

SET2CII

SET3CII

SET4CII

Intelligent Total Station

OPERATOR'S MANUAL

Congratulations on your purchase of the SET CII Series!
Before using the instrument, please read this operator's manual
and verify that all equipment is included, refer to P. 228
"STANDARD EQUIPMENT".

CONTENTS

QUICK GUIDE TO THIS MANUAL	1
1. FEATURES	2

INTRODUCTION

2. PRECAUTIONS	5
3. PARTS OF THE INSTRUMENT	6
4. COMMUNICATION SYSTEM	8
5. KEY FUNCTIONS	9
6. MODE DIAGRAM	12
7. DISPLAY SYMBOLS	13

PREPARATION FOR MEASUREMENT

8. MOUNTING THE BATTERY	17
9. SETTING UP THE INSTRUMENT	18
9.1 Centring	18
9.2 Levelling	19
10. POWER ON	21
[Note: Changing the brightness of the display]	22
[Note: Power-saving cut-off]	22
11. PREPARATION FOR MEASUREMENT	23
11.1 Indexing the vertical and horizontal circles	23
[Note: Horizontal angle backup]	24
[Note: Automatic tilt angle compensation]	24
[Note: Levelling using the tilt angle display]	25
11.2 Focussing and target sighting	26
[Note: Parallax]	27
11.3 Display and reticle illumination	28
11.4 Setting the Instrument options	29

CONTENTS

MEASUREMENT

12. ANGLE MEASUREMENT	33
12.1 Measure the horizontal angle between two points	33
<Horizontal angle 0>	
12.2 Set Horizontal circle to a required value	35
<Set Horizontal circle to a required value>	
12.3 Horizontal angle display	37
<Horizontal angle right/left>	
13. DISTANCE MEASUREMENT	38
13.1 Measurement mode selection	38
13.2 Prism constant input	41
13.3 Atmospheric correction	44
13.4 Return signal checking	48
13.5 Slope distance/Horizontal distance/Height difference measurement	49
13.6 Review of measured data	51
14. COORDINATE MEASUREMENT	52
14.1 Measurement mode selection	52
14.2 Instrument height and target height input	53
14.3 Instrument station coordinates and Backsight station coordinates	56
14.4 Setting the azimuth angle from Instrument station and Backsight station coordinates	61
14.5 3-Dimensional coordinate measurement	62

CONTENTS

ADVANCED MEASUREMENT FUNCTIONS

15. RESECTION MEASUREMENT	67
16. TRAVERSE-STYLE COORDINATE MEASUREMENT	76
17. OFFSET MEASUREMENT	80
18. REM MEASUREMENT	86
19. MISSING LINE MEASUREMENT	90
19.1 Measurement mode selection	90
19.2 Measuring the distance between two or more points ..	91
19.3 Changing of the starting position	94
20. SETTING-OUT MEASUREMENT	96
20.1 Horizontal angle and distance setting-out measurement	97
20.2 Coordinates setting-out measurement.....	101

USING THE MEMORY CARD TO RECORD THE DATA

21. MEMORY CARD OPERATIONS	109
21.1 Card features	109
21.2 Inserting and formatting the card	112
21.3 Changing the instrument options	114
21.4 Job creating and selecting	115
21.5 Instrument data recording	121
21.6 Instrument station data recording	123
21.7 Measured data recording	128
21.8 Note recording	134
21.9 Feature code recording	136
21.10 Feature code recalling to stack	141
21.11 Feature code deleting	144
21.12 Coordinate data recording	147
21.13 Coordinate data recalling to Instrument	152
21.14 Reviewing data stored on the card	162
21.15 Protecting data stored on the card	169
21.16 Data stored on the card output to an external device ..	172

CONTENTS

TROUBLESHOOTING

22. ERROR MESSAGES	175
23. CHECKS AND ADJUSTMENTS	179
23.1 Plate level	179
23.2 Circular level	181
23.3 Reticle	182
23.4 Coincidence of distance measuring axis with reticle ..	186
23.5 Optical plummet	189
23.6 Distance measurement check flow chart	191
23.7 Additive distance constant	193

MEASUREMENT OPTIONS SELECTION

24. CHANGING INSTRUMENT PARAMETERS	197
25. POWER SUPPLIES	207
26. REFLECTING PRISMS AND ACCESSORIES	209

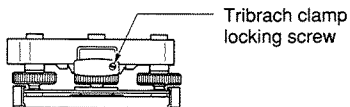
APPENDICES

Appendix 1: MANUALLY INDEXING THE VERTICAL CIRCLE BY FACE LEFT, FACE RIGHT MEASUREMENTS ..	213
Appendix 2: FOR ANGLE MEASUREMENT OF THE HIGHEST ACCURACY	214
<Adjusting the tilt zero point error>	214
<Adjusting the collimation error by Collimation program>	216
Appendix 3: FOR DISTANCE MEASUREMENT OF THE HIGHEST ACCURACY	219
Appendix 4: EARTH-CURVATURE AND REFRACTION CORRECTION	221
Appendix 5: DATA OUTPUT TO AN EXTERNAL DEVICE	222
Appendix 6: STANDARD ACCESSORIES	224
Appendix 7: OPTIONAL ACCESSORIES	225
STANDARD EQUIPMENT	228
MAINTENANCE	229
SPECIFICATIONS	230
ATMOSPHERIC CORRECTION CHART	234

<Important>

The battery has not been charged at the factory.
Please charge the battery fully before using.

<Important>



When the new SET C is shipped, the tribrach clamp is fixed with a screw.

Loosen it and leave it loose.

And if the SET C is again shipped, fix the tribrach clamp with the screw to stop the tribrach becoming detached from the instrument.

The specifications and general appearance of the instrument may be altered at any time and may differ from those appearing in catalogues and this operator's manual.

QUICK GUIDE TO THIS MANUAL

- Ensure that the battery is charged before measurement.

Preparation for measurement

- Battery mounting 17
- Setting up Instrument <Centring 18/Levelling 19> ● Power on 21
- Indexing V & H circles 23 ● Focussing & target sighting 25
- Display & Reticle illumination 26 ● Setting instrument options 29

1

Angle & Distance measurement

- Angle <Set H angle to 0 33/Set H circle to a required value 35/
H angle right/left 37>
- Distance <Measurement mode 39/Prism constant correction 41/
Atmospheric correction 42/Return signal checking 43/Measurement 45>

2

Coordinate measurement

- Measurement mode 52 ● Instrument height & Target height input 53
- Instrument station & Backsight station coordinates input 55
- Setting the azimuth angle 56
- 3-Dimensional coordinate measurement 57

3

Advanced measurement functions

- Resection measurement 67 ● Traverse-style measurement 70
- Offset measurement 81 ● REM measurement 86
- Missing line measurement 90
- Setting-out measurement 95

4

Memory card operations

- Inserting & formatting card 102 ● Changing Instr. options 104
- Creating & Selecting Job 105 ● Recording data <Instr. 107/Instr.station 108/
Measured 109/Note 110/Code 111/Coord 112>
- Recalling data <Code 111/Coord 112> ● Reviewing 113 ● Protecting 115

5

Troubleshooting...

- Error messages 117

6

1

1. FEATURES

< SET CII ADVANCED MEASUREMENT FUNCTIONS >

- Resection measurement
- Traverse-style coordinate measurement
- Offset measurement
- REM measurement
- Missing line measurement
- Setting-out measurement

< MEMORY CARD OPERATION >

- Set the job name
- Record and review the data
Instrument data/Instrument station data/Measured data/Note/Coordinate data/Feature code
One 64Kb card can store approximately 1000 measured target points in angle and distance (S, V, H) format.
- Recall the data stored on Card to Instrument
Feature code/Coordinate data

< TILT ANGLE COMPENSATION >

- Dual axis tilt sensor
- The index error of the tilt angle can be eliminated

< COLLIMATION PROGRAM >

- The collimation error between the centre of the telescope reticle and the sighting line can be calculated, and the correction value specified is set. (for angle measurement of high accuracy.)

< DATA OUTPUT >

- The SET CIIRS232C-compatible data output connector allows 2-way communication with an external device.
- Key operations allow the SET C to output the data stored on the card via the data output connector to an external device using an interface cable.

INTRODUCTION

2. PRECAUTIONS

 **P.5**

3. PARTS OF THE INSTRUMENT

 **P.6**

4. COMMUNICATION SYSTEM

 **P.8**

5. KEY FUNCTIONS

 **P.9**

6. MODE DIAGRAM

 **P.12**

7. DISPLAY SYMBOLS

 **P.13**

2. PRECAUTIONS

- **Never place the SET C 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 C with an umbrella.**

against direct sunlight, rain and humidity.

- **Never carry the SET C on the tripod to another site.**

- **Handle the SET C with care. Avoid heavy shocks or vibration.**

- **When the operator leaves the SET C, the vinyl cover should be placed on the instrument.**

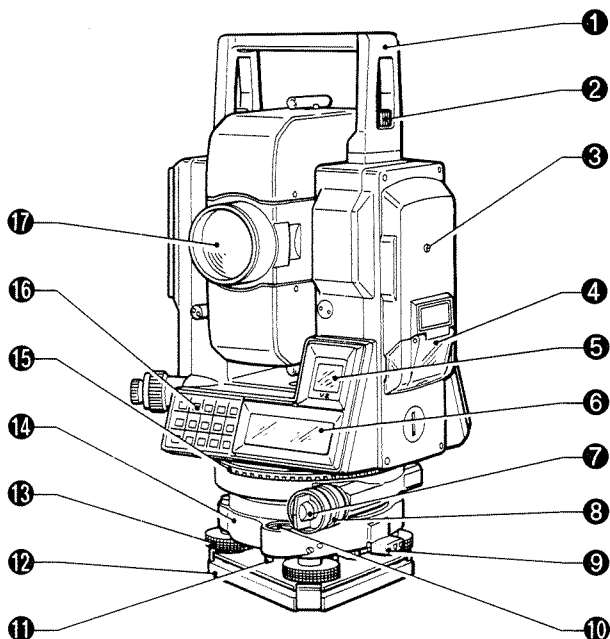
- **Always switch the power off before removing the standard battery.**

- **Remove the standard battery from the SET C before putting it in the case.**

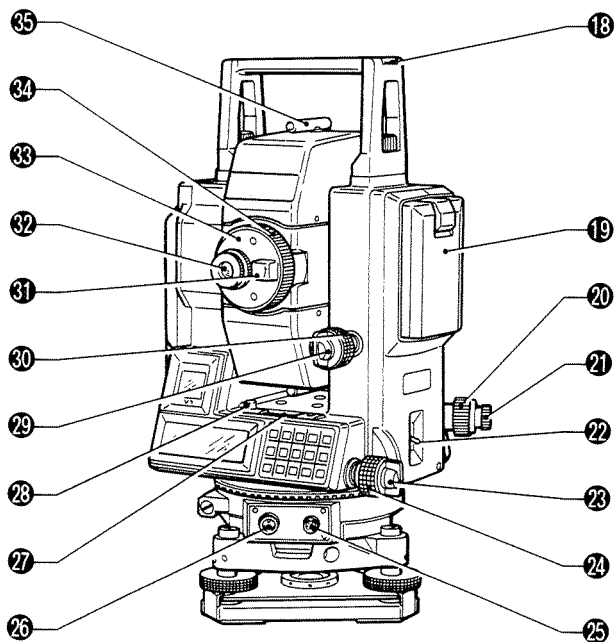
- **When the SET C is placed in the carrying case, follow the layout plan.**

- **Make sure that the SET C 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.**

3. PARTS OF THE INSTRUMENT

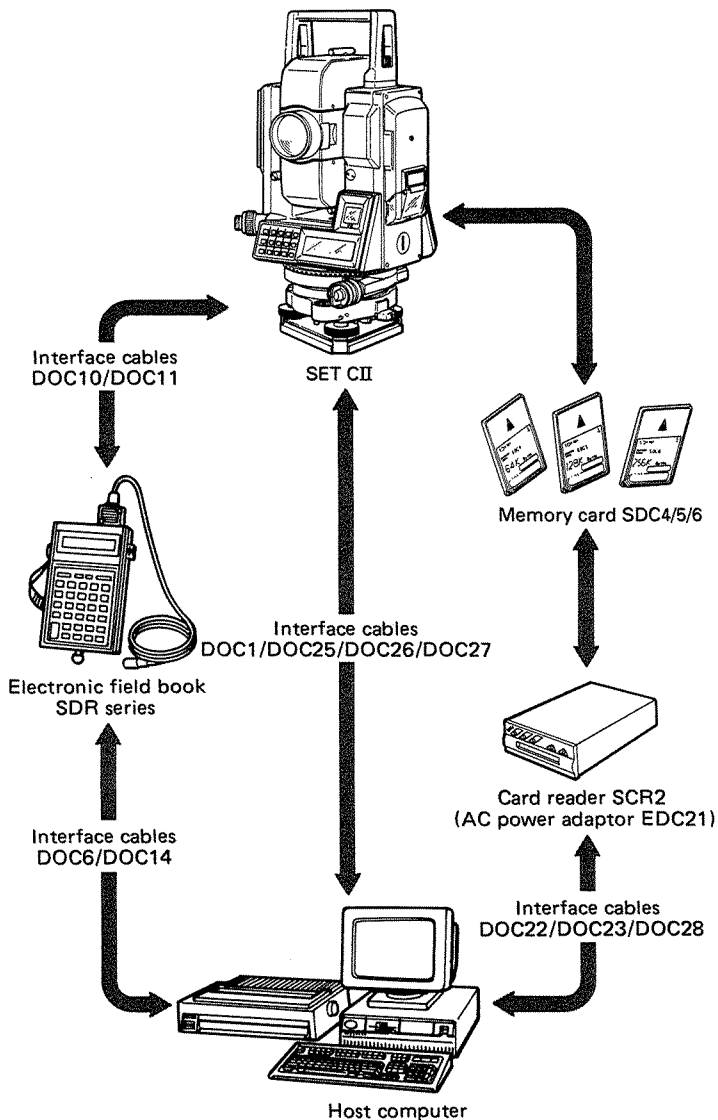


- | | |
|--------------------------|--------------------------------------|
| ① Handle | ⑪ Circular level adjusting screws |
| ② Handle securing screw | ⑫ Base plate |
| ③ Instrument height mark | ⑬ Levelling foot screw |
| ④ Card cover | ⑭ Tribrach |
| ⑤ Sub display | ⑮ Horizontal circle positioning ring |
| ⑥ Main display | ⑯ Keyboard |
| ⑦ Lower clamp | ⑰ Objective lens |
| ⑧ Lower clamp cover | |
| ⑨ Tribrach clamp | |
| ⑩ Circular level | |



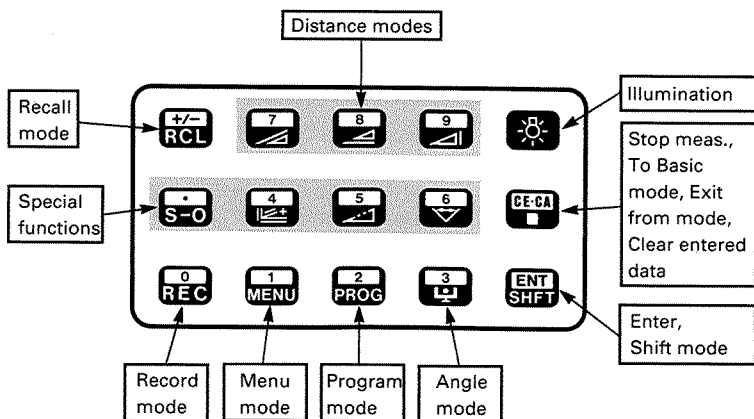
- | | |
|------------------------------------|---------------------------------------|
| 18 Tubular compass slot | 27 Plate level |
| 19 Battery BDC25 | 28 Plate level adjusting screw |
| 20 Optical plummet focussing ring | 29 Vertical clamp |
| 21 Optical plummet eyepiece | 30 Vertical fine motion screw |
| 22 Power switch | 31 Telescope transitting knob |
| 23 Horizontal clamp | 32 Telescope eyepiece |
| 24 Horizontal fine motion screw | 33 Telescope reticle adjustment cover |
| 25 Data output connector | 34 Telescope focussing ring |
| 26 External power source connector | 35 Peep sight |

4. COMMUNICATION SYSTEM

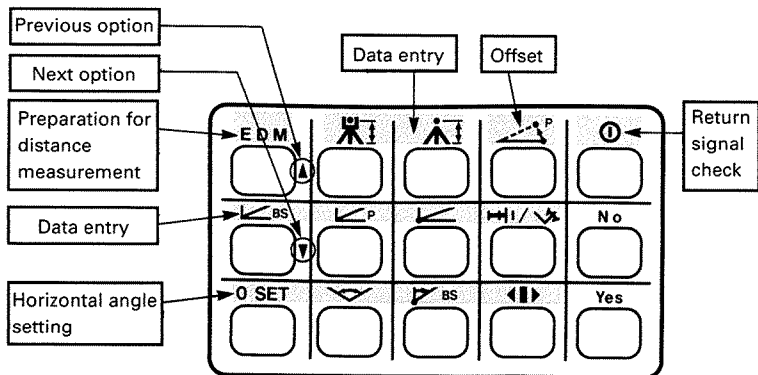


5. KEY FUNCTIONS

<Main functions>



<Shift functions>



EDM



○ < **ENT** **SHIFT** + > : Prism constant/ppm/Distance mode

- (Data input mode): Change the sign of the data input value
(Parameter/Input mode): Move to previous option

● **Recall data from the memory**

BS



○ < **ENT** **SHIFT** + > : Input Backsight station coordinates

- (Data input mode): Input "." (Decimal point)
(Parameter/Input mode): Move to next option

● **Setting out measurement (+ mode key)**

0 SET



○ < **ENT** **SHIFT** + > : Set Horizontal angle to 0/

In Missing line measurement, change the starting point

- (Data input mode): Input "0"

● **Output data to Card or an External device**

7



○ < **ENT** **SHIFT** + > : Input Instrument height

- (Data input mode): Input "7"

● **Measure Slope distance**

4



○ < **ENT** **SHIFT** + > : Input coordinates of point to be set out

- (Data input mode): Input "4"

● **Measure 3-dimensional coordinates**

1



○ < **ENT** **SHIFT** + > : Set horizontal angle to the required value

- (Data input mode): Input "1"

● **Menu mode: Configuration/Card settings/Code settings**

8



○ < **ENT** **SHIFT** + > : Input target height

- (Data input mode): Input "8"

● **Measure Horizontal distance**

5



○ < **ENT** **SHIFT** + > : Input Instrument station coordinates

- (Data input mode): Input "5"

● **Measure remote elevation**



○ < **ENT/SHIFT** + > : Set Azimuth angle from Instrument station and Backsight station coordinates

- (Data input mode): Input "2"

● **Program mode: Resection/Correction/
Set Instrument station coordinates and azimuth angle**



○ < **ENT/SHIFT** + > : Offset measurement

- (Data input mode): Input "9"

● **Measure Height difference**



○ < **ENT/SHIFT** + > : Input distance & horizontal angle setting-out data

- (Data input mode): Input "6"

● **Missing line measurement**



○ < **ENT/SHIFT** + > : Select horizontal angle right or left

- (Data input mode): Input "3"

● **Transfer to Theodolite mode /
Display tilt angle (when Instrument is in Theodolite mode
and the "Tilt correction" parameter is on)**



○ < **ENT/SHIFT** + > : Return signal check (stop: **CE-CA**)

● **Display and Reticle illumination ON/OFF**



- Input "No"

- (Data Input mode): Clear input data

● **Stop measurement and transfer to Basic mode/
Exit from mode**



- Input "Yes"

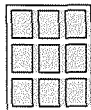
- (Data input mode): Input data into memory

● **Select/Release Shift mode**

7. DISPLAY SYMBOLS

<Sub display>

ppm/P.C/MODE



V1

ppm(Atmospheric correction value)

P.C.(Prism constant correction value)

⊥+ : Tilt angle compensation on

SHFT : Shift

SO : Setting-out measurement mode

MENU : Menu mode

PROG : Program mode

REC : Record mode

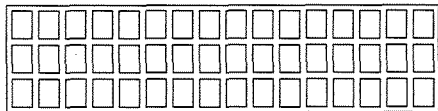
RCL : Recall mode

Stn : Instrument station coordinates

BS : Backsight station coordinates

Pt : Coordinate setting-out data

<Main display>



: Select options

S

: Slope distance

H

: Horizontal distance

ZA

: Zenith angle (Z 0°)

V

: Height difference

VA

: Vertical angle (H 0°)

Ht

: REM value/Instrument height/Target height

Vertical angle

(H 0°±90°)

D

: Distance setting-out data/Offset distance

HAR

: Horizontal angle right

HAL

: Horizontal angle left

dHA

: Horizontal angle from setting-out data

X

: Tilt angle in sighting direction

Y

: Tilt angle in horizontal axis direction

PREPARATION FOR MEASUREMENT


8. MOUNTING THE BATTERY

 P.17

9. SETTING UP THE INSTRUMENT

 P.18

9.1 Centring 

9.2 Levelling 


10. POWER ON


 P.21

11. PREPARATION FOR MEASUREMENT

 P.23

11.1 Indexing the vertical and horizontal circles 

11.2 Focussing and target sighting 

11.3 Display and reticle illumination 

11.4 Setting the Instrument options 

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.

1871. 10. 10. 1871.


1871. 10. 10. 1871.


1871. 10. 10. 1871.

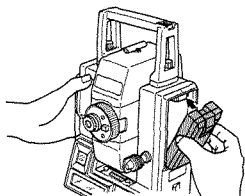
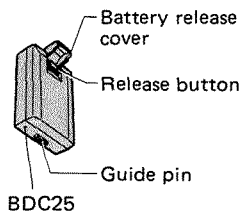
1871. 10. 10. 1871.

1871. 10. 10. 1871.

8. MOUNTING THE BATTERY

- Charge the battery fully before measurement.  P.207

Note: Turn off the power supply switch  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.
- 3) Remove the battery.

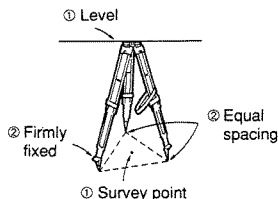
- If the power is to be turned on immediately after replacing the battery, please refer to P. 21.

9. 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.

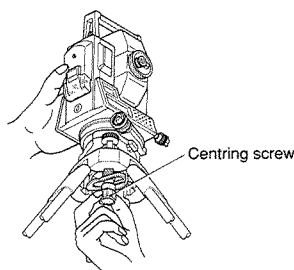
9.1 Centring

Set up the tripod



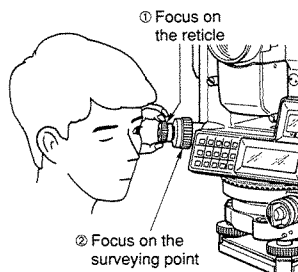
- 1) Make sure the legs are spaced at equal intervals and the head is approximately level.
- 2) Set the tripod so that the head is positioned over the surveying point.
- 3) Make sure the tripod shoes are firmly fixed in the ground.

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.

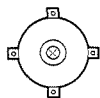
Focus on the surveying point



- 6) Looking through the optical plummet eyepiece, turn the optical plummet eyepiece ② to focus on the reticle.
- 7) Turn the optical plummet focusing ring ② to focus on the surveying point.

9.2 Levelling

Centre the surveying point in the reticle



Optical plummet

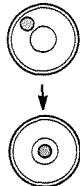
- 1) Adjust the levelling foot screws ⑩ to centre the surveying point in the optical plummet reticle.

Centre the bubble in the circular level

Adjust tripod legs

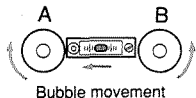
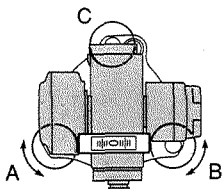


Circular level



- 2) Observe the off-centre direction of the bubble in the circular level ⑩, and shorten the nearest tripod leg, or extend the leg farthest from that direction to centre the bubble.
- 3) One more tripod leg must be adjusted to centre the bubble.

Centre the bubble in the plate level

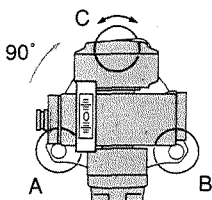


Bubble movement

- 4) Loosen the horizontal clamp ⑫ to turn the upper part of the instrument until the plate level ⑭ is parallel to a line between levelling screws A and B.
- 5) Centre the air bubble, using levelling screws A and B.

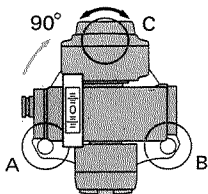
Note : The bubble moves towards a clockwise rotated foot screw.

Turn 90° and centre the bubble



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

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 ⑦.

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

- ① Adjust levelling 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 screw C to remove half of the displacement in this direction.

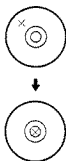
Or try the adjustment described on P.179, under "23.1 Plate level".

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.

Focus on the centre of the reticle again



- 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) Re-tighten the centring screw securely.

Check plate level bubble again

- 13) Check again to make sure the bubble in the plate level is centred. (If not, repeat the procedures starting from step 4).)

10. POWER ON

- When the power is turned on, a self-check is run to make sure the instrument is operating normally.

Turn on the power



SET C model 2
No. 88132
Ver. 58-XX

Self check ok

or

Memory cleared

Battery level 3

- 0: less than 20%
1: less than 50%
2: less than 80%
3: less than 100%

Battery is low

- Turn on the power switch ② after completing sections 8 and 9.
- The instrument name, instrument number, and software version are displayed for several seconds, an audio tone sounds, and the instrument performs self-diagnostic checks.
On successful completion of the checks, "Self check ok" is displayed for 2 secs.

Note: After power-off for more than 1 week, the previously stored data have been cleared from the short-term memory and "Memory cleared" is displayed.

- The remaining battery power is then displayed for 3 seconds as a numeric value.
(BDC25, Coarse meas. mode, Single meas., Temperature 25°C)

If the battery is at the "low" level, the message "Battery is low" will be displayed, and an audio tone sounds. Turn the power off and charge the battery.

If the battery power becomes low during surveying, the same message will be displayed.

ZA 0 SET
HAR 0 SET

- 4) This display indicates that the instrument is ready for vertical and horizontal circle indexing.

- If the parameter horizontal indexing is set to "Manual", a horizontal angle of 0° is displayed, when the power is turned on.

If this error message is displayed, the instrument tilt sensor is indicating that the instrument is off-level. Relevel the instrument once again, using the plate level bubble.

- When "Face 1" is displayed for the vertical angle, please refer to P.213 (Appendix 1: Manually indexing the vertical circle).

Out of range
X > \perp < Y

Instrument parameter No.8 P.197

Parameter No.8 can change the indexing method. Options are indexing by transitting the telescope or indexing by face left, face right sightings.

[Note: Changing the brightness of the display]

- If the display appears too dim or too bright, the keyboard can be used to adjust the brightness level (6 levels).

For a brighter display → Press and at the same time .

For a dimmer display → Press and at the same time .

[Note: Power-saving cut-off]

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

Instrument parameter No.12 P.197

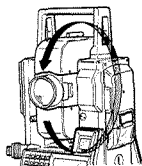
- Parameter No. 12 can be changed so that the SET C will not switch off automatically after 30 minutes.

11. PREPARATION FOR MEASUREMENT

11.1 Indexing the vertical and horizontal circles

(H and V circle indexing parameters - "Auto")

Vertical circle indexing

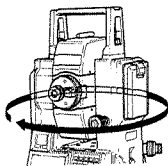


ZA	91° 04' 30"
HAR	0 SET

- 1) Loosen the vertical clamp 29 and transit the telescope completely. (Indexing occurs when the objective lens crosses the horizontal plane in face left.)
- 2) An audio tone sounds, and the vertical angle (ZA) is displayed.

