RUIDE

USER MANUAL

RQS

Version: EN.2020-02

PRECAUTIONS

Thank you for using RUIDE RQS Total Station.

Please read carefully through the User Manual before you switch on the product.

1. Do not collimate the objective lens directly to the sunlight without a filter.

2. Do not stare at the laser beam, or point the laser to the others' eye!

3. Do not store the equipment in extremely high or low temperature.

4. When the equipment is not in use, store it in the case to avoid dust and humidity.

5. If there is a great difference between the temperature in work field or store place, you should leave the equipment in the case until it adapts to the temperature of environment.

6. If the equipment has not been used for a long time, you should remove the battery for separate storage. The battery should be charged once a month.

7. When shipping the equipment, please place it in the carry case. The cushioned material should be used to cover around the case for support.

8. Clean the exposed optical parts by absorbent cotton or lens-paper only!

9. Clean the surface softly with a woolen cloth. If it gets wet, you should dry it immediately before switch-on.

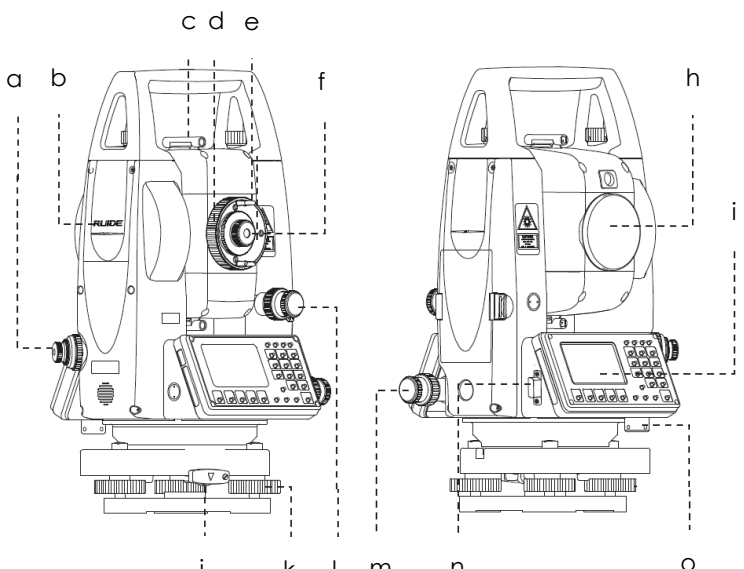
10. Please check the power-supply, functions, indications and parameters of the equipment goes well before operation.

11. Do not disassemble the total station by yourself. Please contact your authorized agency or RUIDE Service Team when you find the equipment abnormal.

MENU

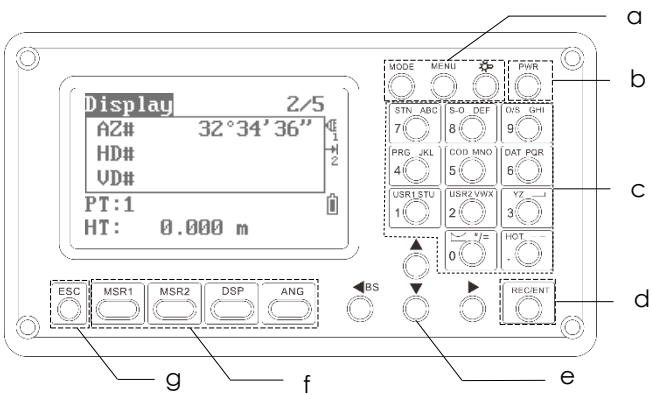
1. INTRODUCTION

1.1 INSTRUMENT COMPONENTS



a) Optical/Laser Plummet
b) Central Mark
c) Collimator
d) Telescope Focusing Ring
e) Eyepiece Focusing Ring
f) Eyepiece
h) Objective Lens
i) Display Unit
j) Tribrach
k) Leveling Screw
l) Vertical Tangent Unit
m) Horizontal Tangent Unit
n) Flash-disk Port
o) ATMOSense

1.2 KEYBOARD

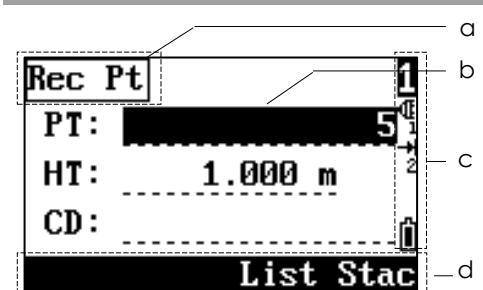


a) Fixed Keys
b) Power Key
c) Alphanumeric Keypad
d) REC/ENT Key
e) Navigation Key
f) Function Keys
g) ESC Key

Key	Description
MODE	Changes the input mode: alphabetic or numeric; or quick code mode.
MENU	Quick access to main menu.
☼	Illumination on or off.
PWR	On/Off key. Switches the instrument on or off.
Alphanumeric	Input text and numerical values. Quick-access to the page of Station/ Stake

Keypad	Out/ Offset/ Program/ Code/ Data/ User1/ User2/ E-bubble/ Hot-key, etc.
Navigation Keys	Controls the focus bar within the screen and the entry bar within a field.
REC/ENT	Accepts the input or records the data. In basic measurement display, press it for 1 second to select the data saving mode (CP or SS).
MSR1/ MSR2	Measure the distance under different modes. It can been predefined by yourself. Press it in 1s to view and change the measuring mode.
DSP	Shift the display. Press it for 1 second to launch customizing items.
ANG	Angle measuring menu. Set HA to 0; input or hold the HA value; Set F1/F2;
ESC	Escape to last page; Cancel the input.

1.3 SCREEN



The screen of RQS can be separate into four parts:

a) Title of this function
b) Active field on screen
c) Status icons
d) Softkeys (Function keys)

1.4 STATUS ICON

Icon	Description
A or 1	Input alphabets or numbers.
	Prism mode, Non-prism mode or reflective sheet under MSR1.
	Prism mode, Non-prism mode or reflective sheet under MSR2.
	Bluetooth on or off.
	The battery symbol indicates the level of the remaining battery capacity.

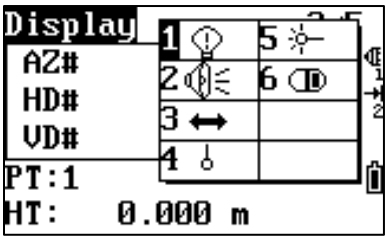
1.5 ABBREVIATION

Icon	Description
HA	Horizontal angle
VA	Vertical angle
SD	Slope distance
AZ	Azimuth angle
HD	Horizontal distance
VD	Vertical distance

Icon	Description
HL/HR	Horizontal left/ right
V%	Ratio of slope
N/E/Z	North/ East/ Elevation
PT	Point
HT	Height
CD	Code

Icon	Description
PPM	Atmospheric correction
P1/ P2	Point 1/ Point 2
HI	Instrument height
BS	Backsight point
ST	Surveying station

1.6 QUICK SET

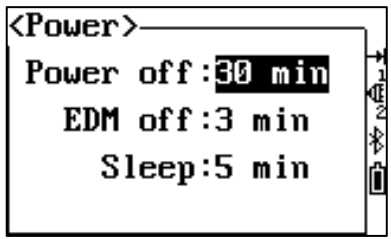


Press the key ☼ in any page to switch the LCD backlight ON and OFF.

Hold the key ☼ in 1 second under measure page to activate a quick setting menu for 1)backlight, 2)sound, 3)contrast, 4)laser plummet, 5)laser pointer.

Press **[▲], [▼]** or numeric key [1], [2], [3], [4], [5], [6] directly to choose the items. Click the numeric key again to switch on or off the selected function.

1.7 AUTO POWER OFF



In default, the equipment will shut down automatically if there is no operation in 30 minutes.

You can also change the setting of power off from [MENU]-3.SET-4.POWER.

2. OPERATION

2.1 PREPARATION

Unpacking

Lay down the case lightly with the cover upward. Unlock the case, and take out the instrument.

Storage of Instrument

Cover the cap, put the instrument into the case with the vertical clamp screw tightened and circular vial upwards (lens towards tribrach).

2.2 INSTRUMENT SETUP

Setting up the tripod

A. Loosen the screws on the tripod legs, pull out to the required length and tighten the screws.
B. Make the center of tripod and the occupied point approximately on the same plumb line.
C. Step on the tripod to make sure if it is well stationed on the ground.

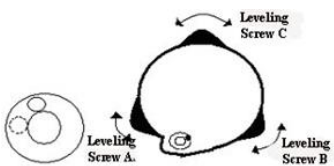
Instrument setup (Laser Plummet)

A. Place and lock the instrument carefully on the tripod
B. Turn on the instrument and activate the laser plummet. Hold the two legs which are not fixed on the ground and decide the position to fix according to the laser dot. When the laser dot is roughly on the station point, fix those 2 legs.

C. Leveling the instrument by circular vial.

a) Rotate the foot-screw A and B to move the bubble in the circular vial, in which case the bubble is located on a line perpendicular to a line running through the centers of the two leveling screw being adjusted .

b) Rotate the foot-screw C to move the bubble to the center of the circular vial.

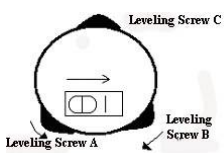


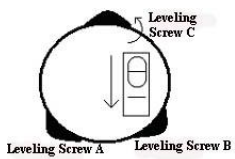
D. Precisely leveling by plate vial

a)Rotate the instrument horizontally by loosening the horizontal clamp unit and place the plate vial parallel to the line connecting rotating the foot-screw A and B, and then bring the bubble to the center of the plate vial by rotating the foot-screw A and B.

b) Rotate the instrument in 90° (100gon) around its vertical axis and turn the remaining leveling screw or leveling C to center the bubble once more.

c) Repeat the steps and check whether the bubble is correctly centered in all directions.





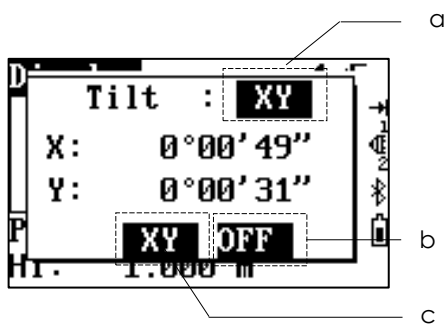
If the laser dot doesn't stay at the center position, please slightly loosen the screw under the tripod head and move the instrument (don't rotate the instrument) until the laser dot is on the station point. Tighten the screw and level the instrument again. Repeat these steps until the instrument is precisely centered and leveled.

Electronic Bubble

To ensure a precise angle measurement, you can also level the instrument by E-bubble.

RQS compensates the vertical angle reading as well as both vertical and horizontal angle reading due to inclination of the vertical axis in the X direction and XY directions.

Note: When the instrument is placed on an unstable stage or in a windy weather condition, the display of vertical angle is unstable. You can switch off the auto tilt correction function of vertical angle.



Activate it by pressing numeric key 0.

a) Current compensation on X or XY directions
b) Press **F3 [DSP]** to off the sensor
c) Press **F2 [MSR2]** to switch from X to XY

2.3 BATTERY

Inserting Battery

Put the battery into the instrument, push it. Check and insert it correctly to side into the housing.

Replacing Battery

Press the battery lock on both sides, remove the battery. When the remaining voltage is less than one grid, please stop your operation and charge it as soon as possible.

Before remove the battery from the instrument, make sure that the power is turned off. Otherwise, the instrument may be damaged.

Charging

The battery must be charged prior to using before the first time operation.

The battery LI-30 should be charged only by the official charger NC-III, which packed together with the instrument. Please connect the power supply in 220V, under 0°~±45°C.

When the indicator on the charger is red, the charging process has begun. When indicator turns green, the charging has finished. For safety, please pull out the battery and charger in time.

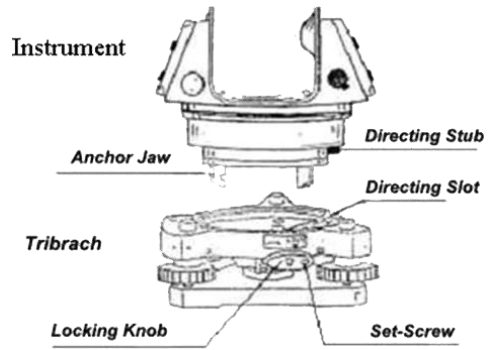
In order to get the maximum service life, please charge the battery at least once in a month.

Note:

a) *The operating time depends on the outside conditions, such as ambient temperature, charging time, the cycles of charging, etc. It is recommended for safety to charge the battery beforehand or to prepare spare full-charged batteries.*

b) *The remaining voltage of battery shows the power regarding to the current measure mode. The consumption of distance measurement is higher than angle measurement in normal. When switching the measurement mode from angle to distance in a low battery voltage, the equipment might be interrupted.*

2.4 TRIBRACH



Dismounting

If necessary, the instrument can be dismounted from tribrach. Turn the locking knob in 180° counter-clockwise to disengage anchor jaws, and take off the instrument.

Mounting

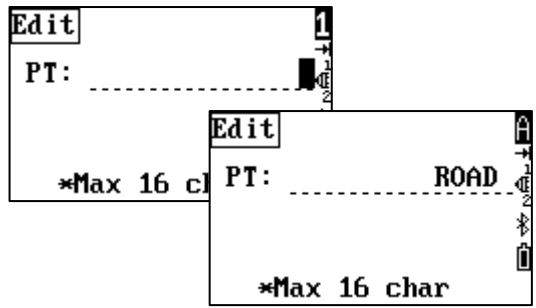
Insert three anchor jaws into holes of tribrach and line up the directing stub. Turn the locking knob about 180° clockwise to mounting the instrument.

2.5 EYEPIECE FOCUSING

Sight the Telescope to bright place and rotate the eyepiece tube to make the reticle clear. Roughly collimate the target by the top of the triangle mark on EDM cover.

Rotate the focusing screw on eyepiece to make the image clear.

2.6 INPUT MODE



When A is shown on the screen, you can input alphabets; When 1 is displayed, numbers can be input.

[MODE] Shift between alphabet and numeric.

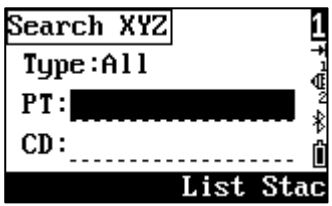
[◀BS] Delete the character at the left side.

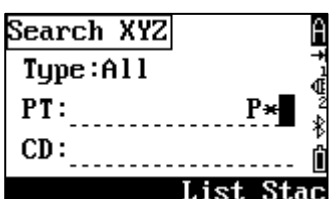
[▶] Modify the character until the cursor stay on the first character and twinkle.

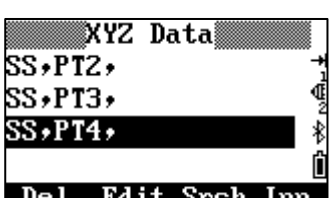
[ESC] Exit and restore previous value.

[REC/ENT] Confirm entry.

2.7 SEARCH VIA ASTERISK [*]







An asterisk [*] can be represented as a character that needs to be found.

The function of searching via the asterisk is useful when the point ID is unknown, and needs to be searched, or a series of points needs to be found.

Example:

* : All points of any length are found.

P : All points with exactly the point ID "P" are found.

P*: All points of any length starting with "P" are found (e.g.: P8, P71, PTST)

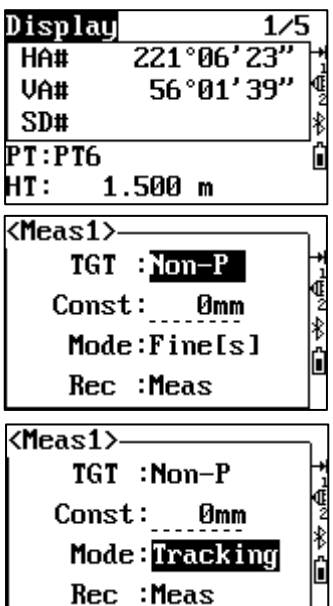
*1: All points of any length with a "1" as the second character are found (e.g.: T1, F15, A1R)

P*1: All points of any length with an "P" as the first character and a "1" as the third character are found.

3. MEASUREMENT

After setting up and switching on correctly, RQS Total Station is immediately ready for measuring.

3.1 F1/F2 [MSR1/MSR2] EDM SETTING



Press **F1[MSR1]** or **F2[MSR2]** for 1 second to enter the EDM setting page.

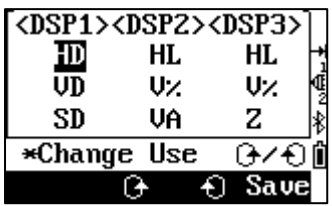
Press [▲] or [▼] to move to the cursor which needs to be modified, and press [◀] or [▶] to change the options.

TGT: Prism, non-prism or reflective sheet.
Const: Input prism constant directly (Scale: -999～999mm).
Mode: Fine[s], Fine [2] ([3]/ [4]/ [5]), Fine[r] and tracking.
Rec: Define the meaning of [REC/ENT] key, among Enter (save), All (measure & save) and Meas (measure).

After setting, press **[REC/ENT]** to save the setting and return to last page.

3.2 F3 [DSP] DISPLAY

Hold **F3 [DSP]** in 1 second under BMS(Basic Measurement Screen) to define your own display page.

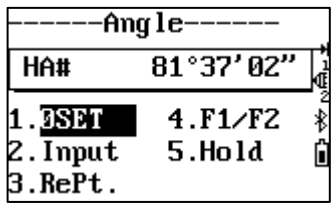


Press **[▶]/[◀], [▲]/[▼]** to select, and **F3** / or **F4** to switch the item among HD/ VD/ SD/ V%/ HL/ VA/ HA/ AZ/ Z.

Press **F4 [Save]** to save the modification.

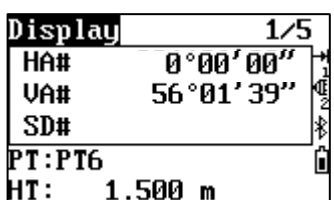
3.3 F4 [ANG] ANGLE

Press **F4 [ANG]** under BMS(Basic Measurement Screen) to activate the Angle Measurement Function.



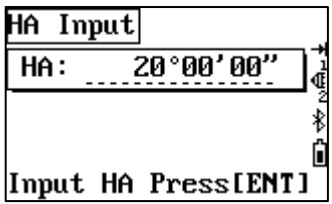
3.3.1 0 Set

Sets the horizontal angle as 0.

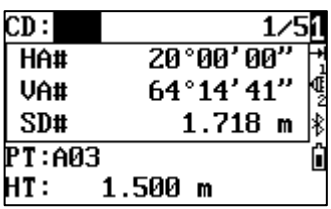


Press **[1] 0SET** to set horizontal angle as 0.

3.3.2 Input HA



(1)



(2)

Press **[2] Input** to enter into the page.

Input horizontal angle PIC(1), and then press **[ENT]** to confirm PIC(2)

3.3.3 Repeat Angle Measurement

This program is used to accumulate repeated angle measurement, displaying the sum of and average value of all observed angles. It records the observation times at the same time.

$$HR\overline{X} = HR\sum \div N$$

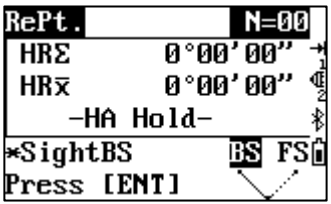
$$HA = BS\,A_z + HR\overline{X} \text{ (normalized)}$$

$HR\overline{X}$ will not updated even the instrument moved.

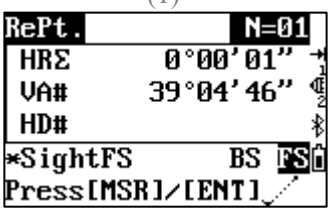
Note:

1) In repeat angle measurement, the HA is replaced by $HR\Sigma$ *, and the number of repeat angles is displayed (for example, N=6).*

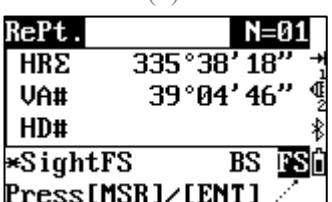
2) This function stores both raw and XYZ data as CP records.



