CONTENT

FOREWORDS

Congratulations on the purchase of STONEX Total Station R Series.

This manual is for the application of STONEX Total Station R Series.

STONEX R2 Total Station is equipped with infrared laser optic-electronic distance meter.

STONEX R2 Total Station is equipped with visible infrared laser distance meter which is operated without sighting a reflector.

In this manual, the parts which are marked "☞" are only applicable to STONEX R2. Before operating the instrument, please read this manual carefully.

FEATURES:

1. Powerful Software Functions

The internal software installed in STONEX R SeriesTotal Station 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.

2. Simplified Operation

STONEX R Series Total Station 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.

3. Absolute Encoding Circle

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

☞4. Reflectorless EDM

The reflectorless laser EDM function equipped in Total Station R Series can be operated the measurement on various materials of different colors (such as the wall surface of constructions, 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.

5. High Precision and Long Measuring Range

The measuring range of STONEX R Series Total Station is 2.4 km with single prism.

6. Reliable Water and Dust Proof Function

R Series Total Station boasts 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 direct to sunlight 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 there is great difference between the temperature in work site and that in store place, you should leave the instrument in the case till it adapts to the temperature of environment.
5. If the instrument has not been used for a long time, you should remove the battery for separate storage. The battery should be charged once a month.
6. When transporting the instrument should be placed in its carrying case, it is recommended that cushioned material should be used around the case for support.
7. For less vibration and better accuracy, the instrument should be set up 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 after use. If it gets wet, dry it immediately.
10. Before working, inspect 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. Since Reflectorless Total Station R2 emits visible laser, do not sight the eyes in use.

SAFETY GUIDE

Internal EDM (Visible Laser)

Warning:

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

On the vertical tangent screw sticks an indication label “CLASS III LASER PRODUCT”. A similar label is sticked 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/Ⅲ a laser product: It is harmful to observe 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 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 those persons who are trained with 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 laser instrument is not in use, take care of it properly. The person who is not authenticated is not allowed to use.

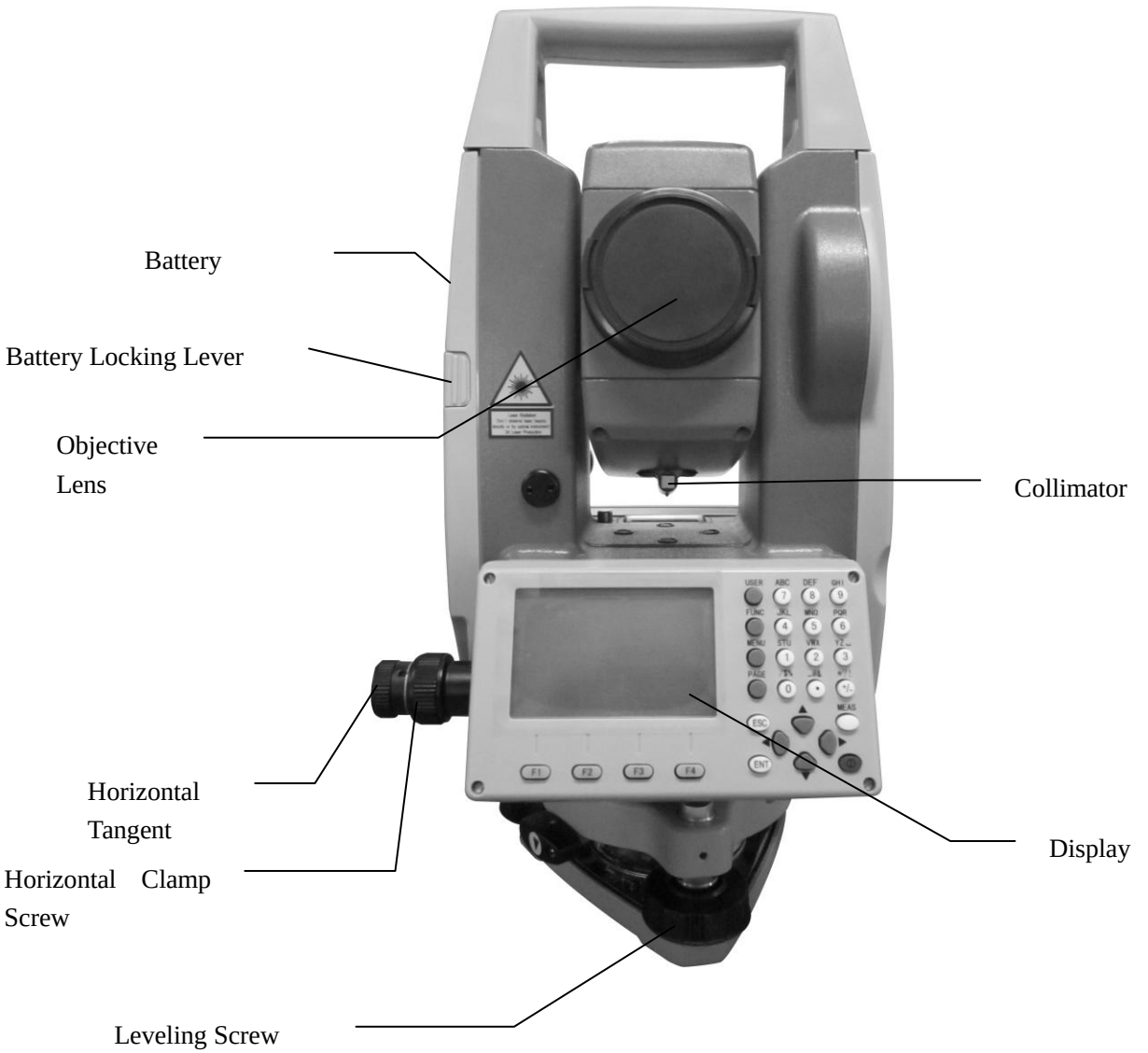
g) Prevent the laser beam from irradiating plane mirror, metal surface, window, etc. especially beware of the surface of plane mirror and concave mirror.

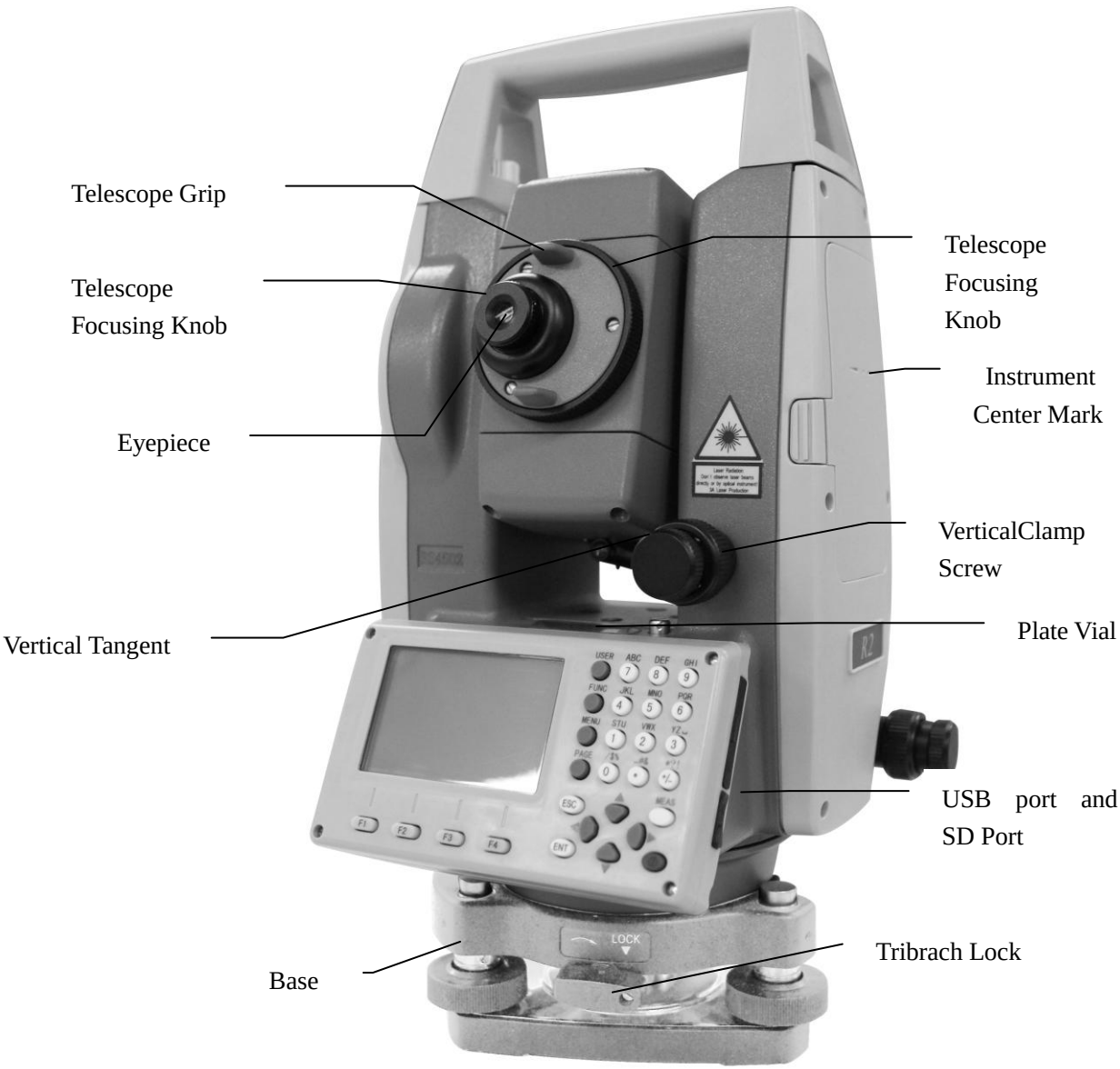
* Harmful distance means the maximum distance between the start point and the point which the laser is weakened to a degree that doesn't harm people.

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.)

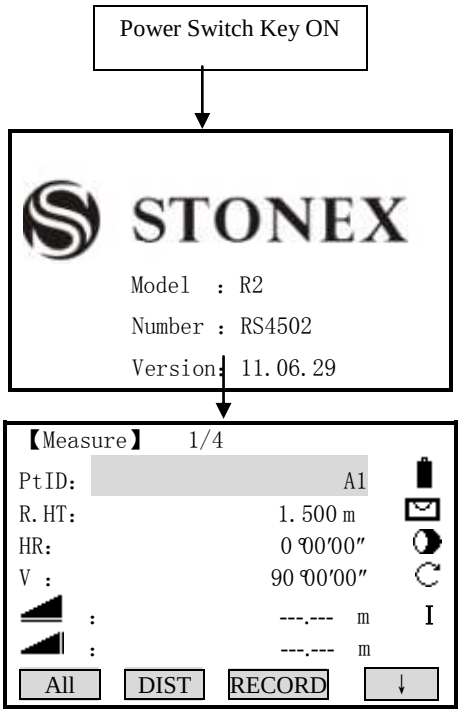
1. NOMENCLATURE AND FUNCTIONS

1.1 NOMENCLATURE (take R2 as example in the full text)




Telescope Grip
Telescope Focusing Knob
Eyepiece
Vertical Tangent
Telescope Focusing Knob
Instrument Center Mark
VerticalClamp Screw
Plate Vial
USB port and SD Port
Tribrach Lock
Base

1.2 DISPLAY

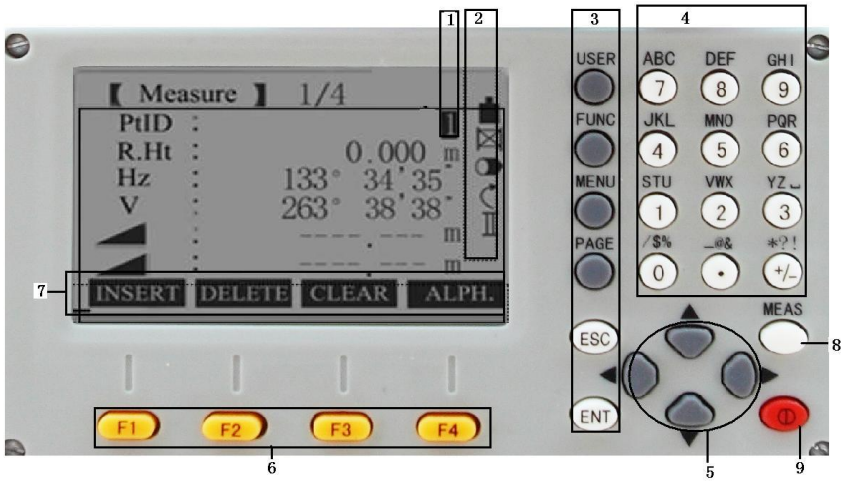


Main Menu

Confirm the battery enough shown on the display. Replace it with another charged battery or charge it when battery level is low. Refer to section 2.3 “Battery Power Remaining Display”.

The chart above is the display screen. It is possible that local software versions are different from the basic version.

1.3KEYPAD



☞It takes R2 for example here.

1) Focus (Actively measured field)
2) Icons
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 keys (Are assigned the variable functions displayed at the bottom of the screen.)
7) Soft bar (Displays functions that can be called up with the Soft keys. It can use to start up figure and character input function in R Series.)
8) Trigger key (important key)
9) Power key

1.4 FIXED KEYS

[User]: User key can be defined. Programmable with function from the "Function" menu.
[FNC]: Measurement key in common use. Several functions could be called up, the instructions are as follows：

- function could be started up directly in different application.
- every function in menu could be appointed to user key (see "4.4 MAIN SETTINGS")

[Menu]: Menu key. Accesses to programs, settings, data manager, communication parameters, instrument adjustments, system information and data transfer, etc.

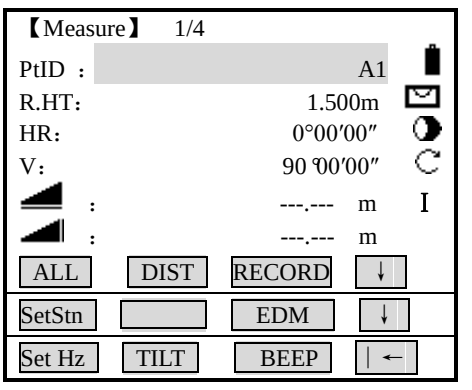
In menus with multiple entries a shortcut number is shown on the right of each entry. Using this number allows a direct start without turning page.

[PAGE]: Page key. Turn to next page when a dialogue consists of several pages.
[ESC]: Quit a dialog or the edit mode with activation of the "previous" value. Return to a higher level.
[ENT]: Confirm an input, continue to the next field.

1.5 TRIGGER KEY

The measurement trigger (important key) has three settings (ALL, DIST, OFF). The key can be activated in Settings or Main Settings menu.

1.6 SOFT KEYS（FUNCTIONAL KEYS）



The measurement data is displayed in the several upper lines of the display, while a selection of commands and functions is at the bottom of the screen, which can be activated with corresponding functional keys. The

meaning of each soft key depends on the applications/functions currently active.

Soft Keys：

Key	Function
[All]	Starts angle and distance measurements, and saves measured values.
[DIST]	Starts angle and distance measurements without saving measured values.
[REC]	Saves displayed values.
[ENH]	Opens the coordinate input mode
[List]	Displays the list of available points
[Search]	Starts the search for the input points
[EDM]	Displays EDM settings
[Esc]	Returns to the previous mode or display.
[Con]	Continues to next mode or display.
[⊢]	Returns to highest soft key level.
[↓]	To next soft key level.
[ENT]	Sets displayed message or dialog and quits the dialog.

1.7 SYMBOLS

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

Key	Content
◆▶	A double arrow indicates choice fields.
◀●	Using the navigation keys the desired parameter can be selected.
●	Quits a selection with the navigation keys or Enter key.
▲,▼,▲▼	Indicates that several pages are available which can be selected with [PAGE].
Ⅰ, Ⅱ	Telescope (alidade) is at Face Ⅰ or Face Ⅱ.
↺ (↻)	Hz is set to “left angle measurement”(or right angle measurement), which is to circumrotate anticlockwise (clockwise)

1.8 ICONS

Measurement mode icons：

Infrared EDM (invisible) for measuring prisms and reflective targets.

☞ Reflectorless EDM (visible) for measuring all targets.

☞ Use reflective foils as reflective targets.

Battery capacity status icon：

The battery symbol indicates the level of the remaining battery capacity (80% full shown in the example).

Compensator status icons：

Compensator is ON

Compensator is OFF

Character/Number inputting mode icons：

01 Numeric Mode

AB Alphanumeric Mode

1.9 MENU TREE

[Menu]>F1-F4 is to confirm the selected menu. Press [PAGE] to view the next page. Menu tree may be different in the order of display.

MENU (P1)

Programs ----------Surveying
----Stake Out
----Free Station
----COGO
----Tie Distance
----Area (plan)
----Remote Height
----Reference Line/Arc
----Roads
----Construction by axes method

Settings ----------Contrast, Trigger Key, User Key, V- Setting,
Tilt Crn, Coll. Crn.
----SectorBeep, Beep，Hz<=>, Face l Def., Data Output, Auto-Off
---- MinReading, Angle Unit, Dist.Unit, Temp.Unit, Press Unit, Code Rec.
----GSI 8/16, Mask 1/2

EDM Settings ----------EDM Mode
----Prism
----Atmospheric Data
----Grid Factors
----Signal
----Multiply Constant

File Management --------Job

----Known points
----Measurements
----Codes
----Initialize Memory
----Memory Statistic

MENU (P2)

Adjustment ----------V- index
----Hz-collimation
----Horizontal Axis
----VO/Axis (Cons, list)
----lnst.Constant
----Tilt Parameter
----State

Comm Parameters ------Baudrate
----DataBits
----Parity
----End Mark
----Stop Bit

Data Transfer ----------Data Send ---- Job
---- Data
---- Format

System Information ----------Battery
----Date
----Time
----Version
----Type
----Number

1.10 AUTO POWER OFF

If no key operation is done for the setting time (30 minutes), the power turns off automatically.

2. PREPARATION FOR MEASUREMENT

2.1 UNPACKING AND STORE OF INSTRUMENT

- Unpacking of instrument

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

- Store of instrument

Cover the telescope cap, place the instrument into the case with the vertical clamp screw and circular level 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:

1 Leveling and Centering the Instrument by plumb bob

1) Setting up the tripod

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

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

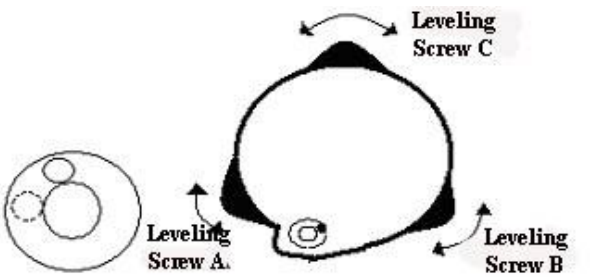
③ Step on the tripod to make sure if it is well stationed on the ground.

2) Attaching the instrument on the tripod

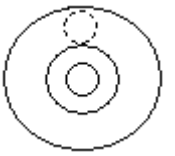
Place the instrument carefully on the tripod head and slide the instrument by loosening the tripod screw. If the plumb bob is positioned right over the center of the point, slightly tighten the tripod.

3) Roughly leveling the instrument by using the circular vial

① Turn 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 .

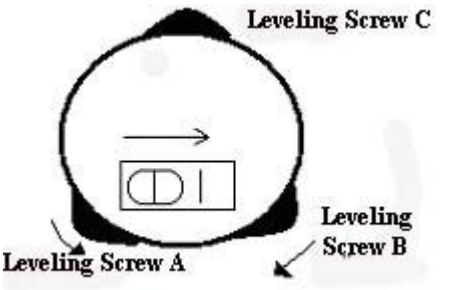


② Turn the leveling screw C to move the bubble to the center of the circular vial.

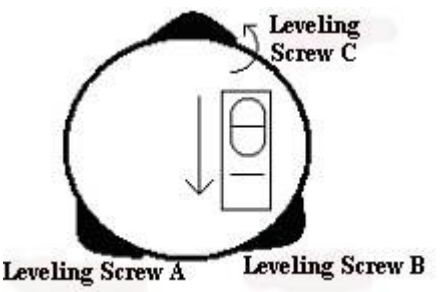


4) Precisely leveling by using the plate vial

① Rotate 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.



② Rotate the instrument 90 (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 90 (100g) rotation of the instrument and check whether the bubble is correctly centered in all directions.

2 Centering 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, and 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.

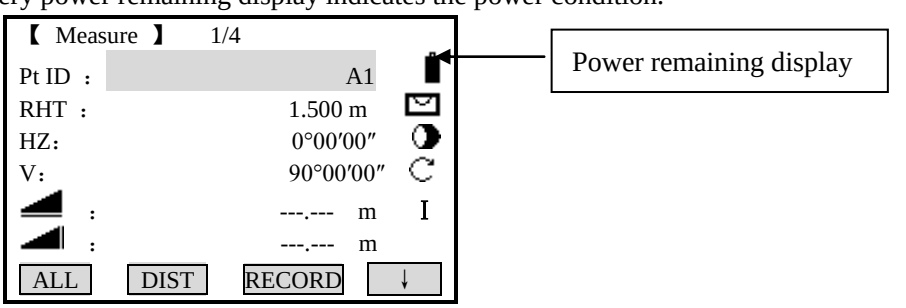
5) Precisely centering and leveling

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 condition.



Note :

① The 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 full charged batteries.

② The battery power remaining display shows the power level regarding the current measurement mode. The distance measurement mode consumes more power than angle measurement mode, so the power enough for the latter is not sure applicable for the

previous one. Pay particular attention to this when switching angle measurement mode to distance measurement mode, because insufficient battery power might lead to interrupted operation.

● Before outdoor operation, battery power status should be well checked.

③ When the measurement mode is changed, the battery power would not immediately show the decrease or increase. 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 charger SC-21 going with the instrument.

☆ Remove the on-board battery from instrument and connect it to battery charger. When the indicator lamp on the battery charger is orange, the recharging process has begun. When charging is complete (indicator lamp turns green), disconnect the charger from its power source.

- **Battery Removal Cautions：**

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

- **Battery Recharging Cautions：**

☆ 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 of 0 ℃～±45 ℃, recharging may be abnormal beyond the specified temperature range .

☆ When the indicator lamp does not light after connecting the battery and charger, either the battery or the charger may be damaged. Please connect professionals for repairing.

- **Battery Charging Cautions：**

☆ 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.

2.4 REFLECTOR PRISMS

When measuring distance, a reflector prism needs to be placed at the target place. Reflector systems come with single prism and triple prisms, which can be mounted with tribrach onto a tripod or mounted onto a prism pole. Reflector systems can be self-configured by users according to job.

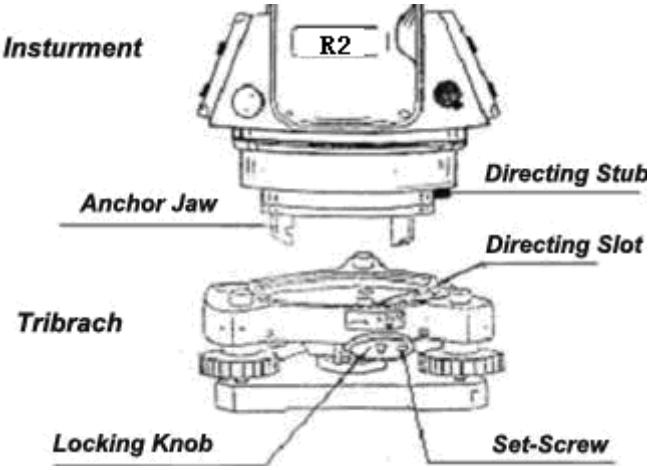
Illustrated are some prism systems that match:



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 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 screwdriver.

2.6 EYEPIECE ADJUSTMENT AND COLLIMATING OBJECT

Method of Collimating Object（for reference）

① Sight the Telescope to bright place and rotate the eyepiece tube to make the reticle clear.

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

STONEX R2 Total Station has alphanumeric keypad; Users therefore can input number and character directly. R2 total station instrument will be introduced particularly as follows.

• R2：

Each key of R2 Total Station Instrument is defined with three characters and one fig.

Numeric fields:

User can only enter numerical values. By pressing a button of the numeric keypad the number will be displayed.

Alphanumeric fields:

User can enter numbers and letters. By pressing a button of the alphanumeric keypad the input opens. By pressing several times you can toggle through the characters. For example: A->B->C->7……

If the sign is [AB] at the lower-right corner of screen, you can input number/letter on the alphanumeric keypad； If it is 01, you can only input numbers. For any requirement for manually inputting, press [F4] to switch between number and letter inputting mode.

• Sign

The characters which can be input in R2 Total Station Instrument are：A～Z . / $ % _ @ & * ? ! + — etc.

+/—： In number/letter inputting mode, "+" and "-" are treated as normal alphanumeric characters with no mathematical function. In numeric inputting mode, it can only be used in front of the input numbers.

• Special characters

* In wildcard searching, it is required to use the sign "*". In character inputting mode of R2 instrument, press +/- key once.

In the edit mode, the position of the decimal place can not be changed. The decimal place is skipped.

All keys can be entered into screen.

Use navigation key ◄ ► to move the cursor.

2.7.1 Inputting Character

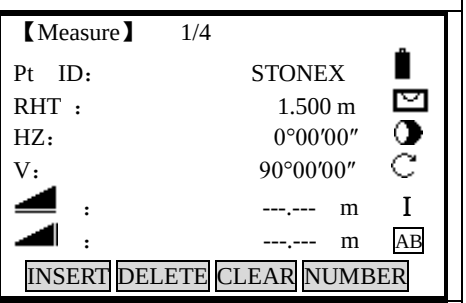
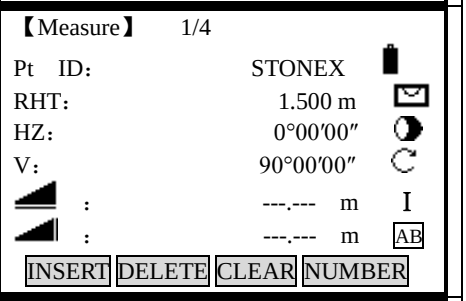
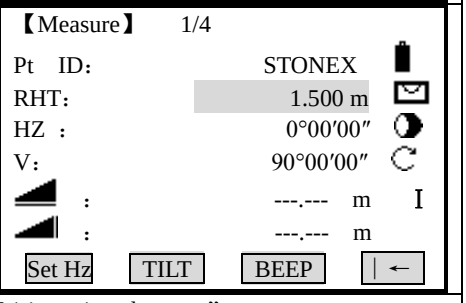
For STONEX R2: each key is defined with three characters and a figure, as entering the number/letter inputting mode, every time you press the keypad, a letter would occur at the cursor, and a number occurs by pressing four times. As the needed character/fig occurs, the cursor moves automatically to the next item.

E.g.: input 123ABF8

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press the key on numeric keypad to start inputting. As the sign at the lower-right corner of the screen is [01], it is in the numeric inputting mode.		【Measure】 1/4 Pt ID ： 1 RHT ： 1.500 m HZ ： 0°00′00″ V ： 90°00′00″ ： ---.--- m ： ---.--- m 01 INSERT DELETE CLEAR NUMBER
② Press numeric key 123, after inputting figures, press [F4] (ALPH) to enter character inputting mode.	Input [1] [2] [3] + [F4]	【Measure】 1/4 Pt ID ： 123 RHT ： 1.500 m HZ ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m AB INSERT DELETE CLEAR NUMBER
③ Press numeric key “7” once, showing letter A, the cursor automatically moves to the next position, press “7” twice, showing B, then press “8” three times, showing F, finally, press “8” four times, to show 8. So as to finish inputting 123ABF8.	Input [A] [B] [F] [8]	【Measure 】 1/4 Pt ID ： 123ABF8 RHT ： 1.500 m HZ ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m AB INSERT DELETE CLEAR NUMBER
④Press [ENT] to end inputting and move to the next item.	[ENT]	【Measure】 1/4 Pt ID ： 123ABF8 RHT ： 1.500 m HZ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m ALL DIST RECORD ↓

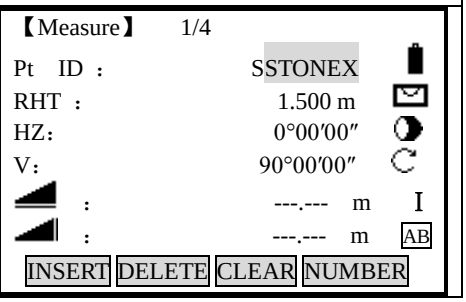
2.7.2 Editing Character

Input characters can be edited.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press navigation key ◄► to move the cursor to the character needed to edit.	◄►	
②Input new character. (e.g.: input "N" here)※1)	Input [N]	
③Press [ENT] to confirm the input.	[ENT]	
※1)About the way to input character, please refer to "2.7.1 inputting character".		

2.7.3 Deleting Character

Input characters can be deleted.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press navigation key ◄► to move the cursor to the character needed to delete.	◄►	

②Press [F2](DELETE).	[F2]	【Measure】 1/4 Pt ID ： STONEX RHT ： 1.500 m HZ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m INSERT DELETE CLEAR NUMBER
③Press [ENT] to confirm the input. To restore the original value, press [ESC] to cancel the amendment.	[ENT] Or [ESC]	【Measure】 1/4 Pt ID ： STONEX RHT ： 1.500 m HZ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m ALL DIST RECORD ↓

2.7.4 Inserting Character

If you omit a certain character in inputting, e.g.: “STONEX” has missed out an “N”, you can insert the character.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press navigation key ◄ ► moving the cursor to “O”.	◄ ►	【Measure】 1/4 Pt ID： STONEX RHT ： 1.500 m HZ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m INSERT DELETE CLEAR NUMBER
② Press [F1](INSERT), insert an empty character on the right of “O” (in the fig inputting mode, insert “0”)	[F1]	【Measure】 1/4 Pt ID： STOEX RHT ： 1.500 m HZ： 0°00′00″ V： 90°00′00″ ： ---.--- m ： ---.--- m INSERT DELETE CLEAR NUMBER

③ The cursor stays at the inserted empty character, input the omitted character (here, input "N"). ※1)	Input [N]	【Measure】 1/4 Pt ID: STONEX RHT : 1.500 m HZ: 0°00′00″ V: 90°00′00″ : ---.--- m : ---.--- m INSERT DELETE CLEAR NUMBER
④Press [ENT] to confirm the input. To restore the original value, press [ESC] to cancel the amendment.	[ENT] Or [ESC]	【Measure】 1/4 Pt ID : STONEX RHT : 1.500 m HZ: 0°00′00″ V : 90°00′00″ : ---.--- m : ---.--- m ALL DIST RECORD ↓
※1) To press [INSERT] at the last character, a space will be inserted (In the fig inputting mode, input 0), and the cursor will move automatically backward (the number of character not exceed the max value.)		

2.8 POINT SEARCH

Pointsearch is a comprehensive function, which use 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 (youngest) known point first.

Direct Search

By entering an actual pointID (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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Program, press Surveying, and after entering measure function, press Setting Station. Input pointID (Here, take "A12" as an example) and press ENT. Then press [F1] (FIND) to start the FIND function.	Input pointID + [F1]	【 Set.Stn 】 Input Station PtID : StnPt: A12 FIND LIST ENH

② Display searching result. Use navigation key ▲ ▼ to select the point, after the point you need is found, press [F4] (OK) or [ENT] to return to last menu.	▲ ▼ + [F4] Or[ENT]	【Pt Searching 】 1/25 A12 Known A12 Meas A12 Meas A12 Meas A12 Meas A12 Meas VIEW ENH JOB OK

Introduction of soft keypad at the bottom of the screen:

[VIEW] Display the coordinates of the selected point.

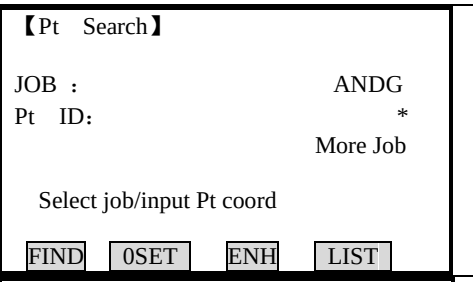
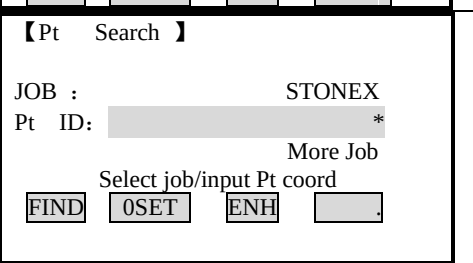
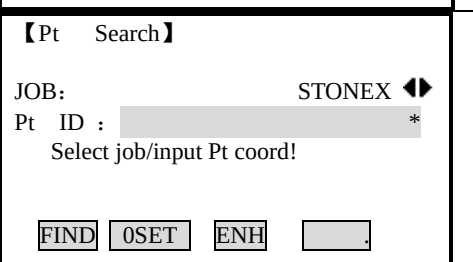
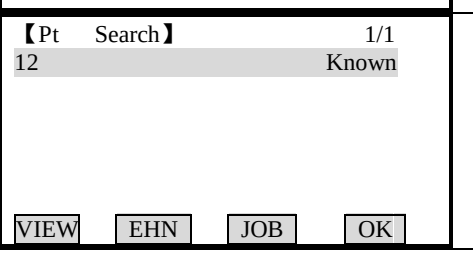
③Use navigation key ▲ ▼ to select a pointID, press [F1](VIEW) to display the coordinate information of this point.	[F1]	【Pt Search Coord VIEW】 Pt ID: A12 X/N : 100.000 m Y/E : 100.000 m H/Z : 26.000 m DATE: 2006.08.21 TIME: 08:20:56 Start Last OK
④Press [ESC] or [F4](OK) to return to last menu.	[ESC] Or [F4]	【Pt Searching】 1/25 A12 Known A12 Meas A12 Meas A12 Meas A12 Meas A12 Meas VIEW ENH JOB OK

[ENH] Inputs coordinate point manually

③If the pointID you need does not exist in the job, press [F2] (ENH) to input coordinate.	[F2]	Coordinate Input JOB: A:\stonex.Pts Pt ID: ---.--- X/N : ---.--- m Y/E : ---.--- m H/Z : ---.--- m BACK SAVE
④Input pointID and E,N,Z coordinate. As one item has been input, press [ENT] to move the cursor to the next item.	Input Pt ID 、ENH + [ENT]	Coordinate Input JOB : STONEX Pt ID: 10 X/N : 10.000m Y/E : 100.200 m H/Z : 10.220 m 01 INSERT DELETE CLEAR
⑤As finishing all inputting, press [F4] to save the pointID into job.	[F4]	

[OK] Confirm the selected point

[JOB] Select the pointID in another different job

③If not find the pointID you need in present job, you can choose it in another job or input coordinate by hand in the selected job. Press [F3] (JOB) key to enter this function.	[F3]	
④Press navigation key ▲ to move cursor to job item, select the other jobs in internal memory, and press [ENT] to move cursor to the next item.	▲ + [ENT]	
⑤Input the pointID to be searched, then press [ENT]. To input the coordinate manually, press [0SET] or [ENH]. ※1)	Input pointID + [ENT]	
⑥Press [F1] to search the pointID meeting the searching conditions in the selected job.	[F1]	

※1)[F2](0SET): Press this key to set E, N, Z coordinate of the input pointID as 0 value.
[F3](ENH): Input coordinates of this point manually.

2.9 WILDCARD SEARCH

Use wildcard "*" representing those characters you are going to search.

Wildcards are always used if the pointID is not fully known, or if batches of points are 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)

OPERATIONAL STEPS: (taking "*" as an example)

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Program, press Surveying, after entering measure function, press Setting Station. Input wildcard "*": (Here takes "*"as an example), and press [ENT]. Then press [F1] (SEARCH) to start searching function.	Input Pt. ID +[F1]	【Set.Stn】 Pt. ID : StnPt : * VIEW LIST ENH .
② Display search result. Use navigation key ▲▼ to select pointID you need, press [F4] (OK) or [ENT] to return to last menu.	▲▼ + [F4] Or [ENT]	【Pt Search】 1/254 2 Known A1 Known 12 Known 111 Meas 233 Meas 201 Meas VIEW ENH JOB OK

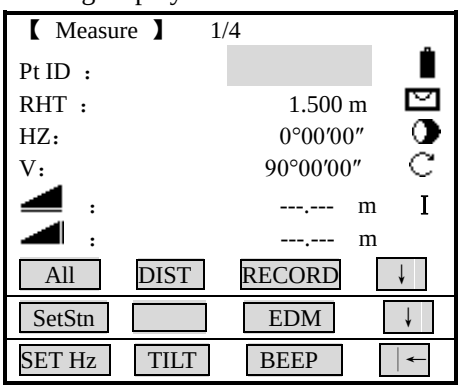
3. ROUTINE MEASUREMENT

3.1 DISTANCE SURVEY CAUTIONS

After setting up and switching on correctly, the Total Station is immediately ready for measuring.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 Start the corresponding function

NOTE:

☞ Measurements to strongly reflecting targets such as to traffic lights in infrared mode should be avoided. The measured distances may be wrong or inaccurate.

☞When the [MEASURE] (Trigger Key) is triggered, the EDM measures the object which is in the beam path at that moment.

☞If e.g. people, cars, animals, swaying branches, etc. cross the laser beam while a measurement is being taken, a fraction of the laser beam is reflected and may lead to incorrect distance values.

☞Avoid interrupting the measuring beam while taking reflectorless measurements or measurements using reflective foils.

☞**Reflectorless EDM**

●Ensure that the laser beams cannot be reflected by any object nearby with high reflectivity.

●When a distance measurement is triggered, the EDM measures to the object which is in the beam path at that moment. In case of temporary obstruction (e.g. a passing vehicle, heavy rain, snow, frog, etc.), the EDM may measure to the obstruction.

●When measuring longer distance, any divergence of the red laser beam from the line of sight might lead to less accurate measurements. This is because the laser beam might not be reflected from the point at which the crosshairs are pointing. Therefore, it is recommended to verify that the R-laser is well collimated with the telescope line of sight. (Please refer to "10.11 REFLECTORLESS EDM")

●Do not collimate the same target with the 2 total stations simultaneously.

☞Accurate measurements to prisms should be made with the standard program (infrared mode).

☞Red Laser Distance Measurement Cooperated with Reflective Foils.

The visible red laser beam can also be used to measure to reflective foils. To guarantee the accuracy the red laser beam must be perpendicular to the reflector foil and it must be well adjusted (refer to "10.11 REFLECTORLESS EDM").

☞ Make sure the additive constant belongs to the selected target (reflector).

3.2 EDM SETTINGS

3.2.1 Setting EDM Mode

Choose distance measurement modes, the measurement modes provided by the instrument are: fine single /fine 2 times /fine 3 times/ fine 4 times/fine 5 times /fine repeat/tracking.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F4](↓) to display the second page soft key of surveying. Press [F3] to enter EDM Settings.	[F4] [F4] [F3]	【Measure】1/4 Pt ID ： RHT: 1.500 m HZ: 0°00′00″ V: 90°00′00″ : ---.--- m : ---.--- m SetStn EDM ↓
② As the cursor stays at EDM Mode, press navigation key ◄ ► to choose the survey mode.	◄ ►	【EDM Settings】 EDM Mode: Tracking◄► Prism: 30.0mm ATMOS GRID SET ↓
③ As finishing setting, Press [F3] (SET) to return to measure function. To cancel the settings, by pressing [ESC], a dialog will show as the right picture. Press [F1] to return to EDM Settings function to reset EDM parameters. Press [F4] to quit and return to measure function.	[F3]	【EDM Settings】 Quit the parameter? CANCEL OK

3.2.2 Setting Distance Measurement Type

STONEX R2 Total Stations can set options of Red Laser (RL) EDM and Invisible Laser (IL) EDM, as well as reflector with prism, non-prism, and reflective foil. User can set them according to the requirements of the job. STONEX R2 Total Stations are only equipped with laser EDM function, which requires that the prism is in accordance with the prism constant.

For more parameters of various kinds of reflectors, please refer to “11. Specification”

OPERATIONAL STEPS	OPERATION	DISPLAY
① After entering into EDM Setting screen, press ▼ to move to reflector item.	▼	【EDM Setting】 EDM Mode: Fine [s] ◀▶ Reflector: Prism ◀▶ Prism: 30.0mm ATMOS GRID SET. ↓
②Press ◀ ▶ to select the reflector type. Press ◀ or ▶ once to change the type of reflector.	◀ ▶	【EDM Setting】 EDM Mode: Fine [s] ◀▶ Reflector: Non-prism ◀▶ Prism: 30.0mm ATMOS GRID SET. ↓
③ After finishing setting, press [F3](SET) to return to measure function. If to cancel the settings, press [ESC], a dialog will appear as the right picture. Press [F1] to return to EDM Settings to renew the EDM parameters. Press [F4] to return to the measure function.	[F3]	【EDM Settings】 Quit the parameter? CANCEL OK

3.2.3 Setting the Prism Constant

Since the constants of prisms manufactured by different companies are different, the corresponding prism constant must be set. Once the prism constant is set, it would be kept even if the machine is turned off.

● Setting illustration: Prism constant -30mm

OPERATIONAL STEPS	OPERATION	DISPLAY
①After entering EDM Settings screen, use navigation key ▼ to move the cursor to Prism item.	▼	【EDM Settings】 EDM Mode: Tracking ◀▶ Prism : 30.0mm ATMOS GRID SET ↓

② Input prism constant and press [ENT]. ※1)～※2)	Input-30 + [ENT]	【EDM Settings】 EDM Mode: Tracking Prism: -30.0mm ATMOS GRID SET ↓
③ After finishing setting, press [F3](SET) to return to measure function. If to cancel the settings, press [ESC], a dialog will appear as the right picture. Press [F1] returning to EDM Settings to renew the EDM parameters. Press [F4] to return to the measure function	[F3]	【EDM Settings】 Quit the parameter? CANCEL OK
※1) About the way to input prism constant please refer to "2.7 INPUTTING MODE' ※2) The scope of prism constant ： -99mm～+99mm, Step Length 0.1mm		

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3.2.4 Setting Atmosphere 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:

$D=S \cdot \cos\alpha$

$H=S \cdot \sin\alpha$

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)

OPERATIONAL STEPS	OPERATION	DISPLAY
①In EDM Settings screen, press [F1] (Atmos) to enter atmospheric correction function.	[F1]	【EDM Settings】 EDM Mode: Tracking Reflect: Prism Prism: 30.0mm ATMOS GRID SET ↓
②The current settings displays on the screen.		【Atmosphere Data】 Retr..Corr: 0.14 Temp: 20℃ Pressure: 1013.2 hPa Atmos PPM: 0 PPM BACK PPM=0 SET
③Input refraction modulus. E.g.: input 0.2, and press [ENT], moving the cursor to Temp item. ※1)，※2)	Input 0.20 + [ENT]	【Atmosphere Data】 RetrCorr: 0.20 Temp : 20℃ Pressure : 1013.2 hPa Atmos PPM: 0 PPM BACK PPM=0 SET
④As the settings are finished, press [F4] to store and return to the previous menu, here you have to press [F3](SET) to save settings and return to measure function.	[F4] [F3]	【EDM Settings】 EDM Mode: Tracking Reflect: Prism Prism: -30.0mm ATMOS GRID SET ↓
※1)The inputting scope of refraction modulus: 0.00(SHUT) ～0.20 ※2) please refer to "2.7 INPUTING MODE" for inputting instruction.		

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 R SERIES 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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In the screen of EDM setting, press [F1] (Atmos) to enter atmospheric correction function.		【EDM Settings 】 EDM Mode: Tracking Reflect: Prism Prism: 30.0mm ATMOS GRID SET ↓
②The current settings display on the screen, use navigation key ▼ to move the cursor to Temp item.	▼	【Atmosphere Data】 Retr.Corr ： 0.14 Temp ： 20℃ Pressure ： 1013.2 hPa Atmos PPM: 0 PPM BACK PPM=0 SET
③Input temperature value, e.g.: Input 26℃, press [ENT] to move the cursor to Pressure item.	Input 26 + [ENT]	【Atmosphere Data】 Retr.Corr: 0.14ATUR Temp: 26℃ Pressure: 1013.2 hPa Atmos PPM: 0 PPM BACK PPM=0 SET

④Input pressure e.g.: input 1020 hPa, and press [ENT], the atmospheric correction value will be calculated by the procedure, the cursor will move to the refraction modulus. ※1)，※2)，※3)，※4)	Input 1020 + [ENT]	【Atmosphere Data】 Retr.Corr： 0.14 Temp： 26℃ Pressure： 1020.0 hPa Atmos PPM： 3 PPM BACK PPM=0 SET
⑤After finishing setting, press [F4] to save and return to the previous menu, here press [F3] (SET) again to save the setting and return to measure function.	[F4] [F3]	【EDM Settings】 EDM Mode： Tracking Prism： -30.0mm ATMOS GRID SET ↓

※1The inputting scope:Temperature:-40～+60℃(step length 0.1℃) or -40～140℉(step length 0.1℉)
Air pressure:420 ～ 799.5 ㎜ Hg(step length 0.1 ㎜ Hg) or 560 ～ 1066 hPa(step length 0.1hpa)
16.5 ～ 31.5 inchHg(step length 0.1 inchHg)

※2)Please refer to "2.7INPUTTING MODE" for inputting instruction.

※3)The atmosphere correction value will be calculated by the instrument according to the inputted temperature and pressure value.

※4)Press [F3](PPM=0) to set Atmos correction as zero.

