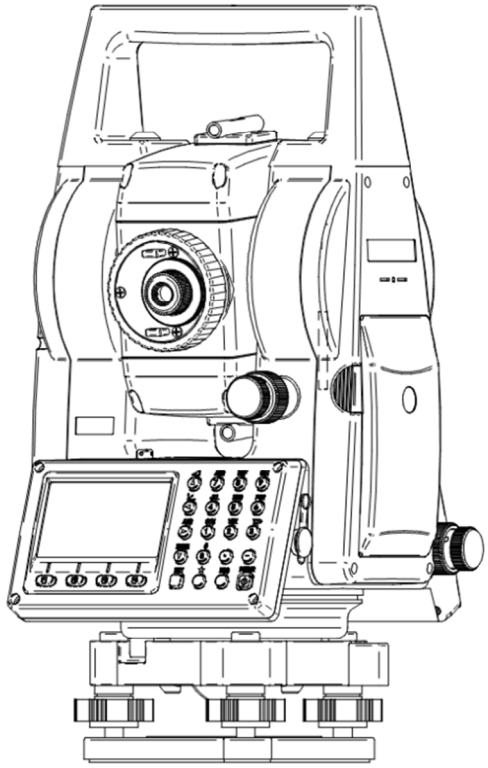
SingularXYZ®

TS1000

ELECTRONIC TOTAL STATION



INSTRUCTION MANUAL

FOREWORD

Thank you for purchasing SingularXYZ TS1000 Total Station. For the best performance of the instruments, please carefully read these instructions and keep them in a convenient location for future reference.

General Handling Precautions

Before starting work or operation, be sure to check that the instrument is functioning correctly with normal performance.

Do not submerge the instrument into water.
The instrument can not be submerged underwater.
The instrument is designed based on the International Standard IP54, therefore it is protected from the normal rainfall.

Setting the instrument on a tripod
When mounting the instrument on a tripod, use a wooden tripod when possible. The vibrations that may occur when using a metallic tripod can effect the measuring precision.

Installing the tribrach
If the tribrach is installed incorrectly , the measuring precision could be effected.
Occasionally check the adjusting screws on the tribrach. Make sure the base fixing lever is locked and the base fixing screws are tightened.

Guarding the instrument against shocks
When transporting the instrument, provide some protection to minimize risk of shocks.
Heavy shocks may cause the measurement to be faulty.

Carrying the instrument
Always carry the instrument by its handgrip.

Exposing the instrument to extreme heat.
Do not leave the instrument in extreme heat for longer than necessary. It could adversely affect its performance.

Sudden changes of temperature
Any sudden change of temperature to the instrument or prism may result in a reduction of measuring distance range, i.e when taking the instrument out from a heated vehicle. Let instrument acclimate itself to ambient temperature.

Battery level check
Confirm battery level remaining before operating.

Taking the battery out
It is recommended not to take the battery or external battery out during the power is on. All the data stored is possible gone at that time. So please do your assembling or taking the battery out after the power is off.

Do not hold the lower part of display unit
When you take out the instrument from a carrying case, or keep into the case, please hold the hand grip and base of the instrument. Please do not hold the lower part of the display unit.

External power source
Use only recommended batteries or external power source. Use of batteries or an external power source not recommended by us may result in equipment failure.

Display for Safe Use

In order to encourage the safe use of products and prevent any danger to the operator and others or damage to properties, important warnings are put on the products and inserted in the instruction manuals.

We suggest that everyone understand the meaning of the following displays and icons before reading the "Safety Cautions" and text.

Display	Meaning
⚠ **WARNING**	**Ignoring or disregard of this display may lead to the danger of death or serious injury.**
⚠ **CAUTION**	**Ignoring or disregard of this display may lead to personal injury or physical damage.**

•Injury refers to hurt, burn, electric shock, etc.

•Physical damage refers to extensive damage to buildings or equipment and furniture.

Safety Cautions

⚠ WARNING
•**There is a risk of fire, electric shock or physical harm if you attempt to disassemble or repair the instrument yourself.** This is only to be carried out by or an authorized dealer, only!
•**Cause eye injury or blindness.** Do not look at the sun through a telescope.
•**High temperature may cause fire.** Do not cover the charger while it is charging.
•**Risk of fire or electric shock.** Do not use damaged power cable, plug and socket.
•**Risk of fire or electric shock.** Do not use a wet battery or charger.
•**May ignite explosively.** Never use an instrument near flammable gas, liquid matter, and do not use in a coal mine.
•**Battery can cause explosion or injury.** Do not dispose in fire or heat.
•**Risk of fire or electric shock.** Do not use any power voltage except the one given on manufacturer's instructions.
•**Battery can cause outbreak of fire.** Do not use any other type of charger other than the one specified.
•**Risk of fire or electric shock.** Do not use an AC cable incompatible with the power supply voltage in use.
•**The short circuit of a battery can cause a fire.** Do not short circuit battery when storing it.

⚠ CAUTION
•Do not connect or disconnect equipment with wet hands, you are at risk of electric shocks if you do!
•Risk of injury by overturn the carrying case. Do not stand or sit on the carrying cases.
•Please note that the tips of tripod can be hazardous, be aware of this when setting up or carrying the tripod.
•Risk of injury by falling down the instrument or case. Do not use a carrying case with a damaged which belts, grips or latches .
•Do not allow skin or clothing to come into contact with acid from the batteries, if this does occur then wash off with copious amounts of water and seek medical advice.
•A plumb bob can cause an injury to a person if used incorrectly.
•It could be dangerous if the instrument falls over, please ensure you attach a handle battery to the instrument securely.
•Ensure that you mount the Tribrach correctly, failing to do so may result in injury if the tribrach were to fall over.
•It could be dangerous if the instrument falls over, please check that you fix the instrument to the tripod correctly.
•Risk of injury by falling down a tripod and an instrument. Always check that the screws of tripod are tightened.
•The battery is to be disposed of safely.
•The appliance is not intended for use by young children or infirm persons without supervision. Young children should be supervised to ensure that they do not play with the appliance.

User

1)This product is for professional use only!
The user is required to be a qualified surveyor or have a good knowledge of surveying, in order to understand the user and safety instructions, before operating, inspecting or adjusting.
2)Wear the required protectors (safety shoes, helmet, etc.) when operating.

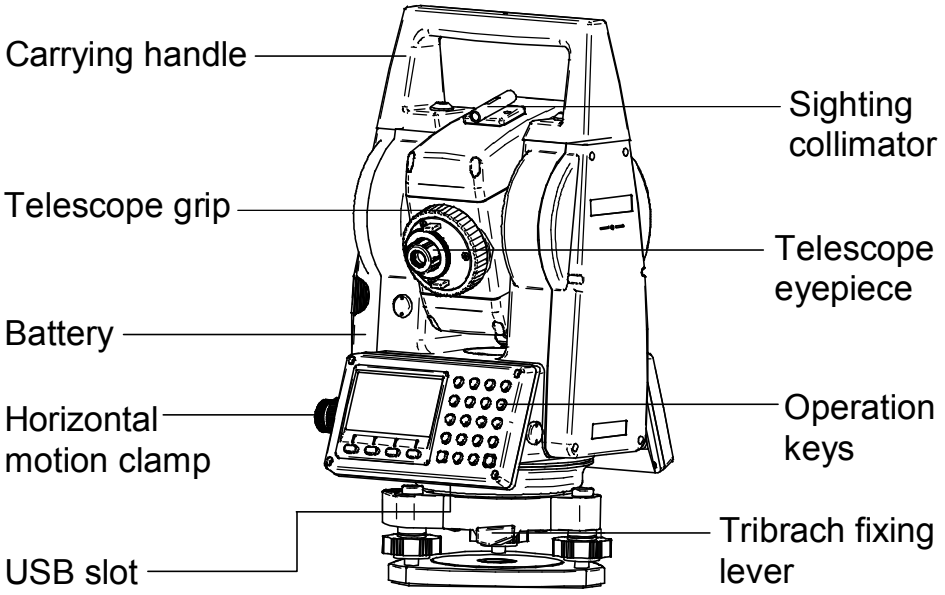
Exceptions from Responsibility

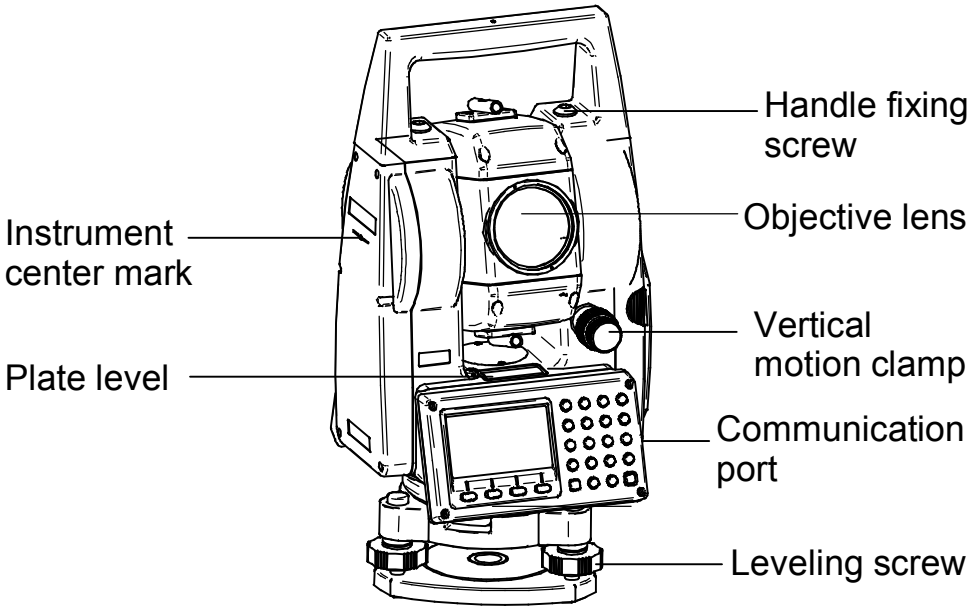
1)The user of this product is expected to follow all operating instructions and make periodic checks of the product's performance.
2)The manufacturer, or its representatives, assumes no responsibility for results of a faulty or intentional usage or misuse including any direct, indirect, consequential damage, and loss of profits.
3)The manufacturer, or its representatives, assumes no responsibility for consequential damage, and loss of profits by any disaster, (an earthquake, storms, floods etc.).
A fire, accident, or an act of a third party and/or a usage any other usual conditions.
4)The manufacturer, or its representatives, assumes no responsibility for any damage, and loss of profits due to a change of data, loss of data, an interruption of business etc., caused by using the product or an unusable product.
5)The manufacturer, or its representatives, assumes no responsibility for any damage, and loss of profits caused by usage except for explained in the user manual.
6)The manufacturer, or its representatives, assumes no responsibility for damage caused by wrong movement, or action due to connecting with other products.

Contents

1 NOMENCLATURE AND FUNCTIONS

1.1 Nomenclature




Handle fixing screw
Objective lens
Instrument center mark
Vertical motion clamp
Plate level
Communication port
Leveling screw

1.2 Display

- **Display**
  The display uses a dot matrix LCD which has 4 lines and 20 characters per line. In general, the upper three lines display measured data, and the bottom line displays the soft key function which changes with the measuring mode.
- **Contrast and Illumination**
  The contrast and illumination of display window are adjusted. see Chapter 6 “SPECIAL MODE (Menu Mode)” or section 1.5 “Star key mode”.

● **Example**

```
V :  90°10'20"
HR: 120°30'40"

0SET HOLD HSET P1↓
```

Angle measurement mode

V-angle : 90°10’20”
H-angle : 120°30’40”

Feet unit

```
HR: 120°30'40"
HD*  123.45 f
VD:   12.34 f
MEAS MODE NP/P P1↓
```

Horizontal-angle : 120°30’40”
Horizontal distance : 123.45ft
Relative elevation : 12.34ft

● **Display marks**

```
HR:  120°30'40"
HD*   65.432 m
VD:   12.345 m
MEAS MODE NP/P P1↓
```

Distance measurement mode

Horizontal-angle : 120°30’40”
Horizontal distance : 65.432m
Relative elevation : 12.345m

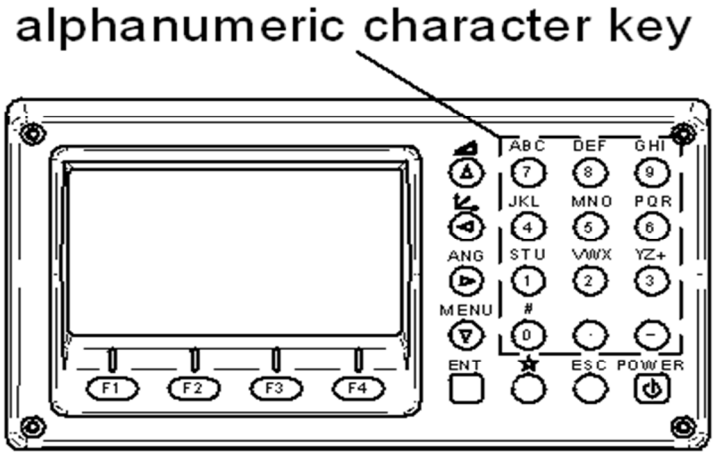
Feet and inch unit

```
HR:  120°30'40" HD*
123.04.6f
VD:    12.03.4f
MEAS MODE NP/P P1↓
```

Horizontal-angle : 120°30’40”
Horizontal distance : 123ft4in6/8in
Relative elevation : 12ft3in4/8in

Display	Contents	Display	Content
V	V-angle	✻	EDM working
HR	H-angle right	m	Meter unit
HL	H-angle left	f	Feet and inch unit
HD	Horizontal distance		
VD	Relative elevation		
SD	Slope distance		
N	N coordinate		
E	E coordinate		
Z	Z coordinate		

1.3 Operating Key

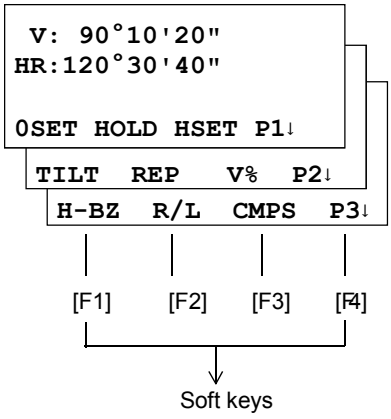


Keys	Name of Key	Function
★	Star key	Star key mode is used for each presetting or displaying as follows. 1 Contrast of the display 2 Reticle illumination 3 Back Light 4 Tilt correction 5 Set audio mode
	Coordinate meas.key	Coordinate measurement mode
	Distance meas.key	Distance measurement mode.
ANG	Angle meas.key	Angle measurement mode
POWER	Power source key	ON/OFF of power source
MENU	Menu key	Switches menu mode and normal mode. To set application measurements and adjust in the menu mode.
ESC	Escape key	Returning to the measurement mode or previous layer mode from the mode set.
ENT	Enter key	Press at the end of inputting values.
F1–F4	Soft key (Function key)	Responds to the message displayed.

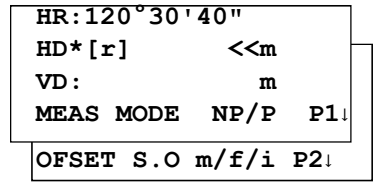
1.4 Function Key (Soft Key)

The Soft Key message is displayed at the bottom line of display. The functions are according to the displayed message.

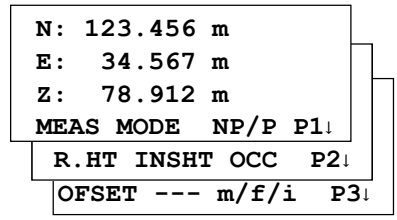
Angle measurement mode



Distance measurement mode



Coordinates measurement mode



Angle measurement

Page	Soft key	Display mark	Function
1	F1	0SET	Angle of Horizontal is set to 0°00'00"
	F2	HOLD	Hold the horizontal angle
	F3	HSET	Sets a required horizontal angle by entering numerals.
	F4	P1↓	The function of soft keys is shown on next page (P2).
2	F1	TILT	Setting Tilt Correction If ON, the display shows tilt correction value.
	F2	REP	Repetition angle measurement mode
	F3	V%	Vertical angle percent grade(%) mode
	F4	P2↓	The function of soft keys is shown on next page (P3).
3	F1	H-BZ	Sets the buzzer sound for every horizontal angle 90°
	F2	R/L	Switches R/L rotation of horizontal angle.
	F3	CMPS	Switches the COMPASS ON/OFF of vertical angle.
	F4	P3↓	The function of soft keys is shown on next page (P1).

Distance measurement mode

1	F1	MEAS	Start measuring
	F2	MODE	Sets a measuring mode, Fine/Coarse/Tracking
	F3	S/A	Select set audio mode
	F4	P1↓	The function of soft keys is shown on next page (P2).
2	F1	OFSET	Select Offset measurement mode
	F2	S.O	Select stake out measurement mode
	F3	NP/P	Switches Non-Prism/ Prism measuring mode.
	F4	P2↓	The function of soft keys is shown on next page (P3).
3	F2	m/f/i	Switches meter, feet or feet and inch unit.
	F4	P3↓	The function of soft keys is shown on next page (P1).

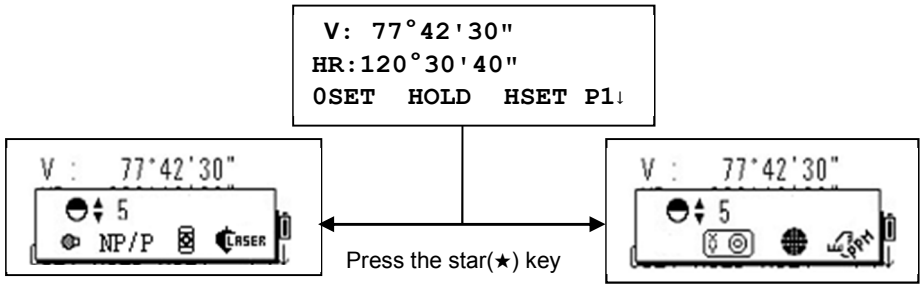
Coordinate measurement mode

1	F1	MEAS	Start measuring
	F2	MODE	Sets a measuring mode, Fine/Coarse/Tracking
	F3	NP/P	Switches Non-Prism/ Prism measuring mode.
	F4	P1↓	The function of soft keys is shown on next page (P2).
2	F1	R.HT	Sets a prism height by input values.
	F2	INSHT	Sets an instrument height by input values.
	F3	OCC	Sets an instrument coordinate point by input values.
	F4	P2↓	The function of soft keys is shown on next page (P3).
3	F1	OFSET	Select Off-set measurement mode
	F2	m/f/i	Switches meter, feet or feet and inch unit.
	F3	S/A	Select set audio mode
	F4	P3↓	The function of soft keys is shown on next page (P1).

1.5 Star key mode

Press the (★) key to view the instrument options. Since there are two screens of options, press (★)again to view the next screen.

Note: Star key mode does not function when the same function as the function assigned to the star key mode is performed from the main routine.



Page	key	Display mark	Function
1	F1		Turn the backlight of the display ON/OFF
	F2	NP/P	Switch prism /non-prism measurement mode
	F3		Turn on/off guider laser
	F4	LASER	Turn on/off laser plummet
	▲or ▼		Adjust the contrast of the display (0 to 9 steps)
2	F2		Display electric circular level graphic.
	F3		Turn the reticle Illumination ON/OFF
	F4	PPM	The light acceptance quantity level for the EDM (SIGNAL), the atmospheric correction value (PPM) and correction value of prism constant (PSM) are displayed.
	▲or ▼		Adjust the contrast of the display (0 to 9 steps)

1.6 Serial signal RS-232C connector

The serial signal connector is used for connecting the TS1000 with a computer or Data Collector, which enables the computer to receive measured data from the TS1000 or to send preset data of horizontal angle, etc. to it.

- The following data will be output at each mode.

Mode	Output
Angle mode (V,HR or HL)	V,HR (or HL)
Horizontal distance mode (HR, HD, VD)	V,HR, HD, VD
Slope distance mode (V, HR,SD)	V,HR, SD,HD
Coordinate mode	N, E, Z, HR (or V,HR,SD,N,E,Z)

- The display and the output at the coarse mode are the same as the contents above.
- Output at the tracking mode is displayed as distance data only.

The details necessary for the connection with the TS1000 is obtained from its Interface Manual which is optionally available. Please refer to the manual.

2 PREPARATION FOR MEASUREMENT

2.1 Setting Instrument Up For Measurement

Mount the instrument to the tripod. Level and center the instrument precisely to insure the best performance. Use tripods with a tripod screw of 5/8 in. diameter and 11 threads per inch, such as the Type E wide- frame wooden tripod.

Reference: Leveling and Centering the Instrument

1. Setting up the Tripod

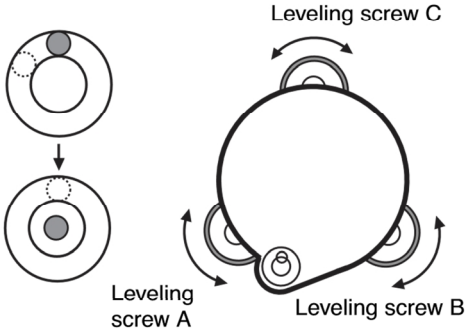
First, extend the extension legs to suitable lengths and tighten the screws on their midsections.

2. Attaching the Instrument on the Tripod Head

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

3. Roughly Leveling the Instrument by Using the Circular Level

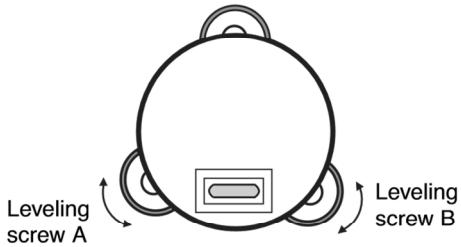
1 Turn the leveling screws A and B to move the bubble in the circular level. The bubble is now located on a line perpendicular to a line running through the centers of the two leveling screws being adjusted.



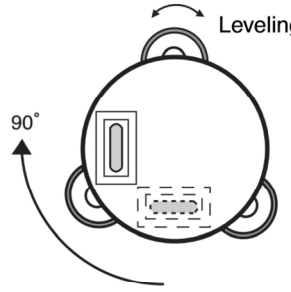
2 Turn the leveling screw C to bring the bubble to the center of the circular level.

4. Centering by Using the Plate Level

1 Rotate the instrument horizontally by using the Horizontal motion/clamp screw and place the plate level parallel with the line connecting leveling screws A and B, and then bring the bubble to the center of the plate level by turning leveling screws A and B.



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

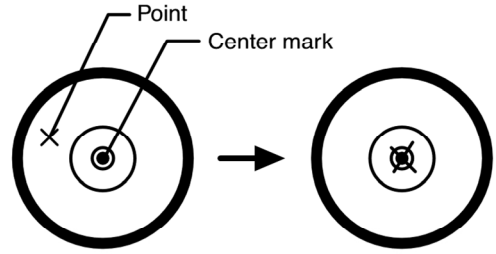


3 Repeat the procedures *1* and *2* for each 90° (100g) rotation of the instrument and check whether the bubble is correctly centered for all four points.

5. Centering by Using the Optical Plummet Telescope

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, and then tighten the tripod screw. Sliding the instrument carefully not to rotate that allows you to get the least dislocation of the bubble.



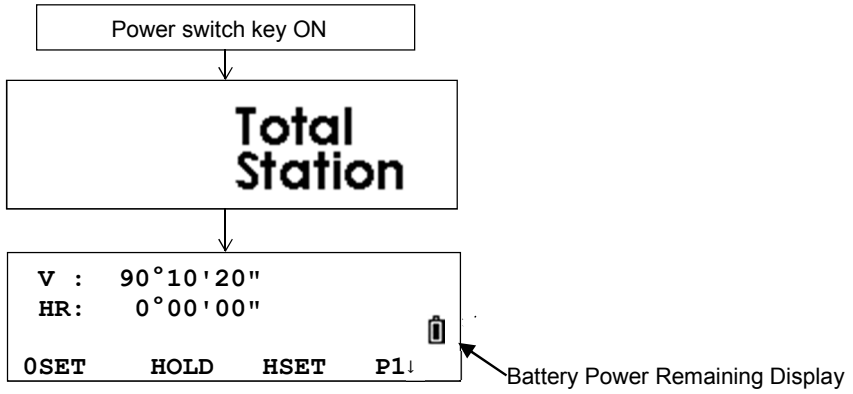
6. Completely Leveling the Instrument

Leveling the instrument precisely in a similar way to 4. Rotate the instrument and check to see that the bubble is in the center of the plate level regardless of telescope direction, then tighten the tripod screw hard.

2.2 Power Switch Key ON

1 Confirm the instrument is leveled.

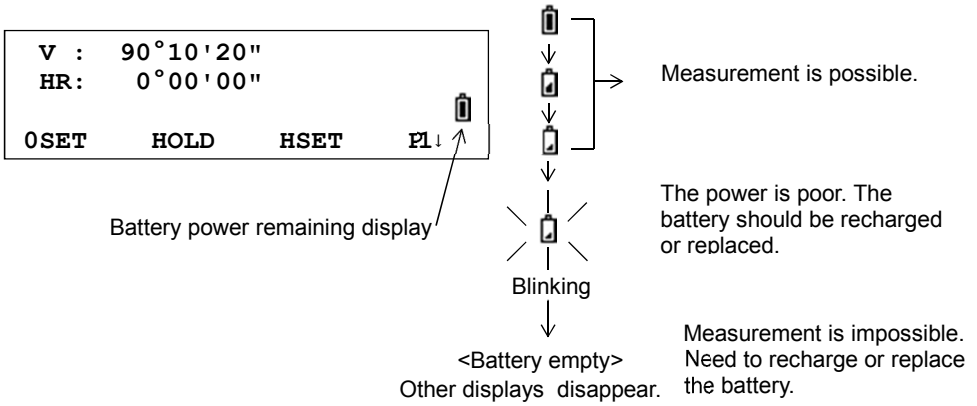
2 Turn the power switch ON.



- Confirm the battery power remaining display. Replace with charged battery or charge when battery level is low or indicates “Battery empty”. see Section 2.3“Battery Power Remaining Display” .

2.3 Battery Power Remaining Display

Battery power remaining display indicates the power condition.

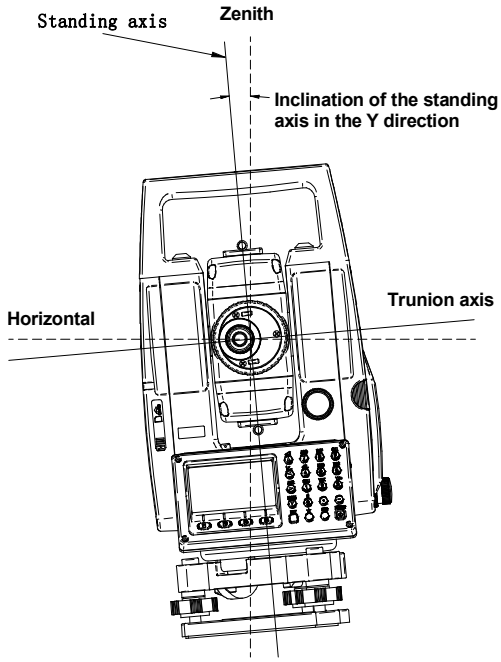


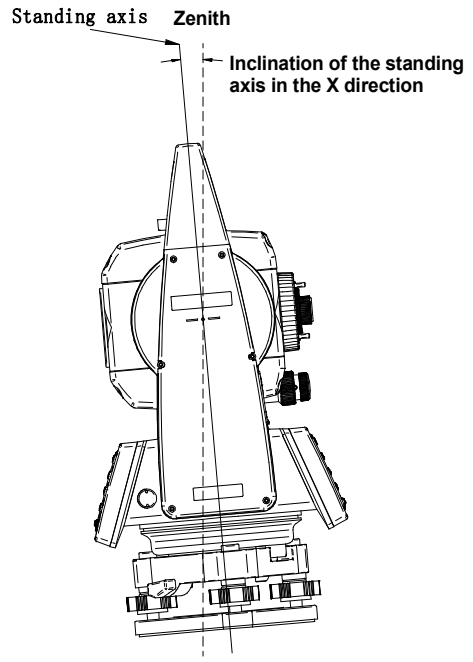
Note:
1
The battery operating time will vary depending on the environmental conditions such as ambient temperature, charging time, the number of times of charging and discharging etc. It is recommended for safety to charge the battery beforehand or to prepare spare full charged batteries.

2
The battery power remaining display shows the power level regarding to the measurement mode now operating.
The safety condition indicated by the battery power remaining display in the angle measurement mode does not necessarily assure the battery’s ability to be used in the distance measurement mode.
It may happen that the mode change from the angle mode to the distance mode will stop the operation because of insufficient battery power for the distance mode which consumes more power than angle mode.

2.4 Vertical and Horizontal Angle Tilt Correction

To ensure a precise angle measurement, tilt sensors must be turned on. The display can also be used to fine level the instrument. If the (TILT OVER) display appears the instrument is out of automatic compensation range and must be leveled manually.





- TS1000 compensates the vertical angle reading due to inclination of the standing axis in the X direction.

When the instrument is out of compensation. (TILT OVER)

```
V :    °  '  "
HR:    °  '  "
   < TILT OVER>
```

- TS1000 compensates both the vertical angle and the horizontal angle readings due to inclination of the standing axis in the X and Y directions.
- The display of Vertical or Horizontal angle is unstable when instrument is on an unstable stage or in a windy day. You can turn off the auto tilt correction function of V /H angle in this case.

● **Setting Tilt Correction by Soft Key**

To enable you to select tilt ON/OFF function. setting is not memorized after power is OFF.