(1)



(2)



(3)

Press **[3] RePt.** to enter the repeat measurement function. System sets the initial value of HR as 0 PIC(1).

Sight the first target point which used for repeat angle measurement. (i.e. Backsight), and press **[ENT]**

Use the horizontal tangent unit to sight the second target point (i.e. foresight), Here the horizontal angle is accumulated. PIC(2) Press **[ENT]** to save the horizontal angles.

Repeat steps to proceed this function as you need.

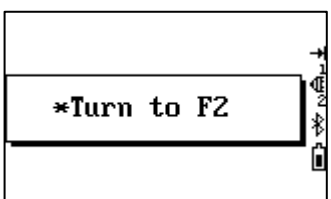
When you have collected enough horizontal angle results, press **[MSR1]** / **[MSR2]** to measure the foresight.

The average value of HA will be calculated. This value is fixed until the process is finished or cancelled. PIC(3)

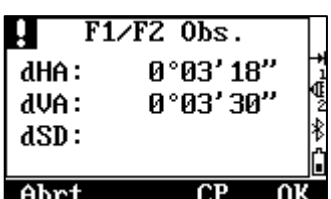
3.3.4 Face-1/Face-2

Using F1/F2 measurements effectively cancels out mechanical constant error to obtain maximum accuracy for measuring angles.

For the HA to be adjusted from a F1/F2 measurement, the Backsight must also have been measured in F1/F2 during the station setup.



(1)



(2)

Press **[4] F1/F2** to enter the repeat measurement function.

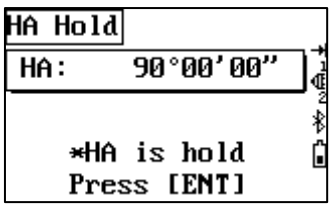
Aim at the target, press **[MSR1]**/ **[MSR2]** (can omit if not take a distance measurement).press **[ANG]** to enter the Angle menu, and then press [4] to enter F1/F2 function.

Rotate the equipment based on the guidance "Turn to F1" or "Turn to F2", then aim at the target again PIC(1).
Press **[ENT]**, program will calculate the observation value of F1/F2.

If you are satisfied with the result, press **F4[OK]**; otherwise press **F1[Abrt]**. PIC(2)

3.3.5 Hold HA

This section explains how to hold the horizontal angle reading.



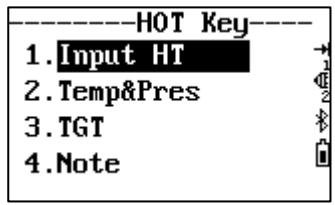
Press **[5] Hold** under the angle menu.

[ENT]: set the current value as horizontal angle.

[ESC]:cancel the process and return to the BMS.

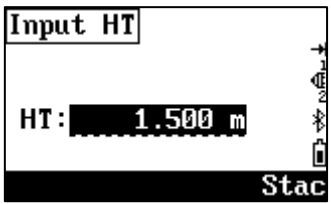
3.4 HOT. KEY

Hot key includes the setting of target height, temperature & pressure, target and note.



Press **[HOT./-+]** key, use **[▲]** or **[▼]** to move to the cursor or press the numeric key directly to choose the menu.

3.4.1 Target Height



Enter the target height by manual; or press **F4 [Stac]** to select from stack. The HT Stack stores the last 20 entered HT values.

Press **[REC/ENT]** to save the setting and return to last page.

3.4.2 Temperature & Pressure

Atmosphere Correction:

The speed of light in air is extremely fast. And it is not a constant, but changes with the temperature and pressure of atmosphere. Once atmosphere correction is set, this instrument can implement atmosphere correction automatically.

Even the instrument is powered off, the atmosphere correction value is still kept.

The formula of atmosphere correction: (unit: meter)

$$PPM = 273.8 - \frac{0.2900 \times \text{pressure value (hPa)}}{1 + 0.00366 \times \text{temperature value (°C)}}$$

If the pressure unit is mmHg: 1hPa = 0.75mmHg

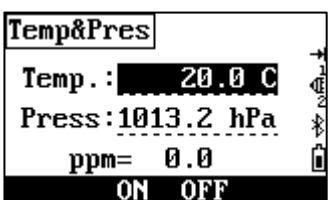
When disregarding atmosphere correction, set PPM value to 0.

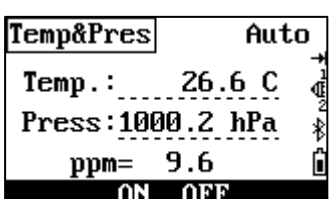
Standard atmospheric condition of Total Station RQS (i.e. the atmospheric condition that the atmosphere correction value of the instrument is 0):

Pressure: 1013 hPa

Temperature: 20°C

Enter the ambient temperature and pressure, the PPM value can be updated automatically.





By Manual Input:

Input the value※ manually and press **[REC/ENT]** , **[▲]** or **[▼]** to move to next item. Press **[REC/ENT]** to confirm.

RQS will calculate the atmosphere correction value [2)], and back to last page automatically.

By ATMOSense:

Press **F2 [ON]** to activate the ATMOSense function, which will detect and fill the Temp and Press automatically

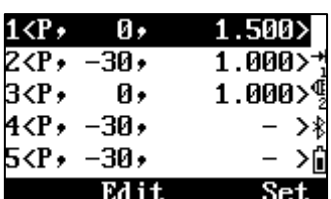
※ The inputting range:

Temperature:-40 - +60° C (step length 0.1° C) or -40 - 140° F (step length 0.1° F)

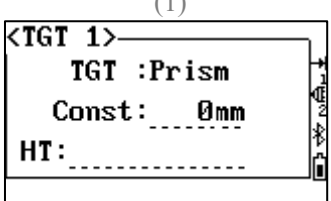
Pressure: 420 - 799.5mmHg (step length 0.1mmHg) or 560 - 1066 hPa (step length 0.1hpa), 16.5 - 31.5 inchHg (step length 0.1 inchHg)

3.4.3 Target Constant

TGT included the settings for the target type (Prism/Non-prism/Sheet), constant (-999mm ~ +999mm), and target height (-9999.999 - 9999.999mm).



(1)



(2)

Select a target by numeric key (from 1 to 5), or **[▲]/[▼]** in the list and press **[REC/ENT]** or **F4 [SET]** to confirm PIC(1).

Or change the constant PIC(2) of selected target by pressing **F2 [Edit].**

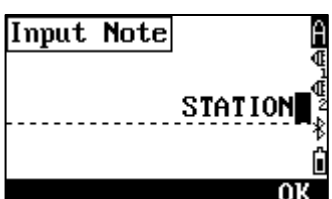
When the constant was selected, the type and settings are copied to the settings under both [MSR1] and [MSR2].
HT can be left blank in the target set, the current HT value will applied to the measurement.

3.4.4 Note

This function can be used at any time on any observation screen.

Each note can be record in max. 50 characters. The note is stored as a code in raw data.

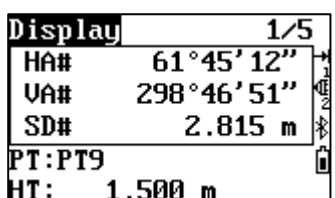
Press **[REC/ENT]** or **F4 [OK]** to confirm.



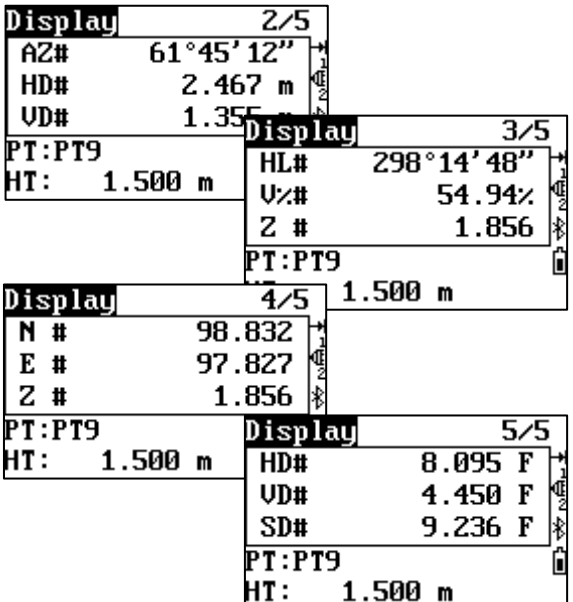
3.5 START SURVEY

After finishing all settings, you can start surveying. Please don't forget to set the job, station and backsight azimuth before measurement.

Collimate to the center of target prism, press **F1 [MSR1]** or **F2 [MSR2]**.



The result is displayed in 5 pages including all data of routine survey.
Press **F3 [DSP]** or **[▲]/[▼]** to switch and view.



Note: Settings that relate to corrections (T-P, Sea level, C&R) are included in the job settings. These settings are job-specific. Changing of any item will create a new job or shut off all jobs.

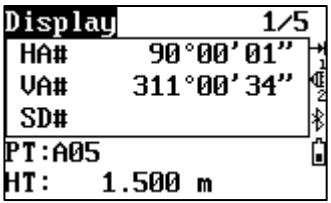
3.6 QUICK CODE

Quick Code let you shoot and record points with featured codes on the field.

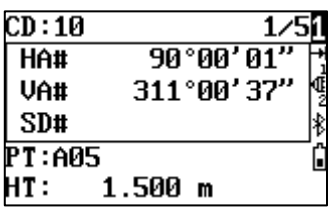
The predefined code can be called up directly via numeric keypad on the instrument.

A total of 256 quick codes can be assigned in R2. Each code can be assigned a unique number by one/ two/three digits.

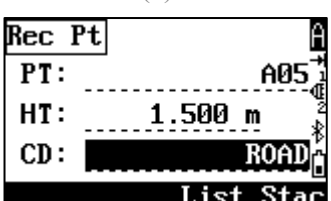
If the number isn't allocated to any codes, R2 will select the code in accordance with the order in which the codes were entered in the code list (e.g.: 01->: first code in the list. 10-> tenth code in the list).



(1)



(2)



(3)

In BMS (Basic Measurement Screen)PIC(1), press **[Mode]** to on or off the Quick Code function

Input the numeric code number of Quick Code, such as 10 PIC(2), and then press **[ENT]**. RQS will search the related code in the internal code list.

Press **[MSR1]/[MSR2]** for measurement. The founded code will called up, shown as CD PIC(3).

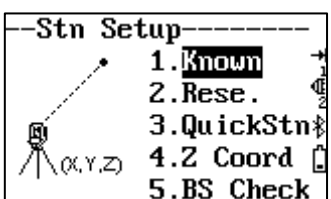
If the quick code corresponding to the code doesn't exist in internal memory, it will display "Code no exist"

Note: About editing Quick Code, please refer to "11.4.5 Code List"; users can upload and download codes from PC, please refer to "Appendix A 3: Code List".

4. STATION SETUP [Key - 7]

Each coordinate computation relates to the currently set station.

Press 7. under BMS to activate the Station Setup menu.

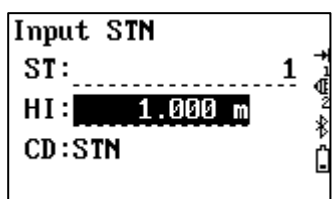


Note: Please set the station by known points before surveying and stake out.

4.1 BY KNOWN POINTS

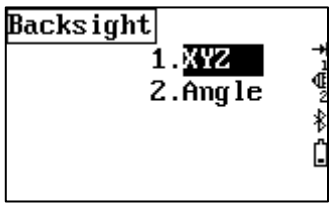
Press **[1] Known** in Stn Setup menu.

Input or select the station with point name, instrument height of station, then press **[ENT]** to confirm.

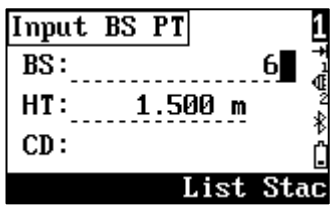


There're two methods to set the backsight point: one is by the coordinates, the other is by the angle.

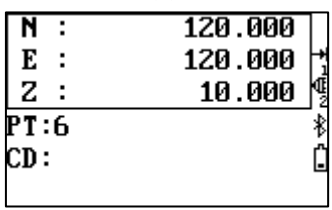
4.1.1 Set the Backsight by XYZ (Coordinate)



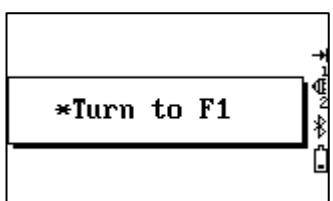
(1)



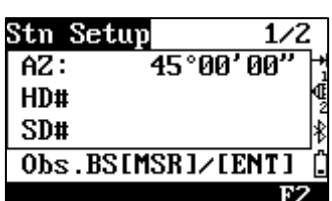
(2)



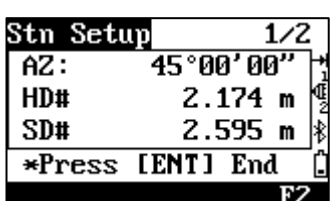
(3)



(4)



(5)



(6)

Press **[1]** to select the XYZ coordinates. PIC(1)

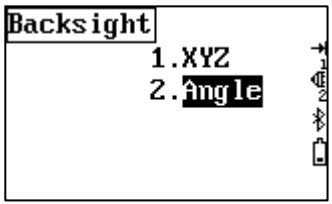
Enter the point name, target height and it's coordinate PIC(2), or select a point from the data list PIC(3) as the backsight, press **[ENT]** to confirm.

Sight the backsight on Face-1 PIC(4), press **[MSR1]** / **[MSR2]** to measure the point with HA/ VA/ SD PIC(5).

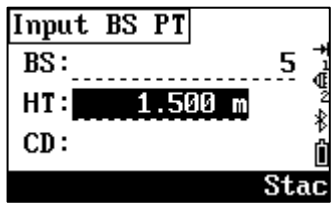
If it is necessary for you to double check the backsight, press **F4 [F2]** to observe the point again.

Otherwise, please press **[ENT]** to finish the station set-up PIC(6).

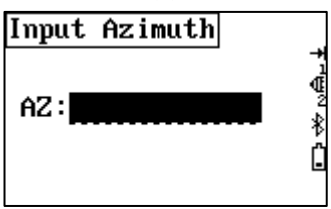
4.1.2 Set the Backsight by Angle (Azimuth)



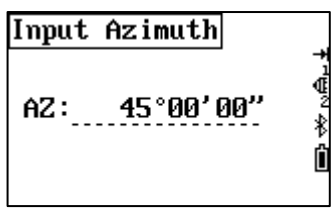
(1)



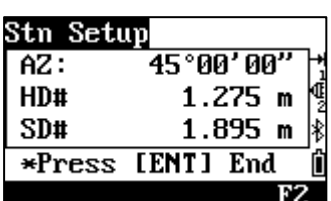
(2)



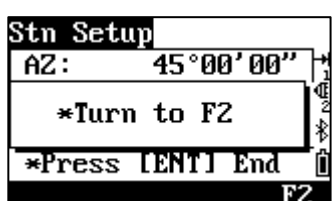
(3)



(4)



(5)



(6)

Press **[2]** to select the angle. PIC(1)

Enter the point name, target height PIC(2), and azimuth angle PIC(3) as the backsight, press **[ENT]** to confirm PIC(4).

Sight the backsight on Face-1, press **[MSR1]** / **[MSR2] or [ENT]** to measure the point with HA/ VA/ SD PIC(5).

If it is necessary for you to double check the backsight, press **F4 [F2]** to observe the point again PIC(6).

Otherwise, please press **[ENT]** to finish the station set-up.

4.2 RESECTION

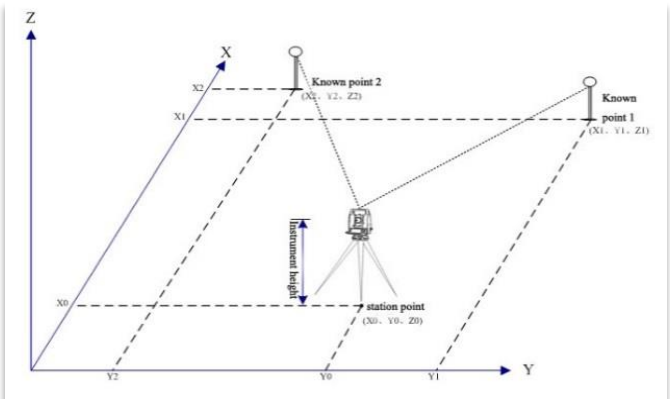
A resection sets up the station by using angle/distance measurements to known points.

--- Support maximum 10 points in a resection.

--- Measurements can be distance & angle, or angle only.

--- Calculation starts automatically when enough measurements are taken.

--- Delete poor observation points and recalculate if necessary.

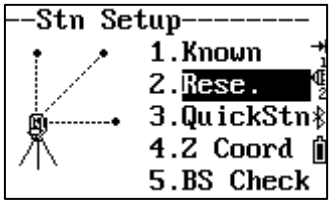


Note:

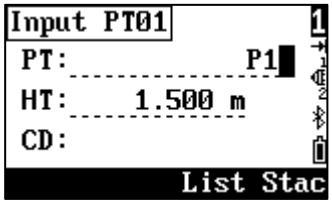
1) If the distance or angle between known points are extremely acute, the result will be less reliable. Please select the known points (or station points) that are widely spaced.

2) The calculation required at least three angle shots, or two distance shot.

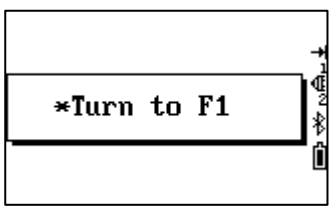
3) Basically, station will calculated from distance-measured data. If no distance has been measured, then Stn-Z is calculated using angle-only measurements to known points with 3D coordinates.



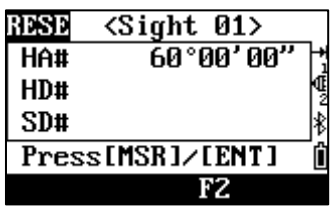
(1)



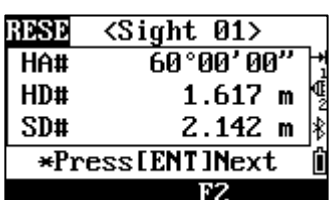
(2)



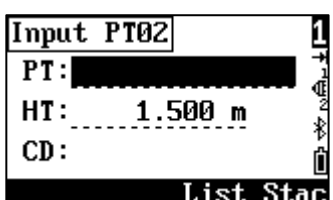
(3)



(4)



(5)



(6)

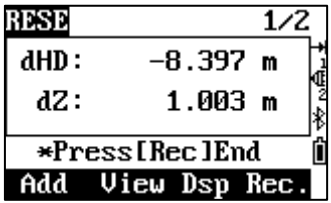
Press **[2] Rese.** in Stn Setup PIC(1)

Input the name, height and coordinate for first target PT01, then press **[ENT]** PIC(2)
If the equipment is in Face-2, it will show "Turn to F1" PIC(3).

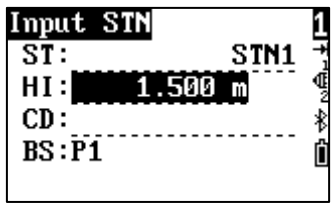
Sight the center of first target, press **[MSR1]/[MSR2]** to measure the distance PIC(4). Press **[ENT]** if only need angle measurement.

Press **[ENT]** to confirm, or remeasure the point in face-2 by **F3[F2]** PIC(5)

Repeat the steps PIC(6) until the station point has been calculated.



(7)



(8)

F1[Add]: add the extra points.
F2[View]: check or delete points.
F3[Dsp]: switch the dialog box.
F4[Rec.] to record the station.

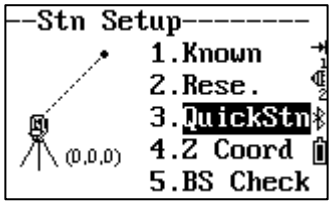
Press **[ENT]** PIC(8) to input or select name, height, code and BS point.

