SANDING

USER MANUAL

TOTAL STATION
STS-750RC SERIES

CONTENTS

FOREWORDS

Congratulations on the purchase of the SANDING Total Station STS-750RC Series.

This manual is for the application of SANDING Total Station STS-750RC Series.

Total Station STS-750RC is equipped with visible infrared laser EDM which can measure the distance without sighting a reflector.

Before operating the instrument, please read this manual carefully.

FEATURES:

Powerful Software Functions

The internal software installed in Total Station STS-750RC Series is precisely designed. It boasts of compact menu structure and complete and practical application programs, which proves efficient and helpful in the process of project measurement and stake-out.

Simplified Operation

Total Station STS-750RC Series has various functional keys, coupled with an input mode combining characters and numbers perfectly. It's simple, practical, and convenient in use, which enables the engineers who don't even have too much surveying experience to master the operation quickly.

Absolute Encoding Disk

The pre-assembled Absolute Encoding Disk enables the user to start measurement directly after switching on the instrument. Even if the user changes the battery during operation, the azimuth data will not be deleted.

Reflectorless EDM

The reflectorless laser EDM function equipped in Total Station STS-750RC Series can be operated the measurement on various materials of different colors (such as the wall surface of building, telegraph pole, wire, cliff, hill and mountain, earth and soil, stump) from long distance with high precision. It brings great convenience to surveyors when measuring a target that is hard or even impossible to reach.

SD card and miniUSB data transfer

With SD card and miniUSB cable, Total Station STS-750RC provides users an enlarged storage and a more convenient data transfer with comparison to previous COM port.

High Precision and Long Measuring Range

The measuring range of Total Station STS-750RC Series is 5.0km with single prism. And the reflectorless range of STS-750RC Series can reach up to 350m.

Reliable Water Dust Proof Function

Total Station STS-750RC Series boasts of water and dust proof function, which realizes a breakthrough in terms of the hardware performance of total station.

PRECAUTIONS

1. Do not collimate the objective lens directly to the sun without a filter.
2. Do not store the instrument in high and low temperature to avoid the sudden or great change of temperature.
3. When the instrument is not in use, place it in the case and avoid shock, dust and humidity.
4. If the temperature in the work site is greatly different from that in the store place, before operation you should leave the instrument in the case with the cover opened until the temperature of the instrument get similar to the surrounding temperature.
5. If the instrument will not be used for a long time, you should remove the battery. And the battery should be recharged once a month.
6. During transportation, the instrument should be placed in the carrying case, it is recommended that cushioned material should be used around the case for support.
7. To meet the requirement of less vibration and better accuracy, the instrument should be mounted on a wooden tripod rather than an aluminum tripod.
8. Clean exposed optical parts with degreased cotton or lens tissue only!
9. Clean the instrument surface with a woolen cloth. If it gets wet, dry it immediately.
10. Before working, check the power, functions and indications of the instrument as well as its initial settings and correction parameters.
11. Unless the user is a maintenance specialist, do not attempt to disassemble the instrument by yourself even if you find the instrument abnormal.
12. Do not sight the eyes when Total Station STS-750RC Series is in work and emits visible laser.

SAFETY GUIDE

Internal EDM (Visible Laser)

Warning:

The total station is equipped with an EDM of a laser grade of 3R/IIIa. It is verified by the following labels.

On the vertical tangent screw sticks an indication label “CLASS III LASER PRODUCT”. Another same label is on the opposite side.

This product is classified as Class 3R laser product, which accords to the following standards.

IEC60825-1:2001 “SAFETY OF LASER PRODUCTS”.

Class 3R/IIIa laser product: It is harmful to observe the laser beam continuously. User should avoid sighting the laser at the eyes. It can reach 5 times the emitting limit of Class2/II with a wavelength of 400mm-700mm.

Warning:

Continuously looking straight at the laser beam is harmful.

Prevention:

Do not stare at the laser beam, or point the laser beam to others' eyes. Reflected laser beam is a valid measurement to the instrument.

Warning:

When the laser beam emits on prism, mirror, metal surface, window, etc., it is dangerous to look straight at the reflex.

Prevention:

Do not stare at the object which reflects the laser beam. When the laser is switched on (under EDM mode), do not look at it on the optical path or near the prism. It is only allowed to observe the prism with the telescope of the total station.

Warning:

Improper operation on laser instrument of Class 3R will bring dangers.

Prevention:

To avoid to be harmed, each user is required to take safety precautions, and take everything under control within the distance that would incur dangers (according to IEC60825-1:2001).

The following shows the explanation related to the key sections of the Standard.

Laser instrument of Class 3R is applicable outdoors and in construction field (measurement, defining lines, leveling).

a) Only specialists who are trained related course and authenticated are allowed to install, adjust, and operate this kind of laser instrument.

b) Stand related warning symbols in the scale of use.

c) Prevent any person to look straight at or use optical instrument to observe the laser beam.

d) To prevent the harm caused by laser, block the laser beam at the end of the working route. When the laser beam exceeds the limit area (harmful distance*) and when there are motivating persons, stopping the laser beam is a must.

e) The optical path of the laser should be set higher or lower than the line of sight.

f) When the instrument is not in use, take care of it properly. The person who is not authenticated is not allowed to use.

g) Prevent the laser beam from irradiating plane mirror, metal surface, window, etc., especially beware of the surface of plane mirror and concave mirror.

** Harmful distance means the maximum distance between the start point and the point which the laser is weakened to a degree that isn't harmful.*

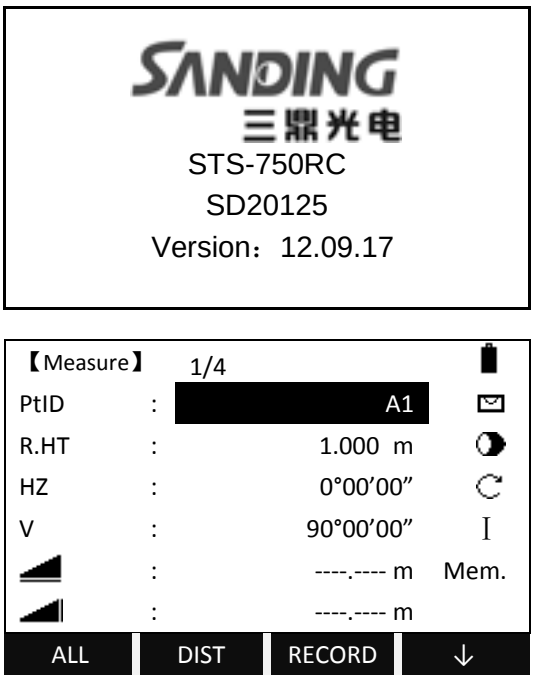
The internal EDM instrument equipped with a Class 3R/III a Laser has a harmful distance of 1000m (3300ft). Beyond this distance, the laser intensity is weakened to Class I (Looking straight at the laser beam causes no harm to the eyes.)

1. IMPORTANT PARTS AND FUNCTIONS

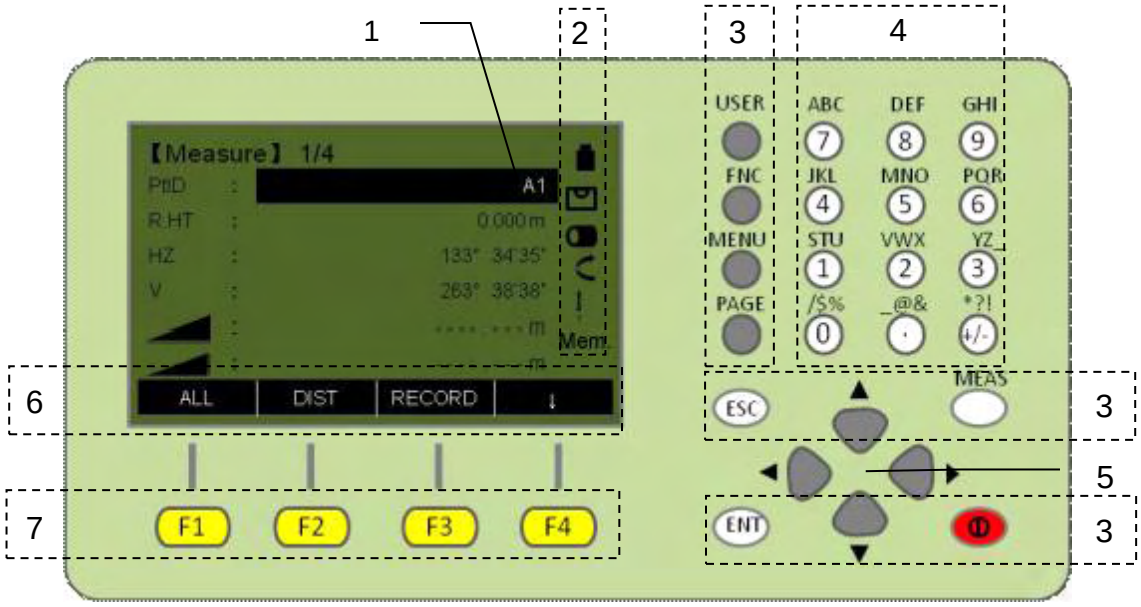
1.1 IMPORTANT PARTS

1) objective lens
2) center mark
3) eyepiece
4) telescope focusing knob
5) collimator
6) Ni-H rechargeable battery
7) horizontal tangent screw
8) display
9) keyboard
10) tribrach lock
11) laser plummet (optical plummet)
12) leveling screw
13) plate vial
14) vertical tangent screw
15) SD card and USB port
16) tribrach
17) circular vial

1.2 DISPLAY



1.3 KEYPAD



1) Focus

Actively measured field.

2) Symbols

3) Fixed keys

Keys with firmly assigned functions.

4) Alphanumeric keys

5) Navigation keys

Control of input bar in edit and input mode or control of focus bar.

6) Soft key bar

Displays functions that can be called up by the soft keys.

7) Function keys

Are assigned the various functions displayed on the bottom of the screen.

1.4 FIXED KEYS

[User]: User key can be defined. It can be defined from the “Function” menu.

[FNC]: Quick access to measurement-supporting functions.

[Menu]: Menu key, to access to *Programs, Settings, EDM Settings, File Management, Adjustment, Comm Parameters, Data Transfer, System Information.*

[PAGE]: Page key. Turn to next page if several pages are available.

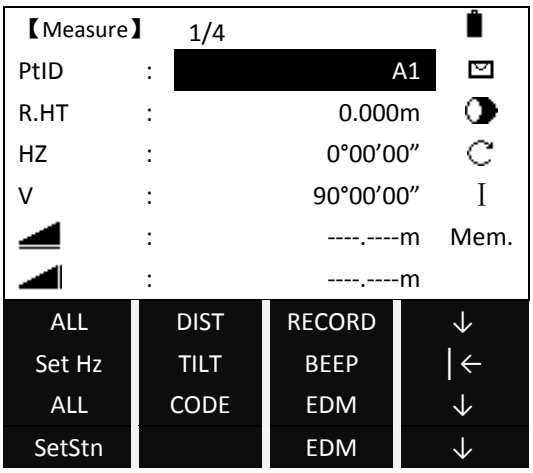
[ESC]: Quit a dialog or the edit mode without saving the changes. Return to an upper menu.

[ENT]: Confirm an input, and continue to the next input field.

1.5 TRIGGER KEY

The measurement trigger key has three settings (All, DIST, OFF), which can be defined in *Settings*.

1.6 SOFT KEYS



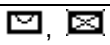
The measurement data is displayed in the several upper lines of the display, while a selection of commands and functions are at the bottom of the screen, which can be chosen by pressing corresponding function keys from F1 to F4.

Soft Keys:

Key	Function
[All]	Starts angle and distance measurements, and saves the measured values.
[DIST]	Starts angle and distance measurements without saving the measured values.
[RECORD]	Saves displayed values.
[ENH]	Opens the coordinates input mode.
[LIST]	Displays the list of existed points.
[SEARCH]	Searches for the point entered.
[EDM]	Enters to EDM settings.
[ESC]	Returns to the previous screen.
[|←]	Returns to the highest soft key level.
[↓]	Turns to next soft key level.
[ENT]	Sets displayed message or dialog and quits dialog.

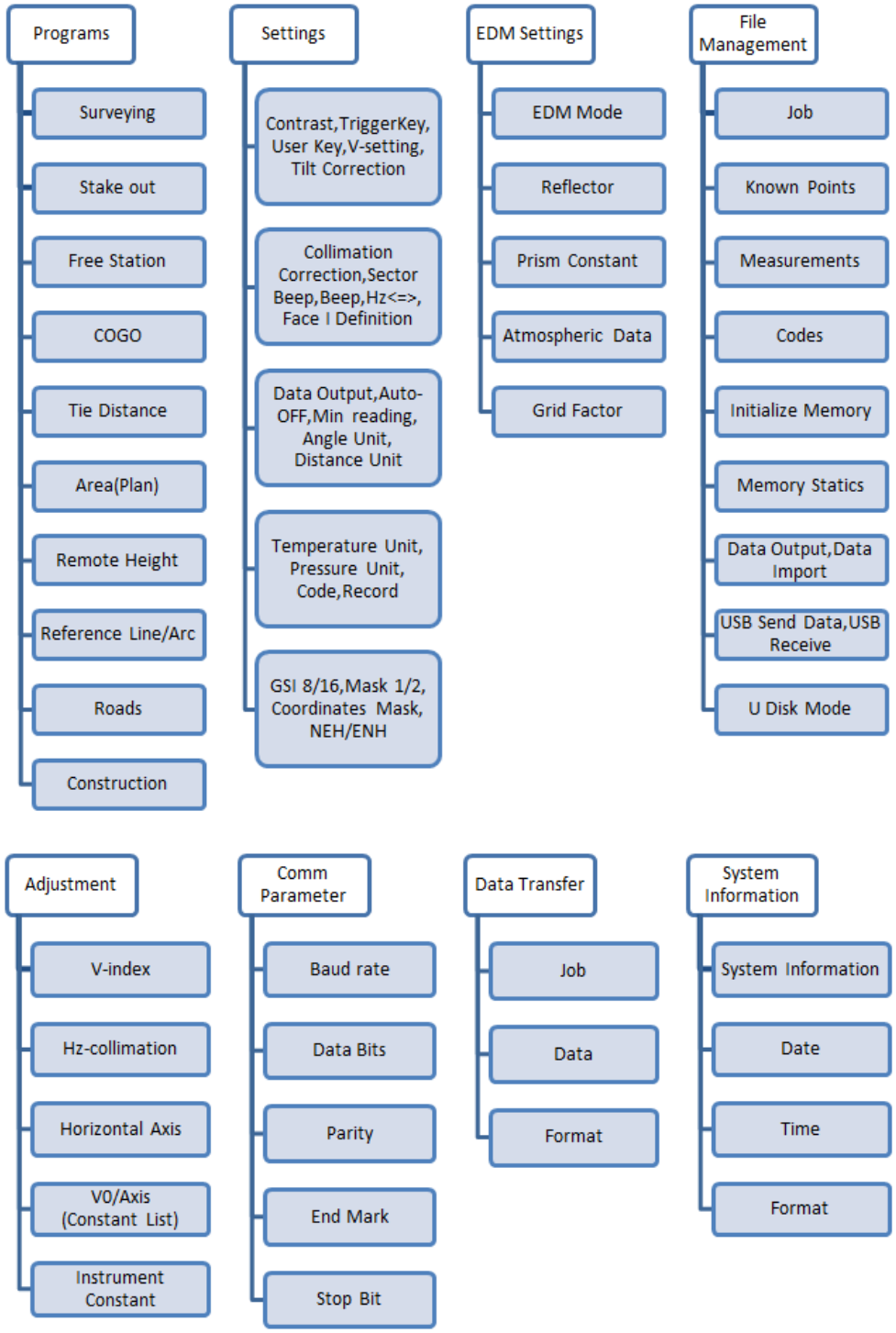
1.7 SYMBOLS

Symbol indicates a particular operating status depending on different software versions.

Key	Meaning
	A double arrow indicates choice fields.
	Using the navigation keys the desired parameter can be selected.
	Quits a selection with the enter key or navigation keys.
	Indicates that several pages are available which can be selected with [PAGE].
Ⅰ, Ⅱ	Telescope position is on Face Ⅰ or Face Ⅱ.
	Hz is set to “left angle measurement”(or right angle measurement), that is to anticlockwise (clockwise).
	IR EDM mode/reflectorless EDM mode/reflecting sheet measurement mode.
	Shows the remaining battery capacity.
	The compensator is on/off.
01, AB	Numeric mode/alphanumeric mode.
Mem. COM.	The measuring data recorded in the internal memory or via com port to data collector.

1.8 MENU TREE

[Menu]>F1-F4: Confirms the selected menu. Press [PAGE] to view the next page.



2. PREPARATION FOR MEASUREMENT

2.1 UNPACKING AND STORE OF INSTRUMENT

· *Unpacking*

Place the case lightly with the cover upward, and unlock the case, take out the instrument.

· *Storing the Instrument*

Cover the telescope cap, place the instrument into the case with the vertical clamp screw and circular vial upwards (Objective lens towards tribrach), and slightly tighten the vertical clamp screw and lock the case.

2.2 INSTRUMENT SETUP

Mount the instrument to the tripod. Level and center the instrument precisely to ensure the best performance.

Operation Reference:

a. Level and center the instrument by plumb bob.

1) Set up the tripod

①First, extend the legs of the tripod to a suitable length, make the tripod head approximately parallel to the ground and tighten the screws.

②Make the centre of the tripod and the occupied point approximately on the same plumb line.

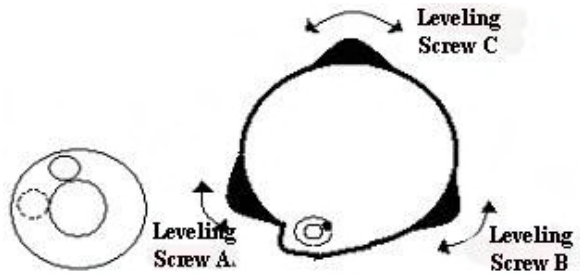
③Step on the tripod to make sure if it is well stationed on the ground.

2) Mount the instrument on the tripod.

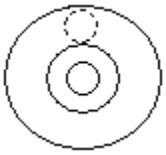
Put the instrument carefully on the tripod head and level the instrument by loosening the tripod screw. If the plumb bob is positioned right over the center of the point, slightly tighten the tripod.

3) Roughly level the instrument by adjusting the circular vial.

①Turn the leveling 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 .

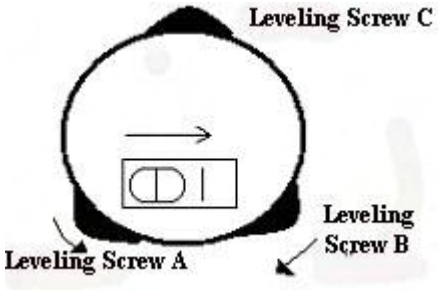


②Turn the leveling screw C to move the bubble to the center of the circular vial.

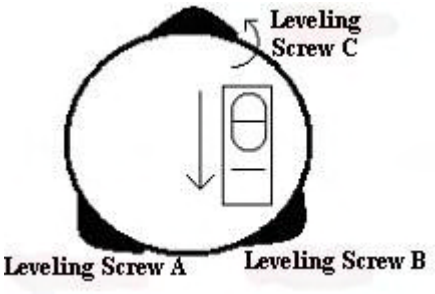


4) Precisely leveling by using the plate vial

①Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel to the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.



②Rotate the instrument 90º(100g) around its vertical axis and turn the remaining leveling screw or leveling C to center the bubble once more.



③Repeat the steps ①② for each 90º(100g) rotation of the instrument and check whether the bubble is correctly centered in all directions.

b. Center by using the optical plummet

1) Set tripod

Lift tripod to suitable height, ensure equal length of three legs, spread and make tripod head parallel to the ground, and place it right above the measurement station point. Prop up tripod on the ground and fix one leg.

2) Install instrument and collimate the point

Set instrument carefully on tripod, tighten the central connecting screw and adjust optical plummet to make the reticle distinctly. Hold the other two unfixed legs with both hands and adjust position of these two legs through observation of optical plummet. As it approximately aims at the station point, make all three legs fixed on the ground. Adjust three leg screws of the instrument to make optical plummet collimate precisely to the station point.

3) Use circular vial to roughly level the instrument.

Adjust length of three legs of tripod, make the circular vial bubble of the instrument in the middle.

4) Use plate vial to level the instrument accurately.

①Rotate the instrument horizontally by loosening the Horizontal Clamp Screw and place the plate vial parallel to the line connecting leveling screw A and B, and then bring the bubble to the center of the plate vial by turning the leveling screws A and B.

②Rotate the instrument 90°, make it perpendicular to the connecting line of level screws A and B. Turn level screw C to make the bubble of the plate vial in the middle.

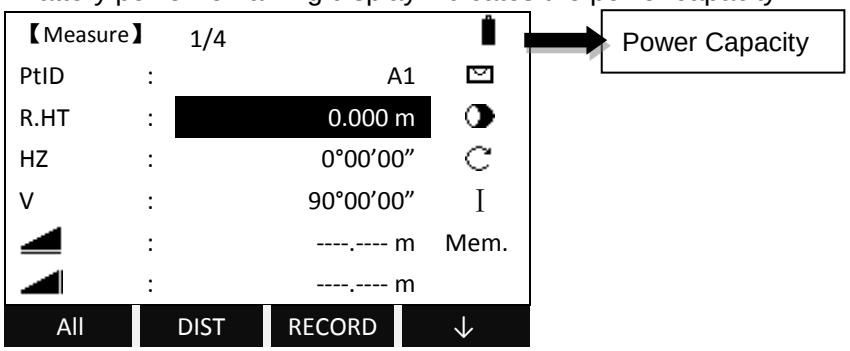
5) Precisely centering and leveling

Through observation of optical plummet, slightly loosen the central connecting screw and move the instrument evenly (Don't rotate the instrument), making the instrument precisely collimating to the station point. Then tighten the central connecting screw and level the instrument precisely again.

Repeat this operation till the instrument collimate precisely to the measurement station point.

2.3 BATTERY POWER REMAINING DISPLAY

Battery power remaining display indicates the power capacity.



Note:

①The battery operating time will vary depending on the environmental conditions such as ambient temperature, charging time, the number of times of charging and discharging, etc. It is recommended for safety to charge the battery beforehand or to prepare spare fully-charged batteries.

②The battery power remaining display shows the power level regarding the current measurement mode. Distance measurement consumes more power than angle measurement. Pay particular attention to this when switching angle measurement mode to distance measurement mode, because insufficient battery power might force the operation interrupted.

Before outdoor operation, battery power status should be checked in advance.

③When the measurement mode is changed, the battery power would not immediately show the actual status. The battery power indicating system shows the general status but not the instantaneous change of battery power.

Battery Recharging Cautions:

☆ Battery should be recharged only with the original charger.

☆ Remove the on-board battery from instrument and connect it to battery charger. When the indicator lamp on the battery charger is flashing in red, the charging is in progress. When charging is complete (indicator lamp turns green), disconnect the charger from its power source.

☆ The charger has built-in circuitry for protection from overcharging. However, do not leave the charger plugged into the power outlet after recharging is completed.

☆ Be sure to recharge the battery at a temperature from 0° to ±45°C. Recharging may be abnormal beyond the specified temperature range .

☆ When the indicator lamp does not flash after connecting the battery and charger, either the battery or the charger might be damaged. Please contact specialists for repairing.

☆ Rechargeable battery can be repeatedly recharged 300 to 500 times. Complete discharge of the battery may shorten its service life.

☆ In order to get the maximum service life, be sure to recharge it at least once a month.

Battery Removal Cautions：

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

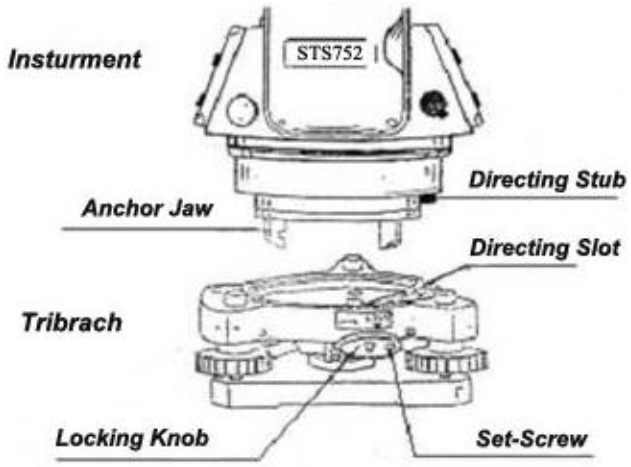
2.4 REFLECTOR PRISMS

When measuring distance, a reflecting system needs to be placed at the target place. A reflector system consists with single prism or triple prisms, which can be mounted on a tribrach or a prism pole. Reflector system can be self-configured by users according to the work requirement.

2.5 MOUNTING AND DISMOUNTING INSTRUMENT FROM TRIBRACH

Dismounting

If necessary, the instrument (including reflector prisms with the same tribrach) can be dismounted from tribrach. Loosen the tribrach locking screw in the locking knob with a screwdriver. Turn the locking knob about 180° counter-clockwise to disengage anchor jaws, and take off the instrument from the tribrach.



Mounting

Insert three anchor jaws into holes in tribrach and line up the directing stub with the directing slot. Turn the locking knob about 180°clockwise and tighten the locking screw with a screw driver.

2.6 EYEPIECE ADJUSTMENT AND COLLIMATING OBJECT

Method of Collimating Object

① Sight the telescope to bright place and rotate the eyepiece tube until you can see the reticle clearly.

② Collimate the target point with top of the triangle mark in the rough collimator. (Keep a certain distance between eye and the collimator).

③ Make the target image clear with the telescope focusing screw.

If there is parallax when your eye moves up, down or left, right, it means the diopter of eyepiece lens or focus is not well adjusted and accuracy will be influenced, so you should adjust the eyepiece tube carefully to eliminate the parallax.

2.7 INPUTTING MODE

Total Station STS-750RC series has alphanumeric keypad. User therefore can input numbers and characters directly.

Each key of Total Station STS-750RC series is defined with three characters and one number.

Numeric Mode: User can only enter numbers.
Alphanumeric Mode: User can enter numbers and letters. By pressing several times you can toggle through the characters. For example: A->B->C->7.
Press [F4] to switch between numeric and alphanumeric input mode.

Sign
The characters which can be input in STS-750RC Series are：A~Z . / $ % _ @ & * ? ! + — etc.
+/—：In alphanumeric input mode, "+" and "-" are considered as normal alphanumeric characters with no mathematical function. In numeric input mode, it can only be used in front of the numbers entered.

Special characters
In wildcard searching, it is required to use the sign “*”. In character input mode of STS-750RC Series, press [+/-] key once.
In the edit mode, the position of the decimal place cannot be changed. The decimal place is skipped.
- All keys can be entered into screen.
- Use navigation key to move the cursor.
- Use navigation key to delete the relevant character

2.8 POINTSEARCH
Pointsearch is a comprehensive function, which uses a procedure to search measurement points or known points in internal memory.
The searching scope can be limited to a particular job or the whole storage.
The search procedure always finds known points before measured points that fulfill the same search criteria. If several points meet the search criteria, then the points are listed according to their storing time. The instrument finds the most current (most newly-recorded) known point first.

Direct Search
By entering an actual PtID (e.g.: “A12”), all points with the corresponding point number are found.
There are many places to start the point searching function. Here, take searching the known points in “setting station” as an example.

STEPS	DISPLAY
[MENU] [Programs] [Surveying] [Setting Station] Input PtID: A12 SEARCH	【Setting Station】 Input Station PtID ! StnPt : A12 Select job/input Pt coord 01 SEARCH LIST ENH
Select the right one and press OK.	【Pt Serach】 1 A12 Known A12 Station VIEW ENH JOB OK
If there is no existing point, after inputting the point name, press F3 to manually input the coordinates.	【Coordinate Input】 Job : A:\DEFAULT.PTS PtID : 01 X/N : 0.226 m Y/R : 0.020 m H/Z : 20.546 m BACK SAVE
If the point doesn't exist in the current job, then after pressing ENT, it will display another screen. User can search the point from other job.	【Pt Search】 Job : DEFAULT PtID : 001 More Job Select job/input PT coord FIND OSET ENH LIST
Press LIST to view the disk of the instrument and select the job. Then press FIND, it will show the point list of the job.	【Pt Search】 Job : SANDING PtID : 01 ore Job Select job/input PT coord FIND OSET ENH LIST

2.9 WILDCARD SEARCH

Use wildcard "*" representing those characters you are going to search. Wildcards are always used if the PtID is not fully known, or if a batch of points is to be searched for.

Examples:

*: All points of any length are found.

A: All points with exactly the pointID "A" are found.

A*: All points of any length starting with "A" are found (e.g.: A8, A71, ABDE)

*1: All points of any length with a "1" as the second character are found (e.g.: W1, F15, A1R)

A*1 All points of any length with an "A" as the first character and a "1" as the third character are found. (e.g.: AD1, AR100, AS16)

STEPS	DISPLAY
[MENU] [Programs] [Surveying] [Setting Station] Input StnPt: 2* SEARCH	【Setting Station】 Input Station PtID! StnPt : 2* SEARCH LIST ENH
Select the right one.	【Pt Search】 1/3 23 Known 22 Known 23 Station VIEW ENH JOB OK

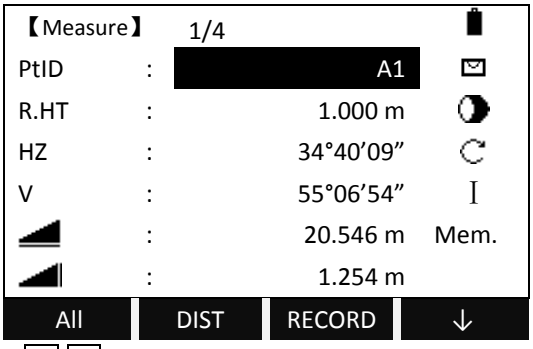
3. ROUTINE MEASUREMENT

3.1 DISTANCE SURVEY CAUTIONS

In the measurement display it is possible to call up fixed keys, and function keys, as well as trigger keys and their functions.

All shown displays are examples. It is possible that local software versions are different from the basic one.

Example of a possible measuring display:



F1-F4 Calling up the assigned functions.

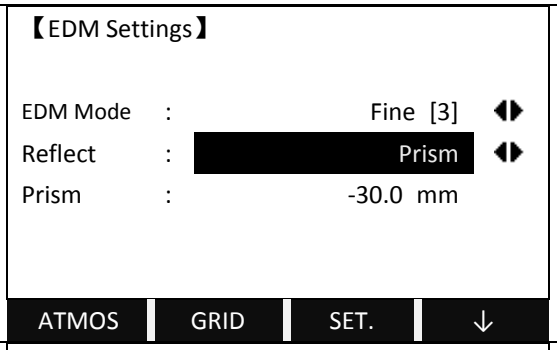
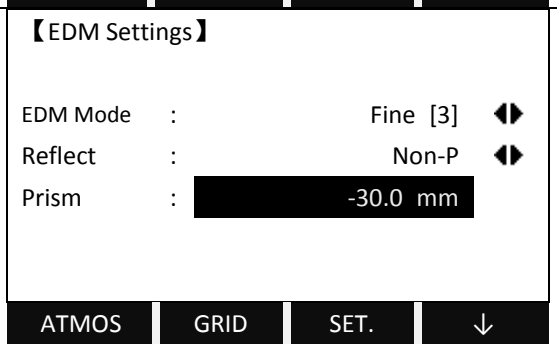
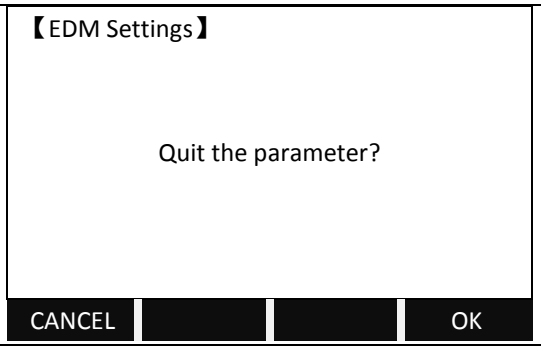
3.2 EDM SETTINGS

3.2.1 Setting EDM Mode, Reflector Modes, and Prism Constant

The measurement modes available are: Fine [r], Tracking, Fine [s], Fine [2], Fine [3], Fine [4], Fine [5].

The Reflector Modes available are: Prism, Non-P, Sheet.

STEPS	DISPLAY
Press F4 to turn to the function key bar as shown on the right. Press EDM.	【Measure】 1/4 PtID : A1 R.HT : 1.000 m HZ : 34°40'09" V : 55°06'54" 20.546 m Mem. 1.254 m SetStn | EDM | ↓
Move the cursor to *EDM Mode* and choose the mode you need.	【EDM Settings】 EDM Mode : Fine [r] Reflect : Prism Prism : -30.0 mm ATMOS | GRID | SET. | ↓

Move the cursor to *Reflect* and choose the reflector mode you need.	
Move the cursor to *Prism* and input the prism constant.	
Press SET. to save the change. Press ESC to quit. Press CANCEL to omit the change. Press OK to save the change.	

3.2.2 Setting Atmospheric Data

Refraction modules:

The instrument will automatically correct the effect of atmosphere refraction and the earth curvature when calculating the horizontal distance and the height differences.

The correction for atmosphere refraction and the earth curvature are done by the formulas as follows:

Corrected Horizontal Distance：

$D = S * [\cos\alpha + \sin\alpha * S * \cos\alpha(K-2) / 2Re]$

Corrected Height Differentia：

$H = S * [\sin\alpha + \cos\alpha * S * \cos\alpha(1-K) / 2Re]$

If the correction of atmosphere refraction and the earth curvature is neglected, the calculation formula of horizontal distance and the height differentia are:

D=S·cosα

H=S·sinα

In formula: K=0.14 ……Atmosphere Refraction Modulus

Re=6370 km ……The Earth Curvature Radius

α (or β) ……...The Vertical Angle Calculated From Horizontal Plane (Vertical Angle)

S ……Oblique Distance

NOTE: The atmosphere refraction modulus of this instrument has been set as: K=0.14. It also can be set shut: (0 VALUE)

Atmospheric Parameters (ppm):

Distance measurement is influenced directly by the atmospheric conditions of the air in which distance measurement are taken.

In order to take into consideration these influences distance measurements are corrected by using atmospheric correction parameters.

Temperature: Air temperature at instrument location.

Pressure: Air pressure at instrument location.

Atmos PPM: Calculated and indicated atmospheric PPM.

●**The calculating formula for atmospheric correction is as follows: (calculating unit：meter)**

$$PPM = 273.8 - \frac{0.2900 \times \text{Pressure Value (hPa)}}{1 + 0.00366 \times \text{Temperature value (℃)}}$$

If the pressure unit adopted is mmHg: make conversion with:

1hPa = 0.75mmHg.