3.2.5 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

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

OPERATIONAL STEPS	OPERATION	DISPLAY
①On the screen of EDM setting , press [F2](GRID) to enter Grid Factor setting.		【EDM Settings】 EDM Mode: Tracking ◆▶ Reflect: Prism ◆▶ Prism: 30.0mm ATMOS GRID SET ↓
②The current settings display on the screen, input Scale and Ht.a.MSL and press [ENT]. The procedure will calculate and display grid. To set All settings to 0 value, press [F3] (0SET). ※1)	Input Scale + [ENT] Input Ht.a.MSL + [ENT]	【Grid Factor】 Scale : 1.000000 Ht.a.MSL: 0.0 m Grid: 1.000000 BACK 0SET SET
③Press [F4](SET) to save the settings and return to the previous menu, then press [F3](SET) again to save the settings being done, and return to measure function.	[F4] [F3]	【EDM Settings】 EDM Mode: Tracking ◆▶ Prism: 30.0mm ATMOS GRID SET ↓
※1) Please refer to "2.7 inputting mode" for inputting instruction.		

3.2.6 Viewing Signal of Distance Measurement

This function displays the intensity of returned-ray signal (signal intensity) being received by the total station instrument, step length 1%. Once refraction ray from the prism is received, this instrument will make beep sound and show the ray intensity which is expressed by %. The best collimation precision can be realized by this function when the target is difficult to find or see.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In EDM setting screen, press [F4] (↓) to display the second page menu, press [F1] to check the signal of distance measurement.	[F4] [F1]	【EDM Settings】 EDM Mode: Tracking ◆▶ Reflect: Prism ◆▶ Prism: 30.0mm ATMOS GRID SET ↓ SIGNAL MulCon ←
②The ray intensity which is received by the machine is expressed by the bar graph and a % displaying on the screen, showed as the right picture. ※ 1)		【EDM SIGNAL】 EDM Type: IR 65% BACK . . .
③Press [F1] to return to EDM setting menu.	[F1]	【EDM Settings】 EDM Mode: Tracking ◆▶ Reflect: Prism ◆▶ Prism: 30.0mm ATMOS GRID SET ↓
※1)IR: infrared distance measurement(distance surveyed by the prism)		

3.2.7 Setting Multiplication Constant

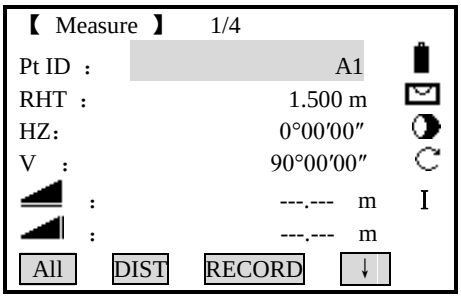
This function clewed the setting of multiply constant. The value of multiplication constant will be obtained by examination

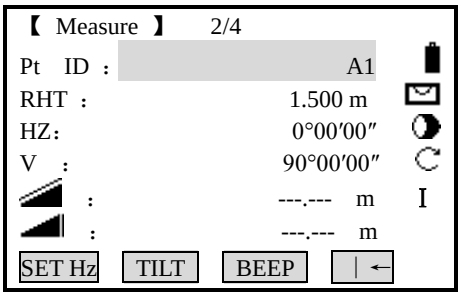
OPERATIONAL STEPS	OPERATION	DISPLAY
① On EDM setting function, press [F4](↓) to display the second page menu, and press [F2] to set Mul-Cons .	[F4] [F2]	【EDM Settings】 EDM Mode: Tracking ◆▶ Prism: 30.0mm ATMOS GRID SET ↓ SIGNAL MulCon ←
②Input Mul-Cons and press ENT	Input Mul-Cons + [ENT]	【Multiplication Cons】 Mul-Cons : 0.0 ppm SAVE

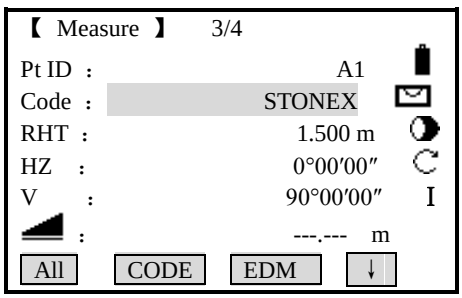
③Press [F4] to save the setting and return to EDM setting menu.	[F4]	【EDM Settings】 EDM Mode: Tracking Reflect: Prism Prism: 30.0mm ATMOS GRID SET ↓

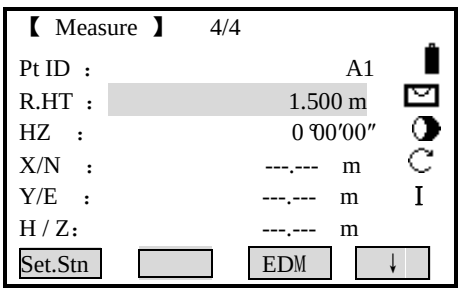
3.3 START SURVEY

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:



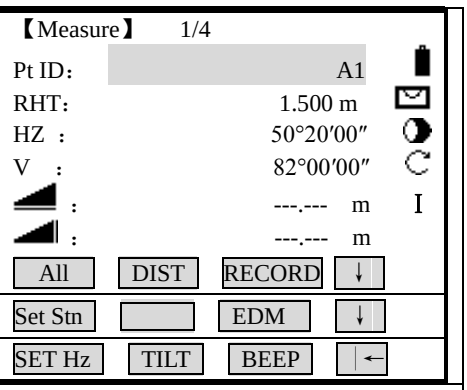
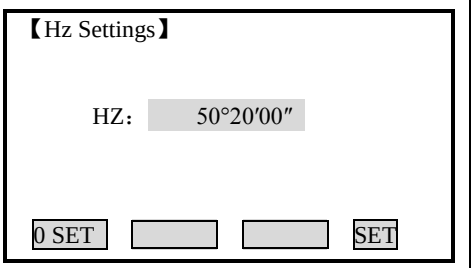
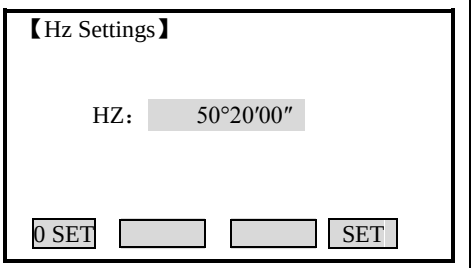
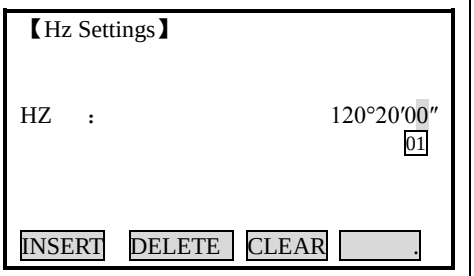
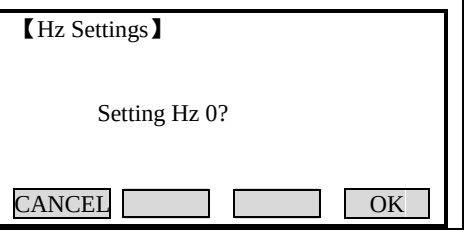


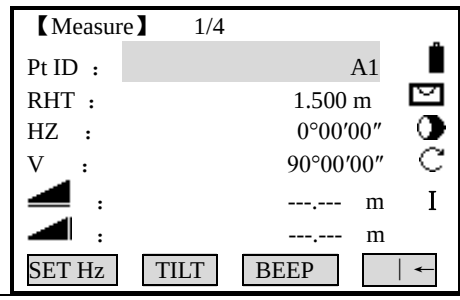




3.3.1 Setting Horizontal Circle

OPERATIONAL STEPS	OPERATION	DISPLAY
①Collimate the target point which is used for orientation setting.	Collimate to the target point	【Measure】 1/4 Pt ID: A1 RHT: 1.500 m HZ : 50°20′00″ V : 82°00′00″ ---.--- m ---.--- m SET Hz TILT BEEP

②Press [F4](↓) twice and turn to the third page of soft key. Press [F1] (SET Hz) to set horizontal angle.	[F4] [F4] [F1]	
③Screen shows the current horizontal angle value A: To choose the readings of the current horizontal circle as the orientation angle, press [F4] (SET) directly.		 A: press [SET]
B: To choose the other angle value as orientation angle, just input the needed angle and press [ENT]. e.g.: input 120°20′30″. ※1)～※3)	[F4]	 B: Input angle
C: To set horizontal angle to zero, press [F1] (0SET). Screen shows as the right picture and presents whether to set horizontal angle to zero? If yes, press [F4] (OK) and return to measure function. To renew settings, press [F1] (CANCEL) to return to horizontal angle setting function.	Input HZ + [ENT]	 Press[0SET]
	[F1] [F4]	

④ Return to measure function, the horizontal angle set just now is displayed, here takes setting zero as an example. ※4)～※5)		

※1)If there is something wrong in inputting, press ◄ ► to move the cursor to the place needed to modify, or press [F3](CLEAR) and input the correct one

※2) If an error numerical value is inputted (such as: 70′) and screen do not response the inputting, a reasonable numerical key has to be pressed

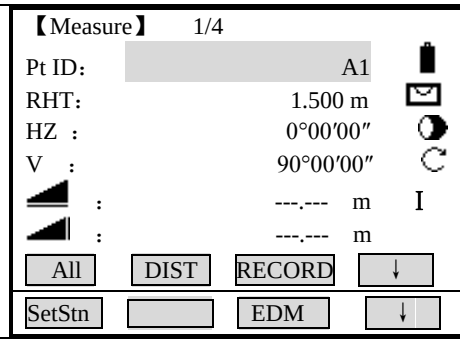
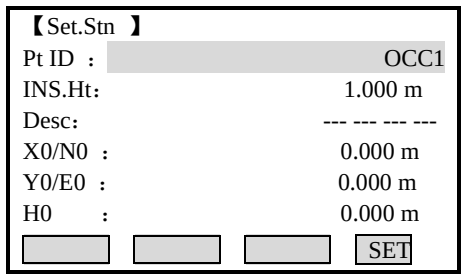
※3)If the angle unit is degree, minute and second, as part of "degree" is finished, you need to press [•] or ► to move the cursor to the next inputting area.

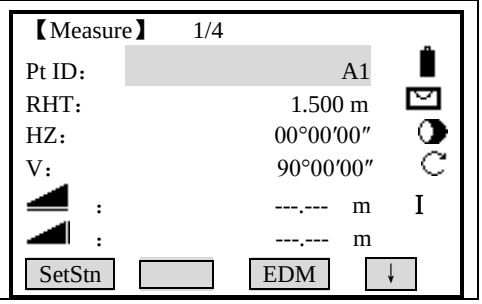
※4) The setting of horizontal left angle/right angle, may be finished in [Main Settings]. Refer to "4.4 Main Settings".

※5) For vertical angle setting, it can also be finished in [Main Settings]. Refer to "4.4 Main Settings".

3.3.2 Setting the Instrument Height and Prism Height

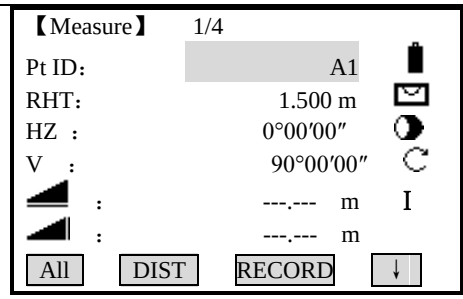
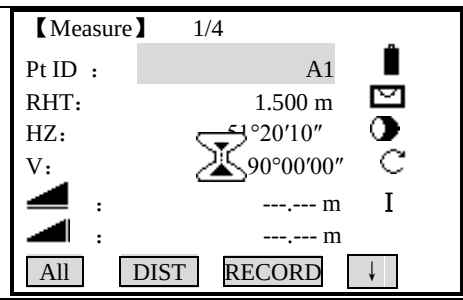
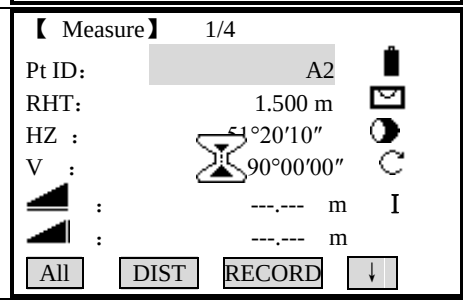
After setting the relative coordinate of the occupied point according to origin point, the instrument automatically converts and displays the prism point Coordinate based on the origin and occupied point.

OPERATIONAL STEPS	OPERATION	DISPPLAY
①Press [F4]([↓]), turn to the second page of soft key, press [F1](SetStn) to set measurement station and instrument height.	[F4] [F1]	
②Input the pointID of measurement station, instrument height and coordinate. After finishing one item, press [ENT] to move the cursor to the next one. Since the Desc. item describes measurement station, it may not be inputted	Input pointID of measurement station point + [ENT] Input INS.Ht + [ENT] Input ENH + [ENT]	

③As all inputting items are finished, press [F4](SET) to keep the data of measurement station and return to measure function.	[F4]	

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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Input pointID and prism height, after finishing one item, press ENT to move the cursor to the next item. Input the coding if necessary.	Input Pt ID + [ENT] Input RHT + [ENT]	
②Collimate the prism center, press [F1](All) or [F2](DIST) + [F3](RECORD) to start survey, and record the data being surveyed. The measured and recorded data include angle, distance, coordinate, press [PAGE] to see	[F1] or [F2] + [F3]	
③Once a point of survey is finished, the pointID will be automatically added 1 by the procedure, collimate the prism center to repeat the steps and start to measure the next point. ※1).		

The other soft keys at the bottom of the screen:

Compensation: To set Open and Shut of tilt compensation, with options of 1-axis and OFF. Please refer to "4.1 LEVELING" for detailed introduction.

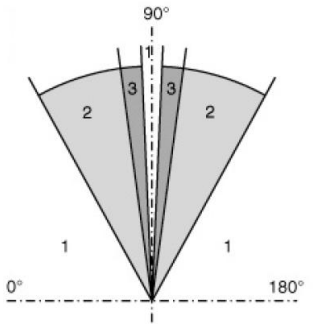
Sector Beep

[F1]ON: Sector Beep sounds at right angles (0 º, 90 º, 180 º, 270 ºor 0，100，200，300gon)

[F2]OFF: Sector Beep switched off.

Sector Beep Example: From 95.0 to 99.5 gon (or from 105.0 to 100.5 gon) a “Fast beep” sounds. From 99.5 to 99.995 gon (or from 100.5 to 100.005 gon) a “Permanent beep” sounds.

As shown in the picture below：



IN GRAPH ： 1) No beep

2) Fast beep (interrupted).

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:

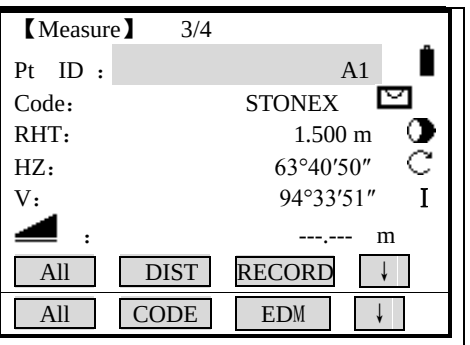
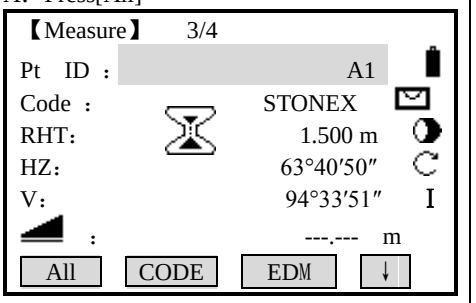
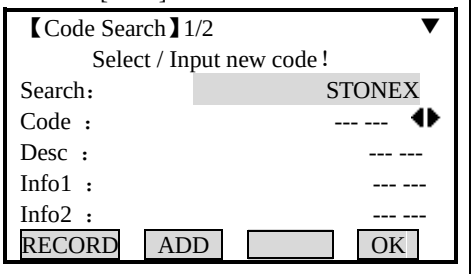
1, Move the cursor to the “Code” column

2, Input coding name

3, Press [All] to start distance measure and record the coding and measurement data together. Press [Code] to search inputted coding and modify the attributes

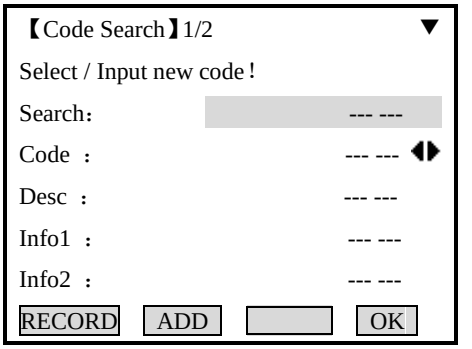
OPERATIONAL STEPS：

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [PAGE] to display measure page of 3/4 and move the cursor to Code item.	[PAGE] + [F4]	【Measure】 3/4 Pt ID: A1 Code: --- --- CODING RHT: 1.500 m HZ:: 63°40′50″ V : 94°33′51″ : ---.--- m All DIST RECORD ↓

②Input the code, and press [F4](↓) to display the second page soft key, here, the single coding being input will not be enlisted in code storeroom. A: Press [F1] (All) to start measurement, save all data of the coding and measurement into job. ※1) B: Press [F2] (Code) to search the codes already inputted.	Input the code + [F4]	 A：Press[All]  B：Press [Code] 

※1)The save sequence of the data of coding and measurement is set in 'Settings' or 'Main settings'
The settings of coding record are: save before, save after. Here explain separately as follows:
save before: to save coding data before practical survey data
save after : to save the coding data closely after practical survey data
Please inquire in "measurements' document

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

☞After Code Search function is started, if the code name is already in the code storeroom, it can be edited. Here the edited data can not be kept in the code storeroom any more. You may press [RECORD] to keep it in data document as a single coding datum, or press [All] (or [DIST] + [RECORD]) to keep it in data document together with those survey data as a single coding datum. Besides, the save sequence of coding data and practical measurement data can also be set (to set in the item Code Record in "Main Settings" and "Settings").
To set code 'save before': represents that as the survey is finished, the coding datum will be saved before practical survey data.
To set code 'save after': represents that this coding datum is saved after practical survey data.

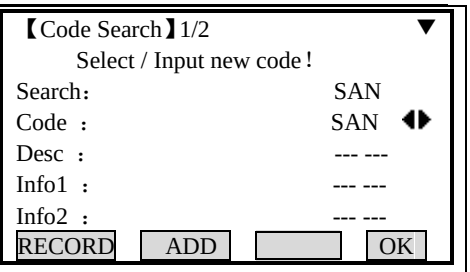
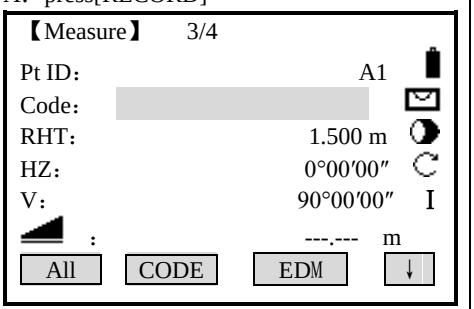
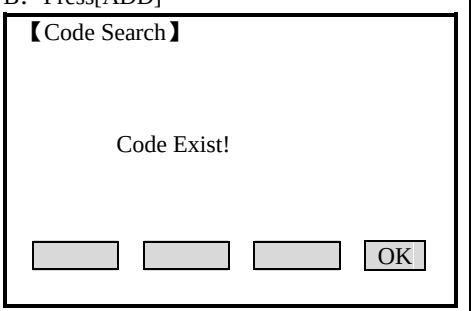
☞If the code input does not exist, after editing, you may press [ADD] to add a new code to code storeroom, or press [RECORD] or [All] (or [DIST] + [RECORD]) to keep it as a single coding datum in survey data document

The operations under two situations are introduced separately:

1）The inputted coding name exists in the store：Extend/edit codes

As the needed code is called up from code list, the attributes can be overwritten freely.

OPERATIONAL STEPS	OPERATION	DISPLAY
①The procedure automatically search the code in code storeroom, if the inputted code exists, it will be displayed in Code item. ※1)		【Code Search】 1/2▼ Select / Input new code ! Search： Code： --- --- ◀▶ Desc： --- --- Info1 ： --- --- Info2 ： 1/2 --- --- RECORD ADD OK

②Expand/edit the coding attributes, as one item is input, press ENT to move the cursor to the next item.	Edit the coding attributes + [ENT]	
③The edited code can be kept in measurement document. A: Press [F1](RECORD) to return to measure function, set the input code as the code of the present measuring point and add a new coding datum to Measurements document. ※ 2) B : Press [F2] (ADD), a dialog appearing as the right picture. The same code can not be added repeatedly, press [F4] to return. ※3) C: Press [F4] (OK) only to set the inputted code as the code of the present measuring point and return to the measure function. ※4)	[F4]	A: press[RECORD]  B: Press[ADD] 

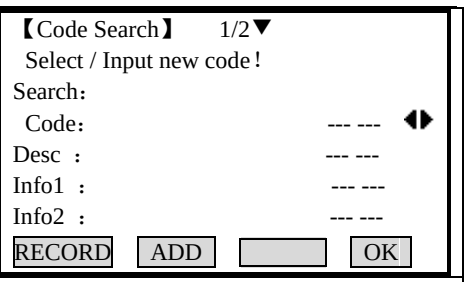
※1) A wildcard"*"can also be input to search all codes in code storeroom, press to display each code. Press [PAGE] to see the other pages of coding attributes.
※2)The added coding data can be found in Measurements of File Management.
※3)The same code name can not be added repeatedly in code storeroom
※4) Press [OK] to conclude the coding function, the coding blocks are kept in the system temporarily, and they can only be recorded together with the practical measurement point.

The settings of coding record in "Settings" or "Main settings" are "save before and save after", here explain separately as follows:

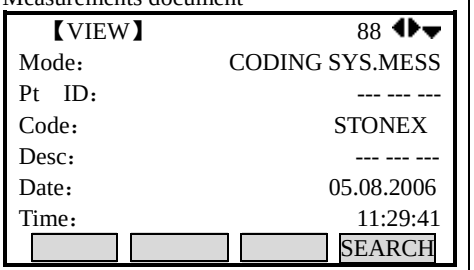
save before: to save coding data before practical survey data
save after : to save the coding data closely after practical survey data
Please inquire in "measurements' document.

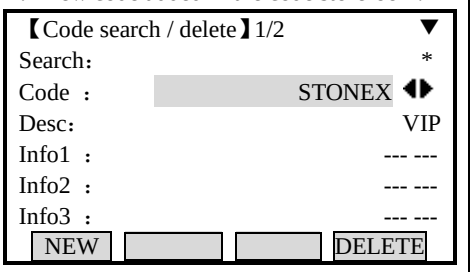
2）If the code does not exist in code storeroom, input each item of coding attributes manually

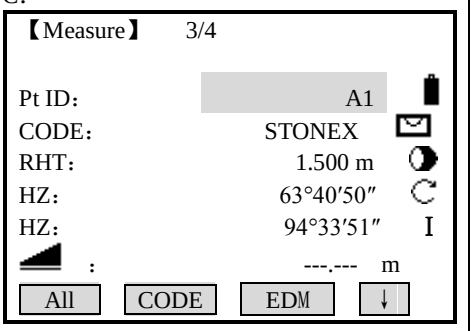
OPERATIONAL STEPS	OPERATION	DISPLAY

<table>
<tr>
<td>①Individual code blocks can be entered directly via keypad. Once an item is finished, press ENT to move the cursor to the next attribute. ※1)</td>
<td>Input the coding attributes
+
[ENT]</td>
<td> 
</td>
</tr>
<tr>
<td>②A: Press [F1](RECORD) to return to Measure function, and set the input coding as the code of the present measuring point, add a new coding datum to Measurements document ※2)

B: Press [F2] (ADD). Besides returning to measure function and setting the input code as the code of present measuring point, a new code will also be added to the code storeroom. ※3)

C: Press [F4] (OK) only to set the input code as the code of present measuring pointID and return to measure function. Only by starting surveying can the input coding be saved into Measurements documents along with measuring operations. ※4)</td>
<td></td>
<td>A : The code data being added to Measurements document
 

B: New code added in the code storeroom:
 

C:
 
</td>
</tr>
</table>

※1)Press [PAGE] to edit /view the other pages of the coding attributes
※2)The added coding datum can be seen in Measurements of File Management.
※3)The added coding can be found in the code storeroom.
※4)Press [OK] to conclude the coding function, the coding blocks are kept in the system temporarily, and they can only be recorded together with the practical measurement point.

The settings of coding record in "Settings" or "Main settings" are: save before and save after, here explain separately as follows:

save before: to save coding data before practical survey data

save after : to save the coding data closely after practical survey data

Please inquire in "Measurements" document.

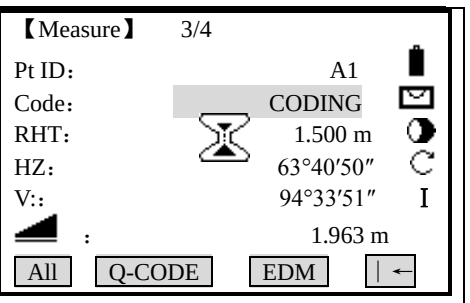
3.3.5 Quick Code

Using the quick code function, a predefined code can be called up directly via numeric keypad on the instrument. The code is selected by entering a two digit number, the measurement is triggered and the measured data and code saved.

A total of 100 codes can be assigned; you may create codes with “Codelist Manager” provided by STONEX Company, and transfer to the instrument. Each code can be assigned a unique one or two digit number in the “Codelist Manager”.

If no numbers are 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.

<table>
<tr><th>OPERATIONAL STEPS</th><th>OPERATION</th><th>DISPLAY</th></tr>
<tr><td>①Collimate the prism center of the target point, and input pointID and prism height, press[PAGE] to display measure page of 3/4，press [F4](↓) to display the third page soft key</td><td>Collimate to the target point + Input PtID, RHT + [PAGE] + [F4]</td><td>【Measure】 3/4
Pt ID: A1
Code : --- --- CODING
RHT: 1.500 m
HZ: 63°40′50″
V: 94°33′51″
: ---.--- m
All DIST RECORD ↓
All CODE EDM ↓
All Q-CODE EDM ←</td></tr>
<tr><td>②Press [F2](Q-CODE) to start quick code function. Screen prompts ‘Q-code active!’ and then return to measure page of 3/4.
Press [F2] again, and shut Q-CODE function.</td><td>[F2]</td><td>Q-code active!</td></tr>
<tr><td>③ The serial number of the input quick coding in internal memory is a 2 digit number. ※1)</td><td>Input the serial number of Q-CODE</td><td>【Measure】 3/4
Pt ID: A1
Code : --- --- CODING
RHT: 1.500 m
HZ: 63°40′50″
V: 94°33′51″
: ---.--- m
All Q-CODE EDM ←</td></tr>
</table>

④Procedure starts code searching to search the quick coding in internal memory. If find the quick coding corresponding to the code, then the survey function will start, and the survey result and quick coding will be displayed as this survey is finished. If the quick coding corresponding to the code doesn't exist in internal memory or the code quantity in internal memory is smaller than the code, it will display "Code no Exist!" ※2)		

※1)Even if only 1digit is dispatched to the coding in "code block manager", 2 digit numeric code should be inputted. E.g.: 4->Input 04
※2)If the code is input on the instrument, or the code has not been dispatched a quick code in "code block manager", the code will be numbered in its save sequence, therefore, as the input quick code is bigger than the total number of codes, the program will prompt "Code no Exist!"

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. (See 4.4 "Main Settings")

Several functions:

Light ON/OFF

Switches display light on/off.

Units

Display the current distance and angle unit. Pressing ◄ or ► can change the units. After one setting is finished, move to the next by pressing ▼ or ▲. When all settings are done, press [SET] to save and return.

Free-Coding

Select codes from the code list or enter a new code.

4.1 LEVELING

As the tilt sensor is activated, automatic correction of vertical angle for unlevelment is displayed.
To ensure a precise angle measurement, tilt sensor must be activated (See 4.4 Main Settings), and the display can be used to fine level the instrument.
If the instrument hasn't been leveled roughly, the screen displays that the instrument is out of the automatic correction range, and that it needs to be leveled manually. Please refer to "2.2 Instrument Setup" for detailed leveling instruction.

STONEX R2 Total Station compensates the vertical angle reading due to inclination of the vertical axis in the X directions.

OPERATION STEPS

OPERATION STEPS	OPERATION	DISPLAY
①Press FUNC to enter into the routine function Menu, then press F1 (Level), then enter the Tilt adjust screen. Then press PAGE to find the value, if the value is within ±3′, it indicates that it is with the designed range of automatic tilt correction. Press [F4] to return to Measure menu. If the value exceeds ±3′, manual leveling is a must.	[F1]	【Tilt Adjust】 F1 Level F2 Target Offset F3 Delete Last Record F4 Main setting F1 F2 F3 F4 【Tilt Adjust】 X：-0°10′21″ Y：-0°07′08″ BACK
②If the instrument hasn't been leveled precisely, rotate the tribrach screws and level the instrument according to the value's changing displayed in the screen.		【Tilt Adjust】 X：-0°00′21″ Y：-0°00′08″ BACK
③After leveling, press [F4] to return to Measure menu.		

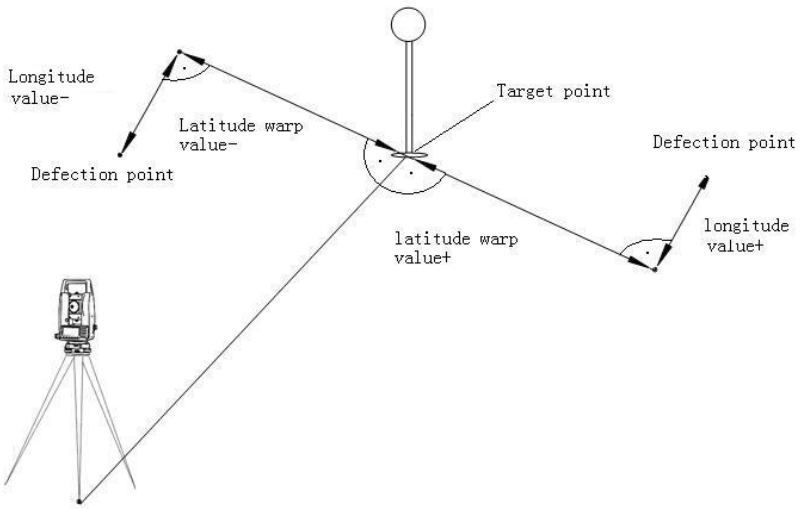
When the instrument is placed on an unstable stage or in a windy weather condition,

the display of vertical angle is unstable. You can switch off the auto tilt correction function of vertical angle.

☞ If the mode of auto correction has been activated, (single axis, see "4.4 Main Settings"), in the condition that the instrument has not been leveled, the program will demand that the instrument 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 perform helpfully. Enter the offset values (length, cross and/or height offset). The values for the angle and distances can be calculated directly for the target point.

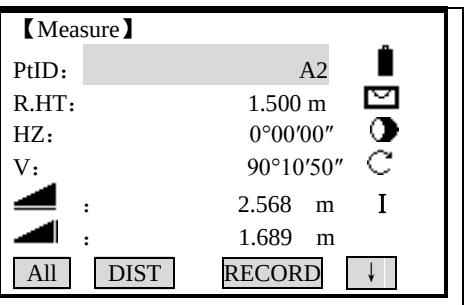
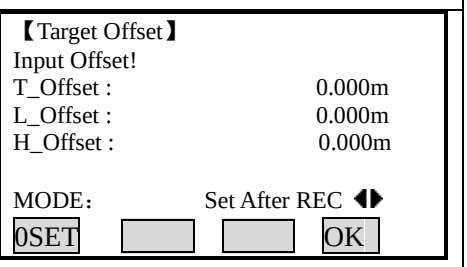


☞ If the height offset value is plus, it indicates that the offset point is higher than the measurement point.

OPERATION STEPS:

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [FNC] to enter into the Function menu.	FNC	【Function】1/4 ▼ F1 Level (1) F2 Target Offset (2) F3 Delete Last Record (3) F4 Main Settings (4) F1 F2 F3 F4

②Press [F2] to enter into Target Offset function. Input the offset values (length, cross and/ or height offset values).Define the period for which the offset is to apply. Press [F1] (OSET) to set eccentricity to zero. Press [F4] to confirm.	[F2] + Input offset values, period of applicability +[ENT] +[F4]	【Target Offset】 Input Offset! T_Offset : 0.000m L_Offset : 0.000m H_Offset : 0.000m MODE: 0set After REC◀▶ 0SET [ ] [ ] OK
③ Press navigation key ◀ ▶ to select the period of applicability. The modes available are: 0Set After REC and Permanent. After finishing all the settings, press [F4] to save.	◀ ▶ + [F4]	【Target Offset】 Input Offset! T_Offset : 0.000m L_Offset : 0.000m H_Offset : 0.000m MODE: 0set After REC◀▶ 0SET [ ] [ ] OK
④ The program calculates the corrected values and returns to the application from which the offset function was started. Collimate the center of reflector and press [F2] to start measuring. ※1)	[F2]	【Measure】 1/4 PtID: A2 R.HT: 1.500 m HZ: 0°00′00″ V: 90°10′50″ : ---.--- m : ---.--- m All DIST RECORD ↓
⑤The corrected angle and distances are displayed when a valid distance measurement has been triggered or exists.		【Measure】 PtID: A2 R.HT: 1.500 m HZ: 0°00′00″ V : 90°10′50″ : 5.568 m : 3.689 m All DIST RECORD ↓
⑥When "0set After REC" is selected: If [All] is started, the program will display the data (the target point) which is calculated by adding the measured result and the offset correction. If [DIST] is started, you must restart measurement after pressing [RECORD] to display the actual value of the measurement point.		Displays the Rec. data beforehand. 【Measure】 PtID: A2 R.HT: 1.500 m HZ: 0°00′00″ V: 90°10′50″ : 5.568 m : 3.689 m All DIST RECORD ↓ Restart measurement, displaying the data of measurement point:

When the "Permanent" is selected, the program will always display the data added the offset correction.		
⑦ If there is no more point of target offset to measure, repeat step ① to restart the Target Offset function.		
※1) If the coordinate of target point is needed to calculate, please set the coordinate of station, heights of instrument and reflector, backsight point, etc.		

The period of applicability can be set as follows:

MODE	EXPLANATION
0set After REC	The offset values are set to 0 after the point is saved.
Permanent	The offset values are applied to all further measurements.

The offset values are always reset to 0 when the application is quit.

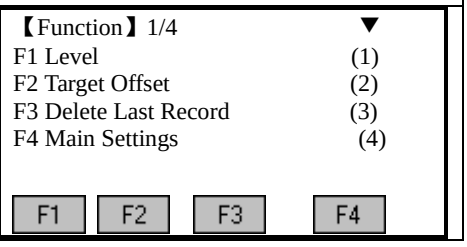
4.3 DELETING LAST RECORD

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 records recorded during measurement can be deleted.

OPERATION STEPS:

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [FNC] to enter into the Function menu.	FNC	

②Press [F3] to delete the last record, as shown on the right.	[F3]	Sure delete final record? CANCEL OK
③Press [F4] to confirm the deleting. If not, press [F1] (CANCEL), the program will return to Measure function.		【Measure】 P + ID: A2 R.HT: 1.500 m HZ: 0°00′00″ V: 90°10′50″ : ---.--- m : ---.--- m All DIST RECORD ↓

4.4 MAIN SETTINGS

This menu enables extensive user-specific settings in order to adapt the instrument to their own requirements.

You can rewrite some important settings.

☞ You can also start this function by selecting “Settings” in “Menu”.

OPERATION STEPS：

OPERATIONAL STEPS	OPERATION	DISPLY
① Press [FNC] to enter into the Function menu and select “Main Settings”, or press [MENU] and select “Settings”.	FNC	【Function】1/4 ▼ F1 Level (1) F2 Target Offset (2) F3 Delete Last Record (3) F4 Main Settings (4) F1 F2 F3 F4
②Press [F4] to enter into Settings function.	[F4]	【Setting】1/4 ▼ Contrast: 4 TriggerKey: OFF User Key: Light V-Setting: Zenith Tilt Crn: OFF Coll. Crn: OFF SET

③Press navigation key ◄ ► to select other modes of this setting, and press [ENT] or ▼ to move on to the next setting. ※1)	◄ ► + [ENT] or ▼	【Setting】1/4 ▼ CONTRAST: 4 ◄► TriggerKey OFF ◄► User Key Light ◄► V SETTING Zenith ◄► Tilt Grn : OFF ◄► Coll. Crn : OFF ◄► SET
④Press [PAGE] to display other pages. Repeat step ③ on other items to be set.	PAGE	【Setting】2/4 ▼ Sector Beep: OFF ◄► Beep : OFF ◄► HZ<=> Right Angle ◄► Face Def. VK-Left ◄► Data Output : Intern ◄► Auto-Off : ON ◄► SET
		【Setting】3/4 ▼ AngReading: 0°00′01″ ◄► Angle Unit : dd.mm.ss ◄► DistReading: 1mm ◄► Dist. Unit: Meter ◄► Tenp. Unit : C ◄► Press Unit hPa ◄► SET
		【Setting】4/4 ▲ GSI 8/16 : GSI 16 ◄► Mask 1/2 : Mask 2 ◄► Coord Mask: X/N Y/E ◄► NEH/ENH: NEH ◄► Code Rec.: Save before ◄► SET
⑤After all settings are done, press [F4] (SET) to save, and quit the Settings menu.		

※1) Press ▲ ▼ to move the cursor upward and downward; press ◄ ► to select other modes in the item.

※2)▲,▼,▲▼ indicate that there are some pages to select by pressing [PAGE].

Detailed instruction to the Settings is shown as follow.

FUNCTION	OPTION	EXPLANATION
Contrast	1～8	Setting the display contrast in 10% steps. Customers can adjust the display to best status through this function.

TriggerKey	All/ Dist/OFF	The trigger key is right above the Power Key. OFF Trigger key deactivated. All Trigger key with same function as the [All] key. Dist Trigger key with same function as the [Dist] key.
User Key	Light/Level/HT Transfer/Offset/ Code/Dist.Unit/ Angle Unit/ Hidden Pt/Delete Rec./ Tracking/Check Tie/ Settings	One function from the Function menu. Customers can designate the [USER] key according the using frequency and habit.
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.	1- axis / OFF	• OFF： Tilt compensation is switched off. • 1-axis V-angle relate to the plumb line. If the instrument is set on an unstable base (e.g. shaking platform, ship, etc.) the compensator should be switched off. This avoids the compensator drifting out of its measuring range and interrupting the measuring process by indicating an error. The compensator setting remains active even after the instrument is switched off.
Coll Crn.	ON/OFF	• ON : HZ Collimation is switched on. • OFF: HZ Collimation is switched off. If option "Coll Crn." is active, each measured HZ angle is corrected. For normal operation, the HZ Collimation remains switched on. See "10. Check and Adjust" for detailed instruction.
Sector Beep	ON/OFF	• ON: Sector Beep sounds at right angles (0°, 90°, 180°, 270°, or 0, 100, 200, 300 gon) • OFF: Sector Beep is switched off.

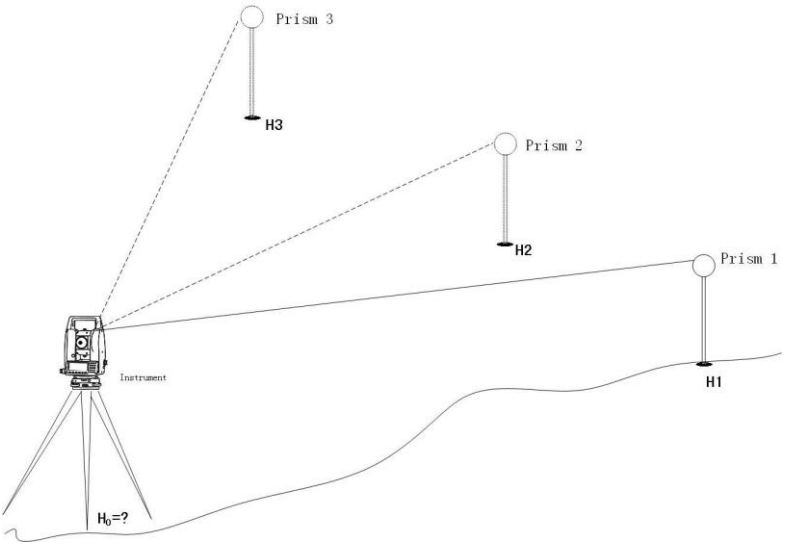
Beep	ON/OFF	The beep is an acoustic signal after each key stroke. ON: Beep switched on. OFF: Beep switched off.
HZ <=>	Right Ang / Left Ang	HZ Incrementation Direction: Right Ang: Set right HZ for "clockwise direction measurement". Left Ang: Set left HZ for "Counter-clock direction measurement".
Face 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. With this aim, 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 ≤3'/±600cc). •OFF: The instrument is switched on permanently. Battery discharges quicker.
Min Reading		The displayed angle format can be selected in three grades. • For 360 ° ′ ″: 0 ′00″01″/0 ′00″05″/0 ′00″10″ • For 360 ᵍ: 0.0001 ᵍ0.005 ᵍ0.0010 ° • 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:0 ~359.9999 ° • 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/in Hg	• 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 (see "3.3.4 Coding")
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

4.5 HEIGHT TRANSFER

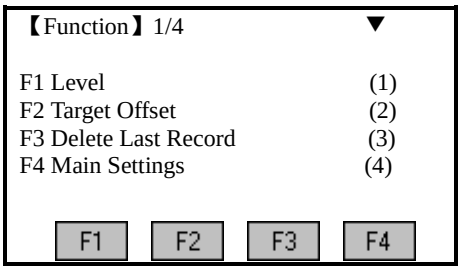
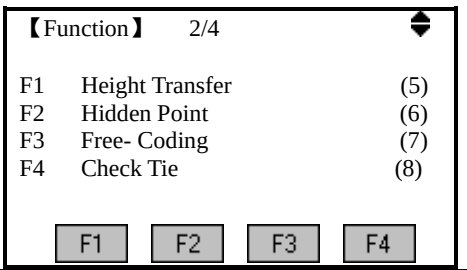
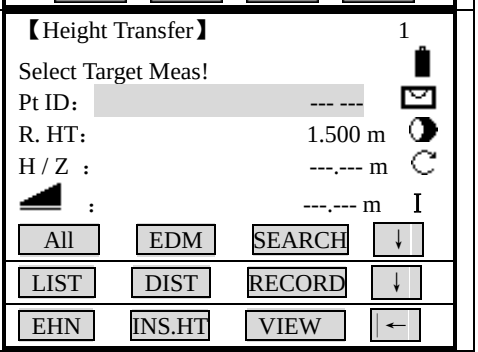
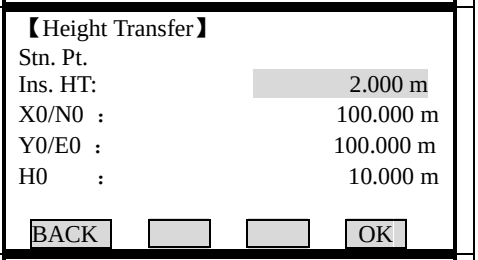
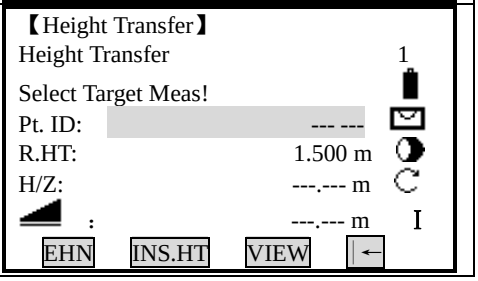
This function determines the height of the instrument from measurements to a maximum of 5 target points with known heights, in two faces.

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



OPERATION STEPS：

OPERATIONAL STEPS	OPERATION	DISPLAY

① Press [FNC] to enter into the Function menu. Press [PAGE] to turn to Page 2.	FNC + PAGE	 
② Press [F1] to enter into Height Transfer function.	[F1]	
③Press [F4](↓) twice to display the third page of soft keys. Press [F2] to enter into the settings of instrument height.	[F4] + [F4] + [F2]	
④ Input the current instrument height, and press [F4] to return to the screen of Height Transfer.	Input instrument height + [F4]	

⑤Select the known point and input the reflector height.

The amount of known points is shown on the upper-left corner of the screen.

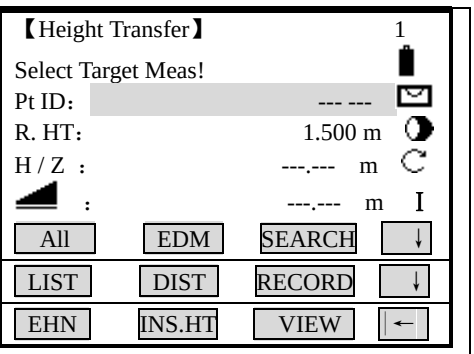
There are 3 ways to select known points.

A：Press [LIST], and press navigation key ▲▼ to call up the needed point from the job. Press [ENT] to return to the screen of Height Transfer measurement.

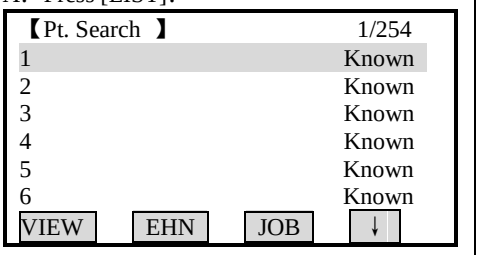
B：Input the known point ID and press [SEARCH] to search whether there is such a point ID in the job. Be there some points with the same ID, press ▲▼ to select the point needed.
Press [ENT] to return to the screen of Height Transfer measurement.