4.3 QUICK STATION

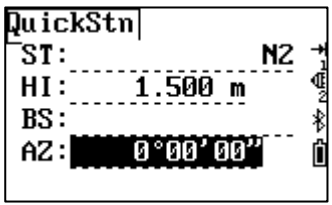
Setting up the station quickly without coordinates。
The station point (ST) in this function defaults to a new point number. For the new point, MP (0, 0, 0) is stored as the coordinates. When the ST is manually changed to a known point name, the station is set up on the coordinates of the known point.

Even if both ST and BS are known points, this function does not calculate the backsight angle (AZ) automatically.

Note: To calculate the AZ between two known points (ST and BS), use [Stn Setup]→[1.Known].



(1)



(2)

Press **[3]QuickStn** to enter the page of quick station PIC(1).

Input the point name and height of station and press **[ENT]**. The default name is increased from the last recorded point

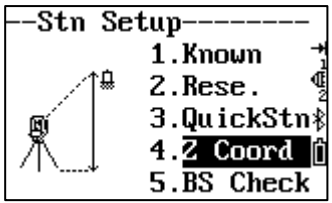
The backsight point and azimuth can keep in blank or input by manual PIC(2).

To complete the station setup, sight the BS and press **[ENT]**.

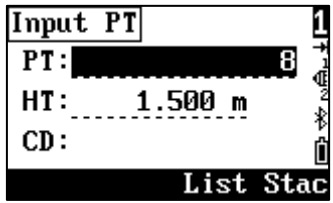
4.4 Z COORDINATE

This function, also can be called as Height Transfer function. It can correct the height of the instrument from the measurement of target points with known height, in two faces. After measuring, the height of station will be updated.

Note: Please complete the station setup before you use the Z Coordinate function.

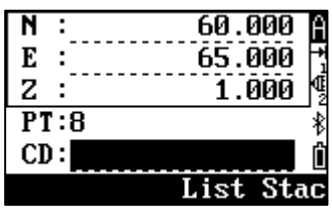


(1)

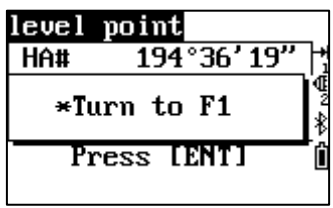


(2)

Press **[4] Z Coord** to enter the height transfer function PIC(1).



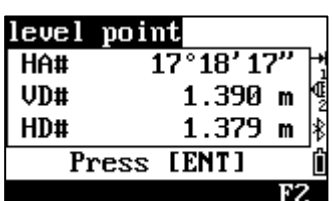
(3)



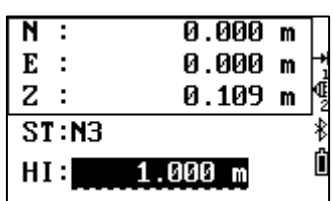
(4)

Input level point PIC(2), it's coordinate PIC(3) and target height, press **[ENT]**

Aim at the target, then press **[MSR1]/ [MSR2]** to measure.
If the equipment is in Face-2, it will show "Turn to F1" PIC(4).



(5)



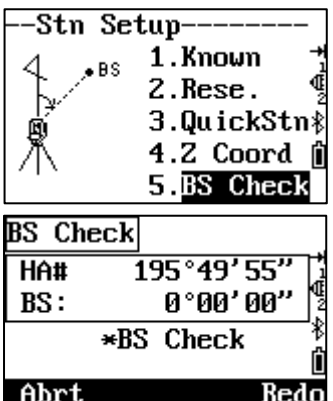
(6)

Press **[ENT]** to confirm, or remeasure the point in face-2 by pressing **F3[F2]** PIC(5)

The station height is updated. You can change the value or press **[ENT]** to record the updated station PIC(6).

4.5 BACKSIGHT CHECK

Press **[5] BS Check** to enter the function. Aim at the backsight.



F4[Redo]/[ENT]: Reset the horizontal angle.

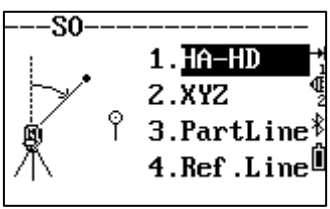
F1[Abrt]/[ESC]: Cancel operation.

5. STAKE OUT [Key - 8]

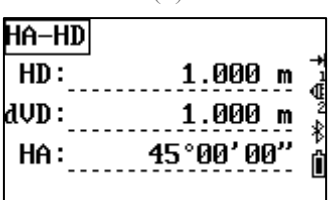
Press 8.  under BMS (Basic Measurement Screen) to activate the Stake Out menu, by angle & distance, coordinate, part line or reference line.

5.1 HA-HD

Stake out the points from memory or manually entered, by angle and distance.



(1)



(2)

Press **[1] HA-HD** under stake out PIC(1).

Input the stake out values, press **[ENT]** to confirm PIC(2).

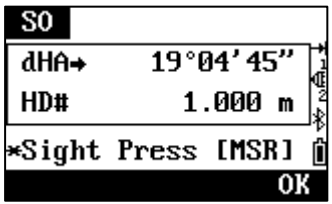
HD: Horizontal distance from station to stakeout point

dVD: Vertical distance from station to stakeout point

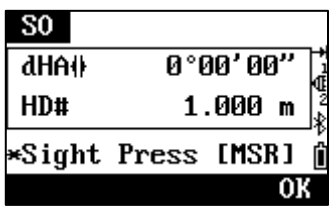
HA: Horizontal angle from station to stakeout point

Start to stake out the point PIC(3). Firstly, rotate the instrument until dHA becomes 0° 00'00" PIC(4).

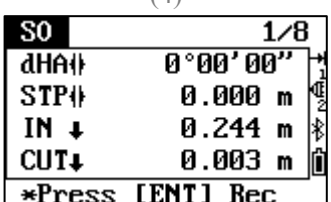
Secondly, aim at the target and press **[MSR1] /[MSR2]** to measure this point.



(3)



(4)



(5)

The differences between the target point and stake out point are displayed.

dHA: HA difference to stake out point
R/L: Right or left (Lateral error)
IN/OUT: Near or far from stake out point
CUT/FIL: Up or down from stake out point

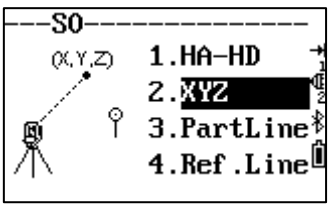
Move the target forward or backward according to guidance, repeat the measurement until the value of R/L and IN/OUT become 0 PIC(5).
It indicates that the current target is on the stake out point.

After staking out, press **[ENT]** to record the stakeout point. The point name can be changed or saved as default.

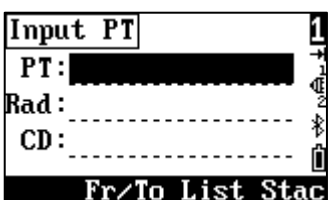
*Note: All observation results display in 8 pages, press [▼] or **F3[DSP]** to view all the data. Including the stake-out result; HA/VA/SD/HD/VD or the other data of target point.*

5.2 XYZ

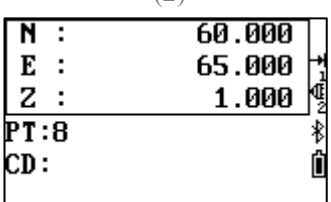
Stake out the points from memory or manually entered, by XYZ (coordinate).



(1)



(2)



(3)

Press **[2] XYZ** under stake out page PIC(1).

Input or select the point name PIC(2) and the coordinate of stake out point PIC(3); Or define the stake out point by radius.

PT: Point name, can be inputted or selected.

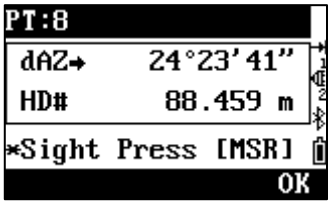
Rad: Radius from station to stake out point

CD: Code of stake out point.

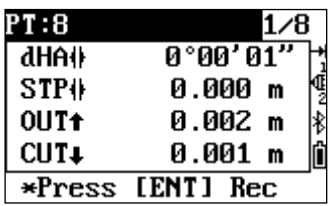
F2[Fr/To]: Select the existed point with coordinate by searching from internal memory. It will show the point list in this range.

F3[List]: Select the existed point name from memory

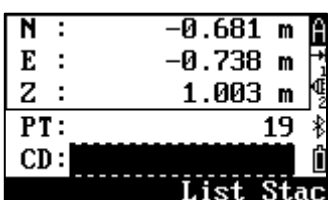
Screen displays coordinates of the selected point name.



(4)



(5)



(6)

Move and measure PIC(4) the target forward or backward according to guidance, repeat the measurement until the value, R/L and IN/OUT become 0 PIC(5).

After staking out, press **[ENT]** to record the stakeout point PIC(6). The point name can be changed or saved as default.

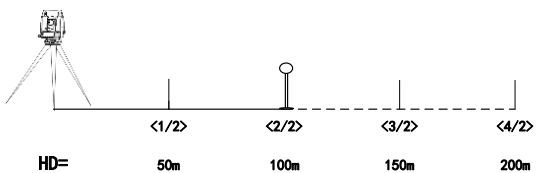
Note:

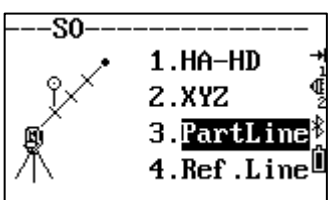
1) *If you have assigned a control job, and additional points are found in the control job, the Ctrl softkey is displayed under the list.*
2) *Use the Add Constant field in [MENU] →[3.Set] →[6.SO] to specify an integer that is added to the point number being staked to generate a new number for recording the staked point. For example, when you stake out AD12 with an Add Constant of 1000, the default number for SO record is AD1012.*

5.3 PART LINE

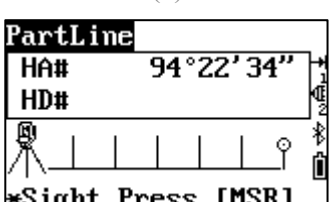
This function, part line stake-out, divides the line between the instrument and the target by an input span number. It will lead you to stake out the points, one by one.

For example, if you measure to the end point at 100 m from the instrument and set the span as 2, the following four points are calculated and can be staked.





(1)

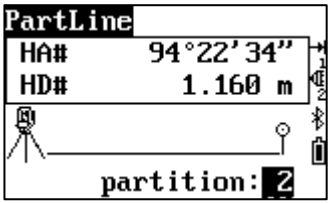


(2)

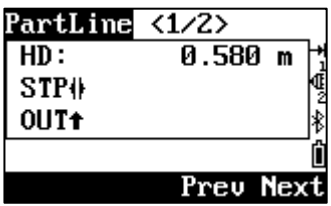
In SO menu press **[3] Part Line** to enter into Part Line SO function PIC(1).

Set up the baseline. Sight the target, and press **[MSR1]/[MSR2]** to measure. RQS will set up a base line between the station and the measured point PIC(2).

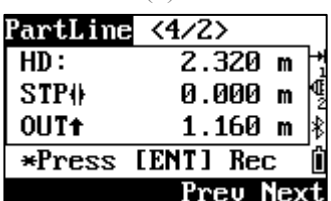
Input the total stake number in Partition PIC(3), and press **[ENT].**



(3)



(4)



(5)

RQS shows the guidance to stake out the first point, press **[MSR1]/ [MSR2]** to measure.

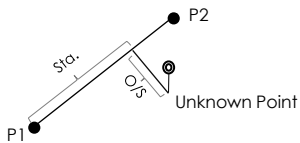
After measurement, the differences between the target and the stakeout point are shown.
Find the stakeout point based on the guidance, press [ENT] to record the point.

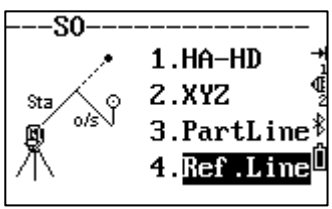
After recording the point, the display returns to the stake out page. Press **F3 [Prev]** or **F4 [Next]**, or **[▲]/[▼]** to stake out other divided points PIC(3/4).

Note: The function can calculate and guide the stake-out points twice times of the distance based on the baseline.

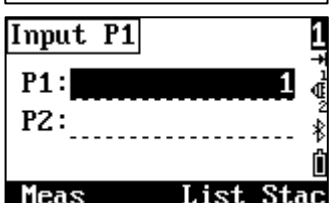
5.4 REFERENCE LINE

This function will calculate the coordinates of the unknown point through two known points (P1, P2) and the offset distance from reference line (P1-P2).

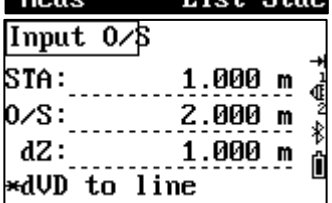




(1)



(2)



(3)

Press **[4] Ref.Line** to enter to reference line stakeout PIC(1).

Input or select two points (P1/P2) to build a reference line PIC(2).

Enter offset value PIC(3). Or keep the value in blank as 0.

Sta：Horizontal distance from P1 to perpendicular point along the reference line.

O/S：Horizontal offset from target to the reference line.

dZ: Vertical offset from target to the reference line.

Find the stake-out point until the guidance becomes 0.

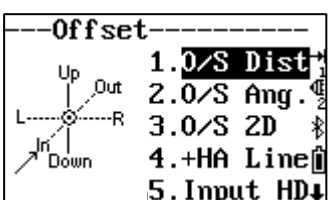
After finding the stake-out point, press **[ENT]** to record

6. OFFSET [Key - 9]

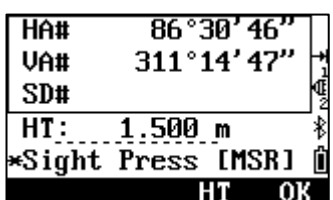
Press 9. under BMS(Basic Measurement Screen) to activate the Offset menu, by distance, angle, points, extended line, column, corner point, etc.

6.1 O/S DIST

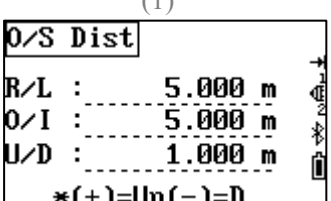
Distance offset calculates from measurement or coordinates longitudinal, parallel offset and height differences of the target point relative to the known point.



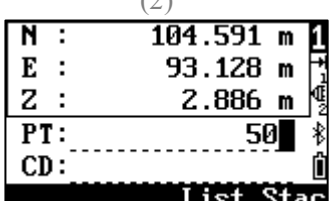
(1)



(2)



(3)



(4)

Press **[1]O/S Dist** to enter the distance offset PIC(1).

Sight the target and press **[MSR 1]/[MSR 2]** to measure PIC(2).

Enter the offset value PIC(3).

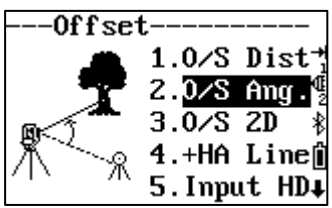
R/L: Lateral deviation.

O/I: Longitudinal deviation.

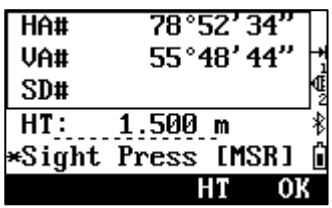
U/D: Altitude deviation.

6.2 O/S ANG

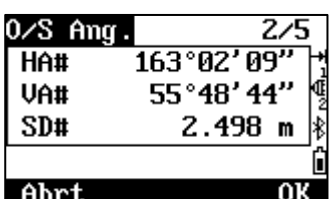
Angle offset calculates from measurement and the relationship of angle difference from the known points.



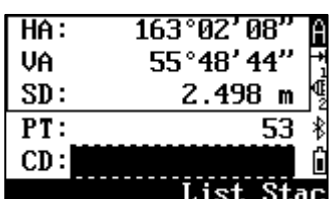
(1)



(2)



(3)



(4)

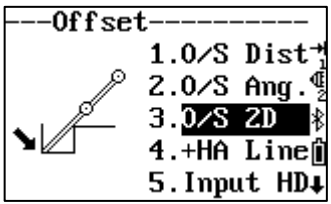
Press **[2]O/S Ang** to enter the angle offset PIC(1).

Sight the target and press **[MSR 1]/[MSR 2]** to measure PIC(2). Then press **F3[DSP]** or **[▼]** to view the other pages of results

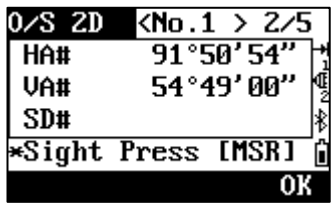
Rotate the EDM with an angle offset. Press **F4[OK]** to confirm PIC(3), then **[ENT]** to record PIC(4).

*Note: You can also record an angle offset in BMS. After distance measurement, rotate the telescope. Press **[DSP]** or [▼] to view other pages of the result. You can see that the coordinates are changed.*

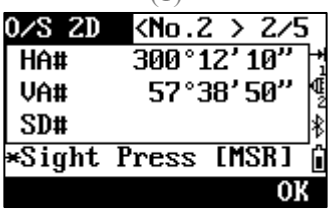
6.3 O/S 2D



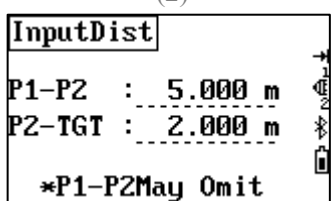
(1)



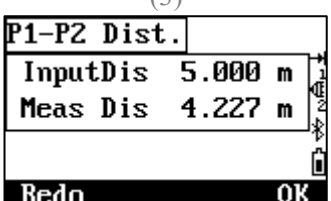
(2)



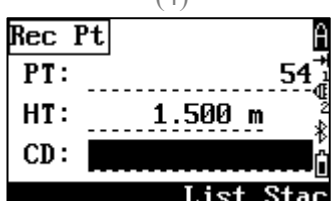
(3)



(4)



(5)



(6)

Press **[3]O/S 2D** to enter the 2-Prism-Pole function PIC(1).

Sight and measure the first and second point (P1/P2) by pressing **[MSR1]** or **[MSR2]** PIC(2/3).

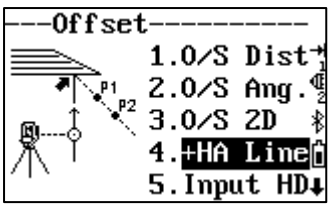
Enter the distance between P2 and the target PIC(4). if you don't need QA check, please leave the value of P1-P2 in blank.

RQS can compare the inputted distance with measured distance to check the accuracy PIC(5).

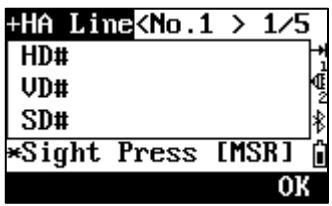
Press **[ENT]** to record the point PIC(6).

6.4 +HA LINE

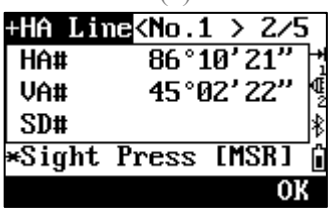
This function is to extend a line by horizontal angle offset.



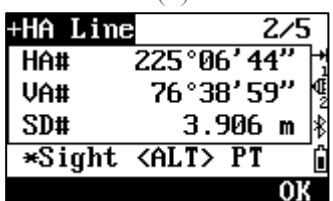
(1)



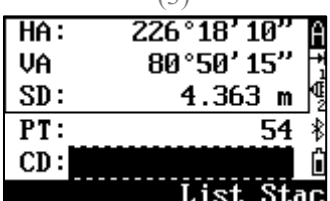
(2)



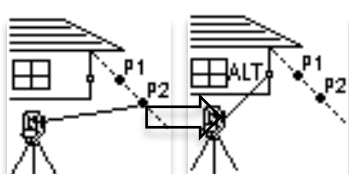
(3)



(4)



(5)



Press **[4]+HA Line** to enter the line extension (+HA) function PIC(1).

