SURVEYING INSTRUMENTS

SET2CII

Intelligent Total Station

OPERATOR'S MANUAL

Congratulations on your purchase of the SET2CII!
Before using the instrument, please read this operator's manual and verify that all equipment is included, refer to P. 226 "STANDARD EQUIPMENT".

Europe version

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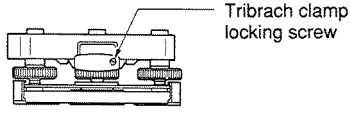
<Important>



When the new SET2C is shipped, the tribrach clamp is fixed with a screw.
Loosen it and leave it loose.
And if the SET2C is again shipped, fix the tribrach clamp with the screw to prevent 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.

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1. FEATURES

< SET2CII ADVANCED MEASUREMENT FUNCTIONS >

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

< IC 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 IC 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 SET2CII RS232C-compatible data output connector allows 2-way communication with an external device.

INTRODUCTION

2. PRECAUTIONS

- **Never place the SET2C 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 SET2C with an umbrella.**
  against direct sunlight, rain and humidity.

- **Never carry the SET2C on the tripod to another site.**

- Handle the SET2C with care. Avoid heavy shocks or vibration.

- When the operator leaves the SET2C, the vinyl cover should be placed on the instrument.

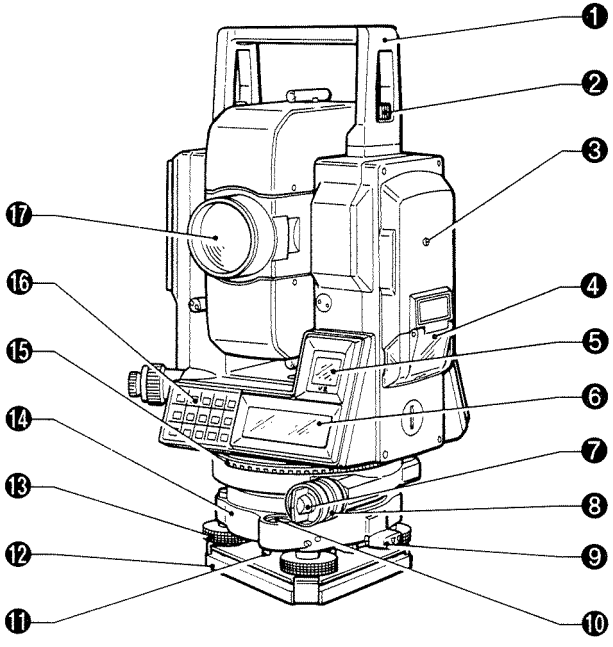
- Always switch the power off before removing the standard battery.

- Remove the standard battery from the SET2C before putting it in the case.

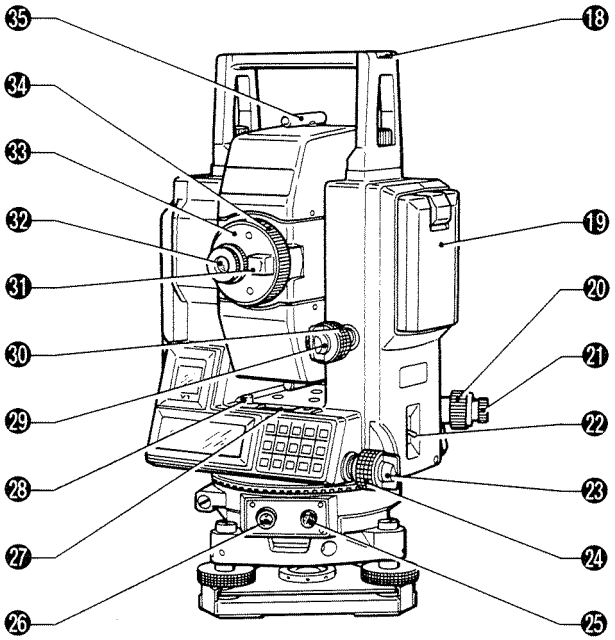
- When the SET2C is placed in the carrying case, follow the layout plan.

- Make sure that the SET2C 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

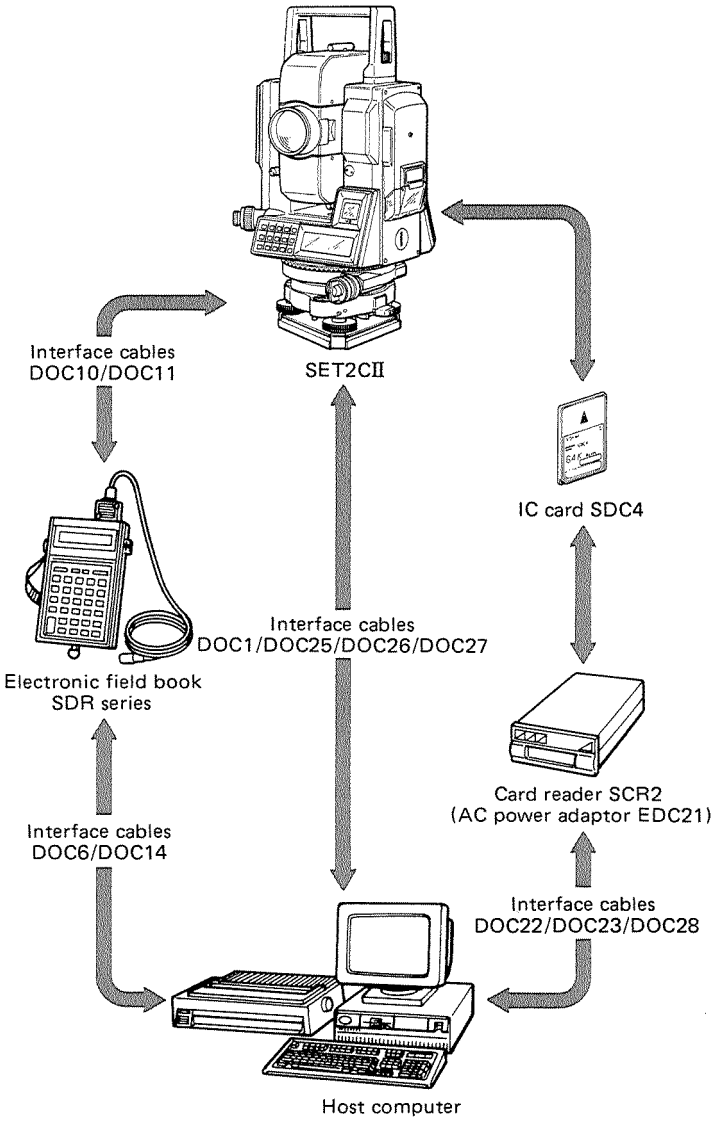


❶ Handle
❷ Handle securing screw
❸ Instrument height mark
❹ IC card cover
❺ Sub display
❻ Main display
❼ Lower clamp
❽ Lower clamp cover
❾ Tribrach clamp
❿ Circular level
⓫ Circular level adjusting screws
⓬ Base plate
⓭ Levelling foot screw
⓮ Tribrach
⓯ Horizontal circle positioning ring
⓰ Keyboard
⓱ Objective lens



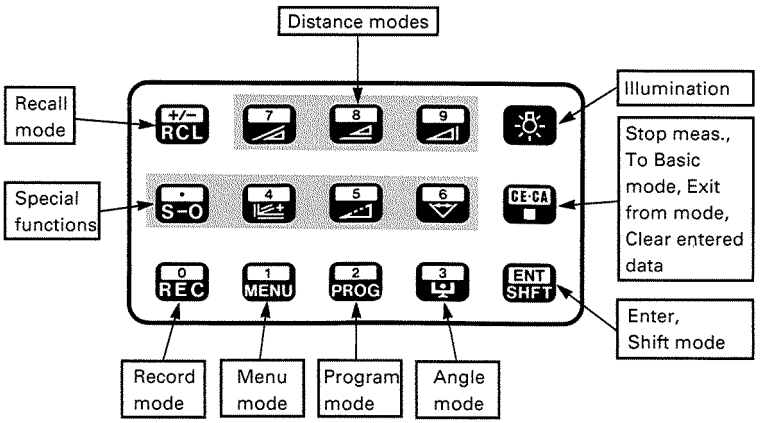
⑱ Tubular compass slot
⑲ Battery BDC25
⑳ Optical plummet focussing ring
㉑ Optical plummet eyepiece
㉒ Power switch
㉓ Horizontal clamp
㉔ Horizontal fine motion screw
㉕ Data output connector
㉖ External power source connector
㉗ Plate level
㉘ Plate level adjusting screw
㉙ Vertical clamp
㉚ Vertical fine motion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

4. COMMUNICATION SYSTEM

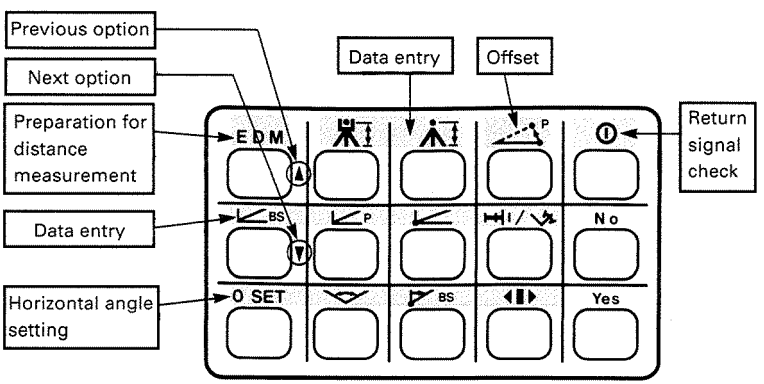


5. KEY FUNCTIONS

<Main functions>



<Shifted functions>



EDM

+/− RCL

○ < ENT SHFT + > : 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

• S-O

○ < ENT SHFT + > : Input Backsight station coordinates

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

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

O SET

0 REC

○ < ENT SHFT + > : Set Horizontal angle to 0/
In Missing line measurement, change the starting point

● (Data input mode): Input "0"

● **Output data to IC card or an External device**

7

○ < ENT SHFT + > : Input Instrument height

● (Data input mode): Enter "7"

● **Measure Slope distance**

P

4

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

● (Data input mode): Enter "4"

● **Measure 3-dimensional coordinates**

1 MENU

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

● (Data input mode): Input "1"

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

8

○ < ENT SHFT + > : Input target height

● (Data input mode): Input "8"

● **Measure Horizontal distance**

5

○ < ENT SHFT + > Input Instrument station coordinates

● (Data input mode): Input "5"

● **Measure remote elevation**

○ < ENT SHFT + > : Set Azimuth angle from Instrument station and Backsight station coordinates

● (Data input mode): Input "2"

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

○ < ENT SHFT + > : Offset measurement

● (Data input mode): Input "9"

● **Measure Height difference**

○ < ENT SHFT + > : Input distance & horizontal angle setting-out data

● (Data input mode): Input "6"

● **Missing line measurement**

○ < ENT SHFT + > : Select horizontal angle right or left

● (Data input mode): Enter "3"

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

○ < ENT SHFT + > : Return signal check (stop: CE·CA)

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

● Input "No"

● (Data Input mode): Clear entered data

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

● Input "Yes"

● (Data input mode): Input data into memory

● **Select/Release Shift mode**

6. MODE DIAGRAM

Switch on → H & V circle indexing

Angle display

- Tilt angle display
- ENT/SHFT + 3 — Select H angle right or left
- ENT/SHFT + 0 SET/REC — Set H angle to 0

Basic mode

Horizontal angle setting

- 1 MENU — Set H angle to a required value
- BS 2 PROG — Set Azimuth angle

Data input

- 5 — Instr station coordinates
- BS S-O — BS station coordinates
- ENT/SHFT + 6 — S-O Distance & H angle
- P 4 — S-O coordinates

Preparation for Distance measurement

- EDM +/- RCL
  - Distance mode
  - Prism constant
  - ppm
- Return signal checking

Distance measurement mode

- 7 — Slope distance
- 8 — Horizontal distance
- 9 — Height difference
- 4 — Coordinates
- 6 — Missing line

1 MENU — **Menu mode**

- Configuration
- Card settings
- Code settings

2 PROG — **Program mode**

- Resection
- Collimation
- Set Instrument station coordinates & Azimuth angle

0 REC — **Record mode**

- Output data to IC card
- Output data to External device

+/- RCL — **Recall mode**

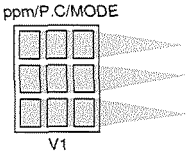
7 8 9 4 5 0 REC

• S-O — **Setting out measurement**

7 8 9 3 4 5

7. DISPLAY SYMBOLS

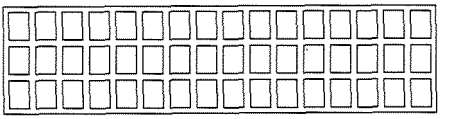
<Sub display>



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>



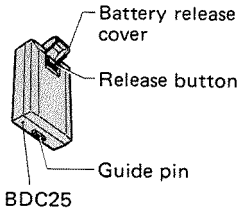
▲▼	:	Select options
ZA	:	Zenith angle (Z 0°)
VA	:	Vertical angle (H 0°) Vertical angle (H 0°±90°)
HAR	:	Horizontal angle right
HAL	:	Horizontal angle left
X	:	Tilt angle in sighting direction
Y	:	Tilt angle in horizontal axis direction
S	:	Slope distance
H	:	Horizontal distance
V	:	Height difference
Ht	:	REM value/Instrument height/Target height
D	:	Distance setting-out data/ Offset distance

PREPARATION FOR MEASUREMENT

8. MOUNTING THE BATTERY

- Charge the battery fully before measurement. ☞ P.205

Note: Turn off the power supply switch ㉑ before replacing the battery.

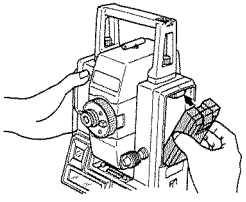


< Mounting the battery >

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.

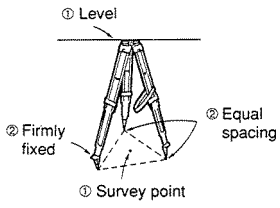
- If the power is to be turned on immediately after replacing the battery, please refer to P. 21.

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.

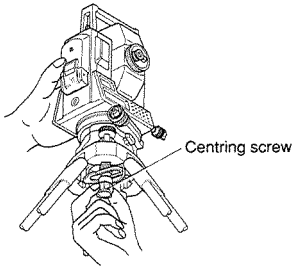
9.1 Centring

Set up the tripod



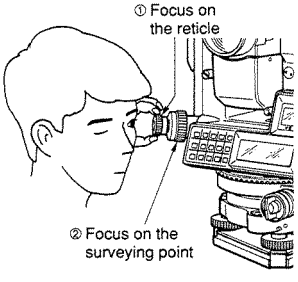
1) Make sure the legs are spaced at equal intervals and the head is approximately level.
2) Set the tripod so that the head is positioned over the surveying point.
3) Make sure the tripod shoes are firmly fixed in the ground.

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.

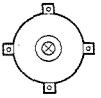
Focus on the surveying point



6) Looking through the optical plummet eyepiece, turn the optical plummet eyepiece ㉑ to focus on the reticle.
7) Turn the optical plummet focussing ring ⑳ to focus on the surveying point.

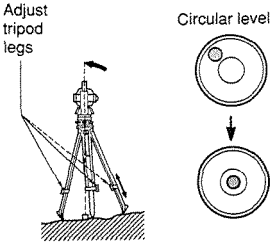
9.2 Levelling

Centre the surveying point in the reticle



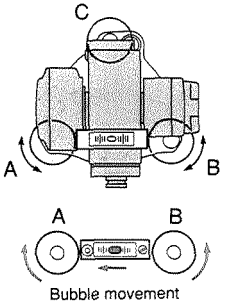
1) Adjust the levelling foot screws ⓭ to centre the surveying point in the optical plummet reticle.

Centre the bubble in the circular level



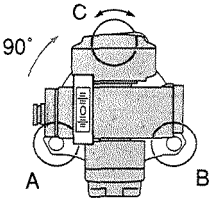
2) Observe the off-centre direction of the bubble in the circular level ⓪, and shorten the nearest tripod leg, or extend the leg farthest from that direction to centre the bubble.
3) One more tripod leg must be adjusted to centre the bubble.

Centre the bubble in the plate level



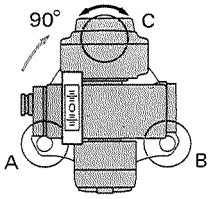
4) Loosen the horizontal clamp ㉘ to turn the upper part of the instrument until the plate level ㉗ is parallel to a line between levelling screws A and B.
5) Centre the air bubble, using levelling screws A and B.
Note : The bubble moves towards a clockwise rotated foot screw.

Turn 90° and centre the bubble



6) Turn the upper part of the instrument through 90°.
The plate level in 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

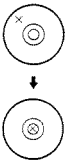


8) Turn the upper part of the instrument a further 90° and check to see if the bubble is in the centre of the plate level ㉗.
If the bubble is off-centre, perform the following:
① Adjust levelling screws A and B in equal and opposite directions, to remove half of the bubble displacement.
② Turn the upper 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.177, 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

SET2C model 2
No. 88132
Ver. 58-03

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

1) Turn on the power switch ㉒ after completing sections 5 and 6.

2) 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.

3) The remaining battery power is then displayed for 3 seconds as a numeric value.
(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.

```
Out of range
X    > ⊥    <  Y
```

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.211 (Appendix 1: Manually indexing the vertical circle).

Instrument parameter No.8 ☞ P.195

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 [ENT SHFT] and [+/- RCL] at the same time .
  For a dimmer display → Press [ENT SHFT] and [· S→O] at the same time .

[Note: Power-saving cut-off]

- SET2C switches off automatically 30 minutes after the last key operation.

Instrument parameter No.12 ☞ P.195

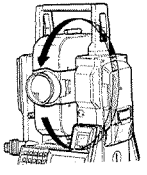
- Parameter No.12 can be changed so that the SET2C will not switch off automatically after 30 minutes.

11. PREPARATION FOR MEASUREMENT

11.1 Indexing the vertical and horizontal circles

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

Vertical circle indexing

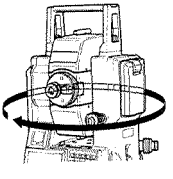


ZA	91° 04' 30"
HAR	0 SET

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.

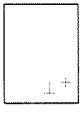
[Note: Horizontal angle back-up]

- The parameter No.9 default setting allows for the memorization of the previous horizontal 0 position at power-off for about 1 week. ("Memory error" 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 SET2C 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.195

- 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 ⊥+ 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 SET2C 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.)

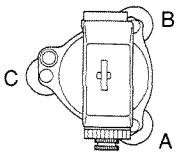
- When the measured vertical angles are within ±1° of the zenith or nadir, tilt compensation is not applied to the horizontal angle. In this situation, the displayed horizontal angle value flashes to show that the tilt compensation is not being applied.

Instrument parameter No.3 ☞ P.195

- 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 ±3' and the minimum display unit is 1". The "Tilt correction (Dual axis)" parameter must be set to "Yes".



1) 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 ㉔.

[3] Tilt angle display

2) Press [3].

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

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

3) The X and Y tilt angles are displayed.

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

4) 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
X > ⊥ < Y

- "Out of range" indicates that the tilt angle exceeds the ±3' measurement range.