C：You may also input a point ID which does not exist, and press [ENH]. Then input the height of the point, save the data and return to the screen of Height Transfer measurement.

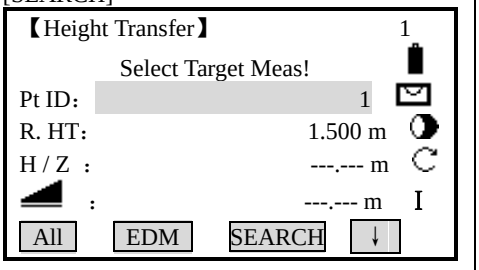
[F1]
Input known point, prism height

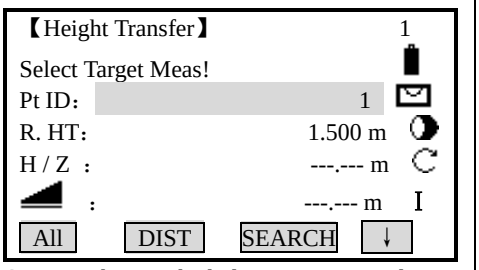


A：Press [LIST]：

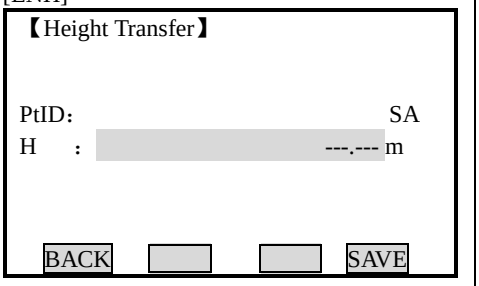


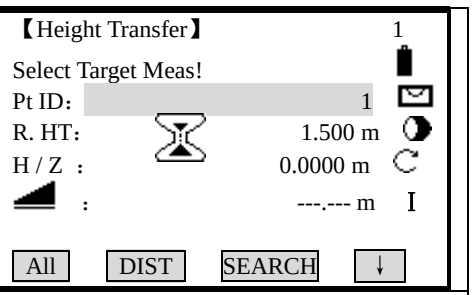
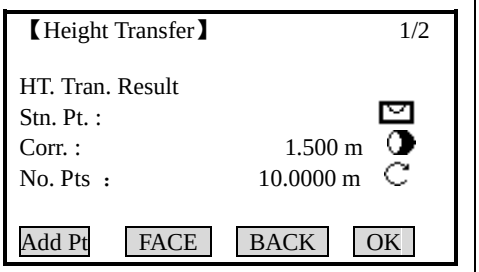
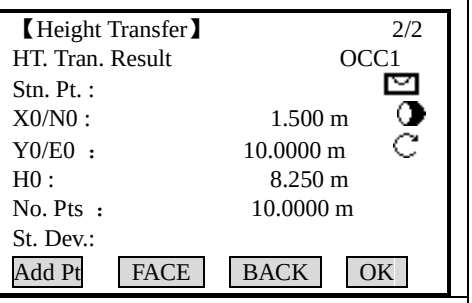
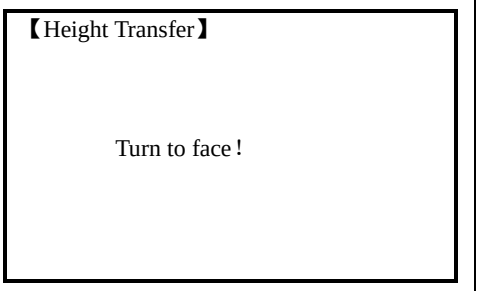
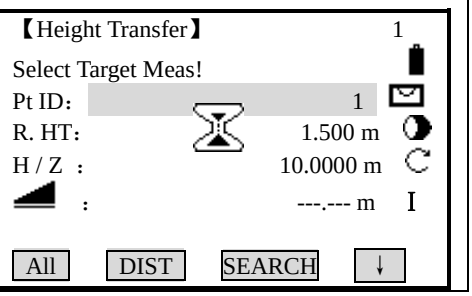
B：Input point ID to the known point, press [SEARCH]





C：Input the ID which does not exist, and press [ENH]

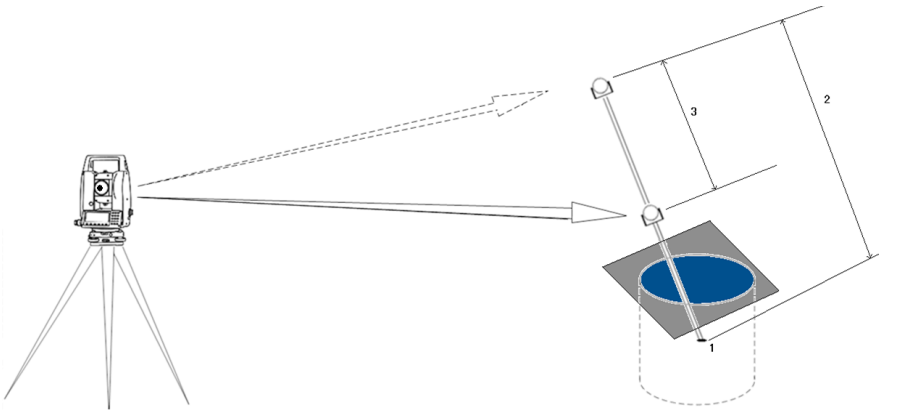


⑥When the screen displays the height of known point, press [F1](All) or [F2](DIST) + [F3](RECORD) to start measuring. The height of station can be calculated.	[F1] Or [F2] + [F3]	
⑦ Press PAGE to turn to Page 2 to display the measurement result.	PAGE	 
⑧Press [F2] (FACE) to measure the same target in second face. If you don't need to face measure the same point, press [F1] (Add Pt) to add a measurement of the known point.	[F2]	 

⑨After the Face measurement, return to the result menu, and press [F1](Add Pt), follow the steps ⑤ ~ ⑧ to continue the measurement of the next known point.	[F1]	【Height Transfer】 1 Select Target Meas! Pt ID: 1 R. HT: 1.500 m H / Z : 10.0000 m : ---.--- m All DIST SEARCH ↓
⑩ This function provides the measurement of a maximum of 5 target points in two faces. After all measurements are completed, press [F4] to confirm the result in the menu of Height Transfer.	[F4]	【HT-Tran. Result】 1/2 ▼ HT. Tran. Result OCC1 Stn. Pt. : H0 : 8.250 m Corr. : No. Pts : 10.0000 m AddPt FACE BACK OK
⑾ [F1](BACK): Back to Height Transfer Result menu. [F2](OLD): Remains the previous station height. [F3](AVE): the average value of the old and new value of station height to set the station height. [F4](NEW): Takes the value calculated in the program as the station height.		【H0 Exist】 Stn. Pt. : Old H0 : New H0 : △H0 : 8.250 m BACK OLD AVE NEW

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

OPERATIONAL STEPS	OPEATION	DISPLAY
① Press [FNC] to enter into the Function menu. Press [PAGE] to turn to Page 2.	[FNC] + [PAGE]	【Function】 2/4 F1 Height Transform (5) F2 Hidden Point (6) F3 Free-Coding (7) F4 Check Tie (8) F1 F2 F3 F4
②Press [F2] to enter into the Hidden Point function.	[F2]	【Hidden Point】 Meas first prism! PtID: ---.--- HZ: 0°00′00″ V: 87°40′00″ : ---.--- m Mem. All DIST RECORD RDD/ED
③ Press [F4] (ROD/ED) to set the total length of the rod, the distance between R1 and R2, and the measurement toleration ※ 1). After entering one setting, press [ENT] to move to the next item. Press [F4] to return to Hidden Point menu after finishing all the settings.	[F4]	【Rod Length Settings】 Rod Length: ---.--- Dist R1-R2: ---.--- Meas. Tol : ---.--- OK
④ Enter the point ID of the first reflector, collimate the reflector and press [F1](All) or [F2] (DIST) + [F3](RECORD) to start measurement.	Input PtID1 + [F1] Or[F2] + [F3]	【Hidden Point】 Meas first prism! Pt. ID: 1 HZ: 0°00′00″ V : 87°40′00″ : ---.--- m Mem. All DIST SEARCH ROD/ED
⑤ Enter the point ID of the second reflector, collimate the reflector and press [F1](All) or [F2] (DIST) + [F3](RECORD) to start measurement.	Input PtID2 + [F1] Or[F2] + [F3]	【Hidden Point】 Meas second prism! Pt. ID: 1 HZ: 0°00′00″ V : 87°40′00″ : ---.--- m Mem. All DIST SEARCH ROD/ED

⑥Displays the result. If the result is unsatisfied, press [F4] to repeat step ④ to redo the measurement. Press [F1] (FINISH) to save the result, and to quit this function.	[F1]	【Hidden Point】 Pt. ID: 1 Desc. : --- --- X/N : 102.205 m Y/E : 98.021 m H/Z : 96.247 m FINISH REMEAS
⑦ If the result exceed the measurement tolerance value, it will display the Over Limit. Press [F1]: Accepts the limit, and displays the coordinate of hidden point. [F4]:Return to step ② to redo the measurement.		【Hidden Point】 Over Limit! Limit: 0.100 m Diff. : 0.247 m ACCEPT REMEAS

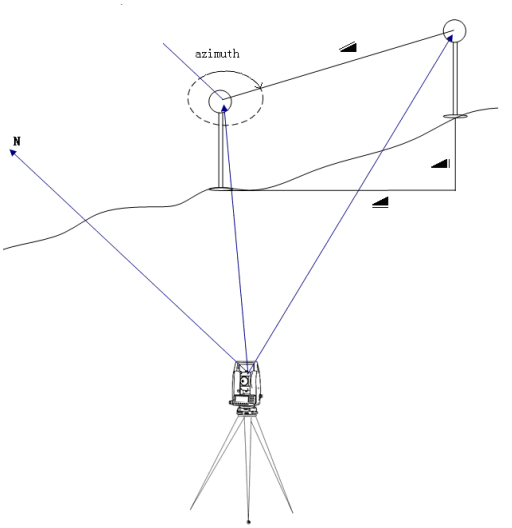
※1) Rod Length: Total length of hidden-point rod.

Dist R1-R2: Spacing between the centers of reflector R1 and R2.

Meas. Tol: Limit of the difference between the given and measured spacing of the reflectors. If the tolerance value is exceeded, the program will prompt a warning.

4.7 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.



OPERATIONAL STEPS	OPEARTION	DISPLAY
① In Measure menu, measure 2 points that are used to check tie. ※1)		【Measure】 1/4 Pt ID: 1 R. HT: 1.500 m H / Z : 10.0000 m : ---.--- m All DIST SEARCH ↓
② After finishing measuring these 2 points, press soft key [FNC] to enter into the Function menu. Then press [PAGE] to turn to Page 2.	[FNC] + [PAGE]	【Function】1/4 F1 Level (1) F2 Target Offset (2) F3 Delete Last Record (3) F4 Main Settings (4) F1 F2 F3 F4 【Function】2/4 F1 Height Transfer (5) F2 Hidden Point (6) F3 Free- Coding (7) F4 Check Tie (8) F1 F2 F3 F4
③ Press [F4] to enter into Check Tie menu. The screen displays the AZ of 2 points, and the relations of the HD, SD and VD.	[F4]	【Check Tie】1/2 AZ: 186°28′36″ Grade: 9.0% △: 4.298 m △: 4.316 m △: 0.396 m OK
④Press [PAGE] to turn to Page 2.	PAGE	【Check Tie】2/2 AZ: 186°28′36″ Grade: 9.0% △X/N: -0.466 m △Y/E: - 4.316 m △H: 0.396 m OK
⑤ Press [F4] (OK) to return to Measure menu.	[F4]	【Measure】 1/4 Pt ID: 1 R. HT: 1.500 m H / Z : 10.0000 m : ---.--- m : 4.316 m All DIST SEARCH ↓
※1) Meaning: The values cannot be calculated as there is less than 2 valid measurements.		

4.8 TRACKING

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

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press soft key [FNC] to enter into Function menu. Press [PAGE] twice to turn to Page 3.	FNC + PAGE	【 FUNCTION 】 3/4 F1 EDM Tracking (9) F2 Light ON/OFF (0) F3 Laser Pointer On/Off F1 F2 F3
② Press [F1] to activate tracking function. Screen displays as the right picture. To deactivate tracking function, just enter into Function menu and press [F1] that sets the EDM Tracking again.		Open Tracking Mode !

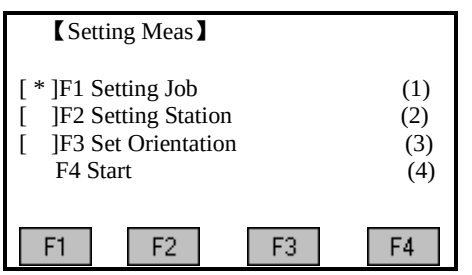
Every time when pressing the soft key that sets EDM Tracking function, the measurement mode will switch between Fine [s] and Tracking.

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

5. PROGRAMS

APPLICATION PRE-SETTINGS

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



[*]: Settings made.

[ ]: Settings not made.

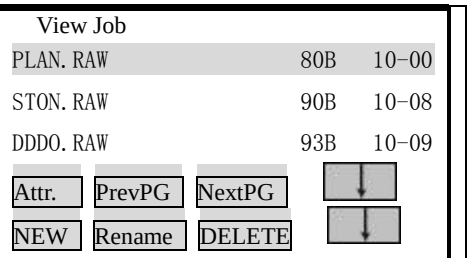
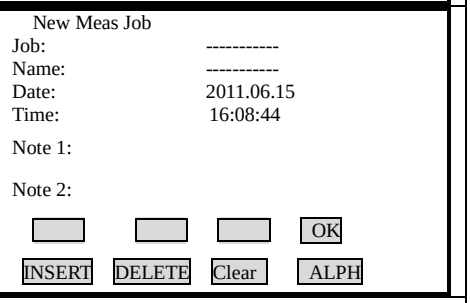
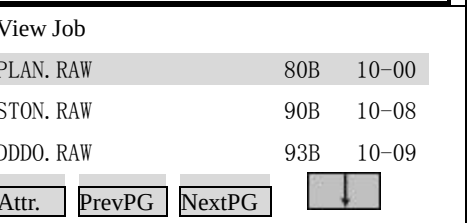
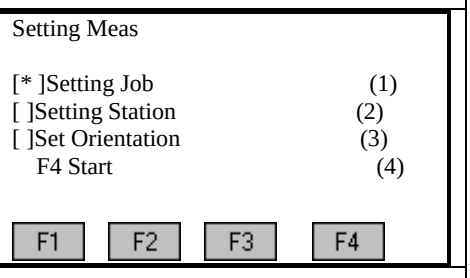
Find further information about individual start-up programs on the subsequent pages!

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.

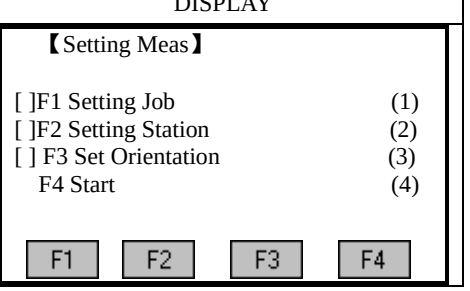
5.1.1 Setting a New Job

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F1] in Setting Meas menu to enter into Setting Job menu.	[F1]	Setting Meas [*]Setting Job (1) [*]Setting Station (2) [*]Set Orientation (3) F4 Start (4) F1 F2 F3 F4
②Press [F1](LIST) to set a new job. Press [OK] to set this job, and return to start-up program.	[F1]	Setting Job Job : DEFAULT Name : -- -- Date : 2011.06.30 Time : 14:10:20 Note 1 : Note 2 : LIST OK
③Press up▲ and down▼ cursor keys to select the disk where you want to create the file. Press [F4] (confirmed). Disk: A local disk Disk: B the SD card carried by the removable disk (if the disk partition has enough space, it will show C / D ... disk, does not support Chinese file name and the Chinese directory)（If SD card is installed，“Disk：B ”will show here）	▲▼ [F4]	View job Disk：A Disk：B Attr. Format OK

④Display file list, press [F4] (P1 ↓) to show the second page of features. Press [F1] (new), create a working file.）	[F4]	
⑤Enter job name, and operator name and so on. After entering one item，press ENT to move the cursor to the next item to be edited.		
⑥Finish inputting, press [F4] (OK) to save job, then create the file successfully. And return to view job. Press ▲▼ to select the file name created just now, and then press [ENT] to set it as current job. In front of the item finished setting, there will be a"*".)		 
※1) The establishment date and time will be added to the system automatically.		

5.1.2 Calling up a Job from Internal Memory

When there is existed job in internal memory, you can call up and set it as the current job.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F1] in the Setting Meas menu to enter into Setting Job function.	[F1]	

②Press [F1] (list) into the disk list. ※ 1) Disk: A local disk Disk: B insert the SD card (if the disk partition has enough space, it will show C / D ... disk, does not support Chinese file name and the Chinese directory) Press [F4] (OK) to enter the disk where the job to be called.)	[F1] + [F4]	View job Disk:A Disk:B Attr. Format OK
③Press navigation key(▲▼) to view all the jobs in internal memory. When selecting the needed job, press [F4] (ENT) to set it as the current job, and then back to the job setting interface.	▲▼ + [F4]	View Job PLAN.RAW 80B 10-00 STON.RAW 90B 10-08 DDDO.RAW 93B 10-09 Attr. PrevPG NextPG ↓
④ Screen displays "Job set ready!" Return to Setting Meas. The project will be set in front of "*" logo The screen displays “Job set already!” and returns to Setting Meas menu. In front of the item finished setting, there will be a"*".		【Setting Meas】 [*] F1 Setting Job (1) [ ] F2 Setting Station (2) [ ] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
Note: It is forbidden to disconnect the SD card during the process of files in it, otherwise，it may lead to data loss or damage.		

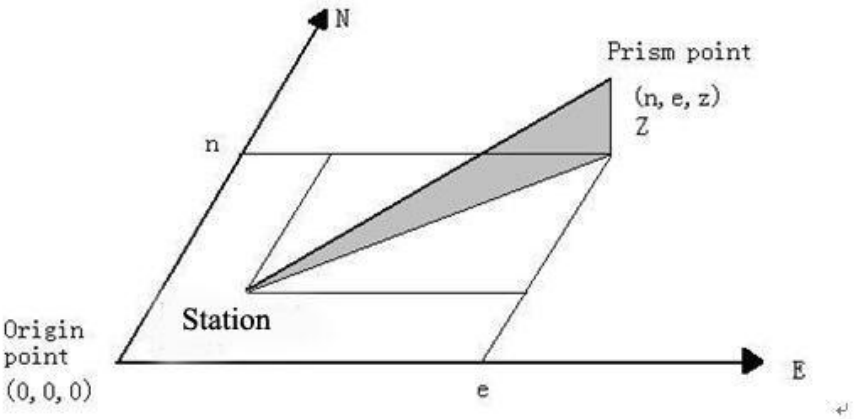
All subsequent recorded data is stored in the current job.

If no job was defined and an application was started or if in “Measure” [All] or [REC] was triggered, then the system automatically creates a new job and names it “DEFAULT”.

5.2 SETTING STATION

Each coordinate computation relates to the currently set station.

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



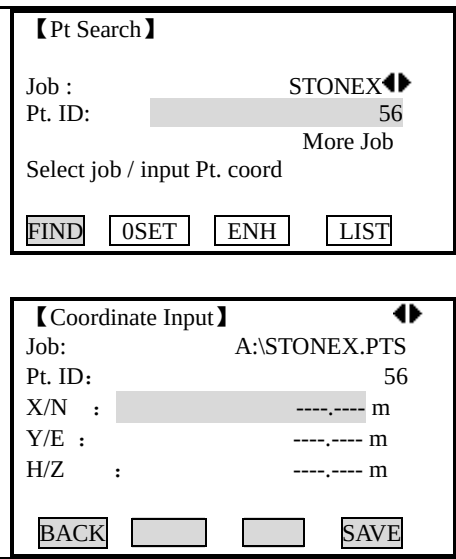
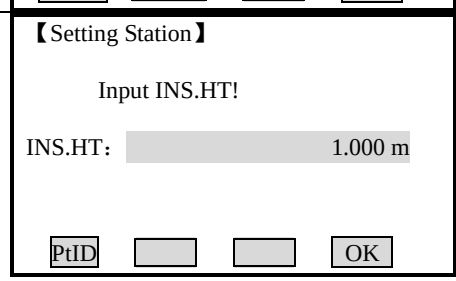
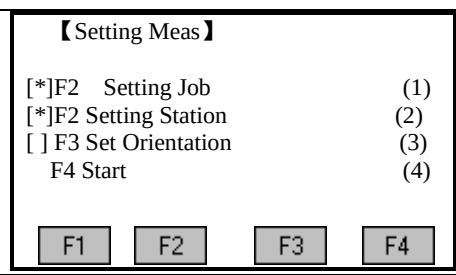
5.2.1 Calling up a Job from Internal Memory-[SEARCH]

STEPS: 1. Select a PtID stored in internal memory.

2. Input instrument height.

[OK] Sets the station.

OPERATIONAL STEPS	OERATION	DISPLAY
①Press [F2] in Setting Meas menu to enter into Setting Station menu.	[F2]	【Setting Meas】 [*] F1 Setting Job (1) [ ] F2 Setting Station (2) [ ] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
② Enter the PtID of known point and press [ENT].※1)	Input PtID + [ENT]	【Setting Station】 Input Station Pt. ID! Stn Pt: SEARCH LIST ENH
③Press[F1](SEARCH): A：If the PtID exists in the job, the screen will display as the right picture. If there are several points, the program will list them separately. B：If the input PtID does not exist, the program will imply "PtID No Exist!", and then display Coordinate Input menu.		A: 【Pt Search】 4 12 Known 12 Meas. 12 Meas. 12 Meas. SEARCH ENH JOB OK B:

You can call up PtID from other jobs to set as the station. Press [F1] (SEARCH). If the point is found, press [OK] in Pt Search menu to set it as the station and set the instrument height. If the point does not exist, press [F3] (ENH) to input the coordinate. [0SET]: Quickly set the coordinate of the point to zero and set it as the station. [ENH]: Displays the Coordinate Input menu. Input the coordinate and save it in the job.		
④ The program implies to input the instrument height. Press [ENT] to confirm, and press [F4] to save it and set it as the station. [PtID]: Return to previous dialog. And set station point.	[F4] Input instrument height + [ENT] [F4]	
⑤ Returns to Setting Meas menu. Settings that are made will display "*" in the front.		
※1)For more information about point search, please refer to "2.8 Point Search". You can also search via wildcard "*". See "2.9 Wildcard Search".		

5.2.2 Calling up Known Point in Internal Memory-[LIST]

In terms of setting station PtID, you can also call it up directly from internal memory without inserting.

②In Setting Station menu, press [F2] (LIST)	[F2]	Setting Station Input Station PtID! Stn Pt: --- --- --- SEARCH LIST ENH
③ Data of all known points and measured points will be displayed.		【Point Search】 12 Known 12 Meas. 12 Meas. 12 Meas. VIEW ENH JOB OK
④Press navigation key ▲▼ to select the needed point. VIEW: to view the coordinate information of the point. ENH: to input coordinate data in the job. JOB: to select data from other job.	▲▼	VIEW : 【Pt Search Coord View】 Pt. ID: 56 X /N: 155.301m Y/E: 152.361m H/Z: 129.569m Date: 2011.06.17 Time: 14:52:06 Start Last OK ENH: Coord Input Job A:\1.PTS Pt. ID: ----.---- * X/N : ----.---- m Y /E : ----.---- m H/E : ----.---- m BACK Save JOB: 【Point Search】 Job : 1 Pt. ID: * More Job Select job / input Pt Coord FIND 0SET ENH LIST
⑤ After selecting the needed point, press [F4] (OK) to enter into INS.Ht inserting menu.	[F4] Input instrument height +[ENT] [F4]	Setting Station Input INS.HT! INS.Ht: 1.000 m PtID OK

5.2.3 Inputting Coordinate Manually

STEPS: 1.Press [ENH] to display the Input Coordinate menu.

2. Input PtID and coordinate.

3. Press [SAVE] to save the station coordinate. Then input instrument height.

If no station was set or no application started and if in "Measure" [All] or [REC] was activated, then the last station is set as the current station.

OPERATONAL STEPS	OPERATION	DISPLAY
① Press [F3] (ENH) in Setting Station menu.	[F3]	Setting Station Input Station Pt. ID! StnPt: ----.---- SEARCH LIST ENH . .
② Input PtID and coordinate. After finishing one setting, press [ENT] to move on to the next item.	Input PtID and coordinate + [ENT]	【Coordinate Input】 Job : STONEX Pt. ID : OCC1 X/N : 100.000 m Y /E : 100.000 m H/Z : ----.---- m 01 INSERT DELETE CLEAR
③Press [F4] to save station coordinate.	[F4]	【Setting Station】 Job : STONEX Pt. ID: OCC1 X/N : 100.000 m Y /E : 100.000 m H : 0.000m BACK SAVE
④ When the screen displays "Data Save!", input the instrument height and press [ENT].	Input instrument height + [ENT]	Setting Station Input INS.HT ! INS.HT: 1.000 m PtID OK
⑤The screen returns to Setting Meas menu. Settings that are made will display "*" in the front.		【Setting Meas】 [*]F1 Setting Job (1) [*]F2 Setting Station (2) [ ] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4

5.3 SETTING ORIENTATION

With the orientation, HZ-direction can be input manually or set by points with

known coordinates.

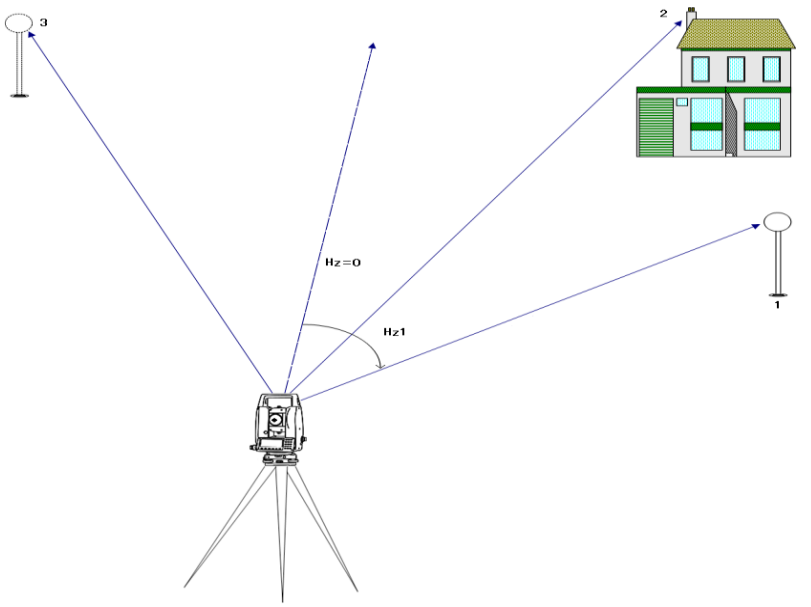
5.3.1 Manually Inputting

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.
4. Press [RECORD] to record HZ-direction and set orientation.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F3] in Setting Meas menu to set the orientation.	[F3]	Setting Meas [*]F1 Setting Job (1) [*] F2 Setting Station (2) [ ] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
② Press [F1] to enter into Set Manually function.	[F1]	Orientation F1 Set manually F2 Known Point F1 F2
③ After Collimating the backsight point, input a random AZ value, reflector height and PtID. After inputting one item, press [ENT].	Input horizontal azimuth value + [ENT]	【Set manually 】 BsPt: 2 R.HT: 1.500 m AZ: 9°11′25″ Sight BsPt Meas & Rec! All EDM SET. OSET
④ Press [F1] (All) to start measurement and set orientation. [SET] ： Set orientation without activating the measurement function. [0SET]：Set AZ to zero.	[F1]	【Set Manually 】 BsPt: 2 R.HT: 1.500m AZ: 9°11′25″ Sight BsPt Meas & Rec! All SET EDM OSET
⑤ The screen returns to Setting Meas menu. Settings that are made will display "*" in the front.		【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. The number of known points can be one or more. This series of instrument provides a method of backsight point orientation with a maximum of 5 known points.

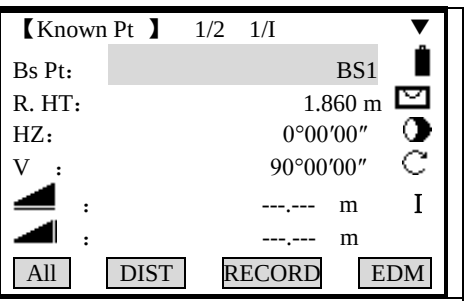
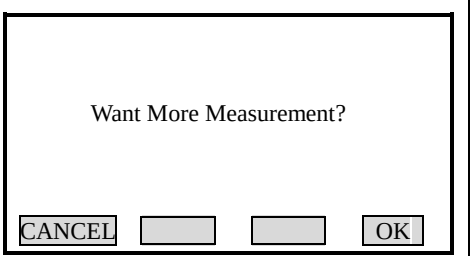
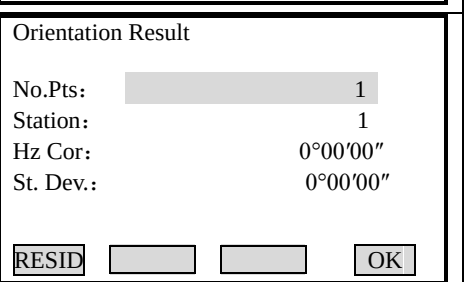


In the picture, 1: Backsight Point 1
2: Back Sight Point 2
3. Backsight Point 3

STEPS ： 1. Press [F2] to activate orientation with coordinates function.
2. Input the orientation PtID and determine the point found.
3. Input and confirm the reflector height. A maximum of 5 target points with known coordinates can be used.

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

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F2] to select the method to set orientation.	[F2]	【 Orientation 】 F1 Set manually F2 Known Point F1 F2
② Input the backsight PtID and press [ENT]. If reflector height is to be input, press navigation key ▼ to move to the R.HT item. ※1)	Input backsight PtID + [ENT]	【Known Pt】 Input BsPt! BsPt ： BS1 R. HT： 1.860 m LIST ENH
③ The program automatically searches if there is an existed PtID. ※2) A：If there is a unique PtID in the job, the screen will enter into backsight measurement menu. B：If there is more than 1 point with the same ID, user is requested to select one data among them. C：If there is no such a PtID in the job, user is requested to input the data of the point.		A： 【Known Pt 】 1/2 ▼ Bs Pt： BS1 R. HT： 1.860 m HZ： 0°00′00″ V ： 90°00′00″ ： ---.--- m ： ---.--- m All DIST RECORD EDM B： 【Pt Search 】 1/3 ▼ BS1 Known 12 Meas. 23 Meas. VIEW ENH JOB OK C： 【Pt Search 】 1/3 Job : STONEX PtID: BS1 More Job Select Job / input Pt Coord. FIND 0SET ENH LIST

④ Collimate Backsight Point 1, press [F1] (All) or [F2] (DIST) to start measurement of orientation with coordinate. [EDM]: change the EDM setting.	[F1] or [F2] + [F3]	
⑤ After each measurement, you will be asked whether you want more measurement. Press [OK] to return to measurement menu and start another measurement. Press [CANCEL] to enter into Orientation Result menu. ※3)	[F1]	
⑤Displays the orientation result.		

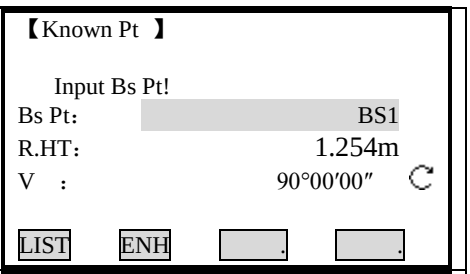
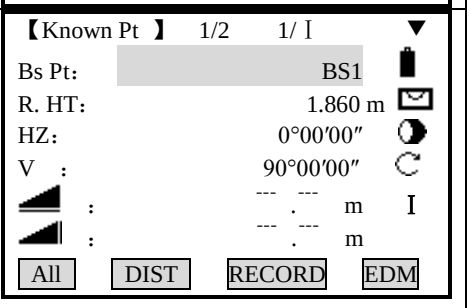
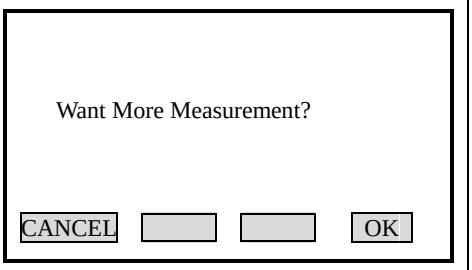
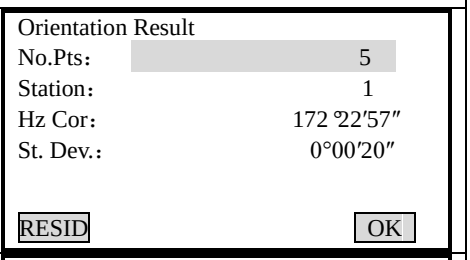
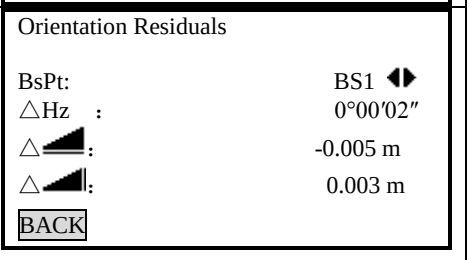
※1) Orientation coordinate can be selected directly by pressing [LIST] from the job, and can also be input by pressing [ENH]. For further information, please refer to "5.2 Setting Station"
※2) For further information about various status, please refer to "5.2 Setting Station."
※3) To start measurement in telescope position Ⅱ, press [F4] (OK). For detailed instruction about measurement in telescope position Ⅱ, refer to the following part.

In step ④ to carry on more measurement, the instrument provides backsight orientation with more points, i.e. setting the backsight orientation through several known points, in order to improve the accuracy of backsight azimuth. This series of total station system provides a backsight orientation with a maximum of 5 points.

In orientation measurement, backsight azimuth can be measured based on single face I or II, or dual face I + II.

OPERATION (Based on Face Ⅰ and Face Ⅱ**):**

OPERATIONAL STEPS	OPERATION	DISPLAY
① Input the first backsight PtID and reflector height, and press [ENT] to enter into backsight measurement function.	Input PtID + [ENT]	【Known Pt】 Input BsPt! BsPt ： BS1 R. HT： 1.860 m LIST ENH
② With Face Ⅰ, collimate on backsight point BS1, press [F1] (All) or [F2] (DIST) + [F3] (RECORD) to start orientation with coordinate measurement. Press [PAGE] to display Page 2 of backsight measurement.	[F1] or [F2] + [F3]	【Known Pt 】 1/2 1/ Bs Pt： BS1 R. HT： 1.860 m HZ： 0°00′00″ V ： 90°00′00″ ： --- .--- m ： --- .--- m All DIST RECORD EDM 【Known Pt 】 2/2 2/ Bs Pt： BS1 R. HT： 1.860 m HZ： 0°00′00″ △AZ ： --°--′--″ ： ----.---- m All DIST RECORD EDM
③ After measurement, the screen displays “Want More Measurement?”. Press [F4] to confirm it.	[F4]	Want More Measurement? CANCEL OK

④ In backsight orientation dialog, input the PtID previously measured in Face Ⅰ. Please follow Step ③ of single point orientation.		
⑤Reverse the telescope, collimate the backsight point BS1, press [F1] (All) OR [F2] (DIST) + [F3] (RECORD) to start orientation with coordinate measurement. ※2)~ ※3) The upper-right corner displays "1/Ⅰ", indicating that first point was measured in telescope position I	[F1] or[F2] + [F3]	
⑥After measurement, when displaying "Want More Measurement?", [CANCEL]: finish measurement and display result. [OK]: Proceed to measure other backsight points. Repeat steps ②~⑤ to measure the orientation of more backsight points. The instrument provides orientation with a maximum of 5 backsight points.		
⑦After all points which are used for backsight orientation are measured, in dialog of step ⑥, press [F4](OK) to display result.	[F4]	
⑧ Press [F1](RESID) to enter into Orientation Residuals dialog. Press navigation key ◄► to view the orientation residuals of other points.	[F1]	

⑨If the residuals are OK, press [F1] to return to Orientation Result dialog. Then press [F4] (OK) to set the calculated HZ orientation, the screen displays "Orientation Set Already!", and returns to Setting Meas menu.	[F1] [F4]	【Setting Meas】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4

※ 1) ▲,▼,◆: Implies that there are several pages selectable. Press [PAGE] to select.

※ 2) Orientation measurement is in Page 2.

△AZ: After the first measurement, the finding of other target points (or the same point when changing the telescope position) is easier by setting the indicated angle difference near to 0°00′0″ by turning the instrument.

△◢: Difference between horizontal distance to target point computed from coordinates and the measured distance.

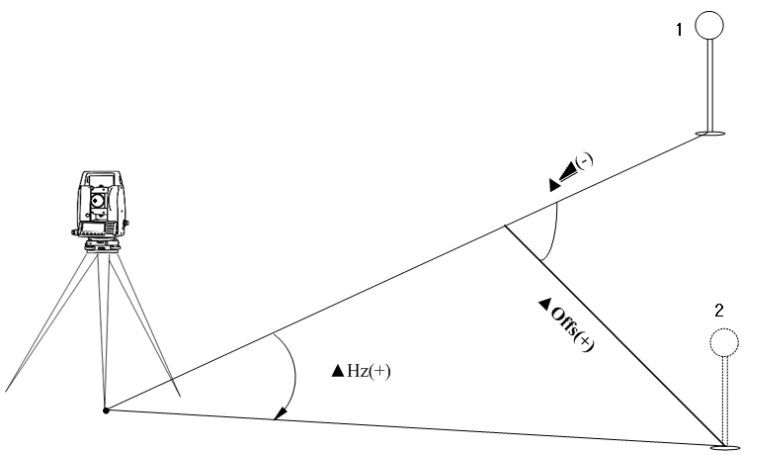
※ 3) If orientation measurement is based only on one face, there is no need to rotate the telescope. Collimate on next point directly.

※ 4) Status indication 1/I: shows that first point was measured in telescope position I.

1/II: shows that first point was measured in telescope position II.

1/I II: First point measured in telescope position I and II.

5.3.3 Displaying Residuals



In the picture, 1 is actual measurement point. 2 is design point.

△: Height correction

△: Correction of the horizontal distance

△Hz : Correction of HZ angle.

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 APPLICATIONS

Introduction

Applications are predefined programs that cover a wide spectrum of surveying duties and facilities daily work in the field.

Applications listed as follow are available.

- Surveying
- Stake Out
- Free Station
- COGO
- Tie Distance
- Area (Plan)
- Remote Height
- Reference Line/Arc
- Roads
- Construction

STEPS:

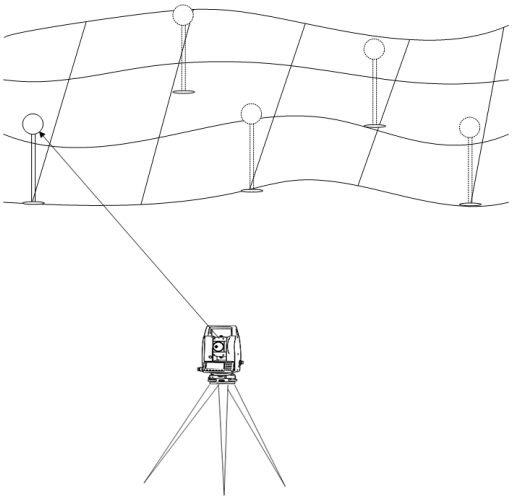
Press fixed key [MENU].

Press [F1]-[F4] to select "Program" option.

Calling up applications and activating start programs. Press [PAGE] to turn to next page.

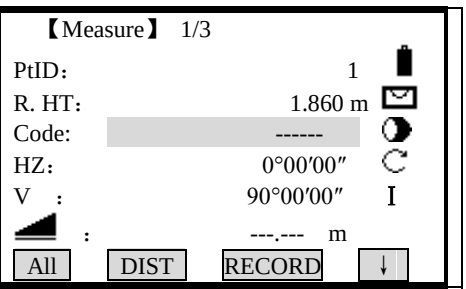
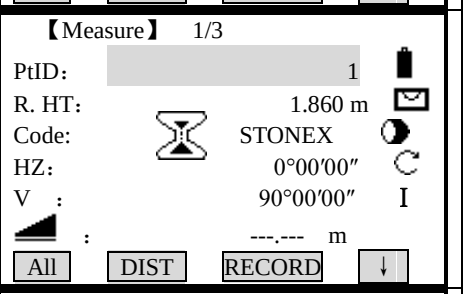
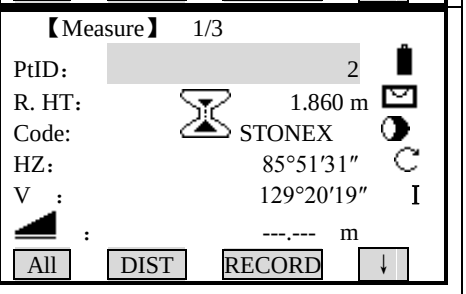
5.5 SURVEYING

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



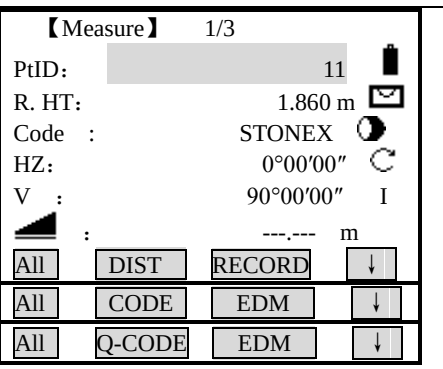
OPERATION: Set job, station and orientation first!!

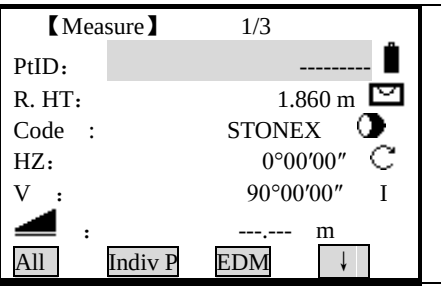
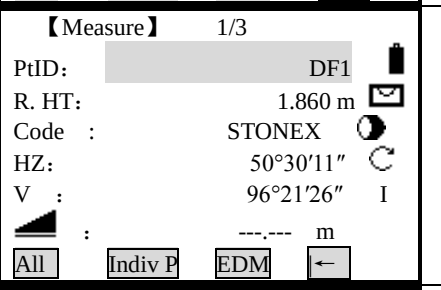
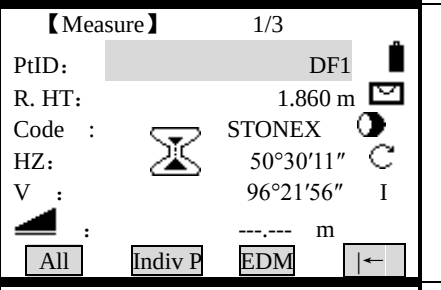
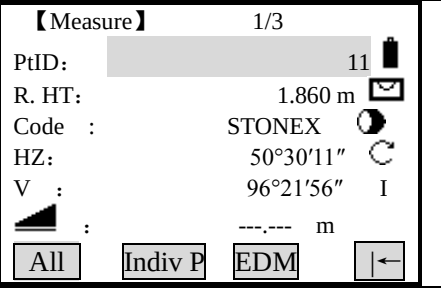
OPERATIONAL STEPS	OPERATION	DISPLAY
① After setting job, station and orientation, press [F4] in Setting Meas menu to start measurement.	[F4]	Setting Meas [*]F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
② Input PtID and press [ENT] to move to next item. ※1)	Input PtID + [ENT]	【Measure】 1/3 PtID: 1 R. HT: 1.860 m Code: ------ HZ: 0°00′00″ V : 90°00′00″ : ---.--- m All DIST RECORD ↓

③ Input reflector height, press [ENT] to move to next item. Enter the code if necessary.	Input prism height + [ENT]	
④ Press [F1] (All) or [F2] (DIST) + [F3] (RECORD) to start measurement and save the data. To see data surveyed and saved includes angle, distance, coordinate, press [PAGE] to view. ※ 2)	[F1] or[F2] + [F3]	
⑤ After measuring one point, PtID will automatically +1. Press [F1] (All) or [F2] (DIST) + [F3] (RECORD) to proceed the measurement of next point. Meanwhile, the screen displays the previous measured data, and turn [PAGE] to view.		
※1) Please refer to "2.7 Input Mode" to know more about the input method. ※2)Once Surveying function is activated, all measurement data (including angle, HD, SD, VD and ENH) will be displayed. Press [PAGE] to view.		

5.5.1 Individual Point

[Indiv P]: In data collection, you can record one single point, exchanging the option between individual point and continuous point by pressing this key.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F4](↓) three times to displays the last page.	[F4]	

		
② Press[F2] (Indiv P) to start Individual Point function. The item of PtID is blank. .	[F2]	
② Input the individual PtID, prism height, code (if necessary). After one item setting finished, press [ENT] to move to next item.	Input PtID, R.HT, Code + [ENT]	
④ Press [F1] (All) or [F2] (DIST) + [F3] (RECORD) to start measurement and save the data measured.	[F1] or[F2] + [F3]	
⑤ As the measurement is finished, the program will automatically deactivate Individual Point function, and displays the previous continuous PtID.		

5.5.2 Coding

Three Coding Methods are available:

1. Simple Coding:

Input a code into the relevant box. The code is stored along with the corresponding measurement.

