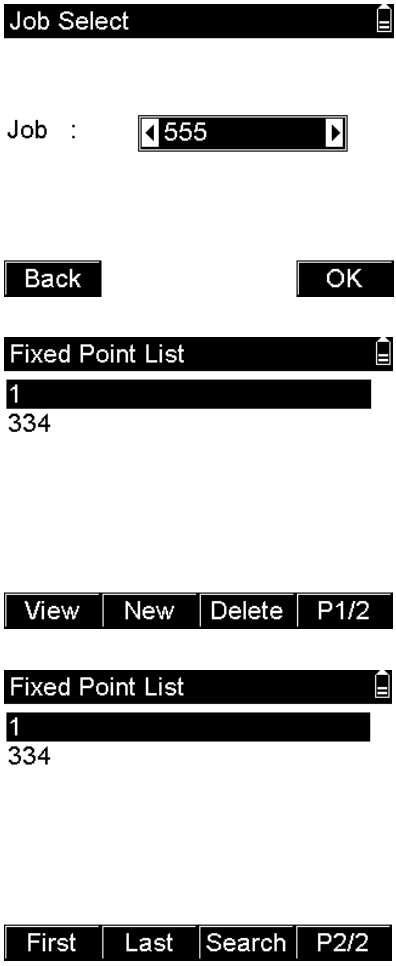




The record in **{Measured List}** list its name and type.

5.3.Fixed Points

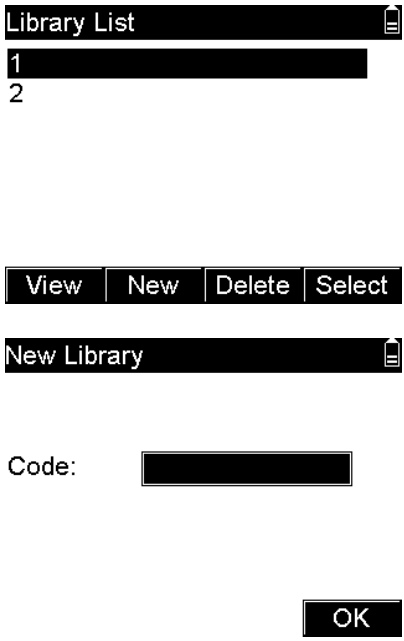
All the points created by importing or inputing are fixed points.

Operation	Interface
①In **{FILE Manager}**press **[3]〈3.Fixed Points〉** to enter **{Job Select}**. ②Use **[◀] [▶]** to toggle the jobs available. Then press **[ENT]** or **[F4]【OK】** to select one and enter **{Fixed Point List}**. The current job will be selected by default ③Use **[▲] [▼]** to highlight a point record and press **[ENT]** or **[F1]【View】** to display the detail information. ④When checking the detail of the fixed point record, press **[F4]【Edit】** to enter **{New Point}** then can modify it. **[F2]【New】**: Enter **{New Point}** to create a new fixed point. **[F3]【Delete】**: Delete the highlighted point record. Press **[F4]【P1/2】** to 2nd page of softkeys **[F1]【First】**: Turn to the first page of the list and highlight the first point record. **[F2]【Last】**: Turn to the last page of the list and highlight the last point record. **[F3]【Search】**: Enter **{Search}** to input a **〈PointID〉** then press **[F4]【OK】** to	

find the related point records. **[F4]【P2/2】**: Turn to the 1st page of softkeys.	
Valid fixed point record contain at least the **〈PointID〉** and the coordinates (**N**, **E**, **Z**).	

4.7. Codes

Codes can be defined manually. All the point can be recorded with a code. Codes help users to manage a large number of points in groups or categories.

Operation	Interface
① In **{FILE Manager}**press **[4]〈4.Codes〉** to enter **{Library List}**. ②Use **[▲] [▼]** to highlight a library. **[F1]【View】**: enter **{Code List}.** **[F2]【New】**: Enter **{New Library}** to create a new library. **[F3]【Delete】**: Delete the highlighted library. **[F4]【Select】**: Selcet the highlighted library as current library. **{Code List}** **[F1]【Last/First】**: Turn to the last/first page of the list and highlight the	

last/first code. **[F2]【Search】**: Enter **{Search}** to input a **〈Code〉** then press **[F4]【OK】** to find the related codes. **[F3]【Delete】**: Delete the highlighted code. **[F4]【New】**: Enter **{New Code}** to create a new code.	

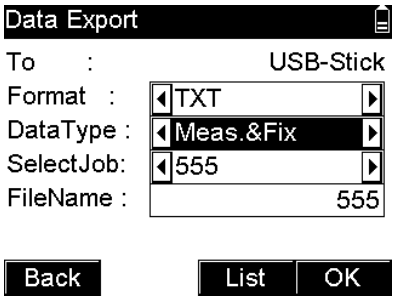
5.4.Data Transfer

The instrument has a USB port, which support USB storge device to perform data transfer. A qualified USB Stick is recommended.

Operation	Interface
In **{FILE Manager}**press **[5]** 〈 **5.Data Transfer**〉 to enter **{Data Transfer}**. Open the waterproof cover on the instrument's USB port and insert the USB flash drive into it, taking care of the orientation.	

Data Export:

Copy the data from the instrument internal memory to the USB Stick.

In **{Data Transfer}**press **[1]** 〈 **1.Data Export**〉 to enter **{Data Export}**. 〈**To**〉: Copy to USB Stick 〈**Format**〉: Select a FILE format which will be create. 〈 **DataType** 〉: The data type to be copied, **Measurement**, **Fixed Point** or both. 〈 **SelectJob** 〉: Select a job to be transfered. 〈**FILEName**〉: Input a FILE name which will be create. **[F3]【List】**: Enter **{Job Manager}** to select a job. **[F4]【OK】**: Perform the transfer. The data FILE will create and copy to the default folder named Jobs in the USB Stick.	

The system support four types data FILE format, **TXT**, **V100N**,

CASS,**SDR**,**POLAR**. **V100N** format is the specialized format for the data conversion tool "**OmecTools.exe**"

About "OmecTools.exe", refer to **11.3**.

When the 〈**Format**〉 is 〈**TXT**〉, Press **[F4]** 【 **OK** 】 will enter in **{Text Formatting 1/2}** to set the text formatting.