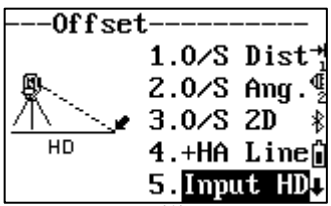
PIC(5)Sight and measure the first and second point (P1/P2) by pressing **[MSR1]** or **[MSR2]** PIC(2/3).

Sight the alternative point PIC(4)on the same vertical line as the desired target point. Press **F4[OK] /[ENT]** to calculate the target.

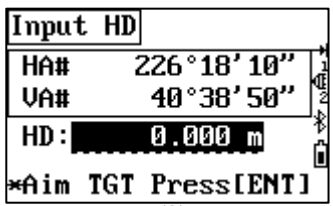
The height of target is fixed to 0.0000 for the offset point.

6.5 INPUT HD

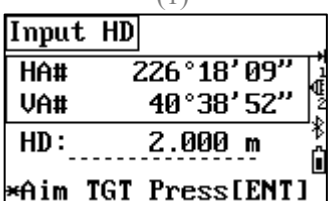
This function is useful when the instrument is very close to the point and it is difficult to measure.



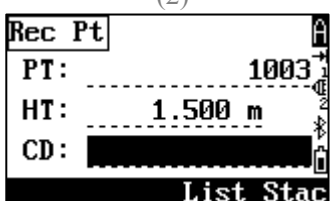
(1)



(2)



(3)



(4)

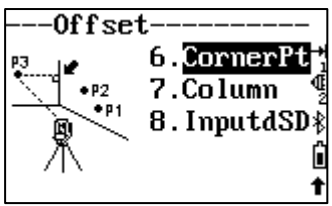
Press **[5] Input HD** to enter the Input HD function PIC(1).

Turn the telescope in the direction of the point that you want to measure PIC(2).

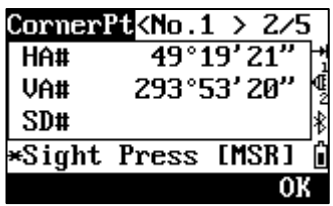
Enter the horizontal distance.
Press **[ENT]** to calculate PIC(3) and save PIC(4).

.

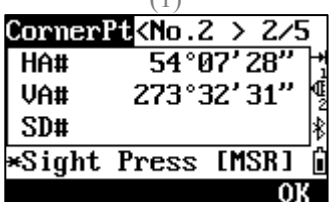
6.6 CORNER PT



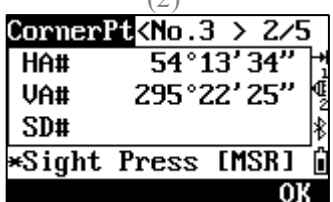
(1)



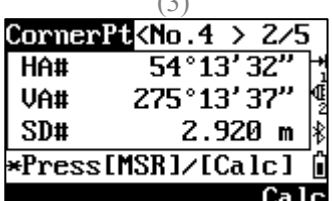
(2)



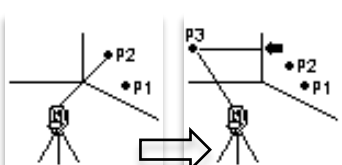
(3)



(4)



(5)



Press **[6] Corner Pt** to enter the corner point function PIC(1).

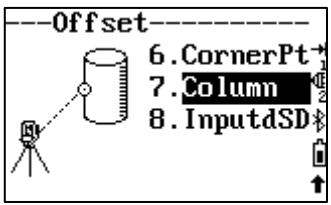
Measure the first and second point P1/P2 on a same wall PIC(2/3), then measure the third point P3 on the second wall PIC(4) .

If the two walls are perpendicular to each other, press **F4[Calc]** to calculate the corner by 3 points.

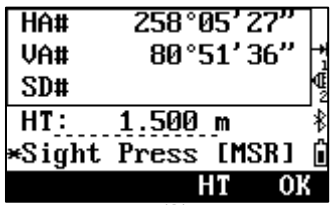
If you take a measurement to the fourth point on second wall, the corner can be calculated as the intersection of two walls.

6.7 COLUMN

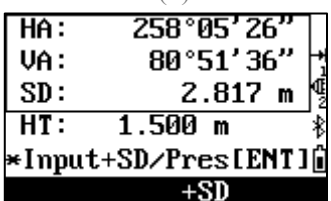
Column offset is widely used in measuring a hidden point that is not directly visible.



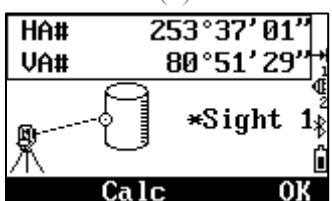
(1)



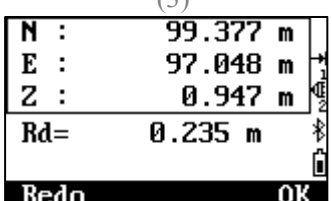
(2)



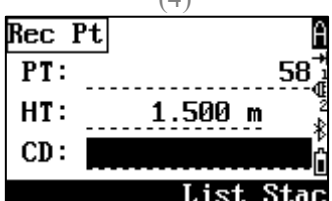
(3)



(4)



(5)



(6)

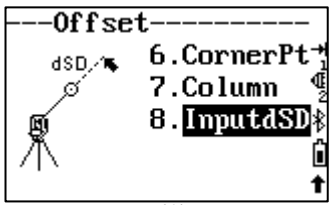
Press **[7] Column** to enter Column function PIC(1).

Aim at the surface of column and press **[MSR1]/ [MSR 2]** to measure PIC(2).

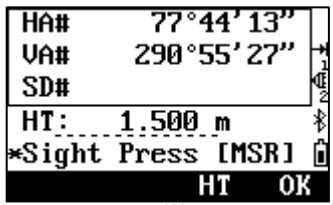
When using a prism attached to the column as target, press **F3[+SD]** to eliminate the offset error PIC(3).

Aim one side of the edge PIC(4). If the center can be calculated, press **[F2]Calc**. Otherwise, aim the other side based on the guidance.

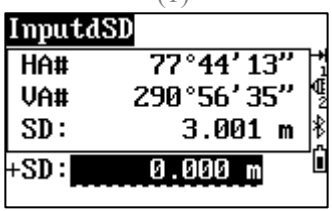
6.8 INPUT dSD



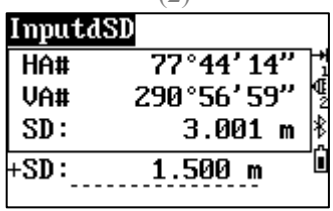
(1)



(2)



(3)



(4)

Press **[8] Input dSD** to enter the function of extended slope distance in offset PIC(1).

Sight the target and press **[MSR1]/ [MSR2]** PIC(2).

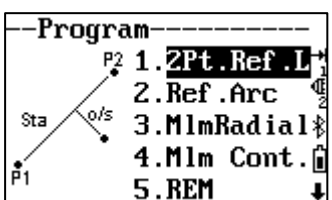
Enter the slope distance between -99.99m to +99.99m PIC(3/4).
Press **[ENT]** to record the point.

7. PROGRAM [Key - 4]

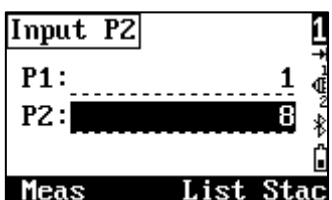
Press 4. under BMS (Basic Measurement Screen) to activate the Program of RQS, including the functions of 2 points reference line, reference arc, MLM, REM, 2-point reference plane, 3-point reference plane, and roads.

7.1 2-POINT REFERENCE LINE (2PT. REF. L)

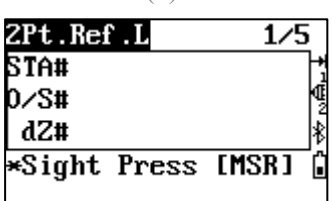
2-point reference line is able to calculate the distance offset between the known point and the reference line P1-P2.



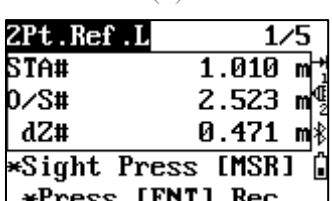
(1)



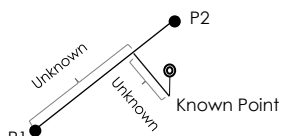
(2)



(3)



(4)



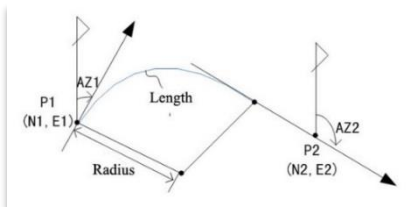
Press **[1]2Pt.Ref.L** under program menu PIC(1).

Input or select two points to build a reference line, as P1-P2 PIC(2).

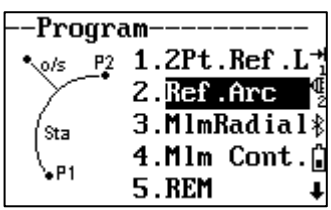
Sight the target and press **[MSR1]** or **[MSR2]** to measure and view the distance offset PIC(3/4).

7.2 REFERENCE ARC (REF. ARC)

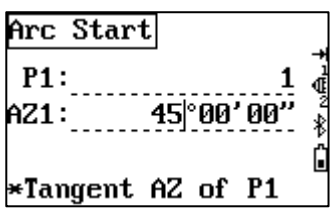
The Reference Arc is able to measure distance and offset values on the arc-curve.



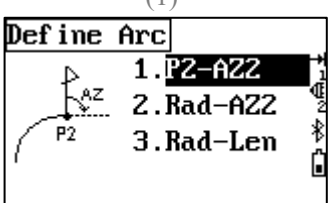
Press **[2] Ref.Arc** under program menu PIC(1).



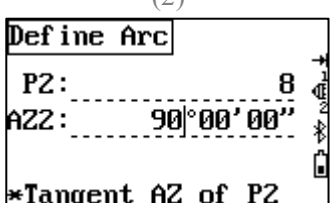
(1)



(2)



(3)



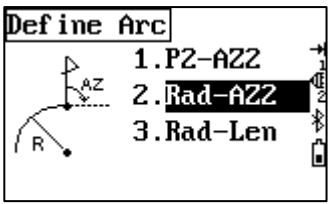
(4)

Enter the start point (P1) PIC(2) and azimuth of its tangent line (AZ1).

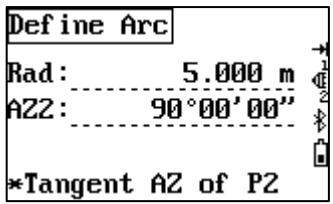
Choose a method to define the arc by P2-AZ2, by Rad-AZ2 or by Rad-Len.

1) P2-AZ2 PIC(3/4)

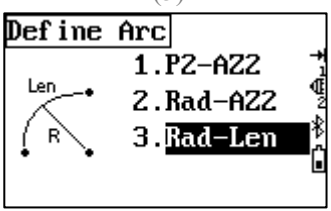
Input or select a point as P2 and azimuth of its tangent line (AZ2).



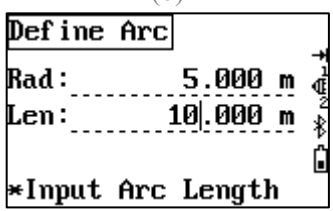
(5)



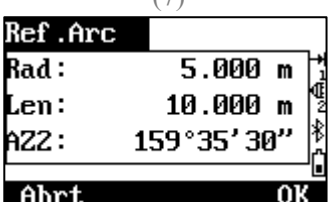
(6)



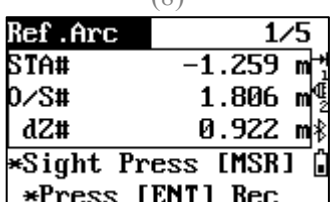
(7)



(8)



(9)



(10)

2) Rad-AZ2 PIC(5/6)

Input the radius and the azimuth of its tangent line (AZ2).

Input a positive value in Radius for the clockwise direction, or a negative value for the counterclockwise direction.

3) **Rad-Len** PIC(7/8)

Input radius value and arc length.

RQS will calculate the curve based on the inputted value PIC(9).

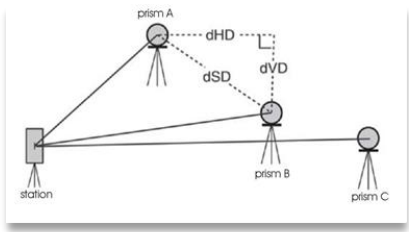
Aim and measure the target by pressing **[MSR1]** or **[MSR2]** PIC(10).

Note: P2 can be any point on the tangent line that exited in the curve.

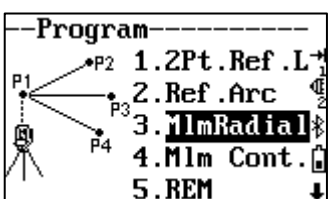
7.3 MLM

MLM, is mainly used to compute the HD/ VD/ SD/ azimuth between two target points, calculated under two methods:

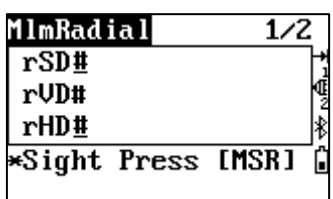
1) MLM Radial(A-B, A-C) , lock the start point
2) MLM Cont. (A-B, B-C) , unlock the start point.



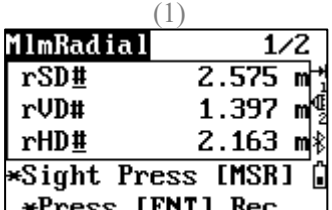
7.3.1 MLM Radial



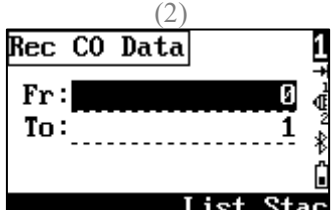
(1)



(2)



(3)

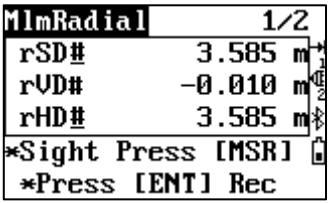


(4)

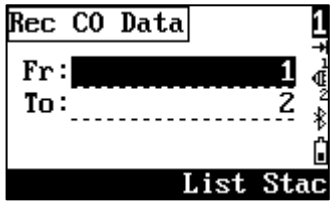
Press **[3] MLM Radial** to enter the function of MLM A-B, A-C PIC(1).

Sight the 1st point and press **[MSR1]/[MSR2]** PIC(2/3/4) to check the distance from station to first point.

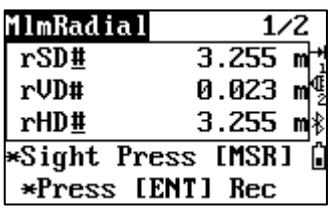
Sight the 2nd point and press **[MSR 1]/[MSR 2]** PIC(5/6) to check the



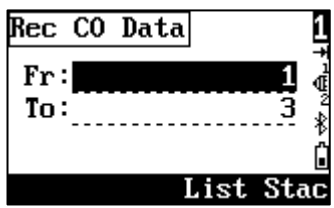
(5)



(6)



(7)



(8)

distances between 1st and 2nd point PIC(7) .

rSD: SD between two points

rVD: VD between two points

rHD: HD between two points.

rAZ: Azimuth between 1st and 2nd point.

rV%: Percentage of grade

rGD: Vertical grade (rHD/rVD)

Repeat the steps to calculate and record the distance between the first and the other points PIC(8).

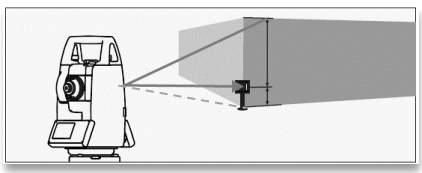
Note: Target A/B/C… will be displayed as point 1/2/3…in RQS. The default point numbers (STN=0, PT=1, PT=2, PT=3…) can be changed.

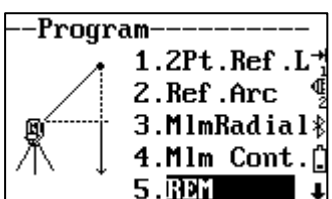
7.3.2 MLM Cont

Press **[3] MLM Cont** to enter the function of MLM A-B, B-C. Please refers to Chapter 7.3.1 MLM Radial.

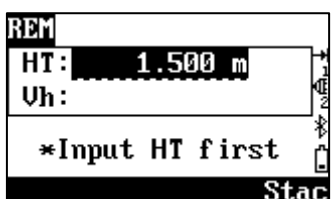
7.4 REM

When you need the information of a target hang in the air, REM can help you measure the point without a reflector. The points directly above the prism can be determined without a reflector at the target point.

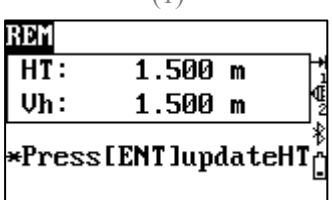




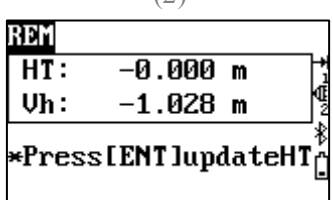
(1)



(2)



(3)



(4)

Press **[5]** to enter the REM PIC(1).

Input the height of target HT PIC(2). Sight the target point and press **[MSR1]**/**[MSR2]** to measure PIC(3).

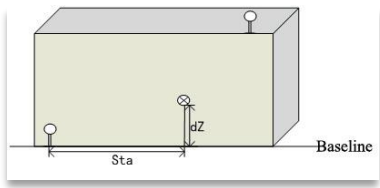
Loosen the vertical clamp, rotate the telescope to aim the target. The difference in vertical height (Vh) is displayed PIC(4).

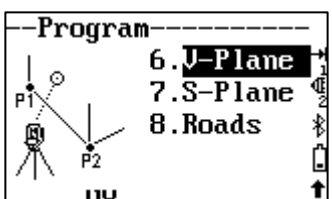
[ENT]: update the target height.

7.5 V-PLANE

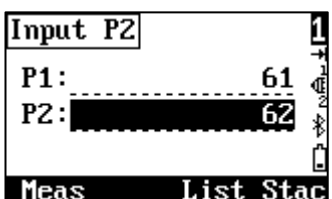
Measure the distance and offset values on a vertical plane, also known as 2 points reference plane.

Press **[6]V-Plane** in the second page of Program PIC(1).

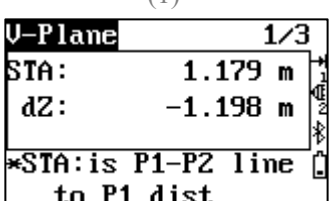




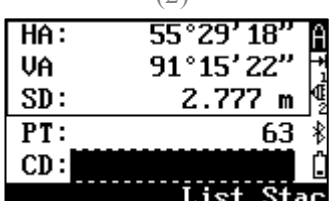
(1)



(2)



(3)



(4)

Input, select or measure two points in a vertical plane PIC(2).

Once the vertical plane has been defined, the Sta and dZ value will update in real-time based on the rotation of telescope PIC(3).

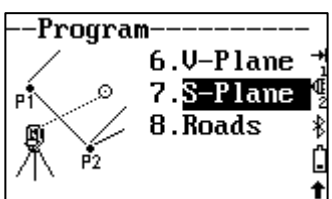
STA: Horizontal distance from P1 to the target along the baseline

dZ: Vertical distance from P1 to the target.

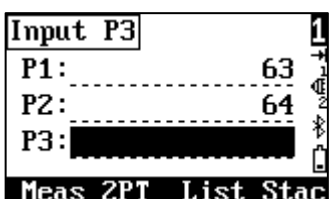
7.6 S-PLANE

Measure the distance and offset values on a slope plane, also known as 3 points reference plane.

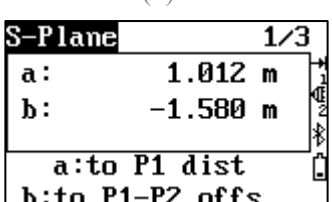
Press **[7] S-Plane** in the second page of Program PIC(1).



