CONTENTS

1. PREPARATION

1.1 Precautions

1. Never point the instrument at the sun without a filter.

2. Never store the instrument in extreme temperatures and avoid sudden changes of temperature.

3. When not using the instrument, place it in the case to avoid shock, dust, and humidity.

4. If there is a great difference in temperature between the work site and the instrument storage location, leaving the instrument in the case until it adjusts to the surrounding temperature.

5. Please remove the battery for separate storage if the instrument is to be storage for an extended time. The battery should be charged once a month during storage.

6. The instrument should be placed in its carrying case during transportation. It is recommended that the original packing case be used for cushioning during extended transportation.

7. Be sure to secure the instrument with one hand when mounting or removing from the tripod.

8. Clean exposed optical parts with degreased cotton or lens tissue only.

9. Clean the instrument's surface with a woolen cloth when finished to use it. Dry it immediately if it gets wet.

10. Check the battery, functions, and indications of the instrument as well as its initial setting and correction parameters before operating.

11. Unless you were a maintenance specialist do not attempt to disassemble the instrument for any reason. Unauthorized disassembly of the instrument can result in a void warranty.

12. The total stations emit a laser during operation. DO NOT stare into the beam or laser source when instrument is operated.

1.2 Appearance


Collimator
Focus Ring
Battery
Eyepiece
Horizontal
Tangent Screw
USB Data Port
RS-232 Port
SD Card

1.3 Unpacking and Storage of the Instrument

Unpacking of the Instrument

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

Storage of the Instrument

Replace the cover on the telescope lens, place the instrument into the case with the vertical clamp screw and circular vial upward (objective lens toward the tribrach), tighten the vertical clamp screw, close and lock the case.

1.4 Instrument Set Up

Mount the instrument onto the tripod and secure firmly. Level and center the instrument precisely to ensure the best performance. Use the tripod with a 5/8” tripod screw.

Operation Reference: Leveling and Centering the Instrument

1). Setting up the tripod

First extend the extension legs to suitable length and tighten the screws, firmly plant the tripod in the ground over the point of beginning.

2). Attaching the instrument to the tripod

Secure the instrument carefully on the tripod and slide the instrument by loosening the tripod mounting screw. If the optical plumb site is positioned over the center of the point tighten the mounting screw.

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

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. Turn the leveling screw C to move the bubble to the center of the circular vial. Recheck the position of the instrument over the point and adjust if needed.

4). Leveling by using the plate vial

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

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

Repeat the procedures for each 90 °(100g) rotation of the instrument and check whether the bubble is correctly centered in all directions.

5). Centering by using the optical plummet(or laser plumment)

Adjust the eyepiece of the optical plummet telescope to your eyesight. Slide the instrument by loosening the tripod screw; place the point on the center mark of the optical plummet. Sliding the instrument carefully as to not rotate the axis will allow you to get the least dislocation of the bubble.(Place star-key after power on, then press F4(LASER)key, press F1(ON)key to turn on the laser plumment. Slide the instrument by loosening the tripod screw; Place laser facular on the occupied pointing, Sliding the instrument carefully as to not rotate the axis will allow you to get the least dislocation of the bubble. The last, press ESC key, and laser plummet turn off automatically.)

6). Complete leveling the instrument

Level the instrument precisely as in Step 4. Rotate the instrument and check to see that the bubble is in the center of the plate level regardless of the telescope direction then tighten the tripod screw firmly.

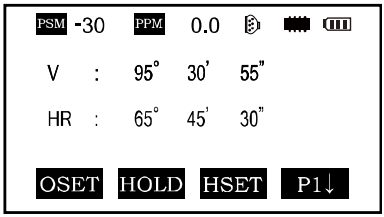
1.5 Battery Removal & Insertion - Information and Recharging

Battery removal & insertion

Insert the battery into the battery slot and push the battery until it clicks.

Press the right and left buttons of the battery compartment to remove the battery.

Battery information



---------- Indicates that battery is fully charged

---------- Indicates that the battery can only be used for about 1 hour.

Recharge the battery or prepare a recharged battery for use.

---------- Recharge the battery or prepare a recharged battery for use.

Note: The working time of the battery is determined by environment conditions, recharging time, and other factors.

Battery Recharging

Battery should be recharged only with the charger supplied with the instrument.

Remove the on-board battery from instrument as instructed and connect to the battery charger.

Battery Removal Caution

▲Before you take the battery out of the instrument, make sure that the power is turned

off. Otherwise the instrument would be damaged.

Recharging Caution:

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

▲Be sure to recharge the battery at a temperature of 0℃～45℃, recharging may be abnormal beyond the specified temperature range.

▲When the indicator lamp does not light after connecting the battery and charger the battery or the charger may be damaged.

Storage Caution:

▲The rechargeable battery can be repeatedly recharged 300-500 times. Complete discharge of the battery may shorten its service life.

▲In order to get the maximum service life be sure to recharge the battery at least once a month.

1.6 Reflector Prisms

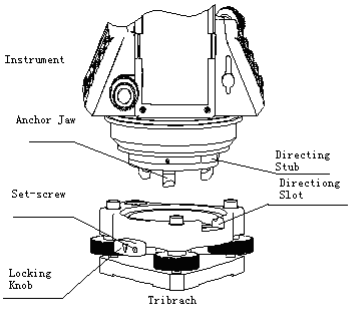
When doing distance measuring in prism mode a reflector prism needs to be placed as the target. Reflector systems can be single or multiple prisms which can be mounted with a tripod/tribrach system or mounted on a prism pole. Unique mini prism systems allow setups at corners that are hard to reach. Reflectorless targets extend the range of the instrument when used in reflectorless mode.

Illustrated are some prisms and a reflector compatible with instruments:

1.7 Mounting and Dismounting the Instrument from the Tribrach

Dismounting

When necessary the instrument can be dismounted from the tribrach. Loosen the tribrach locking screw in the locking knob with a screwdriver if necessary. Turn the locking knob 180 degrees counter-clockwise to disengage anchor jaws and remove the instrument from the tribrach.



Mounting

Insert three anchor jaws into holes in tribrach and line up the directing stub on the instrument with the directing slot of the tribrach. Turn the locking knob 180 degrees clockwise and tighten the locking screw with a screwdriver.

1.8 Eyepiece Adjustment and Object Sighting

Method of Object Sighting (for reference)

1.Sight the telescope to the sky and rotate the eyepiece tube to make the reticule clear.

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

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

If there is parallax when your eye moves up and down or left and right this indicates the diopter of the eyepiece lens or focus is not adjusted well and accuracy will be effected. You should readjust the eyepiece tube carefully to eliminate the parallax.

1.9 Turning the Instrument On and Off

Power on

1. Be sure that the instrument is leveled.
2. Press and momentarily hold the power (POWER) key.
3. Rotate the EDM head in an upwards direction to initialize.
4. To turn OFF press and hold the power key until instrument powers down.

Be sure there is sufficient battery power. If 'Battery Empty' is shown on the display, the battery should be recharged or replaced.

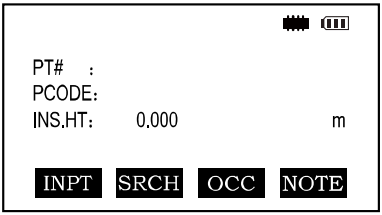
*** DO NOT remove the battery during measuring, otherwise the data will be lost and the instrument would be harmed!! ***

1.10 How To Enter Alphanumeric Characters

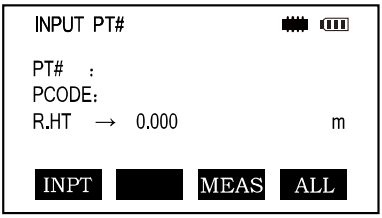
***How to select an item**

[Example 1] Select INS.HT (instrument height) in the data collection mode (first press the MENU button then F1:DATA COLLECT and then select the data file desired. Press F2 to list, the arrow keys to choose and then F4 to select). Press F1 again for OCC.PT# INPUT.

The arrow (→) indicates an item to enter. Press [▲] [▼] key to move the arrow line up or down



Press [▼] move->R..HT



Press F1 INPUT then 1 to input"1"

Press [.] to input ". "

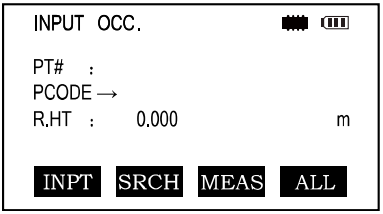
Press [5] to input "5 ", press [ENT]

Then R. HT =1.5 m

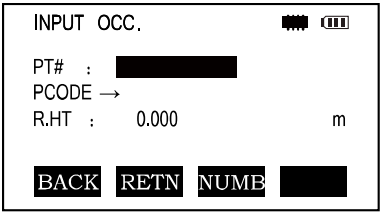
***How to enter characters**

[Example 2] Input the code "ABC1"of instrument point in Data Collection Mode.

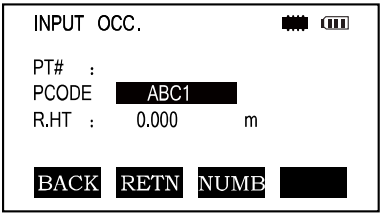
1．Move the arrow to PCODE using the [▲]or [▼]key



2．Press [F1] (input) key



3．Press [F1] key once



Press [7] key once for "A"

Press [7] key twice for "B"

Press [7] key three times for "C"

Press F3 to switch to NUMB Input mode first

Press [1] key once for "1"

Press enter key to finish input

2. FUNCTION KEY AND DISPLAY

2.1 Operating Key

Keys	Names	Function
ANG	Angle meas. key	Angle measurement mode
	Distance meas. key	Distance measurement mode
	Coordinate meas. key	Coordinate measurement mode (▲Up)
S.O	Layout key	Layout measurement mode (▼ Down)
K1	Quick key1	User-defined quick key 1(◀ Left)
K2	Quick key 2	User-defined quick key 2(▶Right)
ESC	Escape key	Return to the measurement mode or previous layer mode.
ENT	Enter key	Press after confirmation of inputting values
M	Menu key	Switches menu mode and normal mode
T	Shift key	Shift distance measuring key

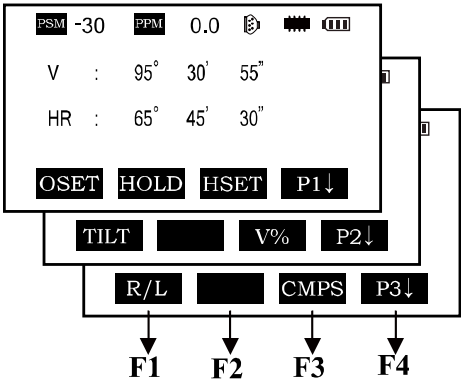
★	Star key	Press once to adjust contrast or twice for illumination of keypad
⏻	Power key	On / Off key press and hold
F1- F4	Soft key (Function key)	Responds to the message displayed
0- 9	Number key	Input numbers
—	Minus key	Input minus sign, displays electronic bubble
.	Point key	On / Off laser pointing function

Display marks：

Display	Content
V	Vertical angle
V%	Vertical angle as a percentage (Gradient display)
HR	Horizontal angle (right)
HL	Horizontal angle (left)
HD	Horizontal distance
VD	Elevation difference
SD	Slope distance
N	North coordinate
E	East coordinate
Z	Z or elevation coordinate
*	EDM working
m/ft	Switches units between meters and feet
m	Meter unit
S/A	Sets temperature, air pressure, prism constant
PSM	Prism constant (unit:mm)
PPM	Atmospheric correction

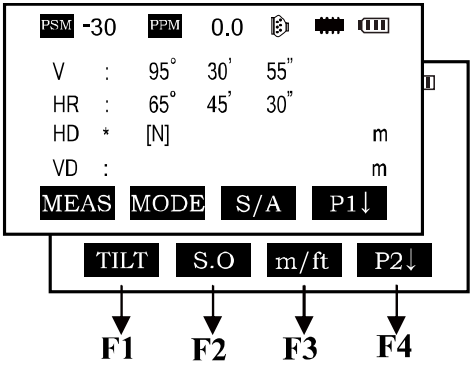
2.2 Function Key

Angle measurement mode (three-page menu)



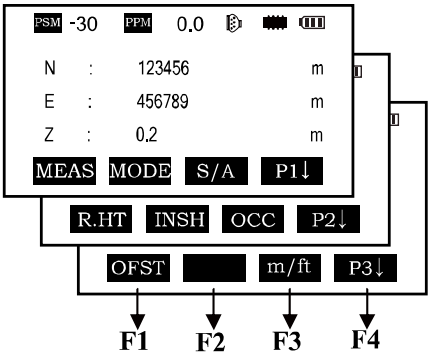
Page	Keys	Display marks	Function
P1	F1	0SET	Horizontal angle is set to 0°0′0″
	F2	HOLD	Hold the horizontal angle
	F3	HSET	Set a required horizontal angle by entering numbers
	F4	P1↓	Scroll to the next page (P2)
P2	F1	TILT	Tilt correction screen. If the correction is turned on the display will show the tilt correction value.
	F2		
	F3	V%	Vertical angle percent grade (%) mode
	F4	P2↓	Scroll to the next page (P3)
P3	F1	R/L	Switches Right/Left rotation of horizontal angle
	F2		
	F3	CMPS	Switches vertical angle “0” position
	F4	P3↓	Scroll to the next page (P1)

Distance measurement mode (two-page menu)



Page	Keys	Display marks	Function
P1	F1	MEAS	Begin measuring
	F2	MODE	Sets measuring mode from: Fine[1]/ Fine[N]/Tracking
	F3	S/A	Sets temperature, air pressure, prism constant
	F4	P1↓	Scroll to the next page (P2)
P2	F1	OFSET	Selects Off-set measurement mode
	F2	S.O.	Selects Stake Out measurement mode
	F3	m / ft	Switches units between meters and feet
	F4	P2↓	Scroll to the next page (P1)

Coordinate measurement mode（three-page menu）

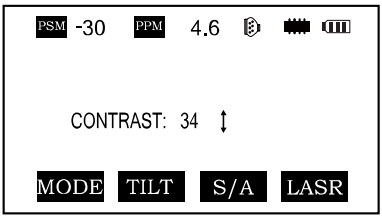


Page	Keys	Display marks	Function
P1	F1	MEAS	Start measuring
	F2	MODE	Sets a measuring mode, Fine/Tracking
	F3	S/A	Sets temperature, air pressure, prism constant
	F4	P1↓	The function of soft keys is shown on next page (P2)
P2	F1	R.HT	Sets prism height
	F2	INSHT	Sets instrument height
	F3	OCC	Sets instrument coordinate.
	F4	P2↓	Shows the function of soft keys on page 3
P3	F1	OFSET	Off-set measurement mode
	F2	BACKSIGHT	Setting a direction angle for back sight orientation
	F3	m / ft	Switches meter and feet unit.
	F4	P3↓	Shows the function of soft keys on page1

2.3 Star-key Mode

The total station(non-reflectorless)：

Press the star key , following is displayed:



1. Contrast adjustment: After pressing star key, adjust the display contrast by pressing [▲] or [▼] key.

2. Illumination: After pressing star key, select [Illumination] by pressing F1(LAMP) key or press star key.

3. Tilt: After pressing star key, select [tilt] by pressing F2 (TILT) key, and select ON or OFF by pressing F1 or F3 key, press F4 (ENT) key.

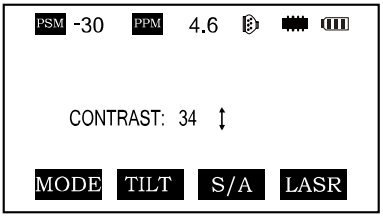
4. S/A: After pressing star key, select [S/A] by pressing F3 (S/A) key, then you can set Prism contrast, air pressure and temperature.

5. Laser plummet: If total station has this function, after pressing star key, select [laser] by pressing F4 (LASR) key, and select ON or OFF by pressing F1 or F2 key.

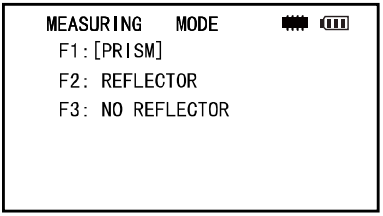
*In some interface, you can turn on or turn off panel backlight by press star key directly.

The total station(reflectorless)：

Press the star key , following is displayed:



1．Mode: Press the F1 (mode) key, the following is displayed :



You can select the type of measure mode by pressing the F1—F3 keys.

2．You can turn on the lamp by pressing the star key once more or by pressing twice from any menu.

2.4 Dot-key Mode

The total station can function as a laser pointer

The laser pointer can be turned on or off by pressing the (.) dot key.

3. INITIAL SETTINGS

The series total station can be reset to the instruments original factory settings.

See Section 11 “Basic Settings”

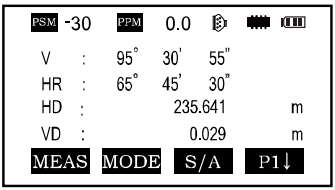
3.1 Setting the Temperature and Atmospheric

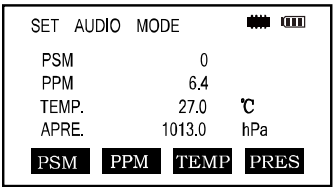
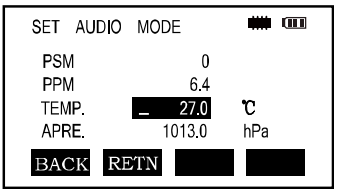
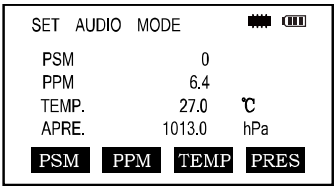
Before manually set the Temperature and Atmospheric, you need to turn off the Auto T-P sensor option.

Press [M] key, press [F4] CONFIG, Press [F2] PARAMETER SET, Press[▼] to second page, press [F3] T-P Sensor, Press [F2] NO to turn off the Auto T-P Sensor.

Pressure

Measure the surrounding temperature and air pressure in advance. Example: temperature +25 °, air pressure 1017.5 hPa

Procedure	Operation	Operating procedure	Display
		Enter the Distance Measurement Mode	

	F3	Press F3 to enter the S/A screen	
Temp. Settings	F3	Press F3 to enter temperature section, enter the correct temperature, press the ENT key to set	
Atms. Pressure	F2	Press F2 key and enter the air pressure, press the ENT key to confirm	
Remarks	Temperature operating range：-30 °~ +60℃ or -22 ~ +140℉ Air pressure：560 ~ 1066 hPa or 420 ~ 800 mmHg or 16.5 ~ 31.5 inHg If the atmospheric correction value calculated from the temperature and air pressure exceeds the range of ±999.9PPM，the operation will return to step 4 automatically, and you should enter the data again.		

3.2 Setting of the Atmospheric Correction

The infrared emitted by the Total Station varies with the air temperature and pressure. Once the atmospheric correction value is set the instrument will correct the distance measuring result automatically.

Air pressure： 1013hPa

Temperature： 20℃

The calculation of atmospheric correction ：

ΔS =273.8 – 0.2900 P / （ 1 + 0.00366T ）(ppm)

ΔS：Correction Coefficient （Unit ppm）

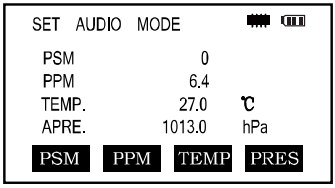
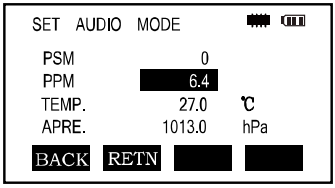
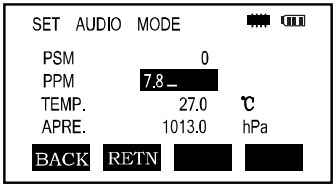
P: Air Pressure （Unit : hPa If the unit is mmHg , please convert using

1hPa = 0.75mmHg

T: temperature （ unit℃）

Direct Setting Method of Atmosphere Correction Value

After measuring the temperature and air pressure the atmosphere correction value can be obtained from an atmospheric correction chart or correction formula (PPM).

Procedure	Operation	Operation Procedure	Display
	F3	Press F3 Key in distance measurement or coordinate measurement mode	
	F2	Press F2 [ppm] key，which shows the current setting value	
	Enter value	Enter atmospheric correction and press ENT	

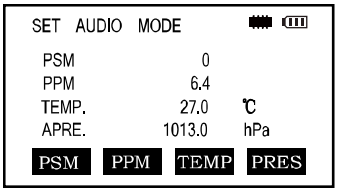
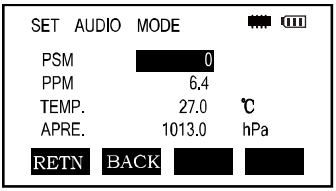
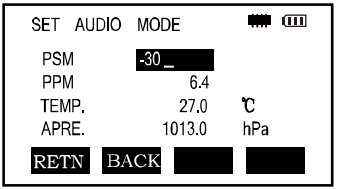
*1）See 2.10“How to Enter Alphanumeric Characters”

Input range：-999. 9PPM to +999. 9 Step length: 0 .1PPM

*2）If Temperature and Atmospheric Pressure are reset, the PPM will be recalculated automatically.

3.3 Setting of the Prism Constant

In the factory the prism constant for the total station is set at -30mm. If the constant of the prism used is not -30mm, you must change this setting. Once the prism constant is set it will become the new default value until changed.

Procedure	Operation	Operation Procedure	Display
	F3	Press F3 (S/A) Key in Distance Measurement Mode or Coord. Measurement Mode.	
②	F1	② Press F1 (PRISM) key	
③	Enter data	Press F1 (INPUT) key to enter the Prism Constant correction value. *1, press F4 to confirm and return to the Setting Mode.	
Input range：-99. 9mm to +99. 9mm Step length 0. 1mm			

*The total station in reflectorless measuring mode sets the prism constant to 0 automatically.

3.4 Setting of the Vertical Angle Tilt Correction

When the tilt sensor is activated the instrument automatically corrects the vertical angle for mislevel. To ensure a precise angle measurement the tilt sensor must be turned on. The tilt sensor display can also be used to fine level the instrument. If the (“X TILT OVER”) display appears the instrument is out of the automatic compensation range and must be leveled manually to within tolerances.

The instruments compensates the vertical angle reading due to inclination of the standing axis in the X direction.

When the instrument is on an unstable footing or used during a windy day the display of vertical angle can be unstable. You can turn off the auto tilt correction function in this case.

Setting the tilt correction

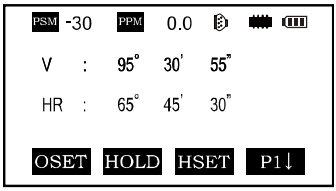
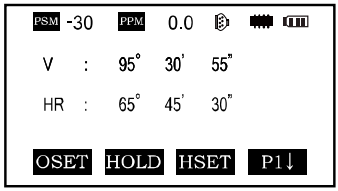
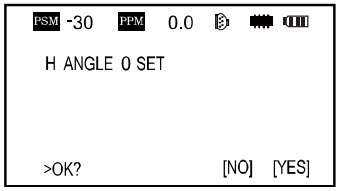
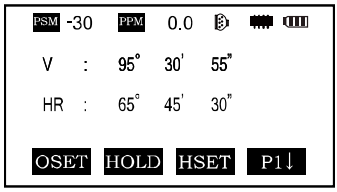
The instrument memorizes the last setting for this feature. To insure the compensator is on check this setting before operating the instrument.

For operation procedures refer to 11.2.1.

4．ANGLE MEASUREMENT

4.1 Measuring Horizontal Angle Right and Vertical Angles

Make sure the angle measurement mode is selected.

Operation procedure	Operation	Display
① Collimate the first target (A)	Collimate A	
To set horizontal angle of target A at 0 º 00’00" press the F1 (0SET) key and then press the F4 (YES) key	F1 F4	 
③ Collimate the second target (B) The required V/H angle to target B will be displayed	Collimate B	

Note : The horizon angle will be saved when the instrument is powered off and displayed when powered on.

Reference: How to Collimate

Point the telescope toward a light surface or sky. Turn the diopter ring and adjust the diopter so that the cross hairs are clearly observed.

Aim the target at the peak of the triangle mark of the sighting collimator. Allow a certain space between the sighting collimator and yourself for collimating.

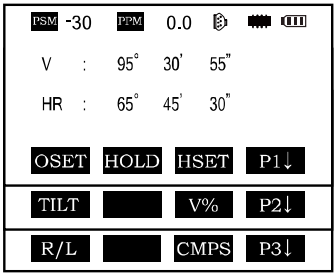
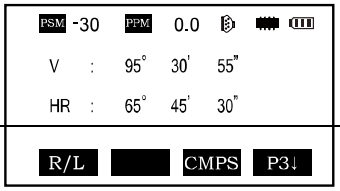
Focus the target with the focusing knob.

If parallax is created between the cross hairs and the target when viewing vertically or horizontally while looking into the telescope, focusing is incorrect or diopter adjustment is poor.

This adversely affects precision in measurement please eliminate the parallax by carefully focusing and using the diopter adjustment.

4.2 Switching Horizontal Angle Right/Left

Make sure the angle measurement mode is selected.

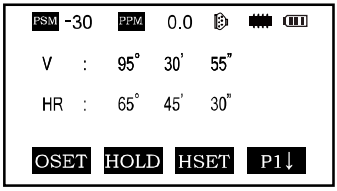
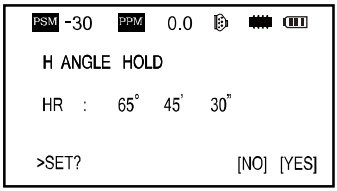
Operation procedure	Operation	Display
Press the F4 Key twice to get the menu to page 3. (P3)	F4 twice	
Press the F1 (R/L) key. The Horizontal Right angle mode	F1	

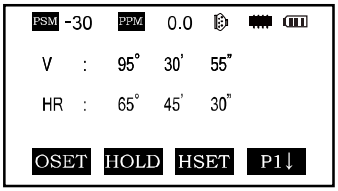
(HR) Switches to Horizontal Left mode (HL)		
Measure as HL mode		
*Each time the F2 (R/L) key is pressed the HR/HL mode switches		

4.3 Setting of the Horizontal Angle

4.3.1 Setting by Holding the Angle

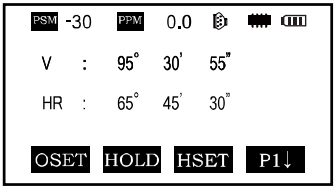
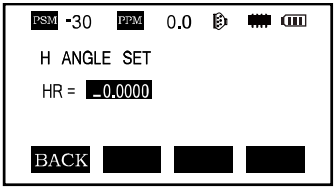
Make sure the angle measurement mode is selected.

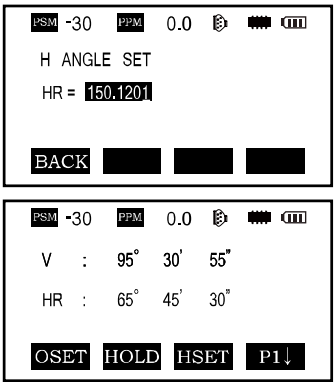
Operation procedure	Operation	Display
① Set the required horizontal angle using the horizontal tangent screw	Display angle	
②Press the F2 (HOLD)key	F2	
③Collimate the target	Collimate	

④Press the F4 (YES) key to finish holding the horizontal angle, the display turns back to the normal angle measurement mode	F4	
*To return to the previous mode, press the ESC key.		

4.3.2 Setting the Horizontal Angle from the Keypad

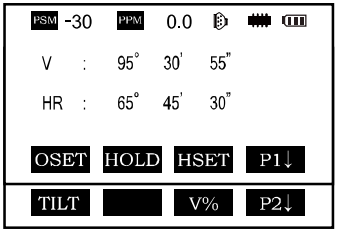
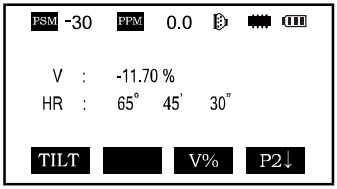
Make sure the angle measurement mode is selected.

Operation procedure	Operation	Display
①Collimate the target	Collimate	
②Press the F3 (HSET) key	F3	

③Input the required horizontal angle by using the keys, for example : 150º10′20″, inputs 150.1020(Not to input [.] between minute and second) Press ENT Carry on normal measurement after entering the required horizontal angle	150.1020 ENT	

4.4 Vertical Angle Percent Grade (%) Mode

Make sure the angle measurement mode is selected.

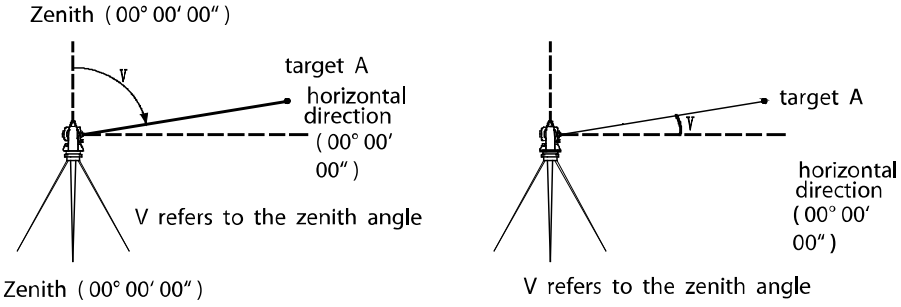
Operation procedure	Operation	Display
Press F4 key to get the function on menu page P2	F4	
Press the F3 (V%) key *	F3	

*Each time the F3 (V%) key is pressed the display mode switches.

When the angle measured is over 45°(100%) from the horizontal <OVERTOP> is displayed.

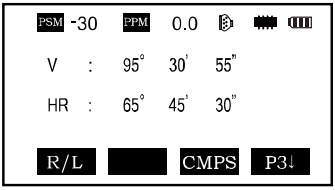
4.5 Setting the Initial Zenith Angle

Vertical angle is displayed as shown below:



Make sure the angle measurement mode is selected.

Operation procedure	Operation	Display
Press F4 key twice to get the menu on page 3 (P3)：	F4 twice	PSM -30 PPM 0.0 V : 95° 30′ 55″ HR : 65° 45′ 30″ OSET HOLD HSET P1↓ R/L CMPS P3↓

Press the F3 (CMPS) key *	F3	
* Each time the F3 key is pressed the display mode switches.		

5. DISTANCE MEASUREMENT

When setting the atmospheric correction obtain the correction value by measuring the temperature and pressure.

5.1 Setting of the Atmospheric Correction

When setting the atmospheric correction obtain the correction value by measuring the temperature and pressure. Refer to Section 3.2 “Setting of the Atmospheric Correction”.

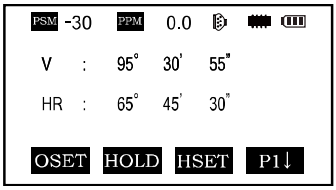
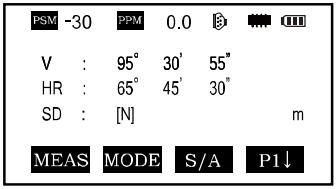
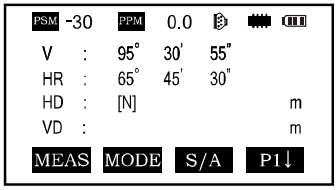
5.2 Setting of the Correction for Prism Constant

The instrument is preset for a Prism Constant value of -30mm at the factory. If the prism is of another constant the instrument needs to be updated with this constant. Refer to

Chapter 3.3 “Setting of the Prism Constant”. The updated value is kept in the instrument memory after the power is shut off.

5.3 Distance Measurement (Continuous Measurement)

Make sure the angle measurement mode is selected.

