SOKKIA

SET3E
SET4E
SET5E
SET5ES

Electronic Total Station

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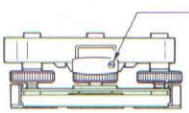
www.konnerlabrana.cl

OPERATOR'S MANUAL

IMPORTANT

- The battery has not been charged at the factory. Please charge the battery fully before using referring to P.127 "21. **POWER SUPPLIES**".



- When the new SET E is shipped, the tribrach clamp is fixed with a screw. Loosen it and leave it loose. And if the SET E is again shipped, fix the tribrach clamp with the screw to stop the tribrach becoming detached from the instrument.

How to switch the power on and off

Press any one of 5 keys to switch the power on

- **Press any one of 5 keys.**

While pressing ESC, press off to switch the power off

Hold down ESC,

While holding ESC, press off

- **If you hold down ESC, the display appears as at left. While holding ESC, press off.**

The power has been switched off.

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IMPORTANT

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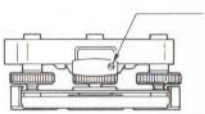

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While holding ESC, press off

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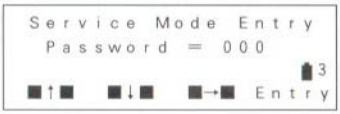
Note



ESC : To Basic mode

• If the display appears as at left for some reason, please press ESC. The instrument returns to Basic mode.
(Usually this mode is not used.)

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FEATURES

LARGE DISPLAY

- Measured data and messages are easy to see because they are displayed on a large display.

DUAL AXIS TILT SENSOR

- The vertical and horizontal angle value can be compensated. ☞ P.22
- The only vertical angle value can be compensated.

SOFT KEY IS USED

- All 4 function keys can be customized for your needs. ☞ P.118

RESUME FUNCTION

- The previous mode at power off is memorized for about 1 week. When the SET E is switched on, the previous mode is resumed. ☞ P.23

AVERAGE IS CALCULATED

- The average of horizontal angle can be calculated and displayed in the repetition mode. ☞ P.31
- The average of distance can be calculated and displayed in the average measurement mode. ☞ P.39

ADVANCED MEASUREMENT

- Resection measurement ☞ P.55
- Missing line measurement ☞ P.60
- Setting-out measurement ☞ P.64
- REM measurement ☞ P.73

COORDINATE DATA CAN BE STORED IN AN INTERNAL MEMORY

- 100 coordinate data can be stored in an internal memory for about 1 week and can be used as coordinates for the instrument station, backsight station, known station (for the resection measurement), and setting-out data. ☞ P.79

DATA OUTPUT

- The SET E RS-232C compatible data output connector is provided for use with a data collector or an external device.

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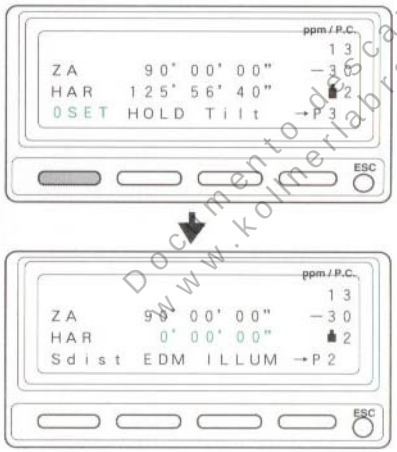
EXPLANATION OF SOFT KEYS

What is the "soft key"?

●One soft key has 2 or more functions and it is able to change its function into the other functions in the measurement mode.

How to use soft keys

●Each function name is displayed in the 4th line of the display. If you press the key under the required function name, the required function is performed. For example, if you press the number one left key at the following display, the horizontal angle display has been set to 0.



By pressing "→PX",

●By pressing the key under "→PX", the next page is displayed.

By pressing "ESC",

●"ESC" key is available in any mode. By pressing the "ESC" key, the mode is closed and display returns to Basic mode. By pressing and holding, the power off and illumination functions are displayed.

Allocating the functions for each key is allowed

●When SET E left the factory, the location of the functions for each key were set to defaults. Any function can be allocated in any page of any mode. To know which functions can be allocated and how to allocate, please refer to P.117 "**20. CHANGING LOCATIONS OF FUNCTIONS FOR KEYS**".

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HOW TO USE THIS MANUAL

- It is not definite where is a function displayed or on which mode and page a function is, because SET E allows to change the location of functions for each key.
  In this manual, the operations are mainly explained using the default location of the functions for keys.

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1. PRECAUTIONS

- **Never place the SET E directly on the ground.**
  Avoid damaging the tripod head and centring screw with sand or dust.
- **Do not aim the telescope at the sun.**
  Avoid damaging the LED of the EDM.
- **Protect the SET E with an umbrella** against direct sunlight, rain and humidity.
- **Never carry the SET E on the tripod to another site.**
- Handle the SET E with care. Avoid heavy shocks or vibration.
- When the operator leaves the SET E, the vinyl cover should be placed on the instrument.
- Always switch the power off before removing the standard battery.
- Remove the standard battery from the SET E before putting it in the carrying case.
- When the SET E is placed in the carrying case, follow the layout plan.
- Make sure that the SET E and the protective lining of the carrying case are dry before closing the case. The case is hermetically sealed and if moisture is trapped inside, damage to the instrument could occur.

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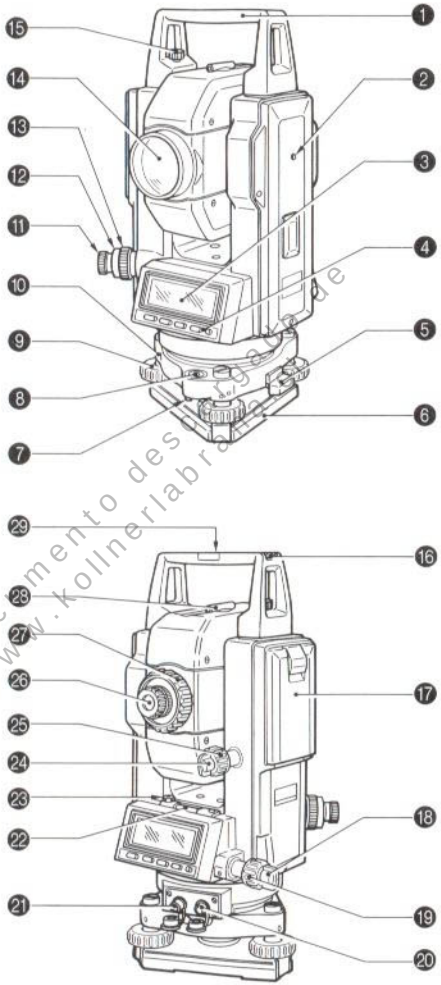
2. PARTS OF THE INSTRUMENT



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❶ Handle
❷ Instrument height mark
❸ Display
❹ Keyboard
❺ Tribrach clamp
❻ Base plate
❼ Circular level adjusting screws
❽ Circular level
❾ Levelling foot screw
❿ Tribrach
⓫ Optical plummet eyepiece
⓬ Optical plummet reticle adjusting cover
⓭ Optical plummet focussing ring
⓮ Objective lens
⓯ Handle securing screw

⓰ Tubular compass slot
⓱ Battery
⓲ Horizontal clamp
⓳ Horizontal fine motion screw *
⓴ Data output connector
㉑ External power source connector
㉒ Plate level
㉓ Plate level adjusting screw
㉔ Vertical clamp
㉕ Vertical fine motion screw *
㉖ Telescope eyepiece
㉗ Telescope focussing ring
㉘ Peep sight
㉙ Instrument centre mark

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*: The horizontal and vertical fine motion screws of SET3E have 2-speed (coarse and fine) motions. The motions is coarse when the screws feel heavy to rotate. The opposite turning direction gives a moveable fine motion "window".

3. DISPLAY SYMBOLS

ZA : Zenith angle (Z=0)
VA : Vertical angle (H=0) / Vertical angle (H=0±90)
: Slope in %
HAR : Horizontal angle right
HAL : Horizontal angle left
HAh : Horizontal angle hold
HARp: Horizontal angle repetition
dHA : Horizontal angle from setting-out data
X : Tilt angle in sighting direction
Y : Tilt angle in horizontal axis direction
⊥+ : Tilt angle compensation on

S : Slope distance
: Slope in % at Missing line measurement
H : Horizontal distance
V : Height difference
Ht. : REM value
_tk : Tracking measurement data
_-A : Average measurement data
Stn : Instrument station coordinates
P : Coordinate setting-out data
N : N coordinate data
E : E coordinate data
Z : Z coordinate data

<Remaining battery power> (BDC25, Temperature=25°C, EDM on)
3▮ : 90 to 100%
2▮ : 50 to 90%
1▮ : 10 to 50%
0▮ : 0 to 10%

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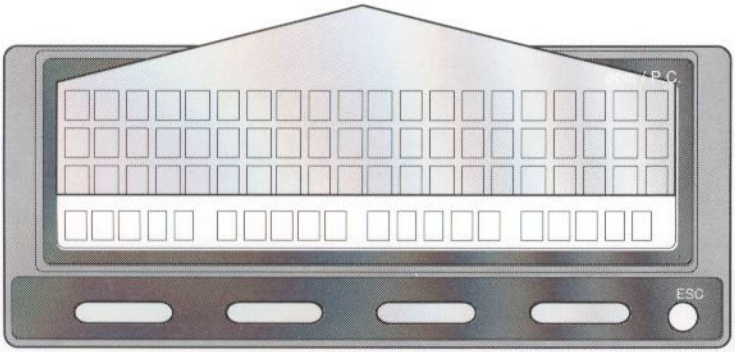

4. KEY FUNCTIONS

●There are the following functions. When SET E left the factory, the location of the functions for each key were set to default.

General

ESC : Transfer to Angle & Distance measurement mode

While holding ESC, ILLUM : Display and reticle illumination ON/OFF

While holding ESC, off : Switch the power off

THEO : Transfer to Theodolite mode

EDM : Transfer to EDM mode

S-O : Transfer to S-O mode

CONF : Transfer to Setting mode

→PX : Go to next page

--- : No function

ILLUM : Display and reticle illumination ON/OFF

Enter : Memorize the selected data

Exit : Exit from each mode

CE : Return to previous display

EDIT : Edit the data

Input : Change the displayed data

Clear : Set the data to 0

off : Switch the power off

↑ * : Move to previous option / Count up

↓ * : Move to next option / Count down

→ * : Move to right option / Go to the next column

1 : Select the number 1

2 : Select the number 2

3 : Select the number 3

* : When ↑, ↓ or → is hold down, its function is done successively.

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For Angle measurement

- **0SET** : Set Horizontal angle to 0 /Index V circle
- **HOLD** : Hold H angle / Release H angle
- **Tilt** : Display the tilt angle
- **REP** : Transfer to Repetition mode
  - **BS** : Finish No.1 point sighting
  - **FS** : Finish No.2 point sighting
- **ZA/%** * : Zenith angle / Slope in %
- **VA/%** * : Vertical angle / Slope in %
- **R/L** : Select Horizontal angle right / left

For Distance measurement

- **_dist** : Measure the distance
- **◢ SHV** : Select Distance mode
  (S=Slope / H=Horizontal / V=Height)
- **PPM** : Go to ppm setting mode
- **M/TRK** : Repeat or single meas. / Tracking meas.
- **SIGNL** : Return signal check
- **f / m** : Change metres / feet for 5 seconds
- **RCL** : Review the measured data in the memory

For Coordinate measurement

- **Stn_P** : Input Instrument station coordinates
- **Ht.** : Input Target & Instrument height
- **BSang** : Input Backsight station coordiantes and set Azimuth angle
- **COORD** : Measure 3-Dimensional coordinates
- **MEM** : Input / Delete / Review Coordinate data

*: "ZA/%" is displayed when parameter No.8 is set to"Zenith 0". "VA/%" is displayed when parameter No.8 is set to "Horizontal 0" or "Horizontal ±90°".

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For Advanced measurement

- **RESEC** : Go to Resection measurement mode
  - **Known** : Input Known point coordinates
  - **StnHt** : Input Instrument height
  - **Obs** : Start the observation of Known station
- **MLM** : Start Missing line measurement
  - **S/%** : Slope in % between 2 points
  - **Move** : Change the starting position
- **REM** : Start Remote elevation measurement
- **S-O_D** : Input Distance setting-out data
- **S-O_P** : Input Coordinates of point to be set out
- **SO_Xd** : Start Distance setting-out measurement
- **SO_HA** : Start H angle setting-out measurement

Note: After performing these function, the display returns to the 1st page of the previous mode and the H angle and V angle are displayed.

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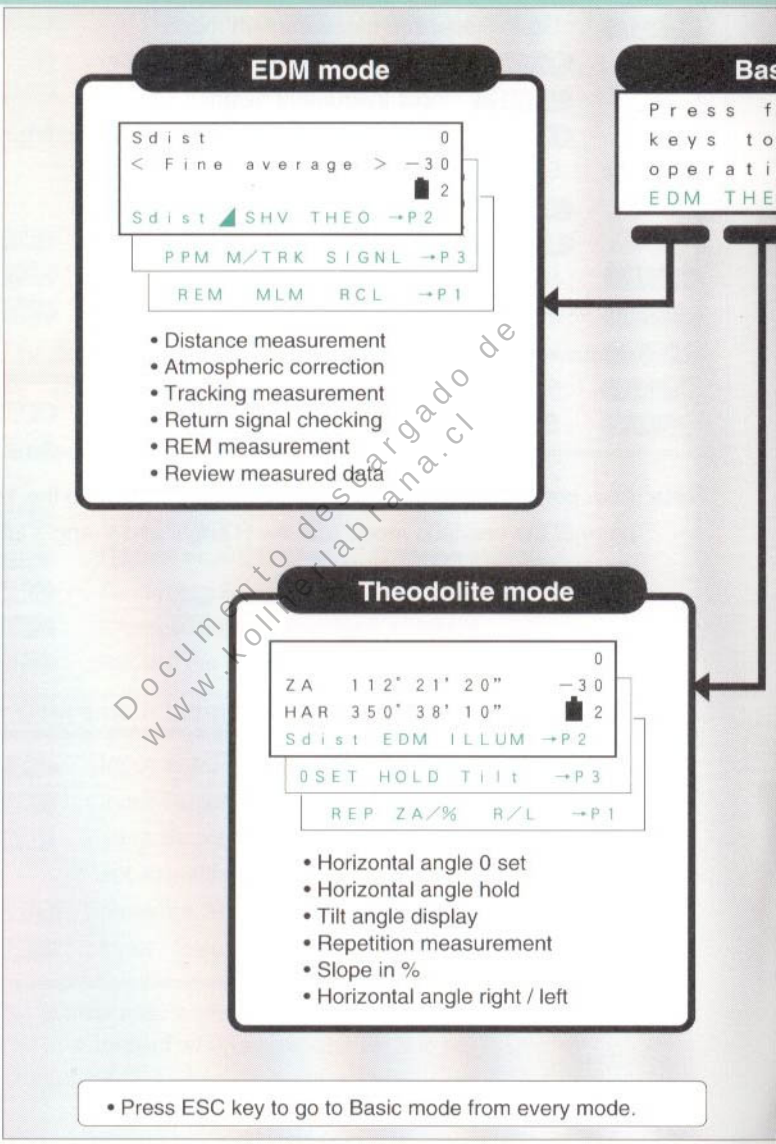
5. MODE DIAGRAM



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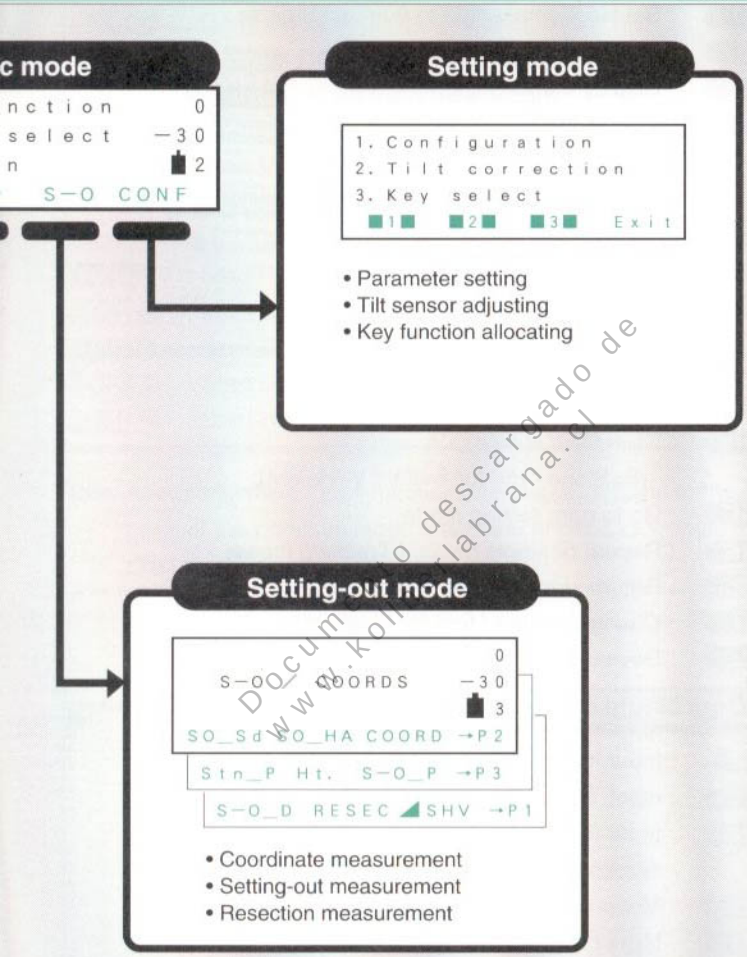

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• This location of the functions for keys is the default setting.

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[Note] Parallax ☞ 23

[Note] Power-saving cut-off ☞ 23

[Note] Levelling using the tilt angle display ☞ 24

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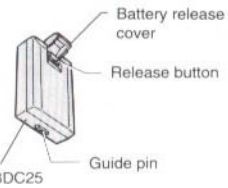
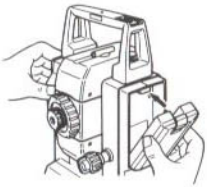
6. MOUNTING THE BATTERY

●Charge the battery fully before measurement. ☞ P.127

Note: Switch off the power before replacing the battery.

Mounting the battery





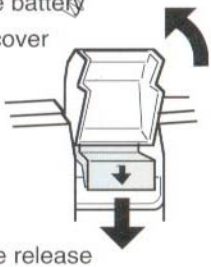
1) **Close the battery release button cover.**

2) **Match the battery guide with the hole in the instrument battery recess.**

3) **Press the top of the battery until a click is heard.**

Removing the battery

1) Open the battery release cover



2) Press the release button **downward**

1) **Open the battery release cover.**

2) **Press the release button downward.**

3) **Remove the battery.**

●If the power is to be switched on immediately after replacing the battery, please refer to P.16.

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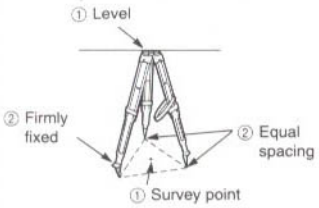
7. SETTING UP THE INSTRUMENT

●Mount the battery in the instrument before performing this operation, because the instrument will tilt slightly if the battery is mounted after levelling.

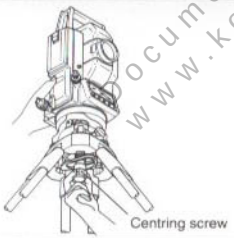
7.1 Centring

Set up the tripod



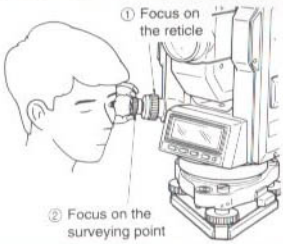
1) Make sure the legs are spaced at equal intervals and the head is approximately level.
2) Set the tripod so that the head is positioned over the surveying point.
3) Make sure the tripod shoes are firmly fixed in the ground.

Install the instrument



4) Place the instrument on the tripod head.
5) Supporting it with one hand, tighten the centring screw on the bottom of the unit to make sure it is secured to the tripod.

Focus on the surveying point



6) Looking through the optical plummet eyepiece ⓫, turn the optical plummet eyepiece to focus on the reticle.
7) Turn the optical plummet focussing ring ⓭ to focus on the surveying point.

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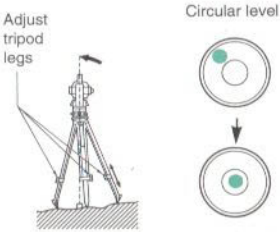
7.2 Levelling

Centre the surveying point in the reticle

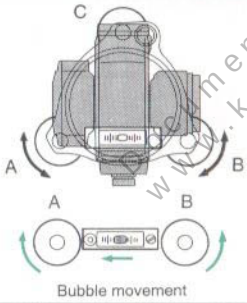
1) **Adjust the levelling foot screws ❾ to centre the surveying point in the optical plummet reticle.**

Centre the bubble in the circular level



2) **Observe the off-centre direction of the bubble in the circular level ❽, and shorten the nearest tripod leg, or extend the leg farthest from the direction to centre the bubble.**
3) **One more tripod leg must be adjusted to centre the bubble.**

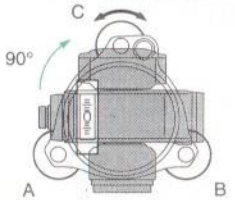
Centre the bubble in the plate level



4) **Loosen the horizontal clamp ⓲ to turn the upper part of the instrument until the plate level ㉒ is parallel to a line between levelling foot screws A and B.**
5) **Centre the air bubble, using levelling foot screws A and B.**

Note: The bubble moves towards a clockwise rotated levelling foot screw.