[Example] Setting X Tilt OFF

Operating procedure	Option	Display
1 Press [F4] key to get the function page 2.	[F4]	V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓ TILT REP V% P2↓
2 Press [F1](TILT) key. In case ON is already selected, the display shows tilt correction value.	[F1]	TILT SENSOR:[X-ON] X:-0°00'25" X-ON XY-ON OFF ENTER
3 Press [F3](OFF) key.	[F3]	TILT SENSOR: [OFF] X-ON XY-ON OFF ENTER
4 Press[F4] [ENTER] key.	[F4]	 V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓

● The setting mode performed here will not be memorized after powering OFF. To set TILT correction in the initialized setting (it is memorized after powering OFF), see Section 6.3.3“Angle Tilt correction (Tilt ON/OFF)” .

2.5 How to Enter Alphanumeric characters

This enables you to enter alphanumeric characters such as the instrument height, prism height, occupied point, backsight point etc..

2.5.1 How to Enter Alphanumeric Characters

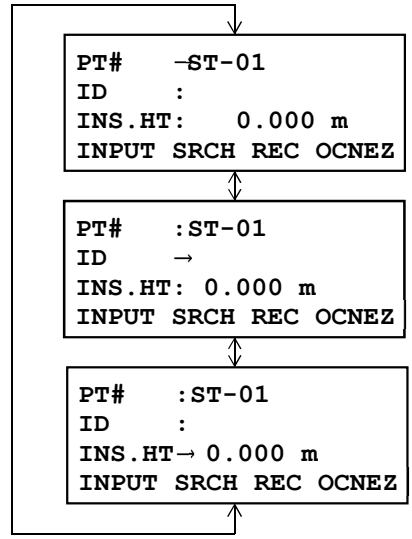
- **How to select a item**

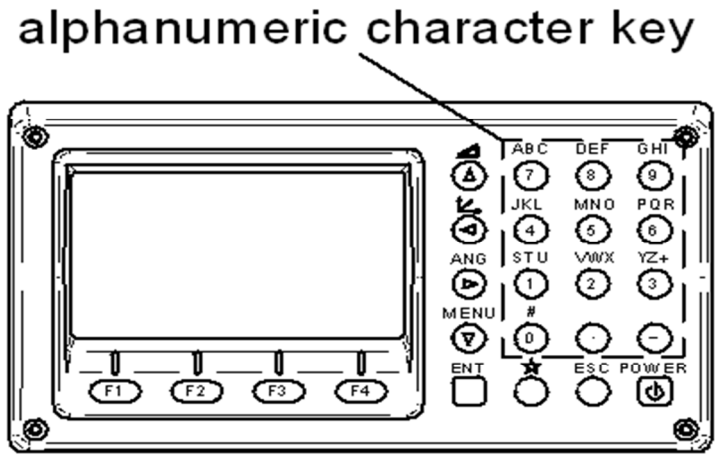
[Example setting] Occupied point in the data collection mode.

The arrow indicates a item to enter.

The arrow line moves up or down when the [▼] key or [▲] key is pressed.

[▼]
or
[▲]





● How to enter characters

[Example setting]

1 Move the arrow to enter a item using the [▼] or [▲] key.

```
PT#  →
ID   :
INS.HT: 0.000m
INPUT SRCH REC OCNEZ
```

2 Press the [F1] (INPUT) key. The arrow changes to the equal (=) .
The instrument switches to numerical input mode.

```
PT#   =
ID    :
INS.HT: 0.000 m
[ALP] --- [CLR][ENT]
```

3 Press the [F1] [ALP] key.
The instrument switches to alphabetical input mode.

```
PT#   =
ID    :
INS.HT: 0.000 m
[NUM] --- [CLR][ENT]
```

4 Enter letters of the alphabet by pressing the alphanumeric characters key.
Example: [1] (STU) key is pressed twice.

```
PT#   =T
ID    :
INS.HT: 0.000 m
[NUM] --- [CLR][ENT]
```

5 Enter other letters of the alphabet in the same way.

```
PT#   =TAN
ID    :
INS.HT: 0.000 m
[NUM] --- [CLR][ENT]
```

6 Press the [F1] (NUM) key, again.
The instrument switches back to numerical input mode.

```
PT#   =TAN
ID    :
INS.HT: 0.000 m
[ALP] --- [CLR][ENT]
```

7 Enter numbers by pressing the alphanumeric characters key.

Example: [-], [1] key is pressed.

```
PT#   =TAN-
ID    :
INS.HT: 0.000 m
[ALP] --- [CLR][ENT]
```

8 Press [F4](ENT) key.
The arrow moves to next item.
Select next character in the same manner.

```
PT#   =TAN-1
ID    →
INS.HT: 0.000 m
[NUM] --- [CLR][ENT]
```

- Press the key【◄】to delete the character before the cursor;
- Press [F3](CLR) key to delete all the characters in the edit box;
- Press the key【►】to move the cursor to the character that needs to be modified and input again.

3 ANGLE MEASUREMENT

3.1 Measuring Horizontal Angle Right and Vertical Angle

Make sure the mode is in Angle measurement.

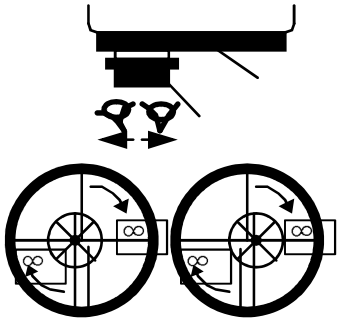
Operating procedure	Operation	Display
1 Collimate the 1st target (A).	Collimate A	V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓
2 Set horizontal angle of target A at 0° 00' 00". Press the [F1](0 set) key and press the [F3](YES) key.	[F1] [F3]	H ANGLE 0 SET > OK? --- --- [YES][NO] V : 90°10'20" HR: 0°00'00" 0SET HOLD HSET P1↓
3 Collimate the 2nd target (B). The required V/H angle to target B will be displayed.	Collimate B	V : 98°36'20" HR: 160°40'20" 0SET HOLD HSET P2↓

Reference : How to Collimate

1 Point the telescope toward the light. Turn the diopter ring and adjust the diopter so that the cross hairs are clearly observed.
(Turn the diopter ring toward you first and then backward to focus.)

2 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. *3* Focus the target with the focusing knob.

*If parallax is created between the cross hairs and the target when viewing Focusing knob vertically or horizontally while looking into the telescope, focusing is incorrect Telescope eyepiece (Diopter ring) or diopter adjustment is poor. This adversely affects precision in measurement or survey Eliminate the parallax by carefully focusing and using diopter adjustment.



3.2 Switching Horizontal Angle Right/Left

Make sure the mode is Angle measurement.

Operating procedure	Operation	Display
1 Press the [F4](↓) key twice to get the function on page 3.	[F4] twice	V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓ TILT REP V% P2↓ H-BZ R/L CMPS P3↓
2 Press the [F2](R/L) key. The mode Horizontal angle Right (HR) switches to Left (HL) mode.	[F2]	V : 90°10'20" HL: 239°29'20" H-BZ R/L CMPS P3↓
3 Measure as HL mode.		

● Every time pressing the [F2](R/L) key, HR/HL mode switches.

3.3 Measuring from the Required Horizontal Angle

3.3.1 Setting by Holding the Angle

Make sure the mode is angle measurement.

Operating procedure	Operation	Display
1 Set the required horizontal angle, using Horizontal tangent screw.	Display angle	V : 90°10'20" HR: 130°40'20" 0SET HOLD HSET P1↓
2 Press the [F2](HOLD) key.	[F2]	H ANGLE HOLD HR= 130°40'20" > SET ? --- --- [YES][NO]
3 Collimate the target.	Collimate	
4 Press the [F3](YES) key to finish holding the horizontal angle.*1) The display turns back to normal angle measurement mode.	[F3]	V : 90°10'20" HR: 130°40'20" 0SET HOLD HSET P1↓

*1) To return to the previous mode, press the [F4](NO) key.

3.3.2 Setting a Horizontal Angle from the Keys

Make sure the mode is Angle measurement.

Operating procedure	Operation	Display
1 Collimate the target.	Collimate	V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓
2 Press the [F3](HSET) key.	[F3]	H ANGLE SET HR=170.3020 --- --- [CLR][ENT]
3 Input the required horizontal angle by using keys. *1) For example :70°40'20" When completed, normal measuring from the required Horizontal angle is possible.	70.4020 [F4]	V : 90°10'20" HR: 70°40'20" 0SET HOLD HSET P1↓

*1) To enter Alphanumeric characters, see Section 2.5 “How to Enter Alphanumeric characters” .

3.4 Vertical Angle Percent Grade(%) Mode

Make sure the mode is Angle measurement.

Operating procedure	Operation	Display
1 Press the [F4](↓) key to get the function on page 2.	[F4]	V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓ TILT REP V% P2↓
2 Press the [F3](V%) key. *1)	[F3]	V : -0.30 % HR: 170°30'20" TILT REP V% P1↓

*1) Every time pressing the [F3](V%) key, the display mode switches.

● When the measurement is carried out over ±45° (±100%) from the horizontal, the display shows <OVER>.

3.5 Repetition Angle Measurement

Repetition angle measurement can be done by horizontal angle right measurement mode.

Make sure the mode is Horizontal Angle Right measurement.

Operating procedure	Operation	Display
1 Press the [F4](↓) key to get the function on page 2.		V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓
2 Press the [F2](REP)key.	[F4]	TILT REP V% P2↓ REPETITION ANGLE > OK? --- --- [YES][NO]
3 Press the [F3](YES) key.	[F2]	REP-ANGLE COUNT[0] Ht: 0°00'00" Hm: 0SET V/H REL HOLD
4 Collimate the target A and press the [F1] (0SET) key.	[F3]	REPETITION ANGLE INITIALIZE > OK? --- --- [YES][NO]
5 Press the [F3] (YES) key.	Collimate A [F1]	REP-ANGLE COUNT[0] Ht: 0°00'00" Hm: 0SET V/H REL HOLD
6 Collimate the target B using the horizontal clamp and tangent screw. Press the [F4](HOLD) key.	[F3]	REP-ANGLE COUNT[1] Ht: 45°10'00" Hm: 45°10'00" 0SET V/H REL HOLD
7 Recollimate target A using the horizontal clamp and tangent screw, and press the [F3](REL)key.	Collimate B [F4]	REP-ANGLE COUNT[1] Ht: 45°10'00" Hm: 45°10'00" 0SET V/H REL HOLD
8 Recollimate target B using the horizontal clamp and tangent screw, and press the [F4](HOLD) key.	Collimate A [F3]	REP-ANGLE COUNT[2] Ht: 90°20'00" Hm: 45°10'00" 0SET V/H REL HOLD
9 Repeat ***7*** to ***8*** to measure the desired number of repetitions. [Example] 4 measurement	Collimate B	REP-ANGLE COUNT[4] Ht: 180°40'00" Hm: 45°10'00" 0SET V/H REL HOLD

10 To return to the normal angle mode, press the [F2](V/H) key or [ESC] key.	[F4]	REPETITION ANGLE Exit > OK? --- --- [YES][NO]
11 Press the [F3](YES) key.	[ESC] or [F2] [F3]	V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓

- Horizontal angle can be accumulated up to (3600°00'00" – minimum reading) (horizontal angle right).
  In case of 5 second reading, horizontal angle can be accumulated up to +3599°59'55".
- Error will be displayed when the results differ from first measurement by more than ±30".

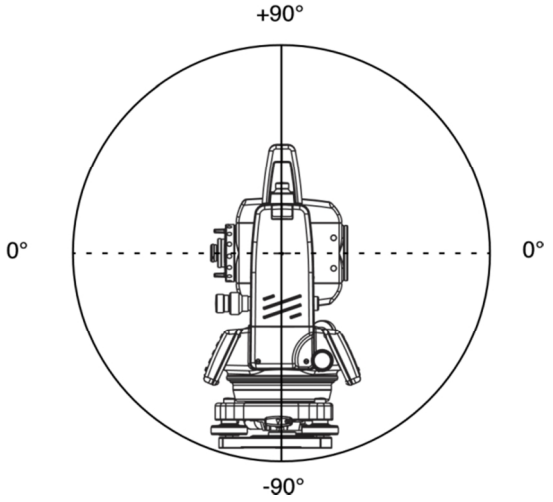
3.6 Buzzer Sounding for Horizontal Angle 90° Increments

When the horizontal angle falls in the range of less than ± 1° of 0°, 90°, 180° or 270°, the buzzer sounds. Buzzer stops only when the horizontal angle is adjusted to 0°00'00", 90°00'00" , 180°00'00" or 270°00'00".
This setting is not memorized after powering off. Refer to 16 "SELECTING MODE" to set the initial setting (memorized after powering off).
Make sure the mode is Angle measurement.

Operating procedure	Operation	Display
1 Press the [F4](↓) key twice to get the function on page 3.	[F4] twice	V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓ H-BZ R/L CMPS P3↓
2 Press the [F1](H-BZ) key. The data previously set is shown.	[F1]	H-ANGLE BUZZER [OFF] [ON] [OFF] --- ENTER
3 Press the [F1](ON) key or [F2](OFF) key to select the buzzer ON/OFF.	[F1] or [F2]	H-ANGLE BUZZER [ON] [ON] [OFF] --- ENTER
4 Press the [F4](ENTER) key.	[F4]	V : 90°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓

3.7 Compasses (vertical angle)

Vertical angle is displayed as shown below.



Operating procedure	Operation	Display
1 Press the [F4](↓) key twice to get the function on page 3.	[F4] twice	V : 98°10'20" HR: 170°30'20" 0SET HOLD HSET P1↓ H-BZ R/L CMPS P3↓
2 Press the [F3](CMPS) key. *1)	[F3]	V : - 8°10'20" HR: 170°30'20" H-BZ R/L CMPS P3↓
*1) Every time pressing the [F3](CMPS) key, the display mode switches ;		

4 DISTANCE MEASUREMENT

4.1 Setting of the Atmospheric Correction

When setting the atmospheric correction, obtain the correction value by measuring the temperature and pressure. Refer to Section 12.2 “Setting of Atmospheric Correction Value”.

4.2 Selecting of the Reflective Target as Non-Prism/Prism

TS1000 can perform Non-Prism measurement. Before measuring, the reflective target type should be set correctly. TS1000 will automatically adjusts the intensity of the laser beam and switches the distance measurement display range to match the type of target used. if the target does not correspond to the target settings, the range and accuracy of distance measurement may be affected.

4.3 Setting of the Correction for Prism Constant

In case “Prism” is selected as reflective target for distance measurement, the constant correction value of the prism must be set correctly. MATO’s prism constant value is -30. Set correction for prism at -30. If the prism is of another manufacture, the appropriate constant shall be set beforehand. Refer to Chapter 11 “SETTING THE PRISM CONSTANT VALUE”. The setting value is kept in the memory even after power is off.

4.4 Distance Measurement (Continuous Measurement)

Make sure the mode displays angle measurement.

Operating procedure	Operation	Display
1 Collimate the center of reflective target (prism).	Collimate P	V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓
2 Press the [ ] key. Distance measurement starts. *1),2)	[ ]	HR: 120°30'40" HD*[r] << m VD: m MEAS MODE NP/P P1
The measured distances are shown. *3)~*5)		HR: 120°30'40" HD* 123.456 m VD: 5.678 m MEAS MODE NP/P P1
● Pressing the [ ] key again, the display changes to horizontal (HR) and vertical (V)angle and slope distance(SD). *6)	[ ]	V : 90°10'20" HR: 120°30'40" SD* 131.678 m MEAS MODE NP/P P1

*1) When EDM is working, the "✳" mark appears in the display.
*2) To change mode from Fine to Coarse or Tracking, refer to section 4.5 “Fine Mode/Tracking Mode/ Coarse Mode”.
To set the distance measurement when the instrument is powered on, refer to Chapter 15 “SELECTING MODE”.
*3) The distance unit indicator "m" (for meter) , "f" (for feet or feet inch) appears and disappears alternatively with buzzer sounds at every renewal of distance data.
*4) Press the F3[NP/P] to switch mode between Prism mode and Non-Prism mode.
*5) To return to the normal measuring angle mode from a distance measuring mode, press the [ANG] key.
*6) It is possible to choose the display order (HR, HD, VD) or (V, HR, SD) for initial measuring distance mode. Refer to Chapter 15 “SELECTING MODE”.

4.5 Distance Measurement (N-time Measurement/Single Measurement)

When the number of times measurement is preset, the TS1000 measures the distance the set number of times. The average distance will be displayed.

When presetting the number of times as 1, it does not display the average distance, because of single measurement. Single measurement is set at the factory.

Make sure the mode displays angle measurement.

Operating procedure	Operation	Display
1 Collimate the center of reflective target (prism).		V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓
2 Press the [◢] key. Continuous measuring starts.*1)	[◢]	HR: 120°30'40" HD*[r] << m VD: m MEAS MODE NP/P P1↓
3 Press [F1](MEAS) key while continuous measuring is exceeding. *2) The average value is displayed and "*" mark disappears.	[F1]	HR: 120°30'40" HD*[n] << m VD: m MEAS MODE NP/P P1↓
● While EDM is working, press [F1](MEAS) key again, the mode will be changed to continuous measuring mode.		HR: 120°30'40" HD: 123.456 m VD: 5.678 m MEAS MODE NP/P P1↓

*1) It is possible to set the measurement mode for N-times measurement mode or continuous measurement mode when the power is turned on. Refer to Chapter 16 “SELECTING MODE”.

*2) For setting the number of times (N-times) in the measurement, refer to Chapter 16 “SELECTING MODE”.

● Choose meter /feet / feet+inch unit by soft key

It is possible to change the unit for distance measurement mode by soft key.
This setting is not memorized after power off. Refer to 15 “SELECTING MODE” to set at the initial setting (memorized after power off).

Operating procedure	Operation	Display
1 Press the [F4] key twice to get the function on page 3	[F4] [F4]	HR: 120°30'40" HD* 2.000 m VD: 3.000 m MEAS MODE NP/P P1↓ OFSET S.O S/A P2↓ --- m/f/i --- P3↓
2 Every time pressing the [F2](m/f/i) key, the display unit will be changed. Every time pressing the [F2](m/f/i) key, the unit mode switches.	[F3]	HR: 120°30'40" HD* 6.560 f VD: 9.845 f --- m/f/i --- P3↓

4.6 Fine Mode/Tracking Mode/Coarse Mode

This setting is not memorized after power is off. Refer to Chapter 15"SELECTING MODE" to set at the initial setting (memorized after power is off).

- •Fine Mode: This is a normal distance measuring mode.
  The unit to be displayed: 1mm. (0.005ft)
  Measurement time: approx. 1.0 sec.
- •Tracking Mode: This mode measures in shorter time than in fine mode.
  It is very useful when tailing the moving object or carrying out stake-out work. The unit to be displayed: 10mm
  Measuring time: approx. 0.3 sec.
- •Coarse Mode: This mode measures in shorter time than in fine mode.
  The unit to be displayed: 10mm or 1mm
  Measuring time: approx. 0.7 sec.

Operating procedure	Operation	Display
1 Press the [F2](MODE) key from the distance measuring mode.*1) The initial character (F/T/C) of set mode is displayed . (F:Fine, T:Tracking, C:Coarse)	[F2]	HR: 120°30'40" HD* 123.456m VD: 5.678m MEAS MODE NP/P P1↓
		HR: 120°30'40" HD* 123.456m VD: 5.678m FINE TRACK COARSE F
2 Press the [F1](FINE) key, [F2](TRACK) key, or [F3](COARSE) key.	[F1]~[F3]	HR: 120°30'40" HD* 123.456m VD: 5.678m MEAS MODE NP/P P1↓
*1) To cancel the setting, press the [ESC] key.		

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

Operating procedure	Operation	Display
1 Press the [F4](↓) key in the distance measuring mode to get the function on page 2.	[F4]	HR: 120°30'40" HD* 123.456 m VD: 5.678 m MEAS MODE NP/P P1↓
		OFSET S.O S/O P2↓
2 Press the [F2](S.O) key. The data previously set is shown.	[F2]	STAKE OUT HD : 0.000 m HD VD SD ---

3 Select the measuring mode by pressing the [F1] to [F3] key.

Example : Horizontal distance

[F1]

```
STAKE OUT
 HD =   0.000 m

 ---  --- [CLR][ENT]
```

Enter data [F4]

4 Enter the distance for stake out. *1)

```
STAKE OUT
 HD :   100.000 m

INPUT --- --- ENTER
```

Collimate P

5 Collimate the target (Prism).

Measuring starts.

```
HR:      120°30'40"
dHD*[r] <<        m
VD:               m
MEAS MODE NP/P  P1↓
```

↓

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

```
HR: 120°30'40"
dHD*[r]   23.456 m
VD:        5.678 m
MEAS MODE NP/P  P1↓
```

6 Move the target until the difference becomes 0m.

*1) Refer to section 2.5 “How to Enter Alphanumeric characters”.

● To return to normal distance measurement mode, stake out distance to "0" m or turn the power off.

4.7 Offset Measurement

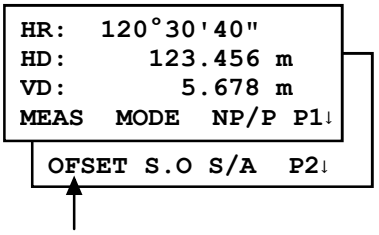
There are four offset measurement modes in the Offset Measurement.

- Angle offset
- Distance offset
- Plane offset
- Column offset

To show the offset measurement menu, press the [OFSET] soft key from distance or coordinate measurement mode.

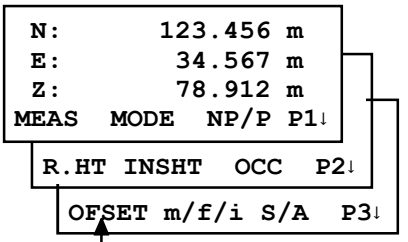
Example:

Distance measurement



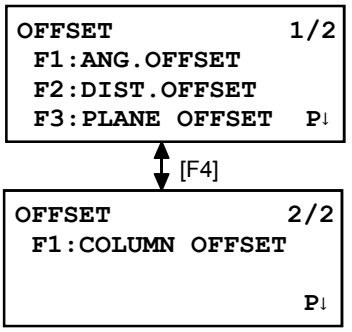
Press the [F1](OFSET) key.

Coordinate measurement



Press the [F1](OFSET) key.

Offset Measurement Menu

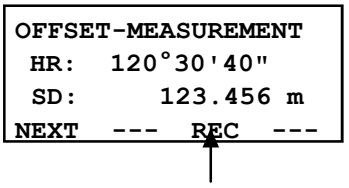


Outputting the Measurement Data

The results of offset measurement can be output to external device.

Setting the function of the [ESC] key to (REC), the [F3] soft key which assigned (REC) will appear in measured result display.

Refer to Chapter 15 “SELECTING MODE” to set this option.



[F3]

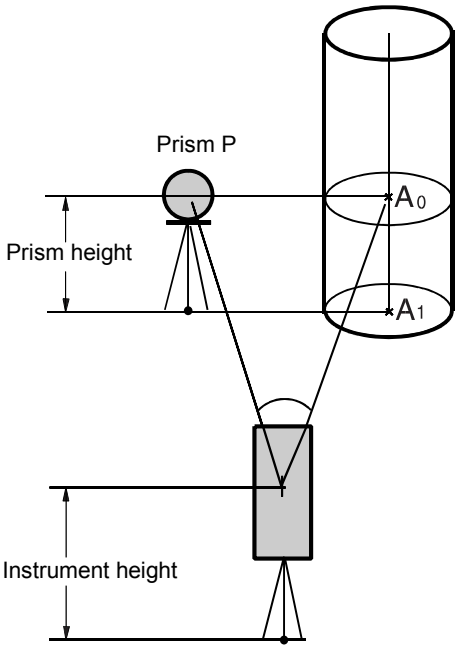
Distance measurement mode of the offset measurement

Offset measurement will be done by N-time fine measurement mode.

For setting measuring times refer to Chapter 15“SELECTING MODE”.

4.7.1 Angle Offset

This mode is useful when it is difficult to set up the prism directly, 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, operate the offset measurement after setting the instrument height/prism height.



When measuring coordinates of ground point A_1 :Set the instrument height/prism height.

When measuring coordinates of point A_0 : Set the instrument height only. (Set the prism height to 0).

When sighting to A_0, you can select one of two ways. One is to fix vertical angle to the prism position even updown the telescope position, and the other is to gear vertical angle to the updown of telescope movement. In case following the vertical angle to the movement of telescope, SD(Slope Distance) and VD(Vertical Distance) will be changed according to the movement of telescope.
To set this option, refer to Chapter 16 “SELECTING MODE”.

- 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 5.1 “Setting Coordinate Values of Occupied Point”..

Operating procedure	Operation	Display
1 Press the [F4](P1) key from distance measuring mode to get the function on page 2.	[F4]	HR: 120°30'40" HD: 123.456 m VD: 5.678 m MEAS MODE NP/P P1↓ OFST S.O S/A P2
2 Press the [F1](OFSET) key.	[F1]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P1↓
3 Press the [F1](ANG. OFFSET) key.	[F1]	OFFSET-MEASUREMENT HR: 120°30'40" HD: m MEAS --- NP/P ---
4 Collimate prism P, and press the [F1](MEAS) key.	Collimate P [F1]	OFFSET-MEASUREMENT HR: 110°20'30" HD*[n] << m >Measuring... ↓

The horizontal distance from the instrument to the prism will be measured.

After measuring, the result added offset value will be shown.

```
OFFSET-MEASUREMENT
HR:   110°20'30"
HD*      56.789
>Measuring...
```

```
OFFSET-MEASUREMENT
HR:   110°20'30"
HD:      56.789 m
NEXT  ---  ---  ---
```

5 Collimate point A_0 using the horizontal motion clamp and horizontal tangent screw.

Collimate A_0

```
OFFSET-MEASUREMENT
HR:   113°30'50"
HD:      56.789 m
NEXT  ---  ---  ---
```

6 Show the relative elevation of point A_0.

[◢]

```
OFFSET-MEASUREMENT
HR:   113°20'30"
VD:       3.456 m
NEXT  ---  ---  ---
```

7 Show the slope distance of point A_0.

Each time pressing the [◢] key, horizontal distance, relative elevation and slope distance are shown in sequence.

[◢]

```
OFFSET-MEASUREMENT
HR:   113°20'30"
SD:      56.894 m
NEXT  ---  ---  ---
```

8 Show N coordinate of point A_0 or A_1.

Each time pressing [↑↗→] key, N,E and Z coordinate are shown in sequence.

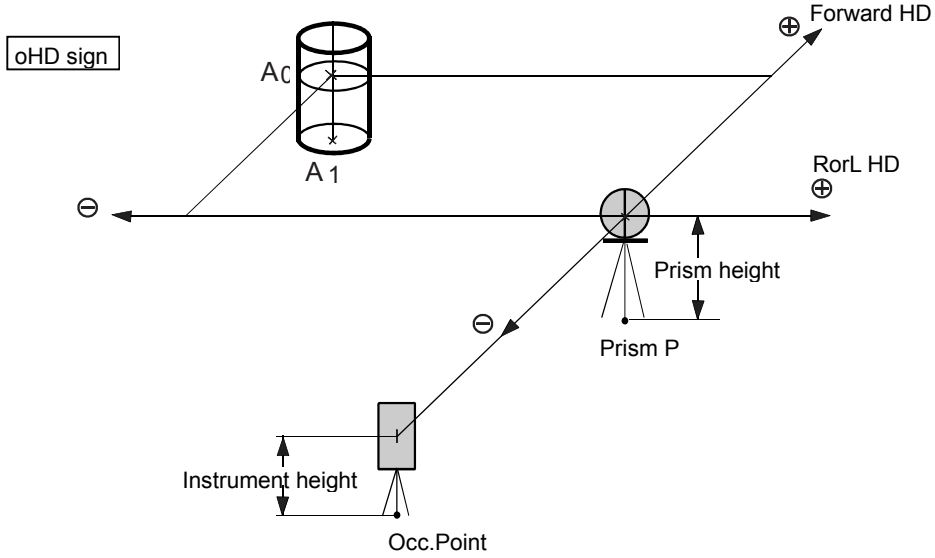
[↑↗→]

```
OFFSET-MEASUREMENT
HR:   113°20'30"
N :     -12.345 m
NEXT  ---  ---  ---
```

- To return to procedure ***4***, press [F1](NEXT) key.
- To return to the previous mode, press [ESC] key.

4.7.2 Distance Offset Measurement

The measurement of a place apart from a prism is possible by inputting offset horizontal distance of front and back / right and left.



When measuring coordinates of ground point A_1: Set the instrument height / prism height.

When measuring coordinates of point A_0: Set the instrument height only. (Set the prism height to 0).

Operating procedure	Operation	Display
1 Press the [F4](P1↓) key from distance measuring mode to get the function on page 2.	[F4]	HR: 120°30'40" HD: 123.456 m VD: 5.678 m MEAS MODE NP/N P1↓ OFSET S.O S/A P2↓
2 Press the [F1](OFSET) key.	[F1]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P↓
3 Press the [F2](DIST. OFFSET) key.	[F2]	DISTANCE OFFSET INPUT RorL HD oHD= m --- --- [CLR] [ENT]
4 Enter Right and Left direction offset value, and press the [F4](ENTER) key.	Enter HD [F4]	DISTANCE OFFSET INPUT FORWARD HD oHD= m --- --- [CLR] [ENT]
5 Enter a Forward direction offset value, and press the [F4](ENTER) key.	Enter HD [F4]	DISTANCE OFFSET HR: 80°30'40" HD: m MEAS --- NP/P ---

6 Collimate prism P, and press the [F1](MEAS) key. Measuring will start.

Collimate P
[F1]

```
DISTANCE OFFSET
 HR:  80°30'40"
 HD* [n]    <<
>Measuring...
```

After measuring, the result added offset value will be shown.

```
DISTANCE OFFSET
 HR:   80°30'40"
 HD*     10.000 m
NEXT  ---  ---  ---
```

7 Show the relative elevation of point P0.

[◢]

- Each time pressing the [◢] key, horizontal distance, relative elevation and slope distance are shown in sequence.

```
DISTANCE OFFSET
 HR:    80°30'40"
 VD:     11.789 m
NEXT  ---  ---  ---
```

```
DISTANCE OFFSET
 HR:    80°30'40"
 SD:     11.789 m
NEXT  ---  ---  ---
```

- Show coordinate of point P0.