〈**Delimiter**〉: Choose how to separate the numbers within each row of point data, the options are **Comma**, **Spacing**, **Tab** and **Semicolon**.

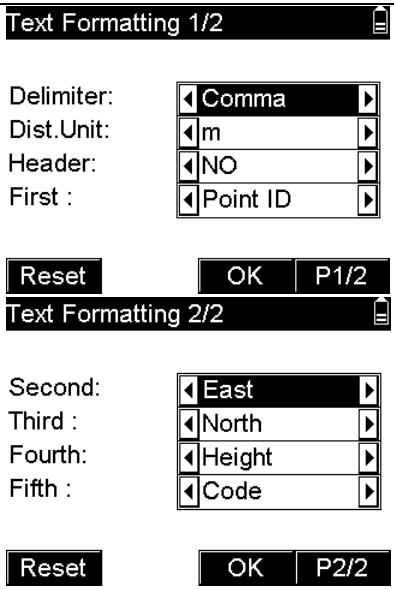
〈**Leng.Unit**〉: Select the unit of length for the point coordinates, options include **m**, **feet** etc.

〈**Header**〉: Whether to add a FILE header in the first row, i.e., a description of the meaning of each column of data.

〈**First…Fifth**〉: Defines the meaning of the text in each column, i.e., the sequence text meaning of a row of point data, optionally **Point ID**, **East**, **North**, **Height**, **Code**, **None**.

[F1] 【**Reset**】: Reset all options to default format.

[F3]【**OK**】: Perform the transfer. The TXT FILE will create and copy to the default folder named Jobs in the USB Stick.



Data Import:

Copy the data from the USB Stick to the instrument internal memory.

①In **{Data Transfer}**press **[2]〈2.Data Import〉** to enter **{Data Import}**.

②Press **[F4]【OK】** to enter**{Select FILE}**.

③Use **[▲] [▼]** to highlight a FILE and press **[ENT]** or **[F4]【OK】** to enter **{Define Job Name}.**

④The default job name is same as the FILE name. Job name can be re-defined manually. After defining the job name, Press **[F4]【OK】** to enter**{Text Formatting}**.

⑤The setting of formatting is same as the setting in TXT export. Set the sequence of point data following the FILE's text formatting. Then press **[F3]【OK】** to perform the transfer. The FILE data will copy to the defined job and all records will be created as fixed points.

Code Import:

Copy the code from the USB Stick to the instrument internal memory.

Operation	**Interface**

① In **{Data Transfer}** press **[3]** **〈3.Code Import〉** to enter **{Define codes}**.

②Press**[F4]【OK】** to enter **{Select FILE}.**

③Use **[▲] [▼]** to highlight a FILE and press **[ENT]** or **[F4]【OK】** to back **{Define codes}, 〈FILE name〉** will display the selected FILE name.

④Press**[F2]【Select】** to perform the transfer.

The instrument automatically searches the data FILEs in the Jobs folder in the root directory of the USB Stick. The import FILE must have the extension "**TXT**".

Code FILEs must be stored in a folder named “Codes” in the root directory.

CAUTION As a media of measurement data, the USB Stick is an important equipment. Some important notes need to be followed when using it to avoid losing important measurement data or causing damage to the instrument or the USB Stick itself:

- We recommend the use of industry standard USB Sticks and cannot be held responsible for data loss or any other errors caused by users using non-standard USB Sticks.
- Avoid removing the USB Stick during import and export transfer.
- Too much data on the USB Stick may cause operation to lag.
- Both the USB port and the USB Stick need to be kept dry and clean. Any contact with liquids needs to be completely dry and clean before operation.
- Avoid dropping the USB Stick or giving it a violent shock.
- Store and use the USB Stick within the specified temperature range.


About the temperature range refer to **10. Technical Data**.

5.5.Data Delete

Delete jobs, or delete part of data in a job.

Operation	Interface

①In **{FILE Manager}**press **[6]** 〈**6.Data Delete**〉 to enter **{Data Delete}**.

②Use **[▲] [▼]** to highlight a item then use **[◄] [►]** to toggle the options available.

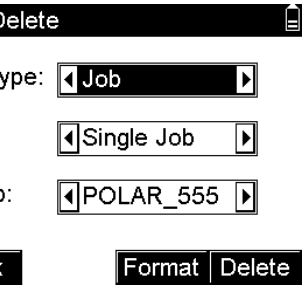
〈 **DataType** 〉 : The datatype to be deleted, can be **Job**, **Measurement** or **Fixed Point**.

〈**Job**〉 : Select **Single Job** or **All Jobs** to operate.

〈 **SelJob** 〉 : If above **Single Job** was actived, a job name can be selected.

[F4]【Delete】: Erase the data selected by above options.

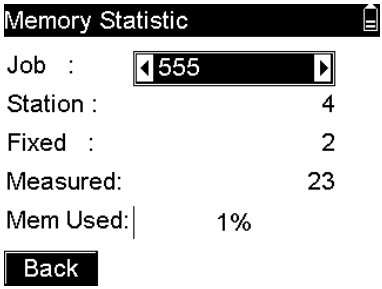
[F3]【Format】 : Erase all the data in internal memory.



Data deletion is not recoverable, please execute with caution.

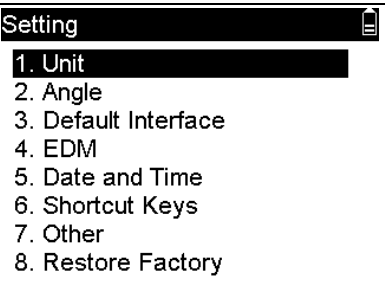
5.6.Memory Statistic

Summary the data by different jobs in the internal memory.

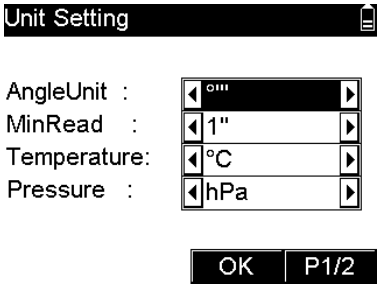
Operation	Interface
In **{FILE Manager}**press **[7]〈7.Memory Statistic〉** to enter **{Memory Statistic}**. **〈Job〉**: Use **[◀] [▶]** to select the job to be summaried. **[F1]【Back】**: return to the previous interface.	