Turn 90° and centre the bubble



6) **Turn the upper part of the instrument though 90°.**
The plate level is now perpendicular to a line between levelling foot screws A and B.
7) **Centre the air bubble, using levelling foot screw C.**

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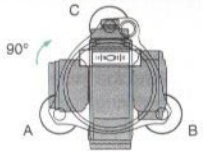
Turn another 90° and check bubble position



8) **Turn the upper part of the instrument a further 90° and check to see if the bubble is in the centre of the plate level.**

If the bubble is off-centre, perform the following:

① Adjust levelling foot screws A and B in equal and opposite directions, to remove half of the bubble displacement.

② Turn the upper part a further 90°, and use levelling foot screw C to remove half of the displacement in this direction.

Or try the adjustment described on P.89 "**18.1 Plate level**".

Check to see if bubble is in same position in any direction

9) **Turn the instrument and check to see if the air bubble is in the same position for any position of the upper part.**
If it is not, repeat the levelling procedure.

SET3E/SET4E/SET5E

10) **Loosen the centring screw slightly.**
11) **Looking through the optical plummet eyepiece, slide the instrument over the tripod head until the surveying point is exactly centred in the reticle.**
12) **Retighten the centring screw securely.**
13) **Check again to make sure the bubble in the plate level is centred. If not, repeat the procedures starting from step 4).**

SET5ES

10) **Turn the tribrach shifting clamp counterclockwise. SET5ES shifting tribrach can be adjusted up to ±8mm.**
11) **Looking through the optical plummet eyepiece, adjust the instrument position on the tribrach to centre the surveying point.**
12) **Tighten the shifting clamp to fix the instrument in the centre position.**

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8. POWER ON AND PREPARATION FOR MEASUREMENT

●The following preparations are required for measurement.

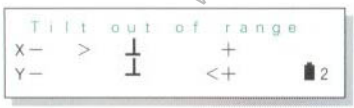
8.1 Power on
8.2 Indexing the vertical and horizontal circles
8.3 Focussing and target sighting
8.4 Display and reticle illumination
8.5 Setting the instrument options

8.1 Power on

Note: ● Power on

Press any one of 5 keys.
When the power is switched on, a self-check is run to make sure the instrument is operating normally. After that, the display indicates that the instrument is ready for vertical and horizontal circle indexing.

●To switch the power off, please refer to P. ii.



X: Tilt angle in the sighting direction
Y: Tilt angle in the horizontal axis direction

●If this error message is displayed, the instrument tilt sensor is indicating that the instrument is off-level.
Relevel the instrument once again until ⏸ is displayed.

<< Instrument parameter No.11 >> ☞ P. 107

●Parameter No.11 can be used to switch off and on the automatic tilt angle compensation; for example, it should be switched off if the display is unsteady due to vibration or strong wind.

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• "Tilt angle compensation" ☞ P.22 [Note] Automatic tilt angle compensation

●After power-off for more than 1 week, the previously stored data have been cleared from the short-term memory and the display appears as at left. After that the instrument is ready for vertical and horizontal circle indexing.

●When "V1" is displayed for the vertical angle, please refer to P.133 "**Appendix1: Manually indexing the vertical circle**".

●The parameter No.10 is set to "Manual", "0" is displayed for the horizontal angle.

●If the battery is at the "low" level, the message "Battery is low !" will be displayed. Switch the power off and charge the battery.

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<< Instrument parameter No.9 >> ☞ P. 107

●Parameter No.9 can change the vertical indexing method. Options are indexing by transitting the telescope or indexing by face left, face right sightings.

<< Instrument parameter No.10 >> ☞ P. 107

●Parameter No.10 can be used to change the horizontal circle indexing method. Options are indexing by rotating the upper part or indexing and zero setting at power-on.

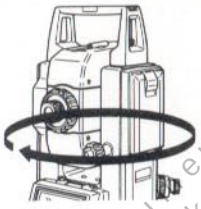
• "Horizontal angle back-up" ☞ P. 22 [Note] Horizontal angle back-up

8.2 Indexing the vertical and horizontal circles

Vertical circle indexing

1) **Loosen the vertical clamp ㉔ and transit the telescope completely.**
(Indexing occurs when the objective lens crosses the horizontal plane in face left.)
An audio tone sounds, and the vertical angle (ZA) is displayed.

Horizontal circle indexing



2) **Loosen the horizontal clamp ⑱ and rotate the upper part of the instrument completely.**
An audio tone sounds, and the horizontal angle (HAR) is displayed.

●Vertical indexing and horizontal indexing have been completed.

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Note: Each time the instrument is switched on, the vertical and horizontal indexes must be redetermined.

●If the parameter No.16 is set to "Resume function on", the previous mode at power off is displayed.

<< Instrument parameter No.16 >> ☞ **P.107**

●Parameter No.16 can be changed to "Resume function" off.

●If the measurement is performed, please refer to following pages.

9. ANGLE MEASUREMENT
10. DISTANCE MEASUREMENT
11. COORDINATE MEASUREMENT
12. RESECTION MEASUREMENT
13. MISSING LINE MEASUREMENT
14. SETTING-OUT MEASUREMENT
15. REM MEASUREMENT

• "Resume function" ☞ P. 23 [Note] Resume function

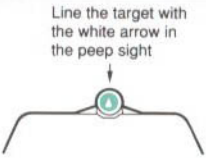
8.3 Focussing and target sighting

Focus on the reticle

1) **Look through the telescope eyepiece ㉖ at a bright and featureless background.**
2) **Turn the eyepiece clockwise, then counterclockwise little by little until just before the reticle image goes out of focus.**

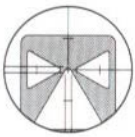
Using these procedures, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.

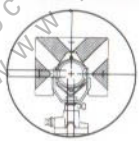
Sight the target



3) **Loosen the vertical ㉔ and horizontal ⑱ clamps, and use the peep sight ㉘ to bring the target into the field of view. Tighten both clamps.**

Focus on the target





4) **Turn the focussing ring ㉗ to focus on the target.**
5) **Turn the vertical ㉕ and horizontal ⑲ fine motion screws to align the target object with the reticle.**

The last adjustment of each fine motion screw should be in the clockwise direction.

Readjust the focus until there is no parallax

6) **Readjust the focus with the focussing ring ㉗ until there is no parallax between the target image and the reticle.**

Note: Observe to the same point of the reticle when the telescope face is changed.

• "There is no parallax" ☞ P. 23[Note] Parallax

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8.4 Display and reticle illumination

In every mode

●In every modes, press ILLUM while holding ESC to turn the display and reticle illumination on and off.

<< Instrument parameter No.13 >> ☞ **P. 107**

●Parameter No.13 can be used to switch ON/OFF the 30-second illumination automatic cut-off facility.

<< Instrument parameter No.12 >> ☞ **P. 107**

●Parameter No.12 can be used to change the brightness of the reticle illumination.

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To display ILLUM function

• The key function allocating allows to display ILLUM.

• Allocating ☞ P.118

8.5 Setting the Instrument options

- Confirm that these parameters, indispensable for measurement, are set according to your required measurement. Be sure to set the parameters of **No.1** and **No.2** to your required options.
- Data storage period: Until next changing (Power-off possible)
- To confirm or change the parameter options, please refer to P.107 "**19. CHANGING INSTRUMENT PARAMETERS**".

No.	Parameter	Options
1	Distance measurement mode	1. Fine and average (Repeat* / Average of 2 to 9 meas.) 2. Fine and single 3. Coarse and single
2	Prism constant correction value	–30mm* (–99 to 0mm, in 1mm steps)
3	Distance unit	1. metres* 2. feet
4	C+R correction	1. No correction* 2. Yes
6	Distance mode	1. Slope distance* 2. Horizontal distance 3. Height difference
7	Angle unit	1. degree* 2. gon 3. mil
8	Vertical angle format	1. Zenith angle (Zenith 0)* 2. Vertical angle (Horizontal 0) 3. Vertical angle (Horizontal ±90°)
11	Tilt correction	1. Horizontal and Vertical angle Yes* 2. Vertical angle Yes 3. No correction
17	Coordinate format	1. N, E, Z* 2. E, N, Z
18	Angle resolution	SET3E: 1. 1" / 0.2mgon / 0.005mil* 2. 5" / 1mgon / 0.02mil SET4E/5E: 1. 5" / 1mgon / 0.02mil* 2. 10" / 2mgon / 0.05mil
19	Temperature and Pressure unit	1. °C, hPa* 2. °C, mmHg 3. °F, hPa / °F, mmHg / °F, inchHg

*: Factory setting

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—[Note] Automatic tilt angle compensation

- When the compensation symbol is shown on the display, the vertical and horizontal angles are automatically compensated for small tilt errors using the 2-axis tilt sensor.
- Read the compensated angle after the displayed angle value becomes steady.
- The formula used for calculation of the compensation value applied to the horizontal angle uses the tilt and vertical angles as shown below:
  Compensated horizontal angle
  = Measured horizontal angle + Tilt in angle Y/ tan (vertical angle)
  Therefore, when SET E is not perfectly levelled, changing the vertical angle by rotating the telescope will cause the displayed horizontal angle value to change. (The displayed horizontal angle value will not change during telescope rotation when the instrument is correctly levelled.)
- When the measured vertical angles are within ±1° of the zenith or nadir, tilt compensation is not applied to the horizontal angle. In this situation, the displayed horizontal angle value flashes to show that the tilt compensation is not being applied.

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—[Note] Horizontal angle back-up

- The parameter No.10 default setting allows for the memorization of the previous horizontal 0 position at power-off for about 1 week. The horizontal left or right angle display selection is also memorized. When next switching on SET E and indexing horizontal circle again, the horizontal angle is recovered at the previously-memorized 0 position. This feature is when the battery voltage becomes low during measurement or after automatic power-off has occurred.

—[Note] Resume function

- "Resume function" means to return to or begin again after interruption. It means that the previous mode is recovered after switching on SET E and indexing vertical and horizontal circle.
- The resume function does not work after more than about 1 week (memory back-up period). In that case or when the resume function "no" is selected, SET E returns to Theodolite mode after switching on and indexing vertical and horizontal circle.

—[Note] Parallax

- This is the relative displacement of the target image with respect to the reticle when the observer's head is moved slightly before the eyepiece.
  Parallax will introduce reading errors and must be removed before observations are taken. Parallax can be removed by refocussing.

—[Note] Power-saving cut-off

- SET E switches off automatically 30 minutes after the last operation.

<< Instrument parameter No.14 >> ☞ **P. 107**

- Parameter No.14 can be changed so that the SET E will not switch off automatically after 30 minutes.

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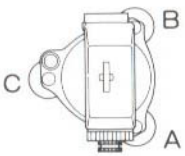
[Note] Levelling using the tilt angle display

●For levelling, the tilt angle X and Y values can be displayed for use as a 2-axis (X,Y) tilt sensor. The measurement range is ±3'.

Set the telescope parallel to a line between levelling foot screws A and B



1) Turn the upper part of the instrument until the telescope is parallel to a line between levelling foot screws A and B and tighten the horizontal fine motion screw ⑲.

From THEO mode to Tilt angle display mode

2nd page of THEO mode

```
                                  0
ZA      0° 01' 20"          -30
HAR     0° 00' 00"           ▮2
0SET  HOLD  Tilt          →P.3
```

```
HAR     0° 00' 00"
Tilt  X   0° 01' 20"
      Y  -0° 00' 40"        ▮2
```

2) In THEO mode, press Tilt.

The X and Y tilt angles are displayed.

Set both tilt angle to 0 referring to the tilt angle

X: Levelling foot screws A and B

Y: Levelling foot screw C

```
HAR     0° 00' 00"
Tilt  X   0° 00' 00"
      Y   0° 00' 00"        ▮2
                          Exit
```

3) Set both tilt angles to 0° by turning the levelling screws A and B for the X direction and C for the Y direction.

4) To exit from the tilt angle display, press Exit to return to the previous mode or press ESC to go to Basic mode.

```
Tilt out of range
X-   >   ⊥      +
Y-       ⊥     <+        ▮2
```

Note: "Tilt out of range" indicates that the tilt angle exceeds the ±3' measurement range.

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Measurement

9. ANGLE MEASUREMENT ☞ 27

9.1 Measure the horizontal angle between 2 points <H angle 0> ☞ 28

9.2 Set Horizontal circle to a required value <H angle hold> ☞ 29

9.3 Horizontal angle display selection <Right / left> ☞ 30

9.4 Horizontal angle repetition ☞ 31

9.5 Slope in % ☞ 33

10. DISTANCE MEASUREMENT ☞ 34

10.1 Atmospheric correction ☞ 35

10.2 Return signal checking ☞ 38

10.3 Distance and angle measurement ☞ 39

10.4 Tracking measurement ☞ 41

10.5 Review of measured data ☞ 42

11. COORDINATE MEASUREMENT ☞ 43

11.1 Target height and instrument height setting ☞ 44

11.2 Instrument station coordinates setting ☞ 46

11.3 Azimuth angle setting ☞ 47

11.4 3-Dimensional coordinate measurement ☞ 50

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9. ANGLE MEASUREMENT

●There are following functions for the angle measurement on SET E.

9.1 Measure the horizontal angle between 2 points <Horizontal angle 0>
9.2 Set Horizontal circle to a required value <H angle hold>
9.3 Horizontal angle display selection <Right / left>
9.4 Horizontal angle repetition
9.5 Slope in %

Check! before Angle measurement:

1. The SET E is set up correctly over the surveying point. ☞ P.13
2. The remaining battery power is adequate.
3. The V and H circles have been indexed. ☞ P.18
4. The instrument parameters have been set. ☞ P.21

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9.1 Measure the horizontal angle between 2 points <H angle 0>

●To measure the angle between 2 points, set the horizontal angle of the target direction.

Note: ●Horizontal angle 0 set

2nd page of THEO mode

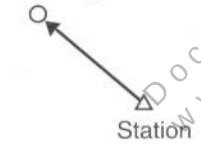
```
                    0
ZA   112° 21' 20"   −30
HAR  350° 38' 10"   ▮2
OSET HOLD Tilt      →P3
```

●In 2nd page of THEO mode

0SET

: Set H angle to zero

```
                    0
ZA   112° 21' 20"   −30
HAR    0° 00' 00"   ▮2
```



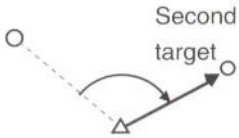
1) **Using horizontal clamp ⑱ and fine motion screw ⑲, sight the first point.**

0SET : Set H angle to zero

2) **In THEO mode, press 0SET .**

```
                    0
ZA   112° 21' 20"   −30
HAR    0° 00' 00"   ▮2
```

The horizontal angle display has been set to "0°".



3) **Sight the second target.**

The displayed horizontal angle is the angle between the 2 points.

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9.2 Set Horizontal circle to a required value <Horizontal angle hold>

● To set the horizontal circle of the target direction to a required value, set the horizontal angle to hold.

Note: ● **H angle hold / release**

2nd page of THEO mode

```
                                  0
ZA    112° 21' 20"            -30
HAR   350° 38' 10"            ▮2
0SET  HOLD  Tilt        →P3
```

2nd page of THEO mode

```
                                  0
ZA    112° 21' 20"            -30
HAh   350° 38' 10"            ▮2
0SET  HOLD  Tilt        →P3
```

● In 2nd page of THEO mode

HOLD : H angle hold

HOLD : H angle hold release

```
                                  0
ZA     80° 21' 20"            -30
HAR    60° 00' 20"            ▮2
```

1) **In THEO mode, use the horizontal clamp ⑱ and fine motion screw ⑲ to turn the theodolite until a required value is shown on the display.**

HOLD : H angle hold

```
                                  0
ZA     80° 21' 20"            -30
HAh    60° 00' 20"            ▮2
```

2) **Press HOLD.**

The horizontal angle is held.

Sight the reference target

HOLD : H angle hold release

3) **Sight the reference target and press HOLD again.** Here, the horizontal angle for target has been set to a required value.

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9.3 Horizontal angle display selection <Right / left>

Note: ● Horizontal angle right / left

3rd page of THEO mode

```
                    0
ZA   112° 21' 20"  −30
HAR   90° 00' 00"  ▮2
 REP  ZA/%  R/L  →P1
```

●In 3rd page of THEO mode

R/L : H angle left

3rd page of THEO mode

```
                    0
ZA   112° 21' 20"  −30
HAL  270° 00' 00"  ▮2
 REP  ZA/%  R/L  →P1
```

R/L : H angle right

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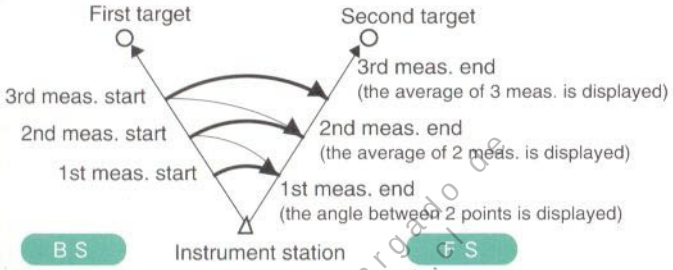
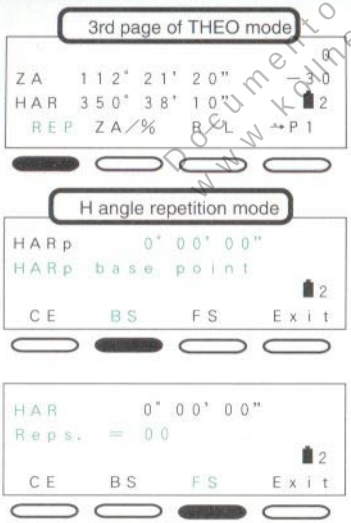
9.4 Horizontal angle repetition

●For higher accuracy horizontal angle measurement, the average of the horizontal angle can be measured by repetition. SET E can calculated and display the average of the horizontal angle.



Note: ●**Horizontal angle repetition**



●In 3rd page of THEO mode

●**Sight the first target**

REP
: For H angle repetition mode

BS
: Start 1st measurement

●**Sight the second target**

FS
: Display the angle between 2 points
(The angle of 2nd target is held.)

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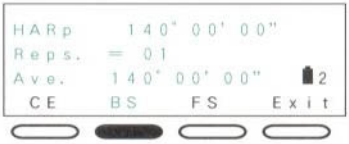
```
HARp     140° 00' 00"
Reps.  = 01
Ave.     140° 00' 00"   ▮2
 CE      BS      FS      Exit
```

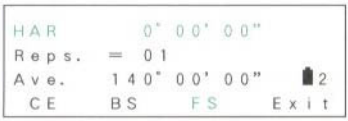


●Sight the first target again

BS

: Horizontal angle hold is released and second measurement begins

```
HAR        0° 00' 00"
Reps.  = 01
Ave.     140° 00' 00"   ▮2
 CE      BS      FS      Exit
```

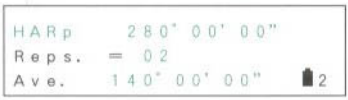


●Sight the second target again

FS

: Display the average of the 2 measurements at the 3rd line (The angle of 2nd target is held.)

```
HARp     280° 00' 00"
Reps.  = 02
Ave.     140° 00' 00"   ▮2
```



●To continue the measurement, repeat the above procedures marked with ⬚ .

```
 CE      BS      FS      Exit
```

Exit

: H angle repetition mode end

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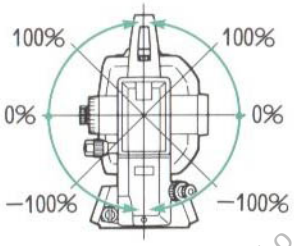
- In Repetition mode, the displayed horizontal angle is not corrected by the tilt sensor.
- When the data output is requested by an external device in H angle repetition mode, H angle from 0°, which is determined before selecting H angle repetition mode, is output. The average of measurements is not output.

- Measurement time: Up to 10 times
- Repetition display range: SET3E: ±3599° 59' 59"
  SET4E/5E: ±3599° 59' 55"
- To previous measurement: **CE** • Exit from the mode: **Exit**

9.5 Slope in %

●SET E can display the slope in %.



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Note: ● Slope in %

3rd page of THEO mode

```
ZA     90° 13' 50"
HAR     0° 00' 00"        1
 REP  ZA/%   R/L    →P1
```

●In 3rd page of THEO mode

ZA/% : Display Slope in %

3rd page of THEO mode

```
VA     −0.402 %
HAR     0° 00' 00"        2
 REP  ZA/%   R/L    →P1
```

ZA/%
: Display Vertical angle

- Display range: Less than ±1000%
- ZA/% is displayed when parameter No. 8 is set to "Zenith 0°".
  VA/% is displayed when parameter No. 8 is set to "Horizontal 0°" or "Horizontal ±90°".