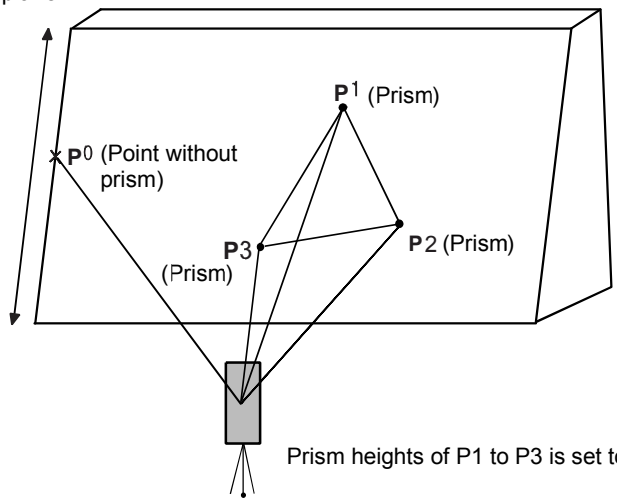
[↑→]

```
 N :     12.345 m
 E :     23.345 m
 Z :      1.345 m
NEXT  ---  ---  ---
```

- To return to procedure ***4***, press [F1](NEXT) key.
- To return to the previous mode, press [ESC] key.

4.7.3 Plane Offset Measurement

Measuring will be taken for the place where direct measuring can not be done, for example distance or coordinate measuring for a edge of a 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 calculates and displays coordinate and distance value of cross point between collimation axis and of the plane.



Prism heights of P1 to P3 is set to zero automatically.

- When setting the coordinate value for the occupied station, refer to Section 5.1 “Setting Coordinate Values of Occupied Point”.

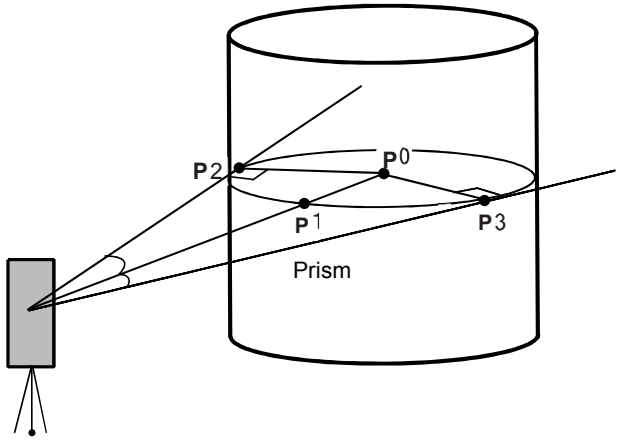
Operating procedure	Operation	Display
1 Press the [F4](P1↓) key from distance measuring mode to get the function on page 2.	[F4]	HR: 120°30'40" HD: 123.456 m VD: 5.678 m MEAS MODE NP/P P1↓ OFSET S.O S/A P2↓
2 Press the [F1](OFSET) key.	[F1]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P↓
3 Press the [F3](PLANE OFFSET) key.	[F3]	PLANE N001#: SD: m MEAS --- NP/P ---
4 Collimate prism P1, and press the [F1](MEAS) key. N-time measuring will start. After measuring, the display will show the second point measurement.	Collimate P1 [F1]	PLANE N001#: SD* [n] << m >Measuring... ↓
5 Measure the second and third points in the same way.	Collimate P2 [F1]	PLANE N002#: SD: m MEAS --- NP/P --- ↓

	Collimate P3 [F1]	PLANE N003#: SD: m MEAS --- NP/P ---
The instrument calculates and displays coordinate and distance value of cross point between collimation axis and of the plane. *1),2)		↓ HR: 80°30'40" HD: 54.321 m VD: 10.000 m EXIT
6 Collimate the edge (P0) of the plane. *3) ,4)	Collimate P0	HR: 75°30'40" HD: 54.600 m VD: -0.487 m EXIT
7 To show the slope distance (SD), press the [ ] key. ● Each time pressing the [ ] key, horizontal distance, relative elevation and slope distance are shown in sequence. ● To show coordinate of point P0, press the [ ] key. ***8*** To escape the measuring, press the [F1](EXIT) key. The display returns to the previous mode.		V : 90°30'40" HR: 75°30'40" SD: 56.602 m EXIT

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

4.7.4 Column Offset Measurement

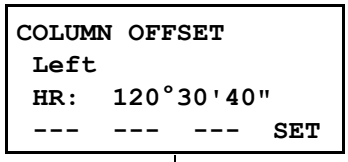
If it is possible to measure circumscription point (P1) of column directly, the distance to the center of the column (P0), coordinate and direction angle can be calculated by measured circumscription points (P2) and (P3).
The direction angle of the center of the column is 1/2 of total direction angle of circumscription points (P2) and (P3).



● When setting the coordinate value for the occupied station, refer to Section 5.1 “Setting Coordinate Values of Occupied Point”.

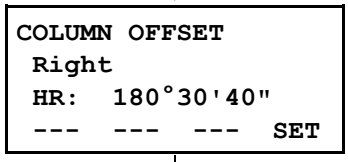
Operating procedure	Operation	Display
1 Press the [F4](P1↓) key from distance measuring mode to get the function on page 2.	[F4]	HR: 120°30'40" HD: 123.456 m VD: 5.678 m MEAS MODE NP/P P1 OFSET S.O S/A P2↓
2 Press the [F1](OFSET) key.	[F1]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P↓
3 Press the [F4](P↓) key.	[F4]	OFFSET 2/2 F1:COLUMN OFFSET P↓
4 Press the [F1](COLUMN OFFSET) key.	[F1]	COLUMN OFFSET Center HD: m MEAS --- NP/P ---
5 Collimate the center of the column (P1) and press the [F1](MEAS) key. N-time measuring will start.	Collimate P1 [F1]	COLUMN OFFSET Center HD* [n] << m >Measuring... ↓

After the measurement, angle measuring display of the left side (P2) will be shown.



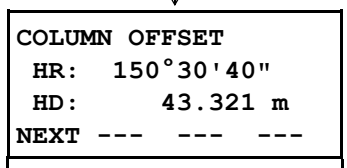
6 Collimate the left side of the column (P2) and press the [F4](SET) key.
After the measurement, angle measuring display of the right side (P3) will be shown.

Collimate P2 [F4]



7 Collimate the right side of the column (P3) and press the [F4](SET) key.

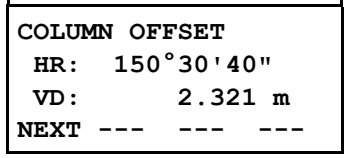
Collimate P3 [F4]



8 The distance between the instrument and center of the column (P0) will be calculated.

To show the relative elevation (VD), press the [◢] key.

[◢]



Each time pressing the [◢] key, horizontal distance, relative elevation and slope distance are shown in sequence.

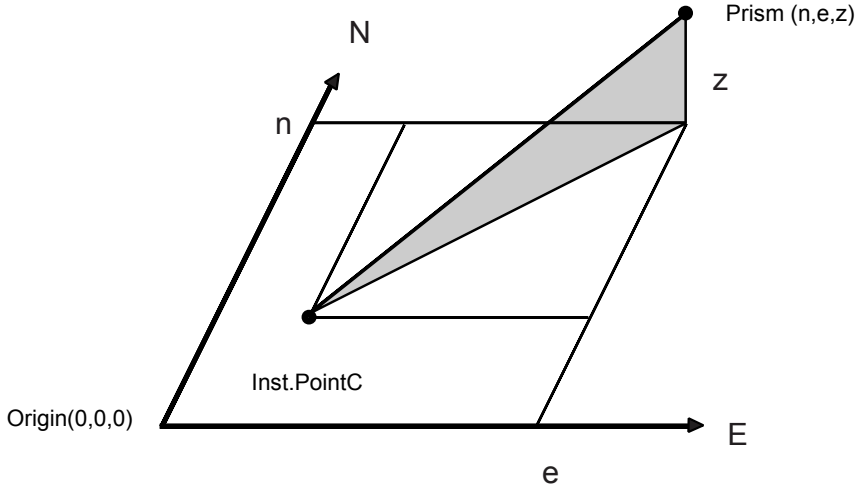
- To show coordinate of point P0, press the [↑↗→] key.
- To escape the measuring, press the [ESC] key.

9 The display returns to the previous mode.

5 COORDINATE MEASUREMENT

5.1 Setting Coordinate Values of Occupied Point

Set the coordinates of the instrument (occupied point) according to coordinate origin, and the instrument automatically converts and displays the unknown point (prism point) coordinates following the origin.
It is possible to retain the coordinates of the occupied point after turning the power off.
Refer to Chapter 16 “SELECTING MODE”.



Operating procedure	Operation	Display
1 Press the [F4](↓) key from the coordinate measurement mode to get the function on page 2.	[F4]	N: 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓ R.HT INSHT OCC P2↓
2 Press the [F3](OCC) key.	[F3]	N= 0.000 m E: 0.000 m Z: 0.000 m --- --- [CLR] [ENT]
3 Enter N coordinate value. *1)	Enter data [F4]	N: -72.000 m E= 0.000 m Z: 0.000 m --- --- [CLR] [ENT]
4 Enter E and Z coordinate values in the same manner. After entering the values, the display returns coordinate measuring display.		N: 51.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input range –9999999.9990 ≦ N,E,Z ≦ +99999999.9990m
–9999999.999 ≦ N,E,Z ≦ +99999999.999 ft.
–9999999.11.7 ≦ N,E,Z ≦ +99999999.11.7 ft.+inch

5.2 Setting Height of the Instrument

It is possible to retain the height of instrument after turning the power off. Refer to Chapter 16 “SELECTING MODE”.

Operating procedure	Operation	Display
1 Press the [F4](↓) key from the coordinate measurement mode to get the function on page 2.	[F4]	N: 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓ R.HT INSHT OCC P2↓
2 Press the [F2](INSHT) key. The current value is displayed.	[F2]	INSTRUMENT HEIGHT INPUT INS.HT= 0.000 m --- --- [CLR][ENT]
3 Enter the instrument height. *1)	Enter Inst.HT [F4]	N: 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input range –999.9999 ≦ Instrument height ≦ +999.9999 m
–999.999 ≦ Instrument height ≦ +999.999 ft.
–999.11.7 ≦ Instrument height ≦ +999.11.7 ft.+inch

5.3 Setting Height of Target (Prism Height)

This mode can be used to obtain Z coordinate values . It is possible to retain the height of target after turning the power off. Refer to Chapter 15 “SELECTING MODE”.

Operating procedure	Operation	Display
1 Press the [F4](↓) key from the coordinate measurement mode to get the function on page 2.	[F4]	N: 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓ R.HT INSHT OCC P2↓
2 Press the [F1](R.HT) key. The current value is displayed.	[F1]	REFLECTOR HEIGHT INPUT R.HT= 0.000 m --- --- [CLR][ENT]
3 Enter the prism height. *1)	Enter R.HT [F4]	N: 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE NP/P P1↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input range –999.9999 ≦ Prism height ≦ +999.9999 m
–999.999 ≦ Prism height ≦ +999.999 ft.
–999.11.7 ≦ Prism height ≦ +999.11.7 ft.+inch

5.4 Execution of Coordinate Measuring

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 5.1 “Setting Coordinate Values of Occupied Point”
- When setting the instrument height and prism height, see Section 5.2 “Setting Height of the Instrument” and 5.3 “Setting Height of Target (Prism Height)”.
- The coordinates of the unknown point are calculated as shown below and displayed:

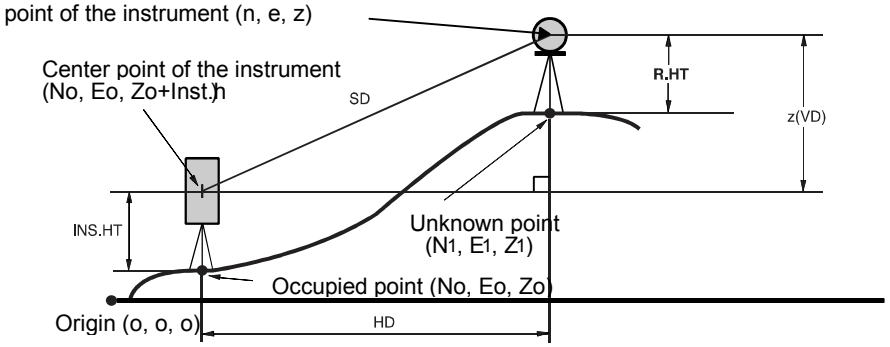
  Coordinates of occupied point : (N_0, E_0, Z_0)
  Instrument height : INS.HT
  Prism height : R.HT
  Vertical distance (Relative elevation) : z (VD) Coordinates of the center of the prism, originated from the center point of the instrument : (n,e,z)
  Coordinates of unknown point : (N_1, E_1, Z_1)

  $N_1=N_0+n$

  $E_1=E_0+e$

  $Z_1=Z_0+INS.HT+z - R.HT$

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



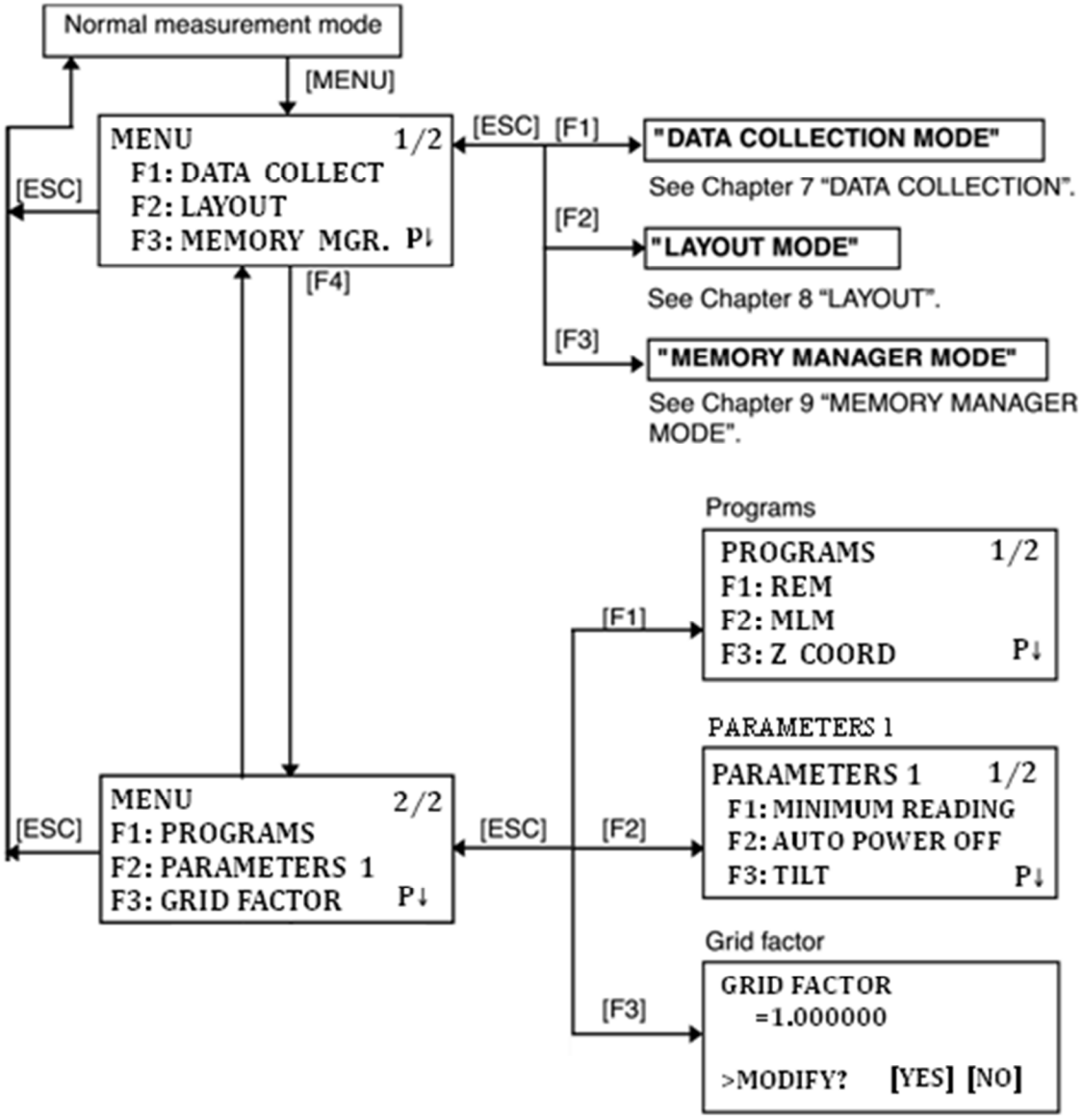
Operating procedure	Operation	Display
1 Set the direction angle of known point A. *1)	Set direction angle	V : 90°10'20" HR: 120°30'40" 0SET HOLD HSET P1↓
2 Collimate target prism.	Collimate P	
3 Press the [ ] key. Measuring starts.	[ ]	N*[r] << m E: m Z: m MEAS MODE NP/P P1↓
The result will be shown.		N* 123.456 m E: 34.567 m Z: 78.912 m MEAS MODE S/A P1↓

*1) Refer to Section 3.3 “Measuring from the Required 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 instrument height will be calculated as 0 when the instrument height is not entered.
- The prism height will be calculated as 0 when the prism height is not set.

6 SPECIAL MODE (Menu Mode)

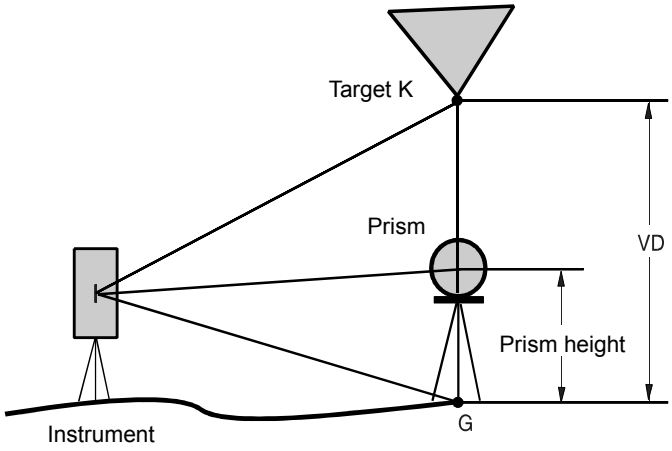
By pressing the [MENU] key, the instrument will be in MENU mode.
In this mode, special measuring , setting and adjustment are possible.



6.1 Application Measurement (PROGRAMS)

6.1.1 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 (Example :h=1.5m)

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F1](REM) key.	[F1]	REM F1:INPUT R.HT F2:NO R.HT
4 Press the [F1] key.	[F1]	REM-1 <STEP-1> R.HT = 0.000 m --- --- [CLR][ENT]
5 Enter prism height. *1)	Enter R.HT [F4]	REM-1 <STEP-2> HD: m MEAS --- NP/P ---
6 Collimate prism.	Collimate P	
7 Press the [F1](MEAS) key. Measuring starts.	[F1]	REM-1 <STEP-2> HD*[n] << m >Measuring...

Horizontal distance (HD) between the instrument and prism will be shown.		REM-1 <STEP-2> HD* 123.456m >Measuring...
8 After measuring, the prism position will be decided. *2)	Collimate K	REM-1 VD: 1.500 m --- R.HT HD ---
9 Collimate target K. Vertical distance (VD) will be shown. *3)		REM-1 VD: 10.456 m --- R.HT HD ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

*2) To return to procedure ***5***, press the [F2](R.HT) key.
To return to procedure ***6***, press the [F3](HD) key.

*3) To return to PROGRAMS Menu, press the [ESC] key.

2) Without prism height input

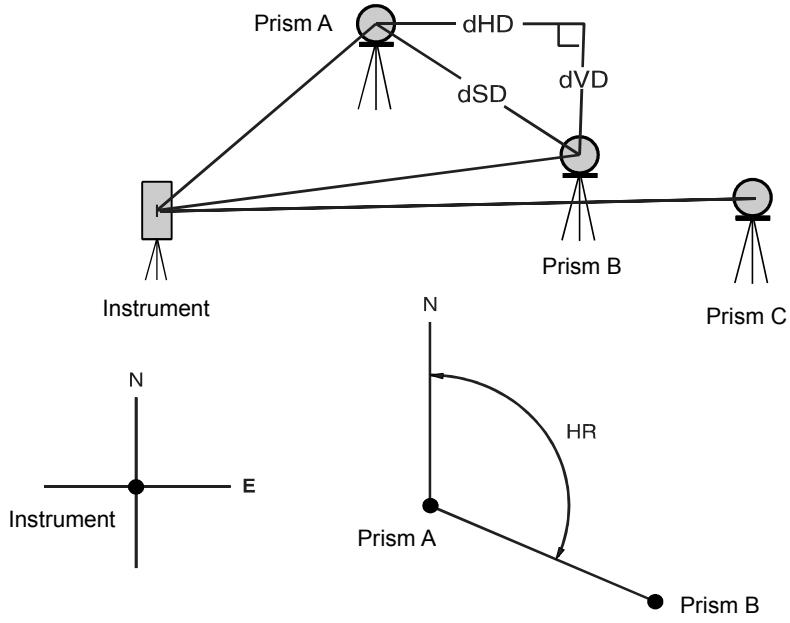
Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F1](REM) key.	[F1]	REM F1:INPUT R.HT F2:NO R.HT
4 Press the [F2] key.	[F2]	REM-2 <STEP-1> HD: m MEAS --- NP/P ---
5 Collimate prism.	Collimate P	REM-2 <STEP-1> HD*[n] << m Measuring...
6 Press the [F1](MEAS) key. Measuring starts.	[F1]	REM-2 <STEP-1> HD* 123.456m >Measuring...
Horizontal distance (HD) between the instrument and prism will be shown.		

7 After measuring, the prism position will be decided.		REM-2 <STEP-2> V : 60°45'50" --- --- --- SET
8 Collimate ground point G.		REM-2 <STEP-2> V : 123°45'50" --- --- --- SET
9 Press the [F4](SET) key. The position of point G will be decided. *1)	Collimate G	REM-2 VD: 0.000 m --- V HD ---
10 Collimate target K. Vertical distance (VD) will be shown. *2)	[F4]	REM-2 VD: 10.456 m --- V HD ---
	Collimate K	

*1) To return to procedure ***5***, press the [F3](HD) key.
To return to procedure ***8***, press the [F2](V) key.
*2) To return to PROGRAMS Menu, press the [ESC] key.

6.1.2 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 is A-B, A-C, A-D,.....
2.MLM-2 (A-B, B-C) :Measurement is 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 same as MLM-1 mode

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F2](MLM) key.	[F2]	MLM F1:USE FILE F2:DON'T USE
4 Press the [F1] or [F2] key to select using coordinate file. [Example:F2 : DON'T USE]	[F2]	GRID FACTOR F1:USE G.F. F2:DON'T USE

5 Press the [F1] or [F2] key to select using GRID FACTOR.
[Example:F2 : DON'T USE]

[F2]

```
MLM
 F1:MLM-1(A-B, A-C)
 F2:MLM-2(A-B, B-C)
```

6 Press the [F1] key.

[F1]

```
 MLM-1(A-B, A-C)
 <STEP-1>
 HD:           m
MEAS R.HT  NEZ NP/P
```

7 Collimate prism A, and press the [F1](MEAS) key. Horizontal distance (HD) between the instrument and prism A will be shown.

Collimate A
[F1]

```
 MLM-1(A-B, A-C)
 <STEP-1>
 HD*[n]       << m
 >Measuring...
```

8 After measuring, the prism position will be decided.

```
MLM-1(A-B, A-C)
 <STEP-2>
 HD:           m
MEAS R.HT  NEZ NP/P
```

9 Collimate prism B and press the [F1](MEAS) key. Horizontal distance (HD) between the instrument and prism B will be shown.

Collimate B
[F1]

```
 MLM-1(A-B, A-C)
 <STEP-2>
 HD* [n]      << m
MEAS R.HT  NEZ NP/P
```

10After measuring, the horizontal distance (dHD) and relative elevation (dVD) between prism A and B will be shown.

[F4]

```
MLM-1(A-B, A-C)
dHD : 123.456 m
dVD :  12.345 m
 ---  ---   HD  ---
```

11To show slope distance (dSD) , press [◢] key.

[◢]

```
 MLM-1(A-B,A-C)
dSD:    234.567m
HR : 12°34'40"
 ---  ---   HD  ---
```

12To measure the distance between points A and C, press the [F3](HD). *1)

[F3]

```
 MLM-1(A-B, A-C)
<STEP-2>
 HD:           m
MEAS R.HT  NEZ NP/P
```

13Collimate point C (Prism C) and press the [F1](MEAS) key.
Horizontal distance (HD) between the instrument and prism C will be shown.

Collimate prism C
[F1]

14After measuring, the horizontal distance (dHD) and relative elevation (dVD) between prism A and C will be shown.

[F4]

```
 MLM-1(A-B, A-C)
dHD :  234.567 m
dVD :   23.456 m
 ---  ---   HD  ---
```

15To measure the distance between points A and D, repeat procedure 12 to14. *1)

*1) To return to previous mode, press the [ESC] key.

- **How to use coordinate data**

It is possible to input coordinate value directly or calculate from coordinate data file

Operating procedure	Operation	Display
To use coordinate data file, select "USE FILE" in step *4*. After procedure ***6***.		MLM-1(A-B, A-C) <STEP-1> HD: m MEAS R.HT NEZ NP/P
1 Press the [F3](NEZ) key. Direct key input display will be shown.	[F3]	N> 0.000 m E: 0.000 m Z: 0.000 m INPUT --- PT# ENTER
2 Press the [F3](PT#) key to use coordinate data file. Point number input display will be shown. Pressing the [F3](HD) key, the display will return to procedure ***6***. After selecting coordinate input mode by pressing the [F3](NEZ or PT# or HD) key, press the [F1](INPUT) key and enter the data.	[F3]	MLM-1(A-B,A-C) PT#:_____ INPUT LIST HD ENTER

6.1.3 Setting Z Coordinate of Occupied Point

Occupied point coordinate data and known point actual measuring data are utilized, z coordinate of occupied point is calculated and reset again.
Known point data and coordinate data can use the coordinate data file.

1) Setting occupied coordinate

[Example setting] Using coordinate data file.

	Operating procedure	Operation	Display
1	After pressing [MENU] key, press [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2	Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3	Press the [F3](Z COORD.) key.	[F3]	Z COORD.SETTING F1:USE FILE F2:DON'T USE
4	Press the [F1](USE FILE) key.	[F1]	SELECT A FILE FN:_____ INPUT LIST --- ENTER
5	Press the [F1](INPUT) key and enter the File Name.	[F1] Enter FN [F4]	Z COORD.SETTING F1:OCC.PT INPUT F2:REF.MEAS
6	Press the [F1] key. **INPUT LIST NEZ ENTER**	[F1]	OCC.PT PT#:_____ INPUTLIST NEZ ENTER
7	Press the [F1](INPUT) key and enter the Point number. Instrument height setting display will be shown.	[F1] Enter PT# [F4]	INSTRUMENT HEIGHT INPUT INS.HT= 0.000 m --- --- [CLR][ENT]
8	Enter the height. The display returns to Z coordinate menu.	Enter HT [F4]	Z COORD.SETTING F1:OCC.PT INPUT F2:REF.MEAS

● For more information about data file, see Chapter 9 “MEMORY MANAGER MODE” .

2) Z Coordinate Calculation from Known Point Measuring Data

[Example setting] Using coordinate data file

Operating procedure	Operation	Display
1 After pressing [MENU] key, press [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/3 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P ↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F3](Z COORD.) key.	[F3]	Z COORD.SETTING F1:USE FILE F2:DON'T USE
4 Press the [F1](USE FILE) key.	[F1]	SELECT A FILE FN:_____ INPUT LIST --- ENTER
5 Press the [F1](INPUT) key and enter the File Name.	[F1] Enter FN [F4]	Z COORD.SETTING F1:OCC.PT INPUT F2:REF.MEAS
6 Press the [F2] key.	[F2]	NOO1# PT#: INPUT LIST NEZ ENTER
7 Press the [F1](INPUT) key and enter the Point Number in coordinate data file.	[F1] Enter PT# [F4]	N: 4.356 m E: 16.283 m Z: 1.553 m >OK ? [YES][NO]
8 Press the [F3](YES) key and enter the Point Number in coordinate data file.	[F3]	REFLECTOR HEIGHT INPUT R.HT= 0.000 m --- --- [CLR][ENT]
9 Enter the height.	Enter R. HT [F4]	REFLECTOR HEIGHT INPUT R.HT: 0.000 m >Sight? [YES][NO]
10 Collimate a prism on the point and press the [F3](YES) key. Measuring starts. *1)	Collimate P [F3]	HR: 120°30'40" HD*[n] << m VD: m >Measuring...

