FORWORDS

Thank you for purchasing Total Station R2 Series.
This manual will give a detailed and complete instruction.
Please read it carefully before using the instrument.

PRECAUTIONS

1. Do not collimate the objective lens directly to the sunlight without a filter.
2. Do not store the instrument in extremely high or low temperature, in order to avoid the sudden or great change of temperature.
3. When the instrument is not in use, store 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 less tissue only!
9. Clean the instrument surface with a woolen cloth after use. If it gets wet, dry it immediately.
10. Before opening, inspect the power, functions and indications of the instrument as well as its initial setting 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.

SAFETY GUIDE

INTEGRATED DISTANCE METER (VISIBLE LASER)

Warning

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

On the vertical tangent screw sticks an indication label "CLASS III LASER PRODUCT".

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.)

LASER PLUMMET

The laser plummet built into the product produces a visible red laser beam which emerges from the bottom of the product. The product is a Class 2/Ⅱ Laser Product.

Class 2 Laser Product is in accordance with:

IEC 60825-1:1993 "Safety of Laser Products"

EN 60825-1:1994 + AⅡ:1996: "Safety of Laser Products".

Class Ⅱ Laser Product is in accordance with:

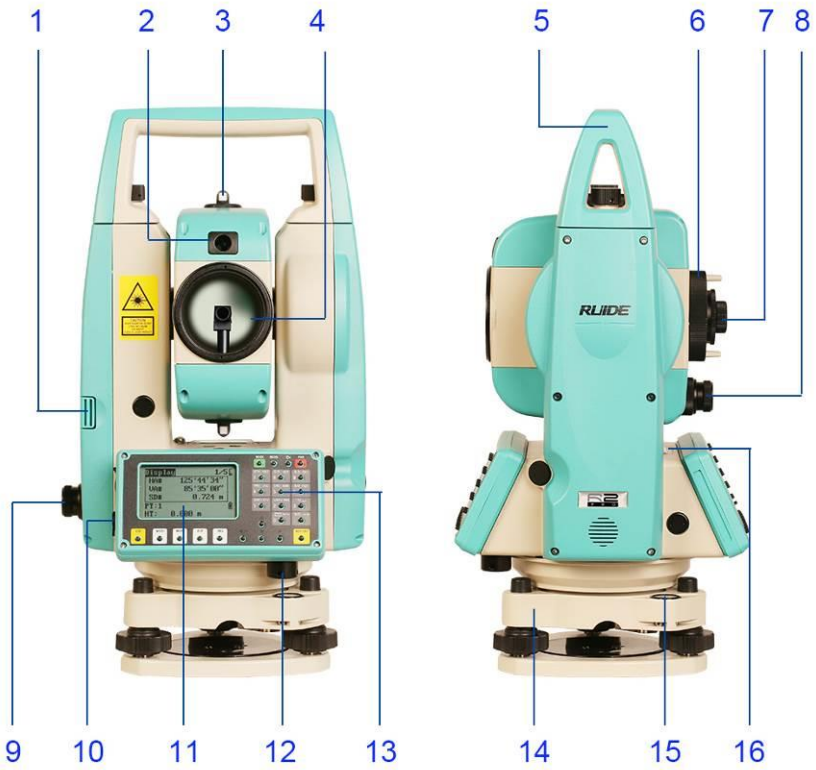
FD121CFR ch.1$ 1040:1998 (U.S. Health and Human Services Secretary, Federal rules code)

Class 2 Laser Products:

Do not stare into the beam or direct it unnecessarily at other persons. Eye protection is normally afforded by aversion responses including the blink reflex.

1. OVERVIEW

1.1 PART NAMES

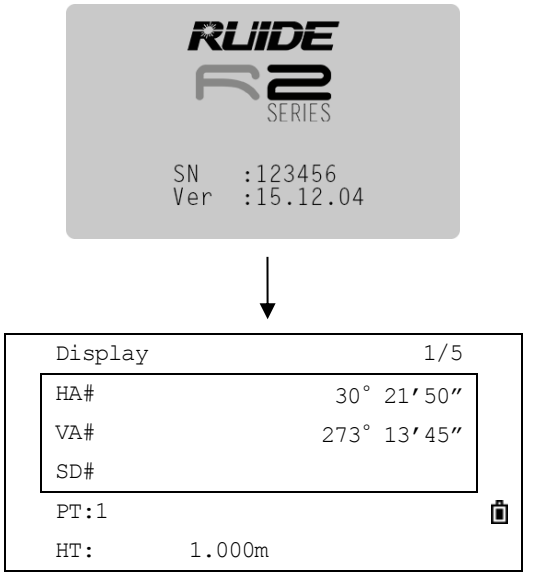


1. Battery	9. Horizontal Clamp Screw
2. Guide Light (R2 Pro only)	10. RS232, SD Card, Mini USB Port
3. Collimator	11. Screen
4. Objective Lens	12. ATMOSense Detector
5. Carrying Handle	13. Keyboard
6. Telescope Focusing Ring	14. Tribrach
7. Telescope Eyepiece	15. Circular Vial
8. Vertical Clamp Screw	16. Plate Vial

ACCESSORIES

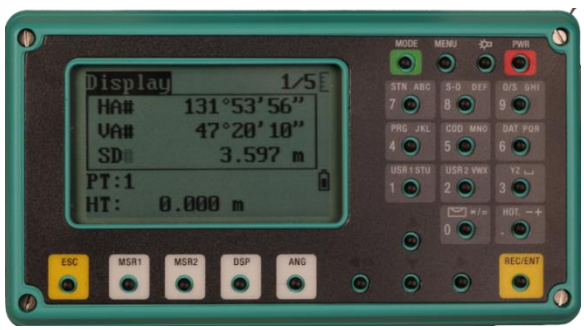
Carrying Case	Fur Brush	User Manual
Battery	Screw Driver	Warranty Card
Charger	Hexagon Wrench	Software CD
Plumb Bob	Cloth	
Adjusting Pin	Rain Cover	

1.2 DISPLAY



Basic Measurement Menu

1.3 KEYPAD



1.4 SOFT KEYS

Key	Function
PWR	Power ON/OFF
☼	Illumination ON/OFF
MENU	Displays the Function Menu ----------MENU---------- 1. Job 6. 1 Sec. 2. Cogo 7. Adjust 3. Set 8. Time 4. Data 9. Format 5. Comm 10. Info

	Changes the input mode: alphabetic or numeric; Launches quick code mode in basic measurement display.
	Accepts the input or records the data. In basic measurement display, press it for 1 second to select the data saving mode (CP or SS).
	Returns to last screen. Cancels the data input.
MSR1	Measures the distance with the mode this key has been predefined. Press it for 1 second to view and change the measuring mode.
MSR2	Measures the distance with the mode this key has been predefined. Press it for 1 second to view and change the measureing mode.
DSP	Shift the display. Press it for 1 second to launch customizing items.
ANG	Displays the angle measuring menu. Or sets the horizontal angle to zero. Or continuous angle measuring. Or F1/F2 angle measuring. Or maintains the horizontal angle.
	Displays the Station Setup menu. Or inputs the number 7, letter A, B, and C.
	Displays the stake-out menu. Press it for 1 second to display the setting about stake-out. Or inputs number 8, and letter D, E, F.
	Displays the Offset Point Measurement menu. Or inputs number 9, letter G,H,I.
	Displays the Programs menu. Or inputs number 4, letter J, K, L.
	Pops out a window to enter a code. The default code value is the last code entered. Or inputs number 5, and letter M, N, O.
	Displays RAW, XYZ, or STN data, depending on your setting. Or inputs number 6, and letter P, Q, R.
	Launches the function that is assigned to the this key. Or inputs number 1, and letter S, T, U.
	Launches the function that is assigned to the this key. Or inputs number 2, and letter V, W, X.
	Inputs number 3, letter Y, Z, and Space.
	Displays the *HOT* menu. Or inputs – and +.
	Displays the electric bubble. Or inputs *, /, =, 0.

1.5 NAVIGATION KEYS & ABBREVIATION

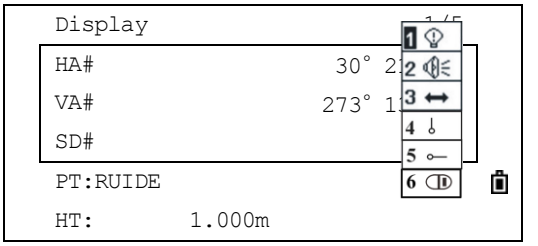
Navigation Keys

Key	Meaning
◀, ▶	Move left or right.
▲, ▼	Display each screen.
⬇, ⬆	There're more than 1 page. Press it to turn the page.
F1, **F2**	Indicates that the telescope (alidade) is on Face1 or Face 2. F1 Face 1 Measurement: the encoding disc is on the left of telescope when measuring. F2 Face 2 Measurement: the encoding disc is on the right of telescope when measuring.

Abbreviation List

HA	horizontal angle
VA	vertical angle
SD	slide distance
AZ	azimuth angle
HD	horizontal distance
VD	vertical distance
HL	Horizontal angle (left): 360°-HA
V%	ratio of slope
N	North coordinate
E	East coordinate
Z	Elevation coordinate
PT	point
HT	height
CD	code
PPM	atmospheric correction value
P1	Point 1
P2	Point 2
HI	instrument height
BS	backsight point
ST	surveying station
Tips	*When "#" is behind any abbreviations above, it means the automatic tilt correction is not activated. *When "d" is in front of any abbreviations above, it means it is a difference value.

1.6 LIGHTS & SOUND



Press the key to turn the LCD backlight ON and OFF.

Press it for 1 second to pop out a quick setting window to adjust more settings about light, sound, contrast, laser and Guide Light.

In the window opened as above, press [▲], [▼] (or press [1], [2], [3], [4], [5] corresponding to the items) to choose the settings for switch. When an item is selected, the function corresponding to the key can be launched ON/OFF by pressing the corresponding number.

1	LCD Back Light
2	Sound and Beep
3	Screen Contrast
4	Laser Plummet
5	Laser Pointer
6	Guide Light

1.7 AUTO POWER OFF

The default Auto Power OFF time is 30 minutes. If no key is pressed for such long time, the total station will be switched off in order to save power.

2. PREPARATION

2.1 UNPACKING AND STORING

· Unpacking

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 vial upwards (Objective lens towards tribrach), and slightly tighten the vertical clamp screw and lock the case.

2.2 INSTRUMENT SETUP

Mount the instrument on a tripod. Level and center the instrument precisely.

Operation Reference:

1. Leveling and Centering the Instrument by plumb bob.

1) Setting up the tripod

a. Extend the legs to suitable length, make the tripod head approximately leveld to the ground and tighten the leg screws.

b. Make the center of the tripod and the occupied point approximately on the same plumb line.

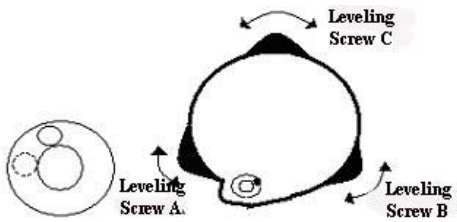
c. Step on the tripod to make sure if it is well stationed on the ground.

2) Fix the instrument on the tripod.

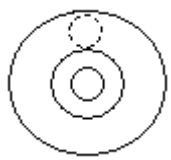
Place the instrument carefully on the tripod head and slide the instrument by loosening the tripod screw. If the plumb bob is positioned right over the center of the point, slightly tighten the tripod.

3) Roughly leveling the instrument by using the circular vial.

a. 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.

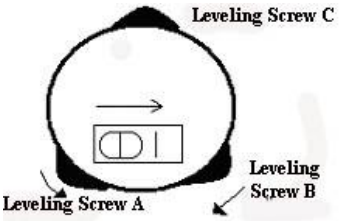


b. Turn the leveling screw C to move the bubble to the center of the circular vial.

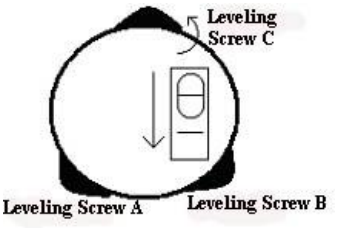


4) Precisely leveling by using the plate vial.

a. 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.



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



c. Repeat the steps a and b for each 90º (100gon) 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; make the circular vial bubble of the instrument in the middle.

4) Use plate vial to level the instrument accurately.

a. 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.

b. Rotate 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

TIPS

1) The battery operating time depends on the environmental conditions such as ambient temperature, charging time, times of charging and discharging etc. It is recommended to fully charge the battery before operation or prepare spare batteries.

2) Distance measurement consumes more power than angle measurement.

3) When the measurement mode is changed, the battery power will not immediately show the decrease or increase. The battery power indicating system shows the general status but not the instantaneous change of battery power.

CAUTIONS

1) Use the original charger HC-III.

Remove the on-board battery and connect it to battery charger. When the indicator light on the battery charger is orange, the recharging process is on. When recharging is complete, the indicator lamp turns green.

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

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

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

When the indicator light does not light after connecting the battery and charger, either the battery or the charger may be damaged. Please contact technician for repairing.

4) Rechargeable battery can be recharged 300 to 500 times. Complete discharge of the battery may shorten its life.

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

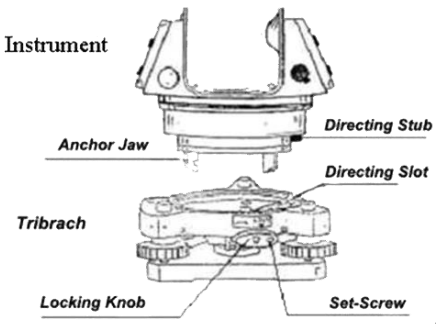
2.4 REFLECTORS

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

2.5 MOUNTING AND DISMOUNTING

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 An 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. You should adjust the eyepiece tube carefully to eliminate the parallax.

2.7 INPUTTING MODE

All characters can be input in the screen.

Press [◀] to delete one character in the left of the cursor.

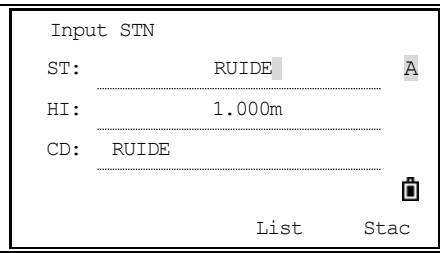
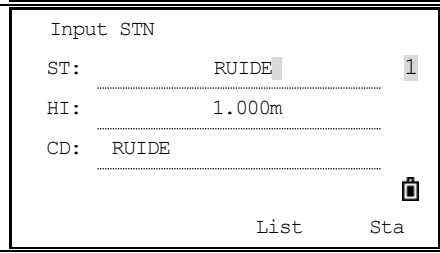
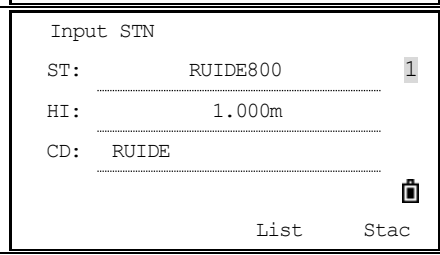
When the inputting scale is wider than the screen, it can be moved to left automatically. When the inputting scale is full, it cannot be input anymore.

When an A is displayed on the upper right corner of the screen, letters can be input via the keypad. While 1 is displayed, numbers can be input. In any measurement screens or screens that need to be input manually, press [MODE] to shift between alphabet mode and numeric mode.

In letter inputting mode, 3 letters are set in one key. Every pressing can display one of the letters in the cursor.

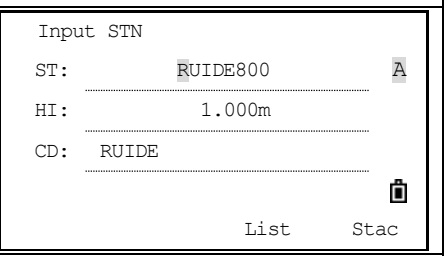
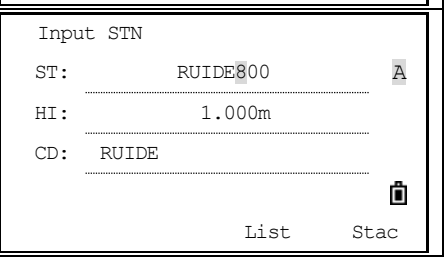
2.7.1 Input Characters

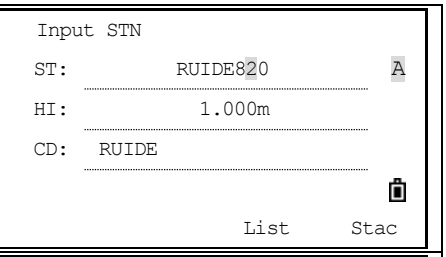
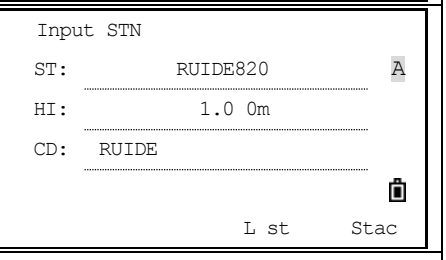
STEP	OPERATION	DISPLAY
a. Make sure that the current inputting mode is alphabet mode. If not, press [MODE].		Input STN ST: A HI: 1.000m CD: RUIDE List Stac

b. Press [6] 3 times to input R. Press [1] 3 times to input U. Press [9] 3 times to input I. Press [8] once to input D. Press [8] twice to input E.	[6] [1] [9] [8] [8]	
c. Press [MODE] to shift the inputting mode to number inputting.	[MODE]	
d. Press [8] and [0]. ※1)	[8] [0]	
e. After inputting, press [REC/ENT] to confirm.※2)	[REC/ENT]	
※1) The maximum length of character of point ID or point number is 16. ※2) If the point ID is wrong, press [ESC] and input again.		

2.7.2 Edit Characters

Characters that have been input can be edited.

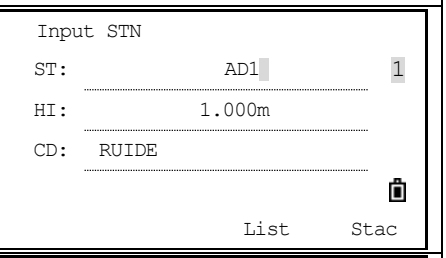
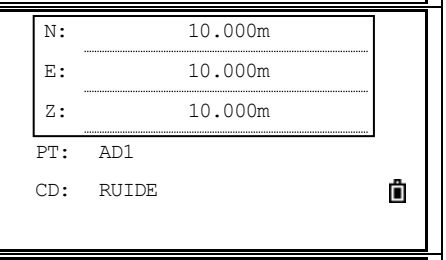
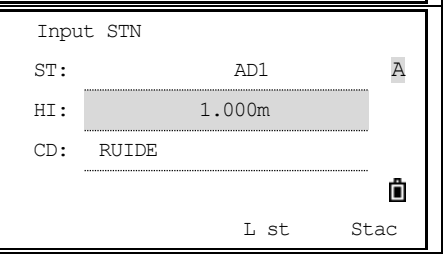
STEP	OPERATION	DISPLAY
a. Move the cursor to the item that needs to be edited, and press [▶], the cursor will stay on the first character and twinkle.	[▶]	
b. Press [▶] to move the cursor to the character that needs to be edited. ※1)	[▶]	

c. Input new character.	New character	
d. Press [REC/ENT] to confirm. The cursor moves to next item.	[REC/ENT]	
※1) Press [◀] to delete the right character.		

2.8 METHOD TO INPUT PTID

Basically, the default name for a new point is the last point name entered, with the last digit incremented. When the last character of the previous point name is alphabetic, it is named by adding 1. When the cursor is in the PT field, there are several ways to specify a point or input coordinates. Here, take station PtID for example.

2.8.1 Enter an Existing Point

STEP	OPERATION	DISPLAY
a. Input PtID in PT blank and press [REC/ENT].	[REC/ENT]	
b. The system automatically searches the PtID in internal memory. When this PtID exists, its coordinates will be displayed on the screen.		
c. Press [REC/ENT] to return to the screen. The point is called up. The cursor moves to next item.	[REC/ENT]	

2.8.2 Enter a New Point

STEP	OPERATION	DISPLAY
a. Input PtID in PT item and press [REC/ENT].	[REC/ENT]	Input STN ST: AD2 1 HI: 1.000m CD: RUIDE List Stac
b. When you input a new point name or number, a coordinate input screen appears. Enter the coordinate. After inputting one item, press [REC/ENT] to move to next item.	Input coordinated [REC/ENT]	N: E: Z: PT: AD2 CD: RUIDE
② After inputting coordinate data, input the code (if necessary) in the last row (CD item). Press [REC/ENT] to store this point to current project.	Input CD [REC/ENT]	N: 10.000m E: 10.000m Z: 10.000m PT: AD2 CD: RUIDE
③Return. The cursor moves to next item.		Input STN ST: AD2 1 HI: 1.000m CD: RUIDE List Sta

2.8.3 Search Via Wildcard ""*

Wildcard "*" can be represented a character that needs to be found.

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

Example:

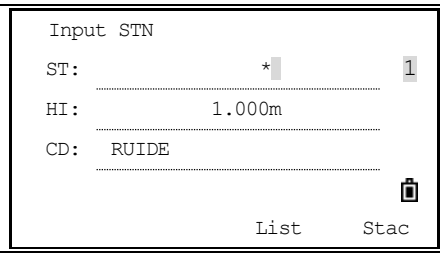
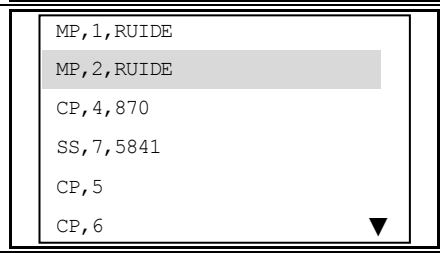
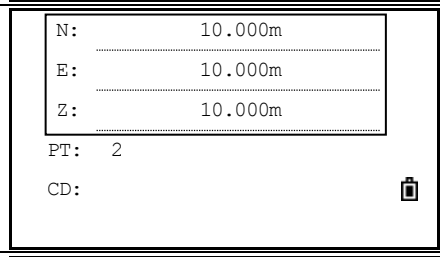
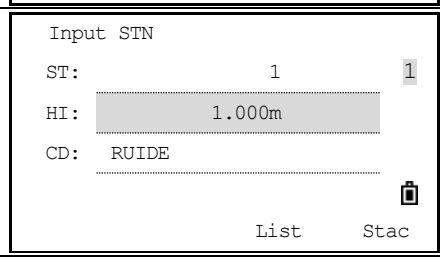
* : All points of any length are found.

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)

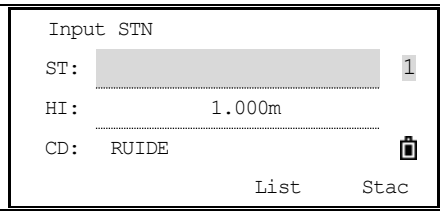
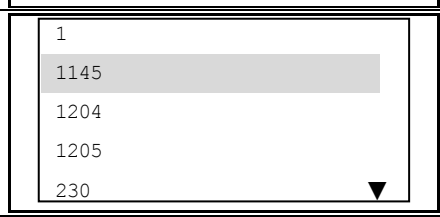
*1: All points of any length with a "1" as the second character are found (e.g.：W1，F15，A1R)

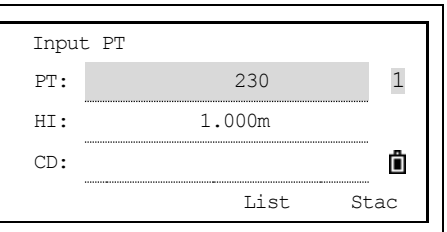
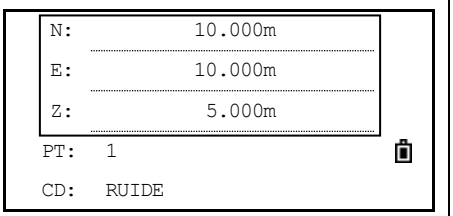
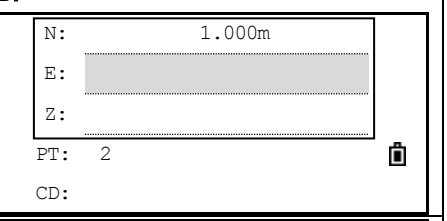
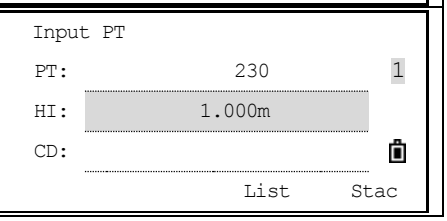
A*1: All points of any length with an "A" as the first character and a "1" as the third character are found.

STEP	OPERATION	DISPLAY
a. In PT item, insert wildcard "*" (take "*" for example), and press [REC/ENT]	Input [*] [REC/ENT]	
b. Press up/down and [REC/ENT] to select the point. When [▲] or [▼] appears in the list，left/right can turn the page.	[▲]/[▼] [REC/ENT]	
c. When a point is select from the list, the coordinate will be displayed on the screen.		
d. Press [REC/ENT] to return. This point is called up. The cursor moves to next item.		

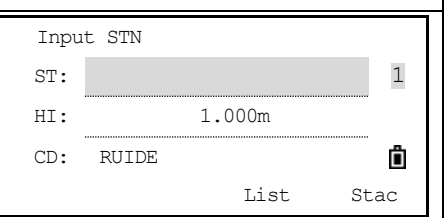
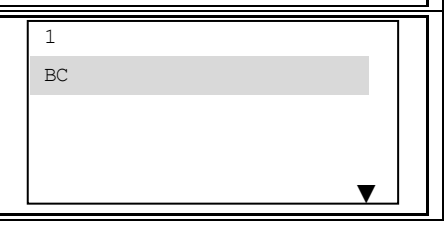
2.8.4 Enter a Point from the Point List

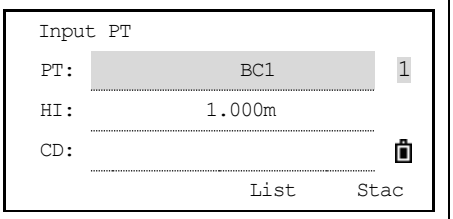
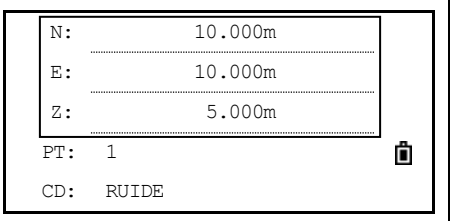
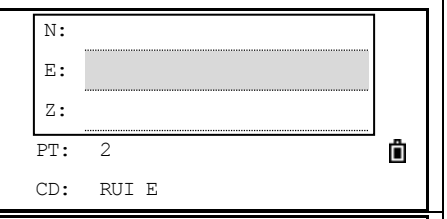
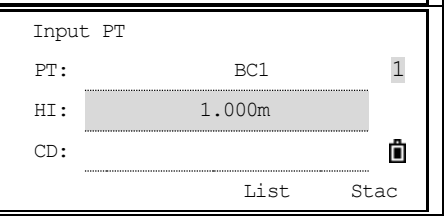
Point ID can be input via [List]. The meaning of the PtID list is the same as that of code list.

STEP	OPERATION	DISPLAY
a. Press [List] soft key when the cursor is in the PT field.	[List]	
b. PtID list is displayed. Press up/down arrowhead to move the cursor to the point that you want to use, and then press [REC/ENT].	[▲]/[▼] [REC/ENT]	

c. When you return to the PT input screen, the selected PtID is entered in the PT field. (You can add digits or alphabetic characters if required.) Press [REC/ENT] to confirm.		
d. A: If the inputted PtID exists in internal memory, its coordinates will be displayed on the screen. Press [REC/ENT] to return. B: If the inputted PtID does not exist, it is required to input coordinate (as shown on the right). Input the coordinate and press [REC/ENT] to move the cursor to the code item. Input the code, press [REC/ENT] to save and quit.		**A:**  **B:** 
e. Return to PT inputting screen. The cursor moves to next item.		

2.8.5 Enter a Point from the Stack

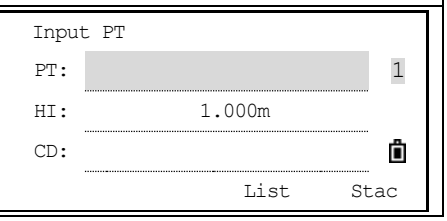
STEP	OPERATION	DISPLAY
a. When the cursor is on ST field, press [Stac].	[Stac]	
b. The stacks of the points are displayed. Press [▲]/ [▼] to select the PtID, and press [REC/ENT].	[▲]/[▼] [REC/ENT]	

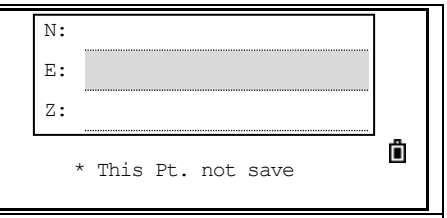
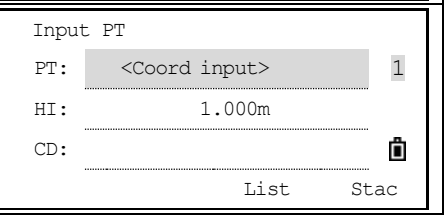
c. When you return to the PT input screen, the selected point name is entered in the PT field, incremented by one. (As shown in the right. If BC is selected, BC1 appears in the PT field; If A098 is selected, A099 appears.) Press [REC/ENT].		
d. A: If the PtID exists in internal memory, its coordinate will be displayed on the screen. Press [REC/ENT] to return. B: If the inputted PtID does not exist, it is required to input coordinate (as shown on the right). Input the coordinate and press [REC/ENT] to move the cursor to the code item. Input the code, press [REC/ENT] to save and quit.		**A:**  **B:** 
e. Return to PT inputting screen. Move the cursor to next item.		

The stack shows the last 20 point names used, in chronological order from last used to first used. Stacks with the same type are covered.

2.8.6 Press [REC/ENT] without a Point Name

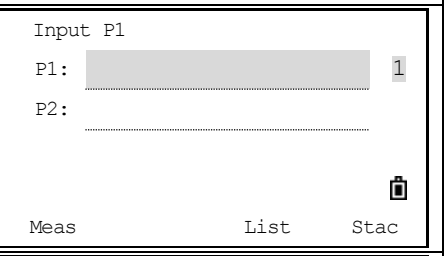
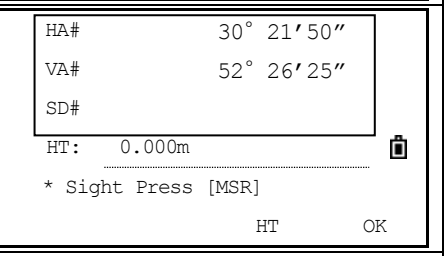
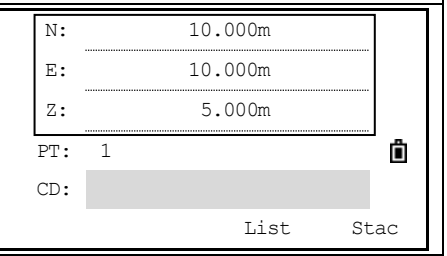
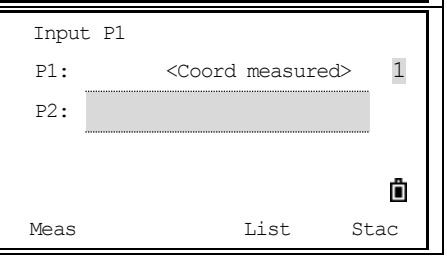
In some occasions of inputting PtID, a temporary coordinate that needn't to be saved can be used. The input coordinates are used in calculation. They are not saved in the database.

STEP	OPERATION	DISPLAY
a. In PT item, press [ENT] directly without inputting its PtID.	[ENT]	

b. A coordinate inputting screen is displayed. Input the coordinate. After inputting one item, press [REC/ENT] to move to next item.	Input coordinate [ENT]	
c. After inputting, press [REC/ENT] to return.	[ENT]	

2.8.7 Record an Instant Measurement

You can also input a point by recording an instant measurement. To do this, press the Meas softkey.

STEP	OPERATION	DISPLAY
a. Press [Meas] in PT inputting screen.	[Meas]	
b. An observation screen appears. Press [MSR1]/[MSR2] to start a measurement. To change the height of the target, press [Hot].	[MSR1] [MSR2]	
c. After measuring, the system automatically enters into the point recording screen. Input PtID and CD, and press [REC/ENT] to record the result.	Input PT & CD	
d. The screen returns. The cursor moves to next item.		

If there's alignment data in internal memory, PtID can be input via chainage number. Please refer to "7.7.8 Setting Station".
The method to input code can be input manually, called up from list and stack. The operational method is same as that of PtID inputting.

2.9 LEVELING

As the tilt sensor is activated, automatic correction of vertical angle for mislevelment is displayed.
To ensure a precise angle measurement, tilt sensor must be activated. 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.
R2 Series compensates the vertical angle reading as well as both vertical and horizontal angle reading due to inclination of the vertical axis in the X direction and XY directions.

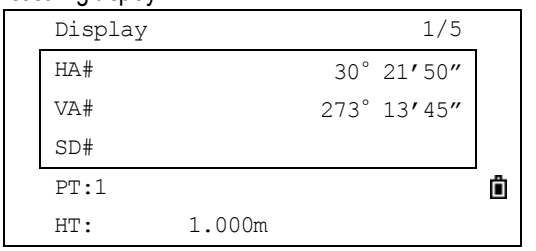
STEP	OPERATION	DISPLAY
a. Press 0 to enter to automatic compensation function. ※1)		Tilt: X X: 0° 21′50″ Y: Over X OFF
b. Tilt compensation value is displayed. If the value is within ±5', it indicates that it is in the automatic compensation range of the raster disc. Press [ESC] to return to measurement function. If it is beyond ±5', it means that it needs to be leveled manually.		Tilt: X X: 0° 00′21″ Y: Over X OFF
c. Press MSR2 to shift the compensation mode to dual axis compensation. ※2)		Tilt: XY X: 0° 00′21″ Y: 0° 02′24″ XY OFF
After leveling, press [ESC] to return to previous status.		
※1) To close automatic compensation, press [OFF].		

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 is ON, 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.