10. DISTANCE MEASUREMENT

●The following preparations are required for Distance measurement.
10.1 Atmospheric correction
10.2 Return signal checking

●The distance is measured according to the parameter No.1 (the measurement mode) which you selected at P.21.
Refer to P.107 to change the measurement mode.

●When the data output is requested by an external device in Average measurement mode, the data are output the selected times.

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Change feet / metre

• The key function allocating allows to display **f / m**. Press **f / m** to change the distance unit for 5 seconds.

• Allocating ☞ P.118

10.1 Atmospheric correction

- The atmospheric correction is necessary for accurate distance measurement, because the velocity of light in air is affected by the temperature and atmospheric pressure.
  SET E is designed so that the correction factor is 0 ppm for a temperature of +15°C (+59°F) and an atmospheric pressure of 1013hPa (29.9 inchHg).

Note: To obtain the average refractive index of the air throughout the measured light path, you should use the average atmospheric pressure and temperature. Take care when calculating the correction factor in mountainous terrain.
Refer to P.134 "**Appendix 2**"

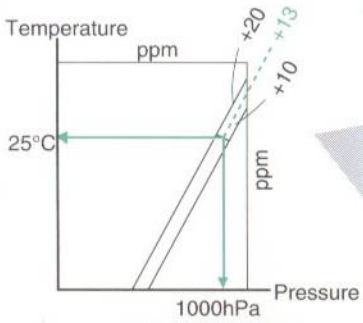
- By inputting the temperature and pressure values, the correction value is calculated and set into the memory. The formula used is as follows:

$$\text{ppm} = 278.96 \times \frac{0.2904 \times P\ (\text{hPa})}{1 + 0.003661 \times T\ (°\text{C})}$$

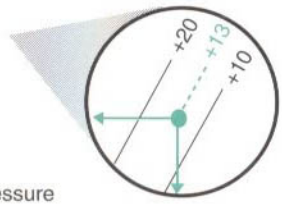
If the atmospheric correction is not required, set the ppm value to 0.

- To input ppm value, read the correction factor from the table on P.146 "**ATMOSPHERIC CORRECTION CHART**".

e.g. ● Temperature = 25°C and Pressure = 1000hPa



- **Read correction value from the table. The correction value is +13ppm.**



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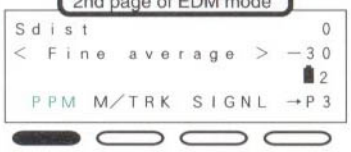
Note: ●ppm setting mode

2nd page of EDM mode

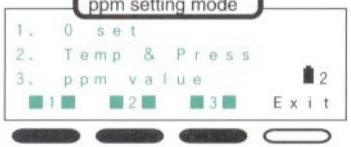


●In 2nd page of EDM mode

PPM

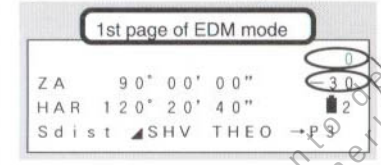
: For ppm setting mode

ppm setting mode



●Not to set the atmospheric correction value: ■1■
(return to EDM mode)

1st page of EDM mode

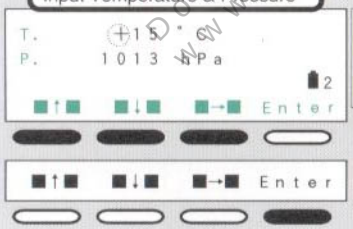


Atmospheric correction value

Prism constant correction value

●To input Temperature and Pressure: ■2■

Input Temperature & Pressure



- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input Temperature

Enter

: Set Temperature to Instrument

●Input Pressure in the same way (EDM mode)

- Temperature input range: −30 to 60°C
- Least input: 1°C
- Pressure input range: 500 to 1400hPa
- Least input: 1hPa
- Data storage period: About a week (Power-off possible)
- Exit from the mode: ESC (To Basic mode)

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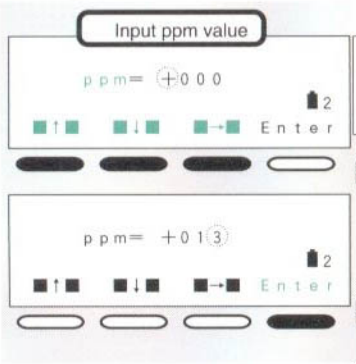
●To input the correction value: [3]



- Count up: [↑]
- Count down: [↓]
- Go to next column: [→]

Input the ppm value

Enter
: Set the ppm to Instrument (EDM mode)

- ppm input range: –499 to 499ppm
- ppm Least input: 1ppm
- Data storage period: About a week (Power-off possible)
- Exit from ppm mode: ESC (To Basic mode)

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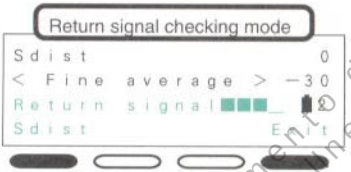
10.2 Return signal checking

●Especially for long distances, it is useful to check that the returned signal is adequate for measurement.

Note: ●**Return signal checking**

2nd page of EDM mode

Return signal checking mode



●In 2nd page of EDM mode

SIGNL
: For Return signal checking mode

"_____": No return signal
"■____": Adequate for measurement
"■■___": Adequate for measurement
"■■■__": Adequate for measurement
"___■": Return signal is too strong

Exit
: Finish Checking mode
or
_dist
: Start measurement

- When "_____" is displayed, Sight the reflecting prism centre again.
- When "____■" is displayed and if this display persists, please contact our agent.
- When the light intensity coming back from the reflecting prism is very high (short distance) the mark "■" is displayed, even for a slight mis-sighting. Therefore make sure that the target centre is sighted correctly.

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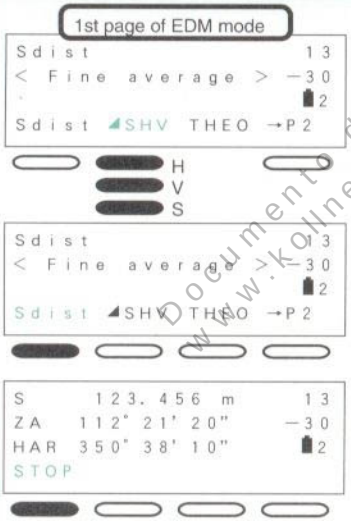
10.3 Distance and angle measurement

Check! before Distance measurement:

1. The SET E is set up correctly over the surveying point. ☞ P.13
2. The remaining battery power is adequate.
3. The V and H circles have been indexed. ☞ P.18
4. The instrument parameters have been set. ☞ P.21
5. The atmospheric correction is set. ☞ P.35
6. The centre of the target is correctly sighted.

Note: ●S/H/V selection and Distance meas.



●In 1st page of EDM mode

◢ SHV
: Select Slope distance / Horizontal distance / Height difference

_dist
: Start Distance measurement
The measured distance, vertical angle and horizontal angle are displayed.

STOP
: Stop measurement

- If the single measurement or the average measurement mode has been selected, the measurement stops automatically.
- Stop the measurement: **STOP**
- The distance and angle measured most recently are stored in memory. Pressing **◢ SHV** allows to display of Horizontal distance or Height difference.

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e.g. ●Measure the horizontal distance 3 times in the fine measurement mode, and display its average

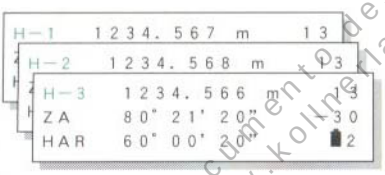
●Confirm the following:

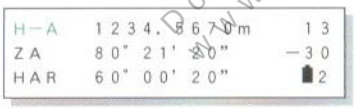
1) The parameter No.1 is set to "fine and average" and "3 times".
2) In EDM mode, "Horizontal distance" is selected by pressing ◢ SHV, or in THEO mode, Hdist is displayed.

Sight the target and start the measurement

Sight the target

Hdist : Start H distance





1) **Sight the target.**

2) **In the 1st page of EDM mode, press Hdist.**

"H dist" flashes and the distance measurement is started.

After that, the horizontal distance, the vertical angle and the horizontal angle are displayed. The distance is measured 3 times.

After 0.4 second, the average of 3 measurements if displayed in 0.1mm steps and the measurement is stopped.
H-A: Average of H distance

●In the case of the average measurement, the last-displayed horizontal distance is calculated by using the average of the selected times measurements of the slope distance and last-measured angle. The height difference is calculated by the same way.

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10.4 Tracking measurement

●Tracking measurement is used for distance measurement of non-high accuracy or for the distance measurement in a short time. Tracking is useful when the distance to a moving reflecting prism is measured, for example, when setting-out points.

●If Tracking is selected, the distance is measured independently of parameter No.1 setting.

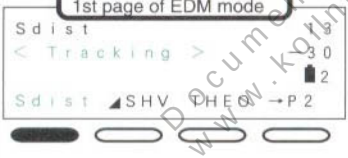
Note: ●Tracking measurement

2nd page of EDM mode

●In 2nd page of EDM mode

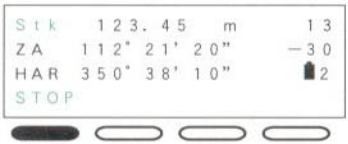
M/TRK
: Select Tracking measurement

1st page of EDM mode



●Sight the reflecting prism

_dist
: Start distance measurement



The measured distance, vertical and horizontal angle are displayed.

STOP
: Stop measurement

• To return to previous mode, press M/TRK again.

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10.5 Review of measured data

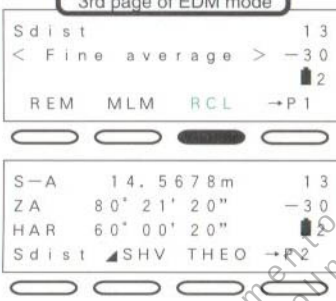
● The distance and angle measured most recently are stored in the memory until the power is switched off.

The stored slope distance, horizontal distance and height difference can be displayed in Recall mode as follows.

Note: ● **Data recall**

3rd page of EDM mode

```
Sdist                    13
< Fine average >        -30
                          ▮2
 REM   MLM   RCL   →P1
```



● In 3rd page of EDM mode

RCL: For Recall mode

```
S-A      14.5678m        13
ZA      80° 21' 20"     -30
HAR     60° 00' 20"       ▮2
Sdist ◢SHV THEO →P2
```

The stored data is displayed

ESC

ESC: End the recall mode (To Basic mode)

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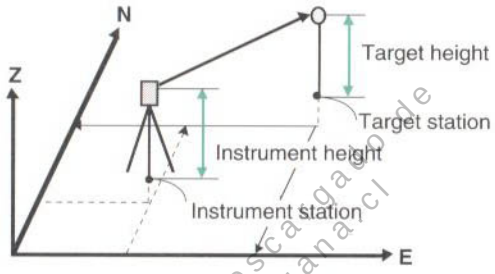
11. COORDINATE MEASUREMENT

●SET E calculates the 3-Dimensional coordinates of the prism position by inputting the instrument height, the target height and the instrument station coordinates and by measuring the slope distance, the horizontal angle and the vertical angle of the prism position.



●The following preparations are required for Coordinate measurement.

11.1 Instrument station coordiantes setting
11.2 Target height and Instrument height setting
11.3 Azimuth angle setting

●The distance is measured according to the parameter No.1 (the measurement mode) which you selected at P.21.
Refer to P.107 to change the measurement mode.

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4

Coordinate data inputting

• The key function allocating allows to display **MEM**. By using this function, SET E can store 100 coordinate data into the memory. The stored data can be used as instrument station coordinates and backsight station coordinates.

• Allocating ☞ P.118
• Operating ☞ P.79

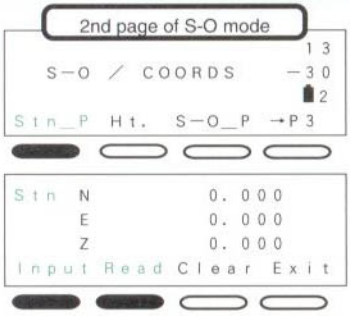
11.1 Instrument station coordinates setting

●The coordinates of the instrument station can be input into SET E.

Note: ●Instrument station coordinates setting

2nd page of S-O mode

```
                    13
S-O / COORDS        -30
                    ▮2
Stn_P Ht. S-O_P →P3
```



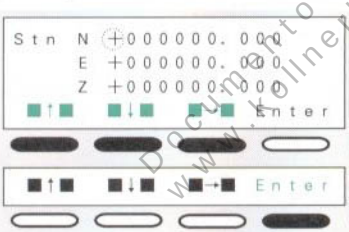
●In 2nd page of S-O mode

Stn_P
: For Instrument station coordinates setting mode

```
Stn N        0.000
    E        0.000
    Z        0.000
Input Read Clear Exit
```

●To input Instrument station coordinates: Input

```
Stn N +000000.000
    E +000000.000
    Z +000000.000
■↑■ ■↓■ ■→■ Enter
```



- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input N coordinate

■↑■ ■↓■ ■→■ Enter

Enter
: Set N coordinate

●Input E and Z coordinates in the same way (S-O mode)

- Input range: –999999.999 to 999999.999m
- Least input: 0.001m
- Retain the displayed value: Exit
- Set the value to 0: Clear
- Data storage period: About a week (Power-off possible)
- Exit from the mode: ESC (To Basic mode)

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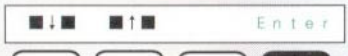
●To read Instrument station coordinates from memory: **Read**

```
Coord.  No. 12345678
            12345679
            12345680
■↓■   ■↑■        Enter
```

- Go to previous point No.: ■↑■
- Go to next point No.: ■↓■

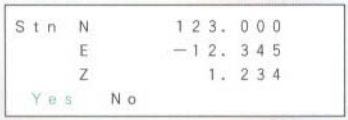
Display the required point number at the first line

```
■↓■   ■↑■        Enter
```



Enter
: Select the point number

```
Stn N      123.000
    E     -12.345
    Z       1.234
 Yes  No
```



Yes
: Set the displayed coordinates (S-O mode)

- When the point numbers are not displayed and the long beep sounds instead of pressing **Read**, there is no coordinate data in the memory. Press **Input** to input the coordinates directly or read again after inputting the coordinate data to the memory.

●If the Instrument station coordinate is not known, the "Resection measurement" can used to determine the instrument station coordinates. ☞ P.55

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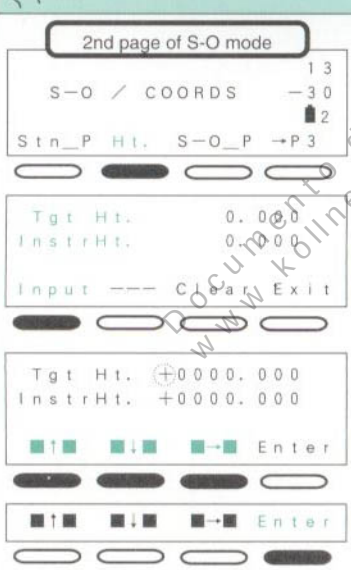
11.2 Target height and Instrument height setting

- In preparation for Coordinate measurement, the instrument height and target height should be input to SET E before the measurement.
  Target height: the height difference between the surveying point and the centre of the target
  Instrument height: the height difference between the surveying point and the instrument station height mark
- The heights of the instrument and target are measured manually beforehand, using a measuring tape, etc.

Note: ●Target height & Instr. height setting



●In 2nd page of S-O mode

Ht.
: For Target & Instrument height setting mode

Input
: For Target & Instr. height setting

- Count up: ■↑■
- Cout down: ■↓■
- Go to next column: ■→■

Input Target height

Enter: Set Target height

●Input Instr. height and set it in the same way (S-O mode)

- Input range: –9999.999 to 9999.999m
- Least input: 0.001m
- Retain the displayed value: **Exit**
- Set the value to 0: **Clear**
- Data storage period: About a week (Power-off possible)
- Exit from the mode: ESC (To Basic mode)

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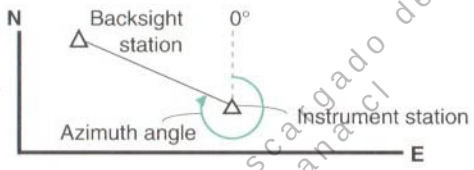
11.3 Azimuth angle setting

- Sight the backsight station and set the azimuth angle of it. This means the horizontal angle is set to zero in the N direction.
- With the SET E, the azimuth angle of the backsight can be automatically calculated from the input instrument station and backsight station coordiantes.
- To use the azimuth angle setting function, allocate BSang beforehand referring to P. 118 "**20.1 Key function allocating**".



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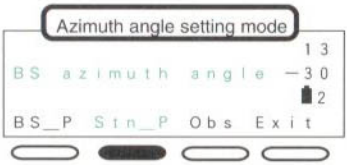
Note: ● Azimuth angle setting

- In any page of any mode

BSang

BSang
: For Azimuth angle setting mode



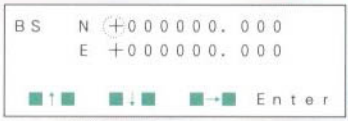
If setting Instrument station coordiantes ☞ P.46 (Azimuth angle setting mode)

BS_P
: For Backsight station coordinates inputting

```
BS   N          0. 000
     E          0. 000

Input Read Clear Exit
```

●To input the coordinates: **Input**

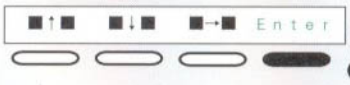
```
BS   N  +000000. 000
     E  +000000. 000

■↑■   ■↓■   ■→■   Enter
```



- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input N coordinate

```
■↑■   ■↓■   ■→■   Enter
```



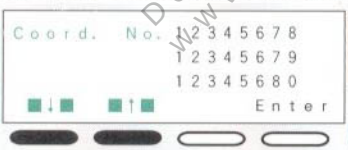
Enter : Set N coordinate

●Input E coordinate in the same way
(Azimuth angle setting mode)

- Input range: –9999.999 to 9999.999m
- Least input: 0.001m
- To previous display: **Exit**
- Set the value to 0: **Clear**
- Exit from the mode: ESC (To Basic mode)
- Data storage period: About a week (Power-off possible)

●To read the coordinate data from memory: **Read**

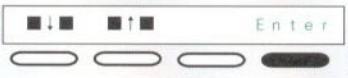
```
Coord.  No. 12345678
            12345679
            12345680
■↓■   ■↑■         Enter
```



- To previous point No.: ■↑■
- To next point No.: ■↓■

Display the required point number at the 1st line

```
■↓■   ■↑■         Enter
```



Enter
: Select the point number

```
BS   N        123. 000
     E        −12. 345

Yes   No
```

Yes
: Set the displayed coordinates
(Azimuth angle setting mode)

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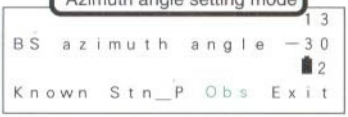
Azimuth angle setting mode



Backsight station

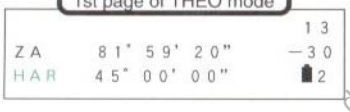
Instrument station

Obs
: Start the observation

●Sight Backsight station

Yes
: Calculate Azimuth angle (Previous mode)

1st page of THEO mode



HAR: Azimuth angle of Backsight station

• When the point numbers are not displayed and the long beep sounds in spite of pressing **Read**, there is no coordinate data in the memory. Press **Input** to input the coordinates directly or read again after inputting the coordinate data to the memory.

●When the instrument station coordinates is determined by the resection measurement, the azimuth angle of the second known station is set automatically. ☞ P.55

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11.4 3-Dimensional coordinate measurement

●The coordinates of the target are calculated using the following formulas and the results are then displayed. It is first necessary to input the instrument station coordinates, the instrument and target heights and to set the azimuth angle.

$N_1 = X_0 + S \times \sin \theta z \times \cos \theta h$
$E_1 = Y_0 + S \times \sin \theta z \times \cos \theta h$
$Z_1 = Z_0 + Mh + S \times \cos \theta z - Ph$

N_0: Instr. station N coordinate S: Slope distance Mh: Instr. height
E_0: Instr. station E coordinate θz: Zenith angle Ph: Target height
Z_0: Instr. station Z coordinate θh: Azimuth angle

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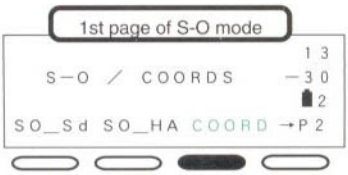
Check! before Coordinate measurement:

1. The SET E is set up correctly over the surveying point. ☞ P.13
2. The remaining battery power is adequate.
3. The V and H circles have been indexed. ☞ P.18
4. The instrument parameters have been set. ☞ P.21
5. The atmospheric correction is set. ☞ P.35
6. 11.1 to 11.3 have been performed. ☞ P.44

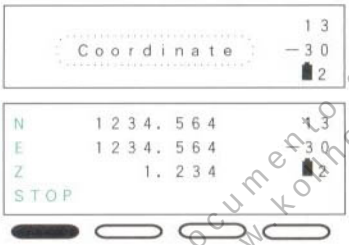
Note: ●Coordinate measurement

●Sight the target



●In 1st page of S-O mode

COORD
: Start Coordinate measurement



STOP
: Stop the measurement

• To measure the next target point, check the target height.