Vertical indexing has been completed.

Horizontal circle indexing




ZA	91° 04' 30"
HAR	350° 39' 00"

- 3) Loosen the horizontal clamp 28 and rotate the upper part of the instrument completely. (Indexing occurs when the plate level 27 passes the 0 mark of the horizontal positioning ring.)
- 4) The audio tone sounds, and the horizontal angle (HAR) is displayed. Horizontal indexing has been completed.

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

[Note: Horizontal angle back-up]

- The parameter No.9 default setting allows for the memorization of the previous horizontal 0 position at power-off for about 1 week. ("Memory cleared" is displayed after more than 1 week of power off.) H and V circles are each provided with a 0 index. When next switching on the SET C and indexing the horizontal circle again, the horizontal angle is recovered at the previously-memorized 0 position. This feature is useful when the battery voltage becomes low during measurement or after automatic power-off has occurred.

Instrument parameter No. 9  P.197

- Parameter No.9 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.

[Note: Automatic tilt angle compensation]

- When the $\perp+$ symbol is shown on the sub-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:

$$\text{Compensated horizontal angle} = \text{Measured horizontal angle} + \frac{\text{Tilt in angle Y}}{\tan(\text{Vertical angle})}$$

Therefore, when the SET C is not perfectly levelled, changing the vertical angle by rotating the telescope will cause the displayed (compensated) horizontal angle value to change. (The displayed horizontal angle value will not change during telescope rotation when the instrument is correctly levelled.)

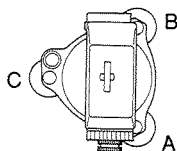
- When the measured vertical angles are within $\pm 1^\circ$ of the zenith or nadir, tilt compensation is not applied to the horizontal angle. In this situation, the displayed horizontal angle value flashes to show that the tilt compensation is not being applied.

Instrument parameter No.3  P.197

- Parameter No.3 can be used to switch off and on the automatic tilt angle compensation; for example, the automatic compensation should be switched off if the display is unsteady due to vibration or strong wind.

[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 tilt angle values are used to automatically correct the vertical and horizontal angles for error due to the non-verticality of the vertical axis. The measurement range is $\pm 3'$. The "Tilt correction (Dual axis)" parameter must be set to "Yes".



Tilt angle display

Tilt angle	
X	0° 01' 20"
Y	-0° 00' 40"

X: Levelling foot screws AB
Y: Levelling foot screw C
(in above illustration)

Tilt angle minimum display unit

SET2C:1"

SET3C:1"

SET4C:5"

Out of range	
X	> \perp < Y

To Theodolite mode

To Basic mode



To record the horizontal, vertical and tilt angles on the card, please refer to P.109.

- In Theodolite mode, 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 ②.

- Press .

- The X and Y tilt angles are displayed.

X : Tilt angle in sighting axis direction

Y : Tilt angle in horizontal axis direction

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

- "Out of range" indicates that the tilt angle exceeds the $\pm 3'$ measurement range.

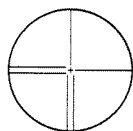
- To exit from the tilt angle display, press to return to Theodolite mode or press to go to Basic mode.



11.2 Focussing and target sighting

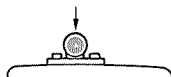
Focus on the reticle

1



Sight the target

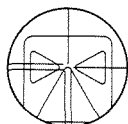
Line the target with
the white arrow in
the peep sight



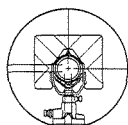
- 1) Look through the telescope eyepiece ② at a bright and featureless background.
- 2) Turn the eyepiece clockwise, then counterclockwise little by little until just before the reticle image goes out of focus. Using this procedure, frequent reticle refocussing is not necessary, since your eye is focussed at infinity.

- 3) Loosen the vertical ②⑨ and horizontal ②③ clamps, and use the peep sight ③⑤ to bring the target into the field of view.
- 4) Tighten both clamps.
- 5) Turn the focussing ring ③④ to focus on the target.
- 6) Turn the vertical ③⑩ and horizontal ②④ 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.



< Target centre >



< Prism centre >

- The relation between the target and the reticle is shown in the illustration at the left.

- 7) First, align the measuring point precisely with the centre of the target.

Then align the reticle precisely with the centre of the target.

- 8) Readjust the focus with the focusing ring 34 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.

[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.

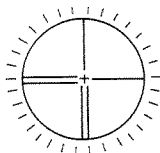
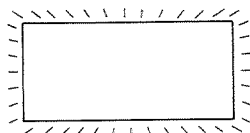
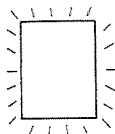



11.3 Display and reticle illumination

Illuminate the display and reticle



- Press the  to turn the display and reticle illumination on and off.



Instrument parameter No.13  P.197


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

Instrument parameter No.15  P.197

- Parameter No.15 can be used to change the brightness of the reticle illumination.

11.4 Setting the Instrument options

- Confirm that these parameters, indispensable for measurement, are set according to your required measurement.
- Data storage period : Until next changing (Power-off possible)
- To confirm or change the parameter options, please refer to P.197 "24. CHANGING INSTRUMENT PARAMETERS".

No.	Parameter		Options
3	Tilt correction		Correction YES* / Correction NO
4	Coordinate format		N, E, Z* / E, N, Z
5	Vertical angle format		Zenith angle (zenith 0°) * / Vertical angle (horizontal 0°) / Vertical angle (horizontal 0° ± 90°)
6	Angle resolution	SET2C	1" (0.2 mgon) * / 5" (1 mgon)
		SET3C	1" (0.2 mgon) * / 5" (1 mgon)
		SET4C	5" (1 mgon) * / 10" (2 mgon)
10	C + R correction		No correction * / Yes K = 0.142 Yes K = 0.20  P. 221
11	1	Distance unit	metres*/feet
	2	Angle unit	360*/400gon
	3	Temperature/Pressure units	°C & mbar* / °C & mm Hg / °F & mbar/ °F & mmHg/ °F & inchHg

*Factory setting

- For other parameters, please refer to P.197 "24. CHANGING INSTRUMENT PARAMETERS".

1000000000

1000000000

1000000000

10

1000000000

10

1000000000

10

1000000000

10

1000000000

1000000000

1000000000

10

1000000000

10

1000000000

10

1000000000

10

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

10

1000000000

1000000000

1000000000

1000000000

1000000000

10

1000000000



MEASUREMENT

12. ANGLE MEASUREMENT

➞ P.33

- 12.1 Measure the horizontal angle between two points ㉔
<Horizontal angle 0>
- 12.2 Set Horizontal circle to a required value ㉕
- 12.3 Horizontal angle display <Angle right/Angle left> ㉖

13. DISTANCE MEASUREMENT

➞ P.38

- 13.1 Measurement mode selection ㉗
- 13.2 Prism constant input ㉘
- 13.3 Atmospheric correction ㉙
- 13.4 Returned signal checking ㉚
- 13.5 Slope distance/Horizontal distance/
Height difference measurement ㉛
- 13.6 Review of measured data ㉜

14. COORDINATE MEASUREMENT

➞ P.52

- 14.1 Measurement mode selection ㉝
- 14.2 Instrument height and target height input ㉞
- 14.3 Instrument station coordinates and backsight station
coordinates input ㉟
- 14.4 Setting the azimuth angle from Instrument and
backsight station coordinates ㊱
- 14.5 3-Dimensional coordinate measurement ㊲

2 1-14

22 1-14

23 1-14

24 1-14

25 1-14

26 1-14

27 1-14

28 1-14

29 1-14

30 1-14

31 1-14

32 1-14

33 1-14

34 1-14

35 1-14

36 1-14

37 1-14

38 1-14

39 1-14

40 1-14

41 1-14

42 1-14

43 1-14

44 1-14

45 1-14

46 1-14

47 1-14

48 1-14

49 1-14

50 1-14

51 1-14

52 1-14

53 1-14

54 1-14

55 1-14

56 1-14




57 1-14

58 1-14

59 1-14

12. ANGLE MEASUREMENT

— Check! before measurement : —

1. SET C is set up correctly over the surveying point.  P.18
2. The V and H circles have been indexed.  P.23
3. The instrument parameters have been set.  P.29



To record the angle values on the card,
please refer to P.109.

12.1 Measure the horizontal angle between two points

< Horizontal angle 0 >

- Set the horizontal angle of the target direction.



Note:

Horizontal angle 0 set

Theodolite mode



: Set H angle
to zero



ZA

HAR

0° 00' 00"



- Measure the angle between two points.

Sight the first target



- 1) Using the horizontal clamp ⑫ and fine motion screw ⑭. Sight the first point.

Set the horizontal angle to 0°



- 2) In Theodolite mode, press **ENT** **SHFT** and **0** **REC**.

ZA	92° 36' 40"
HAR	0° 00' 00"

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

Sight the second target



- 3) Using the horizontal clamp ⑫ and fine motion screw ⑭. Sight the second point.

ZA	90° 30' 20"
HAR	140° 44' 20"

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

12.2 Set Horizontal circle to a required value

- Set the horizontal circle of the target direction to a required value.



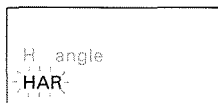
Note:

Set Horizontal circle to a required value

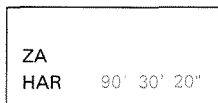
Theodolite mode or Basic mode



: For H angle
input mode



Input H angle value



- Input range
SET 2C : 0° to 359°59'59"
SET 3C : 0° to 359°59'59"
SET 4C : 0° to 359°59'55"
- Least input
SET 2C : 1"
SET 3C : 1"
SET 4C : 5"

◆ Correct the value :

◆ Exit from the input :
(To Theodolite mode)

Setting 90° 30' 20"

→ Input value of 90.302

e.g.

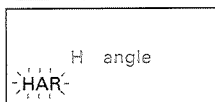
- Set the horizontal angle of reference target R to $60^{\circ} 00' 20''$.

Sight target R



- 1) Using the horizontal clamp ② and fine motion screw ④, sight target R.

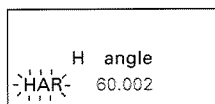
From Theodolite mode or Basic mode to H Angle Input mode



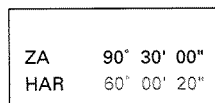
- 2) In Theodolite mode or Basic mode, press .

The display appears as at left, and "HAR" flashes to prompt for the input of the horizontal angle value.

Input the horizontal angle



- 3) Input "60.002".



- 4) Press to finish inputting. The instrument returns to Theodolite mode. Here, the horizontal angle for target R has been set to $60^{\circ} 00' 20''$.

12.3 Horizontal angle display

< Horizontal angle right/left >



Note:

Horizontal angle right/left

Theodolite mode (angle right)



ENT
SHIFT

8
L

: H angle left



ZA
HAL 260° 20' 40"



ENT
SHIFT

8
L

: H angle right



ZA
HAR 90° 30' 20"

13. DISTANCE MEASUREMENT

- The following preparations are required for Distance measurement.

- 13.1 Measurement mode selection
- 13.2 Prism constant input
- 13.3 Atmospheric correction
- 13.4 Return signal checking



To record the distance values on the card, please refer to P.109.

13.1 Measurement mode selection

- Select the measurement mode from the following according to your required measurement.

Measurement mode		Measurement time (slope distance)	Units
Fine meas.	Single	4.7 secs	1mm
	Repeat	First 4.7 secs & every 3.2 secs	
Coarse meas.	Single	1.7 secs	
	Repeat	First 1.7 secs & every 0.7 secs	
Tracking meas.		First 1.6 secs & every 0.3 secs	10mm

**Note:****Measurement mode selection**

Theodolite mode or Basic mode

↓
 : For Preparation mode
 ↓

1. Meas mode
2. Prism const.
3. ppm

↓
 : For selection mode of Distance measurement
 ↓

1. Fine meas
2. Coarse meas
3. Track meas

↓
 : Select Fine meas : Select Tracking meas
 : Select Coarse meas ↓
 Preparation mode

1. Single meas
2. Repeat meas

↓
 : Select Single meas
 : Select Repeat meas
 ↓

Preparation mode

- Data storage period : Until next changing (Power-off possible)
- ◆ Exit from the selection : (to Basic mode)



- Selecting the “Repeat” option under Fine measurement

From Theodolite mode or Basic mode to Preparation mode



1. Meas mode
2. Prism const.
3. ppm

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Preparation mode.

To Selection mode of Distance measurement mode



1. Fine meas
2. Coarse meas
3. Track meas

- 2) Press .

The display appears as at left, and the previously selected measurement type flashes.

Select Fine measurement



1. Single meas
2. Repeat meas

- 3) Press .

The display appears as at left, and the previously selected measurement type flashes.

Select Repeat measurement



1. Meas mode
2. Prism const.
3. ppm

- 4) Press .

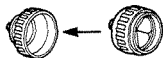
Fine and Repeat measurement modes are set, and the instrument returns to Preparation mode.

- To return to the Basic mode after this, press .

13.2 Prism constant input

- Each reflecting prism type has a different prism constant value. Here, we will input 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



30 mm → Input “-30”.

AP01



40 mm → Input “-40”.

CP01



0 mm → Input “0”

2



Note: Prism constant input

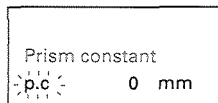
Theodolite mode or Basic mode



: For Preparation mode



: Prism constant input mode



Input correction value

Preparation mode

- Input range : -99mm to +99mm
- Least input : 1mm
- Data storage period : Until next changing (Power-off possible)

- ◆ Retain the displayed value :
- ◆ Correct the value :
- ◆ Exit from the input :



- Set a prism constant of 40 mm (correction value: -40)

From Theodolite mode or Basic mode to Preparation mode



1. Meas mode
2. Prism const.
3. ppm

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Preparation mode.

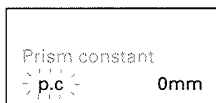
Prism Constant Setting mode



- 2) Press .



← Sub-display

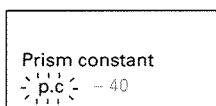


The previously stored correction value is displayed, and "p.c." flashes to prompt for the input of the correction value.

Input the prism constant correction value



- 3) Input "-40".



A prism constant correction value of -40 is input.

← Prism constant
correction value

1. Meas mode
2. Prism const.
3. ppm

4) Press .


The correction value is input, and the instrument returns to Preparation mode.

The entered value is displayed on the second line of the sub-display.

: To Basic mode

- To return to Basic mode after this, press .

13.3 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.  P.219, Appendix 3

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.

 P.219, Appendix 3






- The SET C is designed so that the correction factor is 0 ppm for a temperature of +15°C (+59°F) and an atmospheric pressure of 1013 mbar (29.9 inch Hg).
- By inputting the temperature and pressure values, the correction value is calculated and set into the memory. The formula used is as follows:

$$\text{ppm} = 278.96 - \frac{0.2904 \times P \text{ (mb)}}{1 + 0.003661 \times T \text{ (}^{\circ}\text{C)}}$$



- To input ppm value, read the correction factor from the table on P.234.
- For precise distance measurement, relative humidity should be taken into account together with atmospheric pressure and ambient temperature. See P.219.


Note: ppm setting mode

- T. input range : -30°C to $+60^{\circ}\text{C}$
T. least input : 1°C
- P. input range : 500 mb to 1400mb
P. least input : 1 mbar
- ppm input : -499ppm to 499ppm
ppm least input : 1ppm
- Data storage period :
About a week (Power-off possible)


- ◆ Retain the displayed value :  
- ◆ Correct the value :  (set value to 0)
- ◆ Exit from the input :  
(to Basic mode)

Theodolite mode or Basic mode


  : For Preparation mode


 : For ppm setting mode


1. 0 set
2. Temp & Press
3. ppm value


 : Set 0ppm

Basic mode


 : Set Temperature & Pressure

 15°C
P. 1013 mbar


Input Temperature 

Input Pressure 

Basic mode

 : Set ppm value

ppm value
ppm 0

Input ppm value 

Basic mode



- Temperature of 20°C and Atmospheric pressure of 1010 mbar

From Theodolite mode or Basic mode to Preparation mode



1. Meas mode
2. Prism const.
3. ppm

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Preparation mode.

To ppm setting mode



ppm
- 40 ← Sub-display

- 2) Press .

1. 0 set
2. Temp & Press
3. ppm value

The display appears as at left, showing the ppm setting mode.

Select the input of Temperature and (atmospheric) Pressure



T 15 °C
P. 1013 mbar

- 3) Press .

The previously stored values are displayed.

"T" flashes to prompt for the input of the temperature.

Input Temperature and Pressure

PROG REC ENT SHFT

T.	20	°C
P.	1013	mbar

MENU REC MENU REC ENT SHFT

T.	20	°C
P.	1010	mbar

6	← Atmospheric correction value
- 40	

Press function
keys to select
operation

- 4) Input "20" and press **ENT SHFT**.

The temperature "20°C" is input. "P" flashes to prompt for the input of the pressure.

- 5) Input "1010" and press **ENT SHFT**.

The pressure "1010 mbar" is input, and the instrument returns to Basic mode.

The atmospheric value coefficient is calculated, and is displayed on the first line of the sub-display.

13.4 Return signal checking

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

Note : When the light intensity coming back from the reflecting prism is very high (short distance) an asterisk "*" may be displayed, even for a slight mis-sighting. Therefore make sure that the target centre is sighted correctly.



Note:

Return signal checking

Sight the centre of the target with
Telescope



Theodolite mode or Basic mode



: For Return signal
checking mode



Signal*

- If "*" does not appear, sight the centre of the target correctly.



: Finish
Checking mode
(to Basic mode)



: Start
measurement








Instrument parameter No. 14  P.197

Parameter No. 14 can be used to switch on / off the returned signal audio tone.

13.5 Slope distance / Horizontal distance / Height difference measurement

- The slope distance, the horizontal distance, and the height difference are measured simultaneously with the angle.




Check! before measurement:

1. SET C is set up correctly over the surveying point.  P.18
2. The V and H circles have been indexed.  P.23
3. The Instrument parameters and the units have been set.  P.29
4. The distance measurement mode is selected.  P.38
5. The prism constant correction value is set.  P.41
6. The atmospheric correction is set.  P.44
7. The centre of the target is correctly sighted and the return signal is adequate for measurement.  P.48

2

Start the measurement from Theodolite mode or Basic mode



- 1) In Theodolite mode or Basic mode, press  ,  or  .




This accesses the Distance measurement mode, and the distance measurement is started. The display appears as at left and flashes. (The illustration at the left shows an example of slope distance measurement.)

S	234.567m
ZA	81° 12' 30"
HAR	12° 23' 40"

After about 4.7 seconds (Fine measurement mode) , the distance value, the vertical angle and the horizontal angle are displayed.

Stop the measurement

 : Stop

2) Press  . (The display does not change.)

- If the single measurement mode has been selected, measurement stops automatically.



: Start next measurement





: To Basic mode



: To Theodolite mode

- Press  ,  , or  to start the next measurement.

Press  to return to the Basic mode,
or press  to go to Theodolite mode.


Signal off

After 2 minutes

S	Timeout
ZA	81° 12' 30"
HAR	12° 23' 40"

Note: If "Signal off" is displayed, the return signal strength has become inadequate for measurement. Verify the target sighting. If within 2 minutes the return signal becomes sufficient, the measurement is restarted.

After 2 minutes, the measurement is stopped automatically and the display appears as at left:

In this case, sight the target again and restart the measurement. (The same display appears during measurement if the return signal is too weak. Press  to stop measurement and sight the target again.)

13.6 Review of measured data

- The distance and angle measured most recently are stored in the memory until the power is turned off. The stored slope distance, horizontal distance and height difference can be displayed in Recall mode as follows.



Note:

Data recall

Theodolite mode or Basic mode or
when measured data is displayed



: For Recall mode



: Display the
stored Slope
distance



: Display the
stored
Horizontal
distance

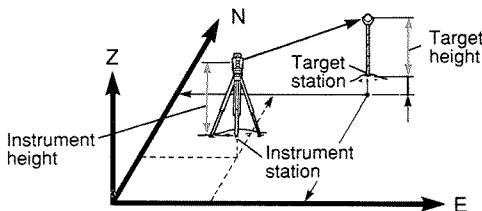


: Display the
stored Height
difference



14. COORDINATE MEASUREMENT

- The SET C calculates the 3-Dimensional coordinates of the prism position. To calculate the Z (Height) coordinate, first enter the instrument and target heights, then the Instrument station coordinates.



- By inputting the Backsight station coordinates, sighting the backsight station and pressing a key on the SET C keyboard, the horizontal angle can be set to the azimuth value.
- The following preparations are required for Coordinate measurement.

- 14.1 Measurement mode selection
- 14.2 Instrument height and target height input
- 14.3 Instrument station coordinates and Backsight station coordinates input
- 14.4 Setting of azimuth angle from the instrument and backsight station coordinates.

14.1 Measurement mode selection

- Select the measurement mode from the following according to your required measurement.
See P.38 "13.1 Measurement mode selection" for key operation.

Measurement mode		Measurement time (slope distance)	Units
Fine meas.	Single	5.1secs	1mm
	Repeat	First 5.1 secs & every 3.3 secs	
Coarse meas.	Single	2.4 secs	
	Repeat	First 2.4 secs & every 0.7 secs	
Tracking meas.		First 2.2 secs & every 0.7 secs	10mm

14.2 Instrument height and target height input

- As preparation for coordinate measurement, the instrument height (the height difference between the surveying point and the instrument station height mark ③) and target height (the height difference between the surveying point and the centre of the target) should be input to the SET C before the measurement.
- The heights of the instrument and the target are measured manually beforehand, using a measuring tape, etc.

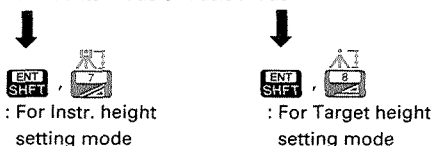


Note:

Instrument height & Target height input

- Input range: -9999.999 to 9999.999m
- Least input : 0.001 m
- Data storage period :
About a week
(Power-off possible)
- Retain the displayed value : (to Basic mode)
- Correct the value : (set value to 0)
- Exit from the input : (to Basic mode)

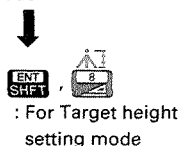
Theodolite mode or Basic mode



Instr
Ht. 0.000m

Input Instrument height

Basic mode



Target
Ht. 0.000m

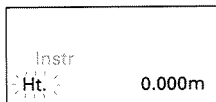
Input Target height

Basic mode





- Input Instrument height of 1.567 m and Target height of 1.234 m

From Theodolite mode or Basic mode to Instrument Height Input mode



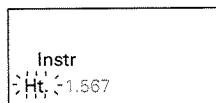
- 1) In Theodolite mode or Basic

mode, press  .

The previously stored value is displayed.

"Ht" flashes to prompt for the input of the instrument height.

Input the instrument height




- 2) Input "1.567".

An instrument height value of 1.567 is input.

Press function keys to select operation

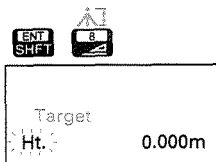


Press function
keys to select
operation

- 3) Press .

The instrument turns to Basic mode.

To Target Height Input mode



- 4) Press **ENT SHFT** .

The previously stored value is displayed.

"Ht." flashes to prompt for the input of the target height.

Input the target height



- 5) Input "1.234".

A target height value of 1.234 is input.




Press function
keys to select
operation

- 6) Press **ENT SHFT**.

The instrument turns to Basic mode.

14.3 Instrument station coordinates and Backsight station coordinates input

- The coordinates of the instrument setting surveying point (instrument station) and those of a point whose coordinates are already known (backsight station) can be input to the SET C.
- The coordinates of the backsight station are input in order to set the horizontal angle in the X-axis direction to 0° .
If the azimuth angle is already known, the following steps are carried out:
 - 1) Input only the coordinates of the instrument station.
 - 2) Sight the backsight station.
 - 3) Press  to turn Theodolite mode, and set the horizontal angle to the azimuth value.

Then skip the instructions in Section 14.4 and go directly to Section 14.5.



To recall the instrument station coordinates and backsight station coordinates from coordinate data stored on the card, please refer to P.109.


**Note:****Instrument & Backsight station coordinates input**

Theodolite mode or Basic mode




: For Instr.
station
coordinates
input mode




Input N-coordinate value 



Input E-coordinate value 



Input Z-coordinate value 







Basic mode



: For Backsight
station
coordinates
input mode



- Input range :
-9999999.999 to 9999999.999
- Least input : 0.001
- Data storage period :
About a week (Power-off possible)

- ◆ Retain the displayed value : 
- ◆ Correct the value :  (set value to 0)
- ◆ Exit form the input :  
(to Basic mode)

e.g.

- Instrument station coordinates are
N = 31.1, E = 21.2, and Z = 1.3, and
Backsight station coordinates are
N = 10.1, E = 20.2, and Z = 3.3

From Theodolite mode or Basic mode to Instrument station coordinate input mode



N	0.000
E	0.000
Z	0.000

- 1) In Theodolite mode or Basic mode, press and .

The previously stored values are displayed.

"N" flashes to prompt for the input of the N coordinate.

Input Instrument station coordinates



: Input N coordinate

N	31.100
E	0.000
Z	0.000

- 2) Input "31.1" and press .

The N coordinate is input.

"E" flashes to prompt for the input of the E coordinate.



: Input E coordinate

N	31.100
E	21.200
Z	0.000

- 3) Input "21.2" and press .

The E coordinate is input.

"Z" flashes to prompt for the input of the Z coordinate.



: Input Z coordinate

N	31.100
E	21.200
Z	1.300

- 4) Input "1.3" and press .

The Z coordinate is input, and the instrument returns to Basic mode.

To Backsight station coordinate input mode



N	20.200
E	20.200
Z	0.000

- 5) Basic mode, press .

The previously stored values are displayed.

"N" flashes to prompt for the input of the N coordinate.

Input Backsight station coordinates



: Input N coordinate value

N	10.100
E	20.200
Z	0.000

- 6) Input "10.1" and press .

The N coordinate is input.

"E" flashes to prompt for the input of the E coordinate.

ENT
SHIFT : Retain displayed
E coordinate

N	10.100	
E	20.200	
Z	0.000	

3 **ENT**
SHIFT **S-O** **3** **ENT**
SHIFT

: Input Z coordinate

N	10.100	
E	20.200	
Z	3.300	

Press function
keys to select
operation

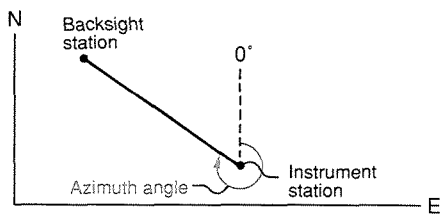
- 7) The displayed value is retained, so simply press **ENT**
SHIFT .

"Z" flashes to prompt for the input of the Z coordinate.

- 8) Input "3.3" and press **ENT**
SHIFT .

The Z coordinate is input, and the instrument returns to the Basic mode.

14.4 Setting the azimuth angle from Instrument and Backsight station coordinates



- With the SETC, the azimuth angle of the backsight can be automatically calculated from the input instrument station and backsight station coordinates. This means the horizontal angle is set to zero in the N direction.