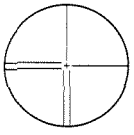
[3] To Theodolite mode
[CE·CA] To Basic mode

5) To exit from the tilt angle display, press [3] to return to Theodolite mode or press [CE·CA] to go to Basic mode.

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

11.2 Focussing and target sighting

Focus on the reticle

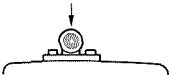


1) Look through the telescope eyepiece ㉜ at a bright and featureless background.

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.

Sight the target

Line the target with the white arrow in the peep sight



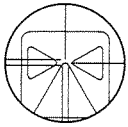
3) Loosen the vertical ㉙ and horizontal ㉘ clamps, and use the peep sight ㉟ to bring the target into the field of view.

4) Tighten both clamps.

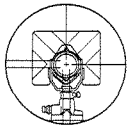
5) Turn the focussing ring ㉞ to focus on the target.

6) Turn the vertical ㉚ 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 ㉔ 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.

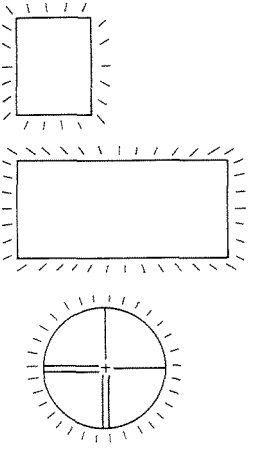
[Note:Parallax]

- 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

Illumination the display and reticle

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



Instrument parameter No.13 ☞ P.195

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

Instrument parameter No.15 ☞ P.195

- 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.195 "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		1" (0.2 mgon) * / 5" (1 mgon)
10	C + R correction		No correction * / Yes K = 0.142 Yes K = 0.20 ☞ P.219
11	1	Distance unit	metres* / feet
	2	Angle unit	360°* / 400gon
	3	Temperature/Pressure units	°C & mbar*/°C & mmHg/°F & mbar/ °F & mmHg/°F & InchHg

* Factory setting

- For other parameters, please refer to P.195 "24. CHANGING INSTRUMENT PARAMETERS".

MEASUREMENT

12. ANGLE MEASUREMENT

Check! before measurement :

1. SET2C 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 IC 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

↓

ENT SHFT 0 SET 0 REC : Set H angle to zero

↓

```
ZA
HAR        0° 00' 00"
```

e.g. • Measure the angle between two points.

Sight the first target

1) Using the horizontal clamp ㉓ and fine motion screw ㉔.
Sight the first point.

Set the horizontal angle to 0°

2) In Theodolite mode, press ENT/SHFT and 0 SET/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 ㉓ and fine motion screw ㉔.
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

↓

ENT/SHFT 1/MENU : For H angle input mode

↓

```
H angle
HAR
```

↓

Input H angle value ENT/SHFT

↓

```
ZA
HAR      90° 30' 20"
```

- Input range :0° 00' 00" to 359° 59' 59"
- Least input : 1"

◆ Correct the value : CE·CA

◆ Exit from the input : CE·CA CE·CA
(To Theodolite mode)

e.g. Setting 90° 30' 20"
→ Input value of 90.302

e.g. • Set the horizontal angle of reference target R to 60° 00'20".

Sight target R

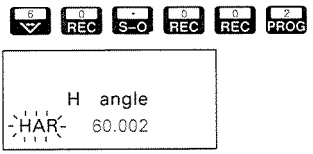
1) Using the horizontal clamp ㉓ and fine motion screw ㉔.
Sight target R.

From Theodolite mode or Basic mode to H Angle Input mode

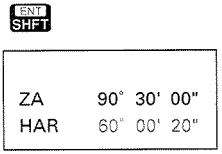
2) In Theodolite mode or Basic mode, press ENT SHFT 1 MENU.

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 ENT SHFT to finish inputting.
The instrument returns to Theodolite mode.
Here, the horizontal angle for target R has been set to 60° 00'20".

12.3 Horizontal angle display

< Horizontal angle right/left >

Note: **Horizontal angle right/left**

Theodolite mode (angle right)

↓

ENT SHFT 3 : H angle left

↓

```
ZA
HAL     260° 20' 40"
```

↓

ENT SHFT 3 : 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 IC card, please refer to P.109.

13.1 Measurement mode selection

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

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

Note: Measurement mode selection

- Data storage period : Until next changing (Power-off possible)

◆ Exit from the selection : CE·CA CE·CA (to Basic mode)

Theodolite mode or Basic mode

↓

ENT SHFT / EDM +/− RCL : For preperation mode

↓

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

↓

1 MENU : For selection mode of Distance measurement

↓

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

↓

1 MENU : Select Fine meas

3 : Select Tracking meas → Preperation mode

2 PROG : Select Coarse meas

↓

1. Single meas
2. Repeat meas

↓

1 MENU : Select Single meas

2 PROG : Select Repeat meas

↓

Preparation mode

e.g. • Selecting the "Repeat" option under Fine measurement

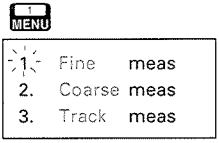
From Theodolite mode or Basic mode to Preparation mode

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

1) In Theodolite mode or Basic mode, press ENT/SHFT EDM +/- RCL.

The display appears as at left, showing Preparation mode.

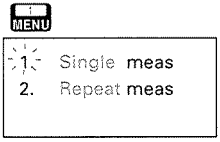
To Selection mode of Distance measurement mode



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

2) Press MENU.
The display appears as at left, and the previously selected measurement type flashes.

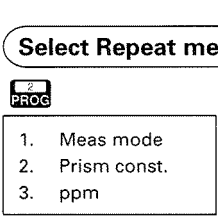
Select Fine measurement



```
1.  Single  meas
2.  Repeat  meas
```

3) Press MENU.
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 PROG.
Fine and Repeat measurement modes are set, and the instrument returns to Preparation mode.

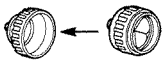
• To return to the Basic mode after this, press CE·CA.

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"

Note: Prism constant input

Theodolite mode or Basic mode

↓

ENT/SHFT EDM +/-/RCL : For Preparaton mode

↓

2/PROG : Prism constant input mode

↓

Prism constant
p.c 0 mm

↓

Input corrected value ENT/SHFT

↓

Preparation mode

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

◆ Retain the displayed value : ENT/SHFT (to Basic mode)

◆ Correct the value : CE·CA (set value to 0)

◆ Exit from the input : CE·CA CE·CA (to Basic mode)

e.g. • Set a prism constant of 40 mm (correction value: –40)

From Theodolite mode or Basic mode to Preparation mode

ENT SHFT EDM +/– RCL

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

1) In Theodolite mode or Basic mode, press ENT SHFT EDM +/– RCL .
The display appears as at left, showing Preparation mode.

Prism Constant Setting mode

2 PROG

```
      0
    p.c
```
← Sub-display

2) Press 2 PROG .

```
Prism constant
 p.c          0mm
```

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

+/– RCL 4 ⇄ 0 REC

```
Prism constant
 p.c   – 40
```

3) Input "–40".

A prism constant correction value of –40 is input.

ENT SHFT

0
– 40

← Prism constant correction value

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

4) Press ENT SHFT .

The correction value is input, and the instument returns to Preparation mode.
The entered value is displayed on the second line of the sub-display.

CE·CA : To Basic mode

- To return to Basic mode after this, press CE·CA .

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.217, 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.217, Appendix 3

- The SET2C 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:

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

- To input ppm value, read the correction factor from the table on page .

- For precise distance measurement, relative humidity should be taken into account together with atmospheric pressure and ambient temperature. See P.217.

Note: ppm setting mode

- T. input range : −30°C to +60°C
  T. input unit : 1°C
- P. input range : 500 mb to1400mb
  P. input unit : 1 mbar
- Data storage period :
  About a week
  (Power-off possible)

◆ Retain the displayed value : ENT SHFT ENT SHFT
◆ Correct the value : CE·CA (set value to 0)
◆ Exit from the input : CE·CA CE·CA
(to Basic mode)

Theodolite mode or Basic mode

↓

ENT SHFT EDM +/- RCL : For Preparation mode

↓

2 : For ppm setting mode

↓

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

↓

1 MENU : Set 0ppm

↓

Preparation mode

↓

2 PROG : Set Temperature & Pressure

↓

T 15°C
P. 1013 mbar

↓

Input Temperature ENT SHFT

↓

Input Pressure ENT SHFT

↓

Preparation mode

↓

3 : Set ppm value

↓

ppm value
ppm 0

↓

Input ppm value ENT SHFT

↓

Preparation mode

e.g. • Temperature of 20°C and
Atmospheric pressure of 1010 mb

From Theodolite mode or Basic mode to Preparation mode

ENT SHFT EDM +/- RCL

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

1) In Theodolite mode or Basic mode,
press ENT SHFT EDM +/- RCL .
The display appears as at left, showing Preparation mode.

To ppm setting mode

3

ppm
– 40

← Sub-display

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

2) Press 3 .

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

Select the input of Temperature and (atmospheric) Pressure

2 PROG

T	15	°C
P.	1013	mbar

3) Press 2 PROG .
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

4) Input "20" and press ENT SHFT .

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

MENU REC MENU REC ENT SHFT

T.	20	°C
P.	1010	mbar

5) Input "1010" and press ENT SHFT .
The pressure "1010 mbar" is input, and the instrument returns to Basic mode.

6
– 40

← Atmospheric correction value

Press function keys to select operation

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

↓

ENT SHFT ① : For Return signal checking mode

↓

Signal

↓

CE·CA : Finish Checking mode (to Basic mode)

↓

7 8 9 : Start measurement

Instrument parameter No. 14 ☞ P.195

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

13.5 Slope distance / Horizontal distance / Height difference measurement

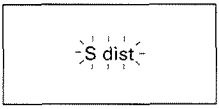
- The slope distance, the horizontal distance, and the height difference are measured simultaneously with the angle.

Check! before measurement:

1. SET2C 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

Start the measurement from Theodolite mode or Basic mode

1) In Theodolite mode or Basic mode, press 7, 8 or 9.



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

CE·CA : Stop

2) Press CE·CA . (The display does not change.)

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

7 , 8 , 9
: Start next measurement
CE·CA : To Basic mode
3 : To Theodolite mode

- Press 7 , 8 , or 9 to start the next measurement.
  Press CE·CA to return to the Basic mode,
  or press 3 to go to Theodolite mode.

Signal off

Note: If "Signal off" is displayed, the return signal strength has become inadequate for measurement. Verify the target sighting. If within 8 seconds the return signal becomes sufficient, the measurement is restarted.

After 8 seconds

S	Signal off
ZA	81° 12' 30"
HAR	12° 23' 40"

After 8 seconds, 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 CE·CA 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

↓

[+/- RCL] : For Recall mode

↓

Recall

↓

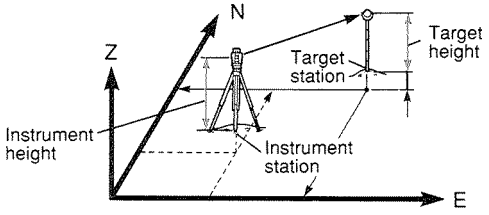
[7] : Display the stored Slope distance → S ZA HAR

[8] : Display the stored Horizontal distance → H ZA HAR

[9] : Display the stored Height distance → V ZA HAR

14. COORDINATE MEASUREMENT

- The SET2C 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 SET2C 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 type		Measurement time (slope distance)	Units
1	Fine meas.	Single	5.1secs	1mm
		Repeat	First 5.1 secs & every 3.3 secs	
2	Coarse meas.	Single	2.4 secs	
		Repeat	First 2.4 secs & every 0.7 secs	
3	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 ❸) and target height (the height difference between the surveying point and the centre of the target) should be input to the SET2C 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 : [ENT SHFT] (to Basic mode)
- ◆ Correct the value : [CE·CA] (set value to 0)
- ◆ Exit from the input : [CE·CA] [CE·CA] (to Basic mode)

Theodolite mode or Basic mode

↓

[ENT SHFT] , [7]
: For Instr. height setting mode

↓

Instr
Ht. 0.000m

↓

Input Instrument height [ENT SHFT]

↓

Basic mode

↓

[ENT SHFT] , [8]
: For Target height setting mode

↓

Target
Ht. 0.000m

↓

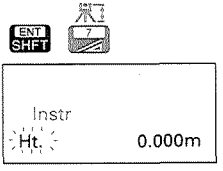
Input Target height [ENT SHFT]

↓

Basic mode

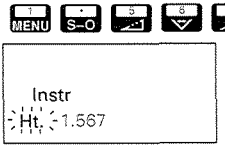
e.g. • Input Instrument height of 1.567 m and Target height of 1.234 m

From Theodolite mode or Basic mode to Instrument Height Input mode



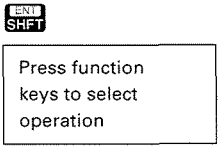
1) In Theodolite mode or Basic mode, press ENT SHFT 7 .
The previously stored value is displayed.
"Ht" flashes to prompt for the input of the instrument height.

Input the instrument height



2) Input "1.567".
An instrument height value of 1.567 is input.

Press function keys to select operation



3) Press ENT SHFT .
The instrument turns to Basic mode.

To Target Height Input mode

```
Target
Ht.          0.000m
```

4) Press ENT/SHFT 8 .
The previously stored value is displayed.
"Ht." flashes to prompt for the input of the target height.

Input the target height

```
Target
Ht.  1.234
```

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 SET2C.

- 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 3 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 IC card, please refer to P109.

Note: Instrument & Target station coordinate input

Theodolite mode or Basic mode

: For Instr. station coordinates input mode

: For Backsight station coordinates input mode

Input N-coordinate value ENT SHFT

Input E-coordinate value ENT SHFT

Input Z-coordinate value ENT SHFT

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 value : ENT SHFT

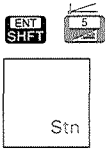
◆ Correct the value : CE-CA (set value to 0)

◆ Exit form the input : CE-CA CE-CA (to Basic mode)

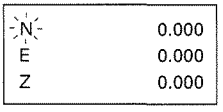
e.g.

- 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



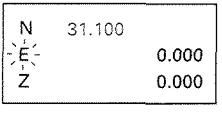
1) In Theodolite mode or Basic mode, press ENT SHFT and 5 .



The previously stored values are displayed.
"N" flashes to prompt for the input of the N coordinate.

Input Instrument station coordinates

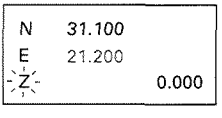
: Input N coordinate



2) Input "31.1" and press ENT SHFT .

The N coordinate is input.
"E" flashes to prompt for the input of the E coordinate.

: Input E coordinate



3) Input "21.2" and press ENT SHFT .

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

BS

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 SHFT : Retain displayed E coordinate

N	10.100	
E		20.200
Z		0.000

3 S-O 3 ENT SHFT

: Input Z coordinate

N	10.100
E	20.200
Z	3.300

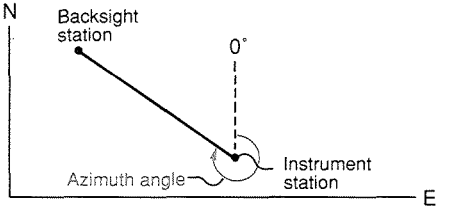
Press function keys to select operation

7) The displayed value is retained, so simply press ENT SHFT .
"Z" flashes to prompt for the input of the Z coordinate.

8) Input "3.3" and press ENT SHFT .

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 SET2C, 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 SHFT 2 PROG (as) Calculate Azimuth angle

↓

ZA HAR

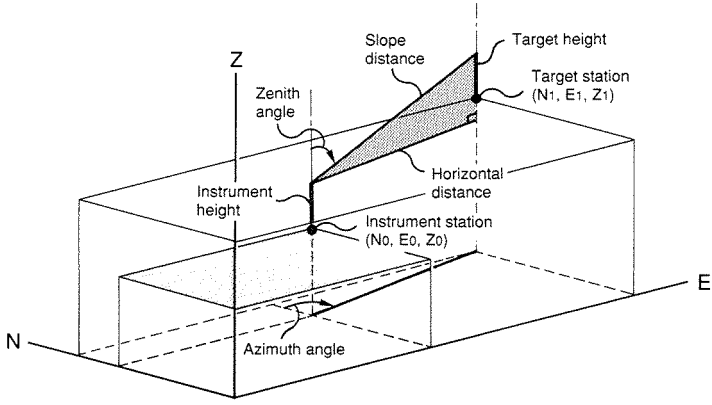
← Azimuth angle

14.5 3- Dimensional coordinate measurement

- The coordinates of the target are calculated using the following fomulas 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).

$$N1 = N_0 + S \times \sin\theta z \times \cos\theta h$$
$$E1 = E_0 + S \times \sin\theta z \times \sin\theta h$$
$$Z1 = Z_0 + Mh + S \times \cos\theta z - Ph$$

Instrument station coordinates: (N_0, E_0, Z_0)
Slope distance : S
Zenith angle : θz
Azimuth angle : θh
Instrument height : Mh
Target height : Ph



Check! before measurement:

1. SET2C 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 station and the backsight station coordinates have been input ☞ P.56
9. 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 ENT SHFT ☞ P.48.)

In Theodolite mode or Basic mode, start the coordinate measurement

[4]

```
Coordinate
```

2) In Theodolite mode or Basic mode, press [4].
This accesses Coordinate Measurement mode, and measurement of the 3-Dimensional coordinates is started. The display appears as at left and flashes.

```
N        123.456
E        345.678
Z          3.456
```

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

Stop the measurement

[CE·CA] : Stop the measurement

3) Press [CE·CA] (display does not change).

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

[7] [8] [9] [4]

: Start next measurement

[CE·CA] : To Basic mode

[3] : To Theodolite

- Press [7], [8], [9] or [4] to start the next measurement.
Pressing [CE·CA] returns to Basic mode, or press [3] to go to Theodolite mode.

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

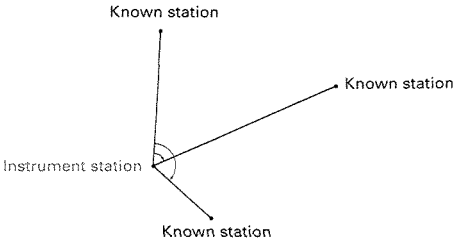
[+/- RCL] [4] : Review the measured data

- If [+/- RCL] and [4] are pressed, the last measured coordinate data can be displayed. ☞ P.51

ADVANCED MEASUREMENT FUNCTIONS

15. RESECTION MEASUREMENT

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



- SET2C 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.)

Note: For the Resection measurement of highest accuracy, please adjust the collimation error beforehand.
See P.212 "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 IC card, please refer to P.109.

- Nullification of calculation will result. The figure below describes the better arrangement.
  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 or more known stations).

□■ : 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 differ from the correct data.

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

↓

[2 PROG] : To Program mode

↓

[1 MENU] : Select Resection measurement

↓

```
Target / Coord.
No.                1
```

↓

Input Backsight number [ENT SHFT]

↓

Input Backsight coordinate value [ENT SHFT]

↓

```
Measure dist?
   Yes / No
```

↓

Yes [ENT SHFT] : Measure distance

No [CE·CA] : Not measure distance

↓

Input Target height [ENT SHFT]

↓

```
More point?
   Yes / No
```

↓

No [CE·CA] : No more point

Yes [ENT SHFT] : More point

↓

A

- 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 : [ENT SHFT]

◆ Correct the value : [CE·CA] (set value to 0)

◆ Exit from the input : [CE·CA] [CE·CA] (to Basic mode)

A

↓

```
Pt.                1
   measure ?
Yes / No (exit)
```

↓

Sight Target

↓

Yes [ENT SHFT] : Start measurement

↓

The measured data is displayed

↓

Instrument station coordinate is displayed and set

↓

Program mode

e.g.