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Advanced measurement functions

12. RESECTION MEASUREMENT ☞ 55

13. MISSING LINE MEASUREMENT ☞ 60

13.1 Measuring the distance between 2 or more points ☞ 61

13.2 Changing of the starting position ☞ 63

14. SETTING-OUT MEASUREMENT ☞ 64

14.1 Horizontal angle and distance setting-out measurement ☞ 65

14.2 Coordinates setting-out measurement ☞ 69

15. REM MEASUREMENT ☞ 73

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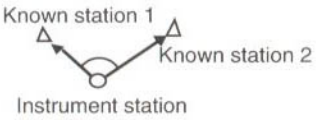
12. RESECTION MEASUREMENT

●The "Resection measurement" is used to determine the instrument station coordinates by observing 2 known stations.



●SET E can calculate the instrument station coordinates by observing 2 known stations. The azimuth angle of the second known station is automatically calculated and set to the instrument.

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5

Coordinate data inputting

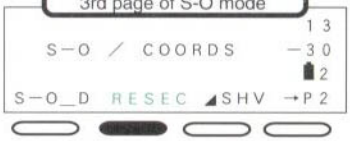
• The ken function allocating allows to display **MEM**. By using this function, SET E can store 100 coordinate data into the memory. The stored data can be used as known station coordinates.

• Allocating ☞ P.118
• Operating ☞ P.79

• Situation of every station ☞ P.59 [Note] Situation to be selected and avoided

Note: ●Resection measurement

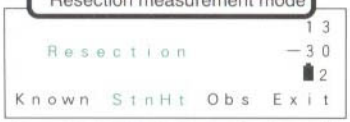
3rd page of S-O mode



●In 3rd page of S-O mode

RESEC
: For Resection measurement mode

Resection measurement mode



If setting Instr. height ☞ P.44 (Resection meas. mode)

Known
: For Known station coordinates and Target heights entering

●To input Known station coordinates: **Input**

- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input the 1st Known station coordinates

Enter
: Set Known station coordinates (Target height input mode)

- Coordinate input range: –999999.999 to 999999.999m
- Least input: 0.001m
- Data storage period: About a week (Power-off possible)

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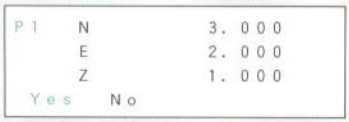
●To read Known station coordinates from memory: **Read**

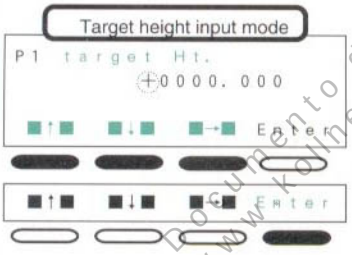
- To previous point No.: ■↑■
- To next point No.: ■↓■

Display the required point number at the first line

Enter
: Select the point number



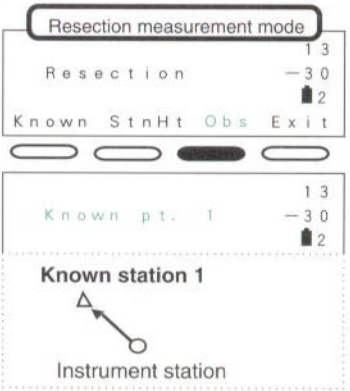
Yes
: Set the displayed coordinates (Target height input mode)



Input the 1st Target height

Enter : Set Target height

●**Set the 2nd Known station coordinates and Target height**
(Resection meas. mode)



Obs
: Start the observations

●**Sight the 1st Target**

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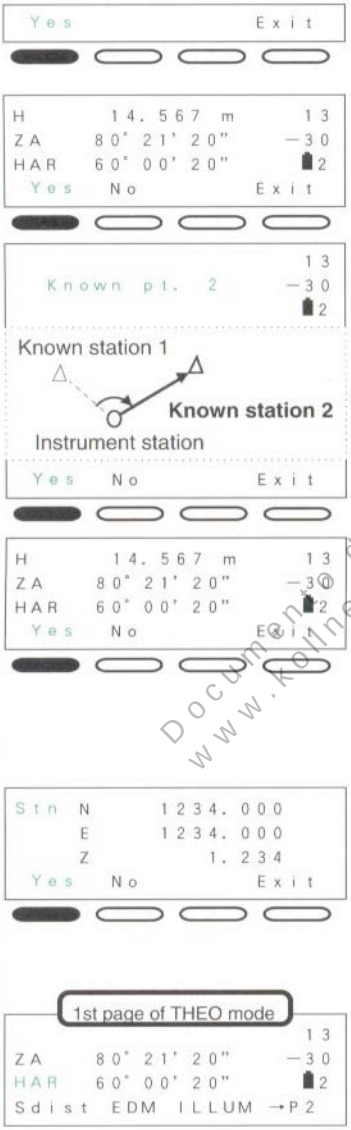

Yes

: Start the measurement
(If Repeat measurement mode has been selected, stop the measurement)

Yes

: Memorize the measured data

● **Sight the 2nd Target**

Yes

: Start the measurement

Yes

: Memorize the measured data
Instrument station coordinates are calculated and displayed

Note: Keep on sighting the 2nd target until the azimuth is displayed.

Yes

: The calculated coordinates are set to the instrument

Instrument turns to THEO mode and the azimuth to 2nd known station is calculated and displayed

HAR: Azimuth to 2nd known station

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- The Z coordinate can be calculated by inputting the Z coordinates of the 2 known stations.
- To check the accuracy of the calculated instrument station coordinates, set the target height of 2nd known station and measure the coordinates. Then compare the measured coordinates with the last-input ones.

- Target height input range: –9999.999 to 9999.999m • Least input: 0.001m
- Exit from Resection measurement mode: **Exit** (To S-O mode)
- Restart the observation: **No**

[Note] Situation to be selected and avoided

●The instrument station coordinates may not be calculated correctly in the following situations:

1) The instrument station and known station are in a straight line or
2) The angle between the 2 known stations is too narrow

This can occur when the distances between the instrument station and the known stations are too long.

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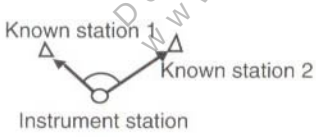
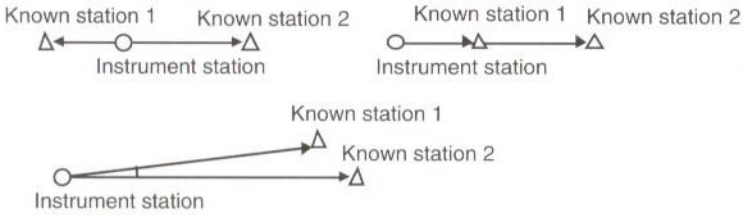
• To be selected

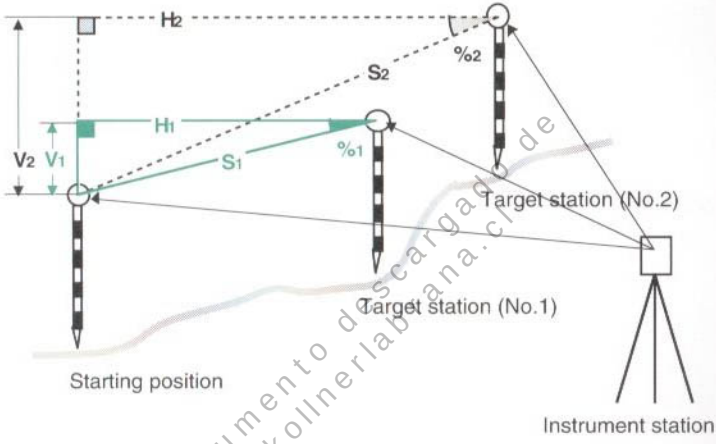


• To be avoided



13. MISSING LINE MEASUREMENT

●The missing line measurement is used to measure the slope, horizontal distances and height difference between the starting position (P1) and any other points without moving the instrument itself.



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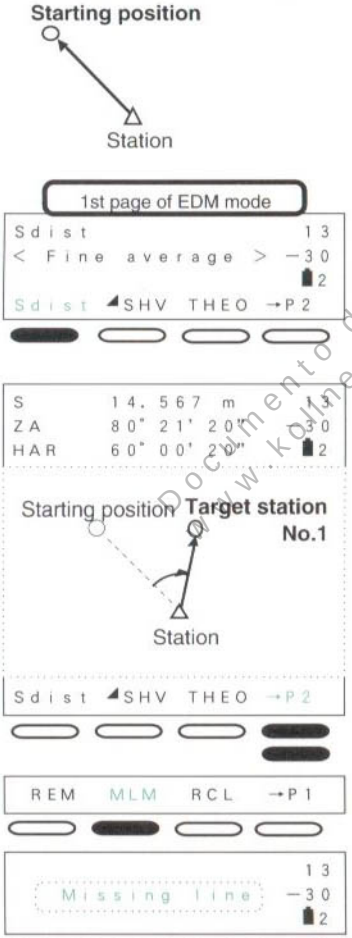
●To measure the distances between the surveying points, set the reflecting prism on a fixed height object, such as a pole.

●The distance is measured according to the parameter No.1 (the measurement mode) which you selected at P.21.
Refer to P.107 to change the measurement mode.

13.1 Measuring the distance between 2 or more points

●SET E can measure the distances to many points consecutively.

Note: ●**Missing line measurement**



●**Sight the reflecting prism on the starting position**

●In 1st page of EDM mode

Sdist , Hdist or Vdist

: Start Distance measurement (Stop the measurement)

●**Sight the reflecting prism on the No.1 point**

→PX →PX

: Go to 3rd page

MLM

: Start Missing line measurement

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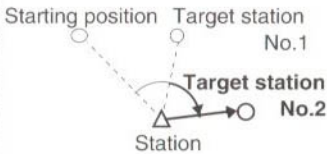
```
S        14.567 m      13
H        20.757 m     -30
V         1.012 m      2
STOP            S/%  Exit
```

STOP
: Stop the measurement

```
S        14.567 m      13
H        20.757 m     -30
V         1.012 m      2
```




```
MLM  Move    S/%  Exit
```

Slope distance, Horizontal distance and Height difference between 2 point is displayed
S: Slope distance
H: Horizontal distance
V: Height difference

● **Sight the reflecting prism on the No.2 point**

MLM
: Start Missing line measurement

- Repeat the above procedures to start the next missing line measurement
- Exit from the missing line mode: **Exit** (To EDM mode)

●SET E can display the slope between 2 points in %.

Note: ●Slope in % between 2 points

```
S        14.567 m      13
H        20.757 m     -30
V         1.012 m      2
 MLM  Move    S/%  Exit
```

●Missing line measurement has finished

S/% : Display Slope in %

```
S        48.755 %      13
H        20.757 m     -30
V         1.012 m      2
```

- Press **S/%** again the slope distance is displayed
- Display range: Less than ±1000% (Horizontal = 0%)

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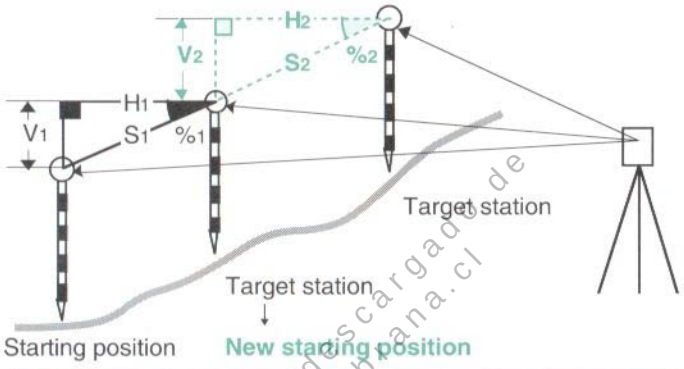
13.2 Changing of the starting position

●The last measured target station can be changed to become the next starting position.



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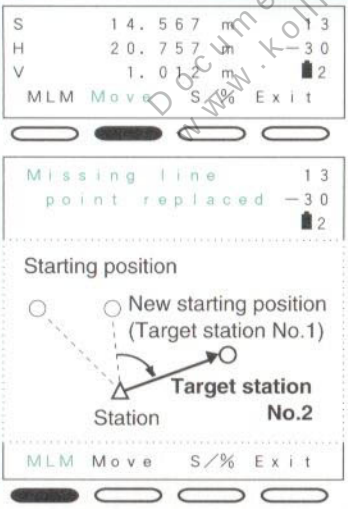
Note: ●Changing of the starting position



●Missing line measurement has finished

Move
: Change the starting position

The data for the last target station is set as the data for the new starting position

●To continue Missing line measurement from the new starting position to the next target stations, sight each target station and press **MLM**

14. SETTING-OUT MEASUREMENT

●The Setting-out measurement is used to set out the required point. The difference between the previously input data to the instrument (the setting-out data) and the measured value can be displayed by measuring the horizontal angle, distance or coordinates of the sighted point.

Displayed value
= Difference between measured value and setting-out data

●The distance is measured according to the parameter No.1 (the measurement mode) which you selected at P.21 or Tracking measurement mode selection.

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5

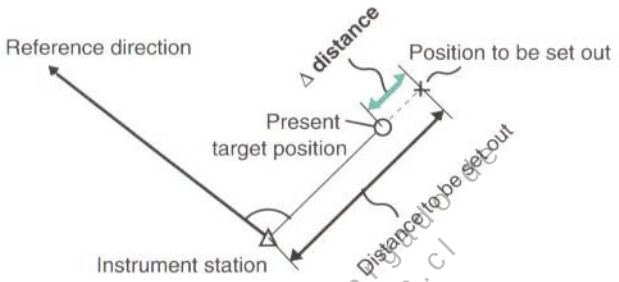
Coordinate data inputting

• The key function allocating allows to display **MEM**. By using this function, SET E can store 100 coordinate data into the memory. The stored data can be used as setting-out data.

• Allocating ☞ P.118
• Operating ☞ P.79

14.1 Distance setting-out measurement

●This measurement is used to set out the point from a reference direction and a certain distance away from the instrument station.



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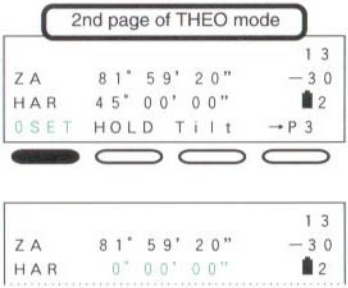
Note: ●Distance setting-out measurement

Reference direction

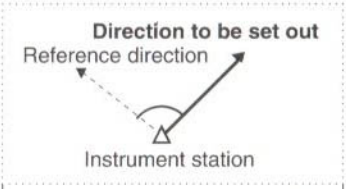
●Sight the reference direction

2nd page of THEO mode



●In 2nd page of THEO mode

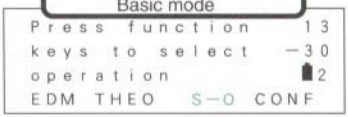
OSET
: Set Horizontal angle to 0



● **Turn the theodolite until a required angle is shown on the display**

ESC esc : Go to Basic mode

Basic mode



S-O : Go to S-O mode

1st page of S-O mode

→PX →PX : Go to 3rd page

S-O_D : For Distance S-O data setting mode

Distance S-O data setting mode

Input : For Distance S-O data setting

- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input Distance S-O data

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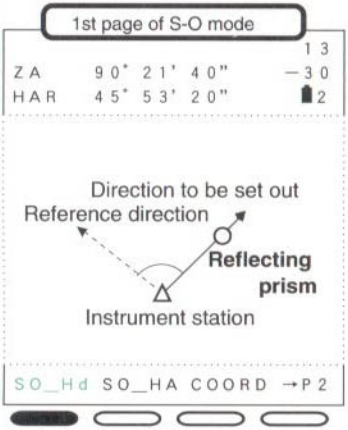
Enter

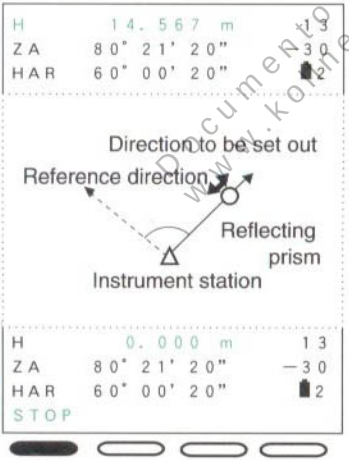
: Set Distance S-O data to Instr. (1st page of S-O mode)



- **Set the reflecting prism on the sighting line and sight it correctly**
- If necessary, press ◢ SHV to select H distance mode or press MTRK to select the Tracking measurement mode.

SO_Hd

: Start Distance S-O meas.



The difference between the setting-out data and the measured distance is displayed at the 1st line

- **Move the reflecting prism towards or away from Instrument until H distance becomes 0m to determine the point**
  – data: Move away from Instr.
  + data: Move towards Instr.

STOP

: Stop the measurement (1st page of S-O mode)

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- It is possible to set out a slope distance, horizontal distance, height difference value after setting the required value.
- When the Repeat measurement or the Tracking measurement is selected, sighting the moving reflecting prism again changes the distance without key operation.

- Retain the displayed value: **Exit** (To 1st page of S-O mode)
- Set the value to 0: **Clear**
- Input range: –9999.999 to 9999.999m
- Least input: 0.001m
- Data storage period: About a week (Power-off possible)

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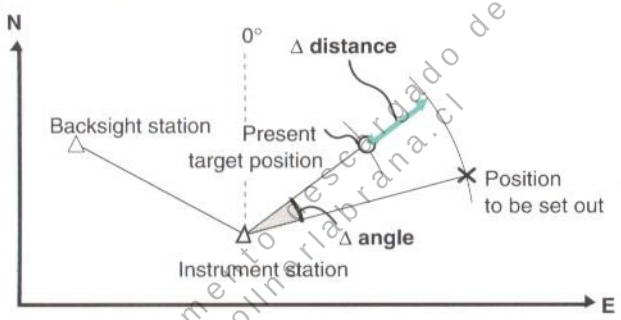
14.2 Coordinates setting-out measurement

- This measurement is used to set out the point of a certain coordinate away from the reference point (the instrument station).

- After setting of the coordinates for the point to be set out, SET E calculates the setting-out horizontal angle and horizontal distance and stores the values in the memory. By selecting the horizontal angle and then the horizontal distance setting-out functions, the required coordinate location can be set out.



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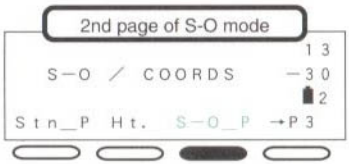
Note: ◎ Coordinates setting-out measurement

- Instrument station coordinates setting and Azimuth angle setting must be completed before measurement



- In 2nd page of S-O mode

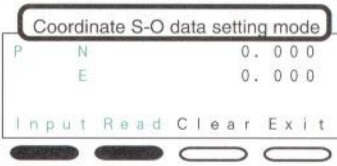
S-O_P
: For Coordinate S-O data setting mode

5

Coordinate S-O data setting mode

```
P    N          0. 000
     E          0. 000

Input Read Clear Exit
```

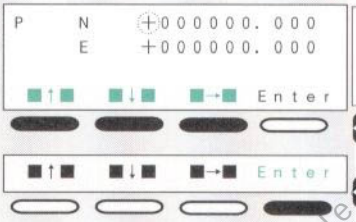


- Retain the displayed value: **Exit** (To 1st page of S-O mode)
- Set the values to 0: **Clear**

●To input S-O coordinates: **Input**

```
P    N    +000000. 000
     E    +000000. 000

■↑■  ■↓■  ■→■  Enter
```



- Count up: ■↑■
- Count down: ■↓■
- Go to next column: ■→■

Input Coordinate S-O data

```
■↑■  ■↓■  ■→■  Enter
```

Enter

: Set Coordinate S-O data to Instrument

The setting-out horizontal distance data and horizontal angle data are calculated and the values are stored in the memory
(1st page of S-O mode)

- Input range: –999999.999 to 999999.999m
- Least input: 0.001m

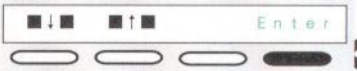
●To read S-O coordinates from memory: **Read**

```
Coord.  No. 12345678
            12345679
            12345680
■↓■  ■↑■        Enter
```

- To previous point No.: ■↑■
- To next point No.: ■↓■

Display the required point number at the first line

```
■↓■  ■↑■        Enter
```



Enter

: Select the point number

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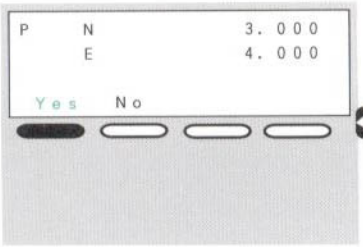
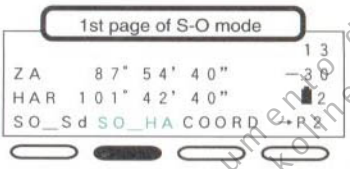


Yes

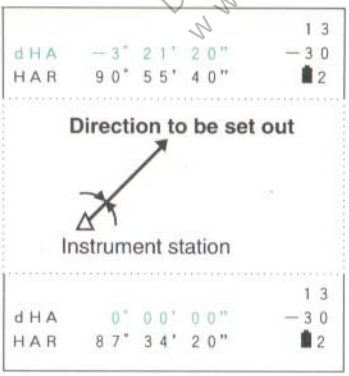
: Set the displayed coordinates
The setting-out horizontal distance data and horizontal angle data are calculated and the values are stored in the memory
(1st page of S-O mode)

- When the point numbers are not displayed and the long beep sounds in spite of pressing **Read**, there is no coordinated data in the memory. Press **Input** to input the coordinates directly or read again after inputting the coordinate data to the memory.