3. ROUTINE MEASUREMENTS

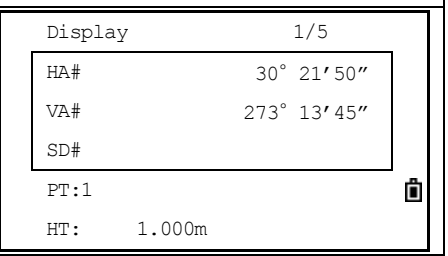
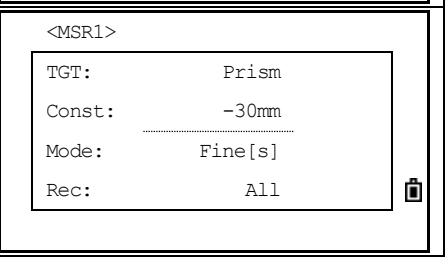
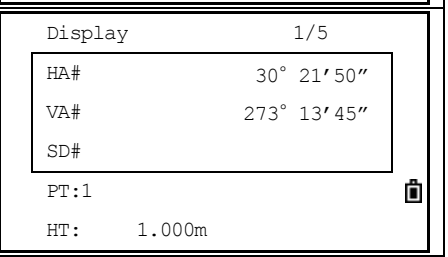
3.1 CAUTIONS FOR DISTANCE MEASUREMENT

After setting up and switching on correctly, the Total Station is immediately ready for measuring.
All shown displays are examples. It is possible that local software versions are different from the basic one.
Example of a possible measuring display:



3.2 EDM SETTING

Press [MSR1] or [MSR2] for 1 second to enter each measurement function it is specified.

STEP	OPERATION	DISPLAY
a. To view the measurement setting, hold down [MSR1] or [MSR2] for one second. Here take measurement mode setting in basic measurement as example.		
b. Take the measurement mode specified on [MSR1] for example. Press [▲] or [▼] to move to the item that needs to be modified, and press [◀] or [▶] to change the options. ※1)	[MSR1]/ [MSR2] for 1 second.	
c. After setting, press [REC/ENT] to save the setting and return to last screen. ※ 2)	[REC/ENT]	

※1) All options in each item in measurement setting:
TGT: Prism, reflector sheet and non-prism (only or reflectorless instrument).
Const: Input prism constant directly (under prism mode). Scale: -999～999mm
Mode: Fine[s], Fine [2] ([3]/ [4]/ [5]), Fine[r], Tracking.
Rec: Enter, All, Meas. This mode controls the mode operation of [MSR1]/MSR2] in basic measurement function.
If "Enter" is adopted, a screen of "Rec Pt" is displayed to inform the user to check and confirm before data is recorded.

"All" is a quick shooting and recording mode. The instrument automatically records the point using the default PtID, and then returns to the basic measurement screen.
"Meas" is the default measuring mode. After a measurement, the instrument stops in the BMS and waits for you to press [REC/ENT] before recording the point.
※2) The measurement mode setting of [MSR2] is the same as it. When pressing [MSR1] or [MSR2], the system activates the corresponding measurement mode to measure.

3.3 HOT KEY

[HOT] Key includes the inputting function of target height, temperature & pressure, target selection and note. It is available on any observation screen.

3.3.1 Set the Height of the Target

To change the height of the target (HT) or temperature, pressure, press [HOT].

STEP	OPERATION	DISPLAY
a. Press [HOT] to display the [HOT] key menu.	[HOT]	HOT Key 1.Input HT 2.Temp&Pres 3.TGT 4.Note
b. Press [1] to enter into HT setting function.	[1]	Input HT HT: 1.800m Stac
c. Enter the height of the target manually or press the [Stac] softkey to display the HT stack. The HT Stack stores the last 20 HT values entered. As shown in the right.	Input target height or [Stac]	Input HT HT: 1.800m Stac 1.000m 2.000m 3.000m 4.000m 5.000m

d. Press [REC/ENT] to return to basic measurement screen.	[REC/ENT]	Display 1/5 HA# 30° 21′50″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m

3.3.2 Set the Temperature & Pressure

Atmosphere Correction:

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

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

The formula of atmosphere correction: (unit: meter))

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

If the pressure unit is mmHg：

1hPa = 0.75mmHg

When disregarding atmosphere correction, set PPM value to 0.

Standard atmospheric condition of Total Station R2 Series (i.e. the atmospheric condition that the atmosphere correction value of the instrument is 0):

Pressure: 1013 hPa

Temperature: 20°C

Using [HOT] Key and [2] can set temperature and pressure values. Enter the ambient temperature and pressure, the PPM value is updated automatically.

STEP	OPERATION	DISPLAY
a. Press [2] in HOT key menu to enter into Temp&Pres Setting.	[2]	HOT Key 1.Input HT 2.Temp&Pres 3.TGT 4.Note
b. The screen displays the current setting values. Input temperature value and press [REC/ENT] to move to next item. Input pressure value and press [REC/ENT].※1)	Input temperature & pressure [REC/ENT]	Temp&Pres Temp: 20.0℃ Press: 1013.2hPa PPM=0.0 ON OFF

c. The program calculates the atmosphere correction value, and return to normal measurement screen. ※2)		Temp&Pres Temp: 20.0℃ Press: 1013.2hPa PPM=0.0 ON OFF
d. Press ON to activate the automatic temperature and pressure sensor, which will detect and fill the Temp and Press automatically. ※3)		Temp&Pres Temp: 28.0℃ Press: 1005.0hPa PPM=9.6 ON OFF

※ 1) The inputting scope: Temperature:-40 - +60°C (step length 0.1°C) or -40 - 140°F (step length 0.1°F)

Air pressure: 420 - 799.5mmHg (step length 0.1mmHg) or 560 - 1066 hPa (step length 0.1hpa)

16.5 - 31.5 inchHg (step length 0.1 inchHg)

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

3.3.3 Select Target Set

A target set specifies settings for the target type, the prism constant, and height of target.

When you change the selected target set, all the three settings are changed. You can use this function to quickly switch between two types of targets, such as a reflecting sheet and a prism.

To select a target set, either press the corresponding numeric key (from 1 to 5), or use [▲]/[▼] to highlight the target set in the list and press [ENT]. To change the settings defined in a target set, highlight the target set in the list. Then press "Edit" softkey.

When a target set is selected, the Type and Const values are copied to both [MSR1] and [MSR2] settings. If you have specified a value for HT, this value is also copied to the current HT.

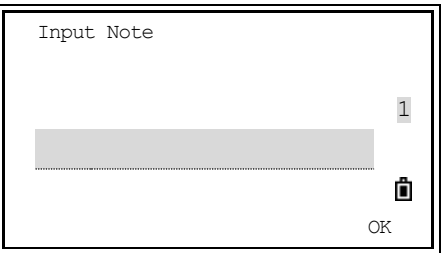
STEP	OPERATION	DISPLAY
a. In Hot Key menu, press numeric key [3] to enter target function.	[3]	HOT Key 1.Input HT 2.Temp&Pres 3.TGT 4.Note

<table>
<tr>
<td>b.
Press [▲]/[▼] or numeric keys [1]～[5] to select target set, and then press [ENT]. To edit the target set, highlight the target set and press Edit. After editing, press [ENT] ※1)</td>
<td>[▲]/[▼]
+
[Edit]</td>
<td>1<N,0, 1.000>
<S,0, 1.000>
3<N,0, 1.000>
4<P,0, 2.000>
5<N,0, 1.000>
Edit Set
Press [Edit]:
<TGT1>
TGT: Non-prism
Const: -30mm
HT: 1.000m</td>
</tr>
<tr>
<td>c.
The system starts the set target set, and returns to BMS.</td>
<td></td>
<td>Display 1/5
HA# 30° 21′50″
VA# 273° 13′45″
SD#
PT:1
HT: 1.000m</td>
</tr>
<tr>
<td colspan="3">※1)Type=prism/non prism/reflector sheet
Constant=-999 - 999mm
HT=-9999.999 - 9999.999mm
“HT” can be left blank in the target set (input the number beyond the max instrument height), the current HT value is always applied to the measurement.</td>
</tr>
</table>

3.3.4 Enter a Field Note

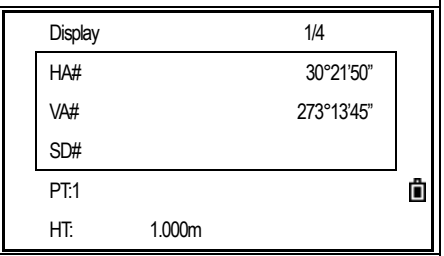
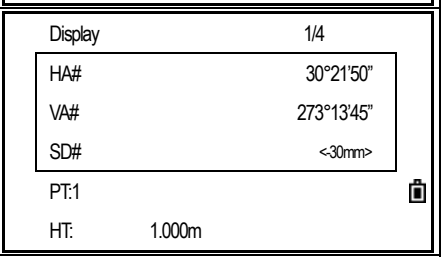
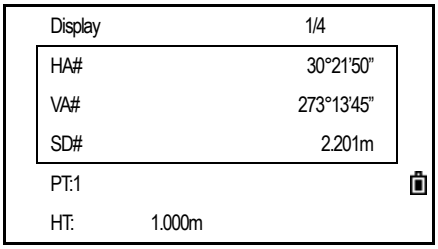
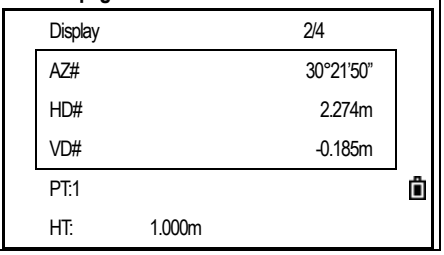
To enter a field note, press [HOT] and then press [4]. This function can be used at any time on any observation screen. Each note can be up to 50 characters. The note is stored as a CD record in the raw data.

STEP	OPERATION	DISPLAY
a. In HOT Key menu press numeric key [4] to enter Note function.	[4]	HOT Key 1.Input HT 2.Temp&Pres 3.TGT 4.Note

b. Input note and then press [ENT]. The instrument returns to the basic measurement screen.	Input Note	

3.4 START SURVEY

After finishing all settings, you can start surveying. The survey result is displayed in 4 pages including all data of routine survey. Press DSP to view. If the 2nd unit is set, a HD/VD/SD screen will appear.
Please set a job, station and backsight azimuth before measurement.

STEP	OPERATION	DISPLAY
a. Collimate to the center of target prism, press [MSR1] or [MSR2].	[MSR1]/ [MSR2]	
b. While the instrument is taking a measurement, the prism constant is displayed in a small font.		
c. Display the result of measurement in four pages, including all normal measure functions such as measure of angle, distance and coordinate, etc. Press [DSP] or [▲]/[▼] to view each page. *If the secondary distance unit is set, another page will display.	DSP or [▲]/[▼]	**First page:**  **Second page:** 

		Third page: Display 3/4 HL# 330°11'38" V%# -8.14% Z# -0.185m PT:1 HT: 1.000m **Fourth page:** Display 4/4 N# -1.974 E# -1.128 Z# -0.185 PT:1 HT: 1.000m

☞To change the height of the target (HT), temperature, or pressure, press [HOT].

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

☞The maximum capacity of R2 Serial is defined by the data type. Up to 10000 points can be collected at most.

3.5 ANGLE MEASUREMENT

To open the Angle menu, press [ANG] in the basic measurement screen.

STEP	OPERATION	DISPLAY
a. In BMS press [ANG] to enter angle observation function.	[ANG]	Display 1/4 HA# 30° 21'50" VA# 273° 13'45" SD# PT:1 HT: 1.000m
b. To select a command from this menu, press the corresponding number key and [ENT].		Angle HA: 273° 13'45" 1.0SET 4.F1/F2 2.Input 5.Hold 3.Rept.

3.5.1 0SET

Press [1] to set HA as 0, and then return to basic measurement screen.

STEP	OPERATION	DISPLAY
a. In Angle menu press [1] to enter to 0SET function.	[1]	Angle HA: 273° 13′45″ 1.0SET 4.F1/F2 2.Input 5.Hold 3.Rept.
b. Program sets the current horizontal angle as 0, and returns to basic measurement screen.		Display 1/4 HA# 0° 00′00″ VA# 273° 13′45 SD# PT:1 HT: 1.000m

3.5.2 Enter the Horizontal Angle

STEP	OPERATION	DISPLAY
a. In Angle menu press [2] to enter into the function of horizontal angle inputting.	[2]	Angle HA: 273° 13′45″ 1.0SE 4.F1/F2 2.Input 5.Hold 3.Rept.
b. Input horizontal angle, and then press [ENT] ※1)	Input HA [ENT]	HA Input HA: 20° 00′00″ 1 * Input HA Press[ENT]
c. Program returns to basic measurement screen, and displays the horizontal angle just input.		Display 1/4 HA# 20° 00′00″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m
※1) To enter 159°46'25", type 159.4625.		

3.5.3 Repeat Angle Measurement

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

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

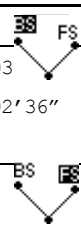
$$HA = BS A_Z + HR\overline{X} \text{ (normalized)}$$

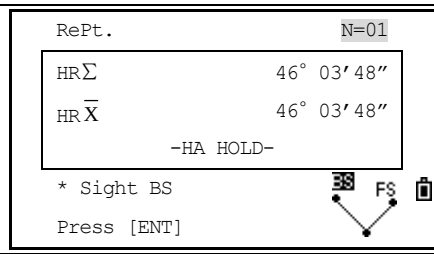
$HR\overline{X}$ is not updated even if the instrument is moved.

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

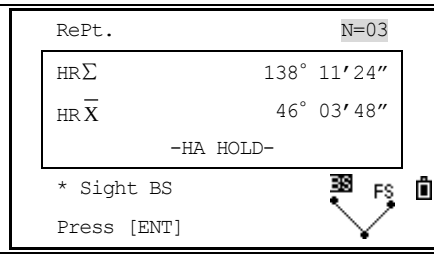
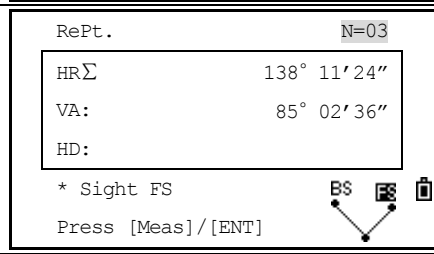
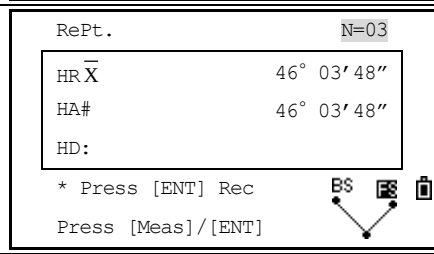
●Horizontal angles can be measured up to3599°59'59".

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

STEP	OPERATION	DISPLAY
a. In Angle menu press [3] to enter to the repeat horizontal angle measurement function.	[3]	Angle HA: 273° 13′45″ 1.0SET 4.F1/F2 2.Input 5.Hold 3.Rept.
b. System sets the initial value of HR as 0.		RePt. N=00 HRΣ 0° 00′00″ $HR\overline{X}$ -HA HOLD- * Sight BS Press [ENT] 
c. Sight the first target point which is used for repeat angle measurement. (i.e. Backsight), and press[ENT]	Sight the backsight [ENT]	RePt. N=01 HRΣ 0° 00′00″ VA: 79° 42′26″ HD: * Sight BS Press [Meas]/[ENT]
d. Use the horizontal clamp screw and tangent to sight the second target point (i.e. foresight), Here the horizontal angle is accumulated. To end repeat angle measurement, press [ESC].	Sight the foresight	RePt. HRΣ 46° 03 VA: 85° 02′36″ HD: * Sight FS Press [Meas]/[ENT] 

e. Press [ENT] to save the horizontal angles. Screen returns to the initial interface of repeat angle measurement. Repeat steps c-e to proceed this function as you need.	[ENT]	

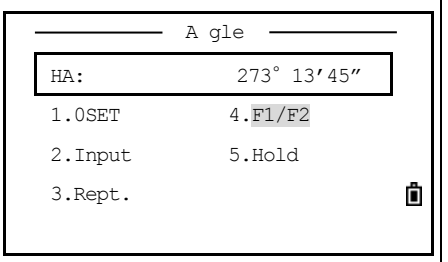
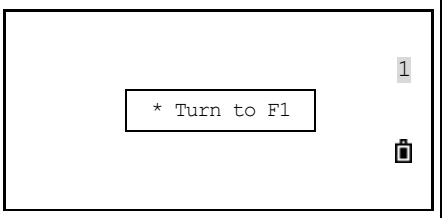
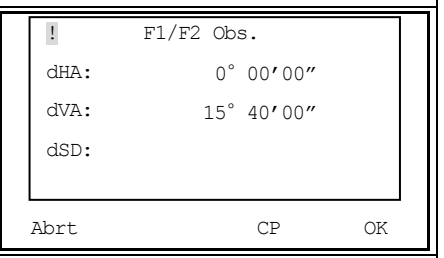
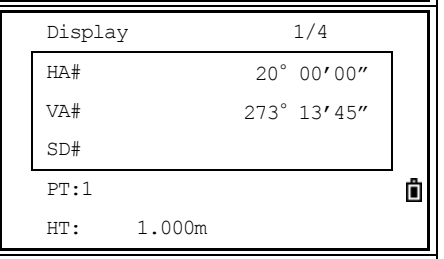
When you have collected enough horizontal angle results, press [MSR1] or [MSR2] to take a measurement to the foresight. The average horizontal angle is displayed. This value is fixed until the process is finished or cancelled.

STEP	OPERATION	DISPLAY
a. When you have accumulated enough horizontal angles, you can take a measurement to the foresight. First sight the backsight and then press [ENT].	Sight the Backsight [ENT]	
b. Sight the foresight， press [MSR1] or [MSR2] to start surveying.	Sight the foresight [MSR1]/ [MSR2]	
c. Display the measuring result.		
Press [ENT] to record.	[ENT]	

3.5.4 Face-1/Face 2 Measurement

Using F1/F2 measurements effectively cancels out mechanical constant error to obtain maximum accuracy for measuring angles. To take F1/F2 data without taking a distance measurement, press [ANG]→[4] to select F1/F2 in the Angle menu.

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

STEP	OPERATION	DISPLAY
a. First sight the center of the target prism, press [MSR1]/ [MSR2] (can omit if not take a distance measurement), press [ANG] to enter into Angle menu, and then press [4] to enter F1/F2 function. ※1)	[4]	
b. Program displays according to the current horizontal circle. If the horizontal circle is on F2, program displays “Turn to F1”, whereas displays “Turn to F2”. Here take “Turn to F1”as example.		
c. Rotate the alidade, and use the horizontal clamp screw and horizontal tangent to sight the same target. Press [ENT], program will calculate the observation value of F1/F2. ※2)	Sight the same target [ENT]	
d. If you are satisfied with the result, press [OK], and otherwise press [Abrt]. Screen returns to BMS.	[OK] or [Abrt]	
※1)To measure the target, after collimating to the prism center, press [MSR1] or [MSR2]. ※2) If you have already taken a distance measurement to the target, you can initiate F1/F2 averaging by flipping the telescope to the other face.		

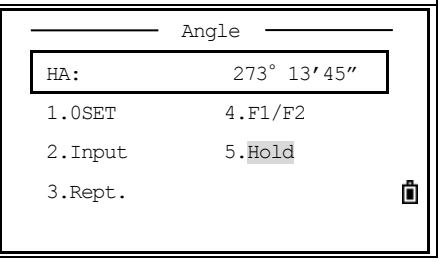
3.5.5 Hold

This seccion explains how to hold the horizontal angle reading.

To hold the horizontal angle to the current value, press [5] or select Hold in the Angle menu.

To set the horizontal angle to the displayed value, press [ENT].

To cancel the process and return to the basic measurement screen, press [ESC].

STEP	OPERATION	DISPLAY
a. Press [ANG] to enter into Angle menu.	[ANG]	

b. Rotate the horizontal circle to needed horizontal angle, or input the needed angle value manually.		Angle HA: 60° 00′00″ 1.0SET 4.F1/F2 2.Input 5.Hold 3.Rept.
c. Press [5] to enter into angle hold function. Use the horizontal clamp screw or horizontal tangent to sight the target.	[5]	HA Hold HA: 60° 00′00″ * HA is hold Press [ENT]
d. Press [ENT] to set the horizontal angle of the target.	[ENT]	Display 1/4 HA# 20° 00′00″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m

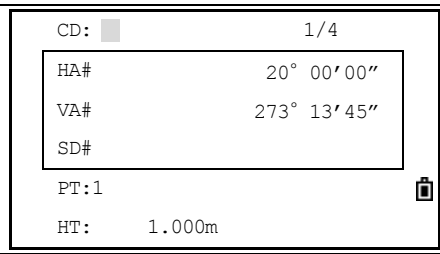
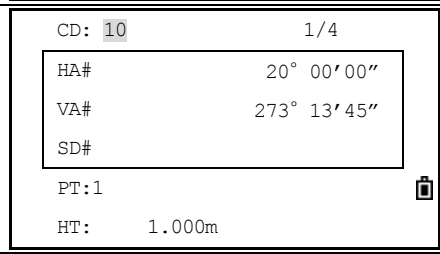
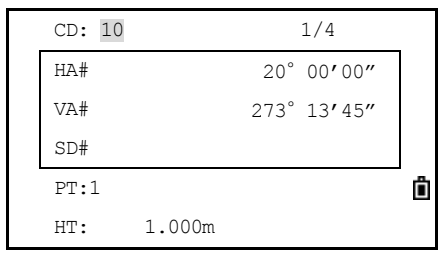
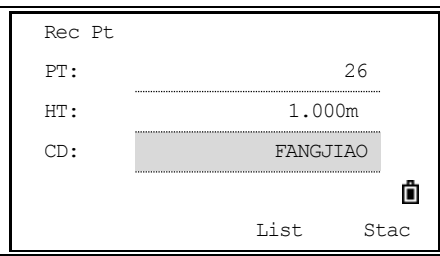
3.6 QUICK CODES

Quick codes (Qcodes) let you shoot and record many points with feature codes in the field.

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, by pressing [MSR1] the measurement is triggered and the measured data and code saved.

A total of 256 quick codes can be assigned. Each code can be assigned a unique one/ two/three digit numbers. If no numbers are allocated to the codes, 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 editing Quick Code, please refer to “11.4.14.4 Add a code”; users can also use the data transferring software provided by RUIDE to create and upload codes, please refer to “Appendix A 3: Code List”.

STEP	OPERATION	DISPLAY
a. In basic measurement screen, press [Mode] to enter into Quick Code function.		Display 1/4 HA# 20° 00′00″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m

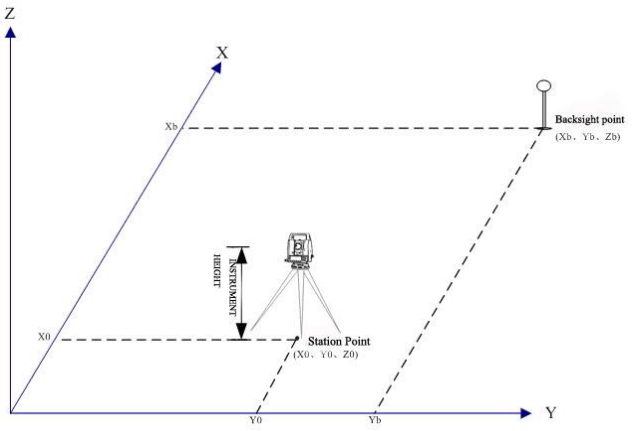
	[MODE]	
b. Input the serial numbers of Quick Code, which should be Arabic numbers, and then press [ENT].	Input the serial numbers of Quick Code [ENT]	
c. Program starts code searching to search the quick coding in internal memory. To find the quick coding corresponding to the code, press [MSR1], after measuring the result and Quick Code are displayed. If the quick code corresponding to the code doesn't exist in internal memory, it will display "Code no exist" ※1)		
d. While finishing measurement, the found code is called up, and screen displays a dialog box for result recording. "CD" column shows the found code. ※2)		
※1) If no quick code is allocated to the codes, the code is numbered in accordance with the order in which the codes were entered in the code list, so you can enter serial numbers to call up quick codes. ※2) To quit Quick Code function, press [MODE] again.		

4. STN ABC 7 KEY

To open the Station Setup menu, press STN ABC 7 in the BMS.

4.1 SET UP A STATION WITH KNOWN POINTS

4.1.1 Set up a Station with Known Coordinates



STEP	OPERATION	DISPLAY
a. In [Stn Setup] menu press [1] to enter into the function of using known point to set station.	[1]	Stn Setup 1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check (X,Y,Z)
b. Input point name, and press [ENT]. ※ 1)	Input point name [ENT]	Input STN ST: 1 A HI: 0.000m CD: List Stac
c. Input height of instrument (HI), then press [ENT]. To re input the known PtID，press [▲] to move to the ST item, then input the PtID.	Input height of instrument [ENT]	Input STN ST: 1 A HI: 1.000m CD: RUIDE List Stac

d. Select an input method for defining the backsight point: 1． To sight the backsight by entering coordinates. 2． To sight the backsight by entering the azimuth and angle.		Backsight 1. XYZ 2. Angle
※1) About method to input PtID, please refer to "2.8 METHOD TO INPUT PTID".		

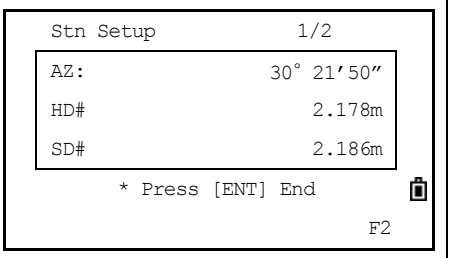
Sight the backsight by entering coordinates

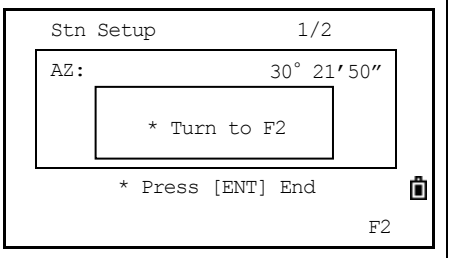
About determine backsight by inputting coordinates, there are two conditions: measuring to and not measuring to the backsight point.

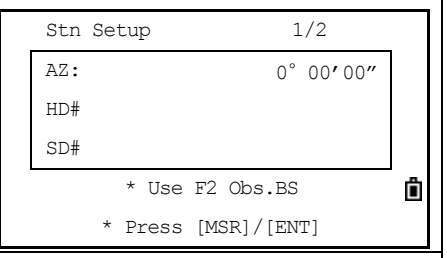
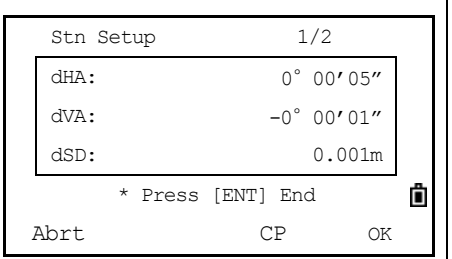
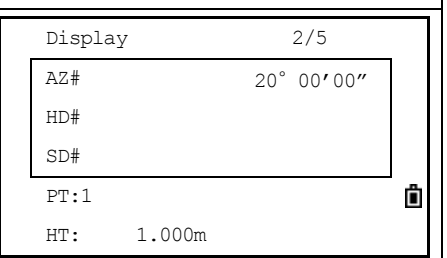
STEP	OPERATION	DISPLAY
a. To enter coordinates for the backsight point (BS), press [1]. Enter the point name, and press [ENT]. ※1)	[1] Enter point name	Input BS PT BS: A HI: 0.000m CD: List Stac
b. There are two conditions: measuring and not measuring the backsight point.		Input BS PT BS: 3 1 HI: 0.000m CD: Stac

1) Measure the backsight point

STEP	OPERATION	DISPLAY
c. If you intend to take a distance measurement to the BS, enter the height of target in the HT field.	Enter the height of target	Input BS PT BS: 3 1 HI: 1.500m CD: Stac
d. Sight the BS on Face-1 (F1), press [MSR1] or [MSR 2] to record a full shot (with HA/VA/SD value). ※1) If the horizontal circle is on Face-2, screen would display "Turn to F1". Rotate the telescope and alidade, and sight the BS point in Face-1.	[MSR 1]/ [MSR 2]	Stn Setup 1/2 AZ: 20° 00′00″ HD: SD: * Obs.BS [MSR]/[ENT] F2

<table>
<tr>
<td>e.
After Measuring, the result is displayed as showed in the right graph. ※2)
A：
To determine the backsight point only by F1，press [ENT] to end measuring.
B1：
To determine the backsight point by F2，press [F2] softkey. As showed in B1.
B2：
To go directly to the Face-2 measurement after taking a distance measurement to the BS on Face-1, flip the telescope. ※3)
Sight the backsight point, press [MSR1] or [MSR2] to start F2 measurement, press [ENT] after measuring. If no need to measure, just press [ENT]. ※2)</td>
<td></td>
<td>A：
 

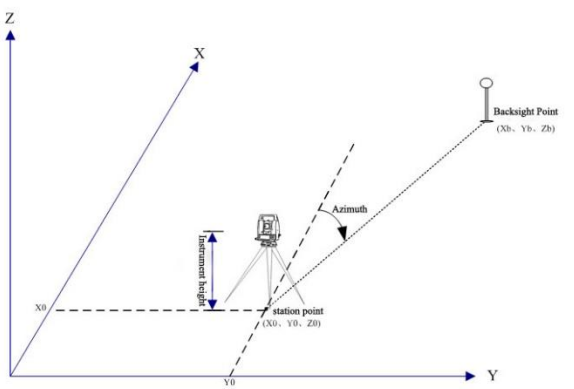
B1：
 

B2：
 
</td>
</tr>
<tr>
<td>f.
Press [DSP] to display a QA screen. (Quality Assessment)
To record a CP record which stores the averaged HA, VA, and SD from the F1/F2 data, press the [CP] softkey. To record only the ST and F1/F2 records, without a CP record, press the [OK] softkey. Press [Abrt] to return to procedure</td>
<td></td>
<td> 
</td>
</tr>
<tr>
<td>g.
Procedure records the station and raw data to current job and finish setting up station. Screen returns to BMS.</td>
<td></td>
<td> 
</td>
</tr>
<tr>
<td colspan="3">※1) AZ：Azimuth calculated by coordinates.
※2) Press [▼] or [DSP] to switch QA screen (dHD/dVD)。
dHD/dVD: indicates the difference between the measured distance and the distance calculated from the known coordinates.
※3) The instrument automatically detects F1/F2.</td>
</tr>
</table>

2) Not measure the backsight point

STEP	OPERATION	DISPLAY
c. If not measuring the backsight point, press [ENT] directly.	[ENT]	Input BS PT BS: 3 1 HI: 0.000m CD: Stac
d. Sight the BS point in F1, and press [ENT] to finish setting. If the horizontal circle is on Face-2, screen would display "Turn to F1". As show in the right graph. Rotate the telescope and alidade, and sight the BS point in Face-1.		Stn Setup 1/2 AZ: 20° 00′00″ HD: SD: * Obs.BS [MSR]/[ENT] F2
e. Procedure records the station and raw data to current job and finish setting up station. Screen returns to basic measurement screen. AZ item displays the result of determining Backsight azimuth.		Display 2/5 AZ# 20° 00′00″ HD# SD# PT:1 HT: 1.000m

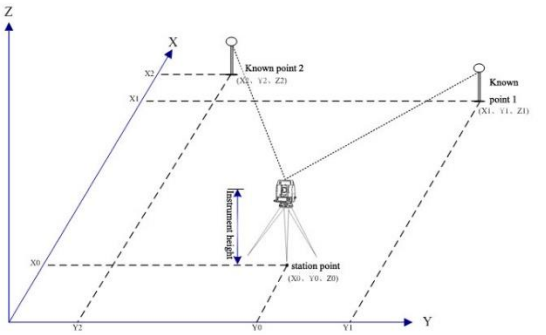
4.1.2 Sight the Backsight by Entering the Azimuth Angle



STEP	OPERATION	DISPLAY
c. To enter the azimuth angle to the backsight point, press [2] in the Backsight screen.	[2]	Backsight 1. XYZ 2. Angle
d. Input a point name, and press [ENT]. Note that the backsight point here can't be known PtID in internal memory, otherwise the program will call up the coordinate of this point and enter to function of sighting the backsight by entering coordinates If only need to input azimuth, when the cursor is on BS field, press [ENT] directly.	[1] Input point name	Input BS PT BS: 1 HI: 1.500m CD: List Stac
e. Enter the azimuth angle to the BS point. If you press [ENT] without entering a value in the AZ field, the azimuth is automatically set to 0°00'00".	Enter the azimuth angle to the BS point	Input Azimuth AZ:
f. Sight the backsight point on F1 and press [ENT]. The screen displays as the right graph. Enter the target height of backsight point and press [ENT].	Sight BS point Input height of target [ENT]	Input BS PT BS: 1 HI: 0.000m CD: List Stac
g. There are also two ways to determine backsight: measure and not measure to the backsight point. A：Not measure, press [ENT] B：measure, press [MSR1] or [MSR 2] Please refer to step d-f of **Measure to the backsight point** in Sighting the backsight by entering coordinates. If the horizontal circle is on F2, the screen would display "Turn to F1". Rotate the telescope and alidade, and sight the backsight point in Face-1.		Stn Setup AZ: 30° 21'50" HD# SD# * Obs.BS [MSR]/[ENT] F2 1 * Turn to F1

h. The system records the station and raw data to current job and finish setting up station. The screen returns to basic measurement screen. AZ item displays the result of determining Backsight azimuth.		Display 2/5 AZ# 0° 00′00″ HD# SD# PT:1 HT: 1.000m

4.2 MULTIPLE POINT RESECTION



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

— You can use a maximum of 10 points in a resection.