2. Expand Coding:

Press [CODE]. The input code 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 abbr. of the code. The code is selected and the measurement starts.

For more information, please refer to "3.3.4 Coding".

5.6 STAKING OUT

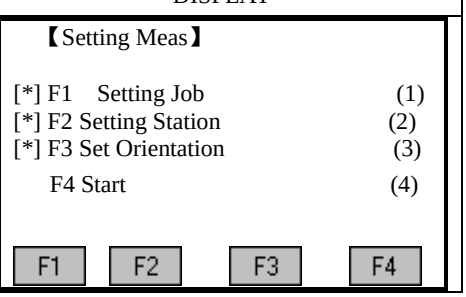
This program calculates the required elements to stake out point coordinates or manually entered angles, horizontal distances and heights. Stake-out differences can be displayed continuously.

Stake Out 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.

5.6.1 Setting Stake-Out Point

5.6.1.1 Calling up Coordinates from job.

OPERATIONAL STEPS	OPERATION	DISPLAY
① After setting job, station and orientation azimuth, press [F4] in Setting Meas menu to start stake-out. ※1)	[F4]	

② In Find item, input the stake-out PtID and press [ENT] to start Pt Search function. (You can also input wildcard "*" to start wildcard search.)	Input stake-out PtID	【Stake Out 】 1/3 FIND : * PtID: 5 Type: Known △Hz : -85°51′31″ △: 2.055 m △: ---.--- m All DIST RECORD ↓
③A: The program searches PtID in the job, and displays the result dialog. All PtIDs will be listed separately. Press [F4] to return to Stake Out menu. (Input wildcard "*" to display all data in the job.) B If the PtID does not exist, the program will advise user to input the coordinate of the point and save it. Then return to Stake Out menu.		A: 【Point Search】 1/25 A12 Known A03 Known 12 Meas. 125 Meas. 212 Meas. VIEW ENH JOB OK B: 【Pt Search】 Job : STONEX PtID : A25 Select Job / input Pt coord. FIND 0SET ENH
④ Press navigation key ◂▯▸ to select the PtID to be staked out. Start staking out.	◂◯▸	【Stake Out 】 1/3 FIND : A*2 PtID: A25 Type: Known △Hz : -85°51′31″ △: 2.055 m △: ---.--- m All DIST RECORD ↓

※1) Methods of setting job, station and orientation have been introduced previously. Please refer to "5.1Setting Job", "5.2 Setting Station", and "5.3 Set Orientation".

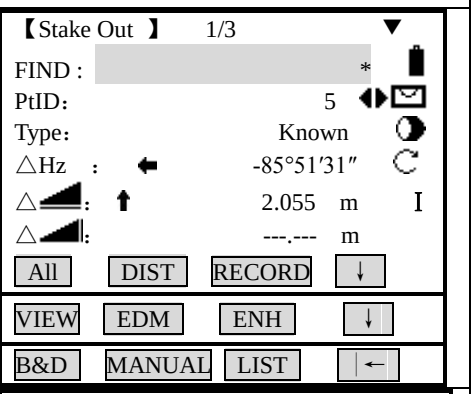
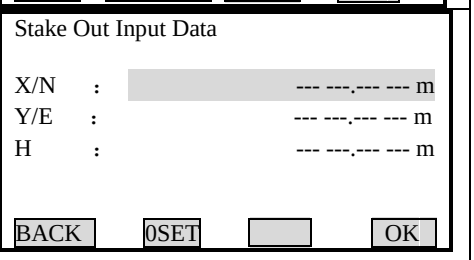
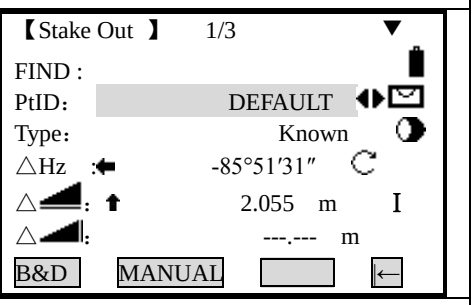
5.6.1.2 Inputting Coordinate Manually

Press [ENH], [MANUAL] to input stake-out point manually.

Approach 1: Press [ENH] to input the coordinate of stake-out point to the job.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F4] (↓) to turn to Page 2.	[F4]	【Stake Out 】 1/3 FIND : * PtID: 5 Type: Known △Hz : -85°51′31″ △: 2.055 m △: ---.--- m All DIST RECORD ↓ VIEW EDM ENH ↓
② Press [F3] (ENH) to input PtID and ENH of the stake-out point. After one setting, press [ENT] to move to next item.	[F3] Input PtID & ENH + [ENT]	【Coordinate Input】 Job : STONEX PtID: X/N : --- ---.--- --- m Y/E : --- ---.--- --- m H/Z : --- ---.--- --- m BACK SAVE
③ After finishing input, press [F4] to save the data, and enter into stake-out program. Start staking out the input points. ※1)	[F4]	【Stake Out 】 1/3 FIND : 5 PtID: 5 Type: Known △Hz : -85°51′31″ △: 2.055 m △: ---.--- m VIEW EDM ENH ↓
※1) Method to stake out is introduced in 5.6.2.		

Approach 2：Press [MANUAL] to input a stake-out point without PtID or saved data.

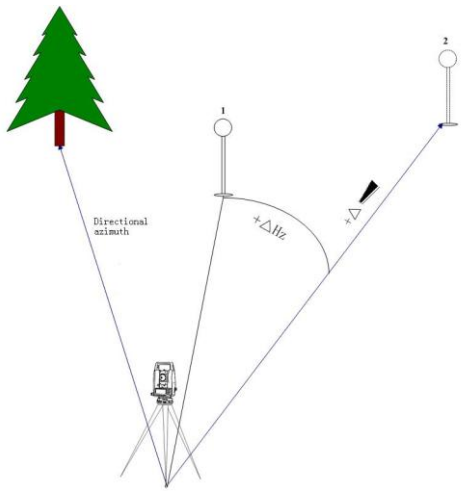
OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F4](↓) twice to turn to Page 3.	[F4]	
② Press [F2] (MANUAL). Input ENH in the dialog. After one inputting, press [ENT] to move to next item. Press [F2] (0SET) if you want to set ENH to 0.	[F2] Input ENH + [ENT]	
③ After inputting ENH, press [F4] (OK) to enter into Stake Out menu. The program automatically set the PtID to “DEFAULT”, and starts to stake out the input points. ※1), ※2)	[F4]	
※1) [MANUAL]: Data that was input will not be saved in the job. ※2 Method to stake-out is introduced in 5.6.2.		

The soft keys below the screen:

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

[RECORD]: Saves the displayed values.

5.6.2 Polar Stake Out



In the picture, 1: Actual 2: Point to be staked out

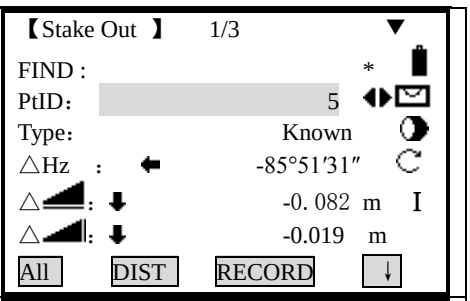
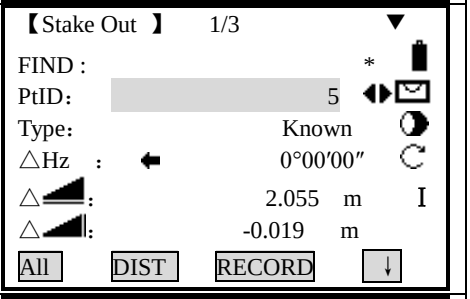
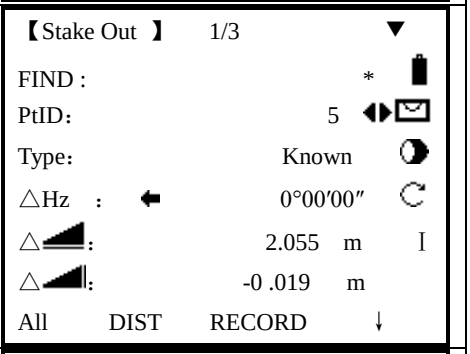
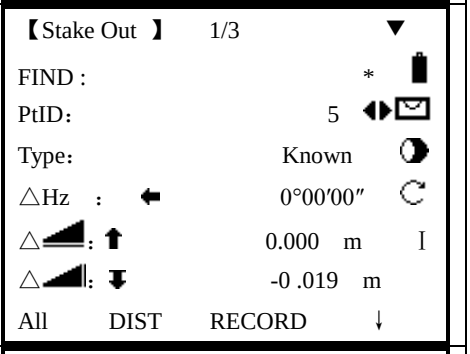
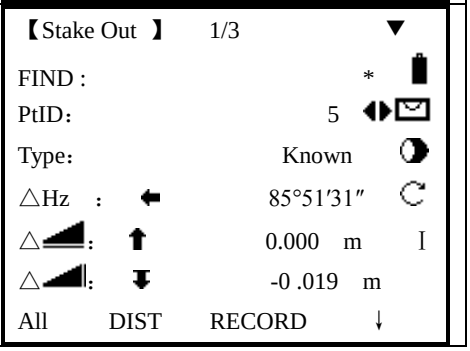
Normal indication of polar stake out offsets.

△**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.

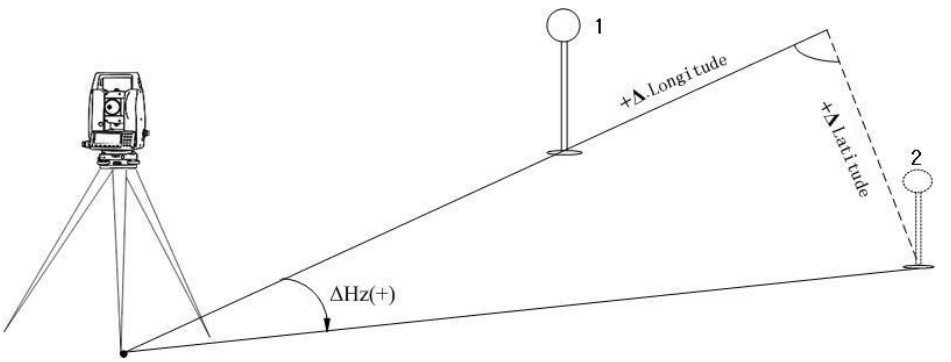
OPERATIONAL STEPS	OPERATION	DISPLAY
① Set the series of data of stake-out point. From point list to select the point to be staked out. You can also call it up from the job by inputting the stake-out PtID in Pt Search menu.		【Stake Out 】 1/3 FIND : * PtID: 5 Type: Known △Hz : -85°51′31″ △: 2.361 m △: ---.--- m All DIST RECORD ↓
②Press [PAGE] to turn to Page 2, and press ▼ to move to R.HT item. Input the prism height.	PAGE + ▼ Input R.HT	【Stake Out 】 2/3 PtID : 5 Type: Meas. R.HT : 2.000 m △L Off: ---.--- m △T Off: ---.--- m △H : ---.--- m All DIST RECORD ↓

③ Collimate the prism, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between measurement point and stake-out point.	[F2]	
④Rotate the telescope until the angle difference is 0°00′00″ and notify the surveyor to move the prism. • Arrowhead means: ⬅: Move the prism left to the station. ➡: Move the prism right to the station.		
⑤Set the prism at 0° direction of telescope and collimate it. Press [F2] (DIST) to start measurement and calculate the stake-out factor offset between the prism and stake-out point.	[F2]	
⑥Move the prism northing or southing according to the arrowhead until the "△" displaying 0 m. • Arrowhead means: ⬇ : Southing the prism to the station ⬆ : Northing the prism to the station.		
⑦When both △Hz and △ are zero, it implies that the current prism point is the stake-out point. △ means the fill/dig data. ⬇ : To dig. The value is the depth to dig. ⬆: To fill. The Value is the height to fill.		

⑧ Stake-out of point is finished. Repeat the above press to select the next point to be staked out. (Or call up the existed PtID in the job via Pt Search function.)		【Stake Out 】 1/3 ▼ FIND : * PtID: 6 Type: Known △Hz : 85°51′31″ △: 2.055 m △: ---.--- m All DIST RECORD ↓

5.6.3 Orthogonal Stake Out

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



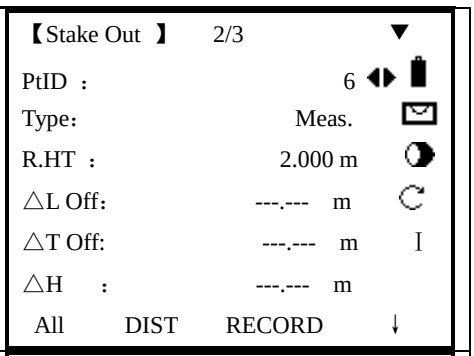
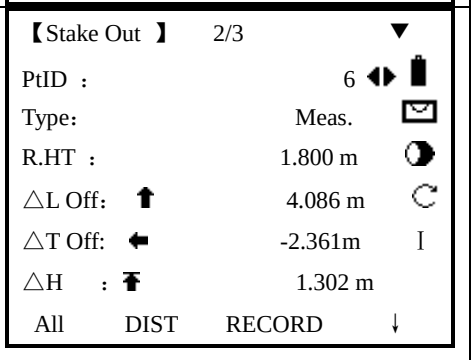
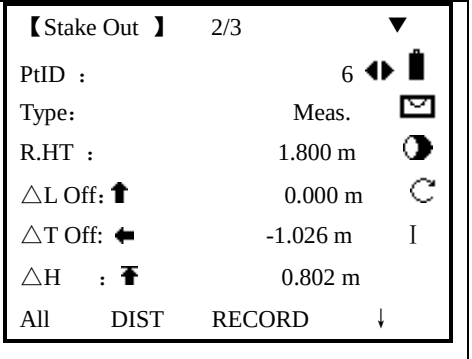
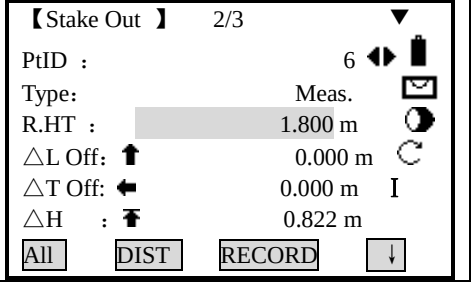
1: Actual 2: Point to be staked out

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

△LOff Longitudinal offset: Positive if the stake-out point is further away.

△TOff Transversal offset, perpendicular to line-of-sight: Positive if the stake-out point is to the right of measured point.

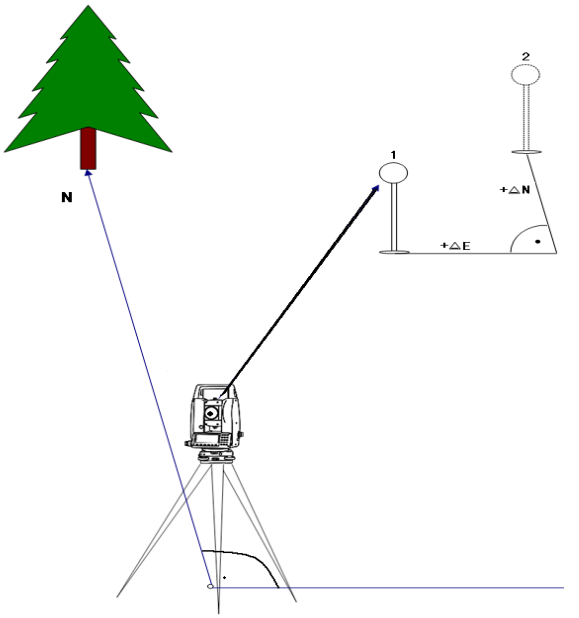
OPERATIONAL STEPS	OPERATION	DISPLY
Press [PAGE] to turn to Page 2 Orthogonal Stake Out, and select the point to be staked out. You can also call up the point to be staked out by inputting the PtID in Pt Search function in Page 1.	PAGE	【Stake Out 】 2/3 ▼ PtID : 6 Type: Meas. R.HT : 2.000 m △L Off: ---.--- m △T Off: ---.--- m △H : ---.--- m All DIST RECORD ↓

②Press ▼ to move to R.HT item and input the prism height.	Input prism height	
③ Collimate the current prism, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between the station point and stake-out point. The arrowhead shows the direction move the prism.	[F2]	
④Move the prism northing or southing according to the arrowhead until the △L Off displays 0 m. • Arrowhead means： ⬇ : Southing the prism to the station ⬆ : Northing the prism to the station. In Stake Out program, if “Fine [r]” or “Tracking” is selected, then the factor difference between prism point and stake-out point can be displayed immediately, which is quite convenient.		
⑤Rotate the telescope until the△TOff displays 0 m, and notify the surveyor to move the prism. • Arrowhead means： ⬅: Westing the prism to the station. ➡: Easting the prism to the station.		

⑥ When both △L Off and △T Off display 0 m, it implies that the current prism point is the stake-out point. △ H means the fill/dig data. ⬇ : To dig. The value is the depth to dig. ⬆: To fill. The Value is the height to fill.		【Stake Out 】 2/3 PtID ： 6 Type: Meas. R.HT ： 2.000m △L Off: ⬆ 0 .000m △T Off: ⬅ 0 .000m △H ： ⬆ 0.822m All DIST RECORD ↓
⑦Staking out of point is finished. Continue to select the next point to stake out. (Or call up the existed PtID in the job via Pt Search function.)		【Stake Out 】 2/3 PtID ： 7 Type: Known R.HT ： 2.000 m △L Off: ---.--- m △T Off: ---.--- m △H ： ---.--- m All DIST RECORD ↓

5.6.4 Coordinate Offset Stake Out

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



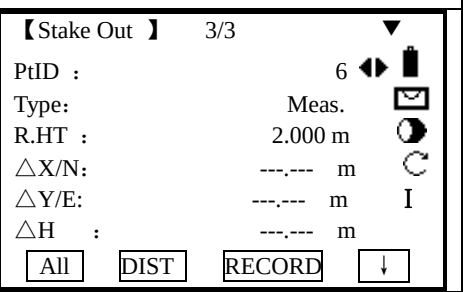
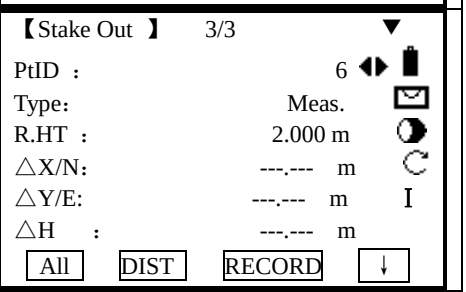
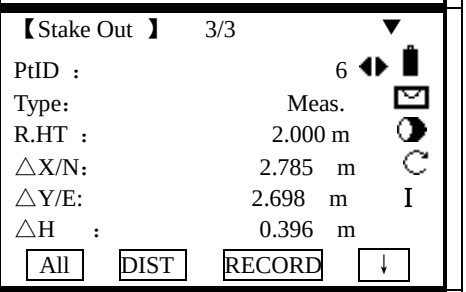
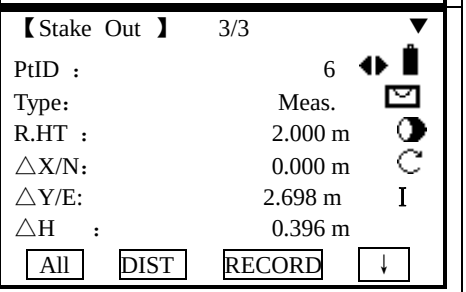
1：Actual prism position 2： Point to be staked out

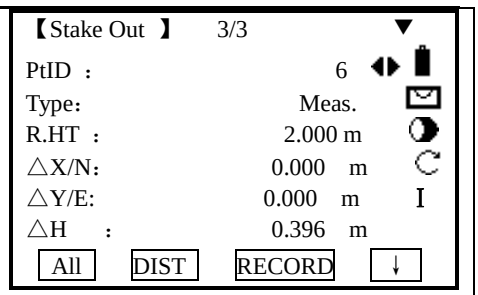
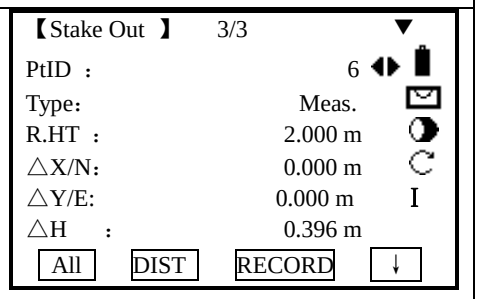
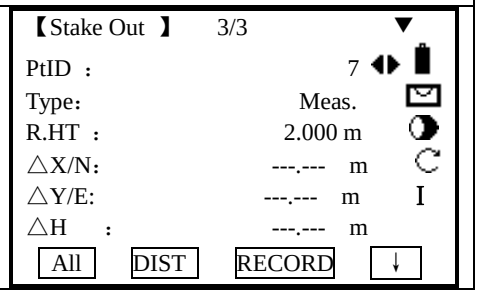
Meaning of several offsets in process of coordinate stake-out.

△ 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

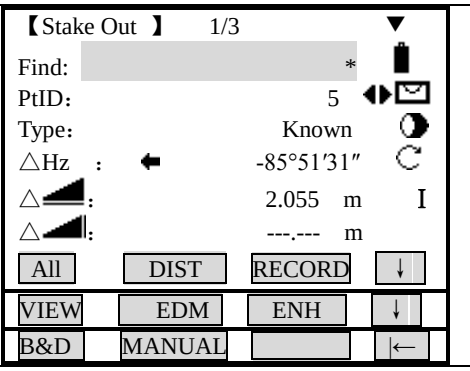
measurement point.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [PAGE] to turn to Page 3, and select the point to be staked out. You can also call up the point to be staked out by inputting the PtID in Pt Search function in Page 1.	PAGE	
②Press ▼ to move to R.HT item and input the prism height.	▼ Input prism height	
③Collimate the prism, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between the station point and stake-out point.	[F2]	
④ Northing the prism in E direction until △Y/E displays 0 m. When △Y/E is positive, it means the stake-out point is on the right of measurement point. Move the prism rightward. When △X/N is negative, it means the stake-out point is on the left of measurement point. Move the prism leftward.		

⑤ Northing the prism on N direction until △X/N displays 0 m. When △X/N is positive, it means the stake-out point is further. Move the prism further from the station. When △X/N is negative, move the prism closer to station.		
⑥ When both △Y/E and △X/N display 0 m, it implies that the current prism point is the stake-out point. △ H means the fill/dig data. △H is positive: To fill. The value is the height to fill. △H is negative: To dig. The value is the depth to dig.		
⑦ Stake-out of point is finished. Continue to select the next point to be staked out. (Or call up the existed PtID in the job via Pt Search function.)		

5.6.5 B & D

Press [B&D]; input the elements of polar stake-out: azimuth and horizontal distance. After inputting, you can start to stake out the azimuth and horizontal distance you input.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F4] (↓) twice to turn to Page 3 of keys.	[F4]	

② Press [F1] (B&D) to display as the right dialog.	[F1]	【New Point(SideShot)】 Input TGT Pt AZ & Dist.! PtID: --- --- AZ: ---°---′---″ : ---.--- m BACK
③ Input the PtID, AZ and HD of the point to be staked out. After inputting, press [ENT] to move to next item. ※1)	Input PtID, AZ, HD + [ENT]	【New Point(SideShot)】 Input TGT Pt AZ & Dist! PtID: 50 AZ: 26°00′00″ : 10.000 m 01 INSERT DELETE CLEAR .
④ Collimate the prism, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between the station point and stake-out point.	[F2]	【Side Shot Stake Out】 PtID: 50 △Hz : -85°51′31″ △: 10.000 m NewPt2 DIST RECORD BACK
⑤Rotate the telescope until the △HZ displays 0°00′00″, and notify the surveyor to move the prism. When △Hz is positive, it means the stake-out point is on the right of measurement point. Move the prism rightward. When △Hz is negative, it means the stake-out point is on the left of measurement point. Move the prism leftward.		【Side Shot Stake Out】 PtID: 50 △Hz : -85°51′31″ △: 1.509 m NewPt2 DIST RECORD BACK
⑥ Set the prism on 0 direction of telescope, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between the station point and stake-out point. When △ is positive, it means the stake-out point is further. Move the prism further from the station. When △ is negative, move prism closer to station.	[F2]	【Side Shot Stake Out】 PtID: 50 △Hz : 0°00′00″ △: 1.509 m NewPt2 DIST RECORD BACK

⑦ Move the prism according to arrowhead until "△" displays 0 m. If "Fine (r)" or "Tracking" is selected to stake out, the factor offset between prism point and stake-out point will be displayed at real time, which is quite convenient.※2)		【Side Shot Stake Out】 PtID: 50 △Hz : 0°00′00″ △: 0.000 m NewPt2 DIST RECORD BACK
⑧ After staking out one point, press [F1] (NewPt2) and repeat Steps ②~⑦ to proceed the input and stake-out operation of next B&D method.		【New Point (Side Shot)】 Input TGT Pt AZ & Dist.! PtID: --- --- AZ: ---°---′---″ : --- --- m BACK
※1) The data input for B&D Stake-Out will not be stored in the job. ※2) Press [F4] (BACK) to return to Stake Out main menu.		

5.7 FREE STATION

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

The following measurements sequences to target points are possible:

HZ-angle and V-angle only

Distance and HZ-angle and V-angle

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:

Single face I or II measurements are always applicable.

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

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

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

Measurement Restrictions:

Status of a height of 0.000 m of the target point

If target points have a valid height of 0.000m, use 0.001 m to avoid problems 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.

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

Easting and northing is determined by the method of least squares, including standard deviation and improvements for HZ-direction and horizontal distances.

The final height is computed from averaged height differences based on the original measurement.

The HZ-circle orientation is computed by the original average face I and face II measurements and the final computed plan position.

OPERRATIONAL STEPS	OPERATION	DISPLAY
① Press [F3] in Programs menu to enter into Free Station function.	[F3]	【Programs】 1/3 ▼ F1 Surveying (1) F2 Stake Out (2) F3 Free Station (3) F4 COGO (4) F1 F2 F3 F4
② Press [F1] in Free Station menu to set the job.	[F1]	【Free Station 】 [ ]F1 Setting Job (1) [ ] F2 Setting Limit (2) F4 Start (4) F1 F2 F4
③ Select or set up a job. Input a job: after input the details of a new job, and press [F4] (OK).		【Setting Job】 5/8 JOB: STONEX Name: --- --- Date: 2011.06.18 Time: 16：02：09 Note1: ---------- Note2: ---------- LIST OK
④ The screen returns to Free Station menu. Press [F2] to set limit.	[F2]	Setting Limit Input Limit! Status: ON◀▶ St. dev. X/N : 0.000 m St. dev. Y/E : 0.000 m St. dev. H/Z : 0.000 m St. dev. Ang: 0°00′00″ SET

⑤ Input the standard deviation. After inputting one item, and press [ENT]. After inputting all deviations, press [F4] (SET), and the screen displays "Limit set already!" and returns to Free Station menu.	Input standard deviations + [F4]	Setting Limit Input Limit! Status: ON◀▶ St. dev. X/N : 0.020 m St. dev. Y/E: 0.020 m St. dev. H/Z : 0.010 m St. dev. Ang: 0°00′00″ [ ] [ ] [ ] [SET]
⑥ Press [F4] to start free station measurement. Set PtID and height of the station. After one setting, press [ENT]. After finishing inputting all items, press [F4] (OK).	[F4] Input station PtID and height + [ENT]	【Free Station STN Pt】 Stn.Pt: OCC1 INS. Ht: 1.500 m [ ] [ ] [ ] [O k]
⑦ Set target PtID and prism height. After inputting, press [F3] (OK). ※1)	Input target PtID and R.HT + [F3]	【Free-Station TGT Pt 】 PtID : 2 R.HT : 2.000 m [SEARCH] [LIST] [OK] [↓]
⑧ Collimate target point 1 and press [F3](DIST) to start measurement.	[F3]	【Free-Station Measure】 PtID : 2 R.HT : 2.000 m HZ: 38°20′06″ V : 20°00′05″ : ---.--- m [RESULT] [Next Pt] [All] [↓]
⑨After finishing the measurement of one point, press [F2] to proceed the measurement of next point and repeat steps ⑦, ⑧. If the measured point is to be remeasured, press [F2] (SKIP) in Page 2 without inputting PtID.	[F2]	【Free-Station TGT Pt】 PtID : 2 R.HT : ---.--- m [SEARCH] [LIST] [OK] [↓] [ENH] [SKIP] [BACK] [|←]

⑩ When there are at least 2 points and 1 side are measured, the station coordinate can be calculated and displayed.

Press [F1] to view the result that shows the coordinate limit between the result and station point. Press [F4] (OK) to display the station coordinate.

【Limit Check】

St.DevX0 : 1.001 m
St.DevY0: 1.569 m
St.DevH0 : 10.000 m

Continue?

BACK | | | OK

St.Dev E0,N0, H0: Standard deviation of the station coordinates

St.DevAng ： Standard deviation of the orientation

Press[OK]:

【Free-Station Result】

Stn.ID ： OCC1
INS.Ht: 1.569 m
X0/N0 ： 10.000 m
Y0/E0 ： 10.001 m
H0 ： 10.000 m

BACK | RESID | StdDev | OK

(Press [F2] to display the residuals. Press [F3] to display to standard deviation. Press [F4] to set the displayed coordinates and instrument height as new station.)

Press [BACK] to measure a known point.

【Free-Station Measure】 1/5

PtID: 2
R.HT: 2.000 m
HZ : 38°20′06″
V： 20°00′05″
: ---.--- m

BACK | NextPt | All | ↓

Press[F2]to display the residuals:

Residual = Calculated value – Measured value

【Free-ST Residuals】 1/2

PtID ： 2
△Hz ： 0°00′01″
△: 0.001 m
△: 0.002 m

BACK | | | OK

Press navigation key to view the residual of each point.

※1) Target point can be called up from job via [SEARCH] and [LIST], and also can be input manually. Please refer to 5.2 Setting Station for detailed instruction.

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! Please repeat the Free Station function!	The measurements may not allow final station coordinates (Eastings, Northings) to be computed，need to repeat measurement.
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.

5.8 COGO

"COGO"

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

- Coordinate of points
- Azimuth between points
- Distance between points

The COGO calculation methods are ：

- Inverse
- Intersection
- Traverse

SOFT KEYS FUNCTIONS ：

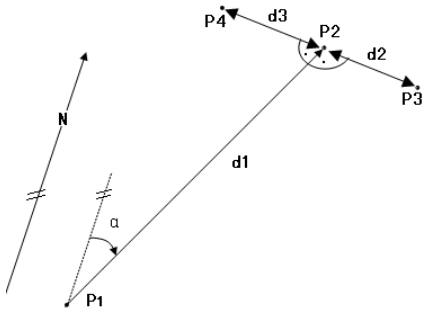
[MEAS] Jump to measurement dialog to measure the point..

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

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

5.8.1 Inverse & Traverse

5.8.1.1 Traverse



The known data in the graph:

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

The unknown datum：

P2 COGO point

P3 COGO point with positive offset

P4 COGO point with negative offset

OPERATIONAL STEPS	OPERATION	DISPLAY
① In COGO Main Menu press [F1], and press [F1] to select Traverse function from Inverse & Traverse menu.	[F1] [F1]	【COGO Main Menu】 F1 Inverse & Traverse F2 Intersections F3 Offset F4 Extention F1 F2 F3 F4 【Inverse & Traverse】 F1 Traverse F2 Inverse F1 F2

② There are several methods to obtain known PtID.

A:

Input the known PtID, and press [F3] (SEARCH) to see if the point exists in Job. If yes , continue inputting the known points to the azimuth of unknown point, distance and deviation quantity; if this point does not exist, you need firstly to input coordinate of the known point and other information later on

B:

If you want to call up the data from Job, directly press [F1] (LIST).

C:

If you want to directly input coordinate, press [F2] (ENH) key.

D:

Also, you may press [F1] (All) to start measurement function. In dialog showed as the right picture, press [F1] (All) or [F2] (DIST) + [F3] (RECORD) to start measuring unknown point and save the result. The result is used for calculation.

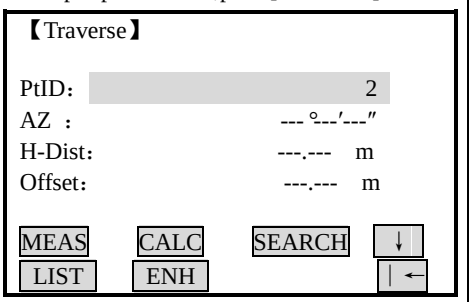
Input PtID
+
[F3]

[F4]
+
[F1]

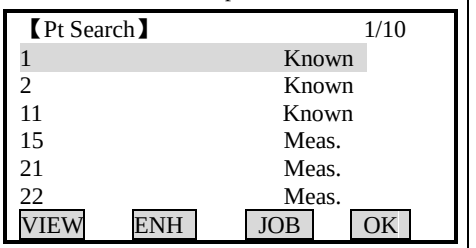
[F4]
+
[F2]

[F1]
+
[F1]
or [F2]
+
[F3]

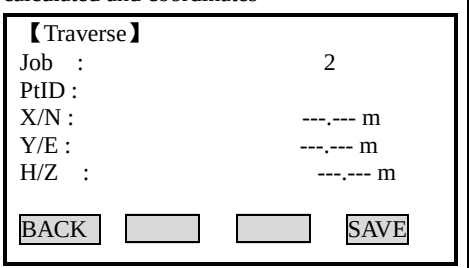
A: Input point name ,press[SEARCH]



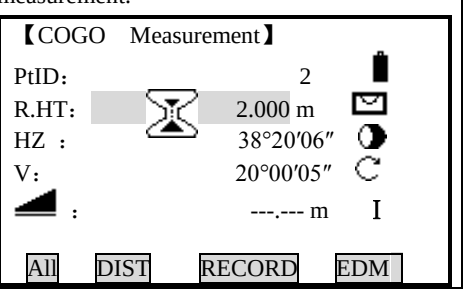
B: Press[LIST], call up PtID from Job



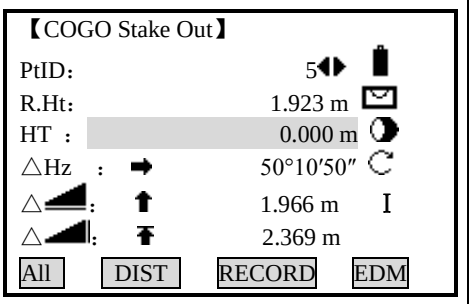
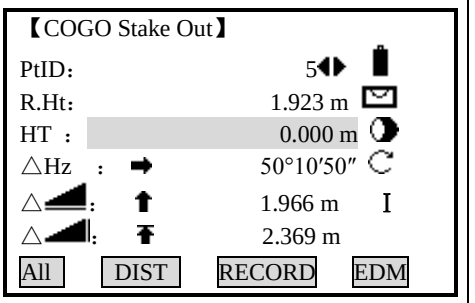
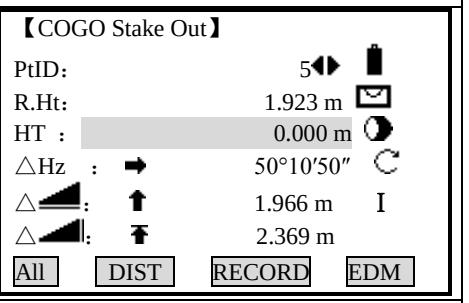
C: Press [ENH] to input the PtID to be calculated and coordinates



D: Press [All] or [DIST] + [RECORD] to start measurement.

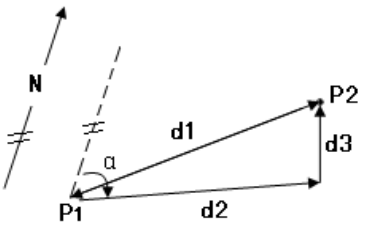


③As all the known PtIDs have been input, press [ENT] to move to the azimuth item, and continue inputting. After finishing all inputting, press [F2] to compute the result.		【COGO New Point】 New Pt: --- --- X/N : 20.000 m Y/E : 10.000 m STAKE RECORD
④If this point needs to be staked out, input the PtID, press [F1](STAKE). ※ 1) If it only needs to record the data, just press [F4]. ※2) Here take staking out as an example.	Input new PtID + [F1]	【COGO New Point】 New Pt: --- --- X/N : 20.000 m Y/E : 10.000 m STAKE RECORD
⑤ As the program displays "Record new point?", press [F4] (OK) to store new points in Job ,and start staking out. If you press [F1] (CANCEL), stake-out is started without storing the data. It is a must to name the calculation result for COGO so as to start staking out.		【COGO New Point】 Record new point?? CANCEL OK
⑥Collimate the prism center, input prism height, or the H/Z if needed. Press [F2] (DIST) to start measurement. If some more points are also needed to be staked out, and as cursor staying on PtID item, press ◄▯▯► to select. ※ 3)	[F2]	【COGO Stake Out】 PtID: 5 R.Ht: 1.923 m H/Z: 0.000 m △Hz : 50°10′50″ △: 1.025 m △: ---.--- m All DIST RECORD EDM
⑦The factor offset between stake-out point and measurement point are displayed and computed in the screen.		【COGO Stake Out】 PtID: 5 R.Ht: 1.923 m HT : 0.000 m △Hz : 50°10′50″ △: 1.966 m △: 2.369 m All DIST RECORD EDM

⑧Rotate the telescope until "△Hz" item displays 0°00′00″, and order the surveyor to move prism. △Hz is positive：The stake-out point is on the right of current measurement point. Move the prism rightward. △Hz is negative：The stake-out point is on the left of current measurement point. Move the prism leftward.		
⑨ Set the prism on zero direction of telescope and collimate it, and press [F2] (DIST) to start measurement and calculate the factor offset between prism point and stake-out point. △ is positive：Stake-out point is further. Move prism away from the measurement station. △ is negative：Move prism closer to measurement station.	[F2]	
⑩ Move prism forward/backward according to the arrowhead until "△" displays 0 m. ※4) △H is positive：It needs to be filled. The height is the value displayed. △H is negative：It needs to be filled. The depth is the value displayed.		

※1)If staking out directly without inputting PtID of new point, the procedure will display "Invalid PtID!"
※2)If to launch Traverse function again, press [ENC].
※3)The Traverse result is the plane value. Therefore, in the process of stake-out, if H/Z is needed, input it separately.
To change EDM setting, press [F4].
※4) Selecting Fine (r) or tracking measurement mode to stake out can display the factor offset between prism point and stake-out point on real time.

5.8.1.2 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

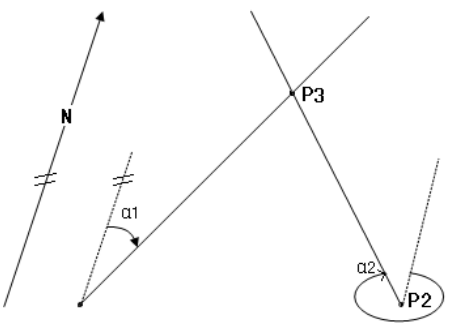
d3 Height distance between P1 and P2

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Inverse & Traverse menu, press [F2], and enter into Inverse function.	[F2]	【Inverse & Traverse】 F1 Traverse F2 Inverse F1 F2
②Input PtID of one known point, and press [ENT] to move to next item. ※1)	Input PtID1 + [ENT]	【Inverse】 From : --- --- --- To --- --- --- MEAS CALC SEARCH ↓
③Input the PtID of another known point, and press [ENT].	Input PtID2 + [ENT]	【Inverse】 From : 21 To : --- --- --- MEAS CALC SEARCH ↓

④ Press [F2](CALC) to display the result.	[F2]	【Inverse Result】 Point 1: 21 Point 2: 22 AZ : 90°00′00″ △: 10.000 m △: 10.000 m △: 0.000 m RECORD
⑤ To record the result, press [F4]. To quit the result menu, press [ESC] to proceed to the next Inverse function.		【Inverse】 From : To: MEAS CALC SEARCH ↓
※1) There are four approaches to obtain the known PtID. Please refer to Step② of the last section "5.8.1.1Traverse".		

5.8.2 Intersections

5.8.2.1 Bearing-Bearing



The known data:

P1 The first known point

P2 The second known point

α 1 Direction from P1 to P3

α 2 Direction from P2 to P3

The unknown data: P3 COGO point

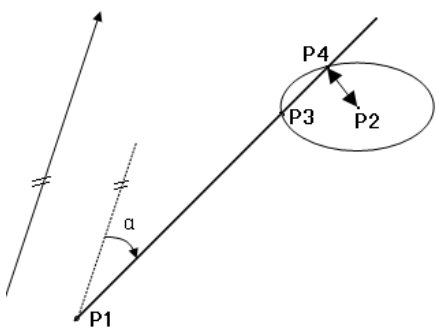
OPERATIONAL STEPS	OPERATION	DISPLAY
①In COGO Main Menu, press [F2], then in Intersection menu, press [F1], to enter into Bearing-Bearing Intersection function.	[F2] [F1]	【COGO Main Menu】 F1 Inverse & Traverse F2 Intersections F3 Offset F4 Extention F1 F2 F3 F4 【Intersections】 F1 Bearing-Bearing F2 Bearing-Distance F3 Distance- Distance F4 By Points F1 F2 F3 F4
②Input PtID of known point P1, and press [ENT] to move to the next item.	Input PtID1 + [ENT]	【Bearing-Bearing】 Input data! Point 1: 10 AZ : --- °---′---″ Point 2: --- AZ: --- °---′---″ MEAS CALC SEARCH ↓ LIST ENH | ←
③Input the azimuth from P1 to P3 and press [ENT] to move to next item.	Input AZ1 + [ENT]	【Bearing-Bearing】 Input data! Point 1: 10 AZ : 45 °00′00″ Point 2: --- AZ: --- °---′---″ MEAS CALC SEARCH ↓ LIST ENH | ←
④Input PtID of another known point P2, and press [ENT] to move to the next item. Repeat step ②.	Input PtID2 + [ENT]	【Bearing-Bearing】 Input data! Point 1: 10 AZ : 45 °00′00″ Point 2: 11 AZ: --- °---′---″ MEAS CALC SEARCH ↓ LIST ENH | ←

⑤Input the azimuth from P2 to P3, and press [ENT].	Input AZ2 + [ENT]	【Bearing-Bearing】 Input data! Point 1: 10 AZ : 45°00′00″ Point 2: 11 AZ: 315°00′00″ MEAS CALC SEARCH ↓ LIST ENH | ←
⑥Press [F2] (CALC) to display the result. To stake out this point, input new PtID, and press [F1] to start staking out.※2) To save the data, press [F4]. To quit result menu, press [ESC] to return to inputting data menu, and re-input the data.	[F2]	【COGO New Point 】 New Point: --- --- --- X/N : 50.000 m Y/E : 50.000 m STAKE RECORD

※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse".

※2) The stake-out operation is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".

5.8.2.2 Bearing-Distance Intersection



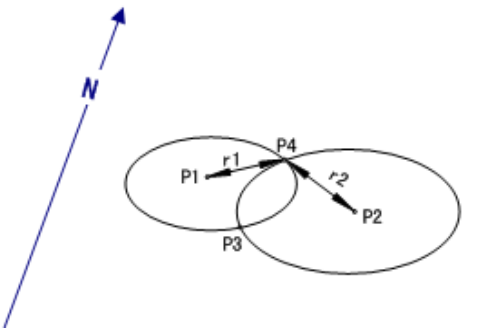
The known data: P1 The first known point
P2 The second known point
α Direction from P1 to P3 and P4
r Radius, viz distance from P2 to P3 or P4
The unknown data: P3 The first COGO point
P4 The second COGO point

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Intersections menu, press [F2] to enter into Bearing-Distance Intersection function.	[F2]	【Intersections】 F1 Bearing-Bearing F2 Bearing-Distance F3 Distance- Distance F4 By Points F1 F2 F3 F4
②Input PtID of the known P1 point, and press [ENT] to move to next item. ※1).	Input PtID1 + [ENT]	【Bearing-Distance】 Input data! Point 1: 10 AZ : --- °---′---″ Point 2: --- H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH ←
③Input azimuth from P1 to unknown points P3 and P4, and press [ENT] to move to next item.	Input azimuth + [ENT]	【Bearing-Distance】 Input data! Point 1: 10 AZ : 45 °00′00″ Point 2: --- H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH ←
④Input PtID of another known point P2. Repeat step ②.	Input PtID2 + ENT]	【Bearing-Distance】 Input data! Point 1: 10 AZ : 45 °00′00″ Point 2: 11 H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH ←
⑤Input horizontal distance between P2 and P3 or P4, and press [ENT].	Input HD + [ENT]	【Bearing-Distance】 Input data! Point 1: 10 AZ : 45 °00′00″ Point 2: 11 H-Dist: 2.000 m MEAS CALC SEARCH ↓ LIST ENH ←
⑥Press [F2] (CALC)to display the result. To stake out this point, input new PtID, and press [F1] to start staking out .※2) To save the data, press [F4]. To quit the result menu, press [ESC] to		【COGO New Point】 New Point : --- --- --- X/N : 114.142 m Y/E : 114.142 m New Point 2: --- --- --- X/N : 85.858 m Y/E : 85.858 m STAKE RECORD

return to data inputting menu, and re-input the data.		

※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse".
※2) The stake-out operation is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".