●The standard atmospheric condition of STS Total Station instrument (e.g. the atmospheric condition under which the atmospheric correction value of the instrument is zero) :

Pressure：1013 hPa

Temperature: 20℃

If regardless of atmospheric correction, please set PPM value as 0.

STEPS	DISPLAY
Press ATMOS.	【EDM Settings】 EDM Mode : Fine [r] Reflect : Prism Prism : -30.0 mm ATMOS GRID SET. ↓

Input the Refraction factor, temperature, pressure, and Atmospheric PPM values. Press SET. to save the change.	【Atmospheric Data】 Refrcorr : 0.14 Temp : 20.0 °C Pressure : 1013.0 hPa Atmos PPM : 0 PPM BACK | | PPM=0. | SET.

Notice:

a. The inputting scope of refraction factor is 0.00(SHUT) ~0.20.
b. The inputting scope: Temperature:-40~+60°C (step length 0.1°C) or -40~140°F (step length 0.1°F).
c. Air pressure:420~799.5mmHg (step length 0.1mmHg) or 560~1066 hPa (step length 0.1hpa) or 16.5~31.5 inchHg (step length 0.1 inchHg).
d. The atmospheric correction value will be calculated according to the temperature and pressure value entered.

3.2.3 Grid Factor

In coordinate calculation, use horizontal distance to multiply scale factor.

Calculation Formula

1. HEIGHT FACTOR= $\frac{R}{R+ELEV}$

   R: The average radius of the earth

   ELEV: The height of the mean sea level

2. SCALE FACTOR

Scale factor: the scale on the measurement station

3. GRID FACTOR

Grid factor = height factor×scale factor

Distance Calculation

1. GRID DISTANCE

   HDg = HD × Grid factor

   HDg: Grid distance

   HD: Ground distance

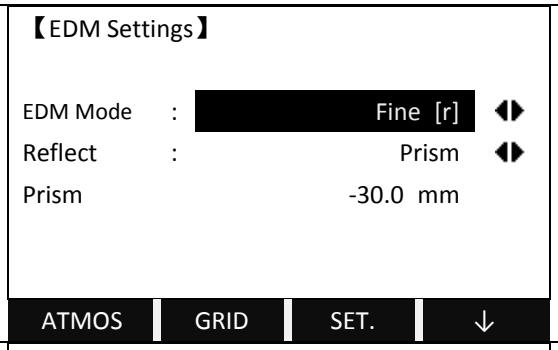
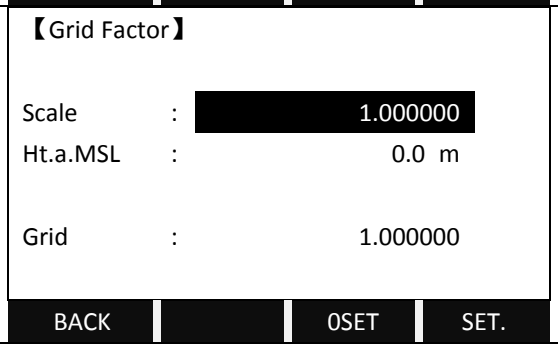
2. GROUND DISTANCE

   HD = $\frac{HDg}{Grid}$

Note: 1).Inputting range of scale:0.990000 ~ 1.010000. The default value: 1.00000

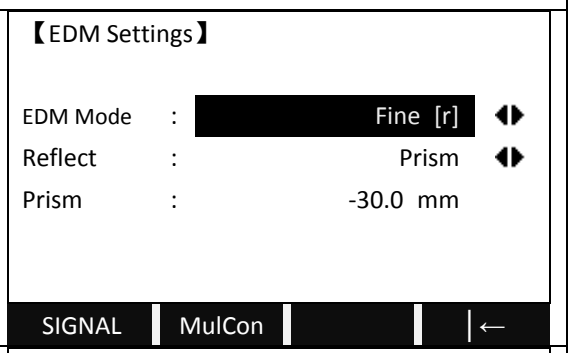
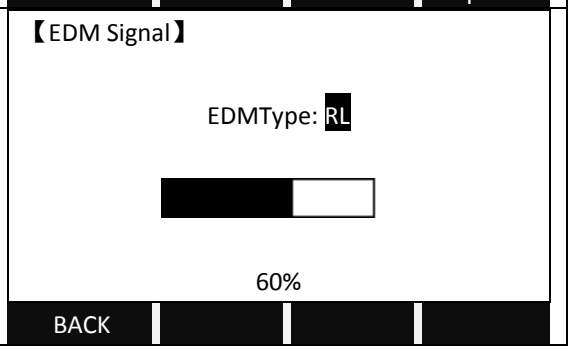
2).Inputting range of average altitude: -9999.8 ~ 9999.8.

The average altitude value is rounded off to the nearest tenth and the default value is zero.

STEPS	DISPLAY
Press GRID.	
Input the scale and Ht.a.MSL. Press SET. to save the change.	

3.2.4 Viewing Signal of Distance Measurement

This function displays the intensity of returned light signal (signal intensity) being received by the total station, step length 1%. Once reflected light from the prism is received, the total station will make beeping sound and show the laser intensity which is expressed by %.

STEPS	DISPALY
Press ⇩ to turn to next page of the function key bar. Press SIGNAL.	
Shows the intensity of the reflected laser.	

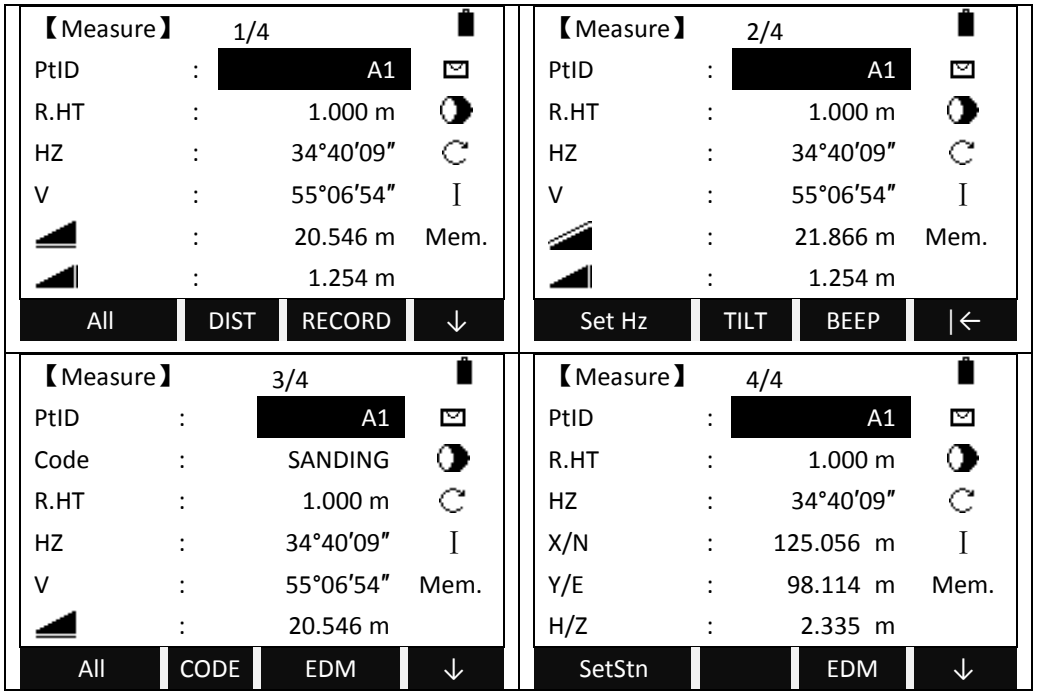
3.2.5 Setting Multiplication Constant

Set the multiply constant. Do not change this setting without indication by your service provider.

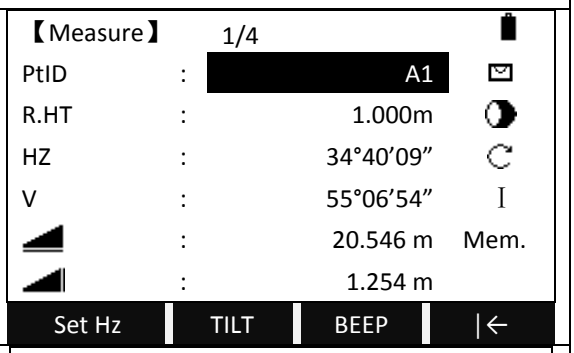
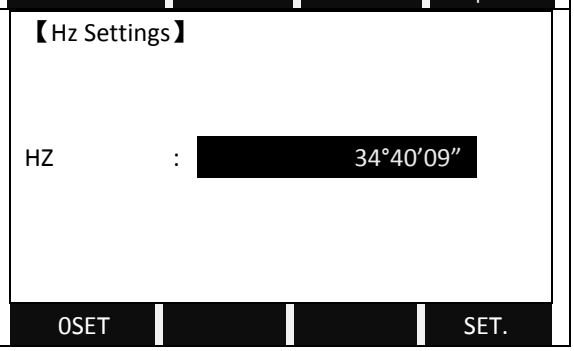
STEPS	DISPLAY
In the second page of the function key bar, press MulCon.	【EDM Settings】 EDM Mode : Fine [r] Reflect : Prism Prism : -30.0 mm SIGNAL | MulCon | | ←|
Input the Multiplication constant, and press SAVE.	【Multiplication Cons.】 Mul-Cons : 0.0 ppm | | | SAVE

3.3 START SURVEY

The routine survey is divided into four pages of menu, including all routine measurement functions, such as angle measurement, distance measurement and coordinate measurement, which are shown as the pictures below:

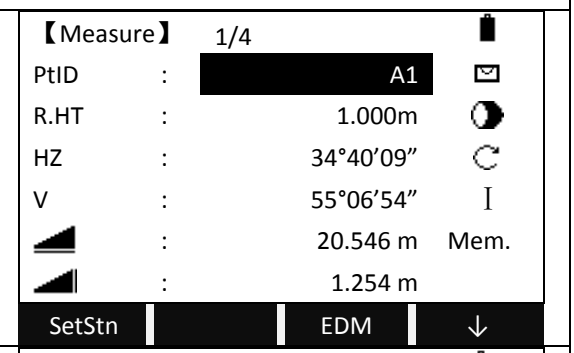
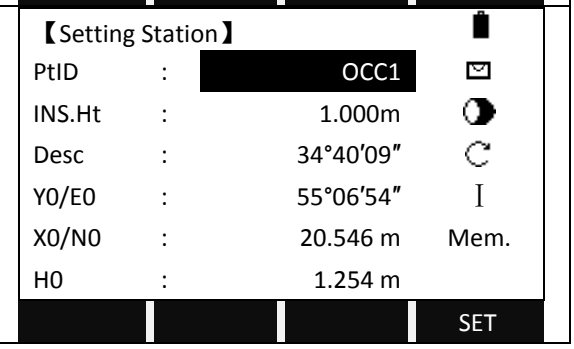


3.3.1 Setting Horizontal Circle

STEPS	DISPLAY
Turn to the third page of the function key bar, and press Set Hz.	
Current horizontal angle will be displayed. a. To set the current horizontal angle as the orientation, press SET. b. To set other value as the orientation, press ENT to input an angle value. c. To set the orientation to 0°00′00″, press 0SET.	

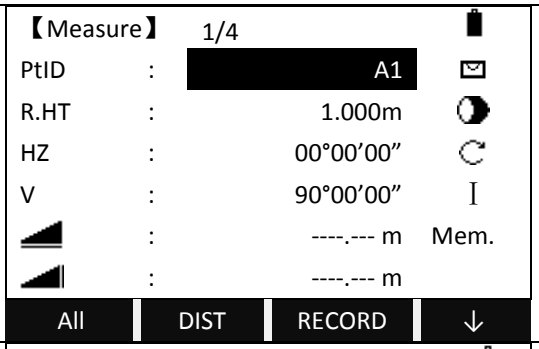
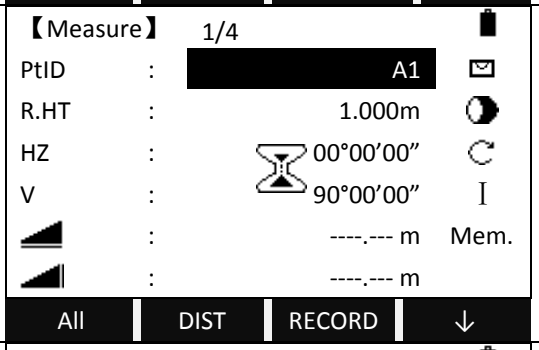
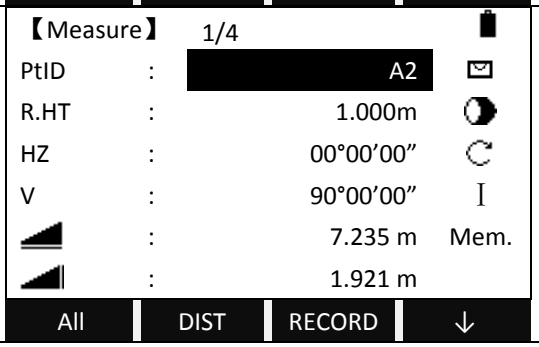
3.3.2 Setting the Instrument Height and Prism Height

After setting the relative coordinate of the occupied point according to origin point, the instrument automatically converts and displays the prism point Coordinate based on the origin and occupied point.

STEPS	DISPLAY
Turn to the second page of the function key bar, and press SetStn.	
Input the PtID, instrument height, description, coordinates, and press SET.	

3.3.3 Measurement

As all settings are finished, you can start survey now. The survey result has four pages including all general survey data, press PAGE to check.

STEPS	DISPLAY
Input the PtID, reflector height, and code if necessary.	
Collimate the center of the prism, or the objective surface you need to measure. Press All to measure the angel and distance, and save the results aftermath. Or press DIST to measure first, and press RECORD to save the results.	
After the measuring, the point name will automatically plus by 1.	

The other soft keys in function key bar:

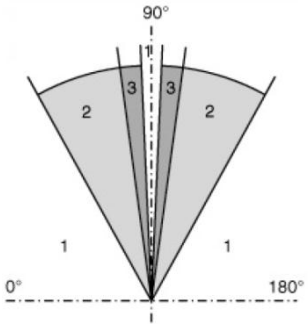
TILT: Sets the compensator, with options of 1-axis, 2-axis and OFF.

Sector Beep

Sector Beep sounds at right angles (0º, 90º, 180º, 270º or 0gon, 100gon, 200gon, 300gon)

Sector Beep Example: From 175°30’00” to 179°30’00”, a fast beep sounds. From 179°30’01” to 180°00’00” a “permanent beep” sounds.

As shown in the picture below：



1) No beep
2) Fast beep
3) Permanent beep

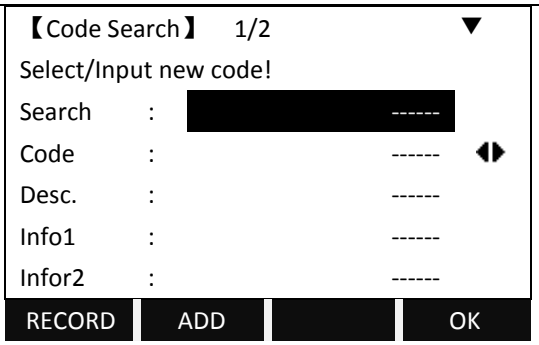
3.3.4 Coding

Codes contain information about recorded points. With the help of coding, points can be assigned to a particular group simplifying later processing. More information on coding can be found under “File Management”.

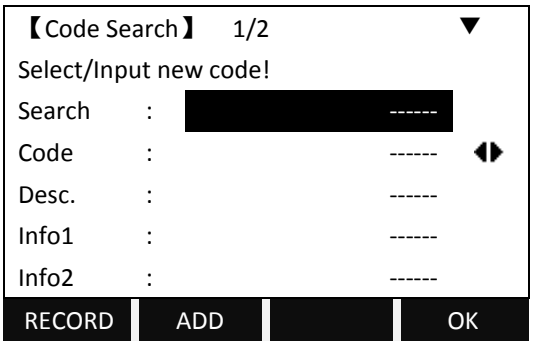
The operational steps of simple coding:

1) Move the cursor to the “Code” column.
2) Input coding name.
3) Press [All] to start distance measure and record the code and measurement result together. Press Code to search the code entered and modify the attributes.

STEPS	DISPLAY
Turn to Page 3/4 of the measure screen.	【Measure】 3/4 PtID : A2 Code : ------ R.HT : 1.000 m HZ : 70°43’23” V : 210°36’08” Mem. : 7.235 m All CODE EDM ↓
Input the code.	【Measure】 3/4 PtID : A2 Code : BS1 R.HT : 1.000 m HZ : 70°43’23” V : 210°36’08” Mem. : 7.235 m INSERT DELETE CLEAR NUMBER

Or press CODE to search the code.	
Notice: the saving sequence of coding data and measurement can be set in “Setting”. The settings of recording the code are: Save before, Save after. Save before: to save the codeblock before the measurement. Save after: to save the codeblock after the measurement.	

After starting [Coding] function, the coding screen shows as follows:



GSI- code：

CODE: Code name

DESC: Additional remark

Info1: Editable information including more content

……

Info8: Lines

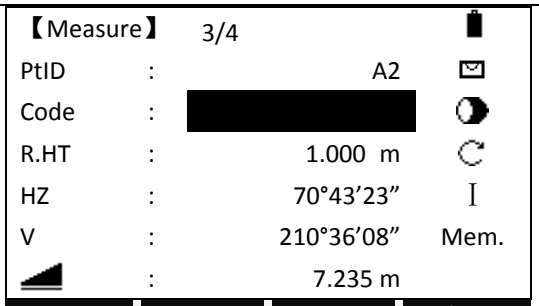
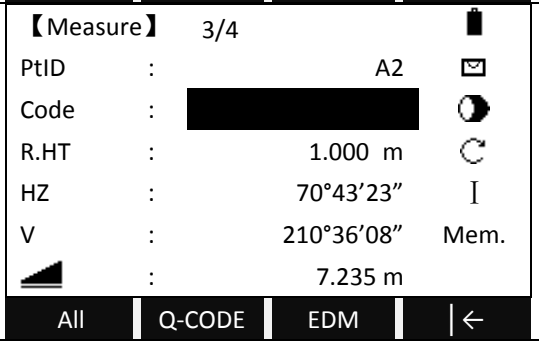
If the code is existed in the storage, it can be edited. Here the edited data cannot be kept in the storage any more. You may press RECORD to save it as a single coding data, or press All (or DIST + RECORD) to save it in the file together with measured data as a single coding data.

If the code entered does not exist, after editing, you may press ADD to add a new code in the storage, or press RECORD or All (or DIST + RECORD) to keep it as a single coding data in the job file.

3.3.5 Quick Code

Using the quick code function, a predefined code can be called up directly via numeric keyboard. The code is selected by entering a two-digit number, then the

measurement will be triggered and the measured data and code will be saved.
A total of 100 codes can be assigned; you may create codes with “Codelist Manager” included in the software CD, and transfer the code list to the total station. Each code can be assigned a unique two- digit number in the “Codelist Manager”.
If no number is allocated to the codes in “Codelist Manager”, the code is selected in accordance with the order in which the codes were entered in the code list (e.g.: 01->: first code in the code list. 10-> tenth code in the code list). About the coding format please refer to appendix A.

STEPS	DISPLAY
Turn the page of function key bar until Q-CODE is shown on the bar, and press Q-CODE.	
Input the 2-digit number which is predefined to call up the corresponding code.	

Notice:
1. Single digit number like “3” will be considered as “03” in the Codelist Manager”.

4. FUNCTIONS

Several functions can be called up via [FNC] key.

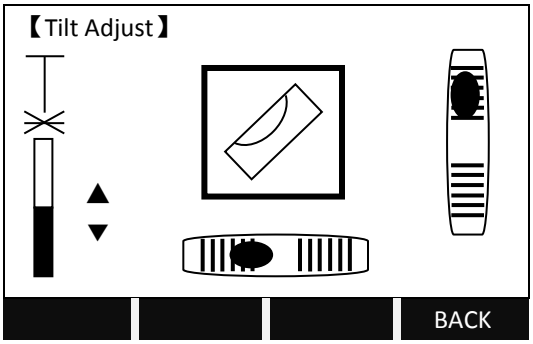
- Functions can also be started directly from different applications.
- Each function from the FNC menu can be assigned to the [USER] key.

4.1 LEVELING

This function enables the electronic bubble and the range of intensity setting of the laser plummet.

To ensure a precise leveling, the electric bubble must be activated.
If the total station over tilts, the screen displays will display the Tilt Adjustment screen automatically. Please refer to "*2.2 Instrument Setup*" for detailed leveling instruction.

Total Station STS-750 Series compensates the vertical angle reading due to inclination of the vertical axis in the X directions.

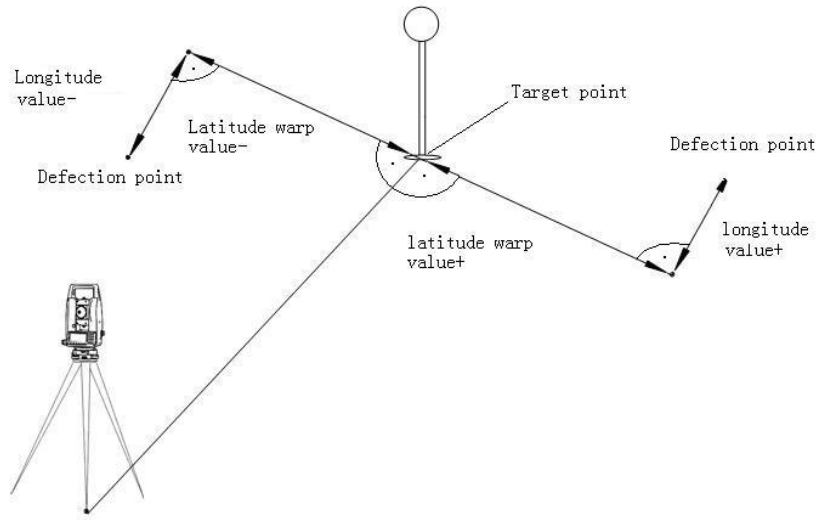


When the instrument is placed on an unstable stage or in a windy condition, the display of vertical angle is unstable. You can switch off the compensator.

When the compensator is switched on, in the condition that the total station is not leveled, the program will demand that the total station must be leveled at first, so as to enter other functions.

4.2 TARGET OFFSET

When it is not possible to set up the reflector or aim the target point directly, this function will be a solution. Enter the offset values (length, cross and/or height offset). The values of the angle and distance can be calculated directly for the target point.



If the height offset value is positive, it indicates that the offset point is higher than the measurement point.

STEPS	DISPLAY
Press FNC on the keyboard. Press F2 to enter to enter to *Target Offset* function.	【Function】 1/4 ▼ F1 Level (1) F2 Target Offset (2) F3 Delete Last Record (3) F4 Main Settings (4) F1 F2 F3 F4
Input the offset values. T_offset: cross (horizontal) offset L_offset: longitude offset H_offset: height offset Mode: choose the validity duration of this function: all offsets reset to 0m after recording, or permanent activating this function. Press OK after the settings.	【Target Offset】 Input Offset! T_Offset : 0.000 m L_Offset : 0.000 m H_Offset : 0.000 m Mode : 0set After REC ◀▶ 0SET OK

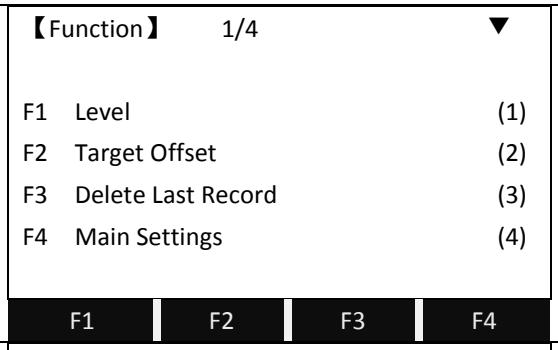
The offset values are always reset to 0 when the application is 0set After REC. If the setting is Permanent, then the measuring will always be the offset result.

4.3 DELETING LAST RECORD

This function deletes the last recorded data block, which can be either a measurement block or a code block.

Deleting the last record is **irreversible**!

Only data recorded during the measurement can be deleted.

STEPS	DISPLAY
Press F3 to enter to *Delete Last Record*.	
Press OK to confirm to delete last record.	

4.4 MAIN SETTINGS

This enables to change the most important settings, which is the same as [MENU] > [Settings].

SETTING	OPTION	MEANING
Contrast	1~16	Setting the display contrast in 10% steps.
TriggerKey	All Dist OFF	Configuration of the trigger key MEAS on the keyboard. OFF: Trigger key deactivated. All: Trigger key with same function as the All key. Dis: Trigger key with same function as the Dist key.
User Key	Tracking/Check Tie/ Settings/Pointer/Light/Level /Ht Transfer/ Offset/ Code/Dist.Unit/Angle Unit/Hidden Pt/Delete Rec.	Configure the USER key with a function from the FNC key.
V-Setting	Zenith Horizon V-(%)	The “0” orientation of the vertical circle can be either selected for the zenith, the horizontal plane or in %. ● Zenith: Zenith=0°; Horizon=90° ● Horizon: Zenith=90°; Horizon=0° ● V-(%): 45°=100%; Horizon=0° If the V-% value increases rapidly and exceed 300%, it displays as “--.--%”.

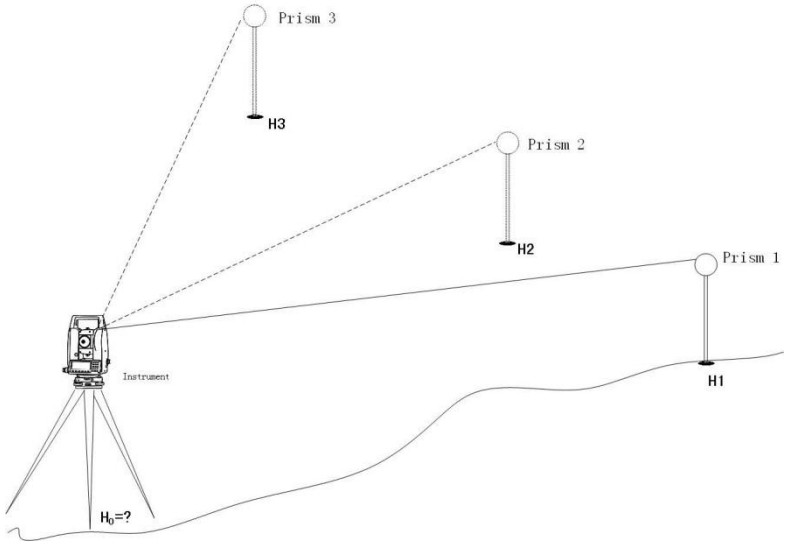
Tilt Crn. (Tilt Correction)	OFF 1-axis 2-axis	OFF: Tilt compensation is switched off. 1-axis: V-angle relate to the plumb line. 2-axis: V-angle refer to the plummet line and the Hz-directions are corrected by the standing axis tilt. The compensator setting remains active even after the instrument is switched off.
Coll Crn. (Collimation Correction)	ON OFF	ON : HZ Collimation is switched on. OFF: HZ Collimation is switched off. If the function “Coll Crn.” is active, each measured horizontal angle is corrected. For normal operation, the Hz Collimation remains switched on.
SectorBeep	ON OFF	ON: Sector Beep sounds at right angles (0°, 90°, 180°, 270°, or 0gon, 100gon, 200gon, 300gon) OFF: Sector Beep is switched off.
Beep	ON OFF	The beep is an acoustic signal after each key stroke. ON: Beep switched on. OFF: Beep switched off.
HZ <=>	Right Ang Left Ang	Hz Increment Direction: Right Ang: Set right Hz for “clockwise direction measurement”. Left Ang: Set left Hz for “Counter-clockwise direction measurement”. “Counter-clockwise” directions are only displayed but saved as “clockwise direction”.
Face Ⅰ Def.	VK-Left VK- Right	Defines the telescope face Ⅰ in relation to the position of the V circle.
Data Output	Intern RS232	Intern: All data is recorded in internal memory. RS232: Data is recorded via the serial interface. A data storage device must be connected.
Auto - OFF	ON OFF	ON: The instrument is switched off after 20 minutes without any action (= no key pressed; V and HZ angle deviation $\leq$3’/$\pm$600cc). OFF: The instrument is switched on permanently. Battery discharges quicker.
Min Reading		The displayed angle format can be selected in three steps. For 360° ′ ″: 0°00′01″/0°00′05″/0°00′10″ For 360°: 0.0001°/0.005°/0.0010° For gon: 0.0001gon/0.0005gon/0.0010gon For mil: 0.01mil/0.05mil/0.10mil

Angle Unit	dd. mm. ss deg gon mil	° ′ ″ (degree, sexagesimal), possible angle values: 0°~359°59′59″ DD (degree, decimal): possible angle values:0º~359.9999º gon, possible angle values: 0gon~399.9999gon mil, possible angle values: 0mil~6399.99mil The setting of the angle units can be changed at any time. The actual displayed values are converted according to the selected unit.
Dist. Unit	Meter US-ft INT-ft ft – in 1/8	M: Meter US-ft: Us-feet INT-ft: International feet ft-in 1/8: US-feet-inch-1/8 inch
Temp. Unit	℃ ℉	℃ Degree Celsius ℉ Degree Fahrenheit
Press Unit	hPa mbar mmHg inHg	hPa: Hecto Pascal mbar: Milliba mmHg: Millimeter mercury column inHg: Inch mercury column
Code Rec.	Save before Save after	Sets if the code block is saved before or after the measurement
GSI 8/16	GSI 8 GSI 16	Select GSI output format. GSI 8: 81..00+12345678 GSI 16: 81..00+1234567890123456
Mask1/2	Mask1 Mask2	Select GSI output mask. ·Mask1: PtlD, Hz, V, SD, ppm+mm, hr, hi ·Mask2: PtlD, Hz, V, SD, E, N, H, hr
After the setting, press F4(Set.) to save the change.		

4.5 HEIGHT TRANSFER

This function determines the height of the instrument from measurements to a maximum of 5 target points with known heights, in two faces.

While measuring to several targets with known heights, the improvement is indicated in the “delta” value.

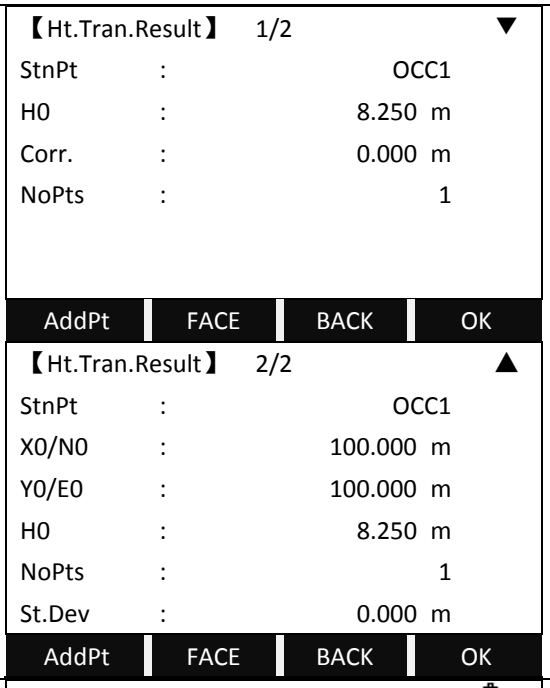


STEPS	DISPLAY
Turn to Page 2/4 in *Function* menu. Press F1, *Height Transfer.*	【Height Transfer】1 Select Target Meas! PtID : ------ R.HT : 1.500 M H/Z : ----.--- m : ----.--- m Mem. EHN | INS.HT | VIEW | |←
Turn to the third page of function key bar and press INS.HT to set the instrument height.	【Height Transfer】 StnPt : OCC1 Ins.HT : 2.000 m Y0/E0 : 100.000 m X0/N0 : 100.000 m H0 : 10.000 m BACK | | | OK
Call up a existed point by pressing LIST or SEARCH in the function key bar. If the point does not exist, input a PtID and press ENH to input the height of the point. Press All to trigger the measurement.	【Height Transfer】 Select Target Meas! PtID : 1 R.HT : 1.500 M H/Z : 10.000 m : ----.--- m Mem. EHN | INS.HT | VIEW | |← All | EDM | SEARCH | ↓ LIST | DIST | RECORD | ↓

The height of station is calculated.

Press PAGE to display the Page 2/2.

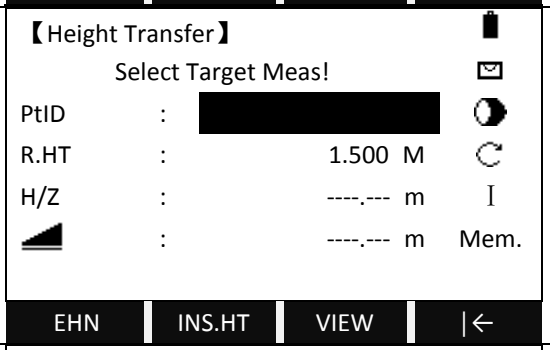
Press FACE, and focus the same point in Face Ⅱ, then press All to measure the same point in Face Ⅱ.



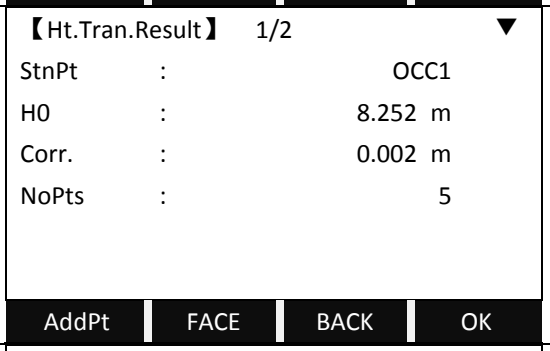
After measurement, press AddPt.

Repeat the procedures above to measure next known point (or new added point) in both Face Ⅰ and Face Ⅱ.

You can measure maximum 5 points.



You can measure maximum 5 points.



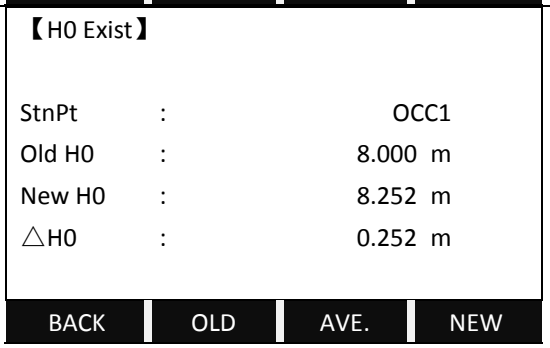
Press OK to confirm the height transfer result.

BACK: Back to the height transfer result.

OLD: Maintain the original station height.