Operation procedure	Operation	Display
Collimate the center of prism *1	Collimate	
Press the [SD] key, distance measurement starts *2 *3;	[SD]	
③The measured distances are shown (*4,*7) By pressing the [SD] key again the display changes to horizontal (HR), vertical (V) angle, vertical distance (VD) and slope distance (SD)	[SD]	

*1) The total station prism mode collimate center of prism when measuring ;

2) When EDM is working, the "" mark appears in the display. The total stations will display "weak signal" when measuring if the signal is weak.

*3) To change the mode from Fine to Tracking, refer to section 5.4 "Fine mode / Tracking Mode". To set the distance measurement on when the instrument is powered up, refer to Chapter 11 "Basic Settings".

*4) The distance unit indicator "m" (for meter) or "ft" (for feet) appears and disappears alternatively with a buzzer sounding at every renewal of distance data.

5) Measurement may repeat automatically in the instrument if the result is affected by external factors.

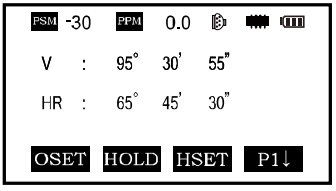
*6) To return to the angle measuring angle mode from the distance-measuring mode, press the ANG key.

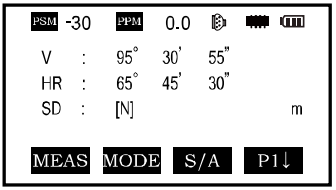
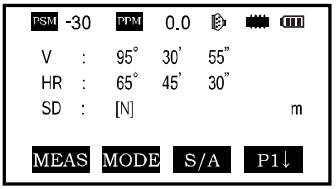
*7) It is possible to choose the display order (HR,HD,VD) or (V, HR,SD) for initial measuring mode. Refer to Chapter 11 "Basic Settings".

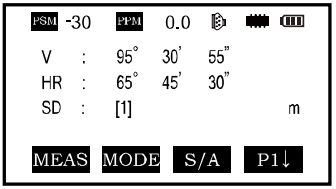
5.4 Changing the Distance Measurement Mode

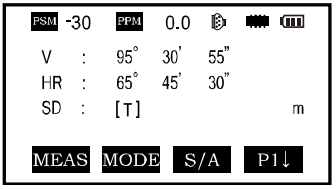
(Repeat Measurement / Single Measurement/
Track Measurement)

Make sure the angle measurement mode is selected.

Operation procedure	Operation	Display
Collimate the center of the prism	Collimate	

<table>
<tr>
<td>Press the  key，Continuous Measurement begins *1；</td>
<td>  </td>
<td> 
</td>
</tr>
<tr>
<td>Press the F2 (MODE) key to switch between Repeat Measurement, Single Measurement and Tracking Measurement. [N], [1], [T]</td>
<td>F2
F1</td>
<td> 



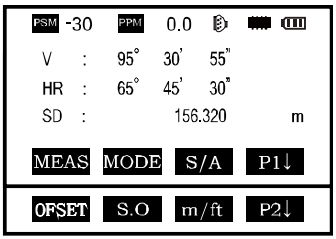
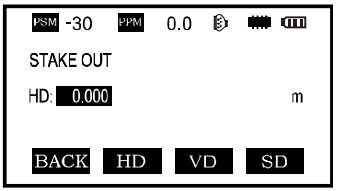
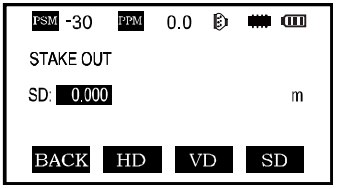

</td>
</tr>
<tr>
<td colspan="3">*1 It is possible to set the measurement mode for N-times measuring mode or continuous measurement mode when the power is turned on. Refer to Chapter 11 “Basic Settings”.</td>
</tr>
</table>

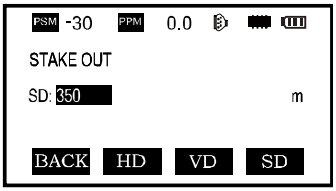
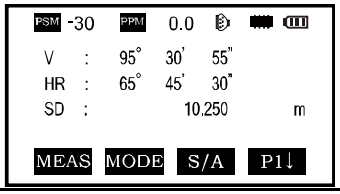
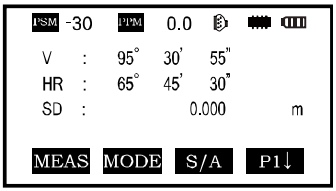
5.5 Stake Out (S.O.)

The difference between the measured distance and the input stake out distance is displayed.

Measured distance - Stake out distance = Displayed value

In a stake out operation you can select either horizontal distance (HD), relative elevation (VD), and slope distance (SD.)

Operation procedure	Operation	Display
Press the F4(↓) key in the distance measuring mode to menu P2	F4	
Press the F2 (S.O) key The data previously set is shown	F2	
Select the measuring mode by pressing the F2 to F4 keys. F2:HD, F3:VD, F4:SD	F1	

Enter the distance 350 , press F4	Enter 350 F4	
Collimate the target (Prism), measurement starts. The difference between the measured distance and the stake out distance is displayed.	Collimate Prism	
Move the target until the difference becomes 0.		
To return to normal distance measurement mode, stake out distance to “0” or switch to other measurement mode.		

5.6 Offset Measurement

There are four offset measurement modes:

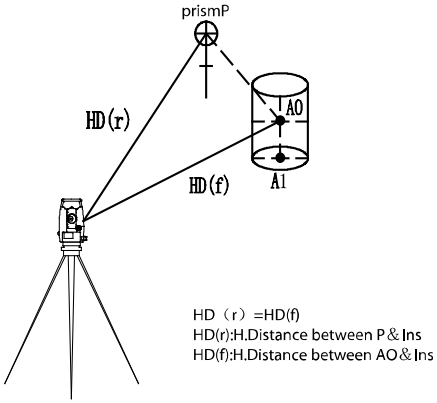
1. Angle offset
2. Distance offset
3. Plane offset
4. Column offset

5.6.1 Angle Offset

This mode is useful when it is difficult to set up the prism directly on target; for example at the center of a tree. Place the prism at the same horizontal distance from the instrument as that of point A0 to measure. To measure the coordinates of the center position use the offset measurement after setting the instrument height/prism height.

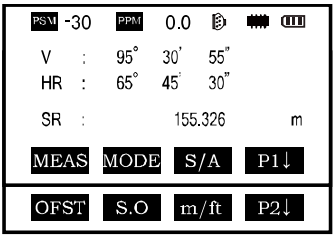
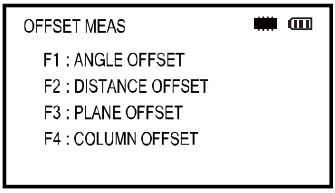
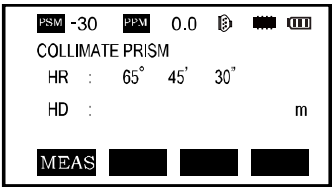
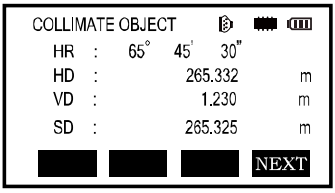
When measuring coordinates of ground point AI: Set the instrument height/Prism height

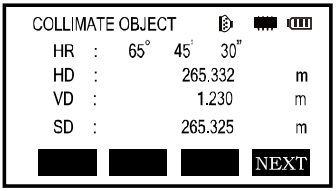
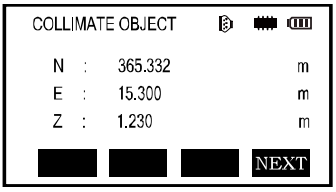
When measuring coordinates of point A0: Set the instrument height only (Set the prism height to 0)



Set the instrument height/prism height before proceeding to the offset measurement mode.

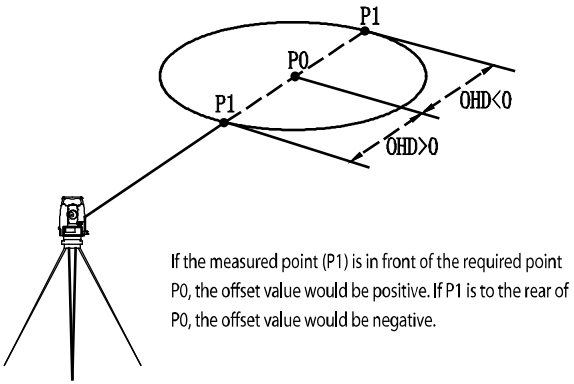
When setting the coordinate value for the occupied station, refer to Section 6.2 “Setting Coordinate Values of an Occupied Point”.

Operation procedure	Operation	Display
Press the F4(↓) key from distance measuring mode to get the function on menu P2	F4	
Press F1 (OFSET) key	F1	
Press F1 (ANG.OFFSET) key	F1	
Collimate prism P, and press the F1 (MEAS) key. The horizontal distance from the instrument to the prism will be measured.	Collimate [P] F1	

<table>
<tr><td>Collimate point AO using the horizontal motion clamp and horizontal tangent screw.</td><td>Collimate AO</td><td> 
</td></tr>
<tr><td>Show the north coordinate, east coordinate and z coordinate of waited measuring point by pressing key.</td><td></td><td> 
</td></tr>
<tr><td colspan="3">To return to procedure 3, press F4 (NEXT) key
To return to the previous mode, press ESC key</td></tr>
</table>

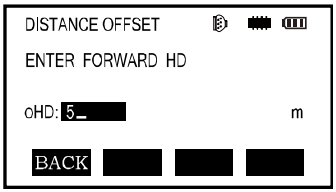
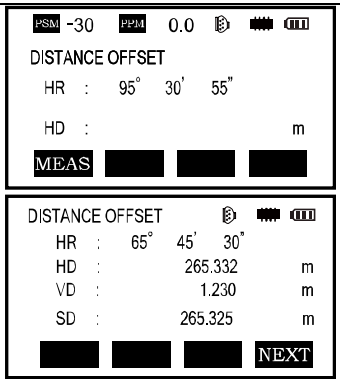
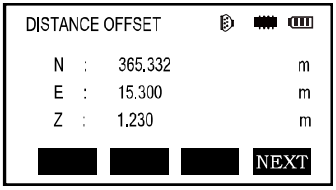
5.6.2 Distance Offset Measurement

Measuring the distance and coordinate of a pond or a tree of which the radius is known. Measuring the distance or coordinate to P0 point, input oHD value as an offset value and measure P1 point as shown in the drawing. The display shows distance or coordinate value to P0 point.



When setting the coordinate value for the occupied station, refer to Section 6.2 'Setting Coordinate of Occupied Point'

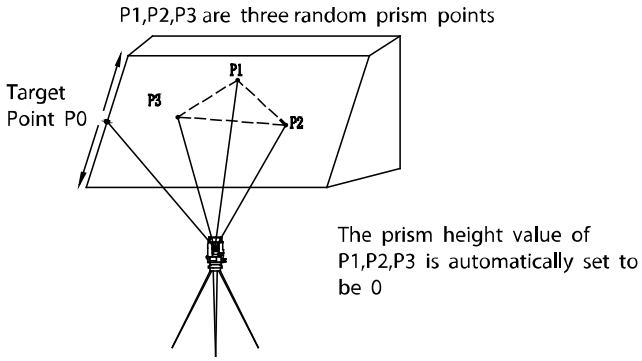
Operation procedure	Operation	Display
① Press the F4 (↓) key from distance measuring mode to get the function on menu P2	F4	PSM -30 PPM 0.0 V : 95° 30' 55" HR : 65° 45' 30" SD : 155.326 m MEAS MOD S/A P1↓ OFST S.O m/ft P2↓
②Press F1 (OFSET) key.	F1	OFFSET MEAS F1 : ANGLE OFFSET F2 : DISTANCE OFFSET F3 : PLANE OFFSET F4 : COLUMN OFFSET
③Press F2 (DIST OFSET) key, enter the measurement of DIST.OFFSET	F2	DISTANCE OFFSET INPUT L OR RHD oHD: 0.000 m BACK
④Enter R HD, press ENT key *1	Enter R HD ENT	DISTANCE OFFSET ENTER R HD oHD: m

⑤Enter forward HD， press ENT key *2	Enter forward HD ENT	
⑥Collimate Prism P1, and press F1 (MEAS) key. Measuring will start. After measuring, the result added offset value will be show。	Collimate P1 F1	
⑦Show the coordinate of Point P0		
To return to procedure 4,press F1 (NEXT) key To return to the previous mode, press ESC key *1) *2) refer to section 8.3.2 “Distance Offset Measurement”		

5.6.3 Plane Offset Measurement

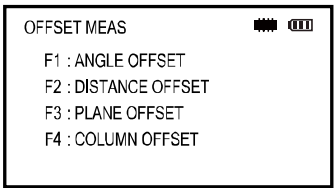
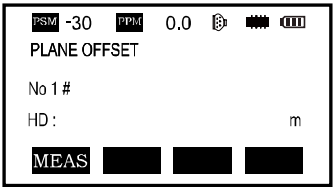
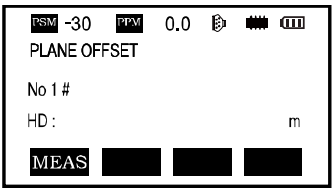
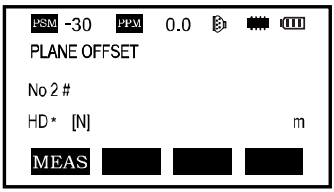
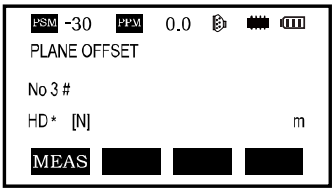
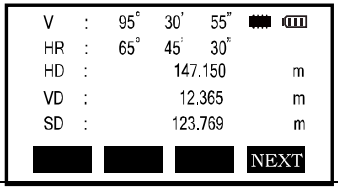
Used to facilitate distance or coordinate measuring for a given plane.

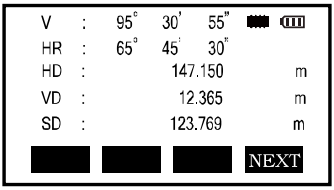
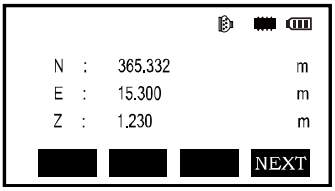
Three random prism points (P1, P2, P3) on a plane will be measured at first in the plane-offset measurement to determine the measured plane. Collimate the measuring target point (P0) then the instrument will calculate and display coordinate and distance values of the cross point between collimation axis and the plane.



When setting the coordinate value for the occupied station, refer to Section 7.2 'Setting Coordinate Value of Occupied Point'.

Operation procedure	Operation	Display
① Press the F4 (↓) key from distance measuring mode to get the function on page 2.	F4	PSM -30 PPM 0.0 V : 95° 30' 55" HR : 65° 45' 30" SD : 226.306 m MEAS MODE S/A P1↓ OFST S.O m/ft P2↓

②Press F1 (OFSET) key	F1	
③Press F3 (PLANE OFSET) key	F3	
④Collimate Prism P1, and press F1 (MEAS) key. N-time measuring will start. After measuring, the display will show the second point measurement.	Collimate P1 F1	
⑤Measure the second and third points in the same way. The instrument calculates and displays coordinate and distance values of the cross point between the collimation axis and of the plane *1*2	Collimate P2 F1 Collimate P3 F1	  

⑥Collimate the edge (P0) of the plane *3*4	Collimate P0	
⑦By pressing  key each time , horizontal distance, relative elevation and slope distance are shown in sequence. To show the coordinate of the point (P0), press  key.		

*1) In case the calculation of plane was not successful by the measured three points, error displays. Start measuring over again from the first point.

*2) Data display is the mode beforehand of offset measurement mode.

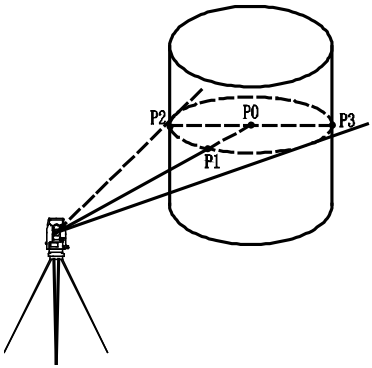
*3) Error will be displayed when collimated to the direction which does not cross with determined plane.

*4) The reflector height of the target point P0 is set to zero automatically.

5.6.4 Column Offset Measurement

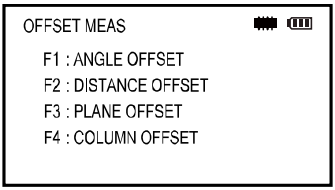
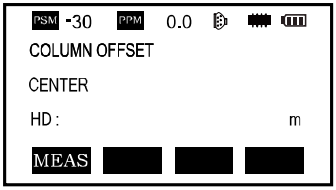
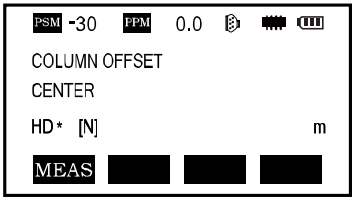
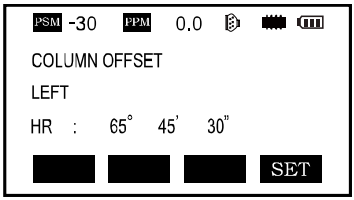
If it is possible to measure circumscription point (P 1) of Column directly the distance to the center of the column (P0), coordinate and direction angle can be calculated by measured circumscription points (P2) and (P3).

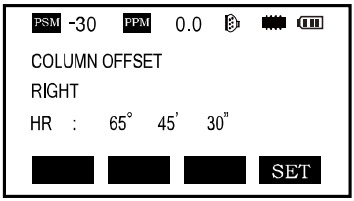
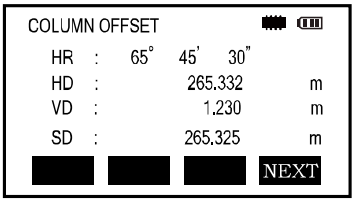
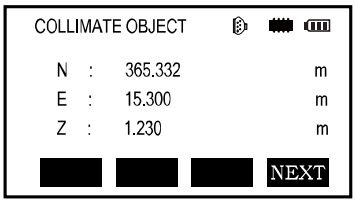
The direction angle of the center of the column is 1/2 of total direction angle of circumscription points (P2) and (P3).



When setting the coordinate value for the occupied station, refer to Section 6.2 'Setting Coordinate Values of Occupied Point'.

Operation procedure	Operation	Display
Press the F4 (↓) key from distance measuring mode to get the function on menu P2	F4	PSM -30 PPM 0.0 V : 95° 30' 55" HR : 65° 45' 30" SD : 106.306 m MEAS MODE S/A P1↓ OFST S.O m/ft P2↓

Press F1 (OFSET) key	F1	
Press F4 (COLUMN OFFSET)key	F4	
Collimate the center of the column (P1) and press F1 (MEAS) key N-time measuring will start. After the measurement, angle-measuring display of the left side (P2) will be shown.	Collimate P1 F1	
Collimate the left side of column(P2) and press F4 (SET) key. After measurement, angle measuring display of the right side (P3) will be shown.	Collimate P2 F4	

⑥Collimate the right side of the column (P3) and press F4 (SET) key. After measurement, the distance between the instrument and the center of column (P0) will be calculated.	Collimate P3 F4	 
To show the coordinate of point P0 , press ⟋ key. *1*2	⟋	

*1) To return to procedure 5, press F4 (NEXT) key

*2) To escape the measuring , press ESC key , the display returns to the previous mode.

6. COORDINATE MEASUREMENT

6.1 Execution of Coordinate Measurement

Measure the coordinates by entering the instrument height and prism height, coordinates of unknown Point will be measured directly.

* When setting coordinate values of occupied point, see Section 6.2 “Setting Coordinate Values of Occupied Station Point”.

* When setting the instrument height and prism height, see Section 6.3 “Setting Height of the Instrument” and 6.4 “Setting Height of Target (prism Height)”.

* To set backsight, determine the backsight azimuth or check the known azimuth, coordinate and distance.

The coordinates of the unknown point are calculated as shown below and displayed：

Coordinates of occupied point：(N0 , E0 , Z0)

Instrument height :INS.HT

Prism height: R.HT

Vertical distance (Relative elevation)：Z (VD)

Coordinates of the center of the prism, originated from the center point of the instrument：(n , e , z)

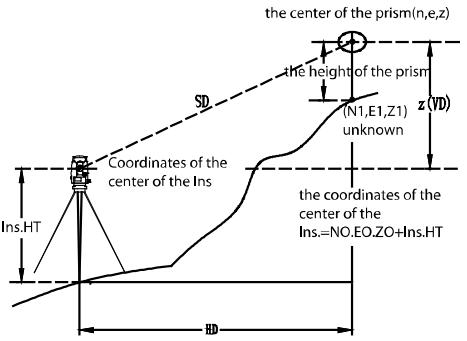
Coordinates of unknown point：(N1 , E1 , Z1)

N1=N0+n

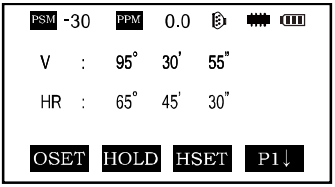
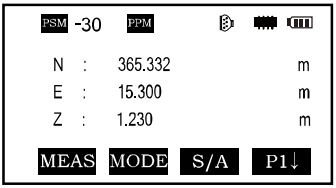
E1=E0+e

Z1=Z0+INS.HT+Z - R.HT

Center point of the instrument (N0, E0, Z0+INS.HT)



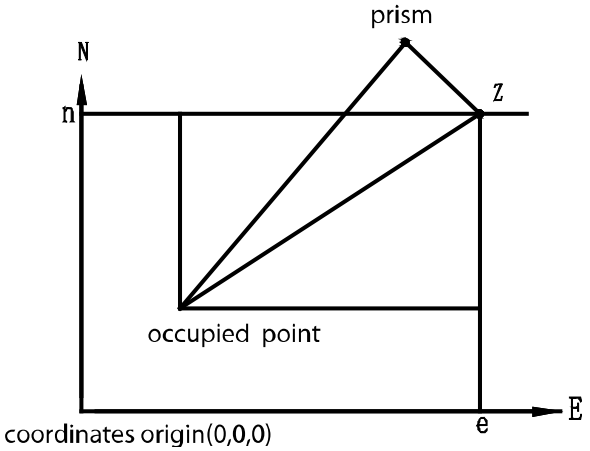
When doing coordinate measurement you need to input coordinates of occupied point, instrument height, the prism height and back sight azimuth.

Operation procedure	Operation	Display
Set the direction angle of known point A *1)	Set direction angle	
Collimate target prism B, and press [⟋] key	Collimate target prism [⟋]	
*1Refer to Section 4.3 “Setting of Horizontal Angle”. In case the coordinate of instrument point is not entered, (0,0,0) will be used as the default for the instrument point. The prism height will be calculated as 0 when the prism height is not set.		

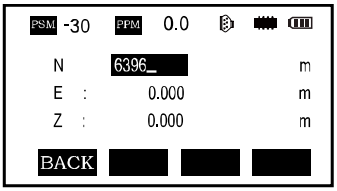
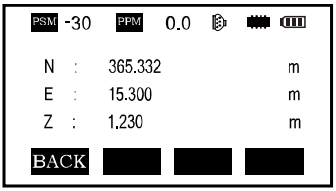
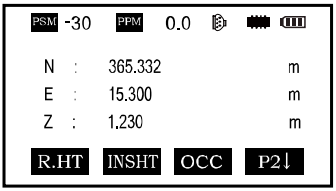
6.2 Setting Coordinate Values of Occupied Point

Set the coordinates of the instrument (occupied point) according to known values and the instrument automatically converts and displays the unknown point (prism point) coordinates following the observation.

The instrument retains the coordinates of the occupied point after turning the power off.

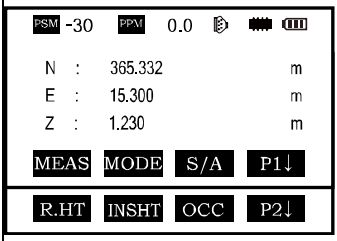


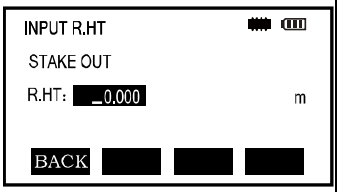
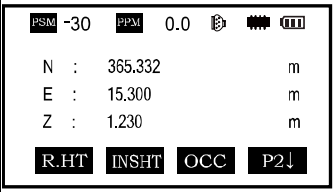
Operation procedure	Operation	Display
Press the F4 (P1↓) key from the coordinate measurement mode to get the function on menu P2.	F4	PSM -30 PPM 0.0 N : 365.332 m E : 15.300 m Z : 1.230 m MEAS MODE S/A P1↓ R.HT INSHT OCC P2↓
Press the F3 (OCC) key	F3	COLLIMATE OBJECT N : 0.000 m E : 0.000 m Z : 0.000 m BACK

③Enter N coordinate value	Enter data ENT	
④ Enter E and Z coordinate values in the same manner. After entering the values, the display returns to the coordinate measuring display menu.	Enter data ENT	 
Input range：-999999.999m/ft ≤N、E、Z ≤ +999999.999m/ft		

6.3 Setting Height of the Instrument

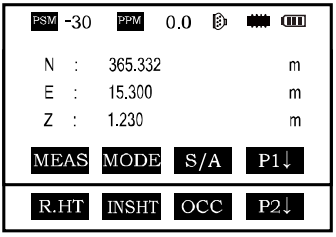
The instrument height value will be retained after the instrument is powered off.

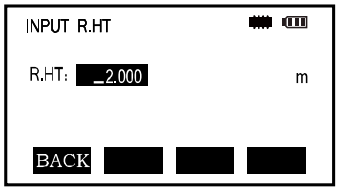
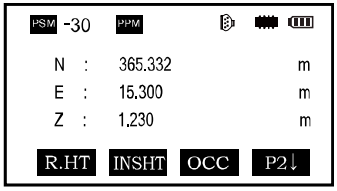
Operation procedure	Operation	Display
Press the F4 (P1↓) key from the coordinate measurement mode to access the P2 menu screen.	F4	

② Press the F2 (I.HT) key, The current value is displayed.	F2	
Enter the instrument height and press the ENT key to get to the coordinate measuring display	Enter the I.H. ENT	
Input range： —999.999≤INS.HT≤+999.999m		

6.4 Setting Height of Target (Prism Height)

This mode can be used to obtain z coordinate values. The target height value will be retained after the instrument is powered off.

Operation procedure	Operation	Display
Press the F4 (P1↓) key from the coordinate measurement mode to access the P2 menu screen.	F4	

<table>
<tr><td>②Press the F1 (R.HT) key
The current value is displayed.</td><td>F1</td><td> 
</td></tr>
<tr><td>Enter the prism height, then press the ENT key to get to the coordinate measuring display</td><td>Enter the prism height
ENT</td><td> 
</td></tr>
<tr><td colspan="3">Input range：
—999.999m≤prism height≤+999.999m/ft</td></tr>
</table>

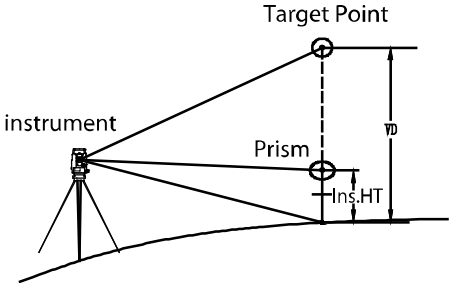
7. SURVEYING PROGRAM

Surveying Program Mode (programs)
By pressing the menu key M , the instrument will be in Menu Mode.

7.1 Remote Elevation Measurement（REM）

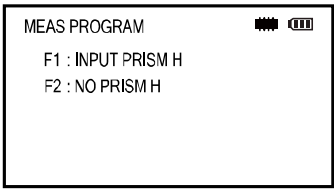
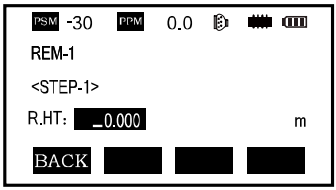
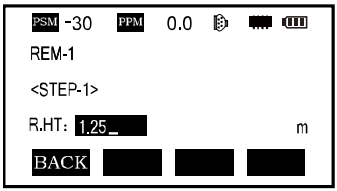
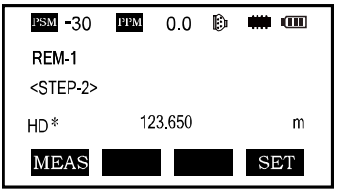
To obtain elevation of the point at which setting the target prism is not possible, place

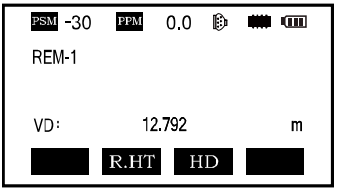
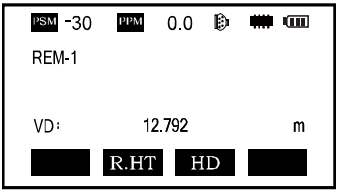
the prism at any point on the vertical line from the target then carry out REM procedure as follows.



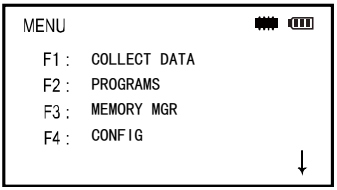
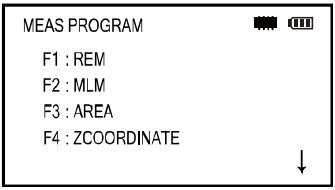
1）With prism height (h) input

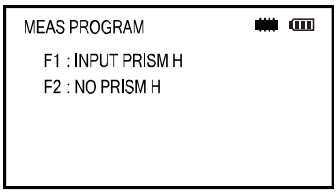
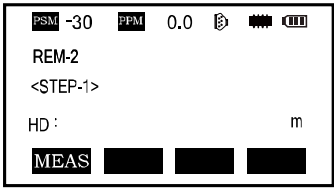
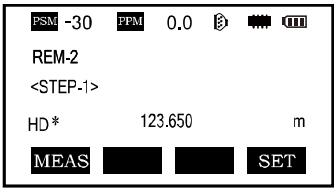
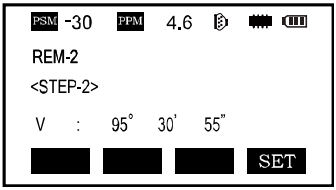
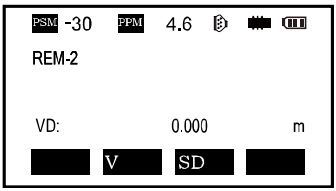
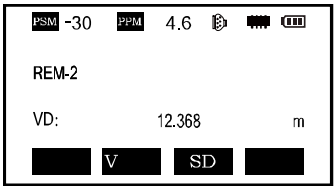
Operation procedure	Operation	Display
Press the M Key	M	MENU F1 : COLLECT DATA F2 : MEAS PROGRAM F3 : MEMORY MGR F4 : CONFIG ↓
Press the F2 key，enter MEAS PROGRAM. menu	F2	MEAS PROGRAM F1 : REM F2 : MLM F3 : AREA F4 : ZCOORDINATE ↓

③Press the F1 (REM) key	F1	
④Press the F1 key	F1	
⑤Enter prism height (1.3 is an example in meters)	F1 Enter prism height 1.3 F4	
⑥Collimate prism	Collimate Prism	
⑦Press the F1 (MEAS) key, measurement starts. Horizontal distance (HD) between the instrument and prism will be shown.	F1	

⑧Press the F4 (SET) The prism position will be decided.	F4	
⑨Collimate target K. Vertical distance (VD) will be shown.	Collimate K	
To return to procedure 5,press F2 (R.HT) key. To return to procedure 6,press F3 (HD) key. To return to PROGRAMS Menu, press the ESC key.		