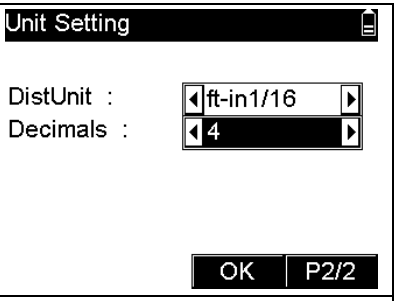
6.Instrument Settings

All customisable parameters and options for the instrument and system can be configured in the instrument settings.

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select **〈4.Setting〉** and press **[ENT]**, or simply press the numeric key **[4]** to enter **{Setting}**.	

6.1.Unit Settings

Operation	Interface
①In **{Setting}** press **[1]** **〈1.Unit〉** to enter **{Unit Setting}**. ②Use **[▲]** **[▼]** to highlight a item then use **[◀]** **[▶]** to toggle the options available. ③Press **[F3]【OK】** to confirm the settings. ④Press**[F4]** **【P1/3】** Turn to the 2nd page.	



〈**AngleUnit**〉: Set the unit of angle.

° ′ ″ : 0°00′00″ – 360°00′00″

gon : 0gon – 400gon

mil : 0mil - 6400mil

° : 0° – 360°

〈**MinRead**〉: Set the mnimum reading of angle.

〈**AngleUnit**〉**° ′ ″** : **1**″/**5**″/**10**″

〈**AngleUnit**〉**gon** : **0.1**mgon/**0.5**mgon/**1**mgon

〈**AngleUnit**〉**mil** : **0.01/0.05/0.1**

〈**AngleUnit**〉**°** : **0.0001/0.0005/0.001**

〈**Temperature**〉:Set the unit of air temperature **℃/℉.**

〈**Pressure**〉: Set the unit of atmospheric pressure.

hPa/mbar/mmHg/inHg

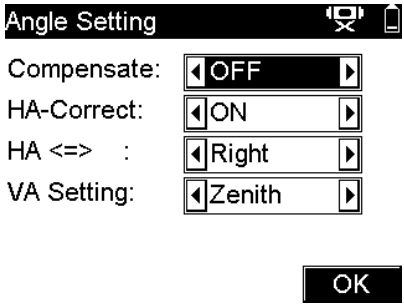
〈**MeasUnit**〉: Set the unit of Distance and coordinates.

m/US-ft (ft)/**INT-ft**(fi)/**ft-in1/16**

〈**Decimals**〉:Set the number of decimal places of Distance and coordinates.

3/4

6.2.Angle Settings

Operation	Interface
①In **{Setting}**press **[2]**〈**2.Angle**〉to enter **{Angle Setting}**. ②Use **[▲] [▼]** to highlight a item then use **[◀] [▶]** to toggle the options available. ③ Press **[F4]**【**OK**】to confirm the settings.	

〈**Compensate**〉:Set the function of tilt compensator.
2-Axes/OFF/1-Axis

Refer to **2.5 Tilt Compensation**

In the measurement interface of angle measurement mode, press **[F1]**【**Level**】of 2nd page of softkey to enter **{Level & Plummet}** to set the compensation. Press **[★]** in the measurement related interfaces also can select then enter **{Level & Plummet}**.

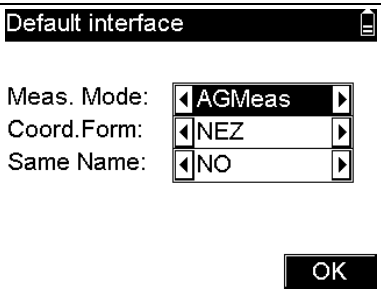
〈**HA-Correct**〉: Set the collimation error auto correction on HA.
ON/OFF

〈**HA <=>**〉: Set the incremental direction of the HA.
Right : HA increases on rotating clockwisely. The HA displays HAR.
Left : HA increases on rotating anticlockwisely. The HA displays HAL.

〈**VA Setting**〉: Set the mode of VA.
Zenith : The VA is 0 when aiming at the zenith.
HZ0 : The VA is 0 when aiming horizontally. Positive VA when rotated

upwards.
Slope % : Display the VA with slope in pecent. Positive VA when rotated upwards.

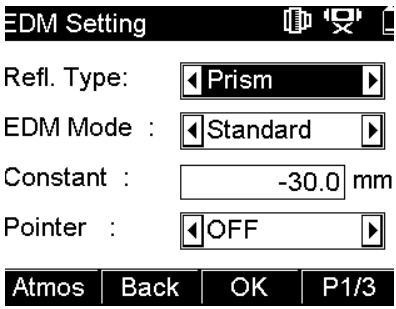
6.3.Default Interface

Operation	Interface
① In **{Setting}** press **[3]** 〈 **3.Default Interface**〉 to enter **{Default Interface}**. ②Use **[▲] [▼]** to highlight a item then use **[◀] [▶]** to toggle the options available. ③Press **[F4]【OK】** to confirm the settings.	
〈**Meas.Mode**〉: Set the first measurement interface after power on. **AGMeas** : Angle measurement interface. **DTMeas** : Distance measurement interface. **CoordMeas** : Coordinates measurement interface.	
〈**Coord.Form**〉: Set the display format of coordinates. **NEZ** : Coordinates order North, East, Height. **ENZ** : Coordinates order East, North, Height.	
〈**Same Name**〉: **YES**: Double names are allowed. **NO**: Double names are not allowed.	

6.4.EDM Settings

The EDM settings define the parameters related to Electronic Distance Meter, which can be set by the users according to the actual measurement needs and the environment.

CAUTION Any setting of the EDM parameters may have an effect on the actual Distance measurement data and thus affect the measurement results. Be careful when entering the parameters, and always check that the EDM settings are appropriate before the measurement is taken to avoid unnecessary errors in the results.

Operation	Interface
①In **{Setting}**press **[4]** **〈4.EDM〉** to enter **{EDM Setting}**. Press **[★]** in the measurement related interfaces then select **〈2.EDM Set〉** also can enter **{EDM Setting}**. ②Use **[▲] [▼]** to highlight a item then use **[◀] [▶]** to toggle the options available. ③ Press **[F3]** **【OK】** to confirm the settings. **[F3]【Back】:** return to the previous interface. **[F4]【P1/3】** Turn to the 2nd page of softkeys.	
〈Refl.Type〉 : Set the type of target on Distance measuring. **Prism** : The target is reflector prism. **Tape** : The target is reflector tape. **NonPrism** : The target is object itself, i.e., reflectless.	