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

Known Station A: Point number = 1
N = 2042.104, E = 1376.491, Z = 0.
Measure angle and distance
Target height is 1.5 m

Known Station B: Point number = 2
N = 1608.521, E = 2426.262, Z = 0.
Measure angle

Known Station C: Point number = 3
N = 862.988, E = 1554.186, Z = 0.
Measure angle and distance
Target height is 1.5 m

From Theodolite mode or Basic mode to Program mode

2 PROG : To Program mode

```
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"

1 MENU

```
Target / Coord.
No.        1000
```

2) Press 1 MENU .
The previously stored value +1 is displayed.
"No." flashes to prompt for the input of the point number.

Input data for Known Station A

[1 MENU] [ENT SHFT] : Input Target No.

N	0.000
E	0.000
Z	0.000

3) Press [1 MENU] [ENT SHFT] .
Target number "1" is input.
"N" flashes to prompt for the input of the N coordinate.

N = 2042.104 [ENT SHFT]
E = 1376.491 [ENT SHFT]
Z = 0 [ENT SHFT]

4) Input the coordinates for Known Station A.
N = 2042.104 [ENT SHFT]
E = 1376.491 [ENT SHFT]
Z = 0 [ENT SHFT]

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

Measure dist?
Yes / No

[Yes ENT SHFT] : Measure distance

5) Press [Yes ENT SHFT] .
The display apears as at left.
"Ht" flashes to prompt for the input of the target height.

Target
Ht. 0.000m

[1 MENU] [. S-O] [5 ←] [ENT SHFT]
: Input Target height

6) Press [1 MENU] , [. S-O] , [5 ←] , [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.)

Target / Coord.
No. 2

Input data for Known Point B

[ENT SHFT] : Input Target No.

N	0.000
E	0.000
Z	0.000

7) The displayed value is retained, so simply press [ENT SHFT] .
The point number "2" is input, and "N" flashes to prompt for the input of the N coordinate.

N = 1608.521 [ENT SHFT]
E = 2426.262 [ENT SHFT]
Z = 0 [ENT SHFT]

```
Measure dist?
   Yes / No
```

[No CE•CA] : Not measure distance

```
      Target / Coord.
-No.-            3
```

8) Input the coordinates for Known Station B.
N = 1608.521 [ENT SHFT]
E = 2426.262 [ENT SHFT]
Z = 0 [ENT SHFT]

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

9) Press [No CE•CA].
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 previouly stored value +1 is displayed.)

Input data for Known Station C

[ENT SHFT] : Input Target No.

```
-N-          0.000
 E           0.000
 Z           0.000
```

N = 862.988 [ENT SHFT]
E = 1554.186 [ENT SHFT]
Z = 0 [ENT SHFT]

```
Measure dist?
   Yes / No
```

10) The displayed value is retained, so simply press [ENT SHFT].
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 [ENT SHFT]
E = 1554.186 [ENT SHFT]
Z = 0 [ENT SHFT]

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

Yes ENT SHFT : Measure distance

```
Target
Ht.          1.500m
```

12) Press Yes ENT SHFT .

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

ENT SHFT : Retain displayed value

```
More point?
  Yes / No
```

13) Press ENT SHFT .

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.

No CE·CA : No more stations

```
Stn
```

```
Pt.          1
  measure ?
Yes / No (exit)
```

14) Press No CE·CA .

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

Observe Known Stations A to C

Sight Known Station A

Yes ENT SHFT : Measurement start

```
H dist
```

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

The horizontal distance measurement is started.

```
H        821.492m
ZA       90° 00' 00"
HAR      0° 00' 00"
```

```
Pt.          2
   measure ?
Yes / No (exit)
```

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).

Sight Known Station B

16) Sight the centre of the reflecting prism of Known Station B correctly ,
and press [Yes ENT SHIFT] .

[Yes ENT SHIFT] : Measurement start

```
ZA       90° 00' 00"
HAR      62° 33' 40"
```

```
Pt.          3
   measure ?
Yes / No (exit)
```

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).

Sight Known Station C

17) Sight the centre of the reflecting prism of Known Point C accurately,
and press [Yes ENT SHIFT] .

[Yes ENT SHIFT] : Measurement start

```
H dist
```

```
ZA       90° 00' 00"
HAR      62° 33' 40"
```

```
Busy ...
```

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           1.500
```

```
1.  Resection
2.  Correction
3.  Pt.  replace
```

CE·CA : To Basic mode

The instrument station coordinates are calculated and displayed.
This value is input as the instrument station coordinate.
The instrument returns to Program mode.

- Press CE·CA to go to Basic mode.

```
*N        0.000
*E        0.000
*Z        0.000
```

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

```
Signal off
```

```
 H          Timeout
ZA
HAR
```

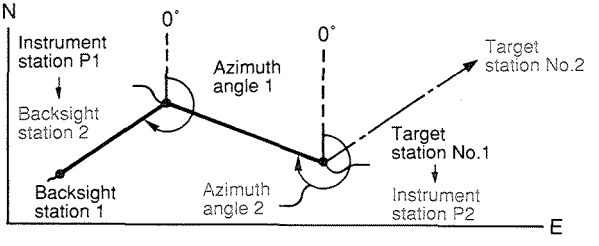
```
Pt.          1
     measure ?
  Yes / No (exit)
```

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 SET2C 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 : Replace Instrument station

↓

Stn pt replace?
Yes / No (exit)

↓

Yes ENT SHIFT : Verify

↓

Replaced

↓

New azimuth angle (HAR) is displayed

↓

ZA
HAR

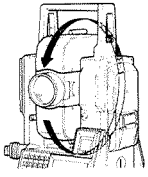
After measuring Station 1, switch off and move the SET2C

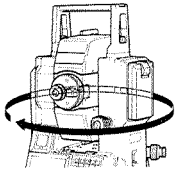
Station No.1

1) After measuring the coordinates of Station No.1 (14.1 ~ 14.5), switch the SET2C off.

2) Move the instrument to Station No.1 and set it up over the survey point.

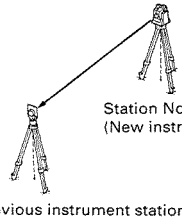
Switch on and index V and H circles





3) Switch the SET2C 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.



Station No.1
(New instrument station)

Previous instrument station P1

From Theodolite mode or Basic mode to Program mode

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 SET2C

Stn pt replace?
Yes / No (exit)

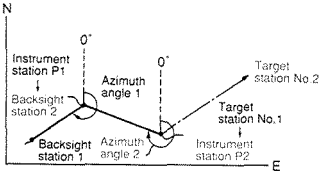
6) Press 3.
The display appears as at left and asks whether the new station coordinates are to replace the previously stored ones.

Replaced

7) Press Yes ENT SHIFT.
The display appears as at left after the coordinates of the 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.

ZA	81° 12' 30"	
HAR	145° 00' 00"	Azimuth angle 2

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



- To interrupt the movement, press CE·CA.

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)

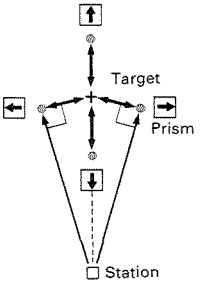
9) Sight the centre of the reflecting prism of station No.2 correctly.

10) Press 4 to go to coordinate measurement mode and start 3-Dimensional coordinate measurement.

17. OFFSET MEASUREMENT

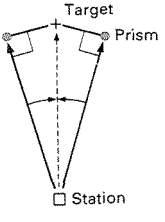
- The Offset measurement is used to measure the distance to points where it is not possible to set a reflecting prism directly, or where the reflecting prism cannot be sighted directly, in order to determine the angle.
- SET2C can determine the distance and angle of the target point by setting the reflecting 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.

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

Note: Offset measurement

- 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 SHFT]
◆ Correct the value : [CE·CA] (set value to 0)
◆ Exit from the input : [CE·CA] [CE·CA] (to Basic mode)

Sight Prism of Offset point

↓

Theodolite mode or Basic mode

↓

[7] [8] [9]

: Start Distance measurement (Stop the measurement)

↓

[ENT SHFT], [9] : To Offset meas. mode

↓

```
    Offset
1.  distance
2.  angle
```

↓

[MENU] : Select "Input distance"

↓

```
Direction
prism :  →
Yes / No(exit)
```

↓

[S-O]↑, [+/- HOL]↓ : Select the direction from Prism to Target

↓

[Yes ENT SHFT] : Set the direction

↓

```
Offset distance
 D-        0.000m
```

↓

Input H distance between Target and Prism [ENT SHFT]

↓

[2 PROG] : Select "Sight target direction"

↓

```
Sight target pt.
Yes / No (exit)
```

↓

Sight target direction

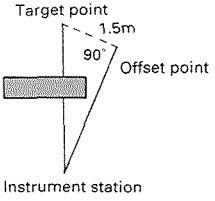
↓

[Yes ENT SHFT] : Verify

↓

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

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

[7] [8] [9]

: Starts the distance measurement

```
-S dist-
```

```
S          3.210m
ZA
HAR
```

1) Set the reflecting prism at the offset point, sight the centre of it correctly, and in Theodolite mode or Basic mode, press either [7], [8], or [9].
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.

[CE·CA] : Stop the measurement

2) For Repeat measurement mode, press [CE·CA].

To Offset Measurement mode

[ENT SHFT] [9]

```
   Offset
1. distance
2. angle
```

3) Press [ENT SHFT] and [9].
The display appears as at left.
The display asks you to select one of the following options:
1. Input the horizontal distance between the target point and the offset point.
2. Sight the direction of the target point.

Select "Input horizontal distance"

MENU

```
▲▼  Direction
 prism :  ↑
 Yes / No(exit)
```

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

Select the offset point direction

RCL ↓ or S-O ↑
: "→"is displayed

```
▲▼  Direction
 prism :  →
 Yes / No(exit)
```

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

Yes ENT SHFT

```
Offset distance
 D.        0.000m
```

When → is displayed, press Yes ENT SHFT.
"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

MENU S-O 5 ENT SHFT

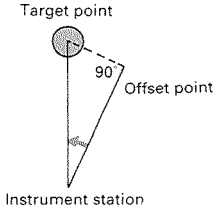
```
 S          4.321m
ZA
HAR
```

6) Input a horizontal distance of 1.5 metres and press ENT SHFT.
The slope distance from the instrument station to the target point and the vertical and horizontal angles are calculated and the results are displayed.

RCL 8 : Display the horizontal distance

- To display the horizontal distance, press RCL 8.

e.g.



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 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

[7] [8] [9]
: Starts the distance measurement

```
S dist
```

```
 S          3.210m
ZA
HAR
```

1) Set the reflecting prism at the offset point, sight the centre of it correctly, and in Theodolite mode or Basic mode press either [7], [8], or [9].

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.

[CE•CA] : Stop the measurement

2) For Repeat measurement mode, press [CE•CA].

To Offset Measurement mode

[ENT SHFT] [9]

```
    Offset
1.  distance
2.  angle
```

3) Press [ENT SHFT] and [9].

The display appears as at left.
The display prompts to select one of the following options:

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

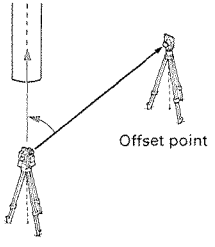
Select "Sight target point direction"

PROG

```
Sight target pt.
 Yes / No (exit)
```

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 ENT SHIFT

```
 S          3.210m
ZA
HAR
```

6) When the direction of the centre of the telephone pole has been sighted, press Yes ENT SHIFT .
The slope distance from the instrument station to the target point and the vertical and horizontal angles are calculated and the results are displayed.

+/− RCL 8 : Display the horizontal distance

- To display the horizontal distance, press +/− RCL 8

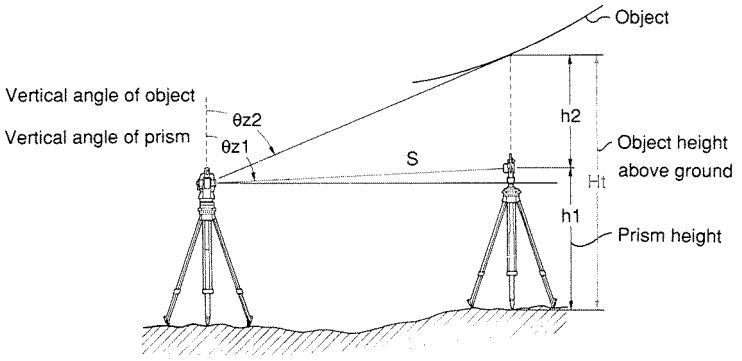
18. REM MEASUREMENT

- 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.

  $Ht = h1 + h2$

  $h2 = S\sin\theta z1 \times \cot\theta z2 - S\cos\theta z1$



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

Note: Remote elevation measurement

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

Sight the prism above or below the object

↓

Theodolite mode or Basic mode

↓

[7] [8] [9]

: Start Distance measurement (Stop the measurement)

↓

Sight the object

↓

[5] : Start REM

↓

The object height is displayed

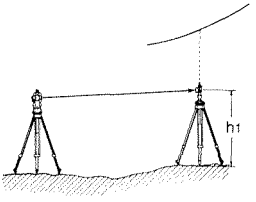
Ht	16.290m
ZA	77° 11' 10"
HAR	123° 45' 50"

↓

[CE+CA] : Stop measurement

e.g. Measure the height to a suspended cable

Set up the prism below the object and measure the distance



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 (h1) with a measuring tape, and input the target height.
☞ P.53

3) Sight the centre of the reflecting prism with the SET2C correctly.

[7] [8] [9]
: Start the measurement

S dist

4) In Theodolite mode or Basic mode,
press either [7], [8], or [9].
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.)

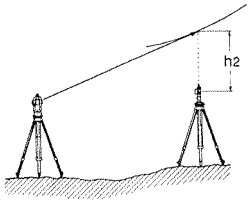
S	50.432m
ZA	89° 45' 20"
HAR	123° 45' 50"

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.

[CE·CA] : Stop the measurement

- For Repeat the measurement mode, press [CE·CA] to stop the measurement.

Sight the object and start REM measurement



5) Sight the object.

[S] : Start the REM measurement

6) Press [S].

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.

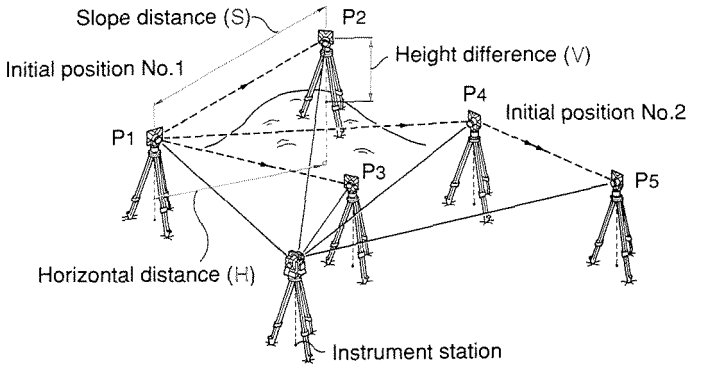
[CE·CA] : Stop the measurement

- Press [CE·CA] 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 SET2C 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 type		Measurement time	Units
1	Fine meas.	Single	5.6 secs	1mm
		Repeat	First 5.6 secs & every 3.3 secs	
2	Coarse meas.	Single	2.9 secs	
		Repeat	First 2.9 secs & every 0.7 secs	
3	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 at the initial position

↓

Theodolite mode or Basic mode

↓

7 8 9

: Start Distance measurement (Stop the measurement)

↓

Sight the object

↓

6 : Start Missing line meas.

↓

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

↓

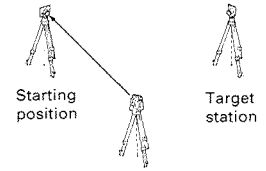
S	m
H	m
V	m

↓

CE·CA : Stop measurement

e.g. • Measure the distances between the starting position and many points consecutively.

Set up the prism on the starting position and start the distance 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 [7], [8], or [9].

[7] [8] [9]
: Starts the distance measurement

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 dist
```

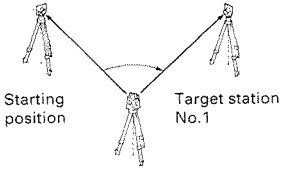
```
S          3.210m
ZA
HAR
```

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.

[CE•CA] : Stop the measurement

2) For Repeat the measurement mode, press [CE•CA].

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

4) Press .

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

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

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

: Stop the measurement

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

Sight Target Station No.2

: Start the missing line 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
```

↓

[ENT SHFT] [0 SET / 0 REC] : Change the initial starting position

↓

```
Point replace?
 Yes / No (exit)
```

↓

[Yes ENT SHFT] : Verify

↓

```
Replaced
```

↓

Basic mode

e.g. Changing the last measured target station No.4, to become the next starting postion

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

S	20.757m
H	27.345m
V	1.012m

1) After the missing line measurement of target station No.4 has been finished, the measured values are displayed.
Press [ENT SHFT] and [0 SET / 0 REC] at this point.

[ENT SHFT] [0 SET / 0 REC]

Point replace?
Yes / No (exit)

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

[Yes / ENT SHFT]

Replaced

2) Press [Yes / ENT SHFT].
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

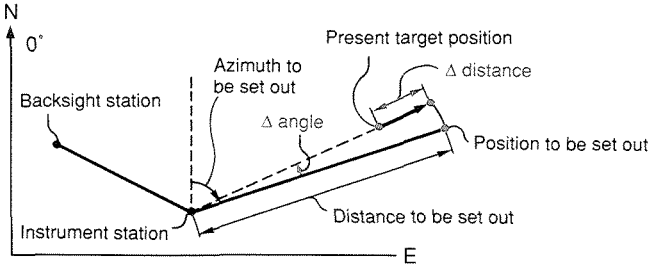
- To continue missing line measurement from the new starting position to the next target stations, sight each target station and press [6].

20. SETTING-OUT MEASUREMENT

- The Setting-out measurement is used to set out the required point.

- In the SET2C, 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

↓

ENT SHFT 6

: For Distance & H angle setting out data input mode

↓

```
 S-O data
 D          0.000m
 HAR      0° 00' 00"
```

↓

Input Distance setting out data ENT SHFT

↓

Input H angle setting out data ENT SHFT

↓

Basic mode

- Distance input range :
  –9999.999 to 9999.999m
  Least input : 0.001m
- Angle input range :
  Angle right 0° to 3 59° 59' 59"
  Least input : 1"
  Display range : ±180°
  (difference between target direction and setting out data)
- Data storage period :
  About a week (Power-off possible)

◆ Retain the displayed value : ENT SHFT

◆ Correct the value : CE•CA (set value to 0)

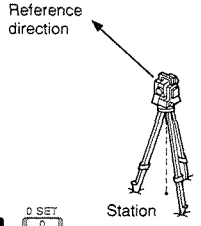
◆ Exit from the input : CE•CA CE•CA (to Basic mode)

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

4

e.g. Setting-out a horizontal angle right 90°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°



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

ENT SHFT 0 SET 0 REC

```
ZA      92° 36' 40"
HAR      0° 00' 00"
```

2) In Theodolite mode, press ENT SHIFT 0 SET 0 REC.
The horizontal angle display has been set to 0°.