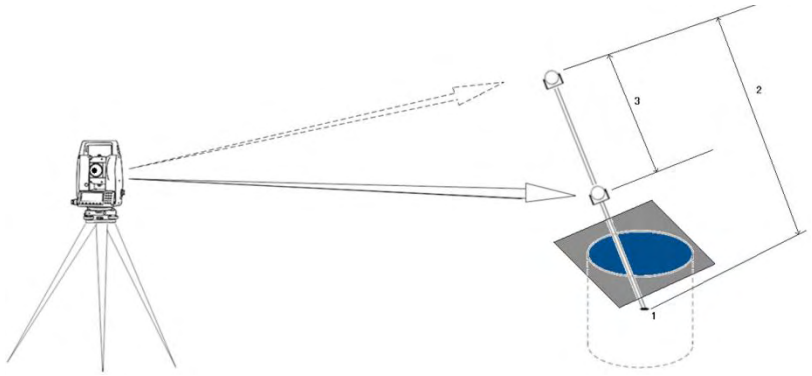
AVE.: Calculate the average value of the original and new heights, and consider it as the station height.

NEW: Consider the new height as the station height.



4.6 HIDDEN POINT MEASUREMENT

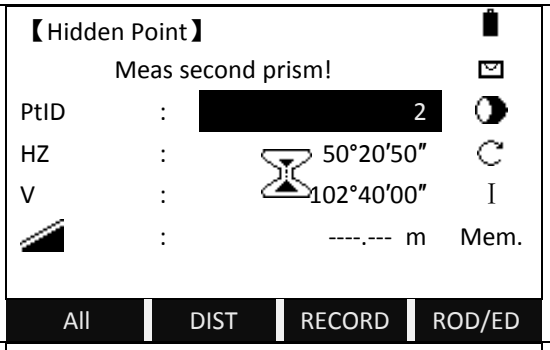
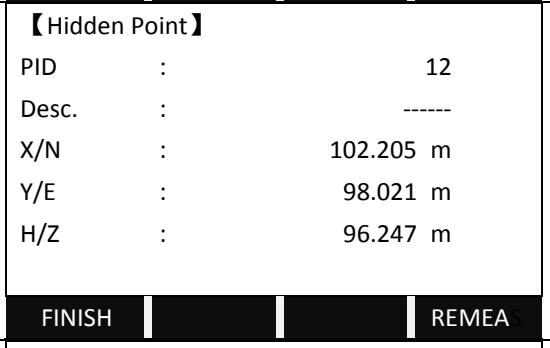
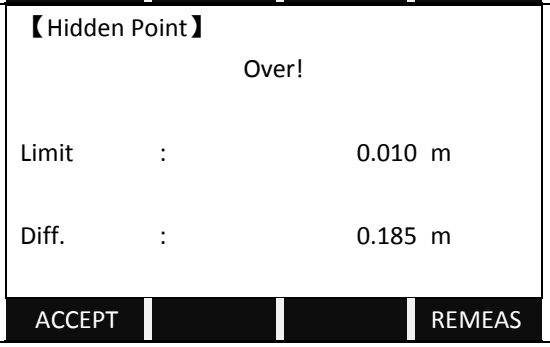
The program allows measuring to a point that is not directly visible, using a special hidden-point rod.



The Picture shown above implies:

1) E, N, H of Hidden Point
2) Rod Length
3) Distance R1-R2

STEPS	DISPLAY
Turn to Page 2/4 in *Function* menu. Press F2, *Hidden Point.*	【Hidden Point】 Meas first prism! PtID : ------ HZ : 0°00′00″ V : 87°40′00″ : ----.--- m Mem. All DIST RECORD ROD/ED
Press ROD/ED. Input the rod length, distance between R1 and R2, and the measure tolerance. *Meas.Tol* is the limit for difference between the given and measured distance of these 2 prisms. If the tolerance value is exceeded, the program will issue a warning.	【Rod Length Settings】 RodLengt : 3.000 m DistR1-R2 : 1.000 m Meas.Tol : 0.010 m 01 INSERT DELETE CLEAR
Focus on the first prism, and press All (or DIST + RECORD).	【Hidden Point】 Meas first prism! PtID : 1 HZ : 0°00′00″ V : 87°40′00″ : ----.--- m Mem. All DIST RECORD ROD/ED

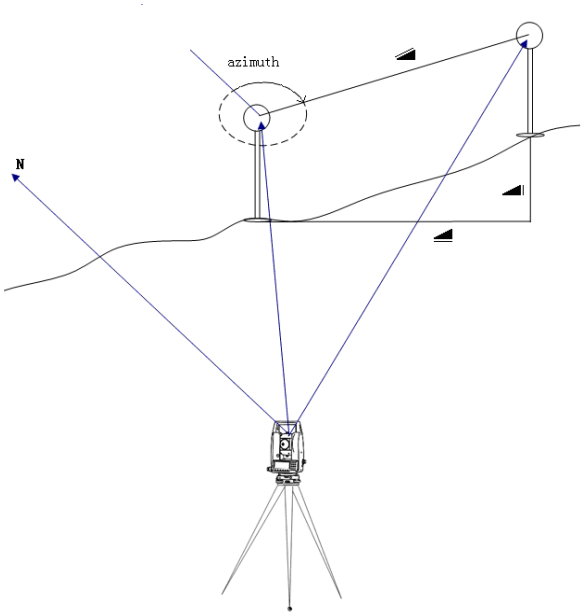
Focus on the second prism, and press All (or DIST + RECORD).	
After measuring these 2 prisms, the result will show. Press FIINISH to save the result. Press REMEAS to measure again.	
If the result is over the tolerance, press ACCEPT to accept the difference. Or press REMEAS to measure again.	

4.7 FREE-CODING

Starts “Coding” to select a code from a code list or enter a new code. Same functionality like soft key CODE.

4.8 CHECKING TIE

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



STEPS	DISPLAY
Before entering to this function ,make sure that there're at least 2 valid measurements. Turn to Page 2/4 in *Function* menu. Press F4, *Check Tie*. AZ of 2 points, and the relations among HD, SD, and VD are displayed. Press PAGE to turn to Page 2/2. Press OK to quit.	【Check Tie】 1/2 ▼ AZ : 186°28′36″ Grade : 9.0% △ : 4.298 m △ : 4.316 m △ : 0.396 m OK 【Check Tie】 2/2 ▲ AZ : 186°28′36″ Grade : 9.0% △X/N : -0.466 m △Y/N : -4.273 m △H : 0.396 m OK

4.9 EDM TRACKING

Switches on or off the tracking measurement mode. The new setting is displayed for approximately one second and then set. The function can only be activated from within the same EDM type and prism type.

Every time when pressing the soft key that sets EDM Tracking function, the measurement mode will switch between Fine [s] and Tracking.

The last active measurement mode remains set when the instrument is switched off.

4.10 LIGHT ON/OFF

Switches display light on/off.

4.11 LASER POINTER ON

Switches the visible laser pointer on. It will be switched off after 60 seconds automatically.

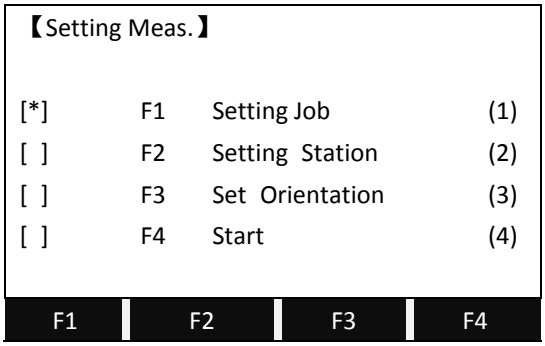
4.12 RETICLE ILLUMINATION ON/OFF

Switches the reticle illumination on or off.

5. PROGRAMS

APPLICATION PRE-SETTINGS

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



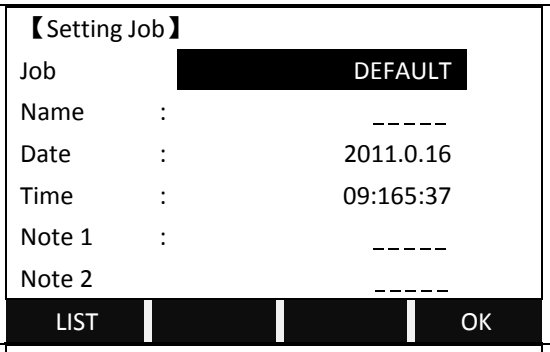
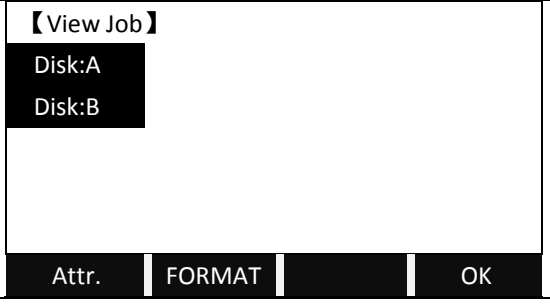
[*]: Settings made.

[ ]: Settings not made.

Find further information about individual start-up programs on the subsequent pages.

5.1 SETTING JOB

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

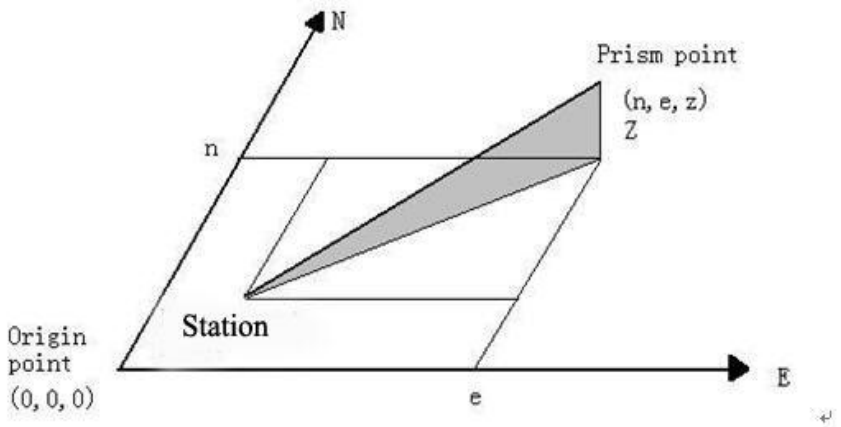
STEPS	DISPLAY
Enter to *Setting Job* by pressing F1. Choose the job. Press F1 to enter the Disk list	
Press the navigation key to select the disk. Disk A: the internal memory Disk B: the SD card memory	

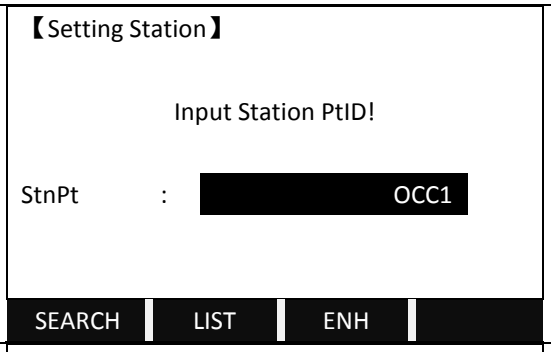
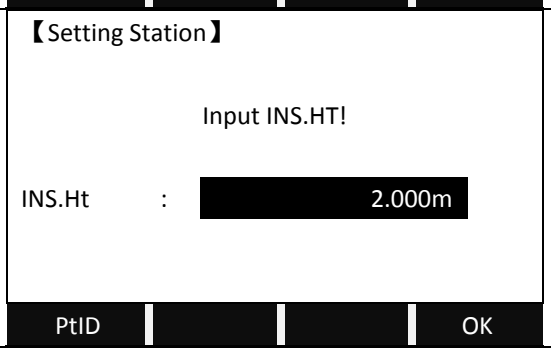
The screen shows the file list. Press F4 to the next page, then press NEW to add a new job.	【View Job】 DEFAULT.RAW 1.82KB 02-03 SANDING.RAW 1.26KB 02-04 NEW | Rename | DELETE | ↓
Enter the job name, operator name, etc. Then press OK to save and set the job.	New Meas Job Job : SANDING Name : _____ Date : 2012.03.01 Time : 14:40:40 Note1 : _____ Note2 : _____ | | | OK
Or select an existing job as the current job. Press ENT.	【View Job】 DEFAULT.RAW 1.82KB 02-03 SANDING.RAW 1.26KB 02-04 Attr. | PrevPG | NextPG | ↓

5.2 SETTING STATION

Each coordinate computation relates to the currently set station.

At least plan coordinates (E, N) are required for the station. The station height can be entered. The coordinates can be entered either manually or read from the internal memory.



STEPS	DISPLAY
Press F2 to enter to *Setting Station*. Press SEARCH, or LIST to find an existed (known) point from internal memory. Or press ENH to input the PtID and its coordinates and save it in the job.	
Enter the instrument height, and press OK to save the station setting.	

5.3 SETTING ORIENTATION

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

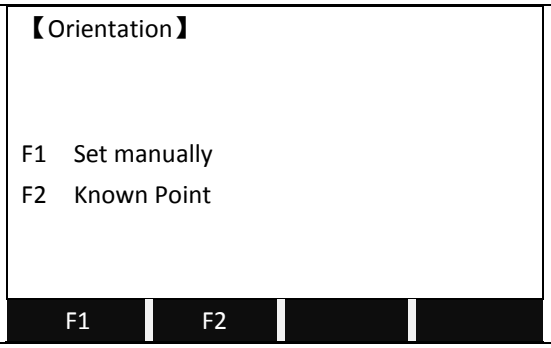
5.3.1 Manually Inputting

STEPS:

1) Press F1 to input a random HZ-orientation.

2) Input Hz-direction, reflector height and PtID.

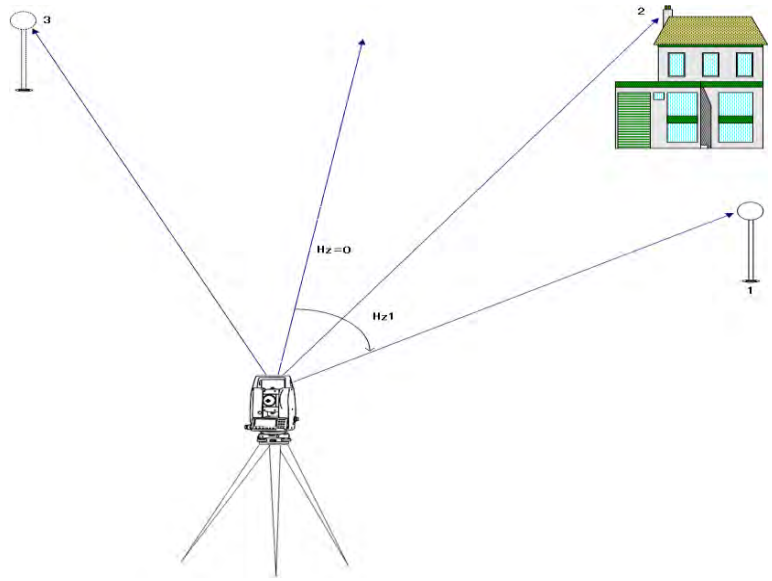
3) Press All to start measurement and set orientation. Or press RECORD to record HZ-direction and set orientation.

STEPS	DISPLAY
Press F3 to enter to *Set Orientation*. Press F1 to set the orientation manually.	

Input the backsight PtID, reflector height, and a random AZ value.	【Set Manually】 BsPt : BS1 R.HT : 1.500 m AZ : 9°11′25″ Sight BsPt Meas&Rec! All EDM SET. 0SET
Press All to trigger the measurement. Or press SET. to set the orientation without activating the measurement. Aftermath, it shows “Orientation!”, and return to the highest level.	【Setting Meas.】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) [ ] F4 Start (4) F1 F2 F3 F4

5.3.2 With Coordinates

A target with known coordinates can also be used to determine the orientation. For determine the orientation, a maximum of 5 target points with known coordinates can be used.



1. Backsight Point 1
2. Backsight Point 2
3. Backsight Point 3

STEPS:

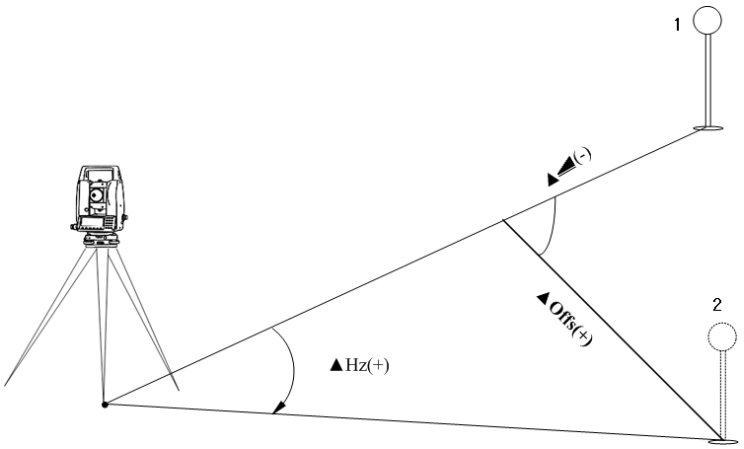
1) Press F2 to set the orientation with coordinates.
2) Input the orientation PtID and to determine the point found.

3) Input and confirm the reflector height.

☞ Orientation coordinates can be either obtained from the internal memory or entered manually.

STEPS	DISPLAY
Press F3 to enter to *Set Orientation*. Press F2 to set the orientation with coordinates.	【Orientation】 F1 Set manually F2 Known Point F1 F2
Input the backsight PtID. Or press LIST to select the point from the list. If the point does not exist, press ENH to input the PtID and its coordinates. If necessary, input the reflector height before entering the BsPt.	【Known Pt】 Input BsPt! BsPt : BS R.HT : 1.860 m LIST ENH
Collimate the backsight point, and press All (or DIST + RECORD) to trigger the measurement. Press EDM to change the EDM setting.	【Known Pt】1/2 1/ BsPt : BS R.HT : 1.500 m HZ : 0°00′00″ : ----.--- m : ----.--- m Mem. All DIST RECORD EDM
Then a dialog saying “Want More Measurement?” pops up. Press OK to start another measurement. Or if you want to measure basing on Face Ⅰ or Face Ⅱ, enter the same backsight point you just measured, and turn to Face Ⅰ or Face Ⅱ to proceed the measurement.	【Known Pt】1/2 3/Ⅰ Ⅱ BsPt : BS1 R.HT : 1.500 m HZ : 0°00′00″ : ----.--- m : ----.--- m Mem. All DIST RECORD EDM

Then a dialog saying "Want More Measurement?" pops up. Press OK to start another measurement. Press CANCEL to show the orientation result. Press OK to confirm the orientation set.	【Orientation Result】 Nopts. : 5 Station : 1 HzCor : 172°22′57″ St.Dev : 0°00′20″ RESID | | | OK
Or press RESID to show the residuals.	【Orientation Residuals】 BsPt : BS1 △Hz : 0°00′02″ △ : -0.005 m △ : 0.003 m BACK | | |



1.Actual measurement point.

2.Design point.

【Orientation Residuals】

BsPt	:	BS1
△Hz	:	0°00′02″
△	:	-0.005 m
△	:	0.003 m

BACK | | | |

△ Hz ： Correction of HZ angle.

△ ： Height correction

△ ： Correction of the horizontal distance

SIGNIFICANT INFORMATION

If the orientation is only measured in telescope Face II, the HZ orientation is based on telescope Face II. If measured only in telescope Face I or mixed the HZ orientation is based on Face I.

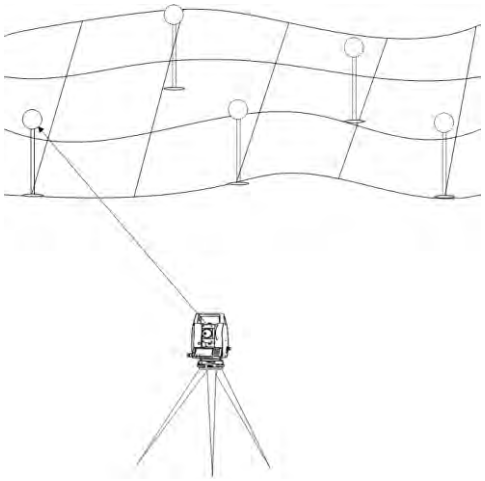
The prism height may not be changed during measurements in the first and second telescope position.

If a target point is measured several times in the same telescope position, the last valid measurement is used for the computation.

If no orientation was set and an application was started, and if in "Measure" ALL or REC was triggered, then the current HZ direction and V-angle are set as orientation.

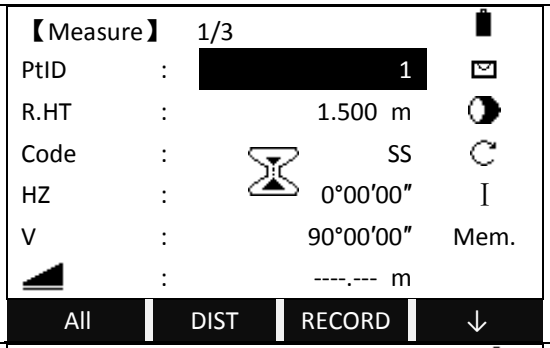
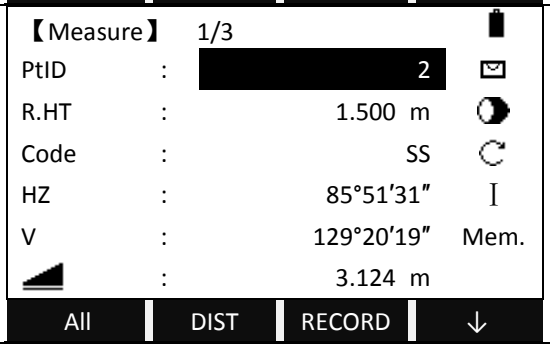
5.4 SURVEYING

The measurement of an unlimited number of points is supported in surveying program. It is comparable to "*Measure*", but includes stationing, orientation and quick coding.



Notice: Set job, station and orientation first.

STEPS	DISPLAY
Press F4 to start *Measure*.	【Setting Meas.】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) [ ] F4 Start (4) F1 F2 F3 F4

Enter the PtID, reflector height, and code, and press All (or DIST + RECORD) to trigger the measurement and save the result.	
After measurement, the PtID will be automatically plus 1.	

5.4.1 Individual Point

[Indiv P]: Switches between individual and current point number.

Individual point: Separately record a point. After measuring the point, the system will continue to the next point of the previous measurement.

5.4.2 Coding

Three Coding Methods are available:

1) Simple Coding = remark:

Input a code into the relevant field. This text is stored with the corresponding measurement with All. The code is not related to a codelist, it is just a simple remark. A codelist on the instrument is not necessary.

2) Expanded Coding:

Press CODE. The code entered is searched within the code list and it is possible to add attributes to the code.

3) Quick Coding:

Press Q-Code and enter the shortcut of the code. The code is selected and the measurement starts.

5.5 STAKING OUT

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

Steps:

1. Setting job
2. Setting station
3. Setting orientation
4. Calling up coordinates from internal memory. These coordinates may be measured, or input manually.
5. Staking out. Three methods of stake-out are available: Polar Stake Out, Orthogonal Stake Out, and Coordinate Offset Stake Out.

5.5.1 Setting Stake-Out Point

5.5.1.1 Calling up Coordinates from job, or Inputting Manually

STEPS	DISPLAY
After setting job, station, and orientation, presses F4 to start to *stake out*.	【Stake Out】 1/3 Find : PtID : 5 Type : Known △Hz : -85°51′31″ △ : 2.055 m Mem. △ : ----.--- m All DIST RECORD ↓
Input the PtID you want to stake out in the field of “Find”, or search via wildcard “*”. Or turn to the second page of the function key bar, and press ENH to a new point to stake out by inputting its coordinates.	【Coordinate Input】 Job : SANDING PtID : ------ X/N : ----.--- m Y/E : ----.--- m H/Z : ----.--- m BACK SAVE

5.5.1.2 Input a Point without a PtID without Saving the Data

STEPS	DISPLAY
Turn to the 3rd page of function key bar and press MANUAL.	【Stake Out】 1/3 Find : PtID : 5 Type : Known △Hz : -85°51′31″ △ : 2.055 m Mem. △ : ----.--- m B&D MANUAL LIST |←

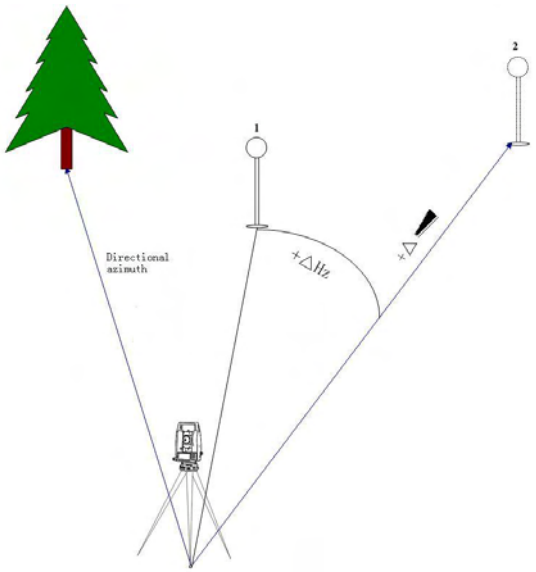
After entering the coordinates, press OK to confirm.	【Stake Out Input Data】 X/N : ----.--- m Y/E : ----.--- m H/Z : ----.--- m BACK 0SET OK
Notice: [MANUAL]: Data that was input will not be saved in the job.	

Soft keys:

DIST: Starts measurement and calculation of the stake-out elements.

RECORD: Saves the displayed values.

5.5.2 Polar Stake Out



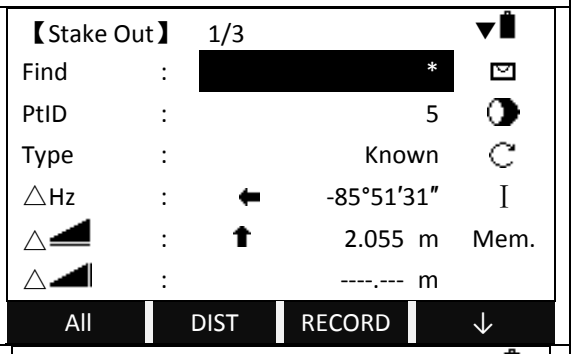
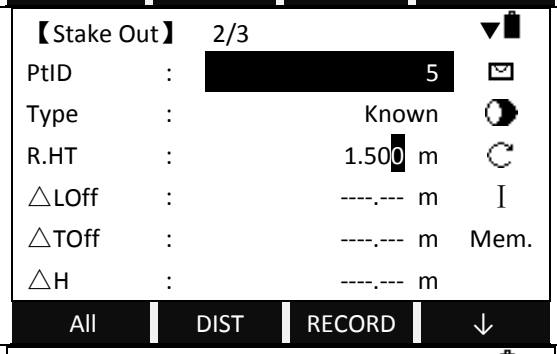
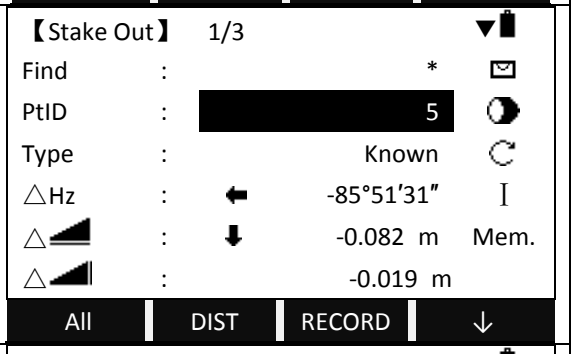
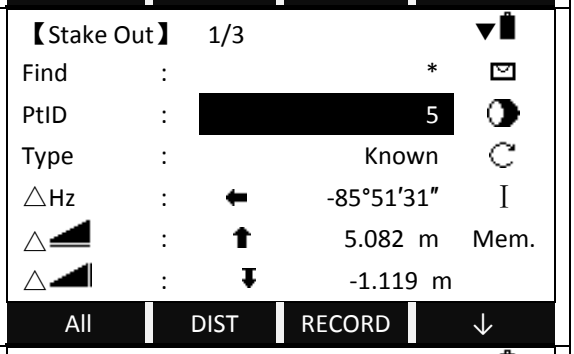
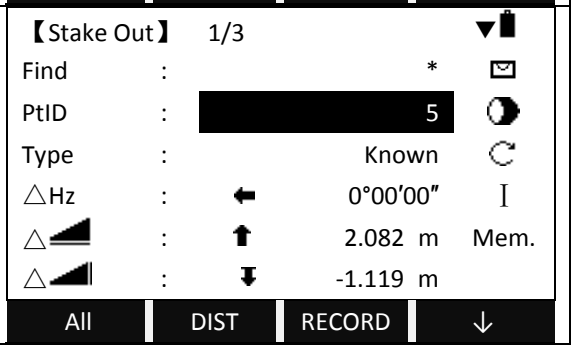
1. Actual
2. Point to be staked out

Normal indication of polar stake out offsets.

∆Hz**:** Angle offset**.** Positive if point to be staked out is to the right of the actual direction.

∆: Longitudinal offset. Positive if point to be staked out is further away.

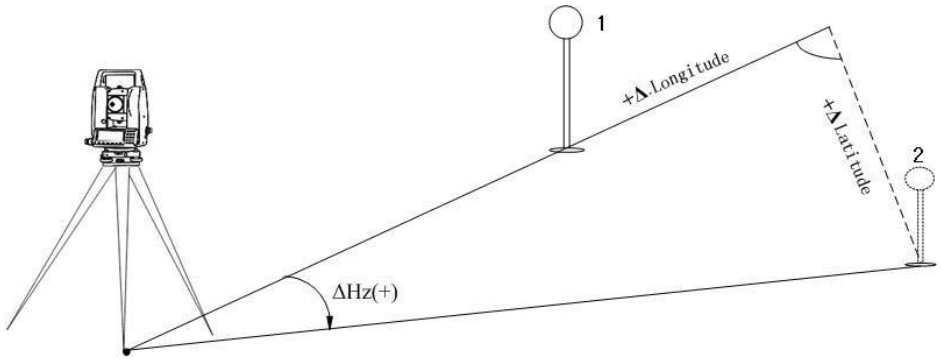
∆: Height offset. Positive if point to be staked out is higher than measured point.

STEPS	DISPLAY
Confirm the point to be stake out.	
Press PAGE to turn to Page 2/3. Input the reflector height.	
Collimate the target prism and press DIST on the 1st page of function bar to trigger the measurement. It will calculate and display the offsets between the current target point and the point to be staked out.	
Rotate the objective lens to make the △ Hz at 0°00′00″. Then indicate the person who holds the prism to move the prism. ⬅: Move the prism leftward. ➡: Move the prism rightward.	
Set the prism at the 0°00′00″ direction where the objective lens is pointing. Press DIST to trigger the measurement again to calculate and display the offsets. Indicate the person who moves the prism to move the prism according to the arrows. Repeat measuring until the △ displays 0.000m.	

When both △Hz and △ are 0, it means the current position of the prism is the point to stake out. △ displays the offset to dig or fill. : Distance to dig. : Distance to fill.	【Stake Out】 1/3 Find : * PtID : 5 Type : Known △Hz : 0°00′00″ △ : 0.000 m △ : -1.119 m All DIST RECORD ↓ Mem.

5.5.3 Orthogonal Stake Out

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



1. Actual
2. Point to be staked out

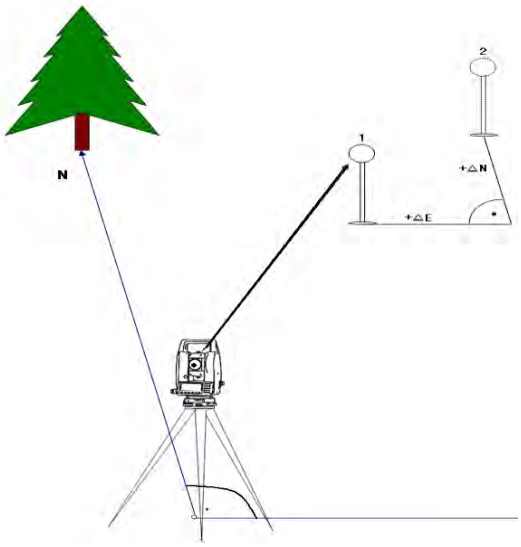
ΔLOff: Longitudinal offset. Positive if the stake-out point is further away.
ΔTOff: Transversal offset. Perpendicular to line-of-sight: Positive if the stake-out point is to the right of measured point.

STEPS	DISPLAY
Turn to Page 2/3 to start *Orthogonal Stake Out*. Select or input the point to stake out. Enter the reflector height.	【Stake Out】 2/3 PtID : 6 Type : Meas. R.HT : 1.800 m △LOff : ----.--- m △TOff : ----.--- m △H : ----.--- m All DIST RECORD ↓ Mem.

Collimate the current prism, and press DIST to measure. The system calculates and displays the offsets between the measured point and the point to stake out.	【Stake Out】 2/3 PtID : 6 Type : Meas. R.HT : 1.800 m △LOff : 4.086 m △TOff : -2.361 m Mem. △H : 1.302 m All DIST RECORD ↓
Indicate the person who moves the prism to move the prism according to the arrows until the △LOff and △TOff are 0 m. Then the current position of the prism is the point to stake out. △H indicates the distance to dig or fill.	【Stake Out】 2/3 PtID : 6 Type : Meas. R.HT : 1.800 m △LOff : 0.000 m △TOff : 0.000 m Mem. △H : 0.822 m All DIST RECORD ↓

5.5.4 Coordinates Offset Stake Out

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



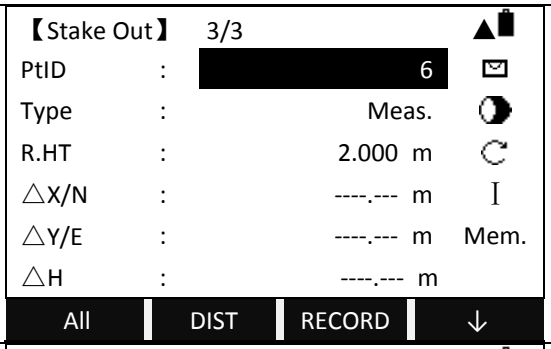
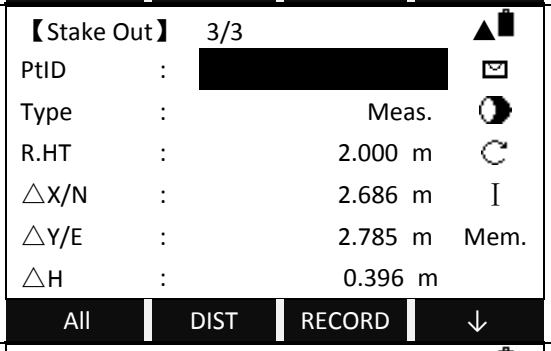
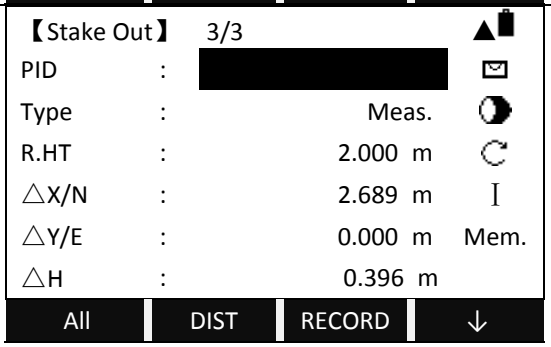
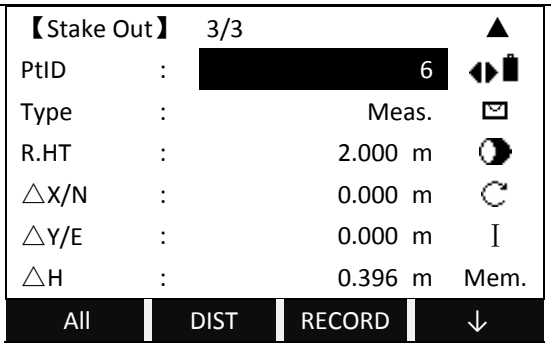
1. Actual prism position
2. Point to be staked out

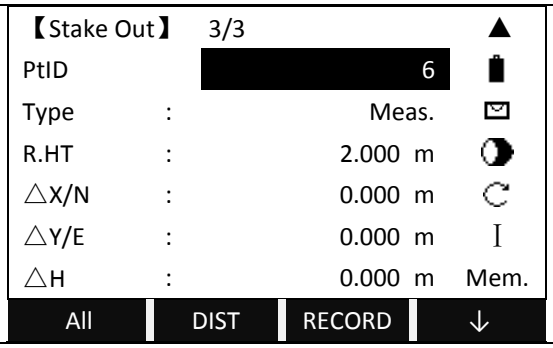
Meaning of several offsets in process of coordinate stake-out.