〈**EDM Mode**〉: Set the mode of EDM working.

Standard : Fine mode, default high precision mode.

Fast : Fast mode with increased measurement speed but possibly slightly reduced accuracy.

Track : Continuous measuring mode.

Repeat : Repeat measuring until manually stop.

Average : After measuring defined times on standard mode, average the results.

〈**Constant**〉: Input the prism constant when 〈**Refl.Type**〉 is **Prism.**
The unit is mm and input range from -999.9 to 999.9.

〈**Pointer**〉: To emit a laser beam coaxial to the telescope, creat a visible red spot on the near target to indicate the current aiming point position
OFF/ON

[F1]【Atmos】: Enter **{Atmospheric}** to set the parameters related to atmosphere.

〈 **PPM** 〉 : Automatically calculated multiplying constant (mm/km, 10^{-6}) according on the parameters below.

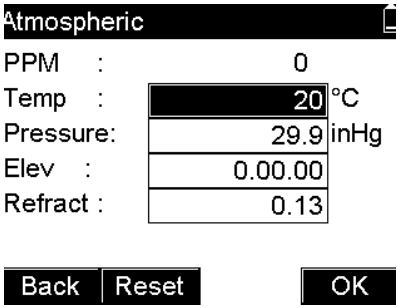
〈 **Temp** 〉 : The air temperature of measuring.

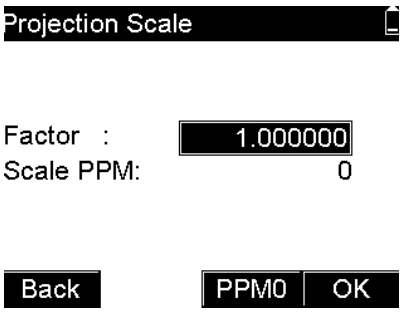
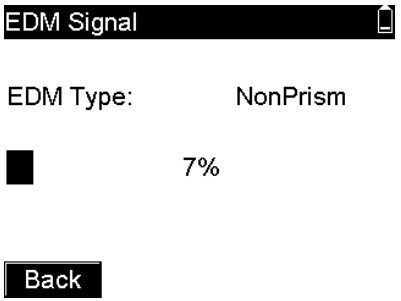
〈**Pressure**〉 & 〈**Elev**〉 : The local air pressure and elevation. Two values are linked, just set either one.

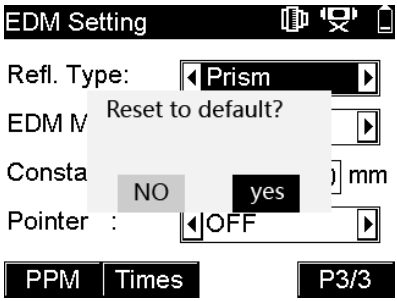
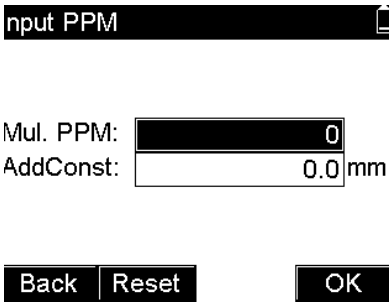
〈 **Refract** 〉 : Atmospheric refractive index.

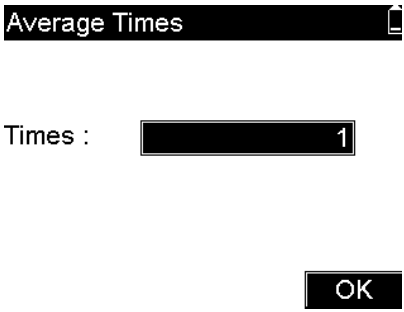
[F1]【Back】: return to the previous interface.

[F2]【Reset】: Reset all parameters in **{Atmospheric}** to default values.

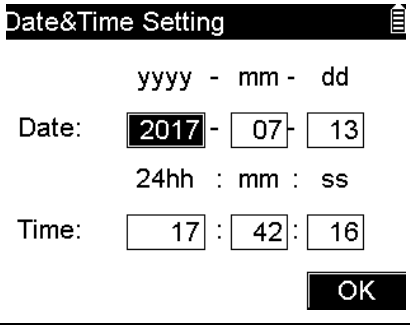


20℃, **1013.25hPa**, **0m**, **0.13** **[F4]【OK】**:Apply the settings and return to the previous interface.	
Distance measurements are directly influenced by atmospheric conditions on the laser path. Atmospheric corrections are required for precision Distance measurements and involved into the VD/HD calculations. Refer to **11.1**, **11.2**.	
2nd page of softkey **[F1]【Scale】**: Enter **{Projection Scale}**. **〈Factor〉**: Set the projection correct scale value. **[F1]【Back】:** return to the previous interface. **[F2]【PPM0】**: Reset the factor to default value 1. **[F4]【OK】** to confirm the setting.	
2nd page of softkey **[F2]【Signal】**: Enter **{Signal}** to test and display the EDM signal (reflected return light intensity) in steps of 1%. **[F1]【Back】:** return to the previous interface.	

2nd page of softkey **[F3]【Reset】:** Reset all EDM parameters in to default values.	
This function can help to improve the aim accuracy when the target prism cannot be accurately identified.	
3rd page of softkey **[F1]【PPM】**: Enter **{Input PPM}** to set additional multiplying and adding constants to correct the Distance result directly when necessary. **〈 Mul.PPM 〉**: Input a multiplying constant (mm/km, 10^{-6}) for Distance measuring. **〈 AddConst 〉**: Input an adding constant (mm) for Distance measuring. **[F2]【Reset】**: Reset all input values to 0. **[F4]【OK】** to confirm the input values.	

3rd page of softkey **[F2]【Times】**: Enter **{Average Times}** to set the number of measuring times of **〈EDM Mode〉 Average**. The default times is 3. **[F4]【OK】** to confirm the input value.	

6.5.Date and Time Setting

Operation	Interface
①In **{Setting}**press **[5]〈5.Date and Time〉** to enter **{Date&Time Setting}**. Set the data and time ②Use **[▲] [▼]** to highlight a item then input a new value. ③Press **[F4]【OK】** to confirm the settings.	