Note:

Setting the azimuth angle

Theodolite mode or Basic mode



Sight Backsight station



ENT
SHIFT



Calculate Azimuth
angle



ZA
HAR

← Azimuth angle

14.5 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 and prism heights, Instrument and Backsight station coordinates and calculate or input the azimuth angle (see previous pages).

$$N1 = N0 + S \times \sin\theta_z \times \cos\theta_h$$

$$E1 = E0 + S \times \sin\theta_z \times \sin\theta_h$$

$$Z1 = Z0 + Mh + S \times \cos\theta_z - Ph$$

Instrument station coordinates: (N0, E0, Z0)

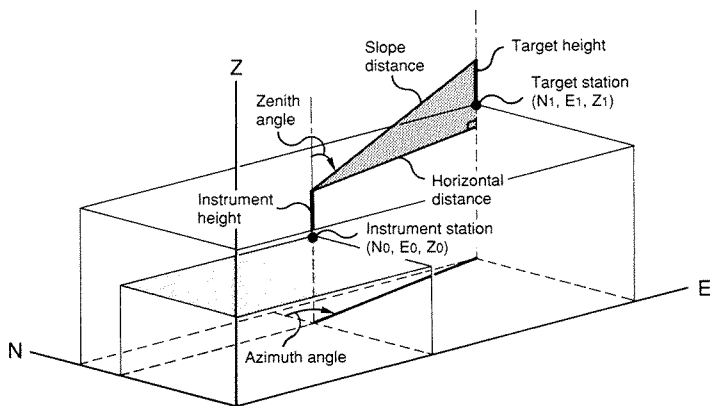
Slope distance : S

Zenith angle : θ_z

Azimuth angle : θ_h











Instrument height : Mh

Target height : Ph






To record the coordinate data on the card, please refer to P.113.

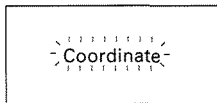
Check! before measurement :

1. SET C is set up correctly over the surveying point.  P.18
2. The V and H circles have been indexed.  P.23
3. The Instrument parameters and the units have been set.  P.29
4. The distance measurement mode is selected.  P.38
5. The prism constant correction value is set.  P.41
6. The atmospheric correction is set.  P.44
7. The centre of the target is correctly sighted and the return signal is adequate for measurement.  P.48
8. The instrument height and target height have been input.  P.53
9. The instrument station and the backsight station coordinates have been input.  P.56
10. The azimuth angle is set.  P.61

Sight the target

- 1) Sight the centre of the reflecting prism correctly. (It is also recommended to check the returned signal by pressing    P.48.)

In Theodolite mode or Basic mode, start the coordinate measurement



N	123.456
E	345.678
Z	3.456

Stop the measurement

: Stop the measurement



: Start next measurement

: To Basic mode

: To Theodolite mode

: Review the measured data

- 2) In Theodolite mode or Basic mode, press .

This accesses Coordinate Measurement mode, and measurement of the 3-Dimensional coordinates is started. The display appears as at left and flashes.

After about 5.1 seconds (Fine measurement mode), the 3-Dimensional coordinates are displayed.

- 3) Press (display does not change).

- If the single measurement mode has been selected, the measurement stops automatically.

- Press , , or to start the next measurement. Pressing returns to Basic mode, or press to go to Theodolite mode.

- To measure the next target point, check the prism constant correction, ppm values, and target height.

- If and are pressed, the last measured coordinate data can be displayed. ➤ P.51

ADVANCED MEASUREMENT FUNCTIONS

15. RESECTION MEASUREMENT

 P.67

16. TRAVERSE-STYLE COORDINATE MEASUREMENT

 P.76

17. OFFSET MEASUREMENT




 P.80

18. REM MEASUREMENT

 P.86



19. MISSING LINE MEASUREMENT

 P.90

- 19.1 Measurement mode selection 
- 19.2 Measuring the distance between two or more points 
- 19.3 Change of the starting position 

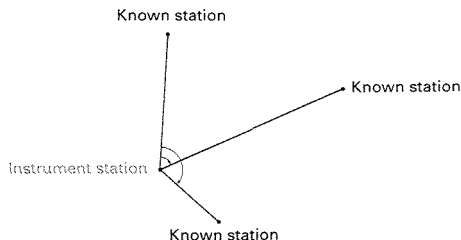
20. SETTING-OUT MEASUREMENT

 P.96

- 20.1 Horizontal angle and distance setting-out measurement 
- 20.2 Coordinates setting-out measurement 

15. RESECTION MEASUREMENT

- The “Resection measurement” is used to determine the instrument station coordinates by observing 2 or more known stations.



- SET C can calculate the instrument station coordinates by method of least squares by observing 2 to 5 known stations.

To calculate the instrument station coordinates;

when measuring distances, observe at least 2 known stations.

or

when unable to measure distances, observe at least 3 known stations.

However, the greater the number of known stations and the greater the number of measured distances, the more precise the results will be.

- The Z coordinate can be calculated by inputting the Z coordinate of at least 1 known station and measuring the distances of 2 or more points. (The Z coordinate cannot be determined using only angle measurement.) Before the resection measurement, input the instrument height.

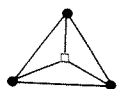
Note: For the Resection measurement of highest accuracy, please adjust the collimation error beforehand.

See P.214 “Appendix 2: For Angle measurement of the highest accuracy, <Adjusting the collimation error by collimation program>”.



To recall the known station's coordinates from coordinate data stored on the card, please refer to P.109.

- It is best to avoid a situation where the unknown station (Instrument station) lies on the same circle as the known stations (in the case of 3 more known stations). Nullification of calculation will result. The figure below describes the better arrangement.



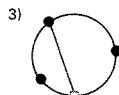
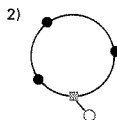
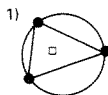
- : Unknown station
(Instrument station)
- : Known station

Note: When calculating the instrument station coordinates by only measuring the angles of 3 known stations, if a station is on the same circle as the known stations, the calculated station coordinate will not be correct.



If this situation is expected, the following action is suggested.

- 1) If possible move the station to the near centre of the triangle or
- 2) Observe other known stations which are not on the circle or
- 3) Measure the distance of one of 3 stations along with the angles.



- If the angle between 2 known stations is narrow, the observing condition is not sufficient to calculate the instrument station coordinates. When the distances between the instrument station and the known stations are long, it is difficult to determine that the angles are narrow thereby avoiding the instrument station being on the same circle as the known stations.



**Note:****Resection measurement**

Theodolite mode or Basic mode

: To Program mode

: Select Resection measurement

 Target / Coord.
 No. 1

Input Known station No.

Input Known station coordinate value

 Measure dist?
 Yes / No

 Yes

: Measure distance

 No

: Not measure distance

Input Target height

 More point?
 Yes / No

 No

: No more point

 Yes

: More point



- Backsight number input range : 1 ~ 99999999

Least input : 1

- Coordinate input range : -9999999.999 to 9999999.999 (m)

Least input : 0.001

- Instr. station coordinate storage period : About a week (Power-off possible)

◆ Retain the displayed value :

◆ Correct the value : (set value to 0)

◆ Exit from the input : (to Basic mode)


 Pt. 1
 measure ?
 Yes / No (exit)

Sight Target

 Yes

: Start measurement

The measured data is displayed

 Instrument station coordinate
 is displayed and set

Basic mode

e.g.

- The instrument station coordinates will be determined from the following data:

Instrument height: 1.5m

Known Station A: Point number = 1

N = 2042.104, E = 1376.491, Z = 116.720

Measure angle and distance

Target height is 1.5 m

Known Station B: Point number = 2

N = 1608.521, E = 2426.262, Z = 251.200

Measure angle


Known Station C: Point number = 3

N = 862.988, E = 1554.186, Z = 101.240

Measure angle and distance

Target height is 1.5 m

From Theodolite mode or Basic mode to Program mode

 : To Program mode

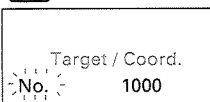
- 1) In Theodolite mode or Basic mode, press .




1. Resection
2. Correction
3. Pt. replace

The display appears as at left, showing Program mode.

Select "Resection"

- 2) Press .

The previously stored value +1 is displayed.

"No." flashes to prompt for the input of the point number.

Input data for Known Station A

MENU **ENT** **SHFT** : Input Target No.

N	0.000
E	0.000
Z	0.000

N = 2042.104 **ENT** **SHFT**

E = 1376.491 **ENT** **SHFT**

Z = 116.72 **ENT** **SHFT**

Measure dist?
Yes / No

Yes
ENT **SHFT** : Measure distance

Target	
Ht	0.000m

MENU **S-O** **S** **ENT** **SHFT**

: Input Target height

Target / Coord.	
No	2

Input data for Known Point B

ENT **SHFT** : Input Target No.

N	0.000
E	0.000
Z	0.000

3) Press **MENU** **ENT** **SHFT** .

Target number "1" is input.
"N" flashes to prompt for the input of the N coordinate.

4) Input the coordinates for Known Station A.

N = 2042.104 **ENT** **SHFT**

E = 1376.491 **ENT** **SHFT**

Z = 116.72 **ENT** **SHFT**

The display then asks whether to measure its distance or not.




5) Press **Yes**
ENT **SHFT** .

The display appears as at left.
"Ht" flashes to prompt for the input of the target height.
If measuring angle only, press **Yes**
ENT **SHFT** .


6) Press **MENU** , **S-O** , **S** , **ENT** **SHFT** .

When the data for the first station has been input, "No." flashes to prompt for the input of the point number of the next known station.

(The previously stored value +1 is displayed.)


N = 1608.521 
 E = 2426.262 
 Z = 251.2 

Measure dist?
Yes / No




 : Not measure distance

Target / Coord.
No. 3

Input data for Known Station C




 : Input Target No.

N	0.000
E	0.000
Z	0.000


N = 862.988 
 E = 1554.186 
 Z = 101.24 

Measure dist?
Yes / No

- 8) Input the coordinates for Known Station B.

N = 1608.521 
 E = 2426.262 
 Z = 251.2 


The display then asks whether to measure its distance or not.

- 9) Press .

When the data for the second station has been input, "No." flashes to prompt for the input of the point number of the next known station.




(The previously stored value +1 is displayed.)

If measuring distance, press .

- 10) The displayed value is retained, so simply press .

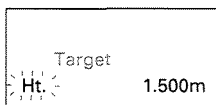
The point number "3" is input, and "N" flashes to prompt for the N coordinate.

- 11) Input the coordinates for Known Station C.

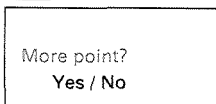
N = 862.988 
 E = 1554.186 
 Z = 101.24 

The display then asks whether to measure its distance or not.

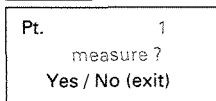
Yes
ENT/SHIFT : Measure distance



ENT/SHIFT : Retain displayed value



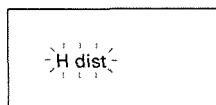
No
CE/CA : No more stations



Observe Known Stations A to C

Sight Known Station A

Yes
ENT/SHIFT : Measurement start



12) Press Yes
ENT/SHIFT .

The display appears as at left. "Ht" flashes to prompt for the input of the target height. (The previously stored target height is displayed.)

If measuring angle only, press No
CE/CA .

13) Press ENT/SHIFT .

When the data for the third station has been input, if the conditions for calculating the instrument station coordinate have been satisfied, the display asks whether you want to observe any further stations. (Observation can be carried out up to 5 stations.)

14) Press No
CE/CA .

The display asks whether you want to observe the first station (Known Station A).


15) Sight the centre of the reflecting prism of Known Point A correctly. Press Yes
ENT/SHIFT .

The horizontal distance measurement is started.

H	820.570m
ZA	81° 59' 20"
HAR	0° 00' 00"

Pt.	2
measure ?	
Yes / No (exit)	


Sight Known Station B

Yes
 : Measurement start

ZA	78° 41' 20"
HAR	62° 33' 40"

Pt.	3
measure ?	
Yes / No (exit)	

Sight Known Station C


Yes
 : Measurement start

H dist	
--------	--


H	490.070m
ZA	78° 28' 00"
HAR	129° 12' 20"

Busy ...	
----------	--

When the measurement has been finished, the measured values are displayed, and the display asks whether you want to observe the second station (Known Station B).

- 16) Sight the centre of the reflecting prism of Known Station B correctly ,
 and press  .

The measurement is started.
 When the measurement has been finished, the measured values are displayed, and the display asks whether you want to observe the third station (Known Station C).

- 17) Sight the centre of the reflecting prism of Known Point C accurately,
 and press  .

The measurement is started.
 When the measurement has been finished, the measured values are displayed. "Busy" will appear on the display while the instrument station coordinates are being calculated.

N	1234.000
E	1234.000
Z	1.234

*N	0.000
*E	0.000
Z	0.000

- | | |
|----|-------------|
| 1. | Resection |
| 2. | Correction |
| 3. | Pt. replace |

Signal off

H	Timeout
ZA	
HAR	

Pt.	1
measure ?	
Yes / No (exit)	

The instrument station coordinates are calculated and displayed.

This value is input as the instrument station coordinate. (Basic mode)

If, for some reason, the instrument station cannot be calculated, the display is as at left.

After that the instrument returns to Program mode.

Nullification may be caused by poor layout of the known points, an error in the known station data input, or an inability to measure the distance or angle, etc.

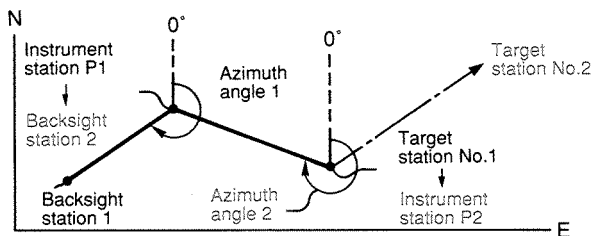
Check the observation conditions and try the procedure again from Step 1).

Note : If "Signal off" is displayed, the return signal strength has become inadequate for measurement. Verify the target sighting. If within 2 minutes the return signal becomes sufficient, the measurement is restarted. After 2 minutes, the measurement is stopped automatically and the display appears as at left.

After that the display asks whether to observe the first station or not.

16. TRAVERSE-STYLE COORDINATE MEASUREMENT

- The traverse-style coordinate measurement is used to measure the second survey station (No.2) coordinate after moving the instrument to the first survey station (No.1) and setting it up.
- The measured coordinate data is stored in the memory for up to about 1 week after power-off. Even after power-off it is possible to set new instrument station coordinates and the azimuth angle for the instrument by sighting back on the first instrument station and pressing a key on the SET C keyboard.



Note: Replacing Instrument station coordinates

After Coordinate measurement and Instr. station movement, sight back on the previous Instr. station



Theodolite mode or Basic mode



2 **PROG** : To Program mode



1. Resection
2. Correction
3. Pt. replace



3 **ENT** : Replace Instrument station



Stn pt replace?
Yes / No (exit)



Yes
ENT **SHFT** : Verify



Replaced

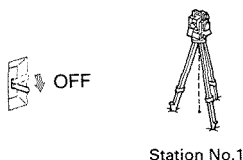


New azimuth angle (HAR) is displayed



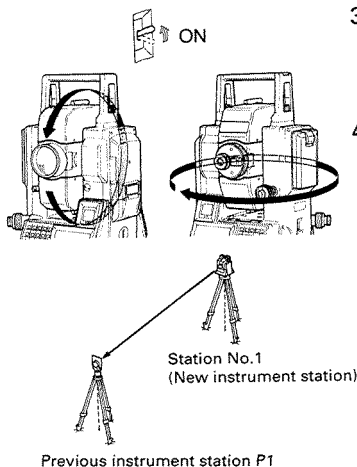
ZA
HAR

After measuring Station 1, switch off and move the SET C



- 1) After measuring the coordinates of Station No.1 (14.1 ~ 14.5), switch the SET C off.
- 2) Move the instrument to Station No.1 and set it up over the survey point.

Switch on and index V and H circles



- 3) Switch the SET C on, and index the vertical and horizontal circles after the self-check.
- 4) From Station No.1, sight back on the original instrument station P1.

From Theodolite mode or Basic mode to Program mode

2
PROG

1. Resection
2. Correction
3. Pt. replace

- 5) Press **2** **PROG**.

The display appears as at left, showing Program mode.

Set the instrument station movement in SET C



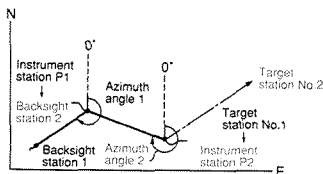
Stn pt replace?
Yes / No (exit)



Replaced

ZA 81° 12' 30"
HAR 145° 00' 00"

Azimuth angle 2



- 6) Press .

The display appears as at left and asks whether the new station coordinates are to replace the previously stored ones.

- 7) Press .

The display appears as at left after the coordinates of Instrument station P1 have been set as the new Backsight station 2, and the measured coordinates of Station No.1 have been set as the new instrument station P2.

The instrument then calculates. The measured coordinates are displayed and the azimuth angle is set.

- To interrupt the movement, press .

- 8) Measure and input the instrument height of instrument station P2 and the target height of Station No.2. (Refer to P.53 14.2)

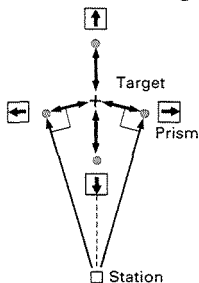
- 9) Sight the centre of the reflecting prism of Station No.2 correctly.

- 10) Press to go to coordinate measurement mode and start 3-Dimensional coordinate measurement.

17. OFFSET MEASUREMENT

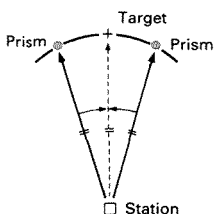
- The Offset measurement is used to measure the distance to point where it is not possible to set a reflecting prism directly, or where the reflecting prism cannot be sighted directly, in order to determine the angle.
- SET C can determine the distance and angle of the target point by setting the reflecting prism at a point (offset point) at a distance from the point to be measured (target point) and measuring the distance and angle of the offset point.
- There are two methods to determine the distance and angle of the target point.

- ① The target point is determined by inputting the distance between the target point and the offset point.



- When the offset point is positioned to the left or right of the target point, the offset point and target point should both be approximately 90° .
- When the offset point is in front of or behind the target point, the offset point should be on a line connecting the instrument station point and the target point.

- ② The target point is determined by sighting the direction of the target point.



- The offset point should be positioned to the right or left of the target point, as close to the target point as possible.



To record the data on the card, please refer to P.109.

Note: Offset measurement

Sight Prism of Offset point

Theodolite mode or Basic mode



: Start Distance measurement
(Stop the measurement)



: To Offset meas.
mode

Offset

1. distance
2. angle



: Select "Input distance"

Direction

prism : →

Yes / No(exit)



: Select the direction
from Prism to Target



: Set the direction

Offset distance

0.000m

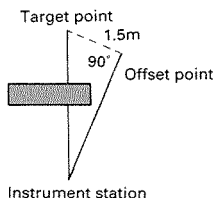
Input H distance
between Target and Prism



The Slope distance, Vertical angle and Horizontal angle
between Measuring point and Target are displayed

- Distance Input range :
9999.999 to 9999.999 m
- Least input : 0.001 m
- Data storage period :
About a week (Power-off possible)
- ◆ Retain the displayed value : ENT/SHIFT
- ◆ Correct the value : CE/CA (set value to 0)
- ◆ Exit from the input : CE/CA, CE/CA
(to Basic mode)

e.g.



- The positions of the target point and the offset point are shown at the left. In this case, determine the slope distance to the target point when the horizontal distance is 1.5m.

Note: The offset point should be positioned so that the line connecting the target point and offset line is at a 90° angle to the line connecting the instrument station and offset point.

Sight the offset point and measure






: Starts the distance measurement


S dist

S 3.210m
ZA
HAR



: Stop the measurement

- Set the reflecting prism at the offset point, sight the centre of it correctly, and in Theodolite mode or Basic mode, press either , , or . After about 4.7 seconds (Fine measurement mode), the distance value, the vertical angle and the horizontal angle are displayed and stored in the instrument memory.

- For Repeat measurement mode, press .

To Offset Measurement mode

ENT
SHIFT



Offset

- distance
- angle

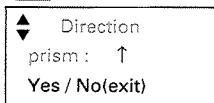
- Press  and .

The display appears as at left.

The display asks you to select one of the following options:

- Input the horizontal distance between the target point and the offset point.
- Sight the direction of the target point.

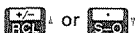
Select "Input horizontal distance"



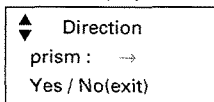
- 4) Press .

The display appears as at left and prompts to select the direction from target point to reflecting prism.

Select the offset point direction



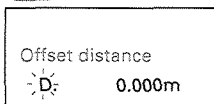
: "→" is displayed



- 5) Press or to display "→".

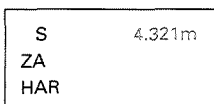
Note :

- : Prism is right of target
- ← : Prism is left of target
- ↑ : Prism is behind target
- ↓ : Prism is in front of target



When → is displayed, press .
"D." flashes to prompt for the input of the horizontal distance between the target point and the offset point.

Input horizontal distance between target point and offset point



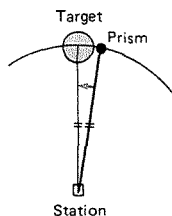
- 6) Input a horizontal distance of 1.5 metres and press .

The slope distance from the instrument station to the target point and the vertical and horizontal angles are calculated and the results are displayed.



: Display the horizontal distance

- To display the horizontal distance, press .



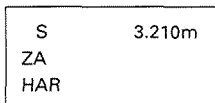
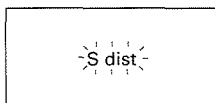
- The positions of the search point and the offset point are shown at the left. In this case, determine the slope distance to the centre point of a telephone pole.




Note: The offset point should be positioned to the right or left of the target point, as close to the target point as possible.

Sight the offset point and measure



: Starts the distance measurement




- Set the reflecting prism at the offset point, sight the centre of it correctly, and in Theodolite mode or Basic mode press either , , or .

After about 4.7 seconds (Fine measurement mode), the distance value, the vertical angle and the horizontal angle are displayed and stored in the instrument memory.

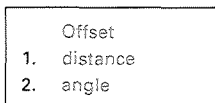
4



: Stop the measurement

- For Repeat measurement mode, press .

To Offset Measurement mode



- Press  and .

The display appears as at left.

The display prompts to select one of the following options:

- Input the horizontal distance between the target point and the offset point.
- Sight the direction of the target point.


Select "Sight target point direction"

 PROG

Sight target pt.

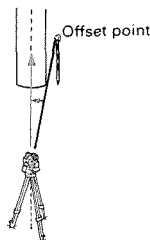
Yes / No (exit)

HAR 0°00'00"

- 4) Press  PROG .

The display appears as at left and prompts to sight the direction the target point.


Sight the search point direction



- 5) Sight the direction of the target point correctly.

Yes


S 3.210m
ZA
HAR



- 6) When the direction of the centre of the telephone pole has been sighted, press  .

The slope distance from the instrument station to the target point and the vertical and horizontal angles are calculated and the results are displayed.



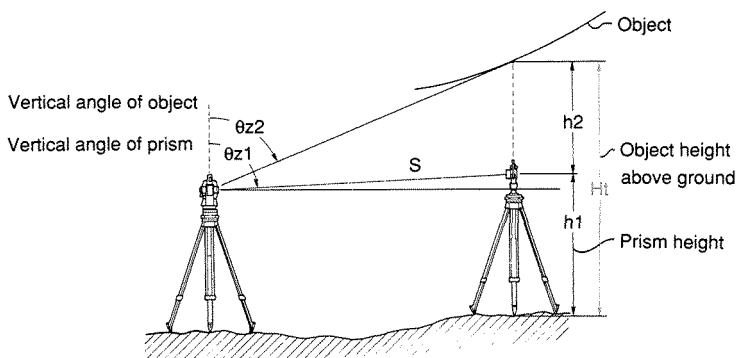


: Display the horizontal distance

- To display the horizontal distance, press  

18. 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.
 $H_t = h_1 + h_2$
 $h_2 = S \sin \theta_{z1} \times \cot \theta_{z2} - S \cos \theta_{z1}$



- The measured values are first displayed after 0.7 seconds and then every 0.5 seconds for all measurement modes.

**Note:****Remote elevation measurement**

Input the target height (h1)
(P. 57)



Sight the prism
above or below the object



Theodolite mode or Basic mode



: Start Distance measurement (Stop the measurement)



Sight the object



: Start REM



The object height is displayed

Ht	16.290m
ZA	77° 11' 10"
HAR	123° 45' 50"

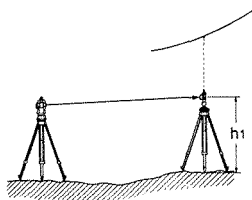


: Stop measurement

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

e.g. ● Measure the height to a suspended cable

Set up the prism below the object and input the target height

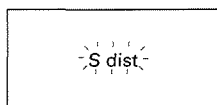


- 1) Set up the reflecting prism directly below the object to be surveyed using an optical nadir or plummet for accurate setting.
- 2) Measure the target height (h_1) with a measuring tape, and input the target height.
 ➞ P.53

Measure the distance



: Start the measurement






4


S	50.432m
ZA	89° 45' 20"
HAR	123° 45' 50"



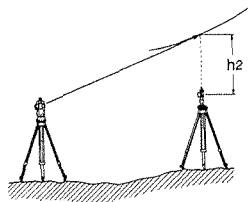
: Stop the measurement

- 3) Sight the centre of the reflecting prism with the SET C correctly.
- 4) In Theodolite mode or Basic mode, press either , , or . This accesses the Distance Measurement mode, and the measurement is started. The display appears as at left and flashes. (The illustration at the left shows an example of slope distance measurement.)



After about 4.7 seconds (Fine measurement mode), the distance value, the vertical angle and the horizontal angle are displayed and stored in the instrument memory.

- For Repeat the measurement mode, press  to stop the measurement.

Sight the object and start REM measurement





5) Sight the object.

 : Start the REM measurement 6) Press .

Ht	16.290m	$h1+h2$
ZA	77° 11' 10"	
HAR	123° 45' 50"	

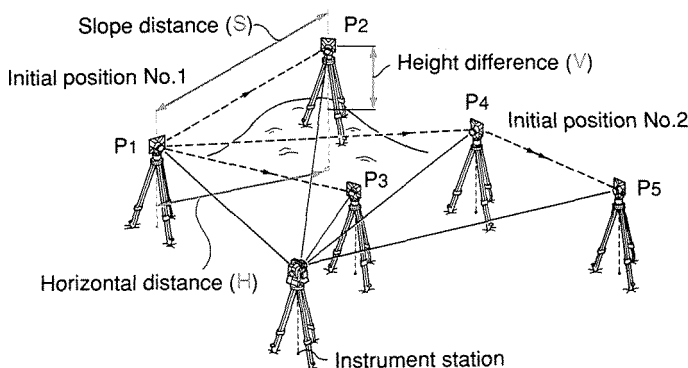
The REM measurement is started. After about 0.7 seconds, the height from the ground to the object Ht ($h1 + h2$) is displayed.

 : Stop the measurement

- Press  to stop the measurement.

19. MISSING LINE MEASUREMENT

- The Missing line measurement is used to measure the slope distance, the horizontal distance, and the height difference between the starting position (P1) and any other points without moving the instrument itself.
- The SET C can measure the distances to many points continuously. It is also possible to change the starting position to that of the last-measured point. ➔ P.94



19.1 Measurement mode selection

- Select the measurement mode from the following according to your required measurement.
See P.38 "13.1 Measurement mode selection" for key operation.

Measurement mode		Measurement time	Units
Fine meas.	Single	5.6 secs	1mm
	Repeat	First 5.6 secs & every 3.3 secs	
Coarse meas.	Single	2.9 secs	
	Repeat	First 2.9 secs & every 0.7 secs	
Tracking meas.		First 2.8 secs & every 0.7 secs	10mm

19.2 Measuring the distance between two or more points

Note: **Missing line measurement**

Sight the prism on the initial position



Theodolite mode or Basic mode



: Start Distance measurement (Stop the measurement)



Sight the prism on the target station



: Start Missing line meas.