△ X/ △ E: Offset of X coordinate between stake-out point and current measurement point.

△ Y/ △ N: Offset of Y coordinate between stake-out point and current

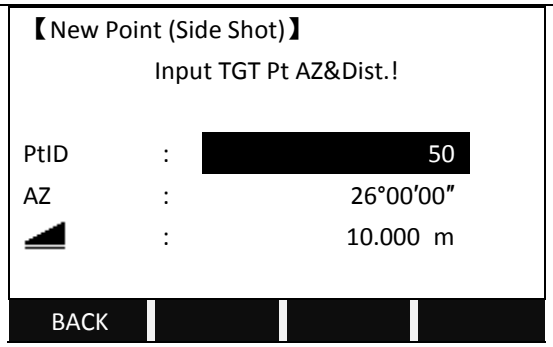
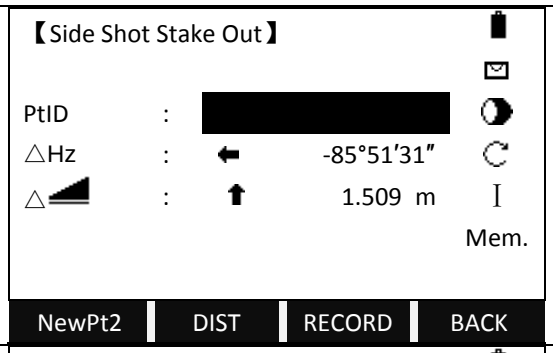
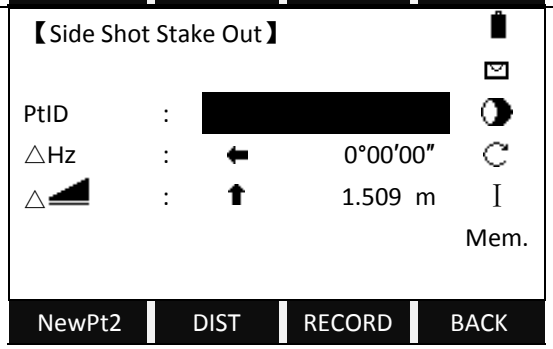
measurement point.

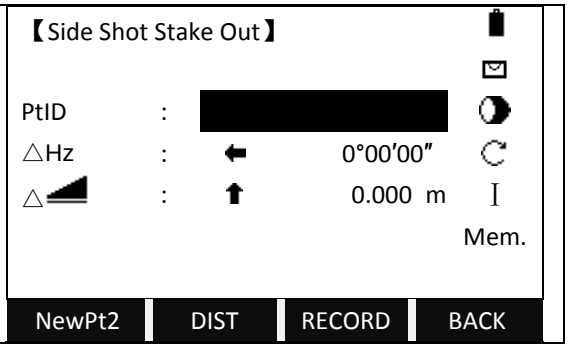
STEPS	DISPLAY
Turn to Page 3/3 to start *Coordinates Stake Out*. Select or input the point to stake out. Enter the reflector height.	
Collimate the current prism, and press DIST to measure. The system calculate and display the offsets between the measured point and the point to stake out.	
Move the prism on E direction until the △Y/E is 0 m. If △Y/E value is positive, it means the point to stake out is on the right of the current prism. Move the prism rightward. If △Y/E value is negative, it means the point to stake out is on the left of the current prism. Move the prism leftward.	
Move the prism on N direction until the △X/N is 0 m. If △X/N value is positive, it means the point to stake out is more far away from the current prism. Move the prism forward. If △Y/E value is negative, it means the point to stake out is close to the current prism. Move the prism close to the station.	

Then the current position of the prism is the point to stake out. △H indicates the distance to dig or fill. △H is positive: to fill. △H is negative: to dig.	

5.5.5 B & D

Bearing and distance stake out. Choose B&D. Input the factors of polar stake-out: azimuth and horizontal distance.

STEPS	DISPLAY
Turn to the 3rd page of the function key bar. Press B&D. Input the PtID, azimuth and horizontal angle to stake out.	
Collimate the current prism, and press DIST to measure. The system calculate and display the offsets between the measured point and the point to stake out.	
Rotate the telescope until the △Hz is 0°00′00″. Indicate the person who moves the prism to move the prism according to the arrows. Set the prism at the direction on the 0°00′00″, and press DIST calculate and display the offsets between the measured point and the point to stake out.	

Move the prism far or close according to the arrows, until △ is 0 m. △ is positive: move the prism far away from the station. △ is negative: move the prism close to the station.	

5.6 FREE STATION

The application “Free Station” is used to determine the instrument position from measurements to a minimum of two known points and a maximum of five known points.

The following measurements sequences to target points are possible:

1) HZ-angle and V-angle only

2) Distance and HZ-angle and V-angle

3) HZ-angle and V angle to some points and HZ-angle and V angle plus distance to other points.

The final calculated results are Easting, Northing and Height of the present station, including the instruments HZ-circle orientation. Standard deviations and residuals for accuracy assessments are provided.

Measuring Techniques:

1) Single face I or II measurements are always applicable.

2) There is no specific point sequence or specific face sequences that are required.

3) Gross errors checks are made for dual face measurements in order to the same point(s) are sighted with the other face.

4) If a target point is measured several times in the same telescope position, the last valid measurement is used for calculation.

Measurement Restrictions:

Target points with 0.000m height

If target points have a valid height of 0.000m, use 0.001m to enable in height processing.

Computation Procedure

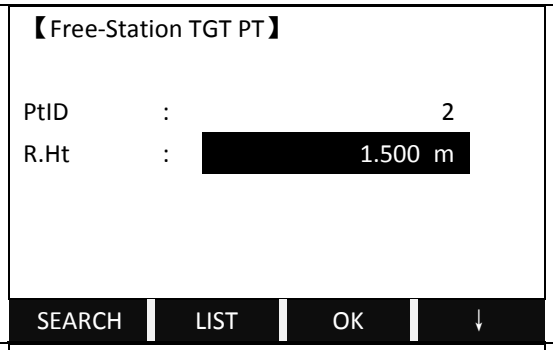
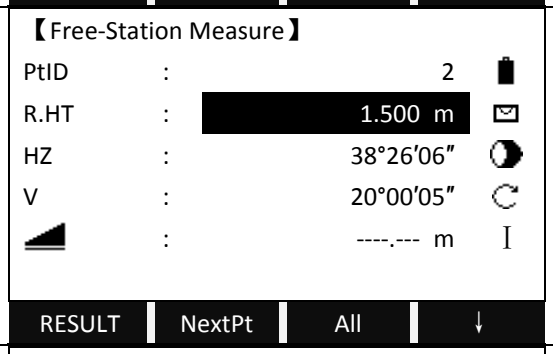
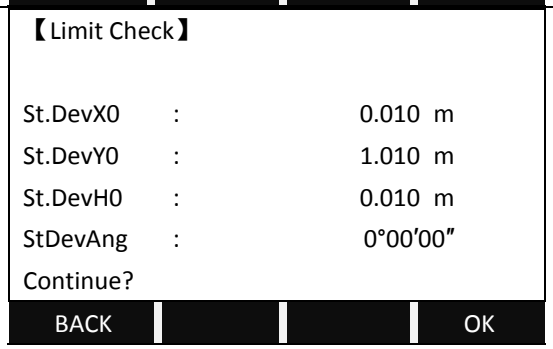
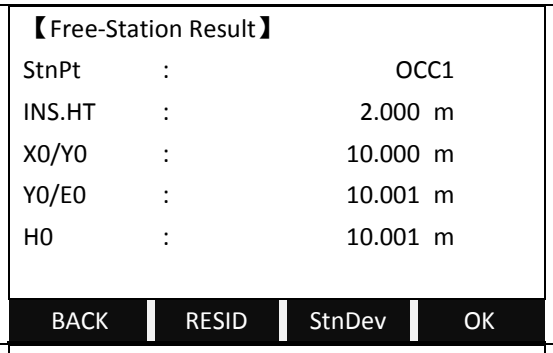
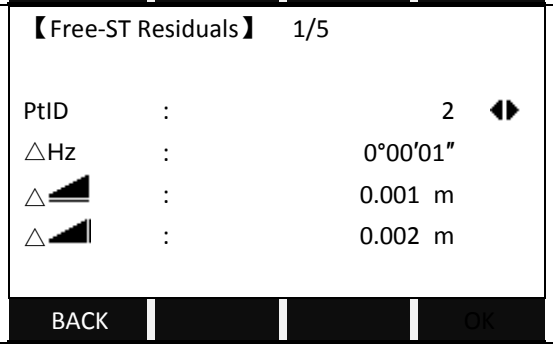
The measuring procedure automatically determines the method of data process, e.g. intersection, 3 point intersection, etc.

If there are more measurements, the procedure will use a least squares adjustment to determine the plan position, heights and azimuth.

1) The average value of face I and face II measurements is called up to the computation process.

2) Easting and northing is determined by the method of least squares, including standard deviation and improvements for HZ-direction and horizontal distances.
3) The final height is computed from averaged height differences based on the original measurement.
4) The HZ-circle orientation is computed by the original average face I and face II measurements and the final computed plan position.

STEPS	DISPLAY
Press F3 to enter to Free Station function in the menu of *Programs*.	【Free Station】 [*] F1 Setting job (1) F2 Setting limit (2) F4 Start (4) F1 F2 F4
Press F1 to set a job. Select the job name, or create a new job by press ADD. After setting the job, press OK. The screen returns to upper level.	【Setting Job】 5/8 Job : SANDING ◀▶ Name : JOHN Date : 2011.01.01 Time : 16:02:09 ADD OK
Press F2 to set the limit. Input all the deviation limits as shown on the right. Press SET. to confirm. The screen returns to upper level.	【Setting Limit】 Input Limit! Status : ON ◀▶ St.dev.X/N : 0.010 m St.dev.Y/E : 0.010 m St.dev.H/Z : 0.010 m St.dev.Ang : 0°00′00″ SET.
Press F4 to start *Free Station.* Input the station point and the instrument height. Press OK to confirm.	【Free-Station STN PT】 StnPt : OCC1 INS.Ht : 2.000 m OK

Input the target point ID and reflector height, and press OK to confirm. You can also call up a point by SEARCH or LIST.	
Collimate the Target Point 2 and press All to trigger the measurement. After one measurement, press NextPt to process to the measurement of the next point.	
When at least 2 points and 1 side are measured, the coordinates of station point can be calculated and displayed.	
Press OK to view the free station result.	
Press RESID to view the residuals.	

Warnings/Messages

Important Messages	Meaning
Selected point has no valid data!	This message occurs if the selected target point has no easting or northing coordinate.
Max 5 points supported!	If 5 points have already been measured and another point is selected, the system supports a maximum of 5 points.
Invalid data - no position computed!	The measurements may not allow final station coordinates (Easting, Northing) to be computed.
Invalid data - no height computed!	Either the target heights are invalid or insufficient measurements are available to compute a final station height.
Insufficient space in job!	The present selected job is full and does not allow further storage.
More points or distances are required!	There is insufficient data measured to be able to compute a position. Either there are not enough points used or not enough distances measured.

5.7 COGO

COGO is an application program to perform coordinate geometry calculations such as:

·Coordinates of points

·Bearings between points

·Distances between points

The COGO calculation methods are:

·Inverse

·Intersection

·Traverse

Soft keys functions:

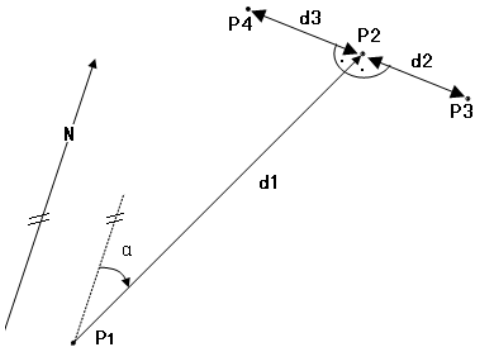
[MEAS] Jump to measurement dialog to measure the point..

[CALC] Once the datum in need is inputted, start calculating.

[STAKE] Once computation point is displayed, user can select to stake out directly.

5.7.1 Traverse & Inverse

5.7.1.1 Traverse



Known:

P1: The known point

α: Direction from P1to P2

d1: Slope distance from P1to P2

d2: Offset right that is positive

d3: Offset Left that is negative

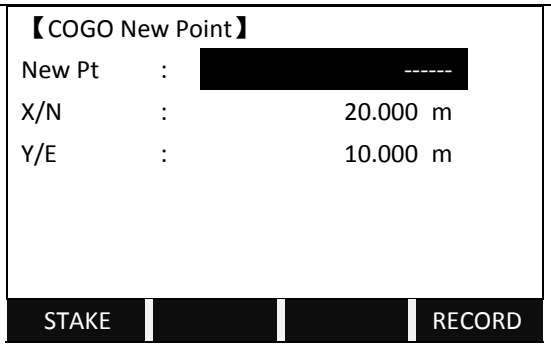
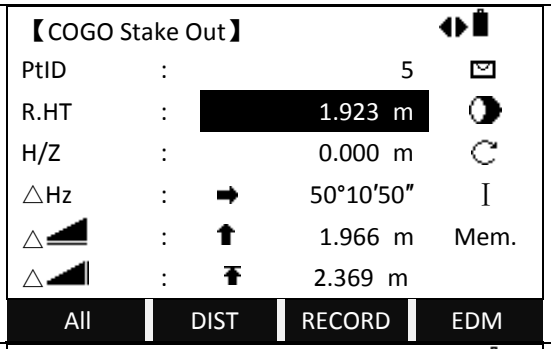
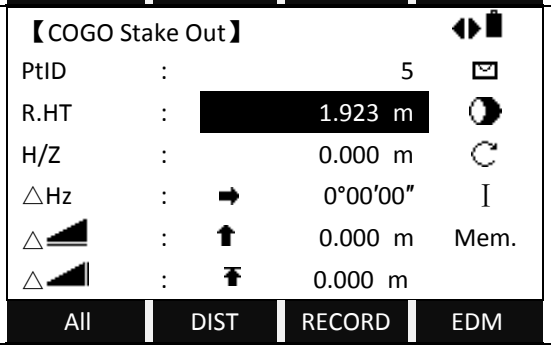
Unknown:

P2:COGO point

P3: COGO point with positive offset

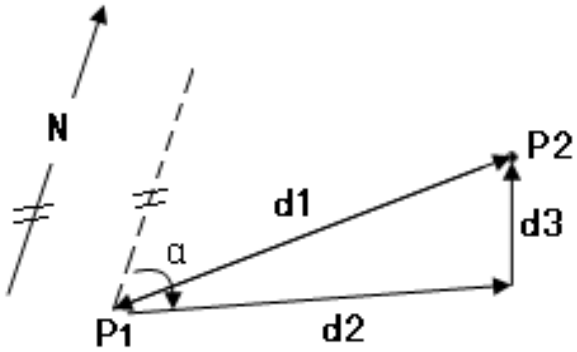
P4: COGO point with negative offset

STEPS	DISPLAY
Press F4 to start *COGO*. And press F1 to select *Inverse & Traverse.* And press F1 to start *Traverse*.	【Traverse】 PtID : 2 AZ : ----°--′--″ H-Dist : ----.--- m Offset : ----.--- m MEAS CALC SEARCH ↓
There're some ways to set the known PtID. Input a known PtID; Call up a existed point from the list; Input the coordinates directly; Or press MEAS to trigger the measurement and get the result. After setting the PtID, input the azimuth, horizontal distance and offset.	【Traverse】 PtID : 2 AZ : 30°00′00″ H-Dist : 2.000 m Offset : 0.500 m MEAS CALC SEARCH ↓

Press CALC to calculate. Input a new PtID. Press RECORD to save. Or press STAKE to start stake out. The system will ask “Record New Point?” Press OK to save the new point to the job. Press CANCEL to start stake out without saving. Entering PtID is necessary for stake out.	
Collimate the prism, input the prism height, and elevation (H/Z) if necessary. Press DIST to start measurement. If more than one points are to stake out, move the cursor to the PtID field and select by◀▶.	
Rotate the telescope until the △Hz is 00°00′00″. Indicate the person to move the prism. △Hz is positive: The prism should be moved rightward. △Hz is negative: The prism should be moved leftward.	

1. If staking out directly without inputting PtID of new point, the system will display “Invalid PtID!”.
2. If to launch Traverse function again, press ESC.
3. The Traverse result is the plane value. Therefore, in the process of stake out, if H/Z is needed, input it separately.
4. Selecting Fine (r) or tracking measuring mode will display the factor offsets between prism point and stake out point on real time.

5.7.1.2 Inverse



The known data:

P1: The first known point

P2: The second known point

The unknown data:

α:Direction from P1 to P2

d1: Slope distance between P1 and P2 .

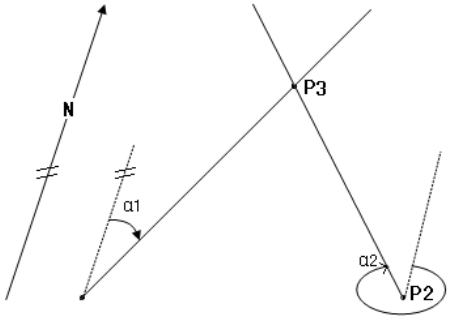
d2: Horizontal distance between P1 and P2

d3: Height distance between P1 and P2

STEPS	DISPLAY
Press F2 to start Inverse. Input 2 known points, one as the point to start and the other as the point to end. Or you can call up the points from the LIST.	【Inverse】 From : 21 To : 22 MEAS CALC SEARCH ↓
Press CALC to calculate the display the result. Press RECORD to save the result. Press ESC to quit and start a new Inverse calculation.	【Inverse Result】 Point1 : 21 Point2 : 21 AZ : 90°00′00″ △ : 10.000 m △ : 10.000 m △ : 0.000 m RECORD

5.7.2 Intersections

5.7.2.1 Bearing-Bearing



The known data:

P1: The first known point

P2: The second known point

α1: Direction from P1 to P3

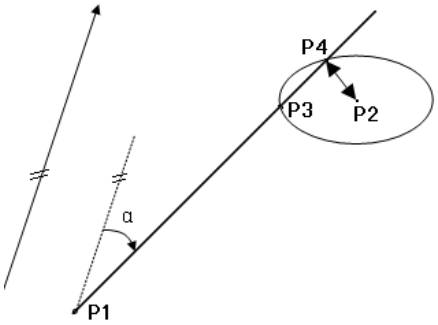
α2: Direction from P2 to P3

The unknown data:

P3: COGO point

STEPS	DISPLAY
In *COGO Main Menu*, press F2 to enter to *Intersection*. Press F1 to start *Bearing-Bearing* Intersection calculation. Enter the PtID of Point1. Input the bearing (azimuth) from P1 to P3. Input the PtID of Point2. Input the bearing (azimuth) from P2 to P3.	【Bearing-Bearing】 Input Data! Point1 : 10 AZ : 45°00′00″ Point2 : 11 AZ : 315°00′00″ MEAS | CALC | SEARCH | ↓
Press CALC to calculate and display the result. To stake out this point, input a new PtID and press STAKE. To save the result, press RECORD.	【COGO New Point】 New Pt : ------ X/N : 50.000 m Y/E : 50.000 m STAKE | | | RECORD

5.7.2.2 Bearing-Distance Intersection



The known data:

P1: The first known point

P2: The second known point

α: Direction from P1 to P3 and P4

r: Radius, i.e. distance from P2 to P3 or P4

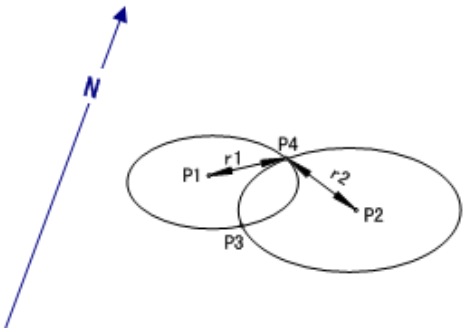
The unknown data:

P3: The first COGO point

P4: The second COGO point

STEPS	DISPLAY
In Intersection menu, press F2 to start *Bearing-Distance* COGO calculation. Enter the PtID of Point1. Input the bearing (azimuth) from P1 to unknown points P3 and P4. Input the PtID of Point2. Input the horizontal distance between P2 and P3 or P4.	【Bearing-Distance】 Input Data! Point1 : 10 AZ : 45°00′00″ Point2 : 11 H-Dist : 2.000 m MEAS CALC SEARCH ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 New Pt : X/N : 114.142 m Y/E : 114.142 m NewPt 2 : ------ X/N : 85.858 m Y/E : 85.858 m STAKE RECORD

5.7.2.3 Distance-Distance Intersection



The known data:

P1: The first known point

P2: The second known point

r1: Radius, as defined by the distance from P1 to P3 or P4

r2: Radius, as defined by the distance from P2 to P3 or P4

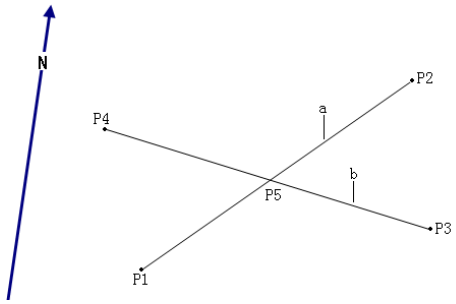
The unknown data:

P3: The first COGO point

P4: Second COGO point

STEPS	DISPLAY
In Intersection menu, press F3 to start *Distance-Distance* COGO calculation. Enter the PtID of Point1. Input the horizontal distance from P1 to P3. Input the PtID of Point2. Input the horizontal distance between P2 and P3 or P4.	【Distance-Distance】 Input Data! Point1 : 10 H-Dist : 50.000 m Point2 : 11 H-Dist : 20.000 m MEAS CALC SEARCH ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 New Pt : ------ X/N : -19.596 m Y/E : 4.000 m NewPt 2 : ------ X/N : 19.596 m Y/E : 4.000 m STAKE RECORD

5.7.2.4 By Points



The known data:

P1: The first known point

P2: The second known points

P3: The third known points

P4: The fourth known points

a: Line from P1 to P2

b: Line from P3 to P4

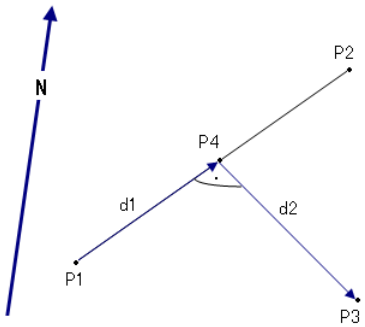
The unknown data:

P5: COGO point

STEPS	DISPLAY
In Intersection menu, press F4 to start *By Points* COGO calculation. Input the known PtID from P1 to P4.	【By Points】 Input Data! Point1 : 10 Point2 : 11 Point3 : 12 Point4 : 13 MEAS | CALC | SEARCH | ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 New Pt : ------ X/N : 40.000 m Y/E : 40.000 m STAKE | | | RECORD

5.7.3 Offset

5.7.3.1 Distance-Offset



The known data:

P1: Baseline start point

P2: Baseline end point

P3: Lateral point

The unknown data:

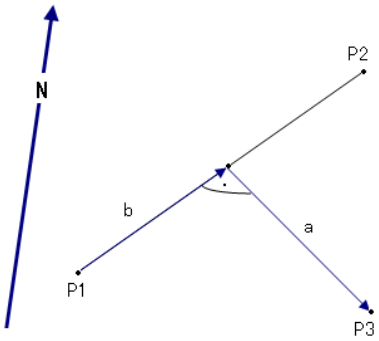
d1: Difference in length/abscissa (HD)

d2: Lateral deviation/ordinate (Offset)

P4: Base point

STEPS	DISPLAY
In *COGO Main Menu*, press F3 to start *Offset* COGO. Press F1 to start *Distance-Offset*. Enter the known PtID of P1 and P2. Input the PtID of the target point P3.	【Distance-Offset】 Define Baseline! Point1 : 20 Point2 : 21 Input Pt-Offset! OffsPt : 8 MEAS CALC SEARCH ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 New Pt : ------ X/N : 40.000 m Y/E : 40.000 m STAKE RECORD

5.7.3.2 Point-Offset



The known data:

P1: Baseline start point

P2: Baseline end point

a: Difference in length/ abscissa (HD)

b: Lateral deviation / ordinate (Offset)

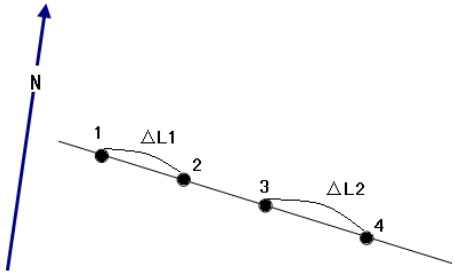
The unknown data:

P3: Lateral point

STEPS	DISPLAY
Press F2 to start *Point-Offset*. Enter the known PtID of P1 and P2. Input the T offset and L offset.	【Point-Offset】 Define Baseline! Point1 : 20 Point2 : 21 Input TOff&LOff! Line : 12.000 m Offset : 20.200 m MEAS CALC SEARCH ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 Nw Pt : ------ X/N : -5.657 m Y/E : 22.627 m STAKE RECORD

5.7.4 Extension

"Extension" is used to compute extension points from the baseline.



The known data: 1: Start point of baseline
3: End point of baseline
△ L1 or △ L2: Distance

The unknown data:
P2, P4: Extended point

STEPS	DISPLAY
In *COGO Main Menu*, press F4 to start *Extension* COGO. Input the known PtID of P1, P2, and horizontal distance between the extended point and the start point or end point.	【Extension】 Define Baseline! Point1 : 20 Point2 : 22 H-Dist : 20.000 Select Base Pt! BasePt : 20 MEAS CALC SEARCH ↓
Press CALC to calculate and display the result. Press STAKE to start staking out the point. Press RECORD to save the result. Press ESC to start a new COGO.	【COGO New Point】 New Pt : ------ X/N : 25.000 m Y/E : 20.000 m STAKE RECORD

5.8 TIE DISTANCE

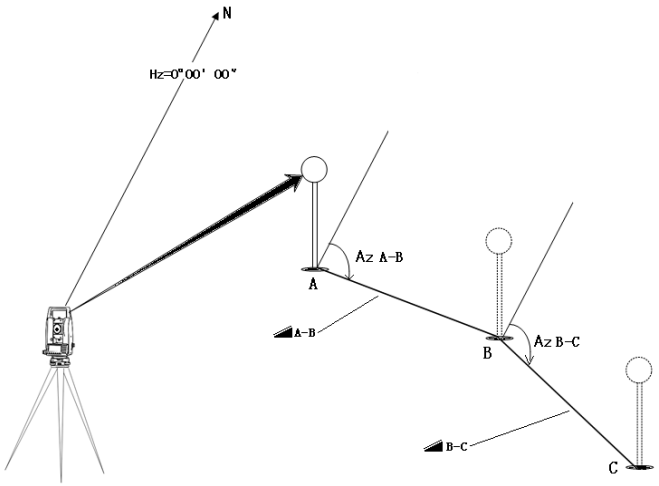
The application Tie Distance computes slope distance, horizontal distance, height difference and azimuth of two target points measured online, selected from the internal memory or entered manually.

User can select between two different methods:

[F1] Polygonal (A-B, B-C)

[F2] Radial (A-B, A-C)

5.8.1 Polygonal (A-B, B-C)



STEPS	DISPLAY
On Page 2/3 of Programs, press F1 to start *Tie Distance*. After setting the job, station, and orientation, presses F4 to start. And press F1 to start *Polygonal (A-B, B-C)*.	【Polygonal】 1/2 Point1 : 1 R.HT : 1.500 m : ----.--- m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓
You can set the P1 via following ways: 1. Input a PtID and prism height, collimate the prism and press All (or DIST + RECORD on 2nd page of function key bar). 2. Call up a known point by SEARCH or LIST. 3. Input a PtID and press ENH to input the coordinates.	【Polygonal】 1/2 Point1 : 1 R.HT : 1.500 m : ----.--- m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓
Use the ways above to confirm the P2.	【Polygonal】 1/2 Point1 : 1 Point 2 : 2 R.HT : 1.500 m : ----.--- m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓

It displays the Tie Distance result. △: HD between Point A and Point B. △: SD between Point A and Point B. △: VD between Point A and Point B. Grade: the slope between Point A and Point b. Press PAGE to display the azimuth between Point A and Point B.	【Tie Distance】 1/2 ▼ Point1 : 1 Point 2 : 2 Grade : -49.6% △ : 0.663 m △ : 0.741 m △ : -0.329 m NewPt1 NewPt2 RADIAL

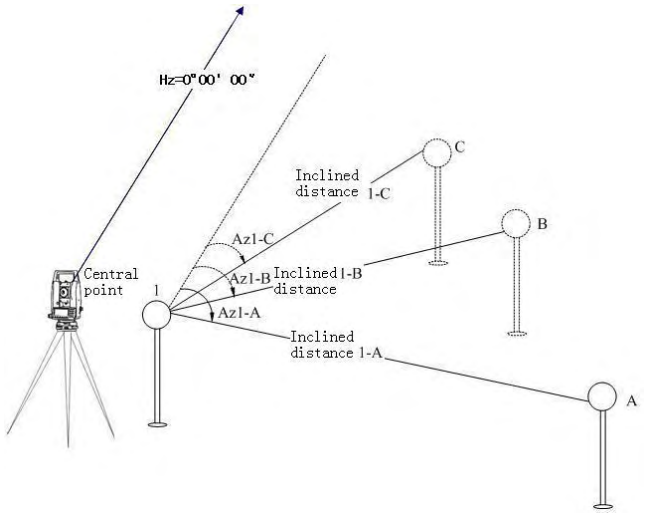
Soft keys – polygonal method:

[F1]([NewPt1]): An additional missing line is computed. Program starts again (at point 1).

[F2]([New Pt2]): Point 2 is set as starting point of a new missing line. New point (Pt2) must be measured.

[F4]([RADIAL])：Switch to radial method.

5.8.2 Radial (A-B, A-C)



STEPS	DISPLAY
In *Tie Distance* Menu, press F2 to start *Radial (A-B, A-C)*. Input the PtID of the central point and its prism height.	【NewPt1】 1/2 NewPt1 : R.HT : 1.500 m : ----.--- m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓

Input the PtID of end point A and its prism height.	【NewPt2】 1/2 NewPt1 : 1 NewPt2 : [redacted] R.HT : 1.500 m △ : ----.--- m △ : ----.--- m △ : ----.--- m Mem. All SEARCH LIST ↓
It displays the Tie Distance result. △: HD between Point A and Point B. △: SD between Point A and Point B. △: VD between Point A and Point B. Grade: the slope between Point A and Point B. Press PAGE to display the azimuth between Point A and Point B.	【Tie Distance】 1/2 ▼ Point1 : 1 Point 2 : [redacted] Grade : -49.6% △ : 0.663 m △ : 0.741 m △ : -0.329 m NewPt1 NewPt2 RADIAL

Soft keys – radial method:

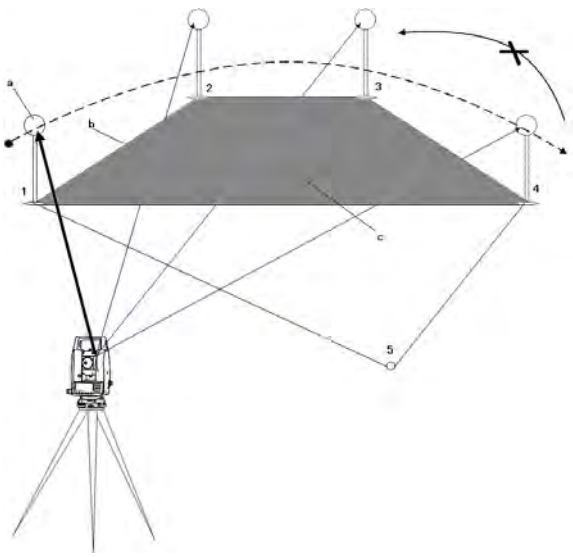
[F1]([NewPt1]): Determine new central point.

[F2]([NewPt2]): Determine new radial point.

[F4]([POLY]): Switch to polygonal method.