In Setting-out Data Input mode

ENT SHFT 6

```
S-O data
D.          0.000m
HAR      0° 00' 00"
```

3) Press ENT SHIFT and 6.
The previously input values are displayed. "D" flashes to prompt for the input of the distance setting-out data.

Input distance setting-out data

1 MENU 2 PROG . S-O 3 4 5

ENT SHFT

```
S-O data
D.      12.345
HAR      0° 00' 00"
```

3) Input "12.345" and press ENT SHIFT.

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

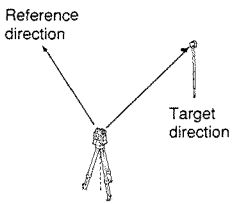
Input horizontal angle setting-out data


```
S-O data
D     12.345
HAR -       90.554
```

```
Press function
keys to select
operation
```

4) Input "90.554" and press FNT/SHFT.
The horizontal angle setting-out data is input, and the display returns to Basic mode.

Set the reflecting prism and start S-O measurement



5) Set the reflecting prism at a position about 90°55′40" from the reference direction and about 12.345 metres from the reference point (the instrument point), and sight the reflecting prism.


: Start H angle S-O measurement

```
      6
    -40
SO  ⊥ +
```

```
Setting out
```

```
dHA     -3° 45' 50"
HAR     94° 41' 30"
```

6) Press S-O and 3.
The setting-out measurement is started, and the horizontal angle "dHA" from the setting-out data is displayed.

7) 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.

: Start H angle S-O measurement

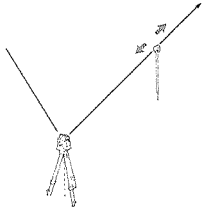
Setting out

-H dist-

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.

H	−4.362m
ZA	
HAR	0° 00' 00"



– data : from the instrument
+ data : towards the instrument

9) 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 8), 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

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)

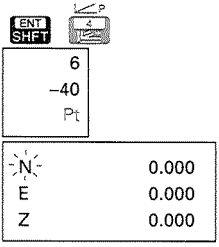
e.g. In this case, the values are as follows:
Instrument station coordinates: N = 20, E = 20, Z = 3
Backsight station coordinates : N = 10, E = 10, Z = 3
Setting out a point : N = 40, E = 30, Z = 4

- 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.

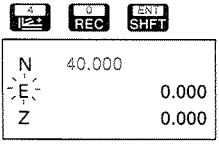
From Theodolite mode or Basic mode to Coordinate Setting-out Data Input mode



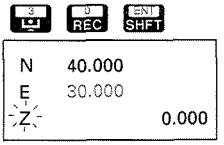
1) Press ENT SHFT and 4 .

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

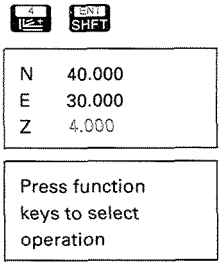


2) Input "40" and press ENT SHFT .
The N coordinate is input. "E" flashes to prompt for the input of the E coordinate setting-out data.



3) Input "30" and press ENT/SHFT .

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/SHFT .

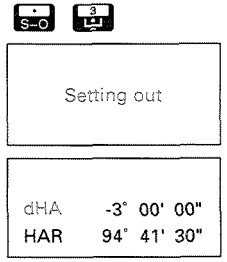
The Z coordinate is input, and the instrument returns to the Basic mode.

The setting-out horizontal distance and horizontal angle from the instrument station coordinates are calculated and the values are stored in the memory.

Note: Input the instrument station coordinates before inputting the setting-out data. Calculations 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.

5) Set the reflecting prism in the appropriate position, and sight its centre.



6) Press S-O and 3 .

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

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 S-O and then 8.

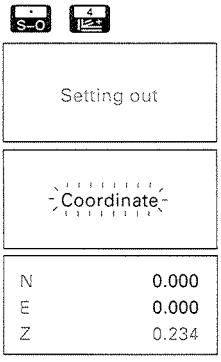
The setting-out measurement is started, and then the horizontal distance measurement is started.

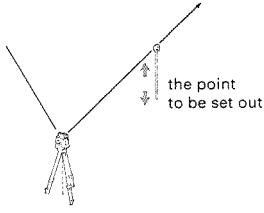
After about 4.7 seconds (Fine measurement mode), the distance from the setting-out data to the reflecting prism is displayed.

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 CE·CA to stop the measurement.

Start coordinates S-O measurement, and determine the height





10) When "H" has become 0.000 m, press [S-O] and then [4] .

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 [CE·CA] to stop the measurement.

USING THE IC CARD TO RECORD THE DATA

21. IC CARD OPERATIONS

☞ P.109

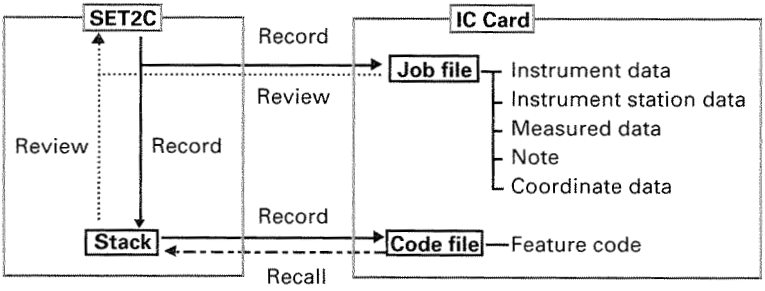
21. IC CARD OPERATIONS

21.1 IC card features

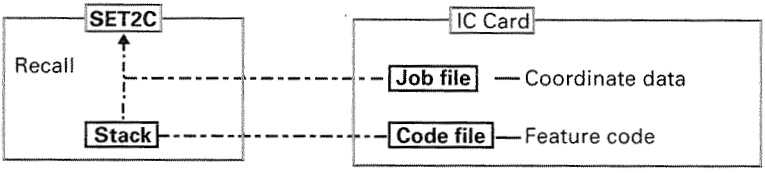
- The following types of data can be recorded by the SET2C on IC cards, and data stored on IC cards can be recalled to the SET2C.

- 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 SET2C can record data in the following formats on IC 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, target 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

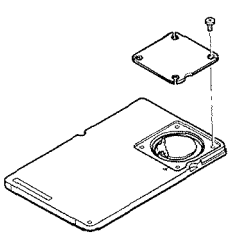
< Code >	→	Feature code, file name
< Card>→<Job/file>	→	North coordinate (E coordinate), E coordinate (N coordinate), Z coordinate, point number, feature code

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

- **Replacing the IC card battery**
  If the battery becomes low, an error meassage 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 IC card is cleared.
If the data on the card is necessary data, be sure to transfer it to a personal computer before replacing the IC card battery.

Card bat low



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 ▲.

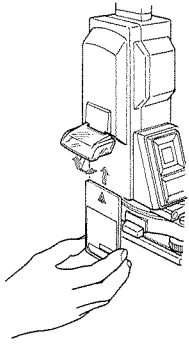
2) Remove the used battery and fit a new one between the electrode springs, with the + side facing upwards. Use pliers made of a non-conductive material (plastic, etc.) when handling the battery.

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

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

21.2 Inserting and formatting IC card

Inserting IC card



- Lift up the SET2C IC card cover ❹ and carefully insert the IC card. The card is inserted with the arrow up and the printed side out. Close the card cover.

Formatting IC card

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

Note: If an IC 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.

[S-O]: Display "format"

```
▲ Card
▼ format
   Yes / No (exit)
```

3) Press [S-O].
The display prompts for the selection of the card formatting.

[Yes ENT SHIFT] : Select "format"

```
Formatting ok ?
   Yes / No (exit)
```

4) Press [Yes ENT SHIFT].
The display prompts for the formatting of the card.

[Yes ENT SHIFT] : Format the card

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

5) Press [Yes ENT SHIFT].
The display asks whether you want to start formatting the IC card or not.

[1 MENU] : Start card formatting

```
Format end
```

```
1.  Config
2.  Card
3.  Code
```

6) Press [1 MENU].
When the formatting has been completed, the display appears as at left, and the instrument returns to Menu mode.

```
Write protected
```

- 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, "21.5 Protecting data stored on the IC 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.195, "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 SET2C can store the instrument data, instrument station data, measured data, and notes and coordinate data in job files on the IC card.
  The job file can be created on the IC card in advance.
  Create the job file on the IC 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 IC 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

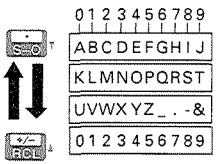
↓

Input the Job name [ENT SHFT]

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

◆ Correct 1 character : [CE·CA]

◆ Exit from the input : [CE·CA] [CE·CA]
(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.

↓

[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

[3] : Delete the Job

↓

[Yes ENT SHFT] : Select the Job name

↓

[Yes ENT SHFT] : Verify

↓

Card setting mode

↓

[CE·CA], [CE·CA] : To Basic mode

e.g. • 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"

[SEQ] : Display K to T

[9] [4] [0 REC]
: Input "TOK"

[SEQ] : Display U to &

[4] : Input "Y"

[+/- RCL] : Display K to T

[4] : Input "O"

[ENT SHFT] : Input finished

▲	KLMNOPQRST
▼	0123456789
press	TOKYO
Job	

▲ Card
▼ Job / file
Yes / No (exit)

5) Press [SEQ] to display "K ~ T".

6) Press [9], [4], [0 REC] to input "TOK".

7) Press [SEQ] to display "U ~ &".

8) Press [4] to input "Y".

9) Press [+/- RCL] to display "K ~ T".

10) Press [4] to input "O".

11) Press [ENT SHFT].
When the Job file has been created, the display returns to Card setting menu.

Select the "Job/file" setting again

[Yes ENT SHFT]

1. create
2. select
3. delete

12) Press [Yes ENT SHFT].
The display appears as at left, showing Job setting menu.

Select the Job "select"

```
Job select
  TOKYO
Yes / No (exit)
```

14) Press [2 PROG] .
The display prompts for the selection of the Job files.

Display "OSAKA"

```
Job select
  OSAKA
Yes / No (exit)
```

15) Press [S-O] ▼ or [+/- RCL] ▲ to display "OSAKA"

Select "OSAKA"

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

16) Press [Yes ENT SHFT] .
The Job file "OSAKA" is selected and the display returns to the card setting menu.


: To Basic mode

- Press [CE-CA] [CE-CA] to return to Basic mode.

e.g. To delete the Job file "FUKUOKA" from the IC card

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 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 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.

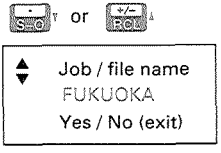
Select the file "delete"

[3]

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

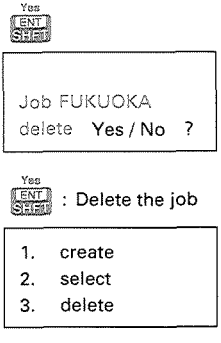
4) Press [3] .
The display prompts for the selection of the file name to be deleted.

Display "FUKUOKA"



5) Press [S⇒O] or [+/- RCL] to display"FUKUOKA".

Select "FUKUOKA"



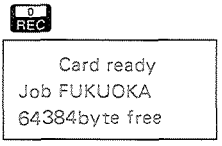
6) Press [Yes ENT SHFT].
The job "FUKUOKA" is selected and the display asks whether this Job is deleted or not.

7) Press [Yes ENT SHFT].
"FUKUOKA" is deleted from the card, and the display returns to Job setting menu.

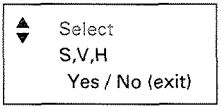
21.5 Instrument data recording

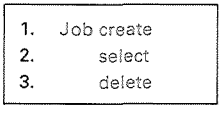
- With the SET2C, the following items can be recorded on the IC card as instrument data:
  - Instrument name
  - Instrument number
  - Software version number

From Theodolite or Basic mode to Record mode

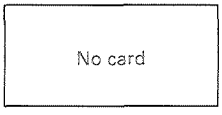


1) In Theodolite mode or Basic mode,
press REC .
The selected job file name and the available space for data recording are displayed.
A new card has 64,384 available bytes (approximately 1000 measured data points in S, V, H format).
After that, the display shows Record mode. And the display prompts for selection of the data format.





- When there is no Job file on the IC 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 IC card is not correctly mounted in the SET2C. Insert the IC 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 REC, there is some problem with the IC card.
  Insert the IC card correctly.

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

Card is full

- When the IC card becomes full of data, "Card is full" is displayed.

Card bat low

- When the IC 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"

S→O or FCL

Select
Instr ID
Yes / No (exit)

2) Press S→O or FCL. to display "Instr ID".

Record Station data

Yes ENT SHFT

Record end

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

3) Press Yes ENT SHFT.
When recording of the station 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 SET2C can record the following items as instrument station data;
  Data, 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 point data recording

Select the Job

↓

REC : For Record mode

↓

S-O ▼ or +/- RCL ▲

:Display of Station data

↓

Yes ENT SHFT : Select to start recording

↓

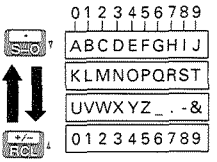
Input data ENT SHFT

↓

Input Station number ENT SHFT

↓

(Input or select code ENT SHFT)



↓

Input Instrument height ENT SHFT

↓

1 MENU : Set 0ppm

2 PROG : Set Temperature & Pressure

↓

Input Temperature ENT SHFT

↓

Input Pressure ENT SHFT

3 : Set ppm value

↓

Input ppm value 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 : CE·CA

(set value to 0)

◆ Exit from the input : CE·CA CE·CA

(to Card setting mode)

e.g. 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.

e.g.

- *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"

[-/S-O]↑ or [+/-/ROL]↓

```
▲▼ Select
   Station data
    Yes / No (exit)
```

1) In Record mode, press [-/S-O]↑ or [+/-/ROL]↓ to display "Station data".

Select the "Station data" recording

Yes [ENT/SHFT]

```
Date  yy. mm. dd
      91. 8.  1 0
```

2) Press Yes [ENT/SHFT].
The previously input data is displayed.

Input the data

91.10.4 [ENT/SHFT]

```
Stn  point
No.          1
```

3) Input "91.10.4" and press [ENT/SHFT].
The data "91.10.4" is input, and "No." flashes to prompt for the input of the station number.

Input the station number

100 [ENT SHFT]

```
▲        ABCDEFGHIJ
▼ press  0123456789
 Cd      ABC
```

```
▲ Code select
▼ TOWER
  Yes / No (exit)
```

4) Input "100" and press [ENT SHFT].
"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 [No CE·CA].

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

[CE·CA] : Single-character delete

[7] : Input "H"

[S=O]▼: Display K to T

[4] : Input "O"

[2 PROG] : Input "M"

[+/− RCL]▲: Display A to J

[4] :Input "E"

[ENT SHFT] : Input finished

```
Instr
 Ht.      0.000m
```

5) Input the code.

Press [CE·CA] to delete one character to the left.

Press [7] to input "H".

Press [S=O]▼ to display "K ~ T".

Press [4] to input "O".

Press [2 PROG] to input "M".

Press [+/− RCL]▲ to display "A ~ J".

Press [4] to input "E".

Press [ENT SHFT].

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

Input the instrument height

1.45 [ENT SHFT]

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

6) Input "1.45" and press [ENT SHFT].
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]

T.	15	°C
P.	1013	mbar

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 PROG] [3] [ENT SHFT]

T.	25	°C
P.	1013	mbar

8) Input "25" and press [ENT SHFT].
A temperature 25°C is input.
"P" flashes to prompt for the input of the pressure.

[9] [8] [0 REC] [ENT SHFT]

N
E
Z

9) Input "980" and press [ENT SHFT].
A pressure "980 mbar" is input.
"N" flashes to prompt for the input of instrument station coordinates.

Input the instrument station coordinates

N =30 ENT SHFT
E =30 ENT SHFT
Z =10 ENT SHFT

10) Input the instrument station coordinates.
N = 30 ENT SHFT
E = 30 ENT SHFT
Z = 10 ENT SHFT

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 SET2C 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

↓

[0 REC] : For Record mode

↓

Sight the target

↓

[· S→O] or [+/− RCL]
:Display of Measured data

↓

[Yes ENT SHFT] : Select to start recording

↓

(Input Target height [ENT SHFT])

↓

The SET2C measures and displays one set of the target point data in the selected format.

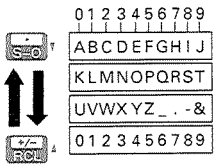
↓

Input Target number [ENT SHFT]

↓

(Input or select code [ENT SHFT])

↓



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: [ENT SHFT]

◆ Correct the value of 1 character : [CE·CA]
(set value to 0)

◆ Exit from the input : [CE·CA] [CE·CA]
(to Record mode)

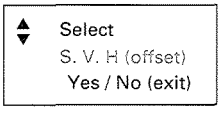
- In Offset measurement, the SET2C measures and displays the offset point data.
  Select Distance inputting or Target sighting.
  Select the direction of offset point from the Target and input the distance between the offset point and Target, or sight the target.

- Use [· S→O] or [+/− RCL] to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

e.g.

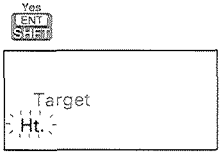
- To record the following offset measurement data
  Target number : No. 2001
  Code : "TREE-1".
  Target height : 1.23 m
  Horizontal distance from target point to offset point : 1.8 m
  Direction of prism from target : Front

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



1) In Record mode, press [S-O] or [+/- FCL] to display "S, V, H (offset)".

Select "S, V, H (offsets)"



2) Press [Yes ENT SHIFT].
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/SHFT]

```
S dist
```

3) Sight the reflection prism for the offset point.
Input "1.23" and press [ENT/SHFT] .
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.

```
S
ZA
HAR
```

```
    Offset
1.  distance
2.  angle
```

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.

Select "distance"

[MENU]

```
▲▼  Direction
 prism :  →
   Yes / No(exit)
```

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.

Select offset point direction

[+/- RCL]▲ or [S-O]▼
: Display "↓"

```
▲▼  Direction
 prism :  ↓
   Yes / No(exit)
```

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

Yes ENT SHFT

```
Offset distance
 D        0.000m
```

When "↓" appears, press Yes ENT SHFT .
"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 ENT SHFT

```
Target point
 No.        1
```

6) Input horizontal distance of "1.8" and press ENT SHFT .

Input the target point number

2001 ENT SHFT

```
▲ Code select
▼ ABC
  Yes / No(exit)
```

7) Input a target number of "2001" and press ENT SHFT .
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. Instead, go directly to step10.

Set the code

+/- RCL ▲ or · S-O ▼
: Display "TREE1"

```
▲ Code select
▼ TREE 1
  Yes / No(exit)
```

8) Press +/- RCL ▲ or · S-O ▼ to display "TREE1".


```
▲        ABCDEFGHIJ
▼ press  0123456789
  Cd     TREE1
```

When "TREE1" is displayed, press Yes 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.