5.8.2.3 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

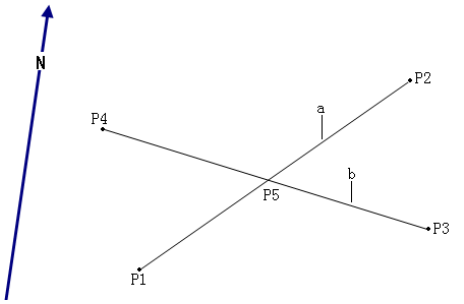
P4 Second COGO point

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Intersections menu, press [F3] to enter into Distance- Distance Intersection function.	[F3]	Intersections F1 Bearing-Bearing F2 Bearing-Distance F3 Distance- Distance F4 By Points F1 F2 F3 F4

②Input PtID of known point P1, and press [ENT] to move to next item. ※1)	Input PtID1 + [ENT]	Distance-Distance Input data! Point 1: 10 H-Dist: ---.--- m Point 2: --- H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH | ←
③Input horizontal distance between P1 and P3 or P4 (r1).	Input HD1 + [ENT]	【Distance-Distance】 Input data! Point 1: 10 H-Dist: 50.000 m Point 2: --- H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH |←
④Input the known point P2. Repeat step ②.	Input PtID2 + [ENT]	【Distance-Distance】 Input data! Point 1: 10 H-Dist: 50.000 m Point 2: 11 H-Dist: ---.--- m MEAS CALC SEARCH ↓ LIST ENH |←
⑤Input horizontal distance between P2 and P3 or P4 (r2).	Input HD2 + [ENT]	【Distance-Distance】 Input data! Point 1: 10 H-Dist: 50.000 m Point 2: 11 H-Dist: 20.000 m MEAS CALC SEARCH ↓ LIST ENH | ←
⑥Press [CALC] to display the result. To stake out this point, input new PtID, and press [F1] to start staking out.※2) To save the data, press [F4]. To quit the result menu, press [ESC] to return to data inputting menu, and re-input the data.	[F2]	【COGO New Point】 New Point : --- --- --- X/N : 4.000 m Y/E : -19.596 m New Point 2: --- --- --- X/N : 4.000 m Y/E : 19.596 m STAKE RECORD

※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse".
※2) The stake-out operation is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".

5.8.2.4 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

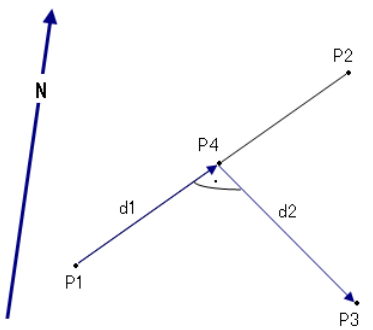
The unknown data: P5 COGO point

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Intersections menu, press [F4] to enter into By Points function.	[F4]	【Intersections】 F1 Bearing-Bearing F2 Bearing-Distance F3 Distance- Distance F4 By Points F1 F2 F3 F4
②Input PtID of the known P1, and press [ENT] to move to next item. ※1)	Input PtID1 + [ENT]	【By Points】 Input data ! Point 1: 10 Point 2: --- --- --- Point 3: --- --- --- Point 4: --- --- --- MEAS CALC SEARCH ↓ LIST ENH |←
③ Input the other known points P2, P3, P4 in the same way, and press [ENT].	Input P2,P3,P4 + [ENT]	【By Points】 Input data ! Point 1: 10 Point 2: 11 Point 3: 12 Point 4: 13 MEAS CALC SEARCH ↓

④Press [F2] (CALC) to display the result. To stake out this point, input new PtID, and press [F1] to start staking out .※2) To save the data, press [F4]. To quit the result menu, press [ESC] to return to data inputting menu, and re-input the data.	[F2]	【COGO New Point】 New Point : --- --- --- X/N ： 40.000 m Y/E ： 40.000 m STAKE RECORD
※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse". ※2) The stake-out operation is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".		

5.8.3 Offset

5.8.3.1 Distance-Offset



The known data:
- P1 Baseline start point
- P2 Baseline end point
- P3 Lateral point

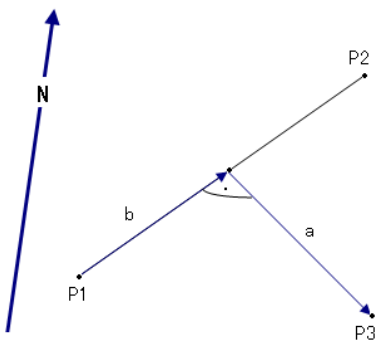
The unknown data:
- d1 Difference in length/abscissa (HD)
- d2 Lateral deviation/ordinate (Offset)
- P4 Base point

OPERATIONAL STEPS	OPERATION	DISPLAY
① In COGO Main Menu, press [F3] to enter into Offset function.	[F3]	【COGO Main Menu】 F1 Inverse & Traverse F2 Intersections F3 Offset F4 Extention F1 F2 F3 F4
② Press [F1] in Offset menu to enter into Distance-Offset function. Define the baseline first.	[F1]	【Offset】 F1 Distance - Offset F2 Point- Offset F1 F2
③Input PtID of the known P1, and press [ENT] to move to next item. ※1)	Input PtID1 + [ENT]	【Distance- Offset】 Input Baseline! Point 1: 20 Point 2: --- --- --- Input Pt-Offset! OffsPt:: --- --- --- MEAS CALC SEARCH ↓ LIST ENH ←
④Input another PtID of the known point P2, and press [ENT].	Input PtID2 + [ENT]	【Distance- Offset】 Input Baseline! Point 1: 20 Point 2: 21 Input Pt-Offset! OffsPt:: --- --- --- MEAS CALC SEARCH ↓
⑤Input PtID of target point P3, and repeat the last step.	Input offset PtID + [ENT]	【Distance- Offset】 Input Baseline! Point 1: 20 Point 2: 21 Input Pt-Offset! OffsPt:: 8 AB MEAS CALC SEARCH ↓
⑥Press [F2] (CALC) to display the result. To stake out this point, input new PtID, and press [F1] to start staking out .※2) To save the data, press [F4]. To quit the result menu, press [ESC] to return to data inputting menu, and	[F2]	【COGO New Point】 New Point : --- --- --- X/N : 40.000 m Y/E: 40.000 m STAKE RECORD

re-input the data.		

※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse".
※2) The stake-out operation of is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".

5.8.3.2 Point-Offset



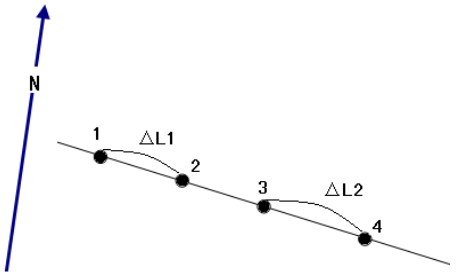
The known data: P1 Baseline start point
P2 Baseline end point
a Difference in length/ abscissa (HD)
b Lateral deviation / ordinate (Offset)
The unknown data: P3 Lateral point

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F3] in COGO Main Menu, and press [F2] in Offset menu to enter into Point-Offset function. Define the baseline first.	[F3] [F2]	【COGO Main Menu】 F1 Inverse & Traverse F2 Intersections F3 Offset F4 Extention F1 F2 F3 F4 【Offset】 F1 Distance - Offset F2 Point- Offset F1 F2 F3 F4

②Input point name of the known P1 point, and press [ENT] to move cursor to the next line. ※1)	Input PtID1 + [ENT]	【Point- Offset】 Define Baseline! Point 1: 20 Point 2: --- --- --- Toff & Loff! Line: --- --- --- Offset : --- --- --- MEAS CALC SEARCH ↓ LIST ENH ←
③ Input another PtID of the known point P2, and press [ENT].	Input PtID2 + [ENT]	【Point- Offset】 Define Baseline! Point 1: 20 Point 2: --- --- --- Toff & Loff! Line: --- --- --- Offset : --- --- --- MEAS CALC SEARCH ↓
④Input Toff & Loff, and press [ENT].	Input Toff & Loff + [ENT]	【Point- Offset】 Define Baseline! Point 1: 20 Point 2: 22 Toff & Loff! Line: 12.000 m Offset : 20.200 m MEAS CALC SEARCH ↓
⑤Press [F2] (CALC) to display the result. To stake out this point, input new PtID, and press [F1] to start staking out. ※2) To save the data, press [F4]. To quit the result menu, press [ESC] to return to data inputting menu, and re-input the data.		【COGO New Point】 New Point : --- --- --- X/N : 22.627 m Y/E : -5.657 m STAKE RECORD
※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse". ※2) The stake-out operation is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".		

5.8.4 Extension

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



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

The unknown data: P2, P4 Extended point

OPERATIONAL STEPS：

OPERATIONAL STEPS	OPERATION	DISPLAY
①In COGO main menu, press [F4] to enter into Extension function. Define baseline firstly.	[F4]	【COGO Main Menu】 F1 Inverse & Traverse F2 Intersections F3 Offset F4 Extention F1 F2 F3 F4
②Input PtID of the start point 1of baseline, and press [ENT] to move to next item. ※1)	Input start PtID of baseline + [ENT]	【Extention】 Define Extention! Point 1: --- --- --- Point 2: --- --- --- H-Dist : ---.--- m Select Base Pt! Base Pt: --- --- --- MEAS CALC SEARCH ↓ LIST ENH | ←
③Input PtID of the end point 3 of baseline, and press [ENT].	Input end PtID of baseline + [ENT]	【Extention】 Define Extention! Point 1: 20 Point 2: 22 H-Dist : ---.--- m Select Base Pt! Base Pt: --- --- --- AB MEAS CALC SEARCH ↓
④ Input the horizontal distance between extended point and start point or end point, and press [ENT]	Input H-Dist + [ENT]	【Extention】 Define Extention! Point 1: 20 Point 2: 22 H-Dist : 20.000 m Select Base Pt! Base Pt: 20 AB MEAS CALC SEARCH ↓

⑤Press ◄►to select the base points of extended point and the point related to horizontal distance, i.e. to decide whether the horizontal distance is the distance between extended point and start point or end point.		【Extention】 Define Extention! Point 1: 20 Point 2: 22 H-Dist : 20.000 m Select Base Pt! Base Pt: 20 ◄► AB MEAS CALC SEARCH ↓
⑥Press [F2] (CALC) to display the result. To stake out this point, input new PtID, and press [F1] to start staking out .※2) To save the data, press [F4]. To quit the result menu, press [ESC] to return to data inputting menu, and re-input the data.	[F2]	【COGO New Point】 New Point: X/N : 20.000 m Y/E : 25.000 m STAKE RECORD

※1) There are four methods to input the known PtID. Please refer to step ② of the last section "5.8.1.1Traverse".

※2) The stake-out operation of is similar to that of Traverse, which has been introduced previously. Please refer to "5.8.1.1 Traverse".

5.9 TIE DISTANCE

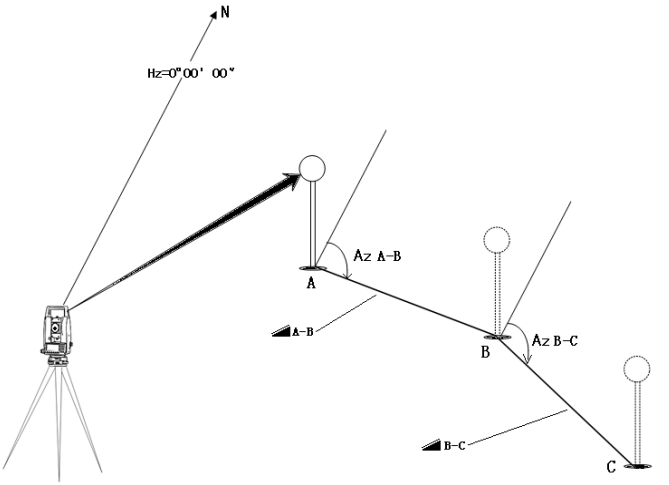
The application Tie Distance computes slope distance, horizontal distance, height difference and azimuth of two target points measured online, selected from the internal memory or entered manually.

User can select between two different methods:

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

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

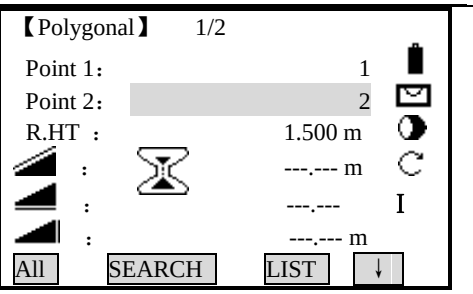
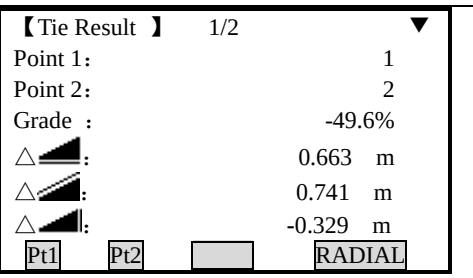
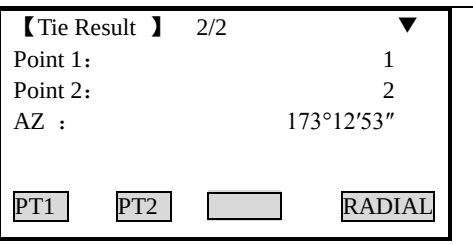
5.9.1 Polygonal (A-B, B-C)



OPERATIONAL STEPS：

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Programs menu, press [PAGE] to enter into Page 2, and press [F1] to start Tie Distance measurement.	PAGE [F1]	【 Programs 】 1/3 F1 Surveying (1) F2 Stake Out (2) F3 Free Station (3) F4 COGO (4) F1 F2 F3 F4 【Programs】 2/3 F1 Tie Distance (5) F2 Area(Plan) (6) F3 Remote Height (7) F4 Reference Line/Arc (8) F1 F2 F3 F4
②Set job, measurement station and orientation, and press [F4] to start measurement (As the method of setting job, station and orientation have been introduced previously, it will not be repeated here.)		【Tie Distance】 [*]F1 Setting Job (1) [*]F2 Setting Station (2) [*]F3 Setting Orientation (3) F4 Start (4) F1 F2 F3 F4

③Select the method of tie distance measurement. Here, take F1 Polygonal for example.	[F1]	【Tie Distance】 Select Method! F1 Polygonal(A-B, B-C) F2 Radial (A-B，A-C) F1 F2
④ Several methods are available to obtain the points applied in tie distance. A：Input PtID of the first target point A1 and the prism height of that point. Collimate the prism center and press [F1] (All) or [F1] (DIST) + [F2] (RECORD) to start measurement. B：Press [LIST]. In Pt Search dialog, through pressing ▲▼ to call up PtID from job. C: Input PtID and press [SEARCH] to see whether the point exists in job. If yes, proceed to the next step; if not, you need to input the coordinate of known point first. D：Press [ENH] and input a PtID that does not exist in job.	Input first target PtID, R.Ht + [F1] or[F1] + [F2] [F3] Input PtID + [F2] [F4] [F4] [F1]	A：Input PtID to start measurement 【Polygonal】 1/2 Point 1: 1 R.HT: 1.500 m : ---. --- m : ---.--- m : ---.--- ALL SEARCH LIST ↓ DIST RECORD EDM ↓ ENH ← B: Press [LIST] or [SEARCH] to call up the point in job. 【Pt Search】 1/10 1 Known 2 Known 11 Known 15 Meas. 21 Meas. 22 Meas. VIEW ENH JOB OK C: Input PtID and press [SEARCH] 【Pt Search】 1 Known VIEW ENH JOB OK D: Press [ENH] to input the coordinate. 【Coordinate Input】 Job: STONEX PtID : 2 X/N : ---.--- m Y/E : ---.--- m H/E : ---.--- m BACK OK

⑤ Set PtID of the second target Point B and prism height. The operation is similar to the above.		
⑥Display result of Tie Distance. △ : The horizontal distance between Point A and Point B. △: The slope distance between Point A and Point B. △: The vertical distance between Point A and Point B. Slope: The slope between Point A and Point B (%).		
⑦Press [PAGE] to turn to Page 2. Azimuth：the azimuth between Point A and Point B.	PAGE	

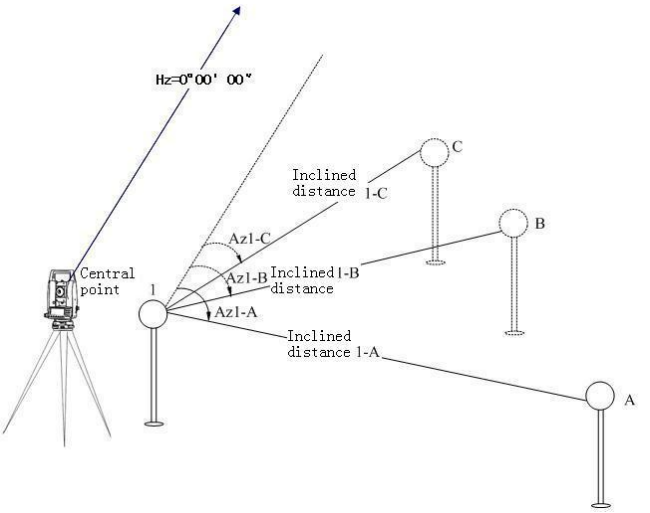
Softkeys – polygonal method:

[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.

5.9.2 Radial (A-B, A-C)



OPERATIONAL STEPS：

OPERATIONAL STEPS	OPERATION	DISPLAY
①Select Tie Distance and press [F2] to take Radial for example.	[F2]	【Tie Distance】 Select Method! F1 Polygonal(A-B, B-C) F2 Radial (A-B，A-C) F1 F2
②Set PtID of Central Point 1 and prism height of that point.※1)	Set central PtID and R.Ht	【New Pt1】 1/2 New Pt1: 1 R.HT: 1.500 m : ---.--- m : ---.--- m : ---.--- m All SEARCH LIST ↓
③Set PtID of end Point A and prism height .	Set end PtID and R.Ht.	【New Pt2】 1/2 New Pt1 : 1 New Pt2 : 2 R.HT : 1.500 m : ---.--- m : ---.--- m : ---.--- m All SEARCH LIST ↓

④Display result of Tie Distance. △ : The horizontal distance between Central Point 1 and Point A. △: The slope distance between Central Point 1 and Point A. △: The vertical distance between Central Point 1 and Point A. Slope: The slope between Point A and Point B (%). AZIMUTH : The azimuth between central point 1 and point A		【Tie Result】 1/2 ▼ NewPt1: 1 NewPt2: 2 Grade: -49.6% △: 0.663 m △: 0.741 m △: -0.329 m NewPt1 NewPt2 POLY . . 【Tie Result】 2/2 ▲ NewPt1: 1 NewPt2: 2 AZ: 173°12′53″ NewPt1 NewPt2 POLY
※1)There are many ways to set point names, please refer to the last section "5.9.POLYGONAL".		

Softkeys – radial method:

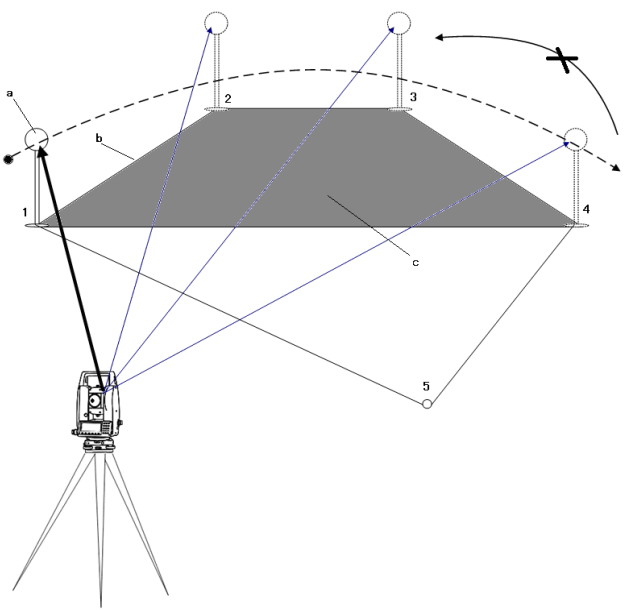
[F1]([NewPt1]): Determine new central point.

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

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

5.10 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.

OPERATIONAL STEPS ：

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Programs menu, press [PAGE] to turn to Page 2. And press [F2] to start Area Measurement.	PAGE [F2]	【Program】 1/3 ▼ F1 Surveying (1) F2 Stake Out (2) F3 Free Station (3) F4 COGO (4) F1 F2 F3 F4 【Programs】 2/3 F1 Tie Distance (1) F2 Area(Plan) (2) F3 Remote Height (3) F4 Reference Line/Arc (4) F1 F2 F3 F4
②Set job, measurement station and backsight orientation, and press [F4] to start area measurement.(As the method of setting job, station and orientation have been introduced previously, it will not be repeated here.).		【Area】 [*]F1 Setting Job (1) [*]F2 Setting Station (2) [*]F3 Setting Orientation (3) F4 Start (4) F1 F2 F3 F4
③ Several methods to obtain points applied in area measurement are available. A：Input PtID of the first target point and the prism height of that point. Collimate the prism center and press [F1] (All) or [F1] (DIST) + [F2] (RECORD) to start measurement. B：Press [LIST], in Pt Search dialog, press ▲▼ to call up PtID directly from job. C: Input PtID and press [SEARCH] to	Input first target PtID and R.Ht + [F1] or[F1] + [F2] [F3]	A：Input PtID to start measurement. 【Area 】 PtID： 1 R.HT： 1.500 m : ---.--- m NoPts : 0 Area : 0.000 m^2 All EDM RESULT ↓ DIST RECORD LIST ↓ ENH SEARCH | ← B：Press[LIST] to call up directly PtID from job

see whether the point exists in job. If yes, proceed to the next step; if not, you need to input the coordinate of known point first. D：Press [ENH] and input a PtID that does not exist in job.	Input point name + [F2] [F4] [F4] [F1]	【Pt Search】 1/10 1 Known 2 Known 11 Known 15 Meas. 21 Meas. 22 Meas. VIEW ENH JOB OK C：Input point name ,press [SEARCH] C: 【Pt Search】 1 Known VIEW ENH JOB OK D：Press [ENH] to input the coordinate. 【Coordinate Input】 Job： STONEX PtID ： 2 X/N ： ___.____ m Y/E ： ___.____ m H/Z ： ___.____ m BACK OK
④Set other PtIDs to be measured and prism height. The method is similar to the above. ※1)		【Area】 1/2 PtID： 4 R.HT： 2.000 m ： ---.--- m NoPts ： 4 AREA： 20.158 m^2 All EDM RESULT ↓
⑤ Points that are applied in area calculation will be counted by program, and displayed in the fifth line. If a minimum of 3 points are measured, press [F3] to view the result.		【Area Result 】 NoPts ： 4 Area： 20.158 m2 Area： 0.000 ha Girth： 11.025 m NEW AddPt
※1)To change EDM setting, press [F2].		

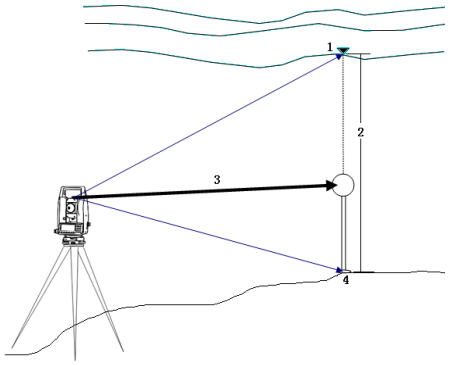
Softkeys:

[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.

5.11 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

Known prism height (Example: prism height (h) =1.500m)

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Programs menu, press [PAGE] to turn to Page 2, and press [F3] to start Remote Height measurement.	PAGE [F3]	【Programs 1/3 ▼ F1 Surveying (1) F2 Stake Out (2) F3 Free Station (3) F4 COGO (4) F1 F2 F3 F4 【Programs】 2/3 ▲▼ F1 Tie Distance (1) F2 Area(Plan) (2) F3 Remote Height (3) F4 Reference Line/Arc (4) F1 F2 F3 F4

②Set job, measurement station and backsight orientation, and press [F4] to start area measurement. (As the method of setting job, station and orientation have been introduced previously; it will not be repeated here.).		【Remote Height】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
③Input PtID of base point, and press [ENT].	Input base PtID + [ENT]	【Base Point】 Sight Meas Base Pt! Pt : 10 R.HT: 1.000 m : ---.--- m All DIST RECORD ↓
④Input the known prism height (Here, take h=1.500 for example), and press [ENT].	Input1.500 + [ENT]	【Base Point】 Sight Meas Base Pt! Pt : 10 R.HT: 1.500 m : ---.--- m All DIST RECORD ↓
⑤Collimate the prism center and press [F1] (All) or [F1] (DIST) + [F2] (RECORD) to start measurement. The position of the base point is set.	[F1] or[F2] + [F3]	【Remote Point】 Sight Meas REM Pt! BasePt : 10 R.HT: 1.500 m : ---.--- m BasePt SAVE
⑥ Aim at the target point (remote point). The result will be viewed.		【Remote Point】 Sight Meas REM Pt! Base Point : 10 Rem. Pt: 11 : 1.758 m △: 3.051 m H /Z : 2.421 m BasePt SAVE

PRISM HEIGHT IS UNKNOWN:

OPERATIONAL STEPS	OPERATION	DISPLAY
①First finish settings of job, station and orientation, and press [F4] to start Remote Height measurement.	[F4]	【Remote Height】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4
②Press [F4](↓) under the screen of Remote Height measurement menu to turn to next key page.	[F4]	【Base Point】 Sight Meas Base Pt! Pt : 10 R.HT: 1.500 m : ---.--- m All DIST RECORD ↓ R.HT EDM | ←
③ Press [F1] (R.Ht) to enter into remote-height measurement mode of unknown prism height .	[F1]	【Base Point】 Sight Meas Base Pt! Pt : 10 : ---.--- m BACK EDM |←
④Press [F4](|←) to return to previous page key. Input PtID of base point, and collimate prism center, by pressing [F1] (All) or [F2] (DIST) + [F3] (RECORD) to start measurement.	[F4] Input base PtID + [F1]	【Base Point】 Sight Meas Base Pt! Base Point: 10 : ---.--- m BACK EDM | ← All DIST RECORD ↓
⑤Screen displays horizontal distance between instrument and prisms. [F1](BACK): Input and measure a new base point.		【Base Point】 Sight Meas Base Pt! BasePt: 10 R.HT : 0.000 m : 1.968 m V: 92°05′52″ BACK V-ANG

⑥Aim at the ground point (base point) where the prism is set, and press [F4] (V-ANG). The base point is set up.	Aim at the top of the prism + [F4]	【Base Point】 Sight Meas Base Pt! BasePt: 10 R.HT : 0.000 m : 1.968 m V: 92°05′52″ BACK V-ANG
⑦ Aim at the target point (remote height point) to view the result.		【Remote Point】 Sight Meas REM Pt! BasePt : 10 RemPt: 11 : 1.969 m △: 1.144 m H : 2.014 m BasePt SAVE

The related soft keys in hanging-height measurement:

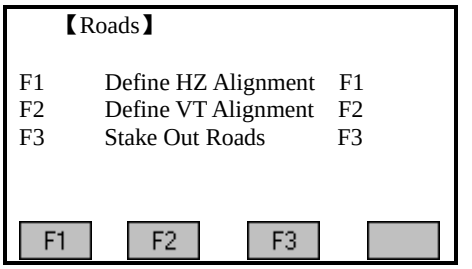
[F1]([BasePt]): Input and measurement of a new base point.

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

5.12 ROAD

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

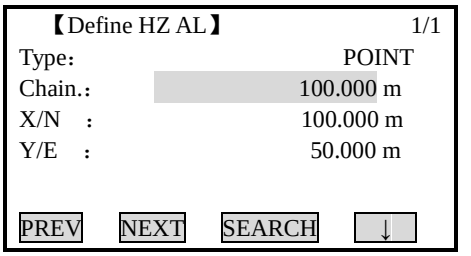
There are two methods to define HZ Alignment:

One is to define HZ Alignment via Line, Arc or Sprial;

The other is to define HZ Alignment via points.

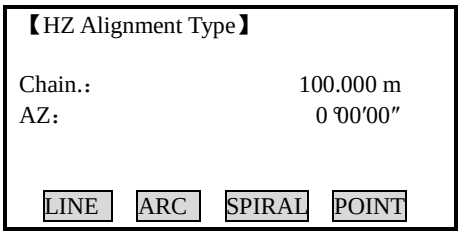
When using Line, Arc or Sprial to define HZ Alignment, the second method is restricted; similarly, when using points to define HZ Alignment, the first method is restricted. The two methods can't mix.

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 poin.



Serial number and the amount of present horizontal alignment are displayed on the upper right corner of the screen.

The element of start point consists of the start chainage and E, N coordinate of start point. Enter these details, and press [F2] (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 [F2] (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.

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Road menu, press [F4] to enter into Road function. As the method to set job, station and orientation have been introduced, they are not to be introduced here.	[F4]	【Roads】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4

②Press [F1] to enter into Define HZ Alignment function.	[F1]	【Roads】 F1 Define HZ Alignment F2 Define VT Alignment F3 Stake Out Roads F1 F2 F3
③ Input the coordinate of start chainage. After finishing one item, press [ENT] to move to the next item.	Input start chainage, and N, E coordinate + [ENT]	【Define HZ AL 】 1/0 Type: Start Pt Chain. : ---.--- m X/N : ---.--- m Y/E : ---.--- m PREV NEXT SEARCH ↓
④ when all items have been input, press [F2] (NEXT) to store start point information. The program displays: "Save Edit Alignment?" If yes, press [F4] (OK). To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL】 Save Edit Alignment? CANCEL OK
⑤ Enter into Horizontal Alignment main menu.		【HZ Alignment Type】 Chain.: 100.000 m AZ: 0 °00′00″ LINE ARC SPIRAL

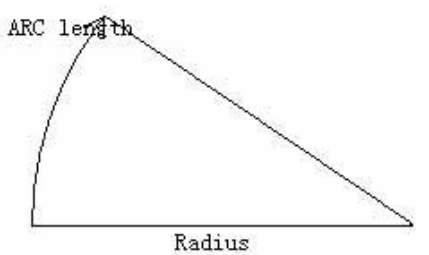
Line

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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F1] (LINE) to enter into HZ Alignment Type menu.	[F1]	【HZ Alignment Type】 Chain.: 100.000 m AZ : 0 °00′00″ LINE ARC SPIRAL POINT

② After inputting AZ angle, press [ENT] to go to next input item. After inputting the length of the line, press [ENT].	Input AZ + [ENT], Input length + [ENT]]	【Define HZ AL 】 2/1 Type: LINE AZ: ---°---′---″ Length: ---.--- m PREV NEXT SEARCH ↓
③ Press [F2] (NEXT), the program displays "Save Edit Alignment?" If yes, press [F4](OK). To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL】 Save Edit Alignment? CANCEL OK
④Press [F4] to store this alignment and return to alignment main menu, and displays chainage of the line, end point and azimuth of this point. • Now, user can define other curves. • When the line is in the middle of road, the azimuth angle of the line is calculated according to the previous elements. If user is to change this azimuth angle, the new azimuth angle can be input manually.		【HZ Alignment Type】 Chain : 131.000 m AZ: 25°00′00″ LINE ARC SPIRAL POINT

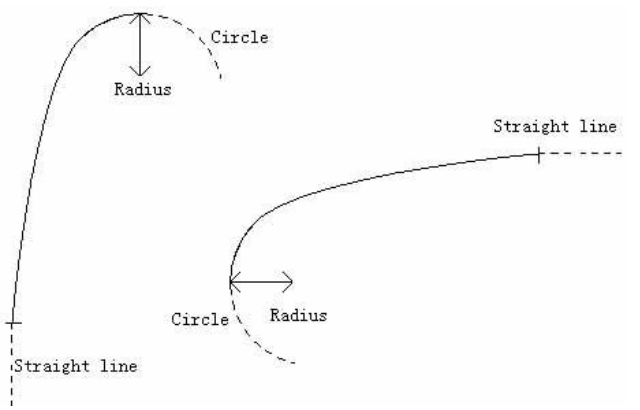
Curve



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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F2] (ARC) to enter into Define Arc Screen function.	[F2]	【HZ Alignment Type】 Chain.: 100.000 m AZ: 0 °00′00″ LINE ARC SPIRAL PT
②Input radius and arc length, then press [ENT] to record this data.	Input radius and arc length + [ENT]	【Define HZ AL】 2/1 Type: ARC Radius : ---.--- m ArcLen: ---.--- m PREV NEXT SEARCH ↓
③Press [F2] (NEXT), the program displays "Save Edit Alignment?" If yes, press [F4](OK). To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL】 Save Edit Alignment? CANCEL OK
④Press [F4] to store this alignment and return to alignment main menu, and displays chainage of end point of the curve and azimuth of this point.		【HZ Alignment Type】 Chain.: 151.000 m AZ : 68 °20′14″ LINE ARC SPIRAL

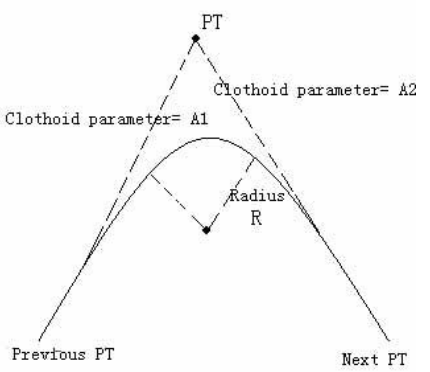
Spiral



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.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press SPRIAL key in the HZ Alignment Type menu to define spiral.	[F3]	【HZ Alignment Type】 Chain. ： 100.000 m AZ： 0°00′00″ LINE ARC SPIRAL POINT
②Enter the radius and arc length of the spiral. Press [ENT] to record the data.	Input the radius and arc length of spiral +[ENT]	【Define HZ AL】 2/1 Type： SPIRAL Radius： ---.--- m ArcLen： ---.--- m PREV NEXT SEARCH ↓
③Press [F2] (NEXT), the program displays "Save Edit Alignment?" If yes, press [F4] (OK). To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL】 Save Edit Alignment? CANCEL OK
④Press [F4] to store this alignment and return to alignment main menu, and displays chainage of end point of the spiral and azimuth of this point.		【HZ Alignment Type】 Chain.： 111.000 m AZ： 80°20′14″ LINE ARC SPRIAL

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.

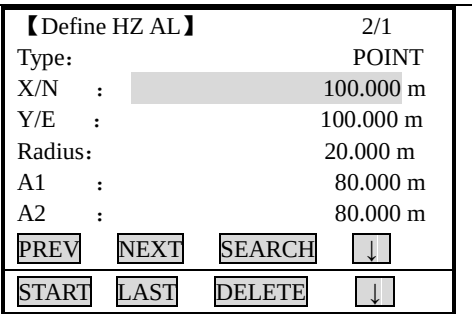
$$A_1 = \sqrt{L_1 \cdot \text{Radiu}}$$

$$A_2 = \sqrt{L_2 \cdot \text{Radiu}}$$

OPERATIONAL STEPS	OPERATION	DISPLAY
① Press [F4] in the HZ Alignment Type menu to define point.	[F4]	【HZ Alignment Type】 Chain.: 100.000 m AZ: 0°00′00″ LINE ARC SPIRAL POINT
②Input N,E coordinate, radius and A1,A2，then press [ENT].	Input N,E, radius and A1, A2 + [ENT]	Define HZ AL 7/6 Type: POINT X/N : ---.--- m Y/E : ---.--- m Radius: ---.--- m A1 : ---.--- m A2 : ---.--- m PREV NEXT SEARCH ↓
③Press [F2] (NEXT), the program displays “Save Edit Alignment?” If yes, press [F4] (OK). To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL 】 Save Edit Alignment? CANCEL OK
④Press [F4] to store this alignment and return to alignment main menu,		【HZ Alignment Type】 Chain.: 151.000 m AZ: 124°20′14″ POINT

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.

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].

OPERATIONAL STEPS:

OPERATIONAL STEPS	OPERATION	DISPLAY
① Use soft keypad below the screen, press [PREV] or [NEXT] to find out the alignment data needed to edit. User may also press [SEARCH] to search for the data needed to edit. In "Find HZ Alignment" dialog, input the chainage of alignment data needed to edit, and press [ENT].	[F1] or[F2] [F3] + Input chain	Define HZ AL 16/16 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 ↓ [SEARCH] : Find HZ Alignment Chain. ---.--- m OK

②Input new data, and press [ENT].	Input new data + [ENT]	Define HZ AL 2/16 Type: LINE Chain.: 151.000 m AZ: 68°20′14″ PREV NEXT SEARCH ↓
③Press [F2] (NEXT), the procedure displays "Save Edit Alignment?". If yes, press [F4] (OK); To re-edit it, press [F1] (CANCEL).	[F2]	【Define HZ AL】 Save Edit Alignment? CANCEL OK
④Screen displays next data.		【Define HZ AL】 3/16 Type: SPIRAL Radius: 22.000 m ArcLen: 12.000 m LINE ARC SPRIAL ↓

5.12.3 Deleting Horizontal Alignment Data

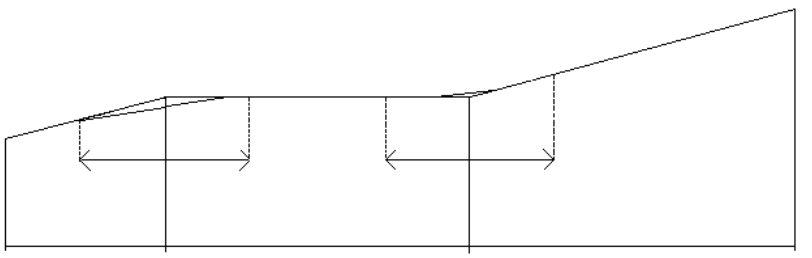
The horizontal alignment data in internal memory can be deleted. Operation is shown below.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Use soft keypad below the screen to display Page 2 of the menu.	[F4]	【Define HZ AL】 16/16 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 |←
②Press [F3] (DELETE), the program displays as the graph shown on the right.	[F3]	【Define HZ AL】 Delete All HZ Alignment? CANCEL OK

③ Press [F4] to delete horizontal alignment data, all the horizontal alignment data in internal memory will be deleted. The system returns to program of Define HZ Alignment. User may re-define horizontal alignment data. (Here, taking deleting horizontal alignment data for example) Press [F1] (CANCEL) if it is not to be deleted.		【Define HZ AL】 1/1 Type: Start Arc Chain. : ---.--- m X/N : ---.--- m Y/E : ---.--- m PREV NEXT SEARCH ↓

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
Height	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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In Road menu, press [F4] to enter into Road menu. As the method to set job, station and orientation have been introduced, they are not to be introduced here.	[F4]	【Roads】 [*] F1 Setting Job (1) [*] F2 Setting Station (2) [*] F3 Set Orientation (3) F4 Start (4) F1 F2 F3 F4

②Press [F2] to enter into Define VT Alignment function.	[F2]	【Roads】 F1 Define HZ Alignment F2 Define VT Alignment F3 Stake Out Roads F1 F2 F3
③Input chainage, height and curve length, and press [ENT]. The curve length of start point and end point must be zero.		【Define VT AL】 1/0 Chain.: 100.000 m H/Z: 12.000 m Length: 0.000 m PREV NEXT SEARCH ↓
④Press [F2] (NEXT), the procedure displays "Save Edit Alignment?". If yes, press [F4] (OK); To re-edit it, press [F1] (CANCEL).	[F2]	【Define VT AL】 Save Edit Alignment? CANCEL OK
⑤Press [F4] to store this alignment data, and returns to Define VT Alignment main menu. Proceed to input next alignment data.		【Define VT AL】 2/1 Chain.: ---.--- m H/Z: ---.--- m Length: ---.--- 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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Use soft keypad below the screen, press [PREV] or [NEXT] to find out the alignment data needed to edit. User may also press [SEARCH] to search for the data needed to edit. In "Find VT Alignment" dialog, input the chainage of alignment data needed to edit, and press [ENT].	[F1] or[F2] [F3] + Input chain	【Define VT AL】 16/16 Chain. : 100.000 m H/Z : 100.000 m Length: 0.000 m PREV NEXT SEARCH ↓ START LAST DELETE |← [SEARCH]: 【Search VT Alignment】 Chain. : ---.--- m OK
②Input new data, and press [ENH].	Input new data + [ENT]	【Define VT AL】 2/2 Chain. : 150.000 m H/Z : 25.010 m Length: 20.000 m PREV NEXT SEARCH ↓
③Press [F2] (NEXT), the procedure displays "Save Edit Alignment?". If yes, press [F4] (OK); To re-edit it, press [F1] (CANCEL).	[F2]	【Define VT AL】 Save Edit Alignment? CANCEL OK
④Screen displays next data.		【Define VT AL】 2/2 Chain. : 280.000 m H/Z: 15.010 m Length: 10.000 m PREV NEXT SEARCH ↓

5.12.6 Deleting Vertical Alignment Data

The vertical alignment data in internal memory can be deleted. Operation is shown below.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Use soft keypad below the screen to display Page 2 of the menu.	[F4]	【Define VT AL】 16/16 Chain. ： 500.000 m H/Z : 25.010 m Length : 0.000 m PREV NEXT SEARCH ↓ START LAST DELETE | ←
②Press [F3] (DELETE), the program displays as the graph shown on the right.	[F3]	【Define VT AL】 Delete All VT AL? CANCEL OK
③ Press [F4] to delete Vertical alignment data, all the Vertical alignment data in internal memory will be deleted. The system returns to program of Define VT Alignment. User may re-define Vertical alignment data. (Here, taking deleting Vertical alignment data for example) Press [F1] (CANCEL) if it is not to be deleted.		【Define VT AL】 1/0 Chain.： ---.--- m H/Z： ---.--- m Length： ---.--- m PREV NEXT SEARCH ↓

5.12.7 Road Stake-Out

To stake out alignment, the alignment type should be defined first. Two methods of defining horizontal alignment are available: installing in the computer via the data communication software provided by *STONEX*; or inputting manually in program "Road".

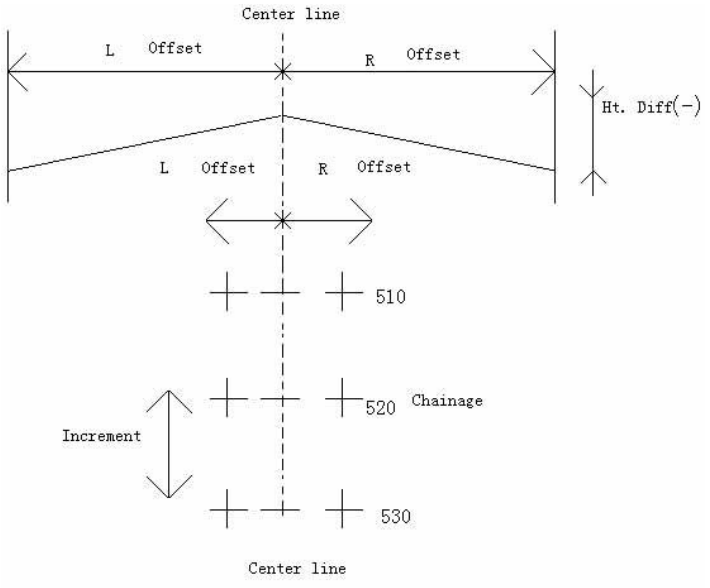
The vertical alignment data is unnecessarily to be defined, unless it is required to compute dig and fill. The method to define is similar to that of horizontal alignment.

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.

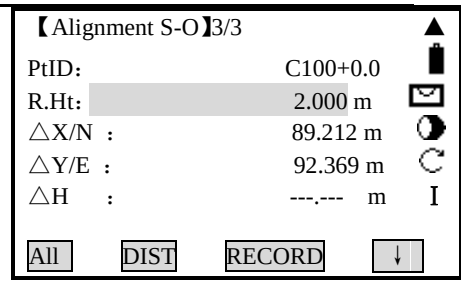
Vertical Difference Left (right): vertical difference between left (right) chainage and the central line point.



☞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, with three methods available:

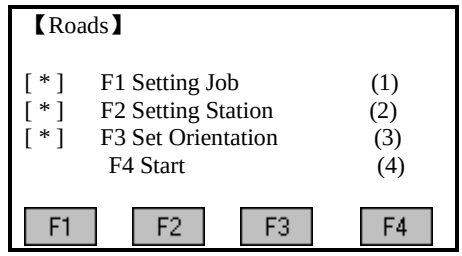
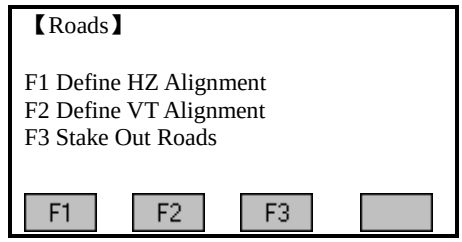
STAKE-OUT METHOD	OFFSET MEANING	DIPLAY
Polar Stake-out	△Hz (Angle Offset): Positive when stake-out point is on the right of the present measurement point. △ (Distance Offset)： Positive when stake-out point is further away. △(Height Offset)：Positive when stake-out point is higher.	【Alignment S-O】 1/3 PtID: C100+0.0 R.Ht: 2.000 m △Hz ： -61°59′32″ △: 127.369 m △: ---.--- m All DIST RECORD ↓
Orthogonal Stake-Out	△LOff (Longitude Offset): Positive when stake-out point is further away. △TOff (Latitude offset): Intercrosses the line of sight. Positive when stake-out point is on the right of the present measurement point.	【Alignment S-O】 2/3 PtID: C100+0.0 R.Ht: 2.000 m △LOff: 58.592 m △TOff: -114.270 m △H ： ---.--- m All DIST RECORD ↓

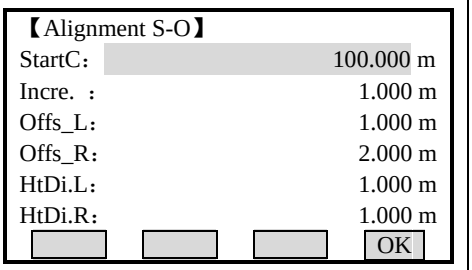
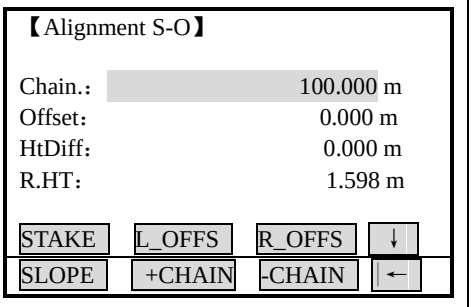
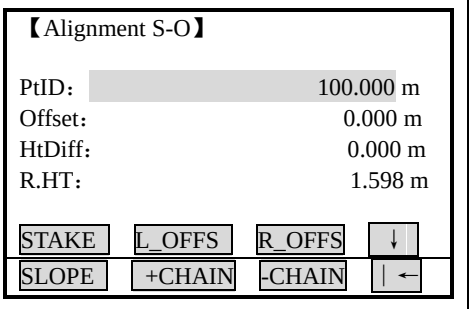
Coordinate Offset Stake- Out	△ X/△ N: X coordinate offset between stake-out point and the present measurement point. △ Y/△ E：Y coordinate offset between stake-out point and the present measurement point.	