5.9 AREA MEASUREMENT (PLANE)

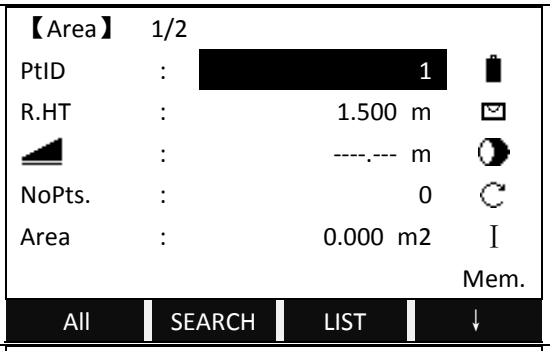
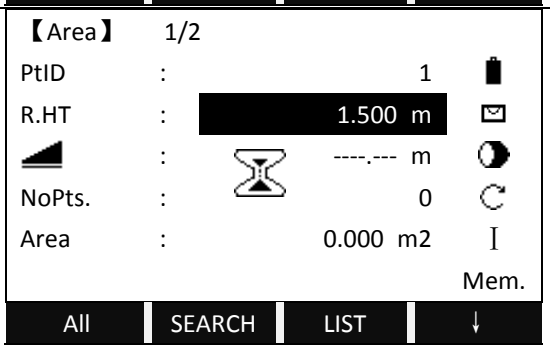
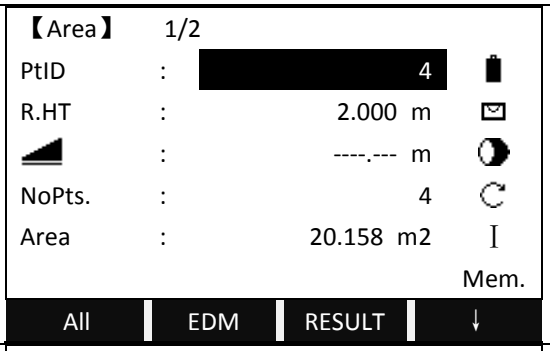
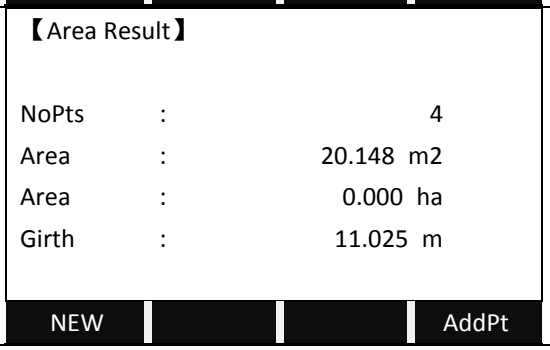
The application program Area is used to calculate online areas of a number of points connected by straights. The target points have to be measured, selected from memory or entered manually via keyboard.



a: Start point

b: Perimeter, polygonal length from start point to

c: Calculated area always closed to the start point P1, projected onto the horizontal plane.

STEPS	DISPLAY
On Page 2/3 of Programs, press F2 to start *Area (Plan).* After setting the job, station and orientation, press F4 to start.	
Enter the first PtID. You can set the point via following ways: 1. Input a PtID and prism height, collimate the prism and press All 2. Call up a known point by SEARCH or LIST. 3. Input a PtID and press ENH to input the coordinates if the point does not exist.	
Enter the other points through the ways above. The areas will be displayed automatically according to the points that are employed to calculate the area.	
When at least 3 points are employed to calculate the area, you can press RESULT to view the result.	

Soft keys:

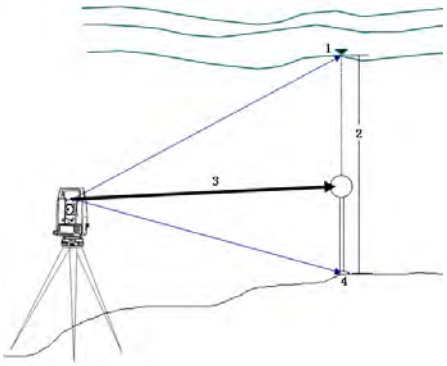
[F1]([NEW]): To start new area measurement. Point number counts from 0.

[F4]([AddPt]): To add new measurement based on current area measurement.

Point number counts from the existed record.

5.10 REMOTE HEIGHT MEASUREMENT (REM)

If the prism cannot be put at the point to be measured, user can firstly collimate base prism below it and measure the horizontal distance. Then collimate the remote point to calculate the vertical difference.



1. Target point (remote point)
2. Height difference
3. Slope distance
4. Base point

If the prism height is known(e.g. prism height (h) =1.500m)

STEPS	DISPLAY
On Page 2/3 of Programs, press F3 to start *Remote Height.* After setting the job, station and orientation, press F4 to start. Input the PtID of Base Point, its prism height.	【Base Point】 Sight Meas Base Pt! BasePt : 10 R.HT : 1.500 m : ----.--- m Mem. All DIST RECORD ↓
Collimate the prism and press All (or DIST + RECORD) to start measurement. The base point is confirmed. Then rotate the telescope to shoot the target point, the remote height will be calculated and displayed.	【Remote Point】 Sight Meas Rem Pt! BasePt : 10 Rem.Pt : 11 : 1.758 m △ : 3.051 m H/Z : 2.421 m Mem. BasePt SAVE

If the prism height is unknown:

STEPS	DISPLAY
On Page 2/3 of Programs, press F3 to start *Remote Height.* After setting the job, station and orientation, press F4 to start. Turn to the 2nd page of the function key bar.	【Base Point】 Sight Meas Base Pt! BasePt : 10 R.HT : 1.500 m : ----.--- m Mem. R.HT? EDM | ←
Press R.HT? to start to calculate the Remote Height without a known prism height. Press F4 to turn the function key bar. Input the PtID of the Base Point. Collimate the prism and press All (or DIST + RECORD) to start measurement.	【Base Point】 Sight Meas Base Pt! BasePt : 10 : ----.--- m Mem. All DIST RECORD ↓
It displays the horizontal distance between the instrument and the prism.	【Base Point】 Sight Meas Rem Pt! BasePt : 10 R.HT : 0.000 m : 1.968 m V : 92°05′52″ Mem. BACK V-ANG
Collimate the ground point of the base point and press V-ANG, the base point is confirmed. Then rotate the telescope to shoot the target point, the remote height will be calculated and displayed.	【Remote Point】 Sight Meas Rem Pt! BasePt : 10 Rem.Pt : 11 : 1.969 m △ : 1.144 m H/Z : 2.014 m Mem. BasePt SAVE

Soft keys:

[F1]([BasePt]): Input and measurement of a new base point.

[F4]([SAVE]): Saves the measured data.

5.11 REFERENCE LINE / ARC

☞ *If equipped with REFERENCE LINE/ARC, then ROAD and CONSTRUCTION SITE STAKE OUT will be deleted.*

This program facilitates stake-out or checking lines for buildings, sections of road, simple excavations, etc.

5.11.1 Reference Line

A reference line can be defined as a known base line. The reference line can be offset longitudinally, in parallel or vertically to the base line, or be rotated around the first base point as required.

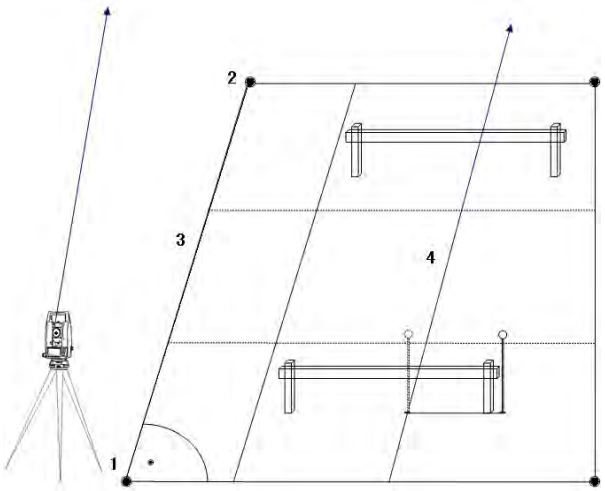
5.11.1.1 Definition of Base Line:

The base line is fixed by 2 base points that can be defined in 3 ways:

·Measured points

·Enter coordinates using keypad

·Select point from memory



1: 1st base point

2: 2nd base point

3: Baseline

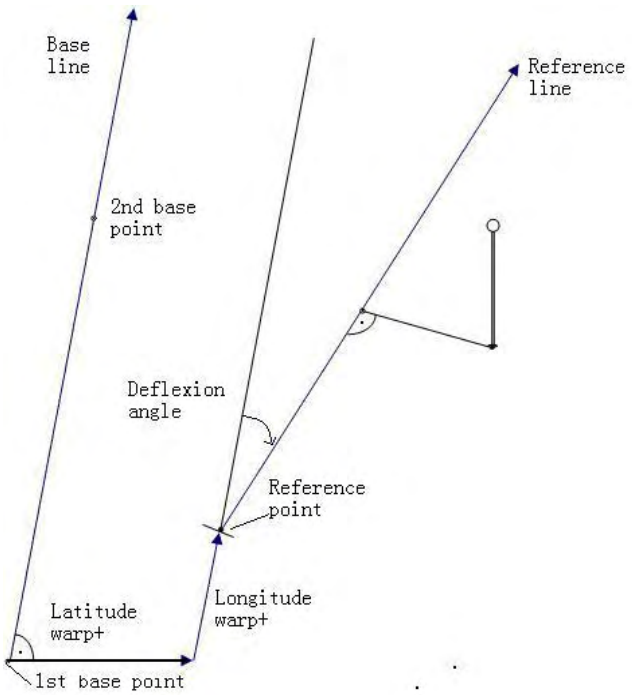
4: Reference line

STEPS	DISPLAY
On Page 2/3 of Programs, press F4 to start *Reference Line/Arc.* After setting the job, station and orientation, press F4. Press F1 to start *Reference Line*. Input the PtID of the 1st base point and its prism height, and press All to start the measurement. You can also call up the point by SEARCH or LIST, or input the coordinates of the PtID does not exist.	【Baseline Define】 1/3 Meas. First Pt! Point1 : 10 R.HT : 1.000 m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓

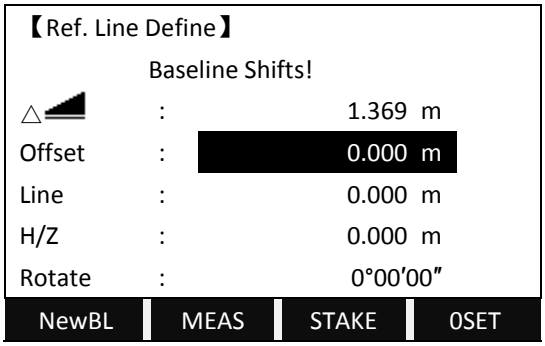
Set the 2nd base point and its prism height with the methods above.	【Baseline Define】 1/3 Meas. Second Pt! Point1 : 10 Point2 : 11 R.HT : 1.000 m : ----.--- m : ----.--- m Mem. All SEARCH LIST ↓
Then a Base Line is defined.	【Ref. Line Define】 Baseline Shifts! △ : 1.369 m Offset : 0.000 m Line : 0.000 m H/Z : 0.000 m Rotate : 0°00′00″ NewBL MEAS STAKE 0SET

5.11.1.2 Reference Line

In the process of using base line, the base line can be offset longitudinally, parallel and vertically or rotated. This new line is called the reference line. All measured data refers to the reference line.



Definition of Reference Line:



Offset: Parallel offset of the reference line to the right, referred to the direction of the base line.

Line: Longitudinal offset of the start point (=reference point) of the reference line in the direction of base point.

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

Rotate: Rotation of the reference line clockwise around the reference point.

The meaning of soft keys under the screen of Ref.Line Define:

[F1]([NewBL]): Return to Ref.Line Define screen to re-define base line.

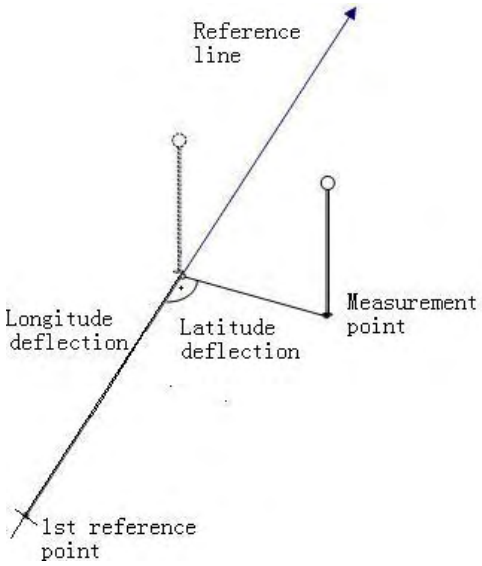
[F2]([MEAS]): The offset value of point to be measured related to the reference line.

[F3]([STAKE]): Activate the Orthogonal Stake Out.

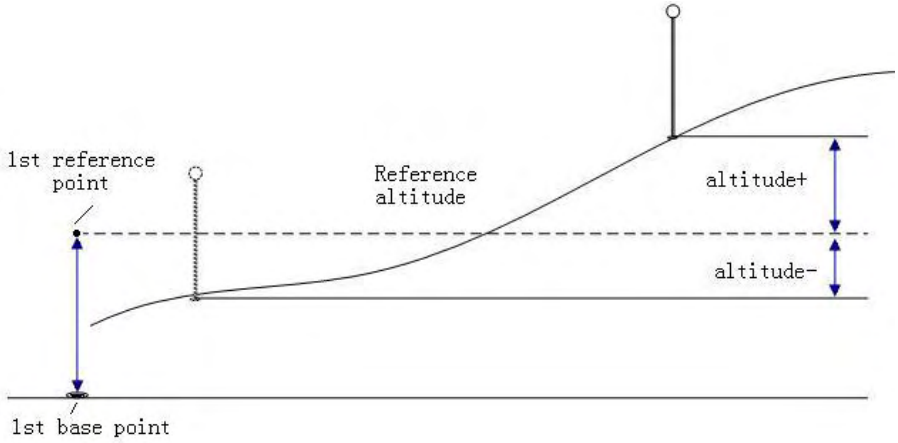
[F4]([0SET]): Set all offset values/rotate to zero.

5.11.1.3 "Line & Offset" Subapplication

The 'Line & Offset' subapplication calculates from measurements or coordinate longitudinal, parallel offsets, and height differences of target point relative to reference line.



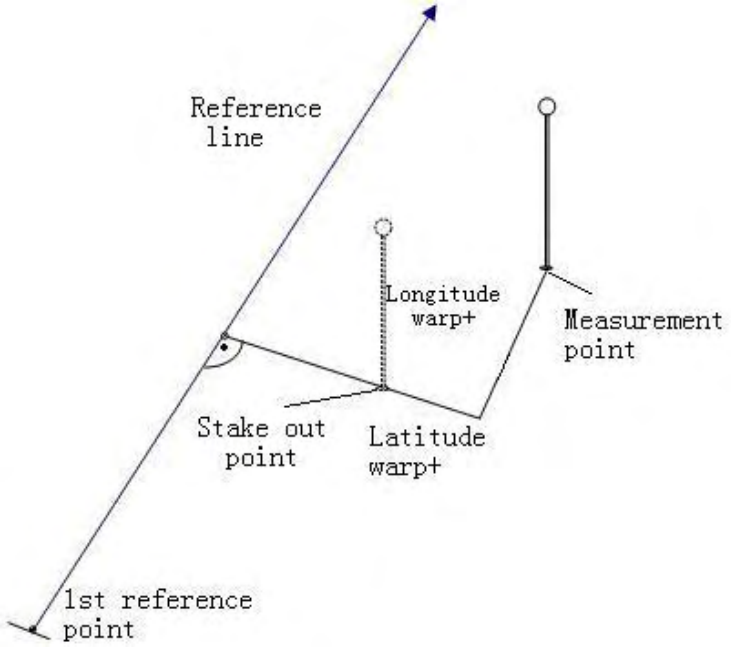
Always computes the height difference with the height of the first reference point (△).



STEPS	DISPLAY
After defining the base line, input the T offset (offset), L offset (Line), elevation (H/Z) and the angle to rotate.	【Ref. Line Define】 Baseline Shifts! △ : 1.369 m Offset : 0.000 m Line : 0.000 m H/Z : 0.000 m Rotate : 0°00′00″ NewBL | MEAS | STAKE | 0SET
Press MEAS to start to measure the L offset, T offset, and height different between the point to measure and the reference line. Input the PtID and its prism height and press All to start measurement. You can also call up the point by SEARCH or LIST, or input the coordinates of the PtID which does not exist. After measuring one point, collimate the next target point to measure via the methods above.	【Line Offset Meas】 PtID : 10 R.HT : 2.000 m △LOff : 1.025 m △TOff : 2.037 m △ : 1.410 m Mem. All | DIST | RECORD | ↓
After measuring one point, collimate the next target point to measure via the methods above. It displays the T offset and L offset between the known point or measured point and the reference line.	【Line Offset Meas】 PtID : 10 R.HT : 2.000 m △LOff : 0.425 m △TOff : -2.037 m △ : 2.010 m Mem. All | DIST | RECORD | ↓

5.11.1.4 Orthogonal Stake-Out

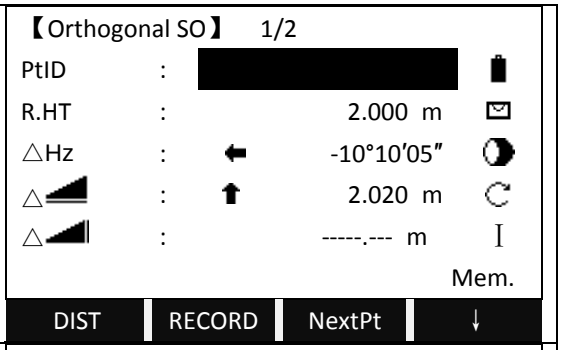
User can enter longitudinal, transverse and height offsets for the target points to be set-out related to the reference line. The program calculates the difference between a measured point and the calculated point. The program displays the orthogonal (pLine, pOffset, p◢) and the polar (pHz,△◢,△◢) differences.



STEPS	DISPLAY
Set the base line and reference line as introduced above. Press STAKE to start the Orthogonal Stake Out.	【Ref. Line Define】 Baseline Shifts! △◢ : 1.369 m Offset : 0.000 m Line : 0.000 m H/Z : 0.000 m Rotate : 0°00′00″ NewBL MEAS STAKE 0SET
Input the PtID and its prism height, as well as the T offset, L offset, elevation. Press OK to start to stake out.	【Input Orthogonal】 Input Orthogonal! PtID : 11 R.HT : 1.560 m Offset : 1.000 m Line : 1.900 m H/Z : 2.050 m BACK 0SET OK

Collimate the prism and press DIST to start measurement.

If you want to redefine the reference line, press Ref.Ln in the 2nd page of the function key bar.

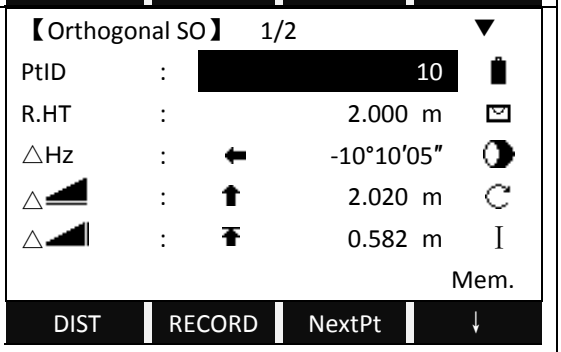


It displays the result.

△Hz: Positive from clockwise to point so take out.

△: Positive when the point so stake out is far ahead from the measured point.

△: Positive when the point to stake out is higher than the measured point.

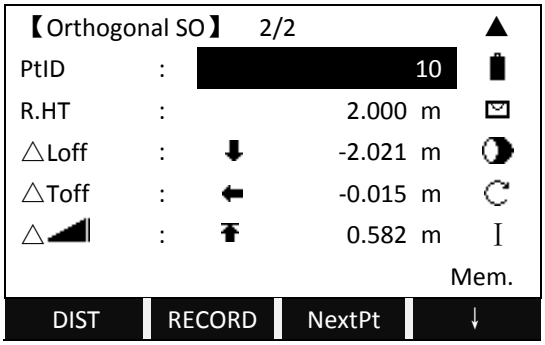


Press PAGE to view the other results.

△Loff: Positive when the point to stake out is far ahead.

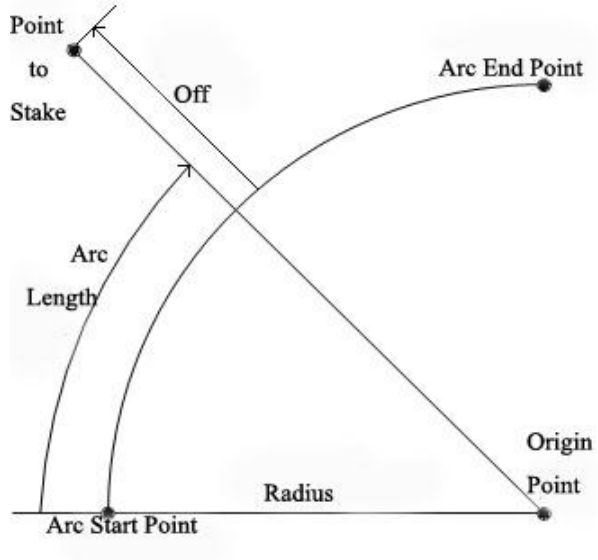
△Toff: Positive when the point to stake out is to the right side of the measured point.

when the △Hz and △ is 0, it means the current pint is the position of the point to stake out. △ indicates the distance to fill or dig.



5.11.2 Reference Arc

This procedure allows user define a reference arc, and the measure or stake out with respect to the arc.



Off: Perpendicular distance from arc.

All arcs are defined in clockwise direction.

All calculations are made in two dimensions.

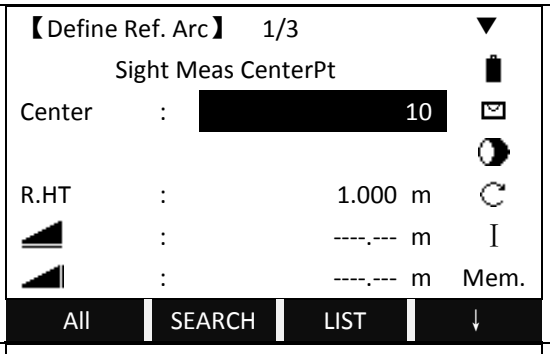
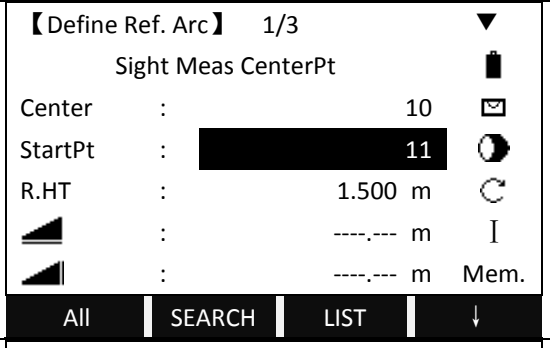
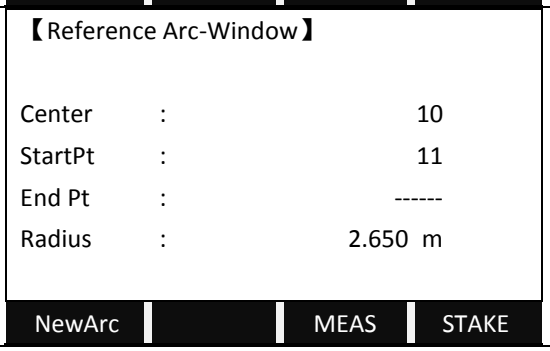
Steps：

1. Define the arc.
2. Decide to measure or to stake out
   1): 'Line & Offset' measurement
   2): Stake out of reference arc
      a: stake-out point
      b: stake-out arc
      c: stake-out chord
      d: stake-out central angle

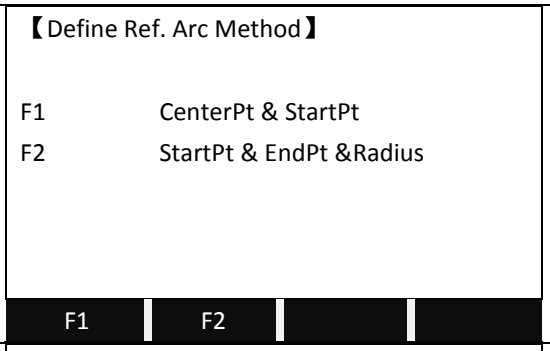
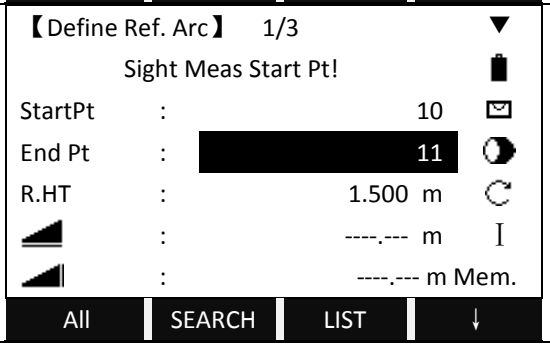
5.11.2.1 Defining Reference Arc

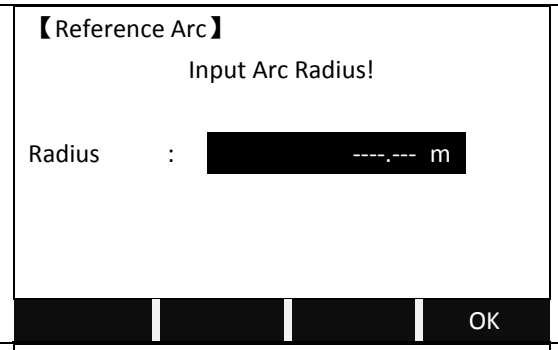
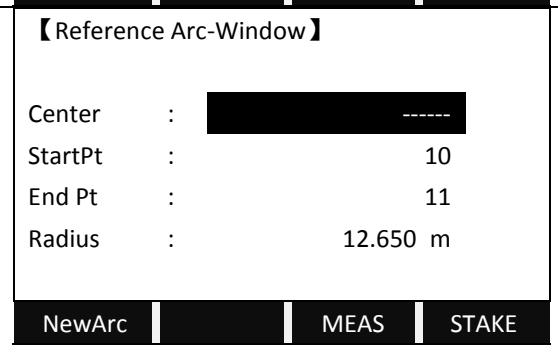
a) Center Point & Start Point

STEPS	DISPLAY
On Page 2/3 of Programs, press F4 to start *Reference Line/Arc.* After setting the job, station and orientation, press F4. Press F2 to start *Reference Arc*. Press F1 to choose to define the reference arc by *CenterPt & StartPt*.	【Define Ref. Arc Method】 F1 CenterPt & StartPt F2 StartPt & EndPt &Radius F1 F2

Set the PtID of the center point of the arc and its prism height. Input the PtID and its prism height and press All to start measurement. You can also call up the point by SEARCH or LIST, or input the coordinates by pressing ENH if the PtID does not exist.	
Set the PtID of the start point and its prism height via the methods above.	
Then a reference arc is defined. Now you are to decide whether to measure or to stake out.	

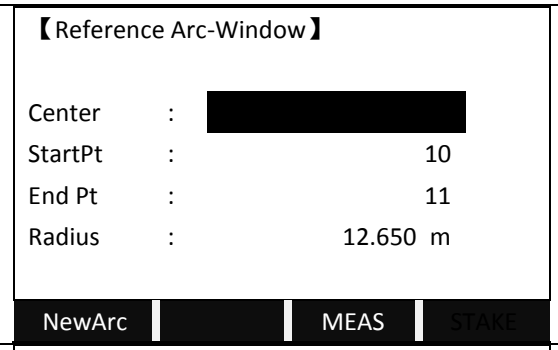
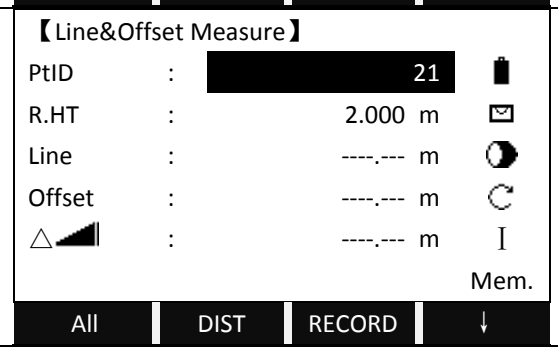
b) CenterPt & EndPt & Radius

Press F2 to choose to define the reference arc by *StartPt & EndPt & Radius*.	
Set the PtID of the start point and its prism height. And set the PtID of the end point and its prism height.	

Input the radius and press OK.	
Then a reference arc is defined. Now you are to decide whether to measure or to stake out.	

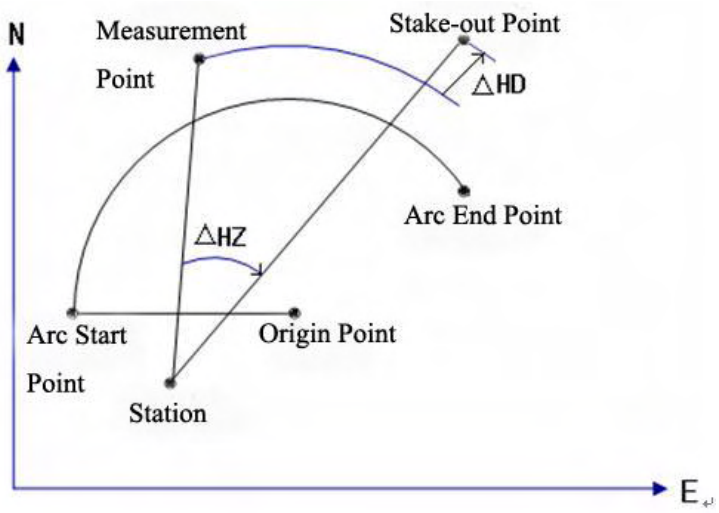
5.11.2.2 "Line & Offset" Subapplication

Here you can measure or select points from memory and you will see Line and Offset referring to the arc.

Press MEAS to start *Line & Offset Measure*.	
Input the PtID and its prism height and press All to start measurement. You can also call up the point by SEARCH or LIST, or input the coordinates by pressing ENH if the PtID does not exist.	

No matter the point to measure is called up from the memory or input manually, the system calculates the line and offset between this coordinates and the reference line.	【Line&Offset Measure】 PtID : 21 R.HT : 2.000 m Line : 14.125 m Offset : 2.364 m △ : 10.000 m Mem. All | DIST | RECORD | ↓

5.11.2.3 "Stake Out" Subapplication



ΔHz: Difference in horizontal angle

ΔHD: Difference in distance measurement

A negative line is impossible to stake out.

The application provides 4 ways to stake out.

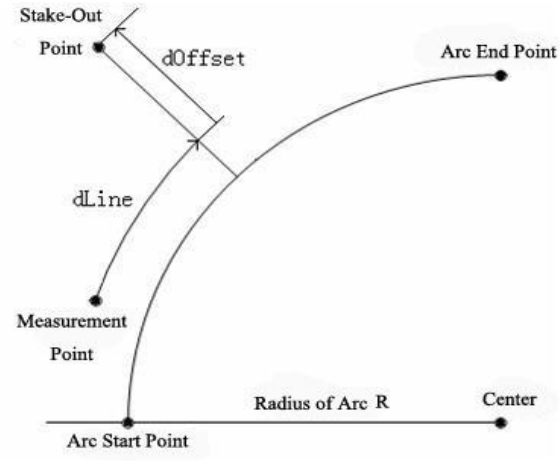
【Ref. Arc Stake out Menu】

F1 Stake Out Point
F2 Stake Out Arc
F3 Stake Out Chord
F4 Stake Out Angle

F1 | F2 | F3 | F4

a) Stake-Out Point

Point can be staked out by entering a line and an offset value.

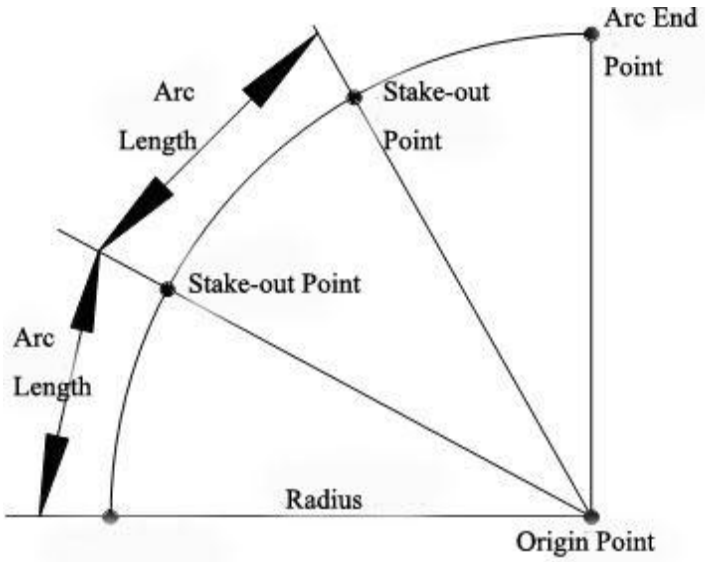


dOffset: The perpendicular distance from stake out points to arc sect.
dLine: The arc length from measurement point to stake-out point and vertical line of reference arc (Line).

Press F1 to start *Stake Out Point*. Input the PtID of the point to stake out, the arc distance (Line) and the radius (Offset). Press STAKE to start stake out.	【Stake Out Point】 PtID : 20 Line : 0.000 m Offset : 0.000 m NewArc | | MEAS | STAKE
Input the PtID of the point to measure and its prism height. Collimate the prism and press DIST to start measurement. The system calculates and displays the stake out offsets between the prism and the point to stake out.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -20°00′00 △▲ : ↓ -0.282 m △▲ : ↓ -0.019 m Mem. DIST | RECORD | NextPt | ↓
When △Hz and △▲ is 0, it means the current position of the prism is the point to stake out. △▲ means the distance to dig or fill.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -00°00′00 △▲ : ↓ 0.000 m △▲ : ↓ -0.019 m Mem. DIST | RECORD | NextPt | ↓

b) Stake Out Arc

This allows staking out a series of equidistant points along the arc.



Press F2 to start *Stake Out Arc*. Input the PtID of the point to stake out. Select the distributing mode of misclosure. Input the length of the arc to stake out, and the system will calculate the Line according to the distributing mode chosen. Input the offset and press OK. Pressing PT- and PT+ can display each line of the arc to stake out.	【Stake Out Arc】 PtID : 20 Miscls : End Arc Arclen : 0.000 m Line : 0.000 m Offset : 0.000 m 0SET | PT- | PT+ | OK
Input the PtID of the point to measure and its prism height. Collimate the prism and press DIST to start measurement. The system calculates and displays the stake out offsets between the prism and the point to stake out.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : -20°00′00 △ : -2.082 m △ : -0.019 m Mem. DIST | RECORD | NextPt | ↓

When △Hz and △ is 0, it means the current position of the prism is the point to stake out. △ mean the distance to dig or fill.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : -00°00′00 △ : 0.000 m △ : -0.019 m Mem. DIST RECORD NextPt ↓

Display content:

1. Misclosure: If the entered arc length is not an integer of the whole arc, there will be a misclosure.

User has 3 options to distribute the misclosure:

1) Start arc: All of the misclosure will be added to the first arc-section.
2) No distribution: All of the misclosure will be added to the last arc-section.
3) Equal: The misclosure will be equally distributed between all sections.

2. Arc length：Enter the length of the arc-segment to be staked out.
3. Line: Shows the line-value of the stake-out point. This is calculated by the arc length and the selected misclosure distribution.
4. Offset: Here you can enter the offset value.

Soft keys

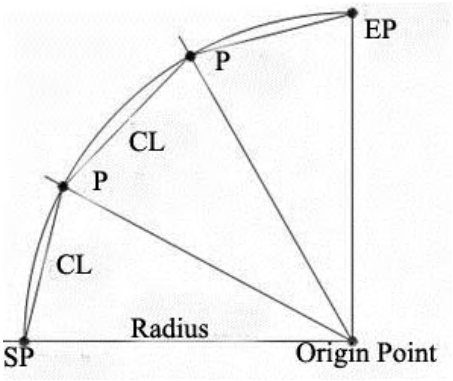
[F1]([0SET]): Set the value to 0.