Stop distance, Horizontal distance and Height difference between the initial position & the target station is displayed



S	m
H	m
V	m

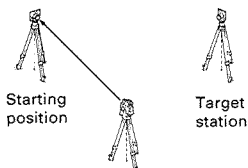


: Stop measurement

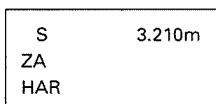
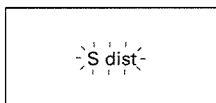


- Measure the distances between the starting position and many points consecutively.




Set up the prism on the starting position and start the distance measurement



: Starts the distance measurement



: Stop the measurement

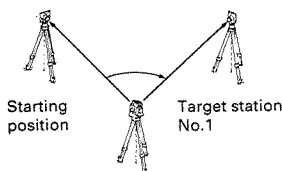
- 1) Set up the reflecting prisms on the required number of target points, sight the centre of the reflecting prism on the starting position. In Theodolite mode or Basic mode press either , , or .

This accesses the Distance Measurement mode, and the distance measurement is started. The display appears as at left and flashes. (The illustration at the left shows an example of slope distance measurement.)


After 4.7 seconds (Fine measurement mode), the distance value, the vertical angle and the horizontal angle are displayed and stored in the instrument memory.

- 2) For Repeat the measurement mode, press .

Sight the prism on the target station and start the missing line measurement




- 3) Sight the centre of the reflecting prism on the target station No.1. If the prism constant and ppm correction for Target Station No.1 are different from those of the starting position, reset these values now.


 : Start the missing line measurement


Missing line

S	20.757m	Slope distance
H	27.345m	Horizontal distance
V	1.012m	Height differ.

 : Stop the measurement


Sight Target Station No.2


 : Start the missing line measurement

4) Press  .

This accesses the Distance Measurement mode and the Missing line measurement is started. The display appears as at left and flashes.

After about 5.6 seconds (Fine measurement mode), the slope distance, the Horizontal distance and the height difference are displayed.

5) For Repeat the measurement mode, press  to stop the measurement.

- After this measurement, to measure the distance between the starting position and Target station No.2 (or between the starting position and Target station No.3), sight the required reflecting prism and press  to start the missing line measurement.

19.3 Change of the starting position

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



Note:

Change of the initial starting position

Missing line measurement has finished

S	m
H	m
V	m



: Change the initial starting position



Point replace?
Yes / No (exit)



Yes
: Verify



Replaced



Basic mode



- Changing the last measured target station No.4, to become the next starting position

After missing line measurement of the last target station is finished, set the next starting position

S	20.757m
H	27.345m
V	1.012m

- After the missing line measurement of target station No.4 has been finished, the measured values are displayed.

Press and at this point.



Point replace?
Yes / No (exit)

The display appears as at left and asks whether the starting position is to be moved.



Replaced

- Press .

The data for Target station No.4 is set as the data for the new starting position, and the display appears as at left. The instrument returns to Basic mode.

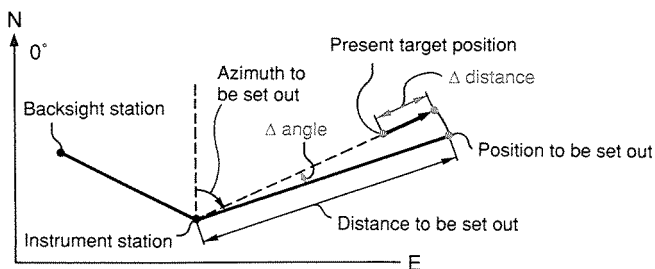
Press function
keys to select
operation

- To continue missing line measurement from the new starting position to the next target stations, sight each target station and press .

20. SETTING-OUT MEASUREMENT

- The Setting-out measurement is used to set out the required point.
- In the SET C, 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



20.1 Horizontal angle and distance setting-out measurement

- This measurement is used to set out the point from a certain direction (horizontal angle) and a certain distance away from a reference point (the instrument station).
- It is possible to set out a slope distance, horizontal distance, height difference or remote elevation value after inputting the required value.



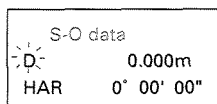
Note:

Horizontal angle & Distance setting-out data input

Theodolite mode or Basic mode



: For Distance & H angle
setting out data input mode



Input Distance
setting out data



Input H angle
setting out data



Basic mode

- Distance input range :
-9999.999 to 9999.999m
Least input : 0.001m
- Angle input range :
SET2C:0° to 359°59'59"
SET3C:0° to 359°59'59"
SET4C:0° to 359°59'55"
Least input:
SET2C:1"
SET3C:1"
SET4C:5"
Display range : $\pm 180^\circ$
(difference between target direction and
setting out data)
- Data storage period :
About a week (Power-off possible)

- ◆ Retain the displayed value :
- ◆ Correct the value : (set value to 0)
- ◆ Exit from the input :
(to Basic mode)

Setting 123° 45' 50"
→ Input value of 123.455

- Setting-out a horizontal angle right $90^{\circ}55'40''$ from the reference object and setting-out a horizontal distance of 12.345 m.

Sight the reference direction from the reference point, and set Horizontal angle to 0°

Reference direction



ZA	$92^{\circ} 36' 40''$
HAR	$0^{\circ} 00' 00''$

- 1) Sight the reference direction from the reference point (the instrument station).

- 2) In Theodolite mode, press .

The horizontal angle display has been set to 0° .

To Setting-out Data Input mode



S-O data	
D	0.000m
HAR	$0^{\circ} 00' 00''$

- 3) Press and .

The previously input values are displayed. "D" flashes to prompt for the input of the distance setting-out data.

Input distance setting-out data



S-O data	
D	12.345
HAR	$0^{\circ} 00' 00''$

- 4) Input "12.345" and press .

The distance setting-out data is input. "HAR" flashes to prompt for the input of the horizontal angle setting-out data.

Input horizontal angle setting-out data



- 5) Input "90.554" and press **ENT SHFT**.

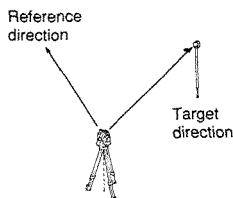
The horizontal angle setting-out data is input, and the display returns to Basic mode.

ENT SHFT

S-O data
D 12.345
HAR 90.554

Press function
keys to select
operation

Set the reflecting prism and start S-O measurement



- 6) Set the reflecting prism at a position about $90^{\circ}55'40''$ from the reference direction and about 12.345 metres from the reference point (the instrument point), and sight the reflecting prism.

S-O **3** : Start H angle S-O measurement



6
-40
SO \perp +

Setting out

dHA $-3^{\circ} 45' 50''$
HAR $94^{\circ} 41' 30''$

- 7) Press **S-O** and **3**.

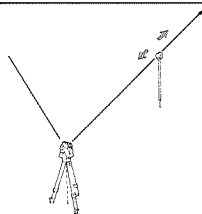
The setting-out measurement is started, and the horizontal angle "dHA" from the setting-out data is displayed.

  : Start H angle S-O measurement

Setting out



-H dist-

H	-4.362m
ZA	
HAR	0° 00' 00"



- data : from the instrument
+ data : towards the instrument

- 8) Move the reflecting prism right or left in the correct direction until the "dHA" becomes 0°00'00". Sighting the moving reflecting prism again changes the "dHA" without key operation.

- 9) When "dHA" has become 0°00'00", press  and then .



The setting-out measurement is started, and then the horizontal distance measurement is started.



After about 4.7 seconds (Fine measurement mode), the distance from the setting-out data to the reflecting prism is displayed.



- 10) Move the reflecting prism towards or away from the instrument until the horizontal distance becomes 0.000 m to determine the point.

If minus data is displayed, move the prism away from the instrument, and if plus data is displayed, move the prism towards the instrument.

When the Repeat measurement is selected, sighting the moving reflecting prism again changes the distance without key operation.

- At Step 9), the following setting-out measurements are possible:
Slope distance, by pressing  and 

Height difference, by pressing  and 

REM, by pressing  and  (after slope distance measurement).

20.2 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 input of the coordinates for the point to be set out, the SET2C 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. The Z-coordinate can also be set out using the setting out coordinate function.



To recall the setting-out coordinate data from coordinate data stored on an IC card, please refer to P.109.



Note:

Coordinate setting-out data input

Theodolite mode or Basic mode



: For Coordinate setting out data input mode



N
E
Z



Input N-coordinate setting-out data



Input E-coordinate setting-out data



Input Z-coordinate setting-out data




Basic mode

- Input range :
-9999999.999 to 9999999.999
- Least input : 0.001
- Data storage period :
About a week (Power-off possible)

◆ Retain the displayed(N,E and Z) value:



◆ Correct the value :  (set value to 0)

◆ Exit from the input :
(to Basic mode)



e.g.

- In this case, the values are as follows:

Instrument station coordinates: $N = 20$, $E = 20$, $Z = 3$

Backsight station coordinates : $N = 10$, $E = 10$, $Z = 3$

Setting out a point : $N = 40$, $E = 30$, $Z = 4$

- The following preparations must be completed before beginning measurement:

14.1 Measurement mode selection

14.2 Instrument height and target height input

14.3 Inputting instrument station and backsight station coordinates

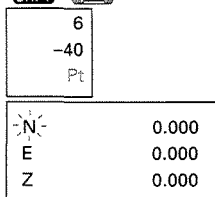
14.4 Setting the azimuth angle

- To set out the Z coordinate, set the reflecting prism on a fixed height object, such as a pole.

From Theodolite mode or Basic mode to Coordinate Setting-out Data Input mode



- 1) Press **ENT SHFT** and .



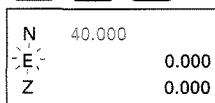
The previously stored values are displayed.

"N" flashes, to prompt for the input of the N coordinate setting-out data.

Input the setting-out data



- 2) Input "40" and press **ENT SHFT**.



The N coordinate is input. "E" flashes to prompt for the input of the E coordinate setting-out data.

3		0	ENT
L		REC	SHIFT
N	40.000		
E	30.000		
Z	0.000		

4		ENT
L		SHIFT
N	40.000	
E	30.000	
Z	4.000	

Press function
keys to select
operation

- 3) Input "30" and
press **ENT** **SHIFT**.

The E coordinate is input. "Z"
flashes to prompt for the input of
the Z coordinate setting-out data.

- 4) Input "4" and
press **ENT** **SHIFT**.

The Z coordinate is input, and the
instrument returns to the Coordi-
nate data input mode.

The setting-out horizontal dis-
tance and horizontal angle from
the instrument station coordi-
nates are calculated and the val-
ues are stored in the memory.

Note: Input the instrument station
coordinates before inputting
the setting-out data. Calcula-
tions may not be carried out
correctly if the data is input in
the reverse order.

Set the prism and start H angle S-O measurement.

4

- 5) Set the reflecting prism in the ap-
propriate position, and sight its
centre.

- 6) Press **S-O** and **L**.

The setting-out measurement is
started, and the horizontal angle
"dHA" from setting-out data to
the sighted direction is displayed.

S-O		L
Setting out		
dHA	-3° 00' 00"	
HAR	94° 41' 30"	

- 7) Move the reflecting prism right or left until the "dHA" value becomes 0°00'00".

Start H distance S-O measurement



Setting out

-H dist-

H	5.364m
ZA	
HAR	0° 00' 00"

H	0.000m
ZA	
HAR	0° 00' 00"

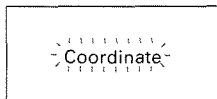
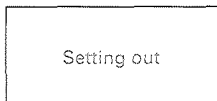
- 8) When "dHA" has become 0°00'00", press and then .

The setting-out measurement is started, and then the horizontal distance measurement is started.

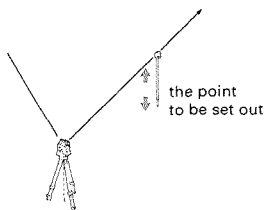
After about 4.7 seconds (Fine measurement mode), the distance from the setting-out data to the reflecting prism is displayed.

- 9) Move the reflecting prism towards or away from the instrument on the sighting line to determine the point until the horizontal distance becomes 0.000 m.
- If the Repeat measurement mode has been selected, press to stop the measurement.

Start coordinates S-O measurement, and determine the height



N	0.000
E	0.000
Z	0.234



- 10) When "H" has become 0.000 m, press and then .

The setting-out measurement is started, and then the coordinate measurement is started.

After about 5.1 seconds (Fine measurement mode), the coordinates from the setting-out data to the reflecting prism are displayed.

Since the horizontal angle and horizontal distance have already been determined, the N and E coordinates are "0"

- 11) Move the reflecting prism up or down until the Z coordinate becomes 0.000, and determine the height.

















The tip of the pole is the point to be set out.

- If the Repeat measurement mode has been selected, press to stop the measurement.

USING THE MEMORY CARD TO RECORD THE DATA

21. MEMORY CARD OPERATIONS

 P.109

- 21.1 Card features 
- 21.2 Inserting and formatting the card 
- 21.3 Changing the instrument options 
- 21.4 Job creating and selecting 
- 21.5 Instrument data recording 
- 21.6 Instrument station data recording 
- 21.7 Measured data recording 
- 21.8 Note recording 
- 21.9 Feature code recording 
- 21.10 Feature code recalling to stack 
- 21.11 Feature code deleting 
- 21.12 Coordinate data recording 
- 21.13 Coordinate data recalling to Instrument 
- 21.14 Reviewing data stored on the card 
- 21.15 Protecting data stored on the card 
- 21.16 Data stored on the card output to an external device 

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

109

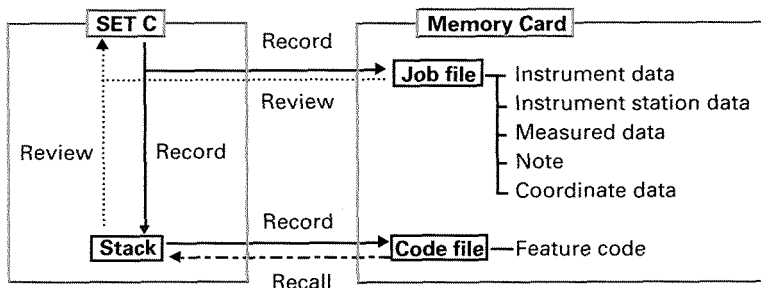
109

21. MEMORY CARD OPERATIONS

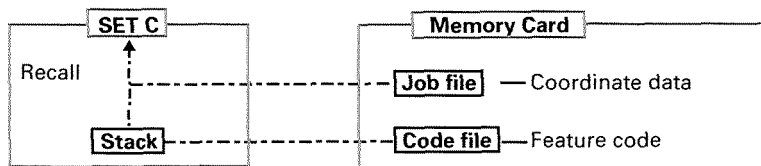
21.1 Card features

- The following types of data can be recorded by the SET C on the cards, and data stored on the cards can be recalled to the SET C.
- One 64Kb card can store 24 files.

1) Recording and reviewing the following data



2) Recalling the following data



3) Protecting the stored data from erasure or reformatting

● The SET C can record data in the following formats on the cards.

1) Record Mode

- When measurement data is recorded, the target number, target code, target height, and atmospheric correction value can be stored, along with the following data.

< S, V, H >

→ Slope distance, vertical angle, horizontal angle

< S, V, H (Offset) >

→ Prism direction and distance from target (only if input through offset measurement)
Slope distance, vertical angle, horizontal angle

< V, H, Tilt >

→ Vertical angle, horizontal angle, X direction tilt angle, Y direction tilt angle

< N, E, Z >

→ N coordinate (E coordinate), E coordinate (N coordinate), Z coordinate

< N, E, Z+S, V, H >

→ N coordinate (E coordinate), E coordinate (N coordinate), Z coordinate, slope distance, vertical angle, horizontal angle

< Note >

→ Remark

< Station data >

→ Date, instrument station number, code, instrument height, temperature, atmospheric pressure, curvature and refraction correction ON/OFF, prism constant correction, automatic tilt angle correction ON/OFF, instrument station N coordinate (E coordinate), E coordinate (N coordinate) Z coordinate

< Instr ID >

→ Instrument name
Instrument number
Software version number

2) Menu Mode

< Code >

→ Feature code, file name

< Card>→<Job/file>

→ North coordinate (E coordinate), E coordinate (N coordinate), Z coordinate, point number, feature code

● Precautions when using the card

The lifetime of the card battery is approximately 2 years, but if the card is used or stored at high temperatures, more battery power is used, thus shortening the life of the battery.

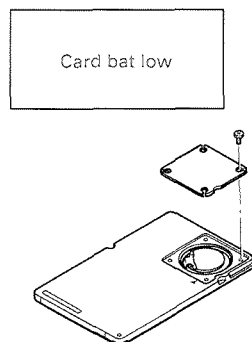
● Replacing the card battery

If the battery becomes low, an error message like that shown below will be displayed. Replace the battery according to the following procedure.

Battery type: Sony CR2016 lithium battery or a battery of similar quality.

Note : When the battery has been replaced, all data on the card is cleared.

If the data on the card is necessary data, be sure to transfer it to a personal computer before replacing the card battery.



- 1) Using a Phillips screwdriver, loosen the 4 screws on the back of the card, and remove the cover.

If the cover cannot be removed from the card itself, using a very thin flat-bladed screwdriver with a narrow tip, take off the cover where it is marked with ▲.

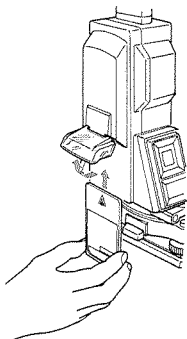
- 2) Remove the used battery and fit a new one between the electrode springs, with the + side facing upwards. Use pliers made of a non-conductive material (plastic, etc.) when handling the battery.

- 3) Replace the cover and tighten that 4 screws as before.

- 4) Format the card referring to P.112, "21.2 Inserting and formatting the card". The message "Card error" will appear before the message "Format end", however, the card will have been formatted and there is no problem.

21.2 Inserting and formatting the card

Inserting the card



- Lift up the SET C card cover ④ and carefully insert the card.
 The card should be inserted with the arrow up and the printed side out.
 Close the card cover.

Formatting the card

- To use a new card, or to clear all of the data stored on a card, it must be formatted.

Note: If a card has been used and the stored data is to be retained, DO NOT REFORMAT THE CARD.

1 MENU : For MENU mode

1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press **1 MENU**.


The display appears as at left, showing Menu mode.

2 PROG : Select "Card" setting


- ▲ Card
 ▼ Job / file
 Yes / No (exit)

- 2) Press **2 PROG**.


The display appears as at left, showing Card setting menu.

 : Display "format"


▲ Card
format
Yes / No (exit)

 : Select "format"

Formatting ok ?
Yes / No (exit)

 : Format the card


Start ?
Yes => press "1"
Exit => press "No"

 : Start card formatting


Format end

1. Config
2. Card
3. Code


Write protected

3) Press .


The display prompts for the selection of the card formatting.

4) Press .

The display prompts for the formatting of the card.

5) Press .

The display asks whether you want to start formatting the card or not.

6) Press .

When the formatting has been completed, the display appears as at left, and the instrument returns to Menu mode.

- If the display appears as at left, the data stored on the card is protected from erasure or overwrite by the write protect function. See P.121, "21.15 Protecting data stored on the card", and cancel the Write Protect function.

21.3 Changing the instrument options

- Confirm that this parameter is set according to the data recording conditions.
- To confirm or change the parameter options, see P.197 “24. CHANGING INSTRUMENT PARAMETERS”.

No.	Parameter		Options
2	Recording	1. Send data to	Card/Out
		2. Set code	Set/Skip
		3. Set target ht	Set/Skip

21.4 Job creating and selecting

- The SET C can store the instrument data, instrument station data, measured data, and notes and coordinate data in job files on the card. The job file can be created on the card in advance. Create the job file on the card, and select the job file to which the data is to be recorded before recording the data. The instrument name, number and software version number are recorded in the job file when the job file is created on the card.



Procedure: Job creating and selecting

In Theodolite mode or Basic mode

↓
1 **MENU** : For Menu mode

↓
2 **PROG** : Select the card setting

↓
Yes
ENT **SHFT** : Select the Job setting

↓
1 **MENU** : Select Job creating

↓
 Input the Job name **ENT** **SHFT**

	0	1	2	3	4	5	6	7	8	9
S=O	A	B	C	D	E	F	G	H	I	J
↑	K	L	M	N	O	P	Q	R	S	T
↓	U	V	W	X	Y	Z	_	.	-	&
RCL	0	1	2	3	4	5	6	7	8	9

↓
Yes
ENT **SHFT** : Select the Job setting

↓
2 **PROG** : Select the Job select

↓
S=O or **RCL** : Display the required Job name

↓
Yes
ENT **SHFT** : Select the Job name

↓
 Record end

↓
 Card setting mode

↓
CE-CA , **CE-CA** : To Basic mode

- Job name can be up to 7 characters long
- Job name storage period :
About a week (Power-off possible)

◆ Correct 1 character :



◆ Exit from the input :



(to Card setting mode)

- Use **S=O** or **RCL** to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

↓
3 **ENT** **SHFT** : Delete the Job

↓
Yes
ENT **SHFT** : Select the Job name

↓
Yes
ENT **SHFT** : Verify

↓
 Card setting mode

↓
CE-CA , **CE-CA** : To Basic mode



- Create Job file "TOKYO" and record data in Job file "OSAKA" (Select Job file).

From Theodolite mode or Basic mode to Menu mode

1 MENU : For MENU mode

1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press **1** MENU .

The display appears as at left, showing the Menu mode.

Select the "Card" setting

2 PROG

- ▲ Card
▼ Job / file
Yes / No (exit)

- 2) Press **2** PROG .

The display appears as at left, showing the Card setting menu.

Select the "Job file" setting

Yes
ENT SHIFT

1. create
2. select
3. delete

- 3) Press **Yes** **ENT** SHIFT .

The display appears as at left, showing Job setting menu.

Select the Job "create"

1 MENU

▲ ABCDEFGHJI
▼ press 0123456789
Job

- 4) Press **1** MENU .

The "Job" flashes to prompt for the input of the Job name.

Input "TOKYO"

: Display K to T

, , REC

: Input "TOK"

: Display U to &

: Input "Y"

REC : Display K to T

: Input "O"

: Input finished

KLMNOPQRST
 press 0123456789
 TOKYO

Card
 Job / file
 Yes / No (exit)

- 5) Press to display "K ~ T".
- 6) Press , , REC to input "TOK".
- 7) Press to display "U ~ &".
- 8) Press to input "Y".
- 9) Press REC to display "K ~ T".
- 10) Press to input "O".
- 11) Press .

When the Job file has been created, the display returns to Card setting menu.

Select the "Job/file" setting again

Yes

1. create
2. select
3. delete

- 12) Press .

The display appears as at left, showing Job setting menu.

Select the Job "select"

Job select
TOKYO
Yes / No (exit)

- 14) Press .

The display prompts for the selection of the Job files.

Display "OSAKA"

or



Job select
OSAKA
Yes / No (exit)

- 15) Press or to display "OSAKA"

Select "OSAKA"

Card
Job / file
Yes / No (exit)

- 16) Press .

The Job file "OSAKA" is selected and the display returns to the card setting menu.



: To Basic mode

- Press to return to Basic mode.



- To delete the Job file "KYOTO" from the card

From Theodolite mode or Basic mode to Menu mode



: For MENU mode

1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Menu mode.

Select the "Card" setting



- ▲ Card
▼ Job / file
Yes / No (exit)

- 2) Press .

The display appears as at left, showing Card setting menu.

Select the "Job/file" setting



1. create
2. select
3. delete

- 3) Press .

The display appears as at left, showing Job setting menu.

Select the file "delete"

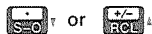


- ▲ Job / file name
▼ OSAKA
Yes / No (exit)

- 4) Press .

The display prompts for the selection of the file name to be deleted.

Display "KYOTO"



Job / file name
KYOTO
Yes / No (exit)

- 5) Press  or  to display "KYOTO".

Select "KYOTO"




Job KYOTO
delete Yes / No ?



: Delete the job

1. create
2. select
3. delete

- 6) Press .

The job "KYOTO" is selected and the display asks whether this Job is deleted or not.

- 7) Press .

"KYOTO" is deleted from the card, and the display returns to Job setting menu.

21.5 Instrument data recording

- With the SET C, the following items can be recorded on the card as instrument data:
 - Instrument name
 - Instrument number
 - Software version number

From Theodolite or Basic mode to Record mode



Card ready
Job KYOTO
64384byte free



Select
S,V,H
Yes / No (exit)

1. Job create
2. select
3. delete

No card

- 1) In Theodolite mode or Basic mode,
press .


The selected job file name and the available space for data recording are displayed.

A new card has 64,384 available bytes (approximately 1000 measured data points in S, V, H format).

After that, the display shows Record mode. And the display prompts for selection of the data format.

- When there is no Job file on the card, the display returns to Job setting menu. Create a Job file (seeing P.116 "21.4 from 4)"). After that, the display changes to Record mode.
- "No card " means that the card is not correctly mounted in the SET C. Insert the card correctly within 10 seconds.
After 10 seconds, the message "Card error" appears and the display returns to Basic mode.

Card error


- If “Card error” is displayed after pressing , there is some problem with the card. Insert the card correctly.

If “Card error” is displayed after inserting the card correctly, please contact your Sokkia agent.



Card is full

- When the card becomes full of data, “Card is full” is displayed.

Card bat low

- When the card battery is running low, “Card bat low” is displayed. Please change the battery.  P.111
Or replace with a new card.

Display “Instr ID”



 or 



Select

Instr ID

Yes / No (exit)

- 2) Press  or , to display “Instr ID”.

Record Instrument data

Yes



Record end



Select

S,V,H

Yes / No (exit)

- 3) Press .

When recording of the instrument data has been finished, the message “Record end” is displayed, and the display returns to the Record mode.

21.6 Instrument station data recording

- The SET C can record the following items as instrument station data;
Date, instrument station number, instrument station code, instrument height, temperature, atmospheric pressure, instrument station coordinates, curvature and refraction correction, prism constant, and automatic tilt angle correction.



Procedure: Instrument station data recording

Select the Job

0 REC : For Record mode

S=O or **RCL**

: Display of Station data

ENT SHFT : Select to start recording

Input date **ENT SHFT**

Input Station number **ENT SHFT**

(Input or select code **ENT SHFT**)

0	1	2	3	4	5	6	7	8	9
A	B	C	D	E	F	G	H	I	J
K	L	M	N	O	P	Q	R	S	T
U	V	W	X	Y	Z	_	.	-	&
0	1	2	3	4	5	6	7	8	9

S=O or **RCL**

Input Instrument height **ENT SHFT**

1 MENU : Set Oppm

2 PROG : Set Temperature & Pressure

3 LCL : Set ppm value

Input Temperature **ENT SHFT**

Input ppm value **ENT SHFT**

Input Pressure **ENT SHFT**

Input N-coordinate **ENT SHFT**

Input E-coordinate **ENT SHFT**

Input Z-coordinate **ENT SHFT**

Record end

Record mode

- Station number input range : 1~99999999
- Code can be up to 13 characters long
- Date, Station number and Code storage period : About a week (Power-off possible)
- Station number displayed is the last-input station number +1.

- Retain the displayed value or code: **ENT SHFT**
- Correct the value of 1 character : **DEL** (set value to 0)
- Exit from the input : **DEL** (to Record mode)

Setting a date of 6th September 1991.
→ Input value of "91.9.6"

- Use **S=O** or **RCL** to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.



- To record the following instrument station data:

Date: October 4, 1991

Instrument station number: No.100

Code: "HOME"

Instrument height: 1.45m

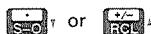
Temperature: 25°C

Atmospheric pressure: 980 mbar

Instrument station coordinates:

N = 30, E = 30, Z = 10

In Record mode, display "Station data"



▲ Select
Station data
Yes / No (exit)

- 1) In Record mode, press or to display "Station data".