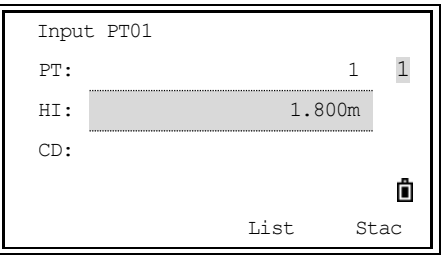
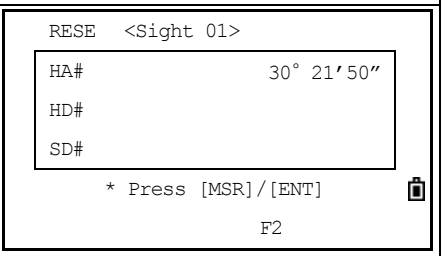
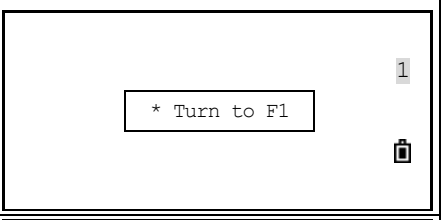
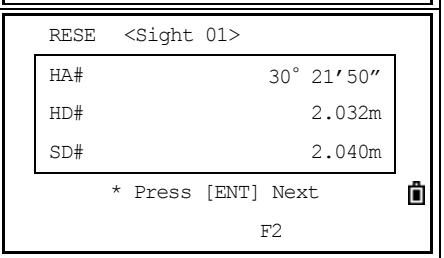
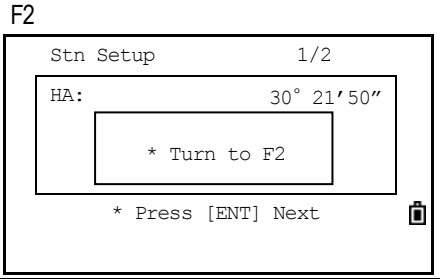
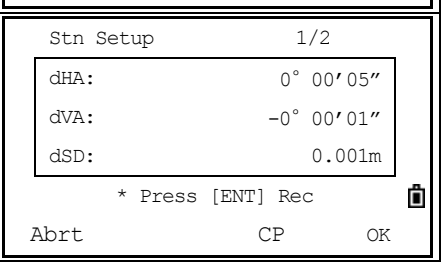
— Measurements can be distance and angle, or angle only.

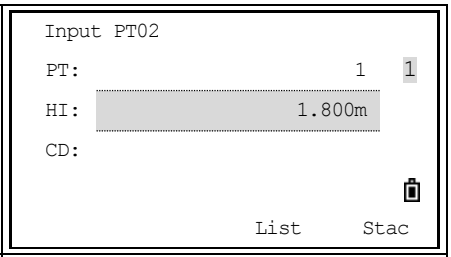
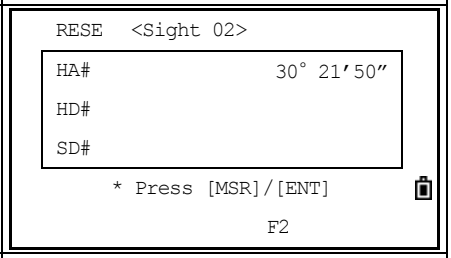
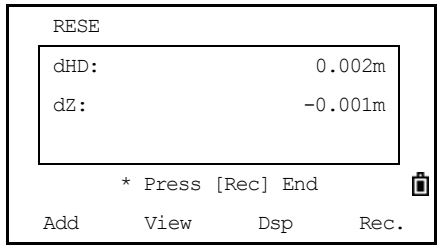
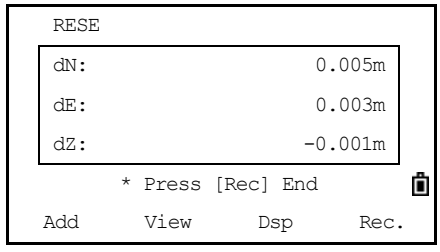
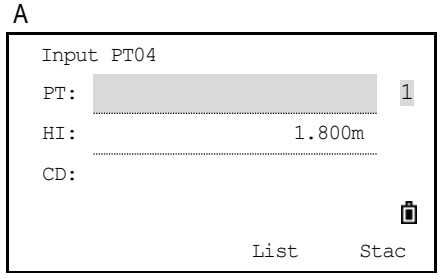
— Calculation starts automatically when enough measurements are taken.

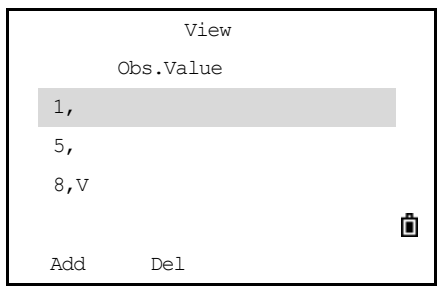
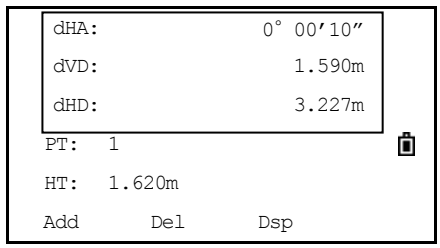
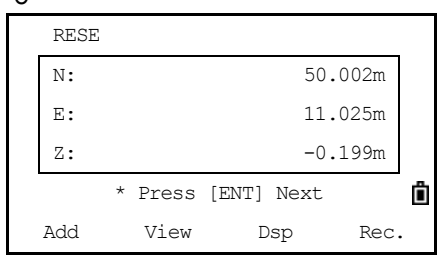
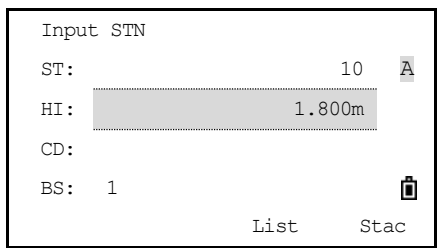
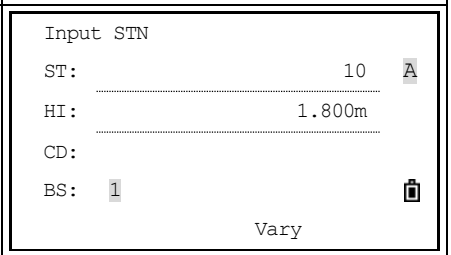
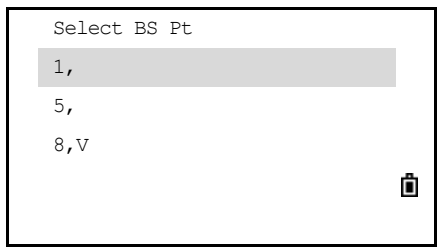
— You can delete poor observations and recalculate if necessary.

●If the angle between known point 1 and known point is extremely acute or extremely oblique, the resulting solution will be less reliable geometrically. For geometric reliability, select known point locations (or station point locations) that are widely spaced.

STEP	OPERATION	DISPLAY
c. In [Stn Setup] menu press [2] to start the resection.	[2]	Stn Setup 1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check
d. Enter the point name for the first observation point (PT1), and press [ENT]. ※1)	Enter the point name for the 1st observation point	Input PT01 PT: 1 HI: 0.000m CD: List Stac

e. Enter the target height and press [ENT].	Enter the target height + [ENT]	
f. Sight the center of first target prism on F1and press [MSR1] or [MSR2] to start survey. If only need to measure angle, press [ENT]. If the horizontal circle is on Face-2, screen would display “Turn to F1”. As show in the right graph. Rotate the telescope and alidade, and sight the BS point in Face-1.	Sight + [MSR1]/ [MSR2]	 
g. The measuring result is displayed, press [ENT]. To measure the backsight point on F2， press [F2] softkey. Rotate the telescope and alidade, and sight the center of target prism, and press [MSR1] or [MSR2]. Press [ENT] after measuring.	[ENT]	 F2 
h. If measured on F1 and F2, a QA screen appears, press [OK] or [ENT] to record the result.	[OK] or [ENT]	

i. Enter the second point (PT2) and its height of target. Press [ENT].	Enter the second point name	
j. Repeat Step c - f to measure target point 02 and other target points.		
k. When the instrument has enough data; it calculates the station (STN) coordinates. As shown in the right graph A. If more than 2 points are available, a standard deviation screen appears. As shown in the right graph B.		A  B 
l. A: To take measurements to strengthen geometry of the resection, press the [Add] softkey.	[Add]	A 

B: To check the measurements to each known point, press the [View] softkey. Press [▲]/[▼] to select point on the screen, and then [ENT] to check the measurements to each known point, ※2) You can delete poor observations or add observation point. ※3)	[View]	B  
C: Press [Dsp] to switch the dialog box of result.	[Dsp]	C 
m. Press [ENT] or [Rec.] to record the station when the results are OK, as shown in the right graph. The "ST" column defaults to the last recorded PT+1.	[ENT] or [Rec.]	
n. BS defaults to the first observed point. To change the BS, press the [Vary] softkey. Use [▲]/ [▼] to select point on the screen, and then press [ENT].	[Vary]	 

o. Screen returns to Input STN menu, press [ENT] to record station and backsight. Screen returns to Stn Setup menu.	[ENT]	Input STN ST: 10 1 HI: 1.800m CD: BS: 5 List Stac

※1) About method to input PtID, please refer to "2.8 METHOD TO INPUT PTID".

※2)dHA：Distributed HA errors in each direction

dVD：VD errors between measured distance and calculated distance

dHD：HD errors between measured distance and calculated distance

※3) To delete a measurement, highlight the measurement data, and then press the DEL softkey. The STN coordinates are automatically recalculated.

●The minimum data required for a resection is either three angle shots, or two distance shot.

●Basically, Stn-Z is calculated from distance-measured data. If no distances are measured, then Stn-Z is calculated using angle-only measurements to known points with 3D coordinates.

4.3 QUICK STATION

Setting up the station quickly without coordinates。

The station point (ST) in this function defaults to a new point number. For the new point, MP (0, 0, 0) is stored as the coordinates. When the ST is manually changed to a known point name, the station is set up on the coordinates of the known point.

Even if both ST and BS are known points, this function does not calculate the backsight angle (AZ) automatically. To calculate the AZ between two known points (ST and BS), use [Stn Setup]→[1.Known].

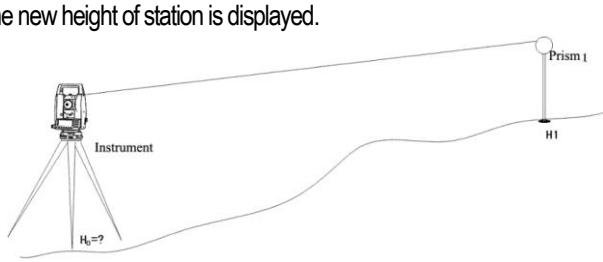
STEP	OPERATION	DISPLAY
c. In [Stn Setup] press [3] to enter into Quick Station function.	[3]	Stn Setup 1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check (0,0,0)
d. Input the point name of ST, and press [ENT]. defaults to the last recorded PT + 1, or ST + 1, depending on the Split ST setting) ※1)	Input the point name of ST [ENT]	QuickStn ST: 1 HI: 1.800m BS: AZ: List Stac

e. Input the height of instrument, and press [ENT].	Input the instrument height [ENT]	QuickStn ST: 123 1 HI: 1.800m BS: AZ:
f. No default PT is assigned to the BS. Leave this field blank, or enter a BS point name.		QuickStn ST: 123 1 HI: 1.800m BS: AZ:
g. The backsight azimuth (AZ) defaults to zero, but you can change this.	Enter azimuth of BS	QuickStn ST: 123 1 HI: 1.800m BS: AZ:
h. To complete the station setup, sight the BS and press [ENT].	[ENT]	
※1) About the Split ST setting, please refer to "11.3 setting". ※2) When you press [ENT] in the AZ field, both HA and AZ are reset to the value you have entered.		

4.4 HEIGHT TRANSFER (DETERMINING STATION ELEVATION)

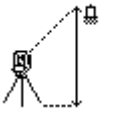
This function determines the height of the instrument from measurements to target points with known heights, in two faces.

After measuring, the new height of station is displayed.



STEP	OPERATION	DISPLAY
a. In [Stn Setup] press [4] to enter into height transfer function.	[4]	Stn Setu 1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check

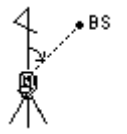
b. If no station is set before, program shows the right graph.		! Invalid STN * Press any key
c. Press any key to return to “Stn Setup” menu, select one method to set station.		Stn Setup 1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check
d. After the program record the station, Input level point, and press [ENT]. ※1)	Enter point name [ENT]	Input PT PT: 1 HI: 1.800m CD: List Stac
e. Enter height of target prism, and press [ENT].	Enter height of target prism [ENT]	Input PT PT: 1 1 HI: 1.800m CD: List Stac
f. Sight the center of prism, press [MSR1] or [MSR2] to start survey. If the horizontal circle is on Face-2, screen would display “Turn to F1”. Rotate the telescope and alidade, and sight the BS point in Face-1.	Sight the target [MSR 1]/ [MSR 2]	Level point HA# 355° 51′59″ VD# HD# * Sight Press [MSR] F2
g. The system finishes the measurement and displays the result.		Level point HA# 355° 51′59″ VD# -0.053m HD# 1.982m * Press [ENT] F2

h. Press [F2] and Rotate the telescope and alidade, and sight the center of target prism. Press [MSR1] or [MSR2]. If not measure on F2, press [ENT] and proceed to Step j.	Rotate the telescope + [MSR 1]/ [MSR 2]	Level point HA# 175° 17′18″ VD# HD# * Sight Press [MSR]
i. After finishing measurement on F2, the result is displayed, press [ENT].	[ENT]	Level point HA# 175° 17′18″ VD# -0.306m HD# 1.959m * Press [ENT] F2
j. The result dialog box is displayed, press [OK] to confirm. To remeasure, press [Abrt].	[OK] or [Abrt]	Stn Setup dHA: 0° 00′00″ dVA: -0° 00′02″ dSD: 0.001m * Press [ENT] Rec Abrt CP OK
k. The updated station coordinates are displayed, the height Z is updated. You can change the HI in this screen.		N: 10.000m E: 10.000m Z: 6.180m ST: 1 HI: 1.600m
l. Press [ENT] to record the updated STN. Screen returns to Stn Setup menu.	[ENT]	Stn Setu  1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check
※1) About method to input PtID, please refer to "2.8 METHOD TO INPUT PTID".		

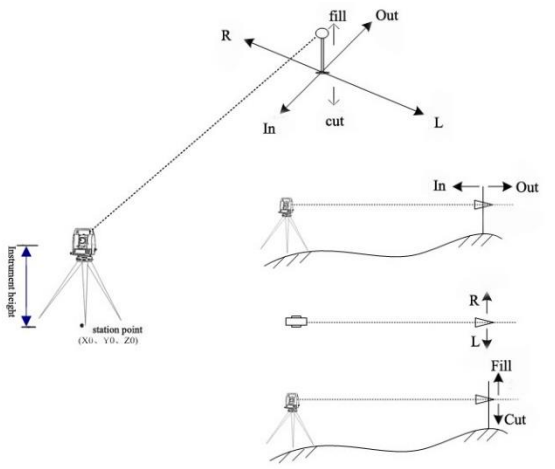
When the HI is changed, the Z coordinate is updated before the station is recorded.

You must complete a station setup before you use the Height Transfer function.

4.5 CHECKING AND RESETTING THE BACKSIGHT DIRECTION

STEP	OPERATION	DISPLAY
a. In [Stn Setup] press [5] to enter into Backsight Check function.	[5]	Stn Setu  1. Known 2. Rese 3. QuickStn 4. Z Coord 5. BS Check
b. Sight the BS point, and press [Redo] or [ENT] to reset the horizontal angle to the HA set in last station setup. Press [Abrt] or [ESC] to cancel the process and return to the basic measurement screen.	Sight the BS point + [Redo]/[ENT]	BS Check HA# 0° 00′00″ BS: 7° 21′28″ * BS Check Abrt Redo
c. Screen returns to the basic measurement screen, and HA is set.		Display 2/5 AZ# 0° 00′00″ HD# SD# PT:1 HT: 1.000m
**You must complete a station setup before you use the BS check function.		

5. 8 KEY

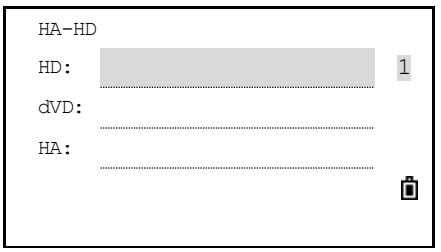
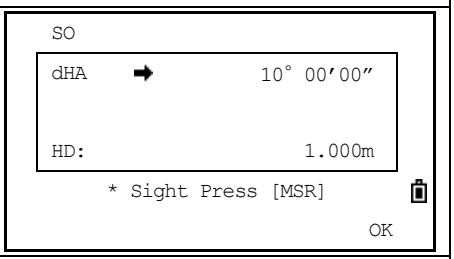
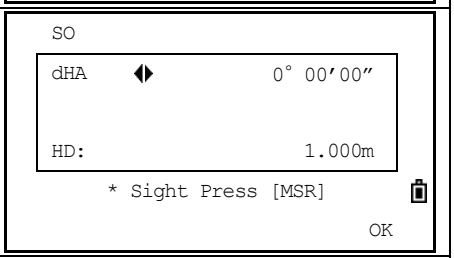
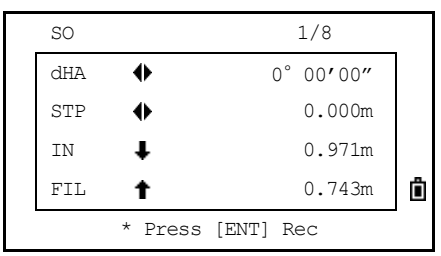
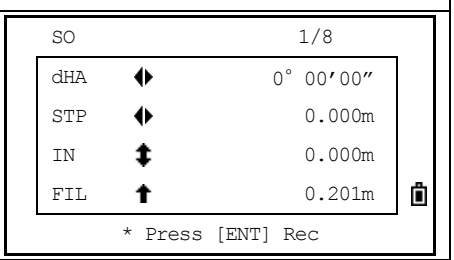


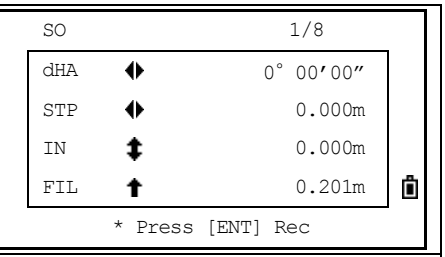
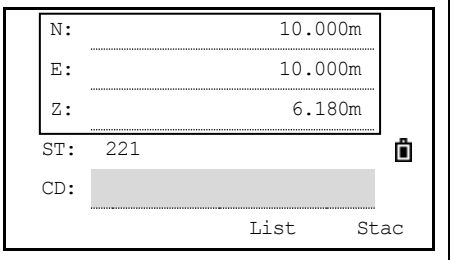
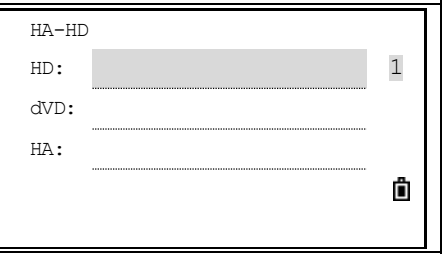
To display the Stakeout menu, press 8.

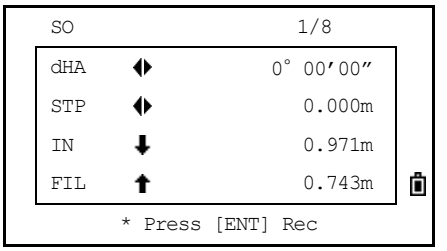
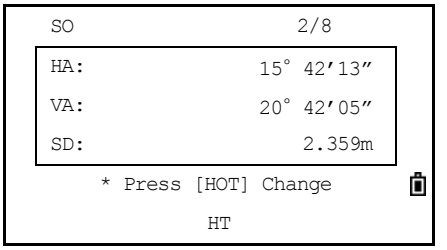
5.1 STAKE OUT ANGLE AND DISTANCE

Specifying the stakeout point by angle and distance

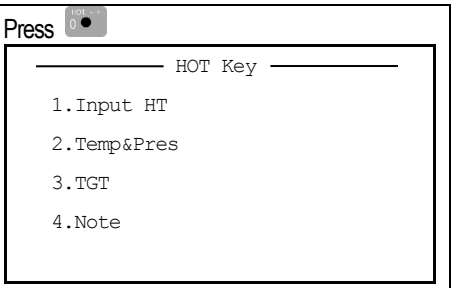
STEP	OPERATION	DISPLAY
a. Press numeric key [8] to enter into stake-out function. You should setup station and backsight azimuth before stake-out. Otherwise the screen displays as the right graph.	[8]	! Station not set 1. Continue 2. Stn Setup * Press [ESC] Abrt
b. Press [Continue] to display ST, HI, and BS set in last operation. Shown as the right graph A. Press [OK] to confirm. Press [STN] to enter "Stn Setup" menu. Select one method to set station. Press [Abrt] to quit the program.		STN Check ST: 1 1 HI: 1.800m BS: 2 Abrt OK
c. After the program record STN data, screen returns to SO main menu.		SO 1. HA-HD 2. XYZ 3. PartLine 4. Ref.Line

d. Press [1] to display the input screen for the distance and angle to the target. Enter the values and press [ENT]. HD： Horizontal distance from station point to stakeout point dVD： Vertical distance from station point to stakeout point HA: Horizontal angle to stakeout point ※1)	[1]	
e. Start staking out. First Rotate the instrument until the dHA displays as 0°00'00".		
f. Sight the target and press [MSR1] or [MSR2] to start measuring.	[MSR 1]/ [MSR 2]	
g. When the measurement is completed, the differences between the target position and the stakeout point are displayed. ※2), ※3) dHA: Difference in horizontal angle to the target point R/L: Right/Left (Lateral error) IN/OUT: In/Out (Longitudinal error) CUT/FIL: Cut/Fill		
h. Move the prism forward or backward according to the arrowhead until IN/OUT field displaying 0 m, ⬇: moving towards to station ⬆: moving away from station		

i. When both R/L and IN/OUT display 0m, it indicates the prism is on the stakeout point. The fifth line shows the data of fill or dig.		
j. After staking out, your can press [ENT] to record the stakeout point. PT defaults to the last recorded PT+1, you can input code if necessary. Press [ENT] to record the point.		
k. After recording the point, it returns to the observation screen. You can continue observation, or press [ESC] to input another angle and distance for stakeout.		
※1) If you press [ENT] without entering HA, the current HA is used. ※2) Once a measurement is taken; the Cut/Fill value and Z coordinate are updated as the VA is changed. ※3) All observation results display in 8 pages, press [▼] or [DSP] to switch between display screens.		

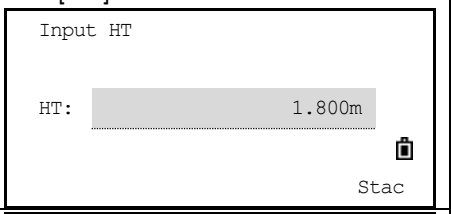
DISPLAY	DESCRIPTION
	This page displays stake-out.
	This page displays the slant distance measurement of target prism. Press [HOT] to enter into HOT Key menu.

Press

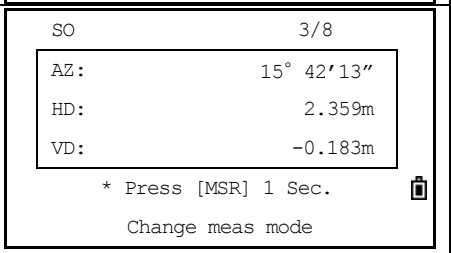


When the cursor is on “Input ht”, Press [ENT] to enter to Input HT function.

Press [ENT]



After inputting the height of the target, press [ENT] to return to page 2/8 of SO.



This page displays the horizontal distance measurement of target prism. Press [MSR1] or [MSR 2] for 1 second to change the measure mode.

Press [▲] or [▼] moving to the item needed to rectify, press [◀] or [▶] to change.

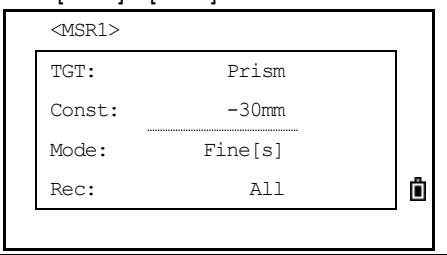
TGT： Prism, non-prism, reflector sheet

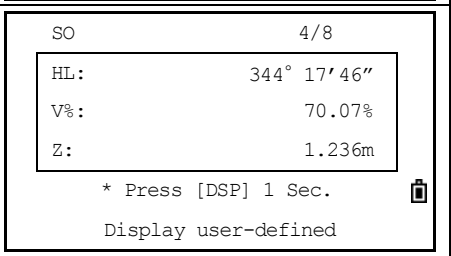
Const： Enter the prism constant directly (In prism mode)

Mode： Fine[s]、Fine[2](3/4/5), Fine[r], Tracking

Rec: Meas, Enter, All

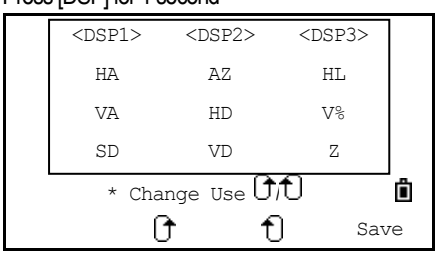
Press [MSR1] or [MSR2]

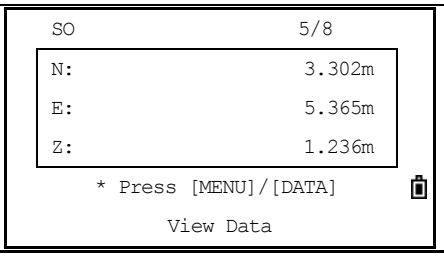
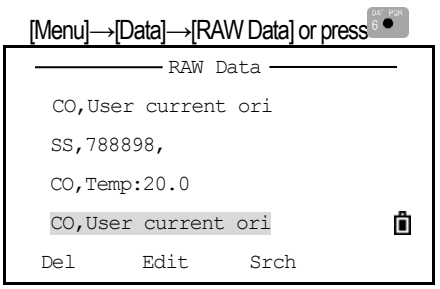
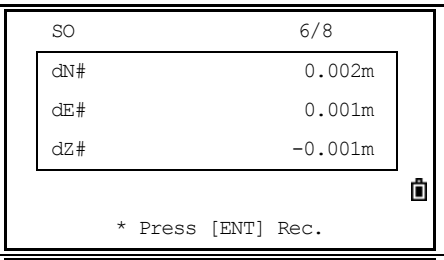
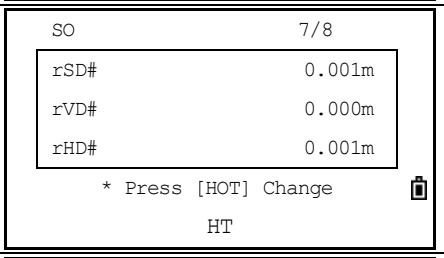
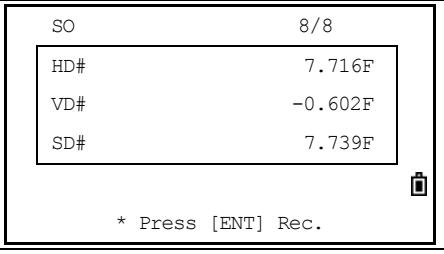




User can change the memory taken up by display screen. Press [▶]/[◀], [▲]/[▼] to select, and use softkey to change, press [ENT] or [Save] to make the rectification valid.

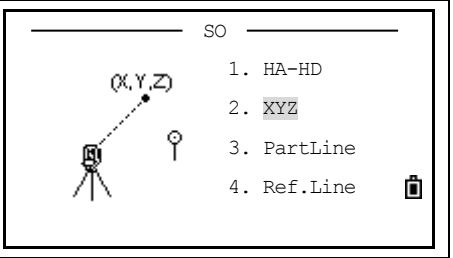
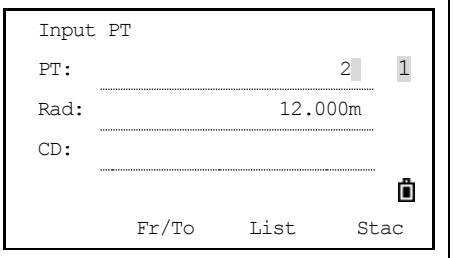
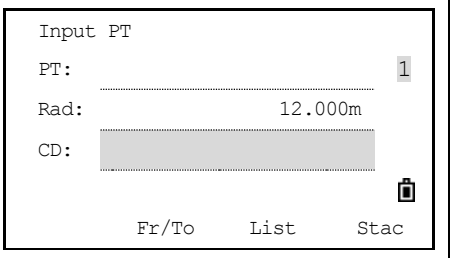
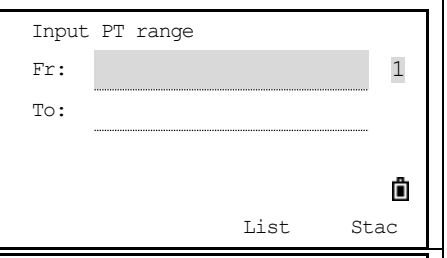
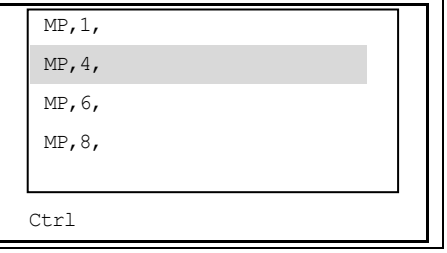
Press [DSP] for 1 second

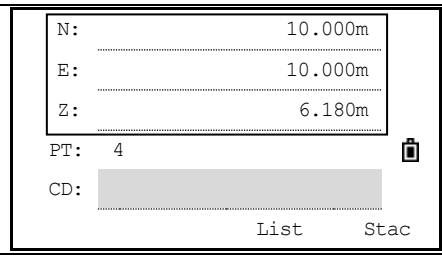
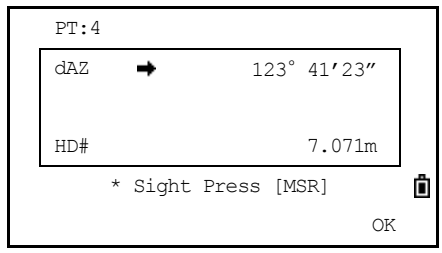
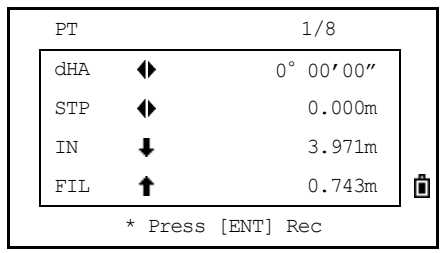
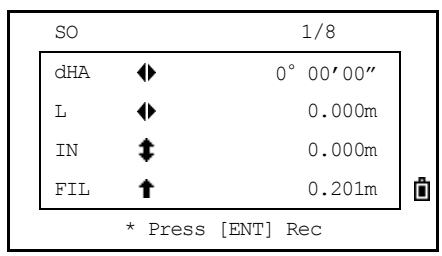
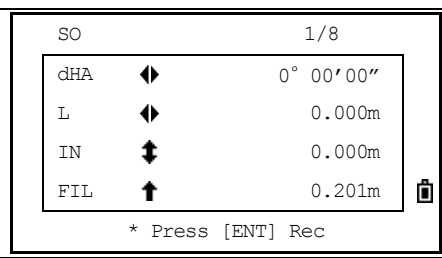
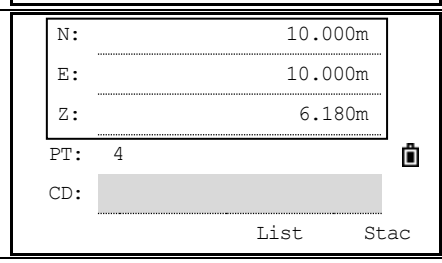


	The screen stays on the measured result，press [ENT] to display detailed information. About the detailed description of data, please refer to “11.4VIEWING RECORDS”.
[Menu]→[Data]→[RAW Data] or press 	
	This page displays coordinate deviation value, press [ENT] to record data.
	Press [HOT] to change the height of target, please refer to page“2/8”.
	If the secondary distance unit is set, 8/8 appears. Setting of secondary unit, please refer to “11.3 SETTING”

5.2 COORDINATES STAKEOUT

Input the XYZ of stakeout point, and carry on stake-out.

STEP	OPERATION	DISPLAY
c. In SO menu, press [2] to enter to coordinate stakeout function.	[2]	
d. A Enter the point name that you want to stake and press [ENT]. After finding the input point name, program proceeds to Step d. To display the coordinates, press [ENT] to confirm.		A 
B Specify the point by code or radius from the instrument. (As shown in graph B). C Specify a stakeout list by range input. To input points by range, press the Fr/To softkey in the PT field., as shown in right graph C. Enter the start point (Fr) and the end point (To). The last digit of point name must be a number. If existing points are found between Fr and To, a point list is displayed, see Step c.		B  C 
e. If several points are found, they are displayed in a list. Then use [▶]/[◀] and [▲]/[▼] to select needed point, and press[ENT]. ※2)		

f. Screen displays coordinates of the selected point name, press [ENT] to confirm.	[ENT]	
g. The delta angle and the distance to the target (HD) are shown. Rotate the instrument until the dAZ is close to 0°00'00", press [MSR1]/ [MSR2]. dHA: Difference in horizontal angle to the target point HD: Distance to the target point	[MSR 1]/ [MSR 2]	
h. After measuring, the deviation value between measure point and stakeout point is shown. ※1) dHA: Difference in horizontal angle to the target point R/L Right/Left (Lateral error) IN/OUT In/Out (Longitudinal error) CUT/FIL Cut/Fill		
i. Ask the rodman to adjust the target position. When the target is on the intended position, the displayed errors become 0m. ⬇: moving towards to station ⬆: moving away from station		
j. When both R/L and IN/OUT display 0m, it indicates the prism is on the stakeout point. The fifth line shows the data of fill or dig.		
k. After staking out, your can press [ENT] to record the stakeout point. PT defaults to the last recorded PT+1, you can input code if necessary. Press [ENT] to record the point.	[ENT]	

I. A: After recording the point, the display returns to the observation screen. You're your press [ESC], the display returns to the PT/CD/R input screen. If you entered the stakeout point using a single point name, PT defaults to the last PT+1.		A Input PT PT: 2 1 Rad: 12.000m CD: Fr/To List Stac
B: If you selected a point from the list, the display returns to the list, unless all points have been selected. Press ESC] to return to the point input screen.		B MP,1, MP,4, MP,6, MP,8, Ctrl

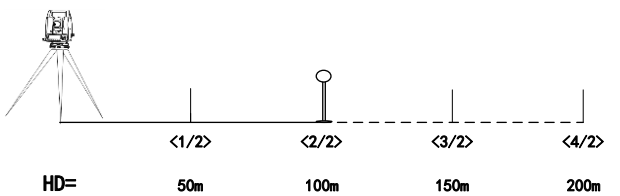
※1) Once a measurement is taken, the Cut/Fill value and Z coordinate are updated as the VA is changed.
※2) If you have assigned a control job, and additional points are found in the control job, the Ctrl softkey is displayed under the list.
※3)Use the Add Constant field in [MENU]→[3.Set]→[6.SO] to specify an integer that is added to the point number being staked to generate a new number for recording the staked point.
For example, when you stake out PT3 with an Add Constant of 1000, the default number for SO record is 1003.When there are letters in the point name, put the Add Constant after the letter.
For example: When you stake out AD12 with an Add Constant of 1000， the default number for SO record is AD1012.