[F2]([PT-]) and [F3] ([PT+]): Toggles through the calculated stake-out points.

[F4]([OK]): Proceed to Stake Out Measure dialog.

c) Stake out Chord

This allows taking out a series of equidistant chords along the arc.



CL: Chord length

SP: Start point of arc

EP: End point of arc

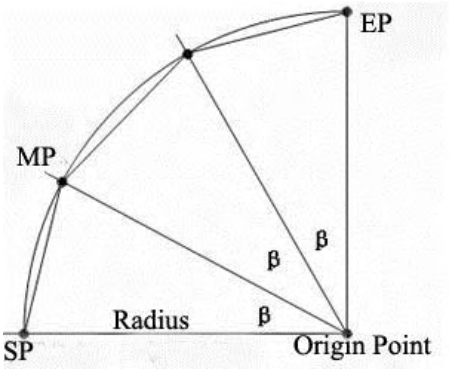
P: Point to stake

Press F3 to start *Stake Out Chord.* Input the PtID of the point to stake out. Select the distributing mode of misclosure. Input the length of the chord to stake out, and the system will calculate the Line according to the distributing mode chosen. Input the offset and press OK. Pressing PT- and PT+ can display each line of the arc to stake out.	【Stake Out Chord】 PtID : 20 Miscls : End Arc ChordL : 0.000 m Line : 0.000 m Offset : 0.000 m OSET PT- PT+ OK
Input the PtID of the point to measure and its prism height. Collimate the prism and press DIST to start measurement. The system calculates and displays the stake out offsets between the prism and the point to stake out.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -20°00′00 △▟ : ↓ -2.082 m △▟ : ↓ -0.019 m Mem. DIST RECORD NextPt ↓
When △Hz and △▟ is 0, it means the current position of the prism is the point to stake out. △▟ mean the distance to dig or fill.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -00°00′00 △▟ : ↓ 0.000 m △▟ : ↓ -0.019 m Mem. DIST RECORD NextPt ↓

The operation keys displayed in dialog of Ref.Arc Stake Out is in accordance with the one of Stake Out Arc introduced previously.

d) Stake out Angle

This allows staking out a series of angles along the arc. The angels are defined by the point on the arc. The screen contents and the buttons shown are the same as described in “Stake out Arc” section.



β: Angle

SP: Start point of arc

EP: End point of arc

MP: measurement point

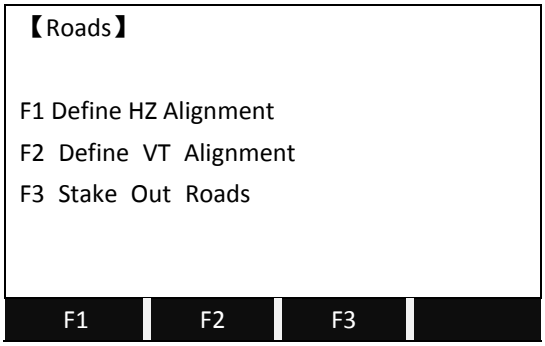
Press F3 to start *Stake Out Angle.* Select the distributing mode of misclosure. Input the angle to stake out, and the system will calculate the Line according to the distributing mode chosen. Input the offset and press OK. Pressing PT- and PT+ can display each line of the arc to stake out.	【Stake Out Chord】 PtID : 20 Miscls : End Arc Angle : 0.000 m Line : 0.000 m Offset : 0.000 m 0SET | PT- | PT+ | OK
Input the PtID of the point to measure and its prism height. Collimate the prism and press DIST to start measurement. The system calculates and displays the stake out offsets between the prism and the point to stake out.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -20°00′00 △▲ : ↓ -2.082 m △▲ : ↓ -0.019 m Mem. DIST | RECORD | NextPt | ↓
When △Hz and △▲ is 0, it means the current position of the prism is the point to stake out. △▲ mean the distance to dig or fill.	【Stake out Reference Arc】 PtID : 21 R.HT : 2.621 m △Hz : ← -00°00′00 △▲ : ↓ 0.000 m △▲ : ↓ -0.019 m Mem. DIST | RECORD | NextPt | ↓

5.12 ROAD

☞ *If equipped with ROAD, then REFERENCE LINE/ ARC will be deleted.*

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

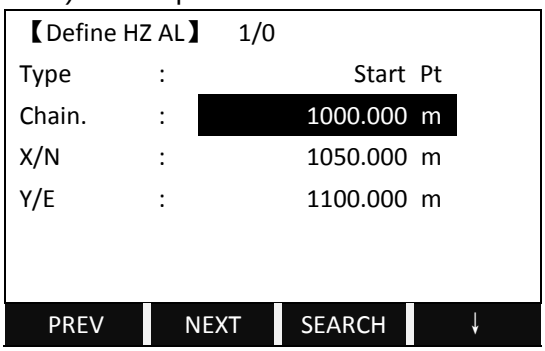
Before starting road design and stake-out, user should set job, station, and orientation first.



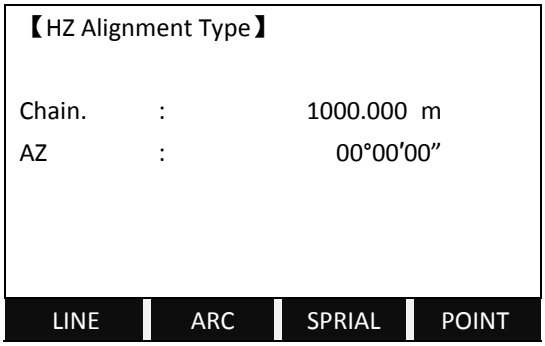
5.12.1 Define HZ Alignment

Horizontal alignment consists of the following elements: start point, line, curve and spiral.

To define a horizontal alignment, user should first input the detailed information (Chain, N, E coordinate) of start point.



The element of start point consists of the start chainage and E, N coordinate of start point. Enter these details, and press NEXT to display the main inputting approach.



The screen displays: current chainage, the azimuth angle of the tangent on the chainage, and the function key of the establishing new line. The system provides four functions: defining line, curve, spiral, and point.

Select a function key, enter the detailed information of the chainage, the alignment elements will be created. Press BACK to calculate the new chainage and azimuth angle automatically and return to the alignment main menu. Now other line type can be defined. Press ESC to quit the present screen and return to the screen of alignment element. Modification on the element entered previously is available.

STEPS	DISPLAY
On Page 3/3 of Programs, press F1 to start *Roads.* After setting the job, station and orientation, press F4. Press F1 to start to *Define HZ Alignment.* Input the chainage, N/X, Y/E. Press NEXT, and confirm to save by press OK	【Define HZ AL】 1/0 Type : Start Pt Chain. : 1000.000 m X/N : 1050.000 m Y/E : 1100.000 m PREV NEXT SEARCH ↓
Then it displays the main menu of defining alignment.	【HZ Alignment Type】 Chain. : 1000.000 m AZ : 00°00′00″ LINE ARC SPRIAL POINT

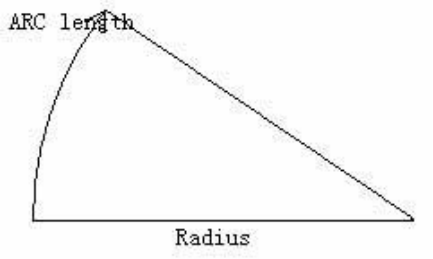
Line

When the start point or other line type is defined, user can define line. A line consists of azimuth angle and distance. The distance value can not be negative.

Press LINE to start *Define HZ Alignment*. Input the azimuth and the length of the line. Press NEXT and then OK to save the edited alignment data.	【Define HZ AL】 2/1 Type : LINE AZ : ----°--′--″ Length : ----.--- m PREV NEXT SEARCH ↓

It returns to the main menu of defining alignment. It displays the end chainage and its azimuth.	【HZ Alignment Type】 Chain. : 1048.420 m AZ : 25°00′00″ LINE ARC SPRIAL POINT

Curve

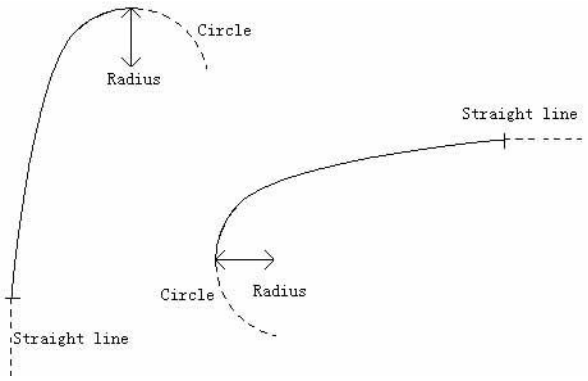


Press ARC in “Hz Alignment type” menu to define the curve. A curve consists of arc length and radius. The rule of radius value: along the forward direction of the curve. When the curve turns right, the radius value is positive; while the curve turns to left, the radius value is minus. The arc length can not be negative.

Press ARC to start to define the arc.	【HZ Alignment Type】 Chain. : 1048.420 m AZ : 25°00′00″ LINE ARC SPRIAL POINT
Input the radius and length of the arc. Press NEXT and then OK to save the edited alignment data.	【Define HZ AL】 3/2 Type : ARC Radius : ----.--- m Arclen : ----.--- m PREV NEXT SEARCH ↓

	【HZ Alignment Type】 Chain. : 1071.561 m AZ : 91°17′38″ LINE ARC SPRIAL POINT

Spiral

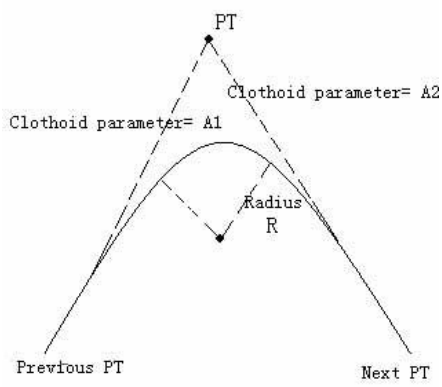


Press SPRIAL in “HZ Alignment Type” menu to define spiral. A spiral consists of the minimum radius and arc length. The rule of radius value: along the forward direction of the curve. When the curve turns right, the radius value is positive. When the curve turns to left, the radius value is minus. The arc length can not be negative.

Press SPRIAL to start to define the spiral.	【HZ Alignment Type】 Chain. : 1071.561 m AZ : 91°17′38″ LINE ARC SPRIAL POINT
Input the radius and arc length of the spiral. Press NEXT and then OK to save the edited alignment data.	【Define HZ AL】 4/3 Type : SPRIAL Radius : ----.--- m Arclen : ----.--- m PREV NEXT SEARCH ↓

It returns to the main menu of defining alignment. It displays the end chainage and its azimuth.	【HZ Alignment Type】 Chain. : 1091.561 m AZ : 119°56′31″ LINE ARC SPRIAL POINT

Point



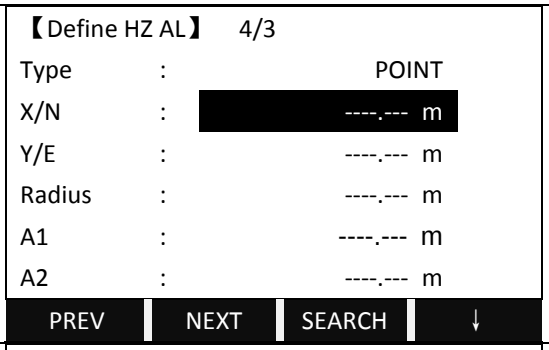
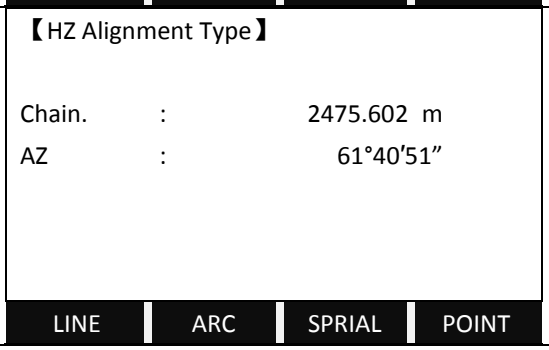
Press POINT in “HZ Alignment Type” menu to define point. A point element consists of coordinate, radius and spiral factors A1 and A2. Radius, A1 and A2 can not be negative. As radius is entered, an arc with specified radius inserted between current point and next point. As spiral factors A1 or A2 are entered, a curve with specified length is inserted between line and arc.

[NOTE]: If user input A1, A2 from according to the lengths L1, L2 of spiral, the following formulas are used to calculate A1 and A2.

$$A_1=\sqrt{L1 \times radius}$$

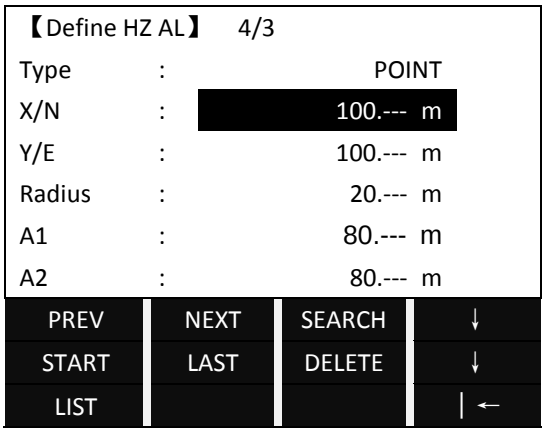
$$A_2=\sqrt{L2 \times radius}$$

Press POINT to start to define points.	【HZ Alignment Type】 Chain. : 1091.561 m AZ : 119°56′31″ LINE ARC SPRIAL POINT

Input the coordinates N/X, Y/E, radius and spiral parameters A1 and A2. Press NEXT and then OK to save the edited alignment data.	
It returns to the main menu of defining alignment. It displays the end chainage and its azimuth.	

5.12.2 Editing Horizontal Alignment Data

In the process of defining horizontal alignment, editing is available.



Soft Keys:

PREV [F1]: Displays the previous point data.

NEXT [F2]: Displays the next point data.

If the present data is at the end of horizontal alignment, press NEXT to return to the alignment main screen, and it means to add a new alignment data.

SEARCH [F3]: Searches for data. When pressing this key, the program will require user to insert a chainage. Then press ENT, and the data of the chainage will be displayed.

PAGE [F4]: Goes to next page (Page 2).

START [F1]: Goes to the beginning of the file, and displays the first alignment

data.

LAST [F2]: Goes to the end of the file, and displays the last alignment data.

LIST [F1]: Displays all the known points and measured data in this job in list. This function can be applied only when the point element of horizontal alignment data is able to be input (or edited).

It is possible to edit data by using the function keys above. After entering the data to be edited, press [ENT] to record the edited data and enter into the inputting screen of next point. To quit without saving data, press [ESC].

STEPS	DISPLAY
Press PREV or NEXT to choose the horizontal alignment data to edit. You can also search for the data by pressing SEARCH and input the chainage.	【Define HZ AL】 4/3 Type : POINT X/N : 100.000 m Y/E : 100.000 m Radius : 20.000 m A1 : 80.000 m A2 : 80.000 m PREV NEXT SEARCH ↓ START LAST DELETE ↓
Enter the new data and press NEXT to save the change.	【Define HZ AL】 2/1 Type : LINE AZ : 50°16'10" Length : 10.000m PREV NEXT SEARCH ↓

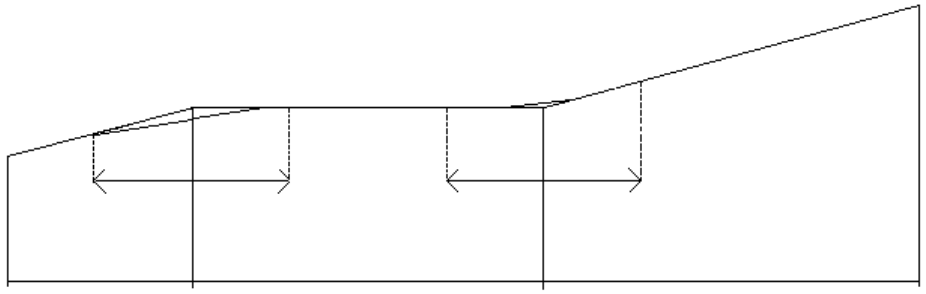
5.12.3 Deleting Horizontal Alignment Data

The horizontal alignment data in internal memory can be deleted.

STEPS	DISPLAY
Choose the data you want to delete. Press DELETE on the 2nd page of the function key bar, and press OK to confirm to delete.	【Define HZ AL】 4/3 Type : POINT X/N : 100.000 m Y/E : 100.000 m Radius : 20.000 m A1 : 80.000 m A2 : 80.000 m START LAST DELETE ↓
Notice: All the horizontal alignment data will be deleted. The system will return to Define HZ AL screen, and you can define new horizontal alignment again.	

5.12.4 Defining Vertical Alignment

A vertical alignment consists of a series of intersections, including a chainage, height 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 entered in any order. After entering one point data, press ENT to save it and go to next inputting screen. Press ESC to quit without saving.

STEPS	DISPLAY
Press F2 to start to *Define VT Alignment*.	【Roads】 F1 Define HZ Alignment F2 Define VT Alignment F3 Stake Out Roads F1 F2 F3
Input the chainage, elevation and curve length. Then press NEXT. The curve lengths of the start point and end point should be 0.000 m. Confirm to save the vertical alignment data. The system will return to define the next vertical alignment data.	【Define VT AL】 1/0 Chain. : 1000.000 m H/Z : 12.000 m Length : 0.000 m PREV NEXT SEARCH ↓

5.12.5 Editing Vertical Alignment Data

It is able to be applied to edit vertical alignment data. The operation steps are similar to that of editing horizontal alignment.

STEPS	DISPLAY
Press PREV or NEXT to choose the vertical alignment data to edit. You can also search for the data by pressing SEARCH and input the chainage.	【Define VT AL】 16/16 Chain. : 100.000 m H/Z : 100.000 m Length : 0.000 m PREV NEXT SEARCH ↓
Enter the new data and press NEXT to save the change. The system will display the next data.	【Define VT AL】 16/16 Chain. : 150.000 m H/Z : 25.010 m Length : 20.000 m PREV NEXT SEARCH ↓

5.12.6 Deleting Vertical Alignment Data

The vertical alignment data in internal memory can be deleted.

STEPS	DISPLAY
Choose the data you want to delete. Press DELETE on the 2nd page of the function key bar, and press OK to confirm to delete.	【Define VT AL】 16/16 Chain. : 500.000 m H/Z : 25.010 m Length : 0.000 m START LAST DELETE ↓
Notice: All the vertical alignment data will be deleted. The system will return to Define VT AL screen, and you can define new vertical alignment again.	

5.12.7 Road Stake-Out

To stake out alignment, the alignment type should be defined first. 2 methods of defining horizontal alignment are available: installing in the computer via the software “SANDING SURVEY OFFICE” provided by *Sanding Optic-Electric Equipment Co., Ltd*; or inputting manually in program “Road”.

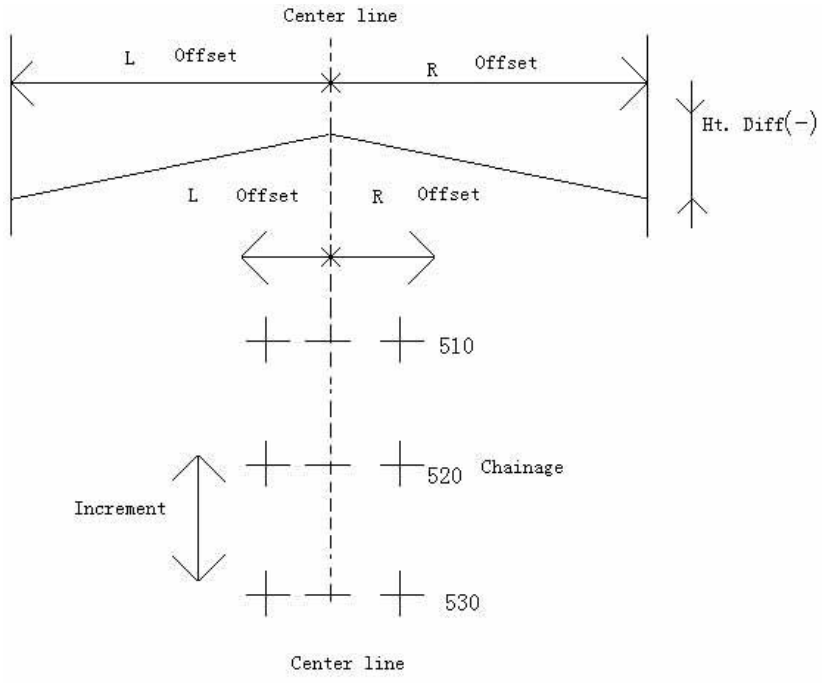
The vertical alignment data is unnecessarily to be defined, unless it is required to compute dig and fill. The method to define is similar to that of horizontal alignment.

Rules of alignment stake-out data:

Offset left: Horizontal distance between the left chainage and central line.

right: Horizontal distance between the right chainage and central line.

Vertical Difference Left (right): vertical difference between left (right) chainage and the central line point.



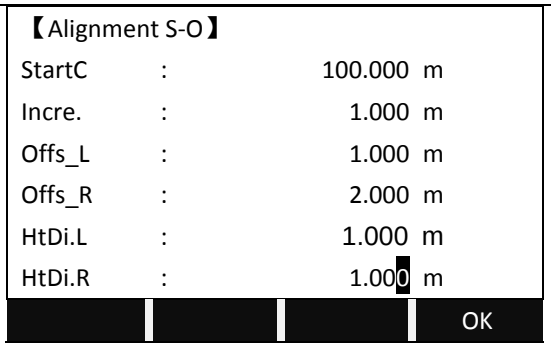
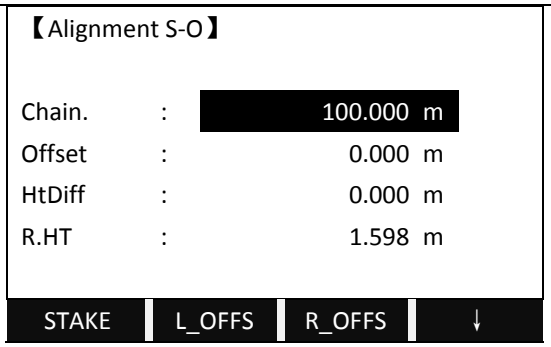
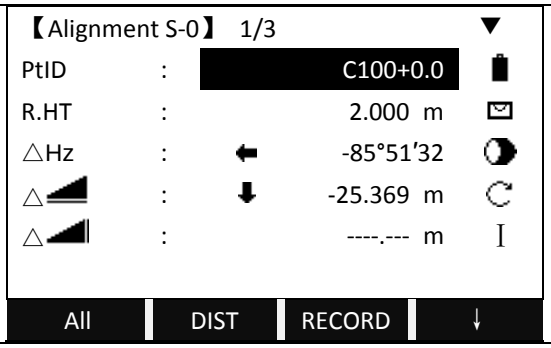
☞In the process of stake-out, user should first stake out points on the central line, then the featured points on both sides.

The method to stake out alignment is similar to that of point stake-out.

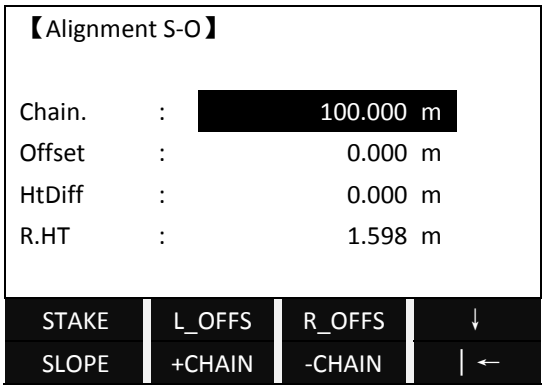
Press PAGE to switch among the three stake-out mode.

Here, take Polar Stake-Out as an example to introduce the operation steps of alignment stake-out in detail. For more information about other methods of stake-out, please refer to "*5.5 STAKE OUT*".

STEPS	DISPLAY
Press F3 to start to *Stake Out Roads*.	【Roads】 F1 Define HZ Alignment F2 Define VT Alignment F3 Stake Out Roads F1 F2 F3

Input the starting chainage, chainage increment, HD from side chainage to central line, and HD if necessary. Offs_L: HD from left chainage to central line. Offs_R: HD from right chainage to central line. HtDi.L: HD between left chainage to central line. HtDi.R: HD between right chainage to central line.	
Then the main stake out screen displays. As default, stake out the central line first, then the left chainage and right chaiange. Press L_OFFS and R_OFFS will show the correspondent chainage, offset and height different. The chainage and offsets can be entered manually. Offset is positive: the offset point is on the right of central line. Offset is negative: the offset point is on the left of central line.	
When the chainage and offset is found, press STAKE to start stake out. The procedure is the same as staking out point.	

Explanation for the Alignment Stake-Out screen:



L_OFFS: This key is used to stake out left chainage. Press it to display the offset and the height difference of the left chainage.

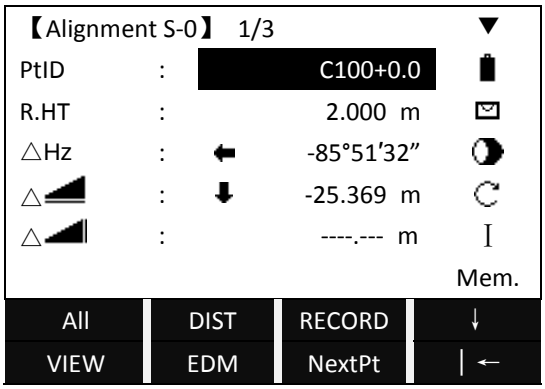
R_OFFS: This key is used to stake out right chainage. Press it to display the offset and the height difference of the right chainage.

+CHAIN: The key is used to increase the chainage.

-CHAIN: The key is used to decrease the chainage.

SLOPE: The key is used to stake out slope.

Screen of Stake Out Function



Explanation for Point ID:

The number behind C is the chainage.

+ Means to stake out points of the right chainage. While staking out points of the left chainage, it shows "-".

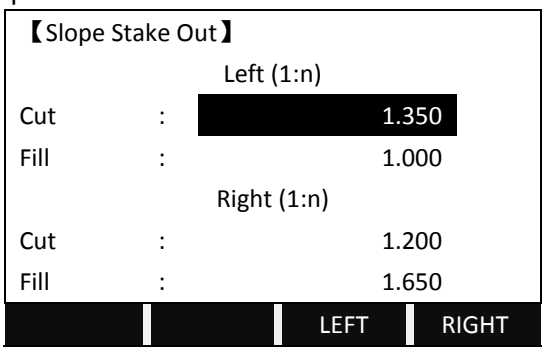
+ (or-) behind the number is the distance between points of right chainage and central line, i.e. the data of the right offset (or left offset) data. Here, the points on the central line read 0.0.

For instance: PtID C100+2.0 expresses the point on the right chainage is 2 m away from the central line, with a chainage of 100.

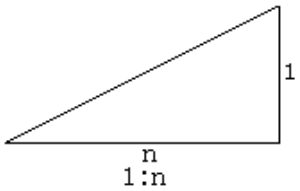
5.12.8 Slope Stake-Out

Slope Stake Out can be launched as part of the Alignment Stake-Out. It is a must to define horizontal and vertical alignments in Road menu previously. In stake-out main screen, press SLOPE to display Slope Stake Out.

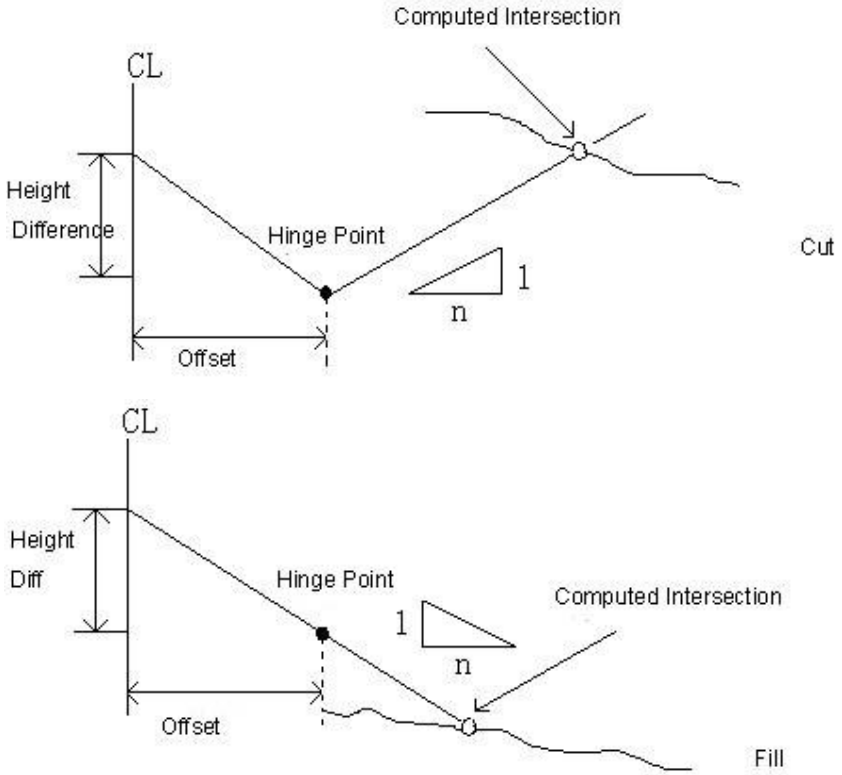
Main Screen of Slope Stake Out



Indeed, the fill/cut value that is input here is a ratio.



The fill/dig data can be entered through left and right slopes. In terms of fill/dig, use positive symbol to input the required slope, the software selects an appropriate slope in the list according to the actual position of the point.
Dig/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.



STEPS	DISPLAY
Turn to 2nd page of the function key bar. Choose the side chainage which is to be staked out the slope. Press SLOPE to start *Slope Stake Out.*	【Alignment S-O】 Chain. : 100.000 m Offset : 0.000 m HtDiff : 0.000 m R.HT : 1.598 m SLOPE +CHAIN -CHAIN | ←

Input the ratio to cut or fill. Then choose the left or right slope to stake out.	【Slope Stake Out】 Left (1:n) Cut : 1.350 Fill : 1.000 Right (1:n) Cut : 1.200 Fill : 1.650 LEFT RIGHT
Input the prism height. Collimate the prism and press DIST.	【Slope Stake Out】 PtID : C100+10.0S R.HT : 2.000 m △LOff : ----.--- m △TOff : ----.--- m Mem. All DIST RECORD EDM

Note:

1) If the earth surface crosses the hinge point, the intersection cannot be calculated.

2) As the fill/dig value of calculated point is zero, therefore the fill/dig value is not displayed.

5.13 CONSTRUCTION SITE STAKE OUT

This application allows defining a construction site by combining set-up of the instrument along a construction line, measuring and stake-out points related to the line.

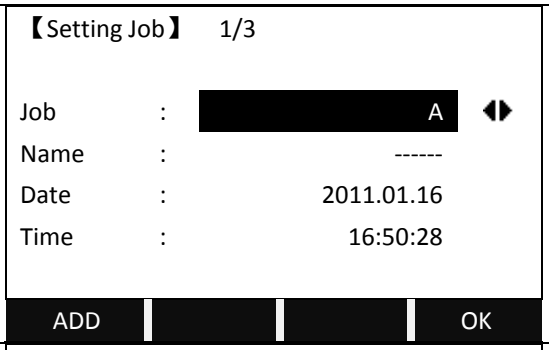
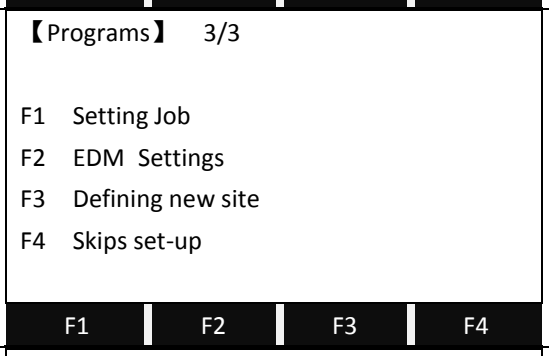
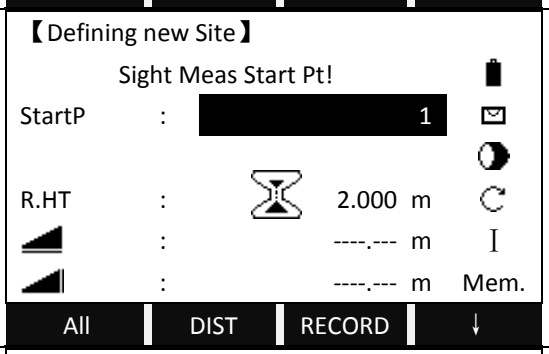
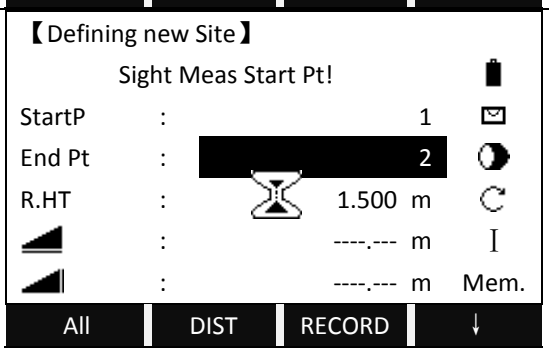
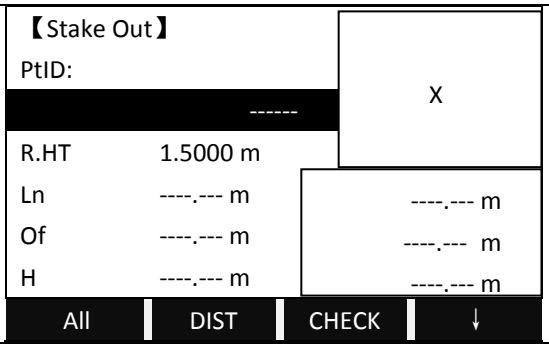
After activating the application, you have 2 options:

a) New construction site

b) Continue with previous site (skips set-up)

5.13.1 Defining New Construction Site

STEPS	DISPLAY
Press F2 to start *Construction* on Page 3/3 of *Programs*.	【Programs】 3/3 F1 Roads (9) F2 Construction (0) F1 F2

Set the job. Press ADD to add a new job. Press OK to set the job you just selected as the current job.	
Press F1 to set a job again. Press F2 to set the EDM Press F3 to define a new construction site. Press F4 to call up the construction site that is set last time. Here, take “Defining new site” as example.	
Input the starting PtID of the construction site and its prism height. Collimate the prism and press All (or DIST + RECORD) to start measurement.	
Input the end PtID of the construction site and its prism height. Collimate the prism and press All (or DIST + RECORD) to start measurement.	
After defining the construction site, it displays the stake out screen.	