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

9) If the displayed code is the required one, press ENT SHFT .
To change the displayed code, press CE·CA to delete the characters one at a time. Input the code required. Then press ENT SHFT .

```
Target          2001
 Record end
```

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

```
▲ Select
▼ S,V,H (offset)
   Yes / No (exit)
```

The display then returns to the Record mode.

```
Data error
```

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 SET2C can record remarks as notes.

Procedure: Note recording

Select the Job file

↓

Record mode

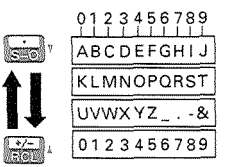
↓

Input note [ENT SHFT]

- Note can be up to 20 characters long

◆ Correct 1 character : [CE·CA]

◆ Exit from the input : [CE·CA] [CE·CA]
(to Record mode)



- Use [S-O] or [+/- RCL] to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

↓

Record end

↓

Record mode

e.g. • To record "CLOUDY" as a note

In Record mode, display "Note"

[S⇒O] or [+/− RCL]

```
▲▼  Select
    Note
     Yes / No (exit)
```

1) In Record mode, press [+/− RCL] or [S⇒O] to display "Note".

Select the "Note" recording

[Yes ENT SHFT]

```
▲▼        ABCDEFGHIJ
press     0123456789
  Rem
```

2) Press [Yes ENT SHFT].
"Rem" flashes to prompt for the input of the note.

Rem: Remark

Input the note

CLOUDY [ENT SHFT]

```
Record end
```

```
▲▼  Select
    S,V,H
     Yes / No (exit)
```

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

21.9 Feature code recording

- The SET2C can record the feature codes in the instrument and on an IC 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:

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.

↓

Record codes in the stack on a card

☞ 21.9

↓

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

- 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 : [CE•CA]

◆ Exit from recording : [CE•CA] [CE•CA] (to Code setting mode)

In Theodolite mode or Basic mode

↓

[1 MENU] : For Menu mode

↓

[3] : Select the code setting

↓

[S•O] or [+/− RCL] : Display "stack+"

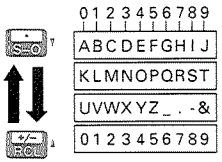
↓

Yes [ENT SHFT] : Select the code recording to stack

↓

Input the feature code [ENT SHFT]

↓



- Use [S•O] or [+/− RCL] to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

[CE•CA] : Stop recording the code to stack

↓

[S•O] or [+/− RCL] : Select the code recording from stack to IC card

↓

Yes [ENT SHFT] : Select the code recording from stack to IC card

↓

Input the feature code [ENT SHFT]

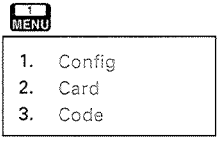
↓

[CE•CA], [CE•CA] : To Basic mode

e.g.

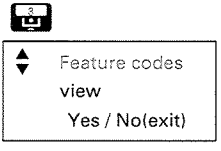
- To record the codes "SCHOOL" and "FACTORY" in a stack, and then to record them on a card under the file name "FCODE-1".

From Theodolite or Basic mode to Menu mode



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

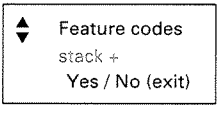
Select "Code" setting



2) Press [3].
The display appears as at left, showing the code setting menu.

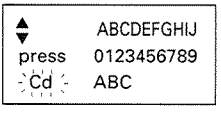
Select code recording in stack (stack +)

[S-O] or [+/- RCL]
: Display "stack +"



3) Press [S-O] or [+/- RCL] to display "stack +".

[Yes ENT SHIFT] : Select "stack +"



4) Press [Yes ENT SHIFT].
"Cd" flashes to prompt for the input of the code.

Input the code

SCHOOL [ENT/SHFT]

```
▲▼        ABCDEFGHIJ
press     0123456789
 Cd
```

```
Stack is full
```

5) Input "SCHOOL" and press [ENT/SHFT] .

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 [CE-CA] to stop inputting the codes and record the codes on the card.

Note: 138 characters can be recorded in one file.
For example, the number of codes composed of 5 characters which can be recorded is 23.

[CE-CA] : Input is finished

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

6) Press [CE-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)

[S=0] ▼ or [+/− RCL] ▲

: Display "card <= stack"

▲▼ Feature codes card <= stack Yes / No (exit)

7) Press [S=0] ▼ or [+/− RCL] ▲ to display "card <= stack".

[Yes ENT SHFT] : Select code in the stack to record on the card

▲▼ ABCDEFGHIJ press 0123456789 FCODE

8) Press [Yes ENT SHFT] .
"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 [ENT SHFT]

▲▼ Feature codes view Yes / No (exit)

9) Input "-1" and press [ENT SHFT] .
"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 [CE·CA] [CE·CA] to return to the Basic mode.

21.10 Feature code recalling to stack

- The SET2C can recall a code file stored on the IC 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 recording

◆ Exit from the input : [CE·CA]

In Theodolite mode or Basic mode

↓

[1 MENU] : For Menu mode

↓

[3] : Select the code setting

↓

[· S-O] ↑ or [+/− RCL] ↓ : Display "card => stack"

↓

[Yes ENT SHIFT] : Select the code to recall from IC card to stack

↓

[· S-O] ↑ or [+/− RCL] ↓ : Display the required code file

↓

[Yes ENT SHIFT] : Select the code file name

↓

[Yes ENT SHIFT] : Verify

↓

[CE·CA], [CE·CA] : To Basic mode

e.g. • 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 MENU]

```
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 "Code" setting

[3]

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

2) Press [3].
The display appears as at left, showing the code setting menu.

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

[• S-O] or [+/- RCL]
: Display "card => stack"

```
▲▼ Feature codes
   card => stack
   Yes / No (exit)
```

3) Press [• S-O] or [+/- RCL] to display "card => stack".

[Yes ENT SHFT] : Select "card => stack"

```
▲▼ Codes file
   FCODE-1
   Yes / No(exit)
```

4) Press [Yes ENT SHFT].
The files can now be selected. (The display prompts for the selection of the code file.)

Select file to be recalled

[S-HO] or [+/- R-CL]
: Display "FCODE5B"

▲▼ Codes file FCODE5B Yes / No(exit)

5) Press [S-HO] or [+/- R-CL] to display "FCODE5B".

[Yes ENT SHIFT] :Display "FCODE5B"

Code stack over write ? Yes / No(exit)

6) Press [Yes ENT SHIFT].
The display asks whether the codes currently stored in the stack are cleared and whether to recall the codes in the "FCODE5B" file.

[Yes ENT SHIFT] : Verify

▲▼ Feature codes view Yes / No (exit)

7) Press [Yes ENT SHIFT].
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.

[CE·CA] [CE·CA] : To Basic mode

- Press [CE·CA] [CE·CA] 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 SET2C 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

↓

1 MENU : For Menu mode

↓

3 : Select the code setting

↓

· S-O ↑ or +/- RCL ↓ : Display "stack –"

↓

Yes ENT SHIFT : Select code deleting from stack

↓

· S-O ↑ or +/- RCL ↓ : Display the required code

↓

Yes ENT SHIFT : Select the code

↓

CE·CA , CE·CA : To Basic mode

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

e.g. • To delete the code"SCHOOL" from a stack

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 "Code" setting

[3 CODE]

▲▼ Feature codes view
Yes / No (exit)

2) Press [3 CODE].
The display appears as at left, showing the code setting menu.

Select code to be deleted from stack (stack-)

[· SHO] or [+/− FCL]

: Display "stack-"

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

3) Press [· SHO] or [+/− FCL] to display "stack-".

[Yes ENT SHIFT] : Select "stack-"

▲▼ Codes select
SCHOOL
Yes / No(exit)

4) Press [Yes ENT SHIFT].
The display prompts for the selection of the code to be deleted.

Select the code to be deleted

[S-O] or [+/- RCL]
: Display "SCHOOL"

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

[Yes ENT SHIFT] : Display "SCHOOL"

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

```
No code data
```

5) Press [S-O] or [+/- RCL] to display "SCHOOL".

6) Press [Yes ENT SHIFT] .
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 [CE·CA] [CE·CA] to return to the Basic mode.

21.12 Coordinate data recording

- The SET2C 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 recording and selection".

Procedure: Coordinate data recording

- FeatureCode can be up to 13 characters long

◆ Correct 1 character : [CE·CA]
◆ Exit from the input : [CE·CA] [CE·CA]
(to Card setting mode)

In Theodolite mode or Basic mode

[1 MENU] : For Menu mode

[3] : Select the card setting

[·/SO]↑ or [+/-/ROL]↓ : Display "data write"

[Yes ENT/SHFT] : Select the coordinate data recording

[Yes ENT/SHFT] : Select the Job name

[No CE·CA] : 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/SHFT], Input E-coordinate data [ENT/SHFT]

Input Z-coordinate data [ENT/SHFT]

Input the point number [ENT/SHFT]

Input the code [ENT/SHFT] or Select the code [Yes ENT/SHFT]

[·/SO]↑ [+/-/ROL]↓

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

- Use [·/SO]↑ or [+/-/ROL]↓ to select the required block of characters. Press the numerical key (0-9) corresponding to the required character.

[Yes ENT/SHFT] : Record the data

Record end, [CE·CA], [CE·CA] : To Basic mode

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 MENU]

```
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 "Card" setting

[2 PROG] : Input is finished

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

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

Select coordinate data recording (data write)

[· S-O]↓ or [+/- RCL]↑
: Display "data write"

```
▲▼  Card
    data write
     Yes / No (exit)
```

3) Press [· S-O]↓ or [+/- RCL]↑ to display "data write".

[Yes ENT SHFT] : Select "data write"

```
Job OSAKA
Yes / No (select)
```

4) Press [Yes ENT SHFT].
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 CE·CA : "select" another file

```
1.  Job create
2.        select
3.        delete
```

5) Press No CE·CA 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 Yes ENT SHFT. Then proceed to step 8).

2 PROG : Select "Job select"

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

6) Press 2 PROG.
The display prompts for the selection of the file name.

- To create a new Job file, press 1 MENU.
The display prompts for the input of the Job file name. Input the Job file name and press ENT SHFT to advance to step 9).

· SHIFT or +/− ROT : Display "COORD.1"

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

7) Press · SHIFT or +/− ROT to display "COORD.1".

Yes ENT SHFT : Select "COORD.1"

```
N        0.000
E        0.000
Z        0.000
```

8) Press Yes ENT SHFT.
"N" flashes to prompt for the input of the N coordinate data.

Input the coordinate value

N =35 [ENT SHFT]
E =67 [ENT SHFT]
Z =48 [ENT SHFT]

```
Point
No.          1000
```

9) Input coordinate values.
N = 35 [ENT SHFT]
E = 67 [ENT SHFT]
Z = 48 [ENT SHFT]

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

Input the point number

201 [ENT SHFT]

```
▲        ABCDEFGHIJ
▼
press    0123456789
Cd
```

10) Input the point number"201" and press [ENT SHFT] .
"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 [ENT SHFT]

```
Data  OK  ?
Yes / No
```

11) Input the code "BS-4" and press [ENT SHFT] .
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 Yes ENT SHIFT .

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.

CE·CA CE·CA :To card setting menu

▲ ▼ Card
Job/file
Yes / No (exit)

13) Press CE·CA CE·CA .

The display returns to the card setting menu.

- Press CE·CA CE·CA to return to Basic mode.

21.13 Coordinate data recalling to Instrument

- The SET2C can recall and use the coordinate data stored on the IC card.

- Recalled coordinate data can be used as follows:
  - Instrument station coordinates
  - Backsight station coordinates
  - Known point coordinates for Resection measurement
  - Setting-out coordinates

- Before recalling the data into the instrument station, the following parameter should be set to "Card".
  To change the parameter, please refer to P.195, "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

◆ Exit from the input : [CE·CA]

↓

[1 MENU] : For Menu mode

↓

[2 PROG] : Select the card setting

↓

[· S·O] ↑ or [+/- ROT] ↓ : Display "data read"

↓

Yes [ENT SHFT] : Select the coordinate data file to recall from IC card to instrument

↓

[· S·O] ↑ or [+/- ROT] ↓ : Display the required coordinate file name

↓

Yes [ENT SHFT] : Select the coordinate file name

↓

[CE·CA], [CE·CA] : To Basic mode

- Recall Instrument station coordinates:

  Press [ENT SHFT] + [S] and input the stored coordinate data point number.
- Recall Backsight station coordinates:

  Press [ENT SHFT] + [· S·O] (BS) and input the stored coordinate data point number.
- Recall Setting out coordinates:

  Press [ENT SHFT] + [4] (P) and input the stored coordinate data point number.

e.g.

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

From Theodolite mode or Basic mode to Menu mode

```
1.  Config
2.  Card
3.  Code
```

1) Press MENU.
The display appears as at left, showing Menu mode.

Select "Card" setting

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

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

Select file recalling (data read)


or


: Display "data read"

```
▲▼  Card
    data read
     Yes / No (exit)
```

3) Press S-O or RCL to display "data read".


: Select "data read"

```
▲▼  Coord.  file
      TOKYO
    Yes / No (exit)
```

4) Press ENT.
The display prompts for the selection of the file name to be recalled.

Select "COORD.5"

[S=O]↑ or [+/- RCL]↓
: Display "COORD.5"

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

5) Press [S=O]↑ or [+/- RCL]↓ to display "COORD.5".

[Yes ENT SHIFT] : Select "COORD.5"

```
Busy...
```

6) Press [Yes ENT SHIFT] .
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.

```
1.  Config
2.  Card
3.  Code
```

- Press [CE•CA] to return to Basic mode.

```
Data table
over write ?
Yes / No (exit)
```

- 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 [Yes ENT SHIFT] ,the file name searching is started.

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 IC 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 ENT/SHFT 5 .

```
 Stn  point
 No.            400
```

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

```
 ▲▼  Coord.  file
       TOKYO
     Yes / No (exit)
```

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.
Press S-O or +/-/ROL to display the file name to be selected.
Press ENT/SHFT to select the displayed file name.

S-O or +/-/ROL : Display the required file name

ENT/SHFT : Select the displayed file

```
 Data  read  from
       TOKYO
 Yes / No (select)
```

Note: When the previously selected file is not on the IC card, the display appears as at left.
Press No/CE-CA to select the file which stores the coordinates to be recalled.

No/CE-CA : Select another file

Input the point number

401 [ENT SHFT]

N	98.765
E	43.210
Z	1.456

2) Input the point number "401" and press [ENT SHFT].

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

▲▼N	98.765
E	43.210
Z	1.456

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 [·/S.O]▼ or [+/-/RCL]▲ to display the coordinates to be recalled. And then press [ENT SHFT] to recall the displayed coordinates.

No data

Keyboard input
Yes / No (select)

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 [Yes ENT SHFT] to input the Instrument station coordinates from keyboard.

Press [No CE·CA] to input the point number again.

[CE·CA]: To Basic mode

- Press [CE·CA] to return to Basic mode.

e.g. **<Input Known station coordinates for Resection measurement by recalling the coordinate data from the IC 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

5

501 [ENT SHFT]

```
Measure dist ?
Yes / No
```

3) Input the point number "501" and press [ENT SHFT].
The display asks whether to measure the distance or not.

Yes ENT SHFT : Measure distance

```
Target
Ht.        1.500m
```

4) Press Yes ENT SHFT .
The previously stored target height is displayed.
"Ht." flashes to prompt for the input of the target height.

ENT SHFT : Retain displayed value

```
Target / Coord.
No.        502
```

5) Press 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.)

Input the data of Known station B

503 ENT SHFT

```
Measure dist ?
Yes / No
```

6) Input the point number "503" and press ENT SHFT .
The display asks whether to measure the distance or not.

No CE·CA : Distance not measured

```
Target / Coord.
No.        504
```

7) Press No CE·CA .
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 [ENT SHFT]

```
Measure dist ?
    Yes / No
```

8) Input the point number "507" and press [ENT SHFT].
The display asks whether to measure the distance or not.

[Yes ENT SHFT] : Measure distance

```
     Target
Ht.        1.500m
```

9) Press [Yes ENT SHFT].
The previously stored target height is displayed.
"Ht." flashes to prompt for the input of the target height.

[ENT SHFT] : Retain displayed value

```
More point ?
    Yes / No
```

10) Press [ENT SHFT].
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.)

[No CE·CA] : No more station

```
Pt.          501
     measure ?
Yes / No (exit)
```

11) Press [No CE·CA].
The display asks whether you want to observe the first station (Known station A) or not.

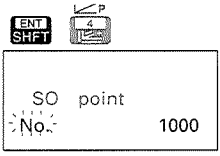
- See P.73 from 15) to continue the resection measurement.

e.g.

<Input Coordinate setting-out data by recalling the coordinate data from the IC 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:

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



1) Press ENT SHFT 4 .
"No." flashes to prompt for the input of the point number.

Input the point number

701 ENT SHFT

N	20.000
E	50.000
Z	0.000

2) Input the point number "701" and press ENT SHFT .
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 IC card

- The SET2C can display data recorded on IC 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	
SET2C	Instr name
No. 88132	Instr No.

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

▲▼ Pt. 1012		Target station number
Code TREE. 100		Code
Ht	1.300 m	Target height
ppm	13	Atmospheric correction
S	8.472 m	Slope distance
ZA	96° 48' 30"	Vertical angle
HAR	244° 57' 55"	Horizontal angle

< Station data >

▲▼ Station data		
Date	92.1.1	Date
Stn	7000	Instrument station number
Code	STATION. 1	Code
Ht	1.500 m	Instrument height
Temp	25°C	Temperature (If 0 ppm or a ppm value has been input directly, "?" is displayed)
Press	1000 mbar	Pressure (If 0 ppm or a ppm value has been input directly, "?" is displayed)
C & R	No	Curvature and refraction correction ON/OFF
PC	–40mm	Prism constant correction
Tilt	ON	Tilt correction ON/OFF
N	10.000	Instrument station N coordinate (E coordinate)
E	10.000	E coordinate (N coordinate)
Z	0.000	Z coordinate

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

▲▼ Pt. 1012		Target station number
Code	TREE. 101	Code
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. SUZUKI	Code
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
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
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

◆ Exit from reviewing : [CE·CA] (to Basic mode)

In Theodolite mode or Basic mode

[+/− RCL] , [0 REC] : For Recall mode

Yes [ENT SHFT] : Select the Job

No [CE·CA] : Select another Job

[· S-O] ▿ or [+/− RCL] ▵ : Display "data read"

Yes [ENT SHFT] : Select the Job name

[· S-O] ▿ or [+/− RCL] ▵ : Display the required data name or point number

Yes [ENT SHFT] : Select the data name or point number

Review the data

● Use [· S-O] ▿ or [+/− RCL] ▵ to display the required data

[CE·CA] , [CE·CA] : 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

[+/- RCL] [0 REC]

```
   10
  -40
  RCL
```

```
Job TOKYO
Yes / No (select)
```

1) In Theodolite mode or Basic mode, press [+/- RCL], [0 REC].
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

[No CE-CA]

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

2) Press [No CE-CA].
The display prompts for the selection of the file name.

Select "OSAKA"

[. S-O]↓ or [+/- RCL]↑
: Display "OSAKA"

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

3) Press [. S-O]↓ or [+/- RCL]↑ to display "OSAKA".

[Yes ENT SHIFT] :Select "OSAKA"

```
▲     Select
▼ Instr ID
  Yes / No (exit)
```

4) Press [Yes ENT SHIFT].
The display prompts for the selection of the data to be reviewed.