SO_HA

: Start H angle S-O measurement
The horizontal angle "dHA" from setting-out data to the sighted direction is displayed



● Use the horizontal clamp and fine motion screw to turn the theodolite until the "dHA" value becomes 0° 00' 00"

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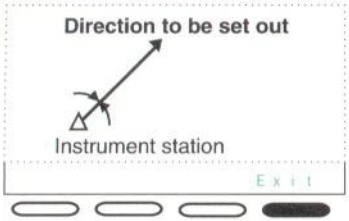
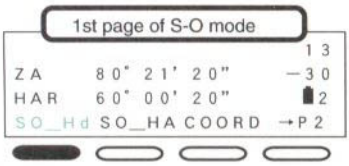


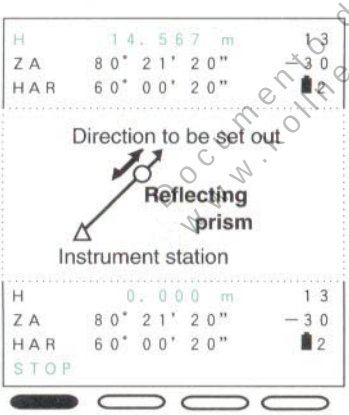
● **Set the reflecting prism on the sighting line and sight it correctly**

Exit
: Stop H angle S-O meas.



● If necessary, press ◢ SHV to select H distance mode or press M/TRK to select the Tracking measurement mode.

SO_Hd
: Start Distance S-O meas.



The difference between the setting-out data and the measured distance is displayed at the 1st line

● **Move the reflecting prism towards or away from the instrument until Horizontal distance becomes 0m to determine the point**
– data: Move away from Instr.
+ data: Move towards Instr.

STOP
: Stop the measurement (1st page of S-O mode)

• To know Distance S-O data, press S-O_D before Distance S-O measurement. After that, press Exit to return to the previous mode.

• Data storage period: About a week (Power-off possible)

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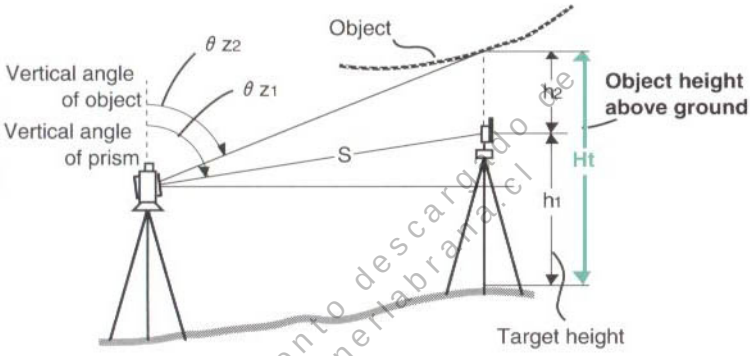
15. REM MEASUREMENT

- When measuring the height of certain objects such as overhead power cables or bridge supports where the reflecting prism cannot usually be positioned, the Remote Elevation Measurement function can be used to calculate the height above the ground using a point directly above or below the object.



- The height of the target is calculated using the following formulas.

$$Ht = h_1 + h_2$$

$$h_2 = S \sin \theta z_1 \times \cot \theta z_2 - S \cos \theta z_1$$

- The measured values of SET3E and SET4E are first displayed after 0.7 seconds and then every 0.5 seconds for all measurement modes. The measured values of SET5E are displayed every 0.3 second for all measurement modes.

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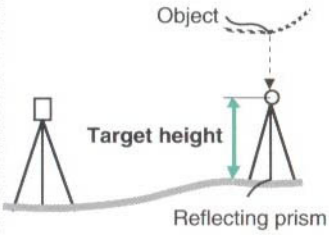
Note: ● Remote elevation measurement



● **Set up the reflecting prism above or below object and measure Target height**

2nd page of S-O mode

```
                    13
S—O / COORDS       —30
                    ▮2
Stn_P Ht. S—O_P →P3
```

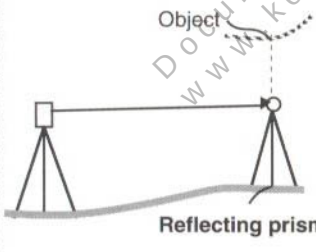
● In 2nd page of S-O mode

● Set the target height ☞ P.44

1st page of S-O mode

```
                    13
ZA    91° 57' 20"  —30
HAR   60° 03' 00"  ▮2
```

● **Sight the reflecting prism**




```
SO_Sd SO_HA COORD →P2
```

ESC ● ESC : Go to Basic mode

Basic mode

```
Press function     13
keys to select    —30
operation          ▮2
EDM THEO S—O CONF
```

EDM : Go to EDM mode

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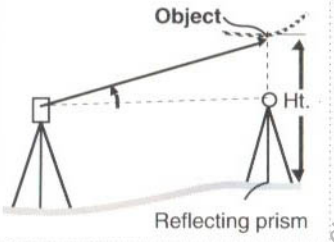
1st page of EDM mode

```
Sdist                    13
< Fine average >        -30
                          2
Sdist ◢SHV THEO →P2
```

Sdist, Hdist or Vdist
: Start Distance measurement
(Stop the measurement)

```
S        12.345 m        13
ZA    80° 21' 20"       -30
HAR   60° 00' 20"         2
```



● **Sight the object**

```
Sdist ◢SHV THEO →P2
```

→PX →PX
: Go to 3rd page

```
REM   MLM   RCL   →P1
```

REM : Start REM

The object height is displayed at the first line

```
Ht.      4.567 m        13
ZA    65° 30' 20"       -30
HAR   60° 00' 20"         2
STOP
```

STOP : Stop REM

• The maximum vertical angle: ±89° from the horizontal line
(Measuring value limit (Ht.): ±9999.999m)

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Using the coordinate data memory function

16. COORDINATE DATA MEMORY FUNCTION ☞ 79

16.1 Coordinate data input / deleting ☞ 80

16.2 Reviewing the coordinate data stored in the memory ☞ 83

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16. COORDINATE DATA MEMORY FUNCTION

●SET E can store coordinate data into the memory.
The coordinate data can be used as instrument station coordinates, backsight station coordinates, known point coordinates, and setting-out coordinates.

●To use this function, allocate MEM beforehand referring to P.118.

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16.1 Coordinate data input / deleting

●To input the coordinate data into the memory or delete the coordinate data in the memory, perform the following procedures.

Note: ●Coordinate data input

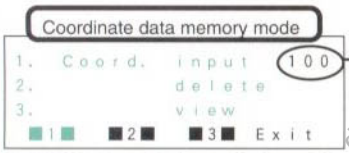
●In any page of any mode

MEM

MEM
: For Coordinate data memory mode

Coordinate data memory mode

```
1.  Coord.  input  100
2.          delete
3.          view
■1■   ■2■   ■3■   Exit
```

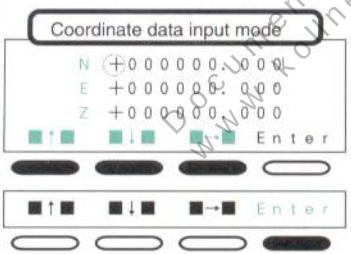


The space available for input of coordinate data

1
: For Coordinate data input mode

Coordinate data input mode

```
N +000000.000
E +000000.000
Z +000000.000
■↑■   ■↓■   ■→■   Enter
```



- Count up: ↑
- Count down: ↓
- Go to next column: →

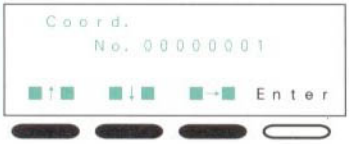
Input N coordinate data

```
■↑■   ■↓■   ■→■   Enter
```

Enter
: Set N coordinate data

●Input E and Z coordinate data in the same way

```
Coord.
No. 00000001
■↑■   ■↓■   ■→■   Enter
```



The previously input number +1 is displayed

Input the point number

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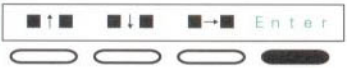


Enter
: Set the point number
(Coordinate data memory mode)

- Up to 100 points of coordinate data can be input
- Coordinate data input range: –999999.999 to 999999.999m
- Coordinate data least input: 0.001m
- Point number input range: 1 to 99999999
- Data storage period: About a week (Power-off possible)
- Exit from the input: ESC (To Basic mode)

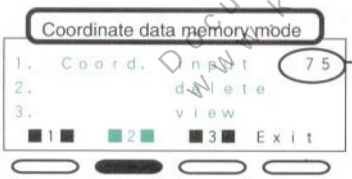
Note: ●Coordinate data deleting

●In any page of any mode

MEM

MEM
: For Coordinate data memory mode

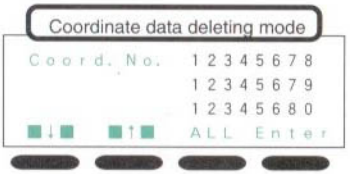
Coordinate data memory mode



The space available for input of coordinate data

2
: For Coordinate data deleting mode

Coordinate data deleting mode



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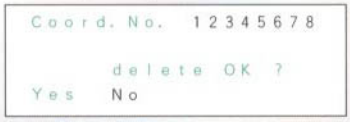
●To delete all data: ALL

```
ALL Coord. data

      delete OK ?
Yes   No
```

Yes : Delete all data
(Coordinate data memory mode)

●To delete a required data, press ↑ or ↓ to display the required point number at the first line and press Enter

```
Coord. No.  12345678

      delete OK ?
Yes   No
```



Yes
: Delete the displayed coordinate data
(Coordinate data memory mode)

• When the long beep sounds instead of selecting the "2. Coord. delete", there is no data in the memory and the display does not change. (Coordinate data me is still displayed)

•Exit from the mode: ESC (To Basic mode)

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16.2 Reviewing the coordinate data stored in the memory

●SET E can display the coordinate data stored in the memory.

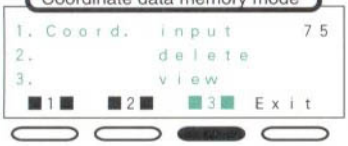
Note: ●Reviewing coordinate data

●In any page of any mode

MEM

Coordinate data memory mode

```
1. Coord.   input      75
2.          delete
3.          view
 ■1■   ■2■   ■3■   Exit
```

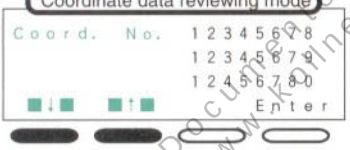


MEM : For Coordinate data memory mode

3 : For Coordinate data reviewing mode

Coordinate data reviewing mode

```
Coord.  No.   12345678
              12345679
              12456780
 ■↓■   ■↑■        Enter
```



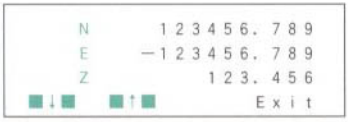
- Go to previous point No.: ■↑■
- Go to next point no.: ■↓■

Display the required point number at the first line

```
 ■↓■   ■↑■        Enter
```

Enter : Select the point number

```
N      123456.789
E     -123456.789
Z         123.456
 ■↓■   ■↑■        Exit
```



- Go to previous point data: ■↑■
- Go to next point datra: ■↓■

Display the required coordinate data

```
 ■↓■   ■↑■        Exit
```

Exit : End (Coordinate data memory mode)

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Troubleshooting

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17. ERROR MESSAGES

- If the following error messages are shown during measurement, see the table below.
- If the same error message is repeated or if other messages are shown, please contact your Sokkia agent.

Message	Meaning	Action
Bad condition	Prism sighting is bad.	Sight the target correctly again. Measure again after confirming the returned signal.
Battery is low !	Battery voltage is too low.	Change the battery or replace it with a charged one.
Data is invalid...	After about 1 week, data stored in the short term memory has been cleared.	
No data	Error when measuring the initial slope distance during either REM or horizontal distance between 2 points measurement.	Sight the reflecting prism to perform slope distance measurement again.
Out of range	During the distance measurement, the tilt angle exceeds ±3'.	Level SET E again.
Out of value	During REM, the vertical angle is more than ±89° or the measured distance is more than 9999.999m. (SET5E: 1999.999m)	Press STOP to stop the measurement.

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Message	Meaning	Action
Signal off	At start of measurement or during the measurement, the returned signal was totally absent or disturbed.	Sight the target correctly agian. Measure again after confirming the returned signal.
	No measured distance data is received within 2 minutes of starting the measurements, or the measured distance data can not be obtained for a total of 1 minute.	
Tilt out of range **X- > ⊥ +** **Y- ⊥ <+**	The tilt sensor range error. The tilt angle exceeds ±3'.	Level SET E again.
E 100	Error when measuring a horizontal angle. *	Index the horizontal circle again.
E 101	Error when measuring a vertical angle. *	Transit the telescope again.

* If SET E telescope or upper part is rotated faster than 4 revolutions per second, the error indication "E 100" or "E 101" is displayed.

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18. CHECKS AND ADJUSTMENTS

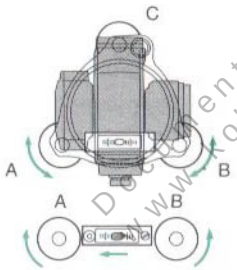
- Periodically, checks and adjustments should be performed before and during measurement. In addition, the instrument should be checked after long storage, transportation or when damage to the instrument is suspected to have occurred due to a strong shock.

- The checks should be performed in the following order.

18.1 Plate level

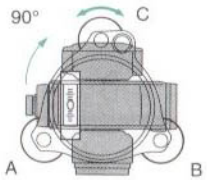
- The glass tube of the plate level is sensitive to temperature changes or shock.

Check



Bubble movement

1) **Turn the upper part of the instrument until the plate level ㉒ is parallel to a line between levelling foot screws A and B. Centre the plate level bubble using levelling foot screws A and B.**
The bubble moves towards a clockwise rotated levelling foot screw.



2) **Loosen the horizontal clamp ⑱ and turn the upper part 90°.**
The plate level is perpendicular to a line between levelling screws A and B.

3) **Centre the plate level bubble using levelling screw C.**

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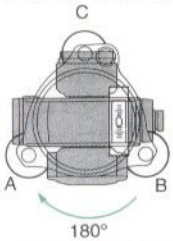
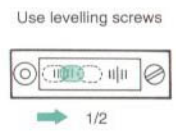
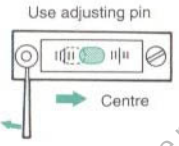


4) **Turn the upper part through 180° and check the bubble position.**
If the bubble is still centred, no adjustment is necessary.
If the bubble is off-centre, adjust as follows:

Adjustment



5) **Correct half of the bubble displacement using levelling foot screw C.**



6) **Correct the remaining half of the displacement by adjusting the screw ㉓ with the adjusting pin.**
The bubble moves away from a clockwise rotation of the adjusting screw.

7) **Repeat the procedures from 1) to 6) until the bubble remains centred for any position of the upper part.**

If the bubble can not be centred, please contact your Sokkia agent.

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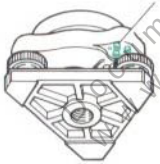
18.2 Circular level

Check

1) **Perform the plate level adjustment or level the instrument carefully using the plate level.**

2) **Check the position of the circular level bubble.**
If the bubble is still centred, no adjustment is necessary.
If the bubble is off-centre, adjust as follows:

Adjustment



3) **Verify the off-centre direction of the bubble.**
4) **Loosen the adjusting screw ❼ farthest from that direction to centre the bubble.**
5) **Adjust all 3 adjusting screws until the tightening tension of each screw is the same, and the bubble is centred.**

- Over-tightening the adjus-ting screws may damage the circular level. Unequal tightening of the screws may mean that the bubble will go out of adjustment.

If the bubble can not be centred, please contact your Sokkia agent.

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18.3 Tilt sensor

● If there is a tilt 0 point error, the tilt angle is not 0 when the instrument is properly levelled, and it causes an angle error. This tilt 0 point error can be checked and adjusted as follows.

Check

● **Carefully level SET E**

Basic mode

```
Press function
keys to select
operation                ▮2
EDM THEO  S-O  CONF
```

● In Basic mode

CONF : For Setting mode

Setting mode

```
1. Configuration
2. Tilt correction
3. Key select
■1■  ■2■  ■3■  Exit
```

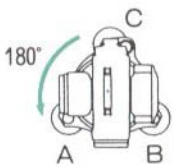
2 : For Tilt sensor checking mode

Tilt sensor checking mode

```
HAR   90° 00' 00"
Tilt  X  -0° 00' 20"
      Y  -0° 00' 40"     ▮2
```

1st line: Horizontal angle
2nd line: Tilt angle of X direction
3rd line: Tilt angle of Y direction

e.g.: $X_1 = -20$
$Y_1 = -40$




```
HAR  270° 00' 00"
Tilt  X   0° 00' 40"
      Y  -0° 00' 20"     ▮2
```

● **Wait for a few seconds until the tilt angle readings are steady, and note the tilt angle values X_1 and Y_1**

● **Loosen the horizontal clamp ⑱ and turn the theodolite through 180° referring the display of horizontal angle. Tighten the horizontal clamp**

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e.g.: $X_2 = 40$
$Y_2 = -20$

e.g.:
X direction = (–20+40) /2=10
Y direction = {–40+(–20)} /2
=–30

● **When the tilt angle readings are steady, note the tilt angle values, X_2 and Y_2**

● **Calculate the offset values.**
$(X_1 + X_2) / 2$
$(Y_1 + Y_2) / 2$

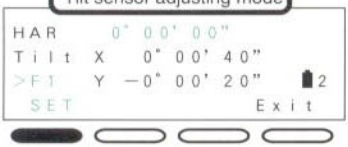
If the offset value (X and Y) are **±10" or less**, no adjustment is necessary

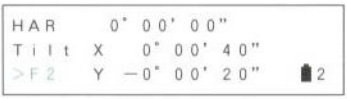
Exit : Finish the check

● **If one of the offset values is greater than ±10", the sensor index should be adjusted as follows without pressing Exit**

Adjustment

Tilt sensor adjusting mode





0SET
: For Tilt sensor adjusting mode

The horizontal angle becomes 0°

SET
: Memorize tilt angle X_2 and Y_2

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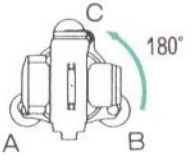

HAR 180° 00' 00"
Tilt X 0° 00' 40"
>F2 Y −0° 00' 20" 2
SET Exit

● **Loosen the horizontal clamp and turn the upper part through 180° referring the display of horizontal angle**

When the tilt angle readings are steady, press **SET**
: Memorize X_2 and Y_2

X=0398 Y=0440
Tilt X −0° 00' 20"
Y −0° 00' 40" 2

e.g.: Tilt 0 point data
X = 398
Y = 440

Enter Exit

The tilt 0 point data is displayed at the first line

If the tilt 0 point data is **greater than 400±120**, stop the adjustment

Exit
: Stop the adjustment
(Please contact your Sokkia agent)

● If it is 400±120 or less, keep on adjustment without pressing **Exit**

Enter Exit

Enter : Set Tilt 0 point data (Tilt sensor checking mode)

Tilt sensor checking mode

HAR 180° 00' 00"
Tilt X 0° 00' 00"
Y −0° 00' 10" 2

The adjusted new tilt angle values, X and Y are displayed

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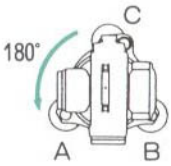
e.g.: $X_3 = 0$
$Y_3 = -10$




```
HAR      0° 00' 00"
Tilt  X  -0° 00' 10"
      Y   0° 00' 00"    ▮2
```

- **When the tilt angle readings are steady, note the tilt angle value, X_3 and Y_3.**
- **Loosen the horizontal clamp and turn the upper part through 180°**

e.g.: $X_4 = -10$
$Y_4 = 0$

e.g.:
X direction = {0+(−10)} /2 = −5
Y direction = (−10+0) /2 = −5

```
OSET                Exit
```

- **When the tilt angle readings are steady, note the Tilt angle value, X_4 and Y_4**
- **Calculate the offset values**
  $(X_3 + X_4) / 2$
  $(Y_3 + Y_4) / 2$
  If the offset values (X and Y) are ±10" or less, the adjustment has been finished

Exit : Finish the check (Setting mode)

Setting mode

```
1.  Configuration
2.  Tilt correction
3.  Key select
 ■1■   ■2■   ■3■   Exit
```

- If one of the offset values are greater than ±10", repeat the adjustment procedures

- Exit from the mode: **Exit**
- If the offset values are greater than ±10" in spite of repeating the adjustment, please contact your Sokkia agent.