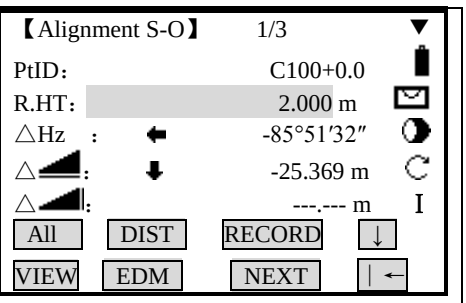
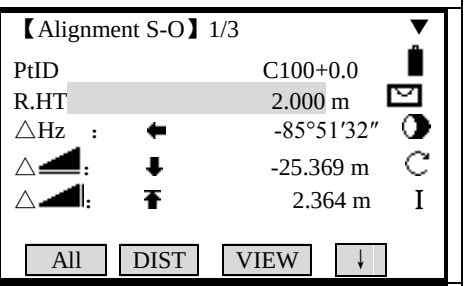
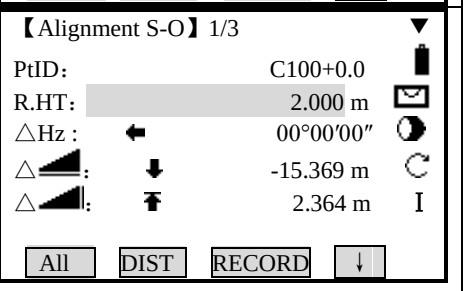
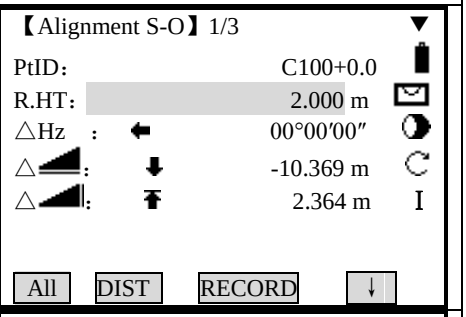
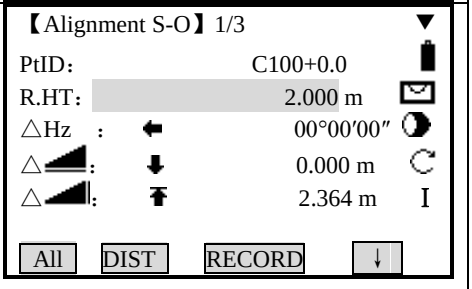
Press [PAGE] to switch among the three stake-out mode.

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 "5.6 STAKE OUT".

OPERATIONAL STEPS： (Take points on the central line for example.)

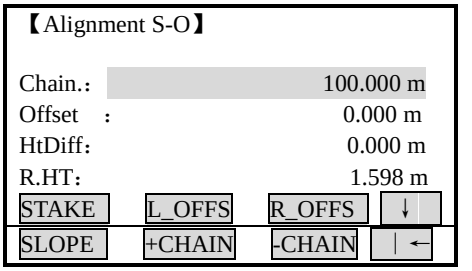
OPERATIONAL STEPS	OPERATION	DISPLAY
①Set job, station and orientation first, then in Road menu, press [F4] to enter into Road function.	[F4]	
② Define horizontal alignment and vertical alignment (as required to compute fill/dig). Press [F3] to start Stake Out Roads program.		

③ Displays the alignment stake-out data. Input start chainage, chainage increment, and the horizontal distance between side chainage point and central line. Height distance is required if fill/dig data is to be staked out. Offs_L：Horizontal distance between the left chainage point and central line. Offs_R：Horizontal distance between the right chainage point and central line. HtDi.L：Height difference between the left chainage point and central line HtDi.R：Height difference between the right chainage point and central line.		
④After the data is input, press [F4] (OK) to enter into the main screen of displaying stake-out point and offset. (See the introduction to Stake-Out Main Menu behind.) Here shows the stake-out data of central line of start chainage.	[F4]	
⑤Here regulates: Stake out points on the central line first, and then press [F2] (or [F3]) to stake out the left (or right) chainage. Press [L_OFFS] (or R_OFFS]), the relative chainage, offset, height difference will be displayed on the screen. Chainage and height difference can be input manually here. Offset is negative: Offset point is on the left of central line. Offset is positive: Offset point is on the right of central line.		

⑥ When the chainage and the offset to be staked out occurs, press [F1](STAKE) to enter into stake-out screen. Input prism height and start staking out. The operational steps are similar to that of Point Stake Out.		
⑦Collimate the current prism, press [F2] (DIST) to start measurement, and calculate and display the stake-out factor offsets of between target point and stake-out point.	[F2]	
⑧Rotate the telescope until △Hz shows an angle offset of 0°00′00″, and order the surveyor to move the prism. • Meanings of arrowheads: ⬅: From measurement station, move the prism leftward. ➡: From measurement station, move the prism rightward.		
⑨Set prism on zero direction based on the telescope and collimate it, press [F2] (DIST) to start measurement and calculate the stake-out factor offset between prism point and stake-out point. Arrowhead direction is the direction the prism is to move.	[F2]	
⑩ Move the prism forward or backward according to arrowhead until △ shows a distance value of 0 m. • Arrowhead's meanings: ⬇: To move the prism toward to the measurement station. ⬆: To move prism further away from the direction of measurement station. In the process of stake-out, if fine (r) or		

tracking measurement mode is selected, the factor offset of between prism point and stake-out point can be displayed at real time, which is of great convenience.		
(11) As both △Hz and △ reads 0, it means that the current prism point is the stake-out point. △ shows the data of fill/cut. : Means it needs to dig. The value is the depth to dig. : Means it needs to fill. The value is height to fill.		【Alignment S-O】1/3 PtID: C100+0.0 R.HT: 2.000 m △Hz : 00° 00′ 00″ △: 0.000 m △: 2.364 m All DIST RECORD ↓
(12) After one point is staked out, press [F4] to display Page 2 of soft keys. Press [F3] (NextPt) to enter the inputting screen of next chainage data; Repeat StepS ⑥～(11) , to stake out each featured point.		【Alignment S-O】 Chain.: 100.000 m Offset: 0.000 m HtDiff: 0.000 m R.HT: 1.598 m STAKE L_OFFS R_OFFS ↓

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.

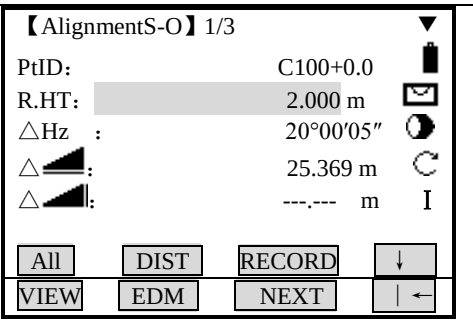
R_OFFS: This key is used to stake out right chainage. Press it to display the offset and the height difference of the right chainage.

+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 "-".

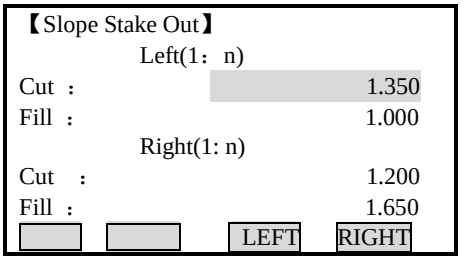
+ (or-) behind the number is the distance between points of right chainage and central line, i.e. the data of the right offset (or left offset) data. Here, the points on the central line read 0.0.

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.

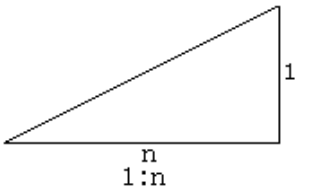
5.12.8 Slope Stake-Out

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 [F1] (SLOPE) to display Slope Stake Out.

Main Screen of Slope Stake Out

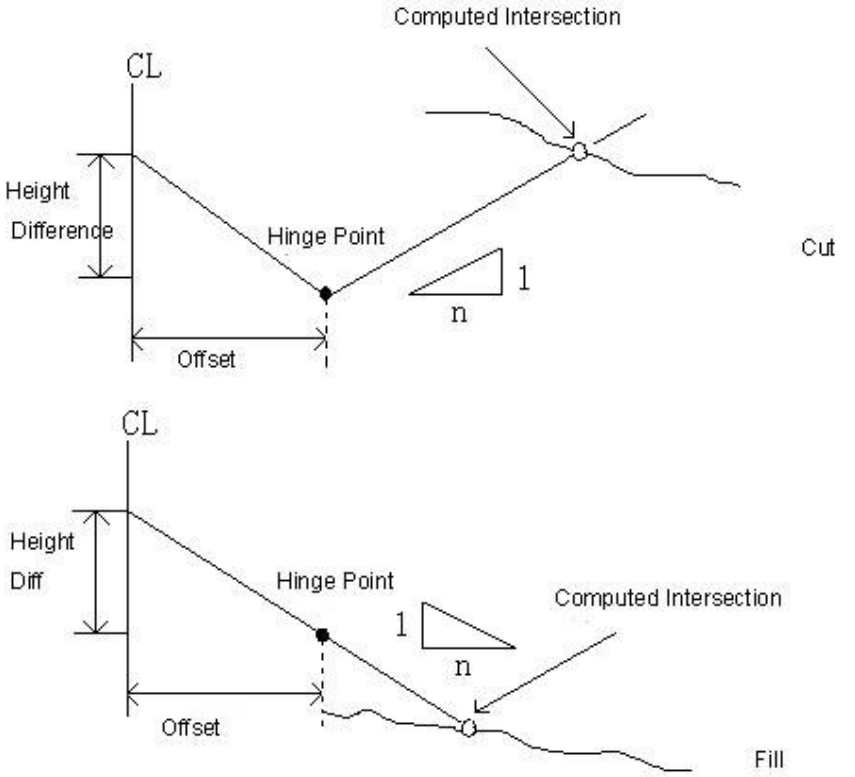


Indeed, the fill/ cut value that are input here is a ratio.



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.



OPERATIONAL STEPS	OPERATION	DISPLAY
①Input (or select) the side chainage to be slope staked out. Press [F4] (↓) to turn to Key Page 2, and press [F1] (SLOPE) to start slope stake-out .	[F4] [F1]	【Alignment S-O】 Chain.: 100.000 m Offset : 0.000 m HtDiff: 0.000 m R.HT: 1.598 m STAKE L_OFFS R_OFFS ↓ SLOPE +CHAIN -CHAIN ←
② Input the ratio of left and right slopes to be filled (or digged). After finishing inputting one item, press [ENT]. When all data are input, select the left (or right) slope to be staked out.		【Slope Stake Out】 (1：n)LEFT Cut : 1.350 Fill : 1.000 (1: n)RIGHT Cut : 1.200 Fill : 1.650 LEFT RIGHT

③ Enter into the screen of Slope Stake Out function, input prism height, collimate the point that is to be intercepted near the slope, and press [F2] (DIST) to start slope stake-out. The system will select an appropriate slope from the data input in last Step. Suppose to set the height of measurement point as the horizontal datum plane, calculate the intercepted point. The list displays the offset between measurement point and calculated point. The method to stake out slope is similar to that of point stake-out. When both △ L-Off △ T_Off are zero, it indicates that the stake-out point is found.	[F2]	【Slope Stake Out】 PtID: C100+10.0S R.HT: 2.000 m △LOff : ---.--- m △TOff : ---.--- m All DIST RECORD EDM
④ After finishing staking out this point, press [ESC] to return to the main screen of Slope Stake Out, input other slope to be staked out to proceed the stake-out of next slope via the same approach.		【Slope Stake Out】 Left(1:n) Cut: 1.350 Fill: 1.000 Right(1: n) Cut: 1.200 Fill : 1.650 LEFT RIGHT

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:

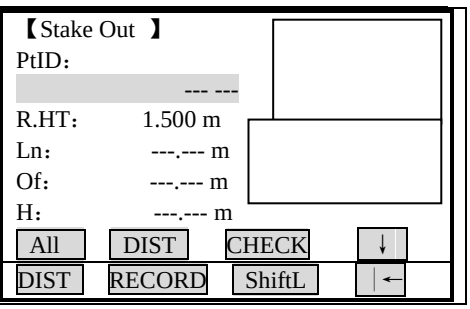
a) New construction site

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

5.13.1 Defining New Construction Site

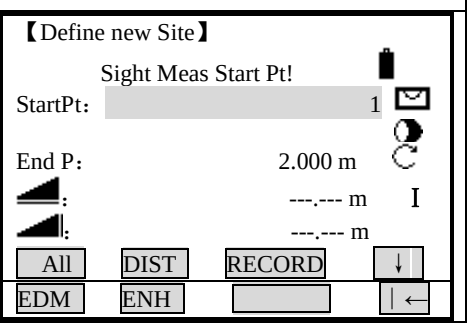
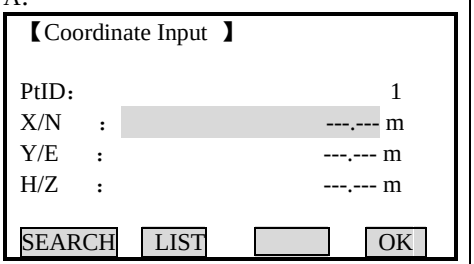
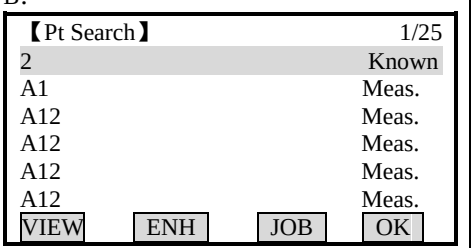
OPERATIONAL STEPS:

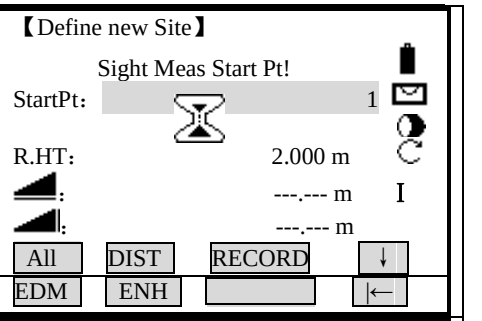
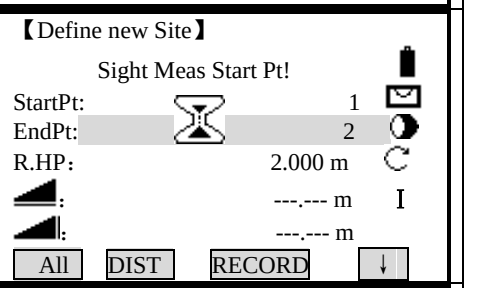
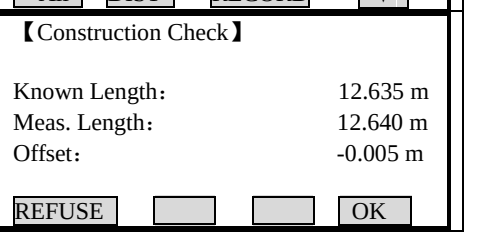
OPERATIONAL STEPS	OPERATION	DISPLAY
①In Program Page 3/3, press [F2] to enter into Construction function.	[F2]	【Programs】 3/3 ▲ F1 Roads (9) F2 Construction (0) F1 F2
②Set Job [F1]：call up a job from internal memory [F4]：Set the file selected by the navigation key as the current job.		【Setting Job】 Job ： A Name： --- --- --- Date： 2011.06.21 Time ： 09:50:28 LIST OK
③Displays the menu of Construction. To re-set a new job, press [F1]. To set EDM, press [F2]. To set a new site, press [F3]. To adopt the site set previously, press [F4]. Here, take setting a new construction site for example: press [F3].	[F3]	【Construction 】 F1 Setting Job F2 EDM Setting F3 Defining new Site F4 Skips set-up F1 F2 F3 F4
④Input the Start PtID of construction site and prism height, collimate the prism center, press [F2] (DIST) + [F3] (RECORD) to start measurement. ※1)	Input start PtID of site + [F2] + [F3]	【Defining new Site】 Sight Meas Start Pt! StartPt： 1 R.HT： 2.000 m ---.--- m ---.--- m All DIST RECORD ↓ EDM ENH ←
⑤Input end PtID of end site and prism height, collimate the prism center, and press [F2](DIST) + [F3] (RECORD) to measure the end point of construction site.	Input end PtID + [F2] + [F3]	【Defining new Site】 Sight Meas End Pt! StartPt： 1 End Pt： 2 R.HT： 1.500 m ---.--- m ---.--- m All DIST RECORD ↓

⑥ After setting the site, enter into Stake Out menu.		

Set Construction Site via Known Point

If the point to be measured here is known point and X, Y coordinates have been input, the program will display the length calculated, the practical length measured, and the dialog of offset value.

OPERATIONAL STEPS	OPERATION	DISPLAY
① Enter setting new line function. Entry dialog of defining start point, press [F4] display the second page soft key.	Input start PtID of site + [F2] + [F3]	
② Press [F2] (ENH) to enter into dialog of coordinate inputting. A： Input directly the known point name and E, N, H coordinate, this operation will not store the known points being inputted to job. B: Through pressing [F1] (SEARCH) or [F2] (LIST) in Graph A to call up known points in job.		A：  B： 

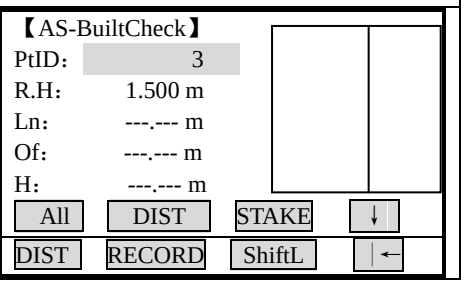
③After the start point of site has been decided, input prism height, collimate the prism center, press [F2](DIST)+ [F3] (RECORD) to start measurement.	[F2] + [F3]	
④ Following Step ② to determine the end point of site, and input the prism height, and press [F2] (DIST) + [F3] (RECORD) to start measurement.	[F2] + [F3]	
⑤To display the result screen. [F1]：Reject the result, and rebuild the site. [F4]：Accept the result to set the line and enter into stake out screen.		

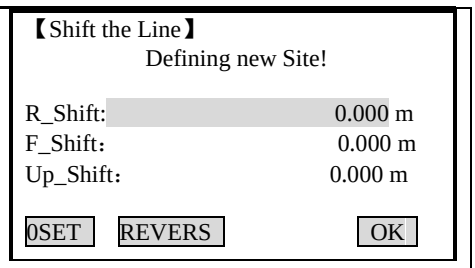
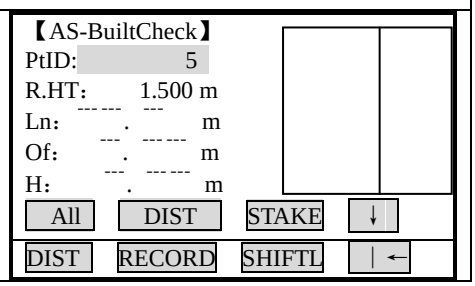
5.13.2 Shifting Line

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

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

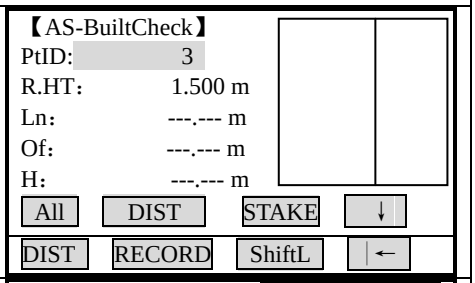
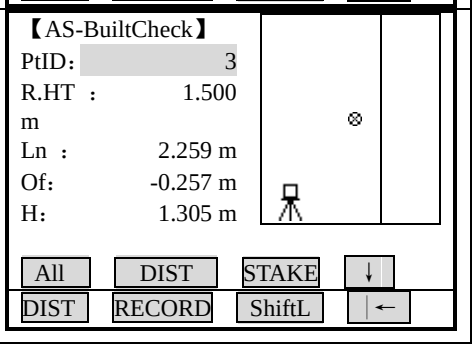
OPERATIONAL STEPS:

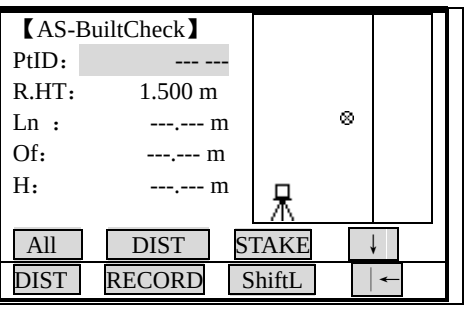
OPERATIONAL STEPS	OPERATION	DISPLAY
① To horizontally shift the line, press [F4] (↓), and press [F3] (ShiftL).	[F4] [F3]	

② Input the shifting value to shift the line. After inputting one item, press [ENT] to move to next item. After finishing inputting all items, press [F4] (OK). To set all shifting value to zero, press [0SET] to reverse the site and press [REVERS].	Input shifting value + [ENT] + [F4]	
④ After rebuild site，return to【AS-BuiltCheck】or【Stake out】screen.		

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.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Input PtID to be measured and prism height.	Input PtID, R.Ht + [ENT]	
②Collimate the prism center, press [F2] (DIST) to start measurement, the screen will display longitude, latitude and the height difference between the target point and line. Meanwhile, the graphic on the right of the screen displays the relation among the prism, station and the line.	[F2]	

③Proceed the measurement of other points in the same approach.		

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.

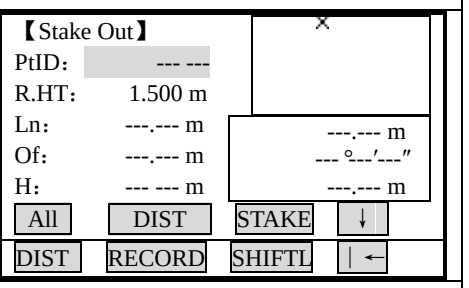
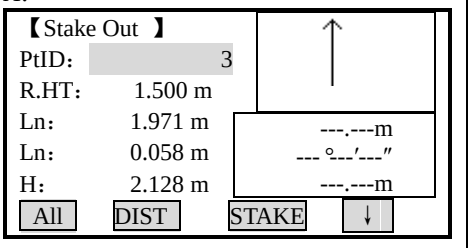
Soft Keys:

[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.

OPERATIONAL STEPS	OPERATION	DISPLAY
① In 【AS-BuiltCheck】menu, press [F3] (STAKE) to enter into Stake Out function.※1)		
② Input the PtID of the point to be staked out and press [ENT]. Move on to next item and input prism height. A：If the PtID exists in the job, it displays the relation between this point and the line. B: If there are several data with the same PtID, it displays the dialog of PtID being found. User can select by	Input PtID & prism height + [ENT]	A:  B:

pressing ▲▼. C：If the point does not exist, user is required to input the coordinate.		【Pt Search 】 1/25 12 Known 12 Meas. 12 Meas. 12 Meas. 12 Meas. 12 Meas. VIEW ENH JOB OK C: 【Pt Search】 Job: STONEX ◀▶ PtID: 56 Select job/input Pt coord SEARCH 0SET ENH OK
③Collimate the prism center, press [F2] (DIST) to start measurement, the screen will display longitude, latitude and height difference between target point and the line. The upper right graphic displays the relation between prism point and stake-out point. Lower right displays a precise offset value and offset direction with an arrowhead.	[F2]	【Stake Out 】 PtID: 3 R.HT : 1.500 m Ln: 1.971 m 1.967 m Of: 0.058 m 0.023 m H: 2.128 m 2.369 m All DIST CHECK ↓
④ Move the prism according to the graphic. When both longitude and latitude arrowhead display zero, it means the stake-out point has been found; H means the filling. Method to stake-out is the same as"5.6 Stake Out". ※2)		【Stake Out 】 PtID: 3 R.HT: 1.500 m Ln: 1.971 m 0.000m Of: 0.058 m 0.000 m H: 2.128 m 0.369 m All DIST CHECK ↓

※1) To shift the line horizontally, press [F3] (ShiftL).

※2) Longitude offset direction is positive (Arrowhead upwards): Target point is further away from measurement point.

Latitude offset is positive (Arrowhead rightwards): Target point is on the right of measurement point

H is positive (Arrowhead upwards): Target point is higher than measurement point.

The height of the line start point is always used as the reference height.

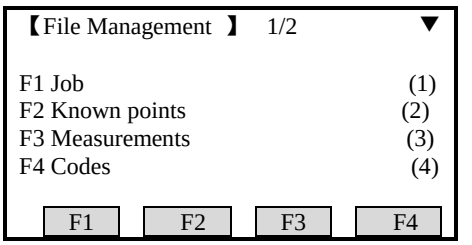
To give a better overview, the graphics are designed in accordance with the scale. Therefore it's possible that the station point moves in the graphic.

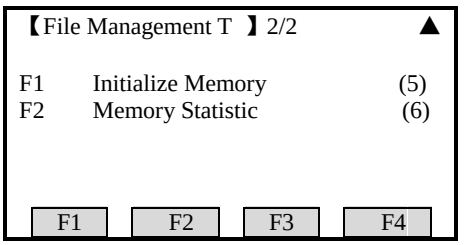
Be aware that the start point and the end point of the line are measured in the previous coordinate system. When staking out these points they appear in the old system and appear as shifted.

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 and examining data in the field.



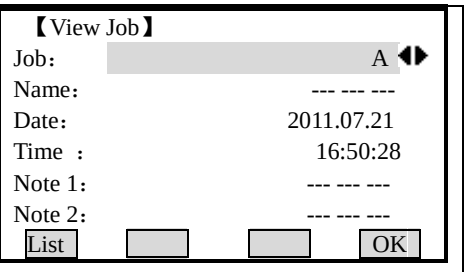
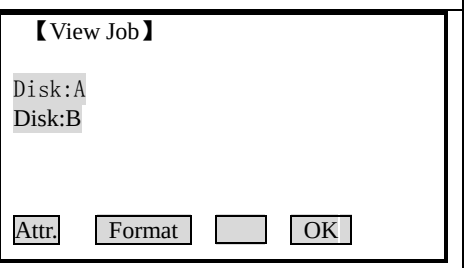
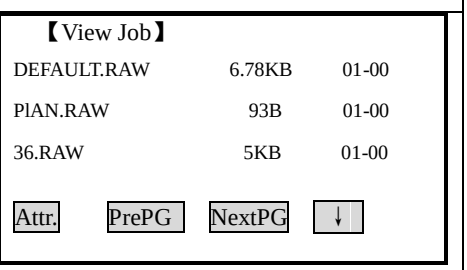


6.1 JOB

- 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 a job includes input of its name and operators.

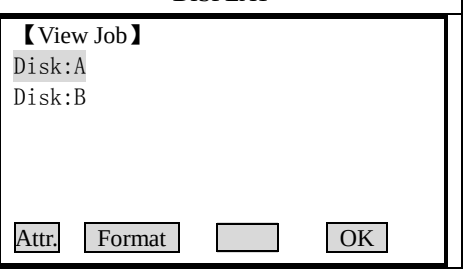
6.1.1 Selecting Job

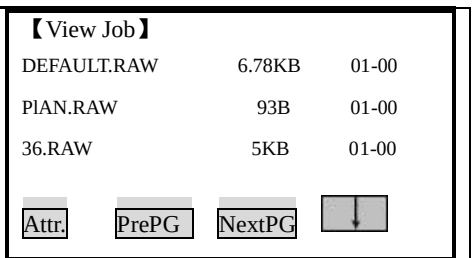
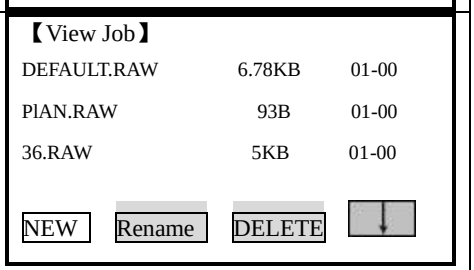
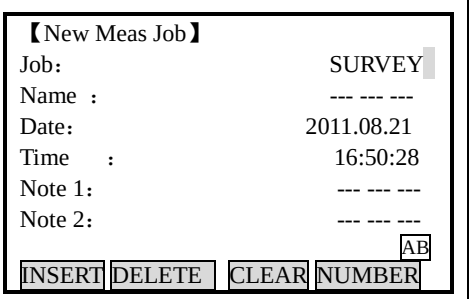
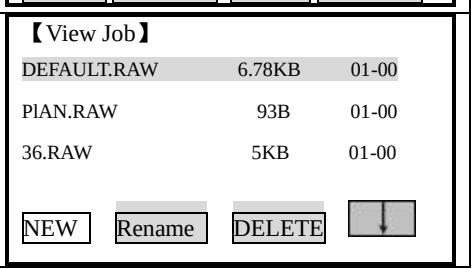
OPERATIONAL STEPS	OPERATION	DISPLAY
①Inside File Management menu, press [F1] to enter into Job function.	[F1]	【File Management】1/2 ▼ F1 Job (1) F2 Known (2) F3 Measurement (3) F4 Code (4) F1 F2 F3 F4

② The Screen displays the name and other information of the current job.		
③Press F1（list）to enter into the screen on the right, then press OK to view jobs in Internal memory.(If a SD card has been installed in the total station, then Disk:B will appear, otherwise, there is only Disk:A (Internal memory))		
④As the required file name appears, press Enter key, and then press F4(OK); the program prompts “Job set already!” Then this file is opened and set as the present job. The measurement data since then are stored in this file.		

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.

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Job menu, press [F4] to turn to next page. ② Then press [F1](NEW) to create a new job.		

		
③Open inputting mode by pressing numeric keypad, input the name of job to be established. To switch between character and figure inputting mode, press [F4]. When displaying AB, it means the status of character inputting, while display [01] means the status of figure inputting. As one item has been finished, press [ENT] to move to the next inputting item. To return to last menu to view the job, press [F1] (VIEW).		 
③After finishing inputting, press [F4] to store this job and return to last menu. The job established is displayed and set as the current job.		

※1) A maximum of 17 jobs are able to be established.

※2) In the whole text, if a SD card has been installed in the total station, then "Disk:B" will appear, otherwise, there is only Disk:A (Internal memory)

[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!"

6.1.3 Deleting Selected Job

OPERATIONAL STEPS	OPERATION	DISPLAY
① In Job menu, press navigation key ▲▼ to select the job file you want to delete.		【View Job】 DEFAULT.RAW 6.78KB 01-00 PlAN.RAW 93B 01-00 36.RAW 5KB 01-00 NEW Rename DELETE ↓
② Press [F3] (DELETE), a dialog shows as the right graph. To confirm to delete, press [F4] (OK). Otherwise, press [F1] (CANCEL) to return to last menu.		【Delete Job】 Delete File PLAN.RAW Are you sure CANCEL OK

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 (X, Y) or height (H).

OPERATIONAL STEPS	OPERATION	DISPLAY
① In File Management menu, press [F2] to enter into Known Points function.	[F2]	【File Management】1/2 ▼ F1 Job (1) F2 Known points (2) F3 Measurement (3) F4 Codes (4) F1 F2 F3 F4
②Input the file name and press【F4】（OK）to find the job.		【View Known Pt】 Job： 2222 List OK

③Then the screen displays the known point information in the present job.		【View Known Pt】 Job : A:\2222.PTS Pt ID: 1 X/N : 100.000 m Y/E : 100.000 m H/Z : 90.000 m SEARCH DELETE ADD EDIT
④press ◀ ▶ to view all the known points in this job one by one. ※1)		【View Known Pt】 Job : A:\2222.PTS Pt ID: 2 X/N : 100.000 m Y/E : 200.000 m H/Z : 80.000 m SEARCH DELETE ADD EDIT

6.2.1 Searching Known Points

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

OPERATIONAL STEPS	OPERATION	DISPLAY
①select a job (or all jobs). Press [F1] (SEARCH) to start Search function.		【View Known Pt 】 Job : A:\2222.PTS Pt ID: 1 X/N : 100.000 m Y/E : 100.000 m H/Z : 90.000 m SEARCH DELETE ADD EDIT
②A dialog appears as the right graph. Input PtID or wildcard "*" and press [ENT].		SEARCH Job : A:\2222.PTS Pt ID: * BACK .
③Displays searching result dialog. If a certain known point is to be searched, the coordinate information of this point appears. If wildcard "*" is input, press ◀ ▶ to display all the known points in the job one by one.		View Known Pt Job: A:\2222.PTS Pt ID: 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

Popup a dialog to input PtID and coordinate of a new known point.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Select the job needed to add a new known point.		【View Known Pt】 Job：A:\2222.PTS Pt ID：1 X/N ：100.000 m Y/E ：100.000 m H/Z ：90.000 m SEARCH DELETE ADD EDIT
②Press [F3](ADD) to start-up data adding function. The screen displays a dialog showed as the right graph. To return to the previous menu, press [F1] (VIEW).		【Input Known Pt】 Job ：A:\2222.PTS Pt ID ：--- --- --- X/N ：---.--- m Y/E ：---.--- m H/Z ：---.--- m VIEW SAVE
③Input PtID and coordinate of the new known point, then press [ENT]. After finishing inputting, press [F4] (SAVE) to finish adding known points, and store after the known points existing in the file. If the PtID input exists in internal memory, the program calls up the coordinate of this point. To store it with the other PtID, press ▲ to move to the PtID item and re-input the PtID. To input new coordinate without changing PtID, press [F4] (SAVE). The screen shows as the right graph. To overwrite the known data, press [F4] (OK). To re-input PtID, press [F1] (CANCEL).		【Input Known Pt 】 Job ：A:\2222.PTS Pt ID ：002 X/N ：100.000 m Y/E ：100.000 m H/Z ：100.000 m VIEW SAVE 【Input Known Pt 】 Pt. exist! Want to cover the data? CANCEL OK
④ After finishing adding a known point, the program automatically add 1 (+1) to the PtID, and continues to input other known points, as shown in the right graph. To quit this program, press [ESC] to return to last menu.		【Input Known Pt】 Job：A:\2222.PTS Pt ID：003 X/N ：100.000 m Y/E ：100.000 m H/Z ：100.000 m VIEW SAVE

6.2.3 Editing the Known Points

This function allows editing known points in internal memory.

OPERATIONAL STEPS	OPERATION	DISPLAY
①Select the job which contains the point to be edited. Press F1[List] to choose the job in internal memory.		View Known Pt Job: 2222 List OK
②Press navigation key ◄▯▯► (or use search function) to find out the data needed to edit.		View Known Pt Job: A:\2222.PTS Pt ID: 10 X/N : 110.000 m Y/E : 102.000 m H : 116.000 m SEARCH DELETE ADD EDIT
③ Press [F4] (EDIT) to start data editing function, and the screen displays this point data. Input new PtID, coordinate, and press [ENT] to move to the next line. For those data needed not edit, press [ENT] directly.		Edit Known Pt Job: A:\2222.PTS Pt ID : 10 X/N : 110.000 m Y/E : 102.000 m H/Z : 116.000 m Back SAVE
④As input is finished, press [F4] to save the edited data.		Edit Known Pt Job: A:\2222.PTS Pt ID : 10 X/N : 110.000 m Y/E : 102.000 m H/Z : 116.000 m Data Save! DELETE OK
⑤After finishing editing data, return to last menu, and the data edited is displayed.		【View Known Pt】 Job : A:\2222.PTS Pt ID : 10 ◄► X/N : 110.000 m Y/E : 102.000 m H/Z : 116.000 m SEARCH DELETE ADD EDIT

6.2.4 Deleting Known Points

Deletes the selected known points in internal memory

OPERATIONAL STEPS	OPERATION	DISPLAY
①Select the job that contains the data to be deleted. Press [ENT] to move to PtID item, by pressing ◄◄► (or use search function) to find out the data to be deleted.	◄◄► [ENT]	【View Known Pt 】 Job：A:\2222.PTS Pt ID： 1 ◄► X/N ： 100.000 m Y/E ： 100.000 m H/Z ： 90.000 m SEARCH DELETE ADD EDIT
② Press [F2] (DELETE) to start deleting data function. The screen displays a dialog showed as the right graph. To delete data, press [F4] (OK). If not to delete, press [F1] (CANCEL).	[F2]	View Known Pt Delete data? Deleted data No Revert! CANCEL OK
③The screen returns to last menu.		【View Known Pt】 Job ： A:\2222.PTS Pt ID ： 1 ◄► X/N ： 100.000 m Y/E ： 100.000 m H/Z ： 90.000 m SEARCH DELETE ADD EDIT

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.

OPERATIONAL STEP：

OPERATIONAL STEPS	OPERATION	DISPLAY
①In File Management menu, press [F3] to enter into point measurement function.	[F3]	【File Management 】 1/2 ▼ F1 Job (1) F2 known points (2) F3 Measurements (3) F4 Code (4) F1 F2 F3 F4
②The system takes the current job name as the default job to view. To examine the other measurement data, input the job name and press [ENT] to move to station point item.	[ENT]	View Measurement Job: 2222 Stn.Pt: * PtID: * F4 View All Meas.Value LIST VIEW
③The examination scope defaulted in this system is all measurement stations in the job to be examined (“*”), as the right graph shows. Therefore, to view all measurement data in job, just press [F4] (VIEW).		【View Measurement】 Job: 2222 Stn.Pt: * PtID: * F4 View All Meas.Value LIST VIEW
④ The screen displays various measurement information starting with the first data in job. “1” on the upper right corner of screen represents that this point is the first data in job. ※1)～※3)		View 1 Type: Para.Sys.ness Date: 2011.06.21 Time: 14:44:12 START LAST FIND

⑤ A: Press [PAGE] to display other pages of this data. B: Press ◀▶ to display all data in the job one by one.		A: Find the other page: EDM Type: IR EDM Mode: Fine[S] Prism type: Prism Prism: -30mm [ ] [START] [LAST] [FIND] B: Find the other data 【View】 2 ◀▶▼ Type : Station SYS.MESS StnPt : OCC1 INS.Ht : 1.000 m Date : 2010.08.22 Time : 14:44:52 [ ] [ ] [ ] [FIND]
⑥Press [F4] (FIND) to return to View Measurements main menu. To return to File Management menu, press [ESC].		【View Measurements】 Job: 2222 Stn.Pt: * PtID: * F4 View All Meas.Value [LIST] [ ] [ ] [VIEW]

※1) The first data of general job documents displays some measurement information, such as: Data of job establishment, type of prism, EDM, etc.

※2) ◀▶ indicates that user can use navigation key ◀◀▶ to display each data in job.

※3) ▼,◆,▲indicates that there are still some other pages of this data, and it may be displayed by pressing [PAGE].

6.3.1.2 Viewing Designated PtID in Job

Starts searching point. R2 Total Station 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 pointIDs or the pointIDs with wildcard "*".

OPERATIONAL STEPS	OPERATION	DISPLAY
①In View Measurements menu, input the job name to search, or Press[F1](LIST) to call the job from internal memory. Then press [ENT] to move to the next inputting area.	◀●	【View Measurements】 Job: 2222 Stn.Pt: * PtID: * F4 View All Meas.Value [LIST] [ ] [ ] [VIEW]

②All searching conditions are based on the premises of measurement stations. So the name of measurement stations input here can be a concrete pointID or pointID with wildcard "*". ※1) A: The system defaults wildcard "*", i.e. all measurement stations. B: Input an existing PtID, and press [ENT].		A: 【View Measurements】 Job: 2222 Stn.Pt: * PtID: * F4 View All Meas.Value LIST VIEW B: 【View Measurements】 Job: 2222 Stn.Pt: OCC1 PtID: * F4 View All Meas.Value LIST VIEW
③ Displays searching result which relies on the settings of job name, measurement station name and PtID. ※2)～※3). A: If the pointIDs that are qualified to searching conditions have been found, they will be displayed on the screen according to their saving sequence. Press navigation key ◄ ► to view one by one. B: If not find the PtID qualified to searching condition, just return to View measurements main menu.		A: View 1◄►▼ Type: Measure PtID: OCC1 HZ : 248° 23′ 50″ V: 51° 18′ 50″ Date: 2011.06.21 Time: 14:44:52 DELETE START LAST FIND B: 【View Measurements】 Job: 2222 StnPt: * PtID: * F4 View All Meas.Value LIST VIEW
④Press [F4] (FIND) to return to View Measurements menu. To return to File Management menu, press [ESC].		【View Measurements】 Job: 2222 StnPt: * PtID: * F4 View All Meas.Value

※1)Since both the names of measurement station and PtID can be input a concrete PtID or wildcard, an explanation on various combined searching result is given here. All the searching results are based on the premises of a selected searching job name：

Measurement station(concrete PtID) + PtID(concrete PtID)： The searching result is the measurement data named by this PtID on a certain measurement station. If there're some more data, view them by pressing◄►.

Measurement station ("*")+PtID(concrete PtID)：The searching result is all measurement data named by this PtID on all measurement stations in job. By pressing ◄►to view them one by one.

Measurement station(concrete PtID)+PtID("*")：The searching result is all tactic points on a certain measurement station. By pressing ◄►can view them one by one.

Measurement station ("*")+ PtID("*"): The searching result is all the measurements in the job, which is the same as "6.3.1.1Viewing All Measurement Points in Job".

※2) ◆► indicates that it can be displayed every data in job via navigation key ◄►.

※3) ▼, ◆, ▲indicates that this data still have some more pages and can be displayed 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 result data of tie distance, etc., can not be deleted.

OPERATIONAL STEPS：

③After finding out the measurement point data to be deleted, press [F1] (DELETE).	[F1]	View 1◆►▼ Type: Measure PtID: OCC1 HZ : 248° 23′ 50″ V: 51° 18′ 50″ Date: 2011.06.21 Time: 14:44:52 DELETE START LAST FIND
④ The data has been deleted, the screen displays the next data.		View 1◆►▼ Type: Measure PtID: 11 HZ : 248° 20′ 50″ V: 51° 5′ 50″ Date: 2011.06.21 Time: 14:44:54 DELETE START LAST FIND

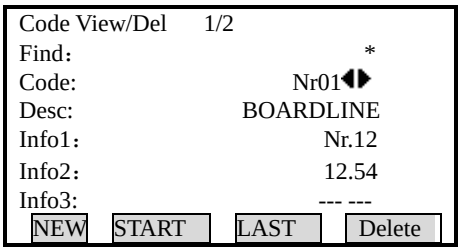
6.4 CODING

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 STONEX 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.

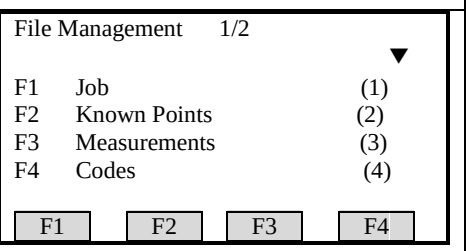
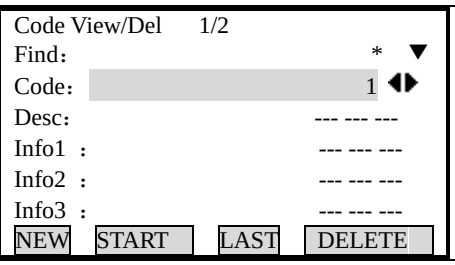
Desc: Appended description.

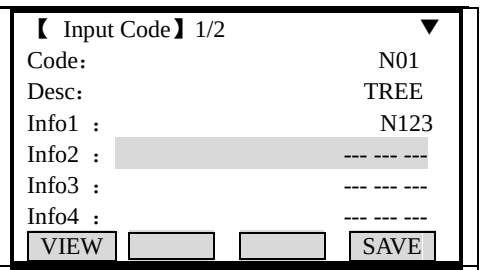
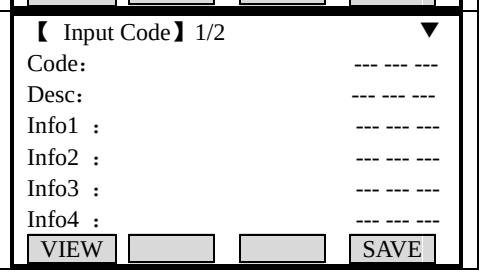
Info1：Editable information which includes more contents.

……

Info8：Other information lines.