Select "Pt. 1008"

S-O or +/- RCL

: Display "Pt. 1008"

Select
Pt. 1008
Yes / No (exit)

3) Press S-O or +/- RCL to display "Pt. 1008".

Yes ENT SHFT

Pt.	1008	
Code	TREE. 1	Target station code

4) Press Yes ENT SHFT.

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

Pt.	1008	
Ht	1.300	Target height
ppm	13	Atmospheric correction

- Press S-O to display the next data and +/- RCL to display the previous data.

Pt.	1008	
Off	B 3.860 m	Prism direction and horizontal distance from target
S	3.740 m	Slope distance to target

Pt.	1008	
ZA	89° 48' 15"	Vertical angle of target
HAR	203° 01' 05"	Horizontal angle of target

5

- Press CE·CA CE·CA to return to Basic mode.

Procedure: Feature code in stack reviewing

In Theodolite mode or Basic mode

◆ Exit from reviewing : [CE•CA] [CE•CA] [CE•CA] (to Basic mode)

[1 MENU] : For Menu mode

[3 ▷] : Select the code setting

Yes [ENT SHIFT] : Select the code reviewing from Stack

[• S=O] ↑ or [+/− RCL] ↓ : Display the required code

[CE•CA], [CE•CA], [CE•CA] : To Basic mode

e.g.

- 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 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 code setting

[3]

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

2) Press [3].
The display appears as at left, showing the code setting menu.

Select code reviewing (view)

[Yes ENT SHIFT] : Select "view"

```
▲▼  TREE. 1
    HOUSE
    SIGNAL
```

[· S-O] or [+/- RCL]
: Display previous or next code

3) Press [Yes ENT SHIFT].
The codes in the stack are displayed.

- Press [· S-O] to display next codes and [+/- RCL] to display previous codes.

- Press [CE·CA], [CE·CA], [CE·CA] to return to Basic mode.

21.15 Protecting data stored on the IC card

- Once data has been recorded on the IC 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 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 the card setting menu.

Select "write protect"

[· S→O] ↑ or [+/− RCL] ↓
: Display "write protect"

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

3) Press [· S→O] ↑ or [+/− RCL] ↓ to display "write protect".

Yes ENT SHIFT : Select "write protect"

```
Write
1.  protect on
2.  enable
```

4) Press Yes ENT SHIFT .

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

Select the card protect function

1 MENU

```
Write protected
```

```
1.  Config
2.  Card
3.  Code
```

5) Press 1 MENU .

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

2 PROG : Cancel the protect function

```
Write enabled
```

```
1.  Config
2.  Card
3.  Code
```

- Press 2 PROG .

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

- Press CE·CA to return to Basic mode.

TROUBLESHOOTING

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 canceled	Displayed when attempting to enter the "card command" menu when the "send data to" parameter (No. 2-1)is set to "out".	Set the "send data to " parameter (No.2-1)to "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 SET2C 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.	
Job exists	Card has the same Job file name.	
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 formated.	Format the card.
Out of range	During REM, the vertical angle is more than±89° or the measured distance is more than 9999.999m	Press CE·CA to stop measuring.
Out of range X > ⊥ <Y	Tilt sensor range error. Tilt angle exceeds ±3'.	Level the SET2C 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.
Tilt error	While setting the azimuth angle, tilt angle exceeds ±3'.	Level the SET2C again.
Tilt Out of range	During distance measurement, tilt angle exceeds ±3'.	Level the SET2C 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 MENU 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 SET2C 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

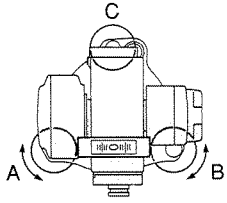
- Periodically, checks and adjustments should be performed before and after measurement. In addition, the instrument should be checked after long storage, transportation or when damage to the instrument is suspected to have occured due to a strong shock.

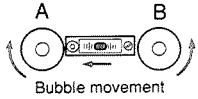
- The checks should be performed in the following order.

23.1 Plate level

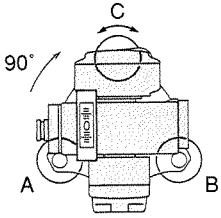
- The glass tube of the plate level is sensitive to temperature changes or shock.

Check





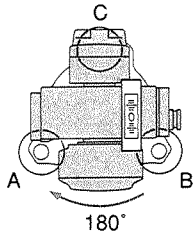
Bubble movement



1) 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.

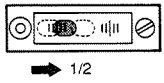
2) Loosen the horizontal clamp ㉓ and turn the upper part 90°.
   The plate level is perpendicular to a line between levelling screws A and B.
   Centre the plate level bubble using levelling screw C.



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:

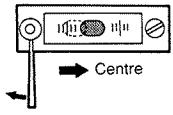
Adjustment

4) Use levelling screws



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

5) Use adjusting pin



5) Correct the remaining half of the displacement by adjusting the screw ㉘ 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

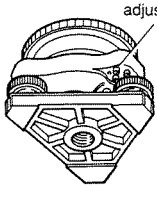
Check

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 three 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.

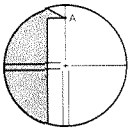
If the bubble can not be centred, please contact your Sokkia agent.

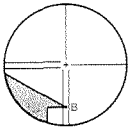
23.3 Reticle

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

Perpendicularity of the reticle to the horizontal axis

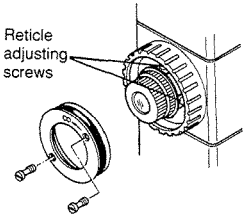
Check



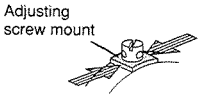


1) Level the SET2C carefully. Select and sight a clear target on the upper part A of the reticle line.
2) Turn the telescope vertical fine motion screw ㉚ until the target is on the lower part of the reticle B. If the target is still positioned centrally within the reticle lines, no adjustment is necessary.
   If the target is off-centre, adjust as follows:

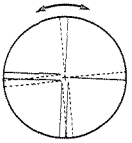
Adjustment



3) Remove the telescope reticle cover ㉝.
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 SET2C. 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° ± 20".
5) Calculate b1+ b2 = 360°00'10". The sum should be within 360° ± 20".
   If a difference of more than ± 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° 34′ 00"
b1 = 90° 30′ 10"
a2 = 198° 34′ 20"
b2 = 269° 30′ 10"

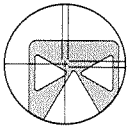
6) Calculate Horizontal angle A and Vertical angle B,

A = (a2+a1)/2+90°=198°34′10"

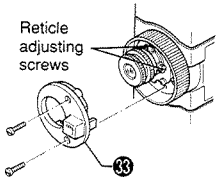
B = (b2–b1)/2+180° = 269°30′00"

ZA	296° 30' 00"
HAR	198° 34' 10"

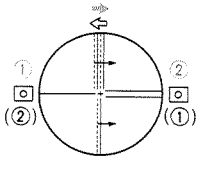
7) While still sighting the target on face right, use the horizontal and vertical fine motion screws to adjust the displayed horizontal and vertical angles to the above values.



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.



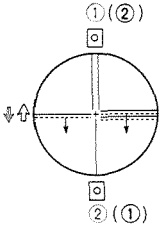
10) To move the vertical reticle line towards the target centre, use the adjusting pin to adjust the left and right adjusting screws as follows: Slightly loosen the top and bottom adjusting screws by the same amount.
To move the reticle to the right (left), first very slightly loosen the left (right) 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.

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

1) Set up a clear prism 50 - 100m from the SET2C on flat ground.

ZA 89° 50' 40" HAR

2) In Theodolite mode, sight the prism centre and read the vertical angle.

c = 89°50'40"

CE·CA : To Basic mode

Press function keys to select operation

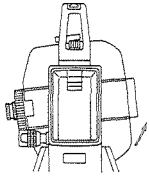
3) Press CE·CA to go to Basic mode.

ENT SHFT , ① : To signal checking mode

Signal *

4) Press ENT SHFT , ① to go to signal checking mode.

"Signal *" is displayed.



5) With the vertical fine motion screw ㉙, elevate the telescope slowly until the "*" symbol disappears.

Signal

CE·CA : Finish checking

Press function keys to select operation

3 : To Basic mode

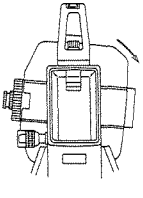
ZA 89° 47' 00"
HAR

CE·CA : To Basic mode

Press function keys to select operation

ENT SHFT ① : To signal checking mode

Signal *



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.

a = 89°47'00"

7) Press CE·CA again to return to Basic mode, then press ENT SHFT , ① to go to the return signal checking mode.

8) Lower the telescope slowly with the vertical fine motion screw until the "*" symbol disappears.

Signal

CE·CA : Finish checking

Press function keys to select operation

3 : To Theodolite mode

ZA	89° 47' 00"
HAR	

$|a - c| \geqq 2'30''$

$|b - c| \geqq 2'30''$

9) 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.

b = 89°54′20"

10) There is no problem if the difference of a and b against c is more than 2′30". The right and left directions require the same check. If any of the differences are less than 2′30", please contact your Sokkia agent.

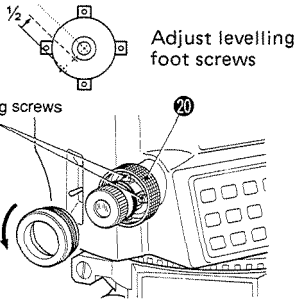
23.5 Optical plummet

Check

1) Level the SET2C 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

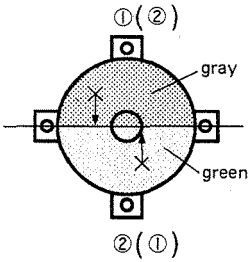


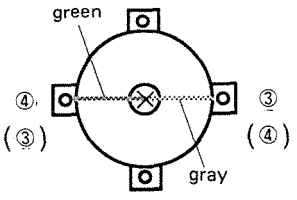
3) Correct half the deviation with the levelling foot screws ⑬.

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.

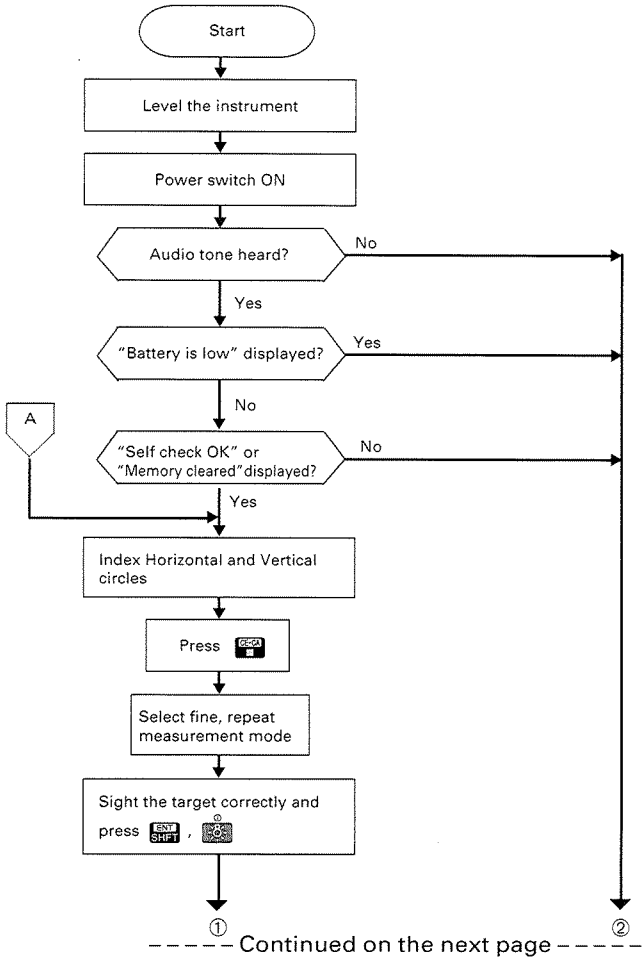
Note: Over-tightening the adjusting screws may mean that the reticle will go out of adjustment.

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.

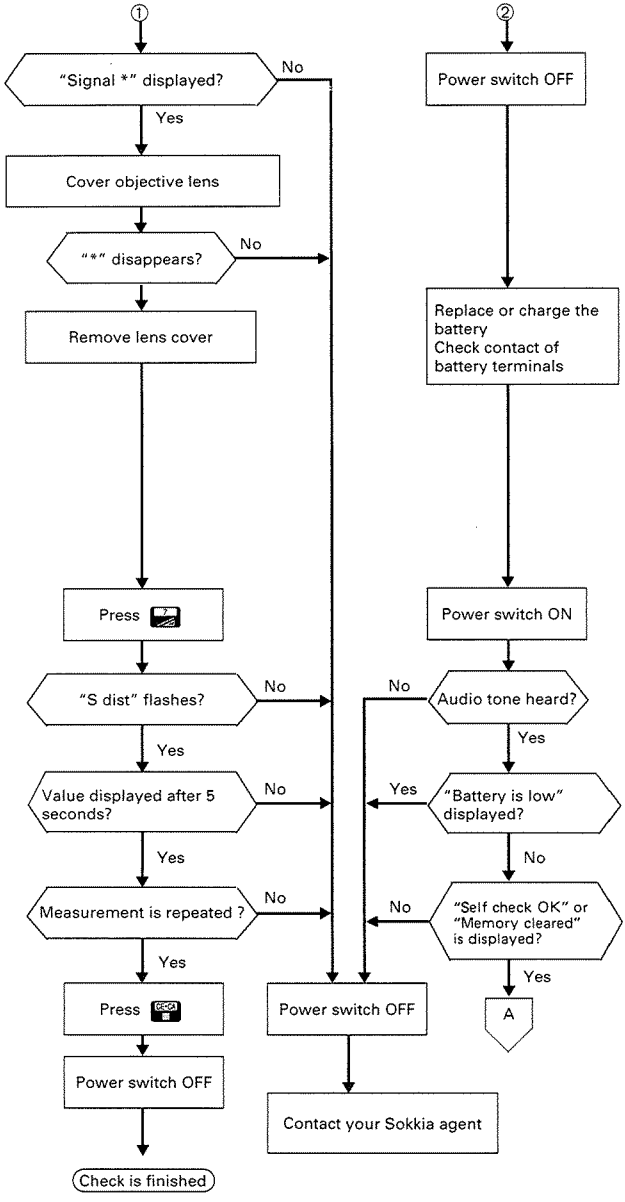
23.6 Distance measurement check flow chart

- If error codes EXXX are displayed, please contact your Sokkia agent.



----- Continued on the next page -----

23.6 Distance measurement check flow chart



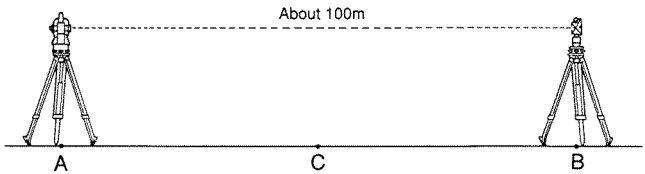
23.7 Additive distance constant

- The additive distance constant K of the SET2C 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.

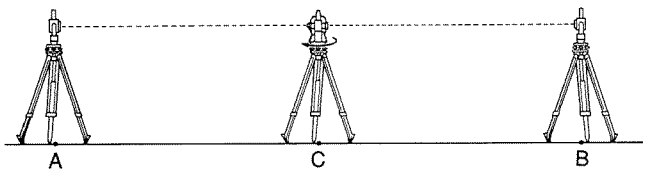
Check

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 SET2C 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 SET2C at A, the target at B and measure (fine measurement) of the distance A-B 10 times.
3) Shift the SET2C to C, and measure (fine measurement) of the distance C-A and C- B 10 times each to targets at A and B.



4) Calculate the averages of $\overline{A\text{-}B}$, $\overline{C\text{-}A}$ and $\overline{C\text{-}B}$.
5) Compute the additive distance K using the formula:

$$K = \overline{A\text{-}B} - (\overline{C\text{-}A} + \overline{C\text{-}B})$$

Obtain the K value several times. If all K values are greater than ±3mm, 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

- 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		*1. 1"
			2. 5"
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
10	C + R correction		*1. No
			2. Yes K=0.142
			3. Yes K=0.20

No.	Parameter		Option	
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

MENU

1. Config
2. Card
3. Code

- In Theodolite mode or Basic mode,
  press MENU .
  The display turns to Menu mode.

To Parameter setting mode

MENU : Select configuration setting

▲▼ Coordinate data from Keyboard

- Press MENU .
  The first parameter "Coordinate data from" is displayed.