2）Without prism height input

Operation procedure	Operation	Display
Press the M menu key	M	
Press the F2 key , enter the measure programs menu.	F2	

③Press the F1 (REM) Key.	F1	
④Press the F2 key to select the mode without prism height.	F2	
Collimate prism, press the F1 (MEAS) key. Measuring starts. Horizontal distance (HD) between the instrument and target will be shown..	Collimate target	
⑥Press the F4 (SET) The target position will be decided.	F4	
Collimate ground point G , press the F4 (SET) key. The position of point G will be decided	F4	
Collimate target K Vertical distance (VD) will be shown	Collimate K	

To return to procedure 5, press the F3 (HD) key.

To return to procedure 6, press the F2 (V) key.

To return to PROGRAMS Menu, press the ESC key.

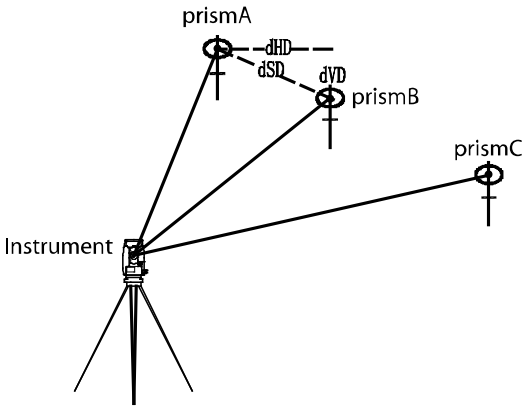
7.2 Missing Line Measurement (MLM)

Measurement for horizontal distance (dHD) , slope distance (dSD),elevation (dVD) and horizontal bearing (HR) between two target prisms.

It is possible to enter the coordinate value directly or calculate from coordinate data file.

MLM Mode has two modes:

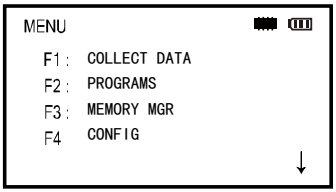
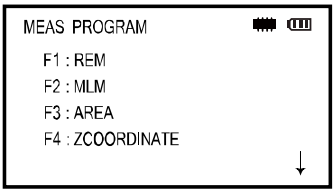
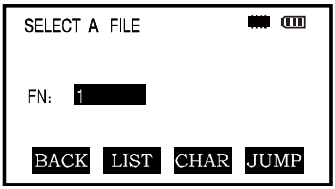
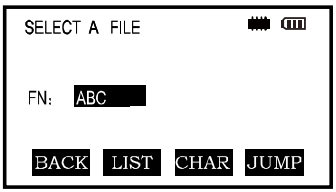
1. MLM-1 (A-B, A-C): Measurement A-B, A-C, A-D
2. MLM-2 (A-B, B-C): Measurement A-B, B-C, C-D

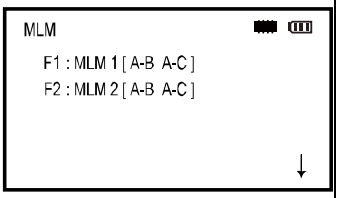
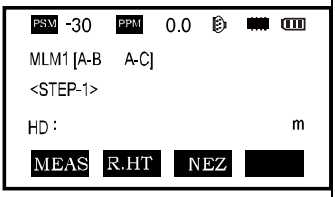
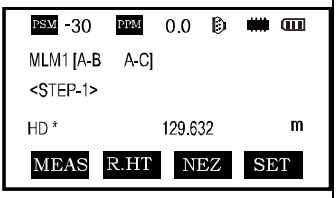
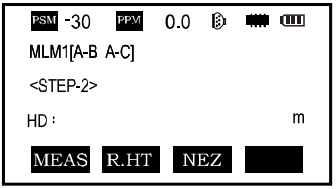
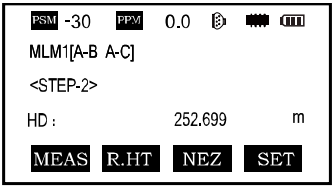


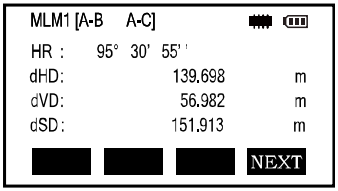
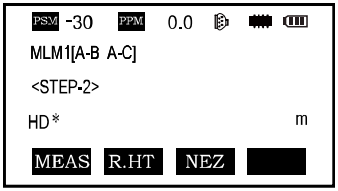
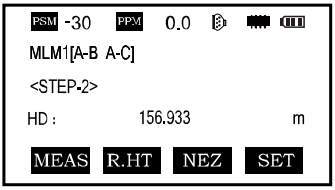
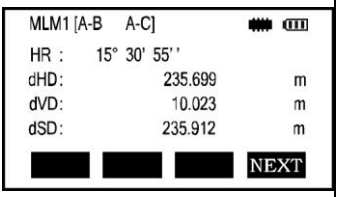
It is necessary to set the direction angle of the instrument.

[Example] MLM-1 (A-B, A-C)

Procedure of MLM-2（A-B，B-C）mode is completely the same as that of MLM-1 mode.

Operation procedure	Operation	Display
①Press the M menu key	M	
②Press the F2 key, enter MEAS PROGRAMS	F2	
③Press the F2 (MLM) key	F2	
④Enter file name	Enter file name	

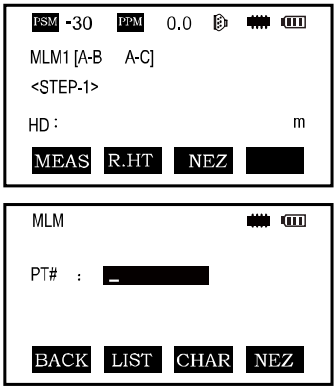
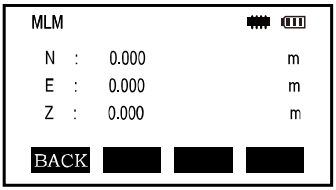
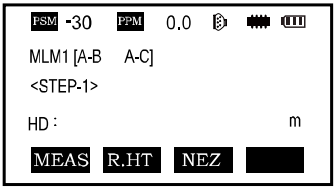
⑤Press ENT key.	ENT	
⑥Press the F1 key	F1	
⑦Collimate prism A, and press the F1 (MEAS) key. Horizontal distance (HD) between the instrument and target A will be shown.	Collimate A F1	
⑧Press the F4 (SET) key The position of the target is confirmed.	F4	
⑨Collimate prism B and press the F1 (MEAS) key. Horizontal distance (HD) between the instrument and target B will be shown..	Collimate B F1	

⑩Press the F4 (SET) key The horizontal distance(dHD) and relative elevation (dVD) between target A and B.	F4	
⑾ To measure the distance between points A and C, press the F4 (NEXT) key*1)	F4	
⑿ Collimate point C (target C) and press the F1 (MEAS) key. Horizontal distance (HD) between the instrument and target C will be shown.	Collimate C F1	
⒀Press the F4 (SET) key. The horizontal distance (dHD) and relative elevation (dvD) between taget A and C will be shown	F4	
⒁ To measure the distance between points A and D, repeat procedure 12 to 14 *		
*To return to Previous mode , press the ESC key.		

HOW TO USE COORDINATE DATA

It is possible to input coordinate values directly or calculate from a coordinate data file.

[Example] Input the data (NEZ) directly:

Operation procedure	Operation	Display
①Press the F3(NEZ) key	F3	
② Press the F4(coordinate) key	F4	
③Enter coordinate, press ENT key to get to the second point.	ENT	

*To return to PROGRAMS Menu, press the ESC key.

7.3 Area Calculation

This mode calculates the area of an enclosed figure.

There are two area calculation methods as follows:

1) Area calculation from Coordinate data file

2) Area calculation from measured data

Note：

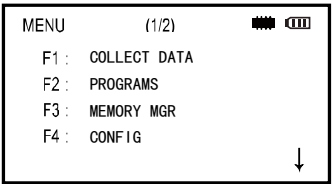
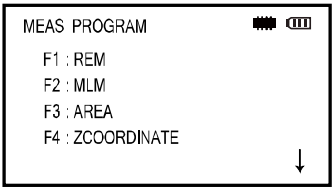
Area is not calculated correctly if observed lines cross each other.

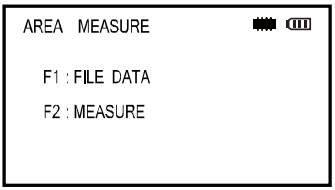
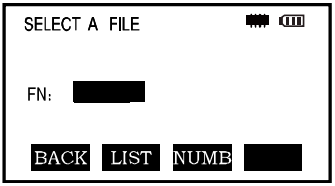
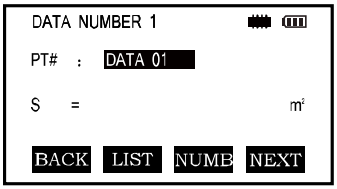
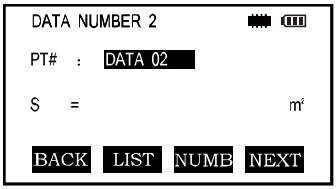
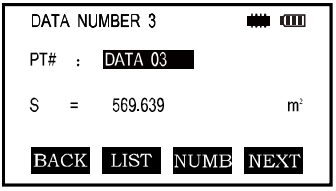
It is not possible to calculate area from a mix of coordinate file data and measured data.

The number of points used for calculation is not limited.

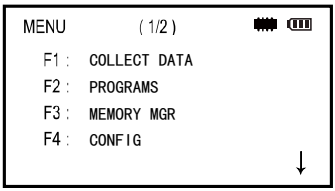
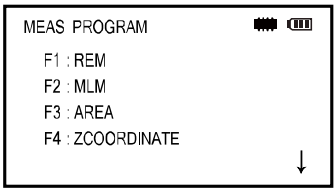
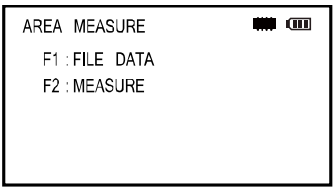
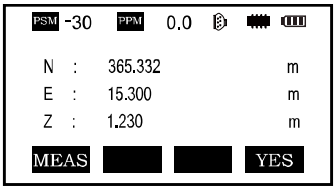
The area to be calculated shall not exceed 200000 sqm. (approx. 49 acres)

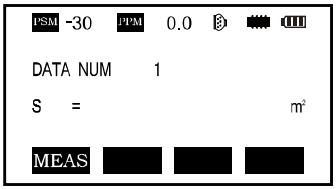
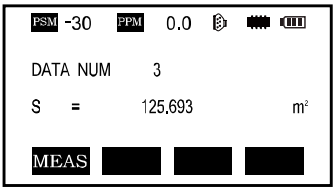
1) Area calculation from Coordinate data file

Operation procedure	Operation	Display
①Press M menu key	M	
②Press the F2 key, enter the Measurement Program.	F2	

③Press F3 (AREA) key	F3	
Press F1 (FILE DATA) key	F1	
Enter file name or press F2 for LIST. Press ENT key, Initial display will be shown .	Enter File name ENT	
⑥Press F4 (NEXT) key The top of the file data (DATA-01) will be set and the second point number will be shown.	F4	
Repeat pressing F4 (NEXT) key to set required number of the points. When 3 points are set, the area surrounded by the points is calculated and the result will be shown.	F4	
* To set the required point number, press F1 (PT#) key. * To show the list of the coordinate data in the file, press F2 (LIST) key.		

2) Area calculation from measured data

Operation procedure	Operation	Display
①Press M menu key	M	
②Press the F2 key, enter the Measurement Program.	F2	
③Press F3 (AREA) key	F3	
Press the F2 (MEASUREMENT) key	F2	
Collimate a target or prism and press the F1 (MEAS) key. Measuring starts *	Collimate Prism F1	

Press the F4 key to affirm	F4	
⑦Collimate a next prism and press F1 (MEAS) key. When 3 points are set, the area surrounded by the points is calculated and the result will be shown.	Collimate F1	
*1 Measurement is N-time measurement mode.		

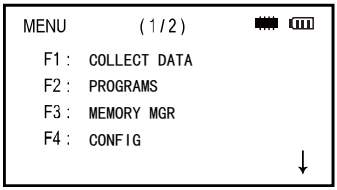
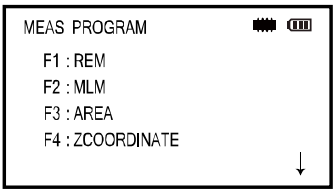
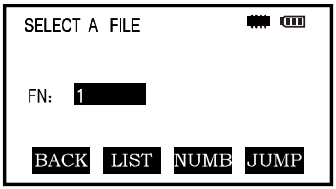
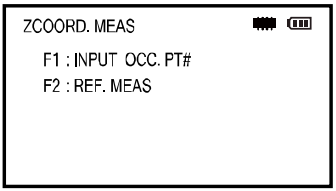
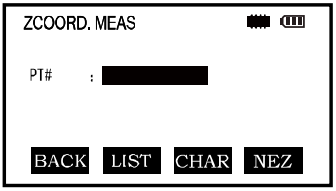
7.4 Setting Z Coordinate of Occupied Point

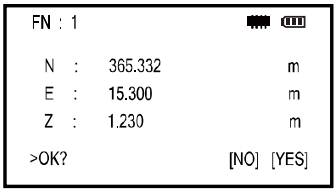
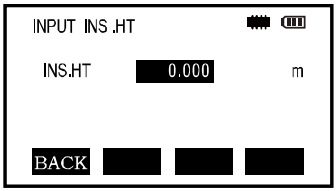
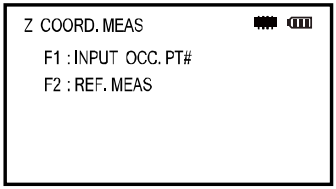
Occupied point coordinate data and known point actual measuring data can be utilized, zcoordinate of occupied point is calculated and reset.

Known point data from a coordinate file can used.

1) Setting z coordinate of occupied point

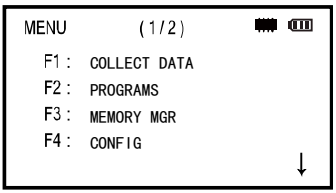
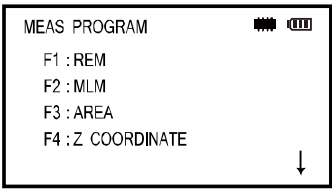
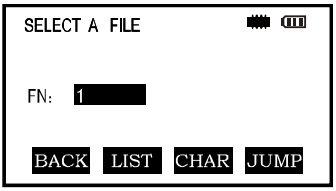
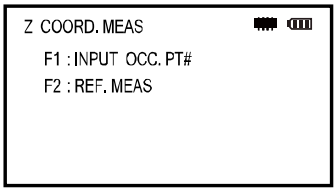
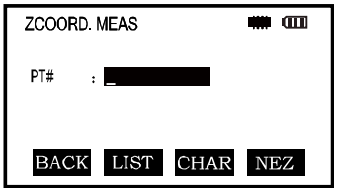
[Example setting] Using coordinate data file

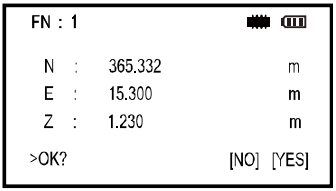
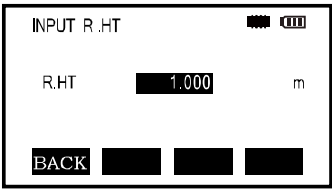
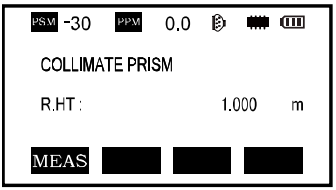
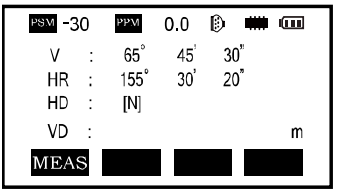
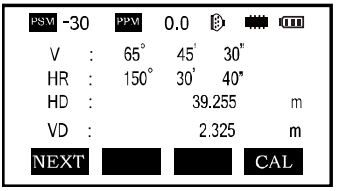
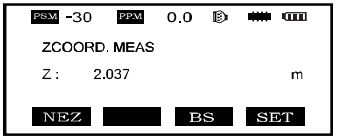
Operation procedure	Operation	Display
①Press the M menu key	M	
② Press the F2 key ,enter PROGRAMS	F2	
③ Press the F4 (Z COORDINATE key	F4	
④Enter the File Name then press ENT to affirm.	Input File Name ENT	
Press the F2 (REF. MEAS) key and enter the point number (press F2 for LIST)	F2	

After input the PT#, press the ENT key, the coordinate of this point is shown.	ENT	
⑦Press the F4 (YES) key to confirm instrument height setting display will be shown.	F4	
Enter the instrument height, press ENT key. Press F1 (MEAS) for observation results	Enter INS.HT ENT	
For more information about data file, see chapter 10 “Memory Management Mode”.		

2）Z coordinate calculation from known point measuring data

[Example setting] Using coordinate data file.

Operation procedure	Operation	Display
Press the M menu key	M	
Press the F2 key, enter MEAS PROGRAMS.	F2	
Press the F4 (Z COORDINATE) key	F4	
Enter the File Name then press ENT to affirm.	INPUT File Name ENT	
⑤Press the F2 key	F2	

⑥Enter the point number in coordinate data file, press ENT to affirm.	Enter PT# ENT	
⑦Press the F4 (YES) key to affirm	F4	
⑧Enter the height then press the ENT to affirm.	Enter R.HT ENT	
⑨Collimate a prism on the point and press the F1 (MEAS)key. Measuring starts *1	Collimate P F1	 
⑩Press the F4 (CAL) key *2 Z: Z coordinate	F4	

⑾Press the F4 (SET) key *3 Z coordinate of the occupied point will be set. Backsight point masuring screen will be shown.	F4	PSM -30 PPM 0.0 BACKSIGHT HR : 155° 30' 20" COLLIMATE [NO] [YES]
⑿ Press the F4 (YES) key. Horizontal angle will be set. The display returns to Measurement Programs menu.	F4	MEAS PROGRAM F1 : REM F2 : MLM F3 : AREA F4 : ZCOORDINATE ↓

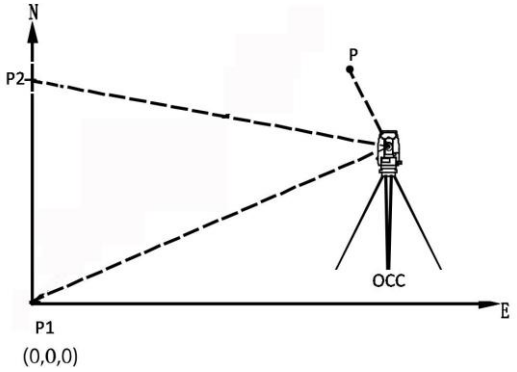
*1 Measurement is Fine Single measurement mode.

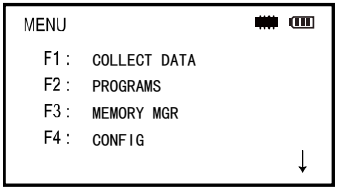
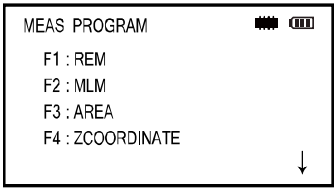
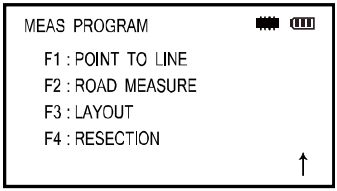
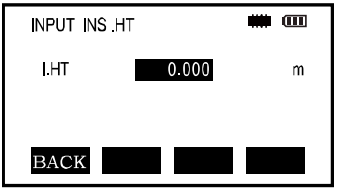
*2 To measure other points, press the F1 (NEXT) key.

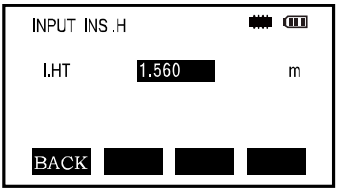
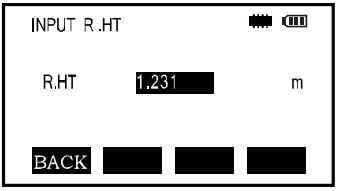
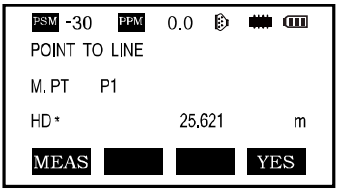
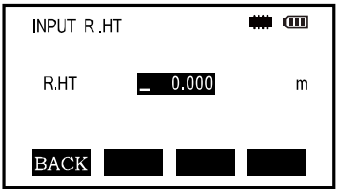
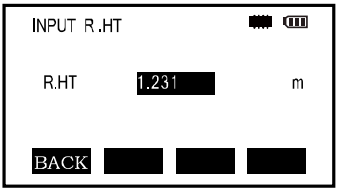
*3 Pressing the F1 or F3 key, the display will be changed alternately.

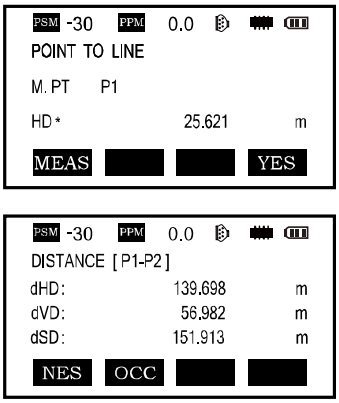
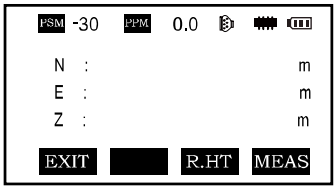
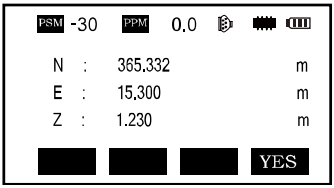
7.5 Point to Line Measurement

This program allows you to define a coordinate system by two points (p1 and p2), then measure them and calculate the relative coordinate of occupied point (station point, OCC) and other target points (P).



Operation procedure	Operation	Display
①Press the M menu key.	M	
②Press the F2 key for the Measure Program menu.	F2	
③Press the ▼ key.	▼	
④Press F1 (POINT TO LINE) key.	F1	

⑤ Input instrument height. Press ENT.	Input INS.HT ENT	
⑥Input prism height of point P1. Press ENT.	Enter R.HT ENT	
⑦Sight at P1 and press F1 (MEAS) key. When measurement result is shown, press F4 YES. It will ask you to input prism height of P2.	Sight at P1, F1 , F4	 
⑧ Input prism height of P2. Press ENT.	Input R.HT ENT	

⑨Sight at P2 and press F1 (MEAS) key. When measurement result is shown, press F4 YES, the distance between P1 and P2 will be shown. Press F2 OCC you can see occupied point coordinate.	Sight at P2 F1 F4	
⑩Sight at point P, Press F1 NEZ key to measure target point P.	Sight at point P F1	
⑪Sight at prism at point P, press F4 (MEAS). Measurement result will be shown.	F4	

7.6 Road Construction

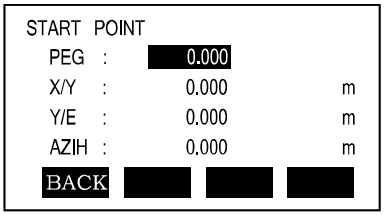
By using this program you can define a straight line, a curve, or a transition curve as a reference to make a measurement and set out. This program will do the computation of coordinates and setting out of the design point according to the stake number and deviation which are defined by the roads design.

In order to use this program the observation station coordinates and backsight azimuth angle need to be set.

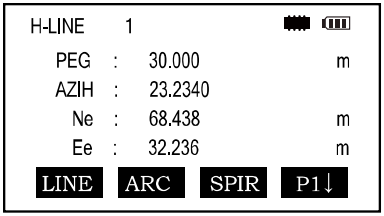
7.6.1 Design: Horizontal Alignment

Horizontal alignment consisted of following elements: start point, straight line, circular curve , transition curve, INTG, WIDE and PEG.

The define option will prompt for the start details（chainage，NEZ，starting azimuth）.



Enter these details in the screen, press [ENT] key to show the mail input routine screen：

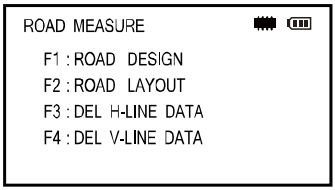
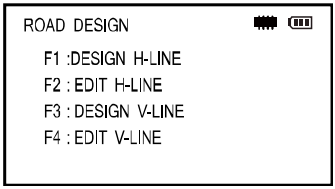
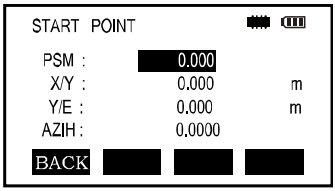
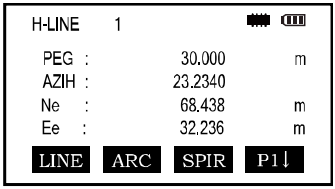


top right corner of the screen shows the number of horizontal alignment.

The main line input screen displays current chainage and the bearing angle (the tangent line from the chainage) and the function key (For creating new line). System provides three functions: defining straight line, circular curve, transition curve. Select a function key, enter the detailed information of the chainage, the alignment elements will be created. Press ENT key, the new chainage and bearing angle will be calculated automatically and the main alignment screen will be restored. Now other line style can be defined, the new elements can be added only in the end of the original alignment file.

Operation procedure is as follows：

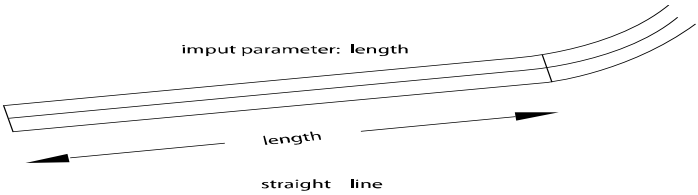
Operation procedure	Operation	Display
In main menu, press F2 key to get MEAS PROGRAM menu, press F4 key to get second page of MEAS PROGRAM menu.	F2 F4	PROGRAMS F1 : POINT TO LINE F2 : POAD MEASURE F3 : LAYOUT F4 : RESECTION ↑
Press F2（ROAD MEASURE）key	F2	SELECT A FILE FN: BACK LIST CHAR

Enter file name, then press ENT key.	F2	
Press F1(ROAD DESIGN)key.	F1	
Press F1(DESIGN H-LINE)key for the H-line menu.	F1	
Input starting chainage, northing coordinate, easting coordinate and starting azimuth. Press ENT key to show the main input routine screen.	Input starting data ENT	

In main input routine screen we can add straight line, circular curve and transition curve to the end of current curve. Select the desired option by pressing F1-F3 keys.

Straight line

When the start point or other line style is well defined it allows you to easily define a straight line. A straight line length value cannot be negative.

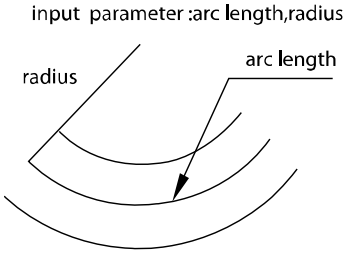


Operation procedure	Operation	Display
Press F1(Line)key from H-LINE menu to get BEELINE.	F1	BEELINE L: 0.000 m BACK
After entering the length of the line press ENT key.	Enter length ENT	BEELINE L: 15.36 m BACK
Return to H-LINE menu.		H-LINE 2 PEG : 230.000 m AZIH : 13.2340 m Ne : 99.369 m Ee : 35.856 m LINE ARC SPIR P1↓

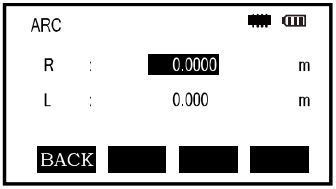
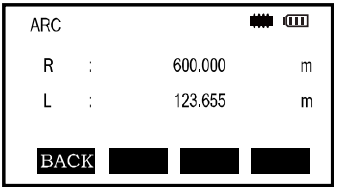
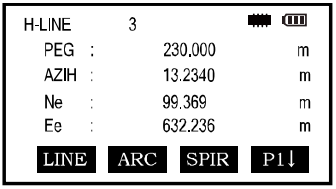
Circular Curve

Press F2 key (ARC) in the "H-LINE Screen", the circular curve can be defined. Circular curves consists of Arc length and the Radius. The radius value rule: Looking along the forward direction of the curve, when the curve rotates to right, the radius value is positive. When the curve rotates to left, the radius value is negative. The arc length cannot be

negative.



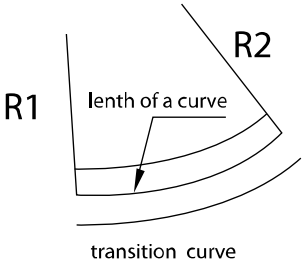
circular ares

Operation procedure	Operation	Display
Press F2(ARC) key from H-LINE menu to get ARC.	F2	
Input the radius of the ARC (R) and press the ENT key. Input the length of the ARC (L) and press the ENT key.	Input R ENT INPUT L ENT	
Return to H-LINE menu with calculated values.		

Transition curve

Press F3 key in the "Main Line Input Screen" and a transition curve can be defined. The inputting of transition curve consists of transition curve parameter "A" , starting radius, and resending radius. If the input radius is ∞ you can input 0 as its value.

input, parameter: radius R1,radius R2, parmeter of a curve(A)

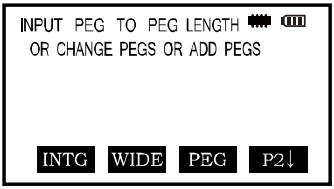
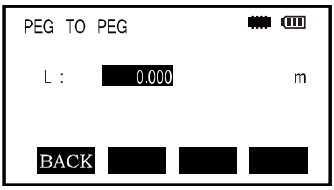
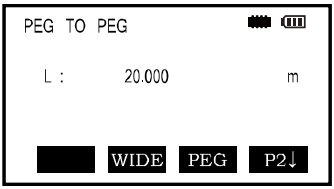


The rule of transition curve parameter A : Looking along the forward direction of the curve. When the curve rotates to right, the radius value is positive. When the curve rotates to left, the radius value is negative.

Operation procedure	Operation	Display
Press F3 key from H-Line menu on page 1	F3	SPIRAL LINE A : 300 m Rs : 62.330 m Re : 500.000 m BACK
Input A，press ENT key. Input radius，press ENT key.	Enter A ENT Enter R ENT	SPIRAL LINE A : 300 m Rs : 62.330 m Re : 500.000 m BACK
Instrument returns to previous mode with solution.		H-LINE 4 PEG : 230.000 m AZIH : 13.2340 m Ne : 99.369 m Ee : 632.236 m LINE ARC SPIR P1↓

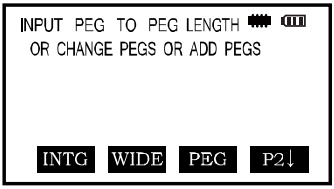
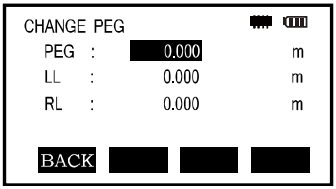
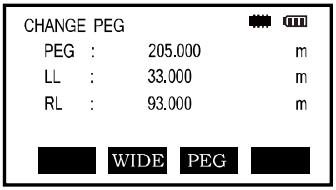
Stake Spacing（INTG）

Press F1 (INTG) on the second page of the main alignment screen then enter into the setting interface of stake spacing interval which needs to be greater than 0.