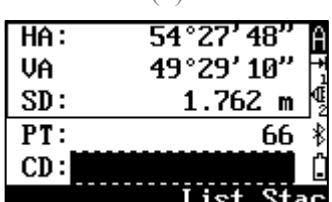
(1)



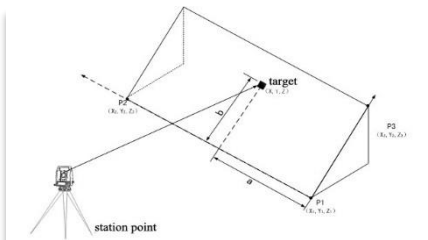
(2)



(3)



(4)



Input, select or measure three points to define a slope plane PIC(2).

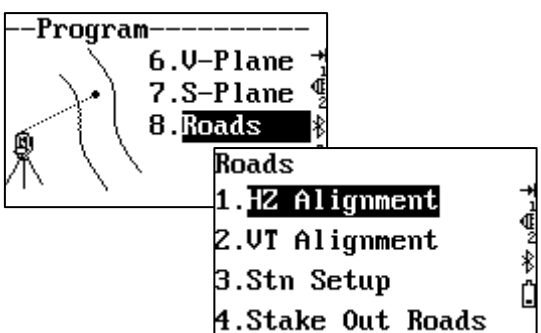
Press **F2 [2PT]** to define the plane by two points in vertical direction.

a: Distance between P1 and the perpendicular point of target on P1-P2 line PIC(3).

b: Distance between the target and perpendicular point on P1-P2.

7.7 ROADS

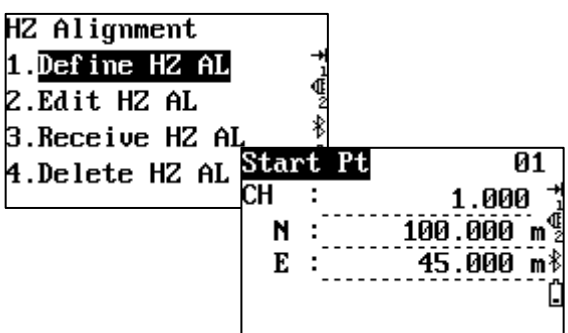
This program enables you to easily define a line, curve or transition curve as a reference to measure or stake out. It supports chainages, as well as incremental stake-outs and offsets.



Before starting road design and stake-out, please set job, station and backsight at first.

7.7.1 HZ Alignment

Horizontal alignment consists of the following elements: start point, straight line, curve and transition curve and intersection points.

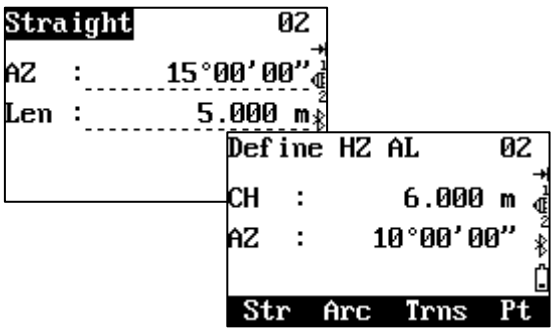


7.7.1.1 Define HZ AL

To define a horizontal alignment, you need to input a chain number, N&E coordinate of start point as the beginning.

1) Straight Line

A straight line consists of two elements: azimuth and length.



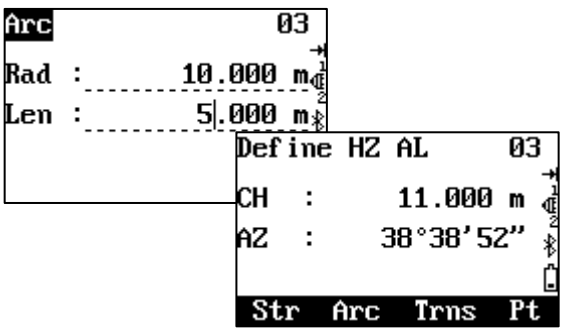
Press **F1[Str]** to define a straight line.

Press **[ENT]** to confirm the inputted value and back to main page of HL Alignment.

Note: the straight line will use the latest azimuth as the current azimuth in default. If the user need to change the azimuth, please input the value by manual.

2) Arc

A curve consists of two elements: length and radius.



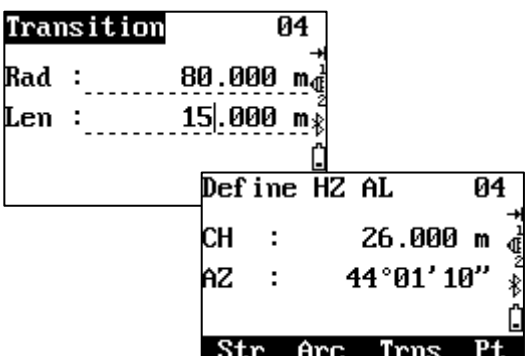
Press **F2[Arc]** to define an arc.

Press **[ENT]** to confirm the inputted value and back to main page of HL Alignment.

Note: When the arc turns right, the radius value is positive; otherwise, it will be negative. The value of length cannot be negative, also cannot longer than the perimeter.

3) Transition

A transition consists of two elements: minimum radius and arc length. The rule of radius value is same as the rule of radius value. Similarly, the arc length can't be negative.

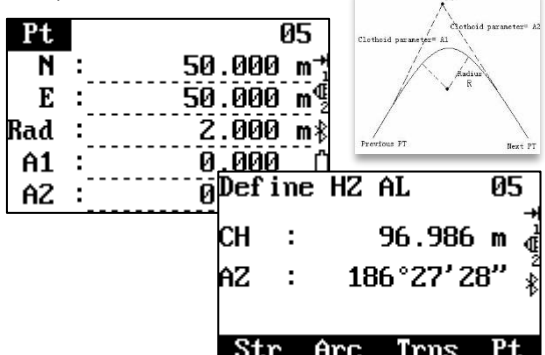


Press **F3[Trns]** to define a transition curve.

Press **[ENT]** to confirm the inputted value and back to main page of HL Alignment.

4) Point

A point consists of three elements: coordinate, radius and parameter of transition A1/A2. If you input the value of radius or A1/A2, an arc or a transition will inserted into current point and next point.

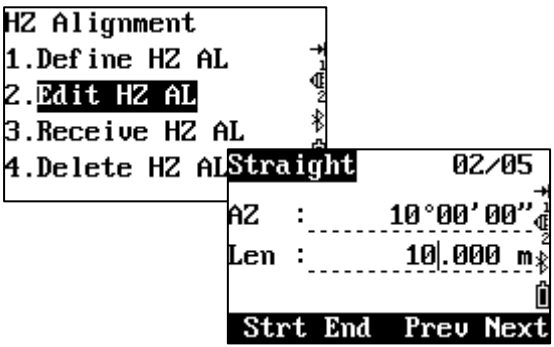


Note: A1/A2 can be calculated as below formula:

$$A1 = \sqrt{L1 \times Radius}$$

$$A2 = \sqrt{L2 \times Radius}$$

7.7.1.2 Edit HZ AL



F1 [Strt]: Back to the data of first element.

F2 [End]: Skip to the data of last element.

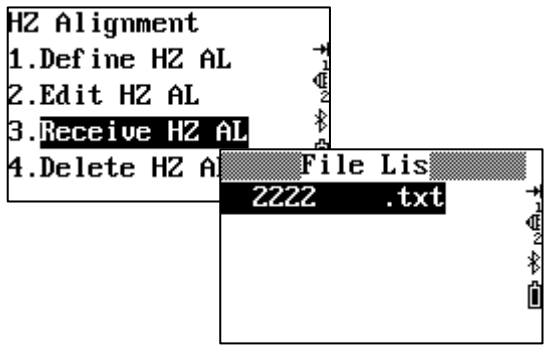
F3 [Prev]: Show the data of previous element

F4 [Next]: Show the data of next element.

Press **[ENT]** to record the editing and enter the next page.

Press **[ESC]** to cancel the operation.

7.7.1.3 Receive HZ AL



Press **F4[Strt]/[ENT]** to import data from USB.

Press **F1[Abrt]/[ESC]** to cancel the operation.

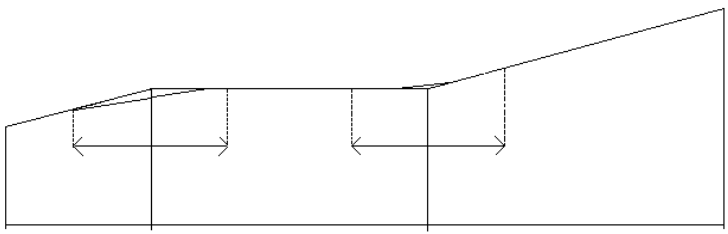
7.7.1.4 Delete HZ AL

Press **F4[OK]/[ENT]** to delete all the data of horizontal alignment.

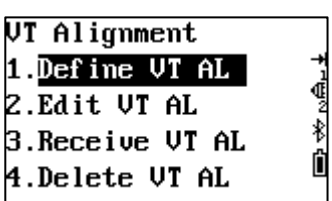
Press **F1[Abrt]/[ESC]** to cancel the operation.

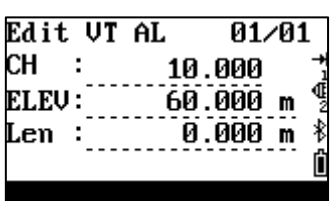
7.7.2 VT Alignment

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.



Chainage	1000	1300	1800	2300
Elevation	50	70	60	90
Curve length	0	300	300	0





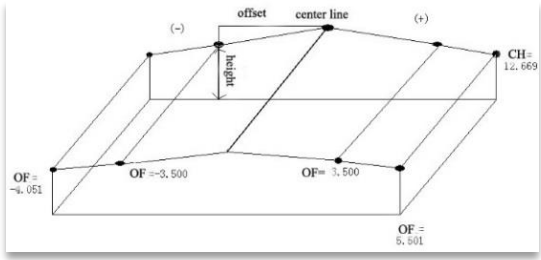
Intersections can be inputted in any order.

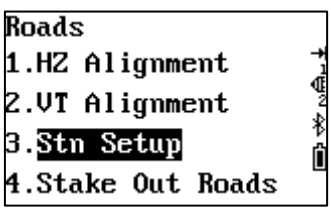
Press **[ENT]** to save it and go to next chainage.

Press **[ESC]** to quit without saving.

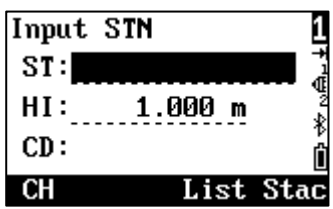
7.7.3 Stn Setup

You can use chainage to setup station when there is horizontal alignment data existed in internal memory.

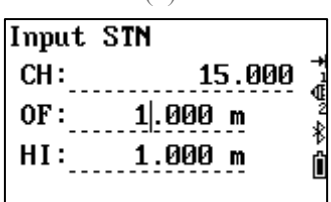




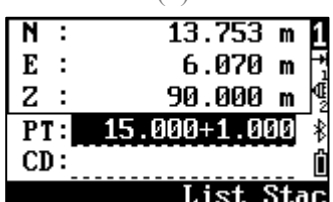
(1)



(2)



(3)



(4)

Press **F1[CH]** PIC(2) to set-up station by chainage. Input the chainage number and make sure that the inputted chainage is in the designed horizontal alignment PIC(3).

CH: Chainage number

OF: Offset of the chainage

HI: Height of instrument

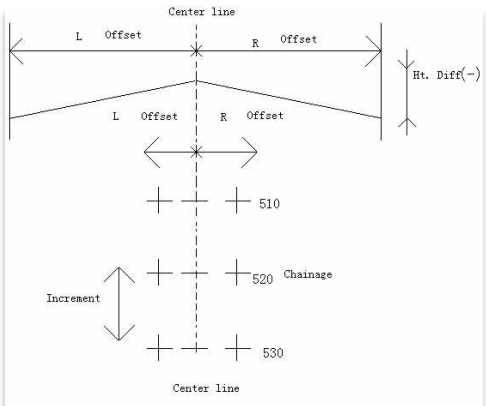
*Note: Press **F1[PT]** to set-up station by point. The other set-up steps, please refer to Chapter 4. STN.*

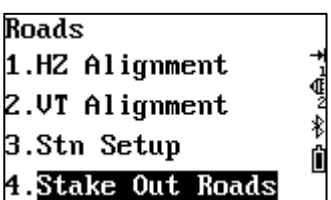
7.7.4 Stake Out Roads

To stake out alignment, the data should be defined first, import from USB/Bluetooth, or input by manual.

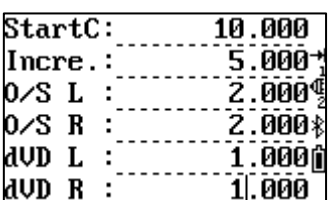
In the Roads stake-out, user should stake-out points on the central line at first, then the side chainage on both sides.

Note: The vertical alignment data is unnecessarily to be defined, unless it is required to compute dig and fill.





(1)



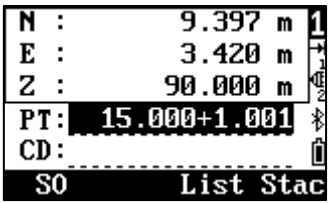
(2)

StartC: Start chainage PIC(2).

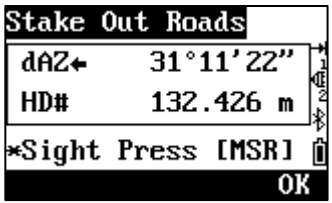
Incre: Increment/ Step.

O/S: Horizontal offset in left and right, between side chainage point and central line.

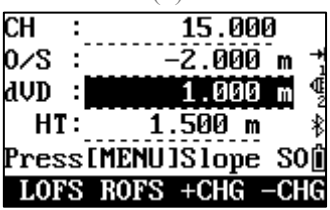
dVD: Height difference between



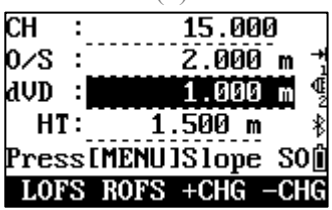
(3)



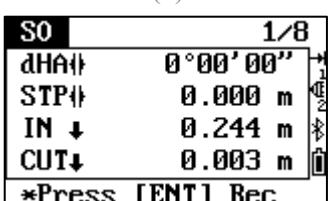
(4)



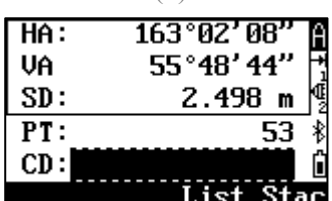
(5)



(6)



(7)



(8)

left and right chainage and central line

After stake-out the points PIC(4) on central line, press **F1[LOFS]** or **F2[ROFS]** PIC(5/6) to stake out left or right chainage.

CH: Current chainage.
O/S: Offset value. Negative means the point is on the left side, otherwise, it is on the right side.

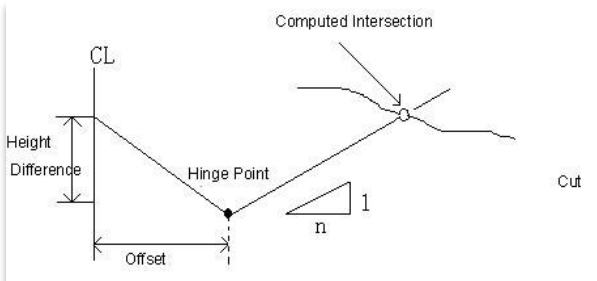
F1[LOFS]: Chainage in left offset.
F2[ROFS]: Chainage in right offset.
F3[+CHG]: Increased step.
F4[-CHG]: Decreased step.

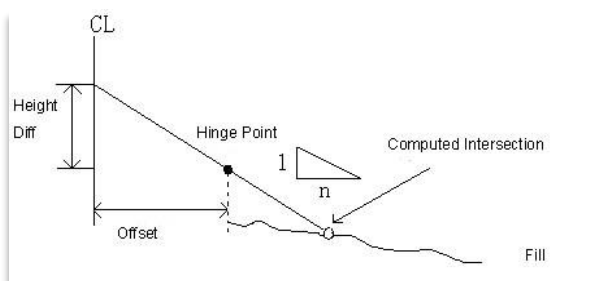
7.7.5 Slope Stake-out

Slope Stake Out can be launched as part of the Alignment Stake-Out with defined horizontal and vertical alignments

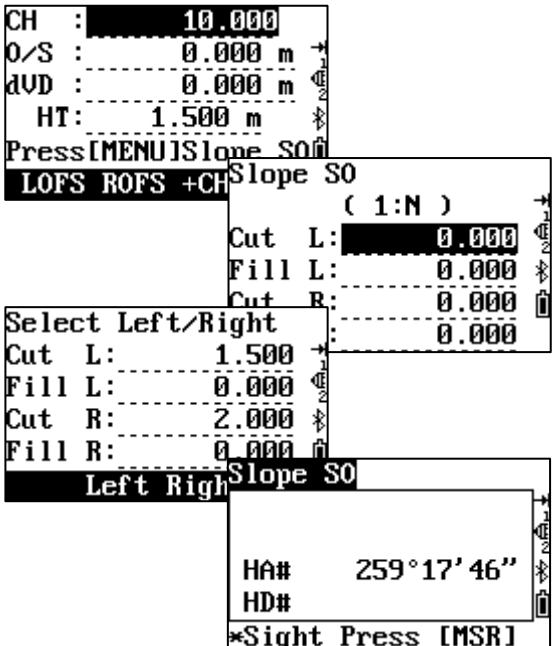
The value of cut & fill here, should be inputted as a ratio (1:n) through left and right slopes under positive number. RQS will select an appropriate slope in the list according to the actual position of the point.

Cut/fill is decided via the estimated height of hinge point. If the height is above the hinge point, the dig slope is used; otherwise the fill slope is used.





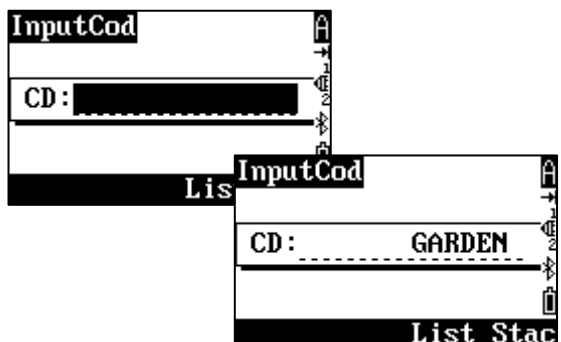
Press **[Menu]** under the info page of chainage in Stake Out Roads.



Input the ratio of left & right slopes to be cut or filled. Then select the slope in left or right side to staked out.

8. CODE [Key - 5]

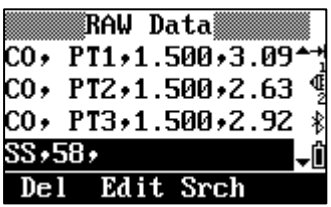
Press 5. under BMS(Basic Measurement Screen) to change the default code that will pop up in CD item when you record the data.



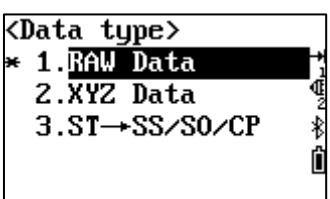
Input the code manually. The inputted code will be entered into **F4[Stac]** in chronological order. Or select code from **F3[List]** as default. To add, delete or edit code in List, please refers to Chapter 11.4.5. Code List.

9. DATA [Key - 6]

Press 6. under BMS (Basic Measurement Screen) or observation screen to check the data list in current job.



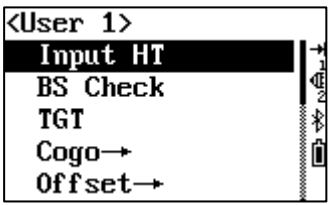
Hold **6.[DAT]** for one second to change the type of data list (when press the 6.DAT).



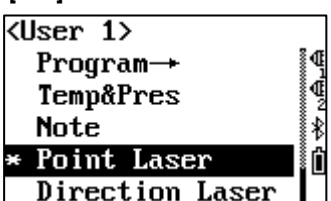
Note: Available to change the type of data by MENU →6.1 Sec.→5.Data.