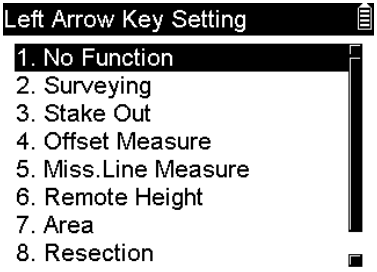
6.6.Shortcut Keys

Operation	Interface

①In **{Setting}**press **[6]〈6.Shortcut Keys〉** to enter **{Shortcur Keys}**. ②Use **[▲] [▼]** to highlight a item then press **[ENT]** to enter the setting.	

There are two shortcut keys whose functions can be defined by users.

Two shortcut keys are the arrow keys **[◀]** and **[▶]**. A key's function can be set as a one-click access application pre-defined. Eight applications can be selected.

For Example: ①In **{Shortcur Keys}** press**[1] 〈1.Left Arrow Key〉** enter **{Left Arrow Key Setting}**. ②Press **[7] 〈7.Area〉** to set the left shortcut key function as the application **Area**. ③In the measurement interface, press **[◀]** can directly enter **{Area Calculate}**.	

6.7.Other Settings

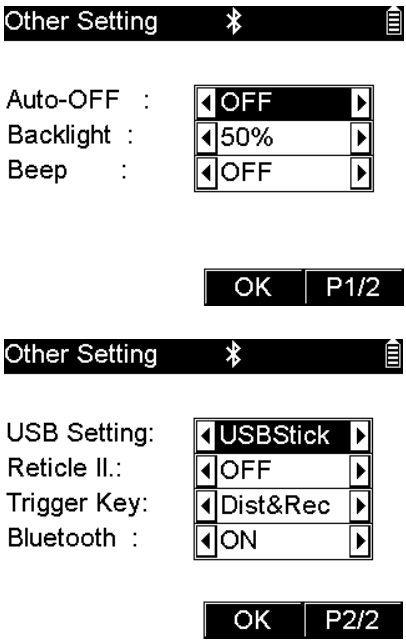
Operation	Interface

①In **{Setting}**press **[7]** 〈**7.Other**〉 to enter **{Other Setting}**.

②Use **[▲] [▼]** to highlight a item then use **[◀] [▶]** to toggle the options available.

③ Press **[F3]** 【**OK**】 to confirm the settings.

[F4]【**P1/2**】 Turn to the 2nd page of softkeys.



〈**Auto-OFF**〉: The instrument will automatically switch off after 15 minutes without any operation.

OFF : Inactive.

10/20/30 Min. : The instrument will automatically switch off after **10/20/30** minutes without any operation.

〈**Backlight**〉: LCD display brightness setting.

0% to **100%** in 10 steps.

〈**Beep**〉:Set the beep sound **ON** or **OFF**.

〈**USB Setting**〉: The default function of USB port is support USB Stick.

〈**Reticle Il.**〉: Switch the illumination for the reticle **OFF** or set a brightness level **G1-4**.

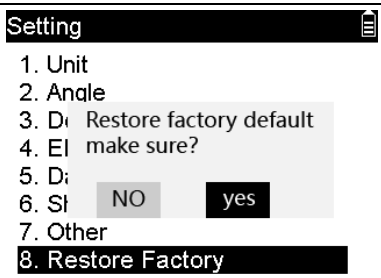
〈**Trigger Key**〉: Set the function of trigger key.

Meas : Touch the trigger key will trigger the function of softkey 【**Meas**】.

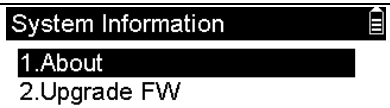
Meas&Rec : Touch the trigger key will trigger the function of softkey 【**All**】(【**Meas**】then【**Rec**】).

OFF : Inactive.
〈**Bluetooth**〉: Set the blurtooth function **ON** or **OFF**. **On** : ✱ will display on the status bar.

6.8.Restore Factory

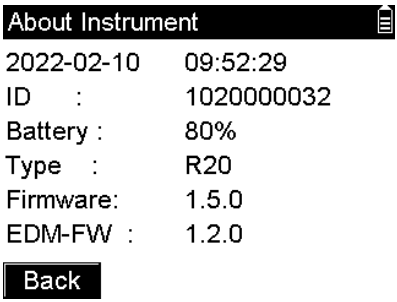
Operation	**Interface**
① In **{Setting}**press **[8]** 〈 **8.Restory Factory**〉. ②use **[◀] [▶]** to select **YES** or **NO** then press **[ENT]**. If choose **YES**, all the settings will be reset to default values or options.	
Restoring the factory settings does not delete any measurement data.	
To delete the data, refer to **5.6 Data Delete**	

Operation	**Interface**

①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select 〈**6.System**〉 and press **[ENT]**, or simply press the numeric key **[6]** to enter **{System Information}**.	

7.System Information

7.1.Instrument Information

Operation	Interface
① In **{System Information}**press **[1]** 〈**1.About**〉 enter **{About Instrument}**. Workspace displays the important information of the instrument and system.	
The first line will show the current date and time of the instrument, which will need to be set if there are inaccuracies. Refer to **6.5**.	
〈**ID**〉: Each instrument will have a unique 10-digit serial number.	

〈**ID**〉should be the same as the serial number on the product label.
〈**Battery**〉: The remaining battery capacity in reference percent value.
Due to various environmental conditions and different working modes, the remaining battery capacity is only a reference value and cannot accurately indicate the remaining operating time of the instrument.
〈**Type**〉: The type of the instrument.
〈**Firmware**〉: The current firmware version number of the instrument.
〈**EDM-FW**〉: The current firmware version number of the EDM.

7.2.System Upgrade

The instrument can add applications or enhance performance by updating its firmware. The laterest version of firmware is always recommended.

Operation	**Interface**
① In **{System Information}**press **[2]** 〈**2.Upgrade FW**〉enter **{Upgrade FW}**. ②Use **[▲] [▼]** to highlight a item then press **[ENT]**.	Upgrade FW 1. Mainboard FW 2. EDM FW 3. LCM FW 4. BOOTLOADER FW

CAUTION The firmware upgrade is a very important operation and needs to be done with care. The instrument must not be powered down or switched off during the upgrade. The battery needs to be at least 30% charged before uploading and the data in the instrument should be

properly backed up.