Select the "Station data" recording



Date yy. mm. dd
91.8. 10

- 2) Press .

The previously input date is displayed.

Input the date

91.10.4



Stn point
No.

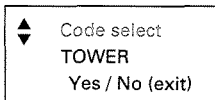
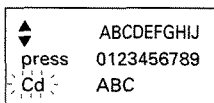
1


- 3) Input "91.10.4" and press .

The date "91.10.4" is input, and "No." flashes to prompt for the input of the station number.

Input the station number


100

ENT
SHIFT

- 4) Input "100" and press .


"100" is input for the station number. "Cd" flashes to prompt for the input of the instrument station code.


If the codes are stored in a stack, the display prompts for the selection of the code. After a code is selected, the code can be edited.

- To input the code directly, press .


Note: If the parameter of the code setting is set to Non-input, this procedure is omitted. Instead, go directly to step 6).


Input the code

 : Single-character delete


 : Input "H"


 : Display K to T

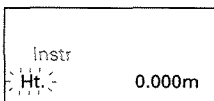
 : Input "O"

 : Input "M"


 : Display A to J


 : Input "E"


 : Input finished





- 5) Input the code.


Press  to delete one character to the left.


Press  to input "H".

Press  to display "K ~ T".

Press  to input "O".

Press  to input "M".

Press  to display "A ~ J".

Press  to input "E".

Press .

The code "HOME" is input, and "Ht" flashes to prompt for the input of the instrument height.

Input the instrument height

1.45

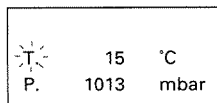
ENT
SHIFT

- 0 set
- Temp & Press
- ppm value

- 6) Input "1.45" and press **ENT** **SHIFT** .

An instrument height value of "1.45" is input, and the display turns to the ppm setting mode.

Select the temperature and pressure input

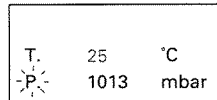
2
PROG

- 7) Press **2** **PROG** .

The previously stored values are displayed.

"T" flashes to prompt for the input of the temperature.

Input the temperature and pressure

2
PROG5
1ENT
SHIFT

- 8) Input "25" and press **ENT** **SHIFT** .

A temperature 25°C is input .




"P" flashes to prompt for the input of the pressure.

9
18
10
RECENT
SHIFT




- 9) Input "980" and press **ENT** **SHIFT** .

A pressure "980 mbar" is input. "N" flashes to prompt for the input of instrument station coordinates.

Input the instrument station coordinates

N = 30 
 E = 30 
 Z = 10 

10) Input the instrument station coordinates.

N = 30 
 E = 30 
 Z = 10 

Record end

▲▼ Select
 S, V, H
 Yes / No (exit)

Recording of the station data is started. When the data has been recorded, the message "Record end" is displayed and the display returns to Record mode.

21.7 Measured data recording

- The SET C can record the following items as measured data:
Target number, target code, target height, atmospheric correction measured data.
- The distance is measured in accordance with the selected distance measurement mode, but the measurement is done only once (single measurement).

Check! before recording the data:

S, V, H

→ Check No.1, 2, 3, 6 below.

S, V, H (offset)

→ Check No.1, 2, 3, 6 below.

V, H, Tilt









→ Check No.1 below.

N, E, Z

→ Check No.1, 2, 4, 5, 6 below.

N, E, Z + S, V, H

→ Check No.1, 2, 4, 5, 6 below.

1. The instrument parameters have been set.  P.29
2. The correct prism constant has been set.  P.41
3. The instrument station data has been performed or else atmospheric correction has been set.  P.44
4. The instrument station data has been performed or else the instrument height, atmospheric correction and instrument station coordinates have been set.  P.53  P.44  P.56
5. The azimuth angle has been set.  P.61
6. The centre of the reflecting prism is being sighted and the return signal is adequate for measurement.  P.13



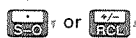
Procedure: Measured data recording

Select the Job



: For Record mode


Sight the target




: Display of Measured data




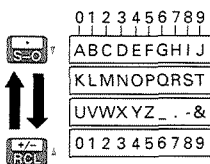
: Select to start recording

(Input Target height )

The SET C measures and displays one set of the target point data in the selected format.

Input Target number 





(Input or select code )





Record end

Record mode

- Target number input range : 1~99999999
- Code can be up to 13 characters long
- Target number, Code and Target height storage period : About a week (Power-off possible)
Target number displayed is the last-Input station number + 1.

- ◆ Retain the displayed value or code: 
- ◆ Correct the value of 1 character : 
- ◆ Exit from the input :  
(to Record mode)

- In Offset measurement, the SET C measures and displays the offset point data.
Select Distance inputting or Target sighting.
Select the direction of offset point from the Target and input the distance between the offset point and Target, or sight the target.



- Use  or  to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.



- To record the following offset measurement data
 Target number : No. 2001
 Code : "TREE1".
 Target height : 1.23 m
 Horizontal distance from target point to offset point : 1.8 m
 Direction of prism from target : Front

In Record mode, display "S, V, H (offset)"



- 1) In Record mode, press  or  to display "S, V, H (offset)".




Select

S, V, H (offset)

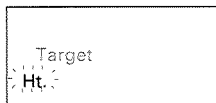
Yes / No (exit)

Select "S, V, H (offset)"



- 2) Press .

The previously stored values are displayed. "Ht" flashes to prompt for the input of the target height.



Note : If the target height setting parameter is set to "Non-input", this procedure is omitted. Instead, go directly to step 4).

Sight reflection prism for offset point and input target height

1.23

ENT
SHIFT

-S dist-

S
ZA
HAR

Offset

1. distance
2. angle

Select "distance"

MENU

 Direction
 prism : →
 Yes / No(exit)
Select offset point direction

RCL or S-O

: Display "↓"

 Direction
 prism : ↓
 Yes / No(exit)

- 3) Sight the reflection prism for the offset point.

Input "1.23" and press ENT SHIFT .

A target height value of 1.23 m is input, and the Distance mode is accessed. Distance measurement is started. The display appears as at left and flashes.

After about 4.7 seconds (Fine measurement mode), the distance value, the vertical angle and horizontal angle are displayed.

The display prompts you to select one of the following options:

1. Input of the horizontal distance from the target point to the offset point.
2. Sight the direction of the target point.

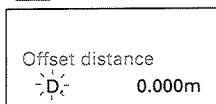
- 4) Press MENU .

The display appears as at left and prompts for the selection of the direction from the target point to the reflecting prism.

- 5) Press RCL or S-O to display "↓".

Note:

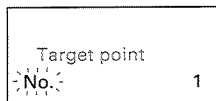
- Prism is right of target
- ← Prism is left of target
- ↑ Prism is behind target
- ↓ Prism is in front of target



When “↓” appears, press . “D” flashes to prompt for the input of the horizontal distance between the target point and offset point.

Input the horizontal distance from the target point to the offset point

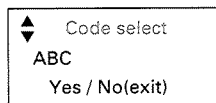
1.8



- 6) Input horizontal distance of “1.8” and press .

Input the target point number

2001

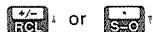


- 7) Input a target number of “2001” and press .

A target number value of “2001” is input. If the codes have been stored in a stack, the first code input is displayed, and the display prompts the selection of the code.

Note: If the parameter of the code setting is set to “Non-input”, this procedure is omitted.

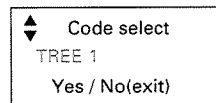
Set the code

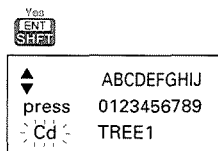


: Display “TREE1”

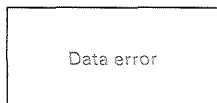
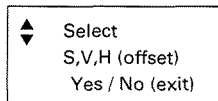
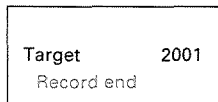
- 8) Press to display “TREE1”.

5





ENT SHFT : The displayed code is the one to be selected



When "TREE1" is displayed, press **ENT SHFT**.

- If the required code is not among the displayed codes, press **No CE-CA**. "Cd" flashes to prompt for the input of the code.

- 9) If the displayed code is the required one, press **ENT SHFT**.

To change the displayed code, press **DEL-CA** to delete the characters one at a time. Input the code required. Then press **ENT SHFT**.

When the code has been input, the target number is displayed, and the recording is finished.

The display then returns to the Record mode.

Note : If the display returns to Record mode following a display like that at the left, there is an error in the measurement. Try levelling the instrument again, or sight the reflecting prism once again and start over from step1).

21.8 Note recording

- The SET C can record remarks as notes.



Procedure:

Note recording

Select the Job file



Record mode



Input note



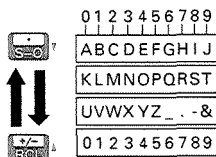
Record end



Record mode

- Note can be up to 20 characters long

- ◆ Correct 1 character :
- ◆ Exit from the input :
(to Record mode)

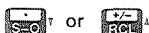


- Use or to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.



- To record "CLOUDY" as a note

In Record mode, display "Note"



- 1) In Record mode, press or to display "Note".

Select
 Note
 Yes / No (exit)

Select the "Note" recording



- 2) Press . "Rem" flashes to prompt for the input of the note.

ABCDEFGHIJ
 press 0123456789
 Rem

Rem: Remark

Input the note

CLOUDY

Record end

- 3) Input "CLOUDY" and press . When the note has been recorded, the display returns to Record mode.

Select
 S,V,H
 Yes / No (exit)

21.9 Feature code recording

- The SET C can record the feature codes in the instrument and on a card in advance.
The feature code is input with recording instrument data and instrument station data.
- The procedure of code file recording to a card and recalling from the card is as follows:

① Record codes in a stack in the instrument

21.9

If codes have been stored in a stack, the codes in that stack are automatically displayed whenever a new code is set, and the display prompts for the selection of the code.
When creating a new file on the card, any codes currently recorded in the stack should be deleted, and then the new codes should be recorded in the stack.

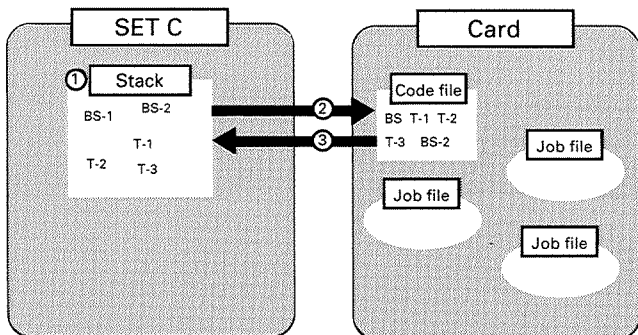
② Record codes in the stack on a card

21.9

③ Recall the codes from the card to the stack in the instrument

21.10

The newly recalled codes are displayed when a new code is set and the display prompts for the selection of the code.



Procedure: Feature code recording

In Theodolite mode or Basic mode

: For Menu mode

: Select the code setting

or : Display "stack+"

Yes
 : Select the code recording to stack

Input the feature code

	0	1	2	3	4	5	6	7	8	9
	A	B	C	D	E	F	G	H	I	J
	K	L	M	N	O	P	Q	R	S	T
	U	V	W	X	Y	Z	_	.	-	&
	0	1	2	3	4	5	6	7	8	9

: Stop recording the code to stack

or : Select the code recording from stack to card

Yes
 : Select the code recording from stack to card

Input the feature code file name

, : To Basic mode

- Feature code can be up to 13 characters long
- Feature code in stack storage period:
About a week (Power-off possible)
- Code file name can be up to 2 characters long after "FCODE"

- ◆ Correct 1 character :
- ◆ Exit from recording :
(to Code setting mode)

- Use or to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.



- To record the codes "SCHOOL" and "FACTORY" in a stack, and then to record them on a card under the file name "FCODE-1".

From Theodolite or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Menu mode.

Select "Code" setting

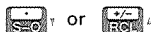


- ▲ Feature codes
view
Yes / No(exit)

- 2) Press .

The display appears as at left, showing the code setting menu.

Select code recording in stack (stack +)



: Display "stack +"

- 3) Press or to display "stack +".

- ▲ Feature codes
stack +
Yes / No (exit)



: Select "stack +"

- 4) Press .

"Cd" flashes to prompt for the input of the code.

- ▲ ABCDEFGHIJ
press 0123456789
Cd ABC

Input the code

SCHOOL

ENT
SHIFT
 ABCDEFGHIJ
0123456789

Cd

Stack is full

DE-CA : Input is finished


 Feature codes
view
Yes / No (exit)

- 5) Input "SCHOOL" and press **ENT/SHIFT**.
The code has been recorded.
"Cd" flashes again to prompt for the input of the next code.

Note : If the message "Stack is full" is displayed, no more codes can be recorded in that stack.

Press **DE-CA** to stop inputting the codes and record the codes on the card.

Note : 140 characters can be recorded in stack.

For example, the number of codes composed of 6 characters is 20.



$140 \div \{6(\text{characters}) + 1(\text{space})\} = 20$
20 codes can be recorded.

- 6) Press **DE-CA** to stop recording the data to the stack.

The display returns to the code setting menu.

- After that, when instrument station data and measured data are to be recorded, the codes stored in the stack will be displayed to select the required one.
- Go back to step 5) and input "FACTORY".

Select code in the stack to be recorded on the card (card <= stack)

 or 

: Display "card <= stack"



Feature codes

card <= stack

Yes / No (exit)

Yes




: Select code in the stack
to record on the card




ABCDEFGHIJ

press 0123456789

FCODE

7) Press  or  to display
"card <= stack".

8) Press .

"FCODE" is displayed to prompt
for the input 2 characters as the
file name for recording the codes
to the card.

Input the file name

-1 



Feature codes



view

Yes / No (exit)

9) Input "-1" and

press .

"FCODE-1" is input, and the display
returns to the code setting
menu.

- The codes in the stack have been
recorded on the card.
- Press   to return to the
Basic mode.


21.10 Feature code recalling to stack


- The SET C can recall a code file stored on the card and input it to the stack in the instrument.
After that, you can select the required code from the recalled code file in the stack when the instrument station data and measured data are recorded.




Procedure: Feature code recalling


In Theodolite mode or Basic mode



◆ Exit from the input : 


 : For Menu mode

 : Select the code setting



 or  : Display "card => stack"

Yes
 : Select the code to recall from card to stack

 or  : Display the required code file

Yes
 : Select the code file name

Yes
 : Verify

 ,  : To Basic mode



- To recall the code file named "FCODE5B", which is stored on a card, to a stack

From Theodolite mode or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing the Menu mode.

Select "Code" setting

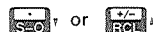


- Feature codes
view
Yes / No (exit)

- 2) Press .

The display appears as at left, showing the code setting menu.

Select code file to be recalled to stack (card => stack)



: Display "card => stack"

- 3) Press or to display "card => stack".



- Feature codes
card => stack
Yes / No (exit)



: Select "card => stack"

- 4) Press .

The files can now be selected.
(The display prompts for the selection of the code file.)



- Codes file
FCODE-1
Yes / No(exit)

Select file to be recalled

or :

Display "FCODE5B"

Codes file
 FCODE5B
 Yes / No(exit)

Yes
 : Display "FCODE5B"

Code stack
 over write ?
 Yes / No(exit)

Yes
 : Verify

Feature codes
 view
 Yes / No (exit)

: To Basic mode

- 5) Press or to display "FCODE5B".

- 6) Press .

The display asks whether the codes currently stored in the stack are cleared and whether to recall the codes in the "FCODE5B" file.

- 7) Press .

The codes in "FCODE5B" are recalled to the stack, and the display returns to the card setting menu.

- After that, when instrument station data and measured data are to be recorded, the codes stored in the stack will be displayed to select the required code.
- Press to return to Basic mode.

Note: If the message "File not exists" is displayed, no files storing codes are stored on the card.

21.11 Feature code deleting

- The SET C can delete a code file stored on a card or a code stored in a stack. If there is no code in the stack, the code can be input directly when the instrument station data and measured data are recorded.
- To delete code files from a card, please refer to P.115, "21.4 Job creating and selecting", and specify the name of the file to be deleted.



Procedure: Feature code deleting

In Theodolite mode or Basic mode

◆ Exit from the input : (to Code setting mode)

: For Menu mode

: Select the code setting

or : Display "stack -"

: Select code deleting from stack

or : Display the required code

: Select the code

, : To Basic mode



- To delete the code "SCHOOL" from a stack

From Theodolite mode or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .
The display appears as at left, showing Menu mode.

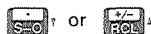
Select "Code" setting



- ▲ Feature codes
▼ view
Yes / No (exit)

- 2) Press .
The display appears as at left, showing the code setting menu.

Select code to be deleted from stack (stack-)



: Display "stack-"

- ▲ Feature codes
▼ stack -
Yes / No (exit)

- 3) Press or to display "stack-".

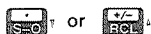


: Select "stack-"

- ▲ Codes select
▼ SCHOOL
Yes / No(exit)

- 4) Press .
The display prompts for the selection of the code to be deleted.

Select the code to be deleted



: Display "SCHOOL"



Codes select

SCHOOL

Yes / No(exit)



: Delete "SCHOOL"



Feature codes
view

Yes / No (exit)

No code data

- 5) Press or to display "SCHOOL".

- 6) Press .

The code "SCHOOL" is deleted from the stack, and the display returns to the card setting menu.

Note : If no codes have been stored in the stack, the message "No code data" appears, and the display returns to the card setting menu.

- Press to return to the Basic mode.

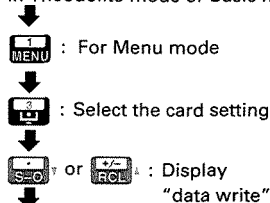
21.12 Coordinate data recording

- The SET C can record coordinate data on cards. The coordinate data is recorded in a Job file, and can be used as instrument station coordinates, backsight station coordinates, known point coordinates, and setting-out coordinates.
- To delete a file with coordinate data in it from a card, please refer to P.115, "21.4 Job creating and selecting".



Procedure: Coordinate data recording

In Theodolite mode or Basic mode



Yes
↓
ENT **SHIFT** : Select the coordinate data recording

Yes
↓
ENT **SHIFT** : Select the Job name

No
↓
CECA : Select or create another Job

↓
1 **MENU** : Create the Job

↓
2 **PROG** : Select the Job

↓
Create the Job

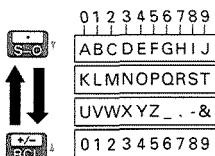
↓
Select the Job

↓
Input N-coordinate data **ENT** **SHIFT**, Input E-coordinate data **ENT** **SHIFT**

↓
Input Z-coordinate data **ENT** **SHIFT**

↓
Input the point number **ENT** **SHIFT**

↓
Input the code **ENT** **SHIFT** or Select the code **Yes** **ENT** **SHIFT**



Yes
↓
ENT **SHIFT** : Record the data

↓
Record end, **CECA**, **CECA** : To Basic mode

- Feature Code can be up to 13 characters long
Coordinate data input range: ± 9999999.999
- Coordinate data least input: 0.001
- Point number input range: 1 ~ 99999999

- ◆ Correct 1 character : **CECA**
- ◆ Exit from the input : **CECA** (to Card setting mode)

- Use **S-O** or **±/RC** to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

e.g.

- To record the coordinate data,
Point number: 201
N-coordinate: 35
E-coordinate: 67
Z-coordinate: 48
Code: BS-4
Job file: COORD.1

From Theodolite mode or Basic mode to Menu mode

1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing the Menu mode.

Select "Card" setting

- Card
 Job / file
 Yes / No (exit)

- 2) Press .

The display appears as at left, showing the card setting menu.

Select coordinate data recording (data write)

or

: Display "data write"

- Card
 data write
 Yes / No (exit)

- 3) Press or to display "data write".

Yes
 : Select "data write"

Job OSAKA
 Yes / No (select)

- 4) Press .

The last selected file name is displayed. The display asks whether the coordinate data is to be recorded in the job file or in another job file.

Select "COORD.1"

No
DE-CA : "select" another file

1. Job create
2. select
3. delete

2
PROG : Select "Job select"

▲ Job / file name
TOKYO
Yes / No (exit)

+/-
S=O or +/-
RCL

: Display "COORD.1"

▲ Job / file name
COORD.1
Yes / No (exit)

Yes
ENT
SHIFT : Select "COORD.1"

N	0.000
E	0.000
Z	0.000

- 5) Press to select or create another job file.

The display returns to the job setting menu.

- To record the data in the displayed Job file, press . Then proceed to step 8).

- 6) Press .

The display prompts for the selection of the file name.

- To create a new Job file, press .




The display prompts for the input of the Job file name. Input the Job file name and press to advance to step 9).

- 7) Press or to display "COORD.1".

- 8) Press .




"N" flashes to prompt for the input of the N coordinate data.

Input the coordinate value

N = 35 
 E = 67 
 Z = 48 




Point
 No. 1000


- 9) Input coordinate values.

N = 35 
 E = 67 
 Z = 48 

The previously stored values are displayed. "No." flashes to prompt for the input of the point number.

Input the point number

201 
 ABCDEFGHIJ
 press 0123456789


- 10) Input the point number "201" and press .


"Cd" flashes to prompt for the input of the code.

Note: If the code is stored in a stack, the display prompts for the selection of the code. After the code is selected, the display appears as at left.

Set the code

BS-4 

Data OK ?
 Yes / No

- 11) Input the code "BS-4" and press .

The display asks whether the coordinate data is recorded on the card or not.

Yes
ENT SHIFT : OK

Coord.	201
Record end	

N	0.000
E	0.000
Z	0.000



12) Press  .

When the recording is confirmed, the point number is displayed, and the recording is finished.

The display then returns to step 8), so that the next coordinate data can be input.

- To record the next coordinate data, go back to step 9) and input the data.

Note: Although it is possible to input up to about 1000 data to the 64Kbyte card, the SET C is only able to recall up to the first recorded 600 coordinate data. Therefore, when recording more than 600 coordinate data, input the additional point data into another job file.

  :To card setting menu

▲▼	Card
	Job/file
	Yes / No (exit)

13) Press   .

The display returns to the card setting menu.

- Press   to return to Basic mode.

21.13 Coordinate data recalling to Instrument

- The SET C can recall and use the coordinate data stored on the card.
- Recalled coordinate data can be used as follows:
 - Instrument station coordinates
 - Backsight station coordinates
 - Known point coordinates for Resection measurement
 - Setting-out coordinates

Note : The SET C is only able to recall up to the first recorded 600 coordinate data from a job file. Therefore, when recording more than 600 coordinate data, input the additional point data into another job file.

- Before recalling the data into the instrument station, the following parameter should be set to "Card".
To change the parameter, please refer to P.197, "24. CHANGING INSTRUMENT PARAMETERS".

No.	Parameter	Options
1	Coordinate data from	Keyboard / Card

Procedure: **Coordinate data file selection to be recalled**

In Theodolite mode or Basic mode



1 : For Menu mode



2 : Select the card setting



or : Display "data read"



Yes
 : Select the coordinate data file to recall from card to instrument



or : Display the required coordinate file name



Yes
 : Select the coordinate file name



or : To Basic mode (Keep the card inserted)

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

- ◆ Exit from the input :

- Recall Instrument station coordinates:

Press + and input the stored coordinate data point number.

- Recall Backsight station coordinates:

Press + and input the stored coordinate data point number.

- Recall Setting out coordinates:

Press + and input the stored coordinate data point number.



- To select or change the file name "COORD.5" to be recalled from the card into the instrument

From Theodolite mode or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) Press

The display appears as at left, showing Menu mode.

Select "Card" setting

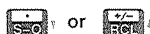


- Card
- Job / file
- Yes / No (exit)

- 2) Press

The display appears as at left, showing the card setting menu.

Select file recalling (data read)



: Display "data read"

- Card
- data read
- Yes / No (exit)

- 3) Press or to display "data read".



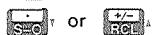
: Select "data read"

- Coord. file
- TOKYO
- Yes / No (exit)

- 4) Press .

The display prompts for the selection of the file name to be recalled.

Select "COORD.5"



: Display "COORD.5"

▲	Coord. file
▼	COORD.5
	Yes / No (exit)



: Select "COORD.5"

Busy...


1. Config
2. Card
3. Code

- 5) Press  or  to display "COORD.5".

- 6) Press .

While searching for the specified file name, the display appears as at left.

When the file has been selected, the display returns to Menu mode.

- Press  to return to Basic mode.

Note: Keep the card inserted until recalling the instrument station coordinates, the backsight coordinates, or the setting out coordinates is completed.

- If this file is different from the previously selected file, the display asks whether the previous selection is cancelled and this file is to be selected or not.

Pressing , the file name searching is started.

Data table over write ? Yes / No (exit)

Note: If there is no data in the selected file, the message "No coord. data" is displayed, and the display returns to Menu mode.

e.g.

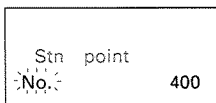
<Input instrument station coordinates by recalling the coordinate data from the card>

- To recall the coordinate data for Point No.401 from the selected file as the instrument station coordinates

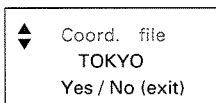
From Theodolite mode or Basic mode to Instrument station coordinates input mode



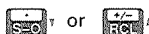
1) Press



"No." flashes to prompt for the input of the point number.



Note: When the file to be recalled is not selected, the display appears as at left and prompts for the selection of the required file.

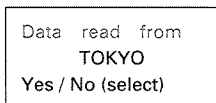


: Display the required file name

to display the file name to be selected.

ENT SHFT : Select the displayed file

Press **ENT SHFT** to select the displayed file name.



Note: When the previously selected file is not on the card, the display appears as at left.



: Select another file

Press **No** to select the file which stores the coordinates to be recalled.

Input the point number


401 


N	98.765
E	43.210
Z	1.456

▲▼ N	98.765
E	43.210
Z	1.456

No data




Keyboard input
Yes / No (exit)

 : To Basic mode


- 2) Input the point number "401" and press .


The coordinate data for 401 is displayed and is input as the instrument station coordinates.


Note : If more than one stored coordinate data record has the same point number, the display flashes to prompt for the selection of the required coordinate data.

Press  or  to display the coordinates to be recalled. And then press  to recall the displayed coordinates.

Note : When the coordinate data is not found, the display appears as at left and asks whether you will input the coordinate data from keyboard or input the point number again.

Press  to input the Instrument station coordinates from keyboard.

Press  to input the point number again.

- Press  to return to Basic mode.



<Input Known station coordinates for Resection measurement by recalling the coordinate data from the card>

- To recall the coordinate data for the following point number from the selected file as the known station coordinates for Resection measurement

Known station A: Point No.=501, Measure angle & distance, Target height is 1.5m

Known station B: Point No.=503, Measure angle

Known station C: Point No.=507, Measure angle & distance, Target height is 1.5m

From Theodolite mode or Basic mode to Program mode

2
PROG

1. Resection
2. Correction
3. Pt. replace

- 1) In Theodolite mode or Basic mode, press **2** PROG .

The display appears as at left, showing Program mode.

Select Resection measurement

1
MENU

Target / Coord.
No. 400

- 2) Press **1** MENU .

"No." flashes to prompt for the input of the point number.

Input the data of Known station A


501

ENT
SHIFT


Measure dist ?
Yes / No

- 3) Input the point number "501" and press **ENT** SHIFT .

The display asks whether to measure the distance or not.

 : Measure distance

Target
Ht. 1.500m


 : Retain displayed value

Target / Coord.
No. 502


Input the data of Known station B

503 

Measure dist ?
Yes / No


 : Distance not measured

Target / Coord.
No. 504


4) Press  .