10. USER KEY [Key – 1/2]

If you use a function frequently in the field, you can assign it to the **1.[USR1]** or **2.[USR2]** key.



Press **[USR1]/[USR2]** in 1 second to define the user key. Press **[ENT]** to select.



Whenever you press the user key, the function which is predefined will activated directly in BMS.

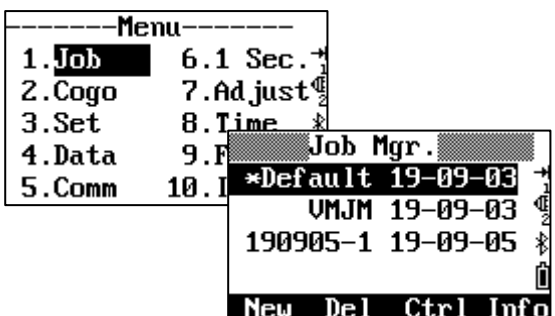
11. MENU

11.1 JOB

Press **1.Job** in Menu to open, create, delete, set or view the information of jobs.

11.1.1 Open a Job

Press **[1] Job** to open the Job Manager.



Move the cursor, press **[ENT]** to open the job.

The meaning of the symbol：

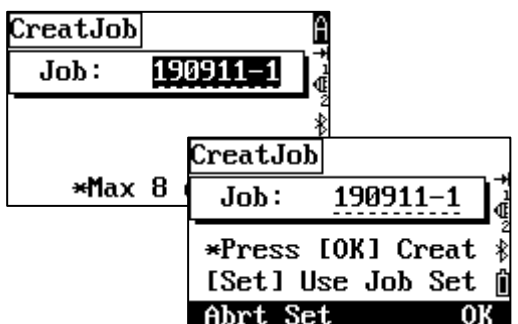
* Current job

@ Control job

！ job settings are different from current job.

11.1.2 Create a New Job

Press **F1[New]** in job list.

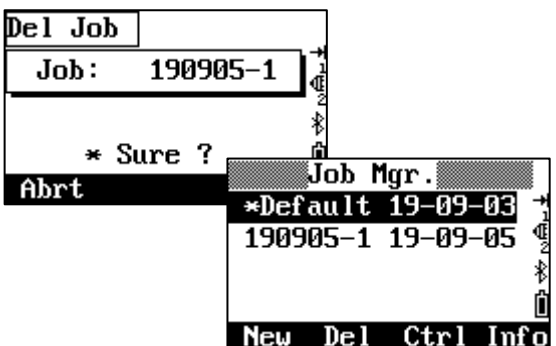


Enter a job name (max. 8 characters)

F2[Set]: Check or modify the settings.(Scale, T-P Sensor, Sea level, C&R Correction, Angle Unit, Distance Unit, Temperature Unit, Pressure Unit, VA 0, AZ 0, NEZ Order and HA).

11.1.3 Delete Job

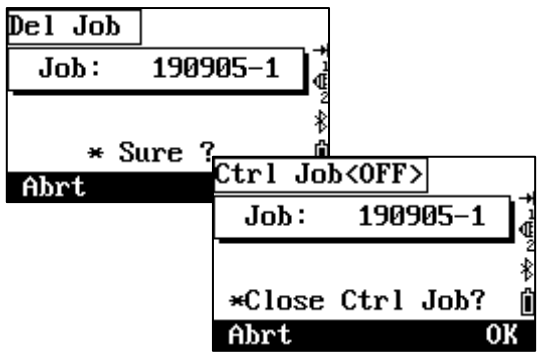
Move the cursor to the job that you want to delete, press **F2[Del]**.



11.1.4 Control Job

After the control job has been set, you can search the point in control job when the system cannot find it in the current job. If the point is valid in control job, RQS will copy the data to the current job as a UP record.

Move the cursor to the job that you want to set as control job, press **F3[Ctrl]** to set or cancel.



11.1.5 Job Info

Press **F4[Info]** to view the information about name, records and create time of current job.

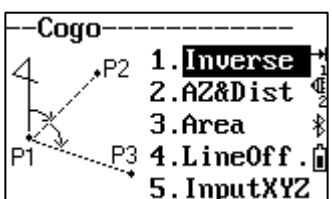
11.2 COGO

Press **2.Cogo** in Menu to select the function of Inverse, AZ&Dist (Traverse), Area, Line Offset and Coordinate Input.

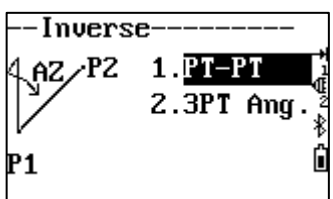
11.2.1 Inverse

Calculate the relationship (angle & distance) by two points or two lines defined by three points.

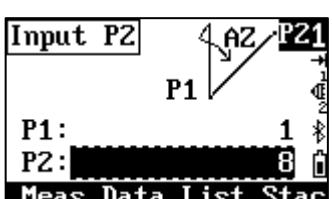
1) PT-PT



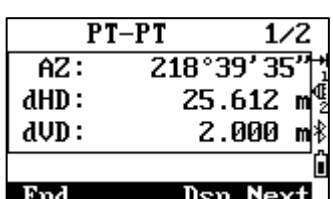
(1)



(2)



(3)



(4)

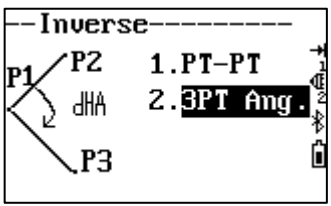
Press **1.[PT-PT]** in COGO PIC(2).

Input by manual PIC(3), measure or select two points from memory. Press **[ENT]** to calculate PIC(4).

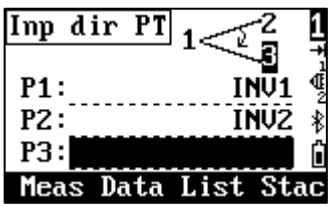
AZ: Azimuth from P1 to P2.
D HD: HD from P1 to P2.
d VD: VD from P1 to P2.
Gd: Grade (HD/VD).
V%: Slope in percent.
rSD: SD from P1 to P2.

2) 3PT Ang.

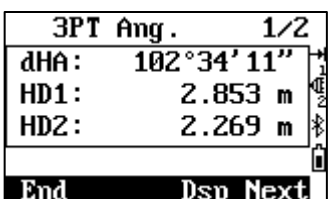
3pt angle calculates the horizontal distance among three points, and the angle between two lines defined by three points. P1 is the base point. Lines are defined by P1-P3 and P1-P2.



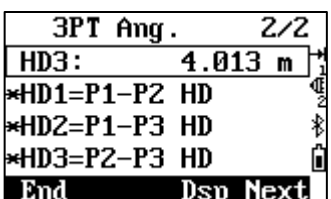
(1)



(2)



(3)



(4)

Press **2.[3PT Ang]** in COGO PIC(1).

Input by manual, measure or select a point from memory as P1, P2 and P3 PIC(2).

Press **[ENT]** to calculate PIC(3).

d HA: Angle between P1-P3 and P1-P2.

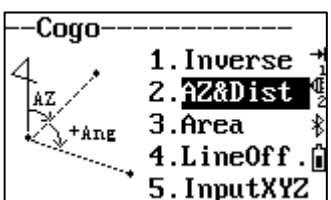
HD: HD between two points.

11.2.2 AZ&Dist

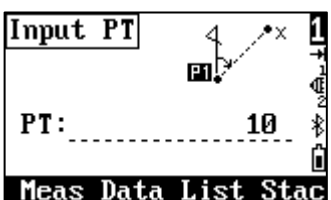
AZ&DIST function, as known as Coordinate Traverse, use angle and distance to calculate the coordinate of a new point. Press **[2] AZ&Dist** in COGO PIC(1).

1) AZ+HD

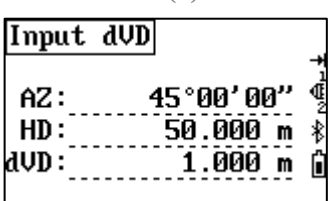
Calculate the coordinates of a new point with a known point, azimuth, HD and VD offset.



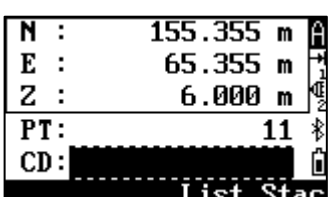
(1)



(2)



(3)



(4)

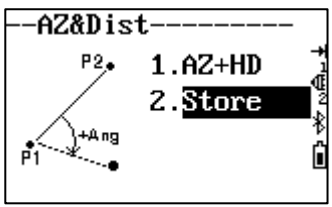
Press **1.[AZ+HD]** in AZ&DIST

Input, measure or select a known point as base PT PIC(2).

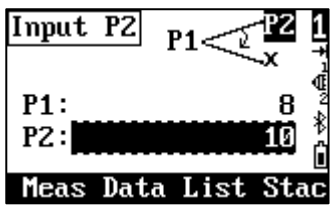
Input azimuth, horizontal distance (HD) and vertical distance (VD) PIC(3) then press **[ENT]** to calculate and record the data PIC(4).

2) Store

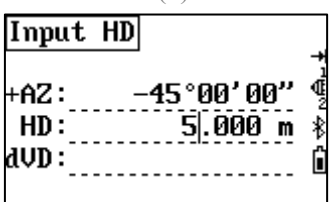
Calculate a new point based on the two defined points, azimuth, horizontal and vertical distances from the line defined by those two points.



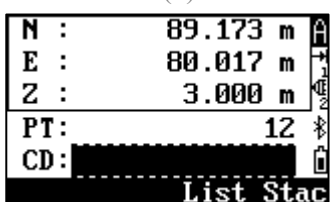
(1)



(2)



(3)



(4)

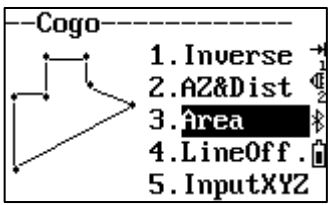
Press **2.[Store]** in AZ&DIST PIC(1).

Input, measure or select two points P1 and P2 PIC(2).

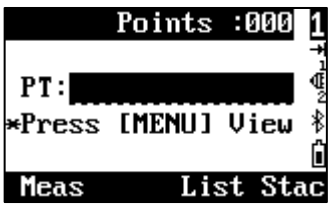
Input azimuth (refers to line P1-P2, it can be negative or positive), horizontal distance (HD) and vertical distance (VD) PIC(3) then press **[ENT]** to calculate PIC(4).

11.2.3 Area

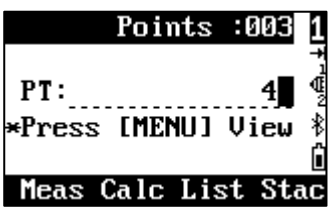
Calculate the area and perimeter of known points. Press **[3] Area** in COGO PIC(1).



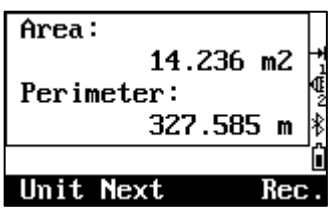
(1)



(2)



(3)



(4)

Input, measure or select the necessary points in correct order PIC(2).

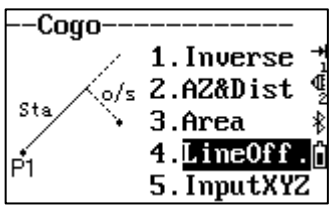
In the upper right corner of the screen, a counter indicates how many points you have entered.

F2 [Calc] to calculate the area and perimeter PIC(3).

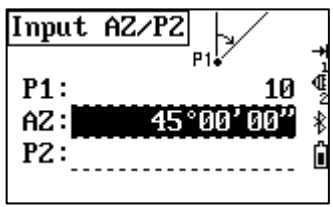
F1 [Unit] to switch the unit of area.
F2 [Next] to add points to the graph.
F4 [Rec.] to record the area calculating results PIC(4).

11.2.4 Line Offset

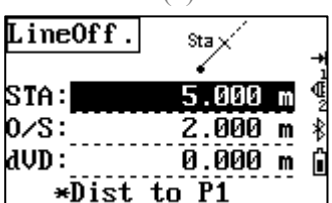
Calculate coordinates from line and the offset. Press **[4] Line Off.** in COGO PIC(1).



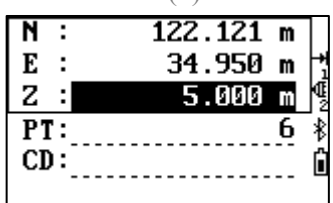
(1)



(2)



(3)



(4)

Input, measure or select P1. Input the azimuth or skip to input P2 to defined a reference line PIC(2).

Enter the HD along the baseline (STA), HD perpendicular to the line (O/S) and vertical distance (d VD) PIC(3).

Press **[ENT]** to calculate PIC(4). The point saved as CC record. Line and the offset value saved as CO records.

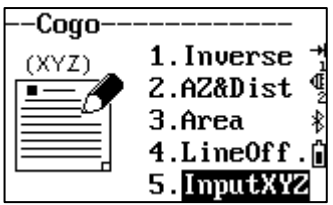
Note:

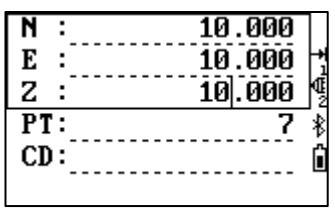
1) A negative value in the Sta field means the opposite direction along the defined bearing line.

2) A negative value in the O/S field is for the left-hand side of the bearing line.

11.2.5 Input XYZ

Press **[5] Input XYZ** in COGO to input the coordinate by manual.





11.3 SET

Press **3.SET** in Menu. Use navigation keys to select or modify the settings of total station.

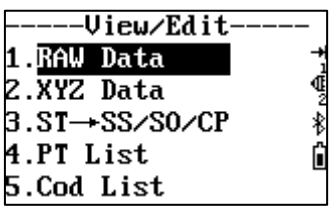
Item		Options
Angle	**VA 0**	Zenith/ Vertical/ Vert±90
	Min. Angle	1"/ 5"/ 10"
	HA	Azimuth/ 0 to BS
Dist.	**Scale**	Numeric value from 0.99to 1.01
	T-P Correction	ON/OFF
	Sea Level	ON/OFF
	C&R Correction (K)	OFF/0.14/0.20
	Max Distance	2000m/5000m
XYZ	**Order**	NEZ/ENZ
	Marker	NEZ/XYZ/YXZ
	AZ 0	North/South
Power	**Power Off**	5 min/10 min/30 min/ OFF
	EDM Off	Now/0.1 min/0.5 min /3 min /10 min/ OFF

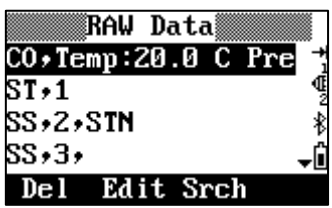
	Sleep	1 min/3 min/5 min/OFF
PPM	**ON/OFF**	Turn on or off the T-P Sensor.
SO	**Add PT**	Default point number to record data in stakeout.
Unit	**Angle**	DEG/GON/MIL
	Distance	Meter/USA Feet/USA Inch/IntlFeet/IntlInch
	Temperature	°C/°F
	Pressure	hPa/mmHg/inHg
Record	**Store DB**	RAW+XYZ/RAW/XYZ
	Record Data	MEM./BT
Other	**XYZ Display**	Quick/Normal/Slow/Enter
	2nd Unit	Meter/USA Feet/USA Inch/Intl Feet/Intl Inch/None
	Beep	ON/OFF
	Split ST	ON/OFF Split ST ON: enter another point name of station.
	Input Code	ALPH/NUM
	User Information	Enter your information less than 20 characters.
BT	**State**	ON/OFF
	Name/PW	Input name and password of Bluetooth.

11.4 DATA

Press **4.Data** in Menu to view or edit the list of raw data, coordinates, stations, points and codes.

11.4.1 Raw Data





ST: Station points.

SO: Stake out points.

CO: Code records.

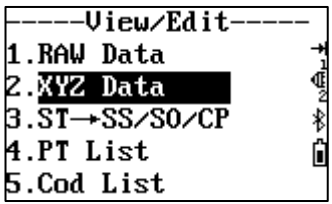
SS: Side-shots. All shots from BMS.

CP: Points in the Angle/ Repeat menu/ BMS.

Press **1.Raw Data** to view, delete (**F1[Del]**), edit (**F2[Edit]**), search (**F3[Srch]**) the raw data from the list. Use navigation key to select.

Note: When you take more than one measurement to the same point and choose to overwrite the XYZ data, the old raw record becomes raw data only. As a result, only one SS (RAW) record keeps its corresponding SS (XYZ) record. Other SS (RAW) records to the same point no longer have coordinates available.

11.4.2 XYZ Data



UP: Uploaded points.

MP: Manually inputted points.

CC: Points calculated in Cogo.

RE: Points calculated in Resection.

SS: Side-shots.

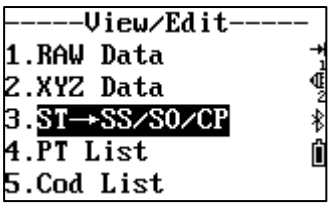
Press **2.XYZ Data** to view, delete (by **F1[Del]**), edit (by **F2[Edit]**), search (by **F3[Srch]**) and input (by **F4[Inp.]**) the coordinate data from the list.

Note:

When the Store DB setting is set to "RAW+XYZ" or "XYZ", shots in BMS (SS records), in various O/S functions (SS records), in 2Pt.Ref. L and Ref.Arc in PRG (SS records) and in some Stakeout functions (SO records) store coordinate records as well. The format of the data is the same as other coordinate records.

All coordinate records contain "N/E/Z", "PT" and "CD" fields.

11.4.3 ST→SS/SO/CP



ST: Station point.

The current station cannot be edited.

Press **3.ST-SS/SO/CP** to view, delete (by **F1[Del]**), edit (by **F2[Edit]**), and search (by **F3[Srch]**) the station data from the list.

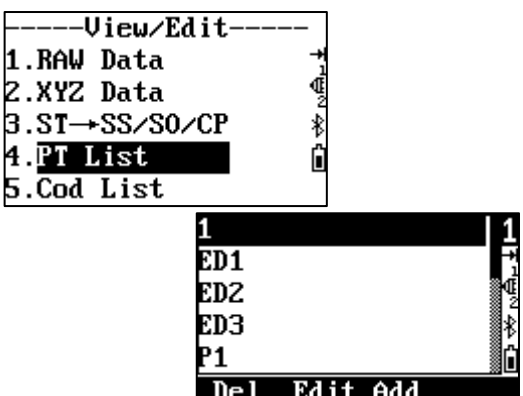
Note:

If the data of station or instrument height has been changed, the coordinates of observation points will not recalculated.

If the data of azimuth or backsight has been changed, the raw data will not recalculated.

11.4.4 PT List

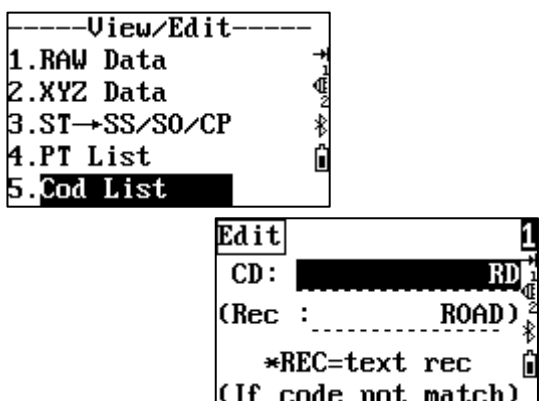
The list of point is useful when you need to handle more than one pattern of point names. You may need to use different points named 1, 2, 3 as well as C1, C2, C3 together, in max. 256 points.



Press **4.PT List** to view, delete (by **F1[Del]**), edit (by **F2[Edit]**), and search (by **F3[Srch]**) the point list.

11.4.5 Code List

The code list is a list of feature codes. You can use it to store your own codes, in max. 256 codes. For example, if you input "RD" in CD field and "ROAD" in Rec, it means when you select RD in code list, ROAD will call up as a code.