Upgrade Procedure:

①Copy the correct firmware FILE to the root directory of the qualified USB Stick.

②Insert the USB Stick securely into the USB port of the instrument.

③Enter the **{Upgrade FW}**, use **[▲] [▼]** to highlight a correct type FW then press **[ENT]**.

④A confirming warning message pops up，**【YES】** is highlight，then press **[ENT]**.

⑤ A power warning message pops up，**【YES】**is highlight，then press **[ENT]**.

⑥The instrument automatically updates the firmware. The beep sound continus till the upgrade end. The display will go down for a period of time during this period.

⑦After a successful firmware update, the instrument will automatically reboot.

8.Calibration

About Calibration

Some error checking and calibration operations can be carried out by the user in the field by running calibration procedures. These procedures need to be carried out carefully and correctly. The detailed procedure is described in the following sections.

The instrument is factory calibrated to exacting specifications, but rapid temperature changes, vibrations or impacts may cause unexpected deviations and a reduction in the accuracy. The user is advised to check and calibrate the instrument frequently.

In the following cases it is highly recommended to check the instrument:

- Before using the instrument for the first time.
- Before each high-precision measurement operation.
- After a bumpy or long transport.
- After long periods of storage.
- After a violent and accidental impact or after falling over.
- The difference between the current temperature and the temperature at the time of the last calibration is greater than 10°C.

In addition to the instrument errors described in this section, some other errors can be calibrated by professional operation. But the calibration process must be carried out either at the factory or an authorised workshop by specialist staff with specialist equipment. Any self-adjustment or calibration will result in unpredictable instrument failure or accuracy problems.

8.1. HZ-collimation and V-index

HZ-collimation

The HZ-collimation (C) is an error due to the fact that the CA of the instrument is not perpendicular to the TA. In the plane formed by the CA and the TA, the angle between the perpendicular line of the TA through the centre of the instrument and the CA is the HZ-collimation Error (C).

Determine the HZ-collimation:

①Set up the tripod and instrument stable.

② Power on the instrument. Precisely level the instrument under the electronic level indication of **{level & Plummet}**.

③In face I, accurately aim at a target about 100m away whose height was similar as the instrument. Record the HA_L.

④Turn to face II, accurately aim at the same target again. Record the HA_R.

⑤$C = (HA_L - HA_R \pm 180°)/2$.

⑥If $|C| > 8''$, a program calibration is required.

V-index

When the VA (Zenith 0) is 90°0′0″, ideally the CA should be precisely perpendicular to the SA. And the actual deviation that exists is the V-index (i).

Determine the HZ-collimation:

①Set up the tripod and instrument stable.

② Power on the instrument. Precisely level the instrument under the electronic level indication of **{level & Plummet}**.

③In face I, accurately aim at a target about 100m away whose height was similar as the instrument. Record the VA_L.

④Turn to face II, accurately aim at the same target again. Record the VA_R.

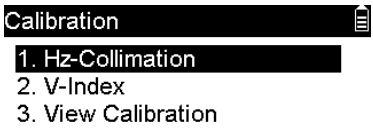
⑤I = (VA$_L$ - VA$_R$ - 360°) / 2. ⑥ If | i | > 10", a program calibration is required.

8.2. Program Calibration

The built-in calibration program can calibrate the following instrument error:

- **Hz-collimation**
- **V-index**
- **Zero error** of the tilt compensator

While calibrating the **V-index**, the instrument will simultaneously calibrate the **Zero error**.

Operation	Interface
①In the measurement interface, press **[M]** to enter **{Main Menu}**. ② Use the navigation keys to select 〈**5.Calib**〉 and press **[ENT]**, or simply press the numeric key **[5]** to enter **{Calibration}**.	

CAUTION Before calibrating the instrument error, the instrument needs to be accurately levelled under the electronic level indication of the **{level & Plummet}** interface.

The relationship between the tribrach, tripod and the ground must be stable and avoid any vibration and impact throughout the procedure.

The instrument must be acclimatised to the ambient temperature before the calibration. The acclimatisation time is approximately 2 minutes for

every 1°C difference in temperature from the storage environment to the working environment. The total minimum acclimatisation time is at least 20 minutes. During the whole procedure the instrument must be protected from direct sunlight which can cause overheating on one side of the instrument.

The procedure for calibrating the HA-colimation and the V-index is the same and requires accurate double-faced observation. During the calibration, the instrument interfaces give clear operating instructions that the user can follow to complete the operation.

Calibration Procedure:

① Set up the tripod and instrument stable.

② Power on the instrument. Precisely level the instrument under the electronic level indication of **{level & Plummet}**.

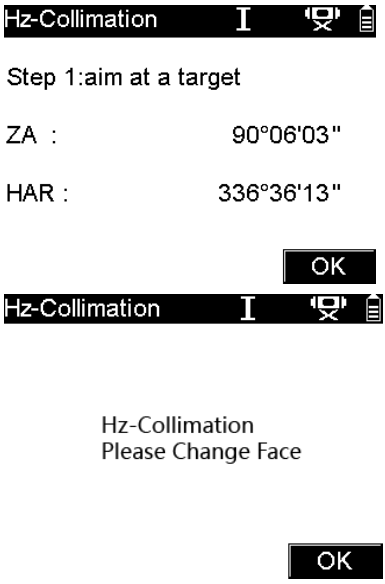
③ Enter in **{Calibration}** then choose **〈1.Hz-collimation〉** or **〈2.V-index〉** to begin a calibration program.

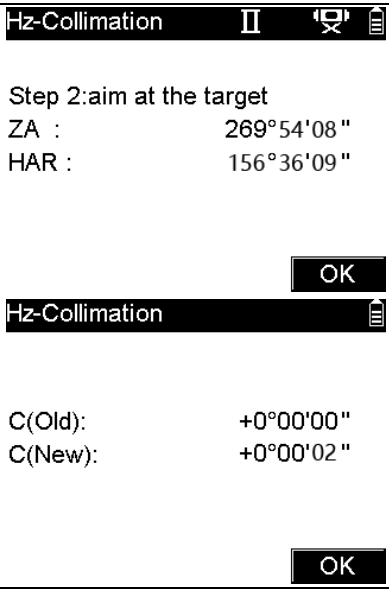
④In face I, accurately aim at a target about 100m away whose height was similar as the instrument. Press **[F4]【OK】**.