		HR: 120°30'40" HD: 12.345 m VD: 23.456 m NEXT --- --- CALC
11 Press the [F4](CALC) key.*2) Z : Z coordinate dZ: Standard deviation		Z COORD. SETTING Z : 1.234 m dZ : 0.002 m --- --- BS SET
12 Press the [F4](SET) key. *3) Z coordinate of the occupied point will be set. Bascksight point measuring screen will be shown.	[F4]	BACKSIGHT HR: 23°20'40" >OK? [YES][NO]
13 Press the [F3](YES) key. Horizontal angle will be set. The display returns to Programs 1/2 menu.	[F4] [F3]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓

*1) Measurement is Fine N-times measurement mode.
*2) To measure other points, press the [F1](NEXT) key.
*3) Pressing the [F3] key, the display will be changed alternately.

6.1.4 Area Calculation

This mode calculate the area of a closed figure.
There are two area calculation methods as follows.

1) Area Calculation from Coordinate data file

2) Area Calculation from Measured data

- Area is not calculated correctly if enclosed lines cross each other.
- It is impossible to calculate what a mix of coordinate file data and measured data.
- If the coordinate data file does not exist, the area calculation from measured data is done automatically.
- The numbers of points used to calculate are not limited.

1) Area Calculation from Coordinate Data File

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2/2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F4](P↓) key to get the PROGRAMS menu on page 2/2.	[F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
4 Press the [F1](AREA) key.	[F1]	AREA F1:FILE DATA F2:MEASUREMENT
5 Press the [F1](FILE DATA) key.	[F1]	SELECT A FILE FN:_____ INPUT LIST --- ENTER
6 Press the [F1](INPUT) key and enter the File Name. Initial display will be shown.	[F1] Enter FN [F4]	AREA 0000 m.sq NEXT# :DATA-01 PT# LIST UNIT NEXT
7 Press the [F4](NEXT) key. *1),2) The top of the file data (DATA-01) will be set and the second point number will be shown.	[F4]	AREA 0001 m.sq NEXT# :DATA-02 PT# LIST UNIT NEXT
8 Repeat pressing the [F4](NEXT) key to set required number of points.	[F4]	

When 3 or more points are set, the area surrounded by the points is calculated and the result will be shown.		AREA 0021 123.456 m.sq NEXT# :DATA-22 PT# LIST UNIT NEXT

*1) To set specify point, press the [F1](PT#) key.
*2) To show the list of the coordinate data in the file, press the [F2](LIST) key.

2) Area Calculation from Measured Data

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2/2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F4](P↓) key to get the PROGRAMS menu on page 2/2.	[F4]	AREA 001 m.sq MEAS --- UNIT NP/P
4 Press the [F1](AREA) key.	[F1]	N*[n] <<< m E: m Z: >Measuring...
5 Press the [F2](MEAS) key.	[F2]	AREA F1:USE G.F. F2:DON'T USE
6 Press the [F1] or [F2] key to select using GRID FACTOR. [Example:F2 : DON'T USE]	[F2]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
7 Collimate a prism and press the [F1](MEAS) key. Measuring starts. *1)	Collimate P [F1]	AREA F1:FILE DATA F2:MEASUREMENT ↓ AREA 0000 m.sq MEAS --- UNIT NP/P
8 Collimate next point and press the [F1](MEAS) key. When 3 or more points are measured, the area	Collimate [F1]	

surrounded by the points is calculated and the result will be shown.		AREA 0003 234.567 m.sq MEAS --- UNIT NP/P

*1) Measurement is Fine N-times measurement mode.

- **To change the display unit**

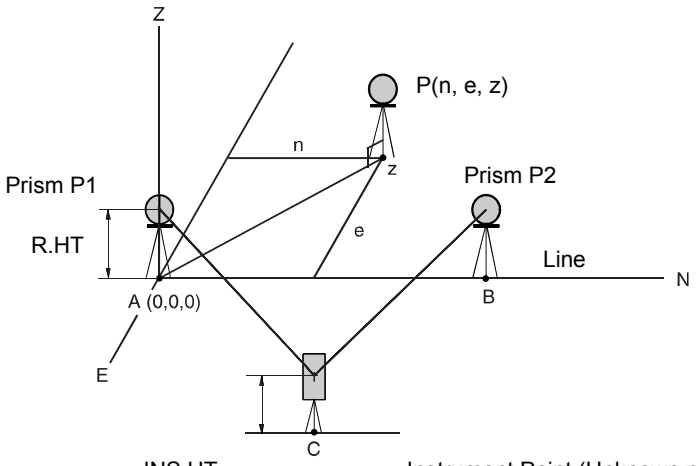
It is possible to change the displayed area unit.

Operating procedure	Operation	Display
		AREA 0003 100.000 m.sq MEAS --- UNIT NP/P
1 Press the [F3](UNIT) key.		AREA 0003 100.000 m.sq m.sq ha ft.sq acre
2 Select a unit by pressing the [F1] to [F4] key. Example: [F2](ha) key.	[F3]	AREA 0003 0.010 ha MEAS --- UNIT NP/P
	[F2]	

- m.sq : square meter ha : hectare ft.sq : square feet acre : acre.

6.1.5 Point to Line Measurement

This mode is used to obtain the coordinate data with the origin point A(0,0,0) and the line AB as N axis. Place the 2 prisms at the points A and B on the line, and place the instrument at unknown point C. After measuring the 2 prisms , the coordinate data and the direction angle of the instrument will be calculated and restored.



Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2/2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PROGRAMS 1/2 F1:REM F2:MLM F3:Z COORD. P↓
3 Press the [F4](P↓) key to get the PROGRAMS menu on page 2/2.	[F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE P↓
4 Press the [F2] key.	[F2]	INSTRUMENT HEIGHT INPUT INS.HT= 0.000 m --- --- [CLR][ENT]
5 Enter instrument height.	Enter INS.HT [F4]	REFLECTOR HEIGHT INPUT R.HT= 0.000 m --- --- [CLR][ENT]
6 Enter reflector A(P1) height.	Enter R.HT [F4]	POINT TO LINE MEAS.P1 HD: m MEAS --- NP/P ---

7 Collimate prism P1 (Origin) and press [F1](MEAS) key.
Measuring starts. *1)

Collimate P1 [F3]

```
POINT TO LINE
MEAS.P1
 HD*[n]         << m
>Measuring...
```

Input display of reflector B(P2) height will be shown.

```
REFLECTOR HEIGHT
INPUT
R.HT=        0.000 m
 --- --- [CLR][ENT]
```

8 Enter reflector B(P2) height.

Enter R. HT [F4]

```
POINT TO LINE
MEAS.P2
 HD:                m
 MEAS --- NP/P ---
```

9 Collimate prism B (P2)(Origin) and press the [F1](MEAS) key.
Measuring starts. *1)

Collimate P2 [F3]

```
POINT TO LINE
MEAS.P2
 HD*[n]         << m
>Measuring...
```

The coordinate data and the direction angle of the instrument are calculated and restored.
The result (The distance between A and B) will be displayed.
dHD: Horizontal distance
dVD:Vertical distance
dSD:Slope distance *2) ,3)

```
DIST. (P1-P2)   1/2
dHD:    10.000 m
dVD:     0.000 m
 NEZ  S.CO  ---  P↓
```

10 Press [F1](NEZ) key to measure other points.

[F1]

```
 N:          0.000 m
 E:          0.000 m
 Z:          0.000 m
EXIT  ---  HT  MEAS
>Measuring...
```

11 Collimate a prism and press [F4](MEAS) key.
Coordinate measurement starts. *4)
The result will be shown. *5)

Collimate P [F4]

```
 N:          3.456 m
 E:          5.432 m
 Z:          0.000 m
EXIT  ---  HT  MEAS
```

*1) Measurement is Fine N-times measurement mode.
*2) To show dSD, press [F4](P↓) key.
*3) To show the new occupied data, press [F2](S.CO) key.
*4) Measurement is Fine N-times measurement mode.
*5) To return to previous mode, press [F1](EXIT) key.

6.2 Setting the GRID FACTOR

GRID FACTOR can reset in this menu mode.
For more information, refer to Section 8.1.1 “Setting the GRID FACTOR”.

Grid Factor can be applied to the following application programs.
It is also possible to cancel the Grid factor function by selecting "DON'T USE" in “SELECTING MODE” .
At this time the setting and selecting screens for Grid Factor will be omitted.

● **Data collection mode**
When the NEZ automatic calculation (NEZ AUTO. CALC) is ON, Grid factor will be applied to the coordinate data recorded into a coordinate data file when the RAW data is measured and recorded. (In this case, Grid Factor is not applied to the RAW data recorded into the measured data file.)

● **PTL (Point To Line measurement)**
When executing PTL measurement mode, the NEZ Auto Calculation wil be turned on compulsorily and Grid factor will be applied to the coordinate data.

● **Layout**
Execution Layout

1. When displaying the difference (dHD) between grid horizontal distance to a layout point (HDg) on the projection plane and measured ground horizontal distance to a prism point (HD) , Grid factor will be applied to grid distance (HDg) in order to reverse-convert grid distance to ground distance.

2. After completion of a layout point, the displayed coordinate data will be applied to grid factor in order to compare with surveying data and calculated data on the projection plane.

(NEW POINT-Side Shot)
In side shot method, a new point coordinate data will be applied to grid factor and the new point coordinate data will be recorded into a coordinate data file.

(NEW POINT - Resection)
In resection method, when a new point calculated coordinate data is displayed or recorded, the new point coordinate data will be applied to grid factor and the coordinate data will be recorded into a coordinate data file.

● **MLM (Missing Line Measurement)**
When selecting grid factor "USE G.F.", measured data will be applied to grid factor. At this time, horizontal distance (dHD) and slope distance (dSD) will be on the projection plane.

● **AREA (Area calculation / Measured method)**
When selecting grid factor "USE G.F.", measured data will be applied to grid factor. At this time, the calculated area will be on the projection plane.

Note: Calculation of Z coordinate is not influenced even if it is applied to grid factor.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F3](GRID FACTOR) key.	[F3]	GRID FACTOR =0.998843 >MODIFY? [YES][NO]

3 Press the [F3](YES) key.	[F3]	GRID FACTOR ELEV.=1000 m SCALE:0.999000 --- --- [CLR][ENT]
4 Enter Elevation. *1) Press the [F4](ENT) key.	Enter ELEV. [F4]	GRID FACTOR ELEV.:2000 m SCALE=1.001000 --- --- [CLR][ENT]
5 Enter Scale Factor in the same way.	Enter Scale [F4]	
Grid Factor is displayed for 1 to 2 second and display returns to menu.		GRID FACTOR =1.000686

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input Range :Elevation : –9,999 to +9,999 meter (–32,805 to +3,2805 ft, ft+in)
Scale Factor: 0.990000 to 1.010000

6.3 Setting Mode 1

In this mode, the following settings are possible.
1. Setting Minimum Reading
2. Auto Power off
3. Angle Tilt Correction
4. Setting for RS-232C communication

● This setting is memorized after power off.

6.3.1 Setting Minimum Reading

Select minimum display unit for angle measurement, coarse distance measurement mode.

● To select minimum display for fine measurement mode, see Chapter 15 “SELECTING MODE” .

Angle Unit			Coarse mode Distance unit
Degree	GON	MIL	
5" / 1"	1mgon / 0.2mgon	0.1mil / 0.01mil	10mm (0.02ft)/ 1mm(0.005ft)

[Example] Minimum angle : 5”, Coarse : 1mm

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4] [F2]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F1] key.	[F1]	PARAMETERS 1 1/2 F1:MINIMUM READING F2:AUTO POWER OFF F3:TILT P↓
3 Press the [F1] key.	[F1]	MINIMUM READING F1:ANGLE F2:COARSE
4 Press the [F1] key.	[F2] [F4]	MINIMUM ANGLE [F1: 1"] F2: 5" ENTER
5 Press the [F2](5") key and press the [F4](ENTER) key.	[F2]	MINIMUM READING F1:ANGLE F2:COARSE
6 Press the [F2] key.	[F1] [F4]	COARSE READING F1: 1mm [F2:10mm] ENTER
7 Press the [F1] key and press the [F4](ENTER) key.		MINIMUM READING F1:ANGLE F2:COARSE

● To return to previous mode, press the [ESC] key.

6.3.2 Auto Power Off

If no key operation is given or no process of measurement is performed for more than 30 minutes (No change exceeding 30" has occurred during horizontal angle or vertical angle measurement.), the power turns off automatically. If the instrument is set at distance measurement mode (No change in distance exceeding 10cm has occurred during distance measurement), the mode changes to angle measurement automatically in case that the instrument does not operate for approximately 10 minutes, and the power turns off after 20 minutes.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F2] key.	[F2]	PARAMETERS 1 1/2 F1:MINIMUM READING F2:AUTO POWER OFF F3:TILT P↓
3 Press the [F2] key. The data previously set is shown.	[F2]	AUTO POWER OFF F1:ON [F2:OFF] ENTER
4 Press the [F1](ON) key or [F2](OFF) key, and press the [F4](ENTER) key.	[F1] or [F2] [F4]	

6.3.3 Angle Tilt correction (Tilt ON/OFF)

In case the instrument is used in an unstable situation, constant indexing of vertical and horizontal angle may be impossible. In this case, the function of tilt correction can be stopped by selecting TILT OFF.

● This setting is memorized after powering off.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2.	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F2] key.	[F2]	PARAMETERS 1 1/2 F1:MINIMUM READING F2:AUTO POWER OFF F3:TILT P↓
3 Press the [F3] key. The data previously set is shown. If already ON, the display shows tilt correction value.	[F3]	TILT SENSOR:[X-ON] X: 0°02'10"
4 Press the [F1](X-ON) key or [F2](XY-ON) key or [F3](OFF) key, and press the [F4](ENTER) key.	[F1], [F3] [F4]	X-ON XY-ON OFF ENTER

6.3.4 Setting RS-232C communication with external device

You can set the parameters for RS-232C communication with external device from parameters setting menu .
The following parameters can be set.

Item	Selecting items
Baud rate	1200, 2400, 4800, 9600, 19200, 38400
Character bit/Parity	7/Even, 7/Odd, 8/None
Stop bit	1, 2
ACK mode	Standard , Omitted
CR,LF	ON, OFF
REC type	REC-A, REC-B
Factory setting	Baud rate:1200 baud, Character bit/Parity:7/Even, CRLF:OFF, REC type: REC-A, ACK:Standard

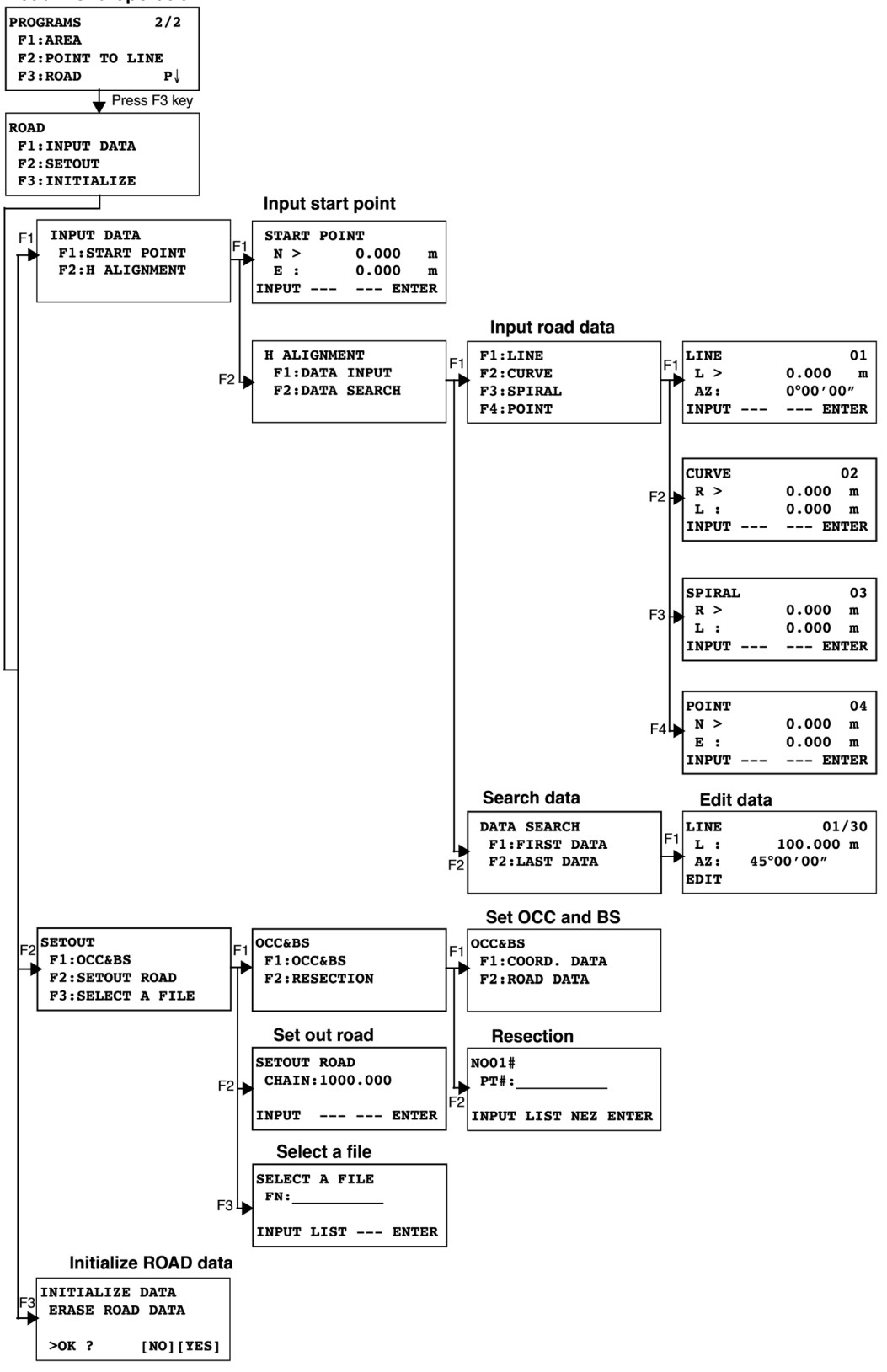
ACK mode, CRLF and REC type are interlocked with the same items in the selecting mode. Refer to 15 “SELECTING MODE”.

Sample setting
STOP BITS: 2

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) key to get the menu on page 2	[MENU] [F4]	MENU 2/2 F1:PROGRAMS F2:PARAMETERS 1 F3:GRID FACTOR P↓
2 Press the [F2] key.	[F2]	PARAMETERS 1 1/2 F1:MINIMUM READING F2:AUTO POWER OFF F3:TILT P↓
3 Press the [F4] key.	[F4]	PARAMETERS 1 2/2 F1:RS-232C P↓
4 Press the [F1] key. The data previously set is shown.	[F1]	RS-232C 1/3 F1:BAUD RATE F2:CHAR./PARITY F3:STOP BITS P↓
5 Press the [F3] key to select STOP BITS. The data previously set is marked.	[F3]	STOP BITS [F1:1] F2:2 ENTER
6 Press the [F2](2) key to select stop bit 2, and press the [F4](ENTER) key.	[F2] [F4]	STOP BITS F1:1 [F2:2] ENTER

6.4 ROAD

● Road menu operation



6.4.1 Input Start Point

To input the start point, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F1], [F1] key. (Refer to “Input start point” on page 6-23.)	[F3] [F1] [F1]	START POINT N = 0.000 m E : 0.000 m --- --- [CLR][ENT]
3 Input coord N, E. ***4*** Press the [ENT] key.	Input coord [ENT]	START POINT CHAIN = 0.000 m INTERVAL:100.000 m --- --- [CLR][ENT]
5 Input value data CHAIN, INTERVAL. ***6*** Press the [ENT] key.	Input data [ENT]	<SET>
		INPUT DATA F1:START POINT F2:H ALIGNMENT

- For [ROAD], in addition to the “Start Point” and “Road Data” input files, other files necessary for the calculations are created. Consequently, if the free area of the memory reaches 10% or less, a “MEMORY POOR” warning message is displayed. (In this case, the instrument can still be operated.)
- CHAIN and INTERVAL input range

  -50,000m≤ CHAIN ≤ +500,000m

  0m<INTERVAL ≤ +5,000m

6.4.2 Input Road Data

[ROAD] is made up of four types of components: LINE, CURVE, SPIRAL and POINT. To input the required components, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2. ***2*** Press the [F3], [F1], [F2],[F1] key. (Refer to “Input road data” on page 6-23.)	[MENU] [F4] [F1] [F4] [F3] [F1] [F2] [F1]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓ F1:LINE F2:CURVE F3:SPIRAL F4:POINT

- The amount of input data varies depending on the type of data, up to a maximum of 30. (In the case of POINT input only, the maximum is 9 points including end point.)
- An error may occur when entering a combination of POINT and other components if the amount of data entered exceeds the maximum amount allowed for internal calculations. If this happens, please reduce the amount of input data.

● Input LINE data

Operating procedure	Operation	Display
1 To input LINE data, press the [F1] key. *1) ***2*** Input LENGTH. ***3*** Press the [ENT] key. ***4*** Input AZIMUTH. ***5*** Press the [ENT] key.	[F1] Input LENGTH [ENT] Input AZIMUTH [ENT]	F1:LINE F2:CURVE F3:SPIRAL F4:POINT LINE 01 L = 0.000 m AZ: 0°00′00″ --- --- [CLR][ENT] LINE 01 L : 100.000 m AZ= 0°00′00″ --- --- [CLR][ENT] <SET>

*1) The number at the top right of the screen shows the amount of data currently entered.

●Input CURVE data

Operating procedure	Operation	Display
1 To input CURVE data, press the [F2] key. *1)	[F2]	F1:LINE F2:CURVE F3:SPIRAL F4:POINT
2 Input RADIUS. ***3*** Press the [ENT] key.	Input RADIUS [ENT]	CURVE 02 R = 0.000 m L : 0.000 m --- --- [CLR][ENT]
4 Input LENGTH. ***5*** Press the [ENT] key.	Input LENGTH [ENT]	CURVE 02 R : 100.000 m L = 0.000 m --- --- [CLR][ENT]
6 Select TURN(direction of turn): RIGHT or LEFT. ***7*** Press the [ENT] key.	Select [F1](LEFT) or [F2](RIGHT) [ENT]	CURVE 02 TURN > RIGHT LEFT RIGHT --- ENTER <SET>
*1) CURVE cannot be input as the first data.		

●Input SPIRAL data

Operating procedure	Operation	Display
1 To input SPIRAL data, press the [F3] key. *1)	[F3]	F1:LINE F2:CURVE F3:SPIRAL F4:POINT
2 Input RADIUS. ***3*** Press the [ENT] key.	Input RADIUS [ENT]	SPIRAL 03 R = 0.000 m L : 0.000 m --- --- [CLR][ENT]
4 Input LENGTH. ***5*** Press the [ENT] key.	Input LENGTH [ENT]	SPIRAL 03 R : 100.000 m L = 0.000 m --- --- [CLR][ENT]
6 Select TURN(direction of turn): RIGHT or LEFT. ***7*** Press the [ENT] key.	Select [F1](LEFT) or [F2](RIGHT) [ENT]	SPIRAL 03 TURN > RIGHT DIR : IN LEFT RIGHT -- ENTER
8 Select DIR(direction): IN(entrance) or OUT(exit). ***9*** Press the [ENT] key.	Select [F1](IN) or [F2](OUT) [ENT]	SPIRAL 03 TURN : LEFT DIR > IN IN OUT --- ENTER
		<SET>

*1) SPIRAL cannot be input as the first data.

●Input POINT data

Operating procedure	Operation	Display
1 To input POINT data, press the [F4] key.	[F4]	F1:LINE F2:CURVE F3:SPIRAL F4:POINT
2 Input N coord. ***3*** Press the [ENT] key.	Input N coord [ENT]	POINT 04 N = 0.000 m E : 0.000 m --- --- [CLR][ENT]
4 Input E coord. ***5*** Press the [ENT] key.	Input E coord [ENT]	POINT 04 N : 100.000 m E = 0.000 m --- --- [CLR][ENT]
6 Input RADIUS. *1) ***7*** ***7*** Press the [ENT] key.	Input RADIUS [ENT]	R > 0.000 m A1: 0.000 A2: 0.000 INPUT --- SKIP ENTER
8 Input parameter A1. *1) ***9*** Press the [ENT] key.	Input parameter A1 [ENT]	R : 100.000 m A1> 0.000 A2: 0.000 INPUT --- SKIP ENTER
10 Input parameter A2. *1) ***11*** Press the [ENT] key.	Input parameter A2 [ENT]	R : 100.000 m A1: 80.000 A2> 0.000 INPUT --- SKIP ENTER
		<SET>

*1) If the data input is not required, press the [SKIP] key.

● When inputting POINT data, if the next data is not POINT data, ROAD is calculated as a straight line irrespective of the values for RADIUS, A1 and A2.

6.4.3 Search Data

To search for input data, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F1], [F2], [F2] key. (Refer to “Search data” on page 6-23.)	[F3] [F1] [F2] [F2]	DATA SEARCH F1:FIRST DATA F2:LAST DATA
3 To search from the first data, select [F1] (FIRST DATA).	[F1]	LINE 01/30 L : 100.000 m AZ: 45°00′00″ EDIT ↓
4 To switch to different data, press the [↓] or [↑] key.	[↓]or [↑]	SPIRAL 30/30 R : 200.000 m L : 100.000 m EDIT ↓

6.4.4 Edit Data

To edit input data, carry out the following operating procedure.

Operating procedure	Operation	Display
1 In DATA SEARCH, press the [F1] key.	[F1]	LINE 01/30 L : 100.000 m AZ: 45°00′00″ EDIT ↓
2 Edit the data.	Edit data	LINE 01/30 L = 100.000 m AZ: 45°00′00″ --- --- [CLR][ENT]

6.4.5 Set OCC and BS

To set the Occupied Point and Backsight Point, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F2], [F1] key. (Refer to “Set OCC and BS” on page 6-23.)	[F3] [F2] [F1]	OCC&BS F1:OCC&BS F2:RESECTION
3 Press the [F1] key. *1)	[F1]	OCC&BS F1:COORD. DATA F2:ROAD DATA
4 To input OCC. PT, press the [F1](COORD. DATA)or [F2](ROAD DATA) key. COORD. DATA: Choose the data from Coord Data and set the Occupied Point. ROAD DATA: Create the data from Road Data and set the Occupied Point. (Example : ROAD DATA)	[F2]	OCC.PT CHAIN= --- --- [CLR][ENT]
5 Input OCC. PT, press the [ENT] key.	Input OCC. PT	
6 Press the [ENT] key. LEFT or RIGHT: Use the offset point. CENTER: Use the center point. (Example : CENTER)	[ENT] [ENT]	CHAIN: 0.000 >CENTER LEFT RIGHT--- ENTER
7 Press the [F3](YES) key.	[F3]	CHAIN:1000.000 >CENTER LEFT RIGHT--- ENTER
8 Input the backsight.	Input Backsight	BACKSIGHT CHAIN=
9 Press the [ENT] key.	[ENT]	--- --- [CLR][ENT]
		CHAIN:1000.000 N : 0.000 m E : 0.000 m >OK? [YES][NO]

10Collimate the backsight. ***11***Press the [F3](YES) key.	Collimate Backsight [F3]	BACKSIGHT H(B)= 45°00′00″ >Sight? [YES][NO] <SET> SETOUT F1:OCC&BS F2:SETOUT ROAD F3:SELECT A FILE

*1) When setting the Occupied Point and Backsight Point using Resection method, select [F2] (RESECTION).
For details of the Resection method, refer to Section 8.3.2 “Resection Method”.

6.4.6 Setout Road

To setout the road, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F2], [F2] key. (Refer to “Set out road” on page 6-23.)	[F3] [F2] [F2]	SETOUT ROAD CHAIN= --- --- [CLR][ENT]
3 Input data.	Input data	SETOUT ROAD CHAIN=1200 --- --- [CLR][ENT]
4 Press the [ENT] key.	[ENT]	CHAIN:1200 > CENTER LEFT RIGHT --- ENTER
5 Select offset. (Example: RIGHT) Press the [F2] key. *1)	[F2]	CHAIN:1200 : RIGHT = m --- --- [CLR][ENT]
6 Input the offset value.	Input offset value	CHAIN:1200 N : 0.000 m E : 0.000 m >OK? [YES][NO]
7 Press the [ENT] key. The setout point coordinates are displayed.	[ENT]	CALCULATED HR= 60°00′00″ HD= 100.000 m ANG DIST --- ---
8 Press the [F3](YES) key. The distance to the setout point and the backsight are displayed. HR: Calculated horizontal angle of the layout point HD: Calculated horizontal distance from the instrument to the layout point	[F3]	CHAIN:1200 HR: 60°00′00″ dHR: 0°00′00″ DIST --- NEZ ---
9 Press the [F1](ANG) key. CHAIN: Layout point HR: Measured (Actual) horizontal angle. dHR: Horizontal angle to be turned to the layout point = Actual horizontal angle - Calculated horizontal angle. Correct direction when dHR = 0°00'00"	[F1]	HD* 100.000 m dHD: 0.000 m MODE ANG NEZ NEXT
10 Press the [F1](DIST) key. HD: Measuring (Actual) horizontal distance dHD: Horizontal distance to be turned to the layout point = Actual horizontal distance – Calculated horizontal distance.	[F1]	

11 Press the [F3](NEZ) key. The coordinate data is shown.	[F3]	N * 70.000 m E : 50.000 m MODE ANG --- NEXT
12 Press the [F4](NEXT) key to set next layout point.	[F4]	
*1) If not selecting offset, press the [ENT] key.		

6.4.7 Select a File

To set the coordinates to be used for the Occupied Point and Backsight Point, carry out the following operating procedure.