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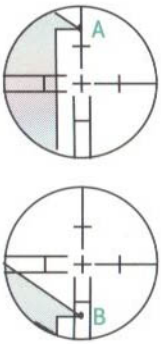
18.4 Reticle

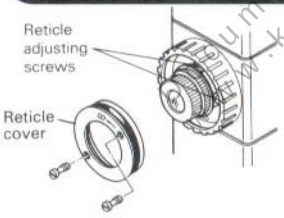
●This adjustment is very delicate, so please contact your Sokkia agent to adjust the reticle.

Check 1 <Perpendicularity of the reticle to the horizontal axis>

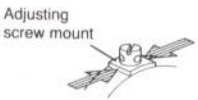


1) **Carefully level SET E. Select and sight a clear target on the upper part A of the reticle line.**
2) **Turn the telescope vertical fine motion screw ㉕ until the target is on the lower part of the reticle B. Check that the target is still positioned centrally within the reticle lines.**
If the target is off-centre, adjust as follows:

Adjustment 1



3) **Remove the telescope reticle cover.**
4) **Slightly loosen one vertical and one horizontal adjustment screw by a certain amount using the adjusting pin.**
5) **Place a small piece of plastic or wood against one side of the top adjusting screw mount as a buffer.**



6) **Look through the eyepiece and gently tap the piece of plastic or wood to rotate the reticle slightly.**
7) **Retighten the two adjusting screws loosened in step 4) by the same amount.**

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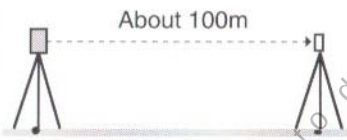
Note: Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

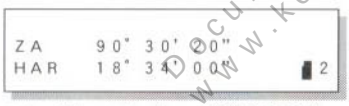
8) **Check the reticle perpendicularity again using procedures 1) and 2) above and repeat the adjustment if necessary.**
9) **Replace the reticle cover.**

Note: After this adjustment, perform the check and adjustment of the reticle position as follows.

Check 2 <Vertical and horizontal reticle line positions>



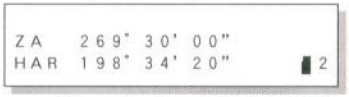
1) **Set up a clear target 100m (328ft) from SET E. Carefully level SET E, switch on and index the vertical and horizontal circles.**



2) **Sight the target on face left. Read the H angle A_1 and V angle B_1.**

e.g.: H angle A_1 = 18° 34' 00"
V angle B_1 = 90° 30' 20"

Telescope face right



3) **Now sight the target on face right and read the H angle A_2 and V angle B_2.**

e.g.: H angle A_2 = 198° 34' 20"
V angle B_2 = 269° 30' 00"

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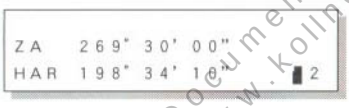
e.g.:
H angle $A_2 - A_1$
$= 198° 34' 20" - 18° 34' 00"$
$= 180° 00' 20"$
V angle $B_2 + B_1$
$= 269° 30' 00" + 90° 30' 20"$
$= 360° 00' 20"$

4) **Calculate $A_2 - A_1$ and $B_2 + B_1$.**
$A_2 - A_1$ should be **within 180° ±20"**
$B_2 + B_1$ should be **within 360° ±20"**.
If a difference of more than ±20" still remains after repeating these procedures several times, adjust as follows.

Adjustment 2

Note: Moving the reticle line effects the distance measurement.
Do not move the reticle more than 20".

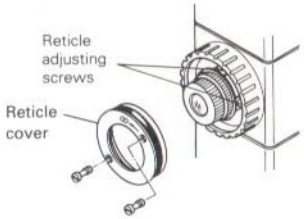
e.g.: H angle $A_1 = 18° 34' 00"$
V angle $B_1 = 90° 30' 10"$
H angle $A_2 = 198° 34' 20"$
V angle $B_2 = 269° 30' 10"$



5) **Calculate the H angle A and V angle B.**
$A = (A_2 + A_1) / 2 + 90°$
$B = (B_2 - B_1) / 2 + 180°$

6) **While still sighting the target on face right, use the horizontal and vertical fine motion screws to adjust the displayed H and V angles to the above values.**

7) **Look through the telescope. The reticle is now slightly shifted from the target.**
Remove the telescope reticle cover.



8) **To move the vertical reticle line towards the target centre, loosen the top and bottom adjusting screws using the adjusting pin.**

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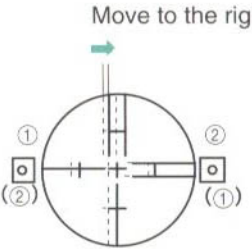
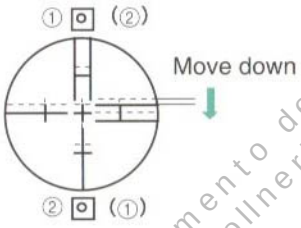


To move the reticle to the right (left),
① very slightly loosen the left (right) adjusting screw,
② tighten the right (left) adjusting screw by this same amount.

To move the horizontal reticle line towards the target centre, loosen the right and left adjusting screws.



To move the reticle down (up),
① slightly loosen the top (bottom) adjusting screw,
② tighten the bottom (top) adjusting screw by this same amount.
[( ) for opposite direction]

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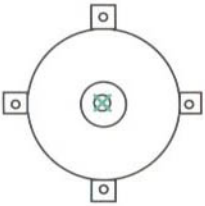
Note: Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

9) **Finally tighten the top and bottom adjusting screws as before.**
Check the reticle position and repeat the procedure until the reticle comes close to the target centre.
10) **Replace the reticle cover.**

18.5 Optical plummet

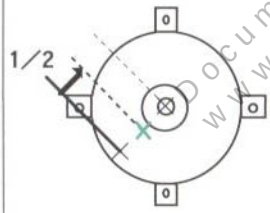
Check



1) **Carefully level SET E and exactly centre a surveying point in the reticle of the optical plummet.**

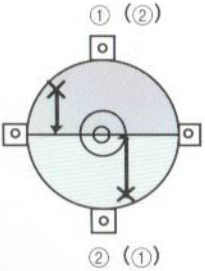
2) **Turn the upper part 180° and check the position of the surveying point in the reticle.**
If the surveying point is still centred, no adjustment is necessary. If the surveying point is not still centred in the optical plummet, adjust as follows.

Adjustment



3) **Correct half the deviation with the levelling foot screw ⑨.**

4) **Unscrew the optical plummet reticle cover ⑫ to adjust the remaining half of the displacement with the 4 adjusting screws.**



5) **When the surveying point is on the part shown in ( ) area:**
① Loosen the upper (lower) screw slightly,
② tighten the lower (upper) screw by the same amount.

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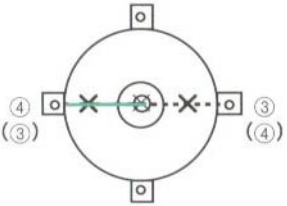

6) **Next, if the surveying point is seen to be on the part shown in solid line (dotted line):**
③ Loosen the right (left) screw slightly,
④ tighten the left (right) screw by the same amount.

Note: Over-tightening the adjusting screws may mean that the reticle will go out of adjustment.

7) **Check the adjustment by rotating the upper part of the instrument. The surveying point should remain centred in the reticle.**
If necessary, repeat the adjustment.
8) **Replace the optical plummet reticle cover.**

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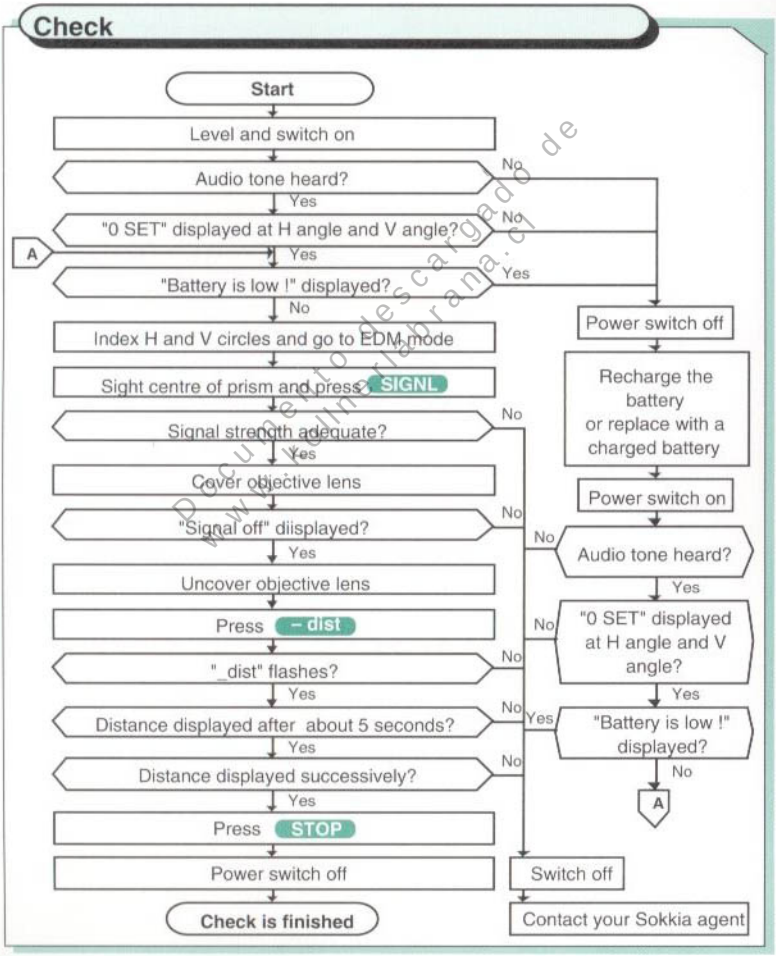
18.6 Distance measurement check flow chart

●Perform the procedures in the flow chart below. If error messages are displayed, please contact your Sokkia agent. (Set parameter No.1 to "Repeat measurement mode" and set parameter No.16 "Resume function off".



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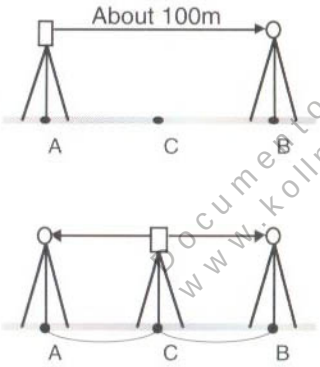
18.7 Additive distance constant

●The additive distance constant K of SET E is adjusted to 0 before delivery. However, it may change over time and so should be determined periodically and then used to correct distances measured.
The most reliable method of confirming the constant is to test SET E on an established baseline. If a baseline is not available, please perform the following procedures.

Note: Errors in setting up the instrument and sighting the target will affect the determination of the additive distance constant, therefore perform these procedures as carefully as possible.

Check



1) **Select points A and B on flat ground about 100m apart, and C in the middle.**
2) **Set up SET E at A and the target at B. Measure (fine measurement) the distance A-B 10 times.**
3) **Shift SET E to C and measure the distance C-A and C-B 10 times each.**
4) **Calculate the averages of AB, CA and CB.**
5) **Compute the additive distance K using the formula:**
   K = AB – (CA + CB)
6) **Obtain the K value several times.**
   If all K values are **greater than ±3mm**, please contact your Sokkia agent.

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- Ensure that the target height is the same as the instrument height. If the ground is not flat, use an automatic level to set the correct instrument heights of all points.

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Measurement options selection

19. CHANGING INSTRUMENT PARAMETERS ☞ 107

20. CHANGING LOCATION OF FUNCTIONS FOR KEYS ☞ 117

20.1 Key function allocating ☞ 118

20.2 Registered location recalling ☞ 125

[Note] Difference between "Enter" and "Key registration" in key function allocating ☞ 126

21. POWER SUPPLIES ☞ 127

22. REFLECTING PRISMS AND ACCESSORIES ☞ 129

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19. CHANGING INSTRUMENT PARAMETERS

- The instrument parameter settings can be changed by key operations to match the required measurement.
- The selected options are stored in the memory until they are changed.

No.	Parameter	Options	
1	Distance measurement mode	1*	0*: Repeat and fine 1: Single and fine 2 to 9: Average of 2 to 9 meas.
		2	Fine and single
		3	Coarse and single
2	Prism constant correction value	–30mm* (–99 to 0mm, in 1 mm steps)	
3	Distance unit	1*	metres
		2	feet
4	C+R correction	1*	No correction
		2	Yes (K = 0.124)
5	Audio for return signal	1*	Audio tone
		2	No audio tone
6	Distance mode	1*	Slope distance
		2	Horizontal distance
		3	Height difference
7	Angle unit	1*	degree
		2	gon
		3	mil
8	V angle format	1*	Zenith angle (Zenith 0°)
		2	Vertical angle (Horizontal 0°)
		3	Vertical angle (Horizontal ±90°)
9	V circle indexing	1*	Transit telescope
		2	Observe face left, face right sightings
10	H circle indexing	1*	Rotate upper part
		2	0° at power on
11	Tilt correction	1*	Horizontal and Vertical angle Yes
		2	Vertical angle Yes
		3	No correction
12	Reticle illumination	1*	Bright
		2	Dim
13	Auto illumination cut-off	1*	Illumination on/off using key
		2	Illumination auto off after 30 seconds

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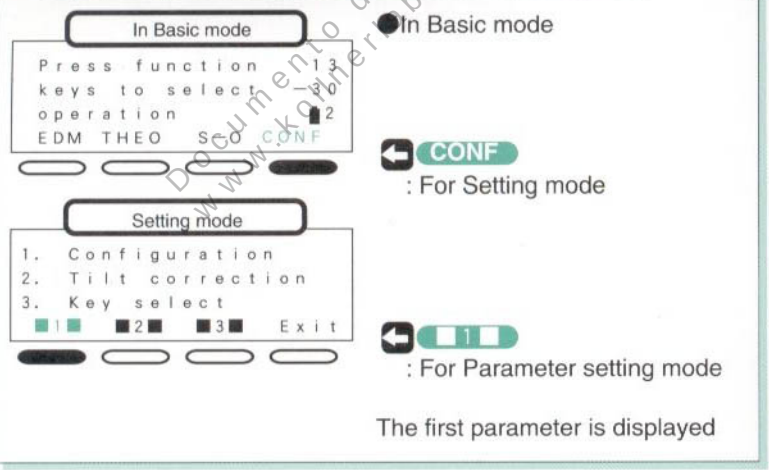
No.	Parameter		Options	
14	Auto power cut-off		1*	Auto power cut-off after 30 minutes
			2	Switch on/off by key
15	Baud rate		1*	1200 baud
			2	9600 baud
16	Resume function		1*	On
			2	Off
17	Coordinate format		1*	N, E, Z
			2	E, N, Z
18	Angle resolution	SET3E	1*	1" (0.2mgon / 0.005mil)
			2	5" (1mgon / 0.02mil)
		SET4E SET5E	1*	5" (1mgon / 0.02mil)
			2	10" (2mgon / 0.05mil)
19	Temperature and pressure unit		1*	°C, hPa
			2	°C, mmHg
			3	°F, hPa / °F, mmHg / °F, inchHg

*: Factory setting

From Basic mode to Setting mode



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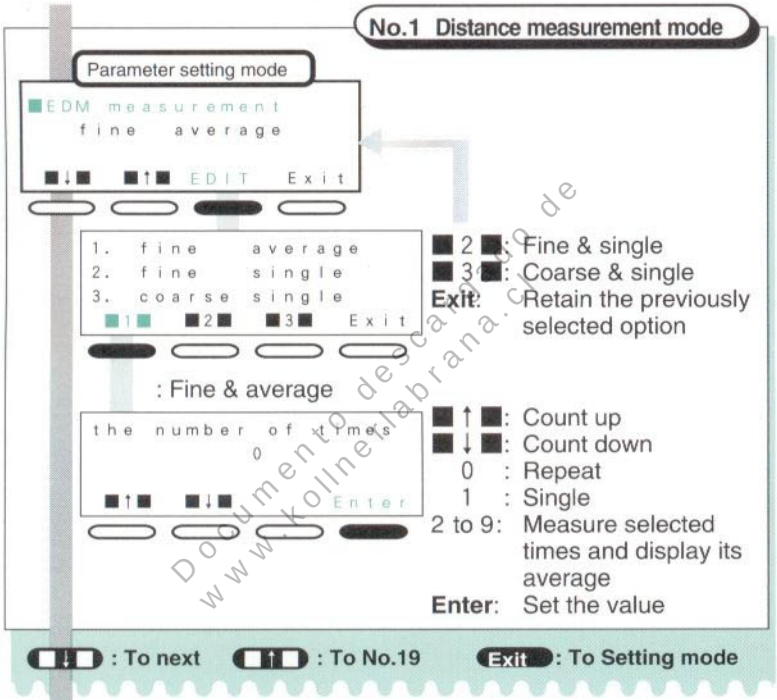
●Select a required options by the following key operations.

To next parameter: ■↓■ To Setting mode: Exit
To previous parameter: ■↑■ To Basic mode: ESC
Change options: EDIT



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No.2 Prism constant correction value

```
■Prism constant
  PC=−30 mm
■↓■  ■↑■  EDIT  Exit
```

- Input range: –99 to 0mm
- Least input: 1mm

```
PC=−30 mm
■↑■  ■↓■  ■→■  Enter
```

■↑■: Count up
■↓■: Count down
■→■: Go to next column
Enter: Set the value

- Each reflecting prism type has a different prism constant value. Here, we will set the constant correction value for the reflecting prism being used.
- The prism constant correction values for reflecting prisms made by Sokkia are as follows:

AP01S + AP01 AP01 CP01

Correction value = –30 Correction value = –40 Correction value = 0

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■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.3 Distance unit

```
■Distance unit
  meter
■↓■  ■↑■  EDIT  Exit
```

```
1. meter
2. feet
■1■  ■2■  Exit
```

■1■: metres
■2■: feet
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

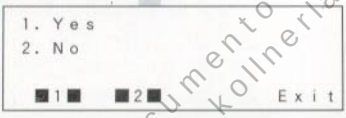
No.4 C + R correction

• Refer to P.136 "Appendix 3: C & R CORRECTION"

■ 1 ■: No correction
■ 2 ■: Yes (K = 0.142)
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

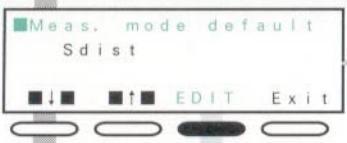
No.5 Audio for return signal

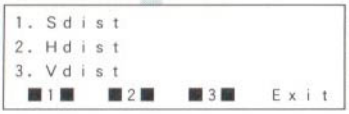


■ 1 ■: Audio tone
■ 2 ■: No audio tone
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.6 Distance mode





• Select distance mode at the power on when the resume function is off.

■ 1 ■: Slope distance
■ 2 ■: Horizontal distance
■ 3 ■: Height difference
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

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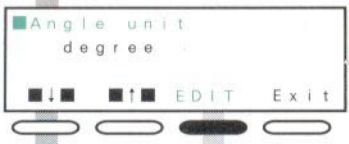
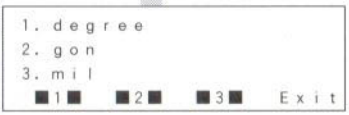
No.7 Angle unit

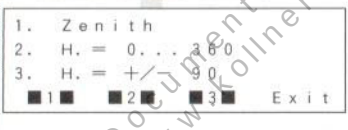




■1■: degree
■2■: gon
■3■: mil
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.8 V angle format



■1■: Zenith 0°
■2■: Horizontal 0°
■3■: Horizontal ±90°
Exit: Retain the previously selected option

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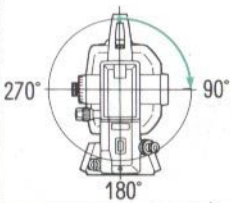
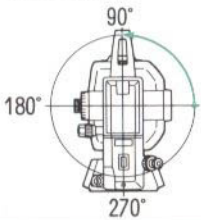
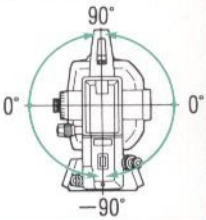
●Zenith 0°



●Horizontal 0°

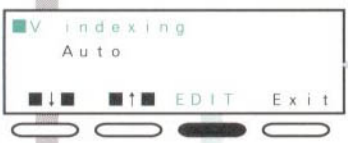


●Horizontal ±90°



■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.9 V circle indexing

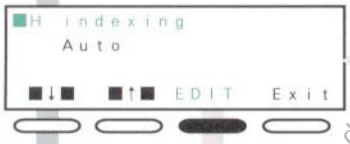


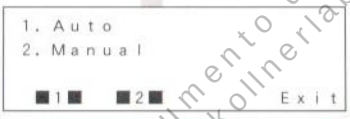
• Refer to P.133 "Appendix 1" to index by face left, face right sighting.