OPERATIONAL STEPS：

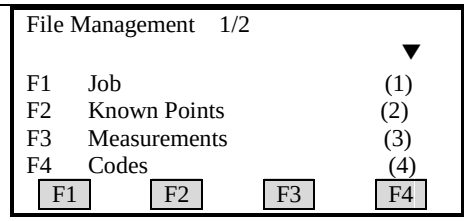
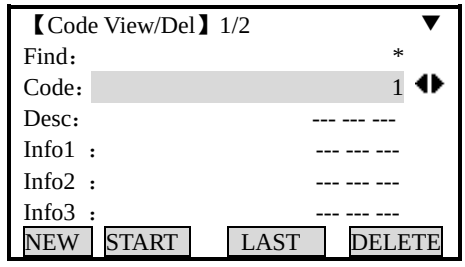
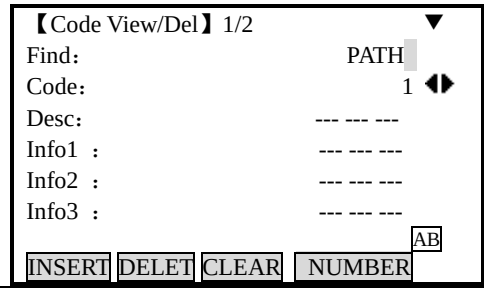
OPERATIONAL STEPS	OPERATION	DISPLAY
①In File Management menu, press [F4] to enter into Code function menu.	[F4]	
②In Code View/Del dialog, press [F1] (NEW) to start input Code function.	[F1]	

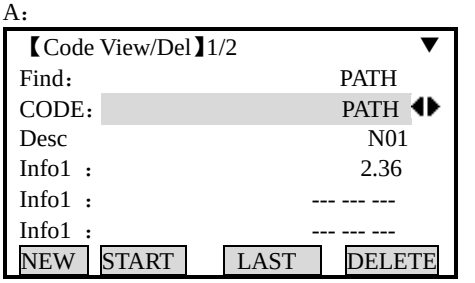
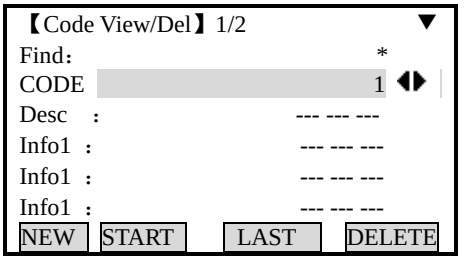
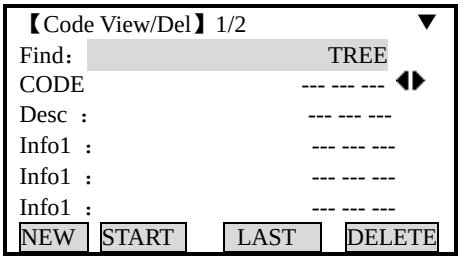
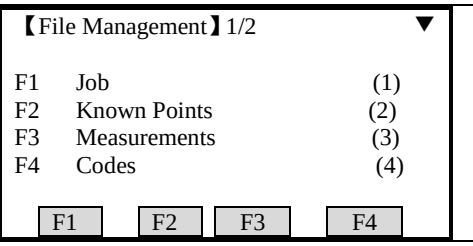
③Input the code and the information, etc. As shown in the right screen.		
④ After finishing inputting, press [F4] to store code. The procedure allows proceeding to input other codes, the data stored will be added after the code existing in the file.		

[SAVE] To store data

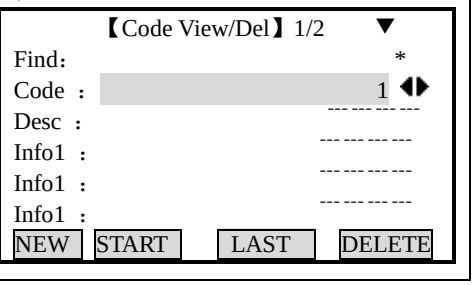
[VIEW] The searching dialog appears.

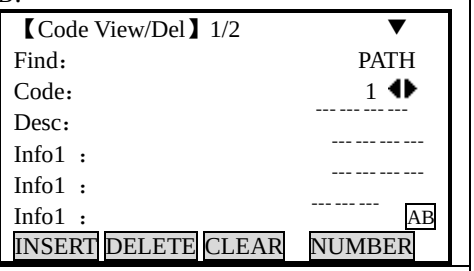
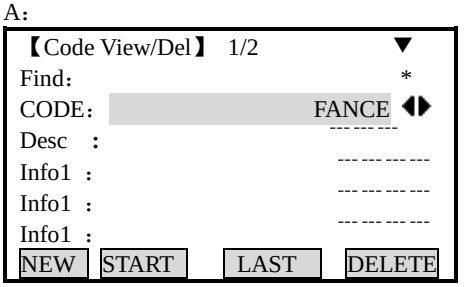
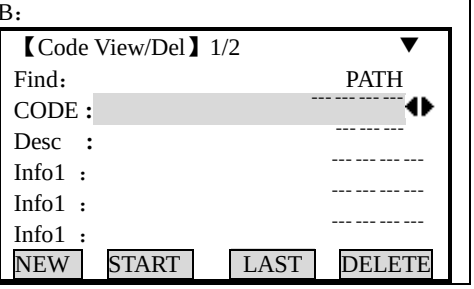
6.4.2 Viewing Code

OPERATIONAL STEPS	OPERATION	DISPLAY
①In File management menu, press [F4] to enter into Code function menu.	[F4]	
② A: Press navigation key to search, the codes in the file will be displayed one by one. B: Press to move to searching item. Input code name to be searched (or wildcard "*"), and press [ENT].		A:  B: 

③ A: The search results are shown on the code item and are highlighted by the cursor. If there are several codes with the same name, display them one by one by pressing◄◄►►. B: If wildcard "*" is input, it will start displaying from the first code in the file. By pressing ◄◄►►to display all codes in the file one by one. C: If the input code doesn't exist in the file, the coding item displays a blank. The cursor stays on the Find item, and user can continue inputting codes to be searched.		A:  B:  C: 
④ Press [ESC] to return to File Management menu.		

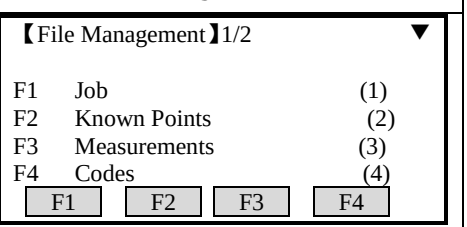
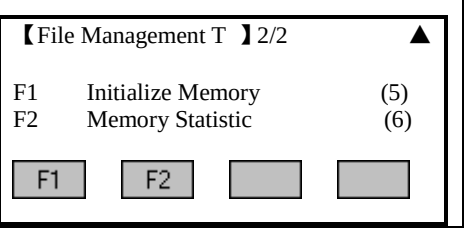
6.4.3 Deleting Code

OPERATIONAL STEPS	OPERATION	DISPLAY
②After entering code function dialog, press directly ◄◄►► to search. The codes in document will be displayed one by one. B:		A: 

Press ▼ to move cursor to Find item, input the code name to be deleted, and press ENT.		B: 
③As the code to be deleted occurs, press [F4] (DELETE). A：If the code to delete is found by◄►, then after this code was deleted, the cursor located displays the next coding information. B： If the code to delete found by inputting code name, then after this code was deleted, at bright black place displays none (If there are several codes with the same name, the next coding information will be displayed.)		A:  B: 

6.5 INTIALIZING INTERNAL MEMORY

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

OPERATIONAL STEPS	OPERATION	DISPLAY
①In File Management menu, press [PAGE] to display Page 2, and press [F1] to enter into Initialize Memory function dialog.	[PAGE] [F1]	 

②Select the job to be deleted, press [ENT] to move to data item. Press ◀▶ to select the data types to be deleted in job. (Job, measurement value, and known point are selectable.)		【Initialization】 Job: 1 DATA: MEAS VAL ◀▶ LIST ROAD CODE DELETE
③Press [F4] (DELETE). The program indicates as the right graph. To cancel deletion, press [F1] to return to Initialize Memory menu, user can select the job and data to be deleted. Press [OK], this data has been deleted. The program returns to Initialize Memory menu, user can also go on selecting job and data to be deleted.		【Initialization】 Delete data? Deleted data No Revert! DELETE OK

※1）[DELETE] Delete the selected data area.
[ROAD] Delete all Horizontal Alignment or delete all vertical Alignment or Delete all Alignment data;
[CODE] Delete all CODE data in internal memory!

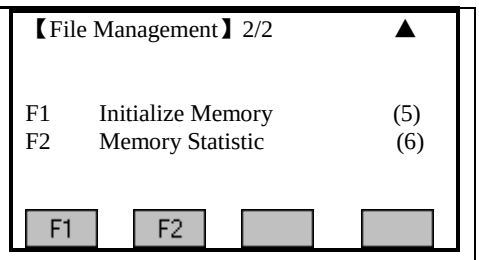
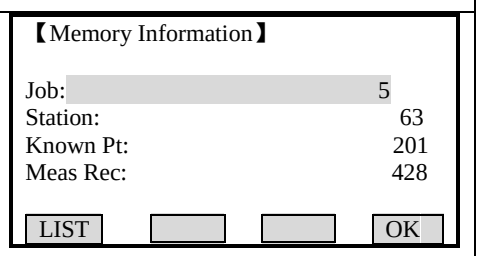
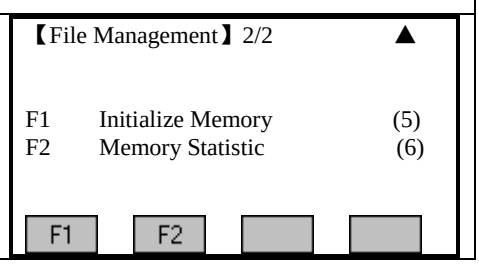
After deleting, the data can not be recovered, therefore, before operation, be sure that the useful data have been downloaded or stored.

6.6 MEMORY STATISTIC

Displays the information of memory, such as：

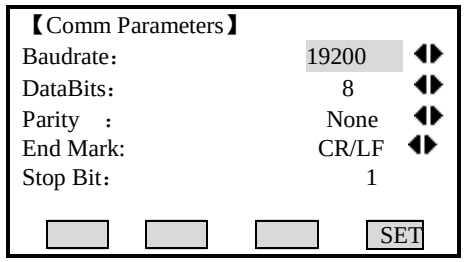
- The amount of the stored known points
- The amount of the recorded data block (measurement points, codes, etc.)。
- The amount of jobs which can be used or still not determined .

OPERATIONAL STEPS	OPERATION	DISPLAY
①In File Management menu, press [PAGE] to display Page 2, press [F2] to enter into Memory Statistic function dialog.	[PAGE] [F2]	【File Management】1/2 ▼ F1 Job (1) F2 Known (2) F3 Measurement (3) F4 Code (4) F1 F2 F3 F4

		
③ Display the information of the internal memory. Press [F1] (LIST) to display information of other job in internal memory one by one.		
③Press [F4] (OK) or [ESC] to return to the Page 2 of File Management.		

7. COMMUNICATION SETTING

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



BAUD RATE:

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

DATA BITS:

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

automatically

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

PARITY：

Even even check

Odd odd check

None None verify (If set data bit as 8)

END MARK：

CR/LF Carriage return and line feed

CR Carriage return

STOP BIT： 1

To be fixed as1.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In [MENU], press [PAGE] to display Page 2, and press [F2] to enter into the dialog of setting communication parameters.	[PAGE] [F2]	【Menu】2/2 ▲ F1 Adjustments (5) F2 Comm Parameters (6) F3 Data Transfer (7) F4 System Information (8) F1 F2 F3 F4
② In the dialog of communication parameters setting, by pressing◂◯◯▸to select each item. And by pressing ◂◯ or ◯▸ per time, the selection will change accordingly.	◂◯◯▸	【Comm Parameters】 Baudrate: 19200 ◂▸ Data Bits: 7 ◂▸ Parity : None ◂▸ End Mark: CR/LF ◂▸ Stop Bit: 1 SET
③After setting one parameter, press [ENT] to move to the next item. Set the other parameters in the same way.	[ENT] + ◂◯◯▸ + [ENT]	【Comm Parameters】 Baudrate: 9600 ◂▸ Data Bits: 7 ◂▸ Parity : None ◂▸ End Mark: CR/LF ◂▸ STOP BIT: 1 SET.
④After setting all parameters, press [F4] (SET) to store the settings, and return to main menu.		【MENU】2/4 ▲ F1 Adjustments (5) F2 Comm Parameters (6) F3 Data Transfer (7) F4 System Information (8) F1 F2 F3 F4

8. DATA TRANSFER

With this special function measured data can be transferred via the serial interface to receiver (e.g. 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.

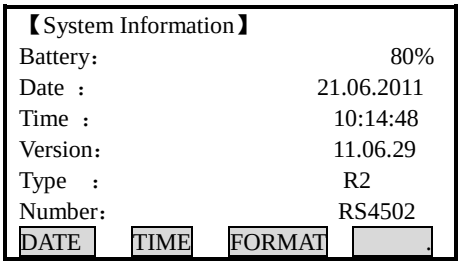
Data：Select the data range to be transferred (measurements, fixed points)

Format： Select output format. GSI is the fixed setting.

OPERATIONAL STEPS	OPERATION	DISPLAY
①In [MENU], press[PAGE] to display Page 2, press [F3] to enter into Data Transfer function dialog.	[F2]	【MENU】2/2 ▲ F1 Adjustments (5) F2 Comm Parameters (6) F3 Data Transfer (7) F4 System Information (8) F1 F2 F3 F4
②Input the job name to be transferred. Press [F1](LIST) to select job in internal memory. In this list you can find all the jobs in internal memory.	◂ ▸	Send Data Job: 2222 Data: MeasVal ◂▸ Transfer: USB◂▸ More Job Format: GSI LIST SEND
③After setting the job, press [ENT] to move to format item. Press ◂ ▸ to select the data to be transferred. The options are: measured value and known point. Press ◂ ▸ again to set the transfer mode: COM or USB.	[ENT] + ◂ ▸	【Send Data】 Job: STONEX Data: MeasVal ◂▸ Transfer: USB◂▸ More Job Format: GSI LIST SEND
④ After finishing setting, ensure that instrument port and receiver are connected with communication cable. Press [F4] (SEND) key.		Meas. Datas Send Transfer: USB A:\Default.RAW Sending…… * 0 BACK

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**

  R2 (for instance)

- **Number**

  Serial number of leaving factory for total station instrument

- **Data**

  Set system date and format.

Soft Keys

[DATE]: Set date

- Format: Select modes of date displaying, three modes are available..
  - yy.mm.dd
  - dd.mm.yy
  - mm.dd.yy
- Date: Input and display the date according to the selected date format.

[TIME]: Set time.

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

☞ For both system and EDM setting are introduced in previous chapters, here they are not to be repeated.

10.EXPORT/IMPORT DATA

To apply this function, it needs to insert SD card to R2 first.

Export data: All the suffix name of the files will be automatically changed to TXT file.

Example: Export code data

Note：**To get the TXT file normally, please don't hide extensions for Known file types.**

Operation steps	Key	Display
① Press PAGE in MENU, it will show the 3rd page, press [F1] to enter data output dialog.	[F1]	【Menu】 3/4 F1 Data Output F2 Data Import F3 USB Send Data F4 USB Receive F1 F2 F3 F4
② Press [F2] to output code data.	[F2]	Data Output F1 Job data (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) F1 F2 F3 F4
③Input the file name to ouput, or press [F1] (list) key, find the txt file in SD card. Then press[F4] to confirm.	[F4]	Data Output JOB： STONEX Date： 2011.06.10 Time： 12: 00: 00 LIST OK
④Run the data file exporting command. After exporting all data, the screen will back to page 3 menu.		CODE From：A: \ PCODE.DAT To：B: \ STONEX.TXT ＊ 13

● The original data in STONEX.TXT will be covered.
●All code data system will be operated in PCODE.DAT
● (＊ 13)： Here display the numbers of data exported.

Data Import: in this mode, the files in local disk can't do this operation mutually.

Example: Import horizontal alignment data(HZ Alignment)

Operation steps	Key	Display
①Press PAGEin MENU, it will show the 3rd page, press[F2] to enter Data Import dialog.	[F2]	Menu 3/4 F1 Data Output F2 Data Import F3 USB Send Data F4 USB Receive F1 F2 F3 F4
② After enter into data import dialog, Press [F3] to import horizontal alignment data.	[F3]	Data Import F1 Job data (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) F1 F2 F3 F4
③Input job name or press [F1] (list), calling the TXT file in SD card. Then press[F4] to confirm.	[F4]	File Import JOB: STONEX Date: 2011.06.10 Time: 12: 00: 00 LIST OK
④Run PC data file importing command. After importing all the datas, it will return to page 3/4 menu.		HZ Alignment 从：B：\DEFAULT.TXT to：A：\Road.HAL ＊ 13 Complete!

- The original data in DEFAULT.TXT will be covered.
- All the horizontal alignment data will be operated in Road.HAL file.
- (＊ 13)： Display the amount of data are exported.
- If the HZ Alignment data to import continue with the existing HZ Alignment data existing on the total station, then you can import it directly; otherwise, if the HZ Alignment data to import has another start point which is different with the existing HZ Alignment data existing on the total station, then the existing HZ Alignment data should be deleted before the new HZ Alignment is imported, otherwise the instrument will appear"Error data".

11. SEND/RECEIVE DATA BY USB

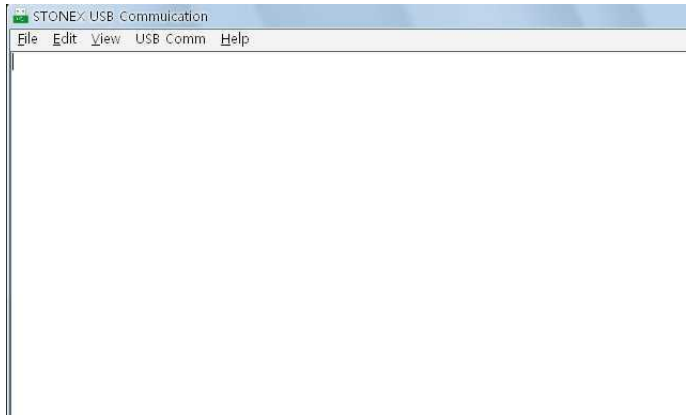
Before send data or receive data via USB port，it is necessary to install a USB driver 

first. Then please make sure peripheral equipment（Such as PC） and R2 have been connected via USB port, the communication parameters on peripheral equipment and total station should be consistent absolutely.

After that, power on the total station then run Stonex survey office software 

, then double click 

to open the USB communication interface as follow:

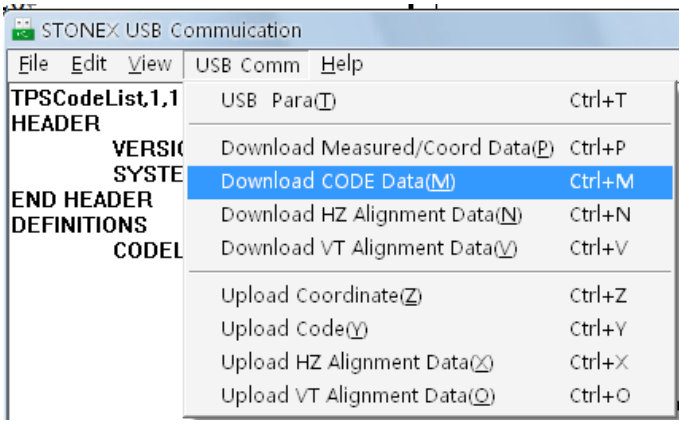


Such as Send CODE via USB

Operating steps	Button	Display
①（First press MENU,then press PAGE to display Page3,and then press the [F3] to get into the USB Send data function.）	[F3]	【 Menu 】 3/4 F1 Data output F2 Data Import F3 USB Send data F4 USB Receive F1 F2 F3 F4
② Display the USB Send data dialog, press [F1] to send CODE data.	[F1]	【Data output】 F1 CODE （1） F2 HZ Alignment （2） F3 VT Alignment （3） F1 F2 F3

③Screen display prompt message: “USB initializing”.)		【Data output】 F1 CODE （1） F2 HZ Alignment （2） F3 VT Alignment （3） USB Initializing…
④Start sending encoded data. At this time the screen shows the number indicates the number of records being sent)		Code Send Transfer：USB A: \ PCODE．DAT Sending… ＊ 20 BACK
●Press [F4] (BACK) key to terminate data transmission operations, return Menu page 3/4 .		

The above are the operations on the total station, after choose CODE data in ② step, you need to choose “Download COED Data(M)” function in STONEX USB Communication software. Then the download process begin as Step④ show.

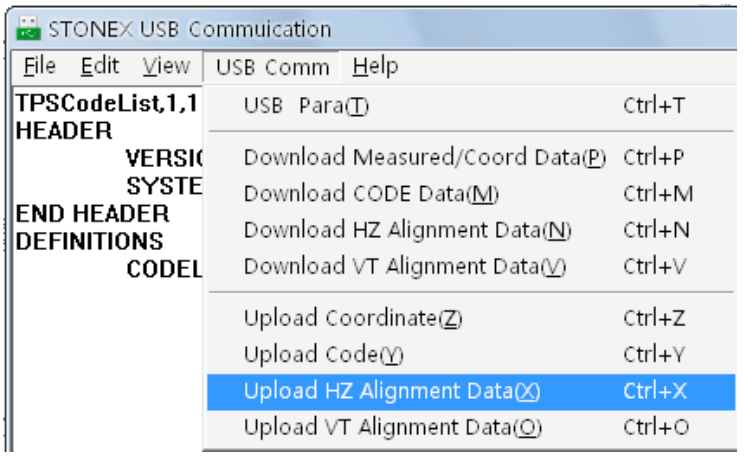


For example：Receive HZ Alignment via USB)

Operating steps	Button	Display
①Press Menu, then press [PAGE] to show the Menu Page3/4,and then press [F4] to find USB receive function）	[F4]	Menu 3/4 F1 Data Output F2 Data Import F3 USB Send Data F4 USB Receive F1 F2 F3 F4

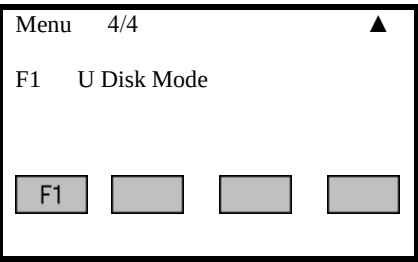
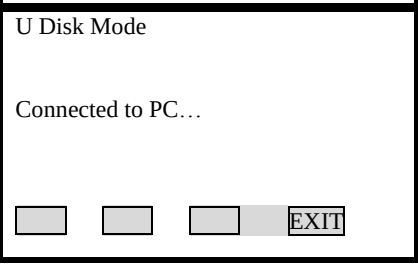
②Display USB Receive function, press [F3] to receive HZ Alignment data.	[F3]	USB Receive F1 KnownPt (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) F1 F2 F3 F4
③The Screen display prompt message: "USB initializing"		USB Receive F1 KnownPt (1) F2 Code (2) F3 HZ Alignment (3) F4 VT Alignment (4) USB initializing…
④Start to receive HZ Alignment data. At this time the screen shows the number which indicates the amount of data being received.		Receive HZ Alignment Transfer：USB A: \ ROAD．HAL Receiving… ＊ 20 BACK
● (Press [F4] (BACK) key to terminate data reception, return Menu page3/4.		

The above are the operations on the total station, after choose HZ Alignment data in ② step, you need to choose "Upload HZ Alignment Data(X)" function in STONEX USB Communication software. Then the upload process begin as Step④ show.



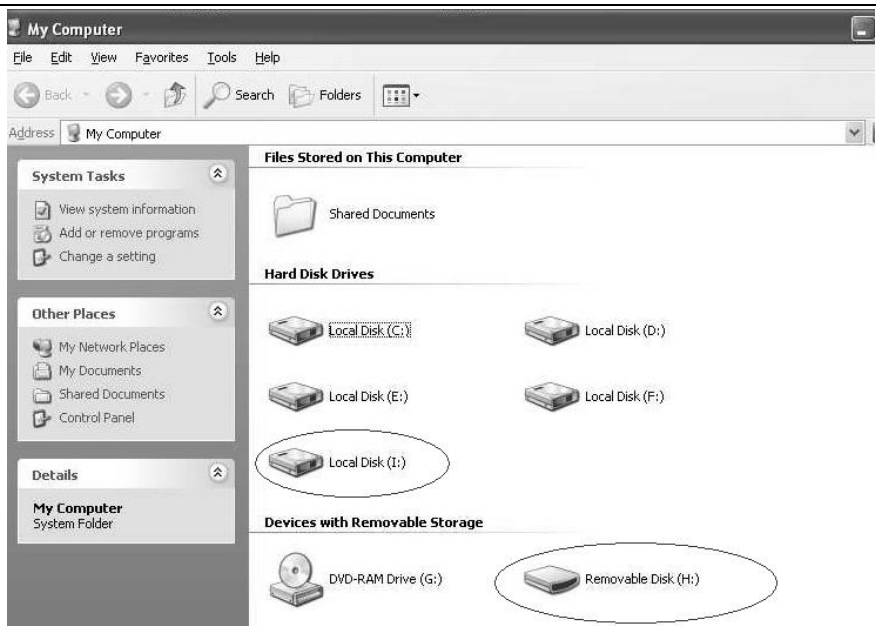
12.U DISK MODE(MEMORY MODE)

Connect R2 with computer via USB cable configured with R2.
And the following section will show the operations on R2.

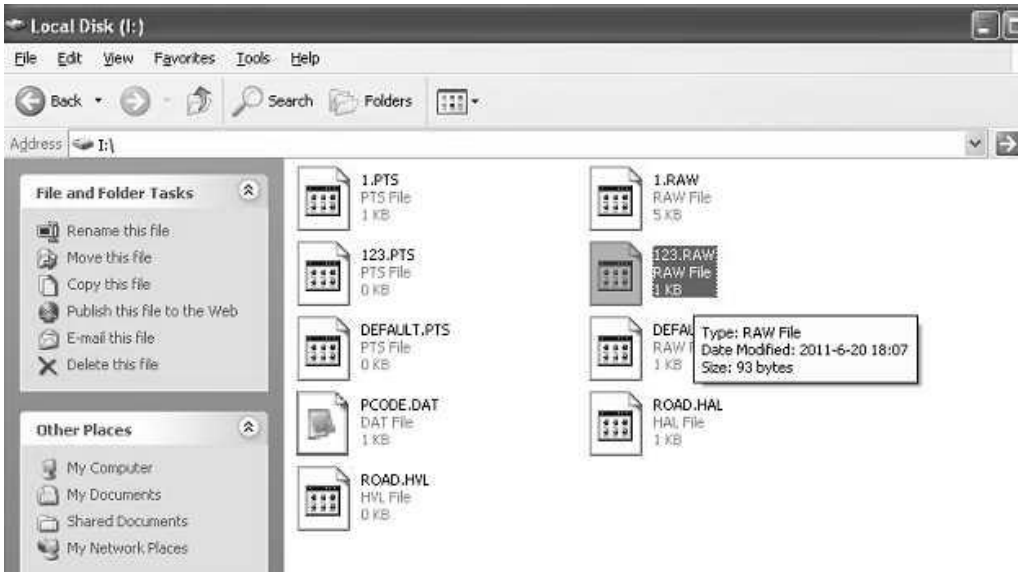
Operating steps	Button	Display
① (Press menu, then press[PAGE] to show the Menu page4/4 , press[F1] to enter U Disk Mode).	[F1]	
②The screen displays ”Connected to PC…”	[F3]	

Then Transfer and edit data files can be done on computer.

③ Run “My computer” there are two disks for R2,
one is internal memory of R2(Local disk I for example),
the other is the removable disk H which is carried by the SD card inserted.



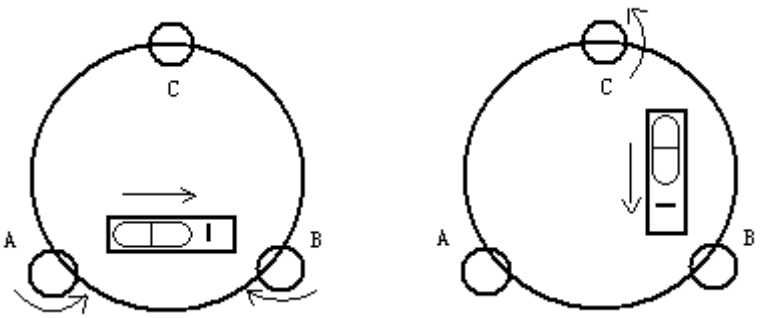
④ Double-click disk I or removable disk H, (example: local disk I) select the file you want to edit, right-click the mouse, in the pop-up menu select Copy.)(See picture below)



13. 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.

13.1 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.

13.2 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 with 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.

13.3 INCLINATION OF RETICLE

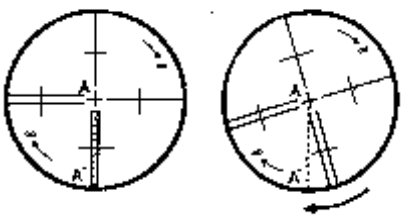
Check:

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.



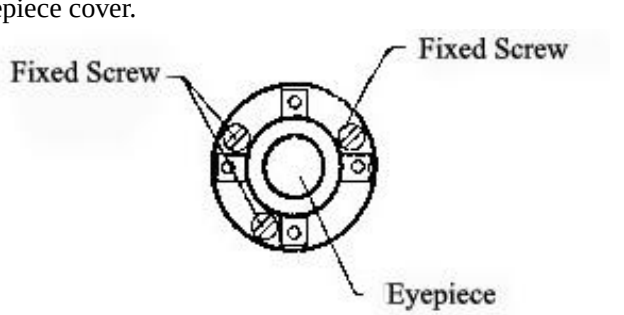
Adjust

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.



13.4 PERPENDICULARITY BETWEEN LINE OF SIGHT AND HORIZONTAL AXIS (2C)

Check

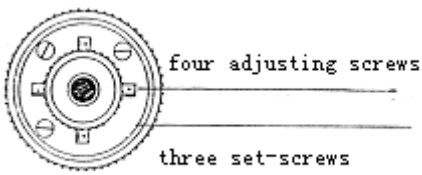
1. Set object A at about 100 meters away the same height as the instrument, and make the vertical angle with ±3°. Then level and center the instrument and turn on the power
2. Sight object A in Face I and read the horizontal angle value. (e.g.: Horizontal angle L=10°13′10″).
3. Loosen the vertical and 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.

Adjust

A. Electronic Adjustment Operation Steps：

OPERATIONAL STEPS	OPERATION	DISPLAY
① After leveling the instrument, press [MENU] to enter into the menu, press [PAGE] to go to the Page 2.	[MENU] + [F4]	【Menu】2/2 ▲ F1 Adjustment (5) F2 Comm Parameters (6) F3 Data Transfer (7) F4 System Information (8) F1 F2 F3 F4
②Press [F1] to enter into Adjustment function.	[F1]	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.list) (4) F1 F2 F3 F4
③Select [F2] Hz-collimation, the screen shows as the right graph:	[F2]	【Hz-collimation】 <Step 1> Front HR ： 332°26′21″ V ： 92°59′42″ Please sight the target! MEAS
④In Face I precisely collimate the target, and press [F1] (MEAS).	Collimate the target + [F1]	【Hz-collimation】 <Step 2> Reverse HR: 152°25′58″ V ： 267°00′20″ Please sight the target! MEAS

⑤ Rotate the telescope, and collimate the same target A precisely in Face Ⅱ. Press [F1] (Meas). When setting is finished, the screen shows as the right graph.	Sight the target in reverse position + [F1]	【Hz-collimation】 Hz-collimation: 0°00′11″ BACK SET
⑥Press [F4] (set) to finish V-Index Adjustment. The screen returns to the Adjustment screen. [SET]: Replace old adjustment value with a new one. [ESC]: Quit the program without saving new adjustment value.	[F4]	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.list) (4) F1 F2 F3 F4



B. Optics Adjustment (professional maintenance man 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.

13.5 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.

13.6 ADJUSTMENT OF VERTICAL INDEX DIFFERENCE (I ANGLE) AND SETTING VERTICAL INDEX O

Inspect the item after finishing the inspection and adjustment of items in 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 − 3 6 0 °) / 2

If the vertical angle is 0 °in horizon. i = (L + R − 1 8 0 °) / 2 or (L + R − 5 4 0 °) / 2 .

4. If | i | ≥1 0″ should set the Vertical Angle 0 Datum again.

Adjust

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F4] to second page of Menu.	[F4]	【Menu】2/2 ▲ F1 Adjustment (5) F2 Comm Parameters (6) F3 Data Transfer (7) F4 System Information (8) F1 F2 F3 F4
②Select [F1] to enter into Adjustment function.	[F1]	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.list) (4) F1 F2 F3 F4

③Press [F1] to start V-Index Adjustment. The screen displays as the right graph:	[F1]	【V-Index】 <Step 1> Front HR: 219°17′58″ V : 94°05′12″ Sight the target! MEAS
④In Face I, precisely collimate target A and press [F1] (MeaS).	Collimate the target + [F1]	【V-Index】 <Step 2> Reverse HR: 39°11′05″ V : 265°54′15″ Sight the target! MEAS
⑤ Rotate the telescope, and collimate the same target precisely in Face Ⅱ. Press [F1] (Meas). When setting is finished, the screen displays as the right graph.	Collimate the prism in reverse position +[F1]	【V-Index】 Index Difference: 3°58′11″ VT Error: 0°00′31″ BACK SET
⑥Press [F4] (set) to finish V-Index Adjustment. The screen returns to the Adjustment menu. [SET]: Replace old adjustment value with the new one. [ESC]: Quit the program without saving new adjustment value.	[F4]	【Adjustment】 ▼ F1 V-index (1) F2 Hz-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.list) (4) F1 F2 F3 F4

Note:

1. Repeat the checking steps to measure the Index Difference (i angle). If the Index

If 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.

13.7 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.

STEP：

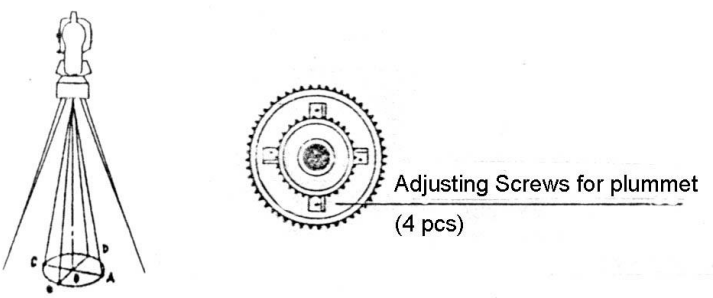
OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [F3] to Horizontal Axis in Adjustment function.	[F3]	【 Adjustment】 ▼ F1 V-index (1) F2 HZ-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.List) (4) F1 F2 F3 F4
②The screen shows as the right graph: In Face I precisely collimate target (obliquity is ±10°~±45°), press [F1] (Meas) 10 times.	Collimate the target in normal position + [F1]10 times	【Horizontal Axis】 [0/10] <Step 1> Front HR: 335°28′41″ V : 107°16′20″ Please sight the target! MEAS INPUT
③Rotate the telescope, and collimate the same target precisely in Face Ⅱ. Press [F1] (Meas) 10 times.	Sight the prism in reverse position +[F1] 10 times	【Horizontal Axis】 [0/10] <Step 2> Reverse HR: 155°27′01″ V : 252°43′47″ Please sight the target! MEAS INPUT
④When finishing setting, the screen shows as the right graph.		【Transverse Axis Error Adjustment】 Transverse Axis Error: 0°00′36″ BACK SET
⑤Press [F4] (set) to finish Index Difference Adjustment. The screen returns to the ADJUSTMENT menu. [SET]: Replace old adjustment value with the new one. [ESC]: Quit the program without saving new adjustment value.	[F4]	【 Adjustment】 ▼ F1 V-index (1) F2 HZ-collimation (2) F3 Horizontal Axis (3) F4 VO/Axis(Cons.List) (4) F1 F2 F3 F4

13.8 PLUMMET

1. 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.

2. Laser plummet

This is a new technology from our factory，it adopts laser beam to center the instrument. Press FNC to find the interface as Fig.1 show:

Fig.1

If the total station has laser plummet, after enter into Fig.1, and press F1 to enter into Fig.2, then the laser beam will appear from the laser plummet. And the shadow in Fig.3 indicates the intensity of the beam.

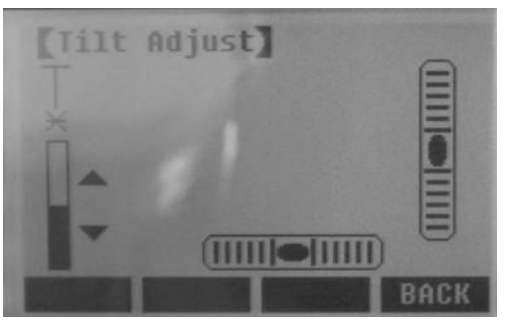


Fig.2

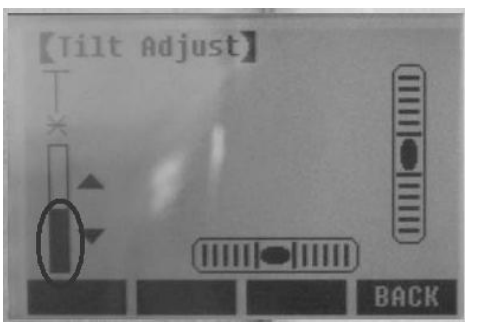


Fig.3

After the laser beam appears, if you press the upper key in Fig.4, then the laser beam will increase. If you the down key below in the circle, then the lase beam will decrease.

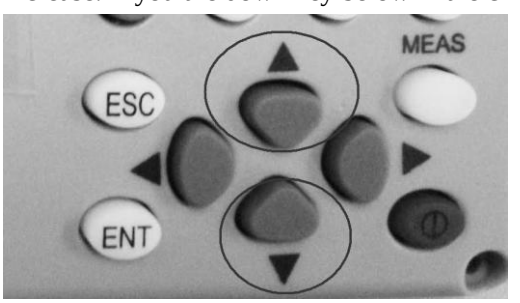


Fig.4

Fig.5 when the shadow is empty, the laser beam is OFF.

Fig.6 when the shadow is full, then the laser beam is Lightest.

13.9 INSTRUMENT CONSTANT (K)

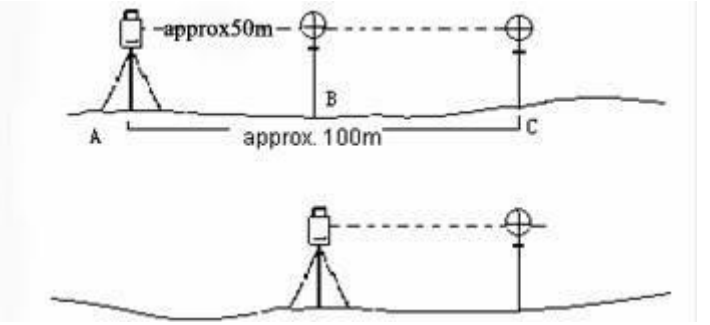
Instrument constant has been checked up and adjusted in the factory, K=0. It seldom changes and it is suggested to check one or two times every year. The inspection should be made on the base line, also can be made according to the following method.

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.

Input Instrument Constant:

OPERATIONAL STEPS	OPERATION	DISPLAY
①Press [PAGE] to go to Page 2 of the Adjustment function.※1)	[F4]	【Adjustment】 ▲ F1 Inst. Constant (5) F2 Tilt Parameter (6) F3 State (7) F1 F2 F3
②Press [F1] to enter into Instrument Constant Setting screen. Input instrument constant.	[F1]	【Inst. Constant Set】 Inst Cons: 0.0 mm SAVE
③Press [F4] to save the setting and return to Adjustment screen.	Input Instrument Constant + [F4]	【Adjustment】 ▲ F1 Inst. Constant (5) F2 Tilt Parameter (6) F3 State (7) F1 F2 F3
※1) F2: Auto compensation parameter is used for factory setting. Please do not modify it.		

13.10 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.

Adjustment:

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

13.11 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.

13.12 TRIBRACH LEVELING SCREW

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

13.13 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.

14. SPECIFICATION

☞Distance measurement (visible laser)

a), Type…… visible red laser

b), carrier wave…… 0.670μ m

c), measuring system…… basis 60 MHZ

d), EDM Type …… coaxial

e), Display (least count) …… 1mm

f,) laser dot size …… approx.7×14 ㎜ / 20m (reflectorless mode only)

approx. 10×20 ㎜ / 50m

g), Accuracy

With reflector:

EDM measuring program	Accuracy Standard deviation	Time per measurement
fine	2 ㎜+2ppm	＜1.8s
fast	3 ㎜+2ppm	＜1.2s
tracking	5 ㎜+2ppm	＜0.8s
IR-tape	5 ㎜+2ppm	＜1.2s

Without reflector:

EDM measuring program	Accuracy Standard deviation	Time per measurement
Reflectorless fine	5+2ppm	＜1.2s
Reflectorless tracking	10+2ppm	＜0.8s

h), range

With reflector

Atmospheric conditions	Standard prism	Reflector tape
5km	1000m	300m
20km	4000m	800m

Without reflector

Atmospheric conditions	No reflector（white	No reflector

	target）※	(grey,0.18)
Object in strong sunlight, severe heat shimmer	160m	100m
Object in shade, or sky overcast	200m	120m

Kodak Grey Card used with exposure meter for reflected light

Other specifications

		R2	R5	R7
Distance Measurement				
Measuring Range(under fair weather condition)	Single prism	2.4 Km	2.0 Km	2.0 Km
	Triple prism	3.0 Km	2.6 Km	2.6 Km
Display		Max：999999.999 m Min : 1 m		
Accuracy		2+2 ppm		
Unit		m / ft selectable		
Measuring time		Fine single shot: 3S Tracking: 1S		
Average measuring times		The average value of 2～5 times		
Meteorologic Correction		Manual input, Auto correction		
Atmospheric refraction and earth curvature correction		Manual input, Auto correction		
Reflection prism correction		Manual input, Auto correction		
Angle Measurement				
Measuring method		Continuous, Absolute encoding		
Diameter of raster disk		79mm		
Minimum reading		1″/ 5″/10″Selectable		
Accuracy		2″	5″	10″
Detection method		Horizontal： Dual Vertical ： Dual		Horizontal：Dual Vertical ：Single
Telescope				
Image		Erect		
Telescope Length		154 mm		
Effective aperture		45 mm (EDM 50 mm)		

Magnification	30×
Field of view	1 °3 0′
Minimum focus	1m
Resolving power	3″
Vertical Compensator	
System	Liquid-electric detection/plate vial
Compensation range	±3′
Resolving power	1″
Vial	
Plate vial	30″／2 mm
Circular vial	10′／2 mm
Optical Plummet	
Image	Erect
Magnification	3×
Focusing range	0.5m～∝
Field of view	5°
Display	
Type	5：Double LCD，Figure key + Letter key 2：Double LCD
On-board Battery	
Power resource	Rechargeable Ni-H battery
Voltage	DC 6V
Continuous operation time	8 hours
Size & weight	
Dimension	200×190×350mm
Weight	6.0 kg

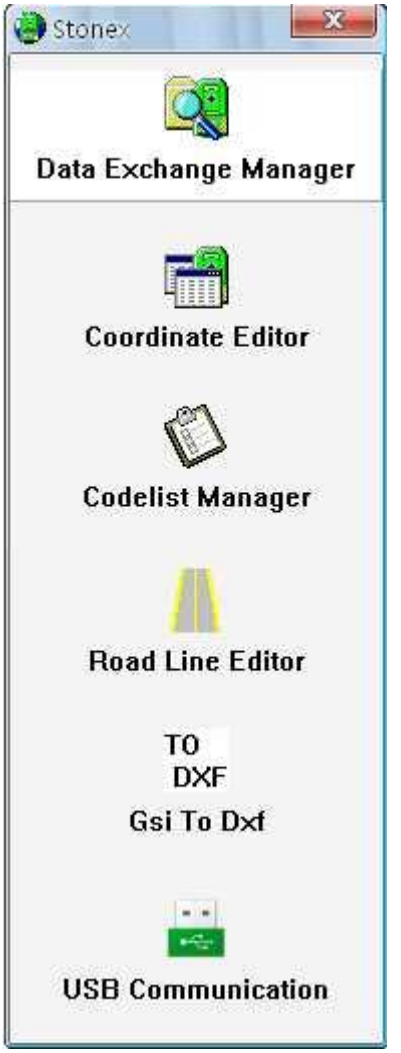
15. ACCESSORIES

Carrying Case	1 pc
Main Body	1 pc
Backup on-board Battery	1 pc
Charger	1 pc
Plummet	1 pc
Correction Pin	2 pcs
Fur Brush	1 pc
Screwdriver	1 pc
Hexagon Wrench	2 pcs
Cloth	1 pc
Dryer	1 pc
Operation Manual	1 pc
Certificate	1 pc
Reflector sheet	1set
RSSP19U data cable	1PC
RSSDR（SD card and reader）	1PC
CD	1PC
User manual	1PC

【 APPENDIX-A 】 DATA COMMUNICATION Via RS232/USB port

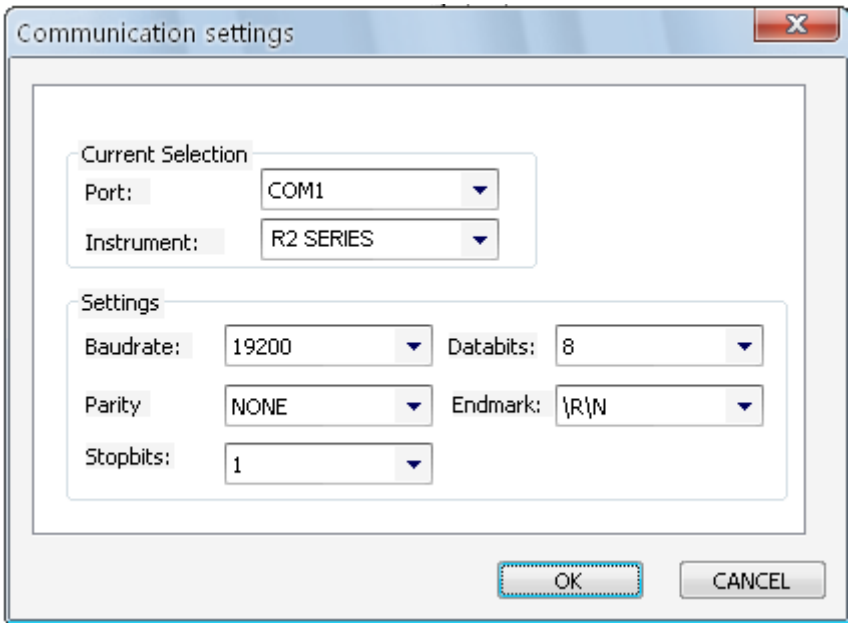
You can also transfer, edit, and manage the data expediently through the data communication software of STONEX Company. With this method, first to connect the total station with computer via the 203U cable(COM port or USB port, if use USB port , you need to install the driver for USB first in the smaller CD together with this 203U cable).