⑤Turn to face II, accurately aim at the same target again. Press **[F4]【OK】**.

⑥Workspace display the new calculated error value and the old value stored.

⑦Press **[F4]【OK】** to confirm the calibration.





In the last calculated value interface, Press **[ESC]** can quit the calibraton and retain the old parameters.

During the calibration process, the program may pop up a message warning if the operation does not comply with the specifications.

Item	Description
〈VA not suitable for calibration〉	The VA was too far off 90°, or aiming deviation was too big in face II.
〈HA not suitable for calibration〉	Aiming deviation was too big in face II.
〈Out of tolerance! Retained〉	The calculation result is exceeded tolerance due to improper operation; the instrument will retain the original set value.

8.3. Mechanical Check and Adjust

Check and Adjust the Instrument Tubular Level and Tribrach Circular Level

①Set up the tripod and instrument stable.

②Power on the instrument. Precisely level the instrument under the electronic level indication of **{level & Plummet}**.

③The bubbles of the tubular level and the circular level should stop right at the centre.

④If not, use the adjusting pin to adjust related screws till the bubbles was at the center.

Check the Laser Plummet

①Set up the tripod and instrument stable. The instrument height is about 1.5m.

②Power on the instrument. Level the instrument under the electronic level indication of **{level & Plummet}**.

③In **{level & Plummet}**, adjust the brightness level of the plummet laser to project a clear spot on the ground. Mark the center of the spot.

④Slowly rotate the instrument horizontally one turn, observe the displacement of the centre of the laser spot.

⑤If the displacement is in a clear circular motion and the diameter of the track circle exceeds 3 mm, a calibration is required.

The plummet laser spot should be checked on a bright, flat horizontal surface (e.g., on a piece of white paper). The size of the laser spot is related to the condition of the projected surface and the ambient brightness. The average laser spot diameter is approximate 2.5mm when the instrument is 1.5m high.


The laser plummet calibration needs to be carried out by an authorised service centre.

9. Care and Transport

9.1. Storage

Storage of the Instrument

The instrument is a precision instrument. In order to ensure the function and accuracy , when not in use for a long period of time, the instrument needs to be stored in a dry place without direct sunlight and within a certain temperature range.

About the temperature range refer to **10. Technical Data**.

Especially in hot weather when instruments need to be stored in transport vehicles such as cars, it is important to be aware of the limits of the temperature range.

Storage of the batteries

- The allowable temperature for storing batteries is -30 °C to +55 °C. The recommended temperature range for storing batteries is -20°C to +30°C in a dry environment.
- Within the recommended storage temperature range, batteries full charged can be stored alone for one year.
- The batteries should be removed from the instrument or charger before storing.
- The battery must be fully recharged again before use after long-term storage.

Always keep batteries away from wet conditions. Wet or waterlogged batteries must be completely dried and checked for proper appearance and voltage before storage and use.

9.2. Transport

Field Manual Transport

- Place the instrument in its original transport case. Carry it properly by hand or use the original carrying strap.
- Alternatively, by keeping the robust mounting and upward, the instrument can be carried with the tripod's legs splayed across on the shoulder.

Collisions and drops of instruments are avoided wherever possible to ensure the safety of persons and instrument.

Transportation by Transport
(car, train, ship, plane, etc.)

When transporting, the transport case must be used. Place the instrument in the case and fasten it securely so that the body of the instrument is not subjected to violent shocks and vibrations.

When instruments are transported during hot or cold seasons, it is important to note the temperature range restrictions. After long Distance transport, the instrument needs to be checked and calibrated according to the operating instructions before the instrument can be used.


Refer to **8. Calibration**.

Battery Transport

National and international regulations and guidelines must be followed when transporting batteries. Or contact your local shipping company for related information before shipping.

9.3. Cleaning and Drying

Surface of Objective and Eyepiece

- Do not touch the optical surfaces with your hands or other hard objects at any time.
- Blow the dust off the lens and prisms before cleaning.
- For cleaning use only a clean soft lens wiping cloth, lens paper, cotton swabs etc. If necessary, use pure water or pure alcohol to moisten them.

Do not use other liquids as they may damage the instrument parts.

Fogging of Glass Surface

If the temperature of the lens is lower than the ambient temperature then it will tend to fog up. Generally, do not wipe, it can be left for a period of time, so that it slowly adapts to the surrounding temperature, the fog will generally disappear on its own.

Drying the Instrument

If the instrument or accessory has been slightly exposed to moisture or water, it can be left in a dry environment at a temperature not exceeding 40 °C for a period of time. After complete drying, the surface should be cleaned.

Always place the instrument in its case and close the cover when not in use in the field.

Cables，Plugs and Charger

Keep clean and dry at all times. When not in use, can wipe with a clean, dry cloth.

Do not use water or wiping tools with water to clean electrical accessories.

10. Technical Data

Item	Specification
Telescope	
Magnification	30×
Image	upright
Objective aperture	44mm
Focusing	1.7m (5.6 ft) to infinity
Field of view	1°30′
Field of view at 100m	2.6m
Angle measurement	
Type	Absolute continuous
Accuracy (standard deviation)	2″
Display resolution ° ° ′ ″ mil gon	 0.0001/0.0005/0.001 1″/5″/10″ 0.01/0.05/0.1 0.1mgon/0.5mgon/1mgon
Distance measurement	
Type	Visible red laser, coaxial
Laser class Prism / Tape Non-Prism	 Class 1 Class 3R
Wavelength	685nm @25°C
Measuring system	Phase measurement
Laser spot	≤12mm x 24mm @50m
Distance measurement range (Cloudy, no fog, no heat shimmer, visibility above 40km)	

Prism mode Standard prism	 3500m
Non-prism mode (Kodak white card, Reflectivity 92%)	800m
Accuracy (standard deviation)	
Prism mode (Standard prism) Standard Fast / Track	 2mm+2ppm 5mm+2ppm
Non-prism mode (Kodak white card, Reflectivity 92%)	 3mm+2ppm @ 5~200m 5mm+3ppm @>200m
Time per Distance measurement	
Prism mode Standard Fast Track	 0.8 s 0.5 s 0.3 s
Non-prism mode	⩾0.3 s
Level sensitivity	
Tubular level	30″/2mm
Circular level	8′/2mm
Compensator	
Type	2-axis optoelectronic circular level
Location	Coaxially mounted on the vertical axis
Setting range	±4′
Setting accuracy	3″
Laser plummet	
Location	Coaxially mounted in the vertical axis
Laser spot	2.5mm (1.5m)
Laser class	Class 2