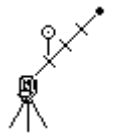
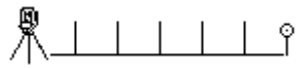
All observation results display in 8 pages: press [▼] or [DSP] to switch between display screens. Detailed introduction please refer to "HA-HD SO".

5.3 PARTLINE SO

This function divides the line between the instrument and the target by an input span number. It then guides you to stake out the points, one by one.

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



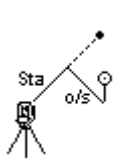
STEP	OPERATION	DISPLAY
a. In SO menu press [3] to enter into PartLine SO function.	[3]	SO  1. HA-HD 2. XYZ 3. PartLine 4. Ref.Line
b. Set up the baseline. Sight the target, and press [MSR1]/[MSR2] to start survey. System set up a base line between the instrument and the measured point.	[MSR 1]/ [MSR 2]	PartLine HA# 123° 41'23" HD# 2.030m  * Sight Press [MSR]
c. Enter the total stake number in Partition field, and press [ENT]. ※1)	Enter the total stake number [ENT]	PartLine HA# 123° 41'23" HD# 2.030m  Partition:
d. The observation screen for the first stake (from the instrument) appears. Sight the prism and press [MSR1]/ [MSR 2].	Sight the first stake out point + [ENT]	PartLine <1/3> HD: 0.667m L ➡ Out ⬇ Prev Next
e. When the measurement is completed, the differences between the target position and the stakeout point are displayed. ※2), ※3) HA: Difference in horizontal angle to the target point R/L: Right/Left (Lateral error) IN/OUT: In/Out (Longitudinal error)		PartLine <1/3> HD: 0.667m STP ◆▶ 0.000m Out ⬇ 0.058m * Press [ENT] Rec Prev Next
f. Ask the rodman to adjust the target position. When the target is on the intended position, the displayed errors become 0 m. ⬇: moving towards to station ⬆: moving away from station		PartLine <1/3> HD: 0.667m STP ◆▶ 0.000m STP ◆▶ 0.000m * Press [ENT] Rec Prev Next

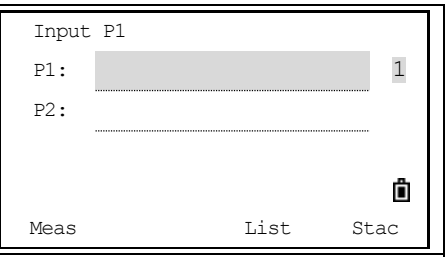
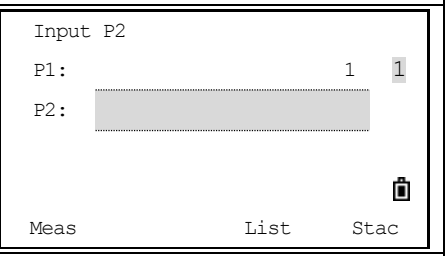
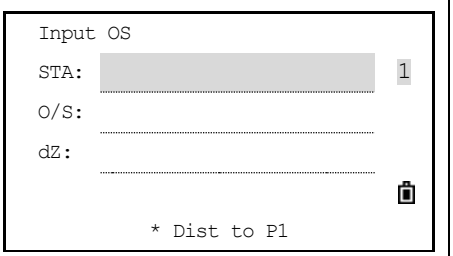
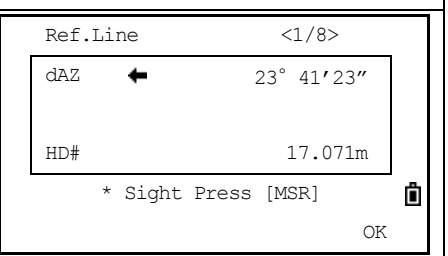
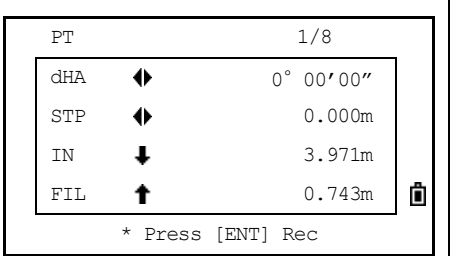
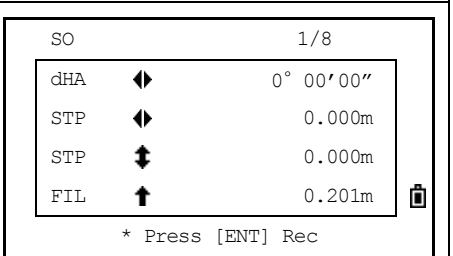
g. If the third line "L/R" does not display 0 m, ask the rodman to adjust the target position. ➡: Rodman moves to his left side. ⬅: Rodman moves to his right side.		PartLine <1/3> HD: 0.667m STP ◆▶ 0.000m STP ◆▶ 0.000m * Press [ENT] Rec Prev Next
h. When both R/L and IN/OUT display 0m, it indicates the prism is on the stakeout point.		PartLine <1/3> HD: 0.667m STP ◆▶ 0.000m STP ◆▶ 0.000m * Press [ENT] Rec Prev Next
i. After staking out, your can press [ENT] to record the stakeout point. PT defaults to the last recorded PT+1, you can input code if necessary. Press [ENT] to record the point.	[ENT]	N: 10.000m E: 10.000m Z: 6.180m PT: 221 CD: List Stac
j. After recording the point, the display returns to the SO screen. Press [Prev]/[Next], or [▲]/[▼] to stake out other divided points. ※2)，※3)		PartLine <2/3> HD: 1.353m L ➡ Out ⬆ * Press [ENT] Rec Prev Next

※1) Use up or down arrowhead to change the guide point.
※2) Prev/[▼]: to the last stakeout point Next/[▲]: to the next stakeout point
※3) You can calculate and guide up to double the number of the stakes.

5.4 REFLINE STAKEOUT

This function allows you to stake out a point based on the Sta, O/S, and dZ to a specified line.

STEP	OPERATION	DISPLAY
a. In [SO] menu press [4] to enter to Ref.Line stakeout function.	[4]	SO  1. HA-HD 2. XYZ 3. PartLine 4. Ref.Line

b. Enter the first point (P1) of the line. ※1)	Enter the 1st point of the line. [ENT]	
c. Enter the second point (P2) of the line.	Enter the second point of the line. [ENT]	
d. Enter offsets to the line. Press [ENT] in a blank field to enter the value 0.0000. Sta：Distance from P1 along the line. O/S：Offset to beeline (+): Right side of the P1-P2 line (-): Left side of the P1-P2 line Dz: dVD to line	Enter offsets	
e. Start stakeout. Rotate the instrument until the dAZ is close to 0°00'00" Sight the target and press [MSR1]/ [MSR2] dAZ: Azimuth error to target point HD: Distance to target point	[MSR 1]/ [MSR 2]	
f. After measuring, the deviation value between measure point and stakeout point is shown. ※1) dHA: Difference in horizontal angle to the target point R/L Right/Left (Lateral error) IN/OUT In/Out (Longitudinal error) CUT/FIL Cut/Fill		
g. Ask the rodman to adjust the target position. When the target is on the intended position, the displayed errors become 0 m. ⬇: moving towards to station ⬆: moving away from station		

h. When both R/L and IN/OUT display 0m, it indicates the prism is on the stakeout point. The fifth line shows the data of fill or dig.		SO 1/8 dHA 0° 00′00″ STP 0.000m STP 0.000m FIL 0.201m * Press [ENT] Rec
i. After staking out, you can press [ENT] to record the stakeout point. PT defaults to the last recorded PT+1, you can input code if necessary. Press [ENT] to record the point.	[ENT]	N: 10.000m E: 10.000m Z: 6.180m PT: 221 CD: List Stac
j. After recording the point, the display returns to the SO screen. Press [ESC] to reinput the offsets. Repeat Step d – l to do Ref.Line stakeout.		Input OS STA: 1 O/S: dZ: * Dist to P1
※1) About method to input PtID, please refer to "2.8 METHOD TO INPUT PTID".		

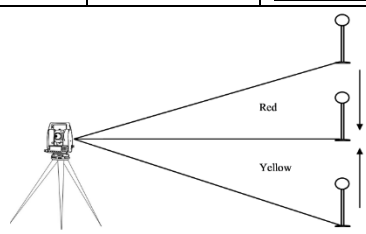
All observation results display in 8 pages: press [▼] or [DSP] to switch between display screens. Detailed introduction please refer to "HA-HD SO".

5.5 GUIDE LIGHT

※ *Only Available on R2 Pro.*

By emitting two visible beams of coherent light, one red and one yellow, enabling the rodman to locate the correct line quickly and easily by finding the position where both light blink alternately.

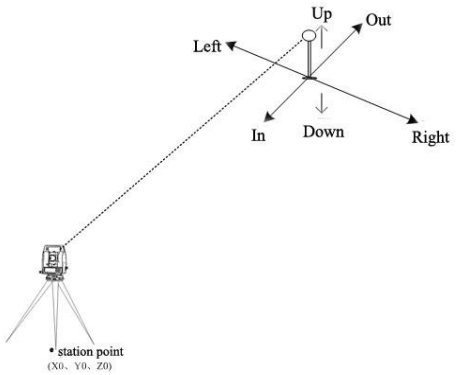
STEP	OPERATION	DISPLAY
Press numeric key [8] to enter to stake-out function. The screen will show "Open the guiding light?". Press [MSR1] to cancel or press [ANG] to activate the guide light function.	[8]	<Set> Open the guiding light? CE OK



- When only seeing the yellow light, move the prism to the right
- When only seeing the red light, move the prism to the left.
- When seeing both lights blinking alternately, it means the prism is in the correct line.

6. 9 KEY

6.1 DISTANCE OFFSETS

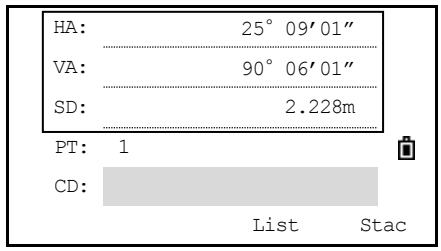
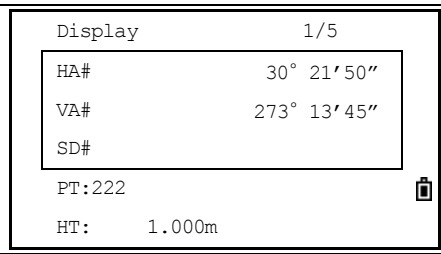


STEP	OPERATION	DISPLAY
a. Press numeric key [9] to enter Offset function. You should setup station and backsight azimuth before offset measurement. Otherwise the screen displays as the right graph.	[9]	! Station not set 1. Continue 2. Stn Setup * Press [ESC] Abrt
b. Press [Continue] to display ST, HI, and BS set in last operation. Shown as the right graph A. Press [OK] to confirm. Press [STN] to enter "Stn Setup" menu. Select one method to set station. Press [Abrt] to quit the program.		STN Check ST: 1 1 HI: 1.800m BS: 2 Abrt OK
c. After the program record STN data, screen returns to Offset menu. Select O/S Dist.	[1]	Offset 1. O/S Dist 2. O/S Ang. 3. O/S 2D 4. +HA Line 5. Input HD (Up, Out, L, R, In, Down)
d. If you have not taken a distance measurement before entering this function, a temporary measurement screen appears. Sight the target and press [MSR 1]/[MSR 2].	[MSR 1]/ [MSR 2]	HA# 15° 42′13″ VA# 263° 01′13″ SD# HT: 1.000m * Sight Press [MSR] HT OK

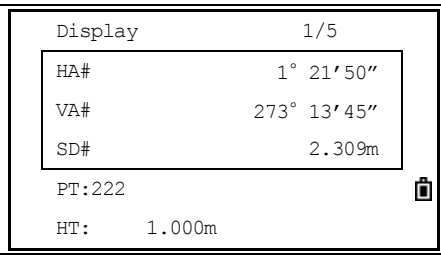
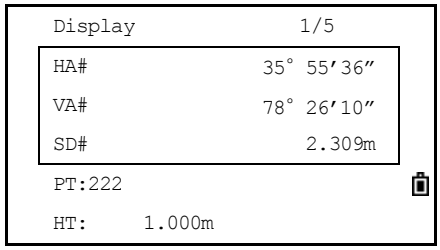
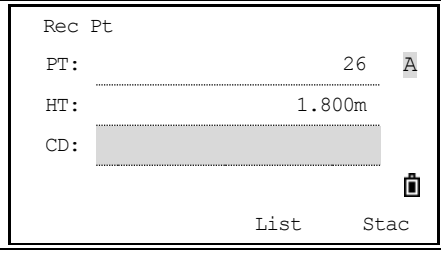
e. Enter combination of distance offset to specify the point. After entering one item, press [ENT] moving to the next.	Enter combination of distance offset to specify the point.	O/S Dist R/L: O/I: U/P: * (+)=R (-)=L
f. The calculated coordinates are shown. Enter a PT and CD value, press [ENT] to record. The display returns to BMS. ※1)	[ENT]	N: 10.000m E: 10.000m Z: 6.180m PT: 221 CD: List Stac
※1) Raw data is also recalculated, based on the distance offset value.		

6.2 MEASURING ANGLE OFFSETS

STEP	OPERATION	DISPLAY
a. In [Offset] menu, press [2] to enter angle offset function	[2]	Offset 1. O/S Dist 2. O/S Ang. 3. O/S 2D 4. +HA Line 5. Input HD
b. If you have not taken a distance measurement before entering this function, a temporary measurement screen appears. Sight the target and press [MSR 1]/[MSR 2].	[MSR 1]/ [MSR 2]	HA# 15° 42′13″ VA# 77° 52′27″ SD# HT: 1.000m * Sight Press [MSR] HT OK
c. The measuring results are shown. Press [DSP] or [▼] to view each dialog box of the results.	[DSP] or [▼]	O/S Ang. 1/5 HA# 15° 41′13″ VA# 77° 52′27″ SD# 3.971m Abrt OK
d. To take the angle offset, rotate the alidade and telescope. The measured distance (HD) remains unchanged.		O/S Ang. 1/5 HA# 25° 09′01″ VA# 90° 06′01″ SD# 3.971m Abrt OK

e. To record the offset point, press [OK], and otherwise press [Abrt]. The XYZ data is also recalculated based on the new angle. In the dialogue box of results calculated by the program, press [ENT] Rec.	[OK]	
f. The display returns to basic measurement screen.		

You can record an angle offset in the basic measurement screen.

STEP	OPERATION	DISPLAY
a. In basic measurement screen, press [MSR 1] or [MSR 2].	[MSR1]/ [MSR2]	
b. After taking a distance measurement, rotate the alidade and/or telescope. Press [DSP] or [▼] to view other pages of the result. You can see that the coordinates are changed with the change of angle.		
c. Then press [ENT] to record the measured distance with the updated angle value.	[ENT]	

6.3 TWO-PRISM POLE

STEP	OPERATION	DISPLAY
a. In [Offset] menu, press [3] to enter the 2Prism Pole function.	[3]	Offset 1. O/S Dist 2. O/S Ang. 3. O/S 2D 4. +HA Line 5. Input HD
b. Sight the first prism and press [MSR1]/[MSR2].	Sight the first prism [MSR1]/ [MSR2]	O/S 2D <No.1> 1/5 HA# 15° 42'13" VA# 94° 01'13" SD# * Sight Press [MSR] OK
c. Program enter measuring the second point automatically. Sight the second prism and press [MSR1]/[MSR2].	Sight the second prism [MSR1]/ [MSR2]	O/S 2D <No.2> 1/5 HA# 43° 19'14" VA# 91° 11'47" SD# * Sight Press [MSR] OK
d. Enter the distance between the second prism and the target point. Alternatively, if you don't need QA information, you can leave the distance between the first and the second prism blank.	Input distances	Input Dist P1-p2: 5.000m 1 P2-TGT: 2.000m * P1-P2 May Omit
e. If you entered a P1-P2 distance, the QA screen appears. Compare the entered value and the measured distance to check the accuracy of the observation. To reinput the distances, press [Redo] to return to Step d. To confirm, please press [OK] or [ENT] to Step f.		P1-P2 Dist InputDis 5.000m Meas Dis 5.005m Redo OK
f. Press [ENT] to record the point.	[ENT]	Rec Pt PT: 26 A HT: 1.000m CD: List Stac

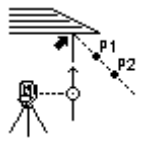
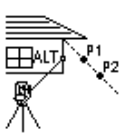
Sample of records:

CO,2Prism O/S:

P1-P2=5.000（5.005），P2-Tgt=2.000

6.4 +HA LINE

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

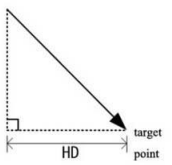
STEP	OPERATION	DISPLAY
a. In [Offset] menu, press [4] to enter the line extension (+HA) function.	[4]	Offset  1. O/S Dist 2. O/S Ang. 3. O/S 2D 4. +HA Line 5. Input HD ▼
b. Sight the first prism (or target), press [MSR1]/[MSR2]. 	Sight the first prism [MSR1]/ [MSR2]	+HA Line <No.1> 1/5 HA# 15° 42’13” VA# 94° 01’13” SD# * Sight Press [MSR] OK
c. Program enter measuring the second point automatically. Sight the second prism and press [MSR1]/[MSR2]. 	Sight the second prism [MSR1]/ [MSR2]	+HA Line <No.2> 1/5 HA# 83° 19’14” VA# 91° 11’47” SD# * Sight Press [MSR] OK
d. Sight the alternative place on the same vertical line as the desired target point. 		+HA Line <No.2> 1/5 HA# 83° 19’14” VA# 91° 11’47” SD# 1.847m * Sight <ALT> PT OK
e. Press [OK] or [ENT] to calculate the coordinates and the raw data of the target point	[OK] or [ENT]	+HA Line <No.2> 1/5 HA# 16° 22’59” VA# 36° 11’39” SD# 1.847m * Sight <ALT> PT O

f. Enter a PT (and CD) value, and press [ENT] to Record the point. The height of target is fixed to 0.0000 for the offset point.	Enter a PT and CD value [ENT]	HA: 16° 22′59″ VA: 36° 11′39″ SD: 5.228m PT: 29 CD: List Stac

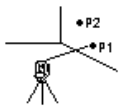
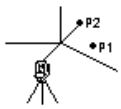
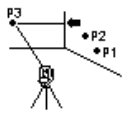
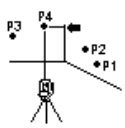
The calculated point (TGT) is stored as a SS record.
Measurements to the first and second target (P1 and P2) are stored as comment records (PT1 and PT2).
The last record records the angle measurement to the ALT (vertically offset point from the actual target point).

6.5 INPUT HD

This function is useful when the instrument is very close to the point and it is difficult to take a measurement using the EDM.

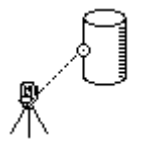
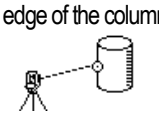
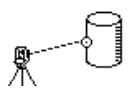
STEP	OPERATION	DISPLAY
a. In [Offset] menu press [5] to enter to Input HD function.	[5]	Offset 1. O/S Dist 2. O/S Ang. 3. O/S 2D 4. +HA Line 5. Input HD HD
b. Turn the telescope in the direction of the point that you want to store.  		Input HD 1/5 HA# 83° 32′21″ VA# 92° 28′56″ HD: * Sight Press [ENT]
c. Enter the HD and press [ENT].	Enter the HD	Input HD 1/5 HA# 83° 32′21″ VA# 92° 28′56″ HD: 12.000m * Sight Press [ENT]
d. Enter a PT (and CD) value and press [ENT], The target point is calculated and recorded as an SS record.	Enter a PT & CD [ENT]	Rec Pt PT: 26 A HT: 1.000m CD: List Stac

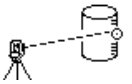
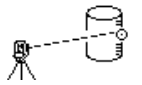
6.6 CALCULATE A CORNER POINT

STEP	OPERATION	DISPLAY
a. In [Offset] menu, press [▼] to display the second page of Offset. Press [6] to enter the corner point function.	[6]	Offset 1. CornerPt 2. Column 3. InputdSD ▲
b. Take a distance measurement to the first prism on the wall. Press [MSR1]/[MSR 2]. 	Sight the first point [MSR1]/ [MSR2]	CornerPt <No.1> 1/5 HA# 86° 20′55″ VA# 68° 39′41″ SD# * Sight Press [MSR] OK
c. Sight a second point on the same wall and press [MSR1]/[MSR2]. 	Sight a second point [MSR1]/ [MSR2]	CornerPt <No.2> 1/5 HA# 96° 06′38″ VA# 56° 36′52″ SD# * Sight Press [MSR] OK
d. Sight the third point on the second wall and press [MSR 1]/[MSR 2]. 	Sight the third point [MSR 1]/ [MSR 2]	CornerPt <No.3> 1/5 HA# 110° 10′05″ VA# 52° 00′41″ SD# * Sight Press [MSR] OK
e. If the two walls are at right angles, press the Calc softkey to calculate the corner point by three points. If you take a measurement to a fourth point, the corner point can be calculated as the intersection of two walls (P1-P2 and P3-P4). 	[Calc]	CornerPt <No.4> 1/5 HA# 110° 10′05″ VA# 52° 00′41″ SD# 6.526m * Press [MSR] or [Calc] Calc

f. Enter a PT (and CD) value and press [ENT], The target point is calculated and recorded as an SS record.	Enter PT and CD [ENT]	Rec Pt PT: 26 A HT: 1.000m CD: List Stac

6.7 COLUMN

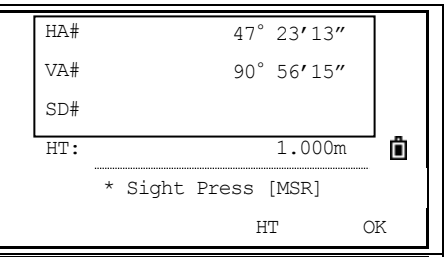
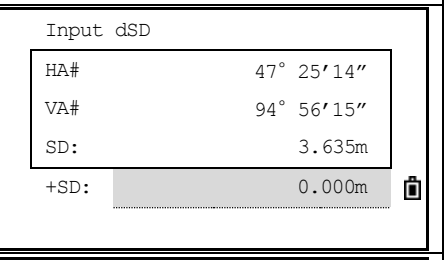
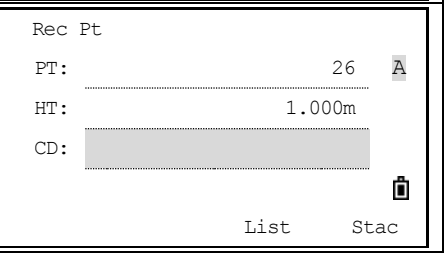
STEP	OPERATION	DISPLAY
a. In Page 2 of [Offset] menu, press [7] to enter Column function.	[7]	Offset  1. CornerPt 2. Column 3. InputdSD ▲
b. If you have't taken a measurement to the column before entering to this function, a temporary measuring screen appears. Sight any point on the surface of the column and press [MSR1]/ [MSR 2].	Sight any point on the surface of the column [MSR1]/ [MSR2]	HA# 47° 42'13" VA# 94° 01'13" SD# HT: 1.000m * Sight Press [MSR] HT OK
c. Press [ENT]. If you use a prism attached to the surface of the column for the distance measurement, press the +SD softkey to eliminate the offset error (from the attached point to the measured surface of the prism) before you press [ENT].	[ENT]	HA# 47° 25'14" VA# 94° 56'15" SD# 3.635m HT: 1.000m * Input +SD/Press [ENT] +SD Press+SD: Column HA# 47° 25'14" VA# 94° 56'15" SD: 3.635m +SD: 0.000m
d. Sight one edge of the column. 	Sight one edge of the column	HA# 80° 32'13" VA# 94° 56'15"  * Sight 1 Calc OK

e. A If you have taken a distance measurement to the center of the column, press the Calc softkey to calculate the offset using one edge angle observation. B Press [ENT] or [OK]. Sight the other edge of the column, as shown in graph B. It also calculates the coordinates of the center point and the radius of the circle. 		A: Press [Calc]. N: 29.369m E: 25.566m Z: -14.177m Rd= 5.369m Redo OK B: HA# 80° 32′13″ VA# 94° 56′15″  * Sight 2 OK
f. In dialog box, if the result is satisfying, press [OK], otherwise press [Redo].	[OK] or [Redo]	N: 29.369m E: 25.566m Z: -14.177m Rd= 5.369m Redo OK
g. Enter a PT (and CD) value and press [ENT], The target point is calculated and recorded as an SS record.	Enter PT and CD [ENT]	Rec Pt PT: 26 A HT: 1.000m CD: List Stac

- The calculated point (center of the circle) is stored as an SS record.
- If you press the +SD softkey before you sight Edge1, the input value is recorded at the end.

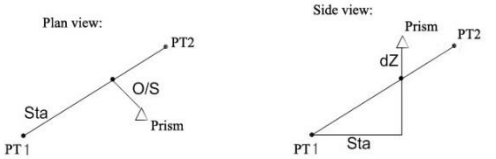
6.8 EXTEND THE SLOPE DISTANCE

STEP	OPERATION	DISPLAY
a. In Page 2 of [Offset] menu, press [8] enter the function for extending the slope distance	[8]	Offset  1. CornerPt 2. Column 3. InputdSD ▲

b. If you have not taken a distance measurement before entering this function, a temporary measurement screen appears. Sight the target and press [MSR1]/ [MSR2].		
c. Enter the slope distance You can enter any value from -99.99 through +99.99m.Press [ENT] to record the point.	Enter the slope distance	
d. Enter a PT (and CD) value and press [ENT], The target point is calculated and recorded as an SS record.	Enter PT and CD + [ENT]	

7. PRG JKL 4 KEY

7.1 2 POINT REFLINE

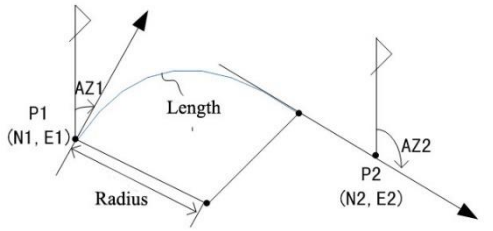


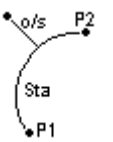
STEP	OPERATION	DISPLAY
a. In [Program] menu, press [1] to enter 2Pt.Ref.Line function.	[1]	Program 1. 2 Pt.Ref.L 2. Ref.Arc 3. MlmRadial 4. Mlm Cont. 5. REM
b. Enter the first point for the reference line P1. ※1)	Input P1	Input P1 P1: P2: Meas List Stac
c. Enter the second point for the reference line.	Input P2	Input P2 P1: 1 P2: Meas List Stac
d. Sight the target and press [MSR1] or [MSR2] to start measurement.	[MSR1]/ [MSR2]	2 Pt.Ref.L 1/5 STA# O/S# dZ# * Sight Press [MSR]
e. After measuring, the results display. ※2) STA: Horizontal distance from P1 to the measure point along the P1-P2 line O/S: Horizontal offset from the P1-P2 line to the measured point dZ: Vertical offset from the P1-P2 line to the measured point		2 Pt.Ref.L 1/5 STA# 1.247m O/S# -1.983m dZ# -0.414m * Sight Press [MSR] * Press [ENT] Rec.

f. Press [ENT] to record.	[ENT]	Rec Pt PT: 11 A HT: 1.000m CD: List Stac
※1) About method to input PtID, please refer to "2.8 METHOD TO INPUT PTID". ※2) Press [▲]/[▼] or [DSP] to view other pages.		

7.2 REFERENCE ARC

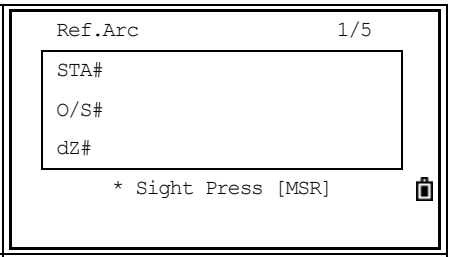
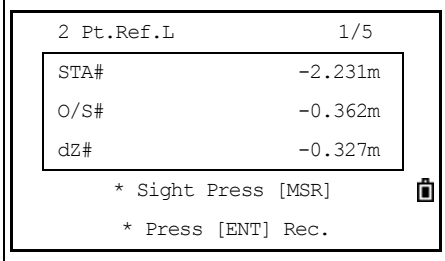
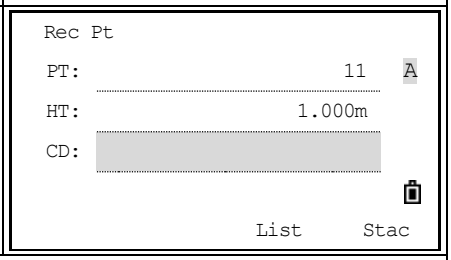
Measuring distance and offset values on the arc-curve.



STEP	OPERATION	DISPLAY
a. In [Program] menu, press [2] to enter Ref. Arc function.	[2]	Program  1. 2 Pt.Ref.L 2. Ref.Arc 3. MlmRadial 4. Mlm Cont. 5. REM ▼
b. Enter the start of the curve point P1. ※ 1)	Input P1	Arc Start P1: 1 AZ1: Meas List Stac
c. Enter the azimuth of its tangent line (AZ1).	Input AZ1	Arc Start P1: 1 1 AZ1: * Tangent AZ of P1

<table>
<tr>
<td>d.
Choose a method to define the arc, as shown in the graph.</td>
<td></td>
<td>Define Arc
 

1. P2-AZ2
2. Rad-AZ2
3. Rad-Len</td>
</tr>
<tr>
<td>e.
A: Use P2-AZ2 to define arc.
Input point name of P2 and azimuth of its tangent line (AZ2). ※2)
B: Use Rad-AZ2 to define arc.
Input the radial and azimuth of its tangent line (AZ2).
In the radius (Rad) field, enter a positive value for a clockwise curve. Enter a negative value for a counterclockwise curve. As shown in graph B.</td>
<td></td>
<td>A
Defind Arc
P2: 1
AZ2:
Meas List Stac
B
Define Arc
Rad: 1
AZ2:
* Rad (-) Counter-cw.
* Rad (+) Clockwise</td>
</tr>
<tr>
<td>C: Use Rad-Len to define arc.
Input radial and arc length. Similarly, in the radius (Rad) field, enter a positive value for a clockwise curve. Enter a negative value for a counterclockwise curve. As shown in graph C.</td>
<td></td>
<td>C
Define Arc
Rad: 1
Len:
* Rad (-) Counter-cw.
* Rad (+) Clockwise</td>
</tr>
<tr>
<td>f.
When all factors have been entered, the instrument calculates the curve. If the curve length (Len) is too large for a circle of the given radius, it is shortened. If the curve is reasonable, press [OK] to confirm. Otherwise press [Abrt] to redefine.</td>
<td>[OK]
or
[Abrt]</td>
<td>Ref.Arc
Rad: 8.000m
Len: 8.378m
AZ2: 62° 00′00″
* Sight Press [MSR]</td>
</tr>
</table>

<table>
<tr>
<td>g.
Sight the center of prism, and press [MSR1] or [MSR2].</td>
<td>[MSR 1]/
[MSR 2]</td>
<td> 
</td>
</tr>
<tr>
<td>h.
After measuring, the results display. ※3)
STA: Horizontal distance from P1 to the measure point along the P1-P2 line
O/S:Horizontal offset from the P1-P2 line to the measured point
dZ: Vertical offset from the P1-P2 line to the measured point</td>
<td></td>
<td> 
</td>
</tr>
<tr>
<td>i.
Press [ENT] to record.</td>
<td>[ENT]</td>
<td> 
</td>
</tr>
<tr>
<td colspan="3">※1) About method to input PtID, please refer to “2.8 METHOD TO INPUT PTID”.
※2) P2 can be any point on the tangent line that is to exit the curve.
※3) Press [▲]/[▼] or [DSP] to view other pages.</td>
</tr>
</table>

7.3 REMOTE DISTANCE MEASUREMENT

This function measures the horizontal distance, vertical distance, and slope distance between two points.

User can select between two different methods:

MimRadial(A-B，A-C)

Mim Cont. (A-B，B-C)

rSD: Slope distance between two points

rHD：Horizontal distance between two points

rVD: Vertical distance between two points

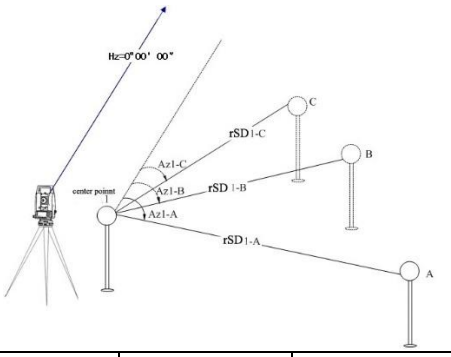
RV%：rV% Percentage of grade (rVD/rHD) × 100%

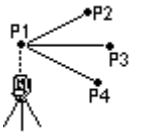
rGD：Vertical grade (rHD/rVD)

rAZ：Azimuth from first point to second point

7.3.1 MimRadial

Measuring between the current and the first point measured.