Operation procedure	Operation	Display
Press F4 on the main alignment screen (1/2) to enter into the main alignment screen (2/2)	F4	
Press F1 to enter into the input interface of stakes space	Enter space ENT	
Return to the main alignment screen.		
Remarks: the stake spacing can be input only once but can be modified during editing of the horizontal alignment.		

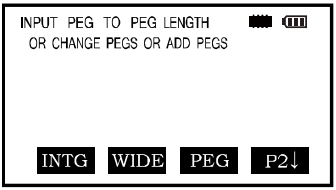
Road Widening Stake Number（WIDE）

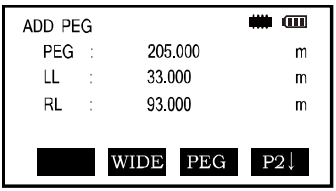
On the second page of the main alignment screen, press F2 (WIDE) to enter into the road widening stake data input interface, and then input the stake number of widening point, left road width and right road width.

Operation procedure	Operation	Display
Press F4 on the main alignment screen (1/2) to enter into the P2 alignment screen (2/2).	F4	
Press F2 (WIDE) to enter into the input interface of road widening stake number.	F2	
Input the stake number, left road width and right road width, and press ENT to confirm.	Enter data ENT	
Remarks: The data of each road widening point will determine the road width between this stake number and next widening point stake number.		

Additional stake number（PEG）

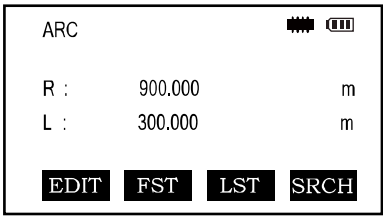
On the second page of the main alignment screen, press F3 (PEG) to enter into the input interface of addition stake data, and then input the stake number of the additional staking point, left road width and right road width.

Operation procedure	Operation	Display
Press F4 on the main alignment screen (1/2) to enter into the main alignment screen (2/2).	F4	

Press F3 (PEG) to enter into the input interface of additional stake number.	F3	
Input the stake number, left road width and right road width, and press ENT to confirm.	Enter data ENT	
Remarks: Two or more additional stake points can be input.		

7.6.2 Editing Horizontal Alignment Data

You can edit the horizontal alignment after input.



From the Road Design Menu select F2: EDIT H-LINE

The function of the soft keys are as follows：

[FST]：Press this key to go to the start of the file，and show the first alignment data；

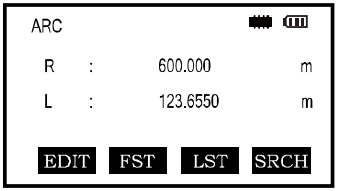
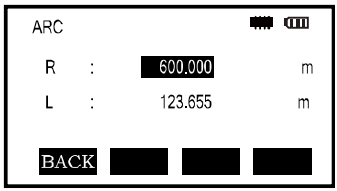
[LST]：Press this key to go to the end of the file，and show the last alignment data；

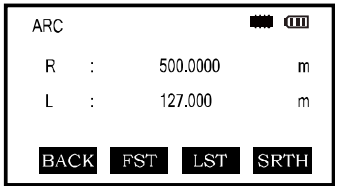
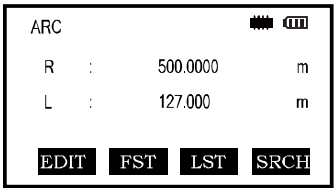
[EDIT]：To edit the current alignment data；

[SRCH]：Search the alignment data by inputting chainage;

It is possible to edit data by using the above function keys. After entering the data to be

modified press [ENT] key to record the modified data.

<table>
<tr><th>Operation procedure</th><th>Operation</th><th>Display</th></tr>
<tr><td>Press F2 (Edit horizontal alignment) on the road design menu to enter into the horizontal alignment editing interface.</td><td>F2</td><td> 
</td></tr>
<tr><td>Through pressing [▲] or [▼], select the alignment data which is required to be modified, and press F1 (edit) to edit it, and finally press ENT (ENTER) to confirm. *1)</td><td>[▲]or[▼]
F1
Enter data
ENT</td><td> 


</td></tr>
<tr><td>Return to the alignment interface, the modified alignment data will be displayed, and then continue to modify the other alignment data as needed</td><td></td><td> 
</td></tr>
<tr><td colspan="3">*1 Or press F4 (search), then input the stake number of the alignment data (chainage) which is required to be modified.</td></tr>
</table>

7.6.3 Receiving Horizontal Alignment

You upload a prepared file of horizontal alignment data from a computer for the

alignment work before setting out.

There are two methods to upload data to the instrument.

1. Directly upload the alignment data to the current operating internal memory from a computer through a data cable (RS-232).

Refer to 10.8 for the operation method

2. Store the alignment data on an SD card, insert the SD card into the instrument and then copy data from SD card to the memory.

Refer to 10.9 for the operation procedures.

The horizontal alignment data format is in the following format:

Number	Data Format	Meaning of Parameters
1	start Z,X,Y,a	Initial Point: Stake number of initial point Z, coordinate X, coordinate Y, initial azimuth a
2	Line Lz	Straight line data: the length of straight line Lz
3	spiral A,Rs,Re	Transition curve data: transition curve parameter A, radius of initial point Rs, radius of end point Re.
4	arc R,Ly	Circular curve data: radius of circular curve R, curve length Ly.
5	wide Zi,wLi,wRi	Widening point data: initiation stake number Zi, width of left road wLi, width of right road wRi.
6	integer L0	Stake Space: the length of stake space is LO
7	peg Zj,wLj,wRj	Additional stake point data: additional stake number Zj, left road width wLj, right road width wRj

Explanation:

1. The data in the first row is the initial point data, and only one point can be entered.

2. The data in the second, third, fourth rows is element data, any combination can be input

according to the requirements.

3. The data in the fifth, sixth, and seventh rows is auxiliary calculation data, choosing whether to enter or not according to the requirements as an option, the default step length is 20m. Only one staking space is available.

4. The transition curve parameter A and circular curve radius R as needed (sign as per the direction of route, curve to left is negative, and curve to right is positive), all other parameters are positive.

5. When the radius of circular curve is ∞, the input radius is 0.

Convert the designed alignment data into *.HAL file using transmission software, then copy the data to SD card or the memory.

For example：

start 0,2541930.604,502841.293,191.5644

line 452.484

arc 1200,165.885

spiral -90,1e20,130

arc -130,214.928

spiral 110,1e20,280

arc 280,77.151

spiral 110,280,1e20

line 100.978

integer 20

wide 0,0,6.5

wide 130.945,1.8,6.5

wide 400,4.5,4.5

wide 1040,0,6.5

peg 130.945,1.8,6.5

peg 220,1.8,0

peg 240,2.338,0

peg 260,2.878,0

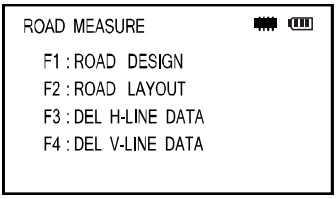
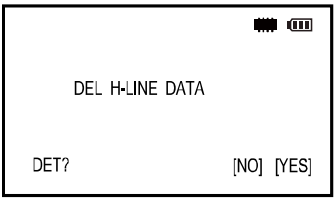
peg 1000,4.5,5.28

peg 1020,4.5,6.038

peg 1033.721,4.5,6.48

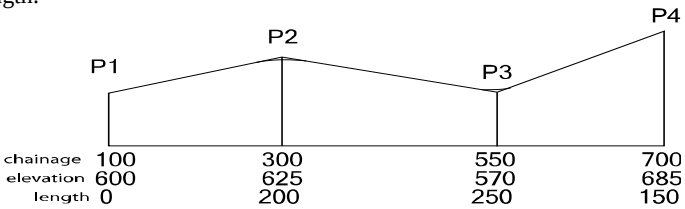
7.6.4 Deleting Horizontal Alignment Data

The horizontal alignment data in the internal memory can be deleted with the procedure as follows:

Operation procedure	Operation	Display
Press F2 (road measurement) in the menu of Measurement Program and choose a file.	F2 Select a file ENT	
Press F3 (DEL H-LINE DATA)	F3	
Press F4 (Yes), the current selected horizontal alignment data will be deleted.		

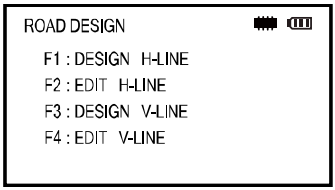
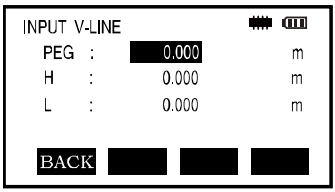
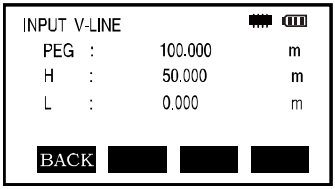
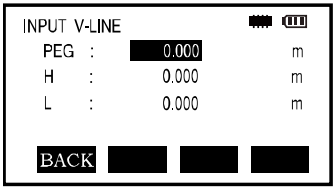
7.6.5 Design: Vertical Curve

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



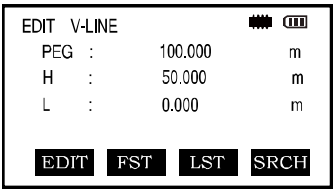
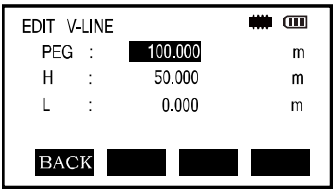
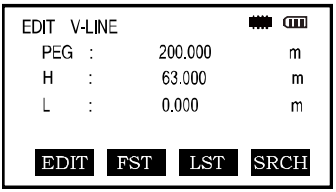
Intersection points can be entered in any order. After entering a point data press ENT to save it and advance to enter the next point. Press ESC to exit without saving.

Operation procedure	Operation	Display
Press F2 key from the menu to get MEAS PROGRAM. Press [] for page 2/2	F2	MEAS PROGRA F1 : POINT TO LINE F2 : ROAD MEASURE F3 : LAYOUT F4 :RESECTION ↑
Press F2 (ROAD MEASURE) key	F2	SELECT A FILE FN: [ ] m BACK LIST CHAR [ ]
Input file name, then press ENT key	ENT	ROAD MEASURE F1 : ROAD DESIGN F2 : ROAD LAYOUT F3 : DEL H-LINE DATA F4 : DEL V-LINE DATA

Press F1 (ROAD DESIGN) key	F1	
Press F3 (DESIGN V-LINE) key	F3	
Input the PEG, H and L of the first point,then press ENT key *1	Enter data ENT	
After inputting each point the menu will advance to the next point. ESC to exit.		
*1 The start and end intersection points must be a zero curve length.		

7.6.6 Editing Vertical Alignment Data

The following procedures are used to edit the data.

Operation procedure	Operation	Display
Press F4 (edit vertical alignment data) in the menu of road design, the last entered point will be shown.	F4	
Press [▲] or [▼] to select the alignment data to be modified. Press F1 (edit) to edit, and press ENT (ENTER). *1	[▲]or[▼] F1 Enter data ENT	
The modified alignment data will be displayed. Continue to select data to modify by using the [▲] or [▼] keys. ESC to end.		
*1Or press F4 (search), then input the stake number of the alignment data (chainage) which is required to be modified.		

7.6.7 Receiving Vertical Alignment Data

The vertical curve data can be prepared in the office and uploaded to the instrument to increase efficiency.

There are two methods to upload data to the instrument.

1. Directly upload the alignment data to the current operating internal memory from a computer through a data cable (RS-232).

Refer to 10.8 for the operation method

2. Store the alignment data on an SD card, insert the SD card into the instrument and then copy the data to memory.

Refer to 10.9 for the operation procedures.

The vertical alignment data format is as follows:

Stake number, elevation, length

Note: The length of the initial point and end point must be 0.

For example：

1015.600，30.000，0.000

1325.000，60.000，200.000

1632.000，27.000，315.000

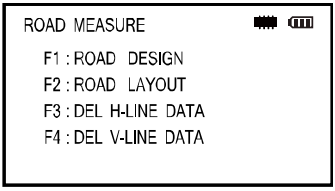
1900.000，33.000，0.000

Convert the designed alignment data into *.VCL file using transmission softwave. Then copy the data to SD card or the memory.

Note: keep the text file and work file names consistant.

7.6.8 Deleting Vertical Alignment Data

The vertical alignment data in the internal memory can be deleted as follows:

Operation procedure	Operation	Display
On measurement procedure menu, press F2 (road measurement) and choose a file.	F2 Select a file ENT	
Press F4 (DEL V-LINE DATA)	F4	
Press F4 (YES), the selected vertical alignment data will be deleted.		

7.6.9 Generating a Road Coordinate File

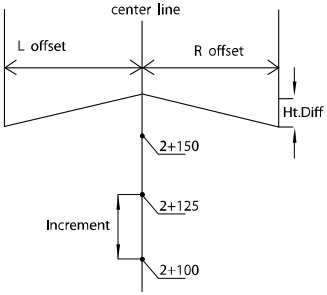
After finishing the operation of vertical and horizontal alignment you can output a coordinate file *.PTS to memory.

The operation procedure is as follows:

Operation procedure	Operation	Display
In the ROAD DESIGN menu press [▼] for menu P2.	[▼]	ROAD DESIGN F1 : CAL AND SAVE CO-ORDINATE TO FILE
Press F1 (CAL AND SAVE COORDINATE TO FILE), the coordinate file *.PTS will be created.	F1	< CONVERT.... >

7.6.10 Road Setting Out Procedures

For the road setting out program the line of the road must be defined. Horizontal and vertical alignment can be done according to the procedures in the previous sections. If vertical data is not required it can be ignored.

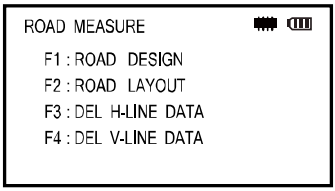
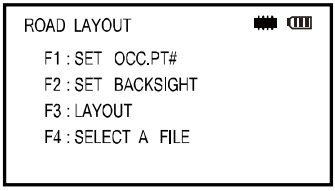
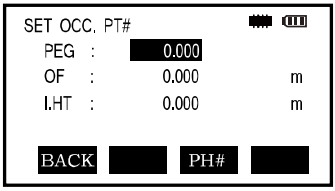
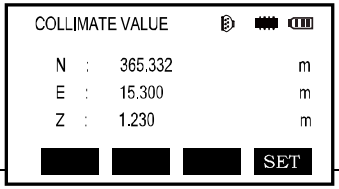


Before setting out the occupied point and backsight should be set. Locations can be determined by the methods described in sections（9.2.3）and（9.2.4) or by inputting stake numbers after defining the horizontal alignment data.

Before setting out, press F4 (select file) on the road setting-out interface to select required coordinate file so as to call the observation station point and backsight point.

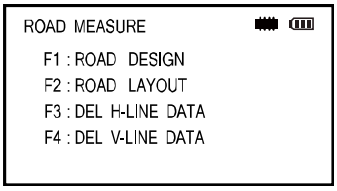
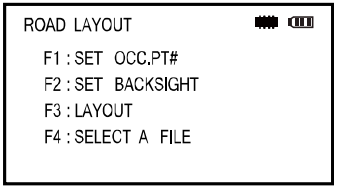
Set observation station point

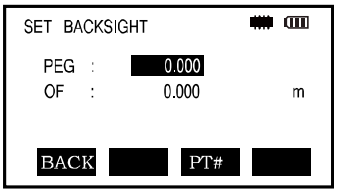
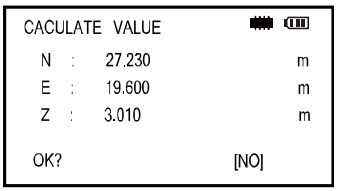
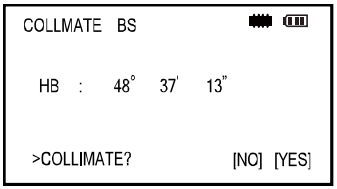
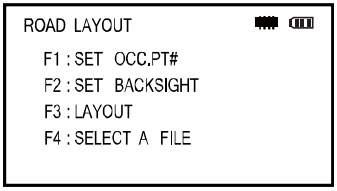
Before setting out, press F4 (select file) on the road setting-out interface to select required coordinate file so as to call the observation station point and backsight point.

Operation procedure	Operation	Display
Press F2 (ROAD MEASURE) in the menu of Measurement Program (2/2). Choose a data file.	F2 Select a file ENT	
Press F2 (ROAD LAYOUT) to enter into the road setting out interface.	F2	
Press F1 key (SET OCC. PT#)	F1	
Input the stake number, offset, and instrument height to set the observation station point. (*1,*2）. Press ENT to confirm,	Enter data ENT	

the instrument will calculate the coordinate of this point automatically.		
Press F4 (setting) to finish the setting of the observation station point and then return to the interface of road setting out menu.	F4	
*1) The input stake number must be on the defined horizontal alignment; otherwise the instrument will display "Invalid Stake Number". *2) Pressing F3 (PT#), you can set the station point from an existing point or by manually entering coordinate values (9.2.3).		

Set backsight point

Operation procedure	Operation	Display
Press F2 (ROAD LAYOUT) in menu 2/2 of ROAD MEASURE.	F2 Select a file ENT	
Press F2 (ROAD LAYOUT) key	F2	

Press the F2 (SET BACKSIGHT) key	F2	
Input the stake number and deviation (offset) to set the backsight point. (*1,*2,*3) . Press ENT to confirm and the instrument will calculate the coordinate of this point automatically.	Enter data ENT	
Press F4 (setting) to finish the setting of the backsight point and the instrument will calculate the backsight azimuth angle automatically.	F4	
Sighting the backsight point, press F4 (YES) to finish the backsight point setting, and then the instrument will configure horizontal circle automatically according to azimuth angle.	F4	

*1) The input stake number must be on the defined horizontal alignment; otherwise, it will display “Invalid Stake Number”.

*2) Pressing F3 (PT#), you can set the station point from an existing point or by

manually entering coordinate values (9.2.3).

*3) The deviation is defined as the distance from offset point to center line.

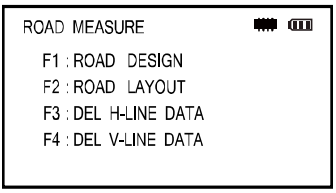
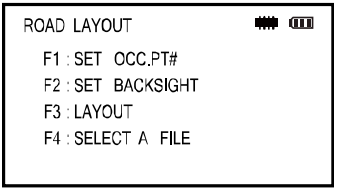
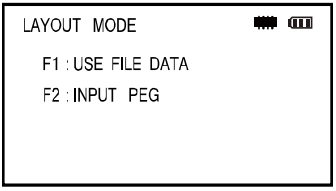
Road setting out

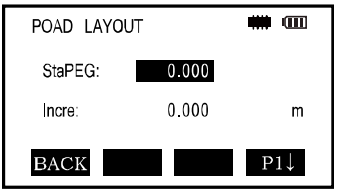
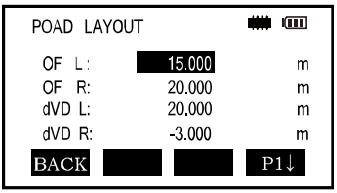
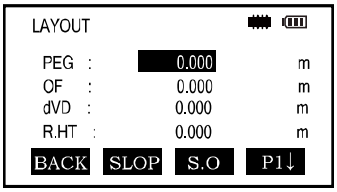
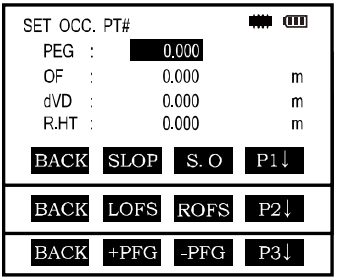
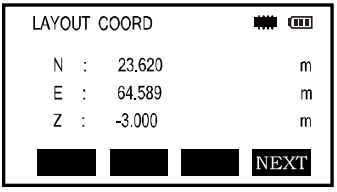
Note：

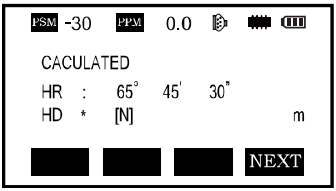
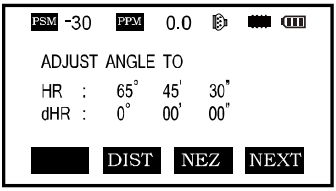
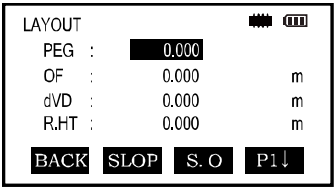
Offset left: the horizontal distance from the left stake point to the center line.

Offset right: the horizontal distance from the right stake point to the center line.

Operation procedure is as follows：

Operation procedure	Operation	Display
Press F2 (ROAD MEASURE) in menu 2/2 of the Measurement Program and choose a file.	F2 Select a file ENT	
Press F2 (ROAD LAYOUT) to enter into the road setting out interface	F4	
Press F3 key (LAYOUT) *1	F3	

Press F2 key (INPUT PEG)	F2	
Input the chainage of the initial stake and the incremental distance of additional stakes, press ENT (ENTER) to confirm. *2	Enter data ENT	
Input the offsets *3 and press ENT (ENTER) to confirm.	Enter data ENT	
Press F4 (P↓) to confirm data of the setting out point. (*4,*5,*6).	F4	
After inputting the data of finished stake number press F3 (LAYOUT) on the first page of software function menu, then the instrument will calculate the	F3	

coordinate of the point to be set out automatically.		
Press F4 (next step) to enter into the interface of the setting-out parameter calculation. *7	F4	
Press F4 (Continue) to adjust dHR to 0. HR: Azimuth angle of setting-out point. dHR : Difference between current azimuth angle and the setting-out point = actual horizontal angle – calculated horizontal angle. A display of Dhr = 0º00'00" means the setting-out direction is correct.	F4	
Press F4 (point changing) to return to ④, and then enter into the input interface of next setting-out point.	F4	

*1) Press F1 to use an existing data file.

*2) Press F4 (P↓) to shift between deviation interface and initial point input interface.

*3) The deviation value of left stake is negative, and the deviation value of right stake

is positive.

*4) On the second page, press F2 (Left) F3 (Right) to switch over among left stake, center line stake and right stake.

*5) On the second page, press F2 (Increase), F3 (Decrease) to switch over between different stake numbers.

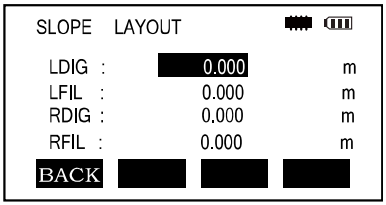
*6) By pressing [▲]or[▼], you can input the deviation, height difference, and elevation of the same stake number manually.

*7) Press F1 (Record) to keep the coordinate of setting-out point.

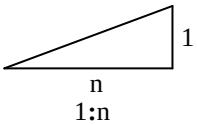
7.6.11 Slope Setting-out

Slope setting-out can be performed as part of the Alignment setout option. After defining the vertical curve and horizontal alignment in the "Define Roads Menu" it is possible to perform slope setting-out. Press the F2 (SLOPE) key, Slope Setout will be displayed.

Main screen of SLOPE LAYOUT：



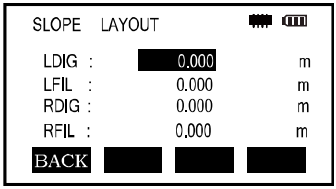
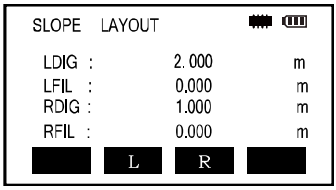
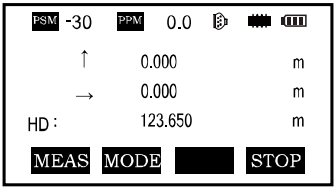
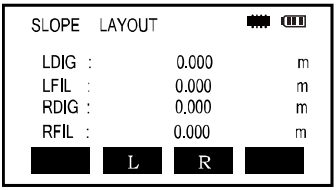
The input cut and fill value ratio is depicted below:



1:n

The left and right slopes may be entered for both cut and fill. Enter the required slopes using positive numbers for both cut and fill. The software selects the appropriate slope from the table depending on whether the situation is on the left or right and in cut or fill.

Cutting or filling is determined by the estimated level at the offset of the hinge point. If the level is above the level of the hinge then the cut slope is used, otherwise the fill slope is used.

Operation procedure	Operation	Display
Press F2(SLOP)key from LAYOUT menu	F2	
Input LDIG, LFIL, RDIG, or RFIL and press the ENT key.*1,*2	Enter data ENT	 
Turn the instrument and measure. When the data displayed in [→] and [↑] is 0, the setting out point is correct.	F1	
To return to the previous mode press the ESC key	ESC	

Note :*1) An intersection can not be computed if the ground surface passes through the hinge point.
*2) The cut is not displayed because the cut at the computed point is zero.

7.7 Stake Out

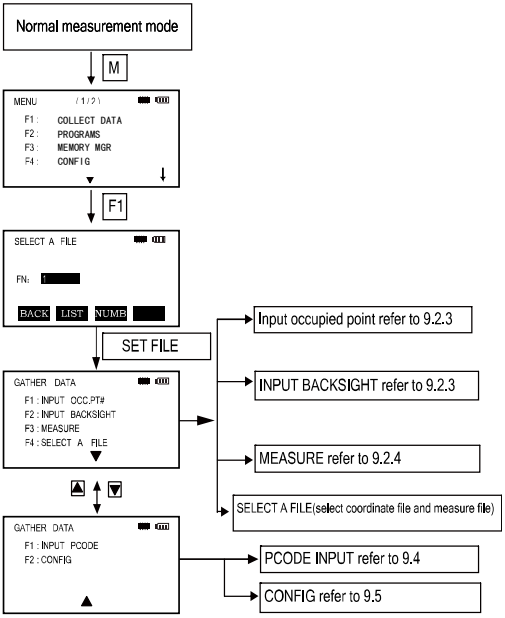
Please refer to Chapter 9 (LAYOUT) for specific operation procedures.

7.8 Resection

Resection will determine an unknown instrument position using a maximum of 7 known coordinates and measurement data.

Specific operation procedures are in section 9.4.2 （Resection）

8. DATA COLLECTION



The total station stores measured data in internal memory or SD card.

The internal memory is shared by the measured data and the coordinate data files.

Measured data:

The collected data is organized into files and you can save measured original data and coordinate data together.

1) When turning the instrument off always have the instrument display on the main menu or angle measurement screen. This ensures completion of the memory access process and avoids possible damage to the stored data.

2)It is recommended to use fully charged batteries to facilitate data collection whenever possible.

8.1 Operation Procedure

1. Select a Data Collection File to save data to.

* You should first go to menu 2/2 of the COLLECT DATA menu, select F2 (CONFIG) and select “YES” or “NO” in “AUTO SAVE COORD.”

2. Select a Coordinate Data file .

3. Set occupied Point including Instrument Height, Point Number and Coordinate.

4. Set Backsight Point, Direction and Azimuth.

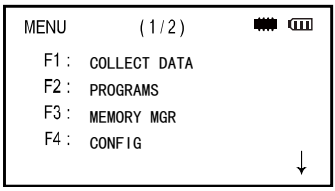
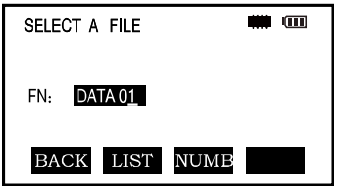
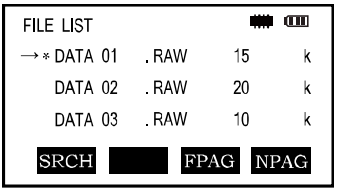
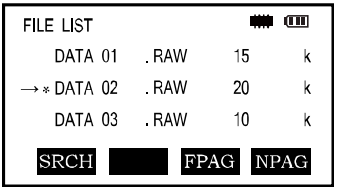
5. Set PT#, PCODE and R.HT ,start collecting and saving data.

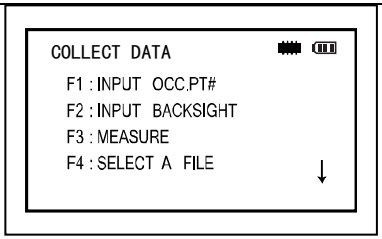
8.2 Preparation

8.2.1 Selecting a File for Data Collection

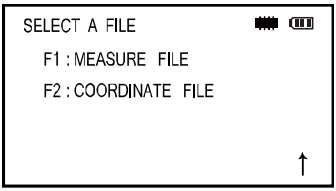
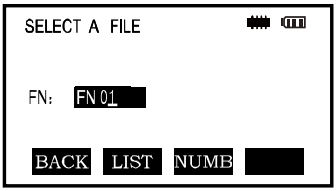
The file used by data collection mode must be selected first.

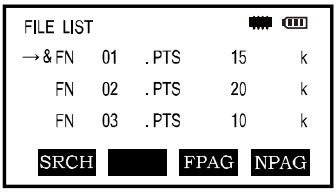
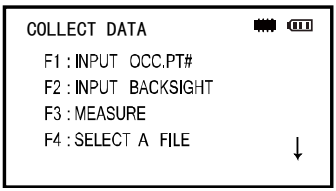
And a selection from data collection menu is possible in the mode.

Operation procedure	Operation	Display
①Press the M key	M	
② Press F1 (COLLECT DATA) key	F1	
③Press F2 (LIST) key to display the list of files *1	F2	
④ Scroll the file list by pressing [▲]or [▼] key, and select a file. (*2,*3)	[▲]or[▼]	

Press the (ENT) key. The file will be set and the COLLECT DATA 1/2 menu will be shown.	F4	
*1) If you want to make a new file or input a file name directly enter a file name and press ENT. *2) When a file has been already selected, a "*" mark is indicated on left of the current file name *3) To search for data use the [▲]or [▼] keys to select a file and press the F1 (SRCH) key.		

8.2.2 Selecting a Coordinate File for Data Collection

Operation procedure	Operation	Display
① Press the F4 (SELECT A FILE) key from the COLLECT DATA menu 1/2.	F4	
② Press the F2 (COORD DATA) key	F2	

③Press the F2 （LIST） key	F2	
④Pressing [▲]or [▼] key to select a file press ENT to return to COLLECT DATA menu 1/2.	ENT	

8.2.3 Occupied Point and Backsight Point

The occupied point coordinates and the direction angle in the data collect mode are linked with the occupied point. It is possible to set or change the occupied point and direction angle from the data collect mode.