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F2] key. (Refer to “Select a file” on page 6-23.)	[F3] [F2]	SETOUT F1:OCC&BS F2:SETOUT ROAD F3:SELECT A FILE
3 Press the [F3] key.	[F3]	SELECT A FILE FN:_____ INPUT LIST --- ENTER
4 Enter the name of the file being used (or select it from the list).	Select a file	
5 Press the [ENT] key.	[ENT]	

6.4.8 Initialize ROAD data

To initialize the data, carry out the following operating procedure

Operating procedure	Operation	Display
1 After pressing the [MENU] key, press the [F4](P↓) , [F1], [F4]key to get the programs menu on page 2/2.	[MENU] [F4] [F1] [F4]	PROGRAMS 2/2 F1:AREA F2:POINT TO LINE F3:ROAD P↓
2 Press the [F3], [F3] key. (Refer to “Initialize ROAD data” on page 6-23.)	[F3] [F3]	INITIALIZE DATA ERASE ROAD DATA >OK? [NO][YES]
3 When the [F4] (YES) key is pressed, all ROAD DATA with the exception of the coordinate data file is erased. Press the [F4] key.	[F4]	

7 DATA COLLECTION

The TS1000 is able to store the measured data into the internal memory.
The internal memory is shared by the measured data files and the coordinate data files. Maximum 128 files can be generated.

Measured data

The collected data is memorized into a files.

The number of measurement points

(In case not using the internal memory in layout mode)

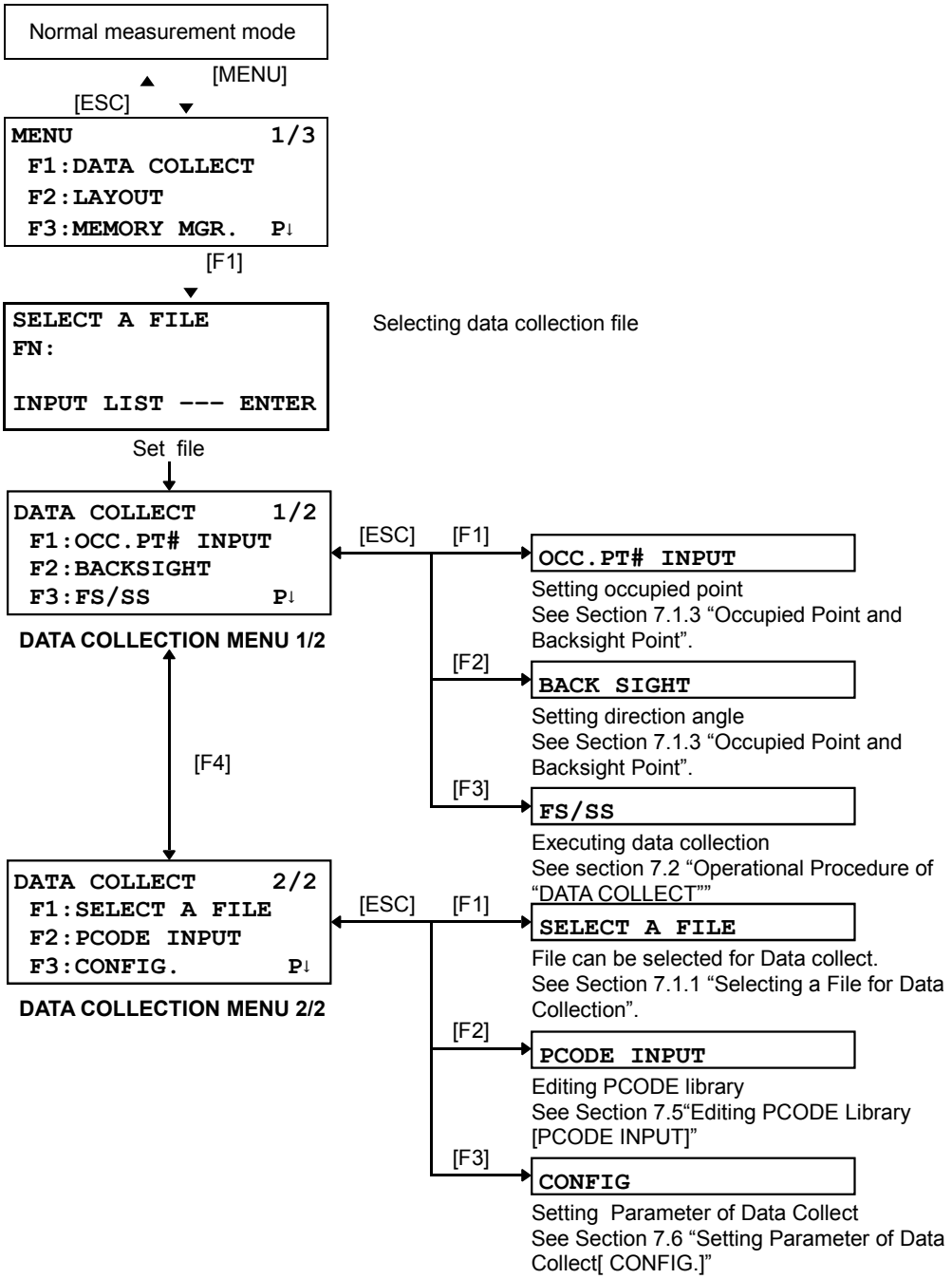
MAX. 40,000 points

Because the internal memory covers both data collection mode and layout mode, the number of measurement points will be decreased when the layout mode is used.
For the internal memory, refer to Chapter 9 “MEMORY MANAGER MODE”.

1) When turning off the power, ensure that you are in the main menu screen or main angle measurement mode.
   This ensures completion of the memory access process and avoids possible damage to the stored data.
2) It is recommended for safety to charge the battery beforehand and prepare fully charged spare batteries.

● **Data collect menu operation**

By pressing the [MENU] key, the instrument will be in MENU 1/3 mode.
Press the [F1](DATA COLLECT) key, the menu of data collect 1/2 will be shown.



7.1 Preparation

7.1.1 Selecting a File for Data Collection

A file used by data collection mode must be selected at first.
Select a file before beginning data collection mode because selection screen of a file is displayed. And a selection from data collection menu is possible in the mode.

Operating procedure	Operation	Display
1 Press [F1](DATA COLLECT) key from menu 1/2.	[F1]	MENU 1/2 F1:DATA COLLECT F2:LAYOUT F3:MEMORY MGR. P↓
2 Press [F2](LIST) key to display the list of file. *1)	[F2]	SELECT A FILE FN: INPUT LIST --- ENTER
3 Scroll file list by pressing [▼] or [▲] key and select a file to use. *2),3)	[▼] or [▲]	AMIDATA /M0123 →*HILDATA /M0345 TOPDATA /M0789 --- SRCH --- ENTER
4 Press [F4](ENTER) key. The file will be set and data collect 1/2 menu will be shown.	[F4]	TOPDATA /M0789 →RAPDATA /M0564 SATDATA /M0456 --- SRCH --- ENTER DATA COLLECT 1/2 F1:OCC.PT# INPUT F2:BACKSIGHT F3:FS/SS P↓

*1) If you want to make a new file or input file name directly, press [F1](INPUT) key and enter a file name.
2) When a file has been selected already, '' mark is indicated on left of current file name.
*3) Data in a file shown with arrow can be searched by pressing [F2](SRCH) key.

● It is possible to select a file from DATA COLLECT 2/2 menu in the same way.

DATA COLLECT 2/2
F1:SELECT A FILE
F2:PCODE INPUT
F3:CONFIG. P↓

7.1.2 Selecting a Coordinate File for Data Collection

When coordinate data in a coordinate data file are used for occupied point or backsight point, select a coordinate file from the data collect menu 2/2 beforehand.

Operating procedure	Operation	Display
1 Press the [F1](SELECT A FILE) key from DATA COLLECT menu 2/2.	[F1]	DATA COLLECT 2/2 F1:SELECT A FILE F2:PCODE INPUT F3:CONFIG. P↓
2 Press the [F2](COORD.DATA) key.	[F2]	SELECT A FILE F1:MEAS.DATA F2:COORD.DATA
3 Select a coordinate file in the same manner as Section 7.1.1 “Selecting a File for Data Collection”.		SELECT A FILE FN: INPUT LIST--- ENTER

7.1.3 Occupied Point and Backsight Point

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

Occupied point can be set by two setting methods as follow.
1) Setting from the coordinate data stored in the internal memory.
2) Direct key input.

The following three setting methods for backsight point can be selected.
1) Setting from the coordinate data stored in the internal memory.
2) Direct key input of coordinate data.
3) Direct key input of setting angle.

Note: See 9.4 “Coordinate Data Direct Key Input” and 9.7.2 “Loading Data” for how to store coordinate into the internal memory.

Example for setting the occupied point:
In case of setting occupied point from the coordinate data stored in the internal memory.

Operating procedure	Operation	Display
1 Press the [F1](OCC.PT# INPUT) key from the data collect menu 1/2. The previous data is shown.	[F1]	PT# →PT-01 ID : INS.HT: 0.000 m INPUT SRCH REC OCNEZ
2 Press the [F4] (OCNEZ) key.	[F4]	OCC.PT PT#: PT-01 INPUT LIST NEZ ENTER
3 Press the [F1](INPUT) key.	[F1]	OCC.PT PT#= PT-01 [ALP][SPC][CLR][ENT]

4 Enter PT#, press [F4](ENT) key. *1)

Enter PT#
[F4]

```
PT#      →PT-11
ID   :
INS.HT:    0.000 m
INPUT SRCH REC OCNEZ
```

5 Enter ID, INS.HT in the same way. *2),3)

Enter ID,
INS.HT

```
PT#      :PT-11
ID     :
INS.HT→    1.335 m
INPUT SRCH REC OCNEZ
```

6 Press [F3](REC) key.

```
>REC ?      [YES][NO]
```

7 Press [F3](YES) key.
The display returns to the data collect menu 1/2.

[F3]

[F3]

```
DATA COLLECT   1/2
 F1:OCC.PT# INPUT
 F2:BACKSIGHT
 F3:FS/SS        P↓
```

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) ID can be input by inputting a register number linked with PCODE Library.
To show the list of PCODE library, press the [F2](SRCH) key.
*3) Press the [F3](REC) key when you do not input the INS.HT.

- The data recorded in data collect is PT#, ID and INS.HT.
- If point is not found in internal memory "PT# DOES NOT EXIST" is displayed.

Example for setting the direction angle:
The following is to memorize the data of the backsight after setting the backsight point from point number.

Operating procedure	Operation	Display
1 Press the [F2](BACKSIGHT) key from the data collect menu 1/2. The previous data is shown.	[F2]	BS# → PCODE : R.HT : 0.000 m INPUT 0SET MEAS BS
2 Press the [F4] (BS) key. *1)	[F4]	BACKSIGHT PT#: INPUT LIST NE/AZ ENT
3 Press the [F1](INPUT) key.	[F1]	BACKSIGHT PT#= [ALP][SPC][CLR][ENT]
4 Enter PT#, press the [F4](ENT) key. *2) Enter PCODE,R.HT in the same way. *3),4)	Enter PT# [F4]	BS# → PT-22 PCODE : MATO R.HT : 0.000 m INPUT 0SET MEAS BS
5 Press the [F3](MEAS) key.	[F3]	BS# → PT-22 PCODE : MATO R.HT : 0.000 m *VH SD NEZ ---
6 Collimate back sight point. Select one of the measuring mode and press the soft key. EXAMPLE : [F2](Slope Distance) key. Measuring starts. Horizontal circle is set to calculated direction angle. Measuring result is memorized and the display returns to the data collect menu 1/2.	Collimate BS [F2]	V : 90°00'00" HR: 0°00'00" SD*[n] <<< m > Measuring... ↓ DATA COLLECT 1/2 F1:OCC.PT# INPUT F2:BACKSIGHT F3:FS/SS P↓

*1) Pressing each time the [F3] key, the input method changes as Coordinate value, Angle, Coordinate point name alternatively.
*2) Refer to Chapter 2.5 “How to Enter Alphanumeric characters”.
*3) PCODE can be input by inputting a register number linked with PCODE Library.
To show the list of PCODE library, press the [F2](SRCH) key.
*4) Data collect sequence can be set to [MEAS→EDIT]. Refer to Section 7.6 “Setting Parameter of Data Collect [CONFIG.]”.

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

7.2 Operational Procedure of “DATA COLLECT”

Operating procedure	Operation	Display
		DATA COLLECT 1/2 F1:OCC.PT# INPUT F2:BACKSIGHT F3:FS/SS P↓
1 Press the [F3](FS/SS) key from the data collect menu 1/2.The previous data is shown.	[F3]	PT# → PCODE : R.HT : 0.000 m INPUT SRCH MEAS ALL
2 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *1)	[F1] Enter PT# [F4]	PT# =PT-01 PCODE : R.HT : 0.000 m [ALP][SPC][CLR][ENT]
3 Enter PCODE, R.HT in the same way. *2),3)	[F1] Enter PCODE [F4] [F1] Enter R.HT [F4]	PT# :PT-01 PCODE → R.HT : 0.000 m INPUT SRCH MEAS ALL PT# →PT-01 PCODE : MATO R.HT : 1.200 m INPUT SRCH MEAS ALL
4 Press the [F3](MEAS) key.	[F3]	VH *SD NEZ OFSET
5 Collimate the target point. ***6*** Press one of the [F1] to [F3] key. *4) Example: [F2](SD) key. Measuring starts.	Collimate [F2]	V : 90°10'20" HR: 120°30'40" SD*[n] < m > Measuring...
		V : 90°10'20" HR: 120°30'40" SD: 98.765 m >OK ? [YES][NO]
7 Press [F3](YES) key. The measuring data is memorized and the display changes to the next point. *5) PT# is automatically incremented.	[F3]	PT# →PT-02 PCODE : MATO R.HT : 1.200m INPUT SRCH MEAS ALL
8 Enter the next point data and collimate the next point.		
9 Press [F4](ALL) key. Measuring starts in the same measuring mode of the previous point. Data is recorded. Continue the measuring in the same way. To finish the mode , press [ESC] key.	Collimate [F4]	V : 90°10'20" HR: 120°30'40" SD*[n] < m > Measuring... < complete > PT# →PT-03 PCODE : MATO R.HT : 1.200 m INPUT SRCH MEAS ALL

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) PCODE can be input by inputting a register number linked with PCODE Library. To show the list of PCODE library, press the [F2](SRCH) key.
3) The mark "" indicates the previous measuring mode.
*4) You can confirm the measured data as follows. Refer to Section 7.6 “Setting Parameter of Data Collect [CONFIG.]”.

Searching the recorded data

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

Operating procedure	Operation	Display
1 While executing the DATA COLLECT mode, press [F2](SRCH) key. *1) The using file name will appear on the top of the right side of the display.	[F2]	PT# →PT-02 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL SEARCH [MATO] F1:FIRST DATA F2:LAST DATA F3:PT# DATA
2 Select one of three search methods by pressing [F1] to [F3] key. *2)	[F1] to [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 MANAGER mode. For more information, refer to Section 9.2 “Searching Data”.

Entering PCODE / ID using PCODE Library

While executing the DATA COLLECT mode, you can enter PCODE /ID from PCODE Library.

Operating procedure	Operation	Display
1 Move the arrow to the PCODE or ID in the DATA COLLECT mode.	[F1]	PT# :PT-02 PCODE → R.HT : 1.200 m INPUT SRCH MEAS ALL
2 Enter a register number linked with PCODE library. (Example) Register number, 32 = MATO	Enter No [F4]	PT# :PT-02 PCODE :MATO R.HT → 1.200 m INPUT SRCH MEAS ALL

Entering PCODE / ID from the list of PCODE

You can also enter PCODE / ID from the list of PCODE.

Operating procedure	Operation	Display
		PT# :PT-02 PCODE → R.HT : 1.200 m INPUT SRCH MEAS ALL
1 Move the arrow to the PCODE or ID in the DATA COLLECT mode, press the [F2](SRCH) key.	[F2]	→001:PCODE01 002:PCODE02 EDIT --- CLR ENTER
2 By pressing the following keys, the register number will increase or decrease. [▲]or[▼]:Increasing or Decreasing one by one [►]or[◄]:By ten Increasing or Decreasing. *1)	[▲]or[▼] [►]or[◄]	031:PCODE31 →032:MATO 033:HILTOP EDIT --- CLR ENTER
3 Press the [F4](ENTER) key.	F4]	PT# :PT-02 PCODE :MATO R.HT → 1.200 m INPUT SRCH MEAS ALL

*1) To edit the PCODE library, press the [F1](EDIT) key.
To delete the PCODE registered with shown an arrow, press the [F3](CLR) key.
PCODE can be edited in DATA COLLECT menu 2/2 or MEMORY MANAGER menu 2/3.

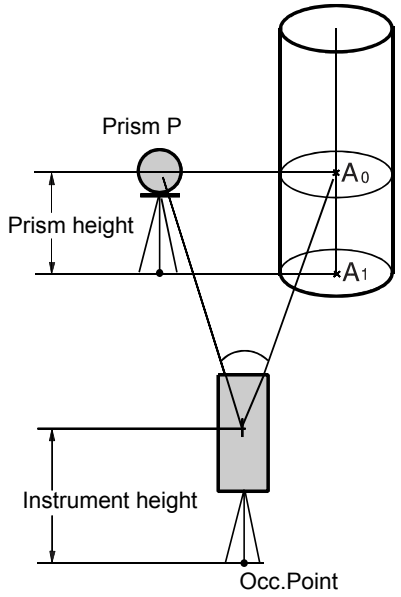
7.3 Data Collect Offset Measurement mode

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.

- Angle offset measurement
- Distance offset measurement
- Plane offset measurement
- Column offset measurement

7.3.1 Angle Offset Measurement

Place the prism at the same horizontal distance from the instrument as that of point A0 to measure.



When measuring coordinates of ground point A1 :Set the instrument height / prism height.
When measuring coordinates of point A0 : Set the instrument height only. (Set the prism height to 0).

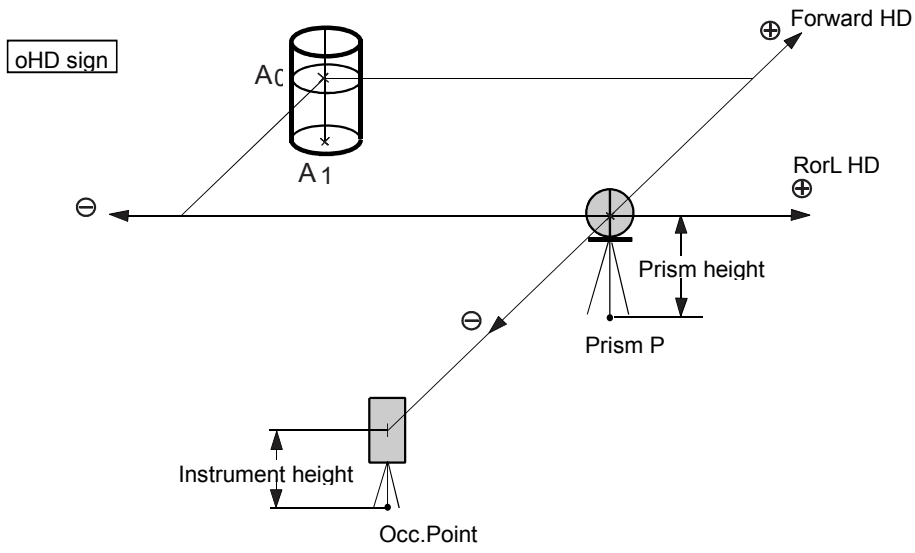
When sighting to A_0, you can select one of two ways. One is to fix vertical angle to the prism position even up down the telescope position, and the other is to gear vertical angle to the up down of telescope movement. In case following the vertical angle to the movement of telescope, SD (Slope Distance) and VD (Vertical Distance) will be changed according to the movement of telescope.
To set this option, refer to Chapter 15 “SELECTING MODE”.

Operating procedure	Operation	Display
1 Press the [F3](MEAS) key.	[F3]	PT# →PT-11 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL VH *SD NEZ OFSET
2 Press the [F4](OFSET)key.	[F4] [F1]	OFFSET 1/2 F1:ANG. OFFSET F2:DIST. OFFSET F3:PLANE OFFSET P↓
3 Press the [F1] key.	[F1]	OFFSET-MEASUREMENT HR: 120°30'40" HD: m MEAS --- NP/P ---
4 Collimate the prism.	Collimate P	
5 Press the [F1](MEAS) key. Continuous measuring starts.	[F1]	OFFSET-MEASUREMENT HR: 120°30'40" HD*[n] < m >measuring ...

		OFFSET-MEASUREMENT HR: 120°30'40" SD* 12.345 m >OK? [YES][NO]
6 Collimate point A0 using the horizontal motion clamp and horizontal tangent screw.	Collimate A0	OFFSET-MEASUREMENT HR: 123°30'40" SD: 12.345 m >OK? [YES][NO]
7 Show the horizontal distance of point A0.	[◢]	OFFSET-MEASUREMENT HR: 123°30'40" HD: 6.543 m >OK? [YES][NO]
8 Show the relative elevation of point A0. ● Each time pressing [◢] key, horizontal distance , relative elevation and slope distance are shown in sequence.	[◢]	OFFSET-MEASUREMENT HR: 123°30'40" VD: 0.843 m >OK? [YES][NO]
9 Show N coordinate of point A0 or A1. ● Each time pressing [↑◿→] key, N,E and Z coordinate are shown in sequence.	[↑◿→]	OFFSET-MEASUREMENT HR: 123°30'40" N : −12.345 m >OK? [YES][NO]
10 Press the [F3](YES) key. The data is recorded and the next measuring point is displayed.	[F3]	PT# →PT-12 PCODE : MATO R.HT : 1.200 m INPUT SRCH MEAS ALL

7.3.2 Distance Offset Measurement

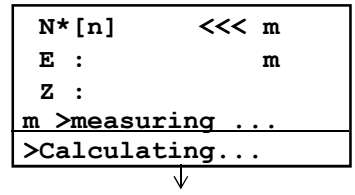
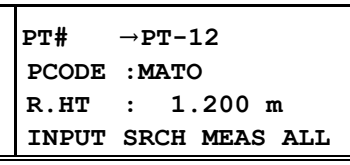
The measurement of a place apart from a prism is possible by inputting offset horizontal distance of front and back / right and left.



When measuring coordinates of ground point A_1: Set the instrument height / prism height.

When measuring coordinates of point A_0: Set the instrument height only. (Set the prism height to 0).

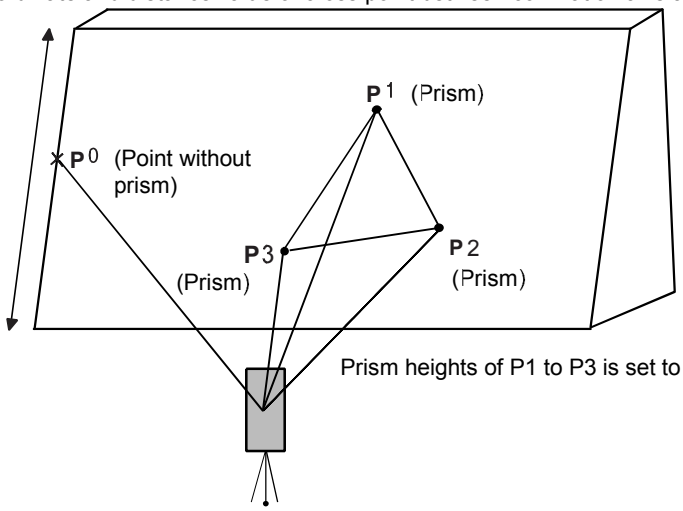
Operating procedure	Operation	Display
1 Press the [F3](MEAS) key.	[F3]	PT# →PT-11 PCODE : MATO R.HT : 1.200 m INPUT SRCH MEAS ALL VH *SD NEZ OFSET
2 Press the [F4](OFSET) key.	[F4]	OFFSET 1/2 F1:ANG. OFFSET F2:DIST. OFFSET F3:PLANE OFFSET P↓
3 Press the [F2] key.	[F2]	DISTANCE OFFSET INPUT RorL HD oHD: 0.000 m --- --- [CLR][ENT]
4 Enter Right and Left direction offset value.*1)	Enter HD [F4]	DISTANCE OFFSET INPUT FORWARD HD oHD: 0.000 m --- --- [CLR][ENT]
5 Enter Forward direction offset value. *1)	Enter HD [F4]	PT# :PT-11 PCODE : MATO R.HT : 1.200 m --- *SD NEZ ---

6 Collimate the prism.	Collimate P	
7 Press the [F2] or [F3] key. Example:[F3](NEZ) key Measuring starts.	[F3]	
The data is recorded and the next measuring point is displayed.		

*1) To skip entering, press the [F3](SKP) key.

7.3.3 Plane Offset Measurement

Measuring will be taken for the place where direct measuring can not be done, for example distance or coordinate measuring for a edge of a plane.
Three random 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 point (P0) then the instrument calculates and displays coordinate and distance value of cross point between collimation axis and of the plane.



Prism heights of P1 to P3 is set to zero automatically.

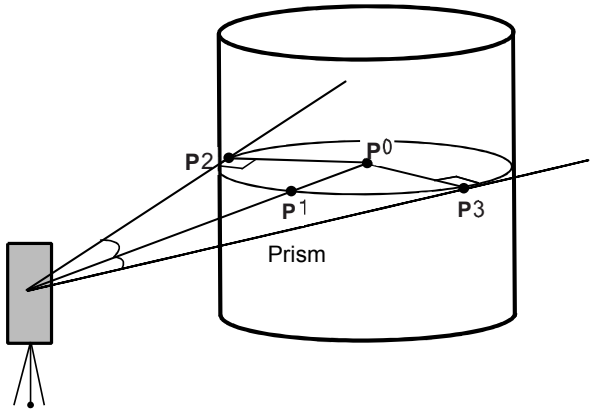
Operating procedure	Operation	Display
1 Press the [F3](MEAS) key.	[F3]	PT# →PT-11 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL VH *SD NEZ OFSET
2 Press the [F4](OFSET) key.	[F4]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P↓
3 Press the [F3](PLANE OFFSET) key.	[F3]	PLANE N001#: SD: m MEAS --- NP/P ---
4 Collimate prism P1, and press the [F1](MEAS) key. Measuring will start. After measuring, the display will show the second point measurement.	Collimate P1 [F1]	PLANE N001#: SD*[n] << m >Measuring...
5 Measure the second and third points in the same way.	Collimate P2 [F1]	PLANE N002#: SD: m MEAS --- NP/P ---

	Collimate P3 [F1]	PLANE N003#: SD: m MEAS --- NP/P ---
The display changes to PT# input in the plane offset measurement. *1) Input point number if necessary.		PLANE PT# →PT-11 PCODE : MATO INPUT SRCH --- MEAS
	[F4]	HR: 80°30'40" HD: 54.321 m VD: 10.000 m >OK? [YES][NO]
6 Press the [F4](MEAS) key. The instrument calculates and displays coordinate and distance value of cross point between collimation axis and of the plane. *2)	Collimate P0	
7 Collimate the edge (P0) of the plane. *3), 4)		HR: 75°30'40" HD: 54.600 m VD: -0.487 m >OK? [YES][NO]
8 To show the slope distance (SD), press the [ ] key. ● Each time pressing the [ ] key, horizontal distance, relative elevation and slope distance are shown in sequence. ● To show coordinate value of point P0, press the [ ] key.		V : 90°30'40" HR: 75°30'40" SD: 54.602 m >OK? [YES][NO]
9 Press the [F3](YES) key. The measured data will be recorded and the next offset point number will be displayed.	[F3]	PLANE PT# →PT-12 PCODE : INPUT SRCH --- MEAS
10To escape the measuring, press the [ESC] key. The display returns to the next point number in data collect mode.	[ESC]	PT# →PT-12 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL

*1) In case the calculation of plane was not successful by the measured three points, errordisplays. 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 the determined plane.
*4) The refrector height of the target point P0 is set to zero automatically

7.3.4 Column Offset Measurement

If it is possible to measure circumscription point (P1) 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).



Operating procedure	Operation	Display
		PT# →PT-11 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL VH *SD NEZ OFSET
1 Press the [F3](MEAS) key.	[F3]	
2 Press the [F4](OFSET) key.	[F4] [F1]	OFFSET 1/2 F1:ANG.OFFSET F2:DIST.OFFSET F3:PLANE OFFSET P↓
3 Press the [F4](P1↓) key.	[F4]	OFFSET 2/2 F1:COLUMN OFFSET P↓
4 Press the [F1](COLUMN OFFSET) key.	[F1]	COLUMN OFFSET Center HD: m MEAS --- NP/P ---
5 Collimate the center of the column (P1) and press the [F1](MEAS) key. Measuring will start.	Collimate P1 [F1]	COLUMN OFFSET Center HD* [n] << m >Measuring...
After the measurement, angle measuring display of the left side (P2) will be shown.		COLUMN OFFSET Left HR: 120°30'40" --- --- --- SET

6 `Collimate the left side of the column (P2) and press the [F4](SET) key. After the measurement, angle measuring display of the right side (P3) will be shown.	Collimate P2 [F4]	COLUMN OFFSET Right HR: 180°30'40" --- --- --- SET
7 Collimate the right side of the column (P3) and press the [F4](SET) key. The distance between the instrument and center of the column (P0) will be calculated.	Collimate P3 [F4]	↓ COLUMN OFFSET HR: 150°30'40" HD: 43.321 m >OK? [YES][NO]
To show the relative elevation (VD), press the [◢] key. Each time pressing the [◢] key, horizontal distance, relative elevation and slope distance are shown in sequence.	[◢]	COLUMN OFFSET HR: 150°30'40" VD: 2.321 m >OK? [YES][NO]
To show coordinate of point P0, press the [↑↙→] key.		
8 Press the [F3](YES) key. The display returns to the next point number in data collect mode.	[F3]	PT# →PT-12 PCODE : R.HT : 1.200 m INPUT SRCH MEAS ALL

7.4 NEZ Auto Calculation

As measured data is collected, coordinates are calculated and stored for traverse or topo collection.
Automatic making out function of coordinate data sets up in CONFIG of data collect. Refer to Section 7.7 “Setting Parameter of Data Collect [CONFIG.]”.
As a default, coordinate data calculated will be saved in a file of the same name as the measurement data file.
When the coordinate data file of the same name as the measurement data file does not exist, it will be generated automatically.
It is possible to change a file for saving coordinate data in the DATA COLLECT Menu 2/2 (F1:SELECT A FILE).
To calculate a coordinate data, it is necessary to add a point number in Data Collect execution. When a coordinate data of the same point number exist already, it can be replaced with the new data by confirming display.