■ 1 ■: Transit telescope
■ 2 ■: F.L./F.R. sighting
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.10 H circle indexing

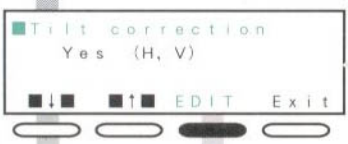


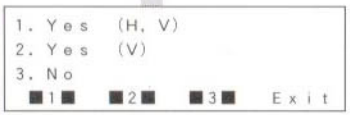


■ 1 ■: Rotate upper part
■ 2 ■: 0° at power on
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.11 Tilt correction





■ 1 ■: H & V angle Yes
■ 2 ■: V angle Yes
■ 3 ■: No
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

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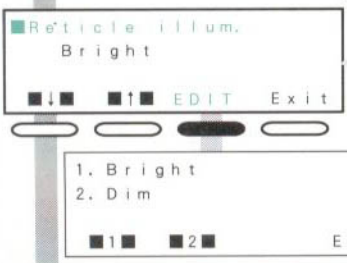
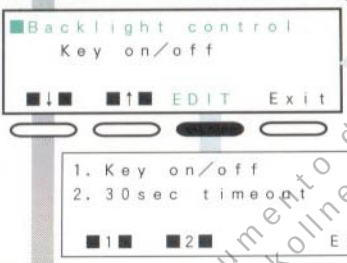
No.12 Reticle illumination



■ 1 ■: Bright
■ 2 ■: Dim
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.13 Auto illumination cut-off



■ 1 ■: On/off using key
■ 2 ■: Auto off after 30secs
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

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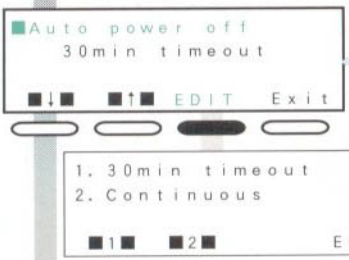
No.14 Auto power cut-off



■ 1 ■: Auto power off after 30mins
■ 2 ■: On/off using key
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.15 Baud rate

■ 1 ■: 1200 baud
■ 2 ■: 9600 baud
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.16 Resume function

■ 1 ■: On
■ 2 ■: Off
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

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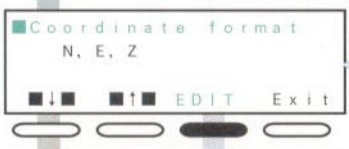
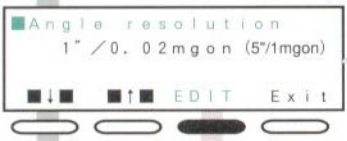
No.17 Coordinate format



■ 1 ■: N, E, Z
■ 2 ■: E, N, Z
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

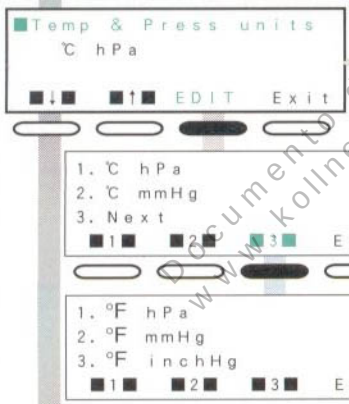
No.18 Angle resolution



■1■: SET3E: 1"
SET4E/5E: 5"
■2■: SET3E: 5"
SET4E/5E: 10"
Exit: Retain the previously selected option

■↓■ : To next ■↑■ : To previous Exit : To Setting mode

No.19 T & P unit



■1■: °C, hPa
■2■: °C, mmHg
Exit: Retain the previously selected option

■1■: °F, hPa
■2■: °F, mmHg
■3■: °F, inchHg
Exit: Retain the previously selected option

■↓■ : To No.1 ■↑■ : To previous Exit : To Setting mode

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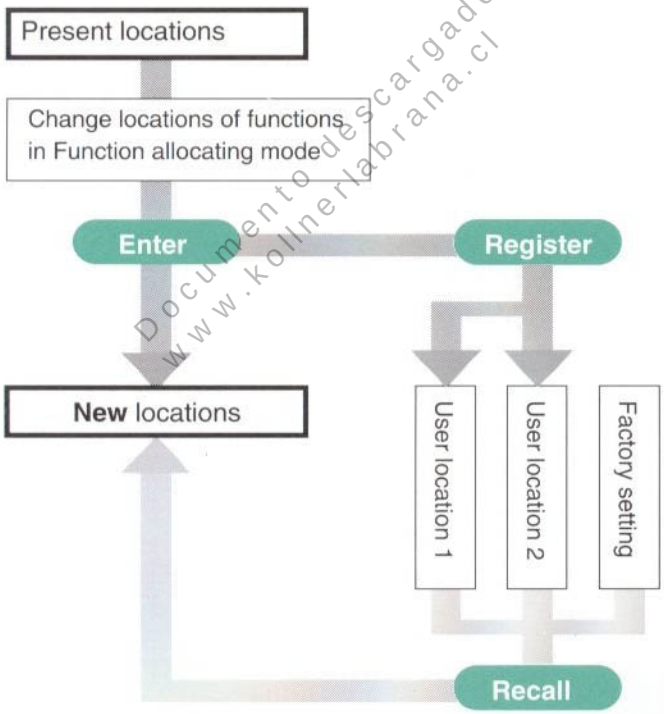
20. CHANGING LOCATION OF FUNCTIONS FOR KEYS

●SET E allows changing locations of the functions for each key. (except ESC) You can arrange the keyboard according to your requirements in order to save key strokes and to avoid mistakes. You will get the most efficiency by customizing function locations for your own applications.



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•Difference between "Enter" and "Register" ☞ P.126 [Note] Difference between "Enter" and "Key registration" in key function allocating

20.1 Key function allocating

●Any functions mentioned below can be allocated **in any page of any mode**. After storing the locations, the locations are stored permanently until they are changed again. 2 locations can be registered at the internal memory. It is able to renew the registered locations.

Note: The previously-stored locations of functions are cleared after changing or registering the new locations.

●The following functions can be allocated in each mode. (THEO, EDM and S-O)

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General

THEO	: Transfer to THEO mode
EDM	: Transfer to EDM mode
S-O	: Transfer to S-O mode
CONF	: Transfer to Setting mode
→PX	: Go to next page
- - -	: No function
ILLUM	: Display and reticle illumination ON/OFF
MEM	: Input / delete / review Coordinate data

For Angle measurement

0SET	: Set Horizontal angle to 0 /Index V circle
HOLD	: Hold H angle / Release H angle
Tilt	: Display the tilt angle
REP	: Transfer to Repetition mode
ZA/%	* : Zenith angle / Slope in %
VA/%	* : Vertical angle / Slope in %
R/L	: Select Horizontal angle right / left

For Distance measurement

_dist	: Measure the distance
◢ SHV	: Select Distance mode (S=Slope / H=Horizontal / V=Height)
PPM	: Go to ppm setting mode
M/TRK	: Repeat or single meas. / Tracking meas.
SIGNL	: Return signal check
f / m	: Change metres / feet for 5 seconds
RCL	: Review the measured data in the memory

For Coordinate measurement

Stn_P	: Input Instrument station coordinates
Ht.	: Input Target & Instrument height
BSang	: Input Backsight station coordinates and set Azimuth angle
COORD	: Measure 3-Dimensional coordinates

For Advanced measurement

RESEC	: Go to Resection measurement mode
MLM	: Start Missing line measurement
REM	: Start Remote elevation measurement
S-O_D	: Input Distance setting-out data
S-O_P	: Input Coordinates of point to be set out
SO_Xd	: Start Distance setting-out measurement
SO_HA	: Start H angle setting-out measurement

*: "ZA/%" is displayed when parameter No.8 is set to "Zenith 0".
"VA/%" is displayed when parameter No.8 is set to "Horizontal 0" or "Horizontal ±90°".

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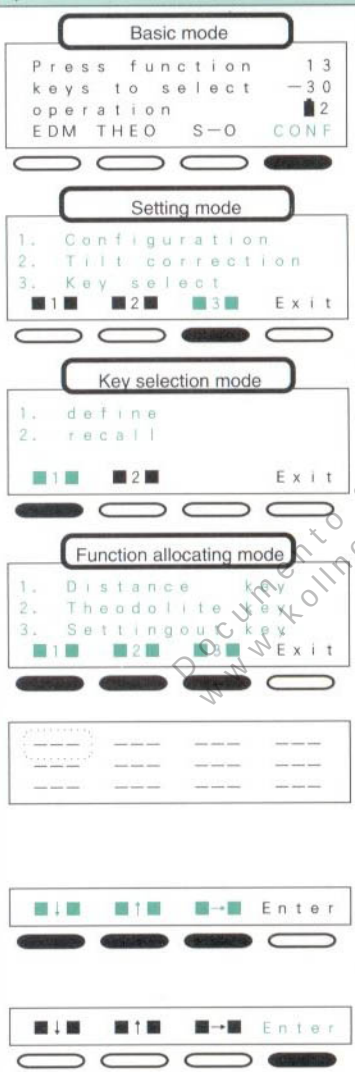
Note: ● Key function allocating



● In Basic mode

CONF : For Setting mode

3 : For Key selection mode

1 : For Function allocating mode

- EDM mode: 1
- THEO mode: 2
- S-O mode: 3

Select the required mode

First line = First page
Second line = Second page
Third line = Third page

- Go to next function: ↓
- Go to previous function: ↑
- Go to next position: →

Display the required function

● **Repeat for the required numbers of functions**

Enter : Enter the new location into memory

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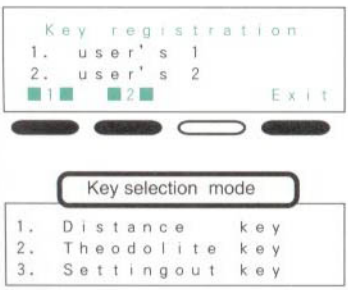

- Register to user's 1: 1
- Register to user's 2: 2
- Not register: Exit

Register the new location to "user's 1" or "user's 2"
(The previously-registered location is cleared.)
or Exit from this mode **without register**
(Function allocating mode)

- If there are more than 5 functions to be allocated, allocate the page-turn function in any location of each line.
- If there is no function to be allocated, allocate "- - -" for key.

- To Setting mode: Exit
- Exit from the mode: ESC (To Basic mode)
- Location storage period: Until next changing (Power-off possible)
- Up to 9 functions in 3 pages can be allocated

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●When Coordinate functions are used, allocate related functions.

- For 3-Dimensional coordinates measurement

  Allocate Ht. and BSang with COORD.

  Ht. (Input Target and Instrument height)
  BSang (Set Azimuth angle)
  COORD (Measure 3-Dimensional coordinates)

  If these are not allocated, the previously stored data is used.

- For Coordinate setting-out measurement

  Allocate S-O_P and SO_HA with SO_Xd.

  S-O_P (Input Coordinates of point to be set out)
  SO_HA (Start H angle setting-out measurement)
  SO_Xd (Start Distance setting-out measurement)

  If these are not allocated, Setting-out measurement is not possible.

e.g. ●<Changing locations of functions>

- RESEC : Go to Resection measurement mode
- S-O_P : Input Coordinate of point to be set out
- SO_HA : Start Horizontal angle setting-out measurement
- SO_Xd (SO_) : Start Distance setting-out measurement
- Ht. : Input Target and Instrument height
- COORD : Start 3-Dimensional coordinate measurement

● "→PX" must be included to access all of the above 6 functions.

Page 1 →P2 RESEC S-O_P SO_HA

Page 2 →P1 SO_Hd Ht. COORD

Basic mode

Press function keys to select operation
1
2
EDM THEO S_O CONF

1) **In Basic mode, press CONF.**

CONF : For Setting mode

Setting mode

1. Configuration
2. Tilt correction
3. Key select
■1■ ■2■ ■3■ Exit

The display turns to Setting mode.

■3■ : For Key selection mode

2) **Press ■3■.**

Key selection mode

1. define
2. recall
■1■ ■2■ Exit

The display turns to Key selection mode.

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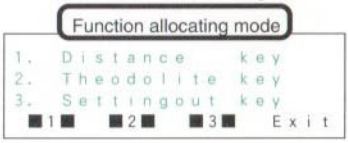
[1]

: For Function allocating mode

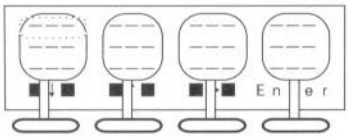


3) **Press [1].**

The display prompts to select the mode to be allocated.

[2]

: Allocating for S-O mode



4) **Press [2].**
The present functions are displayed. The 1st position of 1st line flashes to prompt for the selection of function.

- Allocate the functions for a page on a line. Add the page-turn function to its line.

[↓] or [↑]

: Display "→P2"

[→] : To next position

5) **Press [↓] or [↑] to display "→P2" and press [→].**

The 2nd position of 1st line flashes to prompt for the selection of function.

[↓] or [↑]

: Display "**RESEC**"

[→] : To next position

6) **Press [↓] or [↑] to display "RESEC" and press [→].**

The 3rd position of 1st line flashes to prompt for the selection of function.

Repeat steps 6) to allocate remaining functions

● **Repeat step 6) to allocate "S-O–P", "SO–HA", "→P3"*, "SO–Hd", "Ht." and "COORD".**

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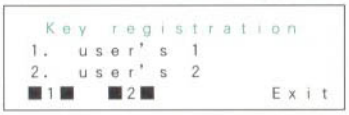
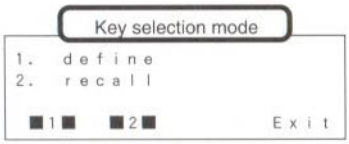
Enter
: Enter the location into memory



Exit : Exit from the mode



7) **Press Enter.**

The new location is entered into memory and the display asks whether this location is registered into the internal memory.

8) **Press Exit.**

The allocating is finished and the display returns to Function allocating mode.

To register this location to "user's 1" or "user's 2", press ■1■ or ■2■.

● **Press Exit again to return to Setting mode. Press ESC to transfer to Basic mode.**

*: In Function allocating mode, "→P3" is displayed at the 2nd line. However, "→P1" is displayed in the THEO, EDM or S-O mode.

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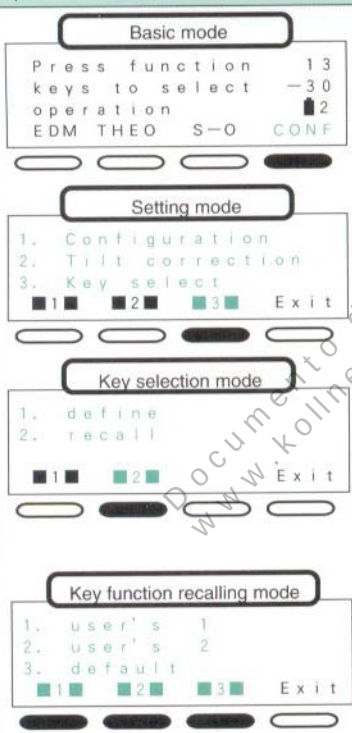
20.2 Registered location recalling

●The factory setting location or the registered locations stored in the memory can be recalled.

Note: ●**Key function recalling**



●In Basic mode

CONF : For Setting mode

3 : For Key selection mode

2 : For Key function recalling mode

- Recall "user's 1": 1
- Recall "user's 2": 2
- Recall Factory setting: 3

Select the required location (Key function mode)

- The previously-stored locations of functions are **cleared** after recalling the registered locations.
- To Setting mode: Exit
- To Basic mode: ESC

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— [Note] Difference between "Enter" and "Key registration" in key function allocation

●There are 2 methods for changing the locations of functions for keys. By knowing how to use "**Enter**" or "**Key registration**" properly, it will be easier to operate SET E.

1) "**Enter**" the new location or **register** the new location:
After **enter**ing the new location, the functions are displayed in the **enter**ed location until next changing.

2) Recall the **register**ed locations:
After **register**ing a location, the **register**ed location can be recalled at any time.

For example, if someone **enter**s another location, you can recall the location you **register**ed.

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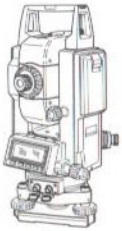
21. POWER SUPPLIES

●SET E can be operated with the following combinations.

Note: Use SET E only with the combinations shown here.



Internal battery
BDC25 *

Charging adaptor
EDC19 *

Charger
CDC27 * [80mins]
(AC90 to 125V)
CDC31 * [80mins]
(AC180 to 264V)

CDC11 [15hrs]
(AC100 to 120V)
CDC11D/E[15hrs]
(AC220 to 240V)

CDC29 [80mins]
(AC90 to 264V)
(double)

CDC32 [80mins]
(DC11 to 16V)
(for cigar lighter)

Cable
EDC3

External battery converter
EDC14 **

AC adaptor
EDC2 **
(AC100 to 240V)

External battery
BDC12 **
(DC6V)

Cable to car cigar lighter
EDC4 (DC12V)

Cable to car battry
EDC5 (DC12V)

Charger
CDC14 (AC100V)
CDC14A(AC120V)
CDC14D(AC220 to 24V)
[15hrs]

* : Standard equipment.
Items not marked with *
are optional accessories.

Note: When using any external power supply(**), it is recommended that the BDC25 battery be left in place to balance the weight on the axes.

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Precautions for battery use and storage

- Store the battery in a place where the temperature is between 0°C and 40°C.
- Charge the battery at least once a month to maintain its quality if it is not used for a long time. If the battery has not been charged for more than a month, charge it fully without regard to the remaining battery power before using.
- Battery operating life is shortened at extreme temperatures.

Precautions for battery charging using the standard charger

To charge the battery, use only the recommended charger.

- Charge the battery at a temperature between 10°C and 40°C. Do not charge the battery for longer than the specified time.
- When charging the battery,
  1) mount it in the adapter,
  2) connect to the battery charger,
  3) and connect the charger to the power supply.

  If using CDC27 or CDC31, the charging lamp flashes during charging and it becomes lighting on when the charging is finished. If using CDC11, check that the charging lamp comes on.
- The battery charger normally becomes warm while charging.

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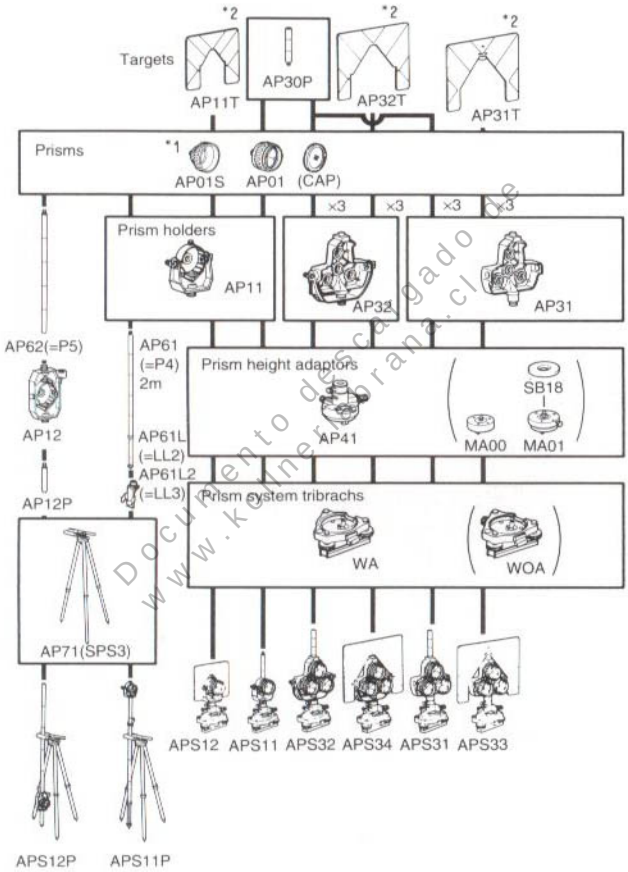
Precautions for the use of external power supplies

- Ensure that the car cigarette lighter has DC12V output and that the negative terminal is grounded.
- Before using EDC2, set the voltage selector to the correct voltage.
- EDC14 has a breaker switch. Normally the red mark appears on the breaker. If not, set the red mark in place.
- When using a car battery, make sure that the polarity is correct.

22. REFLECTING PRISMS AND ACCESSORIES

●All Sokkia reflecting prisms and accessories have standardized screws (5/8" x 11 thread) for ease of use.



●All the above equipment is optional.

*1: To change the stored prism constant value, see P.107.

*2: Fluorescent target paint finishing allows clearer sighting in adverse observing conditions.