Occupied points can be set by two methods:

1) Setting from a known point stored in the internal memory

2) Direct key input

The following three setting methods for backsight point can be selected:

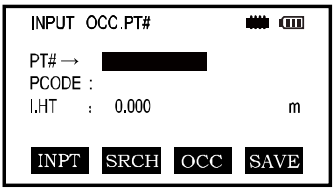
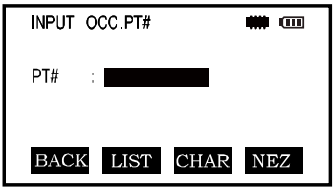
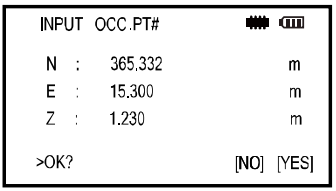
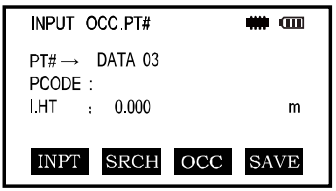
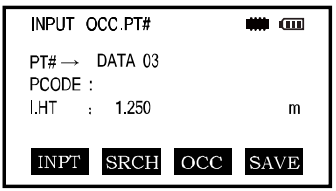
1）Setting from a known point stored in the internal memory

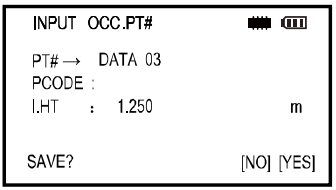
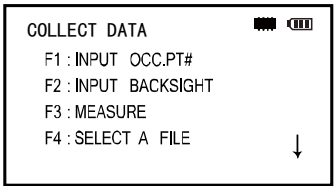
2）Direct key input of coordinate data

3）Direct key input of setting angle

** The setting of the direction angle can be confirmed by measurement.

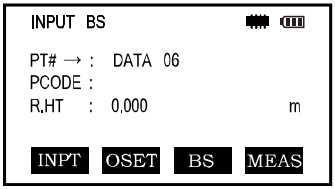
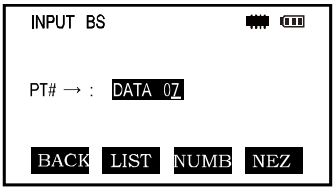
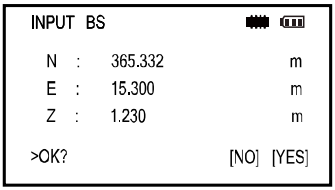
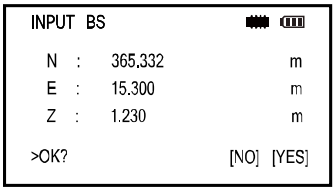
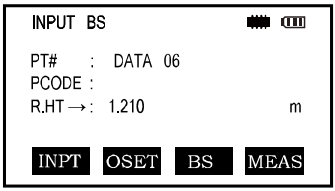
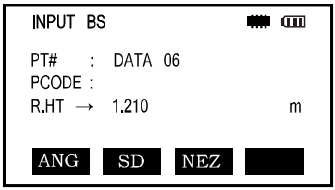
Example of establishing the occupied point from known data:

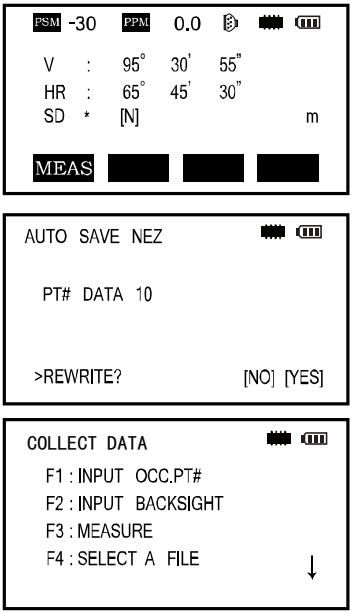
Operation procedure	Operation	Display
①Press the F1 (INPUT OCC.PT #) key from the COLLECT DATA menu 1/2. The previous data is shown.	F1	
②Press the F3 (OCC) key	F3	
③Enter PT #, press ENT key	ENT	
④Press F4 (YES) key to set	F4	
⑤Enter PCODE and INS.HT	Enter PCODE Enter INS.HT	

⑥press F4 (SAVE)key	F4	
⑦Press F4 (YES) key, the display returns to the COLLECT DATA menu 1/2	F4	
The data recorded is PT#, PCODE and INS.HT If a point is not found in internal memory “PT # DOES NOT EXIST” is displayed.		

Example for setting the direction angle：(*The setting of the direction angle must be confirmed by measement.)

The following is to memorize the data of the backsight after setting the backsight point from point number

Operation procedure	Operation	Display
① Press the F2 (INPUT BACKSIGHT) key from the data collect menu 1/2. The previous data is shown.	F2	
②Press the F3 (BS) key	F3	
③Enter backsight point name *1 , press ENT key	ENT	
④Press the F4 (YES) key, collimate the instrument and press F4 (YES), INPUT BS will be displayed.	F4	
⑤ Enter PCODE, R.HT as above . *2	Enter PT # F4	
Press the F4 (MEAS) key	F4	

Collimate back sight point. Select one of the measuring modes and press the soft key. Example： F2 (SD) key - measuring starts. The horizontal circle is set to calculate direction angle. The measuring result is memorized and the display returns to the COLLECT DATA menu 1/2.	Collimate F2	

*1) Refer to Chapter 1.10 “How to Enter Alphanumeric characters”.

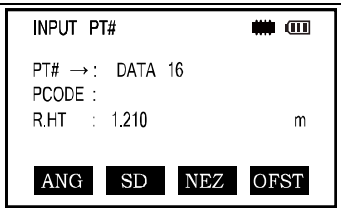
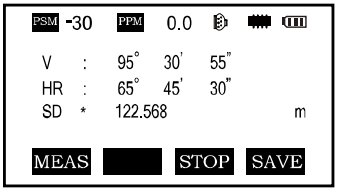
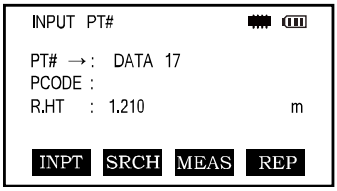
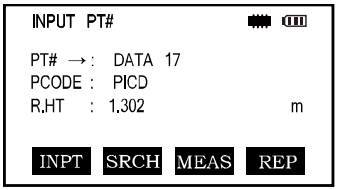
*2)PCODE can be input by inputting a register number linked with the PCODE library.

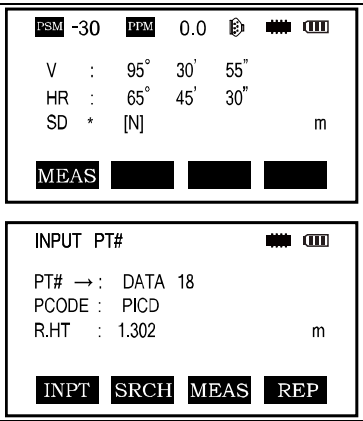
To show the list in the PCODE library press the F2 (SRCH) key.

If the point is not found in internal memory "PT # DOES NOT EXIST” is displayed.

8.2.4 Measuring and Storing the Data

Operation procedure	Operation	Display
①Press the F3 (MEAS) key from the COLLECT DATA menu 1/2 to measure an unknown point.	F3	COLLECT DATA (1/2) F1 : INPUT OCC.PT# F2 : INPUT BACKSIGHT F3 : MEASURE F4 : SELECT A FILE ▼ INPUT OCC.PT# PT# → : PCODE : R.HT : 0.000 m INPT SRCH MEAS ALL
②Press the F1 (INPUT) key and enter the PT # *1 Press the ENT key	F1 Enter PT # ENT	INPUT PH# PT# → DATA 1 PCODE : R.HT : 0.000 m BACK RETN NUMB
③Enter PCODE, R.HT as above *2	F1 Enter PCODE F4 F1 Enter PCODE F4	INPUT PT# PT# : DATA 16 PCODE : R.HT → : 1.210 m BACK RETN NUMB

④Press the F3 (MEAS) key	F3	
⑤Collimate the target point	Collimate	
⑥Press the desired key F1 to F3 to measure. Example: F2 (SD) key and measuring starts. *3 Press F4 (SAVE) to store.	F2	 
⑦Enter the next point data and collimate the instrument.		

⑧Press F4 (REP) key Measuring starts in the same measuring mode of the previous point. Data is recorded Continue the measuring in the same way. Press ESC to finish COLLECT DATA mode.	Collimate F4	

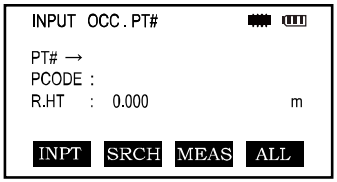
*1) Refer to Chapter 1.10 “How to Enter Alphanumeric characters”.

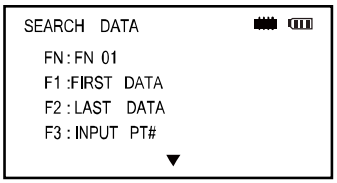
*2) PCODE can be input by inputting a register number linked with PCODE library To show the list in the PCODE library, press the F2 (SRCH) key.

*3) The measurement data will be automatically saved to internal memory when measure mode ONE FINE is selected.

Searching the recorded data

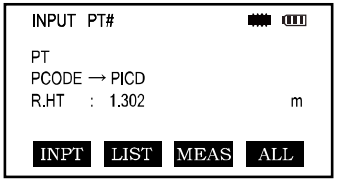
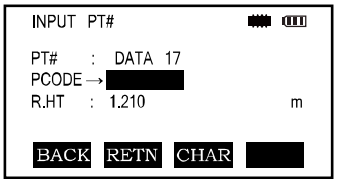
While executing the COLLECT DATA mode you can search the recorded data.

Operation procedure	Operation	Display
① While executing the COLLECT DATA mode, press F2 (SRCH) key.*1 The file name in use will appear on the top of the right side of the display.	F2	

② Select one of three search methods by pressing F1 to F3 key *2	F1—F3	
*1) It is possible to see the PCODE list when the arrow is located beside PCODE or ID. *2) The operation is same as the "SEARCH" in the MEMORY MANAGEMENT MODE For more information, refer to Section 10.3 "Searching Data".		

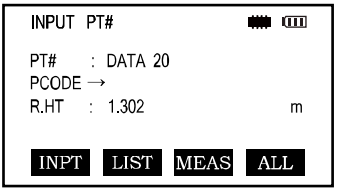
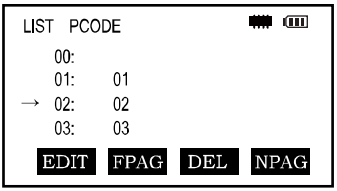
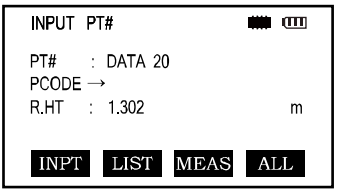
Entering PCODE directly

While executing the Data Collect mode, you can enter PCODE/ID from PCODE Library.

Operation procedure	Operation	Display
①Move the arrow to PCODE in the COLLECT DATA mode, press the F1 (INPUT) key	F1 Enter PCODE ENT	 

Entering PCODE from the list of PCODE's

You also can enter PCODE from the list of PCODE's.

Operation procedure	Operation	Display
① Move the arrow to the PCODE in the COLLECT DATA mode, press the F2 (SRCH) key.	F2	
By pressing the following keys, the register number will increase or decrease. [▲] or [▼]: Increasing or Decreasing one by one.	[▲]or[▼]	
Press the F4 (ENT) key	F4	
*1) To edit the PCODE library, Press the F1 (EDIT) key. To delete the selected PCODE registered press the F3 (DEL) key, PCODE can be edited in COLLECT DATA menu 2/2 or MEMORY MANAGEMENT menu 2/3.		

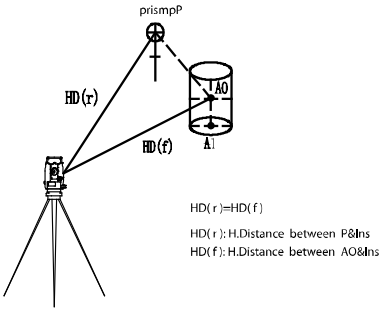
8.3 Data Collect Offset Measurement Mode

This mode is useful when it is difficult to set up the prism directly for example at the center of a tree.

Data Collect Offset Measurement has four measuring methods:

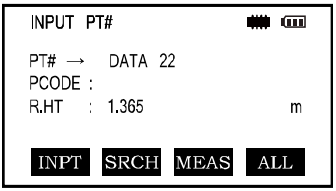
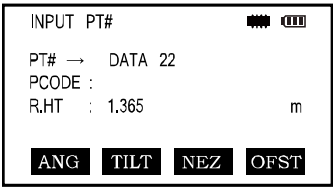
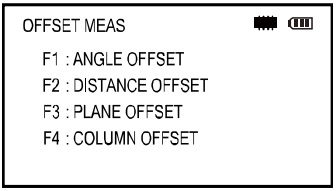
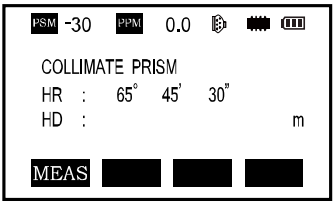
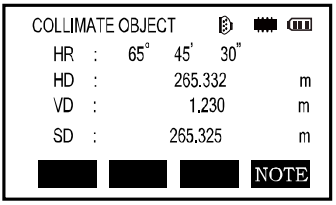
1. Angle Offset Measurement
2. Distance Offset Measurement
3. Plane Offset Measurement
4. Column Offset Measurement

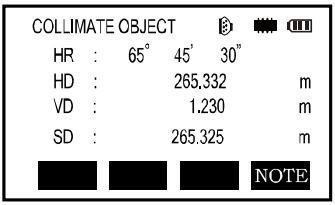
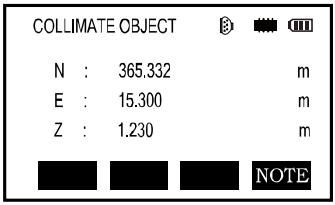
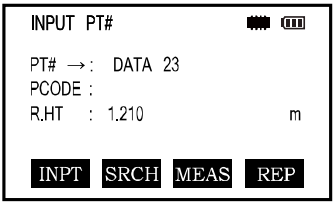
8.3.1 Angle Offset



Place the prism at the same horizontal distance from the instrument as that of the point to be determined (A0). To measure the coordinates of the center position (A0) use the offset measurement feature after setting the instrument height/prism height.

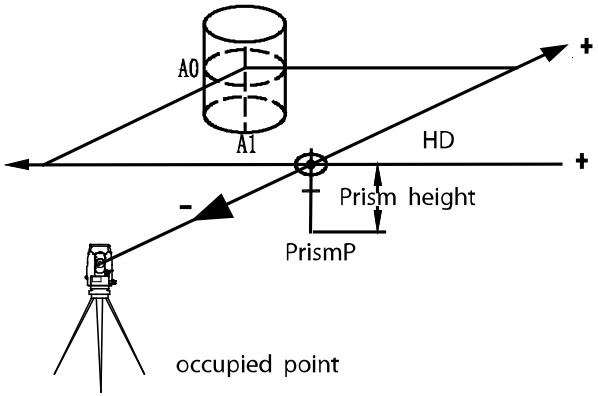
When measuring coordinates of ground point AI: Set the instrument height/Prism height, When measuring coordinates of point A0: Set the instrument height only (Set the prism height to 0).

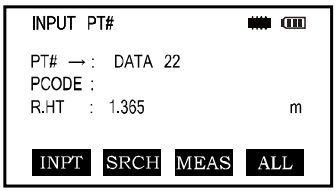
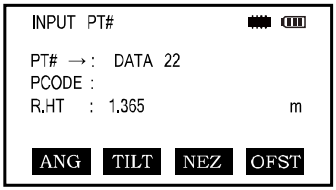
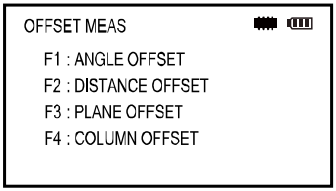
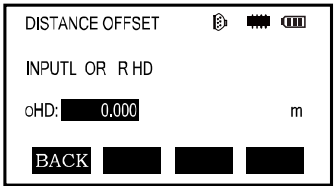
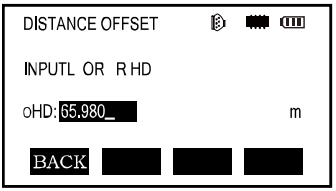
Operation procedure	Operation	Display
①Press F3 (MEAS) key from the COLLECT DATA mode.	F3	 
② Press F4 (OFST) offset key.	F4	
③ Press F1 (ANGLE OFFSET) key.	F1	
④ Collimate the prism	Collimate P	
⑤Press F1 (MEAS) key. Continuous measuring starts, display HR, HD, VD and SD of aim point.	F1	

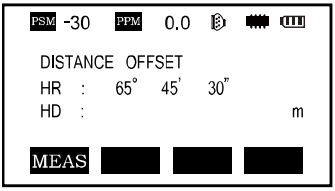
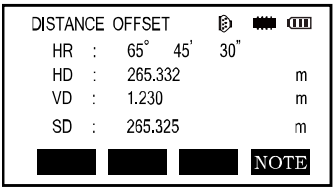
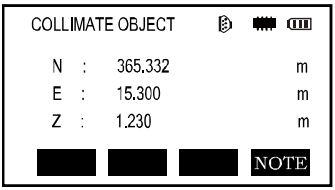
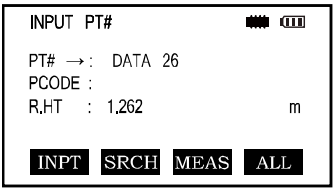
⑥Collimate Point A0 using the horizontal motion clamp and horizontal tangent screw.	Collimate A0	
⑦To show the coordinates of A0 press the [icon] key. Coordinates are shown.	[icon]	
⑧Press F4 key. The data is recorded and the next measuring point is displayed.	F4	

.3.2 Distance Offset Measurement

Obtaining coordinates of a point using a distance offset can be achieved as follows:



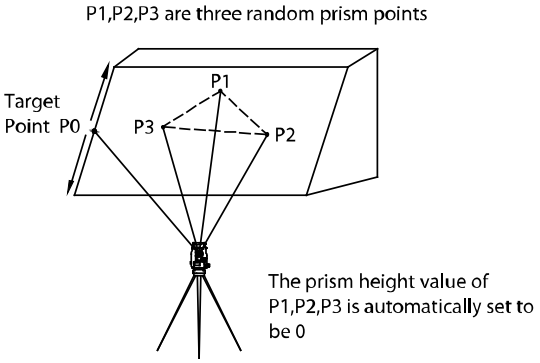
Operation procedure	Operation	Display
①Press F3 (MEAS) key from the COLLECT DATA mode.	F3	 
②Press F4 (OFST) key.	F4	
③ Press F2 (DISTANCE OFFSET) key	F2	
④Enter Right and Left direction offset value (offset left is negative) Press ENTkey.	Enter HD ENT	

⑤Enter Forward direction offset value. (offset towards the front is negative). Press ENT key.	Enter Forward direction offset value ENT	
⑥Collimate the Prism P and press F1, display HR, HD, VD and SD of aim point and add offset correction.	F1 Enter HD F4	 
⑦Press the to display A0 coordinates values, N, E and Z.		
⑧Press F4 (NOTE) key. The data is recorded and the next Measuring point is displayed.	F4	

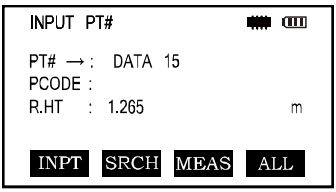
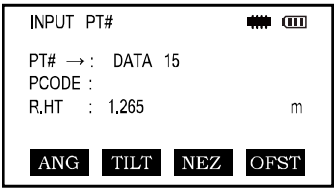
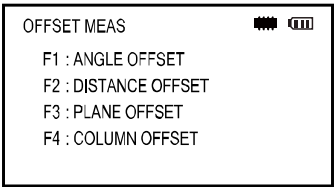
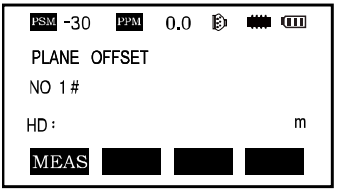
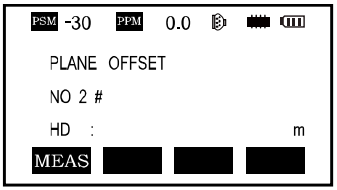
8.3.3 Plane Offset Measurement

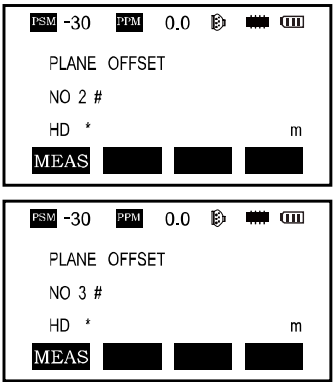
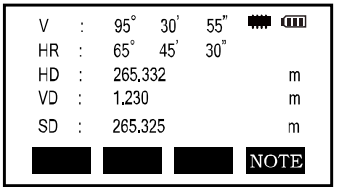
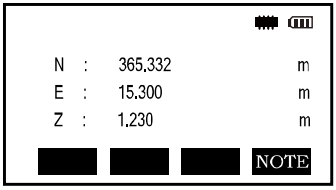
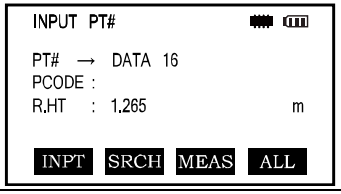
By measuring three known points on a plane other points on that plane can be calculated and determined.

Three random prism points (P1, P2, P3) on a plane need to be measured first. To determine and unknown point collimate the measuring target point (P0), the instrument calculates and displays coordinate and distance value of the cross point between the collimation axis and the plane.



When setting the coordinate value for the occupied station, refer to Section 6.2 “Setting Coordinate Values of Occupied Point”

Operation procedure	Operation	Display
①Press F3 (MEAS) key from COLLECT DATA mode.	F3	 
②Press F4 (0FST) key.	F4	
③Press F3 (PLANE OFFSET) key	F3	
④ Collimate P1, press F1 (MEAS) key. Measuring will start. After measuring, the display will show the second point measurement.	Collimate P1 F1	

⑤Measure the second and third points. The display change to PT# in the plane offset measurement screen.	Collimate P2 F1 Collimate P3 F1	
⑥Collimate the edge (P0) of the plane *1,*2 Instrument displays V, HR, HD, VD and SD	Collimate P0	
⑦Press the  key to display P0 coordinates in N, E and Z.		
⑧Press F4 and the data is recorded. The next offset point number will be displayed.	F4	

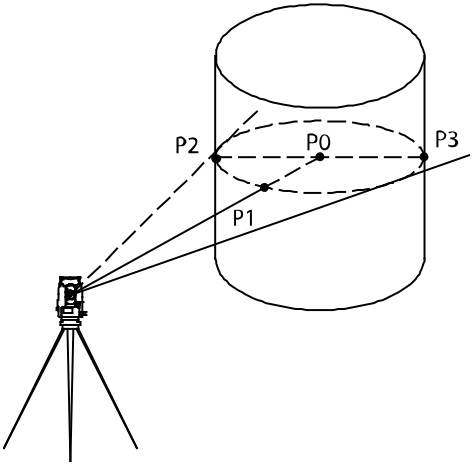
*1) If the calculation of the plane was not successful an error will display. Begin measuring again from the first point.

*2) An error will be displayed when an observation is taken that does not cross the observed plane.

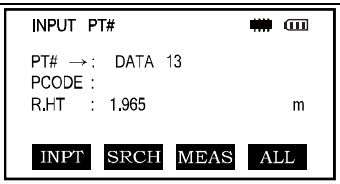
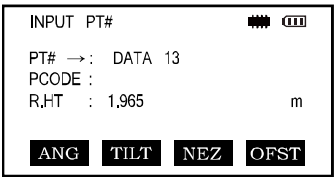
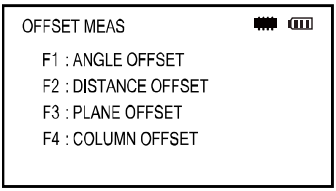
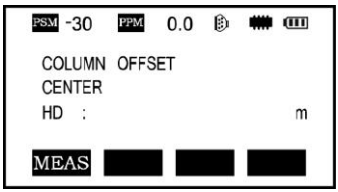
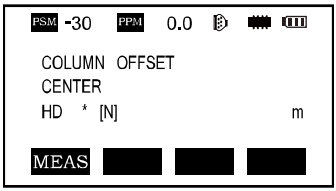
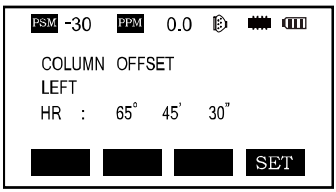
8.3.4 Column Offset Measurement

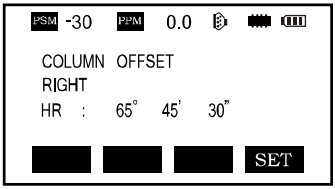
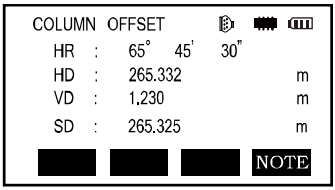
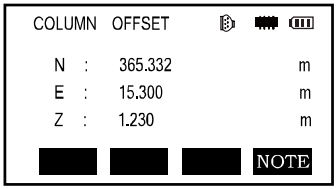
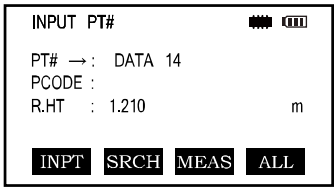
If it is possible to measure the circumscription point (P1) of a column, the distance to the center of the column (P0), coordinate and direction angle can be calculated by observing circumscription points (P2) and (P3).

The direction angle of the center of the column is the average of the observed angles of circumscription points (P2) and (P3).



When setting the coordinate value for the occupied station refer to Section 6.2 “Setting Coordinate Values of Occupied Point”

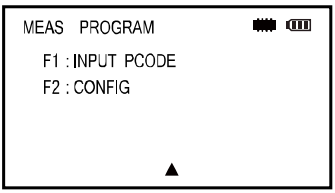
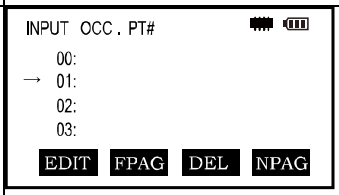
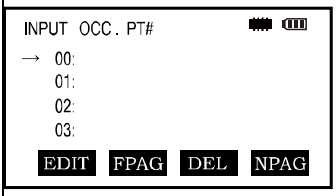
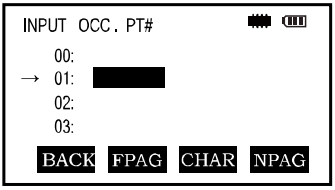
Operation procedure	Operation	Display
①Press F3 (MEAS) key from data collect mode.	F3	 
②Press F4 (0FSET) key.	F4	
③ Press F4 (COLUMN OFFSET) key	F4	
④Collimate the center of the column (P1) and press F1 (MEAS) key. Measuring starts. After the measurement the instrument will display "LEFT" (P2).	F1	 

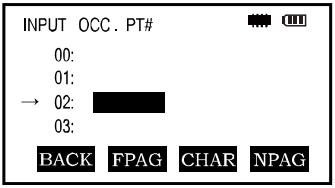
⑤Collimate the left side of the column (P2) and press F4 (SET) key. After the measurement the instrument will display “RIGHT” (P3).	Collimate P2 F4	
⑥Collimate the right side of the column (P3) and press the F4 key, the display shows P0, HR, HD, VD and SD.	Collimate P3 F4	
⑦To show the coordinates of P0, press the key.		
⑧Press F4 and the data is recorded.	F4	

8.4 Editing PCODE Library [PCODE INPUT]

PCODE data can be entered into the PCODE library using the follwing procedures. A PCODE is represented with a number between 1 to 50.

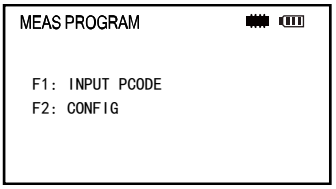
The PCODE data can be also be edited in MEMORY MANAGEMENT menu 2/3.

Operation procedure	Operation	Display
① Press the F1 (PCODE INPUT) key from COLLECT DATA menu 2/2	F1	
② Scroll through the data point list using the [▲]or [▼] keys.	[▲]or [▼]	 
③Press the F1 (EDIT) Key	F1	

④Enter the PCODE and press the (ENT) key, the input window scrolls to the next point *1	F4	
*1) Refer to Chapter 1.10 “How to Enter Alphanumeric characters”.		

8.5 Setting the Data Collection Parameters

The following parameters can be set for the data collection mode.

Menu	Selecting item	Contents
Press the F2 (CONFIG) key from COLLECT DATA menu 2/2		
FI: MEASURE MODE	FINE / TRACK	Selecting distance measurement mode: Fine / Track
F2: MEASURE SEQ	ONE TIMES / REPEAT	Selecting distance measurement mode: one-times / Repeat
F3: SAVE CONFIG	YES / NO	Auto save coordinate data
F4: DATA COLLECT SET	FIRST INPUT PT/ FIRST MEASURE	Point input or measure sequence option

Note: Underlined parameters are default settings.

Set relevant parameters before data collection.

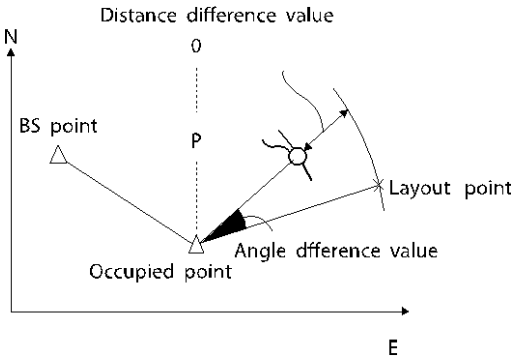
9. LAYOUT

The two functions of LAYOUT mode are staking out known points and surveying unknown points either using a sideshot or resection method. Surveying points can be retrieved from internal memory or coordinates manually entered into the instrument.. The coordinate data is loaded from a computer to the internal memory via RS-232C, USB, or SD card.

The coordinate data is stored in a COORD. DATA file.

For the internal memory refer to Chapter 10 "MEMORY MANAGEMENT MODE"

1) When turning off the power always have the instrument display on the main menu screen or main angle measurement mode screen. Failure to have the instrument in these screens could corrupt the stored data if the instrument is powered off.
2) It is recommended for safety to fully charge the batteries before operation. Always have a fully charged battery on hand for convenience.
3) When recording new data always consider the amount of internal memory available. The SD card port will provide nearly unlimited available storage.



9.1 Setting the Parameters of Data Collection

To use the layout procedure mode use the following steps:

1. Select the data file to record the data collected.
2. Set the occupied point.
3. Set the backsight point or azimuth angle.
4. Input layout point coordinates and follow menu prompts.

9.2 Preparation

9.2.1 Setting the GRID FACTOR

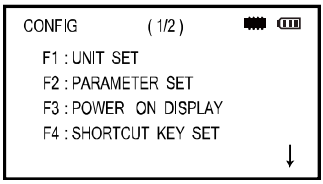
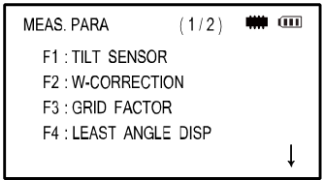
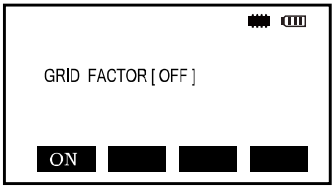
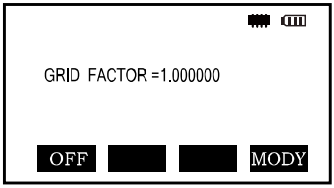
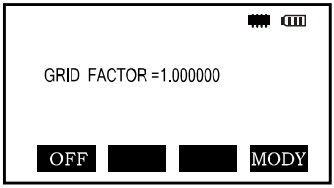
The Grid Factor can be set in the Parameter Set menu of the CONFIG options.

9.2.2 Selecting Coordinate Data File

You can execute a Layout from a selected coordinate data file or you can record new measured data into a selected coordinate data file.

When in LAYOUT MODE the instrument will prompt for a file name.

Operation procedure	Operation	Display
①Press [M] key.	M	MENU (1/2) F1 : GATHER DATA F2 : MEAS PROGRAM F3 : MEMORY MGR F4 : CONFIG ↓

②Press F4 (CONFIG) key	F4	
③Press F2 (PARAMETER SET)	F2	
③ Press F1 (ON) and continue rest set	F1	  

*1) If you want to input file name directly, press the F1 (INPUT)key and enter a file name.

*2) A file will be highlighted by a ▶ indicated on left of the file name. Press ENT to select.