● **Coordinates will be calculated using the grid factor.**
To set the grid factor, see Section 6.2“Setting the GRID FACTOR” .

7.5 Editing PCODE Library [PCODE INPUT]

PCODE data can be entered into PCODE Library in this mode.
A PCODE is liked with a number of 1 to 50.
PCODE can be also edited in MEMORY MANAGER menu 2/3 in the same way.

Operating procedure	Operation	Display
1 Press the [F2](PCODE INPUT) key from Data Collect menu 2/2.	[F2]	DATA COLLECT 2/2 F1:SELECT A FILE F2:PCODE INPUT F3:CONFIG. P↓
		→001: MATO 002:SHANGHAI EDIT --- CLR ---
2 By pressing the following keys, the list will increase or decrease. [▲]or[▼]: Increasing or Decreasing one by one [▶]or[◀]: By ten Increasing or Decreasing.	[▲]or[▼] [▶]or[◀]	011:URAH →012:AMIDAT 013:HILLTO EDIT --- CLR ---
3 Press the [F1](EDIT) key.	[F1]	011:URAH →012=AMIDAT 013:HILLTO [ALP][SPC][CLR][ENT]
4 Enter PCODE and press the [F4](ENT) key. *1)	Enter PCODE [F4]	011:URAH →012:AMISUN 013:HILLTO EDIT --- CLR ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

7.6 Setting Parameter of Data Collect [CONFIG.]

In this mode, the following settings of data collect mode are possible.

● **Setting Items**

Menu	Selecting Item	Contents
F1:DIST MODE	FINE / CRS(1) / CRS(10)	Select Fine /Coarse(1) /Coarse(10) mode in distance measurement mode. The unit to be displayed is as follows. Fine mode: 1mm Coarse (1) mode: 1mm Coarse (10) mode: 10mm
F2:HD/SD	HD/SD	Select the distance measurement mode Horizontal distance or Slope distance.
F3:MEAS. SEQ.	N-TIMES / SINGLE / REPEAT	Select to set measurement mode for distance measurement.
F1:NEZ AUTO. CALC	ON/OFF	It is possible to calculate coordinate value of data collected and store it into coordinate data file in every data collection.

● **How to Set Items**

Example Setting: HD/SD : SD

Operating procedure	Operation	Display
1 Press the [F3] (CONFIG.) key from the data collect menu 2/2. `The CONFIG menu 1/2 is shown.	[F3]	CONFIG. 2/2 F1:DIST MODE F2:HD/SD F3:MEAS.SEQ. P↓
2 Press the [F2] (HD/SD) key. [ ] indicates the current setting.	[F2]	HD/SD [F1:HD] F2:SD ENTER
3 Press the [F2] (SD) key.	[F2]	HD/SD F1:HD [F2:SD] ENTER
4 Press the [F4] (ENTER) key.	[F4]	DATA COLLECT 2/2 F1:SELECT A FILE F2:PCODE INPUT F3:CONFIG. P↓ CONFIG. 1/2 F1:DIST MODE F2:HD/SD F3:MEAS.SEQ. P↓

8 LAYOUT

LAYOUT mode has two functions which are setting of layout points and setting new points using coordinate data in the internal memory.
Also, if the coordinate data is not stored in the internal memory, this can be input from key board. The coordinate data is loaded from PC to the internal memory via RS-232C.

● **The coordinate data**

The coordinate data is memorized into a file.
For the internal memory, refer to Chapter 9 “MEMORY MANAGER MODE”.

The TS1000 is able to store the coordinate data into the internal memory.
The internal memory is shared by the measured data and the coordinate data for layout. Maximum 30 files can be generated.

● **The number of coordinate data**

(In case not using the internal memory in the data collect mode)

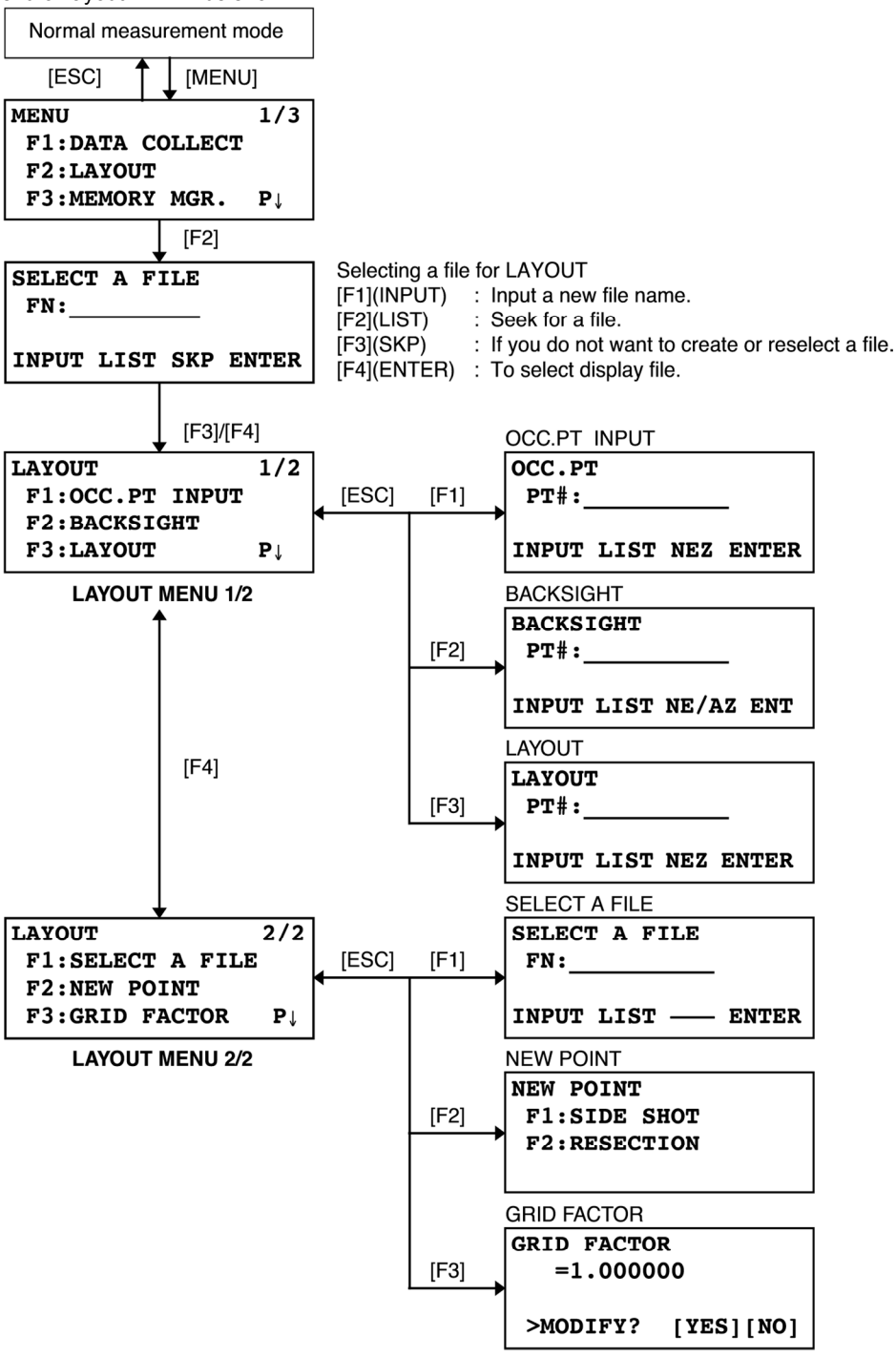
MAX. 40,000 points

Because the internal memory covers both data collection mode and layout mode, the number of coordinate data will be decreased when the data collection mode is used

1) When turning off the power, ensure that you are in the main menu screen or main angle measurement mode.
This ensures completion of the memory access process and avoids possible damage to the stored data.
2) It is recommended for safety to charge the battery beforehand and prepare fully charged spare batteries.
3) When recording new point data, remember to consider the amount of internal memory available.

Layout menu operation

By pressing the [MENU] key, the instrument will be in MENU 1/3 mode. Press the [F2](LAYOUT) key, the menu of layout 1/2 will be shown.



8.1 Preparation

8.1.1 Setting the GRID FACTOR

● **Calculation Formula**

1) Elevation Factor

$$Elevation\ Factor = \frac{R}{R + ELEV.}$$

R : The average radius of the earth
ELEV. : The elevation above mean sea level

2) Scale Factor
Scale Factor : Scale Factor at the surveying station

3) Grid Factor
Grid Factor = Elevation Factor × Scale Factor

Distance Calculation

1) Grid Distance

$$HDg = HD \times Grid\ Factor$$

HDg : Grid distance
HD : Ground distance

2) Ground Distance

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

● **How to Set Grid Factor**

Operating procedure	Operation	Display
1 Press the [F3](GRID FACTOR) key from the Layout menu 2/2.	[F3]	LAYOUT 2/2 F1:SELECT A FILE F2:NEW POINT F3:GRID FACTOR P↓
2 Press the [F3](YES) key.	[F3]	GRID FACTOR =0.998843 >MODIFY?[YES][NO]
3 Enter Elevation. *1) Press the [F4](ENT) key.	Enter ELEV. [F4]	GRID FACTOR ELEV.=1000 m SCALE:0.999000 --- ---[CLR][ENT] GRID FACTOR ELEV.:2000 m SCALE=1.001000 --- ---[CLR][ENT]
4 Enter Scale Factor in the same way. Grid Factor is displayed for 1 to 2 second and display returns to Layout menu 2/2.	Enter Scale [F4]	GRID FACTOR =1.000686

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input Range :Elevation : –9,999 to +9,999 meter (–32,805 to +3,2805 ft, ft+in)
Scale Factor : 0.990000 to 1.010000

8.1.2 Selecting Coordinate Data File

You can execute a Layout from selected coordinate data file, also you can record New point measured data into the selected coordinate data file.

● The only coordinate data file existing can be selected and you can not make a new file in this mode. For more information about File, refer to Chapter 9 “MEMORY MANAGER MODE”.

● When LAYOUT MODE is begun, a file can be selected in the same way.

Operating procedure	Operation	Display
		LAYOUT 2/2 F1:SELECT A FILE F2:NEW POINT F3:GRID FACTOR P↓
1 Press the [F1](SELECT A FILE) key from the Layout menu 2/2.	[F1]	SELECT A FILE FN: INPUT LIST --- ENTER
2 Press the [F2](LIST) key to display the list of coordinate data file.*1)	[F2]	COORDDATA /C0123 →*CZDATA /C0345 MATODATA /C0789 --- SRCH --- ENTER
3 Scroll file list by pressing the [▲]or[▼] key and select a file to use. *2),3)	[▲]or[▼]	*CZDATA /C0345 →MATODATA /C0789 SATIDATA /C0456 --- SRCH --- ENTER
4 Press the [F4](ENTER) key. The file will be set .	[F4]	LAYOUT 2/2 F1:SELECT A FILE F2:NEW POINT F3:GRID FACTOR P↓

*1) If you want to input file name directly, press the [F1](INPUT) key and enter a file name.
2) When a file has been selected already, ‘’ mark is indicated on left of current file name.
For the file discrimination mark (*, @, &), refer to Section 9.3 “FILE MAINTENANCE”.
*3) Data in a file shown with arrow can be searched by pressing the [F2](SRCH) key.

8.1.3 Setting Occupied Point

Occupied point can be set by two setting methods as follows.

1) Setting from the coordinate data stored in the internal memory.
2) Direct key input of coordinate data.

- Example setting :Setting the occupied point from the internal coordinate data file

Operating procedure	Operation	Display
1 Press the [F1](OCC.PT INPUT) key from the Layout menu 1/2.	[F1]	OCC.PT PT#: INPUT LIST NEZ ENTER
2 Press the [F1] (INPUT) key , enter PT# and press the [F4](ENT) key. *1)	[F1] Enter PT# [F4]	INSTRUMENT HEIGHT INPUT INS.HT= 0.000 m --- --- [CLR][ENT]
3 Enter INS.HT in the same way. The display returns to layout menu 1/2.	Enter INS.HT [F4]	LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

- Example setting :Setting Instrument point coordinates directly

Operating procedure	Operation	Display
1 Press the [F1](OCC.PT INPUT) key from the Layout menu 1/2.	[F1]	OCC.PT PT#: INPUT LIST NEZ ENTER
2 Press the [F3] (NEZ) key.	[F3]	N→ 0.000 m E: 0.000 m Z: 0.000 m INPUT --- PT# ENTER
3 Press the [F1](INPUT) key and enter coordinate value. press the [F4](ENT) key. *1),2)	[F1] Enter coord. [F4]	COORD.DATA INPUT PT#: INPUT --- --- ENTER
4 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *2)	[F1] Enter PT# [F4]	INSTRUMENT HEIGHT INPUT INS.HT= 0.000 m --- --- [CLR][ENT]
5 Enter Instrument Height in the same way. The display returns to layout menu 1/2.	Enter INS.HT [F4]	LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) It is possible to record the coordinate value. Refer to Chapter 16 “SELECTING MODE”.

8.1.4 Setting Backsight Point

The following three setting methods for Backsight point can be selected.

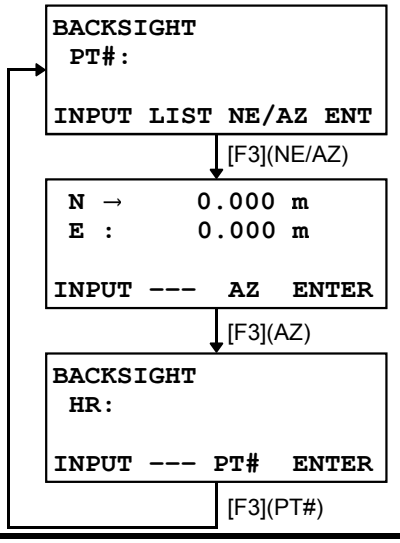
1) Setting from the coordinate data file stored in the internal memory.
2) Direct key input of coordinate data.
3) Direct key input of setting angle.

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

Operating procedure	Operation	Display
1 Press the [F2](BACKSIGHT) key from the Layout menu 1/2.	[F2]	BACKSIGHT PT#: INPUT LIST NE/AZ ENT
2 Press the [F1] (INPUT) key.	[F1]	BACKSIGHT PT#=BK-01 [ALP][SPC][CLR][ENT]
3 Enter PT#, press the [F4](ENT) key. *1)	Enter PT# [F4]	BACKSIGHT H(B)= 0°00'00" >Sight ? [YES][NO]
4 Sight the backsight point and press the [F3](YES) key. The display returns to the layout menu 1/2.	Sight BK [F3]	

*1) Refer to Section 2.6 "How to enter alphanumeric characters".

● With each pressing of [F3] key, method of inputting backsight is changed.



● Example setting: Setting the backsight point coordinates directly

Operating procedure	Operation	Display
1 Press the [F2](BACKSIGHT) key from the Layout menu 1/2.	[F2]	BACKSIGHT PT#: INPUT LIST NE/AZ ENT
2 Press the [F3] (NE/AZ) key.	[F3]	N→ 0.000 m E: 0.000 m INPUT --- AZ ENTER
3 Press the [F1](INPUT) key and enter coordinate value. Press the [F4](ENT) key. *1) , 2)	[F1] Enter coord. [F4]	BACKSIGHT H(B)= 0°00'00" >Sight ? [YES][NO]
4 Sight the backsight point.	Sight BK	
5 Press the [F3](YES) key. The display returns to the layout menu 1/2.	[F3]	LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) It is possible to record the coordinate value. Refer to Chapter 16 “SELECTING MODE”.

8.2 Executing a Layout

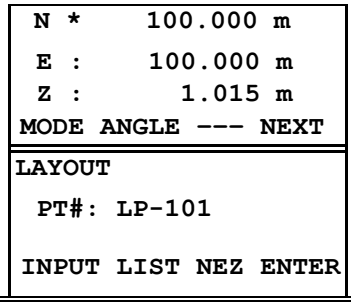
The following methods can be selected for executing a Layout:

1) Recalling points from internal memory by point number.

2) Direct key input of coordinate values.

Example setting : Recalling point from internal memory.

Operating procedure	Operation	Display
		LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓
1 Press the [F3](LAYOUT) key from the layout menu 1/2.	[F3]	LAYOUT PT#: INPUT LIST NEZ ENTER
2 Press the [F1](INPUT) key, and enter PT#. *1)	[F1] Enter PT#	REFLECTOR HEIGHT INPUT R.HT = 0.000 m --- --- [CLR][ENT]
3 Press the [F4](ENT) key. *2) Enter reflector height in the same way.	[F4] Enter R.HT [F4]	CALCULATED HR= 90°10'20" HD= 123.456 m ANGLE DIST --- ---
When the layout point is set, the instrument will start layout calculation. HR: Calculated horizontal angle of the layout point HD: Calculated horizontal distance from the instrument to the layout point	Collimate P	
4 Collimate the prism, and press the [F1](ANGLE) key. PT#: Layout point HR: Measured (Actual) horizontal angle. dHR: Horizontal angle to be turned to the layout point = Actual horizontal angle - Calculated horizontal angle. Correct direction when dHR = 0°00'00"	[F1]	PT#: LP-100 HR: 6°20'40" dHR: 23°40'20" DIST --- NEZ ---
		HD*[t] < m dHD: m dZ: m MODE ANGLE NEZ NEXT
5 Press the [F1](DIST) key. HD: Measuring (Actual) horizontal distance dHD: Horizontal distance to be turned to the layout point = Actual horizontal distance – Calculated horizontal distance. dZ: Vertical distance to be turned to the layout point = Actual vertical distance – Calculated vertical distance.	[F1]	HD* 143.84 m dHD: −13.34 m dZ: −0.05 m MODE ANGLE NEZ NEXT
6 Press the [F1](MODE) key. The fine mode measuring starts.	[F1]	HD*[r] < m dHD: m dZ: m MODE ANGLE NEZ NEXT
		HD* 156.835 m dHD: −3.327 m dZ: −0.046 m MODE ANGLE NEZ NEXT

7 When the display value dHR, dHD and dZ are equal to 0, the layout point is established.*3 ***8*** Press the [F3](NEZ) key. The coordinate data is shown. ***9*** Press the [F4](NEXT) key to set next layout point . PT# is automatically incremented.	[F3] [F4]	

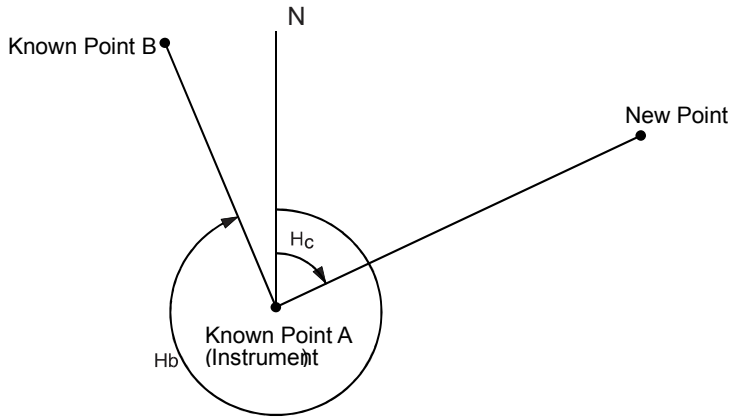
*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) Point number could not be entered when data to comply with the coordinate value does not exist in the file.

8.3 Setting a New Point

New point is required for example when a layout point cannot be sighted from existing control points.

8.3.1 Side Shot Method

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



Operating procedure	Operation	Display
		LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓
1 Press the [F4](↓) key from the layout menu 1/2 to get the layout menu 2/2.	[F4]	LAYOUT 2/2 F1:SELECT A FILE F2:NEW POINT F3:GRID FACTOR P↓
2 Press the [F2](NEW POINT).	[F2]	NEW POINT F1:SIDE SHOT F2:RESECTION
3 Press the [F1](SIDE SHOT) key.	[F1]	SELECT A FILE FN:_____ INPUT LIST----ENTER
4 Press the [F2](LIST) key to display the list of coordinate data file. *1)	[F2]	COORDDATA /C0123 →*CZDATA /C0345 MATODATA /C0789 --- SRCH --- ENTER
5 Scroll file list by pressing[▲]or[▼] key and select a file to use. *2),3)	[▲]or[▼]	*CZDATA /C0345 → MATODATA /C0789 SATIDATA /C0456 --- SRCH --- ENTER

6 Press the [F4](ENTER) key.
The file will be set .

[F4]

```
SIDE SHOT
PT#:

INPUT SRCH --- ENTER
```

7 Press the [F1](INPUT) key, and enter the new point name. *4)
Press the [F4](ENT) key.

[F1]
Enter PT#
[F4]

```
REFLECTOR HEIGHT
INPUT
R.HT  =   0.000 m
 ---  --- [CLR][ENT]
```

8 Enter reflector height in the same way.

Enter R.HT
[F4]

```
REFLECTOR HEIGHT
INPUT
R.HT  :   1.235 m
>Sight ?   [YES][NO]
```

9 Collimate the new point, and press the [F3](YES) key.
Distance measuring starts.

Collimate
[F3]

```
 HR:   123°40'20"
 HD*[n]       < m
 VD:
 > Measuring...
    < complete >
```

↓

```
 N :  1234.567 m
 E :   123.456 m
 Z :     1.234 m
>REC ?     [YES][NO]
```

10 Press the [F3](YES) key.*5)
The name and coordinate value are stored into COORD.DATA.
The input menu for next new point is displayed.
PT# is automatically incremented.

[F3]

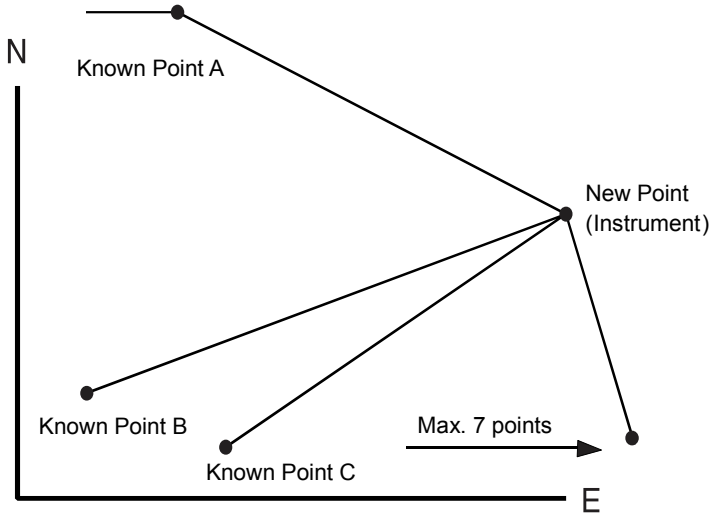
```
SIDE SHOT
 PT#:NP-101

INPUT SRCH --- ENTER
```

*1) If you want to input file name directly, press the [F1](INPUT) key and enter a file name.
2) When a file has been selected already, '' mark is indicated on left of current file name.
For the file discrimination mark (*, @, &), refer to Chapter 9.3 "FILE MAINTENANCE".
*3) Data in a file shown with arrow can be searched by pressing [F2](SRCH) key.
*4) Refer to Section 2.5 "How to Enter Alphanumeric characters".
*5) An error will be displayed when the internal memory is full.

8.3.2 Resection Method

Set up the instrument at a new point, and calculate the coordinate of the new point using the coordinate data of maximum seven known points and the measurements made to these points.

- To calculate the occupied point coordinate value, 2 or more known points must be measured.
- In case more than 2 known points are measured, the occupied point coordinate value will be calculated by the method of least squares.



Operating procedure	Operation	Display
		LAYOUT 1/2 F1:OCC.PT INPUT F2:BACKSIGHT F3:LAYOUT P↓
1 Press the [F4](↓) key from the layout menu 1/2 to get the layout menu 2/2.	[F4]	LAYOUT 2/2 F1:SELECT A FILE F2:NEW POINT F3:GRID FACTOR P↓
2 Press the [F2](NEW POINT).	[F2]	NEW POINT F1:SIDE SHOT F2:RESECTION
3 Press the [F2](RESECTION) key.	[F2]	NEW POINT PT#: INPUT SRCH SKP ENTER
4 Press the [F1](INPUT) key, and enter the new point name. *1) ,2) Press the [F4](ENT) key.	[F1] Enter PT# [F4]	INSTRUMENT HEIGHT INPUT INS.HT = 0.000 m --- --- [CLR][ENT]

5 Enter instrument height in the same way.

Enter INS.HT [F4]

```
NO01#
PT#:

INPUT LIST NEZ ENTER
```

6 Enter the known point A number. *3)

[F1] Enter PT# [F4]

```
REFLECTOR HEIGHT
INPUT
R.HT = 0.000 m
--- --- [CLR][ENT]
```

7 Enter reflector height.

Enter R.HT [F4]

```
REFLECTOR HEIGHT
INPUT
R.HT : 1.235 m
>Sight ?  [YES][NO]
```

8 Collimate the known point A, and press [F3](YES) .
Distance measuring starts

Collimate A [F4]

```
HR: 123°40'20"
HD* < m
VD: m
> Measuring...
    < complete >
```

Known point B entering display will be shown.

```
NO02#
PT#:

INPUT LIST NEZ ENTER
```

9 Same as procedure ***6*** to ***8*** proceed to the known point B.
When two points have been measured , the RESIDUAL ERROR will be calculated. *4) *5)

```
RESIDUAL ERROR
dHD= 0.015 m
dZ = 0.005 m
NEXT --- G.F CALC
```

10 Press the [F1](NEXT) key to measure other points.
Maximum seven points can be measured.

[F1]

```
NO03#
PT#:

INPUT LIST NEZ ENTER
```

11 Same as procedure ***6*** to ***8*** proceed to the known point C.

[F1]

```
HR: 123°40'20"
HD* < m
VD: m
> Measuring...
    < complete >
```

```
HR: 123°40'20"
HD: 123.456 m
VD: 1.234 m
NEXT --- --- CALC
```

12 Press the [F4](CALC) key.
Coordinate data of the new point will be shown

[F4]

```
N :      65.432 m
E :     876.543 m
Z :       1.234 m
---  ---   REC   P↓
```

13 Press the [F4] **(P↓)** key. Standard Deviations of each coordinate will be shown. Unit : (mm) or (inch)	[F4]	SD(n) : 1.23 mm SD(e) : 1.46 mm SD(z) : 0.73 mm --- --- REC P↓
14 Press the [F3](REC) key. *6) 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. The display returns to new point menu.	[F3]	NEW POINT F1:SIDE SHOT F2:RESECTION

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

*2) When there is no need to memorize the new point data, press the [F3](SKP) key.

*3) To enter the known point coordinate data by direct key inputting, press the [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 known point B)

*5) To see the GRID FACTOR value, press the [F3](G.F.) key.

*6) In this case when [F3](SKP) key pressed in step ***4***, the new point data is not stored into the coordinate data file, only the value of occupied coordinate data changes to that of the calculated NEW POINT.

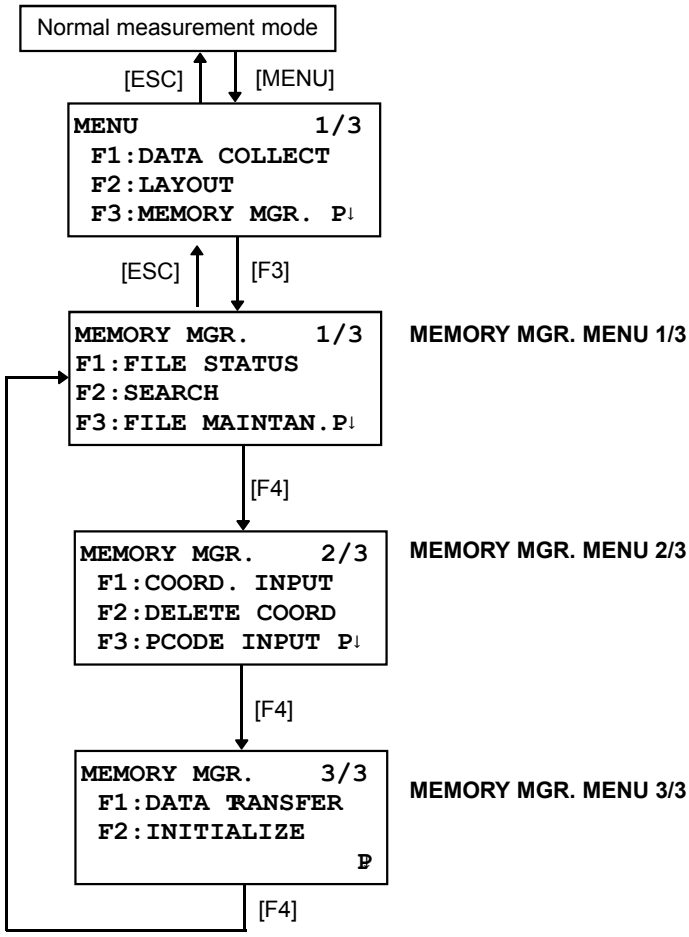
9 MEMORY MANAGER MODE

The following items for internal memory are available in this mode.