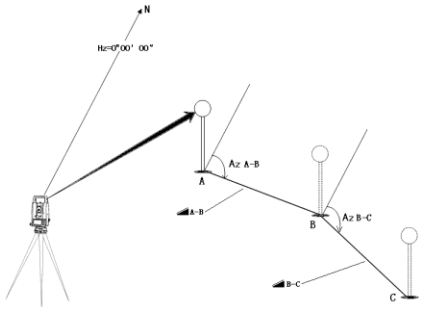


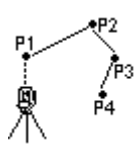
STEP	OPERATION	DISPLAY
a. In [Program] menu, press [3] to enter MimRadial function.	[3]	Program  1. 2 Pt.Ref.L 2. Ref.Arc 3. MlmRadial 4. Mlm Cont. 5. REM ▼
b. Sight the first point and press [MSR1]/[MSR2].	Sight the first point + [MSR1]/ [MSR2]	MlmRadial 1/2 rSD# rVD# rHD# * Sight Press [MSR]
c. The distance from the station point to the first point is displayed.		MlmRadial 1/2 rSD# 2.287m rVD# -0.174m rHD# 2.280m * Sight Press [MSR] * Press [ENT] Rec.
d. Sight the 2nd point press [MSR 1]/[MSR 2], the distances between 1st and 2nd point are displayed. rSD: Slope distance between two points rVD: Vertical distance between two points rHD: Horizontal distance between two points. Press [▲] or [▼] to display next page. rAZ: Azimuth from 1st point to 2nd point rV%: Percentage of grade rGD: Vertical grade (rHD/rVD)	Sight the second point + [MSR1]/ [MSR2]	MlmRadial 1/2 rSD# 2.593m rVD# 0.016m rHD# 2.593m * Sight Press [MSR] * Press [ENT] Rec. The result in second page MlmRadial 1/2 rAZ# 41° 37′02″ rV%# 0.63% rGD# 158.114:1 * Sight Press [MSR] * Press [ENT] Rec.

e. To record the distance and angle information as a comment record, press [ENT] in the 1/2 or 2/2 observation screen. Default point numbers are displayed. (STN=0, PT=1, PT=2, PT=3…), it can be changed.	[ENT]	Rec CO Data Fr: 1 1 To: 2 List Stac
f. After recording, the display returns to MimRadial screen, sight the third point and press [MSR 1]/[MSR 2], the distances between the first and second point are displayed.	Sight the third point + [MSR1]/ [MSR2]	MlmRadial 1/2 rSD# 2.287m rVD# -0.174m rHD# 2.280m * Sight Press [MSR] * Press [ENT] Rec.
g. Press [ENT] to record the distances between the first and second point. Repeat Step d and e to calculate and record the distance between the first point and other points.	[ENT]	Rec CO Data Fr: 1 1 To: 3 List Stac

7.3.2 Mim Cont.

Measuring between the current point and the immediately preceding point.
Other operations are same as MimRadial.

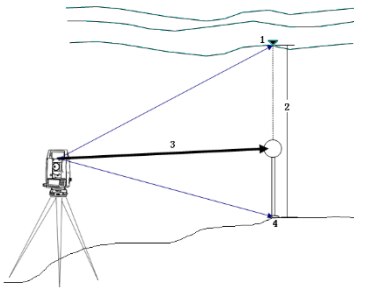


STEP	OPERATION	DISPLAY
a. In [Program] press [4] to enter Mim Cont. function.	[4]	Program  1. 2 Pt.Ref.L 2. Ref.Arc 3. MlmRadial 4. Mlm Cont. 5. REM

b. Sight the first point and press [MSR1]/[MSR2].	Sight 1st point [MSR1]/ [MSR2]	MlmCont. 1/2 rSD# rVD# rHD# * Sight Press [MSR]
c. The distance from the station point to the first point is displayed.		MlmCont. 1/2 rSD# 7.782m rVD# -1.073m rHD# 7.700m * Sight Press [MSR] * Press [ENT] Rec.
d. Sight the second point and press [MSR1]/[MSR2], the distances between the first and second point are displayed. rSD: Slope distance between two points rVD: Vertical distance between two points rHD: Horizontal distance between two points.	Sight the second point [MSR1]/ [MSR2]	MlmRadial 1/2 rSD# 8.402m rVD# -0.133m rHD# 8.401m * Sight Press [MSR] * Press [ENT] Rec.
e. Press [▲] or [▼] to display next page. rAZ: Azimuth from first point to second point rV%：Percentage of grade rGD：Vertical grade (rHD/rVD)		The second page: MlmRadial 1/2 rAZ# 77° 51′02″ rV%# -1.58% rGD# -63.372:1 * Sight Press [MSR] * Press [ENT] Rec.
f. To record the distance and angle information as a comment record, press [ENT] in the 1/2 or 2/2 observation screen. Default point numbers are displayed. (STN=0, PT=1, PT=2, PT=3…), it can be changed.		Rec CO Data Fr: 1 1 To: 2 List Stac
g. After recording, the display returns to MimRadial screen, sight the third point and press [MSR 1]/[MSR 2], the distances between the second and third point are displayed.	Sight the third point [MSR1]/ [MSR2]	MlmRadial 1/2 rSD# 2.593m rVD# 0.016m rHD# 2.593m * Sight Press [MSR] * Press [ENT] Rec.

h. Press [ENT] to record the distances between the first and third point. Repeat Step d & e to calculate and record the distances between the third point and the fourth point by analogy.	[ENT]	Rec CO Data Fr: 2 1 To: 3 List Stac

7.4 REMOTE ELEVATION MEASUREMENT (REM)



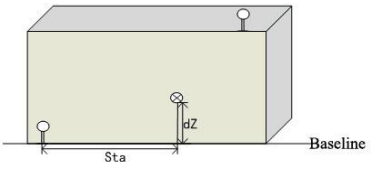
1. Target Point
2. Vh
3. Slope Distance
4. Base Point

STEP	OPERATION	DISPLAY
a. In [Program] press [5] to enter REM function.	[5]	Program 1. 2 Pt.Ref.L 2. Ref.Arc 3. MlmRadial 4. Mlm Cont. 5. REM
b. Enter the height of target HT.	Enter the height of target	REM HT: 0.000m Vh: * Input HT first Stac
c. Sight the target point and press [MSR1]/[MSR2].	Sight the target point [MSR1]/ [MSR2]	REM HT: 1.620m Vh: * Sight Press [MSR] OK

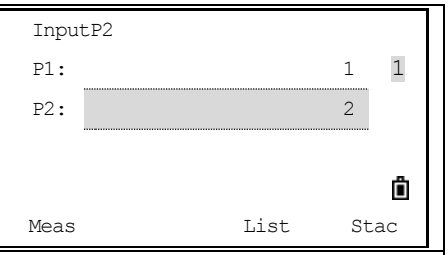
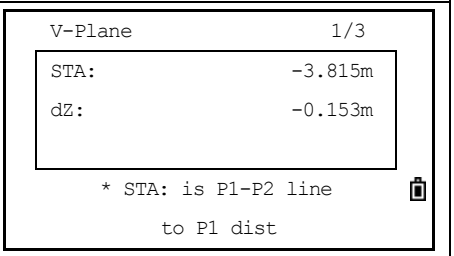
d. The measuring results are displayed.		REM HT: 1.620m Vh: 1.620m * Press [ENT] update HT
e. Loosen the vertical clamp, and turn the telescope to aim at the target point. The difference in elevation (Vh) is displayed.	Sight the target point	REM HT: 1.620m Vh: 3.572m * Press [ENT] update HT
f. You can press [ENT] to update the height of target.	[ENT]	REM HT: -1.977m Vh: 0.000m * Press [ENT] update HT

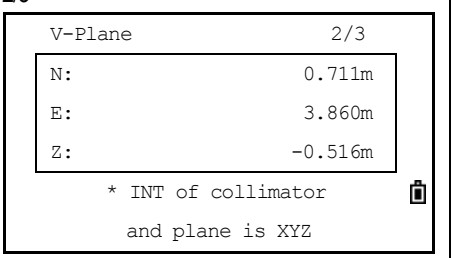
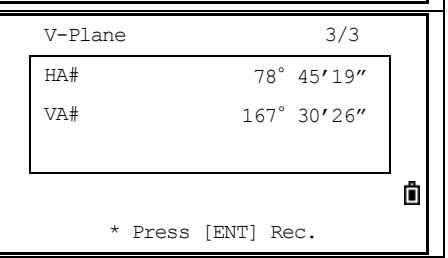
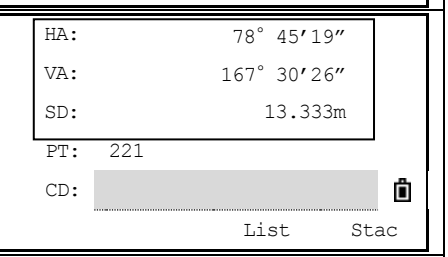
7.5 2-PT REFERENCE PLANE (V-PLANE)

Measuring distance and offset values on the vertical plane.



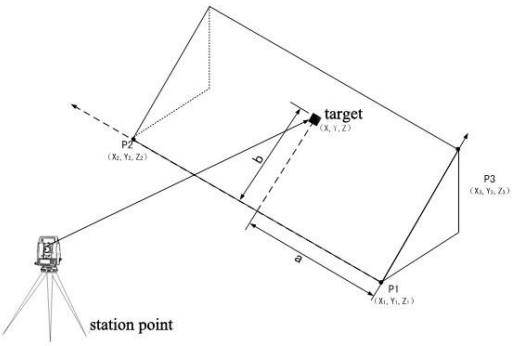
STEP	OPERATION	DISPLAY
a. In the second page of [Program] press[6] to enter 2-Pt Reference Plane (V-Plane) function.	[▼] [6]	Program 1. V-Plane 2. S-Plane 3. Roads P1 P2 ▲
b. Input the first point to define the plane. ※1)	InputP1	InputP1 P1: P2: Meas List Stac

<table>
<tr>
<td>c.
Input the second point on the vertical plane, and press [ENT].</td>
<td>InputP2</td>
<td> 
</td>
</tr>
<tr>
<td>d.
Once the plane is defined, the calculated Sta and dZ values are updated as you move the telescope. No distance measurement is required.
STA：Horizontal distance from P1 to the target point along the baseline
dZ: Vertical distance from P1 to the target point</td>
<td></td>
<td> 

2/3

</td>
</tr>
<tr>
<td>Press [▼] to display other pages. As shown in the right graph.</td>
<td></td>
<td> 
</td>
</tr>
<tr>
<td>e.
To record the point, press [ENT] on any screen. Input PT and CD and then press [ENT] in the dialog box shown as the right graph.</td>
<td>[ENT]</td>
<td> 
</td>
</tr>
<tr>
<td colspan="3">※1) About method to input PtID, please refer to “2.8 METHOD TO INPUT PTID”.</td>
</tr>
</table>

7.6 3-PT REFERENCE PLANE (S-PLANE)

Measuring distance and offset values on the slope.

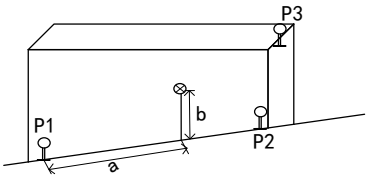


STEP	OPERATION	DISPLAY
a. In the second page of [Program] press [7] to enter 3-Pt Reference Plane (S-PLANE) function.	[▼] [7]	Program 1. V-Plane 2. S-Plane 3. Roads P1 P2
b. Input the first point to define the slope plane.	Input P1	InputP1 P1: P2: P3: Meas L st Stac
c. Input the second point.	Input P2	InputP2 P1: 1 P2: P3: Meas List Stac
d. Input the third point on the plane. If press [2PT] here, the program will define the plane by P1 and P2. ※1)	Input P3	InputP3 P1: 1 P2: 2 P3: Meas 2PT List Stac

<table>
<tr>
<td>e.
Once the plane is defined, the calculated a and b values are updated as you move the telescope. No distance measurement is required.
a: Distance between P1 and the point that is perpendicular to the target point along the P1-P2 line
b: Length of the perpendicular line from the target point to the P1-P2 line

Press [▼] to display other pages. As shown in the right graph.</td>
<td></td>
<td>S-Plane 1/3
a: -9.220m
b: 5.635m
* a: to P1 dist
b: to P1-P2 offs
2/3
S-Plane 2/3
N: 0.711m
E: 3.860m
Z: -0.516m
* INT of collimator and plane is XYZ
3/3
S-Plane 3/3
HA# 78° 45′19″
VA# 167° 30′26″
* Press [ENT] Rec.</td>
</tr>
<tr>
<td>f.
To record the point, press [ENT] on any screen. Input PT and CD and then press [ENT] in the dialog box shown as the right graph.</td>
<td>[ENT]</td>
<td>HA: 78° 45′19″
VA: 167° 30′26″
SD: 13.333m
PT: 221
CD:
List Stac</td>
</tr>
</table>

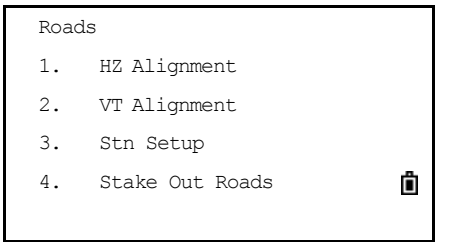
※1) If the plane is defined by two points, the vertical plane is the same as the plane used in the V-Pln function, but the indicating factors are Sta and dZ, not a and b.



7.7 ROADS

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.

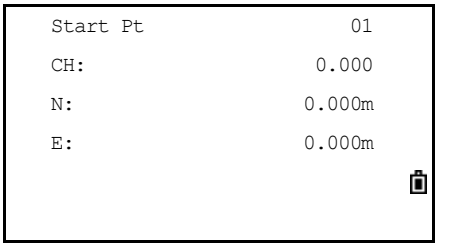
Before starting road design and stake-out, user should set job, station, and orientation first.



7.7.1 Define HZ Alignment

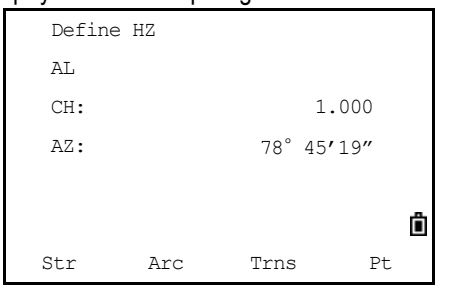
Horizontal alignment consists of the following elements: start point, line, curve and spiral.

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

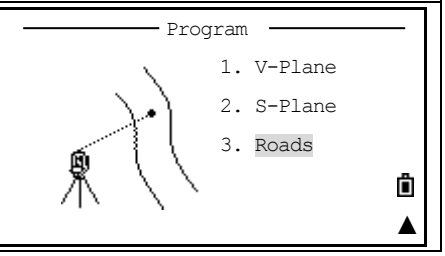


Serial number and the amount of present horizontal alignment are displayed on the upper right corner of the screen.

The element of start point consists of the start chainage and E, N coordinate of start point. Enter these details, and press [ENT] to display the main line inputting screen.



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 [ENT] to calculate the new chainage and azimuth angle automatically and return to the alignment defining main menu. Now other line type can be defined.

STEP	OPERATION	DISPLAY
a. In the second page of [Program] press [8] to enter into Roads design and stake-out function.	[▼] [8]	

b. Select "1.HZ Alignment" to enter into define HZ Alignment function.	[1] [ENT]	Roads 1. HZ Alignment 2. VT Alignment 3. Stn Setup 4. Stake Out Roads
c. Select "Define HZ AL".	[1]	HZ Alignment 1. Define HZ AL 2. Edit HZ AL 3. Receive HZ AL 4. Delete HZ AL
d. Input the chainage of start point, and N, E coordinates. After finishing one item, press [ENT] to move to the next item.	Input chainage of start point, N, E coordinates [ENT]	Start Pt 01 CH: 0.000 N: 0.000m E: 0.000m
e. The display enters to the Define HZ alignment main menu.		Define HZ AL 01 CH: 1.000 AZ: 78° 45'19" Str Arc Trns Pt

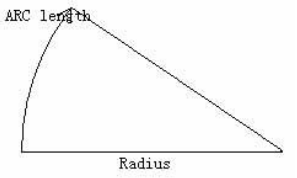
Straight Line

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.

STEP	OPERATION	DISPLAY
a. In Define HZ AL screen press [Str] to enter into the straight line defining menu.	[Str]	Define HZ AL 01 CH: 1.000 AZ: 0° 00'00" Str Arc Trns Pt

b. After inputting AZ angle, press [ENT] to go to next input item. After inputting the length of the line, press [ENT].	Input AZ angle [ENT] Input Length [ENT]	Straight 02 AZ: 0° 00′00″ Len:
c. The display returns to alignment defining 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.		Define HZ 02 AL CH: 11.000 AZ: 25° 00′00″ Str Arc Trns Pt

Arc

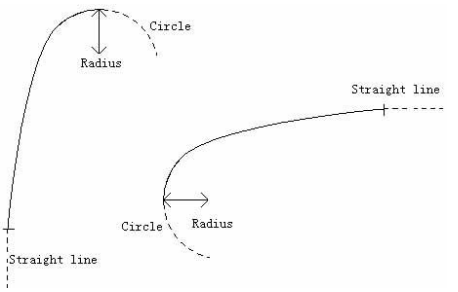


Press [ARC] in "Define HZ AL" menu to define the arc. A curve consists of arc length and radius. The rule of radius value: along the forward direction of the curve. When the arc turns right, the radius value is positive; while the arc turns to left, the radius value is minus. The arc length can neither be negative nor longer than the circumference.

STEP	OPERATION	DISPLAY
a. In Define HZ AL screen press [Arc] to enter to defining arc screen.	[Arc]	Define HZ 01 AL CH: 1.000 AZ: 0° 00′00″ Str Arc Trns Pt
b. Input radius and arc length, and press [ENT] to record this data.	Input radius and arc length + [ENT]	Arc 02 Rad: Len:

c. The display returns to alignment defining main menu, and displays chainage of end point of the arc and azimuth of this point.		Define HZ 02 AL CH: 20.000 AZ: 85° 22′30″ Str Arc Trns Pt

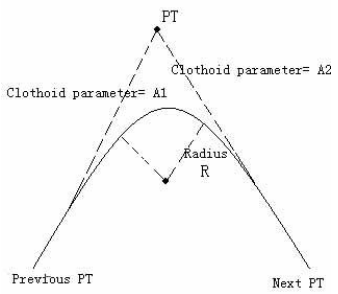
Transition



In Define HZ AL screen press [Trns] to define transition. A transition consists of the minimum radius and arc length. The rule of radius value is same as the rule of radius value. Similarly, the arc length can't be negative.

STEP	OPERATION	DISPLAY
a. In Define HZ AL screen press [Trns] to enter into defining transition screen.	[Trns]	Define HZ 01 AL CH: 1.000 AZ: 0° 00′00″ Str Arc Trns Pt
b. Input radius and arc length, and press [ENT] to record this data.	Input radius and arc length [ENT]	Transition 02 Rad: Len:
c. The display returns to alignment defining main menu, and displays chainage of end point of the transition and azimuth of this point.		Define HZ 01 AL CH: 15.000 AZ: 73° 42′17″ Str Arc Trns Pt

Point



In Define HZ AL screen press [Pt] 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.

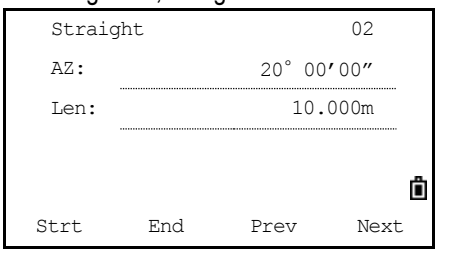
Note: If user input A1, A2 from according to the lengths L1, L2 of spiral, the following formulas are used to calculate A1 and A2.

$$A1 = \sqrt{L1 \times Radius}$$
$$A2 = \sqrt{L2 \times Radius}$$

STEP	OPERATION	DISPLAY
a. In Define HZ AL screen press [Pt] to enter to defining point function.	[Pt]	Define HZ 01 AL CH: 1.000 AZ: 0° 00′00″ Str Arc Trns Pt
b. Input N and E coordinates, radius and A1, A2, then press [ENT].	Input N, E coordinates, radius and A1, A2 [ENT]	Pt 02 N: 0.000m E: 0.000m Rad: 0.000m A1: 0.000 A2: 0.000
c. The display returns to the alignment defining main menu.		Define HZ 01 AL CH: 21.000 AZ: 100° 00′51″ Str Arc Trns Pt

7.7.2 Edit Horizontal Alignment Data

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



Soft keys:

[Strt]: Go to the beginning of the file, and displays the first alignment data.

[End]: Go to the end of the file, and displays the last alignment data.

[Prev]: Display the previous point data.

[Next]: Display the next point 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 to the inputting screen of next point. To quit without saving data, press [ESC].

STEP	OPERATION	DISPLAY
a. In HZ Alignment select "Edit HZ AL".	[2]	HZ Alignment 1. Define HZ AL 2. Edit HZ AL 3. Receive HZ AL 4. Delete HZ AL
b. Screen displays the start point data. Press [Next] softkey to find the alignment data needed to edit.	[Next]	Start Pt 01/05 CH: 10.000 N: 10.000m E: 10.000m End Next
c. Input the new data and press [ENT].	Input new data + [ENT]	Straight 02/05 AZ: 30° 00′10″ Len: 10.000m Strt End Prev Next
d. Screen displays the modified new data. Press [Prev] or [Next] to view and modify other data.		Straight 02 AZ: 30° 00′10″ Len: 15.000m Strt End Prev Next

7.7.3 Receive HZ AL

STEP	OPERATION	DISPLAY
a. In HZ Alignment select "Receive HZ AL".	[3]	HZ Alignment 1. Define HZ AL 2. Edit HZ AL 3. Receive HZ AL 4. Delete HZ AL
b. Press [Comm] to set communication parameter, making the parameter consistent with the setting in communication software. If not transmit, press [Abrt]. Press [▲]/[▼] to move cursor to each parameter, press [◀]/[▶] to select options of each item. After finishing setting, press [ENT].	[Comm]	Receive HZ AL Abrt Comm Strt Press [Comm] <Comm> Baud: 1200 Data.L: 8 Parity: None Stop: 1
c. After setting, press [Strt] to receive.	[Strt]	Receive HZ AL Receive…… Stop
d. After receiving data, the program quit automatically, and returns to HZ Alignment menu.		

7.7.4 Delete Horizontal Alignment Data

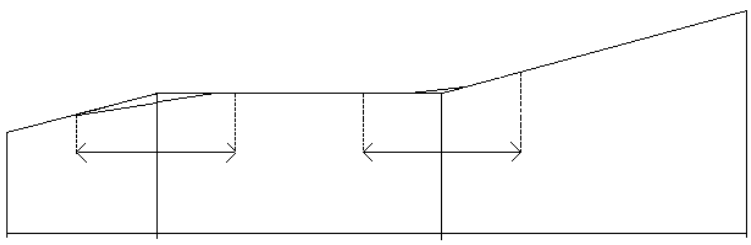
The horizontal alignment data in internal memory can be deleted. Operation is shown below.

STEP	OPERATION	DISPLAY
a. In HZ Alignment select "Delete HZ AL".	[4]	HZ Alignment 1. Define HZ AL 2. Edit HZ AL 3. Receive HZ AL 4. Delete HZ AL

b. The program displays as the graph:		Delete HZ AL * Sure? Abrt OK
c. Press [OK] to delete horizontal alignment data, all the horizontal alignment data in internal memory will be deleted. The system returns to HZ Alignment screen. User may re-define horizontal alignment data. (Here, taking deleting horizontal alignment data for example) Press [Abrt] if it is not to be deleted.	[OK]	HZ Alignment 1. Define HZ AL 2. Edit HZ AL 3. Receive HZ AL 4. Delete HZ AL

7.7.5 Define Vertical Alignment

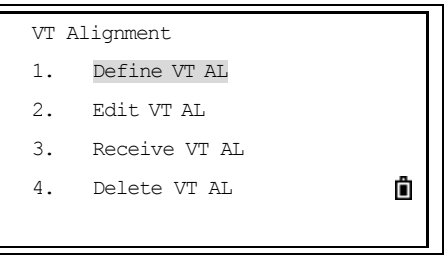
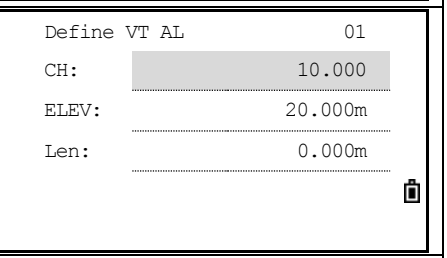
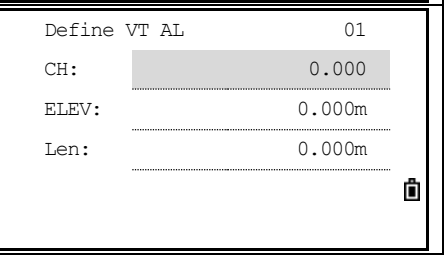
A vertical alignment consists of a series of intersections, including a chainage, height and curve length. The length of start point and end point must be zero.



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

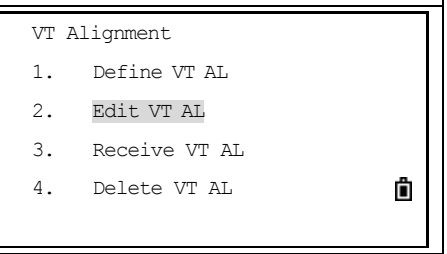
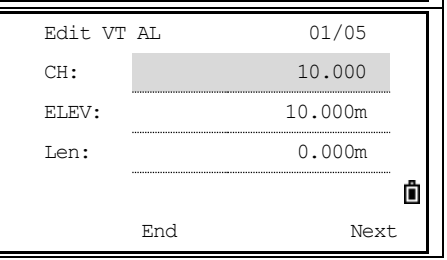
Intersections can be entered in any order. After entering one point data, press [ENT] to save it and go to next inputting screen. Press [ESC] to quit without saving.

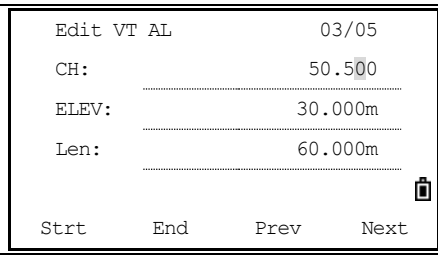
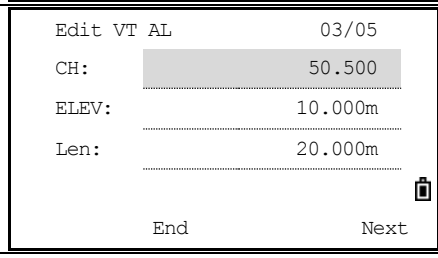
STEP	OPERATION	DISPLAY
a. In Roads menu select "2.VT Alignment" to enter to define VT Alignment function.	[2]	Roads 1. HZ Alignment 2. VT Alignment 3. Stn Setup 4. Stake Out Roads

b. Select "Define VT AL".	[1]	
c. Input chainage, elevation and length, then press [ENT]. The length of start point and end point must be 0.	Input chainage, elevation and length [ENT]	
d. At the bottom of the screen "Complete" displays, saving this alignment data, the display returns to Define VT AL screen to continue inputting the next alignment.		

7.7.6 Edit 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.

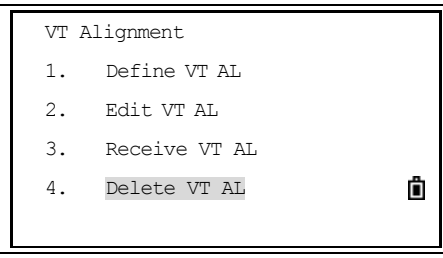
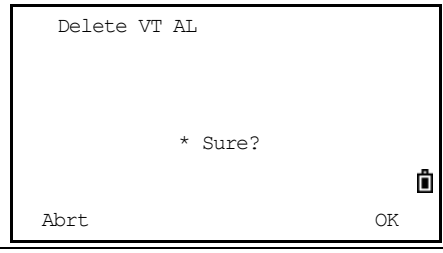
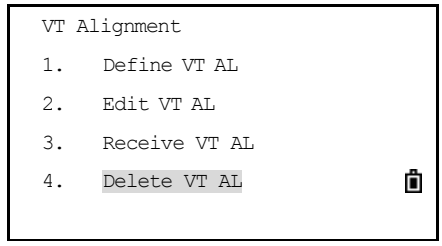
STEP	OPERATION	DISPLAY
a. In VT Alignment select "Edit VT AL".	[2]	
b. Screen displays the first Vertical alignment. Use softkey [Next] to find other alignment that needs to be edited.	[Next]	

c. Input new data and press [ENT].	Input new data [ENT]	
d. Screen displays the modified new data. Press [Prev] or [Next] to view and modify other data.		

The method of Receiving VT AL data is same as Receiving HZ AL data. Please refer to "7.7.3 Receive HZ AL data".

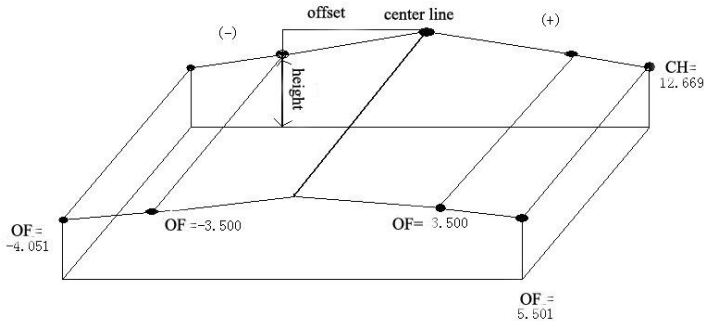
7.7.7 Delete Vertical Alignment Data

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

STEP	OPERATION	DISPLAY
a. In VT Alignment select "Delete VT AL".	[4]	
b. The program displays as the graph.		
c. Press [OK] to delete VT AL, all the vertical alignment data in internal memory will be deleted. The system returns to VT Alignment screen. User may re-define vertical alignment data. (Here take deleting vertical alignment data for example) Press [Abrt] if it is not to be deleted.	[OK]	

7.7.8 Stn Setup

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



STEP	OPERATION	DISPLAY
a. In Roads menu select"3.Stn Setup".	[3]	Roads 1. HZ Alignment 2. VT Alignment 3. Stn Setup 4. Stake Out Roads
b. hen there is horizontal alignment data in memory, you can use [CH] to setup station. Other method to setup station, please refer to Session 4. Key. Press [CH] to start.	[CH]	Input STN ST: 1 HI: 1.000m CD: CH List Stac
c. Input the chainage and press [ENT]. Make sure the input chainage is on the designed horizontal alignment. Press [PT] to enter to setting up station by point function, refer to Session 4. Key.	Input chainage [ENT]	Input STN CH: 1 OF: 0.000m HI: 0.000m PT
d. In OF item input the offset of the chainage to center line. And press [ENT].	Input Offset [ENT]	Input STN CH: 100.00 1 OF: 0.000m HI: 0.000m PT
e. The screen displays detailed data about the chainage. Input height of instrument and press [ENT].	Input height of instrument [ENT]	Input STN CH: 100.00 1 OF: 1.000m HI: 0.000m PT

f. Set backsight point. Backsight point can be also set by chainage. Same as Session 4. 7 Key.		Backsight 1. XYZ 2. Angle

7.7.9 Stake out Roads

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

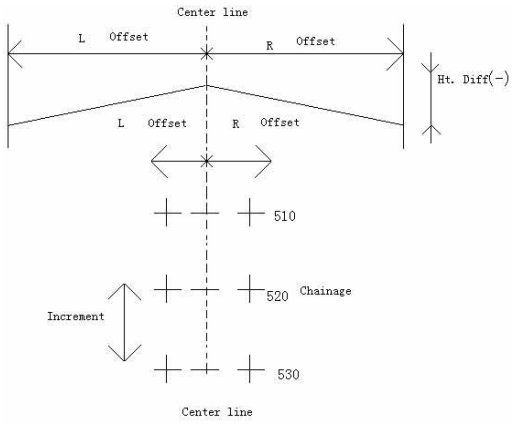
The vertical alignment data is unnecessarily to be defined, unless it is required to compute dig and fill. The method to define is similar to that of horizontal alignment.

Rules of alignment stake-out data:

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

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

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

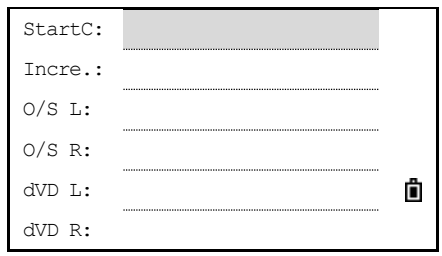
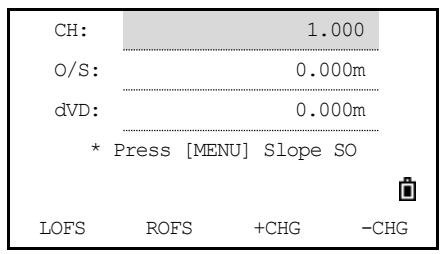
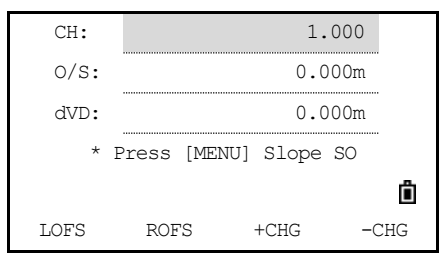
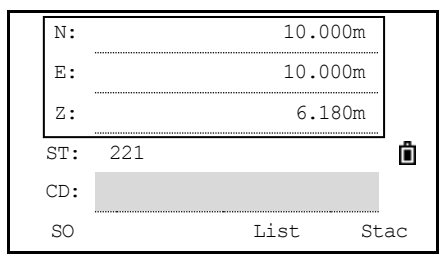


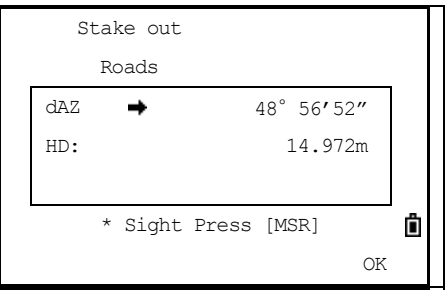
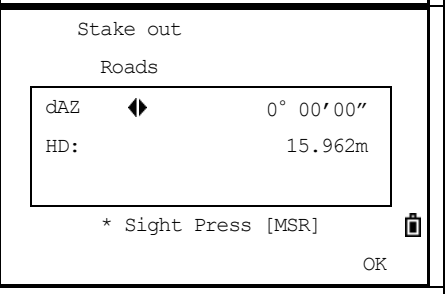
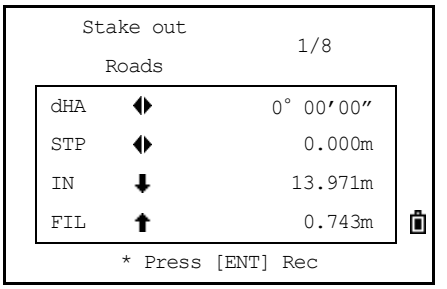
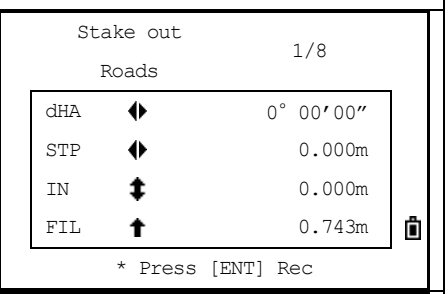
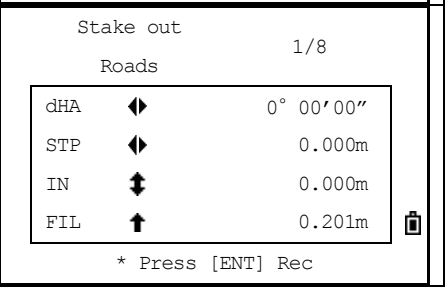
In the process of stake-out, user should first stake out points on the central line, then the featured points on both sides.