3) For the file discrimination mark (, &,), refer to Section 10.4 "FILE MAINTENANCE"

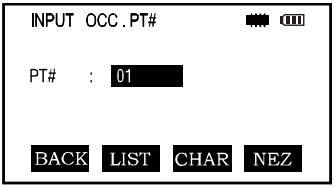
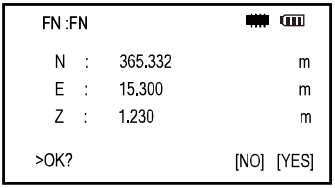
9.2.3 Setting Occupied Point

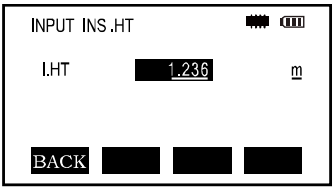
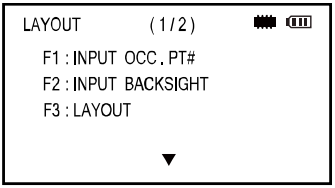
Occupied points can be set by two setting methods:

1) Setting from the coordinate data stored in the internal memory

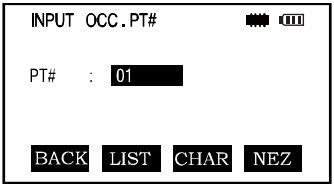
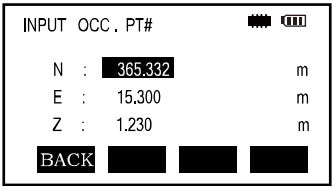
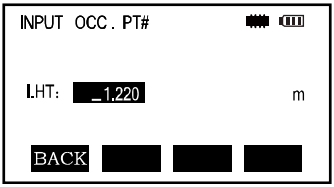
2) Direct key input of coordinate data

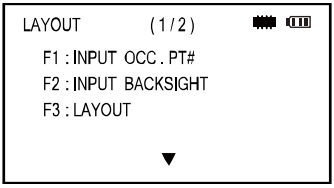
Setting the occupied point from the internal coordinate data file.

Operation procedure	Operation	Display
① Press the F1 (0CC. PT INPUT) key from the Layout menu 1/2.	F1	
②The point can be manually entered or retrieved by F2 LIST. Press ENT key to confirm.	ENT	

③Press the F4 (YES) key to get to the instrument height.	F4	
④Enter INS.HT press ENT. The display returns to layout menu 1/2.	Enter INS.HT ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”		

Example setting: Setting the instrument point coordinates directly

Operation procedure	Operation	Display
Press the F1 (OCC. PT INPUT) key from the Layout menu 1/2. The previous data is shown.	F1	
Press the F4 key	F4	
Enter the coordinate value and press the ENT key. The menu will advance to the INPUT INS HT display.	Enter coordinate ENT	

Enter Instrument Height, press ENT. The display returns to layout menu 1/2.	Enter INS.HT ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”		

9.2.4 Setting Backsight Point

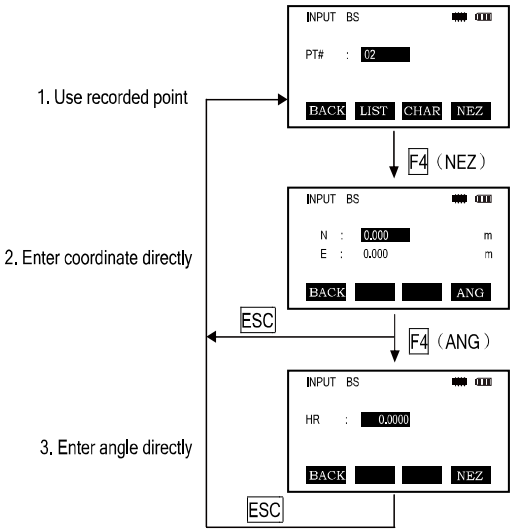
The following three methods for the Backsight point can be used:

1) Setting from the coordinate data file stored in the internal memory.

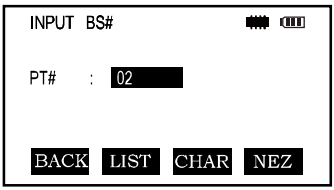
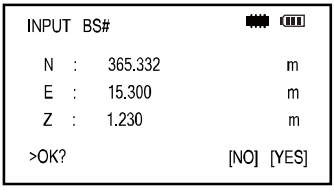
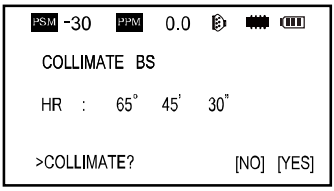
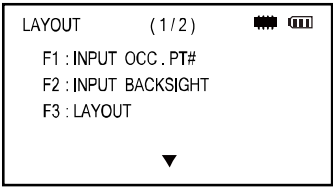
2) Direct key input of coordinate data.

3) Direct key input of azimuth.

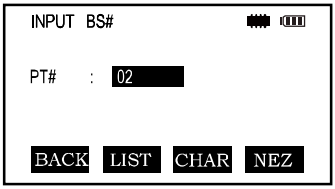
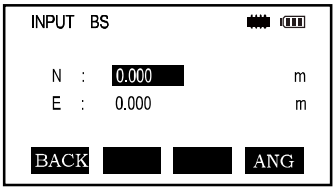
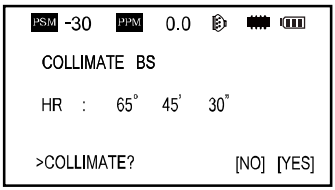
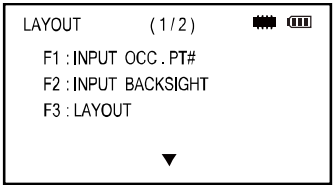
Every press of the F4 key will switch the inputting backsight orientation angle and inputting coordinate data of backsight point directly.



Example setting: Setting the backsight point from the internal coordinate data file

Operation procedure	Operation	Display
Press the F2 (BACKSIGHT INPUT) key from the Layout menu.	F2	
Enter PT# or F2 LIST and select a point *1, press the ENT key.	Enter PT# ENT	
Press the F4 (YES) key , instrument will calculate automatically and show the backsight set display.	F4	
Sight the backsight point and press the F4 (YES) key. The display returns to the layout menu 1/2	Sight BS F4	

Example: Setting instrument point coordinates directly.

Operation procedure	Operation	Display
Press the F2 (BACKSIGHT INPUT) key from the Layout menu 1/2. The previous data is shown.	F2	
Press the F4 (NEZ) key	F4	
Enter the coordinate value and press the ENT key*1	Enter coordinate ENT	
Sight the backsight point	Sight BS	
Press the F4 (YES) key The display returns to the layout menu 1/2.	F4	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”		

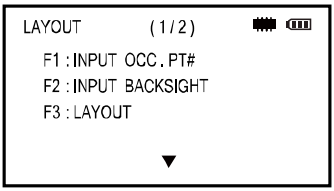
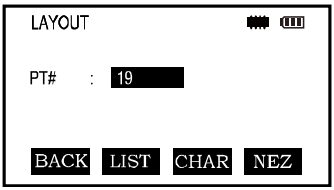
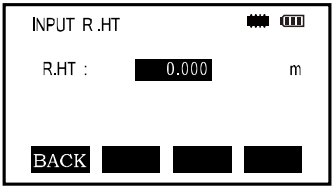
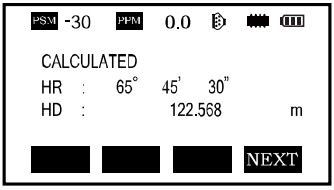
9.3 Executing a Layout

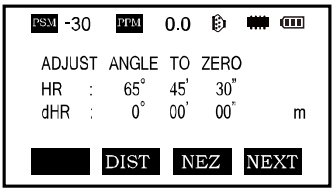
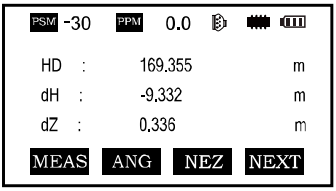
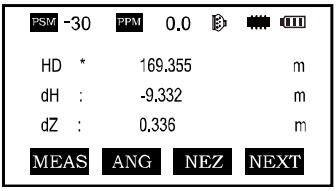
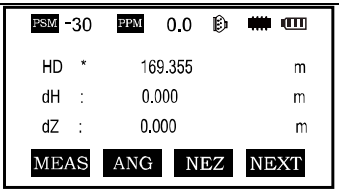
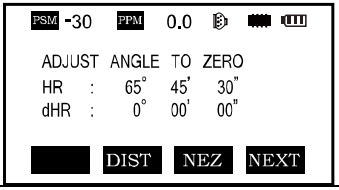
The following methods can be selected for executing a Layout:

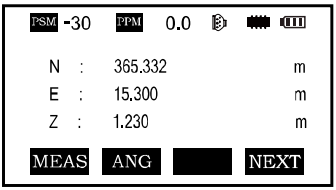
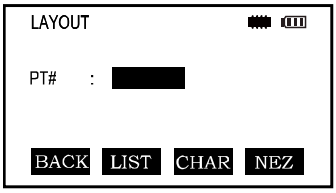
1) Recall points from internal memory by point number

2) Direct key input of coordinate values

Example setting: Recalling a point from internal memory

Operation procedure	Operation	Display
Press the F3 (LAYOUT) key from the layout menu 1/2.	F3	 
Enter the PT# and press the ENT key *2 to get to reflector height screen.	Enter PT# ENT	
Enter the reflector height and press ENT. After inputting values the instrument will calculate the layout point position. HR：Calculated horizontal angle of the layout point HD ： Calculated horizontal distance from the instrument to the layout point.	Enter R.HT F4	

Press the F4 (NEXT) key . HR : Measured (actual) horizontal angle dHR: difference in calculated angle in relation to actual observed angle. Collimate the instrument to dHR=0º00'00"	Collimate	
Press the F2 (DIST) key HD : Measuring (actual) horizontal distance dH : Horizontal distance remaining to the layout point. dZ: Vertical distance remaining to the layout point.	F2	
Press the F1 (MEAS) key. The fine mode measuring starts.	F1	
⑦When the display value dHR, Dhd and DZ are equal to 0 the layout point is established *3		 

Press the F3 (NEZ) key. The measured coordinate data is shown to confirm the value of the layout point.	F3	
Press the F4 (NEXT) key to set next layout point.	F4	

*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”

*2) A point number can not be entered when data to comply with the coordinate value does not exist in the file.

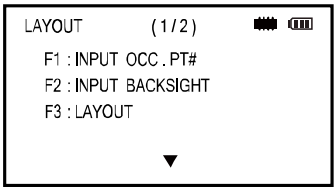
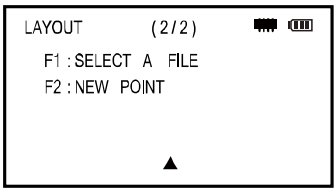
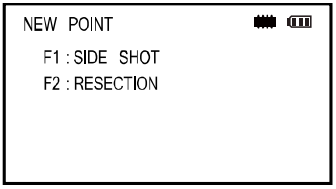
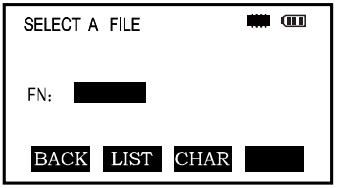
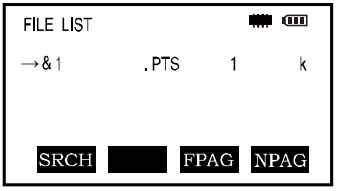
*3) Pressing the  or ANG keys can switch between the layout angle and distance.

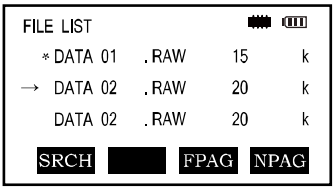
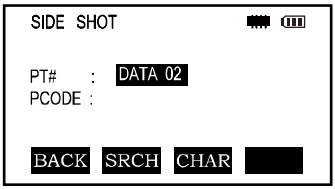
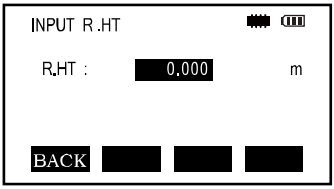
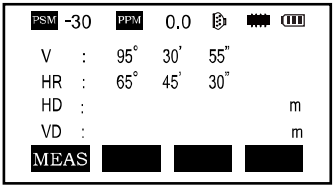
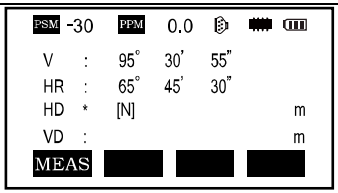
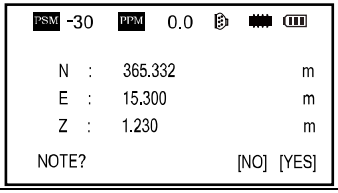
9.4 Setting A New Point

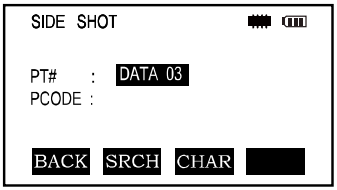
New points can be established by the instrument either using a sideshot or resection method.

9.4.1 Side Shot Method

Set up the instrument at a known point and measure the coordinate of the new points by the side shot method.

Operation procedure	Operation	Display
Press the [▼] key from the layout menu 1/2 to get the layout menu 2/2.	F4	 
Press the F2 (NEW POINT) key	F2	
Press the F1 (SIDE SHOT) key	F1	
Press the F2 (LIST) key to display the list of coordinate data files *1	F2	

Scroll file list by pressing the [▲]or[▼]keys and select a file to use *2,*3	[▲]or[▼]	
Press the F4 (ENT) key. The file will be set.	F4	
Enter the new point name and code.*4 Press the ENT key and the instrument will prompt for the target height.	Enter PT# ENT	
Enter the reflector height and press the ENT key.	Enter R.HT ENT	
⑨Collimate the new point and press the F1 (MEAS) key. Distance measuring starts.	Collimate F1	 

⑩Press the F4 (YES) key *5 The name and coordinate value are stored into the COORD DATA. The input menu for next point is displayed and the PT# is automatically incremented.	F4	

*1) If you want to input a file name directly press the F1 (INPUT) key and enter a file name.

*2) A file will be highlighted by a ▶ indicated on left of the file name. Press ENT to select. For the file discrimination mark refer to Chapter 10.4 "FILE MAINTENANCE".

*3) Data in a file indicated with ▶ can be searched by pressing the F2 (SRCH) key.

*4) Refer to Section 1.10 "to Enter Alphanumeric characters".

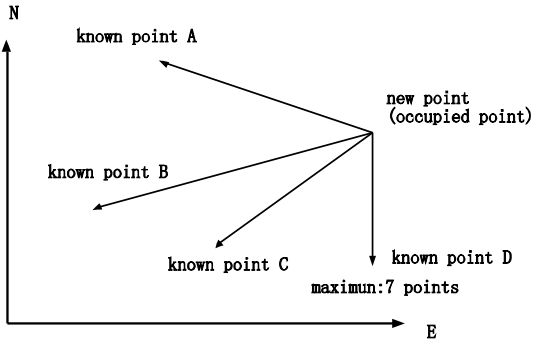
*5) An error will be displayed when the

9.4.2 Resection Method

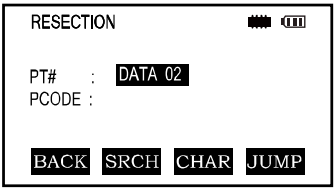
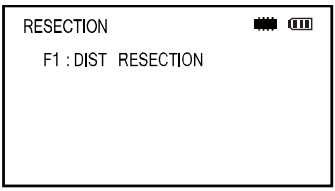
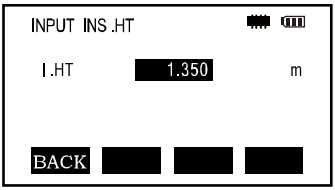
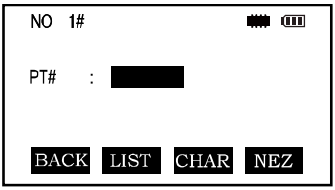
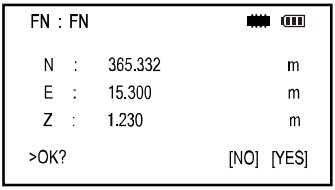
The location of a new point can be determined by observing up to a maximum of seven known points.

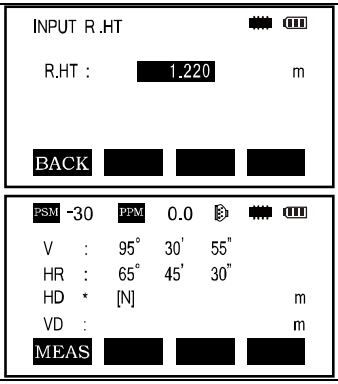
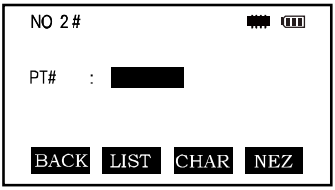
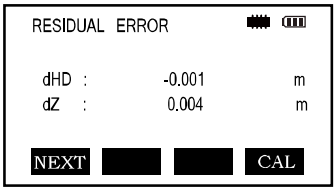
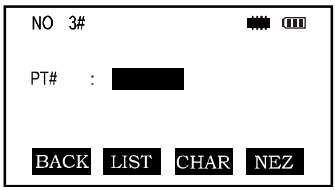
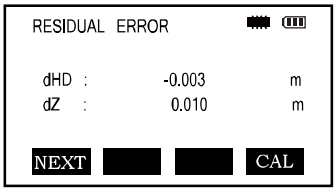
*Resection by distance measurement: 2 or more points must be measured, the angle between two points should not exceed 180°.

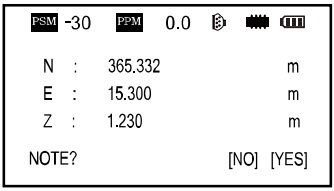
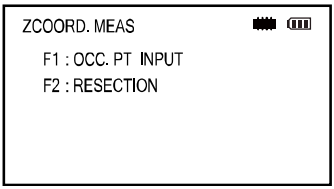
The occupied point coordinate value will be calculated using the least squares method. (except in the case of 3 known points measured by angle measurement only).



Operation procedure	Operation	Display
Press the [▼] key from the ½ layout menu to get to the 2/2 layout menu screen.	F4	LAYOUT (2/2) F1 : SELECT A FILE F2 : NEW POINT ▲
Press F2 (NEW POINT) key	F2	NEW POINT F1 : SIDE SHOT F2 : RESECTION
Press F2 (RESECTION) key	F2	SELECT A FILE FN: BACK LIST CHAR

Enter the File Nane (FN) of the new point and press the ENT key	Enter FN ENT	
Enter the new point name *1,*2 Press the ENT key Enter PCODE press the ENT key again.	Enter PT# ENT	
Press F1 (DIST RESECTION) key	F1	
Enter the instrument height. Press ENT key.	Enter INS.HT ENT	
Enter the first known point number “A” .*3	Enter PT# ENT	

Enter the reflector height, press the ENT key.	F4 Enter R.HT ENT	
⑩Collimate the known point "A" and press F1 (MEAS) the screen advances the the next PT# screen.	Collimate A F1	
⑪Repeat the procedure for the known point "B". *4	Collimate B F1	
⑫ Press F1 (MEAS) key to measure other points. Maximum of seven points.	F1	
⑬Repeat procedure as needed.	Collimate C F1	

⑭Press the F4 (CALC) key. Coordinate data of the new point will be shown.	F4	
⑮Press F4 (YES) key *5 The new point data will be stored into the coordinate data file and the value of occupied coordinate data will change to that of the calculated new point.	F4	

*1) See Section 1.10 “How to Enter Alphanumeric characters”

*2) When there is no need to store the new point data press F3 (SKP) key.

*3) To enter the known point coordinate data by directly press F3 (NEZ) key.

*4) RESIDUAL ERROR

dHD (Horizontal distance between two known points)= Measured Value - Calculated Value

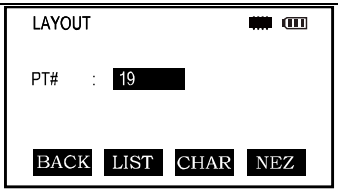
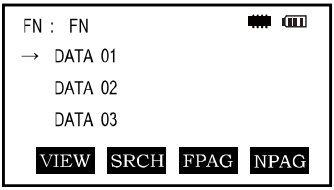
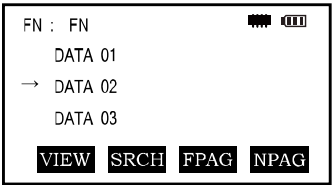
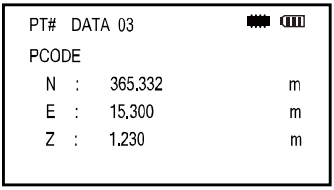
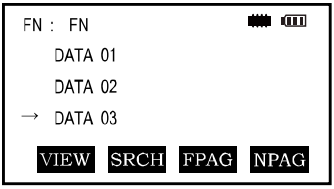
dZ (Z coordinate of the new point calculated from known point A) - (Z coordinate of the new

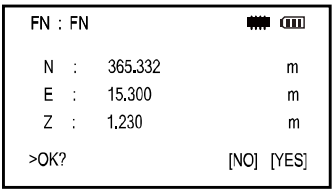
point calculated from Point B)

*5) If the F3 (NO) key is pressed the new point data is not stored to the coordinate data file, only the value of the occupied coordinate data changes to that of the calculated new point.

View Coordinate Data

You can audit the PT# list and enter data from the list you can also see the coordinate data of a point.

Operation procedure	Operation	Display
While executing the Layout Mode, press the F2 (LIST) key. the arrow (▶) indicates selected data	F3 F2	 
②To scroll through the data use the [▲]or[▼] keys.	[▲]or[▼]	
③To show the coordinates of the selected data press the F1 (LIST) key. To scroll through the PT# data use the [▲]or[▼] keys.	F1	
④Press ESC key. The display returns to the list.	ESC	

⑤Press ENT the key. The selected point number is set as the PT# to layout	ENT F4	

10. MEMORY MANAGEMENT MODE

The following internal memory settings are available in this mode:

1) MEMORY MEDIUM: Choose the current data storage medium (flash / SD card)

2) FILE STATE: Checking the number of stored data / Remaining internal memory capacity.

3) DATA SEARCH: Search the recorded data

4) FILE MAINTAIN: Deleting files / Editing file name

5) INPUT COORDINATE: Inputting coordinate data into coordinate data file

6) DEL COORDINATE: Deleting coordinates from a coordinate data file

7) PCODE INPUT: Inputting PCODE DATA into the PCODE library

8) DATA TRANSFER: Sending measured data or coordinate data or PCODE Library data / Uploading coordinate data or PCODE library data/setting

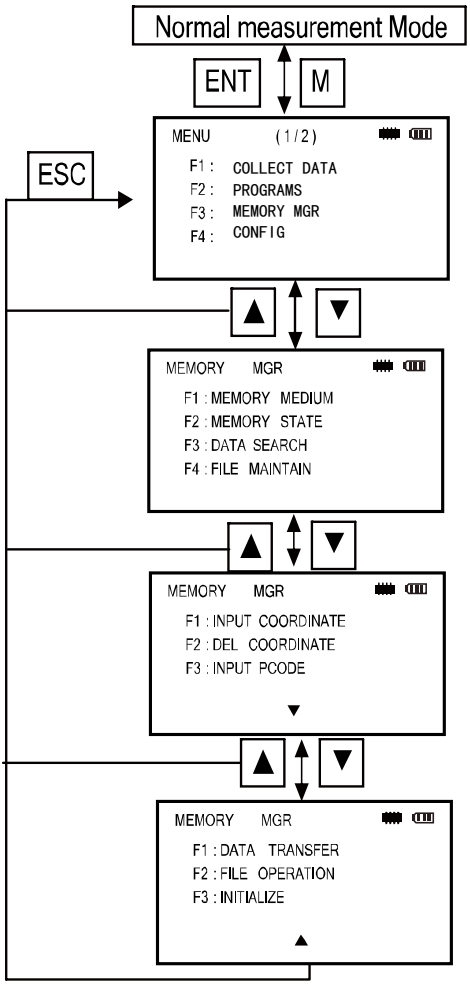
9) FILE OPERATION: Exchange the files of the FLASH memory and SD CARD with each other.

10) INITIALIZE: Initializing internal memory

Memory manager menu operation:

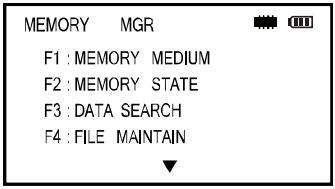
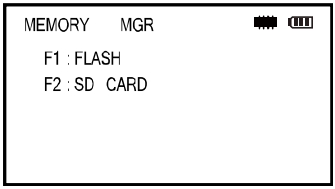
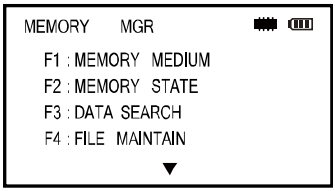
By pressing the M menu key the instrument will be in MENU 1/2 mode.

Press the F3 (MEMORY MGR) key, the menu of MEMORY MGR 1/3 will be shown.


Normal measurement Mode
ENT
M
ESC
MENU (1/2)
F1 : COLLECT DATA
F2 : PROGRAMS
F3 : MEMORY MGR
F4 : CONFIG
MEMORY MGR
F1 : MEMORY MEDIUM
F2 : MEMORY STATE
F3 : DATA SEARCH
F4 : FILE MAINTAIN
MEMORY MGR
F1 : INPUT COORDINATE
F2 : DEL COORDINATE
F3 : INPUT PCODE
MEMORY MGR
F1 : DATA TRANSFER
F2 : FILE OPERATION
F3 : INITIALIZE

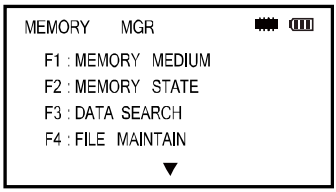
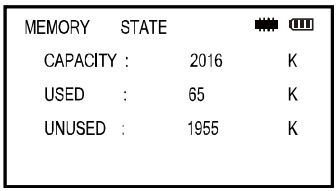
10.1 Choose Storage Medium

This mode is used to select the storage medium.

Operation procedure	Operation	Display
Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
Press F1 (MEMORY MEDIUM) key	F1	
Press the F1 or F2 key to choose the desired storage medium. The menu returns to MEMORY MGR (1/3)	F4	
Note：If the SD card is not present “NO SD CARD!” will be shown on the display.		

10.2 Display Internal Memory Status

This mode is used to check the internal memory status.

Operation procedure	Operation	Display
Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
Press the F2 (MEMORY STATE) key The total capacity, capacity used by the stored data, and free memory is displayed.	F2	
Note: To return to MEMORY MGR menu press the ESC key.		

10.3 Searching Data

This mode is used to search the recorded file data.

The following 3 search methods in each type of file can be selected:

1. First data search
2. Last data search
3. Point number search (MEAS. DATA, COORD. DATA)

Number search (PCODE LIB)

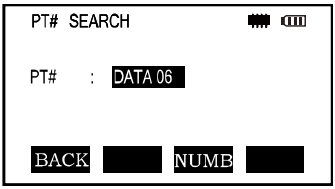
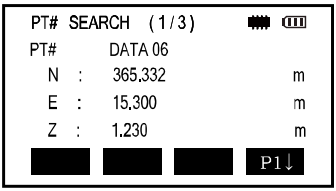
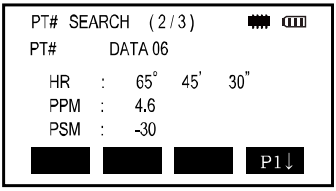
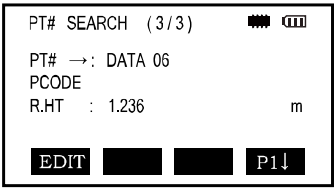
MEASURE DATA: Measured data in the data collect mode

COORDINATE DATA: Coordinate data for layout, control points and new point data measured in the layout mode

PCODE DATA: The data which is registered with a number from 1 to 99 in the Point Code library.

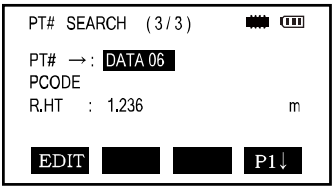
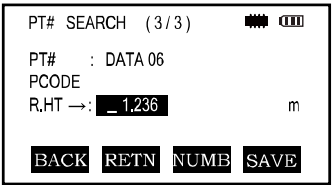
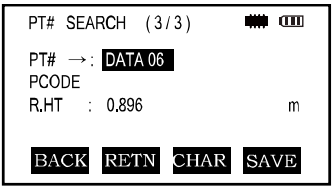
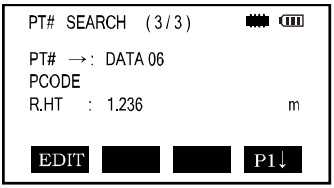
10.3.1 Measured Data Searching

Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	MEMORY MGR F1 : MEMORY MEDIUM F2 : MEMORY STAT F3 : DATA SEARCH F4 : FILE MAINTAIN ▼
② Press the F3 (DATA SEARCH) key	F3	SEARCH DATA F1 : MEASURE DATA F2 : COORDINATE DATA F3 : PCODE DATA F4 : PLOT POINT ▼
③ Press the F1 (MEASURE DATA) key	F1	SELECT A FILE FN: FN01_ BACK LIST NUMB
④Enter the file name and press the ENT key *1,*2	Enter FN ENT	SEARCH DATA FN : FN 02 F1 : FIRST DATA F2 : LAST DATA F3 : INPUT PT# ▼

⑤Press the F3 key to enter PT#, then press the ENT key.	F3 Enter PT# ENT	
Press the F4 (P↓) key to scroll the data for the selected point.	F4	  
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”. *2) To show the file list, press the F2 (LIST) key. Press the [▲]or[▼] key to scroll to next or previous point.		

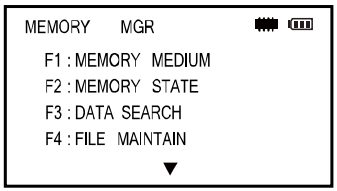
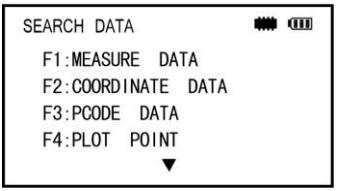
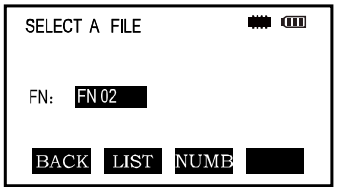
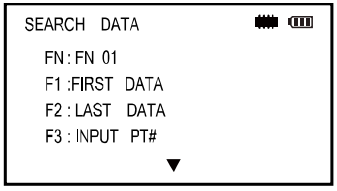
Edit measured data in search mode

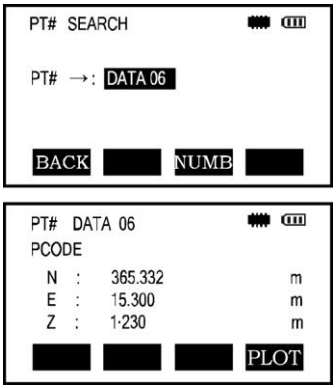
In this mode PT#, ID, Pcode, Instrument Height and Prism Height can be changed but the measured data can not be modified.

Operation procedure	Operation	Display
①Press F1 (EDIT) key in data display 1/3.	F1	
②Press[▲]or[▼]key to select the data item to be modified.	[▲][▼]	
③Enter data. Press ENT key	Enter data ENT	
④Press the F4 (SAVE) key and the corrected data is stored.	F4	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.		