1) FILE STATUS	:	Checking the number of stored data / Remaining internal memory capacity.
2) SEARCH	:	Searching the recorded data.
3) FILE MAINTAN.	:	Deleting files / Editing file name
4) COORD. INPUT	:	Inputting coordinate data into Coord. data file.
5) DELETE COORD.	:	Deleting coordinate data from Coord. data file.
6) PCODE INPUT	:	Inputting PCODE DATA into PCODE Library
7) DATA TRANSFER	:	Sending measured data or coordinate data / Uploading coordinate data Setting communication parameters
8) INITIALIZE	:	Initializing internal memory.

● Memory manager menu operation

By pressing the [MENU] key, the instrument will be in MENU 1/3 mode.
Press the [F3](MEMORY MGR.) key, the menu of MEMORY MGR. 1/3 will be shown.



9.1 Display Internal Memory Status

This mode is used to check the internal memory status.

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P ↓
2 Press the [F1](FILE STATUS) key. The total number of stored measured data files and coordinate files are shown. And the total number of stored measured data and coordinate data in all files are shown	[F1]	MEAS. FILE : 0003 COORD.FILE: 0006 MEAS. DATA : 0100 COORD.DATA: 0050

- To return to MEMORY MGR. menu press the [ESC] key

9.2 Searching Data

This mode is used to search the recorded file data in the DATA COLLECT or LAYOUT mode. The following 3 search methods in each type of files can be selected.

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

MEAS. DATA : Measured data in the data collect mode.
COORD. DATA : Coordinate data for layout, control points and new point data measured in the layout mode.
PCODE LIB. : The data which was registered with a number from 1 to 50 in Point code library.
Point name (PT#, BS#) , ID, PCODE and Height data (INS.HT, R.HT) can be corrected in the searching mode.
Measured value can not be corrected.

9.2.1 Measured Data Searching

Example :Point number searching

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F2](SEARCH) key.	[F2]	SEARCH F1:MEAS. DATA F2:COORD.DATA F3:PCODE LIB.
3 Press the [F1](MEAS. DATA) key.	[F1]	SELECT A FILE FN: INPUT LIST --- ENTER
4 Press the [F1](INPUT) key and enter File Name. Press the [F4](ENT) key. *1),2)	[F1] Enter FN [F4]	MEAS. DATA SEARCH F1:FIRST DATA F2:LAST DATA F3:PT# DATA
5 Press the [F3](PT# DATA) key.	[F3]	PT# DATA SEARCH PT#: INPUT --- --- ENTER
6 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *1)	[F1] Enter PT# [F4] [F4]	PT# MT-104 2/2 V 98°36'20" HR 160°40'20" TILT 0°00'00" ↓
7 Press the [F4](↓) key to scroll data for selected point.		PT# MT-104 1/2 PCODE R.HT 1.200 m EDIT ↓

*1) Refer to Section 2.6 "How to enter alphanumeric characters".
*2) To show the file list, press the [F2](LIST) key.

- " " represents data shown on the display is the stored data.
- Press the [▲]or[▼] key to scroll to next or previous point.
- To search MEAS. DATA of the same point number, press[◀]or[▶] key.

- **To edit the data in searching mode**

Point name (PT#, BS#) , ID, PCODE and Height data (INS.HT, R.HT) can be corrected in the searching mode.
Measured value can not be corrected.

Operating procedure	Operation	Display
1 Press the [F1](EDIT) key from last page of displayed data.	[F1]	PT# TOP-104 2/2 PCODE R.HT 1.000 m EDIT ↓
2 Select the item to correct by pressing [▲]or[▼] key.	[▲]or[▼]	PT# →TOP-104 PCODE : R.HT : 1.000 m INPUT --- --- ENTER
3 Press the [F1](INPUT) key and enter data. *1) Press the [F4](ENT) key.	[F1] Enter Data [F4]	PT# :TOP-104 PCODE : R.HT → 1.000 m INPUT --- --- ENTER
4 Press the [F4](ENTER) key.	[F4]	PT# →TOP-104 PCODE : R.HT : 1.200 m >SAVE? [YES][NO]
5 Press the [F3](YES) key .	[F3]	PT# TOP-104 2/2 PCODE R.HT 1.200 m EDIT

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

- When editing, ID and PCODE are not linked with PCODE LIBRARY.
- Even though the height data (INS.HT, R.HT) are corrected, the measured value can not be corrected.

9.2.2 Coordinate Data Searching

Example searching :Point number searching

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F2](SEARCH) key.	[F2]	SEARCH F1:MEAS. DATA F2:COORD. DATA F3:PCODE LIB.
3 Press the [F2](COORD. DATA) key.	[F2]	SELECT A FILE FN: INPUT LIST --- ENTER
4 Press the [F1](INPUT) key and enter File Name. Press the [F4](ENT) key. *1)	[F1] Enter FN [F4]	COORD. DATA SEARCH F1:FIRST DATA F2:LAST DATA F3:PT# DATA
5 Press the [F3](PT# DATA) key.	[F3]	PT# DATA SEARCH PT#: INPUT --- --- ENTER
6 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *1)	[F1] Enter PT# [F4]	PT# MT-104 1/2 N 100.234 m E 12.345 m Z 1.678 m ↓
7 Press the [F4](↓) key to get the next page.	[F4]	PT# MT-104 1/2 PCODE MATO ↓

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

- " " represents data shown on the display is the stored data.
- Press the [▲] or [▼] key to scroll to next or previous point.
- To search COORD. DATA of the same point number, press the[◀]or[▶] key.

9.2.3 PCODE LIBRARY Searching

Example searching :Number searching

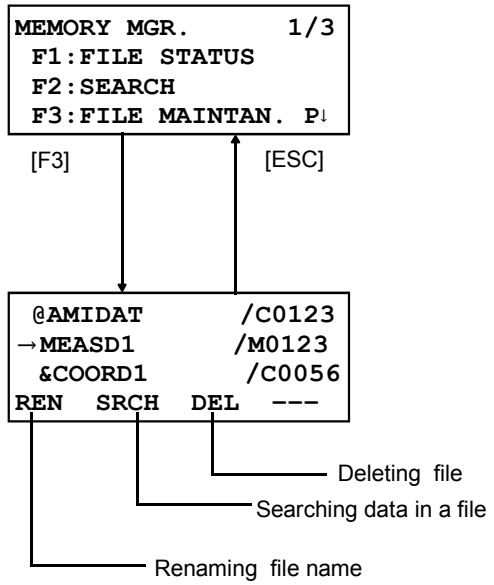
Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F2](SEARCH) key.	[F2]	SEARCH F1:MEAS. DATA F2:COORD. DATA F3:PCODE LIB.
3 Press the [F3](PCODE LIB.) key.	[F3]	PCODE DATA SEARCH F1:FIRST DATA F2:LAST DATA F3:No. SEARCH
4 Press the [F3](No. SEARCH) key.	[F3]	PCODE No. SEARCH No.= --- --- [CLR][ENT]
5 Enter number. Press the [F4](ENT) key. *1) The number and linked data will be shown. *2)	Enter PT# [F4]	011:NAKADAI →012:HILLTOP 013:ITABASH EDIT --- CLR ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
Press the [▲] or [▼] key to scroll to next or previous PCODE data
*2) To correct the PCODE data , press the [F1](EDIT) key.
To delete the PCODE data, press the [F3](CLR) key.

9.3 FILE MAINTENANCE

In this mode, the following items are available.
Renaming file name / Searching data in a file / Deleting files

● **FILE MAINTAN. menu**



Pressing [F3](FILE MAINTAN.) key from MEMORY MANAGER menu 1/3, file list will be shown.

- File discrimination mark (*,@)
  File discrimination mark (*,@) placed before file name indicates the file status.
  For measured data file
  " * " :selected file for DATA COLLECT mode.
  For coordinate data file
  " @ " : selected coordinate file for both LAYOUT and DATA COLLECT mode..
- Data discrimination character (M, C)
  Data discrimination character (M, C) placed before four figures indicates the type of data.
  " M " :Measured data
  " C " :Coordinate data.
- Four figures means the total number of data in the file.
  Press the [▲] or [▼] key to scroll to next file.

9.3.1 Rename a File

An existing file in internal memory can be renamed.

Operating procedure	Operation	Display
1 Press the [F3](FILE MAINTAN.) key from the Memory manager menu 1/3.	[F3]	→MEASD1 /M0123 COORD1 /C0056 REN SRCH DEL ---
2 Select a file by pressing [▲]or[▼] key.	[▲]or[▼]	MEASD1 /M0123 →COORD1 /C0056 COORD2 /C0098 REN SRCH DEL ---
3 Press the [F1](REN) key.	[F1]	MEASD1 /M0123 =COORD1 /C0056 COORD1 /C0098 [ALP] --- [CLR][ENT]
4Enter new file name. Press the [F4](ENT) key. *1)	Enter FN [F4]	MEASD1 /M0123 →COORD5 /C0056 COORD1 /C0098 REN SRCH DEL ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
Existing file name can not be available.
To return to the FILE MAINTAN. Menu , press the [ESC] key.

9.3.2 Searching Data in a File

An existing file in internal memory can be searched.

Operating procedure	Operation	Display
1 Press the [F3](FILE MAINTAN.) key from the Memory manager menu 1/3.	[F3]	→MEASD1 /M0123 COORD1 /C0056 REN SRCH DEL ---
2 Select a file to search by pressing [▲]or[▼] key.	[▲]or[▼]	MEASD1 /M0123 →COORD1 /C0056 COORD2 /C0098 REN SRCH DEL ---
3 Press the [F2](SRCH) key.	[F2]	SEARCH [COORD1] F1:FIRST DATA F2:LAST DATA F3:PT# DATA
4 Select searching method by pressing the [F1] to [F3] key. *1)	[F1] to [F3]	

*1) Because procedures from next are same as procedures of Section 9.2 "Searching Data", refer to Section 9.2 “Searching Data”
To return to the FILE MAINTAN. Menu , press the [ESC] key.

9.3.3 Deleting a File

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

Operating procedure	Operation	Display
1 Press the [F3](FILE MAINTAN.) key from the Memory manager menu 1/3.	[F3]	→MEASD1 /M0123 COORD1 /C0056 REN SRCH DEL ---
2 Select a file to delete by pressing [▲]or[▼] key.	[▲]or[▼]	MEASD1 /M0123 →COORD1 /C0056 COORD2 /C0098 REN SRCH DEL ---
3 Press the [F3](DEL) key.	[F3]	MEASD1 /M0123 →COORD1 /C0056 COORD2 /C0098 >DELETE? [NO][YES]
4 Confirm the deleting, and press the [F4](YES) key.	[F4]	MEASD1 /M0123 →COORD2 /C0098 COORD3 /C0321 REN SRCH DEL ---

● To return to the FILE MAINTAN. Menu , press the [ESC] key.

9.4 Coordinate Data Direct Key Input

9.4.1 Coordinate data input

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

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F4](P↓) key.	[F4]	MEMORY MGR. 2/3 F1:COORD. INPUT F2:DELETE COORD. F3:PCODE INPUT P↓
3 Press the [F1](COORD. INPUT) key.	[F1]	SELECT A FILE FN: INPUT LIST --- ENTER
4 Press the [F1](INPUT) key and enter File Name you want to input. Press the [F4](ENT) key. *1)	[F1] Enter FN [F4]	COORD. DATA INPUT PT#: INPUT --- --- ENTER
5 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *1)	[F1]	N→ 100.234 m E: 12.345 m Z: 1.678 m INPUT --- --- ENTER
6 Enter Coordinate data. Press the [F4](ENT) key. *1)	[F1] Enter PT# [F4]	COORD. DATA INPUT PCODE: INPUT LIST --- ENTER
7 Enter PCODE and press the [F4](ENTER). Next input display is shown, point number (PT#) is automatically incremented.	Enter data [F4]	COORD. DATA INPUT PT#: PT-102 INPUT --- --- ENTER

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

9.5 Delete a Coordinate Data from a File

Coordinate data in a file can be erased.

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F4](P↓) key.	[F4]	MEMORY MGR. 2/3 F1:COORD. INPUT F2:DELETE COORD. F3:PCODE INPUT P↓
3 Press the [F2](DELETE COORD.) key.	[F2]	SELECT A FILE FN: INPUT LIST --- ENTER
4 Press the [F1](INPUT) key and enter File Name. Press the [F4](ENT) key. *1)	[F1] Enter FN [F4]	DELETE COORD. PT#:_____ INPUT LIST --- ENTER
5 Press the [F1](INPUT) key and enter PT#. Press the [F4](ENT) key. *1)	[F1] Enter PT# [F4]	N: 100.234 m E: 12.345 m Z: 1.678 m >DELETE? [YES][NO]
6 Confirm the data and press the [F3](YES) key. Deleting starts. The display will return to the previous display.	[F3]	

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

9.6 Editing PCODE Library

PCODE data can be entered into PCODE Library in this mode.
A PCODE is linked with a number of 1 to 50
PCODE can be also edited in DATA COLLECT menu 2/3 in the same way.

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN. P↓
2 Press the [F4](P↓) key.	[F4]	MEMORY MGR. 2/3 F1:COORD. INPUT F2:DELETE COORD. F3:PCODE INPUT P↓
3 Press the [F3](PCODE INPUT) key.	[F3]	→001:MATO 002:CHANGZHOU 003:MKDAT EDIT --- CLR ---
4 By pressing the following keys, the list will increase or decrease. [▲]or[▼] :Increasing or Decreasing one by one [►]or[◄] :By ten Increasing or Decreasing.	[▲]or[▼] [►]or[◄]	011:URAH →012:AMIDAT 013:HILLTO EDIT --- CLR ---
5 Press the [F1](EDIT) key.	[F1]	011:URAH →012=AMIDAT 013:HILLTO [ALP] --- [CLR][ENT]
6 Enter PCODE and press the [F4](ENT) key. *1)	Enter PCODE [F4]	011:URAH →012:AMISUN 013:HILLTO EDIT --- CLR ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

9.7 Data Communications

You can send a data file stored in the internal memory to a computer directly. Also, you can directly load a coordinate data file and PCODE Library data to the internal memory from the computer.

9.7.1 Sending Data

Example: Sending a Measured data file

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F4](P↓) key twice.	[F4] [F4]	MEMORY MGR. 3/3 F1:DATA TRANSFER F2:INITIALIZE P↓
3 Press the [F1](DATA TRANSFER) key .	[F1]	DATA TRANSFER F1:GTS FORMAT F2:SSS FORMAT
4 Select data format.	[F1]	DATA TRANSFER F1:SEND DATA F2:LOAD DATA F3:COMM. PARAMETERS
5 Press the [F1] key.	[F1]	SEND DATA F1:MEAS. DATA F2:COORD. DATA F3:PCODE DATA
6 Select the type of data to send by pressing [F1][F3] key. Example : [F1](MEAS. DATA)	[F1]	SELECT A FILE FN: INPUT LIST --- ENTER
7 Press the [F1](INPUT) key and enter File Name you want to send. Press the [F4](ENT) key. *1),2)	Enter FN [F4]	SEND MEAS. DATA >OK ? --- --- [YES][NO]
8 Press the [F3](YES) key .*3) The sending starts. The display will return to menu.	[F3]	SEND MEAS. DATA < Sending Data!> STOP

*1) Refer to Section 2.5 “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 the sending, press the [F4](STOP) key.

9.7.2 Loading Data

Coordinate data can be loaded from PC.
Example: Loading a coordinate data file

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F4](P↓) key twice.	[F4] [F4]	MEMORY MGR. 3/3 F1:DATA TRANSFER F2:INITIALIZE P↓
3 Press the [F1](DATA TRANSFER) key .	[F1]	DATA TRANSFER F1:GTS FORMAT F2:SSS FORMAT
4 Press the [F1](GTS FORMAT) key .	[F1]	DATA TRANSFER F1:SEND DATA F2:LOAD DATA F3:COMM.PARAMETERS
5 Press the [F2] key.	[F2]	LOAD DATA F1:COORD. DATA F2:PCODE DATA
6 Select the type of data to load by pressing [F1] or [F2] key. Example : [F1](COORD. DATA)	[F1]	SELECT A FILE FN: INPUT LIST --- ENTER
7 Press the [F1](INPUT) key and enter New File Name you want to receive. Press the [F4](ENT) key. *1) *2)	[F1] Enter FN [F4]	LOAD COORD. DATA >OK ? --- --- [YES][NO]
8 Press the [F3](YES) key.*3) The loading starts. The display will return to menu.	[F3]	LOAD COORD. DATA < Loading Data!> STOP

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) To select a file from the internal memory, press the [F2](LIST)key.
*3) To cancel the loading, press the [F4](STOP) key.

9.7.3 Setting Parameter of Data Communications

● **Items of the Parameter**

Item	Selecting Item	Contents
F1: Protocol	[ACK/NAK], [ONE WAY]	Setting Protocol [ACK/NAK] or [ONE WAY] communication
F2: Baud rate	1200, 2400, 4800, 9600, 19200,38400	Setting transfer speed 1200/2400/4800/9600 /19200/ 38400 baud rate
F3: Char. / Parity	[7/EVEN], [7/ODD], [8/NON]	Setting data length and parity. [7bit, even], [7bit, odd], [8bit,none]
F1: Stop Bits	1, 2	Setting Stop 1 bit or 2bits

● **Example Setting** Baud rate : 19200

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN P↓
2 Press the [F4](P↓) key twice.	[F4] [F4]	MEMORY MGR. 3/3 F1:DATA TRANSFER F2:INITIALIZE P↓
3 Press the [F1](DATA TRANSFER) key .	[F1]	DATA TRANSFER F1:GTS FORMAT F2:SSS FORMAT
4 Press the [F1](GTS FORMAT) key .	[F1]	DATA TRANSFER F1:SEND DATA F2:LOAD DATA F3:COMM.PARAMETERS
5 Press the [F3](COMM. PARAMETERS) key.	[F3]	COMM. PARAMETERS 1/2 F1:PROTOCOL F2:BAUD RATE F3:CHAR./PARITY P↓
6 Press the [F2](BAUD RATE) key. [ ] indicates present setting.	[F2]	BAUD RATE [1200] 2400 4800 9600 19200 38400 ENTER
7 Select the items by pressing [▲]or[▼] , [◀] and [►] keys. *1)	[►] [▼]	BAUD RATE 1200 2400 4800 9600 [19200]38400 ENTER
8 Press the [F4](ENTER) key.	[F4]	COMM. PARAMETERS 1/2 F1:PROTOCOL F2:BAUD RATE F3:CHAR./PARITY P↓

*1) To cancel setting, press the [ESC] key.

9.8 Initialization

This mode is used to initialize the internal memory.
Following data can be initialized.
FILE DATA :All files of measuring data and coordinate data
PCODE DATA: PCODE LIST
ALL DATA: FILE DATA and PCODE DATA
Note that the following data are not initialized even if initialization is executed. : Coordinates of the instrument, Instrument height and Reflector height.

Example Initialization: ALL DATA (FILE data and PCODE data)

Operating procedure	Operation	Display
1 Press the [F3](MEMORY MGR.) key from the menu 1/3.	[F3]	MEMORY MGR. 1/3 F1:FILE STATUS F2:SEARCH F3:FILE MAINTAN. P↓
2 Press the [F4](P↓) key twice.	[F4] [F4]	MEMORY MGR. 3/3 F1:DATA TRANSFER F2:INITIALIZE P↓
3 Press the [F2](INITIALIZE) key.	[F2]	INITIALIZE F1:FILE AREA F2:PCODE LIST F3:ALL DATA
4 Select the data to initialize by pressing one of the [F1] to [F3] key. Example : [F3](ALL DATA)	[F3]	INITIALIZE DATA ERASE ALL DATA ! >OK ? [NO][YES]
5 Confirm the erase data, press the [F4](YES) key. Initializing will start. The display returns to menu.	[F4]	INITIALIZE DATA <Initializing!> ↓ MEMORY MGR. 3/3 F1:DATA TRANSFER F2:INITIALIZE P↓

10 SET AUDIO MODE

The light acceptance quantity level for the EDM (SIGNAL), the atmospheric correction value (PPM) and correction value of prism constant (PSM) are displayed in this mode. When reflected light from the prism is received a buzzer sounds. This function is good for easy collimation when the target is difficult to find.

Operating procedure	Operation	Display
1 Make sure the mode is in the distance measurement mode on page 2.	[F4] [F4]	HR: 120°30'40" HD* 123.456 m VD: 5.678 m MEAS MODE NP/P P1↓ OFST S.O S/A P3↓
2 Pressing the [F3](S/A) key, mode changes to set audio mode. The display indicates correction value of prism constant (PSM), atmospheric correction (PPM) and reflection light level (SIGNAL).		S/A PSM:-30.0 PPM 0.0 SIGNAL:[ ] PRISM PPM T-P ---

- When receiving reflected light, buzzer sounds.
- It is possible to stop the sound, see Chapter 15 “SELECTING MODE” .
- The [F1] to [F3] keys are used for setting atmospheric correction and prism constant.
- To return to normal measuring mode, press the [ESC] key.

11 SETTING THE PRISM CONSTANT VALUE

The prism constant value of is set to zero. When using prisms other than it is necessary to set the prism constant correction value of that specific prism.
Once you set the correction value for prism constant, it is retained after power is OFF.

Operating procedure	Operation	Display
1 Press the [F3](S/A) key on page 3 from distance measurement or coordinates measurement mode.	[F3]	S/A PSM:0.0 PPM 0.0 SIGNAL:[ ] PRISM PPM T-P ---
2 Press the [F1](PRISM) key.	[F1]	PRISM CONST. SET CONST. =-30.0 mm --- --- [CLR][ENT]
3 Input the Prism constant correction value. *1) The display returns to set audio mode.	Enter data [F4]	SET AUDIO MODE PSM:14.0 PPM 0.0 SIGNAL:[ ] PRISM PPM T-P ---

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input range : –99.9mm to +99.9mm,0.1mm step

12 SETTING ATMOSPHERIC CORRECTION

The velocity of light through air is not constant and depends on the atmospheric temperature and pressure. The atmospheric correction system of this instrument corrects automatically when the correction value is set. 15°C/59°F, and 1013.25hPa / 760mmHg / 29.9 inHg is as a standard value for 0ppm in this instrument. The values are kept in the memory even after power is OFF.

12.1 Calculation of Atmospheric Correction

The followings are the correction formulas.
Unit; meter

$$Ka = \{282.86 - \frac{.442 \times p}{3.15 + t}\} \times 10^{-6}$$

Ka: Atmospheric correction value
P : Ambient atmospheric pressure (hPa)
t : Ambient Atmospheric temperature (°C)

The distance L (m) after atmospheric correction is obtained as follow.
L = l (1+Ka) l :Measured distance when atmospheric correction is not set.

12.2 Setting of Atmospheric Correction Value

How to Set Temperature and Pressure Value Directly
Measure the temperature and air pressure surrounding the instrument beforehand. Example : Temperature: +26°C, Pressure:1017 hPa

Operating procedure	Operation	Display
1 Press the [F3](S/A) key on page 3 to set Set Audio Mode from distance or coordinate measurement mode.	[F3]	S/A PSM:0.0 PPM 0.0 SIGNAL:[ ] PRISM PPM T-P ---
2 Press the [F3](T-P) key.	[F3]	TEMP. & PRES. SET TEMP. = 15.0 °C PRES. : 1013.2 hPa --- --- [CLR][ENT]
3 Input Temp.value and Pressure value.*1) Mode returns to Set Audio mode.	Enter Temp. Enter Pres.	TEMP. & PRES. SET TEMP. : 26.0 °C PRES. = 1017.0 hPa --- --- [CLR][ENT]

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

- Range : Temp. –30 to +60°C (0.1°C step) or –22 to +140°F (0.1°F step)
  Pres. 560 to 1066.0hPa (0.1hPa step) ,420 to 800mmHg (0.1mmHg step) or 16.5 to 31.5inHg (0.1inHg step)
- When the atmospheric correction value which is calculated from the input temperature and pressure values exceeds the range ± 999.9ppm, the operating procedure returns to step 3 automatically. Input values again.

- **How to Set the Atmospheric Correction Value Directly**

Measure the temperature and air pressure to find atmospheric correction value (PPM) from the chart or correction formula.

Operating procedure	Operation	Display
1 Press the [F3](S/A) key to set Set Audio Mode from distance or coordinate measurement mode.	[F3]	S/A PSM:0.0 PPM 0.0 SIGNAL:[ ] PRISM PPM T-P ---
2 Press the [F2](PPM) key. Current setting value is displayed.	[F2]	PPM SET PPM = 0.0 ppm --- --- [CLR][ENT]
3 Enter atmospheric correction value. *1) Mode returns to Set Audio mode.	Enter Data [F4]	

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.

● Input range : –999.9ppm to +999.9ppm,0.1ppm step

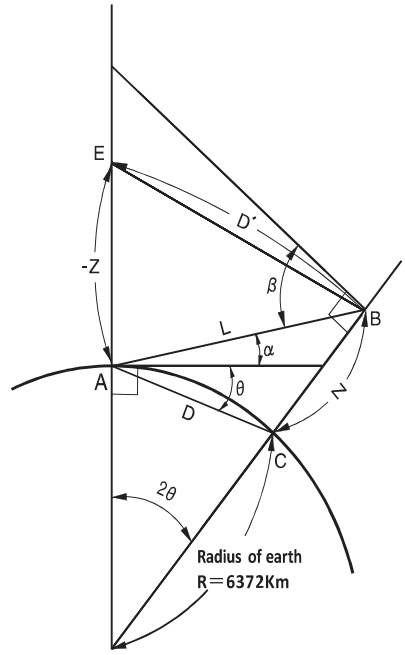
13 CORRECTION FOR REFRACTION AND EARTH CURVATURE

The instrument measures distance, taking into account correction for refraction and earth curvature.

13.1 Distance Calculation Formula

Distance Calculation Formula; with correction for refraction and earth curvature taken into account. Follow the Formula below for converting horizontal and vertical distances.

Horizontal distance D = AC(α) or BE(β)
Vertical distance Z =BC(α) or EA(β)
$D = L\{\cos\alpha - (2\theta - \gamma)\sin\alpha\}$
$Z = L\{\sin\alpha + (\theta - \gamma)\cos\alpha\}$
θ = L.cos α /2R..... Earth curvature correcting item
γ =K•Lcos α /2R..... Atmospheric refraction correcting item
K =0.14 or 0.2..... Coefficient of refraction
R =6372km..... Radius of earth
α (or β)..... Altitude angle
L ..... Slope distance



● The conversion formula for horizontal and vertical distances is as follows when correction for refraction and earth curvature is not applied.
D=L•cos α
Z=L•sin α

Note: The coefficient of the instrument has been set at 0.14 before shipment (K=0.14). if the "K" value is to be changed, refer to 16 “SELECTING MODE”.

14 DETACH/ATTACH OF TRIBRACH

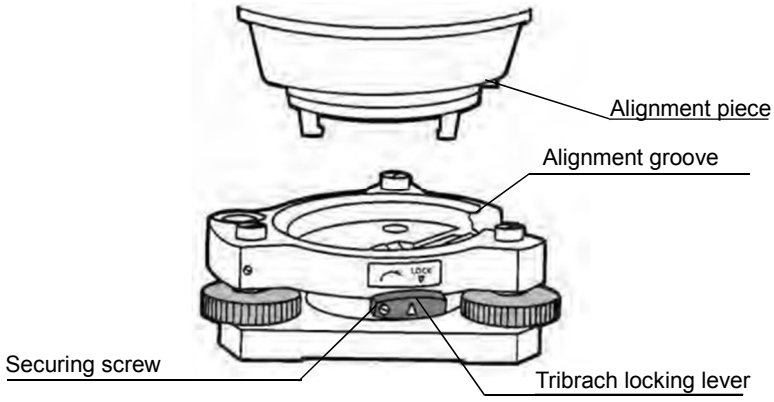
The instrument is easily detached or attached to the tribrach, with a tribrach locking lever loosened or tightened for this purpose.

● **Detachment**

1) Loosen the tribrach locking lever, by revolving it 180° or 200g in the counterclockwise direction (which will point the triangle mark upwards).
2) Grip the carrying handle firmly with one hand while holding the tribrach with the other. Then lift the instrument straight upwards and off.

● **Attachment**

1) Hold the instrument by the carrying handle, with one hand, and carefully lower it on top of the tribrach while, at the same time, coinciding the alignment piece with the tribrach alignment groove on the instrument and tribrach respectively.
2) When fully seated, revolve the tribrach locking lever 180° or 200g clockwise (which will point the triangle mark downwards again).



● **Locking the Tribrach Locking Lever**

The tribrach locking lever can be locked, to prevent it be accidentally removed, especially if the upper instrument section is not being detached very often. Simply tighten the securing screw on the locking lever with the accessory screwdriver, found in the case.

15 SELECTING MODE

15.1 Items of the Selecting Mode

The following modes are available.

Menu	Items	Selecting item	Display
1: UNIT SET	TEMP. & PRES.	°C / °F hPa / mmHg / inHg	Select the unit of temperature for atmospheric correction. Select the unit of air pressure for atmospheric correction .
	ANGLE	DEG(360°) / GON(400G) / MIL(6400M)	Choose degree, gon or mil unit for measuring angle.
	DISTANCE	METER / FEET / FEET and inch	Choose measuring unit for distance meter , feet or feet and inch
	FEET	US SURVEY / INTERNATIONAL	Select the meter / feet conversion factor. US SURVEY feet 1m=3.280833333333333 ft. INTERNATIONAL feet 1m=3.280839895013123 ft.
2: MODE SET	POWER ON MODE	ANGLE MEAS./ DISTANCE MEAS.	Select to set the measurement mode for angle or distance when the power is turned on.
	FINE/CRS/ TRK	FINE / COARSE / TRACK	Select Fine /Coarse / Tracking mode in distance measurement mode, when the power is turned on.
	HD&VD/SD	HD&VD /SD	Specify which is displayed first, horizontal and vertical distance or slope distance, when the power is turned on.
	V ANGLE Z0/H0	Zenith 0 / Horizontal 0	Choose the vertical angle reading from zenith or from level.
	N-TIMES / REPEAT	N-TIMES / REPEAT	Select the measurement mode for distance when the power is turned on.
	TIMES OF MEAS.	0~99	Set N (number of times) for times of distance measurement. When setting number of times as 1, it is single measurement.
	NEZ / ENZ	NEZ / ENZ	Select a coordinate displaying order either NEZ or ENZ.
	EDM OFF TIME	0-99 minutes	The time when EDM is cut off from distance measurement is completed can be changed. This function is effective for shortening the first time measuring time when distance measurement is started from distance measurement completing state. (Default:3minutes) 0 :After completing distance measurement, EDM is cut off immediately. 1-98 :EDM is cut off after 1~98 minutes. 99 :EDM is always switched ON.
	NON-PSM /PRISM	NON-PSM/PRISM	Select the reflective target type for measuring of distance as either Non-Prism or Prism when the power is turned on
	LS.PL.OFF TIME	0-99 minutes	Set the time to automatically turn off the laser plummet after exiting the star key mode (Default:3minutes).