5.13.2 Shifting Line

[ShiftL]: Input horizontal shifting value to horizontally shift the line.

The line can be horizontally shifted according to the requirement of job.

STEPS	DISPLAY
To shift the construction site, turn to 2nd page of the function key bar and press ShiftL.	【Stake Out】 PtID: 3 R.HT 1.5000 m Ln ----.--- m Of ----.--- m H ----.--- m X ----.--- m ---.--- m ----.--- m All DIST CHECK ↓ DIST RECORD ShiftL | ←
Input the distance value to shift.	【Shift the Line】 Defining new Site! R_Shift : 0.000 m L_Shift : 0.000 m Up_Shift : 0.000 m 0SET REVERS OK

5.13.3 As Build Check

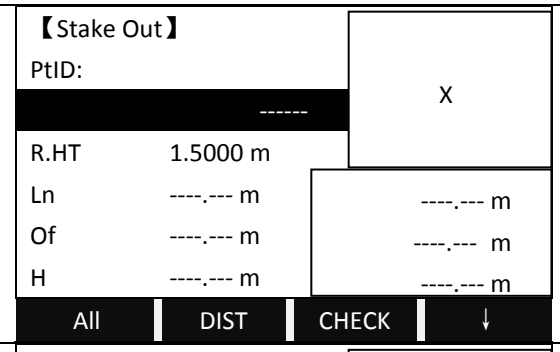
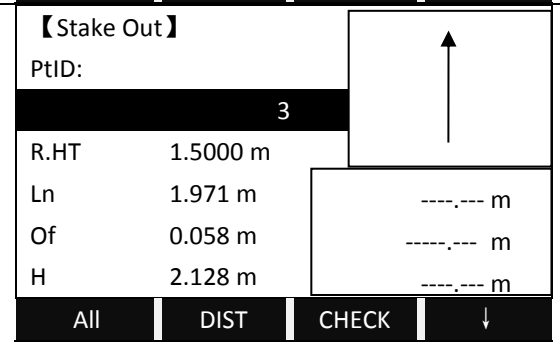
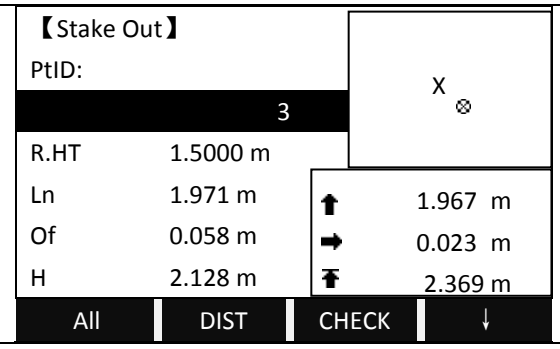
This function shows you the line difference, offset, and the height difference of a measured point in relation to the line.

STEPS	DISPLAY
Press CHECK. Input the PtID of the point to measure and its prism height.	【AS-BuiltCheck】 PtID: 3 R.HT 1.5000 m Ln ----.--- m Of ----.--- m H ----.--- m All DIST STAKE ↓
Collimate the prism and press DIST. It displays the longitude offset, transversal offset and the height offset between the point to measure and the construction site. A graph will also show the positions of the prism, station and construction site on the right.	【AS-BuiltCheck】 PtID: 3 R.HT 1.5000 m Ln 2.259 m Of -0.257 m H 1.305 m All DIST STAKE ↓

Information shown in AS-Builtcheck is introduced follow:
Longitude (in direction of the line) is positive: expresses the point measured lies between the start point and end point of the line.
Right latitude offset is positive: expresses the point measured is on the right of the line.
H is positive: expresses the point measured is higher than the start point of the line.
☞The height of start point of the line is always set as the reference height.
Soft Keys: F3 ([STAKE]): The program switches to Stake Out function.
F3 ([ShiftL]): Input a shift value to shift the line horizontally.

5.13.4 Stake Out

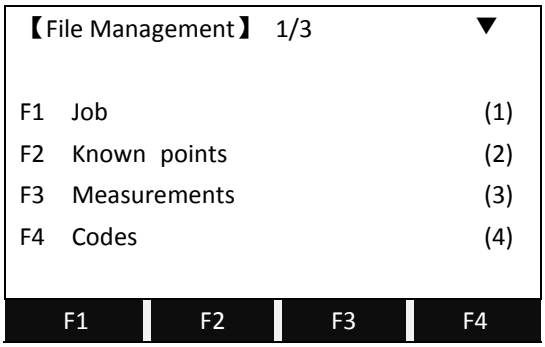
Here you can search or enter points to be staked out related to the measured line.

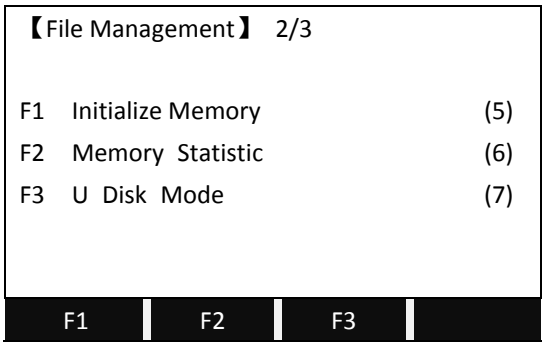
STEPS	DISPLAY
Press STAKE to start to stake out.	
Input the PtID of the point to stake out and its prism height. If the PtID entered exists, it will display the position against the construction site. If there're more than 1 points with the same PtID, it will show a list to choose. If the point does not exist, you will be requested to input the coordinates manually.	
Collimate the prism and press DIST to start measurement. It displays the longitude offset, transversal offset and the height offset between the point to measure and the construction site. Move the prism according to the indications until all the offset values are 0 m.	

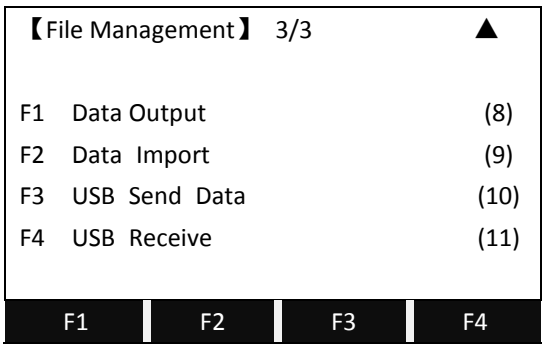
The height of the line start point is always used as the reference height.
The graphics are scaled to give a better overview. Therefore it’s possible that the station point moves in the graphic.
Be aware that the start point and the end point of the line are measured in the previous coordinate system. When staking out these points they appear in the old system and appear as shifted.
During operating the application, the previous Orientation and Station parameters will be replaced by the new calculated ones.

6. FILE MANAGEMENT

File management includes all the functions of inputting, editing, examining data and communication in the field.







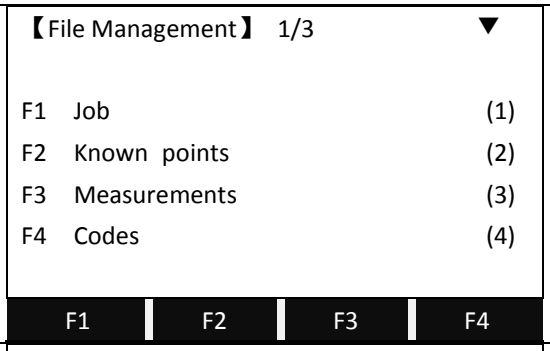
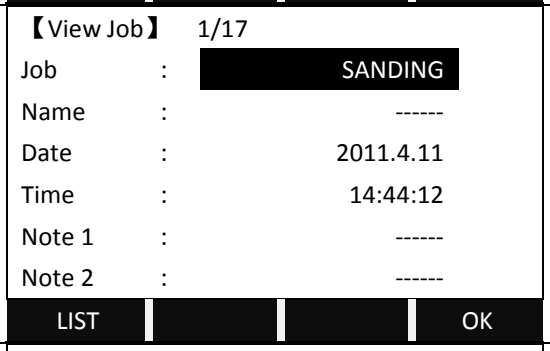
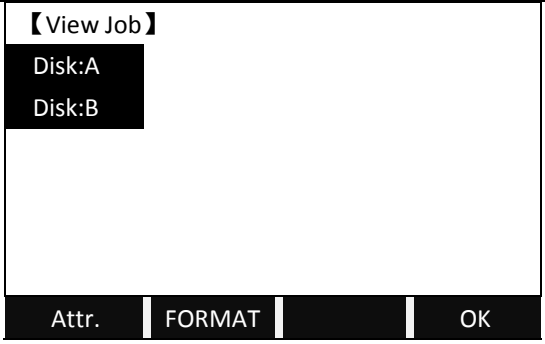
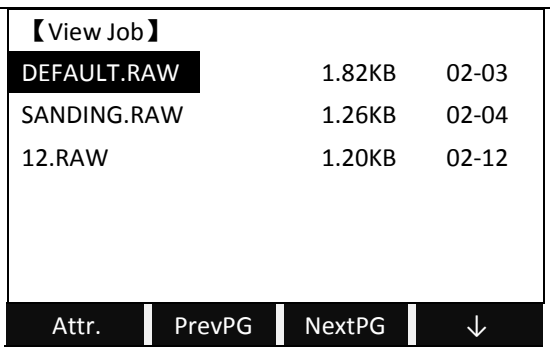
6.1 JOB

All measurement data is stored in selected job, such as: the known points, measurement points, coding and results, etc.

This function can launch new establishment, selection, deletion of a job

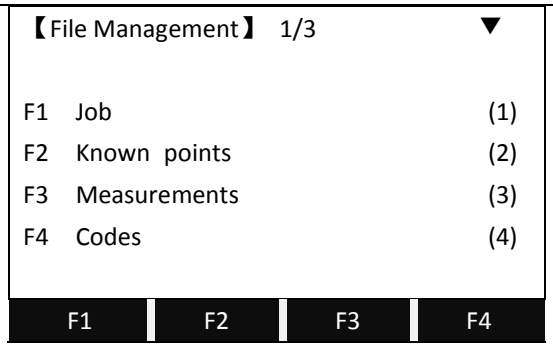
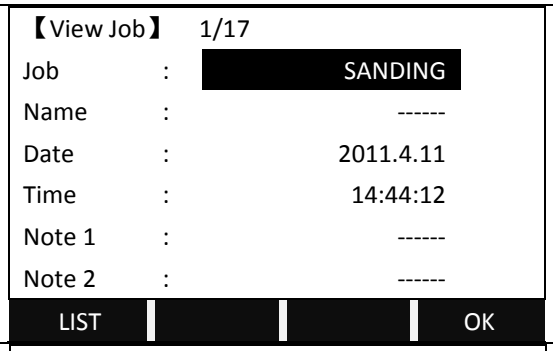
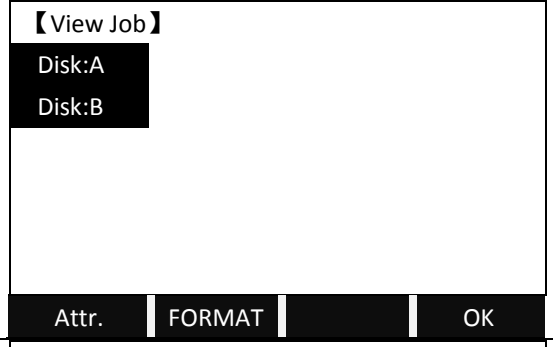
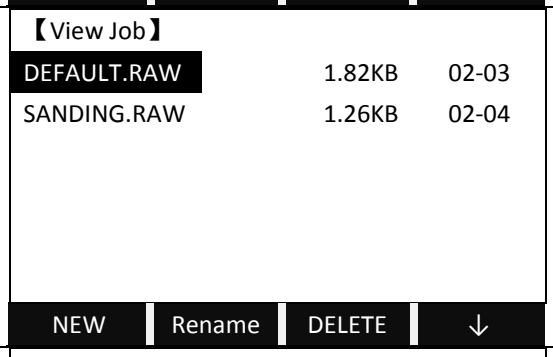
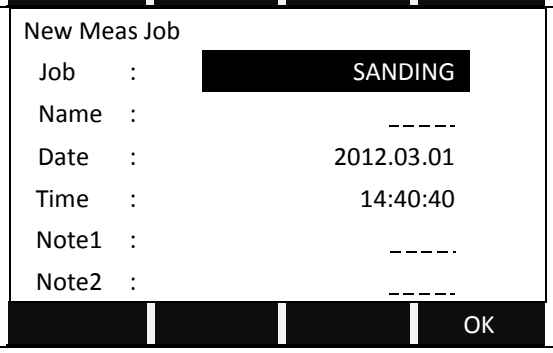
The definition of job includes input of job name and operators.

6.1.1 Selecting Job

STEPS	DISPLAY
Press F1.	
It displays the information of the current job. To select another job, press F1 to view the memory	
Press the navigation key to select the disk. Disk A: the internal memory Disk B: the SD card memory	
The screen shows the file list. Select the right Job and Press ENT. Then the job will be set to the current job.	

6.1.2 Establishing New Job

There are 16 characters in a job. They may be letters of A-Z, or numbers of 0-9 and_, #, $, @, %, +, -, etc. But the first character should not be spaced.

STEPS	DISPLAY
Press F1.	
It displays the information of the current job. To add another new job, press F1 to view the memory	
Press the navigation key to select the disk. Disk A: the internal memory Disk B: the SD card memory	
The screen shows the file list. Press F4 to the next page, then press NEW to add a new job.	
Enter the job name, operator name, etc. Then press OK to save and set the job.	

[Job]：If the document name of job is input randomly by operator, hereafter the data are stored in this job.

[Name]：Name of operator. (Can be default)

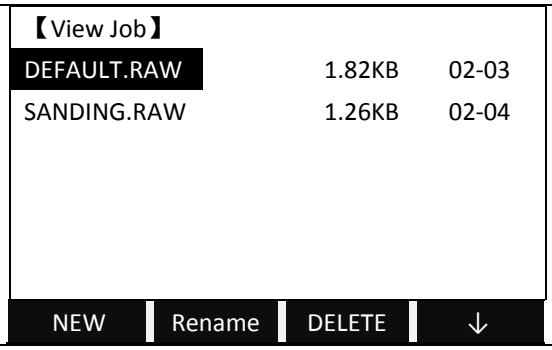
[Note 1] and [Note 2] describe a rough condition of this project. (Can be default)

☞ The system will automatically add the date and time of establishment.

☞ The newly-established job is defaulted as the present job. If this job name exists, the procedure will indicate “JOB EXIST!” Therefore, if it is not assured whether the newly-established job name exists in internal memory, you may view the job names existing in internal memory via ◉ before setting a new job.

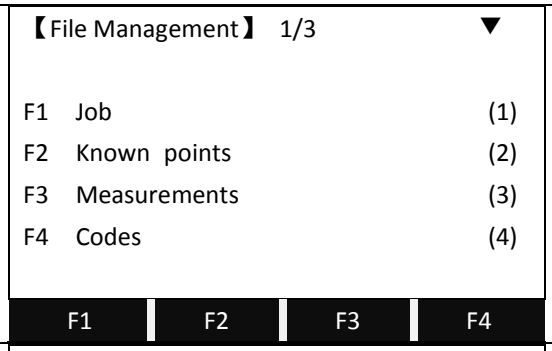
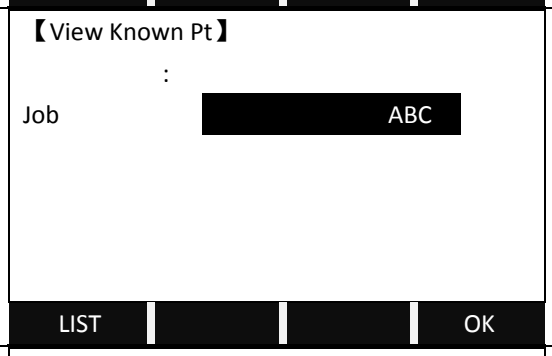
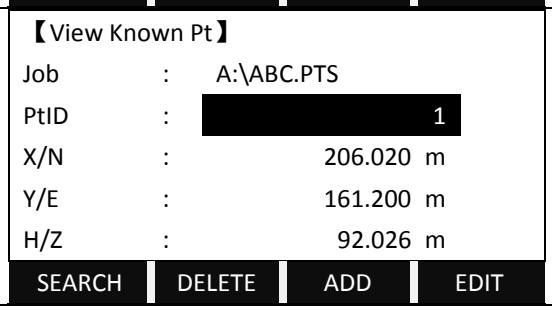
6.1.3 Deleting Selected Job

STEPS	DISPLAY
Press F1.	【File Management】 1/3 ▼ F1 Job (1) F2 Known points (2) F3 Measurements (3) F4 Codes (4) F1 F2 F3 F4
It displays the information of the current job. Press F1 to view the files in the disk.	【View Job】 1/17 Job : SANDING Name : ------ Date : 2011.4.11 Time : 14:44:12 Note 1 : ------ Note 2 : ------ LIST OK
Press the navigation key ▲▼ to select the disk. Disk A: the internal memory Disk B: the SD card memory	【View Job】 Disk:A Disk:B Attr. FORMAT OK

The screen shows the file list. Press F4 to the next page, then press DELETE to delete the selected job.	

6.2 KNOWN POINT

This application allows user to launch operations of searching, editing, and deleting known point in each job in internal memory. Valid known points contain at least the PtID and the coordinates (E, N) or height (H).

STEPS	DISPLAY
Press F2 to manage the known points.	
Insert the job name to be checked, then press OK to enter the job. (Or press LIST to select the job in the memory).	
The screen shows the information of the point. Press ◄ ► to view all the known points in the job.	

6.2.1 Searching Known Points

Input PtID or wildcard "*" to search for known points in selected job.

STEPS	DISPLAY
Choose the job where you want to find a point. Press SEARCH.	【View Known Pt】 Job : A:\ABC.PTS PtID : 1 ◆▶ X/N : 206.020 m Y/E : 161.200 m H/Z : 92.026 m SEARCH DELETE ADD EDIT
Input the PtID or wildcard "*" and press ENT.	【Search】 Job : A:\SANDING.PTS PtID : * BACK
It will display the searching result.	【View Known Pt】 Job : A:\SANDING.PTS PtID : 1 ◆▶ X/N : 0.000 m Y/E : 0.000 m H/Z : 0.000 m SEARCH DELETE ADD EDIT

6.2.2 Adding Known Point

A dialog of inputting PtID and coordinate of a new known point is displayed.

STEPS	DISPLAY
Press ADD to add a point.	【View Known Pt】 Job : A:\SANDING.PTS PtID : 1 ◆▶ X/N : 0.000 m Y/E : 0.000 m H/Z : 0.000 m SEARCH DELETE ADD EDIT

Input the information of a new point and press SAVE. If the PtID exists, the program will call the that point. If need to save as another point, press ▲ to input the new point name.	【Input Known Pt】 Job : A:\SANDING.PTS PtID : ------ X/N : 0.000 m Y/E : 0.000 m H/Z : 0.000 m VIEW SAVE
If no need to save as another point, after insert the new coordinate, press F4, the system will ask whether to cover the data. CANCEL: input a new point name OK : cover the existed point	【Input Known Pt】 Pt . exist ! Want to cover the data ? CANCEL OK

6.2.3 Editing the Known Points

This function allows editing known points in internal memory.

STEPS	DISPLAY
Choose the job and the point and press EDIT.	【View Known Pt】 Job : A:\SANDING.PTS PtID : 1 ◀▶ X/N : 0.000 m Y/E : 0.000 m H/Z : 0.000 m SEARCH DELETE ADD EDIT
Edit the point selected and press SAVE to save the point.	【Edit Known Point】 PtID : 10 X/N : 100.00 m Y/E : 100.00 m H/Z : 88.00 m BACK SAVE

6.2.4 Deleting Known Points

Deletes the selected known points in internal memory

STEPS	DISPLAY
Choose the point you want to delete and press DELETE.	【View Known Pt】 Job : A:\SANDING.PTS PtID : 1 X/N : 0.000 m Y/E : 0.000 m H/Z : 0.000 m SEARCH DELETE ADD EDIT
Press OK to confirm to delete. Or press CANCEL to cancel to delete.	【View Known Pt】 Delete data? Deleted data No Revert! CANCEL OK

6.3 MEASUREMENT DATA

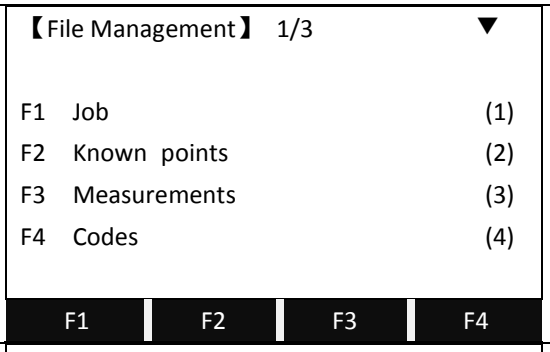
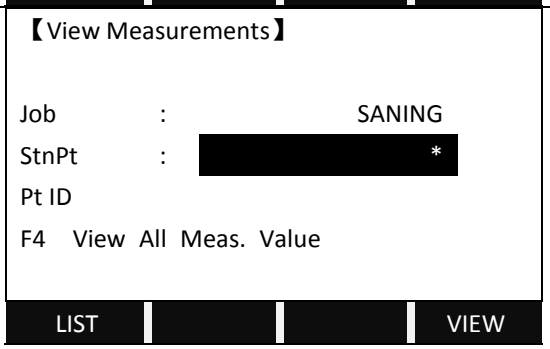
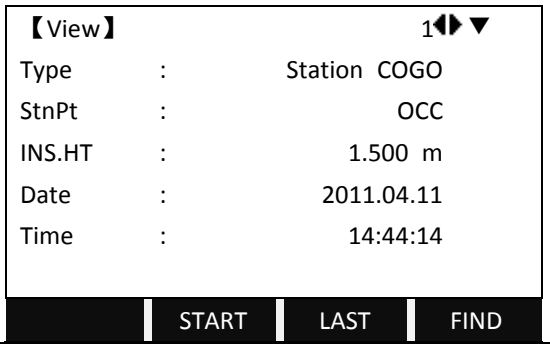
Measurement data available in internal memory can be searched and displayed. Part of them can be deleted.

6.3.1 Viewing Measurement Data

Viewing measurement data is based on the unit of measurement station in selected job. User may view one or all points (“*”) on a measurement station in a certain job; or a certain PtID or all measurement data of all measurement stations (“*”) in internal memory.

6.3.1.1 Viewing All Measurement Points in Job

Confirm the searching scope first: they may be all points of one measurement station in a certain job； Or all points of all measurement stations (“*”) (i.e. all measurement data in this job). Here, take viewing all measurement data in job as an example.

STEPS	DISPLAY
Press F3 to manage the measurements.	
Choose the job where you want to manage the measurement. To view all the measurement in the job, press VIEW.	 

6.3.1.2 Viewing Designated PtID in Job

Starts searching point. Total Station STS-750 Series provides point search function based on taking measurement station as searching condition. Determine the searching scope at first: it may be one PtID of one station in job; Or all measurement data named with this PtID ("*") in job. Therefore, in operation, user can input complete PtIDs or the PtIDs with wildcard "*".

STEPS	DISPLAY
Input the job name. The point ID to be input is based on the Station point. Input the StnPt or the wildcard "*". Input the PtID or the wildcard "*". Press F4 to view the measurement data.	【View Measurements】 Job : SANING StnPt : * PtID : * F4 View All Meas. Value LIST VIEW
It displays the searching result. START: to the first data LAST : to the last data FIND : return to the first screen	【View】 1▼ Type : Station COGO StnPt : OCC1 INS.HT : 1.500 m Date : 2011.04.11 Time : 14:44:14 START LAST FIND

Since the StnPt and PtID all can be designated or wildcard "*", below is the explanation of each combination

1. StnPt(designated) + PtID(designated) the designated point based on the certain station point
2. StnPt(designated) + PtID("*") all the measurement point based on the certain station point
3. StnPt("*") + PtID(designated) the designated point on all the station point
4. StnPt("*") + PtID("*") all the measurement point of the whole job

◀▶ using the navigation key ◀▶ to view all the points

▼、▲ view the other information by pressing PAGE

6.3.2 Deleting Measurement Data

Those invalid or repeated measurement data can be deleted.

*Only data of measurement point can be deleted. For those data of measurement station, orientation, target points of roads and tie distance, etc., cannot be deleted.

Choose the measurement you want to delete and press DELETE.	【View】 3▼ Type : ORT.MeasCOGO PtID : BS1 HZ : 0°00’00” V : 96°50’00” Date : 2011.03.23 Time : 12:02:50 DELETE START LAST FIND

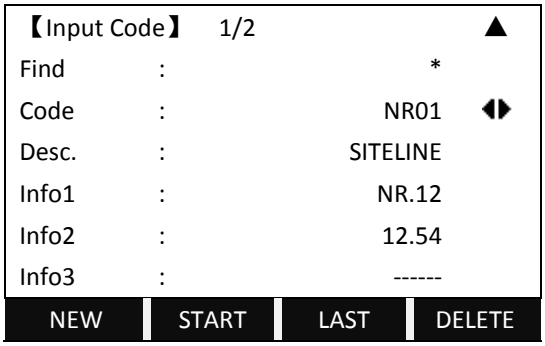
6.4 CODING

Here, it can launch those coding functions of newly-establishment, searching, and deleting in code database.

6.4.1 Manual Code Input

The code in code database can be input manually, or created by the communication software provided by Sanding Company, and transmitted to the instrument.

Each code has one item of explanation and a maximum of 8 attributes that has no more than 16 characters.



GSI- CODING

Code：Code name.

Desc: Appended description.

Info1：Editable information which includes more contents.

……

Info8：Other information lines.

6.4.2 Viewing Code

STEPS	DISPLAY
A: Press ◀▶ to view all the codes.	【Code View/Del】 1/2 ▲ Find : * Code : NR01 ◀▶ Desc. : SITELINE Info1 : NR.12 Info2 : 12.54 Info3 : ------ NEW START LAST DELETE

B: Move the cursor to "Find", and insert the code or the wildcard "*", press ENT 1: If the code exists, the code will be displayed on the screen 2: For wildcard "*", all the code can be viewed by pressing◀▶. 3: If the code does not exist, the cursor will stay on "Find", then insert another code to be viewed.	【Code View/Del】 1/2 ▲ Find : * Code : NR01 ◀▶ Desc. : SITELINE Info1 : NR.12 Info2 : 12.54 Info3 : ------ NEW START LAST DELETE

6.4.3 Deleting Code

STEPS	DISPLAY
Choose the code you want to delete and press DELETE.	【Code View/Del】 1/2 ▲ Find : * Code : NR01 ◀▶ Desc. : SITELINE Info1 : NR.12 Info2 : 12.54 Info3 : ------ NEW START LAST DELETE

6.5 INITIALIZING INTERNAL MEMORY

Deletes jobs, single data areas of a job or all data.

STEPS	DISPLAY
In Page 2/2 of the *File Management*, press F1 to start to *Initialize Memory*.	【File Management】 2/3 F1 Initialize Memory (5) F2 Memory Statistic (6) F3 U Disk Mode (7) F1 F2 F3
Choose the job where you want to delete the data, and choose the type of data you want to delete, such as measurement values, known points, and the entire job. Press DELETE.	【Initialization】 Job : 1 ◀▶ Data : MeasVal ◀▶ LIST ROAD CODE DELETE

☞ ROAD Deleting all the road data, including the HZ, VT or all the alignment.
☞ CODE Deleting all the code data
☞ After deleting, the data cannot be recovered, therefore, before operation, be sure that the useful data have been downloaded or stored.

6.6 MEMORY STATISTIC

Displays the information of memory, such as:

·The amount of the stored known points.
·The amount of the recorded data block (measurement points, codes, etc.).
·The amount of jobs which can be used or still not determined.

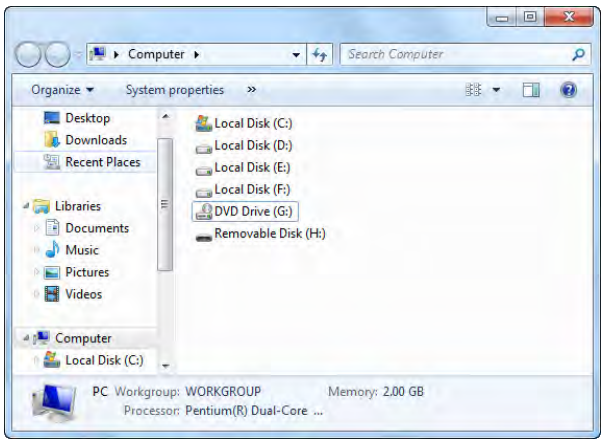
STEPS	DISPLAY
Press F2 to enter to *Memory Statistic*.	【File Management】 2/3 F1 Initialize Memory (5) F2 Memory Statistic (6) F3 U Disk Mode (7) F1 F2 F3
Choose the job you want to view the memory statistic.	【Memory Information】 Job : 5 Station : 63 Known Pt : 201 Meas Rec : 428 Use Job : 2 LIST OK

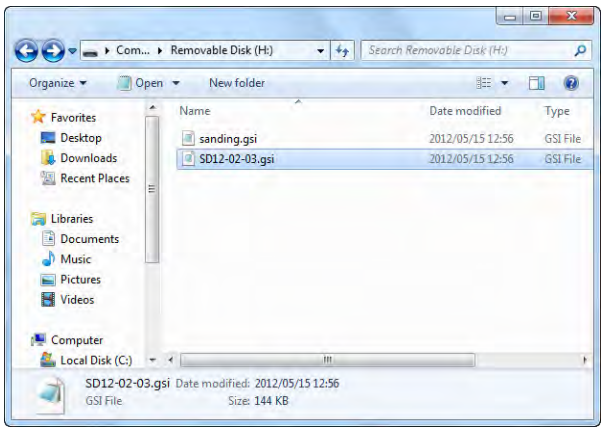
6.7 U DISK MODE

This function enable users to view, transfer and edit the data of the instrument by MY COMPUTER.

STEPS	DISPLAY
Press F3 to enter to *U Disk Mode*.	【File Management】 2/3 F1 Initialize Memory (5) F2 Memory Statistic (6) F3 U Disk Mode (7) F1 F2 F3
Screen shows "Connected to PC". Then users can check the local disk in MY COMPUTER.	【U Disk Mode】 Connected to PC..... EXIT

☞Local disk (F) stands for the internal memory of the total station, Removable Disk (H) stands for the SD card. Then user can view, copy, and edit the data directly from this





6.8 DATA OUTPUT/DATA IMPORT

This function needs an SD card to run.

Data output: the output file will be saved in the SD card with format .txt.

Data import: the import file should be GSI file and with format .txt

For example: output code data

STEPS	DISPLAY
In the third page of file management, press F1 to enter to *Data output*	【File Management】 3/3 ▲ F1 Data Output (8) F2 Data Import (9) F3 USB Send Data (10) F4 USB Receive (11) F1 F2 F3 F4
Press F2 to output the code data to an SD card.	【Data Output】 F1 Job data (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) F1 F2 F3 F4
Enter the file name to contain the code data or press LIST to select the TXT file in the SD card. Press OK	【Output file】 File name : SANDING Time : 2010.10.20 Time : 12:00:00 LIST OK
Start exporting the code data to SANDING.TXT in the SD card.	【Code data】 From A:\PCODE.DAT To B:\SANDING.TXT * 1 BACK
* All the code data stored in the PCODE.DAT file.	

For example: import HZ Alignment

STEPS	DISPLAY
Press F2 to enter to *Data Import*	【File Management】 3/3 ▲ F1 Data Output (8) F2 Data Import (9) F3 USB Send Data (10) F4 USB Receive (11) F1 | F2
Press F3 to import the HZ Alignment data to the internal memory from an SD card.	【Data Import】 F1 Job data (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) F1 | F2 | F3 | F4
Enter the file name to contain the HZ Alignment data or press LIST to select the TXT file in the SD card. Press OK	【Import file】 File name : SANDING Time : 2010.10.20 Time : 12:00:00 LIST | | | OK
Start importing the HZ Alignment data to SANDING.TXT in the SD card.	【HZ Alignment data】 From B:\SANDING.TXT To A:\Road.HAL * 1 | | | BACK
* All the HZ Alignment data stored in the Road.HAL file.	

6.9 USB SEND DATA/USB RECEIVE

Before transferring data through the USB cable, please ensure the PC has been installed the miniUSB cable driver.

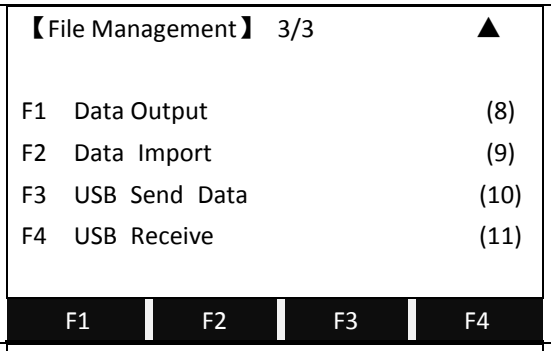
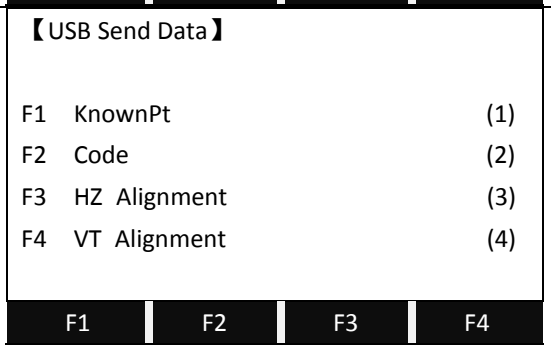
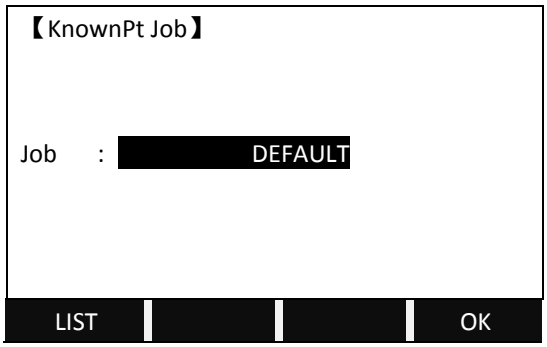
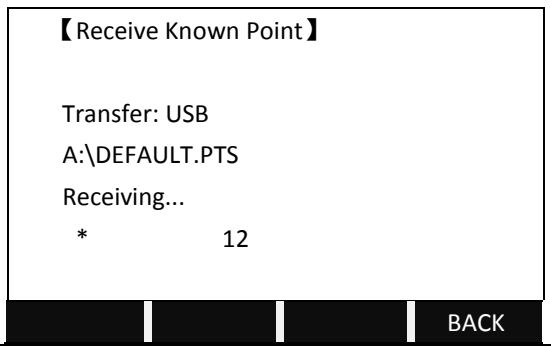
The transferred data through the USB cable can be job data, code, HZ alignment

and VT alignment.