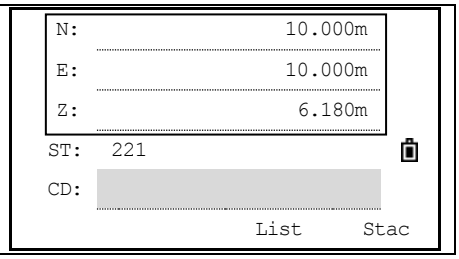
The method to stake out alignment is similar to that of point stake-out, with 3 methods available:

Take points on the central line for example.

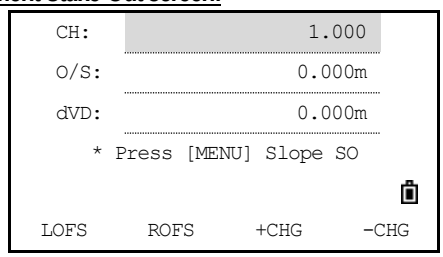
STEP	OPERATION	DISPLAY
a. In Roads menu select "4. Stake Out Roads".	[4]	Roads 1. HZ Alignment 2. VT Alignment 3. Stn Setup 4. Stake Out Roads

b. 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. O/S L: Horizontal distance between the left chainage point and central line. O/S R: Horizontal distance between the right chainage point and central line. dVD L: Height difference between the left chainage point and central line dVD R: Height difference between the right chainage point and central line.	Input data [ENT]	
c. After the data is input, press [ENT] 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.		
d. Steps: Stake out points on the central line first, and then press [LOFS](or [ROFS]) to stake out (or right) chainage. Press [LOFS] (or [ROFS]), 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.		
e. When the chainage and the offset to be staked out occurs, press [ENT] to enter to stake-out. Press [ENT] to save the coordinates of the stake-out point. Program enters to road stake-out screen. Not to save, press [SO].		

f. Enter to the Stake Out Roads screen. The Operational steps are same as point stake-out. Rotate the instrument until the dAZ displays 0°00'00".		
g. Sight the target and then press [MSR 1] or [MSR 2].	[MSR 1]/ [MSR 2]	
h. After measuring, the deviation value between measure point and stakeout point is shown. ※2), ※3) dHA：Difference in horizontal angle to the target point R/L: Right/Left (Lateral error) IN/OUT: In/Out (Longitudinal error) CUT/FIL: Cut/Fill		
i. Ask the rodman to adjust the target position, making R/L and IN/OUT to display 0 m. ⬇: moving towards to station ⬆: moving away from station		
j. When both R/L and IN/OUT display 0m, it indicates the prism is on the stakeout point. The fifth line shows the data of fill or dig.		

k. After staking out, you can press [ENT] to record the stakeout point. PT defaults to the last recorded PT+1, you can input code if necessary. Press [ENT] to record the point.	[ENT]	

Explanation for the Alignment Stake-Out screen:



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

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

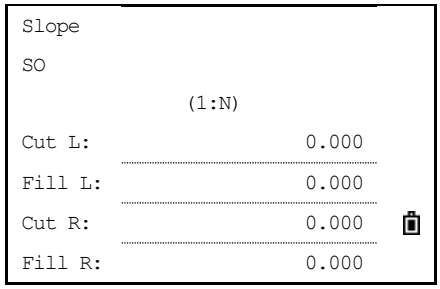
+CHG： The key is used to increase the chainage.

-CHG： The key is used to increase the chainage.

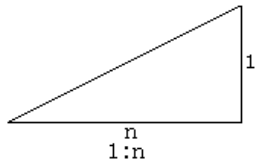
7.7.10 Slope Stake-out

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 [menu] to enter into slope stake-out function.

Slope stake-out screen：

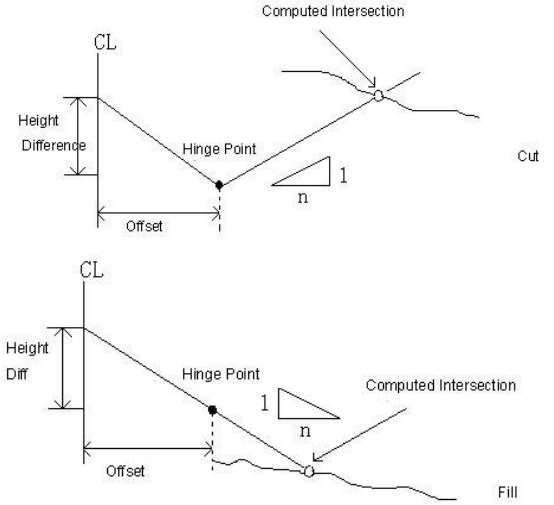


The fill/ cut value that are input here is a ratio.

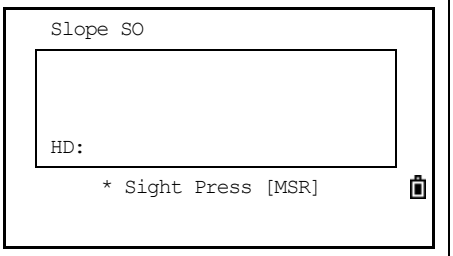
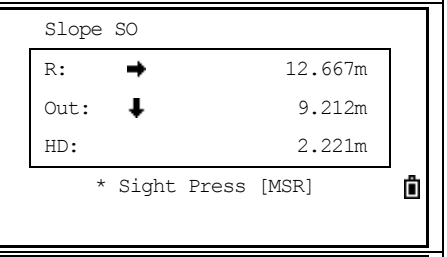
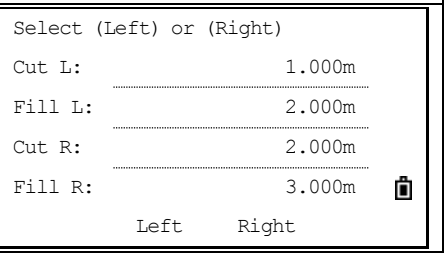


The fill/dig data can be entered through left and right slopes. In terms of fill/dig, use positive symbol to input the required slope, the software selects an appropriate slope in the list according to the actual position of the point.

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.



STEP	OPERATION	DISPLAY
a. In the Stake-out main menu, input (or select) the side chainage to be slope staked out. Press [MENU] to start.	[MENU]	CH: 1.000 O/S: 0.000m dVD: 0.000m * Press [MENU] Slope SO LOFS ROFS +CHG -CHG
b. Input the ratio of left and right slopes to be filled (or digged). After finishing inputting one item, press [ENT].	Input slope + [ENT]	Slope SO (1:N) Cut L: 0.000 Fill L: 0.000 Cut R: 0.000 Fill R: 0.000
c. When all data are input, select the left (or right) slope to be staked out.		Select (Left) or (Right) Cut L: 1.000m Fill L: 2.000m Cut R: 2.000m Fill R: 3.000m Left Right

d. Enter to the screen of Slope Stake Out function, input prism height, collimate the point that is to be intercepted near the slope, and press [MSR1] or [MSR2] 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.	[MSR1]/ [MSR2]	
e. The method to stake out slope is similar to that of point stake-out. When both second line and third line are zero, it indicates that the stake-out point is found.		
f. 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.		

Note:

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

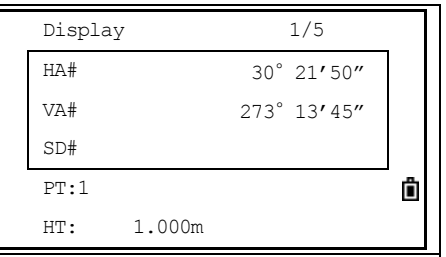
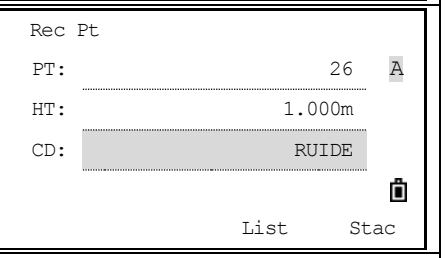
2) As the fill/dig value of calculated point is zero, therefore the fill/dig value is not displayed.

8. 5 KEY

In basic measurement screen, press 5 to change the default feature code that will appear in the CD item when you record a point.

Update the default code

STEP	OPERATION	DISPLAY
a. In basic measurement screen, press [5] (Code) key.	[5]	Display 1/5 HA# 30° 21′50″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m
b. A window for entering the feature code appears.		InputCod A CD: List Stac
c. ※1) A: Input the CD manually. The input code will be entered into Stac in chronological order. B: Select code from [List] window to input. To add, delete or edit code in the List, please refer to "11.4.14 Point Name List and Code List" C: Select code from [Stac] to input. Any place to input code manually can realize code Stac. The stack shows the last 20 point names used, in chronological order from last used to first used.		A: InputCod A CD: RUIDE List Stac B: AD 1 3 ER D C: LIBA XIEPO LUDENG DUIDEYIQ LUBIAO

d. press [ENT] to return to BMS.	[ENT]	
e. Press [Rec/Ent] to see if the default code is the setting you just do.		
※1) About method to input Code, please refer to "11.4.14.4 Add a Code".		

9. DAT FOR 6 KEY

When you press [DAT] in the basic measurement screen or in observation screens in functions such as Stakeout, 2Pt RefLine, etc, the data in the current job is displayed.

Hold [DAT] for one second in the basic measurement screen or an observation screen to display the Data Type screen. Through this screen you can change the type of data that is assigned to [DAT].

●To change the type of data that is assigned to [DAT], go to [MENU] →[6.1 Sec.]→[5.Data]

●For more information, see “11.4 VIEW RECORDS”.

10. USR1 STU 1 / USR2 VWX 2 KEY

If you use a certain function frequently in the field, you can assign it to the [USR1] or [USR2] key. Whenever you press a [USR] key, the function which is predefined is activated directly.

The following functions can be assigned to the [USR] keys:

Input HT	Offset→	Point Laser
BS Check	Program→	Direction Laser
TGT	Temp&Press	(none)
Cogo→	Note	

STEP	OPERATION	DISPLAY
a. In basic measurement screen, press [USR1]/ [USR2] for 1 sec, the function list of [USR] will display. (Here take USR 1 as example.)	Press [1] for 1 second	Display 1/5 HA# 30° 21′50″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m
b. Press [▲]/[▼] to highlight the function and then press [ENT].※1), ※2) If an item on the list has an arrow "→" beside, and if you select this item, the whole menu is assigned to the [USR] key. To assign a specific function from the sub-menu, press [▲]/[▼] to highlight the function. Then press [ENT].	[▲]/[▼] [ENT]	【User1】 Input Ht BS Check TGT Cogo→ *Offset→ Cogo(Menu) Inverse AZ&Dist Area LineOff. Input XYZ
c. The screen returns to basic measurement.		Display 1/5 HA# 30° 21′50″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m

※1) The current predefined function is indicated by an asterisk (*) beside the function name.

※2) Once you have defined a function to a [USR] key, it is activated directly whenever you press that [USR] key in the basic measurement screen.

11. MENU KEY

Press [MENU] to display the MENU screen.

11.1 JOB

11.1.1 Open a Job

STEP	OPERATION	DISPLAY
a. Press [Menu] key, a screen shows as the right graph.	[Menu]	Menu 1.Job 6.1 Sec. 2.Cogo 7.Adjust 3.Set 8.Time 4.Data 9.Format 5.Comm 10.Info
b. Press [1] to open the Job Manager. ※1)	[1]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 R2-1207 17-01-25 SURVEY 17-01-26 New Del Ctrl Info
c. Select the item by [▲]/[▼], and then press [Ent] to open the job. ※2)	[▲]/[▼]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 R2-1207 17-01-25 SURVEY 17-01-26 New Del Ctrl Info
d. Program sets the item as current item, and returns to basic measurement screen.		Display 1/5 HA# 30° 21′50″ VA# 273° 13′45″ SD# PT:1 HT: 1.000m

※1)If there are no job stored, the CreatJob screen appears.

※2)When you open a job, all job settings are automatically changed to match those used in the opened job.

The meaning of the symbol:

* Current job

@ Control job

! Some of the job settings are different from the current job.

11.1.2 Create a New Job

STEP	OPERATION	DISPLAY
a. Press [New] in the job list.	[New]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 R2-1207 17-01-25 SURVEY 17-01-26 New Del Ctrl Info
b. Enter a job name (within eight characters), and press [Ent]. ※1)	Enter a job name [Enter]	Create Job A Job: * Max 8 char
c. To confirm setting a new job, press [OK] or [Enter]; To input a name again, press [Abrt]; To check the settings of the job, press [Set]. ※2)	[OK] Or [Enter]	Create Job A Job: RUIDE800 * Press [OK] create [Set] use job set Abrt Set OK

※1) Within 8 characters.

※2)If it is not necessary to change last setting, the current setting will pass to the new job while pressing [Enter] or [OK] to create a new job.

Job Settings

The following 12 settings are set when a job is created, and they can't be changed. It is different from other temporary settings. It ensures that the data in a job is correctly stored in the database and that all necessary corrections are applied when you store each record.

Item	Option
Scale	0.99000 - 1.01000
T-Pcm.	ON/OFF
SeaLevel	ON/OFF
C&R cm	OFF/0.14/0.200
Angle	DEG/GON/MIL
Dist	Meter/USA Feet/USA Inch/IntlFeet/IntlInch
Temp	°C / °F
Press	hPa/mmHg/inHg
VA 0	Zenith/ Vertical/Vert±90
AZ 0	North/ South
Order	NEZ/ENZ
HA	Azimuth/0 to BS

To change the setting in the selected field, press [◀]/[▶]; To move between fields, press [▲]/[▼].
Alternatively, to move to the next field, press [Enter].
Create a new job automatically while pressing [Enter] in the last field.

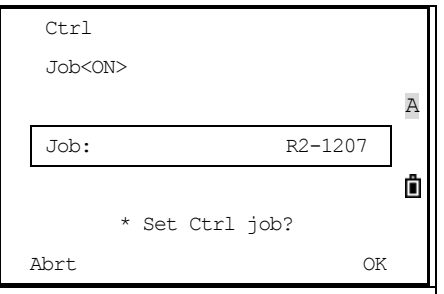
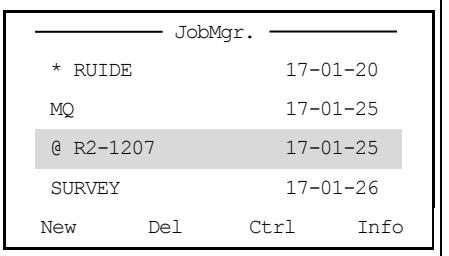
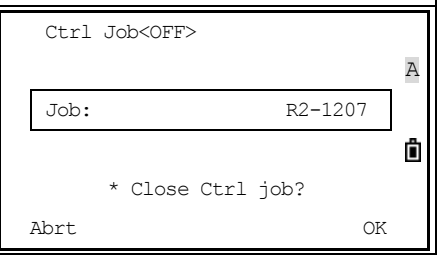
11.1.3 Delete Jobs

STEP	OPERATION	DISPLAY
a. In the job list， move the cursor to the job that you want to delete by [▲]/[▼].	[▲]/[▼]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 R2-1207 17-01-25 SURVEY 17-01-26 New Del Ctrl Info
b. Confirm the job that you want to delete as right screen.		Del Job A Job: R2-1207 * Sure? Abrt OK
c. Press [Ent] or [OK] to delete the job. To cancel the delete operation, press [ESC] or [Abrt] and return to the previous screen.	[ENT] or [OK]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 SURVEY 17-01-26 New Del Ctrl Info

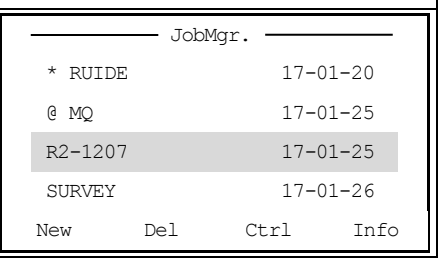
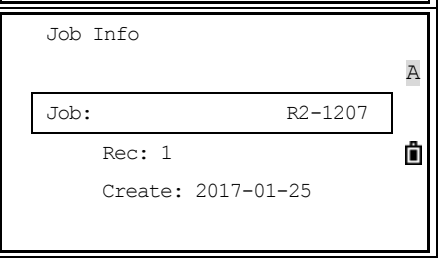
11.1.4 Set the Control Job

If you search for a point when a control job is specified, and the system cannot find the point in the current job, the control job is also searched. If the point is found in the control job, it is copied to the current job as a UP record.
A control job has the same format as a standard job. You can open and modify it like any other job, and you can use it to record any measured data.

STEP	OPERATION	DISPLAY
a. Highlight the job that you want to use as a control job by using by [▲]/[▼].	[▲]/[▼]	JobMgr. * RUIDE 17-01-20 @ MQ 17-01-25 R2-1207 17-01-25 SURVEY 17-01-26 New Del Ctrl Info

b. Press [Ctrl]. A confirmation screen appears.	[Control]	
c. Press [ENT] or [OK] to confirm, otherwise cancel it by [ESC] or [Abrt] and return to the previous screen. If a control job is already assigned, the newly assigned control job replaces it as the control job.	[ENT] or [OK]	
d. To clear the control job selected, highlight the current control job in the job list and press the [Ctrl] softkey.		

11.1.5 Display Job Information

STEP	OPERATION	DISPLAY
a. Highlight the job that you want to display the information by pressing [▲]/[▼].	[▲]/[▼]	
b. The Job Info screen shows the number of records in the job while pressing [Info].	[Info]	

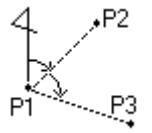
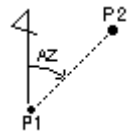
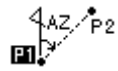
11.2 COORDINATE GEOMETRY (COGO) CALCULATIONS.

In the screen press [2] to show the menu, or access this menu from any observation or PT input screen.

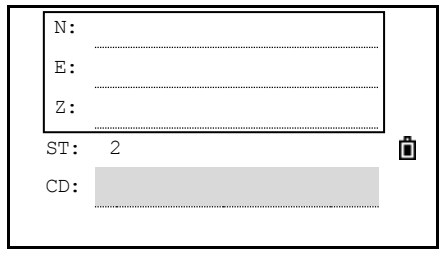
11.2.1 Inverse Calculating

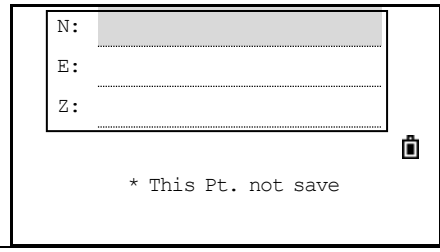
11.2.1.1 Inverse PT-PT

Calculating angle and distance between two coordinates: PT-PT calculates the distance and the angle between two input points.

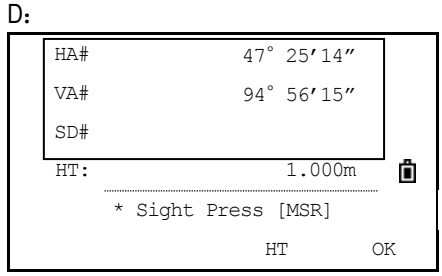
STEP	OPERATION	DISPLAY
a. In the [Menu], press [2] or ([▼]+[Enter]).	[2]	Menu 1.Job 6.1 Sec. 2.Cogo 7.Adjust 3.Set 8.Time 4.Data 9.Format 5.Comm 10.Info
b. Display the Cogo menu.		COGO  1. Inverse 2. AZ@Dist 3. Area 4. LineOff. 5. InputXYZ
c. Press [1] entering PT-PT menu.	[1]	Inverse  1. PT-PT 2. 3PT Ang.
d. Select “PT-PT”, pressing the key [1].	[1]	Input P1  1 P1: P2: Meas Data List Stac
e. Input the name of P1. The way to input: A: Input a point name which exists in the memory. The system calls it up automatically.		A N: 10.000m E: 10.000m Z: 10.000m ST: 2 CD:

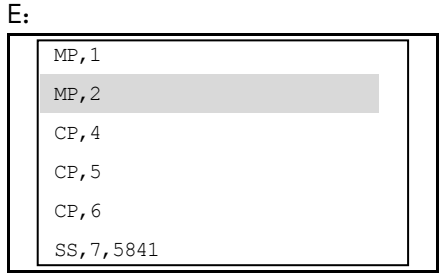
<table>
<tr>
<td>B:
The system requests to enter the information of the point if the point doesn't exist. It will return after the point is recorded.

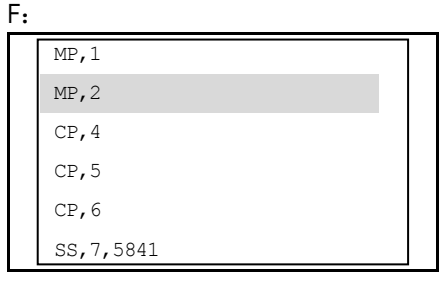
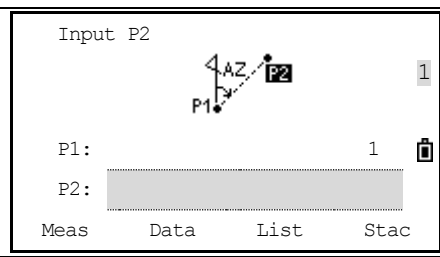
C:
If you press [ENT] without entering a point name, a coordinate input screen appears, and you can enter coordinates. These coordinates are not stored to the database.</td>
<td>Input P1</td>
<td>B
 

C
 
</td>
</tr>
<tr>
<td>D:
By pressing [MSR], as the D graph shows. Press [MSR1] or [MSR2] to measure a point as the first point of the line.

E:
Press [list] to use the point in the memory. To select the point, use the [▲], [▼] key and [ENT] key.
If the ▲ or ▼ appears in the list, turn page by [◀]/[▶] key.

F:
Call up the point by [Stac].</td>
<td></td>
<td>D:
 

E:
 

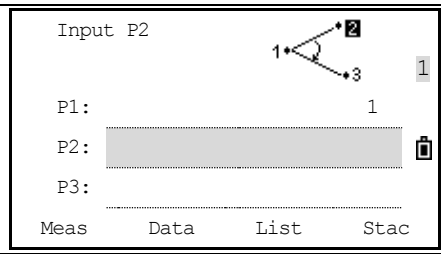
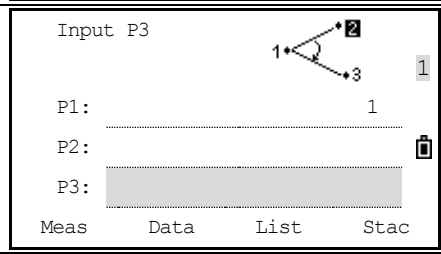
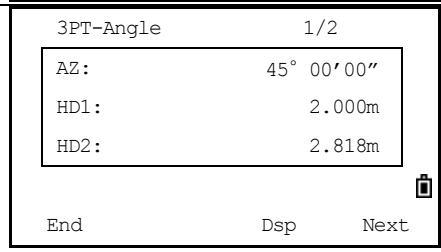
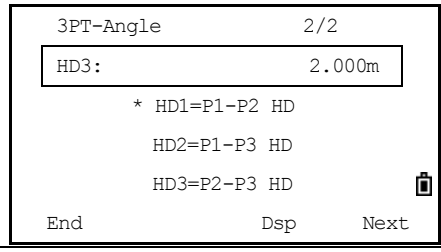
F:
 
</td>
</tr>
<tr>
<td>f.
Input the name of P2.</td>
<td>Input P2</td>
<td> 
</td>
</tr>
</table>

g. The azimuth, horizontal distance, and vertical distance from the first point to the second point are displayed. Press [Dsp] to switch between two pages. ※1)		PT-PT 1/2 AZ: 45° 00′00″ dHD: 2.818m dVD: 2.000m End Dsp Next Page 2: PT-PT 2/2 Gd: 1.414:1 V%: 70.71% rSD: 3.464m End Dsp Next
h. To go on PT-PT, press [Next]; To quit, press [End], the screen returns to Inverse menu.		
※1)Gd: Grade (HD/VD) V%: 100/Gd rSD: Slope distance PT1 to PT2		

11.2.1.2 3PT Angle

The 3pt angle calculates the angle between two lines defined by three points.
PT1 is the base point. Two lines are to be defined by P2 and P3, both from P1.

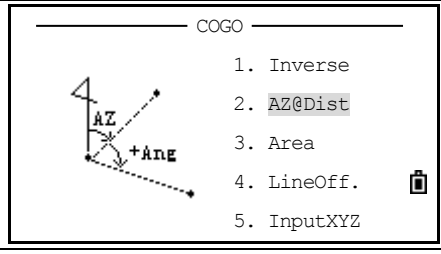
STEP	OPERATION	DISPLAY
a. Press [2] or select [3Pt Angle] in the Inverse menu.	[2]	Inverse 1. PT-PT 2. 3PT Ang. P1 P2 P3 dHA
b. Input the name of base point P1, and press [Ent]. About the input method, see Step e in "PT-PT".	Input P1	Input P1 1 2 3 P1: 1 P2: P3: Meas Data List Stac

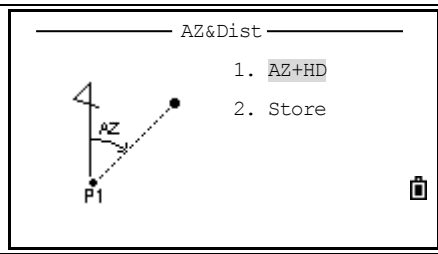
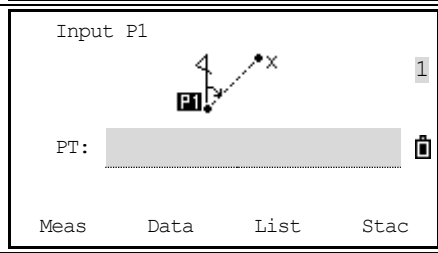
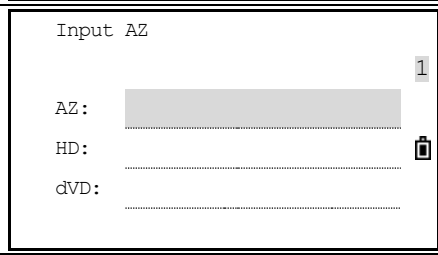
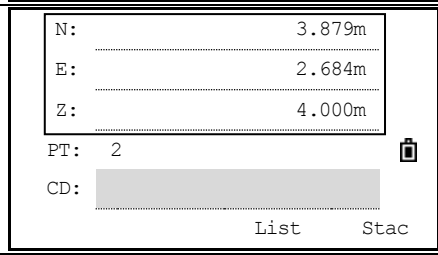
c. Enter the second point (P2) to define the baseline (P1-P2), and press [ENT].	Input P2	
d. Enter the third point (P3) to define the second line (P1-P3). Press [ENT].	Input P3	
e. Display the result of the 3PT Angle. Press [Dsp] to switch between 2 pages.		 Page 2： 
f. To continue 3 Pt. Angle function, press [Next]; To quit, press [End], screen returns to Inverse menu.		

11.2.2 Azimuth and Distance (AZ&Dist)

Use angle and distance to calculate coordinate. There are two ways to calculate new points in AZ&Dist function.

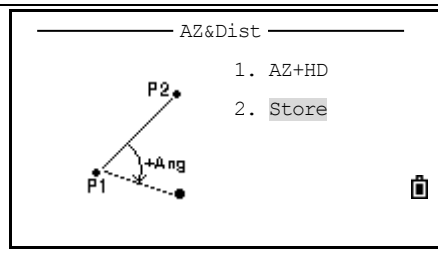
11.2.2.1 AZ+HD

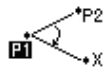
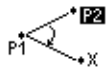
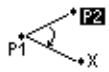
STEP	OPERATION	DISPLAY
a. In Cogo menu press [2] (or [▼] + [ENT]) to enter the AZ&Dist menu.	[2]	

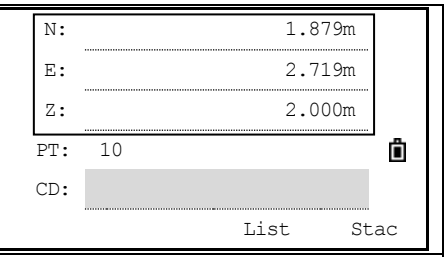
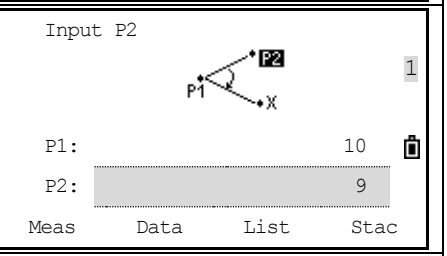
b. In AZ&Dist menu press [1], choosing AZ+HD.	[1]	
c. Input point name of base PT and press [ENT]. About method to input, see "PT-PT" Step e.	Input P1	
d. Input azimuth, horizontal distance (HD) and vertical distance (VD) then press [ENT].	Input HD, dVD	
e. A recording point screen with the calculated coordinates appears. PT defaults to the last recorded PT + 1. Input code and press [ENT] to store the point.		
※1) To input120°35'05", type 120.3505 and [ENT]. If you do not enter a value in the dVD field, the value 0.0000 is used.		

11.2.2.2 Store

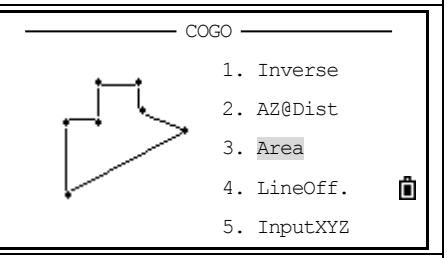
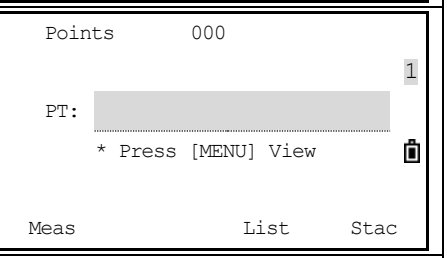
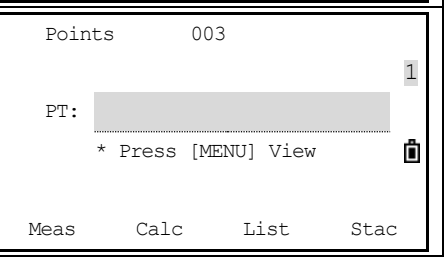
Store function calculates a new point based on the two defined points and angle, horizontal and vertical distances from the line defined by those two points.

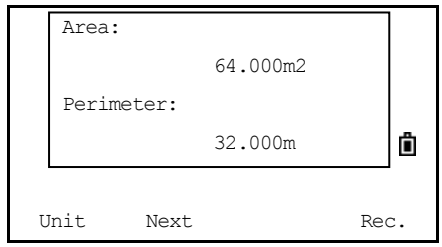
STEP	OPERATION	DISPLAY
a. In AZ&Dist menu press [2] choosing Store.	[2]	

b. Input the point name of P1 and press [ENT]. About method to input, see "PT-PT" Step e.	InputP1	Input P1  1 P1: P2: Meas Data List Stac
c. Input P2 and press [ENT].	Input P2	Input P2  1 P1: 1 P2: Meas Data List Stac
d. Enter the plus-minus angle, horizontal distance, and vertical distance from the baseline defined by P1-P2.If you do not enter a value in the dVD field, the value 0.0000 is used.	Input+AZ, HD, dVD [ENT]	Input+AZ 1 +AZ: HD: dVD:
e. When you press [ENT] in the dVD field, a new point is calculated. The PT name defaults to the last recorded PT + 1. Press [ENT] to record the point.		N: 3.879m E: 2.684m Z: 4.000m PT: 9 CD: List Stac
f. Screen returns to the point input screen. P1 (base PT) defaults to the previously recorded PT. P2 defaults to the previous P1.		Input P2  1 P1: 9 P2: 1 Meas Data List Stac
g. Enter the plus-minus angle, horizontal distance, and vertical distance from the baseline defined by P1-P2, press [ENT].	Input+AZ, HD, dVD [ENT]	Input+AZ 1 +AZ: HD: dVD:

h. A new point is calculated. The PT name defaults to the last recorded PT + 1. Press [ENT] to record the new point.		
i. Screen returns to the point input screen. P1 (base PT) defaults to the previously recorded PT. P2 defaults to the previous P1. This function goes on like this. Press [ESC] to quit the function. ※1)		
※1) To continuously calculate a new point, enter +Ang, HD, and dVD from the previous bearing line. This is a convenient way to enter Store points.		