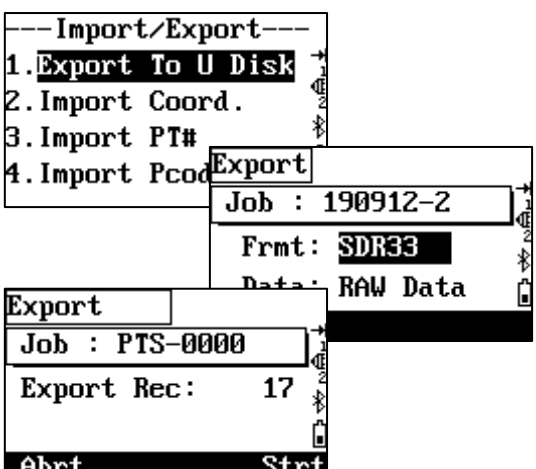
Press **5.Cod List** to view, delete (by **F1[Del]**), edit (by **F2[Edit]**), and search (by **F3[Srch]**) the code list.

11.5 COMMUNICATION

Press **5.COMM** in Menu to exchange data via USB, or export data to Android devices or Windows PC via Bluetooth.

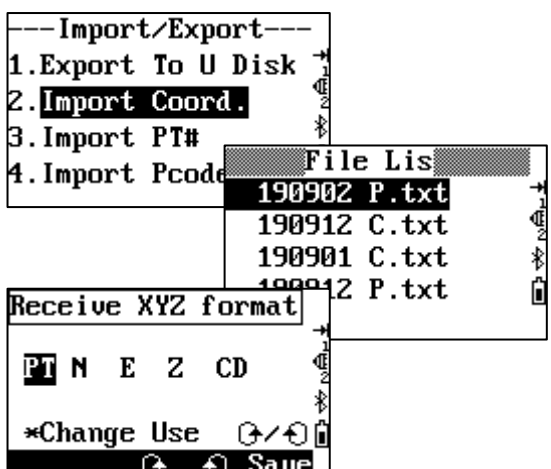
11.5.1 Export to U Disk

Press **1.Export to U Disk** to export raw data or coordinate data under SDR33 or RUIDE format.



11.5.2 Import Coord; Point Number and Code

Press **2.Import Coord. / 3. Import PT# / 4. Import Pcode** to import coordinate, point and codes.

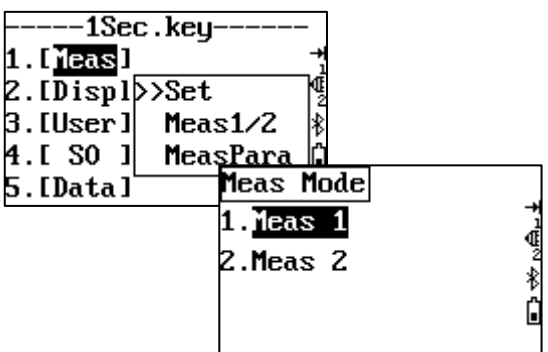


11.6 1 SEC.

Press **6.1 Sec.** to define the function of F1[MSR1]/F2[MSR2], F3[DSP], 1.[USR1]/2.[USR2], 8.[S-O] and 6.[DAT] when you hold it for 1 second.

6.1.1 [MSR]

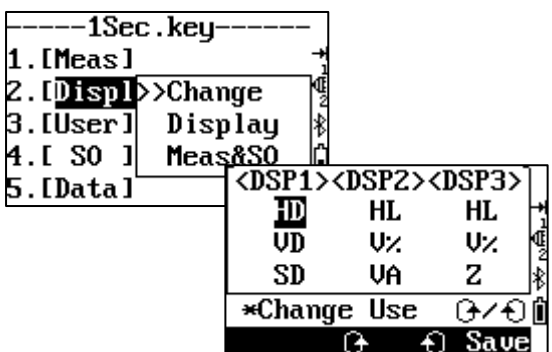
There are two [MSR] keys, F1 and F2. Each [MSR] key has 4 settings to define the target, prism constant, measure mode and [REC].



Refers to Chapter 3.1 EDM Setting for further information.

6.1.2 [DSP]

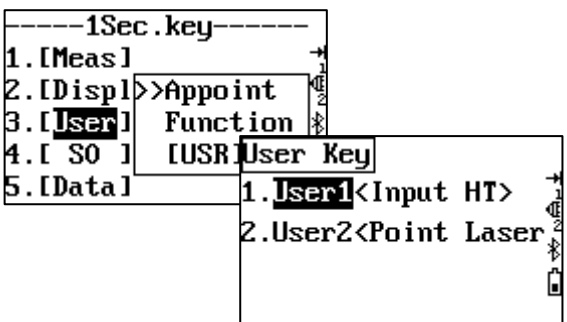
Change the display items for measure results in three pages, under the basic measurement screen and stake-out observation.



Refers to Chapter 3.2 Display for further information.

6.1.3 [USR]

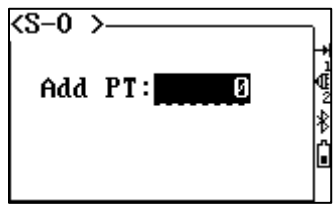
There are two [USR] keys, 1 and 2. The function that is assigned to each key is displayed beside the key name.



Refers to Chapter 10.User for further information.

6.1.4 [S-O]

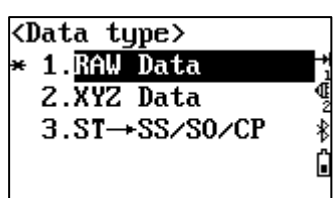
Input the added value of stake-out point.



6.1.5 [DAT]

Select the data type shown under [DAT].

The asterisk (*) indicates the selected type, among raw data, coordinate and station.



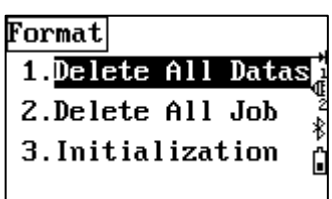
Refers to Chapter 9.Data for further information.

11.7 TIME

Press **8.Time** to set the date (in year-month-day) and time (in 24-hours).

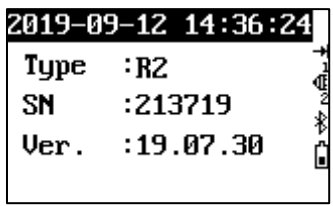
11.8 FORMAT

Press **9.Format** to delete all data; delete all files or delete all and return back to initial settings.



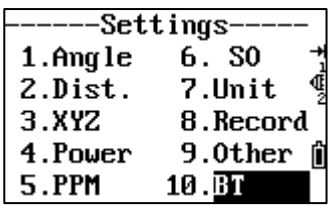
11.9 INFO

Select **10.Info** by navigation key to check the model name, SN and software version.

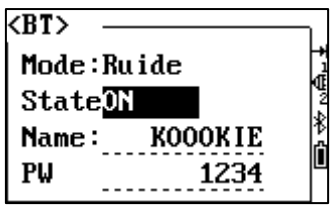


12. BLUETOOTH

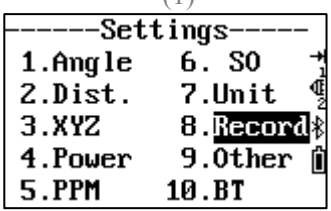
RQS can work with the third-party software on your PDA to control the measurement.



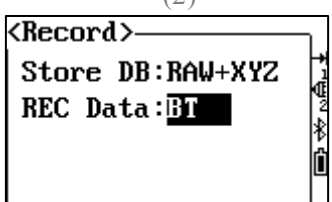
(1)



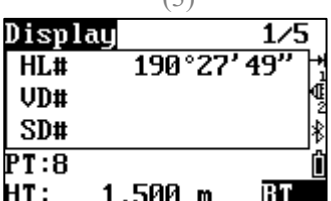
(2)



(3)



(4)



(5)

1. Activate the Bluetooth:
Press **[MENU]-[3.SET]-[10.BT]** PIC(1) to activate the Bluetooth of RQS PIC(2), change the name and password.

There will be a Bluetooth icon shown on the status bar.

2. Set the record method:
Press **[MENU]-[3.SET]-[8.Record]** PIC(3) to change the recording method by Bluetooth PIC(4).

After the setting of Bluetooth, return to BMS PIC(5).

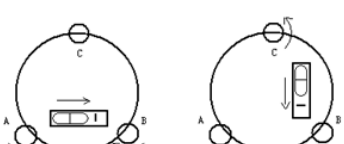
13. INSPECTION & ADJUSTMENT

The instrument has passed the procedure of inspection and adjustment before shipping to your side. However, after long periods of transportation or the changeable environment, some influences may occur to the internal structure. Before the instrument is used for the first time, please check and adjust the functions we introduced in this session to ensure the precision of the job.

13.1 PLATE VIAL

Inspection

Rotate the instrument after set-up (Refers to Chapter 2.2) to see whether the bubble is in center, if not, please adjust the vial.



Adjustment

1. If the bubble of the plate vial moves away from the center, bring it half way back to the center by adjusting the screws, which is parallel to the plate vial. Adjust the remaining half by adjusting pin.
2. Rotate the instrument in 180° to check whether the bubble is in the center. If not, repeat Step 1.
3. Rotate the instrument in 90°, adjust the third screw. Repeat the steps until the bubble remains in the center in any direction.

13.2 CIRCULAR VIAL

Inspection

It is not necessary to adjust the circular vial, except the bubble is not in the center after the adjustment of plate vial.

Adjustment

If the bubble of the circular vial is not in the center, adjust the bubble to the center by using the adjusting pin or hexagon wrench.

First, loosen the screw opposite to the offset side, and then tighten the other adjusting screw on the offset side, bringing the bubble to the center. When the bubble stays in the center, keep the tightness of the three screws uniformly.

13.3 INCLINATION OF RETICLE

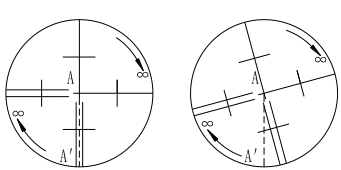
Inspection

1. Sight object A after leveling the equipment, lock the horizontal and vertical tangent unit and make sure that target A is in the center of cross-hair.

2. Move object A to the edge of the field of view, point A' by rotating the vertical tangent screw.

3. Adjustment is not necessary if object A moves along the vertical line of the reticle and point A' still in the vertical line.

Otherwise, as picture shown, A' is deviate to the center of the vertical cross-hair, it is necessary to adjust.



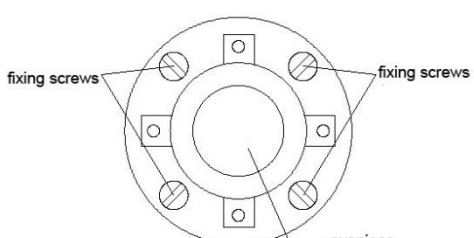
Adjustment

1. Remove the eyepiece cover to expose the four reticle adjusting screws, as picture shown.

2. Loosen the four reticle adjusting screws uniformly by the adjusting pin. Rotate the reticle around the sight line and align the vertical line of the reticle with point A'.

3. Tighten the adjusting screws slightly. Repeat the previous steps to see whether the position is correct.

4. Assemble the eyepiece cover back.



13.4 PERPENDICULARITY BETWEEN SIGHT OF VIEW & HORIZONTAL AXIS (2C)

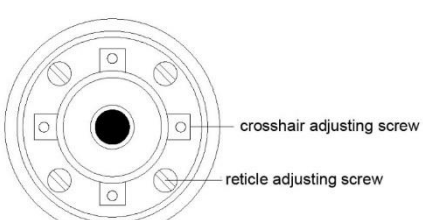
Inspection

1. Set object A at a far distance at the same height as the instrument, leveling the instrument and turn on the power (eg. HL=10° 13'10").

2. Sight object A in horizontal left and read value of HA. (eg. HR= 190° 13'40").

3. Loosen the vertical and horizontal tangent unit and rotate the telescope. Sight object A in horizontal right and read the HA.

4. 2C =HL-HR±180° =-30"≥±20", overrange. So it is necessary to adjust 2C.



Adjustment

1. Use the tangent screw to adjust the horizontal angle to the right reading which has been eliminated C:

R+C=190° 13′ 40″ -15″ =190° 13′ 25″

2. Take off the cover of the reticle between the eyepiece and focusing screw. Adjust the left and right adjusting screws by loosening one and tightening the other. Move the reticle to sight object A exactly.

3. Repeat inspection and adjustment until | 2C | ＜20".

4. Replace the cover of the reticle.

Note: After adjustment, please check the photoelectricity coaxially.

13.5 COMPENSATION OF VERTICAL INDEX DIFFERENCE

Inspection

1. After leveling the instrument, make the EDM parallel with the line connecting the center of the instrument to any one of the screws. Lock the horizontal clamp screw.
2. Switch on the equipment, zero the vertical index. Lock the vertical clamp screw and the instrument will display the vertical angle value.
3. Rotate the vertical tangent slowly in either direction about 10mm in circumference, and the overrange message appears. It means that the tilt of vertical axis is larger than 4', over the range. When rotate the vertical tangent unit in opposite direction back to the original place, the instrument will show the vertical angle again, it means that the compensation of vertical index difference works well.

Adjustment

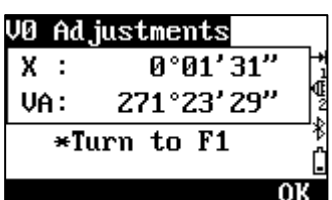
If the compensation function is not working, please send the instrument back to the authorized agency for maintenance.

13.6 VERTICAL 0 (I ANGLE)

The adjustment of vertical index difference (the so-called i-angle).This item must be adjusted after finishing the adjustment of tilt-sensor and crosshair.

Inspection

1. After leveling the instrument, collimate at any target A in HL. Record the value as L.
2. Rotate the EDM and aim at the target A in HR. Record the value as R.
3. If the vertical 0° in zenith, I =(L + R - 360°)/2. If the vertical 0 in horizon, I= (L + R - 180°)/2 or (L + R - 540°)/2.
4. If |i| ≥10", it need to reset the Vertical 0.



Adjustment

1. Press **1.V0 Adjustments** under [Menu]-7.Adjust.
2. Aim at target in Face 1 (HL), press **F4[OK]**.
3. Aim at the same target in Face 2 (HR), press **F4[OK]**.
4. The setting is finished. It will display [SET] on screen.

Note: Repeat the steps to check the Index Difference (i angle). If the difference still cannot meet the requirement, please check whether the steps you did are correct. Then reset again. Or return it to our authorize service center for inspection and repair.

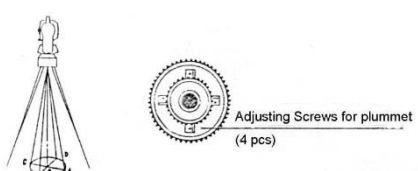
13.7 OPTICAL PLUMMET

Inspection

1. Set the instrument on the tripod and place a piece of white paper with two crisscross lines on it right below the instrument.
2. Adjust the focus of the optical plummet and move the paper so that the intersection point of the lines on the paper comes to the center of the field of view.
3. Adjust the leveling screws so that the center mark of the optical plummet coincides with the intersection point of the cross on the paper.
4. Rotate the instrument around the vertical axis, and observe whether the center mark position coincides with the intersection point of the cross at every 90°.
5. If the center mark always coincides with intersection point, it is not necessary to adjust.

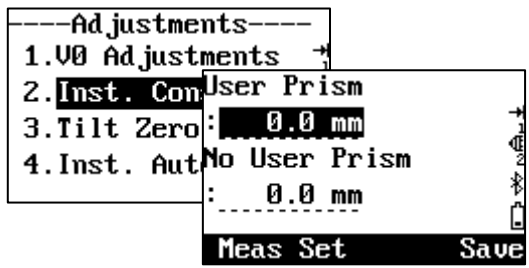
Adjustment

1. Take off the protective cover between the plummet eyepiece and focusing knob.
2. Rotate the instrument and mark the point of the center of optical plummet which falls on the paper in every 90°. Point A, B, C, and D.
3. Draw lines that attach AC and BD and mark the intersection point of the two lines as O.
4. Adjust the four adjusting screws of the optical plummet with an adjusting pin until the center mark coincides with Point O.
5. Repeat the steps to make the instrument meets the requirements.



13.8 INST. CONSTANT (K)

The Instrument constant has been checked and adjusted in the factory, and K=0. It seldom changes and check once or twice in a year.

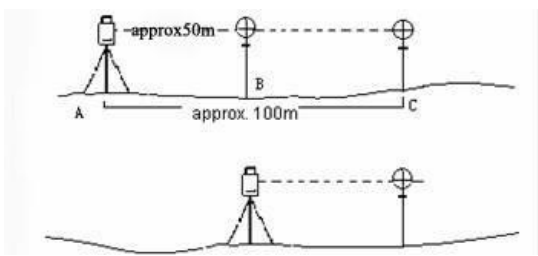


Press **2.Inst.Constant** under [Menu]-7.Adjust.

Inspection

1. Mount and level the instrument on Point A on flat ground. Use the vertical hair to mark Point B and Point C with the distance of 50m on the same line, and collimate the reflector accurately.

2. After setting temperature and pressure value, measure the horizontal distance of AB and AC accurately.



3. Setup the instrument on Point B and center it accurately. Measure the horizontal distance of BC.

4. Then you can get the Instrument Constant: K = AC - (AB + BC). The value of K should be close to 0. If |K|>5mm, the instrument should be strictly inspected on the base alignment, and be adjusted according to the inspection value.

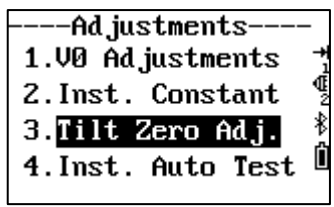
Adjustment

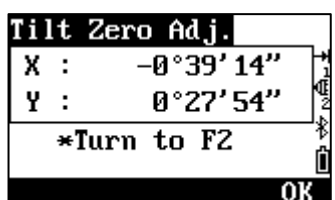
Set the orientation through the vertical hair to make Point A,B, and C on the same line strictly. There must be a fixed and clear centering mark under the Point B.

The coincidence of the target center and the instrument center is very essential to the accuracy. Therefore, it will be the best to use a tripod or a common-used tribrach on the point B. If we replace it with a three-foot adapter and a tribrach, make sure that they are stable and fixed. It is possible to reduce the inconsistency if we just replace the upper part of the prism and the upper part of the instrument.

13.9 TILT-SENSOR

Press **3.Tilt Zero Adj**. under [Menu]-7.Adjust. Focusing the same target by HL and HR, and follow the guidance of equipment





Note: Please adjust the plate vial before the tilt sensor..

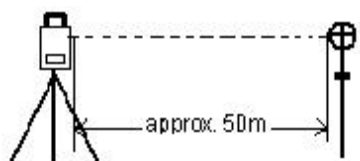
13.10 COINCIDENCE BETWEEN SIGHT OF VIEW AND EMITTING AXIS

Inspection

1. Set the reflector 50m away from the instrument.
2. Collimate and measure the center of target with reticle.
3. Rotate the tangent screw to launch electric collimation and make the light path of EDM unblocked. In the bright zone find the center of emitting photoelectric axis.
4. Check whether the center of reticle coincide with the center of emitting photoelectric axis. If yes, the instrument is eligible.

Adjustment

If there is a huge deviation between the sight of view and emitting axis, please send the instrument to authorized service center for maintenance.



13.11 LEVELING SCREWS ON TRIBRACH

If any of the leveling screws becomes loose, tighten the adjusting screws on the side of leveling screw appropriately.