Change options: ENT SHFT
Next parameter: S=O
Previous parameter: +/− RCL
To Menu mode: CE·CA

- Select option 1: MENU
- Select option 2: PROG
- Select option 3: ⊔
- Retain the previous selection: CE·CA

No.1 Coordinate data from

▲▼ Coordinate data from Keyboard

ENT SHFT

1. Keyboard
2. Card

MENU : Enter from keyboard
PROG : Read from IC 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

Recording

Card Code Tgt.ht
* ** ***

*Card: Send data to IC card
Out: Send data to External device
**Code: Input code
Nothing displayed: Non-input code
***Tgt.ht: Input target height
Nothing displayed: Non-input target height

ENT SHFT / CE•CA

1. Send data to
2. Set code
3. Set target ht

1 MENU : Send data to

1. Card
2. Out

1 MENU : To IC card
2 PROG : To external device
CE•CA : Retain the previously selected option

2 PROG : Set code

1. Set
2. Skip

1 MENU : Input code
2 PROG : Non-input code
CE•CA : Retain the previously selected option

3 : Set target height

1. Set
2. Skip

1 MENU : Input target height
2 PROG : Non-input target height
CE•CA : Retain the previously selected option

SET ▼ Next parameter +/− RCL ▲ Previous parameter CE•CA To Menu mode

No.3 Tilt correction

Tilt correction
(dual axis)
Yes

ENT SHFT

1. Yes
2. No

1 MENU : Tilt correction applied
2 PROG : Correction not applied
CE•CA : Retain the previously selected option

See next page

Next parameter | Previous parameter | To Menu mode

No.4 Coordinate format

Coordinate format
N, E, Z

ENT SHFT

1. N, E, Z
2. E, N, Z

1 MENU : N-coord.,E-coord.,Z-coord.
2 PROG : E-coord.,N-coord.,Z-coord.
CE·CA : Retain the previously selected option

Next parameter | Previous parameter | To Menu mode

No.5 Vertical angle format

V angle format
Zenith

ENT SHFT

1. Zenith
2. H(0 => 360)
3. H. +/– 90

1 MENU : Zenith 0°
2 PROG : Horizontal 0°
3 : Horizontal ±90° (±100gon)
CE·CA : Retain the previously selected option

Next parameter | Previous parameter | To Menu mode

No.6 Angle resolution

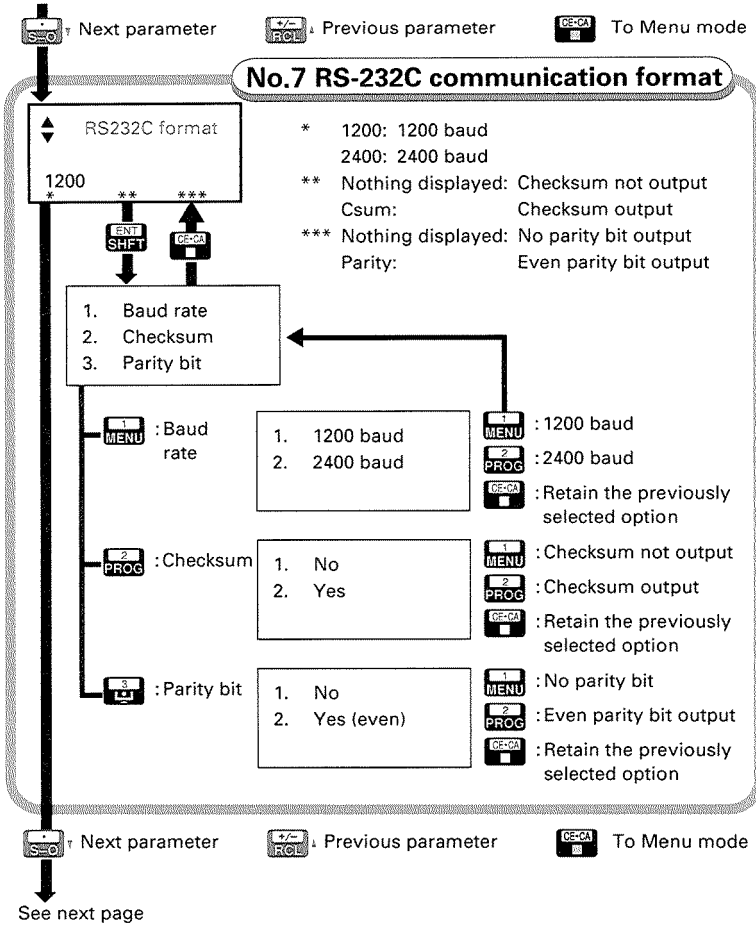
Angle resolution
1"

ENT SHFT

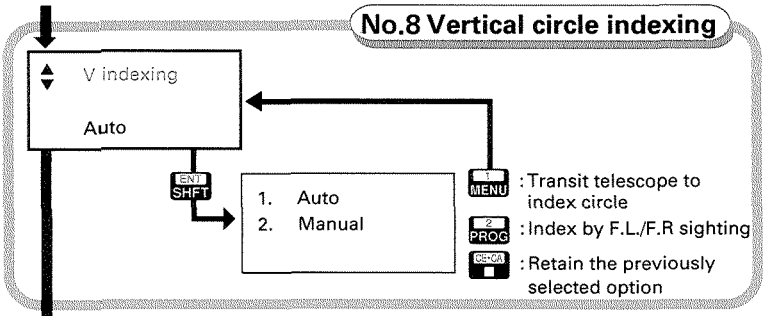
1. 1"
2. 5"

1 MENU : 1"/0.2 mgon
2 PROG : 5"/1 mgon
CE·CA : Retain the previously selected option

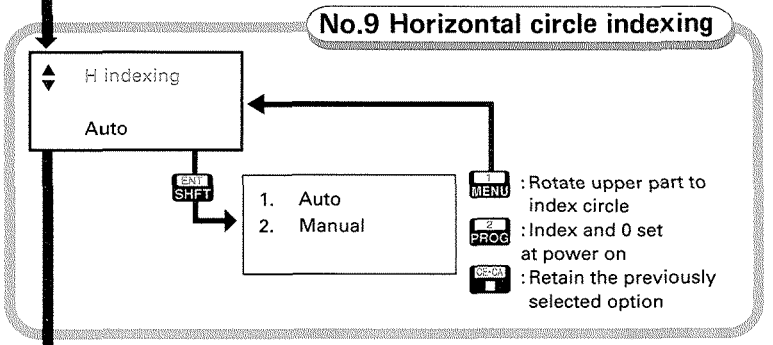
See next page



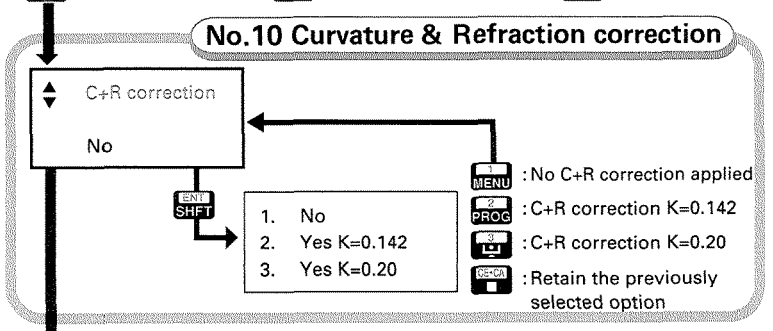
See next page



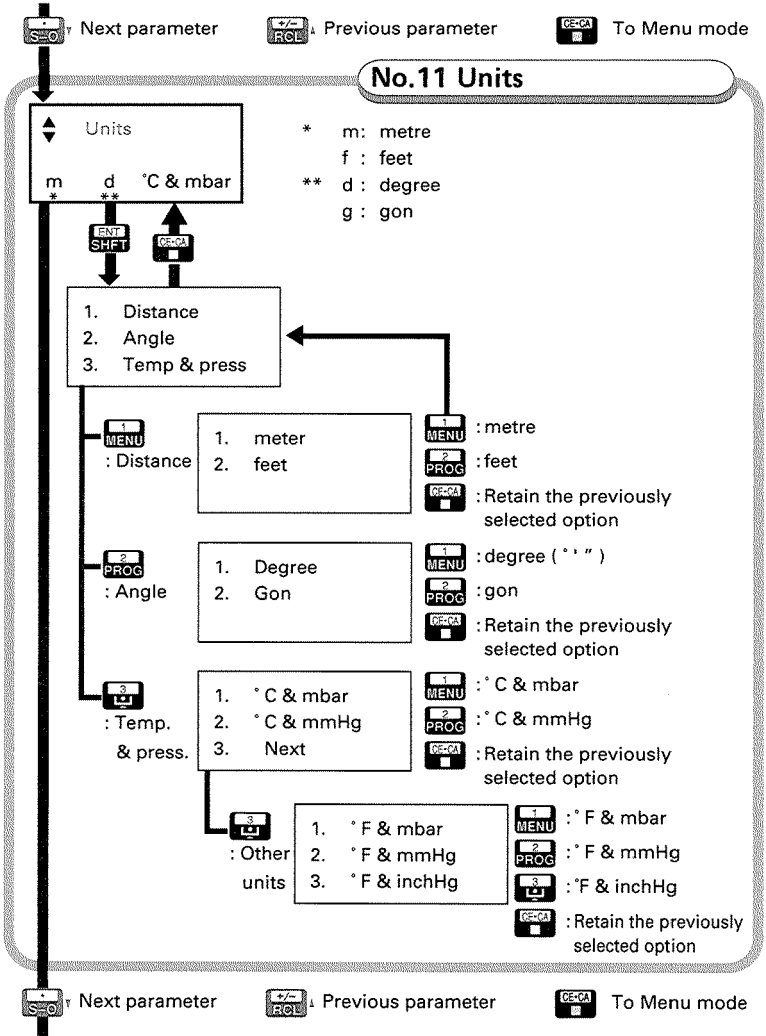
S•O Next parameter +/- RCL Previous parameter CE•CA To Menu mode



S•O Next parameter +/- RCL Previous parameter CE•CA To Menu mode



See next page



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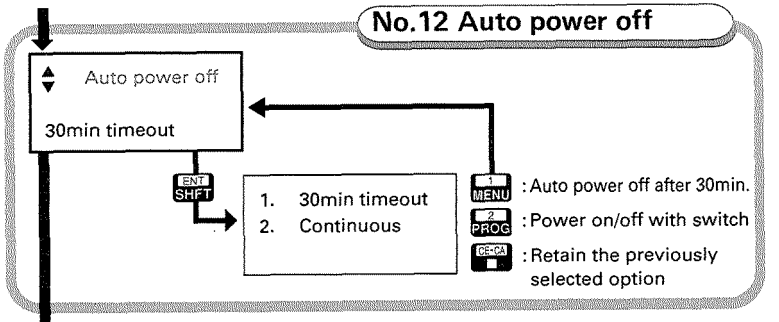
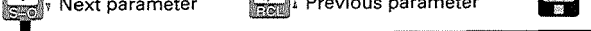
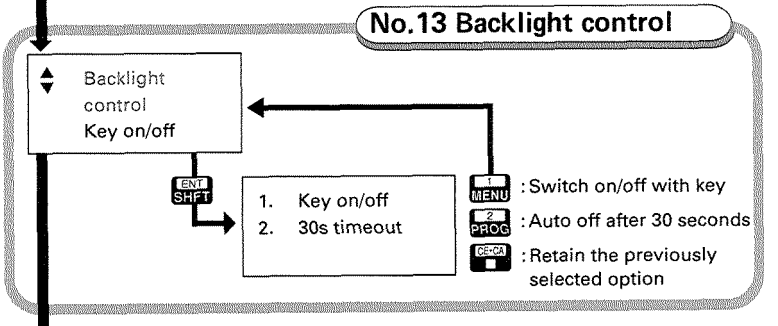
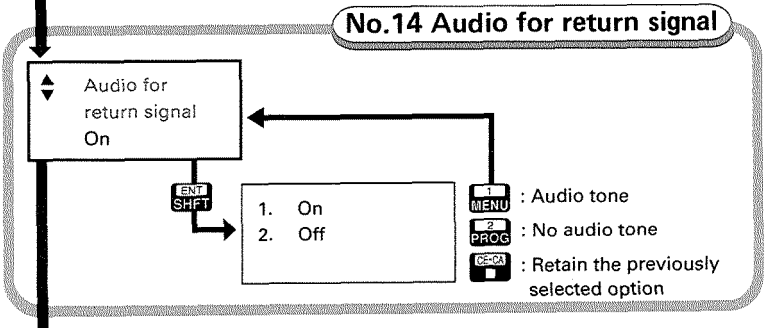
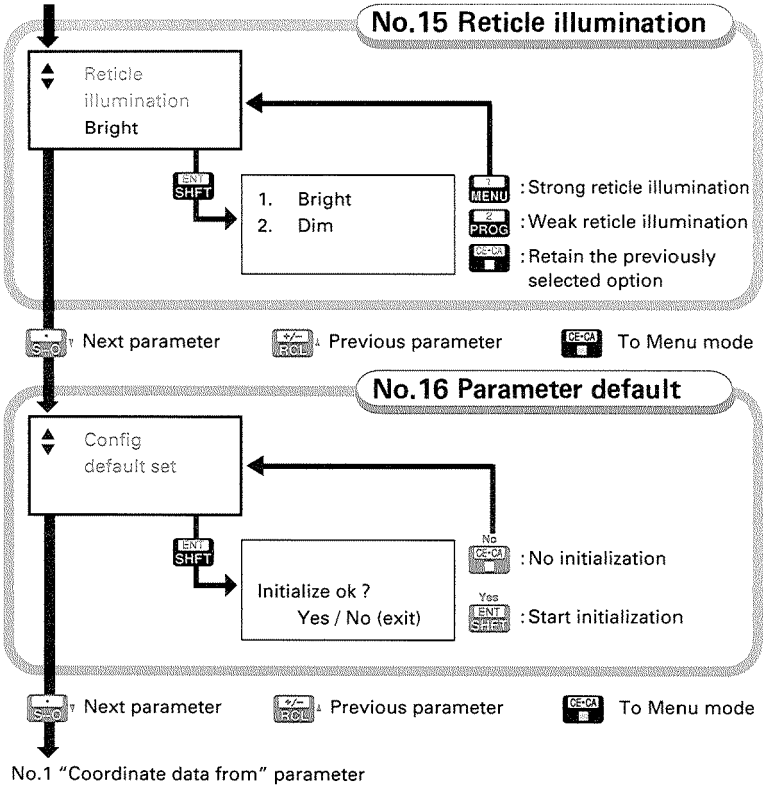








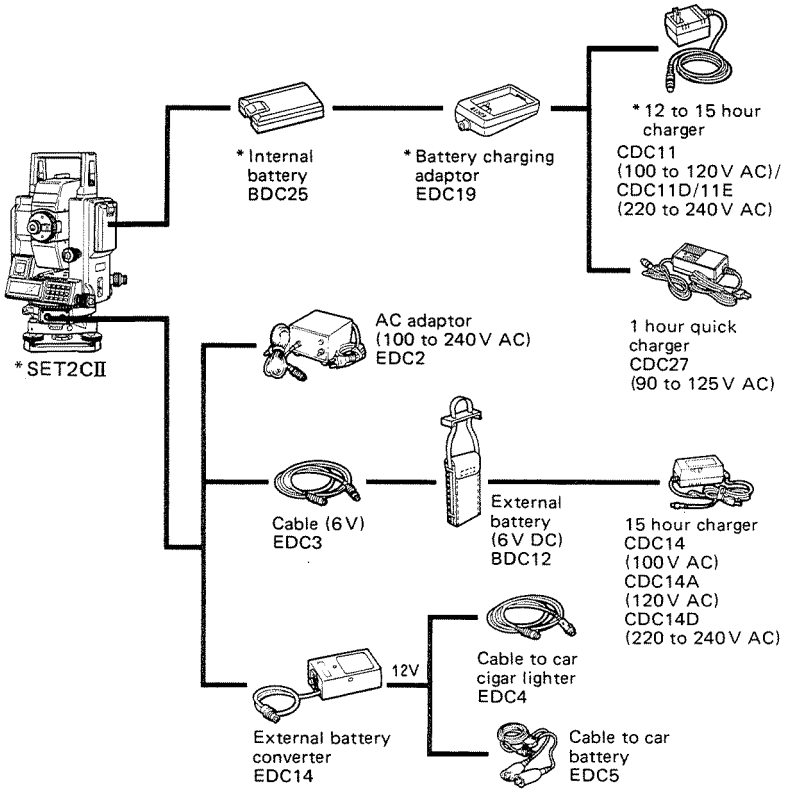
See next page



No.1 "Coordinate data from" parameter

25. POWER SUPPLIES

- The SET2C 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 SET2C only with the combinations shown here.

1) Precautions for battery use and storage

- Charge the battery at least once a month if it is not used for a long time.
- 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.

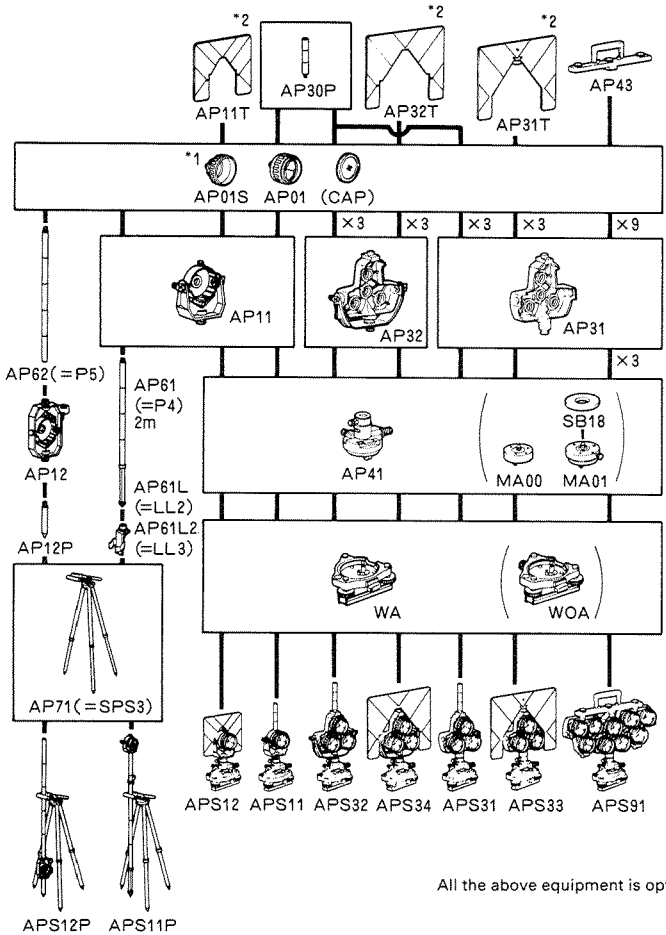
- Charge the battery at a temperature between 10°C and 40°C.
- Do not charge the battery for longer than the specified time.
- When charging the battery, first mount it in the adapter and connect to the battery charger, then connect the charger to the power supply. Check that the charging light is on. If not, switch the power supply off and on and check that the light comes on.
- The battery charger normally becomes warm while charging.
- Battery operating life is shortened at extreme temperatures.

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.

*1: To change the stored prism constant value, see P.41.

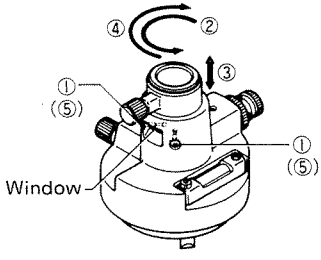
*2: Fluorescent target paint finishing allows clearer sighting in adverse observing conditions.

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 optical plummet of the AP41 as described in Section 23.5.
  Check that the optical plummet of the AP41 sights the same point as that of the SET2C.
- Check that 236 (the height of the SET2C 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

- Like all theodolites, the SET2C will have a small vertical index error. For angle measurement of the highest accuracy, the vertical index error can be removed as follows:

1) In parameter setting mode, select the "V indexing" parameter and set to "2. Manual".

2) In Basic mode, press [3] after step 1), or switch off and on again. "ZA Face 1" is displayed.

3) In face left (Face 1), accurately sight a clear target at a horizontal distance of about 30 m.

Press [ENT SHFT] , [0 SET 0 REC] .

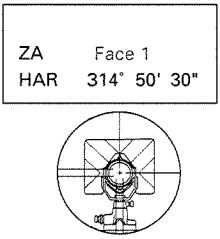
"ZA Face 2" is displayed.

4) Loosen the horizontal clamp ㉓ and rotate the upper part of the SET2C through 180°. In face right (Face 2), accurately sight the same target.

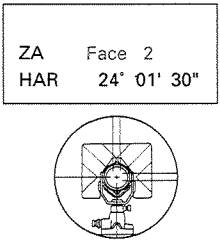
Press [ENT SHFT] , [0 SET 0 REC] .

- The vertical circle has been indexed.

Note: If the power switch is turned off, the vertical circle should be indexed again.



[ENT SHFT] , [0 SET 0 REC] : Index V circle in face left



[ENT SHFT] [0 SET 0 REC] : Index V circle in face right

APPENDIX 2: FOR ANGLE MEASUREMENT OF THE HIGHEST ACCURACY

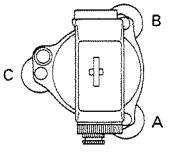
<Adjusting the tilt zero point error>

- 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 ±3' and the minimum display unit is 1".

- Tilt offset data storage period: Until the next adjustment is made (Power-off possible)

1) Level the SET2C 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 SET2C until the telescope is parallel to a line between levelling screws A and B.

ENT SHFT 0 SET 0 REC : Set H angle to zero

ZA	89° 12' 34"
HAR	0° 00' 00"

3) In Theodolite mode,
press ENT SHFT , 0 SET 0 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.

PROG : For Correction mode

```
Select
1.  Collimation
2.  Tilt offset
```

5) Press PROG for Correction mode.

PROG : For Tilt offset mode

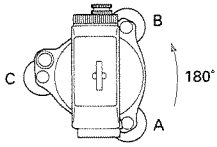
```
      Tilt angle
X        0° 00' 09"
Y       -0° 00' 10"
```

6) Press PROG for Tilt offset mode.