10.3.2 Coordinate Data Searching

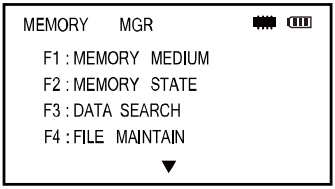
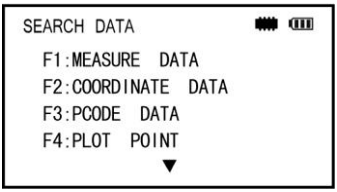
Example searching: Point number searching

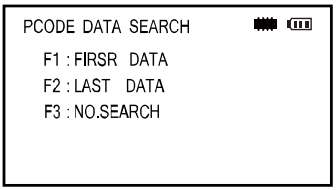
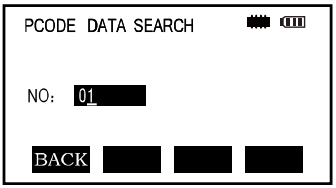
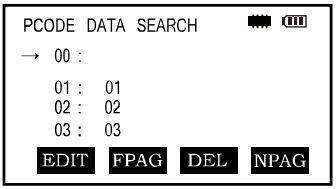
Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2	F3	
② Press the F3 (DATA SEARCH) key	F3	
③Press the F2 (COORD DATA) key	F2	
④Enter the File Name and press the ENT key *1,*2)	Enter FN ENT	

⑤Press the F3 key to enter the PT#, then press the ENT key.	F3 Enter PT# ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”. Press the [▲]or[▼] key to scroll to next or previous point.		

10.3.3 PCODE LIBRARY Searching

Example searching: Register number searching

Operation procedure	Operation	Display
①Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
②Press the F3 (DATA SEARCH) key	F3	

③Press the F3 (PCODE DATA) key	F3	
④Press the F3 (NO. SEARCH) key	F3	
⑤Enter the register number and press the (ENT) key *1 The number and linked data will be shown.	Enter Register no. ENT	

*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.

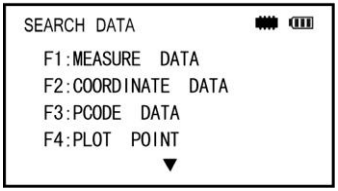
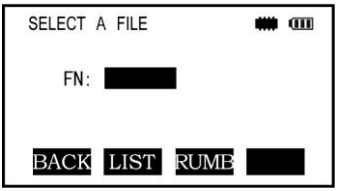
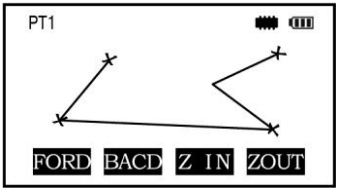
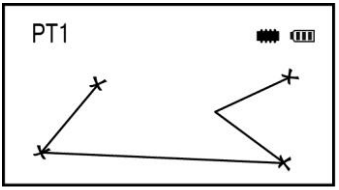
Press the [▲] or [▼] key to scroll to next or PCODE data.

To edit the chosen PCODE press the F1 (EDIT) key.

To delete the PCODE data press the F3 (DEL) key.

10.3.4 Plotting Points

The function is used to display the coordinate points in the coordinate file of the instrument.

Operation procedure	Operation	Display
① Press F3 (MEMORY MGR) key from the menu (1/3)	F3	
②Press F4 key to select a plotting coordinate file	F4	
③ Select the starting points of plotting. Just like the operation of data research after define the plotting starting points, press F4 key	F4	
④Now the coordinate points are displayed on the screen. The black block is the starting points. Press F1 or F2 to find the last point or the next point, press F3 or F4 key to reduce or magnify the picture, press ↖、S.O、K1、K2 key to move the picture.		

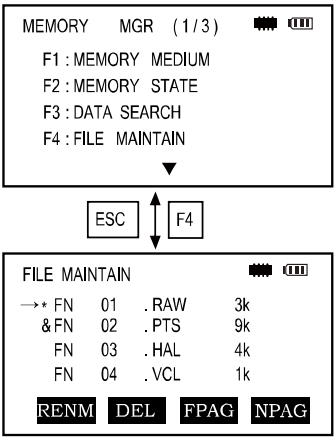
10.4 File Maintenance

In this mode the following options are available:

- Renaming file names
- Searching data in a file
- Deleting files

Pressing F4 (FILE MAINTAIN) key from MEMORY MANAGER menu 1/3 and the file listing will be shown.

FILE MAINTAN menu



File discrimination marks (*, &) are placed before the file name indicating the file status.

"*" : current measure file

"&" : current coordinate file

Data discrimination character (M/ C)

". RAW" Measured data file

".PTS" Coordinate data file

". HAL" Horizontal line layout data file

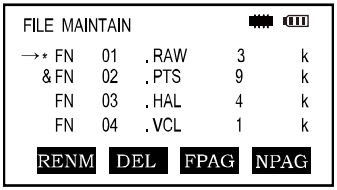
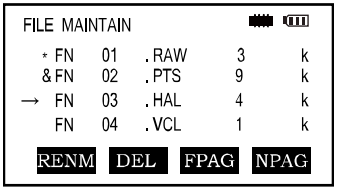
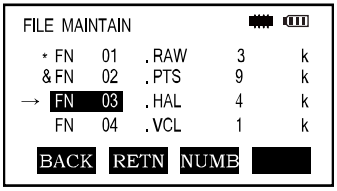
". VCL" Vertical line layout data file

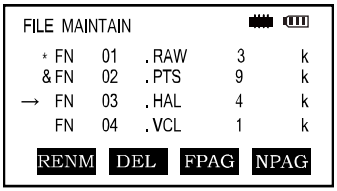
The figures in the far right column indicate the size of the data file.

Press the [▲]or[▼]key to scroll to next file.

10.4.1 Renaming a File

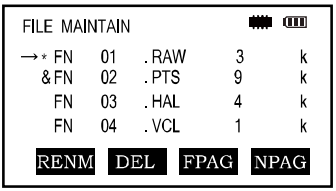
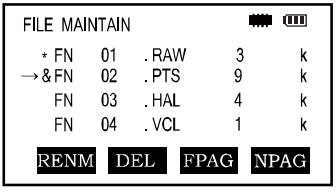
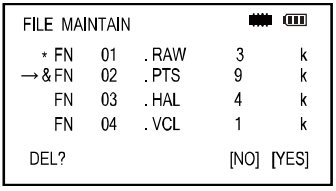
An existing file in internal memory can be renamed.

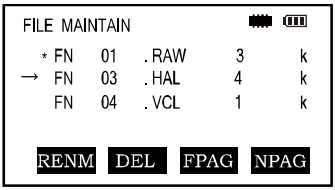
Operation procedure	Operation	Display
Press the F4 (FILE MAINTAIN) key from the Memory manager menu 1/3.	F4	
Select a file by pressing the [▲]or [▼] keys	[▲]or[▼]	
Press the F2 (RENM) key	F2	

Enter the new file name and press the ENT key *1	Enter FN ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”. A file cannot be renamed to that of an existing file, an error message will be displayed. To return to the FILE MAINTAN Menu, press the ESC key.		

10.4.2 Deleting a File

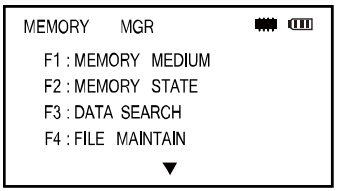
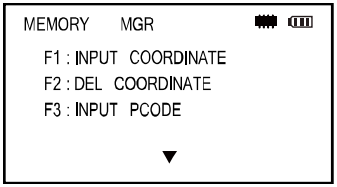
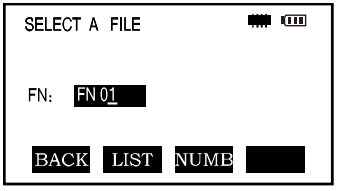
This mode erases a file from internal memory - only one file can be erased at a time.

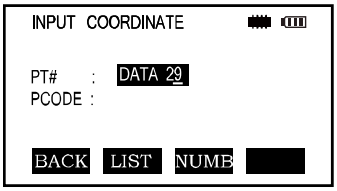
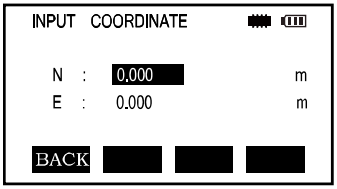
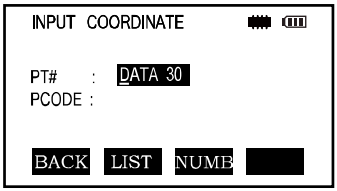
Operation procedure	Operation	Display
① Press the F4 (FILE MAINTAIN) key from the Memory Manager menu 1/3.	F4	
② Select a file to delete by pressing the [▲]or [▼] key.	[▲]or[▼]	
③Press the F2 (DEL) key	F2	

④ Confirm the deleting by pressing the F4 (YES) key.	F4	
To return to the FILE MAINTAIN Menu, press the ESC key.		

10.5 Coordinate Data Direct Key Input

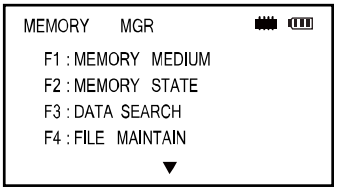
Coordinate data for the layout point or control point can be input directly from the keyboard. The data can be stored into a file in the internal memory.

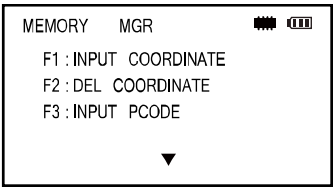
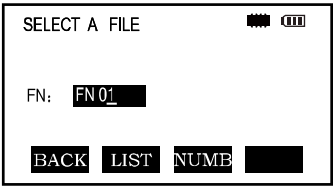
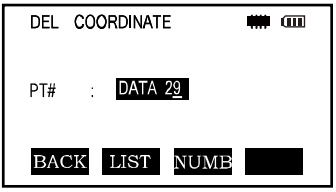
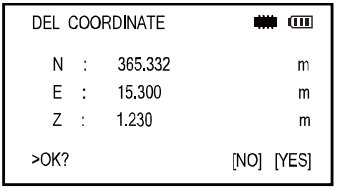
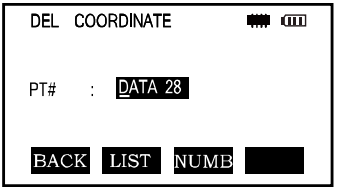
Operation procedure	Operation	Display
①Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
② Press the ▼key for menu MEMORY MGR 2/3	▼	
③ Press the F1 (INPUT COORDINATE) key	F1	

④Enter the File Name you want to input. Press the ENT key *1	Enter PN ENT	
⑤Enter the point number (PT#) you wish to input. Press the ENT key and enter the PCODE and press ENT *1	Enter PT# ENT	
⑥Enter the coordinate data. After storing the new point the next point number (PT#) is automatically incremented and displayed.	Enter COORD ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.		

10.6 Deleting a Coordinate Data From a File

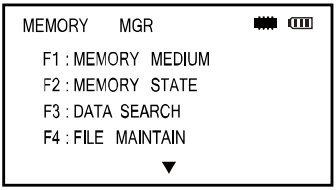
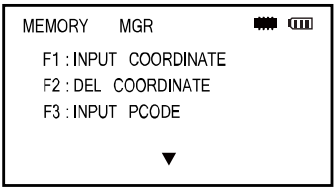
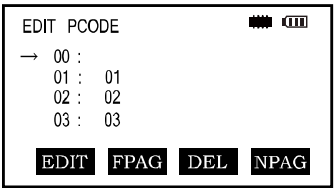
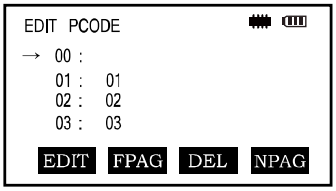
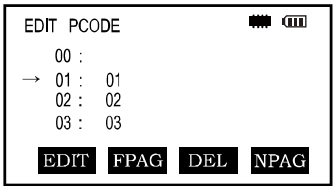
Coordinate data in a file can be erased

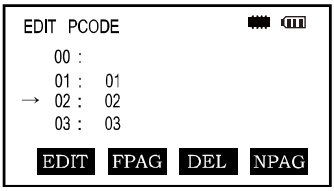
Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	

②Press the ▼ key to scroll the menu.	▼	
③ Press the F2 (DEL COORDINATE) key	F2	
④Enter or select the File Name and press the ENT key *1	Enter PN ENT	
⑤Enter the point number (PT#) and press the ENT key *1	Enter PT# ENT	
⑥ Confirm the data and press the F4 (YES) key to delete. The display will return to the previous display.	F4	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.		

10.7 Editing PCODE Library

PCODE data can be entered into the PCODE Library in this mode. A PCODE is linked with a number 1 to 99. PCODE can also be also edited in the DATA COLLECT menu 2/2.

Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu screen 1/2.	F3	
②Press the ▼ key	▼	
③ Press the F3 (INPUT PCODE) key.	F3	
④ Scroll to the number desired using the [▲]or [▼] keys and F2 or F3 to scroll pages.	[▲]or[▼]	
⑤Press the F1 (EDIT) key.	F1	

⑥Enter the PCODE and press the ENT key, entry scrolls to the next point automatically *1	ENT	
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.		

10.8 Data Communication

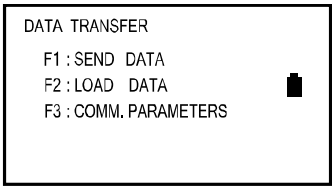
You can send a data file stored in the internal memory to a computer through the DATA TRANSFER menu. Also you can upload a coordinate data file and PCODE Library data to the instrument from a computer. There are two modes of data communication, RS-232 and USB.

1.Transmit data by connecting the instrument to PC with RS-232 cable.

2.Convert file by connecting the instrument to PC with USB cable.

10.8.1 Data Communication with RS-232

RS-232 Data Communication Menu:



F1： SEND DATA - send data from the instrument to the computer

F2： LOAD DATA - load data from the computer to the instrument

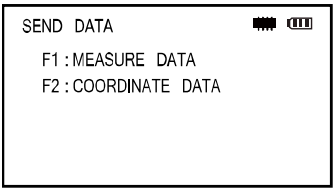
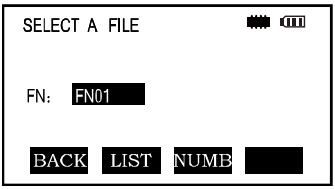
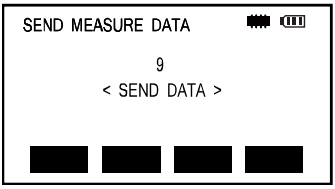
F3： COMM. PARAMETERS - set the communication parameters

Note: When transferring data check that the cables are connected securely and that the parameter settings on the computer and Total Station are consistent.

10.8.1.1 Sending Data

Refer to the Transfer.exe program on the CD included with your instrument. Start this program and follow the prompts for data transfer.

Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	MEMORY MGR (1/3) F1 : MEMORY MEDIUM F2 : MEMORY STATE F3 : DATA SEARCH F4 : FILE MAINTAIN ▼
②Press the ▼ key twice for screen 3/3	▼	MEMORY MGR (3/3) F1 : DATA TRANSFER F2 : FILE OPERATION F3 : INITIALIZE ▼
③ Press the F1 (DATA TRANSFER) key	F1	DATA TRANSEER F1 : SEND DATA F2 : LOAD DATA F3 : COMM.PARAMETERS

④Press the F1 (SEND DATA) key	F1	
⑤Select the type of data to send by pressing the F1 – F2 key. Example: F1 (MEASURE DATA)	F1	
⑥Enter the File Name you want to send and press the ENT key *1,*2	Enter FN ENT	
⑦Press the F4 (YES) key *3 The data transfer begins. The display will return to the SEND DATA menu after the transfer is finished.	F4	

*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”.

*2) To scroll the data press the [▲]or [▼] key. To show the file list press the F2 (LIST) key.

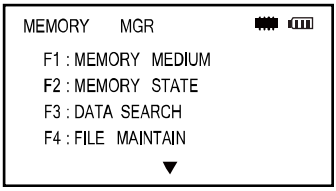
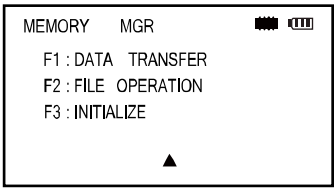
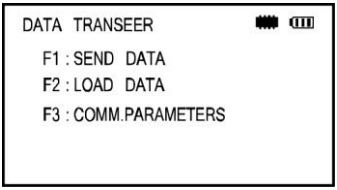
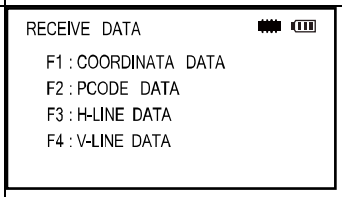
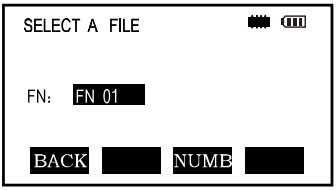
*3) To cancel transfer press the F4 (STOP) key.

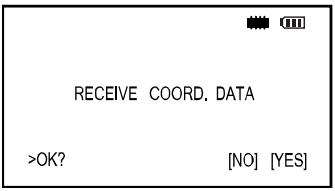
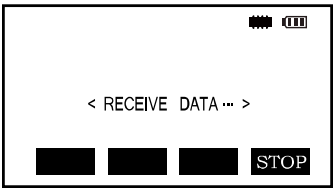
10.8.1.2 Loading Data

Coordinate data files and PCODE Library data can be loaded from a PC. Refer to the Transfer.exe program on the CD included with your instrument. Start this program and

follow the prompts for data transfer.

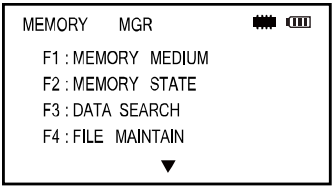
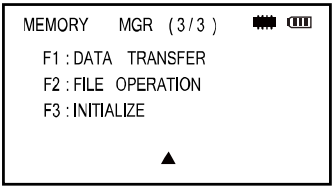
Example: Loading a coordinate data file.

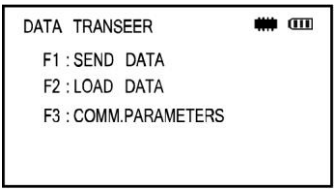
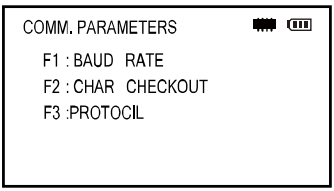
Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
②Press the ▼ key twice for screen 3/3	▼	
③ Press the F1 (DATA TRANSFER) key	F1	
④Press the F2 (LOAD DATA) key	F2	
⑤Select the type of data to load. Example: F1 (COORDINATE DATA)	F1	

⑥Enter a new file name for the data. Press the ENT key *1	ENT	
⑦Press the F4 (YES) key to confirm and start the transfer. *2		
*1) Refer to Section 1.10 “How to Enter Alphanumeric characters”. *2) To cancel the transfer press the F4 (STOP) key.		

10.8.1.3 Setting the Parameters of Data Communication

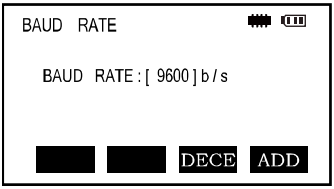
Example setting the baud rate to 4800

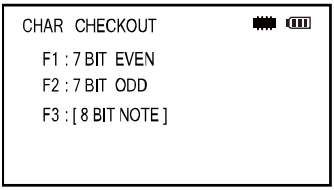
Operation procedure	Operation	Display
① Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
②Press the ▼ key twice	▼	

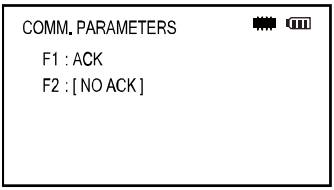
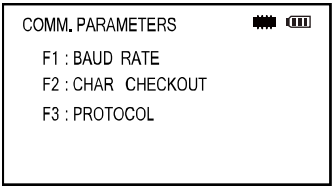
<table>
<tr><td>③ Press the F1 (DATA TRANSFER) key</td><td>F1</td><td> 
</td></tr>
<tr><td>④Press the F3 (COMM PARAMETERS) key</td><td>F3</td><td> 
</td></tr>
<tr><td>⑤Press the F1, F2 and F3 keys one by one to select BAUD RATE, CHAR CHECKOUT and PROTOCOL.

The parameters need to be consistent between the instrument and the Transfer.exe program.</td><td>F1

F2

F3</td><td> 

 
</td></tr>
<tr><td>⑥After selecting each parameter press the ENT key *1</td><td>ENT</td><td> 
</td></tr>
<tr><td colspan="3">*1) BAUD RATE can be set to: 1200, 2400, 4800, 9600, 19200, 38400, 57600, or 115200 b/s. Select by pressing the F3 (DECE) or F4 (ADD) key.</td></tr>
</table>

*2) To cancel the setting press the ESC key.
These settings will be saved as the default values after powering off.

10.8.2 Data Conversion By USB

Start up the instrument, connect the instrument to PC with USB cable, the menu is displayed on the screen as below.

USB Working……
Please disconnection
Press <ESC> to exit!

This reprensents the connection is normal, then you can operate the data file stored in the instrument by data transmission software, It is also possible to copy the file on PC into the instrument.

10.8.2.1 Data Export

Data type in the memory of total station

1. *. RAW—Measurement file
2. *. PTS—Coordinate file
3. *. HAL—Horizontal line location file
4. *. VCL—Verical line location file
5. *. PCOPE. LIB—Pcode file

In order to export the relevant data fromcertain file, you can just open the corresponding file by data transmissing software.

For example: Open TS. RAW file

Start transmission software, select“open EMS file” in the meau“ USB operation”, then select “open*. RAW(measurement data file)” and choose “TS. RAW” file of the memory to realize opening the TS. RAW file, the measurement data will be displayed in the transmission software and can be stored in PC.

10.8.2.2 Data Inport

For example: Inporting POCDE data

Start the data transmission software, import the coding which is needing to be imported in the text box or open the PCODE file of text style which has been edited already.

The encoding format is as below

1. CODE ↙
2. HOUSE ↙
3. TREE ↙

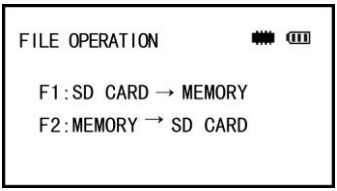
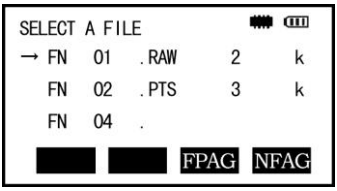
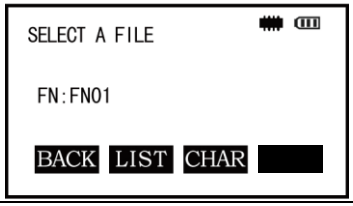
Up to 500 codes can be input, after inputing the codes, select“convert EMS memory file”in the menu“USB operation”,choose “*.txt珹PCODE. LIB” to realize the conversion, store the data in the memory of the instrument.

Note: Only one encoding file is allowed to exist, and the file name can’t be modified, the file can only be covered, In addition, the file can only be stored in the memory, not in the SD card.

10.9 File Operation

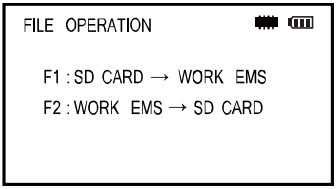
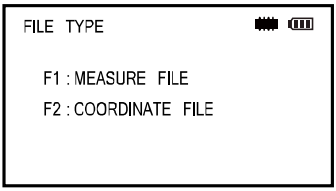
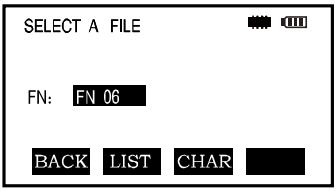
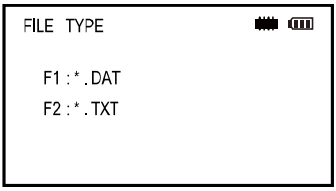
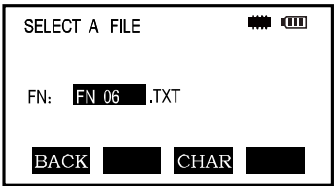
This function is used to realize the mutual copy between the memory and SD card.

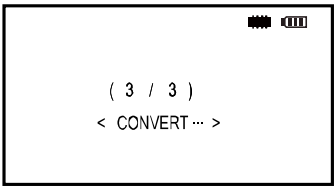
10.9.1 Copy File From SD Card To Memory Of The Instrument

Operation procedure	Operation	Display
① Press F2 key from MEMORY MGR.(3/3) menu to get FILE OPERATION	F2	
② Press F1 key to enter import interface, the file names existing in SD card are displayed.	F1	
③Select a file name , press ENT key.	ENT	
④Input a file name for the inported, then press ENT key to finish the operation.	ENT	

10.9.2 Copy The File From Memory To SD Card.

This operation procedure is similar to the section 10.9.1 just introduced above, the only difference is to press F2 key instead of F1 key in the second step of the section 10.9.1

Operation procedure	Operation	Display
① Press the F2 key from MEMORY MGR.(3/3) menu to get FILE OPERATION	F2	
②Press the F2 key: WORK EMS→SD CARD.	F2	
③Press the F1 or F2 key to choose an export file type.	F1 F2	
④Choose a file to export and press the ENT key.	ENT	
⑤Press the F1 or F2 key to choose an export file data type.	F1 F2	

⑥Enter a new file name and press the ENT key to convert and store.	ENT	

10.10 Initialization

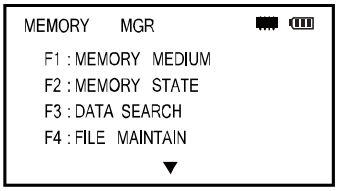
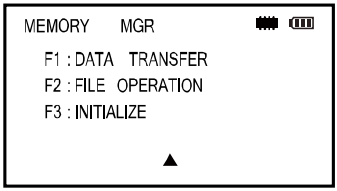
This mode is used to initialize the internal memory. Following data can be initialized:

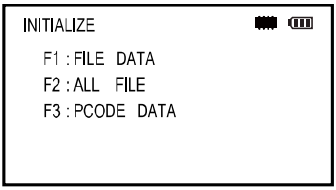
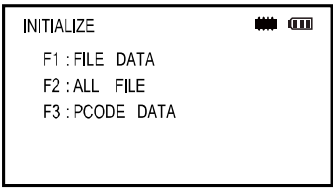
FILE DATA: All measuring data and coordinate data. (data in the files)

PCODE DATA: PCODE list.

ALL FILE: All files will be deleted. (except PCODE).

For example: Initialize all files.

Operation procedure	Operation	Display
①Press the F3 (MEMORY MGR) key from the menu 1/2.	F3	
②Press the ▼ key twice	▼	

③Press the F3 (INITIALIZE) key	F3	
④Select the data to initialize by pressing the F1 to F3 keys. Example：F2 (ALL FILE)	F3	
⑤ To confirm the erase function press the F4 (YES) key. Initializing will begin.	F4	

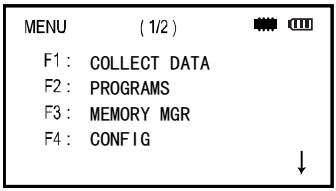
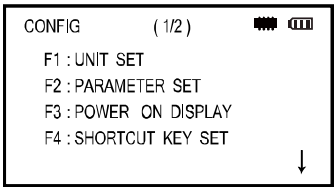
Note: The following data will not be initialized during this process:

- Instrument Coordinates
- Instrument Height
- Target Height.

11. BASIC SETTINGS

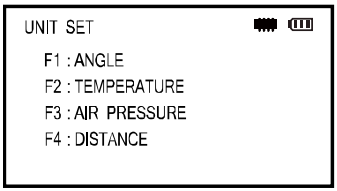
The instruments basic function settings should be monitored and set for each job.

Operation procedure is as follows：

Operation procedure	Operation	Display
Press the M key to get the main MENU 1/2.	M	
Press the F4 (CONFIG) from the main MENU(1/2) to get CONFIG menu.	F4	

11.1 Unit Settings

Setting the instrument units as needed.

Operation procedure	Operation	Display
In CONFIG (1/2), press the F1 key to get to the UNIT SET menu.	F1	
Press the F1 to F4 keys to set the angle, temperature, air pressure and distance		

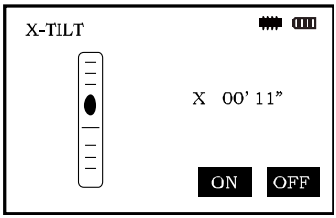
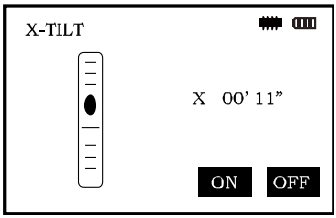
variables.			
Select unit and parameter			
Unit Set	ANGLE	DEG (360 °) GON (400GON) MIL (6400MIL)	Select the desired angle measurement unit DEG/GON/MIL
	TEMPERATURE	Temperature：℃/℉	Select temp. unit：℃/℉
	AIR PRESSURE	Air pressure：hPa /mmHg/inHg	Select air pressure unit： hPa/mmHg/inHg
	DISTANCE	m/ft	Select distance measurement unit：m/ft

11.2 parameter Settings

Setting other parameters.

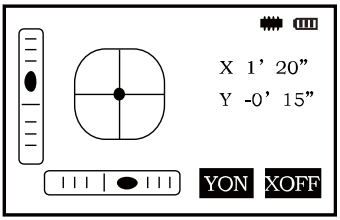
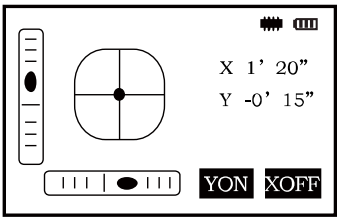
Operation procedure	Operation	Display
In CONFIG (1/2) press the F2 key for the MEAS. PARA. menu screen. Press the ▼ to scroll to the second MEAS. PARA. 2/2 menu.	F2	MEAS. PARA (1/2) F1 : TILT SENSOR F2 : W-CORRECTION F3 : GRID FACTOR F4 : LEAST ANGLE DISP ↓ MEAS. PARA (2/2) F1 : V ANGLE DISP F2 : MEASURE DISTANCE ↑

11.2.1 Setting of the Tilt Sensor

Operation procedure	Operation	Display
Press the F1 key from the MEAS. PARA. menu to get to the TILT SENSOR display.	F1	
Press F3 key turn on ,press F4 key turn off.	F3 F4	

If the instrument is with dual axis compensator.

The operation is as below.

①Press the F1 key from the MEAS. PARA. Seting menu to get to the TILT SENSOR display.	F1	
②Press F3 or F4 key to turn on or off X axis or Y axis compensator.	F3 F4	

11.2.2 Setting of the W-Correction

The instrument will automatically correct the influence of atmosphere refraction and earth curvature when measuring Horizontal Distance and Elevation Difference:

Corrected Horizontal Distance:

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

Corrected Elevation Difference:

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

If the correction of atmospheric refraction and earth curvature is not used the formula of calculating the Horizontal Distance and Elevation Difference is as follows:

$D=S*\cos\alpha$

$H=S*\sin\alpha$

Note: In the factory the atmospheric refraction coefficient of the instrument is set at K=0. 14. For the value of K there are three options, K=0.14, K=0.2, and Off.