The previously stored target height is displayed.


"Ht." flashes to prompt for the input of the target height.

5) Press  .

When the data for the first station has been input, "No." flashes to prompt for the input of the point number of the next known station. (The previously stored value +1 is displayed.)

6) Input the point number "503" and press  .

The display asks whether to measure the distance or not.

7) Press  .

When the data for the second station has been input, "No." flashes to prompt for the input of the point number of the next known station. (The previously stored value +1 is displayed.)

Input the data of Known station C

507

Measure dist ?
Yes / No

Yes

: Measure distance

Target
Ht. 1.500m

: Retain displayed value

More point ?
Yes / No

No

: No more station

Pt. 501
measure ?
Yes / No (exit)

- 8) Input the point number "507" and press .

The display asks whether to measure the distance or not.

- 9) Press .

The previously stored target height is displayed.

"Ht." flashes to prompt for the input of the target height.

- 10) Press .

When the data for the third station has been input, "No." flashes to prompt for the input of the point number of the next known station. (The previously stored value +1 is displayed.)

- 11) Press .

The display asks whether you want to observe the first station (Known station A) or not.

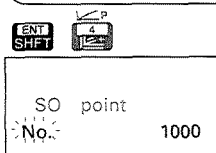
- See P.73 from 15) to continue the resection measurement.



<Input Coordinate setting-out data by recalling the coordinate data from the card>

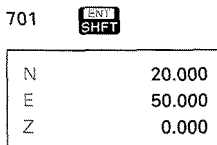
- To recall the coordinate data for Point No. 701 from the selected file as the setting-out coordinate data.
- The following preparations must be completed before beginning measurement:
 - 14.1 Measurement mode selection P.52
 - 14.2 Instrument height and Target height input P.53
 - 14.3 Instrument station coordinates and Backsight station coordinates input P.56
 - 14.4 Setting the azimuth angle from the instrument and backsight station coordinates P.61

From Theodolite mode or Basic mode to Coordinate setting-out data input



- 1) Press .
"No." flashes to prompt for the input of the point number.

Input the point number



- 2) Input the point number "701" and press .
The coordinate data for 701 is displayed and is input as the instrument station coordinates.

- See P.103 from 5) to continue the coordinate setting-out measurement.

21.14 Reviewing data stored on the card

- The SET C can display data recorded on the cards and codes stored in a stack.
- The data in a Job file can be displayed using the Recall mode. The feature codes in a stack can be displayed using Menu mode.
- Data in Job files is displayed in the format shown below.

< Instr ID >

Instr ID
SET C
No. 88132

Instr name
Instr No.

< S, V, H > /

< S, V, H (Offset) > (angle)

◆ Pt. 1012
Code TREE. 100
Ht 1.300 m
ppm 13
S 8.472 m
ZA 96° 48' 30"
HAR 244° 57' 55"

Target station number

Code (If no code,
"?" is displayed)

Target height

Atmospheric correction

Slope distance

Vertical angle

Horizontal angle

< Station data >

◆ Station data
Date 92.1.1
Stn 7000
Code STATION. 1
Ht 1.500 m
Temp 25°C
Press 1000 mbar
C & R No
PC -40mm
Tilt ON
N 10.000
E 10.000
Z 0.000

Date

Instrument station number

Code (If no code, "?" is displayed)

Instrument height

Temperature

(If 0 ppm or a ppm value has been input directly, "?" is displayed)

Pressure

(If 0 ppm or a ppm value has been input directly, "?" is displayed)

Curvature and refraction correction ON/OFF

Prism constant correction

Tilt correction ON/OFF

Instrument station N coordinate (E coordinate)

E coordinate (N coordinate)

Z coordinate

< S, V, H (Offset) > (distance)

▲ Pt. 1012	Target station number
Code TREE. 101	Code (If no code, "?" is displayed)
Ht 1.300 m	Target height
ppm 13	Atmospheric correction
Off B 3.570 m	Prism direction (B: back, F: front, R: right, L: left) and horizontal distance from target
S 8.472 m	Slope distance
ZA 100° 48' 30"	Vertical angle
HAR 244° 57' 55"	Horizontal angle

< V, H, Tilt >

▲ Pt. 1012	Target station number
Code HOUSE. SUZU KI	Code (If no code, "?" is displayed)
Ht 1.300 m	Target height
ppm 13	Atmospheric correction
ZA 100° 48' 30"	Vertical angle
HAR 244° 57' 55"	Horizontal angle
Tilt X 0° 01' 45"	X direction tilt angle
Tilt Y 0° 00' 05"	Y direction tilt angle

< N, E, Z + S, V, H >

▲ Pt. 1014	Target station number
Code TREE. 4	Code (If no code, "?" is displayed)
Ht 1.300 m	Target height
ppm 13	Atmospheric correction
N 62.902	N coordinate (E coordinate)
E 41.930	E coordinate (N coordinate)
Z 0.000	Z coordinate
S 25.487 m	
ZA 100° 48' 30"	
HAR 244° 57' 55"	

< N, E, Z > /

< Coordinate file >

▲ Pt. 1013	Target station number/Point number
Code TREE. 3	Code (If no code, "?" is displayed)
Ht 1.300 m	Target height/empty column if coordinate file
ppm 13	Atmospheric correction/empty column if coordinate file
N 62.902	N coordinate (E coordinate)
E 41.930	E coordinate (N coordinate)
Z 0.000	Z coordinate


<Note >



Note
RAIN

Remark

Procedure: Data in the Job file reviewing

In Theodolite mode or Basic mode

◆ Exit from reviewing : 
(to Basic mode)

 ,  : For Recall mode



Yes



: Select the Job




No



: Select another Job





or  : Display "data read"




Yes



: Select the Job name





or  : Display the required data name or point number





Yes



: Select the data name or point number




Review the data

● Use  or  to display the required data





,  : To Basic mode

e.g.



- To review the measured data for target station number 1008 in the Job file called "OSAKA"

From Theodolite mode or Basic mode to Recall mode



10
-40
RCL

Job TOKYO
Yes / No (select)


- 1) In Theodolite mode or Basic mode, press  , .

The previously selected Job file name is displayed. The display asks whether the file selected is to be reviewed or another file is to be.

Choose another Job file selection

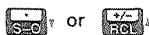


Job / file name
TOKYO
Yes / No (exit)

- 2) Press .

The display prompts for the selection of the file name.

Select "OSAKA"



: Display "OSAKA"


Job / file name
OSAKA
Yes / No (exit)

- 3) Press  or  to display "OSAKA".



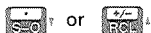
:Select "OSAKA"

Select
Instr ID
Yes / No (exit)

- 4) Press .

The display prompts for the selection of the data to be reviewed.

Select "Pt. 1008"



: Display "Pt. 1008"

▲	Select
Pt.	1008
Yes / No (exit)	



▲	Pt.	1008
Code	TREE. 1	

Target station code



▲	Pt.	1008
Ht	1.300 m	
ppm	13	

Target height
Atmospheric
correction

▲	Pt.	1008
Off	B 3.860 m	
S	3.740 m	

Prism direction and horizontal distance from target
Slope distance to target

▲	Pt.	1008
ZA	89° 48' 15"	
H.A.R	203° 01' 05"	

Vertical angle of target
Horizontal angle of target

- 5) Press or to display "Pt. 1008".

- 6) Press .

The stored data is displayed.
(The illustration at the left shows an example of stored data for an offset measurement.)

- Press to display the next data and to display the previous data.

- Press to return to Basic mode.



Procedure: Feature code in stack reviewing

In Theodolite mode or Basic mode

◆ Exit from reviewing :



: For Menu mode



: Select the code setting



: Select the code reviewing from Stack



or : Display the required code



, , : To Basic mode



- To review codes in a stack

Note: To review codes in a code file recorded on a card, please make sure the code file has been recalled into the stack referring to the instructions on P.141, "21.10 Feature code recalling to stack", in advance.

From Theodolite mode or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press .

The display appears as at left, showing Menu mode.

Select code setting



- ▲ Feature codes
▼ view
Yes / No (exit)

- 2) Press .

The display appears as at left, showing the code setting menu.

Select code reviewing (view)



Yes
: Select "view"

- ▲ TREE. 1
▼ HOUSE
SIGNAL

- 3) Press .

The codes in the stack are displayed.



or .

: Display previous or next code

- Press to display next codes and to display previous codes.

- Press , , to return to Basic mode.

21.15 Protecting data stored on the card

- Once data has been recorded on the card, it can be protected from erasure or formatting by using the Write Protect function.

From Theodolite mode or Basic mode to Menu mode



1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press . The display appears as at left, showing Menu mode.

Select card setting



- ▲▼ Card
- Job / file
- Yes / No (exit)

- 2) Press . The display appears as at left, showing the card setting menu.

Select "write protect"




or



: Display "write protect"


- ▲▼ Card
- write protect
- Yes / No (exit)

- 3) Press or to display "write protect".

 : Select "write protect"

Write

1. protect on
2. enable

4) Press .


The display asks whether the Write Protect function is to be turned on or canceled.

Select the card protect function




Write protected

1. Config
2. Card
3. Code


5) Press .

The message "Write protected" is displayed and the data is protected. The display returns to Menu mode.


 : Cancel the protect function

Write enabled

1. Config
2. Card
3. Code

- Press .

The message "Write enabled" is displayed and the Write Protect function is canceled. The display returns to Menu mode.

- Press  to return to Basic mode.

21.16 Data stored on the card output to an external device

- Key operations allow the SET C to output the data stored on the card via the data output connector to an external device using an interface cable. (For more information, see the Series C 2-way communication manual.)

From Theodolite mode or Basic mode to Menu mode

1
MENU

1. Config
2. Card
3. Code

- 1) In Theodolite mode or Basic mode, press **1** MENU.

The display appears as at left, showing Menu mode.

Select "Card" setting

2
PROG

- ▲ Card
▼ Job / file
Yes / No (exit)

- 2) Press **2** PROG.

The display appears as at left, showing Card setting menu.

Select the "data output"

S=O or **RCL**

- ▲ Card
▼ data output
Yes / No (exit)

- 3) Press **S=O** or **RCL** to display "data output".



▲ Job / file name
ABC
Yes / No (exit)

4) Press .

"data output" is selected and the display prompts for the selection of a file to be output to an external device.

Select the file to be output



or



▲ Job / file name
XYZ
Yes / No (exit)

5) Press or .

to display the file name to be output.

Start the output



Data output...
Exit=>press "No"

6) Press .

The display appears as at left, and the output is started.

- Press to stop the output during outputting.

▲ Job / file name
XYZ
Yes / No (exit)

7) When the output is completed, the display prompts for the next selection of a file to be output.



: To Basic mode

- Press to return to Basic mode.








TROUBLESHOOTING

22. ERROR MESSAGES

 P.175

23. CHECKS AND ADJUSTMENTS

 P.179

- 23.1 Plate level 
- 23.2 Circular level 
- 23.3 Reticle 
- 23.4 Coincidence of distance measuring axis with reticle 
- 23.5 Optical plummet 
- 23.6 Distance measurement check flow chart 
- 23.7 Additive distance constant 

Various results

$$Y_{\text{max}} = 100$$

monon!

Figure 1

— 200 —

1000

Wissenschaft

2004

Acknowledgments

— 22 —

descent

1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 2680, 26

100

www.elsevier.com/locate/jmb

• •

References

10 174

44. *Chlorophyll *a**

100 100

7047204N

100 100

Figure 1. A. *Staphylococcus aureus* B. *Staphylococcus epidermidis* C. *Staphylococcus saprophyticus* D. *Staphylococcus sciuri* E. *Staphylococcus carnosus* F. *Staphylococcus saprophylus* G. *Staphylococcus aureus* H. *Staphylococcus aureus* I. *Staphylococcus aureus* J. *Staphylococcus aureus* K. *Staphylococcus aureus* L. *Staphylococcus aureus* M. *Staphylococcus aureus* N. *Staphylococcus aureus* O. *Staphylococcus aureus* P. *Staphylococcus aureus* Q. *Staphylococcus aureus* R. *Staphylococcus aureus* S. *Staphylococcus aureus* T. *Staphylococcus aureus* U. *Staphylococcus aureus* V. *Staphylococcus aureus* W. *Staphylococcus aureus* X. *Staphylococcus aureus* Y. *Staphylococcus aureus* Z. *Staphylococcus aureus*

Figure 1

8. $\frac{1}{2}$ $\frac{1}{2}$

CONCLUSIONS

^aQuota control.

..

⁴Google.

© 2006 Blackwell

By using a simple





22. 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.

Display	Meaning	Action
Bad cond.	Prism sight is bad.	Sight the target again. Measure again after confirming the returned signal using the signal checking mode.
Battery is low	Battery voltage is too low.	Charge the battery or replace it with a charged one.
Card bat low	Card battery level is too low.	Card should be replaced with a new one. Or, replace the battery in the card.
Card is full	Less than 60 bytes of memory remaining.	Card should be replaced with a new one.
Confirm 0 set	Reset is not performed.	Index the V and H circles again.
Data error	An error has occurred during recording.	Level the SET C again or sight the reflecting prism.
	Error when measuring the initial slope distance during either REM or horizontal distance between two points measurement.	Sight the reflecting prism to perform slope distance measurement again.

Display	Meaning	Action
File exists	Card has had the same code file name.	
File not exists	Card has no code file or Job file.	
Invalid file	The specified file has a different configuration and cannot be selected.	Select the correct file.
Job area over	Card has no area for new Job file or code file.	
Memory cleared	After 1 week, data stored in the short term memory has been cleared.	
No card ↓ Card error	Card is not correctly mounted in the instrument.	Make sure the card has been inserted properly.
	No communication with card.	
	After changing the card battery.	No problem.
No code data	Stack has no feature code data.	
No coord. data	There is no data in the selected file.	
No data	There is no data for the specified point number, or the specified point number does not consist of coordinate data.	
No Job	Card has no Job.	

Display	Meaning	Action
Not formatted	New card. Card has not been formatted.	Format the card.
Out of range	During REM, the vertical angle is more than $\pm 89^\circ$ or the measured distance is more than 9999.999m	Press  to stop measuring.
Out of range X > \perp < Y	Tilt sensor range error. Tilt angle exceeds $\pm 3'$.	Level the SET C again.
Record error	External device does not reply with ACK/NAK. (when "recording" parameter is set to "out".)	Check to see if there are any abnormalities in cables or external equipment, or if there is a problem with the program.
Signal off	At start of measurement, the returned signal was totally absent or disturbed.	Sight the target again. Measure again after confirming the returned signal using the signal checking mode.
Stack is full	There is no area to record codes in stack. (Up to 140 characters)	
Tilt error	While setting the azimuth angle, tilt angle exceeds $\pm 3'$.	Level the SET C again.
Tilt Out of range	During distance measurement, tilt angle exceeds $\pm 3'$.	Level the SET C again.
Time out	No measured distance data is received within 2 minutes of starting the measurements, or the measured distance data cannot be obtained for a total of one minute.	Sight the target again. Measure again after confirming the returned signal using the signal checking mode.

Display	Meaning	Action
Unit error	Instrument distance units do not match those on the card.	Set the distance unit in the data on the card to match that of the instrument.
Write protected	The data on the card is protected and the card cannot be used.	Press  for Menu mode, and change the setting for the card from "Write protected" to "Write enabled".
E 100	Error when measuring a horizontal angle*.	Index the horizontal circle again.
E 101	Error when measuring a vertical angle*.	Index the vertical circle again.

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

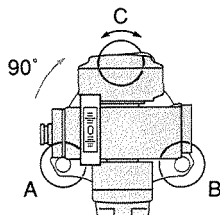
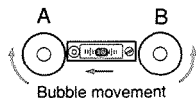
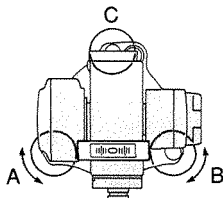
23. CHECKS AND ADJUSTMENTS

- Periodically, checks and adjustments should be performed before and after 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.

23.1 Plate level


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

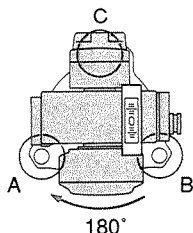
Check



- Turn the upper part of the instrument until the plate level is parallel to a line between levelling foot screws A and B.
Centre the plate level bubble using levelling screws A and B.

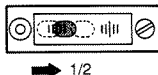
Note: The bubble moves towards a clockwise rotated foot screw.

- Loosen the horizontal clamp  and turn the upper part 90°. The plate level is perpendicular to a line between levelling screws A and B.
Centre the plate level bubble using levelling screw C.

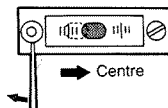


Adjustment

- 4) Use levelling screws



- 5) Use adjusting pin



- 3) 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:

- 4) Correct half of the bubble displacement using levelling screw C.

- 5) Correct the remaining half of the displacement by adjusting the screw Ⓒ with the adjusting pin.

Note: The bubble moves away from a clockwise rotation of the adjusting screw.

- 6) Repeat the procedures from 1) to 5) until the bubble remains centred for any position of the upper part.

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

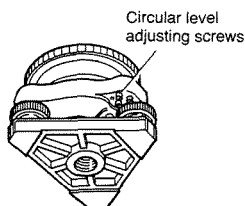
23.2 Circular level

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 off-centre, adjust as follows:

Adjustment



- 3) Verify the off-centre direction of the bubble.
- 4) Loosen the adjusting screw 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.

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

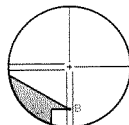
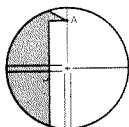
If the bubble can not be centred, please contact your Sokkia agent.

23.3 Reticle

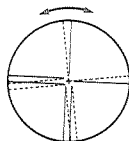
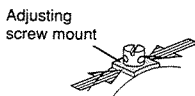
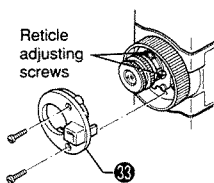
- This adjustment is very delicate. If you have any difficulties, please contact your Sokkia agent.

Perpendicularity of the reticle to the horizontal axis

Check



Adjustment



- 1) Level the SET C carefully. Select and sight a clear target on the upper part A of the reticle line.
- 2) Turn the telescope vertical fine motion screw ③ until the target is on the lower part of the reticle B. If the target is still positioned centrally within the reticle lines, no adjustment is necessary. If the target is off-centre, adjust as follows:

- 3) Remove the telescope reticle cover ③.
- 4) Slightly loosen one vertical and one horizontal adjusting 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.

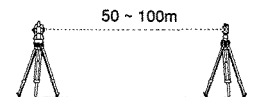
Note: Over-tightening the adjusting screws may damage the reticle. Unequal tightening of the adjusting screws may mean that the reticle will go out of adjustment.

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

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

Vertical and horizontal reticle line positions

Check



ZA	90° 30' 10"
HAR	18° 34' 00"

ZA	269° 30' 00"
HAR	198° 34' 10"

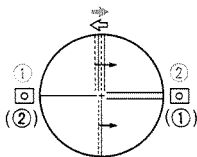
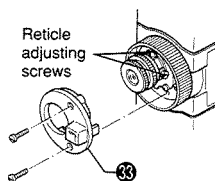
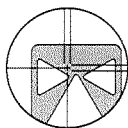
- 1) Set up a clear target 50 - 100m from the SET C. Level the instrument carefully, switch on, and index the vertical and horizontal circles.
- 2) Sight the target on face left. Read the vertical and horizontal angles.
e.g. HAR 18°34'00".....a1
ZA 90°30'10".....b1
- 3) Now sight the target on face right. Read the vertical and horizontal angles.
e.g. HAR 198°34'10"....a2
ZA 269°30'00"....b2
- 4) Calculate $a2 - a1 = 180°00'10"$.
The difference should be within $180° \pm 20"$.
- 5) Calculate $b1 + b2 = 360°00'10"$.
The sum should be within $360° \pm 20"$.
If a difference of more than $\pm 20"$ still remains after repeating these procedures several times, adjust as follows:

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

Adjustment

e.g. $a1 = 18^{\circ} 34' 00''$
 $b1 = 90^{\circ} 30' 10''$
 $a2 = 198^{\circ} 34' 20''$
 $b2 = 269^{\circ} 30' 10''$

ZA	$296^{\circ} 30' 00''$
HAR	$198^{\circ} 34' 10''$



- 6) Calculate Horizontal angle A and Vertical angle B,

$$A = (a2 + a1) / 2 + 90^{\circ} = 198^{\circ} 34' 10''$$

$$B = (b2 - b1) / 2 + 180^{\circ} = 269^{\circ} 30' 00''$$

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

- 8) Look through the telescope. The reticle is now slightly shifted from the target.

- 9) Unscrew the two fixing screws and remove the telescope reticle cover 33.

- 10) To move the vertical reticle line towards the target centre, use the adjusting pin to adjust the left and right adjusting screws as follows: Slightly loosen the top and bottom adjusting screws by the same amount.

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

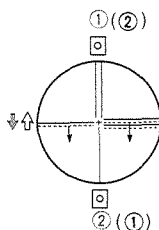
[() for opposite direction]

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.

- 11) To move the horizontal reticle line towards the target centre, adjust the top and bottom adjusting screws as follows:

Slightly loosen the right and left adjusting screws by the same amount.



To move the reticle **down** (up), first slightly loosen the **top** (bottom) adjusting screw, then tighten the **bottom** (top) adjusting screw by this same amount.

Finally tighten the right and left adjusting screws as before.

Check the reticle position and repeat the procedure until the reticle comes close to the target centre.

- 12) Replace the reticle cover.

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.

After this adjustment, please adjust the collimation error referring to P.216 "Appendix 2: <Adjusting the collimation error by collimation program>".

23.4 Coincidence of distance measuring axis with reticle


- After the reticle check, verify that the distance measuring axis is matched with the reticle.

Note: Do not adjust the reticle in this step.



Check



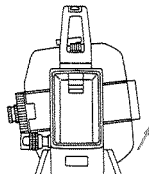
ZA 89° 50' 40"
HAR

 : To Basic mode

Press function
keys to select
operation

  : To signal checking
mode


Signal *



- 1) Set up a clear prism 50 - 100m from the SET C on flat ground.


- 2) In Theodolite mode, sight the prism centre and read the vertical angle.

$$c = 89^{\circ}50'40''$$

- 3) Press  to go to Basic mode.

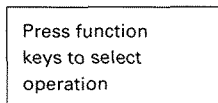
- 4) Press  ,  to go to signal checking mode.

"Signal *" is displayed.

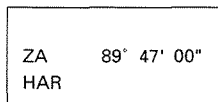
- 5) With the vertical fine motion screw , elevate the telescope slowly until the "*" symbol disappears.



CE/CA : Finish checking

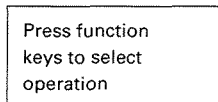


3 : To Theodolite mode

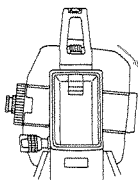
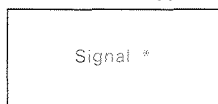


$$a = 89^{\circ}47'00''$$

CE/CA : To Basic mode



ENT SHFT **8** : To signal checking mode




- 6) Press **CE/CA** at this position ("*" not displayed) to return to Basic mode, then press **3** to go to Theodolite mode and read the vertical angle.


- 7) Press **CE/CA** again to return to Basic mode, then press **ENT SHFT** , **8** to go to the return signal checking mode.

- 8) Lower the telescope slowly with the vertical fine motion screw until the "*" symbol disappears.

Signal

 : Finish checking



Press function
keys to select
operation

 : To Theodolite mode

ZA 89° 47' 00"
HAR

$$|a - c| \geq 2'30''$$

$$|b - c| \geq 2'30''$$

- 9) Press  at this position ("*" not displayed) to return to Basic mode, then press  to go to Theodolite mode and read the vertical angle.

$$b = 89^\circ 54' 20''$$

- 10) There is no problem if the difference of a and b against c is more than 2'30" (SET4C: 3'). The right and left directions require the same check. If any of the differences are less than 2'30", please contact your Sokkia agent.

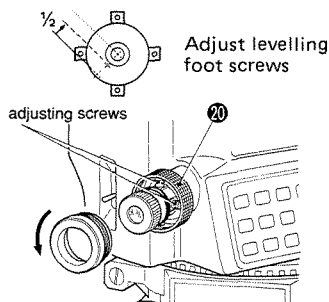
23.5 Optical plummet

Check



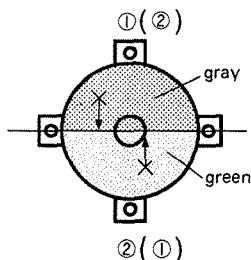
- 1) Level the SETC and exactly centre a surveying point in the reticle of the optical plummet.
- 2) Turn the upper part 180°
If the surveying point is still centred, no adjustment is necessary.
If the surveying point is off-centre, adjust as follows:

Adjustment

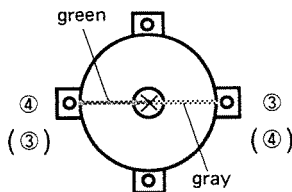


- 3) Correct half the deviation with the levelling foot screws 19.
- 4) Unscrew the optical plummet focussing ring 20.
- 5) Adjust the remaining half of the displacement with the 4 adjusting screws to centre the reticle exactly on the surveying point.

When surveying point is seen as a green (gray) area:



- ① Loosen the upper (lower) screw slightly.
- ② Tighten the lower (upper) screw by the same amount.



Next, if the surveying point is seen to be on the green line (gray line):

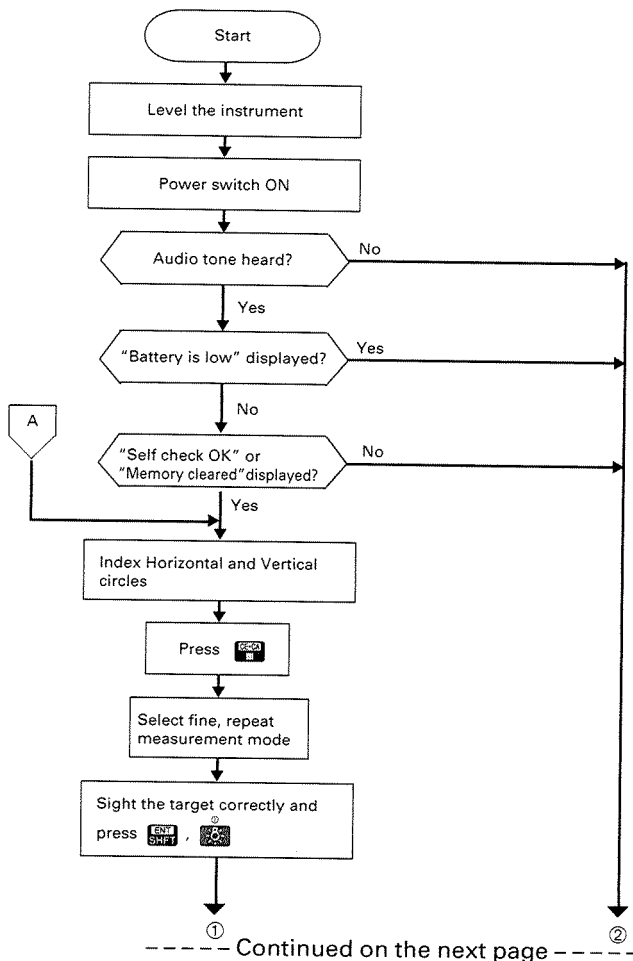
- ③ Loosen the right (left) screw slightly.
- ④ Tighten the left (right) screw by the same amount.