14 SPECIFICATIONS

TELESCOPE	
Length	154mm
Objective Diameter	Telescope:45mm; EDM: 50mm
Magnification	30x
Image	Erect
Field of View	1°30'
Resolving Power	3"
Mini. Focus	1.0m
DISTANCE MEASUREMENT	
Single Prism	5000m
Non-Prism	600m
Accuracy - Prim	±(2mm+2ppm x D)mm
-Non-P	±(3mm+2ppm x D) mm
Interval	Fine: 0.7s, Normal: 0.5s
T-P Correction	Auto Sensing
Prism Constant	Manual Input
Unit	Meter/ Feet/ Inch
ANGLE MEASUREMENT	
Method	Absolute Encoding
Detecting System	H: 2 sides V: 2 sides
Min. Reading	1"/5"/10"
Accuracy	2"
Diameter of Circle	79mm
Vertical Angle 0°	Zenith 0°/ Horizontal 0°
Unit	360°/400 gon/6400 mil
DISPLAY	
Display Unit	Graphic LCD 160x90 dots with Backlight
No. of Unit	2
Keyboard	Alphanumeric Keys
TILT CORRECTION	
Tilt Sensor	Dual Axis
Method	Liquid Electric
Range	±4'
Accuracy	1"
LEVEL SENSITIVITY	
Plate Level	30"/2mm
Circular Level	8'/2mm
OPTICAL PLUMMET (OPTIONAL)	
Image	Erect
Magnification	3X
Focusing Range	0.3m to ∞
Field of View	5°
LASER PLUMMET (DEFAULT)	
Laser Class	Red laser, Class II
Accuracy	<0.4mm @ 1.5m height
Diameter	<2.0mm @ 1.5m height
DATA STORAGE & INTERFACE	
Internal Memory	>10,000 points
Data Interface	USB Drive
GENERAL	
Laser in EDM	Class IIIA
Bluetooth	Bluetooth 2.1, WT12
Battery Type	2 Rechargeable Li-ion Battery
Battery Voltage	DC 7.4V
Working Time	16 hours
Working Temperature	-20°C to +50°C

15. ERROR CODE

CODE	DESCRIPTION	SOLUTION
E001	Error in opening the system file	1. Format the equipment. 2. Turn on the equipment again. If the error code still exist, please return to specialist for repair.
E002	Error in opening files	
E003	Error in initializing files	
E004	Error in writing files	
E005	Error in reading files	
E006	Error in deleting files	
E007	Error in hardware checking	
E031	Error in vertical parity	1.Shut down the equipment 2.Turn on the equipment again to check whether the error code still exist. 3.If yes, try to change a good angle board. 4.If it still doesn't work, please return to specialist for repair.
E032	Error in horizontal parity	
E033	Error in angle measurement	
E034	Error in upper vertical-CCD	
E035	Error in shorter horizontal-CCD	
E036	Error in longer horizontal-CCD	
E037	Error in lower vertical-CCD	
ERROR_32	Error in EDM dimmer motor	1. Shut down the equipment 2. Turn on the equipment. If the error code still exist, please return to specialist for repair.
ERROR_33	Error in EDM high-voltage adjustment	
ERROR_35	Error in internal light path 1	
ERROR_36	Error in internal light path 1	
EDM ERR	Unknown EDM error.	

16. SAFETY GUIDE

16.1 INTERNAL DISTANCE METER (VISIBLE LASER)

Warning

The total Station is equipped with an EDM of Laser Class 3A/III a and it is verified by these labels as follows:

There's an indication label "CLASS III LASER PRODUCT" above the vertical clamp screw on Face Left as well as on the Face Right.

The product is classified as Class 3A laser product, according to the standards as follows:
IEC60825-1:2001 "SAFETY OF LASER PRUDUCTS"
The product is classified as Class III a laser product according to the standards as follows:
FDA21CFR ch.1 § 1040:1998 (U.S. department of Health and Human Services, Code of Federal Regulation)
Class 3A/III a laser product: It is harmful to observe the laser beam continuously. Users should avoid staring at the laser directly. It can reach as much as 5 times the emitting limit of Class 2 / II with a wavelength between 400nm and 700nm.

Warning

It is harmful to continuously look straight at the laser beam.

Prevention

Do not stare at the laser beam, or point the laser beam at others. Reflecting laser beam is also valid.

Warning

When the laser beam emits on prism, mirror, metal surface, window, it might be dangerous to look directly by the reflecting light.

Prevention

Do not stare at the direction which the laser beam might reflects. When the laser is opened, do not look at it near to the optical path or the prism. It is only allowed to observe the prism through the telescope of the total station.

Warning

It is dangerous to make improper use of the Class IIIa laser equipment.

Prevention

To avoid injury, all the users should take safety precautions, and must make sure that everything is under control within the distance that might bring dangers (according to IEC60825-1:2001)

There are explanations of some principle points of related standard as follows:

Class 3R laser product is used in outdoors and construction site (measuring, defining alignment, leveling, etc.). The laser equipment can only be installed, adjusted and operated by those persons who have taken related training course and got the authentication.

a. Set related laser warning marks on site.

b. Prevent anyone from looking straight at the laser beam directly or through optic instrument.

c. To avoid the harm brought by laser, users should block the laser beam at the end of the working route. When the laser beam passes through the restricted area (harmful distance*), and there are persons taking activities, users must stop the laser beam in time.

d. The optical path of the laser beam should

be set higher or lower than the line of sight.

e. When the laser instrument is not in use, users should keep it well. It is not allowed for operation unless the user is authenticated.

f. Prevent the laser beam from accidentally emitting at mirror, mental surface, window, etc. Especially pay attention to the surface of plane mirror or concave mirror.

* Harmful distance suggests that the maximum distance from the start point of the laser beam to the point which the laser beam is weakened to a certain degree that doesn't harm people.

The internal distance measure product which is equipped with a Class3R/III a Laser Product has a harmful distance of 1000m (3300ft). Beyond this distance, the laser strength is weakened to Class I (It is not harmful to look straight at the laser beam

16.2 LASER PLUMMET

The internal laser plummet sends out a ray of red visible laser beam from the bottom of the instrument.

This product is classified as Class 2/II laser product. Class 2 laser product is in accordance with the following standard:
IEC 60825-1:1993 "SAFETY of LASER PRODUCTS"
EN 60825-1:1994+A II:1996 " SAFETY of LASER PRODUCTS".

Class II laser product is in accordance with the following standard:
FDA21CFR ch.1 § 1040:1998 (U.S. Department of Health and Human Services, Code of Federal Regulations).

Class 2/II Laser Product:
Do not stare at the laser beam or point it at others. Users should prevent the laser beam and the strong reflecting light from impinging into eyes so as to avoid incurring harm.

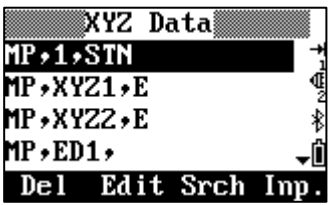
APPENDIX A - DATA FORMAT

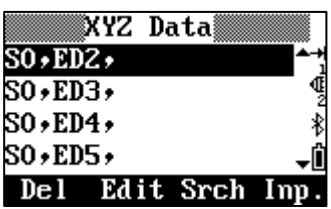
1. RAW DATA

RQS can export the raw data into RUIDE and SDR33 format. The explanations of RUIDE format as follows:

LINE	EXPLANATION
CO,Ruide Raw data	The type of transmitted data
CO,190905-1	File name
CO,Description:	JOB description
CO,Client:	User
CO,Comments:	Notes
CO,Downloaded 2019-09-12 11:17:33	Date and time for data export
CO,Software: Pre-install version: 19.07.30	Software version
CO,Instrument: Ruide RQS 213719	Serial number of this instrument
CO,Dist Units: Metres	Distance unit
CO,Angle Units: DDDMMSS	Angle unit
CO,Zero azimuth: North	AZ Zero azimuth
CO,VA: Zenith	VA Zero azimuth

CO,Coord Order: NEZ	Coordinate order
CO,HA Raw data: Azimuth	HA
CO,Projection correction: OFF	Status of Projection correction
CO,C&R correction: ON	Status of C&R correction
CO,Tilt Correction: OFF	Status of tilt correction
CO,190905-1 <JOB> Created 2019-09-05 17:03:50	JOB creating time
MP,1,,10.000,10.000,1.000,VM	Inputted coordinate. Point ID, N, E, Z, code
CO,Temp:20.0 C Press:1013.2 hPa Prism:0mm 2019.09.06 08:55:19	Temperature, pressure, prism constant, date and time
ST,1,,,,1.000,50.0000,50.0000	Station coordinate. Point ID, instrument height, azimuth (AZ), horizontal angle (HA)
F1,5,1.800,1.999,176.5958,99.2715, 23:26:28	Backsight data. Point ID, target height, SD, HA, VA and time
SS,P2,1.500,2.365,129.1612,53.2854, 10:04:06,RD	Measured data. Point ID, target height, SD, HA, VA, time and code
SO,,,1.800,1.089,5.0432,84.5528, 22:40:28,	Stake-out data. Target height, slope distance, HA, VA and time



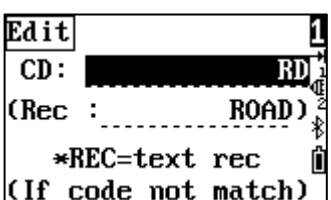


The format of uploaded/downloaded coordinate data is determined by user's setting. If you need to transmit the coordinate data from PC to RQS, please edit the data under the format: **Point ID, E, N, Z, Code**

For example:

1,100.000,100.000,1.000,STN
XYZ1,100.000,200.000,10.000,E
XYZ2,80.000,80.000,2.000,E
ED1,50.000,50.000,1.000,
ED2,99.774,101.070,1.888,
ED3,100.002,99.991,0.650,
ED4,99.485,102.434,1.921,
ED5,99.343,103.109,1.897,
3,100.089,98.843,1.883,
8,80.000,84.000,3.000,
2,25.000,50.000,0.000,

3. CODE LIST

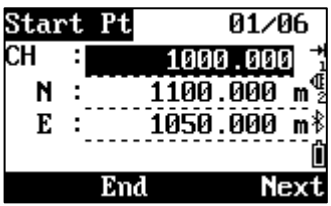


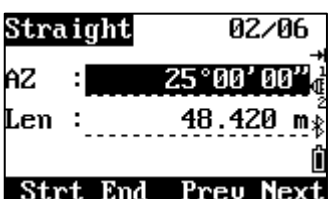
The code list should be guaranteed that every line has one code which included quick code and code, each line should ended by carriage returns. When there is no definition of code, the code is default as the content of serial number. In quick code function, one can transfer code by entering serial number.

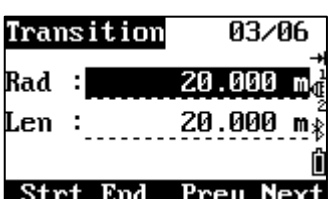
The format of code list is: **Quick-code, Code**

For example:

RD,ROAD
HS,HOUSE
LP,LAMP
TR,TREE
PT,POINT
ST,STATION
BS,BACKSIGHT
SS,SIDE







Transmit the road elements from PC to RQS with initial definition, include the point ID and coordinate of start chainage.

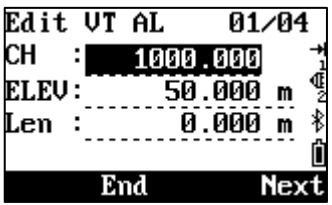
The elements of horizontal alignment should be recorded as the format: **(KEYWORD) nnn, nnn [, nnn]**

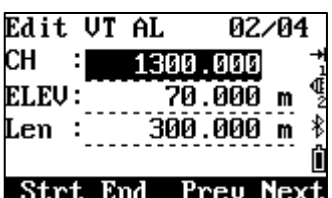
START Chainage#, E, N
STRAIGHT Azimuth, Distance
ARC Radius, Length of arc
TRANSITION Radius, Length of curve
PT N, E, radius, A1, A2

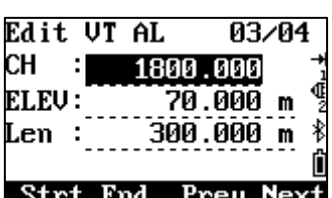
For example:

START 1000.000, 1050.000, 1100.000
STRAIGHT 25.0000, 48.420
SPIRAL 20.000, 20.000
ARC 20.000, 23.141

5. VERTICAL CURVE







Input vertical curve data from computer through point and stake number, the vertical curve data should include the height, curve length, the curve length of start point and terminal point is zero.

The elements of vertical alignment should be recorded as the format: **Stake number, height, length**

For example:

1000.000, 50.000, 0.000
1300.000, 70.000, 300.000
1800.000, 70.000, 300.000
2300.000, 90.000, 0.000

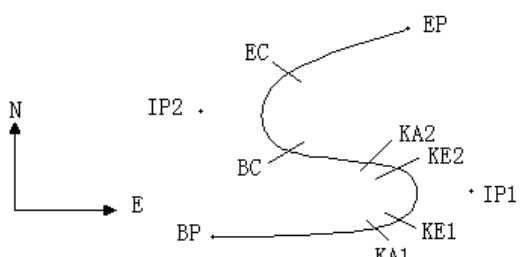
APPENDIX B – CALCULATE ALIGNMENT OF ROADS

The alignment stake-out under ROADS included the elements of straight, arc and transition curve. The alignment data is managed by chainage.

1. ROAD ALIGNMENT ELEMENTS

The elements can be input by manual or transmit from PC.

When data is transmitted from PC or selected PT option, it not necessary to calculate the parameter.



Pt	N	E	R	A1	A2
BP	1100.00	1050.00			
IP1	1300.00	1750.00	100	80	80
IP2	1750.00	1400.00	200	0	0
EP	2000.00	1800.00			

The format of data transfer to PC shown as:

START 0.000, 1050.000, 1100.000 CRLF

PT 1750.000, 1300.000, 100.000, 80.000, 80.000 CRLF

PT 1400.000, 1750.000, 200.000, 0.000, 0.000 CRLF

PT 1800.000, 1800.000, 2000.000 CRLF

2. CALCULATE THE ELEMENTS OF ALIGNMENT

(1) Calculate the length of transition curve

$$L_{1.2} = \frac{A_{1.2}^2}{R}$$

L_{12}: Length of curve

A_{12}: Parameter of curve

R: Radius

Based on this formula:

:

$$L_1 = \frac{A_1^2}{R} = \frac{80^2}{100} = 64 \text{ m, same as } L_2.$$

(2) Calculate the turning angle

$$\tau = \frac{L^2}{2A^2}$$

Based on the formula:

$$\tau_1 = \frac{64^2}{2 \cdot 80^2} = 0.32\text{rad} = 0.32 \frac{180}{\pi} = 18°20'06"$$

$$\therefore \quad \tau_1 = -\tau_2$$

(3) Calculate the transition coordinates

$$N = A \cdot \sqrt{2\tau}\ (1 - \frac{\tau^2}{10} + \frac{\tau^4}{216} - \frac{\tau^6}{9360} ....)$$

$$E = A \cdot \sqrt{2\tau}\ (\frac{\tau}{3} - \frac{\tau^3}{42} + \frac{\tau^5}{1320} - \frac{\tau^7}{7560} ....)$$

Based on the formula:

$$N = 80 \cdot \sqrt{2 \cdot 0.32}\ (1 - \frac{(0.32)^2}{10} + \frac{(0.32)^4}{216} - \frac{(0.32)^6}{9360} ....)$$

$$= 64(1 - \frac{0.01024}{10} + \frac{0.01048576}{216} - \frac{0.00107341824}{9360})$$

$$= 64(1 - 0.01024 + 0.00004855 - 0.00000011)$$

$$= 64 * 0.98981 \qquad = 63.348$$

Calculate the value of E, E=6.777.

This example is symmetry curve N1=N2, E1=E2.

(4) Calculate the rise value

$$\Delta R = E - R(1-\cos\tau)$$

△R=6.777-100(1-cos18°20′06″) =1.700

Symmetry transition △R1=△R2

(5) Calculate the coordinate of trans-point

$N_m = N - R\sin\tau$ =63.348-100sin18°20′06″

=31.891

Symmetry transition $N_{m1}=N_{m2}$

(6) Calculate the tangent distance

$$D_1 = R\tan(\frac{LA}{2}) + \Delta R_2 \cos ec(LA) - \Delta R_1 \cot(LA) + N_{m1}$$

LA=111°55′47″,

Based on the formula:

D_1=100*tan(111°55′47″/2)+1.7(1/sin111°55′47″)–1.7(1/tan 111°55′47″) +31.891

=182.468, and $D_1=D_2$

(7) Calculation of the coordinate KA1

$$N_{KA1} = N_{IP1} - D_1 \cdot \cos\alpha_1$$

$$E_{KA1} = E_{IP1} - D_1 \cdot \sin\alpha_1$$

Bearing from BP to IP1, α_1=74°03′16.6″

NKA1=1300–182.468*cos74°03′16.6″

=1249.872 m

EKA1=11750–182.468*sin74°03′16.6″

=1574.553 m

(8) Calculate the length of arc

$$L = R(LA - \tau_1 + \tau_2)$$

=R(111°55′47″-2 * 18°20′06″)

=131.353 m

(9) Calculate the coordinate of KA2

$$N_{KA2} = N_{IP1} - D_2 \cdot \cos\alpha_2$$

$$E_{KA2} = E_{IP1} - D_2 \cdot \sin\alpha_2$$

Bearing from IP1 to IP2, α_2=322°07′30.1″

N_{KA2}=1300–(-182.468)*cos322°07′30.1″
= 1444.032 m
E_{KA2}=1750–(-182.468)*sin322°07′30.1″
= 1637.976 m

(10) Calculate the coordinates of BC,EC
Length of arc $CL = R \cdot IA$
LA= 95°52′11″

Based on the formula:
CL=200 * 95°52′11″* $\frac{\pi}{180^\circ}$ =334.648 m
Tangent length
$TL = R \cdot \tan(\frac{IA}{2})$ =200*tan(95°52′11″/2)
=221.615 m

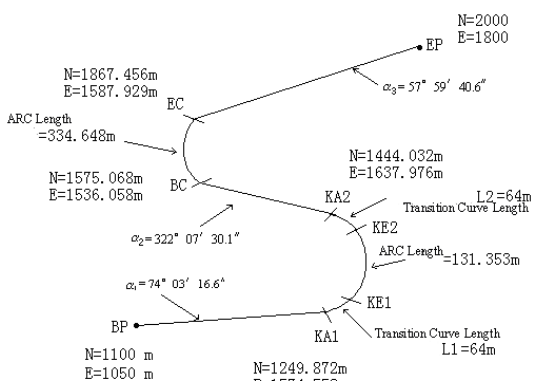
Each coordinates are computed:

$$N_{BC} = N_{IP2} - TL \cdot \cos\alpha_2$$
$$E_{BC} = E_{IP2} - TL \cdot \sin\alpha_2$$

$$N_{EC} = N_{IP2} - TL \cdot \cos\alpha_3$$
$$E_{EC} = E_{IP2} - TL \cdot \sin\alpha_3$$

Here: α_2(Azimuth from IP1 to IP2) = 322°07′30.1″
α_3 (Azimuth from IP2 to EP) = 57°59′40.6″

N_{BC}=1750 - 221.615*cos322°07′30.1″ =1575.068 m
E_{BC}=1400 - 221.615*sin322°07′30.1″ =1536.058 m
N_{EC}=1750 –(-221.615 *cos57°59′40.6″=1867.456 m
E_{EC}=1400 –(-221.615)*sin57°59′40.6″=1587.929 m



The coordinates and the distances are calculated as below

The length of straight line

Line BP -KA1= 545.543m

Line KA2 -BC= 166.005m

Line EC -EP= 250.084m

Start point coordinate (BP)

N 1100.000 m

E 1050.000 m

Straight line between BP and KA1

Azimuth 74°03'16.6"

Distance 545.543 m

Transition curve between KA1 and KE1

Radius -100 m

Length 64 m

Arc between KE1 and KE2

Radius -100 m

Length 131.354 m

Transition curve between KE2 and KA2

Radius -100 m

Length 64 m

Straight line between KA2 and BC

Azimuth 322°07'30.1"

Distance 166.004 m

Arc between BC and EC

Radius 200m

Length 334.648 m

Straight line between EC and EP

Azimuth 57°59'40.6"

Distance 250.084m

- Go to www.ruide.xyz/software to download any necessary software and digital manuals for RQS.
- Materials and specifications are subject to change without notice.

http://www.ruide.xyz

support@ruideinstrument.com