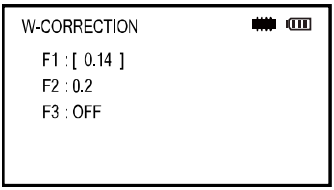
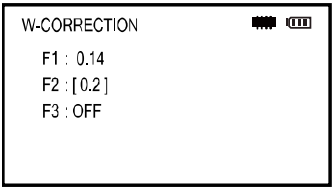
K=0.14…… Atmospheric refraction coefficient

Re=6371km…… Earths Radius

α……The vertical angle calculated from horizon

S ……Slope Distance

Setting is as follows：

Operation procedure	Operation	Display
Press the F2 key from the MEAS. PARA. Menu to get to the W-CORRECTION screen.	F2	
Press F1 to F3 key to select the atmospheric refraction coefficient of the W-CORRECTION.	F1-F3	

11.2.3 Setting the GRID FACTOR

Calculation Formula

1）Elevation factor

Elevation factor =R/(R+ELEV)

R：the average radius of the earth

ELEV：the elevation above mean sea level

2）Scale factor

Scale factor at the surveying station

3）Grid factor

Grid factor = Elevation factor×Scale factor

Distance calculation

1）Grid distance

HDg=HD×Grid factor

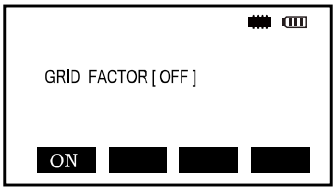
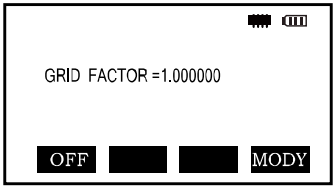
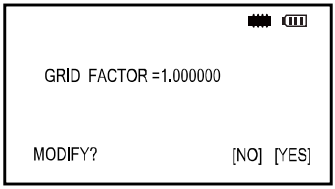
HDg：Grid distance

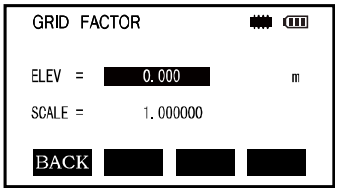
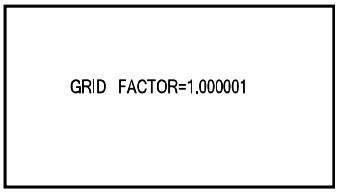
HD：Ground distance

2）Ground distance

HD= HDg/Grid factor

Setting is as follows：

Operation procedure	Operation	Display
Press F3 key from MEAS. PARA. menu to get to the GRID FACTOR screen.	F3	
Press the F1 (ON) key to turn on the GRID FACTOR.	F1	
Press the F4 (MODY) key to modify.	F4	

Press F4 (YES) key to set the elevation (ELEV) and SCALE.	F4	
After modifying press the ENT key and the calculated grid factor is shown.	ENT	

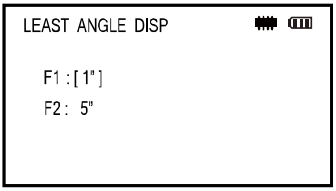
11.2.4 Setting of the Minimum Angle Reading

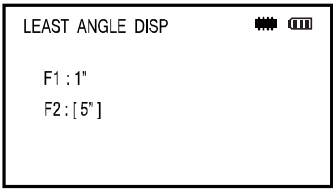
The Total Station can be programmed to display the angle measured to the nearest 1” or 5”.

The instrument can also be set to the desired angle measurement unit.

Mode	unit		
	degree	gon（400 gon）	mil
CST300R	5″/1″	1mgon /0.2mgon	0.1mil/0.01mil

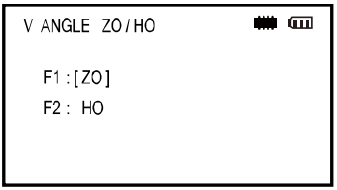
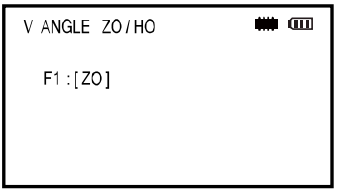
Minimum angle display reading.

Operation procedure	Operation	Display
Press the F4 key from the MEAS. PARA. menu to get to the LEAST ANGLE DISP screen.	F4	

Press F2 to choose 5” or F1 to choose the 1” display mode, then press the ENT key to confirm. This setting does not effect the accuracy of the instrument.	F2	

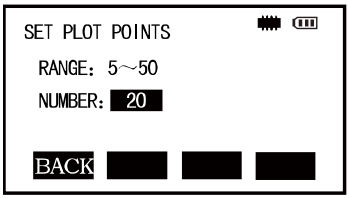
11.2.5 Setting the Vertical Angle Display

The vertical angle display can be measured from Zenith or the horizontal plane. The Z0 (zenith) method is the most often used for surveying purposes, the “0” value will be directly overhead.

Operation procedure	Operation	Display
Press F1 key from MEAS PARA. menu 2/2 for the V ANGLE Z0/H0 screen	F1	
Press the F2 (H0) key then press the ENT key to return to MEAS PARA menu.	F2	

11.2.6 Setting of Plotting Points Number

Setting of the maximum points number displayed on the screen.

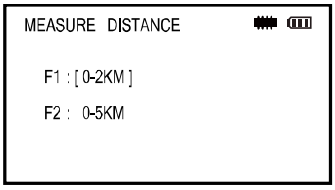
Operation procedure	Operation	Display
Press F2 in the menu measured parameter (2/2) setting interface to enter setting of plotting points number interface.	F2	
Input the points number needing to be displayed and then press ENT key.		

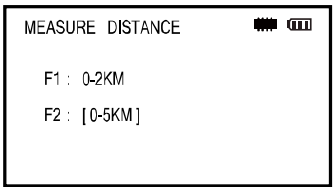
11.2.7 Setting the Distance Range Mode

The Total Station has the option of defining the normal distance measured during operation to increase measuring efficency:

0-2KM (0-1.2 miles): Selecting this option gives the quickest measurement times.

0-5KM (0-3 miles): Use this mode when measuring longer distances.

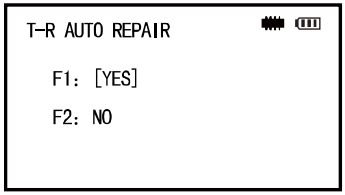
Operation procedure	Operation	Display
Press the F2 key from MEAS PARA. menu 2/2 to get to the MEASURE DISTANCE screen.	F2	

Press the F2 (0-5KM) or F1 (0-2KM) key and then the ENT key to select and return to the MEAS PARA. menu.	F2 or F1	

11.2.8 Automatic Compensation For Temperature And Air Pressure

The total station has function of Auto compensation for temperature and air pressure. You can turn on this function to compensate the temp. and air pressure auto matically, and you can also turn off the automatic compensation to set the temp. and air pressure by hand.

For example: Setting Auto Compensation To Be [ON]

Operation procedure	Operation	Display
Press the F3 in menu "measured parameters setting" (2/2) to get to Auto compensation interface.	F3	
Press F1 to select "YES". Press ENT key to return.	F1	

11.3 Setting the Measure Mode Display

The default display in the measure modes can be set by pressing [F3] POWER ON DISPLAY on menu 1/2 in the CONFIG screen:

Shown	F1: MEASURE MODE	Angle or distance	Choose the angle or distance measuring mode.
	F2: HD&VD /SD	HD&VD /SD	Choose the distance mode - Horizontal &Vertical Distance or Slope Distance
	F3: COORD. FORMAT	ENZ/NEZ	Select the coordinate display order ENZ or NEZ

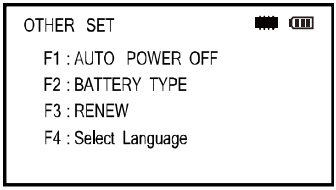
11.4 Setting the Shortcut Keys

The CST300R has two shortcut keys that can be configured by the user.

Shortcut key	Operation	Function
K1	Press the K1 key for 1second	1、 REM 2、 MLM 3、 AREA 4、 Z COORD. 5、 POINT TO LINE 6、 ROAD 7、 RESECTION 8、 NONE
	Press F4 key from CONFIG menu	
K2	Press the K2 key for 1second.	
	Press the F4 key from the CONFIG menu	

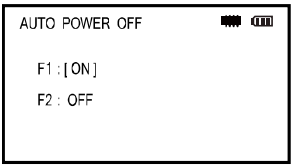
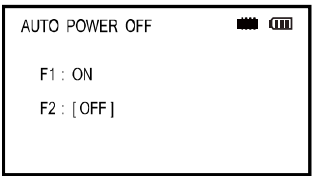
11.5 Other Settings

The instrument can be set to auto matically power off, change the battery type, reset configurations and select the operating language.

Operation procedure	Operation	Display
Press F1 (OTHERS SET) from the CONFIG menu 2/2.	F2	

11.5.1 Auto Power Off

If there is no key operation or ongoing measurement in 60 minutes the instrument will power off automatically.

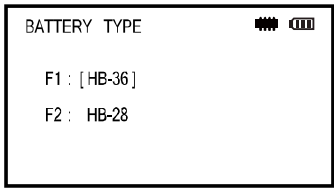
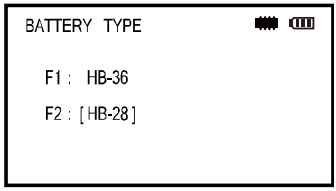
Operation procedure	Operation	Display
Press the F1 key from the OTHERS SET menu to get to AUTO POWER OFF.	F1	
Press the F2 (OFF) key to not select this feature or F1 to engage, press the ENT key and the instrument will return to the OTHER SET menu.	F2	

11.5.2 Choosing Battery Type

The instrument comes with a standard NiMH battery and this option should not be changed.

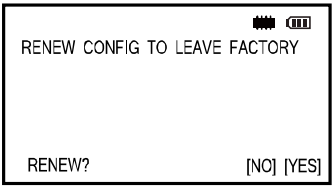
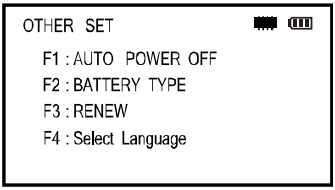
The NB-36 battery option is reserved for future use.

NB-36: battery NB-28: Ni-H battery

Operation procedure	Operation	Display
Press the F2 key from the OTHER SET menu to get to the BATTERY TYPE display.	F2	
Press F2 (NB-28) and ENT to confirm and return to the OTHER SET Menu.	F2	
Note: If BATTERY TYPE is changed to an incorrect setting the instrument will power off.		

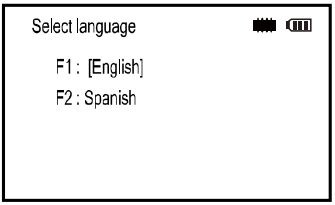
11.5.3 Renew to Factory Configuration

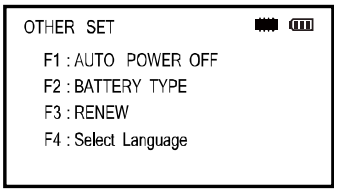
The following procedures reset the instrument settings and parameters to the original factory settings.

Operation procedure	Operation	Display
Press the F3 RENEW key from the OTHERS SET menu.	F3	
Press the F2 (YES) key to reset the instrument. After finished the instrument will return to the OTHERS SET screen.	F2	

11.5.4 Selecting a Language

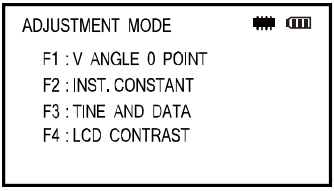
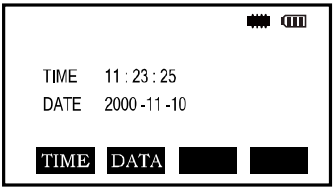
The instrument can be set to an alternative language using the flowing procedures.

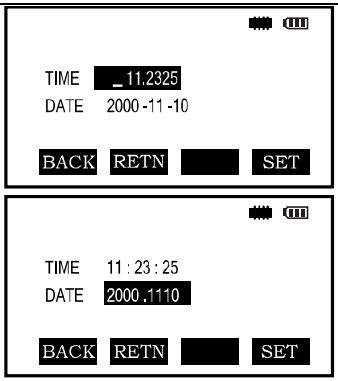
Operation procedure	Operation	Display
Press the F4 SelectLanguage key from the OTHERS SET menu.	F3	

Press the F1 or F2 key to select the desired language, press ENT and the instrument will return to the OTHERS SET screen.	F2	

11.6 Date and Time

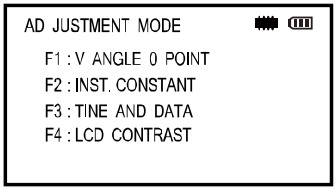
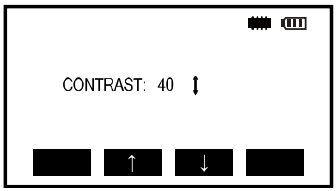
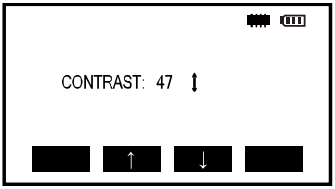
The date and time can be set using the following procedures:

Operation procedure	Operation	Display
Press the F1 (EMENDATION) key from the main menu page 2/2	F1	
Press the F3 (TIME AND DATE) key to set time and date.	F3	

Press the F1 or F2 key to set date and time. After entry press the ESC key to return to ADJUSTMENT MODE.	F1 F2	

11.7 Adjusting the Contrast of the LCD

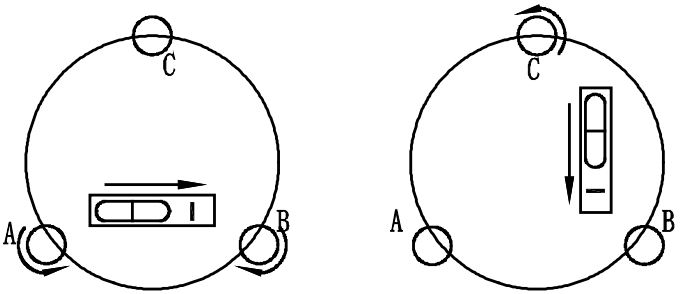
The contrast of the LCD can be adjusted using the following procedures:

Operation procedure	Operation	Display
Press the F1 (EMENDATION) key from the main menu page 2/2.	F1	
Press the F4 (LCD CONTRAST) key to get to the CONTRAST screen.	F4	
Press F2 and F3 keys to set the contrast, after finished press the ESC key to return to ADJUSTMENT MODE.	F2 F3	

12. CHECK AND ADJUSTMENT

The instrument has been checked and adjusted thoroughly at the factory to insure the instrument meets our quality requirements. But long distance transportation and the change of the environment could cause the instrument to go out of adjustment. It is recommended before using the instrument it should be checked and adjusted according to the procedures outlined below.

12.1 Plate Vial



Inspection

Refer to Section 1.4 Instrument Set Up and “Leveling by using the plate vial”

Adjustment

1. Place instrument on the tripod.
2. Face the instrument with two of the three leveling screws in front of you.
3. Rotate the right level screw to center the plate vial bubble.
4. Move instrument CCW and rotate the next right level screw to center the plate vial bubble again.

5. Move instrument CCW and rotate the next right level screw to center the plate vial bubble again.

6. Now, move CCW to the next position and check to see if the bubble is centered.

7. If the plate vial bubble is not centered, remove 1/2 of the error with right level screw and 1/2 of the error with the plate vial adjusting screw.

8. Repeat steps 4, 5, and 6.

9. If there is still an offset error with the plate vial bubble repeat procedure until bubble is centered.

12.2 Circular Vial

Inspection

No adjustment is necessary if the bubble of the circular vial is in the center after inspection and adjustment of the plate vial.

Adjustment

If the bubble of the circular vial is not in the center bring the bubble to the center by using the adjusting pin or hexagon wrench to adjust the bubble adjusting screw. First loosen the screw opposite to the offset side and then tighten the other adjusting screw on the offset side, bringing the bubble to the center. After the bubble stays in the center each of the three adjustment screws should be tightened in a uniform manner.

12.3 Inclination of Reticle

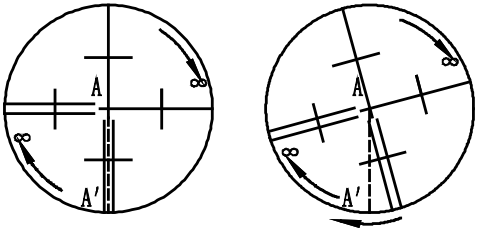
Inspection

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. No adjustment is necessary if object A moves along the vertical line of the reticle and point A' is still in the vertical line.

As illustrated A ' offsets from the center and the cross hair tilts, then the reticle needs adjustment.



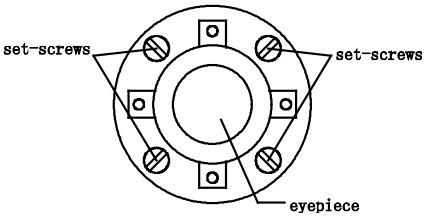
Adjustment

1. If the object A does not move along the vertical line, first remove the eyepiece cover to expose the four reticle adjusting screws.

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

3. Tighten the reticle adjusting screws uniformly, pepeat the inspection and adjustment to see if the adjustment is correct.

4. Replace the eyepiece cover.



12.4 Perpendicularity of Line of Sight to Horizontal Axis (2c)

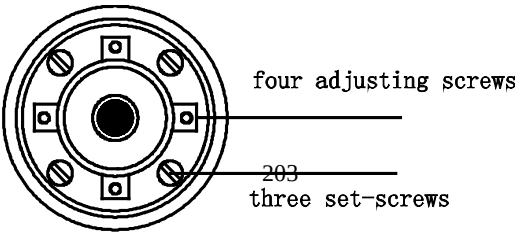
Inspection

1. Set an object A at a far distance the same height as the instrument, then level and center the instrument and turn on the power.

2. Sight object A in the left position and read the horizontal angle value (horizontal angle L=10°13 '10″).

3. Loosen the vertical and horizontal clamp screws and rotate the telescope. Sight object A in right position and read the horizontal angle value.(horizontal angle R = 190°13′40″).

4.2 C = L - (R ±180 °) = - 30″≥±20″ , adjustment is necessary.



Adjustment

1. Use the tangent screw to adjust the horizontal angle reading,

2. Take off the cover of the reticle between the eyepiece and focusing screw. Adjust the two 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.

12.5 Vertical Index Difference Compensation

Inspection

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 has increased to more than 3" at this time and exceeds the designated compensation range.

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.

Adjustment

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) and Vertical Angle 0 Datum

Inspect the item after finishing the inspection and adjustment of item 13.3 and 13.4.

Inspection

1. Power on after leveling the instrument. Sight object A in left position and read the Verticail angle value L.

2. Rotate the telescope. Sight object B in right position and read the Verticail angle value R.

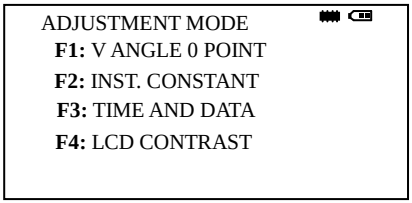
3.If the vertical angle is 0 °in zenith, , i =(L + R - 360 °) / 2

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

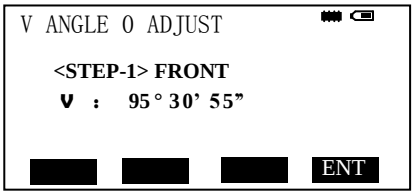
4. If | i | ≥10″ set the Vertical Angle 0 Datum again.

Adjustment

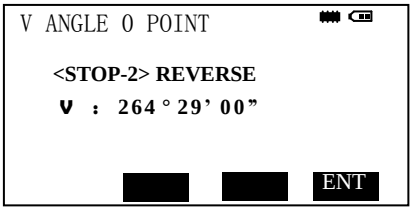
1. After leveling the instrument, go to the main menu screen 2/2 and press the F1 key:



2. In left position rotate the telescope. Precisely sight any target A at the same height as the instrument, the vertical angle is displayed. Press the F4 key:



3. Rotate the telescope and precisely sight the same target. Press the F4 key. The setting is finished and the instrument returns to the previous Angle Measurement Mode:



4. Repeat the inspection steps to measure the Index difference (I angle). If the Index Difference does not meet requirements redo the steps above. Carefull sighting must be done to insure the proper result..

5. If Index Difference does not meet the requirements after the repeated operation the instrument should be returned to factory for inspection and repair.

Method: in step three, press the F1 (SET) key after collimating the target A.

The vertical angles shown in the Vertical Angle 0 Datum are only for reference.

12.7 Optical Plummet

Inspection

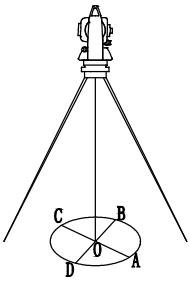
1. Set the instrument on the tripod and place a piece of white paper with two perpendicular lines under the instrument.

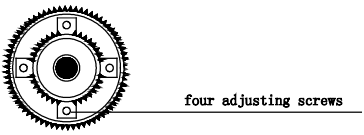
2. Adjust the focus of the optical plummet and move the paper so that the intersection point of the lines on the paper comes to the center of the field of view.

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 at every 90 ° observe whether the center mark position coincides with the intersection point of the cross.

5. If the center mark always coincides with intersection point no adjustment is necessary. Otherwise, the following adjustment is needed.





Adjustment

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

2. Fix the paper. Rotate the instrument and mark the indicated point of the center of the optical plummet on the paper at every 90 °. As illustrated: Point A, B, C, 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 be sure the adjustment is correct.

6. Replace the protective cover.

12.8 Laser Plummet

A laser plummet tribrach may be ourchased separately for the instruments.

12.9 Instrument Constant (K)

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

Inspection

1. Mount and level the instrument on Point A in a flat area. Use the vertical hair to mark Point B and Point C on the same line with the distance of 50m between each point. Set the reflector accurately on each point when measuring.

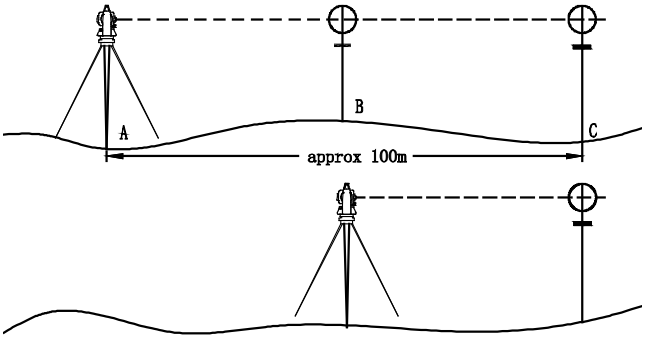
2. After setting temperature and air pressure in the instrument measure the Horizontal Distance of AB and AC accurately.

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

4. Then you can calculate the Instrument Constant:

$$K=AC-(AB+BC)$$

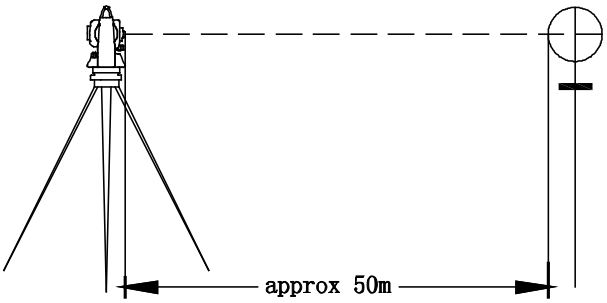
K should be very close to 0, If | K | > 5 mm the instrument should be inspected at a standard baseline site and adjusted according the inspection value.



Adjustment

If a strict inspection proves that the Instrument Constant K has changed the operator can change the constant by entering the adjustment amount. Press F2 in ADJUSTMENT MODE and key in the new constant.

12.10 Parallel between Line of Sight and Emitting Photoelectric Axis



Inspection

1. Set the reflector 50m from the instrument.
2. Sight the center of the reflector prism with reticle.
3. Power on and enter Distance Measurement Mode. Press MEAS to measure.

Rotate the Horzontal Tangent Screw and Vertical Tangent Screw, to do electric collimation and make the light route of EDM unblocked. In the bight zone find the center of emiting photoelectric axis.

4. Check whether the center of reticle coincides with the center of emiting photoelectric axis. If so, the instrument is up to grade.

Adjustment

If there is great difference between the center of reticle and the center of emiting photoelectric axis the instrument needs repair.

12.11 Tribrach Leveling Screw

If the leveling screw becomes loose adjust the two adjusting screws in the leveling screw to tighten appropriately.

13. SPECIFICATIONS

Model		CTS-632R6
Telescope	Image	Erect
	Magnification	30×
	Effective aperture	45mm(EDM:47mm)
	Resolving power	3″
	Field of view	1°30′
	Minimum focus	1 m
	Stadia ratio	100
	Sight distance precision	≤0.4%D
	Tube length	152mm
Angle Measurement	Measuring method	absolute encode
	Dia of circle (vertical, horizontal)	79mm
	Minimum reading	1″/5″Selectable
	Detection method	Horizontal: Dual Vertical: Dual
	Measuring unit	360 °/400gon/6400mil Selectable
	Vertical angle 0 °	Zenith0 °Horizontal0 °Selectable
	Accuracy	2″/5″
	Single prisn(under fair weather condition)	3.5km
	Triple prism(under fair weatjer condition)	5km

Distance Measurement	Reflectorless(white)	600m
	Displaly	Max:999999.999m Min:1mm
	Unit	m/ft
	Accuracy	±(2mm+2ppm Ð)
	Measuring time	Fine single shot:2s Tracking:0.25s
	Measurement system	Basic frequence:80MHZ
	Meteorologic Correction	Manual input,Auto correction
	Atmospheric refraction and earth curvature correction	Manual input,Auto correction,K=0.14/0.2
	Reflection prism correction	Manual input,Auto correction
Vial	Plate vial	30″/ 2mm
	Circular vial	8′/2mm
Vertical Compensator	System	dual axis
	Compensation range	±6′
	Resolving power	1″
Optical Plummet	Image	Erect
	Magnification	3×
	Focusing range	0.3m ~ ∝
	Field of view	5 °
Display	Type	LCD, Six lines, digital
Data Communication	RS-232C, USB,SD Card	

On-board Battery	Power resource	Rechargeable Ni-H battery NB-28
	Voltage	DC 6V
	Continuous operation time	8 hrs
Operation Environment	Operating temperature	-20 °~ +45℃
Size & weight	Dimension	160×150×340mm
	Weight	5.4kg

Part of distance measurement

Laser type 0.670um

Measuring system basic frequency: 60MHZ

EDM type coaxiality

Smallest uint displayed 1mm

Laser spot approx 7×14mm/20m（only no cooperate mode）

approx 10×20mm/50m

Precision

Cooperate mode

measuring mode	precision	measuring time
prism fine	2mm + 2ppm	< 1.2s
prism track	5mm + 2ppm	< 0.5s
IR baffle-board	5mm + 2ppm	< 1s

No cooperate mode

measuring mode	precision	measuring time

fine	3 + 2ppm	< 1.2s
track	10 + 2ppm	< 0.25s

Maximum deviation occurs under unfavourable conditions such as bright sunlight or when measuring to poorly reflecting or very rough surfaces. Measuring errors can occur when measuring toward colorless liquids (e.g.water), dust free glass, Styrofoam or similar semi-permeable surfaces.

Measuring range without reflector(400m)

Atmospheric conditions	No reflector（white target）	No reflector (grey,0.18)
Object in strong sunlight, severe heat shimmer	400m	280m
Object in shade, or sky overcast	320m	200m

Measuring range without reflector(800m)

Atmospheric conditions	No reflector（white target）	No reflector (grey,0.18)
Object in strong sunlight, severe heat shimmer	800m	560m
Object in shade, or sky overcast	640m	400m

※ Kodak Grey Card used with exposure meter for reflected light

14. ERROR DISPLAYS

Error code	Description	Countermeasures
CALC ERROR	Calculation is impossible because of error in data input.	Enter correct data.
FILE EXISTS	The same file name exists.	Use another file name.
FULL FILES	The maximum of 48 files are already created.	If necessary transmit or delete files.
OVERTOP	The measurement is carried out over 45 ° (100%) from the horizontal.	Measure a new point.
MEMORY POOR	Internal memory is nearly full.	Download data from the internal memory to a computer. Switch to SD card memory or change SD cards.
NO FILE	There is no file in internal memory.	Create a file.
FILE NOT SELECTED	When using a file no file is selected.	Confirm and select a file.
PT#EXIST	The point name already exists in the memory.	Confirm the new point name and input again.
PT#DOES NOT EXIST	An incorrect name is entered or PT# does not exist in the internal memory.	Confirm the new point name and input again.
TILT OVER	Instrument tilt is beyond the compensation range of 3′.	Level the instrument properly.
ERROR 01-06	Angle measurement system	If the error code appears

	abnormal	continuously the instrument needs repair.
ERROR 31 ERROR 33	Distance measurement system abnormal	If the error code appears continuously the instrument needs repair.

15. SAFETY INSTRUCTIONS

15.1 Integrated EDM（Visible Laser）

Warning：

Total station with EDM of laser class 3R resp.a-identifiable by：

Warning decal is above the vertical braking screw in Face 1: “Class III Laser Product”.

The product is a class 3R laser product in accordance with:

IEC 60825-1:2001 “Radiation safety of laser products”.

Class 3R laser products：

Direct intrabeam viewing is always hazardous. Avoid direct eye exposure. The accessible emission limit is within five times the accessible emission limits of Class 2 in the wavelength range from 400nm to 700nm.

Warning：

Direct intrabeam viewing is always hazardous.

Precautions：

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

Warning：

Looking directly into the reflected laser beam could be dangerous to the eyes when the laser beam is aimed at areas that reflect like a mirror or emit reflections unexpectedly (e.g. prisms, mirrors, metallic surfaces, windows).

Precautions：

Do not aim at areas that are essentially reflective, such as a mirror, or which could emit unwanted reflections. Do not look through or beside the optical sight at prisms or reflecting objects when the laser is switched on (in laser pointer or distance measurement mode). Aiming at prisms is only permitted when looking through the telescope.

Warning：

The use of Laser Class 3R laser equipment can be dangerous.

Precautions：

To counteract hazards, it is essential for every user to respect the safety precautions and control measures specified in standard IEC60825-1:2001 within the hazardous distance range.

Below is an interpretation of the main points in the relevant section of the standard quoted.

Class 3R laser products used on construction sites and outdoors (surveying, alignment, leveling):

a) Only qualified and trained persons should be assigned to install, adjust and operate the laser equipment.

b) Areas in which these lasers are used should be posted with an appropriate laser warning sign.

c) Precautions should be taken to ensure that persons do not look directly, with or without an optical instrument, into the beam.

d) The laser beam should be terminated at the end of its useful beam path and should in all cases be terminated if the hazardous beam path extends beyond the limit (hazard

distance *)) of the area in which the presence and activities of personnel are monitored for reasons of protection from laser radiation.

e) The laser beam path should be located well above or below eye level wherever practicable.

f) When not in use the laser product should be stored in a cool and dry location.

g) Precautions should be taken to ensure that the laser beam is not unintentionally directed at mirror-like (mirrored) surfaces (e.g. mirrors, metal surfaces, windows) and more importantly, at flat or concave mirror-like surfaces.

*) The hazard distance is the distance from the laser at which beam irradiance or radiant exposure equals the maximum permissible value to which personnel may be exposed without being exposed to a health risk.

Products with an integrated EDM of laser class 3R resp. IIIa has a hazard distance of 1000m (3300ft). After this distance, the laser beam rates as Class 1 (= direct intrabeam viewing is not hazardous).

15.2 Laser Plummet

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

This product is classified as Class 2/IIlaser product.
Class 2 laser product is in accordance with the following standard:
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 the following standard:
FDA21CFR ch.1 § 1040:1998 (U.S. Department of Health and Human Services, Code

of Federal Regulations)

Class 2/II Laser Product:

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