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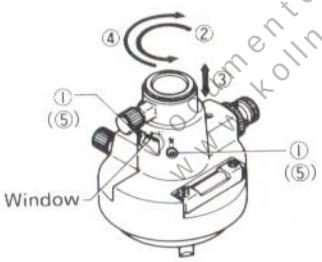
Precautions for use of reflecting prisms

- Carefully face the reflecting prism towards the instrument sight the prism target centre accurately.
- To use the triple prism assembly AP31 or AP32 as a single prism (e.g. for short distances), mount the single prism AP01 in the centre hole of the prism holder.

Precautions for use of the instrument height adaptor AP41

- Check the plate level of the AP41 as described in P.89 "**18.1 Plate level**".
- Check that the optical plummet of the AP41 sights the same point as that of SET E referring to P.100 "**18.5 Optical plummet**".
- Check that "236" (the height of SET E in mm) is displayed in the window of the instrument height adaptor AP41.

The height of the AP41 can be adjusted as follows:



① Loosen the 2 fixing screws.
② Turn the centre part counter-clockwise to unlock it.
③ Move it up or down until "236 appears in the window.
④ Turn the centre part clockwise to lock it.
⑤ Tighten the fixing screws.

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Precaution for use of tribrach

- Use the plate level on the AP41 to adjust the tribrach circular level as described in P.91 "**18.2 Circular level**".

Appendices

Appendix 1: Manually indexing the vertical circle by face left, face right measurements ☞ 133

Appendix 2: For distance measurement of the highest accuracy ☞ 134

Appendix 3: Earth-curvature and refraction correction ☞ 136

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STANDARD EQUIPMENT ☞ 140

MAINTENANCE ☞ 141

SPECIFICATIONS ☞ 142

ATMOSPHERIC CORRECTION CHART ☞ 146

QUICK GUIDE TO THIS MANUAL ☞ 147

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Appendix 1: Manually indexing the vertical circle by face left, face right measurements

- Like all theodolites, SET E will have a small vertical index error. For angle measurement of the highest accuracy, the vertical index error can be removed as follows:
- Set Parameter No.9 to "Manual". ☞ P.107

Sight the target in face left

1) Level SET E.

"V1" is displayed.

2) In face left(V1), accurately sight a clear target at a horizontal distance of about 30m.

OSET

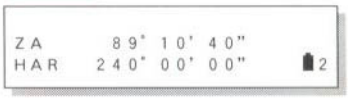
3) Press OSET.

"V2" is displayed.

Sight the target in face right

4) Loosen the horizontal clamp and rotate the upper part of SET E through 180°. In face right(V2), accurately sight the same target.

OSET



5) Press OSET.

The vertical circle has been indexed.

- If the power is switched off, the vertical circle should be indexed again.

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Appendix 2: For distance measurement of the highest accuracy

Atmospheric correction

- SET E uses a beam of infrared light to measure the distance. The velocity of this light in the atmospheric varies according to the temperature and pressure. The distance will be changed by 1ppm by:
  - a variation in temperature of 1°C
  - a variation in pressure of 3.6hPa

  (A 1ppm change means a 1mm difference for every 1km of measured distance.)

  To obtain distance measurement of the highest accuracy, the temperature and pressure must be carefully measured by accurate equipment.
- The ppm correction should be applied when the calculated ppm value is over ±5ppm or if the slope distance is more than 200m.

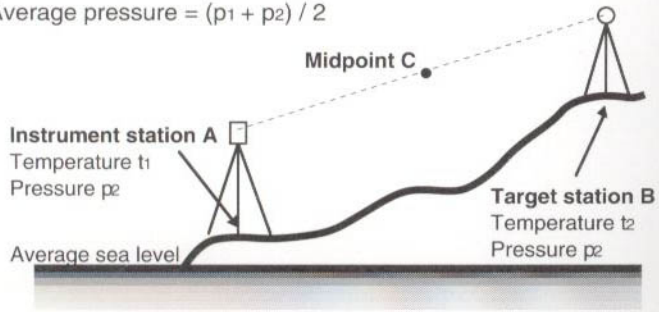
Average temperature and pressure between 2 points in different atmospheric conditions

- In flat terrain: Measure the temperature and pressure at the midpoint of the line as there is little variation in the values.

  In mountainous terrain: Midpoint values should be used. If those values cannot be measure temperature and pressure at the instrument and target stations, then calculate the average values.

  Average temperature = $(t_1 + t_2) / 2$

  Average pressure = $(p_1 + p_2) / 2$



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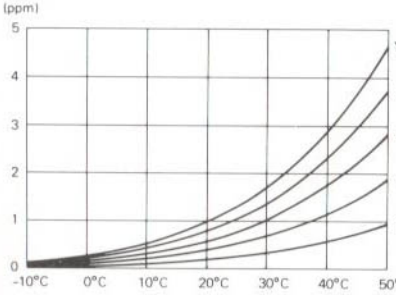
Influence of relative humidity

- The influence of humidity is very small. It is mainly of importance in very hot and humid conditions. The graph below is for atmospheric pressure of 1013hPa.



Correction factor (ppm)

$$= \frac{0.045 \times e(hPa)}{1 + 0.003661 \times t(°C)}$$

e: Partial water vapour pressure

t: Temperature

- If you take the influence of relative humidity into account, please set the correction factor (ppm) by the following method.

①Input the temperature and pressure values. The correction factor A is calculated and displayed at the end of 1st line of display. Measure the distance D.

②Measure the relative humidity and read the correction factor B from above table. For pressure between 500hPa and 1400hPa, if instead of the formula, the graph above is used to look up the correction factor, a difference of less than 0.1ppm will be present.

③Calculate D' by using the following formula.

$$D' = \frac{1+(A+B)\times10^{-6}}{1+A\times10^{-6}} \times D(m)$$

e.g. Temperature: 30°C, Pressure: 1020hPa,
Relative humidity: 80%
Measure distance corrected by only the correction factor A: 2000m
A=12 (the end of first line of display), B=1.4 (above table)

$$D' = \frac{1+(12+1.4)\times10^{-6}\times2000}{1+12\times10^{-6}} = 2000.0028(m)$$

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Appendix 3: Earth-curvature and refraction correction

●When measuring the horizontal distance and height difference, the earth-curvature and refraction correction can be selected by the parameter No.4.

Difference between "no correction" and "applied correction"

<No correction>

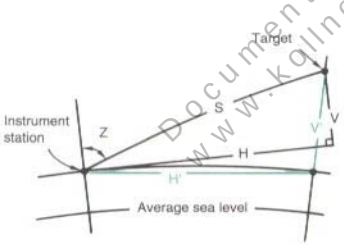
Horizontal distance: $H = S \times \sin Z$

Height difference: $V = S \times \cos Z$

<Applied correction>

Horizontal distance: $H' = S \times \sin z - \frac{1-K/2}{R} \times S^2 \times \sin Z \times \cos Z$

Height difference: $V = S \times \cos Z + \frac{1-K}{2R} \times S^2 \times \sin^2 Z$



S: Slope distance (atmospheric corrected value)
Z: Vertical angle (0° at zenith)
K: Atmospheric refraction constant (0.142)
R: Radius of the earth (6.372×10^6m)

e.g.: Correction value at Z=70° (K=0.142)

S distance	200m	500m	1000m	1500m
H' – H	–0.002m	–0.012m	–0.047m	–0.105m
V' – V	0.002m	0.015m	0.059m	0.134m

Note: The horizontal distance is the distance measured at the height of the surveying point above sea level. If required, reduce this distance to the average sea level and apply the local projection correction.

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Appendix 4: Standard accessories

Plumb bob

●If the weather is calm, or for initial tripod centring, the plumb bob can be used for centring. To use, unwind the plumb bob and attach it to the hook inside the centring screw. Use the cord grip piece to adjust the cord length.

Tubular compass CP7 (Accuracy ±1°)

●To mount the CP7, slide it into the tubular compass slot. To use, loosen the clamping screw to free the compass needle. Turn the instrument in the face left position until the compass needle bisects the index lines. The telescope is now aligned with magnetic north. After use, tighten the clamp and remove the compass from the slot. Replace it in the specified position in the carrying case.

Handle

●The carrying handle can be removed from the instrument as follows:

① Unscrew the handle securing screw

② Slide the handle to the side

③ Remove the handle

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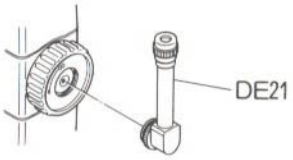
Appendix 5: Optional accessories

Diagonal eyepiece DE21



- The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the handle and the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.

Solar filter OF1/OF1A

OF1

OF1A

- For observations to the sun, and where glare is present. The OF1 and OF1A (flip-up type) filters are mounted on the objective lens.

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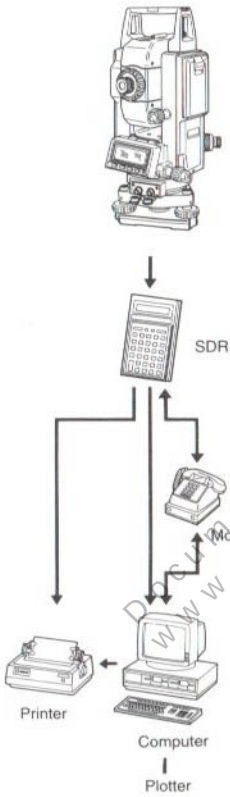
Electronic field book SDR series

●The SDR series collects and stores slope distance, vertical and horizontal angle data from SET E. Calculations can be performed on the data so that the measurements can be verified in the field. The stored data can be transmitted to a data processing system.



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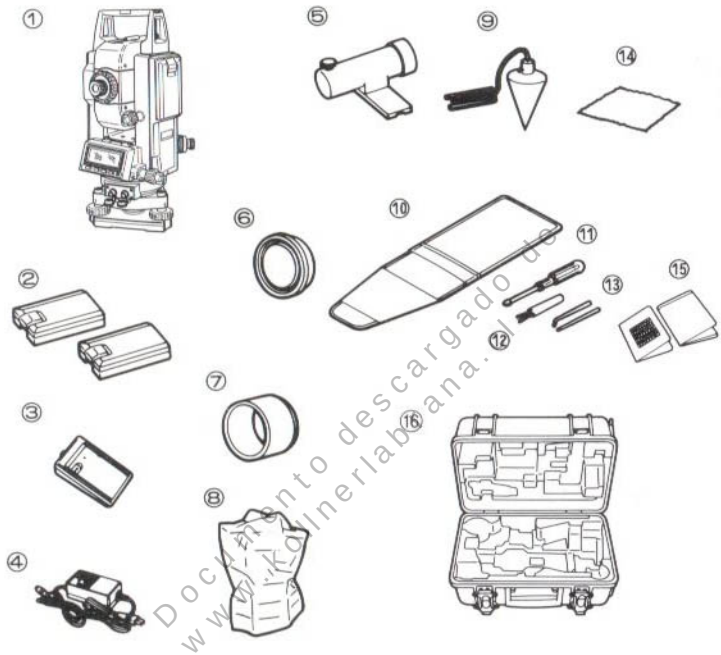
STANDARD EQUIPMENT



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① SET3E/SET4E/SET5E/5ES . 1
② Internal battery, BDC25 1
③ Battery charging adaptor, EDC19 1
④ Battery charger, CDC27/CDC31 1
⑤ Tubular compass, CP7 1
⑥ Lens cap 1
⑦ Lens hood 1
⑧ Vinyl cover 1
⑨ Plumb bob 1
⑩ Tool pouch 1
⑪ Screwdriver 1
⑫ Lens brush 1
⑬ Adjusting pin 1
⑭ Cleaning cloth 1
⑮ Operator's manual 1
Atmospheric correction chart ... 1
⑯ Carring case (SC129) 1

MAINTENANCE

1) Wipe off moisture completely if the instrument gets wet during survey work.

2) Always clean the instrument before returning it to the case. The lens requires special care. Dust it off with the lens brush first, to remove minute particles. Then, after providing a little condensation by breathing on the lens, wipe it with a soft clean cloth or lens tissue.

3) Do not wipe the displays and keyboard or carrying case with an organic solvent.

4) Store SET E in a dry room where the temperature remains fairly constant.

5) If the battery is discharged excessively, its life may be shortened. Store it in a charged state.

6) Check the tripod for loose fit and loose screws.

7) If any trouble is found on the rotatable portion, screws (⑨, ⑪, ⑬, ⑱, ⑲, ㉔ and ㉕) or optical parts (e.g. lens), contact your Sokkia agent.

8) When the instrument is not used for a long time, check it at least once every 3 months.

9) When removing SET E from the carrying case, never pull it out by force. The empty carrying case should then be closed to protect it from moisture.

10) Check SET E for proper adjustment periodically to maintain the instrument accuracy.

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SPECIFICATIONS

Telescope

Length:	165mm
Aperture:	45mm
Magnification:	SET3E/4E: 30x SET5E: 26x
Image:	Erect
Resolving power:	SET3E/4E: 3" SET5E: 3.5"
Field of view:	1°30' (26m / 1000m)
Minimum focus:	1.3m
Reticle illumination	Bright or dim settings (Selectable with parameter)

Angle measurement

Horizontal and Vertical circles type:	Incremental with 0 index
Angle units:	Degree / gon / mil (Selectable with parameter)
Display range:	SET3E: –3599° 59' 59" to 3599° 59' 59" SET4E/5E: –3599° 59' 59" to 3599° 59' 59"
Minimum display:	SET3E: 1" (0.2mgon / 0.005mil) / 5" (1mgon / 0.02mil) SET4E/5E: 5" (1mgon / 0.02mil) / 10" (2mgon / 0.05mil) (Selectable with parameter)
Accuracy:	Standard deviation of mean of measurement take in positions I and II (DIN 18723) SET3E: 3" (1mgon / 0.015mil) SET4E/5E: 5" (1.5mgon / 0.02mil)
Measuring time:	Less than 0.5sec
Automatic compensator:	Selectable ON (V & H / only V) / OFF
Type	Liquid, 2-axis tilt sensor
Minimum display:	SET3E: 1" (0.2mgon / 0.005mil) SET4E/5E: 5" (1mgon / 0.02mil)
Range of compensation:	±3'
Measuring mode:	
Horizontal angle:	Right / Left / Repetition / Hold (Selectable with keyboard)
Vertical angle:	Zenith 0 / Horizontal 0 / Horizontal ±90° (Selectable with parameter) Slope in % (Selectable with keyboard)

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Distance measurement

Measuring range: (Slight haze, visibility about 20km, sunny periods, weak scintillation)
SET3E/4E:
Compact prism CP01: 1.3 to 700m
Standard prism AP x1: 1.3 to 1600m
Standard prism AP x3: 1.3 to 2100m
Standard prism AP x9: 1.3 to 2500m
SET5E:
Compact prism CP01: 1.3 to 500m
Standard prism AP x1: 1.3 to 800m
Standard prism AP X3: 1.3 to 1000m

Minimum display: Fine measurement: 1mm
Coarse measurement: 1mm
Tracking measurement: 10mm

Maximum slope distance: SET3E/4E: 9999.999m
SET5E: 1999.999m

Distance unit: metres / feet (Selectable with parameter)
(Changeable for 5 seconds with keyboard)

Accuracy SET3E: ±(3+2ppmxD)mm
SET4E: ±(3+3ppmxD)mm
SET5E: ±(5+3ppmxD)mm
(unit: mm, Fine measurement)

Measurement mode: Fine & repeat measurement /
Fine & single measurement /
Fine & average measurement /
Coarse & single measurement
(Selectable with parameter)
Tracking measurement (Selectable with keyboard)

Measuring time: (When "C+R correction" is not being applied.)

SET3E / 4E	Fine	Coarse	Tracking
Slope distance	4.7s + every 3.2s	1.7s	1.4s + every 0.3s
Horizontal distance Height difference	4.7s + every 3.3s	1.9s	1.5s + every 0.3s
Coordinates	5.1s + every 3.3s	2.4s	1.7s + every 0.7s
REM	0.7s + every 0.5s		
Horizontal distance between 2 points	5.8s + every 3.3s	2.9s	2.8s + every 0.7s

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SET5E	Fine	Coarse	Tracking
Slope distance Horizontal distance Height difference	4.1s + every 3.0s	1.4s	1.4s + every 0.4s
Coordinates	4.4s + every 3.1s	2.0s	1.9s + every 0.9s
REM		0.3s	
Horizontal distance between 2 points	4.3s + every 3.0s	1.6s	1.4s + every 0.4s

Signal source: Infrared LED
Light intensity control: Automatic
Atmospheric correction:
Temperature input range: –30 to 60°C (in 1°C steps) / –22 to 140°F (in 1°F steps)
Pressure input range: 500 to 1400hPa (in 1hPa steps)/ 375 to 1050mmHg (in 1mmHg steps)/ 14.8 to 41.3inchHg (in 0.1inchHg steps) (Selectable with parameter)
ppm input range: –499 to 499ppm (in 1ppm steps)
Prism constant correction: –99 to 0mm (in 1mm steps)
Earth-curvature and refraction correction: ON / OFF (Selectable with parameter)

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Power supply

Power source: Ni-Cd rechargeable battery, BDC25 (DC6V)
Working duration at 25°C: Distance & Angle measurement:
(Fine & single measurement, measurement interval = every 30 secs)
SET3E/SET4E:
BDC25: About 5 hours (About 600 points)
Optional battery BDC12: About 25 hours (About 3000 points)
SET5E:
BDC25: About 7 hours (About 840 points)
Optional battery BDC12: About 35 hours (About 4200 points)
Angle measurement only:
BDC25: About 9 hours
BDC12: About 45 hours
Charging time: CDC27 / CDC31: About 80 minutes
CDC11 / 11D / 11E: About 15 hours

General

Display:	2 LDC dot matrix displays on each face 20 characters x 4 lines
Keyboard:	5 soft keys Allocating functions for keys and register locations are available
Sensitivity of levels:	Plate level: SET3E/4E: 30" / 2mm SET5E: 40" / 2mm Circular level: 10' / 2mm
Optical plummet:	Image: Erect Magnification: 3x Minimum fucus: 0.1m
Horizontal and vertical fine motion screw	SET3E: 2-speed motion SET4E/5E: 1-speed motion
Self-diagnostic function:	Provided
Power saving auto cut off:	30 minutes after operation / On/off with key (Selectable with parameter)
Data recording:	100 coordinate data can be stored in an internal memory
Data output:	Asynchronous serial, RS-232C compatible
Operating temperature:	–20 to 50°C
Instrument height:	236mm (9.3inch) from tribrach bottom, 193mm (7.6inch) from tribrach dish
Size:	150(W) x 165(D) x 353(H)mm (with handle and battery)
Weight:	SET3E/4E: 5.5kg SET5E/5ES: 5.8kg (with handle and battery)

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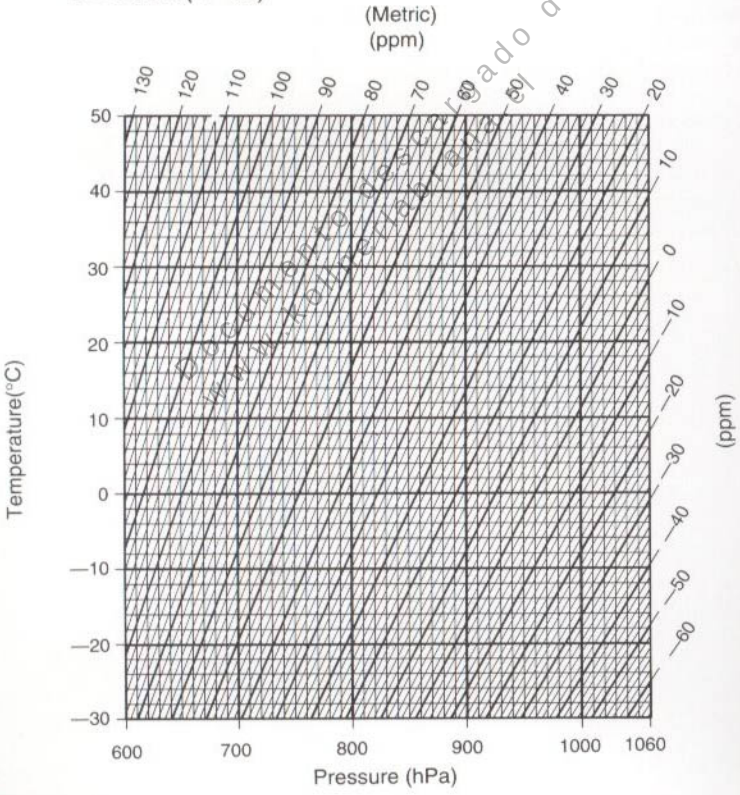
ATMOSPHERIC CORRECTION CHART

- This chart shows the correction every 2ppm, while the atmospheric correction can be input to SET E for every ppm.

- To convert a pressure in mmHg to one in hPa, divide by 0.75.
  To convert a pressure in inchHg to one in hPa, multiply by 33.87.
  hPa = mmHg / 0.75= 33.87 x inchHg

- To convert a temperature in °F to one in °C.
  °C = 0.56 x (°F–32)



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QUICK GUIDE TO THIS MANUAL

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<Levelling> ------ ☞ 14
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●Indexing V & H circles ---------- ☞ 18
●Setting instrument options ---------- ☞ 21

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●Error messages ---------- ☞ 87

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