For example: USB Send Code Data. (For sending job data, please refer to 8. DATA TRANSFER)

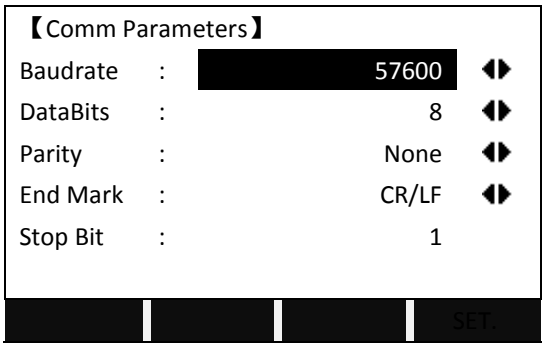
STEPS	DISPLAY
Press F3 to enter to *USB Send Data.*	【File Management】 3/3 ▲ F1 Data Output (8) F2 Data Import (9) F3 USB Send Data (10) F4 USB Receive (11) F1 F2 F3 F4
Press F1 to send the code data to PC through SANDING SURVEY OFFICE.	【USB Send Data】 F1 Code (1) F2 HZ Alignment (2) F3 VT Alignment (3) F1 F2 F3
The screen shows USB initializing..... And it starts sending the code data.	【USB Send Data】 F1 Code (1) F2 HZ Alignment (2) F3 VT Alignment (3) USB initializing..... F1 F2 F3 【Code Send】 Transfer: USB A:\PCODE.DAT Sending... * 0 BACK

For example: USB Receive Known Point Data

STEPS	DISPLAY
Press F4 to enter to *USB Receive.*	
Press F1 to receive the known point data from a PC through SANDING SURVEY OFFICE.	
Choose the job to receive the known point. Or press LIST to select the job from the disk.	
Then press OK. After USB initializing, it starts receiving the known point.	

7. COMMUNICATION SETTING

To communicate data between computer and instrument, you must set communication parameters.



BAUD RATE:

The optional baud rates are as follows**:** 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 [BIT /SECOND].

DATA BITS:

7 Data will be transmitted by 7 bit. As setting Parity check, it is set as 7 bit automatically

8 Data will be transmitted by 8 bit. The parity is set as none automatically.

PARITY:

Even Even check

Odd Odd check

None None verify (If set data bit is 8 data bit)

END MARK:

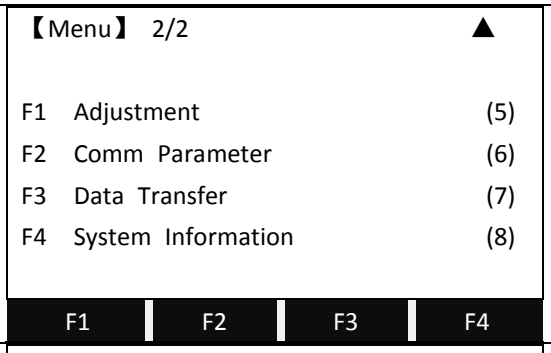
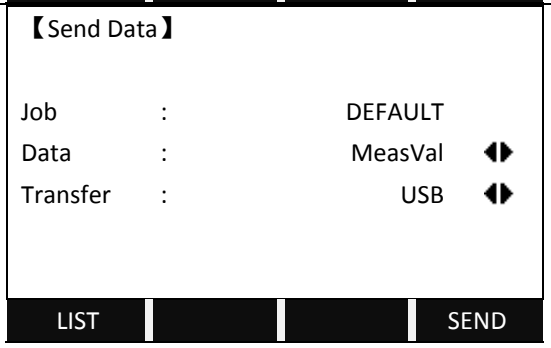
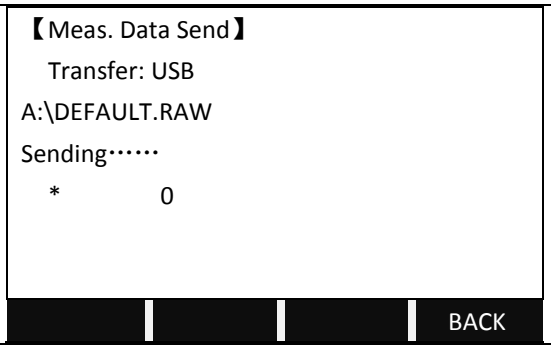
CR/LF Carriage returns and line feed

CR Carriage returns

STOP BIT: 1

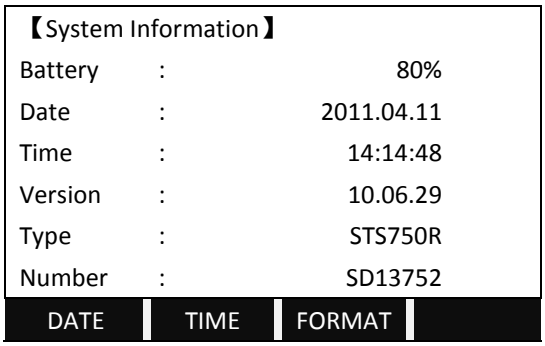
8. DATA TRANSFER

With this special function measured data can be transferred via the serial interface to receiver (e.g. a data collector) or USB interface to a PC. Using this type of transfer the success of the transfer is not checked.
Job: Selection of job from which data should be transferred.
Data: Select the data range to be transferred (measurements, fixed points)
Transfer: COM port or USB port
Format: Select output format. GSI is the fixed setting.

STEPS	DISPLAY
In Page 2/2 of Menu, press F3 to enter to *Data Transfer*.	
Enter the job name or search the job by pressing LIST to view all the jobs. Choose the data type you want to transfer. Choose the transfer mode: COM or USB	
Ensure the total station and the PC or PDA connected. Then press SEND.	

9. SYSTEM INFORMATION

Displays helpful information and sets data / time.



·Battery

Remaining battery power (e.g. 80%).

·Date

Displays the current date.

·Time

Displays current time

·Version

The software of instrument may have different versions which depend on those software packages composing the instrument software.

·Type

STS-750R (for instance)

·Number

Serial number of leaving factory for total station instrument

· Data

Set system date and format.

Soft Keys

[DATE]: Set the date

·Format: Select modes of date displaying.

· yy.mm.dd

· dd.mm.yy

· mm.dd.yy

·Date: Input and display the date according to the selected date format.

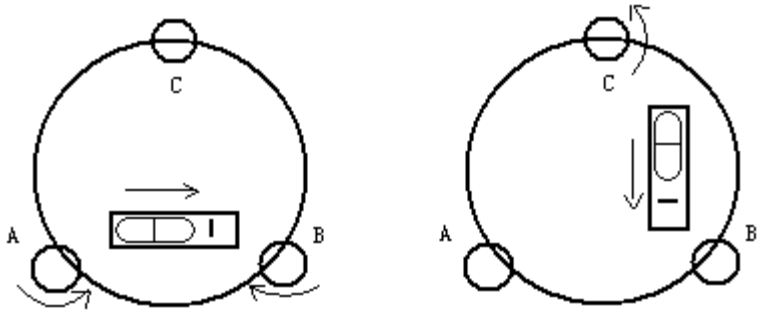
[TIME]： Set the time.

[FORMAT]: Format the system of the total station.

10. CHECK AND ADJUSTMENT

This instrument has undergone a strict process of checking and adjustment, which ensures that it meets quality requirement. However, after long periods of transport or under a changing environment, there may be some influences on the internal structure. Therefore, before the instrument is used for the first time, or before precise surveys, user should launch check and adjustment introduced in this chapter to ensure the precision of the job.

10.1 PLATE VIAL



Check

Please refer to Chapter 3.2 “Leveling by Using Plate Vial”

Adjust

1. Adjust leveling screws, make plate bubble centered;
2. Rotate the instrument 180°; watch the offset of plate level;
3. Tweak adjustment screws (on the right of the plate vial) with the correction pin to make plate bubble to move half of the offset back;
4. Rotate the instrument 180°, check adjustment result;
5. Repeat the steps above until the plate level is centered in all directions.

10.2 CIRCULAR VIAL

Check

No adjustment is required if the bubble of circular vial is in the center after checking and adjustment of the plate vial.

Adjust

1. Adjust circular bubble after plate bubble is centered.
2. Loosen the screw (one or two) opposite to bubble deflective direction;
3. Tighten the screw on the direction accordant deflective until circular bubble is centered;
4. Adjust three adjustment screws for several times until circular bubble is centered;
5. The force power fixing three adjustment screws must be consistent when

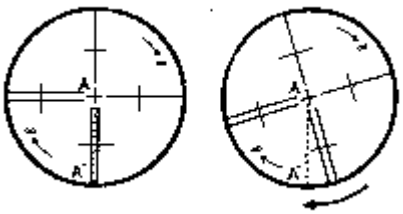
circular level is centered at last.

10.3 INCLINATION OF RETICLE

Check

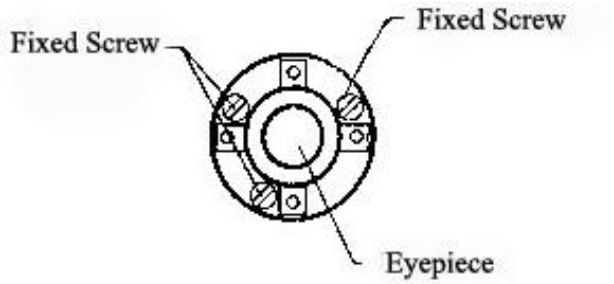
1. Sight object A through the telescope and lock the horizontal and vertical clamp screws.
2. Move object A to the edge of the field of view with the vertical tangent screw (point A′).
3. Adjustment is not necessary if object A moves along the vertical line of the reticle and point A′ still in the vertical line.

As illustrated，A′offsets from the center to the cross hair tilts, then need to adjust the reticle.



Adjust

1. If the object A does not move along with the vertical line, firstly remove the eyepiece cover to expose the three or four reticle adjusting screws.
2. Loosen all the reticle adjusting screws uniformly with an adjusting pin. Rotate the reticle around the sight line and align the vertical line of the reticle with pointA'.
3. Tighten the reticle adjusting screws uniformly. Repeat the inspection and adjustment to see if the adjustment is correct.
4. Replace the eyepiece cover.



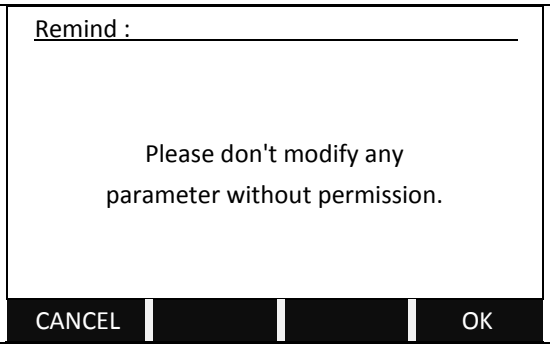
10.4 PERPENDICULARITY BETWEEN SIGHT AXIS AND HORIZONTAL AXIS (2C)

Check

1. Set object A at about 100 meters away the same height as the instrument, and make the vertical angle with ±3°. Then level and center the instrument and turn on the power.

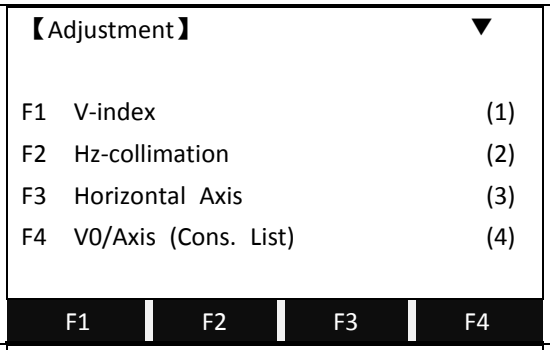
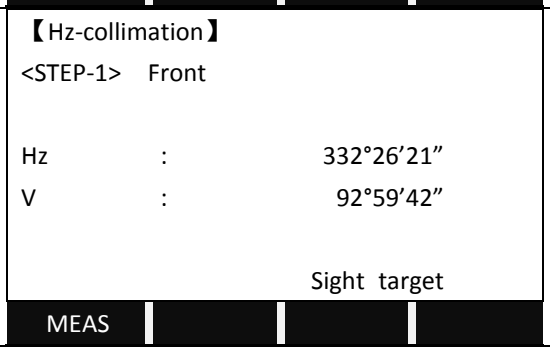
2. Sight object A in Face I and read the horizontal angle value. (e.g.: Horizontal angle L=10°13′10″).
3. Loosen the vertical and horizontal clamp screws and rotate the telescope. Sight object A in Face Ⅱ and read the horizontal angle value. (e.g.: Horizontal angle R= 190°13′40″).
4. 2C=L-R±180°=-30″≥±20″, adjustment is necessary.

Before entering the *Adjustment*, the screen will show as below, we don't suggest users modify any parameter without permission. And please contact your local dealer for support if there is problem with the parameter.

Press F1 on Page 2/2 of the main menu to enter to *Adjustment*. Press OK to enter the menu of *Adjustment*. Press CANCEL to quit.	

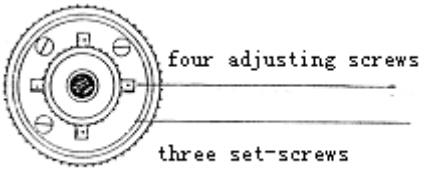
Adjust

A. Electronic Adjustment Operation Steps：

STEPS	DISPLAY
Press F1 on Page 2/2 of the main menu to enter to *Adjustment*. Press F2 to start to check and adjust *Hz-collimation*.	
In Face I, collimate the target, and press MEAS.	

Turn to Face II, collimate the same target and press MEAS.	【Hz-collimation】 <STEP-2> Reverse Hz : 152°25′58″ V : 267°0′20″ Sight target MEAS
It shows the difference. Press SET. to correct the difference. Press BACK to quit without saving the correction.	【Hz-collimation】 H const. : 0°00′11″ BACK SET.

B. Optics Adjustment (professional technician only)



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, need to check the photoelectricity coaxiality.

10.5 VERTICAL INDEX DIFFERENCE COMPENSATION

Check

1. Mount and level the instrument and make the telescope parallel with the line connecting the center of the instrument to any one of the screws. Lock the horizontal clamp screw.
2. After turning on the power, zero the vertical index. Lock the vertical clamp screw and the instrument should display the vertical angle value.
3. Rotate the vertical clamp screw slowly in either direction about 10mm in circumference, and the error message “b” will appear. The vertical axis inclination

has exceeded 3 ´ at this time and exceeds the designated compensation range.
4. Rotate the above screw to its original position, and the instrument display screen will show the vertical angle again, meaning that the vertical index difference compensation function is working.

Adjust

If the compensation function is not working, send the instrument back to the factory for repair.

10.6 VERTICAL INDEX DIFFERENCE (I ANGLE) & SETTING VERTICAL INDEX 0

Before inspecting this session, check and adjust the Session 10.3 and 10.5.

Check

1. Power on after leveling the instrument. Collimate object A in Face I and read the Vertical angle value L.
2. Rotate the telescope. Sight object B in Face Ⅱ and read the Vertical angle value R.
3. If the vertical angle is 0°in zenith, i=(L+R-360°)/2
If the vertical angle is 0° in horizon. i=(L+R-180°)/2 or (L+R-540°)/2.
4. If ｜i｜ ≥10″, you should set the Vertical Angle 0 Datum again.

Adjust

STEPS	DISPLAY
Press F1 to start to adjust the V-index.	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 V0/Axis (Cons. List) (4) F1 | F2 | F3 | F4
In Face I, collimate the target, and press MEAS.	【V-index】 <STEP-1> Front Hz : 335°28′41″ V : 107°16′20″ Sight target MEAS | | |

Turn to Face II, collimate the same target and press MEAS.	【V-index】 <STEP-2> Reverse Hz : 155°27’01” V : 252°43’47” Sight target MEAS
It shows the difference. Press SET. to correct the difference. Press BACK to quit without saving the correction.	【V-index】 V const. : 3°58’11” VADJ_T : 0°00’33” BACK SET.

Note:

1. Repeat the checking steps to measure the Index Difference (i angle). If the Index difference cannot meet the requirement, user should check whether the three steps of the adjustment and the collimation are right. Then set again according to the requirement.
2. If Index Difference still not meets the requirement after the repeated operation, the instrument should be returned to factory for inspection and repair.

10.7 TRANSVERSE AXIS ERROR COMPENSATION ADJUSTMENT

As the transverse axis error only affects the angle of sight, it can be only confirmed through observing the target the height of which is obviously lower or higher than the instrument.

To avoid the influence of sight axis, user must have an associated adjustment before adjusting sight axis.

It is unnecessary to collimate the prism or the target plane to ascertain the transverse axis error. Therefore user is enabled to launch this adjustment at any time. Select a recognizable point which is rather far away from the instrument, and much higher or lower than the instrument. Make sure it can be precisely collimated twice.

STEPS	DISPLAY
Press F3 to start to adjust *Horizontal Axis.*	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 V0/Axis (Cons. List) (4) F1 F2 F3 F4
In Face I, collimate the target, and press MEAS 10 times.	【Horizontal Axis】 [0/10] <STEP-1> Front Hz : 335°28’41” V : 107°16’20” Sight target MEAS INPUT
Turn to Face II, collimate the same target and press MEAS.	【Horizontal Axis】 [0/10] <STEP-2> Reverse Hz : 155°27’01” V : 252°43’47” Sight target MEAS INPUT
It shows the difference. Press SET. to correct the difference. Press BACK to quit without saving the correction.	【Horizontal Axis】 H0 Axis : 0°00’36” BACK SET.

10.8 OPTICAL PLUMMET

Check

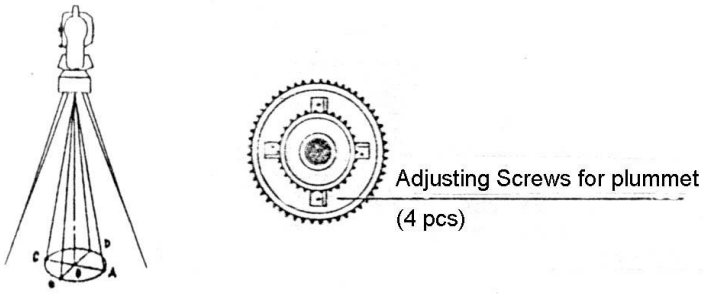
1. Set the instrument on the tripod and place a piece of white paper with two crisscross lines on it right below the instrument.
2. Adjust the focus of the optical plummet and move the paper so that the intersection point of the lines on the paper comes to the center of the field of

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, no adjustment is necessary. Otherwise, the following adjustment is required.



Adjust

1. Take off the protective cover between the optical plummet eyepiece and focusing knob.

2. Fix the paper. Rotate the instrument and mark the point of the center of optical plummet which falls on the paper at every 90°. As illustrated: 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 inspection and adjusting steps to make the instrument meets the requirements.

6. Replace the protective cover.

10.9 INSTRUMENT CONSTANT (K)

Instrument constant has been checked up and adjusted in the factory, K=0. It seldom changes and it is suggested to check one or two times every year. The inspection should be made on the base line, also can be made according to the following method.

Check

1. Mount and level the instrument on Point A at a plain field. Use the vertical hair to mark Point B and Point C with the distance of 50m on the same line, and set the reflector accurately.

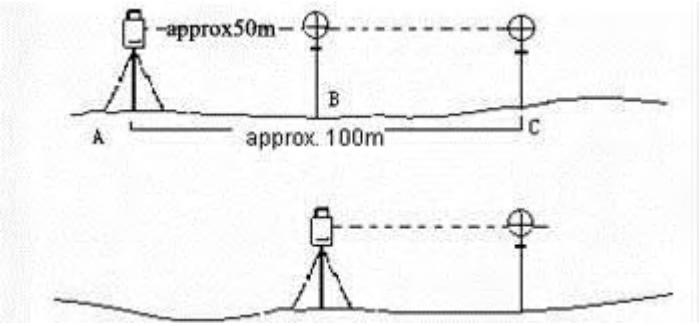
2. After setting temperature and air pressure, measure the horizontal distance of AB and AC accurately.

3. Set the instrument on Point B and center it accurately, measure the Horizontal Distance of BC accurately.

4. Then the Instrument Constant can be obtained:

K=AC-(AB+BC)

K should be near to 0, If ｜K｜>5mm, the instrument should be strictly inspected in the standard baseline site, and adjusted according to the inspection value.



Adjust

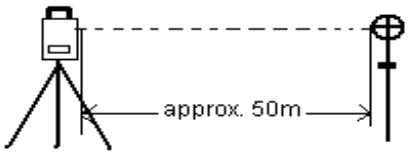
If a strict inspection proves that the Instrument Constant K has changed and is not close to 0. If the operator wants to adjust, should set Stadia Constant according to the Constant K

●Set the orientation via the Vertical Hair to maintain Point A, B, C on the same line precisely. There must be a fixed and clear centering mark on the ground of Point B

●Whether the prism center of Point B coincides with the Instrument Center is a significant step to inspect the accuracy. So on Point B the tripod or compatible tribrach should be used. It will decrease the difference.

STEPS	DISPLAY
Turn to 2nd page of *Adjustment.* Press F1 to set the *Instrument Constant*.	【Adjustment】 ▲ F1 Inst. Constant (5) F1
Input the instrument constant. Press SAVE to save the change.	【Instr. Constant Set】 InstCons : 0.0 mm SAVE

10.10 PARALLEL BETWEEN LINE OF SIGHT AND EMITTING PHOTOELECTRIC AXIS



Check

1. Set the reflector 50m away from the instrument.
2. Collimate the center of the reflector prism with reticle.
3. Switch on the instrument, and enter into Distance Measurement Mode. Press DIST (or All) to measure. Rotate the Horizontal Tangent Screw and Vertical 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 the center of reticle to coincide with the center of emitting photoelectric axis. If so, the instrument is proved eligible.

Adjust

If the center of reticle deviates from the center of emitting photoelectric axis, user should sent the instrument to professional repair department.

10.11 REFLECTORLESS EDM

The red laser beam used for measuring without reflector is arranged coaxially with the line of sight of the telescope, and emerges from the objective port. If the instrument is well adjusted, the red measuring beam will coincide with the visual line of sight. External influences such as shock or large temperature fluctuations can displace the red measuring beam relative to the line of sight.

● The direction of the beam should be inspected before precise measurement of distances, because an excessive deviation of the laser beam from the line of sight can result in imprecise distance measurements.

Warning

Looking straight at the laser beam should be always considered as hazardous.

Precautions:

Do not stare into the beam or direct it towards other people unnecessarily. These measures are also valid for the reflected beam.

Inspection:

A target plate is provided. Set it up between five and 20 meters away with the grey reflective side facing the instrument. Move the telescope to face II. Switch on the red laser beam by activating the laser-point function. Use the telescope crosshair to align the instrument with the centre of the target plate, and then inspect the position of the red laser dot on the target plate. Generally speaking the red spot cannot be seen through the telescope, so look at the target plate from just above the telescope or from just to the side of it.

If the spot illuminates the cross, the achievable adjustment precision has been reached; if it lies outside the limits of the cross, the direction of the beam needs to be adjusted.

If the spot on the more reflective side of the plate is too bright (dazzling), use the white side instead to carry out the inspection.

10.12 TRIBRACH LEVELING SCREW

If the leveling screw appears flexible, adjust the two adjusting screw in the leveling screw to tighten the screw appropriately.

10.13 RELATED PARTS FOR REFLECTOR

1. The Tribrach and Adapter for Reflector

The plate vial and optical plummet in the adapter and tribrach should be checked. Refer to Chapter 10.1 and 10.8. for more information.

2. Perpendicularity of the prism pole

As illustrated in Chapter 10.8, mark '+' on Point C, place the tine of the prism pole on the Point C and do not move during the inspection. Place the two feet tine of Bipod on the cross lines of Point E and F. Adjust the two legs "e' and "f" to make the bubble on the prism pole centered.

Set and level the instrument on Point A near the cross. Sight the tine of Point C with the center of reticle, and fix the Horizontal Clamp Screw. Rotate the telescope upward to make D near the horizontal hair. Flex the prism pole Leg "e" to make the D in the center of reticle. Then both Point C and D are on the central line of reticle.

Set the instrument on Point B to another cross lines. With the same way to flex the Leg "f" to make Point C and D on the central line of reticle.

Through the adjustment of the instrument on Point A and B, prism pole has been perpendicular. If the bubble offsets from the center, adjust the three screws under circular vial to make the bubble centered.

Check and adjust again until the bubble is in the center of the vial from both directions of the prism pole.

11. SPECIFICATION

MODEL	STS-752RC	STS-755RC
DISTANCE MEASUREMENT		
single prism	5.0km	
reflectorless	350m	
accuracy	with reflector: 2mm+2ppm; without reflector: 3mm+5ppm	
reading	max: 99999999.999 min: 1mm	
measuring time	fine: 1s; tracking: 0.5s	
atmospheric refraction & earth curvature correction	manual input, auto correction	
prism constant	manual input, auto correction	
ANGLE MEASUREMENT		
measuring method	absolute encoding	
diameter of raster disk	79mm	
minimum reading	1”/5” selectable	
accuracy	2”	5”
detection method	horizontal: dual vertical: dual	
TELESCOPE		
image	erect	
tube length	154mm	
effective aperture	Telescope: 45mm; EDM: 50mm	
magnification	30X	
field of view	1°30’	
resolving power	3”	
min. focusing distance	1m	
AUTO VERTICAL COMPENSATOR		
system	2-axis liquid-electric	
working range	±3’	
accuracy	1”	
LEVEL		
plate vial	30”/2mm	
circular vial	8’/2mm	
Data Storage		
Internal memory	64M	
SD card	2G	
OPTICAL PLUMMET		
image	erect	
magnification	3X	

focusing range	0.5m ~ ∞
field of view	5°
OTHER	
Display type	2 sides, alphanumeric keyboard
Laser plummet	optional
ON-BOARD BATTERY	
type	rechargeable Ni-H battery
voltage	6V
operating time	8 hours
DIMENSION & WEIGHT	
dimension	200 X 190 X 350mm
weight	6.0kg

12. ACCESSORIES

ITEM	NO.
Carrying Case	1 pc
Main Body	1 pc
Backup on-board Battery	1 pc
Charger	1 pc
Plumb Bob	1 pc
Correction Pin	2 pcs
Fur Brush	1pc
Screwdriver	1pc
Hexagon Wrench	2 pcs
Cloth	1pc
Dryer	1pc
Operation Manual	1pc
Certificate	1pc

[APPENDIX-A] CALCULATING ROAD ALIGNMENT

The road alignment stake-out program can stake out the alignment elements including straight, arc and transition curve.

NOTE:

1) Road alignment data can be uploaded from computer or can be entered manually.
2) Road alignment data is managed by chainage.

1. ROAD ALIGNMENT ELEMENTS

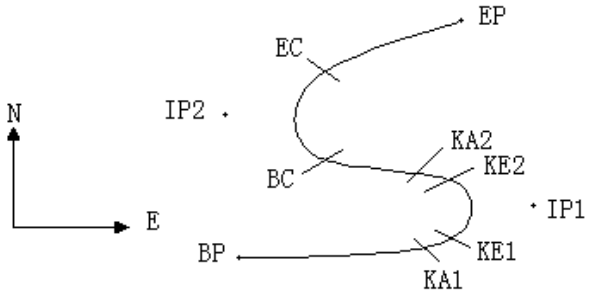
There are two ways to enter the alignment elements:

1) Download from PC.
2) Manually entered on the STS-750RC series.

How to enter the alignment data is explained below:

Alignment Element	Parameter
Straight	Bearing, Distance
Transition Curve	Radius, Length of Transition Curve
Arc	Radius, Length of Arc
PT	N, E, radius, A1, A2

NOTE: When downloading from computer or selecting PT option, you do not have to calculate the Parameter.



Pt	*Northing*	*Easting*	*Radius*	*Transition Curve A1*	*Transition Curve A2*
BP	1100.000	1050.000			
IP1	1300.000	1750.000	100.000	80.000	80.000
IP2	1759.000	1400.000	200.000	0.000	0.000
EP	2000.000	1800.000			

Example:

To enter the following data select DEF AL of ROADS in PROG menu:

Chainage	0
N	1100.000

E	1050.000

Press [ENT] and then press [F4] (PT), Enter the following data:

N	1300.000
E	1750.000
R	100.000
A1	80.000
A2	80.000

Enter the following data in the above way:

N	1750.000
E	1400.000
R	200.000
A1	0.000
A2	0.000

N	2000.000
E	1800.000
R	0.000
A1	0.000
A2	0.000

The format of the data above transmitted to computer is as follows:

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. CALCULATION ROAD ALIGNMENT ELEMENTS

1) Calculation of the length of transition curve

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

$L_{1.2}$: Length of clothoid

$A_{1.2}$: Parameter of clothoid

R : Radius

$$L_1 = \frac{A_1^2}{R} = \frac{80^2}{100} = 64 \text{ m} \qquad L_2 = \frac{A_2^2}{R} = \frac{80^2}{100} = 64 \text{ m}$$

2) Calculation of Deflection Angle

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

$\tau_1 = \frac{64^2}{2 \cdot 80^2}$ = 0.32 rad $\Rightarrow$ deg $\Rightarrow$ $0.32 \frac{180}{\pi}$ =18°20′06″

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

3) Calculation of transition coordinates

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

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

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

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

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

$$= 64 * 0.98981$$

$$= 63.348$$

Similarly, the value of E is:

$$E = 80 \cdot \sqrt{2 \cdot 0.32}\ (\frac{0.32}{3} - \frac{(0.32)^3}{42} + \frac{(0.32)^5}{1320} - \frac{(0.32)^7}{7560} \ldots.)$$

$$= 64(0.10666667 - 0.00078019 + 0.0000025 - 0)$$

$$= 6.777$$

This example is symmetry spiral transition N1=N2，E1=E2

4) Calculation of shift value ΔR

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

$$\Delta R = 6.777 - 100(1 - \cos 18°20'06'')$$

$$= 1.700$$

Symmetry spiral transition $\Delta R_1 = \Delta R_2$

5) Calculation of Spiral Transition coordinate

$N_m = N - R\sin\tau$ =63.348-100sin18°20′06″=31.891

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

6) Calculation of Tangent Distance

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

$LA = +111°55'47''$, $\cos ec = \frac{1}{\sin}$, $\cot = \frac{1}{\tan}$

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

–1.7(1 / tan 111°55′47″) +31.891

=148.06015 + 1.8326 + 0.6844 +31.891

=182.468

$D_1 = D_2$

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 $\Rightarrow$ $\alpha_1 = 74°03′16.6″$

N_{KA1} = 1300 –182.468 * cos 74°03′16.6″=1249.872 m

E_{KA1} = 1750 –182.468 * sin 74°03′16.6″=1574.553 m

8) Calculation of Arc Length

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

=*R* (111°55′47″-2 * 18°20′06″)

=100(75°15′35″ $\frac{\pi}{180^\circ}$)

=131.353 m

9) Calculation of the coordinate 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 $\Rightarrow$ $\alpha_2 = 322°07′30.1″$

N_{KA2} = 1300 –(-182.468) * cos 322°07′30.1″= 1444.032 m

E_{KA2} = 1750 –(-182.468) * sin 322°07′30.1″= 1637.976 m

10) Calculation of coordinates BC，EC which is ARC (IP1,IP2,EP)

Arc length $CL = R \cdot IA$

IA= 95°52′11″

CL=200 * 95°52′11″* $\frac{\pi}{180^\circ}$ =334.648 m

$TL = R \cdot \tan(\frac{IA}{2}) = 200$ * tan(95°52′11″/ 2) =221.615 m

Each coordinates are computed ：

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

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

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

α_3 (Bearing from IP2 to EP) = 57°59′40.6″

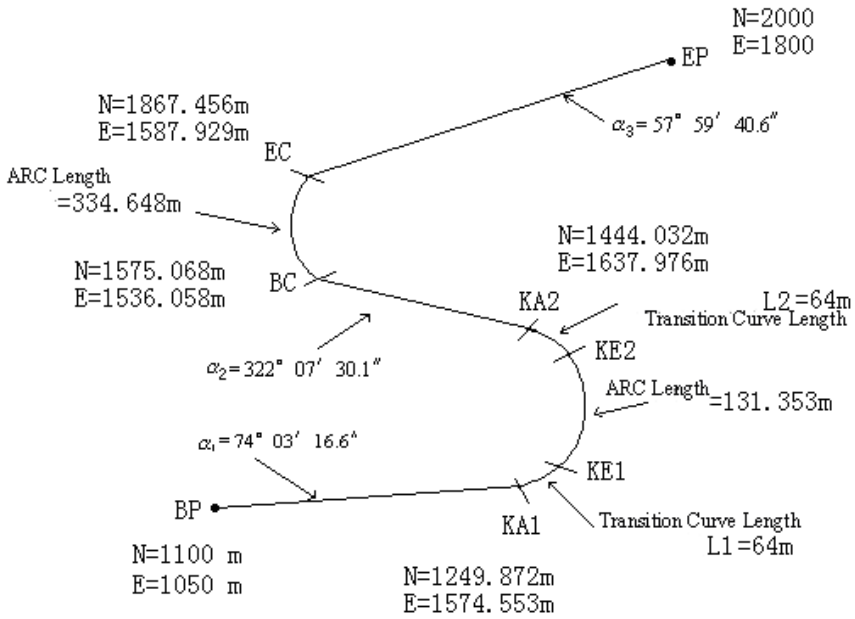
N_{BC} = 1750 - 221.615 * cos322°07′30.1″ =1575.068 m

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 calculated results display as below :



The coordinates and the distance are calculated as below ：

1) Compute the length of straight line

Straight line

BP·KA1= $\sqrt{(1249.872-1100.000)^2+(1574.553-1050)^2} = 545.543$ m

straight line KA2·BC

$= \sqrt{(1575.068-1444.032)^2+(1536.058-1637.976)^2} = 166.005$ m

straight line

EC·EP = $\sqrt{(2000-1867.456)^2+(1800-1587.929)^2} = 250.084$ m

Start point coordinate (BP)

N 1100.000 m

E 1050.000 m

straight line (between BP and KA1)

Bearing 74°03′16.6″

Distance 545.543 m

Transition clothoid (between KA1 and KE1)

Radius -100 m (“-”sign is turn left curve toward the end point)

Length 64 m

ARC (between KE1 and KE2)

Radius -100 m (“-” sign is turn left curve toward the end point)

Length 131.354 m

Transition (Between KE2 and KA2)

Radius -100 m (“-” sign is turn left curve toward the end point)

Length 64 m

Straight line (between KA2 and BC)

Bearing 322°07′30.1″

Distance 166.004 m

Arc (between BC and EC)

Radius 200 (without sign is turn right curve toward the end point)

Length 334.648 m

Straight line (between EC and EP)

Bearing 57°59′40.6″

Distance 250.084 m

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