ENT SHFT, 0 SET REC : Memorize tilt angle

```
      Tilt angle
      Face 2
HAR      0° 00' 00"
```

7) Wait for a few seconds until the tilt angle reading is steady.
Then press ENT SHFT, 0 SET REC.
(X and Y tilt angles will be memorized.)



8) Turn the upper part of the SET2C through 180°.

```
      Tilt angle
      Face 2
HAR    180° 00' 00"
```

ENT SHFT, 0 SET REC : Memorize tilt angle and store the tilt offset data

```
1.  Resection
2.  Correction
3.  Pt. replace
```

9) Wait for a few seconds until the tilt angle reading is steady,
then press ENT SHFT, 0 SET REC.
The tilt zero point error has been adjusted and the display has returned to Program mode.

- Press CE·CA 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>

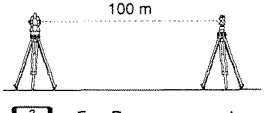
- The displayed angles are corrected automatically by the stored collimation errors.
  These collimation error values can be adjusted and stored by following the relevant procedures.
  Observation can be carried out up to 5 times, so if an accurate sighting can be made, increasing the number of times 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.



1) Set up a clear target at a horizontal distance of a bit longer than 100m from SET2C.

[2 PROG] : For Program mode

1. Resection
2. Correction
3. Pt. replace

2) In Theodolite mode or Basic mode,
press [2 PROG]
for Program mode.

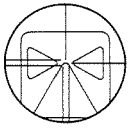
[2 PROG] : For Correction mode

Select
1. Collimation
2. Tilt offset

3) Press [2 PROG]
for Correction mode.

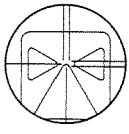
MENU : For Collimation mode

```
Pt.          face 1
     Yes / No (exit)
HAR    359° 59' 59"
```



Yes ENT SHIFT : Memorize H & V angle in face left

```
Pt.          face 2
     Yes / No (exit)
HAR    179° 59' 59"
```



Yes ENT SHIFT : Memorize H & V angle in face right

```
Observe end?
Yes / No (exit)
```

Yes ENT SHIFT : To end observation and calculate the collimation error value

```
Vcoll     0° 00' 12"
Hcoll     0° 00' 08"
```

```
New value set?
     Yes / No (exit)
```

4) Press MENU for Collimation mode.

5) In face left (face 1), sight the target correctly and press Yes ENT SHIFT .

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 Yes ENT SHIFT . 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 Yes ENT SHIFT .

The collimation error value is calculated and displayed.

Following that, the display asks whether a new collimation error value is to be set.

- To continue the observation, press NO CE·CA .

No CE-CA : Re-observe

```
Re-observe ?
Yes / No (exit)
```

- To continue the observation, press No CE-CA.
  The display asks whether observation is to be continued.
  Pressing Yes ENT SHIFT returns the processing to Step 5).

Yes ENT SHIFT : Stop the new collimation error

```
1.  Resection
2.  Correction
3.  Pt. replace
```

8) To set a new collimation error value, press Yes ENT SHIFT.
   The collimation error has been adjusted and the display has returned to Program mode.

- Press CE-CA to go to Basic mode.

```
Vcoll    *0° 00' 12"
Hcoll    *0° 00' 08"
```

```
Re-observe ?
Yes / No (exit)
```

- 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.

Yes ENT SHIFT : 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 redo the observation, press Yes ENT SHIFT. 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 SET2C 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°
  – 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.

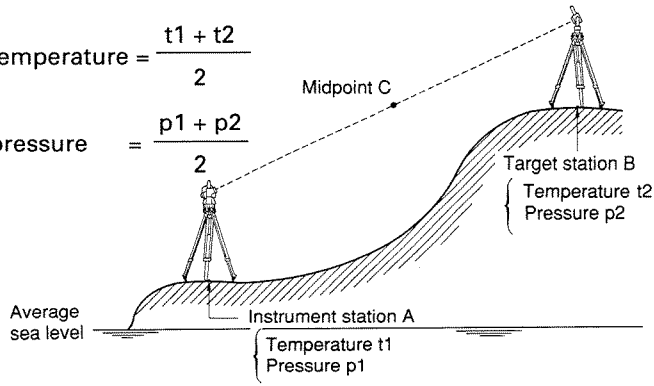
- The ppm correction should be applied when the calculated ppm value is over ±5ppm or if the slope distance is more than 200m.

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.

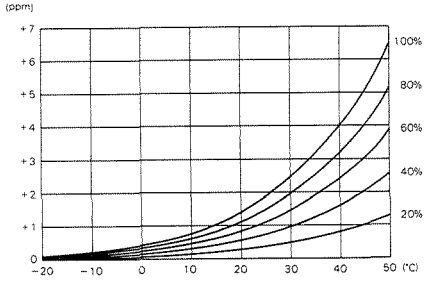
$$\text{Average temperature} = \frac{t1 + t2}{2}$$

$$\text{Average pressure} = \frac{p1 + p2}{2}$$



3) Influence of relative humidity

- The influence of humidity is very small.
  It is mainly of importance in very hot and humid conditions.



Correction factor (ppm)

$$= \frac{0.0615 \times e\ (\text{mbar})}{1 + 0.003661 \times t\ (^\circ\text{C})}$$

e: Partial water vapour pressure
t: Temperature

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

① Input the temperature and pressure values. The correction factor A is calculated and displayed on the sub display.
② Measure the relative humidity and read the correction factor B from above table.
③ Calculate A plus B. (C)
④ Input C in ppm mode.
(Refer to P.44 "13.3 Atmospheric correction")
⑤ 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=2 (above table)

$$D = \frac{1 + (12\ \text{ppm} + 2\text{ppm}) \times 10^{-6}}{1 + 12\ \text{ppm} \times 10^{-6}} \times 3{,}000\text{m}$$

$$= 3{,}000.0059\ \text{m}$$

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.

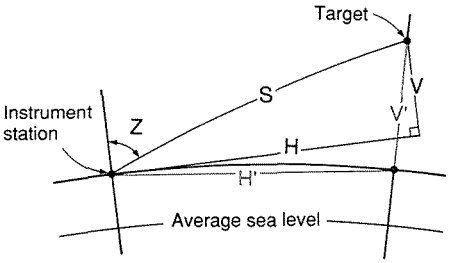
<No correction>

Horizontal distance: $H = S \times \sin Z$
Height difference: $V = S \times \cos Z$

<Applied correction>

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

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



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° (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 SET2C 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 IC card features".

Appendix 5–1: Changing the instrument options

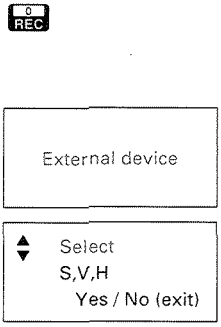
- Confirm that this parameter is set according to the data output to anexternal device condition.
  The "Send data to" parameter should be set to "Out".

- To confirm or change the parameter option, see P.195 "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

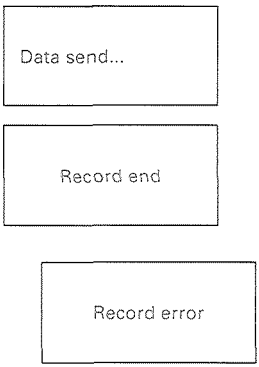
From Theodolite mode or Basic mode to Record mode



- In Theodolite mode and Basic mode, press REC.

  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.

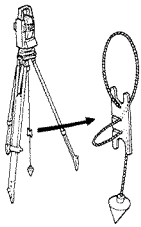
- For subsequent procedures, please see the following sections:
  P.122 "21.5 Instrument data recording 2)–"
  P.123 "21.6 Instrument station data recording 1)–"
  P.128 "21.7 Measured data recording 1)–"
  P.134 "21.8 Note recording 1)–"



- When the data output is started, the display changes to that shown at the left.
  If the data output procedure ends normally, the display changes to that shown at the left, and the screen returns to the Record mode.

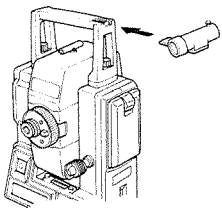
Note: If the message shown at the left appears and the display then returns to the Record mode, the data has not been output. Check the cables and external equipment to see if there are any abnormalities, and check the program for problems.

APPENDIX 6: STANDARD ACCESSORIES



1) Plumb bob

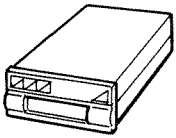
If the weather is calm, or for initial tripod centring, the plumb bob can be used for centring. To use, unwind the plumb bob and attach it to the hook inside the centring screw. Use the cord grip piece to adjust the cord length.



2) Tubular compass CP7 (accuracy ±1°)

To mount the CP7, slide it into the tubular compass slot ⑱. 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 IC card and transfer it to a host computer.
<SCR2 specifications>

AC power adapter:

EDC21	AC100V
EDC21A	AC120V
EDC21B	AC220V
	(Round pin plug)

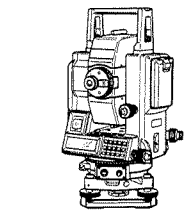
Interface cable:

DOC22	NEC/EPSON
DOC23	IBM connector
DOC28	Toshiba J3100

Input/output: RS232C compatible

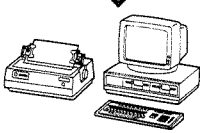
Operation temperature range: 0 to 50°C (32 to 122°F)

Weight: 450g (1 lb)



SET2CII

Interface cables
DOC1/DOC26/DOC27



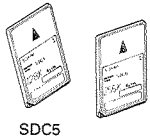
Host computer

2) Interface cables DOC1, DOC25/DOC26/DOC27

The interface cable DOC1 can be used for direct two-way communication between the SET2C 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) IC card SDC5/SDC6



SDC5 SDC6

Measured and input data can be recorded by the SET2C on SDC5 or SDC6 IC cards.

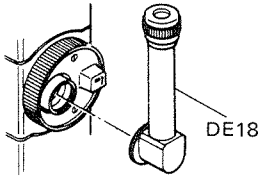
SDC5: 128Kbyte

One 128Kb card can store approximately 2000 measured target points in angle and distance (S, V, H) format.

SDC6: 256Kbyte

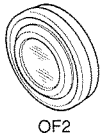
One 256Kb card can store approximately 4000 measured target points in angle and distance (S, V, H) format.

4) Diagonal eyepiece DE18



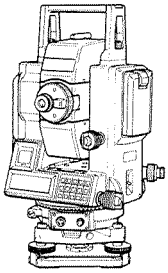
The diagonal eyepiece is convenient for near-vertical observations and in places where space around the instrument is limited. Remove the handle and the telescope eyepiece by unscrewing the mounting ring, and screw in the diagonal eyepiece.

5) Solar filter OF2/OF2A

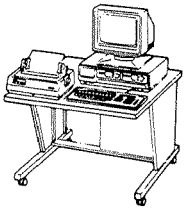


OF2

OF2A



SDR series



6) Electronic field book SDR series

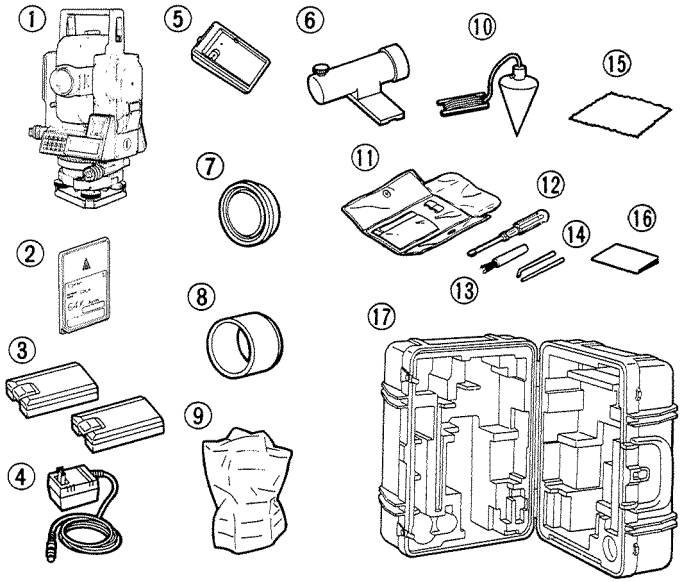
The SDR series collects and stores slope distance, zenith and horizontal angle data from the SET2C.
Calculations can be performed on the data so that the measurements can be verified in the field. The stored data can be transmitted to a data processing system.

<SDR series specifications>

Power source:	"AAS"(SUM3)x4
Memory type:	CMOS
RAM	32, 64 or 128 K
ROM	64 K
Keyboard:	33 keys
Display:	LCD
Baud rate:	300,600,1200, 2400,4800, 9600 bps
Operating temperature range:	0 to 50°C(32 to 122°F)
Weight:	450g (1 lb)

STANDARD EQUIPMENT

- Please verify that all equipment is included.



① SET2C main unit 1
② IC card, SDC4 (64Kb) 1
③ Internal battery, BDC25 2
④ Battery charger, CDC11/CDC11D 1
⑤ Battery charging adaptor, EDC11 1
⑥ Tubular compass, CP7 1
⑦ Lens cap 1
⑧ Lens hood 1
⑨ Vinyl cover 1
⑩ Plumb bob 1
⑪ Tool pouch 1
⑫ Screwdriver 1
⑬ Lens brush 1
⑭ Adjusting pin 2
⑮ Cleaning cloth 1
⑯ Operator's manual 1
2-way communication manual 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 ❺,❻ and keyboard ⓰ or carrying case with an organic solvent.

4) Store the SET2C 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 (⓭, ⓴, 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 SET2C 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 SET2C for proper adjustment periodically to maintain the instrument accuracy.

SPECIFICATIONS

Telescope

Length:	177mm
Aperture:	45mm (EDM:50mm)
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:	0° 00' 00" to 359° 59' 59" 0.0000gon to 399.9998gon
Minimum display:	1" (0.2mgon)/5"(1mgon) (Selectable with parameter)
Angle units:	Degree/Gon (Selectable with parameter)
Accuracy:	Standard deviation of mean of measurement taken in positions I and II (DIN18723) 2" (0.6mgon)
Measuring time:	Less than 0.5second
Automatic compensator:	Selectable ON/OFF with parameter
Type:	Liquid, 2–axis tilt sensor
Minimum display:	1" (0.2mgon)
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)

- Compact prism CP01: 1.3m to 800m (2600 ft)
- Standard prism APX1: 1.3m to 2400m (7800 ft)
- Standard prism APX3: 1.3m to 3100m (10100 ft)
- Standard prism APX9: 1.3m to 3700m (12100 ft)

Standard deviation:

- Fine measurememt: ±(3mm+2ppm • 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:

	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 Height difference	4.7 + every 3.3s	1.9 + every 0.7s	1.8 + every 0.3s
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

(When tilt compensation and "C+R correction" are not being applied.)

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:	500mb to 1400mb (in 1mb steps)/ 375mmHg to 1800mmHg (in 1mmHg steps)/ 14.8inchHg to 70.9inchHg (in 0.1inchHg steps) (Selectable with parameter)
ppm input range:	-499 ~ +499ppm (in 1ppm steps)
Prism constant correction:	-99 ~ +99mm (in 1mm steps)
Earth–curvature and refraction correction:	ON (K=0.142/K=0.20)/OFF (Selectable with parameter)
Audio target acquisition:	ON/OFF (Selectable with parameter)
Signal source:	Infrared LED
Light intensity control:	Automatic

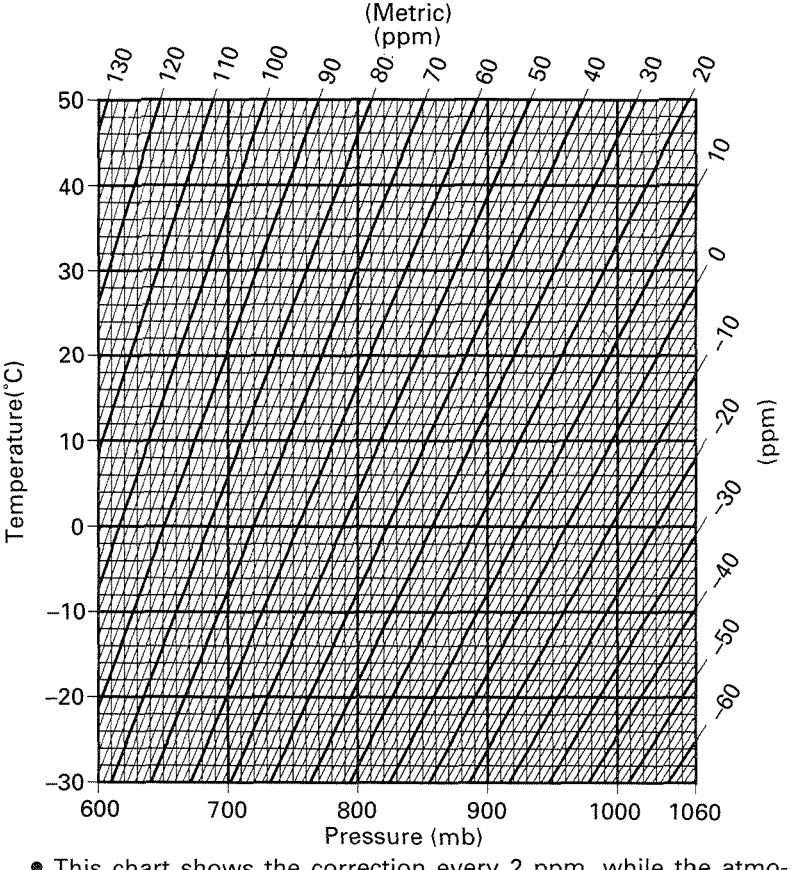
Power supply

Power source:	Ni-Cd rechargeable battery, BDC25 (6V)
Working duration at 25°C (77°F):	Distance & Angle measurement: 2.5 hours (2500 to 2600 points) (Coarse measurement mode, Single measurement, Measurement interval=every 4 secs) Angle measurement only at 25°C: 7.5 hours Using optional battery BDC12; Angle and distance: 10 hours
Charging time	
Charger CDC11/11D	15 hours
Charger CDC27:	1.5 hours

General

Display:	2 LCD 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:	20"/2mm
Circular level:	10'/2mm
Optical plummet:	
Image:	Erect
Magnification:	3x
Minimum focus:	0.5mm (1.64 ft)
Self-diagnostic function:	Provided
Power saving cut off:	30minutes after operation/ ON/OFF with switch (Selectable with parameter)
Operating temperature:	-20°C ~ +50°C (-4°F ~ +122°F)
Data recording:	Non-contact IC card, 64Kbytes
Data input/output:	Asynchronous serial, RS-232C compatible
Instrument height:	236mm (9.3inch) from tribrach bottom, 193mm (7.6inch) from tribrach dish
Size:	181(W) x 177(D) x371(H)mm (Without handle: H:330mm)
Weight:	7.5kg (with internal battery)

ATMOSPHERIC CORRECTION CHART



- This chart shows the correction every 2 ppm, while the atmospheric correction can be input to the SET2C 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.

mbar = mmHg ÷ 0.75 = 33.87 x inchHg

To convert a temperature in °F to one in °C,
compute using the following formula:

°C = 0.56 x (°F − 32)