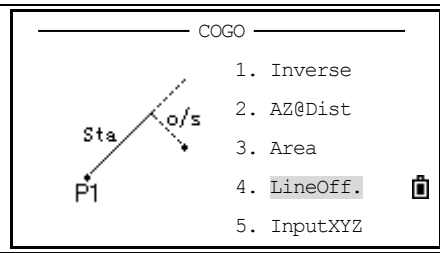
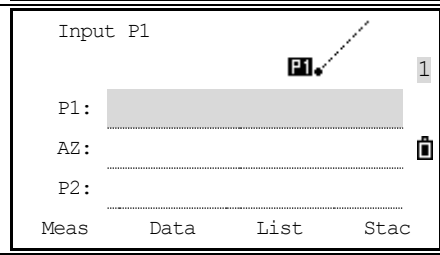
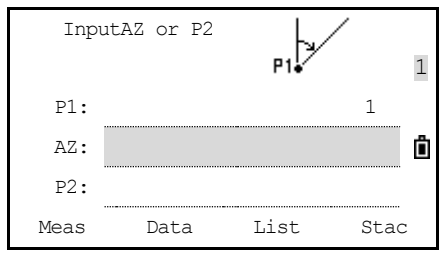
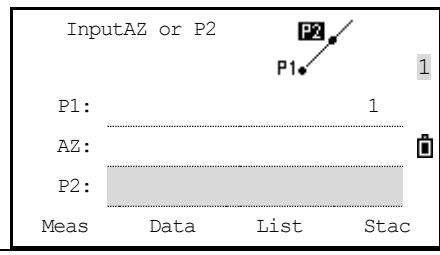
11.2.3 Calculate Area

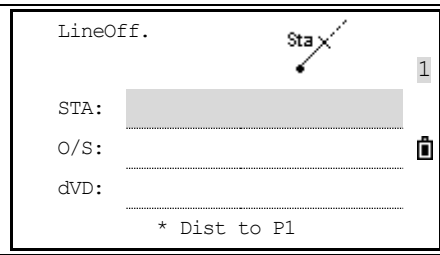
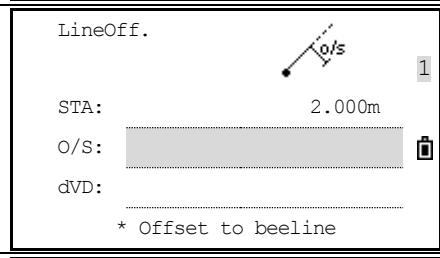
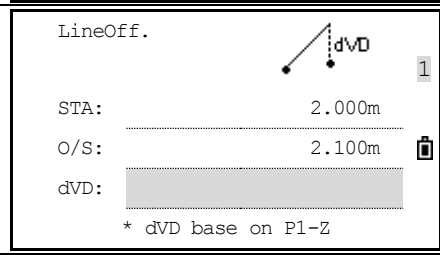
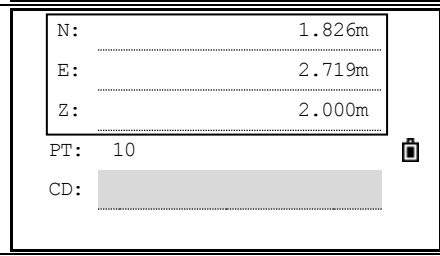
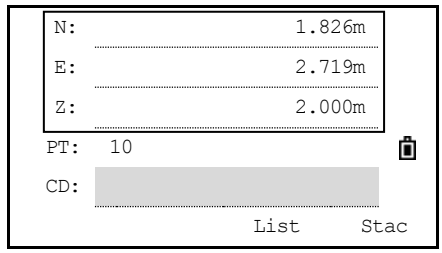
STEP	OPERATION	DISPLAY
a. In Cogo menu press numeric key [3] (or use [▼] + [ENT]) to enter to Area calculating function.	[3]	
b. Input the first point and press [ENT]. In the upper right corner of the screen, a counter indicates how many points you have entered. About method to input, see "PT-PT" Step 4.	Input the first point [ENT]	
c. Continue to enter points until you have defined all the points in the lot.	Input other points [ENT]	

d. Press [Calc] to calculate the area and perimeter. Press [Unit] to switch the unit of area. Press [Next] to add points to the graph. Press [Rec.] to record the area calculating results. ※1)	[Calc]	
※1) The first and last points that you entered are joined to close the area. You must enter the points in the order in which they define the lot.		

11.2.4 Line and Offset

Calculate coordinates from line and offset.

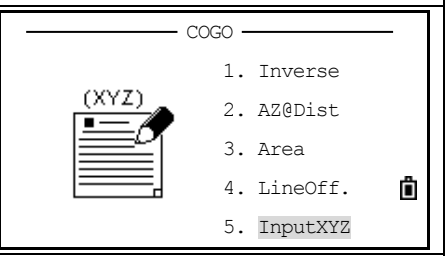
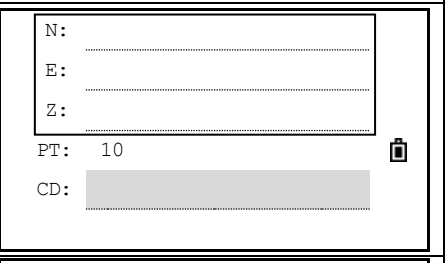
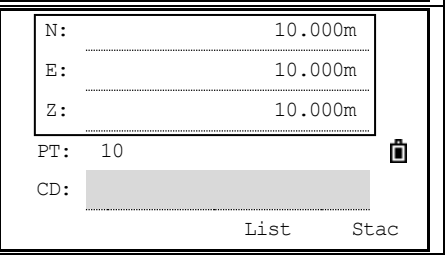
STEP	OPERATION	DISPLAY
a. In Cogo menu press numeric key [4] (or use [▼] + [ENT]) to enter into line and off function.	[4]	
b. Enter the base point (P1). About method to input, see "PT-PT" Step e.	Enter P1	
c. A: Input the AZ bearing. B: Skip AZ item, enter a value in P2 field to specify a azimuth bearing.	InputAZ or P2	A  B 

d. Enter the horizontal distance along the baseline (STA). ※1)	Input STA	
e. Input the horizontal distance perpendicular to the line (O/S). ※2)	Input O/S	
f. Input vertical distance (dVD).	Input dVD	
g. To calculate the coordinates of the point, press [ENT] in the dVD item. You can change the Z coordinate here.		
h. To record the point, press [ENT] in the CD field. The coordinates are stored as a CC record (calculated coordinates). Line definition information and “Sta”, O/S, dVD values are stored in comment (CO) records.	[ENT]	

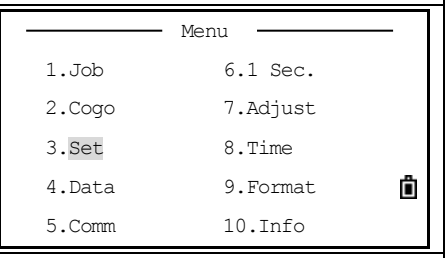
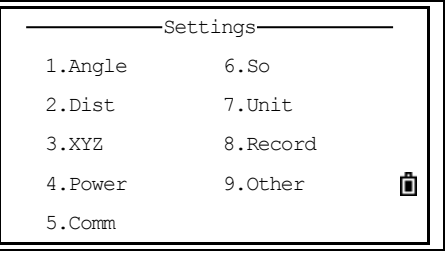
※1) A negative value in the Sta field means the opposite direction along the defined bearing line.

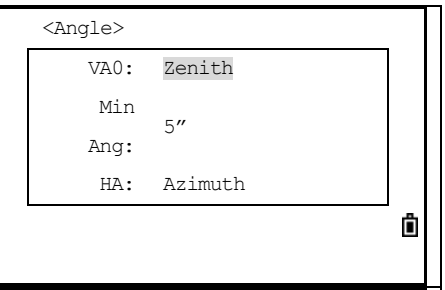
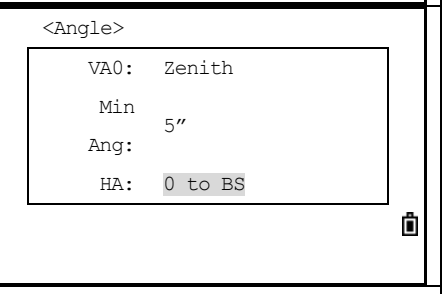
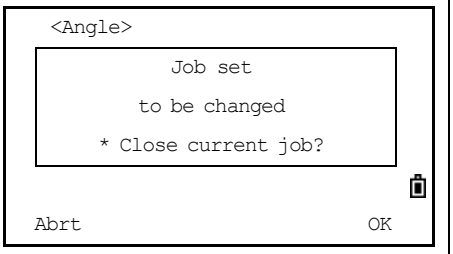
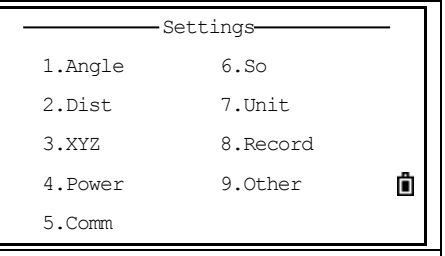
※2) A negative value in the O/S field is for the left-hand side of the bearing line.

11.2.5 Input Coordinates Manually

STEP	OPERATION	DISPLAY
a. In Cogo menu press key [5] (or use [▼] + [ENT]) to manually enter the XYZ coordinates.	[5]	
b. Enter the coordinates using the numeric keys. To move to the next field, press [ENT] or [▼] in a field.	Input coordinates [ENT]	
c. Press [ENT] in Z field to save the point as manually input record. The display returns to the point input screen. The default PT is incremented to the next value.	[ENT]	

11.3 SETTINGS

STEP	OPERATION	DISPLAY
a. In [Menu], press numeric key [3] (or use [▼] + [ENT]) to enter to setting function.	[3]	
b. Use [▲]/[▼] + [ENT] or numeric key to select the item which needs to be set. (Here take angle setting as example.)	[1]	

c. Use [▲]/[▼] to move to items that need to change be changed.	[▲]/[▼]	
d. Press [▶]/[◀] to change the settings, and press [ENT].	[▶]/[◀]	
e. If any of these settings are changed while a job is open, a confirmation screen appears, asking you whether to close the current job. ※1) Press [Abrt] to use the settings in current job and abort the change. Press [OK] to close the job in measure or record function, program will ask whether to select or create a job.		
f. The display returns to Settings menu.		
※1) About the setting of twelve items, see“11.1.2 Creating a New Job”.		

In the following form, the items in ☐ can’t be changed once a job is created.

Item	options
Angle	VA0: Zenith/Vertical/Vert±90
	Min. Ang: 1"/5"/10"
	HA: Azimuth/0 to BS When this field is set to Azimuth, the horizontal angle (HA) that is displayed and recorded is in Azimuth value. When this field is set to 0 to BS, HA is in HA zero to BS value.
	Scale: Numeric value between 0.990000 and 1.010000
	T-P cm: ON/OFF

Dist.	SeaLevel: ON/OFF
	C&R crn: OFF/0.14/0.200 Max Dist: 2000m/5000m (Select max range of laser distance measurement, only for reflectorless total station.)
XYZ	Order: NEZ/ENZ
	Marker: NEZ/XYZ/YXZ
	AZ 0: North/South
Power	Power off: 5 min/10 min/30 min/ OFF
	EDM off: Now/0.1 min/0.5 min /3 min /10 min/ OFF
	Sleep: 1 min/3 min/5 min/OFF
Comm	Mode: Ruide/Setting
	Baud: 1200/2400/4800/9600 /19200/38400/57600/115200
	Data.L: 8/7
	Parity: None/Even/Odd
	Stop: 1/2
SO	Add PT: This field sets the default point number to record observed data in stakeout.
Unit	Angle: DEG/GON/MIL
	Dist: Meter/USA Feet/USA Inch/IntlFeet/IntlInch
	Temp: °C/°F
	Press: hPa/mmHg/inHg
Record	Store DB: RAW+XYZ/RAW/XYZ This setting determines whether raw and/or coordinate data is stored when you record SS, CP, or SO records in the Basic Measurement Screen (BMS) or Stakeout screen.
	REC Data: MEM./COMM Set this item to COM to output data on the COM port. The data is not stored to the job file.
Other	XYZ Dsp: Quick/Normal/Slow/Enter Defines speed to move to the next screen after showing XYZ of the input PT.
	2nd Unit: Meter/USA Feet/USA Inch/IntlFeet/IntlInch/None
	Beep: ON/OFF
	Split ST: ON/OFF You can separate the point numbers of station points from other record type point numbers. If you set the Split ST ON, you can enter single ST number in an additional setting screen. Or you can press [ENT] to use default point name.
	InputCod: ALPH/NUM
	User Information: Enter your information up to 20 characters.

11.4 VIEW RECORDS

You can view data at any time, even in an observation screen or while entering points.

11.4.1 View Raw Data

STEP	OPERATION	DISPLAY
a. In [Menu] press numeric key [4] (or use [▼] + [ENT]) to enter into data function.	[Menu]	Menu 1.Job 6.1 Sec. 2.Cogo 7.Adjust 3.Set 8.Time 4.Data 9.Format 5.Comm 10.Info
b. The data menu displays. Press numeric key [1] choosing the raw data function.	[1]	View/Edit 1. Raw Data 2. XYZ Data 3. ST→SS/SO/CP 4. PT List 5. Cod List
c. The raw data records show in a list. The cursor stays on the last raw data record of current job. Use [▲]/[▼] to choose the records. ※1)	[▲]/[▼]	RAW Data F1,10, F2,10, CP,9,V SS,5 Del Edit Srch
d. To see detailed information for the selected records, press [ENT]. Press [ESC] to return to the record list. ※2),※3)	[ENT]	HA# 47° 25′14″ VA# 94° 56′15″ SD# 3.345m PT: 5 HT: 1.000m Del Edit Dsp [Dsp] N: 10.000m E: 10.000m Z: 10.000m PT: 10 CD: RUIDE Del Edit Dsp

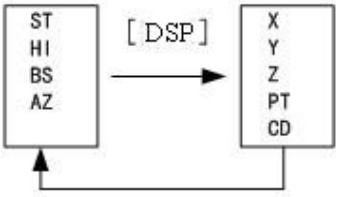
※1)SS：Sideshots (topo shots). All shots from the basic measurement screen are stored as SS records.
CP：Shots taken in the Angle or Repeat menus, or in the basic measurement screen.
F1/F2：Face-1 /Face-2 measurements.
※2) Raw records contain “PT”, “HT”, “CD” and “HA/VA/SD”.
※3) When the Store DB setting is set to RAW+XYZ, press [DSP] to switch between the screens.

When you take more than one measurement to the same point and choose to overwrite the XYZ data,

the old raw record becomes raw data only. As a result, only one SS (RAW) record keeps its corresponding SS (XYZ) record. Other SS (RAW) records to the same point no longer have coordinates available.

11.4.1.1 ST Records

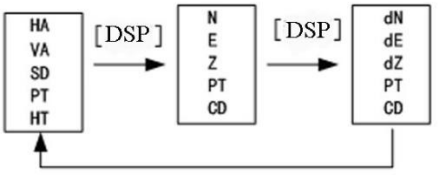
ST (station) records contain "ST", "HT", "BS" and "AZ". Press [Dsp] to view XYZ coordinates.



When you assign a new ST point name in Stn Setup > QuickStn, the coordinates of the station is recorded as (0, 0, 0).

11.4.1.2 SO Records

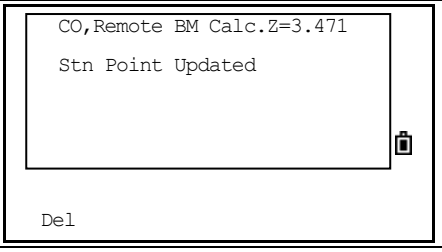
SO： Stakeout shots. These are shots recorded in stakeout functions. Press [DSP] to switch between the screens.



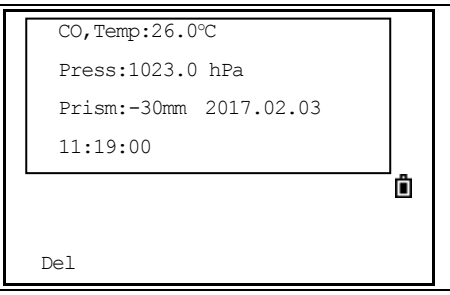
dN/dE/dZ store the difference between the stakeout shot's actual position and its planned position.

11.4.1.3 CO (code) Records

A CO record is a comment added to the job from the system. For example, when you change the Stn-Z using the Z Coord function, or you reset the horizontal angle using the BSCheck function, the system writes a comment record.



As the left graph shows:
Recorded by comment in Z-Coord function.

	Record of temp, pressure and prism constant (SY record), which are saved when you finish station setup.

11.4.2 Delete Raw Records

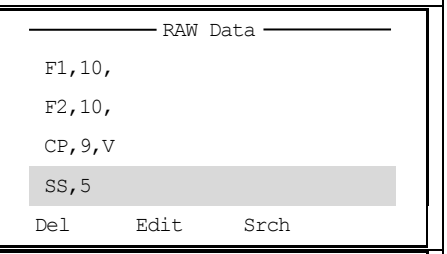
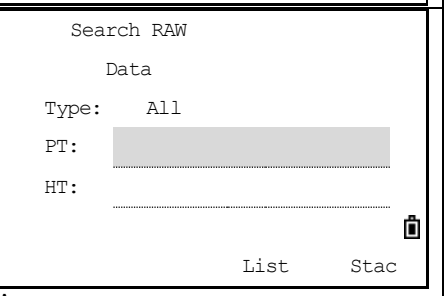
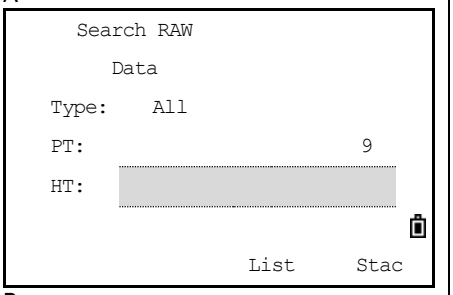
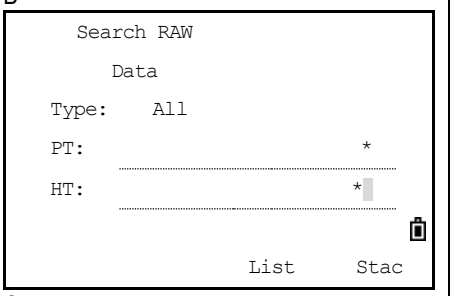
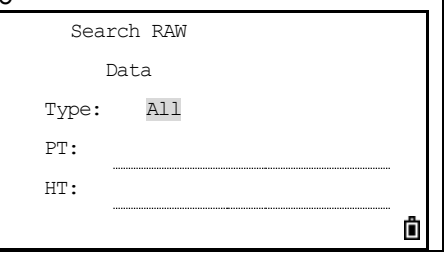
STEP	OPERATION	DISPLAY
a. In the RAW Data screen, use [▲]/[▼] to highlight the record that you want to delete. (Or in data screen which appears after pressing [ENT].) Press [Del].	[▲]/[▼] + [Del]	RAW Data F1,10, F2,10, CP,9,V SS,5 Del Edit Srch Press [ENT]: HA: 47° 25′14″ VA: 94° 56′15″ SD: 3.345m PT: 5 HT: 1.000m Del Edit Dsp
b. To delete data, press [OK] or [ENT]. Not to delete, press [CE].	[OK] or [ENT]	Delete RAW Data SS,5, * Sure? CE OK
c. The system executes the selected operation, and returns to RAW Data screen.		RAW Data F1,10, F2,10, CP,9,V Del Edit Srch

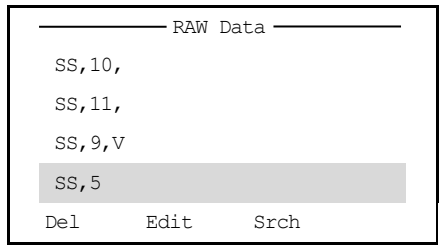
11.4.3 Edit Raw Records

STEP	OPERATION	DISPLAY
a. In RAW Data screen use [▲]/[▼] to highlight the record that you want to edit. (Or in data screen which appears after pressing [ENT].) Press [Edit].	[▲]/[▼] + [Edit]	RAW Data F1,10, F2,10, CP,9,V SS,5 Del Edit Srch Press [ENT]: HA: 47° 25'14" VA: 94° 56'15" SD: 3.345m PT: 5 HT: 1.000m Del Edit Dsp
b. Input the new data manually, or select data from [List] or [Stac], and then press [ENT].	Input new data [ENT]	PT: HT: CD: * Amend & Press [ENT] List Stac
c. To rewrite the data, press [OK] or [ENT]. Otherwise press [CE].	[OK] or [ENT]	Edit RAW SS,5, * Rewirte? CE OK
d. Program executes the selected operation, and returns to RAW Data screen.		RAW Data F1,10, F2,10, CP,9,V SS,5,RUIDE Del Edit Srch

11.4.4 Search Raw Records

In the RAW Data screen, press Srch to access the raw data search function.

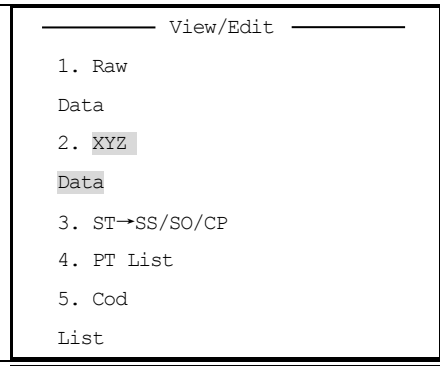
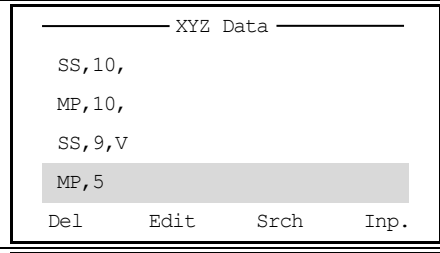
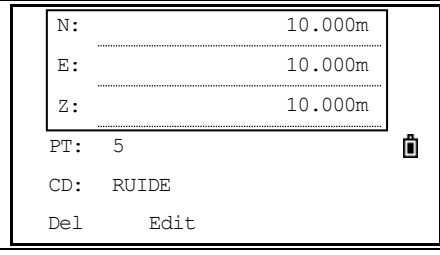
STEP	OPERATION	DISPLAY
a. In RAW Data screen, press [Srch].	[Srch]	
b. Input the search criteria. A: To find a point by name, enter the name in the PT field and press [ENT] twice. B: You can use the wildcard (*) in PT or CD field, for example: Input 30*， you can find 300、301, 302, 3000A, 3010, etc. C: To search by point type, press [▲] to move to the Type field and use [<] or [>] to change the selected point (All/ST/SS/SO/CP/CO/MLM). ※1)		 A  B  C 

c. Detailed data for the selected record appears. Press [ESC] to return to the list. Press [Dsp] to change the fields shown. ※2), ※3)		
※1) If you select a type in the Type item, you do not have to enter a value in the CD item. Press [ENT] in the PT item to start the search. ※2) If more than one point matches the search criteria, the matching points are displayed in a list. Use [▲]/ [▼] to highlight the point you want to use. Then press [ENT] to select it. ※3) If no point matches the specified criteria, "PT Not Exist" displays. Press any key to return to the data screen.		

11.4.5 View Coordinates Data

In Data menu press [2: XYZ Data], then coordinate data is displayed in a list, with the newest record at the bottom of the screen. Use [▲]/[▼] to scroll through the records. (Use [◀]/[▶] to move up or down one page), press [ENT] to see more detailed information.

The header (XYZ, YXZ, NEZ or ENZ) depends on the Coord.

STEP	OPERATION	DISPLAY
a. In Data menu press numeric key [2], choosing XYZ Data.	[2]	
b. The XYZ data list is open. The cursor stays on the last coordinate record of current job. Use [▲]/[▼] to scroll through the records. ※1), ※2)	[▲]/[▼]	
c. After selecting the XYZ Data you want to view, press [ENT] to see more detailed information. Press [ESC] to return to the list. ※3)	[ENT]	

※1)UP：uploaded point coordinates

MP：manually input point coordinates

CC：points calculated in Cogo

RE：Points calculated in Resection.

SS：Sideshots, All shots from the basic measurement screen are stored as SS records.

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

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

11.4.6 Delet Coordinate Records

STEP	OPERATION	DISPLAY
a. In XYZ Data screen, use [▲]/[▼] to highlight the record that you want to delete. (Or in data screen which appears after pressing [ENT]), press [Del].	[▲]/[▼] [Del]	XYZ Data SS,10, MP,10, SS,9,V MP,5 Del Edit Srch Inp. Press [ENT]: HA: 47° 25′14″ VA: 94° 56′15″ SD: 3.345m PT: 5 HT: 1.000m Del Edit Dsp
b. To delete data, press [OK] or [ENT]. Not to delete, press [CE].	[OK] or [ENT]	Delete XYZ SS,5, * Sure? CE OK
c. The system executes the selected operation, and returns to XYZ Data screen.		XYZ Data SS,10, MP,10, SS,9,V Del Edit Srch Inp.

11.4.7 Edit Coordinate Data

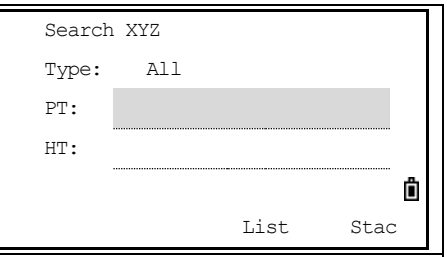
STEP	OPERATION	DISPLAY
a. In XYZ Data screen, use [▲]/[▼] to highlight the record that you want to edit. (Or in data screen which appears after pressing [ENT]), press [Edit].	[▲]/[▼] + [ENT]	XYZ Data SS,10, MP,10, SS,9,V MP,5 Del Edit Srch Inp. Press [ENT]: HA: 47° 25′14″ VA: 94° 56′15″ SD: 3.345m PT: 5 HT: 1.000m Del Edit Dsp
b. You can edit PT, CD and coordinate data. Input the new data manually, and press [ENT].	Input new data [ENT]	N: 10.000m E: 10.000m Z: 10.000m PT: 5 CD:
c. After editing data, press [ENT] in CD field, the program displays as the right graph. To rewrite the data, press [OK] or [ENT]. Otherwise press [CE].※1)	[ENT]	Edit XYZ MP,5, * Rewrite? CE OK
※1) You cannot edit the coordinate records of the current station. ※2) You can't edit the coordinate record from measurement (SS record).		

11.4.8 Search Coordinate Records

Press [Srch] to access the XYZ data search function.

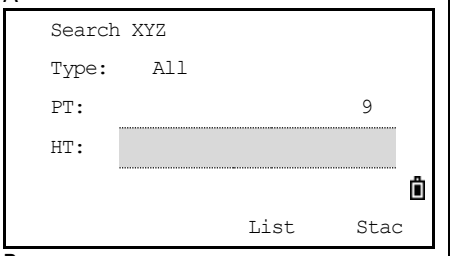
STEP	OPERATION	DISPLAY
a. In XYZ Data screen, Press [Srch].	[Srch]	XYZ Data SS,10, MP,10, SS,9,V MP,5 Del Edit Srch Inp.

b.
Input the search criteria.



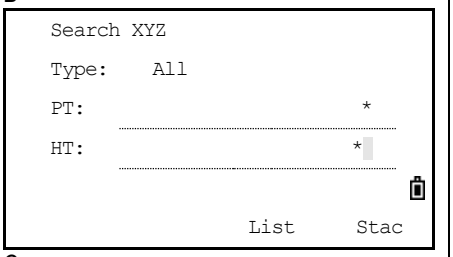
A:
To find a point by name, enter the name in the PT field and press [ENT] twice.

A



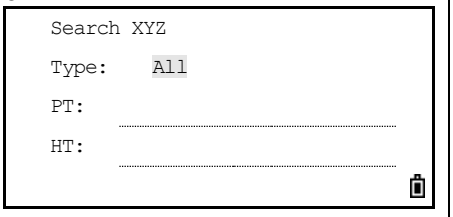
B:
You can use the wildcard. (*) in PT or CD field, for example: Input 30*, you can find 300, 301, 302, 3000A, 3010, etc.

B

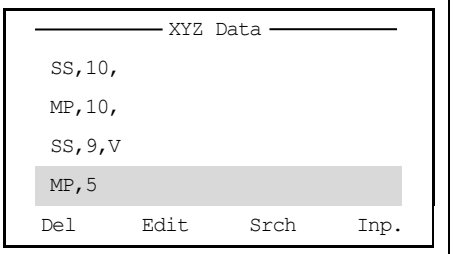


C:
To search by point type, press [▲] to move to the Type field and use [<] or [>] to change the selected point (All/MP/UP/CC/RE).

C

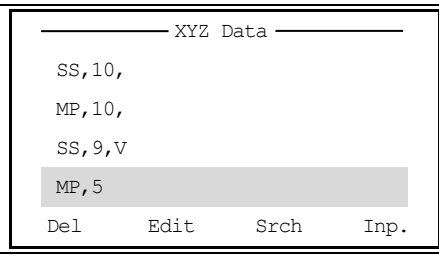
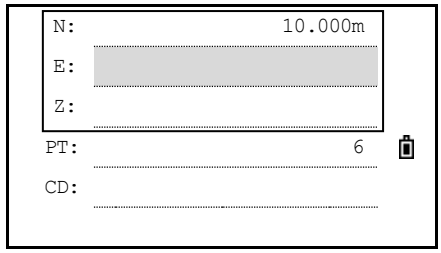
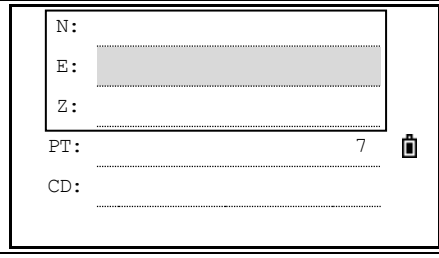


c.
If more than one point matches the search criteria, the matching points are displayed in a list. Use [^] or [v] to highlight the point you want to use.
Press [ENT] to select it.
Detailed data for the selected record appears. Press [ESC] to return to the list.

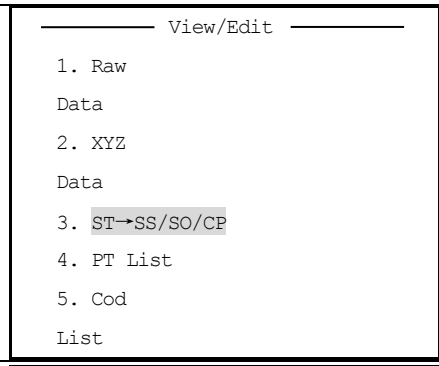
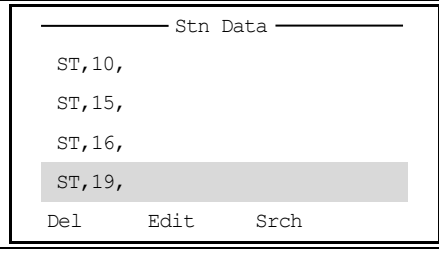


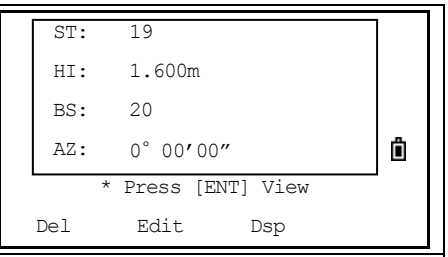
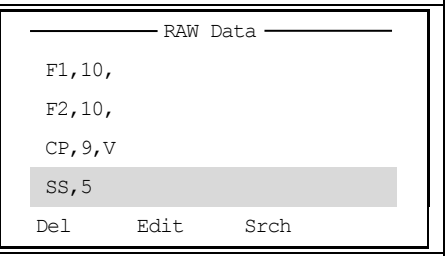
※1) If no point matches the specified criteria, an error screen appears.

11.4.9 Enter Coordinates

STEP	OPERATION	DISPLAY
a. In XYZ Data menu, press [Input].	[Input]	
b. A new input point screen. Displays. The PT field defaults to the last recorded PT + 1, but you can change the value shown. Enter the coordinates and the PT and CD and then press [ENT]. When you press [ENT] in the CD field, the point is stored as an MP record.	Input new data + [ENT]	
c. After you have recording a point, the next point input screen is shown with the updated default You can record NE, NEZ, or Z data to the database.		

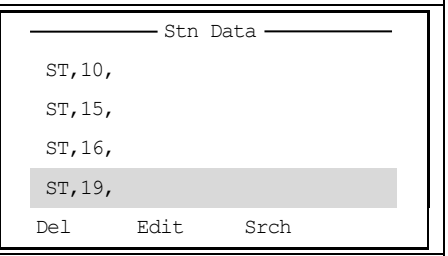
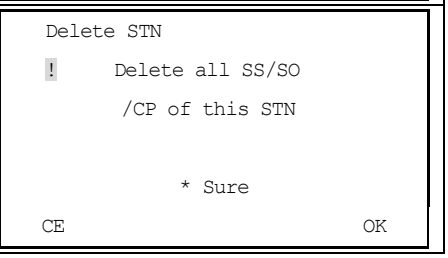
11.4.10 ViewRecords by Station

STEP	OPERATION	DISPLAY
a. In Data menu press numeric key [3] to select ST→SS/SO/CP.	[3]	
b. Station Data list shows. Use [▲]/[▼] to scroll through the records.	[▲]/[▼]	

c. After selecting the Data you want to view, press [ENT] see more detailed information. Press [ESC] to return to the list.	[ENT]	
d. Press [ENT] again display all the observation data from the selected station. ※1)	[ENT]	
※1) For detailed information about each point type and format, see "11.4.1 Viewing Raw Data".		

11.4.11 Delete Station Records

When you delete a ST record, all the observation data from the station is also deleted.

STEP	OPERATION	DISPLAY
a. In Stn Data list, use [▲]/[▼] to highlight the record that you want to delete. (Or in data screen which appears after pressing [ENT]), press [Del].	[▲]/[▼] + [Del]	
b. To delete data, press [OK] or [ENT]. Not to delete, press [CE].	[OK] or [ENT]	
c. If you press [ENT]，a confirming dialog box appears. To delete all data of this station, press [OK] or [ENT]. Not to delete, press [CE].	[OK] or [ENT]	

11.4.12 Edit Station Records

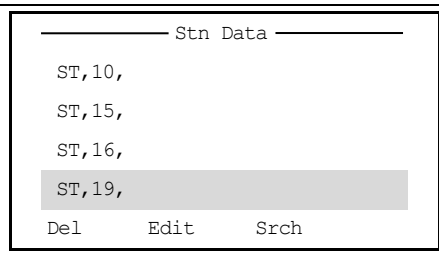
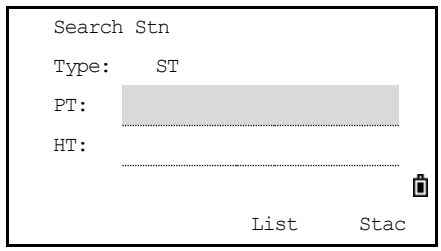
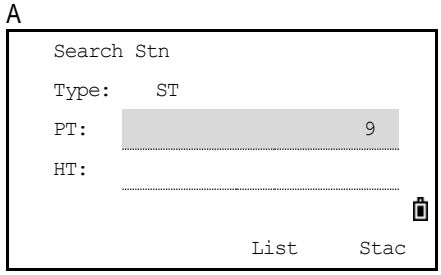
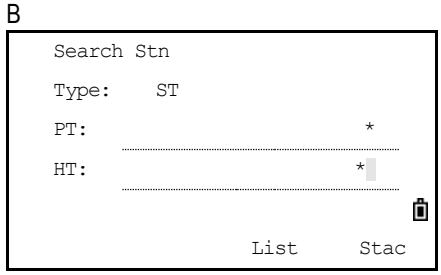
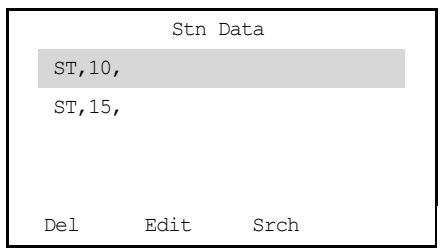
The system will not recalculate the measurements if you change the station record.