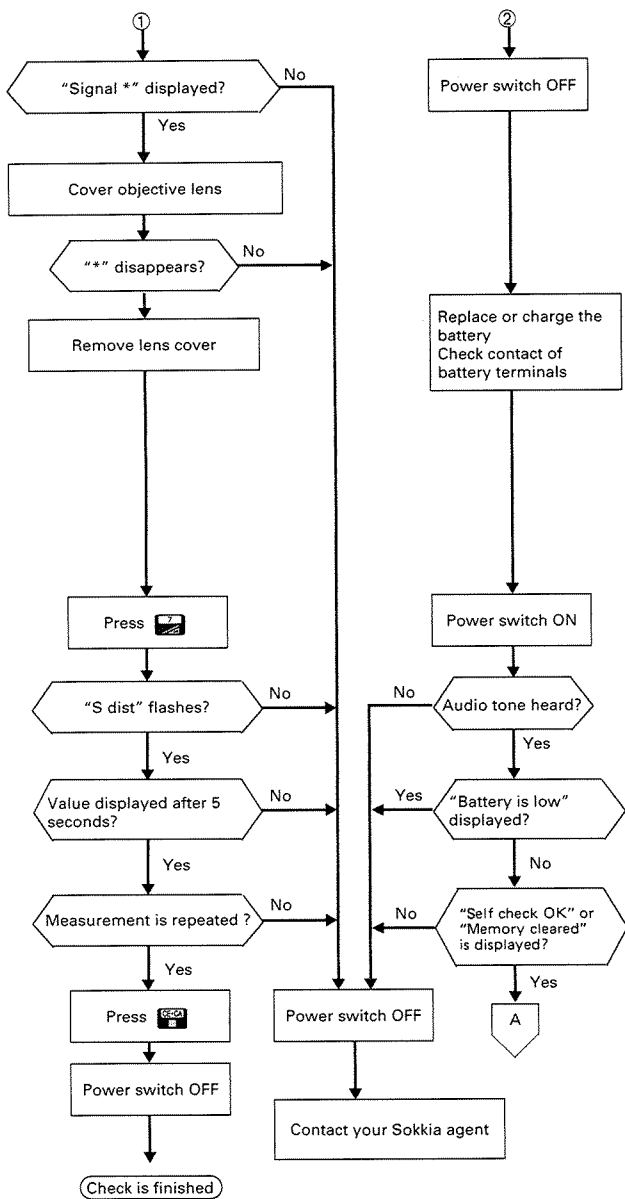
Note: Over-tightening the adjusting screws may mean that the reticle will go out of adjustment.

- 6) Check the adjustment by rotating the upper part of the instrument. The survey point should remain centred in the reticle. If necessary, repeat the adjustment.
- 7) Reattach the optical plummet focussing ring.

23.6 Distance measurement check flow chart

- If error codes EXXX are displayed, please contact your Sokkia agent.





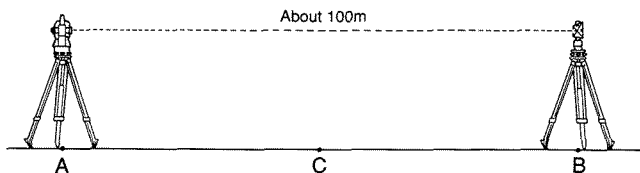
23.7 Additive distance constant

- The additive distance constant K of the SETC 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.

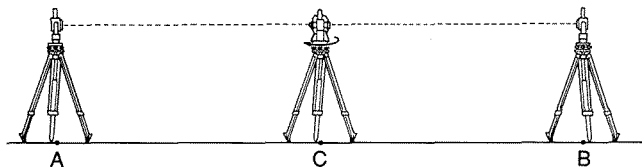
Check

- 1) Select points A and B on flat ground about 100 m (328ft) apart, and C in the middle.

Note: Ensure that the target height is the same as the instrument height of the SETC objective lens centre. If the ground is not flat, use an automatic level to set the correct instrument heights of all points.



- 2) Set up the SETC at A, the target at B and measure (fine measurement) the distance A-B 10 times.
- 3) Shift the SETC to C, and measure (fine measurement) the distance C-A and C-B 10 times each.



- 4) Calculate the averages of $\overline{A-B}$, $\overline{C-A}$ and $\overline{C-B}$.
- 5) Compute the additive distance K using the formula:

$$K = \overline{A-B} - (\overline{C-A} + \overline{C-B})$$

Obtain the K value several times. If all K values are greater than $\pm 3\text{mm}$ (SET4C: $\pm 5\text{mm}$), please contact your Sokkia agent.

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.

MEASUREMENT OPTIONS SELECTION

24. CHANGING INSTRUMENT PARAMETERS  **P.197**

25. POWER SUPPLIES  **P.207**

26. REFLECTING PRISMS AND ACCESSORIES  **P.209**

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

Всего 1900

24. 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.
The factory set options are reset when the "Configuration default set" is initialized.

No.	Parameter		Options
1	Coordinate data from		* 1. Keyboard 2. Card
2	Recording	1. Send data to	* 1. Card 2. External device
		2. Set code	* 1. Input 2. Non-input
		3. Set target height	* 1. Input 2. Non-input
3	Tilt correction		* 1. Tilt correction applied 2. Correction not applied
4	Coordinate format		* 1. N, E, Z 2. E, N, Z
5	V angle format		* 1. Zenith 2. Horizontal 0° - 360° (0 - 400gon) 3. Horizontal ±90° (±100gon)
6	Angle resolution	SET2C, SET3C	* 1. 1" (0.2mgon) 2. 5" (1mgon)
		SET4C	* 1. 5" (1mgon) 2. 10" (2mgon)
7	RS-232C format	1. Baud rate	* 1. 1200 baud 2. 2400 baud
		2. Checksum	* 1. No 2. Yes
		3. Parity bit	* 1. No 2. Yes (even)
8	V indexing		* 1. Auto 2. Manual
9	H indexing		* 1. Auto 2. Manual

No.	Parameter		Option	
10	C + R correction		*1. No	
			2. Yes K=0.142	
			3. Yes K=0.20	
11	Units	1. Distance	*1. metre	
			2. feet	
		2. Angle	*1. Degree	
			2. Gon	
		3. Temperature & pressure	*1. °C & mbar	
			2. °C & mmHg	
			3. Next	1. °F & mbar
				2. °F & mmHg
				3. °F & inchHg
12	Auto power off		*1. 30 minutes timeout	
			2. Power On/Off with switch	
13	Backlight control		*1. On/Off by key operation	
			2. 30 seconds timeout	
14	Audio for return signal		*1. Audio tone	
			2. No audio tone	
15	Reticle illumination		*1. Strong reticle illumination	
			2. Weak reticle illumination	
16	Configuration default set		Initialize : Yes / No	

*Parameter options set at the time the instrument left the factory.

From Theodolite mode or Basic mode to Menu mode

1
MENU

1. Config
2. Card
3. Code

- In Theodolite mode or Basic mode,
press **1** MENU .
The display turns to Menu mode.

To Parameter setting mode

1
MENU

: Select configuration setting

- Press **1** MENU .
The first parameter "Coordinate data from" is displayed.

Coordinate data from
Keyboard

Change options:

Next parameter:

Previous parameter:

To Menu mode:

ENT
SHFT
S-O
RCL
CE/CA

- Select option 1:
- Select option 2:
- Select option 3:
- Retain the previous selection:

1
MENU
2
PROG
3
LJ
CE/CA

No.1 Coordinate data from

Coordinate data from
Keyboard

ENT
SHFT

1. Keyboard
2. Card

1 MENU : Enter from keyboard
2 PROG : Read from card
CE/CA : Retain the previously selected option

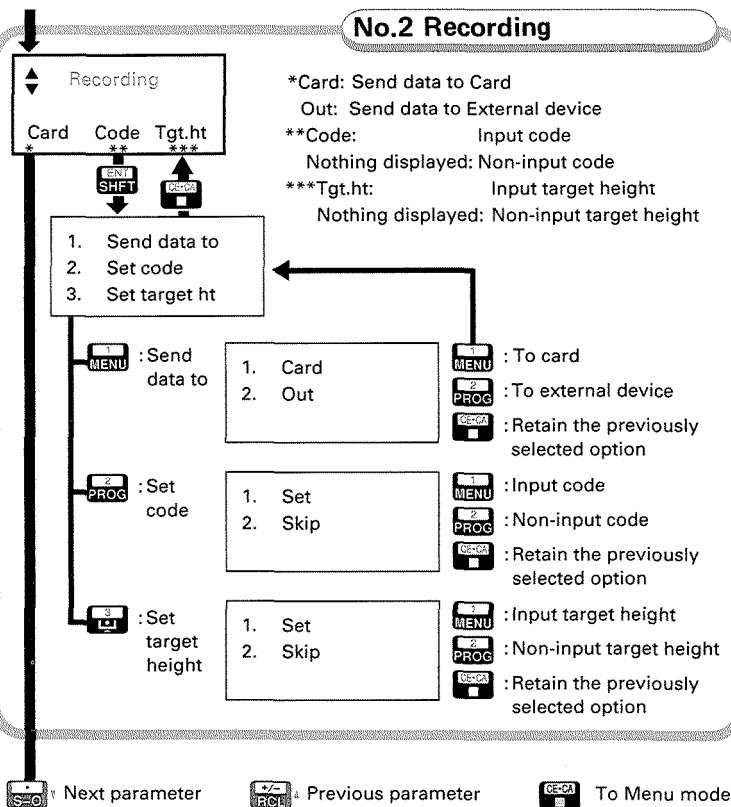
S-O : Next parameter

RCL : Previous parameter

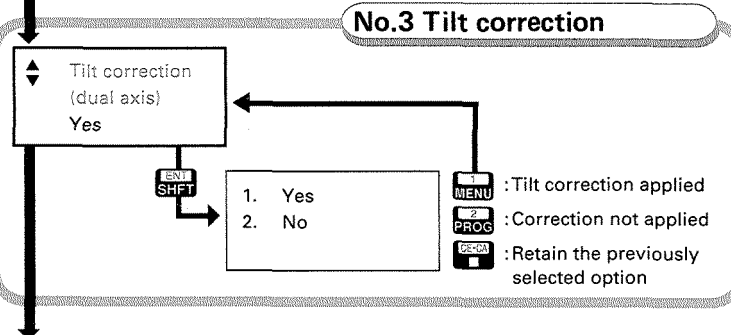
CE/CA : To Menu mode

See next page

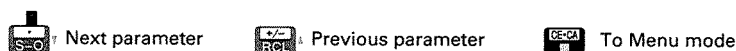
No.2 Recording



No.3 Tilt correction



See next page



No.4 Coordinate format

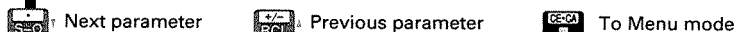
Coordinate
format
N, E, Z

ENT
SHIFT

1. N, E, Z
2. E, N, Z

1
MENU
2
PROG
CE/CA

1 : N-coord., E-coord., Z-coord.
2 : E-coord., N-coord., Z-coord.
CE/CA : Retain the previously
selected option



No.5 Vertical angle format

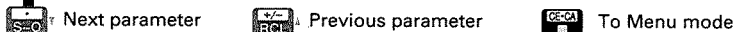
V angle format
Zenith

ENT
SHIFT

1. Zenith
2. H(0 => 360)
3. H. +/- 90

1
MENU
2
PROG
3
CE/CA

1 : Zenith 0°
2 : Horizontal 0°
3 : Horizontal ±90° (±100gon)
CE/CA : Retain the previously
selected option



No.6 Angle resolution

Angle
resolution
1" (5")

ENT
SHIFT

1. 1" (5")
2. 5" (10")

SET2C, SET3C SET4C
1 : 1"/0.2 mgon 5"/1mgon
2 : 5"/1 mgon 10"/2mgon
CE/CA : Retain the previously
selected option

See next page

Next parameter
 Previous parameter
 To Menu mode

No.7 RS-232C communication format

RS232C format

1200

- * 1200: 1200 baud
2400: 2400 baud
- ** Nothing displayed: Checksum not output
Csum: Checksum output
- *** Nothing displayed: No parity bit output
Parity: Even parity bit output

1. Baud rate
2. Checksum
3. Parity bit

: Baud
rate

1. 1200 baud
2. 2400 baud

: 1200 baud
 : 2400 baud

: Retain the previously
selected option

: Checksum

1. No
2. Yes

: Checksum not output
 : Checksum output

: Retain the previously
selected option

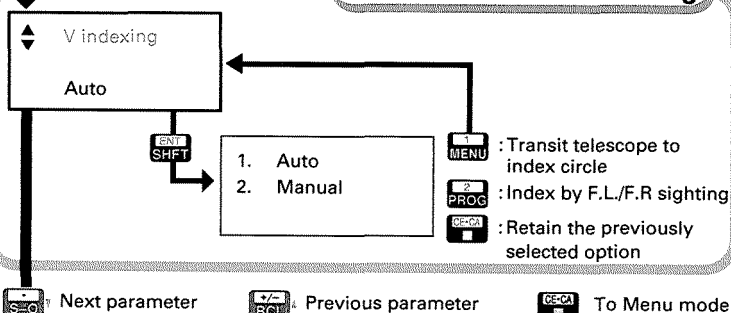
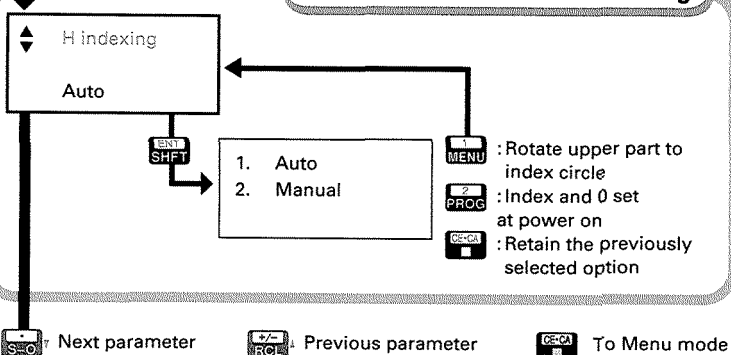
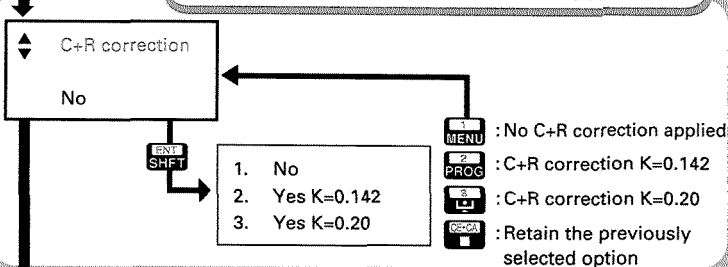
: Parity bit

1. No
2. Yes (even)

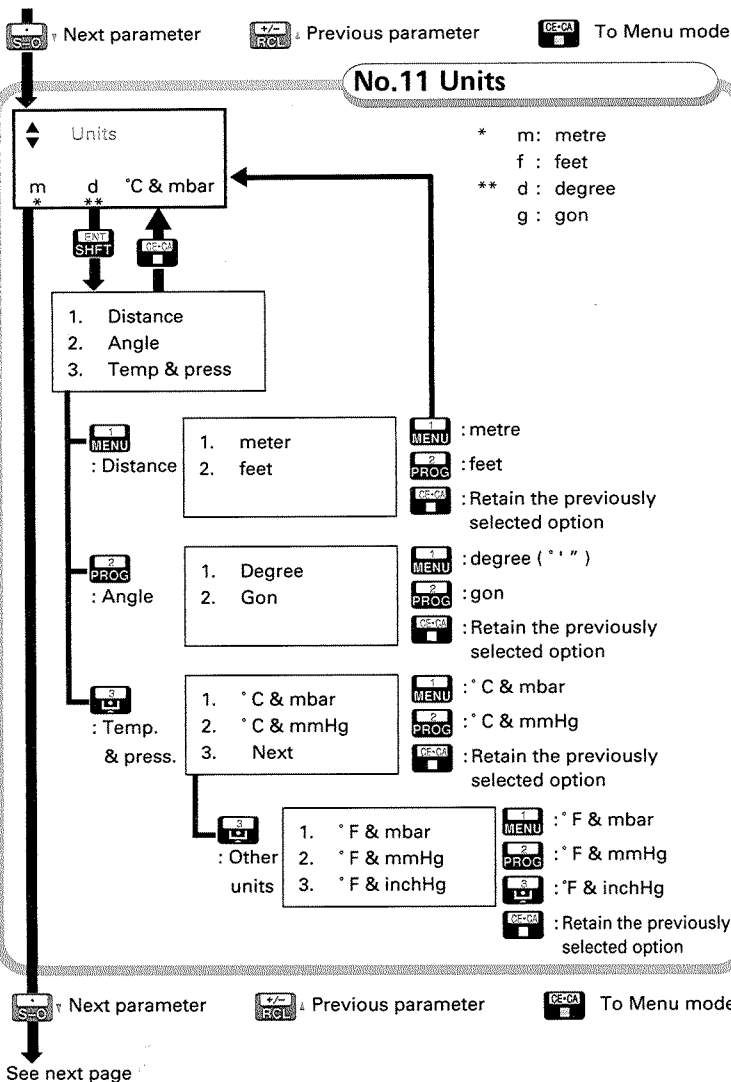
: No parity bit
 : Even parity bit output
 : Retain the previously
selected option

Next parameter
 Previous parameter
 To Menu mode

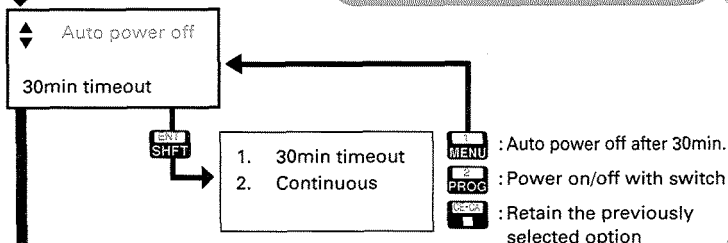
See next page

No.8 Vertical circle indexing**No.9 Horizontal circle indexing****No.10 Curvature & Refraction correction**

See next page

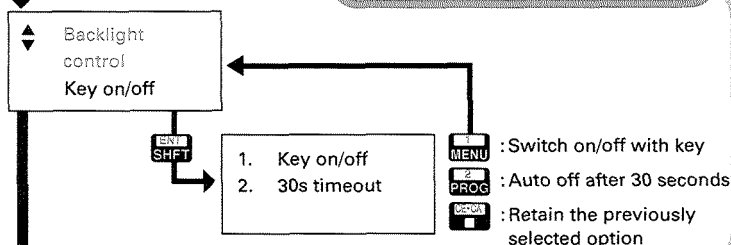


No.12 Auto power off



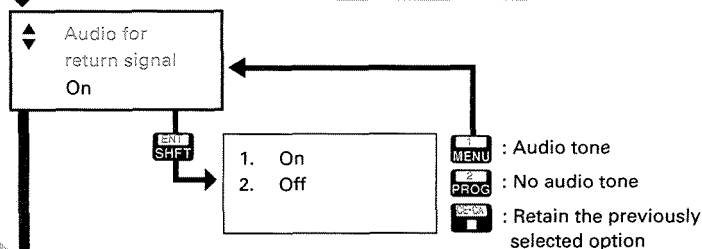
Next parameter
 Previous parameter
 To Menu mode

No.13 Backlight control



Next parameter
 Previous parameter
 To Menu mode

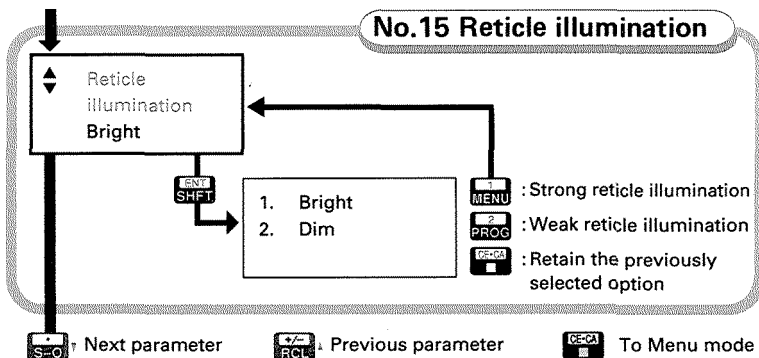
No.14 Audio for return signal



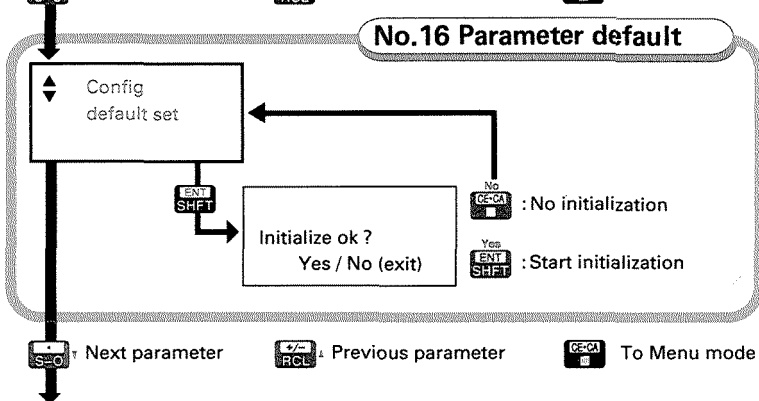
Next parameter
 Previous parameter
 To Menu mode

See next page

No.15 Reticle illumination



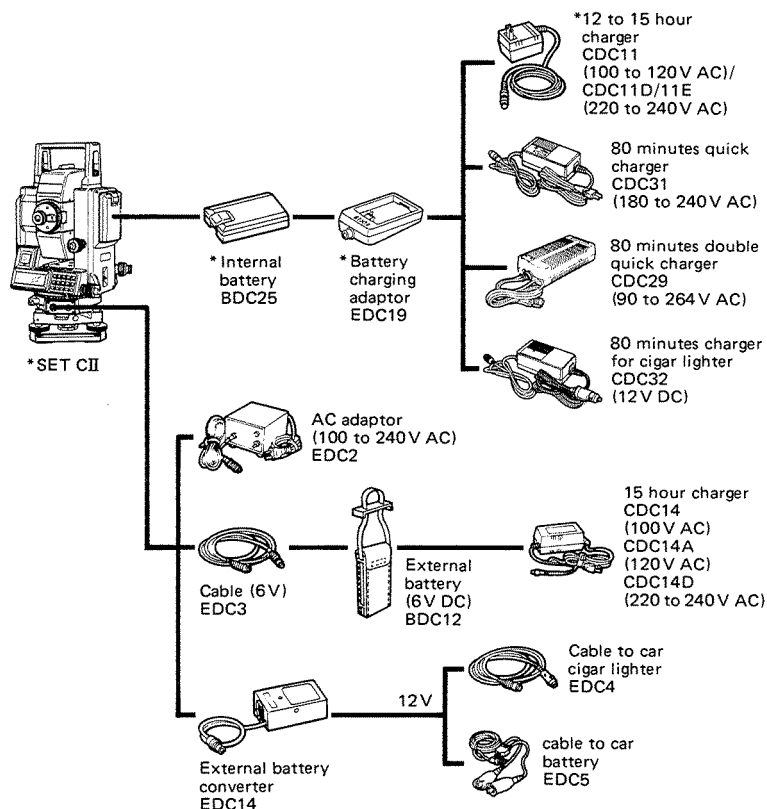
No.16 Parameter default



No.1 "Coordinate data from" parameter

25. POWER SUPPLIES

- The SET C can be operated with the following combinations.



* 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.

Use the SET C only with the combinations shown here.

1) Precautions for battery use and storage

- 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.
- Store the battery in a place where the temperature is between 0°C and 40°C.

2) Precautions for battery charging using the standard charger

To charge the battery, use only the recommended charger.

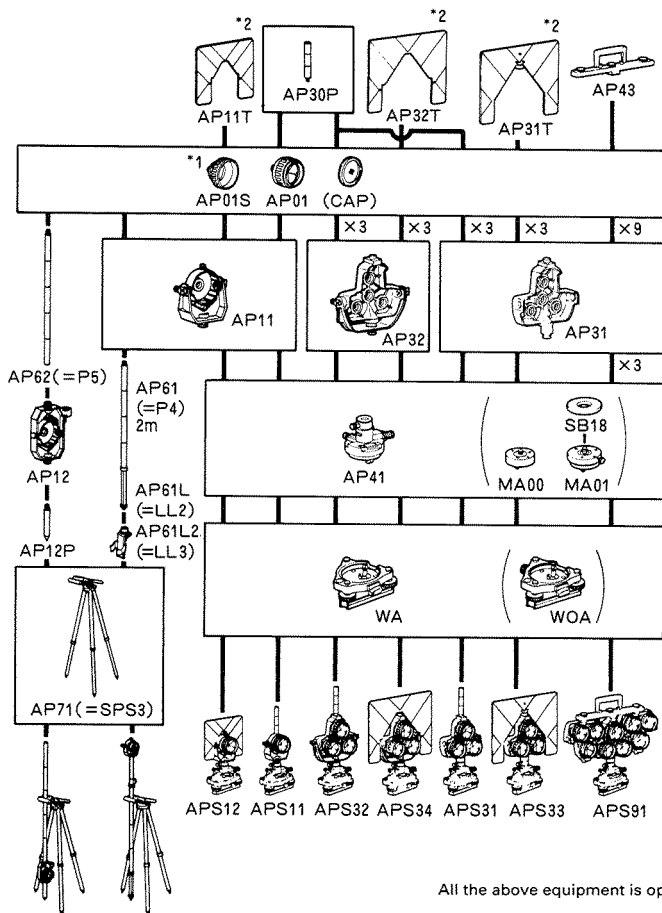
- Charge the battery at a temperature between 10°C and 40°C.
- Do not charge the battery for longer than the specified time.
- When charging the battery, first mount it in the adapter and connect to the battery charger, then connect the charger to the power supply. Check that the charging light is on. If not, switch the power supply off and on and check that the light comes on.
- The battery charger normally becomes warm while charging.

3) Precautions for the use of external power supplies

- When using a car battery, make sure that the polarity is correct.
- Ensure that the car cigarette lighter has 12V 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.

26. 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.

AP12P APS11P

*1: To change the stored prism constant value, see P.41.

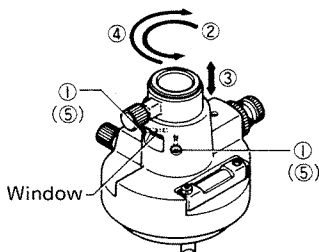
*2: Fluorescent target paint finishing allows clearer sighting in adverse observing conditions.

1) 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.

2) Precautions for use of the instrument height adapter AP41

- Check the Plate level of the AP41 as described in Section 23.1. Check the optical plummet of the AP41 as in 23.1. After all checks and adjustments have been completed, make sure that the AP41 optical plummet sights the same point as the optical plummet of the SET C.
- Check that **236** (the height of the SET C in mm) is displayed in the window of the instrument height adapter 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.

3) Precautions for use of tribrach

- Use the plate level on the AP41 to adjust the tribrach circular level as described in Section 23.2.