Data communication software main menu:



1 SETTING COMMUNICATION PARAMETER

Before data transfer, please make sure peripheral equipment (such as PC) and Total Station have been connected already. Open “Data Exchange Manager”, click “Option”, then “Communication Setting”, the screen shows as below:



Select the peripheral equipment Port in “Current Selection”, which connected with Total Station, and the model of the Total Station.

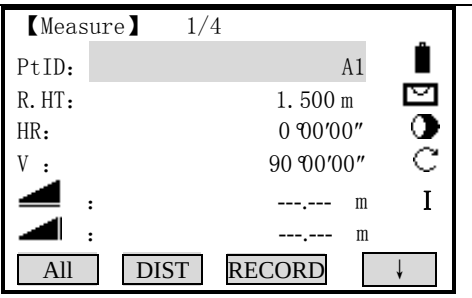
Set the communication parameter in Settings column: Baudrate, Databit, Parity, Endmark, and Stopbit. The communication parameter must be consistent with the Comm Parameter of Total Station.

Press OK to preserve setting and exit.

Default communication settings with which Total Station R series connect with peripheral equipment are as follow:

Model	Baudrate	Databit	Parity	Endmark	Stopbit
R2/R5/R7	19200	8	NO	CRLF	1

Note： Press Menu/PAGE/F2(Comm Parameters) to set the above paramenters on R2 series total station，then press “F4（Set）” to confirm the parameters setting；After that，it is very important to press “ESC” to back the main menu as follows before start transferring data:

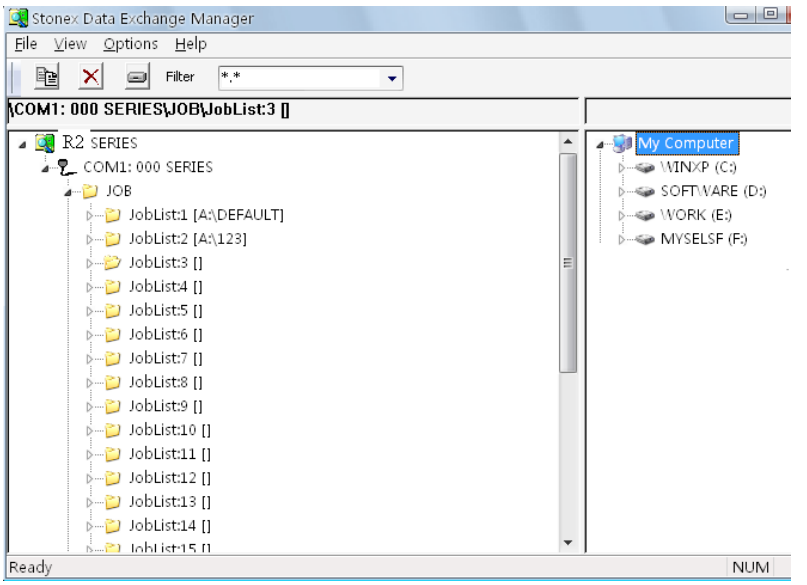


Main menu

2 DATA TRANSFER

Data Exchange Manager allows user to download and upload data between Total Station and peripheral equipment (such as PC). The data that can be transferred contains measurement data, coordinate data, coding data and road line data.

Open data Exchange Manager, showed as the graph below, including two windows of left and right：



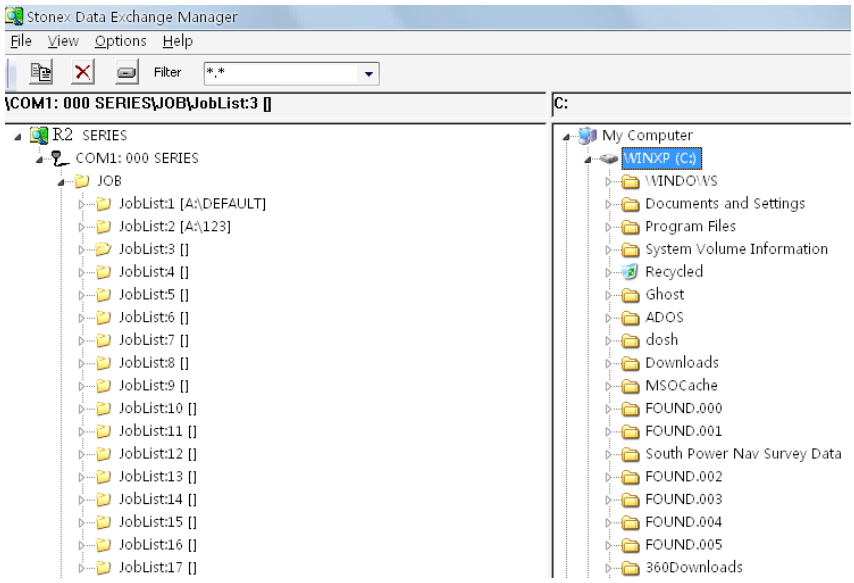
The left window displayed the COM port connected with Total Station Instrument and document files, document information. The right window displayed document files and document information of each driver in PC. Users at the same time can set data types which need to display in “Filter” item.

Through data Exchange Manager one can transmit data conveniently upload to Total Station Instruments or download to PC.

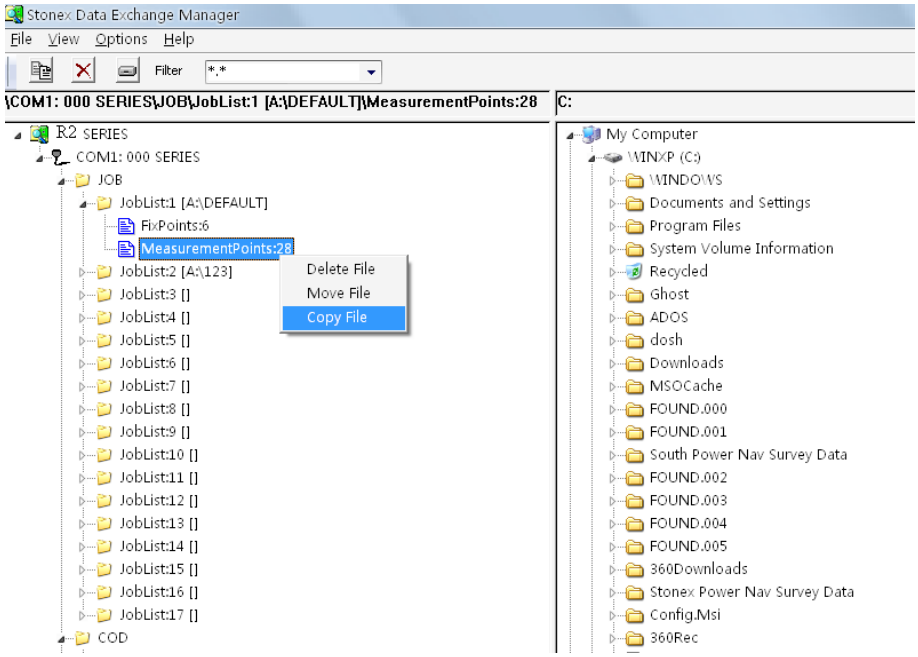
A: DOWNLOAD DATA:

1）In the right window the specified data are transmitted to paths in PC, that is to select

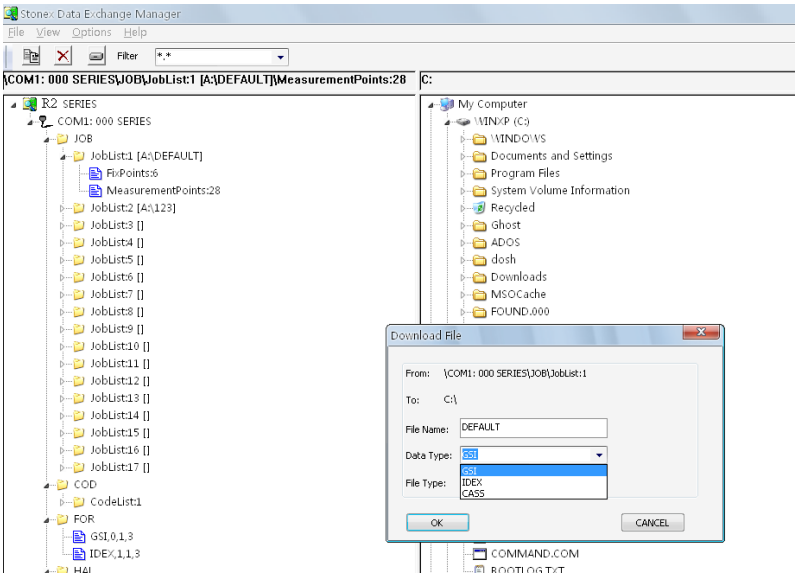
drivers and document files. Showed as the picture below:



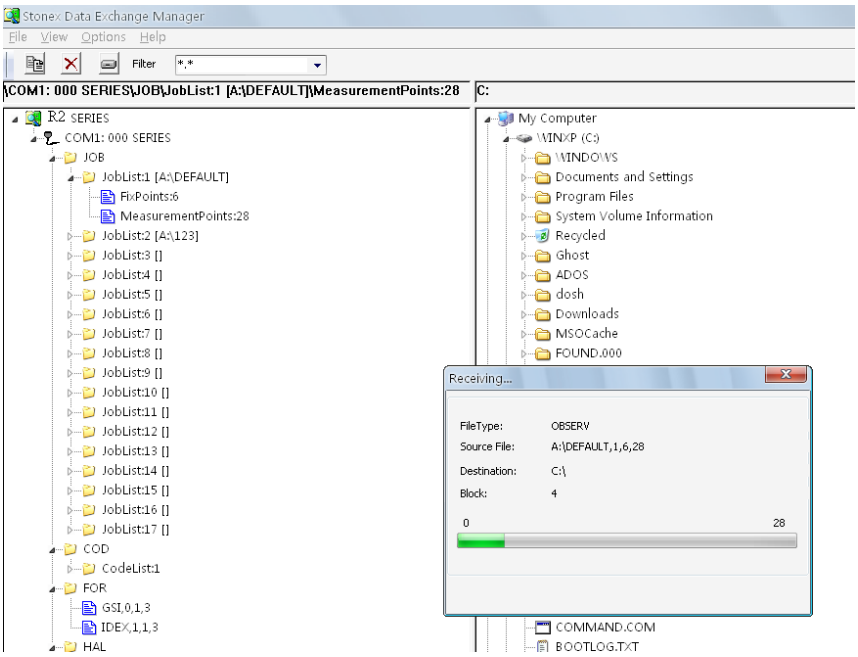
2）On left window, select job names and data type (the known point、measurement data、code or road line data), click right mouse button, and choose “Copy”.



3）Inside dialog springing out select the needed storing data type, there are three modes can be selected: GSI, IDEX and CASS (*DAT).



4）Press “OK” to start data transmission



5）Transmission ends, dialog exit automatically.

Data formats transmitted from Total Station Instrument

Here, taking partial measurement datum as an example：

*110001+0000000000000001 21.034+0000000014301010 22.034+0000000009054140

31..00+0000000000002004 81..00+0000000000001205 82..00-0000000000001601

83..00-0000000000004032 87..10+0000000000005000

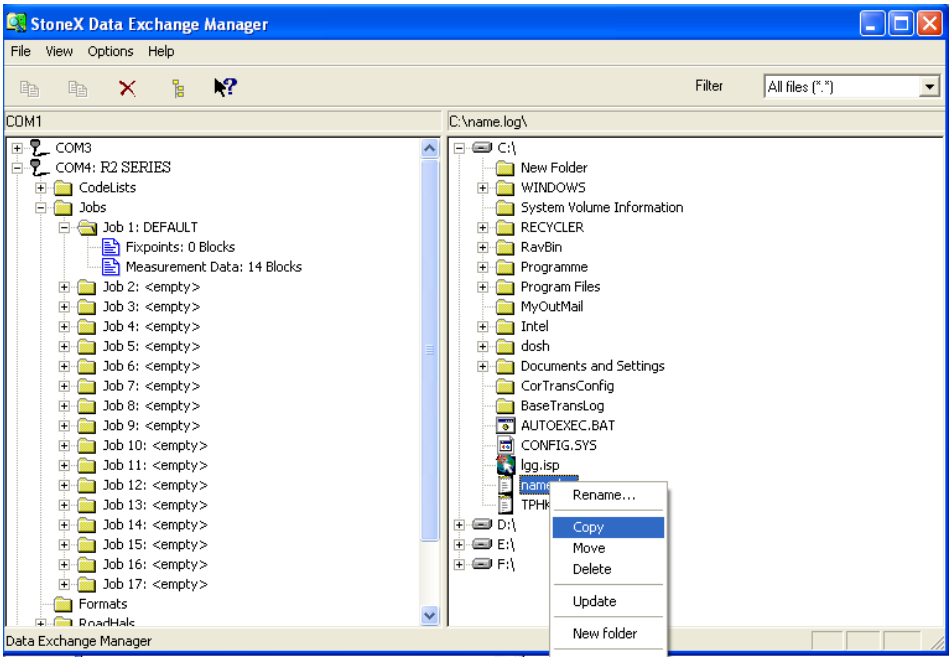
*110002+0000000000000002 21.034+0000000017510540 22.034+0000000008523530 31..00+0000000000014397 81..00+0000000000001205 82..00-0000000000014300 83..00-0000000000002845 87..10+0000000000005000

GSI-ID

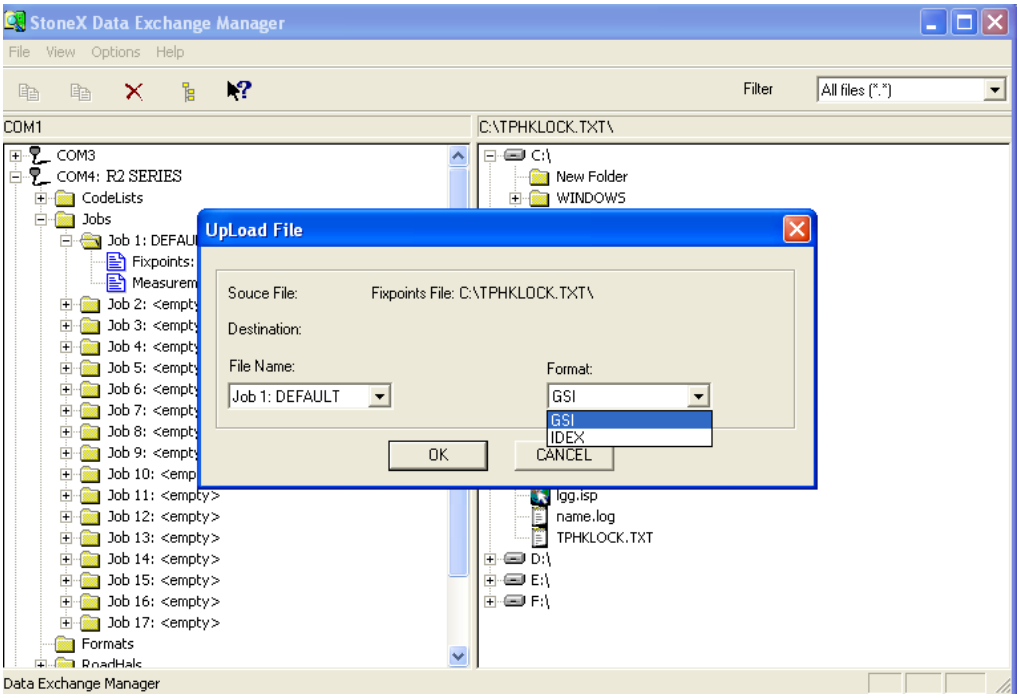
11	PtID
21	HORIZONTAL DIRECTION
22	VERTICAL ANGLE
31	OBLIQUE DISTANCE
32	HORIZONTAL DISTANCE
33	HEIGHT DIFFERENCE
41-49	CODES AND ATTRIBUTES
51	PPM(mm)
58	PRISM CONSTANT
81-83	(X、Y、H) TARGET POINT
84-86	(X、Y、H)MEASUREMENT STATION POINT
87	PRISM HEIGHT
88	INSTRUMENT HEIGHT

B: UPLOAD DATA

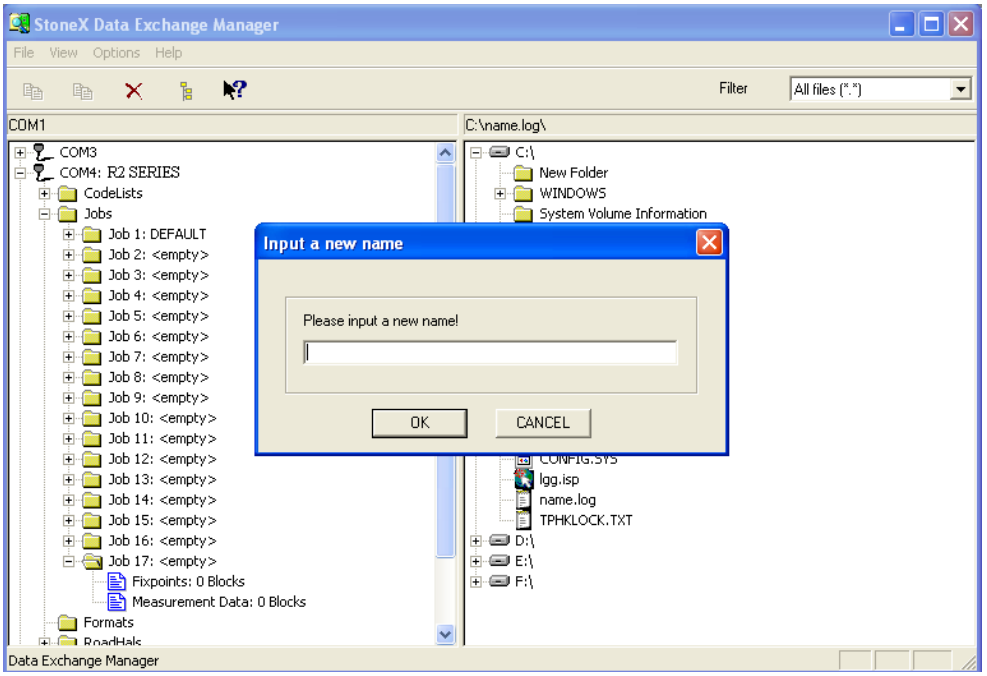
1）In the right window, select data documents which have been edited and will be transmitted to Total Station Instrument, click the right mouse button, select “Copy” showed as the picture below:



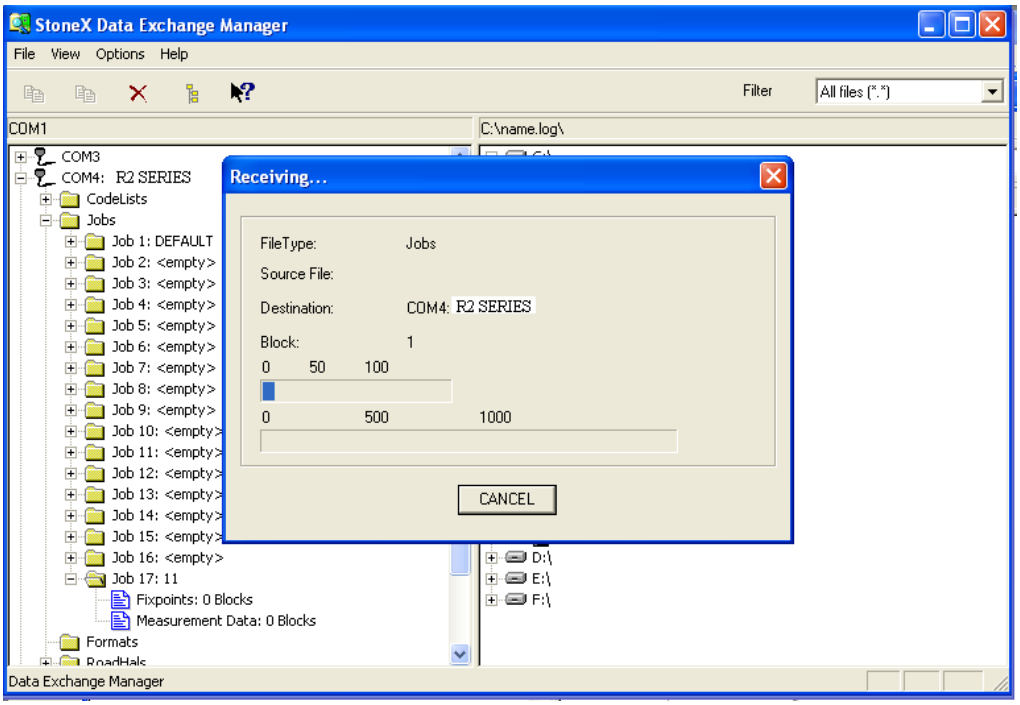
2）Select File Name in internal memory of Total Station Instrument in which the data should be uploaded, showed as the picture below:



3）If the selected job is empty, you need to input document name. Showed as the picture below:



4）Start uploading data



5）As have finished inputting, the dialog quit automatically.

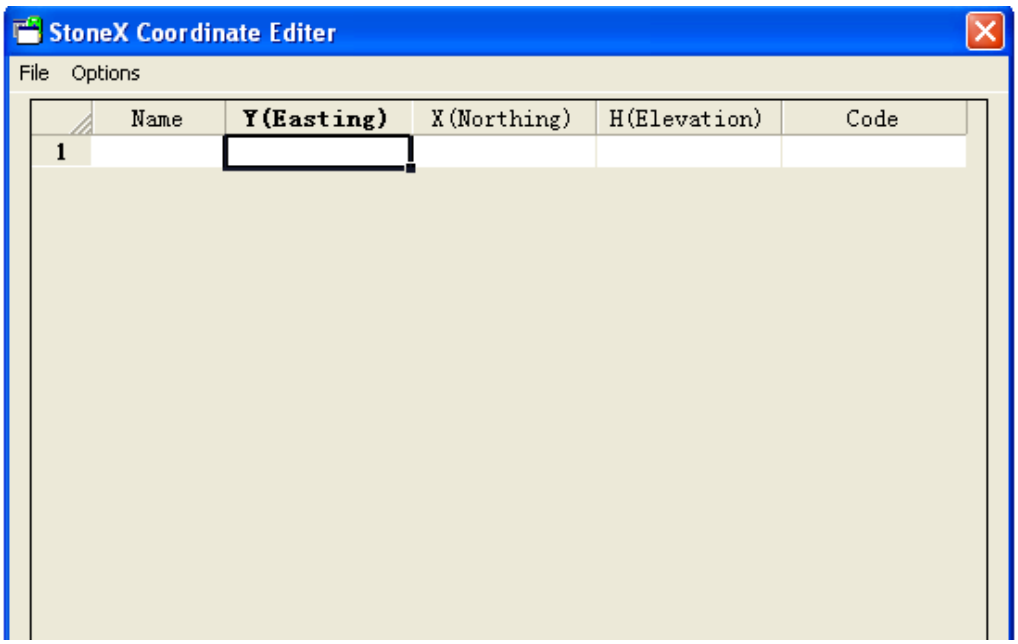
3 COORDINATE EDITING

Through Coordinate Editor, user can edit and store coordinates data. Each row of

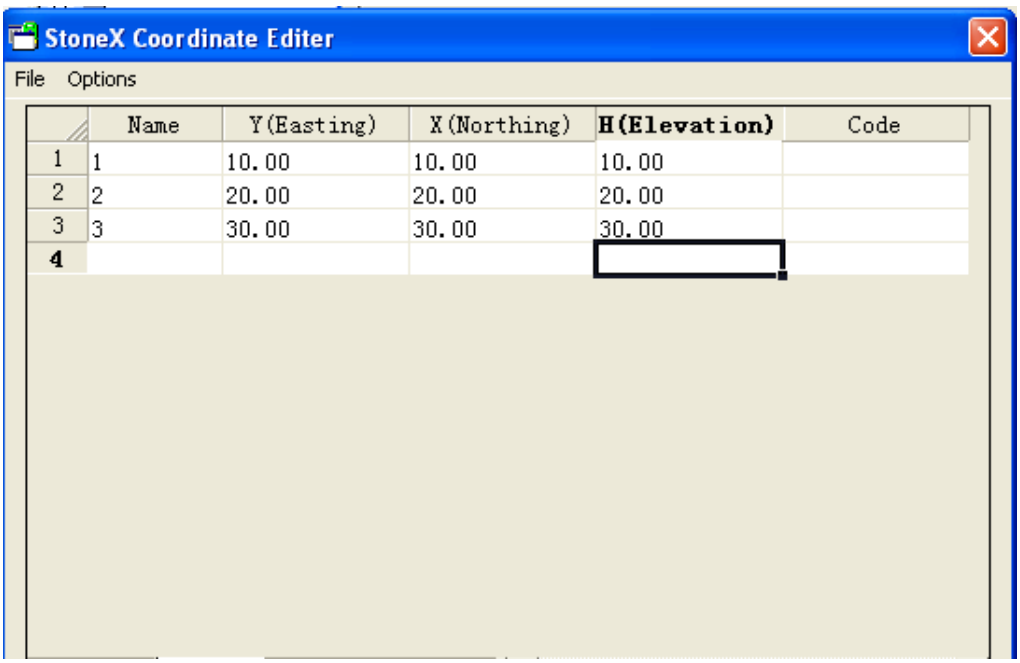
coordinate data includes point number, Y (Easting), X (Northing), H (Elevation). The code here, may not be used and to be edited in Codelist Manager.

A: ESTABLISH A NEW COORDINATE DOCUMENT

1 ） Open “Coordinate Editor”, procedure establish a new coordinate document automatically.



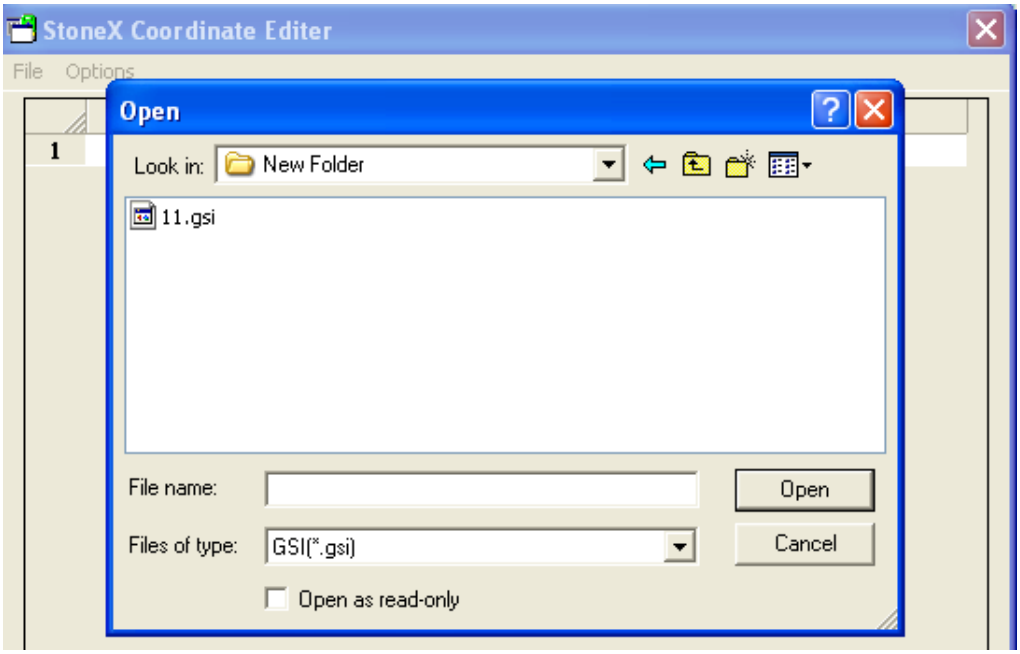
2）Inside dialog input coordinate information, including point number, Y(E coordinate), X(N coordinate), H(elevation). As the picture shown below:



3）Click “File” → “Save”, a document saving dialog springs out. Choose the type of data saving, after inputting document name, click “Save”.

B：OPEN FILE

1） Inside “File” menu select “Open”, in the dialog springing out select coordinate data needed to open. As shown in the picture below:



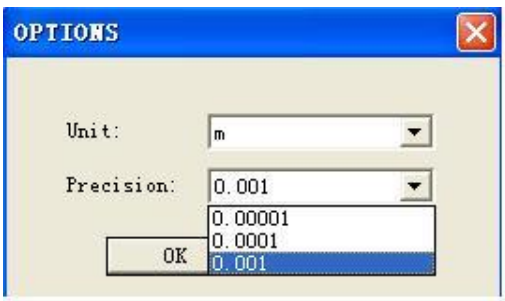
2）Inside “Type” column, set document type that needed to open (GSI, IDX, SOUTHCASS documents of three types are provided), select the document needed to open, and click “OK”.

C：SET PRECISION OF DISTANCE UNIT

User can set precision of distance unit of coordinate data according to requirement. The operational steps are as follows：

Inside “Options” menu press “Setting”.

In the dialog springing out, select precision of distance unit



The precision of each distance unit provided by STONEX transmission software is as follows

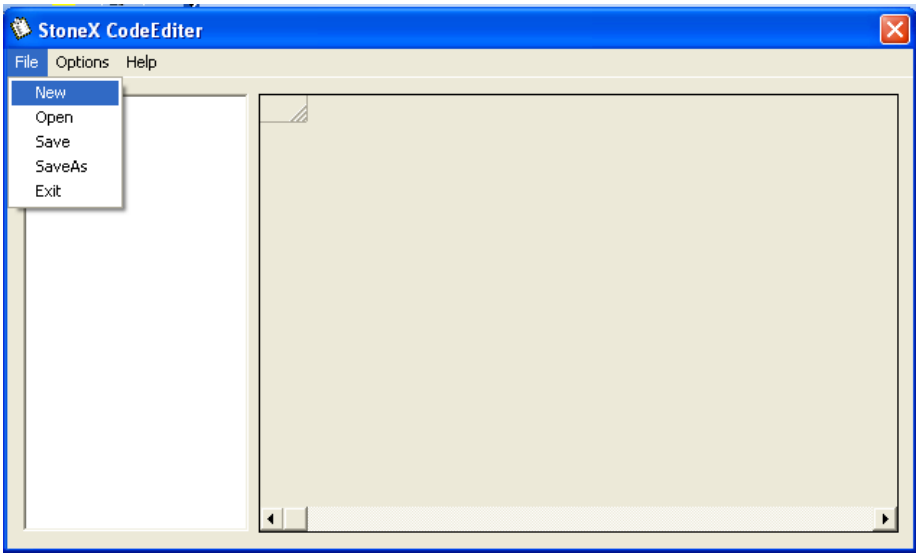
DISTANCE UNIT	PRECISION
METER	0.001 0.0001 0.00001

4 CODELIST EDITTING

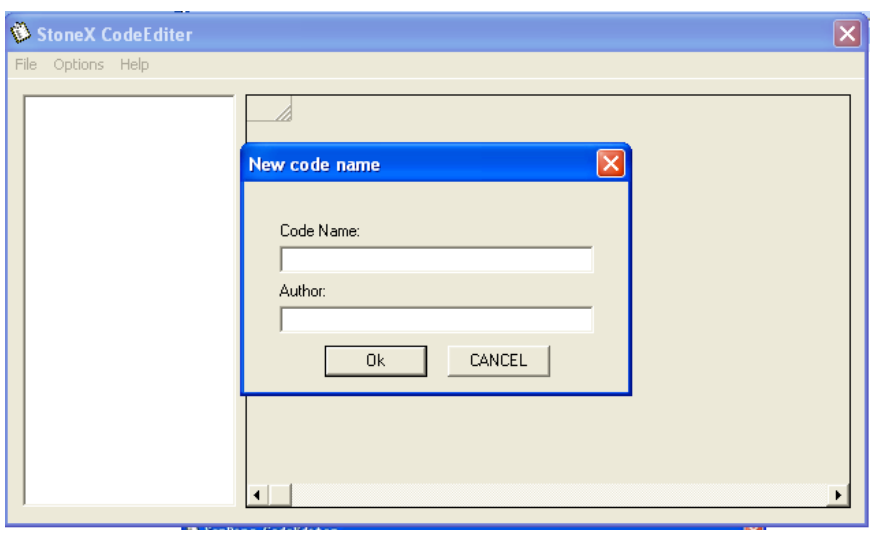
User can set new and edit code block in Codelist Manager. Each code block contains code and attributes, the edited coding block can be transmitted to Total Station Instrument through Data Exchange Manager.

ESTABLISH A NEW CODEBLOCK

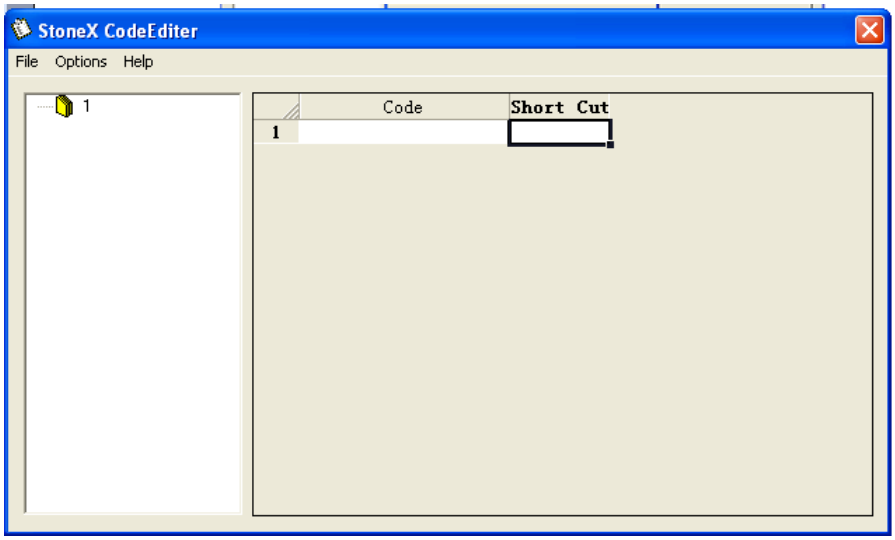
1）Inside “File” menu select “New”, set a new code block document.



2）Program prompt “New code name” dialog, input code name on “Code name”. You can input nothing in “Author” item.



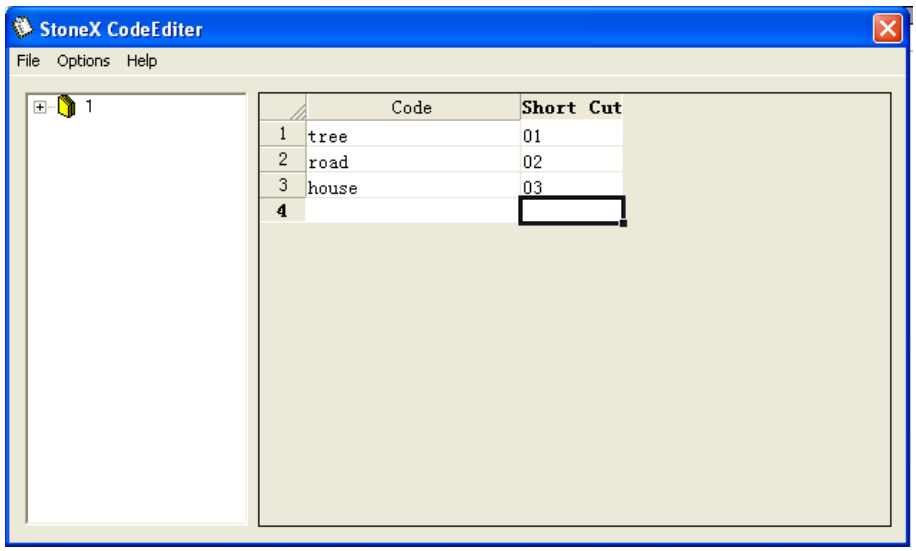
3）Click “OK” and a new code block is set.



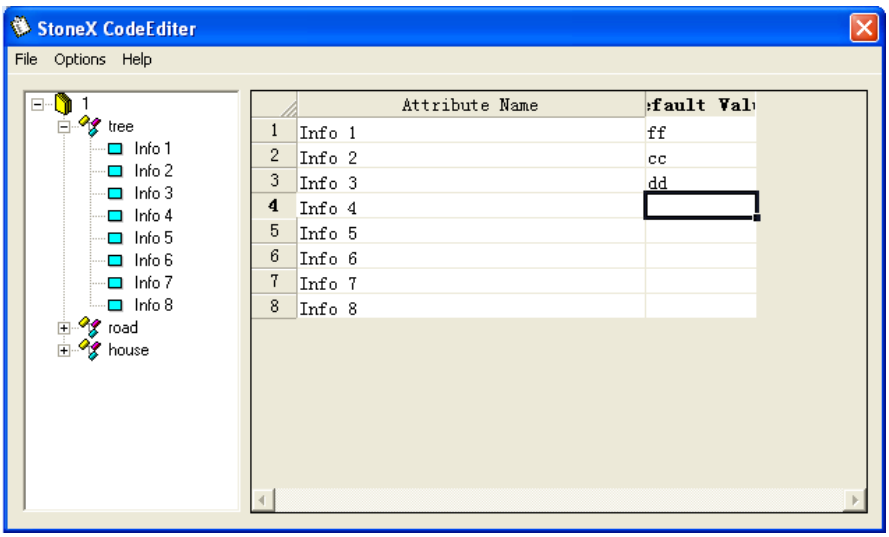
After a code block is set, the later job is to edit code in it. Each code block contains the code and 8 attributes.

4） Set a new code

Input coding name, and define a shortcut key for this code. The shortcut key consists of two Arabic numerals.



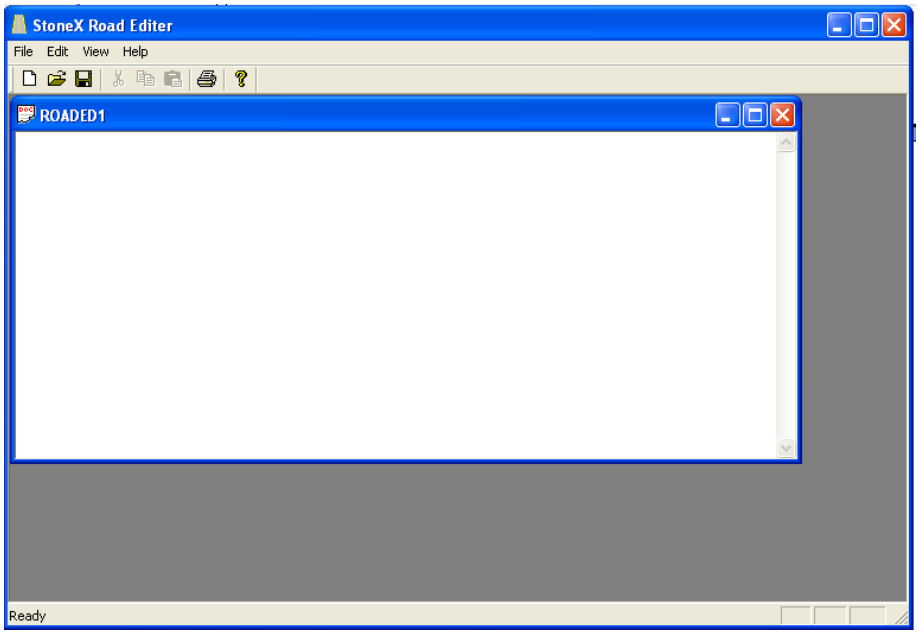
5）On the left window of coding subdirectories, click the code, to enter editing function of code attributes. Input each attribute.



6）After editing it, store the file.

5 DESIGN ROAD LINE DATA

Open “Roadline editor”, the program set a new document automatically. As shown in the picture below:



Later on, user can edit road line data in the established document. As finish editing, save data and then quit the program.

A: HORIZONTAL LINE FORMAT

The horizontal line is transmitted from computer to instrument through line element,

including initial definition. It should be included in initial definition the number of the start stake and coordinate of this point. The line elements include point, straight, arc, and transition curve.

Each recorded format is:

(KEYWORD) nnn, nnn [, nnn]

Here：

START POINT stake number, E, N
STRAIGHT azimuth, distance
ARC radius, arc length
SPIRAL radius, length
PT E，N[，A1，A2]
(A1, A2: LENGTH)

For example1：

START 1000.000, 1050.000, 1100.000
STRAIGHT 25.0000, 48.420
SPIRAL 20.000, 20.000
ARC 20.000, 23.141
SPIRAL 20.000, 20.000
STRAIGHT 148.300, 54.679

Example 2：

START 1000.000, 1050.000, 1100.000
PT 1750.000, 1300.000, 100.000, 80.800
PT 1400.000, 1750.000, 200.000
PT 1800.000, 2000.000

B: VERTICAL CURVE FORMAT

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

Data format is:

Stake number, height, length

For example：

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

【APPENDIX-B】 CALCULATE ROAD ALIGNMENT

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

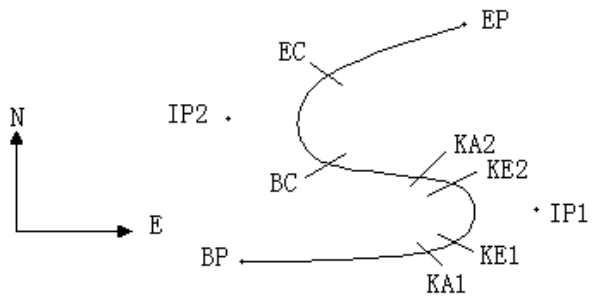
NOTE:
Road alignment data can be uploaded from computer or can be entered manually.
Road alignment data is managed by chainage.

1 ROAD ALIGNMENT ELEMENTS
There are two ways to enter the alignment elements:
Download from PC.
Manually enter on the R 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	North (N)	East (E)	Radius (R)	Transition curve A1	Transition curve A2
BP	1100.000	1050.000			
IP1	1300.000	1750.000	100.000	80.000	80.000
IP2	1750.000	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

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

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

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

(3) Calculation of transition coordinates

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

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

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

$$= 64(1 - \frac{0.01024}{10} + \frac{0.01048576}{216} - \frac{0.0\,0\,1\,0\,7\,3\,44\,1}{9\,3\,6\,0})$$

$$= 64(1 - 0.0\,1\,0\,2 + 0.0\,0\,0\,0\,4\,8 - 0\,0\,0\,0\,0\,0\,0)$$

$$= 64 * 0.98981$$

$$= 63.348$$

Similarly, the value of E is:

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

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

$$= 6.777$$

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 $\Delta R_1 = \Delta R_2$

⑸ Calculation of Spiral Transition coordinate

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

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

⑹ Calculation of Tangent Distance

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

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

$D_1 = 100 * \tan(111°55'47''/2) + 1.7(1/\sin 111°55'47'')$

$-1.7(1/\tan 111°55'47'') + 31.891$

=148.06015 + 1.8326 + 0.6844 +31.891

=182.468

$D_1 = D_2$

⑺ 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 ⇒ $\alpha_1 = 74$ ̊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

⑻ 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

⑼ 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 ⇒ $\alpha_2 = 322$ ̊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

⑽ 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″

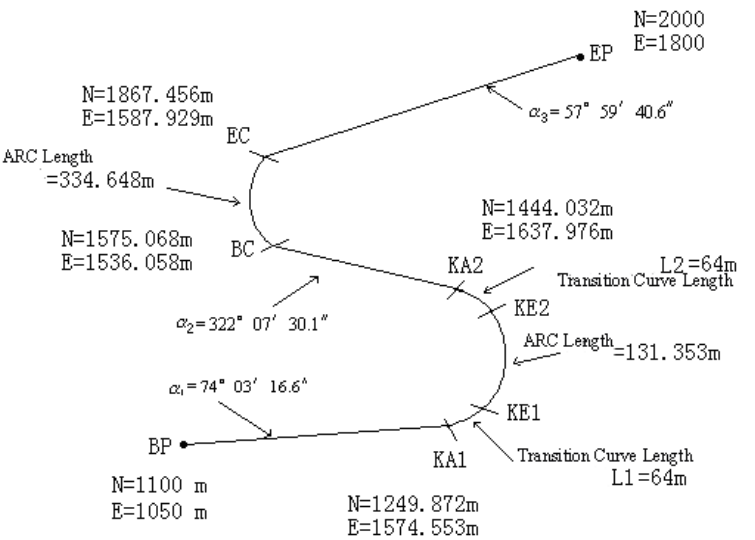
N_{BC} = 1750 - 221.615 * cos322 °07′30.1″ =1575.068 m

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 ：

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