STEP	OPERATION	DISPLAY
a. In Stn Data list, use [▲]/[▼] to highlight the record that you want to edit. (Or in data screen which appears after pressing [ENT].) Press [Edit].	[▲]/[▼] [Edit]	Stn Data ST,10, ST,15, ST,16, ST,19, Del Edit Srch Press[ENT]: ST: 19 HI: 1.600m BS: 20 AZ: 0° 00′00″ * Press [ENT] View Del Edit Dsp
b. Program displays as the right graph. Input the new data manually, or select data from [List] or [Stac], and then press [ENT]. ※1)	Input new data [ENT]	ST: 19 HI: 1.600m BS: 20 AZ: 0° 00′00″ * Amend & Press [ENT] List Stac
c. To rewrite the data, press [OK] or [ENT]. Otherwise press [CE].	[OK] or [ENT]	Edit RAW ST,19, * Rewrite? CE OK
d. The system executes the selected operation, and returns to RAW Data screen.		Stn Data ST,10, ST,15, ST,16, ST,19, Del Edit Srch
※1) You can't edit the current station.		

●If you change the station or instrument height (HT) values, the coordinates of observation points are not recalculated.

●If you change the BS or AZ values, raw records are not recalculated.

11.4.13 Search Station Records

STEP	OPERATION	DISPLAY
a. In Stn Data list, press [Srch].	[Srch]	
b. Input the search criteria. A: To find a point by name, enter the name in the PT field and press [ENT] twice. B: You can use the wildcard. (*) in PT or CD field, for example: Input 30*, you can find 300, 301, 302, 3000A, 3010, etc.		 A  B 
c. If more than one point matches the search criteria, the matching points are displayed in a list. Use [^] or [v] to highlight the point you want to use. Press [ENT] to select it. Detailed data for the selected record appears. Press [ESC] to return to the list.		
※1) If no point matches the specified criteria, an error screen appears.		

11.4.14 Point Name List and Code List

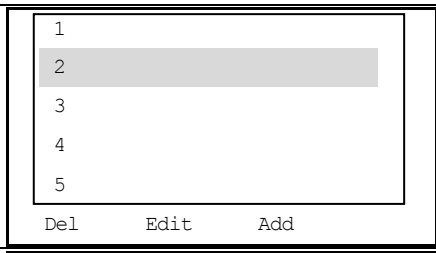
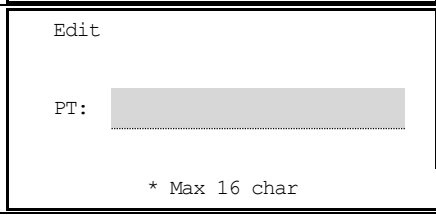
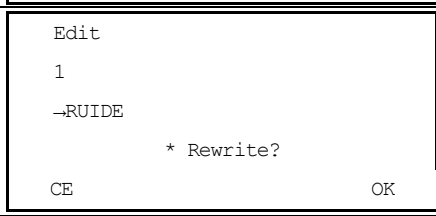
The instrument stores two list files: a list of PT names and a list of CD names. The structure and

functionality of these files is the same，i.e. Delete, Edit, Add points/codes and layer.
The PT name list is useful if you have to handle more than one pattern of point names. For example, you may need to use points named PT=1, 2, 3 as well as PT=C1, C2, C3
The code list is a list of feature codes. You can use it to store your own codes.

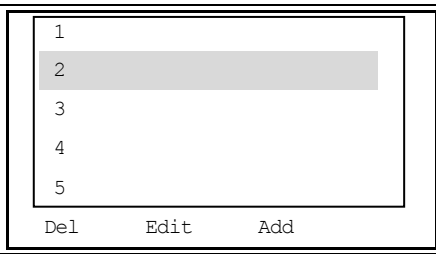
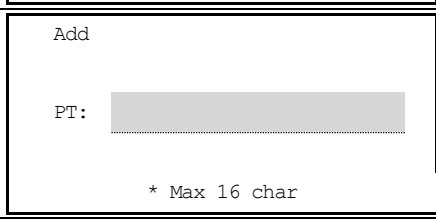
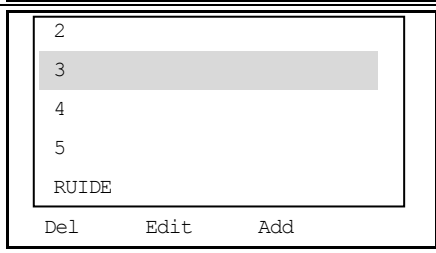
11.4.14.1 Delete Points/Codes

STEP	OPERATION	DISPLAY
a. In Data menu, press numeric key [4] to open PT list.	[4]	View/Edit 1. Raw Data 2. XYZ Data 3. ST→SS/SO/CP 4. PT List 5. Cod List
b. The point list is shown. Use 3 softkeys to customize the list.		1 2 3 4 5 Del Edit Add
c. In PT List use [▲]/[▼] to select the points/ codes you want to delete, and press [Del].	[▲]/[▼] [ENT]	1 2 3 4 5 Del Edit Add
d. A confirmation screen appears. Press [ENT] or [OK] to delete the item. Press [CE] to cancel the deletion.	[OK] Or [ENT]	Delete PT: 1 * Sure? CE OK

11.4.14.2 Edit Points/Codes

STEP	OPERATION	DISPLAY
a. In the PT List use [▲]/[▼] to select the points/ codes you want to edit, and press [Edit].	[▲]/[▼] [Edit]	
b. Input new point name/code, and press [ENT].	Input PT/Code [ENT]	
c. A confirmation screen appears. Press [ENT] or [OK] to accept the changes and update the list. Press [CE] to cancel editing.	[ENT] or [OK]	

11.4.14.3 Add a Point Name

STEP	OPERATION	DISPLAY
a. In the point list, press [Add].	[Add]	
b. Input the PT name, press [ENT].	Input point name [ENT]	
c. The added point appears in the point list. ※1)		
※1) You can store up to 256 points.		

11.4.14.4 Add a Code

STEP	OPERATION	DISPLAY
a. In the Code List press [Add].	[Add]	FANGJIAN LUDING XIEPO GONGLU Del Edit Add
b. Enter the serial number in the CD field. Input code content in Rec field. If you leave the REC field blank, the CD value is stored. After inputting, press [ENT]. ※1), ※2)	Input CD and content [ENT]	Add CD: 105 1 Rec: RUIDE * REC=text rec (If code not match)
c. The added code appears in the code list. ※3)		FANGJIAN LUDING XIEPO GONGLU 105 Del Edit Add

※1) The Rec. field is optional, when you need to save a corresponding code to every serial number, you can input the code content in this field. For example if you input"12" in "CD" field, and input "RUIDE" in "Rec", it means you input RUIDE as a code, with the serial number 12.In Quick Code function you can input serial number (CD) to call up code.

※2) To save the code same as the one in the CD field, leave the Rec field blank and press [ENT].

※3) You can store up to 256 codes.

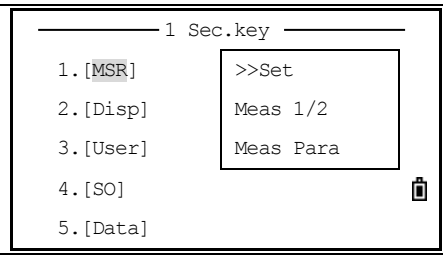
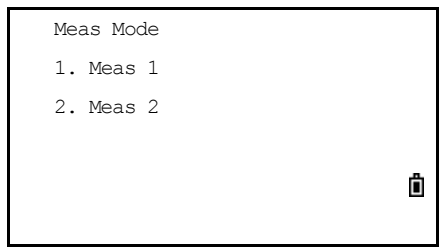
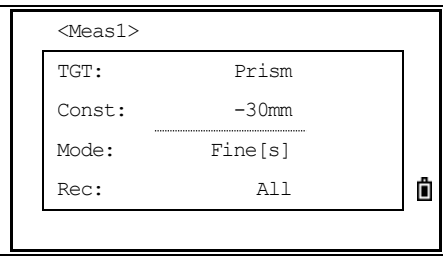
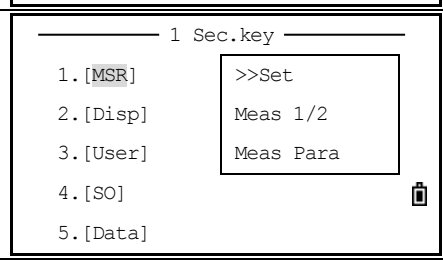
11.5 1 SEC-KEYS

1 Sec.Keys are the functions that when you hold down a certain key for 1 second, the setting of this key will be activated.

In the menu, press [6] to enter into the setting of [MSR], [Disp], [User], [SO] and [Data] keys.

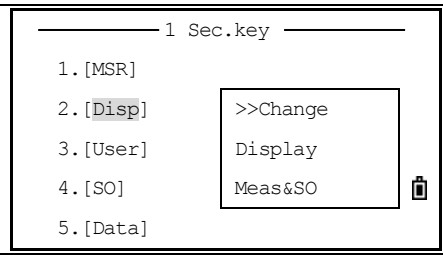
11.5.1 [Meas] Key Setting

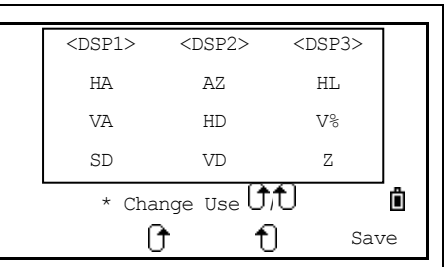
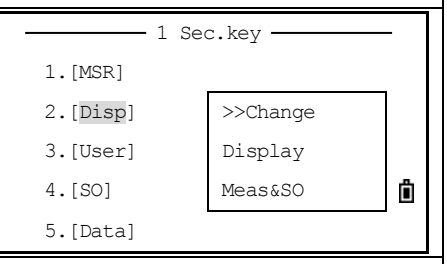
STEP	OPERATION	DISPLAY
a. In [Menu], press numeric key [6](or use [▼]+[ENT]) to enter into 1 Sec. key setting.	[6]	Menu 1.Job 6.1 Sec. 2.Cogo 7.Adjust 3.Set 8.Time 4.Data 9.Format 5.Comm 10.Info

b. In 1Sec.Key menu, press [1] to enter [MSR] setting.	[1]	
c. There are two [MSR] keys, corresponding to [MSR1] and [MSR2] keys under the screen. Each key has its own setting, select the MSR keys which need to set meas mode. Then press [ENT] (or press numeric key [1] or [2] directly.)	[1] or [2]	
d. Each [MSR] key has 4 settings. In the "Const" item, use numeric keys to input values. In the other items, use [▶]/[◀] to change the settings. ※1)	[▶]/[◀] + [▲]/[▼]	
e. After setting, press [ENT] to return to 1 Sec.Key menu.	[ENT]	
※1) You can also access the settings screen by holding down [MSR1] or [MSR2] for one second.		

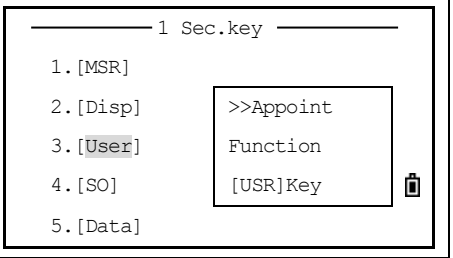
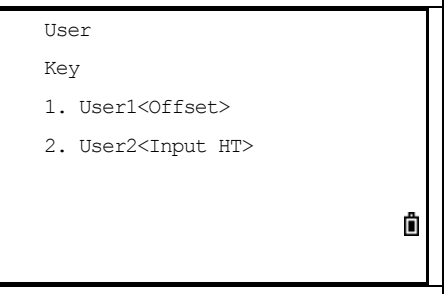
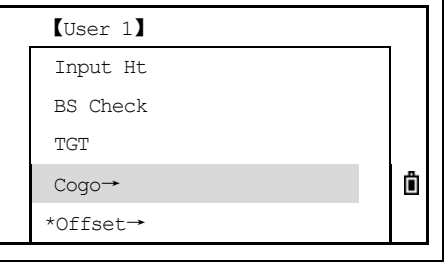
11.5.2 [DISP] Key Settings

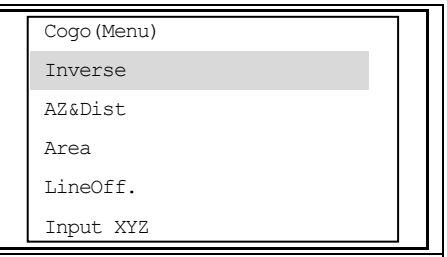
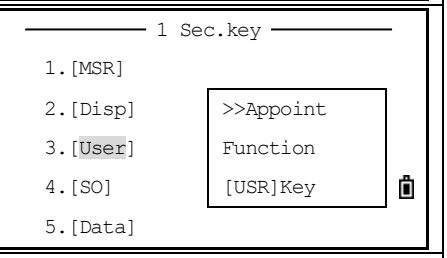
To change the display items in the basic measurement screen, and in SO observation screen, press [2. Disp] in the 1Sec. key menu.

STEP	OPERATION	DISPLAY
a. In 1 Sec. key menu, press [2] to enter to [Disp] setting.	[2]	

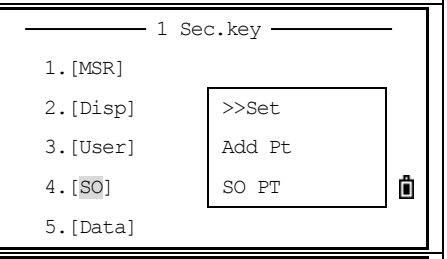
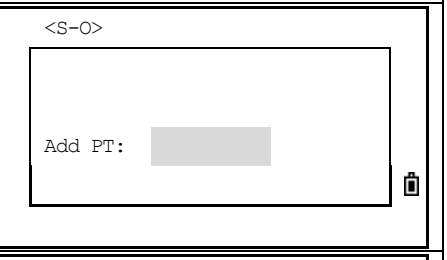
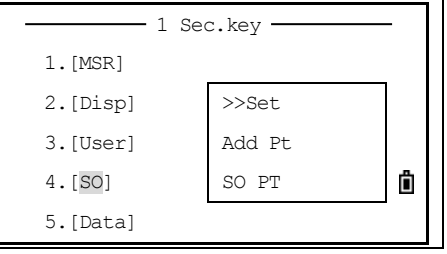
b. To move the cursor, use [▶]/[◀], [▲]/[▼]. To change the display item, press softkey. Press [ENT] or [Save] to save the changes. ※1)	[▶]/[◀] or [▲]/[▼] [ENT]	
c. The sceen returns to 1Sec.key menu.		
※1) You can also access the Disp settings screen by holding down [DSP] for one second.		

11.5.3 [User] Key Settings

STEP	OPERATION	DISPLAY
a. In 1 Sec. Key menu, press [3] to enter to [User] setting.	[3]	
b. There are two [USR] keys. The function that is assigned to each key is displayed beside the key name. Press [1] to enter to [User1] setting. (Here take User1 as example.) ※1)	[1] or [2]	
c. Use [▲]/[▼] to select the expecting function, and then press [ENT].※2) If an item on the list has an arrow "→" beside, and if you select this item, the whole menu is assigned to the [USR] key.	[▲]/[▼] [ENT]	

d. To assign a specific function from the sub-menu, press [▲]/[▼] to highlight the function. Then press [ENT].		
e. After setting, press [ENT] to return to 1Sec.Key menu.	[ENT]	
※1) You can also access the User settings screen by holding down [USR] for one second. ※2) The asterisk (*) indicates the function that is currently assigned to the key.		

11.5.4 [SO] Key Settings

STEP	OPERATION	DISPLAY
a. In 1 Sec. Key menu, press [4] to enter to [SO] setting.	[4]	
b. Input added value of Stake-out point and press [ENT].	Input added value of PT [ENT]	
c. The display returns to 1Sec.Key menu.		

11.5.5 [Data] Key Settings

STEP	OPERATION	DISPLAY
a. In 1 Sec. Key menu, press [5] to enter into [Data] setting.	[5]	1 Sec.key 1.[MSR] 2.[Disp] 3.[User] 4.[SO] 5.[Data] >>Set Data Type [DAT]Key
b. The asterisk (*) indicates the currently selected view format.		【Data type】 * 1. Raw Data 2. XYZ Data 3. ST→SS/SO/CP
c. To move the cursor, use [▲]/[▼] and then [ENT] to confirm. Press [Data] again, the set Data type will display.	[▲]/[▼] [ENT]	【Data type】 1. Raw Data * 2. XYZ Data 3. ST→SS/SO/CP
d. The display returns to 1Sec.Key menu.		1 Sec.key 1.[MSR] 2.[Disp] 3.[User] 4.[SO] 5.[Data] >>Set Data Type [DAT]Key

11.6 DATE AND TIME

<Date>
Date: 2017.03.21
Time: 15:25:05
* yy.mm.dd

In [Menu], select [8. Time] to enter to setting the Date & Time screen.

Date

Enter the date in Year-Month-Day format.

For example, to change the date to Jan. 2, 2007, input:

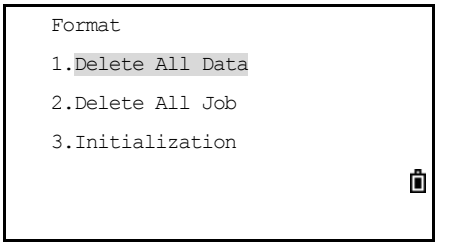
2007 [0] 0102 [ENT].

To move to the Time item, press [ENT] in the Date item.

Time

Enter the time in 24-hour format. The inputting method is same as inputting Date.
Press [ESC] to cancel the input.

11.7 FORMAT



Delete All Datas: Delete all data in the memory, with the jobs and job settings unchanged.
Delete All Job: Delete all files in the memory.
Initialization: Delete all data and files, and return to initial setting.

11.8 INFORMATION

Information of instrument type, number and version are displayed.

Type:

R2 (for instance)

Number

Serial number of the plant.

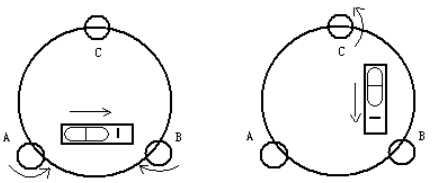
Ver.

On-board software version may differs from time to time.
HVer: version of the angle measurement system
SVer: verison of the distane measurement system

12. 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.

12.1 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.

12.2 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.

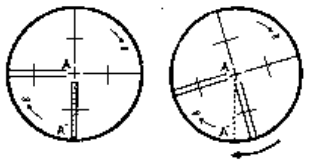
12.3 INCLINATION OF RETICLE

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

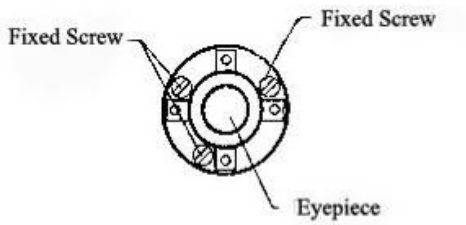
vertical line.

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.



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

Check

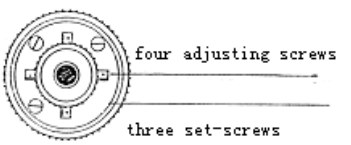
1. Set object A at about 100 meters away the same height as the instrument, and make the vertical angle with ±3°. Then level and center the instrument and turn on the power
2. Sight object A in FaceI and read the horizontal angle value. (e.g.: Horizontal angle L=10°13'10").
3. Loosen the vertical and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

STEP	OPERATION	DISPLAY
a. After leveling the instrument, press [MENU] to enter into the menu, press [7] (or [▼] + [ENT]) to enter Adjustments.	[MENU] [7]	Menu 1.Job 6.1 Sec. 2.Cogo 7.Adjust 3.Set 8.Time 4.Data 9.Format 5.Comm 10.Info

b. In Adjustment press “2. Collimation”.	[2]	Adjustments 1.VO Adjustments 2.Collimation 3.Inst.Constant 4.VADJ Set
c. In Face I precisely collimate the target, and press [OK].	Collimate the target [OK]	Collimation HA# 24° 15′00″ OK
d. The System indicates “Turn to F2”. Rotate the telescope, and collimate the same target precisely in Face, press [OK].	Sight the target in reverse position [OK]	Collimation HA# 204° 15′22″ OK
e. After setting, the screen displays “set”, and returns to Adjustment menu automatically.		Adjustments 1.VO Adjustments 2.Collimation 3.Inst.Constant 4.VADJ Set



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.

12.5 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.

12.6 ADJUSTMENT OF VERTICAL INDEX DIFFERENCE (I ANGLE) & SETTING VERTICAL INDEX O

Inspect the item after finishing the inspection and adjustment of items in 12.3 and 12.5.

Check

1. Power on after leveling the instrument. Collimate object A in Face I and read the Vertical angle value L.
2. Rotate the telescope. Sight object B in Face Ⅱ and read the Vertical angle value R.
3. If the vertical angle is 0° in zenith，i=(L+R-360°)/2

If the vertical angle is 0 ° in horizon. i= (L+R-180°)/2 or (L+R-540°)/2.

4. If ｜i｜ ≥10" should set the Vertical Angle 0 Datum again.

Adjust

STEP	OPERATION	DISPLAY
a. In Adjustments press "1. V0 Adjustments".	[1]	Adjustments 1.VO Adjustments 2.Collimation 3.Inst.Constant 4.VADJ Set
b. In Face I, precisely collimate target and press [OK].	Collimate the target [OK]	VO Adjustments HA: 0° 00′21″ VA: 94° 25′39″ OK

c. System prompt "Turn to F2". Rotate the telescope, and collimate the same target precisely in Face II. Press [OK].	Collimate the prism in reverse position [OK]	VO Adjustments HA: 00° 00′06″ VA: 265° 34′05″ OK
d. The setting is finished，screen displays "Set", and turns back to Adjustments automatically.		

Note:

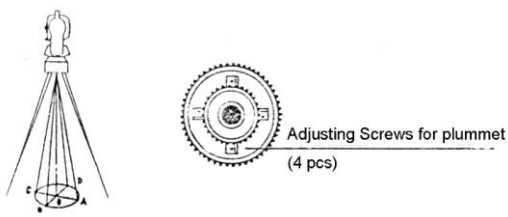
1. Repeat the checking steps to measure the Index Difference (i angle). If the Index Difference cannot meet the requirement, user should check whether the three steps of the adjustment and the collimation are right. Then set again according to the requirement.
2. If Index Difference still not meets the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

12.7 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.

12.8 INSTRUMENT CONSTANT (K)

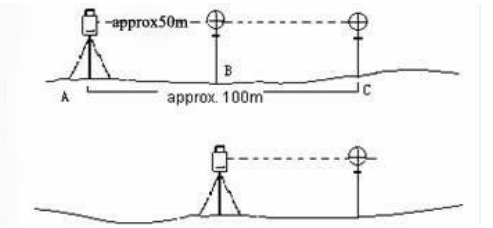
Instrument constant has been checked up and adjusted in the factory, K=0. It seldom changes and it is suggested to check one or two times every year. The inspection should be made on the base line, also can be made according to the following method.

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

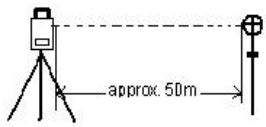
●Whether the prism center of Point B coincides with the Instrument Center is a significant step to inspect the accuracy. So on Point B the tripod or compatible tribrach should be used. It will decrease the difference.

Input Instrument Constant:

STEP	OPERATION	DISPLAY
a. In Adjustments menu press "3. Inst. Constant".	[3]	Adjustments 1.VO Adjustments 2.Collimation 3.Inst.Constant 4.VADJ Set

b. Input the constant, and press [OK] or [Enter]. If not input, press [Abrt].	Input constant + [OK]	Inst.Constant Const: 0.0mm Abrt OK
c. Screen turns back to Adjustments menu.		Adjustments 1.VO Adjustments 2.Collimation 3.Inst.Constant 4.VADJ Set

12.9 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 to Distance Measurement Mode. Press [DIST] (or [All]) to measure. Rotate the Horizontal Tangent Screw and Vertical Tangent Screw to launch electric collimation and make the light path of EDM unblocked. In the bright zone find the center of emitting photoelectric axis.
4. Check the center of reticle to coincide with the center of emitting photoelectric axis. If so, the instrument is proved eligible.

Adjust

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

12.10 TRIBRACH LEVELING SCREW

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

12.11 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.

13. SPECIFICATION

	R2	R2 PRO
TELESCOPE		
Length	154mm	
Objective Lens Diameter	Telescope: 45mm Distance Meter: 50mm	
Magnification	30x	
Image	Erect	
Field of View	1°30'	
Resolving Power	3"	
Mini. Focus	1.0m	
DISTANCE MEASUREMENT		
Single Prism	5000m	
Non-Prism	400m	800m
Accuracy - Prims Mode	±(2mm+2ppm x D)m.s.e.	
Non-Prism	±(3mm+2ppm x D)m.s.e.	
Measuring Time	Fine: 0.7s, Normal: 0.5s	Fine: 0.3s, Normal: 0.2s
Meteorologic Correction	Auto Sensing	
Prism Constant	Manual Input	
ANGLE MEASUREMENT		
Method	Absolute Encoding	
Detecting System	H: 2 sides V: 2sides	
Min. Reading	1"/5"	
Accuracy	2"	
Diameter of Circle	79mm	
Vertical Angle 0°	Zenith: 0°/Horizontal: 0°	
Unit	360°/400gon/6400mil	
DISPLAY		
Display Unit	Graphic LCD 160x90 dots with White Backlight	
No. of Unit	2 sides	
Keyboard	Alphanumeric Keys	
TILT CORRECTION		
Tilt Sensor	Dual Axis	
Method	Liquid Electric	
Range	±4'	
Accuracy	1"	
LEVEL SENSITIVITY		
Plate Level	30"/2mm	
Circular Level	8'/2mm	
OPTICAL PLUMMET (OPTIONAL– INTERNAL LASER PLUMMET)		
Image	Erect	

Magnification	3X
Focusing Range	0.3m ~ ∞
Field of View	5°
DATA STORAGE & INTERFACE	
Internal Memory	>10,000 points or >20,000 coordinates
Data Interface	R232/SD Card/Mini-USB
GENERAL	
Laser Class - EDM	Class IIIA
-Laser Plummet	Class II
Working Temperature	-20°C ~ +50°C
Battery Type	Rechargeable Li-on Battery
Battery Voltage	DC 7.4V
Working Time	16h

14. ERROR CODE LIST

ERROR CODE	DESCRIPTION	SOLUTION
System Error 001	Error in opening the system parameter file	Format. If format is invalidation, the instrument should be sent for repair.
System Error 002	Error in opening files	
System Error 003	Error in initializing files	
System Error 004	Error in writing files	
System Error 005	Error in reading files	
System Error 006	Error in deleting files	
System Error 007	Error in angle board	Change a new board
System Error 034	Upper vertical CCD error	1. Change a good angle board to check whether it works. 2. If no, change this CCD.
System Error 035	Shorter horizontal CCD error	
System Error 036	Longer horizontal CCD error	
System Error 037	Lower vertical CCD error	
System Error 038	Angle error 8	
ERROR36	Problem with internal light path signal	If the signal is 0, change the laser emitter or fiber.
ERROR35	Problem with high voltage and the signal of light intensity	Change the EDM board

【APPENDIX-A】DESIGN ROAD LINE DATA

1. RAW DATA

The format of data transmitted from total station to the PC is as follows:

RUIDE FORMAT: Take RTS item as example

Data Transferred to PC	Explanation
CO,Ruide Raw data	The type of transmitted data
CO,RTS	File name
CO,Description:	JOB description
CO,Client:	
CO,Comments:	
CO,Downloaded 2007-03-02 22:40:59	Download date and time
CO,Software: Pre-install version:07.03.02	Software version number
CO,Instrument: Ruide R2 115101	Serial number of instrument
CO,Dist Units: Metres	Distance unit
CO,Angle Units: DDDMMSS	Angle unit
CO,Zero azimuth: North	AZ Zero azimuth
CO,VA: Zenith	VA Zero azimuth
CO,Coord Order: NEZ	Coordinate order
CO,HA Raw data: HA zero to BS	HA
CO,Projection correction: OFF	Projection correction
CO,C&R correction: ON	C&R correction
CO,Tilt Correction: OFF	Tilt correction
CO,RTS <JOB> Created 2007-03-02 22:37:25	JOB creating time
MP,1,,10.000,10.000,1.000,VM MP,5,,50.000,50.000,5.000,MP	Input coordinate manually，the sequence is: pointID，N/E，E/N，Z，code
CO,Temp:20.0 C Press:1013.2 hPa Prism:-30mm 2007.03.02 22:38:26	Temp, Press, Prism constant, Date, Time
ST,1,,5,,1.600,45.0000,0.0000	Station data, the sequence is: Station pointID, Backsight pointID, height of instrument, azimuth(AZ), horizontal angle (HA)
F1,5,1.800,1.999,176.5958,99.2715, 23:26:28	Result of backsight point F1 orientation, the sequence is: pointID, target height, slope distance, horizontal angle, vertical angle, time
SS,2,1.800,1.088,359.5959,62.4302, 22:38:45,MA	Target point measurement data, the sequence is: PointID, target height, slope distance, HA, VA, code

MP,99,,20.000,3.000,6.000,	
CO,Pt:100 SO deltas N: E: Z:-3.131	
SO,,,1.800,1.089,5.0432,84.5528, 22:40:28,	Data of stake-out, the sequence is: , , , target height, slope distance, HA, VA, time

2. COORDINATES DATA

The format of uploaded/downloaded coordinate data is determined by user's setting. For example: the coordinate format is set as:

PointID, E，N，Z，Code
101,994.890,1000.964,100.113,RUIDE
102,993.936,1007.799,100.800,STN
103,998.515,1009.639,100.426,STN
104,1002.068,1002.568,100.342,STN
1001,1004.729,997.649,100.1153,PT
1002,1003.702,990.838,100.799,PT
1003,7911.990,990.358,100.403,PT
1004,997.311,998.236,100.354,PT

3. CODE LIST

The code list which is put in the code store, should be guaranteed that every line has one code which includes serial number and code, and every line is ended by carriage returns. The format of code list is:

Serial number (quick code number), code

When there is no definition of code, the code is default as the content of serial number. In quick code function, one can transfer code by entering serial number.

For example：

1，VEG
2，BDY
3，CL
4，ROAD
5，ROAD
6，PATH
7，DRAIN
8，CONTROL
9，DRAIN
10，UTILITY

4. HORIZONTAL LINE

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

5. VERTICAL CURVE

Input vertical curve data from 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:

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

1. ROAD ALIGNMENT ELEMENTS

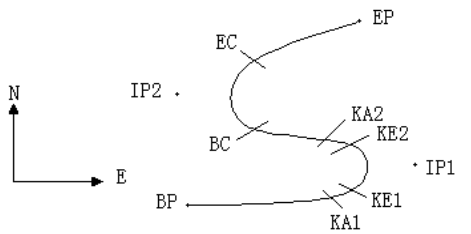
There are two ways to enter the alignment elements:

1) Download from PC.
2) Manually entered on the R2 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:

Stake number 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

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

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

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

$$= 64(1 - \frac{0.01024}{10} + \frac{0.01048576}{216} - \frac{0.0010734182\,4}{9360})$$

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

$$= 64 * 0.98981$$

$$= 63.348$$

Similarly, the value of E is:

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

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

$$= 6.777$$

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

(4) Calculation of shift value ΔR

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

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

$$= 1.700$$

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

(5) Calculation of Spiral Transition coordinates

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

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

(6) Calculation of Tangent Distance

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

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

$D_1 = 100 * \tan(111°55'47"/2) + 1.7(1/\sin 111°55'47") - 1.7(1/\tan 111°55'47") + 31.891$

$=148.06015 + 1.8326 + 0.6844 + 31.891$

$=182.468$

$D_1 = D_2$

(7) Calculation of the coordinate KA1

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

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

Bearing from BP to IP1 $\Rightarrow$ $\alpha_1 = 74°03'16.6"$

$N_{KA1} =$ 1300 –182.468 * cos 74°03'16.6"=1249.872 m

$E_{KA1} =$ 1750 –182.468 * sin 74°03'16.6"=1574.553 m

(8) Calculation of Arc Length

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

$=R(111°55'47"-2 * 18°20'06")$

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

$=131.353$ m

(9) Calculation of the coordinate KA2

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

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

Bearing from IP1 to IP2 $\Rightarrow$ $\alpha_2 = 322°07'30.1"$

$N_{KA2} =$ 1300 –(-182.468) * cos 322°07'30.1"= 1444.032 m

$E_{KA2} =$ 1750 –(-182.468) * sin 322°07'30.1"= 1637.976 m

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

Arc length $CL = R \cdot IA$

IA= 95°52'11"

Then *CL*=200 * 95°52'11"* $\frac{\pi}{180^{\circ}}$ =334.648 m

Tangent length $TL = R \cdot \tan(\frac{IA}{2})$ = 200 * tan(95°52'11"/ 2) =221.615 m

Each coordinates are computed:

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

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

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

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

Here:

α_2 (Bearing from IP1 to IP2) = 322°07'30.1"

α_3 (Bearing from IP2 to EP) = 57°59'40.6"

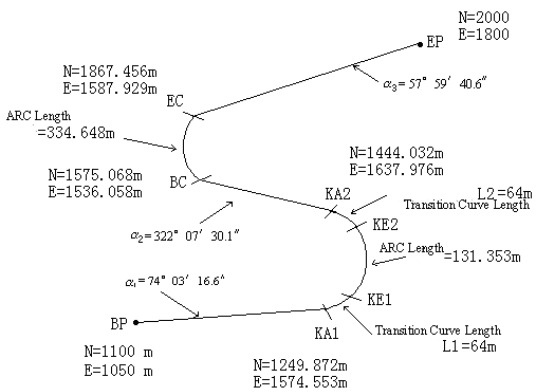
N_{BC} = 1750 - 221.615 * cos322°07'30.1" =1575.068 m

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