APPENDICES

Appendix 1: MANUALLY INDEXING THE VERTICAL CIRCLE BY FACE LEFT, FACE RIGHT MEASUREMENTS  **P.213**

Appendix 2: FOR ANGLE MEASUREMENT OF THE HIGHEST ACCURACY  **P.214**

Appendix 3: FOR DISTANCE MEASUREMENT OF THE HIGHEST ACCURACY  **P.219**

Appendix 4: EARTH-CURVATURE AND REFRACTION CORRECTION  **P.221**


Appendix 5: DATA OUTPUT TO AN EXTERNAL DEVICE  **P.222**

Appendix 6: STANDARD ACCESSORIES  **P.224**

Appendix 7: OPTIONAL ACCESSORIES  **P.225**

STANDARD EQUIPMENT  **P.228**

MAINTENANCE  **P.229**

SPECIFICATIONS  **P.230**

ATMOSPHERIC CORRECTION CHART  **P.234**

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

1000000000

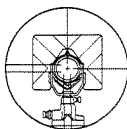
1000000000



APPENDIX 1: MANUALLY INDEXING THE VERTICAL CIRCLE

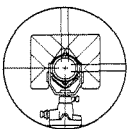
- Like all theodolites, the SET C will have a small vertical index error. For angle measurement of the highest accuracy, the vertical index error can be removed as follows:

ZA Face 1
HAR 314° 50' 30"




ENT SHFT / 0 SET REC : Index V circle in face left

ZA Face 2
HAR 24° 01' 30"




ENT SHFT / 0 SET REC : Index V circle in face right

- In parameter setting mode, select the "V indexing" parameter and set to "2. Manual".
- In Basic mode, press  after step 1), or switch off and on again. "ZA Face 1" is displayed.
- In face left (Face 1), accurately sight a clear target at a horizontal distance of about 30 m.

Press  ,  .

"ZA Face 2" is displayed.

- Loosen the horizontal clamp  and rotate the upper part of the SET C through 180°. In face right (Face 2), accurately sight the same target.

Press  ,  .

- The vertical circle has been indexed.

Note: If the power switch is turned off, the vertical circle should be indexed again.

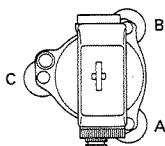
APPENDIX 2: FOR ANGLE MEASUREMENT OF THE HIGHEST ACCURACY

<Adjusting the tilt zero point error>

- The tilt zero point error can be adjusted by the following procedures.
(The "Tilt correction" parameter should be set to "Yes".)
- The range of the tilt sensor is $\pm 3'$.
- Tilt offset data storage period: Until the next adjustment is made
(Power-off possible)

- 1) Level the SET C with the plate level 27.

Tighten the vertical clamp 29 with the telescope approximately horizontal.



- 2) Use the horizontal clamp 28 to turn the upper part of the SET C until the telescope is parallel to a line between levelling screws A and B.

0 SET
ENT SHFT 0 REC : Set H angle to zero

ZA	89° 12' 30"
HAR	0° 00' 00"

- 3) In Theodolite mode, press ENT SHFT , 0 SET REC .

The horizontal angle is set to 0°.

2 PROG : For Program mode

- | | |
|----|-------------|
| 1. | Resection |
| 2. | Correction |
| 3. | Pt. replace |

- 4) Press 2 PROG for Program mode.

2 **PROG** : For Correction mode

Select

1. Collimation
2. Tilt offset

2 **PROG** : For Tilt offset mode

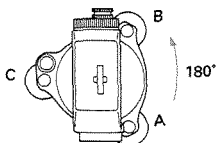
Tilt angle

X	0° 00' 10"
Y	-0° 00' 10"

ENT **0 SET** **REC** : Memorize tilt angle

Tilt angle
Face 2

HAR	0° 00' 00"
-----	------------



Tilt angle
Face 2

HAR	180° 00' 00"
-----	--------------

ENT **0 SET** **REC** : Memorize tilt angle and store the tilt offset data

1. Resection
2. Correction
3. Pt. replace

5) Press **2** **PROG** for Correction mode.

6) Press **2** **PROG** for Tilt offset mode.
Minimum display unit
SET2C : 1"
SET3C : 1"
SET4C : 5"

7) Wait for a few seconds until the tilt angle reading is steady.
Then press **ENT** **0 SET** **REC** .
(X and Y tilt angles will be memorized.)

8) Turn the upper part of the SET C through 180°.

9) Wait for a few seconds until the tilt angle reading is steady,
then press **ENT** **0 SET** **REC** .

The tilt zero point error has been adjusted and the display has returned to Program mode.

- Press **GENA** to go to Basic mode.
- If there is no response when the key is pressed, the range in which adjustment is possible has been exceeded. Please contact your Sokkia agent and request adjustment.

<Adjusting the collimation error by Collimation program>

- The displayed angles are corrected automatically by the stored collimation errors.

These collimation error values can be adjusted and stored by following the relevant procedures.

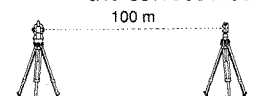
The observation can be carried out up to 5 times, so if an accurate sighting can be made, increasing the number of times the observation is carried out will result in a more precise determination of the collimation error values.


Note: In Tracking measurement mode, the displayed horizontal angle is not corrected by the stored collimation error values.

- If angle measurements are to be made in only one position (e.g. Resection measurement), it is advisable to adjust the correction values accurately.
- Collimation error values storage period:
Until next adjustment (Power-off possible)

Note: Sight the target **carefully** to determine the collimation error accurately.

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 height of all points.




 : For Program mode

- | | |
|----|-------------|
| 1. | Resection |
| 2. | Correction |
| 3. | Pt. replace |


 : For Correction mode

- | | |
|--------|-------------|
| Select | |
| 1. | Collimation |
| 2. | Tilt offset |

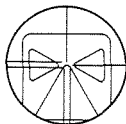
1) Set up a clear target at a horizontal distance of a bit longer than 100m from SET C.


2) In Theodolite mode or Basic mode, press  for Program mode.

3) Press  for Correction mode.

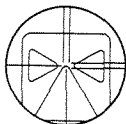
 : For Collimation mode


Pt. face 1
Yes / No (exit)
HAR 359° 59' 55"




 : Memorize H & V
angle in face left

Pt. face 2
Yes / No (exit)
HAR 180° 00' 05"



 : Memorize H & V
angle in face right


Observe end?
Yes / No (repeat)

 : To end observation and
calculate the collimation
error value


Vcoll 0° 00' 15"
Hcoll 0° 00' 05"

New value set?
Yes / No (exit)


- 4) Press  for Collimation mode.

- 5) In face left (face 1), sight the target correctly and press .

A display prompts for the vertical angle and horizontal angle for the telescope face 1 to be stored in the memory.

- 6) In face right (face 2), sight the target correctly, and press . A display prompts for the vertical angle and horizontal angle for the telescope face 2 to be stored in the memory.

The display asks whether the observation is ended or not. (Observation can be carried out up to 5 times.)

- 7) To end the observation process, press .

The collimation error value is calculated and displayed.

Following that, the display asks whether a new collimation error value is to be set.

No
CE-CA : Re-observe

Re-observe ?
Yes / No (exit)

Yes
ENT SHFT : Set the new
collimation error

1. Resection
2. Correction
3. Pt. replace

Vcoll *0° 00' 15"
Hcoll *0° 00' 05"

Re-observe ?
Yes / No (exit)

Yes
ENT SHFT : Re-observe

Pt. face 1
Yes / No (exit)
HAR 0° 00' 00"

or

No
CE-CA : End

1. Resection
2. Correction
3. Pt. replace

- To continue the observation, press No
CE-CA .
The display asks whether observation is to be continued.
Pressing Yes
ENT SHFT returns the processing to Step 5).

- 8) To set a new collimation error value, press Yes
ENT SHFT .
The collimation error has been adjusted and the display has returned to Program mode.

- Press No
CE-CA to go to Basic mode.
- If the range in which adjustment is possible has been exceeded, an asterisk (*) is displayed, and a confirmation message is displayed, the display asks whether you begin observation once again, from the beginning.

To redo the observation, press Yes
ENT SHFT . The procedure reverts to Step 5).

To end the observation process, press No
CE-CA . The display returns to Program mode.

If an asterisk is still displayed after repeated attempts at observation, the allowable adjustment range has been exceeded. Please contact your Sokkia agent and request adjustment.

APPENDIX 3: FOR DISTANCE MEASUREMENT OF THE HIGHEST ACCURACY

1) Atmospheric correction

- The SET C uses a beam of infrared light to measure the distance. The velocity of this light in the atmosphere varies according to the temperature and pressure.

The distance will be changed by 1 ppm by:

- a variation in temperature of 1°C
- a variation in pressure of 3.6 mb

(A 1 ppm 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.

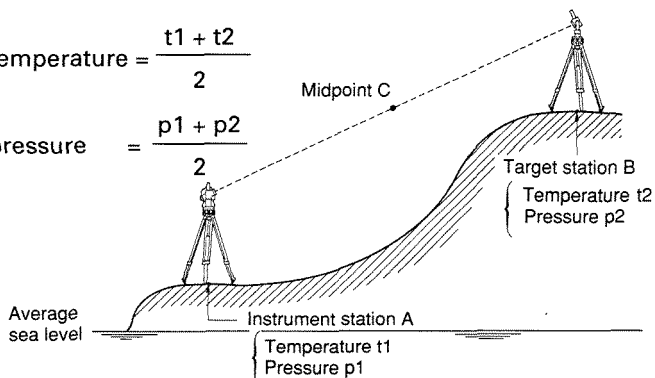
- The ppm correction should be applied when the calculated ppm value is over ± 5 ppm or if the slope distance is more than 200m.

2) 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 measured, take the temperature and pressure at the instrument and target stations, then calculate the average values.

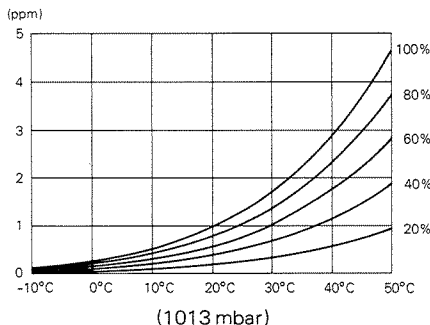
$$\text{Average temperature} = \frac{t_1 + t_2}{2}$$

$$\text{Average pressure} = \frac{p_1 + p_2}{2}$$



3) 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 1013mbar.



Correction factor (ppm)

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

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.

- Input the temperature and pressure values. The correction factor A is calculated and displayed on the sub display.
- Measure the relative humidity and read the correction factor B from above table.

For pressure between 500 mbar and 1400 mbar, if instead of the formula, the graph above is used to look up the correction factor, a difference of less than 0.1 ppm will be present.

- Calculate A plus B. (C)
- Input C in ppm mode.
(Refer to P.44 "13.3 Atmospheric correction")
- Measure the distance. The displayed distance is corrected by the correction factor C.

e.g. Temperature: 30°C, Pressure: 1020mbar,

Relative humidity: 80%

Measured distance corrected by only the correction factor A:
3000m

A=12 (sub display), B=1.4 (above table)

$$D = \frac{1 + (12 \text{ ppm} + 1.4 \text{ ppm}) \times 10^{-6}}{1 + 12 \text{ ppm} \times 10^{-6}} \times 3,000 \text{ m}$$

$$= 3,000.0042 \text{ m}$$

APPENDIX 4: 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 "C & R correction". The Atmospheric refraction constant K can be set to either 0.142 or 0.20.

<No correction>

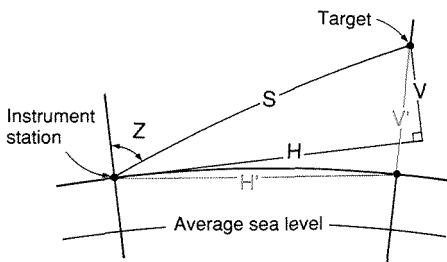
Horizontal distance: $H = S \times \sin Z$

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

<Applied correction>

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

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

R: Radius of the earth (6.372×10^6 m)

e.g. Correction value at $Z=70^\circ$ ($K=0.142$)

S (m)	500	1000	1500
$H'-H$ (m)	- 0.012	- 0.047	- 0.105
$V'-V$ (m)	0.015	0.059	0.134

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.

APPENDIX 5: DATA OUTPUT TO AN EXTERNAL DEVICE

Key operations allow the SET C to output measured and stored data via the data output connector to an external device using an interface cable.

(For more information, see the Series C 2-way communication manual)

- The contents of data which can be output are the same as that of data which can be stored on the card. See P.109 "21.1 Card features".

Appendix 5-1: Changing the instrument options

- Confirm that this parameter is set according to the data output to an external device condition.
The "Send data to" parameter should be set to "Out".
- To confirm or change the parameter option, see P.197 "24. CHANGING INSTRUMENT PARAMETERS".

No.	Parameter		Options
2	Recording	1 Send data to	Card/out
		2 Set code	Set/Skip
		3 Set target ht	Set/Skip

Appendix 5-2: Output of data

From Theodolite mode or Basic mode to Record mode



- In Theodolite mode or Basic mode, press .

External device

The message "External device" is displayed, and the display goes to Record mode. And the display prompts for the selection of the data format to be output.

▲ Select
▼ S,V,H
Yes / No (exit)

- For subsequent procedures, please see the following sections:
P.122 "21.5 Instrument data recording 2)–"
P.123 "21.6 Instrument station data recording 1)–"
P.128 "21.7 Measured data recording 1)–"
P.134 "21.8 Note recording 1)–"

Data send...

- When the data output is started, the display changes to that shown at the left.

Record end

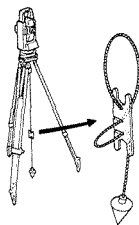
If the data output procedure ends normally, the display changes to that shown at the left, and the screen returns to the Record mode.

Record error

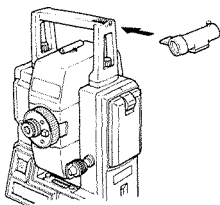
Note: If the message shown at the left appears and the display then returns to the Record mode, the data has not been output. Check the cables and external equipment to see if there are any abnormalities, and check the program for problems.

APPENDIX 6: STANDARD ACCESSORIES

1) 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.

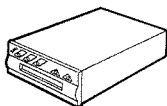


2) Tubular compass CP7 (accuracy $\pm 1^\circ$)

To mount the CP7, slide it into the tubular compass slot ⑩. 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.

APPENDIX 7: OPTIONAL ACCESSORIES

1) Card reader SCR2



The card reader SCR2 can be used to read data stored on the card and transfer it to a host computer.
<SCR2 specifications>

AC power adapter:

EDC21 AC100V

EDC21A AC120V

EDC21B AC220V

(Round pin plug)

Interface cable:

DOC22 NEC/EPSON

DOC23 IBM connector

DOC28 Toshiba J3100

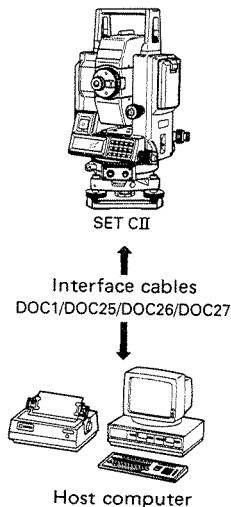
Input/output: RS232C compatible

Operation temperature range:

0 to 50°C (32 to 122°F)

Weight: 450g (1 lb)

2) Interface cables DOC1, DOC25/DOC26/DOC27



The interface cable DOC1 can be used for direct two-way communication between the SET C and a host computer.

This cable is not provided with a connector on the computer end of the cable.

Also available are:

DOC25: NEC connector

DOC26: IBM connector

DOC27: Toshiba J3100

3) Memory card SDC5/SDC6

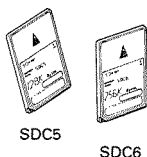
Measured and input data can be recorded by the SET C on SDC5 or SDC6 cards.

SDC5: 128Kbyte

One 128Kb card can store approximately 2000 measured target points in angle and distance (S, V, H) format.

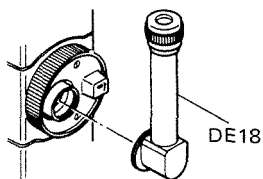
SDC6: 256Kbyte

One 256Kb card can store approximately 4000 measured target points in angle and distance (S, V, H) format.



4) Diagonal eyepiece DE18

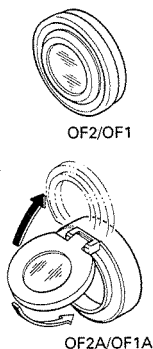
The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the handle and the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.



5) Solar filter OF2/OF2A, OF1/OF1A

For observations made facing the sun, and where glare is present. The OF2/OF1 and OF2A/OF1A (flip-up) filters are mounted on the objective lens.

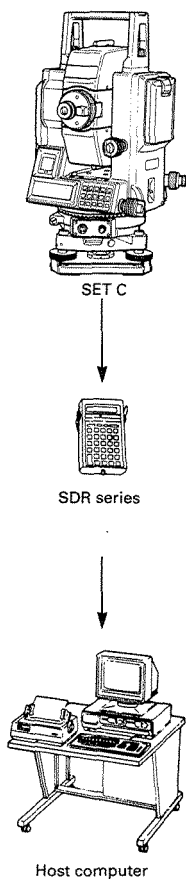
OF2, OF2A: for SET2C, SET3C
OF1, OF1A: for SET4C



6) Electronic field book SDR series

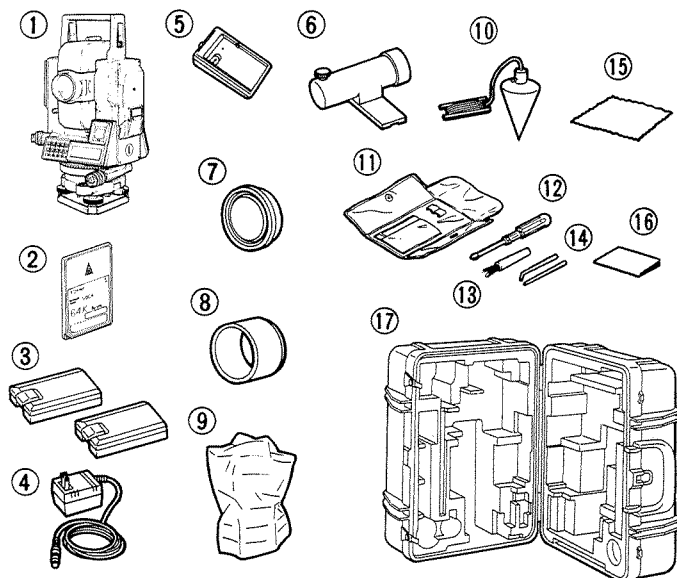
The SDR series collects and stores slope distance, zenith and horizontal angle data from the SET C.

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.



STANDARD EQUIPMENT

- Please verify that all equipment is included.



① SET C main unit	1	⑩ Plumb bob	1
② Memory card, SDC4 (64Kb)	1	⑪ Tool pouch	1
③ Internal battery, BDC25	2	⑫ Screwdriver	1
④ Battery charger, CDC11/CDC11D/CDC11E ..	1	⑬ Lens brush	1
⑤ Battery charging adaptor, EDC19	1	⑭ Adjusting pin	2
⑥ Tubular compass, CP7	1	⑮ Cleaning cloth	1
⑦ Lens cap	1	⑯ Operator's manual	1
⑧ Lens hood	1	2-way communication manual	1
⑨ Vinyl cover	1	Field guide	1
		⑰ Carrying case	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 **5**, **6** and keyboard **10** or carrying case with an organic solvent.
- 4) Store the SET C 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 (**13**, **20**, **21**, **23**, **24**, **29**, **30**) 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 the SET C 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 the SET C for proper adjustment periodically to maintain the instrument accuracy.

SPECIFICATIONS

Telescope

Length:	SET2C:177mm SET3C:177mm SET4C:170mm
Aperture:	45mm
Magnification:	30X
Resolving power:	3"
Image:	Erect
Field of view:	1'30' (26m/1000m)
Minimum focus:	1.3m (4.3 ft)
Reticle illumination:	Bright or dim settings (Selectable with parameter)

Angle measurement

Horizontal and Vertical circles type :	Incremental with 0 index
Display range:	SET2C:0° 00' 00" to 359° 59' 59" (0.0000gon to 399.9998gon) SET3C:0° 00' 00" to 359° 59' 59" (0.0000gon to 399.9998gon) SET4C:0° 00' 00" to 359° 59' 55" (0.0000gon to 399.999gon)
Minimum display:	SET2C:1" (0.2mgon)/5" (1mgon) SET3C:1" (0.2mgon)/5" (1mgon) SET4C:5" (1mgon)/10" (2mgon) (Selectable with parameter)
Angle units:	Degree/gon (Selectable with parameter)
Accuracy:	Standard deviation of mean of measurement taken in positions I and II (DIN18723) SET2C:2" (0.6mgon) SET3C:3" (1mgon) SET4C:5" (1.5mgon)
Measuring time:	Less than 0.5sec

Automatic compensator:	Selectable ON/OFF with parameter
Type:	Liquid, 2-axis tilt sensor
Minimum display:	SET2C:1" (0.2mgon) SET3C:1" (0.2mgon) SET4C:5" (1mgon)
Range of compensation:	±3'
Measuring mode:	
Horizontal angle:	Right/Left (Selectable with keyboard)
Vertical angle:	Zenith 0° (0gon)/Horizontal 0° (0gon)/ Horizontal 0°±90° (0gon ±100gon) (Selectable with parameter)

Distance measurement

Measuring range:	(Slight haze, visibility about 20km, sunny periods, weak scintillation)
SET2C:	Compact prism CP01:1.3m to 800m (2600ft) Standard prism APx1:1.3m to 2400m (7800ft) Standard prism APx3:1.3m to 3100m (10100ft) Standard prism APx9:1.3m to 3700m (12100ft)
SET3C:	Compact prism CP01:1.3m to 700m (2200ft) Standard prism APx1:1.3m to 2200m (7200ft) Standard prism APx3:1.3m to 2900m (9500ft) Standard prism APx9:1.3m to 3500m(11400ft)
SET4C:	Compact prism CP01:1.3m to 600m(1900ft) Standard prism APx1:1.3m to 1200m(3900ft) Standard prism APx3:1.3m to 1700m(5500ft) Standard prism APx9:1.3m to 2200m(7200ft)
Accuracy:	(Standard deviation)
Fine measurement:	SET2C: 3mm+2ppm • D SET3C: 3mm+3ppm • D SET4C: 5mm+3ppm • D
Coarse measurement:	5mm+5ppm • D
Minimum display:	
Fine measurement:	1mm (0.01 ft)
Coarse measurement:	1mm (0.01 ft)
Tracking measurement:	10mm (0.1 ft)
Maximum slope distance:	9999.999m (32808.33 ft)
Distance unit:	metres/feet (Selectable with parameter)

Measuring time:

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

	Fine meas.	Coarse meas.	Tracking meas.
Slope distance	4.7 + every 3.2s	1.7 + every 0.7s	1.6 + every 0.3s
Horizontal distance	4.7 + every 3.3s	1.9 + every 0.7s	1.8 + every 0.3s
Height difference			
Coordinates	5.1+ every 3.3s	2.4 + every 0.7s	2.2 + every 0.7s
REM	0.7s + every 0.5s		
Horizontal distance between two points	5.6 + every 3.3s	2.9 + every 0.7s	2.8 + every 0.7s

Atmospheric correction:

Temperature input range:

-30°C to 60°C (in 1°C steps)/

-22°F to 140°F (in 1°F steps)

(Selectable with parameter)

Pressure input range:

500mbar to 1400mbar (in 1mbar steps)

375mmHg to 1050mmHg (in 1mmHg steps)

14.8inchHg to 41.3inchHg (in 0.1inchHg steps)

(Selectable with parameter)

ppm input range:

-499ppm to 499ppm (in 1ppm steps)

Prism constant correction:

-99mm to 99mm (in 1mm steps)

Earth-curvature and

ON (K=0.142/K=0.20)/OFF

refraction correction:

(Selectable with parameter)

Audio target acquisition:

ON/OFF (Selectable with parameter)

Signal source:

Infrared LED

Light intensity control:

Automatic

Power supply

Power source:

Ni-Cd rechargeable battery, BDC25 (6V)

Working duration

Distance & Angle measurement:

at 25°C (77°F):

2.5 hours (2500 to 2600 points)

(Coarse and Single measurement,

Measurement interval=every 4 secs)

Angle measurement only:

7.5 hours

Using optional battery BDC12

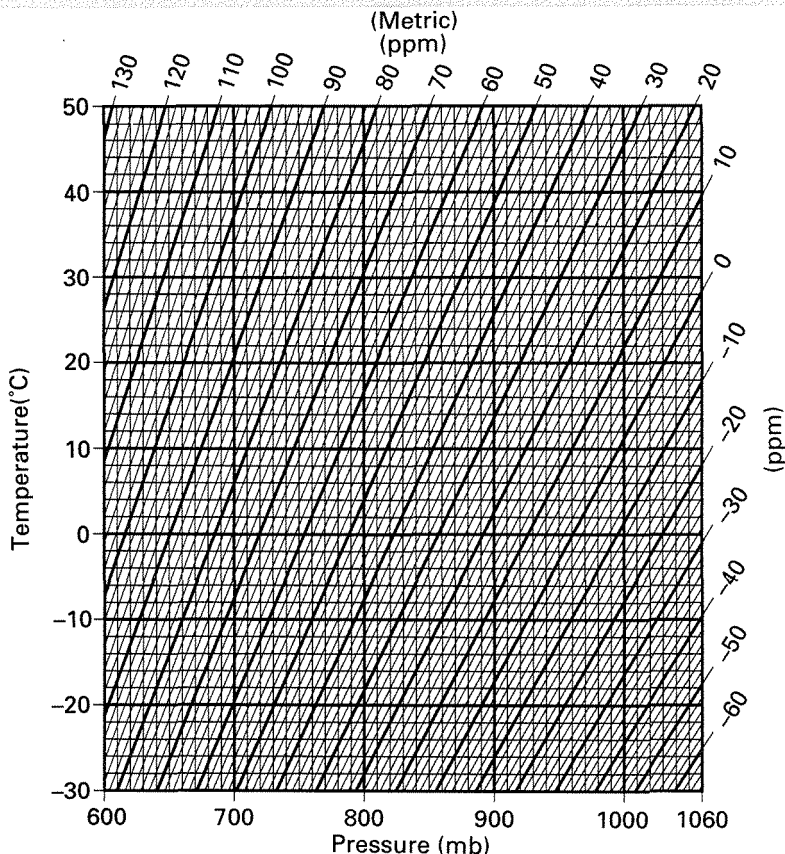
Angle and distance: 10 hours

Charging time:	
CDC11/11D/11E:	15 hours
CDC29:	80 minutes

General

Display:	2LCD dot matrix displays on each face Main display: 16 characters x 3 lines Sub display: 4 characters x 3 lines
Sensitivity of levels:	
Plate level:	SET2C:20" /2mm SET3C:30" /2mm SET4C:30" /2mm 10"/2mm
Circular level:	
Optical plummet:	
Image:	Erect
Magnification:	3x
Minimum focus:	0.1 m (0.3 ft)
Self-diagnostic function:	Provided
Power saving cut off:	30minutes after operation/ ON/OFF with switch (Selectable with parameter)
Operating temperature:	-20°C to 50°C (-4°F to 122°F)
Data recording:	Non-contact Memory card, 64Kbytes
Card battery type:	Sony CR2016 lithium battery or a battery of similar quality Lifetime:2 years
Data input/output:	Asynchronous serial, RS-232C compatible
Size:	236mm (9.3inch) from tribrach bottom, 193mm (7.6inch) from tribrach dish SET2C:181(W)X177(D)X371(H)mm SET3C:181(W)X177(D)X371(H)mm SET4C:181(W)X170(D)X371(H)mm (Without handle: H=330mm)
Weight:	SET2C:7.5Kg SET3C:7.5Kg SET4C:7.4Kg (with internal battery and card)

ATMOSPHERIC CORRECTION CHART



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

To convert a pressure in mmHg to one in mbar, divide by 0.75

To convert a pressure in inchHg to one in mbar, multiply by 33.87.

$$\text{mbar} = \text{mmHg} \div 0.75 = 33.87 \times \text{inchHg}$$

To convert a temperature in °F to one in °C, compute using the following formula:

$$^{\circ}\text{C} = 0.56 \times (^{\circ}\text{F} - 32)$$