3: OTHERS SET	H-ANGLE BUZZER	ON / OFF	Specify whether the buzzer sounds or not for every horizontal angle 90°.
	S/A BUZZER	ON / OFF	Specify whether the buzzer sounds or not in the set audio mode.
	W-CORRECTION	OFF / K=0.14 / K=0.20	Set correction for refraction and earth curvature, coefficient of refraction as ; K=0.14, K=0.20 or no correction.
	NEZ MEMORY	ON / OFF	It is possible to retain the coordinate of instrument point, the instrument height and prism height after power off.
	REC TYPE	REC-A / REC-B	Select REC-A or REC-B for data output. REC-A :The measurement is made again and this new data is output. REC-B : The data being displayed is output.
	CR,LF	ON / OFF	It is possible to output the data with carriage return and line feed.
	ACK MODE	STANDARD / OMITTED	Set the procedure of the communication with external device. STANDARD: Normal procedure OMITTED: Even though the [ACK] is omitted from the external device, the data is not sent again.
	GRID FACTOR	USE G.F. / DON'T USE	Select using GRID FACTOR in calculation of measurement data.

15.2 How to Set Selecting Mode

<Example> : Setting temperature unit °F, NEZ MEMORY: ON

Operating procedure	Operation	Display
1 While pressing [F2] key, turn power ON.	[F2] + Power ON	PARAMETERS 2 F1:UNIT SET F2:MODE SET F3:OTHERS SET
2 Press [F1](UNIT SET) key.	[F1]	UNIT SET 1/2 F1:TEMPERATURE. F2:PRESSURE F3:ANGLE P↓
3 Press [F1](TEMPERATURE) key.	[F1]	TEMPERATURE UNIT [F1: °C] F2: °F ENTER
4 Press [F2] key and [F4](ENTER) key.	[F2] [F4]	TEMPERATURE UNIT F1: °C [F2: °F] ENTER
5 Returns to unit set menu.		UNIT SET 1/2 F1:TEMPERATURE. F2:PRESSURE F3:ANGLE

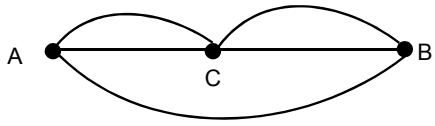
6 Press [ESC] key. Returns to PARAMETERS 2 menu.	[ESC]	PARAMETERS 2 F1:UNIT SET F2:MODE SET F3:OTHERS SET
7 Press [F3](OTHERS SET) key.	[F3]	OTHERS SET 1/5 F1:H-ANGLE BUZZER F2:S/A BUZZER F3:W-CORRECTION P↓
8 Press [F4](P ↓) key, to get the function in page 2 .	[F4]	OTHERS SET 2/5 F1:NEZ MEMORY F2:REC TYPE F3:CR,LF P↓
9 Press [F1] key.	[F1]	NEZ MEMORY F1: ON [F2: OFF] ENTER
10 Press [F1](ON) key, and press [F4] (ENTER) key.	[F1] [F4]	
Returns to OTHERS SET menu.		OTHERS SET 2/5 F1:NEZ MEMORY F2:REC TYPE F3:CR,LF P↓
11 Power off	Power OFF	

16 CHECK AND ADJUSTMENT

16.1 Checking and adjusting of instrument constant

Normally, the instrument constant does not have discrepancy. It is recommended you measure and compare with an accurately measured distance at a location where the precision is specifically monitored on a consistent basis. If such a location is not available, establish your own base line over 20m (when purchasing the instrument) and compare the data measured with the newly purchased instrument.
In both cases note that the setup displacement of the instrument position over the point, the prism, baseline precision, poor collimation, atmospheric correction, and correction for refraction and earth curvature determine the inspection precision. Please keep in mind these points.
Also, when providing a base line in a building, please note that differences in temperature greatly affect the length measured.
If a difference of 5mm or over is the result from the comparative measurement, the following procedure as shown below could be used to change the instrument constant.

1) Provide point C on a straight line, connecting straight line AB which is almost level and about 100m long. Measure straight lines AB, AC and BC.



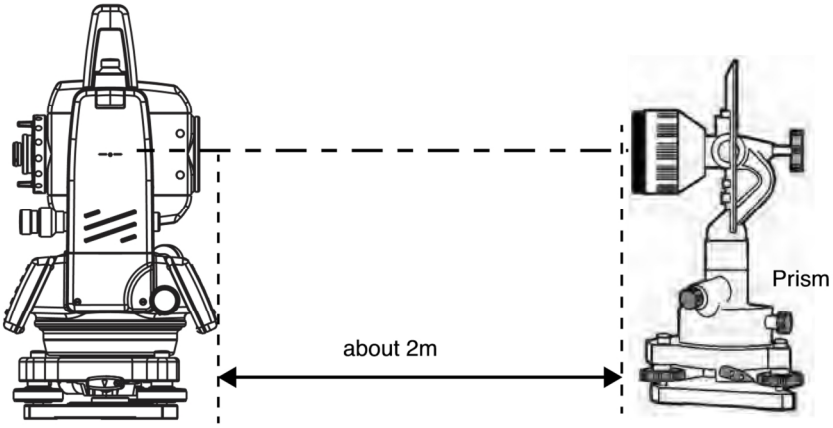
2) Obtain the instrument constant by repeating 1) above several times.
   Instrument constant = AC+BC–AB
3) When there is error between written instrument constant value and calculated value, review Section 17.4 “How to Set the Instrument Constant Value”
4) Once again, measure at a calibrated baseline and compare results.
5) If using above procedure and no difference is found from the instrument constant at the factory or a difference of over 5mm is found, contact dealer.

Note: The seal with which the value is written is stuck on the lower part of the instrument, or the battery removal side of the instrument.

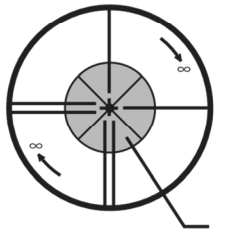
16.2 Checking the Optical Axis

To check if the optical axis of EDM and theodolite are matched, follow the procedure below. It is especially important to check after adjustment of the eyepiece reticle is carried out.

1) Position the Instrument and prism with about 2m apart and face them at each other. (At this time, the power is ON.)

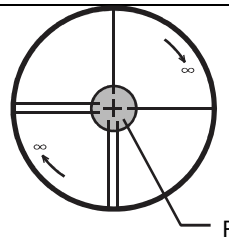


2) Sight through the eyepiece and focus to the prism. Then center the prism on the cross hairs.



3) Set to the measure mode to distance measurement or set audio.
4) Sight through the eyepiece and focus the (blinking) red light spot by turning the focusing knob in the direction of infinity (clockwise). If displacement of the reticle cross hairs is within one-fifth of the diameter of the round red light spot both vertically and horizontally, adjustment will not be required.

Note:	If displacement is more than one-fifth in the above case, and still remains so after rechecking the original line of sight, the instrument must be adjusted by competent technicians. Please contact or your dealer to adjust the instrument.



16.3 Checking/Adjusting the Theodolite Functions

● **Pointers on the Adjustment**

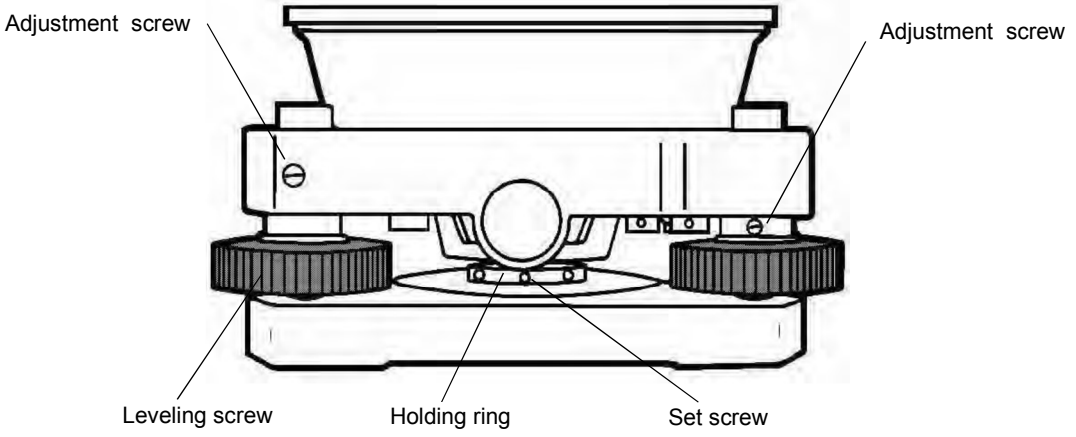
1) Adjust the eyepiece of the telescope properly prior to any checking operation which involves sighting through the telescope.
   Remember to focus properly, with parallax completely eliminated.

2) Carry out the adjustments in the order of item numbers, as the adjustments are dependent one upon another. Adjustments carried out in the wrong sequence may even nullify previous adjustment.
3) Always conclude adjustments by tightening the adjustment screws securely (but do not tighten them more than necessary, as you may strip the threads, twist off the screw or place undue stress on the parts).
   Furthermore, always tighten by revolving in the direction of tightening tension.
4) The attachment screws must also be tightened sufficiently, upon completion of adjustments.
5) Always repeat checking operations after adjustments are made, in order to confirm results.

● **Notes on the Tribrach**

Note that the angle measuring precision may be effected directly if the tribrach has not been installed firmly.

1) If any leveling screw becomes loose and slack or if collimation is unstable due to the looseness of leveling screws, adjust by tightening the adjusting screws (in 2 places) installed over each leveling screw with a screwdriver
2) If there is any slack between the leveling screws and the base, loosen the set screw of the holding ring and tighten the holding ring with adjusting pin, until it is properly adjusted. Re-tighten the set screw on completing the adjustment.

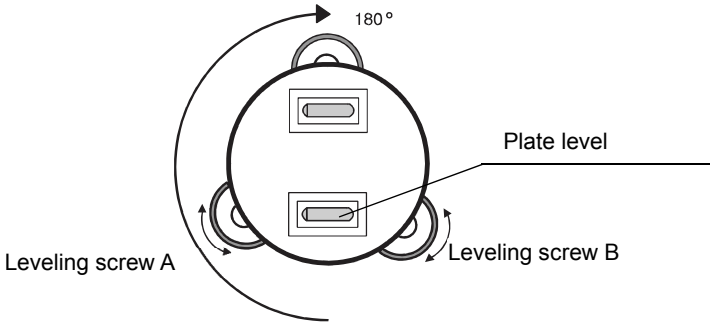


16.3.1Checking /Adjusting the Plate Level

Adjustment is required if the axis of the plate level is not perpendicular to the vertical axis.

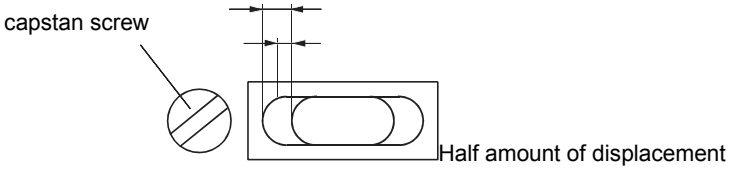
● **Check**

1) Place the plate level parallel to a line running through the centers of two leveling screws, say, A and B. Use these two leveling screws only and place the bubble in the center of the plate level.
2) Rotate the instrument 180° or 200g around the vertical axis and check bubble movement of the plate level. If the bubble has been displaced, then proceed with the following adjustment.



● **Adjustment**

1) Adjust the level adjustment capstan screw, with the accessory adjusting pin and return the bubble towards the center of the plate level. Correct only one-half of the displacement by this method.
2) Correct the remaining amount of the bubble displacement with the leveling screws.
3) Rotate the instrument 180° or 200g around the vertical axis once more and check bubble movement. If the bubble is still displaced, then repeat the adjustment. Level adjustment



16.3.2Checking /Adjusting the Circular Level

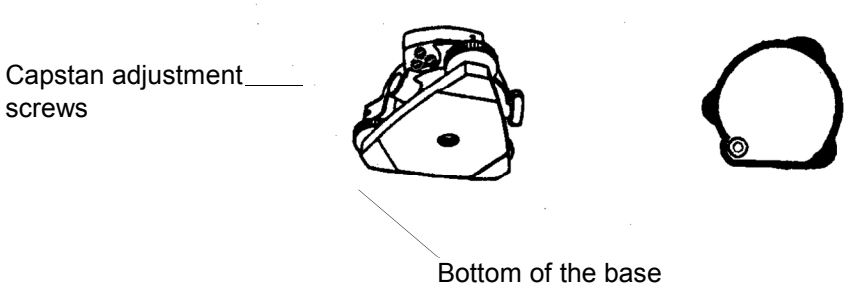
Adjustment is required if the axis of the circular level is also not perpendicular to the vertical axis.

● **Check**

1) Carefully level the instrument with the plate level only. If the bubble of the circular level is centered properly, adjustment is not required. Otherwise, proceed with the following adjustment.

● **Adjustment**

1) Shift the bubble to the center of the circular level, by adjusting three capstan adjustment screws on the bottom surface of the circular level, with the accessory adjusting pin.

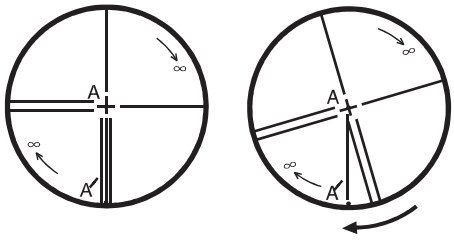


16.3.3 Adjustment of the Vertical Cross-hair

Adjustment is required if the vertical cross-hair is not in a place perpendicular to the horizontal axis of the telescope (since it must be possible to use any point on the hair for measuring horizontal angles or running lines).

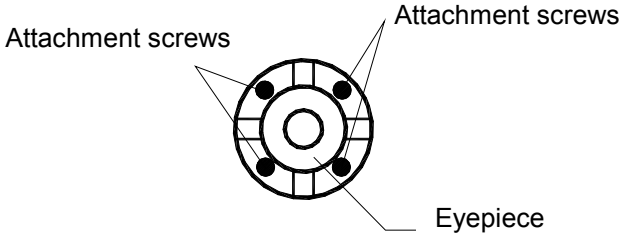
● **Check**

1) Set the instrument up the tripod and carefully level it.
2) Sight the cross-hairs on a well defined Point A at a distance of, at least, 50 meters (160ft.) and clamp horizontal motion.
3) Next swing the telescope vertically using the vertical tangent screw, and check whether the point travels along the length of the vertical cross-hair.
4) If the point appears to move continuously on the hair, the vertical cross-hair lies in a plane perpendicular to the horizontal axis (and adjustment is not required).
5) However, if the point appears to be displaced from the vertical cross-hair, as the telescope is swung vertically, then proceed with the following adjustment.



● **Adjustment**

1) Unscrew the cross-hair adjustment section cover, by revolving it in the counterclockwise direction, and take it off. This will expose four eyepiece section attachment screws.



Eyepiece section

Eyepiece section attachment screws
attachment screws Eyepiece

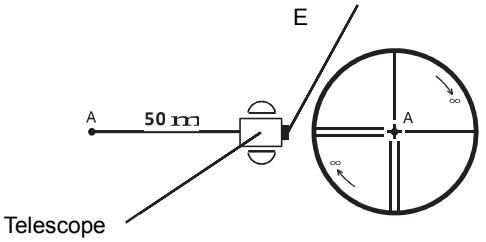
2) Loosen all four attachment screws slightly with the accessory screw-drive (while taking note of the number of revolutions).
   Then revolve the eyepiece section so that the vertical cross-hair coincides to Point A'.
   Finally, re-tighten the four screws by the amount that they were loosened.
3) Check once more and if the point travels the entire length of the vertical cross-hair, further adjustment is not required.

Note:	Perform following adjustment after completing the above adjustment . Section 17.3.4 "Collimation of the Instrument", Section 17.3.6 "Adjustment of Vertical Angle 0 Datum".

16.3.4Collimation of the Instrument

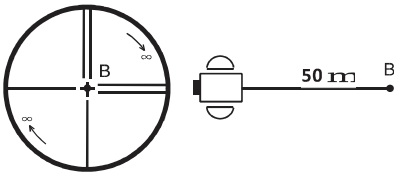
Collimation is required to make the line of sight of the telescope perpendicular to the horizontal axis of the instrument, otherwise, it will not be possible to extend a straight line by direct means.

● **Check**



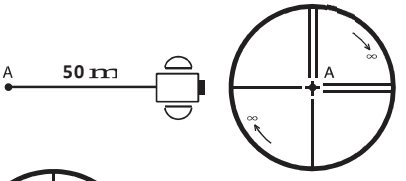
yepiece 1) Set the instrument up with clear sights of about 50 to 60meters (160 to 200 ft.) on both sides of the instrument.

2) Level the instrument properly with the plate level.
3) Sight Point A at approximately 50 meters (160 ft.) distance.

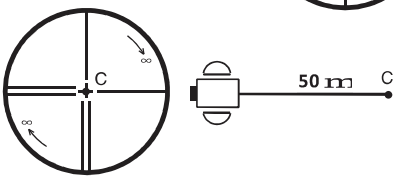


4) Loosen the vertical motion clamp only, and rotate the telescope 180° or 200g around the horizontal axis, so that the telescope is pointed in the opposite direction.
5) Sight Point B, at equal distance as Point A and tighten the vertical motion clamp.

6) Loosen the horizontal motion clamp and rotate the instrument 180° or 200g around the vertical axis. Fix a sight on Point A once more and tighten the horizontal motion clamp.



7) Loosen the vertical motion clamp only and rotate the telescope 180° or 200g around the horizontal axis once more and fix a sight on Point C, which should coincide with previous Point B.
8) If Points B and C do not coincide, adjust in the following manner.

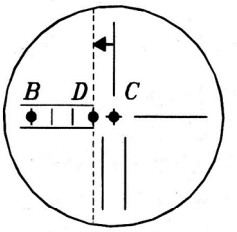


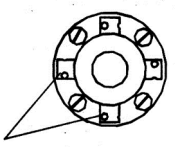
● **Adjustment**

1) Unscrew the cross-hair adjustment section cover.

2) Find Point D at a point between Points C and B, which should be equal to 1/4th the distance between Points B and C and measured from Point C. This is because the apparent error between Points B and C is four times the actual error since the telescope has been reversed twice during the checking operation.

3)Shift the vertical cross-hair line and coincide it with Point D, by revolving the left and right capstan adjustment screws with the adjusting pin.Upon Capstan completing the adjustment, repeat the checking adjustment operation once more. screws If Points B and C coincide, further adjustment is not required. Otherwise , repeat the adjustment.





reticle adjustment screw

Note: 1 First, loosen the capstan adjustment screw on the side to which the vertical cross-hair line must be moved. Then tighten the adjustment screw on the opposite side by an equal amount which will leave the tension of the adjustment screws unchanged. Revolve in the counterclockwise direction to loosen and in the clockwise direction to tighten, but revolve as little as possible.

2 Perform following adjustment after completing above adjustment . Section 17.3.6 “Adjustment of Vertical Angle 0 Datum”, Section 17.2 “Checking the Optical Axis”.

16.3.5Checking / Adjusting the Optical Plummet Telescope

Adjustment is required to make the line of sight of the optical plummet telescope coincide with the vertical axis (otherwise the vertical axis will not be in the true vertical when the instrument is optically plumbed).

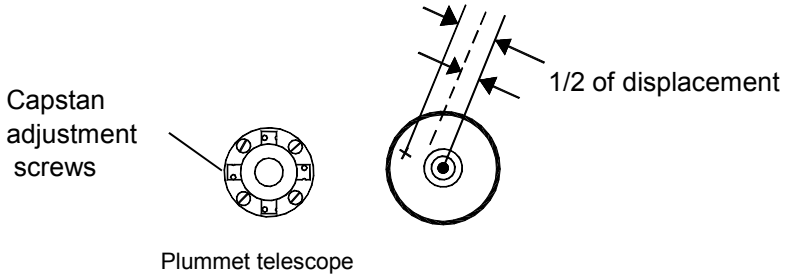
● **Check**

1) Coincide the center mark and the point. (See Chapter 2 “PREPARATION FOR MEASUREMENT”.) 2) Rotate the instrument 180° or 200g around the vertical axis and check the center mark.

If the point is properly centered in the center mark, adjustment is not required. Otherwise, adjust in the following manner.

● **Adjustment**

1) Take off the adjustment section cover of the optical plummet telescope eyepiece. This will expose four capstan adjustment screws which should be adjusted with the accessory adjusting pin to shift the center mark to the point. However, correct only one-half of the displacement in this manner.



2) Use the leveling screws and coincide the point and center mark.
3) Rotate the instrument 180° or 200g around the vertical axis once more and check the center mark. If it is coincided to the point, then further adjustment is not required. Otherwise, repeat the adjustment.

Note: First, loosen the capstan adjustment screw on the side to which the center mark must be moved. Then tighten the adjustment screw on the opposite side by an equal amount which will leave the tension of the adjustment screws unchanged.
Revolve in the counterclockwise direction to loosen and in the clockwise direction to tighten, but revolve as little as possible.

16.3.6 Adjustment of Vertical Angle 0 Datum

If when measuring the vertical angle of target A at telescope position normal (direct) and reverse settings, the amount of normal and reverse measurements combined is other than 360° (ZENITH-0), half of the difference from 360° is the error amount from corrected 0 setting. Carry out adjustment. As adjustment for vertical angle 0 setting is the criteria for determining instrument coordinate origin, use special care for adjustment.

Operating procedure	Operation	Display
1 Level the instrument properly with the plate level. ***2*** While pressing the [F1]key, turn power switch ON. ***3*** Press the [F1] key. ***4*** Collimate target A from the telescope properly in normal setting. ***5*** Press the [F4](ENTER) key. ***6*** Collimate target A in reverse telescope setting. ***7*** Press the [F4](ENTER) key. ***8*** Measured value is set and carry out normal angle measurement. Check that the total amount of normal and reverse angular travel is 360° collimating the target A by normal and reverse positions.	[F1] + Power ON [F1] Collimate A (Normal) [F4] Collimate A (Reverse) [F4]	ADJUSTMENT MODE F1:V ANGLE 0 POINT F2:INST. CONSTANT F3:FRQ CHECK MODE V0 ADJUSTMENT <STEP-1> FRONT V: 90°00'00" ENTER V0 ADJUSTMENT <STEP-2> REVERSE V: 270°00'00" ENTER <SET!> ↓ V : 270°00'00" HR: 120°30'40" 0SET HOLD HSET P1↓

16.4 How to Set the Instrument Constant Value

To set the Instrument constant which is obtained in Section 17.1 “Check and adjusting of instrument constant”, follow as below.

Operating procedure	Operation	Display
1 While pressing the [F1] key, turn power switch ON.	[F1] + POWER ON	ADJUSTMENT MODE F1:V ANGLE 0 POINT F2:INST. CONSTANT
2 Press the [F2] key.	[F2]	INST. CONSTANT SET INST. CONSTANT = - 0.6 mm --- --- [CLR][ENT]
3 Enter the constant value. *1),2)	Enter value [F4]	INST. CONSTANT SET INST. CONSTANT : - 0.7 mm INPUT --- --- ENTER
4 Turn power switch OFF.	Power OFF	

*1) Refer to Section 2.5 “How to Enter Alphanumeric characters”.
*2) To cancel the setting, press the [ESC] key.

17 PRECAUTIONS

1) For transportation, hold by the handle or yoke of the instrument. Never hold by the lens barrel as it can affect the fixing bracket inside and reduce the accuracy of the instrument.

2) Never expose the instrument without a filter to direct sunlight. It may damage the components inside the instrument.

3) Never leave the instrument unprotected in high temperature. The temperature inside instrument may easily reach up to 70°C or above and will reduce the service life.

4) The instrument should be stored in the room temperature range of minus 30°C to plus 60°C.

5) When a high degree of precision is required for measurement, provide shade against direct sunlight for the instrument and tripod.

6) Any sudden change of temperature to the instrument or prism may result in a reduction of measuring distance range, i.e. when taking the instrument out from a heated vehicle.

7) When opening the carrying case and taking out the instrument, place the case horizontally, then open the case.

8) When returning the instrument to its case, be sure to match the white positioning marks provided with the case and place the instrument with the eyepiece upward.

9) For transportation, provide dampening or a cushion appropriately to avoid sudden shock or vibration.

10) For cleaning the instrument after use, remove dust using a cleaning brush, then wipe off with a cloth.

11) For cleaning the lens surface, use a cleaning brush to remove the dust, then use a clean lintless cotton cloth. Moisten it with alcohol (or mixture with ether) to wipe gently in a rotational motion from the center out.

12) Even if any abnormality occurs, never attempt to disassemble or lubricate the instrument yourself. Always consult with or your dealer.

13) To remove the dust on the case, never use thinner or benzine. Use a clean cloth moistened with neutral detergent.

14) Check each part of the tripod after extended use. Parts (screws or clamps) may work themselves free.

18 ERROR DISPLAYS

Error code	Description	Countermeasures
3 points required	When area calculating, there are less than 3 points coordinate data in selected file.	Confirm the file data and calculate again.
CALC ERROR	Calculation is impossible from the data input.	Confirm the input data.
E11	Any abnormality occurs with EDM (distance measuring system).	Repair is required.
Bad memory	Abnormality in internal memory system.	Repair is required.
FILE EXISTS	The same file name exists.	Use another file name.
FULL FILES	When making a file, 30 files already exist.	If necessary, send or delete files.
FAILED INITIALIZE	Initializing can not be done successful.	Confirm initializing data and try to initialize again.
LIMIT OVER	Limit of input data exceeded.	Input again.
MEMORY ERROR	Any abnormality occurs with internal memory.	Initialize the internal memory.
MEMORY POOR	Shortage of capacity of the internal memory.	Download data from internal memory to PC.
NO DATA	The data is not found in the search mode	Confirm the data and search again.
NO FILE	There is no file in internal memory.	If necessary, make files.
FILE NOT SELECTED	When using a file, no file is selected.	Confirm the file and select a file.
P1-P2 distance too short	When in point to line measurement, the horizontal distance between first point and second point is within 1m.	The horizontal distance between first point and second point must be more than 1m.
CIRCULAR ERROR	Known points and occupied point are on the same circle at the resection mode.	Take the different point.
PT# EXIST	Same new point name is already memorized in the memory.	Confirm the new point name and input again.
PT# DOES NOT EXIST	When you enter incorrect name or PT# does not exist in the internal memory.	Enter the correct name or enter point in the internal memory.
RANGE ERROR	When setting a new point, calculation is impossible from the measured data.	Measure again.
Tilt Over	Instrument tilts over more than 3 minutes.	Level the instrument properly.
E06	Abnormality in angle measuring system.	If this error code continues to display, repair is required.

● If error still persist after attempting to clear them, contact your local dealer or head office.

19 SPECIFICATIONS

Telescope

Aperture	: 45mm
Magnification	: 30×
Image	: Erect
Field of view	: 1°30'
Minimum focus	: 1.5m
Reticle illumination	: Provided

Distance measurement

Measuring range（in good atmospheric conditions）

Non- prism : 1000m
（Reflector: Kodak Gray Card, 90% reflective）

Single prism: 7.5 km

Accuracy :	Prism mode	±(2mm+2ppm·D)
	Non-prism mode	±(5mm+3ppm·D)

Minimum reading:

Fine measurement mode	: 1mm (0.005ft.)
Coarse measurement mode	: 10mm (0.02ft.) / 1mm (0.005ft.)
Tracking measurement mode	: 10mm (0.02ft.)

Measuring time

Fine measurement (repeat)	about 1.0sec (first time 2sec)
Coarse measurement (repeat):	about 0.7sec (first time 2sec.)
Tracking measurement:	about 0.3 sec (first time 1.5sec.)

Angle measurement

Minimum reading:	5″ /1″ (1mgon / 0.2mgon)
Standard deviation:	2"(0.6mgon)
Measuring time:	0.1sec

Tilt correction

Type :	Dual-Axis
Range of compensation :	±3′
Correction unit :	1″

Level sensitivity

Circular level: 8′/2mm
Plate level : 30″/2mm

Plummet

Red laser 1.5mm(Ins.H:1.5m)

Data management and transfer

Memory points 40000
Data transmission
RS-232C
Bluetooth
USB flash drive

Battery

Voltage: DC 7.2—7.4V
Capacity
Rechargeable batteries BDC25H 2.5AH
Working duration（20℃）:
Distance and angle measurement: 6 hours
Angle measurement only 20 hours

Rechargeable batteries BDC40L(optional) 3.2AH
Working duration（20℃）:
Distance and angle measurement: 8 hours
Angle measurement only 25 hours

Temperature range

Storage : -40℃～+60℃
Operating : -20℃～+55℃

Dimension 190X210X350mm

Weight 6.5kg