Accuracy	1.5mm (1.5m)
Display and keypad	
LCD	320×240 Pixels, colour
Backlight	LED, adjustable
Number of keys	24
Battery	
Type	Lithium-ion
Voltage	7.4V
Capacity	3350mAh
Operating time	20 hours
Charger	
Inpute	100-240V AC
Charge time	4 hours
Memery and interface	
Memory	>80,000 data blocks
USB	USB Host 2.0
Bluetooth	Bluetooth 5.0
Environmental specifications	
Operating temperature	-20°C to +50°C
Storage temperature	-30°C to +55°C
IP rating	IP54
Dimensions	
Instrument Height Width Length	 365mm±5mm (include handle and tribrach) 200mm 172mm
Case (L×W×H)	N/A
Tilt axis height (Instrument center height) Without tribrach	 198mm

With tribrach	242±5mm
Weight	
Instrument weight (include battery and tribrach)	5.8kg
Carrying weight (with case and accessories)	10.5kg

11. Appendix

11.1. Atmospheric Correction

The Distance results measured by the instrument are correct only when corrected by the atmospheric correction value of ppm (mm/km, 10^{-6}). This scale correction value is calculated from the local meteorological parameters entered at the time of measurement. The atmospheric correction is related to factors such as atmospheric pressure and temperature.

For high precision Distance measurements, the atmospheric correction must be accurate to 1ppm , the relevant meteorological parameters must be redetermined at the time of the Distance measurement. The air temperature must be accurate to 1°C and the atmospheric pressure to 3hPa. The prevailing atmospheric parameters are entered into the instrument and the atmospheric correction for the Distance measurement is automatically calculated.

The instrument default parameters:

Air temperature **20 ℃**
Atmospheric pressure **1013.25 hPa**
Atmospheric correction **0 ppm**

Atmospheric correction formula:

$$\mathbf{kPT} = 279.097 - 0.29528 \times \mathbf{P} / (1 + 0.0036 \times \mathbf{T})$$

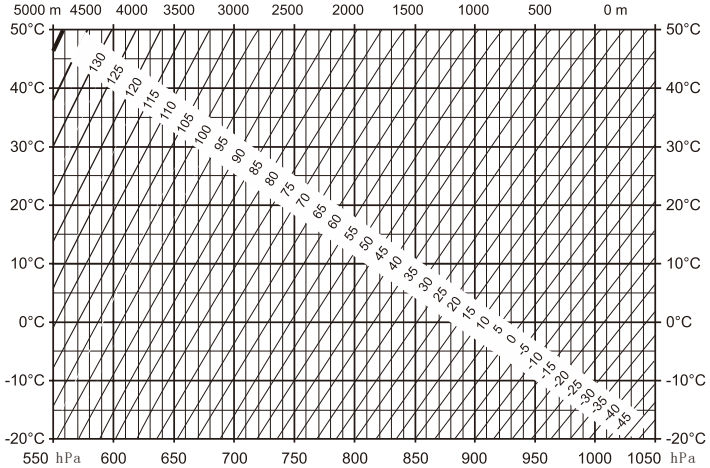
kPT: atmospheric correction (ppm)
P: pressure (hPa)
T: temperature (℃)

SD = **SD**$_0$ × (1 + **kPT**)

SD$_0$: original slope Distance

SD: corrected slope Distance

Atmospheric correction values can be conveniently found on the atmospheric correction chart below. The temperature is read on the horizontal axis of the chart and the pressure on the vertical axis, the value on the diagonal of its intersection is the atmospheric correction value.



For Example:

The air temperature is **+15 ℃**

The atmospheric pressure is **1013 hPa**

From the chart, the atmospheric correction is about **-5 ppm**

11.2. Refraction and Earth Curvature Correction

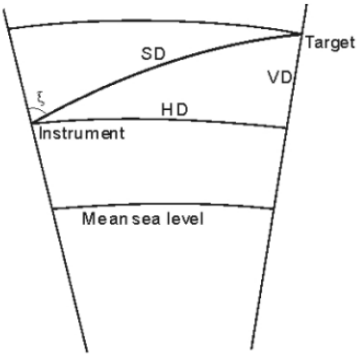
Considering the correction of refraction and earth curvature for Distance measurement, the formula for SD, HD and VD applied in the instrument are as followings:

HD = **Y** - **A** × **X** × **Y**

VD = **X** + **B** × **Y**^{2}

HD: corrected horizontal Distance

VD: corrected vertical Distance



Y = **SD** × | sin **ξ** |

X = **SD** × cos **ξ**

SD: corrected slope Distance

ξ: the **ZA** (zenith 0)

A = (1 – **k** / 2) / **R**

B = (1 – **k** / 2) / 2**R**

k: atmospheric refractive index, default **0.13**

R: average radius of the earth **6.37 × 10**^{6} m

11.3. Data Transfer and Formats

USB Stick

The USB Stick can be used to exchange data between the instrument and other devices such as computers, and for firmware upgrades.

The USB Stick is supplied with the instrument with a capacity of 4GB and supports up to 32GB. Please use our standard USB Stick or a qualified USB Stick.

The USB Stick can be inserted into the USB port of the instrument to export and import data such as measurement points, fixed points, etc. It is also used to upgrade the firmware of the mainboard, EDM etc. by copying the firmware FILE onto the USB Stick.

Bluetooth

The instrument is equipped with Bluetooth 5.0.

The instrument can be used as a Bluetooth slave device to communicate with Bluetooth-enabled mobile phones, pad, notebooks and other master devices for wireless data exchange and operation control.
The standard Bluetooth test app, **TPS Assistant.apk**, is available on the root directory of the USB Stick provided with the instrument. It can be copied to an Android device and installed to test the functionality of the Bluetooth. First, open the **TPS Assistant**, find the Bluetooth name (instrument serial number) and click on it to enter the following interface.

The instrument Bluetooth also supports some measurement software for mobile phones or pad, please contact our technical support if you have any relevant requirements.